



## Urban Development Directorate (UDD)

Ministry of Housing and Public Works

The People's Republic of Bangladesh

82 Shegunbagicha, Dhaka-1000

## Report on Interpretation of Image and Preparation of Base Map

on

Providing Consultancy Services for "Physical Feature  
Survey Work with RTK GPS, Total Station & Using 3D Image  
and Other Survey for Area of "Preparation of Development  
Plan for Benapole-Jessore Highway Corridor Project""

April 2015



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## Report on Interpretation of Image and Preparation of Base Map

Providing Consultancy services for “Physical Feature Survey Work With RTK GPS, Total Station & Using 3D Image and Other Survey for Area of “Preparation of Development Plan for Beanpole-Jessore Highway Corridor Project””

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### ABBREVIATION

3D	Three Dimension
AM/FM	Automated Mapping/Facilities Management
AT	Aerial Triangulation
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BGB	Border Guard of Bangladesh
BLPA	Bangladesh Land Port Authority
BM	Bench Mark
BWDB	Bangladesh Water Development Board
CAD	Computer-aided Design
CAM	Computer-aided Manufacturing
CS	Cadastral Survey
DC	Deputy Commissioner
DEM	Digital Elevation Model
DPHE	Department of Public Health and Engineering
DPW	Digital Photogrammetric Workstation
DTM	Digital Terrain Model
FGD	Focus Group Discussion
GCP	Ground Control Point
GIS	Geographical Information System
GPS	Global Positioning system
GSB	Geological Survey of Bangladesh
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
IT	Information Technology
ITES	Information Technology Enable Service
JV	Joint Venture
LGED	Local Government Engineering Department
LIS	Legislative Information System
MIS	Management Information System
PD	Project Director
PM	Project Manager
RCC	Reinforce Concrete Column
RFP	Request for Proposal
RHD	Roads and Highway
RS	Revised Survey
RTK	Real time kinematic
SAARC	South Asian Association for Regional Cooperation
SOB	Survey of Bangladesh
SRTM	Shuttle Radar Topography Mission
TIN	Triangular Irregular Network
TMC	Technical Management Committee
ToR	Terms of Reference
UDD	Urban Development Directorate

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### **EXECUTIVE SUMMARY**

*Preparation and compilation of base map and demarcation of project boundary* Report is the third official report for providing consultancy services for “**Physical Feature survey work with RTK GPS, Total Station & using 3D image and other Survey for area of “Preparation of Development plan for Beanpole-Jessore Highway Corridor project”**”. The project comprises the large tract of Jessore, Benapole, Jhikargachha Pourashava and Benapole-Jessore highway corridor.

Under the sub-regional cooperation between four nations, India-Bhutan-Nepal-Bangladesh, the working activities of Mongla Port will be many folds and subsequent work-load of *Benapole Land Port* will be increased exponentially. Thus, it is very much necessary to extend the present existing land port facilities at *Benapole Land Port* and the proper planning for accommodating the future growth scenario of said development within the project area and surroundings.

The broad objectives of the project are collection of 3D stereo model satellite image and using photogrammetric method for preparation of the physical feature map and *Digital Elevation Model (DEM)*. Digital Photogrammetric work station with latest software and technology will be used in the project. Formal consultation meeting with client and consultant also has been held about the progress of work at Urban Development Directorate (UDD) and will continue from time to time.

The first chapter of the *preparation and compilation of base map and demarcation of project boundary* report focuses on a brief description of the project objective, scope of service. This chapter also includes a brief introduction discussing the project location, demographic and geographical information.

The *second chapter* focused on about 3D satellite image processing, interpretation and basemap preparation and workflow.

This report is part of the project activities and progress of work. This will guide the project activities including field survey data collection and analysis reports and maps. The project area profile is based on initial survey and data collection and will be useful in understanding the characterization of the project area.

# Chapter 01

Introduction

# CHAPTER 01

## 1.1 Introduction

Physical planning comprises of spatial arrangement relating to physical resources to achieve functional efficiency, public safety and aesthetic quality. Physical/structure planning is primarily concerned with good management and development of land. Strategic Planning provides the mechanism for making comprehensive decision about the use of land and resources. It is an approach that intertwines all segments related to social, economic, physical and environmental dimensions. Many countries, like third world countries have rapidly urbanized and developed in an unplanned manner. Many continue to do so in an unprecedented rate. This has generated the conversion of forest lands, agricultural lands, wetlands, and aquifer recharge areas to industrial and urban uses. This trend has enormous impacts on productive agricultural lands and ecological resources and ecosystems. Industrial and urban development has likewise led to the segregation of land uses, e.g. separation of residential houses, shopping centers, and employment centers. Such land use development patterns have impacts on energy and resource consumption, which have turned out to be unsustainable for humanity, i.e. emergence of global warming and climate change.

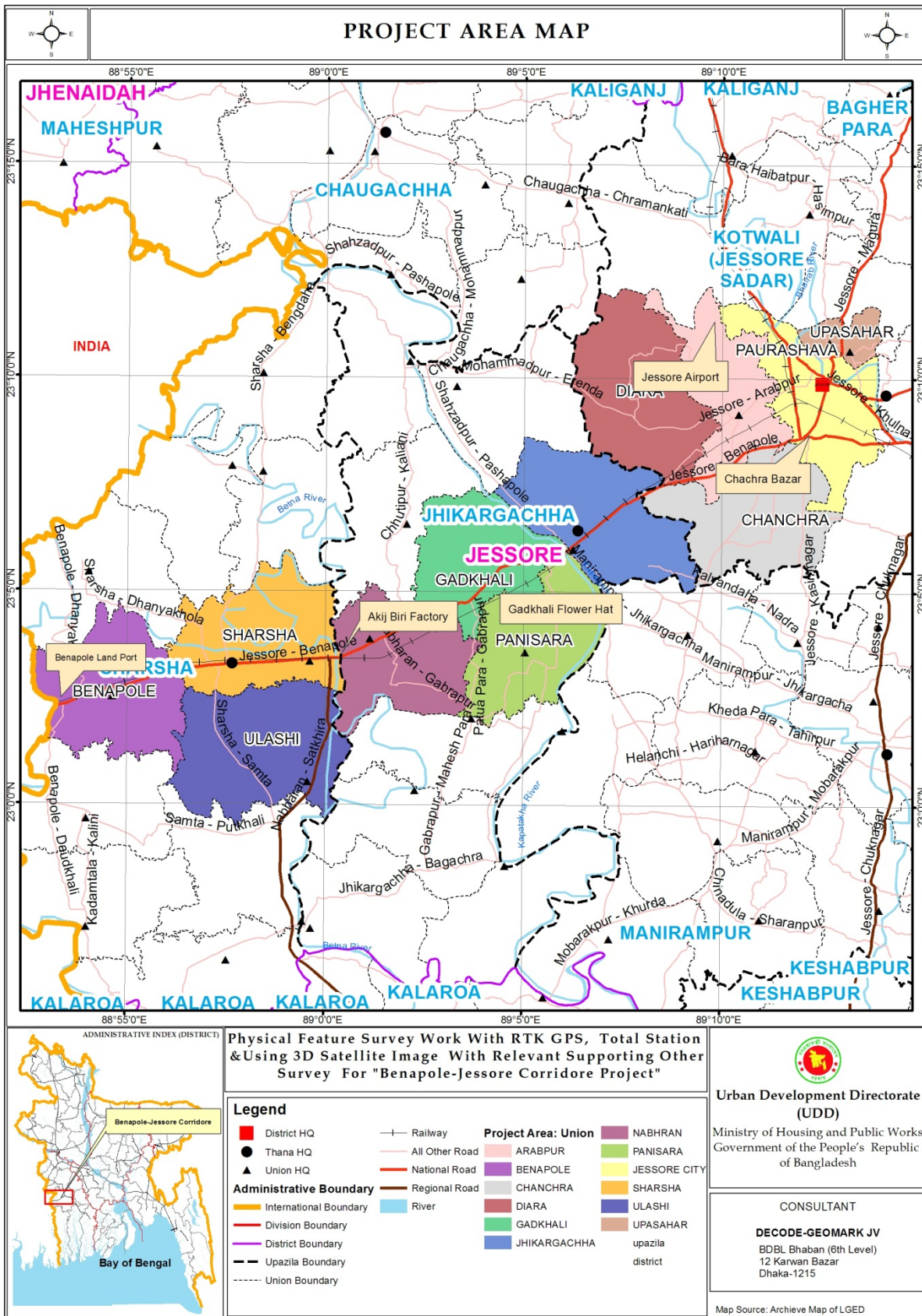
Impacts due to unplanned and unsustainable land development patterns have increased the risks to natural hazards. Vegetation and forest clearance, soil erosion, saline soils and decreasing water tables resulting from unsustainable land uses have brought more droughts, flooding, and landslides. Locations of houses and infrastructures in hazard prone areas have led to unthinkable deaths as well as resource degradation. It could be seen that land reservations such as river deltas, wetlands, coastal marshes, and coastal reservations had been developed for human settlements, making people extensively exposed to natural disasters. It is this link between development and disasters, i.e. development increasing vulnerability, which is consideration of disaster risks has to systematically become part of land use planning. UN Habitat suggests that land use planning is perhaps the most fundamental tool for reducing disaster risk especially when accompanied by political. It is essential that national governments recognize the vulnerability of populations with respect to the physical environment, especially with regard to land, water, and natural resources. The integration of DRR in the land use planning process is vital in ensuring that development would reduce vulnerability to environmental and natural disasters.

Urban Development Directorate (UDD) is the only government organization at the apex for preparing land use plan in Bangladesh. Since its creation, UDD has prepared land use master plan for 50 district towns and 392 Upazila towns from 1984 to 1996. In the recent past UDD has prepared land use master plan for 26 Upazila town / Pourashava / District town by employing its own man power. Besides, UDD has prepared *Structure Plan, Master plan and Detailed Area Plan* for Sylhet and Barisal Divisional Towns and Preparation of Development Plan of Cox's Bazar Town and Sea Beach up to Teknaf.



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Map 01: Benapole-Jessore Project Area Map

## **1.2 Existing Scenario:**

### **1.2.1 Regional Setting:**

**Jessore district** is located in the *Khulna* division of southwestern Bangladesh. It is bounded by *Jhenaidaha* district and *Magura* district on the north, *Satkhira* district and *Khulna* district on the south, *Narail* district and *Khulna* district on the east and *West Bengal* of India on the West.

**Major Rivers of Jessore:** Rivers that flow through this region are the *Bhairab River*, *Mukteshori River*, *Kopothakho River* and *Betna River*.

**Annual Average Temperature of Jessore:** Annual average maximum temperature in Jessore is 37.1°C and minimum temperature is 11.2°C. Annual rainfall is 1537 mm.

### **1.2.2 Jessore District Town:**

*Jessore* town which stands on the river *Bhairab* consists of nine (9) wards and seventy three (73) mahallas. *Jessore* municipality was established in 1864. The area of the town is 25.72 square kilometer. The town has population of 1,178,273 persons.

*Jessore* district was established in 1781. It consists of eight (8) municipalities, eight (8) Upazilas, ninety two (91) unions parishads, one thousand three hundred twenty nine (1329) mouzas, one thousands four hundred and thirty four (1434) villages, and one hundred twenty (120) mahallas.

## **1.3 Objectives:**

Land use survey, physical feature survey, topographic survey (including housing and including squatter settlements survey, investment and employment survey, population and migration study etc.) Urban and rural economy survey, social infrastructure survey, hydrological survey, formal and informal industrial survey and other survey (health facilities, educational facilities, agricultural land demarcation, archaeological, environmental survey etc.)

Survey works shall be conducted on Mouza map R.S/CS or any latest version. All survey data will be 3D data and all feature vertexes must have Z value.

Survey firm have to collect spot level data at minimum 5 m in town areas, 10 meter in rural area on the whole project area in respect to SOB's benchmark and prepare to spot level and contour map from the 3D satellite image.

### **Construction and Establishment of Bench Mark (BM)/Ground Control Point (GCP):**

Pillars covering the project area including approximately 5 km. grid in rural area (pillar 10"x10", Base 3'x 3', height 5'). RCC pillars are to be constructed marking unique identification number Coordinate X, Y of these pillars along with Z value is to be marked on base map for future reference.

## **Preparation of Base Map through Satellite Image Processing by using Photogrammetric Method:**

Base map shall be prepared with the help of photogrammetric system by using 3D satellite image (four bands) with resolution 0.5m accuracy by the survey firm.

The Topographic database shall be obtained from geo-referenced 3D (four bands) image and further cross-checked and ground truthing by using RTK-GPS and Total Station.



Pic. 01: 3D Satellite Image of Project Area,  
*Source: DigitalGlobe, April 2014*

### **1.4 Scope of Works:**

The Survey firms will have to follow the following step-wise integrated activities for the stated scope of work on the intended different survey works. They will interlink the intended survey activities with different steps of other related activities conducted by other different survey firms. A detailed methodology of the specific survey work including procedure for relating its output with that of other different surveys and activities (both attribute and spatial data of physical feature, topographic, land use, transportation, hydrological, socio-economic and other required hard and soft data), which would be imparted by other different survey firms' has to be mentioned clearly in the proposed technical proposal.

The Survey firm shall provide necessary assistance to the Planning Team of UDD till finalization of proposed different plans, for successful completion of the project.

# Chapter 02

GCP Collection and Work Plan

## CHAPTER 02

### **Satellite Image Processing by Using Photogrammetric Method**

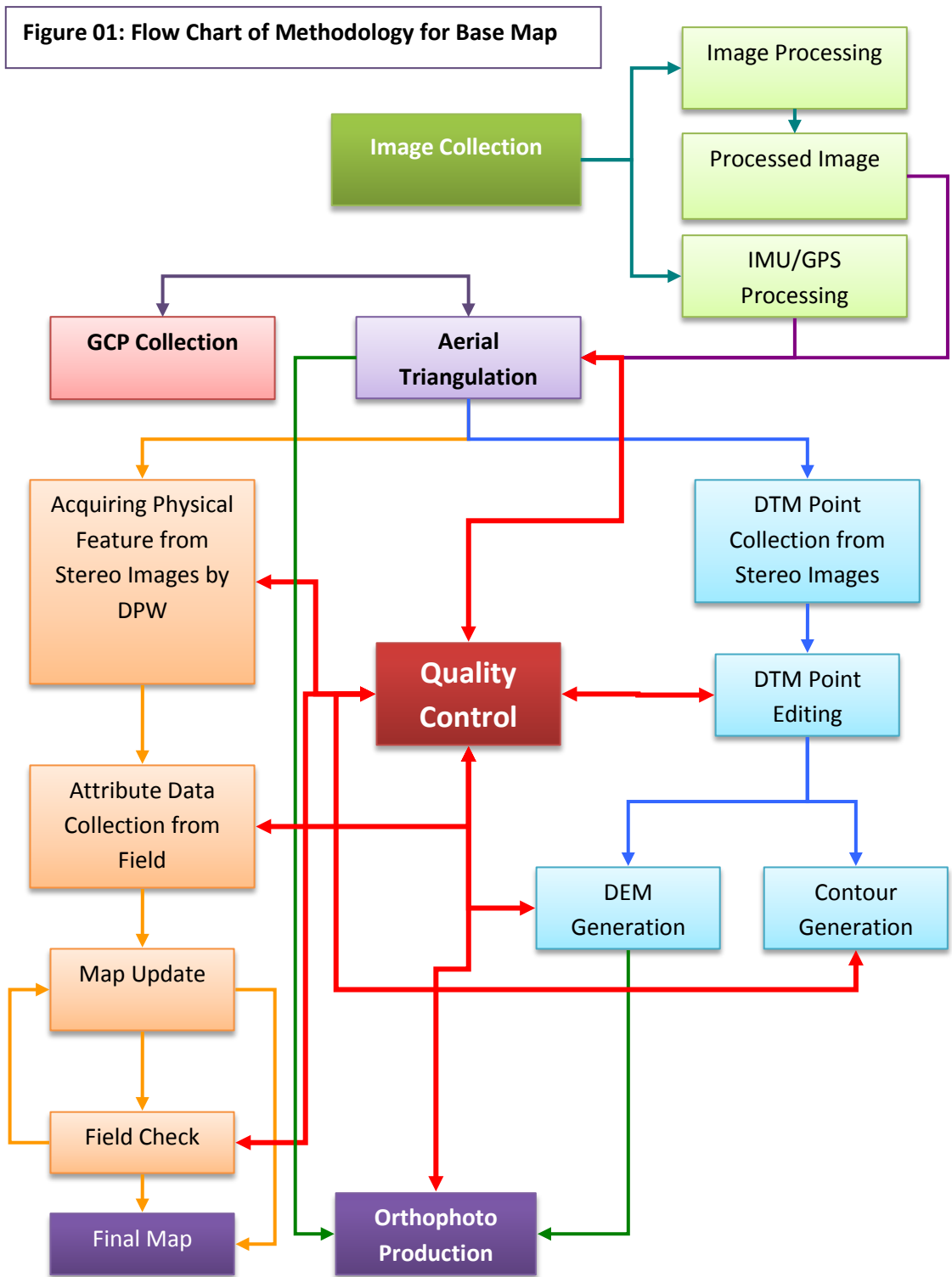
#### **Methodology**

It is understood that development organizations in Bangladesh needs accurate and informative data about the topography to implement its development program. Different techniques have been evolved to determine the shape or relief of the part of the Earth's surface and the location of natural and artificial objects thereon. Among them Transit and Plane Table surveying methods and instruments were standard for direct surveying followed by Total Stations. Traditionally these surveying procedures have used analog methods of recording data and are rarely used now. Although Total Station is rather modern survey equipment and introduced digital data collection, it is only suitable for detailed mapping over small area which must be easily accessible.

Digital Photogrammetry, the digital approach of today's mapping solution, is one of the most reliable technologies for mapping, mosaicking of orthophotos and DEM generation. It is also one of the most important input sources of 3D geospatial data, and has been greatly utilized for geographic object interpretation and object measurement. The high precision 3D spatial data acquired through photogrammetric technique provides strong platform for decision making. Automated procedures for photogrammetric image processing and Digital Elevation Models (DEM) extraction yield high precision terrain models in a short time, reducing manual editing.

The proposed assignment comprises of the following three major objectives:

- creating Digital Terrain Model (DTM)
- creating Geo-spatial Database
- creating Orthophoto



## **2.1 Image 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. We did the following process for the image

Image processing was done after collecting raw digital images. The tasks involved in image processing are

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

### **2.1.1 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 a DVD. To create an individual image we merged all image tiles and created an individual image large image.

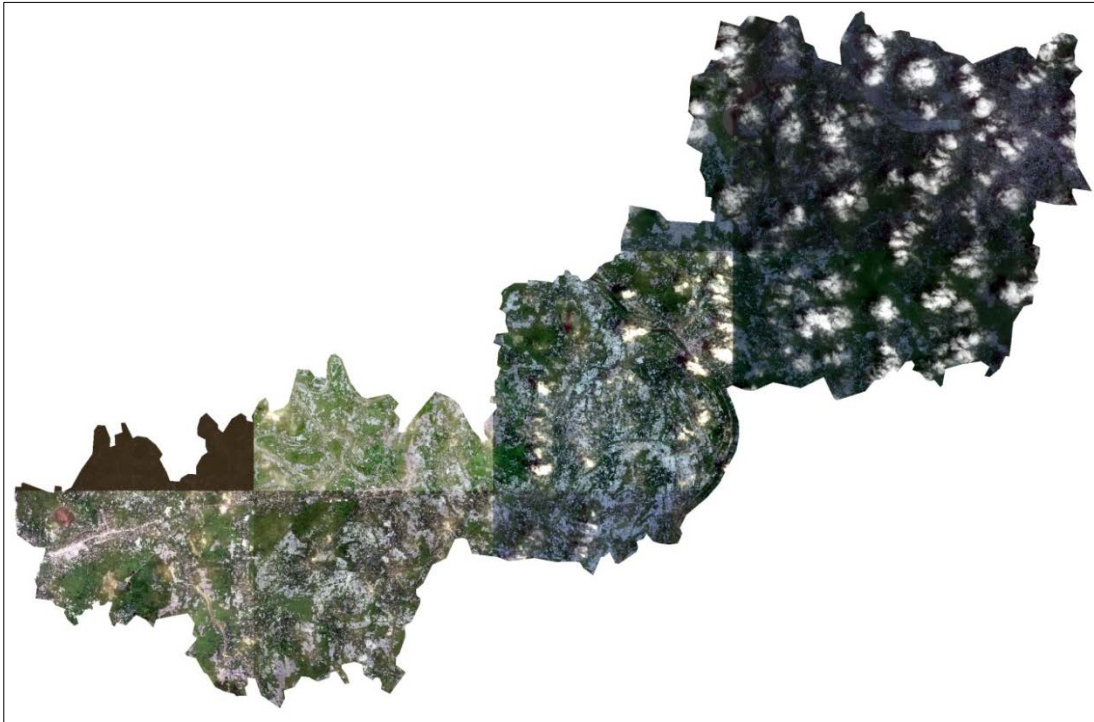
Image tiles color may vary color and contrast. So during the merge process we also adjusted the color and contrast so that we get a color balanced image.

During the image capturing time satellite captured two types of image, one is multispectral (RGB & NIR) image which is low resolution (2.0 meter) and another is high resolution (0.5 meter) panchromatic image. But we need 0.5 meter high resolution (0.5m) multispectral image. To have this 0.5 meter multispectral image we use pan-sharpening tools. This tool produces a 0.5 meter multispectral image by combining 2.0 meter multispectral image and 0.5 meter panchromatic image.

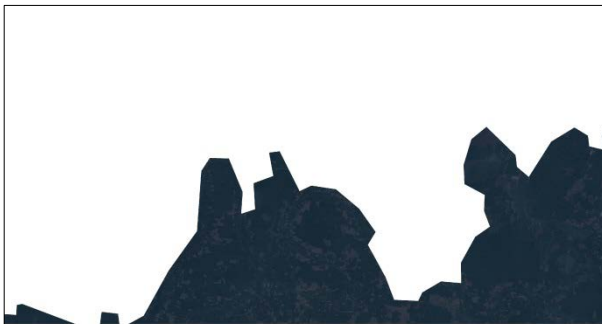
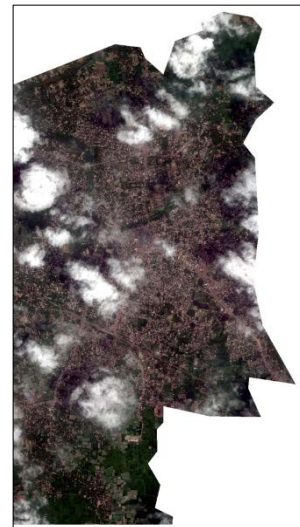
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Pic02: Tiles of satellite image without color and contrast balance



Pic 03: Individual image tile (Total 11)

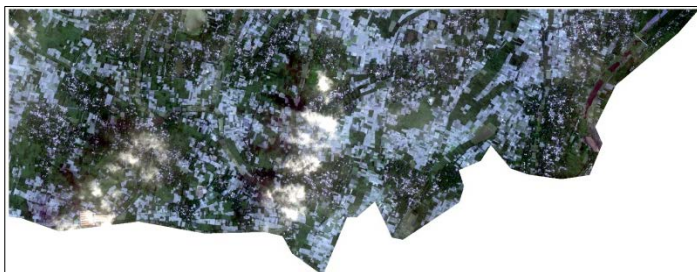
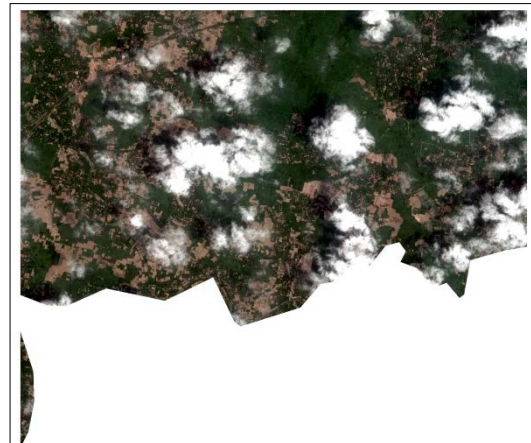
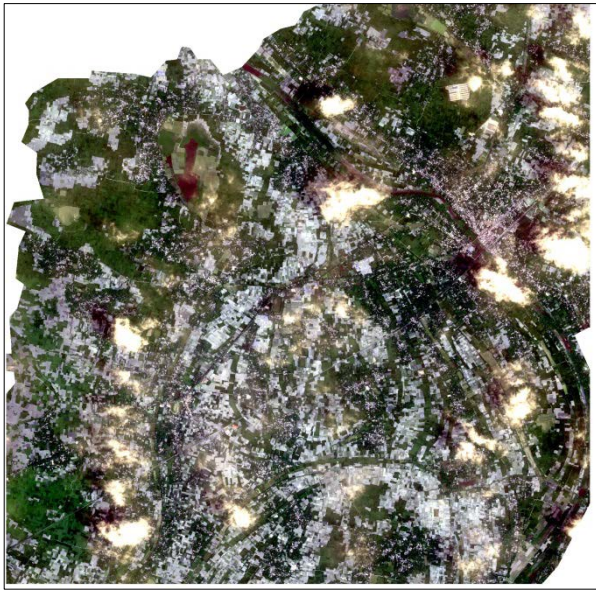




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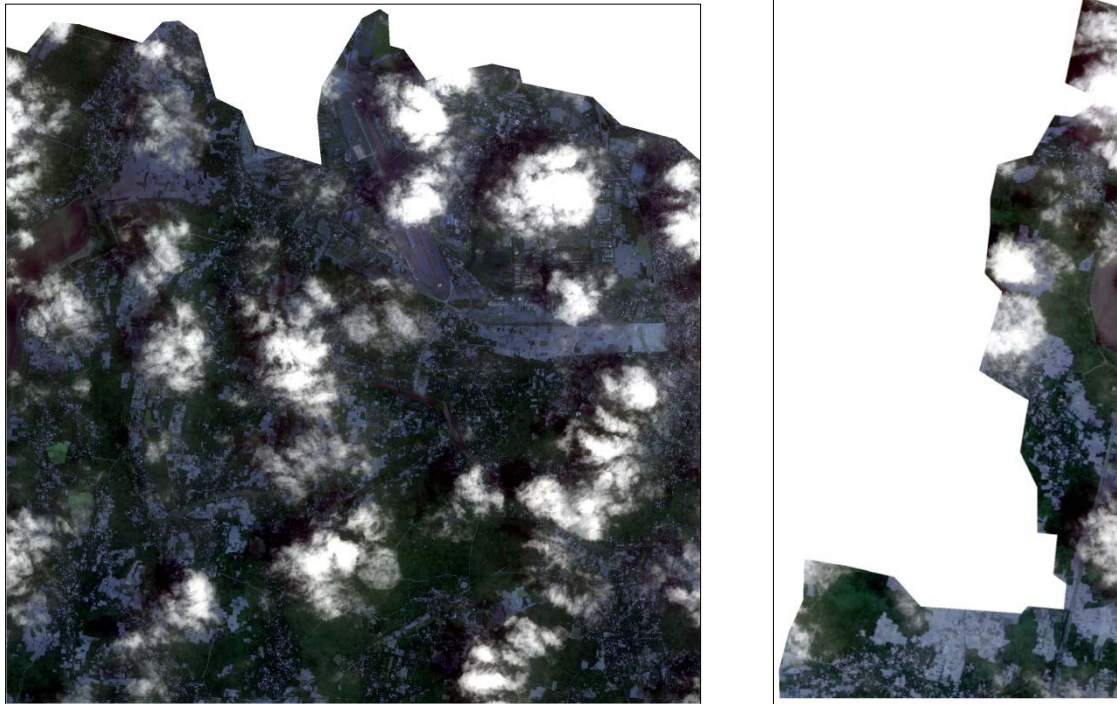
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*Chapter Two*



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Pic 04: Merged satellite image with color and contrast balance



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Pic 05: Satellite Image Multispectral Image 2.0 meter



Pic 06: Satellite Image Panchromatic 0.5 meter  
meter



Pic 07: Pan-sharpen Image- multispectral 0.5 meter



### **2.1.2 Bit rate, Pyramid and Epi-polar Correction:**

**Bid Rate:** In general practice 8 bit images are used. Satellite image can capture 11 bit image. We ordered 8bit image. So there was no need to change the bit rate.

**Pyramid:** To efficiently view and pan the image we must have to build the pyramid. We were using DATEM Summit Evolution for image interpretation. So we created the pyramid by summit evolution software.

**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. We created the 3D models by the Summit Evolution software.

### **2.1.3 GPS/INS Processing**

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

### **2.1.4 Aerial Triangulation**

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

Input for AT	Output of AT
<ul style="list-style-type: none"><li>- IMU data</li><li>- GPS (on board)</li><li>- GCP (collected from field)</li><li>- Image</li></ul>	Geo-referenced Stereo Model

The above GCP and BM were used for correcting the 3d satellite image coordinate using Inpho Match-AT software.

## 2.2 Digital Mapping from Stereo Model:

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

Digital Photogrammetric Workstation (DPW) was used as the platform for acquiring features from digital stereo images (model).

Feature registration was done considering and measuring the position of the object under its



accuracy level. The Summit Evolution & Stereo Plotter of DAT/EM was used for identifying and registration of the objects and Arc GIS 9.3 of ESRI was used for vector data storing and editing.

Pic 08: Photograph of a DPW

Table 01: Map Statistics

Feature Class	Statistics (information)
Building (Structure)	Total no.: 196027 Maximum Build Height From MSL: Max: 40.264 m Min: 7.83m Average: 15.59m
River & Khal	Total Length: 185 Km
Pond/Lake/Ditch	Total No: 12258
Marsh Land and Baor	Total No: 23 (Marsh Land-13, Baor-10)
Railway Tracks	Total Length: 160.2271Km
Drain	Total Length: 14.57Km
Embankment	Total Length: 2.978Km
Boundary Wall	Total Length: 258.205Km
River Dike	Total No: 465

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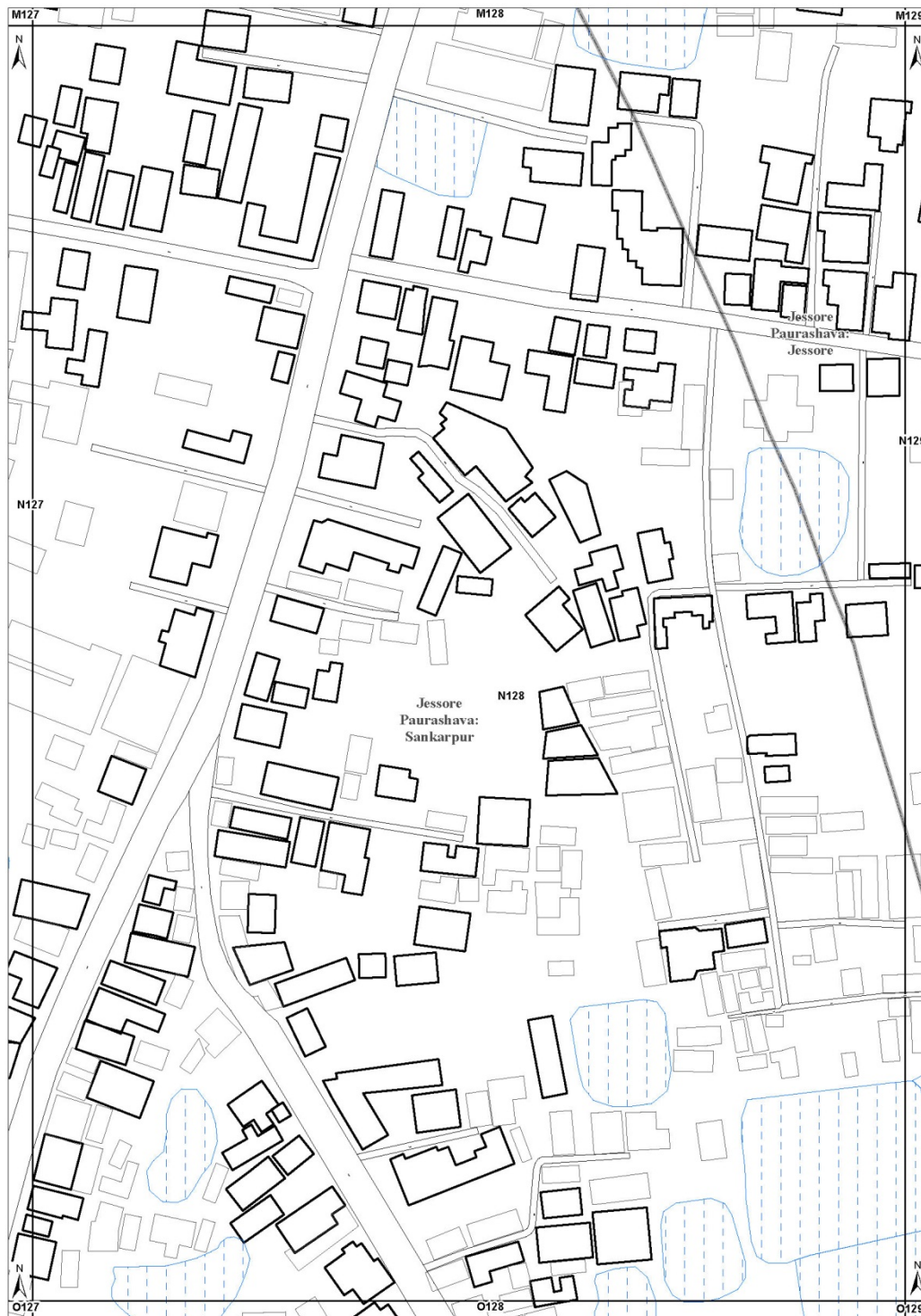
Table 02: Generalize Landuse Information

<b>Classification</b>	<b>Area (Acres)</b>
Administrative- Govt	73.36
Agricultural Area	2,888.02
Borrow Pits	20.05
Commercial Area	84.14
Educational and Research	29.48
Forest	11,183.71
Garden	528.54
Graveyard / Cemetery / Crematorium	17.77
Forest with Settlement	3.03
Industrial Area	128.16
Recreational Area	1.09
Religious Area	0.11
Residential Area	16,915.56
Vacant Lands	662.33
	0.98
Wetlands / Flood Prone	0.03
Brickfield	300.58
Eidgah	2.74
Monument	0.08
Park	1.51
Play Ground	80.48
Restricted Area	348.32
Terminal Bus/Truck	20.43
Terminal Railway Station	13.63
Electric Substation	4.09
Storage Zone	9.62
Water Area	7,501.37

## 2.3 Attribute Data Collection and Field Verification

After digitization complete we prepared field sheet for attribute data collection and filed checking. A3 Size field sheet and log sheet was prepared for field work.

**Pic 09: Field Sheet after Digitization**



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### 2.4 Map Updating

Attribute data and missing map object was collected from the field and was incorporated into the features in this stage. All A3 field sheet was scanned, georeferenced and updated. All building got a unique ID as per field sheets.

**Pic 10: Field Sheet after Field Survey**





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**Pic 11: Log Sheet**

**Urban Development Directorate (UDD)**  
**Preparation of Development Plan for Benapole-Jessore Highway Corridor**  
**Consultant: DECODE-GEOMARK Joint venture**

Grid No: BC-100      Union:      Upz.: সাতার      Date: 8-11-14

Str ID	Type (Pucc/Semi Pucca Katcha)	Name of Structure (USE) (Name of Shop/Office/factory/School/Mosque/Road)	Floor (1- 2- 3- 4- 5- 6 )	Hold No.	Year of Construction	Local Area
01	pucca	R	1		1992	1
02	pucca	R - <u>গাছা বাজার</u>	2		2005	1
03	pucca	R - <u>কাঠা</u>	2		2006	1
04	SP	R	1		2007	1
05	pucca	R	1		2005	1
06	SP	R	2		4	1
07	pucca	R	1		2008	1
08	pucca	R	2		2006	1
09	pucca	R	2		2006	1
10	SP	R	1		2009	1
11	SP	R	1		4	1
12	SP	R	1		4	1
13	SP	R	2		4	1
14	pucca	R - <u>সড়ক</u>	2		1983	1
15	pucca	R - <u>সড়ক</u>	3		2009	1
16	pucca	R - <u>সড়ক</u>	3		2009	1
17	pucca	R - <u>সড়ক</u>	2		4 1965	1
18	pucca	R	2		4	1
19	pucca	R - <u>সড়ক</u>	2		4	1
20	pucca	R	3		4	1
21	pucca	R	2		2008	1
22	pucca	R	2		4	1
23	pucca	R	2		2007	1
24	pucca	R	2		2007	1
25	pucca	R	1		4	1
26	pucca	R	2		2006	1
27	pucca	R	2		4	1
28	pucca	R	1		4	1

Surveyor Name:

Mamun  
8-11-14

Checked By:

## **2.5 Field Check**

All digital map data was delivered to UDD. If any important feature i.e. office, educational institute, religious feature, industrial etc. found missing then we will update it on printed maps according to map scale using measuring tape. It will be faster way to complete project within given time. Later it will be update on main database.

## **2.6 Data Delivery**

After the collection of all filed database, final map data was delivered to UDD on a DVD for approval.

## **2.7 DTM/DEM/TIN/Contour Generation**

Digital photogrammetry is able to acquire 3D points for high spatial resolution DEM generation through semi-automatic procedures, overcoming the problems of process.

In this approach, DTM Points was generated from Stereo Pair images by the software, and editing of the software generated DTM points was checked and edited by the comparing them with stereo model in photogrammetric workstation. Creating and editing of Break lines was done after this stage.

After creating DTM Points, Contour lines were produced with 1.0 meter contour interval. The contour lines were delivered for the project area.

Using DTM Points DEM was generated at a resolution of 10 for the project area. The maximum, minimum and average height is below

<b>Total Project Area</b>	<b>Total Points</b>	<b>Maximum Height (Meter)</b>	<b>Minimum Height (Meter)</b>	<b>Average Height (Meter)</b>
<b>324 Sq.km</b>	<b>32,44,043</b>	<b>18.848</b>	<b>5.08</b>	<b>-1.649</b>

Using DTM Points TIN was created and delivered for the project area. TIN will be used for calculating slope, road crest etc.

## **2.8 Ortho Photo**

An orthophoto is a photograph which geometrically corrected ("orthorectified") such that the scale is uniform: the photo has the same lack of distortion as a map. Orthophoto graphs are commonly used in the creation of a Geographic Information System (GIS).

### **2.8.1 Rectification of Images**

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

Ortho-rectification of every image was carried out using digital photogrammetric system based on result of aerial triangulation and the generated DEM. Obliqueness of the images will be adjusted in this stage.

### **2.8.2 Mosaicking of Orthophoto**

Individual rectified photograph was assembled to form seamless mosaic. Mosaicking of Orthophoto includes the following tasks

- a) Seam line Drawing: Drawing the boundary of the image delineating which part of the image will go which image.
- b) Balancing of Color and Contrast
- c) Feathering

## **2.9 Scope and Limitation**

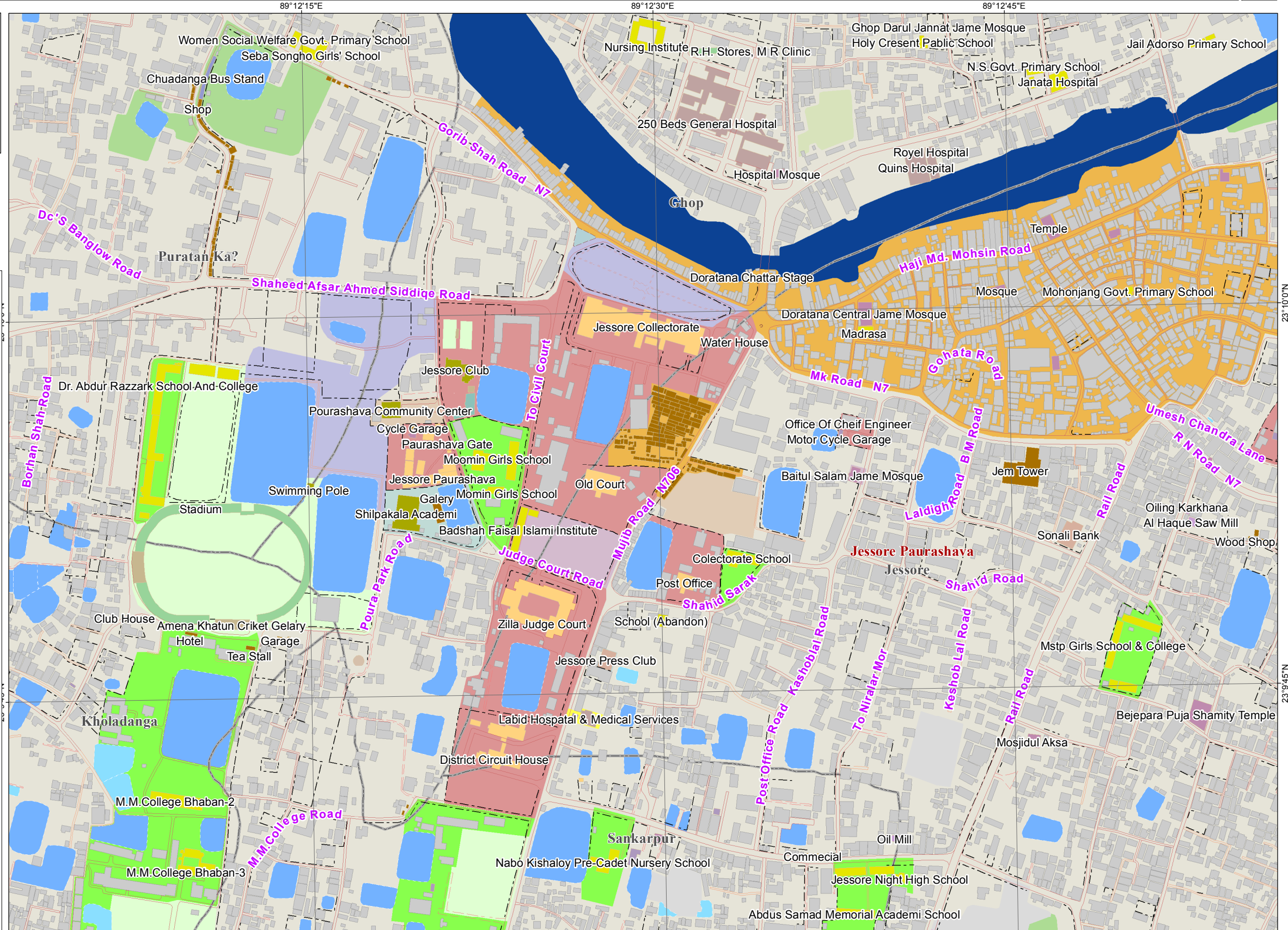
3D photogrammetric provides us to capture geo data in 3D. This means we can measure height value of any object. So the DEM generation is become easier and authentic. We can easily calculate the building floor height from 3D image. Also it solves the object tiling problem in image.

But there are some limitations of this photogrammetric technology. Generally image captures from bird's eye view. So it is difficult to identify object under trees. Under trees/buildings height was calculated using surroundings height points.



# Jessore Ctiy Map- Part

Physical Feature Survey Work With RTK GPS, Total Station & Using 3D Satellite Image With Relevant Supporting Other Survey For "Benapole-Jessore Corridor Project"



**Legend**

- Point features
- Shako
- Sluice Gate
- Highvoltage Line
- Railway Centerline
- River Dike

**Road EdgeLine**

- <all other values>

**Code**

- Footpath
- Katcha
- Pucca
- Road Unsure
- Road-Island
- Semi-Pucca
- Unknown
- Embankment Line
- Boundary Wall

**Building Roof**

- Residential
- Administrative- Govt.
- Administrative- Private, NGO, Others
- Commercial Activities
- Community Facilites
- Education and Reseach
- Health Facilities
- Historic Place
- Industrial Activities
- Miscellaneous/Others
- Mixed Use
- Recreational Facilities
- Religious Activities
- Restricted
- Storage/Godown
- Transport and Communication
- Utility Services
- Bridge

**Water Body**

- Borrow Pits
- Ditch
- GHeer (Fish Cultivation Only)
- Haor / Baor
- Irrigation Canal
- Khal
- Lake
- Marsh Land
- Pond
- River
- Unknown

**Generalize Landuse**

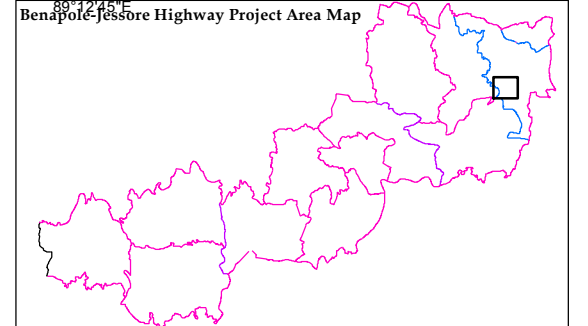
- Administrative- Govt
- Administrative- Private, NGO, Others
- Agricultural Area
- Borrow Pits
- Brickfield
- Commercial Area
- Disaster Prone Area
- Educational and Research
- Eidgah
- Electric Power Plant
- Electric Substation
- Forest
- Forest with Settlement
- Garage
- Garden
- Grass Land
- Graveyard / Cemetry / Crematorium
- Health Facilities
- Helipad
- Historic Place
- Industrial Area
- Monument
- Park
- Play Ground
- Public Gathering
- Pump Station for Flood
- Recreational Area
- Religious Area
- Residential Area
- Restricted Area
- Sand / Sand Dunes/ Char Land
- Slum Area
- Storage Zone
- Terminal Bus/Truck
- Terminal Railway Station
- Unknown
- Vacant Lands
- Water Work
- Wetlands / Flood Prone

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**CONSULTANT**  
**DECODE-GEOMARK JV**  
BDBL Bhaban (6th Level)  
12 Karwan Bazar  
Dhaka-1215

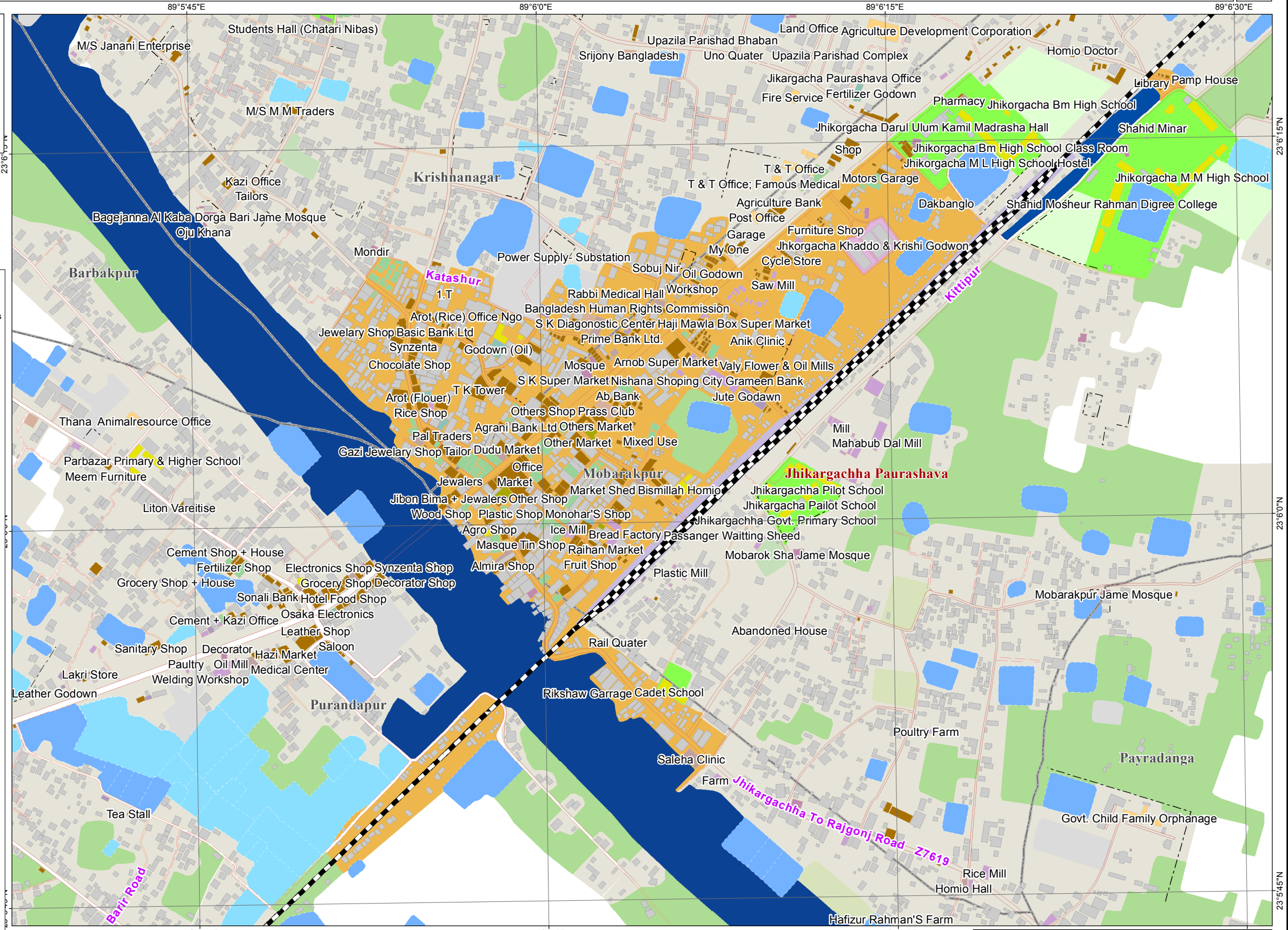
0 5 10 20 Km

Map Source: Mouza- DLRS, Jessore Settlement Office and Satellite Image (DigitalGlobe), Field Survey



# Jhikargacha Ctiy Map- Part

**Physical Feature Survey Work With RTK GPS, Total Station & Using 3D Satellite Image With Relevant Supporting Other Survey For "Benapole-Jessore Corridor Project"**



**Legend**

- Point features
- Shako
- Sluice Gate
- Highvoltage Line
- Railway Centerline
- River Dike

**Road EdgeLine**

- <all other values>

**Code**

- Footpath
- Katcha
- Pucca
- Road Unsure
- Road-Island
- Semi-Pucca
- Unknown
- Embankment Line
- Boundary Wall

**Building Roof**

- Residential
- Administrative- Govt.
- Administrative- Private, NGO, Others
- Commercial Activities
- Community Facilites
- Education and Reseach
- Health Facilities
- Historic Place
- Industrial Activities
- Miscellaneous/Others
- Mixed Use
- Recreational Facilities
- Religious Activities
- Restricted
- Storage/Godown
- Transport and Communication
- Utility Services
- Bridge

**Water Body**

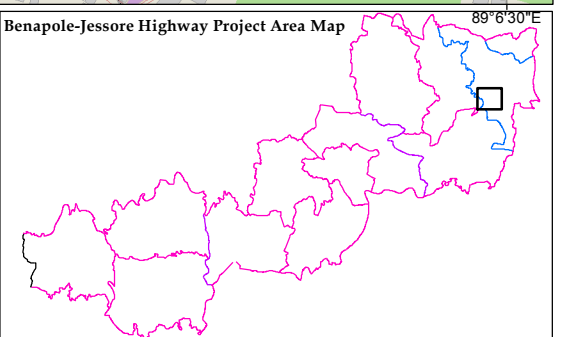
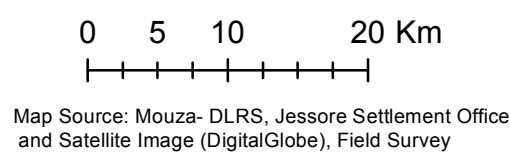
- Borrow Pits
- Ditch
- GHeer (Fish Cultivation Only)
- Haor / Baor
- Irrigation Canal
- Khal
- Lake
- Marsh Land
- Pond
- River
- Unknown

**Generalize Landuse**

- Administrative- Govt
- Administrative- Private, NGO, Others
- Agricultural Area
- Borrow Pits
- Brickfield
- Commercial Area
- Disaster Prone Area
- Educational and Research
- Eidgah
- Electric Power Plant
- Electric Substation
- Forest
- Forest with Settlement
- Garage
- Garden
- Grass Land
- Graveyard / Cemetry / Crematorium
- Health Facilities
- Helipad
- Historic Place
- Industrial Area
- Monument
- Park
- Play Ground
- Public Gathering
- Pump Station for Flood
- Recreational Area
- Religious Area
- Residential Area
- Restricted Area
- Sand / Sand Dunes/ Char Land
- Slum Area
- Storage Zone
- Terminal Bus/Truck
- Terminal Railway Station
- Unknown
- Vacant Lands
- Water Work
- Wetlands / Flood Prone

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**DECODE-GEOMARK JV**  
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12 Karwan Bazar  
Dhaka-1215



# Benapole Ctiy Map- Part

Physical Feature Survey Work With RTK GPS, Total Station & Using 3D Satellite Image With Relevant Supporting Other Survey For "Benapole-Jessore Corridor Project"

**Legend**

- Point features
- Shako
- Sluice Gate
- Highvoltage Line
- Railway Centerline
- River Dike

**Road EdgeLine**

- <all other values>

**Code**

- Footpath
- Katcha
- Pucca
- Road Unsure
- Road-Island
- Semi-Pucca
- Unknown
- Embankment Line
- Boundary Wall

**Building Roof**

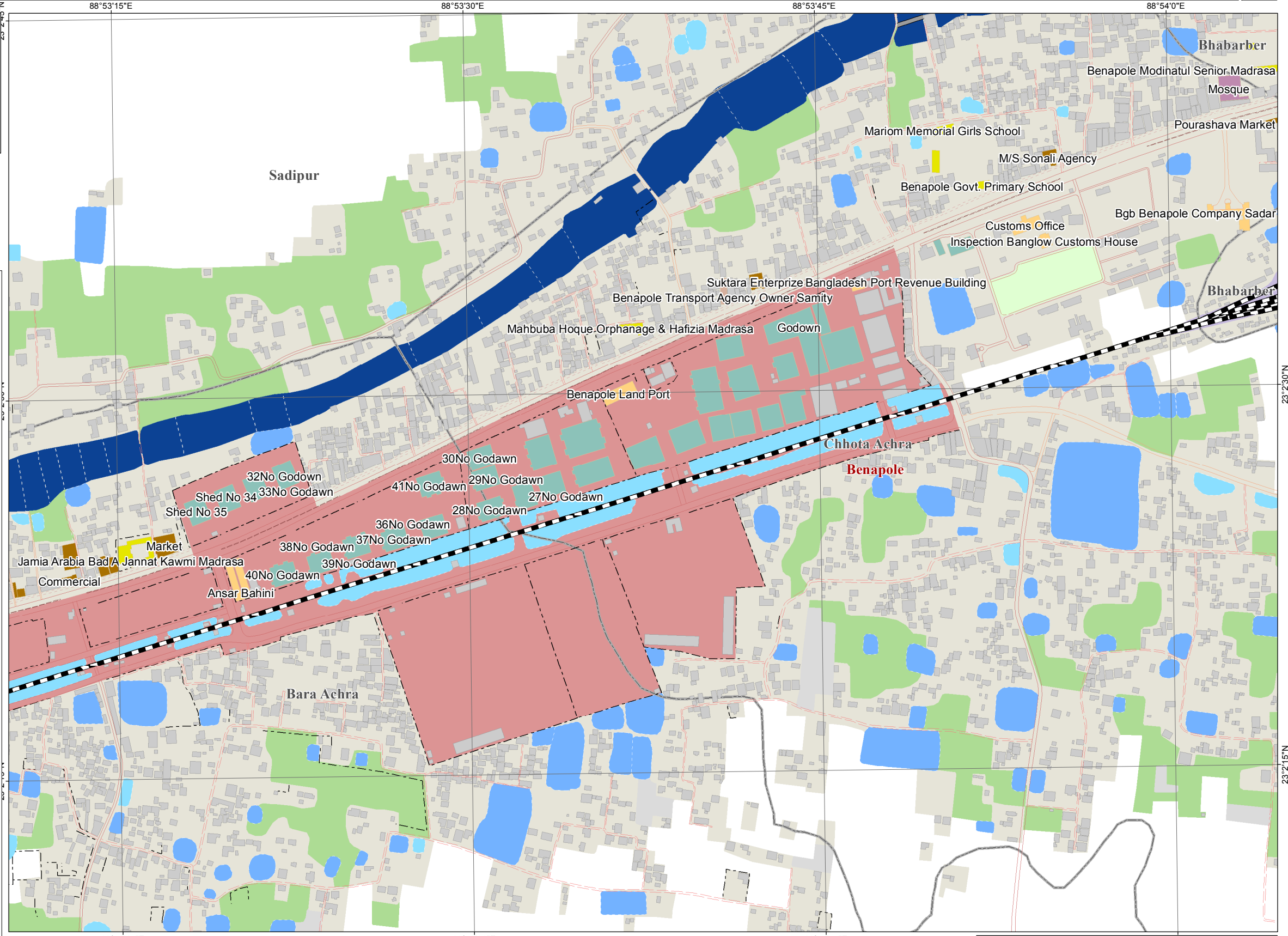
- Residential
- Administrative- Govt.
- Administrative- Private, NGO, Others
- Commercial Activities
- Community Facilites
- Education and Reseach
- Health Facilities
- Historic Place
- Industrial Activities
- Miscellaneous/Others
- Mixed Use
- Recreational Facilities
- Religious Activities
- Restricted
- Storage/Godown
- Transport and Communication
- Utility Services
- Bridge

**Water Body**

- Borrow Pits
- Ditch
- GHeer (Fish Cultivation Only)
- Haor / Baor
- Irrigation Canal
- Khal
- Lake
- Marsh Land
- Pond
- River
- Unknown

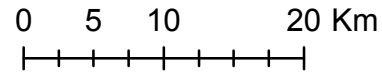
**Generalize Landuse**

- Administrative- Govt
- Administrative- Private, NGO, Others
- Agricultural Area
- Borrow Pits
- Brickfield
- Commercial Area
- Disaster Prone Area
- Educational and Research
- Eidgah
- Electric Power Plant
- Electric Substation
- Forest
- Forest with Settlement
- Garage
- Garden
- Grass Land
- Graveyard / Cemetry / Crematorium
- Helipad
- Historic Place
- Industrial Area
- Monument
- Park
- Play Ground
- Public Gathering
- Pump Station for Flood
- Recreational Area
- Religious Area
- Residential Area
- Restricted Area
- Sand / Sand Dunes/ Char Land
- Slum Area
- Storage Zone
- Terminal Bus/Truck
- Terminal Railway Station
- Unknown
- Vacant Lands
- Water Work
- Wetlands / Flood Prone

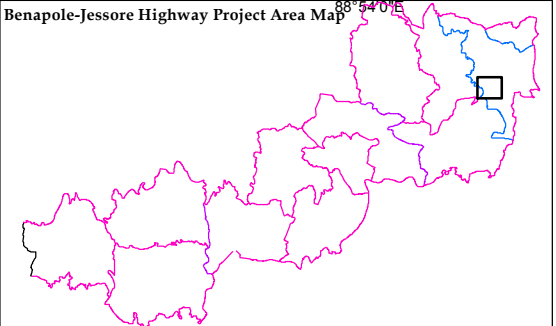


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Map Source: Mouza- DLRS, Jessore Settlement Office and Satellite Image (DigitalGlobe), Field Survey



# 0.3 Meter Contour Maps



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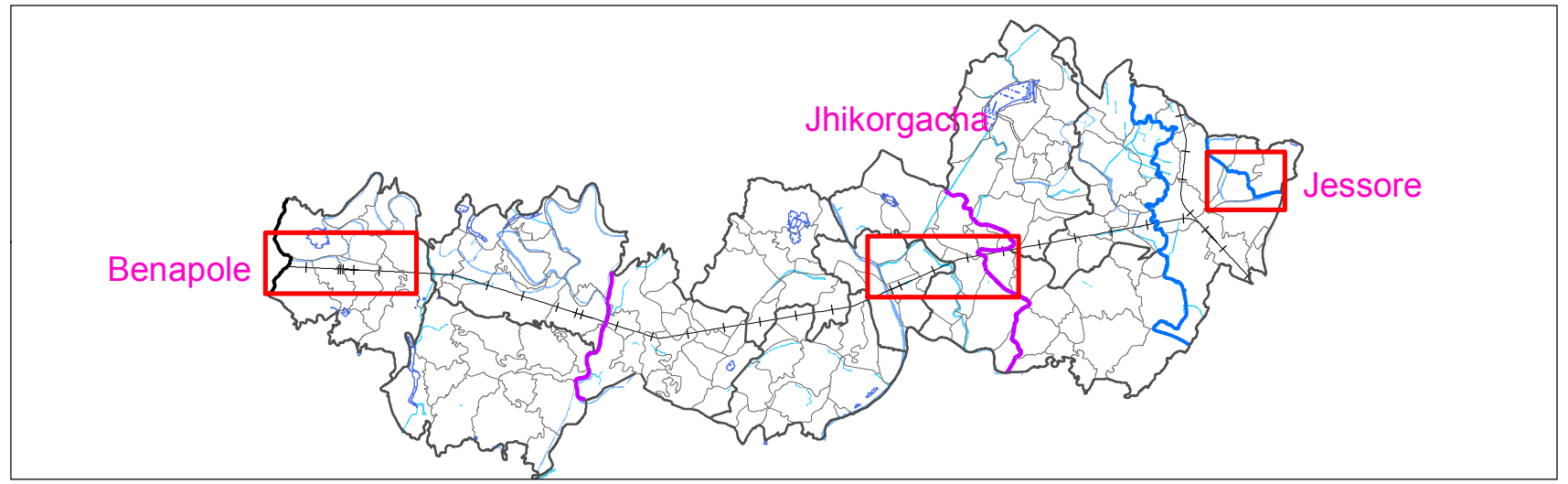
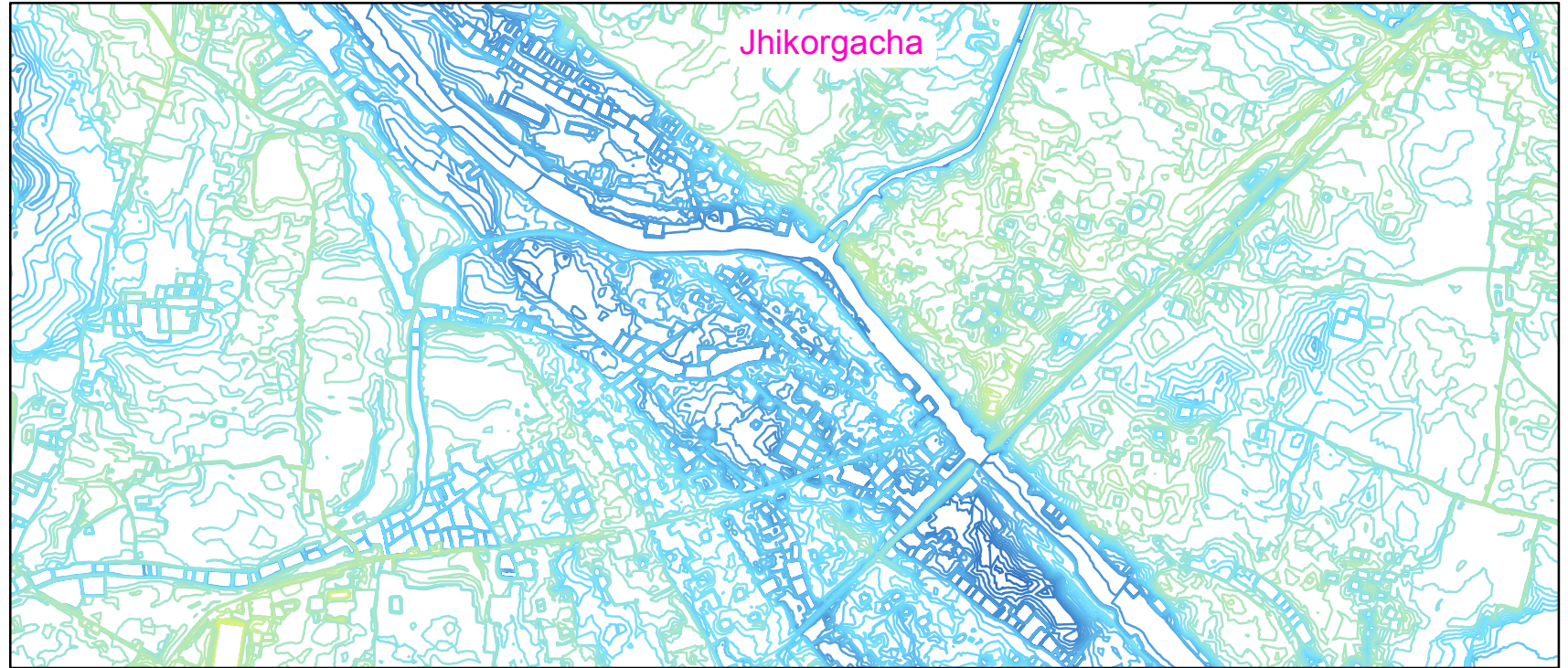
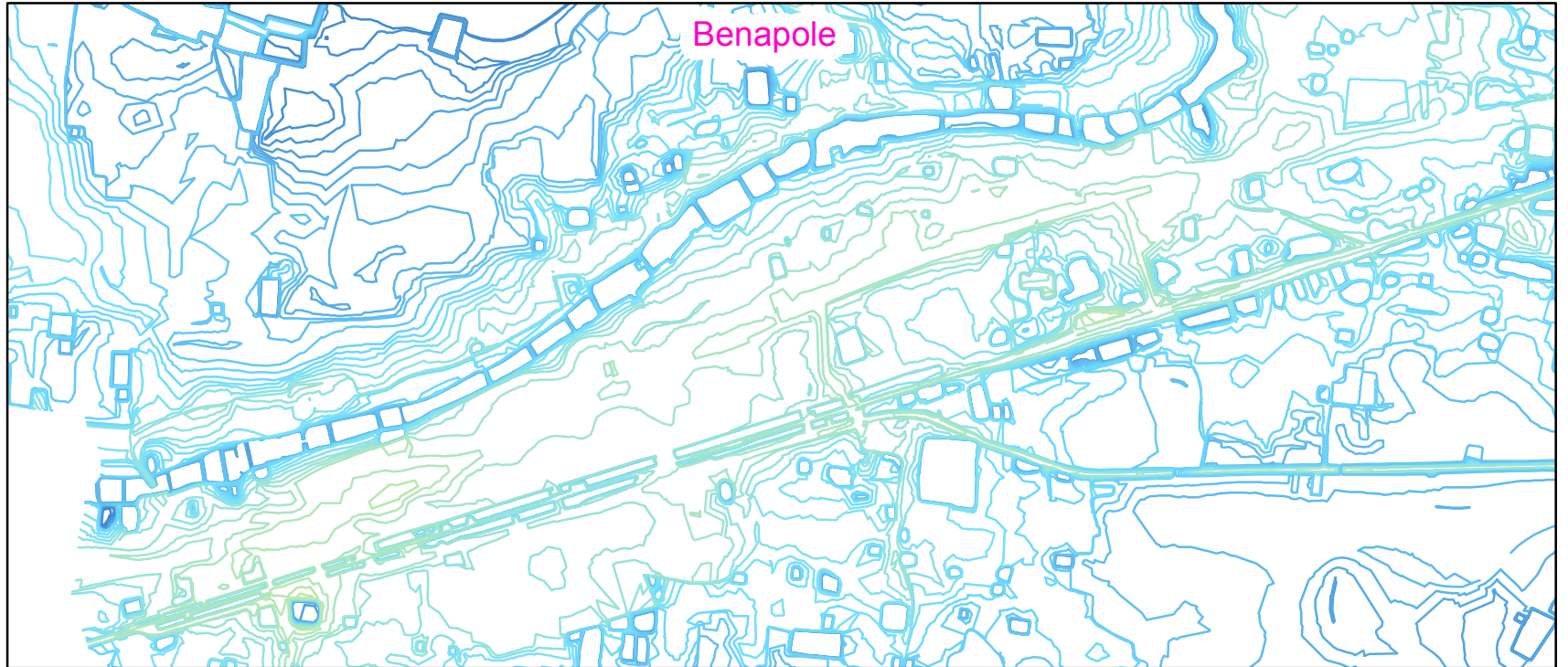
CONSULTANT

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 12 Karwan Bazar  
 Dhaka-1215

Map Source: Stereo Satellite Image (DigitalGlobe)

**Legend**

— Mouza Boundary	— Railway
— International Boundary	Haor / Baor
— Mouza Boundary	Khal
— Pauroshava Boundary	Marsh Land
— Union Boundary	River
— Upazila Boundary	



# Digital Elevation Model



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Dhaka-1215

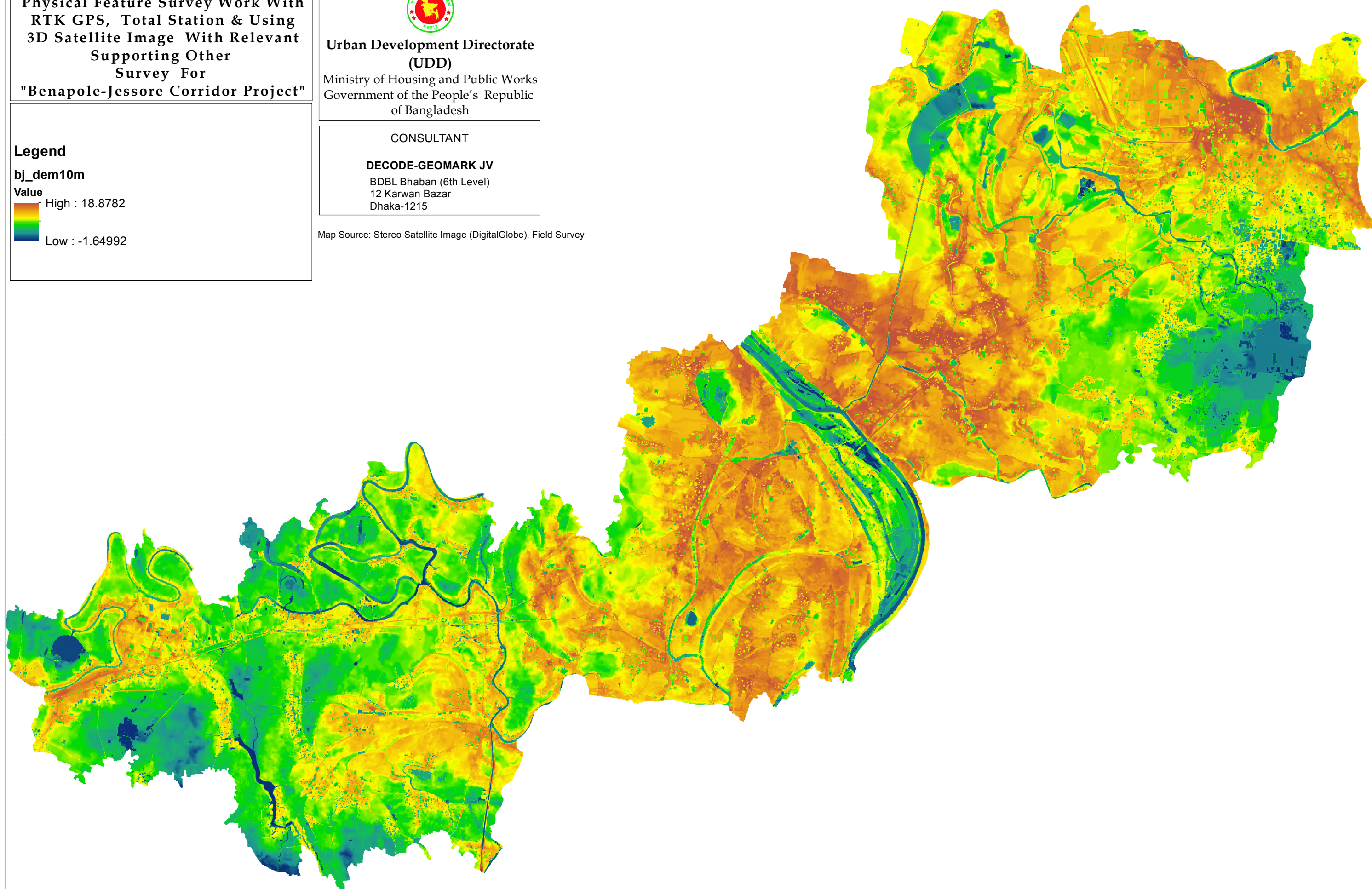
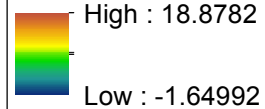
Map Source: Stereo Satellite Image (DigitalGlobe), Field Survey

Physical Feature Survey Work With  
RTK GPS, Total Station & Using  
3D Satellite Image With Relevant  
Supporting Other  
Survey For  
"Benapole-Jessore Corridor Project"

## Legend

bj\_dem10m

Value







# Benapole-Jessore Highway Corridor Development Plan Project Map

Sheet No: B3

Physical Feature Survey Work With  
RTK GPS, Total Station & Using  
3D Satellite Image With Relevant  
Supporting Other  
Survey For  
"Benapole-Jessore Corridor Project"

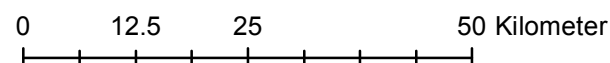


**Urban Development Directorate  
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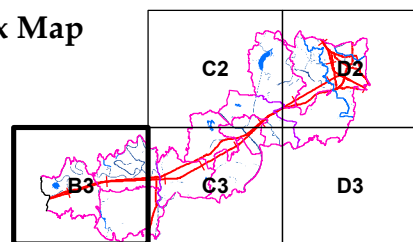
Ministry of Housing and Public Works Government  
of the People's Republic of Bangladesh

CONSULTANT

**DECODE-GEOMARK JV**  
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12 Karwan Bazar, Dhaka-1215

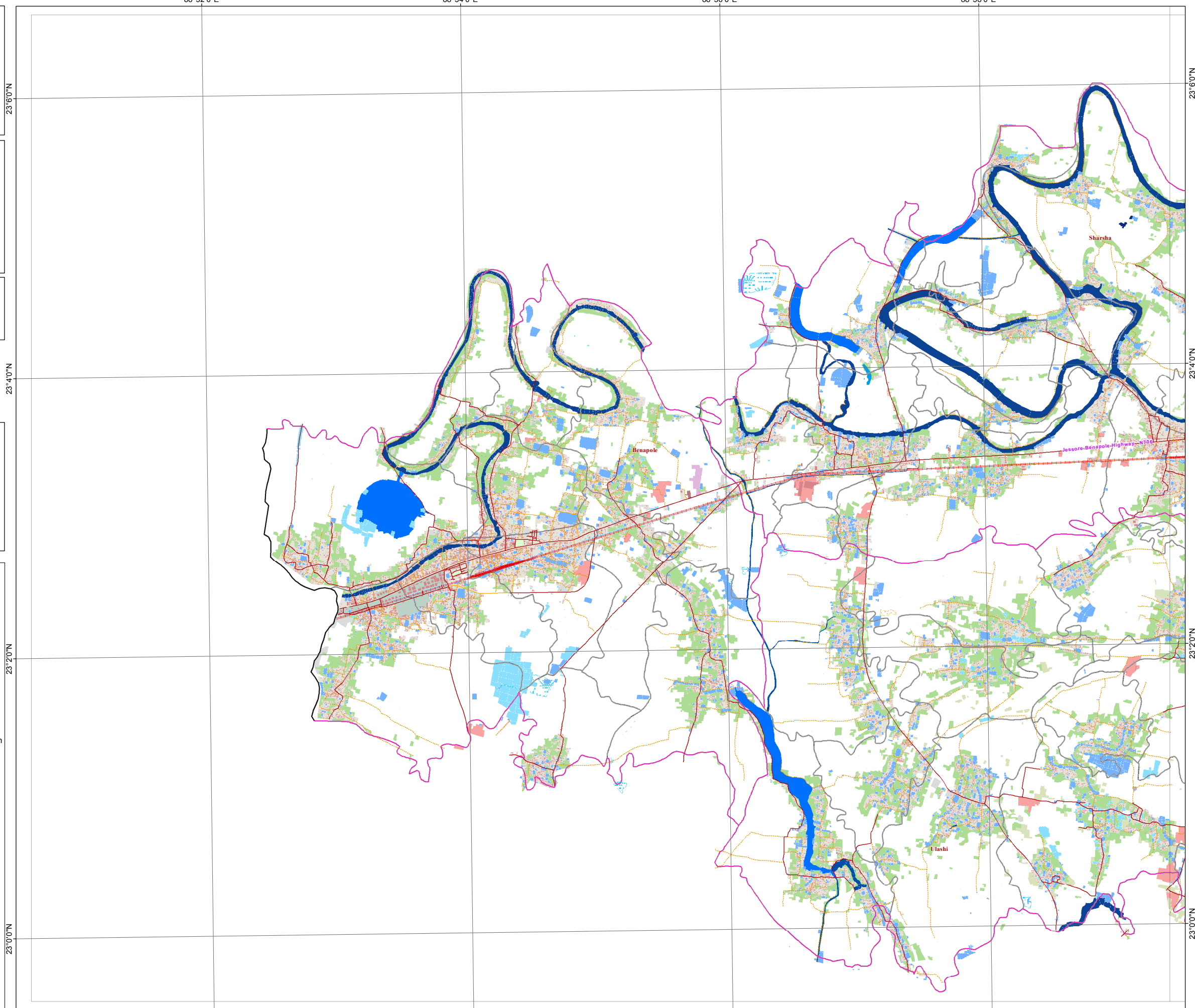


## Index Map



## Legend

<b>Boundary</b>	Agricultural Area
International Boundary	Borrow Pits
Mouza Boundary	Brickfield
Pauroshava Boundary	Commercial Area
Union Boundary	Educational and Research
Upazila Boundary	Eidgah
Sluice Gate	Electric Substation
Highvoltage Line	Forest
Railway Centerline	Forest with Settlement
River Dike	Garden
Embankment Line	Graveyard / Cemetery / Crematorium
<b>Building Roof</b>	Historic Place
Building Roof	Industrial Area
<b>Water Body</b>	Monument
Borrow Pits	Park
Ditch	Play Ground
GHeer (Fish Cultivation Only)	Public Gathering
Haor / Baor	Recreational Area
Irrigation Canal	Religious Area
Khal	Residential Area
Lake	Restricted Area
Marsh Land	Storage Zone
Pond	Terminal Bus/Truck
River	Terminal Railway Station
Unknown	Unknown
<b>Generalize Landuse</b>	Vacant Lands
Administrative- Govt	Water Work
Administrative- Private, NGO, Others	Wetlands / Flood Prone





# Benapole-Jessore Highway Corridor Development Plan Project Map

Sheet No: C2

Physical Feature Survey Work With  
RTK GPS, Total Station & Using  
3D Satellite Image With Relevant  
Supporting Other  
Survey For  
"Benapole-Jessore Corridor Project"



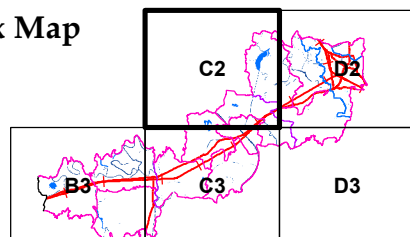
**Urban Development Directorate  
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of the People's Republic of Bangladesh

CONSULTANT  
**DECODE-GEOMARK JV**  
BDBL Bhaban (6th Level)  
12 Karwan Bazar, Dhaka-1215

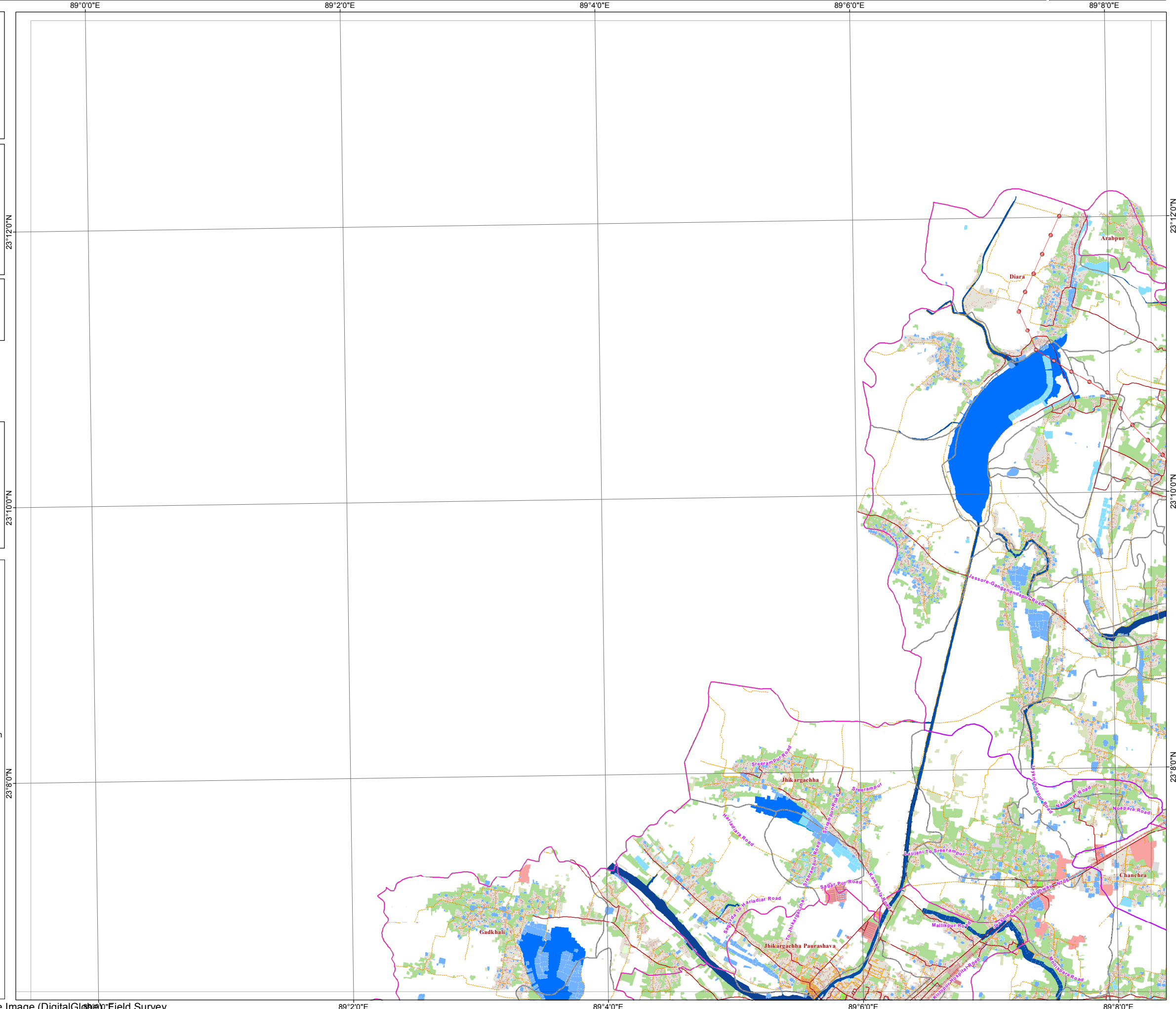
0 12.5 25 50 Kilometer

## Index Map



## Legend

<b>Boundary</b>	Agricultural Area
International Boundary	Borrow Pits
Mouza Boundary	Brickfield
Pauroshava Boundary	Commercial Area
Union Boundary	Educational and Research
Upazila Boundary	Eidgah
Sluice Gate	Electric Substation
Highvoltage Line	Forest
Railway Centerline	Forest with Settlement
River Dike	Garden
Embankment Line	Graveyard / Cemetery / Crematorium
<b>Building Roof</b>	Historic Place
Building Roof	Industrial Area
<b>Water Body</b>	Monument
Borrow Pits	Park
Ditch	Play Ground
GHeer (Fish Cultivation Only)	Public Gathering
Haor / Baor	Recreational Area
Irrigation Canal	Religious Area
Khal	Residential Area
Lake	Restricted Area
Marsh Land	Storage Zone
Pond	Terminal Bus/Truck
River	Terminal Railway Station
Unknown	Unknown
<b>Generalize Landuse</b>	Vacant Lands
Administrative- Govt	Water Work
Administrative- Private, NGO, Others	Wetlands / Flood Prone





# Benapole-Jessore Highway Corridor Development Plan Project Map

Sheet No: C3

Physical Feature Survey Work With  
RTK GPS, Total Station & Using  
3D Satellite Image With Relevant  
Supporting Other  
Survey For  
"Benapole-Jessore Corridor Project"

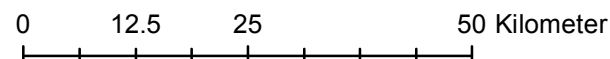


**Urban Development Directorate  
(UDD)**

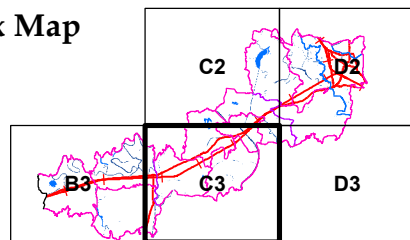
Ministry of Housing and Public Works Government  
of the People's Republic of Bangladesh

CONSULTANT

**DECODE-GEOMARK JV**  
BDBL Bhaban (6th Level)  
12 Karwan Bazar, Dhaka-1215

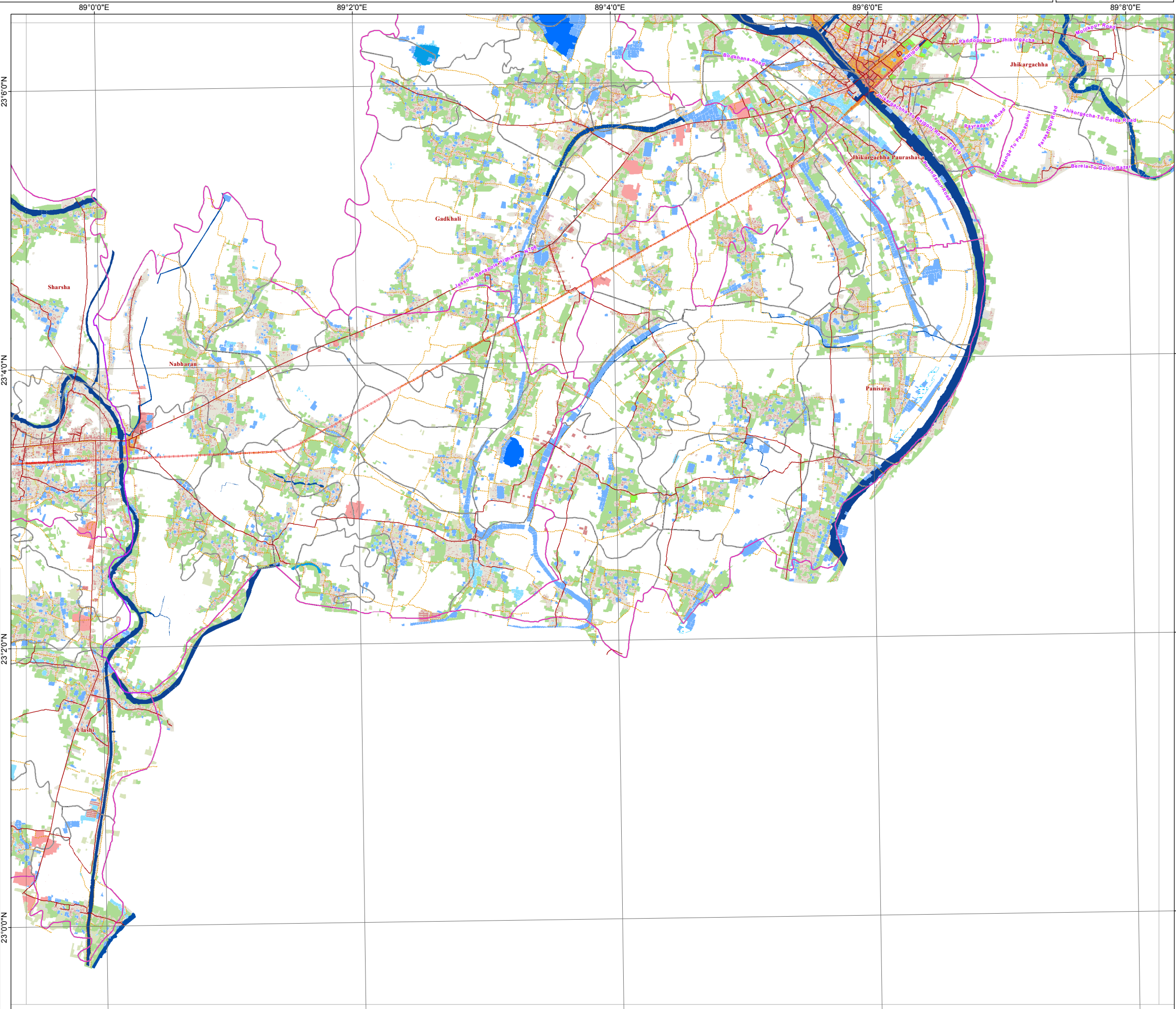


## Index Map



## Legend

<b>Boundary</b>	Agricultural Area
International Boundary	Borrow Pits
Mouza Boundary	Brickfield
Pauroshava Boundary	Commercial Area
Union Boundary	Educational and Research
Upazila Boundary	Eidgah
Sluice Gate	Electric Substation
Highvoltage Line	Forest
Railway Centerline	Forest with Settlement
River Dike	Garden
Embankment Line	Graveyard / Cemetery / Crematorium
<b>Building Roof</b>	Historic Place
Building Roof	Industrial Area
<b>Water Body</b>	Monument
Borrow Pits	Park
Ditch	Play Ground
GHeer (Fish Cultivation Only)	Public Gathering
Haor / Baor	Recreational Area
Irrigation Canal	Religious Area
Khal	Residential Area
Lake	Restricted Area
Marsh Land	Storage Zone
Pond	Terminal Bus/Truck
River	Terminal Railway Station
Unknown	Unknown
<b>Generalize Landuse</b>	Vacant Lands
Administrative- Govt	Water Work
Administrative- Private, NGO, Others	Wetlands / Flood Prone





# Benapole-Jessore Highway Corridor Development Plan Project Map

Sheet No: D2

Physical Feature Survey Work With  
RTK GPS, Total Station & Using  
3D Satellite Image With Relevant  
Supporting Other  
Survey For  
"Benapole-Jessore Corridor Project"

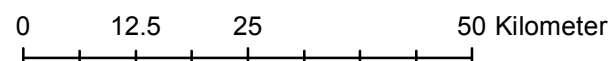


**Urban Development Directorate  
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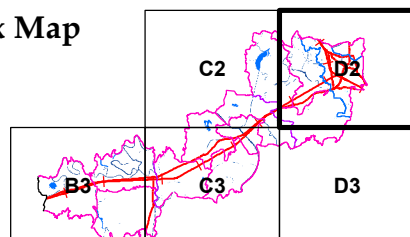
Ministry of Housing and Public Works Government  
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## Index Map



## Legend

### Boundary

- International Boundary
- Mouza Boundary
- Pauroshava Boundary
- Union Boundary
- Upazila Boundary
- Sluice Gate
- Highvoltage Line
- Railway Centerline
- River Dike
- Embankment Line

### Building Roof

- Building Roof

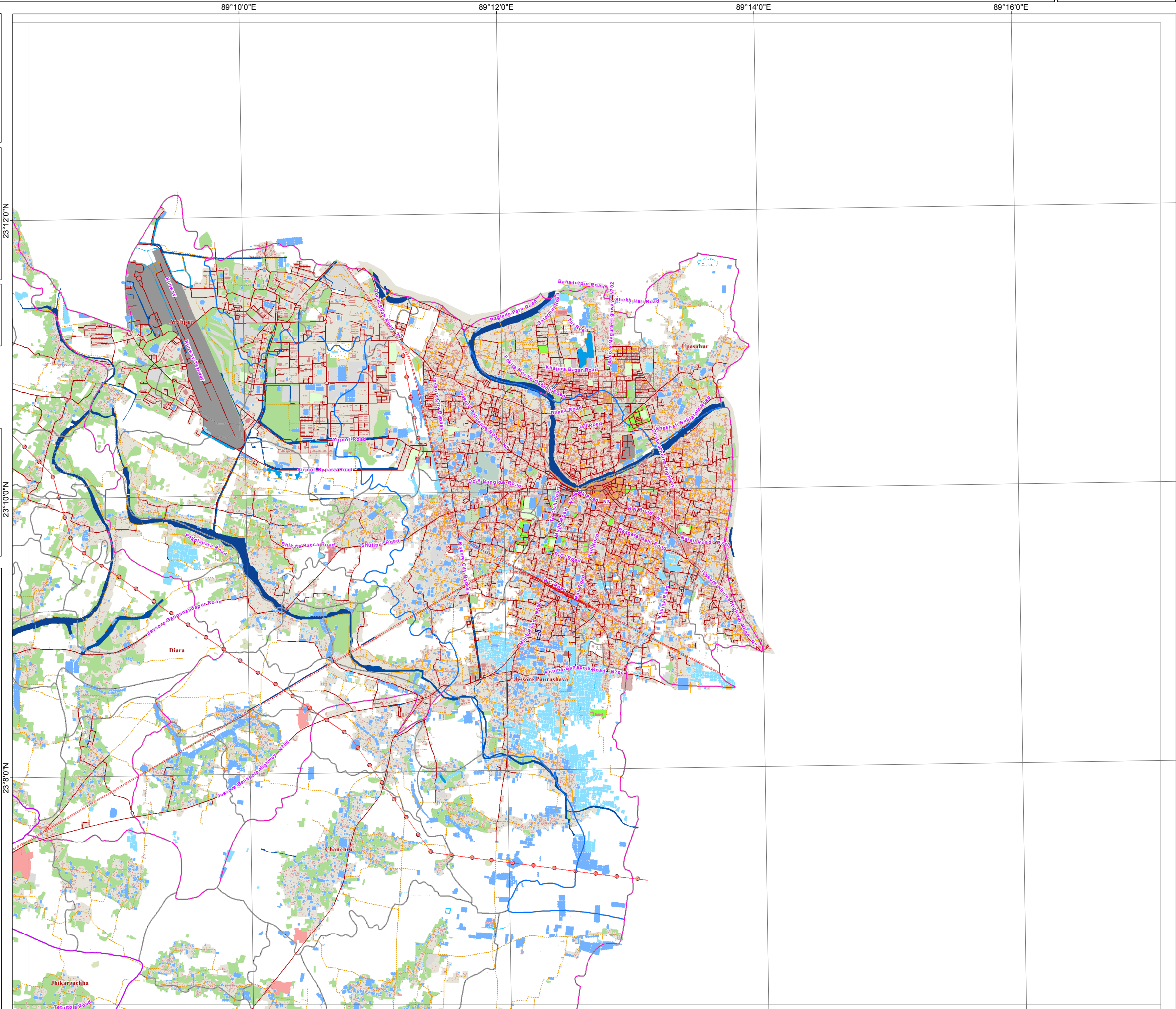
### Water Body

- Borrow Pits
- Ditch
- GHeer (Fish Cultivation Only)
- Haor / Baor
- Irrigation Canal
- Khal
- Lake
- Marsh Land
- Pond
- River
- Unknown

### Generalize Landuse

- Administrative- Govt
- Administrative- Private, NGO, Others

- Agricultural Area
- Borrow Pits
- Brickfield
- Commercial Area
- Educational and Research
- Eidgah
- Electric Substation
- Forest
- Forest with Settlement
- Garden
- Graveyard / Cemetery / Crematorium
- Historic Place
- Industrial Area
- Monument
- Park
- Play Ground
- Public Gathering
- Recreational Area
- Religious Area
- Residential Area
- Restricted Area
- Storage Zone
- Terminal Bus/Truck
- Terminal Railway Station
- Unknown
- Vacant Lands
- Water Work
- Wetlands / Flood Prone





# Benapole-Jessore Highway Corridor Development Plan Project Map

Sheet No: D3

Physical Feature Survey Work With  
RTK GPS, Total Station & Using  
3D Satellite Image With Relevant  
Supporting Other  
Survey For  
"Benapole-Jessore Corridor Project"

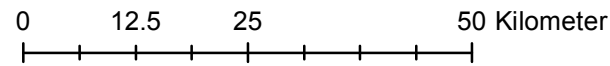


**Urban Development Directorate  
(UDD)**

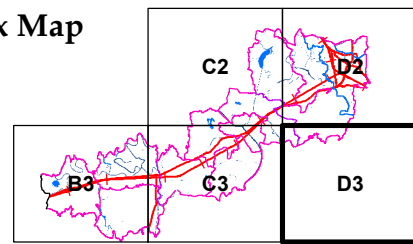
Ministry of Housing and Public Works Government  
of the People's Republic of Bangladesh

CONSULTANT

**DECODE-GEOMARK JV**  
BDBL Bhaban (6th Level)  
12 Karwan Bazar, Dhaka-1215

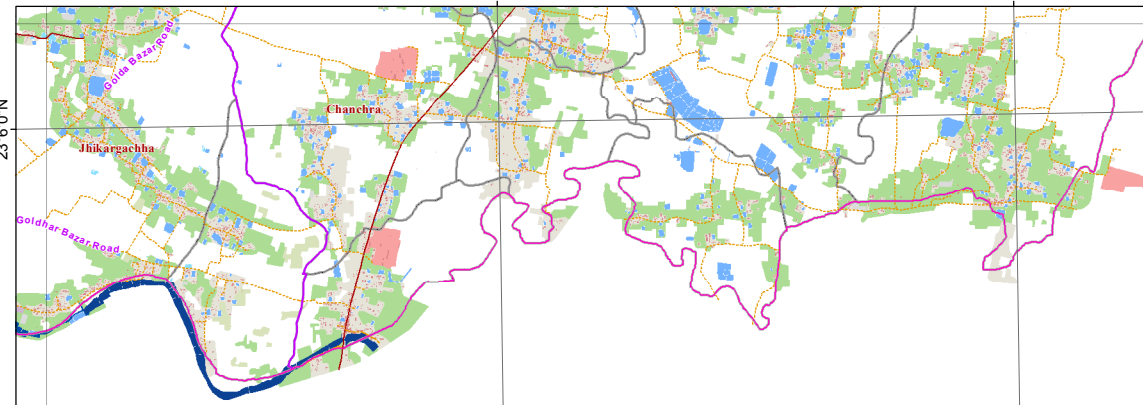


## Index Map



## Legend

<b>Boundary</b>	Agricultural Area
International Boundary	Borrow Pits
Mouza Boundary	Brickfield
Pauroshava Boundary	Commercial Area
Union Boundary	Educational and Research
Upazila Boundary	Eidgah
Sluice Gate	Electric Substation
Highvoltage Line	Forest
Railway Centerline	Forest with Settlement
River Dike	Garden
Embankment Line	Graveyard / Cemetery / Crematorium
<b>Building Roof</b>	Historic Place
Building Roof	Industrial Area
<b>Water Body</b>	Monument
Borrow Pits	Park
Ditch	Play Ground
GHeer (Fish Cultivation Only)	Public Gathering
Haor / Baor	Recreational Area
Irrigation Canal	Religious Area
Khal	Residential Area
Lake	Restricted Area
Marsh Land	Storage Zone
Pond	Terminal Bus/Truck
River	Terminal Railway Station
Unknown	Unknown
<b>Generalize Landuse</b>	Vacant Lands
Administrative- Govt	Water Work
Administrative- Private, NGO, Others	Wetlands / Flood Prone



# Chapter 04

Conclusion

# CHAPTER 04

## Conclusion

### 4.1 Conclusion

As evident from the report the consultants approached to address the following issues as per Tor of the project a) 3D satellite image processing b) 3D digitization d) base map preparation.

All the above tasks have been completed & detail procedure and data are laid down in the report. It may be noted from the report that all the mentioned task have been completed and satisfactory results are achieved.

We are now working to complete the rest of the aspects of the project and looking forward to complete those in time.

Annexure



## Report on Interpretation of Image and Preparation of Base Map

Providing Consultancy services for "Physical Feature Survey Work With RTK GPS, Total Station & Using 3D Image and Other Survey for Area of "Preparation of Development Plan for Benapole-Jessore Highway Corridor Project""

### SOB BM List

**SURVEY OF BANGLADESH**  
Geodetic Detachment  
Tejgaon, Dhaka-1208  
Ph: 02-9131193

#### Coordinate, Heights and Location of Geodetic Control Point.

SI No	ID No	Height above MSL (m)	WGS-84		UTM (Grid)			Description
			Latitude ddmss.sssss	Longitude ddmss.sssss	Zone	Easting (Meter)	Northing (Meter)	
01.	BM-5001	5.3491 ✓	-	-	-	-	-	The pillar is situated just behind the main building of Jessore Degree College and about 300m north-east from Jessore Central Bus Terminal. Vill: Mobarak Kati, Upazila: Jessore Sadar, District: Jessore.
02.	BM-1063	6.2261 ✓	230918.87519	891139.31152	45 Q	724650.632	2562397.410	The pillar is situated about 30m west from rail line & road crossing at Kholadanga. The rail line crossing is near Ma-Moni Saw Mill at Kharaki-Dhaka bypass road in Jessore. Vill: Kholadanga, Upazila: Jessore Sadar, District: Jessore.
03.	BM-1059	7.1181 ✓	-	-	-	-	-	The pillar is situated 7.2m south from south east corner of Hazir Ali Non Govt. Primary School. On Benapol-Jessore road. Vill: Hazir Ali, Upazila: Jhikargachha, District: Jessore.
04.	BM-1060	8.1172 ✓	-	-	-	-	-	The pillar is situated south side of a Km post indicated Jessore-12 & Benapol-26 km. On Jessore-Jhikargachha road. Vill: Kirtipur, Upazila: Jhikargachha, District: Jessore.
05.	BM-1057	6.0819 ✓	-	-	-	-	-	The pillar is situated closed to east boundary wall of Boraj Bagan Girl's High School. On Navaron-Sharsha road. Vill: Boraj Bagan, Upazila: Sharsha, District: Jessore.
06.	GPS-101	7.1150 ✓	230055.50321	885741.05198	45 Q	701012.218	2546572.058	The pillar is situated S.W. corner of Dhalidaha High School's field. It is about 6 km South from Sharsha Upazila. Vill: Dhalidaha, Upazila: Sharsha, District: Jessore.

Note: These values are not to be co-ordinated to any other person/ organisation except this project.

Prepared by: *[Signature]*

Checked by: *[Signature]*



20.05.2010

**Ganesh Chandra Roy**

Assistant Director (Survey)  
Incharge, Geodetic Detachment  
Survey of Bangladesh, Dhaka.

## Report on Interpretation of Image and Preparation of Base Map

Providing Consultancy services for "Physical Feature Survey Work With RTK GPS, Total Station & Using 3D Image and Other Survey for Area of "Preparation of Development Plan for Benapole-Jessore Highway Corridor Project"

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Step-wise detailed activities to be performed by the survey firms are described below:

**STEP 3-I Selection of Ground Control Point (GCP)**

- At least 4 nos. of GCP (Tic) should be selected in ground for each of mouza sheet for conducting GCP survey. The joint team of UDD and consulting firms will select the GCP. Geo-referenced (x, y, z) permanent Bench Mark (BM) pillars uniformly distributed covering the project area have to be established to carry out the total topographic, physical feature and land use survey. Design, drawing of BM pillars have to be approved by the Project Director (PD)

**STEP 3-II Edit Plot Checking of Digitized Mouza Maps and Geo-referencing with Image**

- After digitization of mouza maps edit plots will be produced containing all the features in different colours. The digitized mouza maps will be checked and verified by superimposing on the original mouza maps using the light table. This checking will be done with the joint team of UDD and the respective survey firm. By this edit plot check all possible errors (missing arcs, dislocated arcs, wrong or missing polygon labels, tic location and ID etc) will be solved and final digitized mouza maps will be prepared. After finalization of digitization of mouza maps, all data both soft and hard copy will be submitted to Project Director (PD)

**STEP 3-III Preparation of Report for collecting GCP and satellite image for base map preparation**

**STEP 4: SATELLITE IMAGE PROCESSING BY USING PHOTOGRAMMETRIC METHOD**

- Photogrammetric method uses satellite/aerial stereo images to create Digital Elevation Model and make geospatial database more effectively. With the advent of latest trends in the technologies and unique customer requirements, photogrammetry is now the leading technology for mapping. The field of photogrammetry is a rapid science with new technologies being developed constantly. Within a short period of time, the practice of photogrammetry has changed from analog to digital. The development of digital aerial cameras has advanced significantly over the past 4-5 years. The use of digital aerial images would be more advantageous for all map and image production especially for Digital vector data and Orthophoto generation.

**Step 4-I Methodology**

- Since the internal precision of extracted DEMs is strictly related to the mean scale of photographs, image quality, pixel dimension and, obviously, morphology of the area, Image Collection is a crucial part of the project. Image will be collected from Satellite image provider.
- The Satellite image in 0.5-meter panchromatic and 1.74-meter multi spectral four-band images in stereo pairs will be procured for town area. The 0.5-meter pan and 1.74-meter multi spectral imagery will also be fused to yield 0.5-meter colour imagery (pan-sharpened) and 2.5-meter stereo image will also be collected for country area.

**Step 4-II Image Processing**

- Image processing will be done after collecting raw digital images. The tasks involved in image processing are
  - Epi-polar Correction
  - Color Balance
  - Contrast Adjustment
  - Sharpening
  - Pyramid
  - Bit Rate Setting

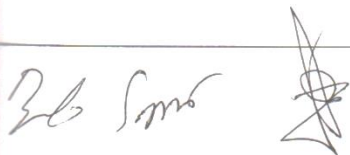
**Step 4-III GCP Collection**

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

**Step 4-IV Aerial Triangulation**

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

Input for AT	Output of AT
<ul style="list-style-type: none"><li>- IMU, RPC data</li><li>- GPS (on board)</li><li>- GCP (collected from field)</li><li>- Image</li></ul>	Georeferenced Stereo Model



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### Step 4-V Digital Mapping from Stereo Model

- After the orientation of stereo models, digital mapping will be carried out. We propose ArcGIS Geodatabase/shapefile model for storing geo-spatial data. The proposed Geodatabase and its Feature classes will be designed based on the followings:
  - Projection Parameters of the Coordinate System
  - Name and type of layer (feature classes)
  - Structure of Attribute Tables of the Feature classes
- Digital Photogrammetric Workstation e.g. Datan Summit Evolution (DPW) will be used as the platform for acquiring features from digital stereo images (model).
- Feature registration will be done considering and measuring the position of the object under its accuracy level. The Summit Evolution & Stereo Plotter of DAT/EM will be used for identifying and registration of the objects and ArcGIS 9.2 of ESRI will be used for vector data storing and editing.

### Step 4-VI Attribute Data Collection

- Attribute data of the features will be collected from the field after producing base map. It will be a step by step procedure.

### Step 4-VII Map Updating

- Attribute data collected from the field, will be incorporated into the features in this stage.

### Step 4-VIII Field Check

- Field checking will be done check the following:
  - Dimension and shape of the features
  - Accuracy of feature's attributes
  - Missing objects.
  - Data will be collected by total station where cloud will be found in the image or some object which is not able to identify in image.

### Step 4-IX DTM/DEM/TIN/Contour Generation

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

#### a. Ortho-rectification of Images

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

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

#### b. Mosaicing of OrthoPhoto

Individual rectified photograph will be assembled to form seamless mosaic.

Mosaicing of OrthoPhoto includes the following tasks

- a) Seam line Drawing: Drawing the boundary of the image delineating which part of the image will go which image.
- b) Balancing of Color and Contrast within different images
- c) Feathering

### Step 4-X

Submission of Report on Image Processing

- Study Area Map (Digital copy in ARC/INFO format & Hard Copy) along with report stating the status of collected information, procedure of establishment of permanent Ground Control Point (GCP) and Temporary Ground Control Point (TGCP), Scanning, digitization and compilation of Mouza Map, demarcation of study area boundary including the technical specifications have to be submitted.

### Step 4-XI

**Report on Interpretation of Image and preparation of base map**

### STEP 5.

SURVEY ACTIVITIES (Field Survey information in original format have to be submitted to the Project Director (PD) at the end of every week.)

(1) A review of the work plans and time schedule for the remaining period of the contract.

(2) Activities to be performed by the survey firms for Draft Survey Report:

- All survey data including
  - Topographic Survey
  - Physical Feature Survey
  - Land Use Survey

Sub Samir

## Report on Interpretation of Image and Preparation of Base Map

Providing Consultancy services for "Physical Feature Survey Work With RTK GPS, Total Station & Using 3D Image and Other Survey for Area of "Preparation of Development Plan for Benapole-Jessore Highway Corridor Project""

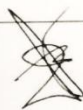
### Appendix 2: Reporting Requirements

#### 1.0 Report submission schedule and Mode of Payment for Image Processing, Physical Feature, Topographic, Land Use and Other Related Surveys

Reports shall be presented and illustrated in a clear and concise professional manner, including maps, plans, diagrams and other graphics. Schedule of submission:

Sl no.	Report	Language	Copy	Period of Submission	Binding Status	Mode of Payment (% of Contract amount)
1	Mobilization Report	English	20	Within 15 days of Signing contract	Spiral Binding	Not more than 10%
2	Inception Report	English	20	End of 1 <sup>st</sup> month	Spiral Binding	Not more than 15%
3	Report on collection of GCP and satellite image for base map preparation	English	20	End of 2 <sup>nd</sup> month	Spiral Binding	Not more than 10%
4	Report on Interpretation of Image and preparation of base map	English	20	End of 3 <sup>rd</sup> month	Spiral Binding	Not more than 20%
5	Draft Survey Report	English	20	End of 4 <sup>th</sup> month	Spiral Binding	Not more than 20%
6	Final Survey Report	English	20	End of 5 <sup>th</sup> month	Spiral Binding	Not more than 20%
7	Survey Completion Report	English	20	After Finalization of Draft Plan	Hard Binding	Not more than 5%

26/1/20



**Report on Collection of GCP and Satellite Image for Base Map Preparation**

*Providing Consultancy services for "Physical Feature Survey Work With RTK GPS, Total Station & Using 3D Image and Other Survey for Area of "Preparation of Development Plan for Benapole-Jessore Highway Corridor Project"*



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