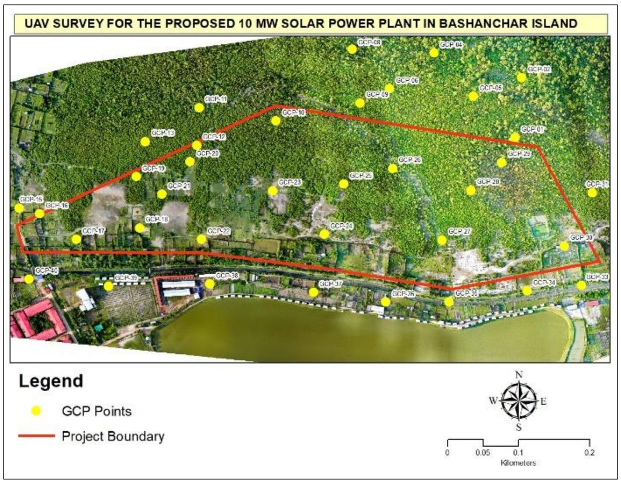
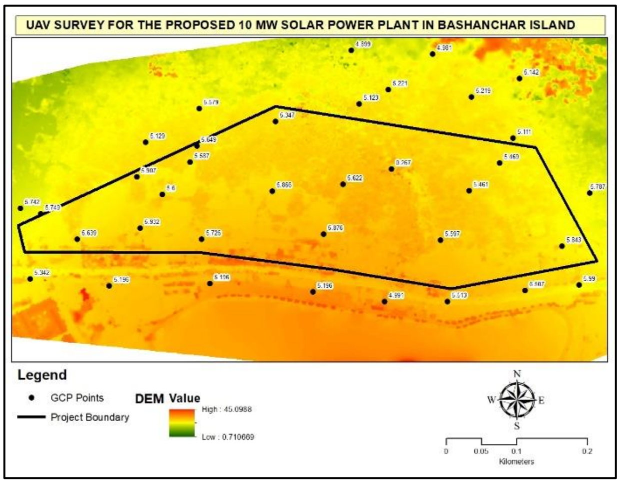
10 MW SOLAR POWER PLANT IN BASHANCHAR ISLAND BY PDB





DIGITAL TOPOGRAPHICAL SURVEY WITH DRONE & RTK

SURVEY REPORT

O.CREEDS
Onushandhani Creeds Ltd.
ONUSHANDHANI CREEDS LIMITED
House: B/160, Flat: 5A, Road: 23, Mohakhali DOHS, Dhaka-1206
E-mail: ceo@ocreeds.com
ISO 9001 2015 CERTIFIED
ISO 14001:2015
www.ocreeds.com

EXECUTIVE SUMMARY

The Solar Power Plant in Bhashanchar Island is extremely important for several environmental, social, and developmental reasons especially considering the island's unique location, purpose, and challenges. A Digital Topographical Survey and Drone Survey was conducted for the proposed Construction of 10 MW SOLAR POWER PLANT IN BASHANCHAR ISLAND, under the supervision of PDB. The objective of this survey was to generate accurate spatial data, establish existing site conditions, and provide a reliable base for engineering design and environmental assessment of the solar power plant.

The survey activities included ground-based digital topographical measurements using Total Station/GNSS technology, combined with a drone-based aerial survey for high-resolution orthophotos and 3D surface models. This integrated approach ensured precise mapping of terrain features, elevation profiles, and existing infrastructure within and around the project area.

Key outputs of the survey include:

- Digital Topographical Maps at appropriate scales, showing natural and man-made features.
- Drone Ortho mosaic Maps and Digital Surface Models (DSM/DTM) for accurate terrain representation.
- Contour Maps reflecting elevation differences critical for solar power plant design.
- Georeferenced CAD Drawings and GIS datasets for further planning and analysis.
- Assessment of Land Profile, drainage pattern, and surrounding land use relevant to environmental management.

The findings from this survey will provide a robust foundation for detailed engineering design, construction planning, and environmental safeguards in the development of the proposed solar power plant. The integration of digital and drone survey technologies ensured high accuracy, efficiency, and cost-effectiveness, aligning with PDB's commitment to sustainable infrastructure development and environmental protection in the Bashanchar region.

Key Findings

The Digital Topographical Survey and Drone Survey of the proposed Solar power plant site at Bashanchar, conducted under PDB, revealed the following key observations:

1. **Topographical Profile**
   - As per digital survey total land within the boundary is 30.00 Acres.
   - The surrounding land is almost flat, with an elevation of 4.5 to 5.5 meters above the mean sea level.
   - The land is flat and sandy.
   - While conducting the survey, we saw that there are very beautiful natural and man-made arrangements for rainwater and drainage with vegetations.
   - A large water body beside the side in southern part.
2. **Drone Orthomosaic & Surface Models**
   - High-resolution drone imagery provided accurate orthophotos and digital surface models (DSM/DTM), enabling precise visualization of terrain and land cover.
   - The drone survey confirmed consistency with ground-based measurements, ensuring data reliability.
3. **Land Use and Existing Features**
   - The proposed plot is in an excellent position with roads on south side.
   - However, there is a canal on the eastern side of the land and a water body about 110 meters away on the southern side.
4. **Geospatial Database Creation**
   - All survey outputs (topographical maps, drone orthomosaic, contour maps, CAD and GIS datasets) form a comprehensive geospatial database for design, construction, and long-term monitoring.

Contents

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

BM	Bench Mark
DEM	Digital Elevation Model
DSM	Digital Surface model
EGM	Earth Gravitational Models
EIA	Environmental Impact Assessment
EO	Exterior Orientation
GCP	Ground Control Points
GNSS	Global Navigation Satellite System
GPS	Global Point System
GSD	Ground Sampling Distance
GSE	Government Science and Engineering
GUI	Graphical User Interface
IO	Interior Orientation
RCC	Reinforced cement concrete
RMSE	Root Mean Square Error
RGB	Red, Green and Blue
SOB	Survey of Bangladesh
UAV	Unmanned Aerial Vehicle
UTM	Universal Transverse Mercator
TBM	Temporary Bench Mark
TOR	Term of Reference

CHAPTER 1 : INTRODUCTION & WORK PLAN

1.1 Background

Bhashanchar is a remote island in the Noakhali district, built up for the relocation of Rohingya refugees. It is far from the national grid, so grid connection is difficult and costly. The solar power plant provides a sustainable and reliable electricity source, reducing dependence on diesel generators or imported fuel. Over 100,000 Rohingya refugees and aid workers live and operate in Bhashanchar. Electricity is needed for housing, schools, hospitals, water supply, sanitation, and communication systems. The solar plant ensures continuous power for these essential services, improving living standards and safety in the settlement.

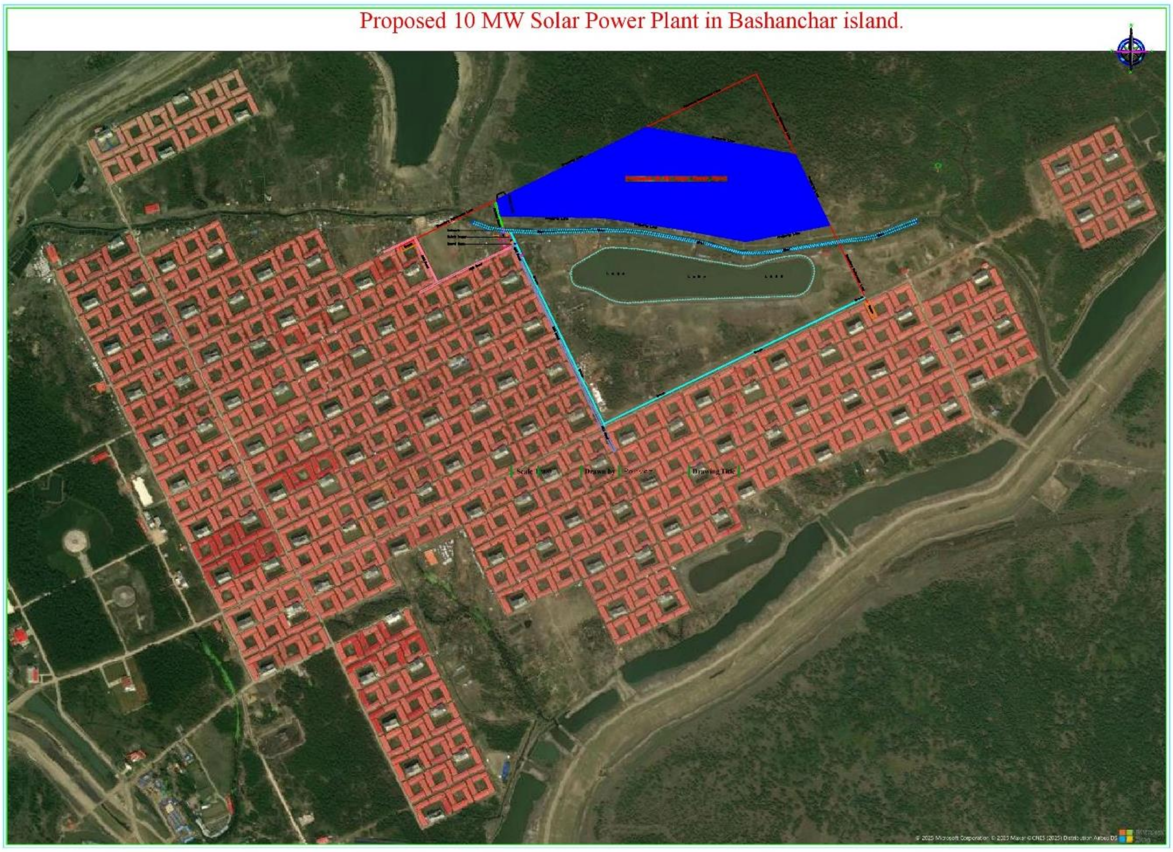


Figure 1: Proposed 10 MW Solar Power Plant site and surroundings

Prior to the commencement of detailed design and construction, it is essential to obtain accurate and reliable spatial data of the project area. A comprehensive Digital Topographical Survey combined with a Drone Survey was therefore commissioned to map the site conditions, land features, elevation profiles, and drainage patterns.

The primary purpose of these surveys is to:

- Provide a precise digital representation of the terrain and land cover.
- Support the engineering design of the proposed solar power plant by generating base maps and contour data

- Identify critical features such as natural drainage channels, vegetation cover, and existing infrastructures.
- Facilitate environmental and hydrological assessments.
- Ensure alignment of the solar power plant design with sustainability, safety, and regulatory standards.

Through the integration of modern ground-based surveying technology and aerial drone mapping, the survey provides a comprehensive geospatial database that will serve as the foundation for planning, design, and construction of the solar power plant project under PDB.

1.2 Primary Objective

To prepare topographic map of the project along the Construction of a Proposed Solar power plant at Bashanchar, Bangladesh.

1.3 Study Area

At Construction of a Proposed Solar power plant at Bashanchar, Bangladesh area is 30.00 acres.

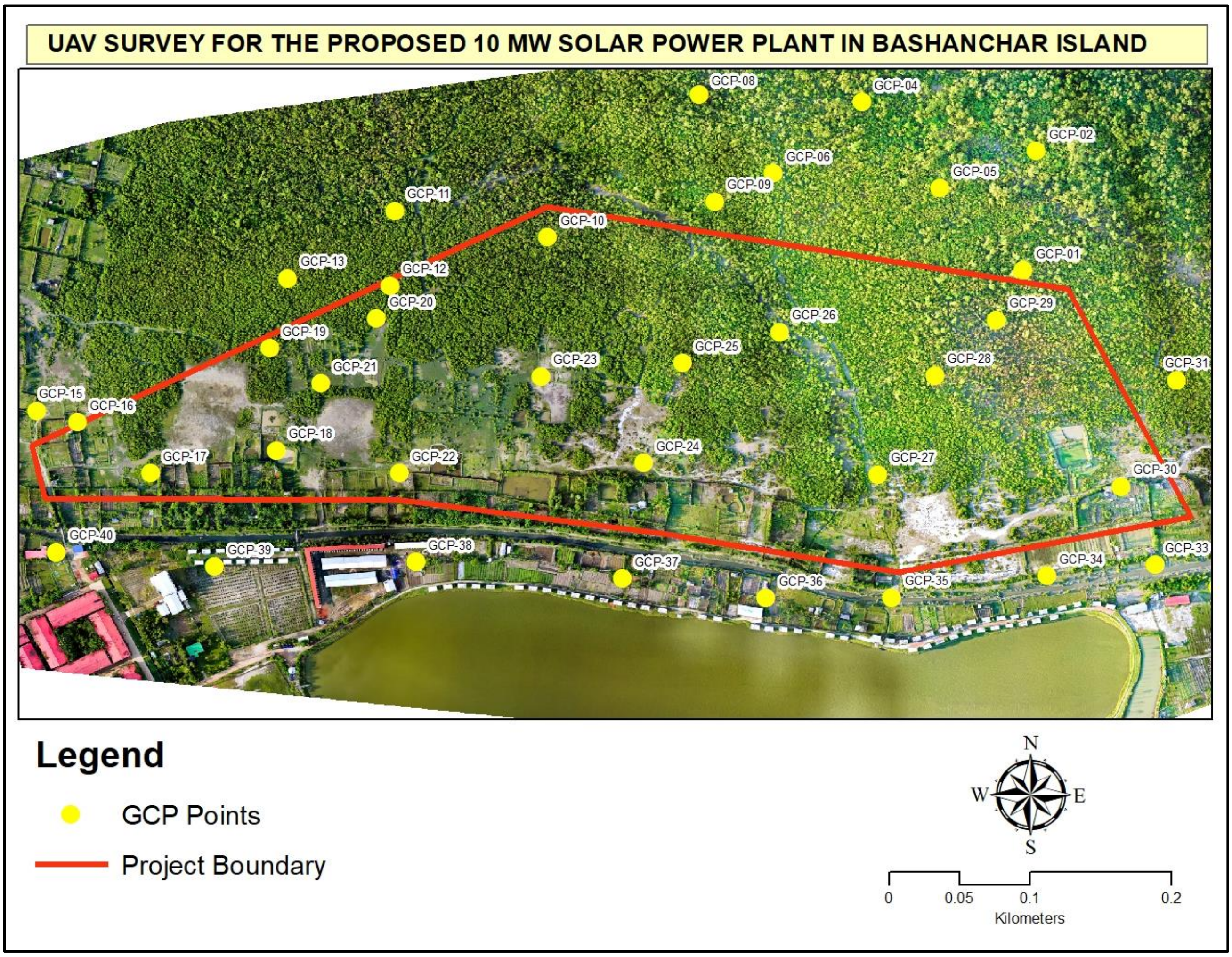


Figure 2: Topographical Survey Area- Construction of a Proposed Solar power plant at Camp 26, Teknaf, Bashanchar, Bangladesh.

1.4 Scope of Work

Table 1 Quantity of Topographical Survey Work Done by The Project

Item	Work Description	Total Quantity	Unit
TBM Establishment	TBM Establishment	02	Nos
	GNSS and Topography Survey by Total Station	30.00	Acres
	Inside of and Outer Side of		
Mapping	Plan Map	30.00	Acres
Drone UAV Survey	Orthophoto, DTM, DSM, DEM	30.00	Acres

1.4.1 The Topographical Survey Is Completed According to Following Time Schedule

Table 2 : Implementation Schedule

Work	Day	2	4	6	8	10	12	14	16	18	20
Reconnaissance Survey	1										
BM & TBM Establishment	1										
GNSS & Fixed Point Establish	1										
Digital Topographical Survey	3										
UAV Survey using Drone	5										
Draft Report & Data	2										
Final UAV Data Submission	5										
Final Report Submission	2										

1.5 Equipment Uses

The Consultant Has Used Key Equipment Listed Here with Satisfies Minimum Specifications and Relevant Examined Proof.

Table 3 : Equipment details

Sl. No.	Name Equipment	Model	No. of Equipment Used
1	GNSS	South INNO-7	2
2	Total Station	SOKKIA IM-52	1
3	Total Station	Sunway	1

1.6 Professional involvement

The positions of the team members were assigned accordingly in order to accomplish the work smoothly and timely. The team has been deployed for the whole project period to work incessantly. The composition of the team is shown in Table 4 Team Composition.

Table 4 :Team Compositors

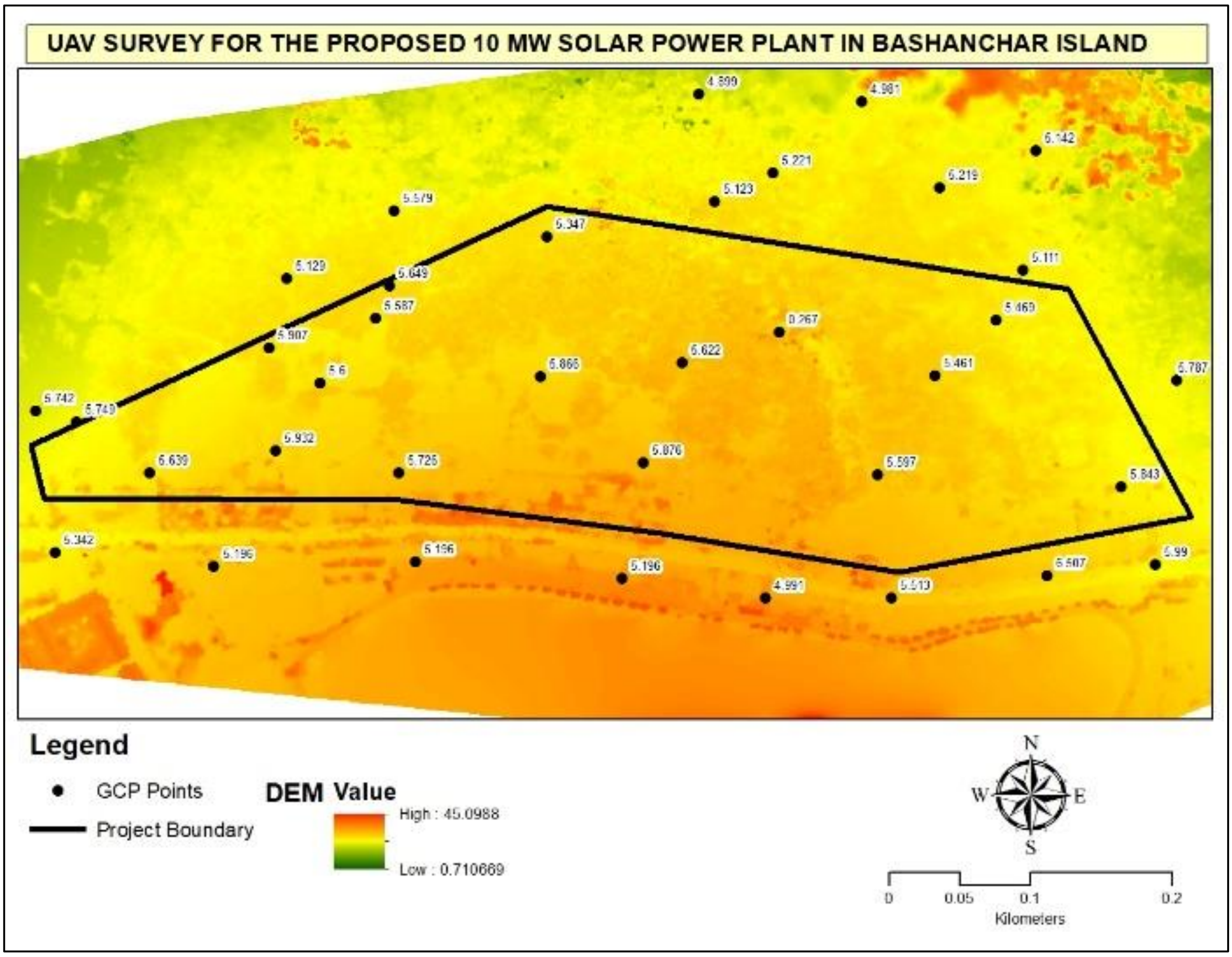
SN	Name	Position
Key Expert		
01	MR. FOYSAL	DRONE PILOT
02	MR. AMINUL	DRONE ASSISTANT
03	MR. SHAHADAT	SURVEY SPECIALIST
NON-KEY EXPERT		
12	MR. AFZAL	TOPO SURVEY HEAD
13	MD. SOHEL RANA	SURVEY ENGINEER
14	MD. UZZAL HOSSEN	SURVEY ENGINEER
15	MD. YAKUB MIA	SURVEY ENGINEER

CHAPTER 2 : METHEDOLOGY

2.1 General

As Long as Not Specified Further Below, the Area Shall Be Surveyed to the Following Criteria: Point Accuracy ± 5 Cm Horizontally, ± 2 Cm Vertically or Better

2.1.1 Existing Area



Within This Stage Basic Data of The Existing Area Shall Be Generated. The Services Shall Embrace the Following Facilities:

Activity 1 Reference Points in A Grid of Approx. 5 By 5 M
Activity 2 Higher Density Where Required Due to Topographical Situation
Activity 3 Topographical Folds Indicating the Upper and The Lower Limits
Activity 4 Abnormalities Of the Area
Activity 5 Utilizations And Vegetation Shall Be Outlined in The Location Plans
Activity 6 On-Grade and Above-Grade Infrastructure Such as Roads, Power and Water Supply
Activity 7 Facilities And Lines, Communication Facilities and Lines and Manholes.
Activity 8 Access Road And Curbside Area

2.2 Methods to conduct topographic surveys

The inside of the Project area has to be worked very carefully and with time. For this we have divided the entire area into various zone for digital topographical survey so that we can easily survey each Zone separately and work easily.

A topographic survey comprises horizontal and vertical plane surveys. It can be carried out using a variety of techniques. The methods we used to conduct the digital topographical survey of the Construction of a Proposed Solar power plant at Bashanchar, Bangladesh are detailed here:

Traverse Surveying: Traverse Surveying is a popular method of surveying. This article includes the definition of traverse surveying along with its classification, errors in traversing, checks, the completed method of traversing and plotting of traverse survey.

There are 02 (Two) Type methods, we will use "Close Traverse Method" for this project.

Closed Traverse: A closed traverse is a series of connected lines whose lengths and bearings are measured off these lines (or sides), which enclose an area.

Assume A is the starting point and E is the end point of a quadrilateral closed traverse that should close on A. The relative closure error or accuracy or precision of the traverse is calculated as AE/(AB+BC+CD+DE) and converted to the form 1/X where X is determined by dividing (AB + BC + CD + DE) by AE

Error Calculation: Bowditch's rule: The Bowditch Rule is a mathematical procedure used to bring the coordinates together. The relative error determined is then distributed to each coordinated point to compensate for the overall error. In general, this method is used to adjust closing error in a closed traverse.

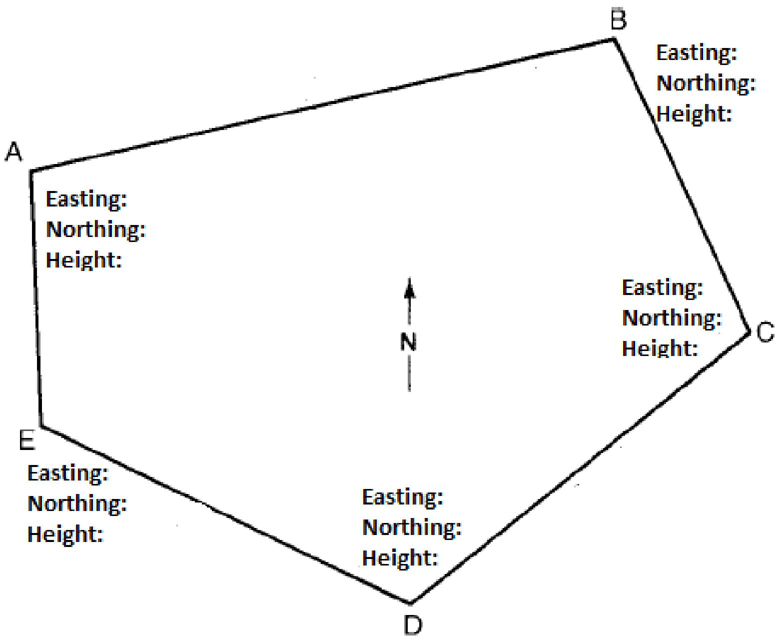


Figure 3: Error Correction Diagram

RTK (Real-Time Kinematic) GPS: It is a technique used in satellite-based positioning systems to provide highly accurate positioning information in real-time. GNSS is a general term for global navigation satellite systems like GPS (United States), GLONASS (Russia), Galileo (European Union), and BeiDou (China).

RTK works by using data from a network of fixed reference stations, which continuously transmit corrections for satellite signals based on their known positions. A mobile receiver, such as a surveying instrument or an autonomous vehicle, can then use this correction data to compute its own precise position relative to the reference stations.

RTK is a differential GNSS technique that uses real-time corrections from a nearby base station or reference network to achieve centimeter-level accuracy. The corrections account for errors such as satellite orbit and clock errors, ionospheric and tropospheric delays, and multipath effects

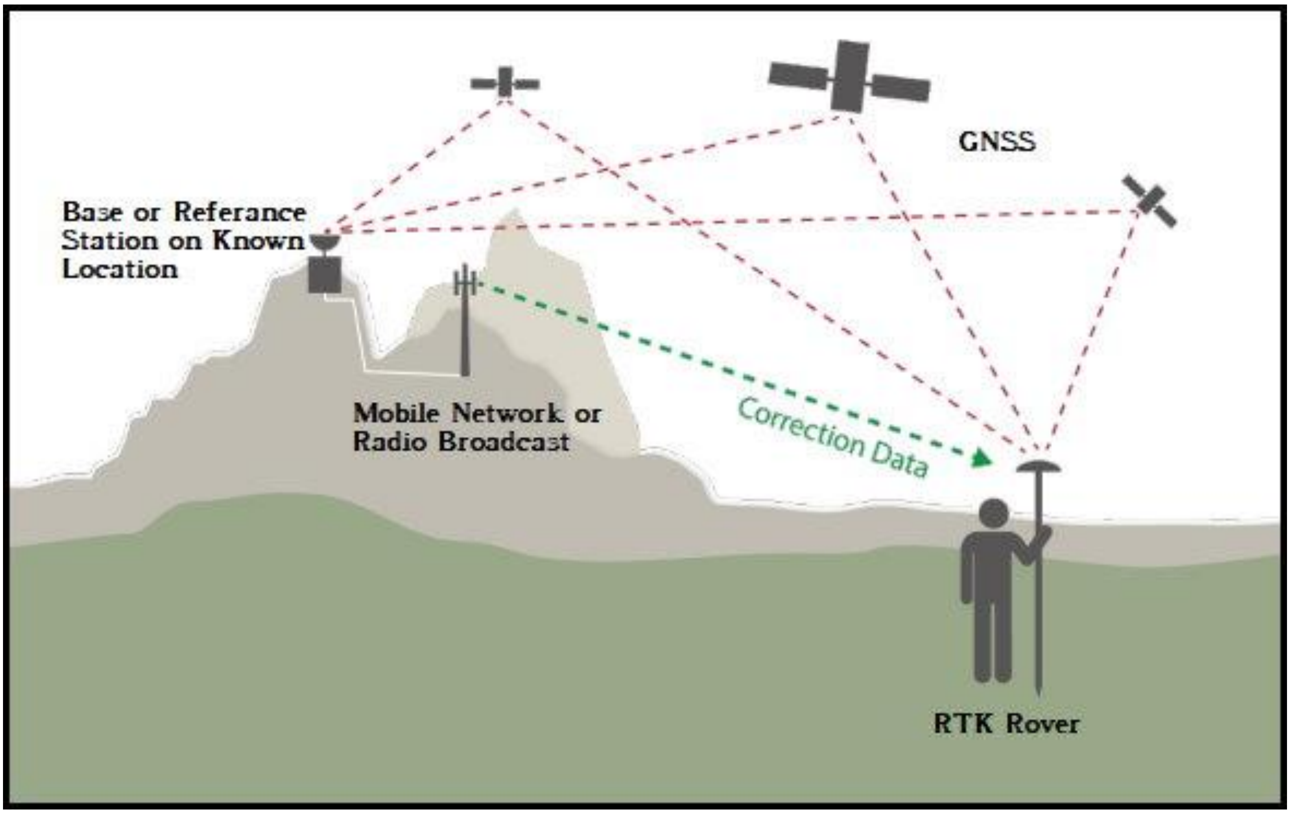


Figure 4 : RTK using GPS

Total Station: Total station surveys are a widely used method to survey topography. With applications ranging from traditional land surveying. Land form evolution monitoring. To land use monitoring. In the geosciences and bio- logical sciences, total stations are now becoming standard tools in monitoring geomorphic change detection of rivers. Streams. Beaches. And mass wasting of hill slopes. Since many total station surveys are now undertaken in remote and/or undeveloped localities, there is often not an established local control network tied to a projected real world coordinate system. Thus, many of these surveys are done from a un- projected local assumed coordinate system

Figure 5 : Total Station for Survey

2.3 Survey Methodology Overview

Personnel from various disciplines have been deployed in the field to collect data that has been processed in the office for preparation of drawings and reports. RTK observations, traverse surveys, fly level surveys, topographic surveys have been done by field personnel. The office team has processed the data from the survey team for topographic survey has prepared drawings for plan and profiles of the alignment. To conduct Topographic Survey of Expansion of Construction of a Proposed Solar power plant at Camp 26, Teknaf, Bashanchar, Bangladesh.

- Reconnaissance survey
- BM and TBM establishment
- Horizontal control survey
- Vertical control survey
- Plan map

2.3.1 Reconnaissance Survey

A reconnaissance survey conducted on October 1st week 2025 served as a pivotal step in gaining comprehensive insights into the project. This preliminary survey aimed to achieve a nuanced understanding of the intricacies associated with the venture. It provided an invaluable opportunity to engage with key officials from both Construction of a Proposed Solar power plant at Camp 26, Teknaf, Bashanchar, Bangladesh.

The primary objectives of this reconnaissance survey were to familiarize the surveying team with the geographical and operational aspects of the project, understand the existing infrastructure, and establish a collaborative relationship with the pertinent authorities. By breaking the ice with officials, the survey team aimed to pave the way for seamless cooperation and information exchange, setting the stage for the subsequent phases of the project.

Through this reconnaissance survey, the team endeavored to lay a robust foundation for the forthcoming activities, ensuring that the survey and subsequent developmental efforts align effectively with the needs and expectations of the project and the regulatory authority.

In this stage, field Reconnaissance has been conducted along the proposed area to observe the existing condition of the land use, position of different topographical features such as project area, run-way, taxiway, apron, utility building, canal, river, drain, existing roads, settlements, agricultural fields, low lands etc.

2.3.2 TBM Establishment

Reconnaissance survey of the site has been carried out prior commencement of works to explore site conditions, route features, presence of infrastructures, etc. as well as location of Bench mark and any other issues important to the project. The Bench marks are permanent, positioned in stable place and convenient for the control and topographic survey work. At first, suitable location has been selected where surrounding was clear from obstacle within 15-degree vertical space to acquire satellite signal. After site selection, we've constructed BMP at each selected site. TBM Pillars has been constructed on site as Reinforced Cement Concrete (RCC) Structure.

O.CREEDS

All primary and secondary points have been measured by Direct Leveling method with Digital Level machine.

- Forward and backward leveling method has been applied for each leveling observation.
- The downloaded data of the digital level with field sheet has been submitted within one day after the observation and sometimes within 2 or 3 days.
- Accuracy of vertical control survey was within the following tolerance: The target tolerance of forward and backward measurement was 2mm.

2.3.3 SOB Bench Mark Pillar Description

The national project is highly technical in feasibility phase reason it is lined with the Bangladesh National Datum which was established by Bangladesh Survey of Bangladesh under ministry of defense. We collected the value both side of the alignment as follows.

TBMs were established at convenient for the control traverse and topographic survey work and shall remain up to the end of all survey work for this project. All TBMs are visible adjacent to primary benchmarks. All TBM are placed on fixed structures or permanent structures that are easily visible and whose value is not likely to change normally.

The TBMs were established at convenient for the control traverse and topographic survey work

O.CREEDS

and shall remain up to the end of all survey work for this project.

In case the location of the bench mark was concrete or hard surface, then a survey nail has been installed for their placement of the benchmarks along with appropriate marking as shown in figure below. The bench mark code was painted on or near the points.

2.3.6 Horizontal Control Survey

Horizontal Control survey has been conducted using RTK based GNSS Method. The bench marks for the study have been measured by GNSS (Global Navigation Satellite System). GNSS survey network has been taken made relation to at least three (3) National Control Points which are precise and accurate UTM zone 46N horizontal coordinates. The horizontal coordinates have been defined as Universal Transverse Mercator (UTM). Primary bench marks have been measured by GNSS observation using the following method:

- Observation method was "Static Positioning" with at least 60 minutes duration times and at least 5 tracking satellites for each session.
- Baseline processing and adjustment has been performed by using software published with the above. All baselines have been processed in dependently and well-arranged results have been submitted first.
- GNSS observation parameter has been applied parameter of WGS84/UTM zone 46N and EGM 2008 v used to get the elevation on the Geoids surface from ellipsoidal data.
- The downloaded data of the GNSS with field sheet has been submitted within the day of observation and sometimes within 2 or 3 days due to error checking.

Coordinate System and Datum Level

The Coordinate System of this project was WGS84 UTM zone 46N. We've followed the Mean Sea Level of the Bay of Bengal (EGM 2008) as the datum level. EGM 2008 has been used to derive Orthometric heights from ellipsoidal data initially. Finally, elevation of GNSS survey points has been corrected by this Geoid Model if there is no Direct Leveling value.

- Name: Universal Transverse Mercator (UTM) Zone 46N
- Projection: Transverse Mercator False Easting: 500000.0
- False Northing 0.0
- Central Meridian: 93.0
- Scale Factor: 0.9996
- Latitude of Origin: 0.0 Linea Unit: Meter
- Zone: Zone 46 Spheroid: WGS1984
- Vertical Datum: Mean Sea Level of Bay of Bengal (EGM 2008)

2.3.7 Vertical Control survey

Vertical Control survey has been conducted using RTK based GNSS Method. Temporary Bench Mark (TBM) has been performed using the Digital Elevation Model (DEM) prepared from Drone survey.

Vertical Control Direct Leveling Using Digital Level

Establishing vertical control, a series of Leveling measurement have been performed by the direct leveling method. Leveling survey network has been made with relation to two (2) National/regional Bench Marks which are authorized by the Survey of Bangladesh (SOB). All primary and secondary points have been measured by Direct Leveling method with Digital Level machine reference with SOB Datum. The double stand (with independent staves) or forward and backward leveling method has been applied for each leveling observation. The downloaded raw data has been calculated by the same day and check error and correct on next day. The leveling measurements were performed within accuracy of 16mm -√D mm, where 'D' is total leveling distance in km.

Leveling Data Processing

Digital automatic levels are a precise instrument used for precise leveling. The operation of digital levels is act on the digital processing of barcode staff at the beginning of measurement, a visual pointing of the instrument into the surface of leveling meter is performed. After that the instrument automatically points the focus of its optical system on the surface of the meter and then a correlation calculation is performed followed by the precise correlation. According to the data received in the processor of the instrument an exact distance from the axes of the instrument to the surface of the level meter is calculated. According to the information received by decoding the data from the photoelectric matrix the height of the level placing is calculated in the processor. During this operation the coded view of the meter is compared with information that saved in the memory of the instrument. The digital levels represented a breakthrough in leveling techniques using the innovative concept of reading a bar-coded staff with digital levels there is up to a 50% time saving when compared with conventional levels. The main reasons are the faster data capture as well as the shorter time and safer means of data processing; it is saving measured data on storage devices. Digital levels measure and save the height and the distance to the staff at the press of a bottom and calculate the height of the point. Advantage: no readings required no copying or writing down and no calculation by hand.

2.4 Aerial Survey

Aerial survey complemented with Aerial Photograph y has been carried out along the project area to produce an Orthophoto map, a 2D traced topographic map by drone aerial photo survey, DEM and DSM of the survey area. For most cases, we've used BM and TBMs as Ground Control Points (GCPs) and at some places, GCPs have been taken using RTK GNSS.

- Ground sampling distance (GSD): Best possible GSD from a flying height of 80m--l00m AGL. GSD varies according to flying height.
- Bands: RGB (Three band natural color imagery)
- Radiometric Resolution: Minimum 8bit per band in accordance with chosen image format
- Front overlap: 60-80% minimum
- Side overlap: 60-80% minimum
- Sun angle no less than 30 degrees to minimize shadows.
- Cloud free (at least 95% cloud free) with minimal smoke, smog, fog and dust. Post processing
- 3D vector (Physical feature) map has been generated from the Orthophoto.
- Initial image processing has been done based on the GCPs. The 3D digital vector map, DSM, DEM and Ortho photos have been submitted in this stage.

2.4.1 Image Capture

The images have been captured using Phantom 4 pro V.02 Unmanned Aerial Vehicle by following appropriate photogrammetric project parameters.

2.4.2 Project Area Demarcation

Project Area was demarcated before the flight according to the TOR.

2.4.3 Selecting the photogrammetric project parameters

The distance of the camera focal length and the flight height of the UAV determine the scale size of the image. The traditional calculation formula of the photogrammetric image scale is the following:

Mb =1: Mb = Ck/H, ... (1)

Here mb is an image scale denominator; C^k is the distance of the focal length; $H9$ is the flight height of the UAV. These values have to be considered and calculated when planning the UAV flight.

The correct flight planning has influence on the accuracy and volume of the collected information about the desired regions. The theoretical planning of the UAV flight is justified by the calculation of the arrangements of the images along the flight route. The scheme of the flight project is given in Figure 19.

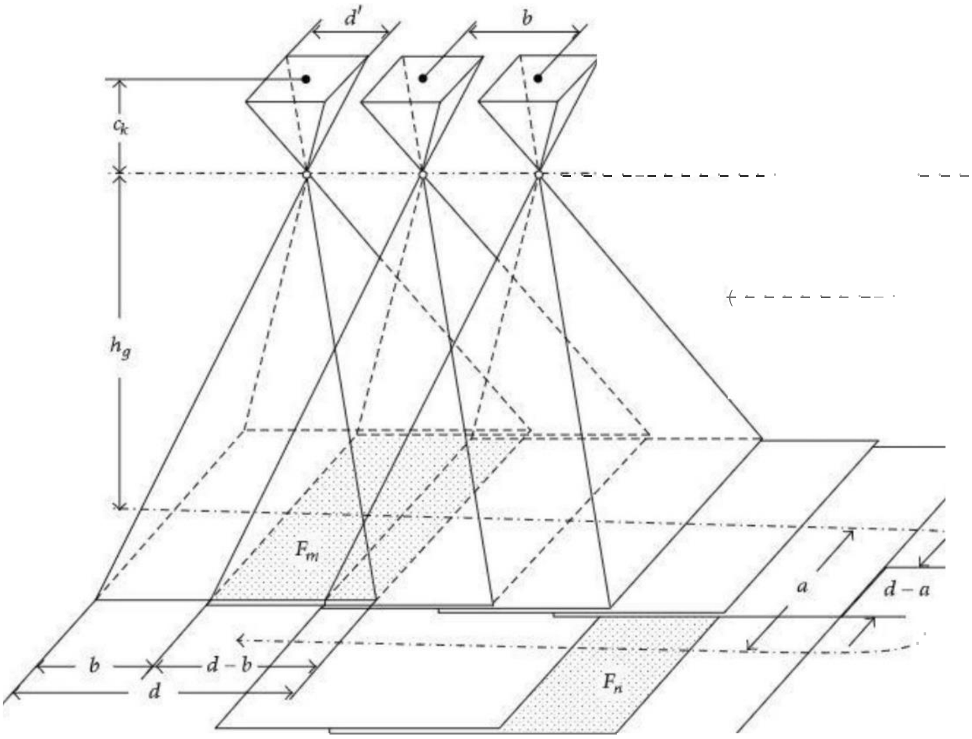


Figure 12 : Flight project scheme

In Figure 01, *d* is the size of the image; p is the longitudinal overlapping of the adjacent images on the flight route; *b* is the base for taking images (the distance between the adjacent centers of the images); *q* is a transverse overlapping of the images between the upper and lower flight routes.

The image size *d* depends on the camera expression. One has to know the size of the image when calculating the longitudinal and transversal overlapping of the images during the flight. The formula for the calculation is

$p = (d-b)/d \times 100$..(2)

$q = (d-a)/d \times 100$..(3)

Where *a* is the distance between the adjacent flights calculated according to this formula:

$a = d \times (1-q/100)$ ....(4)

When selecting the photogrammetric project parameters, it is necessary to take into consideration certain weather conditions that occur during the flight and especially the wind direction. The flow of the air causes the wind speed to increase with increasing height above the ground. The wind blows along the negative direction of z-axis, the positive y-axis points to the sky, and the direction of x-axis is dependent on right-handed rule. The relation between wind speed and height above the surface is described in the articles. Also, flight height can be obtained from Ground Sample Distance (GSD) or a pixel size in the terrain and depends on the camera focal length, camera sensor width, and the distance covered on the ground by one image. The GSD calculation formula is;

$$GSD = (Pix \times H9)/Ck \qquad (5)$$

Where Pix is pitch of the pixel of the camera sensor; Hg is the flight height of the UAV; Ck is the distance of the camera focal length.

Each UAV has its certain flight speed and direction. There are eight possible flight directions (north, northeast, east, southeast, south, southwest, west, and northwest). Also, each UAV has three possible orientations, such as turning left, going straight, and turning right. The traditional recommended photogrammetric flight direction is east-west or north-south. The images taken while keeping to the mentioned above flight directions are easy to process by the photogrammetric method. However, if needed, the direction is possible to be changed.

The flight speed depends on wind speed. The UAV gets Earth-wise speed from GPS (Global Point System). In order to calculate wind velocity vector inertial Cartesian coordinate system wise, additional information on UAV position in space is being taken into account.

Based on the parameters of the photogrammetric project and on the values of the flight project, the UAV flight could be marked using specific software during the flight or previously, when indicating the initial and final points of the planned flight route on the Google Earth map. Thus, on the screen or, to be more exact, on the tables of the software, the beginning and end of the geodetic coordinate points of the route, longitude and latitude, appear. During the process of acquiring images, the coordinates of the image centers GPS, which later could be applied for the photogrammetric measurements of the images, are fixed.

2.4.5 Flight Plan

After calculating all appropriate photogrammetric project parameters, flight plan for the project area was set based on that.

2.4.6 Image Capturing

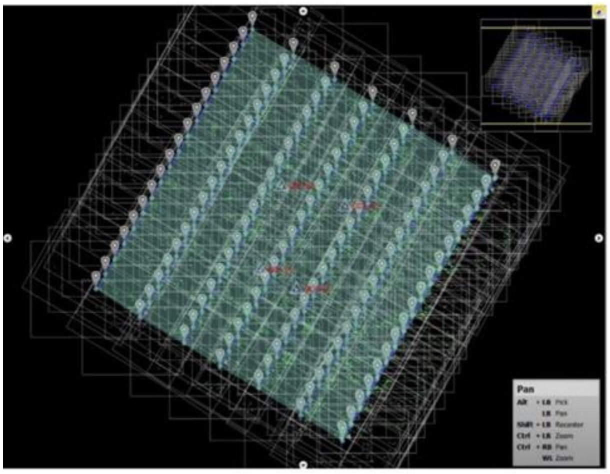
After everything set, we've proceeded for image capturing.

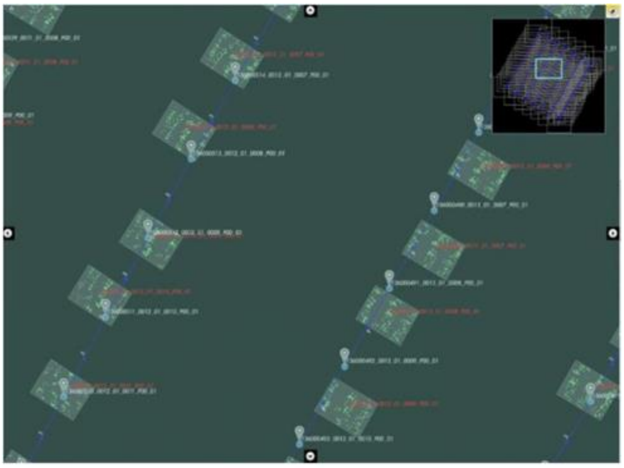
2.5 Aerial Triangulation

Aerial Triangulation (AT) or aero triangulation is the process of contiguous densifying and extending ground control through computational means. It is a very crucial part prior to produce any photogrammetric products, like DTM, DSM, Orthophoto etc., from stereo Images. There are several sophisticated steps for this operation like performing interior orientation; Automatic and/or manual tie point generation; establishing ground control points; and performing a least squares block adjustment etc. The purpose of Aerial Triangulation is to refine the Exterior Orientation parameters (X, Y, Z, n, <l>, K) computed through direct geo-referencing for each Imagery, which helps to achieve the desired accuracy while generating DEM Orthophoto and Other photogrammetric products. In general, Aerial Images with Initial Exterior Orientation (EO), ground control points (GCP) and Interior Orientation (IO) provided by client has been used for AT process. We, follow the latest and high-end aero triangulation approach that minimizes the manual intervention and increases accuracy towards higher side. This is the combination of point selection, point measurement, point transfer and block adjustment in a single process.

2.5.1 Precise DEM Creation

The production of Digital Elevation model (DEM) is an important task in photogrammetry. DEM's are either stand-alone products or they are used for the purpose of generating secondary products such as Orthophoto. The extraction of DEM is mostly carried out in analytical stereo





plotters. The DEM derived from the digital photogrammetric techniques were validated against the DEM derived from analytical stereo plotters that are in use for long time and considered to be more reliable and accurate.

The captured images were processed using dedicated digital photogrammetric software, Airsoft Photo scan, to generate DEM and Orthophoto of the beach. The GCP placed earlier was used for triangulation of the images so that it results in stereoscopic images with coordinates. The process has been done by producing DEM, Orthophoto and RMSE result. Then, a qualitative and quantitative analysis has been done on the DEM and Orthophoto produced from different altitude. The qualitative part has been conducted by analyzing the quality of the DEM and Orthophoto produced. Meanwhile, the quantitative part has been conducted by performing the RMSE calculation over the GCP obtained by RTK-GPS.

2.5.2 3D Mesh Model

Mesh generation is the practice of creating a mesh, a subdivision of a continuous geometric space into discrete geometric and topological cells. Often these cells form a simplicial complex. Usually, the cells partition the geometric input domain. Mesh cells are used as discrete local approximations of the larger domain. Meshes are created by computer algorithms, often with human guidance through a GUI, depending on the complexity of the domain and the type of mesh desired. The goal is to create a mesh that accurately captures the input domain geometry. With high-quality (well-shaped) cells, and without so many cells as to make subsequent calculations intractable. The mesh should also be fine (have small elements) in areas that are important for the subsequent calculations. Triangulated point cloud was generated from images after GCP correction. Then Triangulated point cloud was used to generate dense point cloud by repopulate the Triangulated point cloud. Then a mesh surface was generated from the dense point cloud.

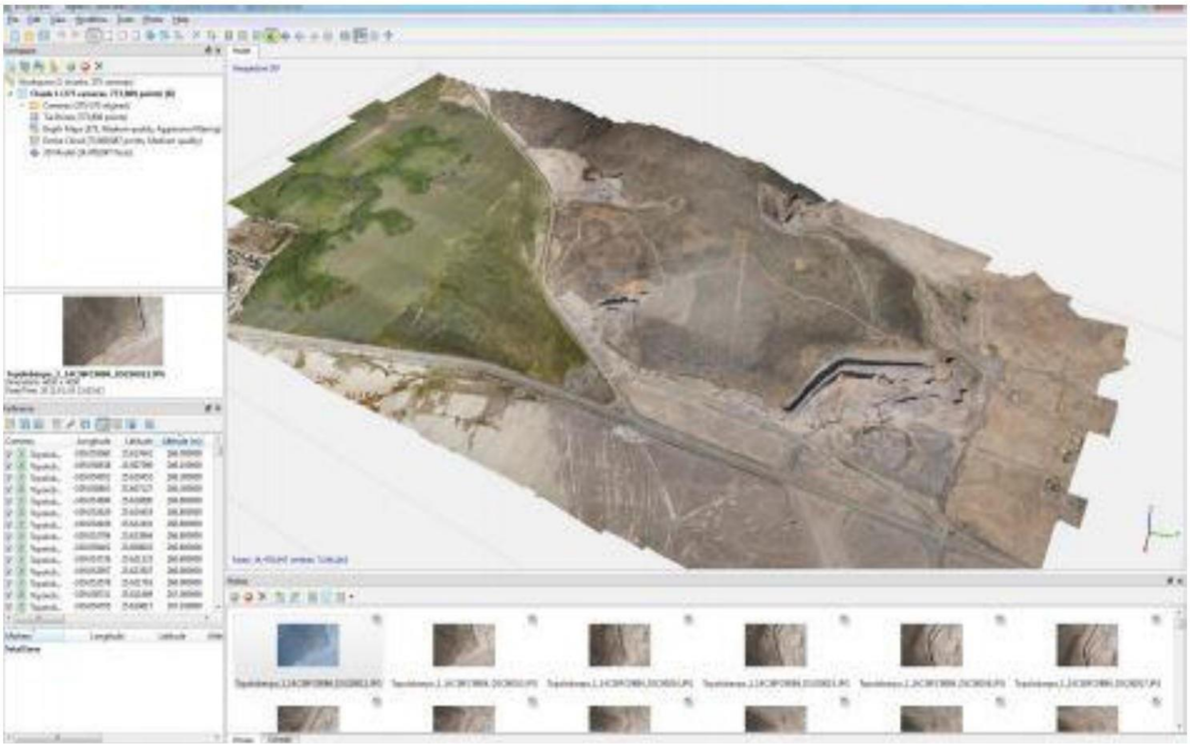


Figure 15: Sample of Dense Cloud

2.5.3 DEM Preparation

Digital elevation model was generated from the 3D point cloud data after GCP triangulation.

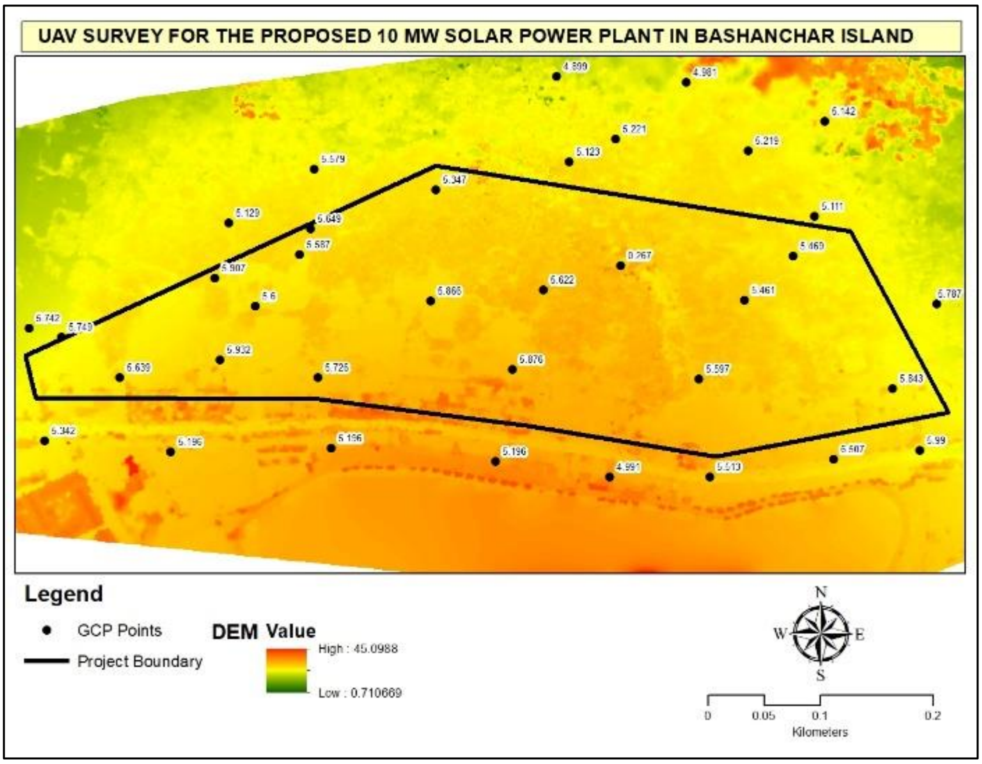


Figure 16 : DEM of digital topographical survey

2.5.4 Orthophoto Preparation

Photomapping Services specializes in high-resolution Orthophoto imagery production including digital Orthophoto and Orthophoto mosaics from raw aerial survey photography and digital image capture. Orthophoto coupled with a topographic mapping project give a precise reference (backdrop) tool that enhances the users understanding of any project area. Combined into Orthophoto mosaics the imagery can cover a large area such as a catchment, river basin, freeway or local government area.

An Orthophoto is an aerial photograph that has been geometrically corrected or 'ortho-rectified' such that the scale of the photograph is uniform and utilized in the same manner as a map. An ortho-photograph can be used to measure true distances of features within the photograph. Planimetric corrections have been applied to remove lens distortions and optics, camera angle, and differences in elevation (topographic relief) through a process of measuring ground control points to 'cross' the photo to the ground, in a drawing-pin like manner. An Orthophoto is an accurate representation of the Earth's surface. Orthophotos have the benefits of high detail, timely coverage combined with the benefits of a map including uniform scale and true geometry. After creating 3D mesh surface from dense point cloud, an ortho rectified image was created merging all the captured images.

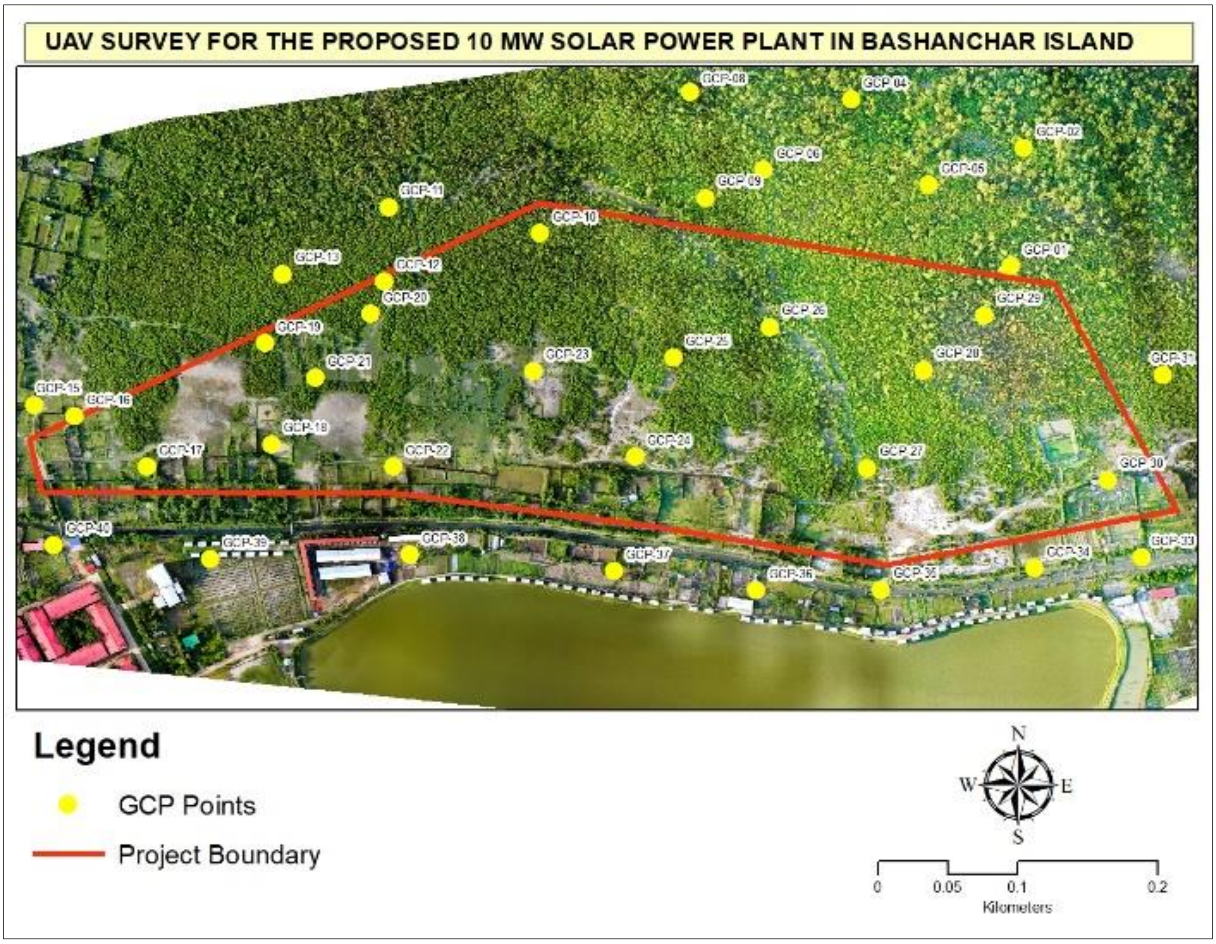


Figure 17 : Orthographic Map of Project Area

CHAPTER 3 : OVERVIEW: ENGINEERING SURVEY

Within the expansive domain of engineering surveys, a meticulous and multi-faceted approach is imperative to ensure the successful planning and execution of diverse projects. This section provides a concise introduction to a spectrum of specialized surveys essential for comprehensive infrastructure development. From assessing drainage systems to scrutinizing electrical installations, examining buildings for equipment placement, evaluating pavements, and surveying utility buildings, water supply systems, and airside components, each survey plays a pivotal role in the overall success and functionality of the project. This diverse set of engineering surveys serves as the bedrock for informed decision-making, optimal design, and sustainable development in the ever-evolving landscape of civil engineering.

3.1 Topographic Survey

The data supplied from the traverse survey was provided to the topographic survey team for detail survey work. To complete the topographic survey within the required time RTK, GPS and UAV (Drone) has been adopted for topographic survey work. During the topographic survey all topographical details have been surveyed from whole side of the area.

A series of activities have been planned and will be performed during the survey. A brief of the systematic plan for the various components of the project. This schedule encompasses a range of critical activities, including topographic Survey, Drainage Survey, Survey of Electrical Installations, Buildings for Equipment Survey, Pavement Survey, Utility Building Survey, Survey of Water Supply System, Airside Surveys, Drone Survey, Environmental Impact Assessment (EIA) Report, and Cyclone Data Collection & Flood Study with Modelling. Each activity has been strategically organized to ensure a methodical and timely execution. This schedule serves as a comprehensive roadmap, detailing the sequence of tasks, their interdependencies, and projected timelines. Regular updates and adjustments will be made as progress unfolds, allowing for effective project management and the achievement of milestones within the stipulated timeframe.

Table 5 Achievements and Progress

No.	Activity	Remarks
1.	Topographic Survey by using RTK	DONE
2	UAV by using Drone	DONE

CHAPTER 4 : CONCLUSION AND RECOMMENDATION

4.1.1 CONCLUSION

The Digital Topographical Survey and Drone Survey carried out for the proposed Construction of a Proposed Solar power plant at Bashanchar, Bangladesh, under the supervision of PDB, successfully provided accurate, reliable, and high-resolution spatial data of the project area. The integration of ground-based digital surveying with drone-based aerial mapping ensured comprehensive coverage of the site, capturing both terrain details and existing features with precision.

The outputs, including topographical maps, contour data, orthomosaic imagery, digital surface models, and georeferenced CAD/GIS datasets, establish a robust foundation for the engineering design and planning of the solar power plant. These deliverables will support effective site development, facilitate drainage and environmental assessments, and guide sustainable construction practices in line with international standards.

Overall, the survey outcomes will significantly contribute to informed decision-making, efficient project implementation, and long-term environmental management of the proposed solar power plant at Bashanchar. This initiative reinforces PDB's commitment to sustainable infrastructure solutions that improve power resilience in Bashanchar.

4.1.2 RECOMMENDATIONS

Based on the outcomes of the Digital Topographical Survey and Drone Survey for the proposed Solar power plant at Bashanchar, the following recommendations are made to ensure effective utilization of survey data and successful project implementation:

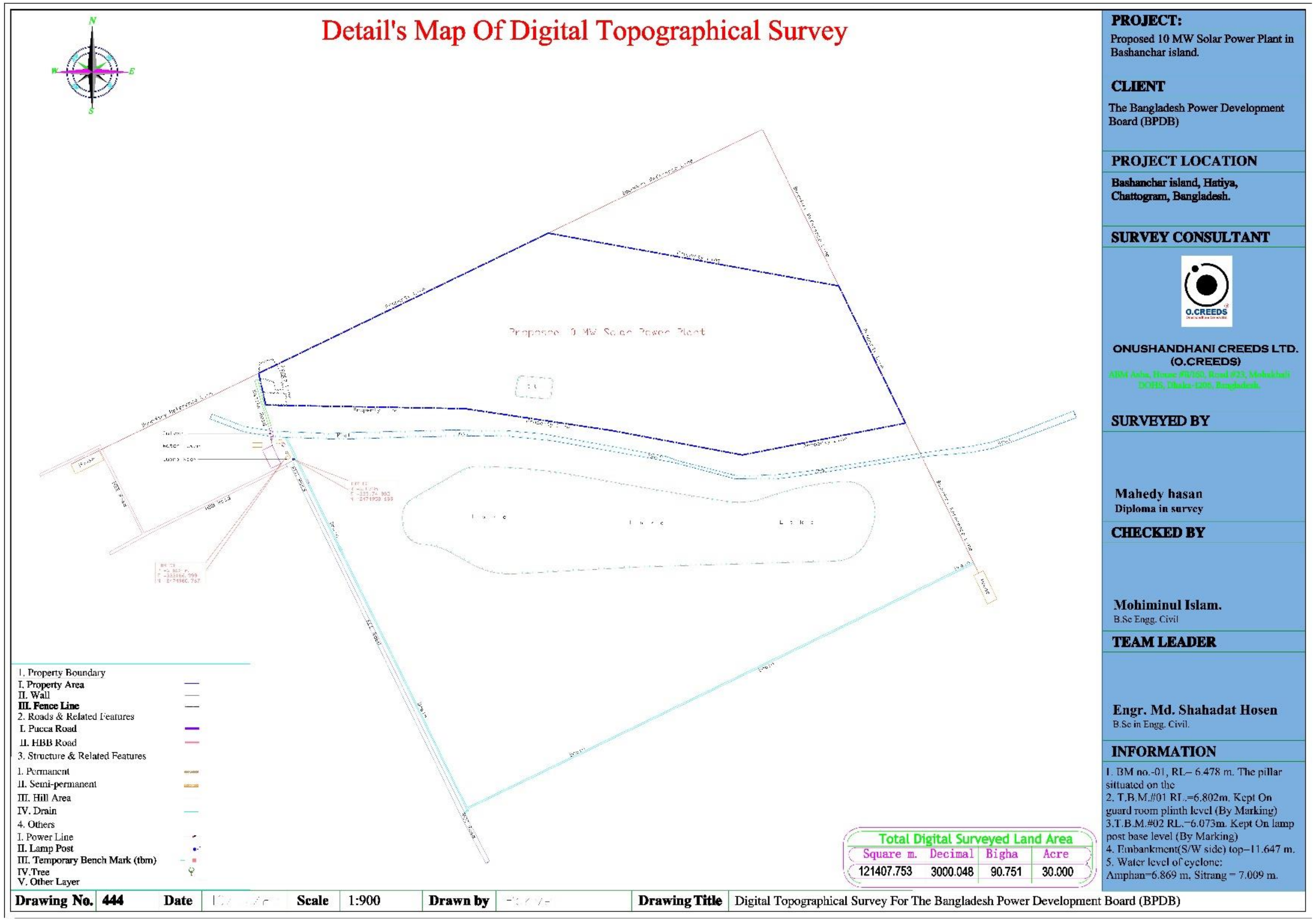
1. **Use Survey Data as Baseline**
    - Employ the topographical maps, contour data, and orthomosaic imagery as the primary reference for engineering design, site grading, and drainage planning.
2. **Incorporate Drainage & Flood Risk Assessment**
    - Given the terrain profile and local hydrological conditions, detailed flood and drainage modeling should be undertaken before finalizing the solar power plant design.
3. **Integrate GIS for Planning & Monitoring**
    - Maintain a GIS database with all survey outputs to support decision-making, progress monitoring, and long-term management of the solar power plant.
4. **Environmental Considerations**
    - Use survey findings to identify sensitive features (e.g., vegetation, water channels) and adopt protective measures to minimize environmental impact during construction.
5. **Regular Updating of Spatial Data**
    - Conduct periodic drone surveys during construction to monitor site development, validate earthwork progress, and ensure compliance with design specifications.

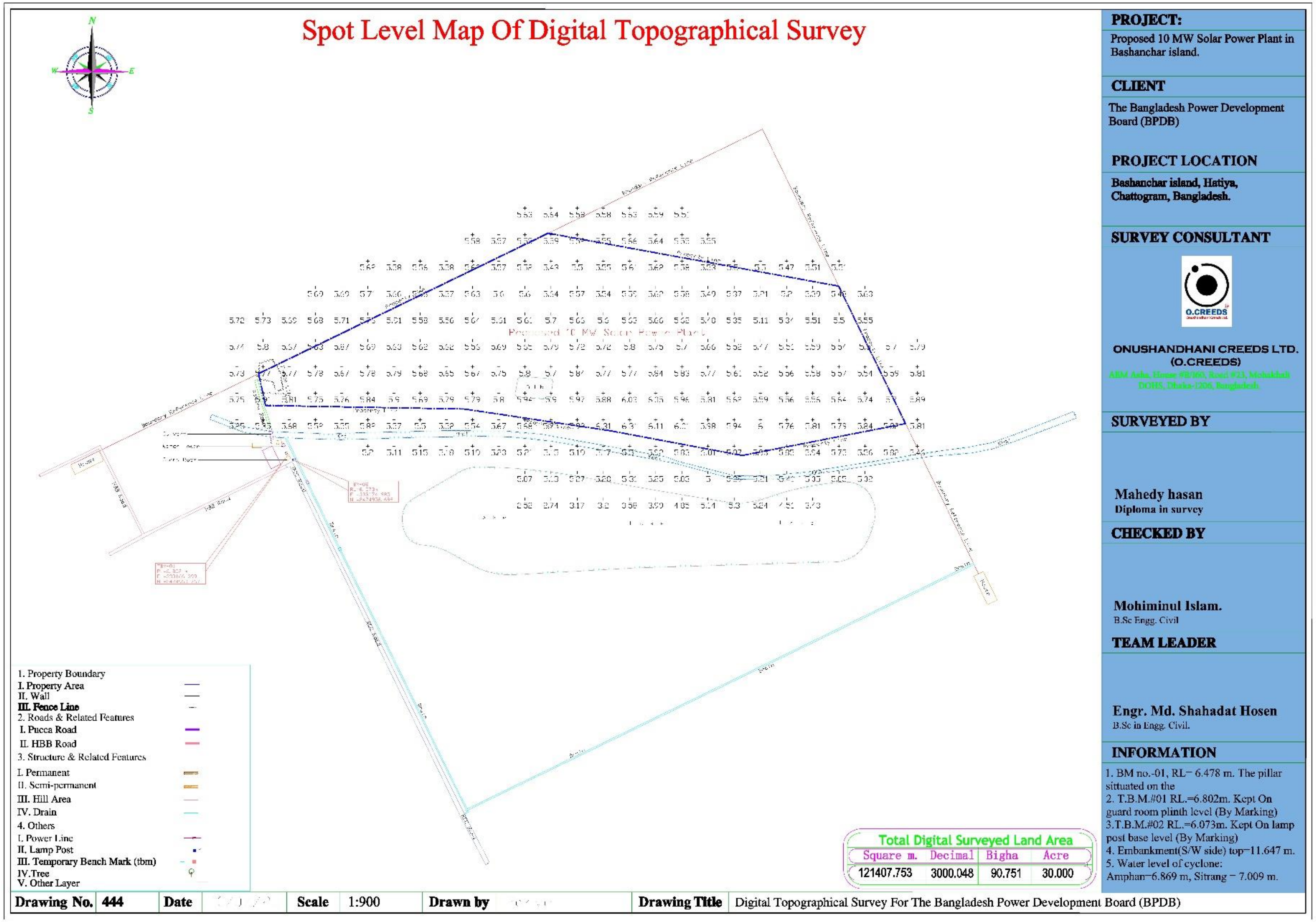
6. **Capacity Building**
    - Train local project staff and stakeholders on interpreting and applying digital survey data to strengthen long-term waste management and infrastructure planning capacity.
7. **Stakeholder Coordination**
    - Share survey findings with engineers, environmental specialists, and PDB project managers to ensure alignment in design, construction, and sustainability objectives.

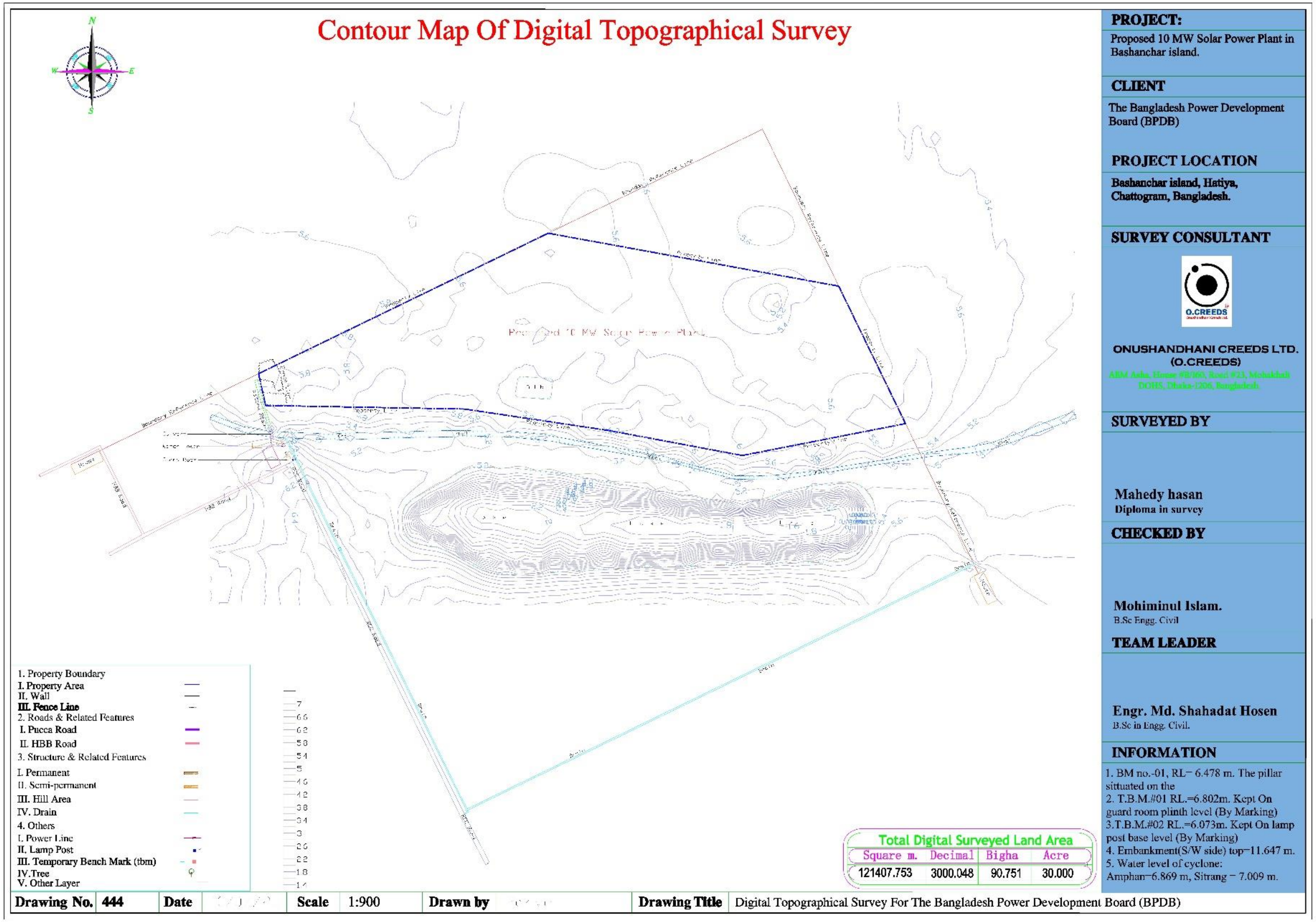
ANNEXURE-1: TEMPORARY BENCHMARK LIST

TBM No.	Description	RL in m.	Easting	Northing	Picture
GPS 0170	The pillar is situated Infront of bashanchar light house.	6.478 m.	332311.876	2473761.174	
TBM-01	Kept On guard room plinth level	6.802	333166.399	2474960.767	
TBM-02	Kept On lamp post base level.	6.073	333174.985	2474958.699	

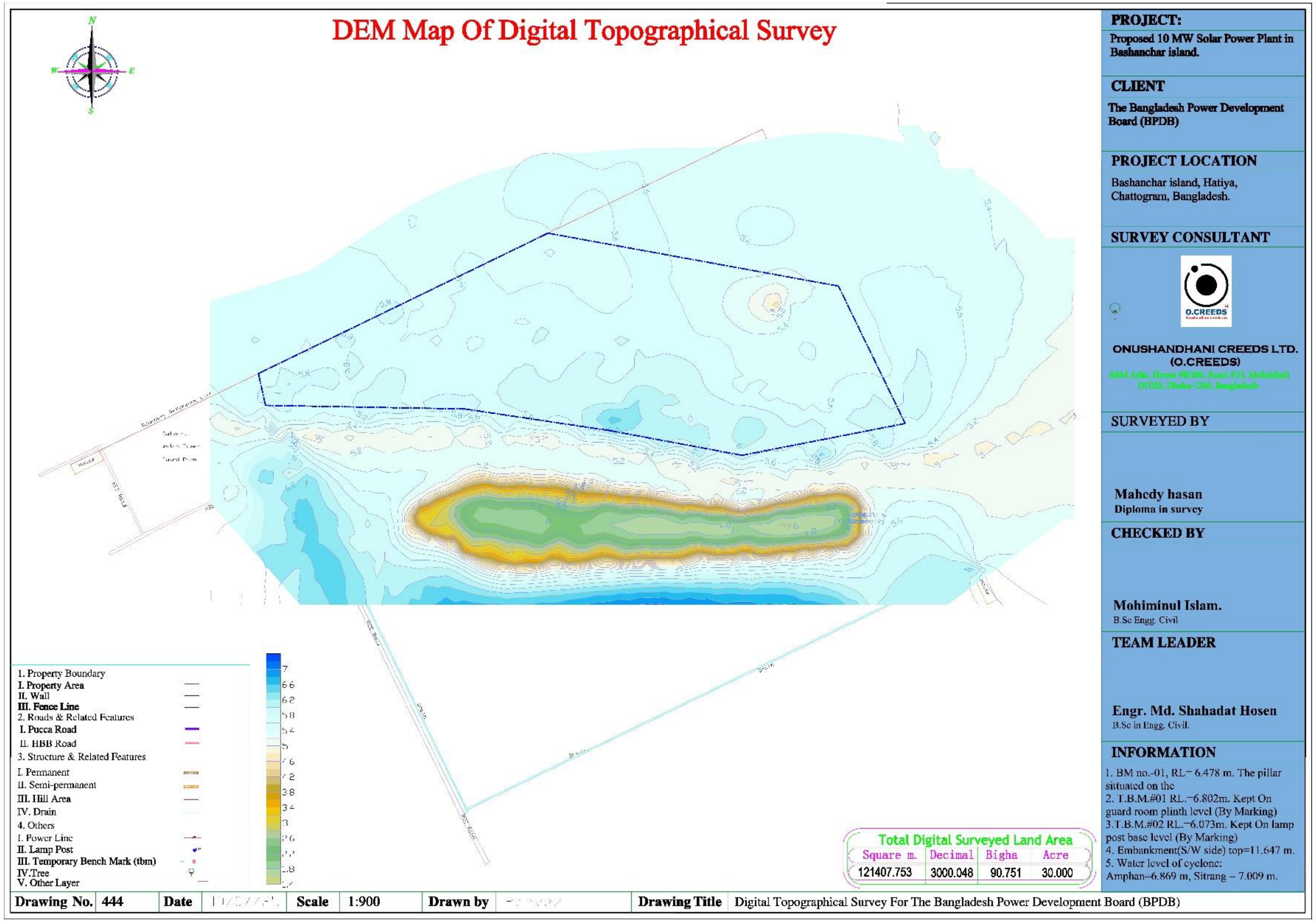
ANNEXURE-2: TOPOGRAPHIC SURVEY OUTPUT

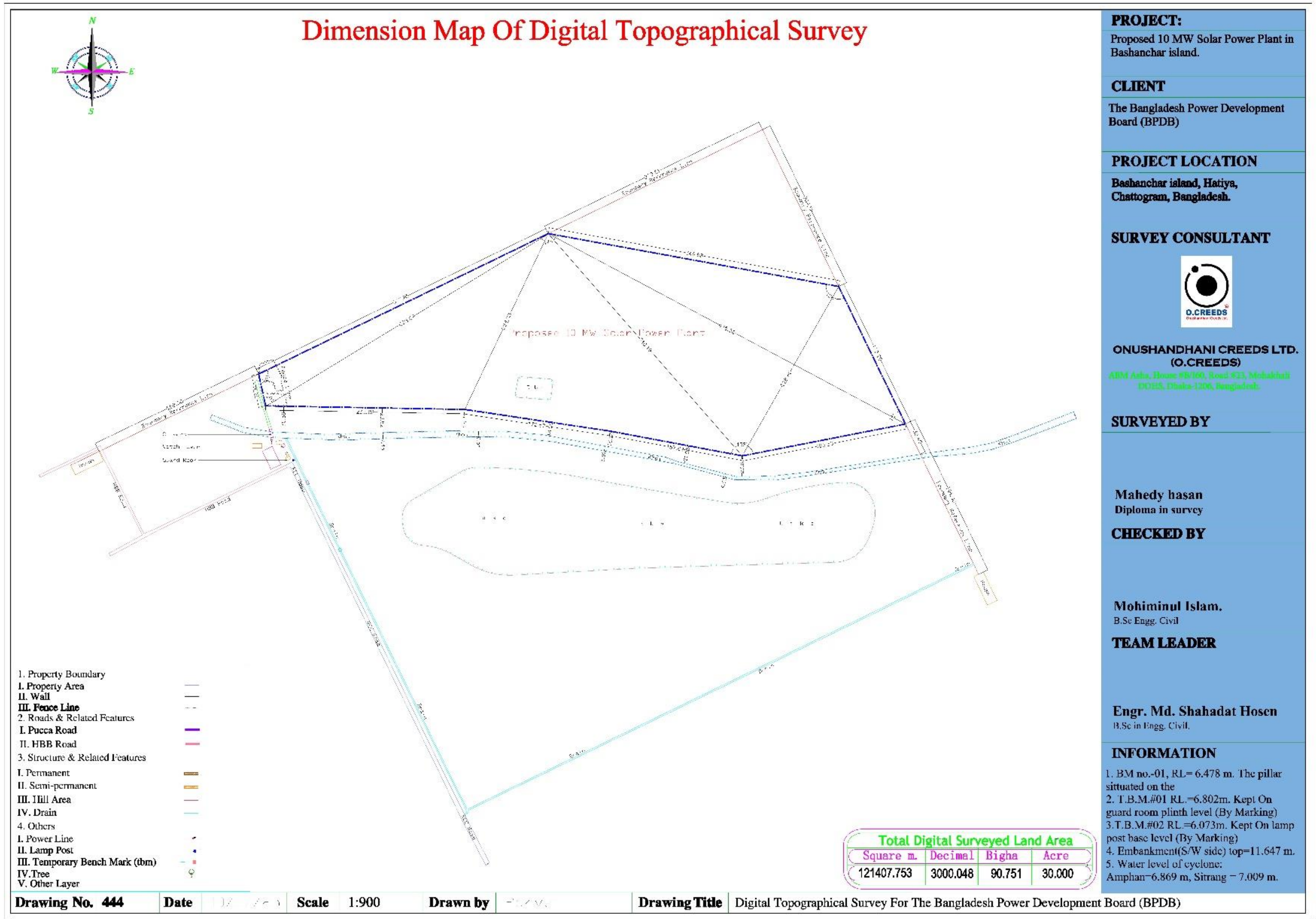



Spot Level Map Of Digital Topographical Survey
PROJECT:
Proposed 10 MW Solar Power Plant in Bashanchar island.
CLIENT
The Bangladesh Power Development Board (BPDB)
PROJECT LOCATION
Bashanchar island, Hatiya, Chattogram, Bangladesh.
SURVEY CONSULTANT
ONUSHANDHANI CREEDS LTD. (O.CREEDS)
SURVEYED BY
Mahedy hasan
Diploma in survey
CHECKED BY
Mohiminul Islam.
B.Sc Engg. Civil
TEAM LEADER
Engr. Md. Shahadat Hosen
B.Sc in Engg. Civil.
INFORMATION
1. BM no.-01, RL= 6.478 m. The pillar situated on the
2. T.B.M.#01 RL.=6.802m. Kept On guard room plinth level (By Marking)
3.T.B.M.#02 RL.=6.073m. Kept On lamp post base level (By Marking)
4. Embankment(S/W side) top=11.647 m.
5. Water level of cyclone: Amphan=6.869 m, Sitrang = 7.009 m.
1. Property Boundary
I. Property Area
II. Wall
III. Fence Line
2. Roads & Related Features
I. Pucca Road
II. HBB Road
3. Structure & Related Features
I. Permanent
II. Semi-permanent
III. Hill Area
IV. Drain
4. Others
I. Power Line
II. Lamp Post
III. Temporary Bench Mark (tbm)
IV. Tree
V. Other Layer
Total Digital Surveyed Land Area
Square m. | Decimal | Bigha | Acre
121407.753 | 3000.048 | 90.751 | 30.000
Drawing No. 444
Date
Scale 1:900
Drawn by
Drawing Title Digital Topographical Survey For The Bangladesh Power Development Board (BPDB)

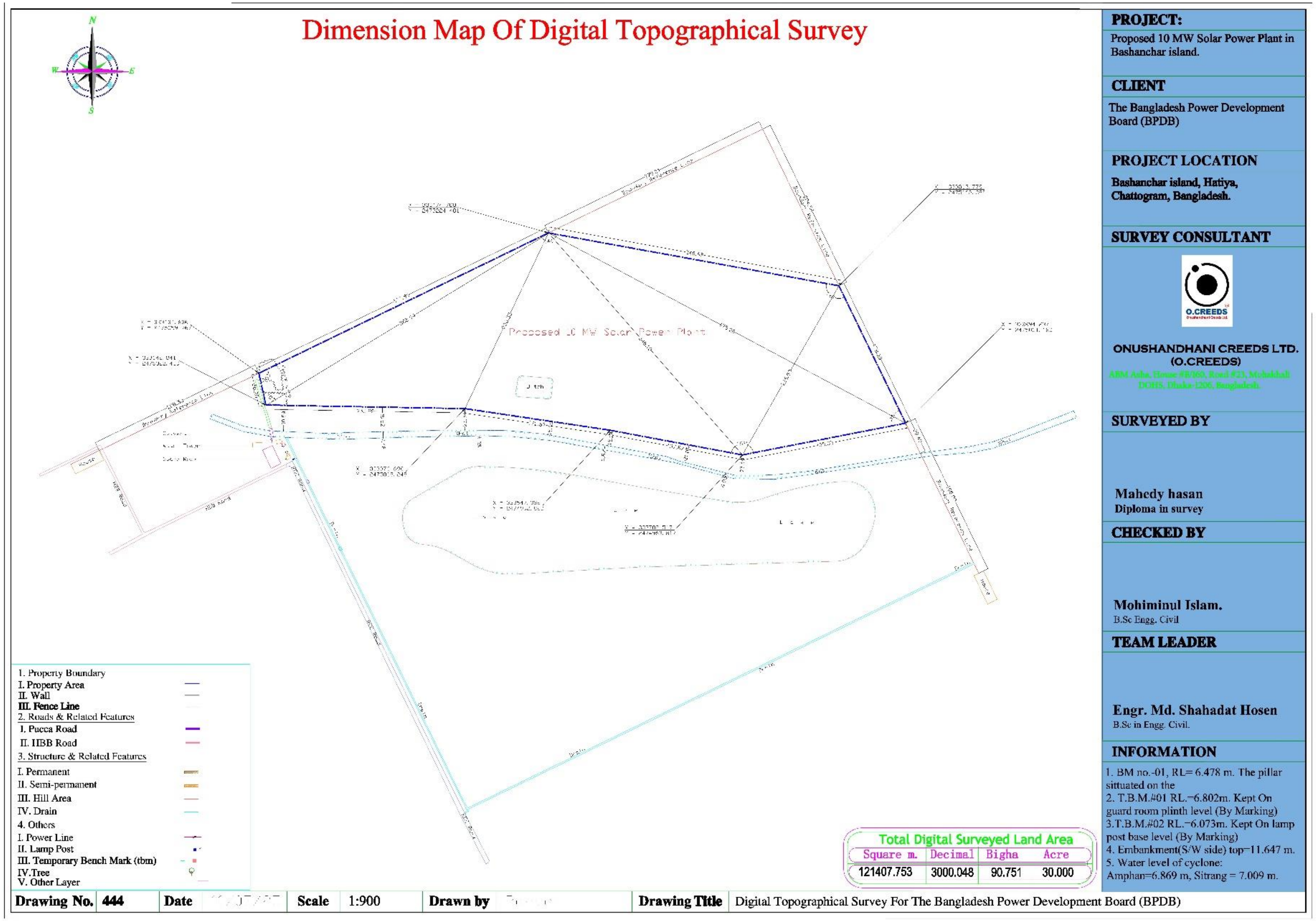


Contour Map Of Digital Topographical Survey
N
W
E
S
PROJECT:
Proposed 10 MW Solar Power Plant in Bashanchar island.
CLIENT
The Bangladesh Power Development Board (BPDB)
PROJECT LOCATION
Bashanchar island, Hatiya, Chattogram, Bangladesh.
SURVEY CONSULTANT
O.CREEDS
ONUSHANDHANI CREEDS LTD. (O.CREEDS)
SURVEYED BY
Mahedy hasan
Diploma in survey
CHECKED BY
Mohiminul Islam.
B.Sc Engg. Civil
TEAM LEADER
Engr. Md. Shahadat Hosen
B.Sc in Engg. Civil.
INFORMATION
1. BM no.-01, RL= 6.478 m. The pillar sittuated on the
2. T.B.M.#01 RL.=6.802m. Kept On guard room plinth level (By Marking)
3.T.B.M.#02 RL.=6.073m. Kept On lamp post base level (By Marking)
4. Embankment(S/W side) top=11.647 m.
5. Water level of cyclone: Amphan=6.869 m, Sitrang = 7.009 m.
1. Property Boundary
I. Property Area
II. Wall
III. Fence Line
2. Roads & Related Features
I. Pucca Road
II. HBB Road
3. Structure & Related Features
I. Permanent
II. Semi-permanent
III. Hill Area
IV. Drain
4. Others
I. Power Line
II. Lamp Post
III. Temporary Bench Mark (tbm)
IV.Tree
V. Other Layer
Total Digital Surveyed Land Area
Square m. | Decimal | Bigha | Acre
121407.753 | 3000.048 | 90.751 | 30.000
Drawing No. 444
Date
Scale 1:900
Drawn by
Drawing Title Digital Topographical Survey For The Bangladesh Power Development Board (BPDB)

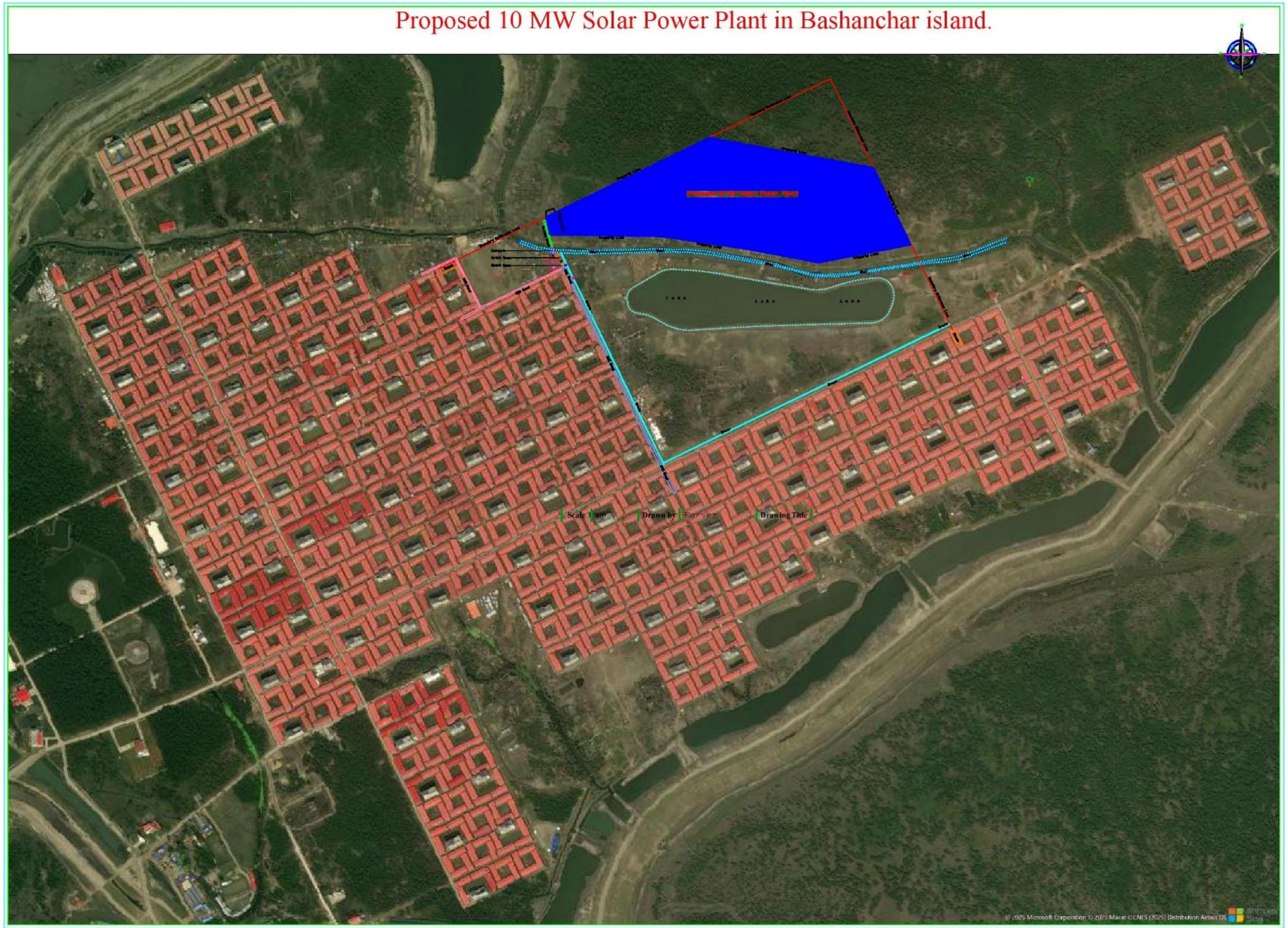

DEM Map Of Digital Topographical Survey
N
W
E
S
PROJECT:
Proposed 10 MW Solar Power Plant in Bashanchar island.
CLIENT
The Bangladesh Power Development Board (BPDB)
PROJECT LOCATION
Bashanchar island, Hatiya, Chattogram, Bangladesh.
SURVEY CONSULTANT
O.CREEDS
ONUSHANDHANI CREEDS LTD. (O.CREEDS)
SURVEYED BY
Mahedy hasan
Diploma in survey
CHECKED BY
Mohiminul Islam.
B.Sc Engg. Civil
TEAM LEADER
Engr. Md. Shahadat Hosen
B.Sc in Engg. Civil.
INFORMATION
1. BM no.-01, RL− 6.478 m. The pillar sittuated on the
2. T.B.M.#01 RL.−6.802m. Kept On guard room plinth level (By Marking)
3.T.B.M.#02 RL.−6.073m. Kept On lamp post base level (By Marking)
4. Embankment(S/W side) top=11.647 m.
5. Water level of cyclone:
Amphan–6.869 m, Sitrang – 7.009 m.
1. Property Boundary
I. Property Area
II. Wall
III. Fence Line
2. Roads & Related Features
I. Pucca Road
II. HBB Road
3. Structure & Related Features
I. Permanent
II. Semi-permanent
III. Hill Area
IV. Drain
4. Others
I. Power Line
II. Lamp Post
III. Temporary Bench Mark (tbm)
IV.Tree
V. Other Layer
7
6.6
6.2
5.8
5.4
5
4.6
4.2
3.8
3.4
3
2.6
1.8
Total Digital Surveyed Land Area
Square m. | Decimal | Bigha | Acre
121407.753 | 3000.048 | 90.751 | 30.000
Drawing No. 444
Date
Scale 1:900
Drawn by
Drawing Title Digital Topographical Survey For The Bangladesh Power Development Board (BPDB)



O.CREEDS
Onushandhani Creeds Ltd.



O.CREEDS
Onushandhani Creeds Ltd.



Proposed 10 MW Solar Power Plant in Bashanchar island.

ANNEXURE-3: DRONE AREAL SNAPS

ANNEXURE-4: FIELD VISIT SNAPS


CLUSTER 107
HOUSE E


O. CREEDS


Rakuten


যতদিন থাকবে প্রাণের স্পন্দন
ততদিন থাকবে আমাদের বন্ধন।