

## THROUGH BATHYMETRY TECHNIQUE: PROVIDING PRECISE LOCATIONS OF SILT DEPOSITION AND REQUIRED TRAINING IN RESERVOIR

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*Abstract-Bathymetry is the foundation of the science of hydrography which measures the underwater physical features of water-body. It is modern technique of active Sonar Technology which helps to track ocean navigation, coastal areas, Reservoir, river and canal. The study focused on providing suitable locations for Dredging and Training works in Matatila Reservoir. Information about reservoir profile is essential for maintaining water at Full reservoir level [FSL] and reservoir management. Presently, Bathymetry technique is use of Multi-beam Echo-sounders [MBES] of variant frequencies for extracting features of underwater in 3-Dimension in GIS enabled environment. Measurement of water depth up-to cm level of accuracy, under water surface contouring and mapping reflects reservoir profiles more precisely. Through this, representative maps are prepared to show variations in depth of water.*

**Keywords-** Bathymetry, Sonar, DGPS, GIS.

### I. INTRODUCTION

Hydrographic Survey is related to large waterbodies such as ocean, sea, rivers, reservoirs, canals and lakes etc for the assessment of sediments load on it and it's shoreline characteristics, when such survey is done on the principal of sound reflection is known as Bathymetric Survey. In bathymetric survey different frequency of sound waves are used to identify variant depth of water, shallower the depth of water higher is the frequency of sound waves (<100metres depth, frequency is more than 200KHz ; >1500 metres depth, frequency is less than 50KHz).Area covered by single survey line depend upon current exact depth of water as swath is set 10-15 times of the current depth as per prescribed rule of USGS for deciding the swath of survey. Higher the depth of water more survey area is covered in a single survey line. In large waterbodies like ocean or sea swath is comparatively higher than rivers or canals hence survey area covered is large in first case. In case of reservoir or lakes swath of survey is required to change frequently according to available depth of water depending upon sediment deposition in reservoir. Topographic maps are prepared by connecting the points of equal elevations whereas Bathymetric maps are prepared by connecting the points of equal depths. Bathymetric contour maps are prepared which indicates plan of reservoir bed showing the line of equal depth from coastline/ bankline or reference point. Sonar survey and mapping gives peeping of submerged surface of reservoir where sediments load are high and where the sediments load is low depends on velocity of water and gradient of bed.

Bathymetric survey of Matatila reservoir on Betwa river in Uttar Pradesh has been done in between October, 2017 to November 2017. Depth of water is computed by setting contour interval of 1metre so as to provide better representation of depth of water and suitability in adequate dredging and training works.

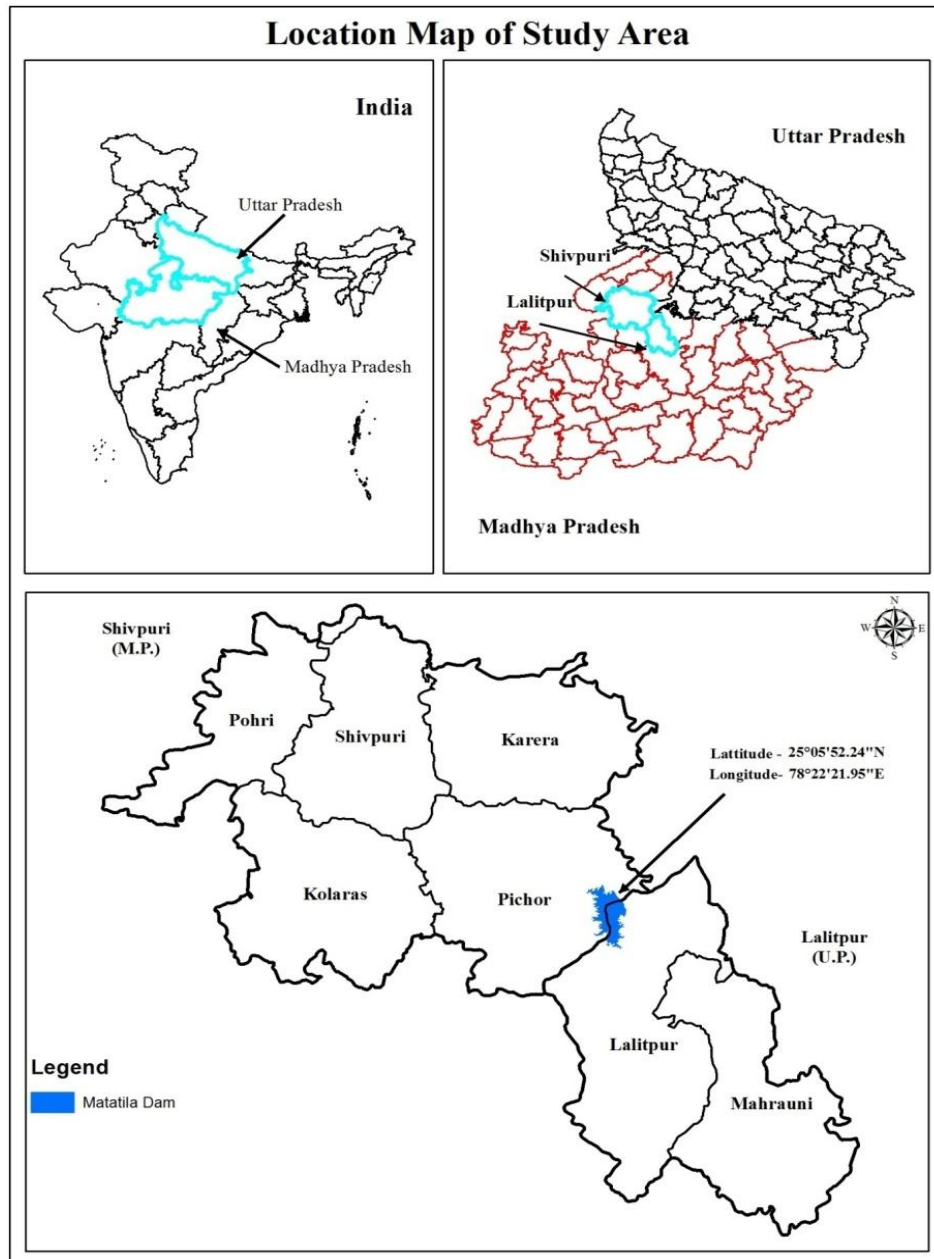
#### i. Objectives:

The objectives of Bathymetric survey of Matatila Reservoir are listed below:-

- I. To measure the depth of water using sonar equipments.
- II. Provide sites for training work required in reservoir.
- III. Preparation of map showing depth of water and profile view.
- IV. Assessment of silt deposition in water.

#### II. Study Area:

Matatila Reservoir named after goddess temple situated on the top of hill close to the reservoir. Matatila is situated in Lalitpur District of Uttar Pradesh and Shivpuri District of Madhya Pradesh with coordinate 25°5'52.24"N latitude and 78°22'21.95"E longitude and nearest town from reservoir is Talbehat. The main objectives for the construction of Matatila Reservoir is to facilitates Irrigation, power generation and drinking water needs of surrounding regions. Matatila Reservoir comes in Survey of India Topographical map sheets numbers G44S and G44M.



**i. History of Matatila Reservoir:**

Matatila Reservoir was constructed in 1964 across river Betwa, 50Km from Jhansi in Uttar Pradesh. Its water is utilized for irrigation, power generation and drinking purposes. Matatila Reservoir is composite Reservoir having 737.42m long, 23 gates, central spillway flanked on either sides by earthen Reservoir of 3657.6m long on left side and 1905m long on right side. Height of earthen Reservoir from ground level is 24.38m. Design Capacity of Matatila Reservoir is 5.26 lac cusecs water.

***Salient features of Matatila Reservoir***

S.N.	Details	Matatila Reservoir
1	Catchment Area	20720.0Km <sup>2</sup>
2	Height of Reservoir	45.5m
3	Top Level	310.90m

4	Full Reservoir Level	308.46m
5	Number of Gates	23 (Each one of 60 ft)
6	Length of Spillway	490m
7	Designed Spillway capacity	5.60lac Cusecs
8	Drinking water Supply	Talbehat, Babina and Jhansi

**ii. Bathymetry Survey Equipments:**

Equipments used in Bathymetry Survey can be broadly categorized as Depth Measurement Equipments, Positioning Equipments and Water Level Measurement Equipments (e.g. river level gauges).

**i. Depth Measurement Equipment:**

Depth measurement is achieved using Multibeam Echosounders (MBES) has the capability to detect small objects and achieve full bottom coverage, an appropriate Motion Sensor and Gyro is correctly integrated with it for its correct functioning. Careful calibration of MBES is required at regular intervals.

The main component of Bathyswath system are Sonar Transducers, Transducer Interface Unit (TIU) and software package real-time functions for data acquisition and processing functions for the acquired data.

**ii. Positioning System Equipments:**

DGPS has been used as primary method to fix survey boat position in Bathymetry Survey. Differential corrections are verified by comparing it with known marks of local base station. GPS receivers are configured to output position in the WGS84 datum with associated quality tags.

Kinematic GPS offers enhanced precision in terms of horizontal position, provided that the footprint of the Echosounder in use is of a comparable dimension.

Equipment Used: Trimble SPS461 Dual Antenna DGPS Receiver as Rover.

**iii. Water Level gauge Equipment:**

River gauge measurements of height and time are required to reduce collected soundings to chart Datum and subsequently used to define Mean Sea Level.



Bathyswath Hardware

Teledyne DMS-25 Motion Sensor



### III. METHODOLOGY:

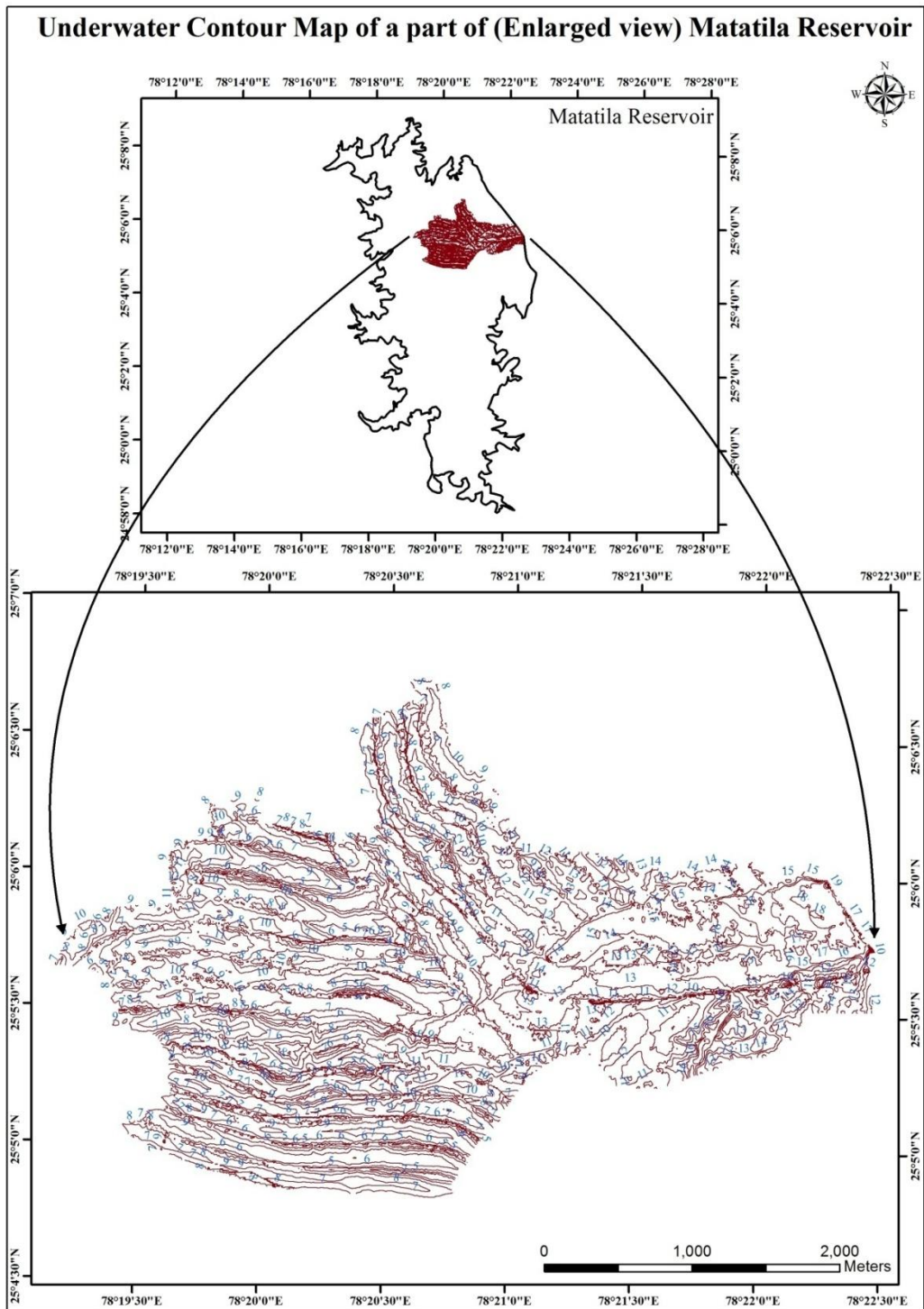
In this study, an advanced engineering Echosounder with recording on data logger linked to position fixer in fully automated way with help of softwares has been used as a part of Bathymetry Survey equipment. Horizontal positioning has been carried out with DGPS, GNSS and Z blade technology enabled instruments that is fixed onboard on boat and gives precise location information of latitude, longitude and altitude. The study aims to draw conclusions from contours generated from depth points collected by sonar pinging.

The Bathymetry survey process is divided into five major stages with each stage divided into a number of groups of instructions or procedures. This section contains broad guidelines that relate to each of these stages.

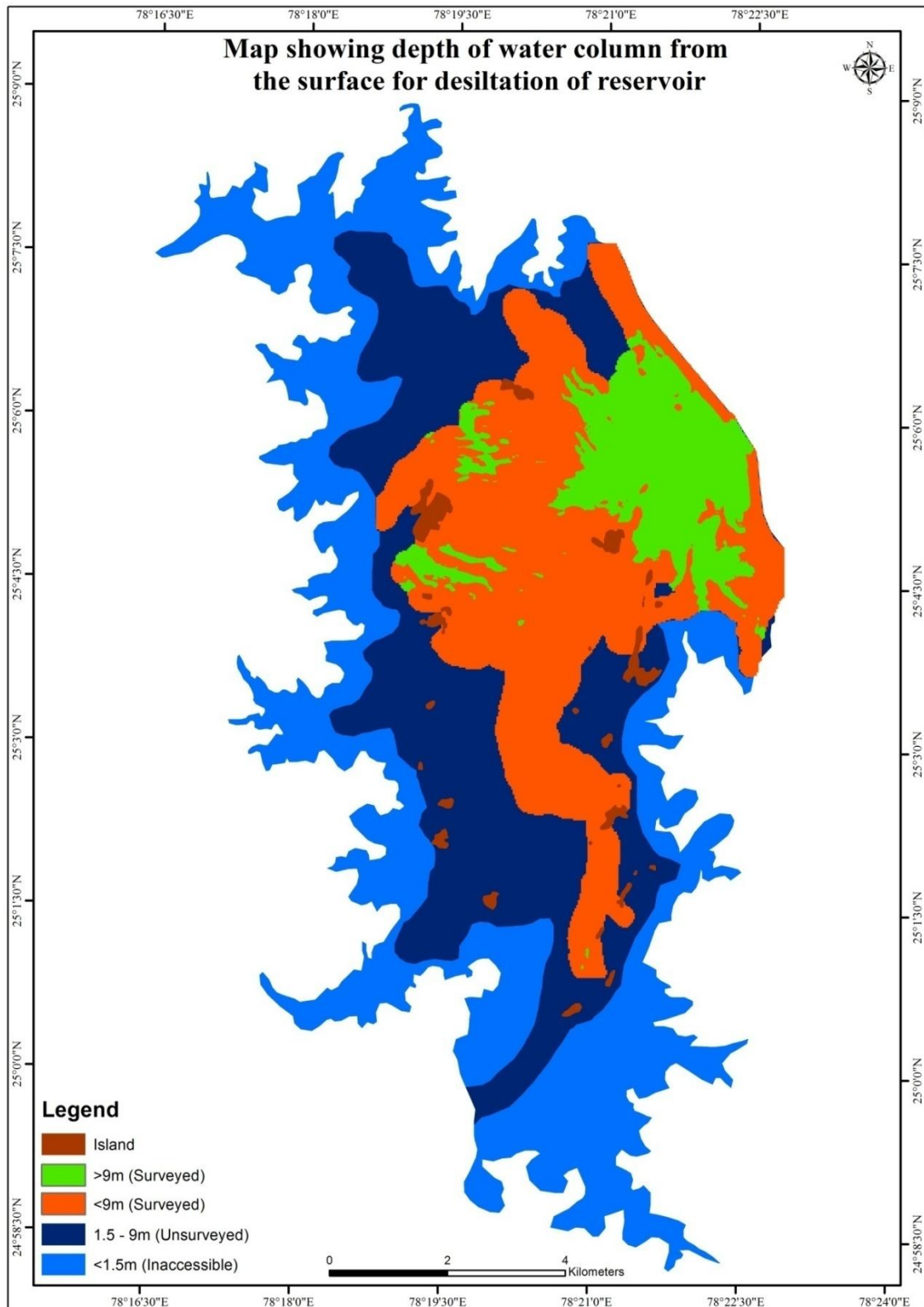
Stage	Group	Instructions or Procedure
Preparation	Planning	Extract current survey data from existing sources and plan observations
	Calibration	Elimination of systematic errors from survey instruments prior to observations
Data Collection	Verification	Configuration of equipment to ensure
	Observation	Data collection, including those observations necessary for ongoing validation
	Data Logging	Ensure appropriate data is logged to correct parameters
Data Processing	Data Cleaning	Removal of invalid data
	Data Selection	Selection of valid data for further
	Data Storage	Storing of selected processed data in appropriate formats
Data Analysis	Quality	Determine quality of surveyed data via proven methods and compare with required standards
	Coverage	Determine if sufficient valid data has been
Data Rendering	Reports	To document the survey process and results to provide adequate transparency
	Plots	To render data as client as required
	Digital Data	To render/archive digital data
	Field Records	To render/archive field records

#### **Data Analysis**

Data collected during survey is being monitored closely to ensure the required standards and desired area of coverage. Cross- line comparisons and other consistency checks are done.



This contour Map shows enlarge view of silt deposition in the central part of the reservoir having a depth variation of 6-9m of water column showing parallel pattern of undulating silt deposition.



This map has been classified into two parts for the water column >9m and <9m as per requirement of dredging purpose in Matatila Reservoir so as to increase water storage capacity of reservoir.

#### IV. CONCLUSION:

Through Bathymetric Survey we are able to provide exact locations of deposited silt islets and variant undulations of silt deposited over the bed of reservoir along this we can also differentiate between masonry and earthen works in reservoir through depth variations of water at edges of reservoir. Bathymetric survey data can be utilized for planned dredging work in specific silt locations to minimize the cost of dredging work and in increasing the water storage capacity of

reservoir. Such survey may also be useful for route planning for different purposes like fishing and sports activities. Bathymetric data are fruitful for irrigation department, central water commission, sports authorities etc.

#### **V. Acknowledgement:**

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