Using Autonomous Surface Vehicles (ASVs) for Rivers Morphological Behaviour/ Siltation Pattern Monitoring

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Introduction

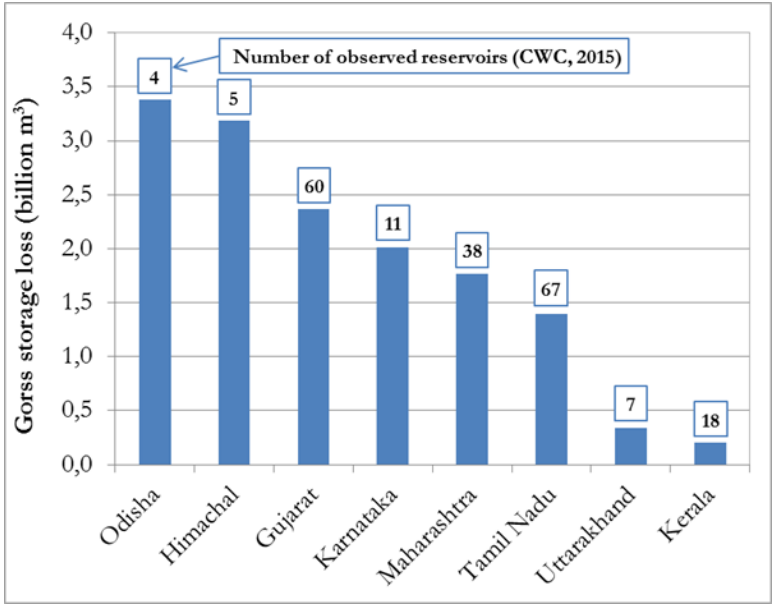
Reservoir Sedimentation
One of the Major Problems for Dam Safety and Water Security

- ✓ Water & Energy Demand
- ✓ Flood Management & Risk
- ✓ Safety Concerns

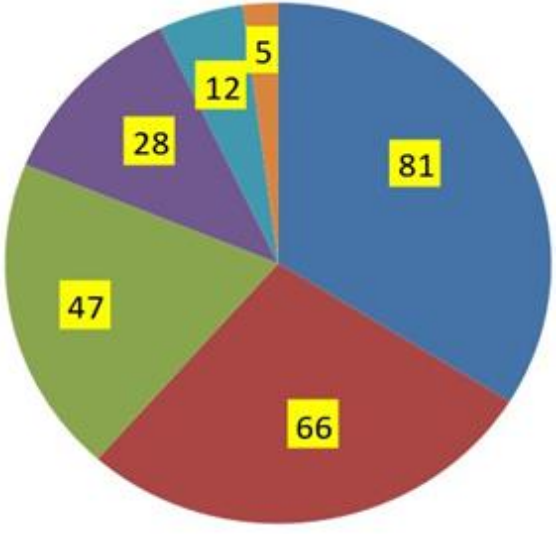
- ✓ ~50% Reservoir Storage Loss by 2050
- ✓ 100% in 200 to 300 Years
  (Global Figure by ICOLD)

Large Dams in India (NRLD, 2018)
5262 (completed), **437** (under construction)
2329 (commissioned before **1980**)

Introduction



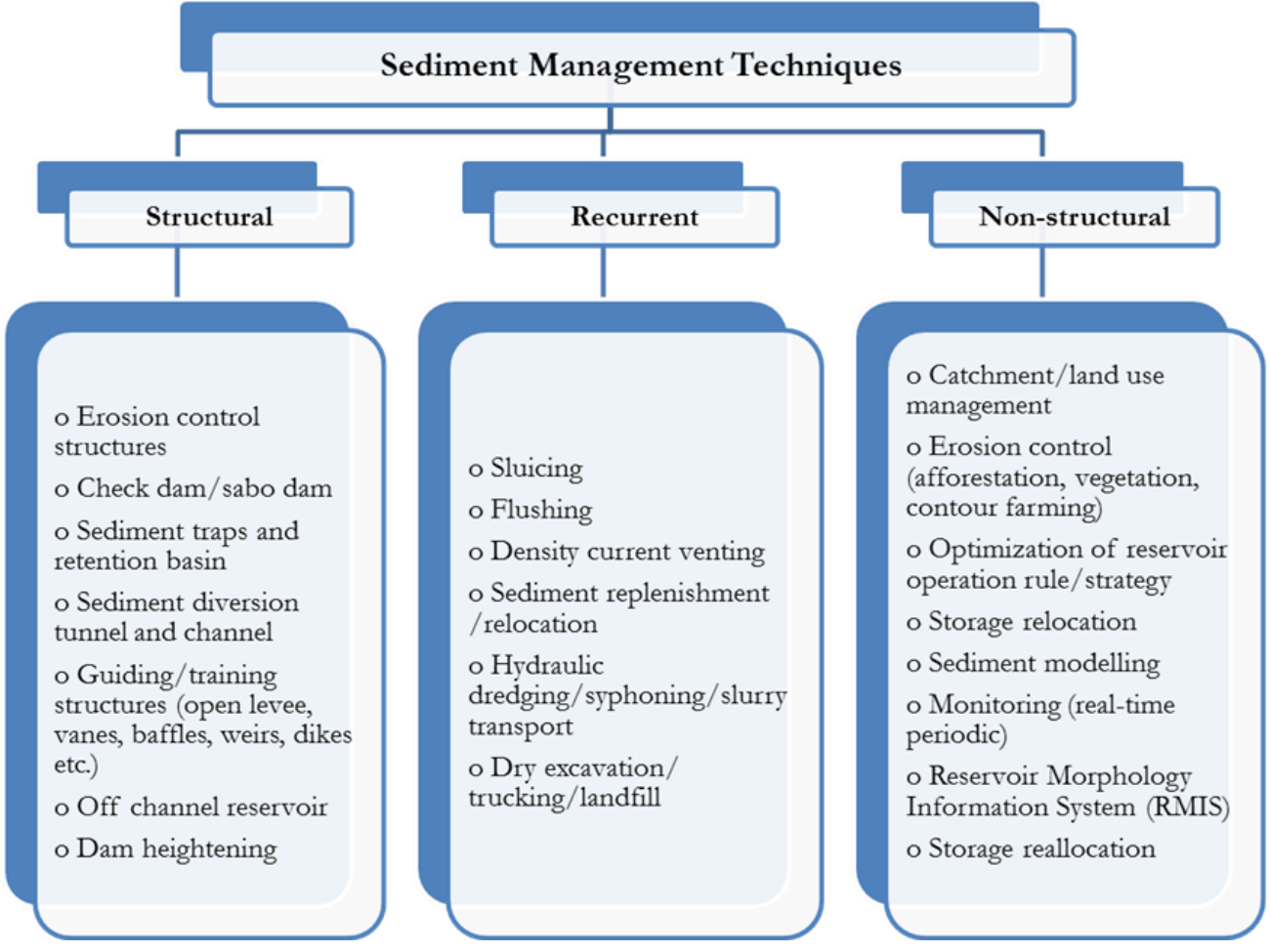
Capacity loss of 239 reservoirs in India (CWC, 2015)



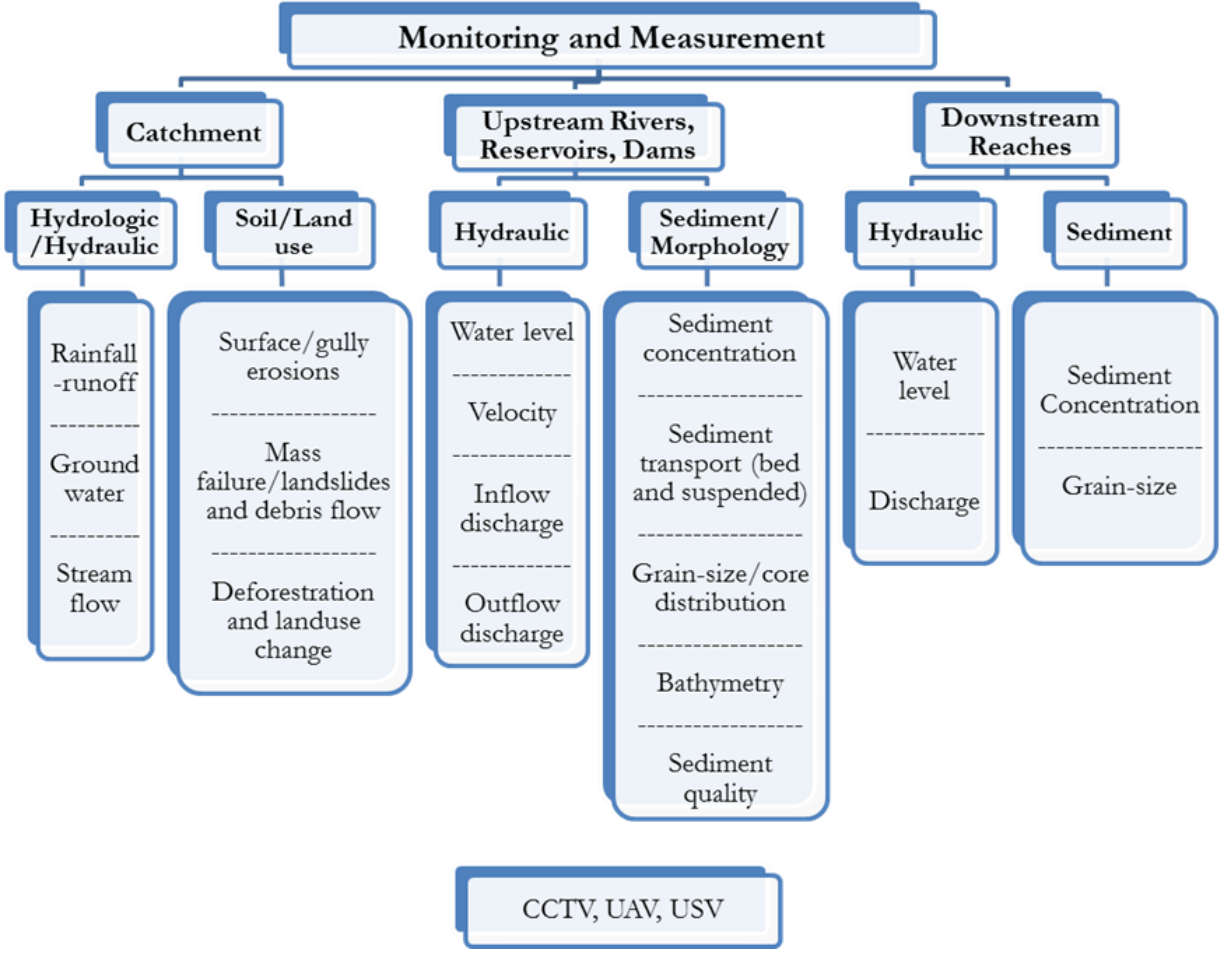
Endangering the safety of dams, water security and livelihood, particularly in a country like India with rapid economic as well as population growth

Assessing Sediment-Induced Problems

“What cannot be measured, cannot be managed”



Monitoring & Measurement: Methods & Techniques



Bathymetry Measurement

The bathymetry is one of the most important measurement data for reservoirs. This can be very helpful not only to quantify changes in storage capacity, but also understanding morphological patterns and development. Such information can be useful for selection, planning, feasibility as well as assessment of sediment-induced problems and selection of short and long term sediment management measures.

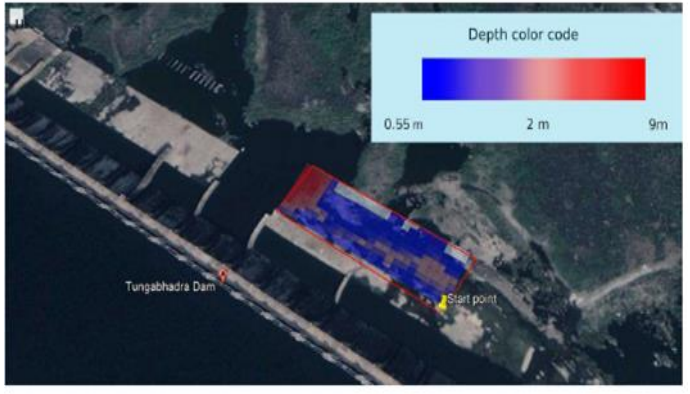
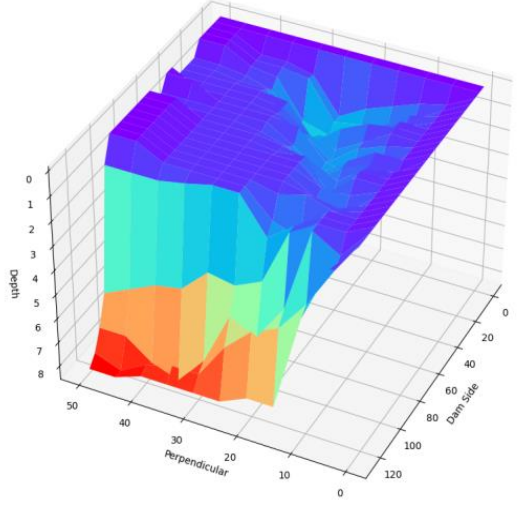


Fig. 2.104 Bathymetry of plunge pool region

Purpose and Frequency

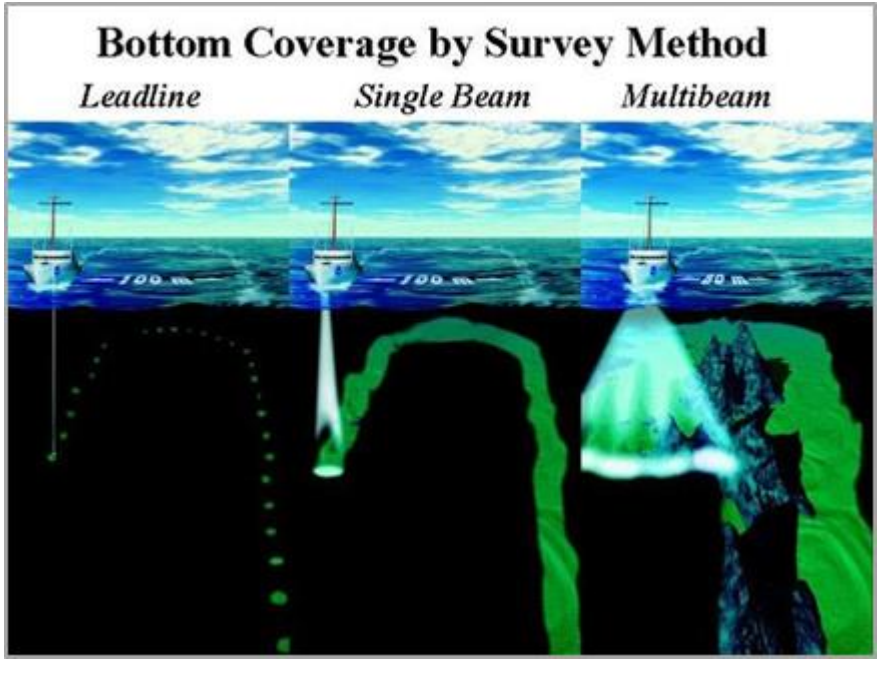
The quantification of new storage capacity, sedimentation level (storage loss) and morphological patterns are the main purposes of the topo-bathymetric survey. Other usefulness of the periodic bathymetry measurement is quantification of inflow sedimentation rate and trap efficiency in combination with outflow transport estimation.

The frequency of surveys in reservoirs depends on several factors, e.g. the reservoir capacity and the tentative amount of sediment deposits. The small reservoirs and those with large sediment inflow shall be more frequently surveyed. On the other hand, the reservoirs with low sediment transport naturally or due to, for example, upstream dams or decrease of the drainage due to erosion control measures etc. can be measured less frequently.

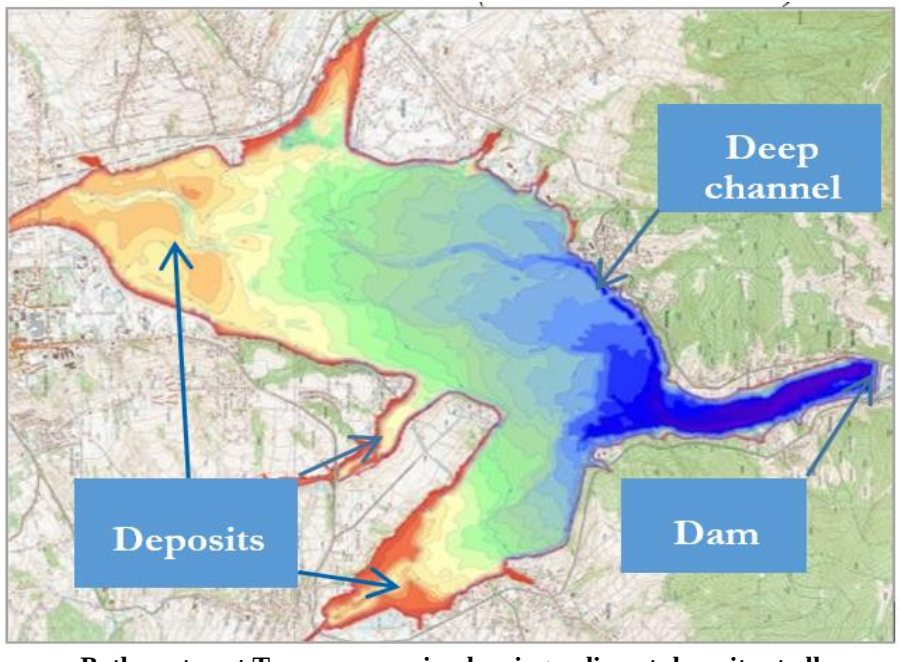


Methods

Traditional manual survey is time consuming, labour intensive and costly . Unmanned and autonomous vehicle can help to solve these problems and allows to understand the consequence of a constantly changing environment. ASV can perform its function, such as navigation and data collection and can either transmits the data to the home base or store the data onboard.



Bathymetry using echo sounders



Bathymetry at Tresna reservoir, showing sediment deposits at all tributaries entering to the reservoir (Dark blue to dark orange color variation denotes deep to shallower areas respectively)

Autonomous Surface Vehicle (ASV)

- Autonomous Surface Vehicles are robotic vehicles that sit on the water surface recording oceanographic data across a range of variables. Usually ASV are designed in Catamaran structures having higher stability due to the wider bean, lesser power requirements due to smaller hydrodynamics resistance and shallower draught. A typical ASV unit has a hull, a propulsion system, navigation system, data collection and transmission system
- Mini-boats that operate on the surface of water autonomously. It could be also operated in a remote control mode.
- Replacement of conventional Diesel Boats
- Can survey in locations and situations where deployment of conventional platforms is not possible, it can be controlled manually or programmed to follow routes introduced through an easy PC-based GUI

Autonomous Surface Vehicle

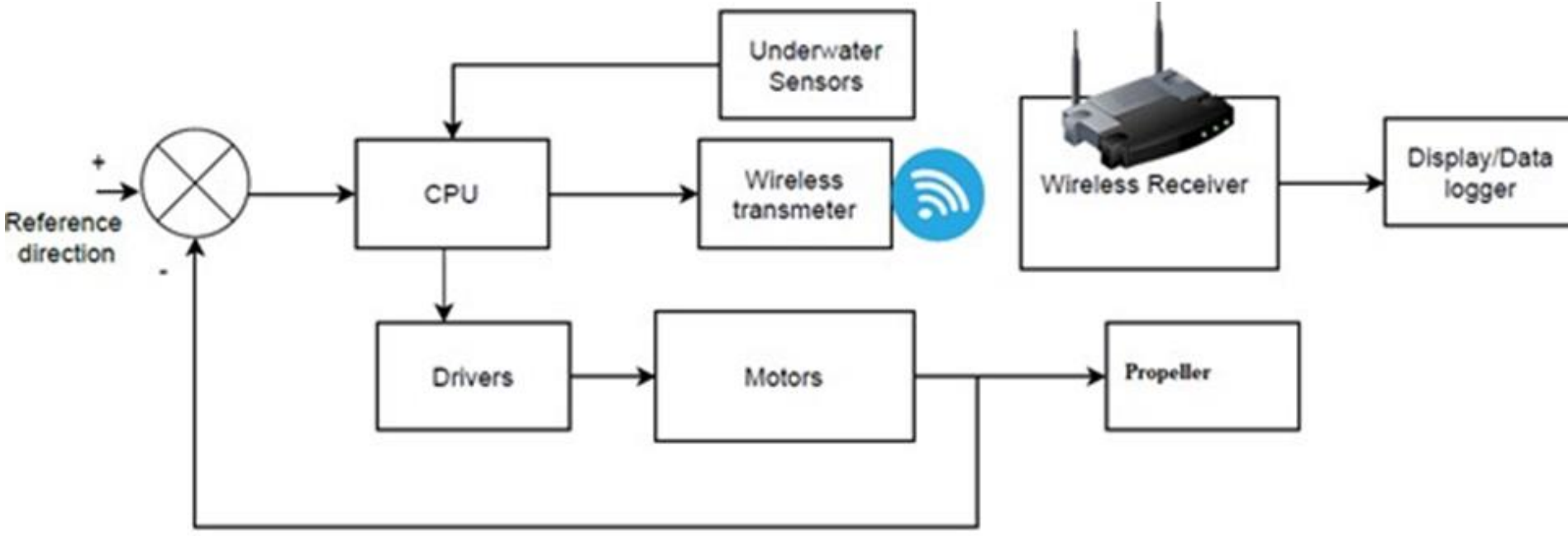
Autonomous Advantages

- ❖ Force multiplier
- ❖ Increased efficiency
- ❖ Reduced risk to personnel
- ❖ Reduced environmental footprint
- ❖ Project cost reduction

Traditional diesel boat

Autonomous Surface Vehicle (ASV)

The unmanned surface vessels (USVs) or the autonomous surface vehicles (ASVs) are crafts that are designed to allow autonomous control of marine platforms which are equipped with state-of-the-art sensors for carrying out a variety of missions like marine environment monitoring, hydrologic survey, target object searching, scientific study and so on



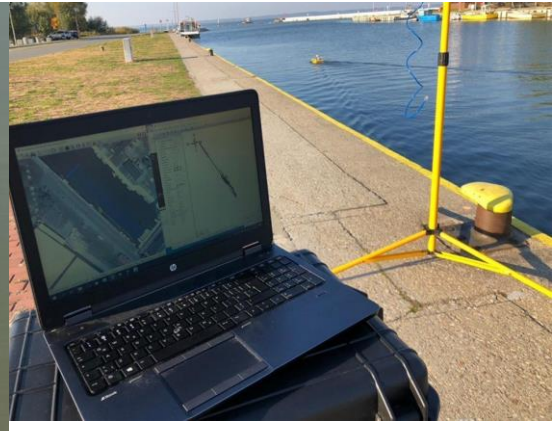
Block diagram of control system

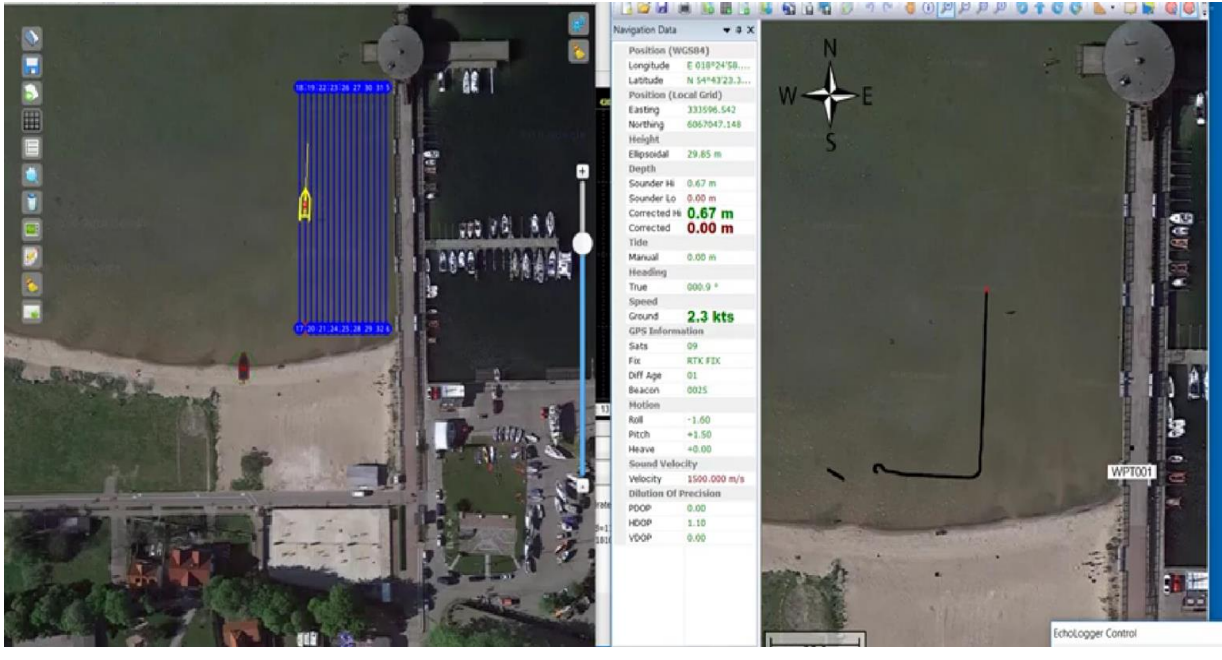
Capabilities of Autonomous Surface Vehicle

Functions	Description
Real-time Data Collection	The sensors onboard the ASV can measure parameters such as turbidity, acoustic backscatter, and water depth, enabling researchers to monitor sediment transport patterns and sedimentation rates instantaneously.
High-resolution Mapping	ASVs can create high-resolution bathymetric maps of dam reservoirs. These detailed maps offer insights into the topography of the reservoir bottom, allowing researchers to identify sediment accumulation zones and erosion-prone areas accurately
Adaptability to Various Sensors	ASVs can be equipped with a variety of sensors, including multibeam echo sounders, ADCPs (Acoustic Doppler Current Profilers), and sediment samplers. This flexibility allows researchers to customize the ASV's payload based on the specific parameters
Long-duration Monitoring	ASVs powered by rechargeable batteries can operate for extended periods, enabling long-duration monitoring and data collection. Continuous monitoring over weeks or months provides valuable insights into seasonal variations and long-term sedimentation trends

Advantages

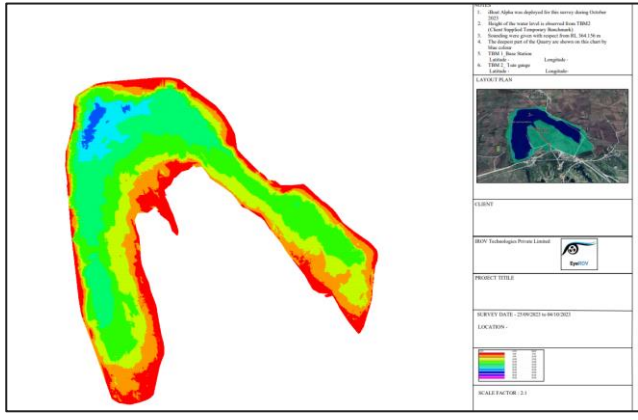
- Portable and Easy deployable
- Real Time Navigation and Monitoring
- Autonomous and Controllable mode of Operation
- Wireless Data Transmission
- GSM/ Wifi/ Radio Telemetry
- Endurance of 8-10 hours
- Speed of 3-4 Knots (Upgradable Options)
- Online real time data logging
- HD Cameras and live video streaming
- Various Mission Modes
- Shallow water operations upto 0.5m water depth
- Multiple Payload Options for Multiple applications
- Mission Planning configurations
- Accurate and Quality Data





Applications

- Bathymetry Solutions
  - Inland Waterways, Lakes, Rivers and Reservoirs
  - Shipping Channel Bathymetry Survey
  - Pre Dredging and Post Dredging Survey
  - Port and Navigation Channel survey for debris and wreckages



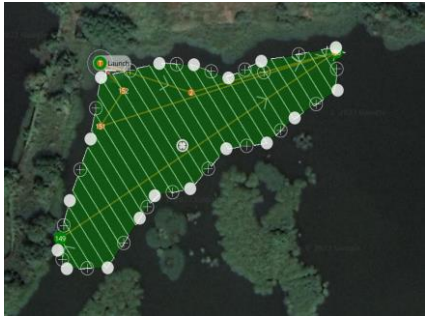
- Oil Spillage Monitoring- Pollution control of lakes and ponds
- Water quality monitoring at specific geo coordinates
- Monitoring of Fauna can be explored using specific payloads
- Visual inspection and Surveillances
  - Inspections of Port assets and wharfs
  - General Port Patrolling and entry - exit vessel monitoring 24*7

Color	Lower	Upper
	0.00	5.00
	5.00	10.00
	10.00	15.00
	15.00	20.00
	20.00	25.00
	25.00	30.00
	30.00	35.00

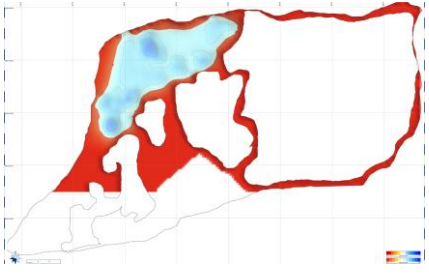
- Emergency and Security Measure
  - Inspections and evidence collections in collisions/sinking incidents
  - Inspection and Rescue planning support during Sinking
  - Outside port inspection and counter measures of intrusions/infiltrations
  - Surveillance and defence activity

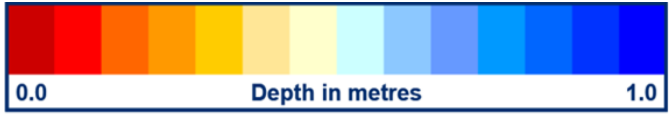
Results

- These comprehensive bathymetric maps show the configuration of the channels, areas of accumulation of debris, and trends in erosion.
- Bathymetric charts are a valuable tool for illustrating the underwater environment.
- Plots comprising the depth values of the survey region can be generated in two dimensions or three dimensions.
- Bathymetric charts' color coding facilitates comprehension of the river's depth.



Predefined survey path





Water Quality Monitoring Sensor system for ASV

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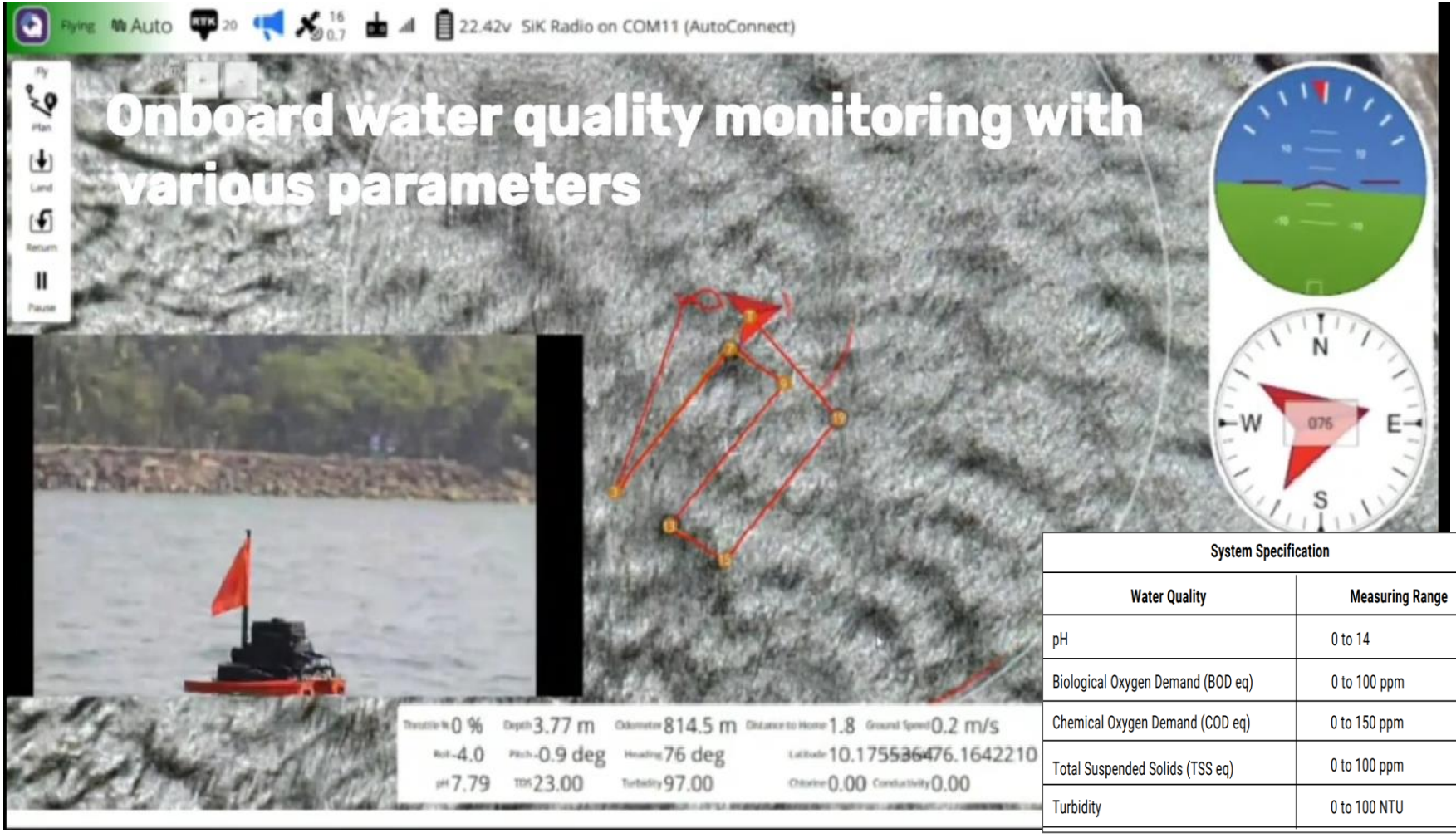

System Specification	
Water Quality	**Measuring Range**
pH	0 to 14
Biological Oxygen Demand (BOD eq)	0 to 100 ppm
Chemical Oxygen Demand (COD eq)	0 to 150 ppm
Total Suspended Solids (TSS eq)	0 to 100 ppm
Turbidity	0 to 100 NTU

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CASE STUDY

September, 2022

BATHYMETRIC SURVEY OF 5 PONDS AT BPCL, IRUMPANAM, KERALA USING AUTONOMOUS SURFACE VEHICLE (ASV)

EyeROV Inspection Services

Location

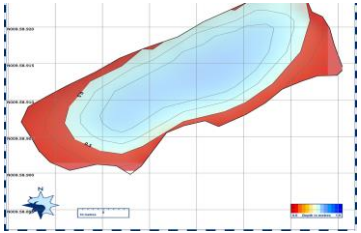
Irumpanam, Kerala

SCOPE OF WORK

- The scope of the work was to carry out the bathymetric survey of five water bodies using ASV before installing floating PV project .

EQUIPMENT USED

- EyeROV iBoat-alpha with Single Beam Echo Sounder and RTK GPS



RESULT

- Bathymetric charts of the five ponds.
- The maximum depth of pond-1, pond-2, pond-3, pond-4, pond-5 were found to be 1.25m, 0.93m, 0.89m, 0.84m, 0.87m.

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CASE STUDY

November 2022

AUTONOMOUS SURFACE VEHICLE DEMO

Client

EyeROV Inspection Services

KICL Kothari Industrial Corporation Limited

भाकाजप्रा IWAI

Location

Gaighat, Patna

Date: 07 /11/2022

SCOPE OF WORK

- To conduct Bathymetry survey using ASV for grid of 500m x 500m with 25m line spacing

EQUIPMENT USED

- EyeROV iBoat-alpha with Single Beam Echo Sounder and RTK GPS

RESULT

- Survey report with key observations and bathymetry chart.

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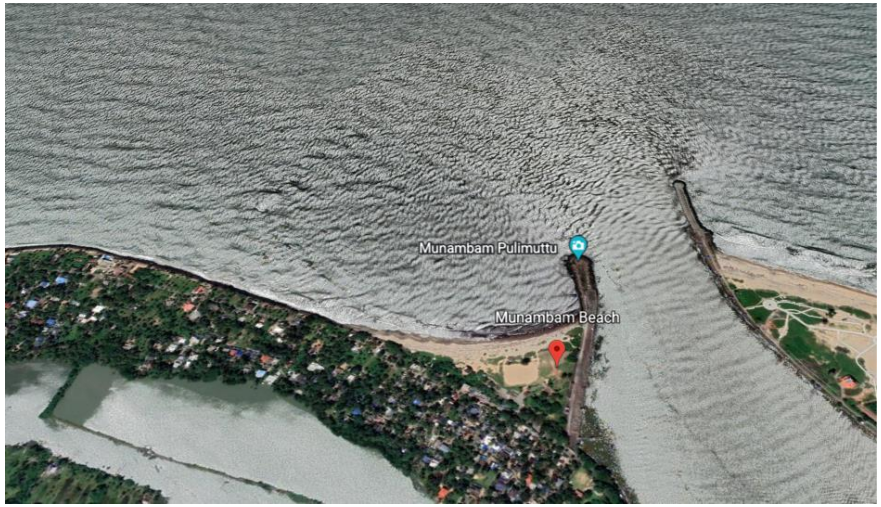
CASE STUDY

January, 2023

ASV DEMO FOR DEWA



EyeROV Inspection Services

Client

هيئة كهرباء ومياه دبي
Dubai Electricity & Water Authority

Location

Kerala, India

Date

12th January 2023

SCOPE OF WORK

- ASV to collect water samples from 50 locations

EQUIPMENT USED

- EyeROV iBoat-alpha with Single Beam Echo Sounder and RTK GPS

RESULT

- ASV was able to collect water samples at different locations

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CASE STUDY

January, 2023

ASV DEMO AT COCHIN PORT TRUST

EyeROV Inspection Services

Client

कोचिन पोर्ट ट्रस्ट
COCHIN PORT TRUST

Location

Kerala, India

Date

13th January 2023

SCOPE OF WORK

The scope of work includes the following:

- **Conducting Bathymetry survey using ASV for grid of 500m x 500m with 25m line spacing.**
- **Survey report with key observations and bathymetry chart.**

EQUIPMENT USED

- **EyeROV iBoat-alpha with Single Beam Echo Sounder and RTK GPS**

RESULT

- **Bathymetric survey was conducted using ASV for grid of 500mm x 500mm with 25m line spacing**
- **Bathymetric chart was made according to the results**

EyeROV

Company Snapshot

- Marine Robotics and AI Company building unmanned robotics solutions for Defense, O&G and marine sector
- Incorporated in **2017** by IIT Alumni, Ex-Samsung & Ex-NIOT
- Executed **50+ projects** and 30+ Clients
- Invested by GAIL, BPCL and V-Guard Founder
- Team of 35+ Members
- 4 Patents, 2 International Publications
- Winners of Dare to Dream 3.0, National Startup Awards

Supported by Maker Village, KSUM, Venture Center

Receiving National Startup Award 2022 from the Hon'ble Minister of Commerce & Industry

Winner of Dare to Dream 3.0 , receiving the award from the Hon'ble Minister of Defence

Existing Products

Product	TUNA	TROUT	iBoat ALPHA
Depth / Range	300m	300m	Range upto 10km
Operating Environment	Sea State 2, 2 kts currents	Sea State 2, 2-3 kts currents	Sea State 2, 4 kts currents
Payloads	2Kg (in water) Full Array	4Kg (in water) Full Array	20 Kg (in air) Full Array

- 1 Design Patent
- 3 Provisional Patent
- 2 International Publications

#Indigenous

Clients & Applications

- 30+ Clients
- 60+ Assets
- 2000+ Underwater Inspection Hours
- Operating in India and Middle-east

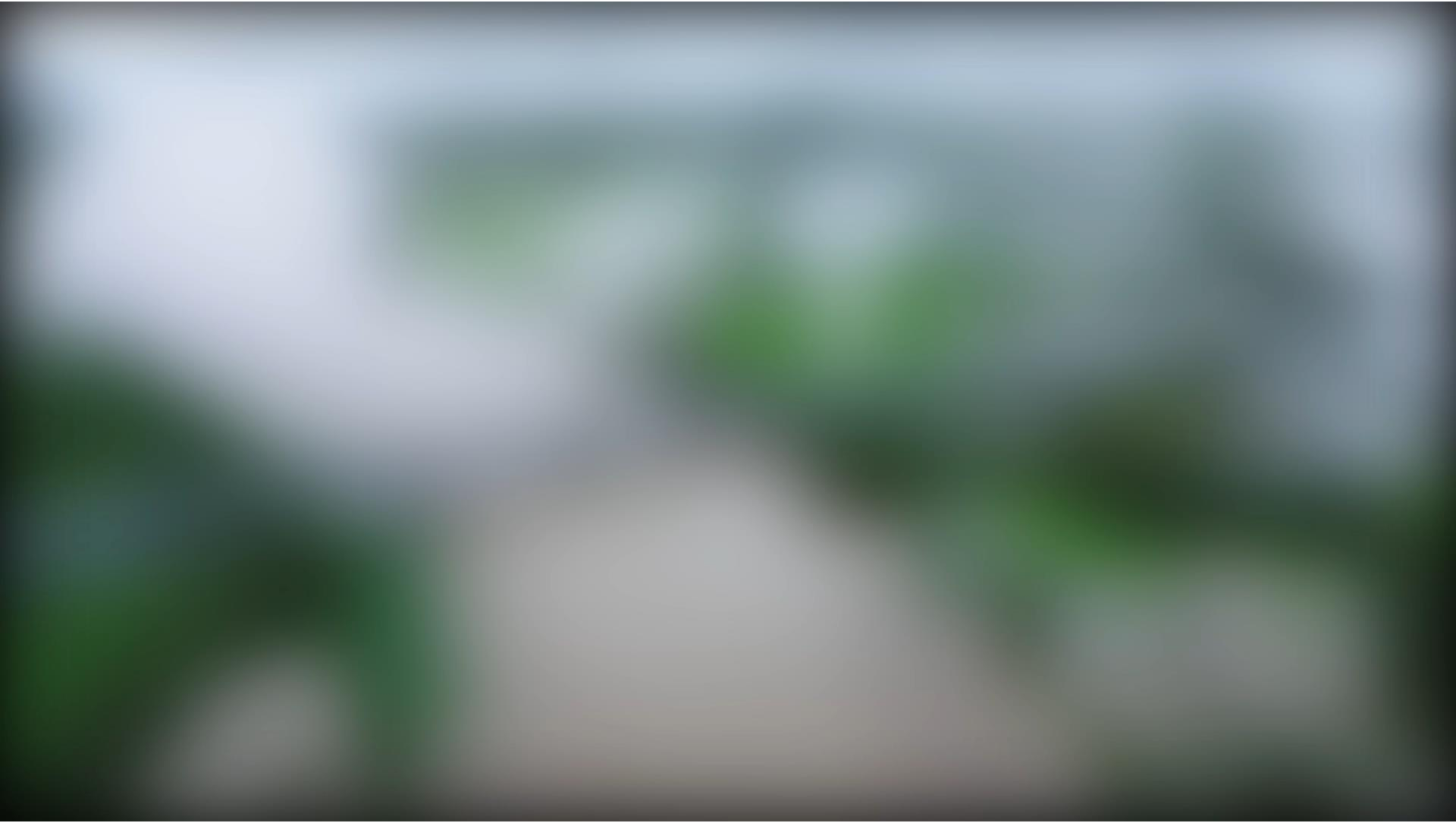
Inspection of Single point Mooring platform, Kochi

Inspection of container ship hull, ICTT

Inspection of Port Berth structures, DP World

Inspection of Bridge Structures, Bhopal Western Central Railway

Inspection of Tungabhadra Dam, Karnataka



Thank You

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