CLIMATE-RESILIENT DAMS AND
HYDROPOWER INFRASTRUCTURE
INTEGRATING
ENVIRONMENTAL SUSTAINABILITY
IN PLANNING AND DEVELOPMENT

Integration of ROV Technology for Climate-Resilient Hydropower Infrastructure Assessment and Management

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Impact of Climate Change on Hydropower Infrastructure

- Increased sedimentation in dams and tunnels.
- Structural stress due to fluctuating water levels.
- Landslides and flooding causing tunnel blockages and failures.
- Reduced power generation efficiency and asset lifespan.

Need for Advanced Inspection Methods

- Regular inspection is critical for safety and operational continuity.
- Diver-based inspections are unsafe in flooded or unstable conditions.
- Dewatering tunnels causes operational disruption and structural stress.
- ROVs provide a safer and more reliable alternative.

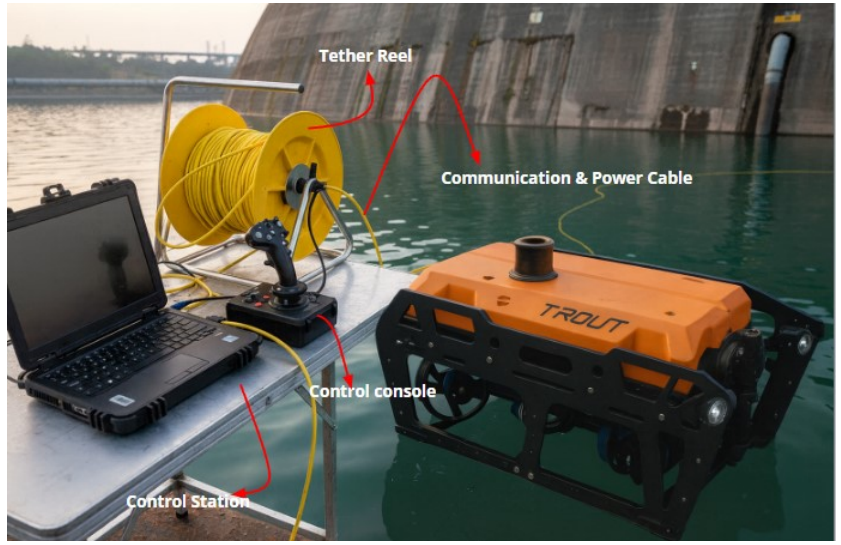
ROV-Based Inspection Solution

- Operates in flooded and partially blocked tunnels.
- No dewatering required, minimizing downtime.
- Capable of long-range inspections up to 10 km from a single entry.
- Real-time data transmission and analysis.
- Fast and consistent method. Reduces the time involved for inspection

ROV-Technology and sensors involved

EyeROV's TSROV system is tailor-made for inspections of long tunnels and critical infrastructure.

Engineered for high endurance and durability in the most challenging environments.



SPECIFICATIONS

Operational Depth	Up to 450 meters
Tether Range	Up to 10 km
Endurance	24+ hours of continuous operation
Software	iControl Hub Suite with customizable dashboards and real-time mission data
Connectivity	Robust tether communication system for extended-range operation

PAYLOADS

Multibeam Imaging Sonar

360° Profiling Sonar

Multi Camera System

High Intensity LEDs

Laser Scaler

Doppler Velocity Log (DVL)

Robotic Arm

Tether Counter

ROV-Technology and sensors involved

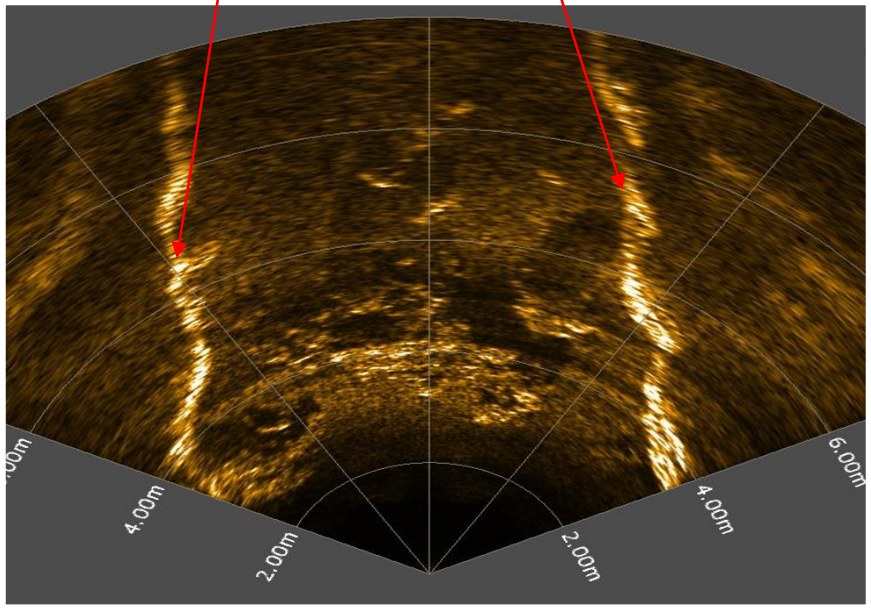
Forward looking multibeam SONAR

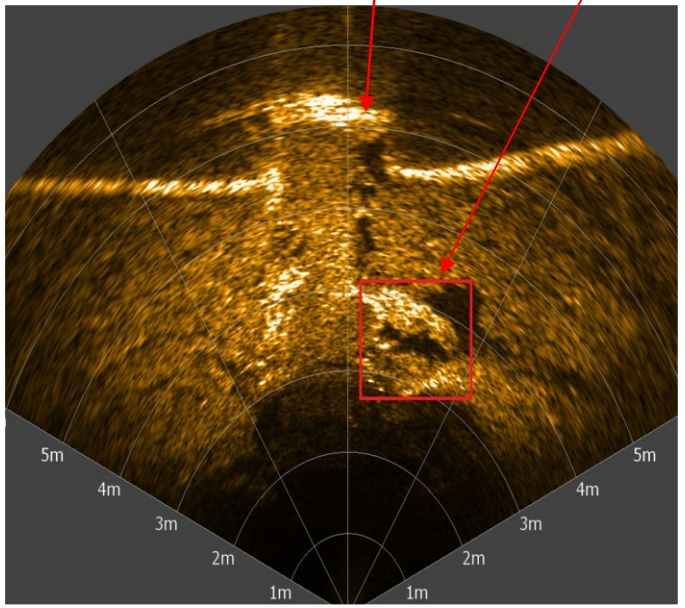
Tunnel side walls

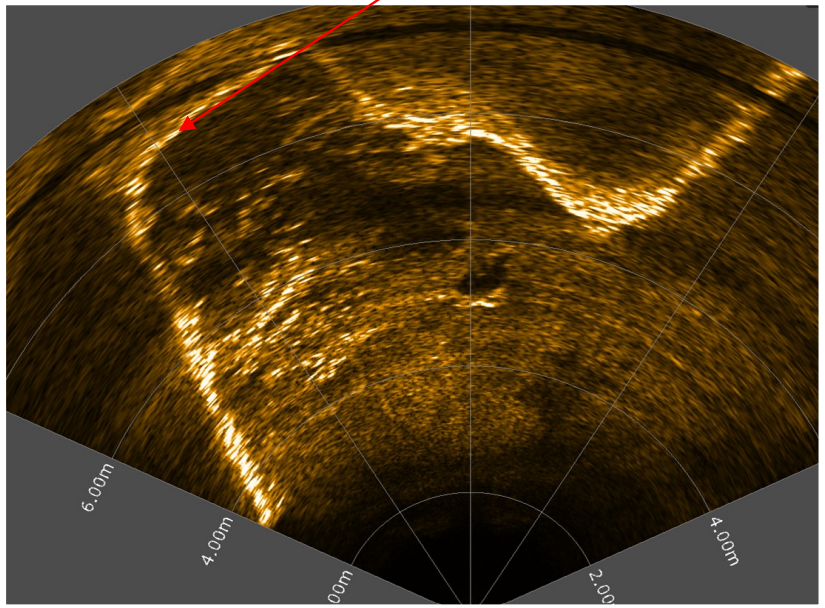
Gate groove

Rock inside

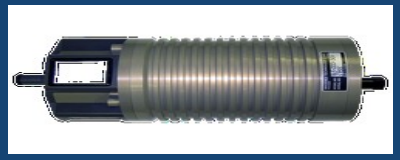
Work area inside tunnel



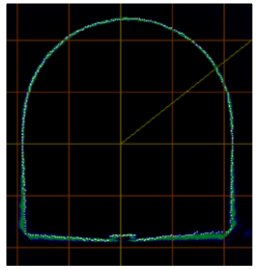


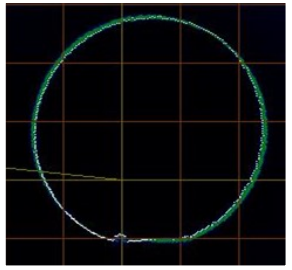


ROV-Technology and sensors involved



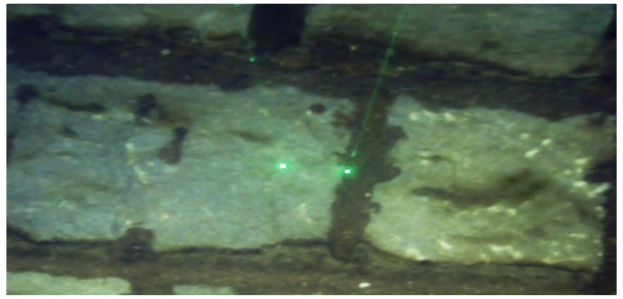
Profiling SONAR





To get profile of the tunnels and also plot tunnel siltation profiles/ 3d model of the tunnel etc

Laser Scaler
(Inhouse Developed)



To measure dimensions of cavities, potholes and cracks

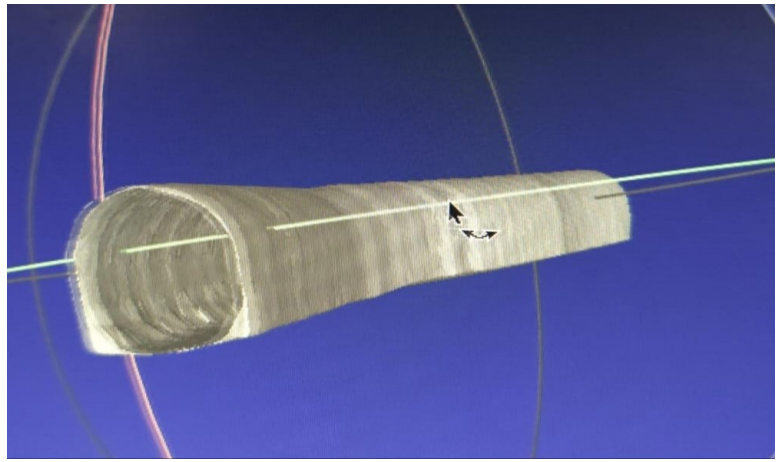
HD Cameras

Used to capture HD images of the tunnel interior

How ROV surveys act as Value addition in Tunnel Surveys

- Visual survey to assess the integrity of the tunnel
- Profile mapping and 3D model of the entire tunnel
- Tunnel siltation profile and Silt volume calculations.
- SONAR survey in zero visibility
- Inspection of Long Tunnels up to 10 km
- Conditional Assessment of Tunnels Interiors

10 Km Tether Winch

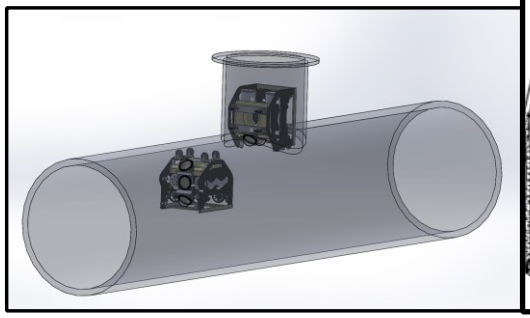


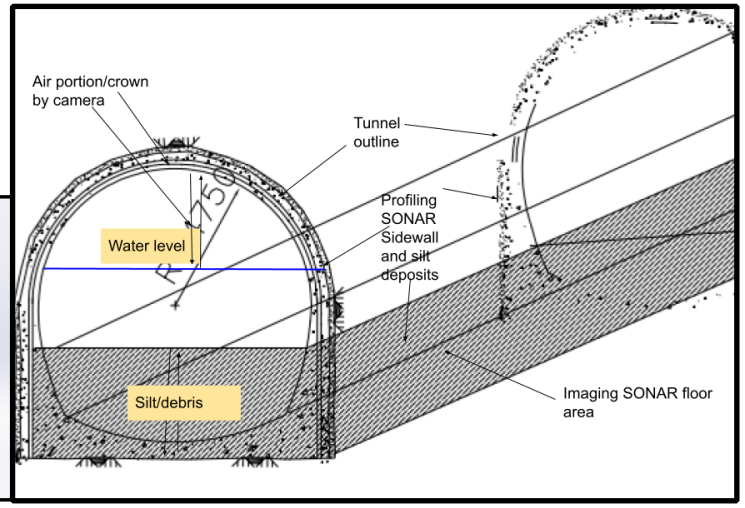
3D Profile of Tunnel

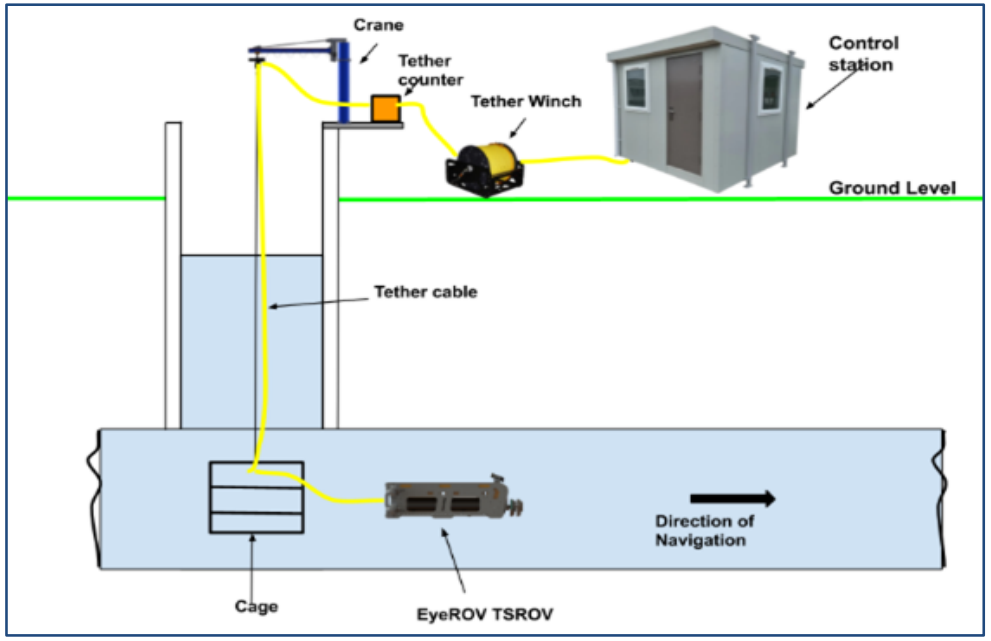
Inspection Methodology

- ROV will dive from the water surface by efficiently utilizing the openings.

  ROV will then follow a “LAWN MOWER” pattern along parallel surveying lines appropriately spaced for maximum coverage and overlap of images.





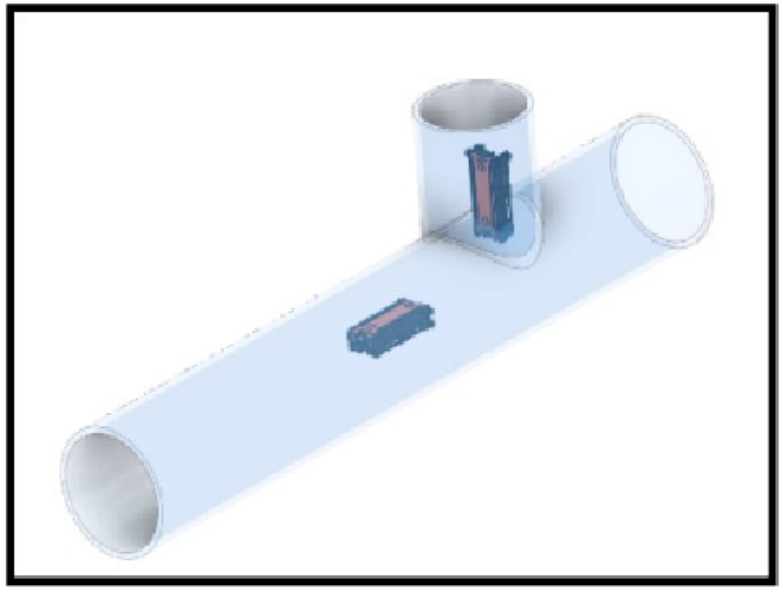


Inspection Methodology

- Control station setup can be done in a nearby vehicle/ ground close to ROV entry point as per site conditions

Vehicle housing the control station

Platform build for Tunnel Survey

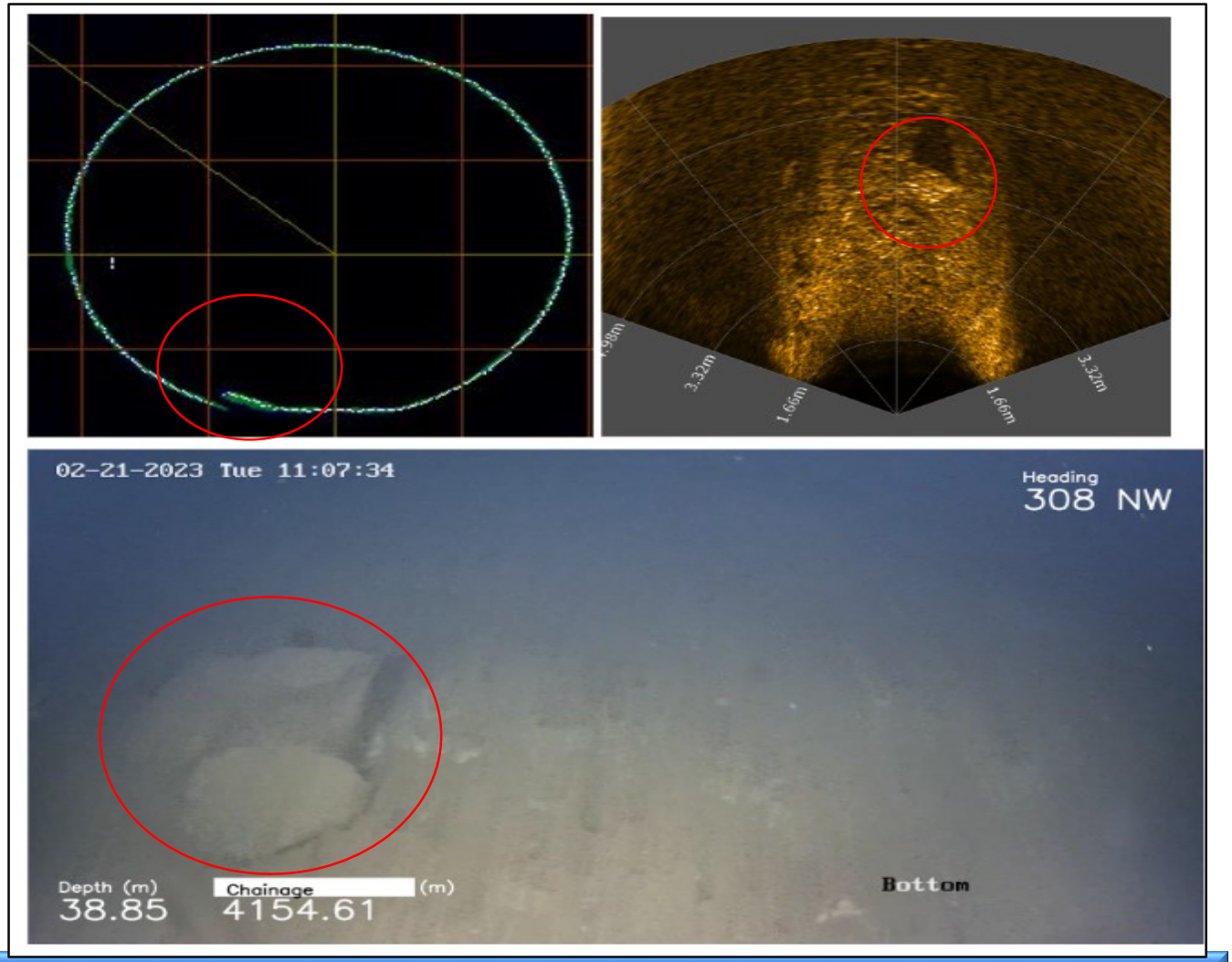


ROV Traversing through the Tunnel

Data Collected from Tunnel Survey

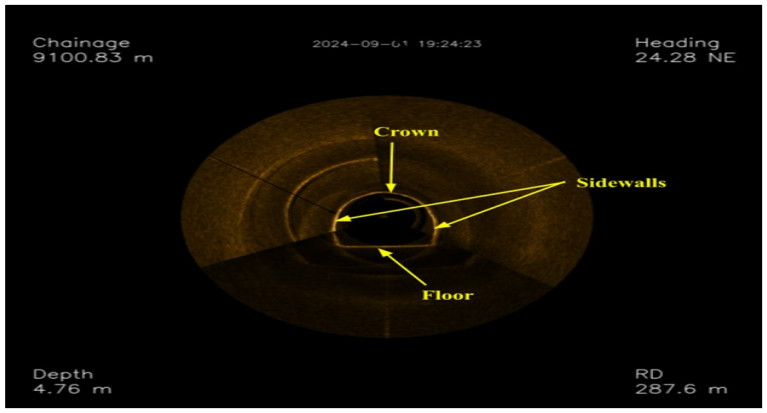
- SONAR Imagery and Profile of the entire tunnel
- HD Videography and photography of

  Areas of interest
- Simultaneous feed from the imaging SONAR, Profiling SONAR and camera

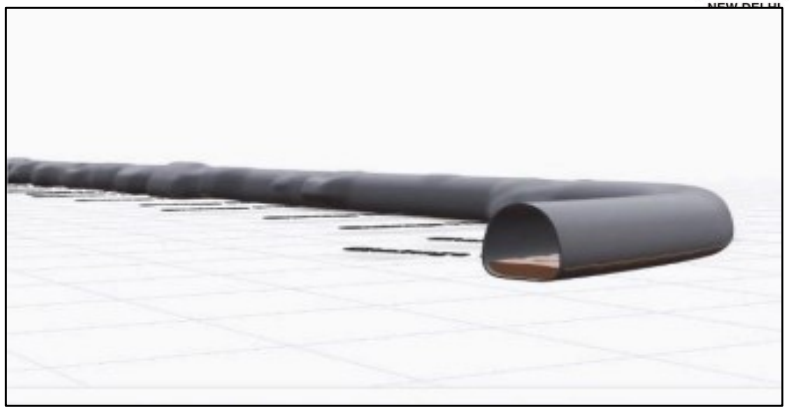


Deliverables after Tunnel Survey

Point cloud data of tunnel

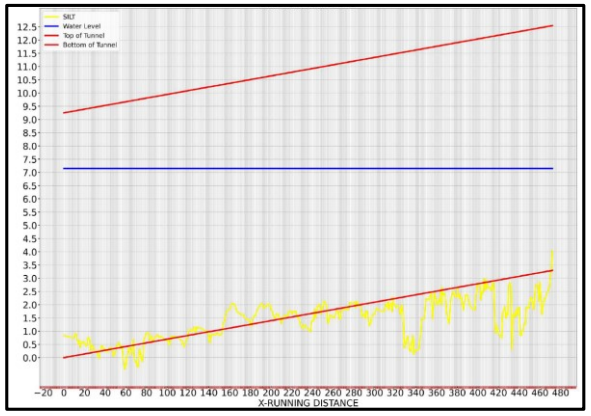


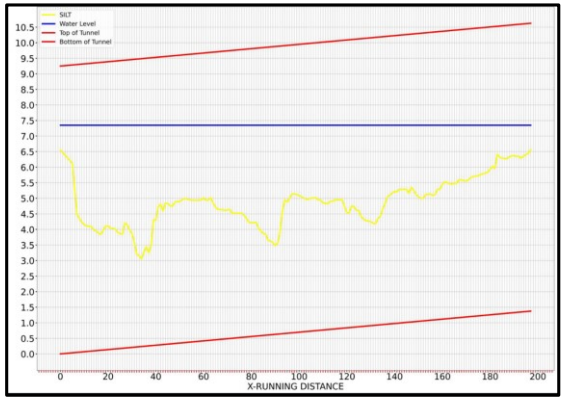
Acoustic SONAR image of Tunnel with marking of Crown, Floor and Sidewalls



3D Model representation of the tunnel

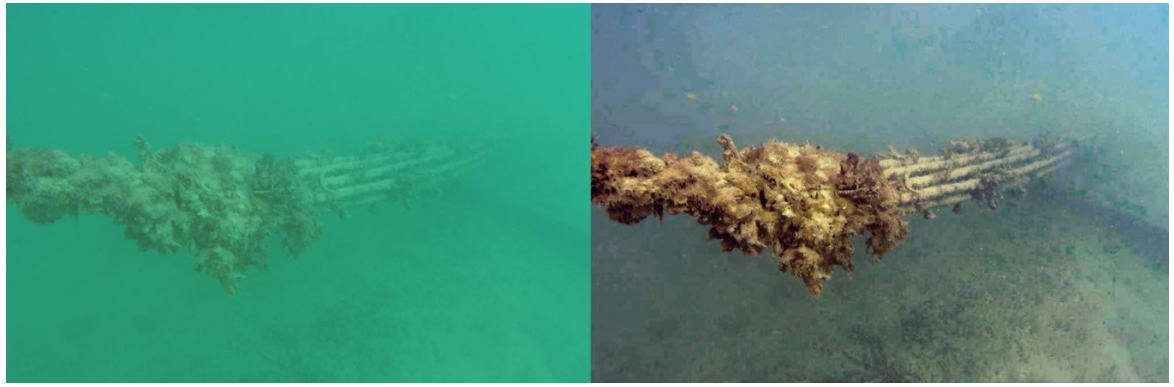
Tunnel Siltation Profile





Digital Reporting Platform

- Digital Reporting
- Automatic Detection of defects powered by AI/ML
- Analytics Report based on criticality
- Enhancement of images in hazy/turbid waters
- 3d model of the structure



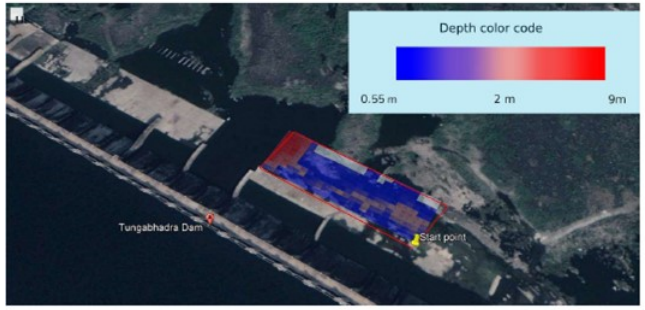
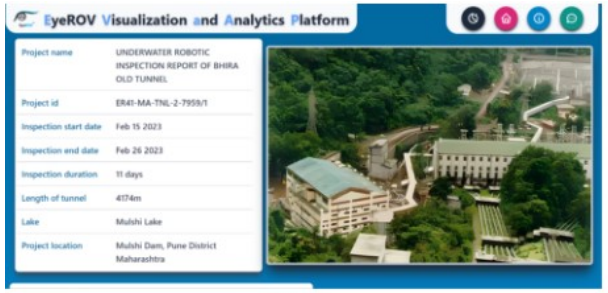
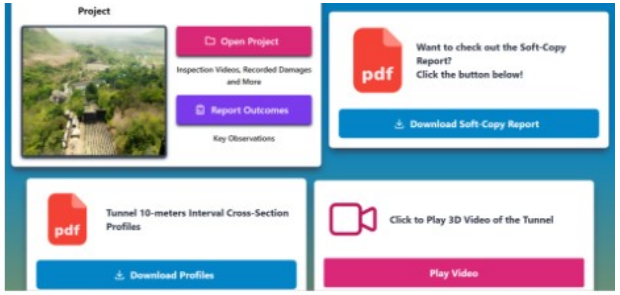


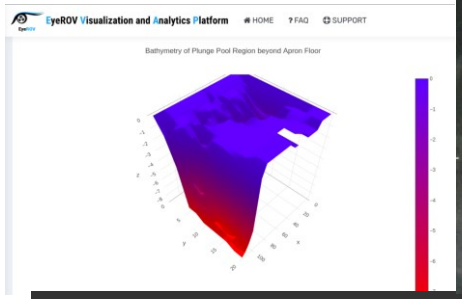
Fig. 2.104 Bathymetry of plunge pool region

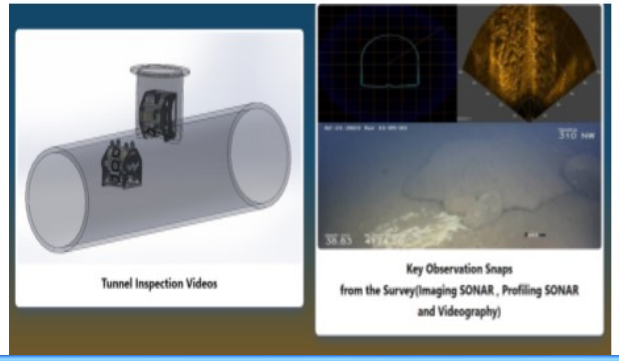
Original/Raw Data

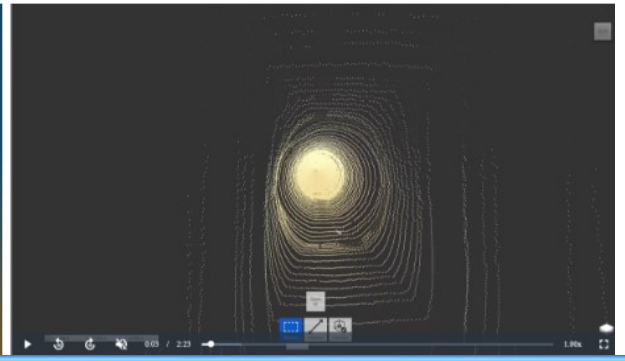
Enhanced

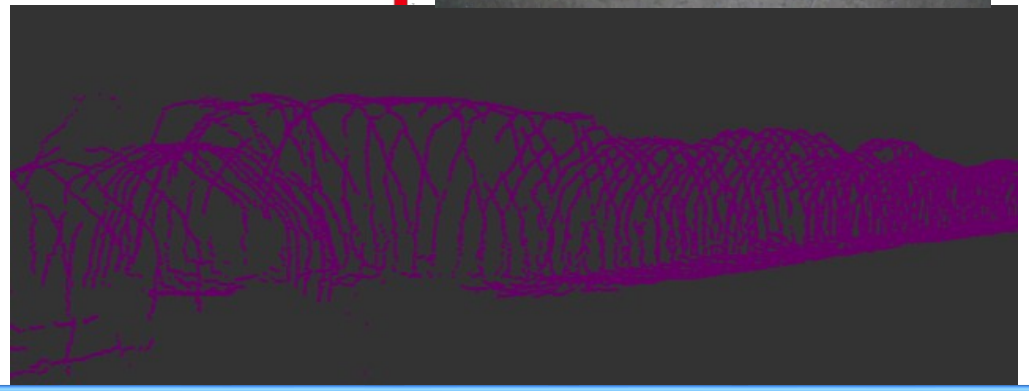




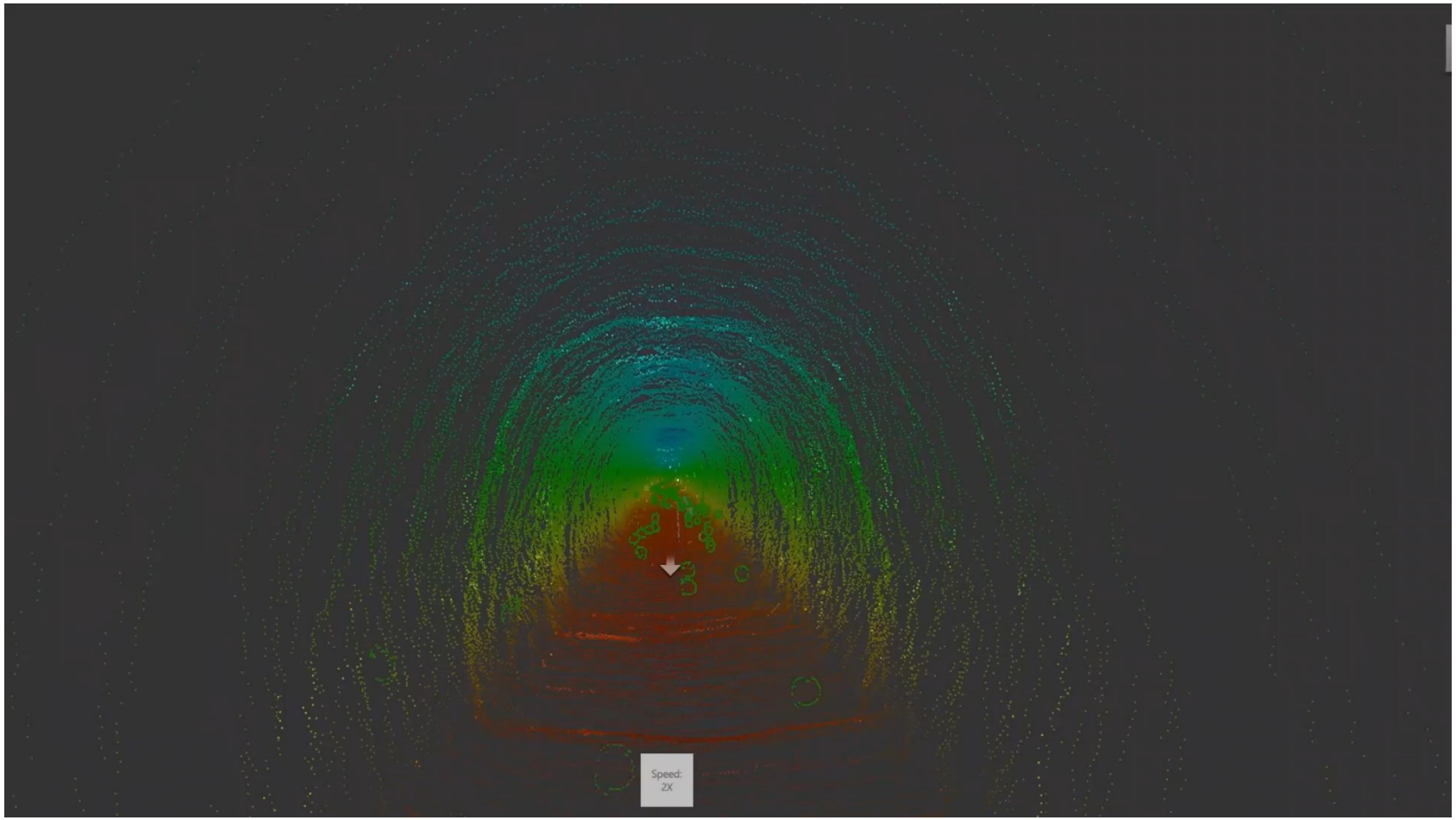








Sample Output



Case Study 5th January, 2026

UMIAM TUNNEL INSPECTION

Client

MePGCL

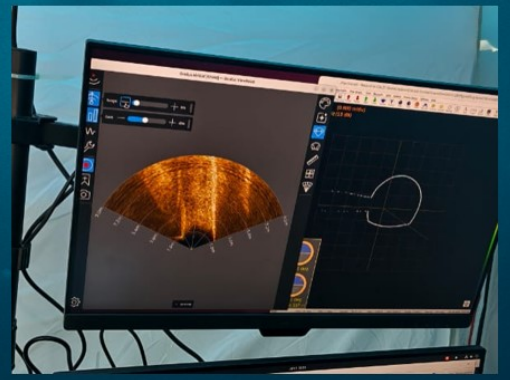
Generating Clean And Green Energy

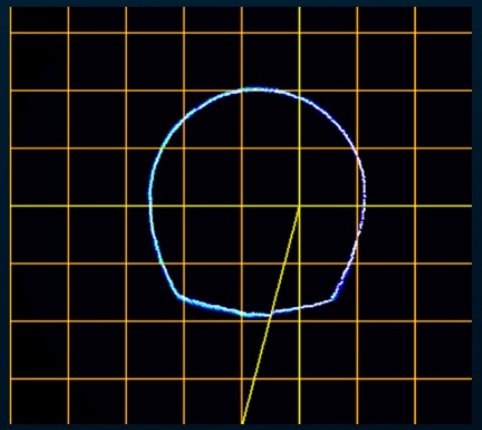
Location

Meghalaya

No of Days

2





Scope of work

- To carry out ROV -based underwater inspection to capture the internal Profile of the Head Race Tunnel (2078.76m long, 3.05m diameter and Horse shoe shape) by using Profiling SONAR, Imaging SONAR, and Camera to clearly understand the tunnel interior, with specific attention to any anomalies/damages observed.

Equipment used

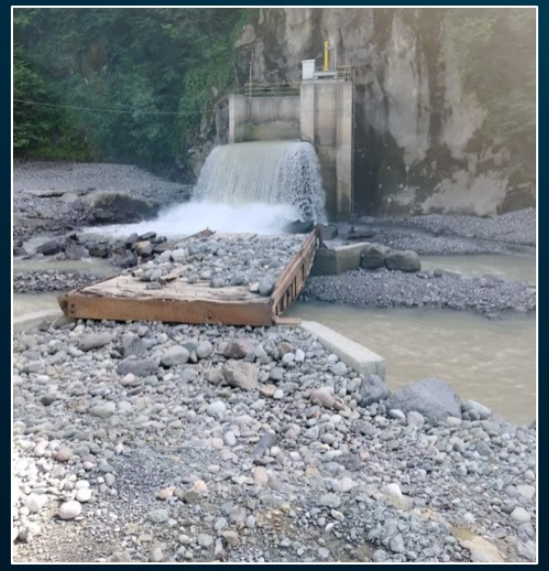
- EyeROV TSROV with high definition cameras and specialised sonar payloads like imaging sonar, Profiling Sonar and DVL were employed for the mission.
- Additional Resources such as Man Powers, Tether, Electronic Hardware were used.

Result

- Profile of the tunnel was captured using Imaging Sonar and videography of tunnel interior using camera were collected
- Consolidated findings in Hard and Soft Copy Reports and transferred to Relevant Authorities

Case Study 01 September, 2024

SKHALTA TUNNEL INSPECTION



Client

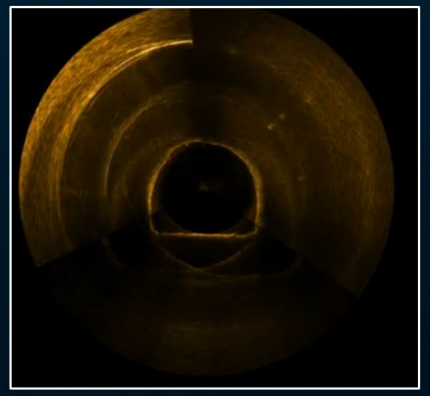
AGL

Location

Georgia

No of Days

4



Scope of work

- To conduct underwater survey of the 9 km Tunnel interiors.
- Provide profile of the entire tunnel and tunnel 3d model.
- Siltation condition inside tunnel

Equipment used

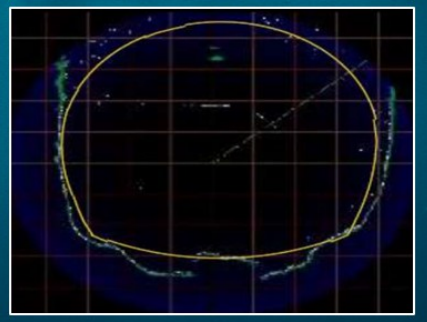
- EyeROV TSROV with high definition cameras and specialised sonar payloads like imaging sonars, DVL were employed for the mission.
- Additional Resources such as Man Powers, Tether, Electronic Hardware were used.

Result

- Profile of the tunnel was captured using Imaging Sonar and videography of tunnel interior using camera were collected
- Consolidated findings in Hard and Soft Copy Reports and transferred to Relevant Authorities

Case Study 14 December,2022

SUBANSIRI DAM DIVERSION TUNNEL INSPECTION



Detailed Report:Link

Client

BGS-SGS-SOMA-JV

Location

Assam

No of Days

3 Days

Scope of work

- To conduct ROV based Underwater survey of Diversion Tunnels to identify the blockages/ anomalies
- To capture Profile of the Diversion Tunnels by using Profiling SONAR, Imaging SONAR and camera to clearly understand the tunnel interior, with specific attention to any anomalies/damages observed.

Equipment used

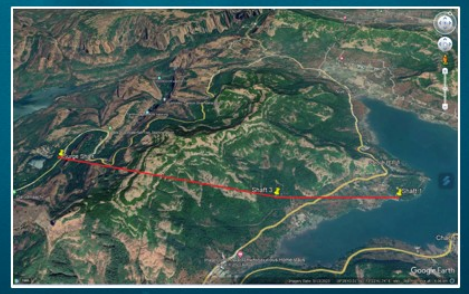
- ROV EyeROV Tuna with high definition camera, lasar scaler and specialised sonar payloads like imaging sonar and profiling sonar was employed for the mission.
- Additional Resources such as Generator, Man Powers, Tether, Electronic Hardware were used.

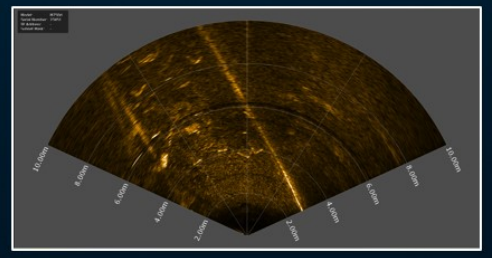
Result

- Profile of the tunnel was captured using profiling sonar,Imaging Sonar and videography using camera were collected.
- Defect mapping and observation of critical defects were done.
- Siltation profile of the tunnels were created using SONAR data

Case Study 15 February,2023

MULSHI DAM - DAWADI TUNNEL ROV INSPECTION





Client

TATA POWER

Location

Pune, Maharashtra

No of Days

11 Days

Detailed Report: Link

Scope of work

- To conduct underwater survey of Tunnel interiors.
- Provide tunnel interior photography , profile of the entire tunnel and tunnel 3d model.

Equipment used

- ROV EyeROV Tuna with high definition camera and profiling sonar and imaging sonar.
- Special OFC cable for coverage of 2km

Result

- Profile of the entire tunnel was captured.
- Employed Image Processing tool such as EVAP (our Inhouse Enhancing Tool) for enhancing RAW Images.
- Consolidated findings in Hard and Soft Copy Reports were made

Conclusion

- ROVs transform inspection of hydropower tunnels and underwater assets.
- Enable safer, faster, and more reliable assessments.
- Support climate resilience and long-term asset sustainability.
- A future-ready approach to infrastructure management.


Thank You
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