SATLAB®
GEOSOLUTIONS

Case Study

*Precision Bathymetry in Vertical Canyons with **HydroBeam M4***

Project Background

A narrow river winds through a dramatic canyon, its steep, near-vertical rock walls rising sharply on either side. Water depths fluctuate unpredictably—from shallow 1-meter patches to deep 20-meter pools—creating a challenging and dynamic underwater landscape. For the local hydropower plant, having an accurate understanding of this terrain isn't just a technical task—it is critical for operational safety. **Traditional surveying tools struggle to obtain reliable measurements along such near-vertical canyon walls, leaving gaps in the data and increasing risk.**

Figure 1: Hydropower Plant

To overcome these challenges, the project team deployed the **HydroBeam M4 multibeam echo-sounder,** designed specifically for high-precision hydrographic surveys in complex and vertical underwater terrains.

Challenges Beneath the Surface

Surveying a canyon like this presents multiple obstacles:

- **Tight confines:** some river sections measure less than 20 meters wide.
- **Vertical walls:** extreme slopes create beam distortion and unpredictable acoustic reflections.
- **Variable depths:** rapid depth changes challenge measurement stability.
- **Acoustic anomalies:** multiple reflections between canyon walls, riverbed, and water surface can produce noisy or misleading data.

Figure 2: Vertical Rock Walls on Both Sides of the River Channel

Deploying the Solution

The project team relied on the **HydroBeam M4**'s advanced capabilities to tackle these challenges head-on:

Figure 3: HydroBeam M4 Multibeam Echosounder

- **150° swath** coverage for extended side-wall data acquisition
- **1024 beams** providing dense, high-resolution bathymetric point clouds
- **Vertical Terrain Algorithm** ensures stable measurements on steep slopes and vertical walls.
- **Integrated GNSS, IMU, and SVS** simplify installation and allow precise positioning and motion compensation

Data Acquisition Workflow

1.Survey Line Planning

- Parallel survey lines with ≥30% overlap to ensure full coverage
- Calibration measurements gathered at key terrain spots

2.Field Survey

- Small manned survey vessel equipped with **HydroBeam M4**
- Sound velocity profiles measured in multiple locations to correct for sound propagation variations

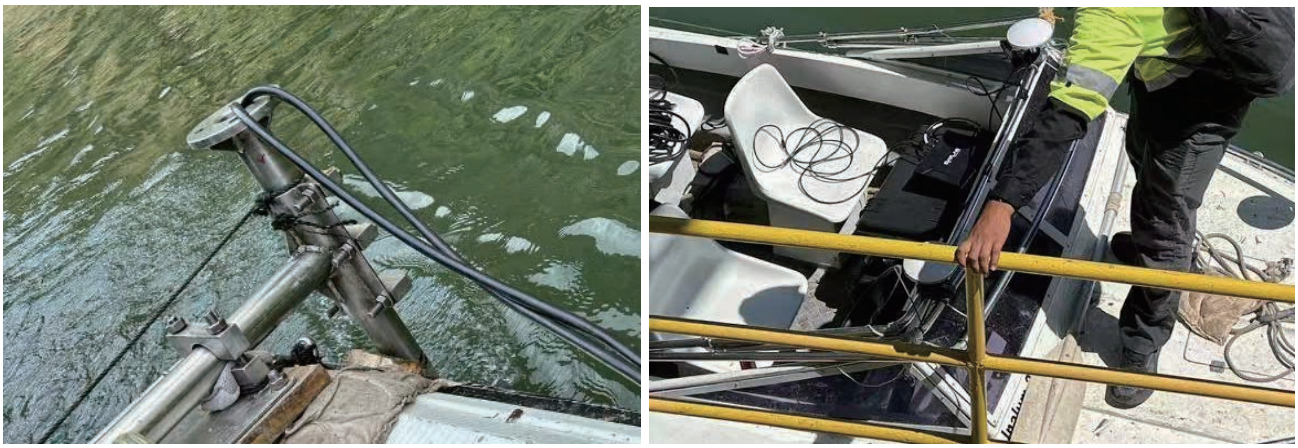

Figure 4: HydroBeam M4 Installed on Small Manned Survey Vessel

3.Real-Time Acquisition

- **HydroBeam Monitor software** automatically adjusts system parameters to ensure stable data.
- **SLHydro Survey software** collects the data and provides real-time visualization.

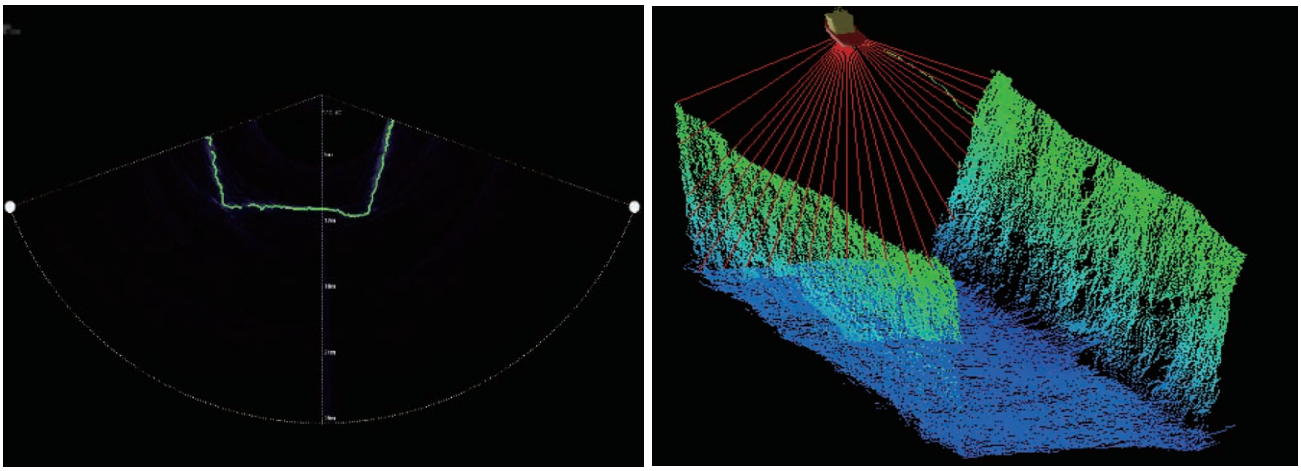

Figure 5: Real-Time Data Visualization

Data Processing

◎Software:

SLHydro Survey used for post-processing

▶**Data Integration:** GNSS, IMU, and multibeam measurements merged with calibration parameters

▶**Noise Filtering:** Removal of anomalous or erroneous depth points

▶**Output:** High-resolution 3D underwater point clouds, contour maps, and cross-sectional profiles suitable for engineering analysis

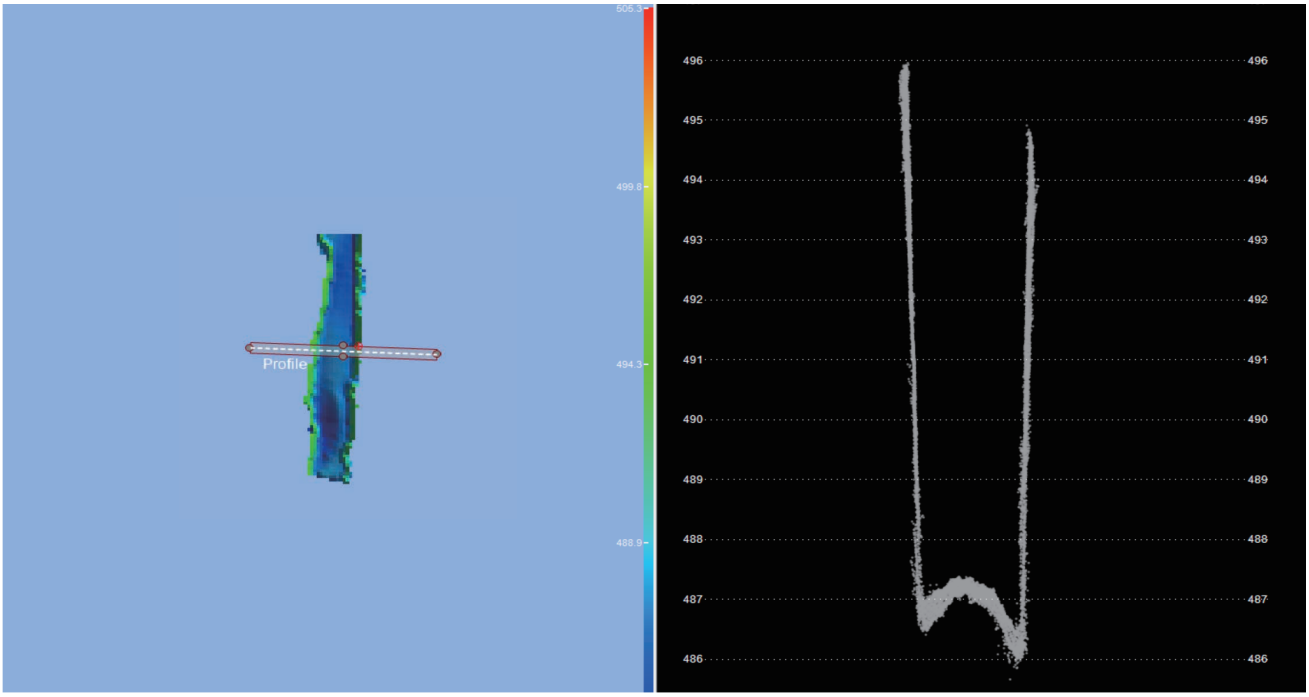

Figure 6: Post-Processing of Survey Data

Deliverables

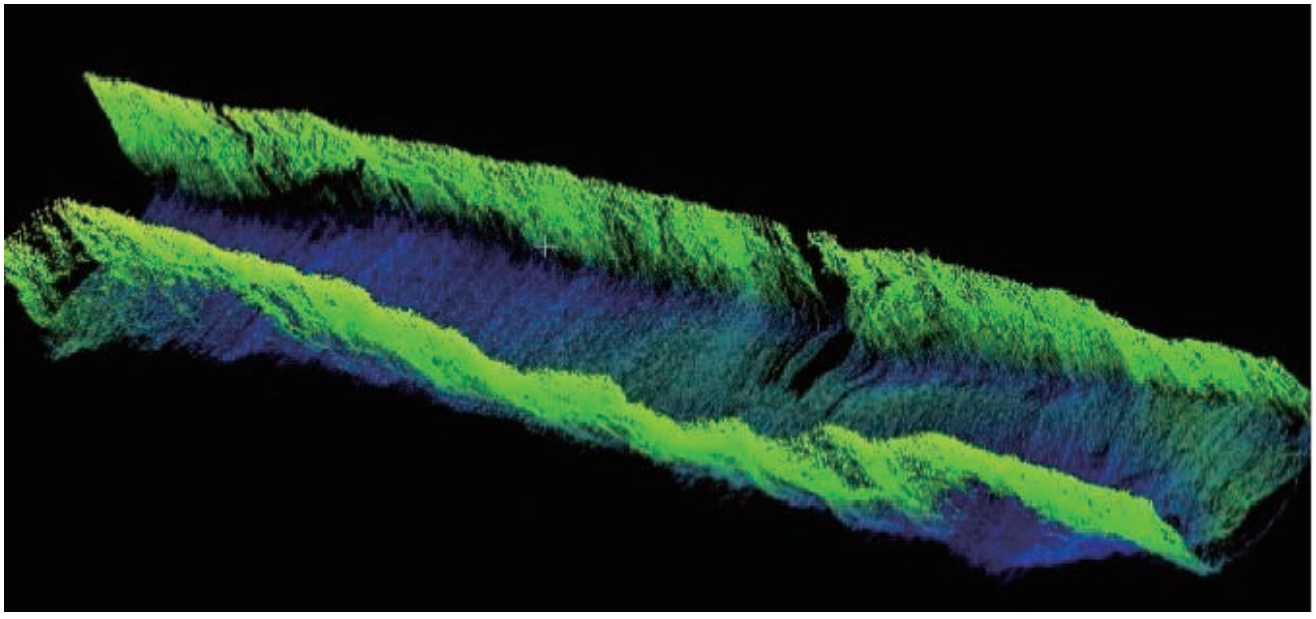

Figure 7: 3D Underwater Point Cloud Visualization

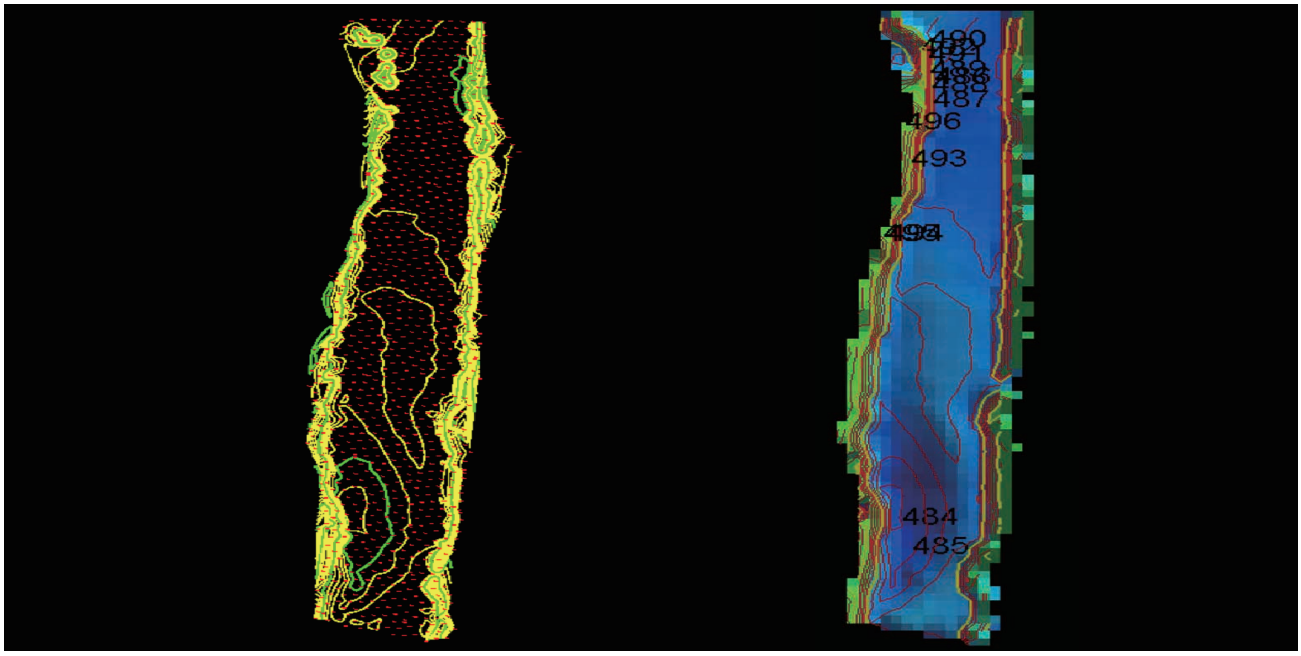

Figure 8: Bathymetric Contour Map

The canyon survey demonstrates that the HydroBeam M4, a modern, integrated, and portable multibeam echosounder, **delivers full-coverage, high-resolution bathymetry that meets IHO standards.** It provides reliable and precise data, enabling engineers and operators to make confident decisions while demonstrating advanced capabilities in hydrographic surveying.

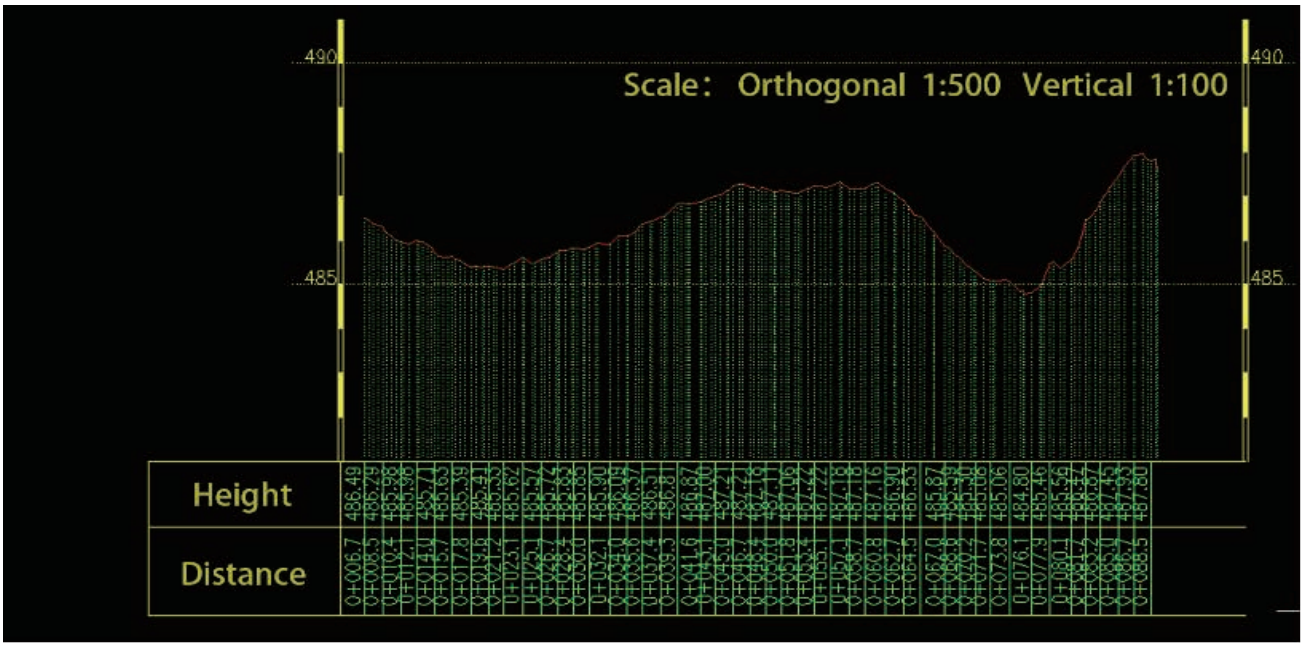

Figure 9: River Cross-Section Profile

Project Outcome

The **HydroBeam M4 multibeam echosounder** successfully transformed a complex vertical canyon survey into a **precise, efficient, and reliable operation**. Beyond delivering high-resolution, full-coverage bathymetry, it empowers engineers and hydropower operators to make informed decisions with confidence, redefining standards for hydrographic surveying in challenging environments.