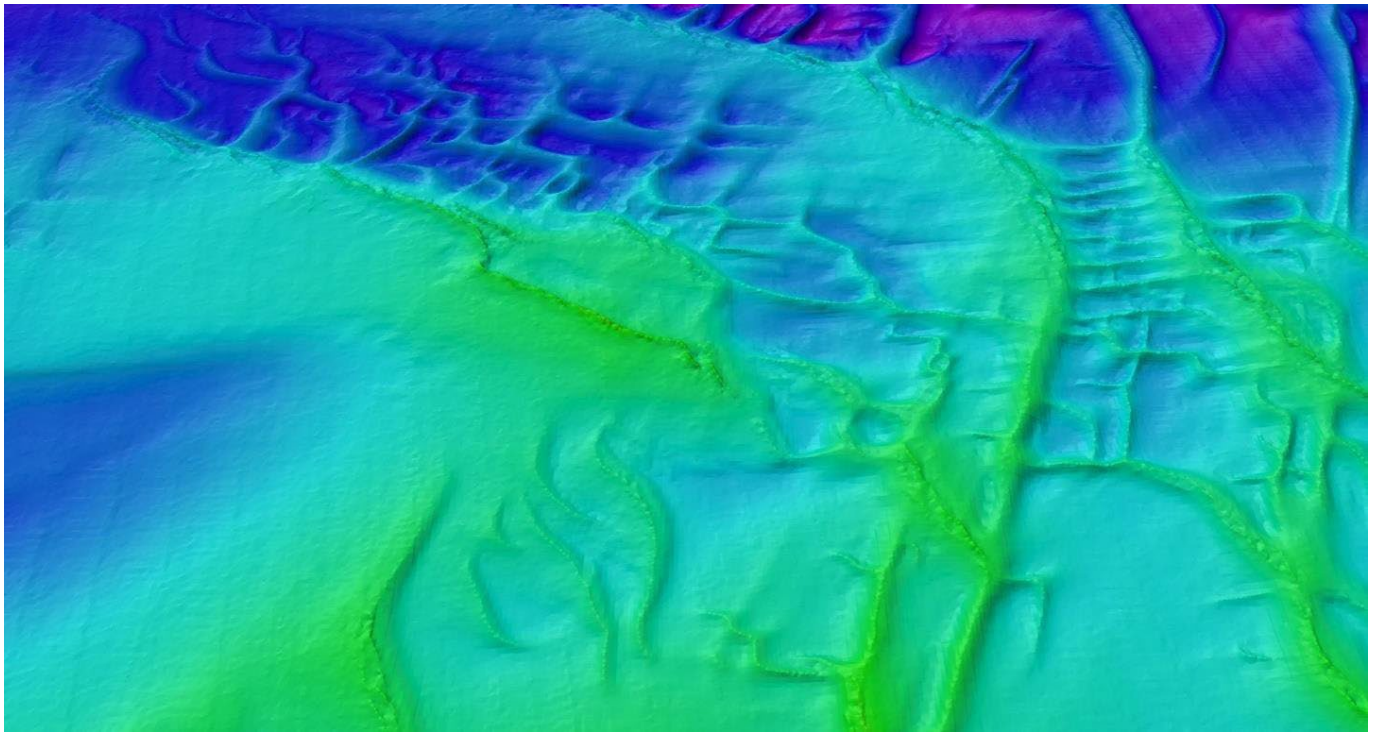
FACT SHEET: Hydrographic Surveying

Mapping the Seabed

Mapping the seabed, or hydrographic surveying, is a complex task. Unlike land surveying, surveyors cannot directly observe the area being measured. Surveys are conducted from a vessel operating on a moving sea surface, often in hazardous conditions such as rocks and shoals. These factors create significant technical challenges.



Seabed surveyed by multi-beam echo sounder

Measuring Depth

Hydrographic surveying primarily uses echo sounders to measure water depth. An echo sounder emits a sound pulse into the water and records the time taken for the signal to travel to the seabed and return. Depth is calculated using the speed of sound in seawater and the measured travel time.

Measured sound pulse travel time (echo sounder to seabed and back to echo sounder)	0.1 sec
Calculated sound pulse travel time (echo sounder to seabed) = 0.1 sec / 2	0.05 sec
Speed of sound in seawater	1500 metres / sec
Measured depth = 0.05 sec x 1500 metres	75 metres

Accuracy Considerations

Several factors influence measurement accuracy:

1. **Instrument Position**

   The echo sounder is mounted below the vessel's waterline, not at the surface. A correction must be applied to account for this offset. In shallow water, even small discrepancies can significantly affect navigation safety.

2. **Tides**

   Tidal variation has a major impact on depth measurements. In some regions, tidal range can exceed 8 metres.

   To ensure consistency, charted depths are referenced to a standard datum known as **Lowest Astronomical Tide (LAT)**. This represents a level that tides rarely fall below.

   To determine actual depth:

   - Add the predicted tide height to the charted depth.
   - For example:
     - Charted depth: 20 m
     - Tide height: 2 m
     - Actual depth: 22 m

   This information is critical for vessel access, particularly in shallow ports and constrained waterways.

3. **Positioning**

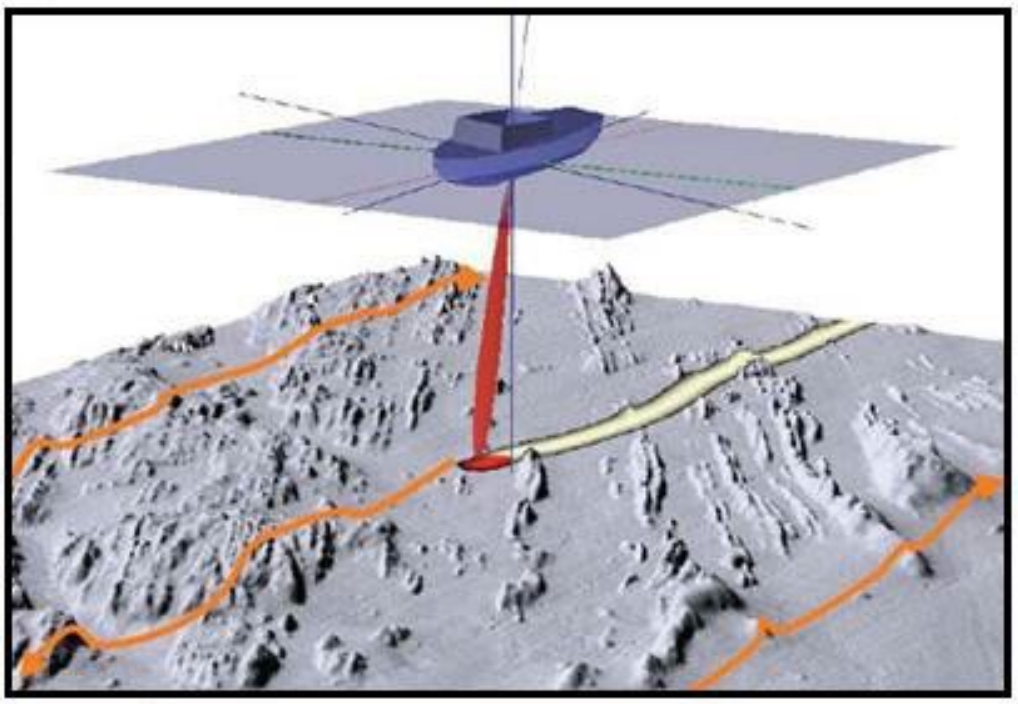
   Accurate positioning is essential in hydrographic surveys. Modern systems use GPS to achieve high positional accuracy. However, some older surveys, particularly those conducted before the 1930s, may have positional errors of several miles. These areas may still appear on charts with cautionary notes if not resurveyed.

Types of Echo Sounders

1. Single Beam Echo Sounders

Single beam systems transmit a sound pulse directly beneath the vessel. They are relatively simple and produce accurate depth measurements at a single point.

Coverage is achieved by navigating the vessel along parallel survey lines. The spacing between lines varies depending on water depth and survey requirements. In some remote areas, data coverage may be sparse.



Single beam echo sounder survey pattern

2. Multi-Beam Echo Sounders

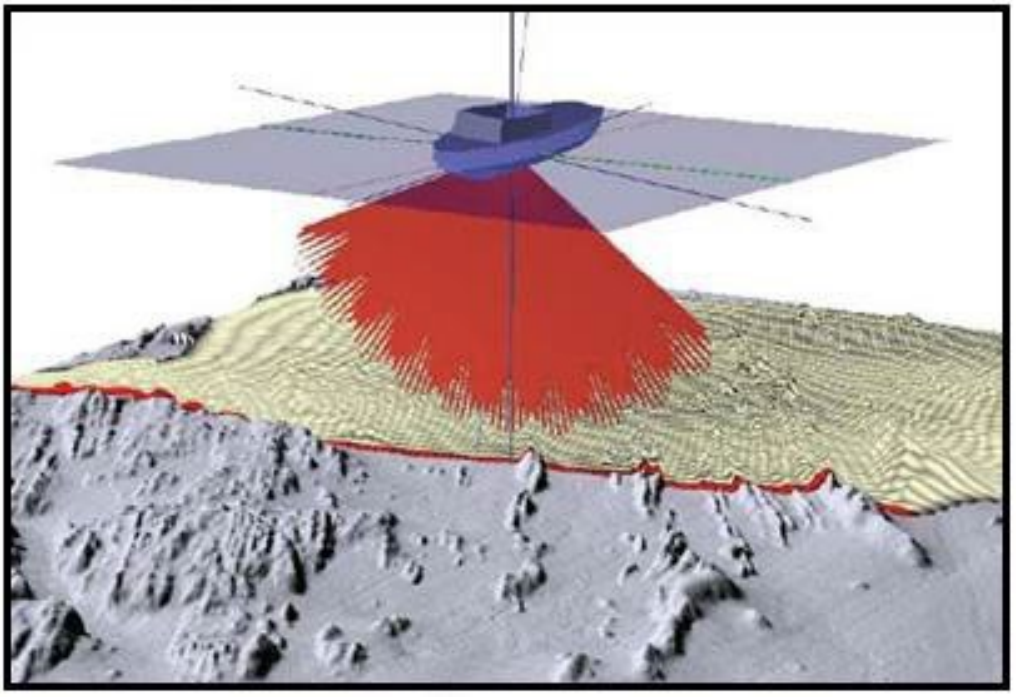
Multi-beam systems transmit multiple sound beams in a fan-shaped pattern, covering a wide area of the seabed in a single pass. These systems can survey a swath up to approximately eight times the water depth.

Advantages include:

- Greater coverage efficiency
- Improved detail of seabed features

Limitations include:

- Sensitivity to variations in sound velocity
- Greater susceptibility to vessel motion
- High data volumes requiring significant processing



Multi-beam echo sounder survey pattern

3. Airborne LiDAR

Airborne LiDAR is used for shallow water surveying, typically up to 50–70 metres depth. The system uses a laser mounted on a low-flying aircraft to measure depth by detecting reflections from the water surface and seabed.

Key characteristics include:

- Rapid data collection over large areas
- High sampling rates
- Limited depth penetration compared to acoustic methods

This technology has been used extensively in Australia, including by the Royal Australian Navy and commercial survey operators.

Summary

Hydrographic surveying integrates acoustic, positioning, and environmental data to produce accurate seabed maps. These maps are essential for safe navigation, maritime operations, and coastal management. Despite advances in technology, environmental variability and historical data limitations continue to present challenges.