

Deep Dive – Diagnosing and Repairing Underwater Problems on Hydraulic Structures

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Australian Water School Webinar Series

December 18, 2024



Who am I?

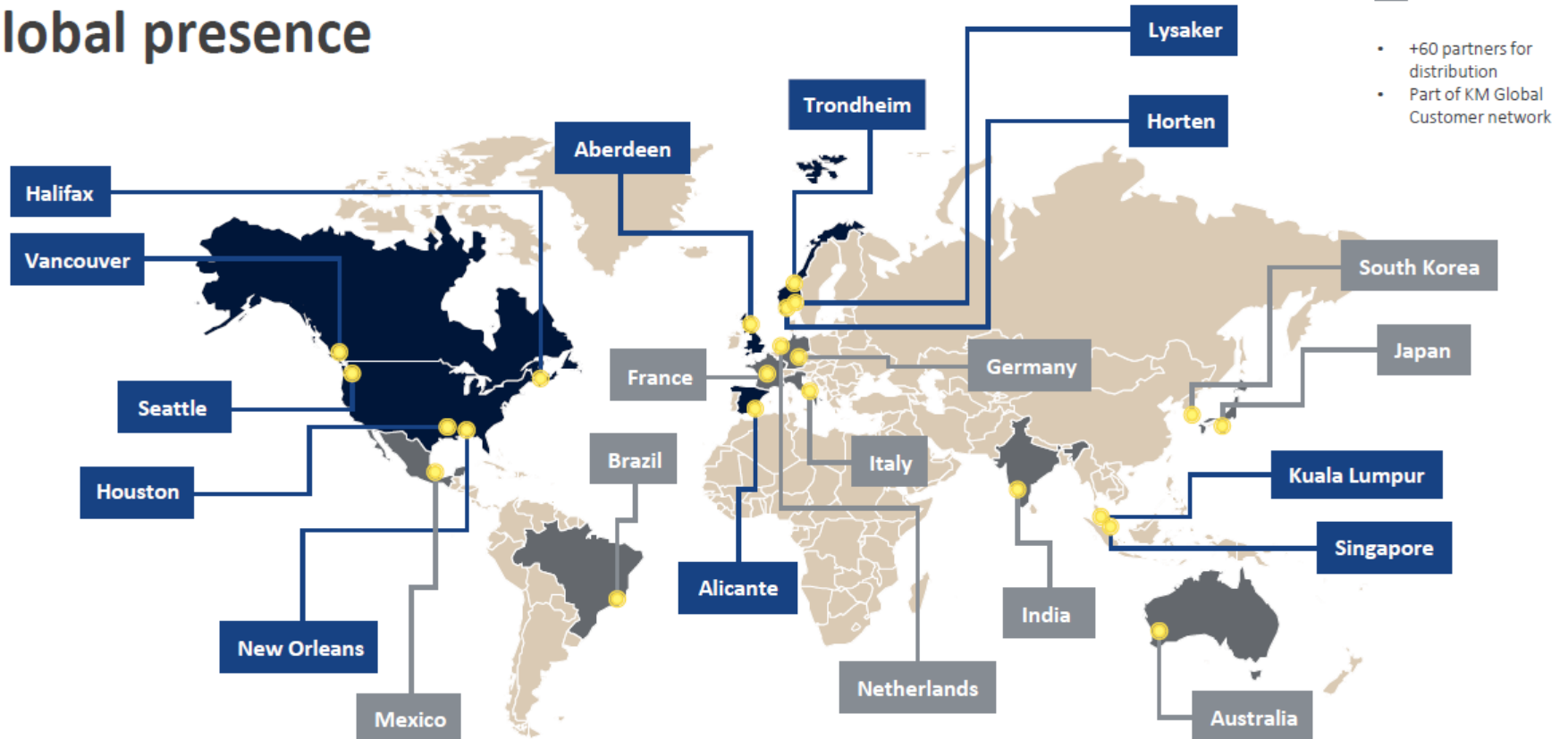
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(Coasts, Ports, Inland Waterways)

jessica.daignault@kd.Kongsberg.com

Cell: (425) 599-8217



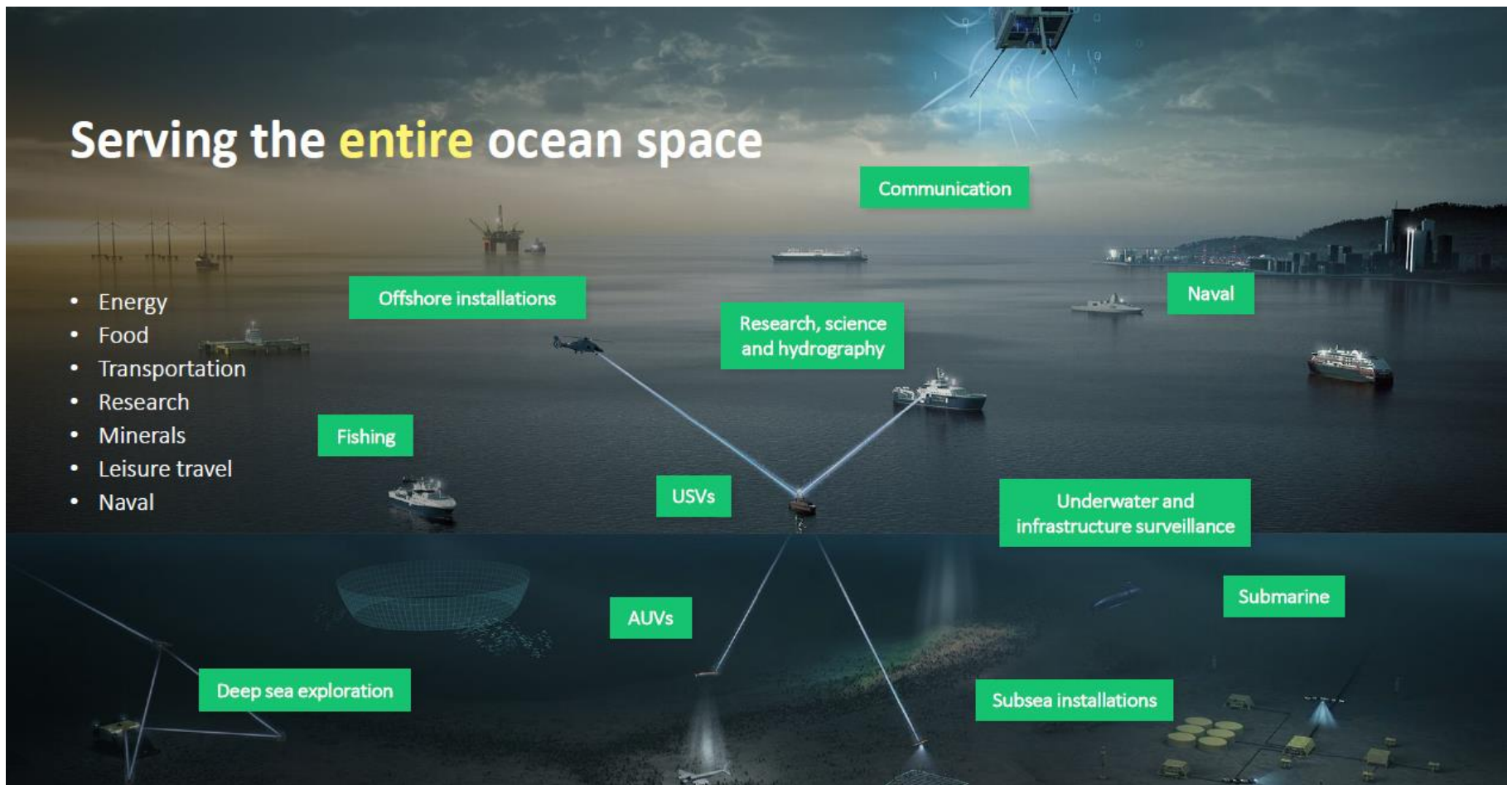
Global presence



See Statement of Proprietary information

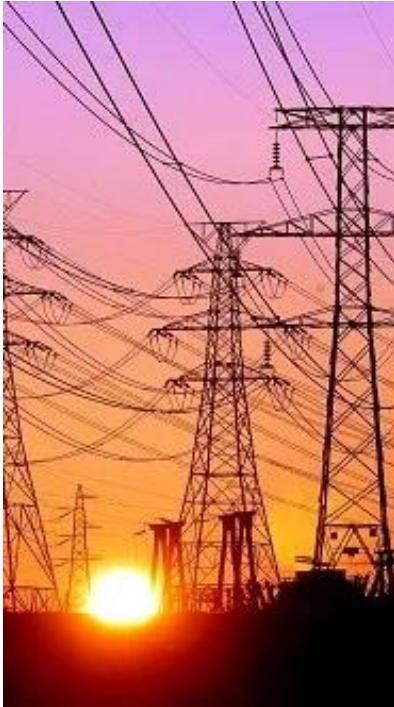
Serving the **entire** ocean space

- Energy
- Food
- Transportation
- Research
- Minerals
- Leisure travel
- Naval



See Statement of Proprietary information

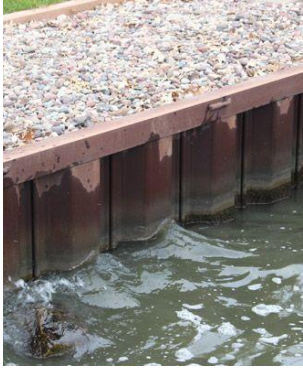
Critical Civil Infrastructure



Infrastructure is defined as critical if its incapacity or destruction has a significant impact on health, safety, security, economics, and social well-being of a state (Council directive 2008)

Coastal Infrastructure

Seawall



Prevents or alleviates overtopping and flooding of the land structures behind due to storm surges and waves

Breakwater



Reduces incoming wave energy, provides a sheltered beach area and shelters vessels from waves and currents

Bridge



Provides transportation connectivity to safely cross features such as waterways, railways, roadways, and other obstacles

Outfall



Discharges municipal or industrial wastewater, stormwater, combined sewer overflows (CSOs) into receiving water body

Causeway



Raises roadway that is often used to cross wetlands or bodies of water

Inland Waterway Infrastructure

Locks



Infrastructure that includes a watertight basin known as a lock chamber, which is used to raise or lower the water level as required.

Dams/Reservoirs



A dam is a large man-made structure built to contain water.

Tailings Ponds



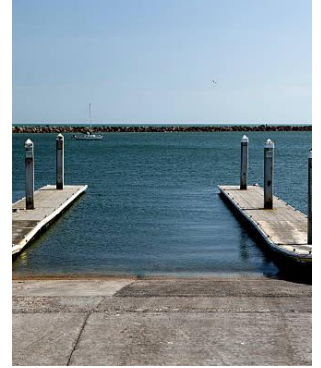
Engineered structure that stores tailing and process-affected water from mining operations.

Canals



An artificial waterway constructed to allow the passage of boats or ships inland or to convey water for irrigation.

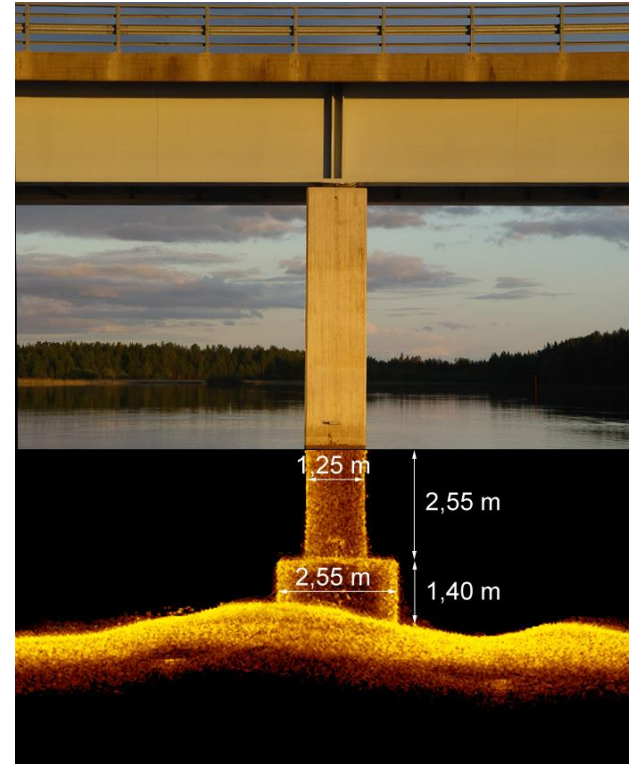
Boat Launch



An inclined concrete slab, set of pads, rails, planks, or other graded slope used for launching boats with trailers or by hand.

Inspections for underwater structures

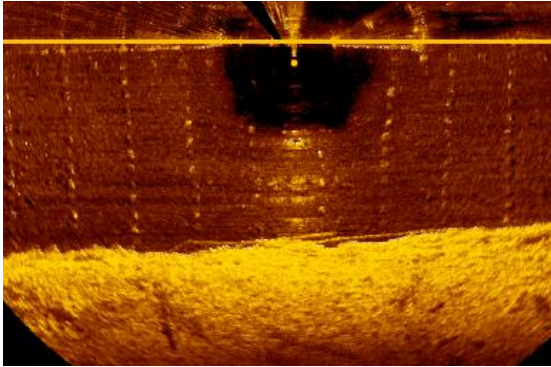
- Need for inspection
 - Waterfront structures are ageing
 - Reduce vulnerabilities in critical infrastructure systems
 - Post-damage assessment
- Challenges with traditional / diving inspections
 - High current
 - Low visibility
 - Large areas
 - Accurate reports



*Data courtesy of Brian Abbott

Coastal/Underwater Infrastructure Building Materials

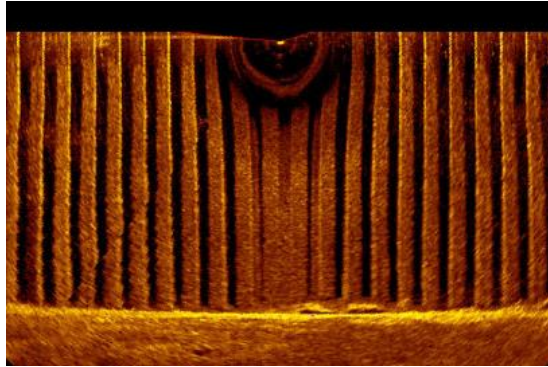
Wood



Wood Timber Wall



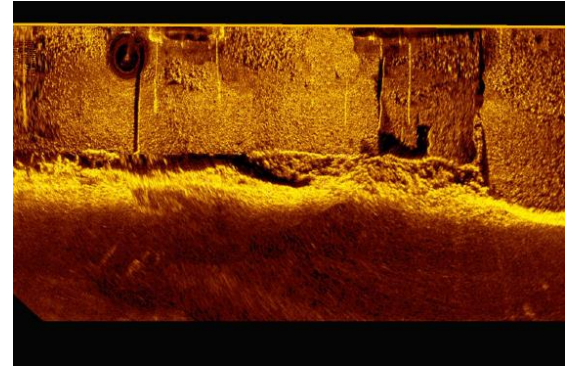
Steel



Sheet Pile Wall



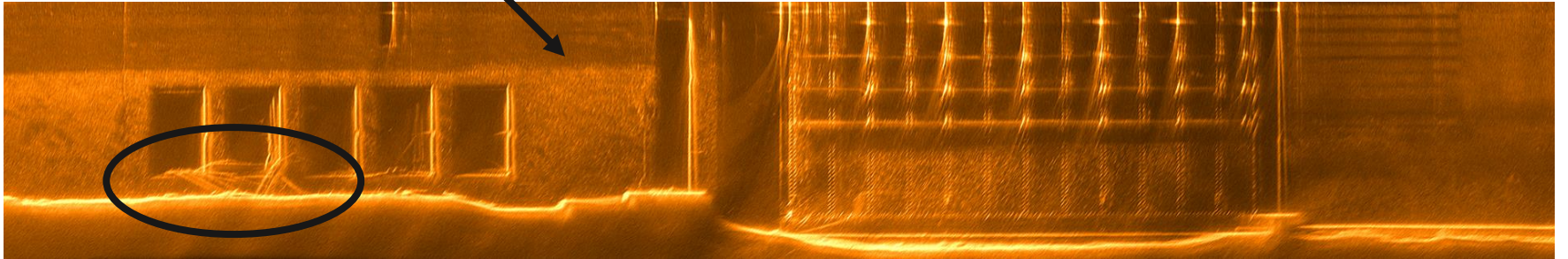
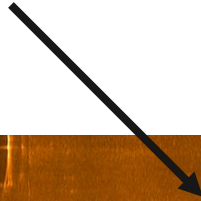
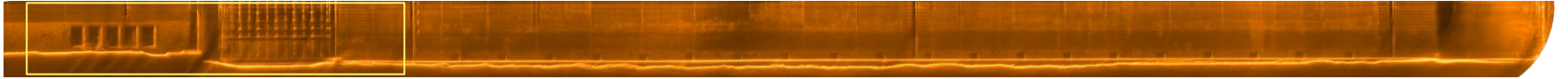
Concrete



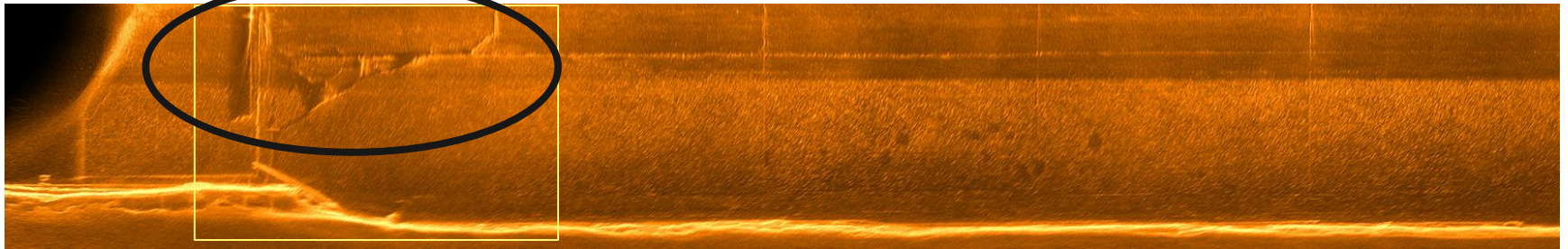
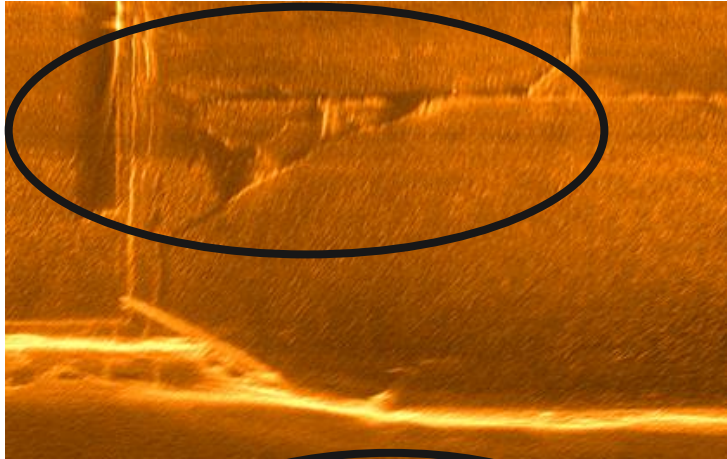
Concrete Wall



Lock Infrastructure Inspection



Ship Strike Damage Inspection



Multibeam Imaging Bridge Inspection

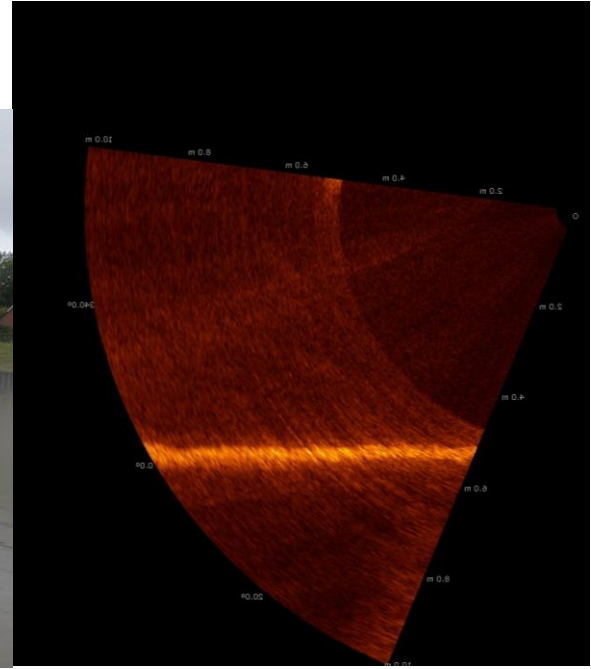
Für lebendige Wasserstraßen



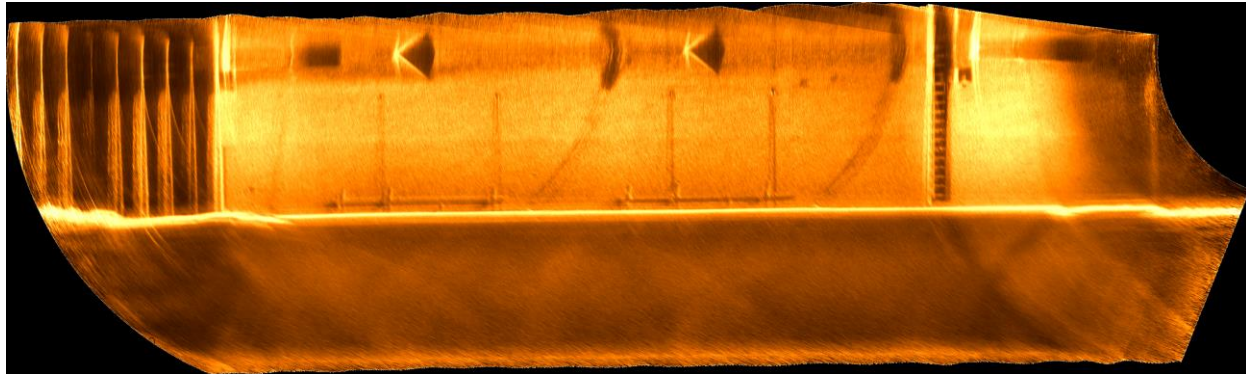
Luftbild Ostesperrwerk



Multibeam Imaging Bridge Inspection



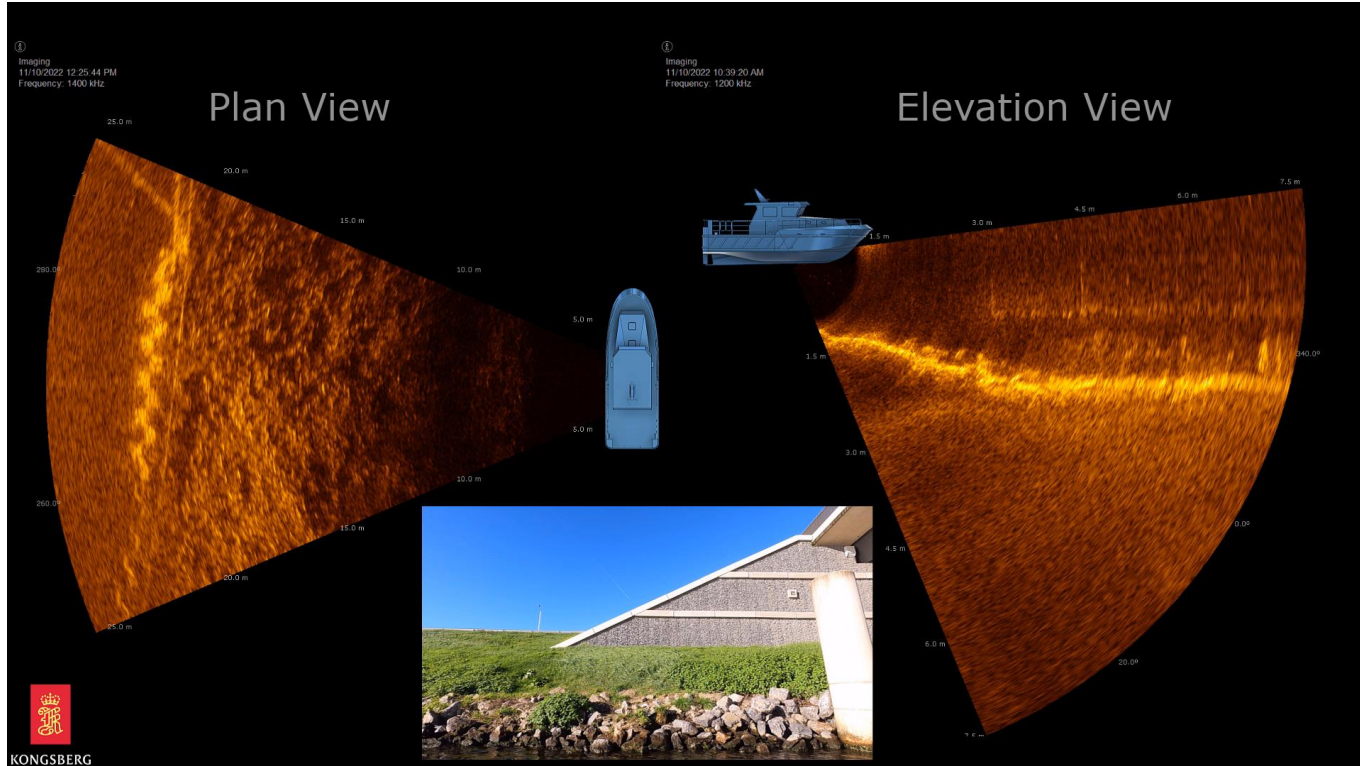
Multibeam Imaging Bridge Inspection





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Flood Barrier Inspection

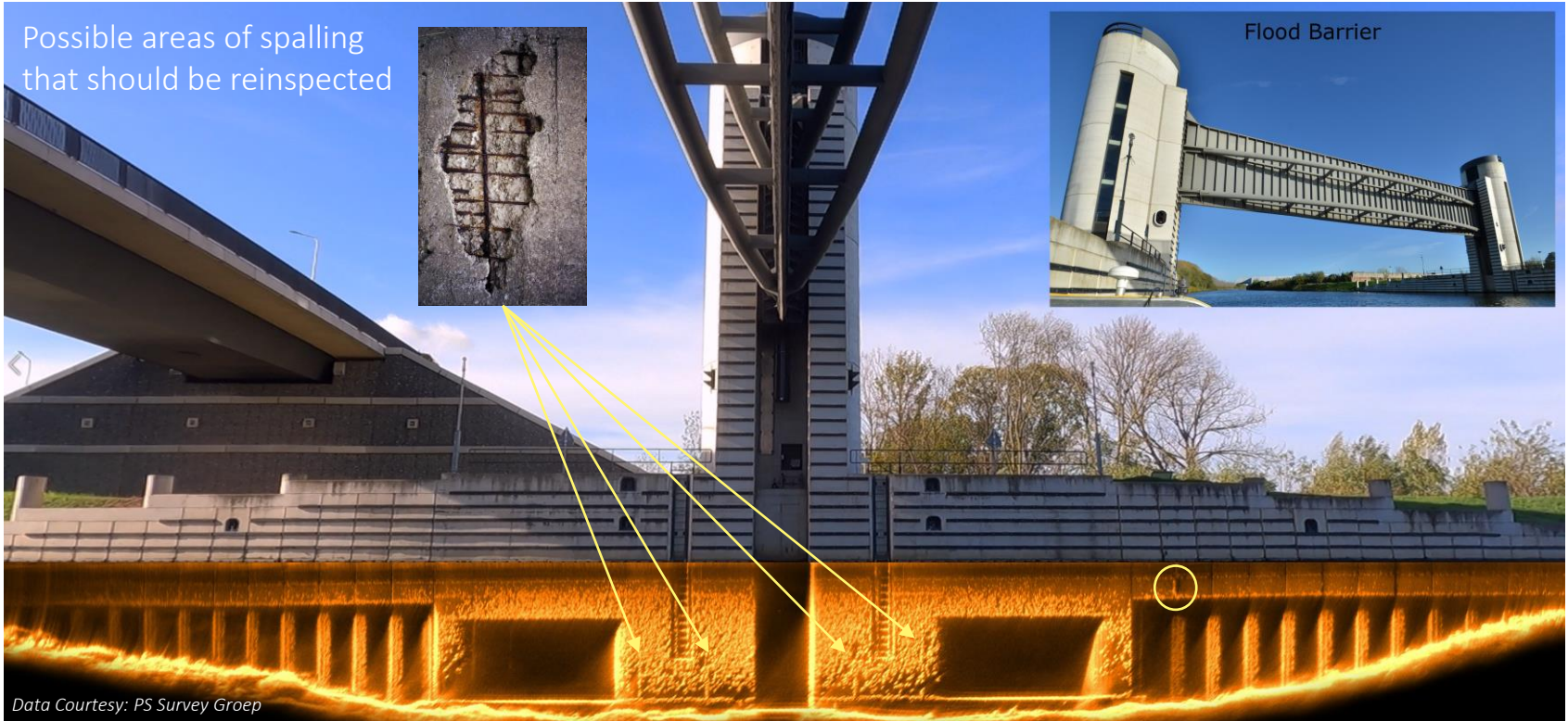


WORLD CLASS – Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary information

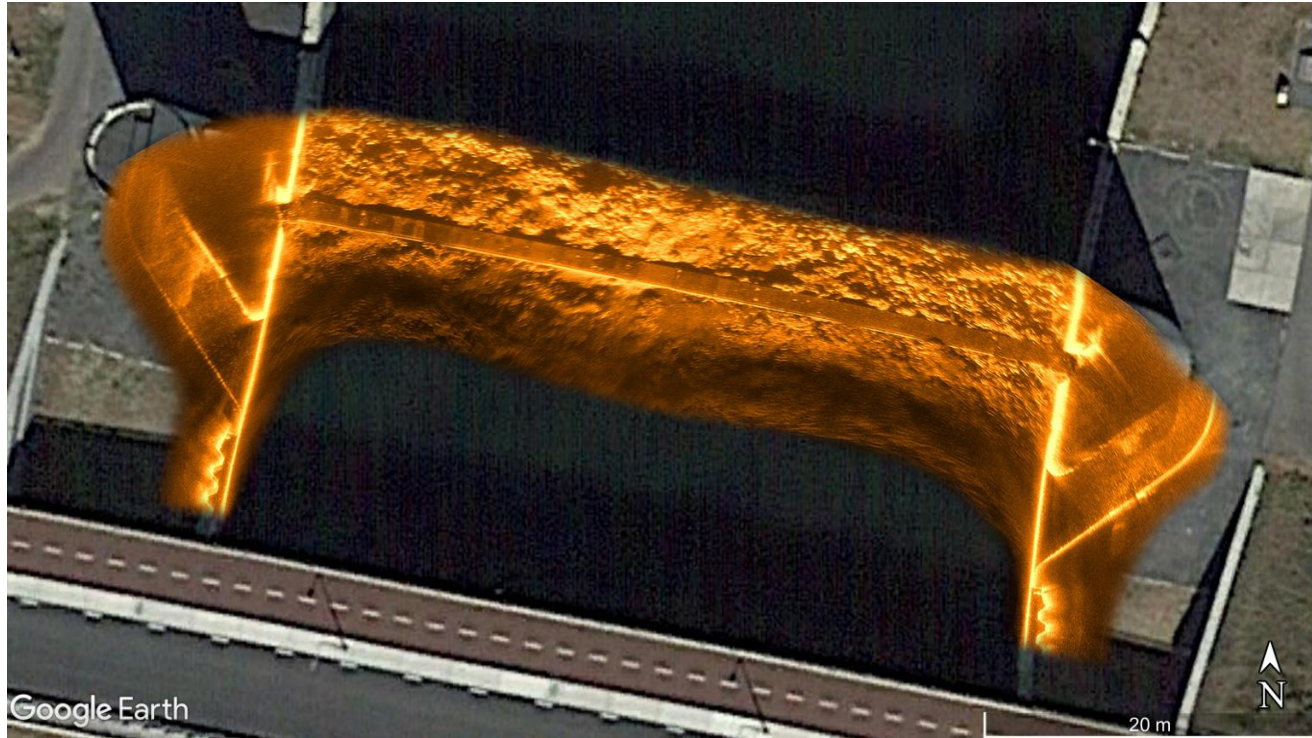
Flood Barrier Inspection

Possible areas of spalling that should be reinspected

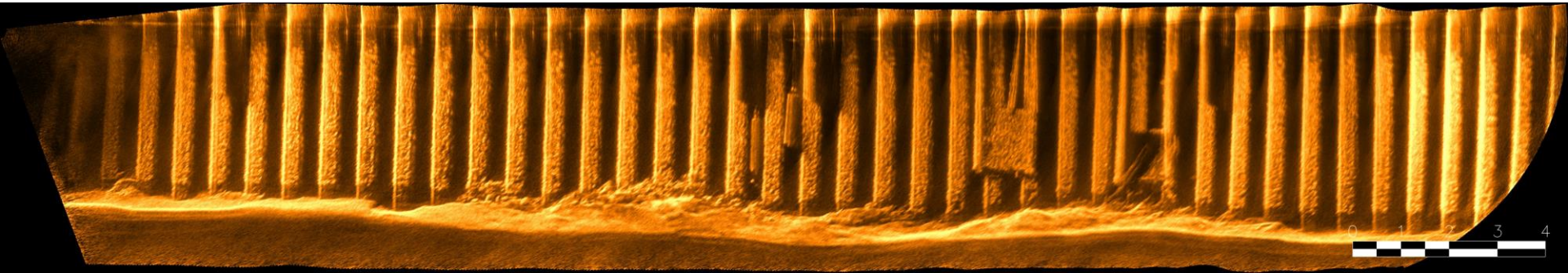
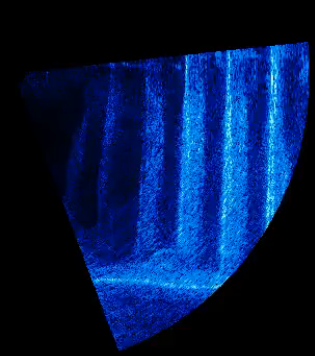


Data Courtesy: PS Survey Groep

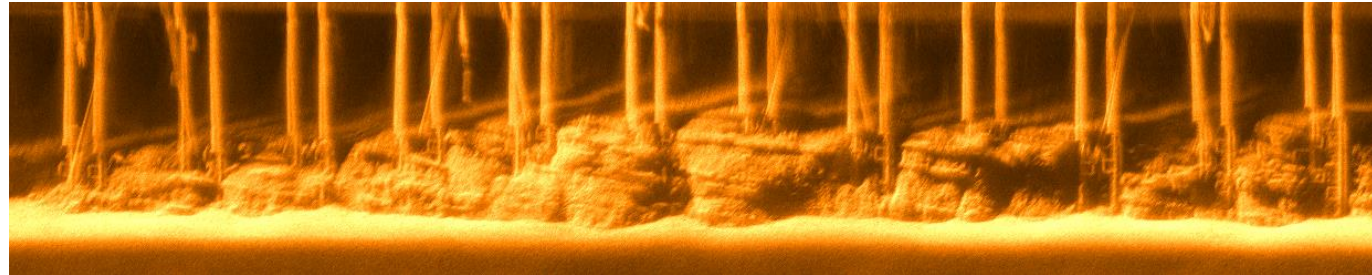
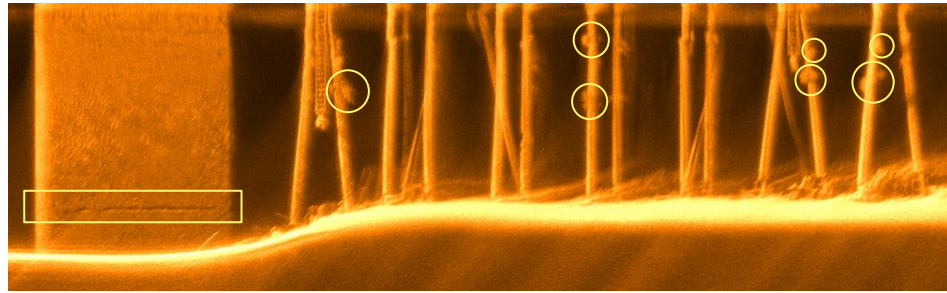
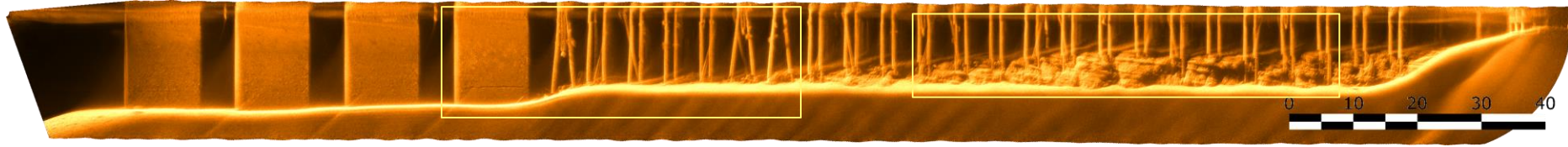
Flood Barrier Inspection



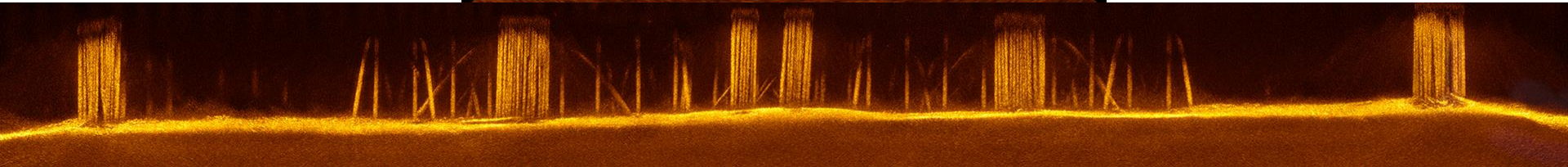
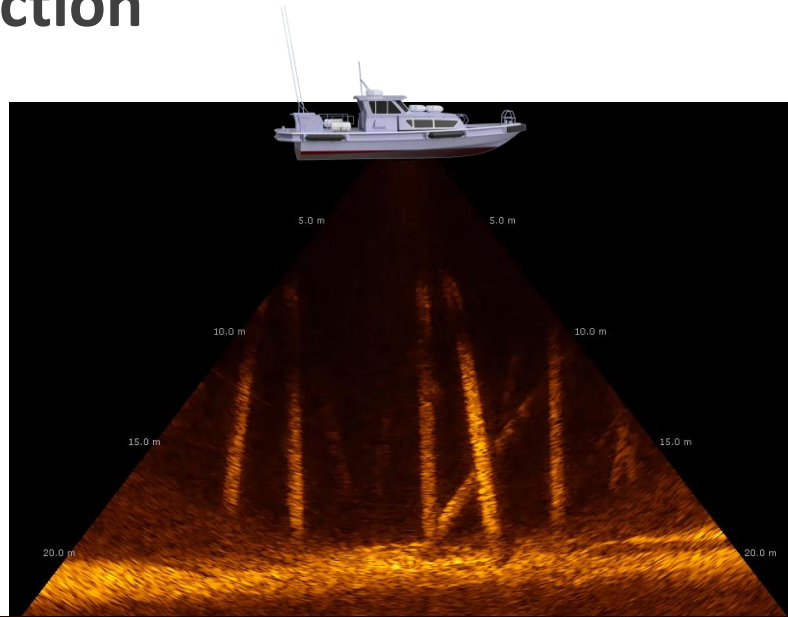
Metal Sheet Pile Wall Inspection



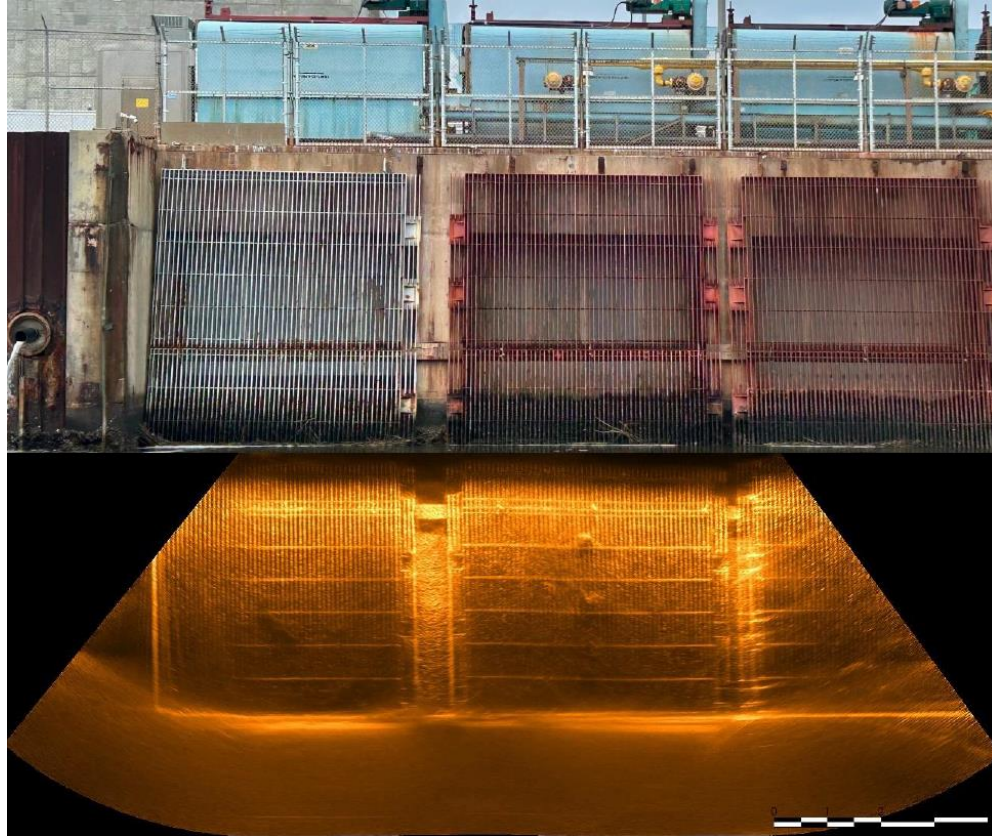
Pier with Concrete and Steel Pilings



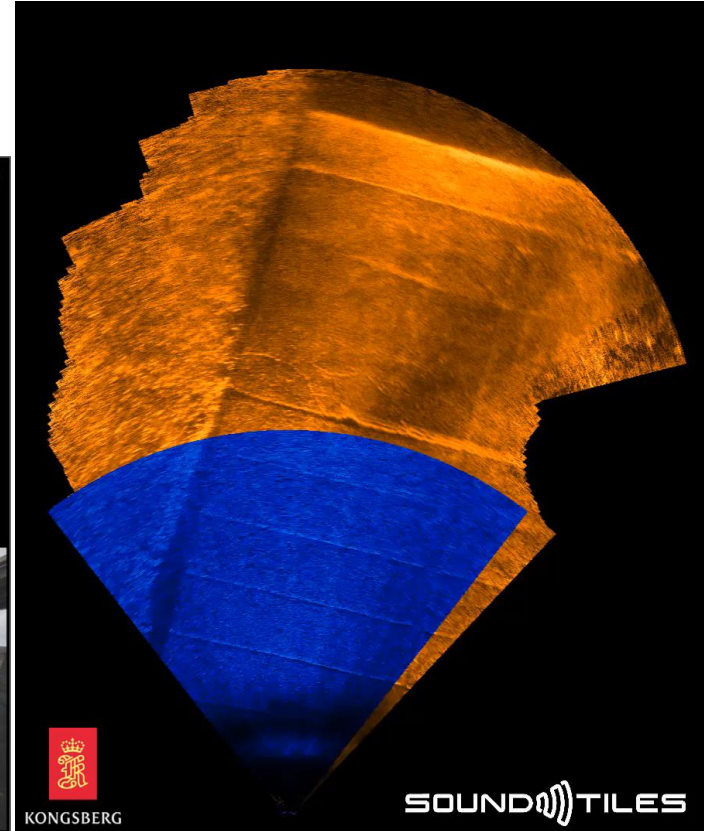
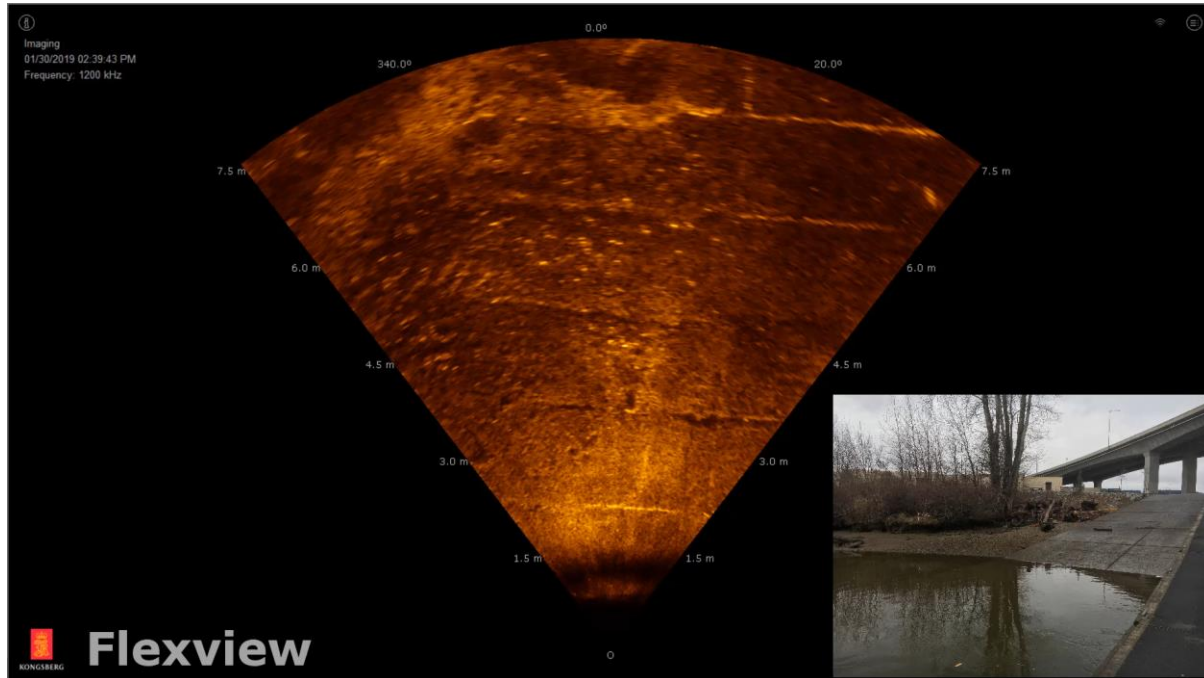
Wood Pile Inspection



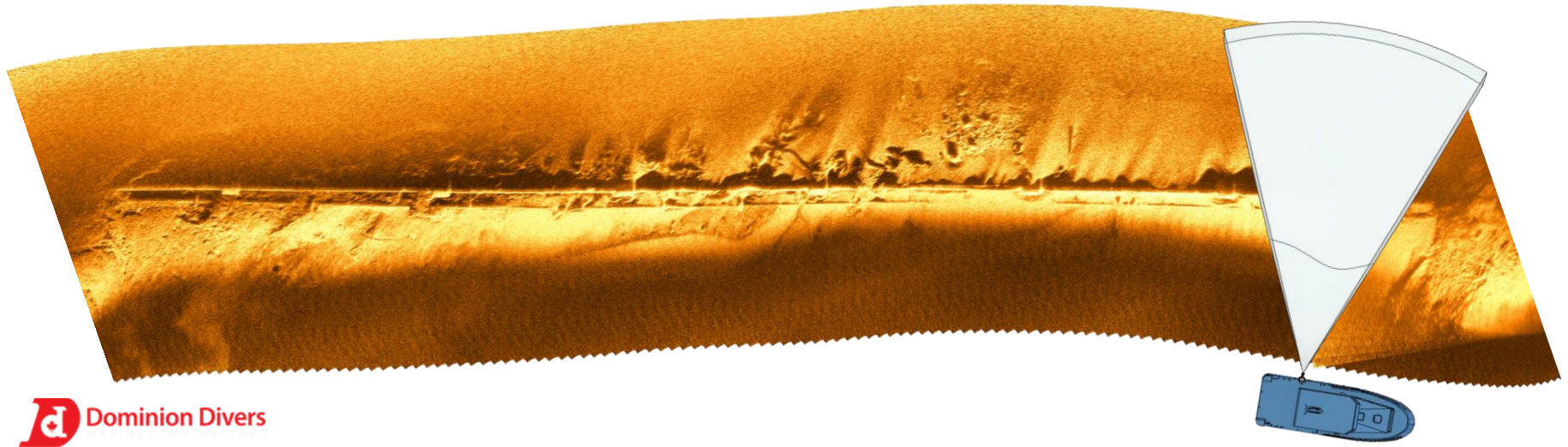
Trash Rack Inspection



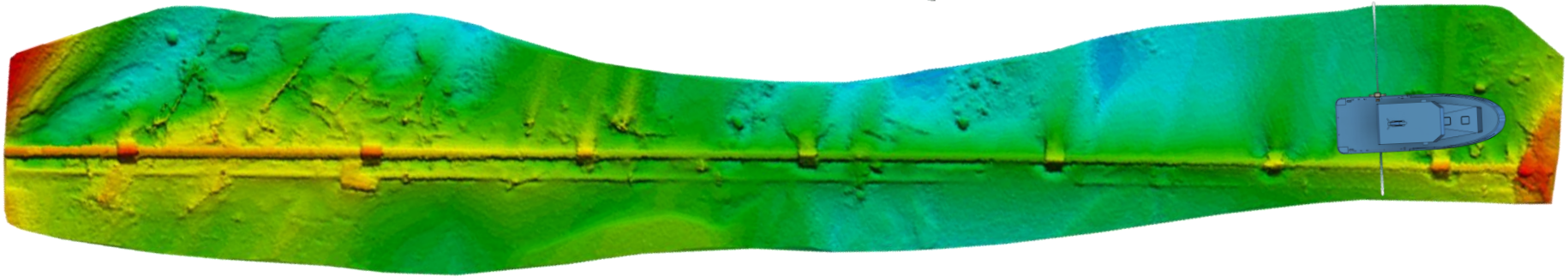
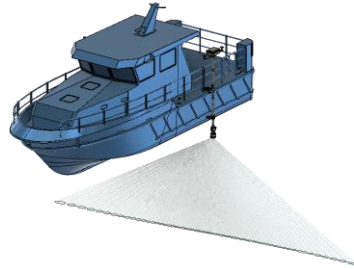
Boat Launch Inspection



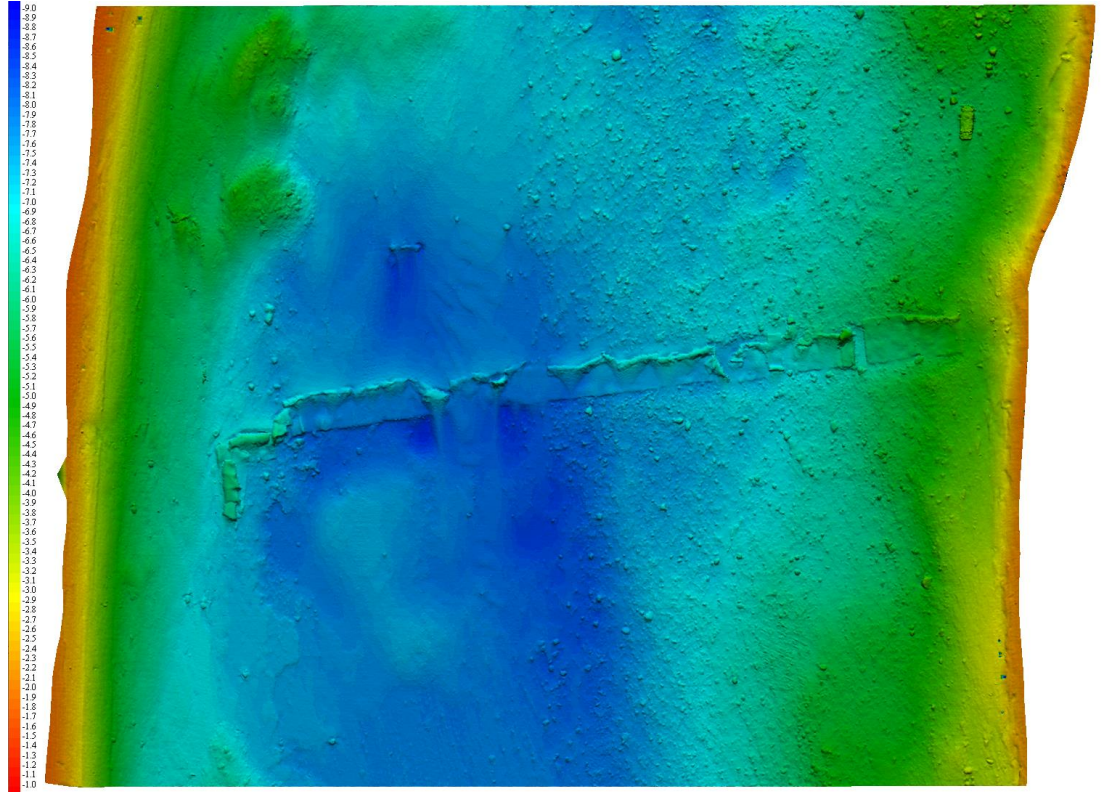
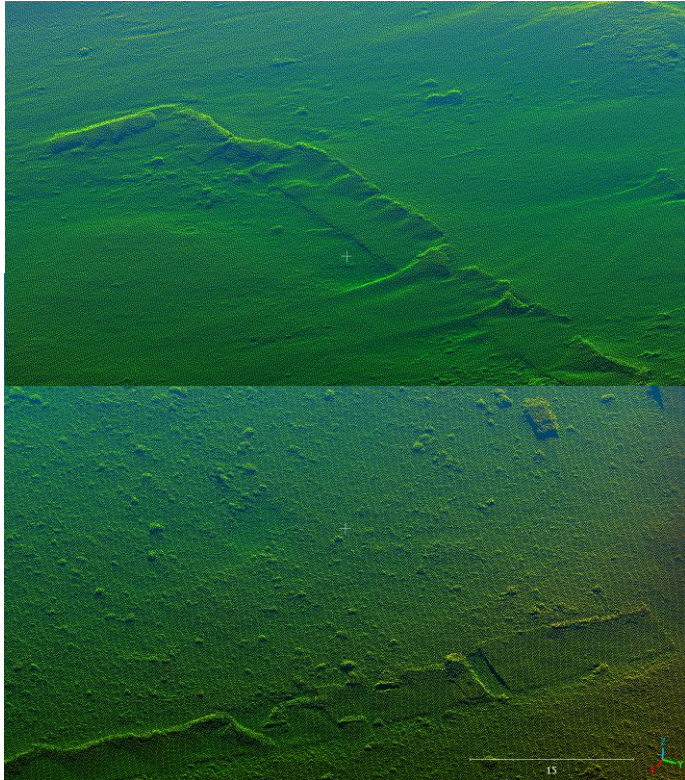
Pipeline 2D Imaging Mosaic



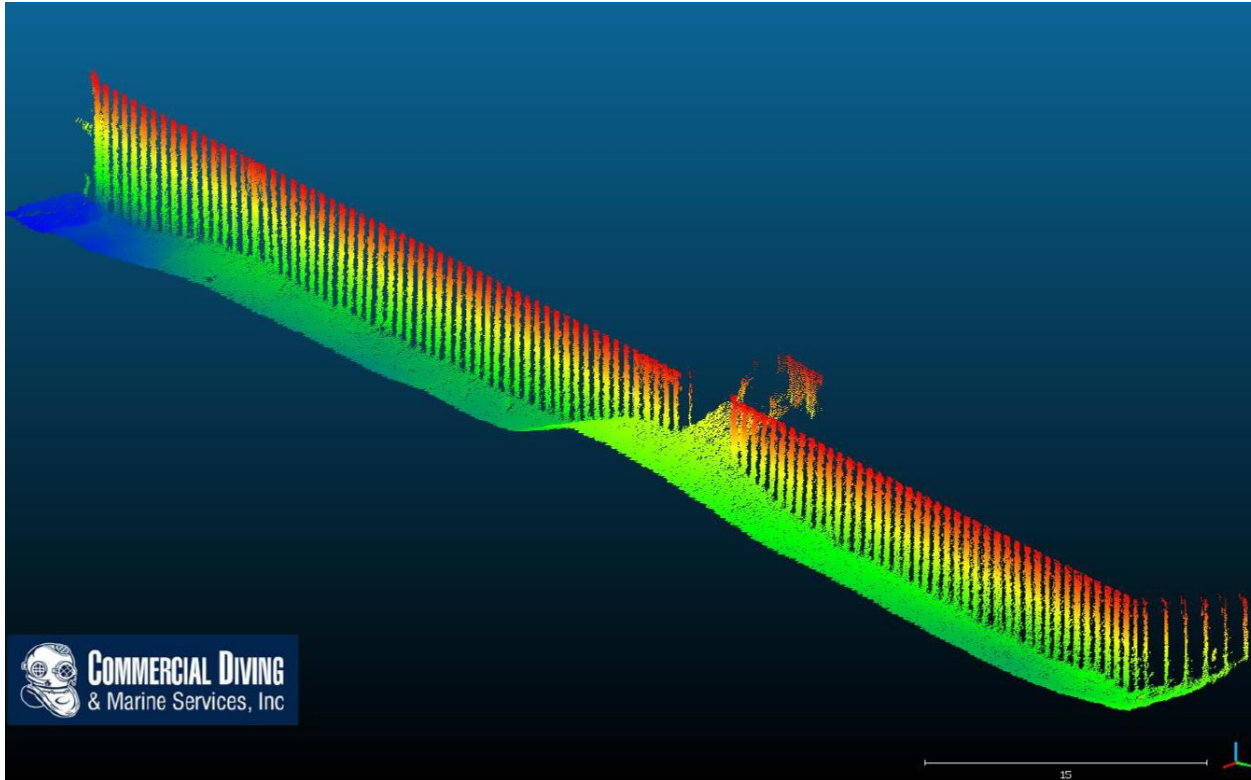
Pipeline 3D Bathymetry



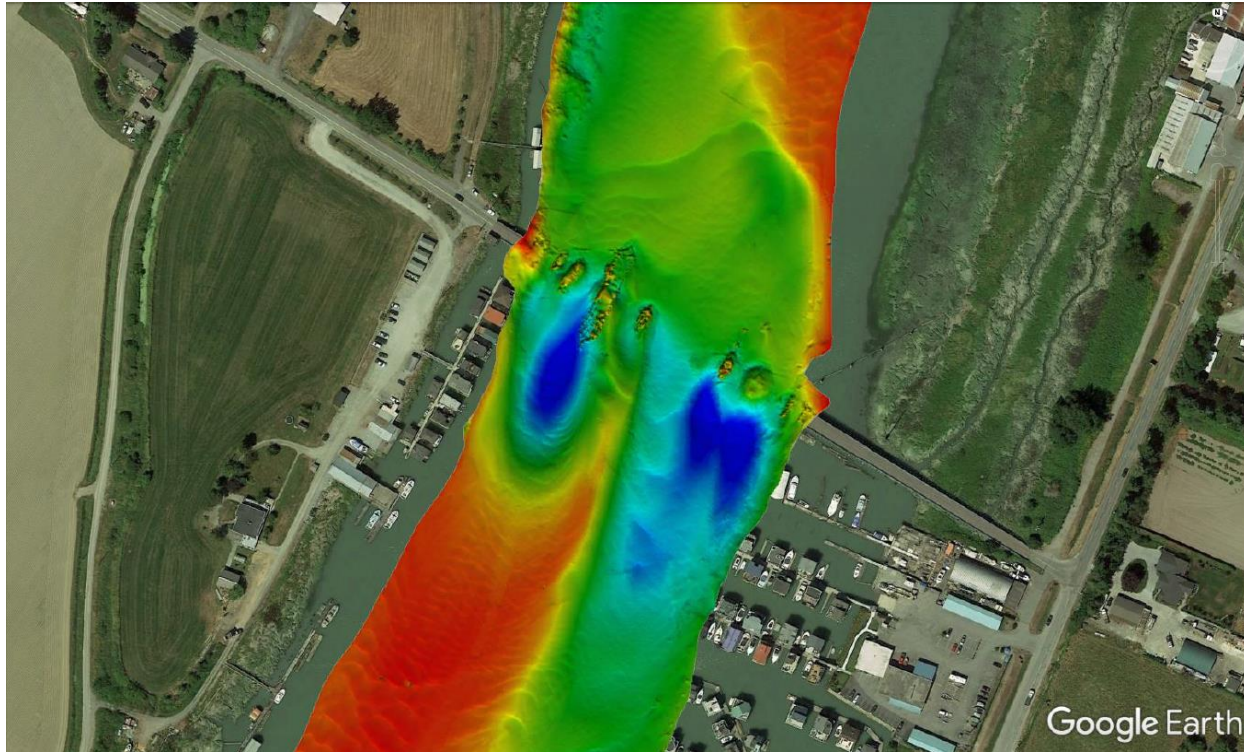
Erosion control mats



Metal Sheet Pile Wall Inspection



Bridge Inspection



Dam Reservoir Siltation & Trash Monitoring

Problem: Accumulation of sediment, rock, logs, and other debris is detected too late, requiring costly drawdown and outage penalties for cleanup to the reservoir and related infrastructure.

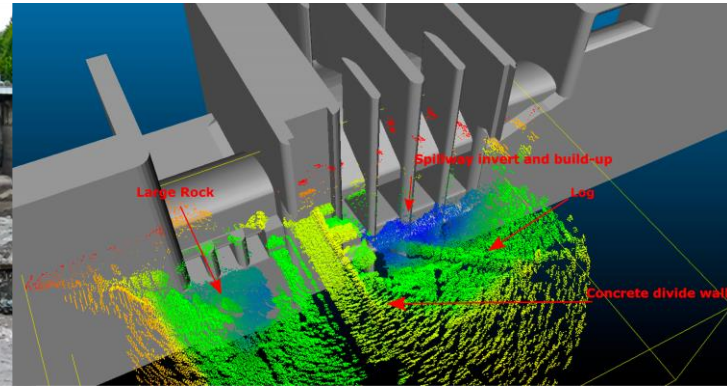
Solution: Permanently-placed DAS Sonar provides BOTH (1) continuous monitoring of siltation, and (2) visualization for accurate dredging and clearing interventions.

Result: Continuous monitoring of sediment and trash accumulation, enabling effective proactive dredge and clean-up operations, maximizing uptime while minimizing expensive interventions for lower, more predictable OpEx.

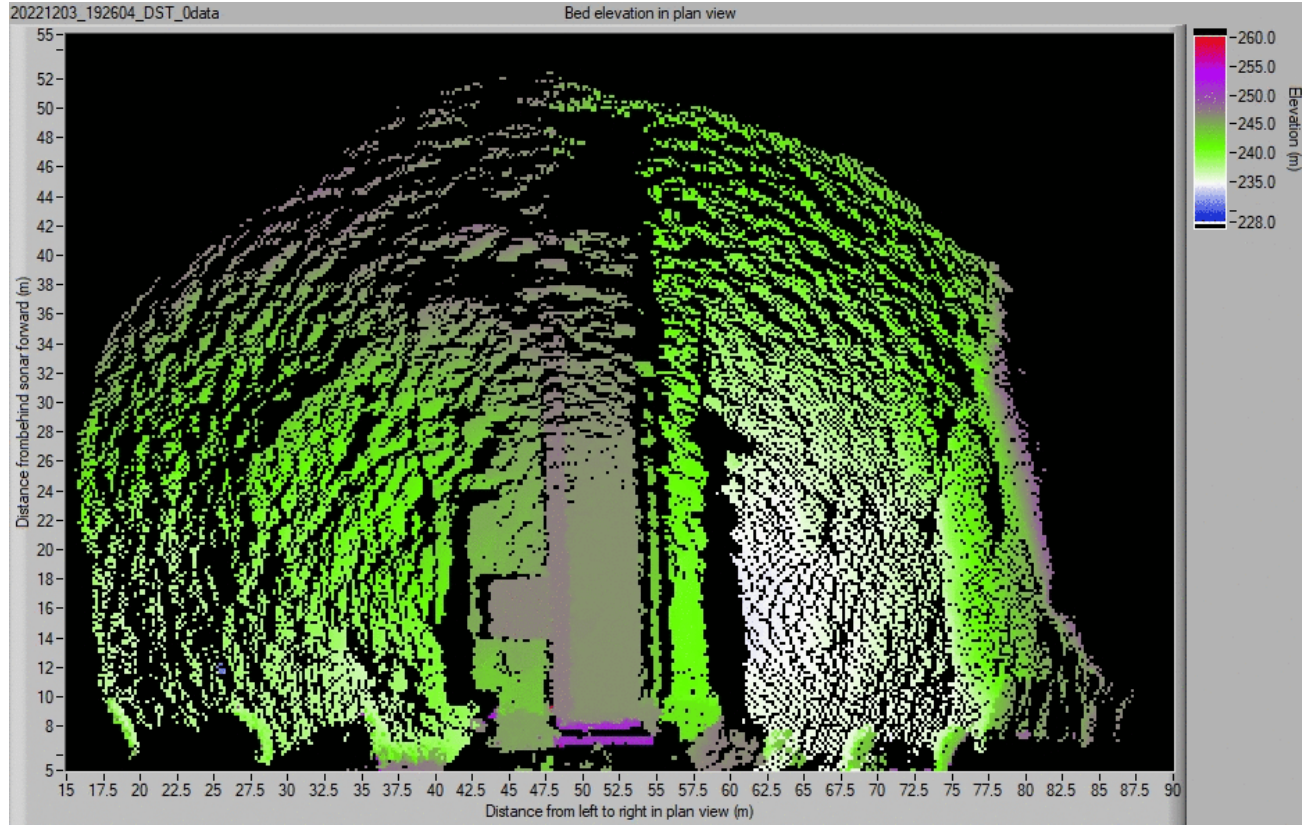
DAS Placement



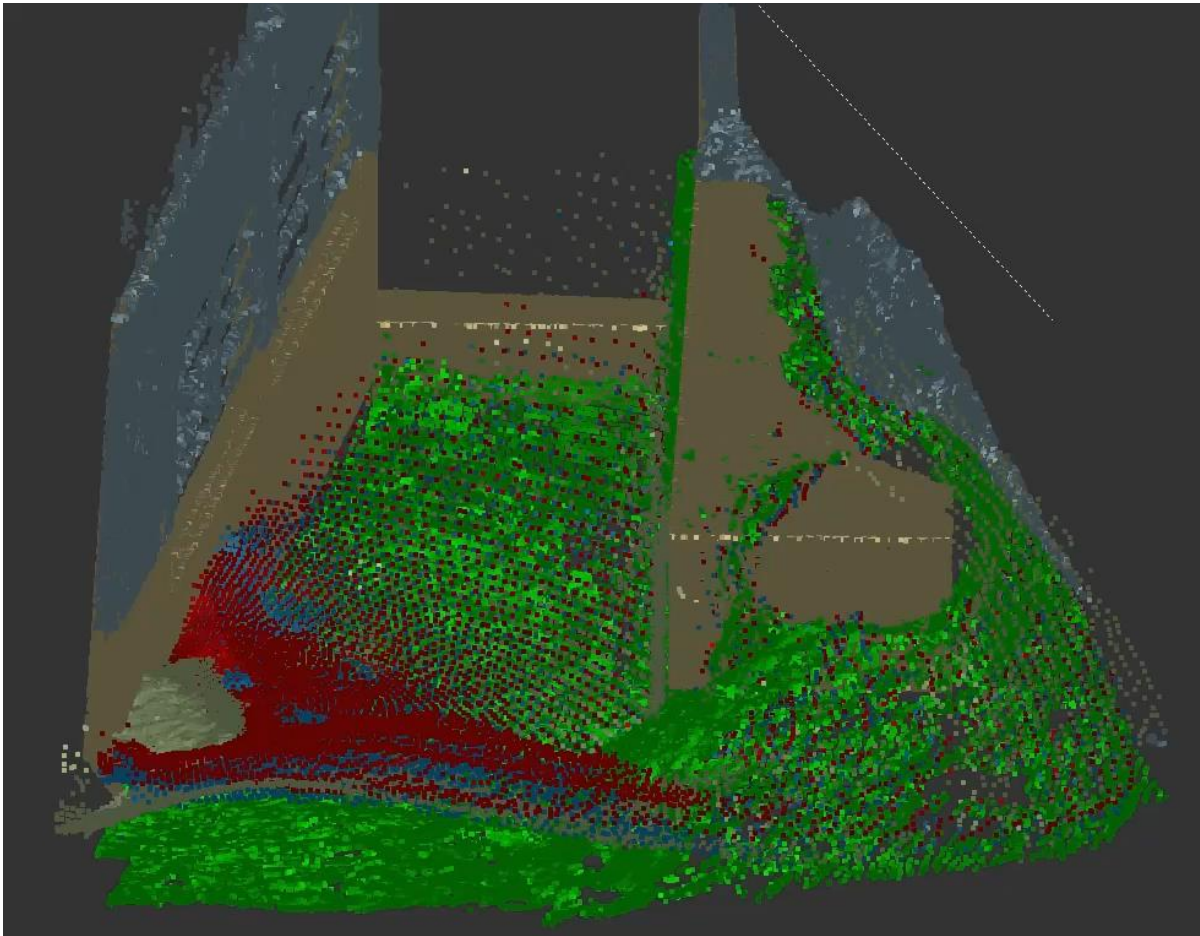
DAS 3D Point-Cloud Visualization



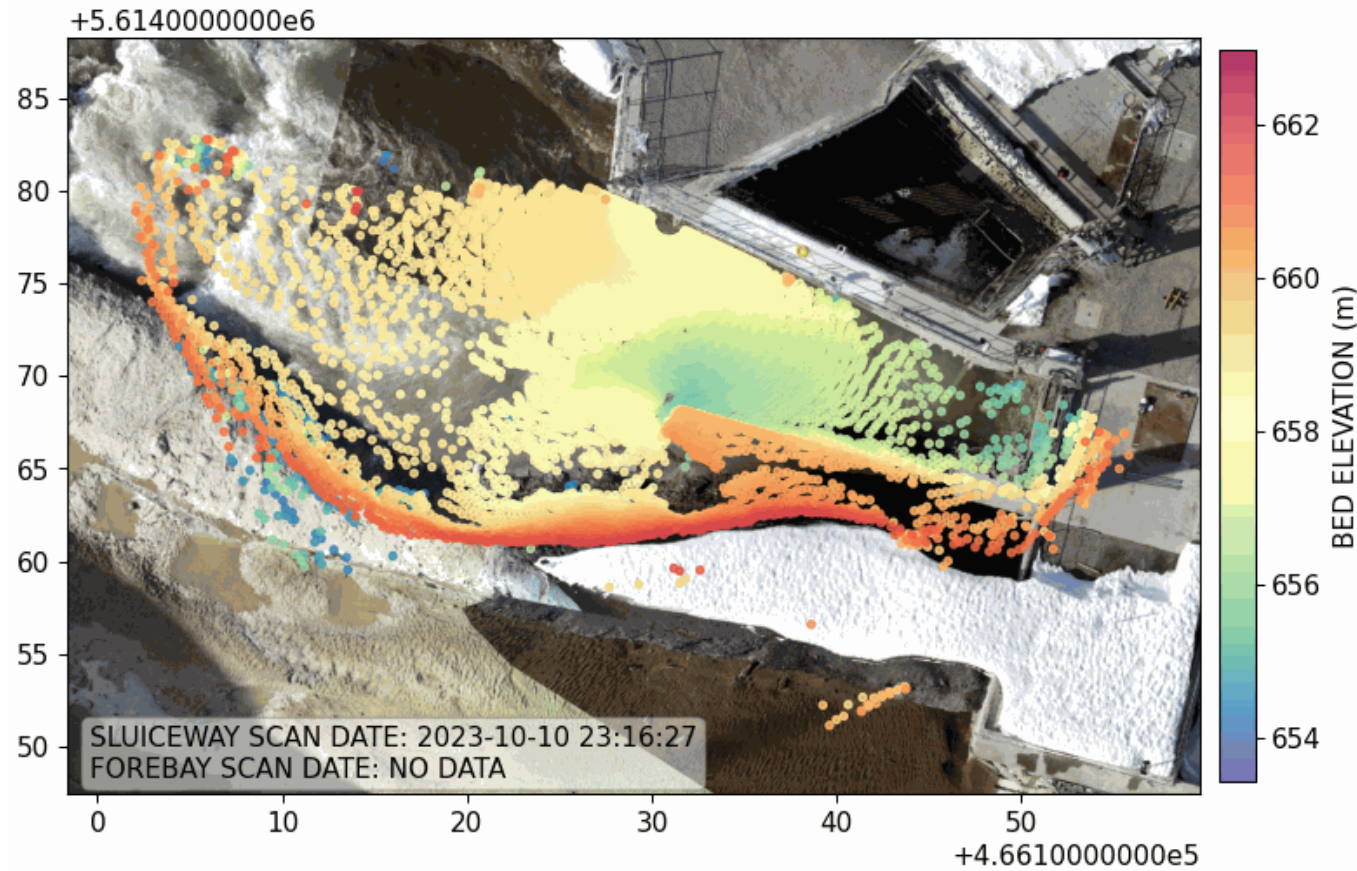
Data Visualization



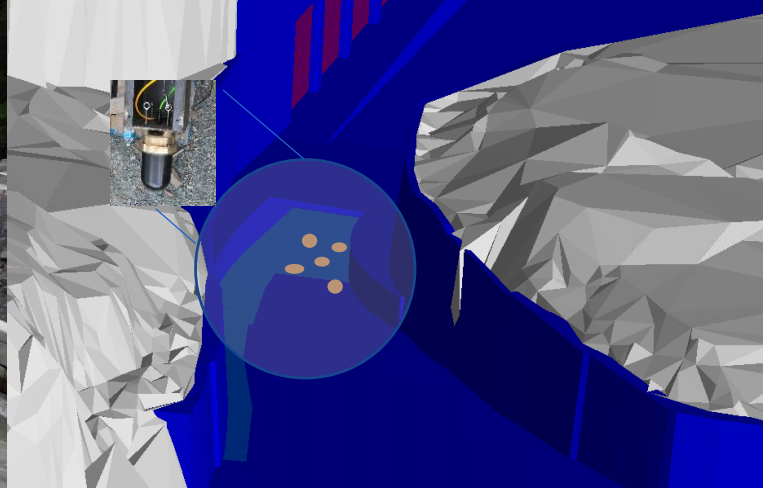
Siltation Over Time



Siltation Over Time

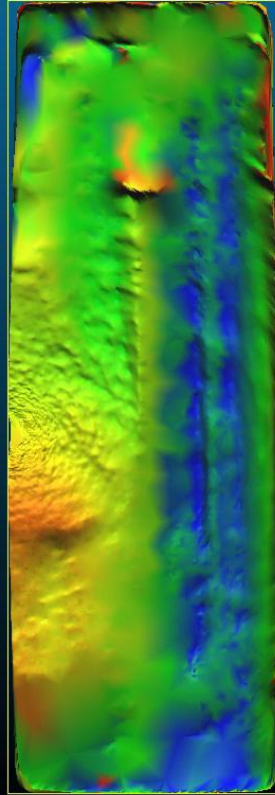


Sluiceway Monitoring



Records bed elevation in turbid water that is fast flowing and has some air

Sonar Records Over Time

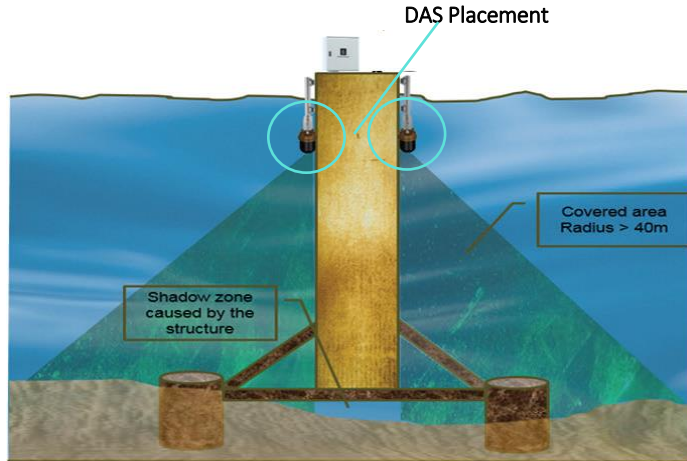


Offshore Wind Scour Monitoring

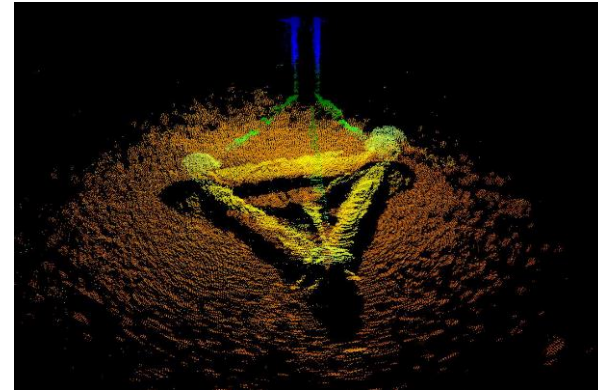
Problem: Periodic inspection doesn't show the impacts of wind and current-induced scour over time and is both expensive and not scalable.

Solution: Permanently-placed DAS Sonars provide a continuous – and remote – monitoring of the seabed around the wind turbine monopile.

Result: Continuous monitoring of sediment and scour conditions, solution that reduces OpEx, ensures uptime, and allows proactive mitigation.

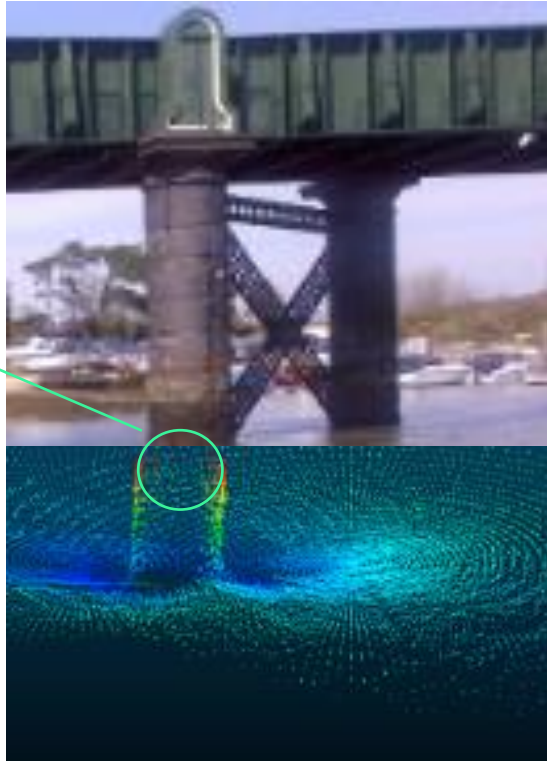


DAS 3D Point-Cloud Visualization



Bridge Pier Scour Monitoring

DAS Placement



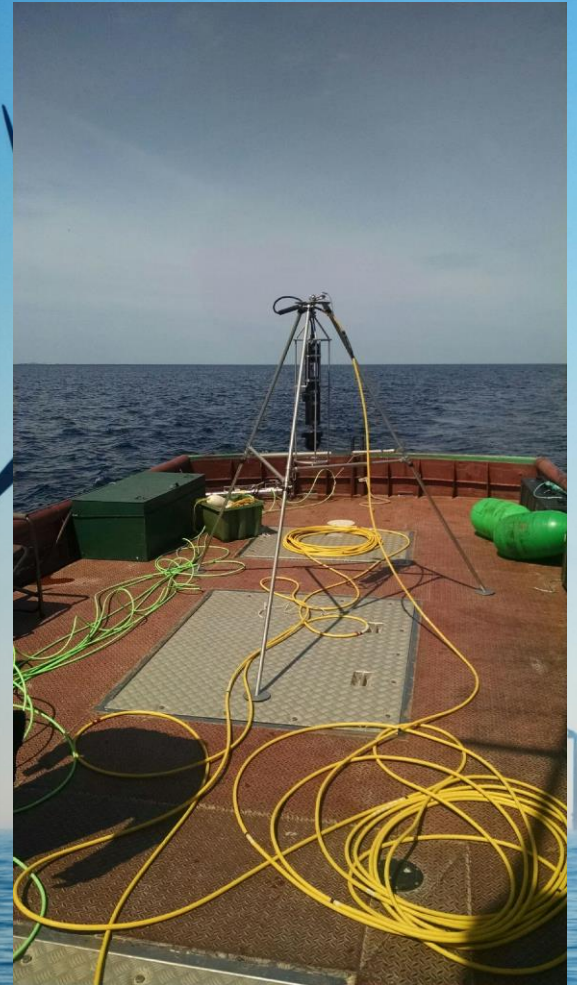
Problem: Periodic inspection doesn't show impacts of wind and current –induced scour over time, and is expensive and not scalable.

Solution: Permanently-placed DAS Sonar provides a continuous – and remote – monitoring of the seabed around the bridge pier.

Result: Continuous monitoring of sediment and scour conditions, solution that determines the bridge's pier integrity, reduces OpEx, and allows proactive mitigation.

DAS 3D Point-Cloud Visualization

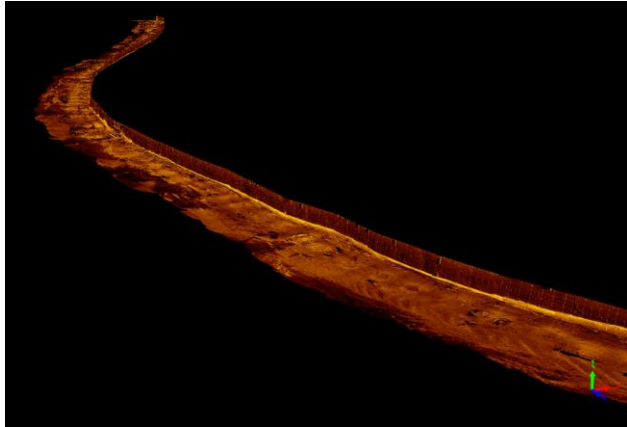
Deep Dive - into Hydraulic structures



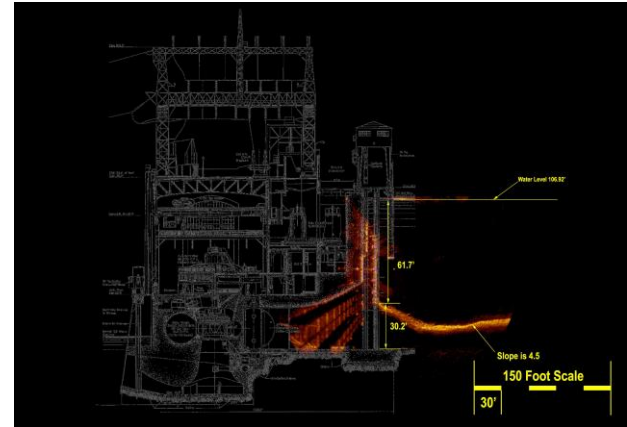
Who am I?



Bridges, Dams, Ports and Harbors, Tunnels - worlds Infrastructures

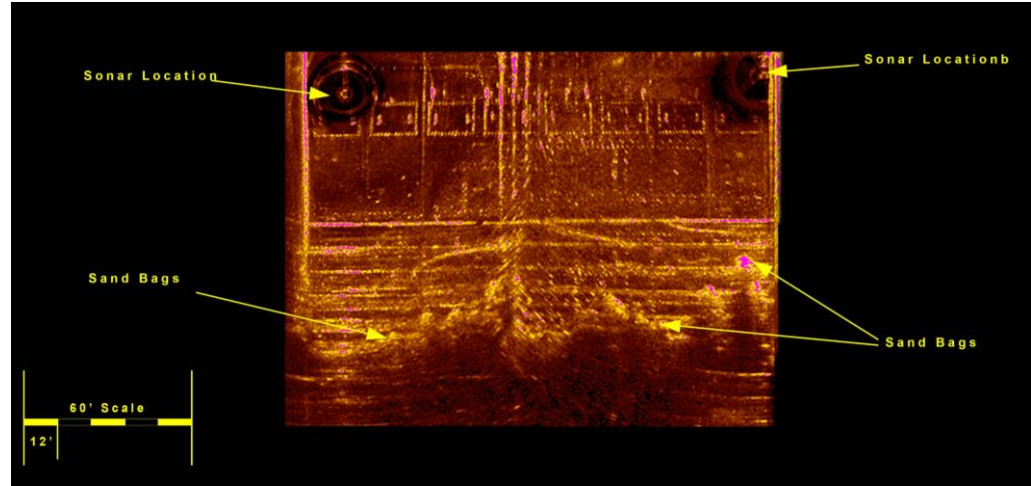


Center Turn Pier 1892 Rail Bridge

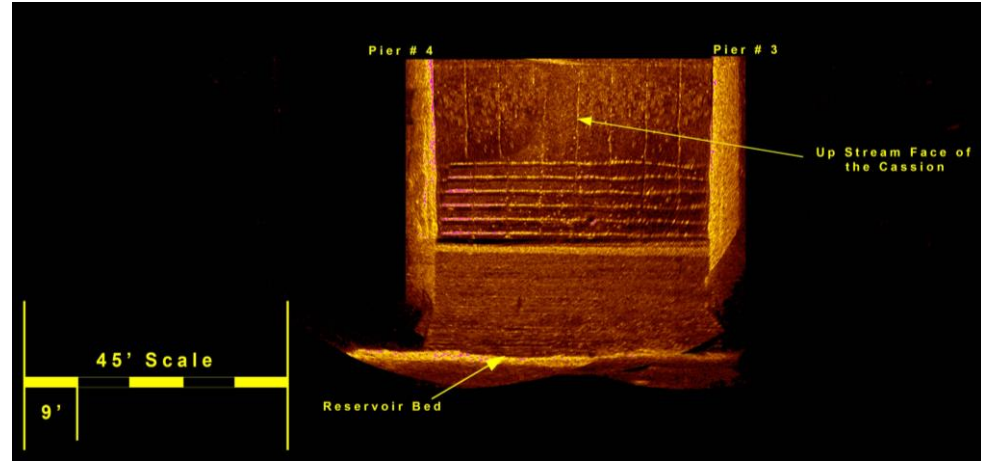
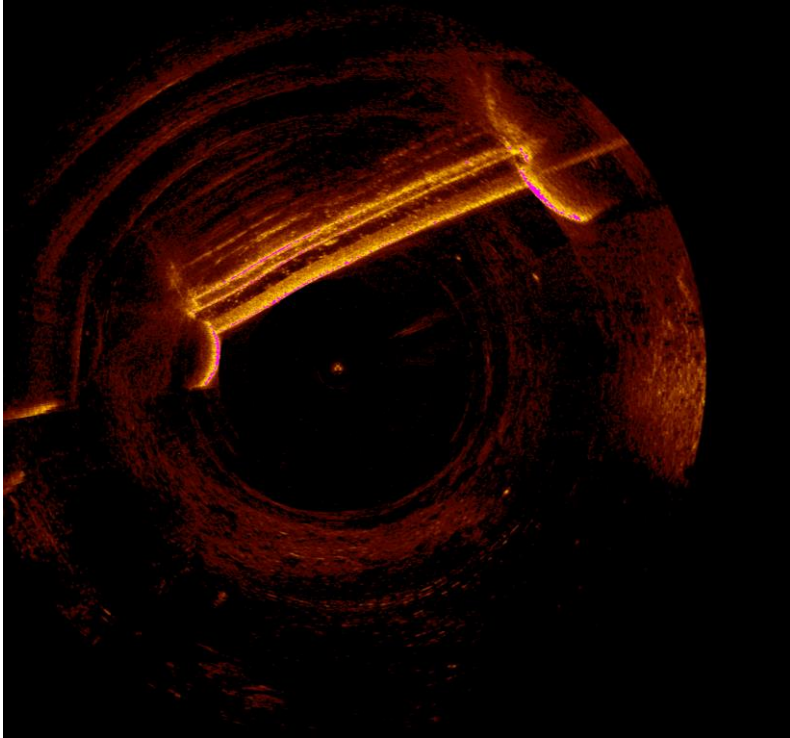


Dam - BulkHead problem

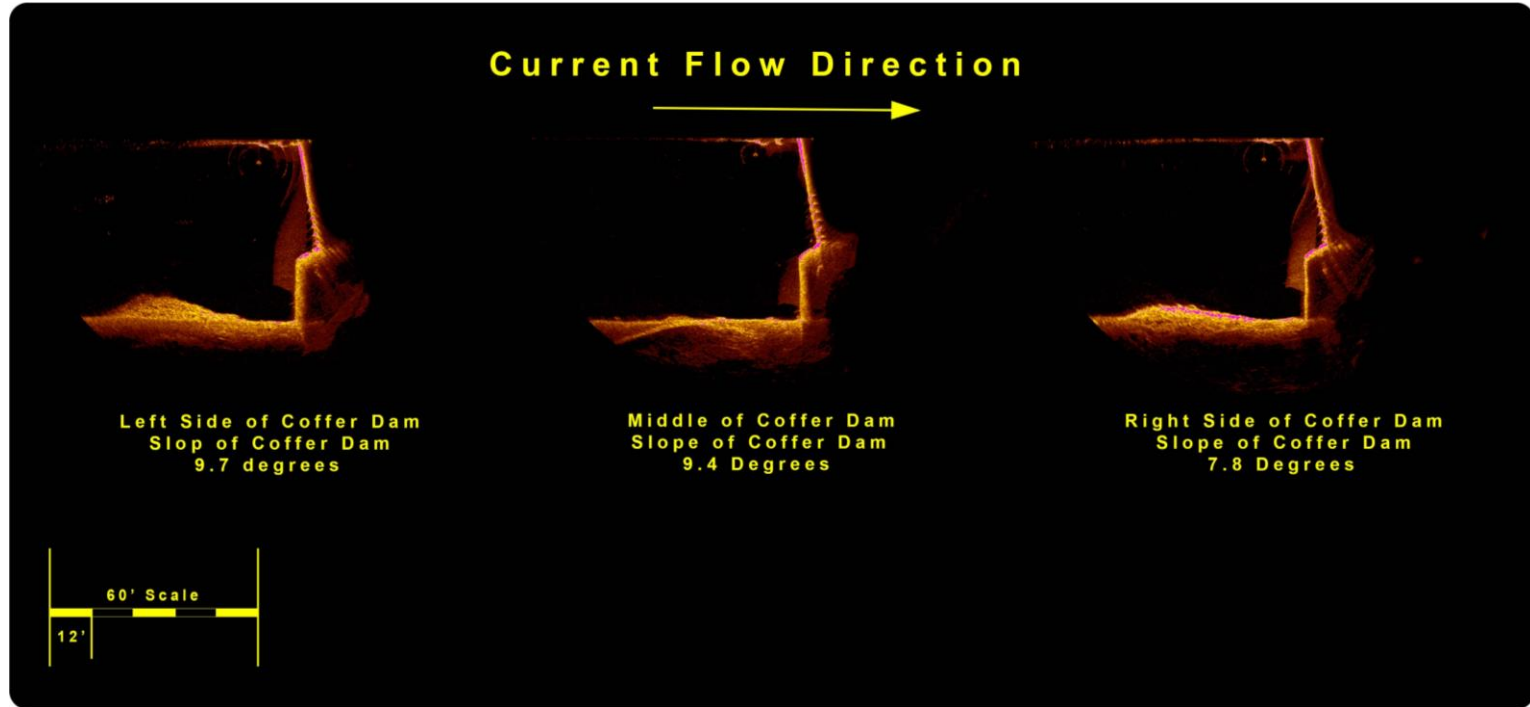




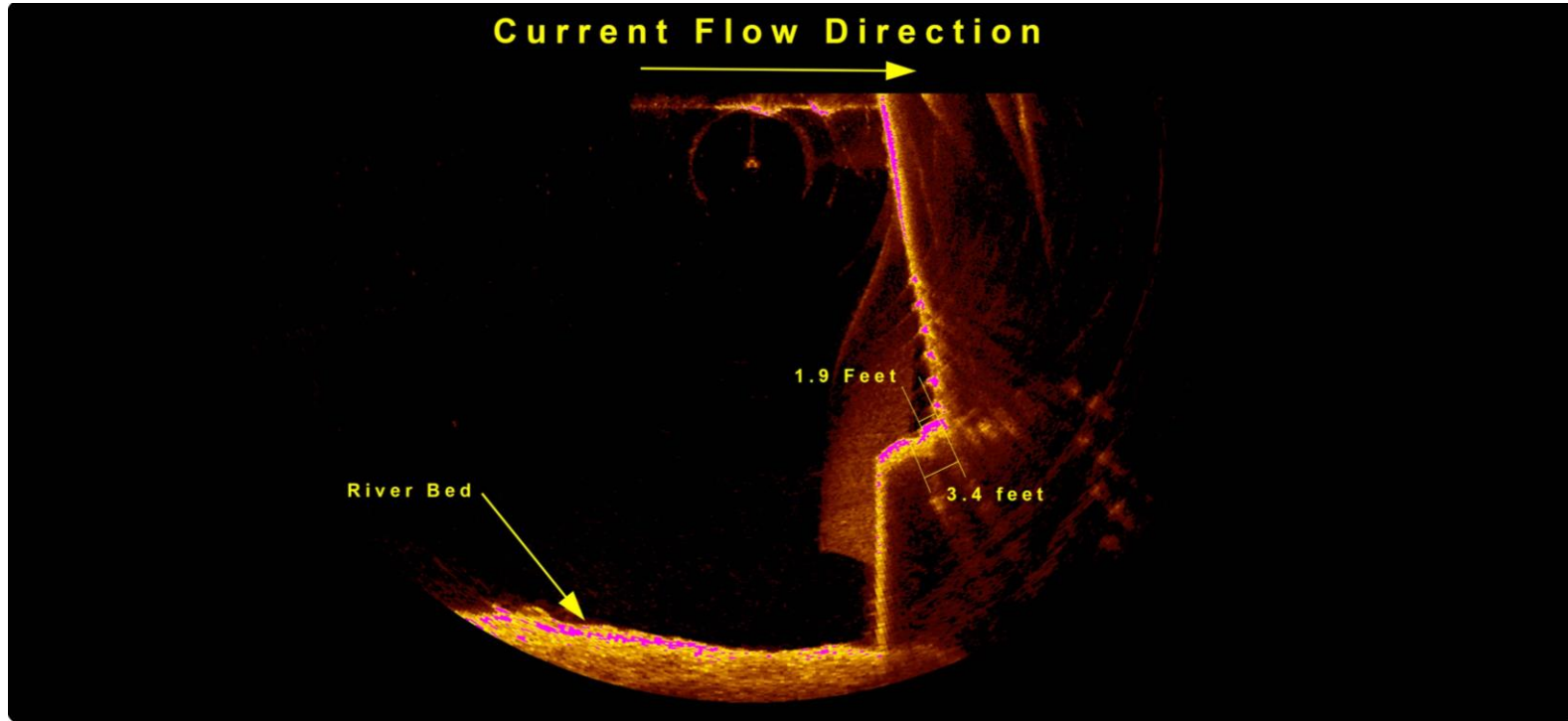
Upstream Side



Changing the Orientation of the sonar.



Right Side of the coffer dam



Delta P issues for Divers



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See Statement of Proprietary information





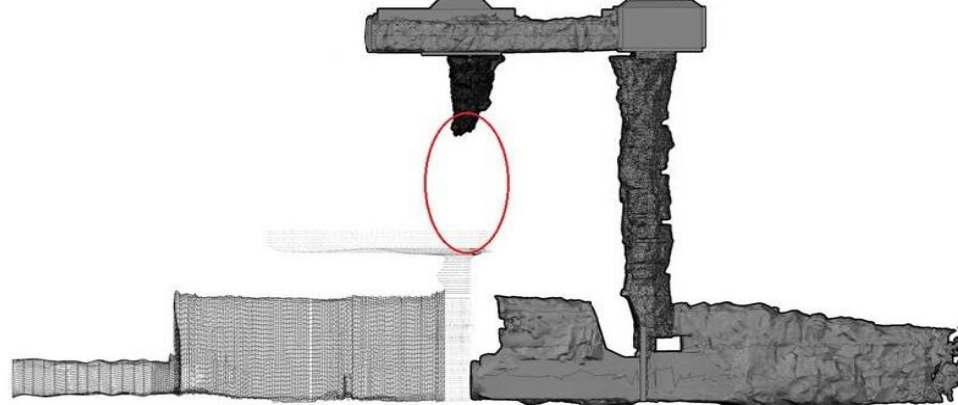
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Mapping a Tunnel for raw water





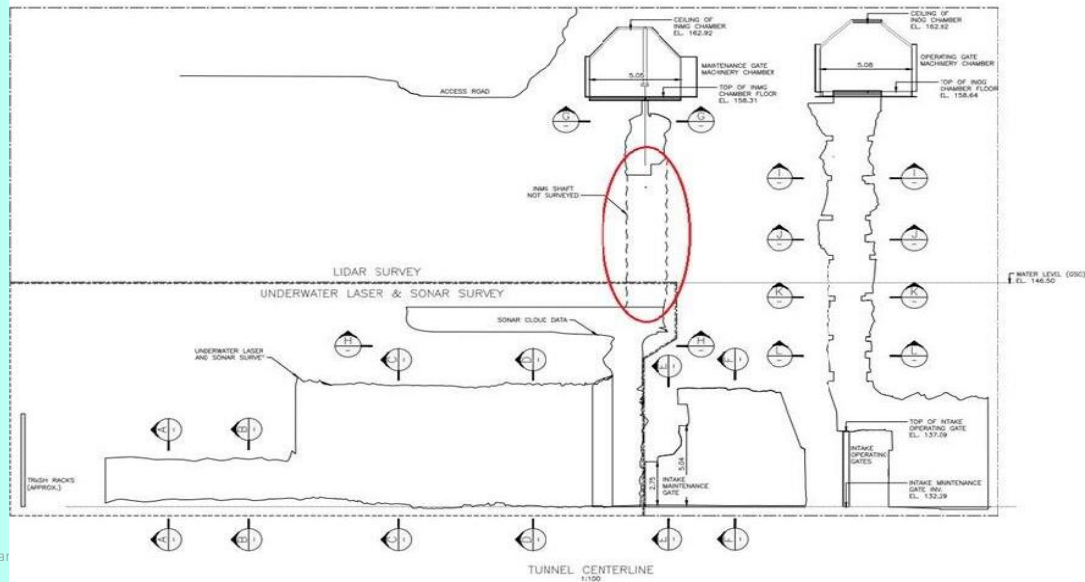
Rough Sketch



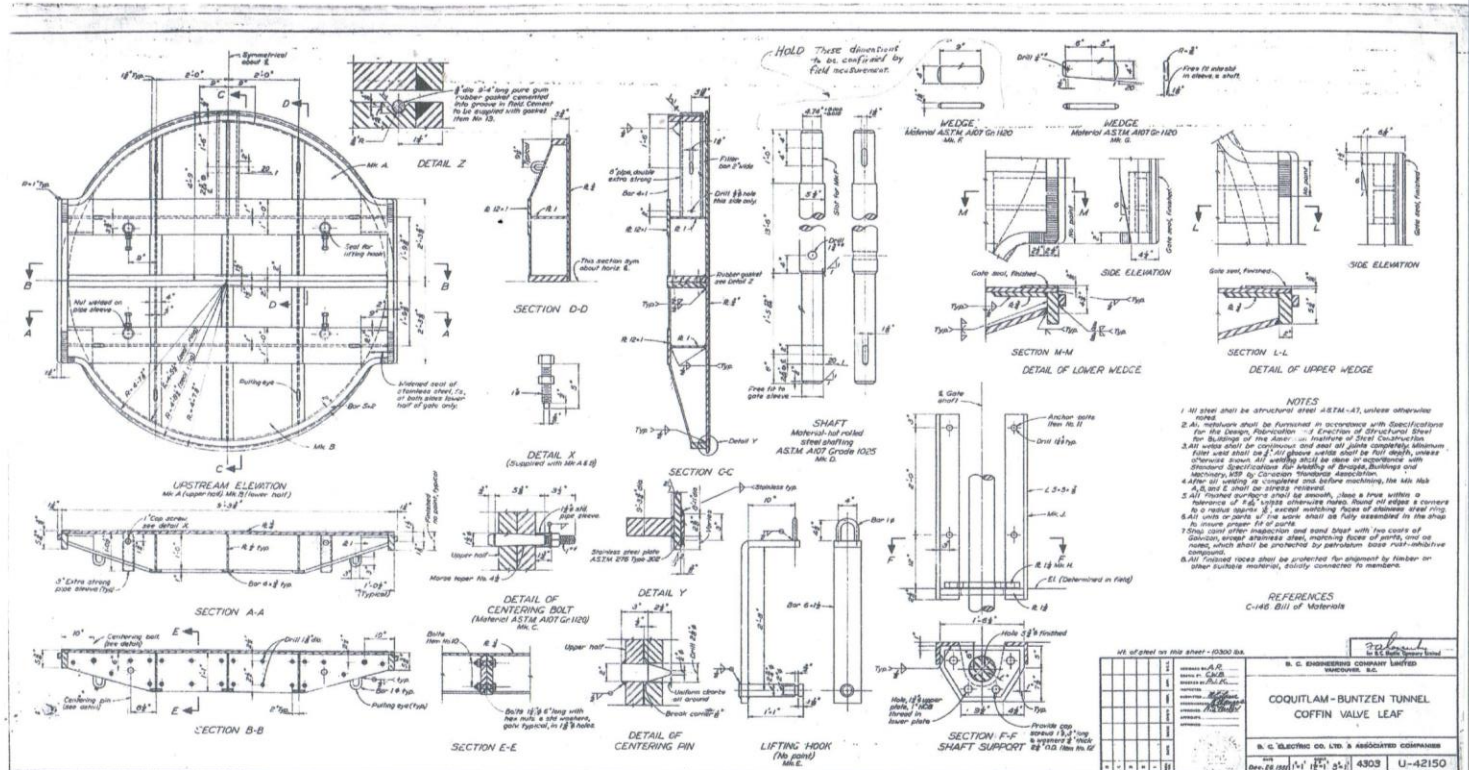
UNDERWATER LASER AND SONAR SURVEY

LIDAR SURVEY

ELEVATION
1100



What's the Job – finding the smallest diameter dimension in the tunnel



Laser Scanning

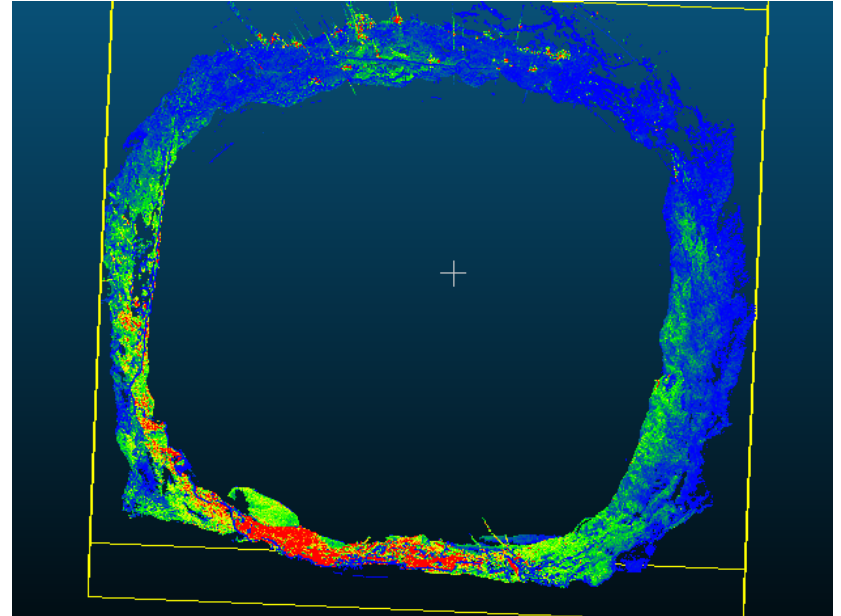
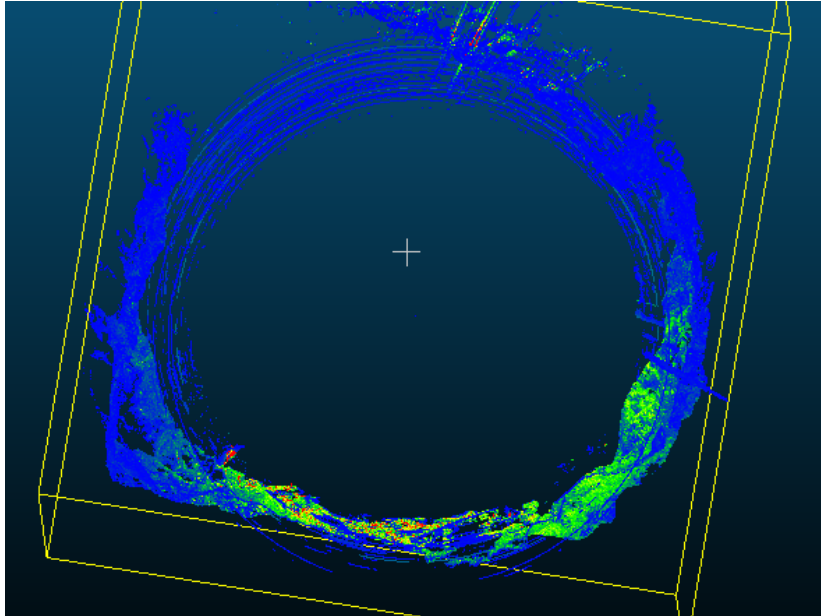




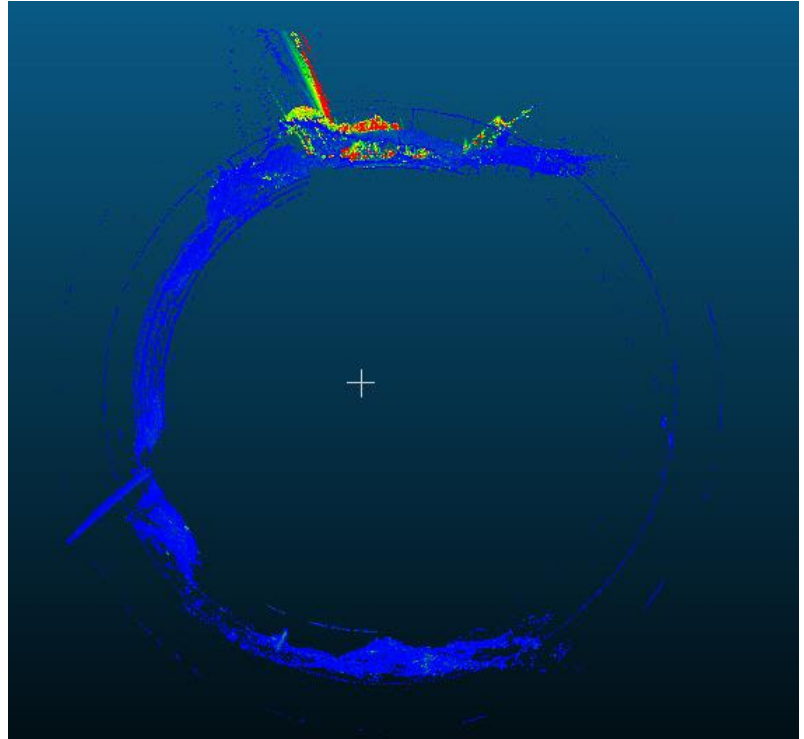
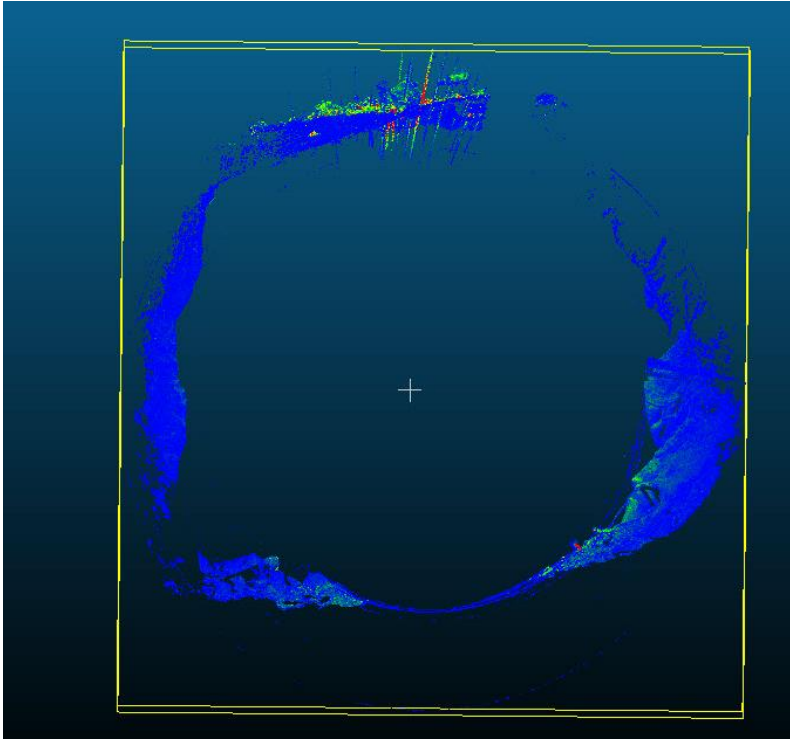
Wiffle balls reference for XYZ data



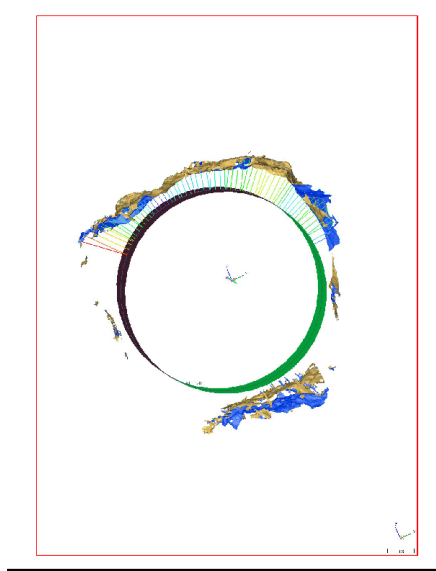
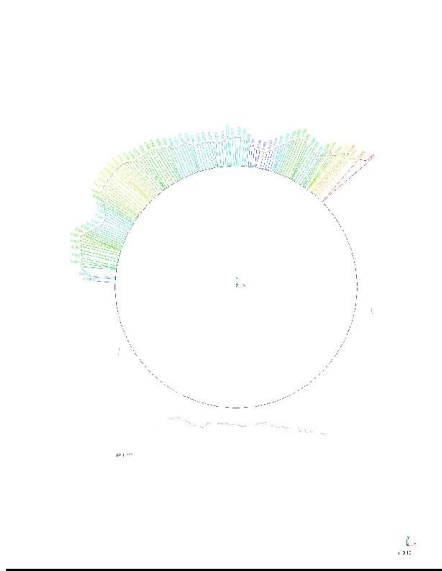
Laser Scan Slice of the Tunnel



Lack of Data



Due to sediment load in the water column kickup by Moving the laser scanner. Need clear water to laser scan.



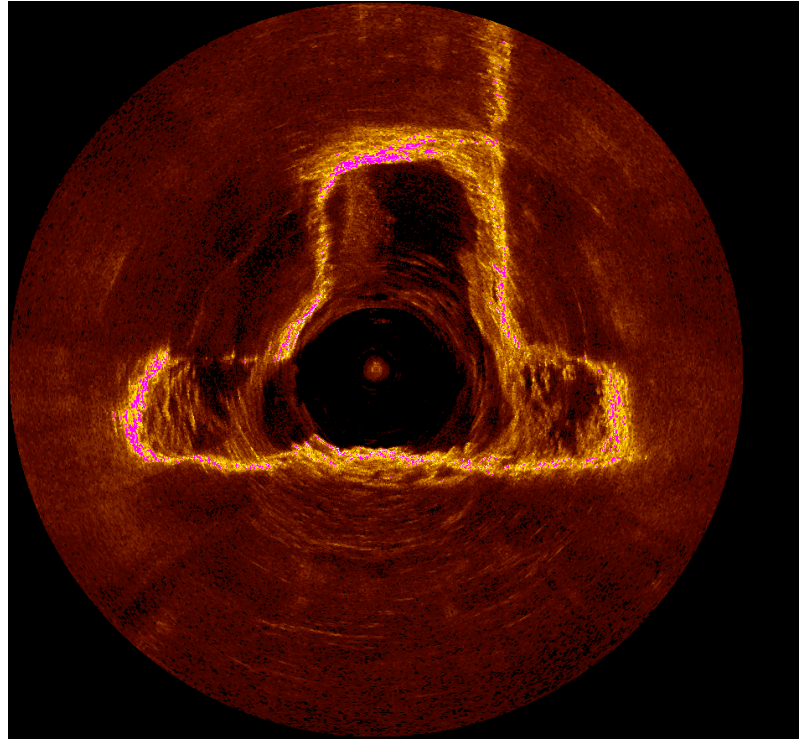
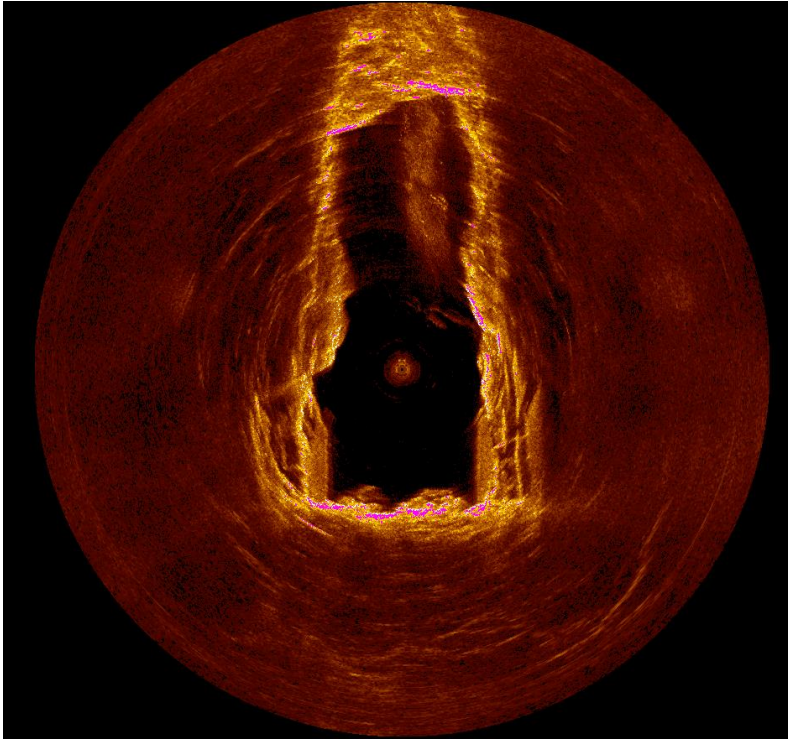
Change over to sonar mapping the tunnel



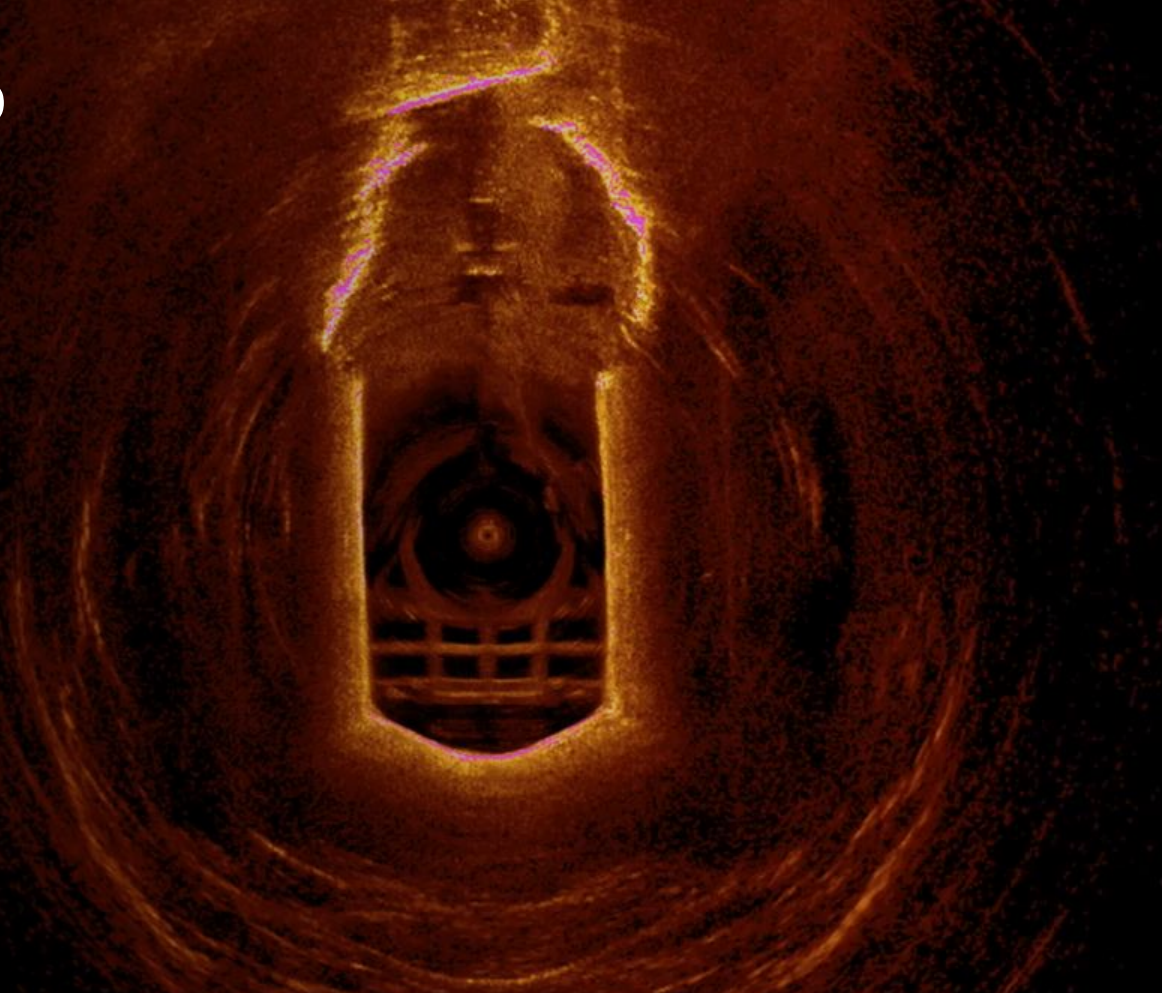
Diver taking the sonar into the Tunnel

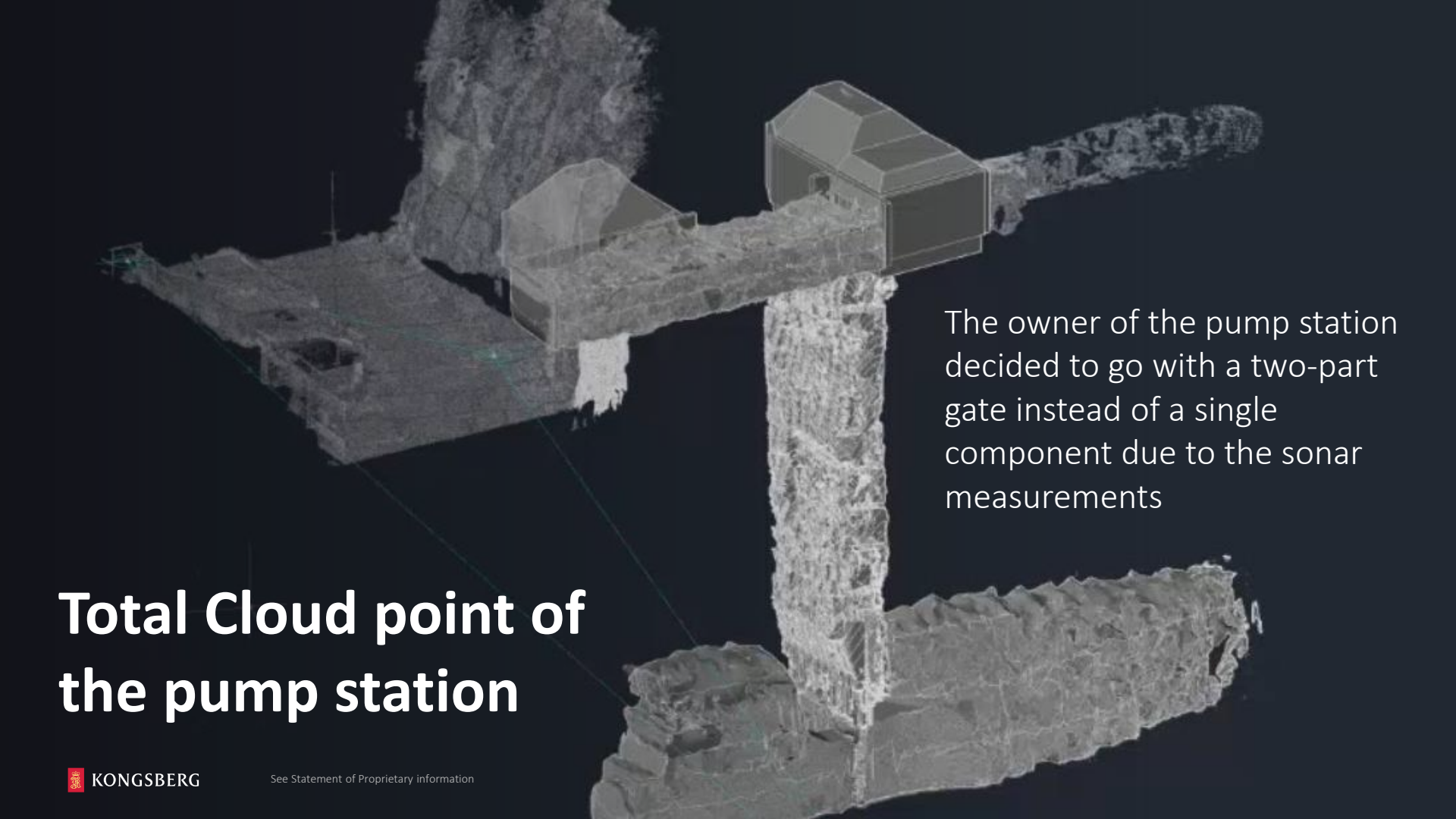


Individual Sonar Images. 15-foot scans for best resolution. 2-3 cm



Switching to Sonar





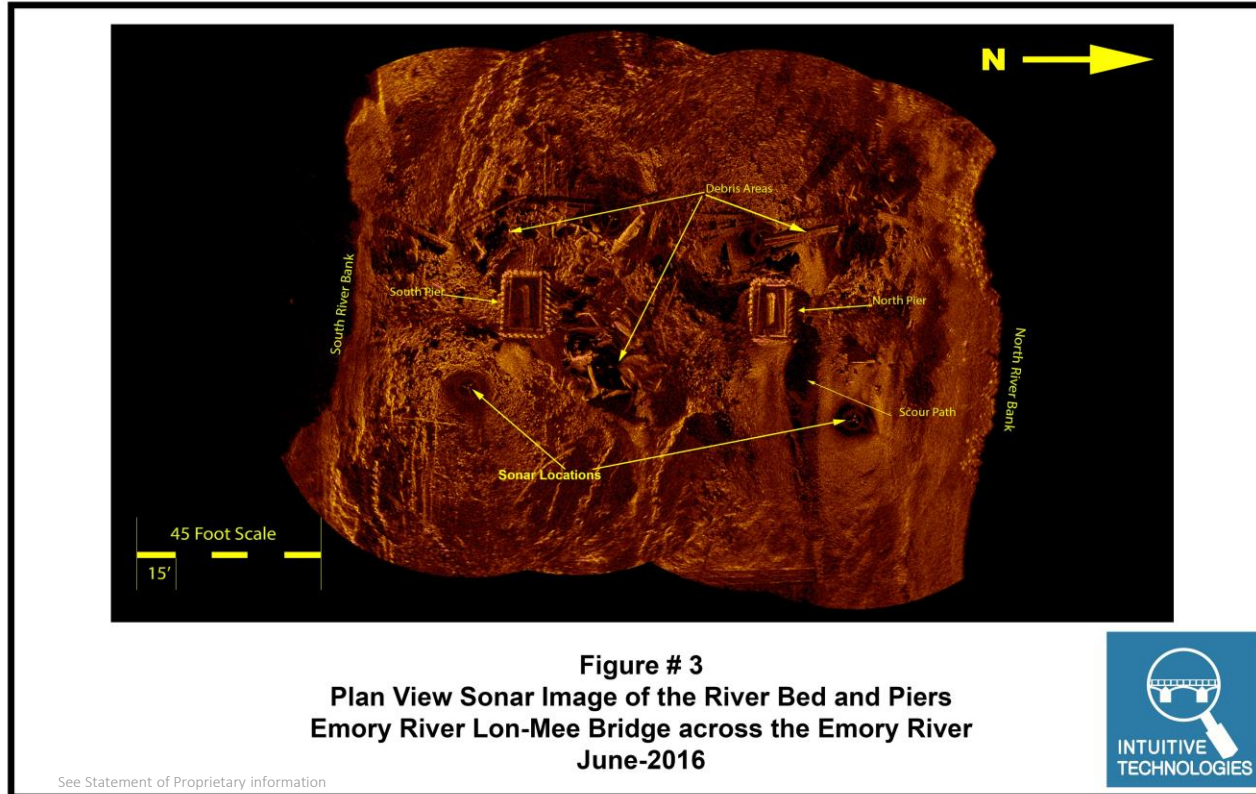
Total Cloud point of the pump station

The owner of the pump station decided to go with a two-part gate instead of a single component due to the sonar measurements

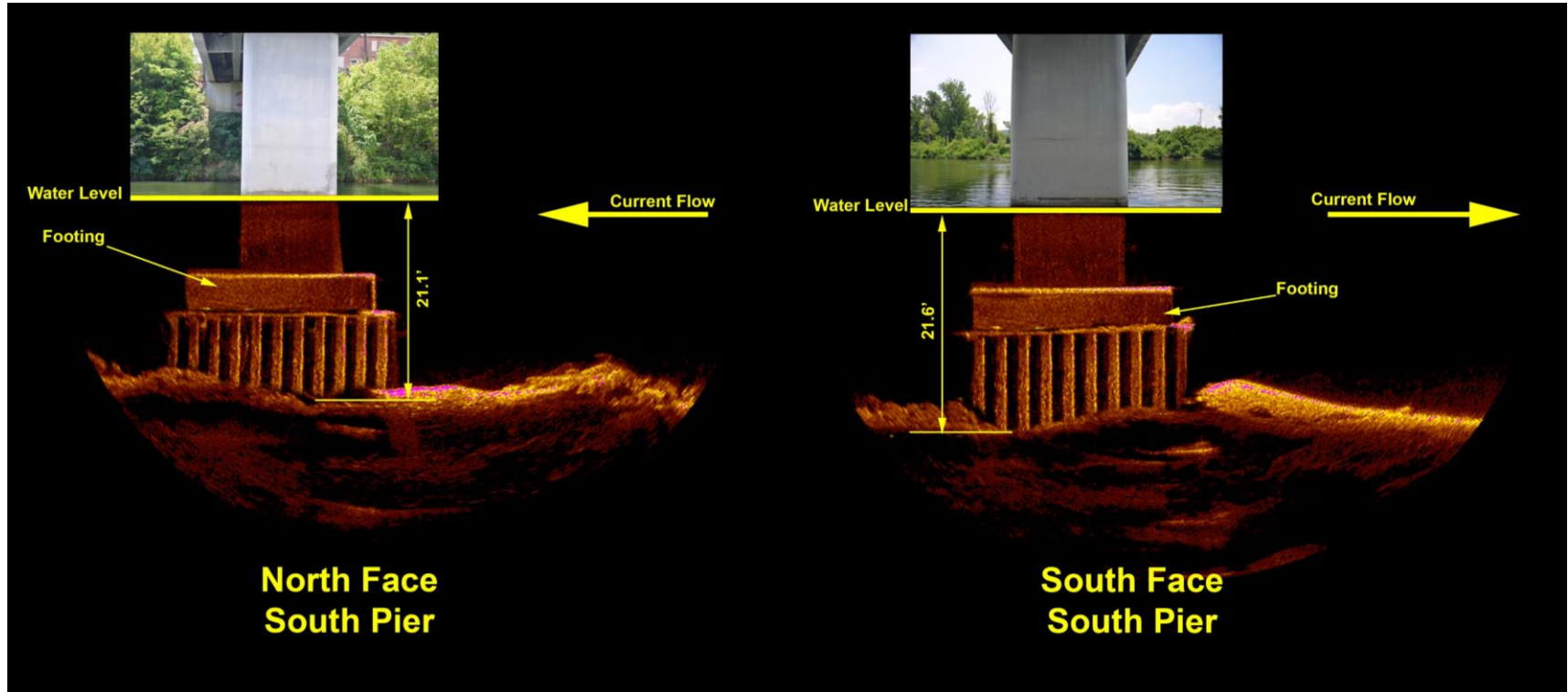
A wide-angle photograph of a multi-lane concrete bridge spanning a river. The bridge has several large, rectangular concrete piers supporting its structure. The water in the river is calm and reflects the sky. In the background, there is a dense forest of green trees. Two tall, thin light poles are visible on the bridge deck. The sky is clear and blue.

Bridge Imaging

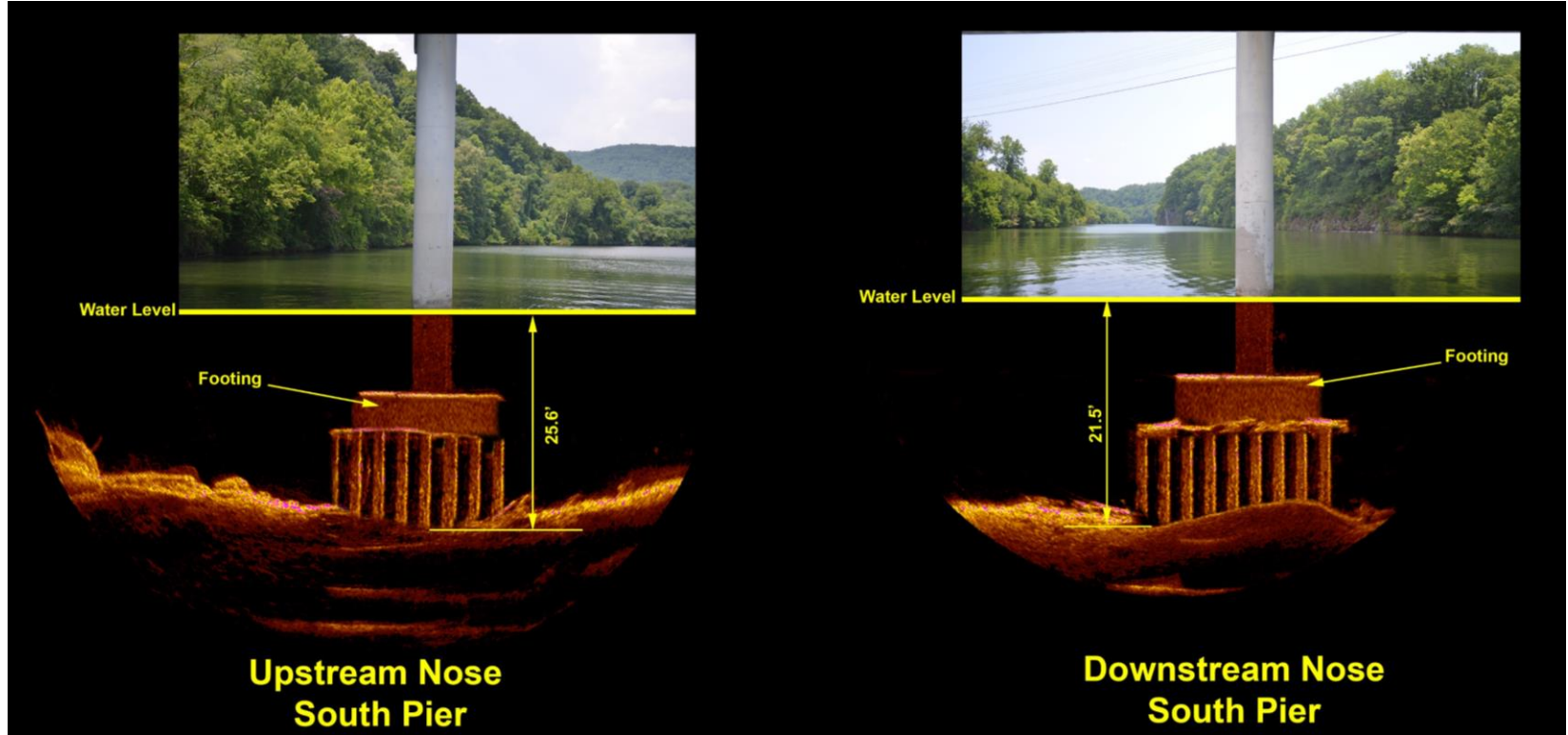
Plan View Image of the Riverbed and Bridge Piers



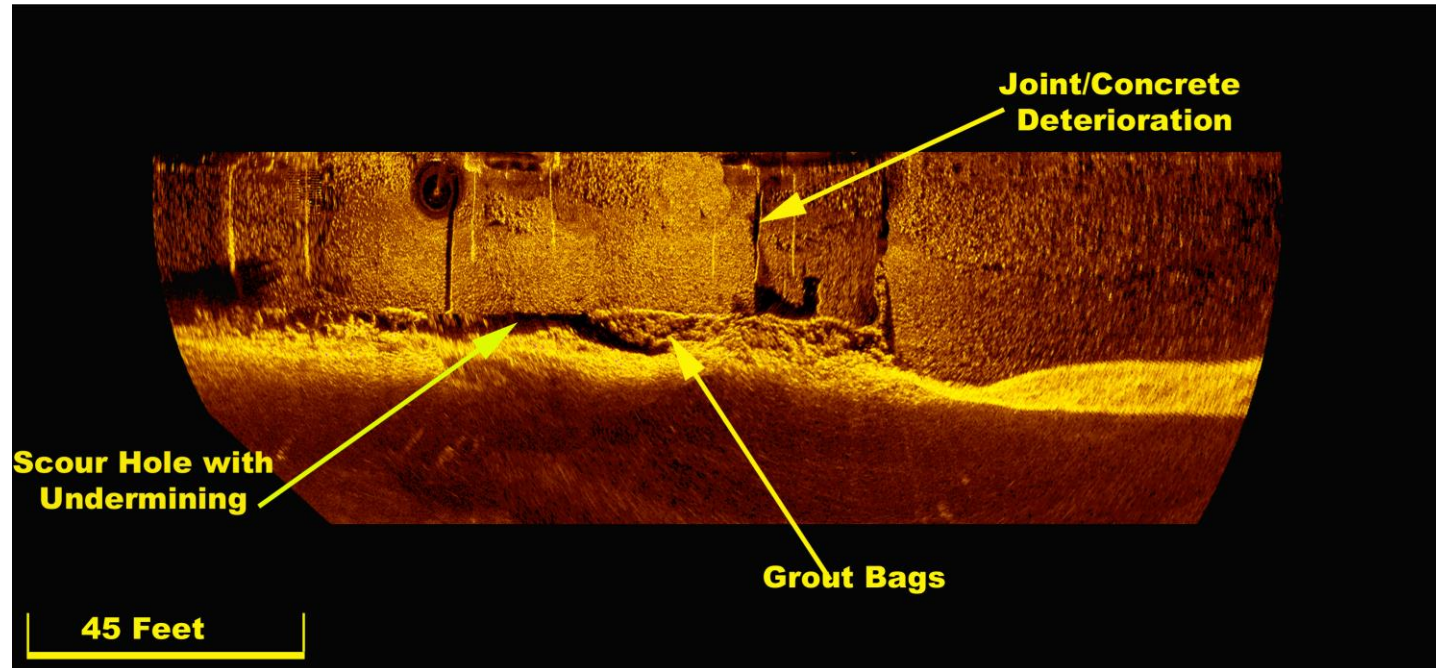
Vertical Views



Vertical Imaging

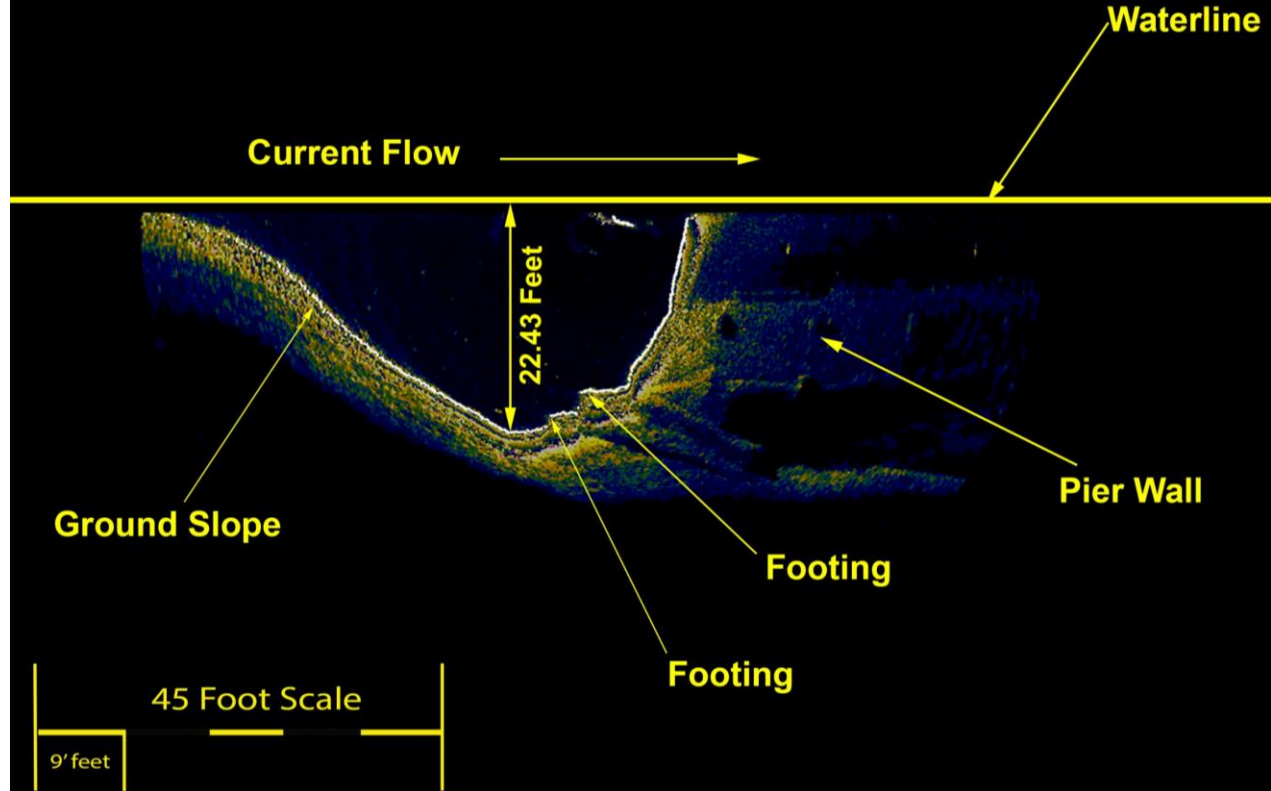


Harbor Wall with structural Defects

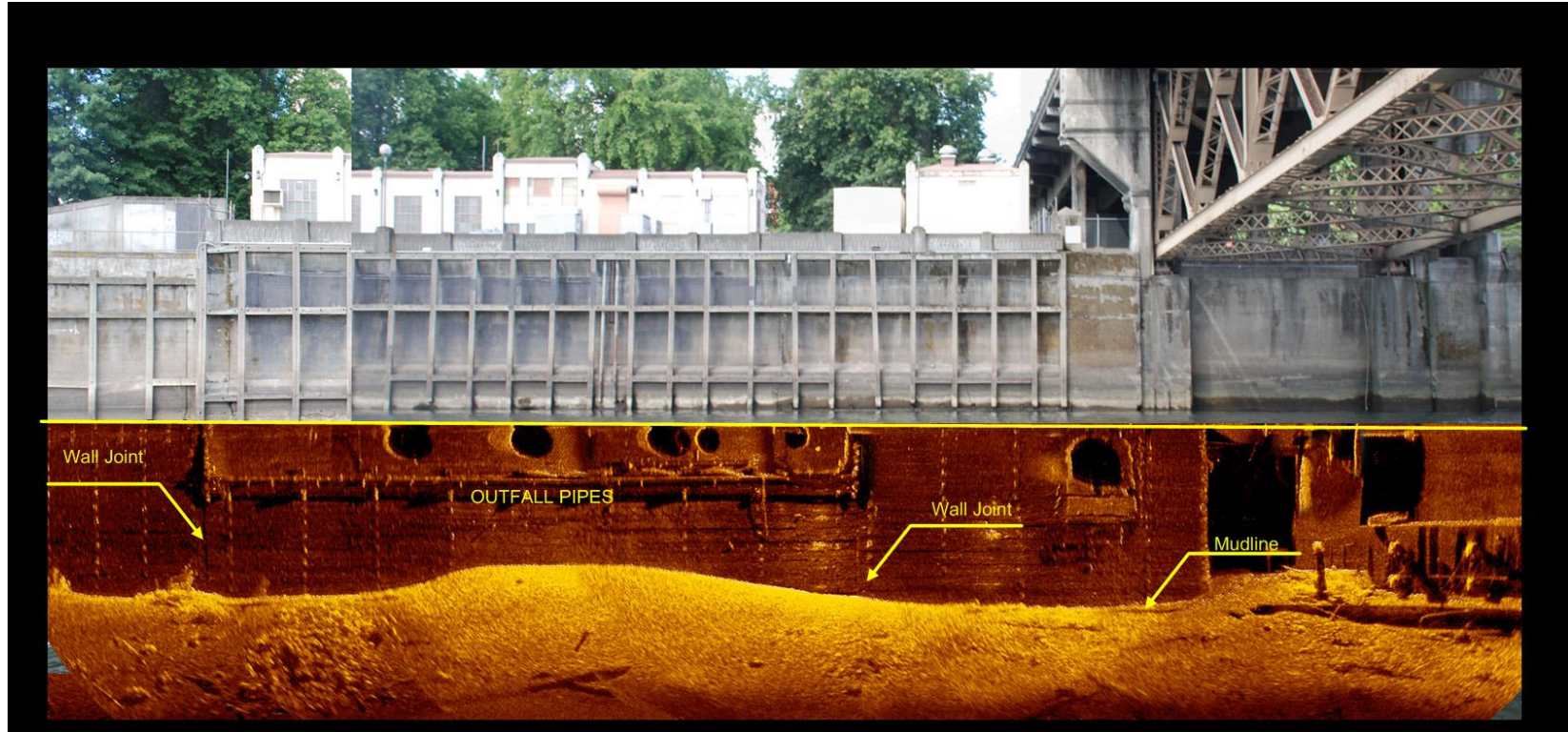


Bridge Scour

Bridge Pier Scour

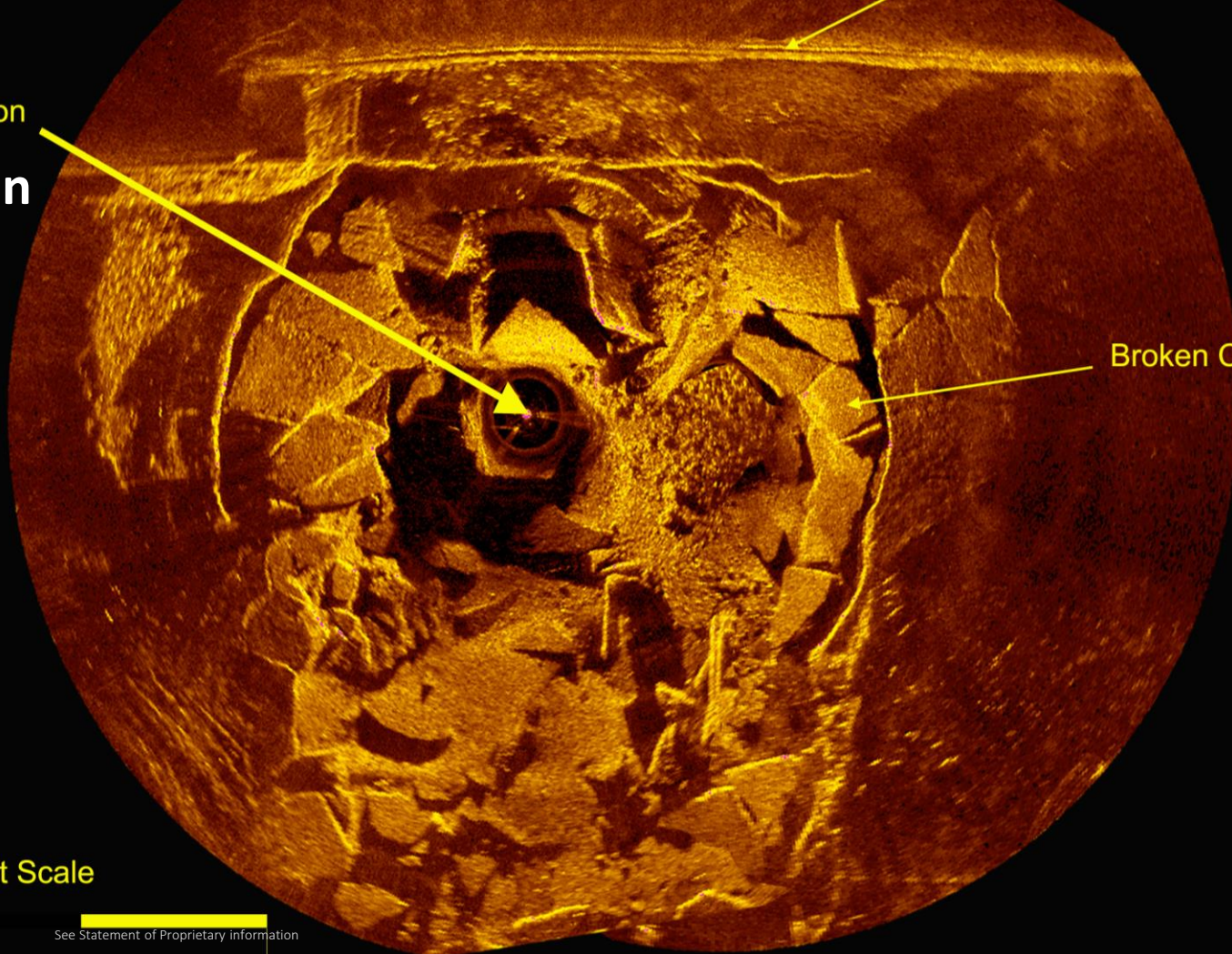


Sea Wall in the vertical plan



Sonar Location

Dam Apron Broken Apart

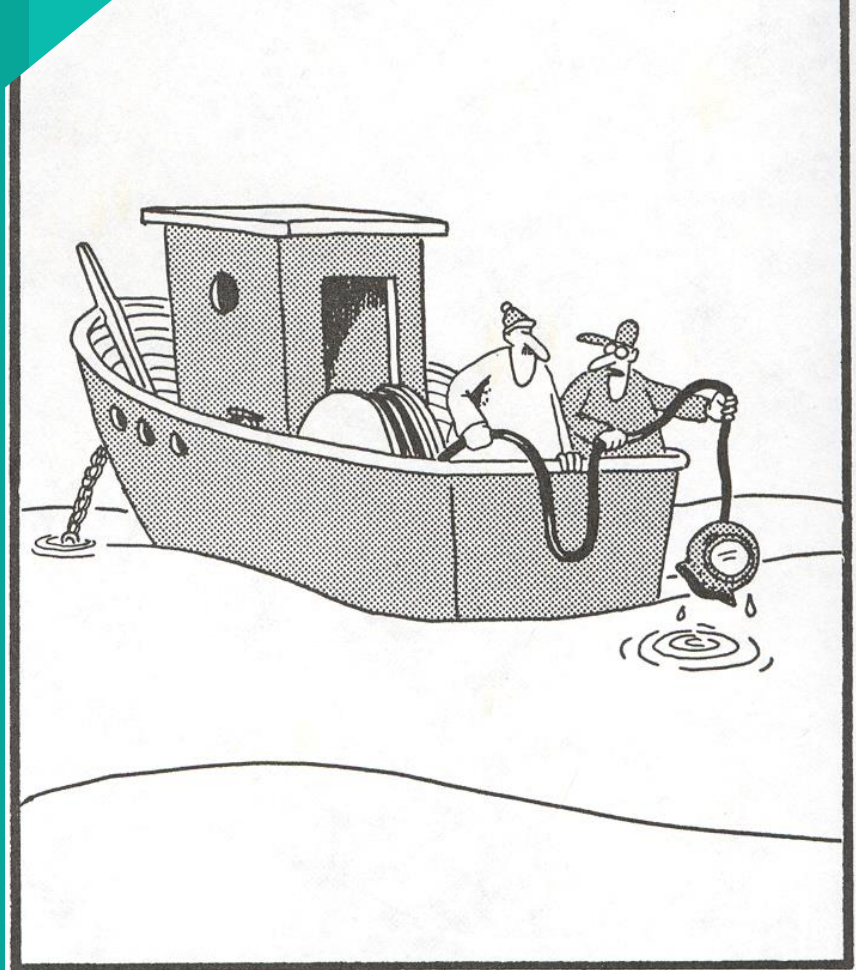


Broken Concrete

60 Foot Scale

Brian Abbott

- ▶ Bdabbott@outlook.com
- ▶ Mobile 517-256-7233



“Well, so that’s it. . . . I thought he was coming up awfully easy.”



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Thank you! ...questions?

Jessica.daignault@kd.kongsberg.com
bdabbot@outlook.com