

The use of highly economic, lighter class AUV's for shallow water infrastructure surveys



Perth, 23rd October 2019

# AGENDA

Introduction to Blue Ocean Monitoring

Background

Equipment

Proof of Concept Trials

Survey Methods

Operational Results

Future Ventures



# BLUE OCEAN MONITORING

We are a global marine survey company, committed to providing highly innovative solutions to offshore industries.

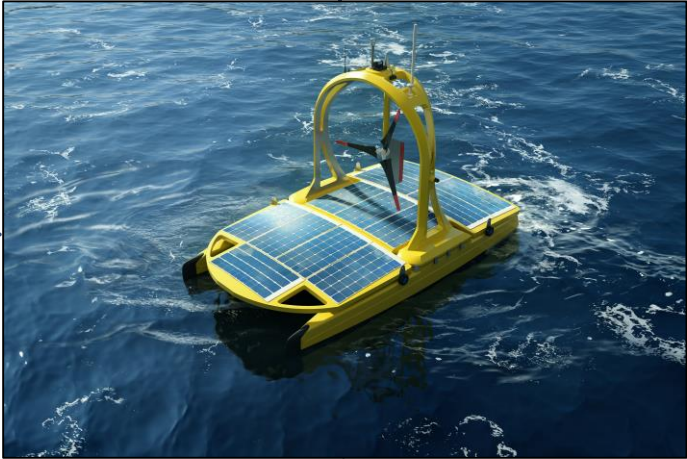
- 
- We **Develop** Autonomous Technology
    - *Vehicle Modification and Refinement*
    - *Sensor Integration and Testing*
    - *Navigational and Control Systems*
  - We **Own/Operate** Autonomous Technology
    - *Autonomous Underwater Vehicles (AUV)*
    - *Autonomous Surface Vehicles (ASV)*

# TECHNOLOGY

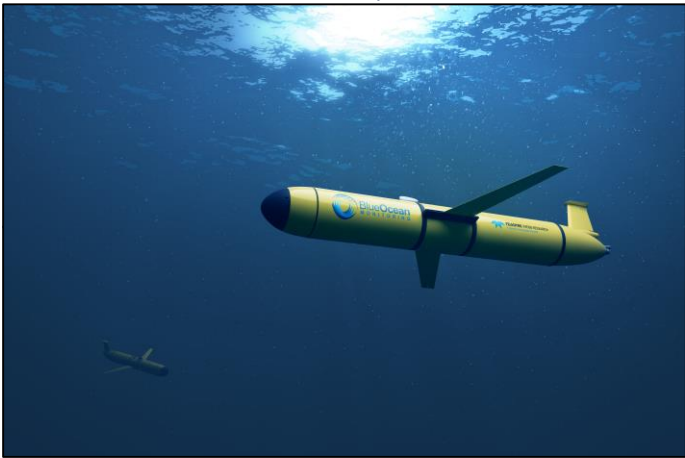
Long Duration  
Gliders

Conventional  
Propulsion

Surface  
(ASV)



Underwater  
(AUV)



We adopt the latest generation of unmanned vehicles specifically designed to significantly lower project costs, reduce survey schedules and minimize human intervention.

# AUTONOMY

Autonomous vehicles are proven in to positively impact your offshore projects by reducing:



**COST**



**RISK**



**SCHEDULING**



**LOGISTICS**

With minimal environmental impact and entirely reliant on onboard power supply, these technologies can significantly improve your specific data requirements in:



**RESOLUTION**



**ACCURACY**



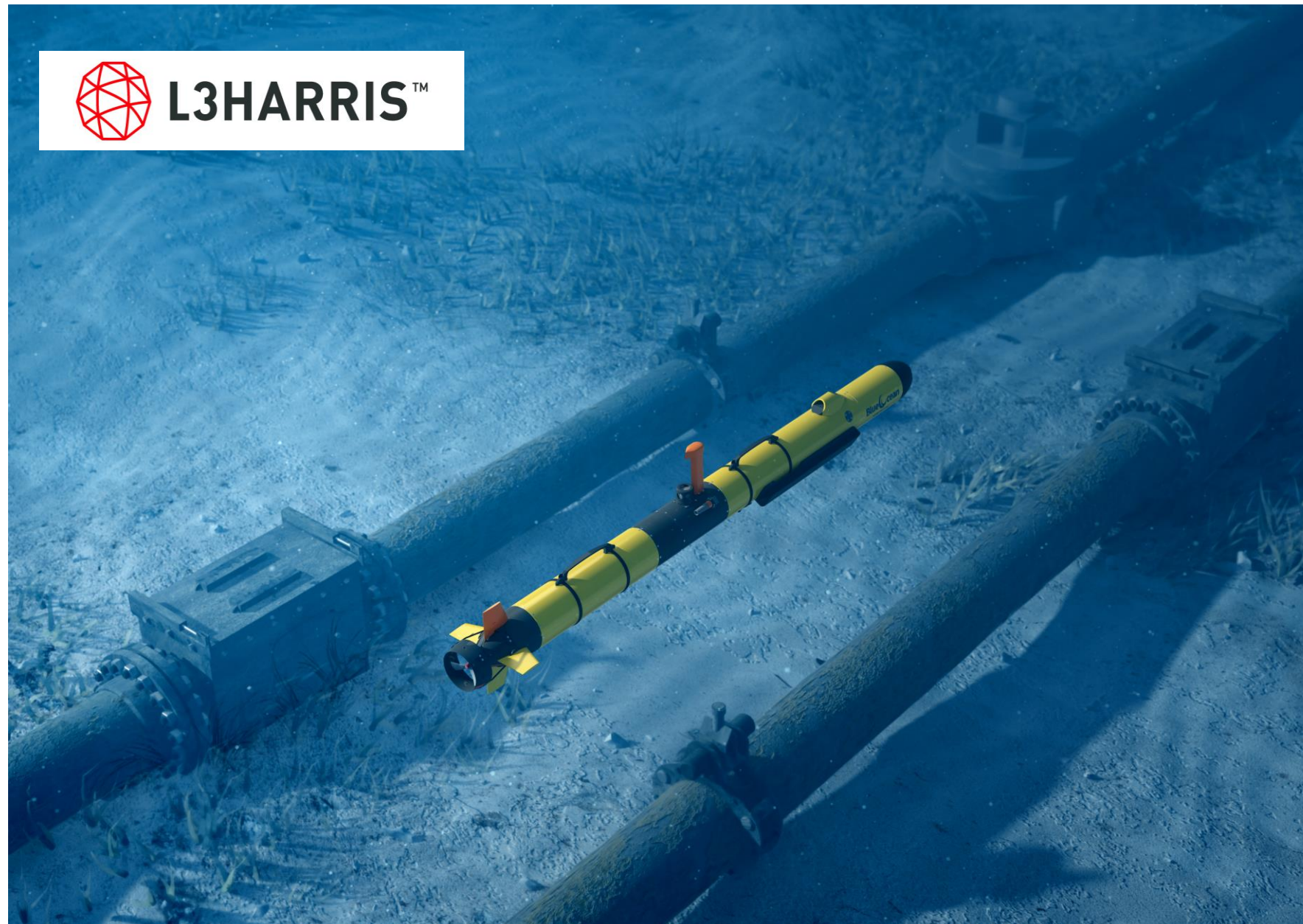
**QUALITY**



**ACCESSIBILITY**



# LIGHT CLASS AUV



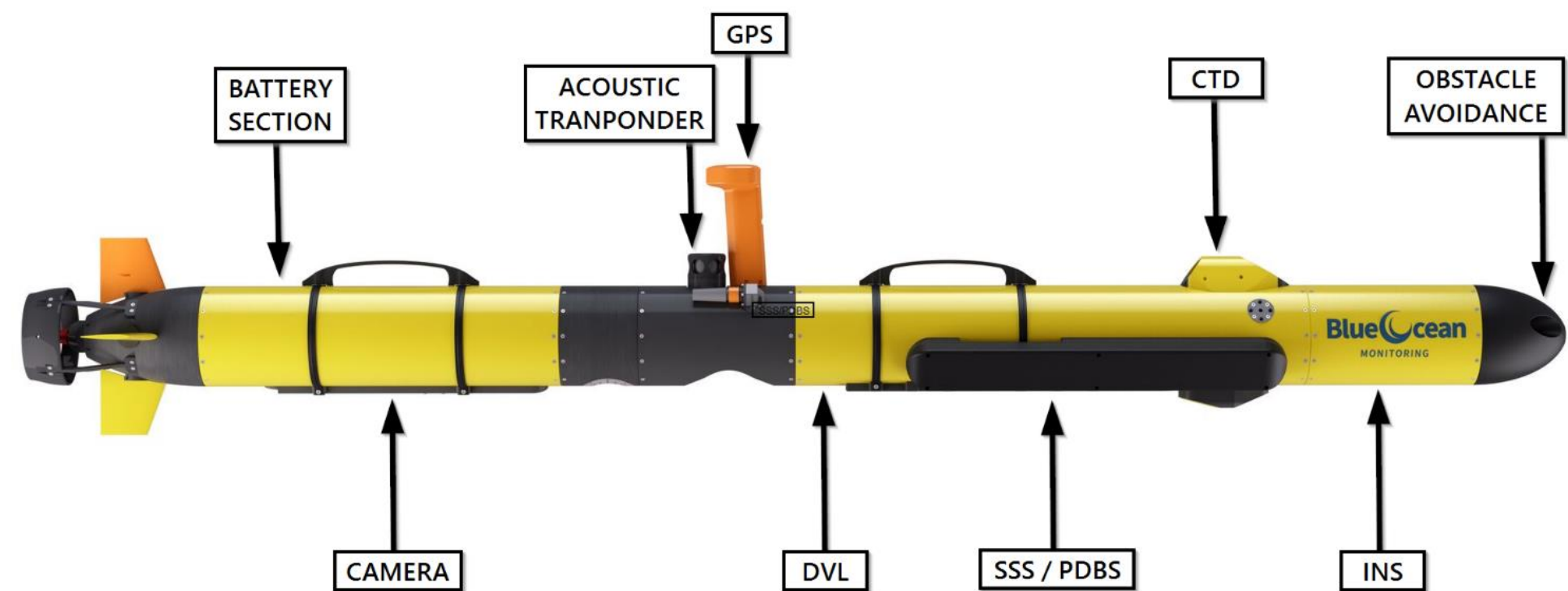
## NAVIGATIONAL PAYLOAD

- Proven Technology
  - Over 300 systems provided to Commercial, Academic and Defence Sectors
- Highly Economic
  - In comparison to conventional ROV or AUV operations
- Minimal Vessel Requirement
  - Small vessel operations with no LARS required

## SENSOR PAYLOAD

- Side Scan Sonar (SSS)
- Interferometric Bathymetry (PDBS)
- Digital Camera (Video and Still)
- Water Quality Sensors
  - e.g. CTD, Turbidity, Fluorometry, DO, pH

# OCEANSERVER IVER-3 AUV



## IVER-3 DETAILS

- Length: 1.8 - 2.1m
- Diameter: 0.15 m
- Weight: 30-35 kg
- Speed: 4 knots
- Duration: 4 - 8 hours
- Depth: 200 m

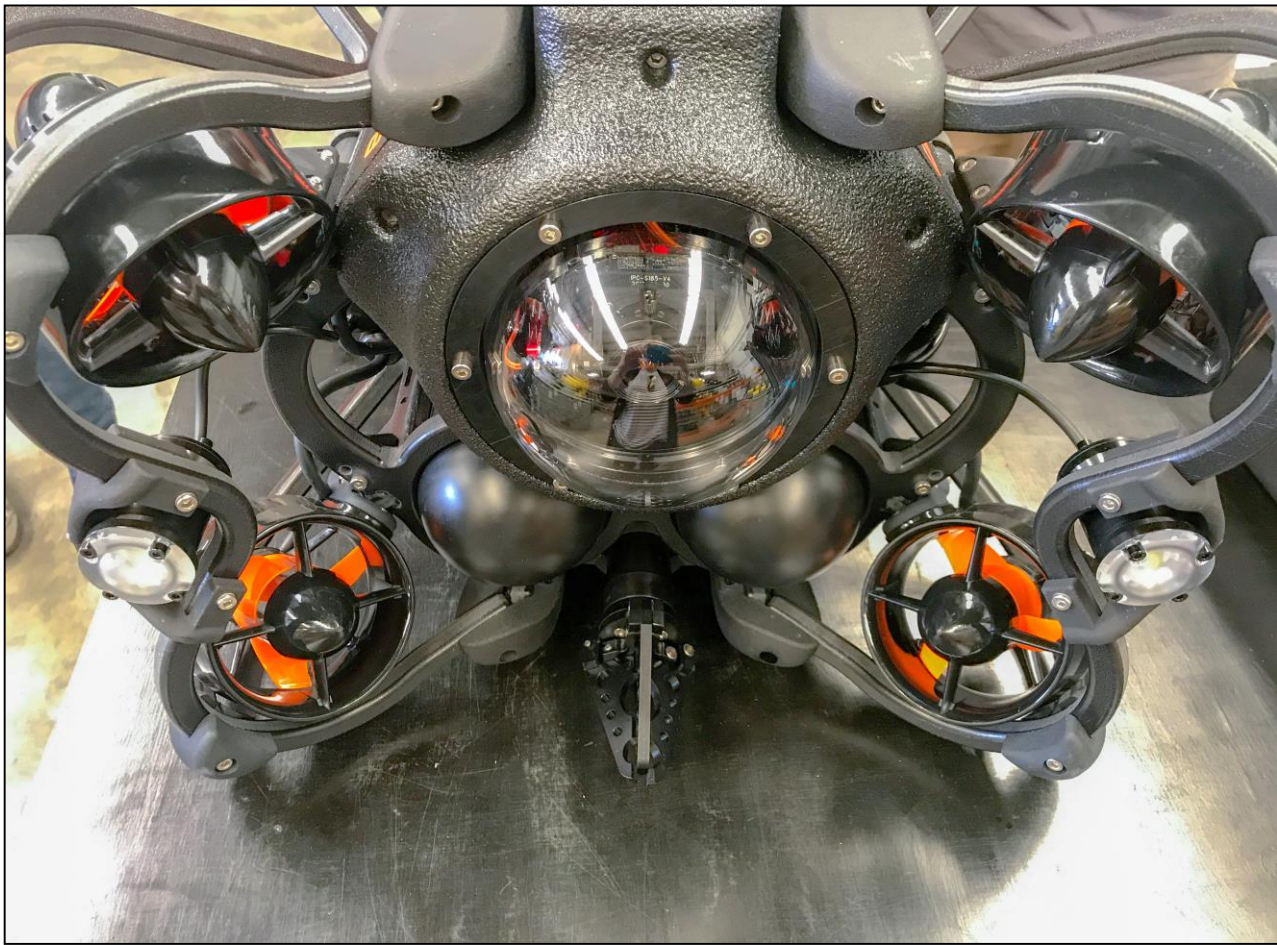
Type	Sensor	Manufacturer	Model
SSS	Side-Scan Sonar	EdgeTech	2205B (600/1 600 kHz)
PDBS	Interferometric Sonar	Edgetech	2205B (600 kHz)
Camera	Digital Camera	Allied Vision	Mako G-234C
GPS	Global Positioning System	u-Blox	NEO-7P
CT	Conductivity, Temperature Sensor	Neil Brown	NBOSI CT
INS	Inertial Navigation System	Ixblue	PHINS-C3
DVL	Doppler Velocity Logger	Teledyne	RDI Explorer
OAS	Object Avoid Sonar	Imaginx	UMS-852
Communications	Acoustic Modem & Transducer	Blueprint Subsea	SeaTrac X010/X150



# Oceanbotics SRV-8 ROV

## SRV-8 DETAILS

- Length: 0.50 m
- Width: 0.43 m
- Height: 0.33 m
- Weight in air: 18 kgs
- Tether Length: 250 m
- Speed: Up to 2 knots



Sensor	Details
Camera	Dual-Mode Low-Light Analog/HD
Lights	Two 135° Beam Angle, 1500 Lumens Each
Imaging Sonar	Blueprint Subsea Oculus M750d (750/1200kHz)
Acoustic Communications	Blueprint Subsea Seatrac X010/X150
Manipulator Arm	3-Jaw RJE Oceanbotics Grabber



# Proof of Concept

## Shallow Pipeline Inspection Surveys

LOCATION: Varanus Island, Western Australia

WATER DEPTHS: 0 - 20 m

DATES: September 2019

# PROOF OF CONCEPT – Varanus Island, Australia

## Scope of Work

## AUV Survey Scope of Work

- North-East Pipelines (3 x 2.2 km)
- South-West Pipelines (3 x 1.5 km)
- Additional Points of Interest
- South-East Pipelines (3 x 1.5 km)

## Primary Sensors

- SSS – Side Scan Sonar
- PDBS – Interferometric Bathymetry
- Camera – Digital Images
- CTD – Conductivity, Temperature and Depth

## Objective

The ultimate objective is to assess free spanning, submergence, movement or deformation of pipeline and compare with results of previous surveys (vessel based, ROV and larger AUV conducted at this site).





# ORGANISATION

## Project Requirements

- On-Site Personnel: 2x AUV Operators
- Freight: 2x Pallets (which include 1x AUV & 1x ROV)
- Mobilization / Demobilization: 1- 2 hours
- Support Vessel: >10m



COST



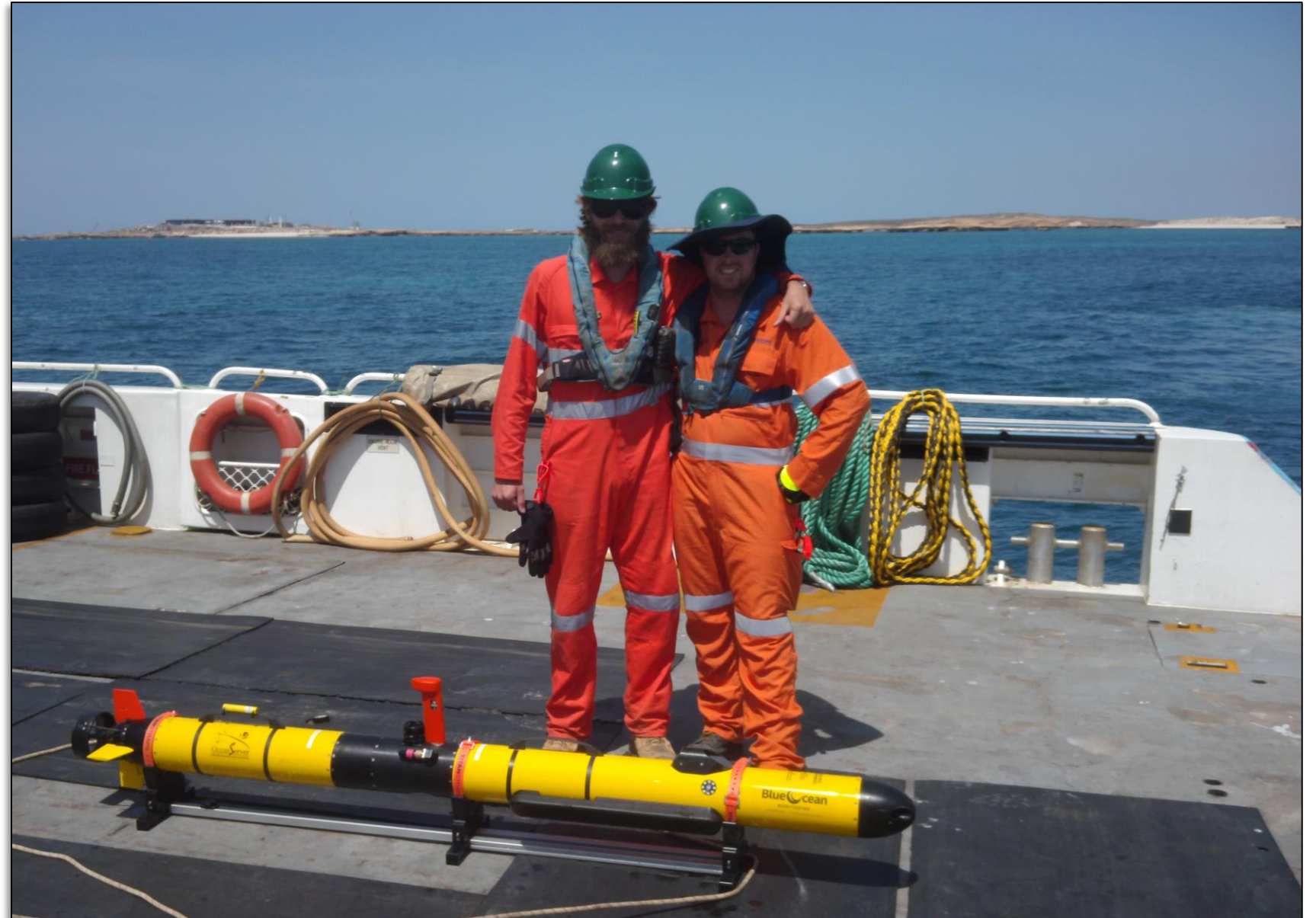
RISK



SCHEDULING



LOGISTICS

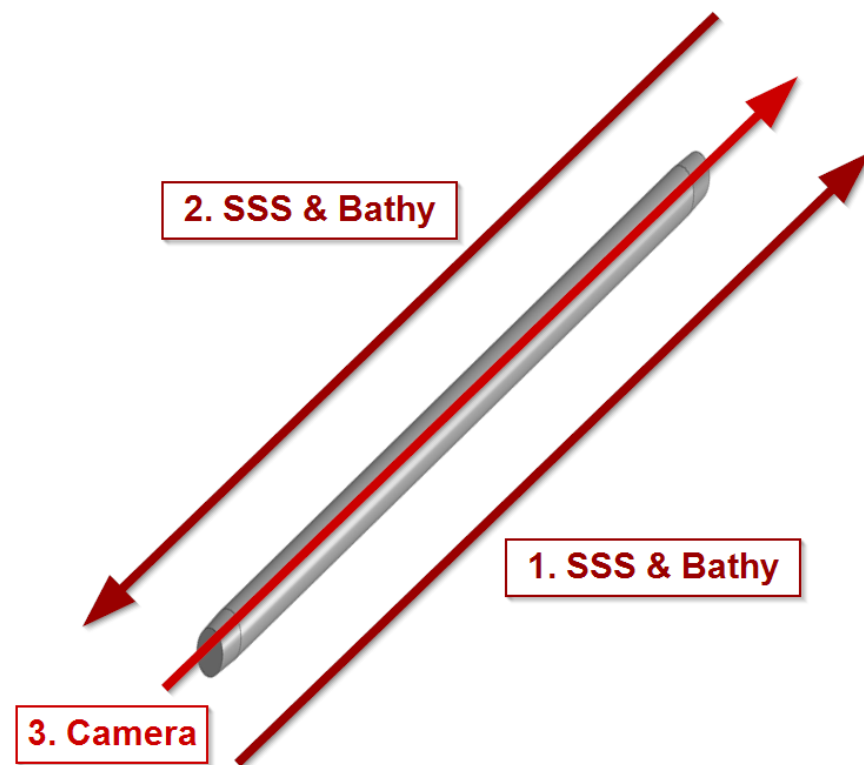




# MISSION PLANNING

## Survey Methodology

- Run surveys from shore to depth & return
- SSS & Bathymetry Runlines 2x – offset pipeline
- Camera Runlines 1x – directly over pipeline
- Position correction surfacing at regular intervals



## AUV Mission Plans

- Created with OceanServer VectorMap Software





# SURVEY SETTINGS

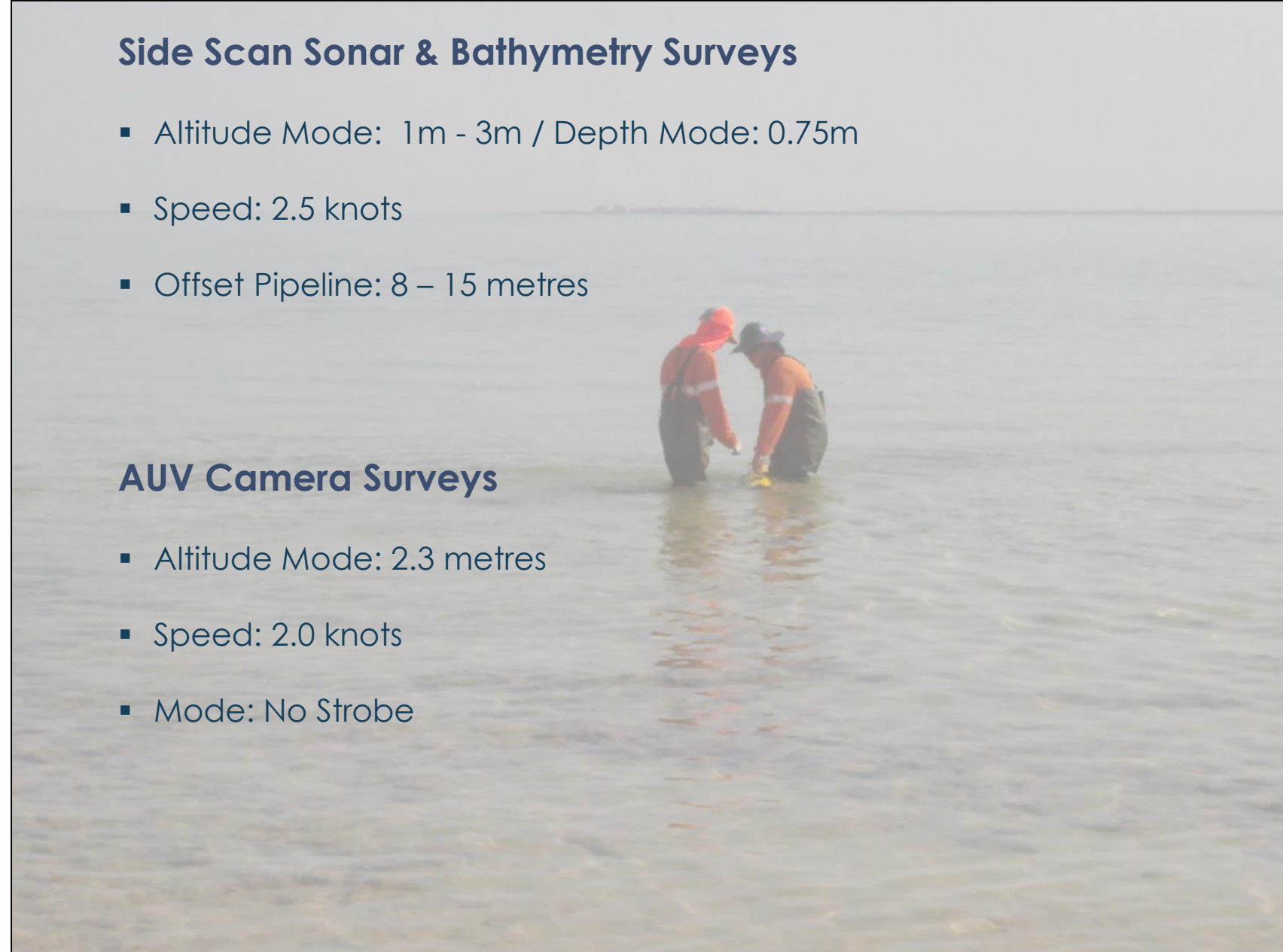


## Side Scan Sonar & Bathymetry Surveys

- Altitude Mode: 1m - 3m / Depth Mode: 0.75m
- Speed: 2.5 knots
- Offset Pipeline: 8 – 15 metres

## AUV Camera Surveys

- Altitude Mode: 2.3 metres
- Speed: 2.0 knots
- Mode: No Strobe





# OPERATIONS

## AUV Launch & Recovery

- All AUV launched from shore to depth
- Recoveries onshore and vessel safe, quick and easy

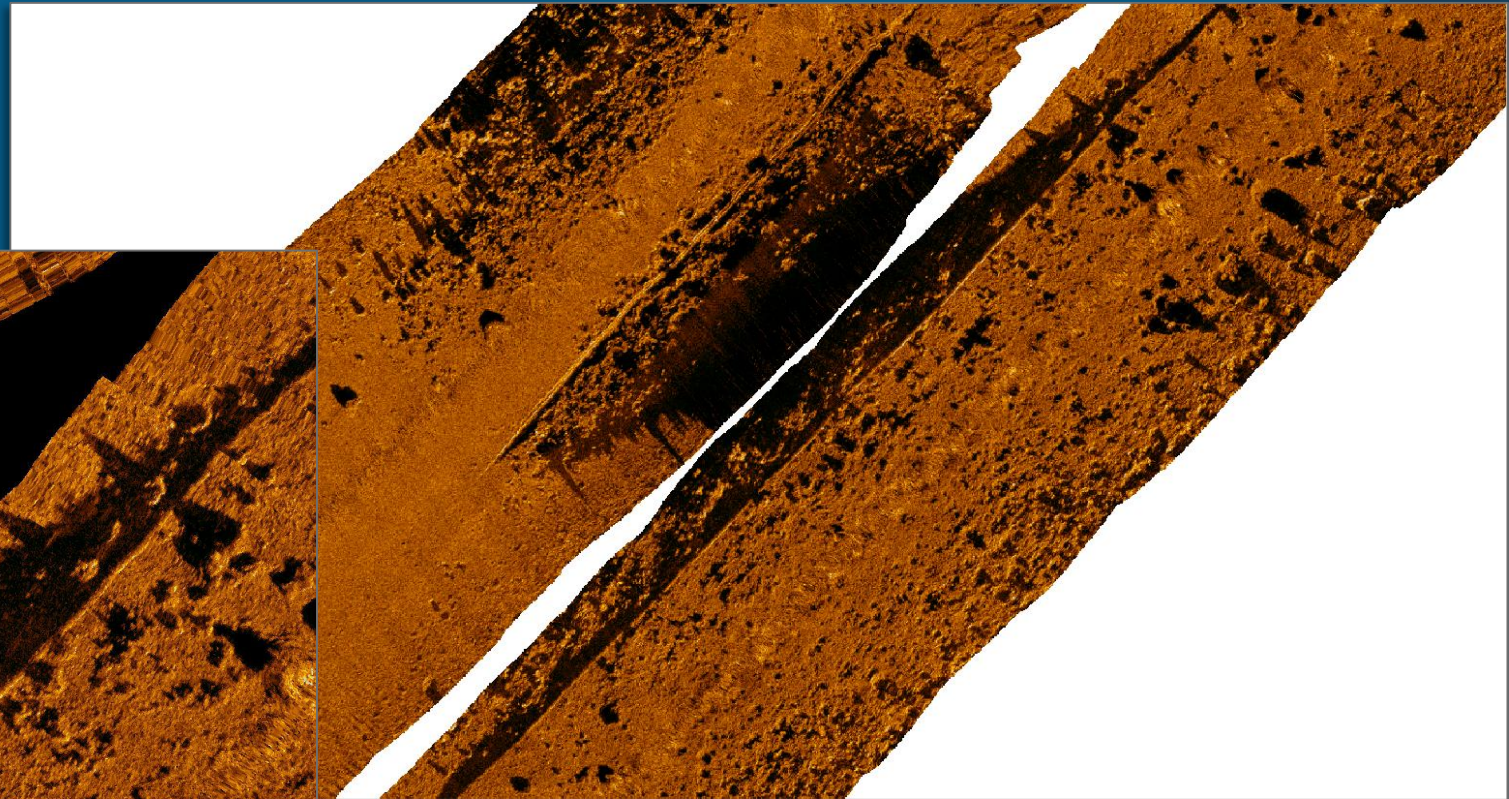
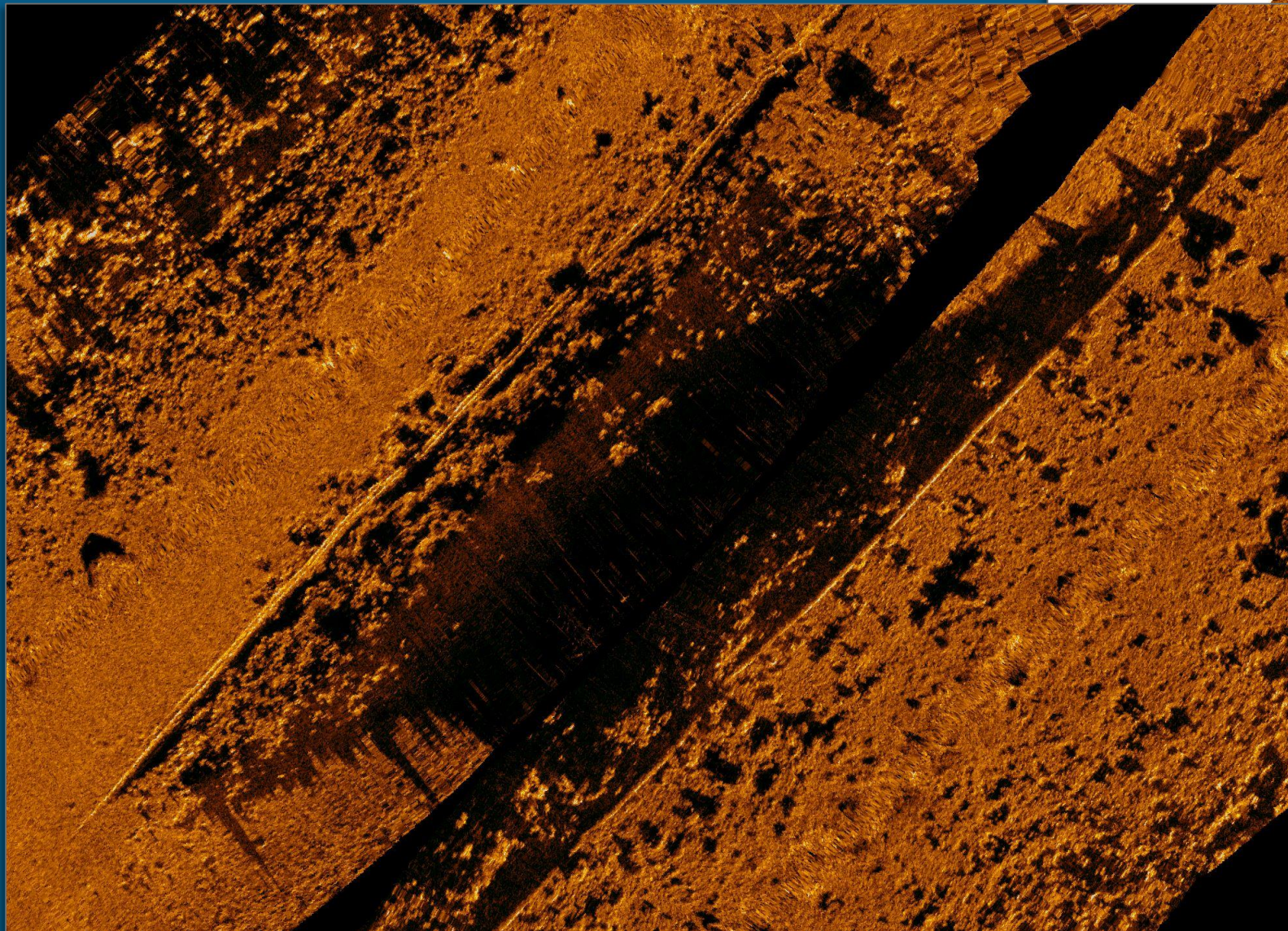


## ROV Launch & Recovery

- ROV conducted visual inspections from both shore and vessel



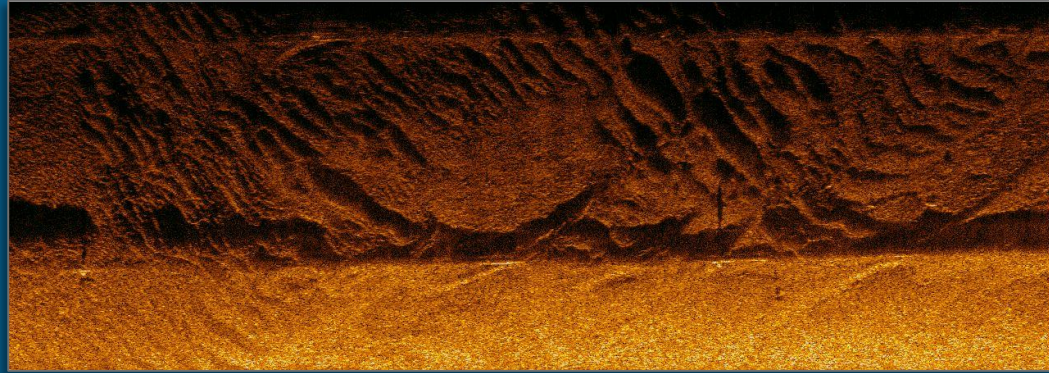
# SIDE-SCAN SONAR DATA: North-East Pipelines



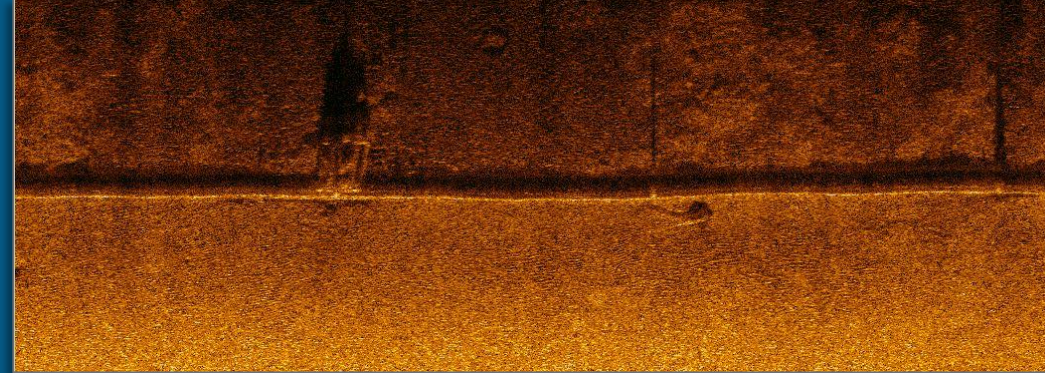
Pipeline Rock Dumping Site



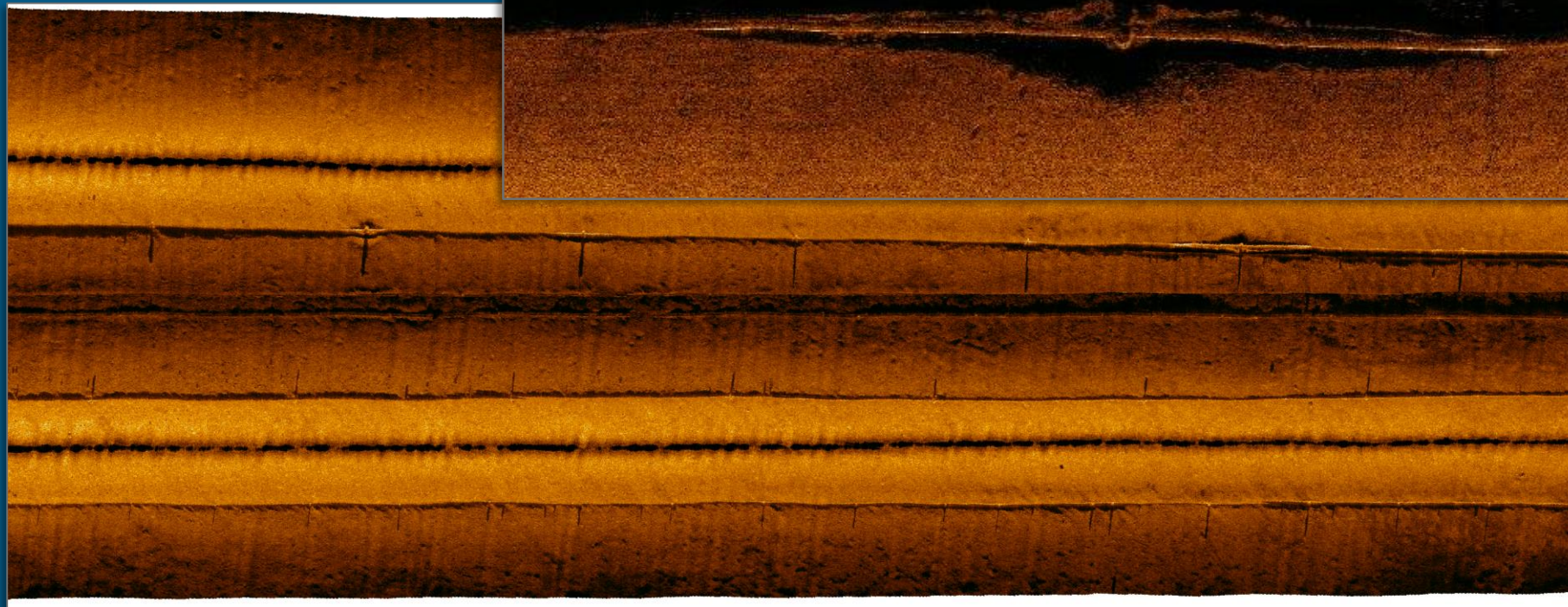
# SIDE-SCAN SONAR DATA: South-West Pipelines



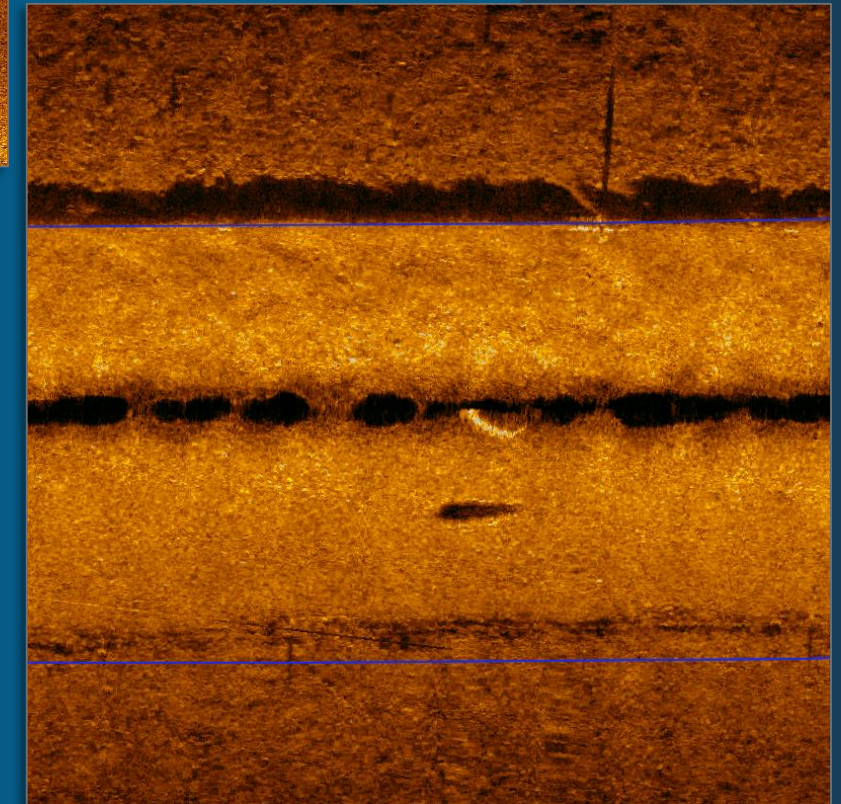
Seabed Characterisation



Infrastructure Visualisation



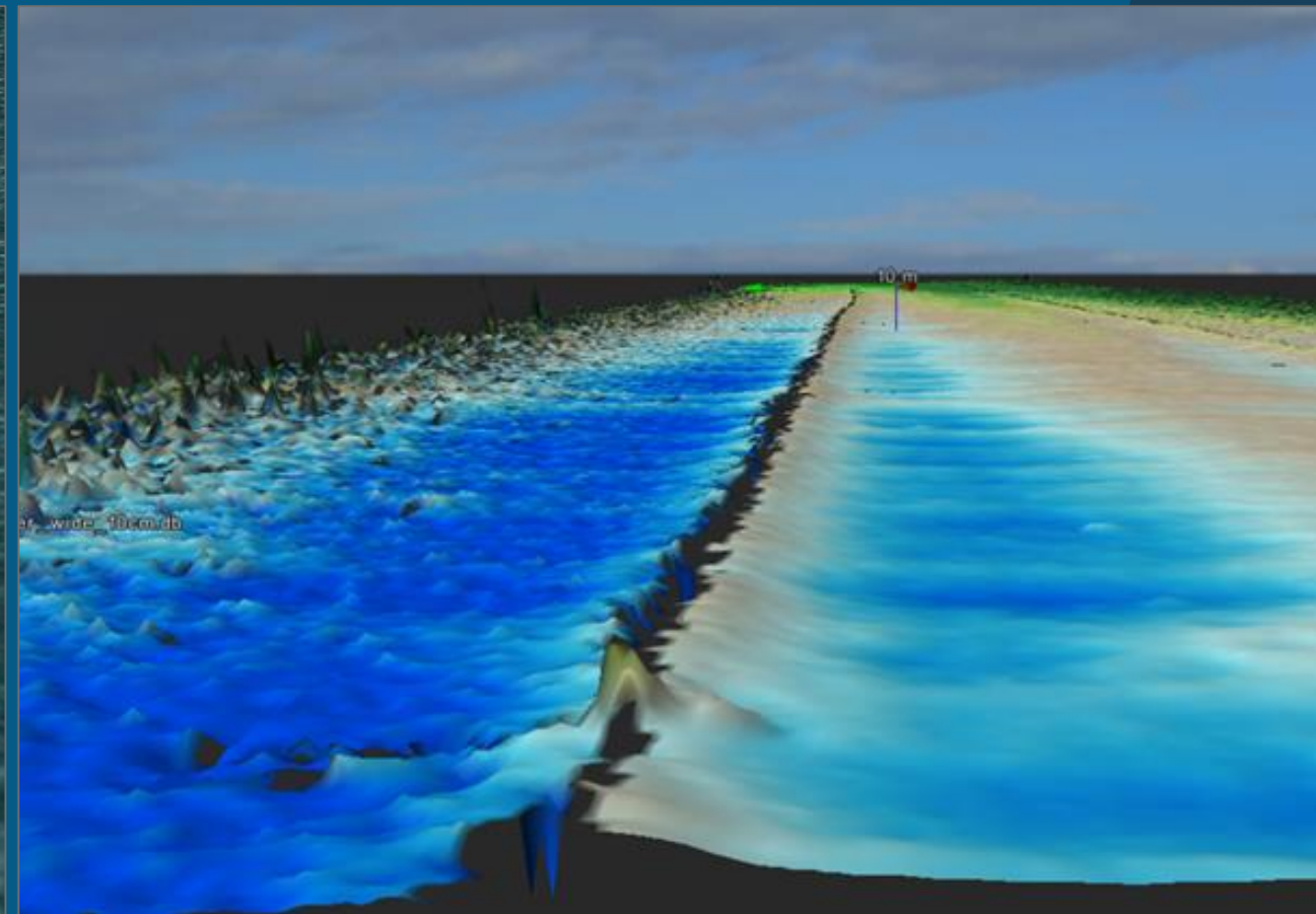
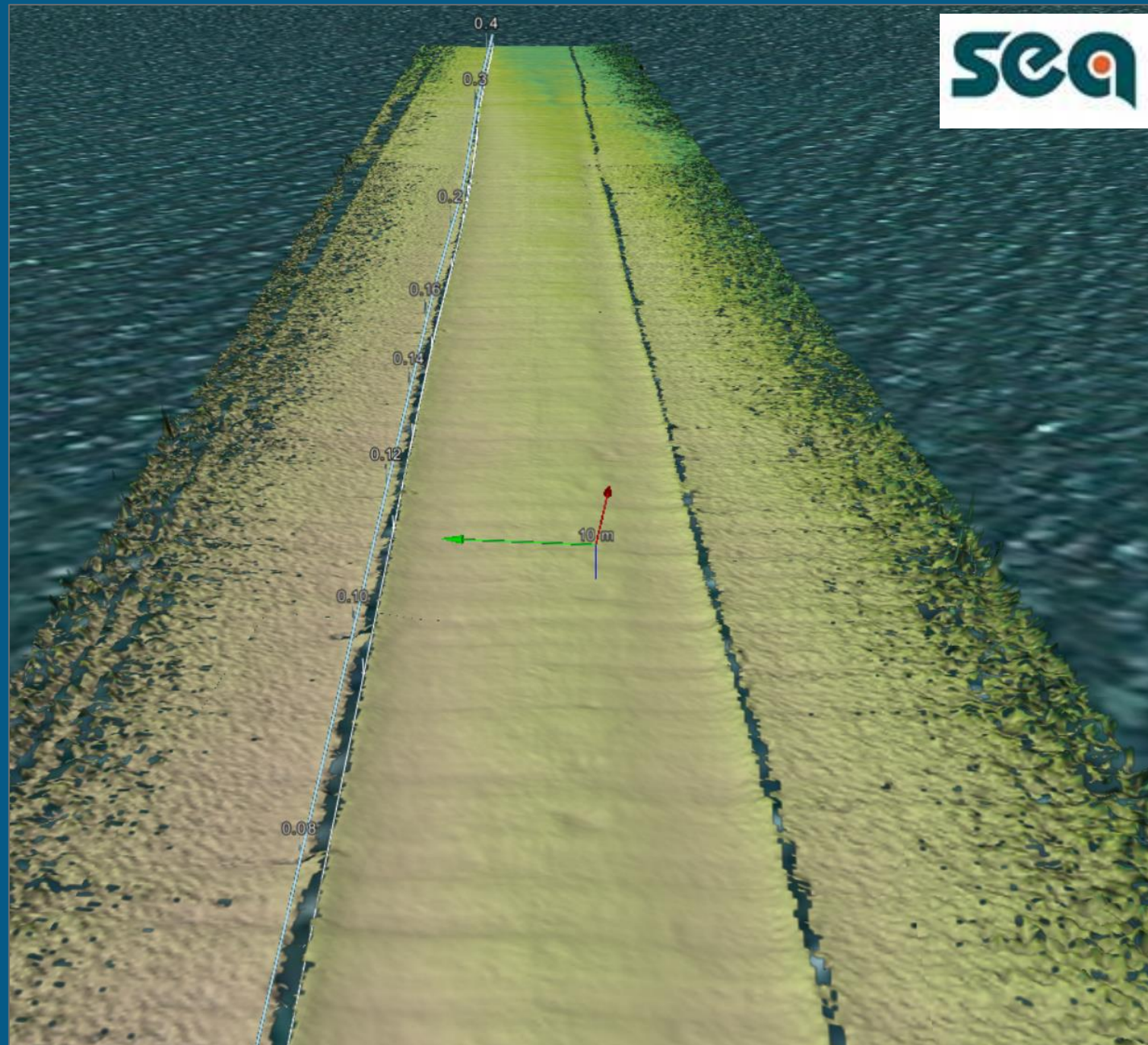
Pipeline Freespan Identification



Environmental Identification



# BATHYMETRY DATA: South-West Pipelines

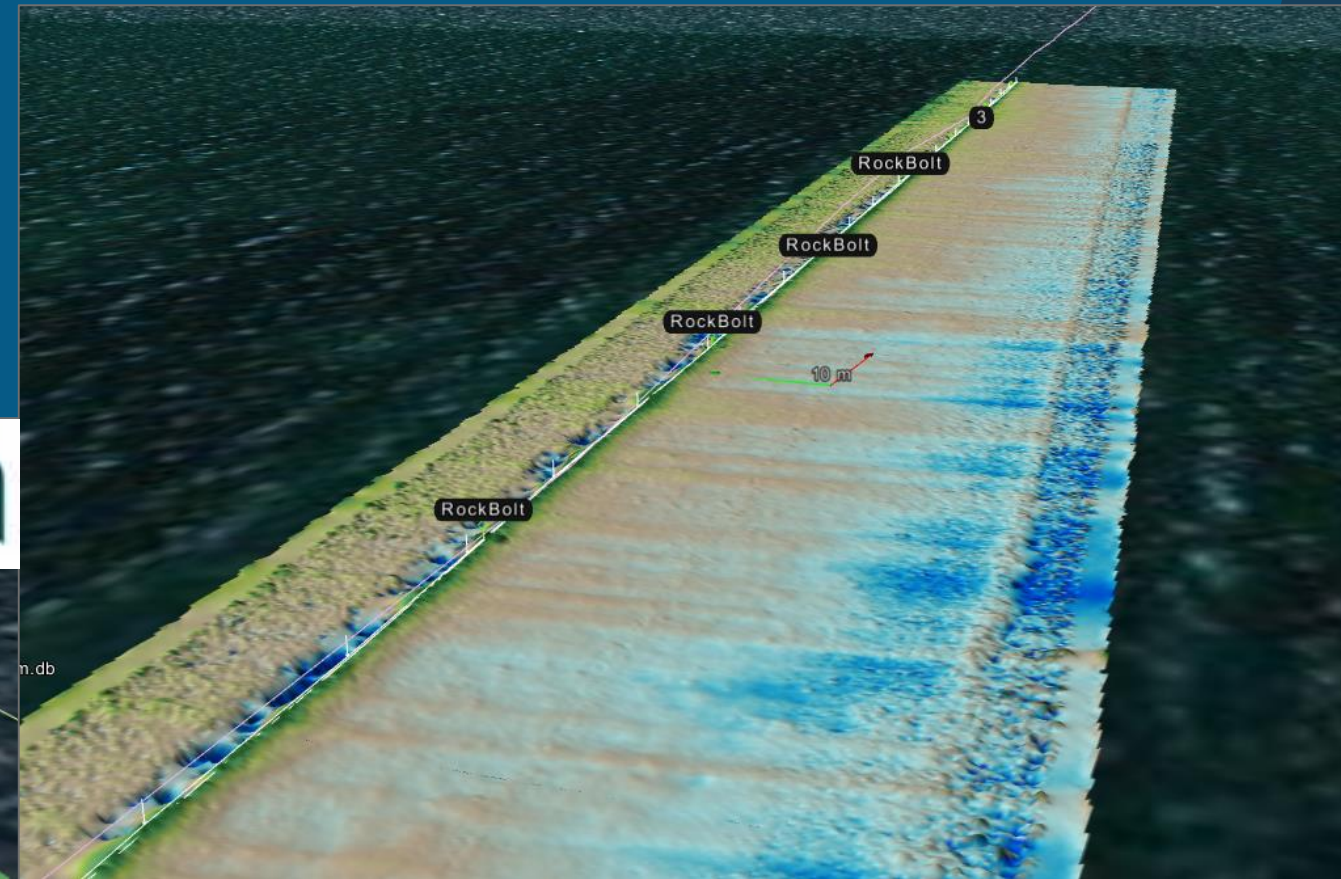
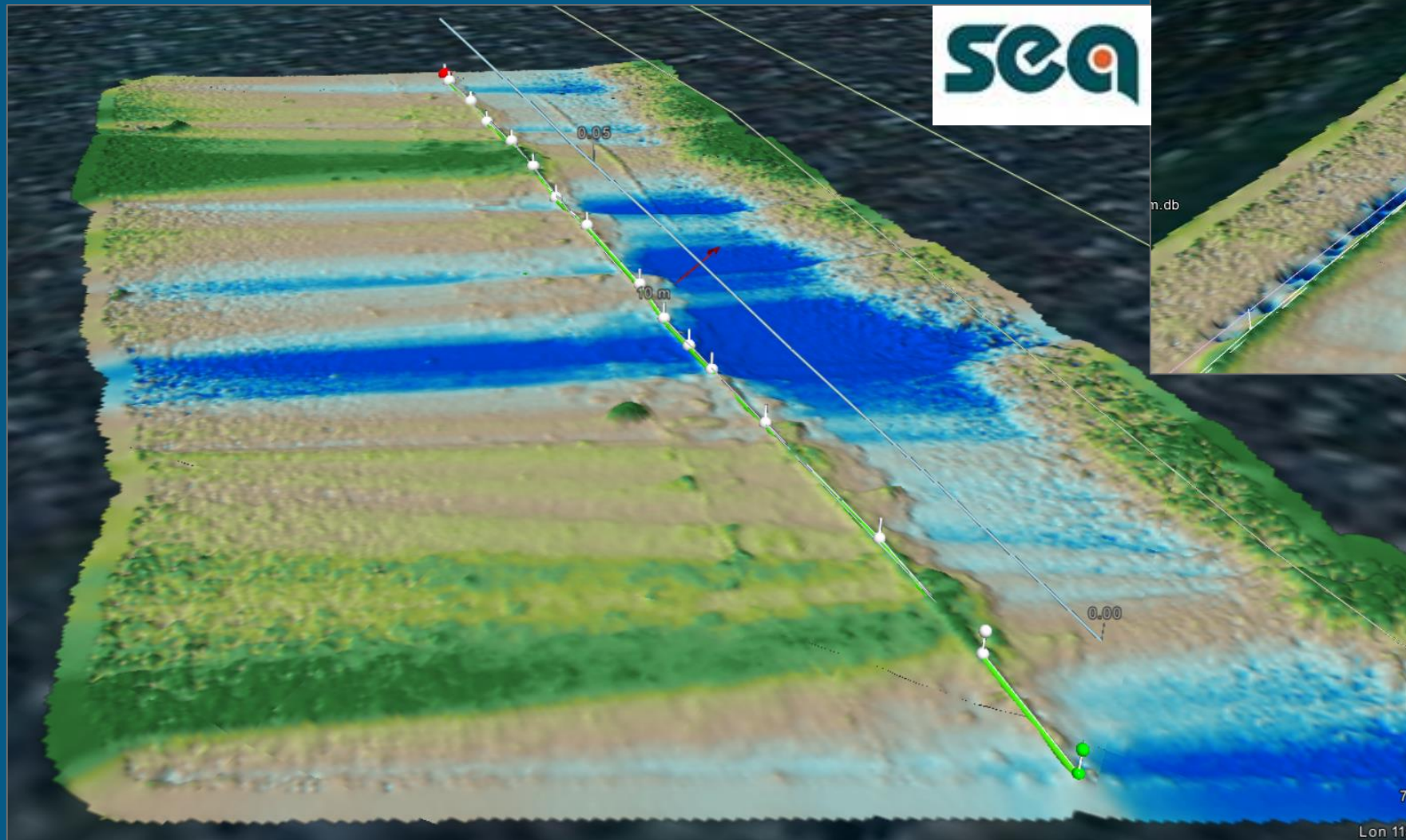


Post-processing data analysis  
by Subsea Engineering  
Associates (S.E.A.)



# BATHYMETRY DATA:

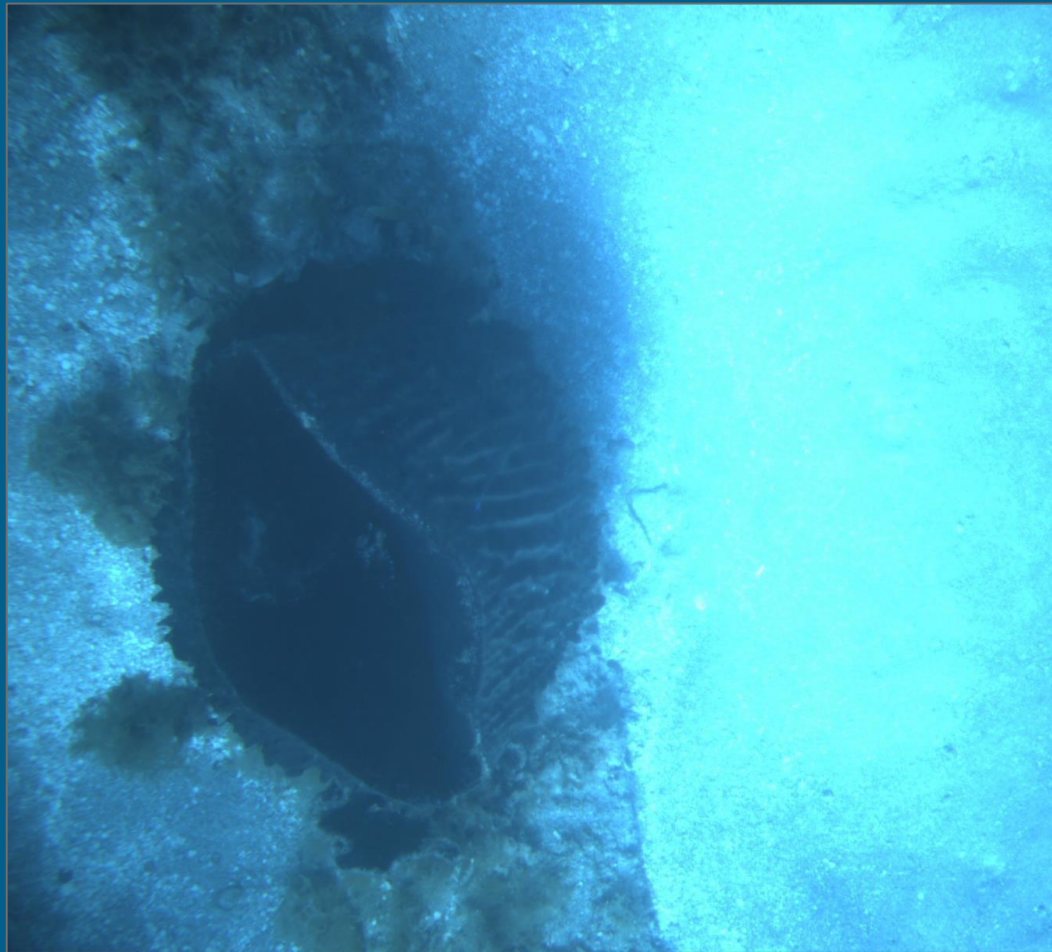
## South-West Pipelines



Post-processing data  
analysis by Subsea  
Engineering Associates  
(S.E.A.)



# AUV CAMERA DATA: South-West Pipelines

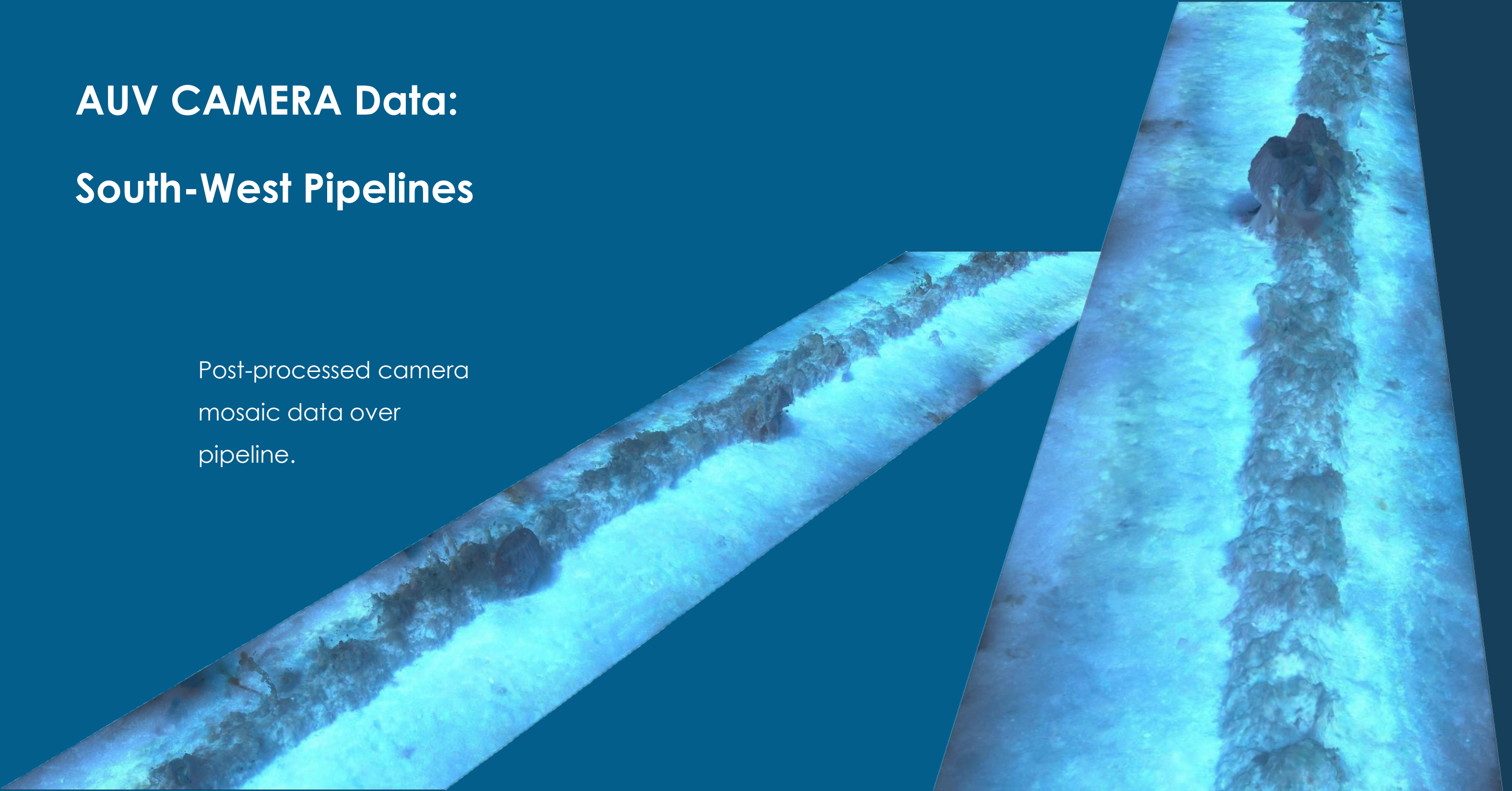


Camera images over pipelines  
depicting marine growth &  
environmental ecosystems



# AUV CAMERA Data: South-West Pipelines

Post-processed camera  
mosaic data over  
pipeline.





# ROV VIDEO DATA:

## South-West Pipelines

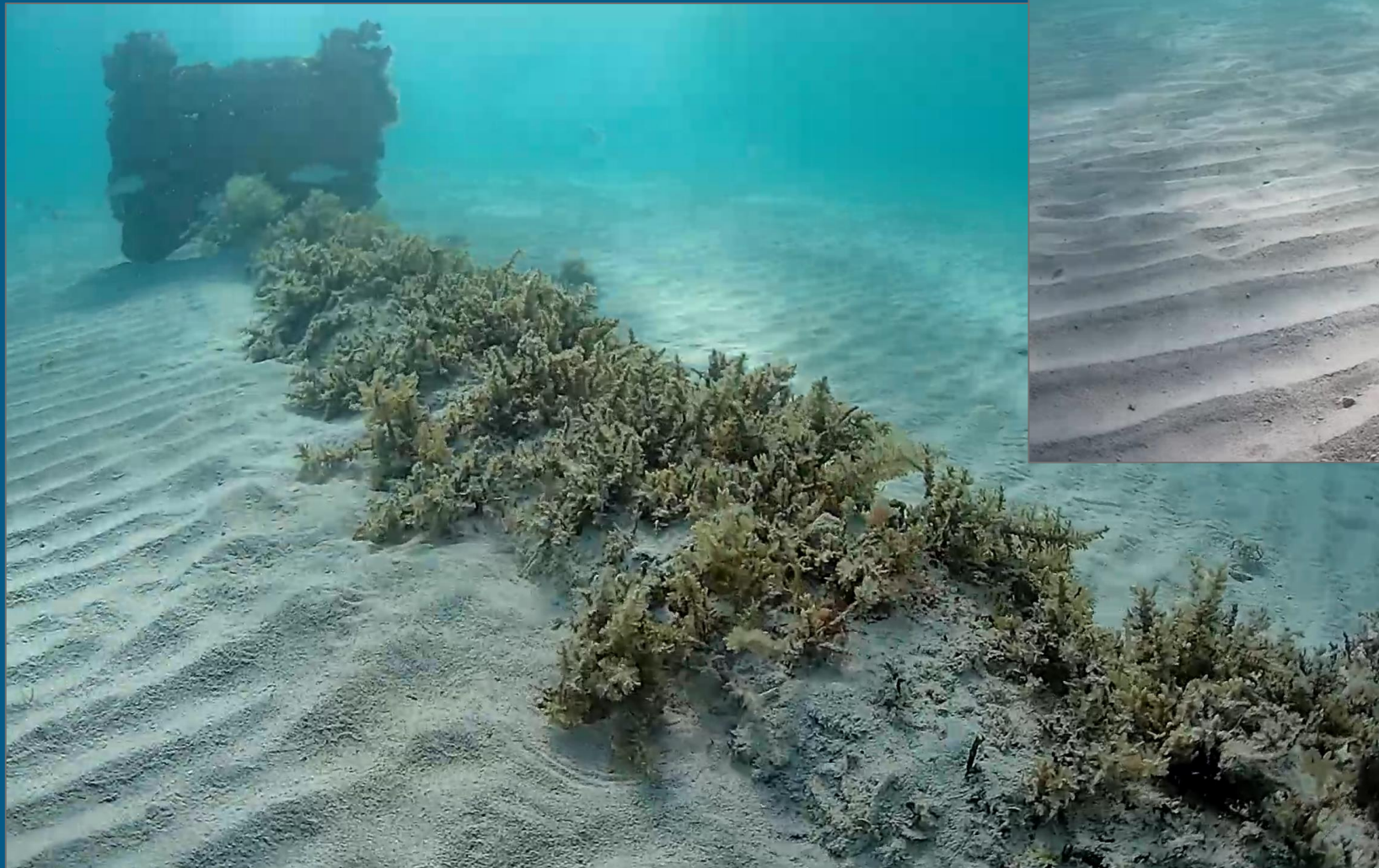


Video still images over pipelines depicting marine growth & environmental ecosystems



# ROV VIDEO DATA:

## South-West Pipelines



Inspection of pipeline  
freespans, burials and  
supports



# Project Outcomes

## Lessons Learnt

1. ✓ **Platform Stability:** AUV handles well in shallow coastal conditions
2. ✓ **Launch & Recovery:** from vessel or shore efficient and safe.
3. ✓ **Accuracy:** Correctly navigate AUV to survey intended pipeline structure.
4. ✓ **Quality:** Acquire consistent and accurate SSS and Bathy data at required resolution over length of pipeline.
5. ✓ **Accessibility:** System flexibility accommodated operational variations
6. ✓ **Camera:** Test newly integrated digital camera along pipeline structure
7. ✓ **Speed:** Fast data download  
(~50GB in 8 minutes)



RESOLUTION



ACCURACY



QUALITY



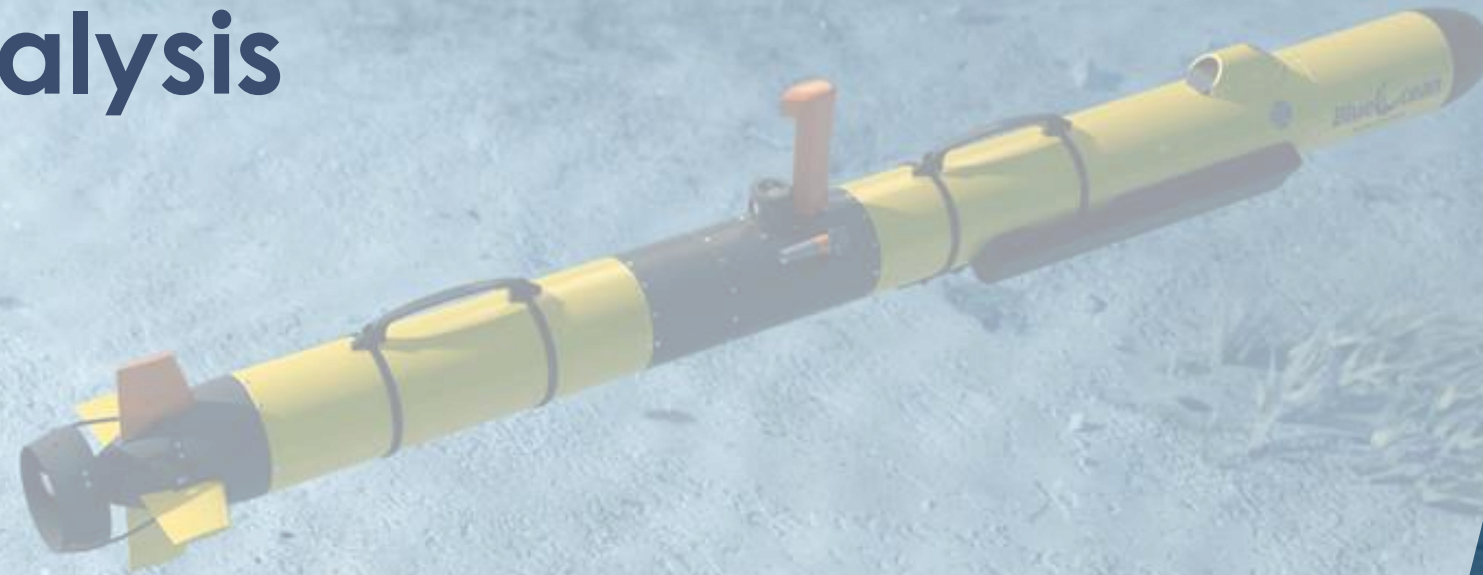
ACCESSIBILITY



# Preliminary Data Analysis

## Data Quality

- SSS – Excellent. High Quality Data.
- PDBS Bathy – Good.
  - Affected by currents and shallow depths
- Camera – Suitable images
  - Over – exposure imagery
- Positioning – good



## Recommendations

- Further tests to determine the optimal survey methodology for data acquisition in a variety of environments.



# AUV OUTLOOK FUTURE

## 1. Procure OceanServer Iver-3

✓ Ordered, received early September 2019

## 2. Conduct Pipeline Inspection Proof of Concept

✓ Project completed at Varanus Island Facility, Western Australia in September 2019 (7 days)

## 4. Conduct Series of Commercial Water Quality and Bathymetry Surveys

- Project secured with major client in Southern Indonesia in November 2019 (30 days)

## 5. Conduct Pipeline Inspection Proof of Concept

- Project secured in Malaysia in December 2019 (5 days)

## 6. Procure Second OceanServer Iver-3 AUV

- Planned in January 2020





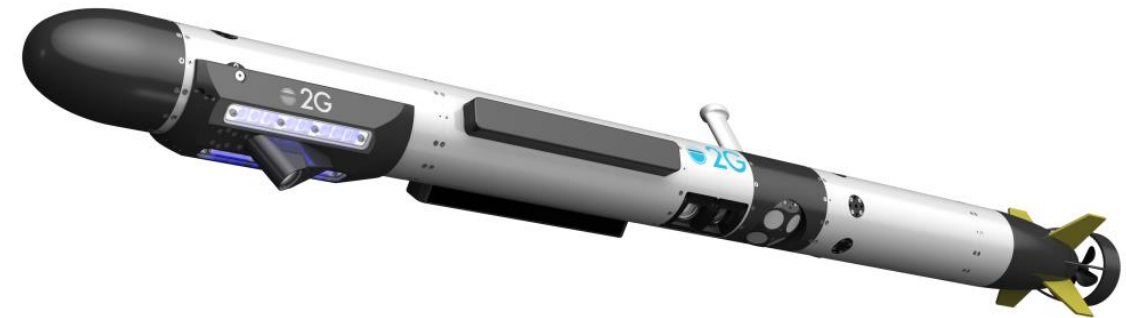
# RESEARCH AND DEVELOPMENT 2019/2020

## Non-Contact Cathodic Protection



- Successfully trialed on larger AUV and ROV platforms
- Iver-3 compatible prototype expected Q4 2019
- Blue Ocean Monitoring to trial system in **Q2 2020** in Australia

## 3D Laser Scanning



- Successfully
- trialed on larger AUV and ROV platforms
- Iver-3 compatible prototype expected Q3 2019
- Blue Ocean Monitoring to trial system in **Q1 2020** in Australia



# CLIENTS





# BLUE OCEAN MONITORING

[www.blueoceanmonitoring.com](http://www.blueoceanmonitoring.com)

## QUESTIONS?

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**BlueOcean**  
MONITORING