

# A Multi-Sensor Approach for Remote Locations



*Presented by:  
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Woolpert Chief Hydrographer*

# Pacific Regional Navigation Initiative (PRNI)

Safe and reliable passage through Pacific waters

Protect fragile ocean environments

Allow Pacific Islands countries' economies to develop



# Multi-Sensor Approach

iXblue Survey Team contracted to Land Information New Zealand (LINZ)

Satellite Derived Bathymetry - EOMAP

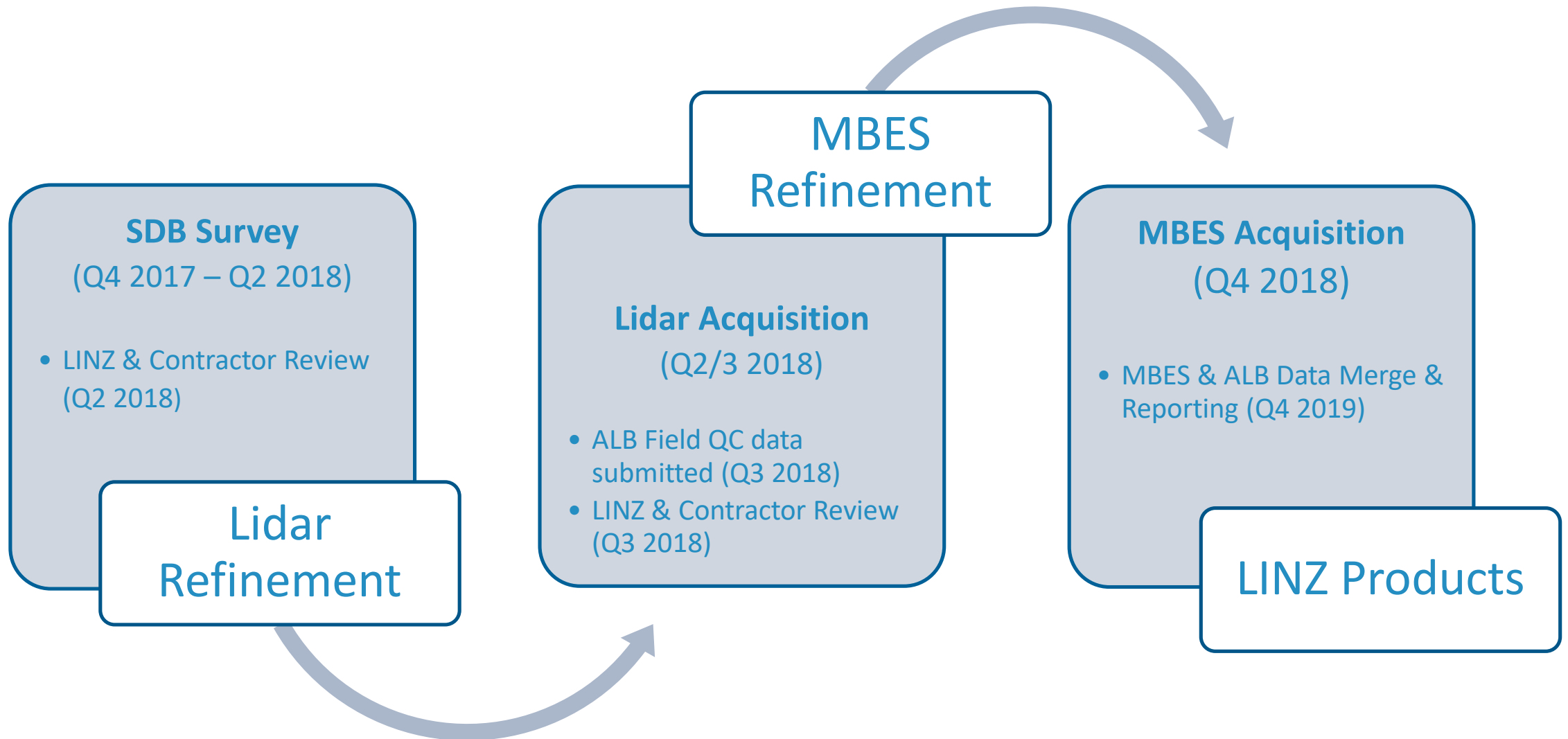
Airborne Topo-Bathy Lidar - Woolpert

Multibeam Echosounder - iXblue

Tide Gauge Install & Datum Computations (iXblue and Woolpert)



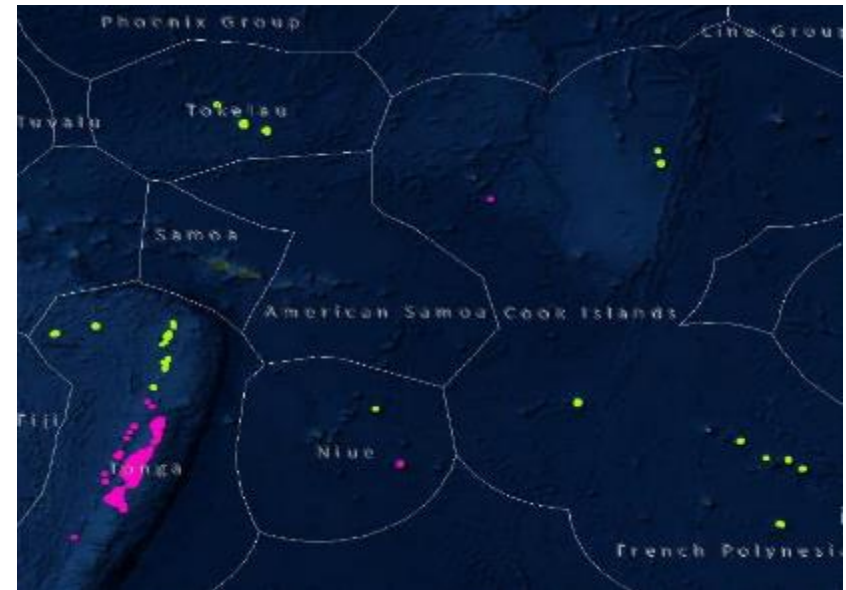
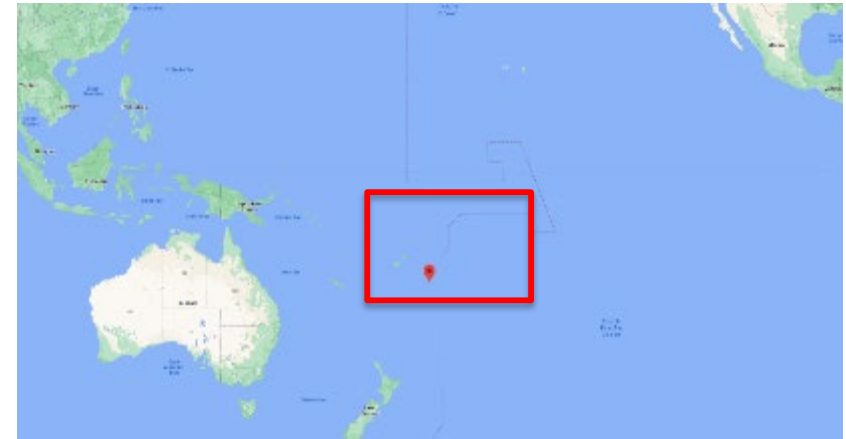
# Project Management Overview



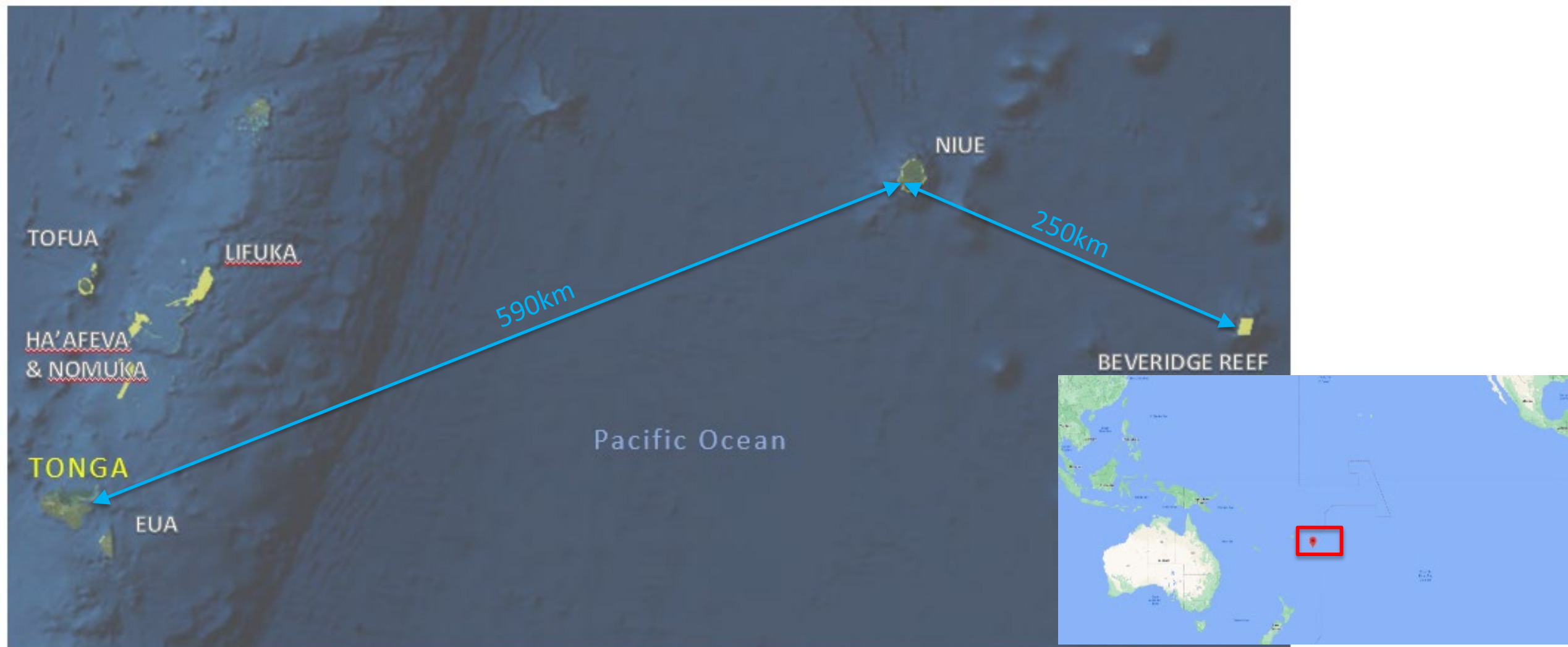
# Phase 1: Satellite Derived Bathymetry (SDB)

- Review > 350,000 sq km using 15m resolution imagery
- 52 Areas of Interest identified
- Over 6,000 sq km of SDB using 2m resolution imagery

Charting products containing SDB data from this project have already been published by LINZ

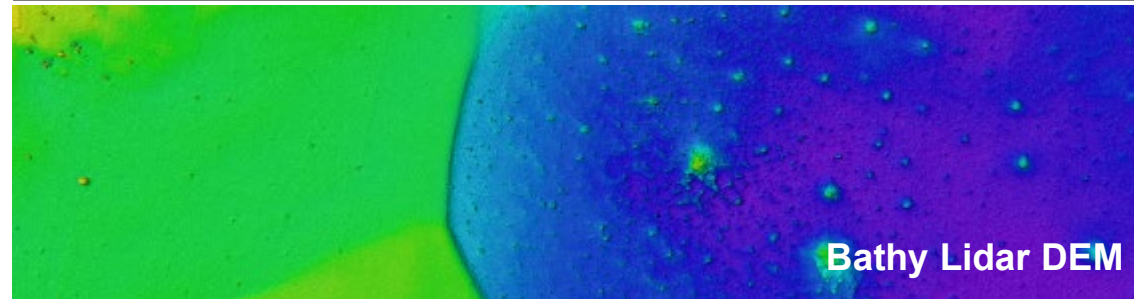
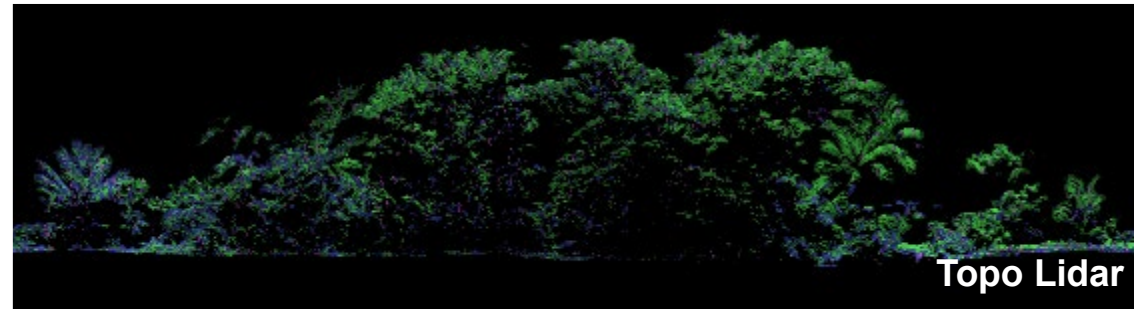
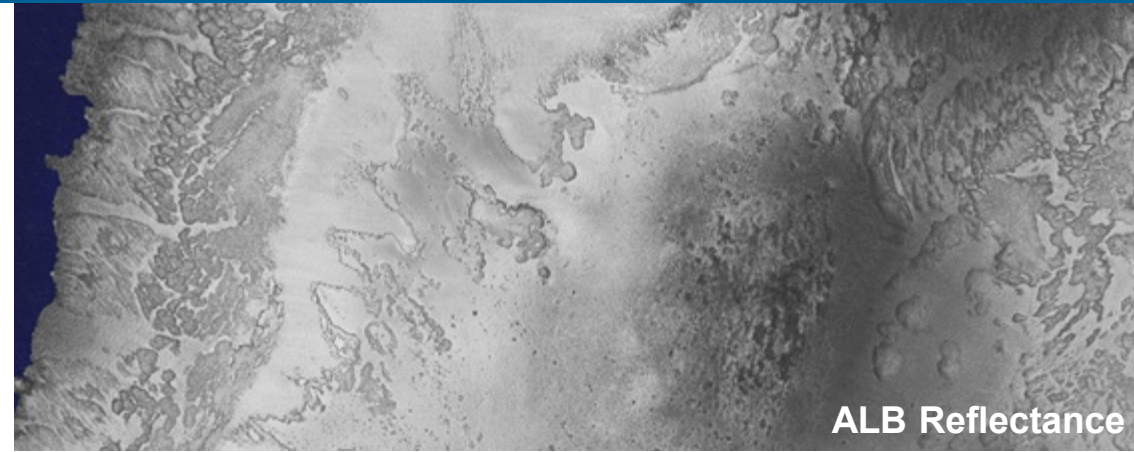


## Phase 2: Topo-Bathymetric Lidar



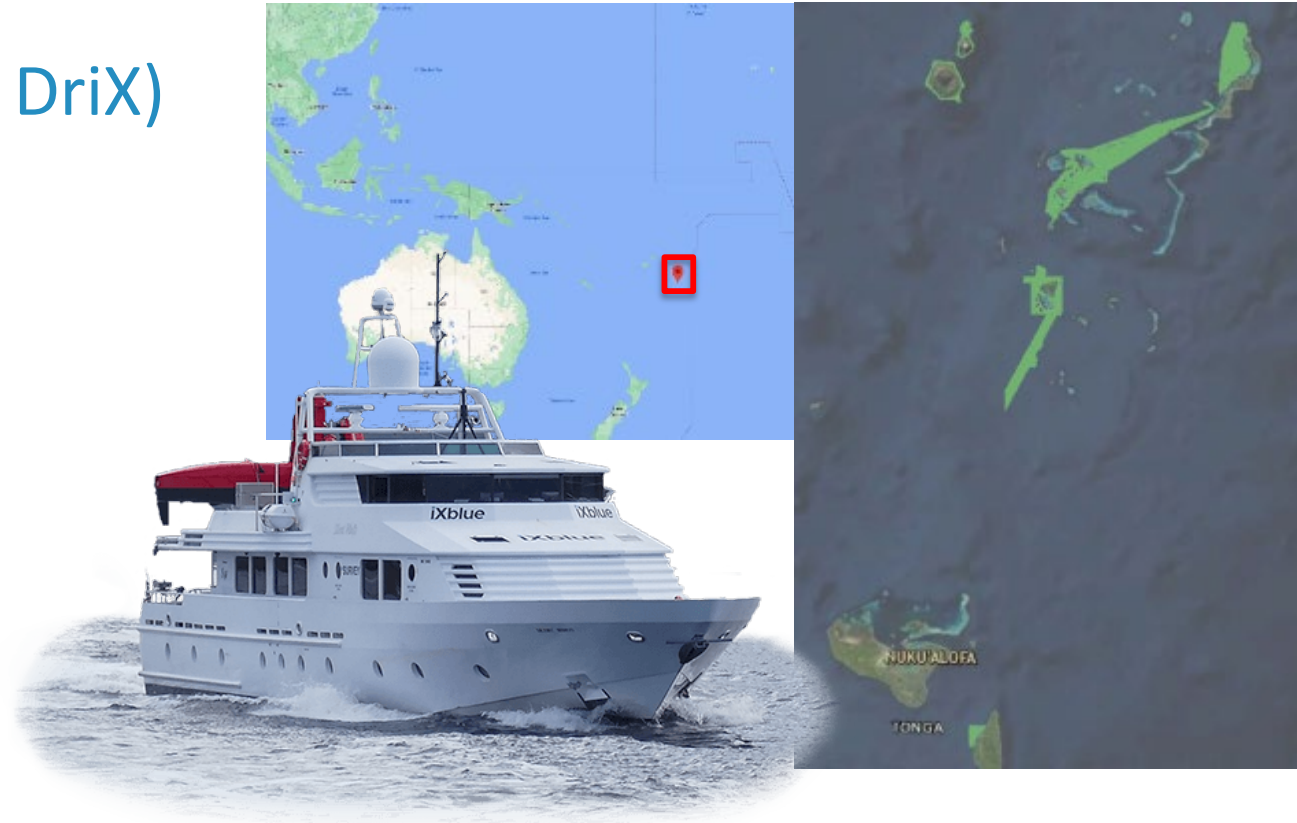
# Phase 2: Topo-Bathymetric Lidar

- Chiroptera 4X
  - 400kHz Topo
  - 140kHz bathy
  - 80MP RCD30 RGBN Camera
- 635 sq km of topo-bathy lidar data
  - 7395 flight line km
  - 9% reflights, 200% Coverage
- Hydrographic Object Detection to 20m
- Max Depth = 47m



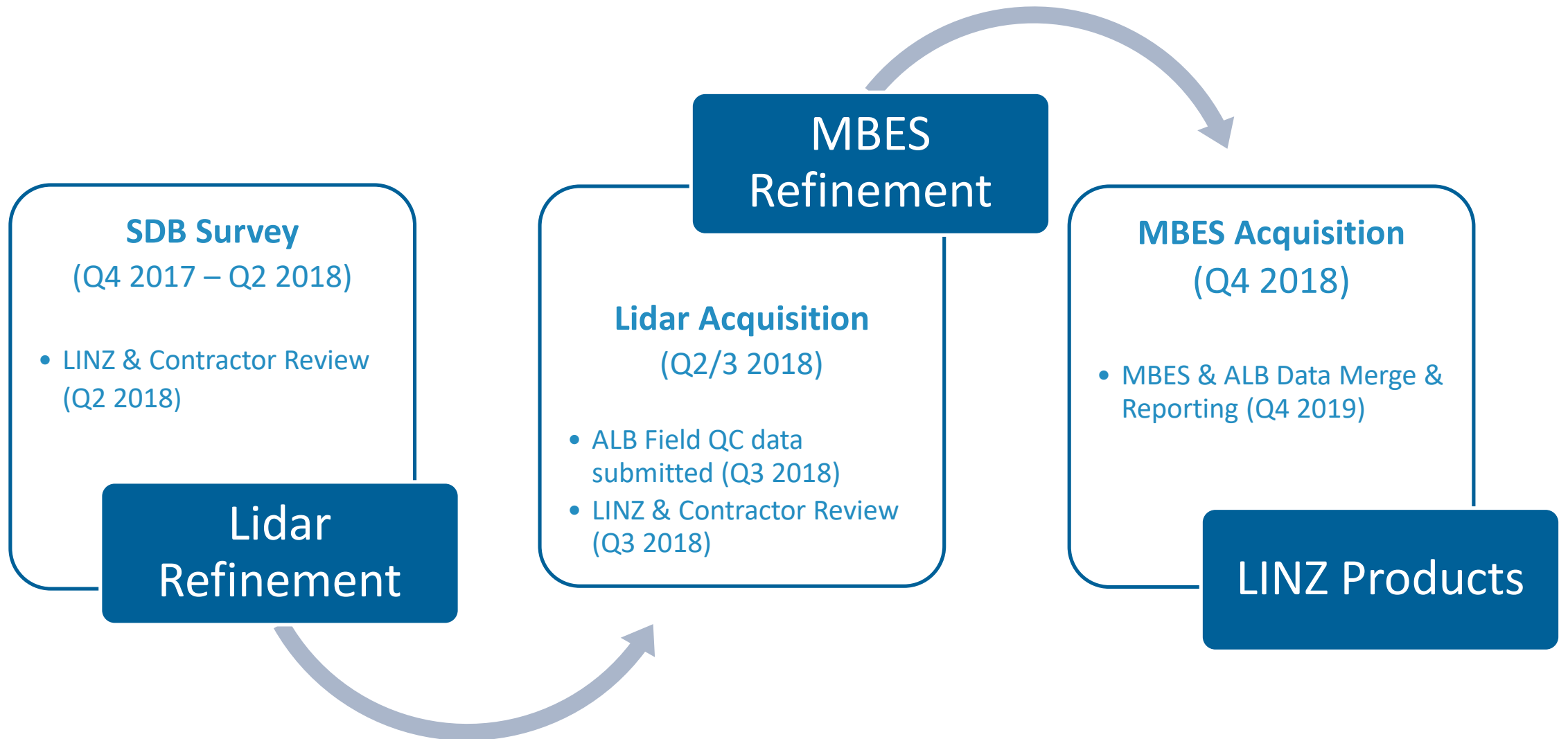
# Phase 3: Multibeam Echo Sounder (MBES)

- 32m Survey Vessel & 8m USV (iXBlue DriX)
  - Identical Survey Suites
  - 200kHz Kongsberg EM2040C MBES
- 590 sq km of MBES data
  - 7450 survey line km (4022 nautical miles)
- 20m to 400m depths





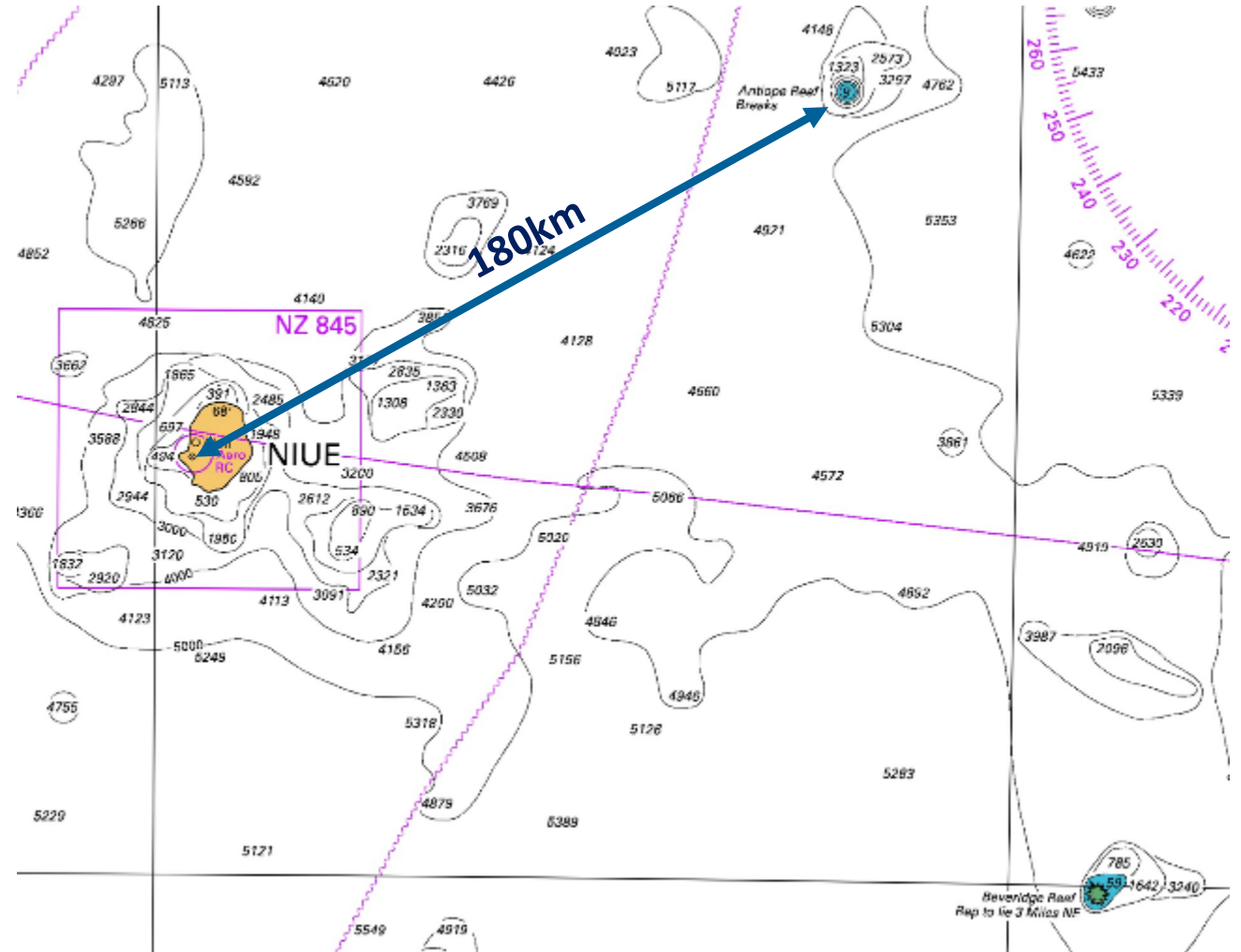
# Project Management Overview



# Lidar Survey Area Refinement – Area Removal

## Prior to any Project Phases

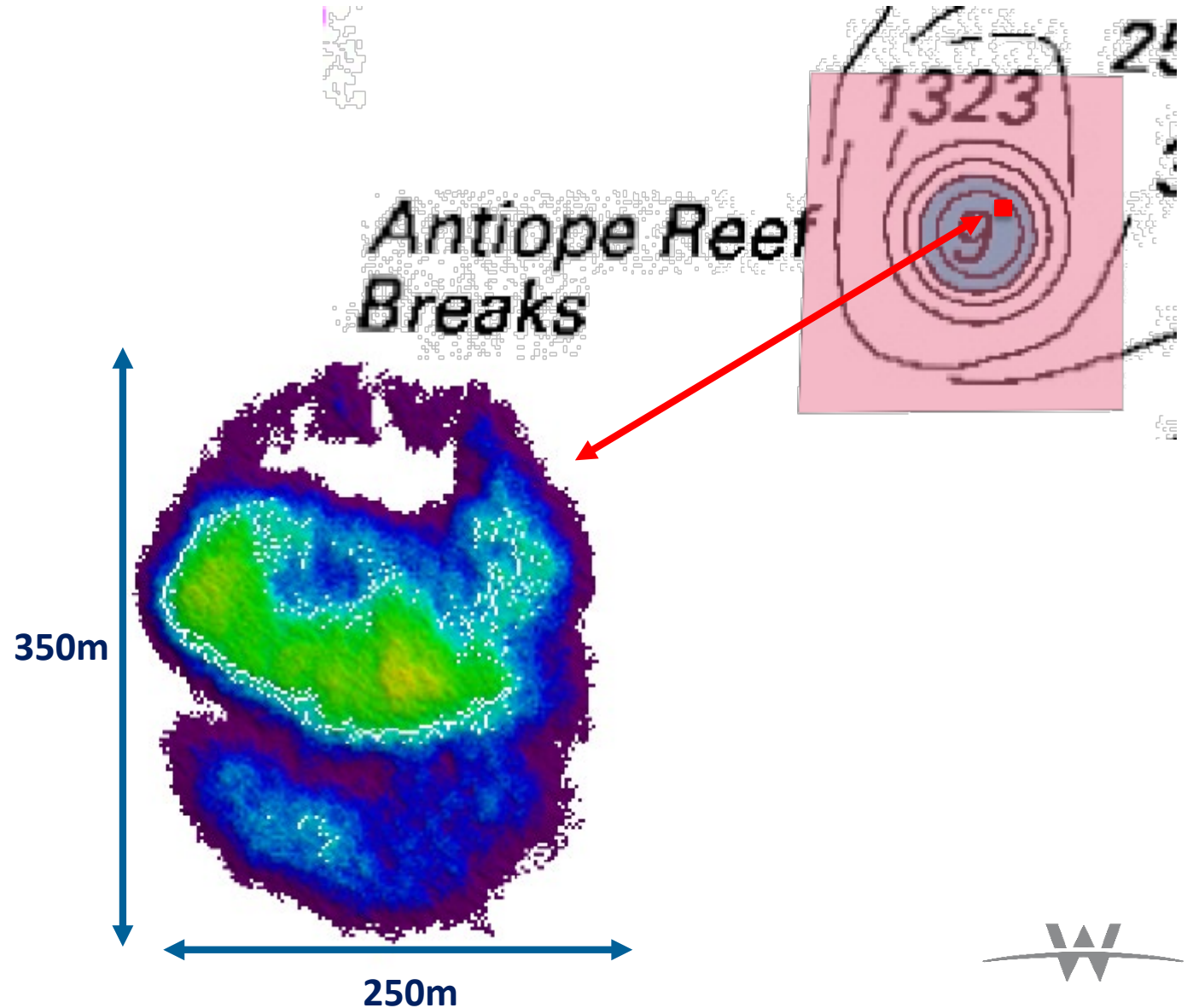
- Antiope Reef targeted for lidar
- 180km from Niue (aircraft base)
- Appeared as large area on chart



# Lidar Survey Area Refinement – Area Removal

After SDB Review

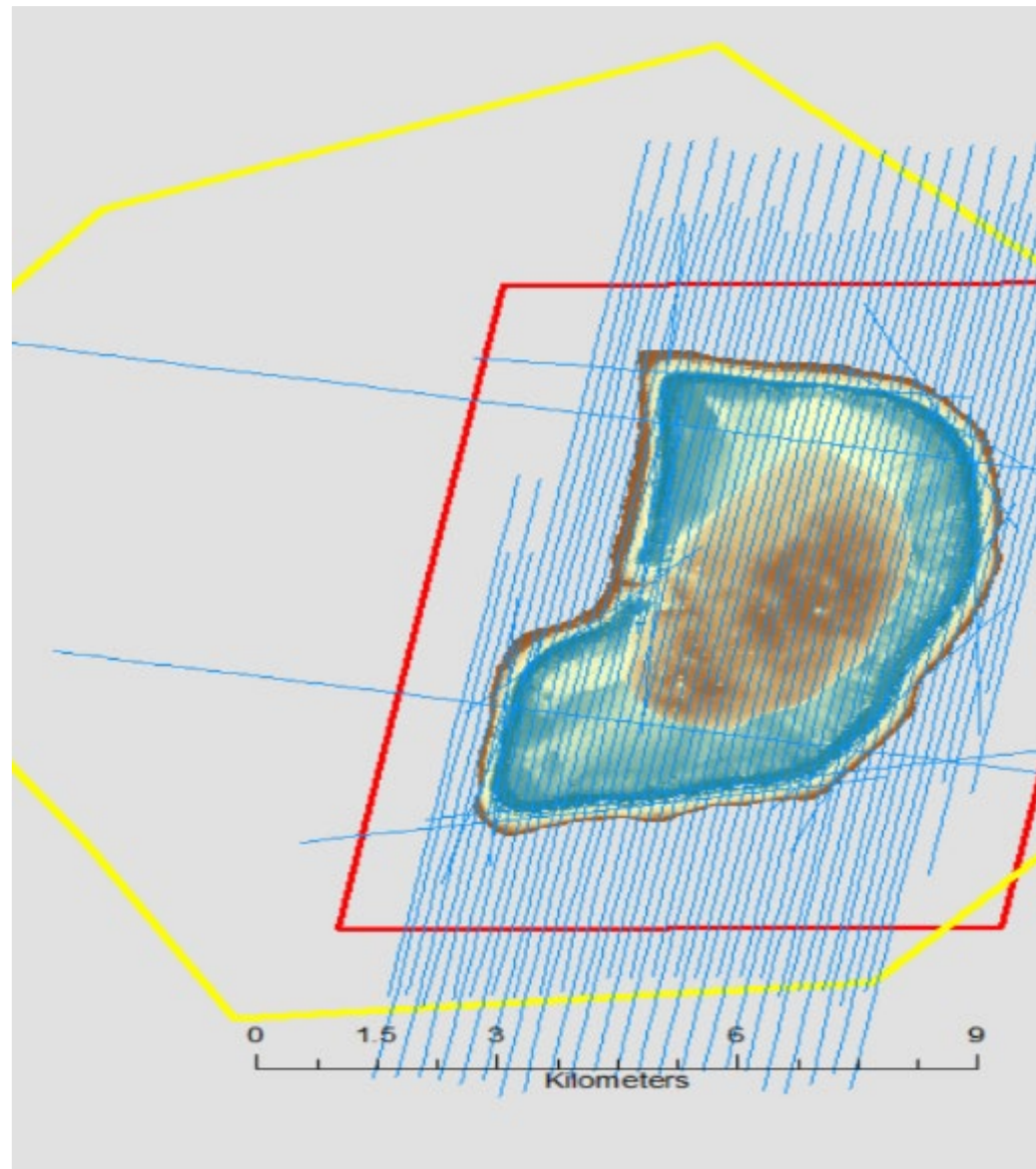
- Small Area 250m x 350m
- Not significant for Navigation
- Lidar not acquired



# Lidar Survey Area Refinement – Area Reduction

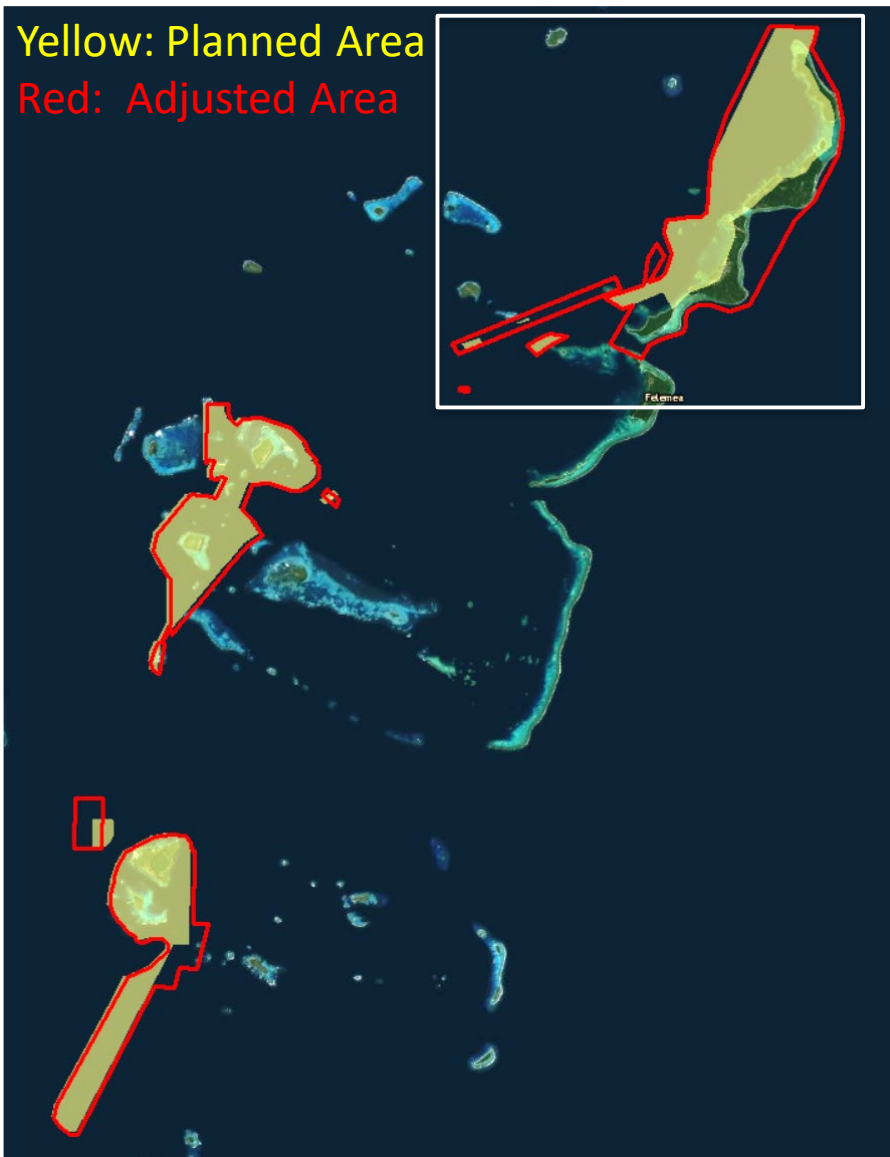
## Beveridge Reef

- SDB and Lidar Surveys
  - Reef provides a safe haven for small vessels
  - Allow technology comparison
  - Add charting confidence



# Lidar Survey Area Refinement – Area Adjustment/Addition

Yellow: Planned Area  
Red: Adjusted Area

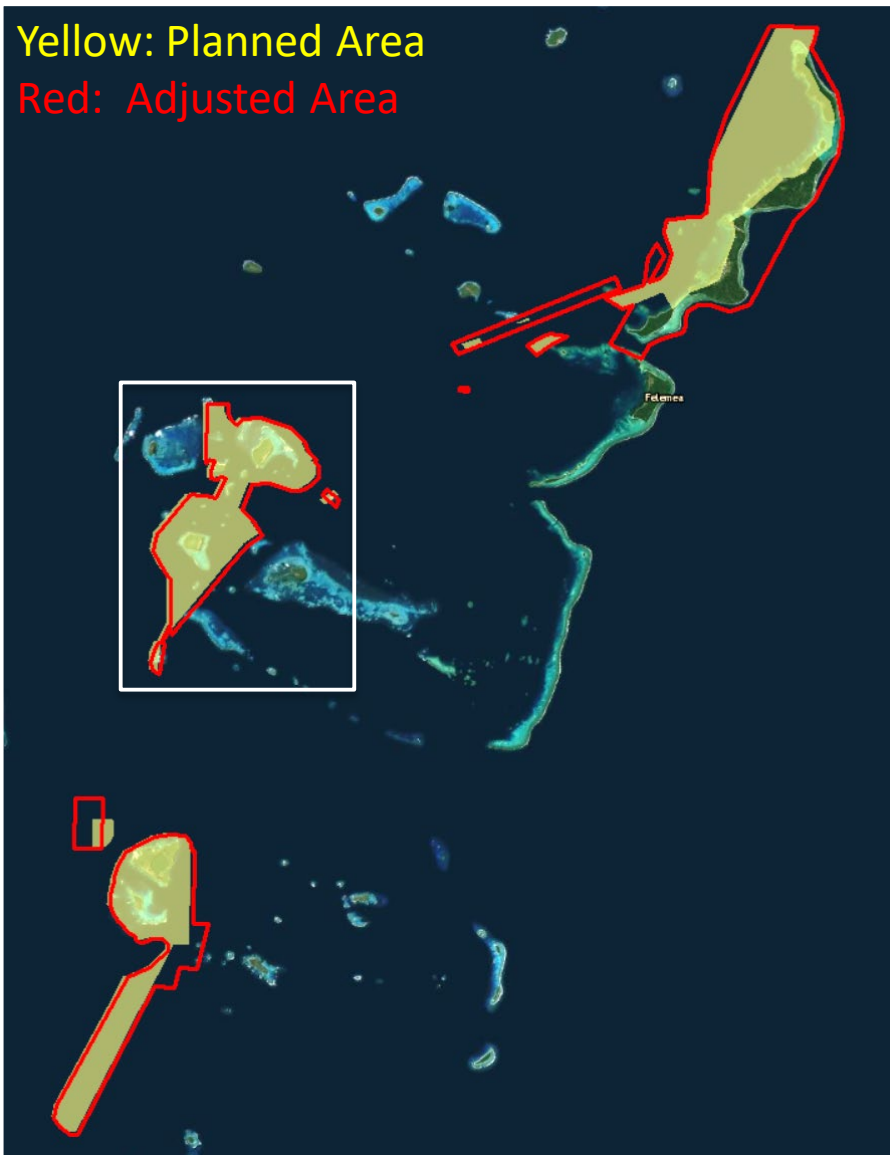


Lifuka, Tonga

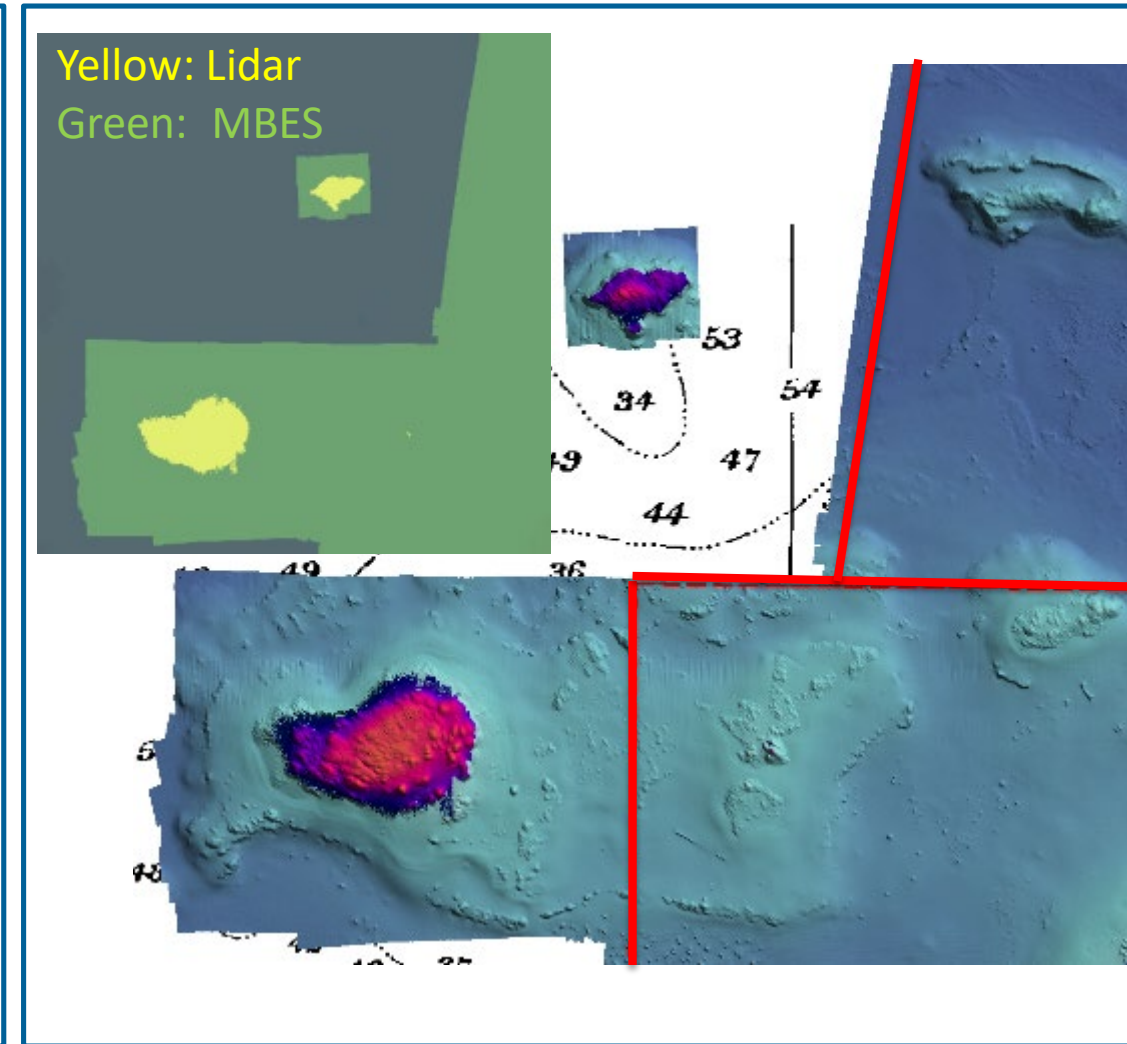
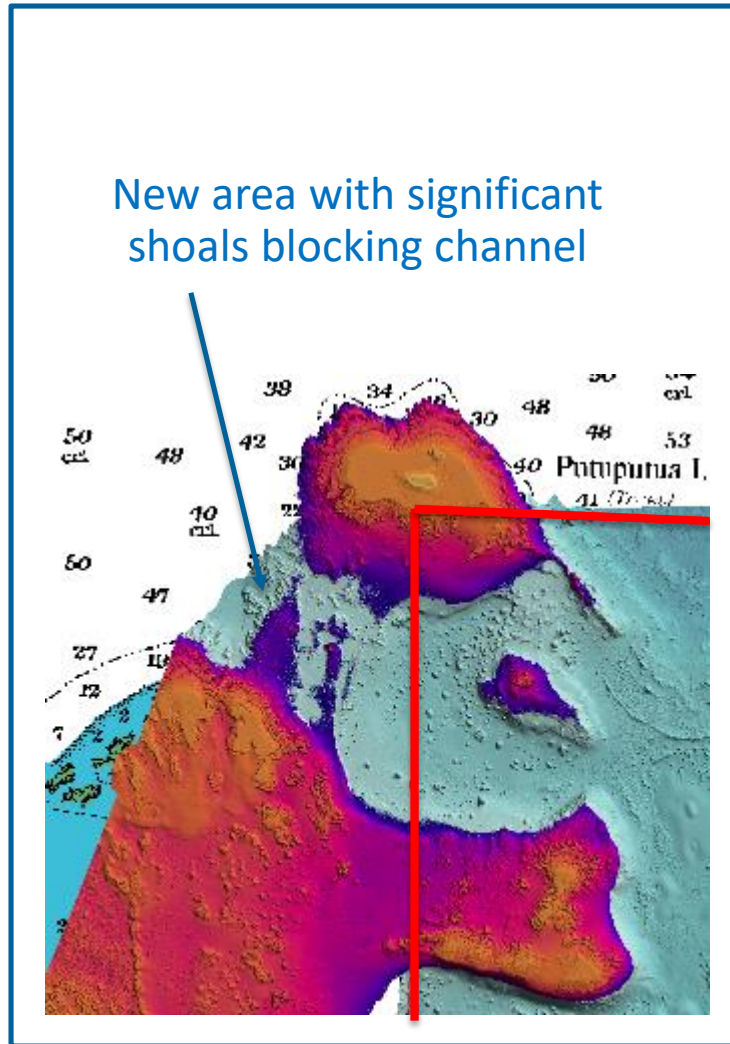
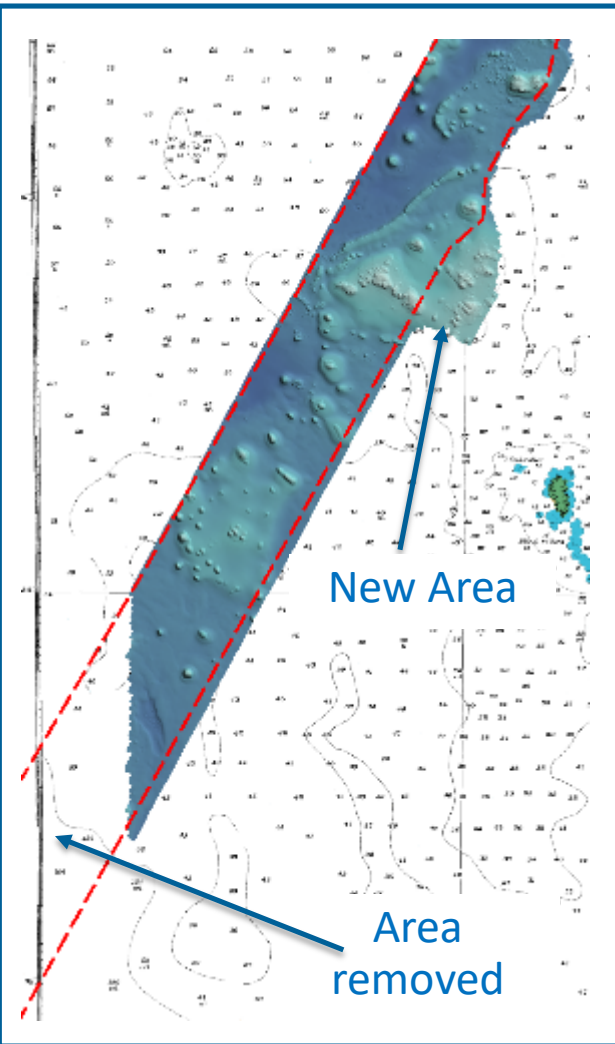
- Additional 92sq km acquired
- Topo-bathy lidar



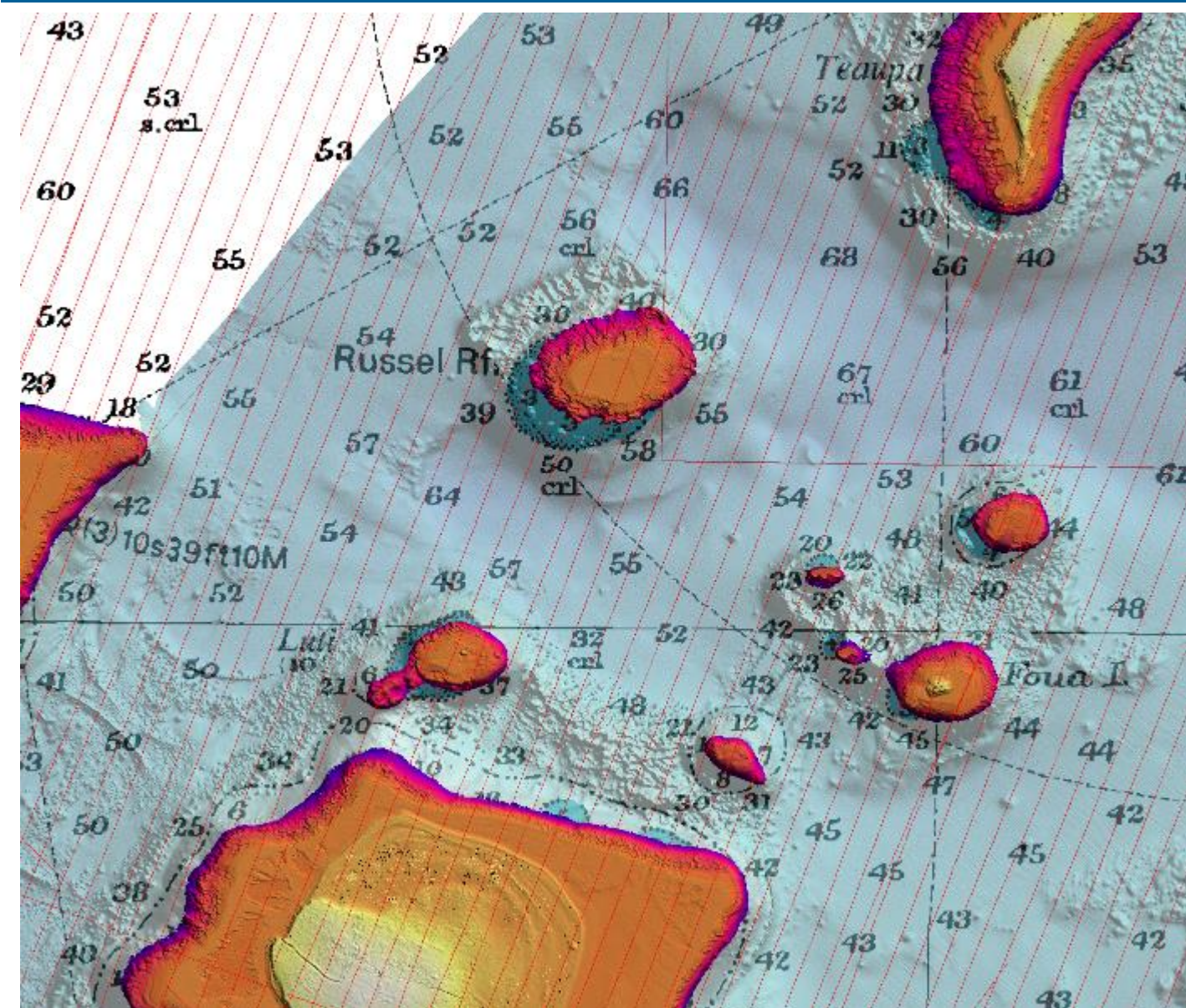
# Lidar Survey Area Refinement – Area Adjustment/Addition



# Multibeam Survey Area Refinement



# Multibeam Risk Management & Efficiency



Lidar coverage used during MBES acquisition:

- Confidence for 24/7 MBES ops
- Efficiency around reefs





# Multibeam Risk Management & Efficiency

Lidar coverage in shallow complex seabeds significantly reduced risk to the multibeam vessel survey team.

MBES work in this environment is:

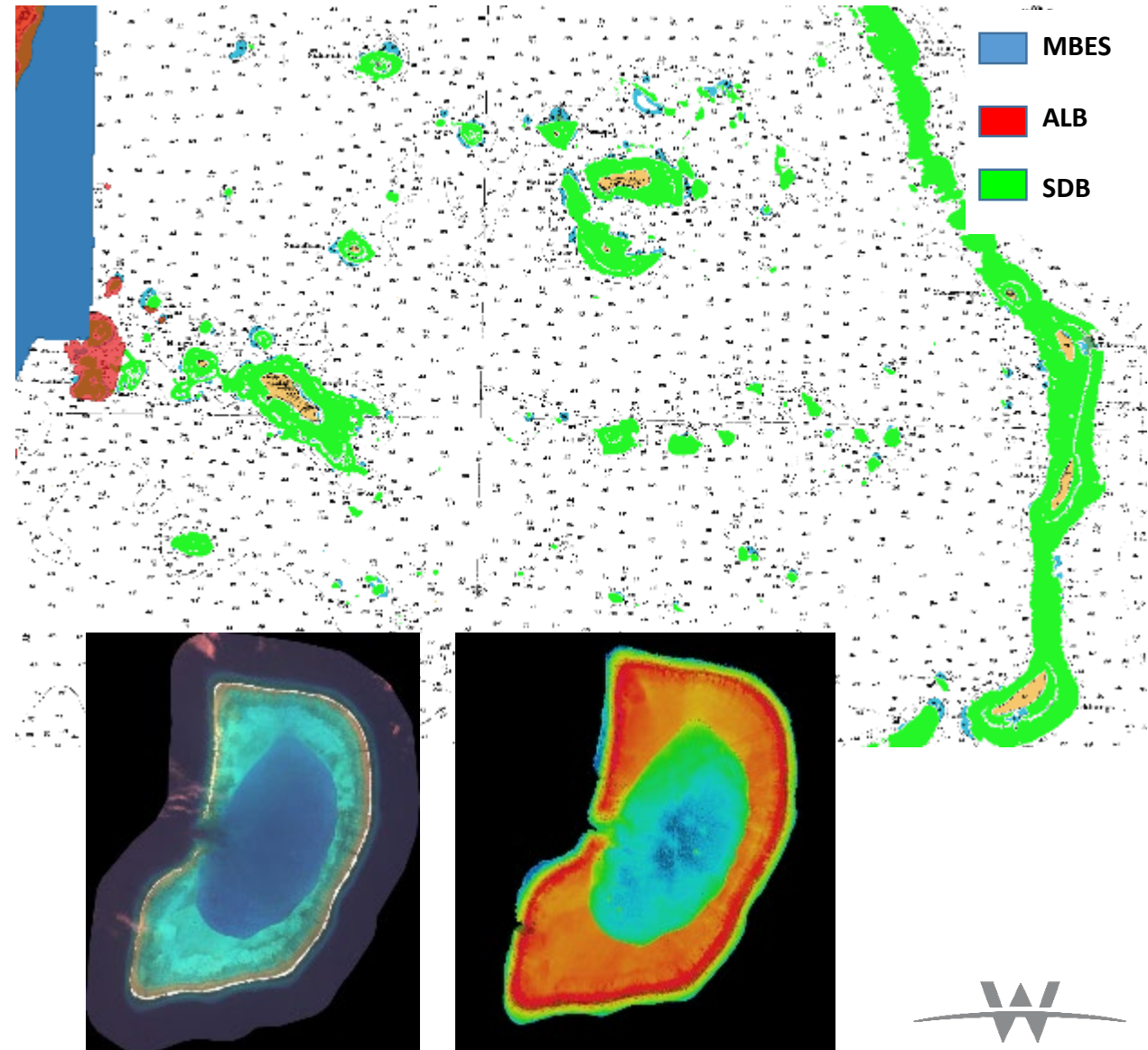
- high risk, high consequences
- extremely time consuming
- costly

Elevation Model Colored by RCD30 Imagery



# Benefits of a Multi-Sensor Approach: SDB

- Vastly more efficient coverage
- More economical (comparatively)
- Plan & prioritize future surveys based on real modern data
- Effective at detecting shoals
- Excellent choice for very remote locations
- Very low risk, high safety factor
  - No boots on the ground



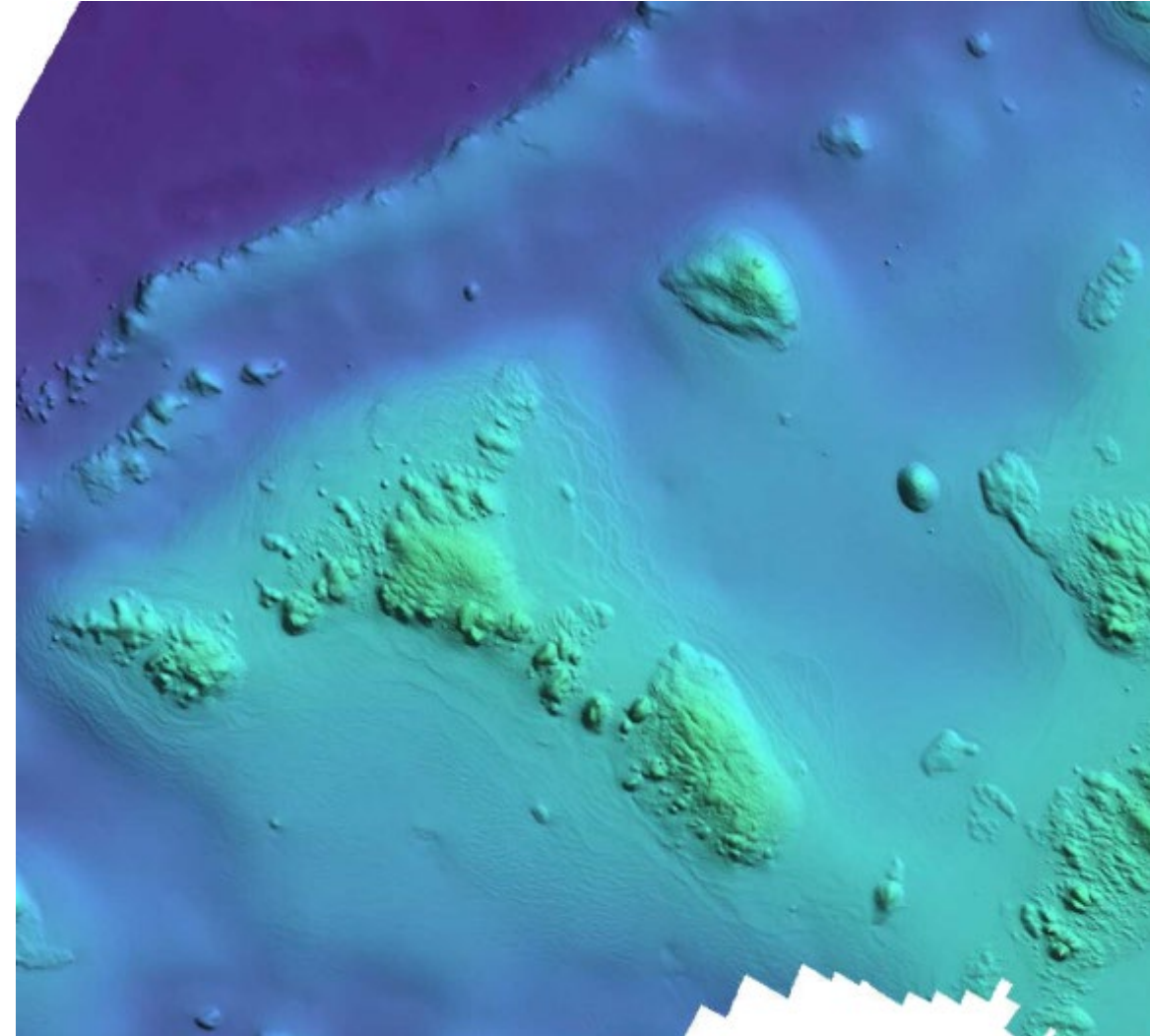
# Benefits of a Multi-Sensor Approach: Topo-Bathy Lidar

- More efficient coverage
- More economical than vessel-based surveys
- Increase safety and efficiency of vessel-based surveys
- Increased resolution versus SDB
- Excellent choice for remote locations
- Multi-Use Dataset: Topo, Bathy, Imagery, Reflectance for Habitat, Land Cover Analysis, etc...



# Benefits of a Multi-Sensor Approach: MBES

- Higher resolution over other technology
- Higher accuracy achievable (dependent on systems, users, location, etc..)
- Fewer environmental limitations
- Multi-Use Dataset: Bathymetry, Backscatter for Geology and Habitat, etc...
- Full depth ranges possible
- USV technology is an effective and efficient force multiplier.



# Multi-Sensor Approach Summary

Right Tool – Right Time – Right Location

Survey more efficiently and effectively

Significantly more coverage than using a single sensor

Full coverage of project area possible

Client and contractor flexibility to adapt to changes

Good coordination and teamwork needed between each phase



# Speaker Contact Information



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