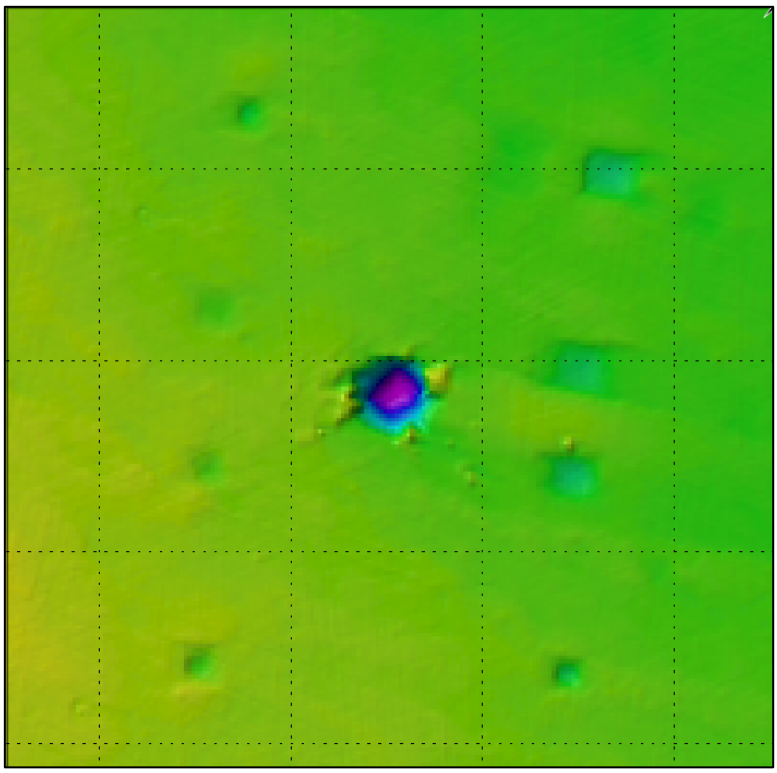
Operations & Results Report

For



Bathymetric & SSS Survey of

Decommissioned Gwynt y Mor OWF Met Mast

Contract Document ID: GyM Met Mast Decom Survey Operations and Results Rev00	
Contract	UHC25021
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Revision:	00
Date:	29/10/2025

REPORT AUTHORISATION AND DISTRIBUTION

Bathymetric & SSS Survey of

Decommissioned Gwynt y Mor OWF Met Mast

Operations & Results Report

Report Status:	Issued for Comment	
Issue Date:	29th October 2025	
Project Manager:	Simon Baldwin	
Site Personnel:	Tom Maw Simon Baldwin Toby McLeay	
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Distribution;

Ziton EU

For the attention of: Mads Albér mal@ziton.eu

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CONTENTS

STANDARD LIST OF COMMON ABBREVIATIONS

(d)GPS	(differential) Global Positioning System
ED50	European Datum 1950
ESA	European Space Agency
GAMS	GPS Azimuth Measurement Subsystem
GPS	Global Positioning System
GSM	Global System for Mobile communications
HF	High Frequency
IHO	International Hydrographic Organisation
IMO	International Maritime Organisation
INS	Inertial Navigation System
kHz	Kilohertz
km	Kilometre
LAT	Lowest Astronomical Tide
MCA	Maritime & Coastguard Agency
MSL	Mean Sea Level
PPE	Personal Protective Equipment
PPP	Precise Point Positioning
PPS	Pulse Per Second
QC	Quality Control
RMS	Route Mean Square
RTK	Real Time Kinematic
SD	Standard Deviation
SVP	Sound Velocity Probe
TVG	Time Variable Gain
USBL	Ultra Short Base Line
UTM	Universal Transverse Mercator
VHF	Very High Frequency
VORF	Vertical Offshore Reference Framework
VRS	Virtual Reference Station
WGS84	World Geodetic System 1984

1. Introduction

1.1 Project Overview

Ultrabeam Hydrographic were asked by Ziton to undertake a multibeam echosounder bathymetric and side scan sonar survey of the location of a decommissioned met mast, located within the Gwynt y Mor windfarm, Liverpool Bay.

The survey requirements were to survey a 100m x 100m box, centred on the decommissioned met mast location with multibeam echosounder and side scan sonar. The required deliverables are an operational and results report, along with DXF/DWG plan view charting, PDF charts and XYZ bathymetric data.

The survey location is as follows:

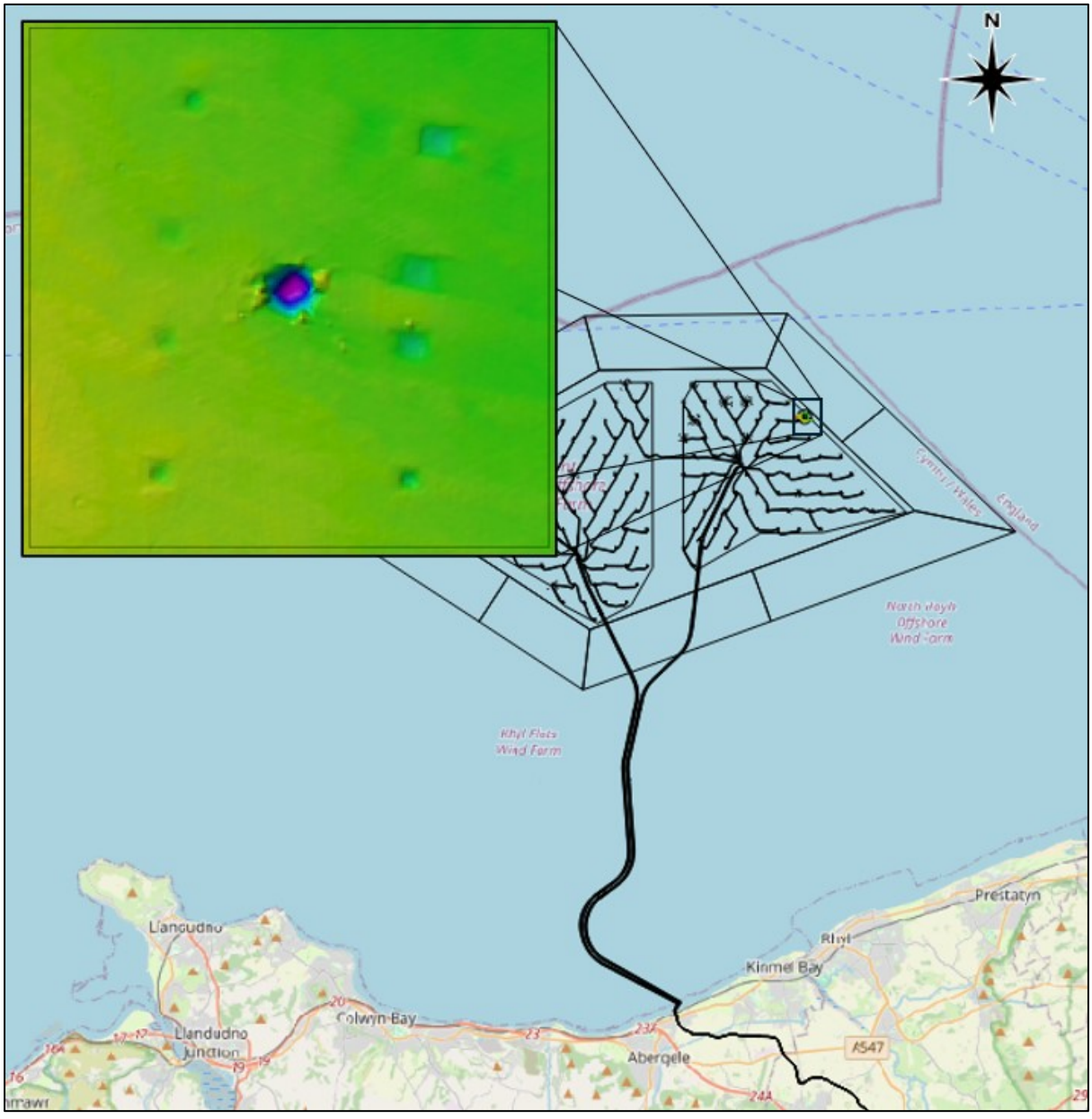


Figure 1.1: Gwynt y Mor Decommissioned Met Mat Location

1.2 Survey Operations Summary

The Geophysical Survey utilised MBES and SSS to survey the 100 x 100m area around the location of the removed met mast.

Geophysical survey data was acquired from our owned and operated RIB, the MV Tracer 3. The Vessel was mobilised at and operated from Conwy Marina, Wales.

The operations were undertaken on the 15th October 2025. This report presents the results of the survey, along with an operational summary.

Data acquisition for the survey was undertaken from the MV Tracer 3, which was equipped with a Norbit Winghead MBES, an Edgetech 4125 side scan sonar and an Applanix POS MV Wavemaster II.

1.3 Operational Summary

MV Tracer 3 was mobilised on the 14th October 2025. Calibrations and verifications were undertaken at sea, to the south east of Puffin Island, on the afternoon of 14th October 2025.

The table below summarises the verifications completed.

Date	Activity
14th October 2025	Personnel and equipment mobilise to site. Commence mobilisation Mount antennas and IMU and measure offsets. Prepare survey pole with MBES unit and the IMU. Install and connect SSS system Full survey systems check Carryout wet testing. Carry out verifications and calibrations, SE of Puffin Island (GAMS calibration and MBES Patch Test)
15th October 2025	Undertake Gwynt y Mor Met Mast Survey. Demobilise Vessel.

1.3 Health and Safety

All work undertaken during the contract by Ultrabeam personnel was carried out within the general guidelines of the company's Health and Safety Policy.

Personal Protective Equipment (PPE) was worn throughout the contract, as required.

Prior to the commencement of field operations, the following activities were completed:

- Field Staff Project Briefing
- Vessel Induction
- Project Safety Meeting
- HIRA

Tool box talks were undertaken on a daily basis before commencing work. No accidents or injuries were reported during the contract.

1.4 Survey Area Bathymetric Coverage

The following figure provides an overview of the MBES data collected during the survey:

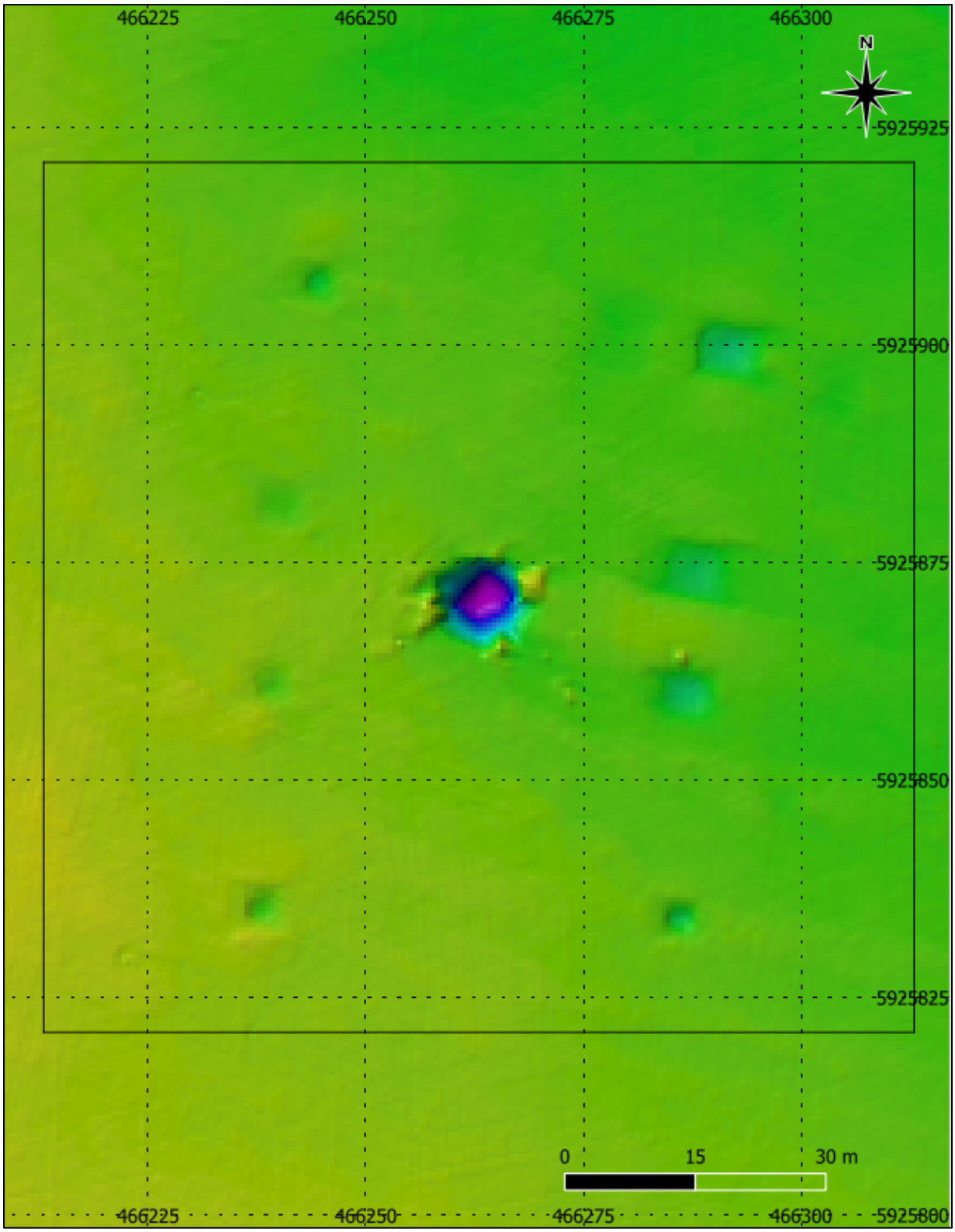


Figure 1.2: Multibeam Echosounder Coverage

1.5 Survey Area Side Scan Sonar Coverage

The following figure provides an overview of the Side Scan Sonar data collected during the survey:

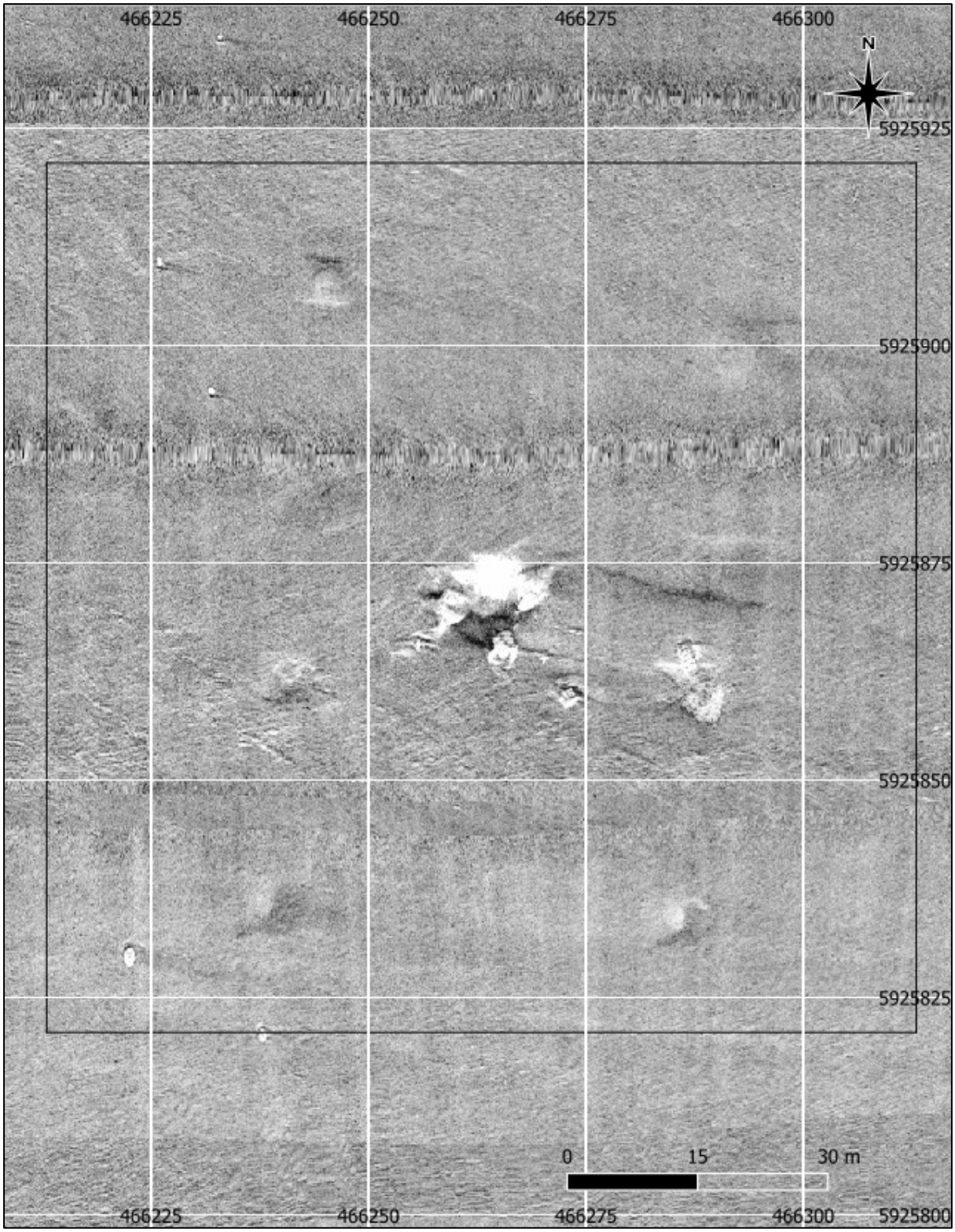


Figure 1.3: Side Scan Sonar Coverage

2. Inshore Field Procedures and Methodology

2.1 Project Personnel

The following personnel were involved during the project:

Role	Name & Contact	Photo
Project Manager & Party Chief	Simon Baldwin Tel: 07583 919 661 Simon.baldwin@ultrahydrographic.com	
Hydrographic Surveyor	Tom maw tom.maw@ultrahydrographic.com	
Vessel Skipper	Toby McLeay toby.mcleay@ultrahydrographic.com	

2.2 Survey Vessel

Survey operations on the decommissioned met mast survey were conducted from our owned and operated RIB, the MV Tracer 3.

The vessel is road transportable and allows flexible mobilisation to anywhere in the UK at short notice. Tracer 3 is extremely capable for a vessel of this size and carries MCA Cat 3 certification allowing her to work up to 20 miles from a safe haven, day or night. Vessel details are set out below:

Figure 2.1: MV Tracer 3

Owner:	Ultrabeam Limited
URN:	S12WB0091137
LOA: **Beam:** **Draft:**	9.0m 3.2m 0.95m
Type of vessel:	Parker 900 Baltic
Built:	2012
Classification:	UK MCA Workboat Code of Practice Category 3, up to 20 miles from safe haven.
Speed:	20 Knots Cruising, 34 Knots sprint.
Main Engine(s):	2 x Mercury 250HP Outboard Motors.

Figure 2.2: MV Tracer 3

2.3 Equipment List

The principal survey positioning, data acquisition and processing equipment mobilised to the *Tracer 3* is outlined below:

Item	Number	
	Online	Spare
Survey Positioning Equipment		
Applanix POS MV WaveMaster II INS c/w Trimble VRS Now RTK corrections	1	0
Survey Data Acquisition and Processing Equipment		
QPS Qinsy Online Integrated Navigation System	1	1
Edgetech Discover SSS Data Acquisition	1	0
QPS Qimera /Applanix POSPac / AutoCAD Offline Survey Data Processing System	1	0
Chesapeake SonarWiz SSS Offline Data Processing System	1	0
Norbit Winghead MBES System c/w AML SVS	1	0
Edgetech 4125 simultaneous dual frequency (400/900kHz) Side Scan Sonar on soft tow cable	1	1
Valeport SWiFT SVP	1	0

The MBES system was mobilised to a recoverable survey pole which was deployed in an 'over the side' arrangement. Once mobilised to the survey pole the MBES transceiver stayed mobilised, being deployed and recovered as required around survey operations.

The SSS towfish (20 kg) was deployed by hand over the stern of Tracer 3 on a soft tow cable. The cable out was managed by the onboard geophysicist, and once deployed, was secured to the stern of the vessel.

The Valeport SWiFT SVP was used to undertake sound velocity profiles through the water column. The SVP was deployed off the vessel in a location confirmed by the Vessel Skipper dependent on wind, current and vessel movements.

2.4 Equipment Layout

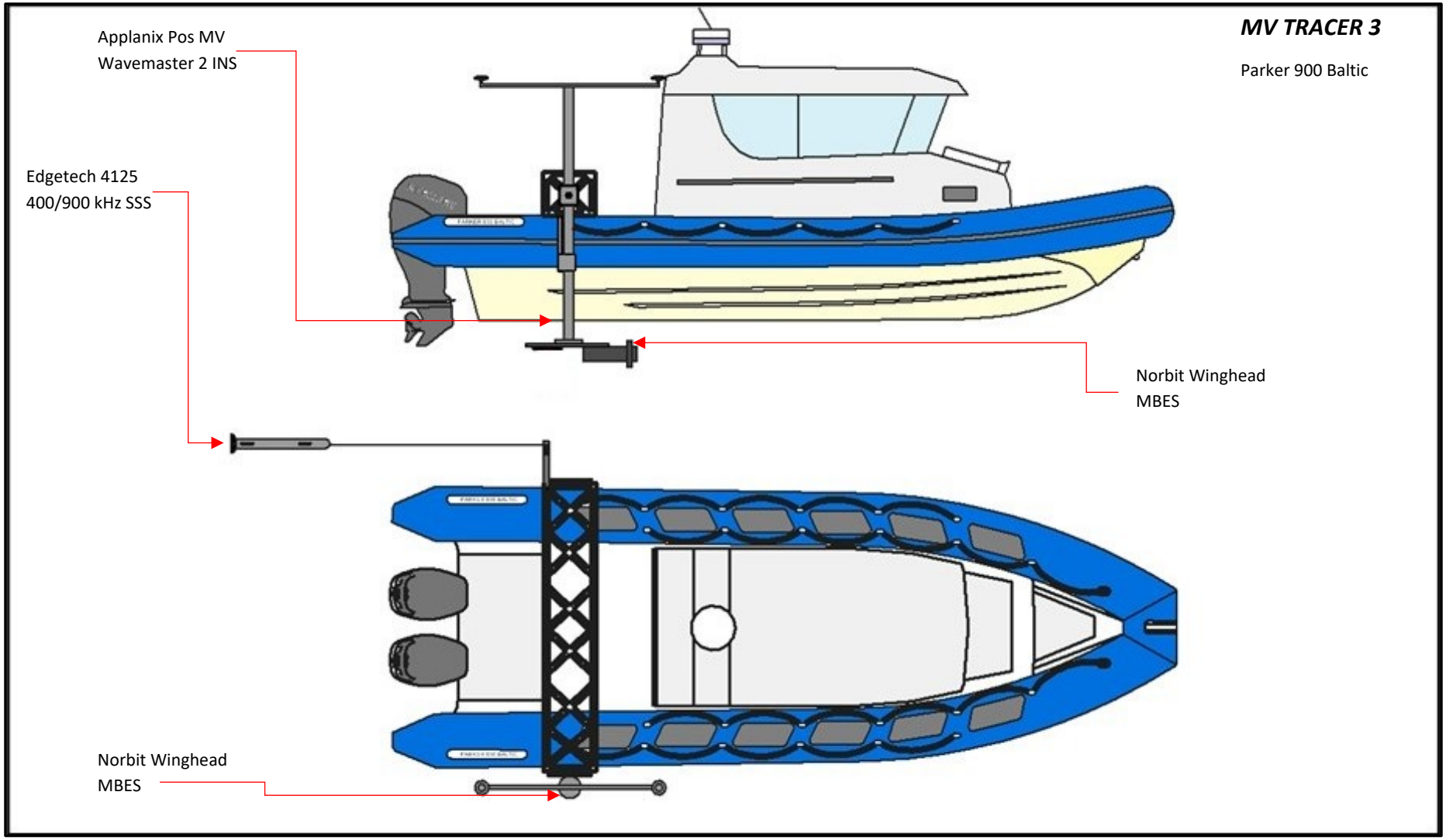


Figure 2.3: Survey Equipment Layout

2.4 Survey Control

2.4.1 Horizontal Control

Global Positioning System Geodetic Parameters	
Datum:	World Geodetic System 1984 (ETRS89)
Spheroid:	World Geodetic System 1984 (WGS84)
Semi major axis:	A = 6378137.000m
Inverse Flattening:	1/f = 298.257223563
Projection Parameters	
Projection:	UTM 30N (Universal Transverse Mercator)
Central Meridian:	3° W
Latitude of Origin:	0° (Equator)
False Easting:	500 000 m
False Northing:	0 m
Scale factor:	0.9996012717
Units:	Metre

Primary position, heading and vessel attitude data was provided by an Applanix POS MV Wavemaster II Inertial Navigation System (INS). The POS MV provides positioning, orientation and attitude data to be applied to remove the effects of vessel dynamics, even during periods of poor GPS signal and total outages. The system comprises of 3 main components:

- Inertial Measurement Unit (IMU) containing high quality accelerometers and gyros, installed as close as possible to the vessel's axis of rotation and gravity.
- Processing Control System (PCS) containing the GPS cards and main system interface.
- 2 x Dual Frequency Trimble GPS receivers, mounted perpendicular to the vessel centreline.

After installation of the Applanix hardware on 14th October 2025, a GAMS calibration was undertaken which involved repeated "figure of 8" manoeuvres with the system heading from the inertial unit only (no GPS heading aiding). The manoeuvres cause the estimated IMU heading accuracy to reduce, and once below the threshold, the system completes the calibration to estimate the vector between the pair of GPS antenna, in the IMU frame.

The POS MV utilised Trimble VRS correction information received via cellular data connection throughout the surveys.

2.4.3 Vertical Control

The vertical datum for this survey is Lowest Astronomical Tide (LAT) using the UKHO VORF model.

The GPS height values were used in real-time to reduce bathymetric data, as well as logged for post processing against the VORF model for the survey area.

The reduction of data to the defined vertical datum uses a GPS Height Measurement based approach. The observed heights from the RTK system have been reduced using the VORF (LAT) Geoid/Ellipsoid separation model.

The VORF model was used online to reduce heights from WGS84 to LAT.

3. Survey Results

The figure below displays the acquired bathymetric data, along with the location details of the nine (9) side scan sonar contacts identified during the survey. Following completion of the survey operations, Ultrabeam were provided with the gridded bathymetric data from a survey carried out prior to the removal of the met mast. Upon review and comparison of the current October 2025 survey and this earlier June 2025 survey, eight of the nine side scan sonar targets identified were clearly visible on both the pre-decommissioning and post-decommissioning surveys. The remaining side scan sonar was a linear target with very little width or height (circa 0.1m) and it would not be possible to identify such a target using the gridded bathymetric data from the pre-decommissioning survey.

As such, we cannot say that there are any items now found on the seabed that were not present during the pre-decommissioning survey. There was no side scan sonar acquisition carried out during the pre-decommissioning survey, and so the presence or non-presence of this small outstanding feature (S_022) cannot be determined using the pre-decommissioning survey.

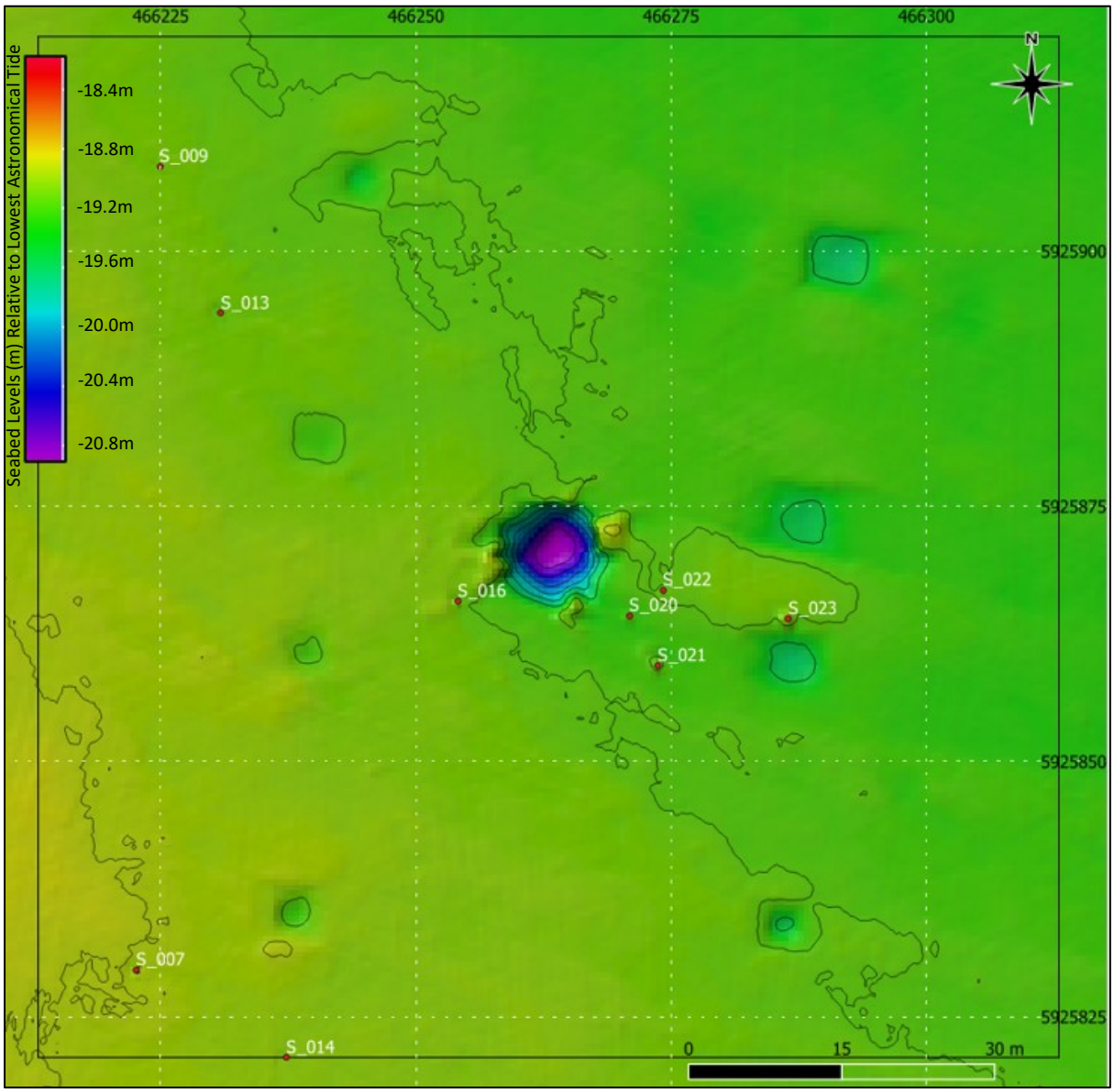


Figure 3.1 – MBES Bathymetry from Post-Decommissioning Survey (SSS Targets Overlain)

The details of the nine side scan sonar contacts identified during the survey are provided below:

Target ID	Easting (m)	Northing (m)	Dimensions (L x W x H)	Description	Comments
S_007	466 222.6	5 925 829.6	1.2 x 1.2 x 0.8	Tyre	Tyre
S_009	466 224.9	5 925 908.3	0.7 x 0.5 x 0.3	Sonar Target	
S_013	466 230.9	5 925 893.9	0.7 x 0.6 x 0.7	Sonar Target	
S_014	466 237.3	5 925 821.0	0.9 x 0.9 x 0.4	Tyre	Tyre
S_016	466 254.1	5 925 865.7	0.5 x 0.5 x 0.4	Debris	
S_020	466 270.9	5 925 864.3	0.8 x 0.9 x 0.4	Debris	
S_021	466 273.7	5 925 859.4	1.5 x 1.5 x 0.3	Debris	Square Debris
S_022	466 274.2	5 925 866.8	2.0 x 0.1 x 0.1	Debris	Linear Debris
S_023	466 286.5	5 925 864.0	3.4 x 1.7 x 0.3	Debris	Rectangular Debris

The below image illustrates the location of these sonar contacts, overlain upon the SSS mosaic:

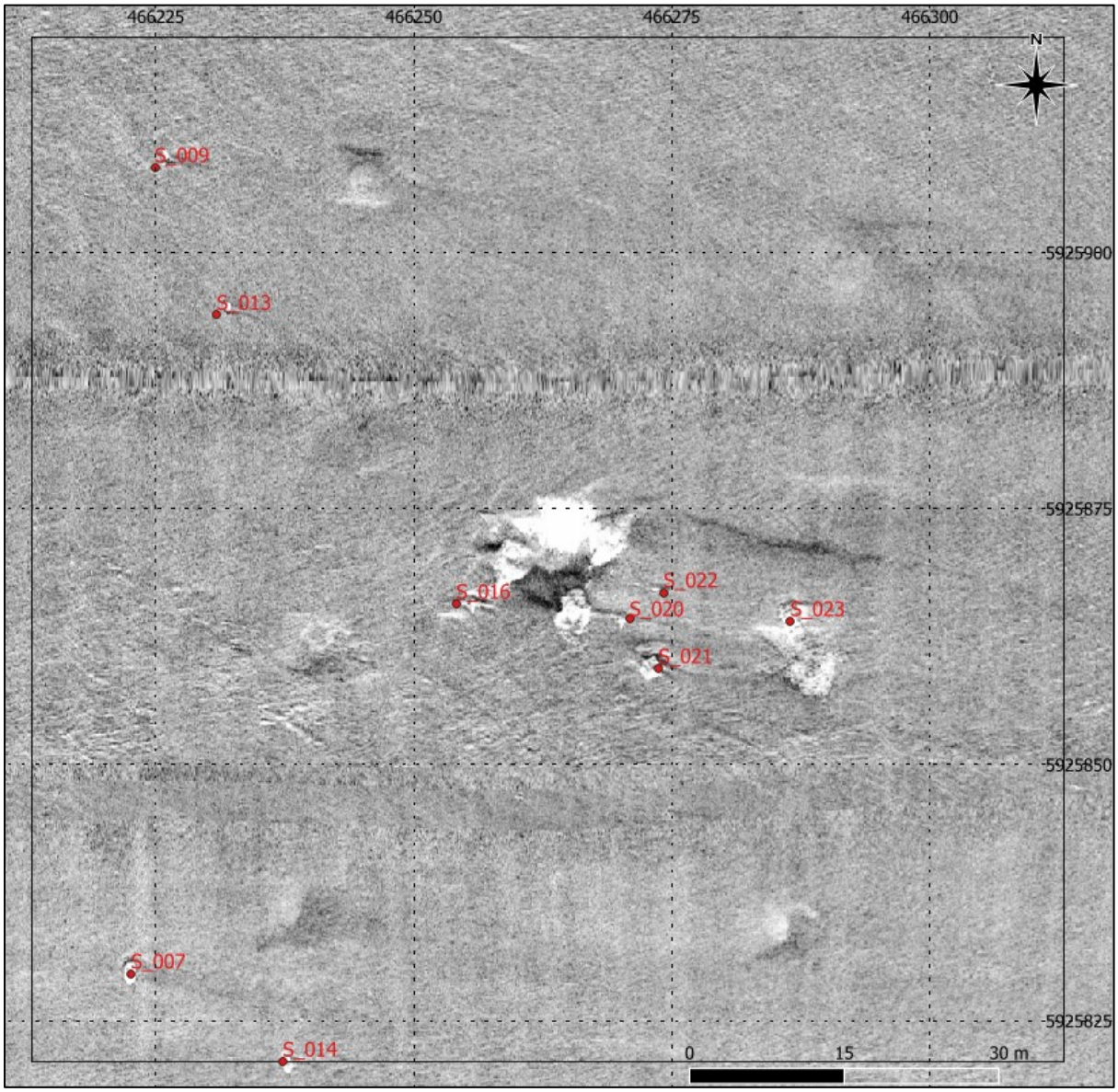


Figure 3.2 – SSS Mosaic from Post-Decommissioning Survey (SSS Targets Overlain)

The following pages provide examples of each of the nine sonar contacts identified within the side scan sonar data.

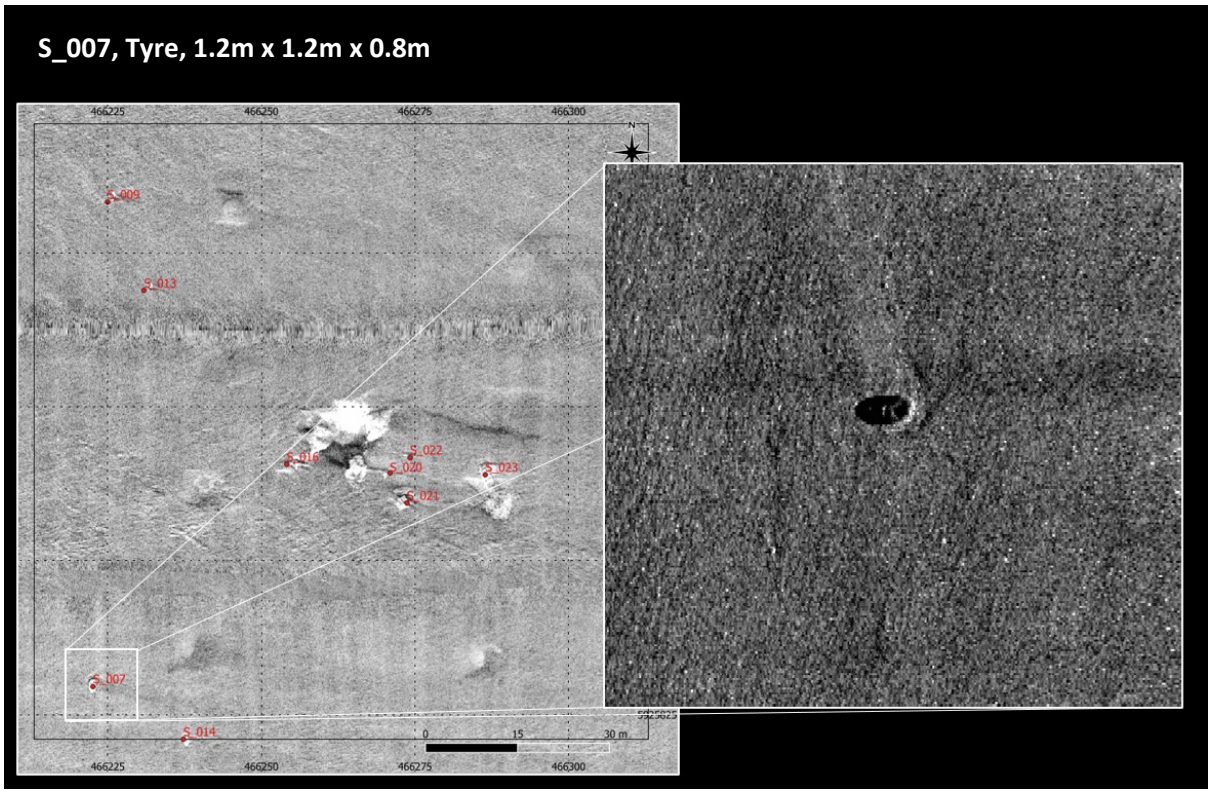


Figure 3.3 – SSS Data Example, showing target S_007

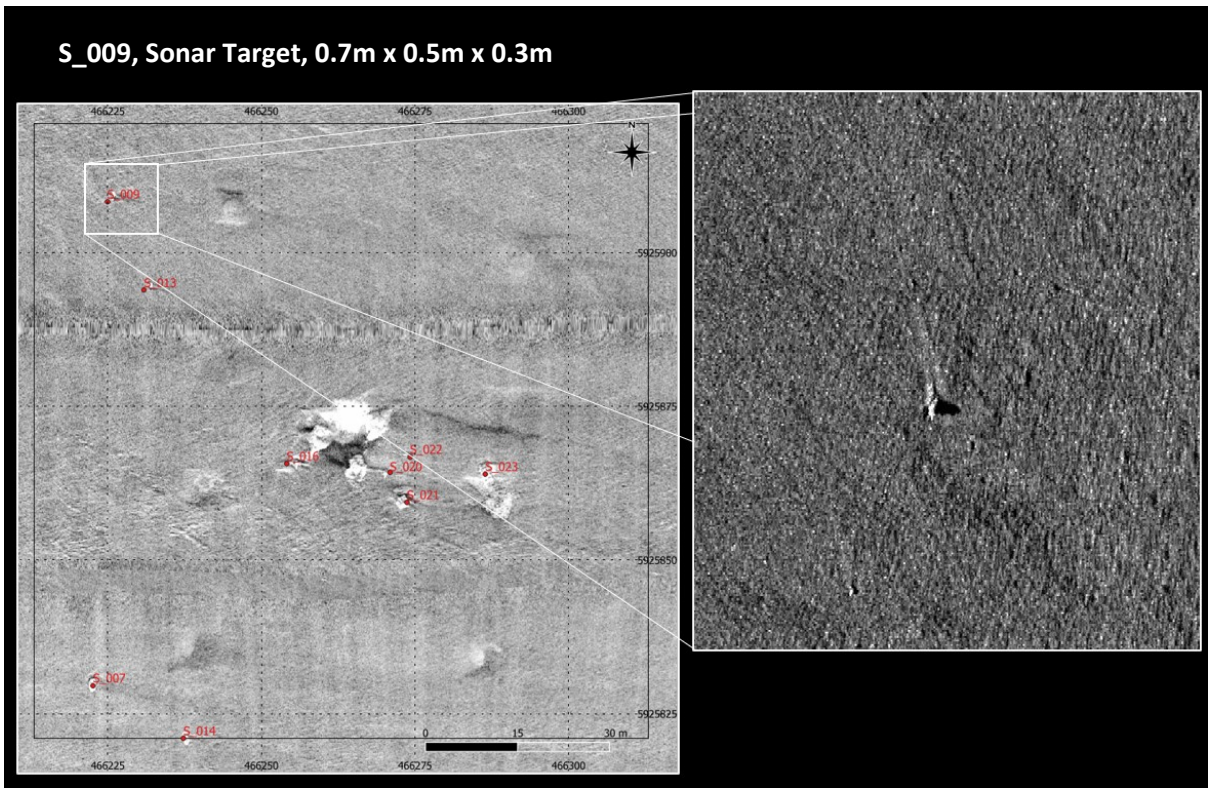


Figure 3.4 – SSS Data Example, showing target S_009

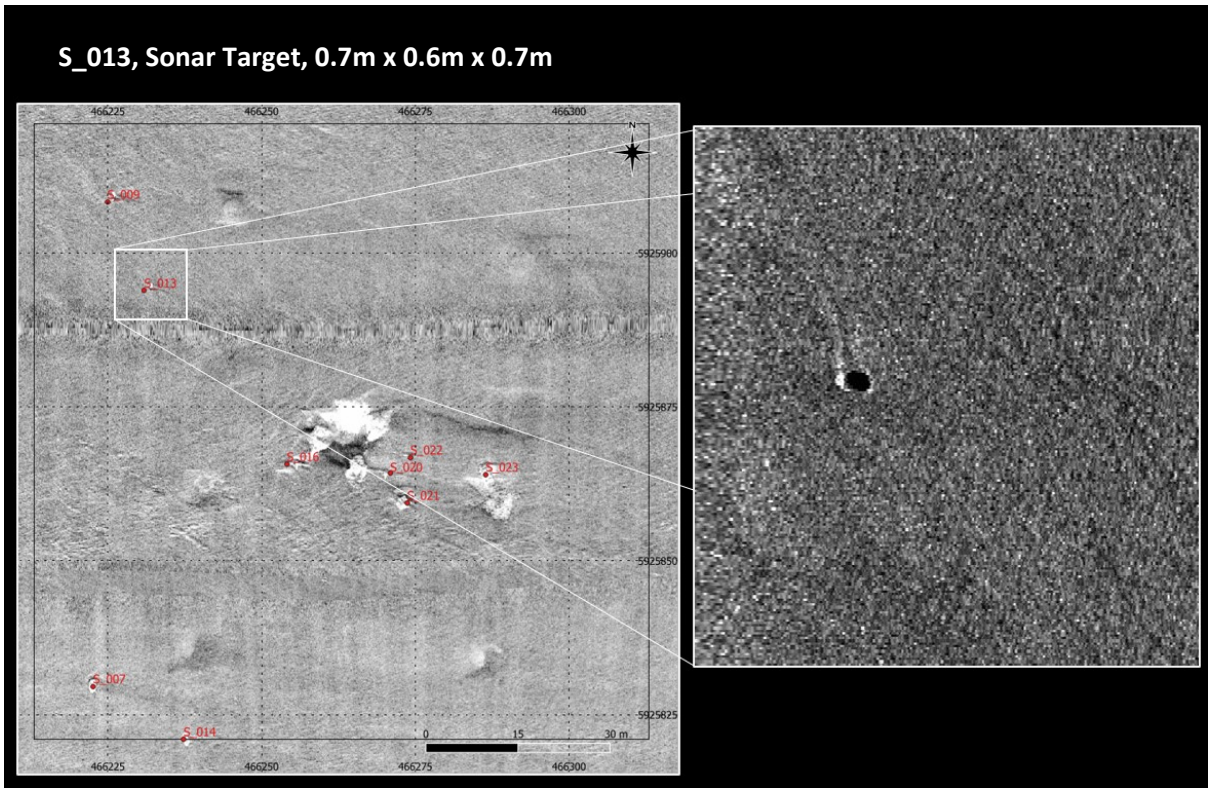


Figure 3.5 – SSS Data Example, showing target S_013

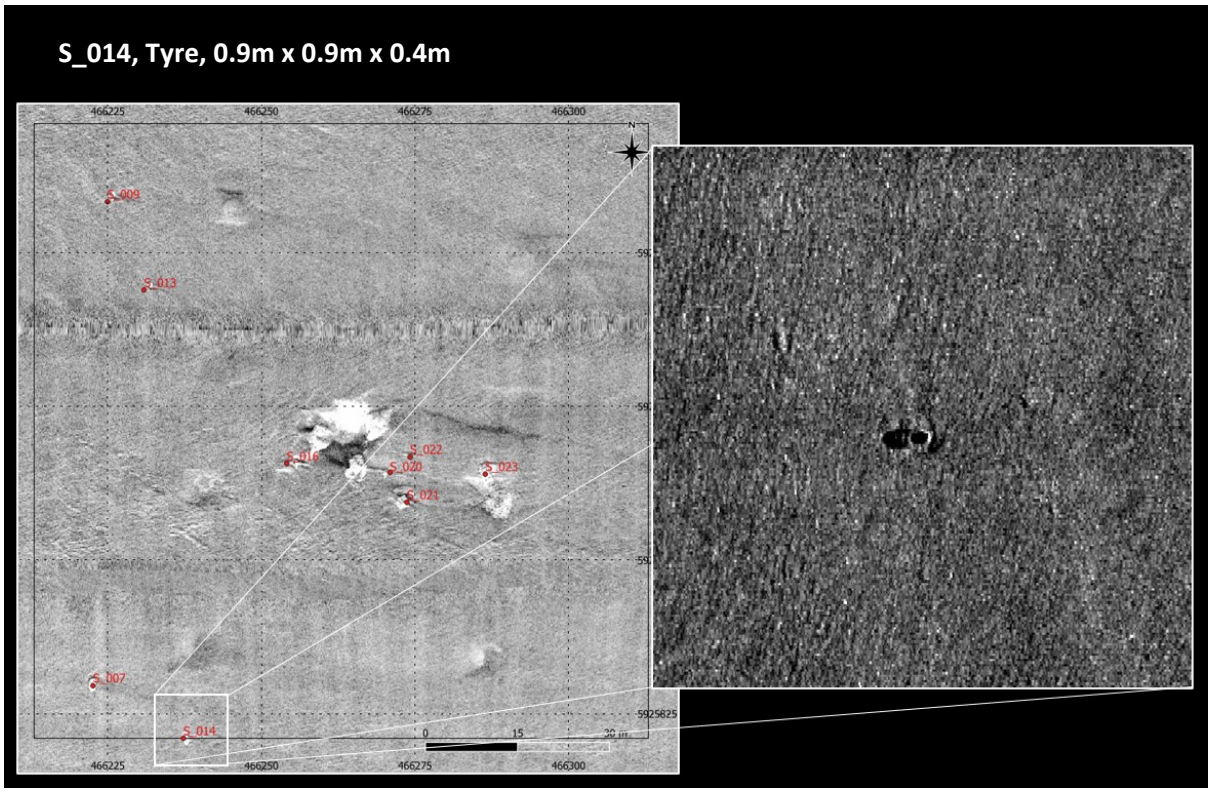


Figure 3.6 – SSS Data Example, showing target S_014

Figure 3.7 – SSS Data Example, showing target S_016

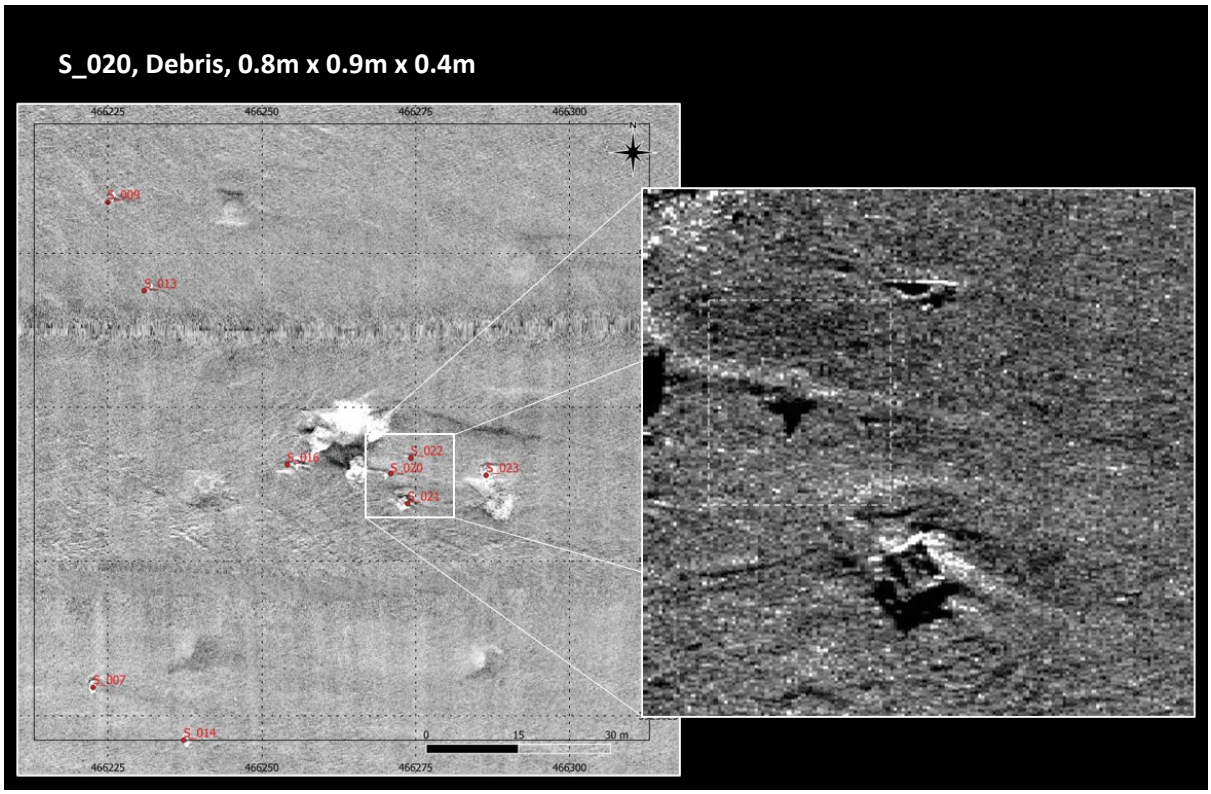


Figure 3.8 – SSS Data Example, showing target S_020

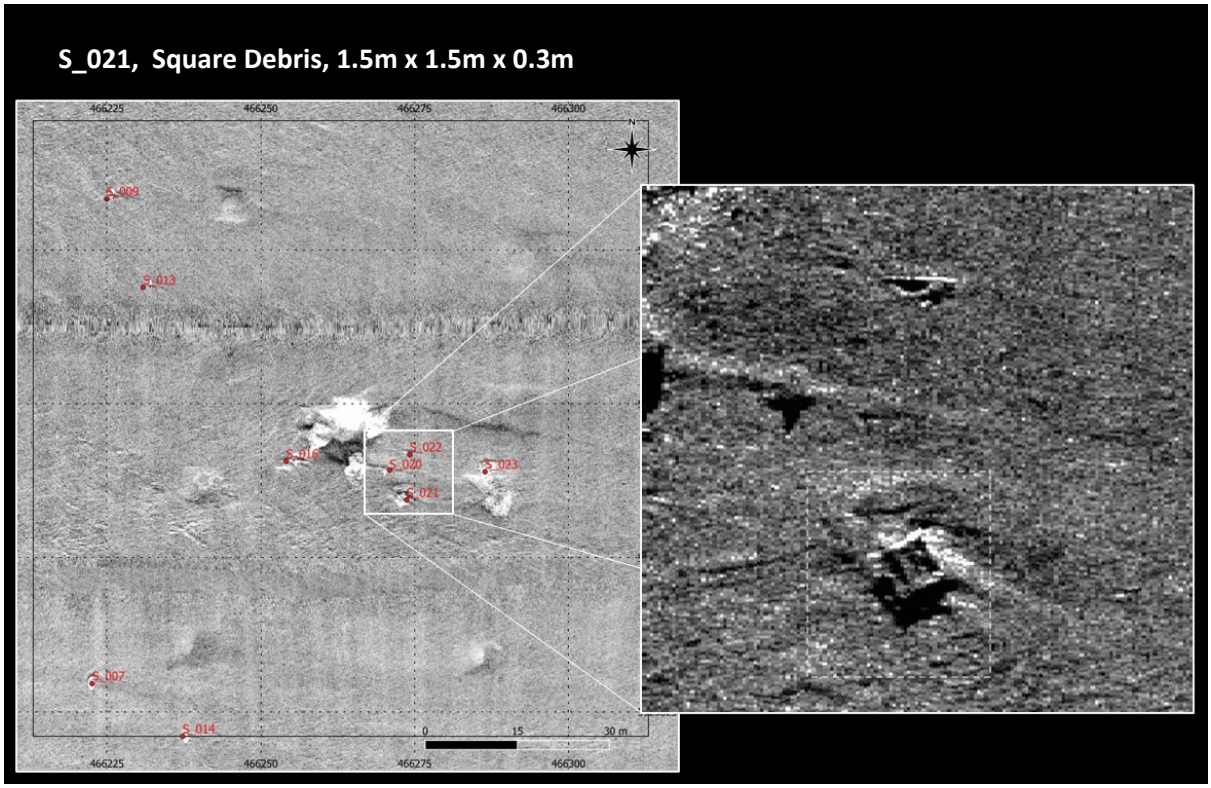


Figure 3.9 – SSS Data Example, showing target S_021

Figure 3.10 – SSS Data Example, showing target S_022

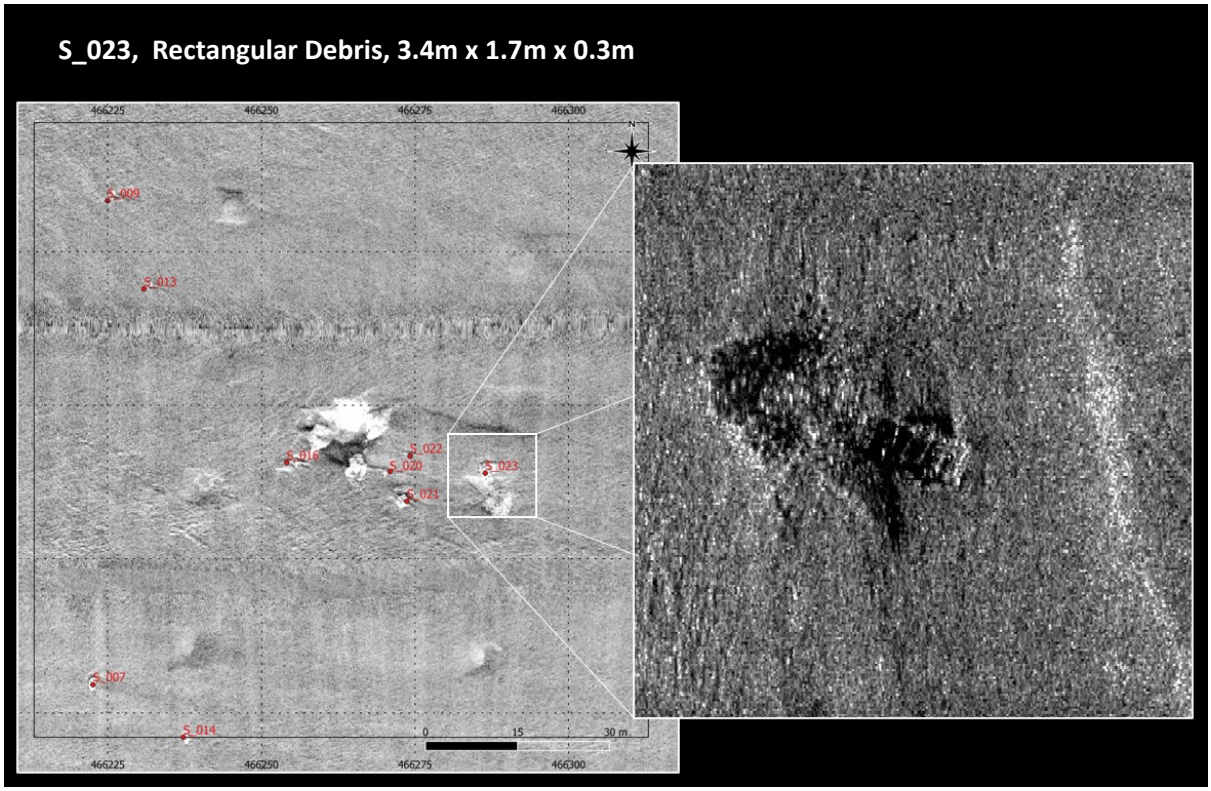


Figure 3.11 – SSS Data Example, showing target S_023

Appendix A – Mobilisation and Calibrations

Project Datum and Spheroid

Datum:	WGS 84 (ITRF 2014)
Source Ellipsoid:	WGS 84 (EPSG 7030)
Semi-major Axis (a):	6 378 137 metres
1st Eccentricity Squared (e^2):	0.006 694 379 99
Inverse Flattening (1/f):	298.257 223 563

Unit:	International Metre
Projection:	Universal Transverse Mercator
Grid:	UTM Zone 30 North (EPSG 32630)
Latitude of Origin:	0° (Equator)
Central Meridian:	3° West
Scale Factor on Central Meridian	0.9996
False Easting	500 000 metres
False Northing	0 metres

Vertical Control

MBES bathymetry was reduced to VORF LAT and the WGS 84 ellipsoid.

Datum Transformation Parameters

Geodetic position computations within the Applanix POS MV WaveMaster and Trimble VRS RTK corrections are conducted relative to ETRS 89. Positioning data received from the Applanix POS MV WaveMaster system shall be transformed to the WGS 84 (ITRF 2014) ellipsoid using the Helmert datum shift parameters outlined below.

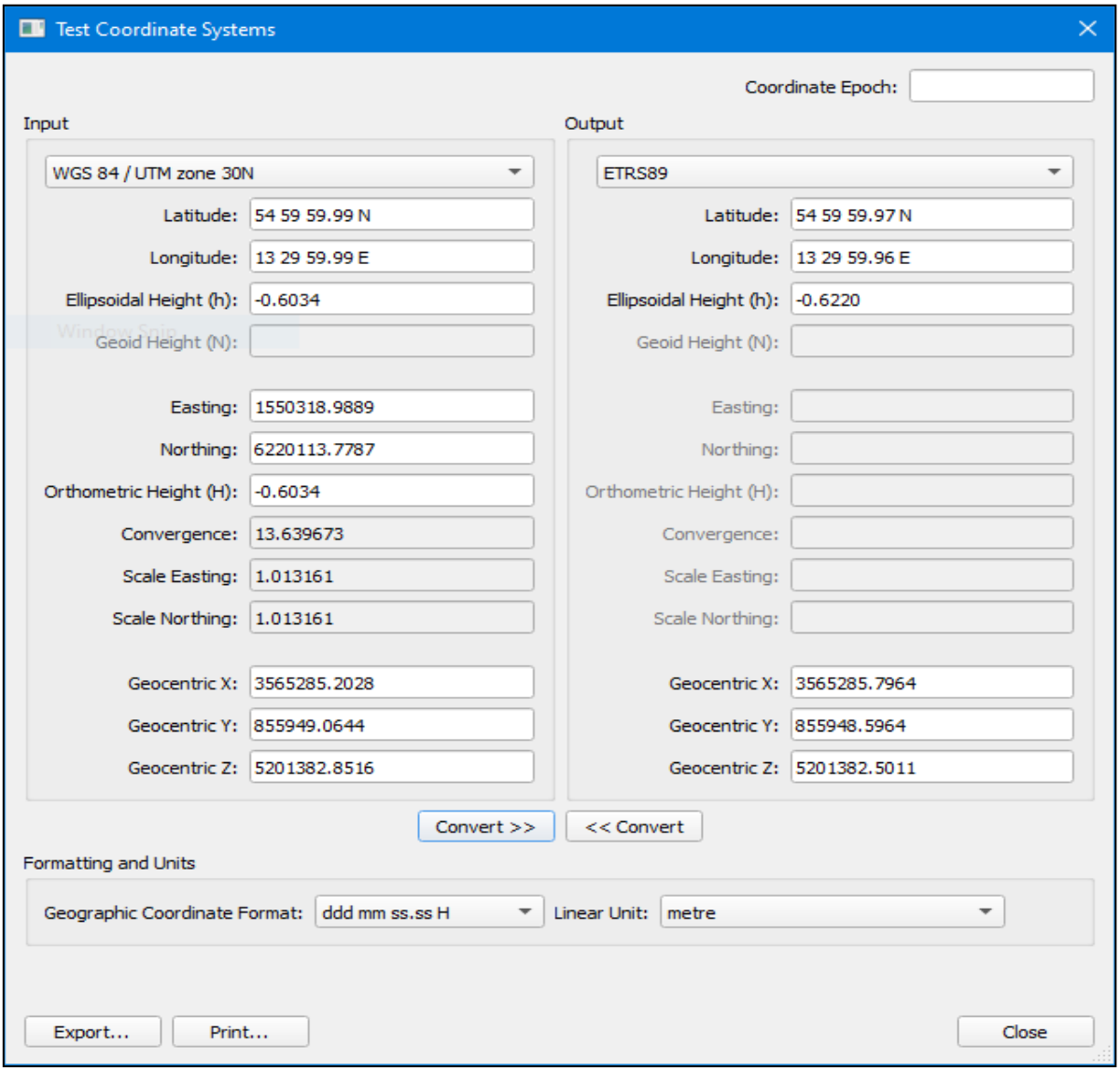
Source Datum:	ETRS 89 (EPSG 4258)
Ellipsoid:	GRS 1980 (EPSG 7019)
Semi-major Axis (a):	6 378 137 metres
1st Eccentricity Squared (e^2):	0.006 694 380 02
Inverse Flattening (1/f):	298.257 222 101

RTK positions from the Applanix POS MV WaveMaster shall be transformed to WGS 84 (ITRF 2014) within Qinsy using the below single stage seven parameter datum transformation.

Datum Transformation (From / To):	ETRS 89 to WGS 84 (ITRF 2014)
Delta X (m):	+0.11025
Delta Y (m):	+0.06711
Delta Z (m):	-0.13289
Rotation X (“):	-0.003543
Rotation Y (“):	-0.014426
Rotation Z (“):	+0.025962
Scale (PPM):	+0.0033

Coordinate Transformation Worked Example

Datum Transformation: WGS84 to ETRS 89, UTM Zone 30 N		
Coordinate	**WGS 84**	**ETRS 89**
Latitude	54° 59’ 59.99’ N	54° 59’ 59.97’ N
Longitude	013° 29’ 59.99’ E	013° 29’ 59.96’ E
Ellipsoidal Height	-0.6034	-0.6220
Geocentric X	3 565 285.2028	3 565 285.7964
Geocentric Y	855 949.0644	855 948.5964
Geocentric Z	5 201 382.8561	5 201 382.5011



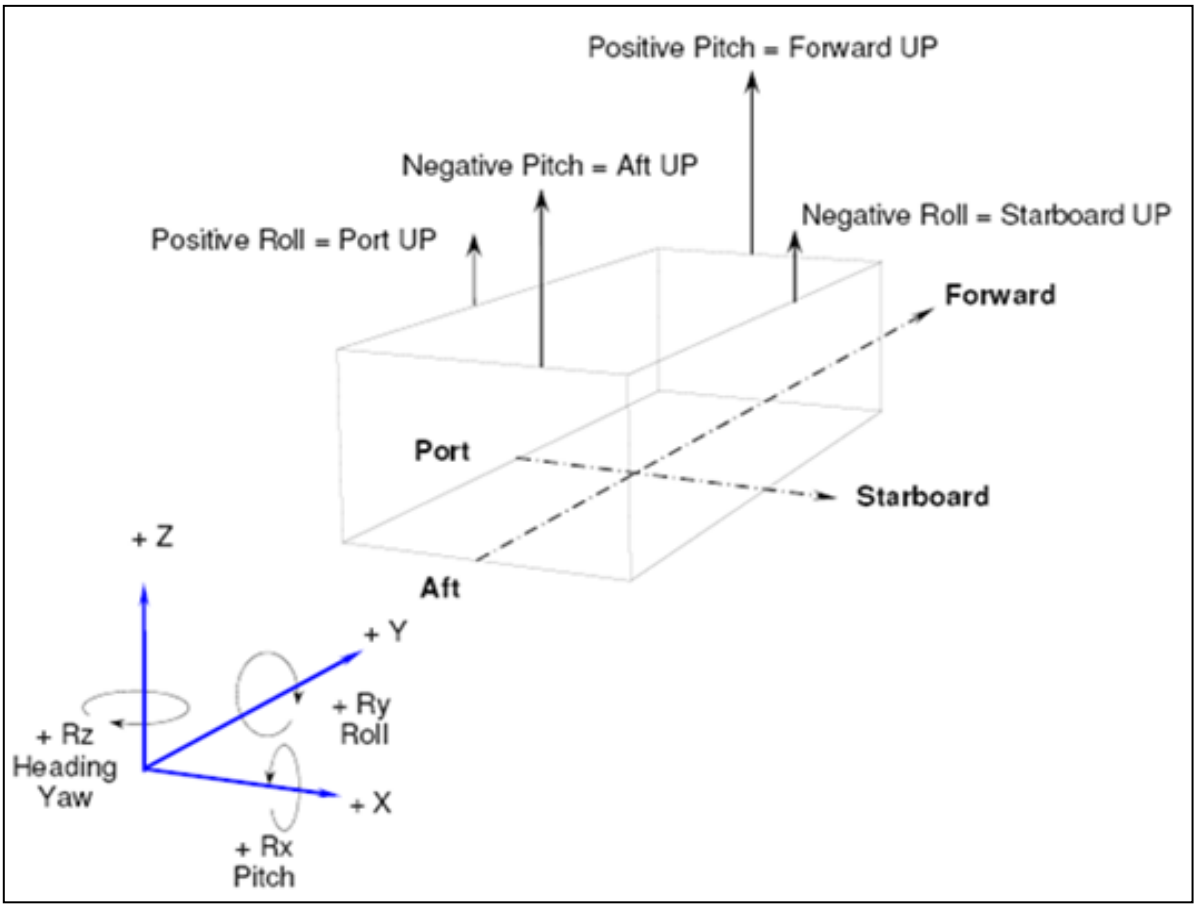
Coordinate Transformation Qinsy Worked Example

Time Parameters

Raw Data	UTC	
Survey Log Sheets	UTC	
Reports	UTC	
	System	**Positive/Negative**
Pulse Source	Applanix POS MV	Positive
Pulse Used by	Qinsy Nav PC	TTL +ve PPS Rising plus time
	Norbit MBES	Rising

Sign Conventions

The illustration below summarises the axis and pitch/roll convention used throughout the survey.



Project Sign Conventions

Units of Measurement

Linear	Metres (m)	
Angular	Degrees (°, +ve clockwise)	Except for datum transformation

System Offsets

Offsets onboard the MV Tracer 3 were determined and confirmed by taped offset measurement. Residual errors in offsets between the IMU and antenna are highlighted in the GAMS verification.

Offsets used during the Survey are detailed below.

	X (m)	Y (m)	Z (m)	Comments
CRP MV Tracer 3	0.000	0.000	0.000	Pole Mount: POS IMU
Sensor				
POS WaveMaster II IMU	0.000	0.000	0.000	Type 45 (Target Reference Point)
POS Primary Antenna	0.000	1.22	2.785	
Norbit MBES	0.000	0.140	-0.239	Tx/Rx Phase centre
Towpoints				
SSS	-3.500	0.200	1.300	
Draft Reference				
Marker on MBES Pole	0	0	1.2	CRP – Waterline

GAMS Calibration

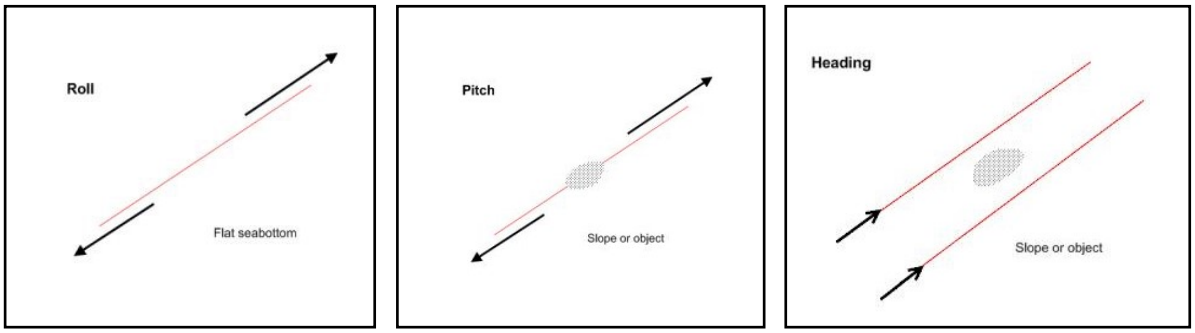
To calibrate the GNSS derived heading calculated by the POS MV, a GAMS (GNSS Azimuth Measurement Subsystem) calibration was performed on 14th October 2025.

The Calibration generates an improved baseline value between the Primary and Secondary antenna phase centres, improved heading alignment.

Multibeam Echo Sounder Patch Test

On 14th October 2025 following the recording of a SVP a patch test was undertaken on the Norbit Winghead MBES mobilised to the vessel Tracer 3.

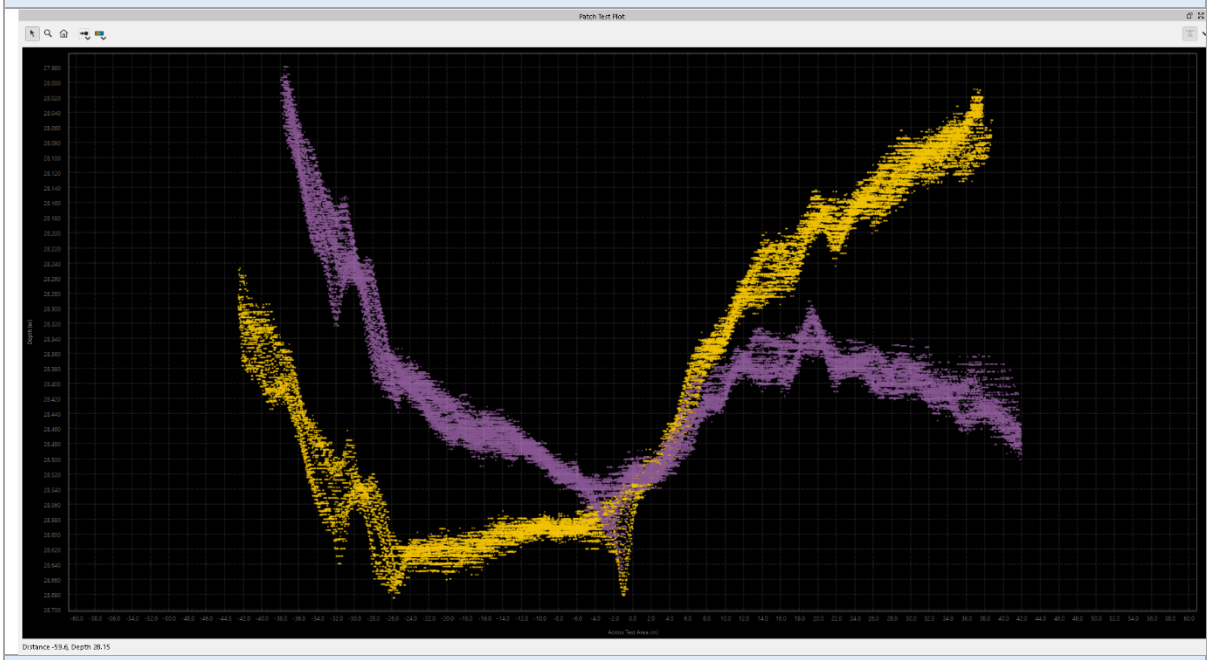
The patch test was undertaken to resolve the angular misalignments between the MBES transducer and the vessel reference frame. Overlapping MBES data is acquired on a series of survey lines, run in alternate directions and different speeds over and adjacent to a significant feature and over an area of flat seabed as shown below.



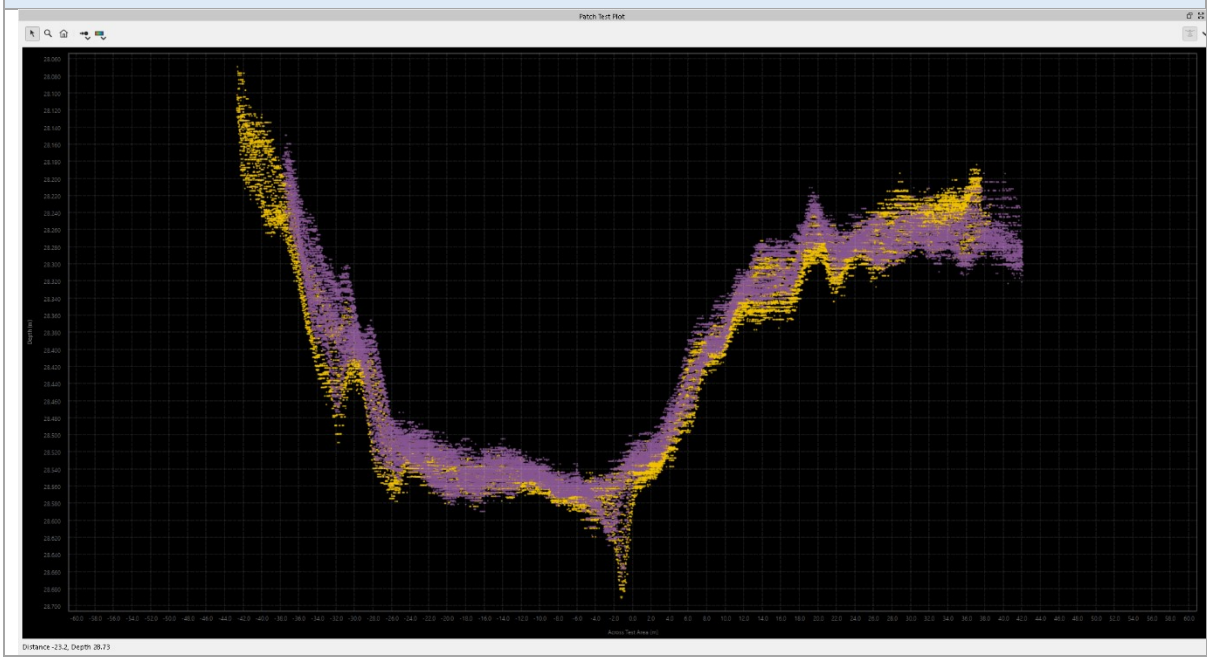
MBES Patch Test Routine

System	Parameter	Original (°)	Offset (°)	New (°)
Norbit	Roll	0.000	0.258	**0.258**
Norbit	Pitch	0.000	0.052	**0.052**
Norbit	Heading	0.000	0.108	**0.108**

Patch Test – ROLL BEFORE

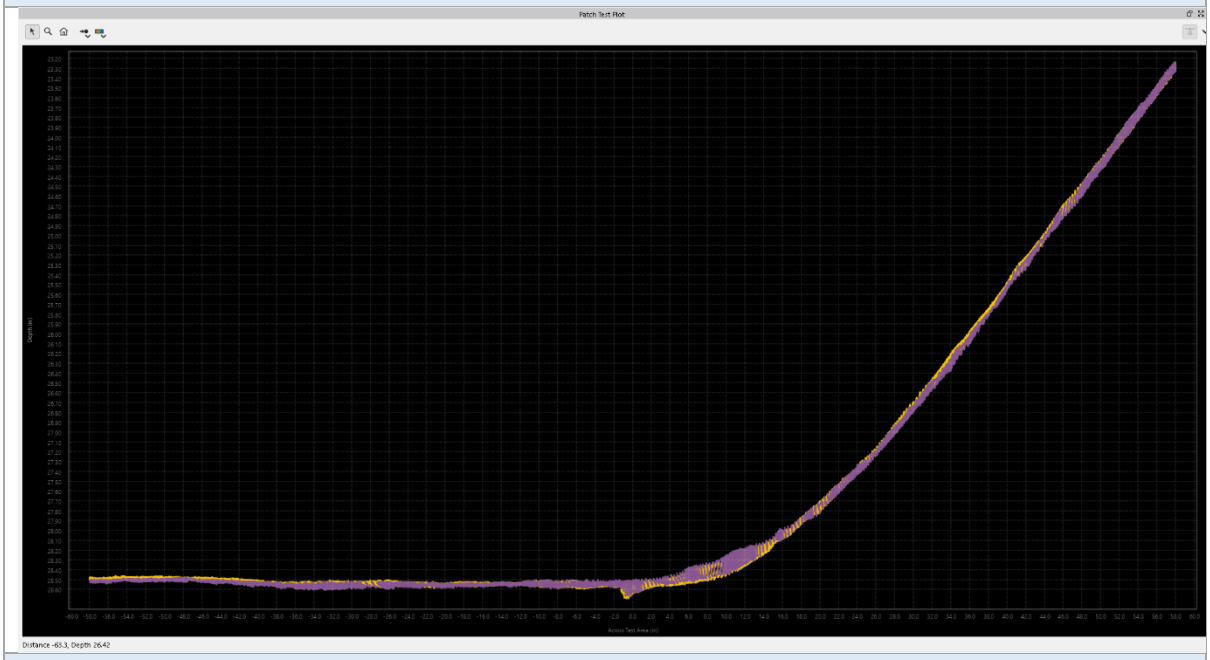


Patch Test – ROLL AFTER

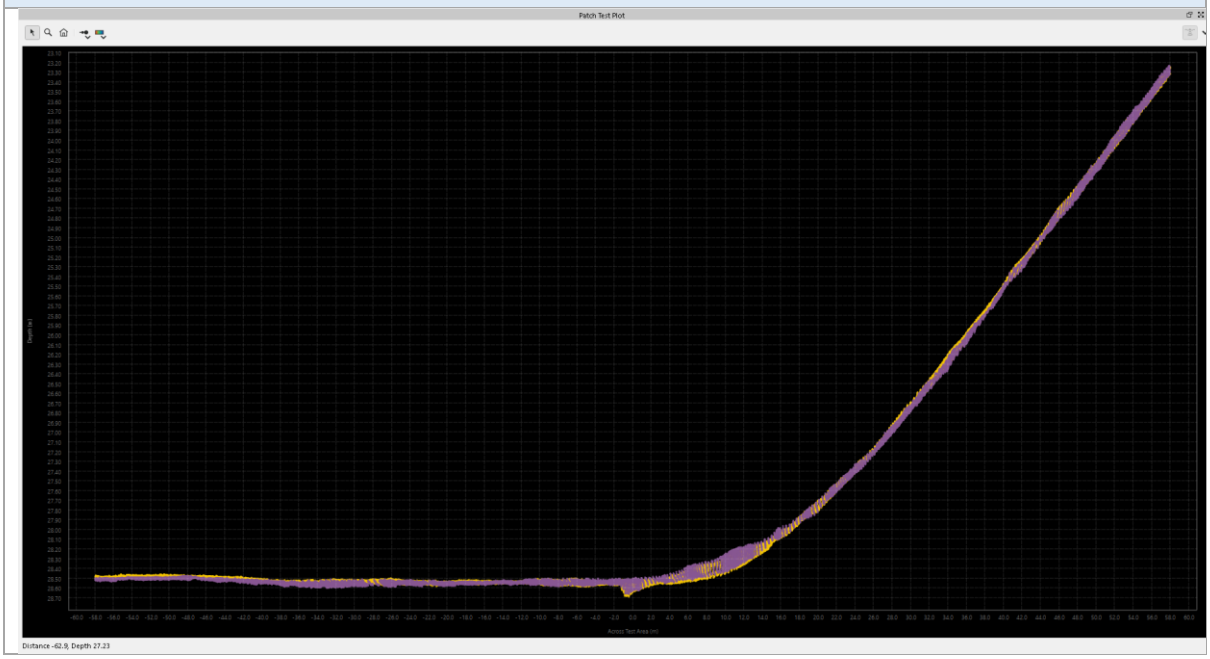


MBES Patch Test Roll (Before/After Plots)

Patch Test – PITCH BEFORE

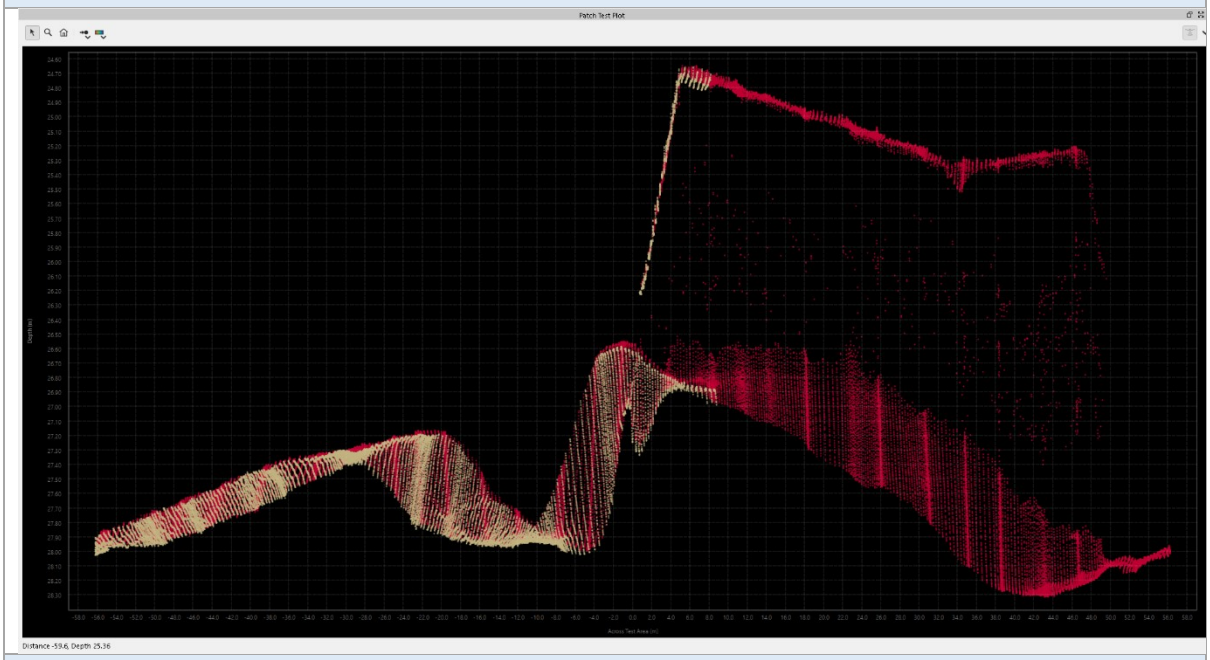


Patch Test – PITCH AFTER

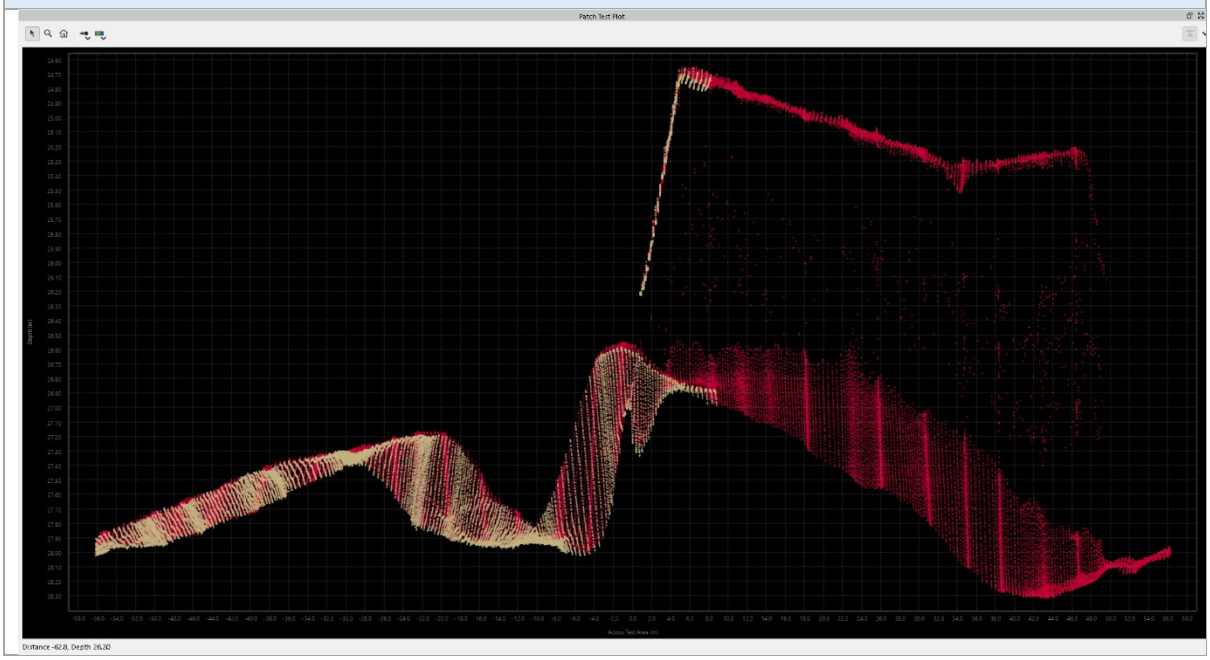


MBES Patch Test Pitch (Before/After Plots)

Patch Test – HEADING BEFORE



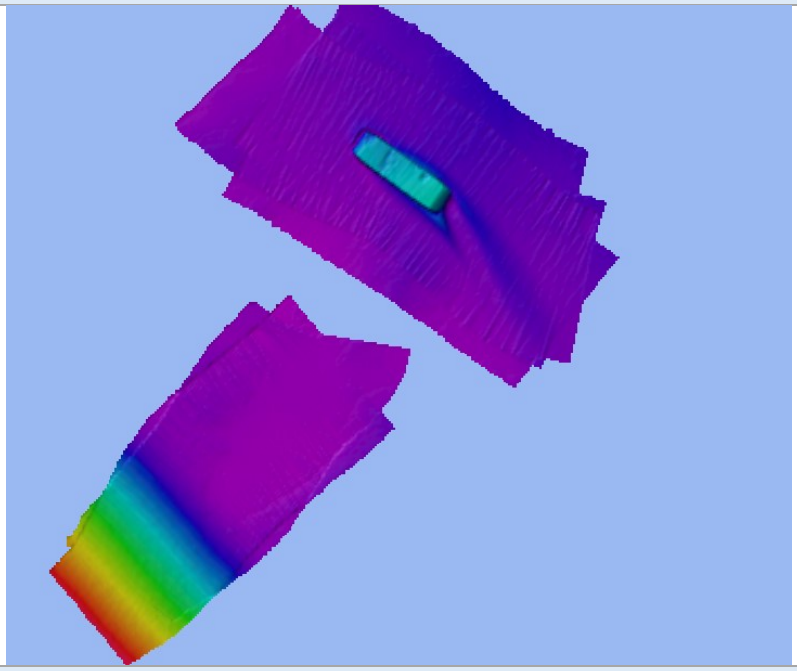
Patch Test – HEADING AFTER



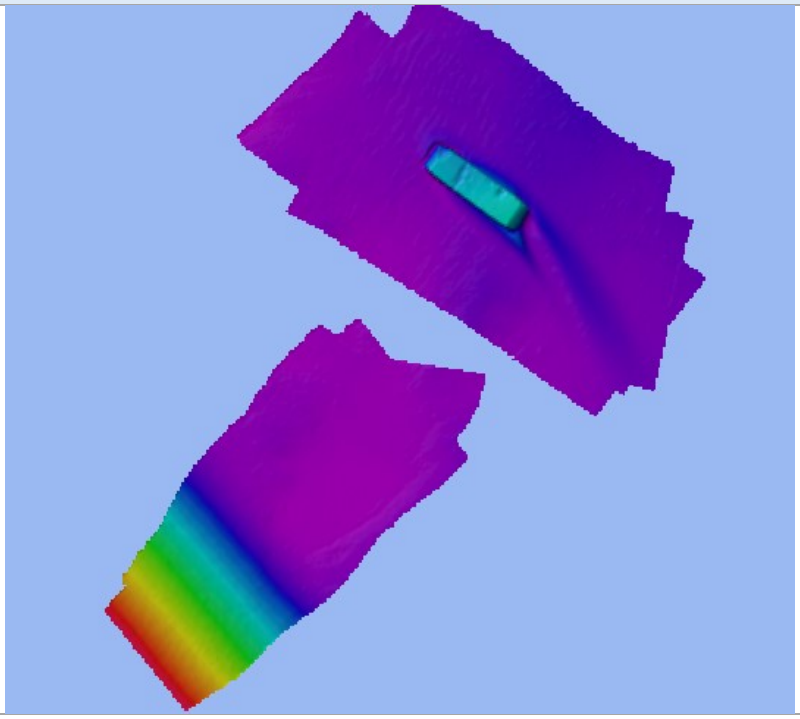
MBES Patch Test Heading (Before/After Plots)

Following completion of the patch tests the results were applied to the survey data. Results are presented overleaf.

Patch Test Area before values applied.

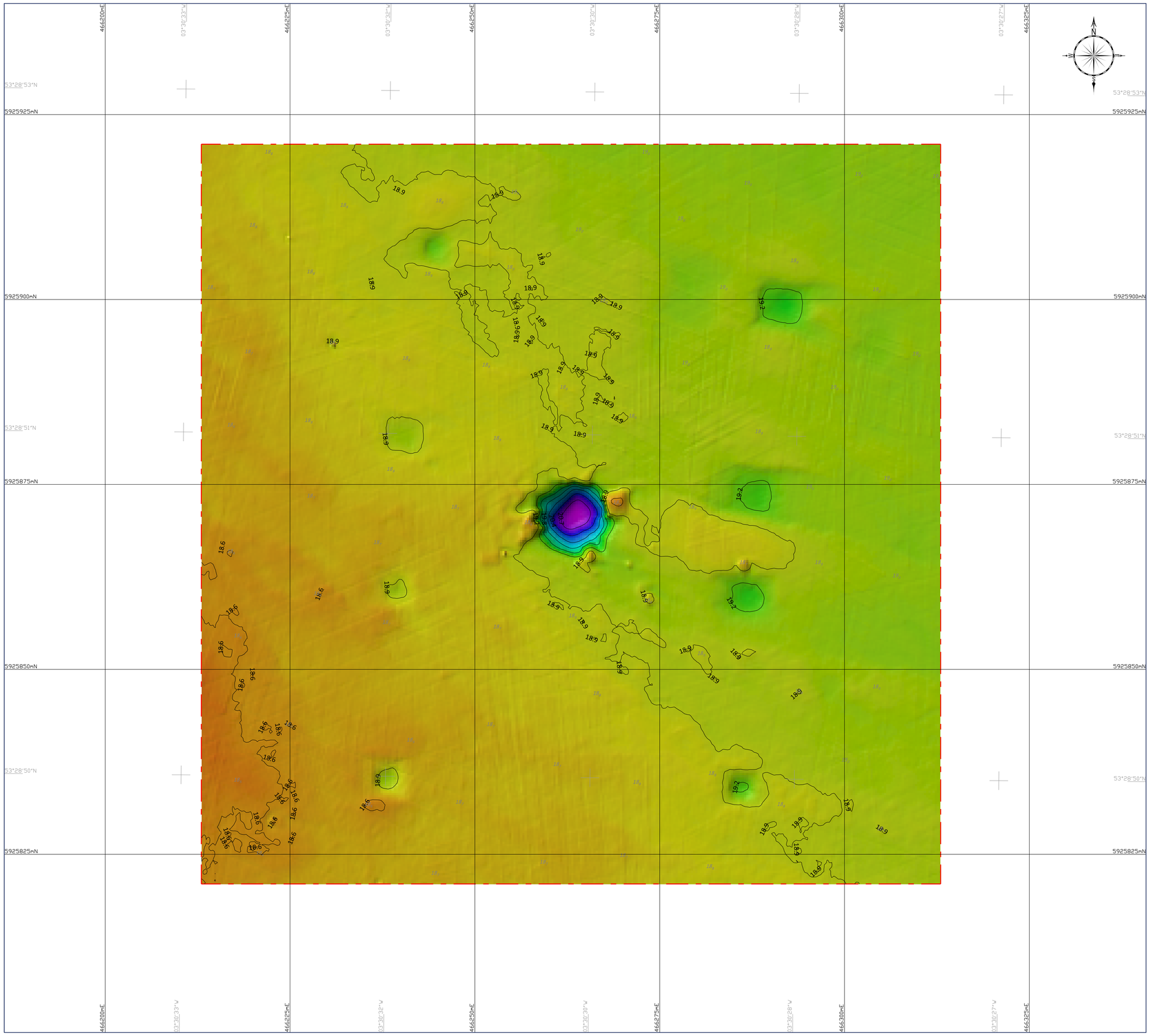


Patch Test Area after values applied.



MBES Patch Test Results

Appendix B – Charting



Legend

Bathymetry

19.5 — Contours at 0.5m intervals relative to LAT

18_9 Representetive spot heights in metres and decimetres relative to LAT

Shaded Relief Bathymetry Scale Bar

18.5 19.0 19.5 20.0 20.5

Elevation in metres relative to LAT

Notes

1. Horizontal Control: Primary surface positioning was provided by the Applanix POS MV Wavemaster II Inertial Navigation System (INS).
2. Vertical Datum: All depths are relative to Lowest Astronomical Tide (LAT) Elevations were derived from GNSS data and shifted from ETRF spheroidal height to LAT.
3. Bathymetry data gridded at 0.1m x 0.1m.

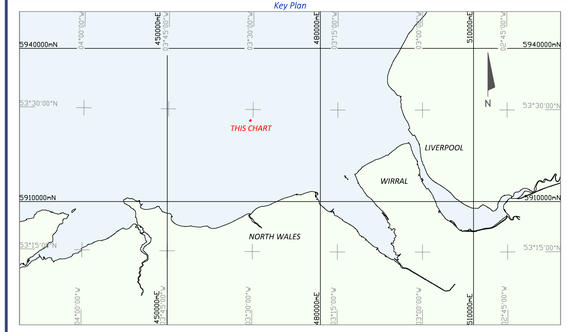
Geodetics:

WGS_1984_UTM_Zone_30N

Projection: Transverse_Mercator
False_Easting: 500000.0
False_Northing: 0.0
Central_Meridian: -3.0
Scale_Factor: 0.9996
Latitude_Of_Origin: 0.0
Linear Unit: Meter (1.0)

Geographic Coordinate System: GCS_WGS_1984
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_WGS_1984
Spheroid: WGS_1984
Semimajor Axis: 6378137.0
Seminor Axis: 6356752.314245179
Inverse Flattening: 298.257223563

Key Plan



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+44 (0) 1736 780 718

Contract:

Bathymetric & SSS Survey of Decommissioned Gwynt y Mor OWF Met Mast

Chart:

Sheded Relief Bathymetry

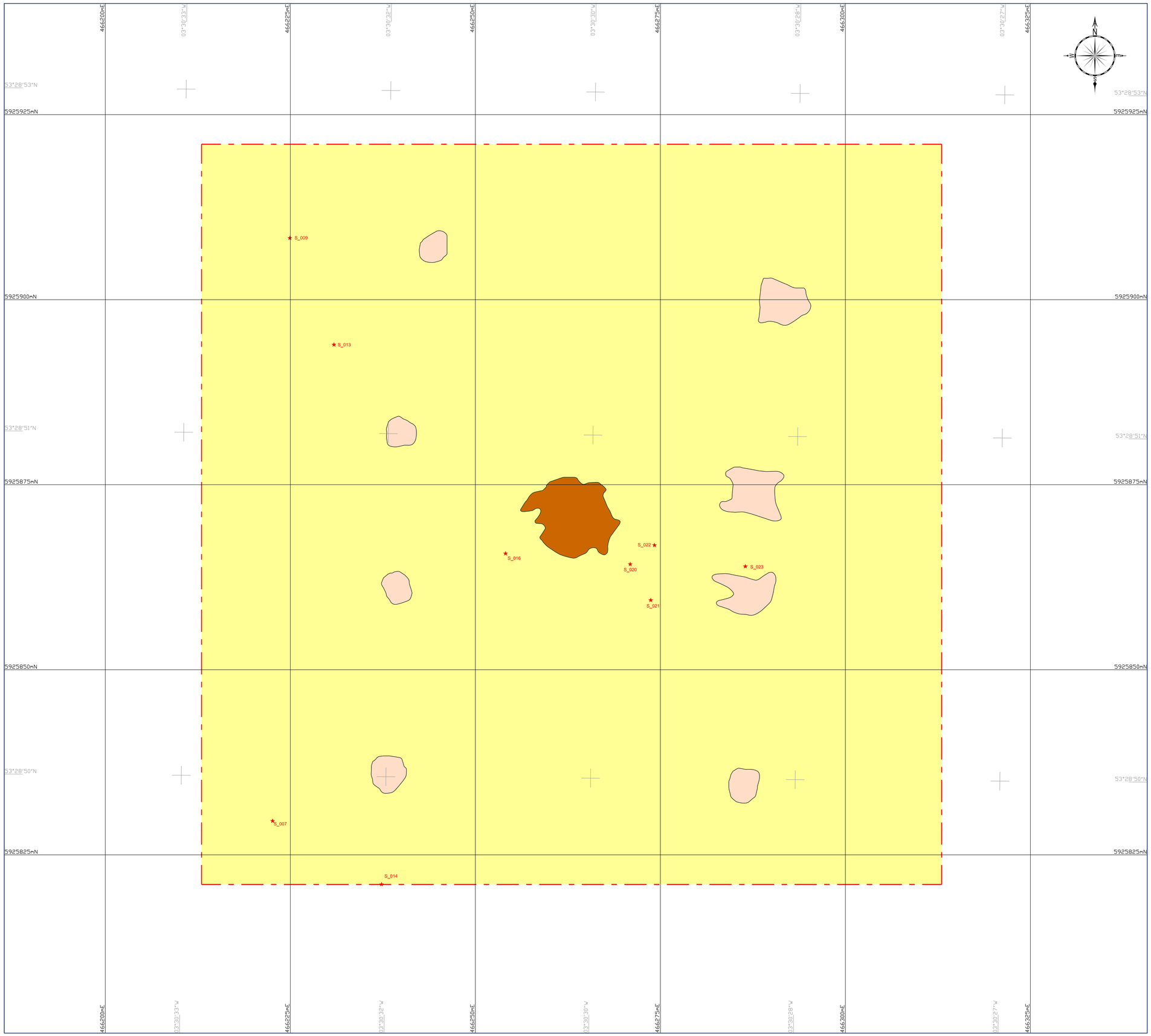
Scale 1:250

5 (m) 0 5 10 15 20 25

Revision:	Date:	Description:	Drawn:	Checked:
3				
2				
1				
0	29/10/2025	Draft	MS	SB

Horiz. Scale:	Vert. Scale:	Chart Number:	Series:	Contract No.:
1:250	N/A	UHC25021_01_BTY_250	01 of 02	UHC25021

Plot size A1



Legend

Seabed Features

- Seabed feature boundary
- SAND
- Depression
- Met-mast removal depression
- ★ S_001 — Side scan sonar target, with identifier

Notes

1. Horizontal Control: Primary surface positioning was provided by the Applanix POS MV Wavemaster II Inertial Navigation System (INS).
2. Vertical Datum: All depths are relative to Lowest Astronomical Tide (LAT) Elevations were derived from GNSS data and shifted from ETRF spheroidal height to LAT.
3. Bathymetry data gridded at 0.1m x 0.1m.
4. Seabed interpretation based on side scan sonar and multibeam echo sounder data.

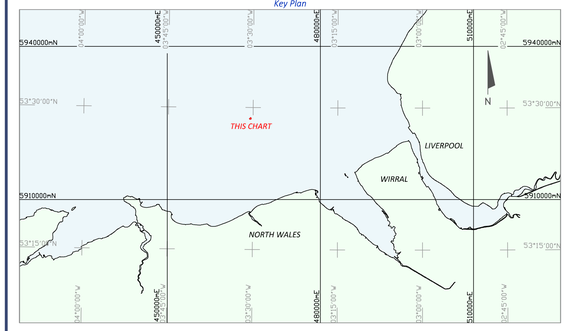
Geodetics:

WGS_1984_UTM_Zone_30N

Projection: Transverse_Mercator
False_Easting: 500000.0
False_Northing: 0.0
Central_Meridian: -3.0
Scale_Factor: 0.9996
Latitude_Of_Origin: 0.0
Linear Unit: Meter (1.0)

Geographic Coordinate System: GCS_WGS_1984
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_WGS_1984
Spheroid: WGS_1984
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314245179
Inverse Flattening: 298.257223563

Key Plan



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+44 (0) 1736 780 718

Contract:

Bathymetric & SSS Survey of Decommissioned Gwynt y Mor OWF Met Mast

Chart:

Seabed Features

Scale 1:250

5 (m) 0 5 10 15 20 25

Revision:	Date:	Description:	Drawn:	Checked:
3				
2				
1				
0	29/10/2025	Draft	MS	SB

Horiz. Scale:	Vert. Scale:	Chart Number:	Series:	Contract No.:
1:250	N/A	UHC25021_02_SBF_250	02 of 02	UHC25021

Plot size A1