Final Report

REACH-600096-RE-003

Final Report

Kystverket - U-864 - Wreck Campaign 2

21 August 2026	Issued for Review	Revision 2

REVISIONS

Rev.	Date	Description	Origin	Checked	Approved
1	2026.07.24	Issued for Review	IP/AA/KB	WNR	VB
2	2026.08.21	Issued for Review	IP/AA/KB	ANØ	VB

PROJECT DATA

Data Type	Description
Project title:	Kystverket - U-864 - Wreck Campaign 2
Project code:	600096
Operation period:	15.03.2026-28.03.2026 – 15.06.2026-29.06.2026
Vessel(s):	Olympic Triton

COMPANY DATA

Data Type	Description
Company	Kystverket
Company document number	-

ABBREVIATIONS

Abbreviation	Definition
ADCP	Acoustic Doppler Current Profiler
AHC	Active Heave Compensation
BRM	Bedrock Measurement
CRS	Coordinate Reference System
CTD	Conductivity, Temperature and Depth
DF	Deck Foreman
DGT	Diffusive Gradients Thin-Film
DP	Dynamic Positioning
DTM	Digital Terrain Model
DVL	Doppler Velocity Log
EPSG	European Petroleum Survey Group Code
FM	Field Memorandum
FMD	Flooded Member Detection
FU	Filter Unit
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GVI	General Visual Inspection
HPU	Hydraulic Power Unit
HPWJ	High Pressure Water Jet
HSE	Health, Safety and Environment
HSEQ	Health, Safety, Environment and Quality
IBC	Intermediate Bulk Container
IMO	International Maritime Organization
INS	Inertial Navigation System
MBES	Multibeam Echo Sounder
MMSI	Maritime Mobile Service Identity
MOC	Management of Change
MRU	Motion Reference Unit
NN2000	Norwegian National Height Datum 2000
OM	Offshore Manager
PDU	Power Distribution Unit
PE	Project Engineer
PPS	Pulse Per Second
ROV	Remotely Operated Vehicle
RS	Reach Subsea
SJA	Safe Job Assessment
SS	Shift Supervisor
TBT	Toolbox talk
TP	Task Plan
USBL	Ultra Short Baseline
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
WROV	Work-Class Remote Operated Vehicle
ZDA	Time and Date

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

The German submarine U-864 was torpedoed by a British submarine in 1945. U-864 broke in half and sank just outside Fedje, Norway, with the two main sections resting on the seabed at water depths ranging from 135 m to 165 m. The submarine is believed to have contained 1,857 mercury canisters, stored in the keel. Eight canisters have been recovered in previous surveys. Campaigns were conducted in 2005, 2006, 2013, 2014, 2016 and 2025 to assess the condition of the wreck and determine the best approach for managing the mercury-contaminated area.

Reach Subsea were contracted by Kystverket for phase 1 and 2 of this campaign. Phase 1 was performed in May 2025 and consisted of visual and geophysical surveys of the submarine, the results of which were used to plan for phase 2.

The objectives for phase 2 consisted primarily of access to the keel sections and removal of mercury canisters.

The wreck is located approximately 4 km west of Fedje (Figure 1-1). A bathymetric overview of the wreck is shown in Figure 1-2. Note the wreck is split into two parts, with the fore section found to the north and the aft section located to the south. The offshore campaign was carried out from the vessel Olympic Triton between 15 March and 28 March 2026, and between 15 June and 29 June 2026.

This report aims to describe the operations performed and the associated results.

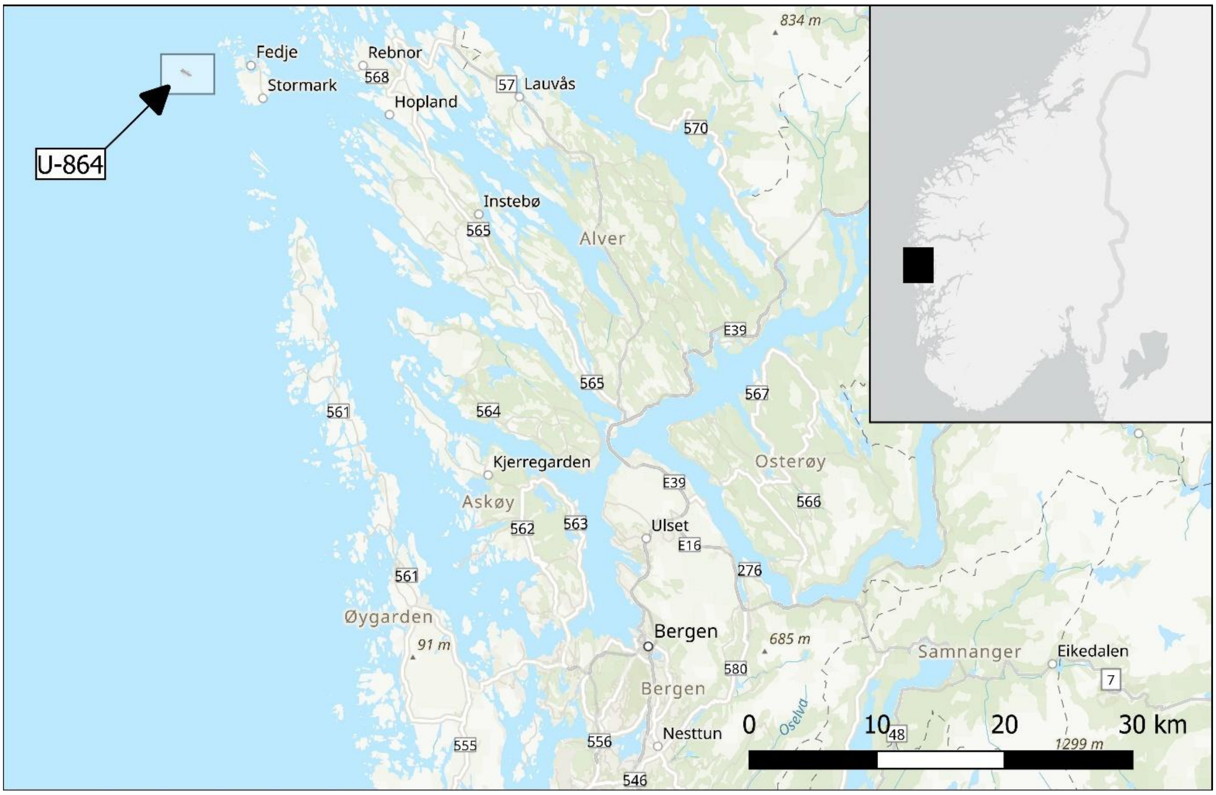

Figure 1-1 Wreck U-864 location

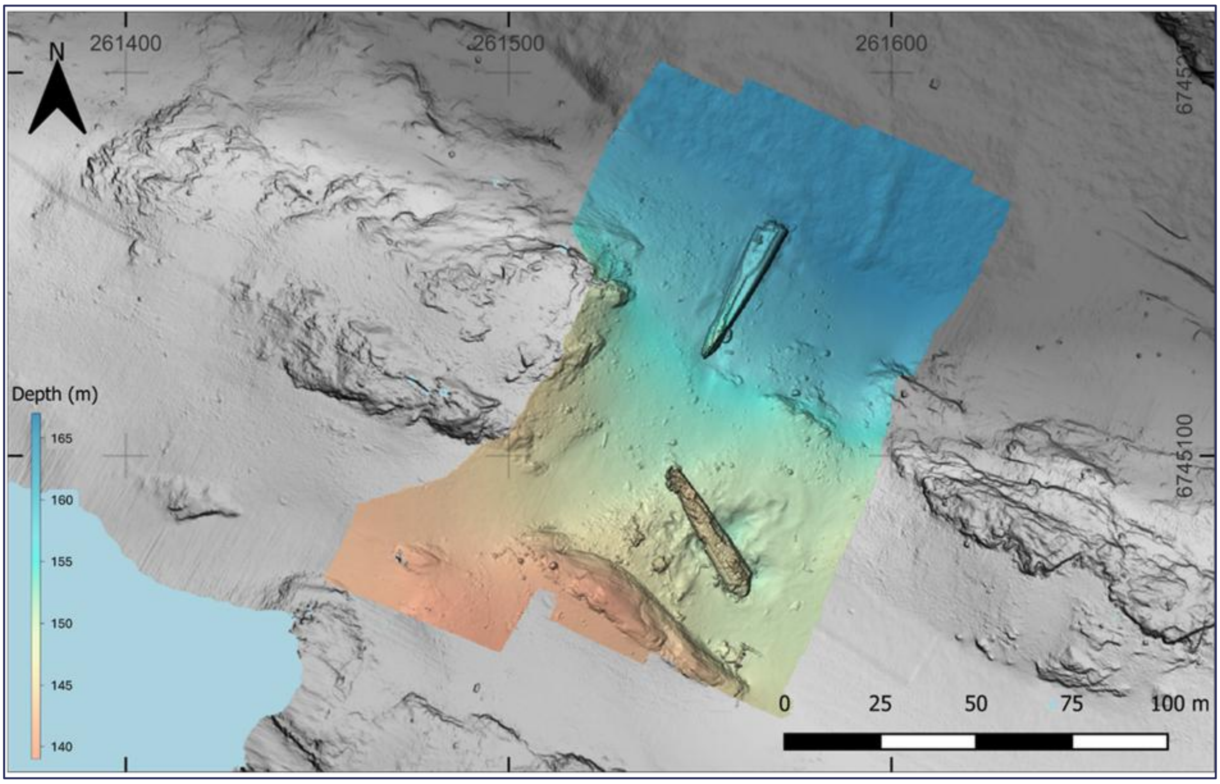

Figure 1-2 Wreck U-864 Bathymetry

1.1 SCOPE OF WORK

The scope of work defined by Kystverket was based on the following RFI (Request for Information) topics:

- RFI 1 - Access to keel section of the wreckage parts
- RFI 2 - Assessment of structural condition of keel section
- RFI 4 - Removal and handling of liquid mercury
- RFI 6 - Reduce spreading of sediments
- RFI 8 - Strategies and technology for monitoring mercury during operations
- RFI 9 - Data communication for monitoring

As a result of RFIs, operations were broken down into the following subtasks:

- Mercury canister retrieval from fore and aft sections
  - Kystverket assigned priority to fore section due to strategic relevance and accessibility
- Handling of retrieved liquid mercury
- Removal of cargo containers
- Retrieval of canisters from surrounding sediments
- Inspection of torpedo room of fore and aft sections
- Investigation of keel compartments
- Environmental monitoring and sediment spreading mitigation
- Geotechnical monitoring of wreck (attitude)
- Measurement of depth to bedrock
- As-left survey of area

Tasks above are summarised in the approximate order of operations in Figure 1-3.

Note several subcontractors were contracted by Reach Subsea to facilitate parts of the scope.

- ScanMatic: sensor-based turbidity monitoring stations and data transmittal
- NIVA: Turbidity monitoring, water sampling, sediment samples and mercury analysis. Assembly of environmental report.
- RENOcean: Access to keel and recovery of mercury canisters
- Franzefoss: Handling and storage of mercury canisters
- SWECO: Geotechnical slope analysis report

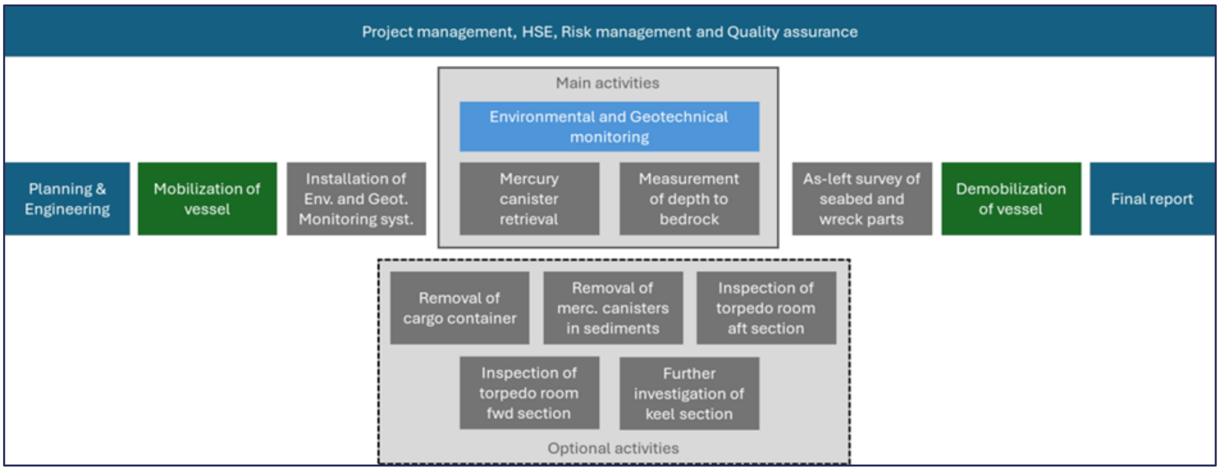

Figure 1-3 Project tasks

1.2 CHANGES TO SCOPE OF WORK

Several management of change documents were issued, as shown in Table 1-1 to capture changes in the scope.

During the first phase of the project, the buoy system, with basket, counter rotation, cables and lines and dead man anchor (DMA), that was planned for turbidity measurements were found to be unsuitable to be launched from deck due to strong currents. A revised launch procedure was written, but due to high seas and wind no new attempt of launching the turbidity buoy system was made. Instead, the CTD sensors on the two ROVs were used to measure turbidity.

During the second phase of the project, technical issues with the Spider dredger were the cause of some of the MOCs. Also, upon gaining access to the wreck's keel, the Client wanted samples of various items of debris found in the wreck. This also required MOCs.

Table 1-1 Management of Changes

MOC	Title	Status
REACH-600096-MOC-001	Buoy lifting point	Closed
REACH-600096-MOC-002	Deploy sediment traps with halved tied back rigging	Closed
REACH-600096-MOC-003	Perform FMD without turbidity measurements	Closed
REACH-600096-MOC-004	Completing MOB Task Plan despite that the latest revision is not yet approved and there are open items in the HAZOP	Deferred
REACH-600096-MOC-005	Leaving for site without all mobilisation checklists completed	Closed
REACH-600096-MOC-006	Deployment of project equipment without turbidity measurements	Closed

MOC	Title	Status
REACH-600096-MOC-007	Change location of FMD position	Closed
REACH-600096-MOC-008	Change rigging on LP-011 20 ft Subsea basket for Mercury recovery	Closed
REACH-600096-MOC-009	Conduct baseline turbidity measurement by use of ROV	Closed
REACH-600096-MOC-010	Changing turbidity measurement method to using ROV to measure turbidity – not signed	Deferred
REACH-600096-MOC-011	Wet storage of filter units	Cancelled
REACH-600096-MOC-012	Installation of visual indicator for wreck movement	Closed
REACH-600096-MOC-013	Dredging without Ren Ocean dredge container	Closed
REACH-600096-MOC-014	Dredging with shorter hose or no hose connected	Closed
REACH-600096-MOC-015	Revision of dredging methodology and filter unit installation	Closed
REACH-600096-MOC-016	Deployment of filter units using ROV-based current measurements during Spider downtime	Deferred
REACH-600096-MOC-017	Access to the keel through Dredge Pit 1 followed by optional ROV cutting operations	Closed
REACH-600096-MOC-018	Access to the keel through Dredge Pit 1 by optional ROV cutting operations	Deferred
REACH-600096-MOC-019	Wet storing of unused filter units	Closed
REACH-600096-MOC-020	Recovery of samples to deck, using IBC containers for cargo content	Closed
REACH-600096-MOC-021	Retrieval of U-864 keel compartment plate	Closed
REACH-600096-MOC-022	Use of cylinder pump to drain liquid mercury	Closed
REACH-600096-MOC-023	Change of procedure for bedrock measurements	Closed
REACH-600096-MOC-024	Aborting recovering of liquid mercury, starting on rock bag support	Closed
REACH-600096-MOC-025	Retrieval of bottom samples from U-864 for lab testing	Closed

1.3 GEODETIC PARAMETERS

1.3.1 HORIZONTAL DATUM

The coordinate reference system (CRS) is WGS84 UTM zone 32 N with parameters detailed in Table 1-2.

Table 1-2 Project Coordinate System

Survey Datum	
Spheroid	WGS84 UTM zone 32 N
Authority	EPSG: 32632
Ellipsoid Data	
Authority	WGS 84
Ellipsoid	EPSG: 7030
Semi major axis (a)	6 378 137.00
Inverse flattening (1/f)	298.257223563
Projection Data	
Authority	EPSG: 16032
Projection type	Universal Transverse Mercator (UTM)
Zone	32 North
Latitude of natural origin	0°
Longitude of natural origin	9 East
False northing	0
False easting	500 000
Scale factor at natural origin	0.9996

1.3.2 VERTICAL DATUM

Soundings were reduced to NN2000. Tidal heights were computed from GPS ellipsoidal height observations and converted to NN2000 using the height reduction model HREF2018B.

Reach Subsea provided vertical offset between NN2000 and Nautical Chart Zero ("Sjøkartnull") in reports and maps to allow for depth conversion.

Table 1-3 Vertical Datum

Geoid Model	Reference
HREF2018B	NN2000

1.3.3 TIME REFERENCE

All survey computers, video and log keeping were synchronised to Coordinated Universal Time (UTC) which was derived from the GNSS (Global Navigation Satellite System) and supplied through a timeserver.

GNSS receiver output one pulse per second (PPS), together with the corresponding ZDA message, and was distributed to all time-critical systems.

1.4 VESSEL

The operation was conducted using Olympic Triton (Figure 1-4).

Figure 1-4 Olympic Triton

Olympic Triton is a multifunctional subsea vessel with a large deck area and large cargo capabilities for most operations. The vessel is equipped with a 150 Te AHC offshore crane, ROV hangar, large moon pool, helideck and can accommodate 100 persons. It has diesel-electric machinery which ensures low noise levels and low fuel consumption. Vessel information is given in Table 1-4.

Table 1-4 Vessel information

Information	Details
Vessel name	Olympic Triton
Year Built	2007
MMSI	257959000
Call Sign	LADM3
IMO	9383754
Length overall	95.0 m
Width	20.5 m
Draft	7.0 m
DP system	Kongsberg K-Pos DP21
Gross Tonnage	5947 Te
Net deck area (available for project)	930 m^2
Crane	AHC 150 Te
Accommodation	100 pax
ROV System(s)	Kystdesign Constructor 07
	Kystdesign Supporter 27

1.5 EQUIPMENT

Olympic Triton was equipped with two Kystdesign WROVs: Constructor 07 and Supporter 27. The Kystdesign ROVs were equipped and designed to meet all requirements for subsea construction and intervention services, in addition to full survey interfaces and capabilities.

1.5.1 SUPPORTER ROV

The Kystdesign Supporter ROV (Figure 1-5) comprised both standard and project-specific equipment. Information about the ROV and the equipment is provided in Table 1-5 through Table 1-7.

The Supporter was fitted with MBES and sensors for measuring current, turbidity and taking water samples. Due to the delicate nature of the MBES and sensors, the Supporter was mainly used for environmental monitoring, as well as as-found and as-left surveys.

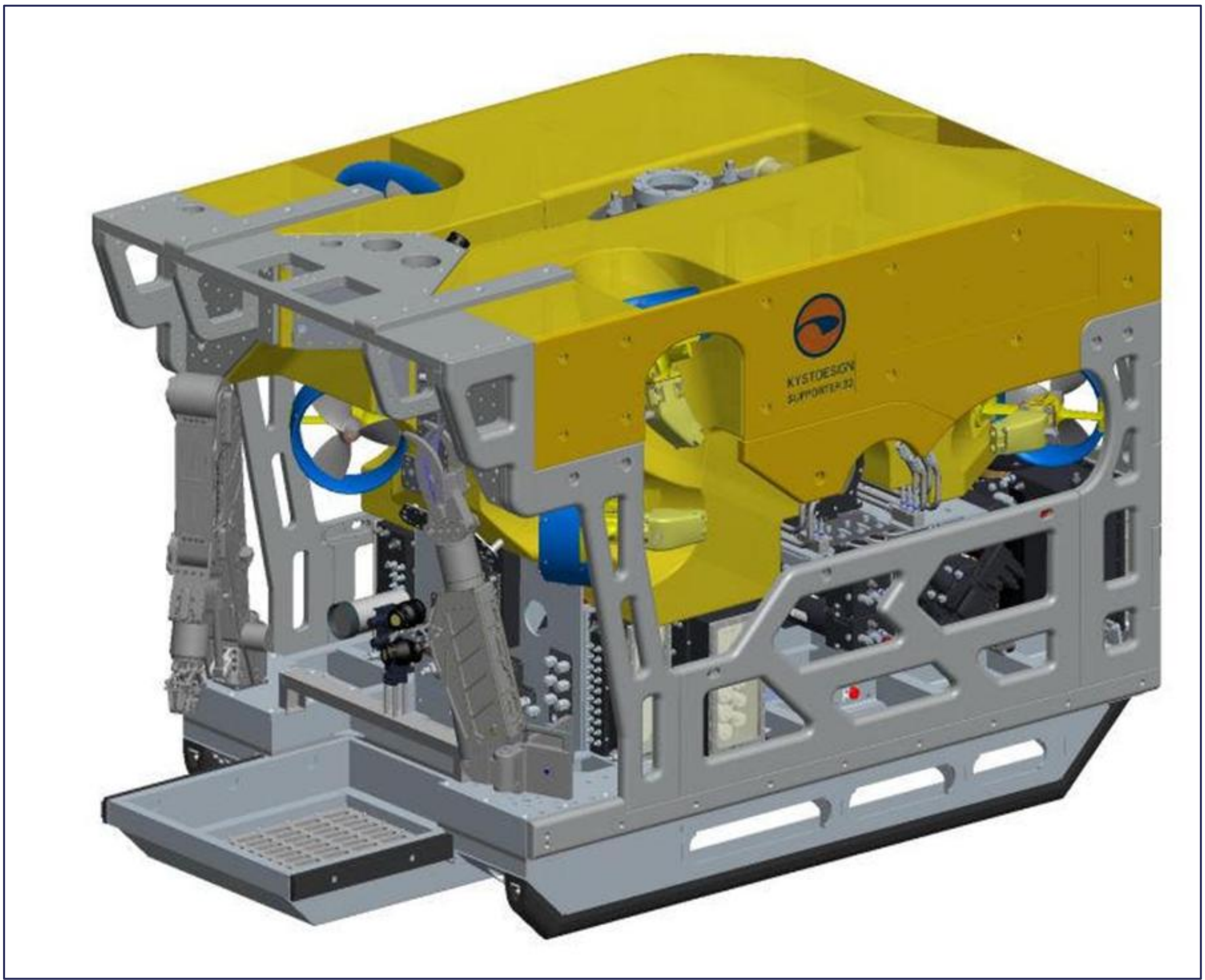

Figure 1-5 Kystdesign Supporter

Table 1-5 Kystdesign Supporter 27 information

Information	Details
Manufacturer	Kystdesign
Model	Supporter 27
Dimensions	2750 x 1700 x 1931 mm (LxWxH)
Weight	3600 kg
Payload	~350 kg with Skid, Manipulators and standard sensors, cameras, lights and P&T installed
Max Depth	3000 msw

Table 1-6 Kystdesign Supporter 27 Standard Equipment

Quantity	Supporter WROV Standard Equipment	Note
2	Imenco Hammerhead	Camera
4	SD PAL	Camera
8	DeepSea LED Sealite 115VAC	Lights
1	Octans 3000	Gyro Compass
1	Gemini 720is	Obstacle Avoidance Sonar
1	Valeport Mini IPS	Depth Sensor
1	Tritech PA500	Altimeter
2	cNode miniS 34-180	Transponder
1	Schilling Titan 4	Manipulator Stbd
1	Schilling Rigmaster	Manipulator Port
1	Dynaset HPW220	Waterjet
1	Saga Subsea 12" Grinder	Grinder
1	Webtool 40 mm	Wire Rope Cutter
1	Saga Subsea Knife	ROV Knife
1	Sonardyne Lodestar Sprint 500 (G3) Sonardyne Syrinx 600 kHz DVL	INS-DVL System
1	Valeport miniIPS1 (>50bar)	Bathymetry
1	Valeport miniSVS Sound Velocity Sensor (>600bar)	MiniSVS
1	Valeport - Mini CTD (Direct Reading)	CTD

Table 1-7 Project Equipment

Quantity	Description
1	MISS Rosette CTD for water sampling and Turbidity Observations
1	Valeport 803 Current Meter
1	RTS Cube Modem
1	R2Sonics 2024 MBES (dual head) + Mounting Frame

1.5.2 CONSTRUCTOR ROV

The Kystdesign Constructor ROV (Figure 1-6) comprised both standard and project-specific equipment. Information about the ROV and the equipment is provided in Table 1-8 through

Table 1-10. The Constructor was fitted with a turbidity sensor, and various tooling for the manipulators. The Constructor was used for various work close to the wreck, such as opening of the keel compartments and handling of the mercury canisters. It was also used as power source for grabs and cyclone dredger.

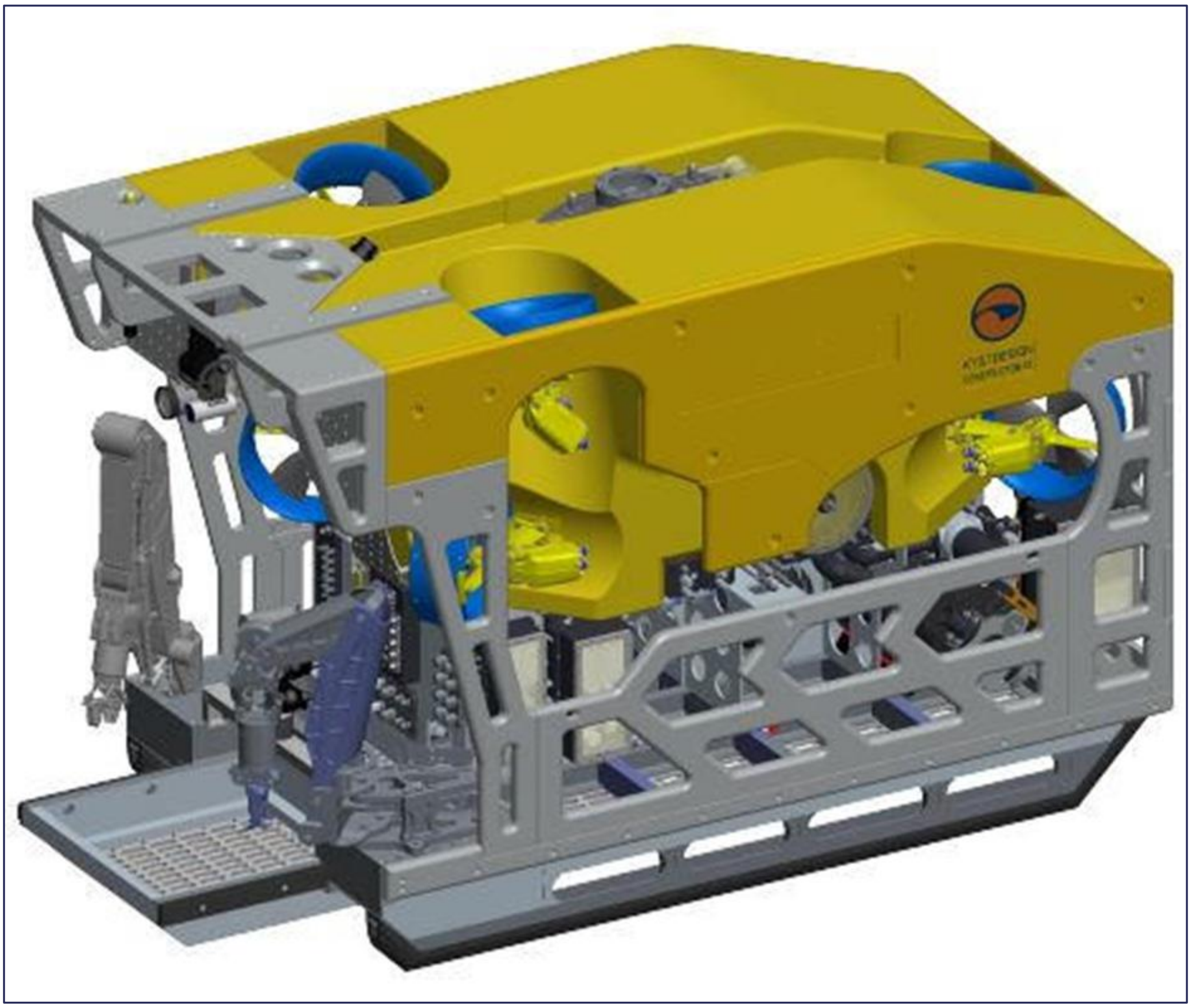

Figure 1-6 Kystdesign Constructor

Table 1-8 Kystdesign Constructor information

Information	Details
Manufacturer	Kystdesign
Model	Constructor 07
Dimensions	3220 x 1700 x 2150 mm (LxWxH)
Weight	4600 kg
Payload	~360 kg with Skid, Manipulators and standard sensors, cameras, lights and P&T installed
Max Depth	3000 msw

Table 1-9 Kystdesign Constructor standard equipment

Quantity	Constructor WROV Standard Equipment	Note
2	Imenco Hammerhead F/Z	Camera
1	B/W Camera	Camera
1	T4 Camera	Camera
2	Greytip	Camera
1	Silvertip (skid)	Camera
1	Fisheye/wide angle	Camera
8	DeepSea LED Sealite 115VAC	Lights
1	Octans 3000	Gyro Compass
1	Gemini 720is	Obstacle Avoidance Sonar
1	Valeport Mini IPS	Depth Sensor
1	Tritech PA500	Altimeter
2	cNode miniS 34-180	Transponder
1	Schilling Titan 4	Manipulator Stbd
1	Schilling Rigmaster	Manipulator Port
1	Dynaset HPW220	Waterjet
1	Saga Subsea 12” Grinder	Grinder
1	Webtool 40 mm	Wire Rope Cutter
1	Saga Subsea Knife	ROV Knife
1	Sonardyne Lodestar Sprint 500 (G3) Sonardyne Syrinx 600 kHz DVL	INS-DVL System
1	Valeport miniIPS1 (>50 bar)	Bathymetry
1	Valeport miniSVS Sound Velocity Sensor (>600 bar)	MiniSVS
1	Valeport - Mini CTD (Direct Reading)	CTD

Table 1-10 Project Equipment

Quantity	Description
2	Rosette for water sampling
6	Buoy, Scanmatic
2	ROV camera on stick
2	35 Te Imenco shackle with wide body shackle
2	12 Te Imenco shackle with wide body shackle
2	ROV Mounted Water Jet
1	ROV Wire Cutter
1	ROV Grinder
2	MIKO ROV Magnet 750 kg
3	RTS Cubes and sufficient magnets
1	SAIV CTD with Turbidity Sensor

1.6 PERSONNEL

A list of project personnel on board the Olympic Triton during operations is provided in Appendix H.

2 MOBILISATION

Mobilisation was performed for each of the trips, with the first commencing on 15 March 2026 and the second starting on 15 June 2026.

Survey specific equipment is documented in the separate mobilisation and calibration report provided in Appendix D.

2.1 FIRST TRIP

The mobilised project equipment is shown in Table 2-1. Item number refers to the deck layouts for the respective trips.

Table 2-1 Mobilised Equipment (first trip)

Description	Quantity	Dimensions (L x W x H) (m)	Mass (Te)	Item no.
Franzefoss 20 ft Container	1	6.10 x 2.44 x 2.60	10.00	3
Franzefoss 10 ft Container	1	3.05 x 2.44 x 2.60	10.00	4
Franzefoss IBC (stored in item 3 during transit)	1	1.00 x 1.00 x 1.00	0.10	5
Franzefoss High Pressure Unit	1	2.24 x 2.36 x 1.70	2.5	26
Chute for RenSpider Umbilical	1	2.32 x 0.92 x 2.01	1.20	6
RenOcean Umbilical Winch	1	3.36 x 2.24 x 2.32	13.70	7
RenOcean Dredge Container	1	6.06 x 2.44 x 2.60	3.60	8
RenSpider	1	2.80 x 2.05 x 3.50	22.00	9
10 m Open Storage Container	1	10.0 x 1.30 x 1.50	8.00	10
10 ft Ren Ocean Storage Container	1	2.99 x 2.44 x 2.99	12.00	11
RenOcean WorkShop Container	1	2.99 x 2.44 x 2.60	10.00	12
RenOcean Control Container	1	2.99 x 2.44 x 2.59	10.00	13
RenOcean Oil Cleaning Unit	1	2.82 x 1.40 x 1.85	2.00	14
RenOcean Power Distribution Unit	1	3.66 x 2.44 x 2.96	12.00	15
RenOcean Small Peel Grab	1	1.50 x 1.50 x 0.70	0.16	25
RenOcean Seabed Penetration Pipe	1	5.50 x 1.34 x 0.24	0.24	27
IKM HP Cleaning Pump Unit HJ-39	1	2.00 x 1.33 x 2.09	3.23	22
Hydraulic Hose Reel w/ HPU	1	3.28 x 2.07 x 2.35	2.30	23
Chute for Hose, Bed Rock Measurement	1	1.47 x 0.32 x 0.96	0.17	24
Mercury Recovery Basket	1	6.10 x 2.44 x 1.40	5.00	16
NIVA Lab Container	1	6.06 x 2.44 x 2.60	10.00	20
Boulder Grab, big	1	1.10 x 1.10 x 0.75	5.40	17
10 ft Subsea Basket -Turbidity with Buoy	6	2.99 x 2.45 x 3.00	5.00	18
7ft Subsea Basket - Inclinometer; Various Tooling	2	2.45 x 2.45 x 3.00	5.00	19
Rigging Container	1	3.05 x 2.44 x 2.60	10.00	21
Rectification Filter Units	14	1.65 x 1.85 x 0.4	2.00	28
Rectification Filter Units	30	2.05 x 2.25 x 0.6	4.00	29
NOR Mudmat 18	5	3.60 x 2.60 x 0.03	0.50	30

2.1.1 DECK LAYOUT

The deck layout utilised on the Olympic Triton is shown in Figure 2-1. A photo of the deck is shown in Figure 2-2.

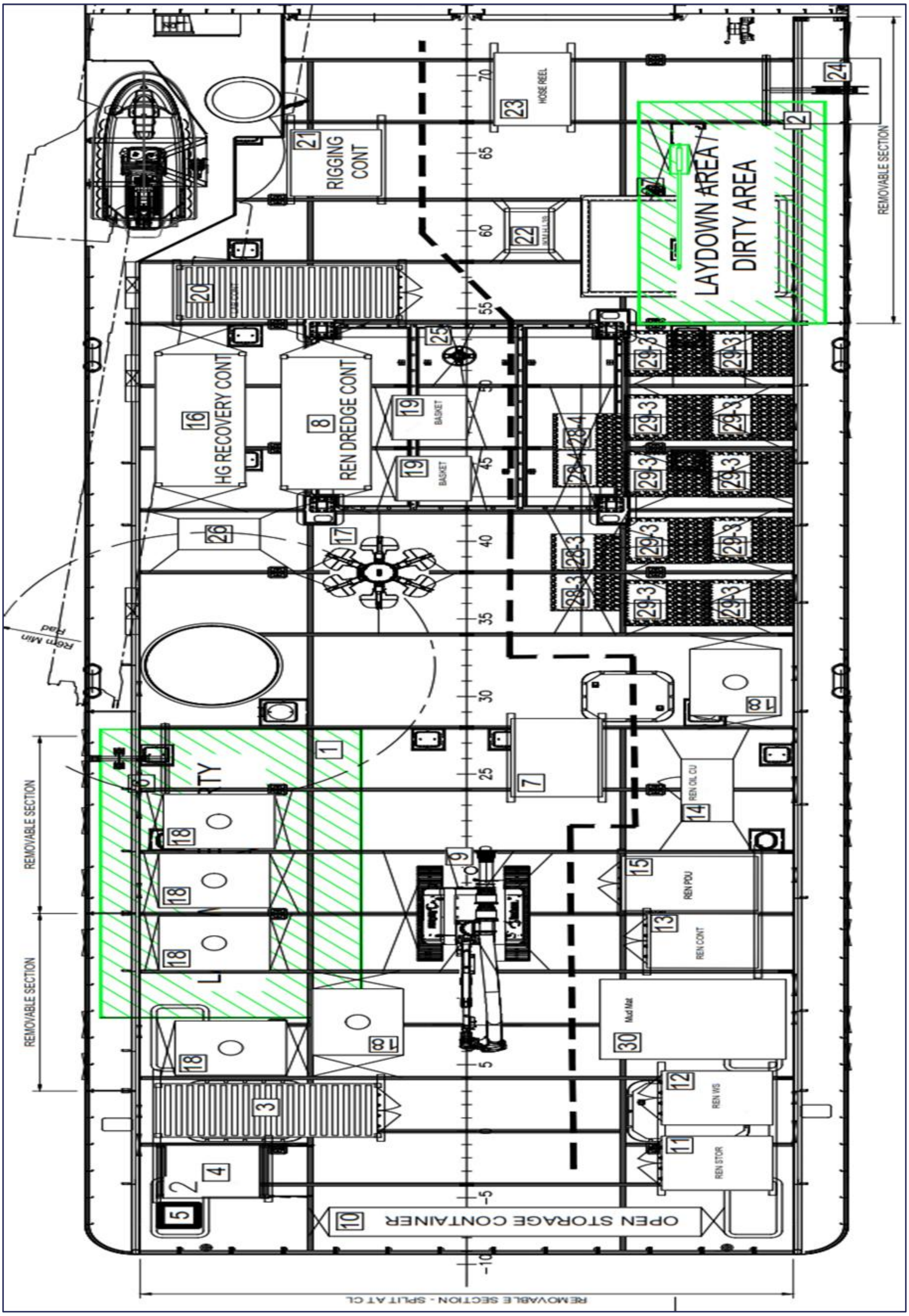

Figure 2-1 Olympic Triton deck layout (first trip)

Figure 2-2 Olympic Triton Aft deck during mobilisation (first trip)

2.1.2 ACTIVITIES

Mobilisation was carried out at CCB, Ågotnes between 15 and 18 March 2026. During this period, the vessel deck was prepared, support steelwork and deck infrastructure were installed, and the full recovery, monitoring and environmental protection spread was mobilised. Activities included loading of project containers, filter units, subsea baskets, monitoring equipment and the RenOcean recovery systems, together with extensive welding, integration, testing and sea-fastening works prior to departure for the field.

Key mobilisation activities included:

<u>15 March 2026</u>

- Personnel mobilisation, project meetings and safety briefings.
- Deck preparation and marking of equipment locations.
- Installation and welding of H-beams and support structures.
- Positioning of rigging container and preparation of deck layout for project equipment.

<u>16 March 2026</u>

- Loading and installation of:
  - RenOcean control, workshop, store and PDU containers.
  - NIVA laboratory container.
  - Franzefoss containers and HPWJ unit.
  - Hydraulic hose reel and support equipment.
- Installation of front and rear chutes.
- Connection of power and communications systems.
- Loading of subsea baskets and associated project tooling.
- Ongoing welding, fabrication and sea-fastening activities.

<u>17 March 2026</u>

- Loading of filter units, dredge container, mud mats and support equipment.
- Installation and preparation of the umbilical winch system.
- Loading of work platforms, recovery baskets and monitoring equipment.
- Integration of RTS cubes, gyros and survey equipment.
- Continued sea-fastening and equipment testing.
- Troubleshooting and repair of HPWJ and survey system interfaces.

<u>18 March 2026</u>

- Final system integration and testing of gyros, monitoring equipment and Spider systems.
- Loading of remaining buoyancy packages, pallets and ancillary equipment.
- Resolution of technical issues associated with the Spider excavator and hydraulic systems.
- Final deck inspections and sea-fastening checks.
- Departure from CCB during the evening and transit to the U-864 site.
- Completion of DP checks, safety reviews and commencement of offshore operations following arrival on location.

2.2 SECOND TRIP

The mobilised project equipment is shown in Table 2-2. Item number refers to the deck layouts for the respective trips.

Table 2-2 Mobilised Equipment (second trip)

Description	Quantity	Dimensions (L x W x H) (m)	Mass (Te)	Item no.
Franzefoss 20 ft Container	1	6.10 x 2.44 x 2.60	10.00	3
Franzefoss 10 ft Container	1	3.05 x 2.44 x 2.60	10.00	4
Franzefoss IBC (stored in item 3 during transit)	1	1.00 x 1.00 x 1.00	0.10	5
Franzefoss High Pressure Unit	1	2.24 x 2.36 x 1.70	2.5	26
Chute for RenSpider Umbilical	1	2.32 x 0.92 x 2.01	1.20	6
RenOcean Umbilical Winch	1	3.36 x 2.24 x 2.32	13.70	7
RenOcean Dredge Container	1	6.06 x 2.44 x 2.60	3.60	8
RenSpider	1	2.80 x 2.05 x 3.50	22.00	9
10 m Open Storage Container	1	10.0 x 1.30 x 1.50	8.00	10
10 ft Ren Ocean Storage Container	1	2.99 x 2.44 x 2.99	12.00	11
RenOcean WorkShop Container	1	2.99 x 2.44 x 2.60	10.00	12
RenOcean Control Container	1	2.99 x 2.44 x 2.59	10.00	13
RenOcean Oil Cleaning Unit	1	2.82 x 1.40 x 1.85	2.00	14
RenOcean Power Distribution Unit	1	3.66 x 2.44 x 2.96	12.00	15
RenOcean High pressure pump	1	2.99 x 2.44 x 2.60	10.00	22
Hydraulic Hose Reel w/ HPU	1	3.28 x 2.07 x 2.35	2.30	23
Chute for Hose, Bed Rock Measurement	1	1.47 x 0.32 x 0.96	0.17	24
RenOcean Small Peel Grab	1	1.50 x 1.50 x 0.70	0.16	25
RenOcean Seabed Penetration Pipe	1	5.50 x 1.34 x 0.24	0.24	27
NIVA Lab Container	1	6.06 x 2.44 x 2.60	10.00	20
Mercury Recovery Basket	1	6.10 x 2.44 x 1.40	5.00	16
Boulder Grab, big	1	1.10 x 1.10 x 0.75	5.40	17
7ft Subsea Basket - Inclinometer; Various Tooling	2	2.45 x 2.45 x 3.00	5.00	19
Rigging Container	1	3.05 x 2.44 x 2.60	10.00	21
Rectification Filter Units	14	1.65 x 1.85 x 0.4	2.00	28
Rectification Filter Units	30	2.05 x 2.25 x 0.6	4.00	29
NOR Mudmat 18	5	3.60 x 2.60 x 0.03	0.50	30

2.2.1 DECK LAYOUT

The deck layout utilised on the Olympic Triton is shown in Figure 2-3.

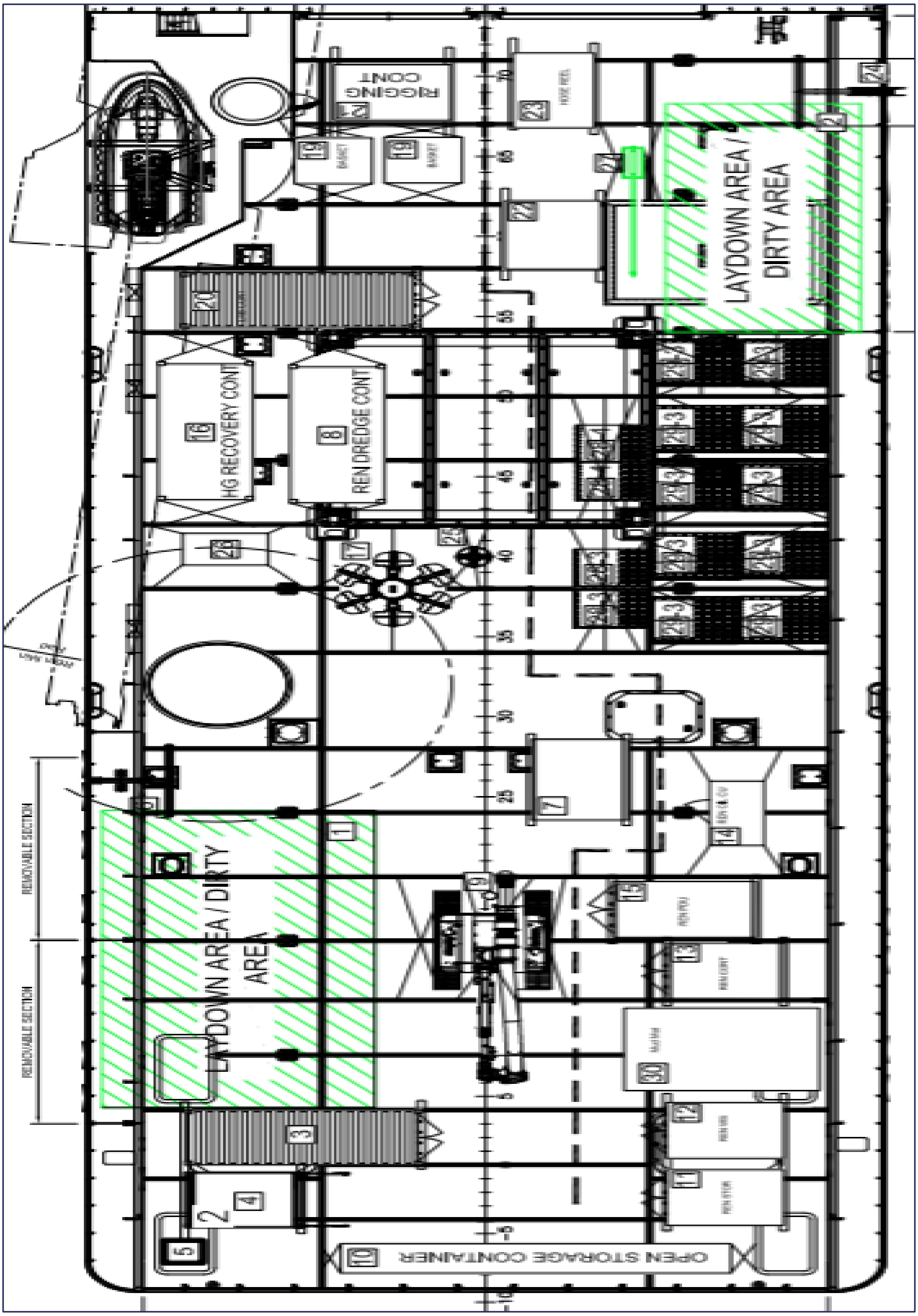

Figure 2-3 Olympic Triton deck layout (second trip)

2.2.2 ACTIVITIES

Mobilisation was undertaken at CCB, Ågotnes between 15 and 18 June 2026. Over approximately three days, the vessel was prepared for offshore operations through installation of deck steelwork, loading of project equipment, integration of recovery and monitoring systems, and completion of testing and sea-fastening activities. Following final readiness checks, the vessel departed CCB on 18 June 2026 and arrived on site later that evening to commence operations.

Key mobilisation activities included:

15 June 2026

- Personnel mobilisation and project inductions.
- Deck preparation, marking of equipment locations and installation of grillages.
- Commencement of welding and hot works for project support structures.
- Fabrication and installation of foundations for containers and project equipment.

16 June 2026

- Loading and installation of project containers, including the NIVA laboratory, RenOcean operational containers and Franzefoss equipment.
- Mobilisation of the HPWJ unit, umbilical winch, oil-cleaning unit and hose reels.
- Installation of cable trays, chutes and associated support structures.
- Ongoing welding, integration and sea-fastening activities.

17 June 2026

- Mobilisation of the RenOcean Spider excavator and mercury recovery spread.
- Loading of filter units, dredge equipment, subsea baskets, work baskets and support equipment.
- Installation and testing of manipulator systems, survey equipment and communications systems.
- Completion of laboratory fit-out and final sea-fastening of deck equipment.
- Project briefings, safety reviews and operational readiness checks.

18 June 2026

- Completion of final inspections and sea-fastening, including NDT, class approval by BV.
- Verification of systems and equipment from each sub contractor.
- Verification of power, communication and monitoring systems.
- Vessel departure from CCB and transit to the U-864 site.
- Arrival on location, completion of DP and safety checks, and commencement of offshore operations.

3 OFFSHORE OPERATIONS

3.1 SUMMARY

Table 3-1 Operation Summary

Date/Time From	Date/Time to	Task	Comment
15.03.2026	18.03.2026	Mobilisation	
19.03.2026	19.03.2026	As Found Survey and deployment of CP baskets	
19.03.2026	19.03.2026	FMD scope	
19.03.2026	19.03.2026	Installation of buoy arrangement	Not successful
20.03.2026	20.03.2026	FMD scope	No results
20.03.2026	21.03.2026	Deployment of Dredge container, mud mats, Mercury recovery container, ADCP and sensor basket, sediment traps. Hull cutting	
20.03.2026	21.03.2026	Installation of various sensors on wreck (cubes)	
23.03.2026	23.03.2026	Wet test RenSpider	
24.05.2026	26.03.2026	Interim Demob CCB, Ågotnes	
27.03.2026	27.03.2026	Recover to deck: All baskets, dredge-container, Mud Mats	
27.03.2026	27.03.2026	As-left survey	
28.03.2026	28.03.2026	Suspension demobilisation at CCB, Ågotnes	
15.06.2026	18.06.2026	Mobilisation for second trip	
18.06.2026	18.06.2026	Spider, dredge container and mercury recovery basket deployed	
18.06.2026	19.06.2026	As found survey and installation of wreck and current monitoring equipment.	
19.06.2026	19.06.2026	Spider on deck due to technical issues and bad weather postponing re-deployment	
20.06.2026	22.06.2026	Spider re-deployed and dredging. Continuous turbidity measurements throughout	
22.06.2026	23.06.2026	Spider malfunction and recovered to deck. Repairs ongoing. Keel found, and access considered	
23.06.2026	24.06.2026	Continue dredging. Use orange peel grabs for rock removal	
24.06.2026	24.06.2026	Obtain access to keel compartments	
24.06.2026	26.06.2026	Recovering mercury canisters, liquid mercury and other debris found on seabed	Collecting liquid mercury not successful. Developed new equipment that managed to collect liquid mercury
26.06.2026	27.06.2026	Cleanup and inspection of keel compartments. Perform bedrock measurement. Recover sediment traps	
27.06.2026	27.06.2026	Deploy rock bags. Recovering various monitoring equipment.	

Date/Time From	Date/Time to	Task	Comment
		Recover mercury recovery basket and dredge exhaust container	
27.06.2026	28.06.2026	Perform GVI and MBES of worksite	
28.06.2026	29.06.2026	Complete work on site, transit to shore and demob	

3.2 AS FOUND SURVEY

3.2.1 FIRST TRIP

An as-found survey was completed on 19 March 2026 following arrival at the U-864 site. ROV inspections of the forward and aft hull sections, together with planned monitoring equipment locations, were undertaken to document site conditions prior to deployment and recovery activities.

Location fixes were taken on frame # 138 Upper position and # 136 Upper position for TP-010.

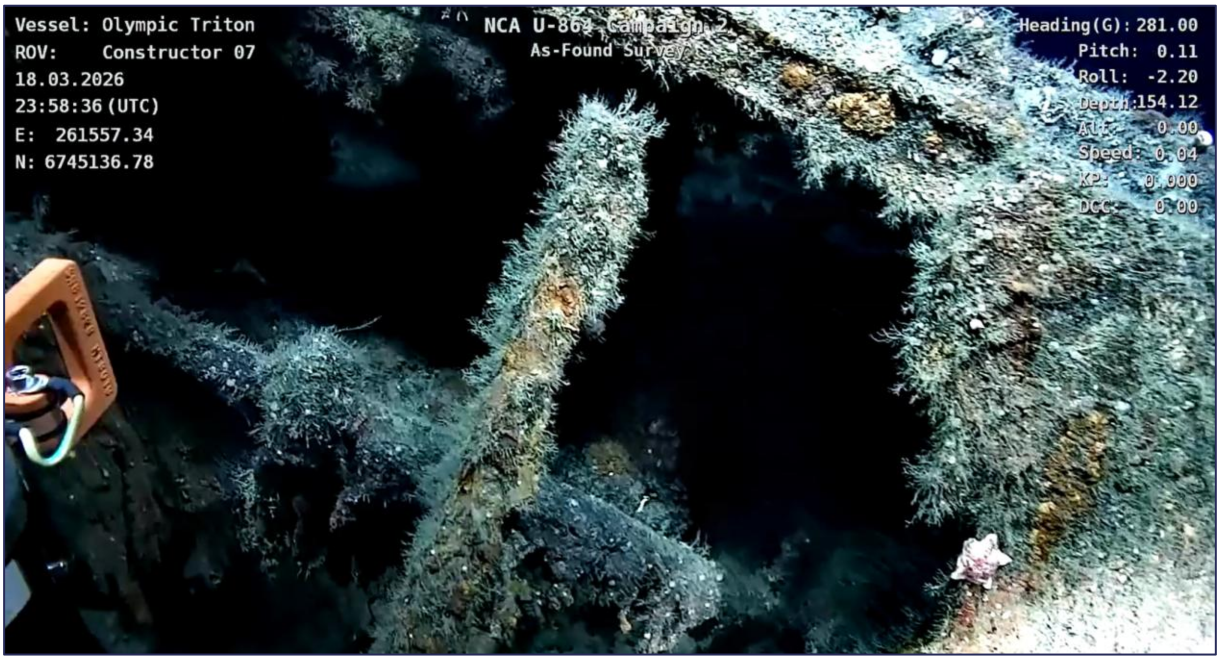

Figure 3-1 Fix taken on frame # 138 (fix position 261557.2 mE, 6745136.7 mN)

Figure 3-2 Fix taken on frame # 136 (fix position 261557.8 mE, 6745137.7 mN)

During the as-found survey locations were cleaned for later placement of the wreck monitoring RTS cubes.

3.2.2 SECOND TRIP

An as-found survey was completed following arrival on site in June 2026. ROV inspections were undertaken to verify wreck and seabed conditions for the dredging campaign and confirm locations for monitoring equipment and excavation activities.

3.3 INSTALLATION OF WRECK MONITORING INSTRUMENTATION

For trip 1 in March 2026, Octans gyros and RTS cubes were installed on the wreck. However, since the RenOcean Spider was not deployed, the gyros were not connected and powered up. Therefore, there are no readings for hull monitoring for the first trip.

For the second in June 2026, two Octans gyros were installed on the hull. The gyros were connected to the RenOcean Spider for power and live readouts on board the Olympic Triton. A RTS Cube was installed for contingency monitoring. As tertiary monitoring, a set of rulers and magnets were installed on the wreck and on the seabed. More information about the monitoring can be found in REACH-600096-FM-008.

Table 3-2 Geotechnical instrumentation

Equipment	Easting	Northing	Installed Time	Installed Date
Octans gyro N2 4517	261551.41	6745130.6	13:17:17 UTC	18.06.2026
Octans gyro N1 4512	261559.73	6745147.88	14:24:08 UTC	18.06.2026
RTS Cube Primary E	261546.94	6745094.45	15:38:50 UTC	18.06.2026
RTS Cube Backup E	261561.23	6745140.10	15:06:35 UTC	18.06.2026
Ruler 1	261561.36	6745138.76	05:47:55 UTC	19.06.2026
Ruler 2	261561.50	6745136.42	06:30:32 UTC	19.06.2026

3.4 INSTALLATION OF ENVIRONMENTAL MONITORING SYSTEM

3.4.1 INSTALLATION OF TURBIDITY SENSORS

Turbidity sensors were planned to be installed together with sediment traps at pre-determined turbidity monitoring locations. Due to stronger-than-expected currents, deploying the online turbidity measurement system in the sea was unsuccessful. It was therefore decided to utilize the ROV's interface to record turbidity measurements. Refer to REACH-600096-MOC-009 for further details. Turbidity measurements were logged using the ROV according to REACH-600096-TP-004.

Due to strong currents, the original plan for 10 fixed turbidity measurement points could not be implemented. The monitoring system was therefore adapted by utilizing CTD sensors on two ROVs, enabling mobile turbidity measurements during operations. The Supporter ROV was designated for monitoring the boundary of the capping area, while the Constructor ROV monitored turbidity close to the work area. The system was successfully tested, and the sensors provided live data through the ROVs.

Due to the stronger than expected currents, subcontractor Lapwing performed an analysis of the buoy systems and their operational viability in various currents. The analysis showed that the buoy system would stay operational with surface currents up to 3 knots. (Lapwing 2026: Analysis of CB1250 buoy. Document number: 20029-TN-01)

Turbidity data was further analysed by NIVA and used for calculating how much mercury that was spread from the operation.

MOC-009 and MOC-010 were prepared, describing alternative solutions to monitor turbidity using the ROVs.

MOC-009 was completed during the first trip in March, while MOC-010 was implemented into task plan number 4 for the second trip in June.

3.4.2 INSTALLATION OF SEDIMENT TRAPS

The sediment traps consisted of an anchor weight, glass tubes for sediment samples, as well as a DGT (Diffuse Gradients in Thin Films) on each trap. Five sediment trap systems were installed, each consisting of two tubes in 2m height from seafloor, and two tubes in 10 m height above seafloor. These tubes collected sediments during the campaign. NIVA personnel prepared the sediment traps and collected the samples.

The sediment traps were installed during the first trip in March at the same locations as intended for the turbidity sensors (Table 3-3).

Table 3-3 Locations of sediment trap deployment

Position	Easting	Northing	Depth
Tu1 Sediment Trap	261 416.60	6 745 103.58	134.98
Tu2 Sediment Trap	261 615.05	6 745 036.51	145.43
Tu3 Sediment Trap	261 595.77	6 745 223.71	169.01
Tu4 Sediment Trap	261 416.60	6 745 103.58	174.01
Tu5 Sediment Trap	261 821.58	6 745 051.36	169.49

Launching commenced 20 March 2026 14:29 and was completed 19:19.

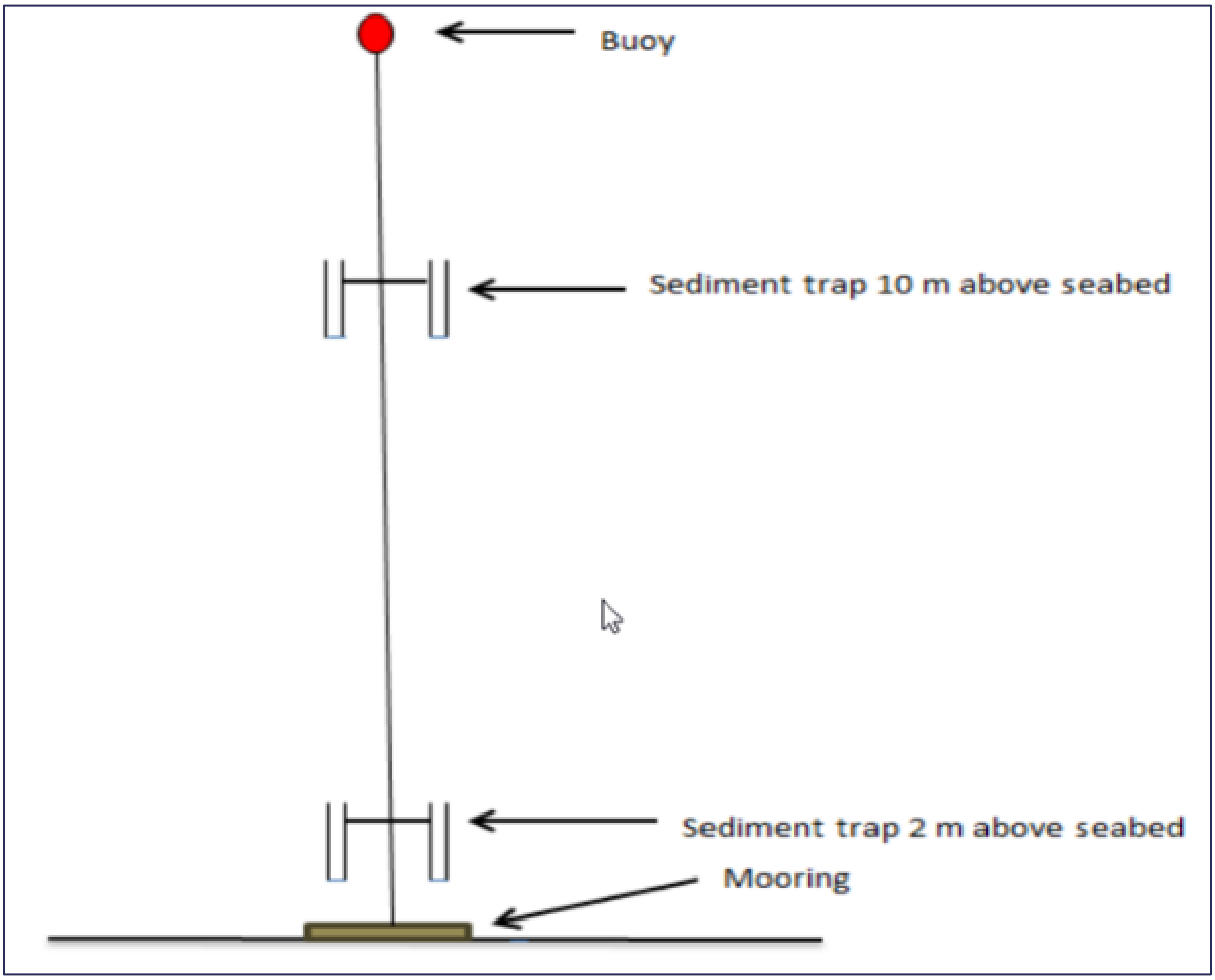

Figure 3-3 Schematic of sediment trap setup

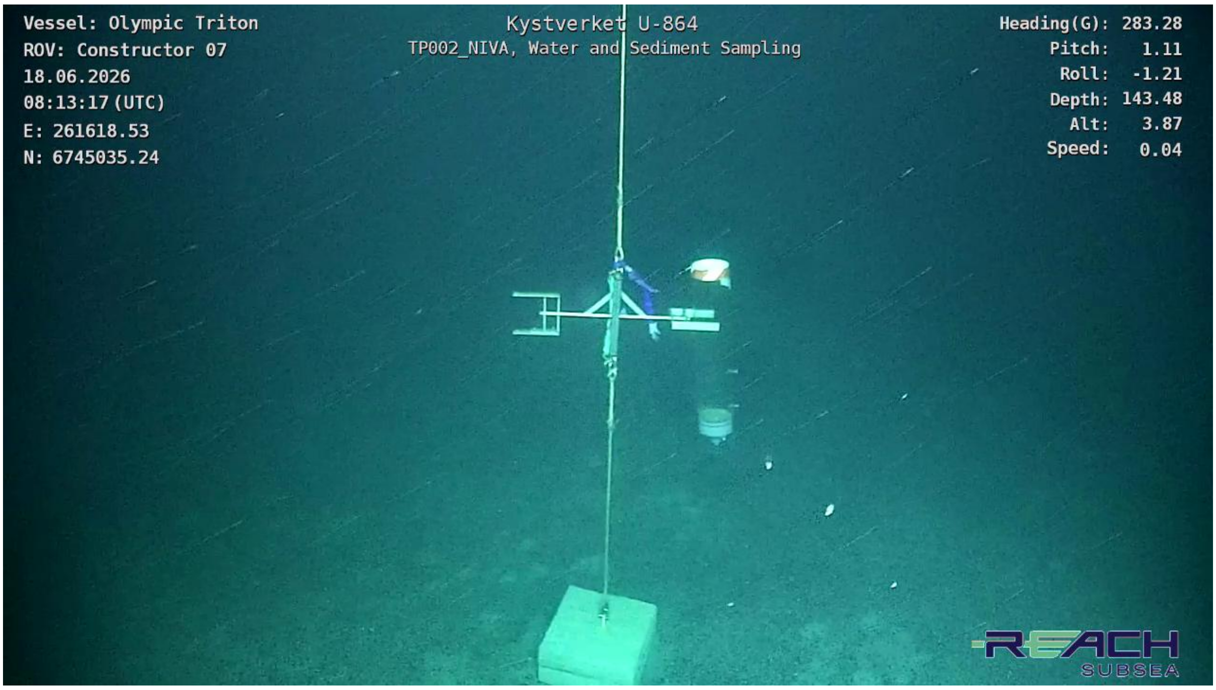

Figure 3-4 Sediment trap with one container mounted

Upon arrival on site in June, a general visual inspection was performed. On NIVA request, the sediment traps that had been on seabed since previous campaign in March 2026 were emptied of their contents, the contents were not analysed. DGT samplers were then attached.

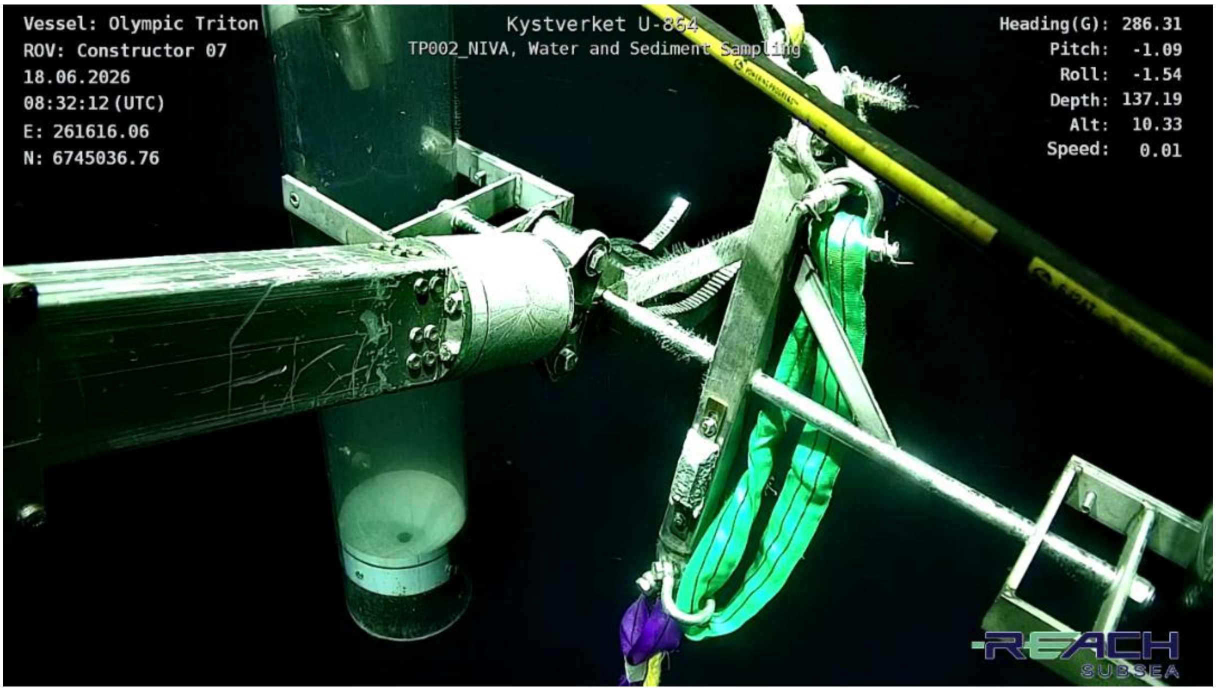

Figure 3-5 Cleaning sediment traps (Tp-002)

Figure 3-6 Constructor 7 attaching DGT with marking

3.4.3 INSTALLATION OF DIFFUSIVE GRADIENTS IN THIN FILMS (DGT)

Three DGTs were installed on the ADCP and two were installed on each of the sediment traps

Figure 3-7 DGT bag installed on sediment trap

The DGT installation on the dredger container was made by connecting the DGT bags onto a shackle with monkey fist and placed on the top (exhaust) of the dredger container. In total 3 DGTs were installed here.

A total of 23 DGTs were installed on various locations during the trip in June. Locations are specified in NIVA report.

3.4.4 INSTALLATION OF ADCP

The ADCP was first deployed on 20 March 2026 in the 20 ft seabed basket on 20 March as part of the environmental and monitoring array installed around the wreck. The equipment remained on the seabed until recovery on 27 March, when the was retrieved for the stand-down period. Note that the ADCP was not utilised during this period.

Following the remobilisation, the ADCP was deployed on 18 June 2026 and was in operation from the 19 June after resolving some communication issues. The ADCP was recovered on 27 June 2026 in preparation for demobilisation. The ADCP was connected to the RenOcean Spider for both power and communications to vessel topside.

ADCP data was logged for further analysis by NIVA.

Figure 3-8 ROV hooking up three 80 m subsea cables for the ADCP and wreck monitoring Octans Inclination Sensors

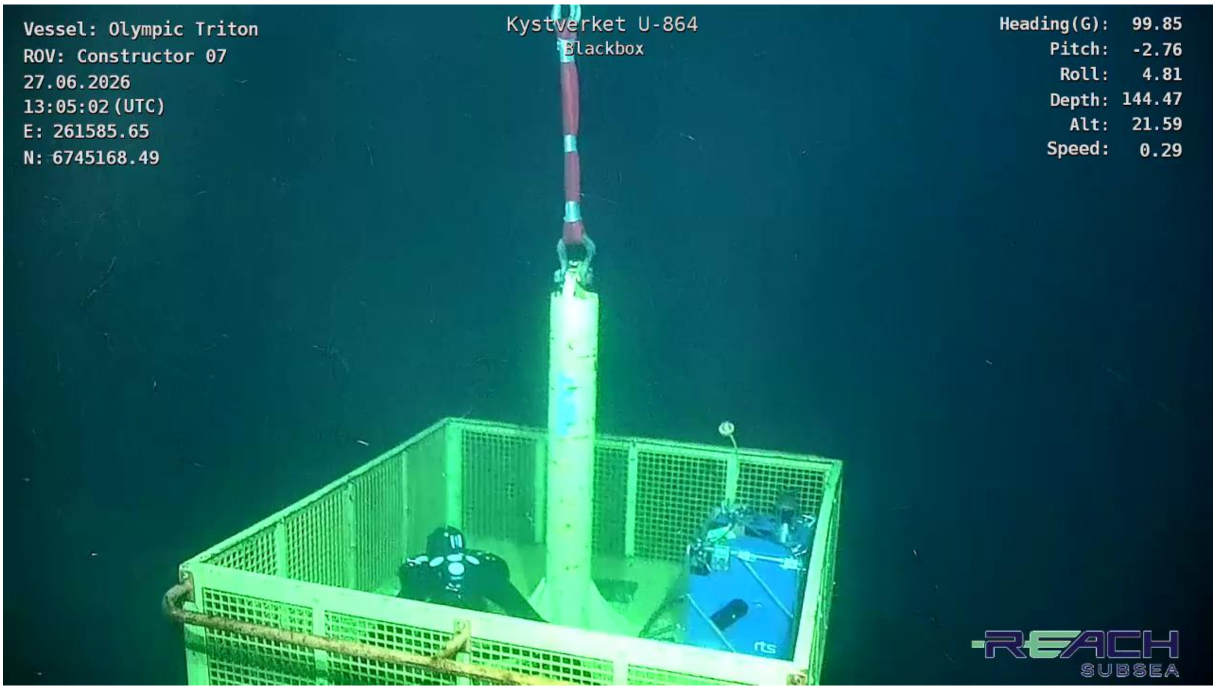

Figure 3-9 Retrieval of ADCP and RTS wreck monitoring cubes

3.4.5 ROV WATER SAMPLING

Water samples were taken as part of the updated turbidity measurement taskplan. Water samples were taken using plastic Niskin bottles, ensuring that the water sample from the wreck site would stay intact all the way to deck where NIVA could perform their analyses.

If the analyses showed high mercury contents, then operations were to be suspended until the mercury levels were below the limit values.

During the project duration it was found that the sample bottles became contaminated from the mercury found in the local environment. This resulted in increasingly elevated mercury levels throughout the project. New, un-contaminated sample bottles was procured to ensure that correct measurements were obtained. This is further elaborated on in NIVA report.

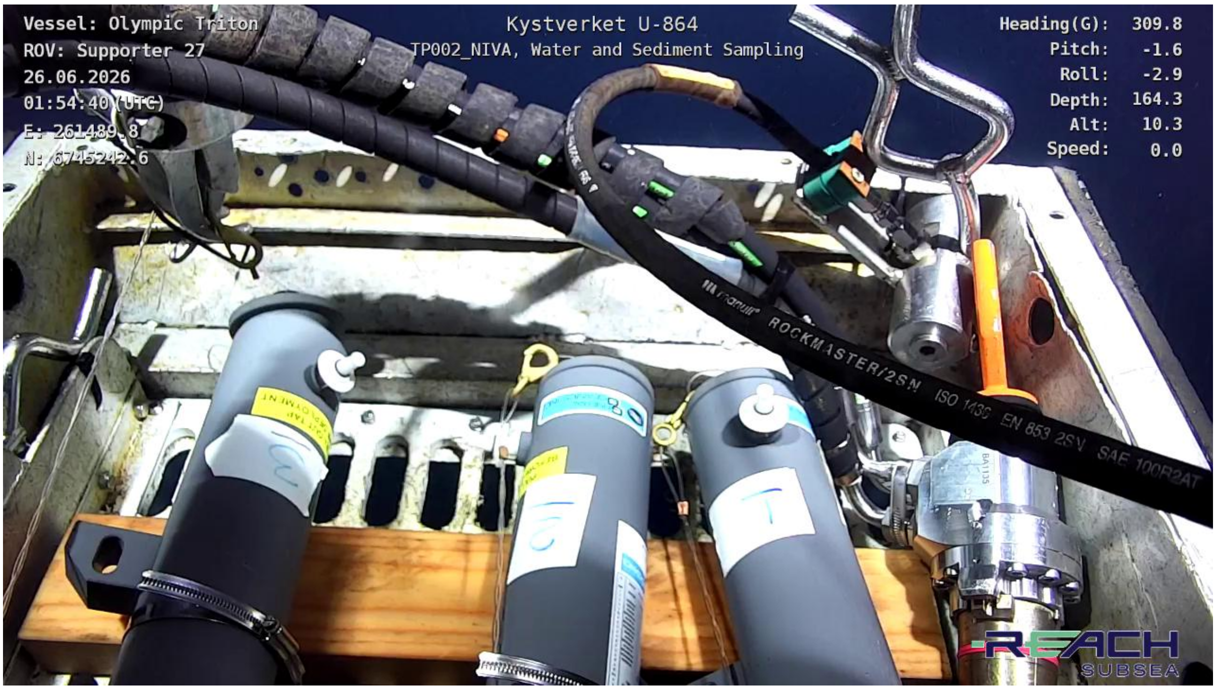

Figure 3-10 Picture showing the Supporter ROV taking a water sample

Figure 3-11 Supporter taking a water sample

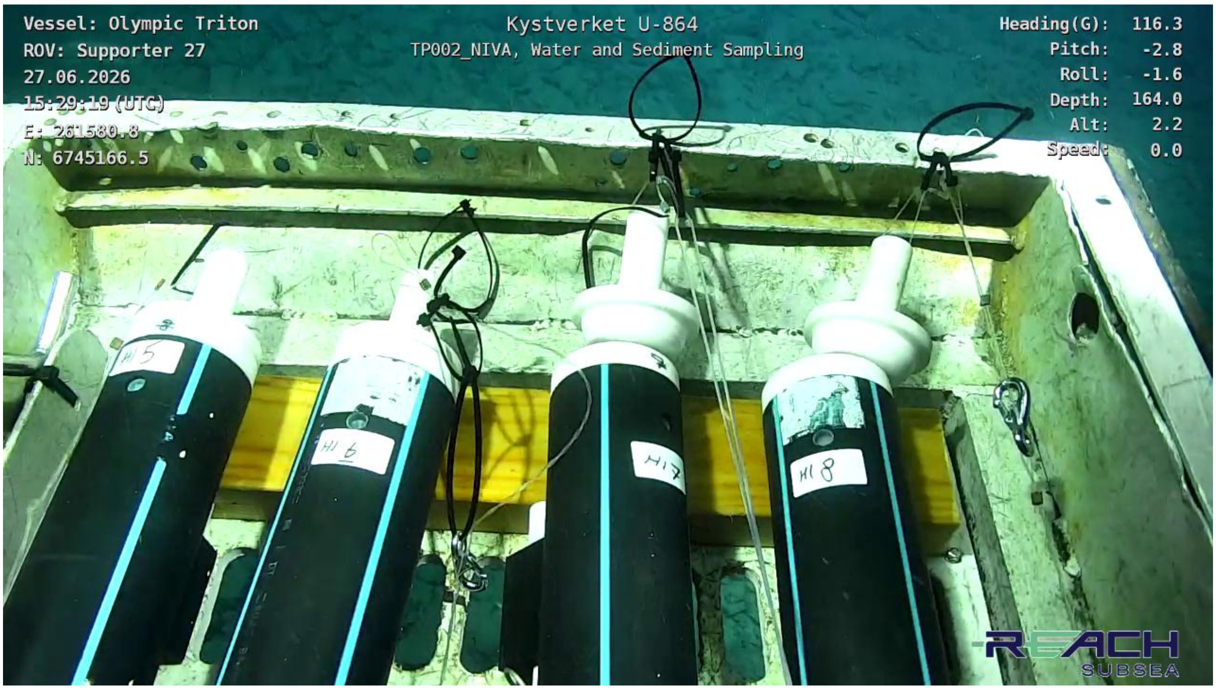

Figure 3-12 Water sampling bottles, two samples taken and the other two ready to go

3.4.6 SOIL SAMPLING OF EXCAVATED AREA

On 26 and 27 June 2026, the Supporter ROV performed soil sampling of the edge of the excavated area for further studies by client. The WROV Constructor 07 was used to collect samples at the points shown in Table 3-4.

Table 3-4 Sediment sampling edge of excavated area locations

Sample Location	Time (UTC)	Easting (m)	Northing (m)
S1	2026-06-26 21:34	261 577.97	6 745 152.61
S2	2026-06-26 23:33	261 566.79	6 745 138.43
S3	2026-06-27 00:10	261 567.80	6 745 147.09
S4	2026-06-27 00:46	261 576.30	6 745 159.95

Soil sampling is described in REACH-600096-FM-003 (C.3) and the locations are shown in Figure 3-13.

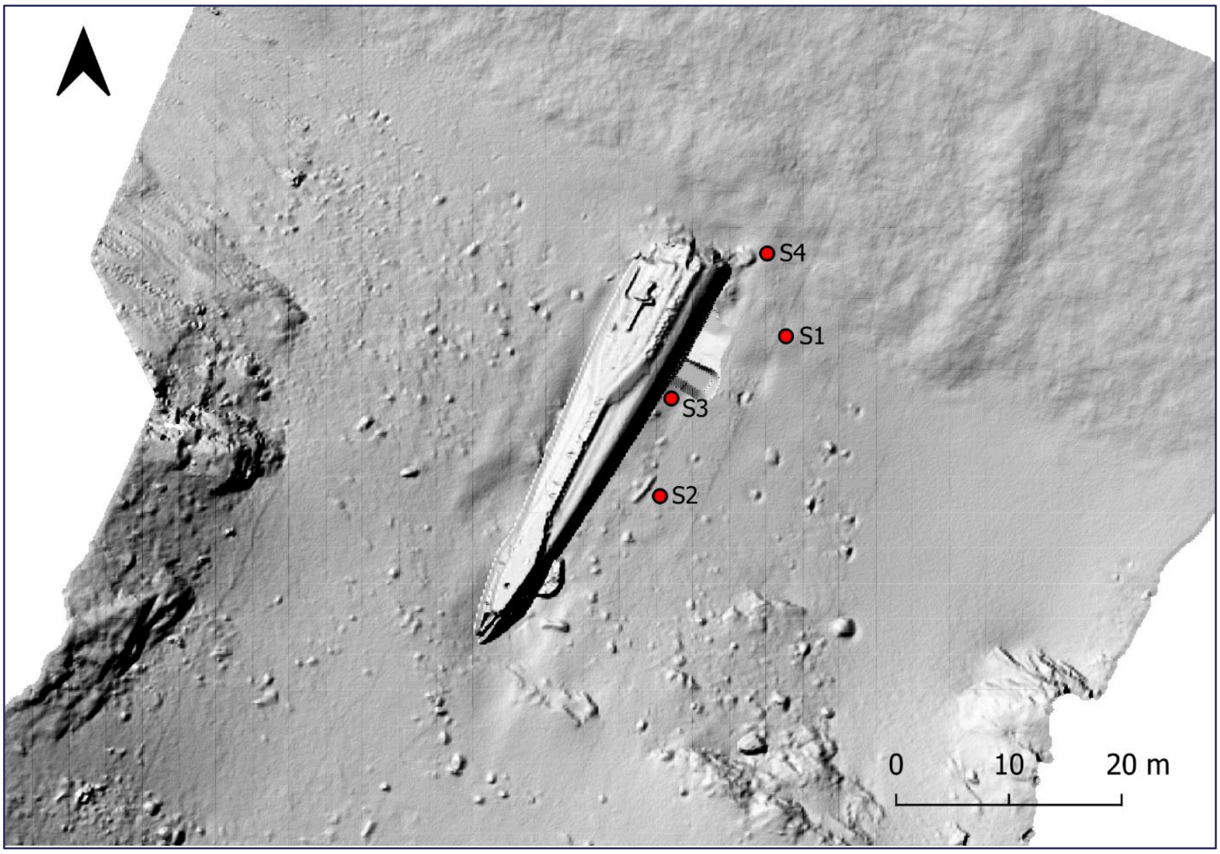

Figure 3-13 Overview of soil sampling locations

3.5 MERCURY CANISTER RETRIEVAL

3.5.1 FWD WRECK SECTION

To gain access to the keel compartment and perform mercury canister retrieval, sediment was required to be dredged from the port side of the FWD section. The RenOcean Spider dredger was utilised for this purpose.

Images of the RenOcean spider are shown in Figure 3-14 through Figure 3-16. Note that a dredging container was utilised to hold the dredged sediment (Figure 3-17). While the intention of the dredging container was sound, it turned out to be of limited use during actual operations in June. Filters on the dredging container became clogged and reduced the flow of the dredger to the extent that the dredger did not work while the container was connected. The decision was made to disconnect the dredge container and to have an open exhaust pipe. A mitigating measure in this regard was to conduct more active turbidity measurements to measure the mercury levels in the area during dredging operations. Mud matts were installed on the seabed on 20 March 2026 in preparation for landing of the dredge container. These were recovered at the end of the campaign.

Dredging operations were undertaken between 20 and 26 June 2026. Dredging was undertaken adjacent to the keel compartment on port side in order to facilitate access. Dredging progress was supported by continuous environmental monitoring, including water sampling and turbidity measurements, with periodic stoppages for equipment maintenance, visibility assessment and environmental verification. Dredging was carried out according to REACH-600096-TP-003 and MOC-015. Initially, three pits were intended to be dredged. Two pits for installation of rock bags to stabilise the wreck, and one pit for access to the keel compartments at frame #95.

The soil conditions experienced on site differed from what was described in the Sweco report, and therefore Sweco was consulted to figure out a way forward. Thus, MOC-015 was prepared to take into account the actual soil behaviour on site, and to accommodate the dredging of the actual soil on site.

Based on the experiences on site, the soil was more solid than what was predicted in the stability assessment made by Sweco. There were lots of rocks of various sizes in the area to be dredged, some large enough to block the dredge pipe. Apart from the rocks, the soil appeared to have uniform properties throughout the excavation area with regards to soil density, strength and layering. Due to the soil being solid, the local slope remained stable for the duration of the operations, with no degradation of the pit wall integrity.

With the soil being solid, the dredging operations progressed more slowly than estimated. For the removal of approx. 45m^3 of soil, a total of approx. 24 hours actual dredging was performed. The immediate factors affecting dredging speed was the soil composition and size and quantity of rocks in the area. Using a strainer on the dredge nozzle could have reduced the time spent dredging or unblocking the suction pipe, but the rocks would still need to be removed from the pit for the ROV to have a stable position for obtaining access to the keel section.

In the earliest phase of the project, no strainer was fitted to the suction nozzle. However, as it became apparent that the dredge pit was littered with large rocks, the Spider was recovered to deck and a strainer was fitted.

Figure 3-14 RenOcean Spider overview

Figure 3-15 RenOcean Spider dredging operations

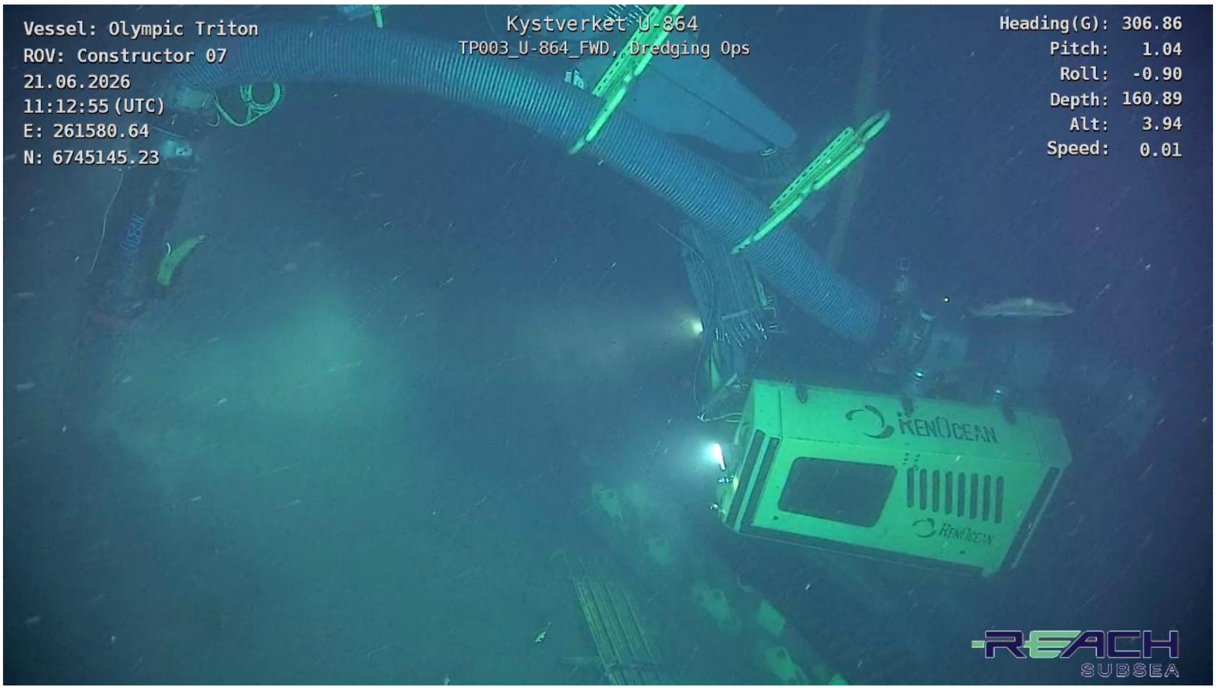

Figure 3-16 Dredging operations on FWD section

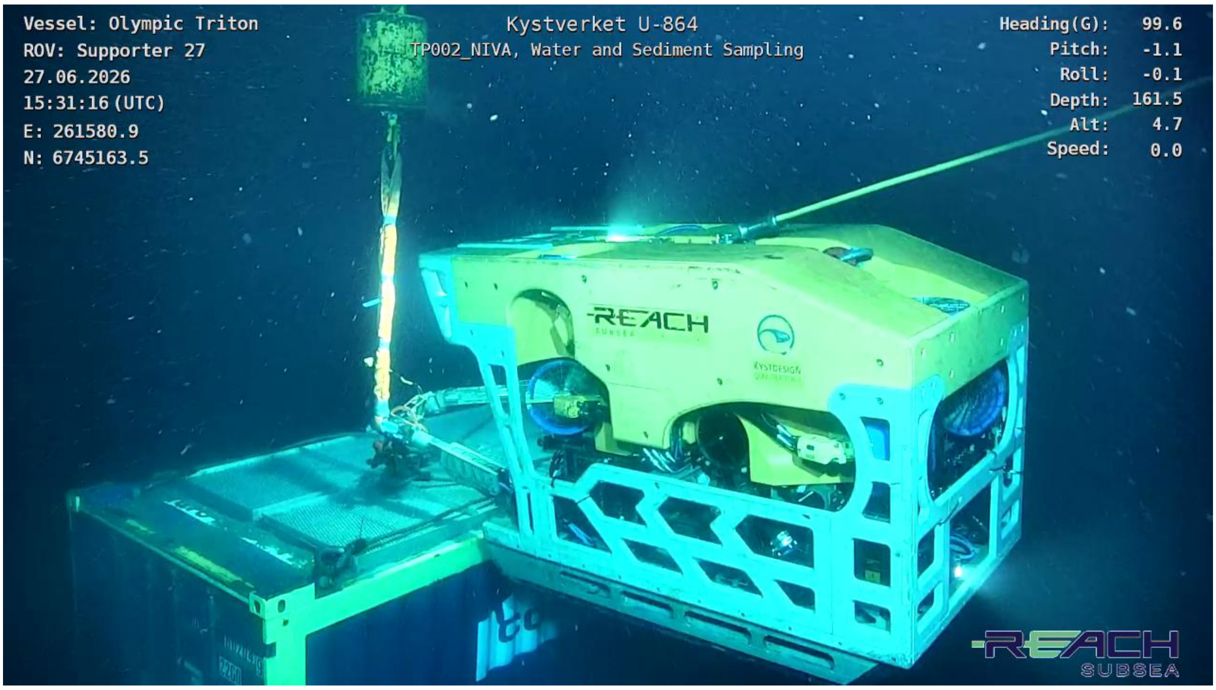

Figure 3-17 Constructor hooking up crane on dredging container

During dredging operations, rocks of various sizes were found. Some small enough to pass through the dredge hose, some large enough to be stopped by the dredge pipe strainer, and some were too large to remove by either RenOcean Spider or the ROVs. Figure 3-18 shows a large rock found in the dredged area, which had to be removed by the large orange peel grab mobilized for the project. Using ROV sonar, the boulder was estimated to be approx. 1.3 x 0.9 x 0.6 meters.

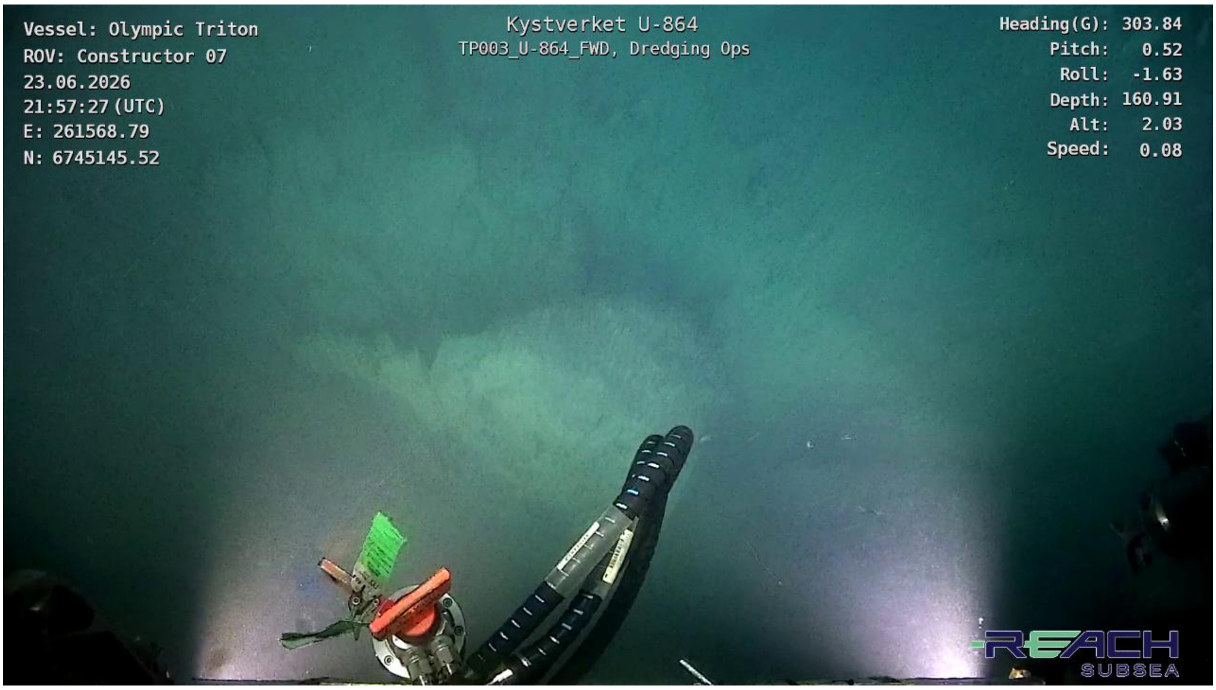

Figure 3-18 Large rock in dredged area

Note that the boulders removed were wet stored to the northwest and northeast of the fore part of the wreck and have been outlined in the delivered GIS database.

Access to the keel was gained at pressure hull frames #60-#66 (#103-#112), and the keel was subsequently opened. Taskplan REACH-600096-TP-003 described that access to keel compartments was to be obtained by cutting an opening in the keel plate, utilising the Spider Belly Basket with grinder. When the dredging operations had provided sufficient access to the keel, it was discovered that a larger keel plate cover could be removed by prying loose the plate from the original fasteners. MOC-017 was prepared to allow for an alternative method of obtaining access to the keel compartments. The plate was pried loose by using the ROV manipulator and a modified crowbar. Once the plate was loose from the fasteners, attempts were made to drag the plate away from the keel section. This turned out to be too difficult for the ROV, due to weight of the plate, as well as the ROV not having sufficient grip on the plate itself. To increase the grip on the plate, the ROV pilots on board modified a plate clamp to be operable by the ROV. This plate clamp was then fastened to the keel plate for more attempts at removing the plate by the ROV. Finally, the clamp was connected to the boom of the Spider by a round sling. This gave the required leverage to remove the plate. Once the plate was free from the keel section, it was re-located to the nearby rock dump for later recovery to deck.

During the process to remove the plate some debris was observed to fall out from the keel section. For the most part the debris consisted of surface corrosion, soil remnants on the steel plate, broken glass and what turned out to be the charred remains of wood. The falling debris caused the vision to deteriorate, requiring frequent stops in the removal process to wait for visibility to operate. Due to the roll angle of the wreck, it is unlikely that liquid mercury was released while removing the keel plate. However unlikely, it is still a possibility that droplets of liquid mercury was released along with the other debris.

The keel plate was recovered for further studies by Client. Refer to REACH-600096-FM-002 for more information (C.2). Note that the removal of the keel plate has also been marked in the GIS deliverable.

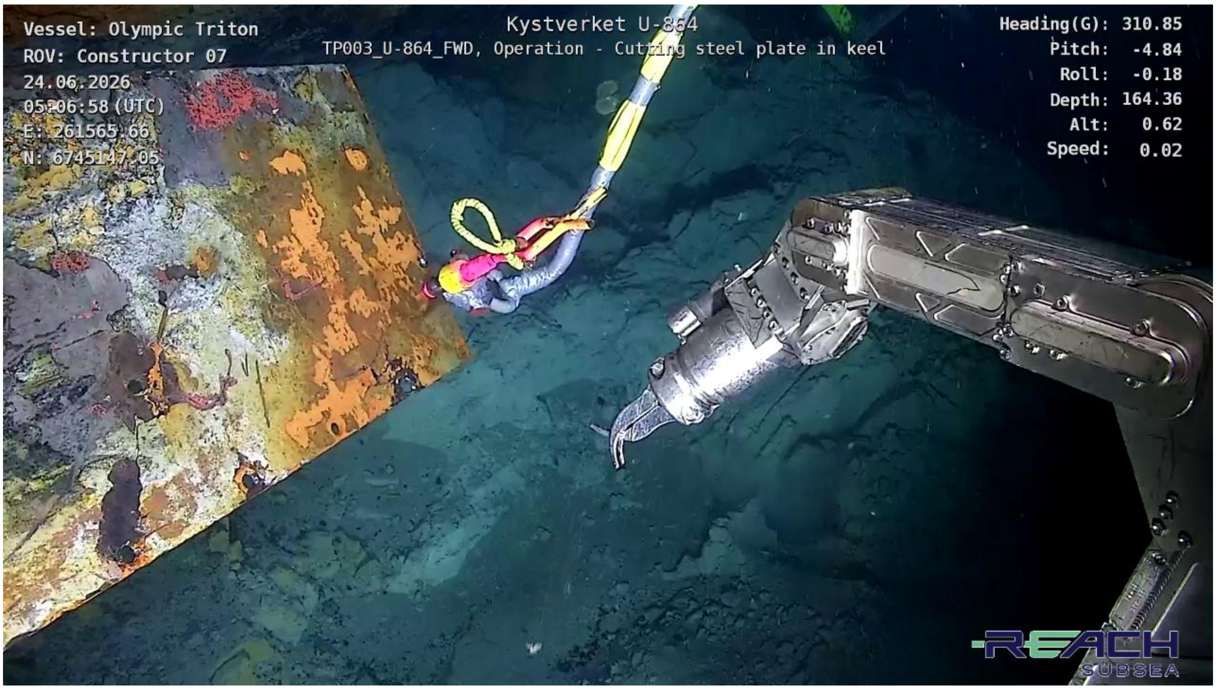

Figure 3-19 Removal of keel plate for access to compartments

Figure 3-20 Keel compartments after removal of keel plate

Figure 3-21 Keel compartments at frames #65-#66 (#110-#112) showing mercury canisters

Total 22 mercury canisters were recovered to the mercury recovery basket.

Figure 3-22 Recovery of mercury canister from keel compartment frames #65-#66 (#110-#112)

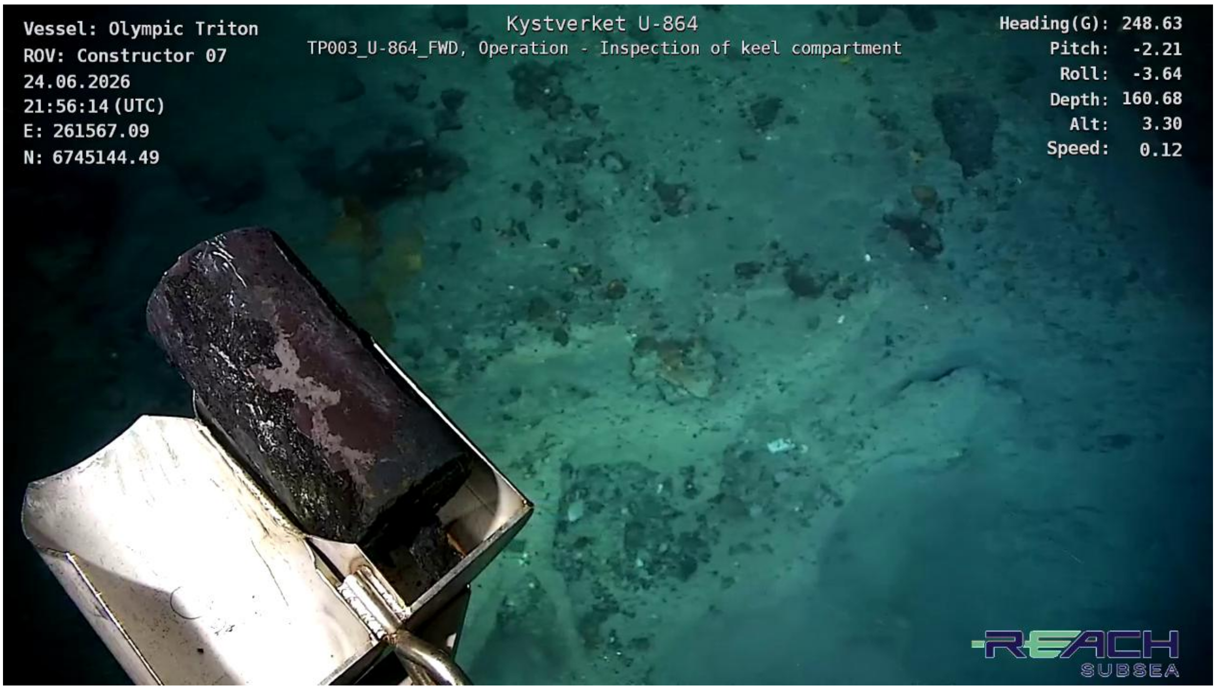

Figure 3-23 Transport of mercury canister from keel compartment to mercury recovery basket

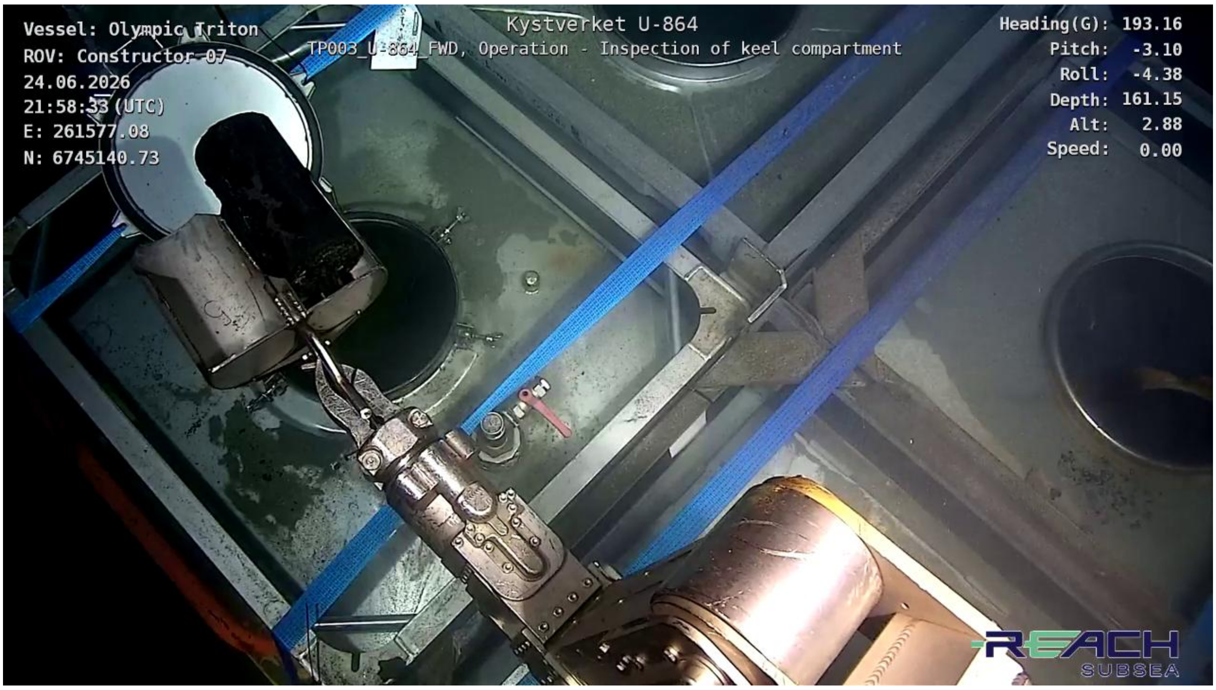

Figure 3-24 Deposit of mercury canister to mercury recovery basket

For more information regarding the mercury container, refer to REACH-600096-FM-004 (C.4).

Figure 3-25 Mercury canisters in IBC container

Liquid mercury from the keel was recovered using the Strike Subsea suction tool, as shown in Figure 3-26 through Figure 3-29.

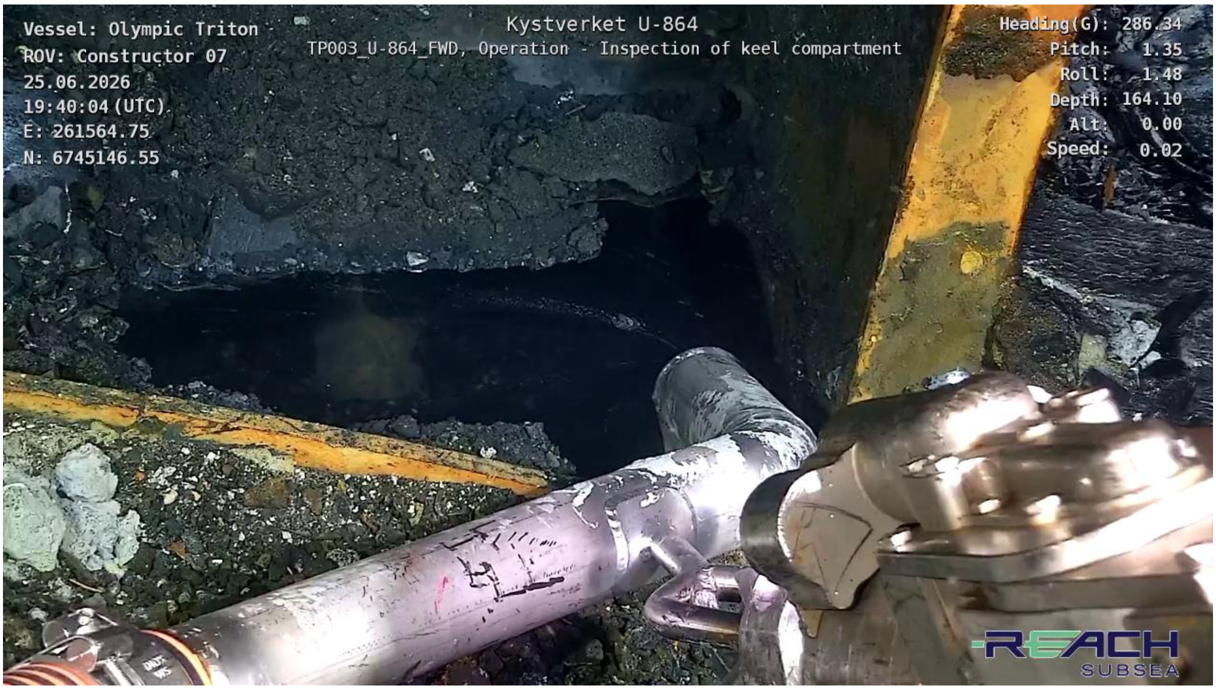

Figure 3-26 Recovery of liquid mercury from keel compartment

Table 3-5 Contents of recovery containers

Container	Main contents	Secondary contents	Comments after completion
1	19 mercury canisters	Approx 7,5 litres liquid mercury	12 canisters with contents 10 empty canisters
2	3 mercury canisters	Approx 10,5 litres liquid mercury	
3	3 scoops of glass, coal, wood		
4	Mercury canister lid		
5	1 bag containing glass, coal, wood		
Cyclone	Unknown quantity of liquid mercury		Empty due to clogged suction pipe

For recovery of liquid mercury, cyclone dredger was intended to be used. The Supporter ROV powered the cyclone, while the Constructor ROV directed the suction nozzle towards the liquid mercury. It was observed that cyclone was efficient with regards to suction of debris, but not suitable for suction of mercury. Due to lack of observation ports in the cyclone holding tank, it was not possible to know how much mercury or debris was in the tank.

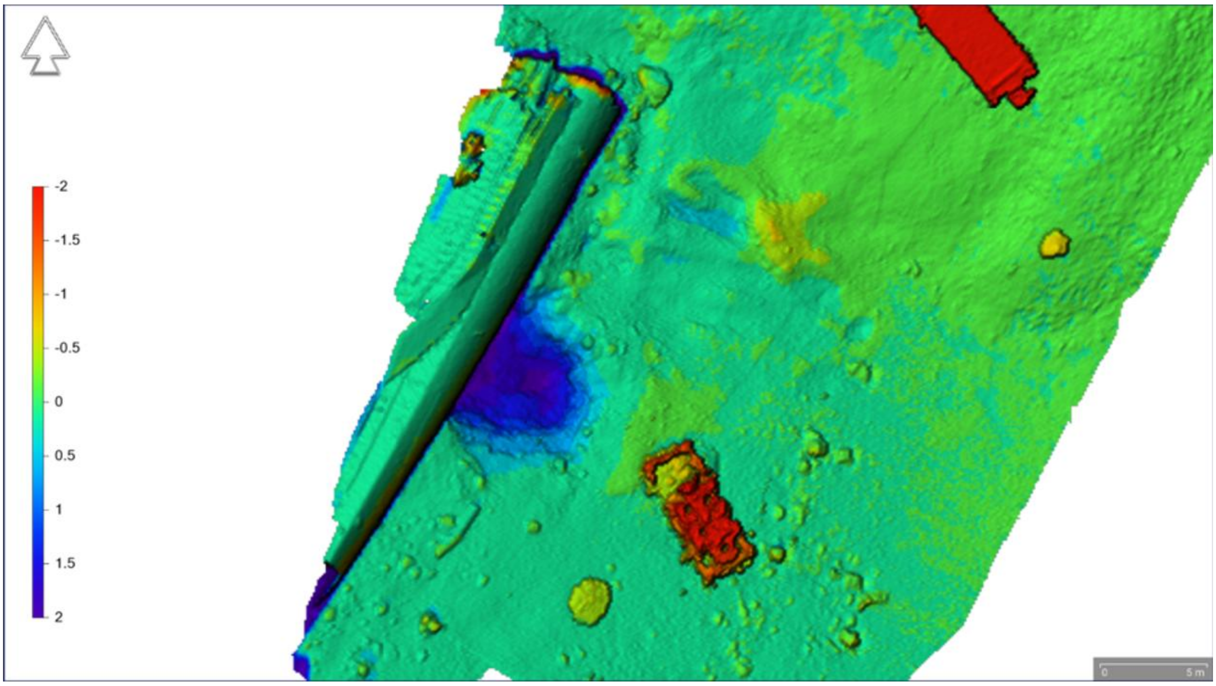

Figure 3-27 MBES showing dredge pit and mercury recovery container

Figure 3-27 show the dredge pit and the mercury recovery container, as well as their relative elevations. The maximum elevation difference between the dredge pit and the top of the mercury recovery container is shown to be around 4 me.

After recovery and delivery of the mercury containers to Franzefoss, it was discovered that the cyclone holding tank only contained seawater. This was due to the suction pipe being clogged by rocks and sand.

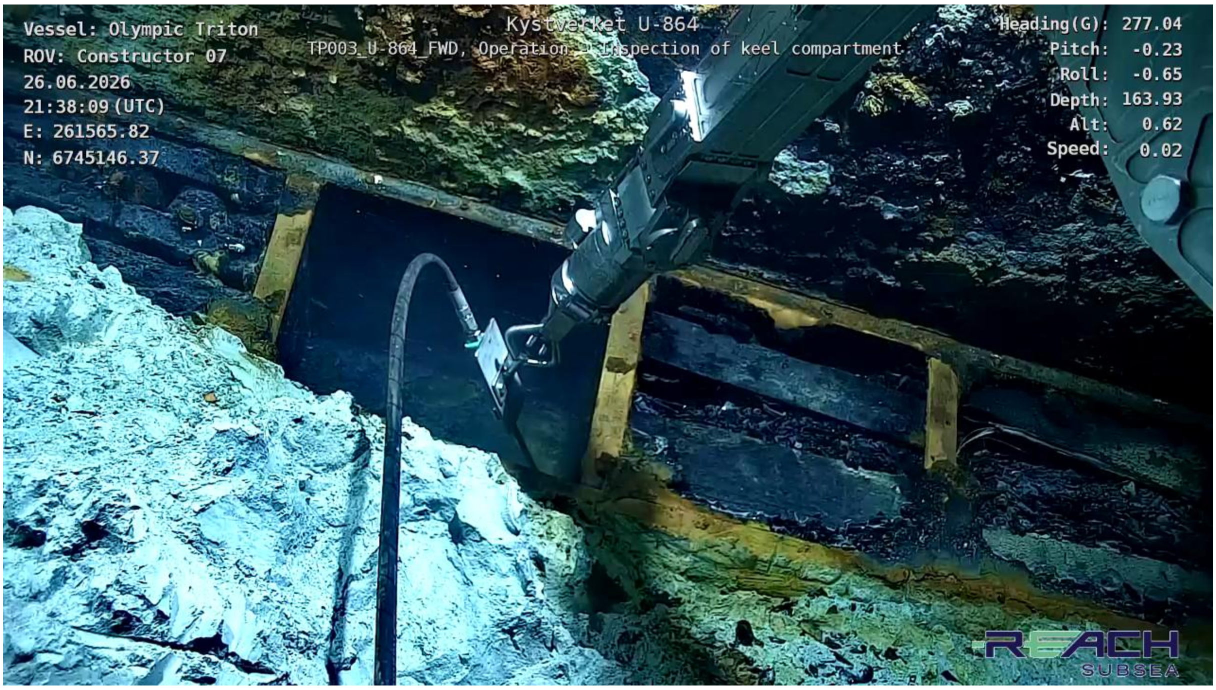

Figure 3-28 Strike Subsea suction tool draining liquid mercury from the storage compartment

Figure 3-29 Emptying the suction tool in IBC mercury storage

Figure 3-30 Liquid mercury flushed in IBC for retrieval to Franzefoss waste disposal

Following operations involving potentially mercury-contaminated materials, all relevant equipment was systematically screened for mercury contamination using detection equipment. Where mercury contamination was detected, the equipment was cleaned in accordance with Franzefoss procedures until acceptable levels were achieved and the equipment was declared safe for further handling, maintenance, inspection, or other work activities.

Areas containing equipment awaiting screening or decontamination were isolated and barriered off to prevent access by non-essential personnel until cleaning activities had been completed and the area was confirmed safe.

Prior to and during demobilisation, all equipment with potential exposure to mercury contamination was inspected, screened, and cleaned as required. Upon completion of decontamination activities, equipment was issued with the appropriate clearance documentation confirming that no unacceptable mercury contamination remained.

Additional verification activities were performed on vessel work areas, including the back deck and ROV hangar, which were screened for mercury contamination. Spill trays within the ROV systems were emptied and inspected to ensure that no mercury-contaminated material entered the vessel's sludge or waste handling systems.

Once mercury recovery operation had been concluded, from the 25 June 2026, filter units were installed in the dredged area (Figure 3-31) to stabilise the area. A total of 43 filter units were deployed to the seabed, and these were comprised of 4T and 2T units. There was a surplus of units lowered to the seabed and due to the mercury contamination hazard, they could not be recovered back to deck. As a result, these were wet stored to the north of the wreck. The associated wet stored units have been marked accordingly in the GIS deliverable.

Figure 3-31 Rock bags installed in dredged area

Figure 3-32 Rock bags installed in dredged area towards FWD wreck

During equipment recovery on 27 June 2026, all subsea equipment was cleaned by the ROVs prior to retrieval. Following recovery to deck, all equipment underwent mercury contamination checks by Franzefoss and was cleaned and decontaminated as required before demobilisation.

During decontamination of equipment on deck, the deck was cordoned off and was only available for Franzefoss crew wearing the required PPE for the task at hand.

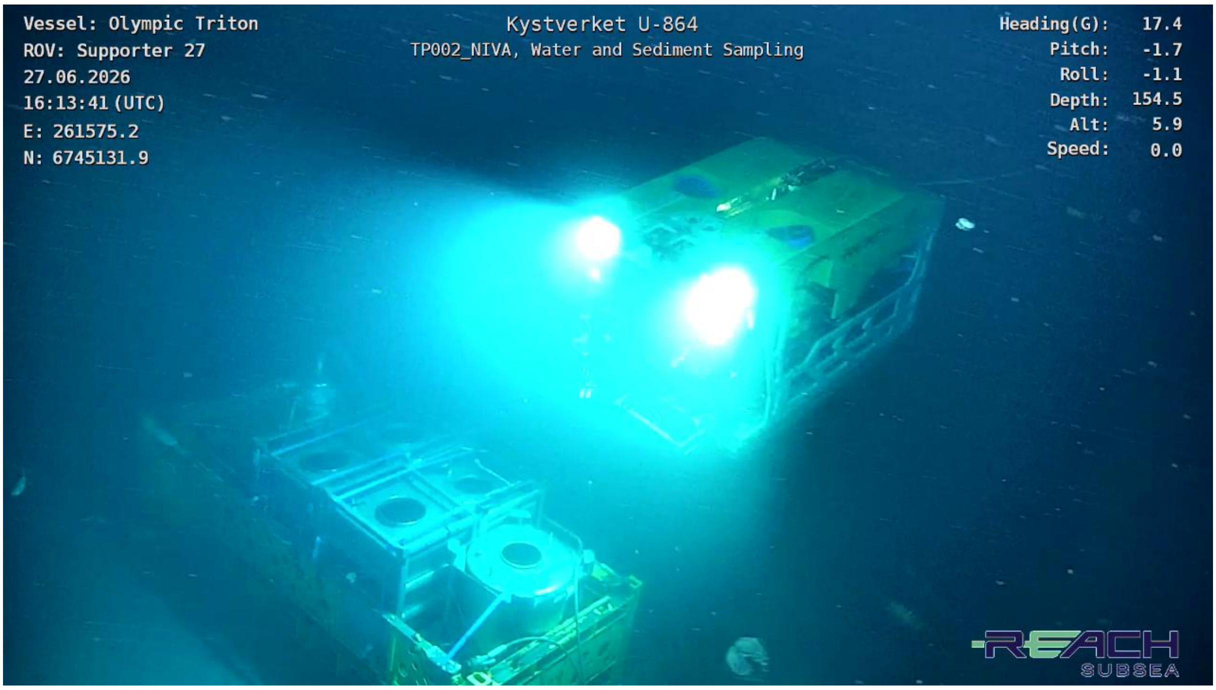

Figure 3-33 Constructor preparing the IBC subsea basket for recovery

3.5.2 AFT WRECK SECTION – OPERATION NOT STARTED

3.6 MEASUREMENT OF THE DEPTH OF SEDIMENT LAYERS TO BEDROCK

On 26 June 2026 RenOcean bedrock measurement pole was deployed at 2 locations on FWD wreck section and 2 locations on AFT section.

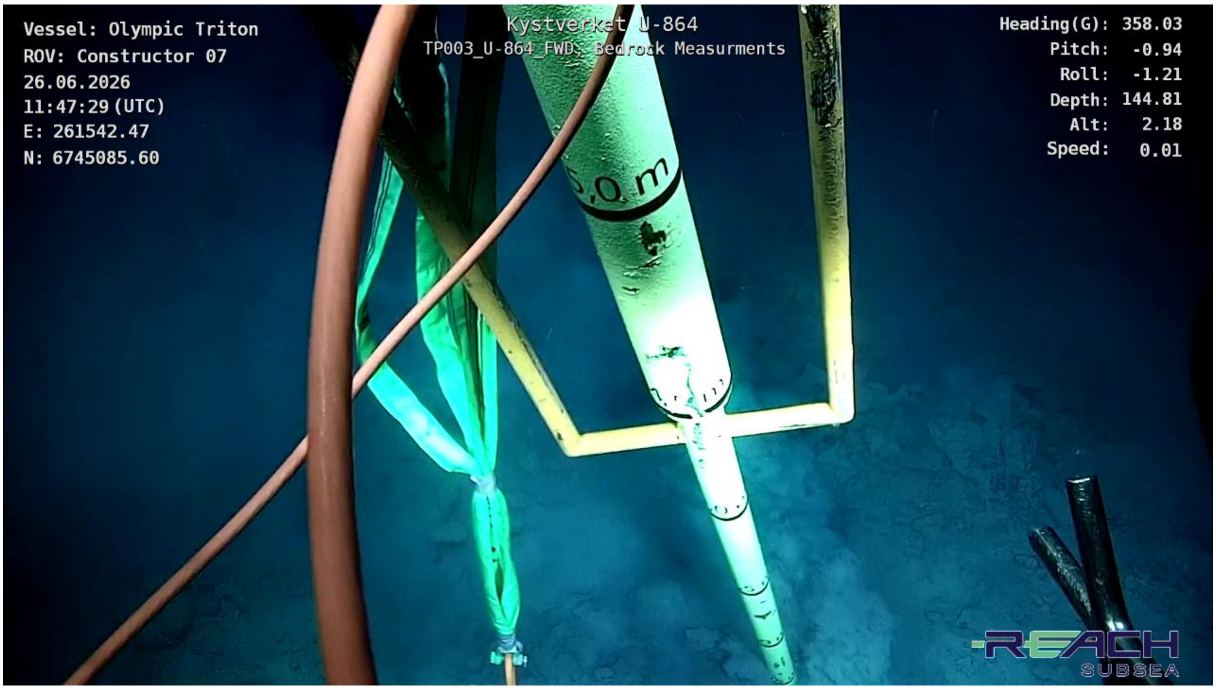

Figure 3-34 Bedrock sampling

Client advised that if first measurement was more than 4 meters, then second measurement at same location was not required. Similarly, if the difference between two measurements on same location exceeded 0,5m, then a third measurement was required.

Two depth measurements to bedrock were scheduled to be performed at each location. Results of the bedrock measurements were also described in REACH-600096-FM-006 (C.6).

Table 3-6 Bedrock measurement locations

BRM Location	Easting (m)	Northing (m)	Comment
BRM_1_1	261,560.62	6,745,155.09	Exceeds 4m
BRM_2_1	261,551.67	6,745,138.57	First Attempt 2.1m
BRM_2_2	261,552.74	6,745,136.90	Second Attempt 2.3m
BRM_2_3	261,552.47	6,745,140.05	Third Attempt 2.3m
BRM_3_1	261,542.41	6,745,089.66	First Attempt 3.2m
BRM_3_2	261,539.70	6,745,086.27	Second Attempt 2.3m
BRM_3_3	261,539.82	6,745,090.55	Third Attempt 2.6m
BRM_4_1	261,594.94	6,745,222.17	First Attempt 3.3m
BRM_4_2	261,591.05	6,745,214.51	Second Attempt 1.2m

After measurement 2 at second location on AFT wreck, Client instructed that bedrock measurement was completed.

3.7 RETRIEVAL OF CANISTERS IN SEDIMENTS – NOT PERFORMED

3.8 INSPECTION OF FWD WRECK SECTION TORPEDO ROOM

Inspection of torpedo room was limited only to the flooded member detection (FMD) operation.

In order to verify whether the fore torpedo room was water filled or not, FMD was attempted between 19 and 20 March 2026. The scope involved creating an access opening between frames #136–#138 (frames #76-#78 on pressure hull), cleaning the exposed structure and carrying out FMD measurements. Cutting was performed on 20 March 2026, the results of which are shown in Figure 3-36. Note that this area of hull cutting has also been marked in the GIS deliverable.

Figure 3-35 Approximate location of cutting for FMD works

Figure 3-36 Post-cutting access of outer hull between frames #136-#138, allowing for FMD works

The operation was not successful due to the shape of the space to be monitored. The equipment needed a opposite wall or plate surface that was roughly perpendicular to the sensor beam and parallel to the surface where the sensor was mounted. The space was trapezoidal in shape resulting in angled surfaces causing misleading returns.

3.9 INVESTIGATION OF KEEL COMPARTMENTS

During the June 2026 campaign, access to keel compartments was obtained at pressure hull frames #60-#66 (#103-#112).

On inspection of the first keel compartment at frame #60, the content seemed to be broken glass, coal and wood. Samples were taken for further study by client on shore.

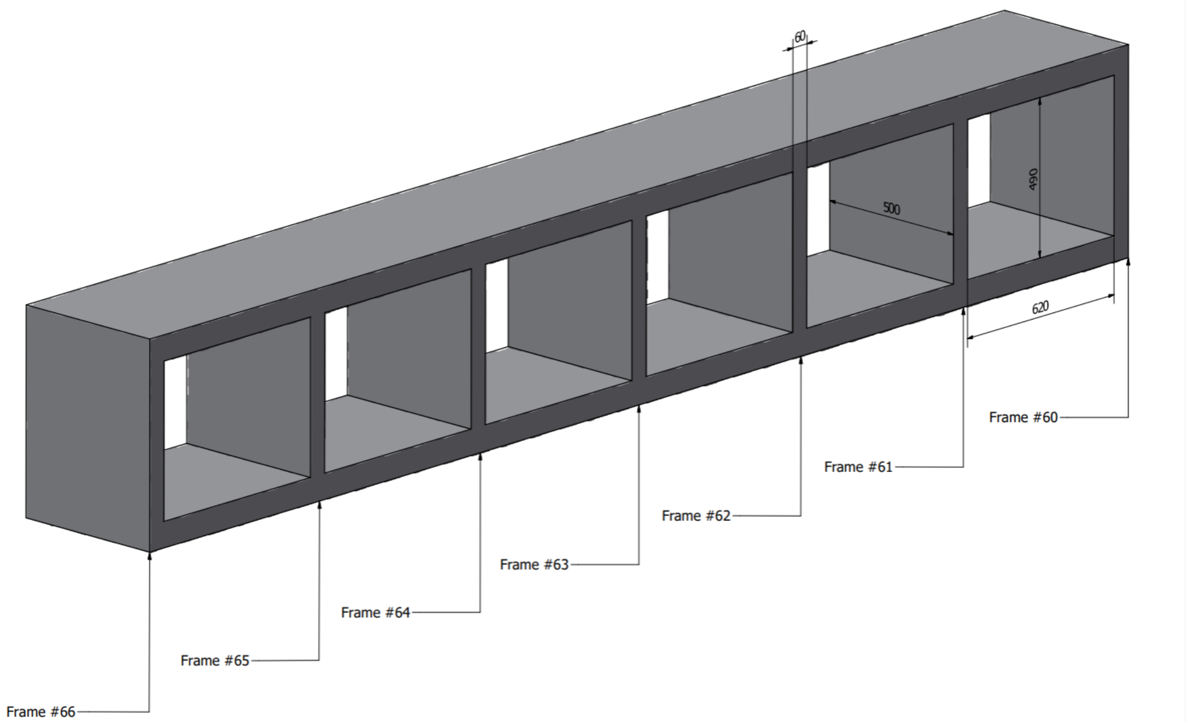

Figure 3-37 Sketch showing measurements of the keel compartments

Measurements of the keel compartment 5 (frame #64-#65) were performed and resulting dimensions were obtained of: 0.62 m (width) x 0.49 m (height) x 0.50 m (depth) x 0.06 m (beam thickness). The process is described in Appendix C.7, REACH-600096-FM-007 Keel Compartment 5 Measurements.

Figure 3-37 shows a sketch of the measurements made of the keel compartments. Note that the dimensions given are for the light opening of the compartments.

Figure 3-38 The keel plate uncovered 6 compartments

Figure 3-39 General visual inspection of the accessible compartments. Keel frame #60 to the right

Figure 3-40 Inspection of keel compartment at frame #60

Figure 3-41 Inspection of first keel compartment #60-#61 (#103-#104) area

On examination further aft in the keel section, at frame #65, mercury canisters were found.

Figure 3-42 First mercury canisters discovered in keel compartment frame #65-#66 (#110-#112)

ROV performed careful cleaning of the area to obtain access for recovering mercury canisters.

Figure 3-43 Measurements of the canister compartment aperture – He 50cm – Width 62cm - Depth 50cm

Figure 3-44 Camera stick used to inspect inside the keel compartment

Inspection of keel compartment 5 at frames #64-#65 showed no apparent openings or breaches between the compartments. The compartments appeared to function as separate volumes; however, it cannot be ruled out that there are openings between them. Efforts were made to clean the inspected compartment of all debris; however enough debris remained to potentially cover the lowest parts of the compartment where any openings possibly would exist.

The condition of the compartment boundaries appeared to be good and solid, which was also reflected in the keel plate that was recovered to deck. Remnants of the mercury canisters and packing materials had affected the surfaces of the boundaries, rendering a qualified assessment of the boundaries difficult.

3.10 ENVIRONMENTAL MONITORING RESULTS

Environmental monitoring was successfully conducted, and results were obtained for all planned monitoring activities after some changes and adjustments.

Most analysed water samples (73%) had total mercury concentrations below 50 ng/L. An estimated 3.5 kg of mercury was transported out of the operational area, with monitoring indicating that a significant fraction of the dispersed mercury occurred in dissolved form rather than being particle-bound. Please refer to the Environmental Monitoring Report (Appendix E) for further details.

3.11 WRECK MONITORING

Wreck monitoring results are detailed in Appendix C.8. For monitoring of wreck movement, four separate references were used. Octans inclinometers for live updates to ROV control room, RTS Cubes mounted on the wreck with internal logging, a set of rulers and magnets set on the wreck and on the seabed and finally USBL beacons were used to monitor potential changes in seabed.

Wreck movement was noted on 19 June 2026 at 00:11 with a pitch and roll change of the fore RTS cube of 0.52 degrees and 1.41 degrees, respectively. This occurred within 10 minutes following the deployment of the RenOcean Spider to the seabed and thus is suspected to be related to the additional load applied to the seabed. No further wreck movement was observed during subsequent operations, including dredging works.

Figure 3-45 Cleaning hull surface for wreck monitoring equipment

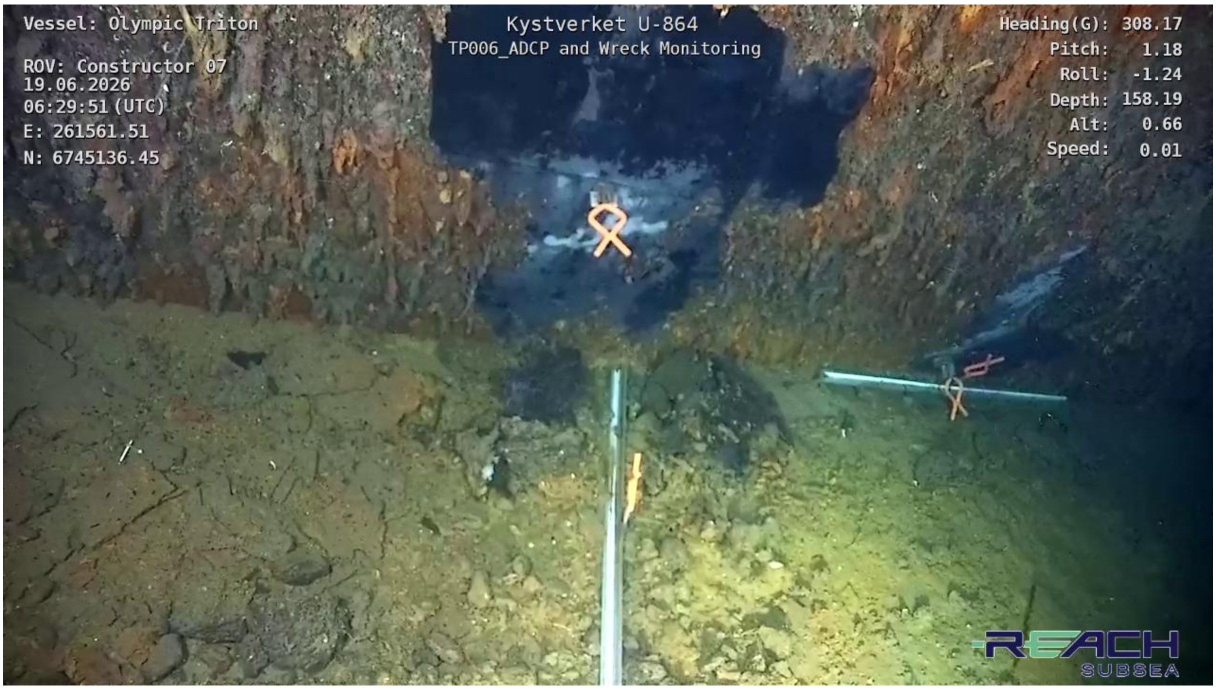

Figure 3-46 Wreck monitoring rulers and magnets installed

3.11.1 RTS CUBE

With the assistance of the RTS Engineer (mobilisation only), a RTS acoustic Modem was installed onto the Supporter WROV, allowing communications to be established with the RTS Cubes whilst the Supporter WROV was deployed subsea. The RTS cubes were the secondary method of inclinometer observations.

Three RTS Cubes were supplied, however only 2 were used (one on each section of the wreck) with the third being the spare. The Primary RTS Cube was deployed on the Aft section of U-864, however due to a conflict in cNode frequencies with the secondary RTS Cube and the Ren Spider, the spare RTS Cube was used for the forward section of the wreck.

An over-the-side modem was also prepared on deck and made ready prior to starting operations in-field. This was to allow observations to the RTS Cube when the Supporter WROV was not deployed subsea.

Table 3-7 Deployed RTS Cube Wreck Monitoring Locations, trip 2

Position	Easting (m)	Northing (m)	Cymbal Frequency
RTS Cube (Spare) FWD Section U-864	261 561.23	6 745 140.10	M05
RTS Cube (Primary) AFT Section U-864	261 546.94	6 745 094.45	M33

Wreck monitoring results are covered in depth in REACH-600096-FM-008 Wreck Monitoring Report

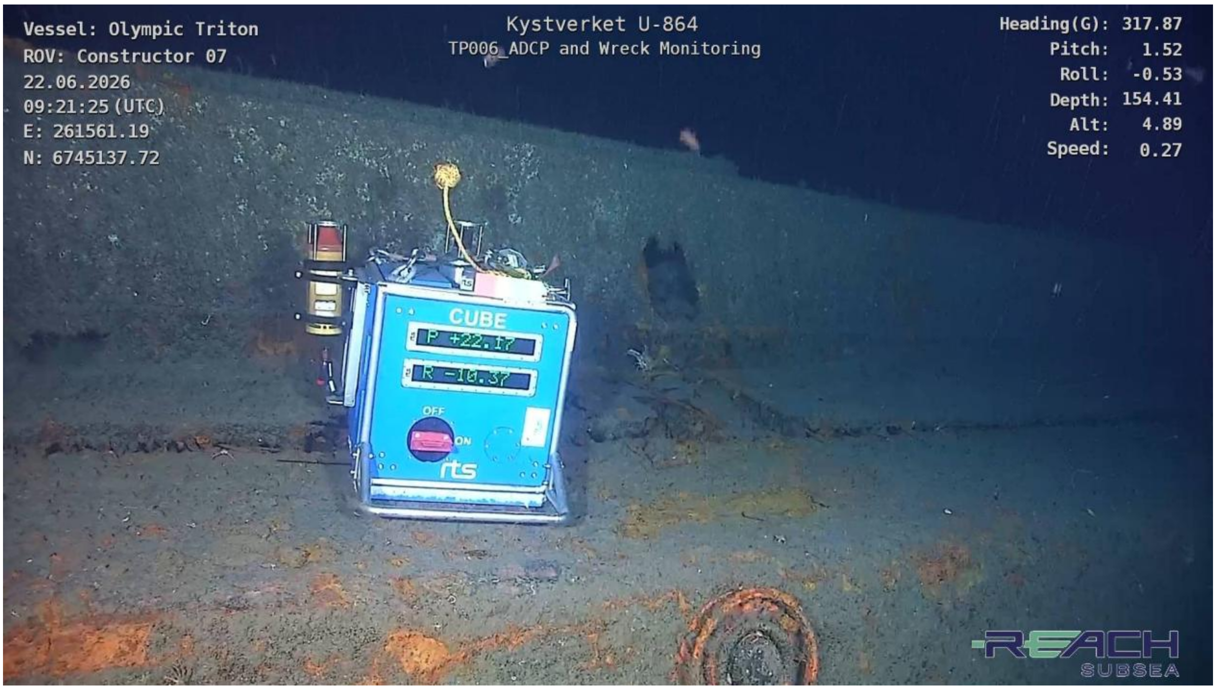

Figure 3-47 RTS Cube Forward Section U-864

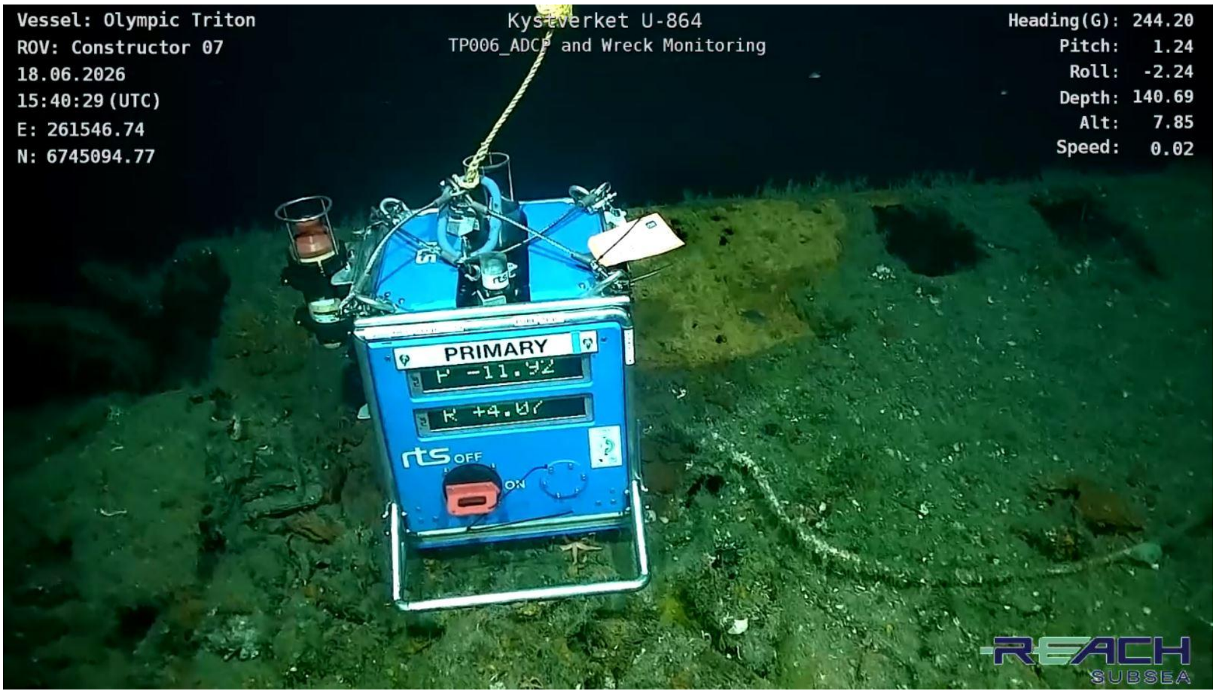

Figure 3-48 RTS Cube Aft Section U-864

3.11.2 OCTANS

Two Octans fiber optic gyro compass were supplied to monitor movement in the forward section of U-864. During Ren Spider dredging operations, the gyros were connected to the Ren Spider hot stab and 80m umbilical providing power and communications.

The Octans were interfaced to Eiva Navipac and continuously monitored for changes in pitch and roll.

Table 3-8 Deployed Octans Wreck Monitoring Locations

Position	Easting (m)	Northing (m)
Octans N1 s/n 4512 FWD Section U-864	261 559.73	6 745 147.88
Octans N2 s/n 4517 AFT Section U-864	261 551.41	6 745 130.60

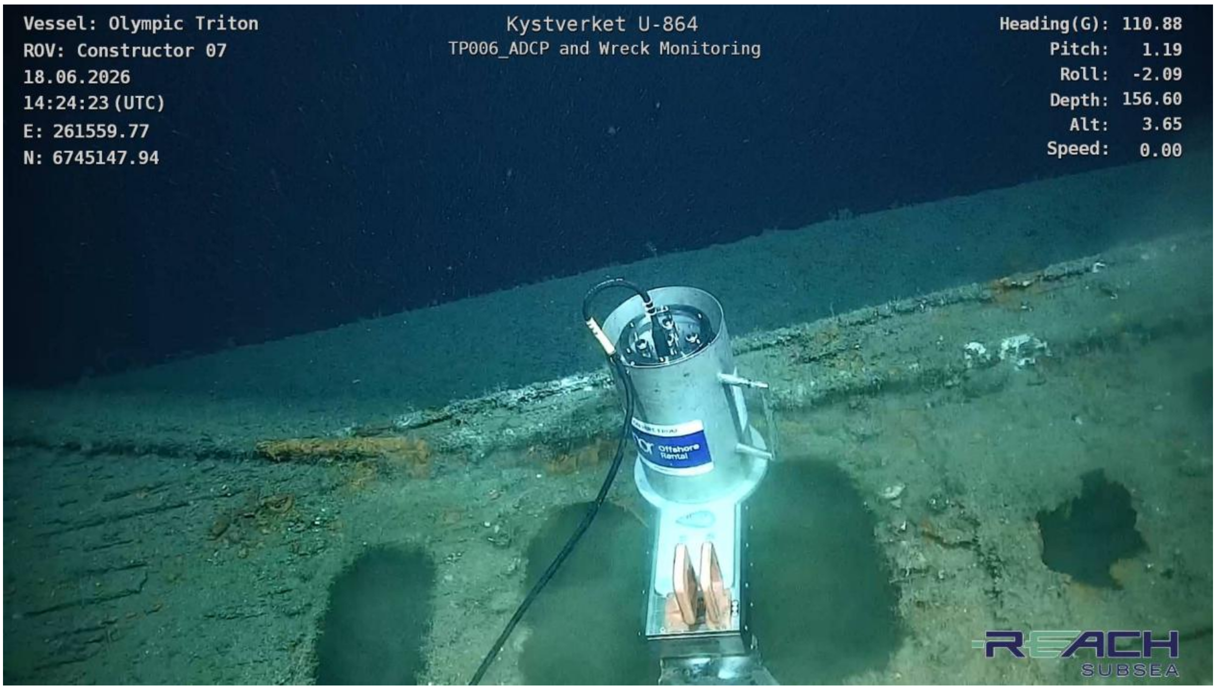

Figure 3-49 Octans MRU installed on Forward Section U-864

3.11.3 USBL MONITORING SYSTEM

Two Kongsberg cNode MiniS transponder were secured into 2x Transponder stands and associated centralising collars. The transponders were assigned unique codes and position updates set to 10 seconds. Acoustic USBL positioning data was monitored throughout the salvage operations to identify possible movement in the seabed.

Table 3-9 Deployed Seabed Monitoring Locations

Position	Easting (m)	Northing (m)	Cymbal Frequency
Seabed A	261 551.96	6 745 117.83	M30
Seabed B	261 525.70	6 745 142.52	M53

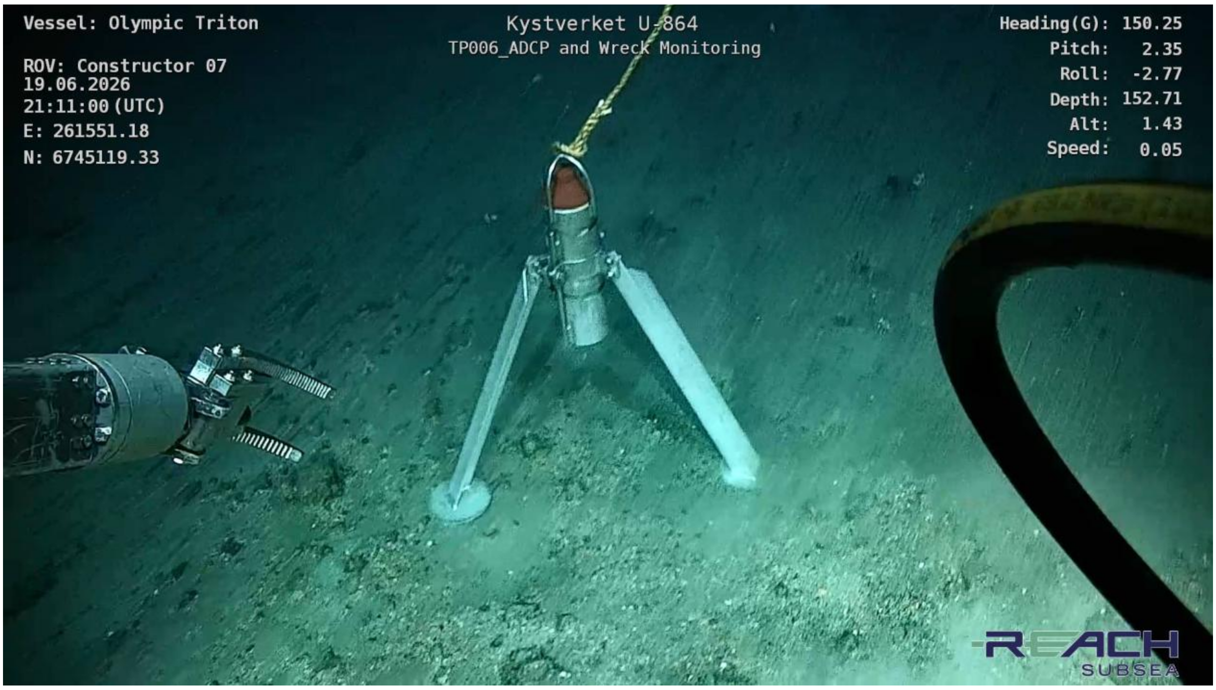

Figure 3-50 Cnode MiniS installed in stand for monitoring seabed movement

3.12 AS-LEFT SURVEY

3.12.1 FIRST TRIP

An as-left survey was performed on 27 March 2026.

Between 03:57 and 04:31 an as-left survey of the forward hull (port side, top and starboard side) was completed by the Constructor ROV. Vessel repositioning was carried out during the survey to provide access to all sides of the wreck. This was then followed by an as-left survey of the aft hull between 09:16 and 09:26. Figure 3-51 displays the orientation of the two ROVs in relation to the wreck during the as-left survey with the constructor ROV shown in green. ROV imagery is shown in Figure 3-52 through Figure 3-58.

An observation during survey was the number and size of rock in area planned to be dredged for access to keel. By frame #95 (approximately pressure hull frame #55), on the port side forward section.

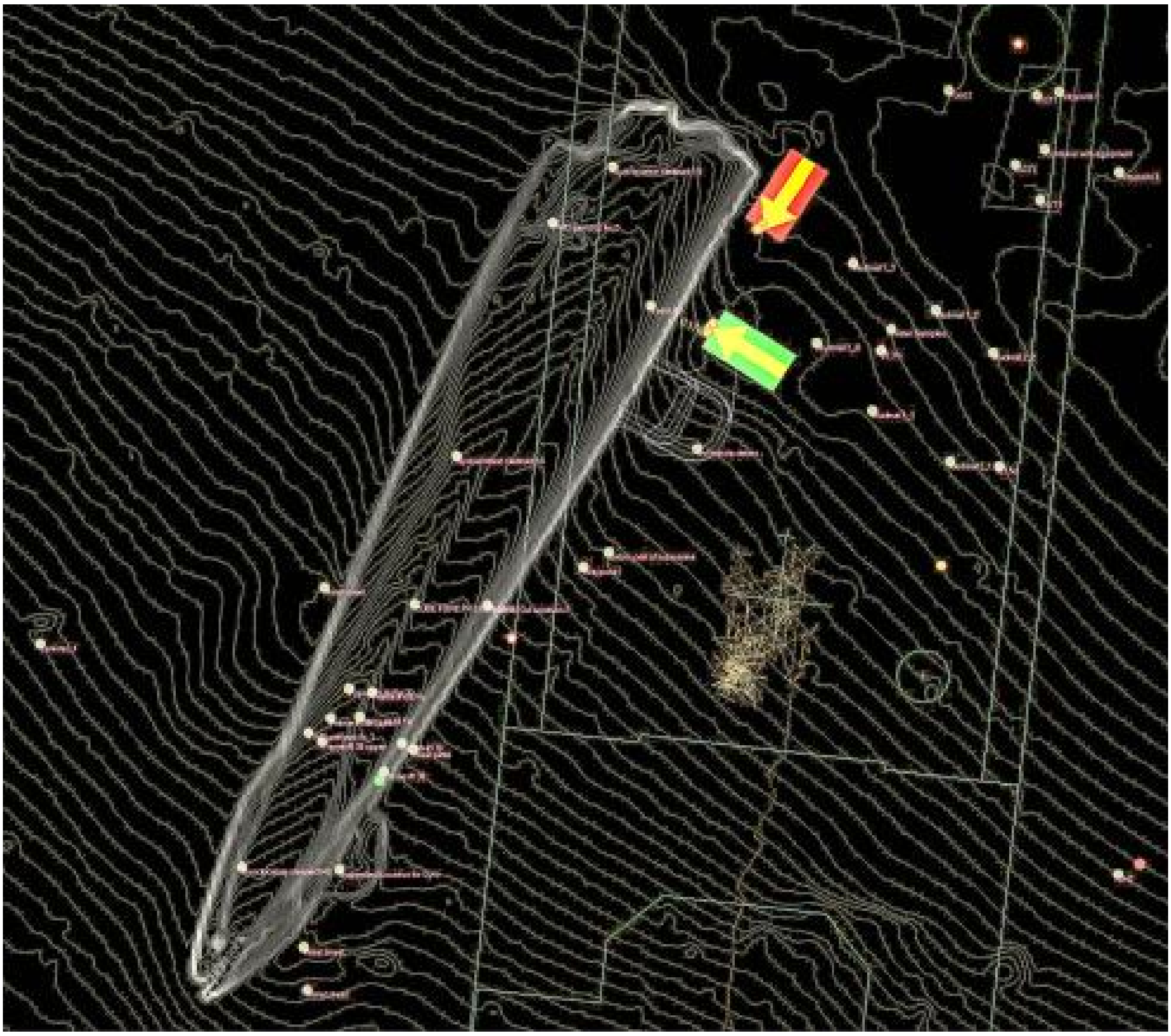

Figure 3-51 Schematic showing ROV positions during as-left survey. Constructor ROV shown in green

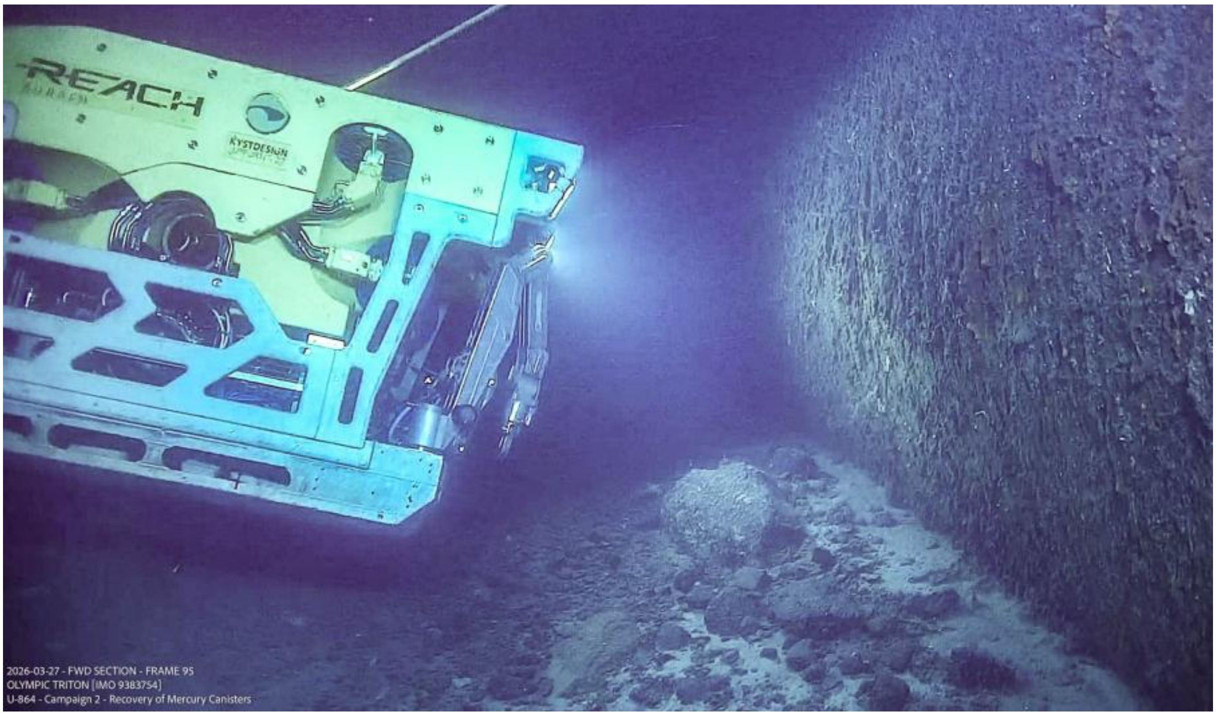

Figure 3-52 From As-Left forward section, port frame #95, #1

Figure 3-53 From As-Left forward section, port frame #95, #2

Figure 3-54 From As-Left forward section, port frame #95, #3

Figure 3-55 From As-Left forward section, port frame #95, #4

Figure 3-56 From As-Left forward section, port frame #95, #5

Figure 3-57 From As-Left forward section, port frame #95, #6

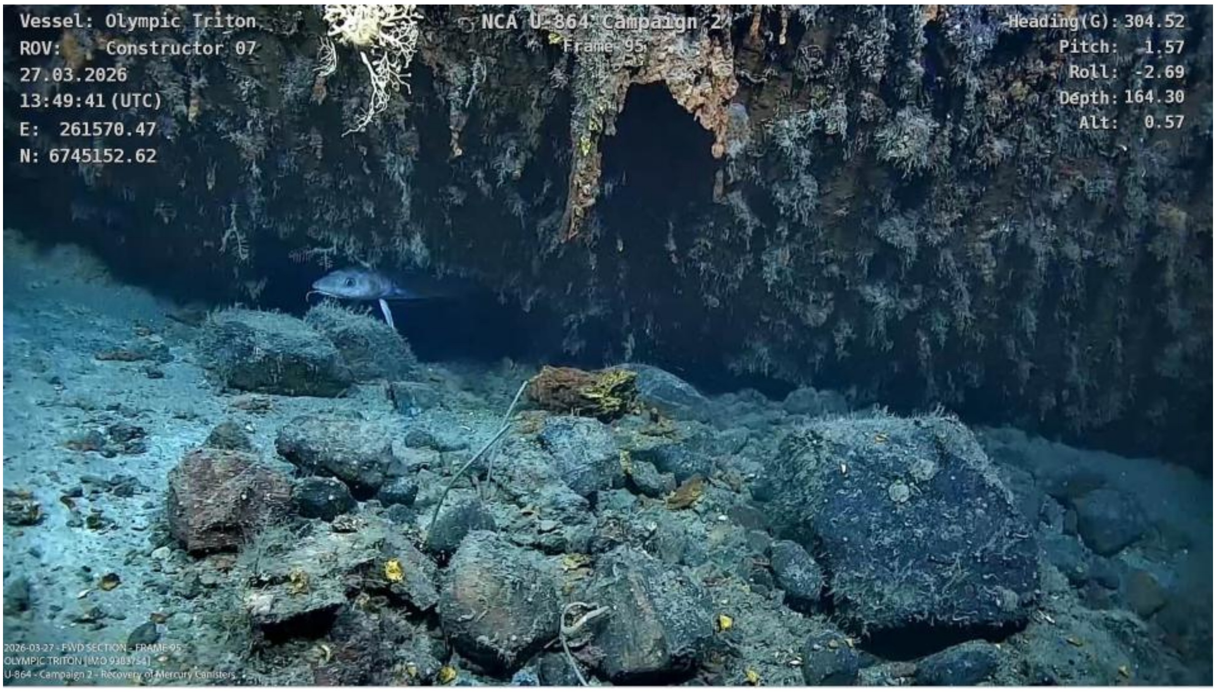

Figure 3-58 From As-Left forward section, port frame #95, #7

3.12.2 SECOND TRIP

Following installation of the filter units and recovery of all subsea equipment, a MBES survey was conducted using WROV Supporter 27 between 18:22 and 21.43 (UTC) on 27 June 2026. A total of seven primary high-fly survey lines were completed at 15m altitude. An additional six secondary low altitude lines were surveyed at 7 m altitude to gain details where shadows may have occurred on the primary lines. Backscatter data was also recorded throughout the survey.

The survey area was approximately 70×140 m in size and covered both the fore and aft sections of the submarine U-864 (Figure 3-59). The coordinates of the survey boundary are presented in Table 3-10.

Table 3-10 Wreck Site Boundary Coordinates

Boundary Point	Easting (m)	Northing (m)
1	261556.37	6745196.52
2	261619.96	6745169.25
3	261561.42	6745040.08
4	261497.83	6745069.35

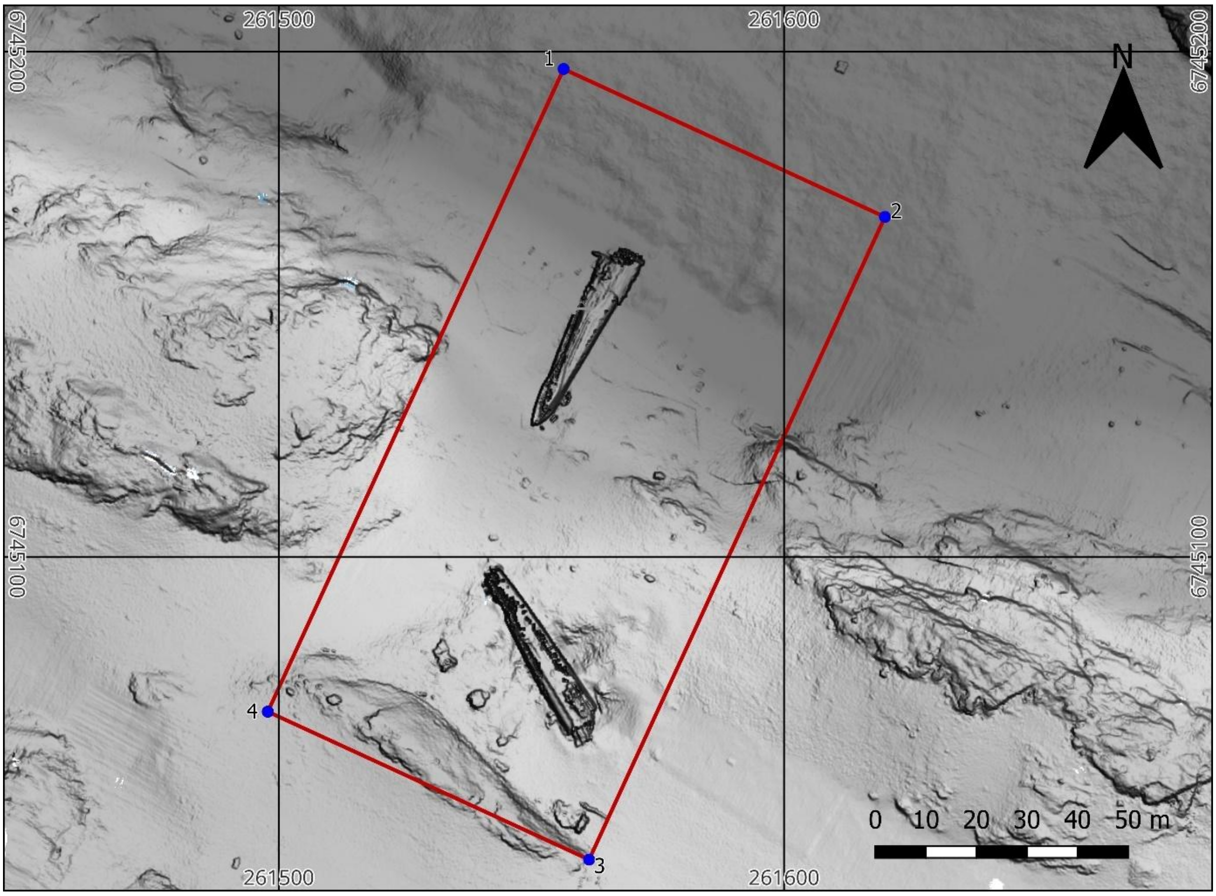

Figure 3-59 U-864 wreck survey area

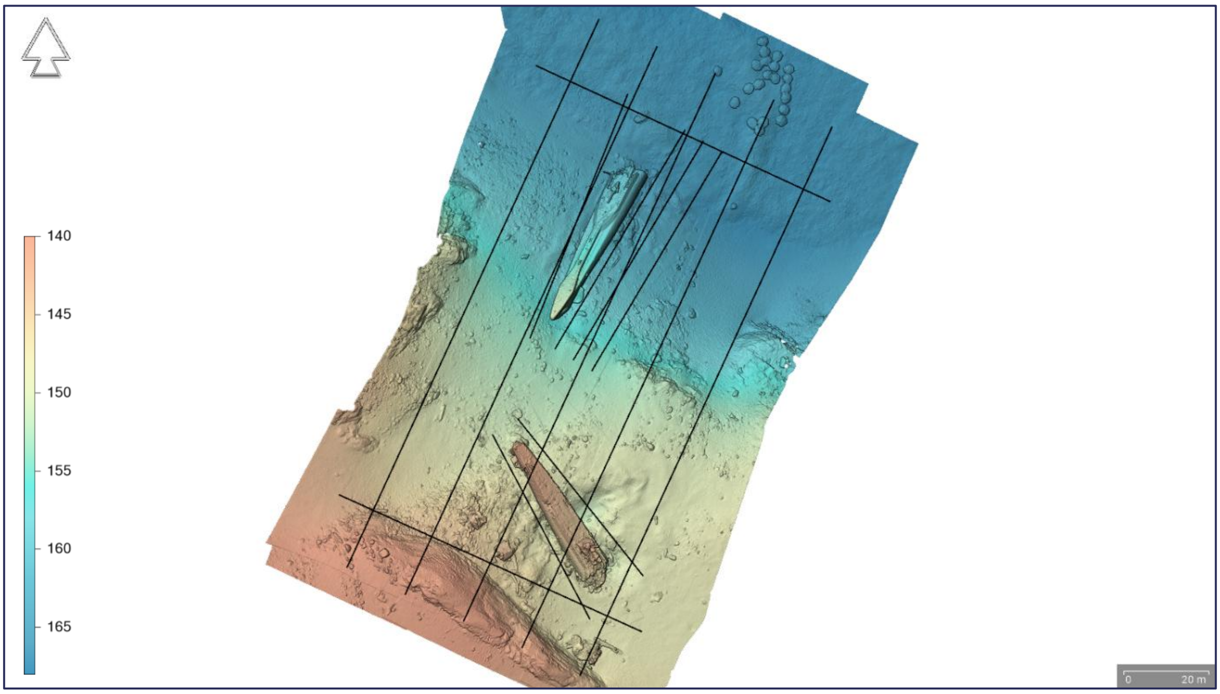

Figure 3-60 Overview As-Left survey lines and multibeam echo sounder data

Using the 2025 DTM as a reference model (REACH-600057-MBES-001-U-864 Gridded Surface-5cm) and the dredging DTM acquired prior to installation of the filter bags, a comparison was performed between the two surfaces to demonstrate depth differences before and after dredging. The resulting comparison is shown in Figure 3-61.

Using the same DTMs, a volume estimate was done, the results of which are shown in Table 3-10, which indicate that approximately 45 m³ of sediment has been removed since the 2025 reference survey.

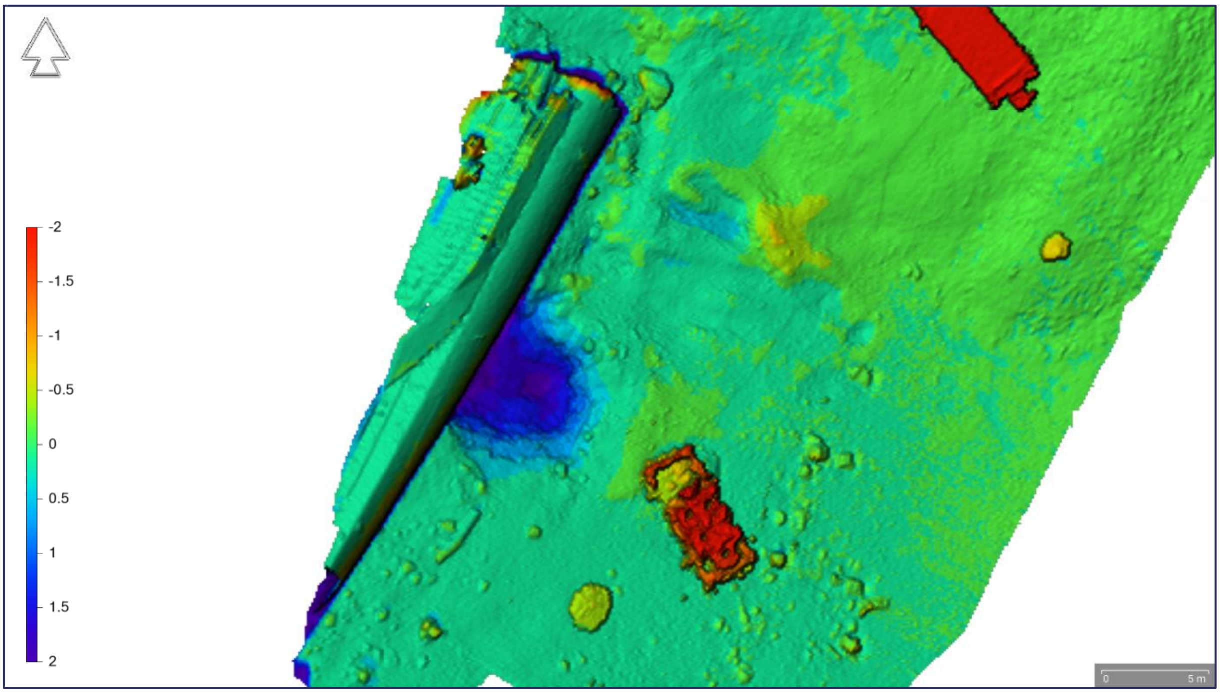

Figure 3-61 Dredged area before installation of rock bags, with difference in depth compared ref DTM

Table 3-11 DTM Volume Estimates

Measurement	Volume (m^3)
Volume above reference model (cut volume):	0.08
Volume below reference model (fill volume):	45.15
Volume difference (cut-fill volume):	45.07

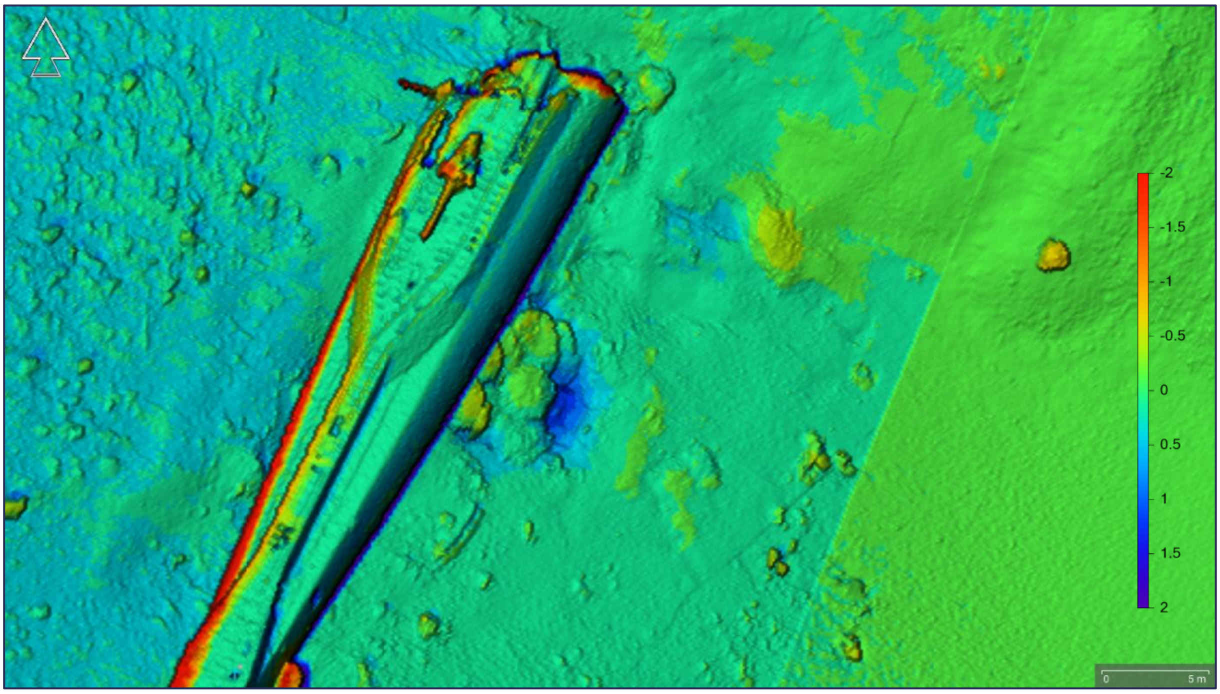

Figure 3-62 Dredged area after installation of rock bags, with difference in depth compared ref DTMAfter the as-left MBES survey, a GVI was performed on 27 June 2026 with the supporter ROV as a final task before leaving the field. No specific observations were made during this GVI. An image of the dredged keel area filled with filter units at the interface with the hull is shown in Figure 3-62.

Figure 3-63 GVI image of filter units adjacent to wreck

4 DEMOBILIZATION

4.1 FIRST TRIP

4.1.1 ACTIVITIES

Following suspension of offshore operations due to weather conditions, the vessel returned to CCB, Ågotnes, arriving at 17:45 on 24 March 2026. Interim demobilisation commenced on 25 March 2026, with removal of the Scanmatic spread, buoyancy equipment and filter units, while project close-out and demobilisation were formally confirmed during meetings held between 12:59 and 13:15. Equipment was progressively disconnected, prepared for storage and offloaded throughout the day. Adverse weather frequently interrupted crane activities, resulting in several temporary stoppages before operations resumed when conditions improved.

Demobilisation continued through 26 March 2026. Between 00:35 and 05:10, major campaign equipment including the peel grab, blast mat, RenOcean oil cleaning unit, work platform, manipulator systems, Spider excavator, NIVA laboratory container and RenOcean PDU container were removed from the vessel. During the day, remaining chutes, winches, mud mats, cable trays, containers and support structures were disconnected and offloaded. Interim demobilisation activities were completed at 16:28, after which the remaining deck cargo was secured and the vessel departed CCB at 18:15 for a sheltered standby area.

With weather conditions improving, the vessel departed the standby location at 00:05 on 27 March 2026 and returned to the U-864 field to recover remaining subsea infrastructure. Throughout the day, environmental monitoring equipment and project assets were recovered, including the cube basket, gyro/ADCP basket, exhaust container, mercury recovery basket, turbidity baskets (TU1–TU5), mud mats, DGT samplers and the DP beacon. Associated as-left surveys of the wreck and monitoring stations were also completed. Following recovery and contamination checks, the vessel departed the field at 20:33 and arrived back alongside at port at 23:32.

Demobilisation was completed on 28 March 2026. Beginning shortly after midnight, the remaining project equipment was offloaded at CCB, including RTS cubes, mud mats, subsea baskets, the dredge exhaust container, HPWJ unit, clump weights, Franzefoss containers, pallets and associated project materials. A final deck walkdown with the bridge team was completed at 04:45, confirming that all campaign equipment had been removed. By 07:10 all remaining vessel equipment and bulwark openings had been secured, returning the vessel to its normal operational configuration.

The following equipment was stored at CCB post interim demobilisation:

- 30 x 4 Te Filter Unit
- 14 x 2 Te Filter Unit
- 2 x chute pedestal
- 15 x 4 locks of chain for weight

Refer to REACH-600096-FM-001 (C.1) for a summary of operations associated with the stand-down period.

Figure 4-1 Vessel deck back to original state

4.2 SECOND TRIP

4.2.1 ACTIVITIES

Demobilisation commenced alongside Franzefoss facilities at Knarrvik on the morning of 28 June 2026. Mercury recovery basket containing five steel IBCs and the cyclone dredger was lifted off the vessel onto a waiting truck. The basket was then transported by Franzefoss to their dedicated mercury handling area for further disposal.

As soon as the mercury recovery basket was landed, the vessel cast off and sailed to CCB for final demobilisation.

Once alongside CCB on 28 June 2026 at 10:00 following completion of offshore operations, final demobilisation commenced. All project equipment was progressively offloaded from the vessel, including associated project infrastructure.

Demobilisation continued through 29 June 2026, with remaining campaign equipment lifted ashore by 01:30. A joint walkdown of the deck was carried out at 02:30, followed by removal of welding equipment and cleaning of debris associated with the filter unit spread. Deck washing commenced at 02:45, and at 03:30 the vessel deck was confirmed clean and clear, completing the demobilisation. All project equipment had been offloaded and the vessel returned to a standard operational configuration.

5 EXPERIENCE AND RECOMMENDATIONS

Figure 5-1 Olympic Triton at the worksite of Fedje

5.1 GENERAL

The campaign done in March had severe issues with the weather conditions in the operation period. In addition, the current in the area was over expected levels, during the launch of the Turbidity sensor system. The baskets for the system were launched at their intended positions, but after one failed attempt to launch the remaining parts, the launching method was revised but was never tested due to the weather conditions. The turbidity sensors and buoys were never launched from the vessel, and experience data is therefore not collected in regards of the suitability for this kind of task and operation area.

After periods waiting on the weather and failing to deploy environmental monitoring buoys, NCA terminated the operation.

For the June campaign, there were issues with key equipment causing delays. Once issues were resolved access to keel was obtained. The turbidity measurement method proved particularly challenging and requires updating for future campaigns.

Table 5-1 Overview of Tasks

Planned Tasks	Status	Comments
Mercury canister retrieval from fore section	Performed	Performed June 2026.
Mercury canister retrieval from aft section	Not started	
Handling of retrieved liquid mercury	Performed	Performed June 2026
Retrieval of canisters from surrounding sediments	Not started	
Investigation of keel compartments	Performed	Performed June 2026

Environmental monitoring and sediment spreading mitigation	Performed	Performed
Geotechnical monitoring of wreck (attitude)	Performed	Performed June 2026
Measurement of depth to bedrock	Performed	Performed June 2026
As-left survey of area	Performed	Performed June 2026

Overall, the offshore campaign was completed with effective cooperation between Reach Subsea, the Client, and all subcontractors involved. Communication between offshore and onshore personnel, as well as between operational disciplines onboard, was considered good throughout both campaigns. Safety, operational planning, and execution benefited from an open and collaborative working environment where issues were communicated and resolved efficiently.

5.2 GENERAL MERCURY HANDLING

All required personnel received a project-specific safety briefing covering the hazards associated with mercury and the controls implemented onboard. Personnel were informed of contamination prevention measures, restricted areas, emergency response arrangements, and reporting requirements. Mercury handling and recovery activities were performed only by personnel with the necessary training, competence, and relevant experience. This ensured that mercury-contaminated materials were managed safely and in compliance with project procedures and regulatory requirements throughout the campaign.

5.3 VESSEL

The vessel performed largely as expected during both offshore campaigns and provided a suitable platform for the project. Weather conditions during the first campaign resulted in periods of waiting on weather, primarily affecting deployment and recovery of subsea equipment.

Two vessel-related incidents involving lifting operations occurred during the project. During mobilisation for the first campaign, the weak link on a tugger wire failed and parted. No injuries occurred, and the incident resulted only in minor operational delays. The event highlighted the importance of verifying the suitability and condition of lifting accessories used during mobilisation activities.

A second incident occurred during recovery of the small boulder grab from the seabed. During recovery, the crane wire, pennant and grab began swinging due to sudden vessel movement. Before the crane operator could regain full control of the lift, the grab impacted the laboratory container with moderate force. No personnel were in the area and no injuries occurred. The incident demonstrated the importance of maintaining exclusion zones during lifting operations and continuously assessing environmental conditions that may affect load control.

Overall, vessel performance and marine operations were considered satisfactory throughout the project.

5.4 PERSONNEL

The project involved personnel from Reach Subsea, Olympic and four subcontractors: NIVA, Scanmatic (first campaign only), RenOcean and Franzefoss.

Throughout the project, numerous positive observations were recorded through the Safety Observation Card system and presented in the daily morning meetings. Personnel consistently demonstrated good communication, teamwork and a willingness to assist across company boundaries. Collaboration between disciplines contributed positively to safe and efficient operations.

During the Lessons Learned process, it was identified that several key project positions could have benefited from dedicated back-to-back personnel. The operational intensity and reporting requirements generated a considerable workload for some functions offshore. Additional personnel coverage would have reduced reporting backlog and provided increased resilience during extended offshore operations.

5.5 EQUIPMENT

Equipment experience has been described in the following subsections. However a couple of minor points were also noted:

- FMD equipment was not suitable for the shape of the volume to be measured.
- Use of aluminium in tools and equipment should be minimised in future operations. Direct metal-to-metal contact between the wreck and any other equipment should be avoided, due to extensive corrosion being experienced during the short period of operations.

5.5.1 TURBIDITY MEASUREMENT EQUIPMENT

The planned turbidity measurement spread intended for use during the first campaign could not be launched due to weather limitations including surface currents and challenges deploying the buoy arrangement. Instead, turbidity monitoring was carried out using sensors mounted on the ROV systems. While this approach provided valuable data, it also created operational constraints by reducing flexibility of the ROVs. There were also some constraints how far away from Olympic Triton the ROVs could do sampling and monitoring. Simultaneous requirements for dredging support, environmental monitoring and water sampling occasionally resulted in competing priorities for ROV utilisation.
While it is theoretically possible for the ROVs to operate up to 150-160 meters out from the vessel, various factors such as seabed conditions, location of other ROV and Spider, as well as vessel heading relative to the launch point of the ROV will need to be considered. Tether management is a vital factor when operating far away from the vessel.

5.5.2 RENOCEAN SPIDER

The RenOcean Spider generally performed well; however, several technical and operational challenges were experienced during the campaign. Following the first offshore campaign, MBES and visual surveys indicated the presence of a significant number of rocks and boulders within the planned dredging areas. This information did not appear to be fully incorporated into planning for the second campaign, and no dedicated mitigations were mobilized to prevent larger stones from entering and obstructing the dredging system.

During dredging operations, the Spider repeatedly experienced blockages caused by stones and boulders entering the dredging nozzle. The Spider was fitted with a Ø14" dredge nozzle with extend/retract function and Ø16'' exhaust nozzle to increase water velocity during the operation. During dredging operations, this extend/retract nozzle broke off, and had to be replaced with a nozzle lacking the extend/retract function. The replacement nozzle was Ø14". The system was not equipped with a backflush capability, limiting the ability to clear blockages subsea and resulting in operational downtime. A manual backflush plate was made offshore and used until backflush was activated. To mitigate the issue, a strainer was subsequently retrofitted to reduce the likelihood of larger rocks entering the dredging system.

Further challenges were experienced with the dredging discharge arrangement. The original exhaust hose configuration required several modifications before a satisfactory solution was established using a fixed discharge arrangement. Various length of exhaust hose was tried before landing on installing a fixed exhaust pipe instead. In addition, the use of a exhaust container for gathering the dredged sediments may have imposed operational constraints on dredging performance, although the extent to which this affected overall efficiency could not be conclusively determined and should be further evaluated. Filters installed in the exhaust container may have contributed to the reduced efficiency of the dredging operations.

The digital twin functionality, intended to estimate dredge volume and size and shape of the excavated area, did not perform as intended and provided limited operational value during the campaign. The system should be reviewed and tested under representative operational conditions prior to future deployments.

Two equipment incidents involving the Spider were recorded. During one event, a minor hydraulic oil spill occurred when a fitting became dislodged from a hydraulic cylinder port. The fitting was repaired, and operations resumed following corrective actions. A second incident occurred when the Spider tipped over on the inclined seabed due to incorrect slewing direction during operations. The incident resulted in damage to the dredging nozzle, requiring repair before operations could continue. Root cause was determined to be human error, with mitigating actions to include seabed inclination, machine orientation and safe slewing direction in pre-task briefing and toolbox talk. No injuries to personnel occurred in either event.

The seabed conditions encountered differed substantially from the original assumptions. While initial assessments indicated predominantly loose sediments, offshore operations identified compact clay and significant quantities of stones and boulders. Future dredging campaigns would benefit from additional site characterization, including CPT investigations, soil coring and detailed boulder mapping, to improve equipment selection, operational planning and risk mitigation.

5.5.3 LIQUID MERCURY RECOVERY EQUIPMENT

The original liquid mercury recovery system did not perform as intended during offshore operations. Liquid mercury was observed escaping from the dredging nozzle during recovery attempts, resulting in limited recovery efficiency. While the exact root cause was not conclusively determined, it is believed that the exceptionally high density of mercury relative to seawater and sediments may have reduced the effectiveness of the suction-based recovery method. The requirement to transport liquid mercury through approximately 4 meters elevation through the recovery system and upwards to the cyclone separator may also have contributed to performance limitations.

As a result, an alternative recovery tool was developed, sourced, and mobilized during the campaign. The tool utilized a cylinder-based vacuum principle, similar to a syringe, allowing direct collection of approx. 4,5-5 litres liquid mercury from the seabed. This method proved significantly more effective and functioned largely as intended during recovery operations. The recovery tool was mounted in the skid drawer of the Constructor ROV and connected to the ROVs hydraulic system for the operation.

The experience demonstrated that direct collection methods is better suited for recovery of free liquid mercury than conventional dredging-based systems. Future operations should consider purpose-built recovery tools specifically designed for high-density liquids and should verify functionality through testing under representative conditions prior to mobilisation.

5.5.4 MERCURY CANISTER HANDLING TOOLING

Various tools were utilized for dislodging and recovering mercury canisters from the keel compartments. Following modifications and operational experience gained throughout the campaign, the tooling generally performed as intended and enabled access to and recovery of canisters from the wreck structure.

As can be seen from the various pictures throughout the report, the double scoop was the preferred tool for transporting mercury canisters from the keel compartment to the mercury recovery basket. However, this scoop was on the large side for picking up the canisters inside the keel compartment. For separating the canisters from each other inside the keel compartment, a POM spear was made. This proved to be too soft to work as intended, and a crowbar was fitted with a fishtail handle so that could be used instead.

5.5.5 FRANZEFOSS

Franzefoss equipment functioned largely as intended during mercury detection activities. However, the mercury sniffer could not reliably identify liquid mercury in all situations, and visual confirmation remained necessary. Future operations should therefore continue to consider visual inspection as an important complement to instrument-based detection methods.

5.6 MOBILIZATION AND DEMOBILISATION

Mobilisation and demobilisation performed according to plan. Sub-contractor had some issues with RENSpider that delayed the mobilisation with some hours.

The first mobilisation experienced several delays associated with installation and integration of project equipment. Challenges included interfacing equipment from multiple contractors, connection to vessel power systems, integration with vessel fire detection systems within laboratory container, and limited survey resources available during mobilisation.

The second mobilisation was completed more efficiently as lessons learned from the first campaign had been incorporated and the majority of interfacing issues had already been addressed. Although some minor delays occurred, overall readiness was achieved within a shorter timeframe.

Demobilisation following the first campaign was conducted as a direct consequence of project postponement caused by unsuitable weather conditions. The subsequent remobilisation was completed without significant issues and demonstrated the benefit of retaining lessons learned and project knowledge between campaigns.

For future projects involving several subcontractors and extensive specialist equipment, early interface testing, increased mobilisation planning, and sufficient survey and technical resources are recommended to reduce mobilisation time and minimize the potential for delays.

5.7 WRECK MONITORING

Wreck attitude data was successfully acquired throughout the dredging operations and confirmed that the activities did not adversely affect the wreck’s attitude or stability. In this regard, the deployed monitoring systems fulfilled their intended purpose.

As described in REACH-600096-FM-008, a minor movement event recorded during deployment of the RenOcean Spider was successfully identified; however, reporting and escalation of the observation could have been undertaken more promptly. For future operations, greater emphasis should be placed on the continuous monitoring of live instrumentation data, with automated alarms and predefined notification thresholds implemented to ensure operators are immediately alerted to any significant changes in monitored parameters.

5.8 ENVIRONMENTAL MONITORING

Environmental monitoring was successfully conducted, and results were obtained for all planned monitoring activities. The monitoring programme included baseline surveys, turbidity measurements, and water sampling to assess mercury dispersion associated with the operations.

Overall, the monitoring approach functioned as intended, despite change of the buoy system to ROVs for turbidity monitoring and some challenges with contamination of sample vessels affecting blank sample results during part of the monitoring period.

For future operations, improvements to water sampling procedures, turbidity monitoring, and sediment trap handling should be considered to further enhance data quality and monitoring performance. Please refer to the Environmental Monitoring Report (Appendix E) for further details.

5.9 ACCESS TO KEEL SECTION COMPARTMENTS

Once the dredged pit was sufficiently deep to access the keel section, various solutions for access to keel section compartments were discussed.

The initial method of access was to cut a section in the keel plate and thereby access the compartments. However, with the improved access given by the dredging operations, it was considered to be more efficient to remove the whole keel plate.

The remaining bolts were unfastened by the ROV manipulator by acting as a crowbar between the keel and the plate. Once sufficiently loosened, a modified plate clamp was fastened to the plate, giving better leverage for the ROV to pull off the plate.

Where a cut opening would only give access to one compartment, removal of the keel plate gave access to six compartments. This provided the opportunity to assess which compartments contained mercury canisters, and which contained other items. It also provided good access for removing the mercury canisters.

A cut opening would likely limit the ROVs access and opportunity to remove mercury canisters.

For future projects, to ensure the best access for the ROV to remove mercury canisters, a complete removal of the keel plate should be the main priority. Cutting of the keel plate to obtain access to a single compartment should only be considered if there is a risk of wreck movement or if the dredged area is unstable. Depending on the ROV used, a pit depth of approx. 1,5-2,5 meters below the keel should be sufficient for reliable access to the keel compartments. Similarly, the pit width should be approx. 1-1,5 meters wider than the compartments being accessed.

During the campaign and because the RenOcean digital twin did not work as intended. The dredge pit was measured with manual instruments to estimate the dredge pit size. This approach did not give an reliable result, therefor an MBES was conducted. It may have been efficient to proceed with an MBES directly.

5.10 RETRIEVAL OF MERCURY CANISTERS IN KEEL AND FREE-FLOATING MERCURY

Special tools had been prepared for lifting and transporting the canisters from the keel compartments to the mercury recovery container.

These tools were utilized for dislodging and recovering mercury canisters from the keel compartments. Following modifications and operational experience gained throughout the campaign, the tooling generally performed as intended and enabled access to and recovery of canisters from the wreck structure.

The original liquid mercury recovery system did not perform as intended during offshore operations. Liquid mercury was observed escaping from the dredging nozzle during recovery attempts, resulting in limited recovery efficiency. While the exact root cause was not conclusively determined, it is believed that the high density of mercury relative to seawater and sediments may have reduced the effectiveness of the suction-based recovery method. The requirement to transport liquid mercury through the recovery system and upwards to the cyclone separator may also have contributed to performance limitations.

As a result, an alternative recovery tool was developed, sourced, and mobilized during the campaign. The tool utilized a cylinder-based vacuum principle, similar to a syringe, allowing direct collection of liquid mercury from the seabed. This method proved significantly more effective and functioned largely as intended during recovery operations.

The experience demonstrated that direct collection methods may be better suited for recovery of free liquid mercury than conventional dredging-based systems. Future operations should consider purpose-built recovery tools specifically designed for high-density liquids and should verify functionality through testing under representative conditions prior to mobilisation.

A larger cyclone dredger with higher suction capacity may still work for retrieval of liquid mercury. However, the direct collection method mentioned above might still be the most effective solution for retrieval of liquid mercury.

5.11 RETRIEVAL OF MERCURY CANISTERS IN SEDIMENTS

Scope not performed.

5.12 CLEANING OF EQUIPMENT

The cleaning of equipment to mitigate against potential mercury contamination was generally performed successfully throughout.

Several points of improvement are listed below but as a summary, a combination of instrument monitoring, detailed visual inspections, and fit-for-purpose storage solutions are recommended to improve both safety and operational efficiency in future mercury recovery projects.

The following improvements were listed as a result of lessons learned discussions:

- Greater efficiency could have been achieved by prioritising the removal of equipment from the "dirty" zone, enabling the crane to be released earlier for subsea operations
- The dirty zone barriers in the ROV hangar were not adequately secured, and strong winds caused the barriers to open
- The use of respiratory protective equipment and radios made verbal communication difficult during critical tasks. As a mitigation measure, hand signals were used; however, a more robust communication plan should be considered for future operations.
- Following cleaning and measurement with the Mercury Vapor Indicator (MVI) on the ROV, visible mercury beads were still observed on the skids despite not being detected by the instrument. While mercury trapped inside valves, piping, and enclosed spaces will typically be detected by the MVI, equipment located on deck with significant natural ventilation may not produce detectable readings. Therefore, a thorough visual inspection is essential and should always complement instrument-based measurements to verify that equipment is free from mercury contamination.

  The stainless-steel IBCs used during this campaign for storage and transportation of canisters were not well suited for this purpose. For future operations, specially designed tanks with improved access for both filling and emptying are recommended. Considerable time was spent emptying and cleaning the IBCs, and a more effective solution will be necessary if larger quantities of canisters and free liquid mercury are recovered during future missions.

6 DELIVERY STRUCTURE

Table 6-1 Summary of Delivery

Folder	Subfolder	Delivery	File Type	Comments
01_REPORT	-	Final report	.pdf	Including Appendices (Survey mobilisation and calibration report and field memos)
02_MBES	Gridded Soundings Contours Raster Shaded Relief	Processed multibeam data	.xyz .shp .dxf .tif .las	
03_GIS	-	Geodatabase Target list	.gdb	GIS database with 3D scene Updated since 2025 with new MBES and environmental monitoring locations
04_EIVA	REACH-600096-NMP-001-U864 TotalModel	Software to view bathymetry 3D	.nmp .exe	Project includes 2025 DTM and 2026 DTM
05_VIDEO	Multiple	Video for all survey	.MPG	

Table 6-2 Field memo summary

Document Code	Title
REACH-600096-FM-001	Operation Closeout
REACH-600096-FM-002	U864 Keel Plate
REACH-600096-FM-003	Sediment Samples
REACH-600096-FM-004	Mercury Container
REACH-600096-FM-005	Preliminary MBES Depth Assessment
REACH-600096-FM-006	Bedrock Measurements
REACH-600096-FM-007	Keel Compartment 5 Measurements
REACH-600096-FM-008	Wreck Monitoring Report

7 REFERENCES

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3. NIVA (2005): *Utlekking og bioakkumulering av kvikksølv fra sedimenter nær U864: Resultater fra eksperimentelle undersøkelser* (21 November 2005). Report no. 5089-2005, pp. 29
4. Geoconsult (2006): *Sluttrapport U-864 - Fase 2 2006: Kartlegging og fjerning av kvikksølvforurensning* (2 November 2006). Report no. 14021-SUR-O15-00001-06C, pp. 43
5. NGI (2006): *Kartlegging og fjerning av kvikksølvforurensning U864: Geotekniske undersøkelser og vurderinger* (06 November 2006). Report no. 20061348-1, pp. 16 + attachements
6. DOF (2013): *Phase 3A Survey and Geotechnical Campaign Report* (18 April 2013). Report no. 600225-DSNO-O15-0002, pp. 92 + attachments
7. DOF (2014): *Phase 3B Keel Inspection U-864 Report* (14 May 2014). Report no. 600246-PJ-O15-0001, pp. 29 + attachments
8. Lapwing 2026: Analysis of CB1250 buoy. Document number: 20029-TN-01

LIST OF APPENDICES

A. TASK PLANS

A.1 REACH-600096-TP-001 MOBILISATION KYSTVERKET U-864
A.2 REACH-600096-TP-002 NIVA SPREAD - WATER- AND SEDIMENT SAMPLING
A.3 REACH-600096-TP-003 U-864 ACCESS TO KEEL AND CANISTER RETRIEVAL FORWARD SECTION
A.4 REACH-600096-TP-004 SCANMATIC - TURBIDITY MONITORING
A.5 REACH-600096-TP-005 SURVEY MOBILISATION AND CALIBRATION
A.6 REACH-600096-TP-006 ADCP AND WRECK MONITORING
A.7 REACH-600096-TP-007 U-864 ACCESS TO KEEL AND CANISTER RETRIEVAL AFT SECTION
A.8 REACH-600096-TP-008 RETRIEVAL OF MERCURY CANISTERS IN SEDIMENTS
A.9 REACH-600096-TP-009 MBES SURVEY
A.10 REACH-600096-TP-010 FLOODING MEASUREMENT OF TORPEDO ROOM
A.11 REACH-600096-TP-011 INTERIM DEMOBILISATION
A.12 REACH-600096-TP-012 INTERIM AND FINAL DEMOBILISATION FOR SUSPENSION
A.13 REACH-600096-TP-013 FINAL DEMOBILISATION

B. MANAGEMENT OF CHANGE

B.1 REACH-600096-MOC-001- USE OF UNCERTIFIED LIFTING POINTS ON BUOYS
B.2 REACH-600096-MOC-002-DEPLOY SEDIMENT TRAPS WITH HALVED-TIED BACK RIGGING
B.3 REACH-600096-MOC-003-PERFORM FMD WITHOUT TURBIDITY MEASUREMENTS
B.4 REACH-600096-MOC-005 LEAVING FOR SITE WITHOUT ALL MOBILISATION CHECKLISTS COMPLETED
B.5 REACH-600096-MOC-006 DEPLOYMENT OF PROJECT EQUIPMENT WITHOUT TURBIDITY MEASUREMENTS
B.6 REACH-600096-MOC-007 CHANGE LOCATION OF FMD POSITION
B.7 REACH-600096-MOC-008 CHANGE RIGGING ON LP-011 20 FT SUBSEA BASKET FOR MERCERY RECOVERY
B.8 REACH-600096-MOC-009 CONDUCT BASELINE TURBIDITY MEASUREMENTS BY USE OF ROV
B.9 REACH-600096-MOC-010 CHANGING TURBIDITY MEASUREMENT METHOD TO USING ROV TO MEASURE TURBIDITY
B.10 REACH-600096-MOC-012 INSTALLATION OF VISIUAL INDICATOR FOR WRECK MOVEMENT
B.11 REACH-600096-MOC-013 DREDGING WITHOUT REN OCEAN DREDGE CONTAINER
B.12 REACH-600096-MOC-014 DREDGING WITH SHORTER HOSE OR NO HOSE CONNECTED
B.13 REACH-600096-MOC-015 REVISION OF DREDGING METHODOLOGY AND FILTER UNIT INSTALLATION
B.14 REACH-600096-MOC-016 DEPLOYMENT OF FILTER UNITS USING ROV-BASED CURRENT MEASUREMENTS DURING SPIDER DOWNTIME
B.15 REACH-600096-MOC-017 ACCESS TO THE KEEL THROUGH DREDGE PIT 1 FOLLOWED BY OPTIONAL ROV CUTTING OPERATIONS
B.16 REACH-600096-MOC-018-ACCESS TO THE KEEL THROUGH DREDGE PIT 1 BY OPTIONAL ROV CUTTING OPERATIONS
B.17 REACH-600096-MOC-019 WET STORING OF UNUSED FILTER UNITS
B.18 REACH-600096-MOC-020 RECOVERY OF SAMPLES TO DECK, USING IBC CONTAINERS FOR CARGO CONTENT
B.19 REACH-600096-MOC-021 RETRIEVAL OF U-864 KEEL COMPARTMENT PLATE_
B.20 REACH-600096-MOC-022 USE OF CYLINDER PUMP TO DRAIN LIQUID MERCURY
B.21 REACH-600096-MOC-023 CHANGE OF PROCEDURE FOR BEDROCK MEASUREMENTS
B.22 REACH-600096-MOC-024 ABORTING RECOVERING OF LIQUID MERCURY, STARTING ON ROCK BAG SUPPORT
B.23 REACH-600096-MOC-025 RETRIEVAL OF BOTTOM SAMPLES FROM U-864 FOR LAB TESTING

C. FIELD MEMORANDUMS

C.1 REACH-600096-FM-001-OPERATION CLOSEOUT
C.2 REACH-600096-FM-002-KYSTVERKET U864 KEEL PLATE REMOVAL

A. TASK PLANS

A.1 REACH-600096-TP-001 MOBILISATION KYSTVERKET U-864

PDF

A.2 REACH-600096-TP-002 NIVA SPREAD - WATER- AND SEDIMENT SAMPLING

PDF

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PDF

A.4 REACH-600096-TP-004 SCANMATIC - TURBIDITY MONITORING

PDF

A.5 REACH-600096-TP-005 SURVEY MOBILISATION AND CALIBRATION

PDF

A.6 REACH-600096-TP-006 ADCP AND WRECK MONITORING

PDF

A.7 REACH-600096-TP-007 U-864 ACCESS TO KEEL AND CANISTER RETRIEVAL AFT SECTION

PDF

A.8 REACH-600096-TP-008 RETRIEVAL OF MERCURY CANISTERS IN SEDIMENTS

PDF

A.9 REACH-600096-TP-009 MBES SURVEY

PDF

A.10 REACH-600096-TP-010 FLOODING MEASUREMENT OF TORPEDO ROOM

PDF

A.11 REACH-600096-TP-011 INTERIM DEMOBILISATION

PDF

A.12 REACH-600096-TP-012 INTERIM AND FINAL DEMOBILISATION FOR SUSPENSION

PDF

A.13 REACH-600096-TP-013 FINAL DEMOBILISATION

PDF

B. MANAGEMENT OF CHANGE

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PDF

B.2 REACH-600096-MOC-002-DEPLOY SEDIMENT TRAPS WITH HALVED-TIED BACK RIGGING

PDF

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PDF

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PDF

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PDF

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PDF

B.7 REACH-600096-MOC-008 CHANGE RIGGING ON LP-011 20 FT SUBSEA BASKET FOR MERCERY RECOVERY

PDF

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PDF

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PDF

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PDF

B.11 REACH-600096-MOC-013 DREDGING WITHOUT REN OCEAN DREDGE CONTAINER

PDF

B.12 REACH-600096-MOC-014 DREDGING WITH SHORTER HOSE OR NO HOSE CONNECTED

PDF

B.13 REACH-600096-MOC-015 REVISION OF DREDGING METHODOLOGY AND FILTER UNIT INSTALLATION

PDF

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PDF

B.15 REACH-600096-MOC-017 ACCESS TO THE KEEL THROUGH DREDGE PIT 1 FOLLOWED BY OPTIONAL ROV CUTTING OPERATIONS

PDF

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PDF

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PDF

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PDF

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PDF

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PDF

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PDF

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PDF

B.23 REACH-600096-MOC-025 RETRIEVAL OF BOTTOM SAMPLES FROM U-864 FOR LAB TESTING

PDF

C. FIELD MEMORANDUMS

C.1 REACH-600096-FM-001-OPERATION CLOSEOUT

PDF

C.2 REACH-600096-FM-002-KYSTVERKET U864 KEEL PLATE REMOVAL

PDF

C.3 REACH-600096-FM-003-U864 SEDIMENT SAMPLES

PDF

C.4 REACH-600096-FM-004-MERCURY CONTAINER

PDF

C.5 REACH-600096-FM-005-U864 PRELIMINARY MBES DEPTH ASSESSMENT

PDF

C.6 REACH-600096-FM-006-U864-BEDROCK MEASUREMENTS

PDF

C.7 REACH-600096-FM-007- KEEL COMPARTMENT 5 MEASUREMENTS

PDF

C.8 REACH-600096-FM-008- WRECK MONITORING REPORT

PDF

D. SURVEY MOBILISATION REPORT

PDF

E. ENVIRONMENTAL MONITORING REPORT

F. SHIFT SUPERVISOR LOGS

PDF

G. ONLINE SURVEY LOGS

PDF

H. LIST OF PERSONNEL