APPENDIX 3-1

CABLE CHARACTERISTICS

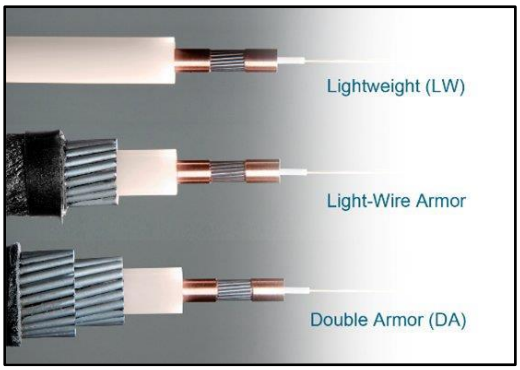
1. CHARACTERISTICS OF AEC2 UNDERWATER FIBRE OPTIC CABLE

1.1 Cable Description

There are three variations of Subcom SL17 marine fibre optic cable to be used during installation of the America Europe Connect 2 Cable system in Irish Territorial Sea and EEZ. The variations comprise lightweight (LW), lightwire armour (LWA) and double armoured (DA). Each is a variation on the SubCom SL17 cable, with the variations comprising different levels of cable armouring.

CABLE TYPE	SELECTION GUIDELINES
Double Armour (DA)	DA is typically used in the near shore portion of the cable where the risks from high-energy environments and external aggression are highest. Maximum deployment depth is typically 600 meters. Typically used in the following areas: • High-energy environments (wave energy, fast currents) and in areas of megaripples / sandwaves (indicating sediment mobility) where buried cable may become exposed; • Rock outcrops, and of less than reasonable sediment cover where abrasion is a risk; • Pipeline crossings; • Where external aggression risks are identified near cable planned for surface lay.
Light-Wire Armour (LWA)	Light Wire Armour is typically used in areas of the continental shelf and slope where the risks of external aggression are present and burial to target depths may not be achieved. Maximum deployment is typically 2000 meters. Typically used in areas: • Where the cable is to be surface laid over marginal bottom conditions with no risk of external aggression; • Where cable burial to target depth is questionable and external aggression risks have been identified; beyond the deployment depth of DA cable • Installation in shore end bore pipes to reduce friction during installation and reduce cost.
Light Weight (LW)	• Used in most benign deep ocean environments to full ocean depth.

Table 1-1 Typical cable armour selection



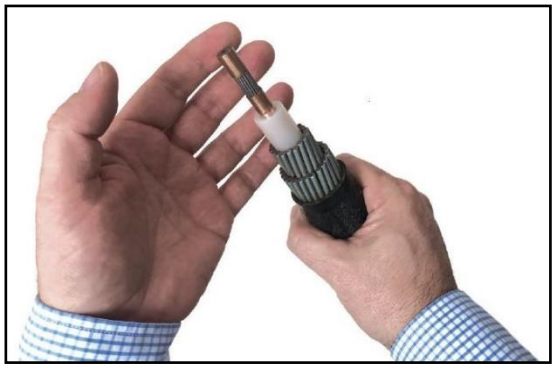


Figure 1-1 Principal cable types, with double armor in human hand

1.1.1 Lightweight (LW)

SL17 Lightweight cable is generally used in deep water where there is little/no risk of external aggression to the cable. Description of the construction of the LW cable, begins at the center with the unit fiber structure (UFS) and moves outward. The current unit fiber cable structure consists of an outer Polybutylene Terephthalate (PBT) tube containing fibers embedded in a buffer gel medium.

A set of 24 ultra-high-strength steel wires are helically formed around the fiber core (UFS) with a lay length of 305 mm [12 in.]. These 24 wires are configured into two layers. The first layer consists of 8 wires, 1.59 mm [0.0627 in] diameter.

The second layer consists of 16 alternating wires of which 8 are 1.50 mm [0.0592 in] diameter, and 8 are 1.13 mm [0.0446 in] diameter. The wires provide tensile stiffness which limits cable and fiber elongation during handling. They also isolate and protect the UFS by forming a pressure vessel. The interstices between the steel wires are filled with a hydrophobic elastomeric water-blocking material which resists longitudinal water ingress.

Outside this, a continuously seam-welded copper sheath is formed around the wires. The sheath forms a seal against radial water and hydrogen diffusion and conducts system power and signals used for cable monitoring and maintenance. A thin layer of ethylene-acrylic acid copolymer and a medium-density polyethylene jacket are then coextruded over the copper sheath. The ethylene-acrylic acid copolymer insures the bonding between the jacket and copper sheath. The polyethylene jacket provides high-voltage insulation, abrasion resistance, and corrosion protection. The polyethylene jacket also provides protection from typical hydrogen sulfide concentrations and provides a suitable finish for cable handling.

The nominal cable diameter of this resultant Lightweight (LW) cable is 17 mm [0.67 in.].

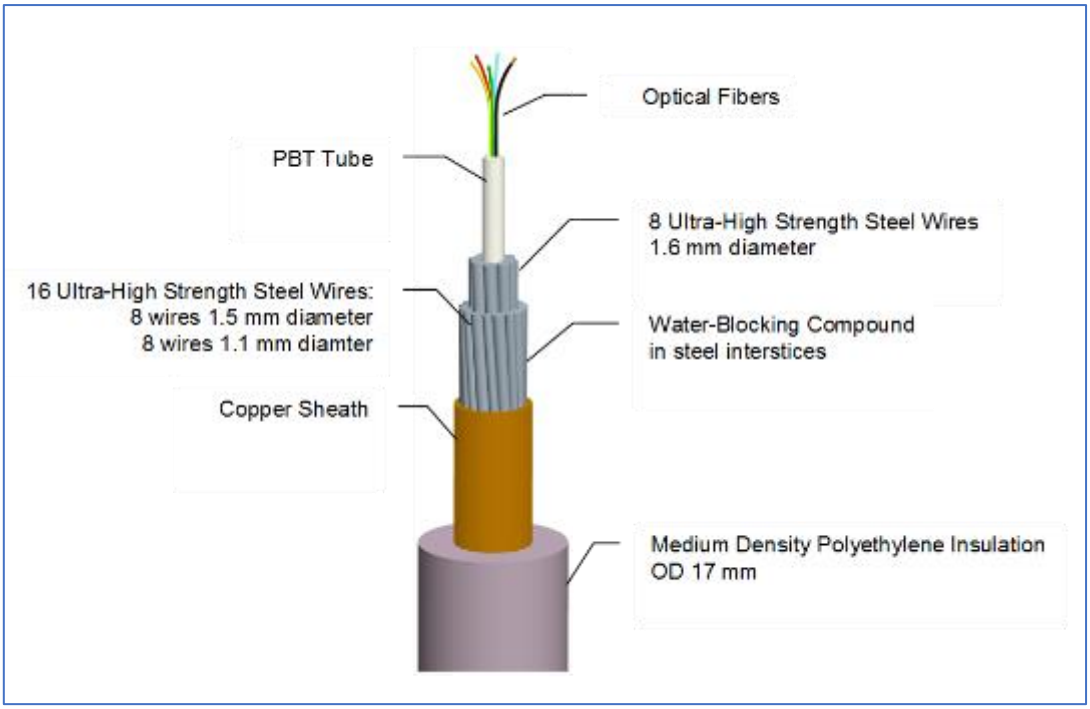


Figure 1-2. SubCom SL17 Lightweight cable

PARAMETER	NOMINAL VALUE
Nominal Permanent Tensile Strength	19 kN
Nominal Operating Tensile Strength	41 kN
Nominal Transient Tensile Strength	58 kN
Fiber and Cable Breaking Load (UTS)	79 kN
Weight in Air	5.79 kN/km
Weight in Water	3.50 kN/km
Outer Diameter	17.0 mm
Minimum Bending Radius	610 mm (storage or tensions < 9 kN) 1,500 mm (for tensions ≥ 9 kN)
Stowage Factor	0.31 m3 per km
Hydrodynamic Constant	45.6 degree-knots (lay) 55.7 degree-knots (recovery)
Cable Modulus	23 km

Table 1-2 SubCom SL17 LW cable properties

1.1.2 Light Wire Armoured (LWA)

SL17 Light Wire Armoured (LWA) cable is used in areas above the continental shelf where the cable is buried and where there is moderate to low risk of external aggression damaging the cable. The construction of LWA cable begins with a finished lightweight (LW) cable which then has 18 tar covered, galvanized, 3.35 mm [0.132 in.] diameter steel wires placed around the LW cable with a lay length of 380 mm [15 in.]. The cable with the tar covered galvanized wires then has two layers of tar impregnated nylon yarn separately laid over the wires and counter laid to each other with a lay length of 152 mm [6.0 in.]. The nominal diameter of the resultant Light Wire Armour cable (LWA) is 28.9 mm [1.14 in.].

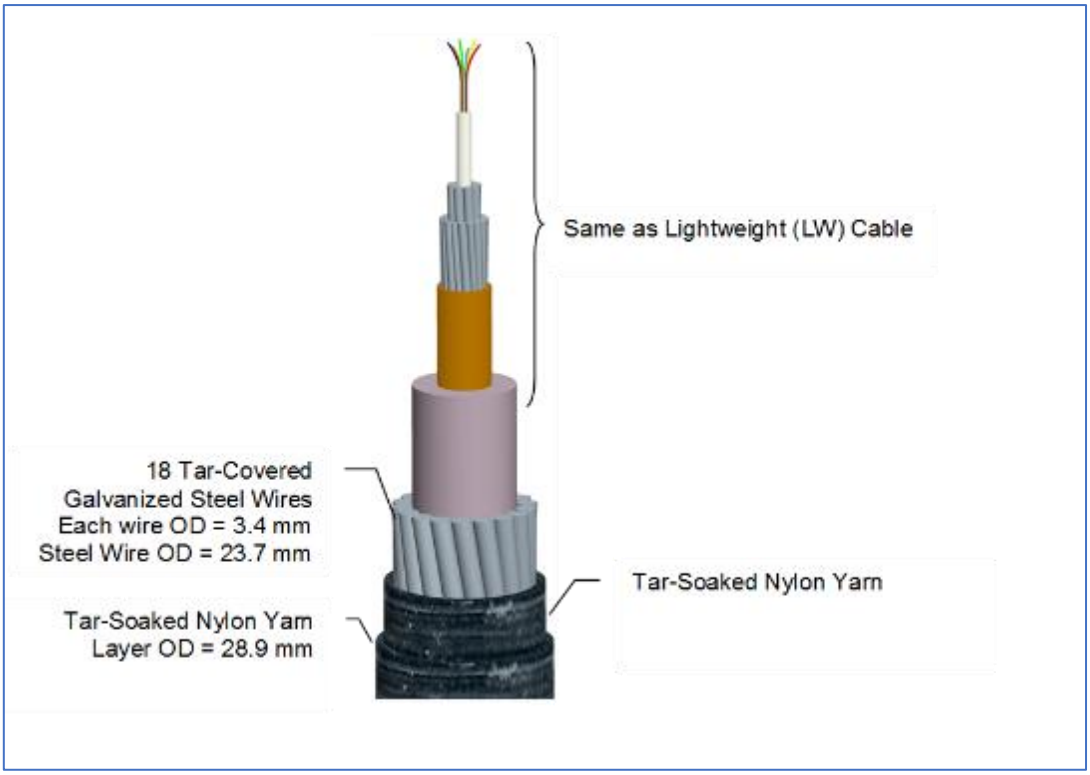


Figure 1-3. SL17 Light Wire armored cable

PARAMETER	NOMINAL VALUE
Nominal Permanent Tensile Strength	79 kN
Nominal Operating Tensile Strength	141 kN
Nominal Transient Tensile Strength	199 kN
Fiber and Cable Breaking Load (UTS)	306 kN
Weight in Air	20.81 kN/km
Weight in Water	14.87 kN/km
Outer Diameter	28.9 mm
Minimum Bending Radius	910 mm (storage or tensions < 9 kN) 1,500 mm (for tensions ≥ 9 kN)
Stowage Factor	0.88 m3 per km
Hydrodynamic Constant	74.3 degree-knots (lay) 88.1degree-knots (recovery)
Cable Modulus	21 km

Table 1-3. SubCom SL17 LWA cable properties

1.1.3 Double Armored (DA)

SL17 Double Armoured (DA) cable is used in areas above the continental shelf where the cable is laid on the surface in hostile ground and where there is a risk of external aggression damaging the cable. The construction of DA cable begins with a finished lightweight (LW) cable which then has 18 tar covered galvanized 3.35 mm [0.132 in.] diameter steel wires laid around the LW cable with a lay length of 380 mm [15 in.]. A second layer of 24 tar covered galvanized 3.35 mm [0.132 in.] diameter steel wires is placed over the first layer of wires with a lay length of 508 mm [20 in.]. The cable structure then has two layers of tar impregnated nylon yarn separately laid over the wires and counter laid to each other with a lay length of 152 mm [6.0 in.]. The nominal cable diameter is 35.9 mm [1.41 in.].

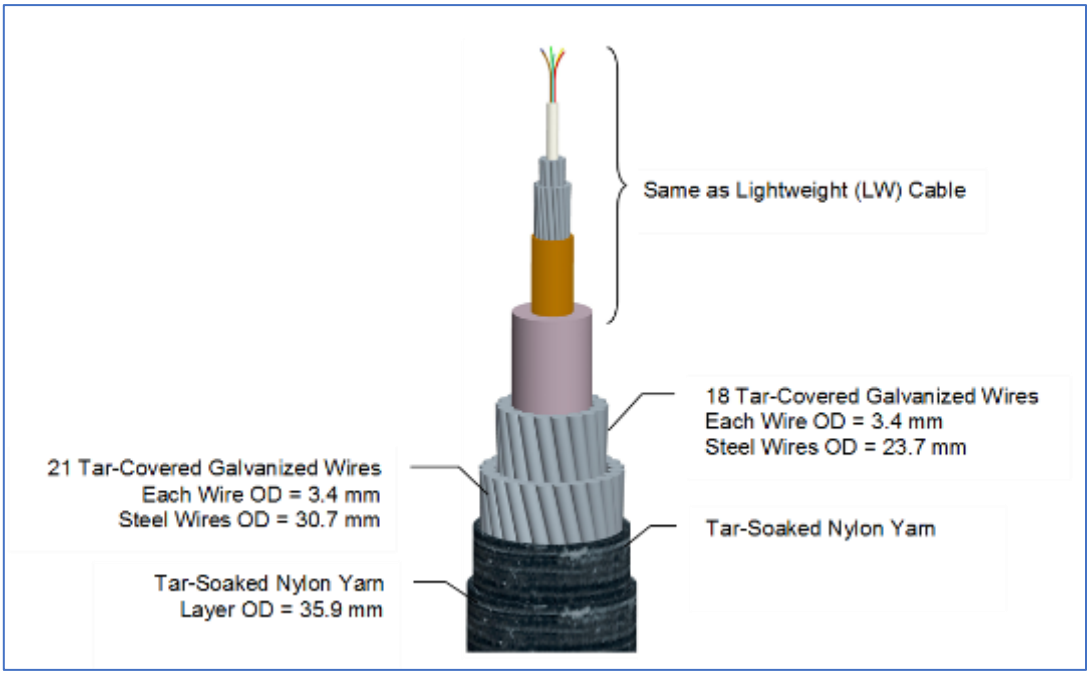


Figure 1-4. SL17 Double armored cable

PARAMETER	NOMINAL VALUE
Nominal Permanent Tensile Strength	160 kN
Nominal Operating Tensile Strength	282 kN
Nominal Transient Tensile Strength	394 kN
Fiber and Cable Breaking Load (UTS)	608 kN
Weight in Air	38.78 kN/km
Weight in Water	30.17 kN/km
Outer Diameter	35.9 mm
Minimum Bending Radius	910 mm (storage or tensions < 9 kN) 1,500 mm (for tensions ≥ 9 kN)
Stowage Factor	1.35 m3 per km
Hydrodynamic Constant	100.7 degree-knots (lay) 112.7 degree-knots (recovery)
Cable Modulus	20 km

Table 1-4. SubCom SL17 DA cable properties

1.1.4 Magnetic Characteristics of SL17 Cables

An extremely low magnetic field may be generated at the exterior of the SL cable surface during normal operation. The *maximum* magnetic field intensity is at the exterior cable surface and decreases inversely with distance from the cable. The magnetic fields induced by cable powering are on the order of 30 to 38 microtesla (µT) at the cable surface.

These values are significantly lower than the background magnetic field produced by the earth. Scientific literature suggests that few species are able to detect and differentiate features of weak magnetic fields from background noise. Therefore, the magnetic fields produced by SubCom's SL undersea cables would not be expected to disrupt marine organisms. As an example of how the magnetic field decreases with distance from the cable, at 1 meter the magnetic field would be .30 to .38 µT or 1/100th of what it is at the surface of the cable.

1.1.5 Heat Generation in SL17 Cables

Localized temperature effects in the vicinity of undersea cable systems have been evaluated based on the maximum powering characteristics of a cable system. The fundamental relation governing the maximum power dissipated P, in a length of cable with resistance R, and applied current I, defines the maximum value for heat dissipation.

SubCom's SL17 cables exhibit very minimal temperature increase due to powering with heat dissipation rates of less than 3 watts per kilometer of cable. As a point of reference, if a 3 watt power source is used to heat a tank containing 1,000 liters (1 cubic meter) of water, it would take more than 387 hours to heat the water one degree Celsius. This calculation does not take into consideration the fact that the cable will be buried. The low heat output, large quantity of water surrounding the cable, and movement of water due to currents and tides result in a negligible environmental effect.

1.2 SL Cable Materials

For all SubCom SL17 cable types, the materials utilized in the external-most layer in direct contact with the marine environment have extremely low water solubility and are inert in marine environments. The materials used in the external-most SL cable designs include Medium Density Polyethylene (MDPE), High Density Polyethylene (HDPE), and for armored cable designs, yarns and asphalt. The following sections address the environmental behavior of the materials in contact with seawater.

1.2.1 Environmental Characteristics of Medium Density Polyethylene (MDPE) (SL-17 and SL-21)

On a percentage basis, MDPE insulated SL-LW cable is the most widely used cable in undersea cable systems. MDPE is a water-insoluble polymeric solid that has a relatively high molecular weight. In an aquatic environment, the outermost MDPE layer is inert and non-toxic and provides protection to the SL cable. The non-toxic nature of MDPE is exhibited by its pervasive use in aquaculture hatchery tanks for the rearing of fish and lobster egg and larvae during sensitive life-stages.

1.2.2 Environmental Characteristics of Asphalt

The asphalt coating used on armored SL cables has low water solubility and is inert and non-toxic in the aquatic environment. These characteristics are well supported by a study and test plan conducted by the American Petroleum Institute (API) for the 'asphalt category' the results of which are reported on the U.S. Environmental Protection Agency's Chemical Right-to-Know HPV Challenge Program web-site

(http://www.epa.gov/HPV/pubs/summaries/asphlcat/c14901tc.htm). Conclusions of this test study include:

- **Stability in Water**

  Hydrolysis of an organic chemical is the transformation process in which a water molecule or hydroxide ion reacts to form a new carbon oxygen bond. Materials in the asphalt category are not subject to hydrolysis as they lack listed reactive groups."

- **Absence of Toxicity to Aquatic Plants and Invertebrates**

  "Asphalt and vacuum residue are not expected to cause acute or chronic toxicity to aquatic organisms due to the extremely low water solubility of these materials. This is supported by aquatic toxicity data from other petroleum products having similar types of hydrocarbon constituents. "

"Asphalt and vacuum residue, which contain saturate and aromatic hydrocarbon molecules of C25 or higher, also would not be considered sufficiently water soluble to elicit acute or chronic toxicity in aquatic animals and plants."

"Fish hatchery ponds lined with hot-mix asphalt are operated by the Oregon Department of Fish and Wildlife and the Washington State Department of Fisheries who have said to produce millions of high quality fish each year."

- **U.S. Environmental Protection Agency Comments**

  "EPA agrees with the stability in water information provided by the submitter. EPA agrees with the use of analog data to satisfy the ecological effects endpoints for the asphalt category. The analog data provided are considered worst-case scenario, in that asphalt category members are more water-insoluble than the analogs. Therefore, asphalt category members are not likely to show acute or chronic ecological effects in aquatic species."

1.2.3 Environmental Characteristics of SL Cable Operating Current

The SL 17 cable is designed to conduct system power for repeater-ed cable systems. The system power in the cable is rated for 15,000 volts but this will not be reached in the Irish Segment. The estimated maximum operational voltage is 1,301 volts in Ireland under normal conditions, and up to 5000 volts under fault conditions. The system line current is 0.949 amps. Consequently, the wattage of the cable will be <1200 watts, meaning that the cable will carry the same power as the cable of a domestic hairdryer. The extremely high insulating properties of the outer polyethylene jacket prevent current leakage. Therefore, environmental effects associated with current leakage are negligible.

1.2.4 Summary of SL Cable Environmental Emissions

The below table is a list of resistance values at 3ºC, the power dissipation per kilometer, and the magnetic field strength at the surface of unarmored SubCom's SL17 undersea cables operating at a maximum operating current of 1.6 Amps.

SL CABLE TYPE	RESISTANCE (OHMS/KM)	POWER DISSIPATION (WATTS/KM) @ 1 AMP	MAGNETIC FIELD STRENGTH, B, AT THE SURFACE OF UNARMORED CABLE (µT)
SL-17	1	2.56	38
SL-21	0.73	1.87	31

Table 1-5. Power (maximum heat) dissipation and magnetic fields for SL LW cable

1.2.5 Operational Characteristics of Repeaters

SubCom's undersea cable system designs may also include power dissipating components such as SubCom's repeaters. In general, repeaters, or "Optical Amplifiers", are inserted into undersea cable systems at a nominal spacing interval of 50 to 90 kilometers within the as-engineered routing. The primary purpose is to amplify the optical signal along the cable route as it travels from Cable Station A to Cable Station B. The copper conductors inside the cable power these repeaters.

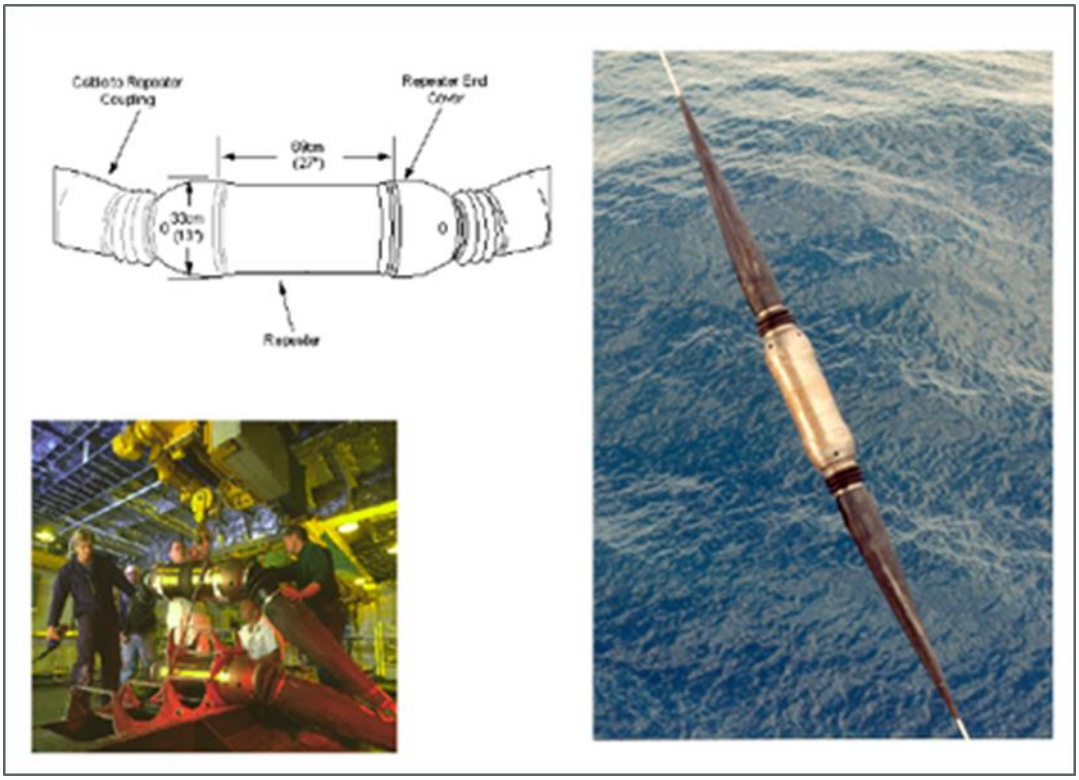


Figure 1-5. SL Repeater / Optical Amplifier

The powering limits and characteristics of the SubCom repeater are provided below.

SubCom Repeaters are powered in series by DC, fed over the cable from shore terminals. Each Repeater contains one internal power supply for each amplifier-pair (amp-pair) and operates at line currents in the range of 0.6 to 1.5 amperes. Table 1-6 defines the electrical design characteristics with maximum operating current for a Repeater.

Characteristic	Specification	Notes
Maximum Voltage, Chassis to Sea Ground	15,000 V	
Maximum Current, up to 25 years	1.6 A	
Repeater Capacitance	6,000 pF	Approximate
Surge Current Rating	600 A	1 ms duration

Table 1-6. Basic Electrical Features of Repeaters

The specific voltage drop of a Repeater depends on the number of fiber-pairs (amp-pairs), the pump laser power required, and the design of the components of that Repeater. Table 1-7 gives a representative range of voltage drops for a Repeater.

Number of Amplified Fiber-Pairs	Typical Repeater Voltage Drop Range
2	14 - 16 V
4	26 - 30 V
6	40 – 45 V
8	54 – 60 V

Table 1-7 Representative range of voltage drops for Repeaters

APPENDIX 3-2

RESOURCES LIST

VESSEL, EQUIPMENT, MATERIAL RESOURCES LIST

Item	QTY	Description	Comment
VESSELS			
•	1	Pulling Vessel	To pull the cable off the Main-Lay Vessel
•	2	Support Vessel	Dive Support / Support vessel over the HDD exit. Later to support articulated pipe installation
•	1	Burial Support Vessel	Support burial operations with SKAS Jet Sledge
ONSHORE EQUIPMENT			
•	1	20 M/T Tracked Excavator	Primary pulling equipment
•	1	20 M/T Tracked Excavator	Excavator – Dead man anchor
•	1	Quadrant with 4/leg	
•	20	Rollers	c/w wooden base
RIGGING			
•	4	15 -30Kg Danforth Anchors or screw anchors	
•	4	4-leg Yale Grip Stoppers (20 M/T SWL)	
•	2	220m 10mm polyprop rope	
•	2	220m 12mm polyprop rope	
•	3	200m length of 36mm Lankforce Rope (8 Strand – 15M/T SWL) c/w spliced protected eyes at both ends	
•	8	50mm Cargo Straps with ratchets (5 M/T low capacity when used in basket configuration)	
•	4	60mm webbing polyester slings (6 M/T load capacity in vertical lifting)	
SHACKLES & TOOLS			
•	4	2 M/T Safety Bow Shackles (G210 Galvanized)	

Item	QTY	Description	Comment
•	8	12 M/T Safety Bow Shackles (G210 Galvanized)	
•	4	20 M/T Safety Bow Shackles (G210 Galvanized)	
•	1	8-10T Regular Swivel	
•	2	Complete Tool Box and power tools	
•	1	Gen-Set 5500KVA	c/w extension cords
DIVE EQUIPMENT			
•	2	Kirby Morgan 18B (Band Mask)	
•	1	LP Compressor	
•	2	Umbilical, 4-part, 33hb-3/8" dive hose 330ft	
•	1	Air control box, 2 diver, 1h.p / 2l.p supply w/ radio	
•	1	Control Box diver underwater communication	
•	6	Diving Cylinders	8x18 Lt, 2 x 12Lt
•	2	Underwater Video Cameras	
• S	1	Approved and Certified Decompression Chamber	To be sourced locally
•	1	SKAS Jet Sled complete with pump and telemetry	c/w hoses and connections
RADIO COMMS AND SURVEY EQUIPMENT			
•	6	VHF Handheld Radios	Icom IC-M 25
•	2	GPS Handheld	Garmin
•	1	Magnetometer	

APPENDIX 6-1

MARINE SURVEY REPORT

Route Survey Report
Part II: Survey Results
Segment 02

Document Number

2018-06-12
Issue: Rev 0.0

TE connectivity
SUBCOM

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Foreword

This document forms part of the Route Survey Report (RTS) and contains detailed survey results for the Cable System.

Results presented here were assembled following analysis of data collected by MV Fugro Discovery for SEGMENT 2 Survey Operation

Issue Status & Document History Record

Current Issue

Issue	Issue Date	Prepared	Reviewed	Approved
Rev 0.0	2018-06-12	[redacted]	[redacted]	

Explanation of Issue:

Revision History

Issue	Issue Date	Prepared	Reviewed	Approved

Amendment / Additions / Deletions etc.

Section	Change
Executive Summary	
1 - Introduction	
2 - Scope of Work - Summary	
3 – Survey Results	
4 – Observed Conditions, Hazards and Restrictions	
5 - Conclusions And Recommendations	
Appendix A: Route Position List	
Appendix B: Land Diver & Inshore Report	
Appendix C: Chart Description	
Appendix D: Bottom Obstruction Report	
Appendix E: Soil Samples	
Appendix F: Cable and Pipelines Crossing Matrix	
Appendix G: Desktop Study	
Appendix H: Oceanography	
Appendix I: Marine Activity Log	
Appendix J: Digital Data Imagery	
Appendix K: Bibliography and References	

EXECUTIVE SUMMARY

The survey of Segment 2 referred to in this report covers the deep and shallow water sections. The water depths varied between 2845m at the BU1 location to 25m at the inshore limit of the Shallow Water Survey near Oldhead.

In general the seabed along the deep water section of Segment 02 route is flat with gentle slopes of less than 1°. The exception to this is towards the Irish coastline, where gradients of up to 38° are encountered.

The BU1 to Oldhead Route encompasses an essentially flat seabed with little or no features in deep water (greater than 1500m WD). Along the route there is a shallow seabed depression of up to 30m depth and over 10km length and the route runs along the NE periphery of it.

Towards the 1500m WD mark near the end of the deep water section of S02, there is an irregular upslope and irregular topography. The 1500m WD contour is reached on a uniform upslope.

From the offshore limit of the Shallow Water Survey, at 1500m the route crosses very steep slopes up to 20° over rocky scarps to the 570m WD contour. From here the route crosses a gently sloping sandy seabed overlying very soft to firm CLAY for much of the corridor. Further inshore the route crosses subcropping glacial TILL with boulder fields and then crosses an extensive area of ROCK outcrop and subcrop with gradients up to 30°. At the nearshore end of the corridor the route crosses sandy seabed with very gentle gradients. Some localised outcrops of glacial TILL with associated boulder fields occur within the generally sandy seabed close to the inshore limit of the survey.

One shipwreck was observed in the survey corridor on the Segment 02 route at 54°04.4506'N, 10°40.8724'W with dimensions of 23m x 8.5m x 0.6m and occurs 125m south-west of the route.

Two marine boundaries are crossed. They are the Exit Ireland EEZ/Enter Ireland CZ and the Exit Ireland CZ/Enter Ireland TS boundaries.

During the survey, winds from northerly directions were mainly encountered. Wind forces varied between 1 and 8. Only during deep water survey in January and March Beaufort 8 was logged. Especially during shallow water survey in May and June 2018 the weather was remarkably good with a maximum wind force of 5 Beaufort. The sea state was mainly 2-4, indicating wave heights of less than 1m. But a permanent swell from the Atlantic was encountered.

According to the Client's data base two IS cables in the deep water section are crossed by the route. They were not observed on the MBES data.

Significant fishing activity was observed at the entrance of Clew Bay in Block 5. Fishermen from Clare Island were not willing to move the gear for the period of survey operations. Several fishing gears were placed on the route and blocked survey operations with towed equipment. Some fishing gear was still observed in Block 4 but stopped in WD of more than 100m. There was not much fishing activities further out in Block 1 to 4 at the time of operations. Low, far off shipping activities was also observed.

At the time this report was written, no changes to the work methodology or the scope that occurred after the submission of the Operations Report were known.

Table of Contents

List of Figures and Tables

List of Abbreviations

A

AC .....Alter Course
AFT .....Stern
AOO .....Area of Operation
ASL .....Assembly Ship Load
ASM .....Automatic Speed Mode

B

BAS.....Burial Assessment Survey
BEC.....Brass end Cap
BFS .....Burial Feasibility Study
BMH .....Beach Manhole
BRH.....Bight Release Hook
BU .....Branching Unit

C

CC .....Cable Counter
CCSI.....Cable Change Ship Instruction
CDEP .....Cable Drum Engine Port (also called PCDE)
CDES .....Cable Drum Engine Starboard (also called SCDE)
CLS .....Cable Landing Station
COTDR .....Coherent Optical Time Domain Reflectometer
CR .....Conductor Resistance
CS .....Cable Ship
CS .....Cable Station
CTE.....Cable Termination Equipment
CTU.....Cable Termination Unit
CX .....Cable Crossing
CZ .....Contiguous Zone

D

DA .....Double Armor
dB.....Decibel
DC .....Direct Current
DFF .....Dispersion Flattened Fiber
DGPS.....Differential Global Positioning System
DLS .....Digital Line Section
DOB .....Depth Of Burial
DOHB.....Draw Off Hold Back Gear
DP .....Differential Positioning
DPR.....Daily Progress Report
DSV.....Dive Support Vessel
DTG.....Detrencher Grapnel

E

EEZ .....Exclusive Economic Zone
EHS.....Enviromental Health & Safety
EIC .....Engineer in Charge
EOB .....End of Burial
EOC.....End Of Cable
ESD .....Electrostatic Discharge
ET .....Electronic Technician

F

FA-NAR ....Factory Alarm – No Apparent Reason
FDC .....Fiber Distribution Cabinet
FF .....Flat Fish
FI.....Final Inspection
FM.....Factory Splice – Millenia Jointing Technology
FP .....Fiber Pairs
FS .....Final Splice
FWD .....Bow
FWE.....Finish With Engines

G

GB.....Optical Termination Box
GEJ.....Gain Equalizer Joint
GMT.....Greenwich Mean Time
GPS .....Global Positioning System
GS.....Gain Equalizer Joint Shape
GT.....Gain Equalizer Joint Tilt

H

HD.....Holding Drive
HDD.....Horizontal Directional Drill
HDF .....High Dispersion Fiber
HDPE.....High Density Polyethylene
HH.....Hand Hole
HPR .....Hydroacoustic Position Reference
HV.....High Voltage

I

ICPC .....International Cable Protection Committee
IFA .....Installed Fiber Assignment
IMO.....International Maritime Organization
INS.....In Service
IP .....Inspection Pass / Initial Pass (ROV)
IR .....Incident Report
IR .....Insulation Resistance
IS .....Initial Splice

J

JB.....Joint Box
JP.....Jetting Pass

K

KP .....Kilometer Post
kV.....Kilovolts

L

Lat. .....Navigational Latitude position in Degrees and Minutes
LBO.....Line Build Out
LCE .....Linear Cable Engine
LFES .....Loop Fiber End Seal
LJ .....Land Joint
LME.....Line Monitoring Equipment
LMF.....Large Mode field Fiber
LMS.....Line Monitoring System
Long. .....Navigational Longitude position in Degrees and Minutes
LP.....Landing Point
LPFF .....Long Prong Flat Fish
LT .....Local Time
LW.....Lightweight cable
LWA .....Light Wire Armor cable

M

m .....meter
mA.....mili Ampere
MARPOL...International Convention on MARitime POLlution
MARSEC...Maritime Security
MH.....Manhole
MJ .....Millennia Joint
MOD.....Ministry of Defense
MOP .....Method of Procedure
MSM.....Manual Speed Mode
MTM .....Manual Tension Mode
N
N.....North
NDSF .....Non Dispersion Shifted Fiber
NMS .....Network Management System
NZDSF .....Non Zero Dispersion Shifted Fiber

O

OADM .....Optical Add/Drop Multiplexing
OGB .....Ocean Ground Bed
OOR .....Out of Range (PLIB)
OOS .....Out of Service
OPL.....Off Port Limits
OSA.....Optical Spectrum Analyzer
OSP.....Outside Plant
OTDR.....Optical Time Domain Reflectometer

P

P.....Port
PA .....Public Announcement
PBD.....Physical Build Diagram
PCDE.....Port Cable Drum Engine (also called CDEP)
PD.....Port Drum
PFE.....Power Feed Equipment
PGU.....Protective Grounding Unit
PLB.....Post Lay Burial
PLDN .....Plow Down
PLGR.....Pre Lay Grapnel Run
PLI .....Post Lay Inspection
PLIB.....Post Lay Inspection & Burial
PLSE .....Pre Lay Shore End
PLUP .....Plow Up
PO.....Pay Out
POL .....Point On Line
POW .....Plan of Work
PSBU.....Power Switched Branching Unit
PSM.....Power Safety Message
PSO .....Power Safety Officer
PU.....Pick Up
PVC .....PolyVinyl Chloride
PWF.....Pre-determined Wavelength Filters

R

R .....Repeater
RC.....Route Clearance
REDP.....Route Engineering Design Package
RIB.....Rigid Inflatable Boat
RL .....Rodent-Lightning Cable
ROV.....Remotely Operated Vehicle
RPL.....Route Position List

S

S .....Starboard
SA.....Single Armor
SAT.....Site Acceptance Test
SB.....Splice Box
SCDE.....Starboard Cable Drum Engine (also called CDES)
SD.....Starboard Drum
SL .....Slim Line
SLD.....Straight Line Diagram
SLLI .....System Load and Lay Instruction
SM .....Ship Splice - Millenia Jointing Technology
SOLAS.....International Convention On Safety Of Life At Sea
SPA .....Special Purpose Application Cable
SPO .....Start Pay Out
SPSO.....Ship Power Safety Officer
SRC .....System Repair Cable
STBD .....Starboard

T

TBD .....To Be Determined
TD.....Touch Down

TDM .....Touch Down Monitoring
TEICS.....Tyco Electronics Integrated Cable Systems
TEMS .....TE SubCom Element Management System
TK.....Tank
TS.....Terminal Station
TS.....Territorial Sea
TTR .....Transmission Testing Room
TW.....Tow Winch

U

USBL.....Ultra Short Base Line
UJ.....Universal Joint
UTC time...Universal Time Coordinated

V

Vs .....Vessel Speed (usually in knots)

W

WD .....Water Depth
WGS.....World Geodetic System
WOW.....Waiting On Weather
WP .....Way Point
WMU .....Wavelength Management Unit

1. INTRODUCTION

1.1. Project Organization

TE Subsea Communications LLC (TE SubCom) has contracted Fugro Germany Marine GmbH to perform a cable route survey to provide geophysical and geotechnical information on the nature of the terrain within a defined corridor centred on the supplied Route Position List (RPL).

The HAVFRUE cable system is a planned transatlantic telecommunication network that will connect the United States of America and Europe. This cable system design spans nearly 8,143.5 km with initial landing points in four markets, including the USA, Ireland, Norway and Denmark, plus a possible option in Germany.

The developers, owners and future operators of the planned subsea fiber-optic cable system are Aqua Comms Ltd, a company based in Dublin – Ireland, as well as Bulk Infrastructure AS, a company based in Oslo – Norway. Aqua Comms Ltd and Bulk Infrastructure AS have contracted TE Subsea Communications LLC (hereafter TE SubCom), a company based in Eatontown, NJ – United States of America, to build and deploy the HAVFRUE subsea cable system.

Figure 1.1 presents a project overview map with all eight segments including the landing sites of the HAVFRUE subsea cable system based on the by TE SubCom supplied RPLs.

The system has the following landing sites:

- Avon-By-The-Sea, New Jersey, USA (Segment 01)
- Oldhead, County Mayo, Ireland (Segment 02)
- Kristiansand, Vest-Agder, Norway (Segment 06)
- Nymindegab South, Rinkøbing, Denmark (Segment 07)
- TBC, Germany (optional Segment 08)

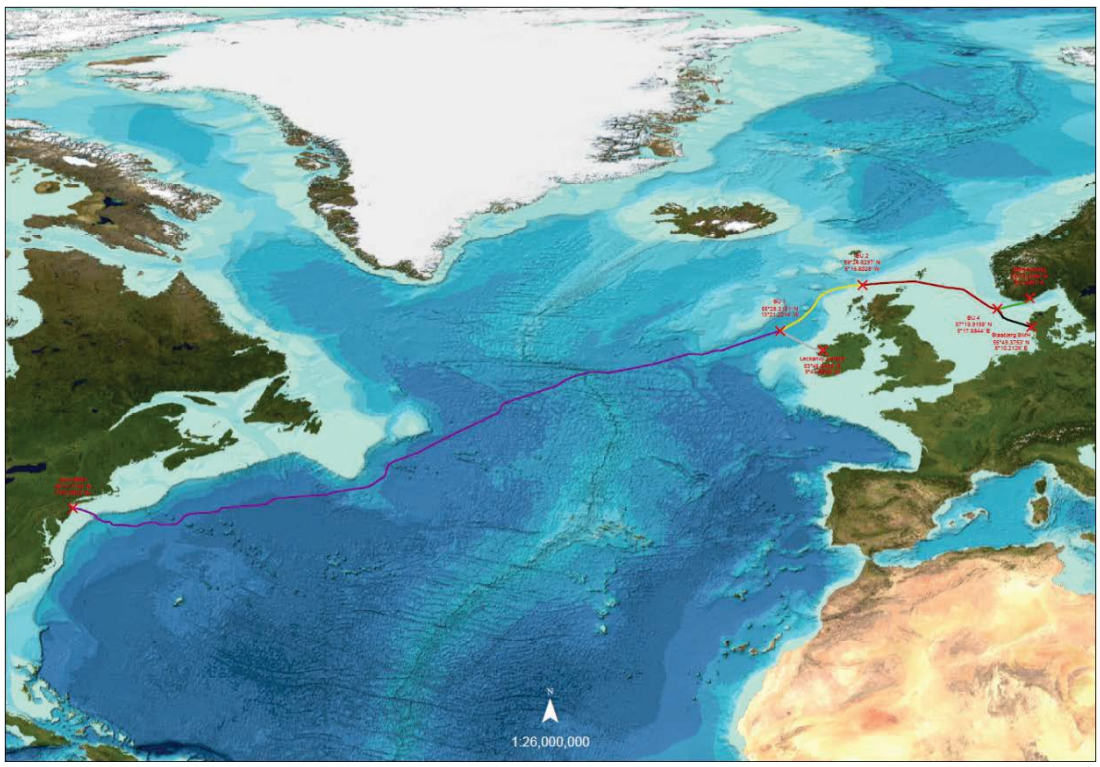


Figure 1-1 .....Overview Chartlet of the System

The figure below gives an overview of Segment 02. The route runs from the BU-1 NW of the Republic of Ireland at 55° 22.1387'N, 013° 03.1736'W to Oldhead, Republic of Ireland at 53° 46.5580'N, 009° 46.3420'W.

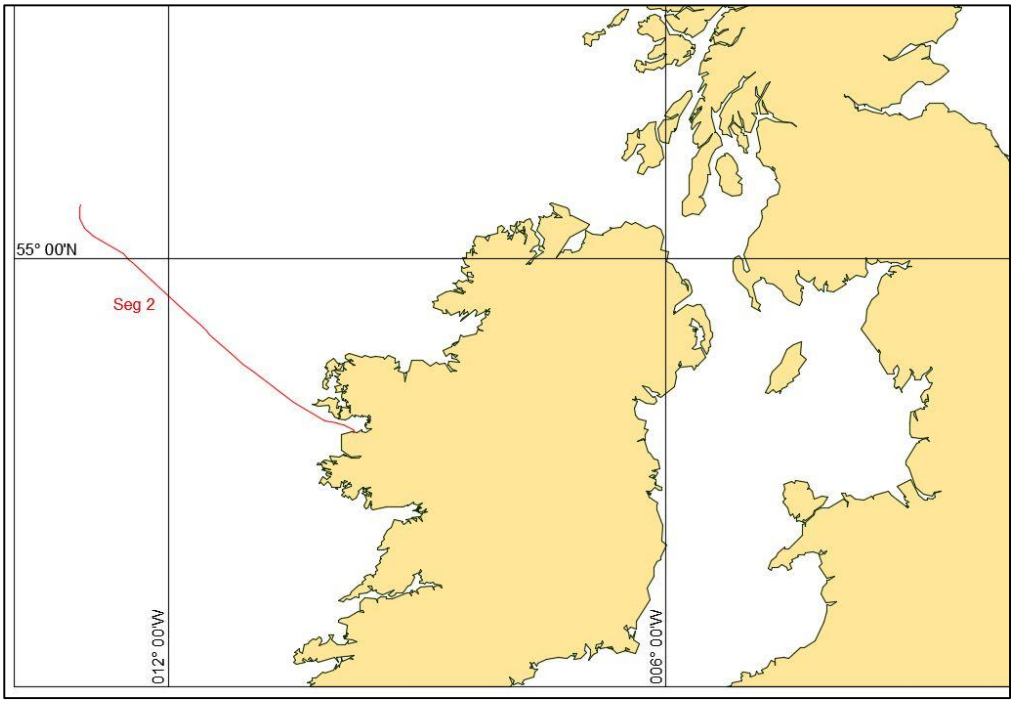


Figure 1-2 .....Overview Chartlet of the S02 route

The survey reported here is the deep and shallow water survey from Segment BU1 in the Northwest of Ireland to the shallow water depth limit (25m WD) offshore Ireland. The survey was carried out along the following RPL, provided by TE SubCom:

HAVFRUE_Seg2_BU1-Oldhead_REDP_Issue7_2018_0524.

1.2. Report Contents

This report discusses the survey operations and presents the detailed results for the survey. The Survey Results comprise:

• Survey Scope;

• Report Narrative and Details;

• Report Appendices with supporting documentation – Supplementary and supporting information in paper and digital format as befits the information;

• North Up Charts;

• Chart Descriptions (as an Appendix C).

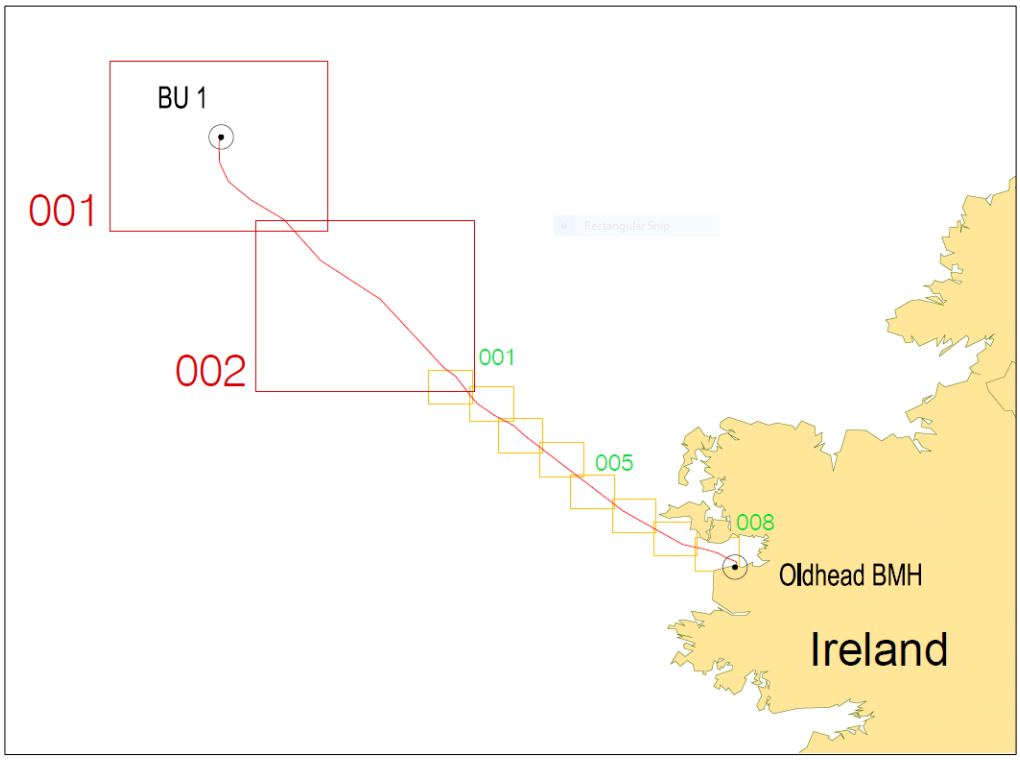


Figure 1-3 .....Overview Chartlet of the NU Chart Layout

1.3. Project Geodesy

NOTE: Tabulated.

Datum Parameters	
Datum	World Geodetic System 1984 (WGS84)
Spheroid	World Geodetic System 1984 (WGS84)
Semi-Major Axis (a)	6 378 137.000 m
Inverse Flattening	298. 257 223 563
Projection Parameters	
Grid Projection	Mercator
Latitude of True scale	30° N
Central Meridian	50° W
False Easting (meters)	3 500 000 m
False Northing (meters)	0 m

Table 1.1.....Project Geodesy

1.4. Project Vertical Datum

The vertical reference level for the bathymetry was the Lowest Astronomical Tide (LAT) using Admiralty tidal predictions. In water depth shallower than 200 m predicted tides were applied. In waters deeper than 200 m no tide was applied (zero tide).

Water depth deeper than 200m	No tide correction (Zero Tide)
Water depth shallower than 200m	Predicted tides – Clare Island

1.5. Glossary of Geologic Terms

Term	Definition
Acoustic penetration	The ability of acoustic waves to travel through the subsurface.
Acoustic reflector	A subsurface that causes the velocity of seismic waves to change.
Bank	Usually of sand or gravel, but may be of rock. A rise in the seabed over a relatively small area, but fairly prominent in relation to its surroundings. When formed of sediment it is often orientated along the tidal flow.
Bedding/Layering	A stratified or layered feature associated with sedimentary rocks and/or loose sediments.
Bedform	Any oscillatory morphological deviations from a flat seabed produced by fluid flow including wave and current activity, generally in a sandy domain.
Bedrock	The solid rock lying beneath seabed sediments.
Boulder	A separated rock mass larger than a cobble, having a diameter greater than 200 mm. It is rounded in form or shaped by abrasion.
Burial depth	Required target burial depth
Carbonate	A mineral type containing the carbonate radical (CO3).
Clay	A complex mineral assemblage with particle size < 0.002 mm.
Coarse sediment	Sediment composed mainly coarse sand and gravel
Cobble	Detrital sediment with particle size between 60 mm and 200 mm diameter.
Cohesive sediment	Sediments – typically clay and/or silt that resist separation due to nature of bonds between fine grained particles
Concretion	Lumps or nodules found in loose sediment, rounded or irregular in shape, usually harder than surrounding medium.
Diagenesis	Process by which chemical and physical properties of soils change.
Escarpment	A high continuous cliff or long, steep slope situated between a lower, more gently inclined surface and a higher surface.
Fine sediment	Sediment composed mainly of silt and clay.
Gas seepage	Escape of fluids (gas) from the seabed.
Glacial Till	Unstratified compact glacial sediment type consisting of fine-grained sediments as well as boulders with dimensions up to a few meters (same as boulder clay).
Gravel	An unconsolidated accumulation consisting of particles larger than sand (diameter 2 mm – 60 mm).
Gravel/Sand/Silt/Clay Patches	Thinly spread patches of gravel, sand, silt or clay no more than 100 m across and commonly less than 2 m thick. May be depositional and subject to movement. Shape may be determined by the relief of the underlying seafloor.
Hardened seafloor (Hardpan)	Loose sediment covering the seafloor partially affected by diagenesis processes that produce a hard surface.
Irregular	Used to qualify a series of features which are not uniform but do have a specific entity, e.g. Sandwaves. Can also be used to describe an area of rock where no regular structure is evident.
Loose sediment	Not cemented sediment, either cohesive or not.

Term	Definition
Medium sediment	Sediment composed mainly of sand (may contain gravel)
Megaripples	Small ridges of sand, usually orientated transverse to the flow and similar in shape to sandwaves but with a height of less than 1 meter. Generally produced by fluid movement (waves and currents) over sediments, generally with wavelength (□) of 0.5 m to 25 m. May not be detectable by echo-sounder and side scan sonar.
Organic rich	Sediment type with a very high content of dead organic material (algae, river input,…); often characterized by a strong smell of hydrogen sulphide; very soft with high water content
Quaternary	Time period, approx. 2 Mio years B.P.
Plateau	A comparatively flat-topped seafloor elevation, usually rising at least 200 m above its surroundings.
Pockmark	Shallow seabed depression typically several ten meters across and a few meters deep. Generally formed in soft fine-grained seabed sediments by the escape of fluids into the water column.
Quartz	Crystalline silica, SiO2, the principal mineral in unconsolidated sand and gravel.
Regular	Used to qualify a series of features which are uniform in amplitude and wavelength, e.g. Sandwaves, ridges.
Reef	Mineral or biogenic concretions, which arise from the sea floor in the eulittoral or sublittoral zone. These reefs often support macro-algae and mussels; primarily in the Baltic higher plants are also supported. This type includes rocky mudflats and sandflats, littoral reefs, and offshore reefs
Ridge	A long narrow raised portion of the seafloor, relatively to its surroundings.
Ripples	Undulations (<0.5 m wave length□) produced by fluid movement (waves and currents) over (generally sandy) sediments. Is generally only detected in high-resolution shallow water multibeam and side scan sonar data.
Rock outcrop	Rock that is exposed at the seafloor. Refers to a cohesive group, not a collection of boulders.
Rock subcrop	Rock/basement covered by a thin layer of loose sediment less than 1-1.5 meter thick. The rock structure may shine through the sediment drape. In rock subcrop areas rock may be intermittently exposed at the seabed surface.
Sabellaria reefs	Reefs formed by Sabellariaspinulosa
Sand	A detrital particle larger than a silt grain and smaller than a gravel, having a diameter in the range of 0.063 mm to 2 mm.
Sand concession	Sand Extraction License.
Sand ribbons	Normally apparent, overlying a coarser type of seabed. Most are straight and parallel with currents. Can be up to 15 km long, 200 m wide and are generally only a few cm thick. Typically, they have a ‘laddered’ appearance due to the presence of ripples.
Sandwave	Straight or sinuous ridges of sand produced by fluid movement (waves and currents) over sediments and commonly aligned across the dominant tidal stream or current. Minimum height is 1 m. Crest separation (wave length □) is generally > 25 meter and can be up to 1000 m with heights reaching 20 m. May be symmetrical or asymmetrical, and may have ripples and megaripples on them.

Term	Definition
Silt	A detrital particle, finer than very fine sand and coarser than clay, in the range of 0.002 mm to 0.063 mm.
Sloping	Refers to any area where there is a general trend in the depth of the seabed, i.e. a bottom gradient. A sloping seabed may be smooth but cannot be flat.
Slumping area	The slipping or sliding down of a mass of sediment relatively soon after its deposition in a sub-aqueous slope.

2. SCOPE OF WORK - SUMMARY

2.1. Route Position Lists

The following RPLs were used for survey operations along the HAVFRUE cable route Segment 02:

HAVFRUE_Seg2_BU1-Oldhead_REDP_Issue7_2018_0524.

2.2. Scope of Work Undertaken

The following Table 2.1 lists the agreed line patterns for areas surveyed vs water depth. In addition the number of lines, ranges, corridor widths, ranges, equipment etc. are shown.

Details of survey operations can be found in the Survey Operations Report.

Water Depth (LAT)	Survey Corridor Width	Survey Line Spacing	No of Survey Lines	SBP Frequency and TWT	SSS Range and Frequency	Vessel Speed
15 – 1000 m	500 m	90 m	5	3.5 KHz	HF 100 m LF 125 m	4 kts
1000m - 1500 m	1000m	90 m	11	3.5 KHz	HF 100 m LF 125 m	4 kts
> 1500 m	min 3x WD or 5x WD at BU1, max 10 km	n/a	1	n/a	n/a	8 kts

Table 2.1.....Summary of Scope of Work (Segment 2)

2.3. Changes to Scope or Methods after Operations

At the time this report was written, no changes to the work methodology or the scope that occurred after the submission of the final Operations Report were known.

3. SURVEY RESULTS

3.1. Segment 02 Ireland

3.1.1. Route Summary

Segment 2 of the Havfrue Cable System commences at BU01 (KP0) off the north west coast of Ireland. The segment extends 287.353 km to the shore at Oldhead, Ireland BMH. This survey covers topographic, diver, inshore and shallow water surveys. The shallow water program of the survey was undertaken by inshore vessel Alumaster and MV Fugro Discovery.

The S02 shallow water survey was carried out along three RPL versions as follows:

- HAVFRUE_Seg2_BU1-Oldhead_REDP_Issue3_2018_0103
- HAVFRUE_Seg2_BU1-Oldhead_REDP_Issue4_2018_0301
- HAVFRUE_Seg2_BU1-Oldhead_REDP_Issue7_2018_0524

3.1.1.1 Overview of Segment (Meta Data)

284.943 km of centerline surveyed, 579.28 km of winglines, 55.62 km of development. A 5 km section in Block 5 at the entrance to Clew Bay was only surveyed by MBES nd SBP as fishing gear blocked operations with towed equipment.

Segment	Survey	Route KP	NU Chart #
Segment 2	Deep water	0.000 – 52.926	Hvf_n100k_S2 001
Segment 2	Deep water	46.934 – 150.238	Hvf_n100k_S2 002
Segment 2	Shallow water	138.184 – 153.741	Hvf_n020k_S2 003
Segment 2	Shallow water	152.338 – 170.392	Hvf_n020k_S2 004
Segment 2	Shallow water	168.471 – 189.965	Hvf_n020k_S2 005
Segment 2	Shallow water	188.821 – 209.049	Hvf_n020k_S2 006
Segment 2	Shallow water	207.546 – 227.836	Hvf_n020k_S2 007
Segment 2	Shallow water	226.686 – 248.212	Hvf_n020k_S2 008
Segment 2	Shallow water	247.160 – 267.444	Hvf_n020k_S2 009
Segment 2	Shallow water	266.504 – 287.353	Hvf_n020k_S2 010

Table 3.1.....North Up Chart Number to survey

3.1.1.2 Overview of Regional Geology

This overview of the regional geology for Segment 2 of the HAVFRUE cable system is referenced to the Desk Top Study “HVF_DTS_4. Geology_DRAFT FINAL_Rev01” of 12/08/2017.

The West Ireland Continental Shelf and Slope

The basement geology of the Northwest European margin mostly comprises metamorphosed Lewisian Gneiss and Devonian Old Red Sandstone. Since the Caledonian Orogeny (approximately 390 Ma, during the Early Devonian), the area has experienced episodic extension, forming half-graben-style basins infilled with siliciclastic and hemipelagic sediments. These half-grabens were reactivated in the Mesozoic to Early Tertiary (Stoker et al., 1993).

Extensional rifting during the Early- to Mid-Cretaceous caused the Rockall Bank and Faroe Block to split away from the European Continental crust.
Sills and dykes intruded into the post-rift sequence during the Late Cretaceous to Early Palaeogene. Basalts were subaerially extruded at several igneous centres during volcanic events and widespread basaltic lava flows covered much of the trough and lower shelf terrace. Igneous activity in the region diminished in the Early Eocene. From the Palaeogene to Neogene, sediments were deposited as a seaward-thickening wedge on the outer shelf (Stoker et al., 1993). Since the Miocene, older sediments in the trough have been eroded and reworked to deposit bedforms such as the Feni Ridge, a large contourite drift on the south-west of the Rockall Bank.
Multiple glacial and interglacial periods throughout the Quaternary were the source of most new sediment input onto the shelves and into the Rockall Trough. This sediment influx had a major influence on the features in the region. During each of the three main glacial intervals (the Anglian, Wolstonian and Devensian, equivalent to the Elsterian, Saalian and Weichselian North-West European stages), various geological formations were deposited, buried, eroded, channelised and consolidated by various glacial, proglacial, periglacial, glaciomarine and marine processes.
Since the end of the last glaciation, sediment input has been low (Masson et al., 2002; Stoker et al., 1998).

Please also refer to the Desk Top Study presented in Appendix G – DTS of this report.

3.1.2. Land, Diver and Inshore Surveys

3.1.2.1 Route Narrative

At the time of issue of this report the results of the land, divers and inshore survey were not available onboard the Fugro Discovery.

3.1.3. Shallow Water (Burial Area)

In the following route description, the occurrence of seabed features, such as depressions, was described by occurrence per 100mx100m area as shown in the table below:

Number of depressions within a 100mx100m area	Description used in charts and report
10 or more	Numerous
4-9	Occasional
1-3	Rare

The areas charted as SCATTERED ROCK are areas covered by numerous boulders (boulder fields) and were drawn where more than 10 boulders were observed within a 100mx100m area.

From the limit of the Shallow Water Survey at the 1500m contour at 54° 26.8707'N, 011° 29.9352'W to 54° 24.2577'N 11° 26.3568'W the route crosses a seabed consisting of subcropping ROCK with SAND cover of 0.5m to 1.0m and with extensive boulder fields. The seabed shallows with variable gradients of up to 12°. A small area of seabed was not surveyed between 54° 25.6061'N, 11° 28.2701'W and 54° 25.3956'N, 11° 27.9923'W due to fishing gear in the water column which snagged the sidescan sonar fish on two lines.

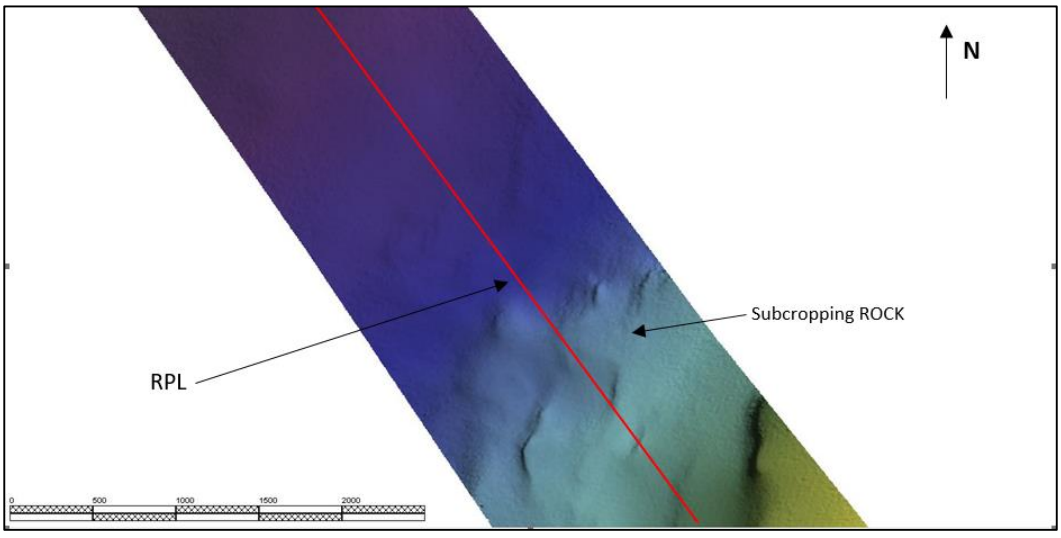


Figure 3-1 MBES Image of irregular seabed over subcropping ROCK. 54° 25.6585N, 11° 28.3378E

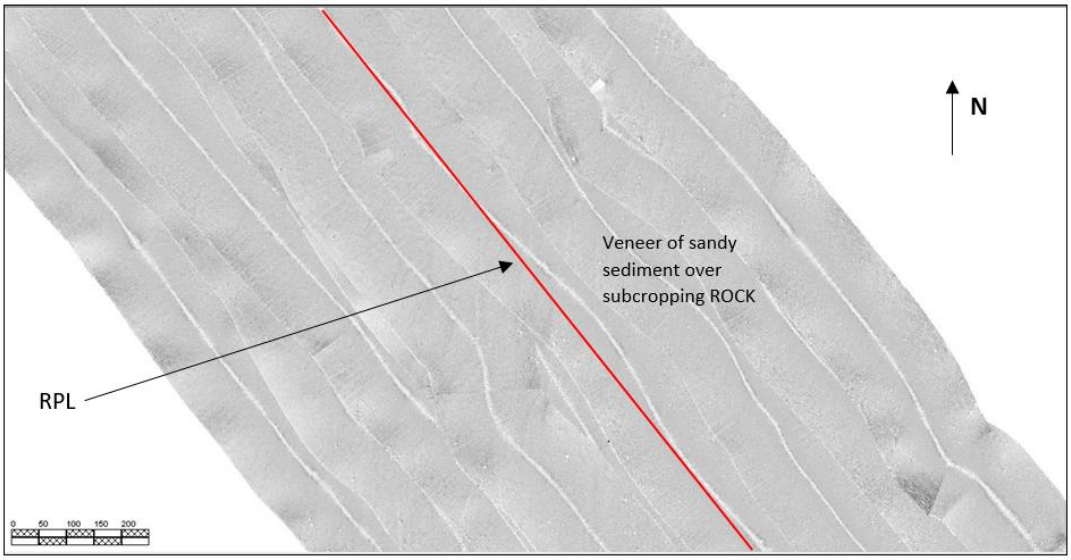


Figure 3-2 SSS Image of boulder fields and SAND veneer over subcropping ROCK. 54° 25.6585N, 11° 28.3378E.

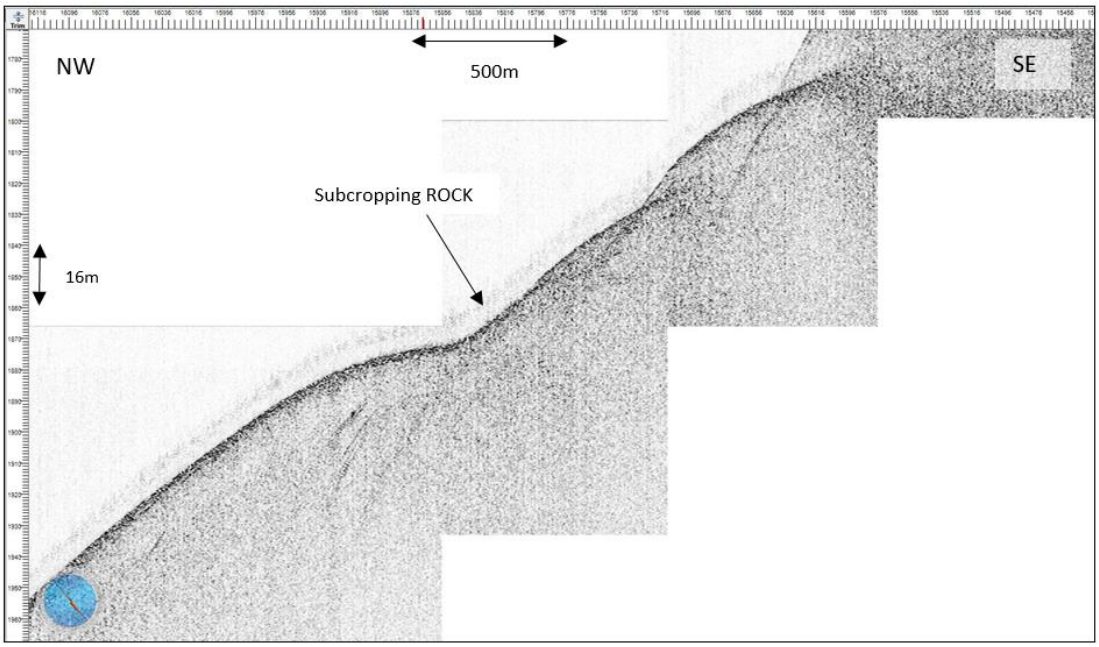


Figure 3-3 SBP Image of subcropping ROCK. 54° 25.6585N, 11° 28.3378E

From 54° 24.2577'N, 11° 26.3568'W to 54° 24.0384'N, 11° 26.0342'W and from 54° 23.9183N, 11° 25.858W to 54° 23.8362'N, 11° 25.7374'W, the route crosses seabed with gradients up to 2° consisting of more than 2m of silty fine SAND.

From 54° 23.8362'N, 11° 25.7374'W to 54° 23.1052'N, 11° 24.3462W the route crosses irregular slopes with very steep gradients up to 15°. The seabed in this interval consists of subcropping ROCK and boulder fields with a short stretch of ROCK outcrop between 54° 23.1537N, 11° 24.4663'W and 54° 23.1052'N, 11° 24.3462W.

From 54° 23.1052'N, 11° 24.3462W to 54° 22.7466'N, 11° 23.4516'W the route crosses a small basin of sediment with gentle slopes of less than 1° and a thickness of more than 2m of silty SAND overlying soft CLAY.

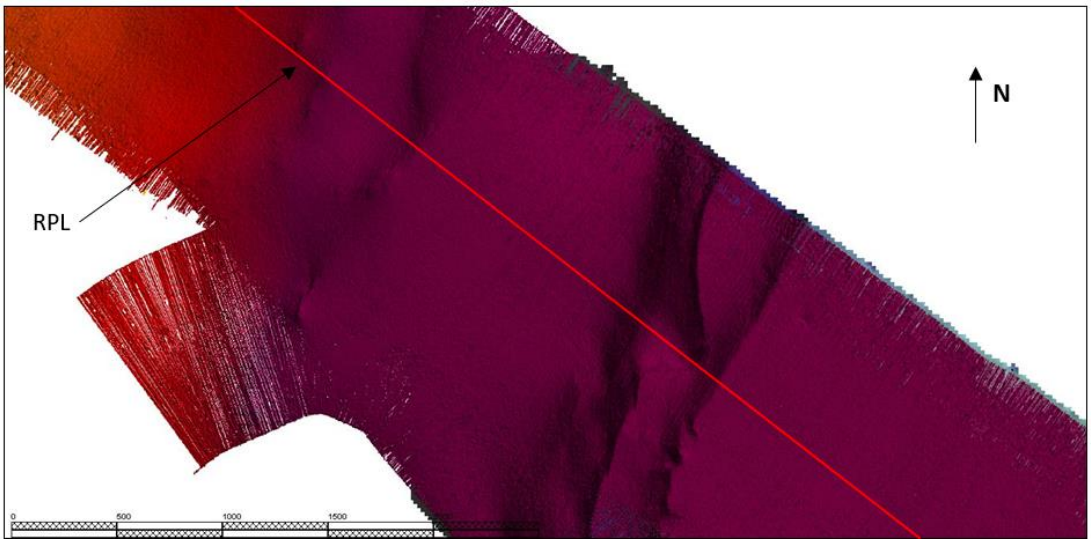


Figure 3-4 MBES Image of smooth seabed in small basin between irregular steep slopes. 54° 22.9339'N, 11° 23.9193'W.

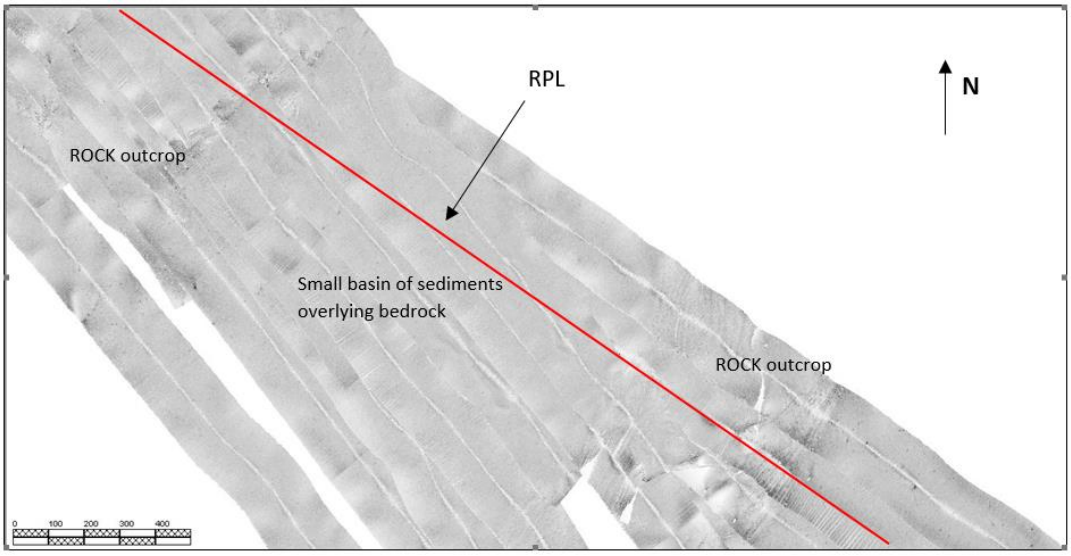


Figure 3-5 SSS Image of smooth sandy seabed in small basin between steep ROCK outcrops. 54° 22.9339'N, 11° 23.9193'W.

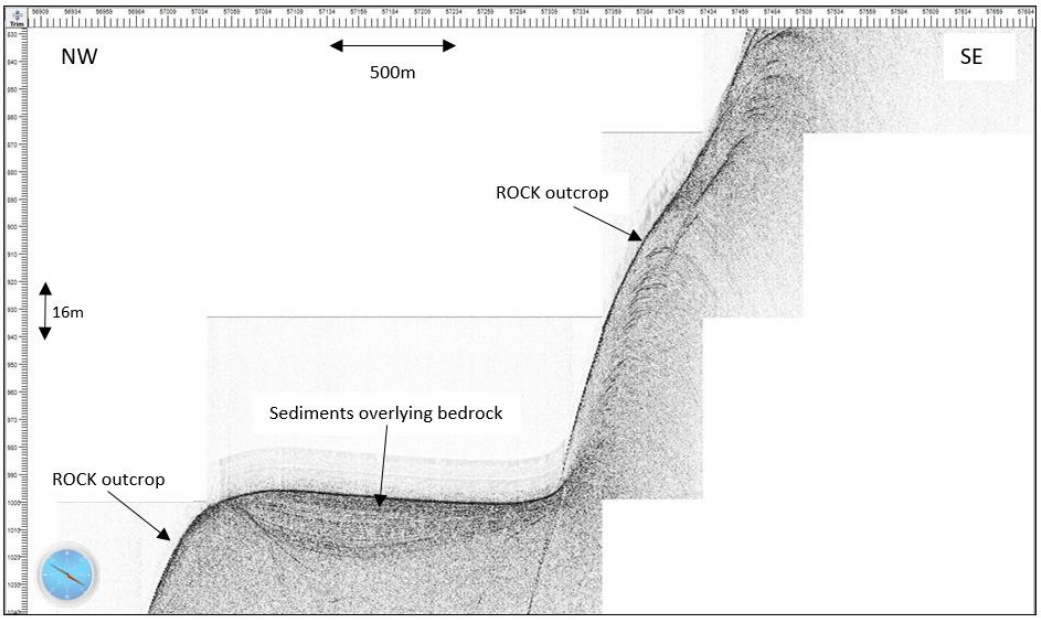


Figure 3-6 SBP Image of small sediment basin between steep ROCK outcrops. 54° 22.9339'N, 11° 23.9193'W.

From 54° 22.7466'N, 11° 23.4516'W to 54° 22.5514N, 11° 22.9694'W the route crosses an area of very steep gradients up to 20°. In this area the route crosses a scarp with ROCK outcrop and some smaller areas of subcrop.

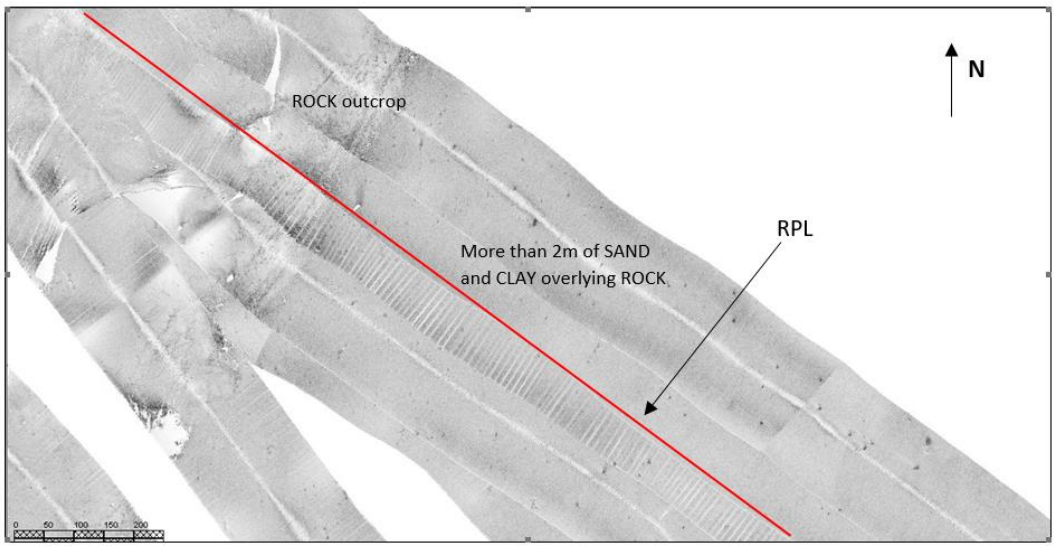


Figure 3-7 SSS image of sediments overlying bedrock at the top of steep rocky scarp. 54° 22.5514N, 11° 22.9694'W.

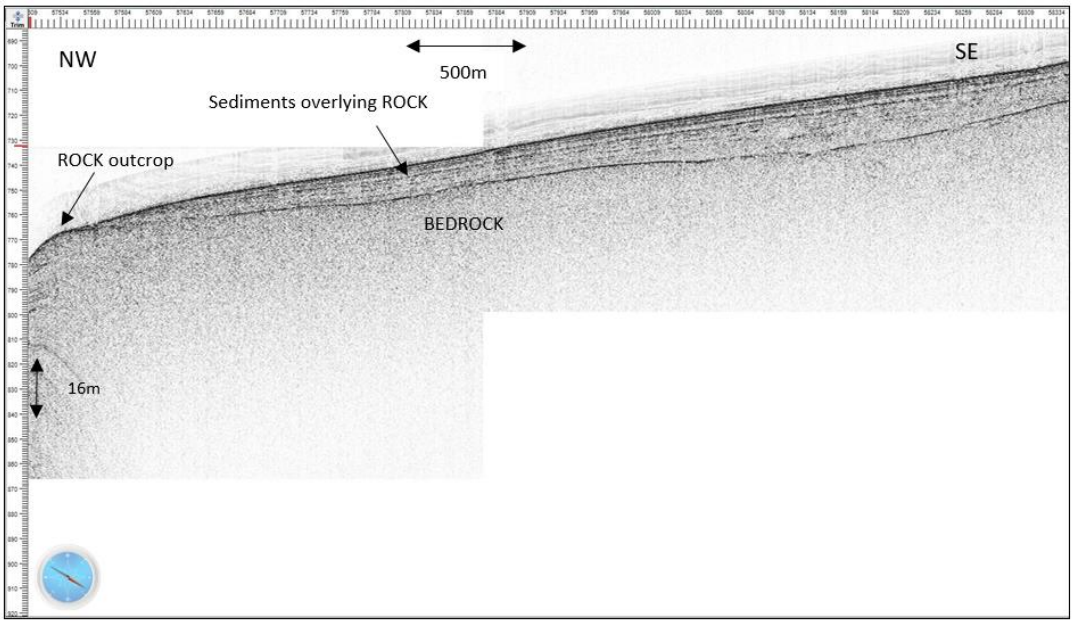


Figure 3-8 SBP Image of thickening sediment succession over ROCK at top of steep scarp. 54° 22.5514N, 11° 22.9694'W.

From 54° 22.5514N, 11° 22.9694'W the sediment succession thickens and the bedrock horizon deepens and disappears on the sub-bottom profiler record.

From the top of the steep scarp at 54° 22.5514N, 11° 22.9694'W the route crosses a gently shallowing seabed with gradients of 1° or less and the seabed consists of silty SAND overlying very soft to soft CLAY. The seabed shows numerous depressions probably resulting from gas or fluid escape from the underlying soft CLAYS. As the route continues in a south-easterly direction the lamination in the sub-bottom profiler record is lost and the sediments become acoustically homogenous.

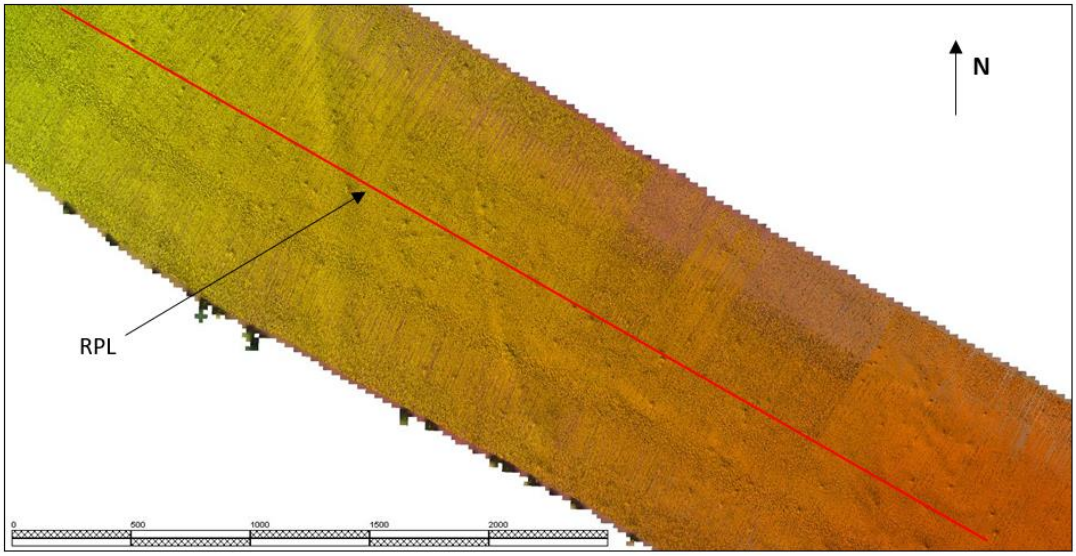


Figure 3-9 MBES Image of gently shallowing seabed with scattered depressions. 54° 20.3666'N 11° 17.3010'W.

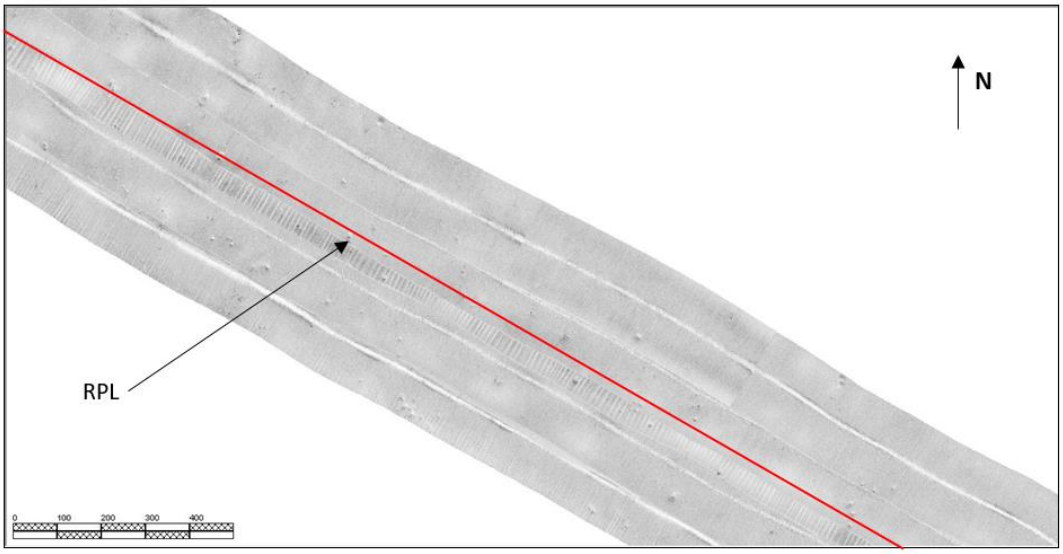


Figure 3-10 SSS Image of sandy seabed with scattered depressions. 54° 20.3666'N 11° 17.3010'W.

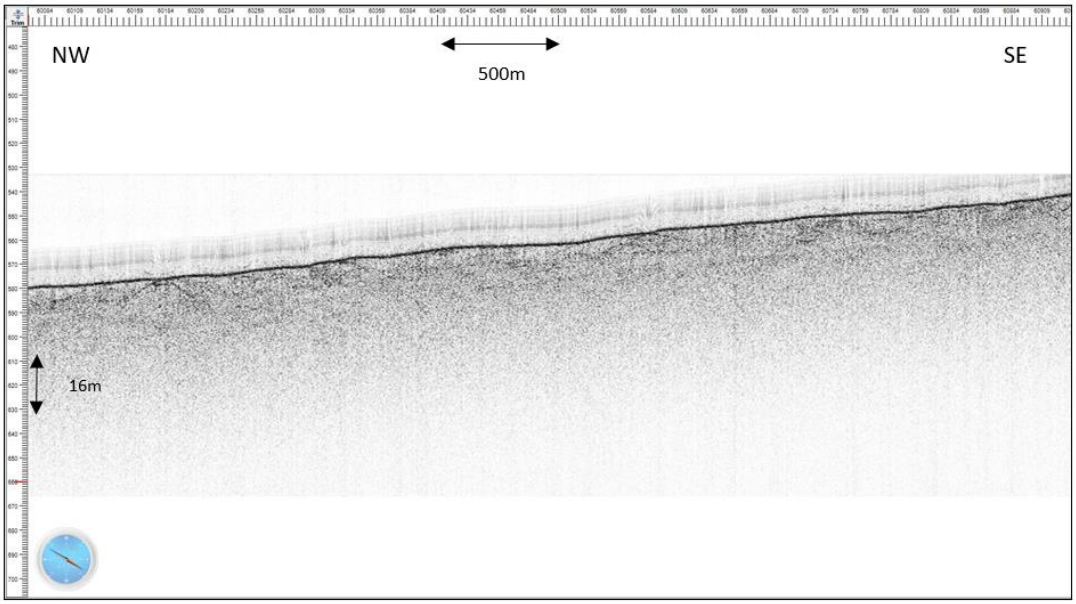


Figure 3-11 SBP Image of sandy seabed over soft CLAY. Sediments show very little internal lamination. 54° 20.3666'N 11° 17.3010'W.

The route continues over a sandy seabed with depressions overlying very soft to soft CLAY to 54° 16.1263'N, 11° 6.7387'W where the shear strength of the underlying CLAY begins to increase.

From 54° 16.1263'N, 11° 6.7387'W to 54° 09.8409'N, 10° 52.7003'W the route crosses a very gently shallowing seabed with occasional seabed depressions. The route crosses the flank of a large depression 8m deep and 1700m in diameter at 54° 15.0859'N, 011° 04.4180'W. Gradients along the route are generally less than 1° but on the edges of scattered seabed depressions they can reach up to 7°. The seabed consists of less than 1m of loose to medium dense silty fine SAND with shell fragments overlying soft to stiff CLAY or sandy CLAY. The sidescan data shows a smooth sandy

seabed with scattered depressions and the sub-bottom profiler data shows no discernable structure beneath the seabed suggesting homogenous CLAY to beyond the limit of acoustic penetration.

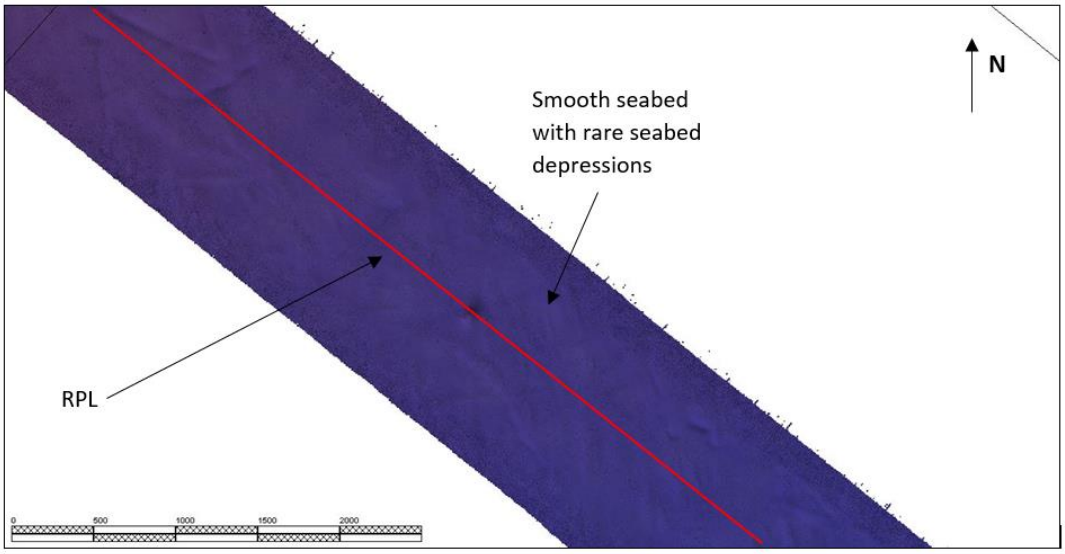


Figure 3-12 MBES Image showing smooth seabed with rare seabed depressions at 54° 15.0821'N,011° 04.4110'W.

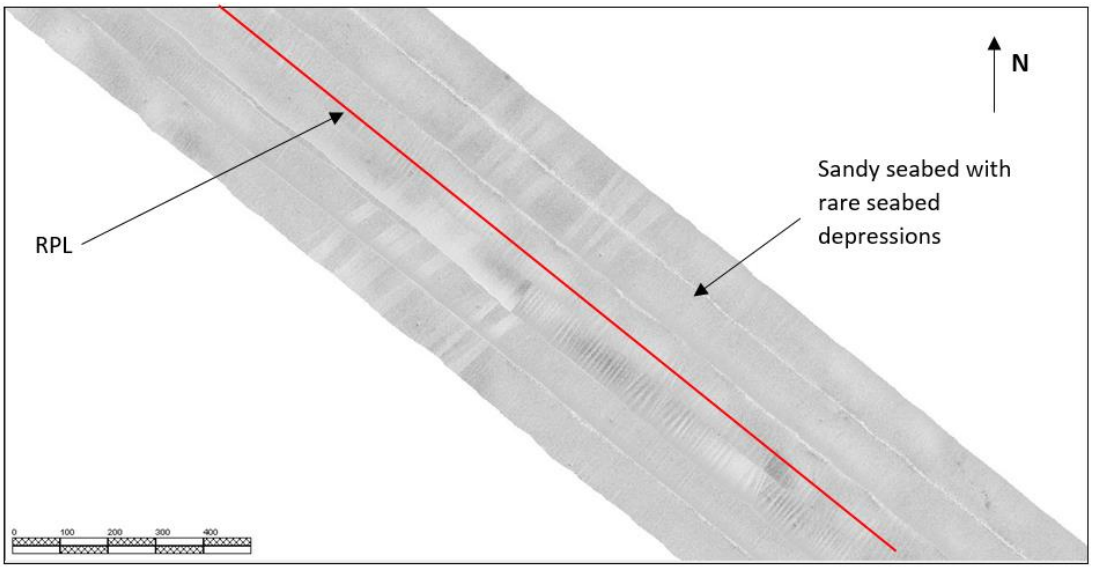


Figure 3-13 SSS Image showing sandy seabed with rare seabed depressions at 54° 15.0821'N,011° 04.4110'W

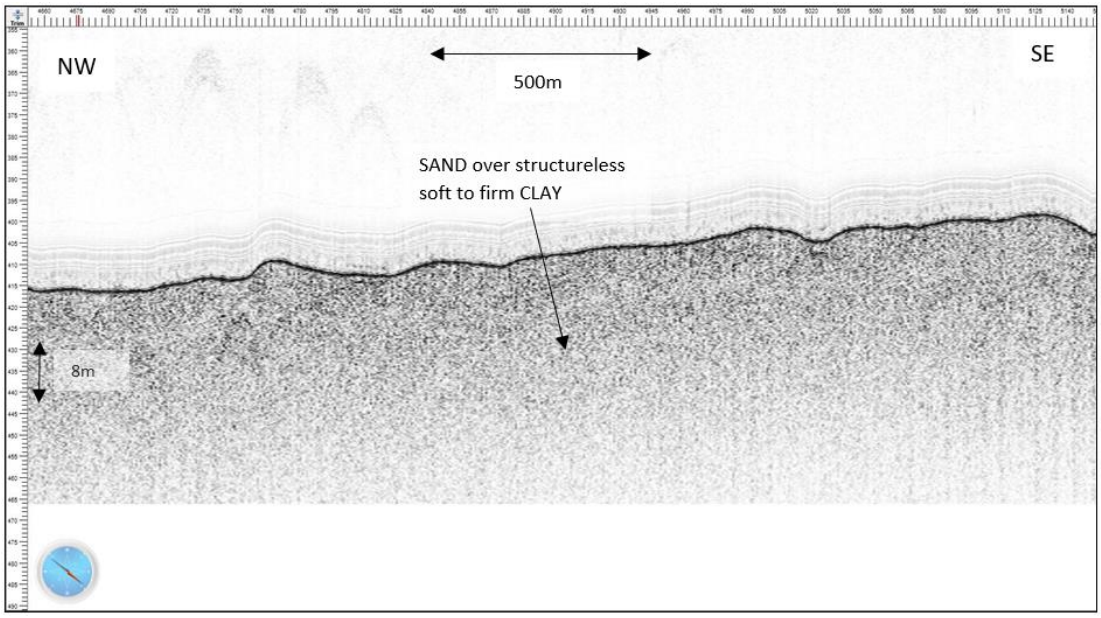


Figure 3-14 SBP Image showing SAND over structureless soft to firm CLAY, 54° 15.0821'N,011° 04.4110'W

From 54° 09.8409'N, 10° 52.7003'W to 54° 4.4957'N, 10° 40.7860'W the route continues over a very gently shallowing seabed with gradient of less than 1° but the depressions observed previously are absent and the seabed geology consists of less than 1m of loose to medium dense clayey SAND with megaripples overlying subcropping TILL (stiff to very stiff overconsolidated CLAY). In this interval the sidescan data shows scattered boulder fields and the sub-bottom profiler data again shows no acoustic structure beneath the seabed.

From 54° 4.4957'N, 10° 40.7860'W to 54° 1.4006'N, 10° 33.8975' W the route crosses a seabed consisting of gravelly SAND and megarippled SAND overlying subcropping TILL. In this area boulder fields are much more extensive and at the south-eastern end of this interval the TILL outcrops at the seabed between 54°02.2904'N, 10°35.8767'W and 54° 1.4006'N, 10° 33.8975' W.

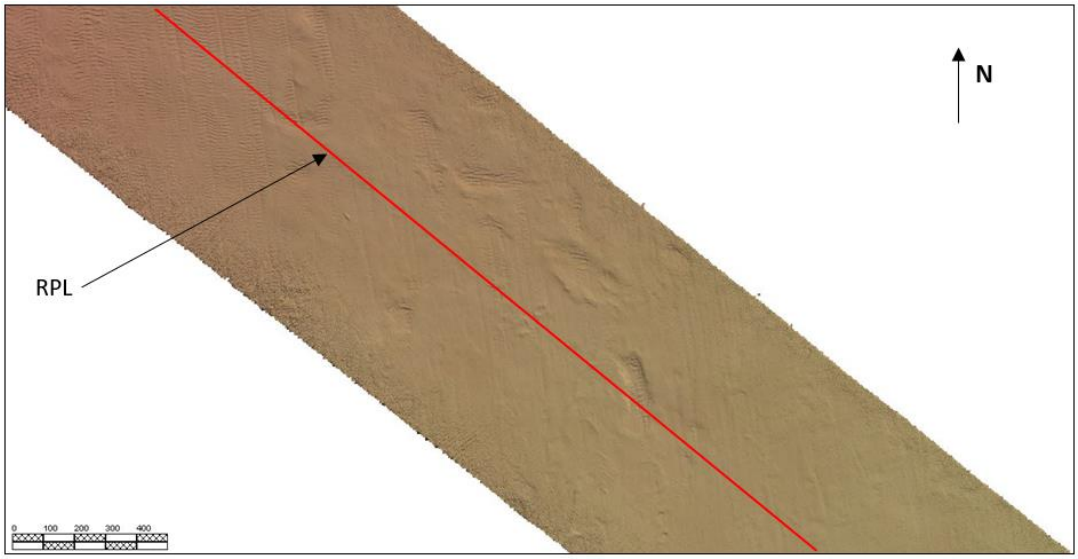


Figure 3-15 MBES Image showing gently undulating seabed. 54° 4.3438'N, 10° 40.4516'W

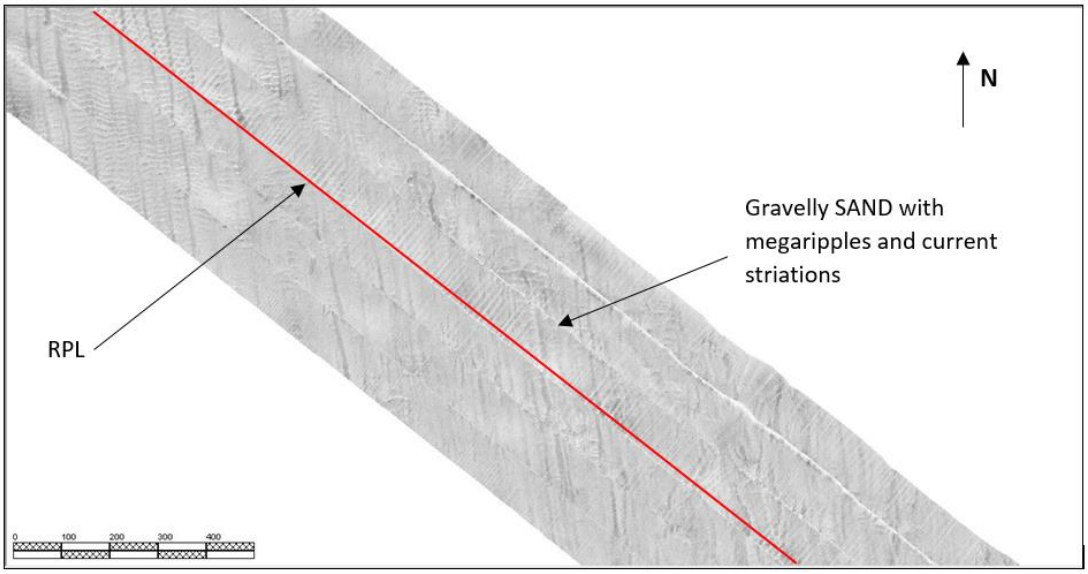


Figure 3-16 SSS Image showing gravelly SAND at seabed with current features. 54° 4.3438'N, 10° 40.4516'W

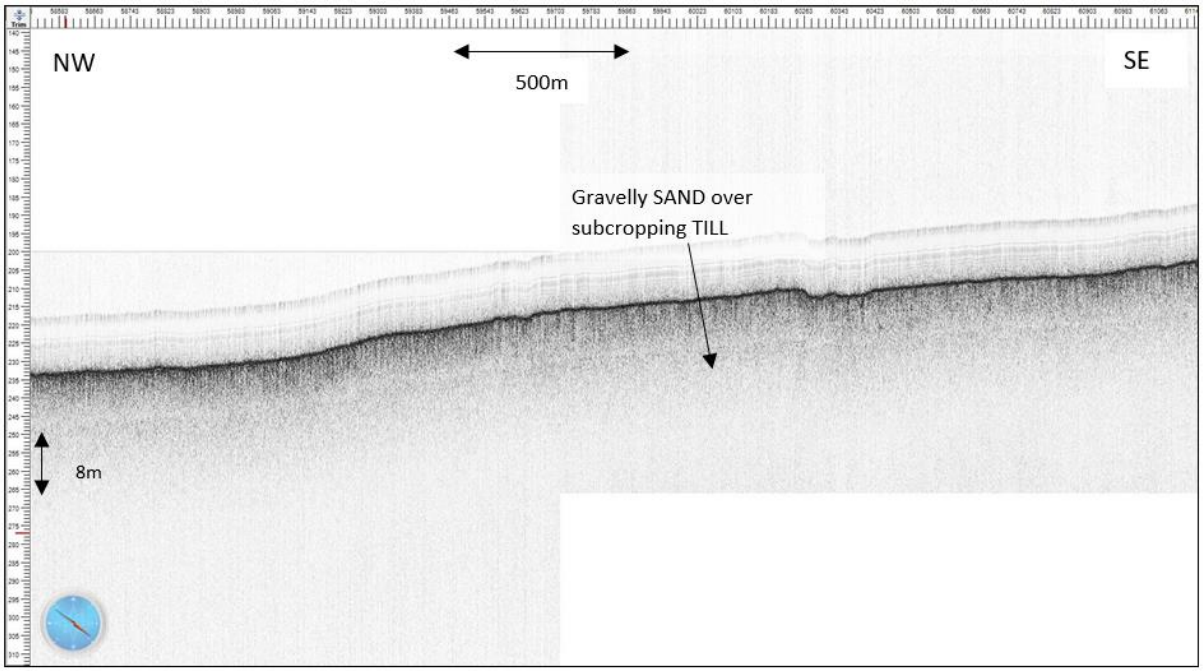


Figure 3-17 SBP Image showing poor penetration in TILL. 54° 4.3438'N, 10° 40.4516'W

From 54° 1.4006'N, 10° 33.8975' W to 54°0.8614'N, 10°32.7001'W the route crosses a gently undulating seabed with gradients of up to 2° in an area of patchy ROCK outcrop and subcrop with boulder fields.

The route then crosses a short stretch of outcropping TILL between 54°0.8614'N, 10°32.7001'W and 54°0.7154'N, 10° 32.3729'W before crossing another stretch of patchy ROCK outcrop and subcrop with a sandy seabed and boulder fields between 54°0.7154'N, 10° 32.3729'W and 53° 58.8431'N, 10° 27.8653'W.

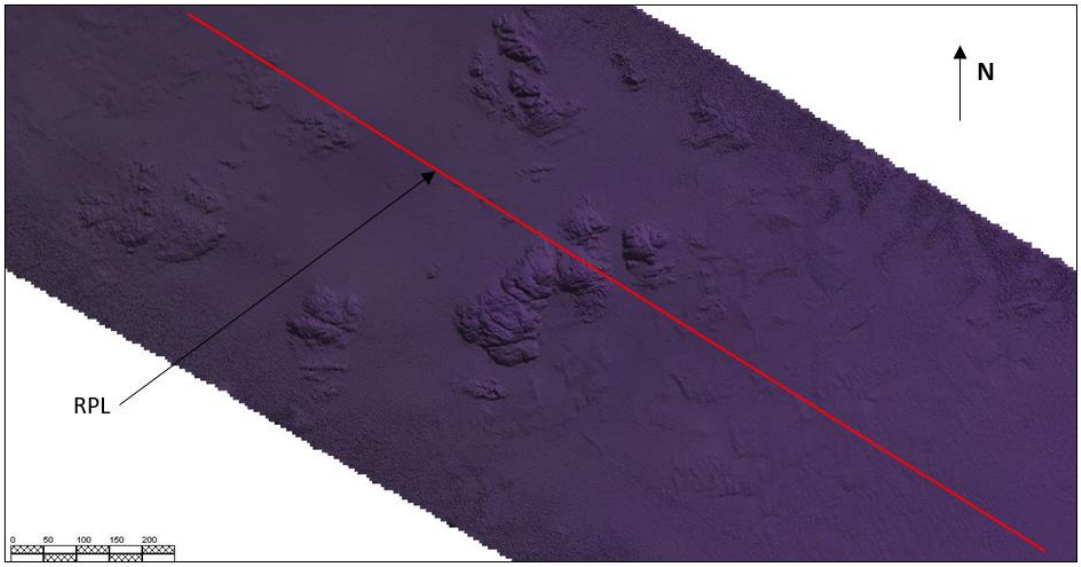


Figure 3-18 MBES Image showing ROCK outcrop surrounded by SAND and boulder fields. 53° 58.9291'N, 10° 28.1246'W.

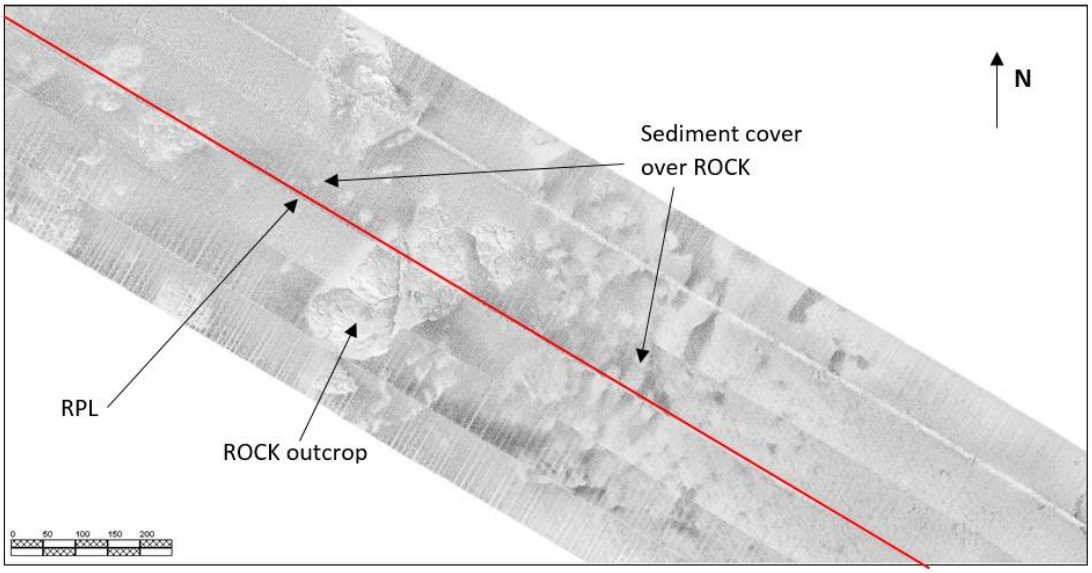


Figure 3-19 SSS Image of ROCK outcrops with surrounding SAND and boulder fields. 53° 58.9291'N, 10° 28.1246'W.

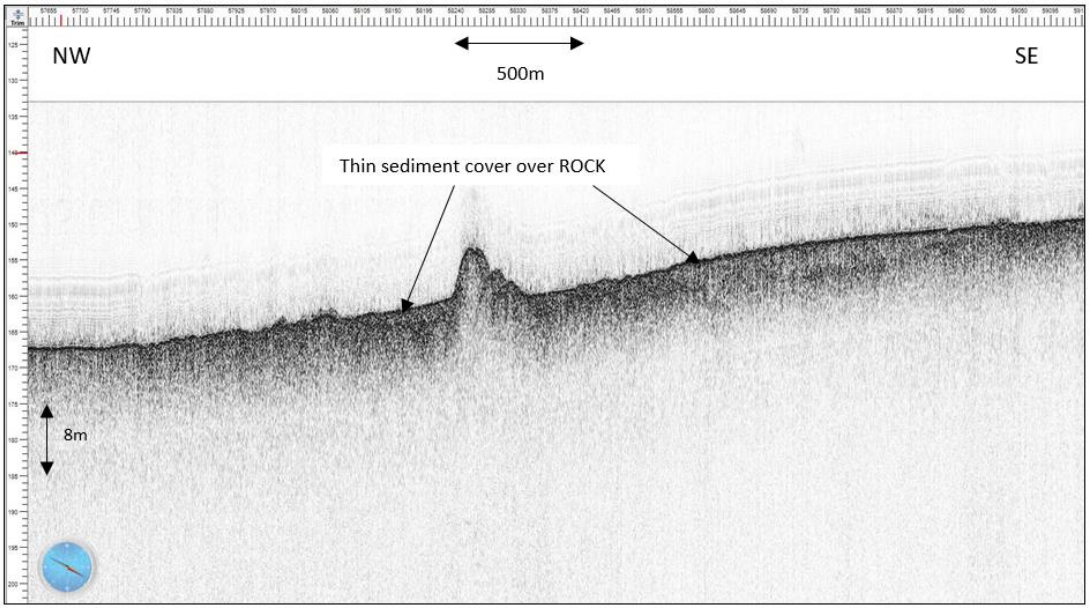


Figure 3-20 SBP Image of ROCK surrounded by thin sediment cover. 53° 58.9291'N, 10° 28.1246'W.

From 53° 58.8431'N, 10° 27.8653'W to 53°58.4158'N, 10°26.5747'W the route crosses a short stretch of sandy seabed, the SAND reaching depths of greater than 2m interspersed with subcropping ROCK.

From 53°58.4158'N, 10°26.5747'W to 53°57.4720'N, 10°23.7295'W the route crosses a stretch of very gently undulating SAND with scattered boulder fields overlying subcropping ROCK with small patches of outcrop.

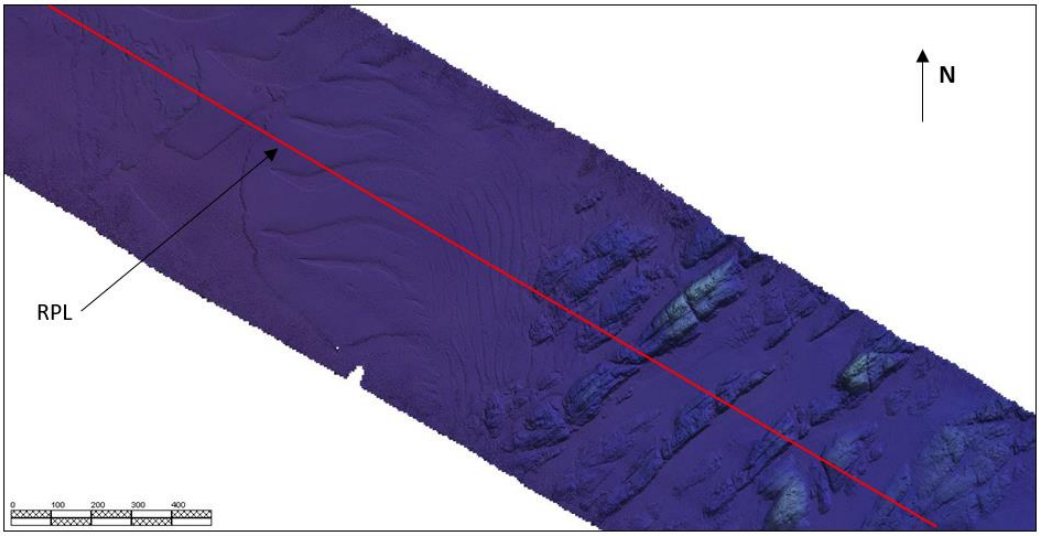


Figure 3-21 MBES Image of GRAVEL ribbons on a sandy seabed with ROCK outcrop in the east. 53°57.4720'N, 10°23.7295'W.

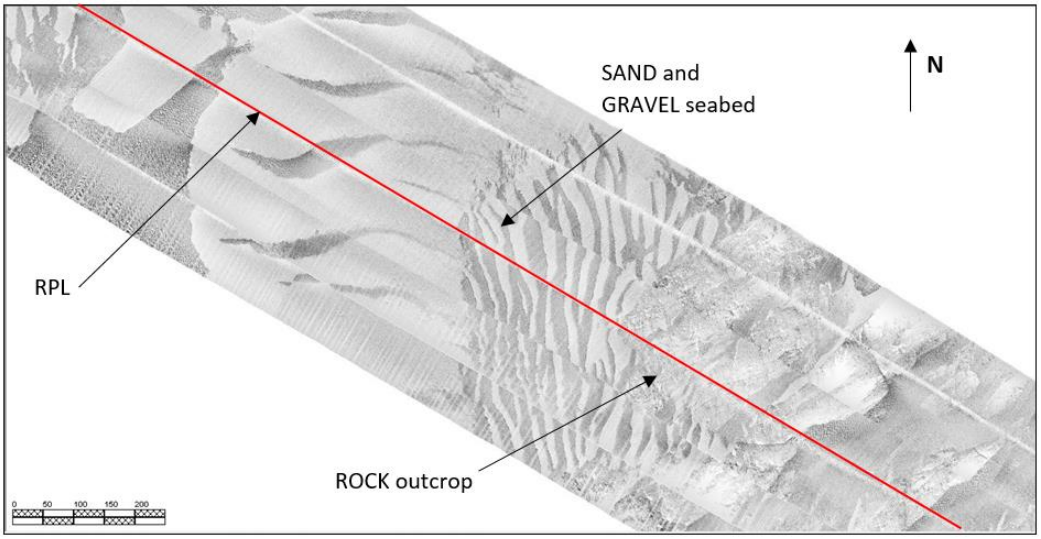


Figure 3-22 SSS Image showing SAND and GRAVEL seabed with ROCK outcrop. 53°57.4720'N, 10°23.7295'W.

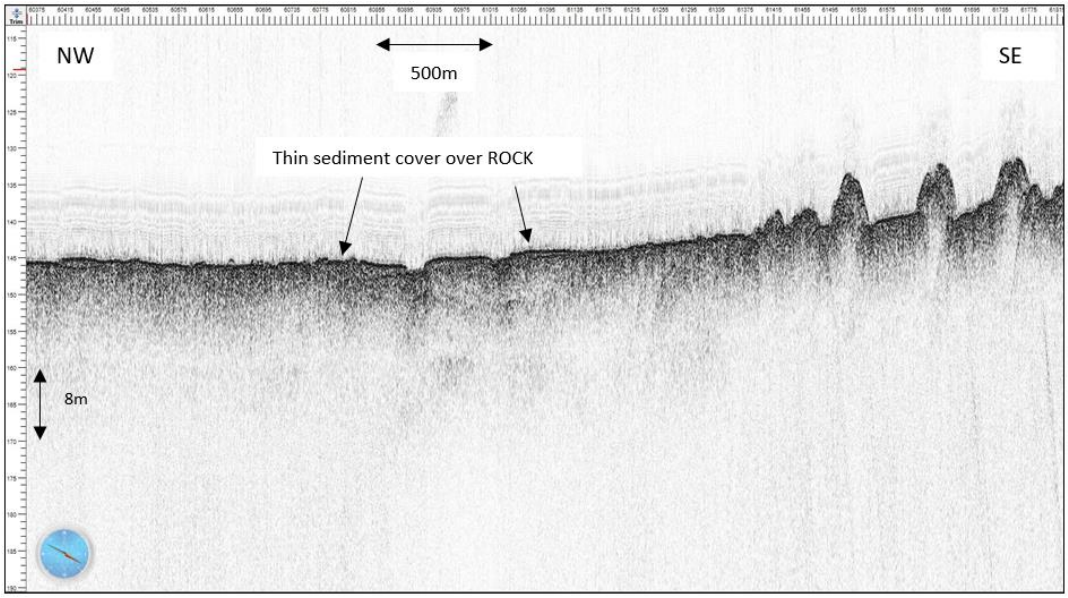


Figure 3-23 SBP Image showing the SAND and GRAVEL cover over ROCK in the same location as above SSS and MBES image. 53°57.4720'N, 10°23.7295'W.

From 53°57.4720'N, 10°23.7295'W the route crosses an extensive stretch of ROCK outcrop with interspersed small areas of SAND over subcropping ROCK and scattered boulder fields. The seabed along this interval shows much more variable relief than over previous sections with gradients up to 30° on the flanks of prominent ROCK outcrops. This extensive interval of ROCK outcrop and boulder fields continues to 53°51.0499N, 10°01.2819'W.

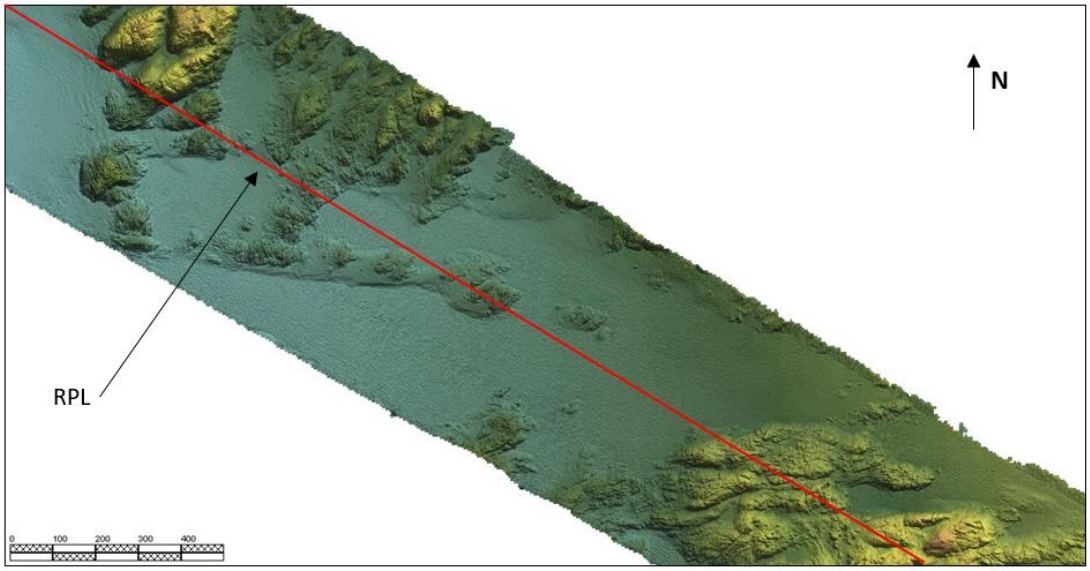


Figure 3-24 MBES Image showing ROCK outcrop and featureless smooth seabed. 53° 55.3994'N 10° 17.4770'W.

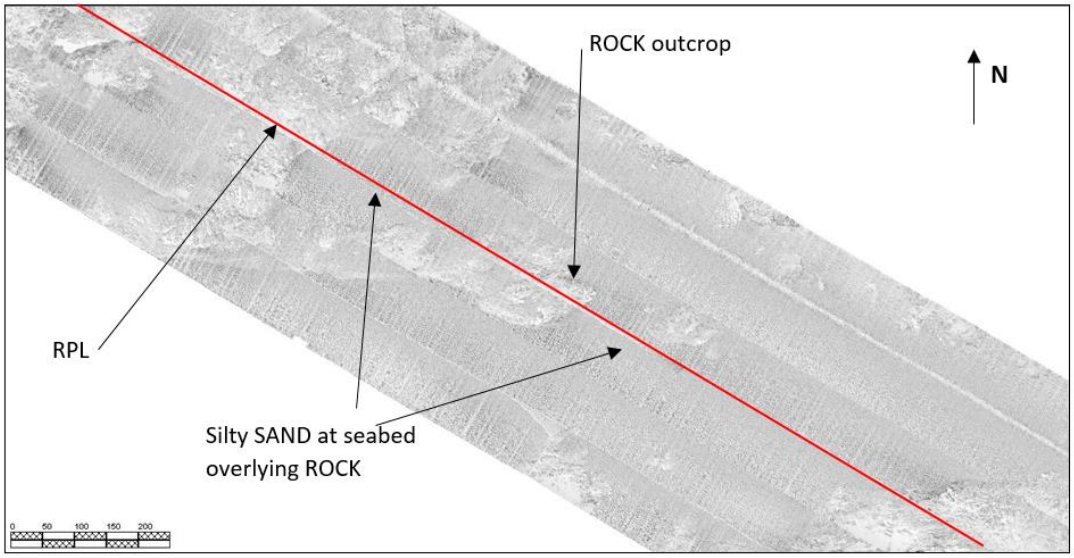


Figure 3-25 SSS Image showing ROCK outcrop and sandy seabed. 53° 55.3994'N 10° 17.4770'W.

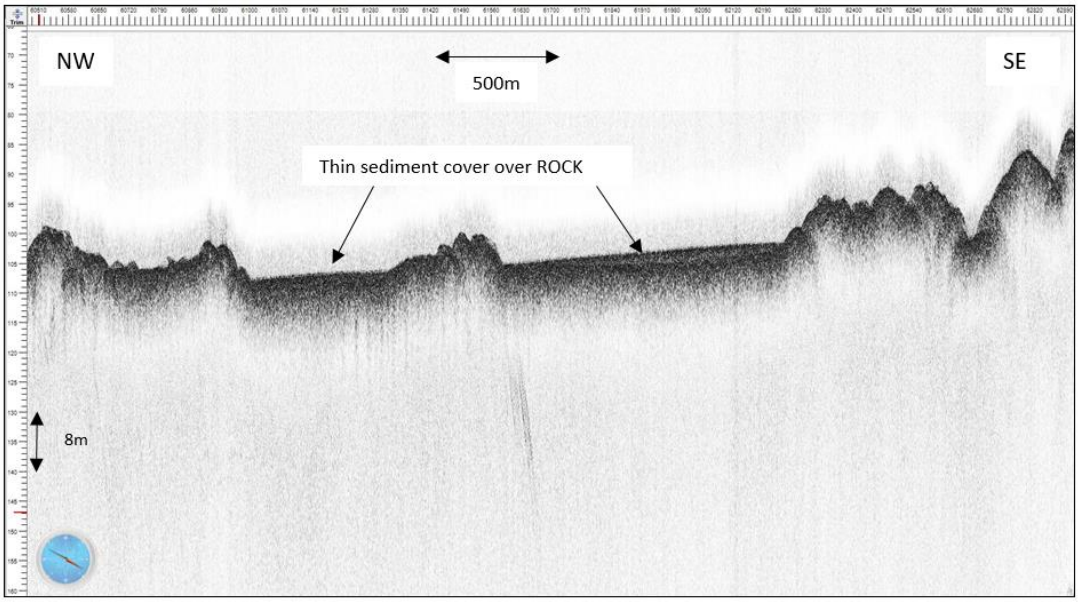


Figure 3-26 SBP image showing veneer of sediment (less than 1.5m) over ROCK outcrop. 53° 55.3994'N 10° 17.4770'W.

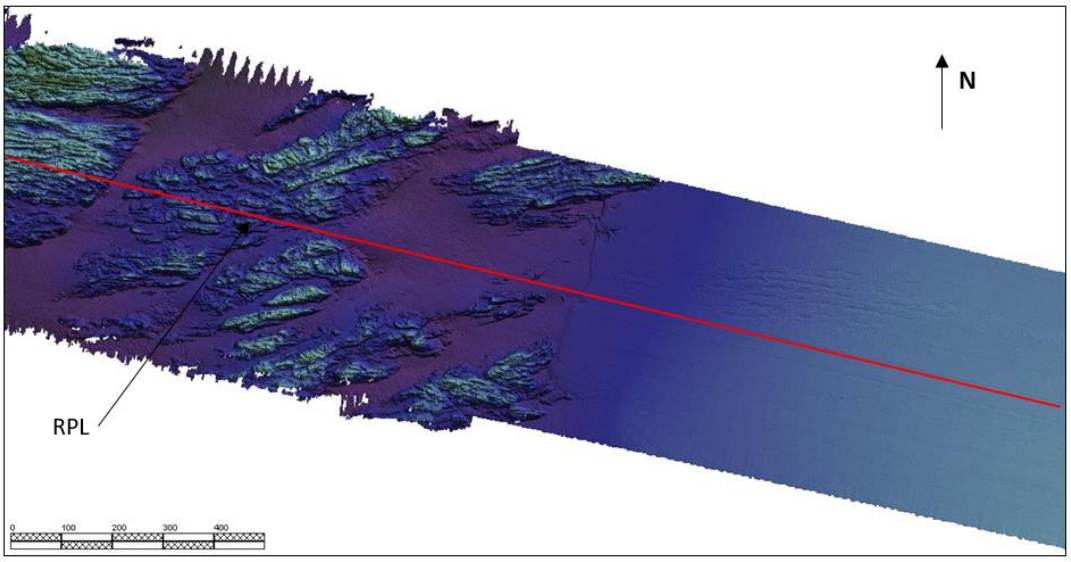


Figure 3-27 MBES image of irregular rocky seabed giving way to smooth seabed at 53°51.0499N, 10°01.2819'W.

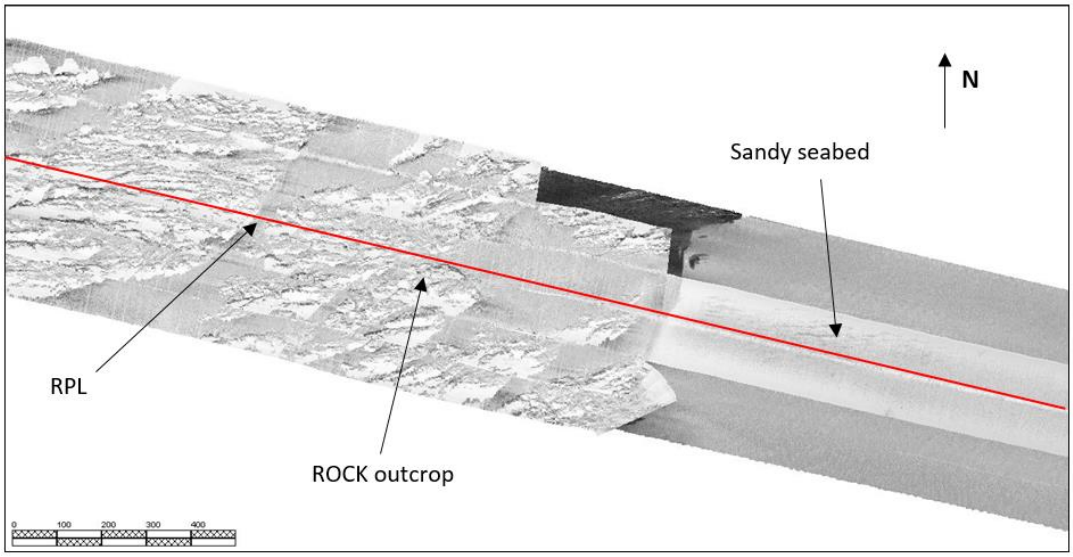


Figure 3-28 SSS and Backscatter image of ROCK outcrop changing to sandy seabed along the route at 53°51.0499N, 10°01.2819'W.

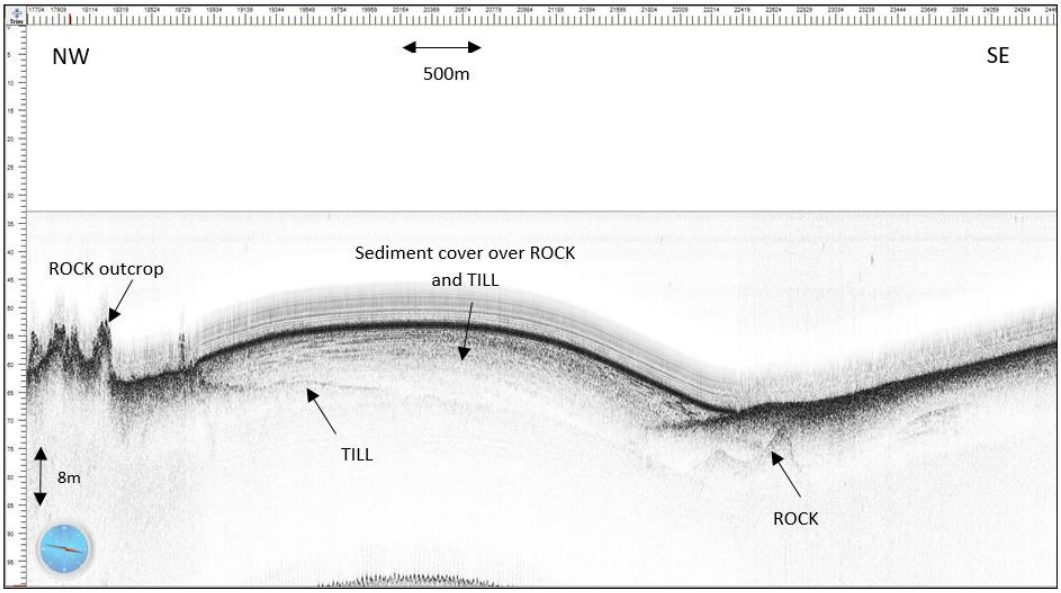


Figure 3-29 SBP Image of ROCK outcrop changing to thick sediment cover over TILL and ROCK at 53°51.0499N, 10°01.2819'W.

From 53°51.0499N, 10°01.2819'W the route enters an area of very gently undulating seabed with gradients of less than 1°. The seabed from this point is composed of a layer of SAND or silty SAND greater than 2m thick. At 53°50.5975'N, 09° 57.9568'W the route passes 50m to the north of a large outcrop of TILL. In the interval between 53°50.6702'N, 09°58.3100'W and 53°50.5084'N, 09°57.0931'W the sandy seabed forms megaripples with a height of 0.3m and a wavelength of 5m.

At approximately 53°50.0599'N, 09°54.5533'W the SAND overlying silty SAND unit grades to SAND and silty SAND overlying sandy CLAY from 1.75m depth. This then grades back to more than 2m of SAND and silty SAND at approximately 53°49.2674'N 09°51.4534'W.

From 53°48.8163'N, 09°50.0281'W to 53°48.7853'N, 09°49.8927'W the route crosses a small outcrop of glacial TILL with numerous boulders. This TILL outcrop has seabed slopes of up to 2°.

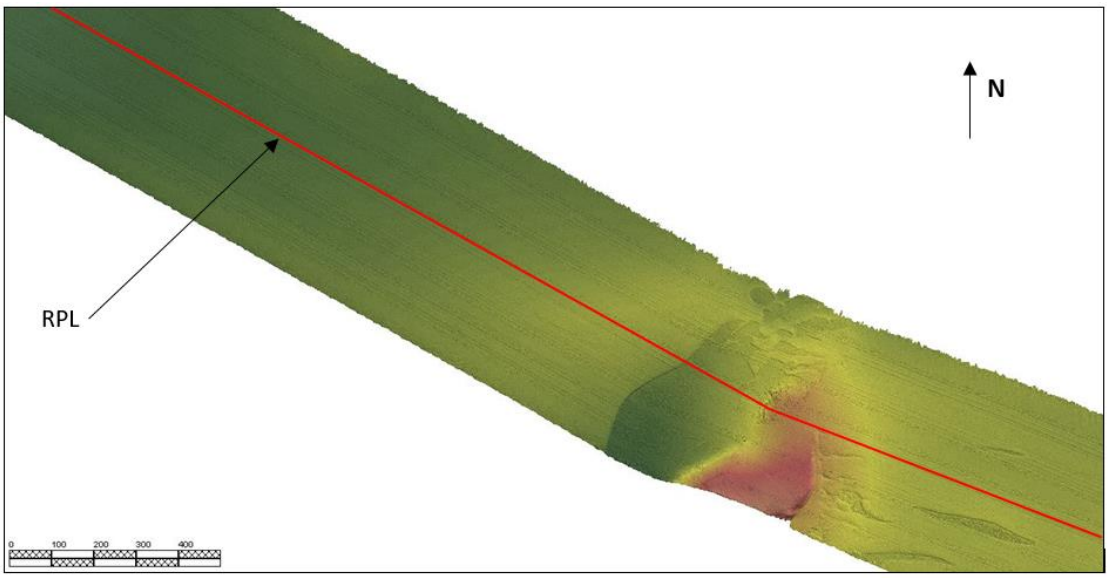


Figure 3-30 MBES Image of smooth seabed and relief at TILL outcrop. 53°48.8163'N, 09°50.0281'W.

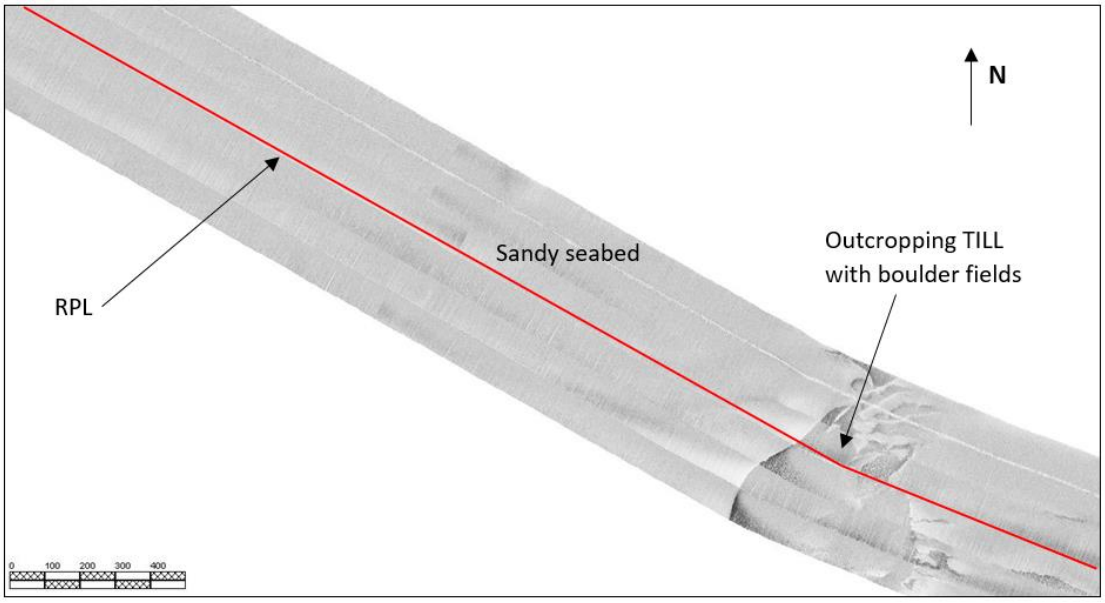


Figure 3-31 SSS Image showing featureless sandy seabed and outcropping TILL with boulder field. 53°48.8163'N, 09°50.0281'W.

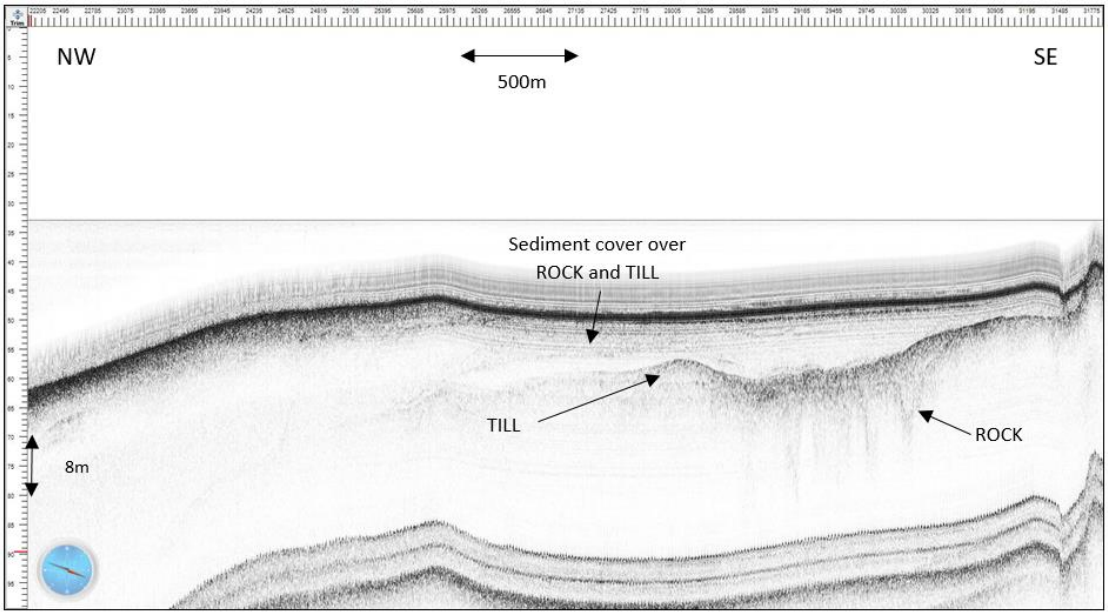


Figure 3-32 SBP image showing sediment pinching out as TILL outcrops at seabed, ROCK can be seen beneath TILL. 53°48.8163'N, 09°50.0281'W.

From 53°48.7853'N, 09°49.8927'W the route crosses a sandy seabed with very gentle gradients of less than 1°. The seabed SAND extends to greater than 2m depth below seabed. At the seabed patches of rippled SAND occur.

Between 53°48.6307'N, 09°49.2363'W and 53° 48.6179'N, 09° 49.1815'N the route crosses a small area of subcropping TILL beneath the sandy seabed with a small boulder field 28m north of the route.

From 53° 48.6179'N, 09° 49.1815'N to 53° 48.0318'N 09° 46.6874'W the route crosses an area of flat seabed consisting of more than 2m of silty SAND overlying clayey SAND.

At 53° 48.3517N, 9°48.0480W a small patch of outcropping TILL with associated boulder field occurs 235m north of the route.

Between 53° 48.0318'N 09° 46.6874'W and 53° 48.0059N 09° 46.5762W the route crosses an area of subcropping TILL with the TILL outcropping 6m to the north of the route at 53° 48.0191N, 09° 46.6187W.

Between 53° 48.0059N 09° 46.5762W and 53° 47.9350N 09° 46.2841W the route crosses an area of flat seabed composed of more than 2m of silty fine SAND.

Between 53° 47.9350N 09° 46.2841W and 53° 47.8520'N, 9° 46.0876'W the route crosses an area of subcropping TILL which outcrops at the seabed along the route from 53° 47.9270N, 09° 46.2651W to 53° 47.8683N, 09° 46.1264W with an associated boulder field.

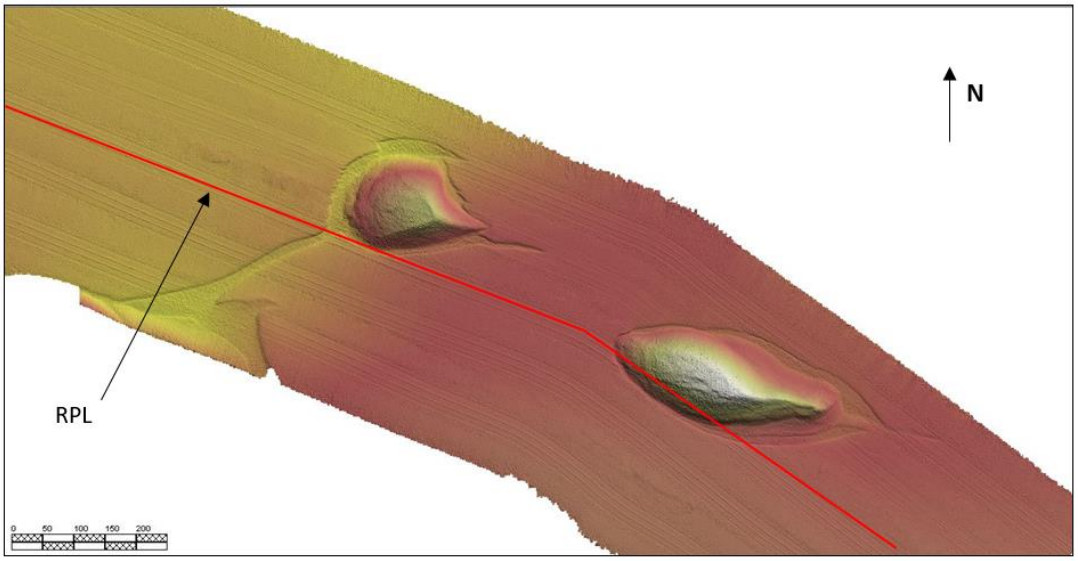


Figure 3-33 MBES Image showing smooth featureless seabed with areas of relief at TILL outcrops. 53° 47.9350N 09° 46.2841W.

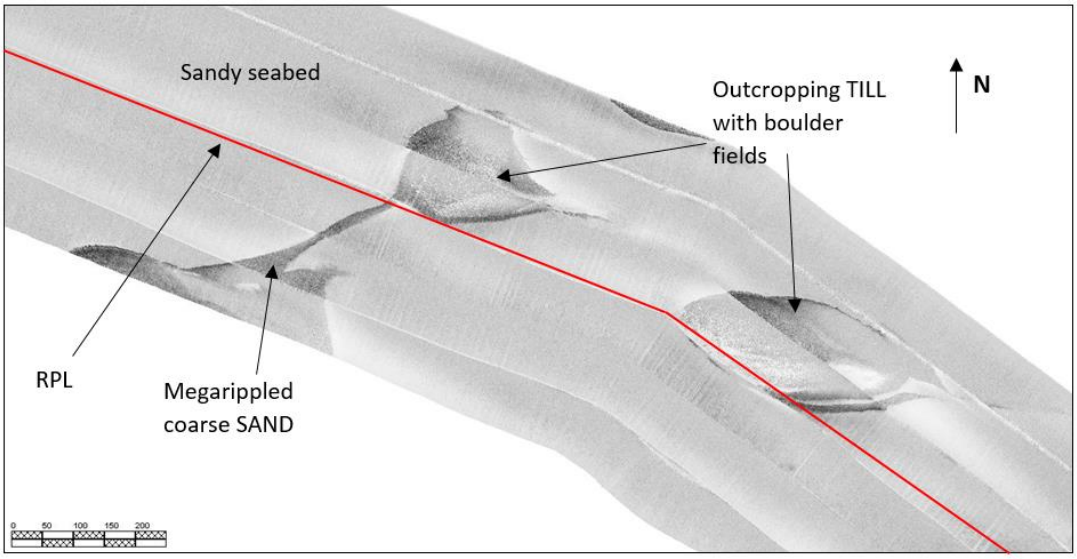


Figure 3-34 SSS Image showing featureless sandy seabed and TILL outcrops with boulder fields. 53° 47.9350N 09° 46.2841W.

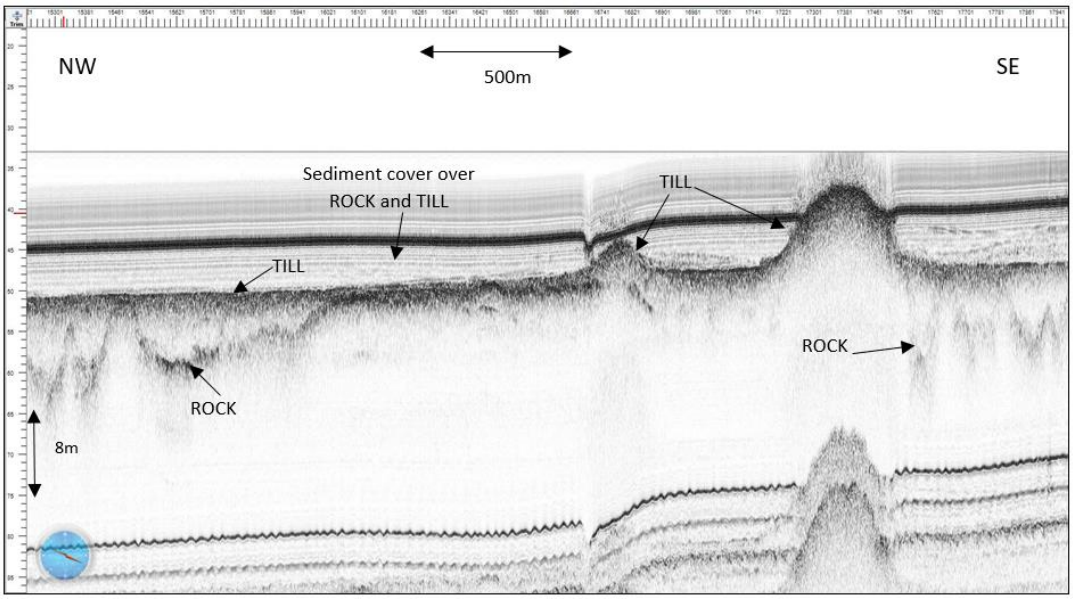


Figure 3-35 SBP Image showing sediment cover pinching out at TILL outcrops, the ROCK head horizon can be seen beneath the TILL. 53° 47.9350N 09° 46.2841W.

From 53° 47.8520'N, 9° 46.0877'W to the limit of the Shallow Water Survey (AC21) at 53° 47.7655N 09° 45.8832W the route crosses a very gently shallowing seabed composed of more than 2m of silty fine SAND.

3.1.3.1 Contacts

Contacts (objects at seabed or in the near-subsurface that might be a hazard to the cable burial feasibility) were picked in all datasets along the along the survey route corridor for Segment 02.

Along the Segment 02 route, numerous boulders (especially in boulder field) were observed. The total number of sonar contacts were too many to identify and only the largest were picked in order to give an average height. These are identified and are illustrated in the charts. 2443 contacts except 6 are interpreted to represent boulders. The remaining contacts are considered to represent items of debris. 1 contact was the shipwreck.

All observed sonar contacts are summarized in Appendix D – Bottom Obstruction Report.

3.1.3.2 Seabed Sampling

Cone Penetration Tests and Gravity cores were taken along the surveyed route every 4 km and 10 km respectively, or where changes in geology were interpreted from the sidescan sonar or sub-bottom profiler. For each failed gravity core, an additional grab sampling program was undertaken.

CPT tests were taken at 57 locations and gravity cores taken at 24 locations. Of these 30 locations, 3 required grab samples to be taken.

Detailed soil sample descriptions and sample logs with photographs are presented in Reference Appendix E - Soil Samples and Geotechnical Tests.

3.1.3.3 Cable Crossings

The proposed cable route crosses two in service cables in the deep water segment.

Details of all cable and pipeline crossings are presented in Reference Appendix F - Cable and Pipeline Crossing Matrix

3.1.3.4 Areas of Concern

Areas of concern include the very steep slopes over ROCK outcrop between the 570m contour at 54° 22.5666'N,011° 23.0051'W and the 1500m contour at 54° 26.8703'N,011° 29.9363'W. ROCK outcrop probably extends deeper than this but is not identifiable on the deep water bathymetry survey. Another area of concern is the extensive area of ROCK outcrop and subcrop and associated steep seabed gradients between the 42m contour at 53° 51.0571'N,010° 01.2977'W and the 140m contour at 54° 01.4335'N,010° 33.9750'W.

Individual Chart Descriptions were generated to provide a 1 page reference to charts. They will serve to direct the reader to this section if greater detail is required of the feature or concern noted. Refer to Appendix C - Chart Descriptions.

3.2. Deep Water

3.2.1.1 Route Narrative

The S02 BU1 to BMH Oldhead survey commenced at the BU1 position at 55° 22.1387'N, 013° 03.1736'W in 2846m WD. At this position the proposed route runs to the SSW over an almost flat seabed at a gradient of less than 1° SSE. At 55° 21.0967'N, 013° 03.9453'W in a similar WD, the route alters course to S, still traversing an almost flat and featureless seabed over a gradient of less than 1° SSE (Figure 3-36).

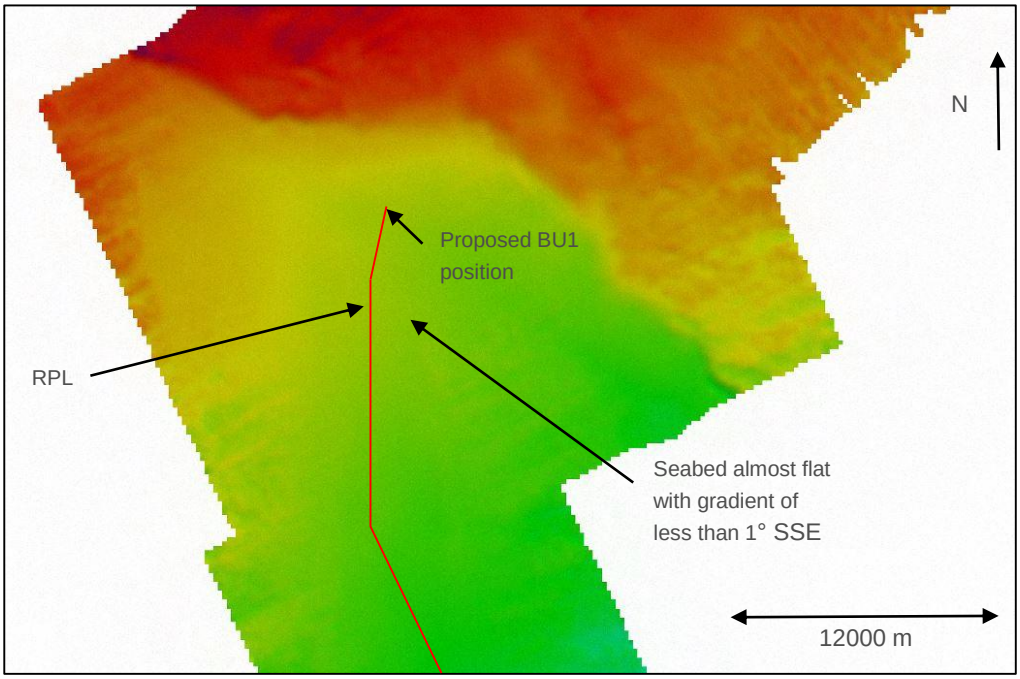


Figure 3-36 .....DTM Illustrating the seabed conditions at BU1

At 55° 16.6406'N, 013° 03.7578'W in 2860m WD the route alters course to the SSE, proceeding in that direction still over a gradient of less than 1° SSE across an almost flat seabed.

This trend remains in effect as the route traverses a flat seabed with a gradient of less than 1° SSE and at 55° 12.4450'N, 013° 00.3678'W in 2880m WD, the route again alters course to the SE at less than 1° SE. Between 55° 08.5870'N, 012° 52.0177'W and 55° 03.5127'N, 012° 37.4901'W, both in 2890m, the seabed is essentially flat with no discernable gradient.

After this point the seabed begins to shoal with a gradient of less than 1° NW as the route alters course slightly, still heading to the SE (Figure 3-37). At 54° 59.6663'N, 012° 28.5295'W in 2880m WD, the INS Hibernia seg A fibre optic cable is crossed by the proposed route as shown on the Client supplied data base. It is shown on the RPL at 107.6m SE of this position at 54° 59.6312'N, 012° 28.4633'W in 2880m WD.

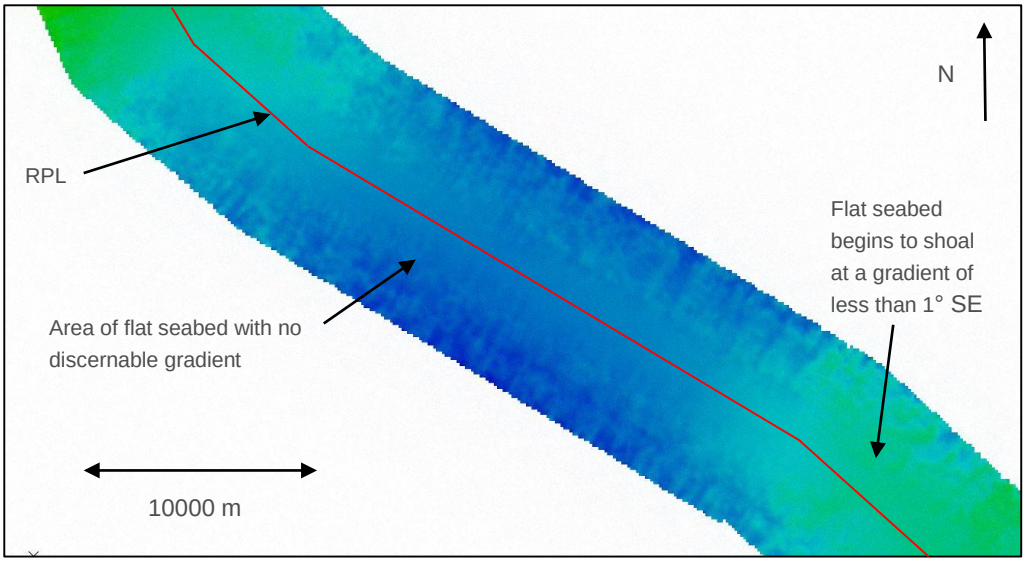


Figure 3-37 .....DTM Illustrating the flat seabed at 55° 08.5870'N, 012° 52.0177'W

The route proceeds to shoal gently to the SE across an almost flat seabed with a gradient of less than 1° NW. Between 54° 46.6734'N, 012° 04.0913'W in 2880m WD and 54° 37.0324'N, 011° 46.0076'W in 2880m WD, the route traverses the NE periphery of a shallow seabed depression of 30m depth and 33.5km along track distance. The slope gradients of this depression are at less than 1° SW, which should not present any hazard to cable emplacement (Figure 3-38).

Within the SE distal section of the depression at 54° 37.9602'N, 011° 47.7712'W in 2880m WD, the INS AEConnect Seg 5 fibre optic cable is crossed by the proposed route.

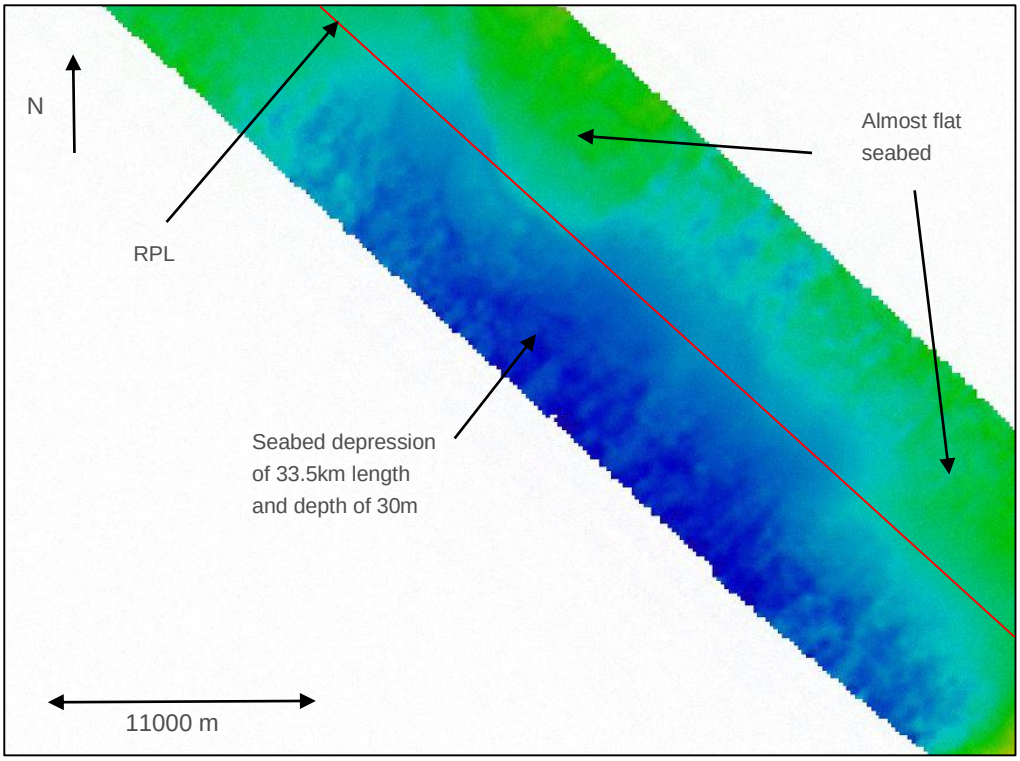


Figure 3-38 .....DTM Illustrating the shallow seabed depression observed at 54° 46.6734'N, 012° 04.0913'W

Almost immediately after the seabed depression the route begins to ascend a slope of approximately 1.5° NW. At 54° 34.4185'N, 011° 41.1559'W in 2790m WD, the route continues to ascend a uniform rise in seabed at a gradient of 2.5° NW.

Between 54° 32.0044'N, 011° 36.6758'W in 2460m WD and 54° 28.9395'N, 011° 31.0095'W in 1910m WD, the route obliquely crosses the SW extent of a few shallow NW to SE trending channels. They are up to 1200m wide and 15m deep with slope gradients of approximately 6° E and W.

Immediately after this point, the overall seabed slope reaches 4° NW, with localized slope gradients of up to 12° NE to 15° NE. The steepest of these slopes is observed between 54° 29.0811'N, 011° 31.2684'W in 1960m WD and 54° 28.4146'N, 011° 30.0903'W in 1900m WD immediately adjacent to the NE of the route alignment.

Beyond this point, the seabed continues up a uniform slope of approximately 8° NNW to the 1500m WD contour at 54° 27.4074'N, 011° 28.2177'W at the end of the deep water survey (Figure 3-39).

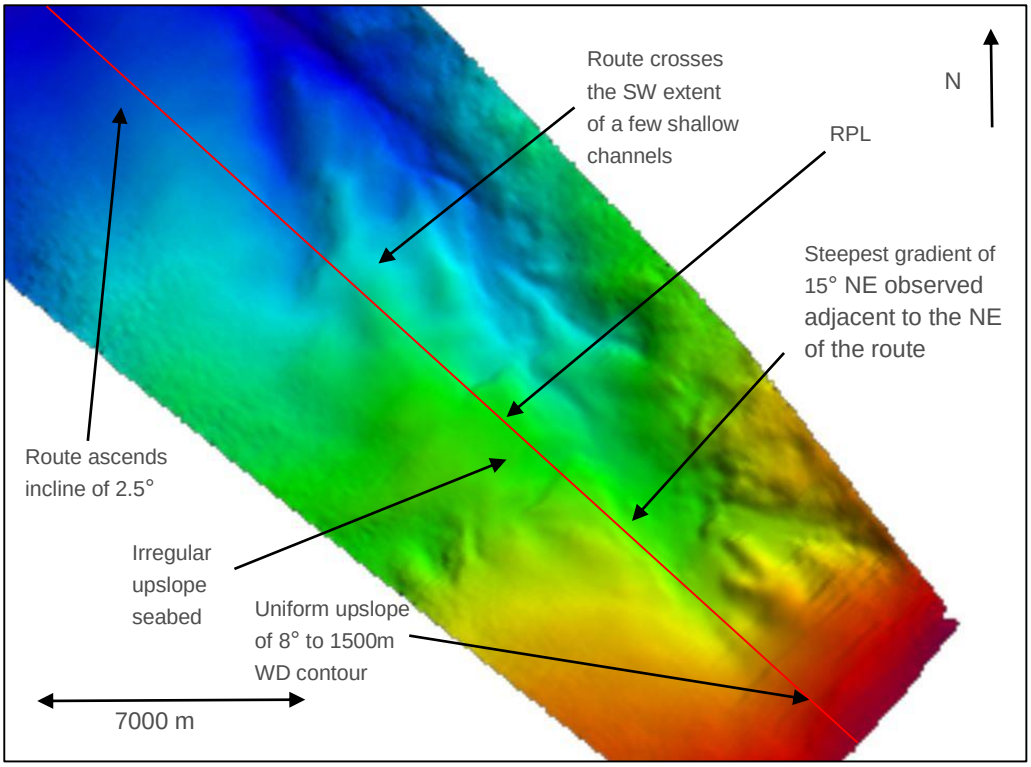


Figure 3-39 .....DTM Illustrating the irregular topography in the approach to the 1500m WD mark

Individual Chart Descriptions were generated to provide a 1 page reference to charts. They will serve to direct the reader to this section if greater detail is required of the feature or concern noted. Reference Appendix C - Chart Descriptions.

3.2.1.2 Cable Crossings

Two INS cables are crossed by the proposed route.

Reference Appendix F - Cable and Pipeline Crossing Matrix.

3.2.1.3 Areas of Concern

There is one area of concern, from 54° 34.4185'N, 011° 41.1559'W to the 1500m WD contour, which may need addressing where the irregular topography with side slopes of up to 15° NE may result in cable movement.

4. OBSERVED CONDITIONS, HAZARDS AND RESTRICTIONS

4.1. Meteorology

Regular environmental and meteorological observations were recorded during the S02 survey, including sea state, swell, atmospheric pressure and wind (direction and force).

Greater detail of daily weather events can be found in the Operations Report Appendix C - Daily Progress Reports.

4.1.1. Temperature and Precipitation

The DTS SubCom-HAVFRUE-201D of 2017-12-18 provides an overview of temperature and precipitation. Of particular relevance to this Segment (02) of the survey is the information given in section 5.2.2 of the DTS 'Oldhead, Mayo, Ireland.'

The DTS gives an overview of the temperature for the European landing sites as ranging from nearly 36° F (2° C) in January, to 66° F (19°C) in July.

The specific temperature and precipitation on the days of the survey of S02 is given below.

During the S02 survey, temperatures were between 9ºC – 21ºC with an air pressure of 984 hpa – 1027hpa.

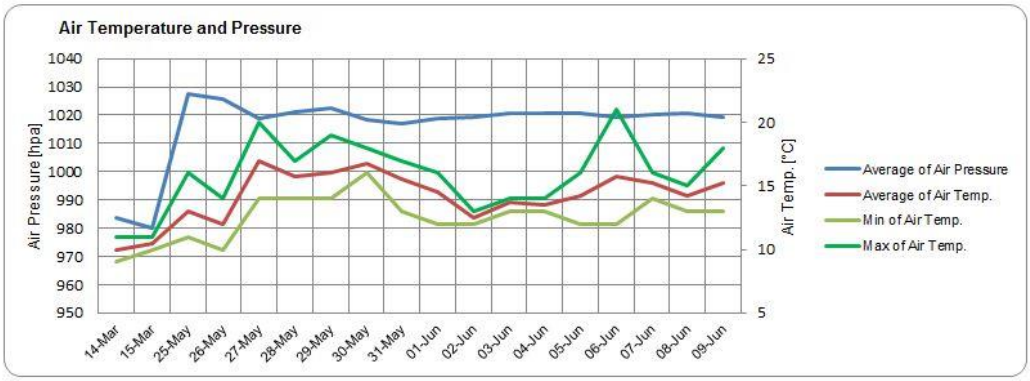


Table 4.1.....Temperature and Precipitation

4.1.2. Wind

The diagrams depicting the weather conditions observed during the S02 survey are presented below. Winds are described by the direction from which they blow.

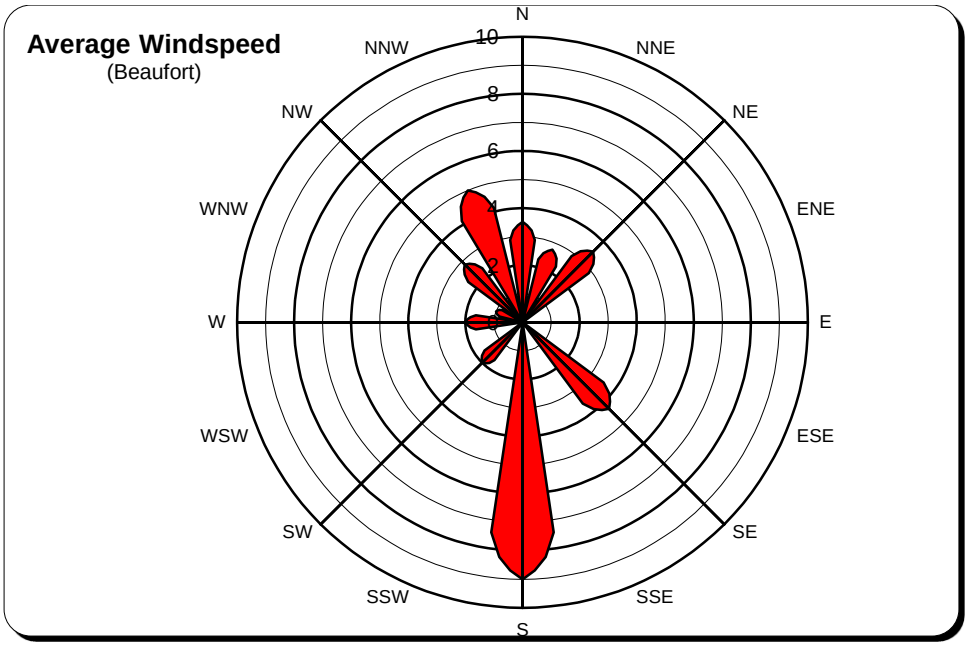


Figure 4-1 .....Average Windspeed

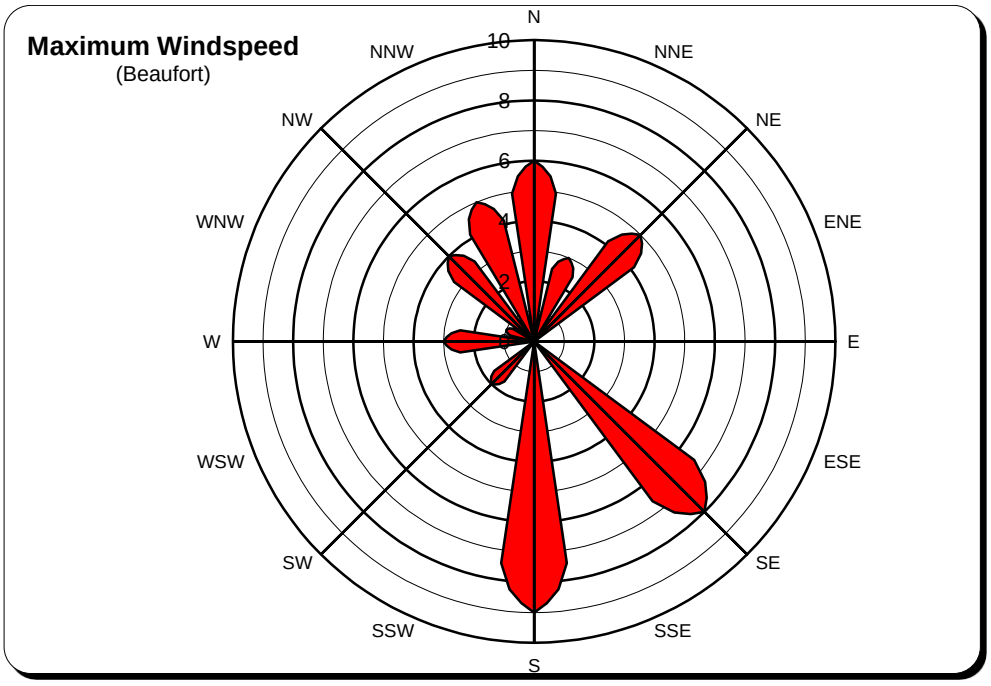


Figure 4-2 .....Maximum Windspeed

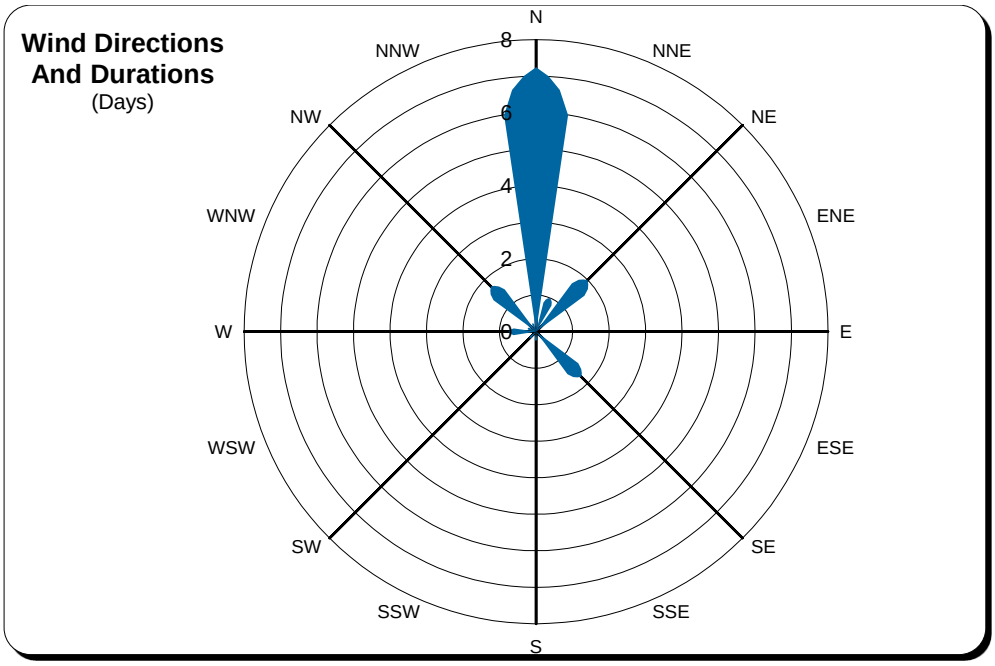


Figure 4-3 .....Wind directions and durations

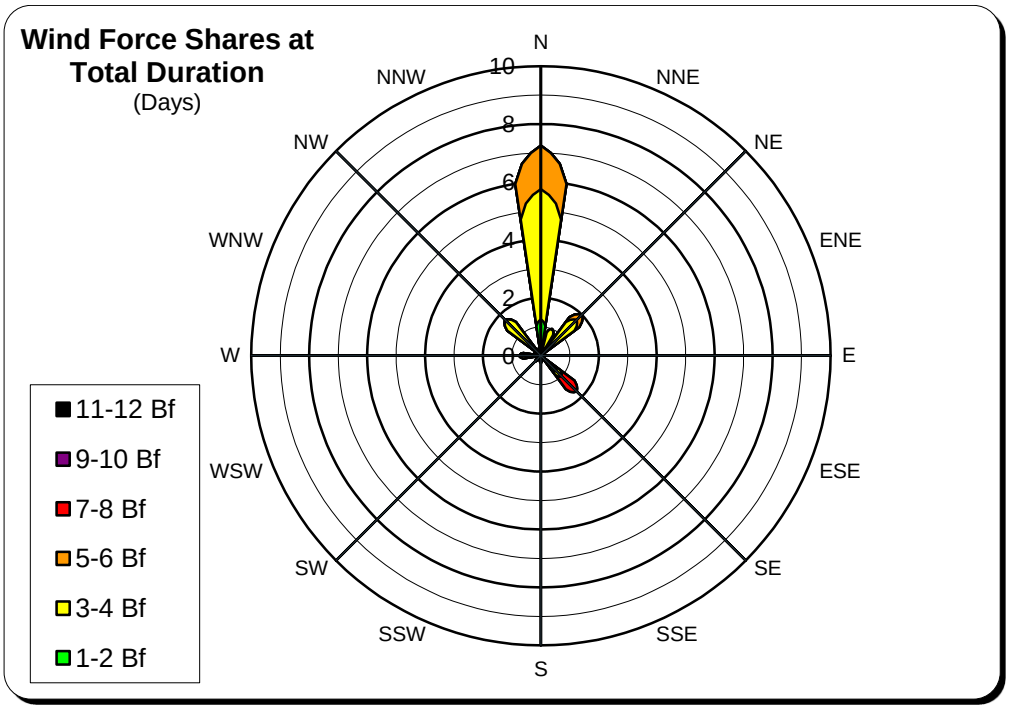


Figure 4-4 .....Wind force shares at total directions

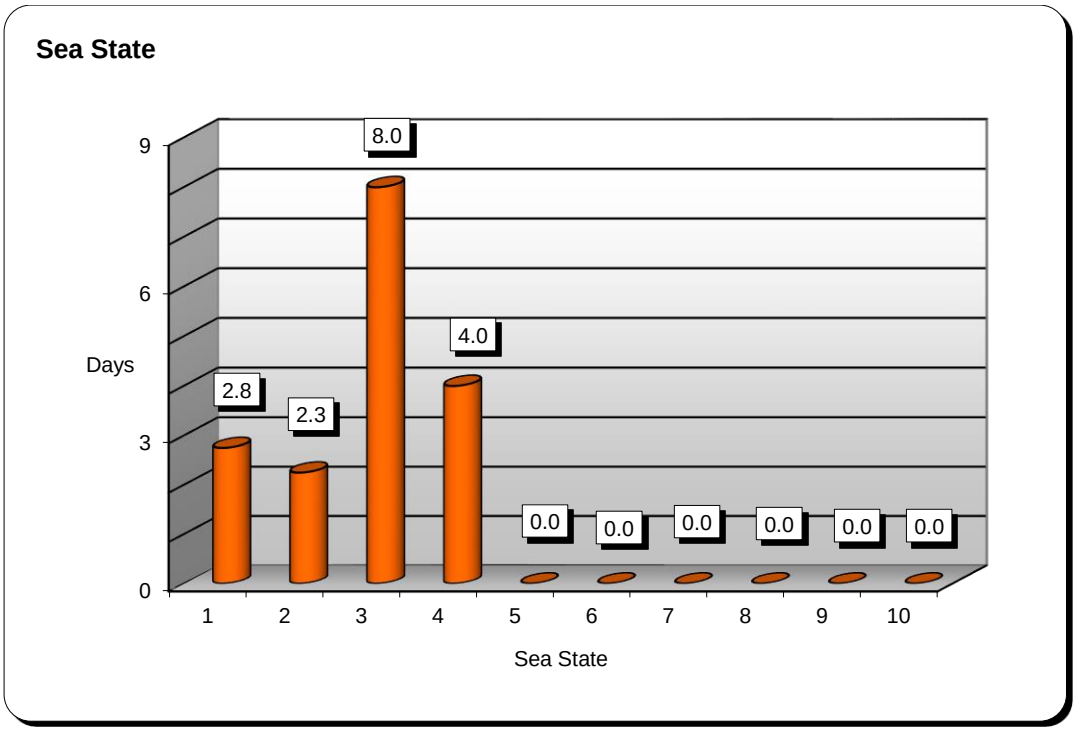


Figure 4-5 .....Sea state

4.1.3. Named Weather Systems

Severe weather conditions were not encountered during the S02 survey.

4.2. Oceanography

4.2.1. Currents

The DTS shows the S02 survey area to be on the S periphery of the Gulf Stream warm currents, moving to the NNE at speeds of 25cm/sec to 40cm/sec.

There were changing currents experienced all along and mostly across the route. In order to keep the SSS and Magnetometer on the survey line vessel offsets up to 150m and more were necessary at times. Especially in the deeper part of the shallow water survey (between 1000m and 1500m) currents were observed wherever the morphology changes (steps).

4.2.2. Tides

4.2.2.1 Inshore Surveys

At the time this report was written, the data of the inshore survey was not available onboard. This section will be updated in the office accordingly.

4.2.2.2 Shallow water survey

No tide data was recorded during Segment S02 shallow water survey. Bathymetric data and subsequent contours or Digital Terrain Model were reduced to the lowest astronomical tide chart datum (LAT) using predicted tides provided by the UKHO Admiralty software 'Total Tide'.

4.2.3. Salinity

Profiles of the water temperature, conductivity and the associated speed of sound were collected at regular intervals during the survey. This information was required primarily for the multibeam systems, although information on seabed temperatures is also an important consideration when designing cable systems. In shallow water a Valeport CTD probe was used to obtain CTD profiles.

The CTD profiles obtained during the S02 survey measured salinity between 34 - 36 ppth.

Refer to Appendix H – Oceanography to review the CTD profiles obtained during survey of S02

4.2.4. Sea Temperature & Sound Velocity

The CTD profiles obtained during the S02 survey measured a more or less constant water temperature throughout the entire water column of 9°-11° C.

Reference Appendix H - Oceanography.

4.3. Hazards and Restrictions

Reference Appendix D - Bottom Obstruction Report.

4.3.1. Existing and Planned Cables

According to the Client's data base two IS cables are crossed by the route in the deep water part. None of these cable were identified in the multibeam data.

4.3.2. Cable Faults

During the Segment 02 survey no new information on cable faults was received. The Survey Scope of Work did not include collection of new data on Cable Faults. Please refer to Desk Top Study (Reference Appendix G - DTS) for details on cable fault history within this area.

4.3.3. Natural Resources and Exploitation

4.3.3.1 Mineral Resources

Numerous mineral extraction areas are reported in the desk top study and are shown mainly in areas of Europe such as Germany, the Netherlands, Denmark and UK.

Along the S02 route, there do not appear to be any such areas.

4.3.3.2 Oil and Gas

The DTS shows numerous areas along the Havfrue cable route. Segment 2 is passing through two exploration blocks, the IR LO16/20, Europa O&G and the IR LO16/26, Predator O&G. Furthermore the route passes the nearby Corrib Gasfield.

4.3.4. Restricted Areas and Obstructions

There do not appear to be any restricted areas or obstructions in the Segment 02 survey corridor.

4.3.4.1 Maritime Boundaries

Segment	Country	KP Range	NU Charts
02	Ireland	0-287.353	001-010

Table 4.2.....Cable System Segments by Country

4.3.4.2 Shipwrecks and Obstructions

One shipwreck was observed in the survey corridor on the Segment 02 route at 54°04.4506'N, 10°40.8724'W with dimensions of 23m x 8.5m x 0.6m and occurs 125m south-west of the route.

The wreck is almost buried by the surrounding sand and has very low relief.

4.3.4.3 Anchorages and Restricted Areas

No anchorages or restricted areas were identified or reported in the DTS for Segment 02.

4.3.4.4 Military Exercise Areas

The desk top study does not show any areas of military activity close to or within the Segment 02 survey corridor.

4.3.4.5 Submarine Cable Areas

Two INS cables are crossed by the proposed route in deep water.

Reference Appendix F - Cable and Pipeline Crossing Matrix.

4.3.4.6 Dump Sites (Waste and Ordnance)

No dump sites reported.

4.3.5. Shipping

Very low shipping activities were observed

Please refer to Appendix I for details. Reference Appendix I - Marine Activity Logs.

4.3.6. Environmental and Biological Restrictions

Environmental or biological restriction areas were not identified in the DTS for Segment 02.

4.3.7. Piracy

There were no incidents of piracy in Segment 02. This is not an area of piracy.

4.4. Fisheries

4.4.1. Fishing activities

Regular observations on marine traffic and fishing activities in the area were recorded during the survey, including vessel name, call sign and observed activity. Observations are detailed in the table below and in Appendix I of this report.

In general low fishing vessel activity was observed crossing the route during the survey. But deployed fishing gear was observed in Block 5 at the entrance to Clew Bay.

Date and time	Latitude	Longitude	Remark
2018-05-28, 06:00	53° 55.20'N	010° 16.90'W	Passed fishing buoys stbd side, after pass found that buoys been dragged by towed equipment
2018-05-31, 02:58	54° 28.72'N	011° 24.90'W	FV Breitz Arvor II, distance to our position 5.58 NM
2018-06-03, 03:02	54° 03.73'N	010° 54.81'W 005° 44.20'E	FV Anchosa, CPA 5.0NM
2018-06-08, 01:41	54° 22.42'N	011° 12.82'W	Panagia Stenton CPA 2.75

5. CONCLUSIONS AND RECOMMENDATIONS

Referenced material can be found in Appendix K - Bibliography and References.

Concern	Y	N	Comment
Irregular/Very Irregular topography and/or steep slopes	✓		Very steep slopes and irregular topography over rock outcrops.
Intervals of no burial	✓		No burial in areas of rock and till outcrop
Intervals of reduced burial	✓		Reduced burial in areas of subcropping rock and till
Hazardous Geomorphology	✓		Very steep slopes and irregular topography over rock outcrop could result in cable suspension.
Sonar Contacts – Obstructions	✓		Numerous boulder fields could hinder ploughing of cable
Cable Crossings	✓		Two cable crossings in deep water survey section.
Strong Seasonal Weather		✓	
Strong or Abnormal Currents		✓	
Mineral or Hydrocarbon Exploitation		✓	
List of Countries Waters traversed	✓		Ireland
Anchorages and Restricted Areas		✓	
Shipping Impact		✓	
Environmentally Sensitive Areas		✓	
Risk of Piracy		✓	
Fisheries Activity and Zones	✓		Lot of fishing gear in Block 5 Entrance to Clew Bay. A potential single lost fishing gear in Block 2 (1150m WD). Is marked as hazard area.

Table 5.1.....Concern Overview

APPENDIX 10-1

ARCHAEOLOGICAL ASSESSMENT – MARINE SURVEY

Marine Archaeological Assessment

Marine Survey and Site Investigation Works within the Havfrue Cable Route Corridor

Client: McMahon Design and Management

Author: [redacted]

Job No. G18005

Date: 10/07/2018

Detection Device Licence: 18R004

Geo-Mara Ltd. CoisCuain, Ballynamanagh, Clarinbridge, Co. Galway, Ireland
Tel: + 353 91 485790, Email:info@geo-mara.com, Web: www.Geo-Mara.com

Contents

1 Introduction

A new transatlantic telecom system, HAVFRUE, is being planned from New Jersey in the USA to Blaaberg in Denmark with a branching unit to Old Head, Co. Mayo. The project is being developed by America Europe Connect 2 (AEC2) Ltd, an Irish company who have recently constructed the AEC 1 transatlantic cable system. The system is being designed and will be installed by TE SubCom on behalf of AEC 2.

The report focuses on the examination of bathymetric and geophysical survey in the areas surrounding the proposed geotechnical locations.

This examination of the survey results allowed the geotechnical work to proceed in parallel with the survey work.

The geophysical and geotechnical survey was undertaken utilizing the vessel MV Fugro Discovery operated by Fugro Germany Marine GmbH (FGMG). For the inshore survey the small boat Alumaster, operated by Fugro Germany Marine GmbH (FGMG) was used.

Beach probing was carried out at 19 locations along the proposed corridor at Old Head beach. This beach probing was conducted to investigate the depth of sand deposits along the beach and was monitored by a licensed archaeologist. Nothing of any archaeological significance was noted at any of the locations.

Geomara previously completed a desktop marine archaeological assessment of the proposed marine survey and site investigation works within the Havfrue Cable Route Corridor.

The assessment comprised an introduction to the study area; and the identification of cultural heritage sites, features and deposits located along the proposed cable route corridor. In order to provide a comprehensive assessment, an extensive desk-based study of the route corridor was undertaken. The potential impact of the proposed scheme on the receiving environment was addressed and mitigation measures to ameliorate these impacts were presented.

During the course of data acquisition one unknown wreck site was noted 126m to the south west of the centreline of the RPL.

Nothing of any archaeological significance was noted at any of the proposed geotechnical locations.

2 Permits and Planning Background

All project permits for operations in Irish waters were in place before the start of survey operations. The Detection Device Licence was granted by the Department of Culture, Heritage and the Gaeltacht on 14.03.2018.

The Method statement accompanying the detection device licence outlined the measures required to ameliorate the impacts of the proposed geotechnical works;

- As the geophysical survey proceeds, on-board processing and charting will be carried out in a 200m zone around the seven specific sampling/ vibrocore locations. The data and charts will be e-mailed to shore for review by a licensed Marine Archaeologist.
- The shore based marine archaeologist will then analyse the charts and data for the presence of unrecorded seabed and sub seabed archaeological features finds or deposits.
- Only where no such features are identified within the 200m zone surrounding the proposed sampling location will the sampling proceed.

The Site Investigation Licence was granted by the Department of Housing, Planning and Local Government on 08.05.2018.

The second specific condition of the site investigation license states that;

2. The Licensee shall ensure that the mitigation measure set out in Section 7 of the document entitled "Marine Archaeological Assessment of a proposed Marine Survey and Site Investigation Works within the Havfrue Cable Route Corridor", Prepared by Geo-Mara Ltd, dated 19th December 2017 are implemented in full.

Section 7 of the report states;

The following mitigation recommendations are presented in connection with the proposed cable:

1. It is recommended that all sites of cultural heritage interested included in this report are avoided.

2. Inspection and testing at the 3 No. proposed trial pits on the sea shore at Old Head should be archaeological led. Where archaeological features, finds or deposits are identified the trial pit shall be abandoned and the cable route and consequent trial pit locations will be revised.

3. The proposed bathymetric and geophysical survey results should be assessed by a suitably qualified archaeologist prior to any site investigations. A line plan showing number of survey lines as a function of depth will be provided prior to start of survey operations. Any previously unrecorded archaeological seabed or sub-seabed features will be avoided by rerouting the cable route as well as any proposed site investigations.

4. The proposed Diver Swim Survey will comply with the requirements of the Underwater Archaeology Unit of the Department of Culture, Heritage & the Gaeltacht. Results of dive swim survey to be assessed by a suitably qualified archaeologist. A diver swim survey (spot dive) may be required to investigate and identify any obstacles or archaeological features found during the small boat survey up to safe diving limits.

5. Should the proposed cable route be subject to further revision, details of these revisions will be forwarded to the project archaeologist for assessment

6. On completion of the surveys and site investigations a report will be produced summarising all archaeological aspects of the project and submitted to DCHG and the National Museum of Ireland

3 Bathymetric and Geophysical surveys

The survey methodology ensured that there were no gaps or unsurveyed areas between all of the different survey operations.

For the marine route survey;

- Sidescan ranges were limited to those providing the greatest resolution possible (able to resolve a 0.5m object (L x W x H) or better), while following the required minimum line spacing and overlap.
- Bathymetry data collection comply with International Hydrographic Office standards (S44).
- Survey line spacing was designed to ensure adequate coverage and overlap of geophysical measurements
- For swathe bathymetry, “20% overlap” signified that adjacent acquisition swathes within the survey corridor overlap by 20%.
- For side scan sonar (SSS), 100% overlap required two passes of complete coverage over a given area of seafloor, with the two passes each ensonifying the seafloor from opposite directions to ensure targets are adequately imaged.
- Sub-bottom equipment was able to discern nature and density of the upper 3 metres of seabed, and was used on a non-interfering basis with other sounding systems. Tie lines will be performed to verify primary survey data and will have a nominal spacing of 10 times the primary line spacing
- Features such as archaeological features, shallow reefs, surge channels, debris fields, or anything that could be a hazard to the cable or installation team were noted.

The following techniques were used for the cable route survey. The resulting data from all techniques was reviewed for evidence of the presence of cultural heritage.

- Multibeam Sonar
- Side Scan Sonar
- Marine Magnetometer
- Sub Bottom Profiler

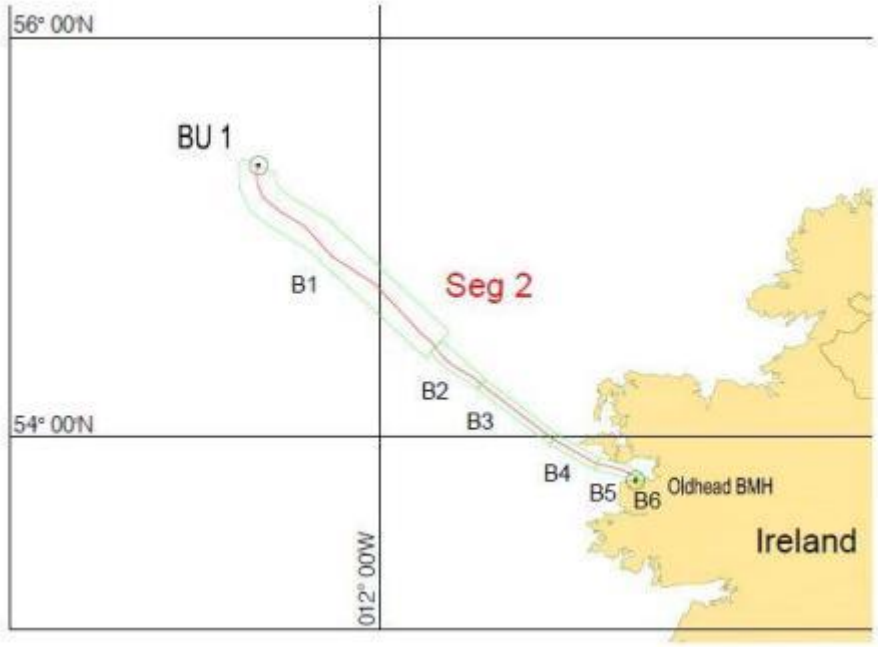


Figure 1. Segment 2 divided into 6 survey blocks

Segment 2 was divided into 6 sections (Survey Blocks 1-6) whereas Block 6 is the shortest with only appr. 3km. Block 6 containing all Inshore survey operations. Block 1 is the largest with appr. 150km and covers the whole deep water section. Block 2-4 varies between 30 km and 50 km.

Block 1-5 were surveyed by Fugro Discovery. Block 1 was completed on 15.03.2018, Block 2-5 were surveyed between 23.05.2018 and 10.06.2018.

MV Fugro Discovery	
Length Overall	70.0 m
Length PP	61.4 m
Beam	12.6
Draught	6.0 m
Draught with Gondola	6.5 m
GRT	2018 t
Speed	Cruising speed: 10 kts, max. speed: 13 kts
SOLAS	IMO No.: 9152882, Call Sign: 3EKE6
Year of Construction	1997
Owner	Fugro

Figure 2. MV Fugro Discovery

	Started	Finished
Landfall Survey	26 May 2018	01 June 2018
Inshore survey	26 May 2018	01 June 2018
Shallow and Deep Water Survey	25 January 2018	29 January 2018
	28 February 2018	15 March 2018
	21 May 20-18	09 June 2018

Table 1. Survey Dates

Figure 3. Nearshore AUV

3.1 Survey Equipment

MV Fugro Discovery – Deep and Shallow Water Segments

System	Type
Surface Positioning System	Starpack G2+ / Seapath 330+
Data logging and Navigation	QPS Qinsy 8.17.1
Multi Beam Echo Sounder	EM712
Heading and MRU	Seapath 330+ with Seatex MRU5+
Sound Velocity Probes	Valeport Midas SVX2
Sound Velocity Sensor	Valeport mini SVS
Sub-bottom Profiler	Knudsen Chirp 3260
Sidescan sonar	Edgetech FS 4200
Magnetometer	Geometrics - G882
Ultra Short Base Line System	Kongsberg HiPAP 502
Sampling	Gravity Corer, Van-Veen Grab Sampler
Cone Penetration Test (CPT)	DATEM Neptune 3000

Figure 4. Survey equipment

4 Geotechnical Investigations

Sediment sampling and CPT operations are performed in order to ground truth the geophysical interpretation and to gain further understanding of in-situ conditions. Gathered information is incorporated and assists with the geological interpretation.

Seabed sediment samples were collected along the center line of the route to the end of burial depth. Geotechnical locations were decided on board the survey vessel by the Geologists and Party Chief in consultation with Client's Representative.

With respect to geotechnical methodology (GC) the project scope of work specifies:

- Nominal distance between coring positions is 10 km
- 2 attempts with the gravity corer
- 2 attempts with the grab sampler (when coring has failed)
- A core / sample was deemed successful with
- Recovery of no less than 2 m of soil. If stiff or hard soils were encountered below 1 m of seabed and were clearly indicated in the sample, a 1 m soil sample was deemed acceptable. Any sample site yielding less than 1 m of recovery had to be investigated a second time unless there was obvious damage to the coring equipment indicating a hard or rocky substrate
- Recovery of a full bucket of soils. The volume of soil recovered was dependent on the size of the unit deployed. Recovery of rocks and/or coral material was taken as an indication of a hard seabed and was deemed acceptable.

4.1 Sediment Samples – Core

Gravity cores were photographed measured in length and analyzed according the British Standard BS5930 (1.3) to describe sediment samples and seabed classifications. The shear strength was measured with a pocket Torvane tester.

4.2 Sediment Samples - Grab/Dredge

Grab samples were photographed, measured in mass and analyzed according the British Standard BS5930 (1.3) to describe sediment samples and seabed classifications.

4.3 CPT's

CPTs were performed from the MV Fugro Discovery. They recorded in situ geotechnical data that was then used to assist in the development of a burial feasibility study for the segment. A Datem Neptune 3000 CPT unit was used for this operation. The location of CPT stations was agreed in advance with the Client's Representative on board.
With respect to geotechnical methodology (CPT) the project scope of work specifies:

- Nominal distance between CPT positions is 4 km
- Target depth set to 3 m and tip resistance to 20 MPa.
- An attempt was deemed successful when a penetration of 2 m below the seabed was achieved.
- Any push resulting in less than 2 m penetration triggered a second attempt. In this case the CPT was relocated by approximately 5 m before commencing the second attempt.

CPT data is recorded via Neptune software before it is processed using a custom spreadsheet template. Relevant data (depth, cone end resistance, sleeve friction, pore pressure, friction ratio, shear strength and relative density) is plotted in standardized manner enabling competent data interpretation. Various soil evaluation models incorporated into the spreadsheet template assure accurate data interpretation.

5 Archaeological screening in advance of geotechnical works

As the geophysical survey proceeded, on-board processing and charting was carried out in a 200m zone around the specific sampling/ vibrocore locations. The data and charts were emailed to shore for review by a licensed Marine Archaeologist.

The shore based marine archaeologist then analysed the charts and data for the presence of potential unrecorded seabed and sub seabed archaeological features finds or deposits. Nothing of any archaeological significance was noted at any of the locations.

It was agreed in advance by all project parties that only where no such features were identified within the 200m zone surrounding the proposed sampling location did the sampling proceed.

HAVFRUE SEGMENT 02 - PLANNED GEOTECHNICAL LOCATION

Block	Type	Number	Station	LAT	LONG	Comments	STATUS
5	CPT	1	Primary	53.807482N	9.807813W	Checked 02/06	No Archaeology
5	CPT	1S	Secondary	53.808236N	9.811013W	Checked 02/06	No Archaeology
5	CPT	2	Primary	53.810631N	9.821104W	Checked 29/05	No Archaeology
5	CPT	2S	Secondary	53.811056N	9.822952W	Checked 29/05	No Archaeology
5	CPT	3	Primary	53.823546N	9.865393W	Checked 29/05	No Archaeology
5	CPT	3S	Secondary	53.822462N	9.862012W	Checked 29/05	No Archaeology
5	CPT	4	Primary	53.840015N	9.939663W	Checked 29/05	No Archaeology
5	CPT	4S	Secondary	53.839180N	9.935544W	Checked 29/05	No Archaeology
5	CPT	5	Primary	53.848295N	10.000022W	Checked 02/06	No Archaeology
5	CPT	5S	Secondary	53.848775N	10.003781W	Checked 02/06	No Archaeology
5	CPT	6	Primary	53.854598N	10.050444W	Checked 29/05	No Archaeology
5	CPT	6S	Secondary	53.854180N	10.047205W	Checked 29/05	No Archaeology
4	CPT	7	Primary	53.872769N	10.145556W	Checked 29/05	No Archaeology
4	CPT	7S	Secondary	53.871966N	10.143169W	Checked 29/05	No Archaeology
4	CPT	8	Primary	53.885719N	10.178704W	Checked 29/05	No Archaeology
4	CPT	8S	Secondary	53.886195N	10.180149W	Checked 29/05	No Archaeology
4	CPT	9	Primary	53.905768N	10.238955W	Checked 29/05	No Archaeology
4	CPT	9S	Secondary	53.905505N	10.238156W	Checked 29/05	No Archaeology
4	CPT	10	Primary	53.921658N	10.286629W	Checked 02/06	No Archaeology
4	CPT	10S	Secondary	53.922098N	10.287943W	Checked 02/06	No Archaeology
4	CPT	11	Primary	53.944072N	10.348025W	Checked 29/05	No Archaeology
4	CPT	11S	Secondary	53.944629N	10.349588W	Checked 29/05	No Archaeology
4	CPT	12	Primary	53.959886N	10.402327W	Checked 29/05	No Archaeology
4	CPT	12S	Secondary	53.960706N	10.404765W	Checked 29/05	No Archaeology
4	CPT	13	Primary	53.972094N	10.438840W	Checked 29/05	No Archaeology
4	CPT	13S	Secondary	53.972601N	10.440388W	Checked 29/05	No Archaeology
4	CPT	14	Primary	53.983158N	10.472576W	Checked 29/05	No Archaeology
4	CPT	14S	Secondary	53.982690N	10.471243W	Checked 29/05	No Archaeology
5	GC	1	Primary	NA	NA	Checked 30/05	No Archaeology
5	GC	1S	Secondary	NA	NA	Checked 30/05	No Archaeology
5	GC	2	Primary	53.835559N	9.916012W	Checked 29/05	No Archaeology
5	GC	2S	Secondary	53.836361N	9.920318W	Checked 29/05	No Archaeology
5	GC	3	Primary	53.850637N	10.019484W	Checked 29/05	No Archaeology
5	GC	3S	Secondary	53.850051N	10.015021W	Checked 29/05	No Archaeology
4	GC	4	Primary	53.883814N	10.173031W	Checked 29/05	No Archaeology

4	GC	4S	Secondary	53.884274N	10.174443W	Checked 29/05	No Archaeology
4	GC	5	Primary	53.935370N	10.327975W	Checked 29/05	No Archaeology
4	GC	5S	Secondary	53.934682N	10.325992W	Checked 29/05	No Archaeology
4	GC	6	Primary	53.97857N	10.458798W	Checked 29/05	No Archaeology
4	GC	6S	Secondary	53.977919N	10.456723W	Checked 29/05	No Archaeology
3	CPT	15	Primary	54.009152N	10.533155W	Checked 02/06	No Archaeology
3	CPT	15S	Secondary	54.011037N	10.537337W	Checked 02/06	No Archaeology
3	CPT	16	Primary	54.030626N	10.580934W	Checked 02/06	No Archaeology
3	CPT	16S	Secondary	54.030078N	10.579683W	Checked 02/06	No Archaeology
3	CPT	17	Primary	54.059339N	10.644542W	Checked 02/06	No Archaeology
3	CPT	17S	Secondary	54.058858N	10.643481W	Checked 02/06	No Archaeology
3	CPT	18	Primary	54.085089N	10.701538W	Checked 02/06	No Archaeology
3	CPT	18S	Secondary	54.086556N	10.704706W	Checked 02/06	No Archaeology
3	CPT	19	Primary	54.097350N	10.728752W	Checked 02/06	No Archaeology
3	CPT	19S	Secondary	54.098578N	10.731405W	Checked 02/06	No Archaeology
3	CPT	20	Primary	54.118951N	10.776632W	Checked 02/06	No Archaeology
3	CPT	20S	Secondary	54.119984N	10.778951W	Checked 02/06	No Archaeology
3	CPT	21	Primary	54.140910N	10.825658W	Checked 02/06	No Archaeology
3	CPT	21S	Secondary	54.142358N	10.828847W	Checked 02/06	No Archaeology
3	CPT	22	Primary	54.167579N	10.885030W	Checked 02/06	No Archaeology
3	CPT	22S	Secondary	54.168985N	10.888259W	Checked 02/06	No Archaeology
3	CPT	23	Primary	54.184251N	10.922419W	Checked 02/06	No Archaeology
3	CPT	23S	Secondary	54.185126N	10.924552W	Checked 02/06	No Archaeology
3	GC	7	Primary	54.032899N	10.585708W	Checked 01/06	No Archaeology
3	GC	7S	Secondary	54.030692N	10.581076W	Checked 01/06	No Archaeology
3	GC	8	Primary	54.089358N	10.711043W	Checked 01/06	No Archaeology
3	GC	8S	Secondary	54.091734N	10.716153W	Checked 01/06	No Archaeology
3	GC	9	Primary	54.146141N	10.837272W	Checked 01/06	No Archaeology
3	GC	9S	Secondary	54.147235N	10.839716W	Checked 01/06	No Archaeology
3	GC	10	Primary	54.194930N	10.947213W	Checked 01/06	No Archaeology
3	GC	10S	Secondary	54.192341N	10.941537W	Checked 01/06	No Archaeology

Table 2. Planned geotechnical locations

The Multibeam and Sidescan geotiffs of the proposed primary and secondary geotechnical locations were imported into Global Mapper a GIS program. They were analysed and a chart of each location was produced.

All the charts produced are contained in Appendix 1 and Appendix 2 below.

6 Monitoring of beach probing

Beach probing was carried out at 19 locations along the proposed corridor at Old Head beach on the 31st May 2018. The beach probing was conducted to investigate the depth of sand deposits along the beach and was monitored by a licensed archaeologist.

Positions were determined using a Garmin GPSMAP 78 handheld GPS device. Penetration was determined by dropping the weight until either the maximum penetration of 2 m was achieved, the maximum number of 150 hits per probing was performed or no further change in penetration could be observed.

The probing revealed that the beach deposits were very shallow with only two of the locations revealing deposits in excess of 2m. The beach was observed to be composed of fine, and fine to medium SAND with occasional shell fragments and cobbles.

Nothing of any archaeological significance was noted.

Figure 5. Beach probing locations Old Head

Sample ID	Easting (m)	Northing (m)
S02_LB_BP001	449220.610	5958940.470
S02_LB_BP002	449245.630	5958946.330
S02_LB_BP003	449270.820	5958948.240
S02_LB_BP004	449294.480	5958955.830
S02_LB_BP005	449318.000	5958966.110
S02_LB_BP006	449338.460	5958980.270
S02_LB_BP007	449356.160	5958996.870
S02_LB_BP008	449255.53	5958892.89
S02_LB_BP009	449282.36	5958898.25
S02_LB_BP010	449302	5958899.69
S02_LB_BP011	449323.61	5958905.74
S02_LB_BP012	449348	5958916.4
S02_LB_BP013	449368.75	5958929.36
S02_LB_BP014	449210.61	5958983.63
S02_LB_BP015	449236.94	5958989.28
S02_LB_BP016	449267.56	5958991.53
S02_LB_BP017	449293.36	5959002.81
S02_LB_BP018	449317.22	5959013.24
S02_LB_BP019	449335.93	5959030.8

Table 3. Beach probing locations

Figure 6. Beach probing

7 Wreck Site

During the course of data acquisition one unknown wreck site was noted 126m to the south west of the centreline of the RPL. The wreck was reported to the Underwater Archaeological Unit. Due to the distance from the centreline it was not deemed necessary to re route the RPL.

OBSTACLE NO. FD-03			
Ship / Unit:		MV Fugro Discovery	
Survey:		220-17-720	
Date Located:	29/05/2018	Date Examined:	29/05/2018

Listed Position:	Unknown	
Fixed Position (UTM Zone 29 / WGS84):	389 999 mW	5 993 081 mN
	54° 04.4505' N Lat	010 ° 40.8722' W Lon
Method of Positioning: Fugro Starfix HP DGPS	Accuracy: <50 cm	

Depth Data (ELLIPSOID)	
Swept Clear:	No sweep performed
Swept Foul:	No sweep performed
Least E/S Depth:	156.9 m (LAT)
General Depth:	157.5m (LAT)
Scour Depth:	None

Tidal Observations	
Tidal Observations at:	Predicted tidal correction was used – No GPS
Co-tidal adjustments by:	

Contact Data	
Sonar Height:	0.6 m (at highest point)
Sonar Length:	25.6 m
Sonar Width:	7.2 m
Orientation:	140°/320°
Bow Orientation:	N/A
Sonar Signal Strength:	Weak
Magnetic Anomaly:	No
Scour Length:	None
Seabed Texture:	N/A
Debris Field:	No
Buoyage:	No buoyage

Description:
The vessel has a weak sonar signal and low relief and appears to be partially buried in the surrounding sediment but is not broken or dispersed.
Refer to multibeam and side-scan sonar images displaying the vessel.

Table 4. Possible wreck details

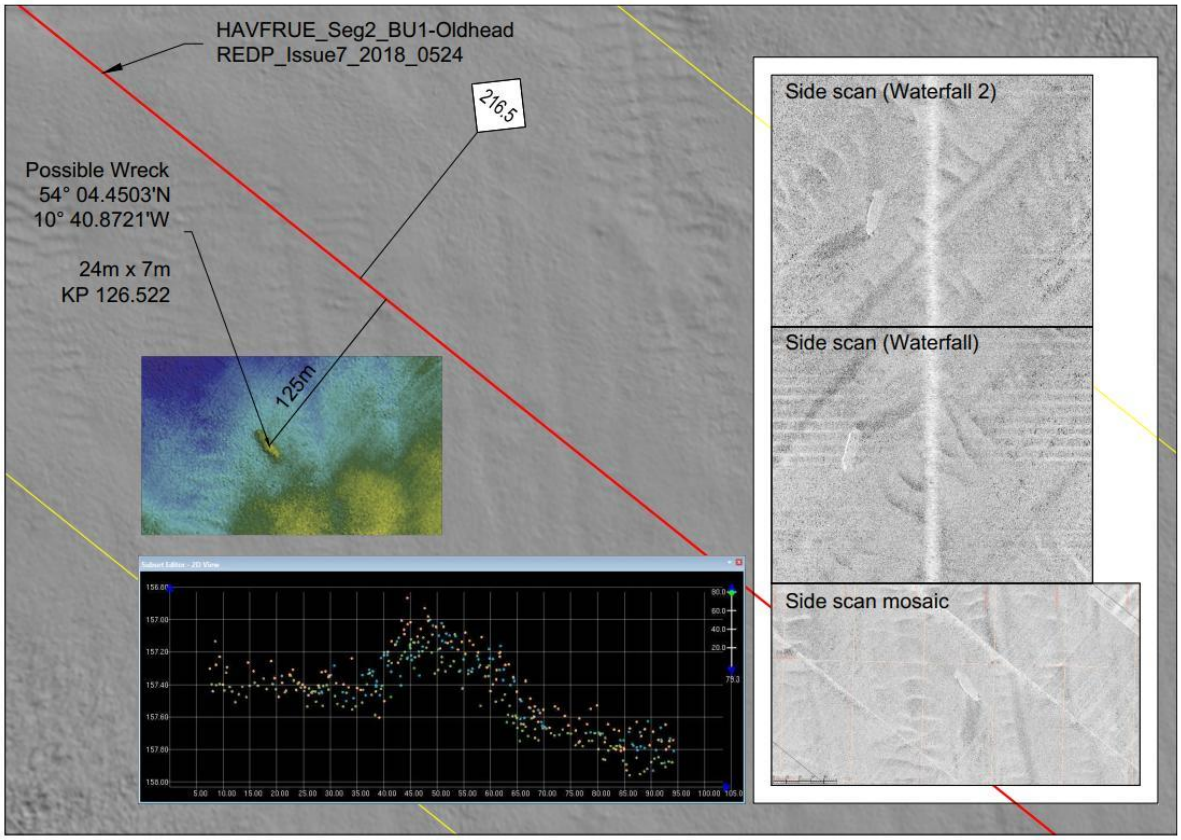


Figure 7. Possible wreck

8 Conclusion

Nothing of any archaeological significance was noted during the examination of the bathymetric and geophysical data in advance of geotechnical work proceeding along the Havfrue cable route corridor.

Nothing of any archaeological significance was noted during the monitoring of beach probing at 19 locations on Old Head beach within the proposed route corridor.

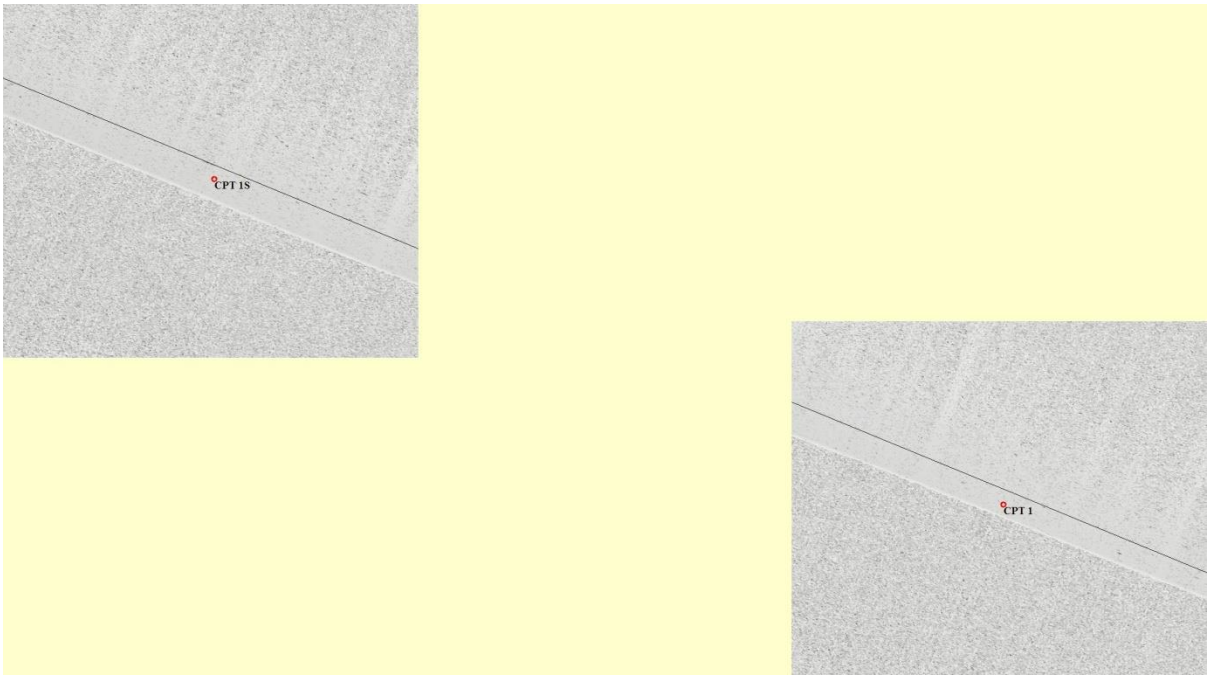
During the course of survey data acquisition one unknown wreck site (potentially of archaeological significance) was noted 126m to the south west of the centreline of the RPL.

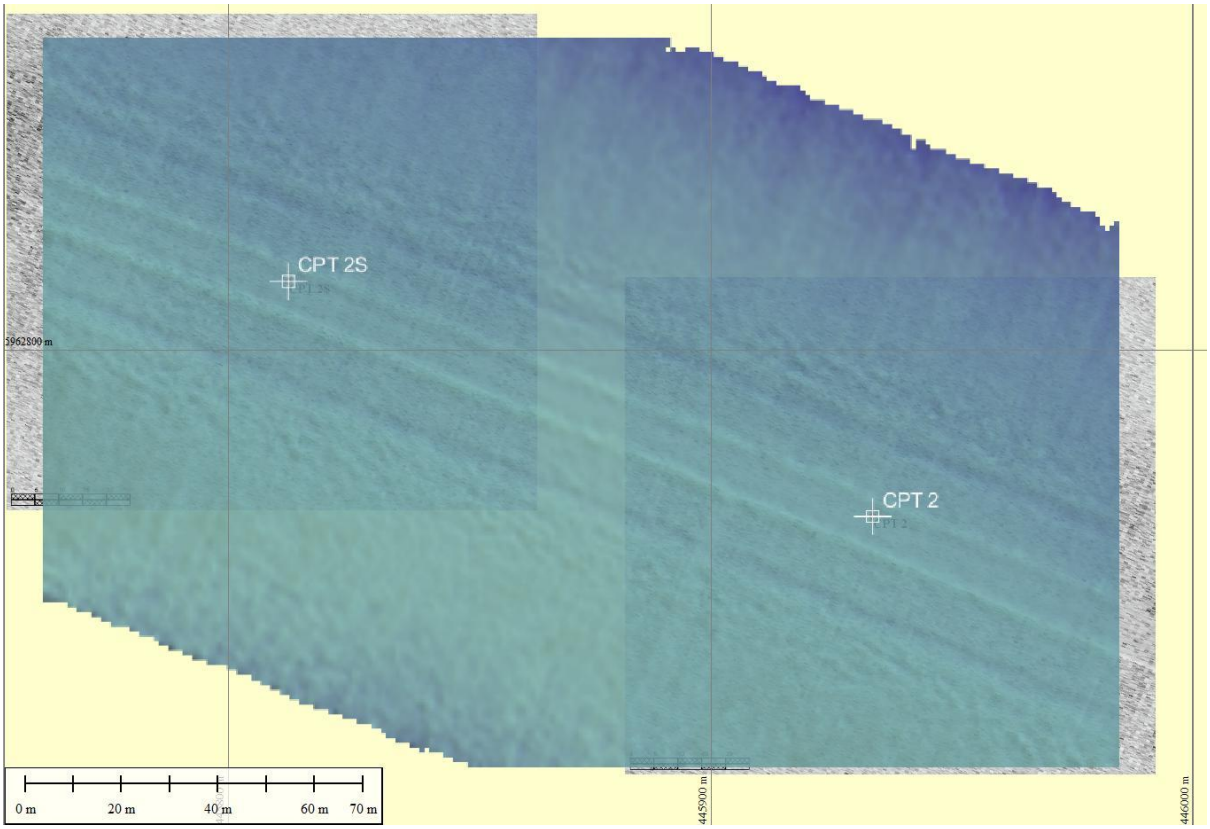
This again highlights the potential for further advance works to reveal archaeological features finds and deposits.

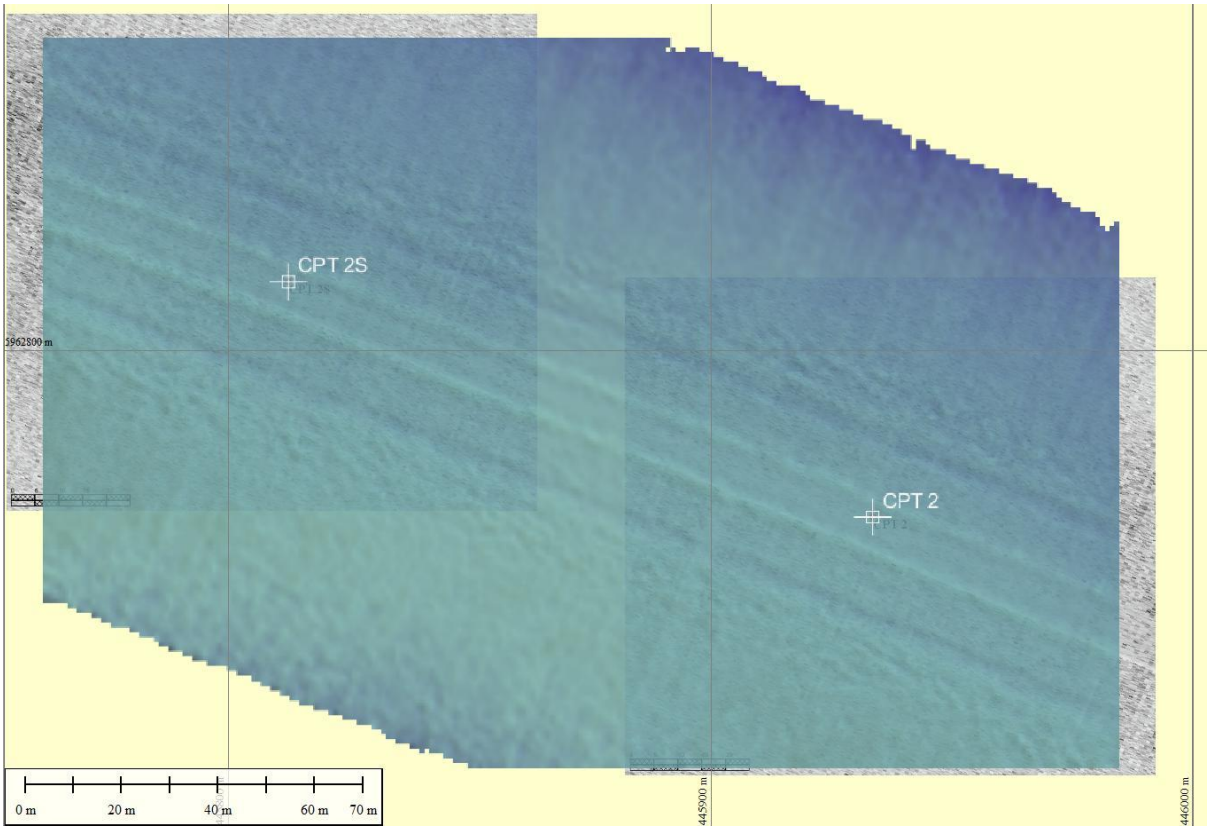
The trenching for seabed cable installation and associated beachhead works at Old Head will also require monitoring in order to ameliorate the potential impacts.

The recommendations in section 7 of the marine archaeological assessment report should continue to be adhered to in full.

Appendix 1 - CPT Location Charts



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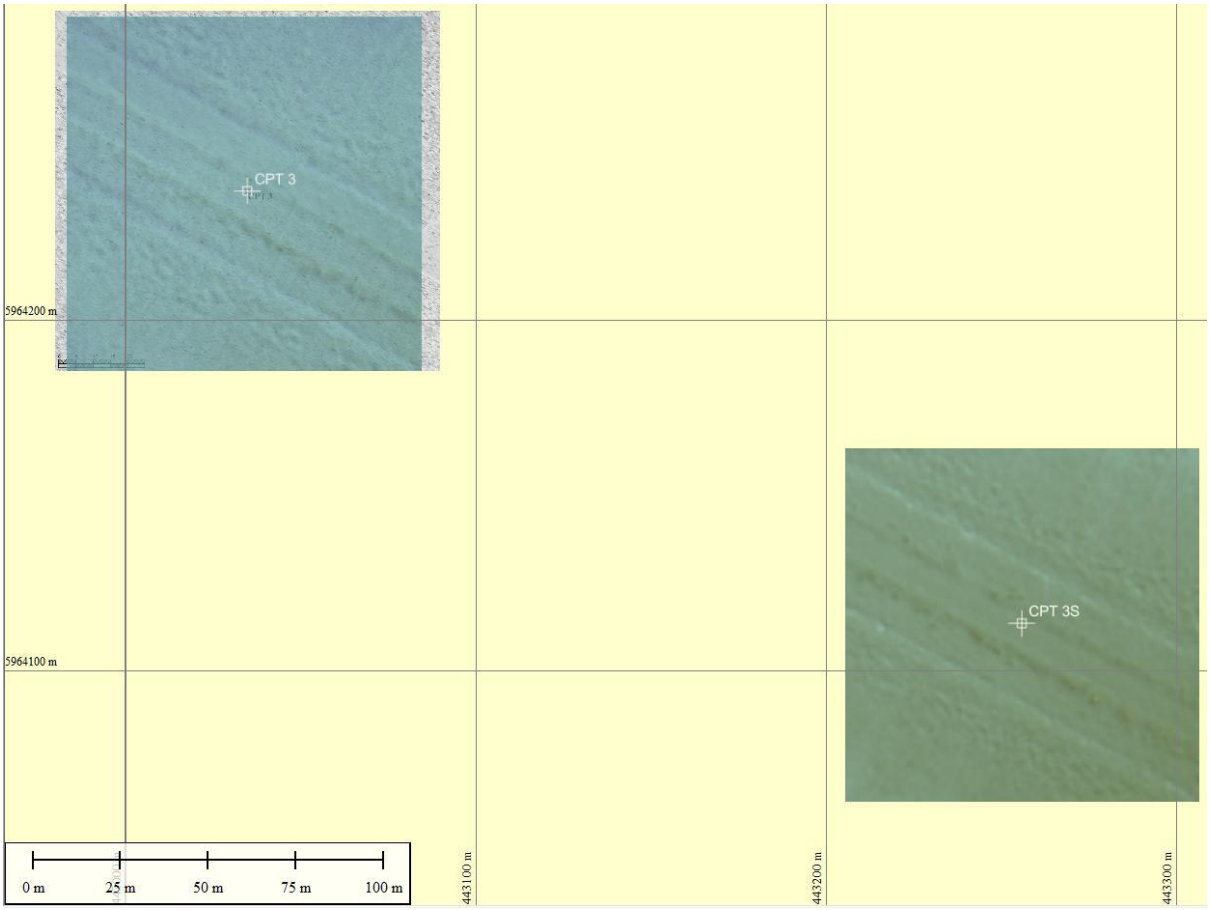
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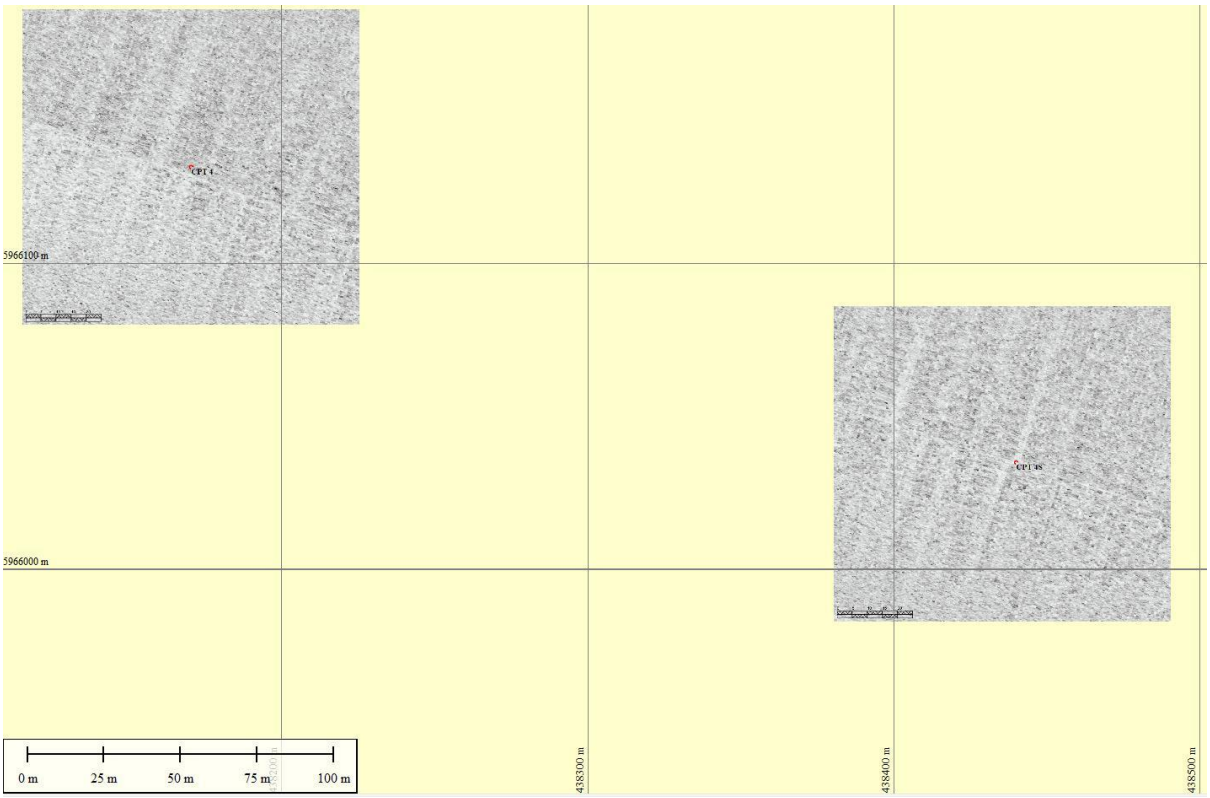
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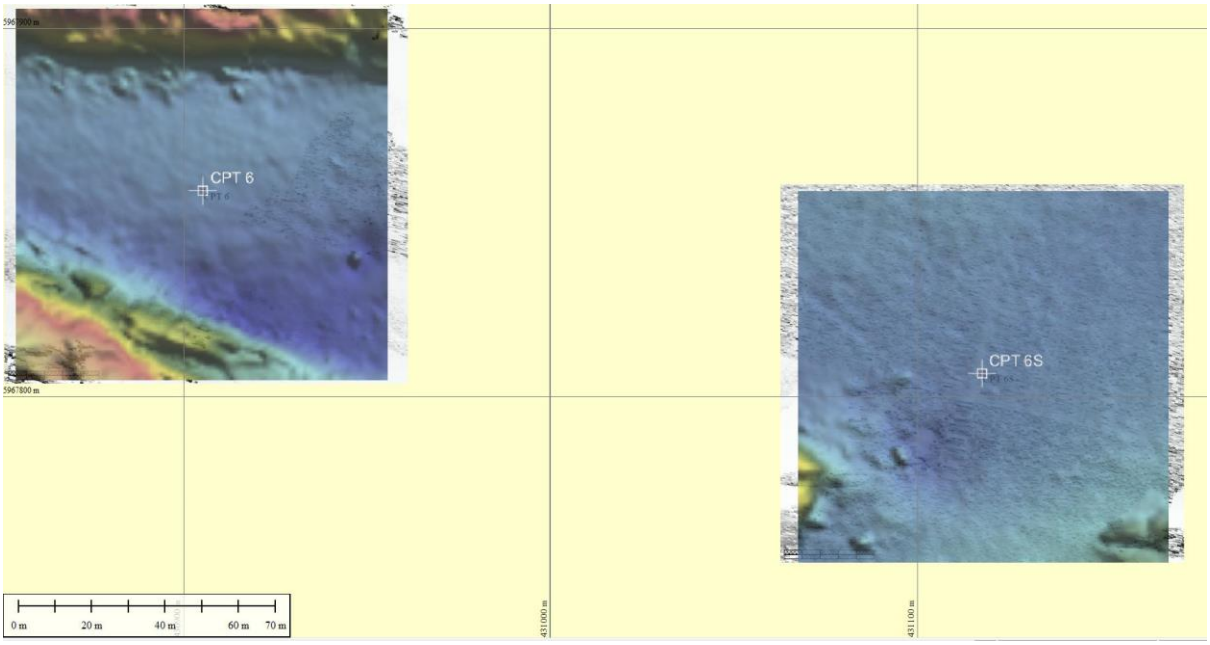
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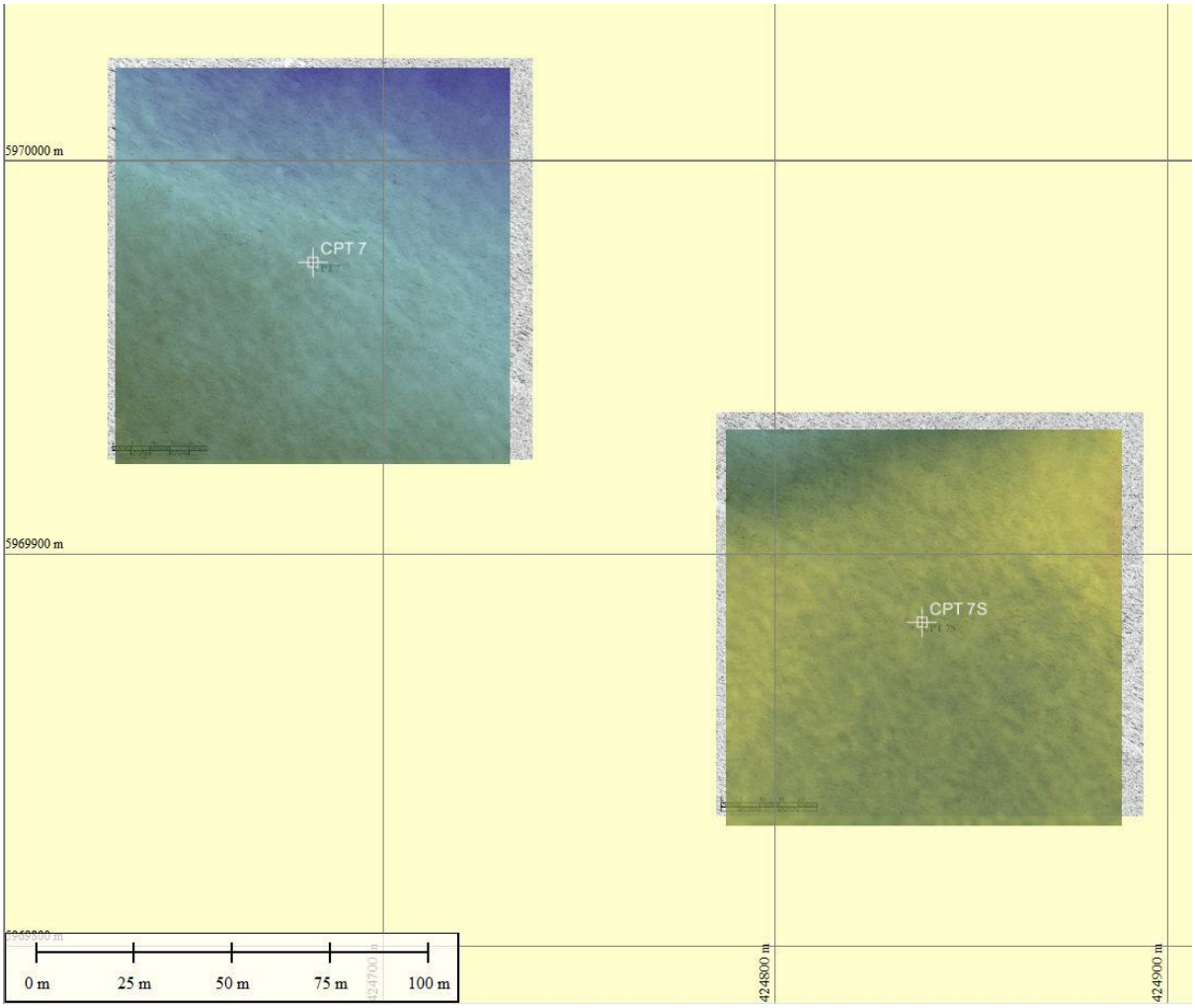
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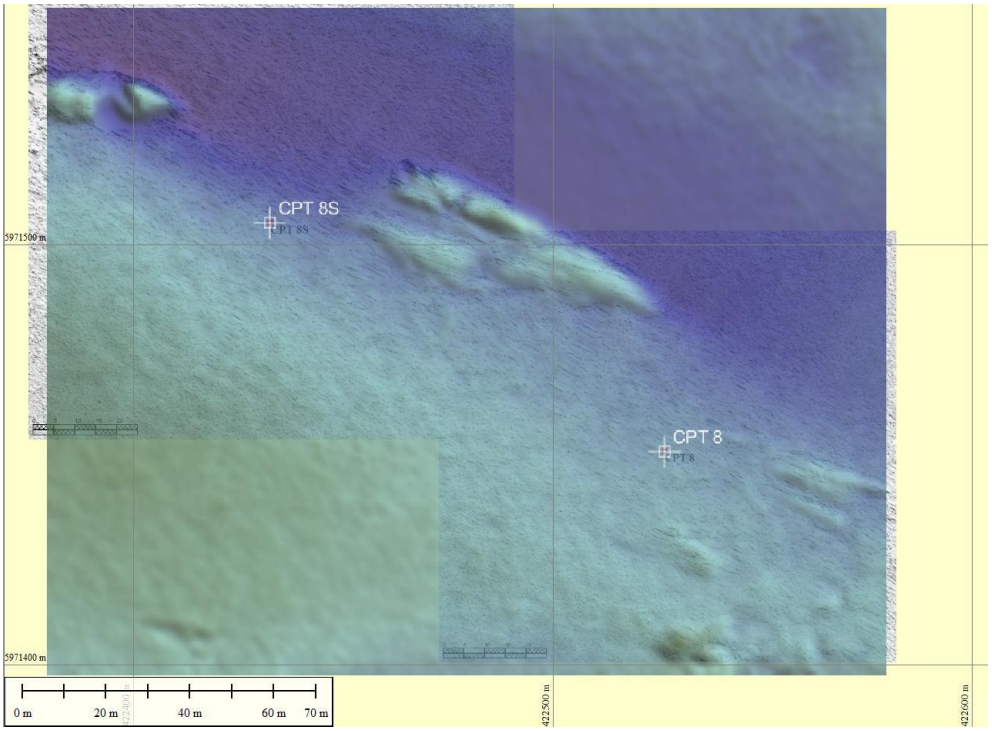
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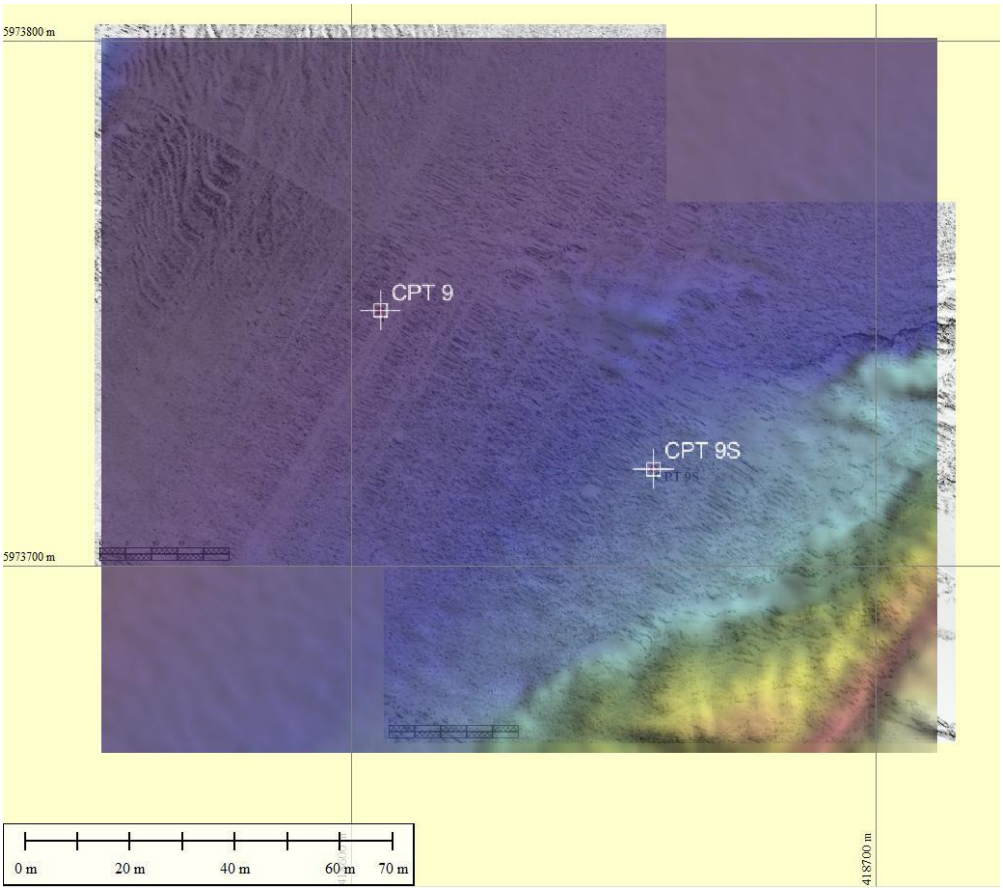
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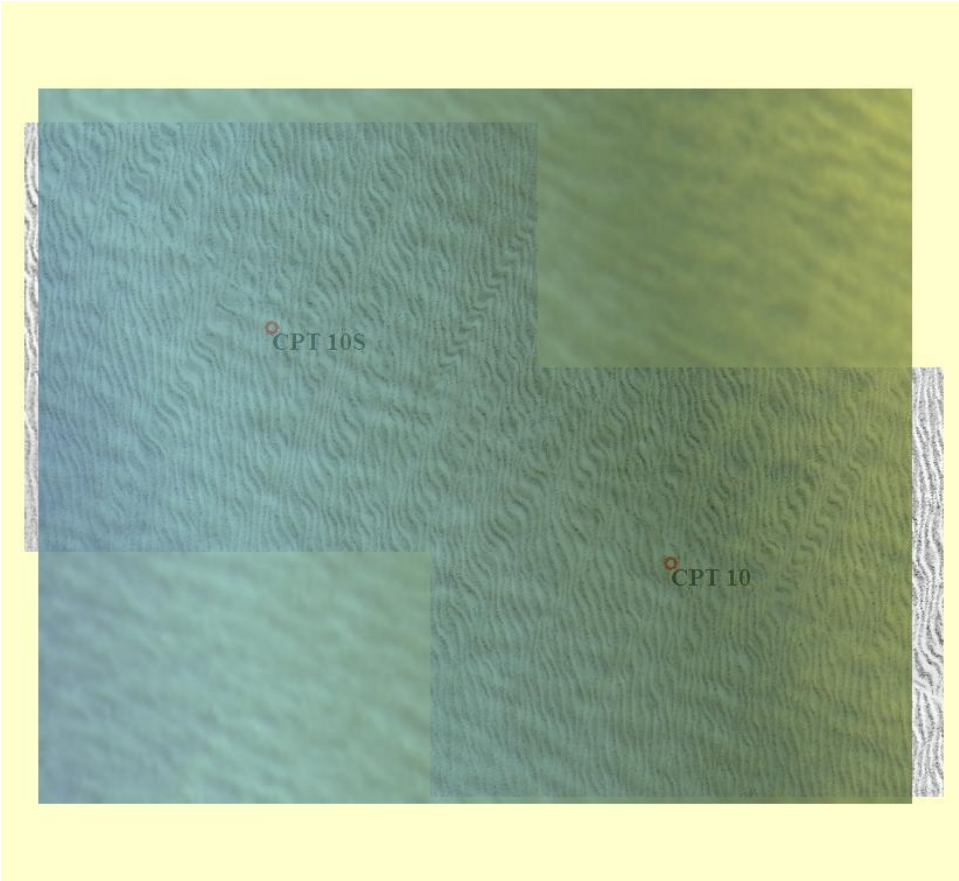
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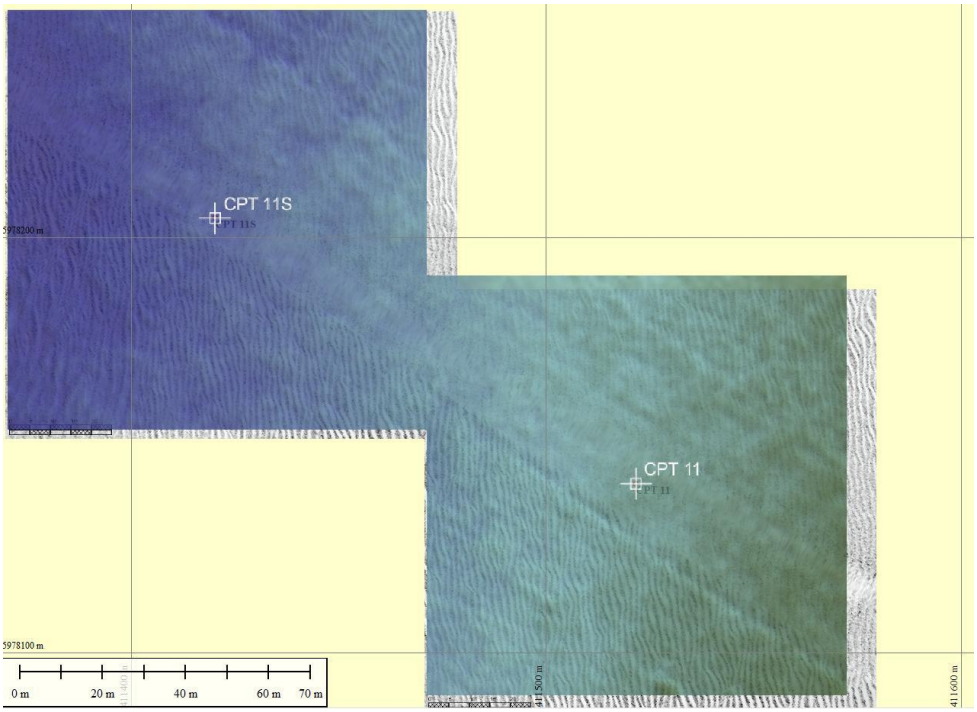
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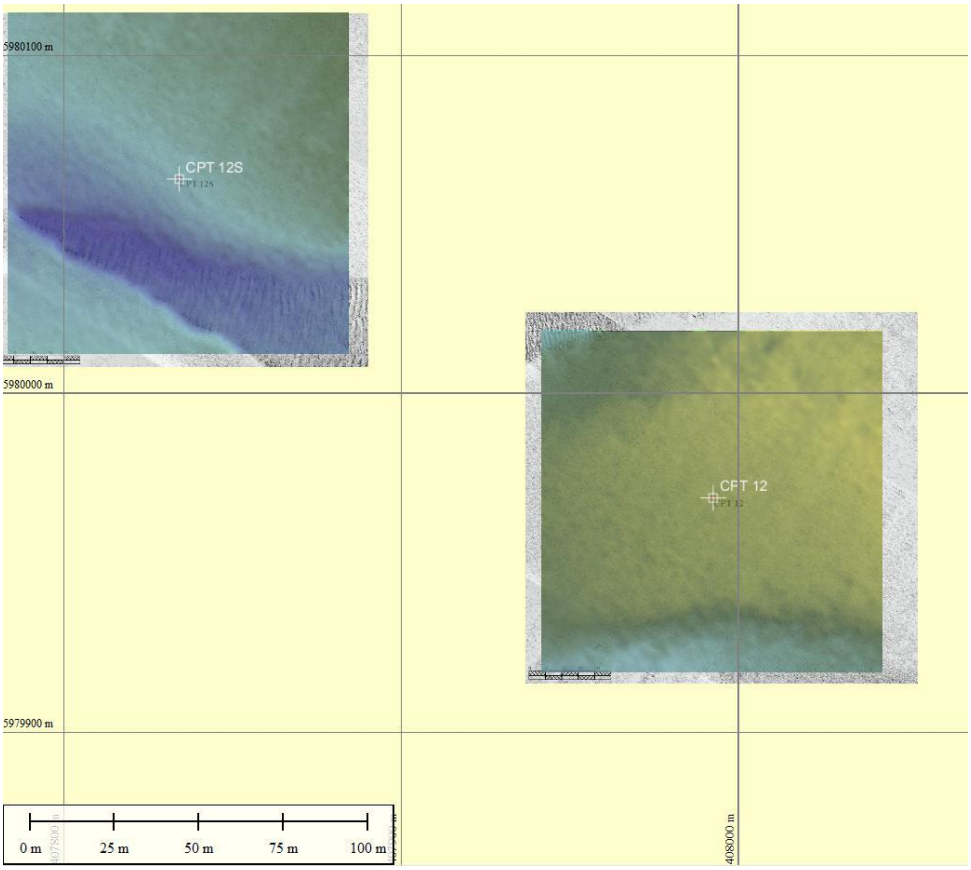
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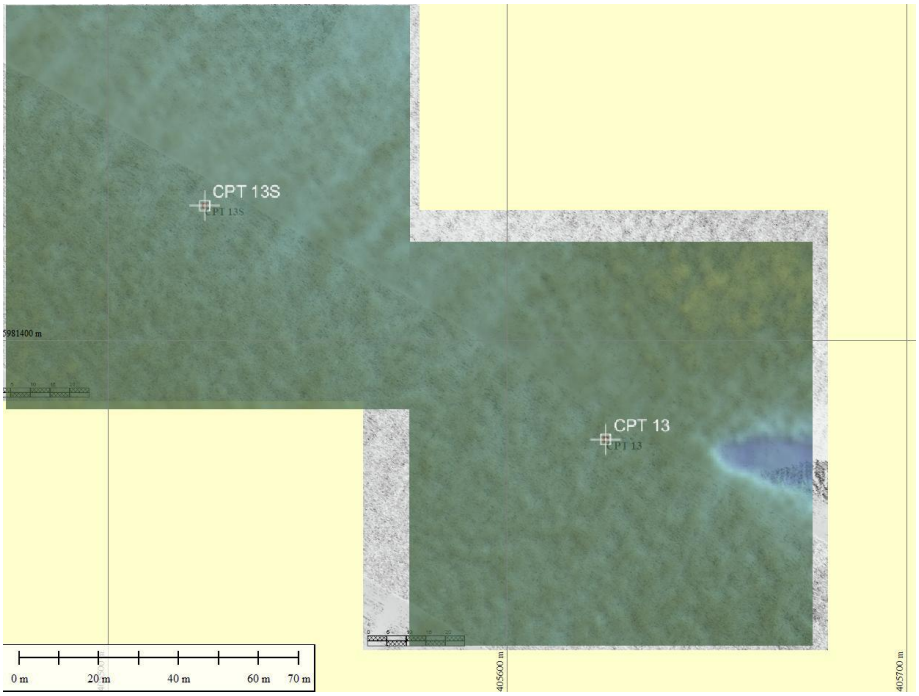
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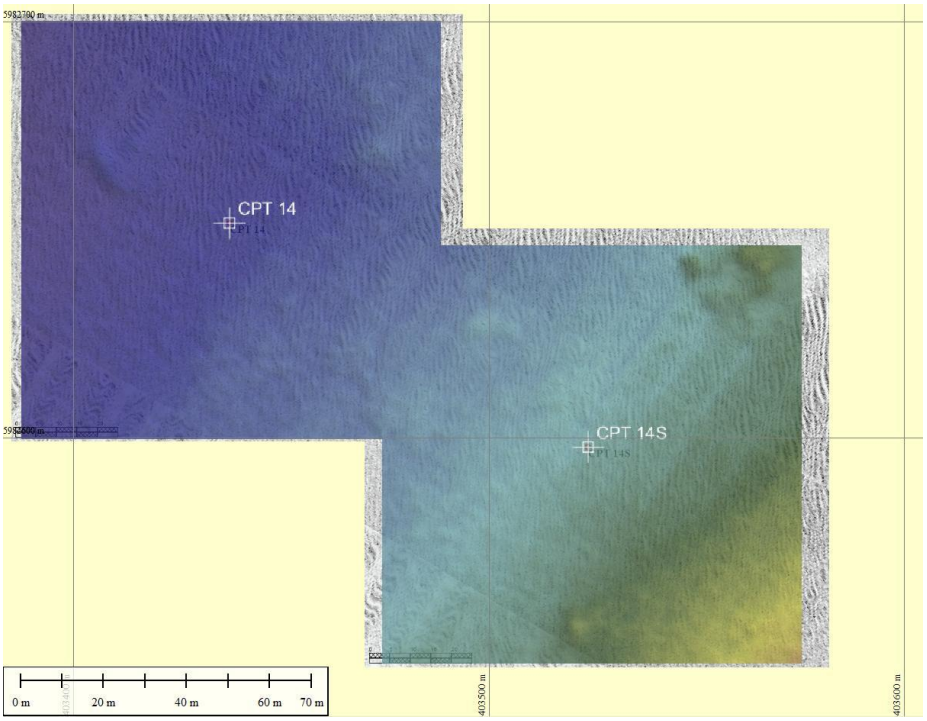
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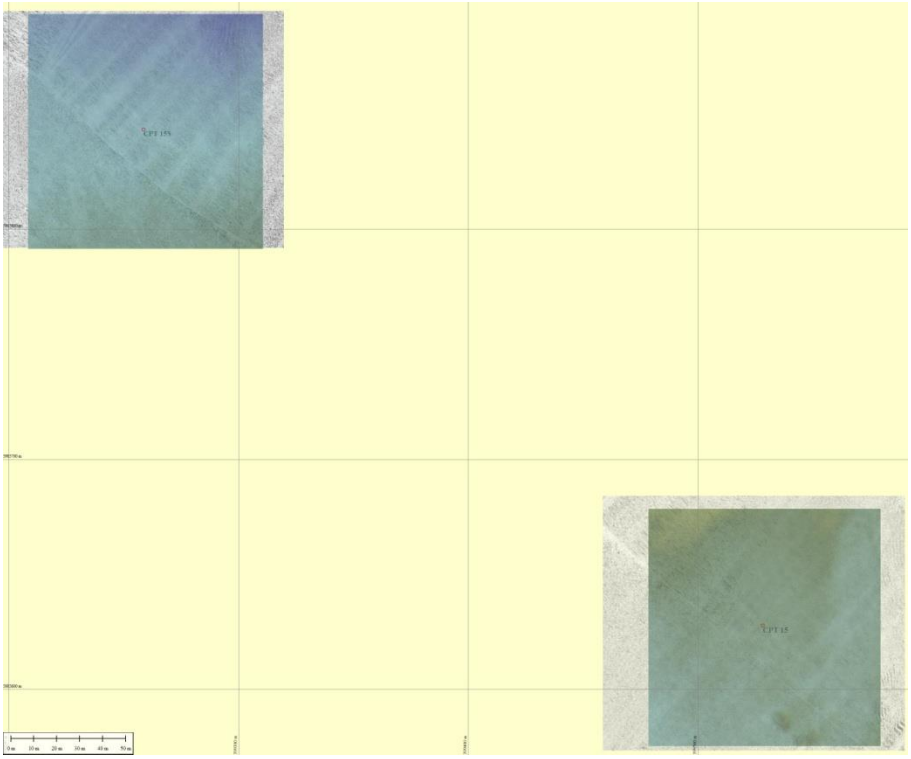

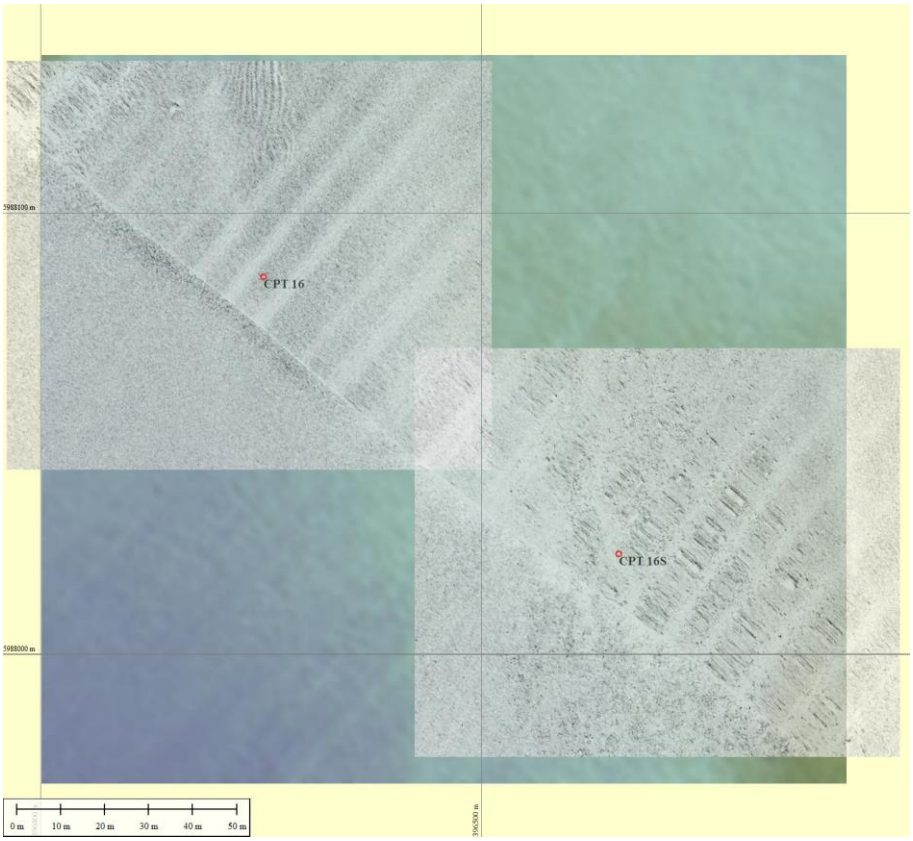
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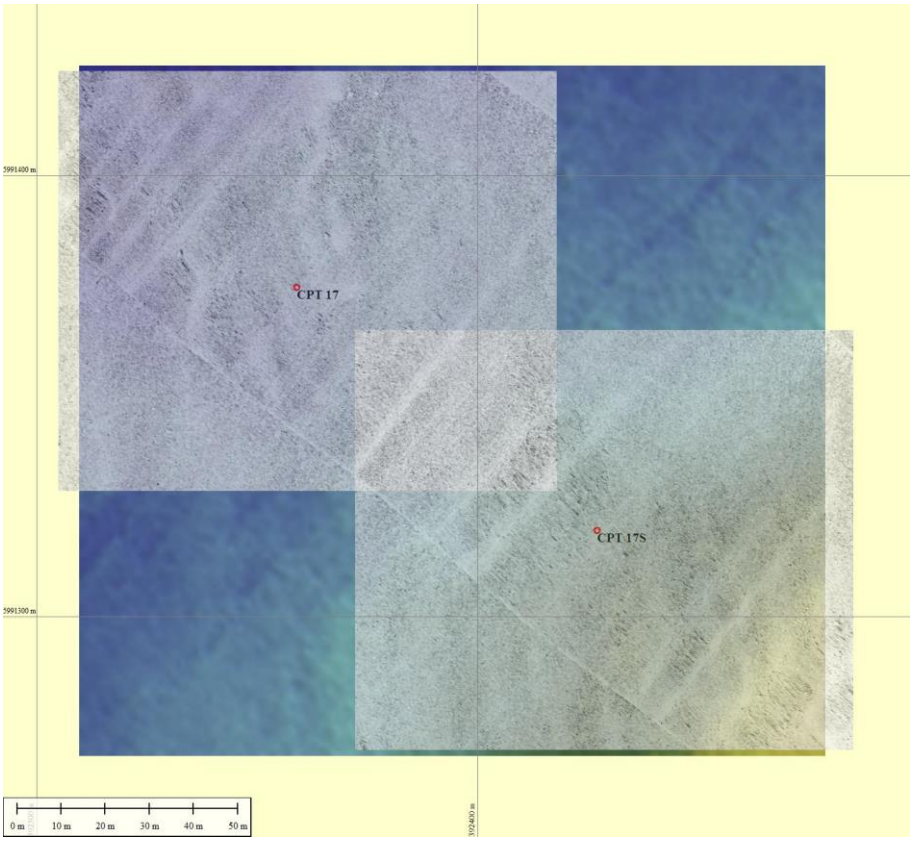
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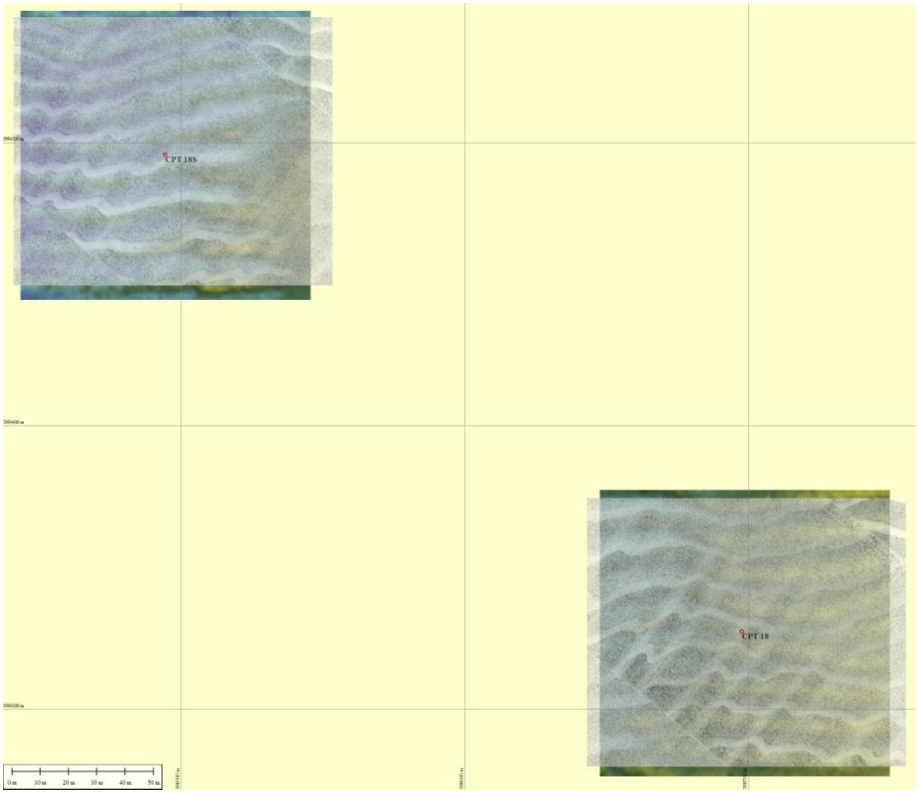
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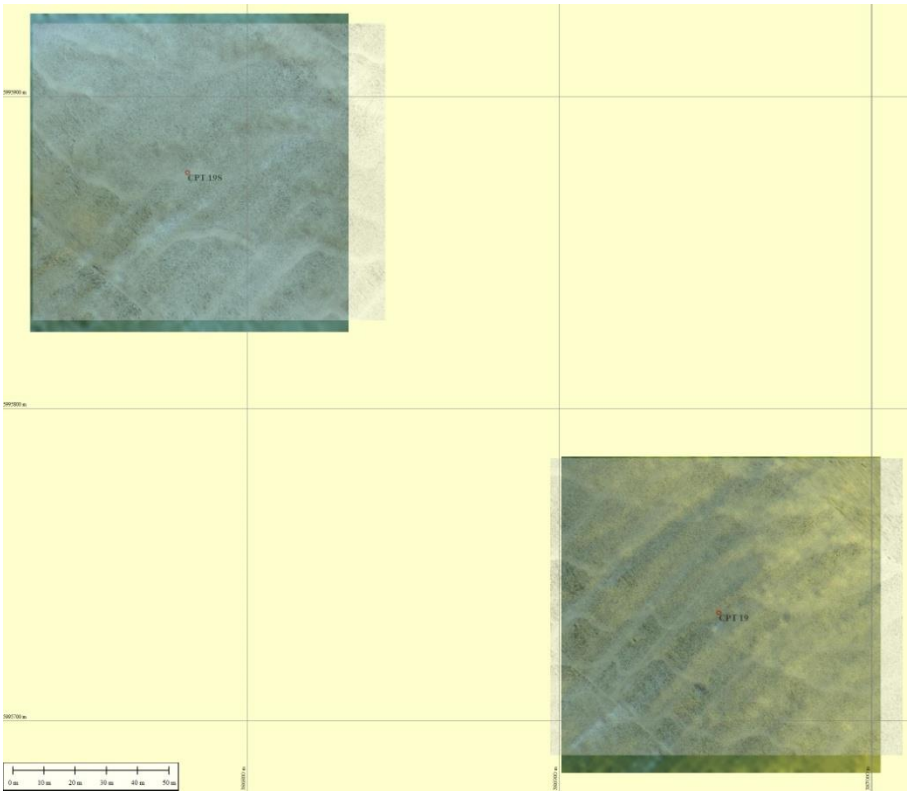
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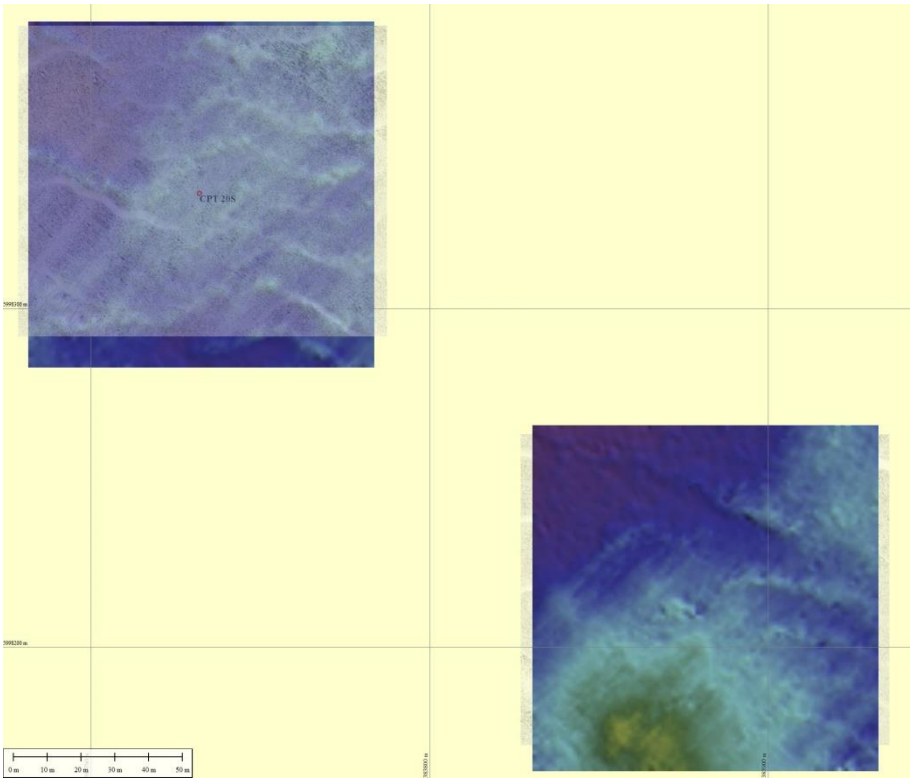
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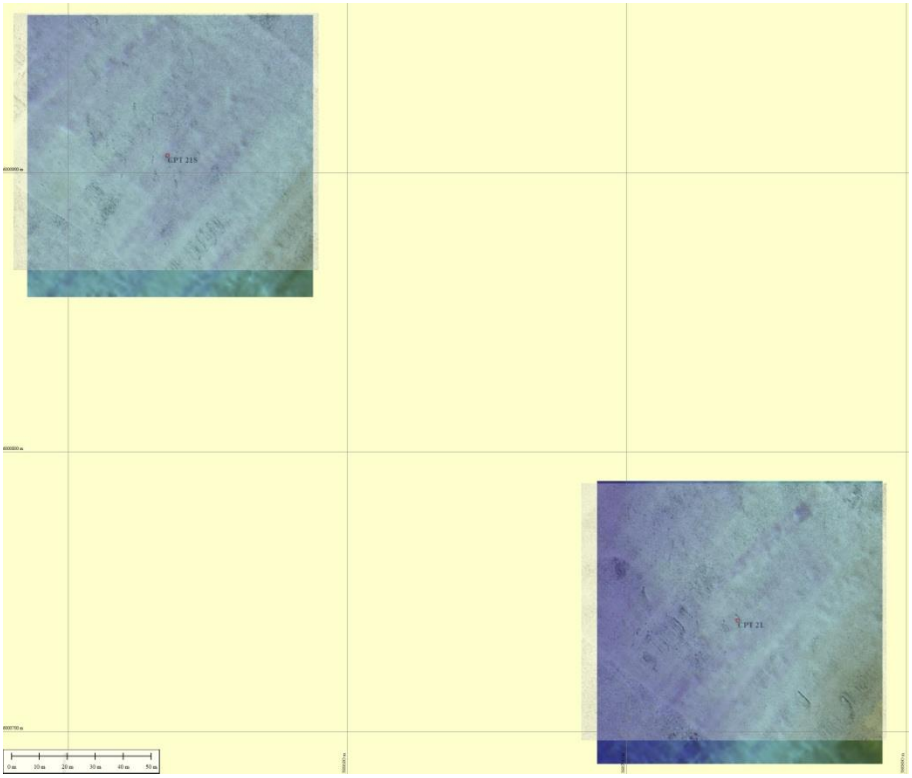
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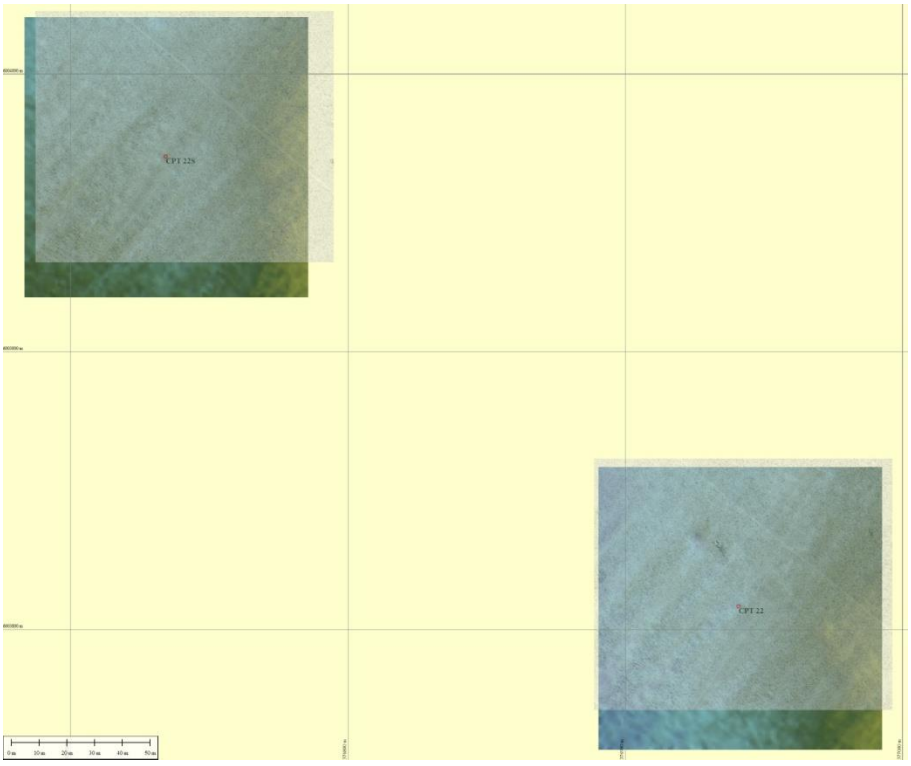
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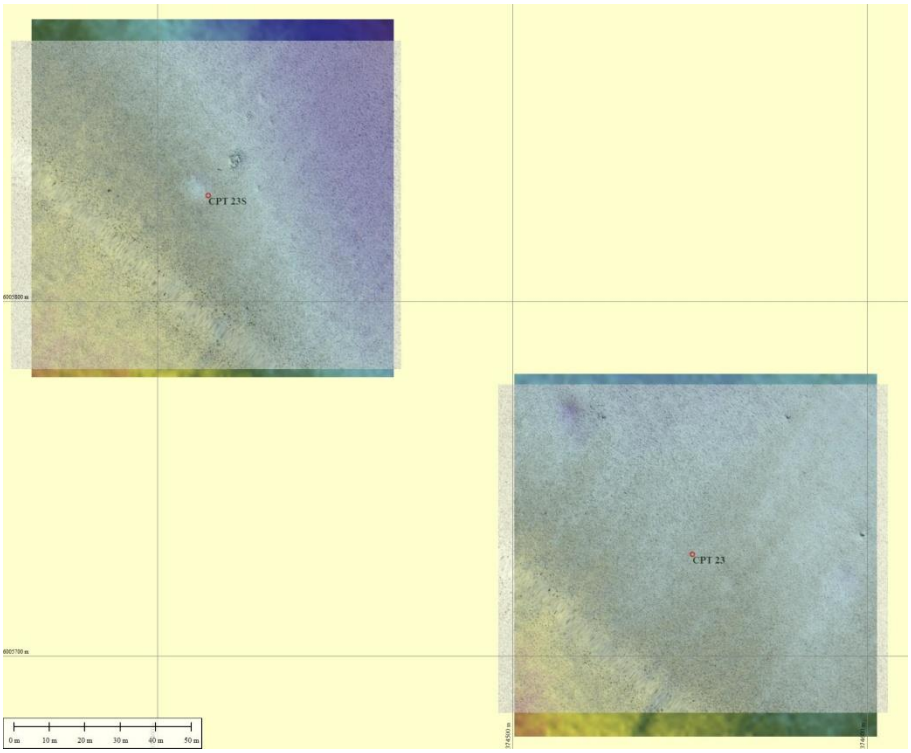
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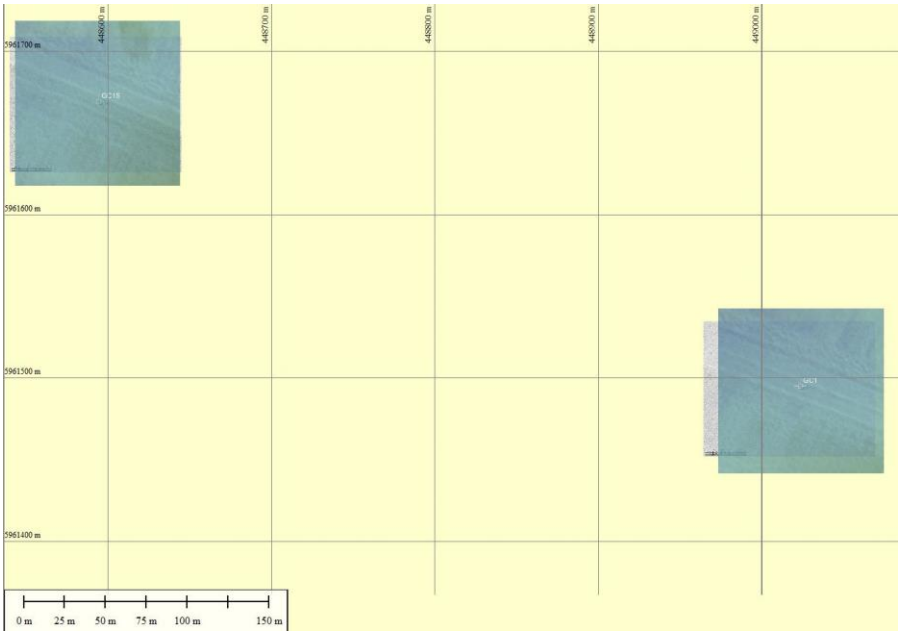
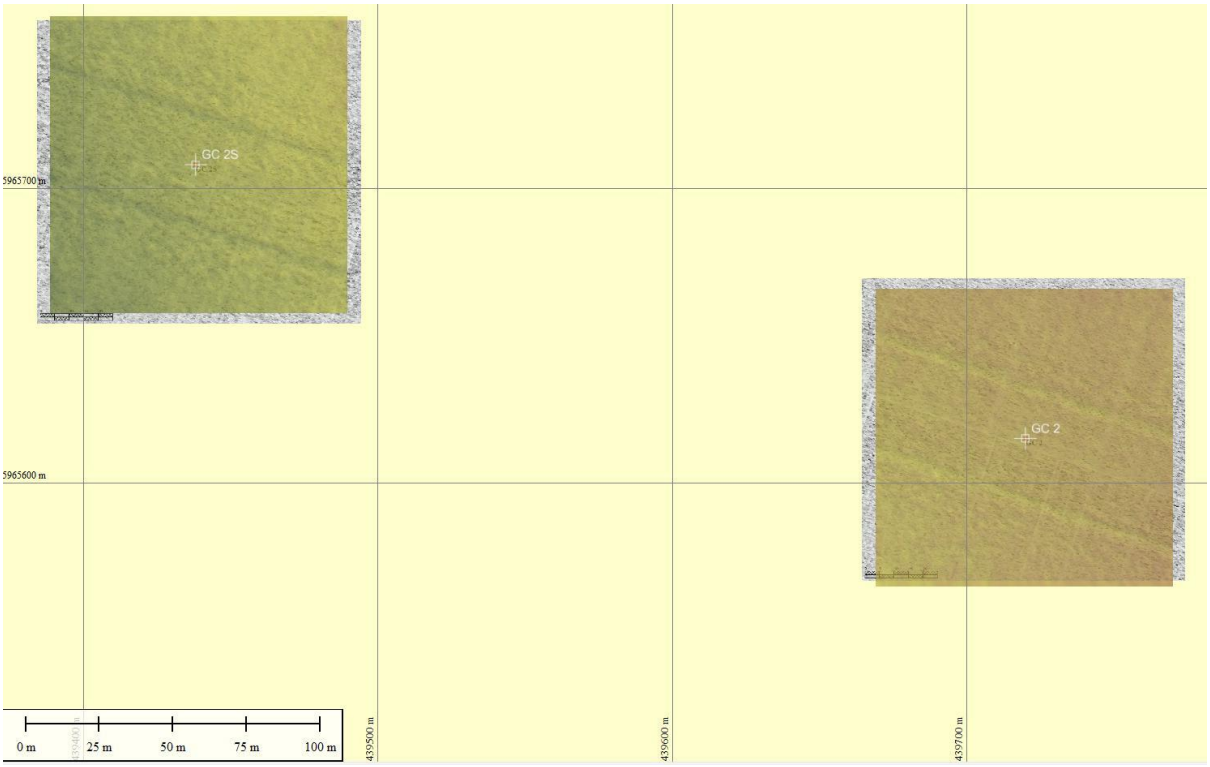
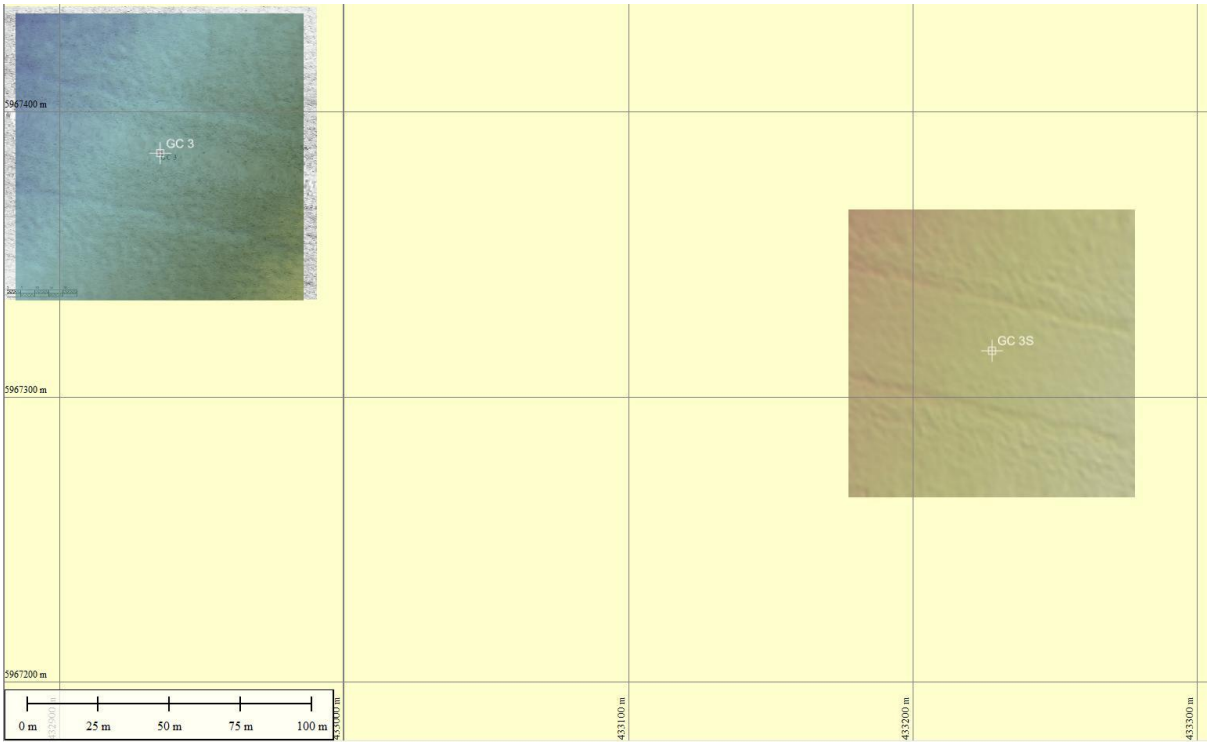
Appendix 2 – Grab Sample Location Charts



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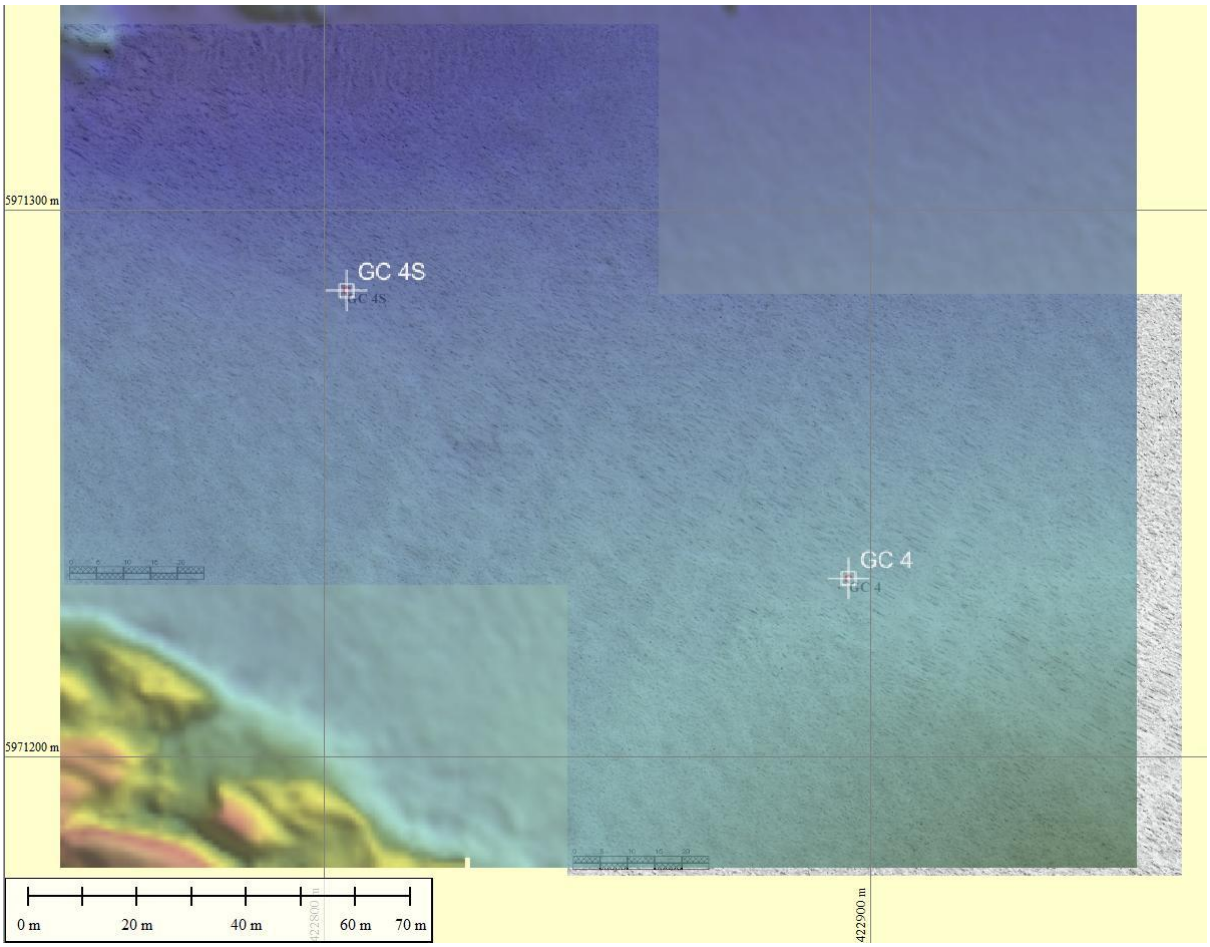
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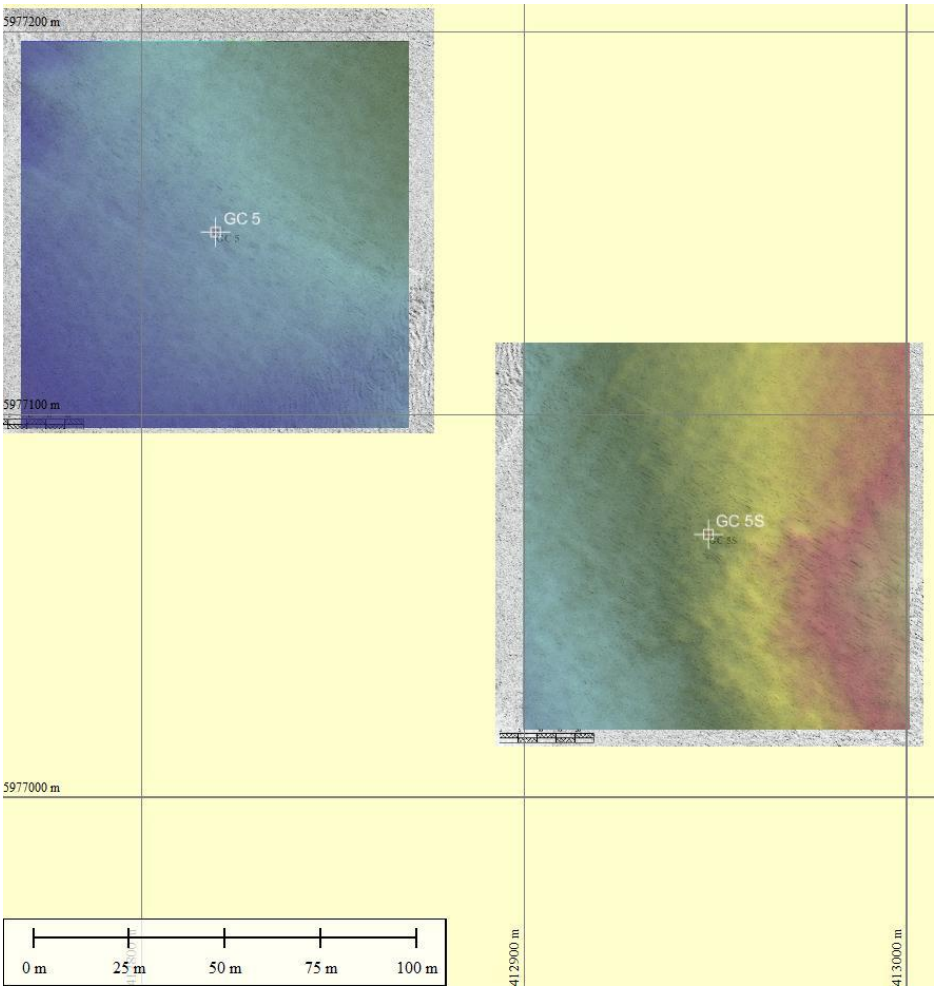
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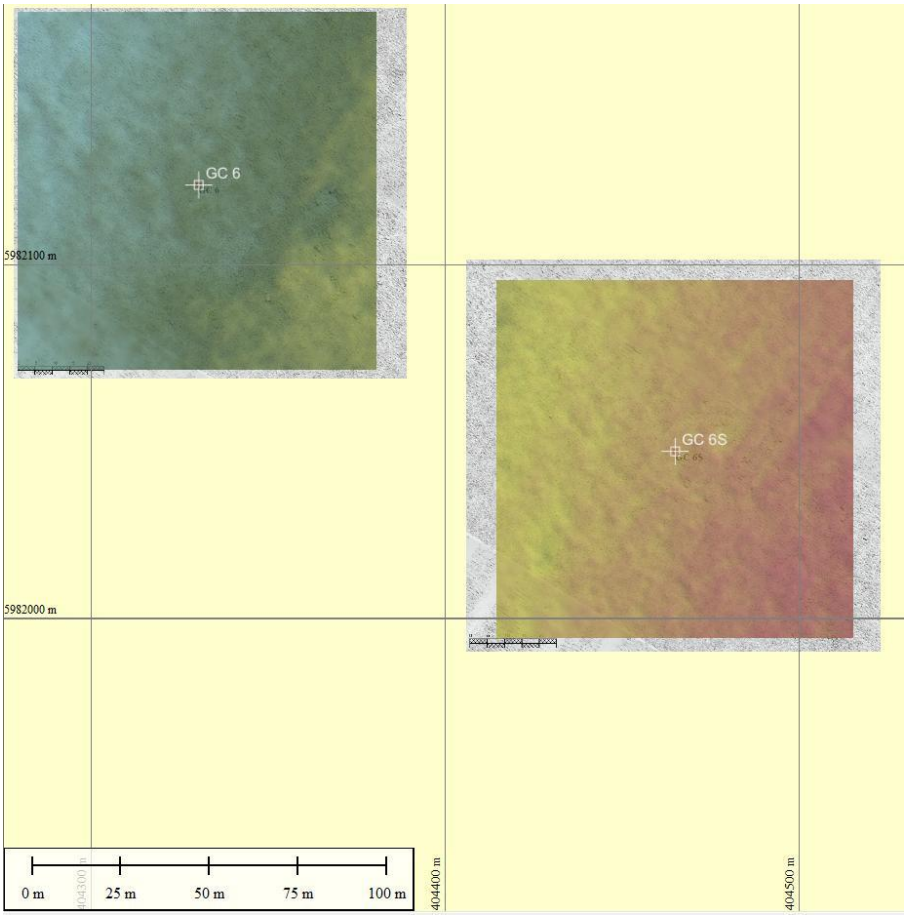
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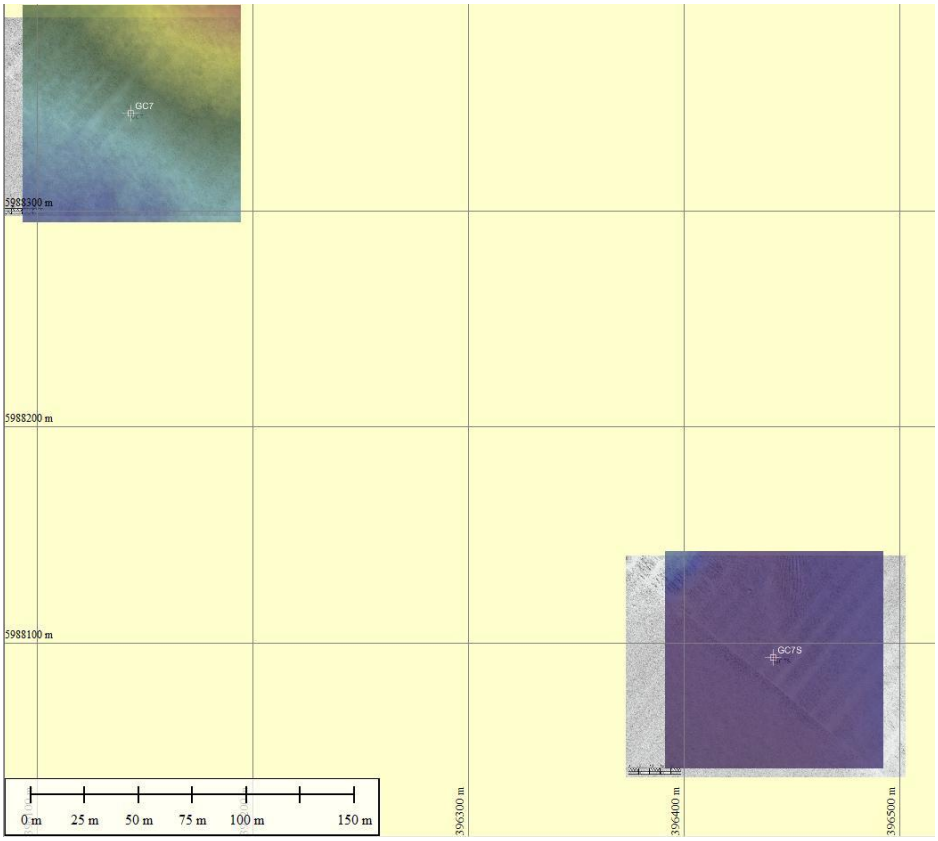
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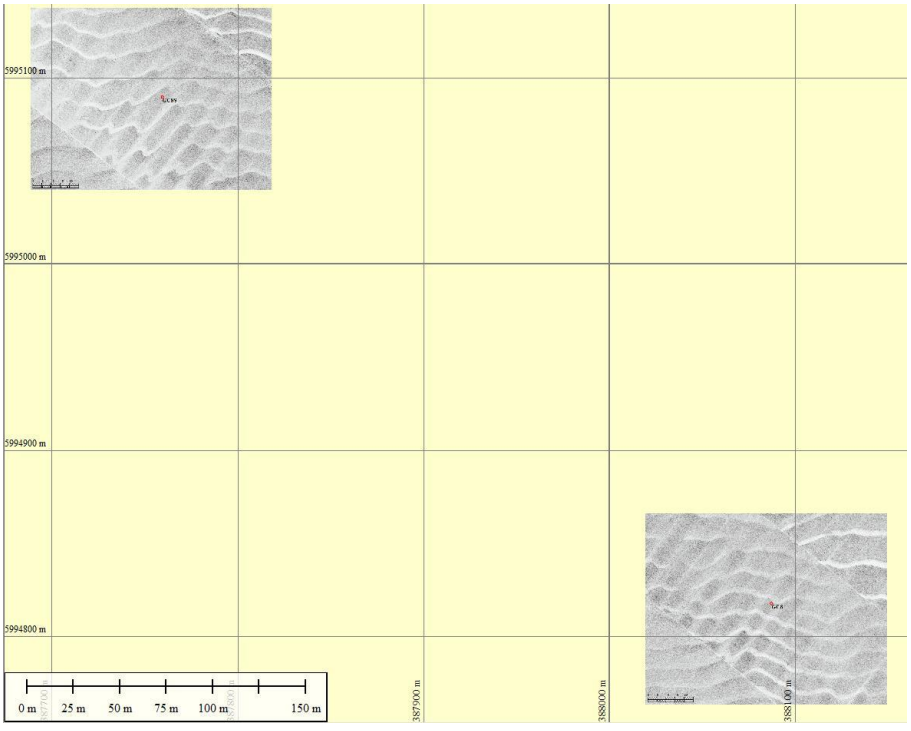
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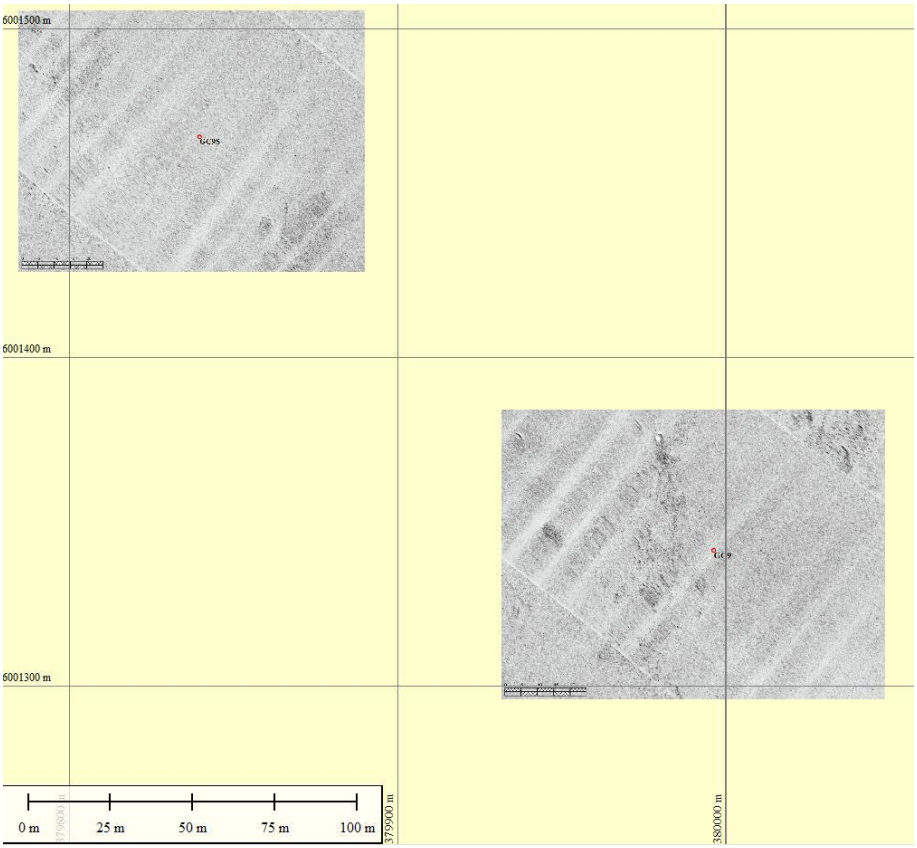
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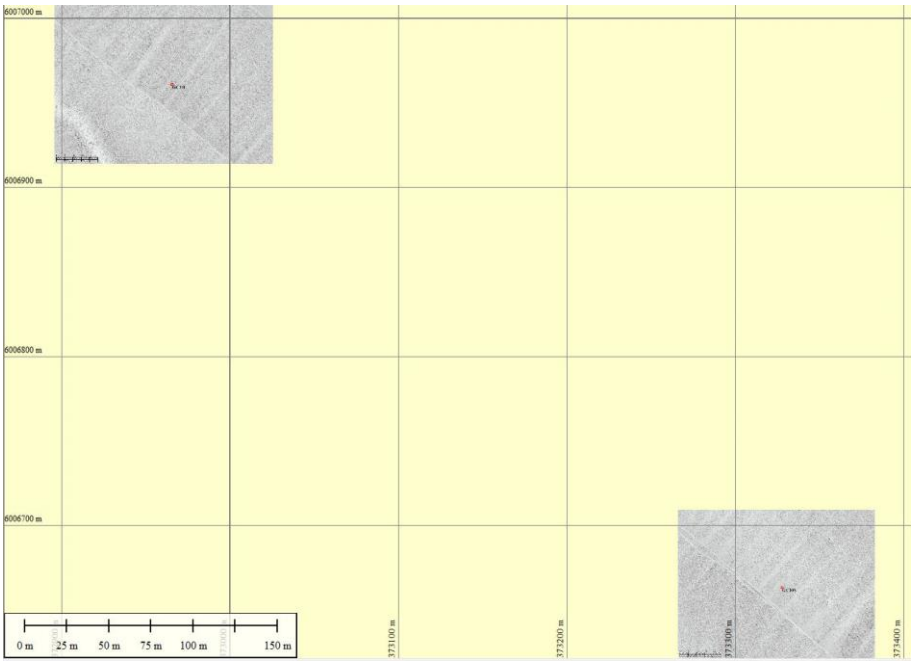
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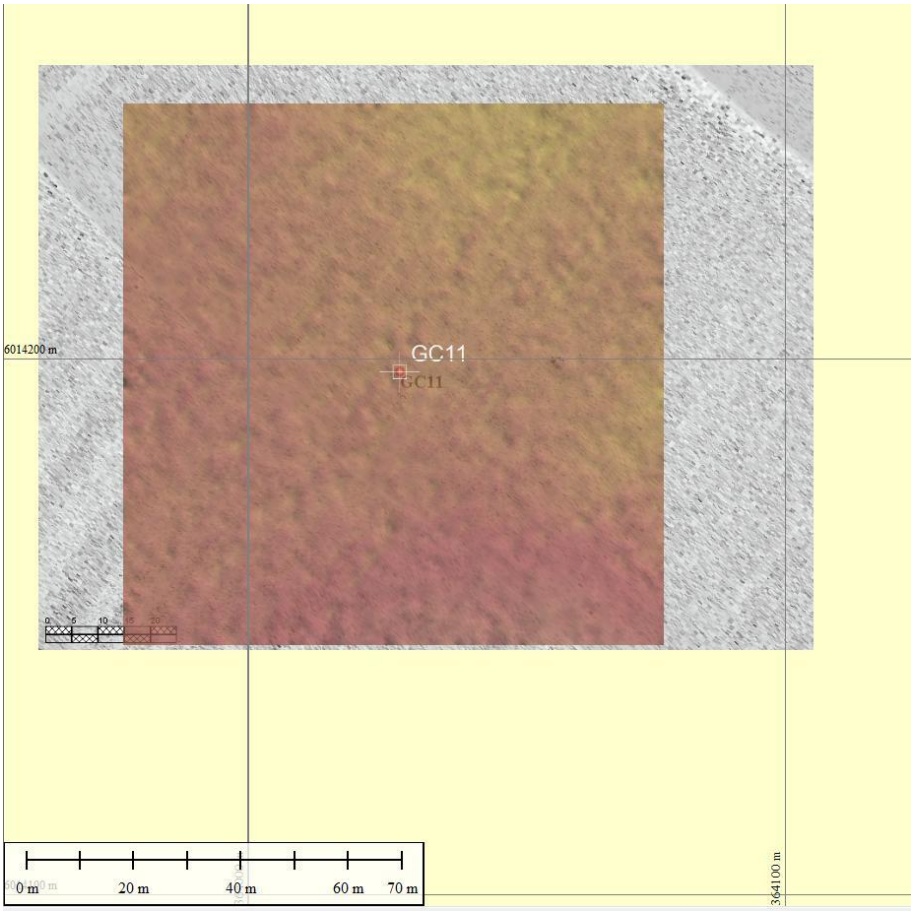
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APPENDIX 10-2

MARINE ARCHAEOLOGICAL ASSESSMENT OF PREFERRED ROUTE

Marine Archaeological Assessment of the Preferred Route within the Havfrue Cable Route Corridor

Client: McMahon Design and Management

Author: [redacted] *and* [redacted]

Checked By: [redacted]

Job No. [redacted]

Date: 05/10/2018

Detection Device Licence: [redacted]

Geo-Mara Ltd. CoisCuain, Ballynamanagh, Clarinbridge, Co. Galway, Ireland
Tel: + 353 876485228, Email:info@geo-mara.com, Web: www.Geo-Mara.com

Contents

Non-Technical Summary

McMahon Design and Management on behalf of TE Subcom commissioned Geomara Ltd. to undertake a marine archaeological assessment in connection with the proposed Havfrue Fibre Optic Cable making landfall at Old Head Beach, Co. Mayo.

This report outlines the measures taken to ameliorate the archaeological impacts as a result of pre installation work on the Havfrue transatlantic cable. It specifically details the results of the archaeological assessment of the geophysical and geotechnical survey data. It also proposes appropriate measures to mitigate any impacts on cultural heritage resources. The report addresses the section of the Havfrue fibre optic cable system within the Irish jurisdiction.

The Site Investigation Licence (18R004) was granted by the Department of Housing, Planning and Local Government on 08.05.2018.

The assessment comprises an introduction to the study area; and the identification of cultural heritage sites, features and deposits located along the proposed cable route corridor. In order to provide a comprehensive assessment, an extensive desk-based study of the route corridor has been undertaken. The desk based study has been followed up by an extensive review of the geophysical data. The results of the archaeological screening of the proposed geotechnical locations along the route corridor and the monitoring of the beach probing at Old Head also form part of the assessment.

The desk study revealed one known cultural heritage asset located on the foreshore at Old Head, Louisburgh, Co. Mayo, the possible remains of a wreck (**W11423**) or the Coastguard Station or the Salt Pans which is recorded as in ruins on the 1st Ed. 6 inch OS map. During the course of data acquisition one previously unknown wreck site was noted 126m to the south west of the centreline of the RPL at Kp126.522.

The following mitigation recommendations are presented in connection with the proposed cable installation:

1. The cable installation on the beach at Oldhead and the construction of the beach manhole should be the subject of archaeological monitoring.
2. Archaeological monitoring of the prelay grapnel run should be undertaken in order to identify any previously unrecorded features finds or deposits.
3. All plough trenching should be the subject of archaeological monitoring
4. It is recommended that procedures should be put in place to ensure that any previously unrecorded cultural heritage assets encountered during the project should be assessed by a suitably qualified archaeologist and avoided by the cable laying operations.
5. Should the proposed cable route be subject to further revision, details of these revisions should be forwarded to the project archaeologist for assessment.
6. On completion of the cable installation a report will be produced summarising all archaeological aspects of the project and submitted to DAHG and the National Museum of Ireland

1 Introduction

McMahon Design and Management on behalf of TESubcom commissioned Geomara Ltd. to undertake a marine archaeological assessment in connection with the proposed Havfrue Fibre Optic Cable making landfall at Old Head Beach, Co. Mayo.

This report outlines the measures taken to ameliorate the archaeological impacts as a result of pre installation work on the Havfrue transatlantic cable. It specifically details the results of the archaeological assessment of the geophysical and geotechnical survey data. It also proposes appropriate measures to mitigate any impacts on cultural heritage resources. The report addresses the section within the Irish jurisdiction.

The assessment comprises an introduction to the study area; and the identification of cultural heritage sites, features and deposits located along the proposed cable route corridor. In order to provide a comprehensive assessment, an extensive desk-based study of the route corridor has been undertaken. The desk based study has been followed up by an extensive review of the geophysical data. The results of the archaeological screening of the proposed geotechnical locations along the route corridor and the monitoring of the beach probing at Old Head also form part of the assessment.

The potential impact of the proposed scheme on the receiving environment is addressed and mitigation measures to ameliorate these impacts are presented.

2 Project Details

A new transatlantic telecom system, HAVFRUE, is being planned from New Jersey in the USA to Blaaberg in Denmark with a branching units to Old Head, Co. Mayo and Kristiansand Norway. The project is being developed by America Europe Connect 2 (AEC2) Ltd, an Irish company who have recently constructed the AEC 1 transatlantic cable system. The system is being designed and will be installed by TE SubCom on behalf of AEC 2.

2.1 Location

The proposed cable route comprises a 500m corridor over a distance of71.571km, extending from the limit of the Irish territorial waters in a NW- SE orientation to run between Achill Island and Clare Island and into Clew Bay before turning south to make landfall at Old Head Beach on the south side of Clew Bay

Figure 1. HAVFRUE cable route from 12NM limit to landfall at Oldhead

Figure 2. HAVFRUE cable route through Clew Bay

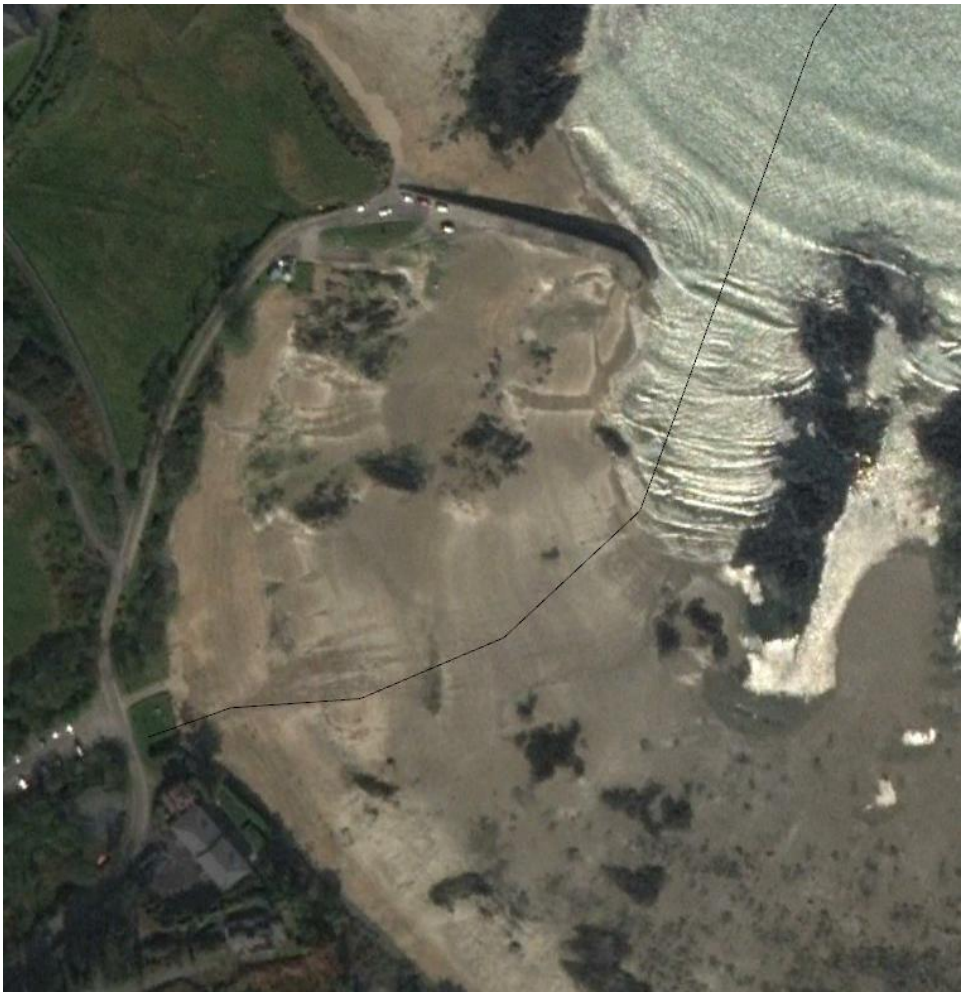


Figure 3. Havfrue cable route at the landfall at Oldhead

2.2 Planning Background

All project permits for operations in Irish waters were in place before the start of survey operations. The Detection Device Licence was granted by the Department of Culture, Heritage and the Gaeltacht on 14.03.2018.

The Method Statement accompanying the detection device licence outlined the measures required to ameliorate the impacts of the proposed geotechnical works;

- As the geophysical survey proceeds, on-board processing and charting will be carried out in a 200m zone around the seven specific sampling/ vibrocore locations. The data and charts will be e-mailed to shore for review by a licensed Marine Archaeologist.
- The shore based marine archaeologist will then analyse the charts and data for the presence of unrecorded seabed and subsea bed archaeological features finds or deposits.
- Only where no such features are identified within the 200m zone surrounding the proposed sampling location will the sampling proceed.

The Site Investigation Licence was granted by the Department of Housing, Planning and Local Government on 08.05.2018.

The second specific condition of the Site Investigation Licence states that;

2. The Licensee shall ensure that the mitigation measure set out in Section 7 of the document entitled "Marine Archaeological Assessment of a proposed Marine Survey and Site Investigation Works within the Havfrue Cable Route Corridor", Prepared by Geo-Mara Ltd, dated 19th December 2017 are implemented in full.

Section 7 of the report states;

The following mitigation recommendations are presented in connection with the proposed cable:

1. It is recommended that all sites of cultural heritage interested included in this report are avoided.

2. Inspection and testing at the 3 No. proposed trial pits on the sea shore at Old Head should be archaeological led. Where archaeological features, finds or deposits are identified the trial pit shall be abandoned and the cable route and consequent trial pit locations will be revised.

3. The proposed bathymetric and geophysical survey results should be assessed by a suitably qualified archaeologist prior to any site investigations. A line plan showing number of survey lines as a function of depth will be provided prior to start of survey operations. Any previously unrecorded archaeological seabed or sub-seabed features will be avoided by rerouting the cable route as well as any proposed site investigations.

4. The proposed Diver Swim Survey will comply with the requirements of the Underwater Archaeology Unit of the Department of Culture, Heritage & the Gaeltacht. Results of dive swim survey to be assessed by a suitably qualified archaeologist. A diver swim survey (spot dive) may be required to investigate and identify any obstacles or archaeological features found during the small boat survey up to safe diving limits.

5. Should the proposed cable route be subject to further revision, details of these revisions will be forwarded to the project archaeologist for assessment

6. On completion of the surveys and site investigations a report will be produced summarising all archaeological aspects of the project and submitted to DCHG and the National Museum of Ireland

2.3 Route Position List

The route position list has changed on numerous occasions as a result of preliminary assessments and other operational considerations. On the 31st of July 2018 issue 8 was issued and this was used

for all of the charting and survey reporting. The latest revision Issue 9 is shown in Appendix 1. It differs in only very minor respects to previous revisions.

Below is a table showing key turning points.

KEY TURNING POINTS (TO WGS-84)			
Turning Point	**Chainage**	**Latitude**	**Longitude**
TP 0	0	53°46'35.88	09°46'14.24
TP 1	0.02	53°46'35.86	09°46'13.25
TP 2	0.06	53°46'36.00	09°46'10.85
TP 3	0.18	53°46'38.24	09°46'05.51
TP 4	0.38	53°46'44.10	09°46'01.80
TP 5	1.11	53°47'05.34	09°45'43.86
TP 6	1.787	53°47'26.88	09°45'42.36
TP 7	2.407	53°47'45.93	09°45'52.99
TP 8	2.963	53°47'56.39	09°46'17.71
TP 9	7.597	53°48'51.35	09°50'11.53
TP 10	11.071	53°49'46.00	09°52'59.32
TP 11	15.272	53°50'26.93	09°56'38.40
TP 12	17.075	53°50'39.70	09°58'14.61
TP 13	26.27	53°51'42.61	10°06'26.24
TP 14	54.855	53°59'16.68	10°29'10.73
TP 15	71.541	53°04'44.22	10°41'19.37
TP 16	95.658	53°12'37.62	10°58'55.31

Table 1. Route Position List (WGS84)

2.4 Legislative framework

This assessment takes into account the following legislative procedures and guidelines:

- The National Monuments Act (1930-2004),
- The Foreshore Act (1933),
- Merchant Shipping Act (1995);
- Valetta Convention;
- ICOMOS; and
- UNESCO

3 Assessment Methodology

Archaeological assessment has been described as "the overall process of assessing the impact of a development" (DAHGI, 1999, Policy and Guidelines on Archaeological Excavation. Govt. Publications Office, Dublin).

The principle aim of assessment is to anticipate and avoid impacts on the archaeological resource. Archaeological assessment may be required as part of the planning process in response to developments which may be located in the vicinity of archaeological monuments (The Heritage Council. 2000).

This document has been prepared with reference to specific criteria set out in the Guidelines on Information to be Contained in an Environmental Impact Statement (EPA 2002) and the Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA 2003).

This report details 6individual phases, all of which followed in succession and contributed towards the complete assessment of the project. These phases were:

- Desktop Study
- Screening of Geotechnical Locations
- Beach Probe Monitoring
- Geophysical Survey Review and Monitoring
- Impact Assessment
- Provision of suggested mitigatory measures

3.1 Desk Based Assessment

The desk-based assessment is a documentary and cartographic search utilising a number of sources in order to locate all known cultural heritage assets within the study area and within the general location of the proposed cable route. An additional purpose of the desktop study is to provide an historical and archaeological background to the subject site.

Geomara consulted the following sources:

- Local and National Libraries
- The National Monuments and Site Register,
- The National Museum – topographical files included in the Heritage Council Heritage maps database (The hard copy topographic files were not available for the month of December)
- The Geological Survey of Ireland – aerial photographs,
- Examination of historic maps and related sources,
- The Architectural Archive of Ireland,
- The National Archives of Ireland,
- Historic Annals,
- Lewis' Topographical Dictionary
- Mayo County Development Plan (2014-2020)
- Genealogical Societies and Local Historical Societies.
- The Ports and Harbour Archive
- The National Shipwreck Inventory

A variety of sources have been consulted to provide information on potential impacts and the relationship of the proposed cable route within the wider maritime context to include all known maritime and terrestrial cultural heritage assets. Together these provide an overview of the proposed cable route and its surroundings which can then be used to determine areas of archaeological potential.

3.2 Screening of Geotechnical Locations

As the geophysical survey proceeded, on-board processing and charting was carried out in a 200m zone around the specific sampling/vibrocore locations. The data and charts were emailed to shore for review by a licensed Marine Archaeologist.

The shore-based Marine Archaeologist then analysed the charts and data for the presence of unrecorded seabed and subsea bed archaeological features finds or deposits.

It was agreed in advance by all project parties that only where no such features were identified within the 200m zone surrounding the proposed sampling location did the sampling proceed.

The multibeam and sidescan geotiffs of the proposed primary and secondary geotechnical locations were imported into Global Mapper a GIS program. They were analysed and a chart of each location was produced.

3.3 Beach Probe Monitoring

Beach probing was carried out at 19 locations along the proposed corridor at Old Head beach on the 31st May 2018. The beach probing was conducted to investigate the depth of sand deposits along the beach and was monitored by a licensed archaeologist.

3.4 Geophysical Survey Review and Monitoring

The results from the bathymetric and geophysical surveys conducted along the route corridor were assessed from an archaeological perspective. Multibeam and sidescan geotiffs and charts of the entire survey corridor were examined in order to identify archaeological features, finds or deposits on the seabed. The bottom obstruction report and the contact report produced by Fugro (survey contractors) lists all of the seabed features revealed by the sidescan and magnetometer surveys. Each identified feature is given a unique reference code. The contact report was also reviewed to identify any potential archaeological features. The Sub bottom profiles, in particular those from the nearshore, were also reviewed in order to assess the potential for submerged archaeological landscape features.

4 Existing Environment

4.1 Introduction

In describing the receiving environment, the context, character, significance and sensitivity of the baseline receiving environment into which the proposed development will fit is assessed. This takes account of any other proposed developments that are likely to proceed.

4.2 Planning Context in Relation to Archaeology and Cultural Heritage

The Mayo County Development Plan 2014-2020 addresses issues relating to Cultural Heritage and sets out a wide range of policies under a number of sub headings. This assessment takes account of all the stated policies and related objectives.

Appendix VIII of Section 2 of the County Development Plan also contains a list of Major Sites of Archaeological Importance in the County in State Ownership or Guardianship and National Monuments in Mayo that are the subject of Preservation Orders. Section 7 contains the List of Structures on the Record of Protected Structures for County Mayo.

4.3 Archaeology

For archaeological sites and material, the Mayo County Development Plan 2014-2020 includes the following policies:

- Protect the archaeological heritage and especially sites identified in the Record of Monuments and Places, National Monuments in the ownership or guardianship of the State, and National Monuments that are the subject of Preservation Orders, and to safeguard the integrity of the archaeological sites in their setting.

- Require that planning applications within the zones of archaeological potential as outlined in the Record of Monuments and Places include an archaeological assessment as set out in the Development Guidance document.
- Require that all large-scale planning applications (i.e. development of lands on 0.5 ha or more in area or 1km or more in length) include an archaeological assessment as set out in the Development Guidance document16
- Facilitate appropriate guidance in relation to the protection of the archaeological heritage in the County.
- Promote public awareness and appreciation of the archaeological heritage of the County.
- Protect the tentative World Heritage Site in Mayo on the UNESCO Tentative List - Ireland 2010, The Céide Fields, from inappropriate development and support its nomination to World Heritage Status.
- Facilitate public access to National Monuments in State care or in the ownership of the State where it can be demonstrated that the development will not have significant adverse effects on the environment, the integrity of the Natura 2000 network, residential amenity or visual amenity.
- Ensure the preservation of National Monuments that are the subject of Preservation Orders and features of archaeological interest in areas that are identified as Zones of Archaeological Potential in the Record of Monuments and Places.
- Protect, enhance and promote awareness of the industrial heritage of the County.
- Protect historic burial grounds within the County and encourage their maintenance in accordance with best conservation principles.

4.4 Architecture

The Planning and Development Act 2000 (Part II, Section 10) places an obligation on all Local Authorities to include in its Development Plan objectives for the protection of structures or parts of structures, which are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. These buildings and structures are compiled on a register known as the Record of Protected Structures (RPS), and are outlined in Section 7 of the Mayo County Development Plan 2014-2020.

The following policies are considered relevant:

- AH-01 It is an objective of the Council to protect buildings and structures included in the Record of Protected Structures (RPS) which forms part of this Plan (Volume 4).
- AH-02 It is an objective of the Council to review the Record of Protected Structures including taking into consideration ministerial recommendations arising from the National Inventory of Architectural Heritage and add structures of special interest as appropriate, including industrial, maritime or vernacular heritage.

- AH-03 It is an objective of the Council to ensure that any development, modification, alteration, or extension affecting a Protected Structure and/or its setting is sensitively designed and sited and is appropriate in terms of the proposed materials, scale, density and layout, impact on historic features and junction with the Protected Structure and would not detract from the special interest, character and setting of the Protected Structure.
- AH-04 It is an objective of the Council to promote and improve the understanding of the architectural heritage of Mayo.
- AH-05 It is an objective of the Council to ensure that any new development or alteration to a building within or adjoining an Architectural Conservation Area positively enhances the character of the area and is appropriate in terms of the proposed materials, scale, density and layout, proportions, plot ratio and building lines.
- AH-06 It is the objective of the Council to identify places of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest and to define them as Architectural Conservation Areas and to undertake an assessment to inform the potential ACA designation for the following areas:

a) Ballinrobe
b) Killala
c) Pontoon
d) Dugort

- AH-07 It is an objective of the Council to protect the character of an Architectural Conservation Area and to prohibit the demolition of a structure that positively enhances the character of an Architectural Conservation Area, except in very exceptional circumstances. Where demolition is granted an assessment of the impact of the replacement structure on the character of the Architectural Conservation Area will be required.
- AH-08 It is an objective of the Council to require that proposals for development within historic gardens, demesnes and estates include an appraisal of the designed landscape prior to the initial design of any development, so that this evaluation informs the design and respects the built heritage and horticultural elements of the site.
- AH-09 It is an objective of the Council to protect buildings and features of industrial and maritime heritage.
- AH-10 It is an objective of the Council to promote the sympathetic maintenance and re-use of vernacular built heritage and to encourage the retention of original fabric such as windows, doors, renders, pub/shop-fronts, roof coverings and interiors etc.
- AH-11 It is an objective of the Council to promote the sympathetic maintenance of traditional features and other built heritage such as stone walls and other elements such as post-boxes, water pumps, paving etc.

- AH-12 It is an objective of the Council to ensure that measures to upgrade the energy efficiency of Protected Structures and historic buildings do not damage the historic fabric.
- AH-13 It is an objective of the Council to promote a high quality built environment by encouraging excellence in design (both rural and urban); and innovative design and site layout solutions that address concerns of environmental sustainability, with regard to matters such as energy efficiency, use of materials etc.

4.5 Landscape Character Areas

The Mayo County Development Plan recognises that the county's landscape is not homogenous, and neither are the pressures on it. Section4 of the Mayo County Development Plan 2014-2020 defines the objectives of Mayo County Council in relation to heritage.

- It is an objective of the Council, through the Landscape Appraisal of County Mayo, to recognise and facilitate appropriate development in a manner that has regard to the character and sensitivity of the landscape and to ensure that development will not have a disproportionate effect on the existing or future character of a landscape in terms of location, design and visual prominence.
- It is an objective of the Council that all proposed development shall be considered in the context of the Landscape Appraisal of County Mayo with reference to the four Principal Policy Areas shown on Map 3A Landscape Protection Policy Areas and the Landscape Sensitivity Matrix (Figure 3), provided such policies do not conflict with any specific objectives of this Plan.
- It is an objective of the Council to protect the unique landscape of the County which is a cultural, environmental and economic asset of inestimable value.

'*Landscape and scenery are often important considerations in making planning decisions. It is important, therefore, to provide clear, fair and easily anticipated landscape policies to guide applications and decisions. In this way disappointments can be anticipated and avoided while also ensuring that decisions are more easily understood and accepted. To address these, an independent 'Landscape Appraisal for County Mayo' was commissioned. Its purpose was to identify and describe the landscape character of each part of the County. Following this, the capacity of each area to accept change – without disproportionate effects was evaluated and a series of policies to guide developments in each type of landscape was proposed.'*

The *Landscape Appraisal for County Mayo* is contained in Section 4 of the Mayo County Development Plan 2014 - 2020.Section 2.3.4 of the document states that with regard to coastal vistas, '*The main concern for natural linear features such as coast lines and ridge lines is to avoid penetration by development that will interrupt and reduce the integrity of such elements*.'

4.6 Geological Baseline

Clew Bay is dominated by a spectacular example of a drowned drumlin field. These elongated hills are composed of glacially derived sediments which were inundated by rising sea levels at the end of the last glaciation. The Geological Survey of Ireland (GSI) Bedrock Geology of Ireland 1:1,000,000 map indicates that the area of landfall at Old Head is composed mainly of Paleozoic Serpentinite and sedimentary melange. Further within the bay area between Louisburgh and Mulranny and towards Clare Island the geological formation is comprised mainly of Mississipian limestone and calcareous shale. The ridge between Achill Island and Clew bay is composed of a Silurian sandstone/siltstone conglomerate. Further offshore to the west, beyond Clare Island and Achill, are paleozoicmeta sedimetary rocks.

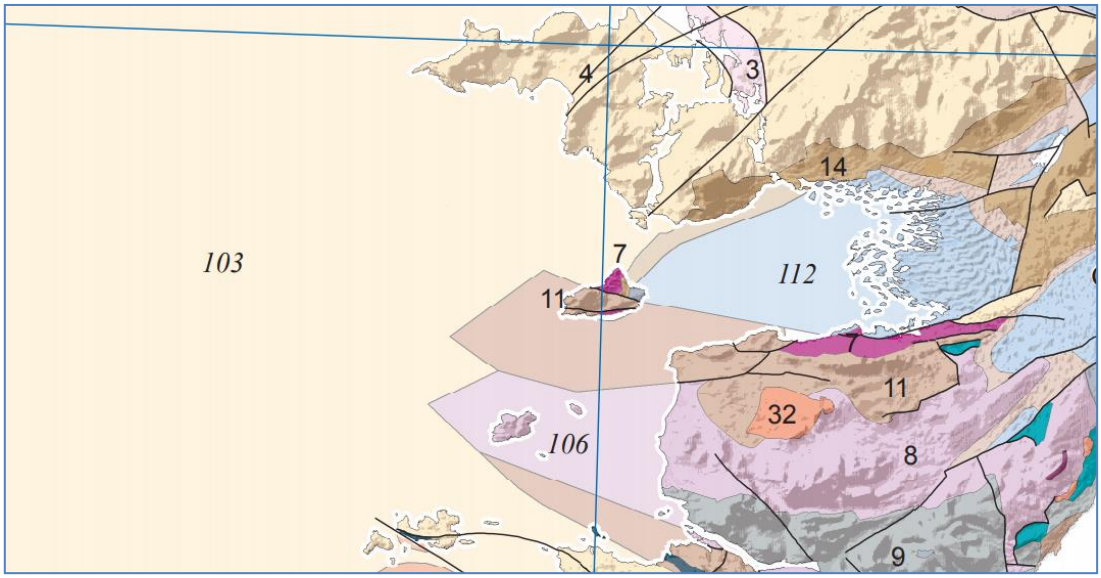


Figure 4. Extract from the GSI Bedrock Geology of Ireland 1:1,000,000 map

4.7 Bathymetry and Seabed Typology

The proposed cable route runs from the 160m water depth at the 12 mile limit, roughly south east where it passes across a ridge which rises to approximately 25m between Achill Island and Clare Island. It then crosses the relatively flat expanse of Clew Bay before turning southward to make landfall at Old Head.

The maps and profile below show the cable route overlaid on the GEBCO (General Bathymetric Chart of the Ocean) gridded bathymetric data sets which are available at 30 arc second of latitude and longitude. The profile of the route clearly shows the ridge encountered between Achill Island and Clare Island.

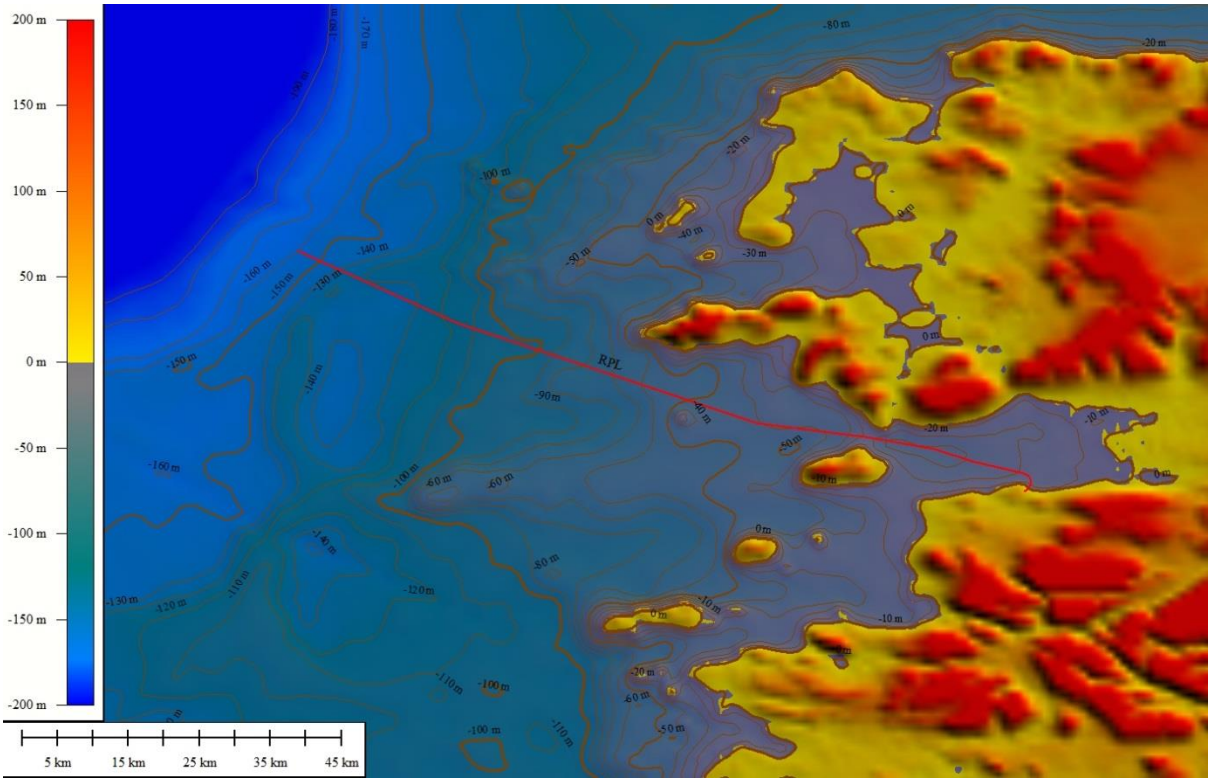


Figure 5. Proposed cable route overlaid on the GEBCO gridded bathymetry dataset with contours

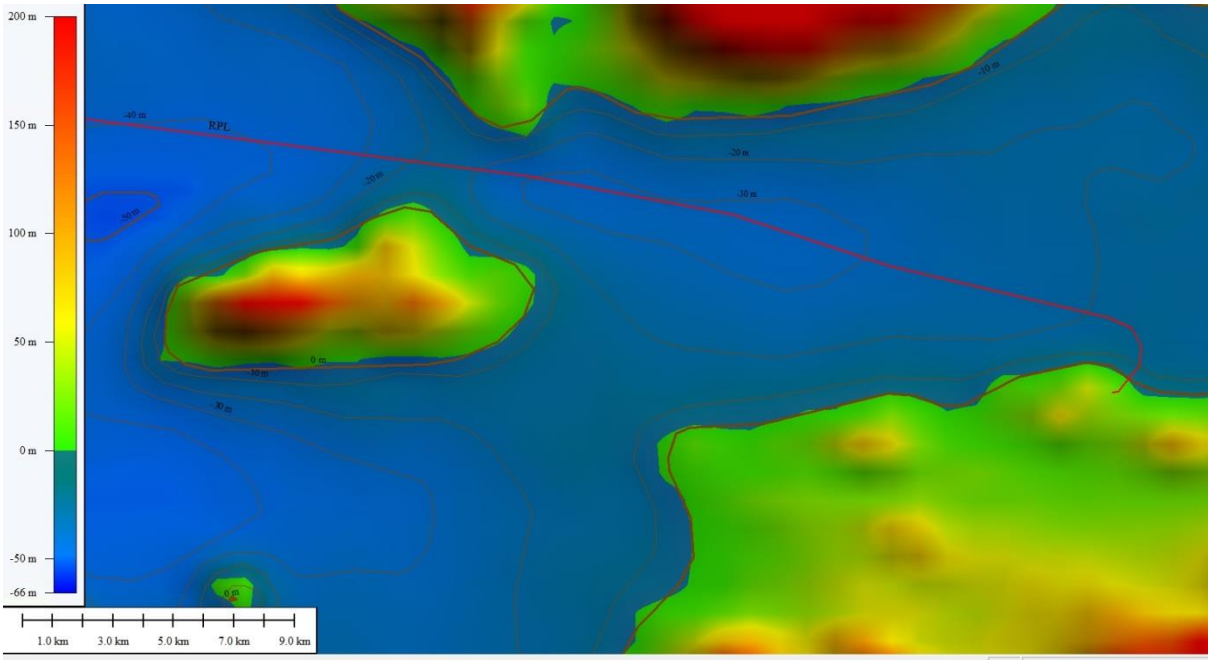


Figure 6. Proposed cable route through Clew Bay overlaid on the GEBCO gridded bathymetry data set

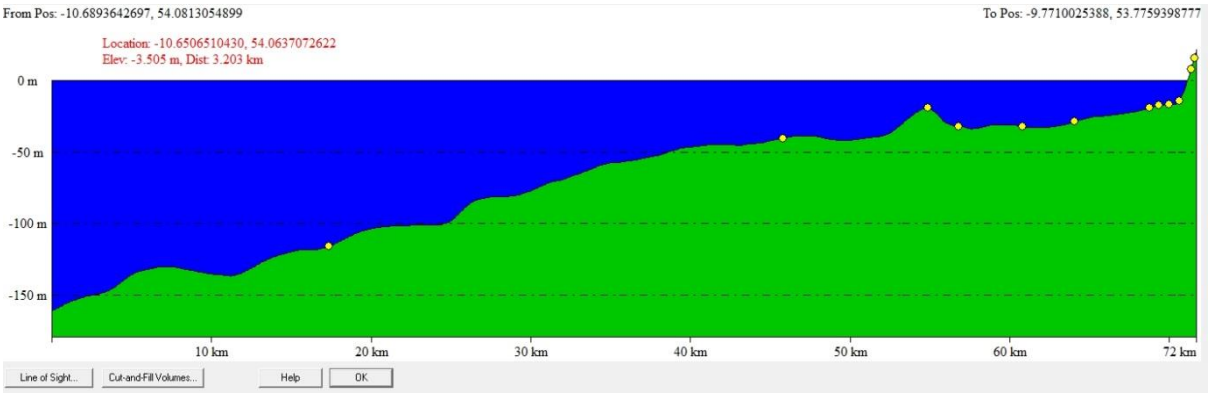


Figure 7. Profile of the proposed cable route from the 12NM limit to landfall at Oldhead

4.8 Clew Bay

Clew Bay is a west facing bay made up of a drowned drumlin field. The bay is overlooked by Croagh Patrick to the south. To the north, the Nephin Mountain range dominates the landscape. Clare Island is positioned on the most western extent of the bay and lies between Roonagh Point to the south and Achill Beg. Clew Bay has a rich maritime past and a long history of fishing and shipping which has contributed to the local economy and to its industries in the area. The bay is well known due to the O' Malley family and their possessions in the middle ages. Grace O' Malley known as the Pirate Queen, owned castles on Clare Island, Achill and Rockfleet.

The Uí Mháille were a seafaring family and controlled most of what is now the barony of Murrisk. Human settlement dates to prehistory and the Ceide Fields to the north date back to the first farmers during the Neolithic Period. Additionally, evidence through extensive excavations on Achill Island to the north of the cable route identified numerous archaeological sites such as a deserted village (**MA053-003003**), Megalithic Tombs (**MA042-020, MA042-021001**) and Enclosure sites (**MA042-021005**). Achill Beg to the south of Achill Island is also rich with archaeological monuments and sites such as enclosures (**MA075-01800**), children's burial grounds and hut sites (**MA065-033002**). Clare Island, to the south of the proposed cable, has a long history of occupation similar to Achill and sites such as Bronze Age fulacht fiadh (**MA085-009005**), holy wells (**MA085-012002**) and enclosures (**MA085-009002**) are all present throughout the island. Old Head, where the cable route will finally makes landfall, is possibly an anglicised version of the original placename Seancheann and there is evidence of prehistoric occupation in the area. Two Midden sites (**MA086-012 & MA086-018**) suggest ecofacts associated with human occupation in the area which can date to prehistory and further evidence backs up this evidence with an ancient cooking site called a FulachtFiadh (MA086-017)which is located 1km southwest of the beach at Old Head. The construction of the Old Head pier, begun in 1822, completed in 1829, 'perfect' 1830, is a cranked L-shaped in plan and has a sandstone ashlar battered wall. It represents an important component of early 19thcentury built heritage in the area.

The aerial view below indicates a possible wreck (**W11423**) or the remains of the Coastguard station or Salt Pans which are recorded as in ruins on the 1st Ed. OS 6-inchmap.

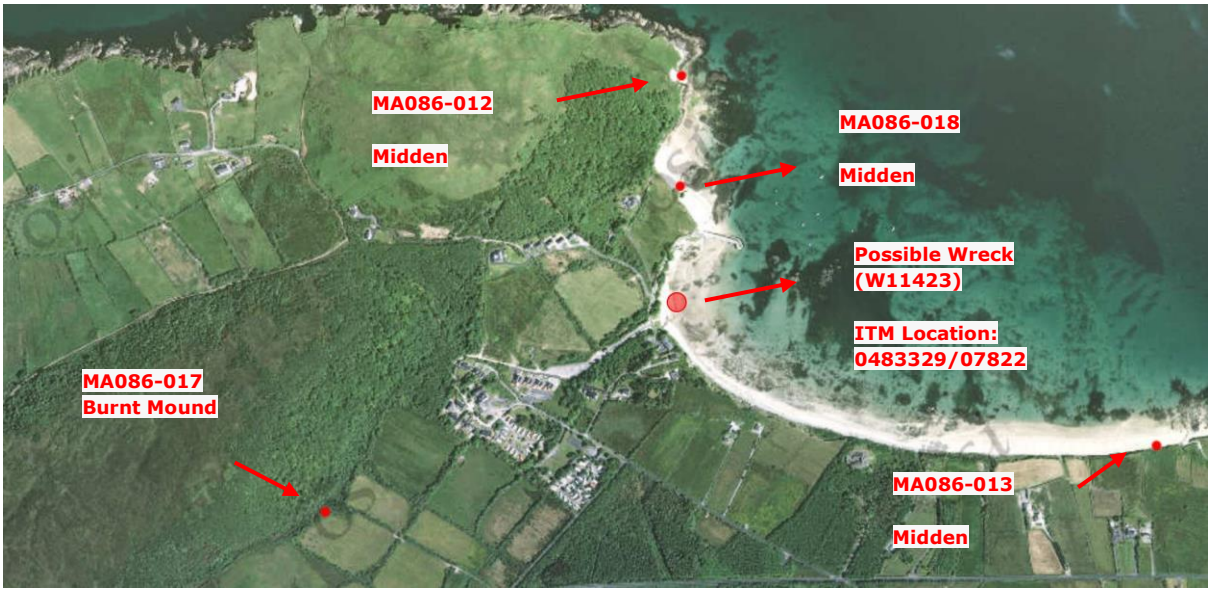


Figure 8. RMP site locations at Oldhead including the possible Wreck (W11423)

5 Cultural Heritage within the Cable Route Corridor

The desk study revealed the following baseline environment prior to bathymetric/geophysical survey and the geotechnical investigations;

5.1 Onshore Cultural Heritage Assets Listed by the DAHG and National Museum of Ireland

There are four known archaeological sites in the vicinity of the proposed route corridor. These are listed on the Sites and Monuments Record (SMR) of the DAHG. A FulachtFiadh (**MA086-017)** this is located 1km west of the proposed cable route. The three other SMR's are located directly to the north and one to the southeast of the proposed cable route where it makes landfall. The two archaeological sites to the north are middens (**MA086-012 & MA086-018).**These are roughly 300m and 500m away from the cable route. The last midden (**MA086-013)** is in the townland of Falduff almost 1km to the southeast. None of these sites will be affected by the proposed development.

5.2 Known Possible Shipwreck Site

There is one known possible wreck **(W11423)** which was reported and identified in 2010 on Old Head beach which may be impacted by the proposed cable route making landfall. The timbers are c. 150m from the wheelchair access ramp for Old Head and are located at ITM co-ords: 0483329, 0782279. The timbers have been allocated a wreck no. W11423 with the National Shipwreck Inventory of Ireland. There is a possibility of the timbers being part of the Coastguard Station or Salt Pans shown on the 1st Ed. OS Map but due to the uncertainty of the amount of timbers they have been left in-situ on Old Head Beach. The initial proposed route was modified to stay further away from this feature.

Figure 9. Timber beam and block on the beach at Oldhead

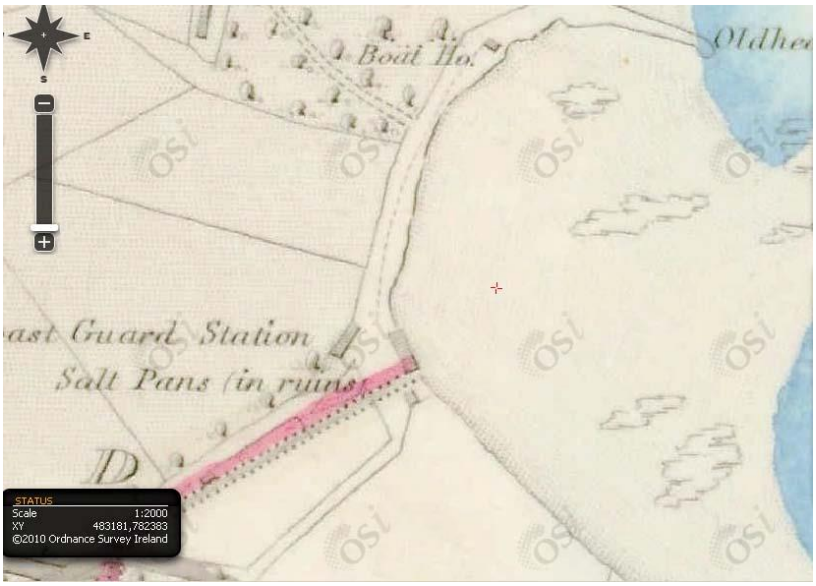


Figure 10. Coastguard Stat ion, Pier and Salt Pans are all marked on the Ordnance Survey six inch map. The location of the timbers on the beach are marked by a red cross

Figure 11. Cable route and possible wreck site overlaid on an aerial photograph of Oldhead beach

5.3 Areas of Archaeological Potential

The Shipwreck Inventory for County Mayo was consulted in the Underwater Archaeology Unit offices for vessels lost in the survey area using the following place names; Achill Island, Achill Beg, Clare Island, Clew Bay, Corraun, Dooagh, Keel, Killsallagh, Louisburgh, Mallaranny, Newport, Old Head, Westport.

Clew Bay and the Achill Island and Clare Island coasts are noted locations for shipwrecks as can be gleaned from the Shipwreck Inventory (Appendix 2). The precise locations of these shipwrecks are difficult to identify even when location details are present in the inventory

The large cluster of coastal sites listed in the record of monuments and places (Appendix 4) surrounding the cable route corridor such as promontory forts, enclosures, hut sites, standing stones and middens demonstrate the potential for areas of archaeological activity and resultant associated possible features finds and deposits. The four finds listed on the Heritage Council Heritage maps database from the topographic files from the surrounding townlands also demonstrate the potential for archaeological features (Appendix 3).

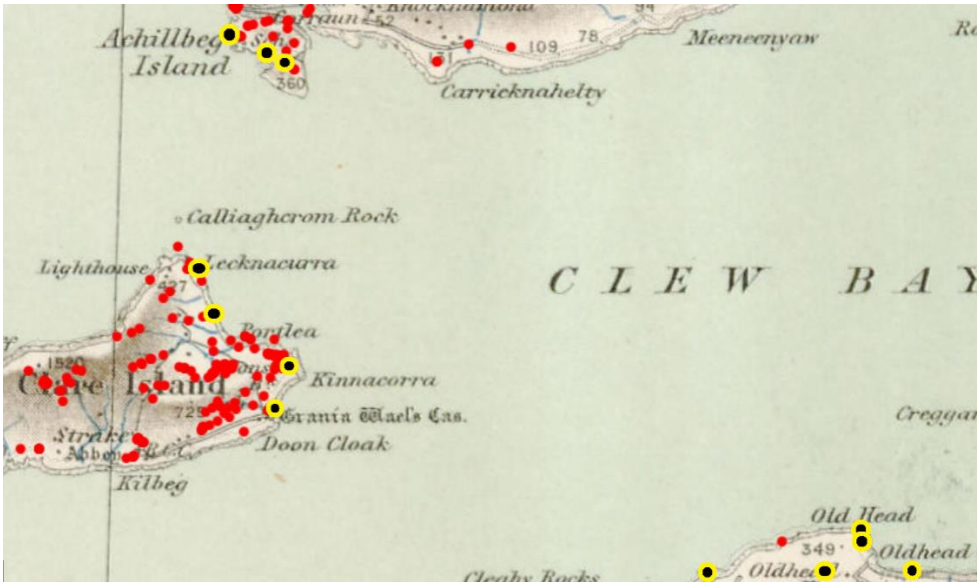


Figure 12. Six inch OSI map indicating RMP's including sites and monuments nearest the cable route

6 Bathymetry and Geophysical Surveys

The marine survey covered a 500 metre wide corridor out to the 1000m water depth and included;

- Bathymetry
- Side Scan Sonar
- Sub-Bottom Profiling
- Magnetometer

The survey of segment 2 comprised the following route sections:

- Deep water survey > 1000m
- Shallow water survey <1000m
- Inshore survey and Landfall survey

6.1 Survey Specifications

The surveys ensured that there were no gaps or unsurveyed areas between all of the different survey operations.

The landfall for Segment 2 at Old Head, Louisburgh, Ireland, was conducted according to the specification listed below;

Landing Site Survey	
Survey limit	Extending 50 m inland of the BMH and to the LAT datum level or the low water mark at the time of survey
Corridor width	250 m wide corridor
Determining Sediment Depth across the Beach (i.e.BMH to LWM)	Probing until 2 m depth every 25 m, except at locations where special requirements exist
Positioned and photographed	All prominent features, natural and cultural

Table 2. Landing site survey specification

The inshore survey for Segment 2 at Old Head, Louisburgh, Ireland was performed according to the specification below;

Inshore Survey	
Survey limit	3 m to 15 m (LAT)
Corridor width	500 m
Minimum number of lines	7 lines
Minimum overlap of data	20% Bathy, 100% SSS
Maximum survey speed	4 knots
Overlap with shallow water survey	500 m (unless prohibited by steep seafloor gradients)
Sampling	Grab samples every 500 m, min # of attempts: 2

Table 3. Inshore survey specification

The following shows the requirements of the shallow water survey;

Shallow water Survey	
Survey Limit Scope	15 m - 1500m
Corridor width 15 m – 1000m WD	500 m
Corridor width 1000 m – 1500m WD	1000 m
Minimum number of lines	3 lines
Minimum overlap of data	20% Bathy, 100% SSS
Maximum survey speed	4 knots
Overlap with deep	1500 m

water survey	
Sampling	Every 10 km one Gravity Core (GC) or Grab Sample (after GC failure), min. 2m attempts, 1m recovery successful (2 attempts with GC and 2 with GS)
CPT	Every 4 km, 3 m push attempt, 2m push successful (min. 2 attempts)

Table 4. Shallow water survey specification

The following Table shows the requirements of the Deep water survey.

Deep Water Survey	
Survey limit – scope	1000 m (USA), 1500 m (Europe) to full ocean depth
Corridor width	Minimum 3 x WD to maximum of 10 km
Minimum number of lines	1 line
Minimum overlap of data	n/a
Maximum survey speed	8 knots
Overlap with shallow water survey	1000 m

Table 5. Deep water survey specification

6.2 Survey Dates

	Started	Finished
Landfall Survey	26 May 2018	01 June 2018
Inshore survey	26 May 2018	01 June 2018
Shallow and Deep Water Survey	25 January 2018	29 January 2018
	28 February 2018	15 March 2018
	21 May 20-18	09 June 2018

Table 6. Survey Dates

6.3 Survey Blocks

The survey of Segment 2 was divided into 6 sections (Survey Blocks 1-6).

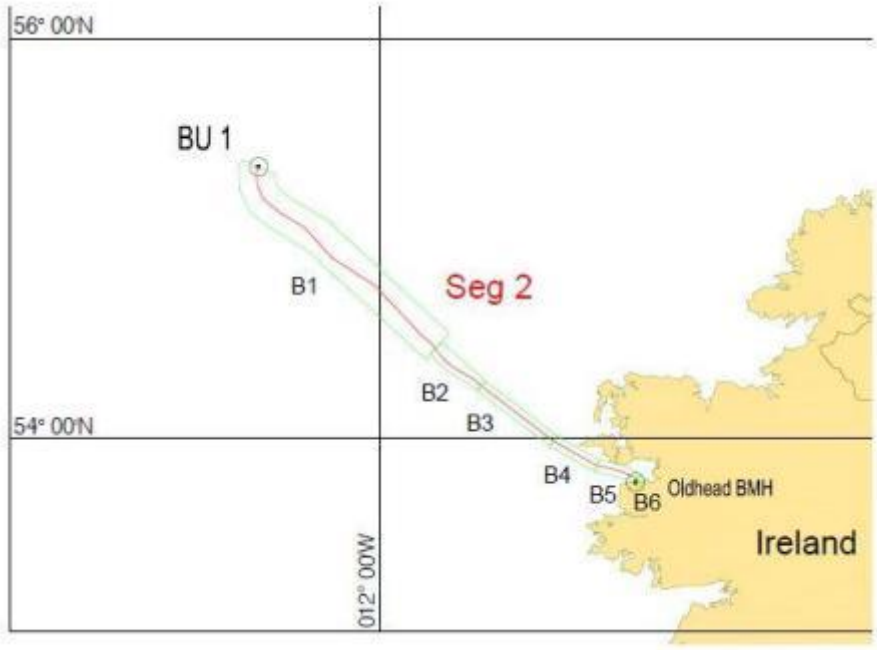


Figure 13. Segment 2 divided into 6 survey blocks

Block 6 is the shortest with only appr. 3km. Block 6 contained all Inshore survey operations. Block 1 is the largest with appr. 150km and covers the whole deep water section. Block 2-4 varies between 30 km and 50 km.

6.4 Vessels and Equipment

The geophysical and geotechnical survey was undertaken utilizing the vessel MV Fugro Discovery operated by Fugro Germany Marine GmbH (FGMG).

MV Fugro Discovery	
Length Overall	70.0 m
Length PP	61.4 m
Beam	12.6
Draught	6.0 m
Draught with Gondola	6.5 m
GRT	2018 t
Speed	Cruising speed: 10 kts, max. speed: 13 kts
SOLAS	IMO No.: 9152882, Call Sign: 3EKE6
Year of Construction	1997
Owner	Fugro

Figure 14. MV Fugro Discovery

MV Fugro Discovery – Deep and Shallow Water Segments

System	Type
Surface Positioning System	Starpack G2+ / Seapath 330+
Data logging and Navigation	QPS Qinsy 8.17.1
Multi Beam Echo Sounder	EM712
Heading and MRU	Seapath 330+ with Seatex MRU5+
Sound Velocity Probes	Valeport Midas SVX2
Sound Velocity Sensor	Valeport mini SVS
Sub-bottom Profiler	Knudsen Chirp 3260
Sidescan sonar	Edgetech FS 4200
Magnetometer	Geometrics - G882
Ultra Short Base Line System	Kongsberg HiPAP 502
Sampling	Gravity Corer, Van-Veen Grab Sampler
Cone Penetration Test (CPT)	DATEM Neptune 3000

Figure 15. MV Fugro Discovery - Equipment

For the inshore survey the small boat Alumaster, operated by Fugro Germany Marine GmbH (FGMG) was used.

Figure 16. MV Alumaster

MV Alumaster	
Length	6.5m
Beaam	2.3m
Draught	0.4
Speed	7Knts
Type	Aluminium Cabin Work Boat
Propulsion	36 HP YanmarDeiesel Outboard
Electrical Supply	220/24/12 V
Owner	Fugro

Table 7. MV Alumaster Details

System	Type
Surface Positioning System	Fugro Starfix G2/G4
Data logging and Navigation	QPS Qinsy
Multi Beam Echo Sounder	Edgetech 6205
Heading and MRU	Applanix POS MV WaveMaster II
Sound Velocity Probes	Valeport Monitor SVP
Sub-bottom Profiler	Innomar SES 2000 Compact
Sidescan sonar	Edgetech 6205
Magnetometer	G882 Magnetometer

Figure 17. MV Alumaster Equipment List

7 Geotechnical Investigations

Soil sampling and CPT operations are performed in order to ground truth the geophysical interpretation and to gain further understanding of in-situ conditions. Gathered information is incorporated to the geological interpretation.

Seabed soil samples were collected along the center line of the route to the end of burial depth. Geotechnical locations were decided on board the survey vessel by the Geologists and Party Chief in consultation with Client's Representative.

With respect to geotechnical methodology (GC) the project scope of work specifies:

- Nominal distance between coring positions is 10 km
- 2 attempts with the gravity corer
- 2 attempts with the grab sampler (when coring has failed)
- A core / sample was deemed successful with
- Recovery of no less than 2 m of soil. If stiff or hard soils were encountered below 1 m of seabed and were clearly indicated in the sample, a 1 m soil sample was deemed acceptable. Any sample site yielding less than 1 m of recovery had to be investigated a second time unless there was obvious damage to the coring equipment indicating a hard or rocky substrate

- Recovery of a full bucket of soils. The volume of soil recovered was dependent on the size of the unit deployed. Recovery of rocks and/or coral material was taken as an indication of a hard seabed and was deemed acceptable.

7.1 Soil Samples - Core

Gravity cores were photographed measured in length and analyzed according the British Standard BS5930 (1.3) to describe sediment samples and seabed classifications. The shear strength was measured with a pocket Torvane tester.

7.2 Soil Samples - Grab/Dredge

Grab samples were photographed, measured in mass and analyzed according the British Standard BS5930 (1.3) to describe sediment samples and seabed classifications.

7.3 CPTs

CPTs were performed onboard MV Fugro Discovery to acquire geotechnical data for the burial feasibility information along the cable route. A Datem Neptune 3000 CPT unit was used for this operation. The location of CPT stations was agreed in advance with the Client's Representative on board.

With respect to geotechnical methodology (CPT) the project scope of work specifies:

- Nominal distance between CPT positions is 4 km
- Target depth set to 3 m and tip resistance to 20 MPa.
- An attempt was deemed successful when a penetration of 2 m below the seabed was achieved.
- Any push resulting in less than 2 m penetration triggered a second attempt. In this case the CPT was relocated by approximately 5 m before commencing the second attempt.

CPT data is recorded via Neptune software before it is processed using a custom spreadsheet template. Relevant data (depth, cone end resistance, sleeve friction, pore pressure, friction ratio, shear strength and relative density) is plotted in standardized manner enabling competent data interpretation. Various soil evaluation models incorporated into the spreadsheet template assure accurate data interpretation.

8 Survey Results

The following section outlines the results obtained during the inshore, shallow and deep water surveys along the HAVFRUE Cable System Segment 2 between BU1 and the limit with the inshore water survey leading to the Beach Manhole (BMH). It also details the archaeological review of the survey data.

8.1 Land and inshore Surveys

The land section extends from the intertidal zone to the BMH. Above the high tide shoreline, the route lies on a narrow belt of fine SAND. The BMH itself is located on the grass of a flowerbed located between the beach and the adjacent road.

The seabed in the inshore area is composed of silty SAND. TILL and ROCK is present <2 m below the seafloor and partially crops out nearshore and close to the seaward end of the survey area. The seafloor exhibits areas with ripples.

A total of 93 sonar contacts were identified, 8 of which are considered to represent debris, 78 were interpreted as boulders, 5 rock outcrops and 2 depressions.

A total of 27 magnetometer contacts were identified within the survey corridor.

No cable or pipeline crossings have been detected in inshore and beach areas.

A walkover survey was undertaken on the 30th May 2018 within the route corridor along the beach at low tide. The walkover did not reveal any archaeological feature finds or deposits.

A review of the MBES and Sidescan geotiffs did not reveal anything of archaeological significance. The bottom obstruction report and the sidescan and magnetometer contact report was reviewed and nothing of any archaeological significance was noted. It is possible that the magnetic anomalies may have an archaeological source. Nothing of an archaeological nature was noted in the sub bottom profiles.

8.2 Shallow Water

From the start of the shallow water survey, the route crosses sandy seabed with very gentle gradients. Some localized outcrops of glacial TILL with associated boulder fields occur within the generally sandy seabed.

Further along the route, it crosses an extensive area of ROCK outcrops and subcrops with gradients up to 30°, and then runs over a gently sloping sandy seabed overlying very soft to firm CLAY with seabed depressions for much of the corridor.

Along the route there is a shallow seabed depression of up to 30m depth and over 10km length and the route runs along the NE periphery of it.

From the 570 m WD contour to the offshore limit of the shallow water survey, the route crosses very steep slopes up to 28° over rocky scarps.

Along the Segment 02, numerous boulders (especially in boulder fields) were observed. The total number of sonar contacts were too many to identify and only the largest were picked in order to give an average height. These are identified and are illustrated in the charts. 2424 sonar contacts are interpreted to represent boulders, 4 contacts are interpreted to represent items of debris, 125 depressions and 1 SSS contact was a shipwreck.

In total 37 magnetic contacts were identified along the route. Three areas of MAG anomalies aligned on a diagonal line along the route at 53°48.6563'N, 009°48.8515'W, 53° 53.7084'N, 010° 12.1810'W and 54°12.3458'N, 010°58.4387'W were identified and could represent possible unknown cable or linear debris. Of these three areas according to the bathymetric and sidescan sonar surveys, there isn't any surface expression.

A review of the MBES and Sidescan geotiffs revealed one area of archaeological significance. A shipwreck was identified in both data sets and is dealt with in Section 11 of this report. The bottom obstruction report and the sidescan and magnetometer contact report was reviewed and nothing of any archaeological significance apart from the shipwreck was noted. It is possible that the magnetic anomalies may have an archaeological source. Nothing of an archaeological nature was noted in the sub bottom profiles.

8.3 Deep Water

In General, the seabed along the deep water section of Segment 02 route is flat with gentle slopes of less than 1°. The exception to this is around the 1900-2000 m WD mark, where the seabed shows gradients of up to 32° with an irregular topography within the corridor.

No sidescan sonar or magnetometer was required in deep water.

9 Archaeological Screening in Advance of Geotechnical Works

As the geophysical survey proceeded, on-board processing and charting was carried out in a 200m zone around the specific sampling/ vibrocore locations. The data and charts were emailed to shore for review by a licensed Marine Archaeologist

The Multibeam and Sidescan geotiffs of the proposed primary and secondary geotechnical locations were imported into Global Mapper a GIS program. They were analysed and a chart was produced for each location.

Nothing of any archaeological significance was noted at any of the locations.

HAVFRUE SEGMENT 02 - PLANNED GEOTECHNICAL LOCATION

Block	Type	Number	Station	LAT	LONG	Comments	STATUS
5	CPT	1	Primary	53.807482N	9.807813W	Checked 02/06	No Archaeology
5	CPT	1S	Secondary	53.808236N	9.811013W	Checked 02/06	No Archaeology
5	CPT	2	Primary	53.810631N	9.821104W	Checked 29/05	No Archaeology
5	CPT	2S	Secondary	53.811056N	9.822952W	Checked 29/05	No Archaeology
5	CPT	3	Primary	53.823546N	9.865393W	Checked 29/05	No Archaeology
5	CPT	3S	Secondary	53.822462N	9.862012W	Checked 29/05	No Archaeology
5	CPT	4	Primary	53.840015N	9.939663W	Checked 29/05	No Archaeology
5	CPT	4S	Secondary	53.839180N	9.935544W	Checked 29/05	No Archaeology
5	CPT	5	Primary	53.848295N	10.000022W	Checked 02/06	No Archaeology
5	CPT	5S	Secondary	53.848775N	10.003781W	Checked 02/06	No Archaeology
5	CPT	6	Primary	53.854598N	10.050444W	Checked 29/05	No Archaeology

5	CPT	6S	Secondary	53.854180N	10.047205W	Checked 29/05	No Archaeology
4	CPT	7	Primary	53.872769N	10.145556W	Checked 29/05	No Archaeology
4	CPT	7S	Secondary	53.871966N	10.143169W	Checked 29/05	No Archaeology
4	CPT	8	Primary	53.885719N	10.178704W	Checked 29/05	No Archaeology
4	CPT	8S	Secondary	53.886195N	10.180149W	Checked 29/05	No Archaeology
4	CPT	9	Primary	53.905768N	10.238955W	Checked 29/05	No Archaeology
4	CPT	9S	Secondary	53.905505N	10.238156W	Checked 29/05	No Archaeology
4	CPT	10	Primary	53.921658N	10.286629W	Checked 02/06	No Archaeology
4	CPT	10S	Secondary	53.922098N	10.287943W	Checked 02/06	No Archaeology
4	CPT	11	Primary	53.944072N	10.348025W	Checked 29/05	No Archaeology
4	CPT	11S	Secondary	53.944629N	10.349588W	Checked 29/05	No Archaeology
4	CPT	12	Primary	53.959886N	10.402327W	Checked 29/05	No Archaeology
4	CPT	12S	Secondary	53.960706N	10.404765W	Checked 29/05	No Archaeology
4	CPT	13	Primary	53.972094N	10.438840W	Checked 29/05	No Archaeology
4	CPT	13S	Secondary	53.972601N	10.440388W	Checked 29/05	No Archaeology
4	CPT	14	Primary	53.983158N	10.472576W	Checked 29/05	No Archaeology
4	CPT	14S	Secondary	53.982690N	10.471243W	Checked 29/05	No Archaeology
5	GC	1	Primary	NA	NA	Checked 30/05	No Archaeology
5	GC	1S	Secondary	NA	NA	Checked 30/05	No Archaeology
5	GC	2	Primary	53.835559N	9.916012W	Checked 29/05	No Archaeology
5	GC	2S	Secondary	53.836361N	9.920318W	Checked 29/05	No Archaeology
5	GC	3	Primary	53.850637N	10.019484W	Checked 29/05	No Archaeology
5	GC	3S	Secondary	53.850051N	10.015021W	Checked 29/05	No Archaeology
4	GC	4	Primary	53.883814N	10.173031W	Checked 29/05	No Archaeology
4	GC	4S	Secondary	53.884274N	10.174443W	Checked 29/05	No Archaeology
4	GC	5	Primary	53.935370N	10.327975W	Checked 29/05	No Archaeology
4	GC	5S	Secondary	53.934682N	10.325992W	Checked 29/05	No Archaeology
4	GC	6	Primary	53.97857N	10.458798W	Checked 29/05	No Archaeology
4	GC	6S	Secondary	53.977919N	10.456723W	Checked 29/05	No Archaeology
3	CPT	15	Primary	54.009152N	10.533155W	Checked 02/06	No Archaeology
3	CPT	15S	Secondary	54.011037N	10.537337W	Checked 02/06	No Archaeology
3	CPT	16	Primary	54.030626N	10.580934W	Checked 02/06	No Archaeology
3	CPT	16S	Secondary	54.030078N	10.579683W	Checked 02/06	No Archaeology
3	CPT	17	Primary	54.059339N	10.644542W	Checked 02/06	No Archaeology
3	CPT	17S	Secondary	54.058858N	10.643481W	Checked 02/06	No Archaeology
3	CPT	18	Primary	54.085089N	10.701538W	Checked 02/06	No Archaeology
3	CPT	18S	Secondary	54.086556N	10.704706W	Checked 02/06	No Archaeology
3	CPT	19	Primary	54.097350N	10.728752W	Checked 02/06	No Archaeology
3	CPT	19S	Secondary	54.098578N	10.731405W	Checked 02/06	No Archaeology
3	CPT	20	Primary	54.118951N	10.776632W	Checked 02/06	No Archaeology
3	CPT	20S	Secondary	54.119984N	10.778951W	Checked 02/06	No Archaeology
3	CPT	21	Primary	54.140910N	10.825658W	Checked 02/06	No Archaeology
3	CPT	21S	Secondary	54.142358N	10.828847W	Checked 02/06	No Archaeology
3	CPT	22	Primary	54.167579N	10.885030W	Checked 02/06	No Archaeology
3	CPT	22S	Secondary	54.168985N	10.888259W	Checked 02/06	No Archaeology
3	CPT	23	Primary	54.184251N	10.922419W	Checked 02/06	No Archaeology
3	CPT	23S	Secondary	54.185126N	10.924552W	Checked 02/06	No Archaeology
3	GC	7	Primary	54.032899N	10.585708W	Checked 01/06	No Archaeology
3	GC	7S	Secondary	54.030692N	10.581076W	Checked 01/06	No Archaeology
3	GC	8	Primary	54.089358N	10.711043W	Checked 01/06	No Archaeology
3	GC	8S	Secondary	54.091734N	10.716153W	Checked 01/06	No Archaeology
3	GC	9	Primary	54.146141N	10.837272W	Checked 01/06	No Archaeology
3	GC	9S	Secondary	54.147235N	10.839716W	Checked 01/06	No Archaeology
3	GC	10	Primary	54.194930N	10.947213W	Checked 01/06	No Archaeology

3	GC	10S	Secondary	54.192341N	10.941537W	Checked 01/06	No Archaeology

Table 8. Planned geotechnical locations

All the charts produced are contained in Appendix 6 and Appendix 7.

10 Beach Probing

Beach probing was carried out at 19 locations along the proposed corridor at Old Head beach on the 31st May 2018. The beach probing was conducted to investigate the depth of sand deposits along the beach and was monitored by a licensed archaeologist.

Positions were determined using a Garmin GPSMAP 78 handheld GPS device. Penetration was determined by dropping the weight until either the maximum penetration of 2 m was achieved, the maximum number of 150 hits per probing was performed or no further change in penetration could be observed.

The probing revealed that the beach deposits were very shallow with only two of the locations revealing deposits in excess of2m. The beach was observed to be composed of fine, and fine to medium SAND with occasional shell fragments and cobbles.

Nothing of any archaeological significance was noted.

Figure 18. Beach probing locations Oldhead

Sample ID	Easting (m)	Northing (m)
S02_LB_BP001	449220.610	5958940.470
S02_LB_BP002	449245.630	5958946.330
S02_LB_BP003	449270.820	5958948.240
S02_LB_BP004	449294.480	5958955.830
S02_LB_BP005	449318.000	5958966.110
S02_LB_BP006	449338.460	5958980.270
S02_LB_BP007	449356.160	5958996.870
S02_LB_BP008	449255.53	5958892.89
S02_LB_BP009	449282.36	5958898.25
S02_LB_BP010	449302	5958899.69
S02_LB_BP011	449323.61	5958905.74
S02_LB_BP012	449348	5958916.4
S02_LB_BP013	449368.75	5958929.36
S02_LB_BP014	449210.61	5958983.63
S02_LB_BP015	449236.94	5958989.28
S02_LB_BP016	449267.56	5958991.53
S02_LB_BP017	449293.36	5959002.81
S02_LB_BP018	449317.22	5959013.24
S02_LB_BP019	449335.93	5959030.8

Table 9. Beach probing locations

Figure 19 Beach probing at Oldhead

11 Wreck Site

During the course of data acquisition one unknown wreck site was noted 126m to the south west of the centreline of the RPL at Kp 126.522. The wreck was reported to the Underwater Archaeological Unit. Due to the distance from the RPL it was not deemed necessary to re route the RPL.

OBSTACLE NO. FD-03			
Ship / Unit:		MV Fugro Discovery	
Survey:		220-17-720	
Date Located:	29/05/2018	Date Examined:	29/05/2018

Listed Position:	Unknown	
Fixed Position (UTM Zone 29 / WGS84):	389 999 mW	5 993 081 mN
	54° 04.4505' N Lat	010 ° 40.8722' W Lon
Method of Positioning: Fugro Starfix HP DGPS	Accuracy: <50 cm	

Depth Data (ELLIPSOID)	
Swept Clear:	No sweep performed
Swept Foul:	No sweep performed
Least E/S Depth:	156.9 m (LAT)
General Depth:	157.5m (LAT)
Scour Depth:	None

Tidal Observations	
Tidal Observations at:	Predicted tidal correction was used – No GPS
Co-tidal adjustments by:	

Contact Data	
Sonar Height:	0.6 m (at highest point)
Sonar Length:	25.6 m
Sonar Width:	7.2 m
Orientation:	140°/320°
Bow Orientation:	N/A
Sonar Signal Strength:	Weak
Magnetic Anomaly:	No
Scour Length:	None
Seabed Texture:	N/A
Debris Field:	No
Buoyage:	No buoyage

Description:
The vessel has a weak sonar signal and low relief and appears to be partially buried in the surrounding sediment but is not broken or dispersed.
Refer to multibeam and side-scan sonar images displaying the vessel.

Table 10. Wreck details

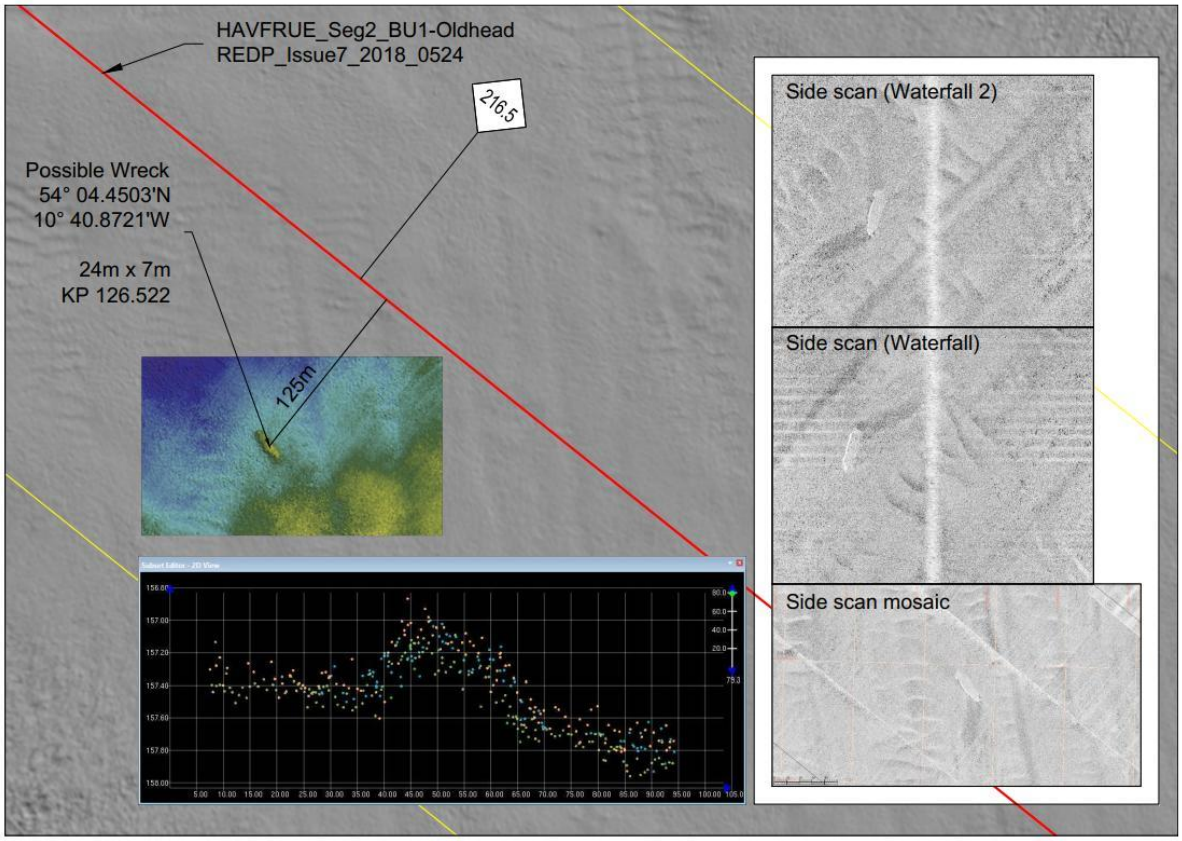


Figure 19. Multibeam and sidescan images of the wreck

12 Proposed Cable Development Details

12.1 Landfall at Oldhead

The procedure for the shore end will involve pulling the cable ashore using a winch or an excavator or other suitable piece of heavy equipment

The Beach Manhole is to be constructed onshore on the existing grassed area between the shoreline and the local County Road. The manhole will be 3m x 2m x 2m deep and is to be constructed in reinforced concrete. The construction work will involve a mechanical excavator, some formwork, steel reinforcement and delivery of concrete

12.2 Cable installation on the beach

A section of duct will be installed at a depth of 1.5m from the Beach Manhole to the shoreline. The trench will be excavated, the duct will be installed and the trench will be backfilled immediately.

Excavation of the trench on the beach will commence at the end of the duct from the Beach Manhole. The excavation of the trench will continue until the target depth of 1.5m is achieved. Articulated pipe, typically 200mm in diameter, is then installed and the trench is backfilled immediately.

Cable installation is achieved by a cable ship stationing offshore near its minimum working depth. A messenger line is hauled ashore and a winch, located near the Beach Manhole pulls the cable through the pre-installed duct and into the manhole. A trench is then excavated, parallel to the cable, out to the Low Water Line. When the trench is excavated the cable is lowered into the trench and the trench is backfilled with the previously excavated material

12.3 Jetting

Seaward from the Low Water Line the subsea cable will be buried by means of seawater jetting systems. The jets are directed into the seabed by the burial tool, emulsifying the seabed in the region for burial and a trench is formed. The jetting system slowly moves along the seabed on the required cable track, forming the trench into which the cable is placed.

12.4 Pre-Lay Grapnel Run

A Pre-Lay Grapnel run will be undertaken prior to commencement of Main-Lay. This activity is to ensure that the planned line of the cable is clear of seabed debris which may include chains, steel cables, anchors, nets etc. Any debris recovered will be hauled on-board and disposed of at an appropriate landfill site.

12.5 Offshore Cable Installation

The Main Lay vessel will pick up the end of the cable for the Inshore Section and this will then be jointed to the main cable on board the Main Lay Vessel. The Main Lay Vessel will then proceed to deploy and bury the cable in the seabed using a sea-plough. The sea-plough is towed by the Main Lay Vessel and is designed to bury the cable at a depth which will be secure from fishing activities. The plough uses a minimally invasive plough-share to create a furrow in the seabed approximately 750mm in width. As the plough moves forward the cable is placed in the bottom of the furrow which backfills with the natural movement of sediment on the seafloor. Typical ploughing speed is less than 1 knot and is dependent on the stiffness of the seabed sediment. There is no significant noise generation during ploughing operations. Cable installation by plough produces only a minor plume of suspension of seabed sediments in the water column and this is transient and localised due to the nature of the ploughing and natural backfill activities. The target burial depth for the HAVFRUE cable systems is 1.5 metres. In areas of stiff soil, the actual burial depth may be reduced but is planned to be still at a depth which will be protect the cable from fishing operations and generally not less than 0.4 to 0.6 metres.

12.5 Post Lay Burial

Post lay burial will take place in the following instances

- Planned recoveries of the burial tool, e.g. ploughshare change locations
- Initial and final splice positions within the buried sections – Post-Lay Inspection and Burial is planned for the initial splice location between the Pre-Lay Shore End and main lay section of the cable to 1.5 metre target burial depth
- Unplanned recoveries due to burial tool breakdown, weather delay, etc.
- Surface-laid sections due to sea plough malfunction where the plough is not brought back on board

- Water depths or seabed types that exceed the operational limits of the sea plough

The post Lay burial will be undertaken with an ROV and a jetting tool to bury the cable to the required depth.

13 Impact Assessment

The cable installation works has the potential to cause direct and indirect impacts on cultural heritage assets within area of the proposed cable route. Direct impacts may be caused during installation of marine cables during burial, protection repair or removal. Indirect impacts, both positive and negative, may be caused by the disturbance and subsequent re-deposition of sediments which may partially or completely cover or uncover cultural heritage assets. Further indirect impacts may be caused by the deployment of anchors or burial/deburial tools in the vicinity of cultural heritage assets.

Prior to the installation of a subsea cable, the seabed will be cleared of debris by means of a Pre Lay Grapnel Run (PLGR). During this process, a grapnel is towed along the seabed to remove any debris from the main lay route. It is carefully controlled to ensure clearance of the specified area and to avoid dragging on any existing cables and pipelines located along the route.

The cable is normally laid and buried as a continuous operation using a plough. Ploughs are equipped with a cable tracking system, and forward obstacle avoidance sonar. They are normally deployed and recovered by means of an 'A' frame located at the stern of the cable ship. Once launched the vessel proceeds along the proposed cable route, at a speed around 1 knot, depending on factors such as seabed conditions, weather, tide and current. Ploughing will be terminated upon completion of work, equipment failure, cable and pipeline crossings and un-ploughable ground. In these cases, the plough is recovered to deck or "flown" over small sections of un-ploughable ground. Un-ploughable ground maybe rock, granite and other hard seabed, extremely hard soil, extremely soft seabed, mega ripples and areas of steep seabed slopes.

Once main lay operations have been completed the route will be inspected and where necessary additional attempts made to bury the cable. This may be carried out by divers in shallow water or by free-swimming or tracked ROVs equipped with additional jetting or trenching tools. The inspection shall check cable slack and the condition of reinstatement. The cable trench is likely to be only 0.5metres in width and the dimensions of the likely 'zone of influence' for the proposed cable footprint is a width of 2m. Cable burial depths are normally to an average depth of 1.5- 2 metres along most of the route. The cable will most likely be laid using a Dynamically Positioned (DP) vessel and so anchor assessments will not be necessary.

13.1 Impacts on Maritime Cultural Heritage

The types of impact that the proposed development will have on the baseline environment is addressed under the following categories:

Type of Impact	Description
Direct Impact	Direct impacts on marine archaeological sites, features, deposits and artefacts that may be affected by the laying of the cable. These might include the preparation and clearing of the seabed prior to installation or cable laying operations.
Indirect Impact	Potential damage to marine archaeological sites and features within the proposed development may be caused by indirect impacts. These might include scour around cables, and changes to the sediment regime within the area of the development. Some indirect impacts may be beneficial, for instance the burial of sites and features by increased sedimentation.
Secondary Impact	Secondary impacts on marine archaeological sites, features and artefacts that may be affected by the development.
Cumulative Impact	The assessment will consider the potential for the effects of cumulative impacts on sites, features and artefacts of cultural heritage interest associated with the proposed development. Possible impacts may include effects within the proposed development such as continued interference through cable laying activities upon a relict landscape surface or deposit. Impacts outside the development area may include the effects of several developments within the same locality on the cultural heritage resource.

Table 11. Types of impact

13.2 Direct Impacts

The desk based study identified a possible wreck site (W11423) on the beach at Oldhead. The RPL for the cable was altered to avoid the location. The site however highlights the possibility of other unidentified features finds or deposits being disturbed during cable lay operations at the beach. This is particularly so given the archaeological potential of the coast as demonstrated by the recorded monuments and finds from the surrounding area (Section 5 and Appendix 3 and 4).

Clew Bay and the area around Achil Island have numerous reports of shipwreck sites as can be seen from the itemised examples from the shipwreck inventory (Appendix 2). Only one shipwreck was identified however during the bathymetric and geophysical surveys of the proposed cable route. This wreck was identified 125m to the south of the RPL at Kp126.522 and it was agreed by all relevant parties that the RPL did not need to be rerouted to avoid it. The ship wreck site however highlights the possibility of encountering other similar shipwreck sites which have no surface expression.

The sidescan and magnetometer contact report from the geophysical survey identifies 1000's of boulders, depressions, outcrops and debris. The contact report has been reviewed and nothing of archaeological significance was noted however it cannot be precluded that none of these contacts are archaeological in nature or point to other archaeological features finds or deposits buried below the surface. In particular some of the magnetometer anomalies may have an archaeological provenance.

13.3 Indirect Impacts

Although there may be some minor changes in the sediment regime around the cable trench, no significant indirect impacts from the proposed scheme have been identified as part of this assessment.

13.3 Secondary impact

No secondary impacts have been identified.

13.4 Cumulative Impacts

The proposed cable route crosses two in service cables in the deep water segment. Notwithstanding this the cumulative impacts of the cable lay operations arenot significant.

14 Mitigation

There are various ways that potential impacts of a development can be mitigated. Mitigation measures usually involve avoidance (the implementation of exclusion zones and design alterations), reduction (the introduction of measures to deal with unexpected discoveries during works), or offsetting (excavation and recording of a site before an impact occurs). Ideally, sites and features of cultural heritage interest should be subject to as little disturbance as possible, where policy normally dictates a presumption in favour of preservation in situ in line with current national policy.

Overall, the aim is to minimise the impact on cultural heritage assets through the appropriate siting of infrastructure and works. As such, the preferred mitigation for the disturbance of a site of cultural heritage interest would be avoidance, so that the cable and associated operations are micro-sited to avoid wrecks or identified sites and features of cultural heritage interest.

This can be achieved through the use of 'exclusion zones'. These should be marked on project charts to avoid potential sites and features of maritime cultural heritage interest. The size of the exclusion zone is normally dependent on the certainty the target represents a wreck or site and the potential importance or sensitivity of that asset (historically significant or not).

Adherence to the implementation of the exclusion zones during scheme operations can be checked through procedures and protocols set out in a works method statement. Protocols should be established before the start of scheme operations detailing instructions to follow in the event of unexpected discoveries, with contact details of the relevant stakeholders.

Given the results of the impact assessment above, the mitigation strategies outlined here detail the measures to be adopted in order to ameliorate the direct, indirect and secondary impacts that the proposed cable may have on features of maritime cultural heritage interest within the proposed scheme. If these measures are employed it is envisaged that the proposed cable installation will have no impact on features of maritime cultural heritage interest.

The following mitigation recommendations are presented in connection with the proposed cable:

1. The cable installation on the beach at Oldhead and the construction of the beach manhole should be the subject of archaeological monitoring.
2. Archaeological monitoring of the prelay grapnel run should be undertaken in order to identify any previously unrecorded features finds or deposits.
3. All plough trenching should be the subject of archaeological monitoring

4. It is recommended that procedures should be put in place to ensure that any previously unrecorded cultural heritage assets encountered during the project should be assessed by a suitably qualified archaeologist and avoided by the cable laying operations.
5. Should the proposed cable route be subject to further revision, details of these revisions should be forwarded to the project archaeologist for assessment.
6. On completion of the cable installation a report will be produced summarising all archaeological aspects of the project and submitted to DAHG and the National Museum of Ireland.

Appendix 1 RPL Revision 9

Pos No.	Position (WGS-84)		Depth (m)	Heading	Route Distance		Cable Type	Comments
	Latitude	Longitude			Between (km)	Total (km)		
0	53 46.5925N	009 46.2462W	0			0.000		BMH Oldhead
				69.62	0.000		17DA	
	53 46.5925N	009 46.2462W	0			0.000		
				69.62	0.030		17DA	
1	53 46.5980N	009 46.2210W	0			0.030		
				85.17	0.044		17DA	
2	53 46.6000N	009 46.1810W	0			0.074		
				65.76	0.054		17DA	
3	53 46.6120N	009 46.1360W	0			0.128		
				46.19	0.067		17DA	
4	53 46.6370N	009 46.0920W	0			0.195		
				20.54	0.047		17DA	
5	53 46.6610N	009 46.0768W	0			0.242		Landing Point
				20.54	0.147		17DA	
6	53 46.7350N	009 46.0300W	1			0.389		
				31.46	0.298		17DA	
7	53 46.8722N	009 45.8883W	5			0.687		5m
				31.46	0.133		17DA	
8	53 46.9332N	009 45.8253W	10			0.820		10m
				31.46	0.201		17DA	
9	53 47.0258N	009 45.7296W	15			1.021		15m
				31.46	0.211		17DA	
10	53 47.1225N	009 45.6297W	17			1.232		
				25.77	0.283		17DA	
11	53 47.2599N	009 45.5177W	20			1.515		
				25.77	0.070		17DA	
12	53 47.2942N	009 45.4897W	21			1.585		
				25.77	0.064		17DA	
13	53 47.3251N	009 45.4645W	22			1.649		
				12.83	0.190		17DA	
14	53	009	23			1.839		

	47.4252N	45.4260W						
				357.10	0.143		17DA	
15	53 47.5019N	009 45.4326W	23			1.982		
				342.94	0.190		17DA	
16	53 47.5997N	009 45.4833W	24			2.172		
				330.52	0.337		17DA	
17	53 47.7578N	009 45.6343W	25			2.509		25m
				330.52	0.025		17DA	
18	53 47.7698N	009 45.6457W	25			2.534		
				320.17	0.316		17DA	
19	53 47.9004N	009 45.8296W	27			2.850		
				306.39	0.345		17DA	
20	53 48.0110N	009 46.0831W	27			3.195		
				298.56	0.371		17DA	
21	53 48.1065N	009 46.3797W	28			3.566		
				289.22	0.305		17DA	
22	53 48.1606N	009 46.6416W	29			3.871		
				289.22	0.365		17LWA	
23	53 48.2255N	009 46.9561W	29			4.236		
				284.09	0.843		17LWA	
24	53 48.3360N	009 47.7005W	29			5.079		
				295.18	1.397		17LWA	
25	53 48.6563N	009 48.8515W	31			6.476		
				295.18	0.359		17LWA	
26	53 48.7388N	009 49.1480W	31			6.835		
				291.96	1.533		17LWA	
27	53 49.0477N	009 50.4431W	32			8.368		
				295.51	3.098		17LWA	
28	53 49.7670N	009 52.9903W	35			11.466		
				288.52	4.203		17LWA	
29	53 50.4868N	009 56.6224W	40			15.669		
				282.22	4.953		17LWA	
30	53 51.0519N	010 01.0353W	40			20.622		
				282.22	0.109		17DA	
31	53 51.0644N	010 01.1329W	41			20.731		
				282.22	0.455		17DA	
32	53	010	45			21.186		

	51.1164N	01.5384W						
				273.51	0.229		17DA	
33	53 51.1239N	010 01.7460W	43			21.415		
				273.51	0.619		17DA	
34	53 51.1443N	010 02.3093W	42			22.034		
				284.30	0.463		17DA	
35	53 51.2060N	010 02.7189W	39			22.497		
				297.34	0.100		17DA	
36	53 51.2307N	010 02.7995W	43			22.597		
				297.34	0.126		17DA	
37	53 51.2620N	010 02.9018W	46			22.723		
				285.36	0.288		17DA	
38	53 51.3031N	010 03.1552W	45			23.011		
				306.69	0.161		17DA	
39	53 51.3549N	010 03.2729W	46			23.172		
				306.69	0.055		17DA	
40	53 51.3725N	010 03.3127W	43			23.227		
				306.69	0.033		17DA	
41	53 51.3833N	010 03.3373W	44			23.260		
				283.23	0.110		17DA	
42	53 51.3969N	010 03.4350W	44			23.370		
				283.23	0.296		17DA	
43	53 51.4334N	010 03.6978W	44			23.666		
				272.81	0.320		17DA	
44	53 51.4419N	010 03.9887W	40			23.986		
				285.66	0.359		17DA	
45	53 51.4941N	010 04.3037W	45			24.345		
				285.66	0.043		17DA	
46	53 51.5004N	010 04.3420W	48			24.388		
				281.35	0.154		17DA	
47	53 51.5167N	010 04.4795W	50			24.542		
				281.35	0.125		17DA	
48	53 51.5299N	010 04.5910W	44			24.667		
				264.35	0.258		17DA	
49	53 51.5162N	010 04.8256W	46			24.925		
				270.21	0.264		17DA	
50	53	010	42			25.189		

	51.5168N	05.0666W						
				275.68	0.210		17DA	
51	53 51.5280N	010 05.2569W	44			25.399		
				275.68	0.186		17DA	
52	53 51.5379N	010 05.4253W	46			25.585		
				267.63	0.054		17DA	
53	53 51.5367N	010 05.4748W	47			25.639		
				267.63	0.230		17DA	
54	53 51.5315N	010 05.6841W	46			25.869		
				286.38	0.221		17DA	
55	53 51.5651N	010 05.8773W	42			26.090		
				286.38	0.254		17DA	
56	53 51.6038N	010 06.0999W	46			26.344		
				280.60	0.084		17DA	
57	53 51.6121N	010 06.1753W	47			26.428		
				280.60	0.241		17DA	
58	53 51.6360N	010 06.3908W	46			26.669		
				290.61	0.236		17DA	
59	53 51.6808N	010 06.5924W	45			26.905		
				301.09	0.032		17DA	
60	53 51.6896N	010 06.6171W	45			26.937		
				301.09	0.093		17DA	
61	53 51.7156N	010 06.6899W	47			27.030		
				301.09	0.180		17DA	
62	53 51.7657N	010 06.8307W	45			27.210		
				278.13	0.291		17DA	
63	53 51.7879N	010 07.0930W	46			27.501		
				294.50	0.206		17DA	
64	53 51.8340N	010 07.2642W	44			27.707		
				309.53	0.193		17DA	
65	53 51.9002N	010 07.4000W	43			27.900		
				290.14	0.150		17DA	
66	53 51.9282N	010 07.5288W	44			28.050		
				290.14	0.089		17DA	
67	53 51.9445N	010 07.6043W	46			28.139		
				300.60	0.317		17DA	
68	53	010	49			28.456		

	52.0316N	07.8533W						
				300.26	0.231		17DA	
69	53 52.0943N	010 08.0353W	49			28.687		
				309.03	0.259		17DA	
70	53 52.1824N	010 08.2191W	49			28.946		
				305.52	0.060		17DA	
71	53 52.2011N	010 08.2635W	49			29.006		
				305.52	0.183		17DA	
72	53 52.2584N	010 08.3994W	49			29.189		
				305.52	0.249		17DA	
73	53 52.3364N	010 08.5841W	49			29.438		
				313.11	0.257		17DA	
74	53 52.4313N	010 08.7557W	50			29.695		
				313.11	0.073		17DA	
75	53 52.4581N	010 08.8041W	50			29.768		
				297.52	0.225		17DA	
76	53 52.5141N	010 08.9859W	47			29.993		
				311.36	0.217		17DA	
77	53 52.5916N	010 09.1349W	45			30.210		
				312.67	0.425		17DA	
78	53 52.7466N	010 09.4196W	43			30.635		
				295.28	0.272		17DA	
79	53 52.8093N	010 09.6445W	43			30.907		
				280.16	0.499		17DA	
80	53 52.8568N	010 10.0924W	46			31.406		
				283.48	0.344		17DA	
81	53 52.9000N	010 10.3976W	49			31.750		
				301.70	0.289		17DA	
82	53 52.9817N	010 10.6215W	52			32.039		
				323.27	0.088		17DA	
83	53 53.0199N	010 10.6697W	52			32.127		
				323.27	0.234		17DA	
84	53 53.1209N	010 10.7973W	55			32.361		
				307.71	0.216		17DA	
85	53 53.1924N	010 10.9538W	55			32.577		
				307.71	0.225		17DA	
86	53	010	56			32.802		

	53.2664N	11.1159W						
				301.04	0.393		17DA	
87	53 53.3755N	010 11.4228W	57			33.195		
				319.66	0.281		17DA	
88	53 53.4909N	010 11.5888W	58			33.476		
				302.83	0.580		17DA	
89	53 53.6607N	010 12.0341W	60			34.056		
				301.20	0.181		17DA	
90	53 53.7113N	010 12.1756W	58			34.237		
				301.20	0.150		17DA	
91	53 53.7529N	010 12.2920W	56			34.387		
				293.37	0.470		17DA	
92	53 53.8536N	010 12.6864W	56			34.857		
				315.00	0.234		17DA	
93	53 53.9426N	010 12.8372W	61			35.091		
				309.02	0.319		17DA	
94	53 54.0509N	010 13.0634W	62			35.410		
				290.91	0.165		17DA	
95	53 54.0826N	010 13.2040W	66			35.575		
				290.91	0.116		17DA	
96	53 54.1049N	010 13.3028W	69			35.691		
				314.23	0.405		17DA	
97	53 54.2574N	010 13.5681W	72			36.096		
				299.94	0.330		17DA	
98	53 54.3460N	010 13.8287W	73			36.426		
				285.75	0.480		17DA	
99	53 54.4163N	010 14.2508W	70			36.906		
				285.75	0.126		17DA	
100	53 54.4348N	010 14.3618W	67			37.032		
				287.06	0.112		17DA	
101	53 54.4524N	010 14.4590W	65			37.144		
				287.06	0.106		17DA	
102	53 54.4693N	010 14.5519W	66			37.250		
				287.06	0.118		17DA	
103	53 54.4879N	010 14.6549W	66			37.368		
				309.05	0.264		17DA	
104	53	010	67			37.632		

	54.5773N	14.8416W						
				296.48	0.248		17DA	
105	53 54.6371N	010 15.0447W	62			37.880		
				290.36	0.132		17DA	
106	53 54.6618N	010 15.1577W	65			38.012		
				290.36	0.123		17DA	
107	53 54.6849N	010 15.2628W	66			38.135		
				299.15	0.067		17DA	
108	53 54.7025N	010 15.3164W	67			38.202		
				299.15	0.204		17DA	
109	53 54.7562N	010 15.4793W	53			38.406		
				311.96	0.313		17DA	
110	53 54.8689N	010 15.6917W	57			38.719		
				295.33	0.569		17DA	
111	53 55.0001N	010 16.1611W	61			39.288		
				320.18	0.310		17DA	
112	53 55.1283N	010 16.3422W	70			39.598		
				320.18	0.058		17DA	
113	53 55.1523N	010 16.3761W	71			39.656		
				296.12	0.382		17DA	
114	53 55.2430N	010 16.6895W	72			40.038		
				296.12	0.119		17DA	
115	53 55.2714N	010 16.7876W	73			40.157		
				296.12	0.738		17DA	
116	53 55.4463N	010 17.3922W	77			40.895		
				283.63	0.566		17DA	
117	53 55.5183N	010 17.8950W	79			41.461		
				283.63	0.452		17DA	
118	53 55.5757N	010 18.2964W	79			41.913		
				302.08	0.159		17DA	
119	53 55.6210N	010 18.4188W	80			42.072		
				302.08	0.209		17DA	
120	53 55.6809N	010 18.5807W	81			42.281		
				302.08	0.038		17DA	
121	53 55.6919N	010 18.6104W	79			42.319		
				297.30	0.542		17DA	
122	53	010	81			42.861		

	55.8259N	19.0504W						
				302.70	0.438		17DA	
123	53 55.9533N	010 19.3868W	80			43.299		
				287.60	0.028		17DA	
124	53 55.9580N	010 19.4116W	81			43.327		
				287.60	0.525		17DA	
125	53 56.0435N	010 19.8683W	87			43.852		
				297.61	0.123		17DA	
126	53 56.0742N	010 19.9679W	87			43.975		
				297.61	0.384		17DA	
127	53 56.1702N	010 20.2787W	87			44.359		
				313.77	0.062		17DA	
128	53 56.1935N	010 20.3200W	88			44.421		
				313.77	0.153		17DA	
129	53 56.2506N	010 20.4210W	88			44.574		
				313.77	0.143		17DA	
130	53 56.3036N	010 20.5148W	88			44.717		
				330.38	0.182		17DA	
131	53 56.3892N	010 20.5973W	89			44.899		
				330.38	0.264		17DA	
132	53 56.5128N	010 20.7163W	90			45.163		
				303.45	0.360		17DA	
133	53 56.6198N	010 20.9909W	91			45.523		
				303.45	0.045		17DA	
134	53 56.6330N	010 21.0249W	91			45.568		
				285.59	0.277		17DA	
135	53 56.6733N	010 21.2693W	91			45.845		
				285.59	0.120		17DA	
136	53 56.6906N	010 21.3746W	92			45.965		
				285.59	0.165		17DA	
137	53 56.7144N	010 21.5194W	92			46.130		
				293.59	0.291		17DA	
138	53 56.7772N	010 21.7633W	93			46.421		
				293.59	0.120		17DA	
139	53 56.8031N	010 21.8638W	94			46.541		
				295.91	0.541		17DA	
140	53	010	95			47.082		

	56.9307N	22.3091W						
				295.91	0.006		17DA	
141	53 56.9320N	010 22.3135W	95			47.088		
				288.73	0.438		17DA	
142	53 57.0078N	010 22.6926W	95			47.526		
				298.98	0.170		17DA	
143	53 57.0523N	010 22.8289W	97			47.696		
				298.98	0.070		17DA	
144	53 57.0705N	010 22.8847W	97			47.766		
				298.98	0.119		17DA	
145	53 57.1017N	010 22.9801W	98			47.885		
				298.98	0.044		17DA	
146	53 57.1131N	010 23.0151W	98			47.929		
				292.67	0.171		17DA	
147	53 57.1485N	010 23.1588W	98			48.100		
				292.67	0.209		17DA	
148	53 57.1920N	010 23.3351W	99			48.309		
				292.67	0.083		17DA	
149	53 57.2094N	010 23.4057W	100			48.392		
				307.49	0.056		17DA	
150	53 57.2275N	010 23.4457W	101			48.448		
				307.49	0.423		17DA	
151	53 57.3664N	010 23.7528W	102			48.871		
				307.49	0.122		17DA	
152	53 57.4063N	010 23.8410W	103			48.993		
				299.52	0.133		17DA	
153	53 57.4417N	010 23.9471W	103			49.126		
				299.52	0.270		17DA	
154	53 57.5134N	010 24.1617W	104			49.396		
				293.81	0.523		17DA	
155	53 57.6271N	010 24.5988W	106			49.919		
				304.37	0.594		17DA	
156	53 57.8081N	010 25.0474W	106			50.513		
				317.24	0.421		17DA	
157	53 57.9746N	010 25.3086W	105			50.934		
				310.66	0.311		17DA	
158	53	010	105			51.245		

	58.0840N	25.5246W						
				295.86	0.294		17DA	
159	53 58.1531N	010 25.7664W	106			51.539		
				280.81	0.366		17DA	
160	53 58.1901N	010 26.0950W	107			51.905		
				296.17	0.327		17DA	
161	53 58.2679N	010 26.3635W	107			52.232		
				310.94	0.293		17DA	
162	53 58.3713N	010 26.5657W	107			52.525		
				314.47	0.232		17DA	
163	53 58.4589N	010 26.7170W	108			52.757		
				299.49	0.822		17DA	
164	53 58.6771N	010 27.3714W	109			53.579		
				309.68	0.814		17DA	
165	53 58.9573N	010 27.9446W	114			54.393		
				296.19	0.721		17DA	
166	53 59.1288N	010 28.5360W	119			55.114		
				282.87	0.355		17DA	
167	53 59.1714N	010 28.8526W	121			55.469		
				273.30	0.275		17DA	
168	53 59.1799N	010 29.1033W	122			55.744		
				292.24	0.287		17DA	
169	53 59.2385N	010 29.3462W	123			56.031		
				292.24	0.056		17DA	
170	53 59.2500N	010 29.3942W	123			56.087		
				307.66	0.486		17DA	
171	53 59.4100N	010 29.7461W	125			56.573		
				322.19	0.387		17DA	
172	53 59.5748N	010 29.9631W	124			56.960		
				337.19	0.539		17DA	
173	53 59.8428N	010 30.1543W	123			57.499		
				322.98	0.269		17DA	
174	53 59.9583N	010 30.3021W	124			57.768		
				300.73	0.292		17DA	
175	54 00.0388N	010 30.5319W	125			58.060		
				288.32	0.274		17DA	
176	54	010	125			58.334		

	00.0852N	30.7698W						
				300.20	0.272		17DA	
177	54 00.1590N	010 30.9851W	126			58.606		
				315.32	0.287		17DA	
178	54 00.2689N	010 31.1695W	128			58.893		
				330.41	0.246		17DA	
179	54 00.3843N	010 31.2808W	127			59.139		
				315.50	0.022		17DA	
180	54 00.3929N	010 31.2952W	127			59.161		
				315.50	0.194		17DA	
181	54 00.4675N	010 31.4196W	131			59.355		
				315.50	0.070		17DA	
182	54 00.4941N	010 31.4640W	132			59.425		
				305.99	0.522		17DA	
183	54 00.6598N	010 31.8513W	135			59.947		
				301.69	0.545		17DA	
184	54 00.8141N	010 32.2756W	133			60.492		
				308.35	0.965		17DA	
185	54 01.1368N	010 32.9682W	140			61.457		
				283.74	0.454		17DA	
186	54 01.1949N	010 33.3718W	140			61.911		
				273.81	0.289		17DA	
187	54 01.2053N	010 33.6355W	140			62.200		
				273.81	0.034		17DA	
188	54 01.2065N	010 33.6667W	139			62.234		
				288.30	0.293		17DA	
189	54 01.2560N	010 33.9212W	140			62.527		
				304.87	0.331		17DA	
190	54 01.3582N	010 34.1702W	139			62.858		
				307.58	0.798		17DA	
191	54 01.6203N	010 34.7488W	138			63.656		
				320.83	0.366		17DA	
192	54 01.7736N	010 34.9609W	139			64.022		
				329.20	0.957		17DA	
193	54 02.2163N	010 35.4093W	127			64.979		
				307.76	1.544		17DA	
194	54	010	134			66.523		

	02.7262N	36.5278W						
				299.67	0.296		17DA	
195	54 02.8052N	010 36.7634W	131			66.819		
				312.58	0.674		17DA	
196	54 03.0507N	010 37.2175W	131			67.493		
				306.00	1.412		17DA	
197	54 03.4984N	010 38.2648W	144			68.905		
				293.93	0.460		17DA	
198	54 03.5988N	010 38.6494W	148			69.365		
				306.21	1.250		17DA	
199	54 03.9968N	010 39.5734W	152			70.615		
				315.56	0.638		17DA	
200	54 04.2426N	010 39.9832W	154			71.253		
				300.59	1.096		17DA	
201	54 04.5431N	010 40.8478W	158			72.349		
				309.20	0.664		17DA	
202	54 04.7693N	010 41.3194W	162			73.013	17DA	Exit Ireland TS/Enter Ireland CZ

Appendix 2 Shipwreck Inventory

The Shipwreck Inventory of Ireland includes all known wrecks for the years up to and including 1945. The Shipwreck Inventory is principally a desktop survey with information gathered from a broad range of cartographic, archaeological and historical sources, both documentary and pictorial. Approximately 10,000 records have been compiled and integrated into the shipwreck database thus far. Wrecks over 100 years old and archaeological objects found underwater are protected under the National Monuments (Amendment) Acts 1987 and 1994. Significant wrecks less than 100 years old can be designated by Underwater Heritage Order on account of their historical, archaeological or artistic importance as is the case with the wreck of the RMS Lusitania located off Kinsale Head. Underwater Heritage Orders can also be used to designate areas of seabed or land covered by water to more clearly define and protect wreck sites and archaeological objects. Under the legislation all diving on known protected wreck sites or with the intention of searching for archaeological underwater material is subject to licensing requirements. The Shipwreck Inventory for County Mayo was consulted in the Underwater Archaeology Unit offices for vessels lost in the survey area using the following place names; Achill Island, Achill Beg, Clare Island, Clew Bay, Corraun, Dooagh, Keel, Killsallagh, Louisburgh, Mallaranny, Newport, Old Head, Westport. There were a large number of shipwrecks recorded in the area and they are as follows;

Site Name	Date of Loss	Place of Loss	Description	Reference
Aghia Eirine (SS) W06657	10/12/ 1940	Achill Island, Zone 909, Western shore adjacenat to Claggan and Dumha Eige townlands 53 53 13.420N, 09 59 03.180W	4,330 ton steamer foundered en route from Cardiff to Buenos Aires with cargo of coal. The steamer lost control of its steering and ran ashore on the western cliffs of Achill Island. Part of the wreck was salvaged in 1941 by Mr. J Sweeney and a local diver, Mr j, Gorman. The wreck lies on a rocky seabed in roughly 15 meters of water.	Bourke 1994, 188: Meide 2006.
Abigail W06656	24/01/ 1847	Westport, Zone 909, exact location unknown	No description available	PP 1851, Vol. L11, 6; Lloyd's List 10,255, Wednesday 27th January 1847
Allen	4 Jan. 1811	near Westport	This ship was en route from the Azores to Liverpool, under Price, when she was wrecked. The crew and cargo were saved.	L. L. no. 4530, 22 January 1811
Amelia	19/12/	Achill Head, Zone	No description available	Bourke 1998,138,

W06668	1815	909, exact location unknown		Llyods Listno.5032 19th December 1815, Freemans journal LVII, 4thJanuary 1816, 4.
Apapa (MV) W06678	15/11/1940	Achill Head, 235 nautical miles west of Zone 909 54 34 00.000N, 16 47 00.000W	No description available	Hocking, 1969, 39; BVLS 1939-45, 13.
Argyle W06683	15/10/1842	Louisburg, Zone 909, exact location unknown	No description available	PP1843, Vol. IX, 42
Arrow W06684	20/09/1782	Mayo Coast, Zone 909, exact location unknown	No description available	Bourke, 2000, 105.
Ashcrest (SS) W06685	07/12/1940	Mayo, 54 35 00.000N, 09 20 00.000W	No description available	UKHO Wreck Data 1996, Hocking 1989, 51
Assistance W06686	16/04/1838	Black Island Bay, near Westport, Zone 909, exact location unknown	No description available	Bourke, 2000, 105.
Botley Wood W06690	05/02/1847	Westport (on shore), Zone 909 Exact location unknown	No description available	PP 1851, Vol LII, 7.
Clan Menzie SS W09551	29/07/1940	54 10 00.000N, 54 10 00.000W	No description available	N/A
Clyde W06701	22/12/1847	Achill Island, Zone 909, exact location unknown	No description available	PP 1851, Vol. LII, 39; Lloyds list 10, 539, Tuesday 28th December 1847

Columbus W06702	10/05/1834	Louisburgh, Zone 909, exact location unknown	No description available	PP1836, Vol. XVII, 310.
CS Parnell W06705	Unknown	Inishgort Lighthouse, Clew Bay, 5 cable degrees from 53 50 04.000N, 09 36 56.000W	No description available	UKHO Wreck data 1996
Catherine	5 Feb. 1822	near Westport	This vessel of Leith was en route from Westport to Liverpool under Captain Morrison. She went ashore and broke up.	Bourke, 1998, 138
Catharine / Catherine	19 Nov. 1822	Clew Bay	A vessel laden with timber, supposedly the Catharine, was totally wrecked.	Bourke, 1998, 137 L. L. no. 5754, 26 November 1822
Charles Stuart Parnell	June 1928	between Island Mór and the channel between Inisgort and Collanbeg, Ilanmore Harbour, Westport Bay	This 200-ton wooden ketch was a rigged sailing vessel and worked as the supply ship for the local lighthouses. She was burned and lost but now lies on sand and coral at 12 metres, in a broken state.	Bourke, 1994, 188
Chio	24 Jan. 1852	Culleen Island, Clew Bay	This Greek brig dragged her anchor in a force 9 gale and went ashore on the island. She sustained a lot of damage but was expected to be got off on the next spring tide. She got off on the 20th with her copper slightly damaged.	CSP, 1852-53, Vol. LXI, 26-27
Creteboom	22 Sept. 1937	Mayo Position 54 08 08.5N, 009 08 15.0W WreckNo.0073000	This British tug weighed 685 tons and measured 125 x 27 x 14 feet. She was built during WWI to tow barges of iron ore from Spain to the UK. She was built by John Ver Mehr and Co. of Shorham and was constructed of ferroconcrete due to the shortage of steel. She had a 3 cylinder, 725ihp engine. The vessel was tied to the hull of registered tug Pressman when she arrived at Ballina on the 22nd September 1937. They encountered bad weather whilst crossing the bar and collided.	Admiralty Data 1996

			The Crete boom suffered a crack below the waterline but it was not noticed until she came alongside the jetty. Efforts were made to keep her afloat, but she was let go away from the jetty where she sank and settled into mid stream. She stayed there for 30 years before being re-floated during the mid-70's and moved 25 yards to her present position. In 1967/68, a stranded wreck was seen on a sandbank in mid stream, on the approaches to Ballina, on an aerial photograph.	
Dispatch W06707	02/11/1884	Iniskea, Zone 909, exact location unknown	No description available	Bourke, 2000, 106.
Dunvegan Castle (SS) W06711	28/08/1940	Achill Head, 37 miles west of Zone 909, 55 05 00.000N, 11 00 00.000W	No description available	ASS.P26; BVLS. 1939-45, 5: Larn and Larn 2002, LCSLR. 1939-45, 118: LR 1940-41 No. 73466(D); SIC Vol.2, 134; Union castle line history, 118, Hocking 1989, 198; Lloyds list 30,278, Friday 27th September 1940.
Edward W06714	24/12/1815	Achill Head, Zone 909, exact location unknown	No description available	Bourke 1998, 138
El Grand Grin W06715	C 1588	Clare Island, Zone 909, exact location unknown	No description available	Bourke 1994, 189; Bourke 1998, 137; Flanagan, L, 1988, 22.
Eliza	13 Nov. 1847	Westport Bay	This 123-ton sailing vessel was on the shore	. CSP, 1851, Vol. LII, 35
Embassage (SS)	27/08/1941	Achill Head 100 miles west of Zone 909, 54 00	No description available	Hocking 1969, 212; BVLS 1939-45, 26.

W06718		00.000N, 13 00 00.000W		
Emerald W06720	15/07/ 1847	Louisburgh, Zone 909, exact location unknown	No description available	PP 1851, Vol. LII, 25.
Fancy	1696	Inishlyre Roads, Clew Bay	This Man O' War vessel originally belonged to Charles II of the 1694 Spanish expedition from Corunna. Henry Everly (Long Ben) took over the vessel and used her for piracy. The vessel is recorded arriving in Mayo in June 1696 with 20 pirates on board. It is not certain what happened to the ship but it is thought to have been abandoned or wrecked	Bourke, 1994, 193
Flor W06729	18/03/ 1854	Westport, Zone 909, exact location unknown	No description available	PP 1854-55, Vol XXXIV, 44-5; PP 1861, Vol.LXII, 39; Lloyds List No 12579, July 20th 1854
Flora	7 April 1899	Inishlyre Roads, Clew Bay	This 44-ton wooden sloop of Westport was 52 years old. The master and owner was J. Moran of Careholly, Westport. She was at anchor at Inishlyre, in ballast, with two crew aboard. She was hit by the schooner Kate, of Westport, in a WSW force 9 wind and she became a total loss.	CSP, 1900, Vol. LXXVII, 157
Flying Cloud W06732	25/07/ 1895	Achillbeg, Zone 909, exact location unknown	No description available	PP 1898, LXXXIII, 107
Forest Monarch	20 Nov. 1848	Inniskeagh Island (Inishkea ?)	N/A	CSP, 1852-3, Vol. XCVIII, 2
Gemini W06738	12/12/ 1822	Clare Island, Zone 909, exact location unknown	No description available	Bourke 1998, 139; Lloyds Listno. 5736, 18th October 1822
George W06739	02/02/ 1802	Westport, Zone 909, exact location unknown	No description available	Bourke 1998, 138; Larn and Larn 2002; Lloyds Listno. 4226,

				2 February 1802; Lloyds list, No 4226, 02/02/1802 Tuesday. LR 1801 No 61 (G); SIC Vol. 2, 138
George W06740	26/11/ 1822	Clew Bay, Zone 909, exact location unknown	This vessel was en route from Quebec to Greenock, under Captain McAlpine. She was abandoned by the crew and the vessel drifted into the bay. The captain and one of her 12 crew were picked up by the Sultan.	Bourke 1998, 137; Lloyds list 5, 745, 26th November 1822.
Gertrude W06743	18/09/ 1744	Westport, Zone 909, exact location unknown	No description available	Lloyds list, No. 921, 18th September 1744
Helena	1 March 1833	off Westport	This 97-ton vessel of Alloa (Port of Grangemouth) was 30 years old and second class. She was en route from Glasgow to Limerick when she was lost.	Bourke, 1998, 137 CSP, 1836, Vol. XVII, 300, 371
Helena W06751	12/01/ 1808	Newport, Zone 909, exact location unknown	No description available	Larn and Larn 2002, Llyods list No 4205: 20/11/1807
Hope W06756	19/12/ 1835	Achill Island, Zone 909, exact location unknown	No description available	ILR; Larn and Larn 2002 STS Apx 1, 88.
Hope W06757	05/04/ 1818	Achill head, Zone 909, exact location unknown	No description available	Bourke 1994, 194, PP 1896, Vol XVII, 293.
Hopewell W06758	26/12/ 1833	Achill Island, Saddle head, Zone 909, exact location unknown	No description available	Larn and Larn 2002 LR 1833 No 884 (H)
Jane	25 Feb. 1794	near Westport	This ship was en route from Lisbon to Dublin, under Buchanon, when she went ashore.	Bourke, 1998, 138 L. L. no. 2589, 25 February 1794
Jeanie W06770	1894	Achill, Zone 909, exact location unknown	No description available	PP 1894, Vol. LXXVI, Floating derelicts, 87

Jenny W06771	13/01/ 1894	Achillbeg Island, Zone 909, exact location unknown	No description available	Bourke 1998, 188; Larn and Larn 2002, LCR 1894, 15(h); LR 1893-4 No 364(j); PP 1985, LXXVII, 138; SIC Vol. 1, 188; Lloyds list, No 17, 589 Mon. 15th January 1894, 7, c.16 Lloyds list, No. 17, 592 Thursday 18th January 1894, 10; Lloyds list, No 17, 601 Monday 29th January 1894, 7, c 18; Lloyds list, No 17, 604 Thursday 1st February 1894, 10.
Leguan	15 Sept. 1860	Clew Bay	Official Number: 13,026. This Glasgow based, 349-ton, vessel was en route from Grenada to Greenock with a cargo of rum, sugar and molasses. She was caught in a gale on the 13th and took shelter at Mayo Island but drifted into Clew bay. She was at risk of going ashore at Leckanvey, near Westport, so the master, William Buchanan, had the masts cut. On the 14th three pilot boats went out to the stricken vessel despite the bad weather. The men boarded the vessel but their three boats sank. The master of Leguan was unable to get ashore until 6 a.m. on the 15th. While he was ashore trying to get an anchor and a steam tug, a fire broke out on his vessel. The fire spread rapidly so the crew, fearing there was powder on board, left the vessel. She became a total loss. An inquiry ordered at Westport found Master Buchanan at fault for anchoring at Mayo Island when he could have gone to Inishgort. He was also blamed for going ashore on the 15th when the officer left onboard was not capable of holding the vessel. The cause of the fire was not discovered. The crew of the three pilot	CSP, 1861, Vol. LXIII, 418, 432

			boats were rewarded with £5 by the Merchant Mariner Fund	
Leopard	1665	Mayo	This 400-ton Dutch vessel left Wielingen on 28th October 1665. The vessel was thought to have been wrecked west of the Shetlands but it is likely to have occurred at Mayo. Attempts were made to salvage the vessel in August 1666. A ship came from Crookhaven to retrieve the anchor and cables.	Bourke, 1994, 192
Leopard	9 Dec. 1794	Near Westport	This ship was en route from London to Galway when lost. Part of the cargo was saved. She was under Ross or Captain Fose. Bourke, 1998, 136, 138	L. L. no. 2671, 9 December 1794
Loven	3 Sept. 1802	Off Westport	This vessel was en route from Altona to Marseilles under Cornelefon when she was lost. The crew survived.	L. L. no. 4287, 3 September 1802
Liberator W06784	14/01/ 1895	Clew Bay, Achill Island, Curran Coast, Zone 909, exact location unknown	No description available	Larn and Larn 2002 BOT WkRtn 1895 Appx C Table 1, 135 (656); NLR; PP 1896, LXXV 135.
Lizzie D. Small W06785	25/11/ 1922	Westport, offshore, Two mile rock E of, Zone 909, exact location unknown	No description available	Larn and Larn 2002 LCR 1922, 12(g); NLR
Love W06786	26/06/ 1833	Louisburgh, Zone 909, exact location unknown	No description available	Bourke 1994, 194; PP 1836, Vol. XVII, 302
Lugar	1889	Inishgort	This steam ship was in a derelict state when the Lightkeeper of Inishgort noted it. The vessel struck some rocks but floated off and 'proceeded.'	CSP, 1894, Vol. LXXVI, Floating Derelicts, 85
Maria	10 Jan. 1849	Westport Bay	This vessel of Londonderry was en route from Liverpool or from New York to Galway when she was lost. The crew survived.	Bourke, 1994, 194; CSP, 1852-3, Vol. XCVIII, 2
Mary and Sally	30 Jan. 1808	near Westport	This vessel was en route from Belfast or from Charlestown to Belfast, under Captain Brown. She was wrecked but the cargo was hoped to be saved.	Bourke, 1998, 139 L. L. no. 4230, 19 February 1808

Mary	2 June 1890	off Rosmoney Point, Clew Bay	This 1-ton unregistered wooden lug was 16 years old. The master and owner was M. Gibbons of Rosmoney, Co. Mayo. She was en route from Rosmoney to a vessel in Clew Bay with 2 crew and a cargo of stone. She encountered a SW force 9 wind and was lost. One life was lost.	CSP, 1890-91, Vol. LXXVI, 111
Mary	11 Sept. 1894	Rossport	This wooden Curragh weighed 1 ton. She was fishing at Rossport, Co Mayo, when it capsized and later broke up. One of the four crew was lost.	CSP, 1896, Vol. LXXV, 150
Mary	26 Dec. 1897	Co. Mayo	This 4-year old wooden fishing canoe weighed 1 ton. The master and owner was M. Ryan from Beelderig, Co. Mayo. She was en route from Balderig, Mayo, fishing.	CSP, 1899, Vol. LXXXVII, 132
Nelson	27 Jan. 1847	Westport	This sailing vessel was on the shore.	CSP, 1851, Vol. LII, 6
Nimroud	28 Jan. 1875	abandoned off the coast of Mayo	This 826-ton wooden barque of Cardiff, Official No. 3,913, was built in Miramichi, New Brunswick in 1853. Her owner was R. W. Morris of Clifton, Gloucestershire, and her master was William Oakley. She was en route from the Penarth Roads to St. Vincent, Cape de Verd, with a 1,000-ton cargo of coal and 20 crew. During bad weather several of the lanyards of the fore and main rigging were lost and had to be replaced. On the 11th the mainmast went over the side, carrying with it the mizen mast. The wreckage was cut away but the ship continued to labour heavily. On the 12th the foremast went over the side, carrying the bowsprit with it. A raft was got over the bows, with an anchor hung over to keep her head to the sea. Other efforts were made to erect temporary sails. The vessel drifted until off Slyne Head and then northwards towards the Bills Rocks, and on towards Achill Head. When within 3 miles of land, the crew insisted on leaving the ship. They took to the boats with the master but 2 crewmen stayed on board. The boats landed with the assistance of coastguards. The two men on board let go the anchors and were rescued the	CSP, 1875, Vol. LXX, 204, 318

			following day. The vessel was eventually taken in tow by the Rose of Glasgow and brought to Westport. The court found that the master was placed in such a position that he was not considered guilty of default in leaving the vessel but he did show a want of energy and decision. His certificate was returned.	
Nancy W06814	15/02/1893	Clew Bay, Innislyre, Zone 909, exact location unknown	No description available	Larn and Larn 2002 BOT WK Rtn 1893 Appx C Table 1, 114(474); NLR; PP 1894 LXXXVII, 114
Neptune W06816	21/01/1860	Meenaun (Minion) Cliffs, Mecnaxon Hill, Dukenella Townland, Achill Island, Zone 909, exact location unknown	No description available	Lloyds list, No.14, 293, Wednesday 25th January 1860; Lloyds list, No.14, 295, Friday 27th January 1860; Bourke 1994, 188; PP 1861, Vol. LVIII, 39, 53, 66; PP 1861, Vol. LXIII, 408/39
Neptune W06817	23/01/1838	Iniskea, Zone 909, exact location unknown	No description available	Bourke 2000, 105, Lloyds List, No. 7460 Wednesday January 31st, 1838
No Name W06820	21/03/1896	Clare Island, Zone 909, exact location unknown	No description available	Larn and Larn 2002 BOT WkRtn 1896, Appx C table 1, 136 (866); NLR; PP 1897, LXXXVIII, 136
No Name W11142	Unknown	Currown peninsula clew bay 53 5123.069N, 09 5048.306W	No description available	No Name W11142
No Name	Unknown	Old Head Clew bay	No description available	No Name

W11423		53 46 37.226N, 094612.494W		W11423
Ortolan W06826	01/10/1882	Achill Island, Zone 909, exact location unknown	No description available	Lloyds List, No 21, 424, Thursday 28th December 1882; PP 1886, Vol LIX, 182-83, PP 1884 LXXI 124.
Pearle W06833	28/01/1854	Achill Island, Zone 909, exact location unknown	No description available	PP 1845-55, Vol XXXIV, 30-31; Lloyds List, No. 12437, Thursday 2ndFeburary 1854, 4 c 8
Pearl	6 Dec. 1904	Innislyre	This wooden smack of Westport weighed 36 tons and was 57 years old. The master and owner was T. Kelly of Island More, Westport. She was at anchor at Innislyre, in ballast, with no crew aboard when she burnt. She was a total loss. There was a SSW force 7 at the time.	CSP, 1906, Vol. CVIII, 147, 637
Otter	unknown	Clew Bay	A number of cannon balls were found in the bay and are thought to have come from the Otter.	Bourke, 1994, 193
Reformer	24 March 1856	south point of Innishack	This 145-ton brig was carrying a cargo of wheat when she was stranded in a SE force 3 wind. She became a total loss and four of the eight men on board were lost.	CSP, 1861, Vol. LXIII, 39
Rodney	May 1834	Westport	The American brig Rodney of Boston was laden with cotton and naval stores. The brig Douglas of Southerland rescued her and brought the passengers safely to Westport.	Freemans Journal, 21 May 1834, Column Ship News
Rosa W06845	02/02/1822	Westport 10 Miles W of Zone 909, exact location unknown	No description available	Larn and Larn 2002, Lloyds List No 5671 and 5680: 03.02 and 12.03.1822 Tuesday. LR 1822 No 271 (C); SIC Vol.2, 138. Lloyds list 5, 671, 3rd February 1822
Rudyard	16/09/	Clare Island, 74km	No description available	BVLS 1939-45, 56;

Kippling W06848	1939	West Zone 909, 53 50 00.000N, 11 10 00.000W		Larn and Larn 2002 LCWLR 1939-45, 7; Lloyds List No. 38, 961 Tuesday 19th September
Salem W06851	Febura ry 1840	Westport, Zone 909, exact location unknown	No description available	Irish National archive, Westport harbour commission 1081/1/1
San Nicholas Prodanelli W06852	1588	Curraun Peninsula, Zone 909, exact location unknown	No description available	Bourke 1994, 189, Irish Independent 26.6.1997
Sentry (SS) W06857	04/05/ 1911	Achill Island entrance to Keel Harbour, Zone 909, exact location unknown	No description available	Bourke 1994, 188; Lloyds List, No. 22, 964, Thursday 4th May 1911, 10 c. 22; Lloyds List, No. 22, 966 Saturday 6th May 1911, 11 c.22; Lloyds list, No. 22, 967 Monday 8th May 1911, 8 c.22
Shamrock W06858	05/11/ 1911	Achill Island, Derreen Point, Zone 909, exact location unknown	No description available	Larn and Larn 2002 BOT WkRtn 1911 Appx C Table 1, 95 (393); NLR
Six Brothers W06865	01/04/ 1763	Newport ‘ sound of actrill’, Zone 909, exact location unknown	No description available	Larn and Larn 2002, Lloyds List No 2840: 01.04 1763 Friday; Lloyds List No 2840, Friday 1st April 1763
Sollecito Bochese W06866	10/02/ 1850	Achill, Zone 909, exact location unknown	No description available	Bourke 1994, 194; PP 1852-3, Vol XCVIII, 4; Lloyds list, No. 11 203, Friday 15thFeburary 1850; Lloyds list No 11205,

				Monday 18thFeburary 1850
Somand W06867	20/09/ 1886	Achill Head, Zone 909, exact location unknown	No description available	Lloyds list, No. 15, 326, Tuesday 5th October 1886, BOT WkRtn 1886 Appx C Table 1, 121 (887); Bourke 1994, 195; Larn and Larn 2002; LR 1886-7 No 1315(S); PP 1888, XC, 121; SIC Vol 1, 194
Sophia W06868	22/11/ 1901	Clare Island, Zone 909, exact location unknown	No description available	Bourke 1994, 192; PP 1902, LXIII, 127
St Patrick W06877	09/11/ 1876	Achill, 130 miles of, Zone 909. Exact location unknown	No description available	PP 1877, Vol. LXXV, 75
St Patrick W06878	16/10/ 1792	Achill Head, Zone 909, exact location unknown	No description available	Lloyds Listno, 2445, 16 1792
St Patrick W06881	16/10/ 1793	Achill Head, Zone 909	No description available	Larn and Larn 2002, Lloyds List No 2445,: 16.10.1792 Tuesday; NLR
Star of Peace W06884	26/02/ 1886	Clare Island, Zone 909, exact location unknown	No description available	Lloyds list No. 15, 140, Monday 1stMarch 1886; PP 1887, LXXIV, 134
Successful W10071	Unkno wn	Achill Sound Bleannohaeg Strand, 53 5607.476N, 09 5552.788W	No description available	

Sutherland W06886	Unknown	Clare Island, Zone 909, exact location unknown	No description available	Bourke 1994, 192
Swallow W06887	01/12/1825	Westport, Clogher Head, Zone 909, exact location unknown	No description available	Larn and Larn 2002, Lloyds list No 6071: 09.12.1825 Friday (R)
Sheldrake	7 May 1842	Clew Bay	This 119-ton schooner was built in 1827 and was classed as '𝔼 1 – 41'. She belonged to the port of Dartmouth and the master was Foster. She was en route from Liverpool to Westport when she became stranded.	CSP, 1843, Vol. IX, 36
Speedwell	Jan. 1760	near Newport	This vessel was en route from America with a cargo of flax when she was lost. The captain was Pratt.	Bourke, 1998, 136
T.H Haviland W06888	06/01/1884	Westport, Zone 909, exact location unknown	No description available	Bourke 2000, 105
Thistle W06895	04/03/1832	Westport, Quay near, Zone 909, exact location unknown	No description available	Bourke 2000,106, Lloyds list No. 6724, Tuesday March 13, 1832
Thomas W06896	14/12/1830	Westport Bay, Zone 909, exact location unknown	No description available	Bourke 2000, 105; Lloyds List No. 6596, Tuesday December 21st 1830
Thomas Richardson W06898	18/12/1842	Achill Head, Zone 909, exact location unknown	No description available	PP 1843, Vol, IX, App 3, 44
Thomas and Rebecca	1835	in Westport Bay	This vessel of Dumfries weighed 91 tons. She was 34 years old when she was wrecked.	Bourke, 1998, 137; CSP, 1836, Vol. XVII, 371
Valiant	21 Nov. 1819	c.30 miles from Westport	This vessel of Aberdovey was en route from Kilrush to Glasgow, under the command of Lewis, when she was lost. One of the crew drowned.	L. L. no. 5443, 30 November 1819
Ulysses W06903	12/01/1808	Newport, Zone 909, exact location unknown	No description available	Larn and Larn 2002, Lloyds List No 4, 219: 12.01.1808 Tuesday (R)

Unknown W06926	Unknown	Achill Sound May, 53 56 10.000N, 55 55 00.000W	No description available	UKHO Wreck Data 1966
Upwey Grange MV W06964	08/08/1940	Achill Head 200 miles W, 54 20 00.000N, 15 28 00.000W	No description available	Hockinf 1969 726-7 BUIS 919-459
unknown	20 April 1830	Aunasead, Westport	A boat containing nineteen people who had been employed to collect seaweed was upset in a storm off Aunasead, in the bay of Westport. 10 of the crew were drowned.	Freemans Journal, Tue. 20 April 1830, Column Melancholy Accident and loss of life
unknown	18th / 19th century	Poll naRaite	This vessel was under the command of Captain O' Malley, a well known smuggler, and was carrying goods for Newport. The vessel was sunk by the revenue boat Sloopeen Vaughan 12551.	Bourke, 1994, 194
unknown	14 June 1894	Clew Bay	This hooker was en route from Achill to Glasgow with passengers when she was overturned by a gust of wind. Thirtytwo people were drowned. The Gardinia, the Laird line steamer, had been waiting to take aboard passengers for its Westport to Glasgow service. The bodies of the victims were taken back to Achill on the new railway.	Bourke, 1994, 190
unknown	1917 - 1918	near Westport?	This 27-foot steam pinnace was part of the coastguard station at Ros naMihil, near Westport. A local man swam to the vessel and released the anchor. He then holed the vessel causing her to sink. The wreck was not found despite searches by two naval vessels.	Bourke, 1998, 137

Appendix 3 Topographic Files

The following files were found in and around Newport, Westport and Clew Bay. These are listed below:

Townland	Finds Description
Newport	Bronze palstave 1933: 570; copper hammer head 1929: 1353
Kilbride	Later Bronze Age hoard
Muckanagh	Wooden bowl 1977: 2173
Derryloughan More	Bog butter with wooden container

*The NMI research section was closed for the month of December. Topographical files included in the Heritage Council Heritage maps database were examined.

Appendix 4 Recorded Sites and Monuments

The following townlands were researched:

Achill Island, Achill Beg, Clare Island, Clew Bay, Carraholy, Dooagh, Glen, Keel, Killsallagh, Leckanvy, Louisburgh, Mallaranny, Murrisk, Newport, Old Head, Westport

SMR No.	Class	Townland	ITM Easting	ITM Northing	Irish Grid Easting	Irish Grid Northing
MA065-004-	Church	Beal Feirste	474274	798570	74296	298556
MA085-009002-	Enclosure	Capnagower	471598	786226	71620	286210
MA085-009003-	House - indeterminate date	Capnagower	471778	786226	71800	286210
MA085-009004-	House - indeterminate date	Capnagower	471686	786218	71708	286202
MA085-009005-	Fulachtfia	Capnagower	471449	786246	71470	286230
MA085-009006-	Fulachtfia	Capnagower	471469	786256	71490	286240
MA085-009007-	Fulachtfia	Capnagower	471479	786256	71500	286240
MA085-009008-	Anomalous stone group	Capnagower	471778	786216	71800	286200
MA085-012001-	Ringfort - cashel	Capnagower	471824	786017	71846	286001
MA085-012002-	Ritual site - holy well	Capnagower	471820	786031	71842	286015
MA085-012003-	Altar	Capnagower	471823	786021	71845	286005
MA085-012004-	Clochan	Capnagower	471822	786024	71844	286008
MA085-012005-	Penitential station	Capnagower	471811	786003	71833	285987
MA085-031----	Midden	Capnagower	471384	785407	71405	285390
MA085-046----	Fulachtfia	Capnagower	471801	786048	71823	286032
MA085-048----	Fulachtfia	Capnagower	471710	786058	71732	286042
MA085-049----	Fulachtfia	Capnagower	471701	786025	71723	286009
MA085-050----	Fulachtfia	Capnagower	471629	786006	71651	285990

MA085-051----	Fulachtfia	Capnagower	471739	785987	71761	285971
MA085-052----	Fulachtfia	Capnagower	471754	785963	71776	285947

MA085-053----	Fulachtfia	Capnagower	471759	785984	71781	285968
MA085-054----	Enclosure	Capnagower	471745	785997	71767	285981
MA085-055----	Fulachtfia	Capnagower	471839	785965	71861	285949
MA085-056----	Fulachtfia	Capnagower	471592	785933	71614	285916
MA085-057----	Fulachtfia	Capnagower	471669	786107	71691	286091
MA085-058----	Fulachtfia	Capnagower	471487	786220	71508	286204
MA085-059----	Fulachtfia	Capnagower	471576	786214	71598	286198
MA085-060----	Fulachtfia	Capnagower	471586	786196	71608	286180
MA085-062----	House - indeterminate date	Capnagower	471763	786022	71785	286006
MA085-016001-	Fulachtfia	Glen	470174	784764	70195	284747
MA085-016002-	Fulachtfia	Glen	470155	784752	70176	284735
MA085-016003-	Fulachtfia	Glen	470145	784729	70166	284712
MA085-016004-	Fulachtfia	Glen	470127	784717	70148	284700
MA085-016005-	Fulachtfia	Glen	470168	784793	70189	284776
MA085-017----	Fulachtfia	Glen	470299	784827	70320	284810
MA085-018----	Fulachtfia	Glen	470459	784887	70480	284870
MA085-022----	Promontory fort - coastal	Glen	470990	784675	71011	284658
MA085-023001-	Castle - unclassified	Glen	471474	785115	71495	285098
MA085-023002-	Promontory fort - coastal	Glen	471489	785124	71510	285107
MA085-040----	Burial ground	Glen	470600	785045	70621	285028
MA085-041----	Fulachtfia	Glen	470689	784984	70710	284967
MA085-042----	Fulachtfia	Glen	471168	785204	71189	285187
MA085-043----	Fulachtfia	Glen	470830	785139	70851	285122
MA085-078----	Midden	Glen	471479	785097	71500	285080
MA075-027----	Water mill - unclassified	Maum	470709	786516	70730	286500
MA085-047----	Fulachtfia	Maum	470364	786285	70385	286269
MA075-029----	House - 18th/19th	Ballytoohy beg	469569	786946	69590	286930

	century					
MA075-005001-	Promontory fort - coastal	Ballytoohy more	469986	787971	70007	287955
MA075-005002-	Hut site	Ballytoohy more	469965	787955	69986	287939
MA075-005003-	Hut site	Ballytoohy more	469996	788007	70017	287991
MA075-026----	Standing stone	Ballytoohy more	469879	786896	69900	286880
MA075-028----	Redundant record	Ballytoohy more	0	0	0	0
MA075-030----	Fulachtfia	Ballytoohy more	469499	787476	69520	287460
MA075-031----	Enclosure	Ballytoohy more	470169	786986	70190	286970
MA075-032----	Enclosure	Ballytoohy more	470339	787046	70360	287030
MA075-033----	Fulachtfia	Ballytoohy more	469844	787941	69865	287925
MA075-034----	Mass-rock	Ballytoohy more	469364	787351	69385	287335
MA042-020----	Megalithic tomb - court tomb	Keel east	464560	807312	64580	307300
MA042-021001-	Megalithic tomb - court tomb	Keel east	464939	807597	64959	307585
MA042-021002-	Megalithic structure	Keel east	464801	807571	64821	307559
MA042-021003-	Earthwork	Keel east	464880	807578	64900	307566
MA042-021004-	Megalithic tomb - unclassified	Keel east	464930	807492	64950	307480
MA042-021005-	Enclosure	Keel east	464910	807482	64930	307470
MA042-021006-	Mound	Keel east	464770	807342	64790	307330
MA042-021007-	Stone circle	Keel east	464670	807452	64690	307440
MA042-021008-	Cist	Keel east	464740	807519	64760	307507
MA042-021009-	Cist	Keel east	464756	807600	64776	307588
MA042-021011-	Cist	Keel east	464970	807592	64990	307580
MA042-021012-	Cist	Keel east	464960	807482	64980	307470
MA042-037----	Standing stone	Keel east	462603	806126	62623	306114
MA054-008----	Cairn - unclassified	Keel east	462460	805002	62480	304990
MA054-009----	Structure	Keel east	0	0	0	0
MA054-010----	Enclosure	Keel east	462853	804845	62873	304833
MA054-011----	Redundant record	Keel east	462790	804792	62810	304780
MA054-012----	Road - road/trackway	Keel east	462670	804656	62690	304644

MA054-013----	Children's burial ground	Keel east	463041	804516	63061	304503
MA054-014001-	Midden	Keel east	464038	804800	64058	304788
MA054-014002-	Field system	Keel east	464038	804800	64058	304788
MA054-015001-	Megalithic tomb - unclassified	Keel east	462430	805634	62449	305622
MA054-015002-	Megalithic tomb - unclassified	Keel east	462482	805725	62502	305713
MA054-015003-	Megalithic tomb - unclassified	Keel east	462284	805825	62303	305813
MA054-015004-	Cairn - unclassified	Keel east	462820	805662	62840	305650
MA054-015005-	Cairn - unclassified	Keel east	462594	805718	62614	305706
MA054-015006-	Standing stone	Keel east	462716	805558	62736	305546
MA054-015007-	House - indeterminate date	Keel east	462577	805826	62597	305814
MA054-015008-	Structure	Keel east	462576	805825	62596	305813
MA041-002----	Settlement cluster	Keel west	458879	806372	58898	306360
MA041-003----	Settlement cluster	Keel west	458679	806032	58698	306020
MA053-001----	Booley hut	Keel west	454223	805523	54241	305511
MA053-002----	Burial	Keel west	455792	805112	55810	305100
MA053-003001-	Cross	Keel west	455816	804487	55834	304474
MA053-003002-	Altar	Keel west	455816	804487	55834	304474
MA053-003003-	Settlement cluster	Keel west	455822	804477	55840	304464
MA053-003004-	Field system	Keel west	455817	804433	55835	304420
MA053-003005-	House - indeterminate date	Keel west	455638	804556	55656	304543
MA053-003006-	House - indeterminate date	Keel west	455751	804374	55769	304361
MA053-003007-	House - indeterminate date	Keel west	455817	804433	55835	304420
MA053-003008-	Standing stone	Keel west	455817	804433	55835	304420
MA053-003009-	Ogham stone	Keel west	455531	804431	55549	304418
MA053-004----	House - indeterminate date	Keel west	456127	803690	56145	303677
MA053-005----	House - 18th/19th	Keel west	458911	804253	58930	304240

	century					
MA054-001----	Structure	Keel west	459865	805292	59884	305280
MA054-002----	House - 18th/19th century	Keel west	459612	804370	59631	304357
MA054-024----	House - indeterminate date	Keel west	459743	804418	59762	304405
MA054-025----	House - indeterminate date	Keel west	460003	804661	60022	304649
MA087-025----	Enclosure	Leckanvy	487991	782116	88016	282099
MA087-026----	Ringfort - cashel	Leckanvy	488355	781777	88380	281760
MA087-068----	Mill - unclassified	Leckanvy	488782	782373	88807	282356
MA087-054----	Standing stone	Murrisk demesne	491609	782490	91635	282473
MA087-055----	Standing stone	Murrisk demesne	491638	782491	91664	282474
MA087-056----	Standing stone	Murrisk demesne	491762	782467	91788	282450
MA087-054----	Standing stone	Murrisk demesne	491609	782490	91635	282473
MA068-013----	Enclosure	Newport	497862	793906	97889	293891
MA065-002----	Children's burial ground	Na Sraithã	471586	797641	71607	297627
MA086-012----	Midden	Old Head	483340	782756	83364	282739
MA086-017----	Burnt mound	Old Head	482586	781837	82610	281820
MA086-018----	Midden	Old Head	483338	782525	83362	282508
MA055-016----	Settlement cluster	Poll Raithnã (sweeney)	475243	800007	75265	299994
MA055-018----	Field boundary	Poll Raithnã (sweeney)	474219	800355	74241	300342
MA055-019----	Field boundary	Poll Raithnã (sweeney)	474181	800345	74203	300332
MA055-020----	Field boundary	Poll Raithnã (sweeney)	474177	800353	74199	300340

Appendix 5 Archaeological Excavations

Achill Island, Achill Beg, Clare Island, Clew Bay, Carraholy, Dooagh, Glen, Keel, Killsallagh, Leckanvy, Louisburgh, Mallaranny, Murrisk, Newport, Old Head, Westport

County	Mayo	**Site Name**	Old Head
SMR No.	SMR:86:12, 86:18	**Licence No.**	99E0552
Site Type	Monitoring	**Description**	Monitoring of pipe-laying in the vicinity of two middens did not reveal anything of archaeological significance.
ITM	E 482546m, N 781837m	**Latitude/Longitude**	53.772863, -9.781837

County	Mayo	**Site Name**	Clare Island
SMR No.	N/A	**Licence No.**	04E0346
Site Type	Monitoring	**Description**	Nothing of archaeological significance has been found so far while monitoring the excavation of the seabed in preparation for the construction of a new pier on the island. Work was postponed in the autumn due to the unreliability of the weather. The project is due to restart in the spring.
ITM	E 468589m, N 785728m	**Latitude/Longitude**	53.804477, -9.99510

County	Mayo	**Site Name**	KINNAWONEEN, CLARE ISLAND
SMR No.	N/A	**Licence No.**	02D048, 02R091
Site Type	Underwater assessment	**Description**	An assessment took place of the impact of the proposed pier development at Kinnawoneen, Clare Island, on any submerged archaeological heritage. The proposed development will construct a 110m piled harbour wall travelling east from the tip of Kinnawoneen. Associated with this construction will be the placement of rock armour on the exposed exterior and interior landward side of the harbour. Dredging of the interior of the harbour will allow access at all stages of the tide. A desktop survey has shown that the development area has been subject

			to significant human influence, both from landward and seaward fronts, for several centuries. Its proximity to SMR 85:23(01, 02), Granuaille's Castle, combined with the considerable erosion which has taken place in the area, makes this landscape an area of archaeological importance. The inspection undertaken on 14 June revealed that there are no archaeological sites within the development zone. Editor's note: Though carried out in 2002, this summary was received too late for inclusion in the bulletin of that year.
ITM	E 471479m, N 785017m	**Latitude/Longitude**	53.798806, -9.950959

County	Mayo	**Site Name**	KINNAWONEEN, CLARE ISLAND
SMR No.	SMR 85:23	**Licence No.**	04E0346
Site Type	Monitoring	**Description**	Monitoring of the excavation of the seabed in preparation for the construction of a new pier on Clare Island, Co. Mayo, was carried out in August 2004 (Excavations 2004, No. 1142) and again from May to June 2005. The pier was constructed within the zone of archaeological potential for a tower-house said to have been built by the pirate queen Granuaile, and the possible site of an earlier promontory fort. The excavation works were carried out by a long-reach mechanical excavator using a toothed bucket. A haul road c. 6m wide, constructed from core rock, was built from the landward end of the works towards the pier. While sitting on the haul road, the long-reach excavator excavated the toe to the required depth (1.6m below existing bed level) and cast the material towards the structure for later incorporation into the permanent works. The later

			stages of the excavation were carried out from a barge. The area excavated for the toe measured between 11m and 12m wide by c. 120m long. An overhanging part of the headland upon which the castle was built, c. 5m wide by c. 2m deep, was also removed. The thin layer of topsoil was removed first to reveal bedrock, which was then removed by the mechanical excavator with a toothed bucket. Nothing of archaeological significance was found in the course of the project.
ITM	E 468589m, N 785728m	**Latitude/Longitude**	53.804477, -9.995108

County	Mayo	**Site Name**	Glen, Clare Island
SMR No.	N/A	**Licence No.**	CO27, E2017
Site Type	Testing	**Description**	Testing of the area of a proposed carpark on Clare Island adjacent to the national monument MA085–023(01), Grania Wael's castle, and MA085–023(02), a possible promontory fort, was carried out on 24 and 25 October 2006. The proposed development area was a section of land situated immediately south-south-west of Grania Wael's Castle just outside its current boundary wall; it measured c. 51m south-west/north-east by c. 23m. The site had been levelled off about 25 years ago by its then owner to accommodate three sheds that occupied the site until recently. This levelling involved reducing the original ground level by about 3m along the south-south-west edge of the proposed development area. Local information suggests that there had been a pronounced downhill slope, which extended at least to the middle of the area. The removal of this portion of the hill, which overlooked the proposed

			carpark area from the south-south-west, created a steep scarp that cut deeply into natural on that edge and removed over half of the original topsoil on a good deal of this area. The clearing of the area 25 years ago has left little of the original ground on this site untouched. The test-trenches, all 2m wide, were laid out as three, set parallel and 6m apart; these first three crossed the main area of the carpark from north-east to south-west. They ranged in length from 25m to 18m, depending on the outline of the carpark area. A fourth, 2m-wide, test-trench crossed a narrow 9m-wide extension to the carpark at the south-west corner; this trench was 27m long. These four trenches were dug by a small mechanical excavator using a toothless bucket. As the spoil from the trenches was deposited it was scattered as a thin layer to allow examination by sifting with shovel and trowel. As the ground was dug up it became obvious that what was being excavated was largely natural sandy gravel and moraine material. A small area of organic beach sand in Trench I indicated where original ground surface survived. No archaeological material was revealed by this testing.
ITM	E 470625m, N 784910m	**Latitude/Longitude**	53.797634, -9.963867

County	Mayo	**Site Name**	Capnagower, Clare Island
SMR No.	MA085–050	**Licence No.**	10E0375
Site Type	Burnt Mound	**Description**	Pre-development testing was carried out between 20 and 23 September 2010 at a site at Capnagower townland on Clare Island. The proposed development consists of the construction of a hostel, lodge, marine activities centre and

			reference library with public bar and restaurant, effluent treatment system and all ancillary site works. Testing was required, as six monuments were located within the area. These consisted of five fulachtafiadh, MA085–049–053 and an enclosure, MA085–054. One of the fulachtafiadh was not extant (MA085–051). The proposed development had the potential to adversely impact on only one of the fulachtafiadh (MA085–050). The site was located along the east coast of Clare Island near Kinnacorra Point. It consisted of undulating poor pasture with rock outcrop and was enclosed by drystone walls. A marshy area was located in the north-western half of the site, drained by a stream running through its south-east end. The site was subdivided by drystone walls, especially in its south-eastern half, while the remains of former cultivation ridges or 'lazy-beds' were prominent along the north-west end and in the south-eastern half of the site. Testing consisted of the excavation (by machine) of seven trenches located to best cover the development area, especially that portion of the proposed access road which was near MA085–050. The trenches measured 33m, 39.3m, 5.3m, 43.2m, 9.9m, 40.3m and 34.4m long respectively, 1.4–2m wide and 0.1–0.9m deep. Evidence of the burnt mound was revealed in two of the test-trenches excavated. Below the topsoil in the remaining five trenches were orange/grey/brown plastic sandy clay and orange/grey/brown loose sand (natural subsoils). No artefacts

			were recovered during testing.
ITM	E 471731m, N 785886m	**Latitude/Longitude**	53.806680, -9.947499

County	Mayo	**Site Name**	Strake, Clare Island
SMR No.	MA085-013	**Licence No.**	13E056
Site Type	Possible Ditch	**Description**	Monitoring of groundworks at a development at St Patrick's National School in Strake townland on Clare Island, County Mayo was carried out on 5 and 10 April 2013. The development consisted of an extension to the school, which is located at Kille in the south-west of the island. Monitoring was necessary due to the location of the site within the constraint for ecclesiastical remains (MA085-013) with a graveyard (MA085-013002) 40m to the east and Clare Island Abbey (MA085-013001 and National Monument No. 97), 51m to the east. The existing school building was constructed in the 1880s with an extension added in the 1990s. The location of the proposed extension consisted of an area of grass bisected by the concrete footprint of an outbuilding demolished in the past and bounded to the east and south by concrete footpaths. The excavated area measured 10m east-west by 7m and 0.3-0.8m deep. Below the topsoil and concrete on the surface was modern rubble fill, which contained a number of services, orange/grey loose sand and orange/brown (rust coloured) bedrock. In the western half of the area excavated a possible ditch feature extended north-north-west/south-south-east across the site (NGC 068907 284462). The feature was located 0.5–0.8m below the surface at its north-north-west end and measured 5.2-5.3m long, 1.8-2.4m wide and up to 0.7m deep (not fully excavated). It was filled with dark

			grey/brown friable silt loam with a moderate amount of small rocks and appeared to be cut into the bedrock. Unfortunately the fill did not contain any datable artefacts or material. The south-south-east end of the possible ditch was disturbed by the existing school building. Given its location and orientation the feature could form part of an ecclesiastical enclosure, although there is no surface evidence for such an enclosure in the vicinity of the monument (MA085-013). Following discussions with National Monuments Service and Mayo County Council it was decided not to excavate the feature as it could safely be preserved *in situ*.
ITM	E 468887m, N 784476m	**Latitude/Longitude**	53.793302, -9.990042

County	Mayo	**Site Name**	CORRAUN
SMR No.	N/A	**Licence No.**	09E0124
Site Type	No archaeological significance	**Description**	Testing was carried out of a greenfield site adjacent to a quarry at Corraun, Ballyhaunis. The work was conducted as part of the planning application for the proposed development, which was an extension of the existing sand and gravel extraction pit with all associated site works. Test-trenches were excavated c. 10m apart and were running north-west to south-east with five trenches running parallel at 50m intervals. No subsurface archaeological remains were found during the testing programme.
ITM	E 549388m, N 774984m	**Latitude/Longitude**	53.722069, -8.766856

County	Mayo	**Site Name**	Corraun
SMR No.	N/A	**Licence No.**	16E0186
Site Type	Burnt spread and possible wooden	**Description**	Fadó Archaeology were commissioned to carry out a

	trackway		programme of archaeological testing at Corraun Co. Mayo on behalf of Archer Consulting Engineers for M.F. Sand Ltd. The proposed development work entailed the extension of the quarry by an area of 5.029ha, for the extraction of sand and gravel, together with a programme of reinstatement works. The quarry was located in undulating pasture land characterized by small field systems enclosed by stone walls. Natural drumlin features occurred to the north and north-east of the site. An extensive area of bogland lay to the west of the proposed development area. 32 linear test trenches were excavated across the entire development site. The length of the trenches ranged between 8m to 162m. The depth of the trenches ranged from 0.15m to 1m. The stratigraphy in Test Trenches 1, 2, 13-32 consisted of grass sod over topsoil over a substrate consisting of dark orange boulder clay and light greyish yellow clay with frequent deposits of sandy gravel. In the south-western area of the development, where Test Trenches 3-12 were excavated, the stratigraphy consisted of peat overlying light greyish white clay. During the course of the testing in this area archaeological material was noted in Test Trenches 9-12. In Test Trench 9 traces of a burnt spread was found 0.5m below the ground level. The spread consisted of charcoal, ash and fire-cracked stones over an area of approximately 24m north-south x 9m. In Test Trenches 10-12 there were remnants of what may be a possible wooden trackway or togher measuring 7m south-west/north-east by 41m. Several timbers were noted lying in a horizontal position

			and embedded in the peat substrate, 0.35m below the surface. The largest timber measured 1.2m x 0.2m, while the smallest measured 0.2m x 0.1m. There were also small fragments of twigs and other vegetation occurring along with these larger pieces. There were no traces of tool marks on the exposed timbers. Following consultation with [redacted] planning archaeologist for Mayo County Council, it was decided that the exposed archaeological material be covered in geotextile material and carefully backfilled under strict archaeological supervision. An exclusion zone of 5m from the archaeological material was set out and a wire and post fence erected to prevent access to this area of the site. It was recommended that no future work take place in this area of the site to prevent any unnecessary disturbance to the subsurface archaeological remains.
ITM	N/A	**Latitude/Longitude**	53.720916, -8.773805

County	Mayo	**Site Name**	Dungurrough, Achillbeg
SMR No.	MA065–032(1–3)	**Licence No.**	08E0515
Site Type	Promontory fort	**Description**	This licence was one of two taken out to facilitate the taking of phosphate samples from Dun Kilmore (see No. 865 below) and Dungurrough promontory forts by [redacted] for a PhD she is pursuing with the Department of Archaeology, UCD. The samples were taken at regular points on a grid over both promontories. Areas of relatively high phosphate content were identified, mainly reflecting the visible earthworks, but others reflecting further subsurface remains. None of the levels located were deemed high enough to indicate definite areas of settlement. The full results of the work will be

			outlined in [redacted] forthcoming PhD.
ITM	E 470789m, N 793245m	**Latitude/Longitude**	53.872532, -9.964881

County	Mayo	**Site Name**	Dun Kilmore, Achillbeg
SMR No.	MA075–001(1–4)	**Licence No.**	08E0514
Site Type	Promontory fort	**Description**	This licence was one of two taken out to facilitate the taking of phosphate samples from Dun Kilmore and Dungurrough (see No. 864 above) promontory forts by [redacted] for a PhD she is pursuing with the Department of Archaeology, UCD. The samples were taken at regular points on a grid over both promontories. Areas of relatively high phosphate content were identified, mainly reflecting the visible earthworks, but others reflecting further subsurface remains. In particular one area of increased phosphate on Dun Kilmore might signify the location of an additional structure, perhaps a watchtower. None of the levels located were deemed high enough to indicate definite areas of settlement. The full results of the work will be outlined in [redacted] forthcoming PhD.
ITM	E 470811m, N 792589m	**Latitude/Longitude**	53.866648, -9.964271

County	Mayo	**Site Name**	Keem bay, keel west, achill island
SMR No.	MA053–00303	**Licence No.**	09E0302
Site Type	Deserted village	**Description**	An excavation was undertaken at a house site within the deserted village settlement at Keem Bay, Achill Island, Co. Mayo. This excavation formed part of the 2009 programme for the Achill Archaeological Field School. The purpose of the excavation was

			to investigate the deserted village settlement at Keem Bay, to better understand the date of the settlement, the nature of the buildings and whether it was a site of permanent or seasonal occupation. The results of the excavations indicate that the buildings within this settlement are likely to be closely comparable to those found at Carraun Point and also to the beehive huts recorded in early archival photographs taken on the island. The localisation of demolition rubble or collapse material within the interior of the structure investigated indicates that it may have been deliberately demolished at the end of its use. Unfortunately, due to the limitations of the investigation, definitive dating evidence was not obtained, nor was it possible to fully establish the nature of the settlement (permanent/seasonal).
ITM	E 455982m, N 804351m	**Latitude/Longitude**	53.968360, -10.195099

County	Mayo	**Site Name**	Boycott's House, Keel West
SMR No.	MA053-003	**Licence No.**	12E0059
Site Type	Archaeological complex	**Description**	Situated on high ground overlooking Keem Bay at the western end of Achill Island, 'Boycott's House' is a ruined single-storey structure which, according to local tradition, was built by 'Captain' Charles Cunningham Boycott upon his arrival to Achill in 1854. A cursory analysis of the site indicated that the standing L-shaped structure represented the second and third phases of construction, while a rectangular, grass-covered mound adjacent to the end of the second-phase building appeared to represent the first phase of Boycott's House.

			The Achill Archaeological Field School undertook an excavation on the site of the first-phase structure from March to June 2012 and an 11m x 7m trench revealed the complete ground plan of the building. The first-phase building was a timber-framed structure which rested upon a stone plinth and which was clad externally with corrugated iron – proof of the local tradition that Boycott lived in an 'iron house' when he first came to the island to farm 2,000 acres of rented land in the vicinity ofKeem Bay. The timber-framed house appears to have been quickly extended with the construction of the stone-built phases (Phases 2 and 3) and the entire building was subsequently abandoned after being consumed in an accidental fire in the late 1860s. A very large artefact assemblage was recovered during the excavation and this included pottery and clay pipe fragments, various metal artefacts and numerous fragments of window and vessel glass, some of the lead and glass fragments showing clear evidence of heat distortion from the fire. A series of internal walls, first thought to represent room divisions, were later recognised as inserted sub-walls which carried the timber floor within the house and which replaced two original cross beams. A concentration of rubble in the centre of the house has been interpreted as a fallen chimneybreast, since many of the stones within this layer rested on-edge, though this interpretation cannot be fully proven.
ITM	E 455650m, N 804556m	**Latitude/Longitude**	53.970108, -10.200251

County	Mayo	**Site Name**	Keel East
SMR No.	MA042-021002 &	**Licence No.**	14E0109

	MA042-021003		
Site Type	Possible prehistoric enclosure	**Description**	The 'Cromlech Tumulus' site in Keel East, Achill Island, Co Mayo, was partially excavated by the staff and students of Achill Archaeological Field School during the summer of 2014. The site is listed on the Mayo sites and monuments record as 'Megalithic Structure', but its actual nature has been debated since the late 19th century when Wood Martin described it as a "sepulchral complex" and suggested that at least parts of the site belonged to the megalithic tradition. Westropp and O'Kelly both described the site as a series of huts, probably of an early medieval date, whilst Pigott and Powell suggested that it was a ruined megalithic tomb with a later burial mound constructed over the western end. De Valéra and Ó Nualláin examined the site as part of the Megalithic Survey of Ireland but did not list the site as being megalithic and suggested it represented a series of post-medieval buildings. Prior to excavation the site was subject to a detailed GPS and a topographic survey, confirming the general layout as described by Pigott and Powell. The site appeared to consist of two distinct elements, a circular mound with a central hollow at the west, and a series of small stone structures at the east. A pre-bog field wall connects the eastern end of the site to the well-known court tomb located about 130m to the east. Excavation in 2014 focused on the western half of the site. Rather than being a distinct circular mound this turned out to be the edge of a large ovoid enclosure defined by an earthen bank with inner and outer dry stone faces and a width of over 2m. The course of the enclosure was not fully traced

			but it must measure at least 15m by 20m. An entrance was located at the south, defined by two orthostats set into the top of the bank. Inside the enclosed space were a large number of post-holes and pits suggesting a lengthy occupation, although in the area so far examined no building ground plans have been identified. No dateable artefacts were recovered, only a small selection of coarse stone tools, but charcoal samples have been submitted for radiocarbon dating. Two very slight buildings constructed of turf and stone walls were discovered overlying the enclosure bank, the latest of which had created the impression of the circular mound with the central hollow. At this stage the site appears to be an enclosed large scale settlement site overlain by a much smaller scale period of occupation. In addition, a single trench was excavated over the pre-bog wall that connects the 'Cromlech Tumulus' to the court tomb. This proved to be a simple boulder wall around 1m wide, quite different to the large and complicated Bronze Age walls excavated elsewhere on Slievemore. During 2015 excavations will examine more of the interior of the enclosure and the stone foundations visible in the eastern part of the site, and several more stretches of the pre bog wall.
ITM	E 64820m, N 307560m	**Latitude/Longitude**	53.595880, -10.344023

County	Mayo	**Site Name**	Keel West
SMR No.	MA053-003003 & MA053-00300	**Licence No.**	09E0302 Extension
Site Type	Settlement cluster and field system	**Description**	During July and August 2015 Achill Archaeological Field School undertook a series of excavations within a settlement cluster at Keem Bay, Achill Island (MA053-003003).

			The largest visible foundation within the settlement, House 3, had originally been the subject of a limited excavation directed by [redacted] in 2009. The earlier work had demonstrated that a substantial stone-built foundation survived underneath the turf and, importantly, that intact floor deposits were present. Excavations in 2015 were conducted as an extension to the original license issued in 2009. A large rectangular trench measuring 13m by 7m, with a 0.5m wide cross baulk running through the centre, was placed over the building. The cross baulk was removed towards the end of the excavation, once the intact floor deposits were reached. House 3 proved to be a small sub-rectangular house with neatly constructed dry stone walls. The curved corners incorporated particularly large boulders, presumably placed to reinforce these natural weak points in the building. The house measured 8.75m by 4.7m externally and just 6.66m by 2.8m internally. It was divided into two compartments, separated by a stone-lined cross drain, with a larger living compartment with an open hearth on one side and a smaller compartment on the other which was probably used to house animals. Despite the small size of the house it was arranged in the classic byre style. The upslope end of the building was set into a terrace cut into the hillside and the floor of the downslope end had been built up to provide a level interior. House 3 appears to be a permanently occupied house which conforms to historical accounts of early 19th-century houses on Achill. A total of 291 artefacts were recovered during the 2015 season.

			The majority of these came from a narrow area between the upslope end of the building and the cut of the terrace on which the building was constructed, an area which was clearly used as a dump. The majority of the artefacts were small pieces of late 18th-century/early 19th-century creamware. The dump was sealed over by a layer of collapse from the building's walls, indicating that the dump was contemporary with the occupation of the house rather than being a later deposit. A fragment of an iron stove door and a very well manufactured Erricsson Wizard stropping handle for sharpening razor blades (patented 1924) were also recovered, but these came from the base of the overlying turf and seem to have been dumped at the site during the early 20th century. Added to the 48 artefacts recovered in 2009 a grand total of 339 artefacts were recovered from this building. A small linear trench measuring 10m by 2m was placed over a series of lazy beds separated by a sunken linear feature located around 60m south of House 3. This showed that the linear feature was a narrow open drain but although 30 finds with a general 19th-century date were recovered from the trench, the finds were not from contexts that could be used to accurately date either the lazy beds or the drain. A small rectangular trench measuring 4m by 3m was placed over the corner of an elongated rectangular foundation defined by a narrow earthen bank located about 85m south east of House 3. The bank was found to be of a simple earthen construction and it seems unlikely that it could have been the foundation of a domestic building, and it was probably an unroofed animal pen although it could have

			been a crude agricultural building. A massive assemblage of over 1327 finds came from this trench, a mixture of glass and creamware fragments and small heavily corroded iron objects. Unfortunately the vast majority of these finds came from upper layers and are thought to result from the site being used as a dump either during the occupation or subsequent renovation of the adjacent Coastguard Station. The construction date of the enclosure was therefore not established.
ITM	E 455817m, N 804433m	**Latitude/Longitude**	53.969054, -10.197656

County	Mayo	**Site Name**	Keel East
SMR No.	MA042-021002 & MA042-021003	**Licence No.**	14E0109
Site Type	Bronze Age building and medieval huts	**Description**	The second season at the Cromlech Tumulus site on Slievemore (MA042-021002) concentrated on Quadrant 3 at the north-west of the site, completing the investigation of the western half of the Cromlech Tumulus. The trench investigated the interior and north-western part of the wall of a large oval-shaped Middle Bronze Age building which has previously produced a radiocarbon date of 1409 and 1229 BC. The wall of the building was examined in detail and shown to be a complex construction with stone faces retaining an earthen core. The outer wall face consisted of several courses of long narrow boulders whilst the internal wall face consisted of large upright stone slabs on top of which rested several courses of neat dry stone work made out of medium sized stones. The earthen core consisted of thin layers of yellowish brown charcoal-rich soil, suggesting the material had been relocated from elsewhere, possibly a

			nearby midden deposit. The three elements combined to create a wall 2.4m wide and 0.7m high. The interior of the building contained a dense spread of features. Around the perimeter of the building there was a band of substantial post-holes, with diameters of around 0.4m and depths of between 0.4m and 0.8m. Although not displaying a particularly regular pattern it did seem that two concentric rings were present, and the close spacing between the two rings suggested they had not been used simultaneously. In the central area there was a dense spread of smaller post-holes, stake-holes and shallow pits. The density of features within the central area again suggests a lengthy and complex period of use for the building, rather than the features all being in use simultaneously. An unusually large pit was found close to the northern perimeter of the building, where it had cut through a series of earlier post-holes. A very unusual artefact was recovered from the upper fill of this pit, a small carved stone head made out of a small water-rolled pebble with a quartz core. Two small pieces of plain Bronze Age pottery were recovered from two of the smaller internal features, an extremely rare find for Achill which appears to be essentially aceramic until recent times. The rest of the finds assemblage consisted of small lithic flakes and simple cores, hammerstones and rounded pebbles of unknown purpose. This material is very reminiscent of the finds assemblages from the two Middle Bronze Age houses previously excavated by Achill Archaeological Field School on Slievemore, which

			are located about 2km to the west. An unexpected discovery during the 2015 season was to find that a substantial pre-bog field wall was connected to the north-west corner of the site, constructed over the outer edge of the oval building's wall. The course of this wall is difficult to follow as it has been damaged by a small stream, but it appears to continue northwards from the site for some distance. Work is due to continue in this eastern part of this site during 2016.
ITM	E 64820m, N 307560m	**Latitude/Longitude**	49.287639, -15.360848

County	Mayo	**Site Name**	Keel East, Achill Island
SMR No.	MA042-021002	**Licence No.**	14E0109
Site Type	Bronze Age building and post-medieval huts	**Description**	During May and June 2016 a third season of work was undertaken at the site of the Cromlech Tumulus (MA042-021002) and the Danish Ditch pre-bog field wall (MA042-021003). Work in 2014 and 2015 had completed four large trenches over the western side of the Cromlech Tumulus site, showing it to be a large Middle Bronze Age building overlain by a number of much smaller late medieval and post-medieval buildings. Two narrow trenches had also been excavated over the Danish Ditch pre-bog field wall establishing it to be a reasonably narrow field wall that survived to no great height. During 2016 work at the Cromlech Tumulus site concentrated on a single large trench, Quadrant 5, which was excavated over the eastern part of the site, and measured 10m by 5.5m. This area of the site contained the only standing building remains, a small section of a dry stone hut with a portion of a corbelled roof that was still intact.

			Dating this building and determining its function was one of the main goals of the season's work. Another main goal was to identify the eastern wall of the large Middle Bronze Age building. It was also suspected that the Danish Ditch pre-bog field wall connected to the Cromlech Tumulus site in this area and a third goal was therefore to identify and record this feature. Removal of the turf and overlying peat deposits revealed a dense spread of soil and small and medium size stones, overlain by a number of small slab-like boulders which are thought to have resulted from the collapse of the roof of the stone-walled hut. A substantial area of rubble was located immediately east and south of the stone-walled hut, which is thought to have derived from the collapse of the walls of the eastern end of the structure. The interior of the small stone hut was cleared of rubble revealing a simple earth floor with a small hearth close to the western end of the building. The building was found to have been very small with dimensions of just 2.8m east-west by 2.4m. It is suspected to be either a small post-medieval booley house or other type of simple shelter. The walls of the Middle Bronze Age building were identified along the eastern side of the northern part of the trench, as had been expected. However an unexpected discovery was a long curving entrance passage that was lined with stone but unpaved, and which ran for over 5m across the northern end of the trench. The pre-bog field wall was identified coming into the middle of the trench from the east. It had a width of 1.4m and five courses of stonework survived *in situ*. An exploratory

			cutting was made through the deposit of soil and stone that covered the trench and this was found to be up to 0.7m deep and to conceal a substantial stone wall that may be part of a small circular building built against the southern side of the entrance of the Middle Bronze Age building; this wall overlay a large stone-filled pit of currently unknown date and purpose. Work on the site during 2017 will concentrate on removing the rest of this soil and stone deposit and examining any other features it conceals. A trench measuring 10m by 2m was excavated over the Danish Ditch pre-bog field wall. Unexpectedly it revealed a pair of parallel east-west aligned field walls separated by a 4.5m wide terrace. It therefore appears that the Danish Ditch may actually be a formally laid out road, potentially making this is a very important finding. In the centre of the terrace a stone-built oval hearth was discovered, separating the road into two channels and potentially indicating that the road could be illuminated at night.
ITM	E 64820m, N 307560m	**Latitude/Longitude**	49.287639, -15.360848

County	Mayo	**Site Name**	Keem, Keel West
SMR No.	MA053-003003	**Licence No.**	09E0302
Site Type	Early 19th-century house, settlement cluster	**Description**	In June and July 2016 Achill Archaeological Field School (AAFS) carried out an excavation at the settlement cluster of Keem (MA053 – 003003), on the western-most tip of Achill Island, Co. Mayo. The excavation, directed by [redacted] and [redacted] formed part of a broader programme of research by AAFS into the Keem Bay landscape, and was the fourth season of excavation in Keem

			([redacted]2015; [redacted] 2012; [redacted] 2009). The first-edition OS map (1838) shows 40 buildings at the Keem settlement cluster. The village was demolished in the mid-19th century, possibly by Charles Boycott. Today the low, grassed-over remains of about 14 buildings can be made out. While morphologically the settlement bears many hallmarks of a permanent rundale house cluster, ethnographic material collected in the 1940s also associates it with booleying or transhumance (Ó Moghráin and Ó Duilearga 1943, 169). In 2009 Bolger began excavating Building 3, the largest footprint in the settlement cluster. Rathbone completed the excavation of Building 3 in 2015. In 2016 AAFS decided to return to Keem to investigate Building 4, located immediately west of Building 3. Prior to excavation the site appeared as a small grassed-over oval bank with occasional stones protruding through the surface. The bank defined a building that seemed to measure approximately 8m by 4m, a little smaller than Building 3 which measured 9.5m by 4.5m. A trench measuring 10m by 6m was set up over Building 4, divided into 4 separate quadrants by a pair of L-shaped baulks measuring 0.5m wide. The site was dug by hand and backfilled when the excavation was finished. Building 4 was oblong in plan, both internally and externally, with straight side walls and distinctive rounded corners. Internally it measured 2.5–2.7m wide (north-east/south-west), by 5.6m long. It was slightly trapezoidal in shape with the south-east end being 0.2m wider than the north-west end. The

			entrance (0.7m wide and 1.2m deep) was located slightly off centre, in the south-east end of the south-west long wall of the building, c.2m from the internal face of the south-east end wall. The building had mass walls of earth and sod retained by inner and outer stone walls. The north-west end was c.1m wide, while the north-east and south-west walls were between 1.1m and 1.2m wide. The width of the south-east wall could not be discerned as its outer face was completely robbed-out. The structure was built directly on the old topsoil. At the north-west, upslope end of the building the old topsoil had been completely scarped away by a shallow cut to create a level platform for the building. Excess topsoil was removed to the downslope south-east end of the site to raise it up. The building had a number of internal features including a drain running diagonally north-south across the north-west third towards the entrance. It was 1.8m long and 0.4m wide. The drain was composed of a shallow cut filled with at least two layers of tightly packed flat stones. A single side stone was found on the west side of the feature, held in place by a deposit of very firm orangey-brown sandy silt that served as packing material for the feature. The top level of stones in the drain would have been flush with the floor of the building. The drain's outlet appears to have simply been the entrance of the building. There was a curious short stone setting, 1.2m by 0.3m, perpendicular to the entrance. It was a single course deep and abutted the internal retaining wall. The feature is difficult to interpret. It is in a similar position to the cross-

			drain in Building 3, but there is no evidence for it having been part of such a feature. Nor is there evidence for it having traversed the width of the building. It seems unlikely to have formed a dry-stone internal dividing wall. One possibility is that it formed a low seating bench, perhaps associated with Heath 3 (see below). The occupation of the building was represented by a number of organic-rich accretions of soil, the laying down of at least two episodes of stony threshold material inside the entrance, and the making and use of three distinct hearths. External features, including an area of rough cobbling and a drainage gully, are also dated to this phase. The building had three hearths. All three were located in the central third of the building. Hearths 1 and 3 were bowl-shaped, cut into the soft old topsoil layer while Hearth 2 had a much more shallow cut and lay directly on the very hard B horizon subsoil. Hearths 1 and 2 were flush with the long north-east wall of the building, and were located roughly opposite the door. Hearth 3, probably the earliest, lay in the middle of the floor, just under 1m north-east of the entrance to the building. The pattern of use in all three hearths bears similarities. In pit-cut hearths 1 and 3, there is evidence for use (ash and charcoal layers**)** followed by what seems to be deliberate backfilling. Analogously, Hearth 2 has a use layer**,** followed by a layer of backfilling. A number of contexts exterior to the building can also be assigned to this phase, including a shallow gully that ran around the north-west side of the building. To the north-east of the building, flush with the external retaining wall, was a layer of rough

			cobbling that consisted of a layer of sub-rounded cobbles in a matrix of mid brown sandy-silt. The context was truncated by the excavation trench from 2015 for Building 3, and presumably extended north-east across the narrow area between Building 3 and Building 4 (c.2m wide). There is some evidence for pre-structure activity to the south-east of the building. Three irregular pockets of charcoal-rich material were encountered downslope of the building on its south-east side. A total of 74 archaeological objects were unearthed during the excavation. Just over 40% of the assemblage comprised glass, most of it green or brown historic bottle glass. Pottery was the next largest category, making up about 23% of the assemblage (17 items). Creamwares, pearlwares and earthenwares dominated, indicating a late-18th or early-19th century date. Diagnostic pieces include a large (broken) piece of a shell-edged pearlware dish, black-glazed Buckley-type ware and a fragment of slip-trailed earthenware, possibly from Staffordshire. Fourteen stone objects were also collected. These mostly comprised fragments of slate, which is not found in the local geology. Some of this slate may be roofing material derived from buildings in the vicinity. Amethyst was also retained. Keem was the site of an amethyst quarry that was well known from at least the early 19th century. Contemporary travel writers reported buying amethyst crystals from local children. The amethyst must have been deliberately collected and is therefore deemed to be of archaeological significance. A single worked stone object was

			found; it is an oblong piece of schist with a partially drilled hole through one end. It may be a half-made weight. Three fragments of very badly corroded iron were found. It is not possible to determine what they were. Two of the most interesting finds from the site are glass beads, one black and one white. The beads were both recovered from the north corner of the building. They may well have been part of a single object, perhaps a rosary. A sheep/goat skull was found in the later collapse layers, as were a number of animal teeth.
ITM	E 455842m, N 804457m	**Latitude/Longitude**	53.969128, -10.196821

County	Mayo	**Site Name**	Keel East, Achill Island
SMR No.	MA042-021002-; MA042-021003	**Licence No.**	14E0109
Site Type	Bronze age building and fulachtfia	**Description**	Introduction During July and August 2017 Achill Archaeological Field School carried out a fourth and final season at the Cromlech Tumulus (MA042-021002) and the Danish Ditch pre-bog field wall (MA042-021003), on Slievemore mountain, Keel East townland, Achill Island. The first three seasons at the site were directed by [redacted], and the fourth season by [redacted] During 2016 work a large 10m by 5.5m trench (Quadrant 5) orientated north-south was excavated over the eastern side of the site. This trench could not be fully excavated due to time constrains and so the picture that emerged was necessarily partial. At its uppermost levels the trench contained a small post-medieval *clochán* or corbelled stone hut (2.8m east-west by 2.4m). [redacted] identified part of the walls of the Middle Bronze Age (MBA)

			building in the north-east corner of the trench, and a feature that he termed an 'entrance passage' curving for 5m along the northern edge of the cutting. To the east of the trench he found part of a stone wall forming a 'small circular building built against the southern side of the entrance of the Middle Bronze Age building'. Finally, he uncovered part of a pre-bog field wall coming into the middle of the trench from the east. After the excavation was finished the trench was covered in terram and the sod was replaced. FulachtFia In 2017 Quadrant 5 was reopened in a bid to fully resolve the area. Work began by excavating the overlying layer of soil and stone rubble concealing the structural remains. Once this was removed the curving eastern wall of the MBA structure became visible along the western side of the trench. The wall was composed of a bank of earth and stone. It soon became apparent that what [redacted] had identified as the MBA building's 'entrance passage' and the 'small circular building' were both structural elements of a stone-lined fulachtfia. The feature comprised a stone-lined trough orientated north-west/south-east and measuring 1.8m long by c. 1m wide and 0.45m deep. It was built in the corner between the junction of the eastern wall of the MBA building and the pre-bog field wall, and thus post-dates both features. A stone ledge or platform flanked the southern side of the trough and the entire feature was surrounded by a low stone wall/kerb of variable height. This wall or kerb served as a revetment for the burnt mound that formed part of the fulachtfia. The mound arced around the trough and was most pronounced on its

			northern and eastern sides. To the south the burnt mound respected the earlier pre-bog field wall. It comprised a deposit of heat-shattered and degraded stone mixed with charcoal and silty sediment up to 0.5m deep. Significant quantities of water-rolled beach cobbles were present in the deposit; most of these were pink sandstone ultimately derived from the Corraun Peninsula. No bone was found in the burnt mound, but a deposit of ceramics thought to represent a single coarse Bronze Age vessel was found in the deposit to the north of the trough. After the final use of the fulachtfia it was deliberately filled in with large stones and the trough was paved with rough slabs to create a level surface. A large sherd of coarse prehistoric pottery found above this layer indicates that this 'closing' of the monument occurred in antiquity. Lithics Scatter A sondage through the burnt mound in the north-east corner of the trench showed that it overlay a layer containing dense concentrations of worked chert, flint and quartz, with occasional sherds of prehistoric pottery, and moderate concentrations of charcoal. This layer was found to extend along the entire eastern edge of the trench at its lowest levels. A line of four stake-holes were associated with this layer in the southern half of the trench. The dense concentration of lithics, including chips of debitage and partially worked beach-rolled flints suggest that this may constitute a knapping area. A small chert leaf-shaped arrow head and a chert hollow scraper retrieved from this layer suggest a Neolithic date. Other notable finds from the 2017 season include a stone spindle whorl recovered from the upper layers in

			the southern half of the site. The 'Danish Ditch' During the last two weeks of the excavation a 12m by 2m trench was excavated across the path of the 'Danish Ditch', the pre-bog field wall running between the MBA building and a nearby Neolithic court tomb. This was the fourth slot trench excavated over the features since we began our project here in 2014. Previous work has tracked the path of the monument and our 2016 trench was especially significant, revealing that the feature comprises a pair of parallel banks. Our 2017 trench was empty, despite being carefully lined up with the known line of the monument. While analysis is ongoing it seems that it may have been robbed out in antiquity–perhaps related to the construction of the *fulachtfia*.
ITM	E 464801m, N 807571m	**Latitude/Longitude**	53.999659, -10.062213

County	Mayo	**Site Name**	Dooagh Beach
SMR No.	N/A	**Licence No.**	14E0125
Site Type	Early Modern animal burial ground	**Description**	Heavy storms at the beginning of 2014 cleared away a deep shingle bank on Dooagh Beach, Achill Island, Co Mayo, exposing a large peat bed. Examination of this peat bed revealed that a large number of rectangular pits had been cut into its upper surface. In some instances it could be seen that some of the pits contained large mammal bones but it was not clear from surface examination if the pits contained complete animal burials or if they simply contained assortments of articulated or semi-articulated animal bones in a manner consistent with waste disposal. The site was subject to a detailed GPS and photographic survey which established that a total of 26 pits were visible in the area of freshly

			exposed peat, although it later became clear that further pits were present to the immediate east of the site where the same peat formation was exposed in a vertical cliff face from which large animal bones could be seen protruding in at least 20 separate locations. In May 2014 two of the most intact looking pits within the cluster were excavated by Achill Archaeological Field School. Pit 22 was found to measure 2.67m by 1.02m with a maximum depth of 0.49m. It contained an intact pony skeleton with its legs folded up underneath its body in a fashion thought to indicate that the animal had been killed at the burial site. Pit 26 was found to measure 2.03m by 1.63m, with a maximum depth of 0.67m. It contained an intact pony skeleton with its legs fully extended out from the body, necessitating the excavation of a much larger pit. It is thought therefore that the animal died elsewhere and had been brought to the beach for burial after rigor mortis had set in. Examination of the two pony skeletons suggested that both animals had a hard working life and had been fed a nutritionally poor diet. The pony in Pit 22 is estimated to have had a withers height of between 13 and 15 hands, whilst the pony in Pit 26 is estimated to have a withers height of between 12 and 14 hands. These heights lie comfortably within the height range for Connemara ponies and it is known that a large number of Connemara ponies were imported to Achill in the late 19th century. The horseshoes associated with the two excavated ponies indicated that the animals date from the middle of the 19th century or later. Local accounts indicate that animals were

			being buried in this location up until the 1950s. The site seems to have been used for the burial of large animal carcasses in a community that was too far removed from an abattoir to make removal of animals feasible. In July 2014 the shingle bank that had previously protected the site was re-established by Mayo County Council engineers, during work to remedy storm damage in advance of the Achill Half Marathon. It is thought that the site is currently reasonably well protected.
ITM	E 460535m, N 804916m	**Latitude/Longitude**	53.974686, -10.126023

County	Mayo	**Site Name**	MURRISK DEMESNE
SMR No.	SMR 87:46	**Licence No.**	97E0007
Site Type	N/A	**Description**	Test-trenching in advance of development yielded no features, deposits or finds of archaeological significance.
ITM	E 491334m, N 782510m	**Latitude/Longitude**	53.780814, -9.648830

County	Mayo	**Site Name**	NEWPORT
SMR No.	SMR 67:37, 67:61	**Licence No.**	04D078
Site Type	Intertidal assessment	**Description**	An impact assessment was undertaken of a proposed sewerage scheme in Newport. The proposed development consists of the upgrading of the sewerage scheme at Newport, with the construction of a new pumping station wastewater treatment plant, while two different options for outfall pipes were proposed. Some of the proposed development is located within the intertidal zone. A number of sites are located within or adjacent to the intertidal zones proposed in the present development. These include SMR 67:37, an enclosure and possible hut site in Lisduff; 67:61, a possible enclosure in Rosmore; and 68:13, an enclosure in Newport, which is no longer extant. The

			proposed development would particularly impact on the former two sites. No new archaeological features or artefacts were identified during the walkover of the relevant areas of the intertidal zone.
ITM	E 498339m, N 793982m	**Latitude/Longitude**	53.885276, -9.546368

County	Mayo	**Site Name**	NEWPORT ROAD REALIGNMENT SCHEME
SMR No.	N/A	**Licence No.**	05E0699
Site Type	Testing	**Description**	The Newport road realignment scheme involves the construction of 3km of new road immediately west of Castlebar, Co. Mayo. Groundworks associated with this scheme are being monitored. Two burnt spreads were found during monitoring and these were excavated under licence 05E1056 (see No. 1119 above). Excavation is ongoing at the site of a windmill (SMR 78:10) at Drumshinnagh, under licence 05E0733 (see No. 1118 above). Work on this scheme is ongoing.
ITM	E 511244m, N 799206m	**Latitude/Longitude**	53.934581, -9.351646

County	Mayo	**Site Name**	Castlebar to Newport Road Realignment Scheme
SMR No.	N/A	**Licence No.**	05E0699
Site Type	Testing	**Description**	Three kilometres of new road were constructed as part of the R311, Castlebar to Newport road realignment scheme, in Co. Mayo. During the monitoring of groundworks associated with this scheme (Excavations 2005, No. 1129) six fulachtafiadh were found. Two of these (Drumshinnagh I and II) were excavated under licence 05E1056 (Excavations 2005, No. 1119). Two more (Drumshinnagh III and IV) were excavated under licence 06E1018 (see No. 1449 below). Two further fulachtafiadh, one located in Derrycoosh townland

			and a second in Drumshinnagh townland, at the limits of the land acquisition line, were preserved in situ. In addition, excavation was undertaken at the site of a recorded windmill (MA078–010) in Drumshinnagh townland under licence 05E0733 (see Excavations 2005, No. 1118, and No. 1448 below).
ITM	E 511244m, N 799206m	**Latitude/Longitude**	53.934581, -9.351646

County	Mayo	**Site Name**	N59 Rossow Bends Roads Scheme
SMR No.	N/A	**Licence No.**	13E0250
Site Type	Fulachtafiadh, burnt spreads and pits	**Description**	Pre-development testing was carried out on the N59 Rossow Bends Roads Scheme: Part of the overall N59 Westport-Mallaranny Road Realignment Project. Test excavations were carried out in green field areas that are within the footprint of the proposed N59 Rossow Bends Section and also within seventeen proposed areas for the recovery of material excavated during the construction of the road that is unsuitable for reuse. The stratigraphy of the test areas ranged from light, well-drained sandy topsoil on the large drumlin within the footprint of the road, to pockets of low-lying waterlogged peat, also within the footprint of the road and in the Proposed Recovery areas.

			A total of ten archaeological sites were identified by these test excavations. All were identified within the Proposed Recovery Areas. Three of these sites are located in peripheral areas and preservation *in situ* is proposed. Disturbed material from a fourth site in Carrowbeg (Fergus) was identified, however there is no predicted impact on this site. A burnt spread (Drumard 1), four *fulachtafiadh* (Drumard 2-4 and Keeloges 1) and two conjoined pits (Keeloges 2) were identified in Drumard and Keeloges townlands. As these sites will be directly impacted on by the development, a programme of excavation is scheduled for 2014. **Drumard Townland (Recovery Area No. 28)** Four archaeological sites are located in this Recovery Area adjacent to the current N59, 3km north of Westport, Co. Mayo. Sites Drumard 1-4 are located in a wet, peaty hollow between a modern house, which is on raised ground, and the existing main road. Drumard 1, burnt spread (NGR: 498091 787722), consists of a deposit of burnt stone and charcoal, roughly circular in plan with a diameter of 4m and a thickness of 0.1m where cut at the northern edge and has a maximum thickness of 0.2m. The deposit consists of angular heat-fractured stone in a charcoal-rich matrix. The stones are generally light grey sandstone *c*. 0.08m in diameter with frequent smaller stones and grit and occasional larger stones up to 0.2m in diameter. A broken flint disc scraper was recovered from the top of the stone deposit. This site is scheduled for excavation in 2014 under licence

			14E0031. Drumard 2, *fulachtfiadh* (NGR: 498269 787601), is located near the southern field boundary and appears to be an undisturbed site. The mound, consisting of heat-fractured stone in a charcoal-rich peaty matrix, is oval in plan measuring 6m by 8m with a maximum thickness of 0.6m. There is a large hollow in its northern half (1.7m by 3.2m) creating a classic crescent-shaped mound. The hollow may overlie an intact trough. This site is scheduled for excavation in 2014 under licence 14E0032. Drumard 3, *fulachtfiadh* (NGR: 498218 787629), is located to the south of the centre of the field on peat, adjacent to a large land drain. The mound, consisting of heat-fractured stone in a charcoal-rich peaty matrix, is roughly circular in plan with a diameter of 9m and a maximum thickness of 0.7m. The northern extremity of the mound was cut by the land drain. This site is scheduled for excavation in 2014 under licence 14E0033. Drumard 4, *fulachtfiadh* (NGR 498188 787624), is located on the subsoil, 10m north of Drumard 3, at a depth of *c.* 0.7m from the surface overlain by peat. It consists of a 0.1m thick (max.) spread of burnt stone and charcoal which is circular in plan with a diameter of 5m. An isolated wood feature was located adjacent to this spread *c.* 0.35m higher in the peat and 2m to the north. It consists of a number of poorly preserved horizontal roundwoods placed parallel to each other possibly forming a wooden platform or trough base. At least one of these timbers was cut and retains distinctive chop-marks. The surviving feature measures 1.8m north-south by 0.9m. This site is scheduled for excavation in 2014 under licence

			14E0034. **Keeloges (ED Newport East), (Recovery Area No. 12)** Two archaeological sites are located in a Recovery Area adjacent to the current N59, 5km west of Newport. Sites Keeloges 1-2 are located on relatively dry ground within a field which is predominantly comprised of wet peat. Keeloges 1, *fulachtfiadh* (NGR: 494766 795749), is located on the eastern end of low glacial ridge immediately adjacent to lower lying marshy ground. The *in situ* remains of a mound of burnt stone and charcoal rest directly on firm, relatively dry boulder clay with the eastern side (*c*. 2m) resting on low-lying marshy ground, The mound is roughly oval in plan measuring 21m north-south by 12m. The *in situ* mound material is generally less than 0.2m thick reaching up to 0.6m thick where the natural subsoil slopes down to the south-east. The western side of the site is delimited by a substantial drain and the overlying topsoil contained frequent displaced burnt stones and modern pottery. This site is scheduled for excavation in 2014 under licence 14E0035. Keeloges 2, two pits/hearths abutting each other (NGR: 494794 795792), are located in a low-lying wet area adjacent to Keeloges 1. They consist of two roughly circular charcoal-rich deposits *c*. 0.8m in diameter, resting on or cut into the natural, stony boulder-clay. This site is scheduled for excavation in 2014 under licence 14E0036. Four sites, to be preserved *in situ*, were identified in three recovery areas in Carrowsallagh, Conrea and Carrowbeg (Fergus) townlands.

			Carrowsallagh I: *fulachtfiadh* (NGR: 4993181 796077) A *fulachtfiadh* mound was identified in the south-east adjacent to and 10m from the river. This mound was located on sandy subsoil adjacent to the river. Its upper level was exposed for a length of 10.5m east-west and a 12m perpendicular trench was opened across the centre of the mound to establish its north-south dimensions which were 6.7m. The *in situ* remains consist of a low compact mound of burnt stone and charcoal, *c*. 0.4m (max.) above the surrounding subsoil falling away gradually from its centre. The upper levels of this mound are likely to have been disturbed by subsequent agriculture as heat-fractured stones were spread through the topsoil around and adjacent to the mound. The overlying sod and topsoil reached a maximum thickness of 0.4m and there were no surface indications of the underlying mound. **Carrowsallagh II: possible *fulachtfiadh* (NGR: 493100 796105)** Remains of a possible *fulachtfiadh* were located 70m to the west of Carrowsallagh I, also adjacent to the river which runs along the southern boundary of Recovery Area 7. This site consists of a low mound of burnt stone and fragments of charcoal, 4.5m north-south by 2.5m with a maximum thickness of 0.4m. Two patches of burning and a loose deposit of burnt stone occur adjacent to this mound. **Conrea I: burnt spread (NGR: 498342 787456)** A burnt spread was identified in the northern corner of this Recovery Area. It had a maximum diameter of 3.5m, occurred at a depth of 0.2m and was at least 0.1m thick forming a

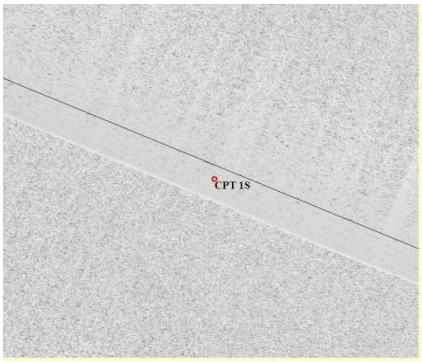
			low mound and rested on the natural subsoil. This feature continued beyond the limit of excavation to the north-east. Further burnt stone was identified in the adjacent drain 7.5m to the north-east. This burnt spread may be the remains of a *fulachtfiadh* and it has been proposed for preservation *in situ*. **Carrowbeg (Fergus) I: disturbed burnt spread (NGR: 492700 796344)** Disturbed burnt stone similar to *fulachtfiadh* mound material was identified in the west of the area but no *in situ* remains were identified. This is indicative of a *fulachtfiadh* within or near the area which has been disturbed or destroyed. Topsoil was removed from this disturbed area prior to its acquisition by Mayo County Council and there is no predicted further archaeological impact.
ITM	E 498392m, N 790675m	**Latitude/Longitude**	53.855584, -9.544470

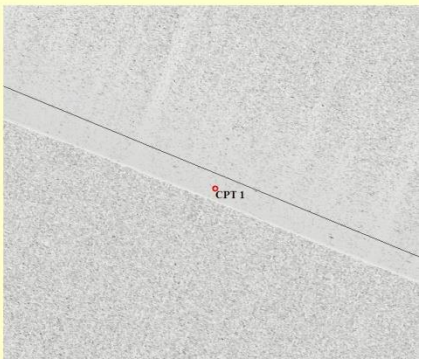
County	Mayo	**Site Name**	Keeloges 1, Newport
SMR No.	N/A	**Licence No.**	14E0035
Site Type	Late Neolithic - Middle Bronze Age	**Description**	Keeloges 1 consisted of two Late Neolithic/Copper Age burnt spreads (004) and (005) and a trough (007). A Middle Bronze Age trough (006) and the remnants of an undated former timber platform (014) were also present. The final evaluation of the findings of the excavation indicates that the *fulachtfiadh* at Keeloges 1 most likely represents two phases of activity dating to the Late Neolithic/Copper Age and the Middle Bronze Age respectively. A fragment of willow charcoal taken from burnt spread material (005) returned a Late Neolithic/Copper Age date of 2456 – 2204 cal BC (2σ) (UBA-26942); a fragment of alder charcoal taken from burnt spread material (004) returned a Late

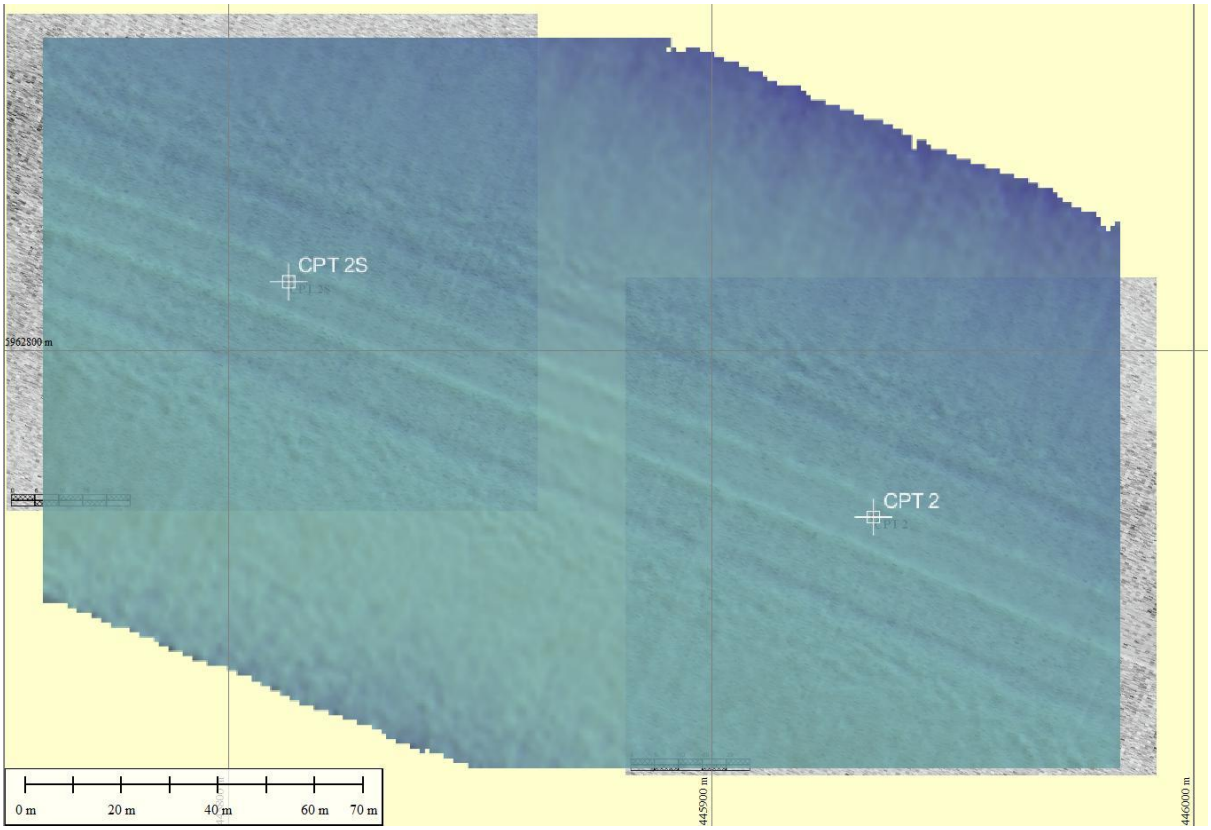
			Neolithic/Copper Age date of 2435 - 2142 cal BC (2σ) (UBA-26943). A fragment of alder charcoal taken from the fill (010) of the trough (006) returned a Middle Bronze Age date (1608 – 1436 cal BC (2σ) (UBA-26944). The excavation was undertaken between 5 and 16 May 2014 in advance of the construction of the N59 Rossow Bends Scheme, Co. Mayo, which extends from Deerpark East townland located to the north of Westport, to Murrevagh townland to east of Mulranny village.
ITM	E 494766m, N 795749m	**Latitude/Longitude**	53.541583, -9.364693

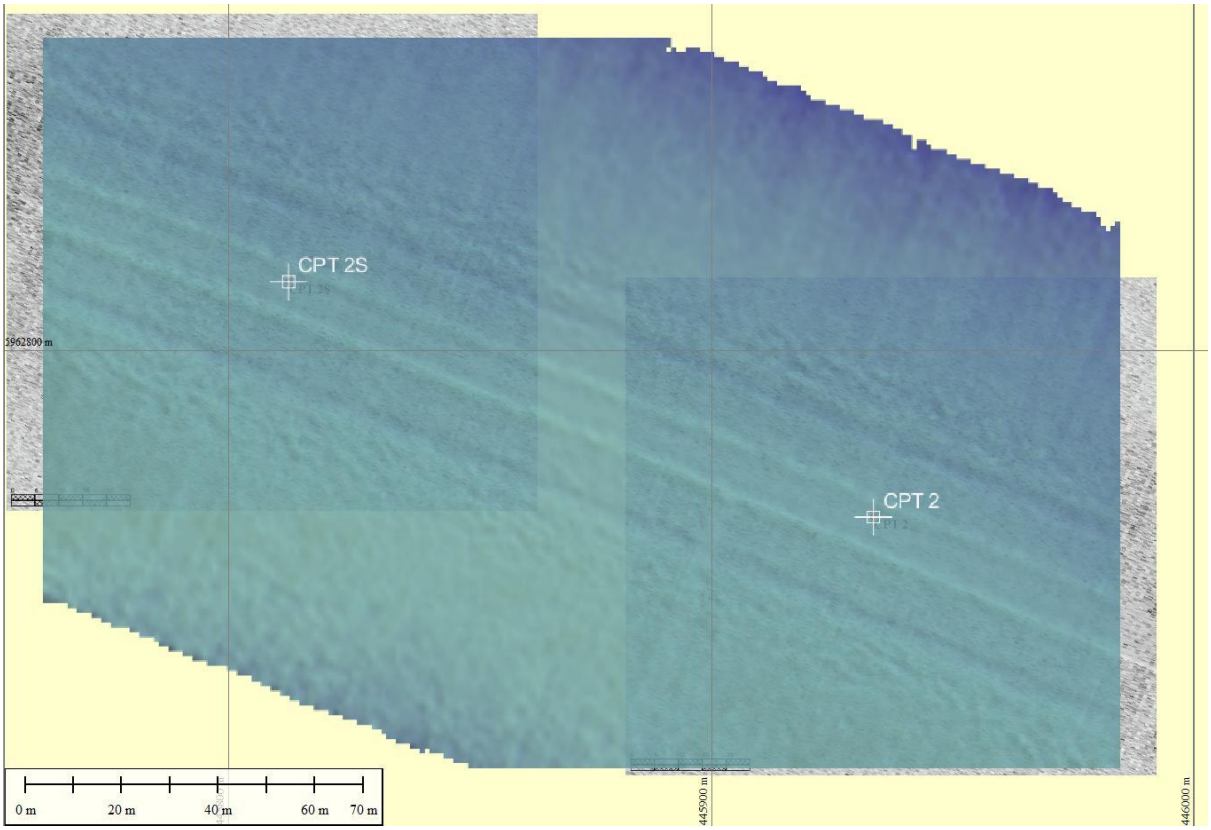
County	Mayo	**Site Name**	Keeloges 2, Newport
SMR No.	N/A	**Licence No.**	14E0036
Site Type	Early/Middle Neolithic	**Description**	Keeloges 2 consisted of two spreads (004) and (005) of burnt mound material commonly associated with fulachtaífiadh. One phase of activity was identified. While usually associated with the Bronze Age, radiocarbon dating of ash charcoal from one of the spreads returned an Early/Middle Neolithic date. An oak charcoal fragment taken from one of the spreads of burnt mound material (004) returned an Early/Middle Neolithic date of 3637 – 3382 cal BC (2σ) (26945). The excavation was undertaken on 14 May 2014 in advance of the construction of the N59 Rossow Bends Scheme, Co. Mayo, which extends from Deerpark East townland located to the north of Westport, to Murrevagh townland to east of Mulranny Village.
ITM	E 494794m, N 795792m	**Latitude/Longitude**	53.542994, -9.363213

Appendix 6 CPT Location Charts





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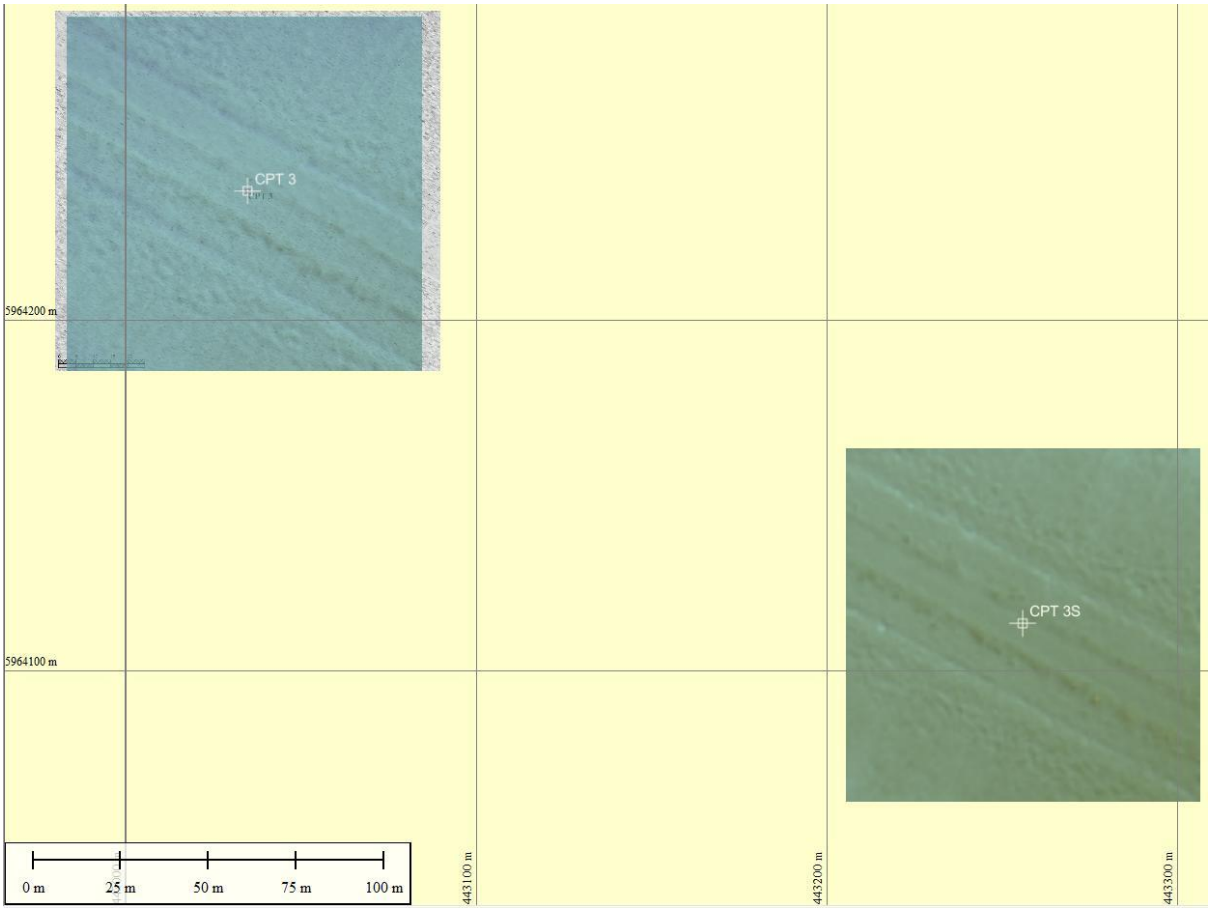
446000 m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CPT 3S
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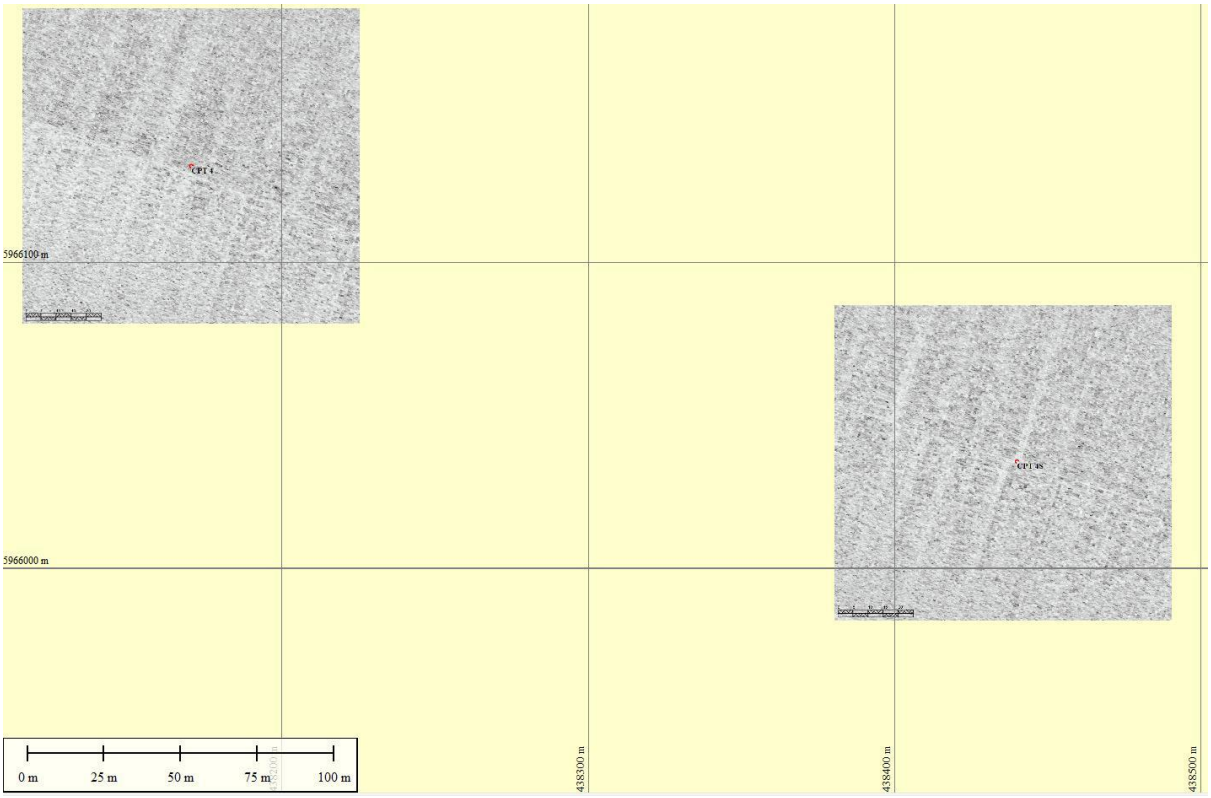
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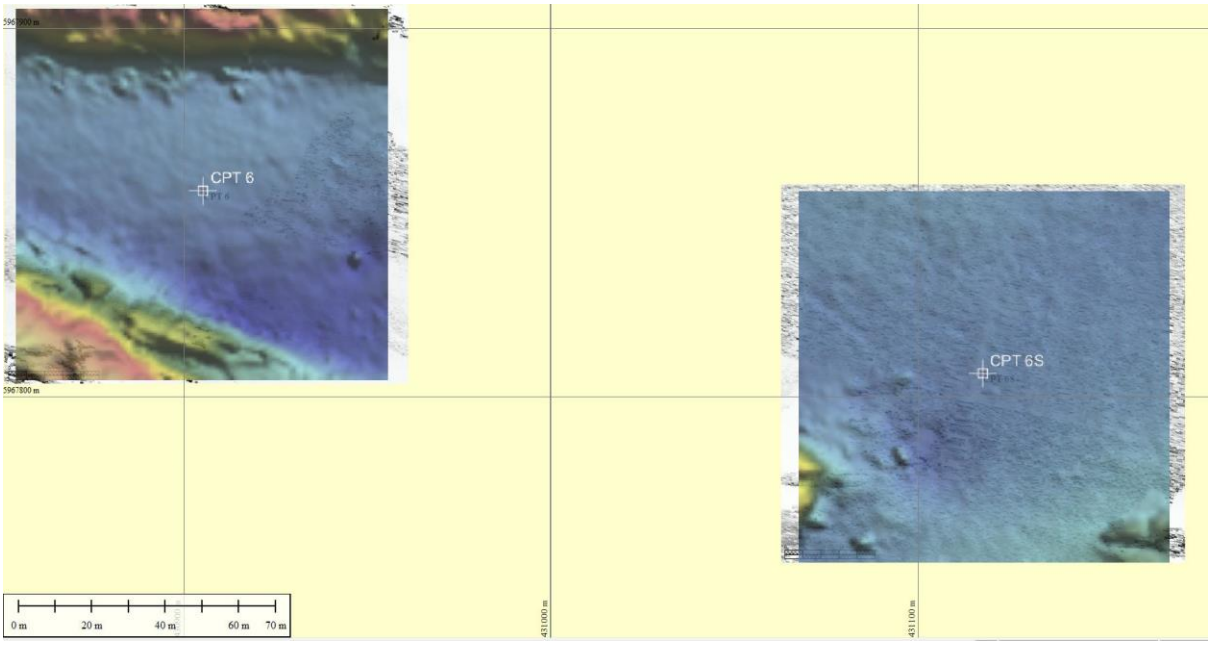
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CPT 6S
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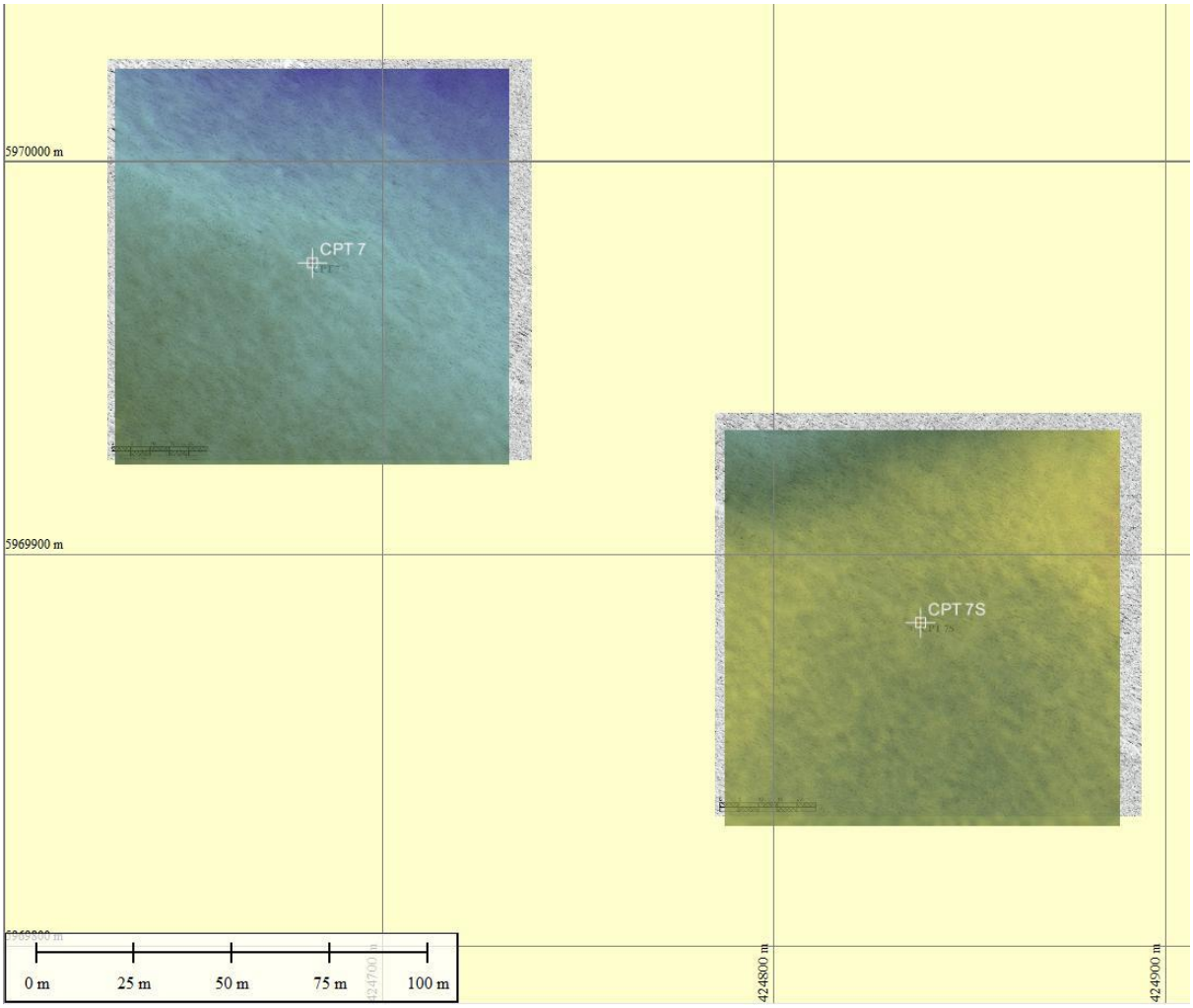
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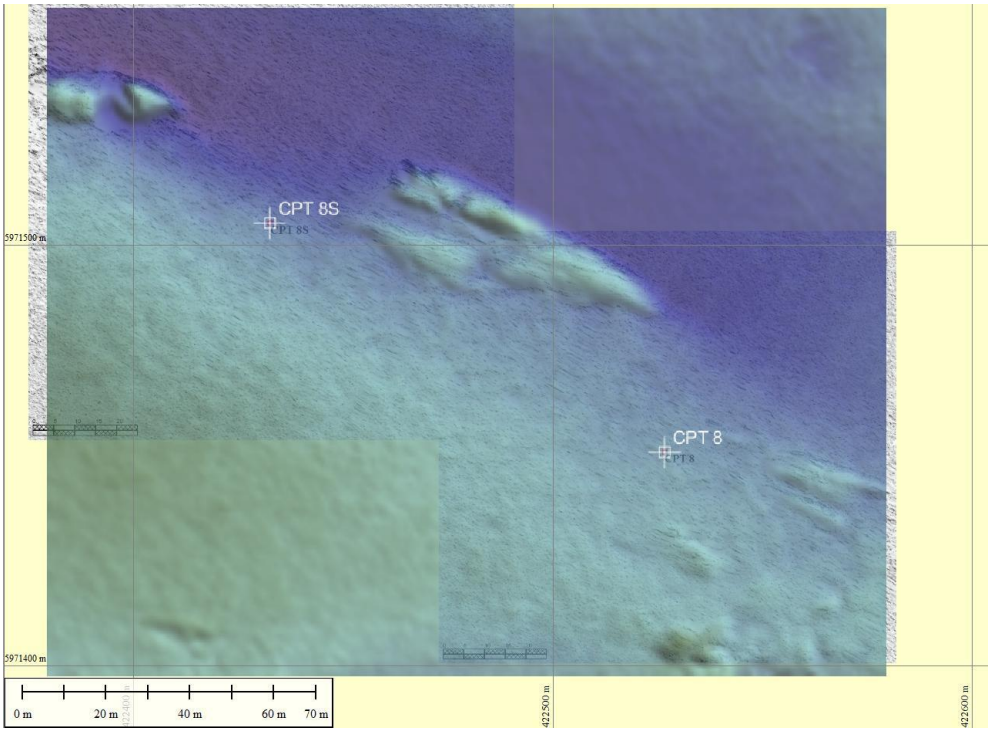
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CPT 8
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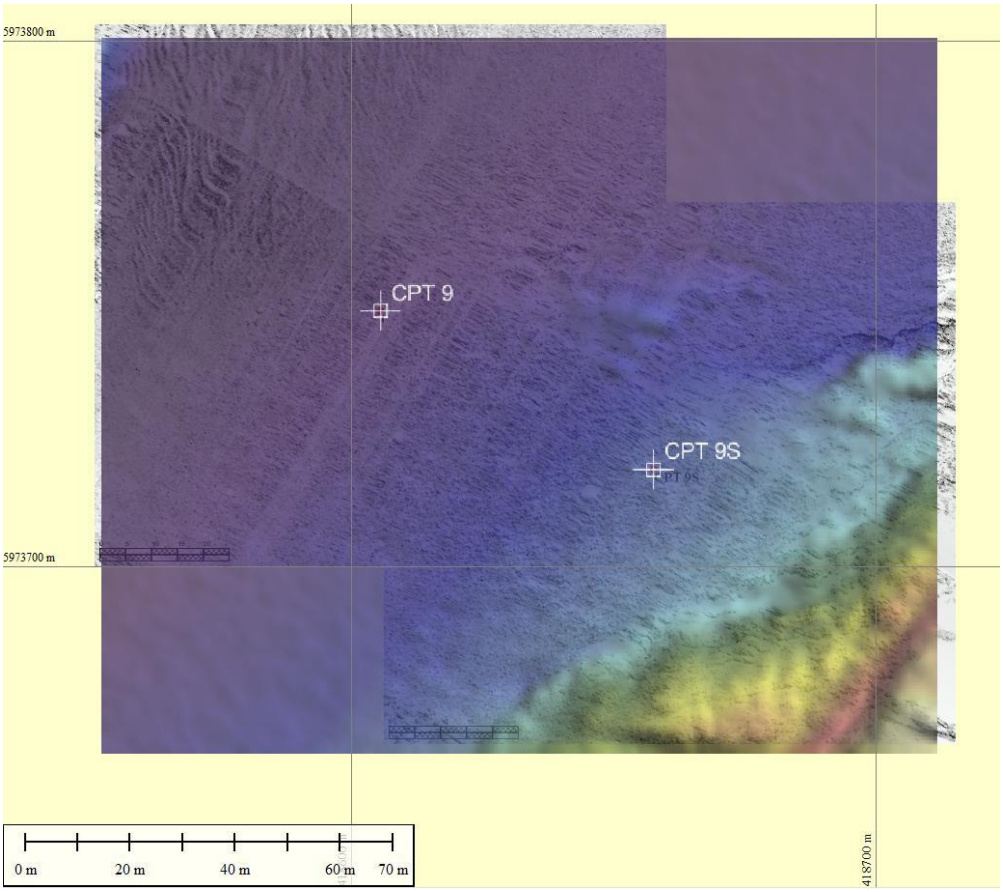
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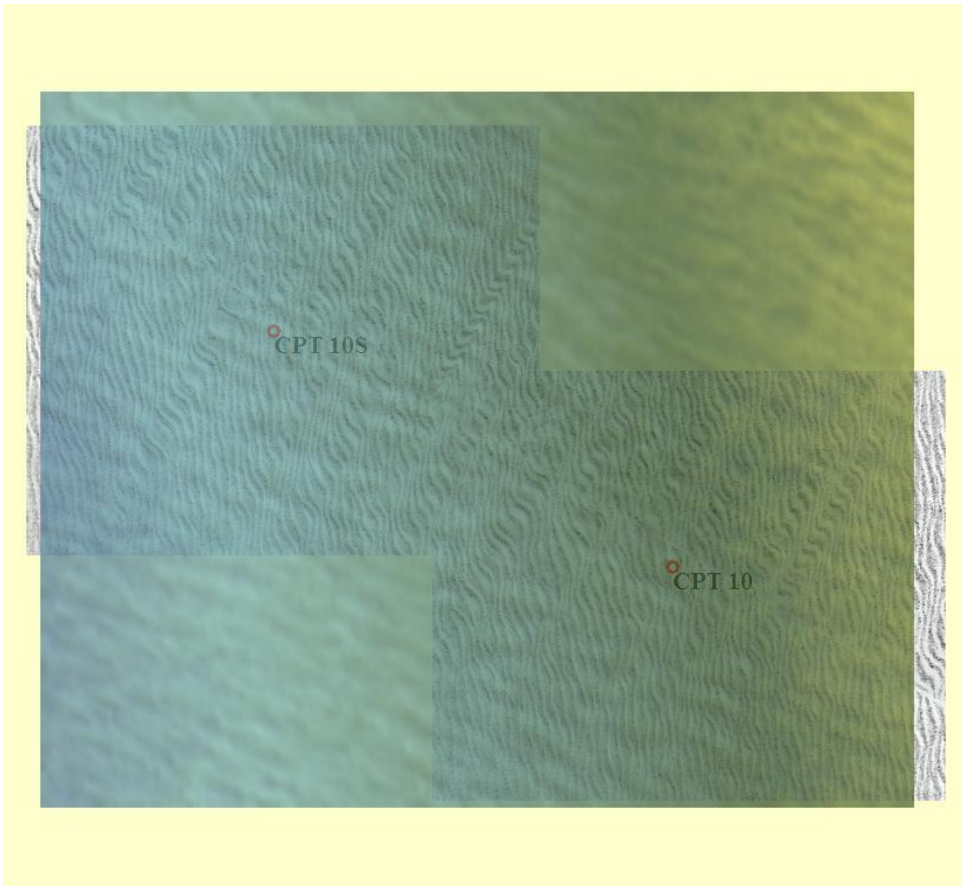
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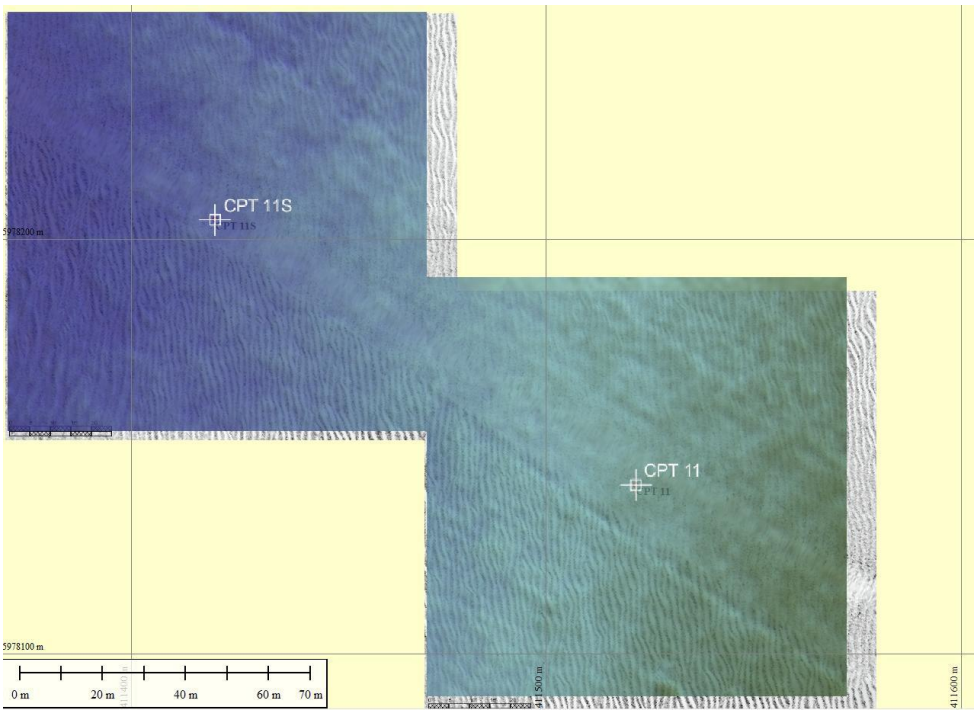
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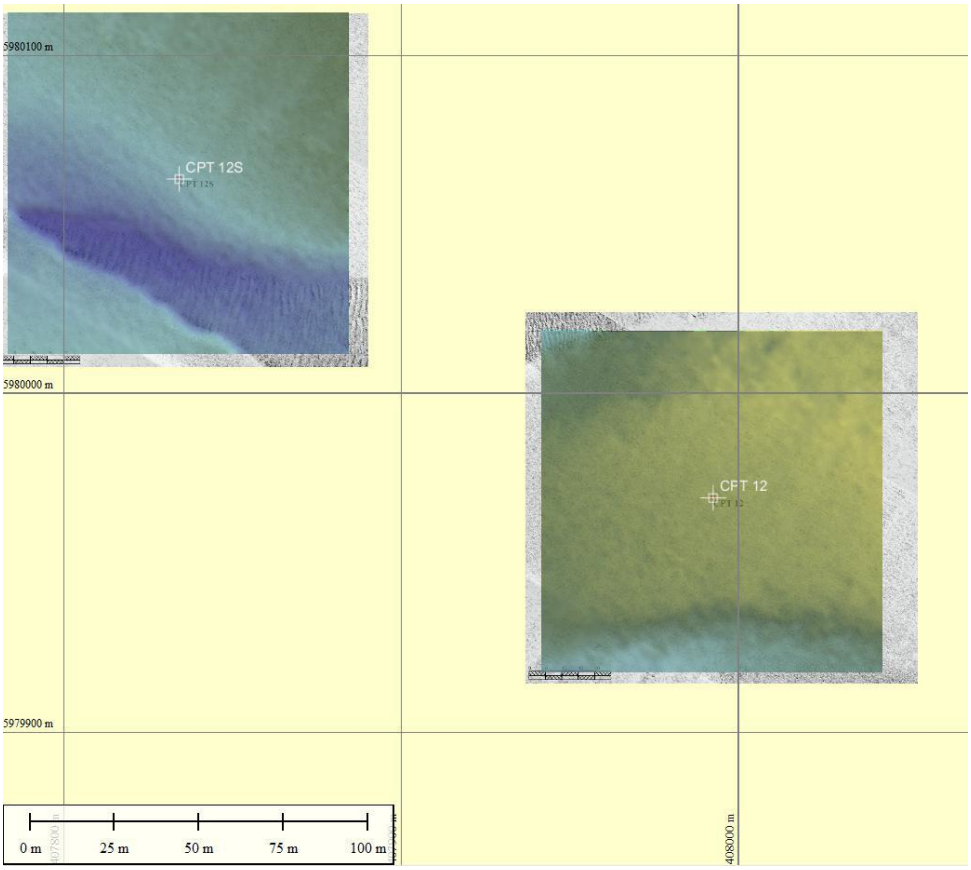
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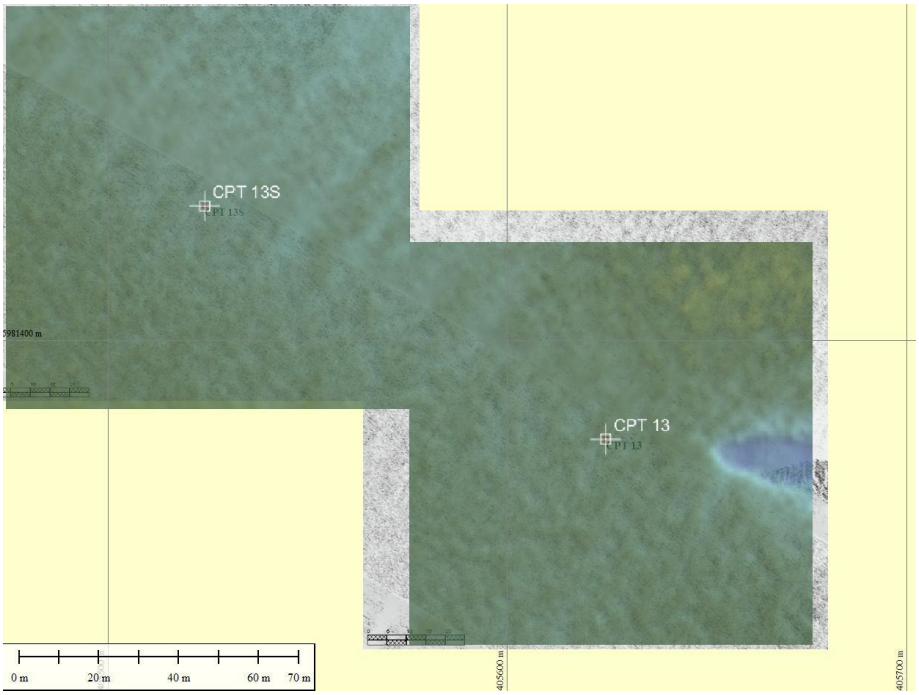
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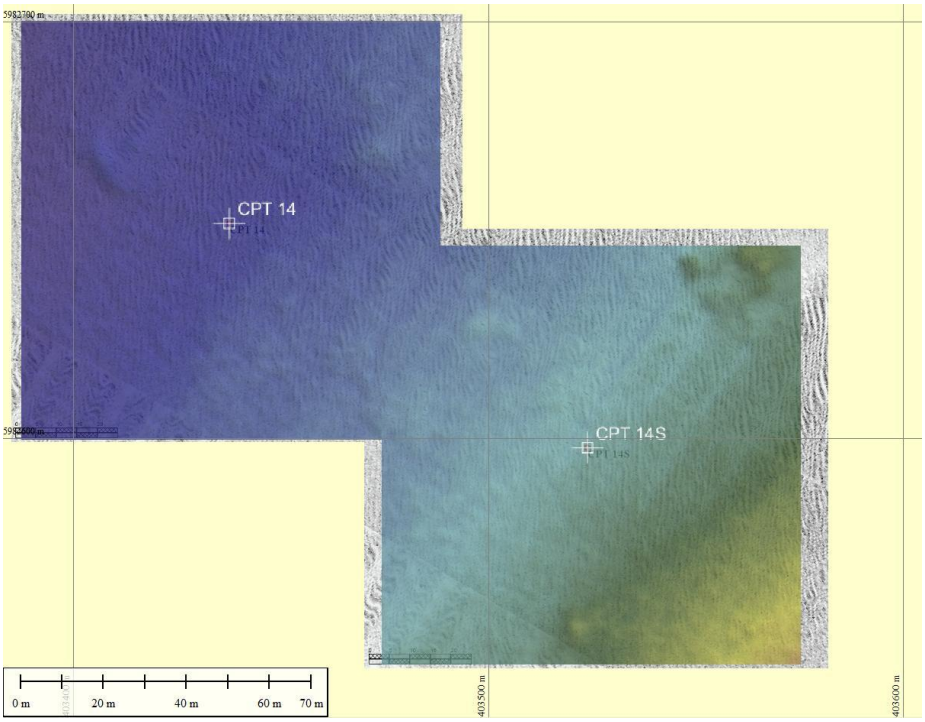
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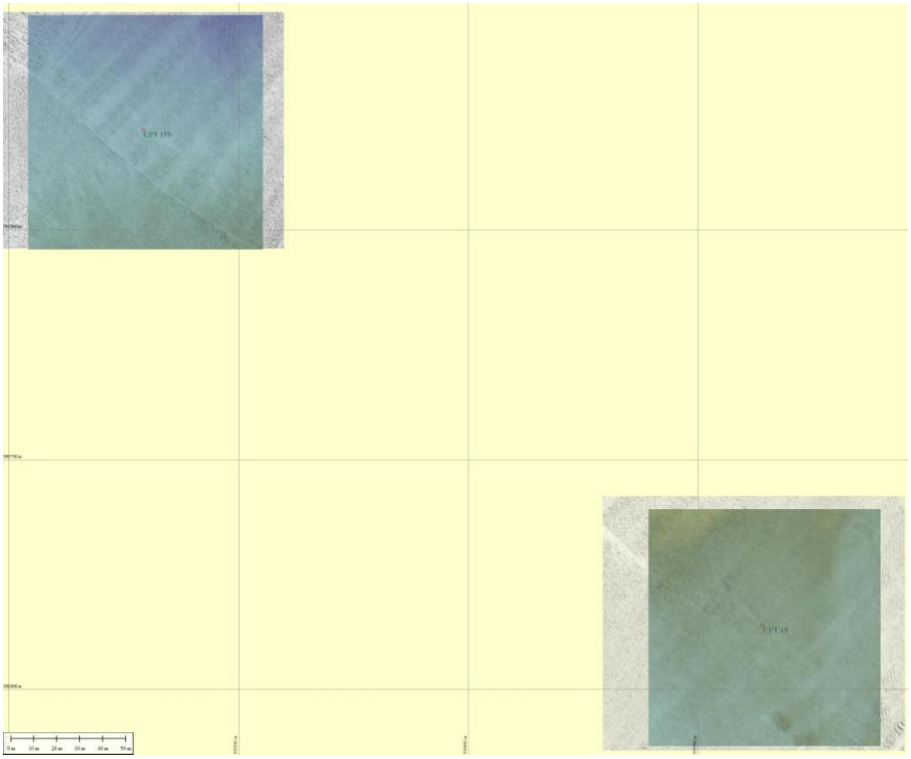

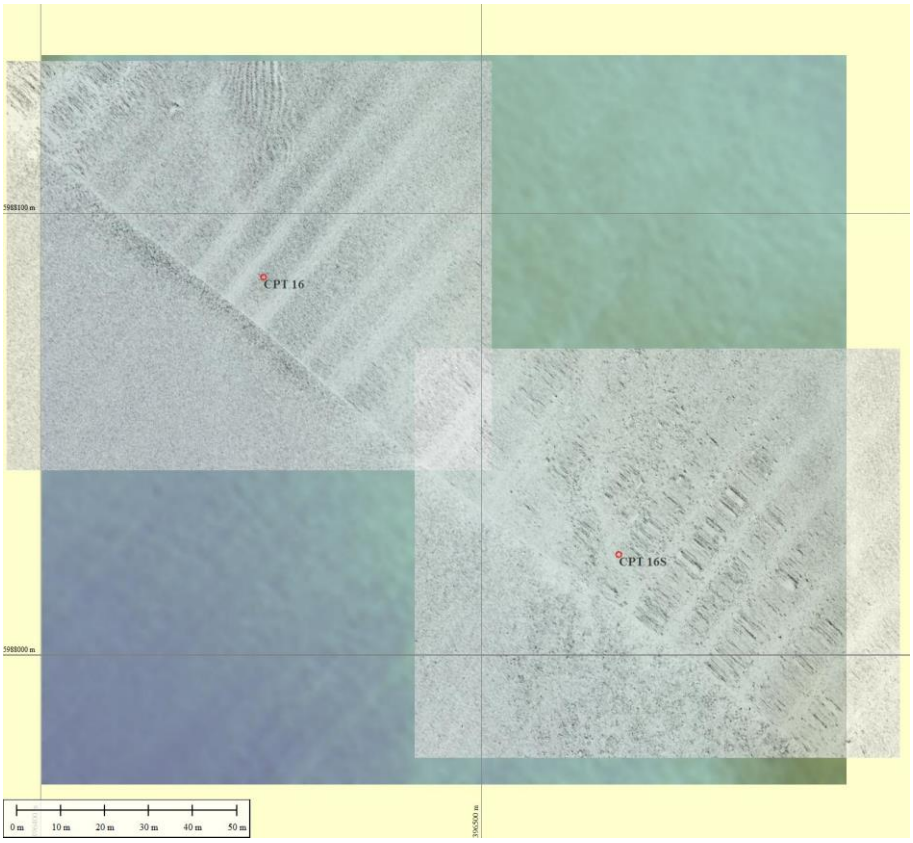
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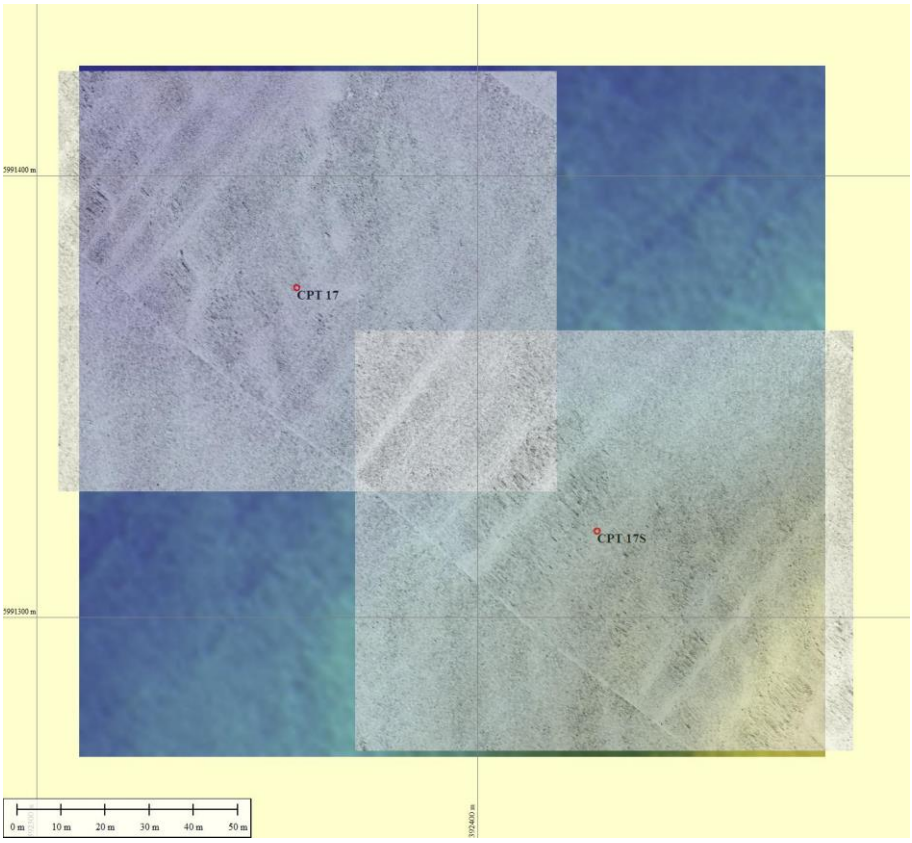
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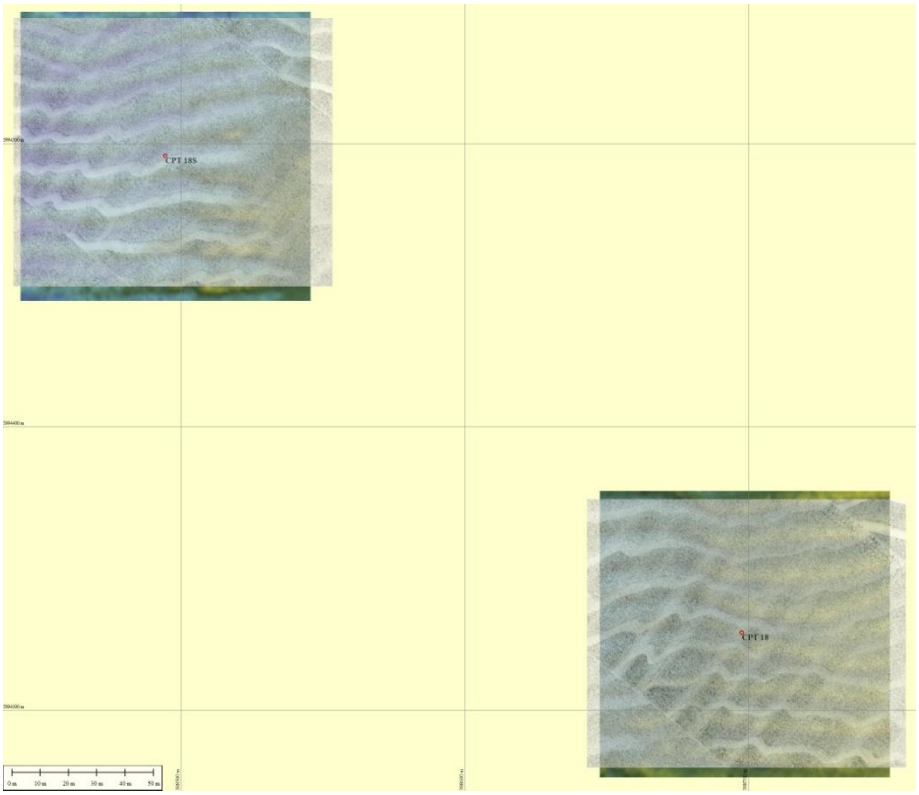
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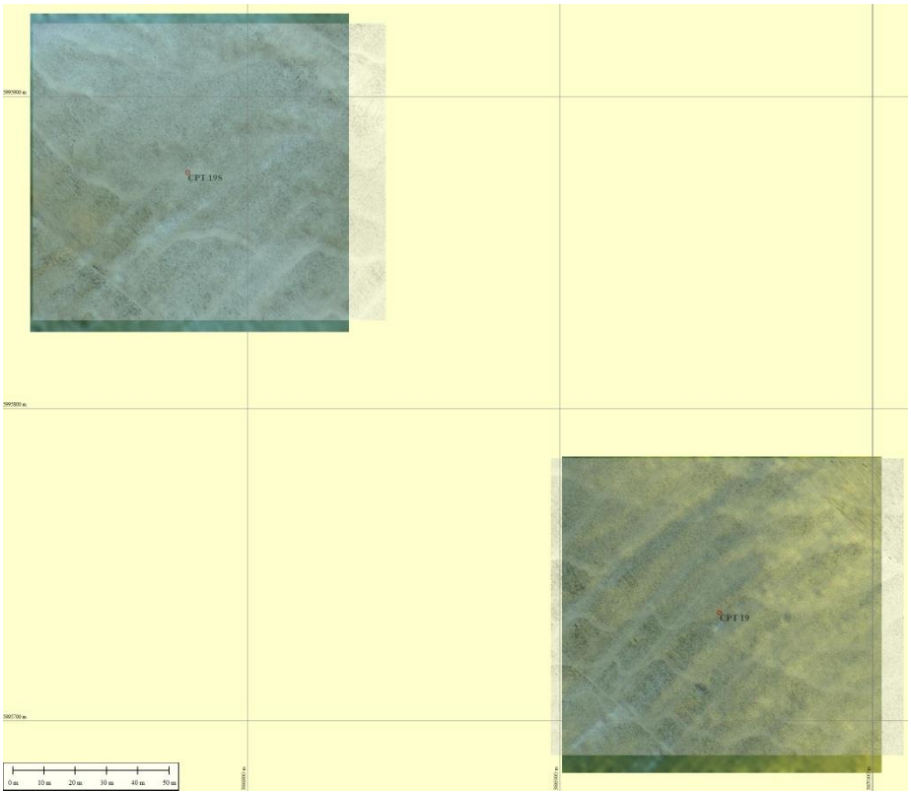
CPT 18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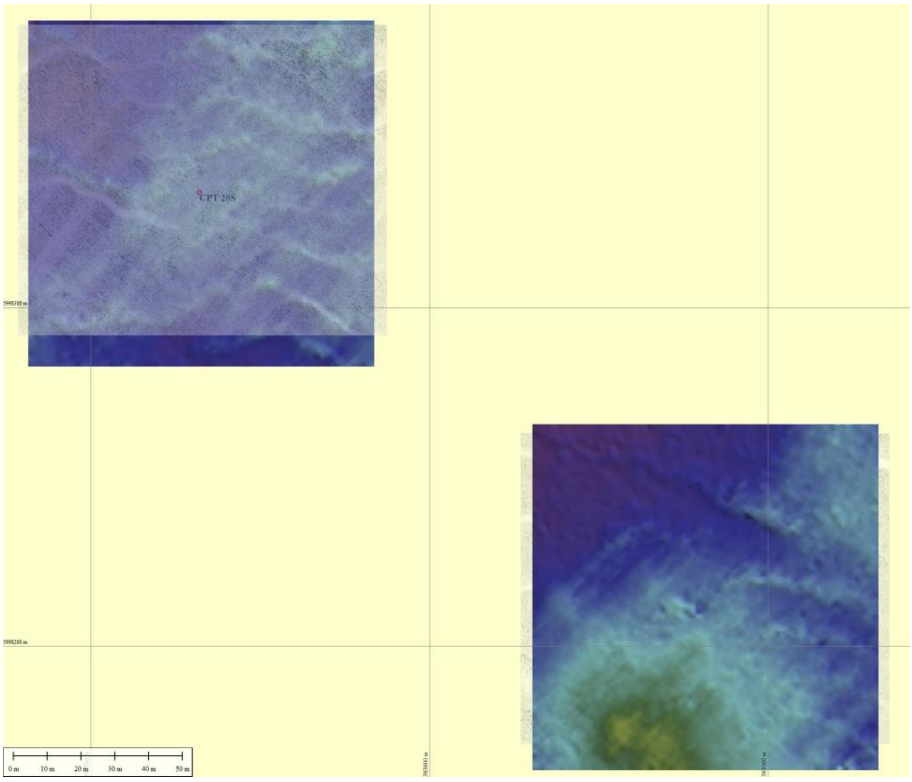
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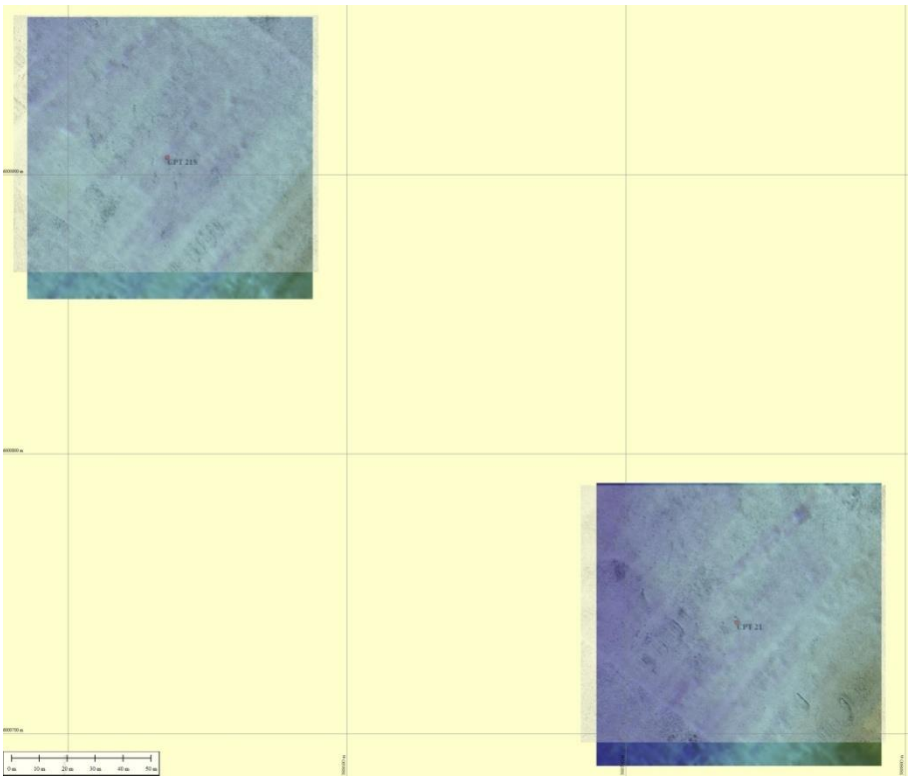

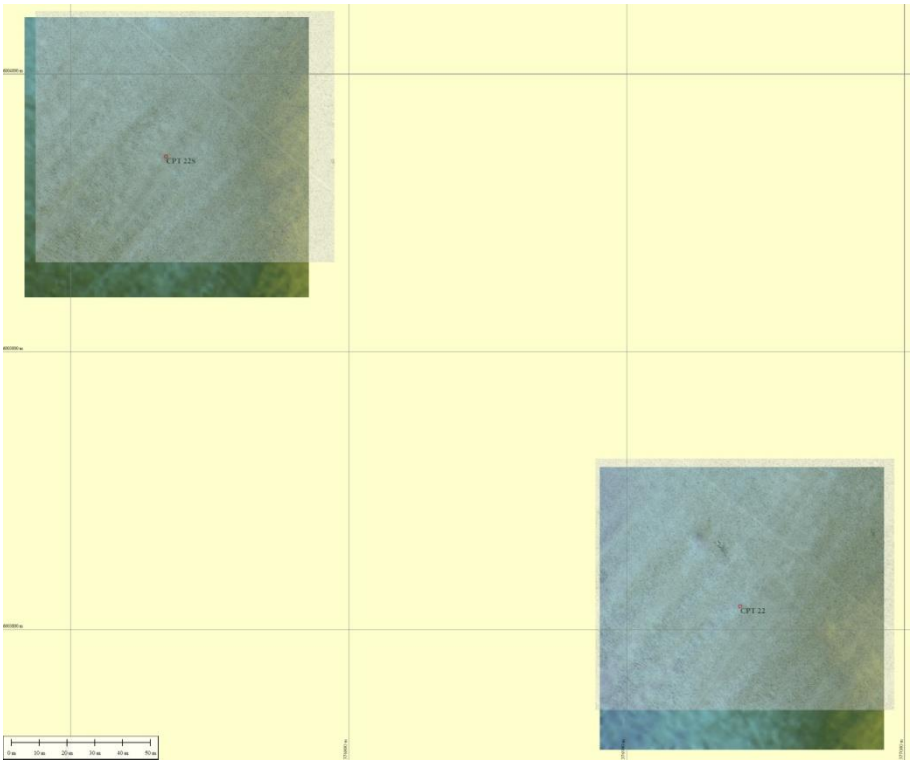

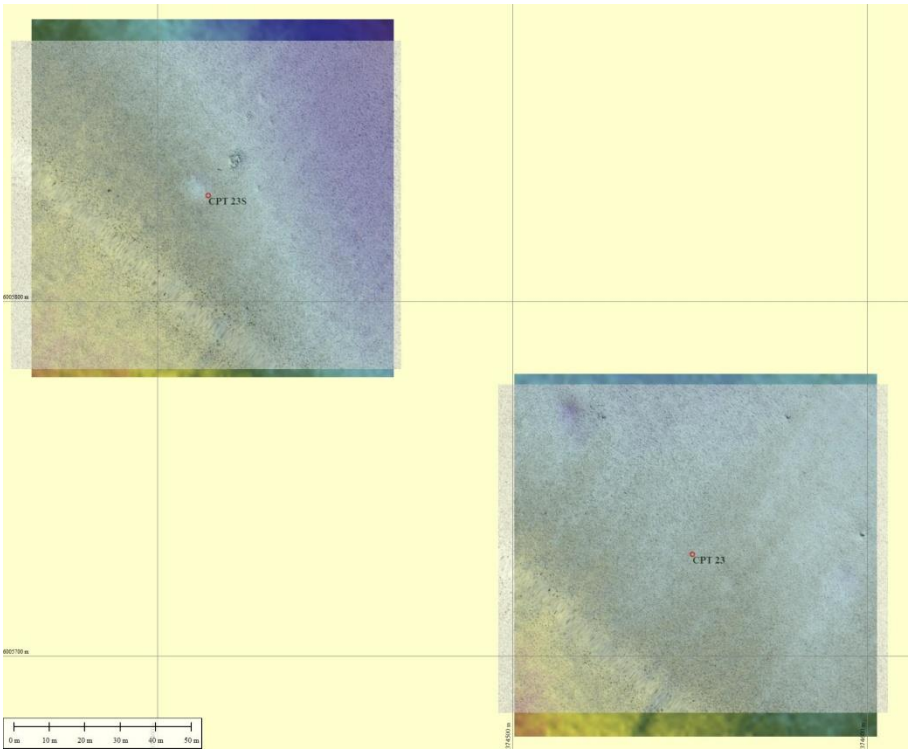
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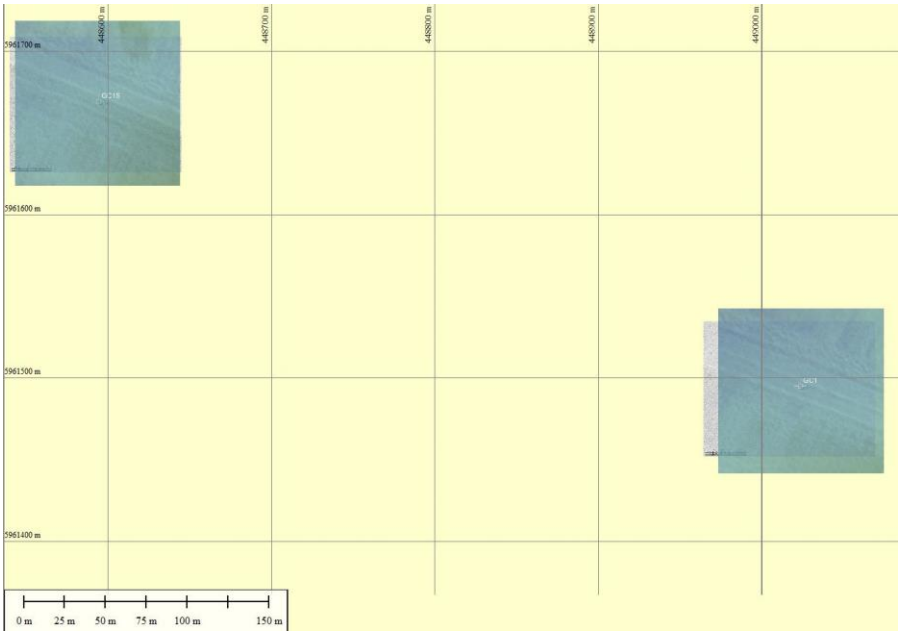
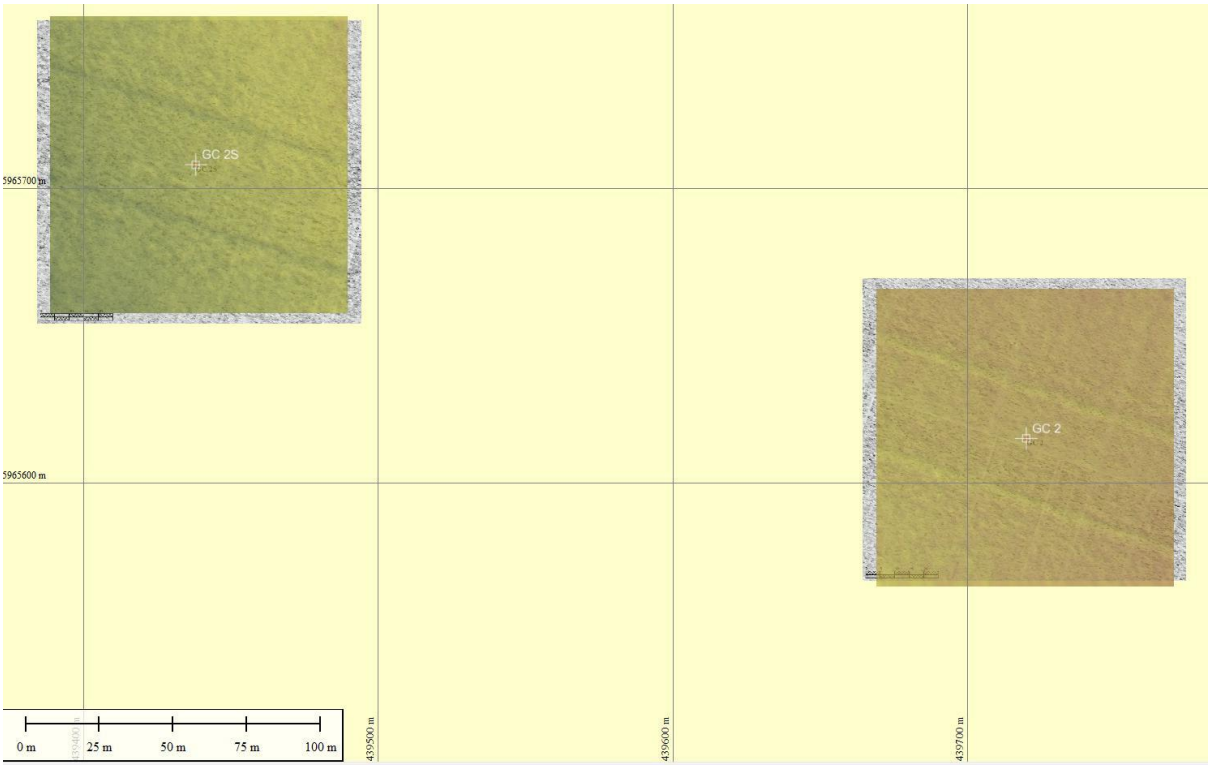
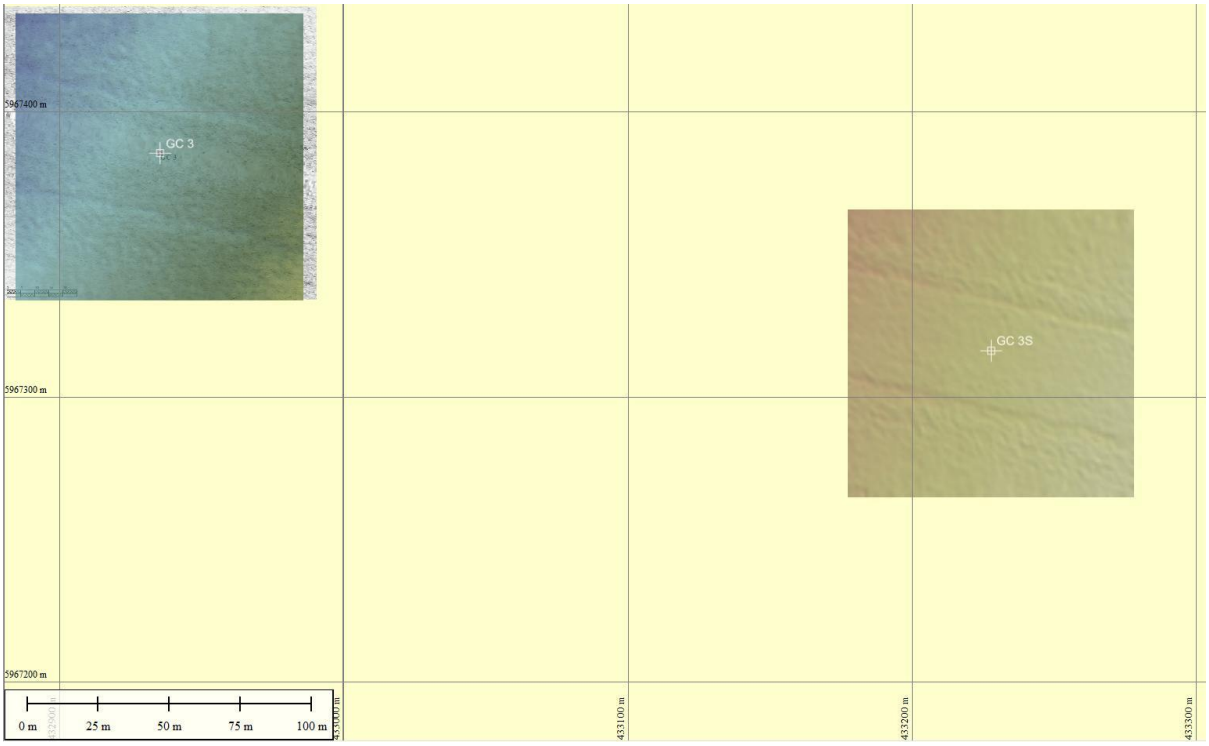
Appendix 7 Grab Sample Location Charts



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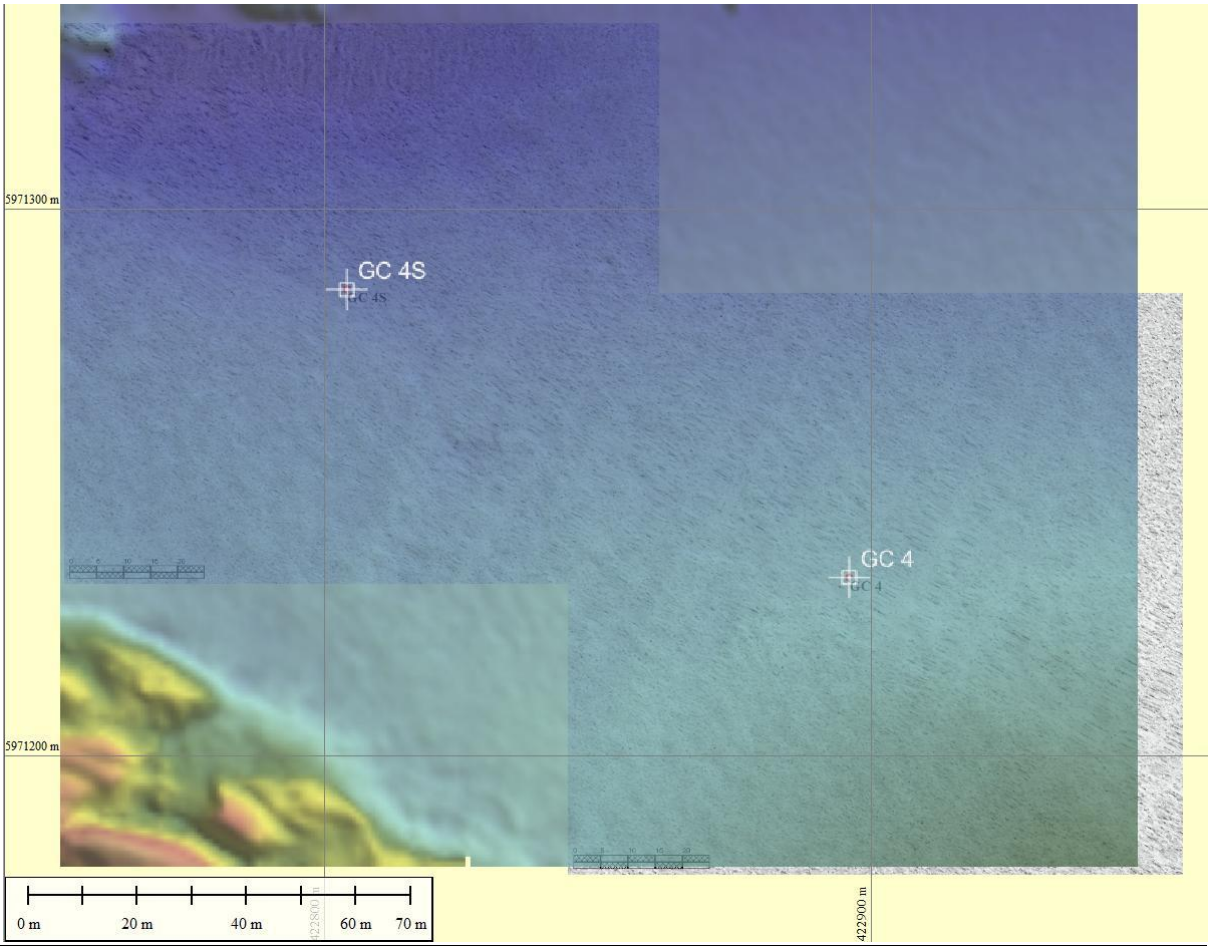
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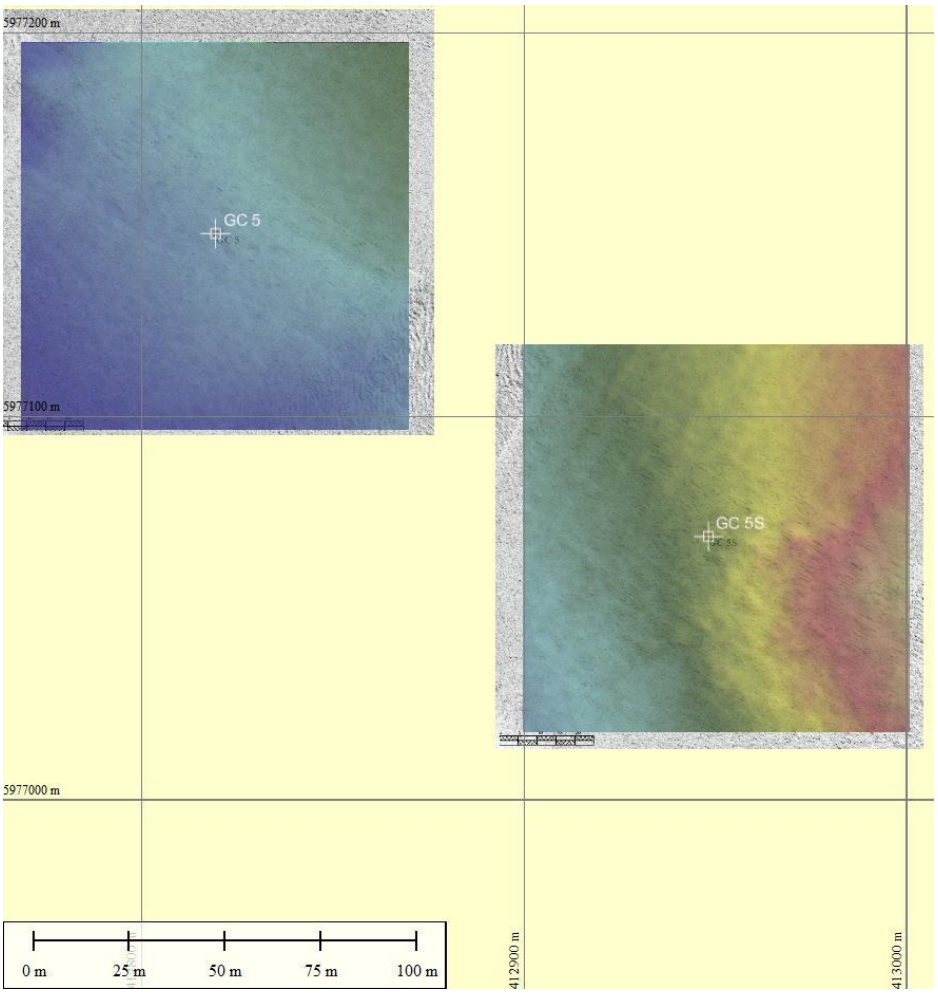
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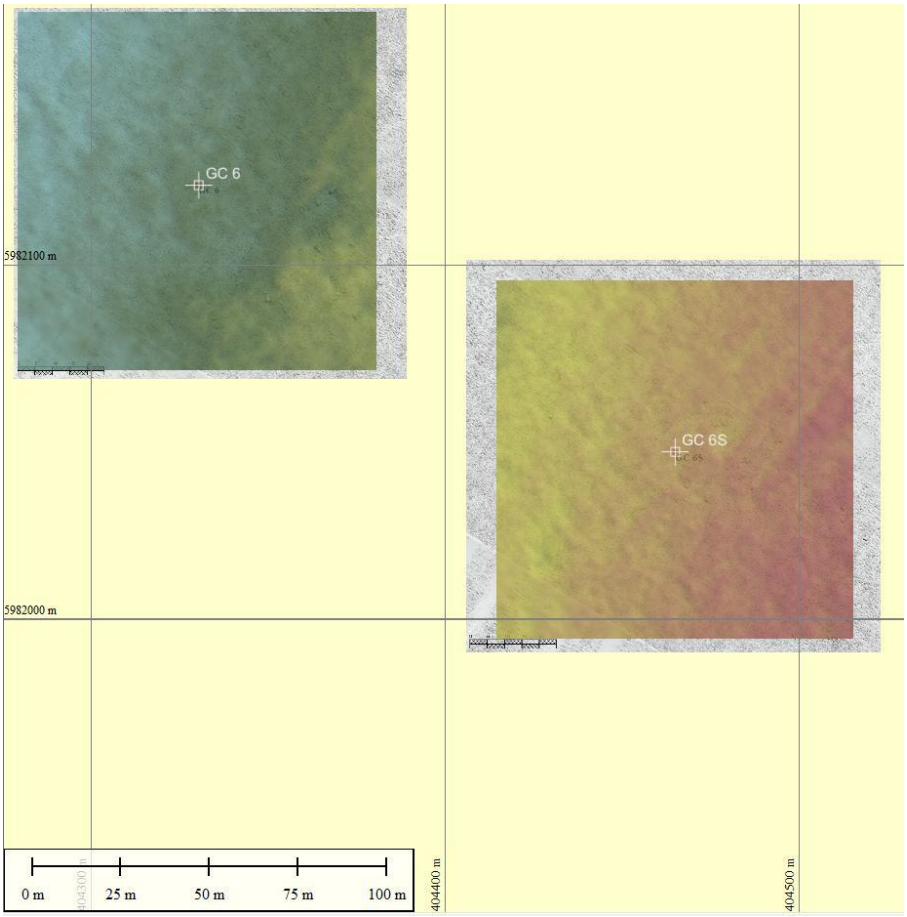
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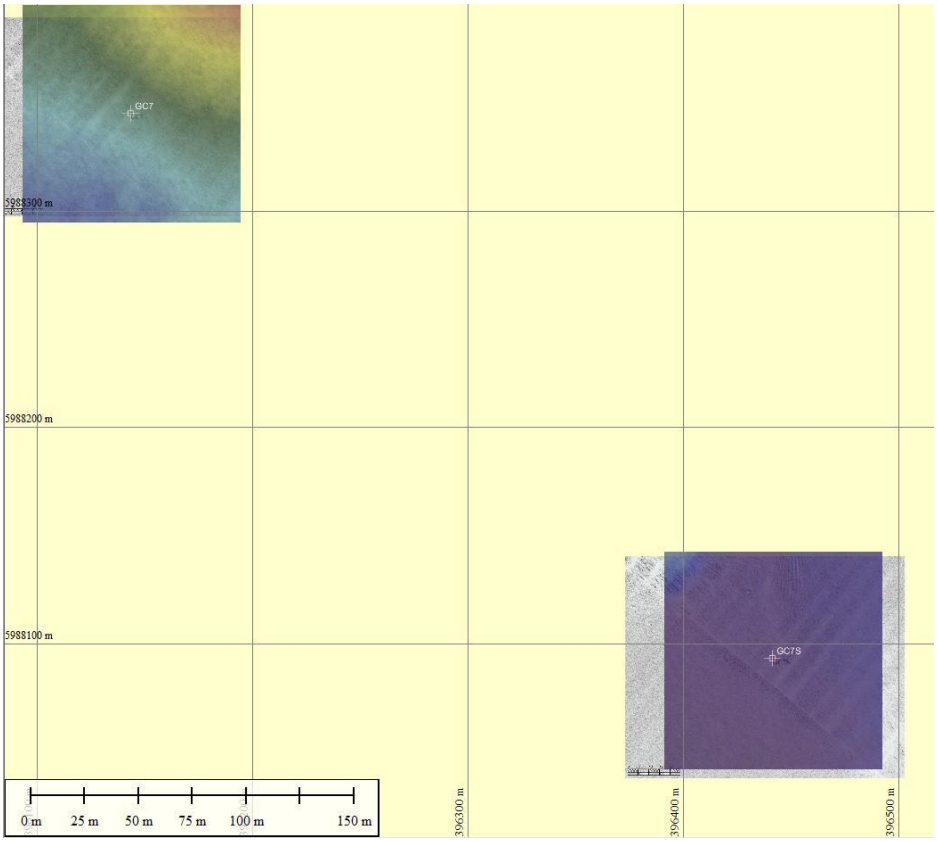
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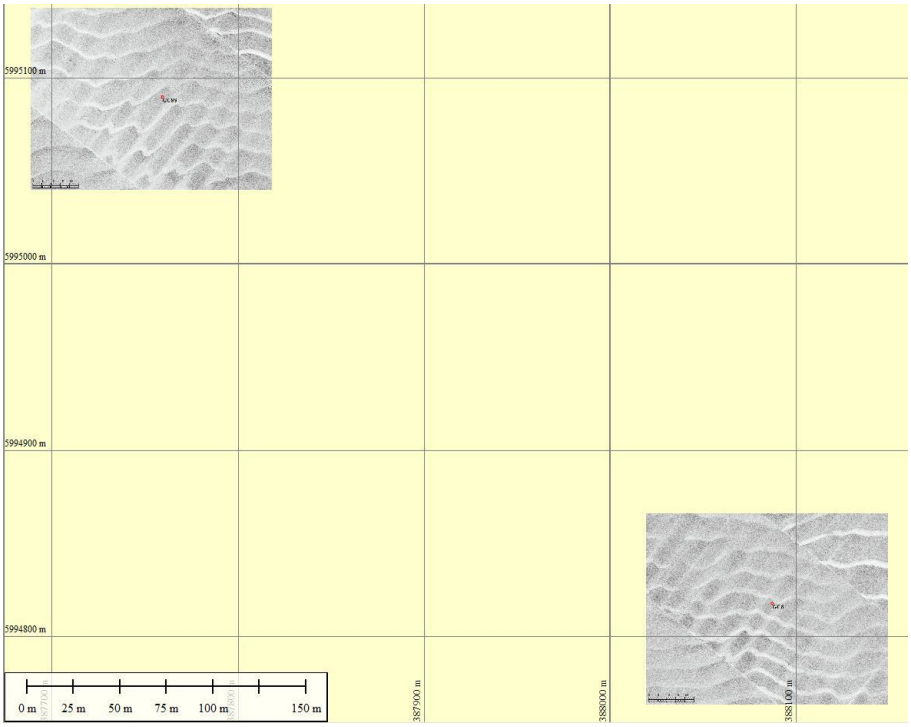
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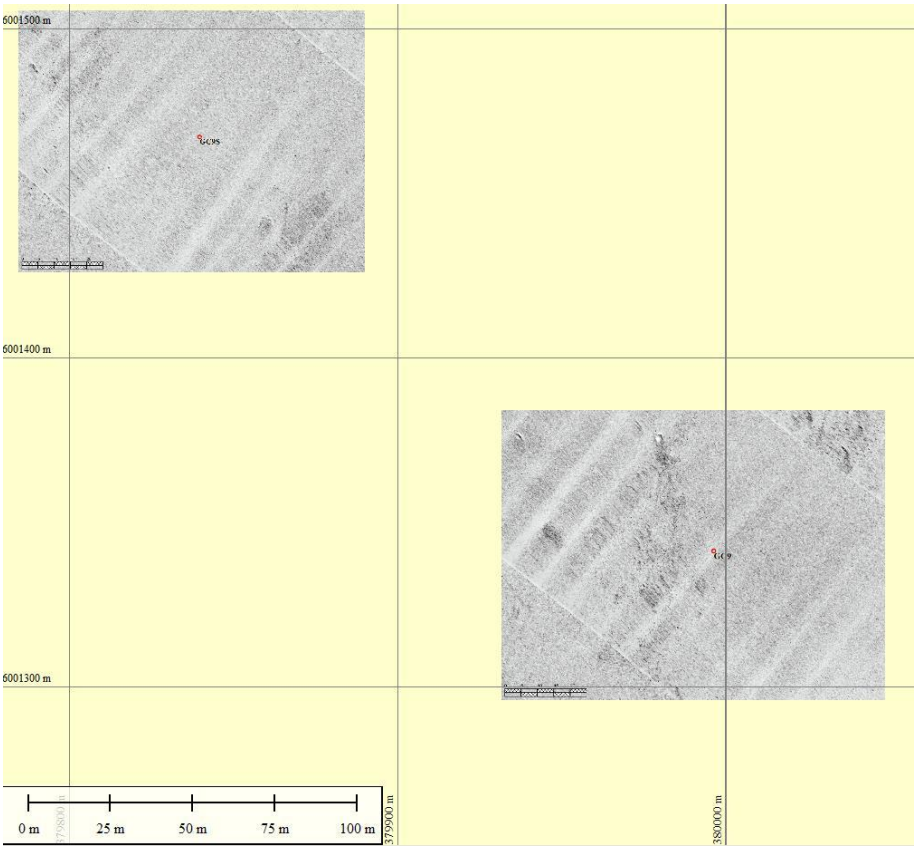
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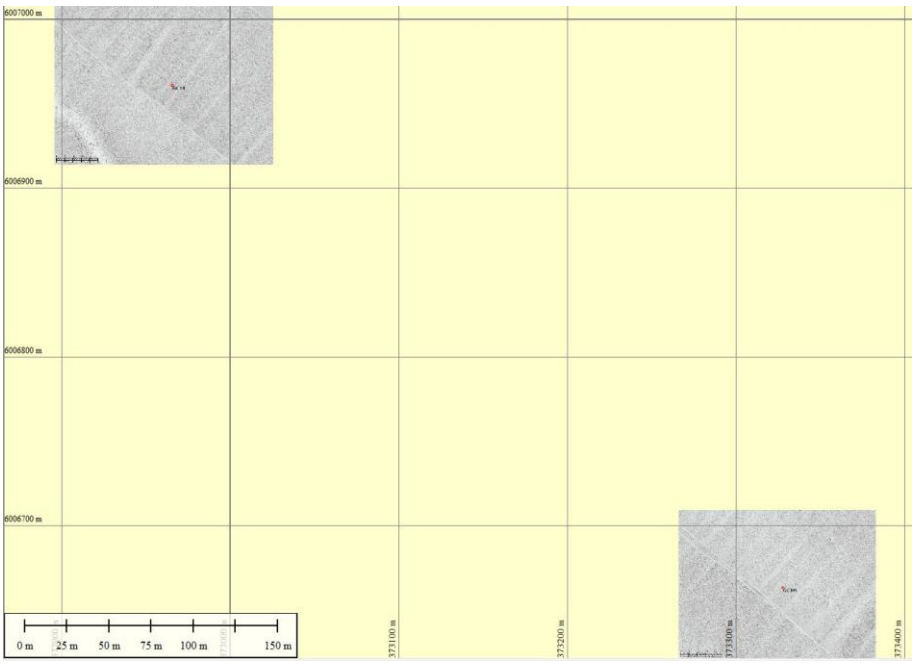
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APPENDIX 10-3

OLD HEAD ARCHAEOLOGICAL ASSESSMENT

[redacted], MA, MUBC, MIAI,
ARCHAEOLOGICAL AND HISTORIC BUILDINGS CONSULTANT
[redacted]
[redacted], GALWAY
[redacted]/086[redacted]

Archaeological Assessment (Field and Desk) at Old Head, Louisburgh, Co. Mayo.

Client: America Europe Connect 2 Ltd.

Consultant: McCarthy Keville O'Sullivan Ltd. Planning & Environmental Consultants, Block 1, GF.S.C. Moneenageisha Road, Galway

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List of Illustrations

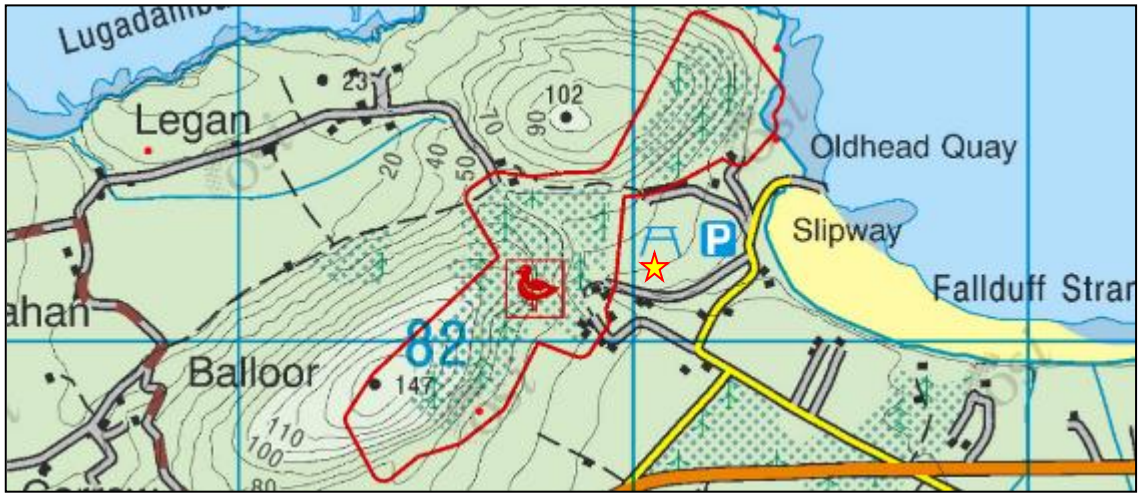
List of Plates

General Introduction

This archaeological assessment was prepared by the writer at the request of America Europe Connect 2 Ltd., through McCarthy, Keville O'Sullivan, Galway. (Illus. 1). A field and desk study was requested by the client to assess the archaeological impact of a proposed cable and cable landing station at Oldhead townland, Louisburgh, Co. Mayo.

The works are being undertaken as part of the HAVFRUE Subsea Cable System Project which involves running a sub-sea communication cable from New Jersey, USA, to Norway and Denmark, with a branch coming ashore at Oldhead.

A site visit was carried out on 30th July 2018, and the writer is grateful to [redacted] owner of the site, for his assistance.



Illus. 1 Site Location. OS Discovery Series Map. Indicating site under investigation

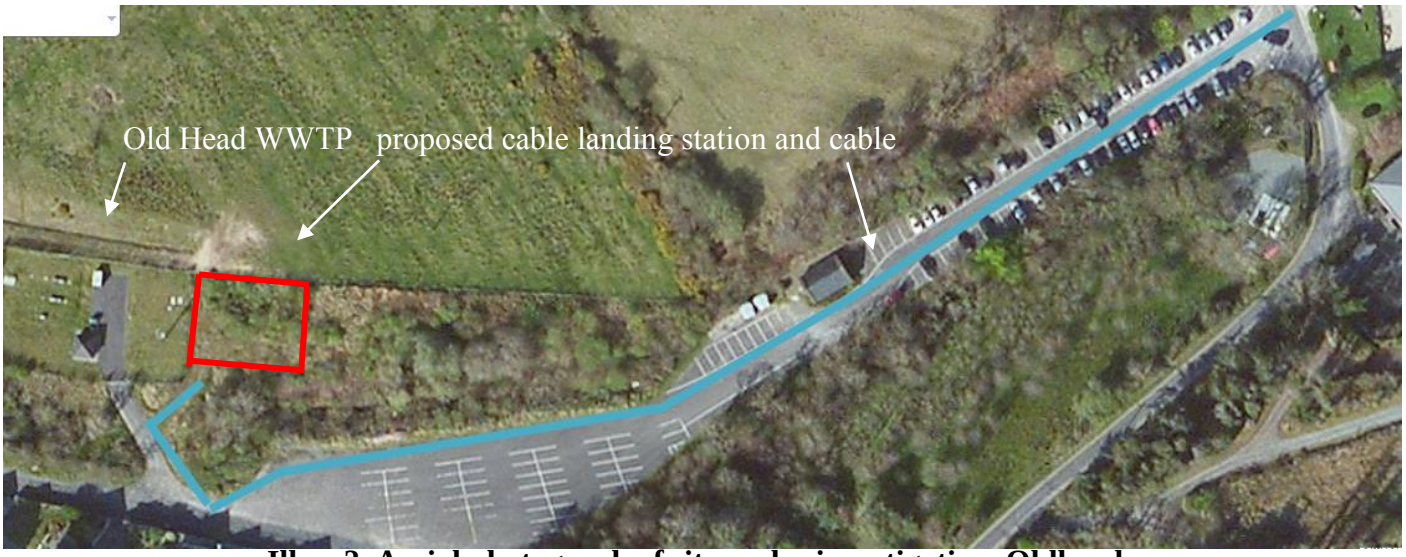
Brief

An archaeological field and desk assessment was requested to inform the client of the archaeological potential of the site. The brief was as follows:

1. Historical research, including cartographic research, was carried out.
2. A site visit was undertaken.
3. A report, including an impact assessment, was prepared.

Locational Information

Townland	Oldhead townland
Description:	Greenfield site
OS Map No.:	Sheet Mayo 086
Forms of Protection:	RMP – N/A RPS – N/A



Illus. 2 Aerial photograph of site under investigation, Oldhead townland, Louisburgh.

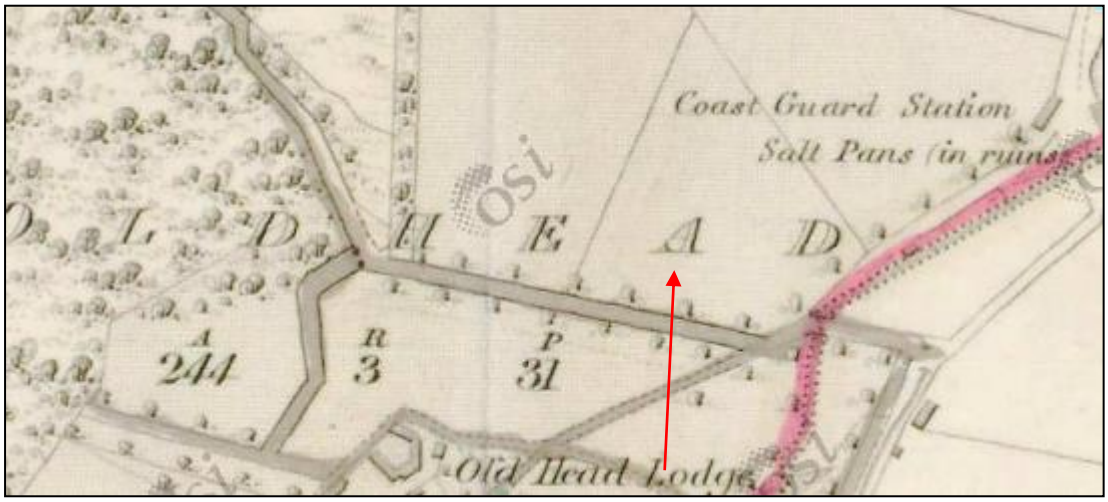
Historical Information

Oldhead townland is located in the parish of Kilgeever and the barony of Murrisk in the county of Mayo. The name Oldhead is derived from the Irish *An Sean Cheann*[1]. The townland was part of an estate which was bought by John Browne of Westport, (Marquess of Sligo and 3rd Earl of Altamont), in 1794 from John Evelyn of Bath, England[2]. Evelyn himself just held the estate for two years, having bought it from Edmond Jordan in 1792. The Jordan's had been granted the land, which had previously been owned by Henry Garvey, in 1678. There were two houses of note within the townland: Oldhead Lodge and Boathaven Lodge, both of which were leased out by the Browne's during their ownership of the estate. A fine nineteenth

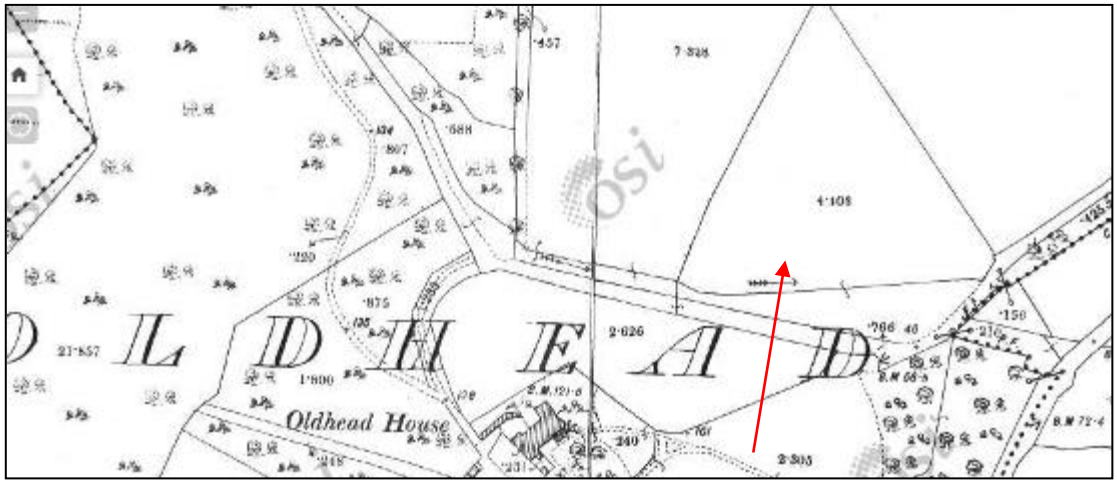
[1] www.logainm.ie
[2] www.landedestates.ie

century feature of Oldhead townland is the stone-built quay to the north of Old Head Beach. This was built in the late 1820s to a design by Alexander Nimmo.

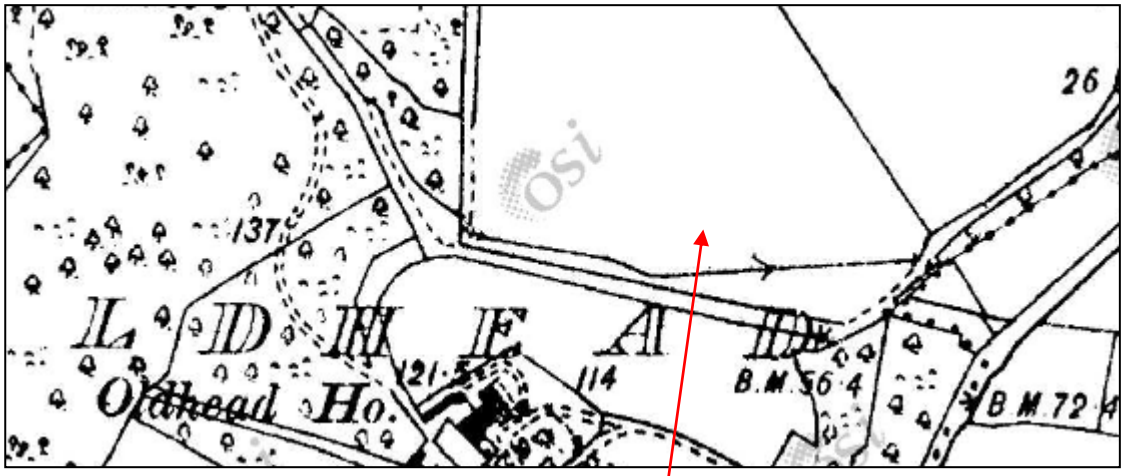
There are three Recorded Monuments in the townland, comprising two middens (RMP No. MA086-012 and MA086-018) and a burnt mound (RMP No. MA086-017). The burnt mound is located at a distance of c. 575m south-west of the site under investigation and the nearest midden to the site is at a remove of c. 280m (RMP No. MA086-018) from the cable trench.



Illus. 3 Historic Mapping. Extract of the First Edition OS 6" Map, GA103, 1838. © Government of Ireland.



Illus. 4 Historic Mapping. Extract of the Second Edition OS 25" Map, GA103, 1890-98. © Government of Ireland.



Illus. 5 Historic Mapping. Extract of the Cassini Edition, OS 6" Sheet, GA103, 1915. © Government of Ireland.

The cartographic evidence shows the site under investigation as a greenfield site in the early-nineteenth century (Illus. 3). The First Edition OS 6" map for the area is 1837-9 with the Second Edition dating to 1893-00 (Illus. 4). The Cassini Edition 6" Map (Illus. 5), 1923-25, continues to show the site as undeveloped ground.

Previous archaeological work was carried out in Oldhead townland in 1999 by [redacted], archaeologist. Archaeological monitoring of pipelaying was undertaken in the vicinity of the two middens in the townland (RMP No.'s MA086-012 and 018), under licence 99E0552 and there was nothing of archaeological significance discovered[3].

Siting and Access

The site under investigation is located c. 4kms north-east of Louisburgh and 20kms south-west of Westport, to the south of Clew Bay (Illus. 1). It comprises two parts: the cable landing station and the cable trench itself. The cable landing station is c. 260m west of Old Head Beach (also known as Falduff Strand), which is a sheltered beach that extends for over 1.1kms. The scenic location is further enhanced by views of Croagh Patrick to the east (frontsplate). The cable trench is proposed to run through the existing public car park that extends to the south-west from the public road and via a short length of surfaced access road leading from the car park to the Old Head WWTP. The site of the cable landing station adjoins the WWTP to its eastern side (Illus. 2).

[3] www.excavations.ie

Site Description

The site under investigation comprises a small lowland area centrally located in the irregularly-shaped townland of Oldhead, to the north-west of a modern car park which leads from the public road to the east (Illus. 2). It is proposed that the cable will be excavated in a shallow trench leading westward through the car park, turning to the north to connect with the cable landing station site.

The site of the proposed cable landing station is located to the east of an existing waste water treatment plant (The Old Head WWTP and Agglomeration, EPA Certificate of Registration Ref.: A0074-01), (Plate 3). The landing station compound will measure 25m north-south and 20m east-west (Illus. 6). An 8m wide area between the proposed landing station compound and the WWTP to the west will not be developed. It currently contains a narrow access pathway under grass leading to agricultural lands to the north (Plate 2). This pathway is flanked by dense vegetation, with a narrow strip to the west, adjacent to the high metal fence which surrounds the WWTP and a more extensive area to the east, in the vicinity of the proposed cable landing station compound. The area to the east is densely overgrown and inaccessible (Plates 5-6).

Plate 1 Access path to the existing treatment plant, with site under investigation to the right.

Plate 2 Western side of site under site investigation.

Plate 3 North-western side of under investigation.

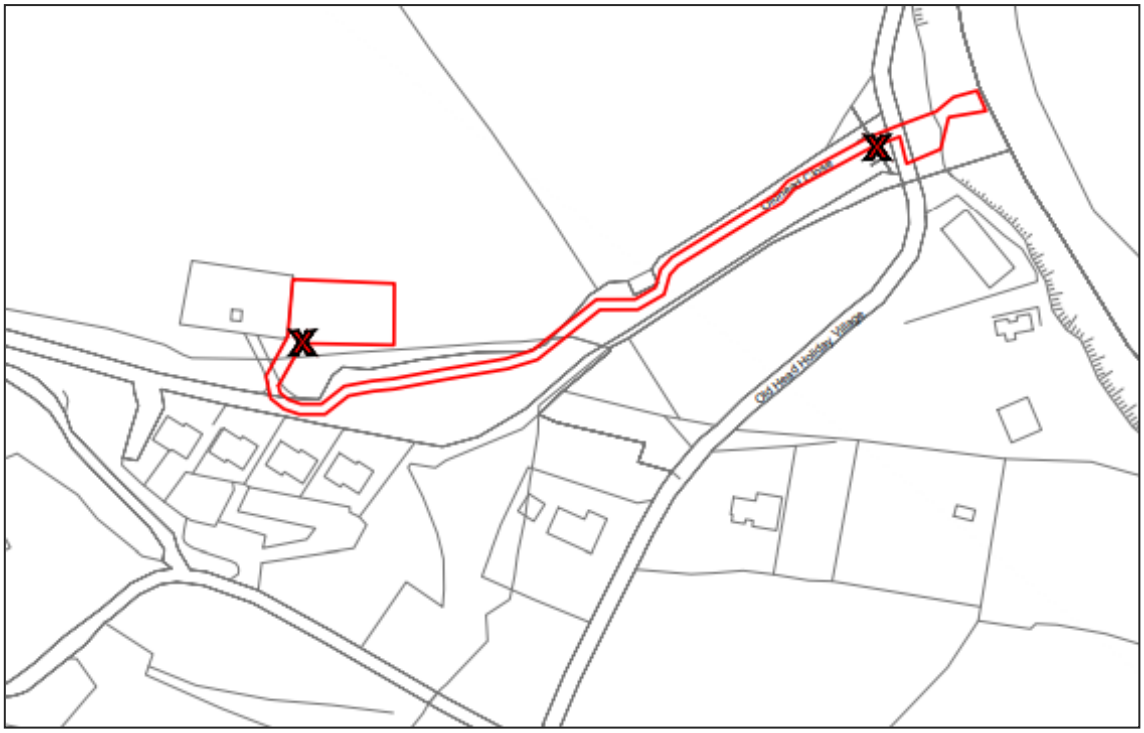
Plate 4 Treatment plant, from north-east.

Plate 5 Site under investigation, from north-west.

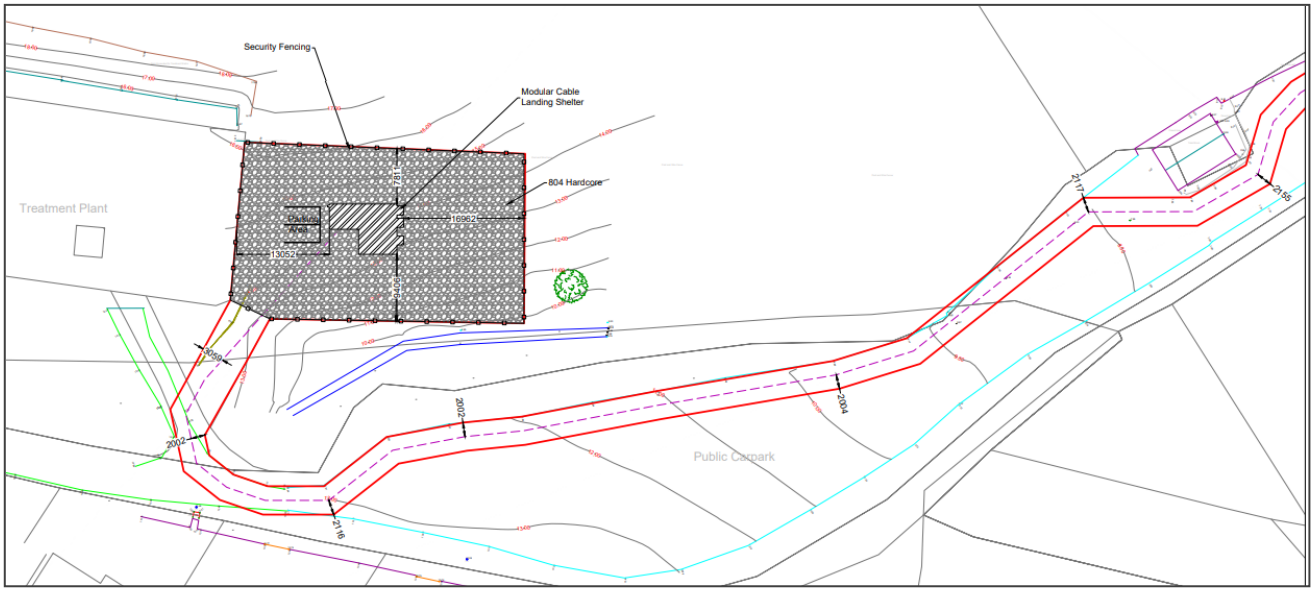
Plate 6 Overgrown area in centre of site under investigation.

Due to uneven ground and dense vegetation, comprising trees, shrubs and ground trailing vegetation, the area to the east of the grassed pathway was not walked. The Old Head WWTP was constructed in 2000 and aerial photographs from that time show the plant during construction (Plate 7). The groundworks associated with the WWTP extended into the area of the proposed cable landing station site and it appears that topsoil stripping was undertaken over much of the area now proposed for development.

Plate 7 Aerial photograph dating to 2000 sowing groundworks associated with the construction of the Old Head WWTP.



Illus. 6 Plan of the proposed development.



Illus. 7 Plan of the proposed cable landing compound and cable route.

The car park at Old Head has a north-east/south-west length of over 250m. Over half of this car park, that section to the south-west, was constructed post-2000. The nature and extent of groundworks required to establish the car park are unclear but the pre-2000 aerial photographs of the area show the site now occupied by the car park to the south-west as tree-lined and under grass.

The Proposed Development

The works proposed at Oldhead townland are part of a project which involves running a sub-sea communication cable from New Jersey, USA, to Norway and Denmark, (HAVFRUE Subsea Cable System Project). A branch will come ashore at Oldhead and a shallow trench is required to bring the cable from the shore to the cable landing compound.

The overall footprint of the development during construction will be 25m north-south by 20m east-west (Illus. 7).

Archaeological Impact Assessment

The development of the site as a cable landing station, with an associated linear cable trench, is being proposed by America Europe Connect 2 Ltd. The potential impacts of the proposed development of the site are examined below.

Potential Impact	Assessment
Physical impact on known archaeological sites:	There are no extant archaeological sites within or close to the site boundary. The site is not within the *Zone of Notification* for any Recorded Monument. There are no protected structures on or near the site.
Physical impact on destroyed archaeological sites:	The historic mapping does not record the presence of known but destroyed archaeological sites within the site boundary.
Physical impact on undiscovered archaeological or historic features or finds:	The archaeological profile of the surrounding area suggests that the site has low archaeological potential.

Conclusions

The site under investigation in Oldhead townland is a small low-lying site currently under dense vegetative growth, with an adjacent area of car parking, over half of which was laid in c. 2000. It is proposed to construct a cable landing station on the site, which will measure 25m north-south and 20m east-west and to excavate a shallow trench for the cable from the shore. There is an 8m wide area to the west of the proposed cable landing compound that will be undeveloped and further to the west is the Old Head WWTP, which was constructed in 2000.

There are no Recorded Monuments on or close to the site of the proposed development. The site of the cable landing site was disturbed during the construction of the Old Head WWTP, with an aerial photograph taken during the construction phase at the site suggesting that a large part of the proposed development site was stripped of topsoil during these works. The same photographs show the south-western part of the car park as undeveloped until c. 2000, with the narrower car park to the east in existence before this.

The archaeological potential of the subject site appears to be low and it seems unlikely that the proposed development on the site would have a physical impact on archaeological material. There is no issue of visual impact as there are no Recorded Monuments in the vicinity.

It is recommended that ground disturbance for both the excavation of the cable trench and for the groundworks at the cable landing site are subject to archaeological monitoring.