Geophysical Survey Data Integration Report

3GW Project Area Geophysical Surveys Integration | Danish North Sea

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Energinet Eltransmission A/S

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7 March 2023

Dear Sir/Madam,

We have the pleasure of submitting the ‘Geophysical Data Integration Report’ for the ‘Energinet Denmark 3GW Project Area. This report presents the results of the Geophysical Survey from both Lots 1 and 2 within the Energy Islands site.

This report was prepared by Ana-Clara Mello, Maddalena Falco, Bart-Jan Tijmes, and Marijn van Cappelle under the supervision of Jennifer Fowler (Project Reporting and Deliverables Manager).

We hope that you find this report to your satisfaction; should you have any queries, please do not hesitate to contact us.

Yours faithfully,

J. Fowler

Jennifer Fowler
Project Reporting and Deliverables Manager

Executive Summary

Bathymetry	
Water depths range from 25.75 m to 49.7 m (MSL). The site is characterised by gentle seafloor slopes, on average ranging between approximately 0˚ and 5˚. Localised gradients, exceeding 10°, were observed in areas of seafloor scour and areas of potential debris.	
Seafloor Morphology	
Morphological features were observed on the seafloor, which included: sand bars, sand waves; mega ripples; large ripples; ripples; areas of boulders; possible pingo remnants or archaeological sites of interest; ridges; possible biogenic features; rock dump; trawl marks, which are evidence of an extensive fishing activity and are present across the entire site.	
Substrate Type	
Following the classification presented in the Danish Råstofbekendtgørelsen (BEK no. 1680 of 17/12/2018, Phase IB), there were six substrate types identified within the 3GW Project Area: 1a – silty soft bottom; comprising mainly mud and sandy mud and muddy sand; 1b – solid sandy bottom; comprising mainly gravel and coarse sand, muddy sand, and sand; 2a – Sand, gravel and pebbles – few larger stones; 2b –sand, gravel and pebbles – seabed cover of larger stones 1% to 10%; 3 – Sand, gravel and pebbles – seafloor cover of larger stones 10% to 25% ; 4- Stony areas and stone reefs, seabed cover of larger stones 25% to 100%.	
Seafloor Sediments	
Based on the results on the backscatter data and grab sampling campaign, the dominant seafloor sediment in the 3GW Project Area is sand, with areas of higher component of finer sediment defined as muddy sand and mud and sandy mud. Areas of gravel and coarse sand were identified mostly in the north-eastern area.	
Seabed Anomaly Targets and Potential Site-Specific Hazards	
Wrecks	Four (4) wrecks and two (2) possible wrecks were observed in the area: Fallwind wreck (EA_R_SSS_00580), HMS Tarpon Submarine Shipwreck (S_FR_B03_0006), two (2) unidentified Wreck (S_RE_SSS_00580; S_FR_B03_0069); and two (2) possible wrecks (EA_P_SSS_00591; S_RE_B05_0547). The wrecks can be seen in SSS, MBES, and MAG datasets.
Cables	Two (2) telecommunication cables are crossing the 3GW Project Area – Havfrue and TAT14. Both cables are orientated in NW – SE direction and were observed in sub-bottom and in the magnetometer data.
Pipeline	One (1) gas pipeline is crossing the 3GW Project Area site – EuroPipe. It is intermittently exposed and was observed in SSS, MBES, MAG and SBP datasets.
Man-made objects	1730 anomalies were identified as man-made objects on SSS, MBES, and MAG datasets (including wrecks, cables, pipeline, rock dumps, debris, and others).
Seafloor anomalies	The seafloor anomalies were identified from SSS, MBES, and MAG datasets. In total, 4030 magnetic anomalies and 21882 side scan sonar anomalies were observed across the site. Inside the OWF Zone West area, SSS anomalies were rationalised to the MBES position. Inside the OWF Zone East area, 61309 anomalies were identified on the MBES.
Boulders and coarse materials	In total 18412 anomalies were picked and classified as (possible) boulders with SSS in the OWF Zone West area, and approximately 64130 anomalies were picked and classified as boulders with MBES and SSS inside the OWF Zone East area. The deduplication process identified 16 coincident SSS anomalies inside the overlap area which were deleted. A total of 82525 boulders were mapped inside the 3GW Project Area. The boulders are spread evenly across the entire 3GW Project Area except for the area stretching from SW to NE in the northern part of the site where the unit U10 is thicker. The areas where the boulder density reached at least 40 boulders in a seafloor area measuring 100 m x 100 m were defined as boulder fields.

Mobile seafloor sediments	Areas of sand bars, sand waves, large ripples and ripples were identified within the 3GW Project Area. During the acquisition seafloor mobility was observed where large ripples and ripples are present, however there was no evidence of sand waves mobility.
Shallow Geology	
Unit U10	Unit U10 is present across most of the site and forms a thin (less than 3 m thick) layer of Holocene sediments. In the north and centre of the site, Unit U10 is thicker, reaching a maximum thickness of 22 m. Unit U10 has two internal horizons, H05 and H06.
Unit U20	Unit U20 forms the local infill of channels, with a maximum thickness of 111 m. In the north, Unit U20 has a sheet-like geometry locally.
Deformed Unit D24	Unit D24 has a sheet-like geometry with a horizontal to undulating base. The unit has a thickness of up to 44 m. The unit shows evidence for deformation with the presence of folded reflectors, dipping thrust-faults and transparent seismic facies.
Unit U25	Unit U25 has a sheet-like geometry with a horizontal to undulating base. The unit has a thickness of up to 26 m. Internally, the unit is horizontally stratified with medium to high amplitude, closely spaced parallel reflectors. Locally acoustically transparent or with internal channels.
Unit U30	Unit U30 is present in two shallow and broad valleys. The unit reaches a thickness up to 32 m. Internally, this unit is acoustically laminated to acoustically transparent and forms a transition between underlying Unit U35 and Unit U60 to overlying Unit U25.
Unit U35	Unit U35 fills a wide valley with an east-west orientation and two tributaries with a north-south orientation and has a thickness of up to 58 m thick. Internally, Unit U35 has a complex acoustic character from locally stratified, acoustically transparent to chaotic. The chaotic intervals comprise discontinuities high amplitude reflectors with sharp to transitional terminations. Acoustic characters also include internal erosion surfaces and inclined reflectors.
Unit U40	Unit U40 is a channelised unit. Maximum thickness is up to 131 m. Internally, unit is acoustically chaotic or locally contains low to high amplitude stratification parallel to the base of the channel.
Unit U50	Unit U50 is locally present in the north-east of the site with a thickness of up to 17 m thick. It has an acoustically transparent to stratified seismic character.
Unit U60	Unit U60 fills a wide valley and has a thickness of up to 56 m thick. Internally, Unit U60 has a complex acoustic character from locally stratified, acoustically transparent to chaotic. The chaotic intervals comprise discontinuous high amplitude reflectors with sharp to transitional terminations.
Unit U70	Unit U70 forms the infill of deep glacial valleys with a north-east to southwest orientation. The base often lies deeper than the maximum penetration of the 2D-UUHR seismic data (i.e., approximately 200 m below MSL). Two seismic facies are observed. The lower part of the valley-fill is acoustically chaotic to transparent, whereas towards the top the valley-fill is stratified. Internal horizon H69 is interpreted in some of the valleys of Unit U70 and forms the boundary between acoustically chaotic seismic characters and stratified acoustic characters.
Unit U90	Unit U90 is present throughout most of the site, except in the north and where it is cut out by valleys of Unit U70. It has a thickness of up to 87 m. Internally, Unit U90 has a complex seismic character, interpreted to comprise early to middle Pleistocene fluvial deposits. Two internal reflectors are present: horizons H75 and H85 and mark changes in seismic character.
BSU (Base Seismic Unit)	The BSU is present throughout most of the site except where it is incised by channels of Unit U70. This unit is stratified and is interpreted to comprise Miocene marine and deltaic deposits.
Geological Features	
Glacial deformation	Glacial deformation was observed at two levels, in BSU and in deformed Unit D24. In the north and east, the BSU contains a well-defined thrust-faults forming a thrusted complex, with a detachment surface at approximately 140 m MSL. In the north, Unit D24 is deformed to a various degree. Deformation includes folding and thrust-faults.

Faults	Normal faults and an inverted normal fault with a generally north-south orientation are present in the BSU.
Salt Tectonics	Two areas with normal faults in a circular planform are associated with salt diapirs.
Deformation associated with tunnel valleys	Deformation of the BSU is observed around tunnel valleys of Unit U70.
Burried Channels and Tunnel Valleys	Buried channels and tunnel valleys are present at several levels throughout the site.
Gravel, cobbles and boulders	Gravel, cobbles and boulders could be associated with fluvial and glacial deposits throughout the site at several levels.
Seismic anomalies	Seismic anomalies with a high amplitude and reverse polarity are present at two levels (level 1 and level 2) in Unit U90.
Acoustic blanking	Acoustic blanking associated with the potential presence of gas is locally present in Unit U20.

Document Arrangement

Document Number	Document Title	Company
F176286-REP-MOB-001	Mobilisation Report	Fugro
F176286-REP-OPS-001	Operations Report	Fugro
F176286-REP-GEOP-001	Geophysical Survey Report (WPA scope)	Fugro
F176286-REP-MAG-001	Magnetometer Box Survey Report (WPB scope)	Fugro
103783-ENN-MMT-MAC-REP-FRANKLIN-A	Mobilisation and Calibration Report – Northern Franklin	MMT
103783-ENN-MMT-MAC-REP-RELUME-A	Mobilisation and Calibration Report - Relume	MMT
103783-ENN-MMT-SUR-REP-OPREPWPA-REVA	Operations Report WP-A (OWF survey area)	MMT
103783-ENN-MMT-SUR-REP-SURVWPA	Geophysical Survey Report (WPA scope)	MMT
F176286-REP-GEOP-002	**Geophysical Survey Integration Report (V09)**	**Fugro**

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Appendices

Figures in the Main Text

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Abbreviations

AI	Artificial intelligence
ALARP	As low as reasonably practicable
BEK	Danish Råstofbekendtgørelsen
BSF	Below seafloor
BSU	Base seismic unit
CM	Central meridian
COG	Centre of gravity
CRP	Central reference point
CUBE	Combined Uncertainty and Bathymetric Estimator
DGPS	Differential global positioning system
DTM	Digital terrain model
DTU	Technical University of Denmark
EGN	Empirical gain normalisation
ENC	Electronic navigational charts
EPSG	European Petroleum Survey Group
ETRS	European Terrestrial Reference System
GEOP	Geophysical
GEUS	Nationale Geologiske Undersøgelser for Danmark og Grønland (Geological Survey of Denmark and Greenland)
GHz	Geohazard
GIS	Geographic information system
GNSS	Global navigation satellite system
OWF	Offshore Wind Farm
HF	High frequency
HIPS	Hydrographic Information Processing System
HV	High voltage
HVF	HIPS vessel file
IHO	International Hydrographic Office
KDE	Kernel density estimation
LF	Low frequency
MAG	Magnetometer
MBES	Multibeam echosounder
MCS	Multi-channel seismic
MIG	Migrated
MMO	Man-made object
ML	Machine learning
MLSS	Multi-level stacked sparker

MOB	Mobilisation
MRU	Motion reference unit
MSL	Mean Sea Level
MSS	Mean sea surface
MVP	Moving velocity profile
NE	North-east
NW	Northwest
OCR	Offshore Client Representative
OPS	Operations
OWF	Offshore Wind Farm
PEP	Project execution plan
PSD	Particle-size distribution
QC	Quality control
QHD	Qinhuangdao
REP	Report
SBP	Sub-bottom profiler
SE	South-east
SEG	Society of Exploration Geophysicists
SIPS	Sonar Information Processing System
SSS	Side scan sonar
SVP	Sound velocity probe
SVS	Sound velocity sensor
SW	Southwest
TPU	Total propagated uncertainty
TQ	Technical query
TSG	Template Survey Geodatabase
TVU/THU	Total vertical uncertainty / total horizontal uncertainty
UUHR	Ultra ultra high resolution
USBL	Ultra short baseline
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
WPA	Work package A

1. Introduction

1.1 General

Energinet Eltransmission A/S (Energinet) is developing a new offshore wind farm and Energy Island in the Danish Sector of the North Sea. This report details the integration of the results from the geophysical surveys, conducted by Fugro and MMT (2021), covering the North Sea 3GW Project Area.

The project site, henceforth referred to as 3GW Project Area (or 'site') is located offshore Denmark approximately 59 km west of Thorsminde and covers an area of approximately 1052 km^2 (Figure 1.1). The site was surveyed in 2021 by two different companies MMT (OWF Zone East) and Fugro (OWF Zone West). This report aims to describe the integration process between data acquired during both surveys and provide an overview of the 3GW Project Area. The detailed results of each survey are presented in 103783-ENN-MMT-SUR-REP-SURVWPA-B and F176286-REP-GEOP-001.

Guidelines on the use of this report are provided in Appendix A.

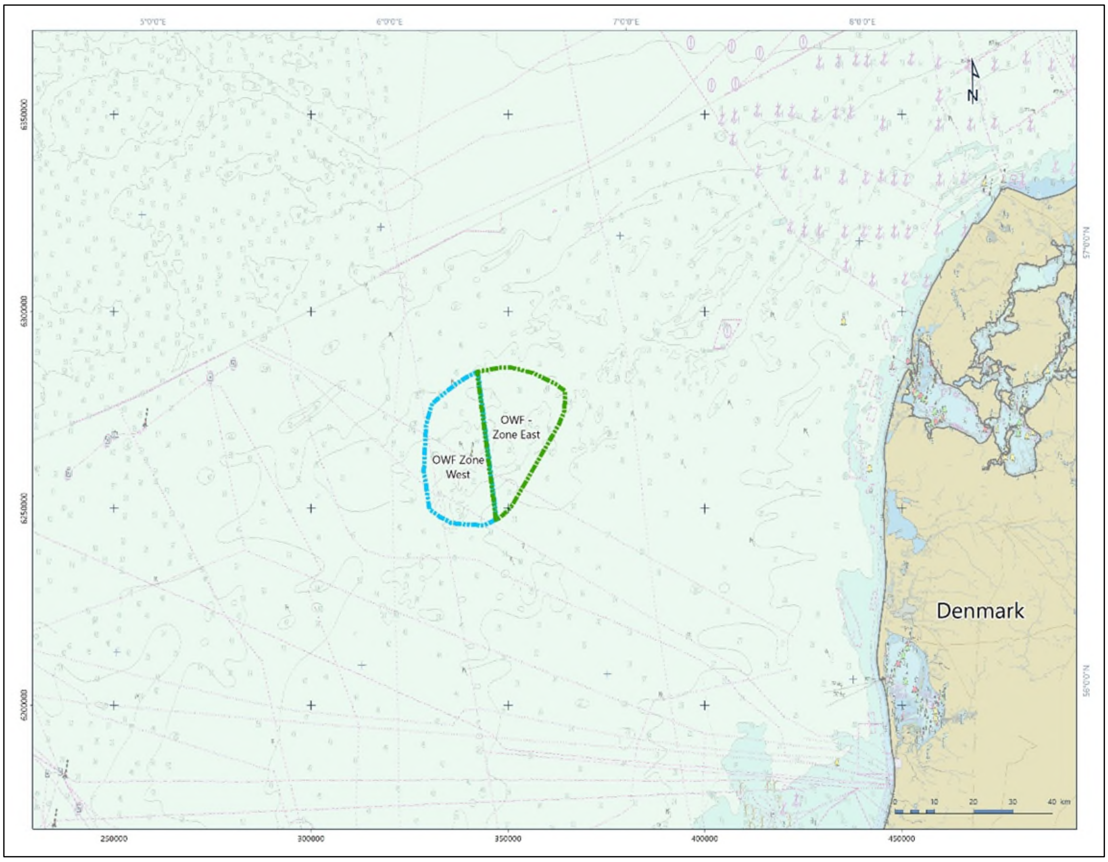


Figure 1.1: Location of the OWF Zone West and OWF Zone East (together referred to as 3GW Project Area), offshore Denmark.

1.2 Project and Integration Overview

1.2.1 Project Overview

Energinet contracted Fugro Netherlands Marine (Fugro) and MMT to perform geophysical surveys in the OWF Zone West and OWF Zone East areas of the 3GW Project Area, respectively.

MMT operations occurred between 1 May to 12 June 2021 with M/V Relume, and from 11 June to 18 August 2021 with M/V Northern Franklin. Details of the operations onboard both vessels are provided in report 103783-ENN-MMT-SUR-REP-OPREPWPA-RevA.

Fugro operations occurred between 24 May and 19 October 2021 with Fugro Pioneer. Details of the operations onboard Fugro Pioneer are provided in report F176286-REP-OPS-001.

Information on the main survey requirements for the geophysical survey operations can be found in Table 1.1 and in reports 103783-ENN-MMT-SUR-REP-OPREPWPA-RevA and F176286-REP-OPS-001.

Table 1.1: Survey requirements overview.

Equipment Method	Energinet Requirement
Vessels	Suitable research/survey vessel
Line Spacing	Line plan to accommodate all the requirements
Survey Priority	Not specified
Max Vessel Speed	Maximum of 4.0 knots (±10%)
Surface Positioning	■ Two independent systems available; ■ Dynamic heading accuracy of ± 0.2° or better; ■ Static heading accuracy of ± 0.05° or better; ■ Horizontal uncertainty of the vessel of ± 0.5m or better.
USBL	+/-2 m accuracy for data acquired from towed sensors
2D-UUHR	■ Minimum penetration: 100 m, dependent on geology; ■ Fundamental frequency between 1 kHz and 3 kHz; ■ Vertical resolution better than 0.3 m; ■ Fire rate ≥ 2 pulses/second; ■ Variable energy levels between 100 J and 1000 J; ■ A suitable multi-channel and multi-element hydrophone streamer (e.g. 48 channels @ 3.125 m) with depth control plus depth measurement for continuously monitoring and recording of streamer depth.

Equipment Method	Energinet Requirement
Multibeam Echo sounder/Backscatter	■ 100% coverage; ■ Equal distance mode; ■ Motion compensated; ■ 0.25 m x 0.25 m bin size / 16 x pings per 1.0 m x 1.0 m (for accepted exceptions refer to TQ); ■ THU is <0.5 m; ■ TVU is compliant with IHO Special Order; ■ Grid standard deviation (95% confidence interval) is less than 0.2 m.
Parametric SBP	■ High-frequency single channel sub-bottom profiler system; ■ Minimum penetration: 10 m, dependent on geology; ■ Vertical resolution: better than 0.3 m.
Side Scan Sonar	■ Minimum target size insonification of 0.5 m along the shortest axis; ■ Dual channel system operating at both HF and LF; ■ 200% coverage including nadir; ■ Altitude to be set to 8-12% of range; ■ Survey speed to be a maximum of 4.0 knots (±10%).
Magnetometer	■ 5 m maximum altitude; ■ Magnetometer measurement sensitivity: 0.01 nT; ■ Magnetometer sampling frequency: 1 – 20 Hz (selectable); ■ Maximum noise level: 2 nT.
SVP	The speed of sound in water shall be measured in the survey area at suitable time intervals.
Grab Sampling	■ Precise positioning of the grab sample location (not more than 5 m from the designated position); ■ Accuracy of the positioning better than 2 m; ■ Safe storage of the sample (at least 3 kg – refer to TQ) for onshore delivery with proper labelling

1.2.1 Integration Overview

The aim of the offshore geophysical surveys was to map the bathymetry, the static and dynamic elements of the seafloor, and the sub-seafloor geology to at least 100 m below seafloor (BSF).

The acquired data will be used as the basis for:

- Initial marine archaeological site assessment;
- Planning of environmental investigations;
- Planning of initial geotechnical investigations;
- Decision of foundation concept and preliminary foundation design;
- Assessment of subsea inter-array cable burial design;
- Assessment of installation conditions for foundations and subsea cables.

Following the separate geophysical surveys Fugro was contracted, to integrate the data acquired across the OWF Zone East and OWF Zone West areas and integrate and align the associate seafloor and sub-seafloor interpretation.

To achieve these objectives the integration process included integrating following datasets:

- Bathymetry;
- Backscatter;
- Seafloor anomalies:
  - Side Scan Sonar anomalies;
  - Multibeam anomalies;
  - Magnetometer anomalies;
  - Seafloor features;
  - Man-made object anomalies;
- Seafloor Sediments:
  - Seafloor classification;
  - Substrate;
  - Seafloor morphology;
- Sub-Seafloor Geology:
  - Seismostratigraphic Units;
  - Geological Features.

1.3 Geodetic Parameters

The project geodetic and projection parameters are summarised in Table 1.2.

Table 1.2: Project geodetic and projection parameters.

Project Global Positioning System Geodetic Parameters	
Datum	ETRS89
EPSG code	25832
Semi major axis	6 378 137.000 m
Semi minor axis	6 356 752.314 m
Inverse flattening	298.257222101
Project Projection Parameters	
Grid Projection	Universal Transverse Mercator, Northern Hemisphere
UTM Zone	32 N
Central Meridian	009° 00′ 00.000″ East
Latitude of Origin	00° 00′ 00.000″ North
False Easting	500 000 m
False Northing	0 m
Scale Factor at Central Meridian	0.9996
Units	Metres

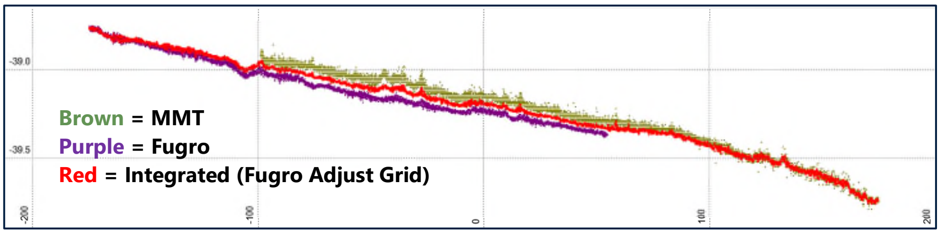
1.4 Vertical Datum

The vertical datum for North Sea 3GW Project Area was reduced to Mean Sea Level (MSL) utilising the DTU21 MSL Tide Model as a vertical offshore reference frame supplied by the Technical University of Denmark (DTU).

2. Integration Methodology

2.1 Bathymetry & Backscatter Integration

Table 2.1: Bathymetry and Backscatter Integration

Type	Integration Methodology
Bathymetry	Software used for integration: Fugro Starfix.Workbench & Fugro Adjust Grid Small variable vertical mismatch residuals were observed when overlaying both bathymetry datasets. Residuals were will within project specification and equipment accuracy. Fugro Adjust Grid was utilized to balance out small vertical difference between both bathymetry dataset by calculating a difference grid in the overlap area. The difference grid was buffered by 70 m over which the difference was brought back to zero, then divided by two to allow an equal distribution of the vertical difference residual and applied to both datasets to resolve before being merged. The integration process only modified depths within the overlap area plus a 70 m buffer to each side. Features within the area of depth modifications were maintained due to careful setting selection and QC. 
Backscatter	Software used for integration: Fugro Starfix.Workbench No normalization residuals were observed. Datasets were combined using regular Fugro Starfix.Workbench gridding algorithm. Slight smoothing of backscatter data was observed within the overlap area.
THU	Software used for integration: Fugro Starfix.Workbench Integration based on preserving maximum THU value expressing the maximum horizontal uncertainty values associated to a given grid cell / soundings.
TVU	Software used for integration: Fugro Starfix.Workbench Integration based on preserving maximum TVU value expressing the maximum vertical uncertainty values associated to a given grid cell / soundings.
Raster definition difference	Fugro converted the MMT ASCII (Bathymetry, TVU and THU) and raster (Backscatter), assuming the grid cell coordinate and values represent the centre of the grid cell. Comparing Fugro's integrated raster against the original MMT raster reviled a 1/2 grid cell shift of the MMT data, indicating that there is a difference in grid cell definition between the MMT and Fugro datasets. The cell content value remains the same, except for the area where datasets were integrated. Integrated bathymetry datasets delivered as part of this work scope are refer to the centre of the grid cell.
Note for all datasets	Limitation, MMT ASCII contained 2 decimal points, Fugro data contained 3 decimal points.

2.2 Seafloor Anomalies Integration

Integration of the seafloor anomaly listings required careful review of the associated attributes to ensure a smooth integration. It was decided that the initial classification would be used as the basis to standardize the integrated product, with the addition of the

“Integration class” (INTEGCLASS) attribute. This ‘integration class’ attribute contains a simplified classification of features (e.g., ‘possible debris strong return’, ‘possible debris weak return‘, ‘possible debris or scar’ all become ‘debris_suspected debris’.

The ‘integration class’ attribute was included in the digital MBES, SSS, and MAG anomaly listings in addition to the original MMT/Fugro comments regarding classification of the anomalies. These are present in the integrated Template Survey Geodatabase (TSG).

As the survey of the OWF Zone West and OWF Zone East was performed by Fugro and MMT, respectively, an overlap of 200 m was kept ensuring no gaps occurred in the 3GW Project Area. Within the overlap area, deduplication of the SSS, MBES, and MAG anomalies was applied.

The deduplication was performed by a combination of an automatic and manual processes, and comprised the following steps:

- Automatic correlation of all anomalies of a sensor in a radius of 2 m;
- Manual review of the similarities between correlated anomalies;
- Where anomalies were assessed to be similar, deduplication was performed, and one anomaly was maintained to represent the specific anomaly in the integrated product.

Table 2.2 summarizes the digital files that were integrated and the final name convention following the integration process.

Table 2.2: Overview of SSS anomalies inside 3GW Project Area.

OWF Zone West	OWF Zone East	Integrated shapefile 3GW Project Area
SN2021_013_SSS_ANOMALY_PTS	SN2021_012_SSS_ANOMALY_PTS	3GW2022_SSS_ANOMALY_PTS
SN2021_013_MAG_ANOMALY_PTS	SN2021_012_MAG_ANOMALY_PTS	3GW2022_MAG _ANOMALY_PTS
SN2021_013_MBES_ANOMALY_PTS	SNNNNN_seq_MBES_ANOMALY_PTS	3GW2022_MBES_ANOMALY_PTS
SN2021_013_MMO_PTS	SN2021_012_MMO_PTS	3GW2022_MMO_PTS
SN2021_013_MMO_LIN	SNYYYY_seq_MMO_LIN	3GW2022_MMO_LIN

2.2.1 Side Scan Sonar Anomalies Integration

Integration of the SSS anomalies was conducted by assessing the similarities and discrepancies within the data. Table 2.3 provides a summary of the analysis.

During the integration process, it was noted that classification within both the OWF Zone East and OWF Zone West was done differently. As a result, the SSS anomalies in OWF Zone East have 791 different classifications which are listed in the comment field of the digital file. Some of these classifications are specific to an anomaly (e.g., dimensions). In OWF Zone West, only eight (8) distinct classifications were used.

To provide an overview of the anomalies inside the 3G Project Area, the comment classes were grouped according to their characteristics (Table 2.3). The INTEGCLASS attribute, described in Section 2.2, contains the updated classification.

Table 2.3: Assessment of SSS anomaly data inside 3GW Project Area

SSS Anomaly Points			
OWF Zone West		OWF Zone East	
SNO2021_013_SSS_ANOMALY_PTS		SN2021_012_ANOMALY	
OBJECT ID	1 to 18596	**OBJECTID**	1 to 3286
COMMENT	Boulder Debris_Suspected Debris Isolated Depression_Pockmark Pipeline Seabed Mound Unidentified Wreck	**COMMENT**	Comments are variable, including: MB_B06_000848, 1.31m M-0087, 2.99m Elongated Elongated strong return Linear debris Possible Possible debris Possible debris weak return Possible debris strong return
MBES_ANOMALY_ID	NA	**MBES_ANOMALY_ID**	737 out of 3286
MAG_ANOMALY_ID	33 out of 18596	**MAG_ANOMALY_ID**	26 out of 3286
LENGTH (m)	0.95 to 3064.33	**LENGTH (m)**	0.33 to 82.78
WIDTH (m)	0 to 20.61	**WIDTH (m)**	0.00 to 22.61
HEIGHT (m)	0 to 3.94	**HEIGHT (m)**	0.00 to 5.11
Total integrated SSS anomalies		**21882**	
Total deduplicated SSS anomalies		**16**	

Notes:
- MBES_ANOMALY_ID numbers refers to the correlated MBES anomalies
- MAG_ANOMALY_ID numbers refers to the correlated magnetometer anomalies

During the deduplication process, 21 SSS correlated anomalies were found between Fugro and MMT interpretation datasets. Out of these, 16 anomalies required actual deduplication within the overlap area as these are considered to be identical anomalies (i.e., duplicates). The remaining five (5) anomalies had differing classifications between Fugro and MMT and were all maintained in the final digital files/anomalies list.

Table 2.4 provides an overview of the integrated SSS classification. All integrated SSS anomalies are provided in Appendix C.

Table 2.4: Overview of SSS anomalies inside 3GW Project Area

Integrated Class	Total
Boulder	18412
Unclassified	2365
MB_B0X_XXXXXX, yy.yym *	736
Debris / Suspected Debris	169
Pipeline	45

Integrated Class	Total
Seabed Mound	14
Linear Debris	18
Other	2
M-XXXX.y.yym *	13
Possible Sediment Mound	13
Elongated	11
Possible fishing gear	9
Possible Boulder	7
Isolated Depression / Pockmark	6
Unidentified	36
Wreck	6
Possible Scar	3
Possible Wire	1
Total	**21866**
Notes: * MB-B0_XXXXXX.y.yym and MB-XXXX.y.yym refer to specific target IDs (X) and dimensions (Y)	

2.2.2 Multibeam Anomalies Integration

MBES was used as a primary sensor for picking anomalies inside the OWF Zone East area. Boulders were primarily interpreted in the MBES data, while all other contacts, and some boulders, were interpreted in the SSS data (103783-ENN-MMT-SUR-REP-SURVWPA). In OWF Zone West, SSS was used as the primary sensor for anomaly picking, which were then correlated with MBES data (F176286-REP-GEOP-001 05).

Due to these difference in methodology, no MBES anomalies were provided for OWF Zone West and hence the integration process was not applied. The majority of the MBES anomalies picked in the OWF Zone East, overlap with the boulder fields mapped inside OWF Zone West. Individual boulders in OWF Zone West are included in the SSS anomalies listing.

For the east area, 61309 MBES anomalies were observed (Table 2.5). All MBES contacts were classified as boulders (103783-ENN-MMT-SUR-REP-SURVWPA).

Table 2.5: MBES anomaly attributes in 3GW Project Area

MBES Anomaly Points			
OWF Zone West		**OWF Zone East**	
SN2021_013_MBES_ANOMALY_PTS		SNNNNN_seq_MBES_ANOMALY_PTS	
OBJECT ID	NA	**OBJECT ID**	1 out of 61309
LENGTH	NA	**LENGTH**	1 to 8.75m

MBES Anomaly Points			
WIDTH	NA	**WIDTH**	0.4 to 6.6m
HEIGHT	NA	**HEIGHT**	0.01 to 1.95m
COMMENT	NA	**COMMENT**	M-XXX, yy.ym S_FR_B0X_XXXX, yy.ym S_RE_B0X_XXXX, yy.ym No Comment
MAG_ANOMALY_ID	NA	**MAG_ANOMALY_ID**	M-XXXX
SSS_ANOMALY_ID	NA	**SSS_ANOMALY_ID**	S_XX_B0X_XXXX
No MBES anomalies		Total of MBES anomalies: 61309	
Notes: NA: No MBES anomalies interpretated XXXX refer to specific target IDs and y.yy refer to anomaly dimensions			

An overview of MBES anomalies is summarized in Table 2.6.

Table 2.6: Overview of observed MBES anomalies inside 3GW Project Area

Comment	Total Anomalies
"-"*	60448
M-XXX, y.yym**	44
S_FR_B0X_XXXX, y.yym**	395
S_RE_B0X_XXXX, y.yym**	440
Total	**61309**
Notes: * '-' no comment/classification provided ** XXXX refer to specific target IDs and y.yy refer to anomaly dimensions	

2.2.3 Magnetometer Anomalies Integration

The magnetometer anomalies integration is summarized in Table 2.7.

As with SSS anomaly classification, the identified magnetometer anomalies have many different classifications in OWF Zone East. Some classification refers to the specific anomaly nomenclature (e.g., MB_B0_XXXX,yy.ym, where 'X' refers to anomaly ID and 'y' refers to dimensions). In OWF Zone West, the magnetometer anomalies were classified differently, only using 'Non-discrete', 'Discrete', and 'Linear'.

During the integration of datasets, the magnetometer anomalies of OWF Zone East were reclassified accordingly. The reclassification is presented in the INTEGCLASS field inside the TSG.

Within the overlap area, no anomalies were observed to correlate. One (1) anomaly in the OWF Zone East dataset was picked in the OWF Zone West. To avoid duplicity, this target was omitted from the final integrated database (Table 2.8).

Table 2.7: Magnetometer anomaly attributes in 3GW Project Area

Magnetometer Anomalies			
OWF Zone West		OWF Zone East	
SN2021_013_MAG_ANOMALY_PTS		SN2021_012_MAG_ANOMALY_PTS	
OBJECT ID	1 to 3257	**OBJECT ID**	1 to 773
P2P_NT	Intensity (nT)	**P2P_NT**	Intensity (nT)
COMMENT	Discrete Non-Discrete Linear Features	**COMMENT**	"Likely linear anomaly" *Comments are variable
SSS_ANOMALY_ID	33 out of 3257	**SSS_ANOMALY_ID**	26 out of 773
NA	NA	**MBES_ANOMALY_ID**	19 out of 773
Type	Complex Dipole Positive	**NA**	NA
Total integrated MAG anomalies		**4030**	
Total deduplicated MAG anomalies		**1**	
Notes: NA: associated MBES anomalies not provided in original dataset			

Table 2.8: Deduplicated Magnetometer Anomaly

Deduplicated Target					
TARGETID	SRCNAME	P2P_NT	COMMENT	TYPE	Lot
M-0032 (omitted)	BM1_2D_00000	17.8	BG Cable	NA	Lot 1
Notes: Observed anomaly is located inside OWF Zone West and omitted from the final integrated database.					

An overview of MAG anomalies following the integration and deduplication process is presented in Table 2.9.

Table 2.9: Overview of Magnetometer anomalies and Integrated Classification

Comment	Total	Integrated Data Classification
Non-discrete	1616	Non-discrete
Linear feature	358	Linear
Likely linear anomaly	161	

<table>
<tr><th>Comment</th><th>Total</th><th>Integrated Data Classification</th></tr>
<tr><td>BG Cable</td><td>96</td><td></td></tr>
<tr><td>Discrete</td><td>1283</td><td rowspan="9">Discrete</td></tr>
<tr><td>Null</td><td>401</td></tr>
<tr><td>Likely artefact or geology</td><td>53</td></tr>
<tr><td>S_XX_B0X_XXXX*</td><td>19</td></tr>
<tr><td>Associated with wreck</td><td>18</td></tr>
<tr><td>MB_M0X_000XX*</td><td>12</td></tr>
<tr><td>Long wavelength</td><td>7</td></tr>
<tr><td>Picked from Total field</td><td>4</td></tr>
<tr><td>Associated with adjacent Anomaly</td><td>1</td></tr>
<tr><td>Total</td><td colspan="2">4029</td></tr>
<tr><td colspan="3">Notes:
* XXXX refer to specific target IDs</td></tr>
</table>

2.2.4 Seabed Features Integration

Interpreted seabed features correspond to the natural features mapped inside 3GW Project Area. Integration of the seabed features anomalies was carried out by assessing the attributes of the data; these attributes are summarized in Table 2.10.

During the deduplication process, 58 seabed features were found to be correlated between Fugro and MMT interpretation datasets. Of these, 15 anomalies required deduplication within the overlap area as these are considered to be identical anomalies (i.e., duplicates).

The remaining 43 anomalies were identified either on SSS or MBES, but not on both sensors together. As these anomalies were not identified on both sensors, they were not omitted from the final digital files/anomalies list.

Table 2.10: Seabed features attribute in 3GW Project Area

Seabed Feature Points			
OWF Zone West		**OWF Zone East**	
SN2021_013_SEABED_FEATURES_PTS		SN2021_012_SEABED_FEATURES_PTS	
OBJECT ID	1 to 18432	**OBJECTID**	1 to 64139
LENGTH	0.95 to 7.67	**LENGTH**	1.0 to 2.79
WIDTH	0 to 4.57	**WIDTH**	0.6 to 22.16
HEIGHT	0 to 2.11	**HEIGHT**	0.10 to 0.75
COMMENT	<Null> nmh (no measured height)	**COMMENT**	Boulder Other

Seabed Feature Points			
EQUIP_TYPE	Side Scan Sonar	**EQUIP_TYPE**	Side Scan Sonar Multibeam Echosounder
SEABEDFEATURE	Pockmarks Boulder Seabed Mound	**SEABEDFEATURE**	Other
MBES_ANOMALY_ID	NA	**MBES_ANOMALY_ID**	737 out of 3286
Total integrated SSS anomalies		**82571**	
Total deduplicated SSS anomalies		**15**	

An overview of seabed feature anomalies after the integration process is presented in Table 2.11.

Table 2.11: Overview of Seafloor Features

Seabed Feature	Total Anomalies
Boulder	82536
Seabed mound	14
Pockmark	6
Total	**82556**

2.2.5 Man-made Objects Anomalies Integration

The man-made objects (MMO) data were derived from points, linear, and polygons anomalies mapped with multiple sensors (SSS, MAG, MBES), and classified as features related to infrastructure, cables, rock dumps, etc.

MMO were subdivided into three categories: (i) Points, (ii) Linear Features, and (iii) Polygons, described in Sections 2.2.5.1 to 2.2.5.3. The assessment of each category is present in Table 2.12 to Table 2.18: .

In F176286-REP-GEOP-001 05 (OWF Zone West), communication cables were only included as linear features. In the OWF Zone East they were included as both linear and points. For the final integration the communication cables in OWF Zone West are included as points (338 point features) mapped from magnetometer sensor.

In the OWF Zone East all magnetometer anomalies were categorized as MMO. No attempt was made to distinguish between the MMO or geological signal (103783-ENN- MMT-SUR-REP-SURVWPA).

2.2.5.1 MMO Points

Integration of the MMO point anomalies was carried by the assessment of data, which attributes are summarized in Table 2.12.

During the deduplication process, one (1) anomaly was found to be correlated between Fugro and MMT interpretation datasets.

Table 2.12: MMO points attributes in 3GW Project Area

NOTES MMO PTS			
OWF Zone West		OWF Zone East	
MAG SN2021_012_MMO_PTS		MMO SN2021_013_MMO_PTS	
OBJECT ID	0 out of 164	**OBJECT ID**	0 out of 1229
SHAPE	Point	**SHAPE**	Point
EQUIP_TYPE	Side Scan Sonar	**EQUIP_TYPE**	Side Scan Sonar Magnetometer Multiple methods - Integrated interpretation
TARGET_ID	EA_X_SSS_0000X*	**TARGET_ID**	"MMO_S_FR_B03_0001"
COMMENT	Cluster of debris Fallwind Wreck Fishing Gear Linear Measured on MBES Possible Wreck (91D - ENC DataBase) Wreck Debris'	**COMMENT**	Comments are variable, including: Possible fishing gear Possible debris weak return BG Cable <Null> etc
MMO_TYPE	Debris_Suspected Debris Pipeline Unidentified Wreck	**MMO_TYPE**	Cable Fish Net Wire Wreck Other
MAG_ANOMALY_ID	EA_X_MAG_0000X* 20 out of 164	**MAG_ANOMALY_ID**	M-000X* 798 out of 1229
SSS_ANOMALY_ID	EA_X_SSS_0000X* All records	**SSS_ANOMALY_ID**	S_FR_B03_00XX* 482 out of 1229
Total of integrated MMO anomalies		**1731**	
Total deduplicated MMO anomalies		**1**	
Notes: * X refers to specific target IDs.			

The overview of MMO point anomalies after integration and deduplication process is summarized in Table 2.13 and the classification of mapped MMO points is shown in Table 2.14.

Table 2.13: Deduplicated MMO points

TARGETID	EQUIP. TYPE	SSS ANOMALY ID	MAG ANOMALY ID	COMMENT	MMO TYPE	OWF
MMO_S_RE_B01_0178 (omitted)	SSS	S_RE_B01_0178			Other	OWFW

Table 2.14: Summary of MMO point anomalies inside 3GW Project Area

MMO TYPE	Total Anomalies
Cable	435
Debris Suspected Debris	111
Fish Net	11
Other	1094
Pipeline	45
Unidentified	6
Wire	4
Wreck	24
Total Anomalies	**1730**

2.2.5.2 MMO Linear

Integration of the MMO linear anomalies was carried by assessing the data attributes which are summarized in Table 2.15.

During the deduplication process, one (1) anomaly was correlated within the specified 2 m correlation radius. The identified anomaly was observed as part of a cable stretching through both OWF Zone East and OWF Zone West of the 3GW Project Area. The linear feature merged into one feature (Table 2.16).

Table 2.15: Assessment of MMO linear anomalies inside 3GW Project Area

MMO Linear			
OWF West		OWF East	
MMO Linear SN2021_013_MMO_LIN		**MMO** SNYYYY_seq_MMO_LIN	
OBJECT ID	1 to 72	**OBJECT ID**	1 to 33
EQUIP_TYPE	Side Scan Sonar	**EQUIP_TYPE**	Magnetometer
COMMENT	<Null> Fishing Gear Linear Measured on MBES Wreck Debris	**COMMENT**	BG Cable Likely linear anomaly Likely Linear Anomaly, likely Geology Possible linear feature Possible unknown wreck
MMO_TYPE	Unidentified Suspected Debris	**MMO_TYPE**	Cable Other

MMO Linear			
	Pipeline Cable		Wreck
CONFLEVEL	LOW MEDIUM HIGH	**CONFLEVEL**	HIGH
MAG_ANOMALY_ID	*01 anomaly per target per line feature 21 out 72	**MAG_ANOMALY_ID**	*More than 01 anomaly addressed per line feature 31 out of 33
SSS_ANOMALY_ID	*01 anomaly per target per line feature 70 out of 72	**SSS_ANOMALY_ID**	*More than 01 anomaly addressed per line feature 7 out of 33
Total integrated MMO linear anomalies		**105**	
Total deduplicated MMO linear anomalies		**1**	

An overview of MMO linear anomalies after the integration process is presented in Table 2.16.

Table 2.16: Integrated MMO linear anomaly

Target ID	Equip. Type	Magnetometer anomaly ID	Associated SSS anomaly ID	Comment	MMO type
LF_M-0032	MAG	M-0744,M-0743,M-0742, M-0741,M-0740,M-0722,M-0721,M-0720,M-0708,M-0690,M-0689,M-0688,M-0686,M-0685,M-0643,M-0642,M-0626,M-0624,M-0623,M-0594,M-0592,M-0591,M-0583,M-0582,M-0581,M-0572,M-0554,M-0553,M-0552,M-0551,M-0536,M-0535,M-0518,M-0517,M-0505	S_FR_B03_0061 EA_Y_SSS_00345	BG Cable	Cable

The overview of MMO linear anomalies after integration process is summarized in Table 2.17.

Table 2.17: Summary of MMO linear anomalies inside survey area

MMO TYPE	Total Anomalies
Cable (CB)	2
Debris Suspected Debris (DB)	19
Wreck (DW)	1
Pipeline (PIP)	50
Unidentified (UN)	1
Other (OD)	31
Total Anomalies	**104**

2.2.5.3 MMO Polygons

Man-made objects represented by polygons were only identified in the OWF Zone West side. For this reason, no integration was made between both databases. The polygons mapped in the survey area are two observed rock dumps.

Table 2.18: Assessment of MMO polygons inside 3GW Project Area

MMO Polygons			
OWF West		OWF East	
MMO Polygon SN2021_013_MMO_POL		**MMO Polygon** SNYYYY_seq_MMO_POL	
EQUIP_TYPE	Multibeam Echosounder	**EQUIP_TYPE**	NA
COMMENT	This feature isn't picked as target, it doesn't have target ID	**COMMENT**	NA
MMO_TYPE	Rock Dump	**MMO_TYPE**	NA
MAG_ANOMALY_ID	<Null>	**MAG_ANOMALY_ID**	NA
SSS_ANOMALY_ID	<Null>	**SSS_ANOMALY_ID**	NA
OBJECT ID	1 and 2	**OBJECT ID**	NA
SHAPE	Polygon	**SHAPE**	NA
Total integrated MMO polygons		**2**	
Notes: NA: No MMO polygons interpretated			

2.3 Seafloor Classification Integration

2.3.1 Seafloor Classification Integration

The integration of seafloor classification was focused in the overlap area of OWF Zone East and OWF Zone West areas. Despite the continuity and similar geological characteristics, different classifications were applied in both areas during the initial interpretation. The following section describes the methodology applied for integration process for the seafloor sediment classification, seafloor morphology, and substrate results in the 3GW Project Area.

2.3.2 Seafloor Sediment Integration

The main differences observed in the sediment interpretation in the OWF Zone East and OWF Zone West side, was the presence of till/diamicton in the west area. This sediment was classified as a mix of sediment. No tills were recognised in the acquired geotechnical data and hence this classification was changed to 'diamicton' only. Table 2.19: summarizes the classifications used for both OWF Zone West and OWF Zone East site, and the 3GW Project Area.

Table 2.19: Overview Sediment Classification within3GW Project Area.

OWF Zone West Sediment Classes	OWF Zone East Sediment Classes	Final Integrated Sediment Class
Gravel and coarse sand	Gravel and coarse sand	Gravel and coarse sand
Sand	Sand	Sand
Mud and sandy mud	Mud and sandy mud	Mud and sandy mud
Muddy sand	Muddy sand	Muddy sand
Till/ diamicton	Not identified	Diamicton

Within the overlap area, mismatches between the initially mapped polygons were identified. Where there was no mismatch in the overlap area, it was decided to keep the original classification of the OWF Zone East.

In case of mismatches, some general conversions were applied to merge both data. The polygons were merged following similar backscatter intensity. The main conversions applied are summarized in Table 2.20, however, locally some exceptions were applied.

Table 2.20: Overall conversion applied for sediment polygons inside overlap area.

Sediment Classes OWF Zone East	Conversion Integration (Applied to some polygons)
Gravel and coarse sand	▪ Till/diamicton where H30 was very close to the surface ▪ Changed to sand in other places
Sand	Muddy sand
Muddy sand	Mud and sandy mud in some cases
Mud and sandy mud	Unchanged, some areas were merged with the muddy sand

As a result of the integration, several polygons within the overlap between OWF Zone West and OWF Zone East as well as within the areas affected by the changes inside the overlap were reclassified. The original interpretation remained unchanged in the easternmost part of the OWF Zone East. As such, local mismatches might be observed between the central and eastern parts of the 3GW Project Area within the range of conversion described in Table 2.20.

2.3.3 Substrate Integration

The main differences observed in the sediment interpretation in both areas, were the presence of the Class 4 (stony areas and stone reefs), within OWF Zone East. This class was not mapped inside the OWF Zone West; however, it seems to correlate to the till/diamicton sediment type observed, and to the seafloor morphology class "Areas of numerous boulders (boulder field)".

For the integration of the data, in the overlap area, the Class 4 was changed to Class 3 (sand, gravel, and pebbles). Outside the overlap area, no changes were made with the polygons of this class.

Table 2.21 summarizes the substrate classifications used for the 3GW Project Area. The overall conversion process is shown in Table 2.22.

Table 2.21: Overview substrate classification inside 3GW Project Area.

Substrate Classes 3GW
1a - Sand, silty, soft bottom
1b - Sand, solid sandy bottom
2a - Sand, gravel and pebbles
2b - Sand, gravel and pebbles seabed covered with larger stones 1% to 10%
3 - Sand, gravel, and pebbles, seabed covered with larger stones 10% to 25%
4* - Stony areas and stone reefs, seabed covered with larger stones 25% to 100%
Notes: *Class only mapped inside OWF Zone East

Table 2.22: Overall conversion applied for sediment polygons inside overlap area.

Sediment Classes OWF Zone East	Conversion Integration (Applied to some polygons)
1a	1a
1b	
2a	1b
2b	2b
3	3
4	

As a result of the integration, several polygons within the overlap between OWF Zone West and OWF Zone East as well as within the areas affected by the changes inside the overlap were reclassified. The original interpretation remained unchanged in the easternmost part of the OWF Zone East. As such, local mismatches might be observed between the central and eastern parts of the 3GW Project Area within the range of conversion described in Table 2.22.

2.3.4 Seafloor Morphology Integration

The main differences observed between seafloor morphology interpretation in OWF Zone West and OWF Zone East are summarized in Table 2.23.

Table 2.23: Overview seafloor morphological classification inside 3GW Project Area.

OWF Zone West Morphology Classes	OWF Zone East Morphology Classes	3GW Project Area Final Integrated Morphology Class
NA	Sand bars	Sand bars
Sand waves	Sand waves	Sand waves

OWF Zone West Morphology Classes	OWF Zone East Morphology Classes	3GW Project Area Final Integrated Morphology Class
Large ripples	Large ripples	Large ripples
NA	Mega ripples	Mega ripples
Ripples	Ripples	Ripples
NA	Other	Other
Other- Possible Biogenic	NA	Other- Possible Biogenic
Other – Possible Pingo remnant	NA	Other – Possible Pingo remnant
Other – Ridge	NA	Other – Ridge
NA	NA	Other - Sediment Mound
Boulder Field, High Density	Boulder Field, High Density	Boulder Field, High Density
Boulder Field, Numerous	Boulder Field, Numerous	Boulder Field, Numerous
Trawl Mark area	Trawl Mark area	Trawl Mark area
Notes: NA: Not interpretated		

Inside the overlap area, some mismatches were observed between the original mapped polygons. Where the interpreted polygons were not intersecting the overlap area, the original classification of the OWF Zone East would be maintained.

The polygons were merged based on similarities. Some changes were made to the boulder fields in OWF Zone East, by changing the class 'Boulder Field – Numerous' to 'Boulder Field - High Density'.

Furthermore, some bedforms that were not fully mapped in the overlap area saw extended interpretation, where required.

2.4 Parametric Sub-Bottom Profiler and Multichannel 2D-UUHR Seismic Data Integration

The following strategy was applied for SBP and 2D-UUHR Seismic Data integration:

- Compiling historical geotechnical, geophysical and geological data from client-provided sources and Fugro database as well as from available literature;
- Grids in meters MSL from Fugro (2022) and MMT (2022) were loaded in Kingdom in order to be able to examine and compare the grids against each other and the seismic data;
- These grids of both OWF Zone West and East were examined and compared. Even though multiple subsurface interpretation alignment meetings were held successfully between Fugro and MMT, some differences in interpretation in the OWF Zone West and OWF Zone East exist;

- Locally, small areas of originally interpreted grids, were moved and combined with other grids to make a consistent sub-surface model; see Section 3.3 for details on the integration results;
- Contours of these new grids were prepared in ArcGIS. In case the contours could not be generated in ArcGIS, Fugro inhouse software was then utilised;
- Recommendations for further improvements are presented in Section 3.5.

Grids underly the integration of subsurface interpretation in the 3GW project area. The horizon interpretation was not integrated and hence left untouched. This report refers to horizons, when describing units (e.g., tops and bases), but reader should keep in mind that the digital deliverables (Appendix D) associated with this report only contain gridded information.

3. Integration Results

3.1 Regional Geological Setting

The Danish Sector of the North Sea was influenced by the Eridanos River system from the Cenozoic to Middle Pleistocene. The Eridanos River flowed through what is now the Baltic Sea towards the west through what is now Denmark into the North Sea (Figure 3.1). Cenozoic deposits are expected to comprise coarsening upward deltaic successions of clay and sand. Over time fluvial sediments were deposited and the main depo-centre of this Eridanos River system shifted westward during the Early to Middle Pleistocene (Figure 3.1).

During the Middle to Late Pleistocene, the site was under the influence of a series of glaciations separated by interglacial periods (Figure 3.2). This resulted in a complex stratigraphic architecture. The pre-Pleistocene and Early Pleistocene sediments were glacio-tectonically deformed during the glaciations (Huuse and Lykke-Andersen, 2000a; Larsen and Andersen, 2005).

During the Elsterian and Saalian glacial periods, the ice sheet covered the site completely. The action of the ice sheet eroded glacial valleys, which cut up to 350 m into older deposits. The complex infill of these valleys comprises sand, clay and locally till (Huuse and Lykke-Andersen, 2000b; COWI, 2021; Kirkham *et al.,* 2021). Deposits of the Saalian glacial landscape ('Bakkeøer') are preserved in Jutland and in the Danish Sector of the North Sea. These deposits comprise sediments deposited in periglacial and subglacial environments (Larsen and Andersen, 2005; GEUS and Orbicon, 2010; Ramboll, 2021).

Interglacial deposits are locally preserved and consist of Holsteinian and Eemian marine sand and clay (Jensen *et al.,* 2008; Larsen and Andersen, 2005; GEUS and Orbicon, 2010; Ramboll, 2021).

During the Weichselian glacial period, the southern margin of the ice-sheet was approximately located in the northern part of the study area (Huuse and Lykke-Andersen, 2000b). As a result, in the north of the site, till and glacio-tectonic deformation, whereas in the south of the site outwash plain deposits may be expected (GEUS and Orbicon, 2010; Ramboll, 2021).

In the late Weichselian to early Holocene, after the end of the last glacial maximum, marine transgression commenced and deposition in fluvial and estuarine environments prevailed in at the site (Leth, 1996; Larsen and Andersen, 2005; Jensen *et al.,* 2008).

During the Holocene, the site was inundated by the North Sea and marine sands were deposited (Leth, 1996; GEUS and Orbicon, 2010; Ramboll, 2021).

Figure 3.3 gives an overview of the expected stratigraphy at the site (GEUS and Orbicon, 2010; Ramboll, 2021).

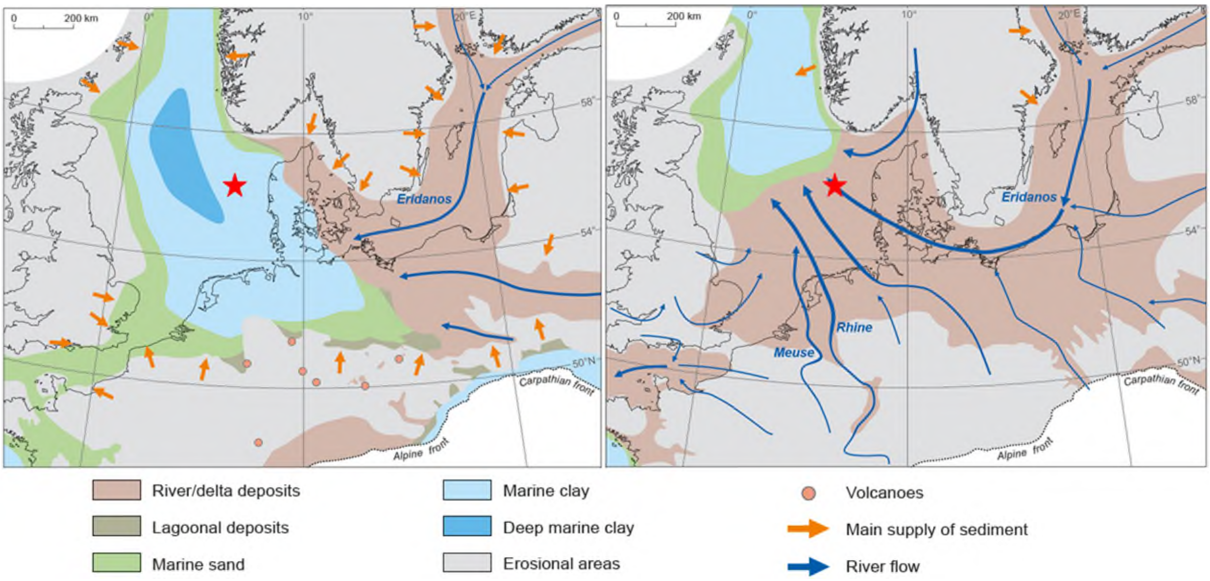


Figure 3.1: Miocene palaeogeography - left image and Early to Middle Pleistocene palaeogeography - right image (after Gibbard and Lewin, 2016). The site location is marked with a red star.

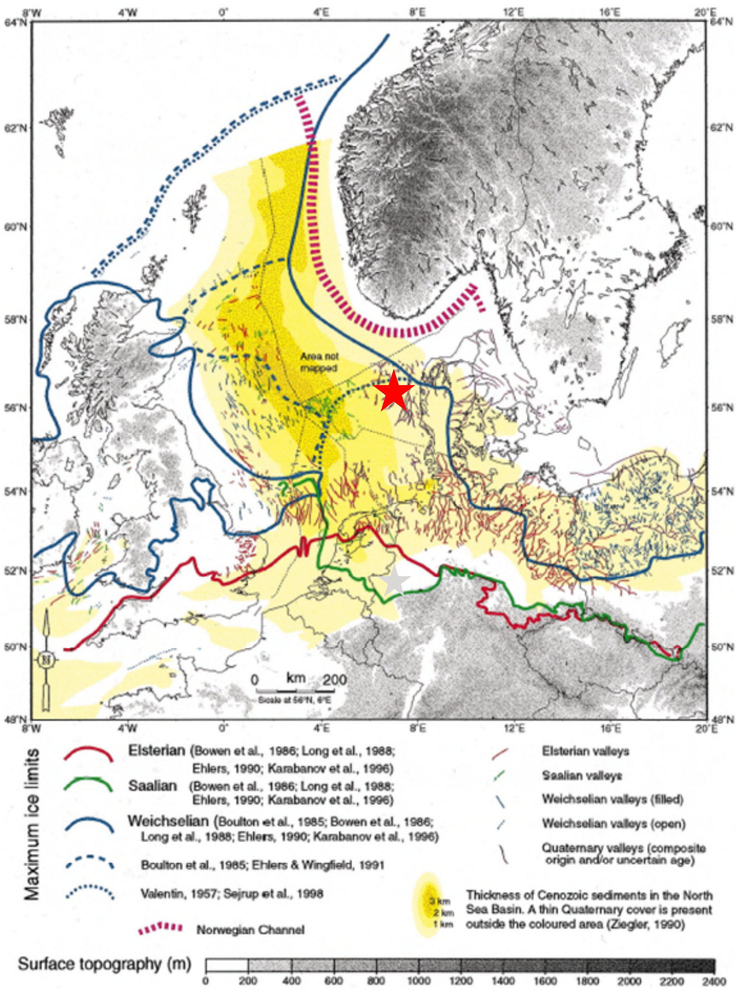


Figure 3.2: Ice sheet extent and location of tunnel valleys of the three main glaciations (after Huuse and Lykke-Andersen, 2000b). The site location is marked with a red star.

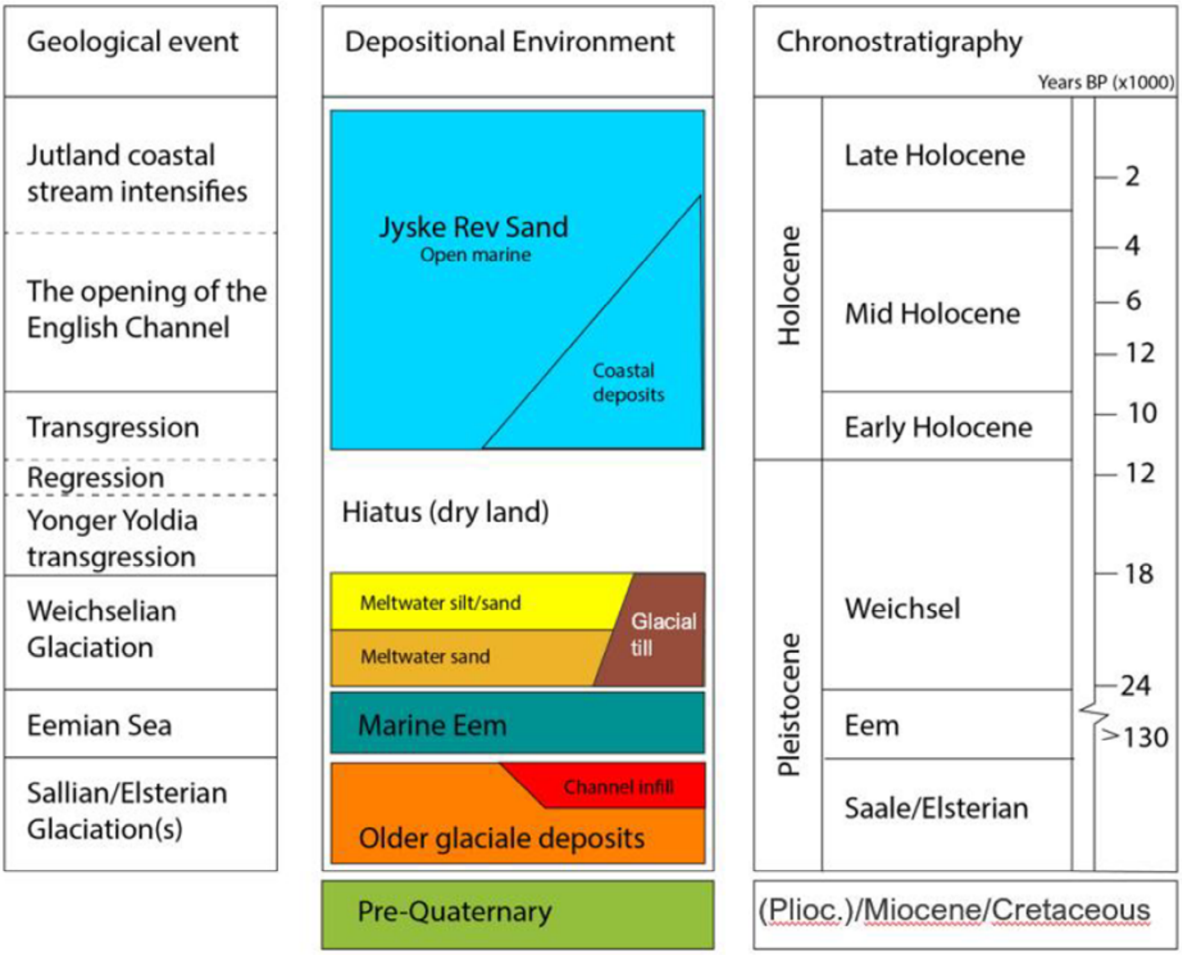


Figure 3.3: Expected stratigraphy at the site (after GEUS and Orbicon, 2010; Ramboll, 2021)

3.2 Seafloor Conditions

3.2.1 Bathymetry

An overview of the bathymetry within the 3GW Project Area is shown in Figure 3.4 and charts provided separately (see Appendix C). Seafloor gradient is illustrated in Figure 3.5.

In the 3GW Project Area water depths range from 25.75 m to 49.70 m MSL. The minimum water depth was observed in the central part of the site (Figure 3.6) and the maximum depth was recorded in the northern part of the site.

The bathymetry across the site is dominated by the presence of dynamic morphology with mobile bedforms represented by sand bars, sand waves, large ripples, mega ripples, and ripples (Figure 3.7). Sand bars were observed at the central and at the eastern part of the Project Area. Sand waves were predominantly observed at the shallowest depths, in the north, central, and southwest areas, and are often superimposed by large ripples. The general orientation of the features observed is SW-NE. A detailed description of the features identified is presented in F176286-REP-GEOP-001 05 and 103783-ENN- MMT-SUR-REP-SURVWPA.

The seafloor is characterised by gentle slopes, ranging between approximately 0˚ and 5˚. Locally, in areas of seafloor scouring, gradients can exceed 10˚ (Figure 3.5).

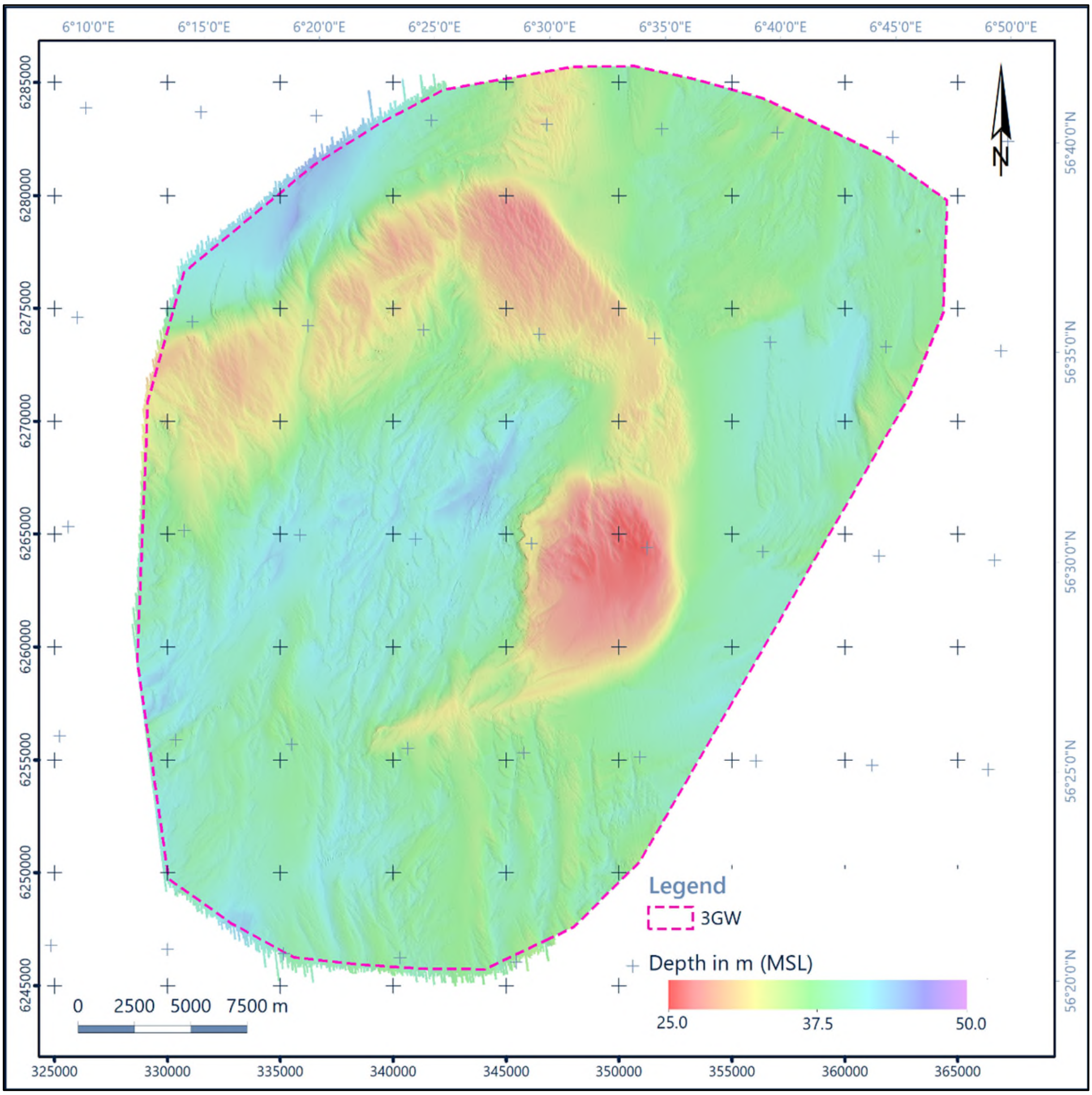


Figure 3.4: Bathymetry overview of the 3GW Project Area

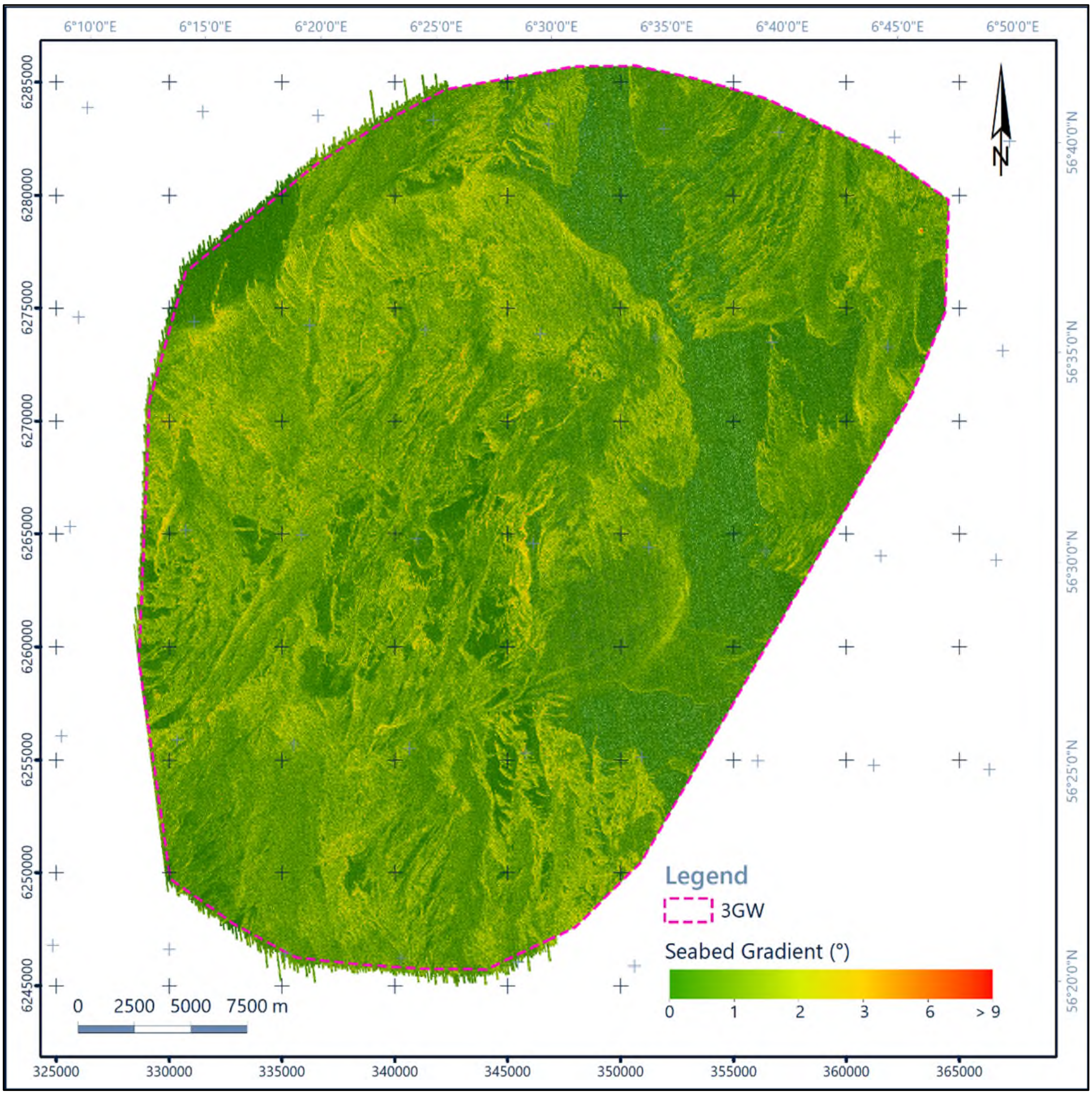


Figure 3.5: Seafloor gradient overview in the 3GW Project Area

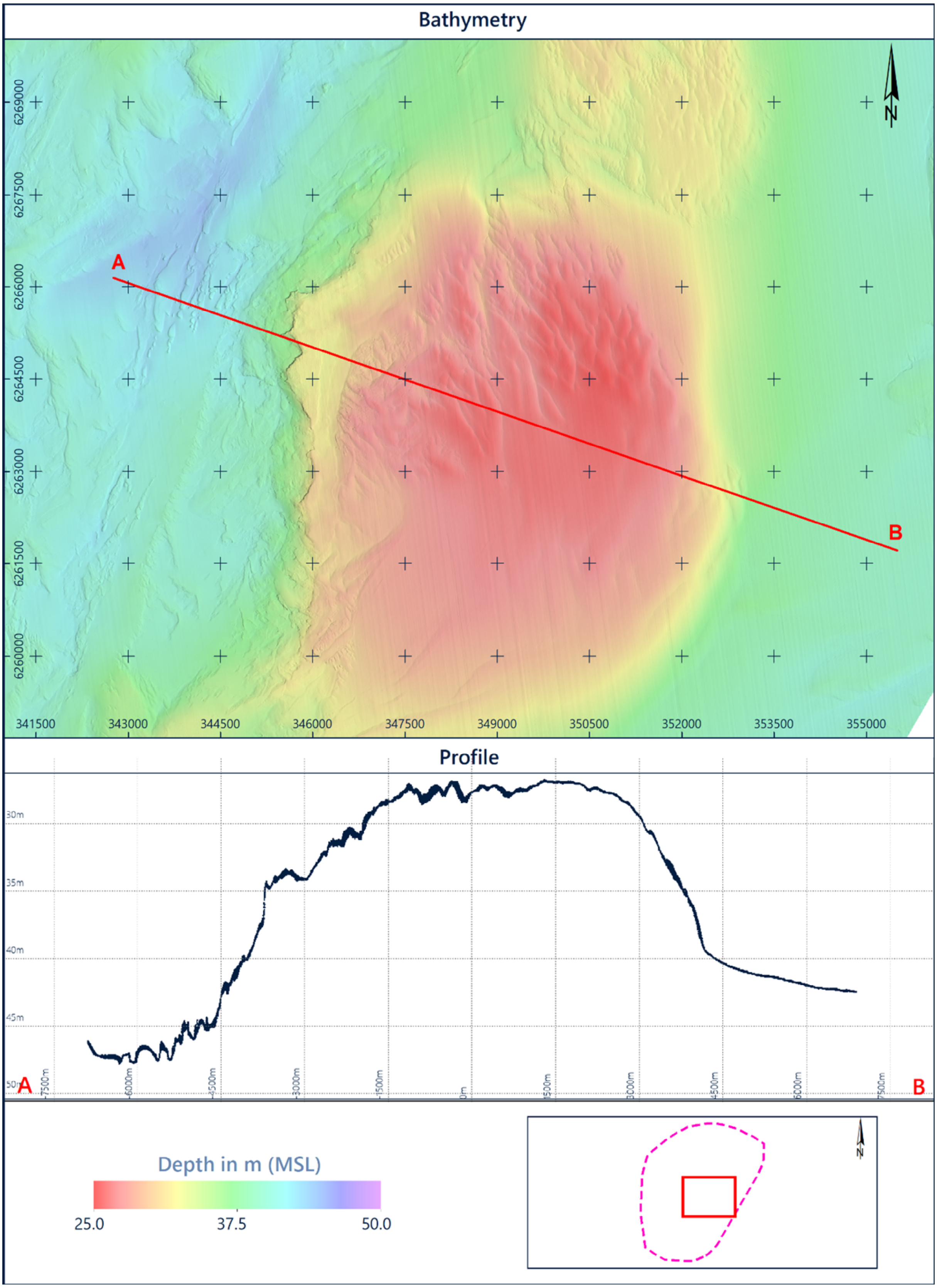


Figure 3.6: Profile crossing the shallowest area in the 3GW Project Area.

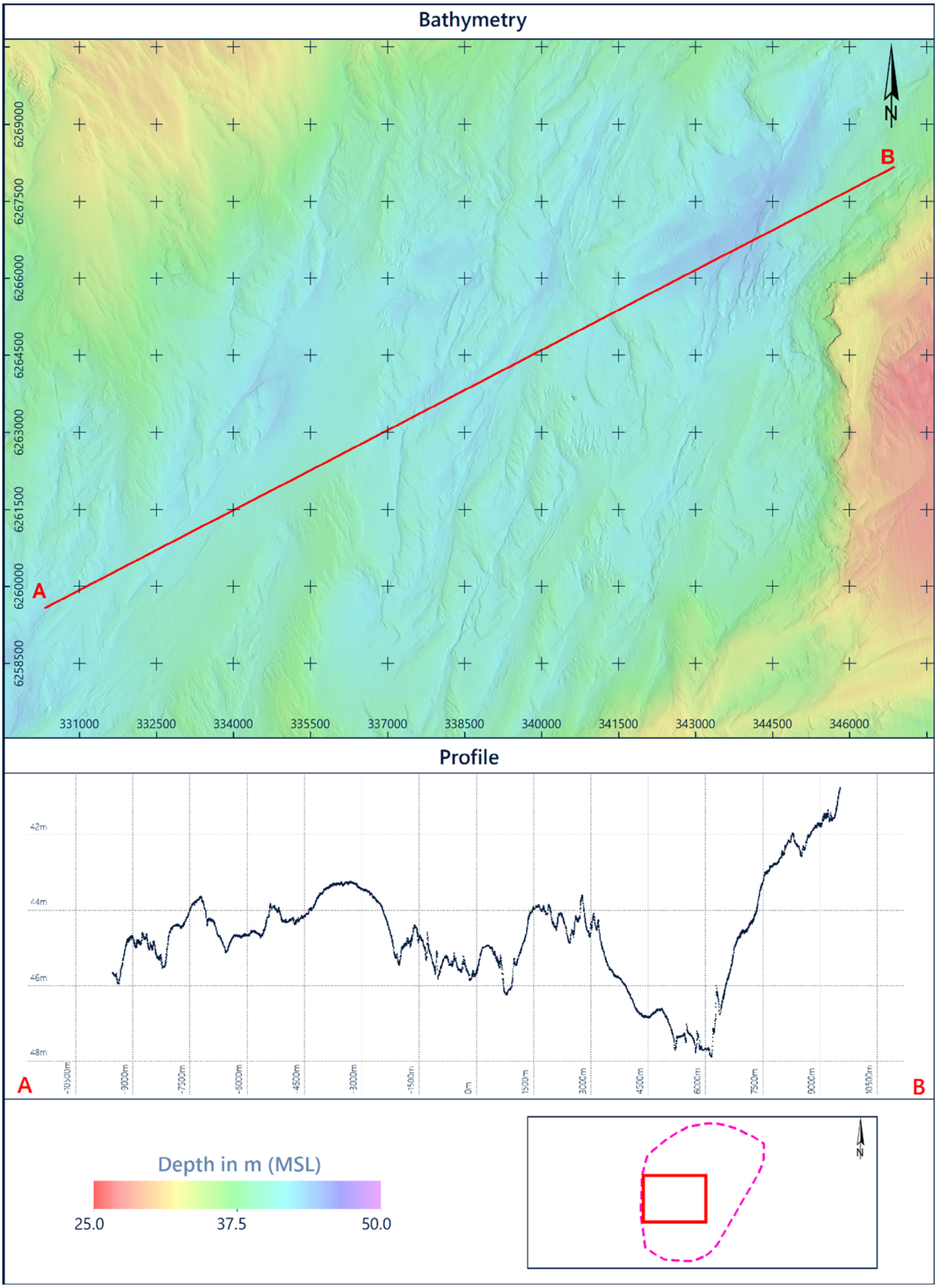


Figure 3.7: Profile crossing an area in the 3GW Project Area.

3.2.2 Seafloor Morphology

Morphological features of varying dimensions were identified at the seafloor. These features are a result of the interplay of variable sub-seafloor geological conditions and past and present hydrodynamic conditions (e.g., tides, currents) under the influence of changes in sea level.

Seafloor morphology interpretation was based on the combination of MBES, backscatter, SSS, and SBP datasets. The data analysis was carried out using acoustic characteristics such as overall pattern, reflectivity, and backscatter strength. Seafloor sediment interpretation was also taken into consideration when defining the feature boundaries.

The following natural morphological features were identified within the 3GW Project Area:

- Sand bars;
- Sand waves;
- Large ripples;
- Mega ripples;
- Ripples;
- Possible biogenic features;
- Possible pingo remnants or potential sites of archaeological interest;
- Ridges;
- Sediment mound;
- Areas of high-density boulders (boulder field);
- Areas of numerous boulders (boulder field);

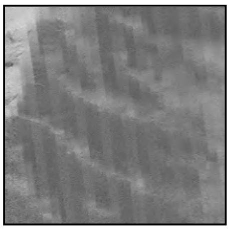
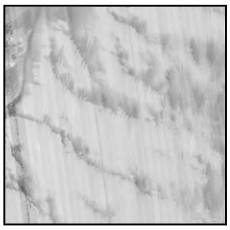
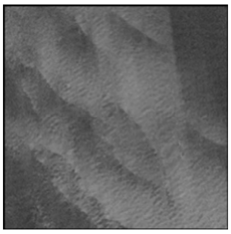
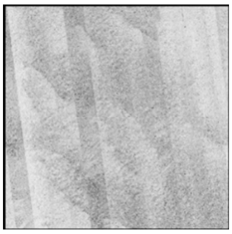
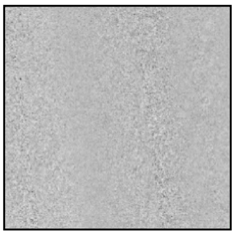
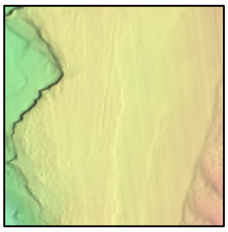
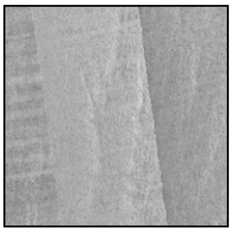
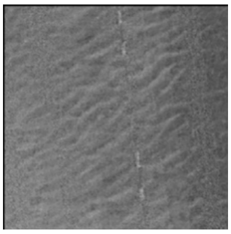
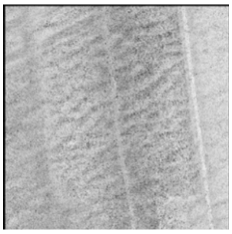
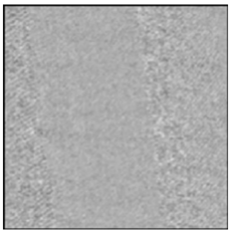
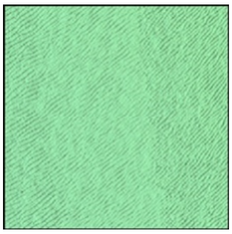
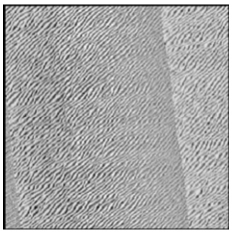
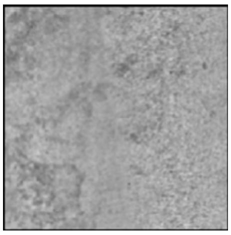
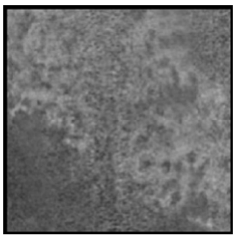
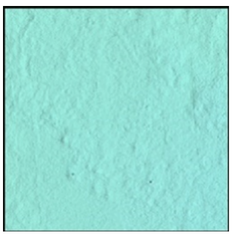
Additionally, the following morphological features of anthropogenic origin were identified:

- Rock dumps;
- Trawl marks areas.

An overview of the seafloor morphology is shown in Figure 3.8 and Figure 3.9. Localised features (i.e., possible pingo remnants, ridges, and possible biogenic features) are not included in the figures due to their limited size and the large scale used to create the overview images. All the identified morphological features are presented in charts provided in a separate PDF file (see Appendix C).

The acoustic characteristics of the natural morphological features identified are summarised in Table 3.1, while the anthropogenic features identified are summarised in Table 3.2.

Table 3.1: Acoustic characteristics of the natural morphological features identified in the 3GW Project Area.

Backscatter Image	MBES Image	SSS Image	Acoustic Description	Morphological Interpretation
			Low to high reflectivity	Sand bars
			Low reflectivity	Sand waves
			High reflectivity	Mega ripples
			Medium reflectivity	Large ripples
			High reflectivity	Ripples
			Medium reflectivity	Area of high-density boulders (boulder field)
			Medium reflectivity	Area of numerous boulders (boulder field)

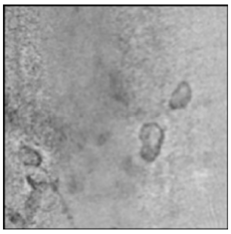
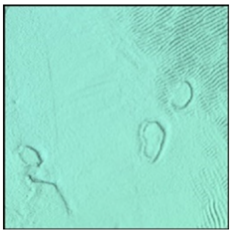
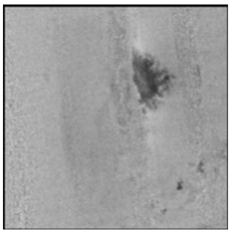
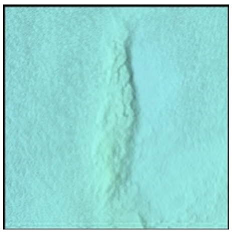
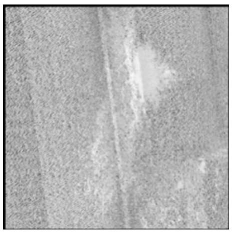
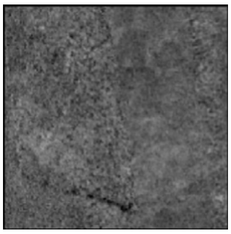
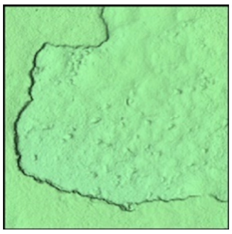
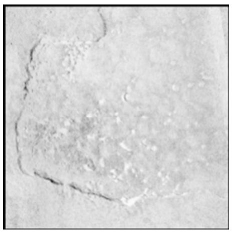
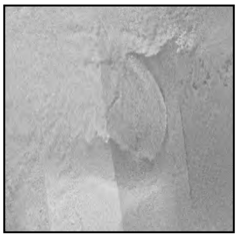
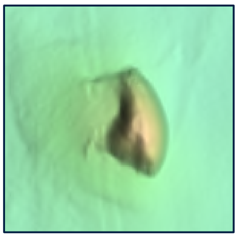
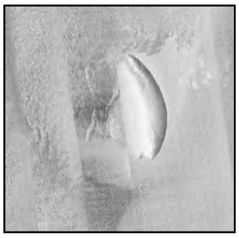
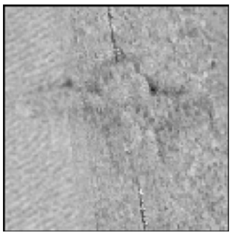
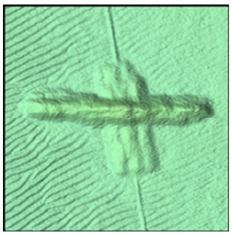
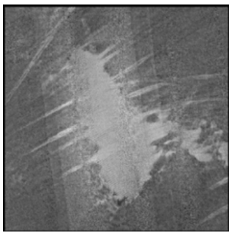
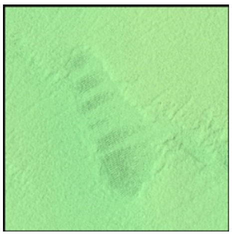
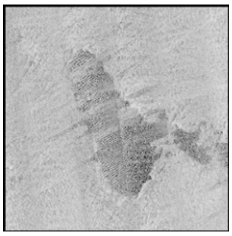
Backscatter Image	MBES Image	SSS Image	Acoustic Description	Morphological Interpretation
			Low reflectivity	Possible pingo remnant
			Medium reflectivity	Ridge
			Low reflectivity	Possible biogenic feature
			Medium reflectivity	Sediment Mound

Table 3.2: Acoustic characteristics of the anthropogenic morphological features identified in the 3GW Project Area.

Backscatter Image	MBES Image	SSS Image	Acoustic Description	Morphological Interpretation
			Medium reflectivity	Rock dump
			Medium reflectivity	Area of trawl marks

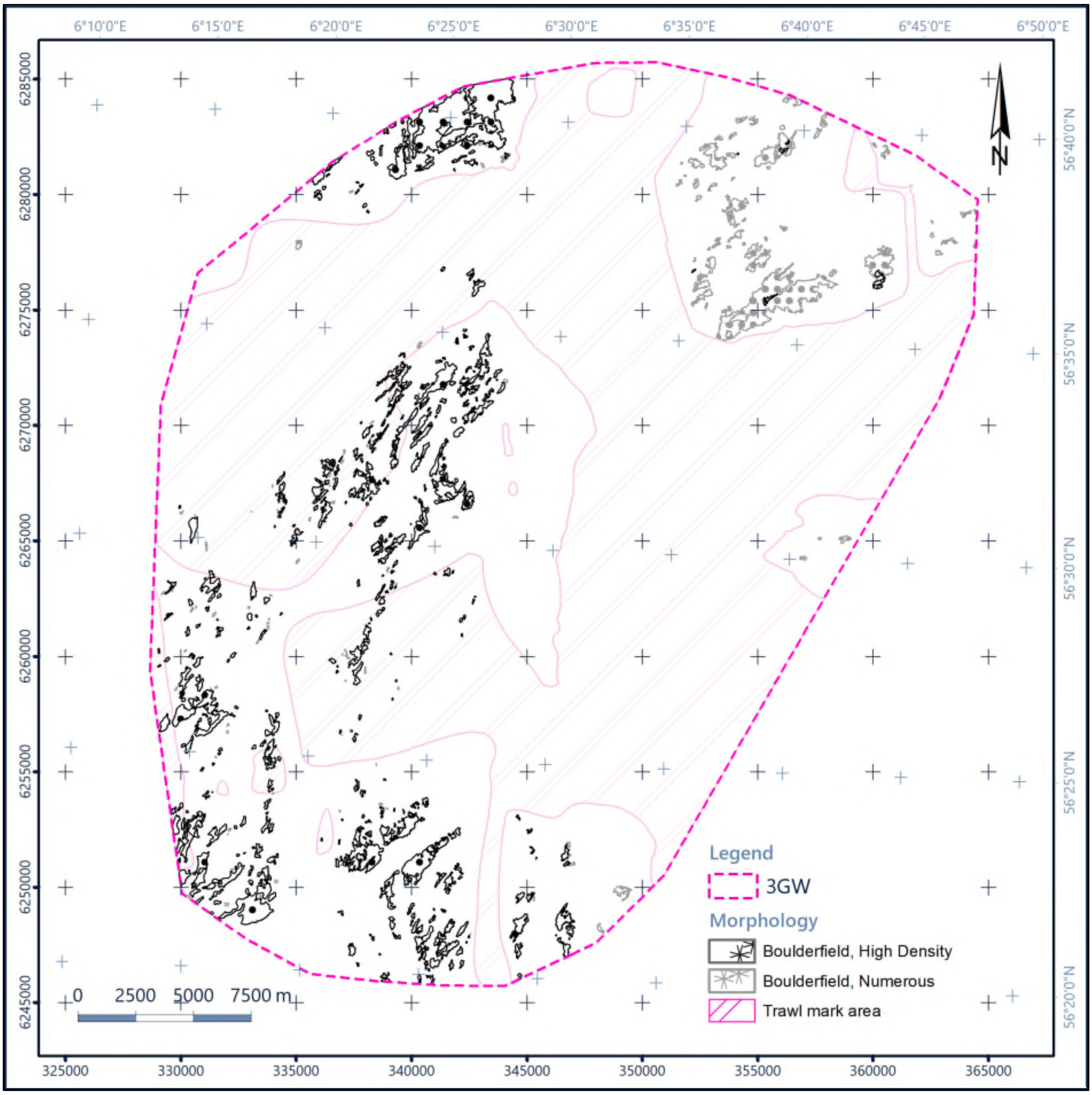


Figure 3.8: Overview of the selected morphological features in the 3GW Project Area

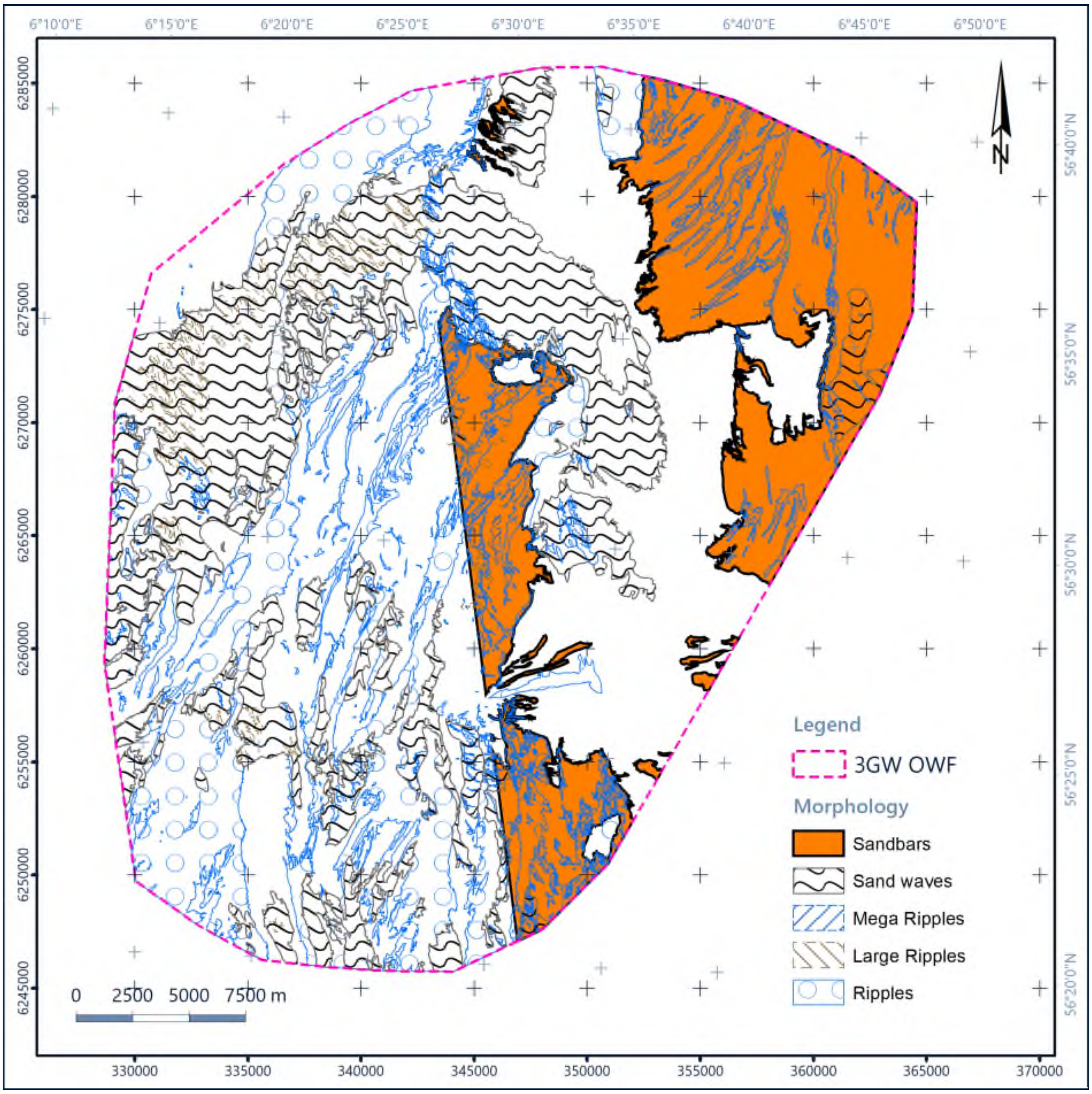


Figure 3.9: Overview of the morphological features (bedforms) in the 3GW Project Area.

3.2.2.1 Bedforms

The 3GW Project Area is exposed to tidal currents, and thereby characterized by various types of bedforms. In the OWF Zone East, areas of mass sediment migration were observed, with sandbars, sand ridges, and sand dunes classified under the additional seabed feature category of sand bars.

Sand bars representing bedforms exceeding 200 m in wavelength were interpreted only in the OWF Zone East and were not interpreted within the OWF Zone West. Within the OWF Zone West original classification was followed and bedforms of 50 m – 200 m and larger in wavelength were classified as sand waves.

Sand waves were observed across the entire site, often superimposed by large- and small-scale ripples. The wavelength of these sand waves ranges from 200 m to 400 m, with an average height of 4 m. The bedforms classified within the 3GW Project Area follows the classification presented in Table 3.3. Detailed information and data examples are presented F176286-REP-GEOP-001 05 and 103783-ENN- MMT-SUR-REP-SURVWPA.

Table 3.3: Bedform classification applied to the features observed in the 3GW Project Area.

Bedform	Dimensions
Ripples	Wavelength < 5 m Height < 0.01 m to 0.1 m
Large Ripples	Wavelength 5 m to 15 m Height 0.1 m to 1 m
Mega Ripples	Wavelength 15 m to 50 m Height 1 m to 3 m
Sand Waves	Wavelength 50 m to 200 m Height 3 m to 5 m
Sand Bars	Wavelength > 200m

Most of the sand waves described are superimposed by large ripples. The large ripples are mostly identified in the northwest and central area and have wavelengths ranging from 6 m to 15 m and heights varying between 0.15 m and 0.40 m. Their crests are generally oriented in SW-NE direction. Mega ripples with wavelengths of approximately 30 m were observed locally in the central part of the 3GW Project Area.

The ripples were found within gravel, coarse sand, and sand, which sometimes fill the pre-existing depressions. The average wavelength is approximately 2 m, while the average height is approximately 0.10 m. Ripples were observed throughout of the 3GW Project Area.

3.2.2.2 Boulder Fields

Boulder fields are areas defined as comprising at least 40 boulders in a seafloor area measuring 100 m x 100 m. Two types of boulder fields are present within the site (Table 3.4).

Table 3.4: Boulder field types identified in the 3GW Project Area.

Boulder Field Types	Number of Boulders within 100 m x 100 m Area
Type 1: Intermediate boulder density	40 - 80
Type 2: High boulder density	> 80
No minimum size requirement, all boulders count towards the minimum boulder amount to determine boulder fields.	

Most of the anomalies observed in SSS and MBES datasets are interpreted as boulders The boulders are spread across the site except in the shallower regions. F176286-REP-GEOP-001 05 and 103783-ENN- MMT-SUR-REP-SURVWPA present further detailed information.

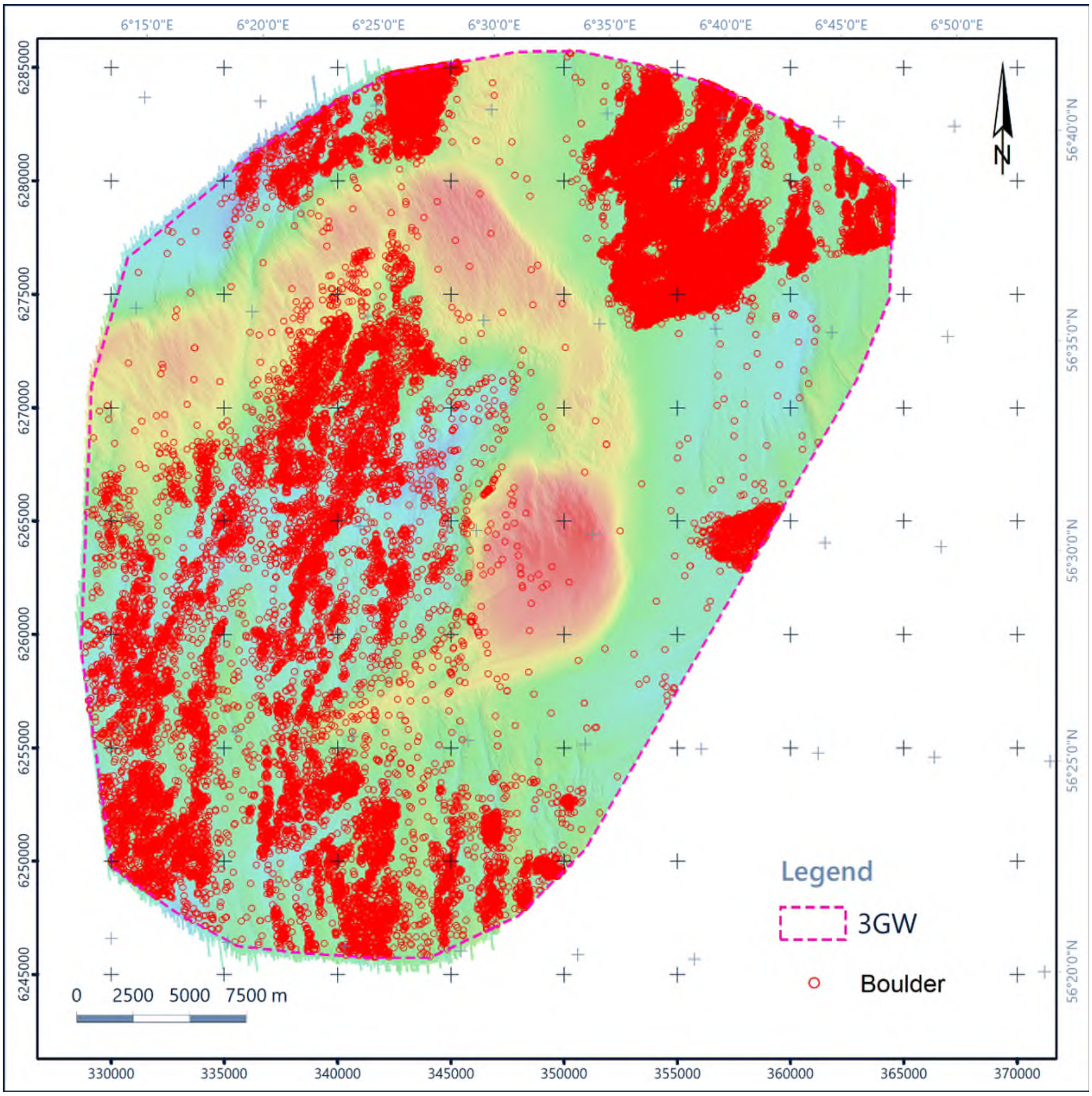


Figure 3.10: Boulder distribution in the 3GW Project Area.

3.2.2.3 Ridges

In the 3GW Project Area, isolated topographical highs of elongated shapes were classified as ridges. These ridges exhibit relatively high gradient and are predominantly associated with diamicton, and gravel and coarse sand sediments. Ridges were mostly observed in the northern and central parts of the site and are characterised by varying dimensions. F176286-REP-GEOP-001 05 and 103783-ENN- MMT-SUR-REP-SURVWPA present further detailed information.

3.2.2.4 Other Features

Possible Pingo Remnants or Potential Sites of Archaeological Interest

Four (4) semi-circular features were observed and may represent possible pingo remnants or potential sites of archaeological interest. These features have varying dimensions, with diameters of 10 m to 40 m, while the heights range from 0.2 m to 0.5 m. Details are presented in F176286-REP-GEOP-001 05 and 103783-ENN-MMT-SUR-REP-SURVWPA.

Possible Biogenic Areas

In the OWF Zone West, possible biogenic areas were observed and mapped for the purpose of further environmental investigation. These features are very similar in shape to boulders but are characterised by very low reflectivity strength as seen on SSS data. In the OWF Zone East, similar features were observed and named as 'Area of interest'. Details of those features are presented in F176286-REP-GEOP-001 05 and 103783-ENN-MMT-SUR-REP-SURVWPA.

Trawl Marks

Most of the site shows evidence of extensive fishing activity. Numerous well-preserved trawl marks of various orientations were observed in the SSS, backscatter, and MBES data. The density of trawl scars is lower in the southwestern part of the site compared to the density observed elsewhere within the site (Figure 3.8).

3.2.3 Substrate Type

An overview of the substrate type interpretation and classification is shown in Figure 3.11 and presented in the charts provided in a separate PDF file (see Appendix C).

The substrate type interpretation and classification were based on the results of the Particle Size Distribution (PSD) analysis done on acquired grab samples, which were cross-correlated with overall seafloor pattern, roughness, reflectivity, backscatter strength (Figure 3.12), and further supported by SSS dataset. The substrate type classification follows the Danish Råstofbekendtgørelsen (BEK no. 1680 of 17/12/2018, Phase IB). An overview of the grab samples results is presented in Figure 3.13.

The substrate type polygon boundaries were derived from seafloor sediment interpretation. More information about the methodology for substrate and seabed classification is present in section 6.2 of report 103783-ENN-MMT-SUR-REP-SURVWPA and section 4.2.3 of report F176286-REP-GEOP-001 05.

The substrate types identified within the site are presented in Table 2.21.

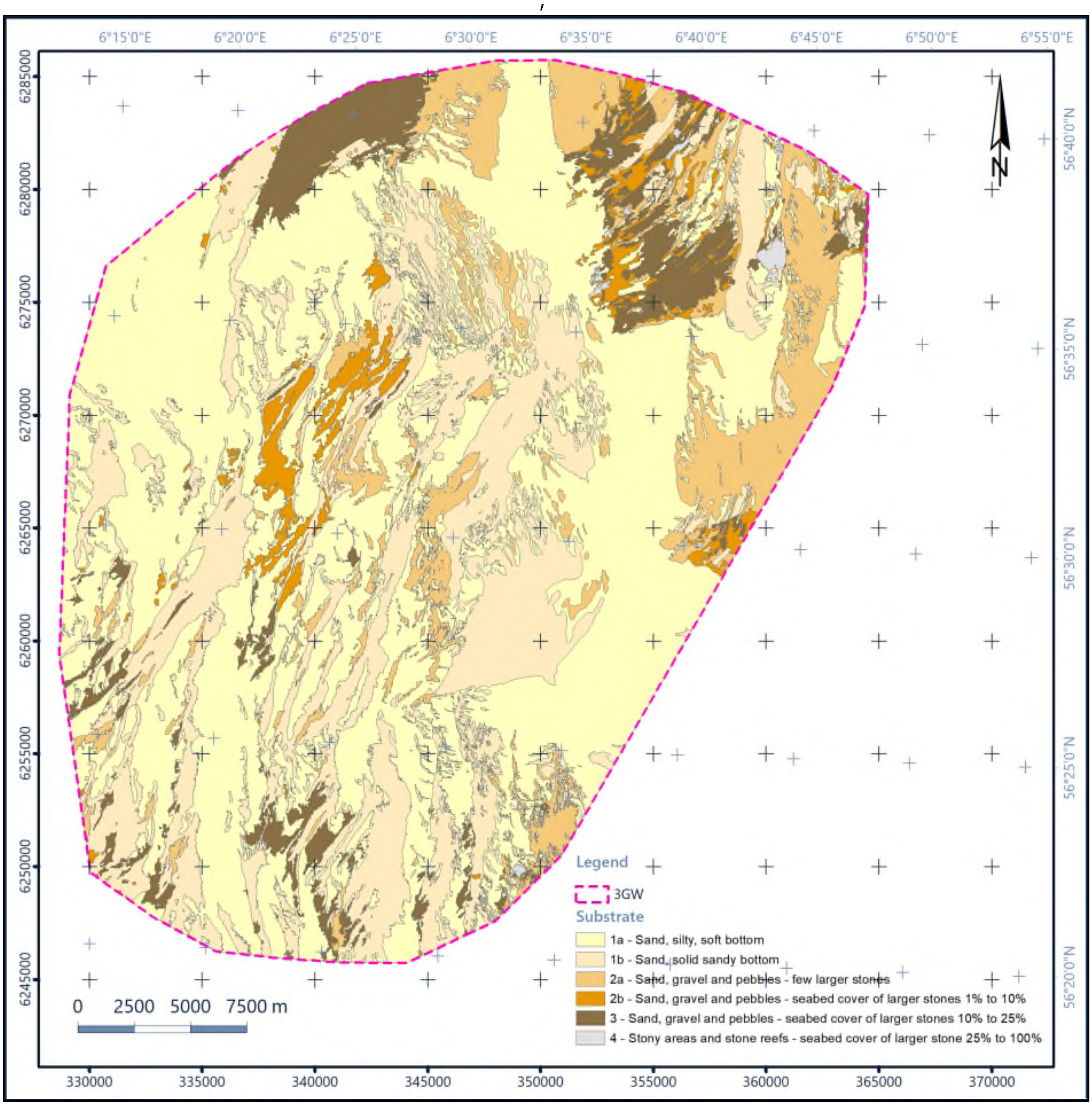


Figure 3.11: Overview of the substrate types in the 3GW Project Area.

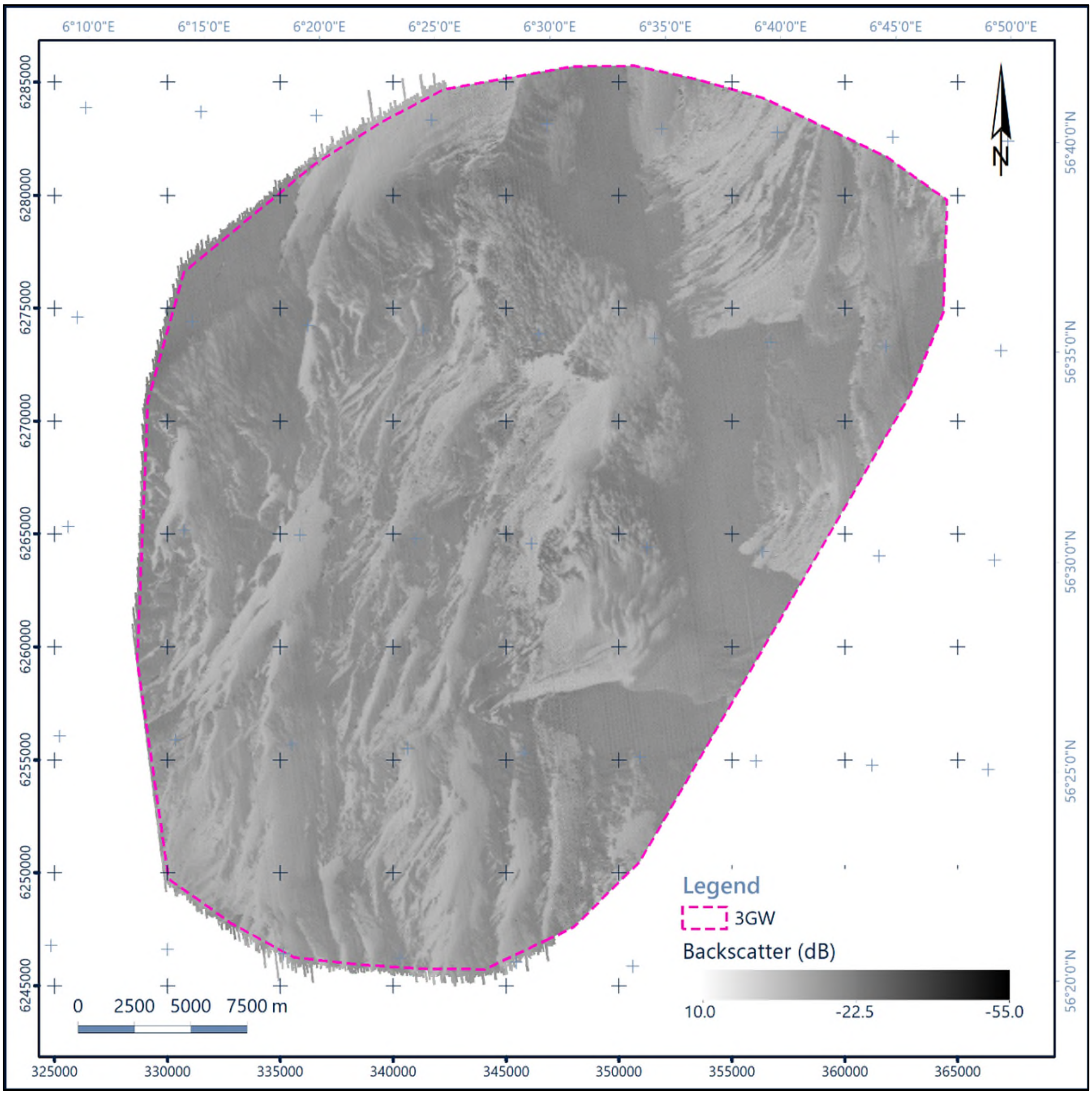


Figure 3.12: Overview of the backscatter data in the 3GW Project Area.

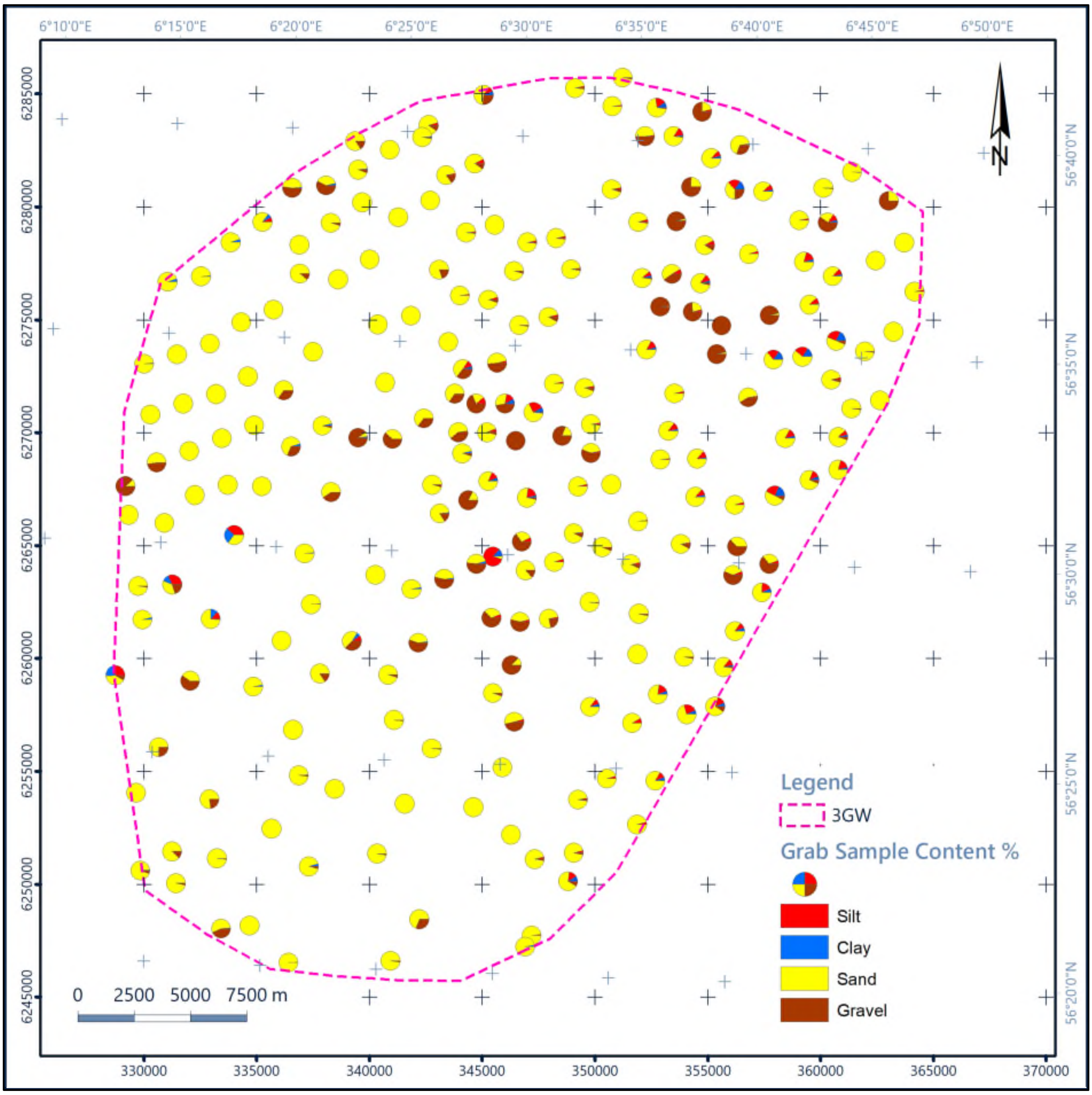


Figure 3.13: Overview of the grab samples collected in the 3GW Project Area.

3.2.4 Seafloor Sediments

An overview of the seafloor sediment interpretation and classification is shown in Figure 3.14 and presented in the charts provided (Appendix C).

Seafloor sediment interpretation and classification were based on a combination of SSS, MBES, and backscatter datasets and correlated with the sub-surface geology interpreted in the SBP data. The data analysis was carried out using acoustic characteristics such as overall pattern, roughness, reflectivity, and backscatter strength.

In addition, seafloor sediment interpretation incorporated soil description of grab samples following the onshore laboratory analysis. The grab sample soil descriptions are based on Danish standard (Larsen *et al.*, 1995) and GEUS terminology was used to define mapped sediment classes.

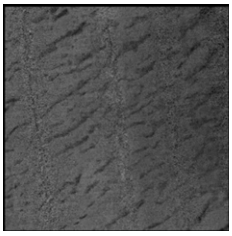
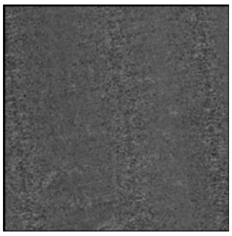
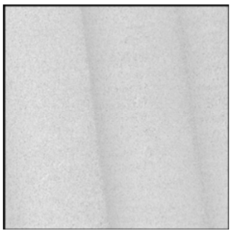
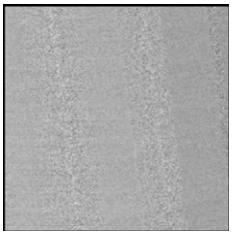
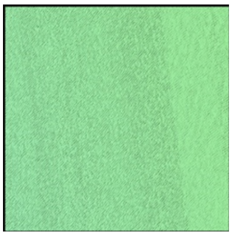
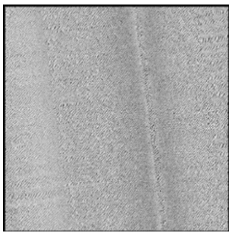
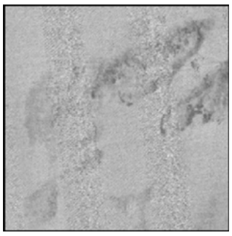
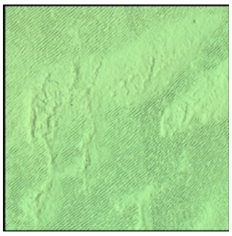
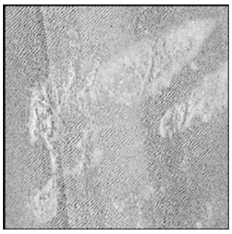
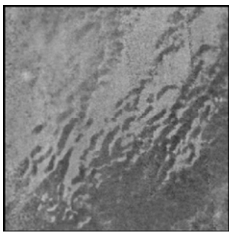
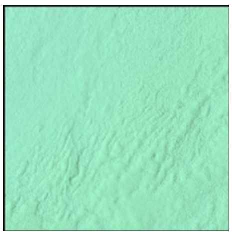
An overview of the backscatter data is presented in Figure 3.12, followed by an overview of the grab sampling results shown in Figure 3.13.

The seafloor sediments identified in the 3GW Project Area comprise the following:

- Mud and sandy mud;
- Muddy sand;
- Sand;
- Gravel and coarse sand;
- Diamicton.

The acoustic characteristics of the identified sediment types are summarised in Table 3.5.

Table 3.5: Acoustic characteristics of the sediment types identified in the 3GW Project Area.

Backscatter Image	MBES Image	SSS Image	Acoustic Characteristics	Geological Interpretation
			Low to very low reflectivity	Mud and sandy mud
			Medium to low reflectivity	Muddy sand
			High reflectivity	Sand
			High reflectivity	Gravel and coarse sand
			High reflectivity	Diamicton

The dominant sediment type within the site is sand, with areas of higher component of finer sediment defined as muddy sand and mud and sandy mud. Areas of gravel and coarse sand were identified where the Holocene unit is relatively thin.

The diamicton refers to a poorly sorted sediment containing a wide range of grain sizes as observed in the SSS dataset, grab samples, and geotechnical data (F176286-REP-GEOP-001 05).

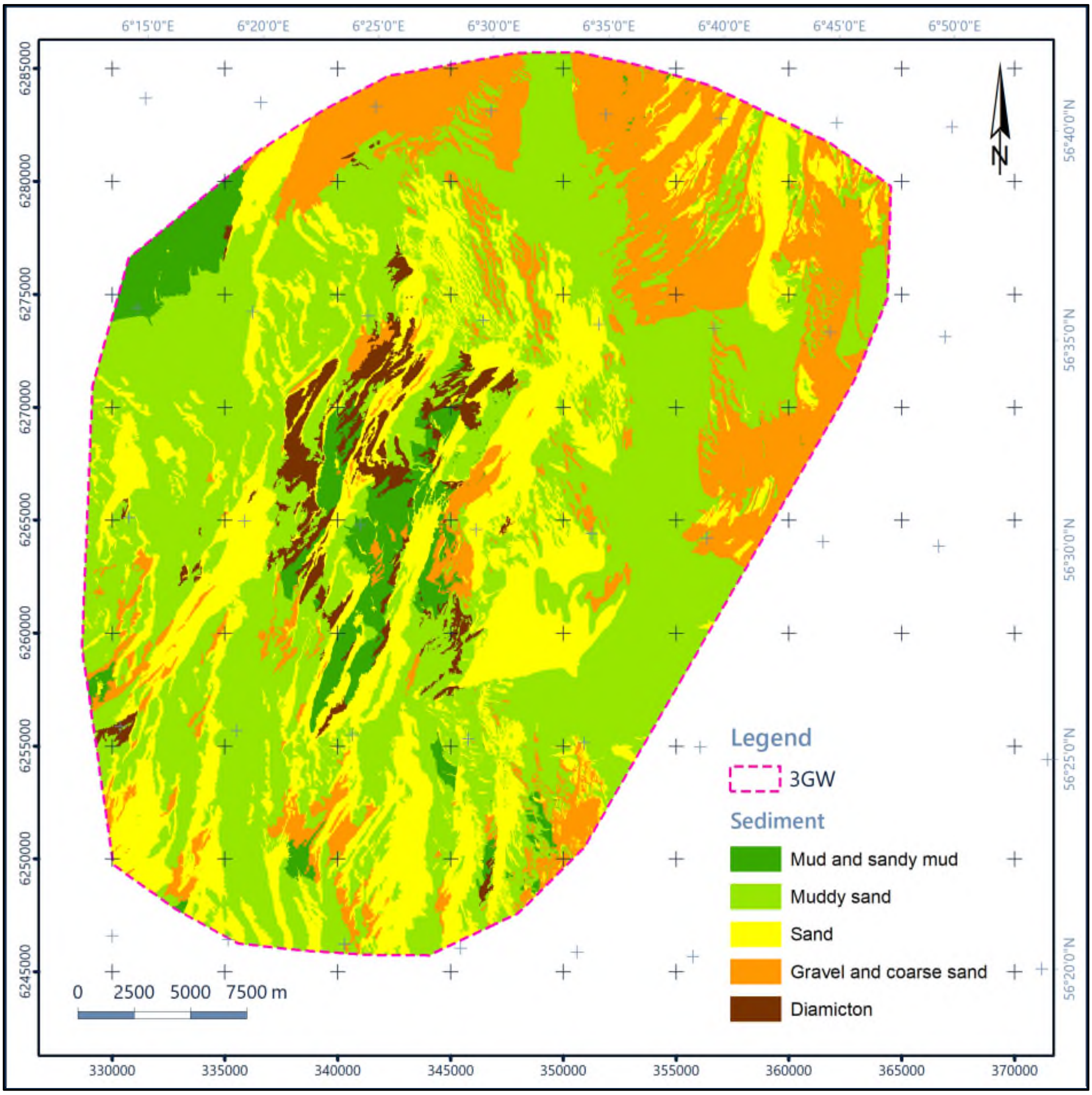


Figure 3.14: Overview of the seafloor sediment interpretation in the 3GW Project Area.

3.2.5 Seafloor Features and Targets

Seafloor features and targets were identified in the SSS, MBES, and MAG data, and cross-correlated where possible. The identified targets are shown on charts provided in a separate PDF file (Appendix C).

Table 3.6 summarises the quantities of targets picked.

Table 3.6: Summary of seafloor anomalies found in the 3GW Project Area.

Sensor	Number of Integrated Anomalies
MBES	61309
SSS	21866
MAG	4029

Table 3.7 presents the integrated interpretation of the observed seafloor features.

Table 3.7: Summary of seafloor features of natural origin identified in the 3GW Project Area.

Integrated Class	Quantity Integration Class	Sensor
Boulder	82536	SSS, MBES
Seabed mound	14	SSS
Isolated depression/Pockmark	6	SSS
Other	9	SSS

The methodology for seafloor features integration is presented in Section 2.2.

3.2.5.1 Side Scan Sonar and MBES Targets

The main classes of the targets of natural origin observed in the site are discussed in this section. Descriptions of man-made objects follow in section 3.2.6.

Details of all the identified SSS and MBES targets are presented in the target list supplied in the TSG database as part of the final deliverables. F176286-REP-GEOP-001 05 and 103783-ENN-MMT-SUR-REP-SURVWPA present further detailed information.

Boulders

Most of the identified targets observed in the SSS and MBES datasets were boulders of varying dimensions (Figure 3.10). Boulders were observed throughout the site except for the central shallowest area stretching from SW to NE in the northern part of the site.

The boulder fields were mapped following two methodologies – manual and automatic, which are described in detail in F176286-REP-GEOP-001 05 and 103783-ENN-MMT-SUR-REP-SURVWPA. Boulder fields observed in the area are presented in Figure 3.15.

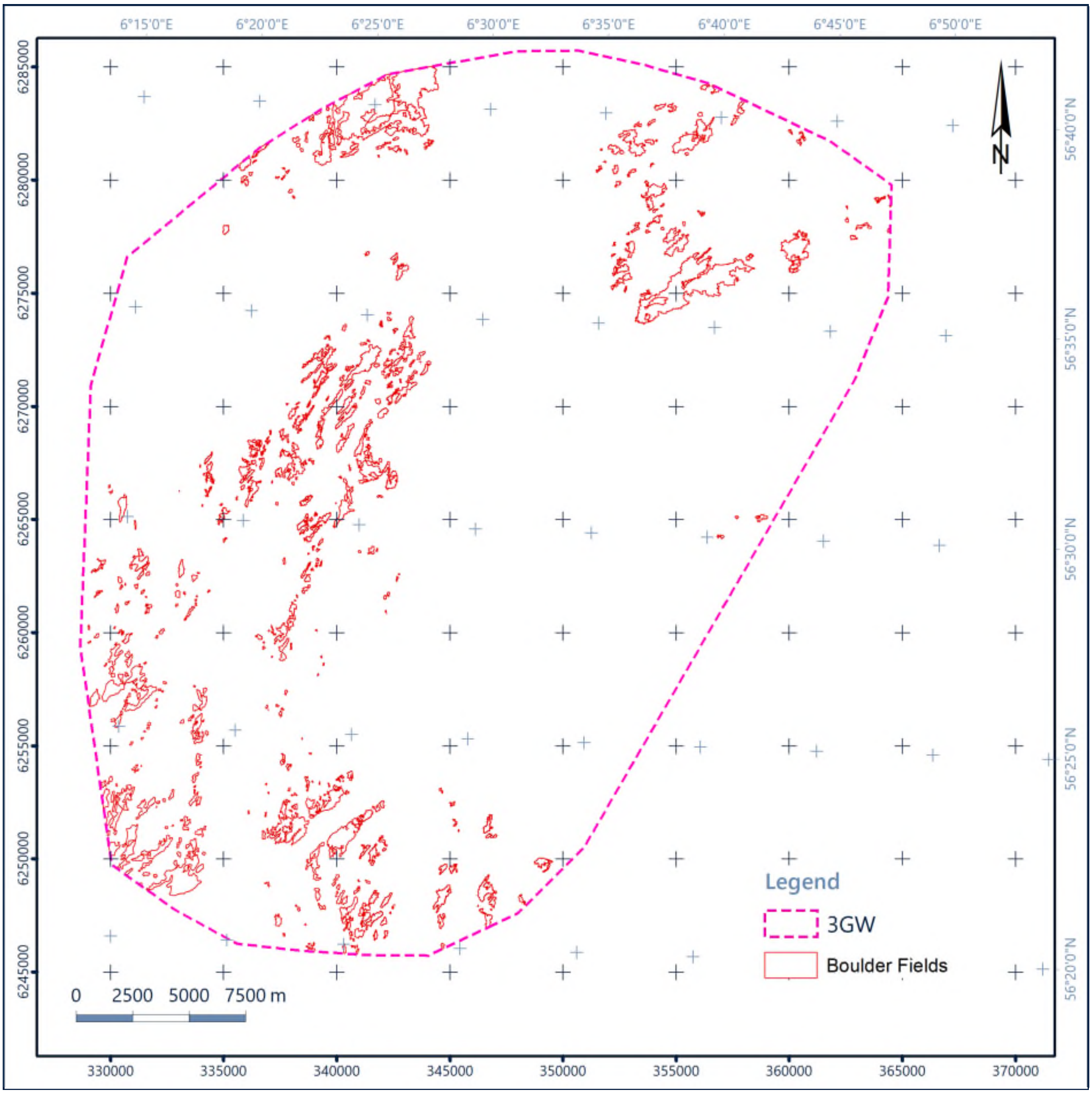


Figure 3.15: Manually defined boulder polygons in the 3GW Project Area.

Seabed Mounds (Possible Sediment Mound)

Fourteen (14) targets were identified as seabed mounds in the OWF Zone West area. The SSS reflectivity of the seabed mounds is medium to low which can indicate geological origin. In the OWF Zone East area, 13 targets were identified as possible sediment mounds. One (1) isolated sediment mound was observed in the north-eastern area, with dimensions of approximately 160m (l) x 120m (w) x 9.5m (h) (103783-ENN-MMT-SUR-REP-SURVWPA).

Depressions

Six (6) SSS targets were classified as isolated depressions. These depressions measure approximately 0.5 m to 2 m in diameter, while their depths do not exceed 0.1 m below the surrounding seafloor. Some of these targets had no observed shadow and their dimensions were subsequently marked with ‘non-measurable height’. For these targets the height column lists 0 m. Detailed examples are presented in 103783-ENN-MMT-SUR-REP-SURVWPA and F176286-REP-GEOP-001 05.

3.2.5.2 Magnetometer Anomalies

A total of 4029 anomalies of peak to peak amplitudes ranging from 0.8 nT to 27040 nT were identified within the site. The magnetic residual grid shows evidence of anomalies caused by targets (e.g., wrecks), man-made structures such as cables and pipelines, and the geological conditions present across the site.

Additionally, each anomaly was interpreted as non-discrete or discrete. Non-discrete anomalies are those observed very close to each other; defining the exact start and end of the anomaly is not possible (Figure 3.16).

Discrete anomalies are observed in separation from other anomalies, i.e., start and end of the anomaly is clearly defined (Figure 3.17). Both classifications were based on the single magnetometer data, which do not provide full information about the size and shape of the anomaly and should be treated as approximations.

Details of all the identified magnetometer anomalies are presented in the target list supplied in the GIS database as part of the final deliverables. Detailed examples of the magnetometer anomalies are presented in 103783-ENN-MMT-SUR-REP-SURVWPA and F176286-REP-GEOP-001 05.

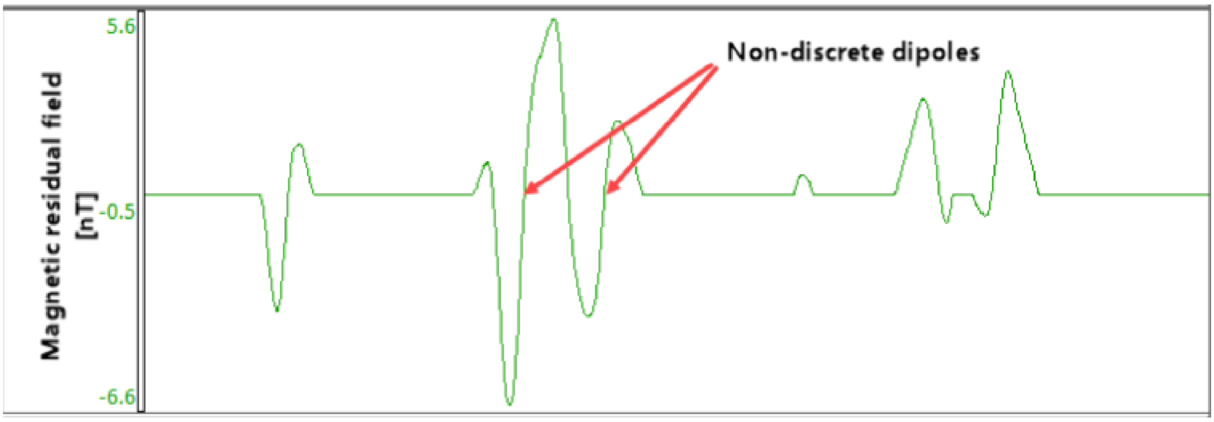


Figure 3.16: Example of two-non discrete magnetic anomalies

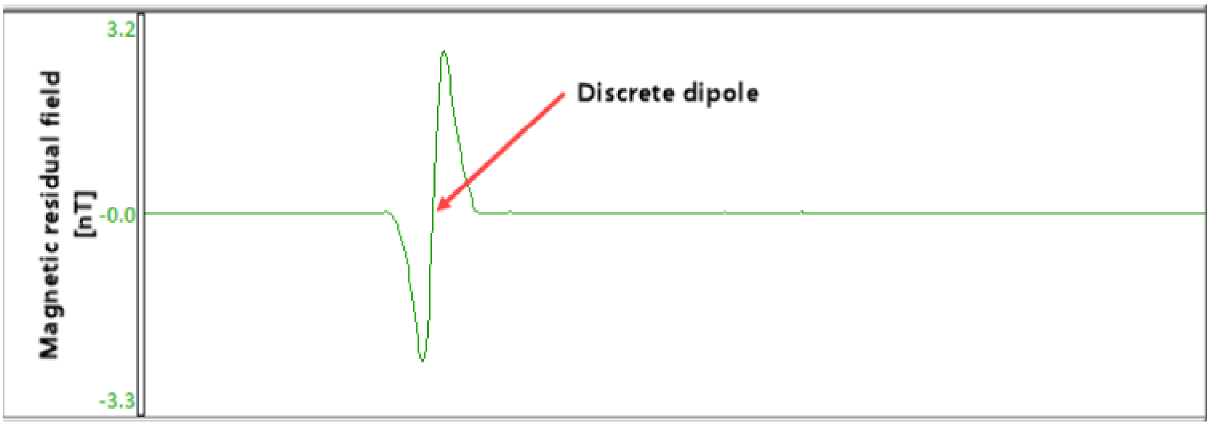


Figure 3.17: Example of a discrete magnetic anomaly

3.2.5.3 Target Cross-Correlation

Automatic and manual cross-correlations of all seafloor targets observed in SSS, MBES, and MAG anomalies were performed based on the criteria presented in Table 3.8 with the following results.

Table 3.8: Cross-correlation between targets identified on SSS, MBES, and MAG datasets.

Correlated Sensors	Correlation Criteria	Total Correlated Targets
SSS and MBES (OWF West)	■ Manual cross-correlation ■ SSS targets observed on the MBES 0.25 m grid were moved to MBES position ■ No cross-correlation radius was used	OWF Zone West – 15222
SSS/MBES/MAG	■ Automatic spatial cross-correlation followed by manual cross-correlation where relevant ■ One to one method: the nearest targets within a 2 m radius (OWF Zone West) and 5 m radius (OWF Zone East) were correlated. ■ Manual cross-correlation for MAG anomalies (e.g., Wrecks)	SSS /MAG - 59 MBES/MAG - 24
MBES and SSS	Seabed Features MBES to SSS	MBES/SSS OWF Zone East - 840

In addition to the automatic spatial cross-correlation between SSS targets and MAG anomalies, both datasets were reviewed and in several cases the features falling outside the correlation radius were cross-correlated manually. Manual cross-correlation was carried out for targets identified as wrecks. For pipeline targets, no fixed radius was assumed, and the cross-correlation was based on individual interpretation of the available datasets.

The seafloor targets correlating with magnetic anomalies included boulders, debris/suspected debris, pipeline, and wrecks. Observed targets were interpreted and classified based on the SSS and MBES datasets.

3.2.6 Seafloor Man-Made Objects

Several targets observed in the SSS, MAG, MBES, and SBP datasets and included in respective target lists were further classified as potential man-made objects (MMOs) (Figure 3.18).

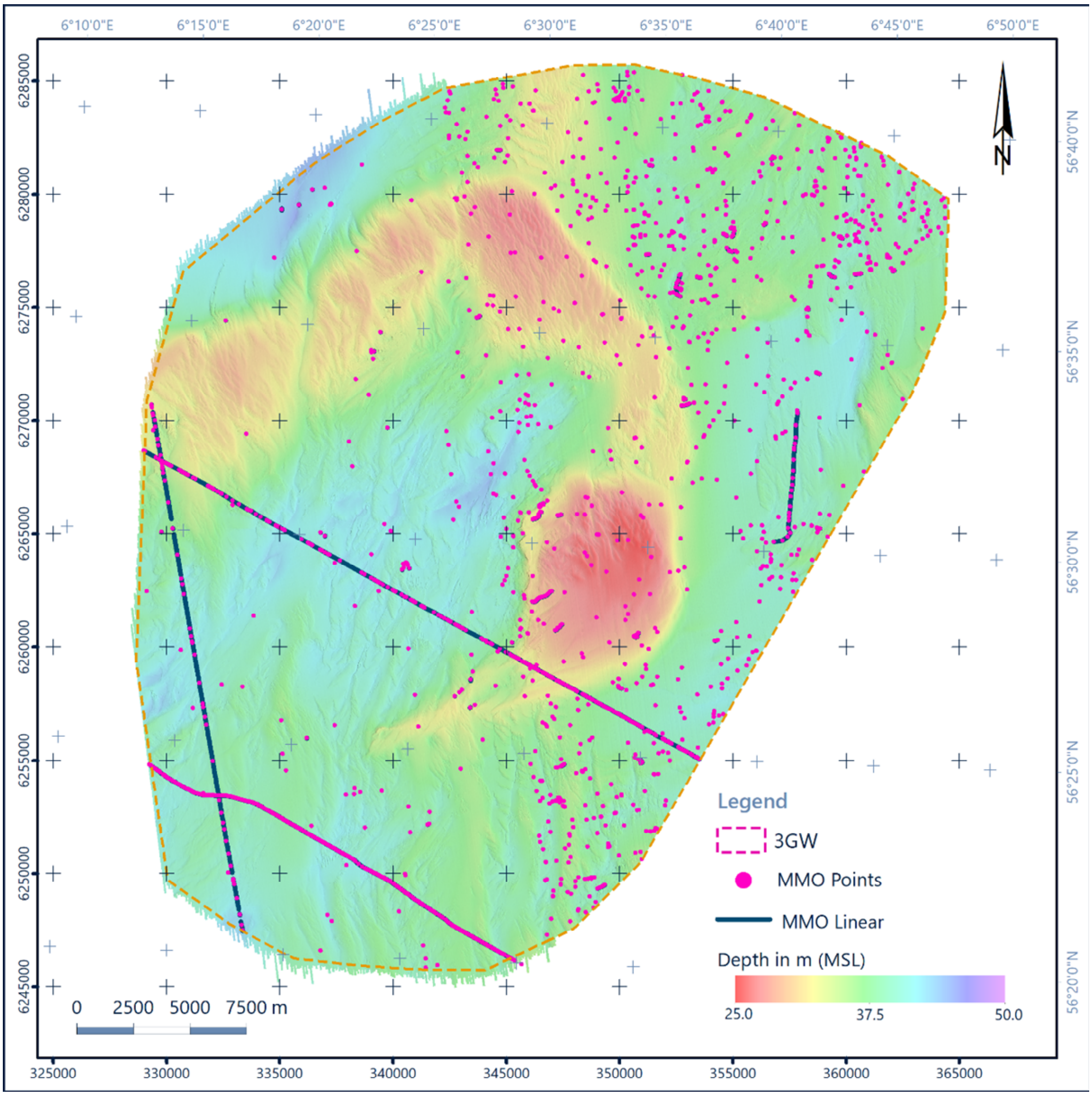


Figure 3.18: Man-made objects (linear and points) observed in the 3GW Project Area.

Each target interpreted as potential MMO was assigned a type as specified in a document provided by Energinet (Template Survey Geodatabase (TSG): Requirements to TSG). Table 3.9 presents a summary of identified MMOs within the 3GW Project Area.

Table 3.9: Summary of man-made objects observed in the site.

	MMO TYPE	Total Targets
MMO Points	Cable	435
	Debris / Suspected Debris	111
	Fish Net	11
	Other	1094
	Pipeline	45
	Unidentified	6
	Wire	4
	Wreck	24

	MMO TYPE	Total Targets
MMO Linear	Cable (CB)	2
	Debris / Suspected Debris (DB)	19
	Wreck (DW)	1
	Other (OD)	31
	Pipeline (PP)	50
	Unidentified (UN)	1
MMO Polygon	Rock Dump	2

Suspected Debris

Suspected debris was observed throughout the whole site. Items interpreted as potential debris are generally characterised by more angular or elongated shape and relatively high reflectivity compared to the targets described as boulders. It should be noted that certain ambiguity of the interpretation is to be expected and some of the targets interpreted as debris may in fact be of geological origin.

Wrecks

Four (4) charted wrecks and two (2) possible shipwrecks were identified within the survey area. The wrecks are summarized in Table 3.10 with their respective dimensions.

Table 3.10: Possible wrecks in the 3GW Project Area

Target		Details	Dimensions	Easting [m]	Northing [m]
EA_R_SSS_00580	A	Shipwreck – Fallwind Wreck	73.43 x 20.61m	340612.4	6263664.83
S_RE_B01_0324	B	Shipwreck	19.77 x 15.80 x 1.66	347323.0	6253311.3
S_FR_B03_0006	C	Shipwreck HMS Tarpon Submarine	82.78 x 8.46 x 5.11	348875.5	6284051.0
S_FR_B03_0069	D	Shipwreck	56.22 x 20.43 x 1.37	349881.9	6284268.9
EA_P_SSS_00591	E	Shipwreck - Possible Wreck (91D - ENC Database)	31.49 x 45.8	337224.9	6279528.8
S_RE_B05_0547	F	Possible unknown shipwreck	12.15 x 5.09 x 0.46	358715.6	6272109.0

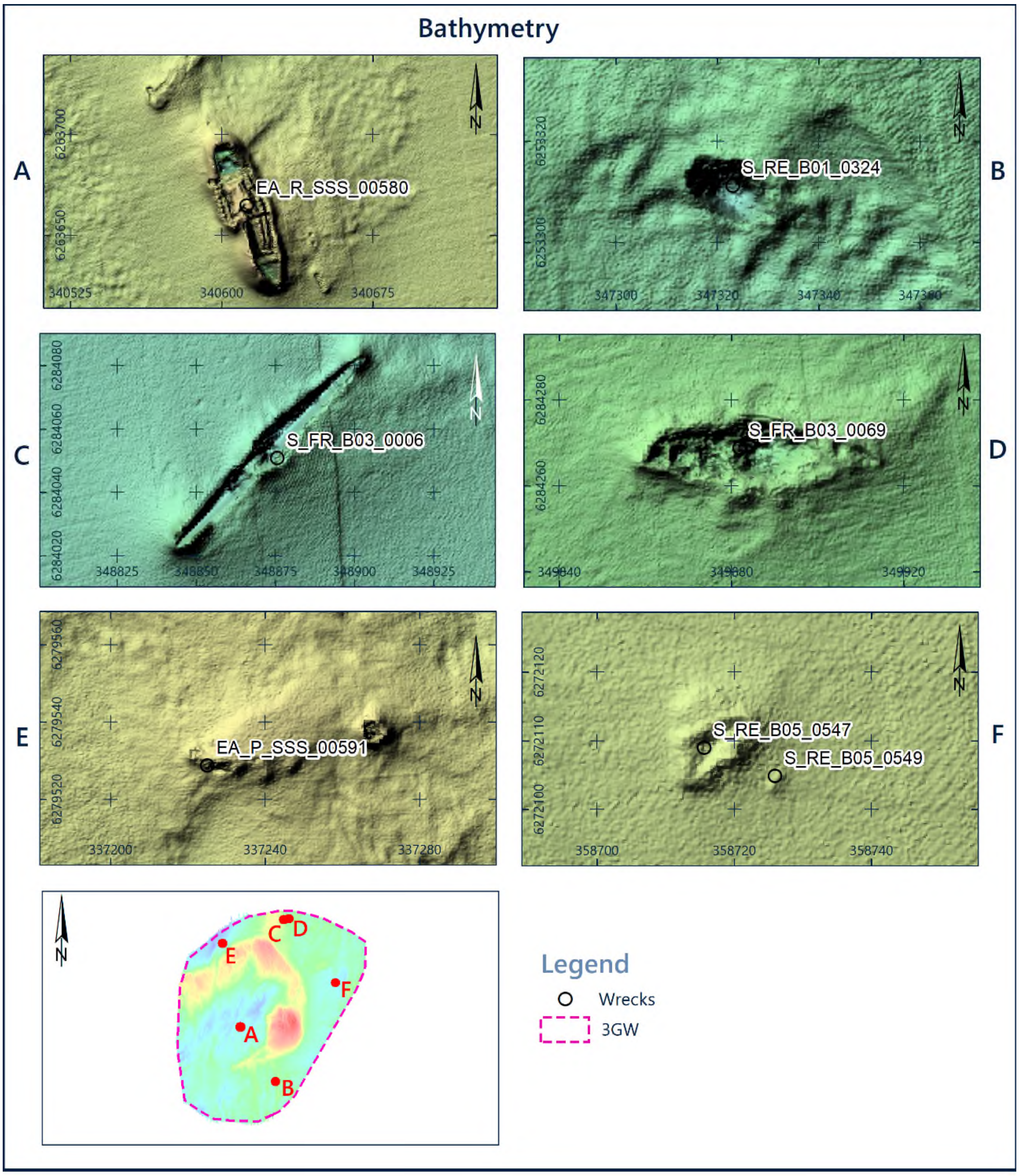


Figure 3.19: Shipwrecks and Potential shipwrecks observed in the 3GW Project Area.

Pipelines and cables

One (1) pipeline and two (2) cables were identified within the site. The pipeline, identified as the Europipe II gas pipeline, runs NNE-SSW in the north-western side of the survey area. Forty-five (45) sections of exposed pipeline were identified, with a total length of approximately 20 km.

The cables were identified as the cables Havfrue/AEC-2 and TAT14 Segment K. Both cables cross the 3GW Project Area in a NW-SE direction. The cables were identified with magnetometer and sub-bottom profiler . Rock dumps were observed at the crossings of the cables and the Europipe II pipeline. Table 3.11 provides details of the pipeline found in the site, and Figure 3.20 and Figure 3.21 provide data examples of the pipeline. The interpretation of the out-of-plane reflection of the pipeline is called '2DUUHR_Pipeline' in the digital deliverables.

Table 3.11: Pipeline found in the 3GW Project Area.

Name	Details
Europipe II	42 Inch gas pipeline
Havfreu/AEC-2	Fibre-optic cable
TAT14 Segment K	Fibre-optic cable

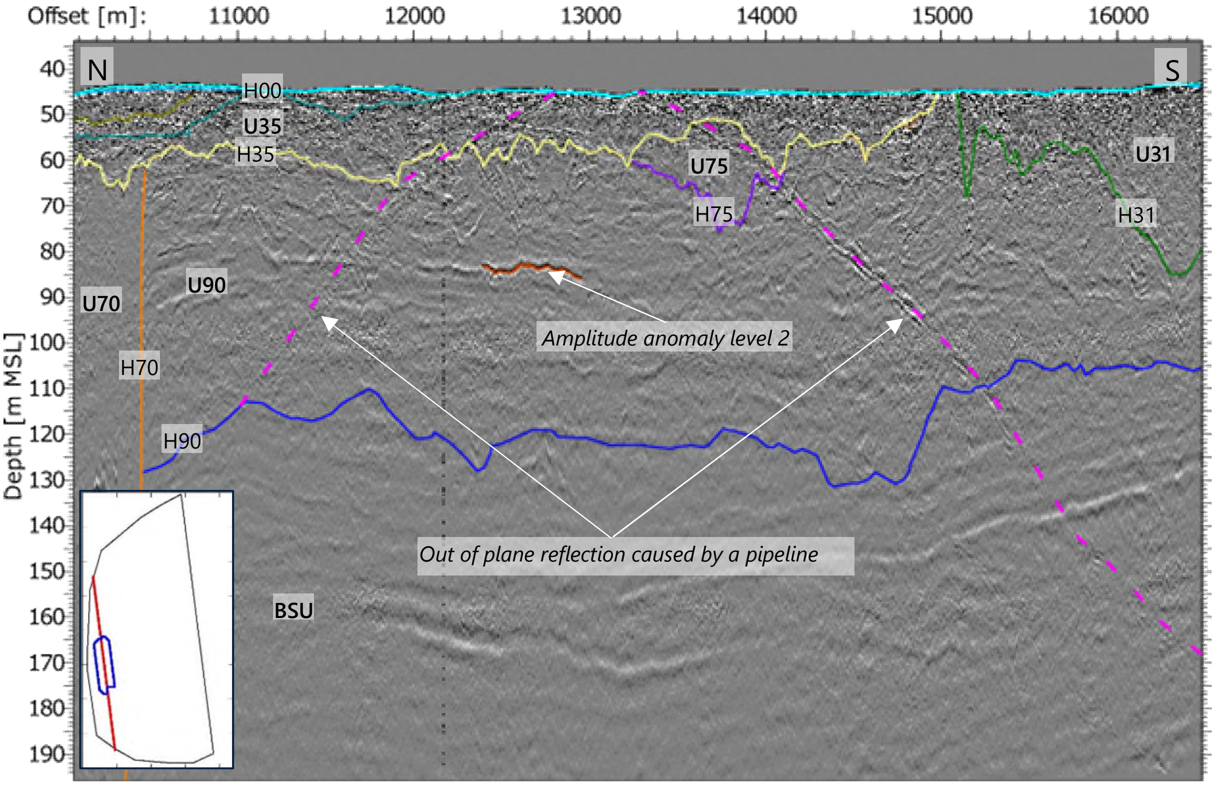


Figure 3.20: 2D-UUHR data example (line EAD2041P01.MIG) showing out-of-plane reflection of the Europipe II pipeline.

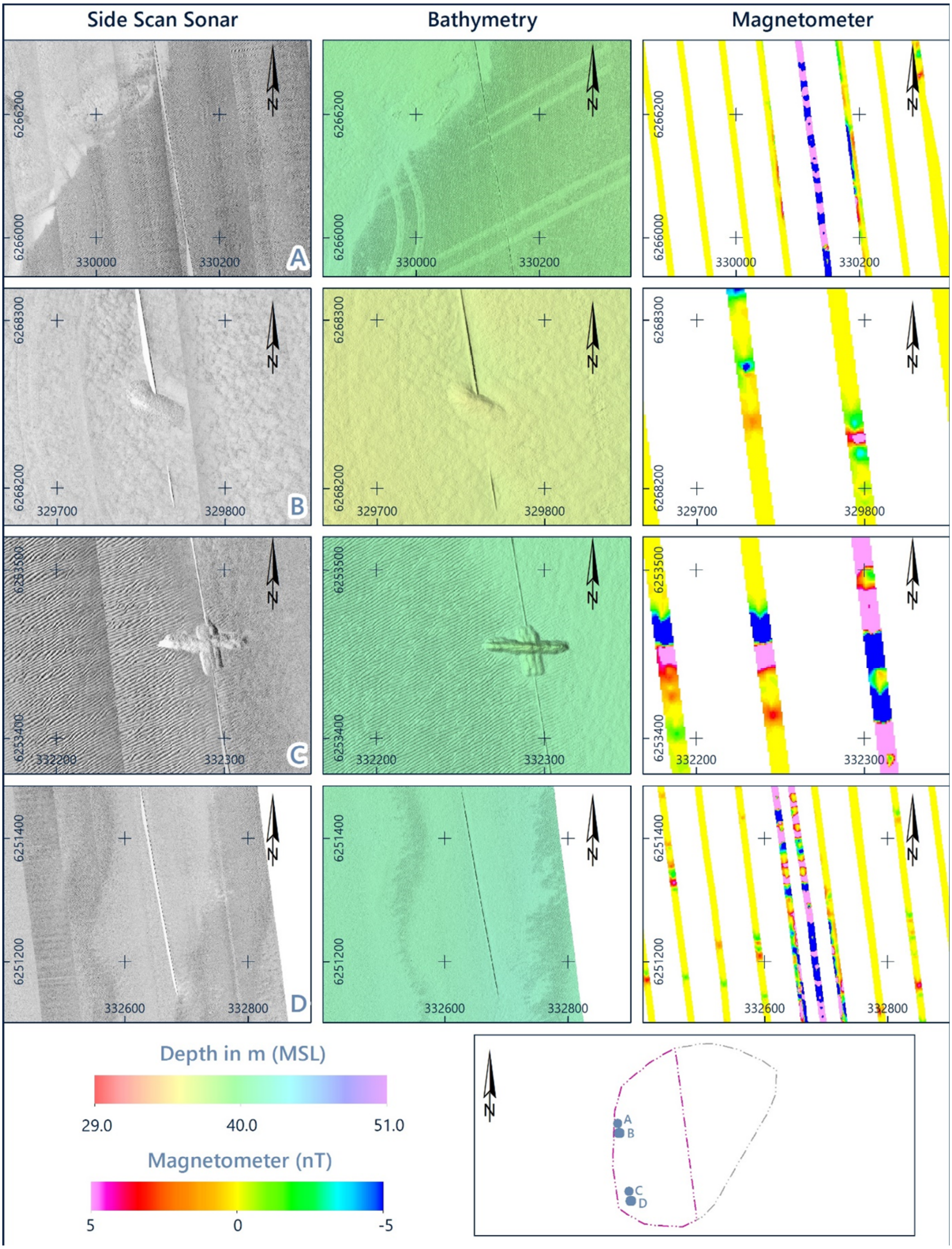


Figure 3.21: Example of exposed sections of the Europipe II pipeline and rock dumps at the crossings with the two cables (F176286-REP-GEOP-001 05).

Rock Dumps

Two (2) rock dumps, associated with Europipe II were identified on SSS and MBES datasets during the morphological classification.

3.3 Sub-Seafloor Geology

3.3.1 Seismostratigraphic Units

3.3.1.1 Overview

Table 3.12 presents a comparison of identified horizons in OWF Zone West and OWF Zone East.

Table 3.12: Overview of the integration of horizons of OWF Zone West and OWF Zone East

3GW Project Area Grid (integration outcome)	3GW Project Area Unit (integration outcome)	OWF Zone West (F176286-REP-GEOP-001 05)		OWF Zone East (103783-ENN- MMT-SUR-REP-SURVWPA)	
		Horizon	Dataset	Horizon	Dataset
3GW_H05 (internal Unit U10)	Unit U10	H05	SBP	H05	SBP
3GW_H06 (internal Unit U10)		H06	SBP	H10i	SBP
3GW_H10 (base Unit U10)		H10	SBP and 2D-UUHR	H10	SBP
3GW_H20 (base Unit U20)	Unit U20	H20	2D-UUHR	H20	2D-UUHR
3GW_H24 (base Deformed Unit D24)	Deformed Unit D24	H24	2D-UUHR	Not interpreted	
3GW_H25 (base Unit U25)	Unit U25	Not interpreted		H25	2D-UUHR
3GW_H30 (base Unit U30)	Unit U30	H30	2D-UUHR	H30	2D-UUHR
3GW_H35 (base Unit U35)	Unit U35	H35 (part)	2D-UUHR	H35	2D-UUHR
3GW_H40 (base Unit U40)	Unit U40	H31	2D-UUHR	H40	2D-UUHR
3GW_H50 (base Unit U50)	Unit U50	Absent		H50	2D-UUHR
3GW_H60 (base Unit U60)	Unit U60	H35 (part)	2D-UUHR	H60	2D-UUHR
3GW_H69 (internal Unit U70)	Unit U70	H69	2D-UUHR	Not interpreted	
3GW_H70 (base Unit U70 and locally base of deformed BSU)	Unit U70 and locally deformed BSU	H70	2D-UUHR	H70, KSA and KSB	2D-UUHR
3GW_H75 (internal Unit U90)	Unit U90	H75	2D-UUHR	Absent	
3GW_H85 (internal Unit U90)		Not interpreted		H85	2D-UUHR
3GW_H90 (base Unit U90)		H90	2D-UUHR	H90	2D-UUHR

Comments are as follows:

- In OWF Zone West, 12 horizons have been interpreted, which delineate ten seismostratigraphic units. Three horizons are internal horizons within a seismostratigraphic unit. Details are presented in F176286-REP-GEOP-001 05;
- In OWF Zone East, 14 horizons have been interpreted, which delineate 12 seismostratigraphic units. One horizon is an internal horizon within a seismostratigraphic unit. Additionally, two horizons have been interpreted which delineate two kinematic

units which have undergone deformation. Details are presented in 103783-ENN- MMT-SUR-REP-SURVWPA;
- Deformed Unit D24 is not interpreted in OWF Zone East;
- In OWF Zone West, H35 is split in H35 and H60;
- Some individual channels of H40 in OWF Zone East have been reclassified;
- Some individual channels of H70 in OWF Zone East have been reclassified.
- In OWF Zone East Unit U70 and deformed BSU were not distinguished from each other;
- H85 is not interpreted in OWF Zone West, however, is present in a small area.

The interpretation of Fugro (F176286-REP-GEOP-001 05) and MMT (103783-ENN-MMT-SUR-REP-SURVWPA) have been combined into 16 horizons which delineate 12 seismostratigraphic units (Table 3.12). Five horizons are classified as internal horizons.

For the integration, the sub-surface interpretation of both OWF Zone West and East were examined and compared. Even though multiple sub-surface interpretation alignment meetings were held successfully between Fugro and MMT, some differences in interpretation in the OWF Zone West and OWF Zone East exist. Reasons for this include:

- Data acquisition and processing were done by separate entities and with different tools and techniques leading to comparable, yet, in places, different data quality and resolution;
- Geological conditions vary spatially, and sub-surface conditions have been affected by different phenomena in OWF Zone East versus OWF Zone West (e.g., glaciotectonism).

A description of the seismostratigraphic units is provided in Table 3.13. A schematic overview of the horizons and seismostratigraphic units is shown in Figure 3.22. The stratigraphic framework (depositional environment and age) is based on the character of the seismic facies and available literature for the Danish Sector of the North Sea (e.g., Larsen and Andersen, 2005; GEUS and Orbicon, 2010; Ramboll, 2021) and based on the interpretations provided in F176286-REP-GEOP-001 05 and 103783-ENN-MMT-SUR-REP-SURVWPA.

This section and following sub-sections should be read in conjunction with the geological charts and geological profiles provided separately (see Appendix C).

Table 3.13: Overview of the integrated horizons and seismostratigraphic units identified 3GW Project Area

Data	Unit	Horizon		Seismic Character	Expected Lithology	Depositional Environment	Age
		Base	Internal				
SBP / 2D-UUHR	U10	H10	H05 H06	Horizontal base; acoustically transparent with point reflectors; below horizons H05 and H06 with clinoforms dipping north and east	SAND with shells and shell fragments	Marine and coastal	Holocene
2D-UUHR	U20	H20	-	Channelised to planar base; various internal character: stratified with low to high amplitude reflectors parallel to the base, acoustically transparent or chaotic	SAND and/or CLAY	Fluvial, estuarine and coastal	Late Weichselian to early Holocene
	D24	H24	-	Horizontal and locally channelised base; shows evidence of deformation, originally stratified; folded reflectors, dipping thrust-faults, chaotic and transparent	CLAY with laminae to beds of silt and sand	(Glacio-) Marine and/or lacustrine deformed in push-moraine	Eemian to Weichselian
	U25	H25	-	Horizontal base; internally stratified with parallel, closely spaced, medium to high amplitude reflectors; locally the top of the unit contains small-scale channels with seismically transparent infill; horizon H25 is the base of the strongly laminated acoustic character	CLAY with laminae to beds of silt and sand	(Glacio-) Marine and/or (glacio-) lacustrine	
	U30	H30	-	Horizontal base; internally acoustically chaotic to stratified; the basal horizon H30 locally forms an unconformity with underlying units; this unit forms the transition between U25 and U35	SAND fining upward to CLAY	(Glacio-) Marine and/or (glacio-) lacustrine	Early to Middle Pleistocene
	U35	H35	-	Horizontal to undulating base; internally complex from locally stratified, transparent to chaotic, with discontinuous high amplitude reflectors with sharp to transitional terminations	Silty SAND, gravelly towards the base	(Glacio-) Fluvial	
	U40	H40	-	Channelised base (deep valleys); internally acoustically chaotic, locally stratified, with low to high amplitude reflectors parallel to the base of the channel	SAND and/or CLAY	Glacial valley fill	
	U50	H50	-	Horizontal to undulating base; acoustically transparent	CLAY	(Glacio-) Marine and/or (glacio-) lacustrine	
	U60	H60	-	Horizontal to undulating base; internally complex from locally stratified, transparent to chaotic, with discontinuous high amplitude reflectors with sharp to transitional terminations	Silty SAND, gravelly towards the base	(Glacio-) Fluvial	
	U70	H70	H69	Channelised base (deep valleys); the lower part of the valley-fill is acoustically chaotic to transparent, towards the top (above H69) the valley-fill is transparent to stratified; In the north and east, H90 is locally the base of deformed BSU	SAND and/or CLAY	Glacial valley fill	

Data	Unit	Horizon		Seismic Character	Expected Lithology	Depositional Environment	Age
		Base	Internal				
	U90	H90	H75 H85	Horizontal to undulating base; internally complex, with acoustically transparent intervals, chaotic, locally stratified intervals, with parallel horizontal to inclined reflectors	SAND with laminae to beds of clay or peat/organic clay, locally gravelly	(Glacio-) Fluvial	
	BSU	-	-	Stratified with low to high amplitude reflectors, locally chaotic towards the top	CLAY coarsening upward to SAND	Pro-delta to delta-front	Miocene

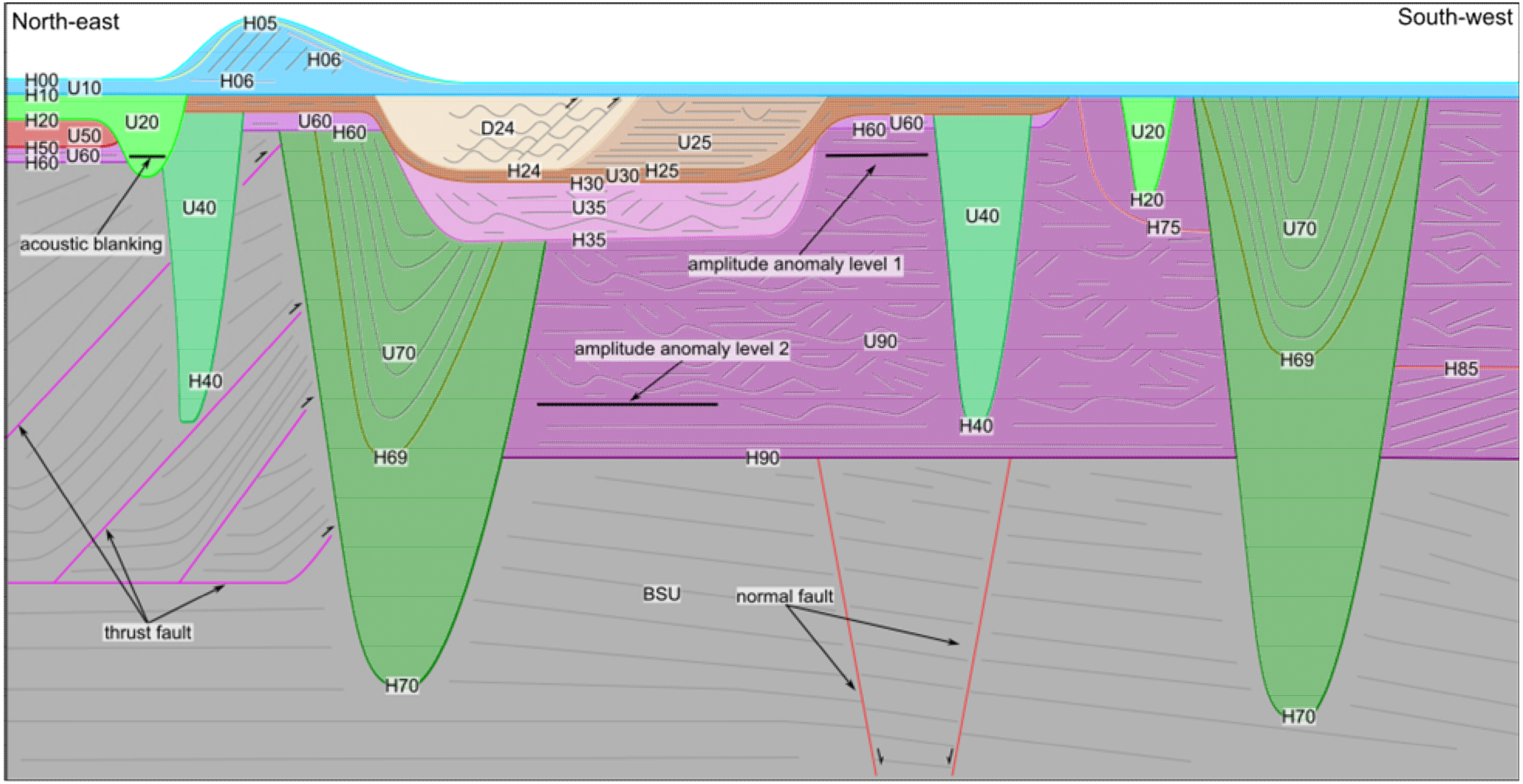


Figure 3.22: Schematic overview of the horizons and seismostratigraphic units.

3.3.1.2 Unit BSU (Base Seismic Unit)

The BSU is the deepest interpreted unit within the depth of penetration of the 2D-UUHR data and is present throughout the 3GW Project Area except where it is cut by valleys of Unit U70.

Internally, the BSU is stratified with parallel reflectors dipping gently towards the west. Towards the top of the unit, the stratification becomes less defined. In the north and east of the 3GW Project Area, this unit has been deformed by thrust faults (see Section 3.4.1). Normal faults are present in this unit throughout the 3GW Project Area (see Sections 3.4.2 and 3.4.3).

In OWF Zone East, deformed BSU has been interpreted as Unit KSA and Unit KSB (see Section 3.4.1). In this integration, Unit KSA and part of Unit KSB have been re-classified as Unit U70 because Unit KSA and Unit KSB include channels which are corresponding to Unit U70 channels in OWF Zone West (Section 3.3.1.4).

In previous studies, this unit was considered as bedrock of Miocene age (Ramboll., 2021). It is interpreted that the BSU are coarsening upward pro-delta clay to delta-front sand deposits of Miocene age of the Eridanos River delta (Figure 3.1). The westward dip of the strata may be a structural dip or clinoforms of a prograding river delta (Overeem *et al.,* 2001; Gibbard and Lewin, 2016).

Recommendations to improve this unit are given in Section 3.5.1.

3.3.1.3 Unit U90

Unit U90 has a sheet-like geometry and always overlies the BSU. The unit is present throughout the 3GW Project Area, except in the north and east and where it is cut out by valleys of Unit U70. It has a thickness of up to 87 m (Figure 3.23, Figure 3.24). The base of Unit U90 is marked by horizon 3GW_H90, which has a flat to irregular geometry.

This basal horizon H90 of OWF Zone West and OWF Zone East match well, except in a small area (Figure 3.27) where re-interpretation is recommended (Figure 3.28, see Section 3.5.2).

Internally, Unit U90 has a complex seismic character, including transparent, chaotic intervals and local stratification, with horizontal to inclined parallel reflectors. Locally, internal erosion surfaces are present. The internal erosion surfaces and inclined stratification may represent fluvial channel and bar deposits.

Amplitude anomalies with a reverse polarity occur at two levels within this unit (see Section 3.4.7) and may be associated with beds of peat and/or organic clay.

Horizon 3GW_H75 (interpreted as H75 in OWF Zone West) and Horizon 3GW_H85 (interpreted as H85 in OWF Zone East) are present locally and have been re-classified as internal horizons of Unit U90 (Figure 3.25, Figure 3.26).

It is interpreted that Unit U90 forms Early to Middle Pleistocene braided fluvial delta-top deposits of the Cenozoic delta system of the Eridanos River (Figure 3.1; Overeem *et al.,* 2001; Gibbard and Lewin, 2016; COWI, 2021).

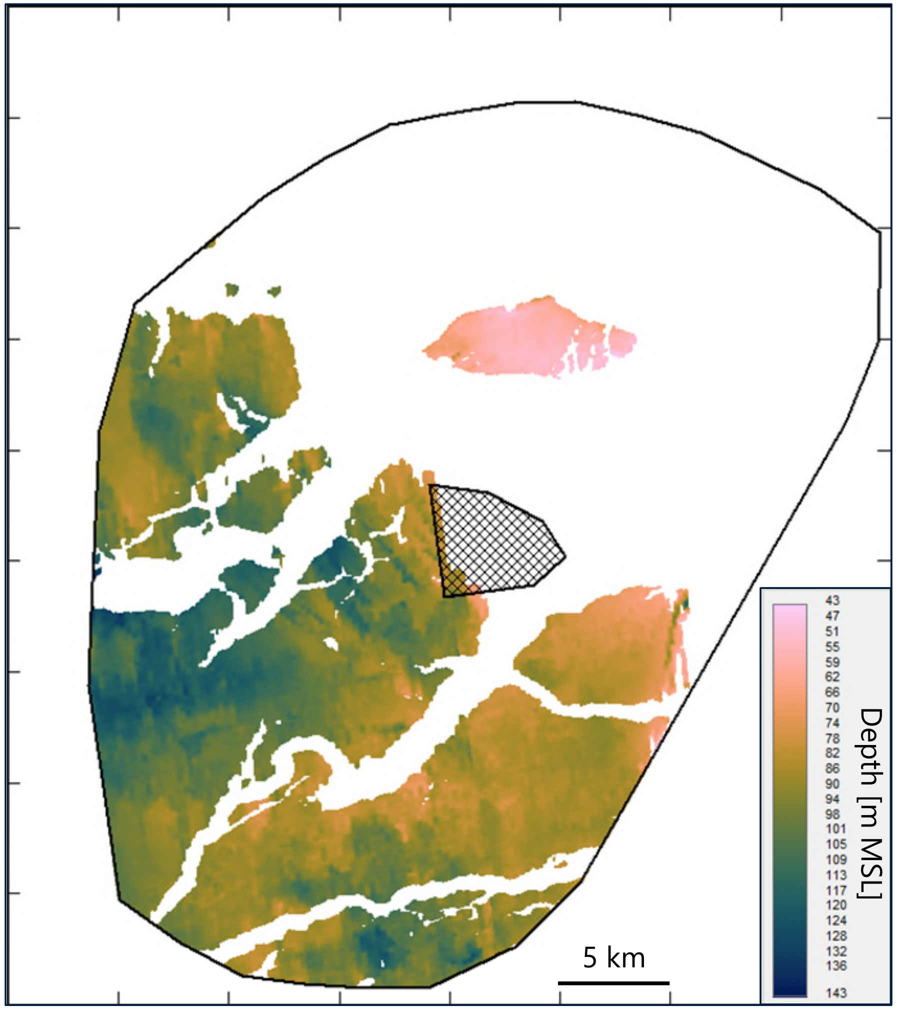


Figure 3.23: Depth to horizon 3GW_H90 (base of Unit U90). Black: Area were re-interpretation is recommended.

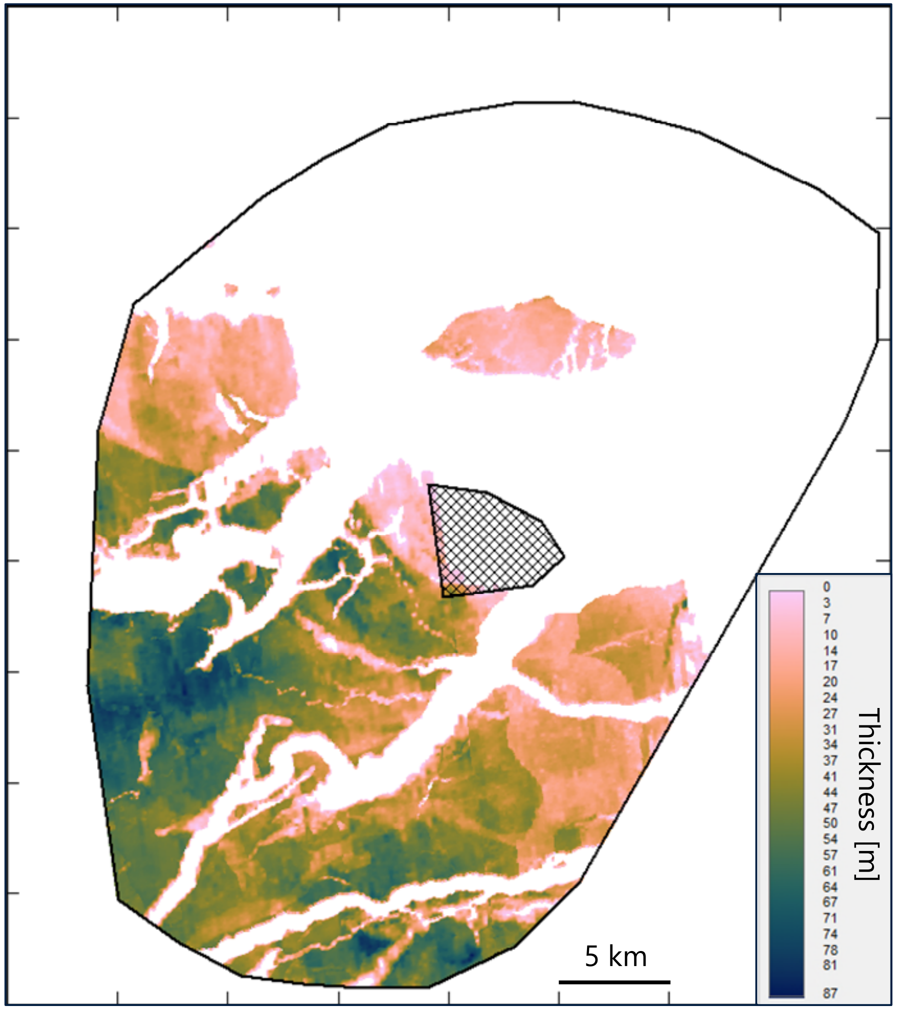


Figure 3.24: Thickness of Unit U90. Black: Area were re-interpretation is recommended.

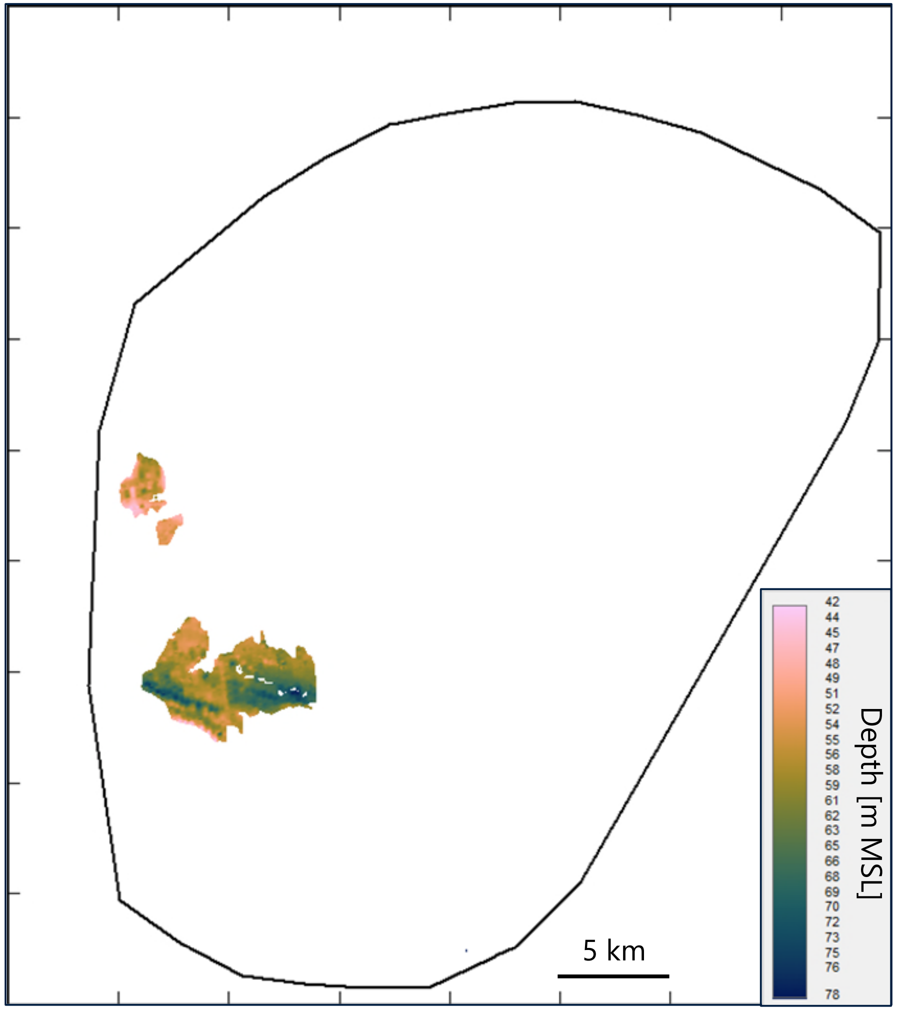


Figure 3.25: Depth to horizon 3GW_H75 (internal horizon in Unit U90).

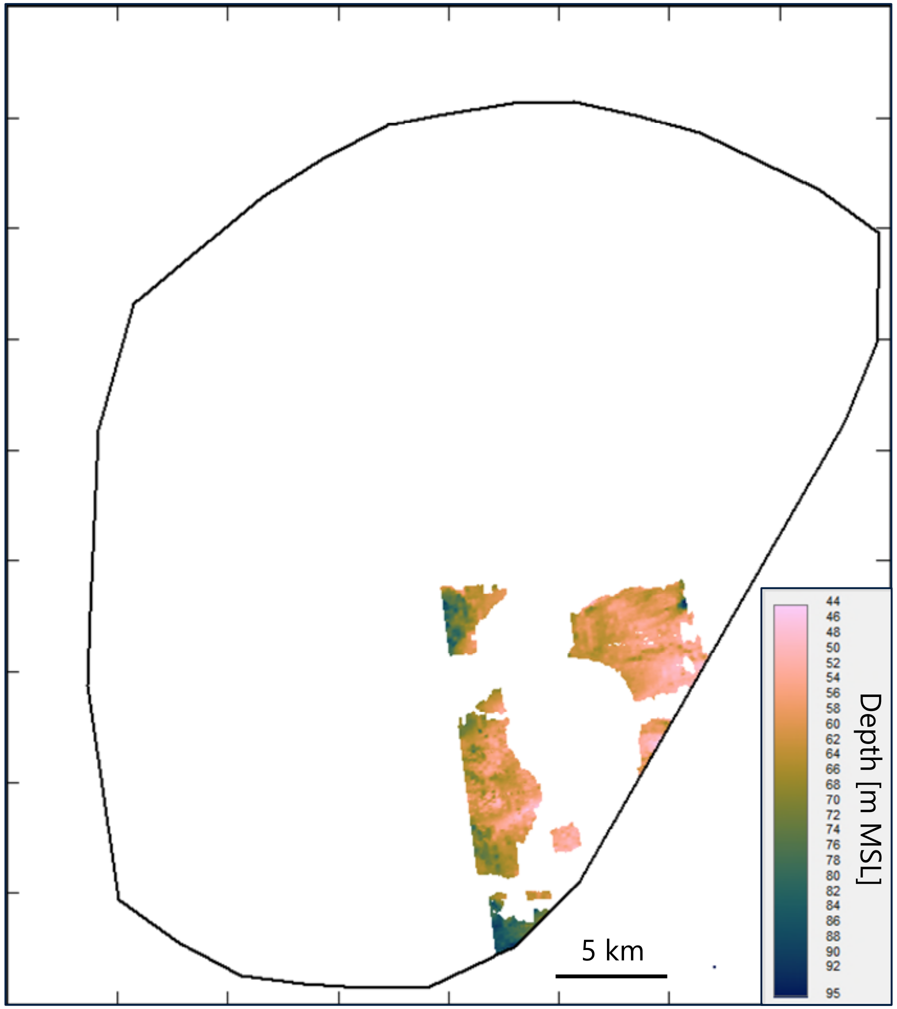


Figure 3.26: Depth to horizon 3GW_H85 (internal horizon in Unit U90).

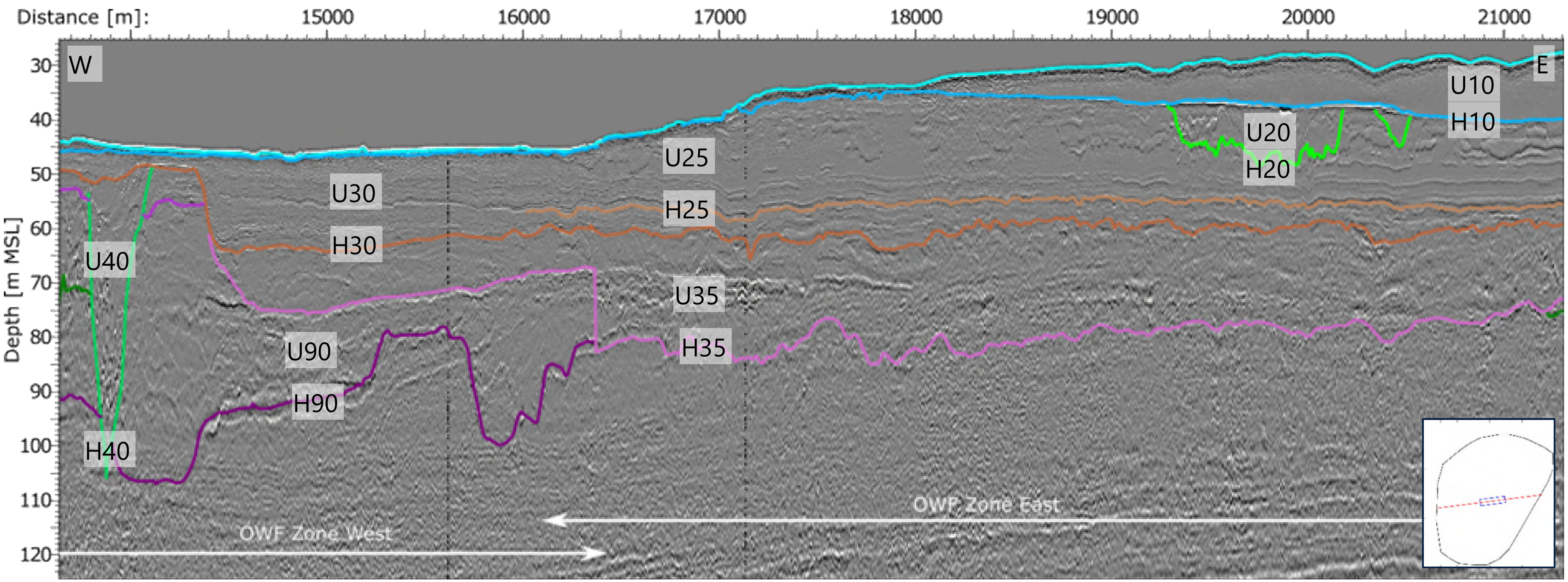


Figure 3.27: Mismatches in the integration of H25, H35 and H90.

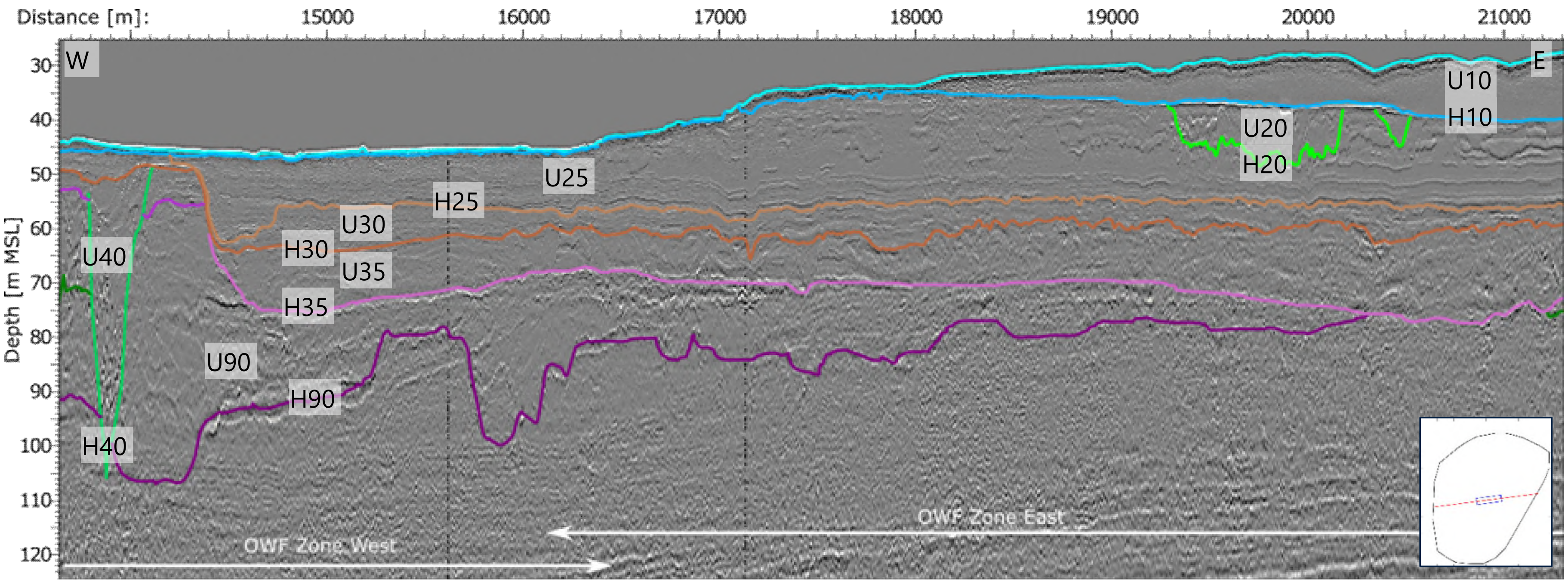


Figure 3.28: Recommended re-interpretation of H25, H35 and H90.

3.3.1.4 Unit U70

Unit U70 forms the infill of deep valleys (relatively low width/depth ratio) with a north-east to southwest orientation (Figure 3.29 to Figure 3.31). The base of these valleys is marked by horizon 3GW_H70, which often occurs deeper than the maximum penetration of the 2D-UUHR seismic data (i.e., approximately 200 m below MSL).

Two seismic facies are observed in Unit U70. The lower part of the valley-fill is often acoustically chaotic to transparent, whereas towards the top the valley-fill is stratified. At the base of the stratified interval a clear reflector is often observed, which is interpreted as horizon 3GW_H69 (Figure 3.32).

Horizon H70 of OWF Zone West has been merged with horizon KSA and part of horizon KSB of OWF Zone East to become horizon 3GW_H70. Internal horizon H69 of OWF Zone West has been merged with horizon H70 in OWF Zone East to become horizon 3GW_H69.

Merging of these horizons resulted in mismatches. To avoid clear mismatches, some individual channels have been reclassified. See Figure 3.32 and Figure 3.33 for an overview of which channels have been re-classified.

In OWF Zone East, deformed BSU has been interpreted as Unit KSA and KSB (Figure 3.34). In this integration, Unit KSA and part of Unit KSB have been re-classified as Unit U70 (Figure 3.35). It is recommended to re-interpret 3GW_H70 in the area of the thrusted complex, area with normal faults, and area with deformation associated with a tunnel valley (Figure 3.36). This would make it able to distinguish between tunnel valleys and deformed BSU (see Section 3.5.1).

Unit U70 is interpreted to be the syn- to post-glacial infill of glacial valleys, which were eroded during the Elsterian and/or Saalian glaciations (Figure 3.2; Huuse and Lykke-Andersen, 2000; COWI, 2021; Kirkham *et al.,* 2021).

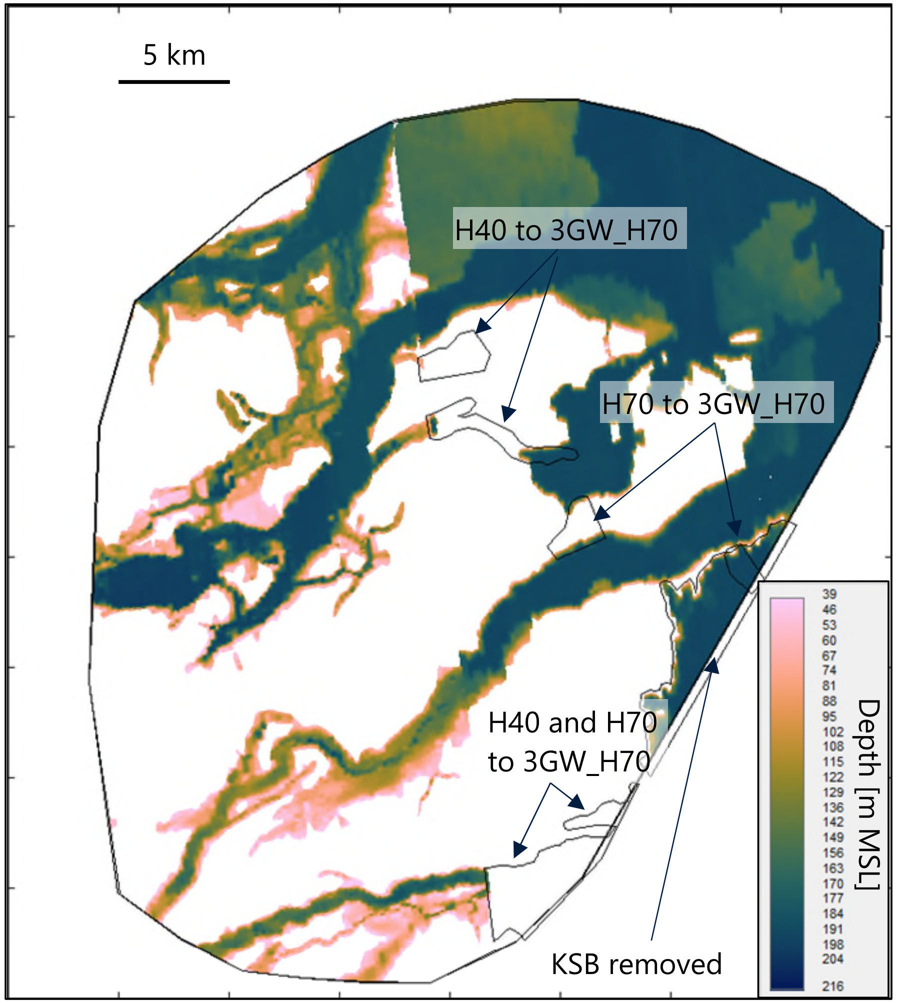
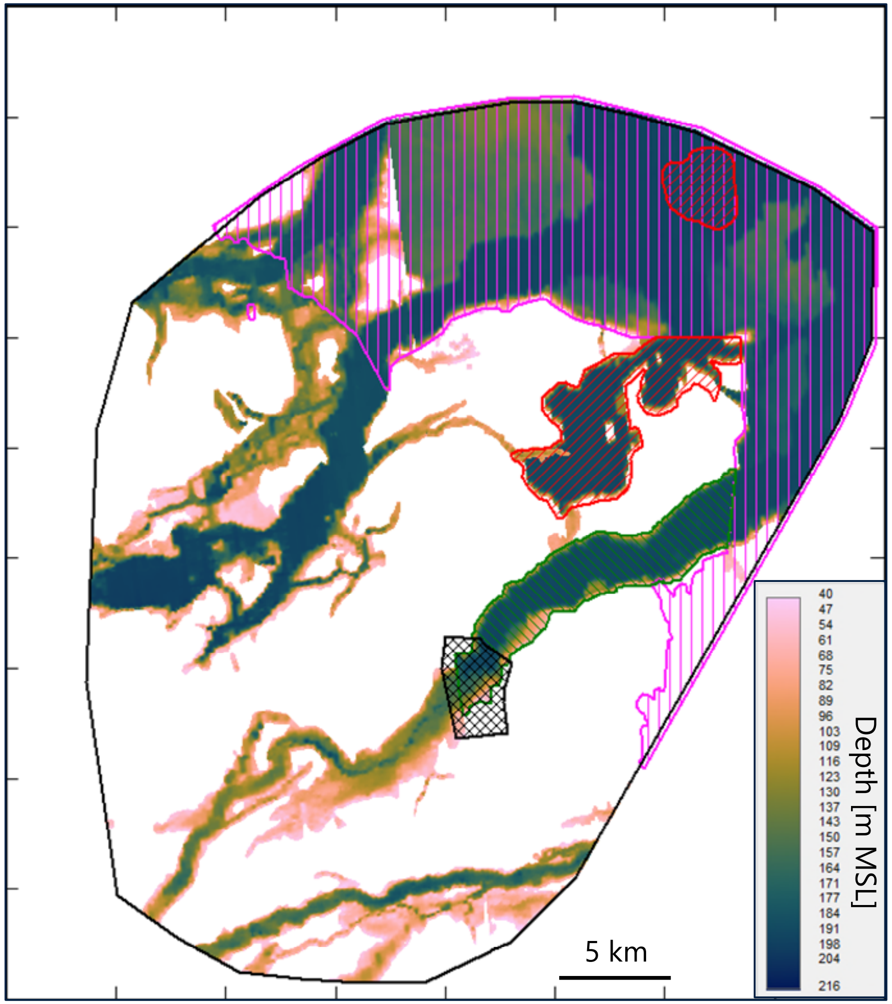


Figure 3.29: Merge of the un-edited horizon H70 of OWF Zone West and horizon KSA of OWF Zone East. Re-classification of parts of channels are indicated.



igure 3.30: Depth to horizon 3GW_H70 (base of Unit U70). Black: Area were re-nterpretation is recommended; Pink: Thrusted complex; Red: Area with normal aults; Dark green: Deformation associated with tunnel valley.

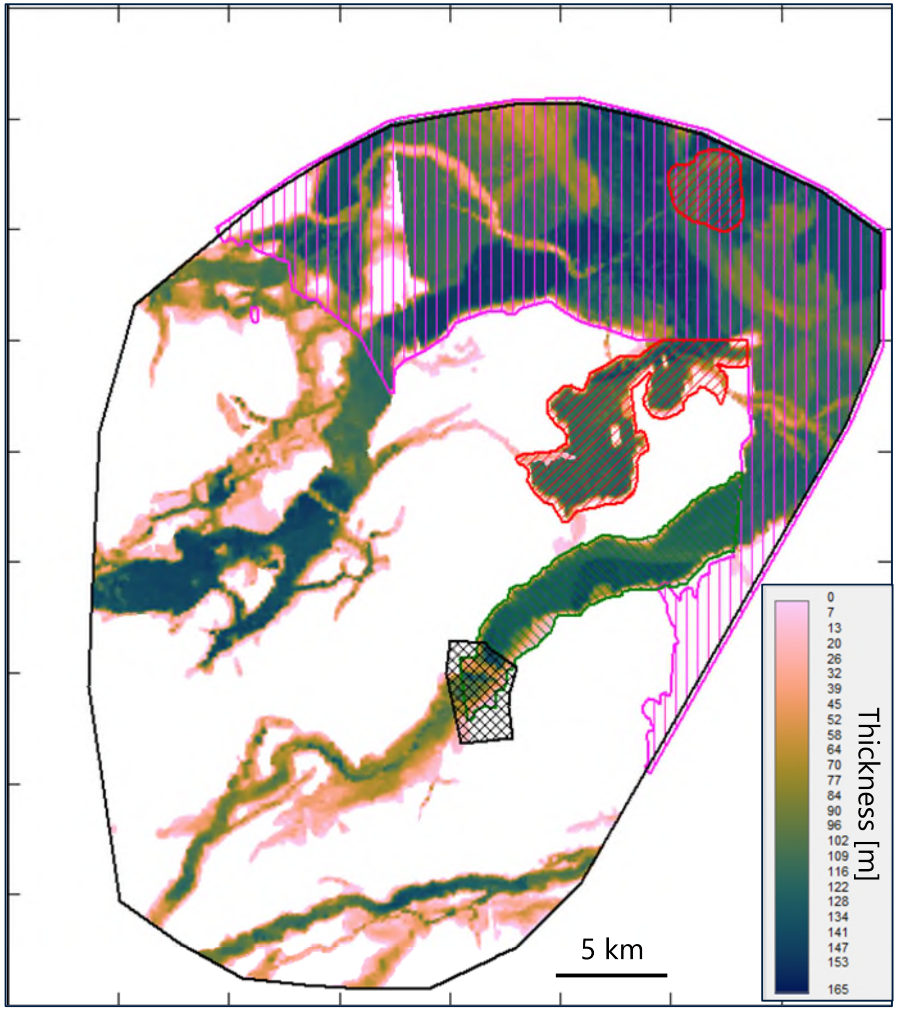


Figure 3.31: Thickness of Unit U70. Black: Area were re-interpretation is recommended; Pink: Thrusted complex; Red: Area with normal faults; Dark green: Deformation associated with tunnel valley.

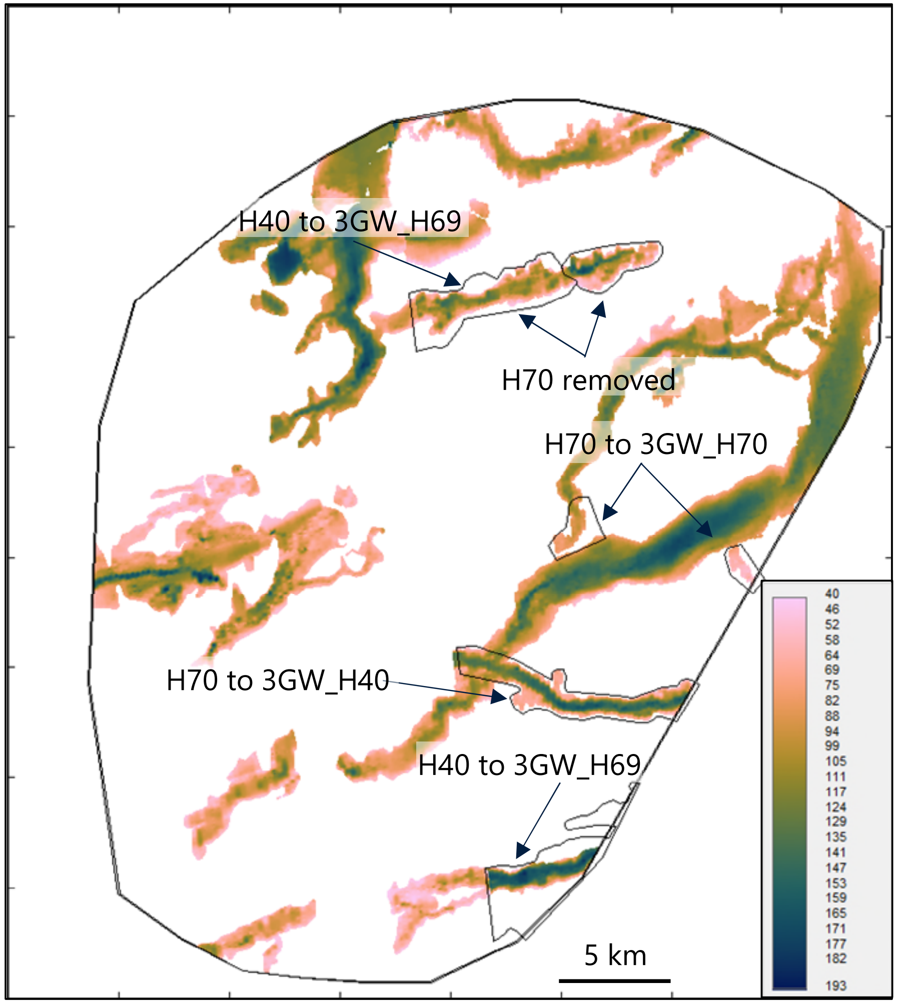
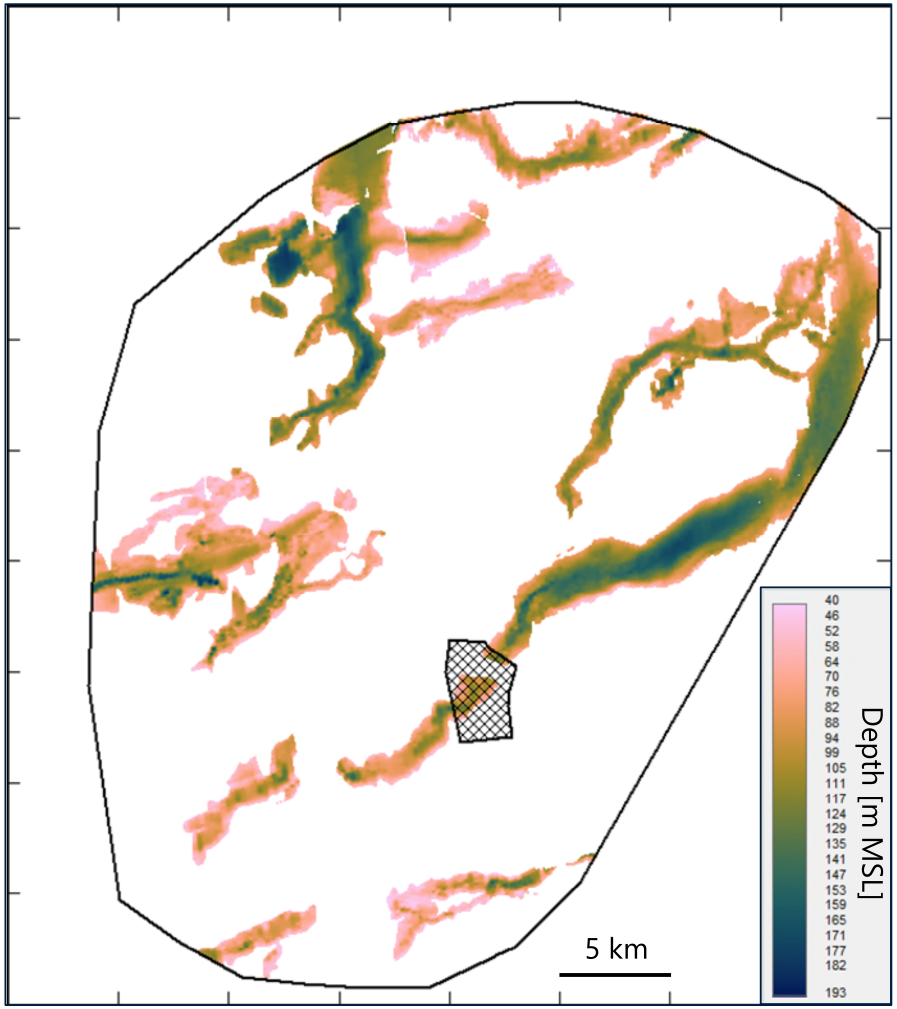


Figure 3.32: Merge of the un-edited horizon H69 of OWF Zone West and horizon H70 of OWF Zone East. Re-classification of parts of channels are indicated.



igure 3.33: Depth to horizon 3GW_H69 (internal horizon in Unit U70). Black: Area vere re-interpretation is recommended.

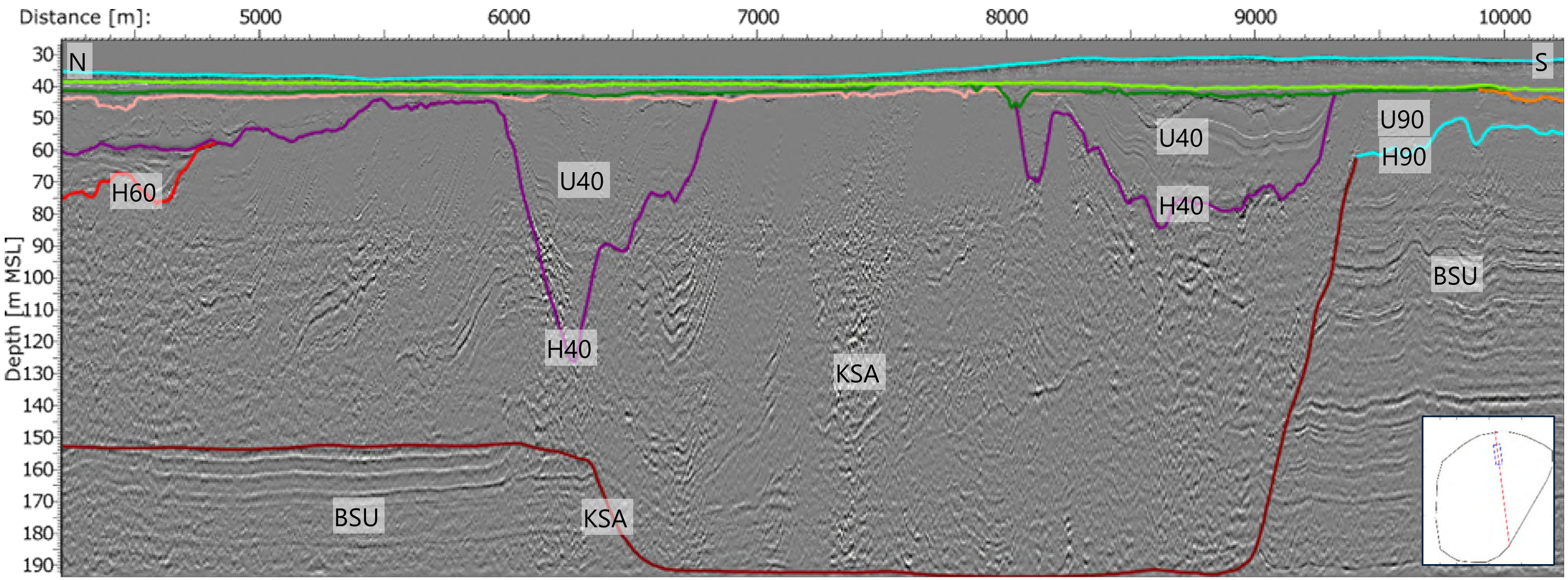


Figure 3.34: Original interpretation of KSA and BSU in OWF Zone East. The colour coding is the colour coding used by 103783-ENN-MMT-SUR-REP-SURVWPA for OWF Zone East.

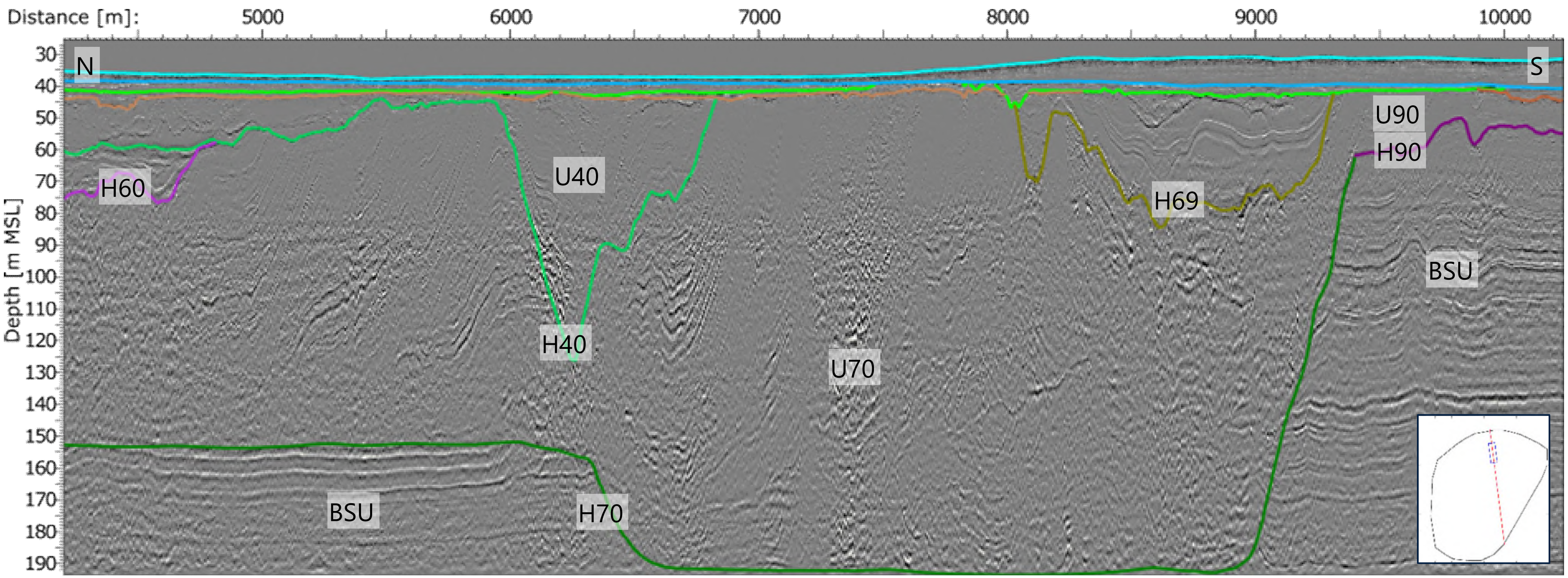


Figure 3.35: Reclassification into BSU and U70 in this report.

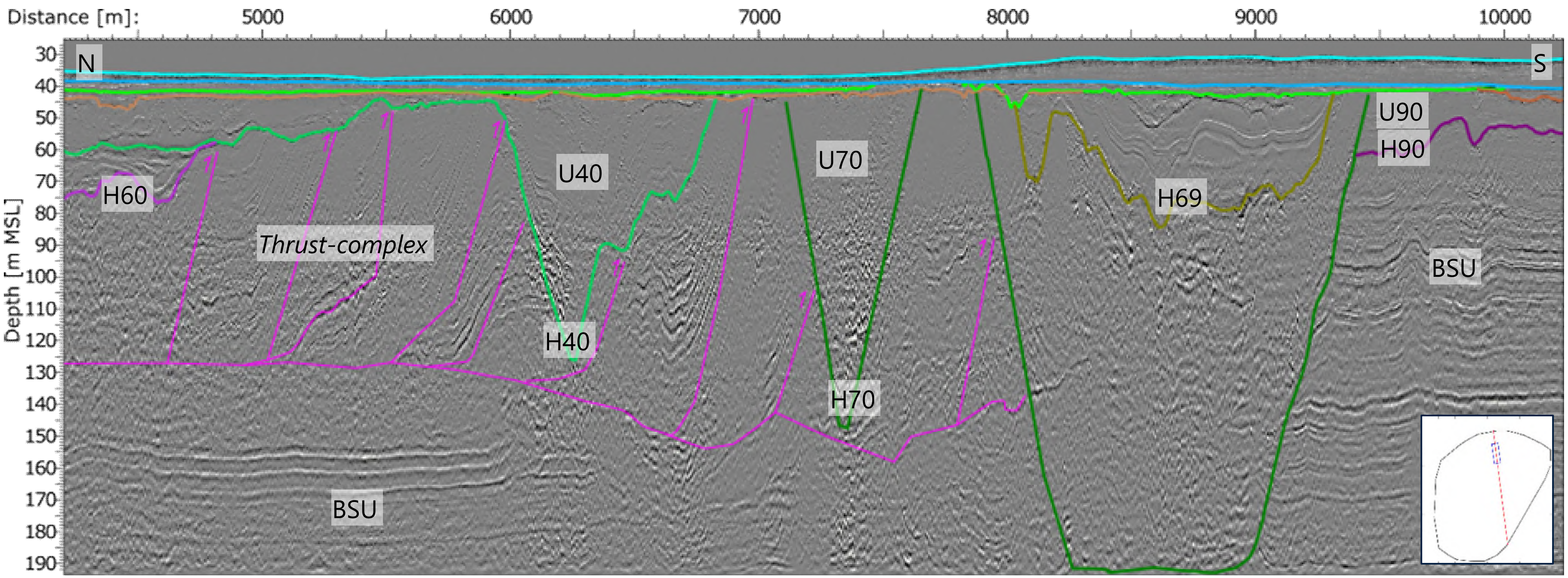


Figure 3.36: Recommended re-interpretation.

3.3.1.5 Unit U60

Unit U60 has a sheet-like geometry with flat to undulating base. The basal horizon 3GW_H60 forms an angular unconformity truncating the underlying units, most notably Unit U70. Unit U60 reaches a thickness of up to 56 m (Figure 3.37 and Figure 3.38).

Internally, Unit U60 has a complex acoustic character from locally stratified, to acoustically transparent, to chaotic. The chaotic intervals comprise of discontinuous, high amplitude reflectors with sharp to transitional terminations. Complexities also include internal erosion surfaces and inclined reflectors.

Horizon H35 of OWF Zone West has been split into horizons 3GW_H35 and 3GW_H60 (Figure 3.39). The part of the horizon with the wide, shallow valley (Figure 3.37, Figure 3.38) has been re-classified as 3GW_H35, the part outside the shallow, wide valley has been re-classified as 3GW_H60. No changes were made to the interpretation of OWF Zone East.

It is possible that the stepped character of Unit U35 and Unit U60 are river terraces. See the description Unit U35 (Section 3.3.1.8) for more details.

The internal erosion surfaces are considered to have been formed by fluvial channels and that the inclined stratification are fluvial bar deposits. The areas with inclined stratification are relatively local (less than 1 km wide) and dip in variable directions. Therefore, these are interpreted to be bars deposited in a braided river. The horizontal stratification is interpreted to be overbank deposits.

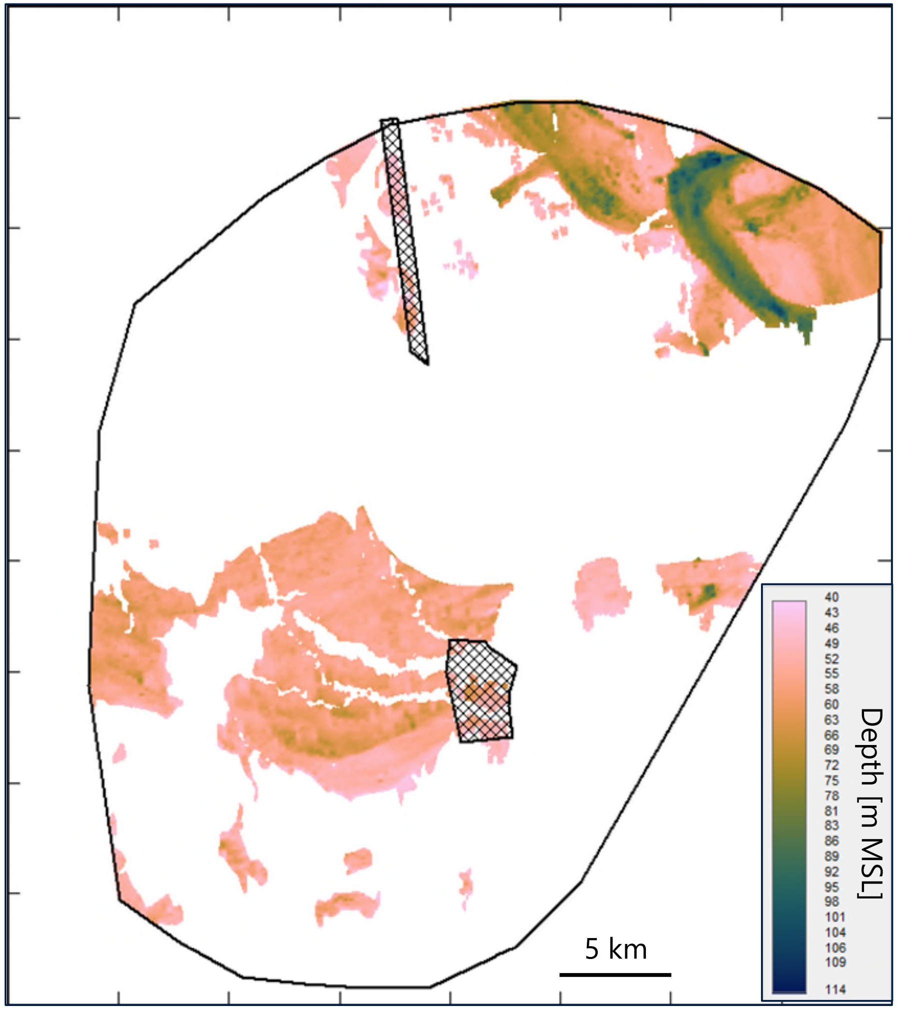


Figure 3.37: Depth to horizon 3GW_H60 (base of Unit U60). Black: Area were re-interpretation is recommended.

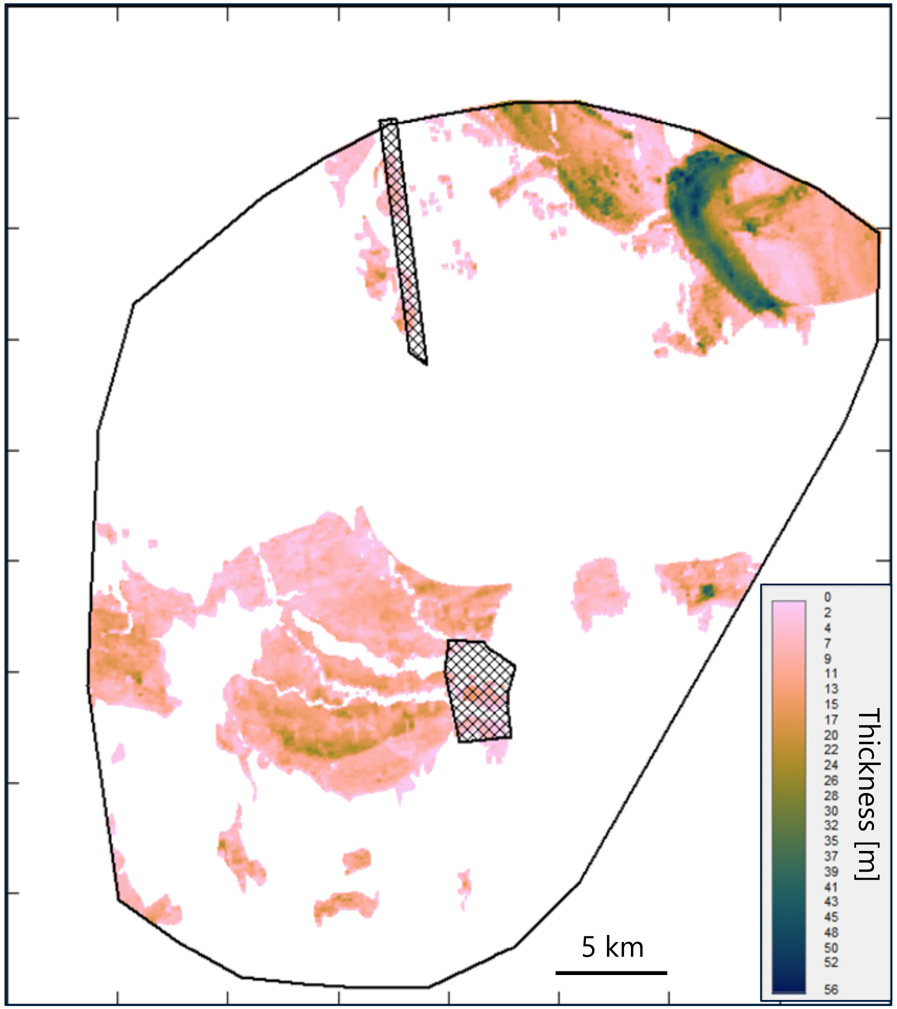


Figure 3.38: Thickness of Unit U60. Black: Area were re-interpretation is recommended.

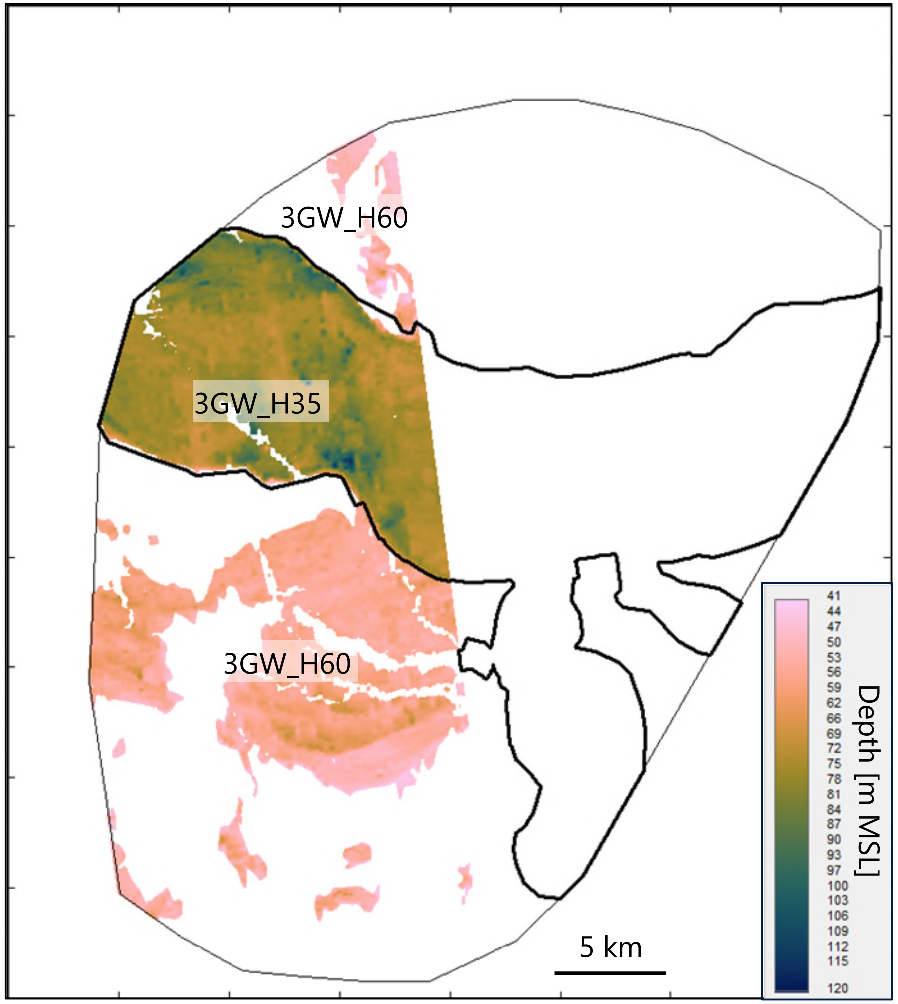


Figure 3.39: Map showing how H35 from OWF Zone West is split in 3GW_H35 and 3GW_H60.

3.3.1.6 Unit U50

Unit U50 has a sheet-like geometry with a horizontal to undulating base and steep erosional margins. Unit U50 is locally present in the north-east of the 3GW Project Area and has not been interpreted in OWF Zone West. The unit reaches a maximum thickness of up to 17 m (Figure 3.40 and Figure 3.41). The base of Unit U50 is marked by horizon H50.

Internally, the unit is acoustically transparent or is stratified with low amplitude parallel reflectors.

It is interpreted that Unit U50 was deposited in a (glacio-) marine or (glacio-) lacustrine environment.

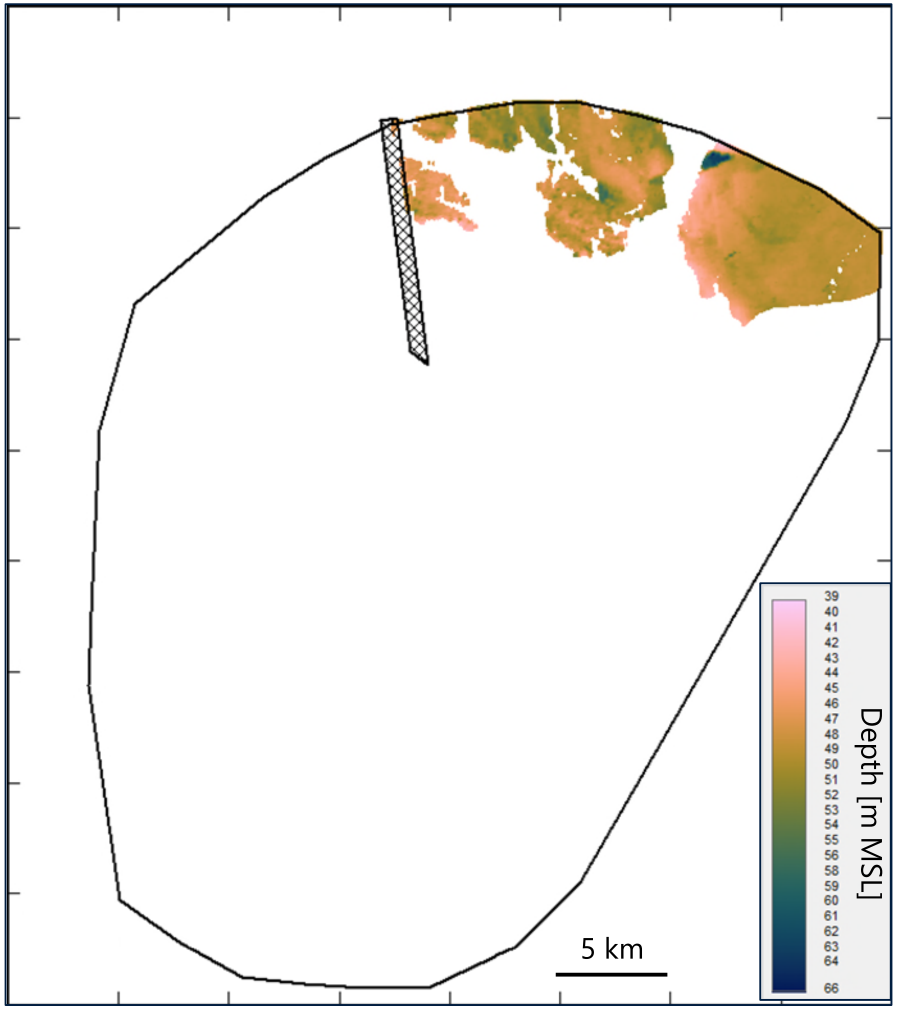


Figure 3.40: Depth to horizon 3GW_H50 (base of Unit U50). Black: Area were re-interpretation is recommended.

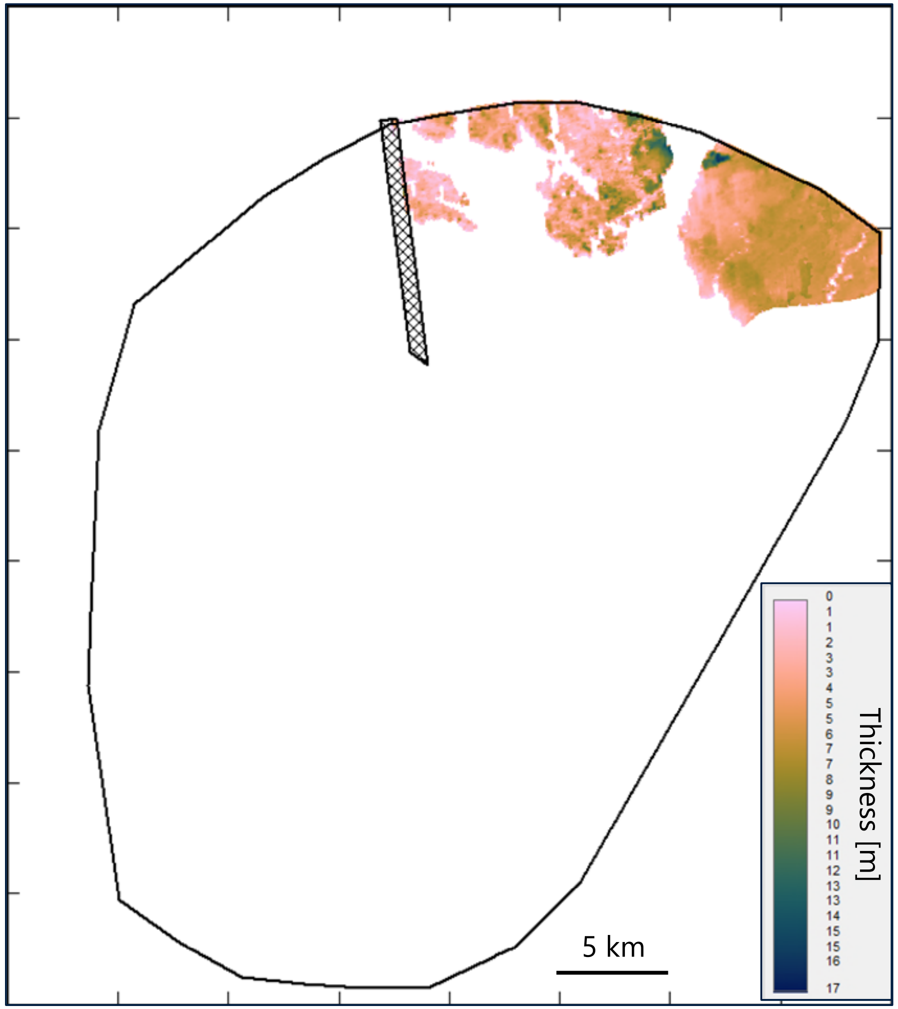


Figure 3.41: Thickness of Unit U50. Black: Area were re-interpretation is recommended.

3.3.1.7 Unit U40

Unit U40 forms the infill of deep channels (relatively low width/depth ratio) with a northwest to southeast orientation and with a thickness of up to 131 m (Figure 3.43, Figure 3.44). The base of Unit U40 is marked by horizon 3GW_H40, which often cuts into Units U60 and U90. The top of Unit U40 is often truncated by horizon 3GW_H30 and horizon 3GW_H35.

In planar view, this unit shows wide meandering channel system with tributary channels. Internally, this unit is acoustically chaotic or locally stratified with low to high amplitude reflectors, parallel to the base of the channel. The seismic character is similar to the deep channel of Unit U20 (see Section 3.3.1.12) and the deep valleys of Unit U70. However, the stratigraphical position of Unit U40 indicates an older age than Unit U35 and a younger age than Unit U60.

Horizon H31 of OWF Zone West has been merged with horizon H40 of OWF Zone East to become horizon 3GW_H40. This resulted in quite some mismatches. Therefore, some individual channels have been reclassified. See Figure 3.42 for an overview of which channels have been re-classified.

Unit U40 is interpreted to be the syn- to post-glacial infill of glacial valleys, which were eroded during the Elsterian and/or Saalian glaciations (Figure 3.2; Huuse and Lykke-Andersen, 2000; COWI, 2021; Kirkham *et al.*, 2021).

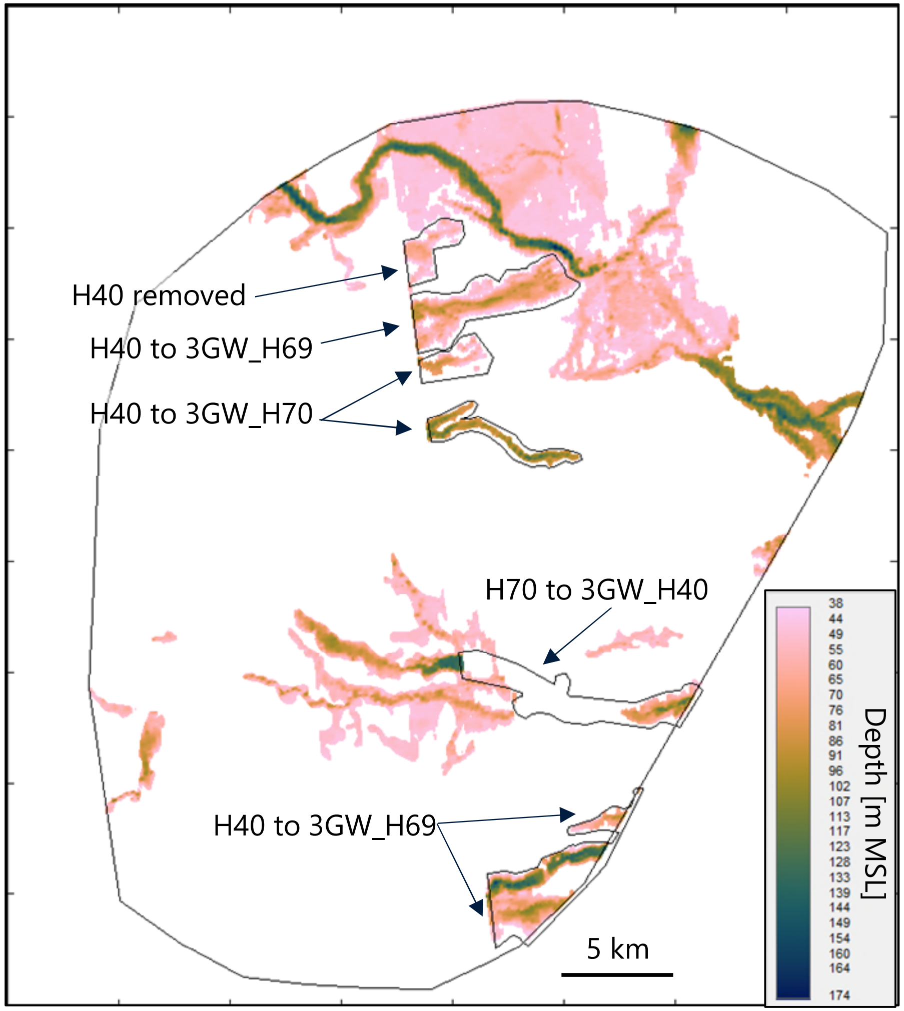
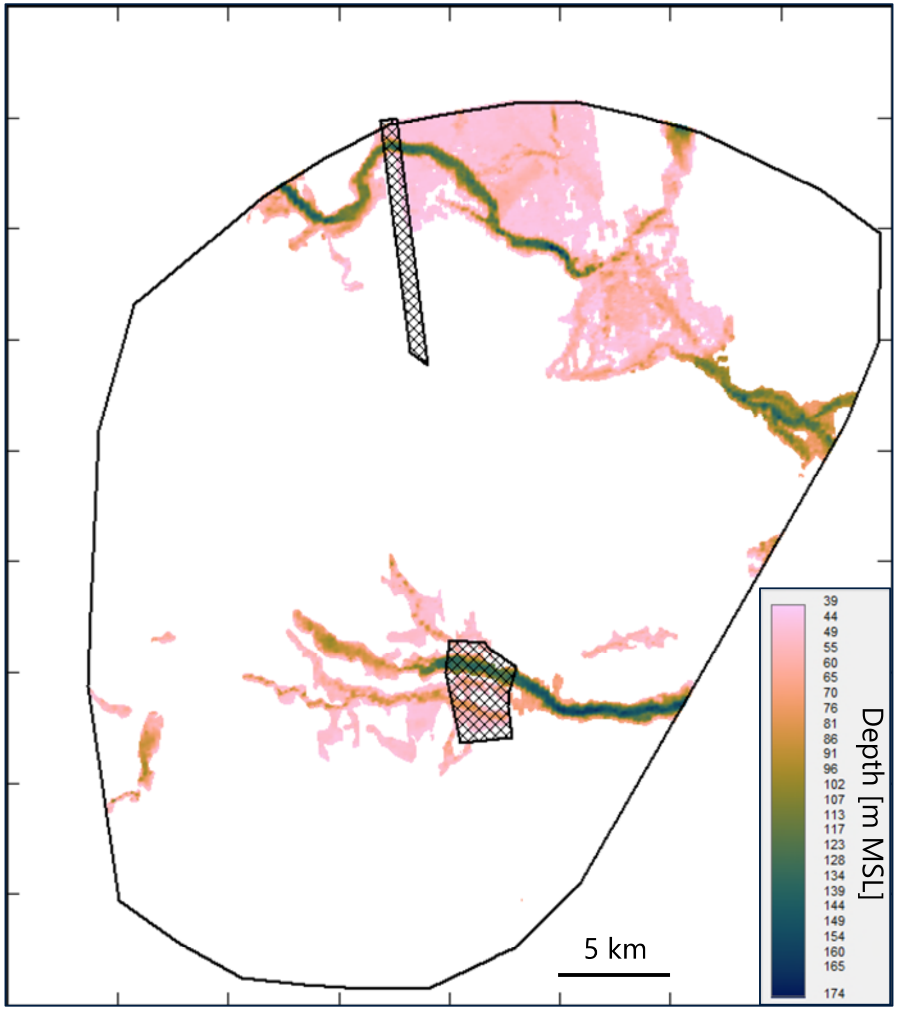


Figure 3.42: Merge of the un-edited horizon H31 of OWF Zone West and horizon H40 of OWF Zone East. Re-classification of parts of channels are indicated.



igure 3.43: Depth to horizon GW_H40 (base of Unit U40). Black: Area were re-nterpretation is recommended.

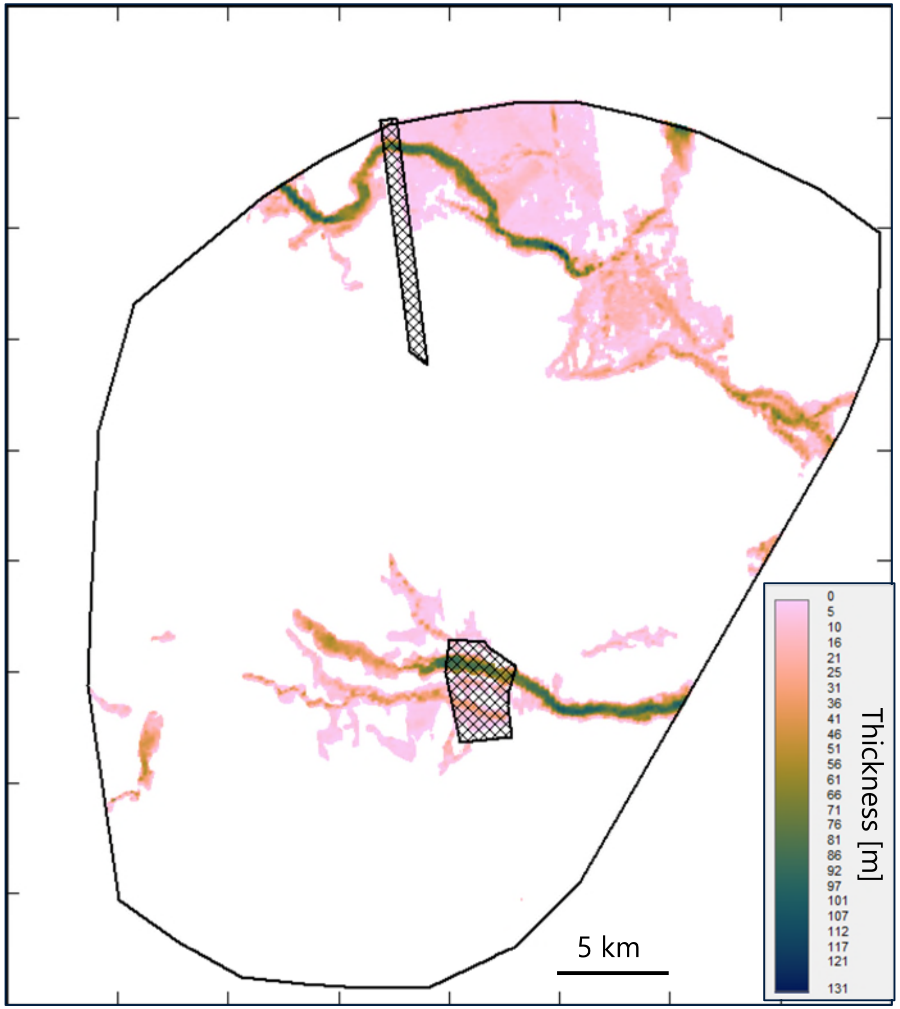


Figure 3.44: Thickness of Unit U40. Black: Area were re-interpretation is recommended.

3.3.1.8 Unit U35

Unit U35 has a flat to undulating base and fills a wide (relatively high width/depth ratio), west-east oriented valley which crosses the 3GW Project Area, and two smaller north-south oriented tributary valleys (Figure 3.45). The basal horizon 3GW_H35 forms an angular unconformity with the underlaying units, most notably Unit U70. The thickness of this unit reaches up to 58 m (Figure 3.46).

Internally, Unit U35 has a complex acoustic character from locally stratified, to acoustically transparent to chaotic. The chaotic intervals comprise of discontinuous, high amplitude reflectors with sharp to transitional terminations. Acoustic characters include internal erosion surfaces and inclined reflectors.

Horizon H35 of OWF Zone West has been split into two separate horizons. The part of the horizon with the wide, shallow valley (Figure 3.39, Figure 3.45) has been re-classified as 3GW_H35, the part outside the shallow, wide valley has been re-classified as 3GW_H60.

It is possible that the stepped character of Unit U35 and Unit U60 are river terraces. The curved valley-margins associated with the increased depth of the base of this unit suggests that the valleys were eroded by a meandering channel. River terraces may form during relative sea-level drops such as at the beginning of an ice-age or during isostatic rebound after a glaciation.

The internal erosion surfaces are likely formed by fluvial channels and that the inclined stratification represents bar deposits. The areas with inclined stratification are relatively local (less than 1 km wide). Therefore, these are interpreted to be bars deposited in a braided river. The horizontal stratification is interpreted to be overbank deposits.

The scale of the valleys (approximately 10 km wide) resembles the river terraces of the Lower Rhine Valley (Erkens *et al.,* 2011), Meuse valley (Woolderink *et al.,* 2019) and the Danube and Tisza River (Gábris and Nádor, 2007). Therefore, the valleys may be palaeo-valleys of the Eridanos River, which was similar in scale to the Rhine and Danube.The fluvial deposits of Unit U35 and Unit U60 may correspond to the remnants of the Saalian palaeo-landscape (‘Bakkeøer’), which is recognized in the nearshore areas and onshore Jutland (Larsen and Andersen, 2005; GEUS and Orbicon, 2010; Ramboll, 2021).Unit U35 is younger than Unit U40 and Unit U70, which are interpreted to be Elsterian and/or Saalian in age and older than Unit U25 and Unit U30, which are interpreted to be Eemian to Weichselian in age. Based on the stratigraphic position, this unit could be between late Elsterian and early Weichselian in age.

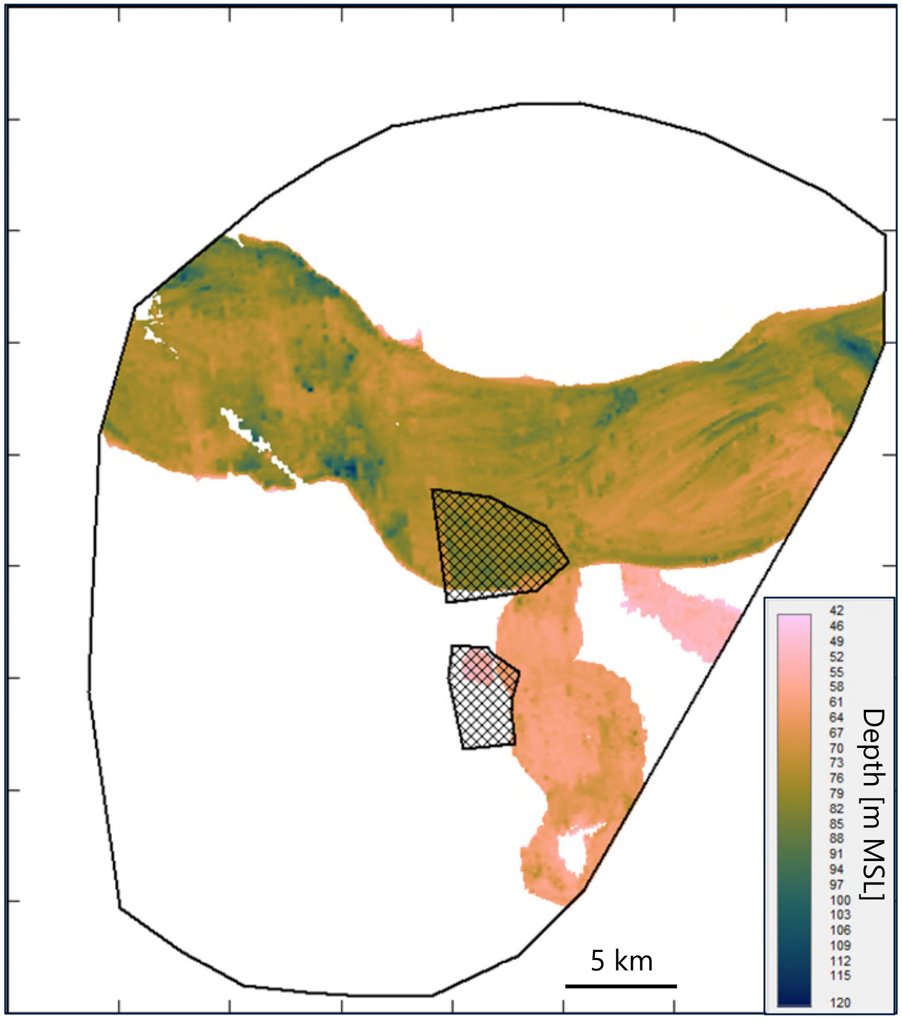


Figure 3.45: Depth to horizon 3GW_H35 (base of Unit U35). Black: Area were re-interpretation is recommended.

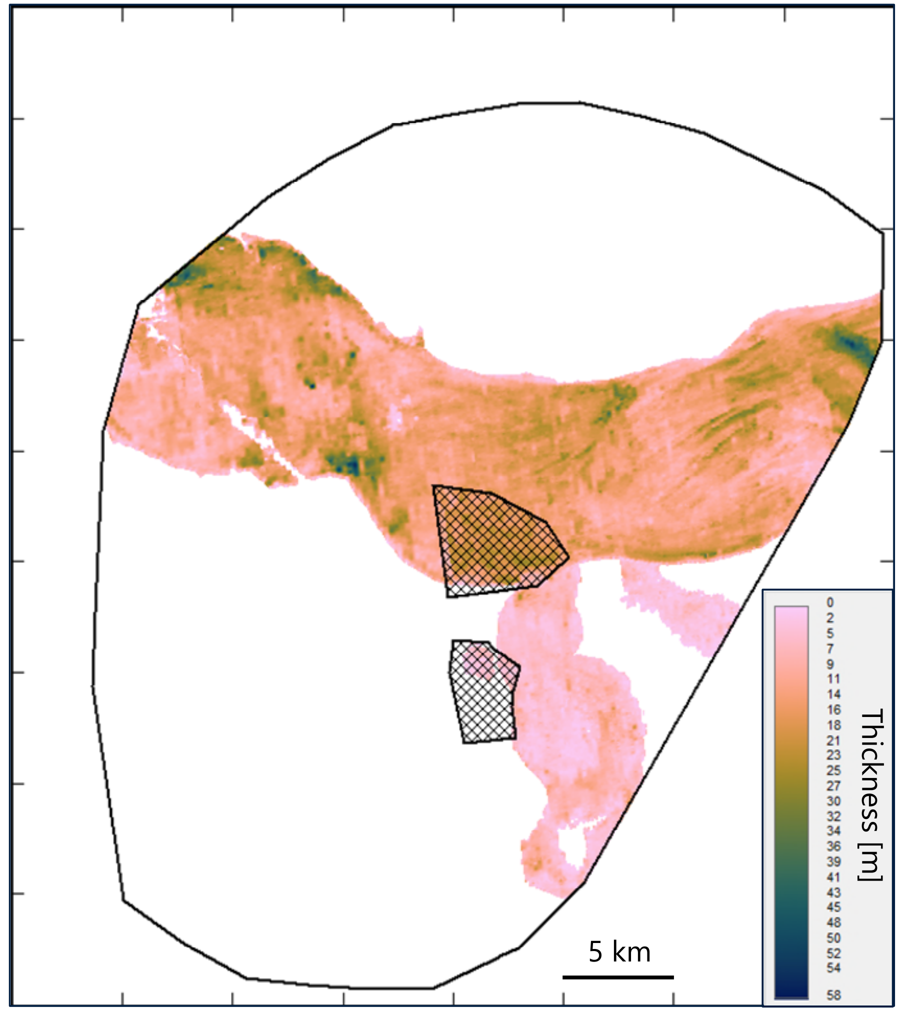


Figure 3.46: Thickness of Unit U35. Black: Area were re-interpretation is recommended.

3.3.1.9 Unit U30

Unit U30 has a sheet-like geometry with a horizontal to undulating base and steep erosional margins. The unit reaches a maximum thickness up to 32 m (Figure 3.47 and Figure 3.48). The base of Unit U30 is marked by horizon 3GW_H30, a low to medium amplitude positive amplitude reflector.

Horizon 3GW_H30 is an unconformity which truncates underlying units. Unit U30 fills the topography of valleys of Unit U35 and Unit U60.

Internally, the unit is acoustically complex to stratified. Unit U30 is often relatively thin and forms a transition from underlying Unit U35 and Unit U60 with an acoustically complex seismic character to the overlying Unit U25 with an acoustically stratified seismic character.

Horizon H30 has been interpreted in both OWF Zone West and OWF Zone East and has been merged without major resulting issues.

As this unit forms a transition between the underlying units with a (glacio-) fluvial depositional environment to the overlying unit with a (glacio-) marine or (glacio-) lacustrine environment, it is interpreted that this unit was deposited during a marine transgression of the 3GW Project Area in a (glacio-) fluvial, coastal, (glacio-) lacustrine to (glacio-) marine depositional environment. This unit is interpreted to represent a marine transgression, that possibly occurred during the Eemian interglacial.

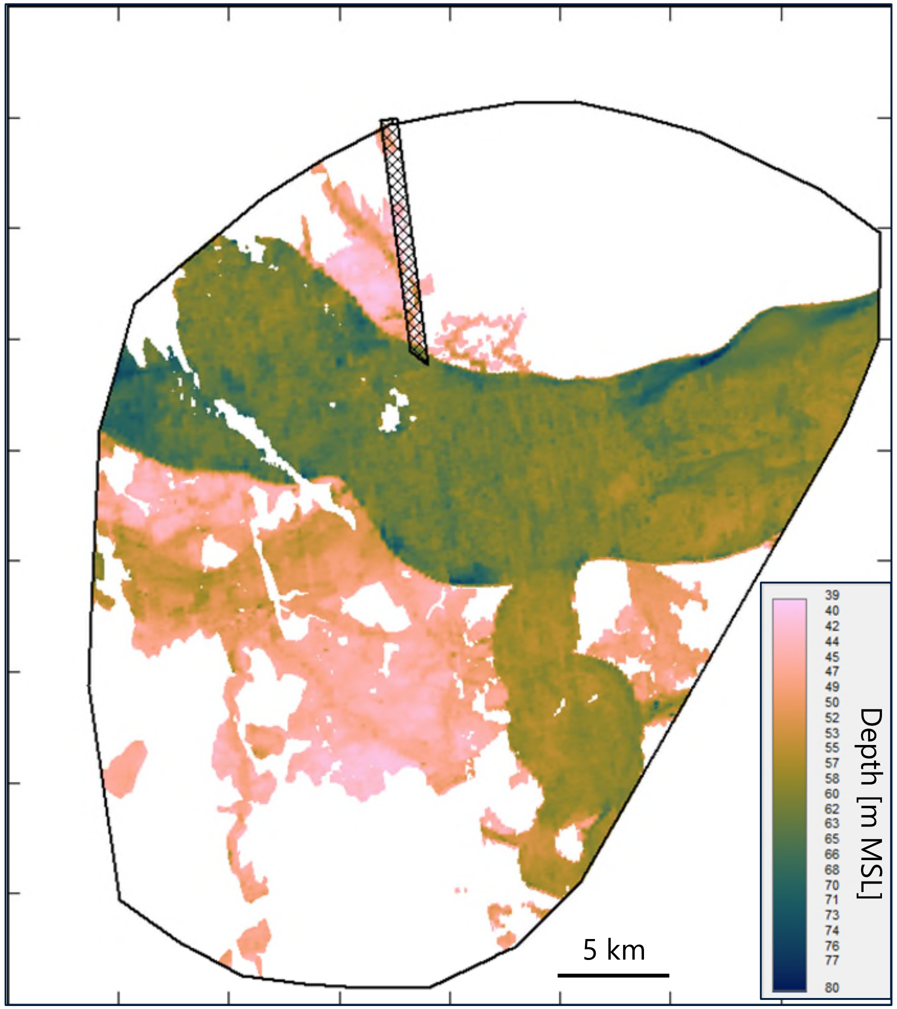


Figure 3.47: Depth to horizon 3GW_H30 (base of Unit U30). Black: Area were re-interpretation is recommended.

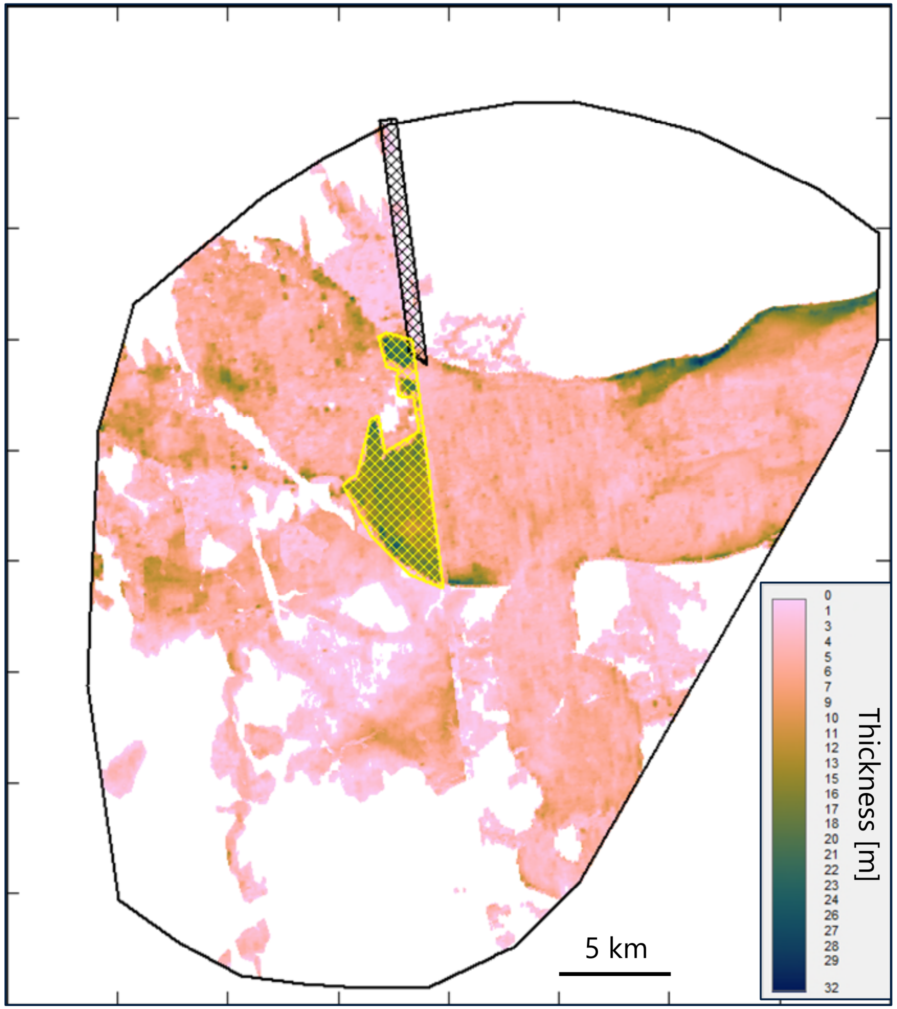


Figure 3.48: Thickness of Unit U30. Black: Area were re-interpretation is recommended; Yellow: Area where it is recommended to interpret horizon 3GW_H25 in order to reduce the thickness of Unit U30.

3.3.1.10 Unit U25

Unit U25 has a sheet-like geometry with a horizontal to undulating base and steep erosional margins. The unit reaches a maximum thickness up to 26 m (Figure 3.49, Figure 3.50). The base of Unit U25 is marked by horizon 3GW_H25. The distribution of Unit U25 is closely associated with the distribution of the underlying Unit U30, Unit U35 and Unit U60. The distribution of Unit U25 is also closely associated with deformed unit D24, which mainly comprises material which represents the deformed equivalent of Unit U25.

Internally, the unit is stratified with horizontal medium to high amplitude, closely spaced parallel reflectors. Locally, in the east of the 3GW Project Area, internal channels with acoustically transparent infill are present in this unit, especially in the upper part.

Horizon H25 is only interpreted in OWF Zone East. In OWF Zone West, the interval with the stratified seismic character was included in Unit U30 because it is often thin or absent. It is possible to extent the interpretation of Horizon 3GW_H25 over short distances in OWF Zone West. (Figure 3.27, Figure 3.28; yellow area in Figure 3.49 and Figure 3.50; See also Section 3.5.3).

For OWF Zone East, this unit was interpreted to be deposited on a flood plain and/or transgressive estuary due to the presence of channels towards the top of the unit. Here we interpret that the stratified Unit U25 was deposited in a (glacio-) marine or (glacio-) lacustrine environment (Larsen and Andersen, 2005; GEUS and Orbicon, 2010; Ramboll, 2021). The channels towards the top of the unit are interpreted to be turbidity channels (Dong *et al.,* 2015; Howlett *et al.,* 2022). The stratigraphic position of this unit (underneath Unit D24) indicates an Eemian or Weichselian age.

Unit U25 may correlate to the Ling Bank Formation and/or Dogger Bank Formation in the British sector of the North Sea. The Ling Bank Formation may be of Eemian age, the Dogger Bank Formation is Weichselian in age (Fyfe, 1986; Jeffrey *et al.,* 1991).

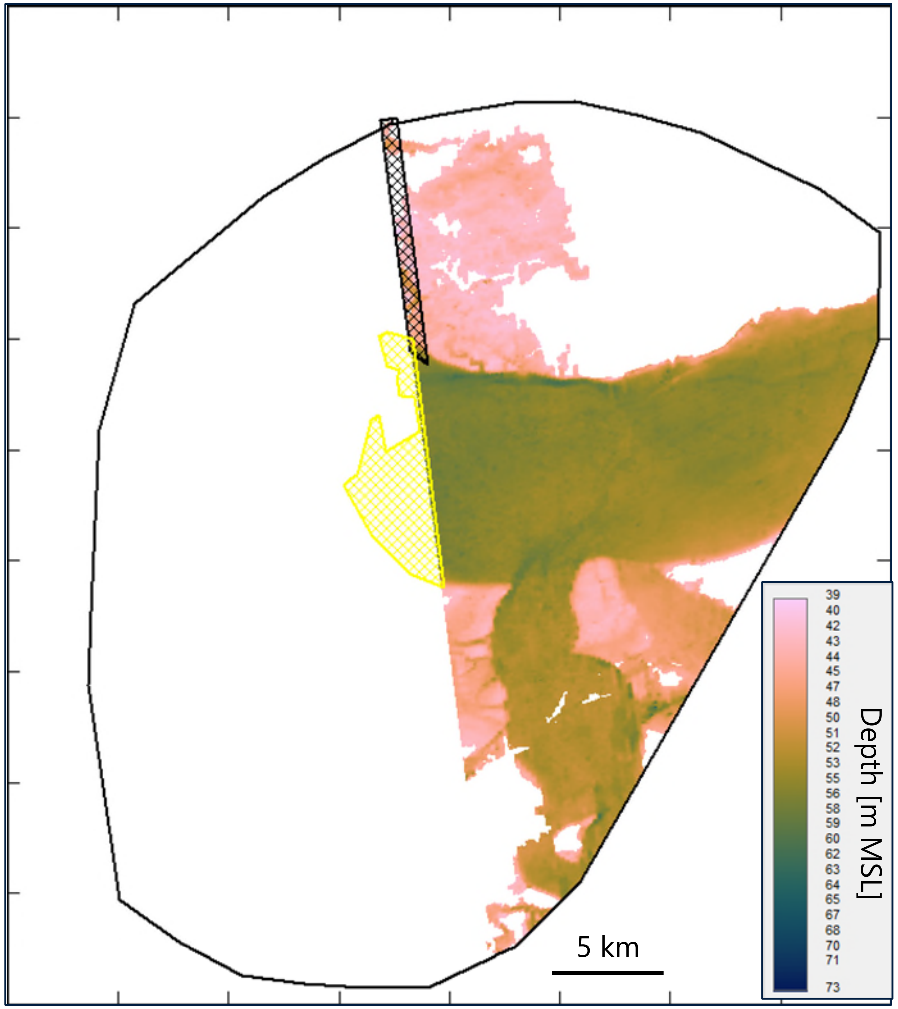


Figure 3.49: Depth to horizon 3GW_H25 (base of Unit U25). Black: Area were re-interpretation is recommended; Yellow: Area where it is recommended to interpret horizon 3GW_H25.

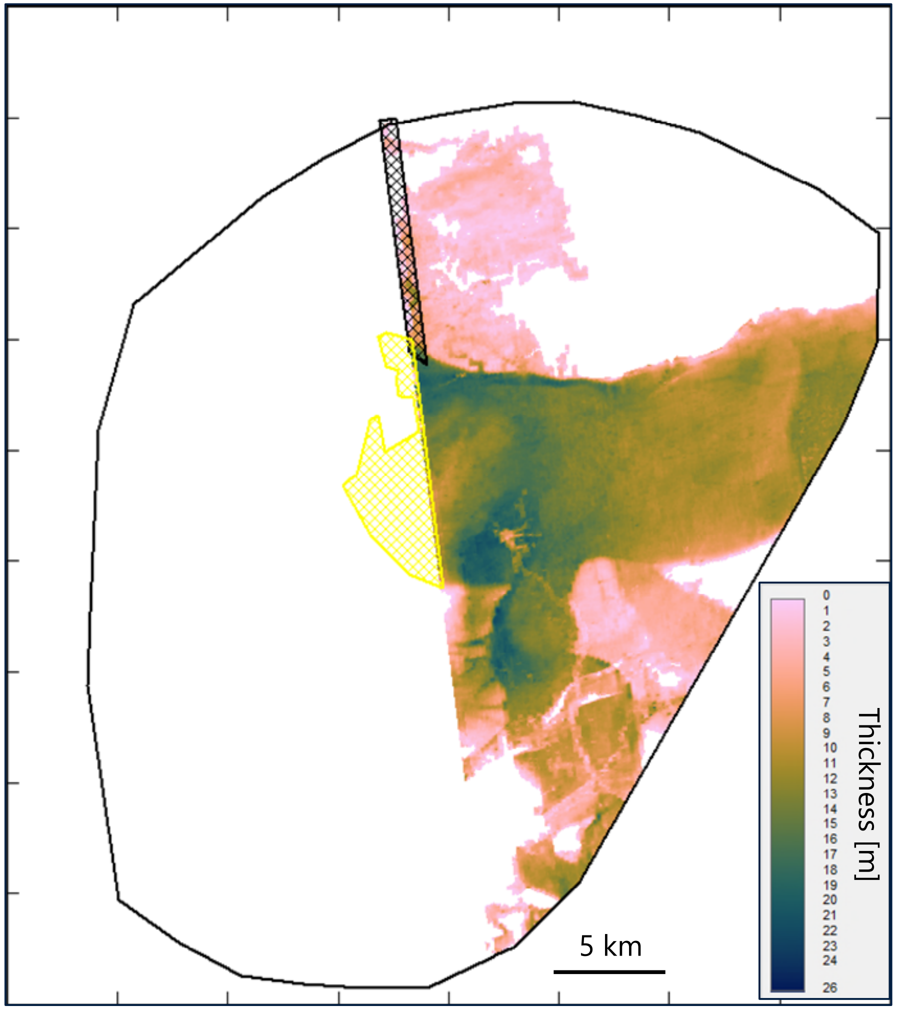


Figure 3.50: Thickness of Unit U25. Black: Area were re-interpretation is recommended; Yellow: Area where it is recommended to interpret horizon 3GW_H25.

3.3.1.11 Unit D24

Unit D24 has a sheet-like geometry with a horizontal to undulating base. The unit has a thickness of up to 44 m (Figure 3.51, Figure 3.52). The base is marked by horizon GW3_H24. The unit is present in the north and its distribution correlates with the distribution of Unit U25 and underlying Unit U30, Unit U35 and Unit U60. Unit D24 is interpreted to be the same material as Unit U25, however Unit D24 is glacially deformed and locally incorporates beds of deeper units.

Internally, the unit shows evidence for deformation. In areas where the unit is less deformed, the original stratification appears to be folded. Where this unit is more deformed, northward dipping thrust faults are observed. Transparent seismic character observed in some areas may indicate strongly deformed sediments, e.g., a complete loss of the original stratification.

Deformed Unit D24 was only interpreted in OWF Zone West. However, there are areas in OWF Zone East where Unit U25 is deformed. In OWF Zone East the areas of deformed Unit U25 are included in Unit U25.

The maximum ice extent during the Weichselian was situated within the northern part of the 3GW Project Area (Figure 3.2; Huuse and Lykke-Andersen, 2000b; GEUS and Orbicon, 2010; Ramboll, 2021). Therefore, it is interpreted that this unit may represent a push-moraine formed during the Weichselian glacial period.

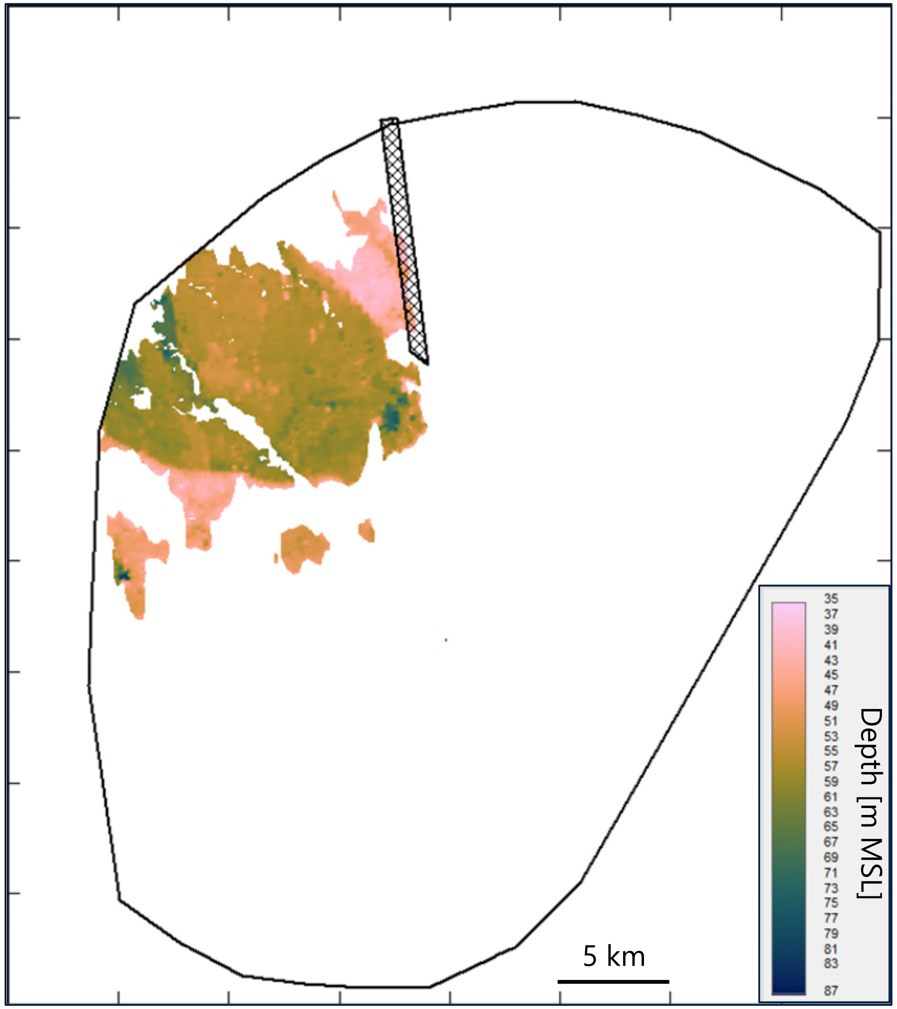


Figure 3.51: Depth to horizon 3GW_H24 (base of Deformed Unit D24). Black: Area were re-interpretation is recommended.

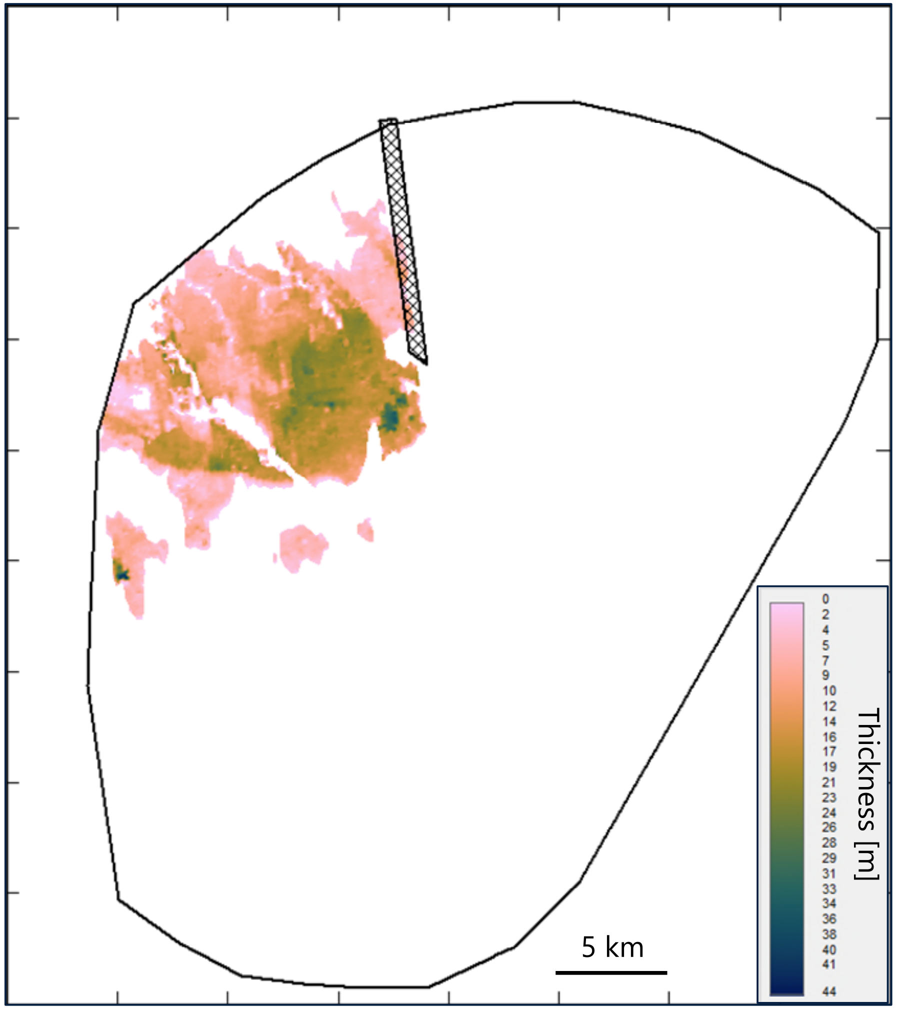


Figure 3.52: Thickness of Deformed Unit D24. Black: Area were re-interpretation is recommended.

3.3.1.12 Unit U20

Unit U20 forms the infill of channels that vary in dimension. The maximum thickness reaches approximately 111 m (Figure 3.53, Figure 3.54). The base of Unit U20 is marked by horizon H20, a low to high amplitude positive reflector, or a change in seismic character.

Internally, the unit contains low to high amplitude stratification parallel to the base of the channel. Locally this unit is seismically transparent or chaotic. In the southern part of the 3GW Project Area, the unit forms one large channel with a west-southwest to east-northeast orientation and is connected with numerous small channels forming a tributary network (Figure 3.53, Figure 3.54). In the northern part of the 3GW Project Area the unit forms one deep, narrow channel with a northwest to southeast orientation, and associated smaller channels that run parallel to the deep channel (Figure 3.53, Figure 3.54). These channels are associated with some smaller tributary channels. In the north and northwest of the site, Unit U20 has in general a sheet-like geometry (Figure 3.53, Figure 3.54).

Horizon H20 has been interpreted in both OWF Zone West and OWF Zone East and has been merged into 3GW_H20, without major resulting issues.

The channels of this unit were eroded and partially filled in a fluvial and estuarine depositional environment when the site was flooded after the last glacial maximum (late Weichselian to early Holocene). In the north and northwest of the 3GW Project Area, where Unit U20 forms a relatively thin horizontal layer, this unit was deposited in a coastal environment at the river-mouth, which flowed towards the northwest, where the palaeo-coastline was situated (Leth, 1996; Larsen and Andersen, 2005; Jensen *et al.,* 2008).

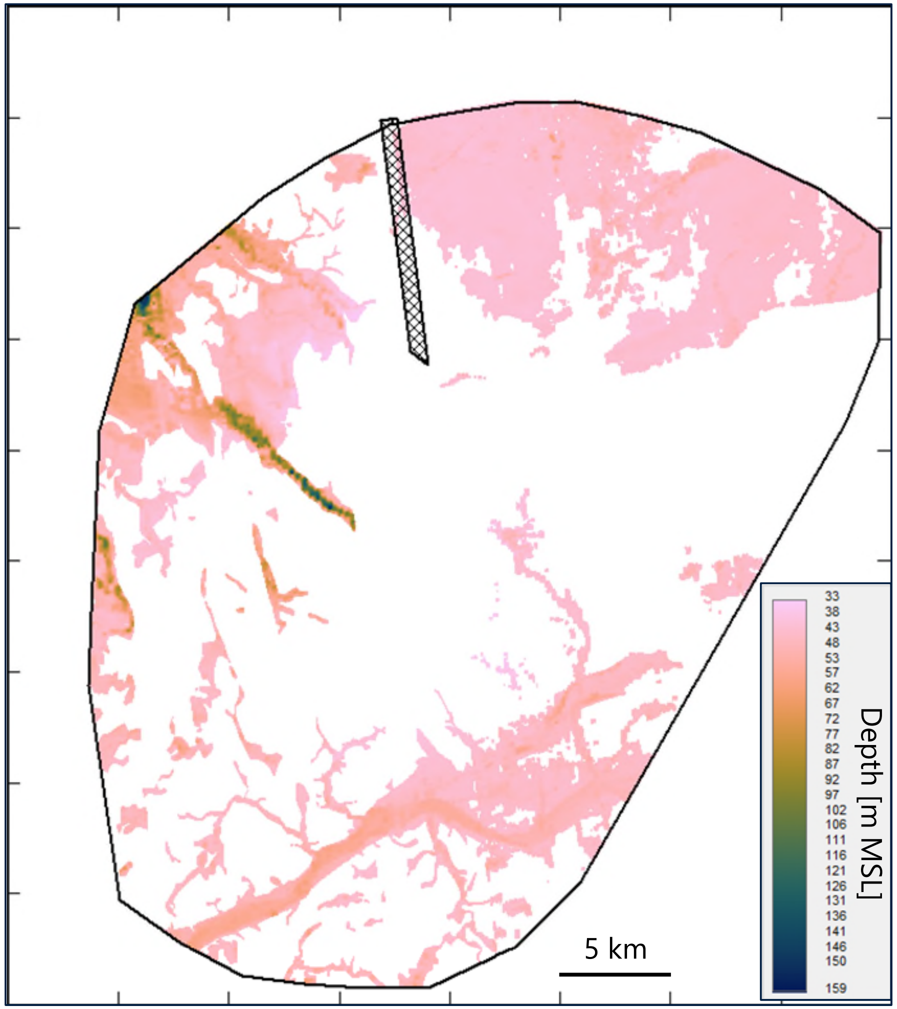


Figure 3.53: Depth to horizon 3GW_H20 (base of Unit U20). Black: Area were re-interpretation is recommended.

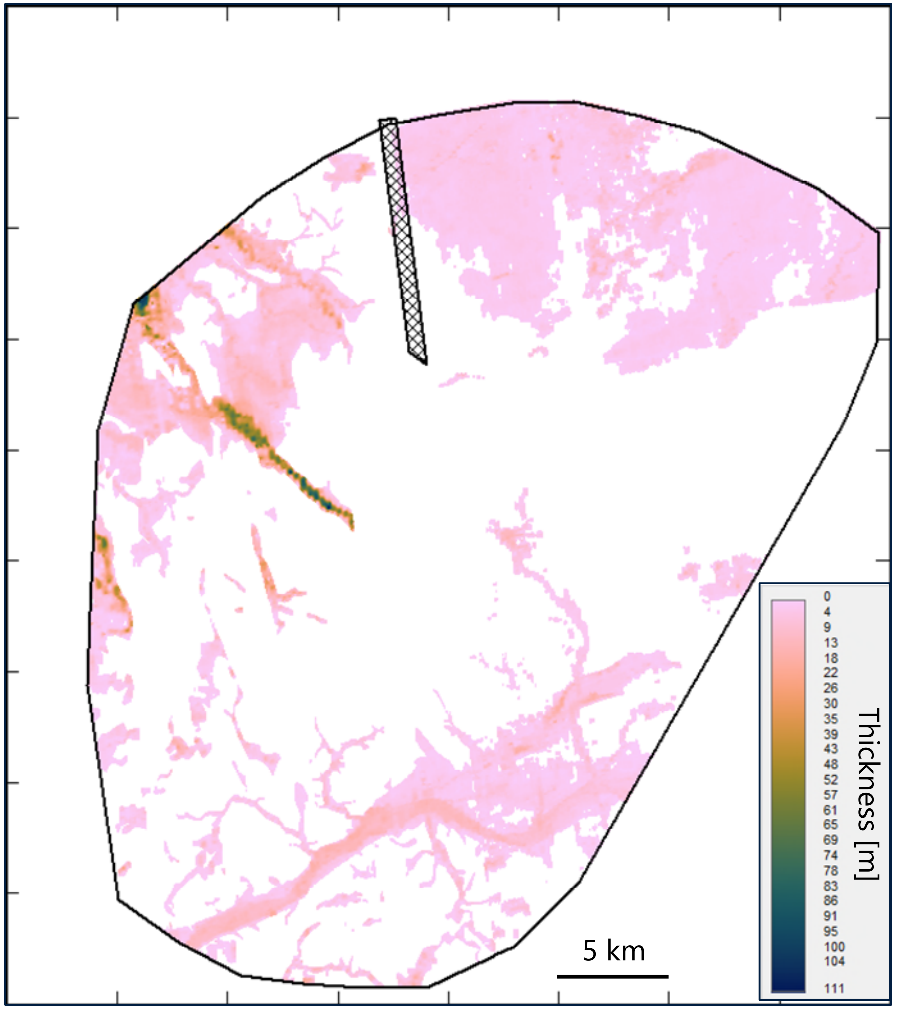


Figure 3.54: Thickness of Unit U20. Black: Area were re-interpretation is recommended.

3.3.1.13 Unit U10

Unit U10 is present across almost the entire site and is generally less than 5 m thick (Figure 3.56). In the north of the site, Unit U10 is thicker, reaching a maximum thickness of 22 m in the northwest and central part of the 3GW Project Area. The area where Unit U10 is thicker corresponds to the bathymetric shallow area (Figure 3.55).

Locally, the base of Unit 10 (horizon H10) may be within the seafloor pulse of the SBP data. It should be noted that the seismic data cannot resolve a top layer thinner than 0.3 m (Peuchen and Westgate, 2018). Therefore, in areas where Unit U10 is interpreted to be absent, a thin layer (<0.3 m) of Unit U10 cannot be excluded.

The basal horizon H10 has a horizontal to undulating geometry and is generally a medium to high amplitude positive reflector. Where Unit U10 overlies Unit U20, Unit U25 or Unit U30, horizon H10 can be a low amplitude positive or negative reflector. The basal horizon H10 has been interpreted on the 2D-UUHR and SBP datasets. In the north and central part of the site, where Unit U10 is thicker, two internal horizons H05 and H06 were observed on the SBP data (Figure 3.57, Figure 3.58)

In the area where Unit U10 is thin, i.e., less than approximately 5 m, its internal seismic character is acoustically transparent on 2D-UUHR data and acoustically transparent to chaotic on the SBP data.

Horizon H10 has been interpreted in both OWF Zone West and OWF Zone East and have been merged into 3GW_H10, without major resulting issues. Internal horizon H05 has also been interpreted in both OWF Zone West and OWF Zone East and has been merged (3GW_H05), without major resulting issues. Internal horizon H06 in OWF Zone West has been merged with internal horizon H10i of OWF Zone East, resulting in horizon 3GW_H06.

In OWF Zone West the internal horizons 3GW_H05 and 3GW_H06 form the top and base of an interval with inclined stratification dipping towards the north. The interval above 3GW_H05 is acoustically transparent to chaotic. The interval between 3GW_H10 and 3GW_H06 is acoustically transparent to complex with internal reflectors. In the far north of the site, the interval between 3GW_H10 and 3GW_H06 comprises high amplitude stratified to chaotic reflectors. In OWF Zone East both internal horizons are picked above the inclined stratification dipping towards the north and east.

Unit represents Holocene marine sediments, which were deposited during and after the Holocene transgression. The internal inclined stratification in the north and central part of the site where Unit U10 is thick may represent a short period of coastline progradation of spits or barrier-islands in the early Holocene.

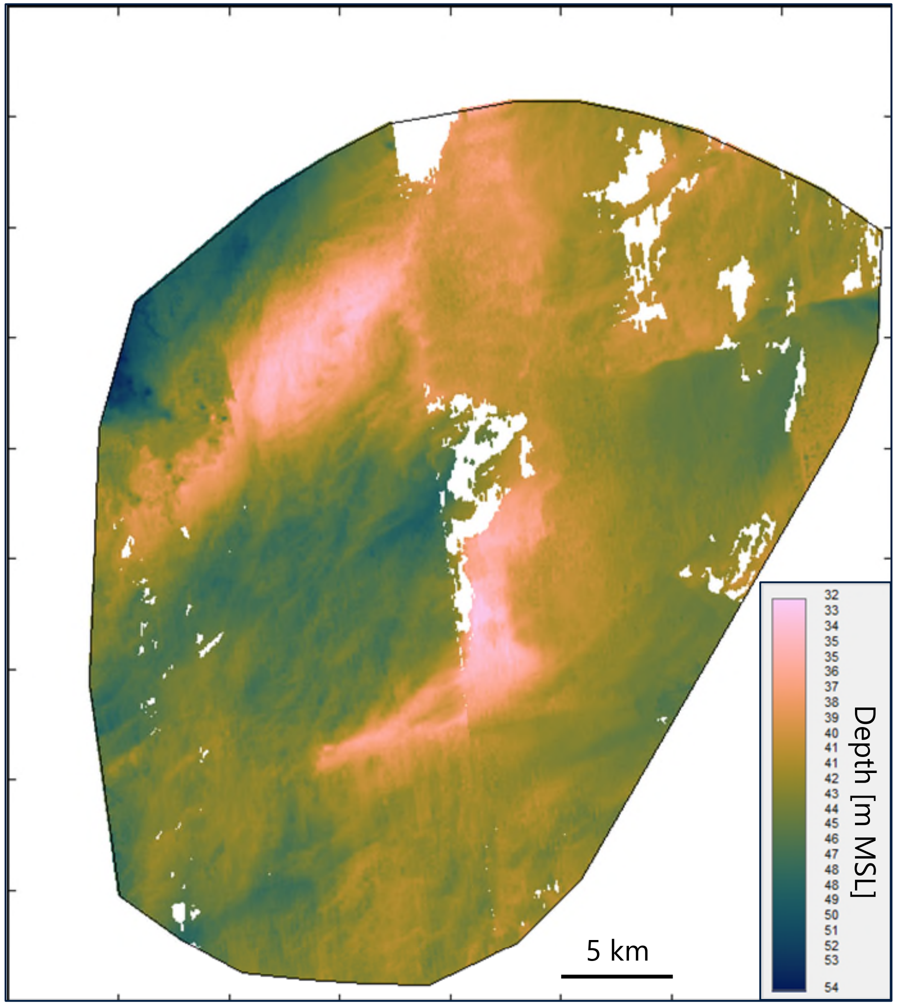


Figure 3.55: Depth to horizon 3GW_H10 (base of Unit U10).

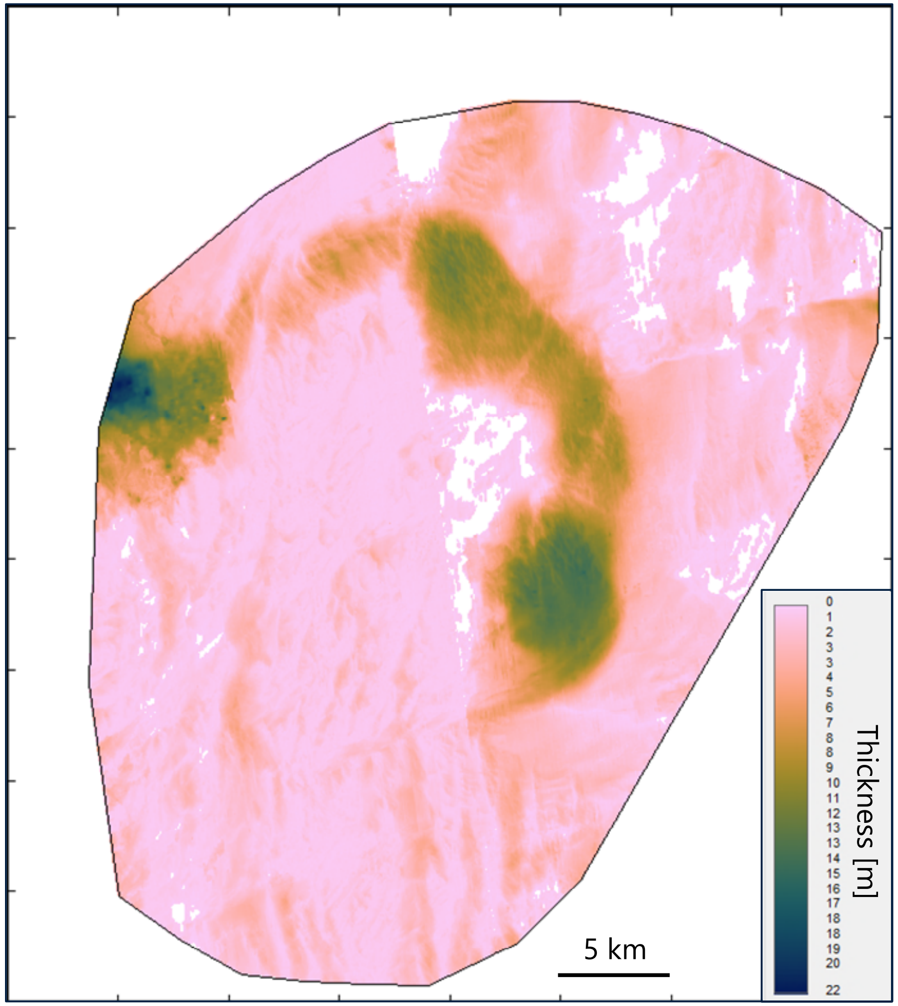


Figure 3.56: Thickness of Unit U10.

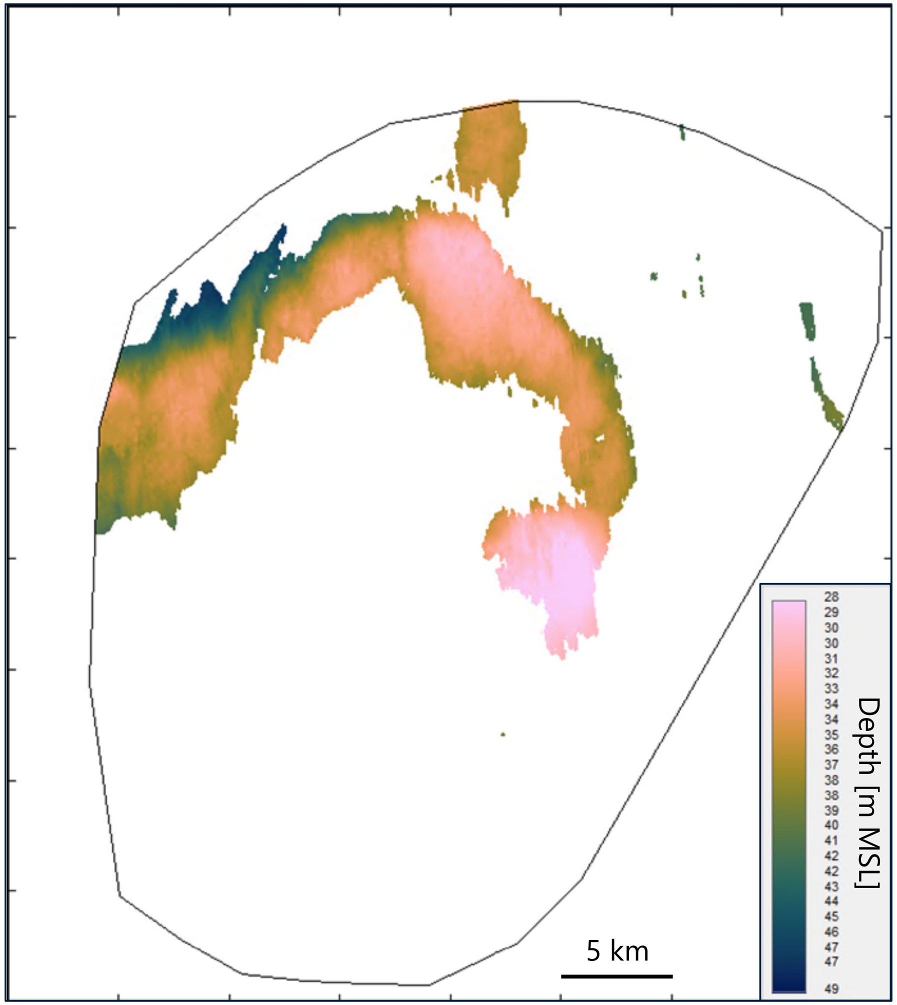


Figure 3.57: Depth to horizon 3GW_H05 (internal horizon in Unit U10).

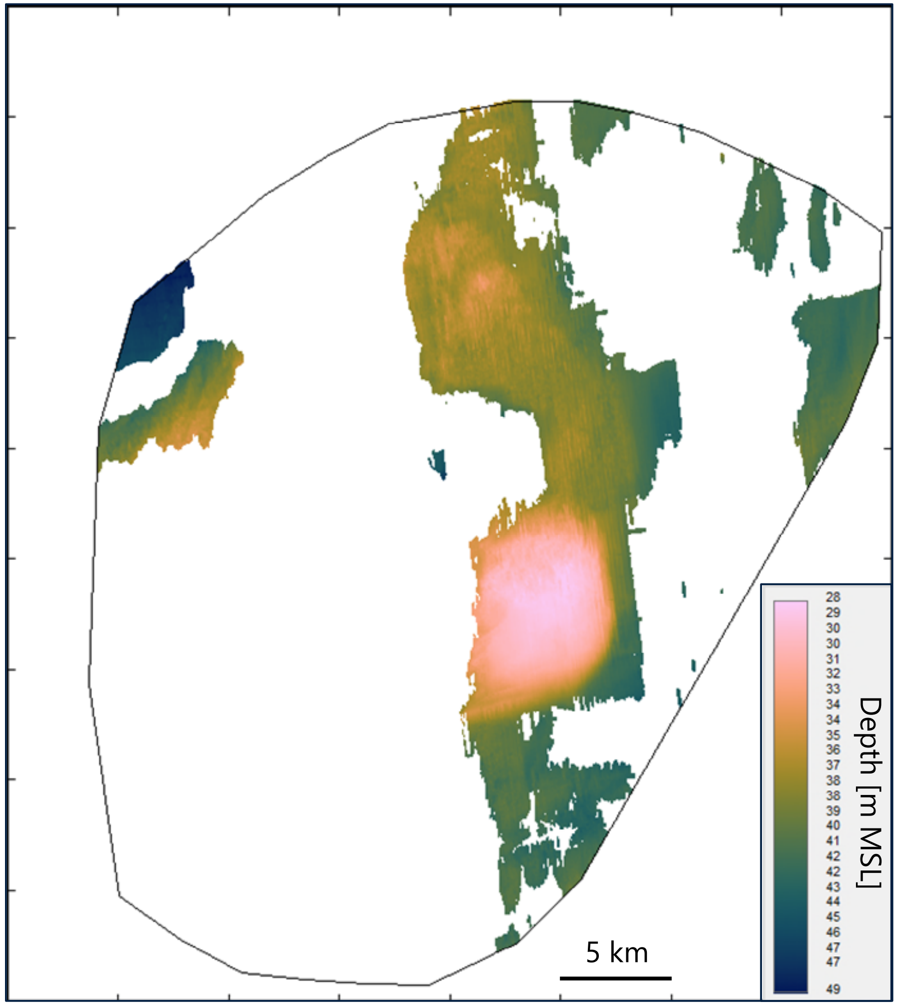


Figure 3.58: Depth to horizon H06 (internal horizon in Unit U10).

3.4 Geological Features

Nine 'sub-seabed hazards' have been interpreted in OWF Zone East. Four types of 'geological features' have been interpreted in OWF Zone West. These have been integrated in eight types of 'geological features. Table 3.14 provides an overview of the integration of geological features.

Table 3.14: Overview of integration of geological features of OWF Zone West and OWF Zone East

3GW Project Area Integration	OWF Zone West (F176286-REP-GEOP-001 05)	OWF Zone East (103783-ENN-MMT-SUR-REP-SURVWPA)	Discussed in section
Acoustic blanking	Acoustic blanking	GHz Gas	Acoustic Blanking
Amplitude anomaly level 1	Amplitude anomaly level 1	Not present	Amplitude Anomalies
Amplitude anomaly level 2	Amplitude anomaly level 2	Ghz SK U85	Amplitude Anomalies
Thrusted complex	Thrusted complex	UKSA Thrusting and UKSB Thrusting	Glacial Deformation
Unit D24	Unit D24	Faults	Glacial Deformation
Area with normal faults	Not present	UKSA Subsidence and UKSA Extension	Salt Tectonics
Normal faults	Normal faults	Faults	Faults
Inverted normal fault	Inverted normal fault	Faults	Faults
Deformation associated with tunnel valley	Not present	UKSA Tunnel Valley	Gravitational Deformation
Feature not considered for integration	Not interpreted	Ghz Channels	Buried Channels and Tunnel Valleys
Feature not considered for integration	Not interpreted	GHz SK10	Amplitude Anomalies
Feature not considered for integration	Not interpreted	GHz SK20	Amplitude Anomalies
Feature not considered for integration	Not interpreted	GHz SK25	Amplitude Anomalies
Feature not considered for integration	Not interpreted	GHz SK30	Amplitude Anomalies
Feature not considered for integration	Not interpreted	GHz SK35	Amplitude Anomalies
Feature not considered for integration	Not interpreted	GHz SK40	Amplitude Anomalies
Feature not considered for integration	Not interpreted	GHz SK50	Amplitude Anomalies
Feature not considered for integration	Not interpreted	GHz SK60	Amplitude Anomalies
Feature not considered for integration	Not interpreted	GHz gravel	Gravel, Cobbles and Boulders
Feature not considered for integration	Not interpreted	GHz lacustrine	Not discussed
Note: GHz is an abbreviation for 'geohazard'			

3.4.1 Glacial Deformation

Glacial deformation was observed at two levels, in Unit D24 and Unit U25, and in BSU.

In the north, Unit U25 appears deformed to various degrees. The parts where Unit U25 is deformed in OWF Zone West, it is classified as deformed Unit D24 with basal horizon H25. Deformation within Unit U25 includes folding and thrust faults In OWF Zone East, individual faults are picked, but not in which unit they occur. Acoustic transparency observed locally in the unit may indicate a high degree of disturbance.

During the Weichselian, the maximum extent of the ice sheet was over the northernmost part of the site (Figure 3.2; GEUS and Orbicon, 2010; Ramboll, 2021). Since the observed deformation features are limited to the shallow sub-surface and the northern part of the site, it is interpreted that the deformation of Unit D24 is the result of Weichselian ice-push.

In the north, the BSU contains well-defined thrust-faults forming a thrusted complex with a detachment surface at approximately 140 m MSL. In OWF Zone West, the area of deformed BSU was indicated with a polygon ‘thrusted complex’. In OWF Zone East, deformed BSU was included in Unit KSA and Unit KSB. The ‘thrusted complex’ was extended to cover Unit KSA and Unit KSB where they comprise thrust faults (Figure 3.59).

The thrust faults in BSU are interpreted to be the result of ice-push (Huuse and Lykke-Andersen, 2000a; Larsen and Andersen, 2005; Winsemann *et al.,* 2020; Cartelle *et al.,* 2021). The orientation of the thrust faults indicate that the ice-push came from the north and east. Because only the BSU is deformed, it is interpreted that deformation took place in an earlier glacial, namely the Elsterian and/or Saalian glaciation.

3.4.2 Faults

Normal faults and an inverted normal fault were observed in the BSU (Figure 3.59). They extend locally into the base of the overlying Unit U90. In OWF Zone West, individual normal faults and one inverted normal fault have been mapped as lines. In OWF Zone East, one individually picked normal fault has been integrated with the normal fault lines of OWF Zone West.

The normal faults with a northwest to southeast and north-northwest to south-southeast orientation are considered to the result of late Cenozoic extension. The inversion of the normal fault in the east of the site may be related to ice-push during the Elsterian and/or Saalian ice age.

3.4.3 Salt Tectonics

In OWF Zone East, an area of ‘subsidence’ and an area of ‘extension’ have been recognized. Both areas are interpreted as part of Unit KSA. Both areas have been combined in ‘area with normal faults’ (Figure 3.59). Both areas have a circular shape in map view and correlate to the presence of salt domes in the subsurface (103783-ENN-MMT-SUR-REP-SURVWPA).

3.4.4 Deformation Associated with Tunnel Valleys

In OWF Zone East, part 'gravitational deformation' was mapped as part of Unit KSA. Unit KSA has been re-classified as Unit U70. The area of 'gravitational deformation' has been re-classified as 'deformation associated with tunnel valleys' (Figure 3.59).

3.4.5 Buried Channels and Tunnel Valleys

Buried channels and tunnel valleys are present at several levels throughout the site.

Unit U20 is the shallowest channelised unit, containing relatively narrow and shallow channels. One channel of Unit U20 is relatively narrow and deep.

Unit U40 and Unit U70 are the infill of tunnel valleys which are relatively narrow and deep. Unit U70 contains an internal change is acoustic character, where the interval above internal horizon H69 is more stratified and the internal below it is acoustically chaotic.

Deformed Unit D24, Unit U25, Unit U30, Unit U35 and Unit U60 are also channelised units, but they fill relatively wide and shallow valleys with river terraces.

Unit U35, Unit U60 and Unit U90 are interpreted to be deposits of braided river systems and contain internal channels and erosion surfaces.

In OWF Zone East, internal channels are mapped as 'Ghz Channels' at the levels listed above. No separate mapping of internal channels was done for the OWF Zone West.

3.4.6 Gravel, Cobbles, and Boulders

Unit U35, Unit U60, and Unit U90 are fluvial units interpreted to be deposited in a braided river environment. Braided rivers may be associated with the presence of gravel and cobbles. In Unit U35, relatively high amplitude internal reflectors are present which may represent gravel beds.

Unit U40 and Unit U70 are interpreted to be the infill of glacial tunnel valleys. Glacial deposits are often poorly sorted deposits and may contain gravel, cobbles, and boulders.

In OWF Zone East, gravel beds are mapped as 'Ghz Gravel' at the levels listed above. These have not been considered for integration in this report.

3.4.7 Amplitude Anomalies

Anomalies with a reversed amplitude are interpreted at two levels within Unit U90. No acoustic blanking is associated with these anomalies. These seismic anomalies may represent beds and/or laminae of peat or organic rich clay (Figure 3.61, Figure 3.62). In OWF Zone West, these features were mapped as 'amplitude anomalies level 1 and level 2'. In OWF Zone East anomalies in Unit U90 were mapped as 'Ghz SK U85'. For this report, 'Ghz SK U85' was merged with 'amplitude anomalies level 2' from OWF Zone West.

In OWF Zone East, additional seismic anomalies in form of high amplitude anomalies are present throughout the site at several levels (GHz SK10, GHz SK20, GHz SK25, GHz SK30, GHz SK35, GHz SK40, GHz SK50 and GHz SK60). These features do not have counterparts in OWF Zone West and have not been considered for integration.

3.4.8 Acoustic Blanking

Acoustic blanking and/or signal distortion was observed below some (limited) amplitude anomalies. These features were typically present between 3 m and 16 m BSF and are associated with channels of Unit U20 (Figure 3.60). The degree of signal distortion and/or blanking may vary slightly between neighbouring seismic lines. The acoustic blanking can be due to the presence of gas in the soil. In OWF Zone West these features were mapped as 'acoustic blanking'. In OWF Zone East these features were mapped as 'GHz Gas'.

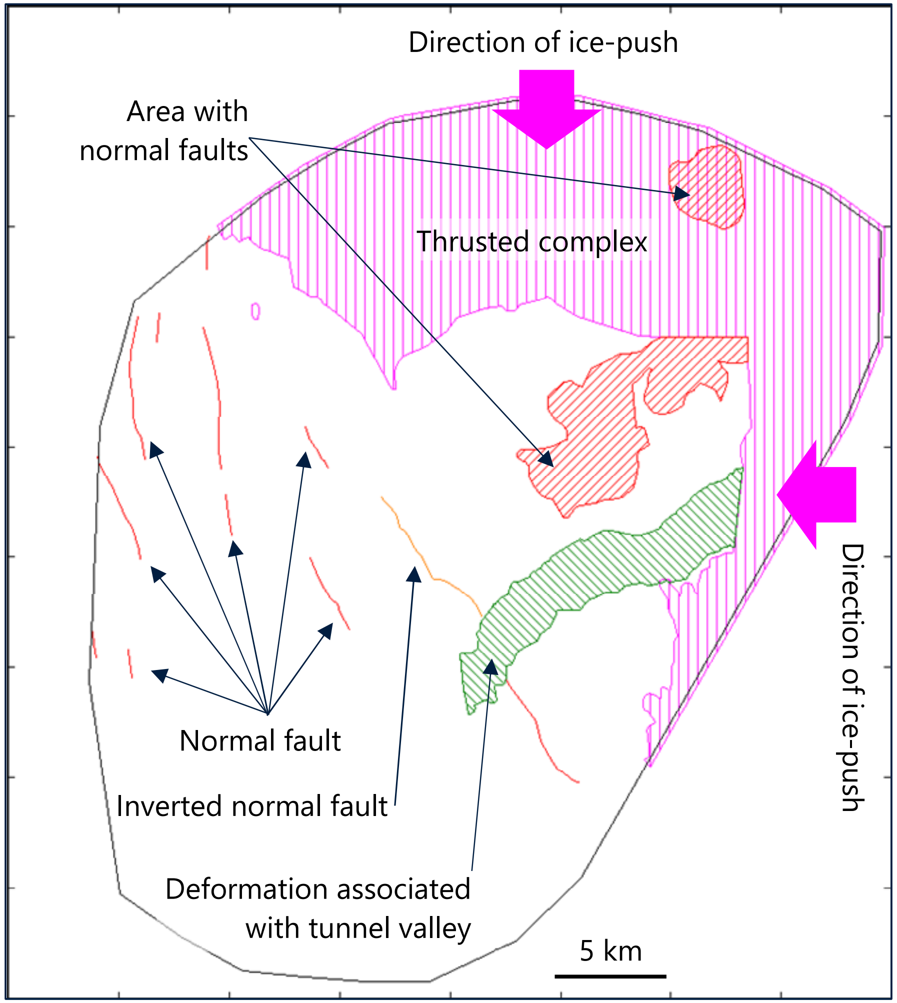


Figure 3.59: Areas with deformation.

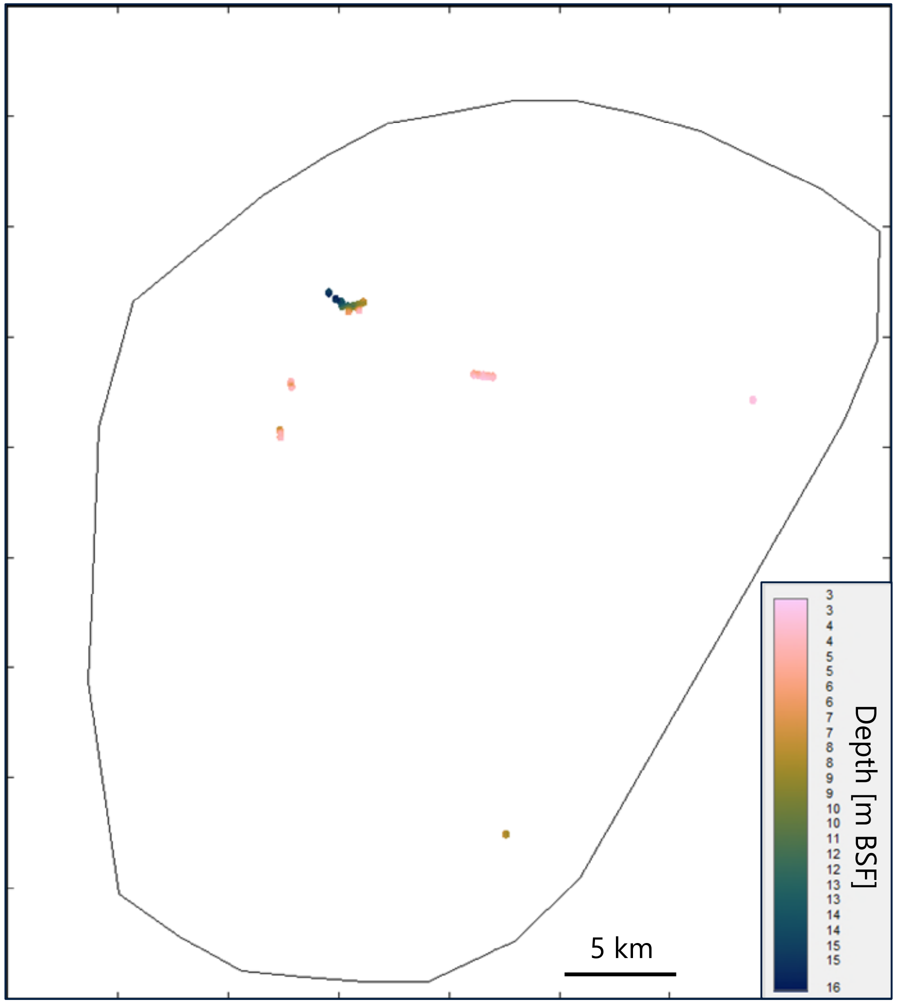


Figure 3.60: Areas with acoustic blanking.

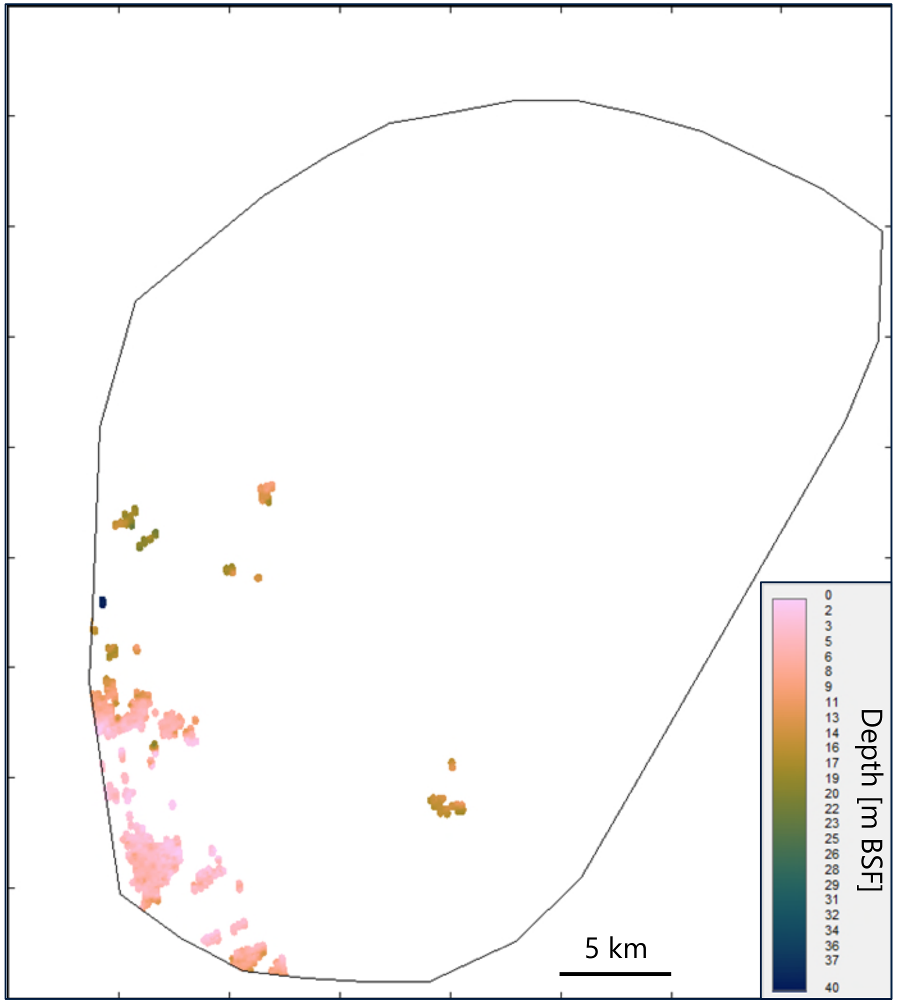


Figure 3.61: Map of amplitude anomalies level 1.

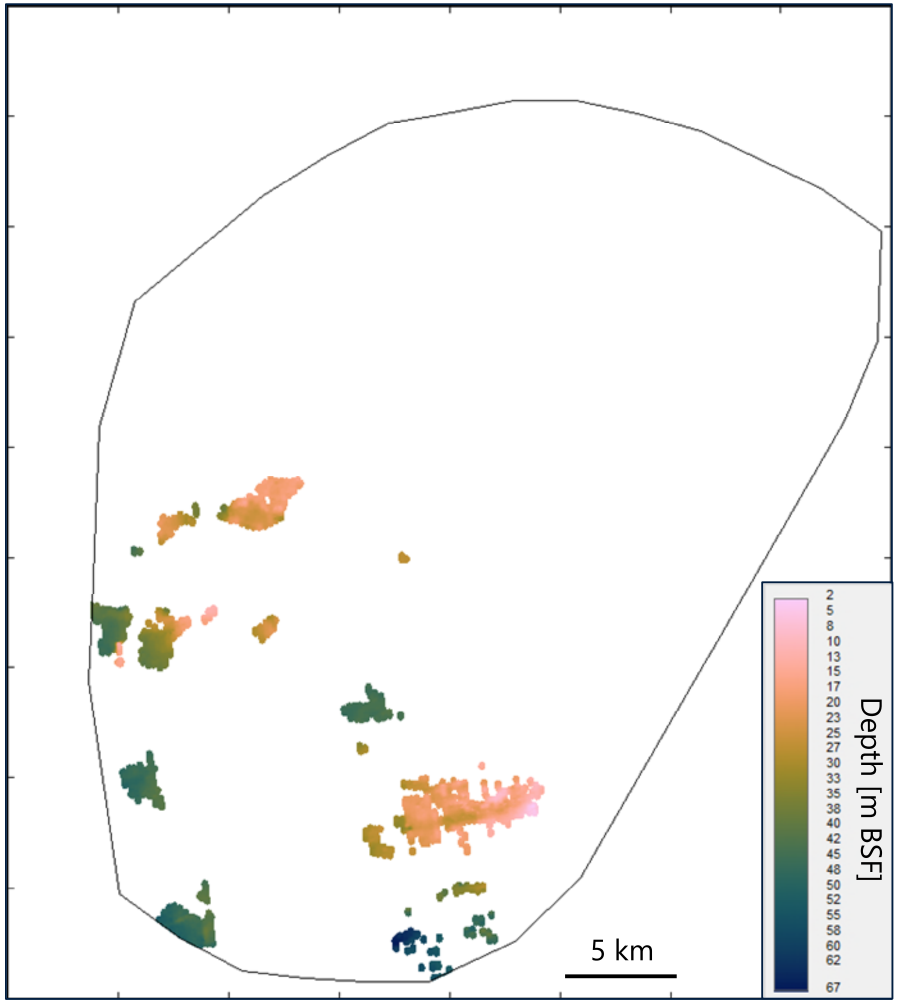


Figure 3.62: Map of amplitude anomalies level 2.

3.5 Recommendations

This section provides recommendations that may further improve the consistency of interpretation between OWF Zone West and OWF Zone East. An overview of the areas where a partial re-interpretation of the horizons is recommended is given in Figure 3.63.

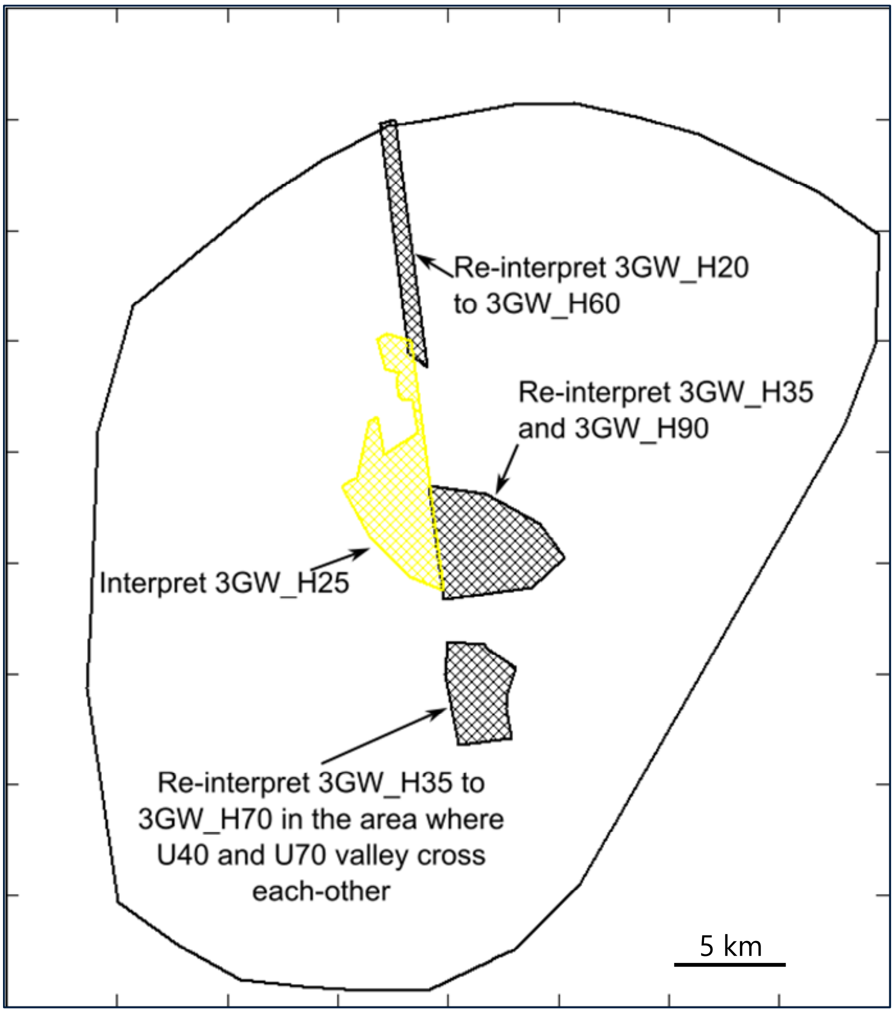


Figure 3.63: Overview of areas where re-interpretation of the horizons is recommended.

3.5.1 U70 tunnel valleys

In OWF Zone East, the lower part of Unit U70 with a chaotic acoustic character, and BSU deformed by thrust faults, have both been interpreted with basal horizons KSA and KSB (Figure 3.34). Both horizons have been combined with horizon H70 in OWF Zone West (Figure 3.30, Figure 3.31, Figure 3.35). It is recommended to re-interpret integrated horizon 3GW_H70 in OWF Zone East in the ‘thrusted complex’, ‘area with normal faults’ and the area with ‘deformation associated with tunnel valley’ (Figure 3.36) in order to distinguish between the infill of tunnel valleys (Unit U70) and BSU which has been deformed by thrust faults (Figure 3.30 and Figure 3.36).

3.5.2 3GW_H35 and 3GW_H90 in the wide and shallow valley

In OWF Zone East, in the wide, shallow valley of U35 close to OWF Zone West, it is recommended to re-interpret 3GW_H35 and 3GW_H90 (Figure 3.23, Figure 3.27, Figure 3.28, and Figure 3.45).

3.5.3 H25 in OWF Zone West

Horizon H25 (base of Unit U25) is only interpreted in OWF Zone East. In OWF Zone West the stratified acoustic character of Unit U25 is included in Unit U30, however H25 can locally be identified. Unit U25 probably contains mainly CLAY, while Unit U30 probably contains mainly SAND. In order to distinguish between these two soil types, it is recommended to extend the interpretation of horizon 3GW_H25 in to OWF Zone West (Figure 3.27, Figure 3.28, Figure 3.47, Figure 3.49).

3.5.4 Crossing of Unit U40 and Unit U70 valleys in the south

In the south of the site, a valley of Unit U40 crosses a valley of Unit U70 (Figure 3.64). Originally, both valleys were interpreted to be part of Unit U70, and partially part of Unit KSA (Figure 3.64; MMT, 2022). However, for the integration it was needed to classify one of the two channels as Unit U40 to keep the right stratigraphic order with respect to Unit U60 (Figure 3.65). Therefore, it is recommended to re-interpret horizons 3GW_H35 to 3GW_H70 in the indicated area to maintain a consistent stratigraphic order of the horizons within this area (Figure 3.66).

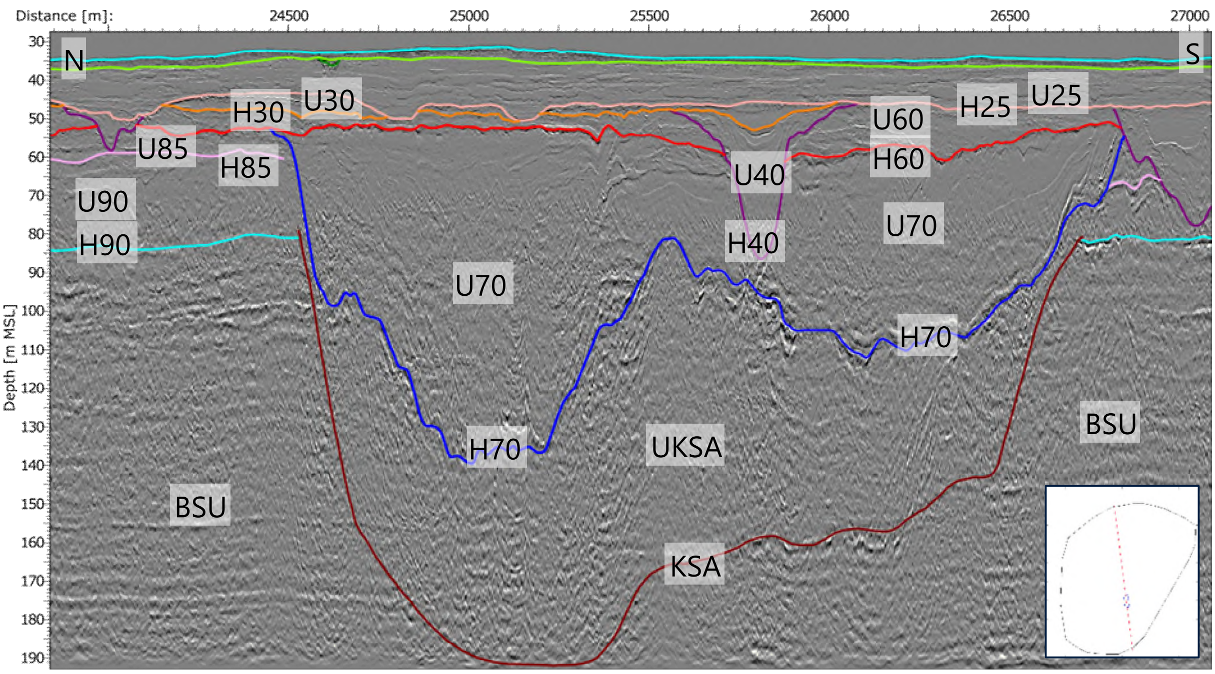


Figure 3.64: Original interpretation of the area where valleys of Unit U40 and Unit U70 cross each other in the south of the site. The colour coding is the colour coding used by MMT (103783-ENN-MMT-SUR-REP-SURVWPA) for OWF Zone East.

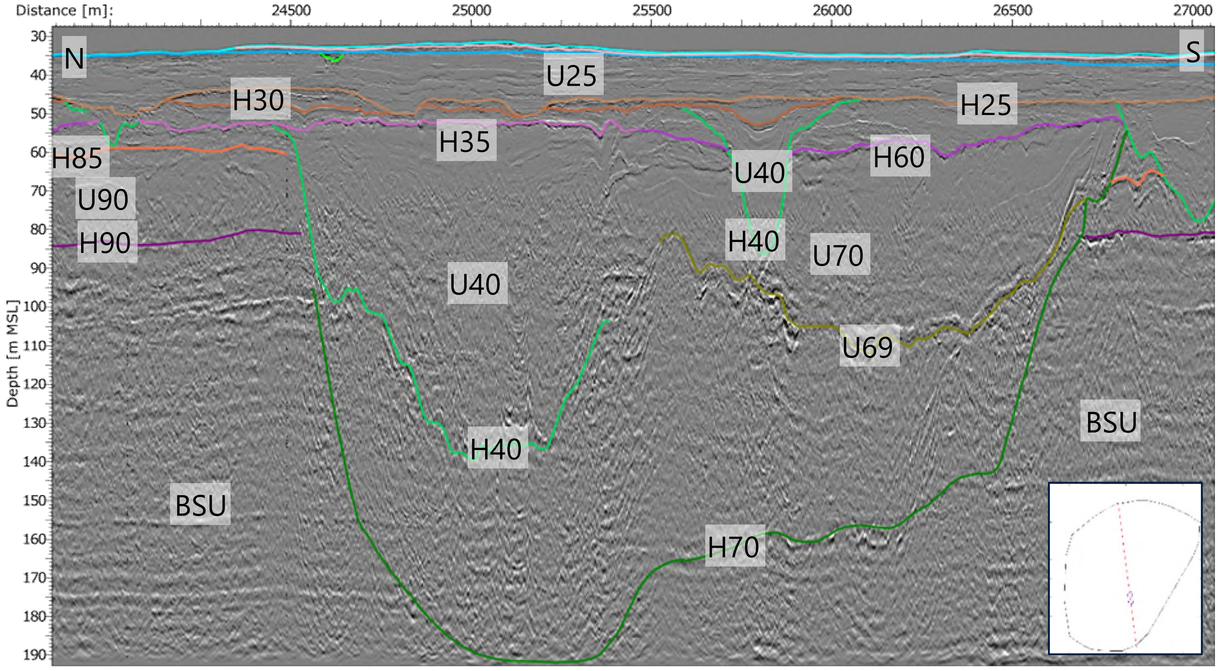


Figure 3.65: Reclassification of the valleys and overlaying horizons in this report.

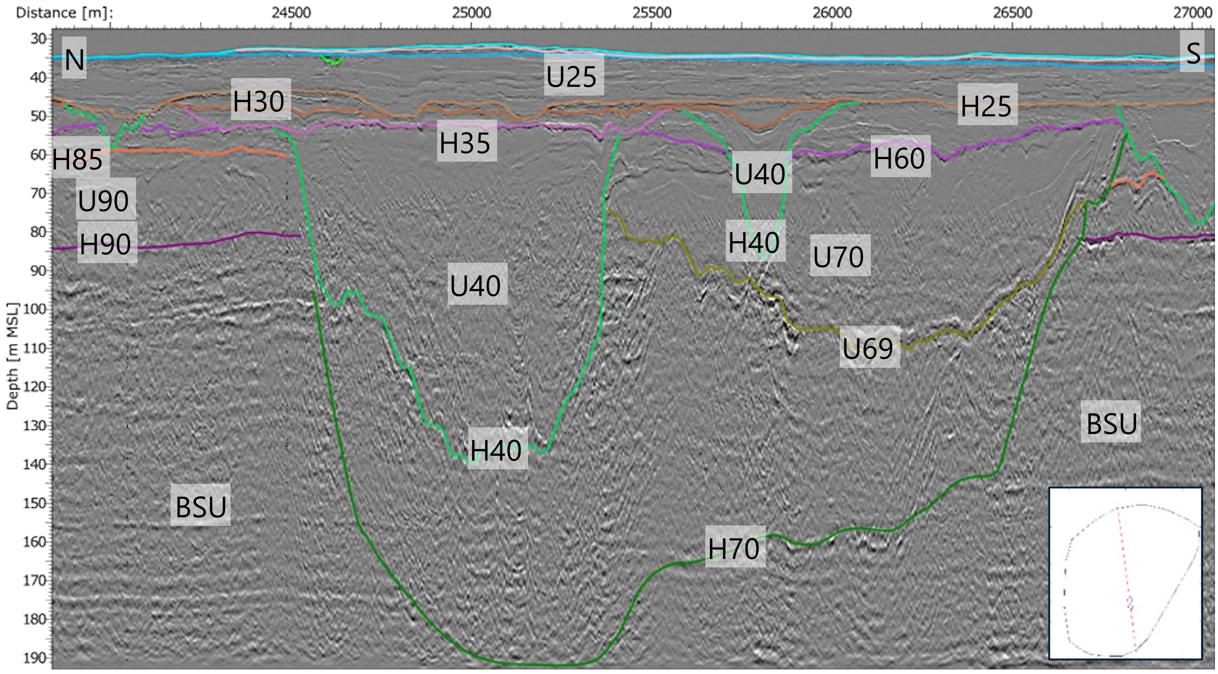


Figure 3.66: Recommended re-interpretation.

3.5.5 Boundary of OWF Zone West and OWF Zone East in the North

In the north of the site, deformed BSU is relatively close to the seafloor. Only a relatively thin cover of Quaternary units is present. This relatively thin Quaternary cover does contain internal reflectors. However, the seismic character is not well pronounced reducing interpretability. In OWF Zone West and OWF Zone East different choices of interpretation have been made resulting in a mismatch (Figure 3.67). It is recommended to re-interpret and simplify the interpretation by removing the horizontal parts of the interpretation of horizon

3GW_H40 and reclassify as 3GW_H60 as Unit U40 is generally a channelised unit, not a planar unit. A re-interpretation as horizon 3GW_H60 is assessed to be preferred in most locations because as it than correctly overlays Unit U70 valleys, and underlays the shallower Unit U20 and Unit U40 (Figure 3.68).

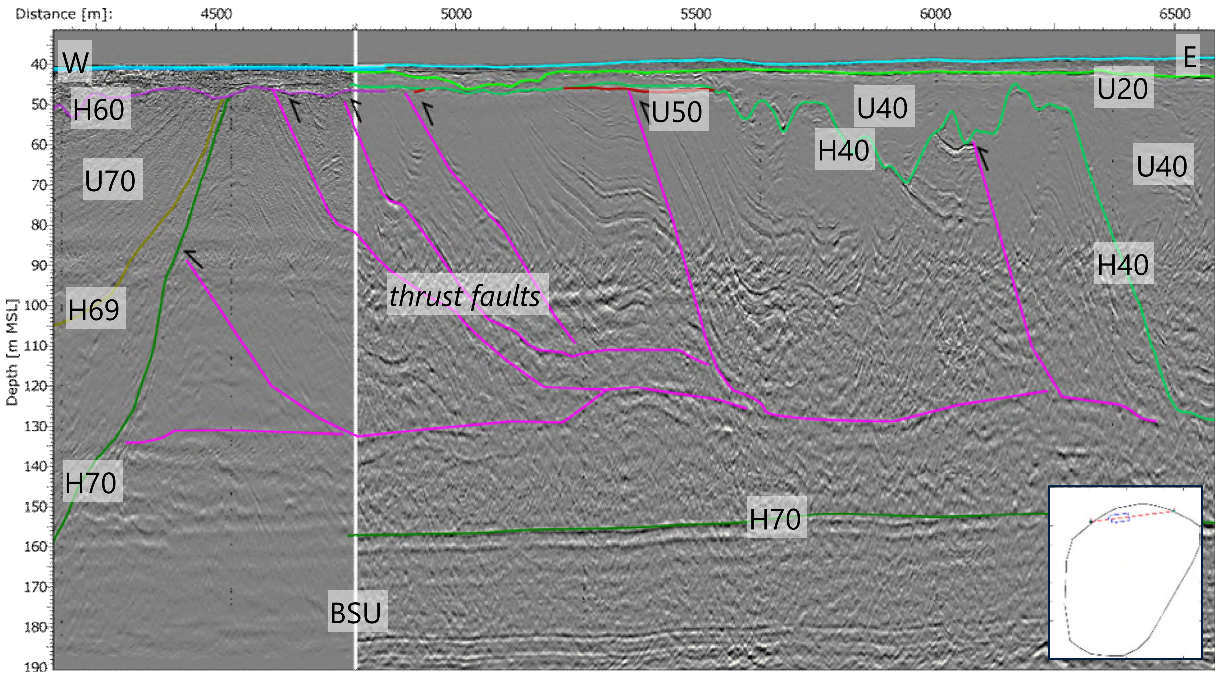


Figure 3.67: Integration of the horizons at the boundary of OWF Zone West and OWF Zone East in the north of the south.

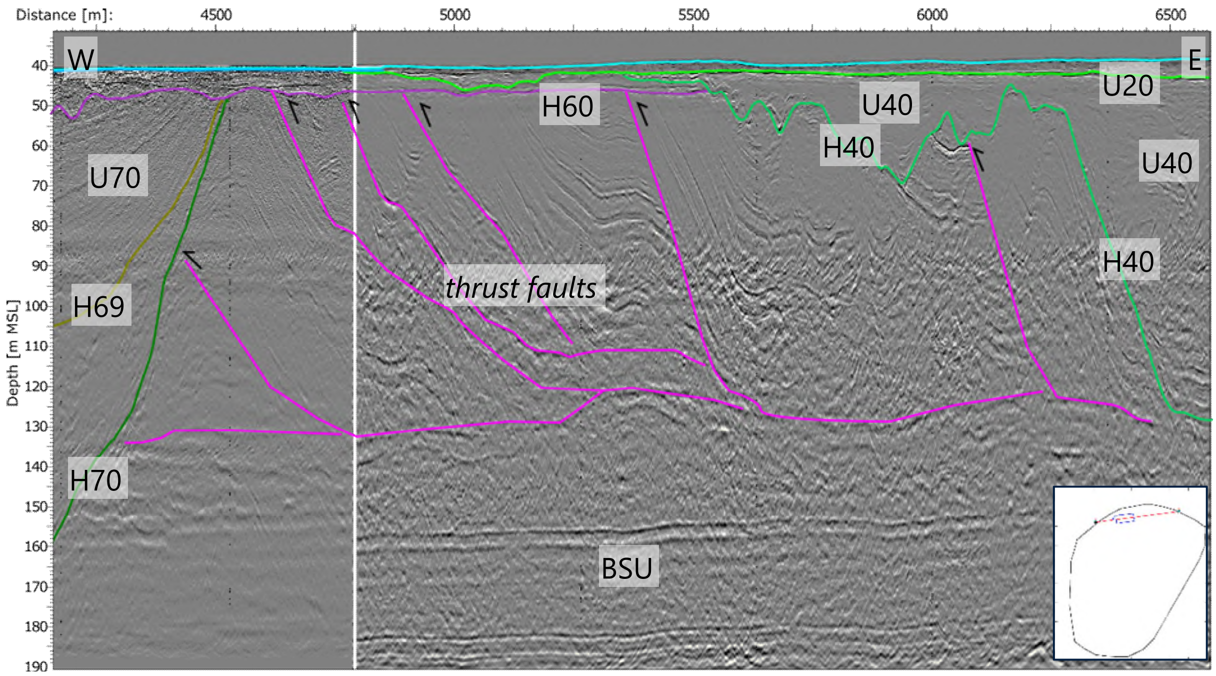


Figure 3.68: Recommended re-interpretation. Also note the recommended re-interpretation of H70 in OWF Zone East (see Section 3.5.1).

3.6 Archaeological Findings and Targets with Archaeological Potential

Fugro's expertise is limited regarding identification of archaeological findings. Thus, four (4) charted wrecks and two (2) possible shipwrecks were identified and classified as archaeological.

Detailed positions and measurements of the wrecks and debris items are presented in Table 3.15. All the wrecks were cross checked against the Seawar Museum database and four (4) of them were confirmed. Refer to section 3.2.6 and Figure 3.19 for data examples, and F176286-REP-GEOP-001 05 and 103783-ENN-MMT-SUR-REP-SURVWPA for detailed information.

Table 3.15: Positions and measurements of wrecks found within the 3GW Project Area.

SSS_ID	Details	Easting [m]	Northing [m]	Length [m]	Width [m]	Height [m]
EA_R_SSS_00580*	Shipwreck – Fallwind Wreck	340612.4	6263664.8	73.4	20.6	3.9
S_RE_B01_0324*	Shipwreck	347323.0	6253311.3	19.8	15.8	1.7
S_FR_B03_0006*	Shipwreck - HMS Tarpon Submarine	348875.5	6284051.0	82.8	8.5	5.1
S_FR_B03_0069*	Shipwreck	349881.9	6284268.9	56.2	20.4	1.4
EA_P_SSS_00591	Shipwreck - Possible Wreck (91D - ENC Database)	337224.9	6279528.8	31.5	11.9	0.9
S_RE_B05_0547	Possible unknown shipwreck	358715.6	6272109.0	12.2	5.1	0.5

Notes:
*wrecks present in the Seawar Museum database
-all the numbers in the table were rounded to one decimal point

In OWF Zone West four (4) features were identified as possible pingo remnants (Section 3.2.2). Due to the regular circular shape these features are marked also as anomalies with archaeological potential. Detailed positions and measurements are presented in Table 3.16. Data example is shown in Table 3.1 in Section 3.2.2.

Table 3.16: Positions and measurements of (potential) archaeological findings within the 3GW Project Area.

Easting [m]	Northing [m]	Length [m]	Width [m]	Height [m]
338943.9	6257793.4	10.7	7.2	0.3
338992.0	6257800.1	16.5	7.0	0.2
339003.6	6257818.6	12.7	7.6	0.2
339026.7	6272222.6	38.5	25.2	0.5

Notes:
-all the numbers in the table were rounded to one decimal point

Fugro cannot exclude or confirm archaeological potential of the identified seafloor anomalies supplied in the GIS database as part of the final deliverables.

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Appendices

Appendix A

Guidelines on Use of Report

This report (the "Report") was prepared as part of the services (the "Services") provided by Fugro for its client (the "Client") and in accordance with the terms of the relevant contract between the two parties (the Contract") and to the extent to which Fugro relied on Client or third-party information as was set out in the Contract.

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Appendix B

Deduplication Results

Table B.1: Duplicated Anomalies – SSS Points

Targets Maintained							Targets Deleted								
Survey ID Lot 2	Target ID Lot 2	Comment Lot 2	Mag Anomaly Lot 2	Length Lot 2	Width Lot 2	Height Lot 2	Survey ID Lot 1	Target ID Lot 1	Comment Lot 1	Mag Anomaly Lot 1	Length Lot 1	Width Lot 1	Height Lot 1	MBES Anomaly Lot 1	Distance (m)
SN2021_013	EA_Y_SSS_00490	Boulder	---	1.02	0.5	0.29	SN2021_012	S_RE_B01_0005	---	---	1.54	0.64	0.28	---	0.95
SN2021_013	EA_Y_SSS_00734	Boulder	---	0.97	0.47	0.43	SN2021_012	S_RE_B01_0033	---	---	1.03	0.6	0.41	---	1.35
SN2021_013	EA_Y_SSS_00045	Boulder	---	1.1	0.46	0.52	SN2021_012	S_RE_B01_0046	---	---	1.41	0.55	0.33	---	0.70
SN2021_013	EA_Y_SSS_00718	Boulder	---	1.04	0.4	0.27	SN2021_012	S_RE_B01_0048	---	---	1.52	0.56	0.16	---	0.51
SN2021_013	EA_Y_SSS_00356	Boulder	---	1.89	1.15	0.33	SN2021_012	S_RE_B01_0090	---	---	1.57	0.91	0.38	---	0.73
SN2021_013	EA_Y_SSS_00039	Boulder	---	1.18	0.41	0.32	SN2021_012	S_RE_B01_0095	---	---	1.1	1.12	0.25	---	1.29
SN2021_013	EA_Y_SSS_00026	Boulder	---	1.41	0.88	0.42	SN2021_012	S_RE_B01_0172	---	---	1.75	1.43	0.35	---	1.42
SN2021_013	EA_Y_SSS_00030	Boulder	---	1.17	0.94	0.29	SN2021_012	S_RE_B01_0188	---	---	1.36	0.86	0.18	---	1.06
SN2021_013	EA_Y_SSS_00374	Boulder	---	1.23	0.55	0.23	SN2021_012	S_RE_B01_0198	---	---	1.04	0.72	0.15	---	0.86
SN2021_013	EA_Y_SSS_00605	Boulder	---	0.99	0.94	0.59	SN2021_012	S_RE_B01_0234	---	---	1.62	1.32	0.51	---	0.68
SN2021_013	EA_Y_SSS_00604	Boulder	---	1.17	0.47	0.26	SN2021_012	S_RE_B01_0238	---	---	1.05	0.41	0.18	---	0.94
SN2021_013	EA_Y_SSS_00582	Boulder	---	1.02	0.87	0.23	SN2021_012	S_RE_B01_0284	---	---	1.29	1.04	0.22	---	1.46
SN2021_013	EA_Y_SSS_00042	Boulder	---	1.09	0.58	0.49	SN2021_012	S_RE_B01_0679	---	---	1.4	0.69	0.36	---	1.31

SN2021_013	EA_Y_SSS_00355	Boulder	---	2.13	0.84	0.4	SN2021_012	S_RE_B01_0683	---	---	2.01	0.98	0.62	---	0.93
SN2021_013	EA_Y_SSS_00034	Boulder	---	1	0.57	0.28	SN2021_012	S_RE_B01_0688	---	---	1.48	0.71	0.35	---	1.477
SN2021_013	EA_Y_SSS_00033	Boulder	---	1.36	0.68	0.19	SN2021_012	S_RE_B01_0717	---	---	1.4	0.54	0.19	---	0.51
Targets maintained due to different classification															
SN2021_013	EA_Y_SSS_00379	Boulder	---	3.58	0.8	0.1	SN2021_012	S_RE_B01_0175	Linear debris	---	2.86	0.92	0.24	---	1.47
SN2021_013	EA_Y_SSS_00345	Debris Suspected Debris	EA_Y_MAG_00660	5.02	0.69	0.98	SN2021_012	S_RE_B01_0178	MB_B01_025566, 1.12m	---	3.24	1.35	1.13	MB_B01_025566	1.53
SN2021_013	EA_Y_SSS_00054	Boulder	---	1.94	0.53	0.49	SN2021_012	S_RE_B01_0664	Possible boulder	---	2.76	1.18	0.44	---	0.81
SN2021_013	EA_Y_SSS_00041	Boulder	---	2.33	1.04	0.47	SN2021_012	S_RE_B01_0682	Possible fishing gear	---	3.64	1.67	0.45	---	1.47
SN2021_013	EA_Y_SSS_00362	Boulder	---	2.6	0.97	0.63	SN2021_012	S_RE_B01_0684	Possible fishing gear	---	2.59	1.63	0.53	---	1.27

Table B.2: Duplicated Anomalies – Seafloor Features

Targets Maintained								Targets Deleted								Distance Between Targets (m)
Survey ID Lot 2	TargetID Lot 2	Length Lot 2	Heigth Lot 2	Width Lot 2	Comment Lot 2	Equip_Type Lot 2	SBDFeature Lot 2	SurveyID Lot 1	TargetID Lot 1	Length Lot 1	Heigth Lot 1	Width Lot 1	Comment Lot 1	Equip_Ty Lot 1	Sbdfeatu Lot 1	
SN2021_013	EA_Y_SSS_00490	1.02	0.29	0.5	---	SSS	Boulder	SN2021_012	S_RE_B01_0005	1.54	0.28	0.64	Boulder	SSS	98	0.951
SN2021_013	EA_Y_SSS_00734	0.97	0.43	0.47	---	SSS	Boulder	SN2021_012	S_RE_B01_0033	1.03	0.41	0.6	Boulder	SSS	98	1.35
SN2021_013	EA_Y_SSS_00045	1.1	0.52	0.46	---	SSS	Boulder	SN2021_012	S_RE_B01_0046	1.41	0.33	0.55	Boulder	SSS	98	0.70
SN2021_013	EA_Y_SSS_00718	1.04	0.27	0.4	---	SSS	Boulder	SN2021_012	S_RE_B01_0048	1.52	0.16	0.56	Boulder	SSS	98	0.51
SN2021_013	EA_Y_SSS_00039	1.18	0.32	0.41	---	SSS	Boulder	SN2021_012	S_RE_B01_0095	1.1	0.25	1.12	Boulder	SSS	98	1.30
SN2021_013	EA_Y_SSS_00026	1.41	0.42	0.88	---	SSS	Boulder	SN2021_012	S_RE_B01_0172	1.75	0.35	1.43	Boulder	SSS	98	1.42
SN2021_013	EA_Y_SSS_00030	1.17	0.29	0.94	---	SSS	Boulder	SN2021_012	S_RE_B01_0188	1.36	0.18	0.86	Boulder	SSS	98	1.06
SN2021_013	EA_Y_SSS_00374	1.23	0.23	0.55	---	SSS	Boulder	SN2021_012	S_RE_B01_0198	1.04	0.15	0.72	Boulder	SSS	98	0.86
SN2021_013	EA_Y_SSS_00605	0.99	0.59	0.94	---	SSS	Boulder	SN2021_012	S_RE_B01_0234	1.62	0.51	1.32	Boulder	SSS	98	0.68
SN2021_013	EA_Y_SSS_00604	1.17	0.26	0.47	---	SSS	Boulder	SN2021_012	S_RE_B01_0238	1.05	0.18	0.41	Boulder	SSS	98	0.94
SN2021_013	EA_Y_SSS_00582	1.02	0.23	0.87	---	SSS	Boulder	SN2021_012	S_RE_B01_0284	1.29	0.22	1.04	Boulder	SSS	98	1.46
SN2021_013	EA_Y_SSS_00042	1.09	0.49	0.58	---	SSS	Boulder	SN2021_012	S_RE_B01_0679	1.4	0.36	0.69	Boulder	SSS	98	1.31
SN2021_013	EA_Y_SSS_00355	2.13	0.4	0.84	---	SSS	Boulder	SN2021_012	S_RE_B01_0683	2.01	0.62	0.98	Boulder	SSS	98	0.93
SN2021_013	EA_Y_SSS_00034	1	0.28	0.57	---	SSS	Boulder	SN2021_012	S_RE_B01_0688	1.48	0.35	0.71	Boulder	SSS	98	1.47
SN2021_013	EA_Y_SSS_00033	1.36	0.19	0.68	---	SSS	Boulder	SN2021_012	S_RE_B01_0717	1.4	0.19	0.54	Boulder	SSS	98	0.51

Table B.1: Correlation MBES Anomalies and SSS Anomalies – Deduplication Not Applied

Survey ID Lot 1	Target ID Lot 1	Lenght Lot 1	Width Lot 1	Height Lot 1	Comment Lot 1	Mag Anomaly Lot 1	SSS Anomaly Lot 1	Survey ID Lot 2	Target ID Lot 2	Comment Lot 2	Mag Anomaly Lot 2	Length Lot 2	Width Lot 2	Height Lot 1	Distance
SN2021_012	MB_B01_027690	1.58	1.26	0.28	---	---	---	SN2021_013	EA_Y_SSS_00007	Boulder	---	1.4	1.17	0.37	0.20
SN2021_012	MB_B01_029564	1.58	1.26	0.32	---	---	---	SN2021_013	EA_Y_SSS_00022	Boulder	---	1.45	0.67	0.93	0.32
SN2021_012	MB_B01_035047	1.12	1.01	0.25	---	---	---	SN2021_013	EA_Y_SSS_00024	Boulder	---	1.25	0.6	0.68	1.05
SN2021_012	MB_B01_035936	1.12	1.01	0.24	---	---	---	SN2021_013	EA_Y_SSS_00024	Boulder	---	1.25	0.6	0.68	0.28
SN2021_012	MB_B01_026408	1.9	1.44	0.54	---	---	---	SN2021_013	EA_Y_SSS_00027	Boulder	---	1.57	1.15	0.48	0.21
SN2021_012	MB_B01_019132	1.6	1.41	0.18	---	---	---	SN2021_013	EA_Y_SSS_00029	Boulder	---	1	0.9	0.32	0.57
SN2021_012	MB_B01_027407	1.58	1.42	0.32	---	---	---	SN2021_013	EA_Y_SSS_00031	Boulder	---	1.04	0.66	0.36	0.67
SN2021_012	MB_B01_035364	1.35	0.97	0.15	---	---	---	SN2021_013	EA_Y_SSS_00047	Boulder	---	1.34	0.89	0.55	1.48
SN2021_012	MB_B01_024015	2.57	1.48	0.29	---	---	---	SN2021_013	EA_Y_SSS_00072	Boulder	---	1.65	0.58	0.42	0.35
SN2021_012	MB_B01_018623	1.82	1.51	0.28	---	---	---	SN2021_013	EA_Y_SSS_00095	Boulder	---	1.22	0.61	0.59	0.37
SN2021_012	MB_B01_017791	3.09	1.88	0.29	---	---	---	SN2021_013	EA_Y_SSS_00099	Boulder	---	2.05	0.52	0.5	0.76
SN2021_012	MB_B01_026789	2.14	1.29	0.31	---	---	---	SN2021_013	EA_Y_SSS_00346	Boulder	---	1.52	1.15	0.32	0.37
SN2021_012	MB_B01_019058	1.58	1.34	0.28	---	---	---	SN2021_013	EA_Y_SSS_00349	Boulder	---	1.56	1.29	0.57	0.77
SN2021_012	MB_B01_027718	1.82	1.1	0.47	---	---	---	SN2021_013	EA_Y_SSS_00351	Boulder	---	1.03	0.88	0.51	0.36
SN2021_012	MB_B01_026727	2.26	1.49	0.31	---	---	---	SN2021_013	EA_Y_SSS_00376	Boulder	---	2.32	0.76	0.23	0.33
SN2021_012	MB_B01_025865	2.14	1.84	0.36	---	---	---	SN2021_013	EA_Y_SSS_00377	Boulder	---	2.41	0.82	0.2	0.17
SN2021_012	MB_B01_025512	2.93	2.07	0.41	---	---	---	SN2021_013	EA_Y_SSS_00378	Boulder	---	2.36	1.53	0.48	0.85
SN2021_012	MB_B01_018514	1.9	1.58	0.19	---	---	---	SN2021_013	EA_Y_SSS_00599	Boulder	---	0.98	0.68	0.24	0.24
SN2021_012	MB_B01_025223	1.25	1.2	0.21	---	---	---	SN2021_013	EA_Y_SSS_00612	Boulder	---	0.98	0.39	0.29	0.63
SN2021_012	MB_B01_033991	1.27	0.88	0.23	---	---	---	SN2021_013	EA_Y_SSS_00614	Boulder	---	0.99	0.39	0.3	0.86
SN2021_012	MB_B01_60245	1.6	0.7	0.2	---	---	---	SN2021_013	EA_Y_SSS_00683	Boulder	---	1.01	0.51	0.43	0.85
SN2021_012	MB_B01_73377	1.8	0.9	0.2	---	---	---	SN2021_013	EA_Y_SSS_00683	Boulder	---	1.01	0.51	0.43	0.83
SN2021_012	MB_B01_028613	1.52	1.11	0.44	---	---	---	SN2021_013	EA_Y_SSS_00685	Boulder	---	1.18	0.85	0.56	0.52
SN2021_012	MB_B01_025839	2.31	1.95	0.66	---	---	---	SN2021_013	EA_Y_SSS_00686	Boulder	---	1.53	0.93	0.45	0.60
SN2021_012	MB_B01_032729	1.25	1.1	0.36	---	---	---	SN2021_013	EA_Y_SSS_00686	Boulder	---	1.53	0.93	0.45	1.91
SN2021_012	MB_B01_018437	2.14	1.58	0.18	---	---	---	SN2021_013	EA_Y_SSS_00687	Boulder	---	1.57	0.55	0.24	0.60
SN2021_012	MB_B01_017655	3.35	2.91	0.53	---	---	---	SN2021_013	EA_Y_SSS_00688	Boulder	---	1.48	1.31	0.73	0.45
SN2021_012	MB_B01_60322	1.5	0.9	0.1	---	---	---	SN2021_013	EA_Y_SSS_00691	Boulder	---	1.17	0.4	0.28	0.93
SN2021_012	MB_B01_73454	1.7	1.1	0.1	---	---	---	SN2021_013	EA_Y_SSS_00691	Boulder	---	1.17	0.4	0.28	0.90
SN2021_012	MB_B01_027459	1.82	1.51	0.23	---	---	---	SN2021_013	EA_Y_SSS_00715	Boulder	---	1.19	0.69	0.28	0.37
SN2021_012	MB_B01_026993	2.02	1.36	0.27	---	---	---	SN2021_013	EA_Y_SSS_00716	Boulder	---	1.05	0.57	0.31	0.38
SN2021_012	MB_B01_60895	1	0.7	0.4	S_RE_B01_0788,2.46m	---	S_RE_B01_0788	SN2021_013	EA_Y_SSS_00738	Boulder	---	1.17	0.78	0.54	0.34

Survey ID Lot 1	Target ID Lot 1	Lenght Lot 1	Width Lot 1	Height Lot 1	Comment Lot 1	Mag Anomaly Lot 1	SSS Anomaly Lot 1	Survey ID Lot 2	Target ID Lot 2	Comment Lot 2	Mag Anomaly Lot 2	Length Lot 2	Width Lot 2	Height Lot 1	Distance
SN2021_012	MB_B01_019219	1.6	1.33	0.21	---	---	---	SN2021_013	EA_Y_SSS_00749	Boulder	---	1.09	0.52	0.33	0.40
SN2021_012	MB_B01_018531	2.02	1.67	0.24	---	---	---	SN2021_013	EA_Y_SSS_00750	Boulder	---	1.39	0.98	0.4	0.48
SN2021_012	MB_B01_018430	1.9	1.71	0.3	---	---	---	SN2021_013	EA_Y_SSS_00763	Boulder	---	1.27	0.4	0.31	0.48
SN2021_012	MB_B01_018138	2.37	1.9	0.23	---	---	---	SN2021_013	EA_Y_SSS_00764	Boulder	---	1.18	0.57	0.31	0.54
SN2021_012	MB_B01_022998	3.02	1.97	0.17	---	---	---	SN2021_013	EA_Y_SSS_00765	Boulder	---	1.55	0.85	0.35	0.49
SN2021_012	MB_B01_028591	1.58	1.19	0.46	---	---	---	SN2021_013	EA_Y_SSS_00767	Boulder	---	1.28	1.08	0.86	1.34
SN2021_012	MB_B01_018452	2.02	1.58	0.26	---	---	---	SN2021_013	EA_Y_SSS_00769	Boulder	---	0.98	0.61	0.48	0.28
SN2021_012	MB_B01_018780	1.68	1.45	0.31	---	---	---	SN2021_013	EA_Y_SSS_00789	Boulder	---	1.01	0.62	0.46	0.38
SN2021_012	MB_B01_021139	1.35	1.02	0.26	---	---	---	SN2021_013	EA_Y_SSS_00790	Boulder	---	1.11	0.55	0.57	0.57
SN2021_012	MB_B01_028199	1.9	1.35	0.26	---	---	---	SN2021_013	EA_Y_SSS_00790	Boulder	---	1.11	0.55	0.57	0.47
SN2021_012	MB_B01_028368	1.58	1.26	0.36	---	---	---	SN2021_013	EA_Y_SSS_00799	Boulder	---	1.4	0.5	0.49	0.560045

Appendix C

Charts

Table C.1: Charts (detailed below) have been presented as a separate PDF file.

Chart Type	Chart Name
OVERVIEW CHART	SN2021_013_EnergyIsland_3GW_01_NU_50k_OVERVIEW.pdf
CRP TRACKS AND GRAB SAMPLE LOCATION CHART	SN2021_013_EnergyIsland_3GW_02_NU_25k_CRP_GRAB.pdf
CRP TRACKS AND GRAB SAMPLE LOCATION CHART	SN2021_013_EnergyIsland_3GW_03_NU_25k_CRP_GRAB.pdf
CRP TRACKS AND GRAB SAMPLE LOCATION CHART	SN2021_013_EnergyIsland_3GW_04_NU_25k_CRP_GRAB.pdf
CRP TRACKS AND GRAB SAMPLE LOCATION CHART	SN2021_013_EnergyIsland_3GW_05_NU_25k_CRP_GRAB.pdf
SHADED RELIEF BATHYMETRY CHART	SN2021_013_EnergyIsland_3GW_06_NU_25k_SHR_BTY.pdf
SHADED RELIEF BATHYMETRY CHART	SN2021_013_EnergyIsland_3GW_07_NU_25k_SHR_BTY.pdf
SHADED RELIEF BATHYMETRY CHART	SN2021_013_EnergyIsland_3GW_08_NU_25k_SHR_BTY.pdf
SHADED RELIEF BATHYMETRY CHART	SN2021_013_EnergyIsland_3GW_09_NU_25k_SHR_BTY.pdf
BACKSCATTER MOSAIC CHART	SN2021_013_EnergyIsland_3GW_10_NU_25k_BKS.pdf
BACKSCATTER MOSAIC CHART	SN2021_013_EnergyIsland_3GW_11_NU_25k_BKS.pdf
BACKSCATTER MOSAIC CHART	SN2021_013_EnergyIsland_3GW_12_NU_25k_BKS.pdf
BACKSCATTER MOSAIC CHART	SN2021_013_EnergyIsland_3GW_13_NU_25k_BKS.pdf
SEAFLOOR CLASSIFICATION - GEOLOGY CHART	SN2021_013_EnergyIsland_3GW_14_NU_25k_SBC_GEOLOGY.pdf
SEAFLOOR CLASSIFICATION - GEOLOGY CHART	SN2021_013_EnergyIsland_3GW_15_NU_25k_SBC_GEOLOGY.pdf
SEAFLOOR CLASSIFICATION - GEOLOGY CHART	SN2021_013_EnergyIsland_3GW_16_NU_25k_SBC_GEOLOGY.pdf
SEAFLOOR CLASSIFICATION - GEOLOGY CHART	SN2021_013_EnergyIsland_3GW_17_NU_25k_SBC_GEOLOGY.pdf
SEAFLOOR CLASSIFICATION - MORPHOLOGY CHART	SN2021_013_EnergyIsland_3GW_18_NU_25k_SBC_MORPHOLOGY.pdf
SEAFLOOR CLASSIFICATION - MORPHOLOGY CHART	SN2021_013_EnergyIsland_3GW_19_NU_25k_SBC_MORPHOLOGY.pdf
SEAFLOOR CLASSIFICATION - MORPHOLOGY CHART	SN2021_013_EnergyIsland_3GW_20_NU_25k_SBC_MORPHOLOGY.pdf
SEAFLOOR CLASSIFICATION - MORPHOLOGY CHART	SN2021_013_EnergyIsland_3GW_21_NU_25k_SBC_MORPHOLOGY.pdf
SEAFLOOR CLASSIFICATION - SUBSTRATE TYPE CHART	SN2021_013_EnergyIsland_3GW_22_NU_25k_SBC_SUBSTRATE.pdf
SEAFLOOR CLASSIFICATION - SUBSTRATE TYPE CHART	SN2021_013_EnergyIsland_3GW_23_NU_25k_SBC_SUBSTRATE.pdf
SEAFLOOR CLASSIFICATION - SUBSTRATE TYPE CHART	SN2021_013_EnergyIsland_3GW_24_NU_25k_SBC_SUBSTRATE.pdf
SEAFLOOR CLASSIFICATION - SUBSTRATE TYPE CHART	SN2021_013_EnergyIsland_3GW_25_NU_25k_SBC_SUBSTRATE.pdf
SEABED OBJECTS CHART	SN2021_013_EnergyIsland_3GW_26_NU_25k_SBO.pdf

Chart Type	Chart Name
SEABED OBJECTS CHART	SN2021_013_EnergyIsland_3GW_27_NU_25k_SBO.pdf
SEABED OBJECTS CHART	SN2021_013_EnergyIsland_3GW_28_NU_25k_SBO.pdf
SEABED OBJECTS CHART	SN2021_013_EnergyIsland_3GW_29_NU_25k_SBO.pdf
SEABED FEATURES CHART	SN2021_013_EnergyIsland_3GW_30_NU_25k_SBF.pdf
SEABED FEATURES CHART	SN2021_013_EnergyIsland_3GW_31_NU_25k_SBF.pdf
SEABED FEATURES CHART	SN2021_013_EnergyIsland_3GW_32_NU_25k_SBF.pdf
SEABED FEATURES CHART	SN2021_013_EnergyIsland_3GW_33_NU_25k_SBF.pdf
DEPTH TO HORIZON H05 (METRES BSF) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_34_NU_25k_SBG_BSF_H05.pdf
DEPTH TO HORIZON H05 (METRES BSF) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_35_NU_25k_SBG_BSF_H05.pdf
DEPTH TO HORIZON H05 (METRES BSF) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_36_NU_25k_SBG_BSF_H05.pdf
DEPTH TO HORIZON H05 (METRES BSF) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_37_NU_25k_SBG_BSF_H05.pdf
DEPTH TO HORIZON H06 (METRES BSF) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_38_NU_25k_SBG_BSF_H06.pdf
DEPTH TO HORIZON H06 (METRES BSF) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_39_NU_25k_SBG_BSF_H06.pdf
DEPTH TO HORIZON H06 (METRES BSF) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_40_NU_25k_SBG_BSF_H06.pdf
DEPTH TO HORIZON H06 (METRES BSF) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_41_NU_25k_SBG_BSF_H06.pdf
DEPTH TO HORIZON H10 (METRES BSF) - BASE OF UNIT U10	SN2021_013_EnergyIsland_3GW_42_NU_25k_SBG_BSF_H10.pdf
DEPTH TO HORIZON H10 (METRES BSF) - BASE OF UNIT U10	SN2021_013_EnergyIsland_3GW_43_NU_25k_SBG_BSF_H10.pdf
DEPTH TO HORIZON H10 (METRES BSF) - BASE OF UNIT U10	SN2021_013_EnergyIsland_3GW_44_NU_25k_SBG_BSF_H10.pdf
DEPTH TO HORIZON H10 (METRES BSF) - BASE OF UNIT U10	SN2021_013_EnergyIsland_3GW_45_NU_25k_SBG_BSF_H10.pdf
DEPTH TO HORIZON H20 (METRES MSL) - BASE OF UNIT U20	SN2021_013_EnergyIsland_3GW_46_NU_25k_SBG_BSF_H20.pdf
DEPTH TO HORIZON H20 (METRES MSL) - BASE OF UNIT U20	SN2021_013_EnergyIsland_3GW_47_NU_25k_SBG_BSF_H20.pdf
DEPTH TO HORIZON H20 (METRES MSL) - BASE OF UNIT U20	SN2021_013_EnergyIsland_3GW_48_NU_25k_SBG_BSF_H20.pdf
DEPTH TO HORIZON H20 (METRES MSL) - BASE OF UNIT U20	SN2021_013_EnergyIsland_3GW_49_NU_25k_SBG_BSF_H20.pdf
DEPTH TO HORIZON H24 (METRES BSF) - BASE OF UNIT D24	SN2021_013_EnergyIsland_3GW_50_NU_25k_SBG_BSF_H24.pdf
DEPTH TO HORIZON H24 (METRES BSF) - BASE OF UNIT D24	SN2021_013_EnergyIsland_3GW_51_NU_25k_SBG_BSF_H24.pdf

Chart Type	Chart Name
DEPTH TO HORIZON H24 (METRES BSF) - BASE OF UNIT D24	SN2021_013_EnergyIsland_3GW_52_NU_25k_SBG_BSF_H24.pdf
DEPTH TO HORIZON H24 (METRES BSF) - BASE OF UNIT D24	SN2021_013_EnergyIsland_3GW_53_NU_25k_SBG_BSF_H24.pdf
DEPTH TO HORIZON H25 (METRES BSF) - BASE OF UNIT U25	SN2021_013_EnergyIsland_3GW_54_NU_25k_SBG_BSF_H25.pdf
DEPTH TO HORIZON H25 (METRES BSF) - BASE OF UNIT U25	SN2021_013_EnergyIsland_3GW_55_NU_25k_SBG_BSF_H25.pdf
DEPTH TO HORIZON H25 (METRES BSF) - BASE OF UNIT U25	SN2021_013_EnergyIsland_3GW_56_NU_25k_SBG_BSF_H25.pdf
DEPTH TO HORIZON H25 (METRES BSF) - BASE OF UNIT U25	SN2021_013_EnergyIsland_3GW_57_NU_25k_SBG_BSF_H25.pdf
DEPTH TO HORIZON H30 (METRES BSF) - BASE OF UNIT U30	SN2021_013_EnergyIsland_3GW_58_NU_25k_SBG_BSF_H30.pdf
DEPTH TO HORIZON H30 (METRES BSF) - BASE OF UNIT U30	SN2021_013_EnergyIsland_3GW_59_NU_25k_SBG_BSF_H30.pdf
DEPTH TO HORIZON H30 (METRES BSF) - BASE OF UNIT U30	SN2021_013_EnergyIsland_3GW_60_NU_25k_SBG_BSF_H30.pdf
DEPTH TO HORIZON H30 (METRES BSF) - BASE OF UNIT U30	SN2021_013_EnergyIsland_3GW_61_NU_25k_SBG_BSF_H30.pdf
DEPTH TO HORIZON H35 (METRES BSF) - BASE OF UNIT U35	SN2021_013_EnergyIsland_3GW_62_NU_25k_SBG_BSF_H35.pdf
DEPTH TO HORIZON H35 (METRES BSF) - BASE OF UNIT U35	SN2021_013_EnergyIsland_3GW_63_NU_25k_SBG_BSF_H35.pdf
DEPTH TO HORIZON H35 (METRES BSF) - BASE OF UNIT U35	SN2021_013_EnergyIsland_3GW_64_NU_25k_SBG_BSF_H35.pdf
DEPTH TO HORIZON H35 (METRES BSF) - BASE OF UNIT U35	SN2021_013_EnergyIsland_3GW_65_NU_25k_SBG_BSF_H35.pdf
DEPTH TO HORIZON H40 (METRES BSF) - BASE OF UNIT U40	SN2021_013_EnergyIsland_3GW_66_NU_25k_SBG_BSF_H40.pdf
DEPTH TO HORIZON H40 (METRES BSF) - BASE OF UNIT U40	SN2021_013_EnergyIsland_3GW_67_NU_25k_SBG_BSF_H40.pdf
DEPTH TO HORIZON H40 (METRES BSF) - BASE OF UNIT U40	SN2021_013_EnergyIsland_3GW_68_NU_25k_SBG_BSF_H40.pdf
DEPTH TO HORIZON H40 (METRES BSF) - BASE OF UNIT U40	SN2021_013_EnergyIsland_3GW_69_NU_25k_SBG_BSF_H40.pdf
DEPTH TO HORIZON H50 (METRES BSF) - BASE OF UNIT U50	SN2021_013_EnergyIsland_3GW_70_NU_25k_SBG_BSF_H50.pdf
DEPTH TO HORIZON H50 (METRES BSF) - BASE OF UNIT U50	SN2021_013_EnergyIsland_3GW_71_NU_25k_SBG_BSF_H50.pdf
DEPTH TO HORIZON H50 (METRES BSF) - BASE OF UNIT U50	SN2021_013_EnergyIsland_3GW_72_NU_25k_SBG_BSF_H50.pdf
DEPTH TO HORIZON H50 (METRES BSF) - BASE OF UNIT U50	SN2021_013_EnergyIsland_3GW_73_NU_25k_SBG_BSF_H50.pdf

Chart Type	Chart Name
DEPTH TO HORIZON H60 (METRES BSF) - BASE OF UNIT U60	SN2021_013_EnergyIsland_3GW_74_NU_25k_SBG_BSF_H60.pdf
DEPTH TO HORIZON H60 (METRES BSF) - BASE OF UNIT U60	SN2021_013_EnergyIsland_3GW_75_NU_25k_SBG_BSF_H60.pdf
DEPTH TO HORIZON H60 (METRES BSF) - BASE OF UNIT U60	SN2021_013_EnergyIsland_3GW_76_NU_25k_SBG_BSF_H60.pdf
DEPTH TO HORIZON H60 (METRES BSF) - BASE OF UNIT U60	SN2021_013_EnergyIsland_3GW_77_NU_25k_SBG_BSF_H60.pdf
DEPTH TO HORIZON H69 (METRES BSF) – INTERNAL HORIZON IN UNIT U70	SN2021_013_EnergyIsland_3GW_78_NU_25k_SBG_BSF_H69.pdf
DEPTH TO HORIZON H69 (METRES BSF) – INTERNAL HORIZON IN UNIT U70	SN2021_013_EnergyIsland_3GW_79_NU_25k_SBG_BSF_H69.pdf
DEPTH TO HORIZON H69 (METRES BSF) – INTERNAL HORIZON IN UNIT U70	SN2021_013_EnergyIsland_3GW_80_NU_25k_SBG_BSF_H69.pdf
DEPTH TO HORIZON H69 (METRES BSF) – INTERNAL HORIZON IN UNIT U70	SN2021_013_EnergyIsland_3GW_81_NU_25k_SBG_BSF_H69.pdf
DEPTH TO HORIZON H70 (METRES BSF) - BASE OF UNIT U70	SN2021_013_EnergyIsland_3GW_82_NU_25k_SBG_BSF_H70.pdf
DEPTH TO HORIZON H70 (METRES BSF) - BASE OF UNIT U70	SN2021_013_EnergyIsland_3GW_83_NU_25k_SBG_BSF_H70.pdf
DEPTH TO HORIZON H70 (METRES BSF) - BASE OF UNIT U70	SN2021_013_EnergyIsland_3GW_84_NU_25k_SBG_BSF_H70.pdf
DEPTH TO HORIZON H70 (METRES BSF) - BASE OF UNIT U70	SN2021_013_EnergyIsland_3GW_85_NU_25k_SBG_BSF_H70.pdf
DEPTH TO HORIZON H75 (METRES BSF) – INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_86_NU_25k_SBG_BSF_H75.pdf
DEPTH TO HORIZON H75 (METRES BSF) – INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_87_NU_25k_SBG_BSF_H75.pdf
DEPTH TO HORIZON H75 (METRES BSF) – INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_88_NU_25k_SBG_BSF_H75.pdf
DEPTH TO HORIZON H75 (METRES BSF) – INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_89_NU_25k_SBG_BSF_H75.pdf
DEPTH TO HORIZON H85 (METRES BSF) – INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_90_NU_25k_SBG_BSF_H85.pdf
DEPTH TO HORIZON H85 (METRES BSF) – INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_91_NU_25k_SBG_BSF_H85.pdf
DEPTH TO HORIZON H85 (METRES BSF) – INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_92_NU_25k_SBG_BSF_H85.pdf
DEPTH TO HORIZON H85 (METRES BSF) – INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_93_NU_25k_SBG_BSF_H85.pdf
DEPTH TO HORIZON H90 (METRES BSF) - BASE OF UNIT U90	SN2021_013_EnergyIsland_3GW_94_NU_25k_SBG_BSF_H90.pdf
DEPTH TO HORIZON H90 (METRES BSF) - BASE OF UNIT U90	SN2021_013_EnergyIsland_3GW_95_NU_25k_SBG_BSF_H90.pdf

Chart Type	Chart Name
DEPTH TO HORIZON H90 (METRES BSF) - BASE OF UNIT U90	SN2021_013_EnergyIsland_3GW_96_NU_25k_SBG_BSF_H90.pdf
DEPTH TO HORIZON H90 (METRES BSF) - BASE OF UNIT U90	SN2021_013_EnergyIsland_3GW_97_NU_25k_SBG_BSF_H90.pdf
DEPTH TO HORIZON H05 (METRES MSL) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_98_NU_25k_SBG_MSL_H05.pdf
DEPTH TO HORIZON H05 (METRES MSL) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_99_NU_25k_SBG_MSL_H05.pdf
DEPTH TO HORIZON H05 (METRES MSL) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_100_NU_25k_SBG_MSL_H05.pdf
DEPTH TO HORIZON H05 (METRES MSL) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_101_NU_25k_SBG_MSL_H05.pdf
DEPTH TO HORIZON H06 (METRES MSL) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_102_NU_25k_SBG_MSL_H06.pdf
DEPTH TO HORIZON H06 (METRES MSL) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_103_NU_25k_SBG_MSL_H06.pdf
DEPTH TO HORIZON H06 (METRES MSL) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_104_NU_25k_SBG_MSL_H06.pdf
DEPTH TO HORIZON H06 (METRES MSL) – INTERNAL HORIZON IN UNIT U10	SN2021_013_EnergyIsland_3GW_105_NU_25k_SBG_MSL_H06.pdf
DEPTH TO HORIZON H10 (METRES MSL) - BASE OF UNIT U10	SN2021_013_EnergyIsland_3GW_106_NU_25k_SBG_MSL_H10.pdf
DEPTH TO HORIZON H10 (METRES MSL) - BASE OF UNIT U10	SN2021_013_EnergyIsland_3GW_107_NU_25k_SBG_MSL_H10.pdf
DEPTH TO HORIZON H10 (METRES MSL) - BASE OF UNIT U10	SN2021_013_EnergyIsland_3GW_108_NU_25k_SBG_MSL_H10.pdf
DEPTH TO HORIZON H10 (METRES MSL) - BASE OF UNIT U10	SN2021_013_EnergyIsland_3GW_109_NU_25k_SBG_MSL_H10.pdf
DEPTH TO HORIZON H20 (METRES MSL) - BASE OF UNIT U20	SN2021_013_EnergyIsland_3GW_110_NU_25k_SBG_MSL_H20.pdf
DEPTH TO HORIZON H20 (METRES MSL) - BASE OF UNIT U20	SN2021_013_EnergyIsland_3GW_111_NU_25k_SBG_MSL_H20.pdf
DEPTH TO HORIZON H20 (METRES MSL) - BASE OF UNIT U20	SN2021_013_EnergyIsland_3GW_112_NU_25k_SBG_MSL_H20.pdf
DEPTH TO HORIZON H20 (METRES MSL) - BASE OF UNIT U20	SN2021_013_EnergyIsland_3GW_113_NU_25k_SBG_MSL_H20.pdf
DEPTH TO HORIZON H24 (METRES MSL) - BASE OF UNIT D24	SN2021_013_EnergyIsland_3GW_114_NU_25k_SBG_MSL_H24.pdf
DEPTH TO HORIZON H24 (METRES MSL) - BASE OF UNIT D24	SN2021_013_EnergyIsland_3GW_115_NU_25k_SBG_MSL_H24.pdf
DEPTH TO HORIZON H24 (METRES MSL) - BASE OF UNIT D24	SN2021_013_EnergyIsland_3GW_116_NU_25k_SBG_MSL_H24.pdf
DEPTH TO HORIZON H24 (METRES MSL) - BASE OF UNIT D24	SN2021_013_EnergyIsland_3GW_117_NU_25k_SBG_MSL_H24.pdf

Chart Type	Chart Name
DEPTH TO HORIZON H25 (METRES MSL) - BASE OF UNIT U25	SN2021_013_EnergyIsland_3GW_118_NU_25k_SBG_MSL_H25.pdf
DEPTH TO HORIZON H25 (METRES MSL) - BASE OF UNIT U25	SN2021_013_EnergyIsland_3GW_119_NU_25k_SBG_MSL_H25.pdf
DEPTH TO HORIZON H25 (METRES MSL) - BASE OF UNIT U25	SN2021_013_EnergyIsland_3GW_120_NU_25k_SBG_MSL_H25.pdf
DEPTH TO HORIZON H25 (METRES MSL) - BASE OF UNIT U25	SN2021_013_EnergyIsland_3GW_121_NU_25k_SBG_MSL_H25.pdf
DEPTH TO HORIZON H30 (METRES MSL) - BASE OF UNIT U30	SN2021_013_EnergyIsland_3GW_122_NU_25k_SBG_MSL_H30.pdf
DEPTH TO HORIZON H30 (METRES MSL) - BASE OF UNIT U30	SN2021_013_EnergyIsland_3GW_123_NU_25k_SBG_MSL_H30.pdf
DEPTH TO HORIZON H30 (METRES MSL) - BASE OF UNIT U30	SN2021_013_EnergyIsland_3GW_124_NU_25k_SBG_MSL_H30.pdf
DEPTH TO HORIZON H30 (METRES MSL) - BASE OF UNIT U30	SN2021_013_EnergyIsland_3GW_125_NU_25k_SBG_MSL_H30.pdf
DEPTH TO HORIZON H35 (METRES MSL) - BASE OF UNIT U35	SN2021_013_EnergyIsland_3GW_126_NU_25k_SBG_MSL_H35.pdf
DEPTH TO HORIZON H35 (METRES MSL) - BASE OF UNIT U35	SN2021_013_EnergyIsland_3GW_127_NU_25k_SBG_MSL_H35.pdf
DEPTH TO HORIZON H35 (METRES MSL) - BASE OF UNIT U35	SN2021_013_EnergyIsland_3GW_128_NU_25k_SBG_MSL_H35.pdf
DEPTH TO HORIZON H35 (METRES MSL) - BASE OF UNIT U35	SN2021_013_EnergyIsland_3GW_129_NU_25k_SBG_MSL_H35.pdf
DEPTH TO HORIZON H40 (METRES MSL) - BASE OF UNIT U40	SN2021_013_EnergyIsland_3GW_130_NU_25k_SBG_MSL_H40.pdf
DEPTH TO HORIZON H40 (METRES MSL) - BASE OF UNIT U40	SN2021_013_EnergyIsland_3GW_131_NU_25k_SBG_MSL_H40.pdf
DEPTH TO HORIZON H40 (METRES MSL) - BASE OF UNIT U40	SN2021_013_EnergyIsland_3GW_132_NU_25k_SBG_MSL_H40.pdf
DEPTH TO HORIZON H40 (METRES MSL) - BASE OF UNIT U40	SN2021_013_EnergyIsland_3GW_133_NU_25k_SBG_MSL_H40.pdf
DEPTH TO HORIZON H50 (METRES MSL) - BASE OF UNIT U50	SN2021_013_EnergyIsland_3GW_134_NU_25k_SBG_MSL_H50.pdf
DEPTH TO HORIZON H50 (METRES MSL) - BASE OF UNIT U50	SN2021_013_EnergyIsland_3GW_135_NU_25k_SBG_MSL_H50.pdf
DEPTH TO HORIZON H50 (METRES MSL) - BASE OF UNIT U50	SN2021_013_EnergyIsland_3GW_136_NU_25k_SBG_MSL_H50.pdf
DEPTH TO HORIZON H50 (METRES MSL) - BASE OF UNIT U50	SN2021_013_EnergyIsland_3GW_137_NU_25k_SBG_MSL_H50.pdf
DEPTH TO HORIZON H60 (METRES MSL) - BASE OF UNIT U60	SN2021_013_EnergyIsland_3GW_138_NU_25k_SBG_MSL_H60.pdf
DEPTH TO HORIZON H60 (METRES MSL) - BASE OF UNIT U60	SN2021_013_EnergyIsland_3GW_139_NU_25k_SBG_MSL_H60.pdf

Chart Type	Chart Name
DEPTH TO HORIZON H60 (METRES MSL) - BASE OF UNIT U60	SN2021_013_EnergyIsland_3GW_140_NU_25k_SBG_MSL_H60.pdf
DEPTH TO HORIZON H60 (METRES MSL) - BASE OF UNIT U60	SN2021_013_EnergyIsland_3GW_141_NU_25k_SBG_MSL_H60.pdf
DEPTH TO HORIZON H69 (METRES MSL) - INTERNAL HORIZON IN UNIT U70	SN2021_013_EnergyIsland_3GW_142_NU_25k_SBG_MSL_H69.pdf
DEPTH TO HORIZON H69 (METRES MSL) - INTERNAL HORIZON IN UNIT U70	SN2021_013_EnergyIsland_3GW_143_NU_25k_SBG_MSL_H69.pdf
DEPTH TO HORIZON H69 (METRES MSL) - INTERNAL HORIZON IN UNIT U70	SN2021_013_EnergyIsland_3GW_144_NU_25k_SBG_MSL_H69.pdf
DEPTH TO HORIZON H69 (METRES MSL) - INTERNAL HORIZON IN UNIT U70	SN2021_013_EnergyIsland_3GW_145_NU_25k_SBG_MSL_H69.pdf
DEPTH TO HORIZON H70 (METRES MSL) - BASE OF UNIT U70	SN2021_013_EnergyIsland_3GW_146_NU_25k_SBG_MSL_H70.pdf
DEPTH TO HORIZON H70 (METRES MSL) - BASE OF UNIT U70	SN2021_013_EnergyIsland_3GW_147_NU_25k_SBG_MSL_H70.pdf
DEPTH TO HORIZON H70 (METRES MSL) - BASE OF UNIT U70	SN2021_013_EnergyIsland_3GW_148_NU_25k_SBG_MSL_H70.pdf
DEPTH TO HORIZON H70 (METRES MSL) - BASE OF UNIT U70	SN2021_013_EnergyIsland_3GW_149_NU_25k_SBG_MSL_H70.pdf
DEPTH TO HORIZON H75 (METRES MSL) - INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_150_NU_25k_SBG_MSL_H75.pdf
DEPTH TO HORIZON H75 (METRES MSL) - INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_151_NU_25k_SBG_MSL_H75.pdf
DEPTH TO HORIZON H75 (METRES MSL) - INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_152_NU_25k_SBG_MSL_H75.pdf
DEPTH TO HORIZON H75 (METRES MSL) - INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_153_NU_25k_SBG_MSL_H75.pdf
DEPTH TO HORIZON H85 (METRES MSL) - INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_154_NU_25k_SBG_MSL_H85.pdf
DEPTH TO HORIZON H85 (METRES MSL) - INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_155_NU_25k_SBG_MSL_H85.pdf
DEPTH TO HORIZON H85 (METRES MSL) - INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_156_NU_25k_SBG_MSL_H85.pdf
DEPTH TO HORIZON H85 (METRES MSL) - INTERNAL HORIZON IN UNIT U90	SN2021_013_EnergyIsland_3GW_157_NU_25k_SBG_MSL_H85.pdf
DEPTH TO HORIZON H90 (METRES MSL) - BASE OF UNIT U90	SN2021_013_EnergyIsland_3GW_158_NU_25k_SBG_MSL_H90.pdf
DEPTH TO HORIZON H90 (METRES MSL) - BASE OF UNIT U90	SN2021_013_EnergyIsland_3GW_159_NU_25k_SBG_MSL_H90.pdf
DEPTH TO HORIZON H90 (METRES MSL) - BASE OF UNIT U90	SN2021_013_EnergyIsland_3GW_160_NU_25k_SBG_MSL_H90.pdf
DEPTH TO HORIZON H90 (METRES MSL) - BASE OF UNIT U90	SN2021_013_EnergyIsland_3GW_161_NU_25k_SBG_MSL_H90.pdf
GEOLOGICAL FEATURES CHART	SN2021_013_EnergyIsland_3GW_162_NU_25k_GEOF.pdf

Chart Type	Chart Name
GEOLOGICAL FEATURES CHART	SN2021_013_EnergyIsland_3GW_163_NU_25k_GEOF.pdf
GEOLOGICAL FEATURES CHART	SN2021_013_EnergyIsland_3GW_164_NU_25k_GEOF.pdf
GEOLOGICAL FEATURES CHART	SN2021_013_EnergyIsland_3GW_165_NU_25k_GEOF.pdf

Appendix D

Digital Deliverables

Table D.1: Digital Deliverables for the 3GW Project Area Geophysical Results Integration.

Deliverable Type	Sensor	Deliverable ID	Deliverable Content	Format
Final Deliverable	MBES	03	Gridded data, 0.25 m	GeoTIFF / Vector Geodatabase
Final Deliverable	MBES	05	Gridded data, 1.00 m	GeoTIFF / Vector Geodatabase
Final Deliverable	MBES	07	Gridded data, 5.00 m	GeoTIFF / Vector Geodatabase
Final Deliverable	MBES	08	Bathymetric Contours (0.5 m)	Vector Geodatabase
Final Deliverable	MBES	09	Bathymetry Vessel Tracks	Vector Geodatabase
Final Deliverable	MBES	11	TVU (1.00 m)	GeoTIFF / Raster Geodatabase
Final Deliverable	MBES	13	THU (1.00 m)	GeoTIFF / Raster Geodatabase
Final Deliverable	MBES	14	Backscatter	GeoTIFF / Raster Geodatabase
Final Deliverable	MBES	16	Target List	Vector Geodatabase
Final Deliverable	SSS	20	SSS instrument tracks	Vector Geodatabase
Final Deliverable	SSS	21	SSS Target List	Vector Geodatabase
Final Deliverable	MAG	24	MAG instrument tracks	Vector Geodatabase
Final Deliverable	MAG	25	MAG Anomaly target list	Vector Geodatabase
Final Deliverable	SBP & 2DUHRS data	28	SBP and UHRS instrument tracks	Vector Geodatabase
Final Deliverable	SBP & 2DUHRS data	29	SBP and UHRS Anomaly target list	Vector Geodatabase
Final Deliverable	SBP & 2DUHRS data	31a	Generated elevation grids relative to vertical datum for each interpreted horizon in 5 m resolution	GeoTIFF / Raster Geodatabase
Final Deliverable	SBP & 2DUHRS data	32a	Generated depth below seabed (BSB) grids for each interpreted horizon in 5 m resolution	GeoTIFF / Raster Geodatabase

Deliverable Type	Sensor	Deliverable ID	Deliverable Content	Format
Final Deliverable	SBP & 2DUHRS data	33a	Generated Isochore (layer thickness) grids for each interpreted soil unit in 5 m resolution	GeoTIFF / Raster Geodatabase
Final Deliverable	Grab sampling data	35	Grab sample positions	Vector Geodatabase
Final Deliverable	Grab sampling data	36	Grab sample classification	xlsx
Final Deliverable	Integrated seabed interpretation data	38	Seabed Surface Geology, as polygons	Vector Geodatabase
Final Deliverable	Integrated seabed interpretation data	39	Seabed Surface Point Features	Vector Geodatabase
Final Deliverable	Integrated seabed interpretation data	40	Seabed Surface Line Features	Vector Geodatabase
Final Deliverable	Integrated seabed interpretation data	41	Seabed Surface Polygon Features	Vector Geodatabase
Final Deliverable	Integrated seabed interpretation data	42	Seabed Substrate type	Vector Geodatabase
Final Deliverable	Integrated seabed interpretation data	43	Man-Made-Objects	Vector Geodatabase
Final Deliverable	Integrated seabed interpretation data	44	Man-Made-Objects	Vector Geodatabase
Final Deliverable	Integrated seabed interpretation data	45	Man-Made-Objects	Vector Geodatabase
Final Deliverable	Report	47	Geophysical Survey Results Integrated Report (charts as enclosures)	PDF