

# **RWE Renewables UK Dogger Bank South (West) Limited**

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# **Dogger Bank South Offshore Wind Farms**

**Environmental Statement**

**Volume 7**

**Appendix 8-2 Met Mast Survey Analysis**

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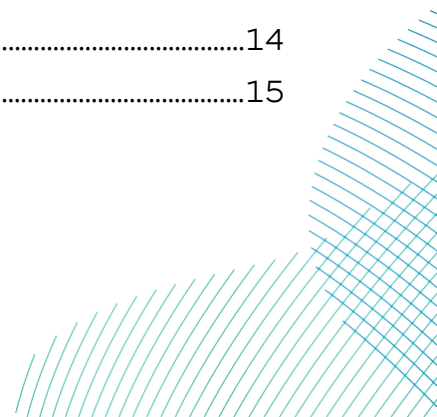
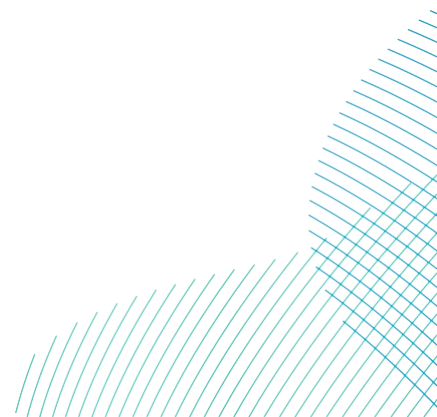


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## Acronyms

Term	Definition
ADGS	Acoustic Ground Discrimination
GEMS	Geophysical Survey Report
MBES	Multibeam Echo Sounder
SAC	Special Area of Conservation
SBP	Sub-bottom Profiler
WTG	Wind Turbine Generator



## 8.2 Introduction

1. As part of its programme to address gaps in evidence of potential impacts on sand bank features, the Applicants intend to undertake monitoring across the Dogger Bank SAC that will obtain data to assess the ability of the sand bank to recover following disturbance to the seabed (e.g., after removal of infrastructure). The aim of the programme is to demonstrate that the seabed does recover and that there is, in effect, no difference between undisturbed and previously disturbed habitats.
2. Two met masts were located in the Dogger Bank Wind Farm zone between 2013 and 2017 (**Plate 8-2-1**). The met masts were installed on suction bucket foundations (~15m diameter cylinders) and during their lifetime received at least four separate jack-up barge visits per mast. This makes the met masts a good test case for investigating seabed disturbance effects via comparison of pre-installation and post-removal survey data.

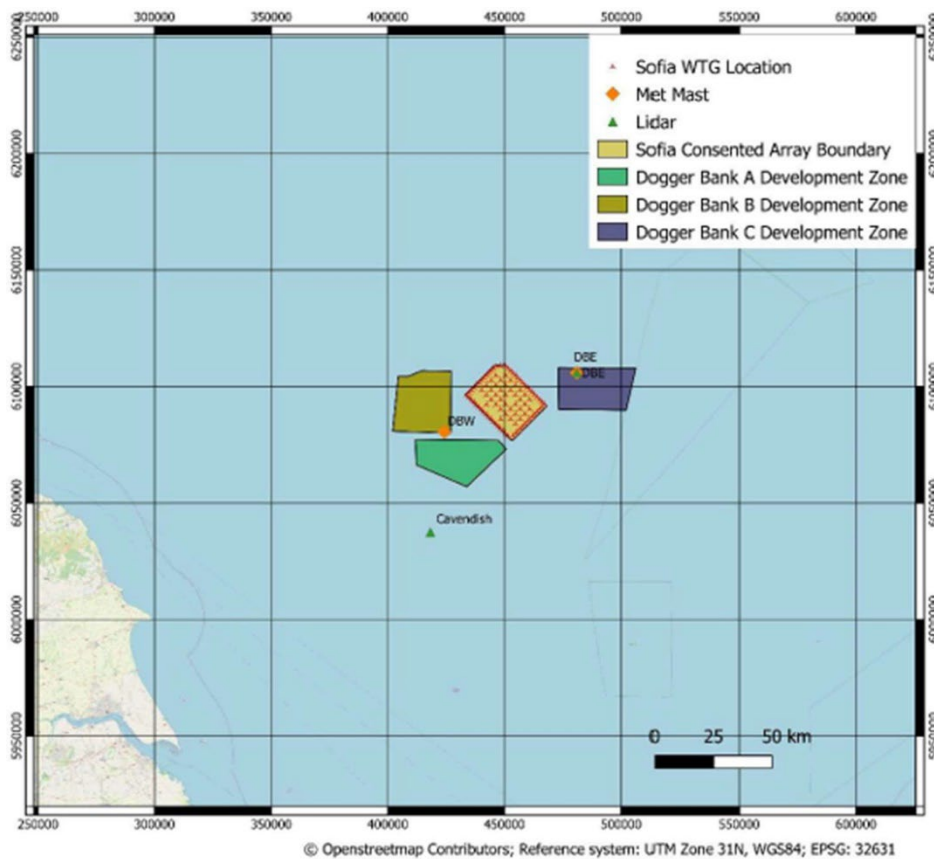


Plate 8-2-1 Met Mast West and Met Mast East within the Sofia Wind Farm Area

## 8.2.1 Pre-Installation Survey

### 8.2.1.1 Background

3. This survey was undertaken by GEMS between July and December 2010 and involved collecting:
  - Bathymetric data to establish the site depths and bathymetric profiles. This data was also used for acoustic ground discrimination (ADGS), in order to identify different environmental habitats and sedimentation patterns at the seabed to inform the design of the environmental survey.
  - Side scan sonar data to identify any seabed features and verify the position of existing infrastructure (e.g., pipelines), with a particular emphasis on identifying hazards to future engineering works and to inform the design of the environmental survey and of appropriate ground truthing locations.
  - Sub-bottom profiler (SBP) data in order to characterize, in high resolution, the stratigraphy of the site to a minimum depth of 50m below seabed. This was achieved by utilising both pinger and sparker profilers, and the characterisation placed particular emphasis on identifying hazards, such as gas charged bodies and faults, to future engineering works, and to identify suitable locations for subsurface sampling.
  - Magnetic data to verify the position of existing infrastructure and identify any unknown ferrous bodies that may pose an obstruction or hazard to future engineering works.
  
4. The geophysical survey over the proposed locations of the met masts was taken over a series of main lines (at 100m spacing) and three cross lines (at 500m spacing) within a 1km by 1km grid. Additional main lines and cross lines were added at Met Mast East, centred on the proposed met mast location. The locations of these lines are shown in **Plate 8-2-2**. Single beam echosounder, swath bathymetry, side scan sonar, pinger SBP, sparker SBP and magnetometer data were acquired on all survey lines.

Table 8-2-1 Proposed Met Mast Locations at Pre-installation Survey

Location	Easting	Northing	Latitude	Longitude
Met Mast West	424 267	6 080 624	54° 52' 01"N	1° 49' 12"E
Met Mast East	481 017	6 105 899	55° 05' 58" N	2° 42' 09" E



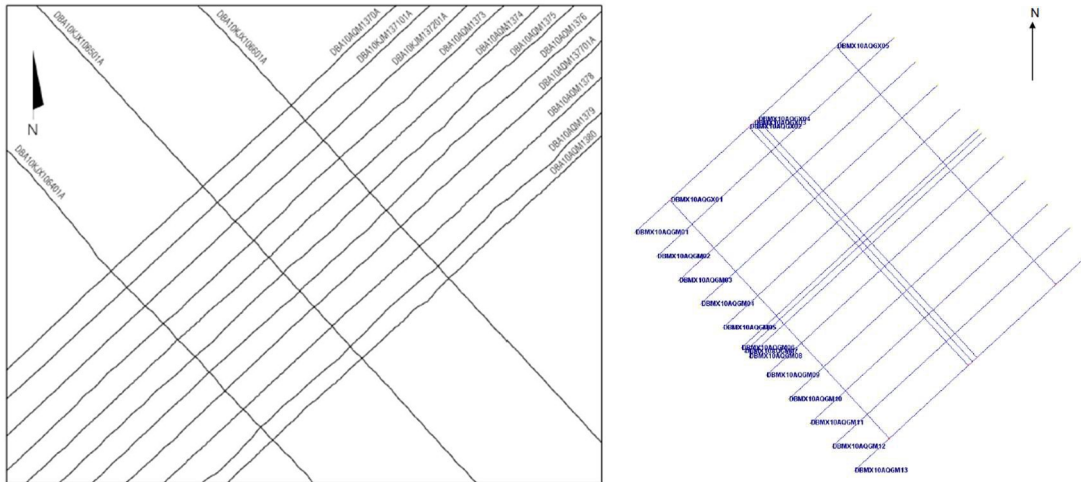


Plate 8-2-2 Pre-installation Survey Lines for Met Mast West (left) and Met Mast East (right) Survey Areas

### 8.2.1.2 Factual Interpretation of Pre-installation Survey: Met Mast West

5. The associated geophysical survey report (GEMS, 2011a) states the following:

*Water depth in the Met Mast West survey area ranges between 21.4m in the north, and 24.5m in the west. The seabed as seen in **Plate 8-2-3** is generally flat with a valley feature 2m deeper on the west corner of the survey area. The whole survey area lies within 20m – 25m below LAT. The gradient throughout the majority of the survey area does not exceed 0.5° with the exception of the western corner, where the seabed slopes at up to 2 degrees. The seabed sediments within the survey area are likely to consist mainly of gravelly SAND, usually in the range of 0.1 to 0.2m thick and generally less than 1m thick.*

*Met Mast West was located centrally within the survey area on flat level seabed at a depth of 22.6m.*

6. Trawl scars were identified within the survey area (**Plate 8-2-4**), passing close to the Met Mast West location. These scars trended with a north west to south east alignment.



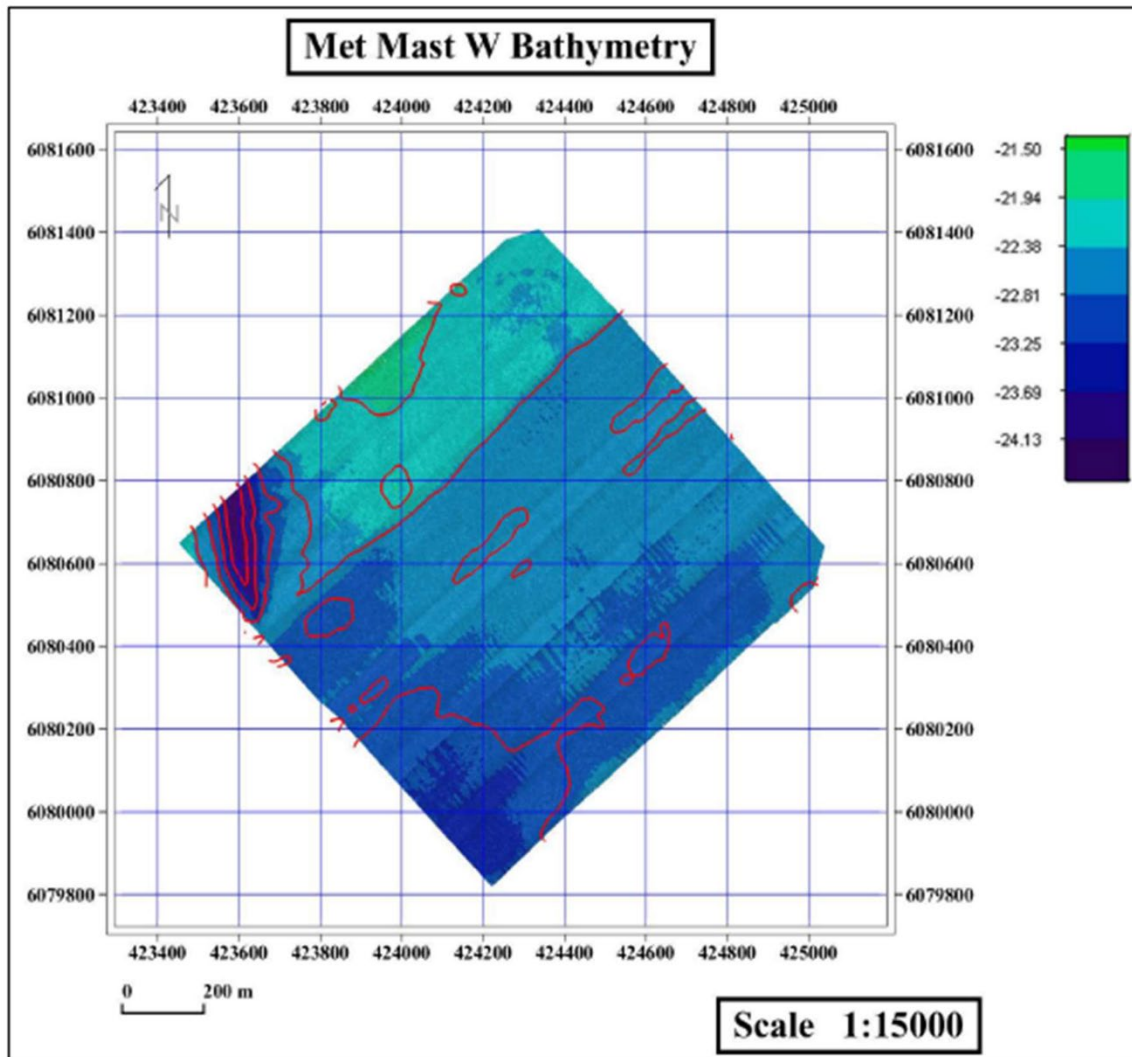


Plate 8-2-3 Met Mast West Survey Area Bathymetry (Pre-Installation)

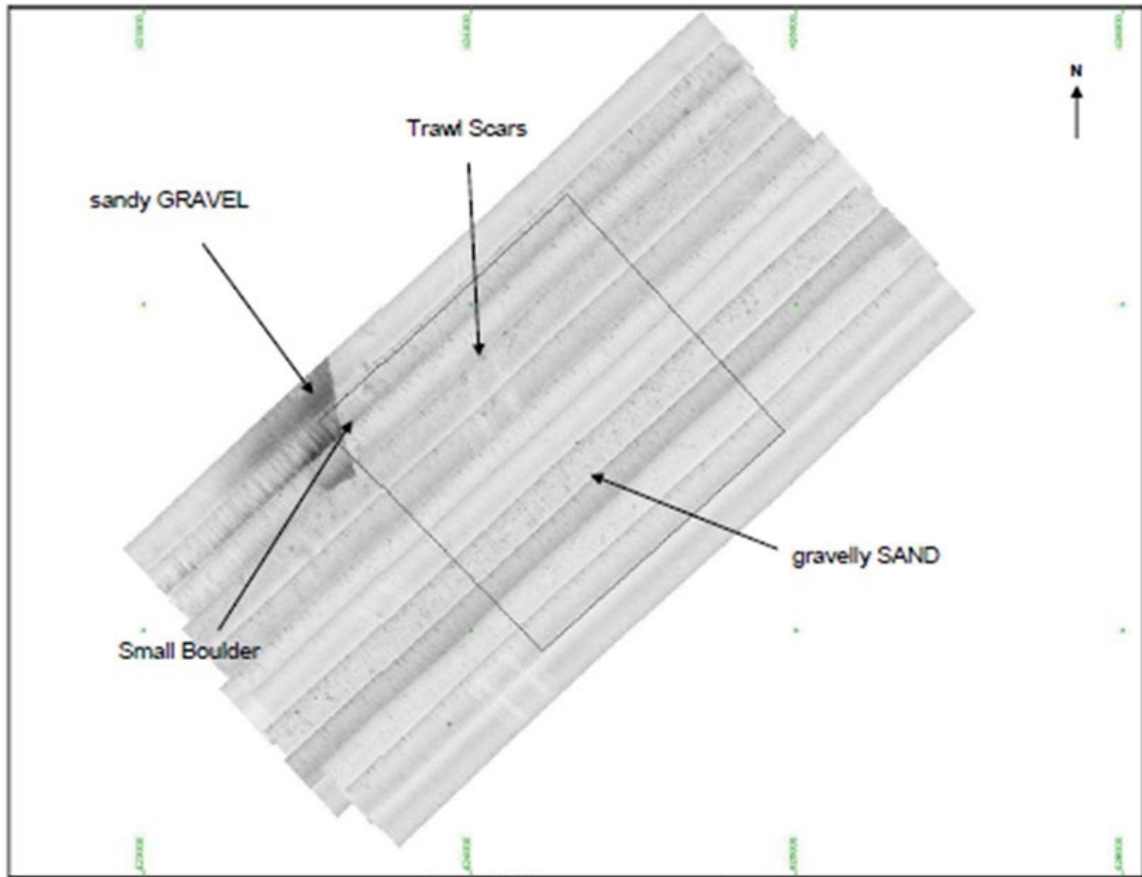


Plate 8-2-4 Trawl Scars in Met Mast West Survey Area (Pre-installation) Side-scan Sonar

## 8.2.1.3 Factual Interpretation of Pre-installation Survey: Met Mast East

7. The associated geophysical survey report (GEMS, 2011b) states the following:

*The water depth in the Met Mast East survey area varied from 24.3m in the “south-east, to 25.6 m in the west (Plate 8-2-5). The seabed is generally flat with no distinguishable features visible and generally with a dominant surface sediment likely to be gravelly SAND.*

*Met Mast East was located centrally within the survey area on flat level seabed at a depth of 24.6m.*

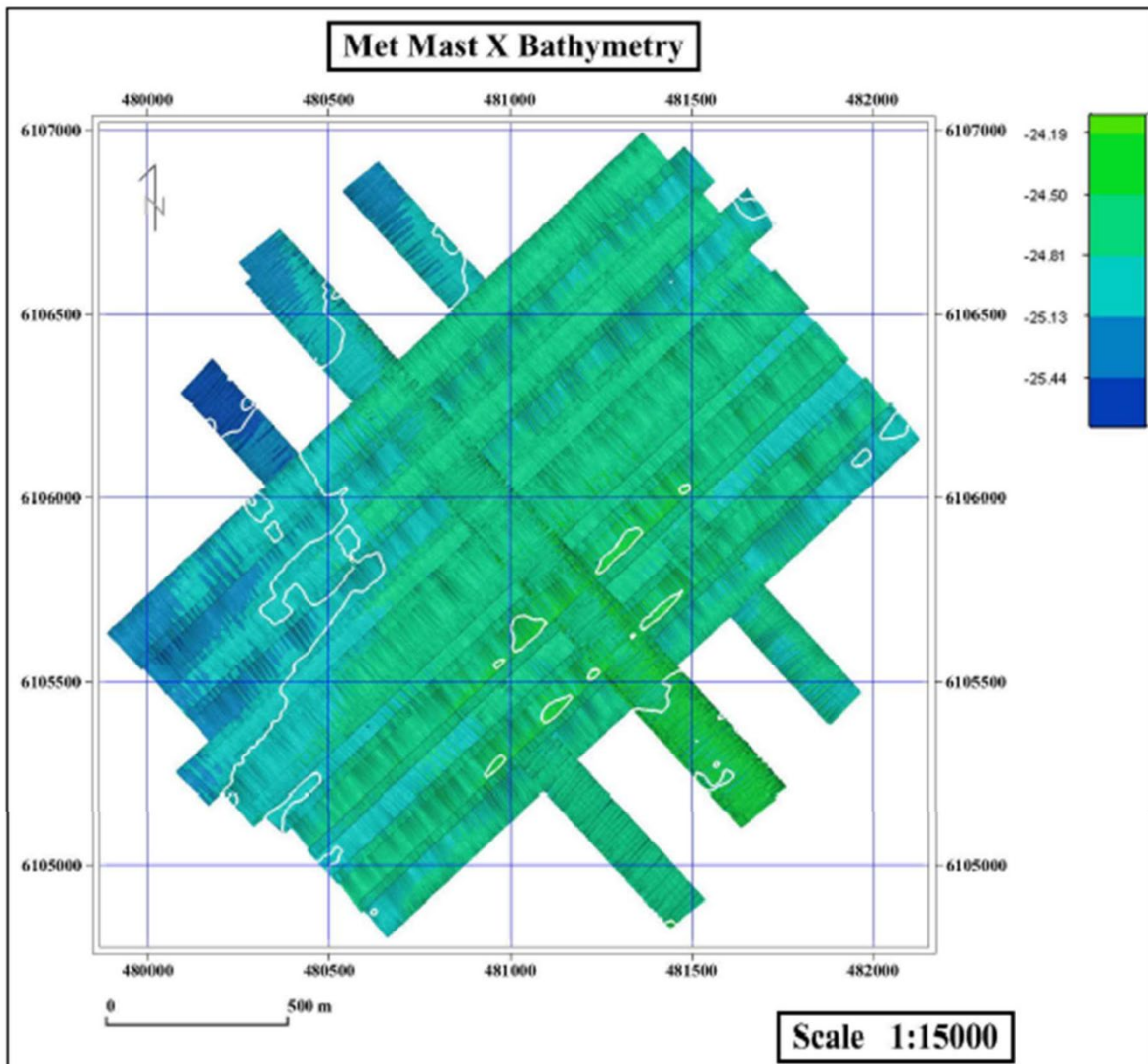


Plate 8-2-5 Met Mast East Survey Area Bathymetry (Pre-installation)

## 8.2.2 Post-removal Survey

### 8.2.2.1 Background

8. This survey was undertaken by Fugro in September 2022 and involved collecting:
  - Bathymetric data using Multibeam Echo Sounder (MBES) to establish the site depths and bathymetry.
9. The geophysical survey over each former met mast locations was undertaken over a series of main lines (line spacing 100m) and a single cross line within a 1km by 1km grid. The locations of these lines are shown in **Plate 8-2-6**. The orientation of the main lines and cross lines was re-orientated by 90° compared to the GEMS pre-installation survey. MBES data were acquired on all survey lines providing 100% coverage for both Met Mast locations.

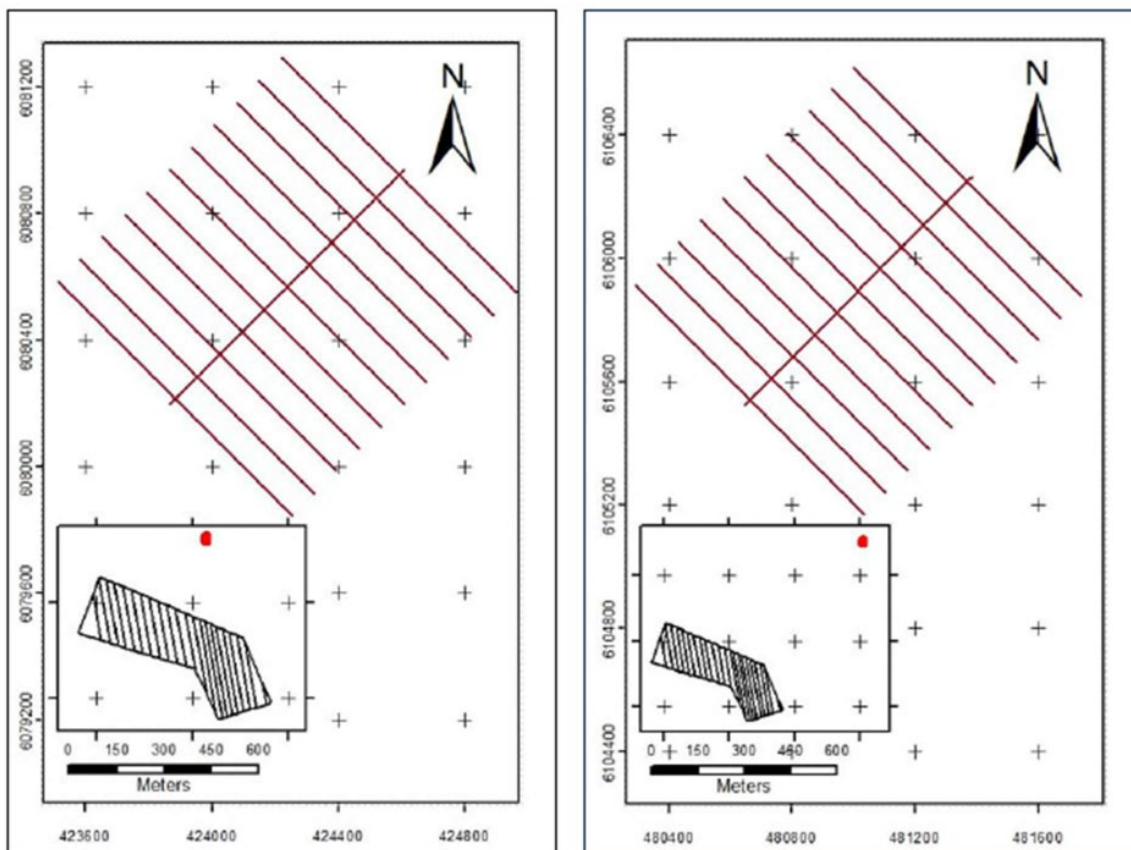


Plate 8-2-6 Post-recovery Survey Lines for Met Mast West (left) and Met Mast East (right) Survey Areas

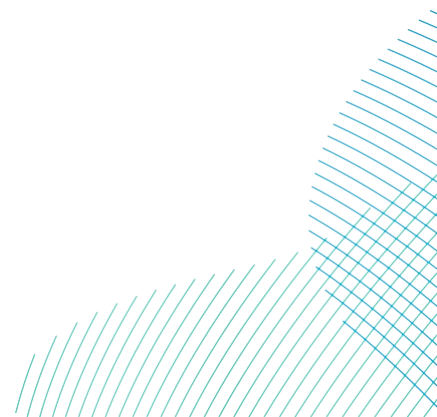
Table 8-2-2 Actual Met Mast Locations at Post-recovery Survey (Met masts removal at time of survey)

Location	Easting	Northing
Met Mast West	424233.36	6080568.01
Met Mast East	481014.84	6105894.67

### 8.2.2.2 Factual Interpretation of Post-removal Survey: Met Mast West

10. The associated geophysical survey report (Fugro, 2022) states the following:

*Water depth in the Met Mast West survey area ranges between 21.7m in the north, and 24.5m in the west **Plate 8-2-7**. The seabed was observed to be relatively flat, with the exception of a trench which is around 470m in length, seen in **Plate 8-2-8** along with a cross profile of water depth across the trench. It is roughly orientated in a north-south direction cutting through the west section of the site. There are also some small depressions located to the north of the site, which are located within 200m of each other. The depths of these depressions range from 22.5m to 23m LAT.*





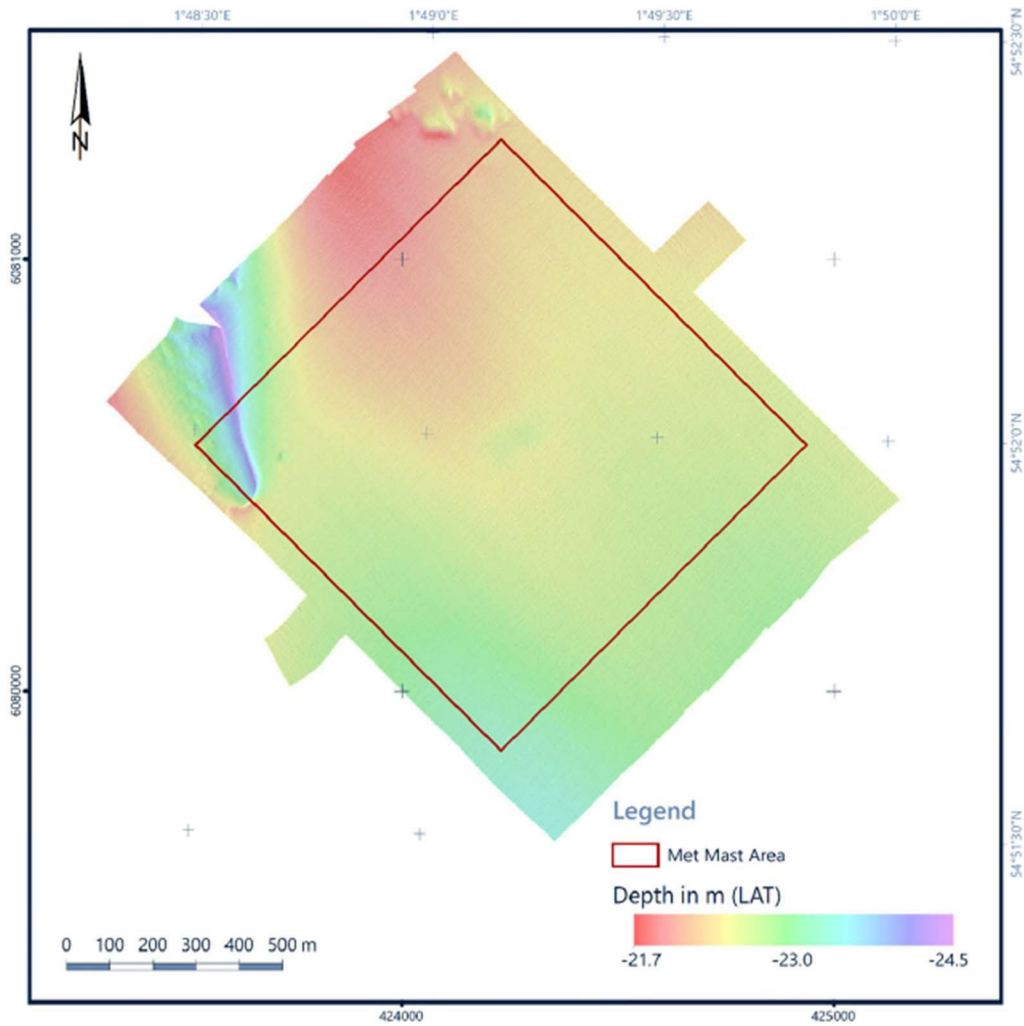


Plate 8-2-7 Met Mast West Survey Area Bathymetry (Post-recovery)

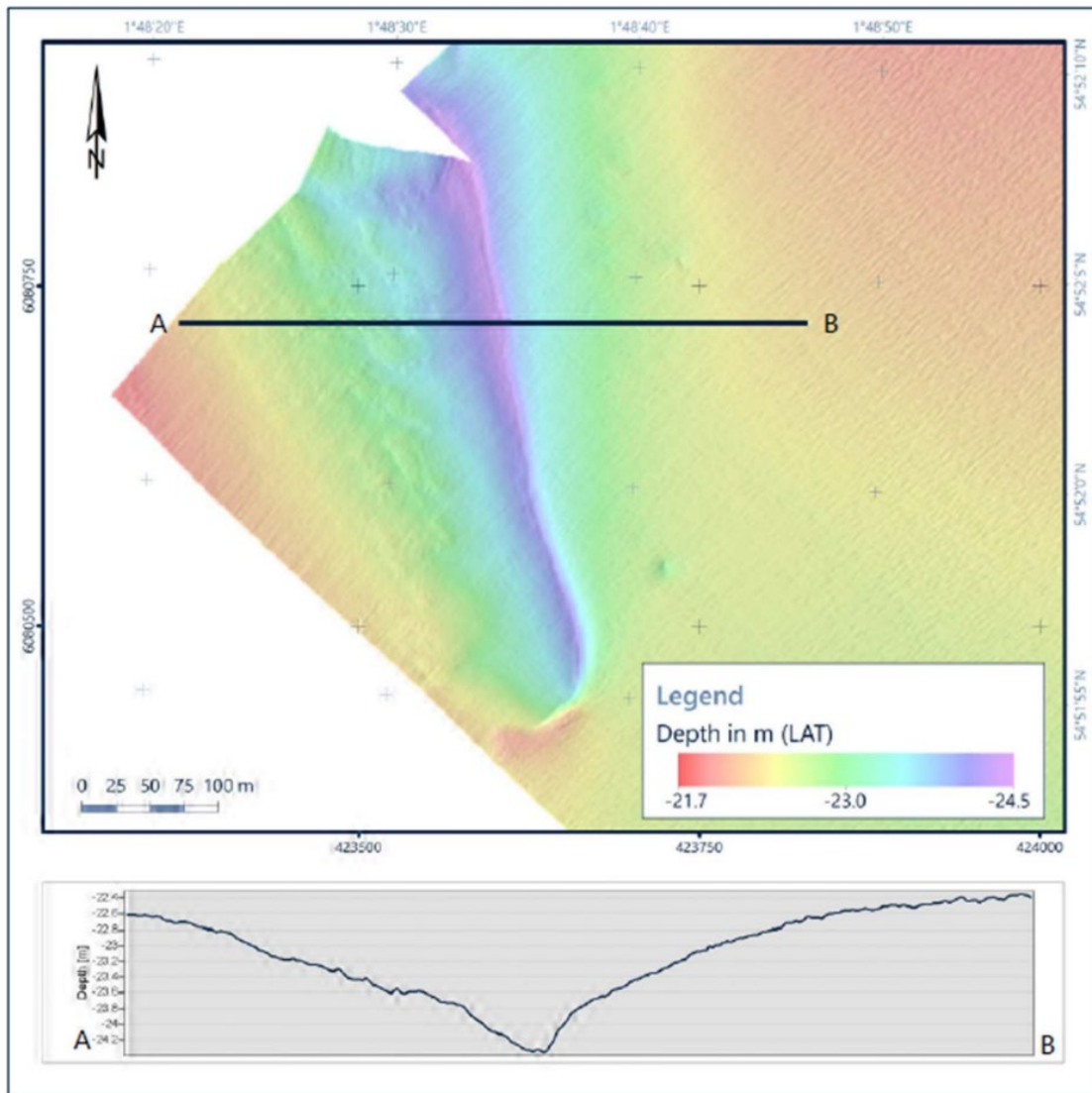


Plate 8-2-8 Met Mast West Survey Area Trench (Post-recovery)

### 8.2.2.3 Factual Interpretation of Post-removal Survey: Met Mast East

11. The associated geophysical survey report (Fugro, 2022) states the following:

*The water depth in the Met Mast East survey area varied from 24.5m in the south-east, to 25.5m in the west. The natural seabed was observed to be flat and featureless, with the exception of three small depressions (indicated with red circles in **Plate 8-2-9**).*



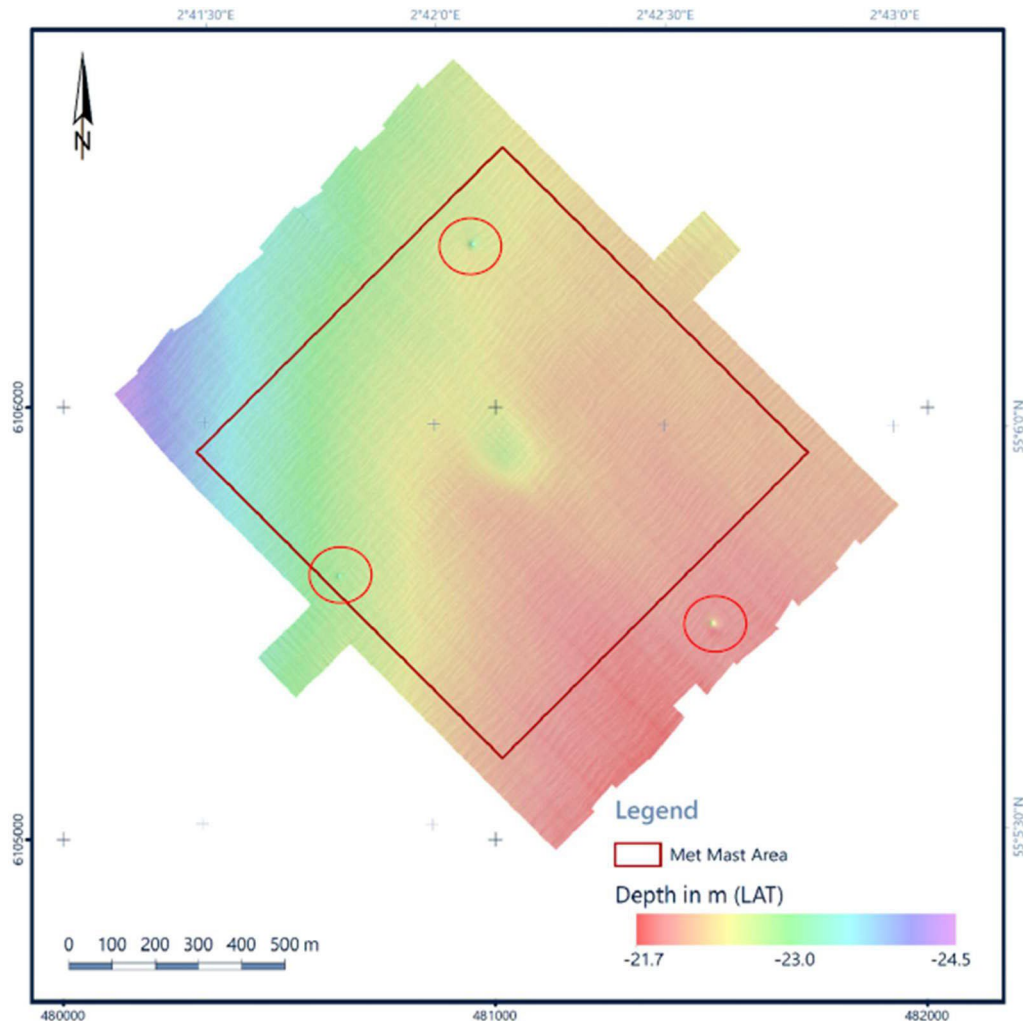


Plate 8-2-9 Met Mast East Survey Area Seabed Depressions (Post-recovery)

### 8.2.3 Analysis of Changes between Surveys

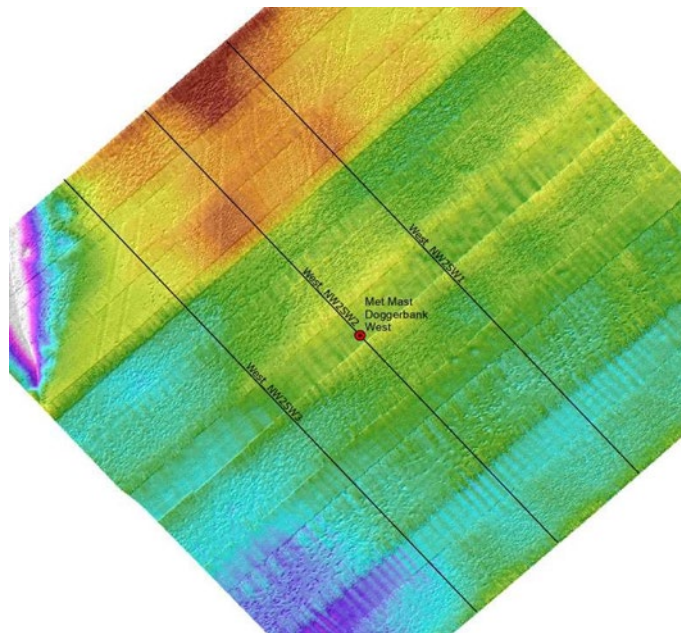
#### 8.2.3.1 Background

12. The pre-installation and post-recovery survey data have been analysed in GIS. This has involved applying a 'hill shade' effect to each dataset so that any topographic undulations, indentations or scars on the seabed are accentuated for ease of interpretation.
13. For each of the met mast survey areas a plot has been produced showing the seabed bathymetry from the pre-installation survey, the post-recovery survey and a difference plot of the changes between surveys.
14. A similar plot has been produced, zooming-in more closely to the seabed closely adjacent to the met mast locations.

15. Additionally, an ArcReader 'project' has been created for each survey to enable close on-screen viewing, with the ability to toggle 'hill shade' effects on or off as required.

### 8.2.3.2 Met Mast West

16. In the Met Mast West survey area, there appears to be a slight 'banding' in the bathymetry that was derived from the pre-installation survey (see earlier Figure 3). Given that this effect appears along the alignment of the main survey lines, it is concluded that this is an apparent bathymetric effect caused by the stitching together of data from adjacent survey lines. This has been investigated further by extracting some transects through the pre-installation data, the location of which are shown in **Plate 8-2-10** and the cross-sectional profiles of which are shown in **Plate 8-2-11**. These plots clearly show the 'jumps' in level at relatively even spacings along the transects from the pre-installation survey and can be compared against the much smoother cross-section of the post-recovery survey at an equivalent transect location (although this is partly due to the re-orientation of survey lines during the data collection).



*Plate 8-2-10 Transects Locations through the Met Mast West Survey Area*

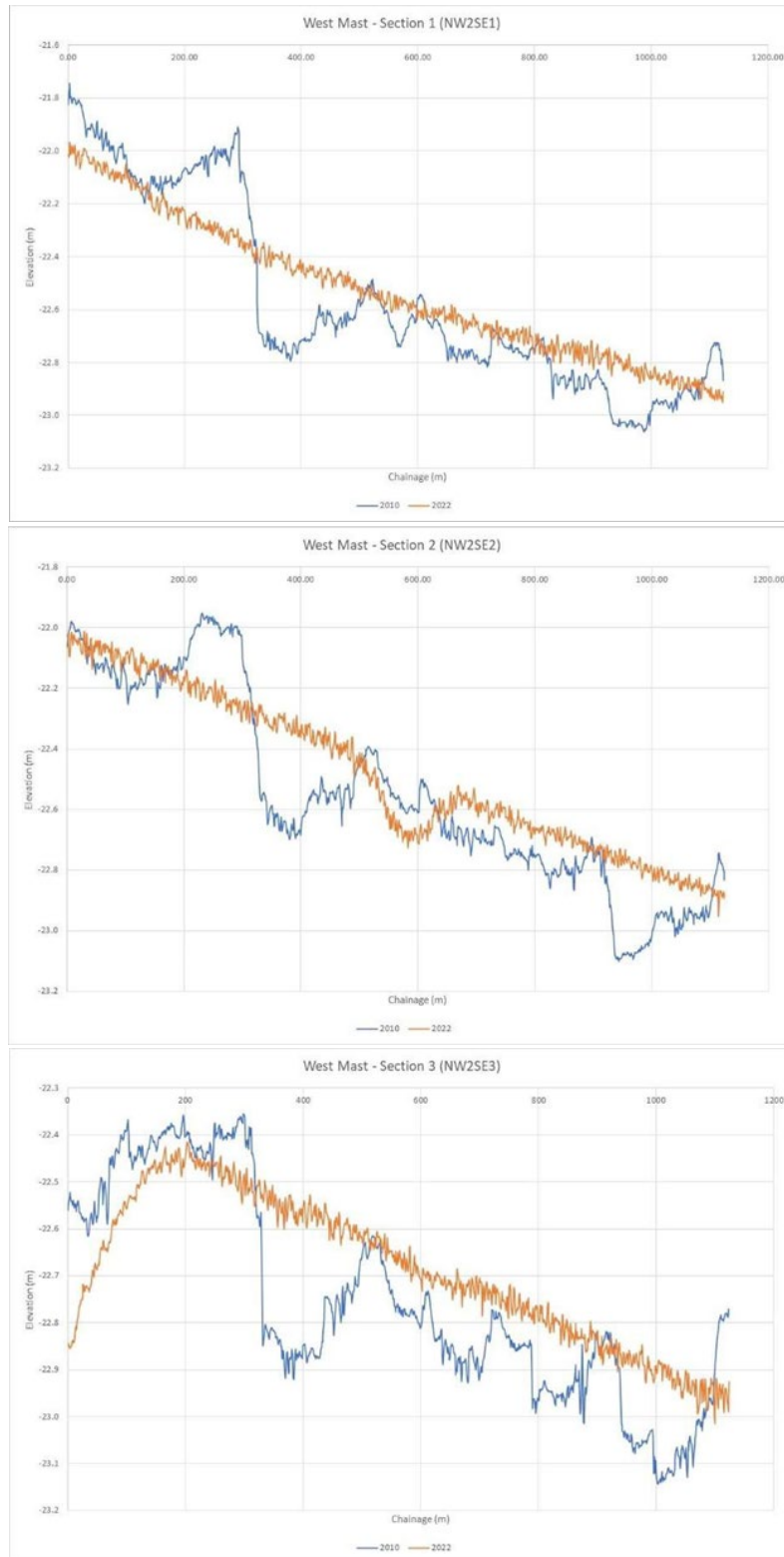


Plate 8-2-11 Cross-sections at Met Mast West Survey Area

17. This 'banding' effect translates itself into the difference plot (**Figure 8-2-1**) where apparent lowering and accretion appears in southwest-northeast alignment bands throughout the survey area. This is of such an extent and magnitude that it masks smaller natural changes.
18. The trench previously described in the western corner of the survey area is clearly discernible in both the pre-installation and post-recovery surveys. There has been a degree of natural change in this area (beyond the apparent change caused by the banding in the pre-installation bathymetry), but such change is a more global phenomenon and not associated with the presence of the met mast.
19. The aforementioned trawl scars are also subtly apparent in the pre-installation survey. In fact, there appear to be several other seabed scars in this survey running in twin lines approximately north-south aligned in parts of the survey area in addition to those described in the factual report. However, by the time of the post-recovery survey these are not at all visible in the data, suggesting that a veneer of sand has infilled them.
20. The met mast location was within an area of seabed that was locally shallower than the immediate surrounds at the time of the pre-installation survey (**Figure 8-2-2**), although the precise met mast location was in a slightly deeper zone within area this locally shallower context. It appears that by the time of the post-recovery survey there have been some areas of both shoaling and deepening in parts of the wider survey area between surveys. These appear to be associated with wider-scale changes rather than local to the met mast alone. Having said that, there is one area of seabed lowering showing on the difference plot, adjacent to the met mast location (extending along a southwest-northeast axis), although this too runs in an alignment that may mean it is associated with artefacts of the survey 'banding' rather than a real change.
21. In fact, similar magnitude changes appear associated with this same survey transect 'band' further northeast away from the met mast, supporting this conclusion. There certainly does not appear to be distinct scouring of the seabed visible in the hill shade layer close to the met mast location. However, it is noticeable from **Plate 8-2-11** that there is an apparent slight 'dip' in seabed level in the post-recovery survey at Section 2, centred on the met mast location (this dip is not apparent in Section 1 or Section 3 which do not cross the met mast location). To investigate this further at a micro-scale a N-S aligned transect and a W-E aligned transect have been taken across the Met Mast West survey area, each centred on the met mast location (**Plate 8-2-12**).

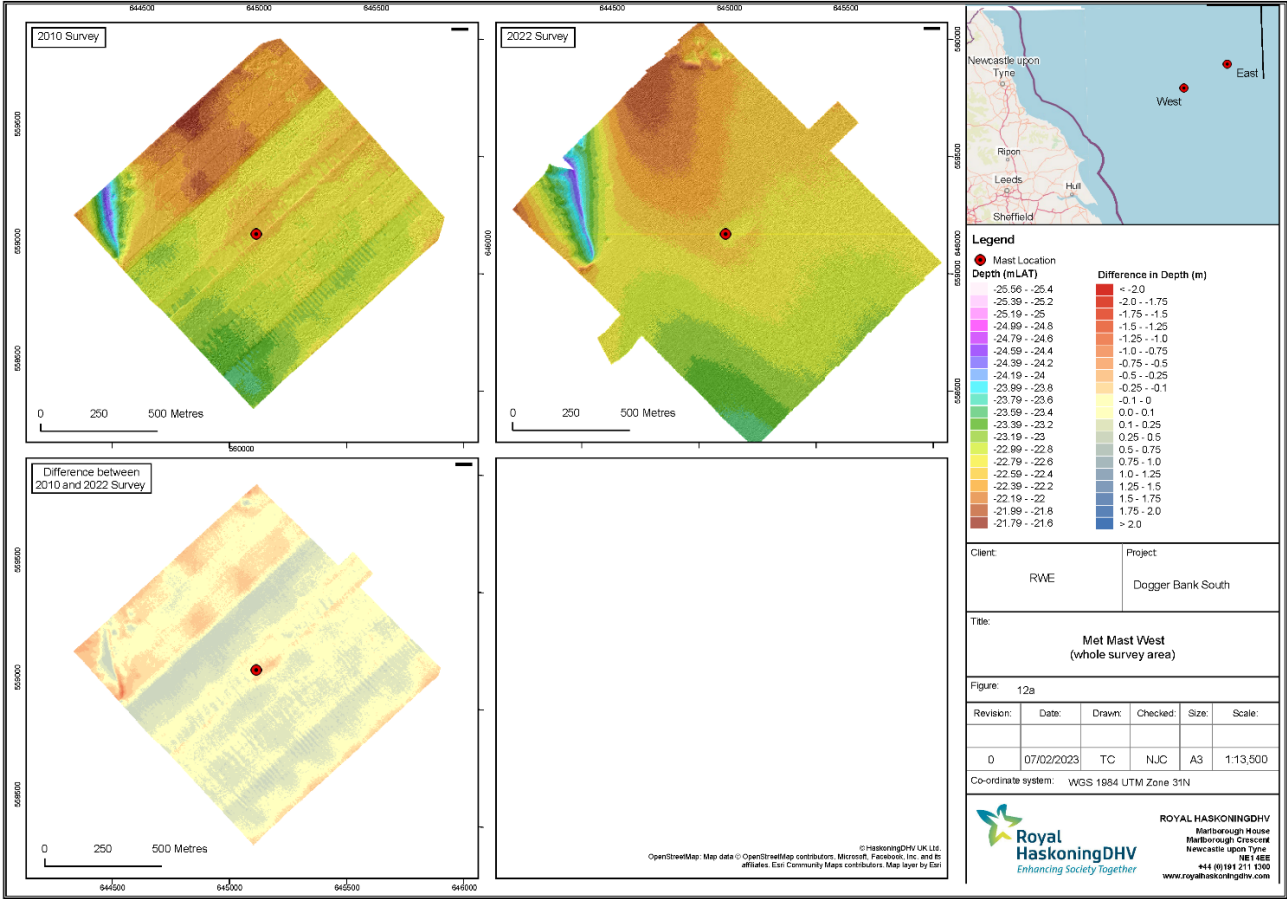


Figure 8-2-1 Met Mast West Survey Area



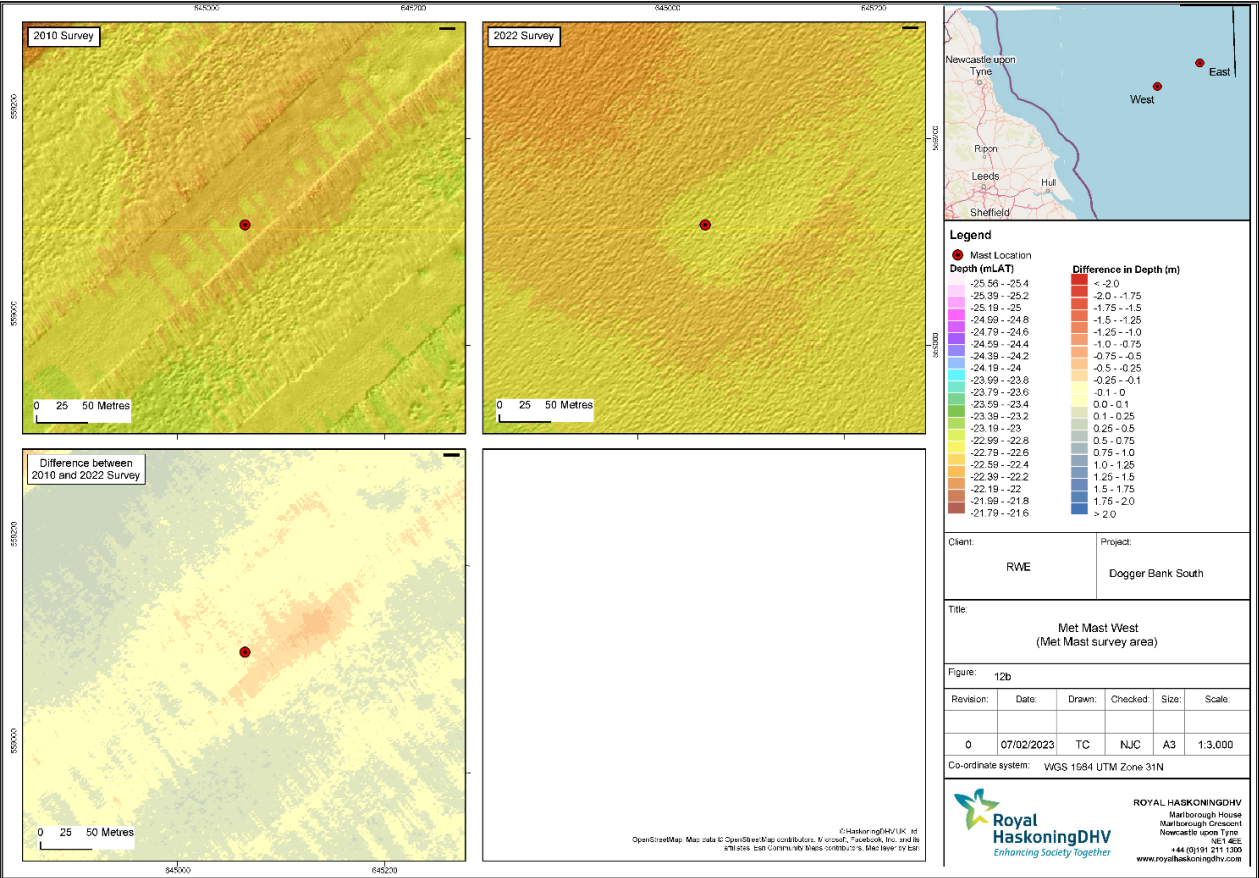
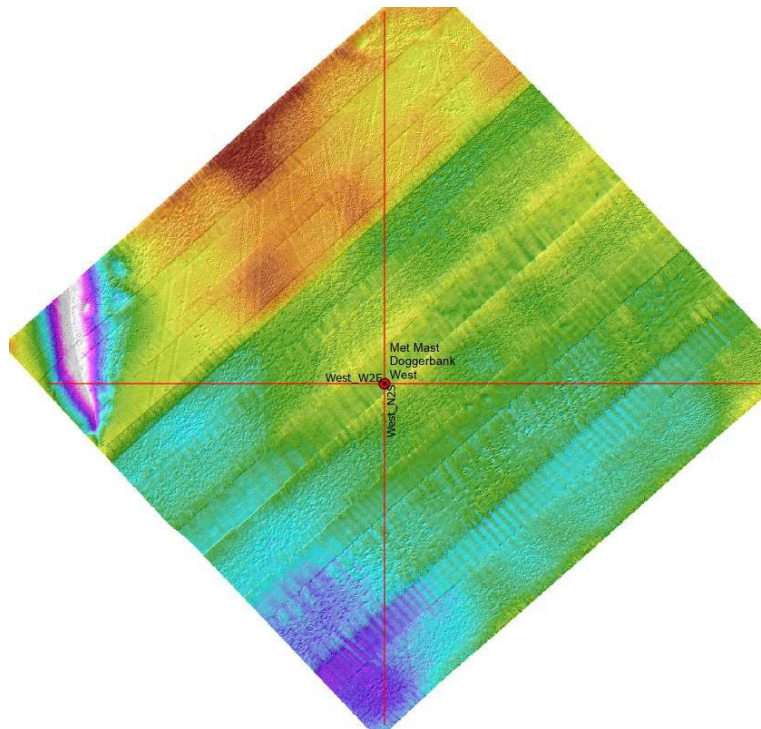


Figure 8-2-2 Met Mast West Survey Area



*Plate 8-2-12 N-S and W-E Transects Locations through the Met Mast West Survey Area*

22. The resulting cross-sectional profiles are presented in **Plate 8-2-13**. It should be noted that the y-axis, depicting the vertical depth level of the seabed, is much exaggerated compared to the x-axis showing the chainage along the survey transect. Nonetheless, there is a slight depression in the seabed centred around the former met mast location (with levels around 0.1 – 0.2m lower than surrounding seabed). This is not a significant depth change and is barely distinguishable when viewed at a different (less refined) scale and some lower areas of seabed appears at this location along both transect locations in the pre-installation survey (although see earlier comments regarding that survey's accuracy).



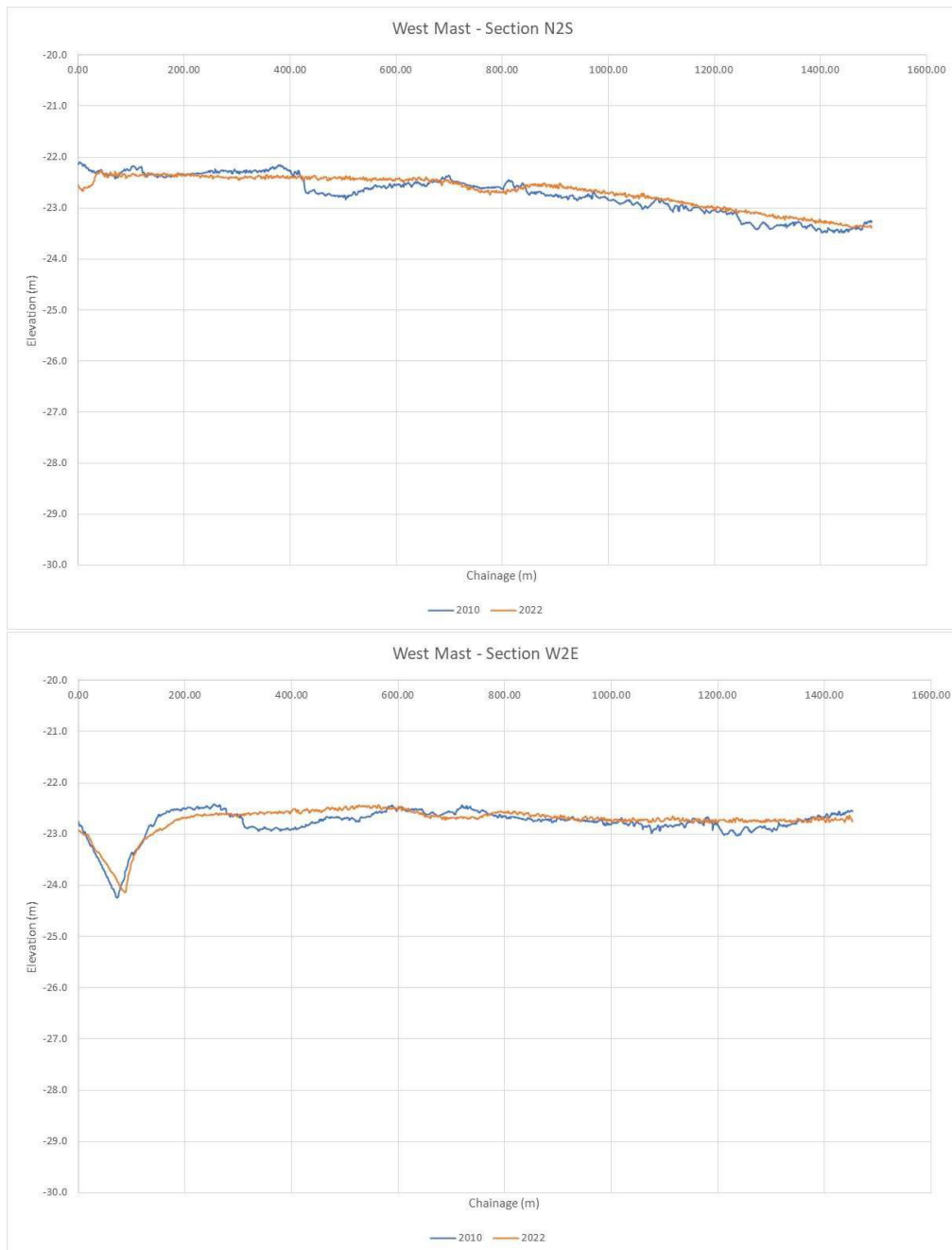


Plate 8-2-13 N-S (top) and W-E (bottom) Transect Cross-sections Centred at Met Mast West ( Note: Met mast was at N-S transect chainage 781m and W-E transect chainage 687m)

## 8.2.3.3 Met Mast East

23. In the Met Mast East survey area, there is considerable ‘banding’ in the bathymetry that was derived from the pre-installation survey (Figure 5). As for the Met Mast West survey, this has been investigated further by extracting some transects through the pre-installation data. the transect locations are shown in **Plate 8-2-14**. The cross-sectional profiles of these transects are show in **Plate 8-2-15**. These plots show distinct ‘jumps’ in level at relatively even spacings along the transects from the pre-installation survey and can be compared against the much smoother cross-section of the post-recovery survey at an equivalent transect location (although this is partly due to the re-orientation of survey lines during the data collection). This effect translates itself into the difference plot where apparent lowering appears in bands throughout the survey area.

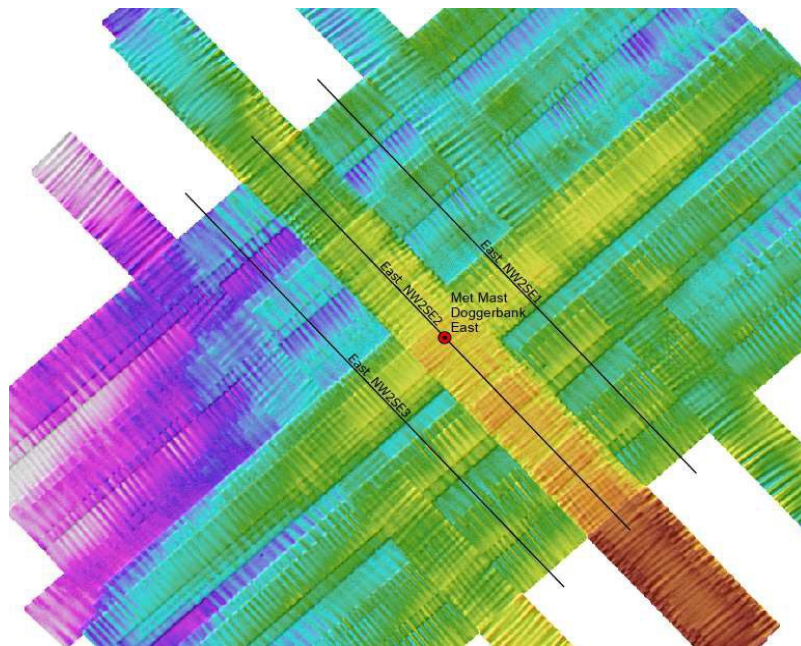


Plate 8-2-14 Transect Locations through the Met Mast East Survey Area

24. As for the Met Mast West analysis, this ‘banding’ effect translates into the difference plot (**Figure 8-2-3** and **Figure 8-2-4**) where apparent lowering and accretion appears in southwest-northeast alignment bands throughout the survey area. This is of such an extent and magnitude that it masks smaller natural changes.

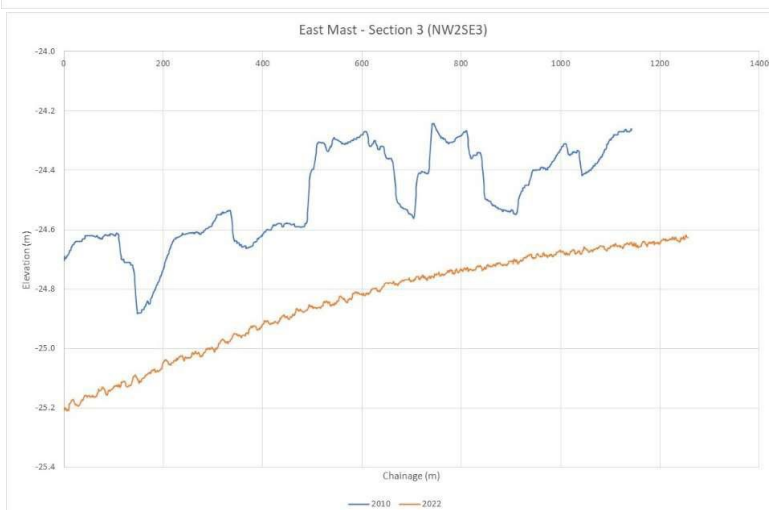
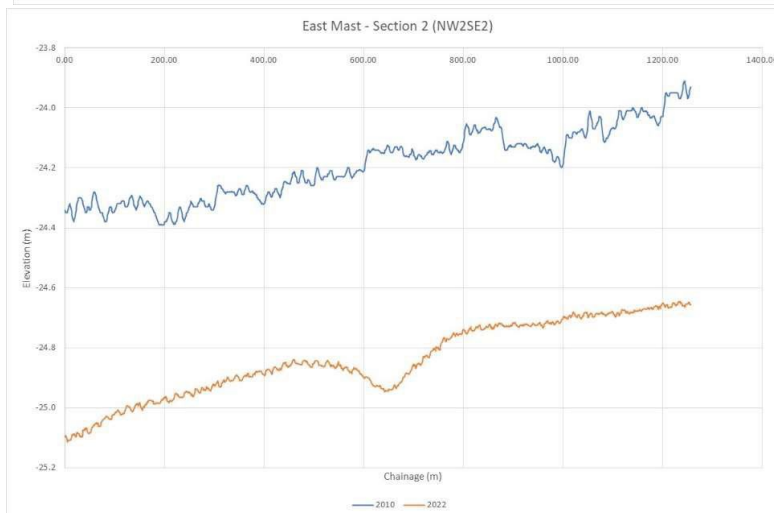
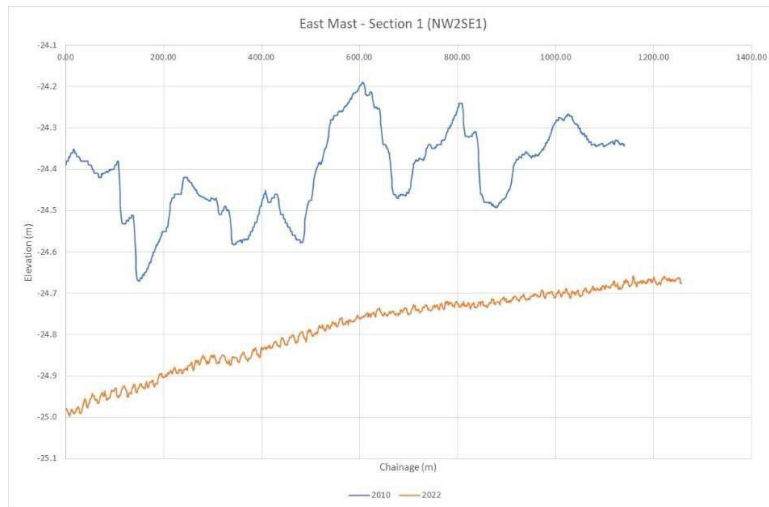
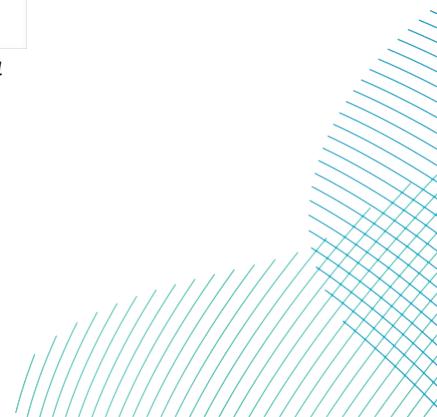


Plate 8-2-15 Cross-sections at Met Mast East Survey Area



25. The three previously-described seabed depressions are seen in the post-recovery survey, but at distances well away from the met mast location.
26. When considering the seabed in the immediate vicinity of the met mast location (Figure 18b), there are no scouring effects visible in the hill shade layer close to the met mast location. However, the -24.8mCD seabed contour has a notable curvature in plan alignment, with the seabed remaining slightly deeper around the met mast location than the seabed further east, north and south. Also, it is noticeable from Figure 16 that there is an apparent slight 'dip' in seabed level in the post-recovery survey at Section 2, centred on the met mast location (this dip is not apparent in Section 1 or Section 3 which do not cross the met mast location). This is similar to that experienced at Section 2 of the Met Mast West location.
27. So, to investigate this further at a micro-scale a N-S aligned transect and a W-E aligned transect have been taken across the Met Mast West survey area, each centred on the met mast location (**Plate 8-2-16**).

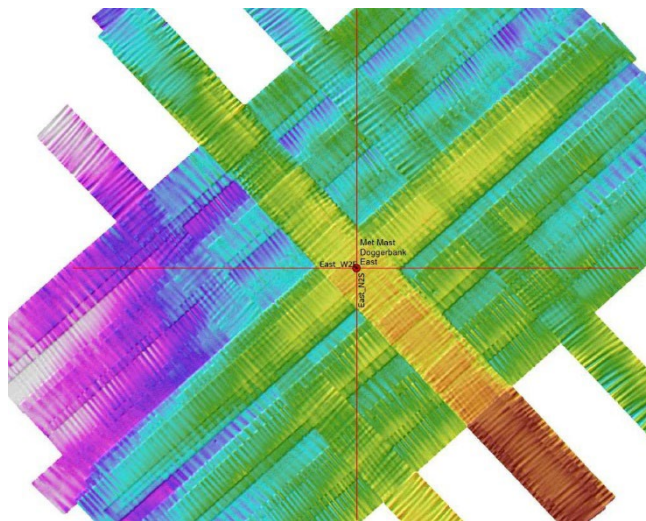


Plate 8-2-16 N-S and W-E Transects Locations through the Met Mast East Survey Area

28. The resulting cross-sectional profiles are presented in **Plate 8-2-17**. It should be noted that the y-axis, depicting the vertical depth level of the seabed, is much exaggerated compared to the x-axis showing the chainage along the survey transect. Nonetheless, there is a slight depression in the seabed centred around the former met mast location (with levels around 0.1 – 0.2m lower than surrounding seabed). This is not a significant depth change and is barely distinguishable when viewed at a different scale and some lower areas of seabed appears at both transect locations in the pre-installation survey (although see earlier comments regarding that survey's accuracy).

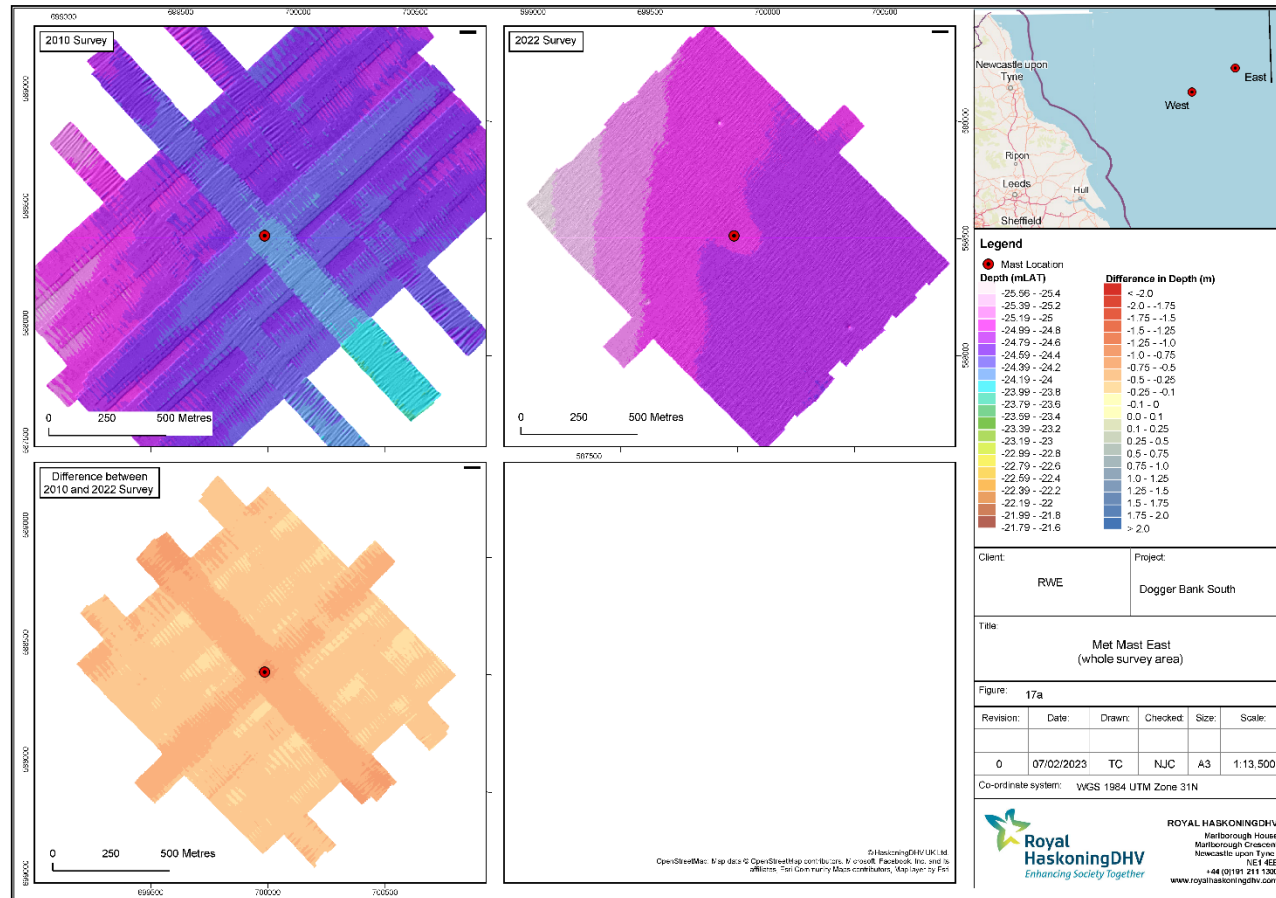


Figure 8-2-3 Met Mast East Survey Area



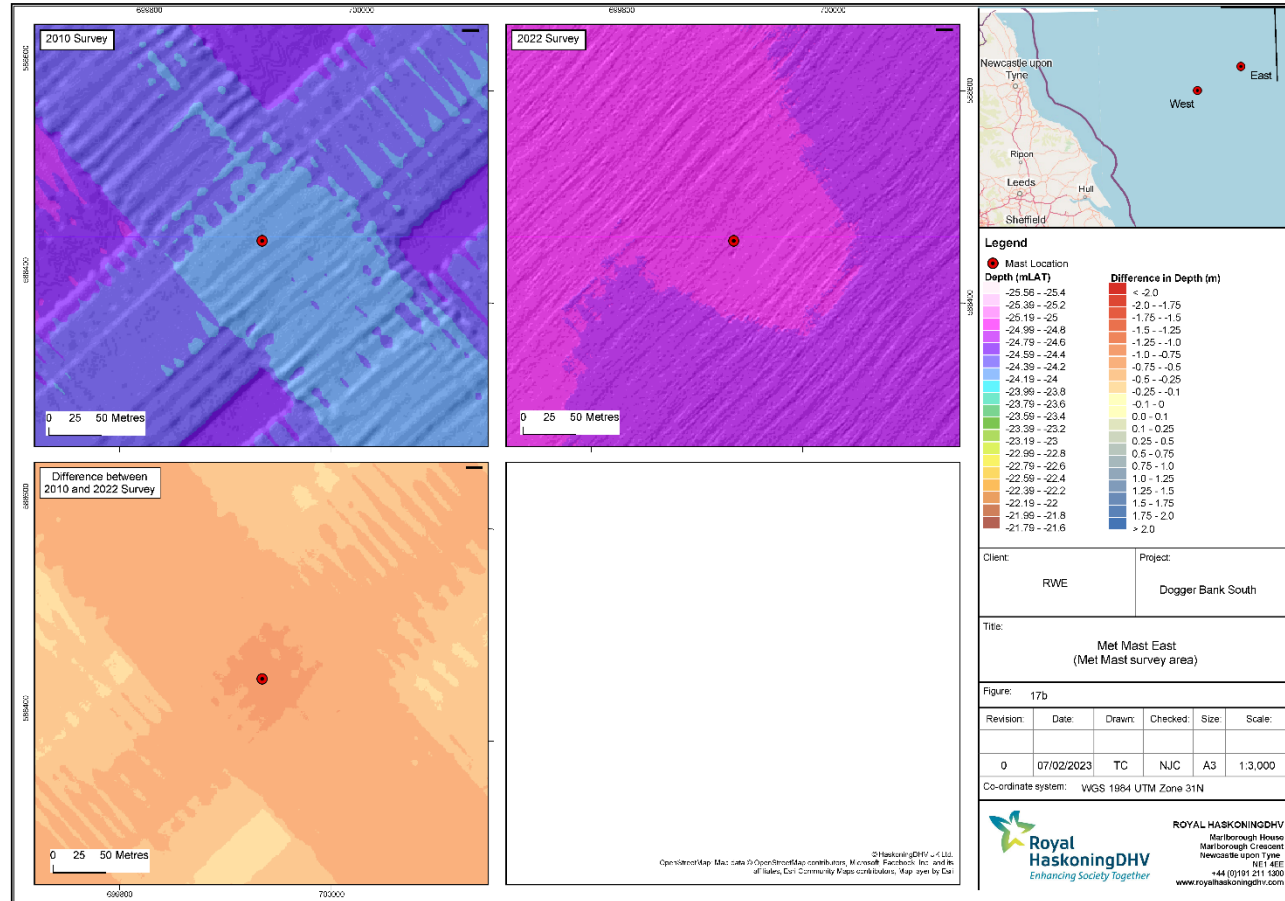


Figure 8-2-4 Met Mast East Survey Area



Plate 8-2-17 N-S (top) and W-E (bottom) Transect Cross-sections Centred at Met Mast East (Note: Met mast was at N-S transect chainage 770m and W-E transect chainage 822m)



## 8.2.4 Conclusions

29. The pre-installation survey has notable 'banding' in the combined bathymetric dataset. This is an artefact of the stitching together of survey data from adjacent survey lines. This makes it difficult to discern seabed changes from a difference plot between the pre-installation and post-recovery surveys unless such changes exceed the limits of the survey accuracy.
30. More usefully, the post-recovery dataset offers a more seamless bathymetric representation and a high quality dataset. Despite this, even when applying a hill shade effect to these data to accentuate any seabed depressions, evidence of significant scour holes around the location of the now-removed met masts is absent.
31. However, the extraction and examination of cross-sectional transects (N-S and W-E) centred on each met mast location reveal a very subtle shallow (0.1 – 0.2m) panning of the seabed centred on each former met mast location. These are not significant features and are very difficult to discern from the data. This is likely to be an artefact of (near-complete) infilling of a former scour hole following removal of each met mast.
32. Given that trawl marks on the seabed that were clearly distinguishable in the pre-installation survey at the Met Mast West survey area had been fully infilled by natural process by the time of the post-recovery survey, it is envisaged that full infilling of scour holes around former met mast locations will be attained in the near future.

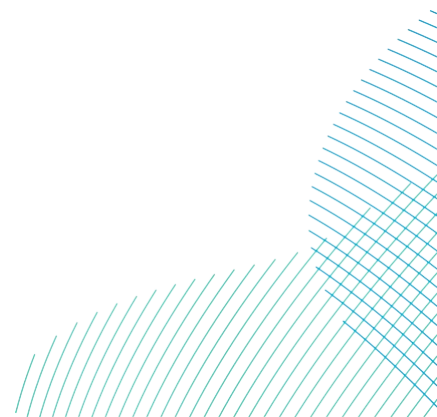


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