# Dudgeon Offshore Wind Farm

Post-construction archaeological monitoring assessment

of 2018 geophysical data

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wessexarchaeology

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**DATA LICENCES**

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## Contents



### List of Tables



### List of Figures

**Summary**

Wessex Archaeology was commissioned by Royal HaskoningDHV to undertake a post-construction archaeological monitoring assessment of geophysical data acquired from the Dudgeon Offshore Wind Farm by MMT in 2018. This was to be undertaken to satisfy the conditions for archaeological monitoring as set out in Marine Licence L/2012/00218/10.

The Dudgeon Offshore Wind Farm comprises 67 turbines and their associated inter-array cabling, with two export cables. The wind farm covers an area of 55 km² and the export cables are approximately 35 km from the offshore substation to landfall at Sheringham. Wessex Archaeology has been involved in several phases of work for the Dudgeon development since 2009 including geophysical assessments, Written Schemes of Investigation, Desk-based Assessments, palaeoenvironmental assessments, and archaeological assessment of Remotely Operated Vehicle survey data.

The assessment data comprised sidescan sonar and multibeam echosounder which were used to assess the presence of seabed features of archaeological potential, and to determine any possible impact (direct or indirect) on previously identified features of archaeological that may have occurred as a result of wind farm construction. The results of this assessment were then compared to the results of the archaeological assessment of data acquired by Osiris Projects in 2012 and 2013 and the subsequent ground-truthing Remotely Operated Vehicle surveys of potential Unexploded Ordnance.

This assessment has resulted in a total of 32 anomalies being identified;

- A total of 24 anomalies have been previously identified
- A total of 8 anomalies have been newly identified during this phase of assessment
- Six anomalies within the current study area were assessed as potential Unexploded Ordnance (MMT 2015a; 2015b; 2015c, Wessex Archaeology 2015a; 2015b). One (**70293**) was found to be a 1000 lb Air Dropped Bomb and has been disposed of *in situ*. Another (**70542**) has been identified as a metal bar and has been retained as of potential archaeological interest. Four anomalies (**70084**, **70149**, **70175** and **70211**) were found to be modern wire and are no longer considered of archaeological potential.

Twenty Archaeological Exclusion Zones are in place within or in the proximity of the Dudgeon Offshore Wind Farm and its associated Export Cable Route (Statoil 2016). Of these, seven were either covered or partially covered by geophysical data acquired for this post-construction monitoring. Where the Archaeological Exclusion Zones were covered by geophysical data, the data were assessed for evidence of any incursions into the Archaeological Exclusion Zones. Based on this assessment, no evidence was seen on the geophysical data of incursions into any of the Archaeological Exclusion Zones.

All anomalies within the study areas have been classified as A2. For features assigned A2 archaeological discrimination rating, no Archaeological Exclusion Zones are recommended at this time. However, avoidance of these features by micro-siting is recommended if they are proposed to be directly impacted by future ground works at the wind farm site.

It is recommended that if any objects of possible archaeological interest are recovered during the operation phase, that they should be reported using the established *Offshore Renewables Protocol for Archaeological Discoveries*. This will establish whether the recovered objects are of archaeological interest and recommend appropriate mitigation measures.

**Acknowledgements**

This assessment of geophysical data was commissioned by Royal HaskoningDHV, and the assistance of Gemma Starmore and Victoria Cooper of Royal HaskoningDHV is acknowledged in this respect.

The geophysical data used for this assessment were originally acquired by MMT in 2018.

# Dudgeon Offshore Wind Farm

# Post-construction archaeological monitoring assessment of 2018 geophysical data

## 1 INTRODUCTION

### 1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Royal HaskoningDHV to undertake a post-construction archaeological monitoring assessment of geophysical data acquired from the Dudgeon Offshore Wind Farm (OWF) and export cable route (ECR). This was undertaken to satisfy the conditions for archaeological monitoring as set out in the Marine Licence L/2012/00218/10.

1.1.2 The Dudgeon OWF is located in the North Sea approximately 35 km north of the north coast of Norfolk (Figure 1). The Dudgeon OWF comprises one substation, 67 turbines and their associated infield cabling, and two export cables. The OWF covers an area of 55 km$^2$, and the export cables are approximately 35 km from the offshore substation to landfall at Sheringham.

1.1.3 The geophysical data assessed by Wessex Archaeology were acquired by MMT in 2018 and comprised sidescan sonar (SSS) and multibeam echosounder (MBES) data sets.

1.1.4 This geophysical assessment is the latest in a series of projects conducted by Wessex Archaeology for Dudgeon OWF development. In addition to presenting the results of the current archaeological assessment of the 2018 survey data, this document will also present the comparison of this assessment with the results of the previous assessments of 2008 and 2013 geophysical data. This comprises SSS, MBES, and marine magnetometer (Mag.) datasets (Wessex Archaeology 2009a; 2009b; and 2014b) as well as the assessment of Remotely Operated Vehicle (ROV) survey data of potential Unexploded Ordnance (UXO), and the archaeological analysis thereof, that are within the development footprint (Royal HaskoningDHV 2015 and Wessex Archaeology 2015a; 2015b).

1.1.5 Two separate study areas were used to carry out this assessment, based on the interpreted direct and indirect impact of wind farm construction on the seabed. The first study area comprised a 10 m corridor centred on each infield cable and the export cable routes (i.e. 5 m either side), a 40 m radius circle centred on each turbine, and a 20 m buffer extended out from the full extent of the substation. The original methodology was to use a 20 m radius circle centred on each turbine or other seabed infrastructure position however, on assessing the MBES data, it was apparent that this would not encompass enough of the seabed directly impacted by turbine installation.

1.1.6 The second study area was based on a comparison between the MBES data acquired for this survey, and the 2013 pre-construction MBES data (Wessex Archaeology 2014b). The data were analysed to identify any areas of the seabed that have experienced either a loss or accumulation of sediment of 0.5 m or greater between the two data sets, that is not deemed to be due to natural processes. This included any direct impact areas not included in the first study area (e.g. jack up footprints).

1.1.7 In addition to these study areas, the extents of any archaeological exclusion zones (AEZs) present within, or in the proximity of, the Dudgeon OWF and its associated ECR were assessed for any direct or indirect impacts from wind farm construction. These AEZs were the final selection agreed with Historic England through the construction phase Written Scheme of Investigation (WSI) (Statoil 2016). The AEZs to be assessed are shown in Table 1 below:

**Table 1** Archaeological Exclusion Zones

| ID | Description | AEZ Buffer Distance | Easting | Northing |
|---|---|---|---|---|
| 70819 / 70842 (MMT: X40705A / X40706) | Unknown aircraft engines | 50 | 377540 | 5872079 |
| 7036 | Clan Morrison | 120 | 386046 | 5887236 |
| 7034 | Unknown | 70 | 388916 | 5905990 |
| 7035 | Aquarius (possibly) | 70 | 387699 | 5905833 |
| 7083 | Wreck | 65 | 395481 | 5897503 |
| 7193 | Wreck | 60 | 384688 | 5884093 |
| 7037 | Unknown | 50 | 385965 | 5887063 |
| 7044 | Rosalie (Possibly) | 100 | 374750 | 5868441 |
| 7300 | Debris | 100 | 392840 | 5906487 |
| 7301 | Debris | 100 | 394650 | 5905203 |
| 7302 | Debris | 100 | 404466 | 5900142 |
| 7303 | Debris | 100 | 394629 | 5905287 |
| 7304 | Debris | 100 | 404655 | 5900345 |
| 7307 | Seafloor disturbance | 100 | 398186 | 5901045 |
| 7308 | Seafloor disturbance | 100 | 397042 | 5903667 |
| 7309 | Seafloor disturbance | 100 | 393809 | 5904540 |
| 7310 | Wreck | 100 | 397542 | 5902844 |
| 7306 (MMT: 27727) | Wreck | 50 | 390692 | 5907452 |
| 70402 (MMT: M30912) | Wreck | 50 | 383832 | 5883307 |
| 70832 (MMT: M41062) | Unknown – aircraft propellers | 30 | 377943 | 5872312 |

1.1.8 Any geophysical anomalies identified outside of the defined study areas are considered beyond the scope of this report and are not included in the results or gazetteer of anomalies.

## 1.2 Previous work

1.2.1 Wessex Archaeology has previously undertaken a series of assessments for the Dudgeon OWF and ECR development, including Desk-Based Assessment (DBA), archaeological interpretation of geophysical datasets, and a Written Scheme of Investigation (WSI) for archaeological monitoring. The assessments and related surveys are outlined in Table 2 below in chronological order:

**Table 2** Summary of previous work undertaken by Wessex Archaeology

| Project reference | Date | Project type | Report reference |
|---|---|---|---|
| 69680.04 | April 2009 | Geophysical assessment for the Dudgeon OWF extension area | Wessex Archaeology 2009a |

| Project reference | Date | Project type | Report reference |
|---|---|---|---|
| 69680.08 | May 2009 | Archaeological desk-based assessment with geophysical assessment | Wessex Archaeology 2009b |
| 69681.03 | July 2014 | Stages 1 to 3 geoarchaeological and palaeoenvironmental assessment | Wessex Archaeology 2014a |
| 69682.04 | July 2014 | Geophysical assessment of 2013 data | Wessex Archaeology 2014b |
| 69683.04 | July 2014 | Archaeological monitoring and mitigation written scheme of investigation | Wessex Archaeology 2014c |
| 69683.05 | August 2014 | Review of archaeological material during unexploded Ordnance survey (turbine locations and cable route) | Wessex Archaeology 2014d |
| 69684.01 | May 2015 | Archaeological assessment of UXO survey | Wessex Archaeology 2015a |
| 69684.02 | October 2015 | Archaeological assessment of UXO survey results April – May 2015 | Wessex Archaeology 2015b |
| 69685.01 | August 2016 | Dudgeon Offshore Wind Farm stage 4 palaeoenvironmental analysis, borehole BH06 | Wessex Archaeology 2016 |

1.2.2 In addition to this, a third assessment of ROV data was undertaken by Royal HaskoningDHV (Royal HaskoningDHV 2015) and a construction phase WSI written (Statoil 2016), both of which were reviewed as part of this assessment.

## 1.3 Aims and objectives

1.3.1 The aim of this assessment is to undertake a post-construction archaeological monitoring assessment of geophysical data within the Dudgeon OWF and ECR, in order to satisfy the conditions for archaeological monitoring as set out in the Marine Licence L/2012/00218/10. This is to be undertaken through the following objectives:

- Assess the provided geophysical data to identify, locate, and characterise hitherto unrecorded marine sites of archaeological potential;
- confirm the presence of known or previously located marine sites of archaeological potential and to comment on their apparent character;
- compare the results of the geophysical assessment with the results of previous assessments in the area, and with known records (e.g. from the United Kingdom Hydrographic Office (UKHO));
- comment on any effects (direct or indirect) of the development on known archaeological sites and previously identified anomalies of archaeological potential, and the effectiveness of the implemented AEZs; and
- provide recommendations for archaeological mitigation where necessary.

## 1.4 Co-ordinate system

1.4.1 The survey data were acquired in WGS84 UTM31N projected coordinates, and the results are presented in the same coordinate system.

# 2 METHODOLOGY

## 2.1 Data sources

2.1.1 A number of data sources were consulted during this assessment, including:

- geophysical survey datasets acquired by MMT in 2018;
- client supplied shapefiles of the as-laid positions of the OWF and ECR infrastructure;
- known wreck and obstruction locations and information for the study area acquired via the UKHO;
- client supplied reports, including the offshore verification of possible UXO targets within the study area (MMT 2015a; 2015b, Royal HaskoningDHV 2015);
- client supplied Construction Phase WSI (Statoil 2016);
- past reports and assessments undertaken by Wessex Archaeology within the Dudgeon OWF and ECR (Wessex Archaeology 2009a; 2009b; 2014b; 2014c; 2014d; 2015a and 2015b).

## 2.2 Geophysical data – technical specifications

2.2.1 Geophysical data were acquired by MMT during August 2018. Further details on the equipment used is in Table 3.

2.2.2 The data collected consisted of SSS and MBES data sets. The survey was split into two main sections, the OWF consisting of the turbines, infield cables and substation, and the ECR.

2.2.3 For the OWF, the lines were spaced at approximately 65 m and run at a north-west to south-east alignment. The ECRs were covered by at least three survey lines per cable to ensure complete coverage, covering a width of 210 m.

**Table 3** Summary of survey equipment

| Survey Company | Survey Vessel | Data Type | Equipment | Data Format |
|---|---|---|---|---|
| MMT | Unknown | MBES | Hull-mounted EM2040 | *.xyz* |
| | | SSS | Edgetech (300 / 600 kHz, 75 m and 100 m range) | *.jsf* |

## 2.3 Geophysical data – processing

2.3.1 A number of datasets were assessed over the study area, each dataset was processed separately by Wessex Archaeology using the following software (Table 4).

**Table 4** Software used for geophysical assessment

| Dataset | Processing Software | Interpretation and rationalisation |
|---|---|---|
| MBES | QPS Fledermaus v7.8 | ArcGIS 10.6.1 |
| SSS | CodaOctopus Survey Engine v5.7 and v5.11 (64 bit) | |

2.3.2 The MBES data were analysed to identify any unusual seabed structures that could be shipwrecks or other anthropogenic debris. The data were gridded at 0.5 m and analysed using QPS Fledermaus software, which enables a 3-D visualisation of the acquired data and geo-picking of seabed anomalies.

2.3.3 The high frequency *.jsf* SSS data files were first converted to *.cod* files using CodaOctopus File Utilities, before being processed using CodaOctopus Survey Engine Sidescan+ software. This allowed the data to be replayed with various gain settings in order to optimise the quality of the images. The data were interpreted for any objects of possible anthropogenic origin. This involves creating a database of anomalies within Coda by tagging individual features of possible archaeological potential, recording their positions and dimensions, and acquiring an image of each anomaly for future reference.

2.3.4 A mosaic of the SSS is produced during this process to assess the quality of the sonar towfish positioning. This process allows the position of anomalies to be checked between different survey lines and for the positioning to be further refined if necessary.

2.3.5 The form, size and/or extent of an anomaly is a guide to its potential to be an anthropogenic feature and therefore of archaeological interest. A single small but prominent anomaly may be part of a much more extensive feature that is largely buried. Similarly, a scatter of minor anomalies may define the edges of a buried but intact feature, or it may be all that remains as a result of past impacts from, for example, dredging or fishing. Assessment is made of such groups of anomalies during data interpretation to determine which of these alternatives is most likely.

## 2.4 Geophysical data – data quality

2.4.1 Once processed, the geophysical data sets were individually assessed for quality and their suitability for archaeological purposes, and rated using the following criteria (Table 5).

**Table 5** Criteria for assigning data quality rating

| Data quality | Description |
|---|---|
| Good | Data which are clear and unaffected or only slightly affected by weather conditions, sea state, background noise or data artefacts. Seabed datasets are suitable for the interpretation of upstanding and partially buried wrecks, debris fields, and small individual anomalies. The structure of wrecks is clear, allowing assessments on wreck condition to be made. These data provide the highest probability that anomalies of archaeological potential will be identified. |
| Average | Data which are moderately affected by weather conditions, sea state and noise. Seabed datasets are suitable for the identification of upstanding and partially buried wrecks, the larger elements of debris fields and dispersed sites, and larger individual anomalies. Dispersed and/or partially buried wrecks may be difficult to identify. These data are not considered to be detrimentally affected to a significant degree. |
| Below Average | Data which are affected by weather conditions, sea state and noise to a significant degree. Seabed datasets are suitable for the identification of relatively intact, upstanding wrecks and large individual anomalies. Dispersed and/or partially buried wrecks, or small isolated anomalies may not be clearly resolved. |
| Variable | This category contains datasets where the individual lines range in quality. Confidence of interpretation is subsequently likely to vary within the study area. |

2.4.2 The MBES data were rated as ‘Good’ using the above criteria. The data quality and resolution of 0.5 m was found to be of a good standard and suitable for archaeological assessment of objects and debris over 0.5 m in size.

2.4.3 The SSS data have been rated as 'Good' using the above criteria table. Some lines were affected by weather conditions causing motion artefacts in the data, and a small number of lines appeared to have sediment in the water column which obscured some of the data. However, a majority of the lines were of good quality which allowed coverage to be achieved and, as such, the data are considered suitable for archaeological assessment.

2.4.4 It should be noted that the 2018 geophysical data coverage terminates approximately 3 km from the ECR landfall location. As such, it is possible that there are features of archaeological potential within this area that have not been identified.

## 2.5 Geophysical data – anomaly grouping and discrimination

2.5.1 The previous section describes the initial interpretation of all available geophysical datasets which were conducted independently of one another. This inevitably leads to the possibility of any one object being the cause of numerous anomalies in different datasets and apparently overstating the number of archaeological features in the exploration area.

2.5.2 To address this fact the anomalies were grouped together; allowing one ID number to be assigned to a single object for which there may be, for example, a UKHO record and multiple SSS anomalies.

2.5.3 At this stage, the gazetteers of anomalies created during the previous phase of work at the Dudgeon OWF site were also grouped with the data interpretation (Wessex Archaeology 2009a, 2009b, 2014b). The results of the current and previous archaeological assessments were also grouped with the results of the ROV surveys of potential UXO carried out in 2013 and 2014 by Fugro, which were subsequently archaeologically assessed by MMT (MMT 2015a; 2015b and 2015c) and Wessex Archaeology (2015a, 2015b).

2.5.4 Where previously identified anomalies were subsequently found to be non-archaeological, or have been recorded as 'cleared' after the UXO assessments, these have been updated but retained within this report for positioning purposes.

2.5.5 Any sites located outside of the defined study areas, either previously recorded in known databases (e.g. UKHO) or identified during this or previous geophysical assessments, are deemed beyond the scope of the current project and are subsequently not included in this report.

2.5.6 During grouping of the interpretation results with the results of previous phases of work, any identified anomaly from the current 2018 dataset that matches a previously identified feature retains the original anomaly number assigned for previous Wessex Archaeology report. However, positions and dimensions are updated to reflect the more recent data. Any newly identified anomalies of archaeological potential have been assigned a new ID number, beginning 71000.

2.5.7 Once all the geophysical anomalies and desk-based information have been grouped, a discrimination flag is added to the record in order to discriminate against those which are not thought to be of an archaeological concern. For anomalies located on the seabed, these flags are ascribed as follows (Table 6).

**Table 6** Criteria discriminating relevance of identified features to proposed scheme

| Overview classification | Discrimination | Criteria | Data type |
|---|---|---|---|
| | | | |
| Archaeological | A1 | Anthropogenic origin of archaeological interest | MBES, SSS |
| Archaeological | A2 | Uncertain origin of possible archaeological interest | MBES, SSS |
| Archaeological | A3 | Historic record of possible archaeological interest with no corresponding geophysical anomaly | MBES, SSS |
| | | | |
| Non-archaeological | U1 | Not of anthropogenic origin | MBES, SSS |
| Non-archaeological | U2 | Known non-archaeological feature / Feature of non-archaeological interest | MBES, SSS |
| Non-archaeological | U3 | Recorded loss | MBES, SSS |
| | | | |
| Non-impact | O1 | Outside horizontal footprint of study area | MBES, SSS |
| Non-impact | O2 | Outside vertical footprint of proposed impact | N/A |
| Non-impact | O3 | Area subsequently cleared after data acquired, anomaly/object recovered | MBES, SSS, UXO |

2.5.8 The grouping and discrimination of information at this stage is based on all available information and is not definitive. It allows for all features of potential archaeological interest to be highlighted, while retaining all the information produced during the course of the geophysical interpretation and desk-based assessment for further evaluation should more information become available.

# 3 SEABED FEATURES ASSESSMENT

## 3.1 Introduction

3.1.1 The results of this assessment are collated in gazetteer format detailed in Appendix 1 and presented in Figure 2a-g.

3.1.2 To aid in the identification of previous anomalies that may have been impacted by the installation of the array areas and ECR, a five-metre buffer was created around the provided infield cables and ECRs shapefiles. Surrounding the wind turbines, a 40 m buffer was created around the central point in order to assess the entire turbine footprint as well as any material likely to have been impacted. The substation was allocated a 20 m buffer around the edge of the station footprint. A secondary study area was produced based on a comparison between the 2013 pre-construction MBES data and the 2019 post-construction MBES data. Previous anomalies located within these study areas are considered to have potentially been impacted by the development which is further detailed in the gazetteers. It is assumed that anomalies outside of these study areas are unlikely to have been impacted unless otherwise stated.

3.1.3 Newly identified features located within the buffer zones have been recorded as potentially impacted within the gazetteer, as their presence within the post-construction data set may be due to disturbance of the seabed caused by the installation. Such disturbance has the

potential to expose anomalies previously buried and unrecorded during earlier phases of assessment.

3.1.4 For the purposes of this report, any anomalies identified within the study areas that have been confirmed as UXO by ROV are retained in the gazetteer as A2 'Debris' (or O3 if cleared) anomalies. Although the necessity to remove and dispose of such UXO features is obviously understood, as the remnants of past military activity and part of military history they are considered to be of archaeological interest. Retaining these features within the gazetteer creates a record of their existence in the area.

3.1.5 Anomalies which have been identified during previous assessments and subsequently found to be non-archaeological have been updated and retained within this report for positioning purposes.

## 3.2 Seabed features assessment results

3.2.1 After the grouping and discrimination phases as outlined in Section 2.5, including the results from previous phases of work, a total of 32 features were identified in the study area. Of these, 27 were interpreted as being of archaeological potential. One feature that had been previously identified in earlier geophysical assessments had been confirmed as UXO and was cleared. A further four anomalies have been investigated by ROV and found to be length of wire and thought to be of non-archaeological interest. These have been retained in the gazetteer for positioning purposes.

3.2.2 The identified features are discriminated as shown in Table 7:

**Table 7** Features of archaeological potential within the study area

| Archaeological discrimination | Quantity | Interpretation |
|---|---|---|
| A1 | 0 | Anthropogenic origin of archaeological interest |
| A2 | 27 | Uncertain origin of possible archaeological interest |
| U2 | 4 | Known non-archaeological feature / Feature of non-archaeological interest |
| O3 | 1 | Area subsequently cleared after data acquired, anomaly/object recovered |
| **Total** | **32** | |

3.2.3 Furthermore, these features can be classified by probable type, which can further aid in assigning archaeological potential and importance (Table 8).

**Table 8** Types of anomaly identified

| Anomaly classification | Definition | Number of anomalies |
|---|---|---|
| Debris | Distinct objects on the seabed, generally exhibiting height or with evidence of structure, that are potentially anthropogenic in origin | 2 |
| Seabed disturbance | An area of disturbance without individual, distinct objects. Potentially indicates wreck debris or other anthropogenic features buried just below the seabed. | 3 |
| Rope/chain | Curvilinear dark reflectors, often with a small amount of height, indicating rope or chain (if ferrous) | 2 |
| Bright reflector | Individual objects or areas of low reflectivity, characteristic of materials that absorb acoustic energy, | 2 |

| Anomaly classification | Definition | Number of anomalies |
|---|---|---|
| | such as waterlogged wood or synthetic materials. Precise nature is uncertain | |
| Dark reflector | Individual objects or areas of high reflectivity, displaying some anthropogenic characteristics. Precise nature is uncertain | 3 |
| Mound | A mounded feature with height not considered to be natural. Mounds may form over wreck sites or other debris. | 1 |
| Magnetic | No associated seabed surface expression, and have the potential to represent possible buried ferrous debris or buried wreck sites | 19 |
| **Total** | | **32** |

## 3.3 ECR

3.3.1 A total of 19 anomalies of archaeological potential were identified within the ECR (Figures 2a-g), all of which have been assigned an A2 discrimination (see Appendix 2 for full list of anomalies).

3.3.2 Of these A2 anomalies, one has been interpreted as an item of debris (**70709**). This was originally identified during the 2014 assessment (Wessex Archaeology 2014b) and reported as being a medium sized item of possible debris, identified in the SSS data as a hard-edged dark reflector with an internal shadow, possibly comprising two rounded pieces. This feature was located in the nearshore end of the ECR which was not covered by the 2018 geophysical data. As such, no comment can be made on the current state of the feature, or whether it has been impacted by the installation of the export cable.

3.3.3 One anomaly has been classified as a seabed disturbance (**71000**). This was newly identified in the 2018 SSS data as a rectangular area of low reflectivity measuring 9.6 x 6.2 m. This is possibly a natural feature or related to the installation of the ECR; however, it has been retained as potential archaeology based on its anomalous shape.

3.3.4 Two features (**71002** and **71004**) have been classified as lengths of rope/chain. If lengths of rope, the features may not be of archaeological potential in themselves, but they may be attached to archaeological features (e.g. anchors) or be snagged on mostly buried debris not visible in the SSS or MBES data. Neither of these features were identified during previous phases of assessment.

3.3.5 Two anomalies have been classified as dark reflectors (**71003** and **71005**), the largest of which is feature **71005** which was identified in the SSS data as a faint dark reflector measuring 4.1 x 1.0 x 0.3 m. These features are possibly natural, however they have the potential of being items of debris and, as such, has been retained. Neither of these features were identified during previous phases of assessment.

3.3.6 Two anomalies have been classified as bright reflectors (**71001** and **71006**), the largest of which is anomaly **71001** which was identified as a small, irregularly shaped bright reflector. A small, possibly associated feature was identified 4 m to the north-west however, as this second feature sits outside of the study area, it has not been reported on at this time. Neither of these features were identified during previous phases of assessment.

3.3.7 The remaining twelve A2 anomalies located in the ECR (for full list see Appendix 1) have been classified as magnetic anomalies, with no associated SSS or MBES feature. These

magnetic anomalies ranged in size from 49 nT (**70345**) to 337 nT (**7251**), and all are interpreted to be possible ferrous debris which are either present on the seabed with no surface expression, or potentially buried. These features were all identified during previous phases of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on the presence previously identified magnetic anomalies, or whether they have been impacted by the installation of infrastructure.

3.3.8 Magnetic anomaly **70542** (MMT target number: M43600 (MMT 2015b)) was originally identified and reported on as a distinct dipole in the 2013 survey dataset (Wessex Archaeology 2014b). It was investigated during the 2014 UXO assessment and found to be a partially buried metal bar (MMT 2015b). This was then reviewed and deemed by Wessex Archaeology to be of low archaeological interest (Wessex Archaeology 2015b: Appendix 1). The ROV report does not state whether the feature was removed or left *in-situ*. As such, the feature has been retained here as a precaution.

### 3.4 OWF

3.4.1 A total of eight anomalies were identified within the OWF (Figures 2a-g). Of these, five have been assigned an A2 discrimination (see Appendix 2 for full list of anomalies).

3.4.2 One of these A2 anomalies has been classified as an item of debris (**71007**). This is identified on the 2018 SSS data as an irregularly shaped object with dimensions of up to 29.2 x 5.7 m. The position of the feature changes between survey lines, suggesting that it is mobile on the seabed, possibly being moved by currents. As such, the feature might only be located within the study area occasionally. The form of the feature also appears to differ between different survey lines, appearing as a bright reflector on one line and a possible dark reflector with height on an adjacent line. The feature appears to extend out from the centre of a jack-up footprint, possibly suggesting that it is a modern item of associated debris. However, as this cannot be confirmed without further investigation, the feature has been retained as a precaution. This feature was not identified during any of the previous phases of assessment.

3.4.3 One feature was identified as a seabed disturbance (**70348**). This was identified during the 2014 geophysical assessment as an isolated anomaly with a semi-circular bright reflector adjacent to a semi-circular dark reflector creating a hollow circle (Wessex Archaeology 2014b). The feature was not identified on the SSS or MBES data during this phase of assessment.

3.4.4 One feature was identified as a dark reflector (**70223**). This was identified during the 2014 geophysical assessment as a hard-edged and irregularly shaped object measuring 0.8 x 0.4 x 0.2 m (Wessex Archaeology 2014b). This feature is possibly natural, however it has the potential of being an item of debris and, as such, has been retained. The feature was not identified on the SSS or MBES data during this phase of assessment.

3.4.5 One feature was identified as a mound (**70341**). This was identified during the 2014 geophysical assessment as a small, oval mound measuring 8.0 x 5.0 x 0.1 m (Wessex Archaeology 2014b). The feature was not identified on the SSS or MBES data during this phase of assessment.

3.4.6 The remaining A2 anomaly within the OWF (**70015**) was identified during the 2014 geophysical assessment and classified as a magnetic anomaly, with an amplitude of 17 nT, with no associated SSS or MBES feature. This is interpreted to be possible ferrous debris which is either present on the seabed with no surface expression, or potentially buried.

3.4.7 As with the magnetic anomalies identified within the ECR, no magnetometer data have been acquired for this phase of assessment and therefore no comment can be made on the presence of the previously identified magnetic anomaly, or whether it has been impacted by the installation of infrastructure.

3.4.8 One anomaly has been assigned an O3 discrimination. Anomaly **70293** (MMT target number: F(M)12814 (MMT 2015a)) was first identified in the 2013 geophysical data and classified as an item of debris (Wessex Archaeology 2014b). It was visible in the SSS data as a distinct, elongated anomaly, with a corresponding magnetic anomaly of 70 nT. During the 2014 UXO assessment, it was confirmed to be a 1000 lb air dropped bomb. It was successfully detonated in May 2015 (MMT & Statoil 2015a: 37) however, its position has been retained here as it is deemed to be of archaeological interest as evidence of conflict (Wessex Archaeology 2014b).

3.4.9 Two anomalies (**70175** and **70211**) were identified during the 2014 geophysical data assessment and classified as magnetic anomalies. ROV investigations were carried out close to both these features which revealed lengths of wire at both locations, thought to be of non-archaeological interest. Due to the proximity, it is likely that the originally identified magnetic anomalies are related to the lengths of wire found during ROV investigations. As such, both features have been re-discriminated as U2 features of non-archaeological interest, however they have been retained in this report for positioning purposes.

## 3.5 MBES comparison study areas

3.5.1 The 2018 MBES data was compared against the 2013 pre-construction MBES data in order to identify any areas of the seabed that have experienced either a loss or accumulation of sediment of 0.5 m or greater between the two data sets, that is not deemed to be due to natural processes.

3.5.2 In total, 65 additional areas of jack-up footprints, and seven mounds thought to be excess material related to the installation of the OWF, were identified (Figure 2a-g). These areas were used to form additional study areas, to identify any features which may have been impacted by the installation, which lie outside of the original study areas.

3.5.3 Within these additional study areas, three anomalies have been identified which may have been impacted during the installation of the OWF and its associated cables, all of which are magnetic anomalies, with no associated SSS or MBES feature, which were identified during the 2014 data assessment (Wessex Archaeology 2014b). These magnetic anomalies ranged in size from 15nT (**70095**) to 51nT (**70313**), and all are interpreted to be possible ferrous debris which are either present on the seabed with no surface expression, or potentially buried. As no magnetometer data have been acquired for this phase of assessment, no comment can be made on the presence previously identified magnetic anomalies.

3.5.4 A further two previously identified magnetic anomalies (**70084** and **70149**) were identified within these additional areas. Both of which were investigated by ROV during UXO operations and found to be lengths of wire of non-archaeological interest (Wessex Archaeology 2015a). As such, both of these have been re-discriminated as U2 anomalies of non-archaeological interest and retained in this report gazetteer for positioning purposes.

3.5.5 There was no clear evidence of scour related to the OWF or associated cables. It should be noted that there is evidence of the natural movement of sand waves across the site, which may have obscured some areas of additional jack-up footprints or other evidence of impact.

### 3.6 AEZ Assessment

3.6.1 Within the Dudgeon OWF and ECR, and the surrounding area, a total of 20 AEZ are in place (Figure 3) which were recommended based on previous geophysical assessments and ROV operations (as detailed in Table 1).

3.6.2 Where these were covered, whether partially or in their entirety, by the geophysical data acquired for this post-construction assessment, the data were assessed in order to identify any direct or indirect impacts from wind farm construction.

3.6.3 Of these 20 AEZs, seven were covered by the geophysical data. Of these, four were covered in their entirety (**7034**, **7309**, **7306** (MMT: 27727) and **70832** (MMT: M41062)). All of these features were identified on the geophysical data. There is no evidence of impact to these features or of any incursions into their current AEZs.

3.6.4 The remaining three AEZs were only partially covered by the geophysical data (**70819**/**70842** (MMT: X40705A/X40706), **7083** and **70402** (MMT: M30912)). Based on the areas that were covered, there is no evidence of impact to these features or of any incursions into their current AEZs. However, as they were not covered in their entirety, it may be that there is evidence of incursions beyond the range of the geophysical data.

3.6.5 The remaining 13 AEZs were outside of the geophysical data range (**7035-7**, **7044**, **7193**, **7300-4**, **7307-8** and **7310**). As these were not covered by the geophysical data acquired for this phase of assessment, no comment can be made on any direct or indirect impacts from wind farm construction on the features and their AEZs.

## 4 CONCLUSIONS AND RECOMMENDATIONS

4.1.1 The assessment of the geophysical data within the study area resulted in a total of 28 anomalies identified as being of possible archaeological interest. These are summarised as follows:

- A total of 27 were assigned an A2 archaeological rating; uncertain origin of possible archaeological interest; of which 25 anomalies have been newly identified.
- One item (**70293**) was given an O3 archaeological discrimination, which was found during 2015 UXO operations to be a 1000lb air-dropped bomb and reported as being subsequently detonated.
- Four previously identified magnetic anomalies (**70084**, **70149**, **70175** and **70211**) were investigated by ROV and found to be features of non-archaeological interest.

4.1.2 Fifteen anomalies within the study areas are previously identified magnetic anomalies which cannot be compared with the new dataset. Therefore, it cannot be confirmed either way whether these anomalies have been affected by the installation of the OWF and ECRs.

4.1.3 All the previously identified anomalies which have not been observed within the new dataset, and any newly identified anomalies, are considered likely to have been buried or become uncovered by seabed sediments, which may have been affected by the installation of the OWF and ECRs. As such, it is possible that all the anomalies listed in the gazetteer (Appendix 1) have been impacted by the installation of the OWF and its associated ECR, with the possible exception of **70293** which is no longer expected to be present on the seabed.

4.1.4 Twenty AEZs are located within, or in the proximity of, the Dudgeon OWF and its associated ECR. Of these, seven were covered, in part of in their entirety, by geophysical data acquired for this phase of assessment. On assessment of these seven AEZs, there was no clear evidence of direct or indirect impact to the features, nor of any incursions into their AEZ. The results of this AEZ assessment are laid out in Table 9.

**Table 9** Recommended AEZs within the study area

| ID Number | Classification | Original Assessment | Position (WGS84 UTM31N) | | Evidence of impact | Exclusion Zone |
|---|---|---|---|---|---|---|
| | | | Easting | Northing | | |
| 70819 / 70842 (MMT: X40705A / X40706) | Unknown aircraft engines | 69682 | 377540 | 5872079 | No evidence of direct or indirect impact. | 50 |
| 7034 | Unknown | 69680 | 388916 | 5905990 | No evidence of direct or indirect impact. | 70 |
| 7309 | Seafloor disturbance | 69680 | 393809 | 5904540 | No evidence of direct or indirect impact. | 100 |
| 7306 (MMT: 27727) | Wreck | 69680 | 390692 | 5907452 | No evidence of direct or indirect impact. | 50 |
| 70832 (MMT: M41062) | Unknown – aircraft propellers | 69682 | 377943 | 5872312 | No evidence of direct or indirect impact. | 30 |
| 70819 / 70842 (MMT: X40705A / X40706) | Unknown aircraft engines | 69682 | 377540 | 5872079 | No evidence of direct or indirect impact. | 50 |
| 7034 | Unknown | 69680 | 388916 | 5905990 | No evidence of direct or indirect impact. | 70 |

4.1.5 For features assigned A2 archaeological discrimination rating, no AEZs are recommended at this time. However, avoidance of these features by micro-siting is recommended if they are proposed to be directly impacted by monitoring works in the future.

4.1.6 It is recommended that if any objects of possible archaeological interest are recovered during any groundwork operations, that they should be reported using the established *Protocol for Archaeological Discoveries: Offshore Renewables Projects* (The Crown Estate 2014). This will establish whether the recovered objects are of archaeological interest and recommend appropriate mitigation measures.

# 5 REFERENCES

MMT 2015a Marine Survey Report ST15816 Offshore Verification of Possible UXO – Dudgeon. MMT Document No. 101936-STO-MMT-SUR-REP-ST15816

MMT 2015b Target Verification Sheet: Dudgeon UXO Verification and Clearance Survey ST15816: Export Cable MAG/SBP/WA Targets

MMT 2015c Archaeological Report ST15816: Archaeological Restricted Areas 7306, 70402 and 7173/7175, Document No: 101936-STO-MMT-SUR-REP-ARCHAERE

Royal HaskoningDHV 2015 Dudgeon Offshore Wind Farm Archaeological Mitigation Summary Note November 2015. Unpublished report. Ref: IEMN/PB2438/304514/001/D01

Statoil 2016 Dudgeon Offshore Wind Farm Construction Phase Written Scheme of Investigation. Prepared by Royal HaskoningDHV on behalf of Statoil.

The Crown Estate 2014 Protocol for Archaeological Discoveries: Offshore Renewables Projects. Published by Wessex Archaeology, Salisbury, on behalf of The Crown Estate. (2nd issue, July 2014 (revised)).

Wessex Archaeology 2009a Dudgeon Offshore Wind Farm Extension Area: Archaeological Assessment of Marine Geophysical Data. Salisbury unpubl rep 69680.04

Wessex Archaeology 2009b Dudgeon Offshore Wind Farm: Archaeological Desk Based and Geophysical Assessment. Salisbury, unpubl rep 69680.08

Wessex Archaeology 2014a Dudgeon Offshore Wind Farm, Stage 1 to 3 Geoarchaeological assessment. Salisbury unpubl rep 69681.03

Wessex Archaeology 2014b Dudgeon Offshore Wind Farm: Geophysical Assessment of 2013 data. Salisbury unpubl rep 69682.04

Wessex Archaeology 2014c Dudgeon Offshore Wind Farm: Archaeological Monitoring and Mitigation Written Scheme of Investigation. Salisbury unpubl rep 69683.04

Wessex Archaeology 2014d Dudgeon Offshore Wind Farm: Review of Archaeological Material During Unexploded Ordnance Survey (Turbine Locations and Cable Route): Method Statement. Salisbury unpubl rep 69683.06

Wessex Archaeology 2015a Dudgeon Offshore Wind Farm: Archaeological Assessment of UXO Survey Results. Salisbury unpubl rep 69684.01

Wessex Archaeology 2015b Dudgeon Offshore Wind Farm: Archaeological Assessment of UXO Survey Results April – May 2015. Salisbury unpubl rep 69684.02

Wessex Archaeology 2016 Dudgeon Offshore Wind Farm: Stage 4 Palaeoenvironmental Analysis, Borehole BH06. Salisbury unpubl rep 69685.01

# APPENDICES

## Appendix 1: Seabed features of archaeological potential

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71000 | Seabed disturbance | 377247 | 5871637 | A2 | 9.6 | 6.2 | 0.0 | - | A seafloor disturbance comprising a rectangular area of low reflectivity. Possibly natural however retained as a feature of potential interest based on anomalous shape. This feature was not identified during previous phases of assessment, which may indicate that it has been exposed, either through natural processes or during the installation of the export cable, or that it is a modern feature. | - | 69686 (2019) | ECR |
| 71001 | Bright reflector | 377558 | 5871928 | A2 | 5.4 | 1.3 | 0.0 | - | A small, irregularly shaped bright reflector identified on the SSS data during this phase of assessment. A slightly elongate and possibly associated bright reflector is identified nearby; however, as it is located just outside the study area, it has not been reported on at this time. This feature was not identified during previous phases of assessment, which may indicate that it has been exposed, either through natural processes or during the installation of the export cable, or that it is a modern feature. | - | 69686 (2019) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71002 | Rope/chain | 377942 | 5872370 | A2 | 34.1 | 1.7 | 0.0 | - | A curvilinear bright reflector identified on the SSS data with no corresponding MBES anomaly, possibly representing a length of rope/chain. This feature was not identified during previous phases of assessment, which may indicate that it has been exposed, either through natural processes or during the installation of the export cable, or that it is a modern feature. | - | 69686 (2019) | ECR |
| 71003 | Dark reflector | 379526 | 5874235 | A2 | 3.2 | 0.8 | 0.2 | - | A faint, isolated, poorly defined dark reflector with a bright shadow, identified on the SSS data in an area of relatively flat seafloor. The feature has no clear corresponding MBES anomaly. Possibly natural, however has the potential of being an item of debris. This feature was not identified during previous phases of assessment, which may indicate that it has been exposed, either through natural processes or during the installation of the export cable, or that it is a modern feature. | - | 69686 (2019) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71004 | Rope/chain | 381592 | 5877130 | A2 | 11.3 | 1.2 | 0.0 | - | A curvilinear bright reflector, identified on the SSS data in an area of rippled seabed, interpreted as being a short length of rope/chain. This feature was not identified during previous phases of assessment, which may indicate that it has been exposed, either through natural processes or during the installation of the export cable, or that it is a modern feature. | - | 69686 (2019) | ECR |
| 71005 | Dark reflector | 385120 | 5885735 | A2 | 4.1 | 1.0 | 0.3 | - | A faint dark reflector in an area of relatively flat seabed identified on the SSS data. The feature corresponds with a small mound in the MBES data. Possibly natural, however has the potential of being an item of debris. This feature was not identified during previous phases of assessment, which may indicate that it has been exposed, either through natural processes or during the installation of the export cable, or that it is a modern feature. | - | 69686 (2019) | ECR |
| 71006 | Bright reflector | 391106 | 5901792 | A2 | 3.9 | 1.2 | 0.0 | - | An isolated bright linear reflector in an area of flat seabed. Visible across multiple SSS survey lines, but not in associated MBES data. This feature was not identified during previous phases of assessment, which may indicate that it has been exposed, either through natural processes or during the installation of the export cable, or that it is a modern feature. | - | 69686 (2019) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70345 | Magnetic | 391385 | 5902158 | A2 | - | - | - | 49 | A distinct dipole originally identified during the 2014 phase of assessment, with no corresponding seabed anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69682 (2014) | ECR |
| 7251 | Magnetic | 388335 | 5892949 | A2 | - | - | - | 337 | A magnetic anomaly was identified during the 2009 and 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the export cable. | - | 69680 (2009), 69682 (2014) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7256 | Magnetic | 390069 | 5897741 | A2 | - | - | - | 147 | A magnetic anomaly was identified during the 2009 and 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69680 (2009), 69682 (2014) | ECR |
| 70406 | Magnetic | 386210 | 5888395 | A2 | - | - | - | 111 | A magnetic anomaly originally identified during the 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69682 (2014) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70414 | Magnetic | 386367 | 5888763 | A2 | - | - | - | 55 | A magnetic anomaly originally identified during the 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69682 (2014) | ECR |
| 70482 | Magnetic | 388253 | 5892736 | A2 | - | - | - | 25 | A magnetic anomaly originally identified during the 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69682 (2014) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70497 | Magnetic | 388705 | 5893946 | A2 | - | - | - | 109 | A distinct anomaly originally identified during the 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69682 (2014) | ECR |
| 70527 | Magnetic | 389792 | 5896341 | A2 | - | - | - | 75 | A magnetic anomaly originally identified during the 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69682 (2014) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70542 | Magnetic | 380475 | 5875762 | A2 | - | - | - | 112 | Distinct dipole identified on the magnetometer data during the 2014 phase of assessment. This feature was found to be a metal bar during UXO ground truthing operations however, without further investigation, it is not possible to establish whether this feature is of archaeological interest. Nothing was identified on the SSS or MBES data during this phase of assessment. It is not stated in the UXO report whether the feature was lifted or remains *in situ* and, as such, the feature has been retained as a precaution. | M43600 | 69682 (2014) | ECR |
| 70580 | Magnetic | 377823 | 5872308 | A2 | - | - | - | 93 | A magnetic anomaly originally identified during the 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69682 (2014) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70655 | Magnetic | 384219 | 5883953 | A2 | - | - | - | 67 | A magnetic anomaly originally identified during the 2014 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the ECR. | - | 69682 (2014) | ECR |
| 70709 | Debris | 375913 | 5870240 | A2 | 2.5 | 1.0 | 0.6 | - | A medium sized item of possible debris was identified during the 2014 phase of assessment. The feature is described as a hard-edged dark reflector with an internal shadow, possibly comprised two rounded pieces. This feature was located in the nearshore section of the ECR and, as such, was not covered by the 2019 geophysical data. Therefore, no comment can be made on its current state or whether it has been impacted by the installation of the export cable. | - | 69682 (2014) | ECR |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70223 | Dark reflector | 393062 | 5904174 | A2 | 0.8 | 0.4 | 0.2 | - | A dark reflector was identified during the 2014 data assessment, reported as being hard-edged and irregularly shaped. The feature was not identified on the SSS or MBES data during this phase of assessment, possibly indicating burial, either through natural processes or by installation of the OWF. Due to the proximity of this feature to the as-laid infield cable position, it is likely that this feature will have been impacted during cable emplacement. | - | 69682 (2014) | OWF (Infield cable) |
| 70348 | Seafloor Disturbance | 391709 | 5902818 | A2 | 3.3 | 2.5 | 0.1 | - | A seabed disturbance was identified during the 2014 data assessment, reported as being an isolated anomaly with a semi-circular bright reflector adjacent to a semi-circular dark reflector creating a hollow circle. The feature was not identified on the SSS or MBES data during this phase of assessment, possibly indicating burial, either through natural processes or by installation of the OWF. Due to the proximity of this feature to the as-laid infield cable position, it is likely that this feature will have been impacted during cable emplacement. | - | 69682 (2014) | OWF (Infield cable) |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70015 | Magnetic | 389340 | 5901511 | A2 | - | - | - | 17 | A monopole originally identified during the 2014 phase of assessment, with no corresponding seabed anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the OWF. | - | 69682 (2014) | OWF (Infield cable) |
| 70341 | Mound | 391131 | 5901406 | A2 | 8.0 | 5.0 | 0.1 | - | A small oval mound was identified in the MBES data during the 2014 data assessment. This feature was not identified on the SSS or MBES data during this phase of assessment, possibly indicating burial, either through natural processes or by installation of the OWF. Due to the proximity of this feature to the infield cable location, it is likely that this feature will have been impacted during cable emplacement. | - | 69682 (2014) | OWF (Infield cable) |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71007 | Debris | 388593 | 5902241 | A2 | 29.2 | 5.7 | 0.0 | - | An irregularly shaped feature identified on the SSS data. The appearance and position of the feature appears to differ between survey lines, suggesting that the feature is mobile on the seabed, possibly being moved by currents. The feature appears to extend out from a jack-up footprint related to the installation of a nearby turbine. It is therefore likely that this is an associated item of modern debris. However, as the potential remains for this to be an item of archaeological potential that has been disturbed by modern anthropogenic activity, the feature has been retained as a precaution. This feature was not identified during a previous phase of assessment, which may indicate that it has been exposed, either through natural processes or during the installation of the export cable, or that it is a modern feature. | - | 69686 (2019) | OWF (Turbine) |
| 70175 | Magnetic | 395639 | 5903486 | U2 | - | - | - | 32 | A negative monopole originally identified during the 2014 phase of assessment, with no corresponding seabed anomaly, indicating ferrous debris which is either buried or has no surface expression. This feature was later ground-truthed during UXO operations and found to be a length of wire which is not thought to be of archaeological interest. | F29408 | 69682 (2014) | OWF (Infield cable) |

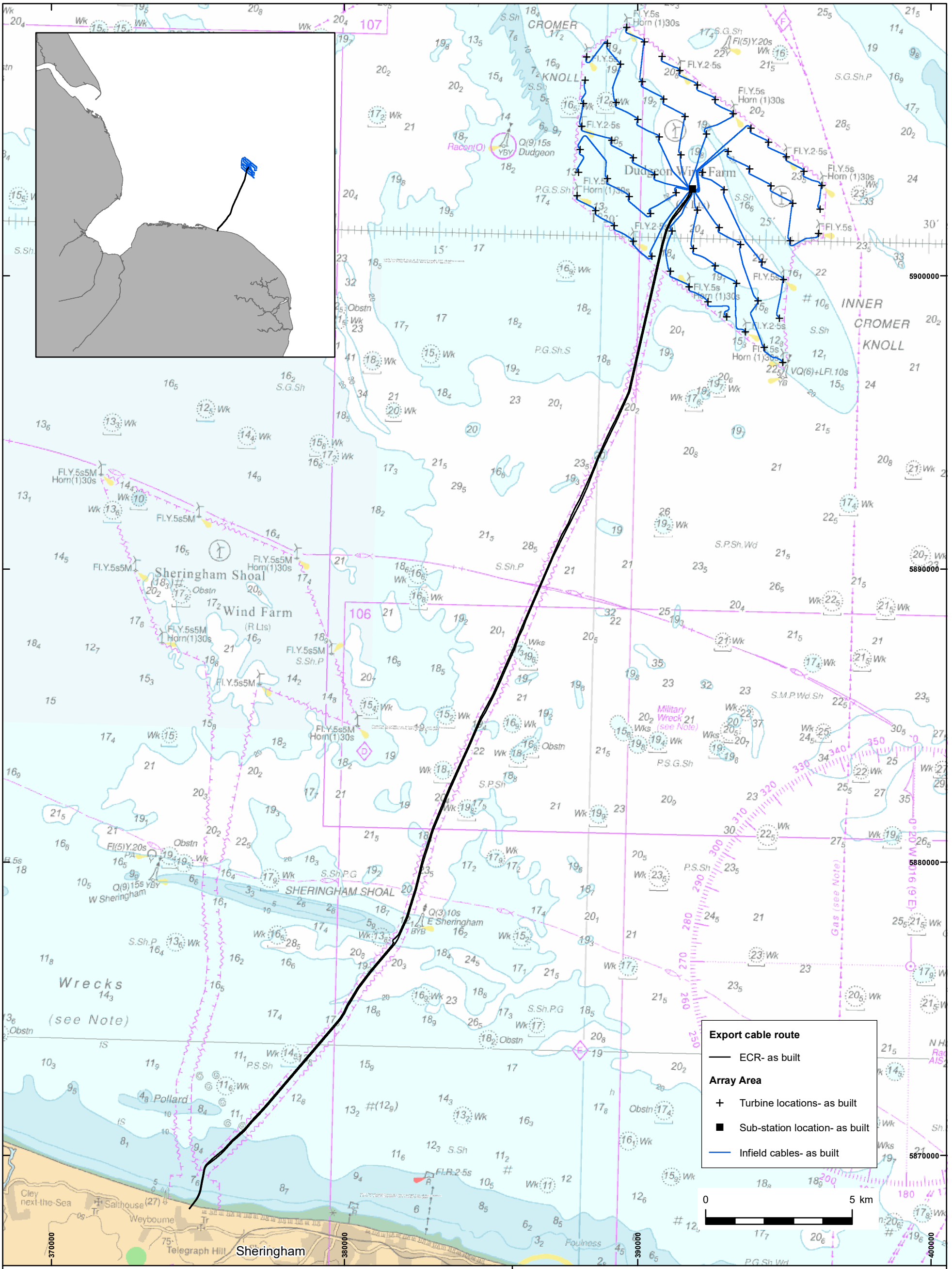
| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70211 | Magnetic | 394564 | 5903019 | U2 | - | - | - | 29 | A positive monopole originally identified during the 2014 phase of assessment, with no corresponding seabed anomaly, indicating ferrous debris which is either buried or has no surface expression. This feature was later ground-truthed during UXO operations and found to be a length of wire which is not thought to be of archaeological interest. | F23359 | 69682 (2014) | OWF (Turbine) |
| 70293 | Debris | 393385 | 5899718 | O3 | 2.2 | 0.6 | 0.3 | 70 | An isolated, distinct and slightly elongate anomaly with two near parallel elongate features and an associated magnetic anomaly was identified during the 2014 geophysical assessment. This feature was later ground-truthed during UXO operations and found to be a 1000 lb Air dropped bomb. This is reported as being cleared during the 2015 UXO assessment and, as such, it is no longer thought to be present within the study area. | F12814, M12814 | 69682 (2014) | OWF (Turbine) |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70313 | Magnetic | 392359 | 5899211 | A2 | - | - | - | 51 | A relatively spread out magnetic anomaly originally identified during the 2013 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the OWF. | - | 69682 (2014) | OWF (Additional Areas) |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70095 | Magnetic | 390195 | 5908089 | A2 | - | - | - | 15 | An asymmetric dipole originally identified during the 2013 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment. As no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the OWF. | - | 69682 (2014) | OWF (Additional Areas) |
| 70149 | Magnetic | 392381 | 5904896 | U2 | - | - | - | 84 | An asymmetric dipole originally identified during the 2013 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. This feature was later ground-truthed during UXO operations and found to be a length of wire which is not thought to be of archaeological interest. | F22836 | 69682 (2014) | OWF (Additional Areas) |

| ID | Classification | Easting | Northing | Archaeological discrimination | Length (m) | Width (m) | Height (m) | Magnetic Amplitude (nT) | Description | External references | Source Project | Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70084 | Magnetic | 390758 | 5904774 | U2 | - | - | - | 100 | A magnetic anomaly originally identified during the 2013 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. This feature was later ground-truthed during UXO operations and found to be a length of wire which is not thought to be of archaeological interest. | F19778 | 69682 (2014) | OWF (Additional Areas) |
| 70282 | Magnetic | 393672 | 5898174 | A2 | - | - | - | 33 | A small magnetic anomaly originally identified during the 2013 phase of assessment, with no corresponding SSS or MBES anomaly, indicating ferrous debris which is either buried or has no surface expression. The feature was not identified on the SSS or MBES data during this phase of assessment however, as no magnetometer data have been acquired for this assessment, no comment can be made on its presence or whether it has been impacted by the installation of the OWF. | OWF (Additional Areas) | - | 69682 (2014) |

1. Co-ordinates are in WGS84 UTM31N
2. Positional accuracy estimated ±10 m

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Coordinate system:
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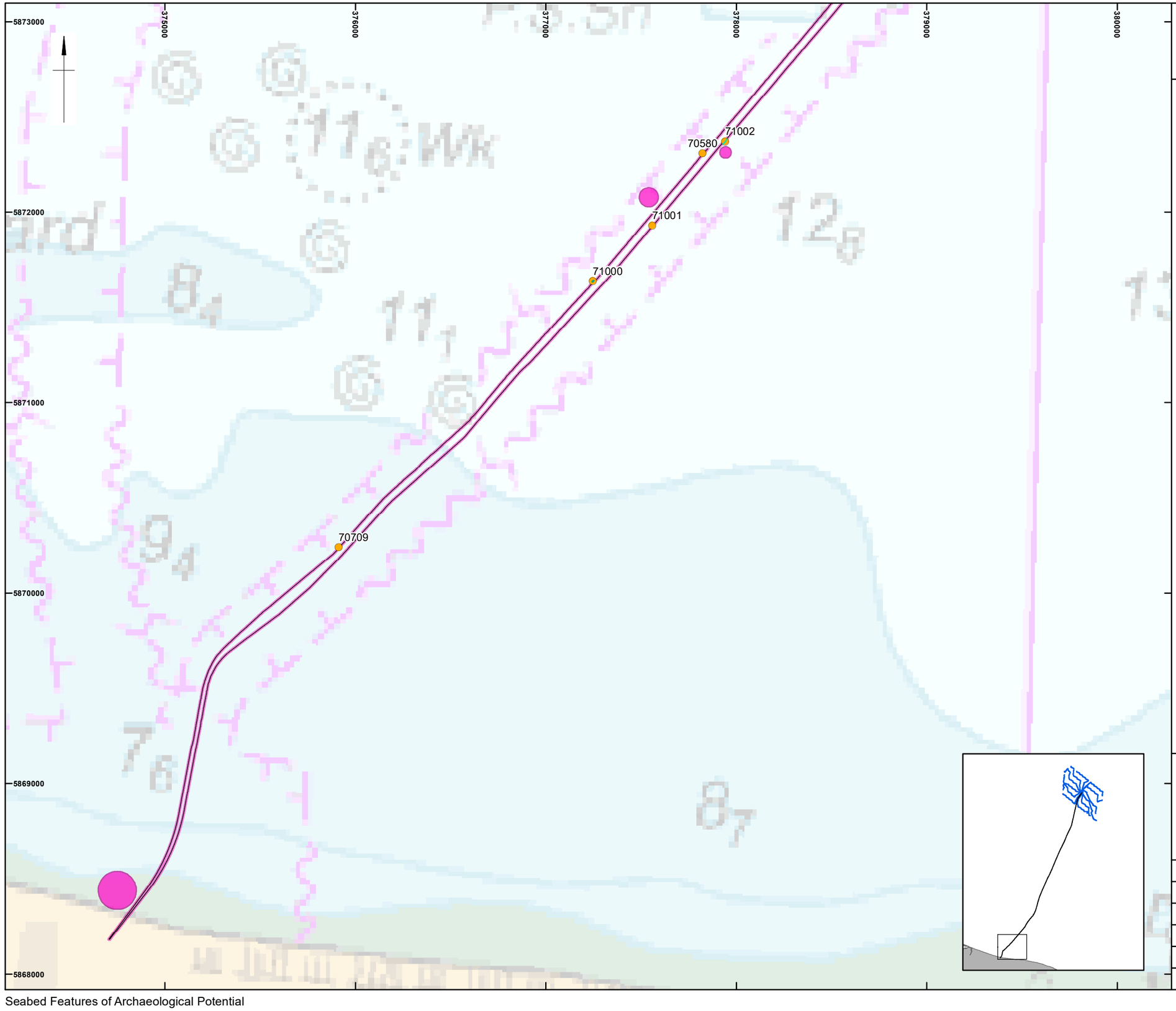
Location of Dudgeon Offshore Wind Farm

Figure 1




**Export cable route**

- ECR- as built
- ECR 10 m study area

**Array Area**

- Turbine locations- as built
- Turbine 40 m study area
- Sub-station location- as built
- Sub-station 20 m study area
- Infield cables- as built
- Infield cables- 10 m study area
- Additional footprint study area

**Anomalies of Archaeological Potential**

- A2 – Uncertain origin of possible archaeological interest

- Seabed feature extents
- Linear seabed features
- Archaeological Exclusion Zone (AEZ)

0 1 km

Coordinate system: WGS84 UTM Z31N

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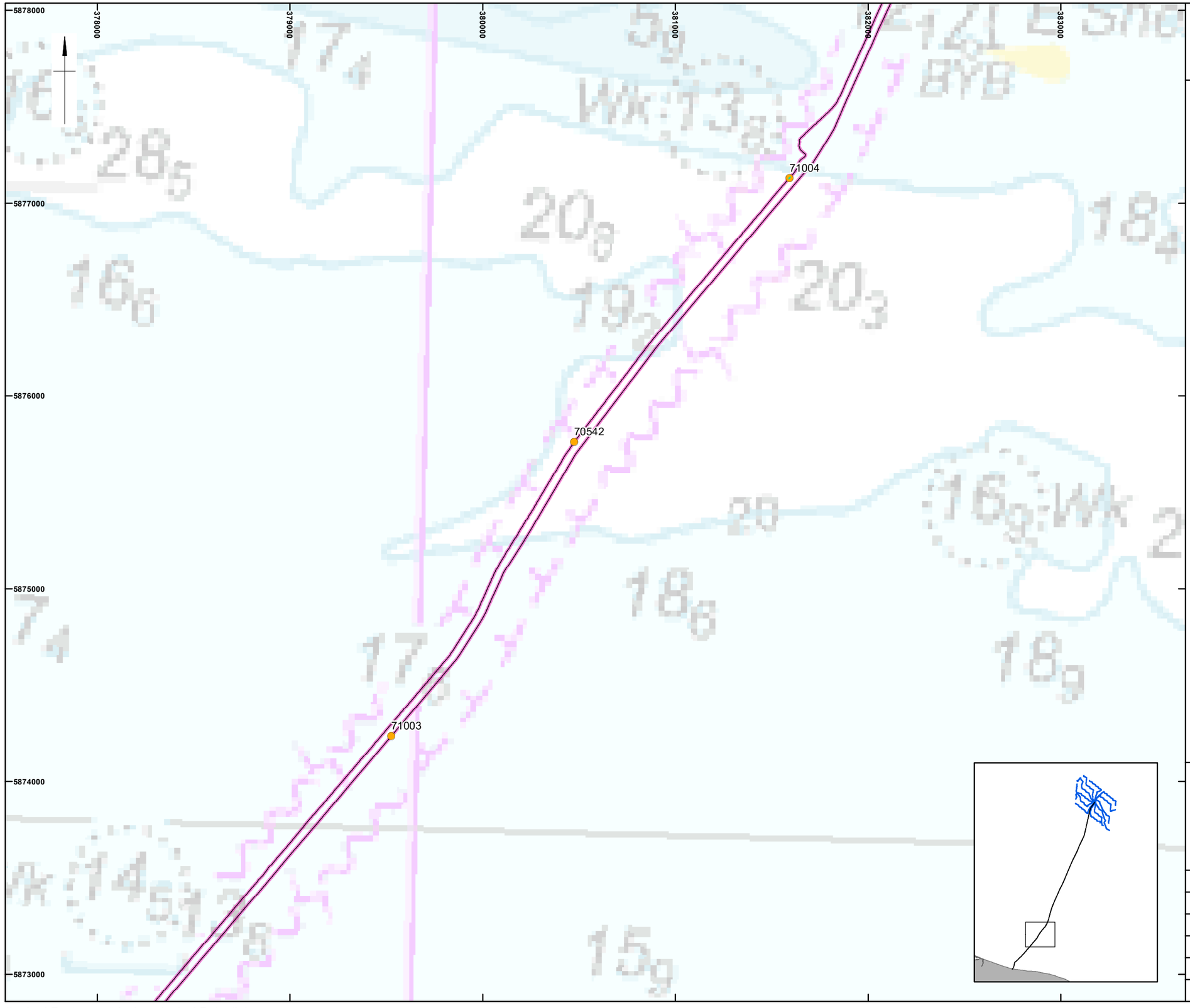
Seabed Features of Archaeological Potential

Figure 2a




**Export cable route**

- ECR- as built
- ECR 10 m study area

**Array Area**

- Turbine locations- as built
- Turbine 40 m study area
- Sub-station location- as built
- Sub-station 20 m study area
- Infield cables- as built
- Infield cables- 10 m study area
- Additional footprint study area

**Anomalies of Archaeological Potential**

- A2 – Uncertain origin of possible archaeological interest

- Linear seabed features

0 1 km

Coordinate system: WGS84 UTM Z31N

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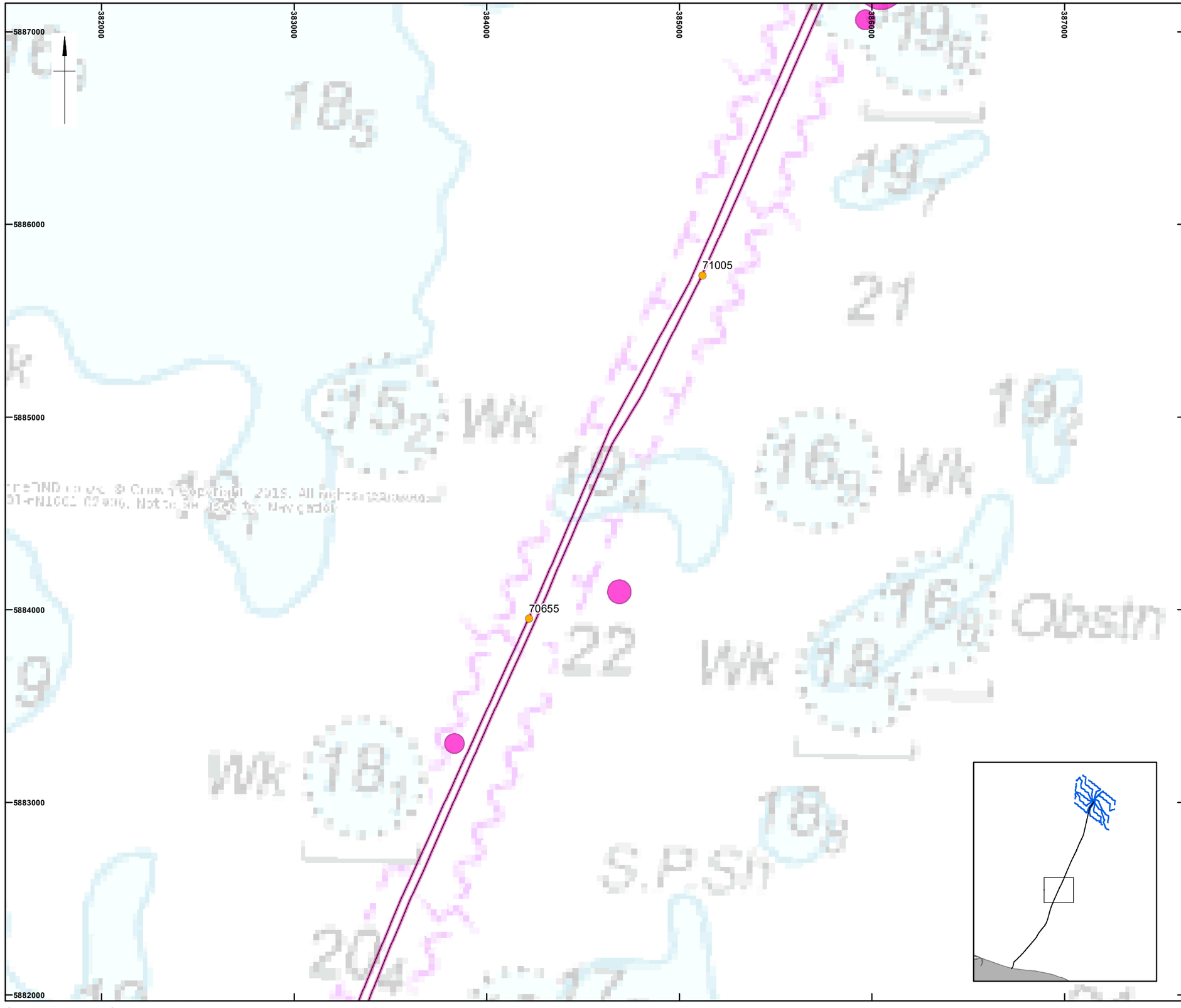
Seabed Features of Archaeological Potential

Figure 2b




Coordinate system: WGS84 UTM Z31N

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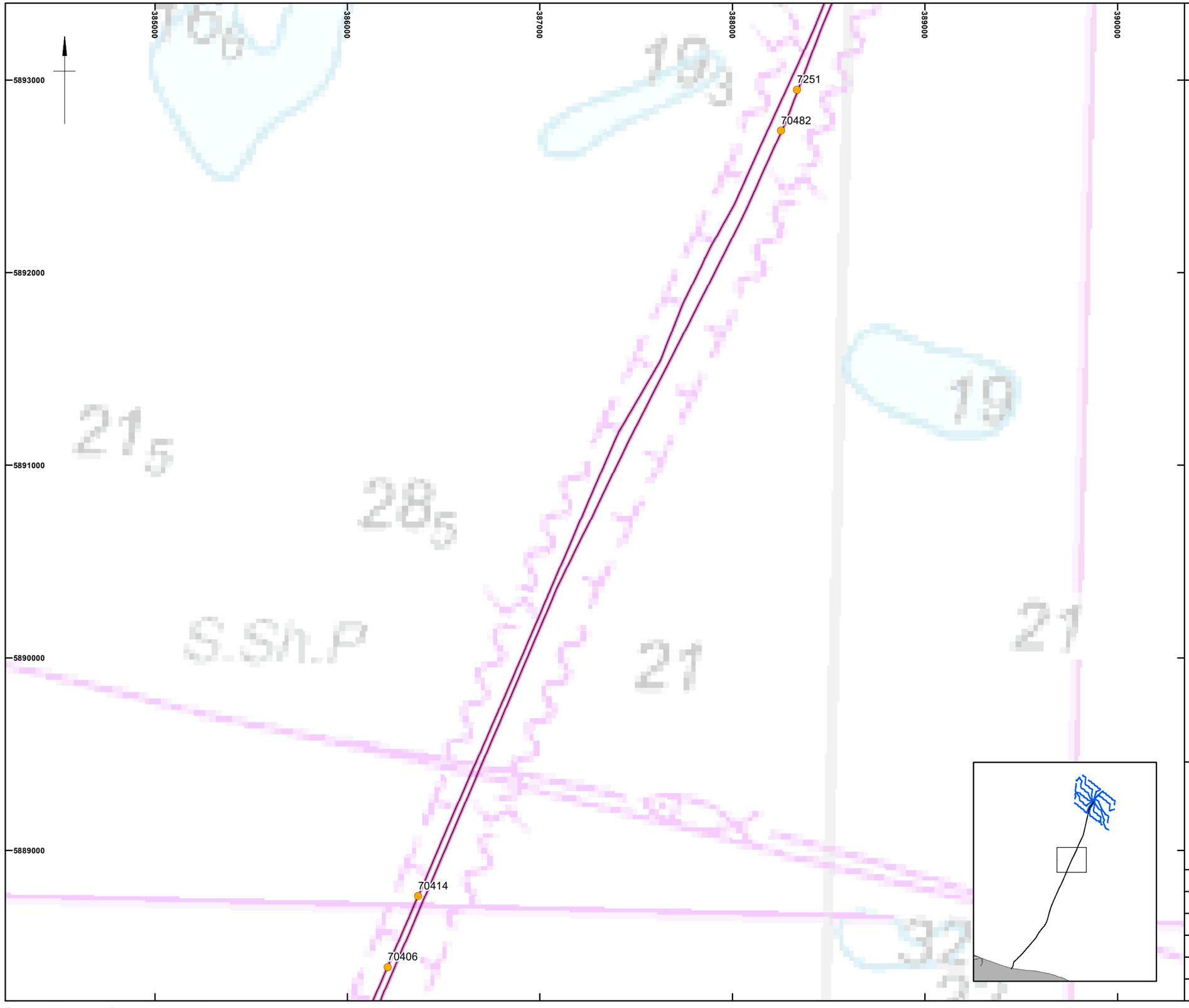
Seabed Features of Archaeological Potential

Figure 2c




**Export cable route**

- ECR- as built
- ECR 10 m study area

**Array Area**

- Turbine locations- as built
- Turbine 40 m study area
- Sub-station location- as built
- Sub-station 20 m study area
- Infield cables- as built
- Infield cables- 10 m study area
- Additional footprint study area

**Anomalies of Archaeological Potential**

- A2 – Uncertain origin of possible archaeological interest

0 1 km

Coordinate system: WGS84 UTM Z31N

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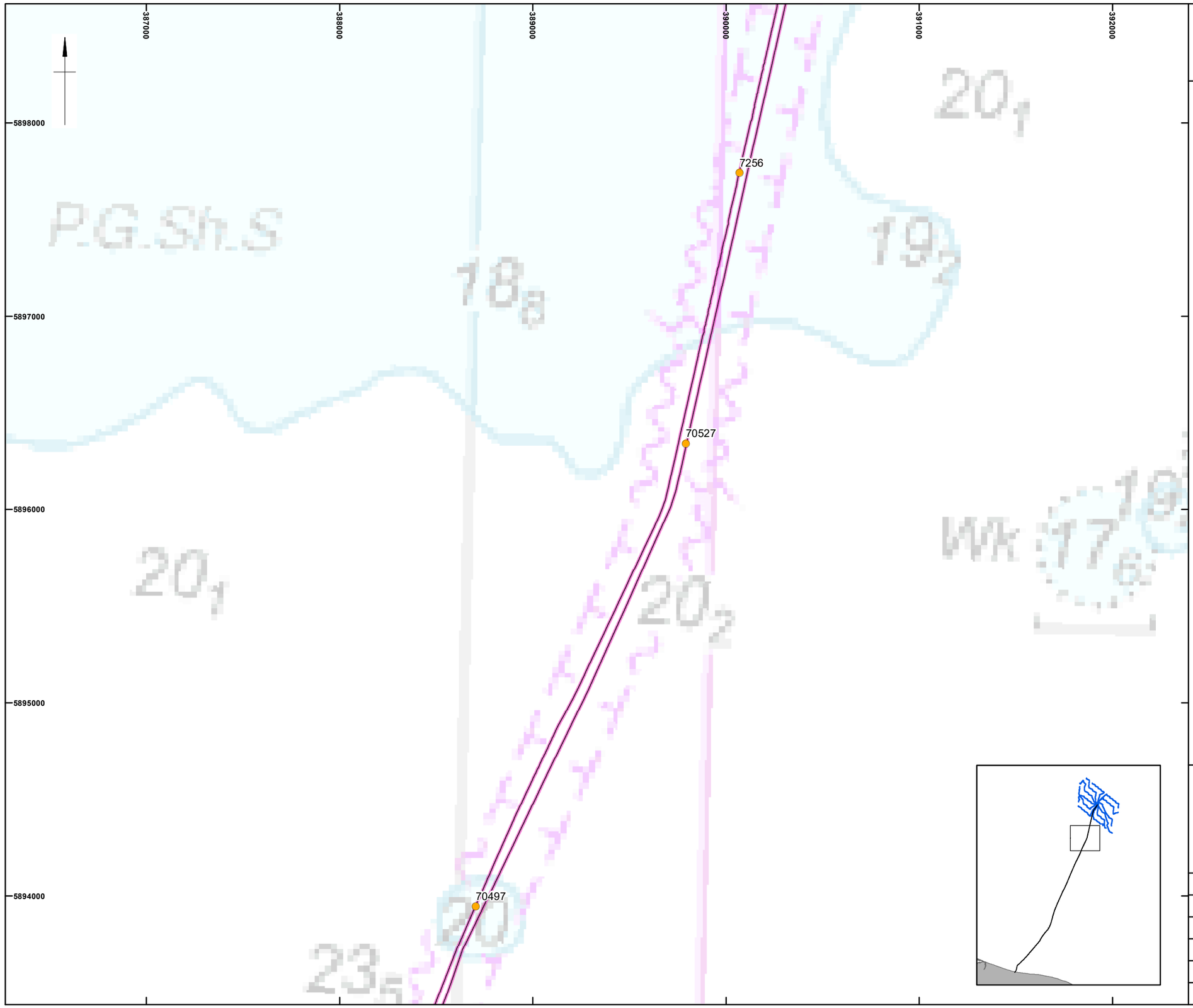
Seabed Features of Archaeological Potential

Figure 2d




**Export cable route**

- ECR- as built
- ECR 10 m study area

**Array Area**

- Turbine locations- as built
- Turbine 40 m study area
- Sub-station location- as built
- Sub-station 20 m study area
- Infield cables- as built
- Infield cables- 10 m study area
- Additional footprint study area

**Anomalies of Archaeological Potential**

- A2 – Uncertain origin of possible archaeological interest

0 1 km

Coordinate system: WGS84 UTM Z31N

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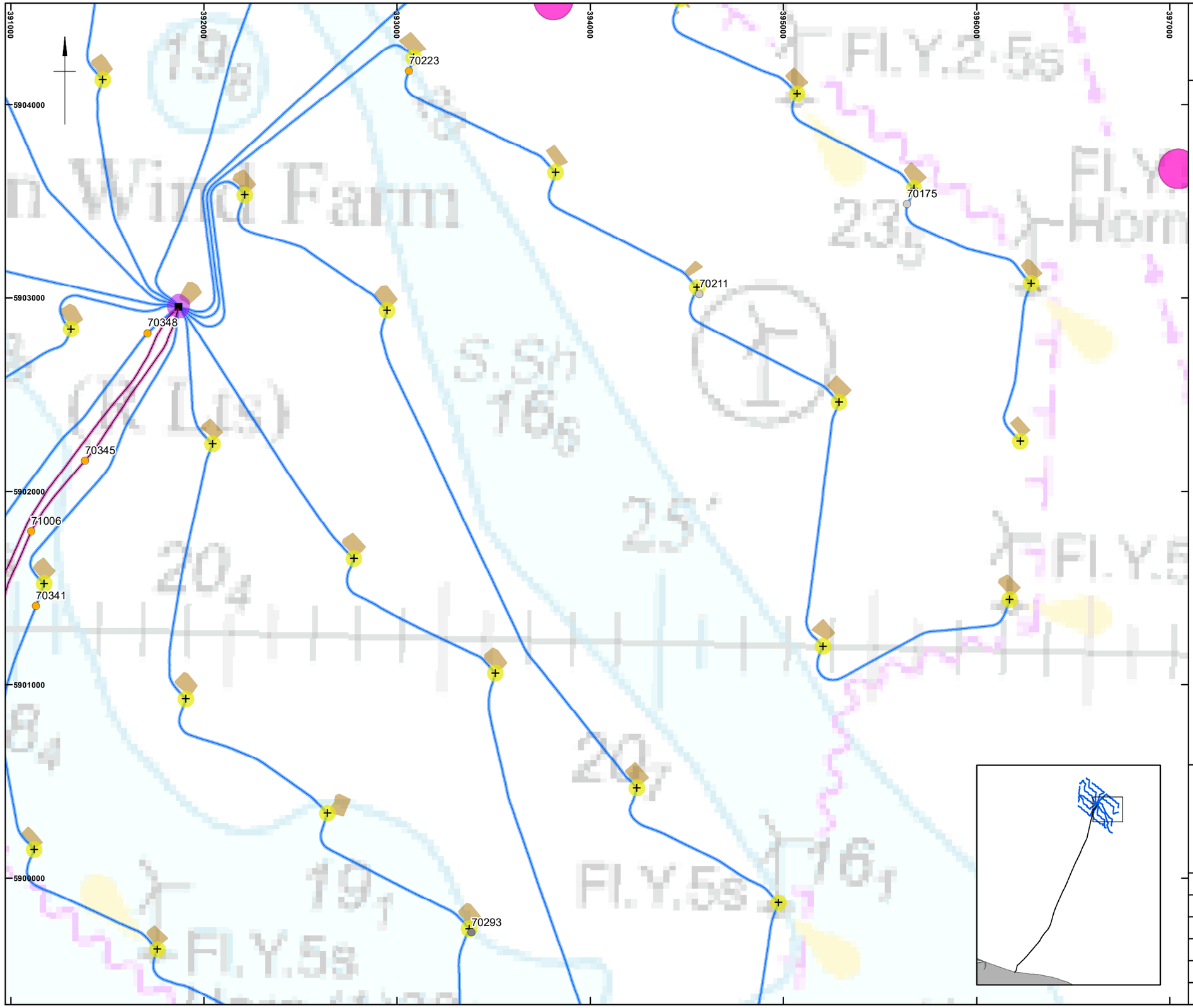
| FigsMXD\Geophys\2019_08_28 | |

Seabed Features of Archaeological Potential

Figure 2e




**Export cable route**

- ECR- as built
- ECR 10 m study area

**Array Area**

- Turbine locations- as built
- Turbine 40 m study area
- Sub-station location- as built
- Sub-station 20 m study area
- Infield cables- as built
- Infield cables- 10 m study area
- Additional footprint study area

**Anomalies of Archaeological Potential**

- A2 – Uncertain origin of possible archaeological interest

**Anomalies re-discriminated as of no archaeological potential**

- U2 – Known non-archaeological feature / Feature of non-archaeological interest
- O3 – Area subsequently cleared after data acquired, anomaly/object recovered

- Archaeological Exclusion Zone (AEZ)

0 1 km

Coordinate system: WGS84 UTM Z31N

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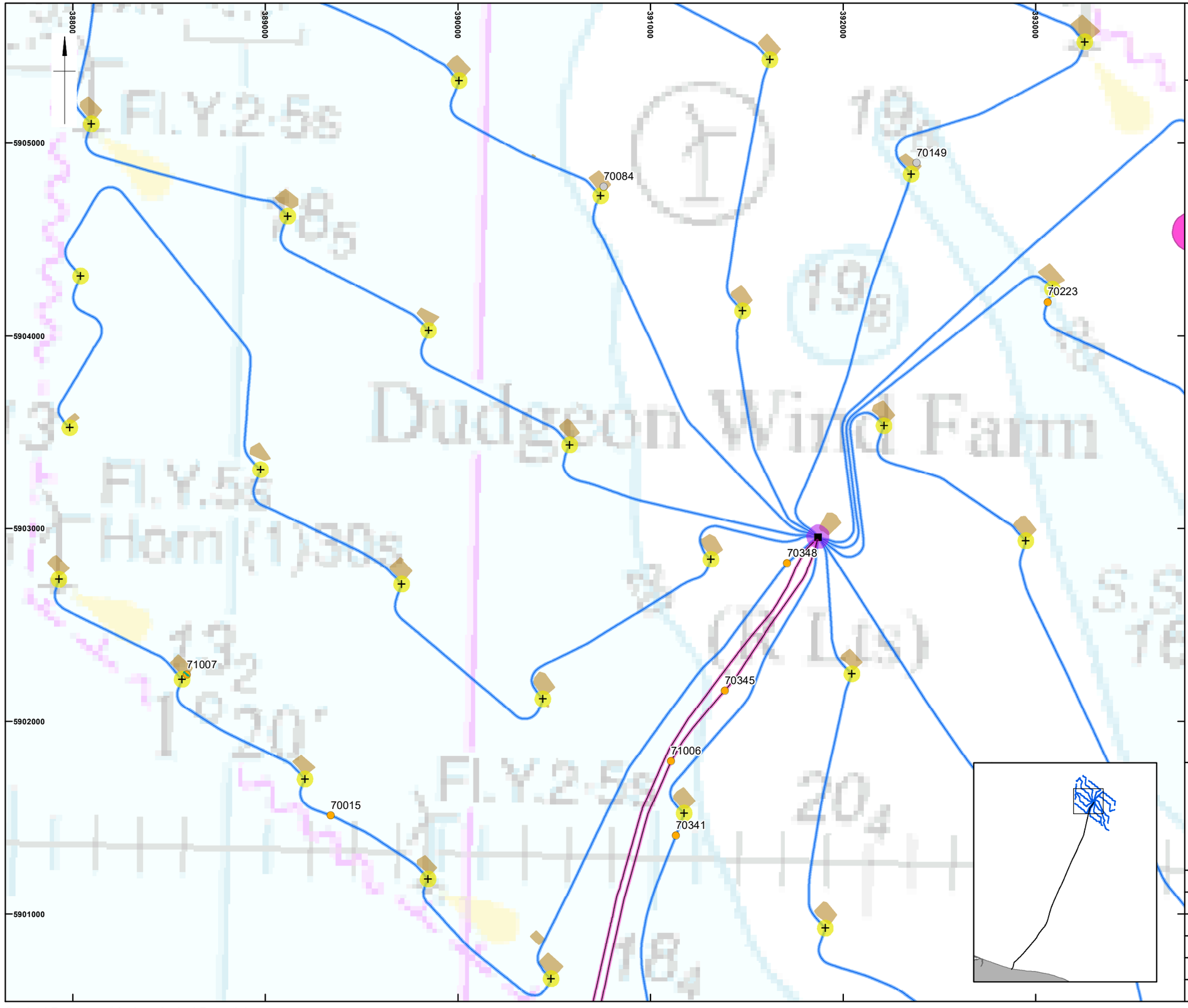
Seabed Features of Archaeological Potential

Figure 2f




**Export cable route**

- ECR- as built
- ECR 10 m study area

**Array Area**

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- Turbine 40 m study area
- Sub-station location- as built
- Sub-station 20 m study area
- Infield cables- as built
- Infield cables- 10 m study area
- Additional footprint study area

**Anomalies of Archaeological Potential**

- A2 – Uncertain origin of possible archaeological interest

**Anomalies re-discriminated as of no archaeological potential**

- U2 – Known non-archaeological feature / Feature of non-archaeological interest

- Seabed feature extents
- Archaeological Exclusion Zone (AEZ)

0 1 km

Coordinate system: WGS84 UTM Z31N

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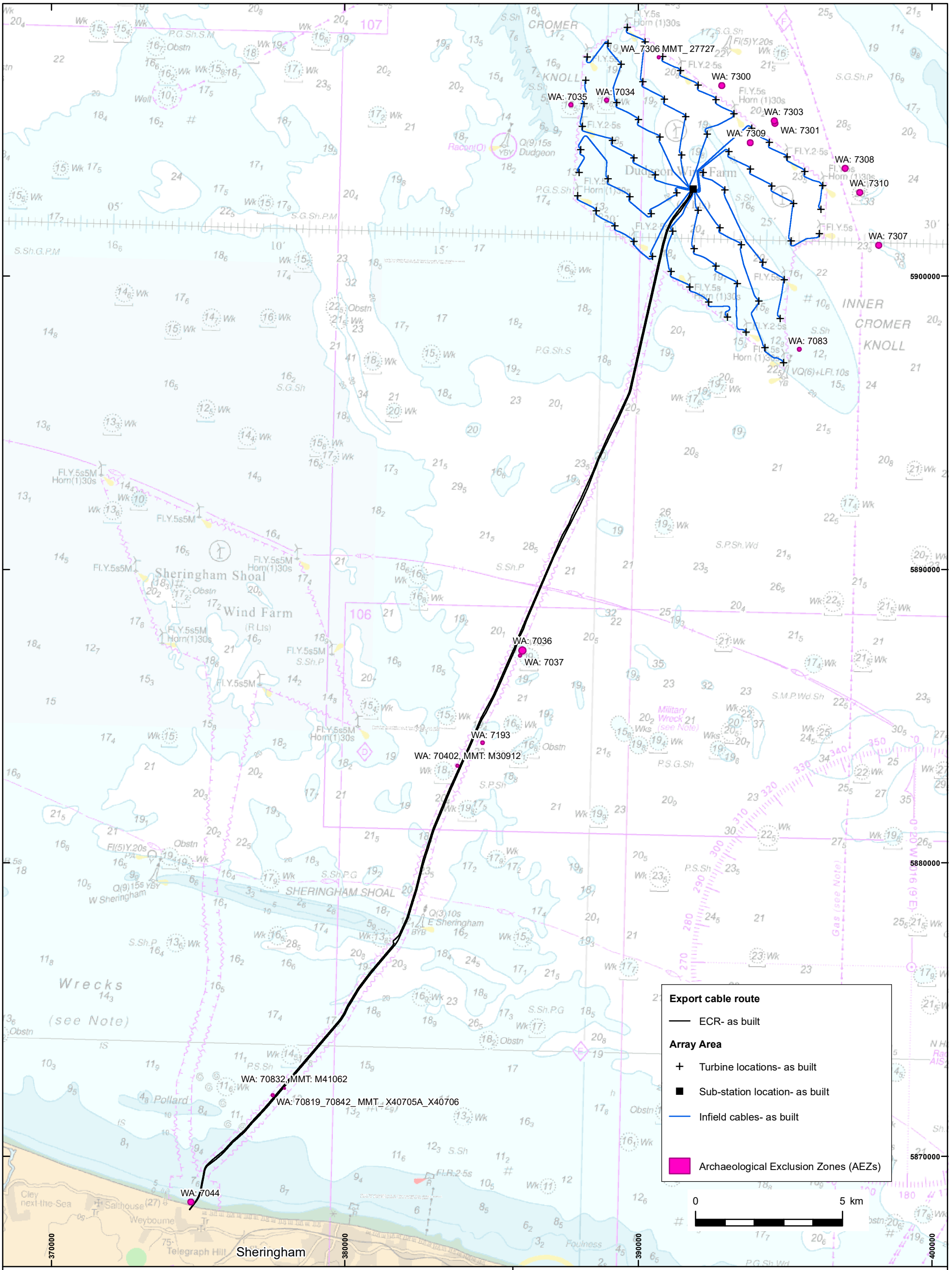
Seabed Features of Archaeological Potential

Figure 2g

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Archaeological Exclusion Zones within Dudgeon OWF and ECR area

Figure 3

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