
**BARROW OFFSHORE WIND FARM
JETTING TRIALS
SUSPENDED SEDIMENT MONITORING**

OPERATIONS REPORT

C5031

December 2005

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JETTING TRIALS

SUSPENDED SEDIMENT MONITORING

REPORT

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Vestas-KBR

For the attention of:-

John Longstaff

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1. INTRODUCTION

On the instructions of Vestas-KBR, Ocean Marine Research were commissioned to provide support to cable jetting trials, carried out at approximately KP16.6 along the export cable route. The vessel 'Terramar' was positioned over the cable to deploy the jetting system in an attempt to assess the effectiveness of this tool for cable burial and trenching. The levels of sediment, agitated into suspension by the jetting process, had to be monitored to provide DEFRA with information in order to assess the environmental impact of this method of trenching.

A series of three transects were recorded during the jetting operations with a recording turbidity sensor being deployed from a small vessel, directly down tide of the works. The vessel moved across the area of anticipated sediment plume in a zig-zag pattern, moving very slowly and gradually getting further away from the area being trenched. A series of water samples were collected adjacent to the sensor and cross correlated to reference the sensor readings to actual sediment concentrations. The majority of the samples and readings were taken at a point approximately 25% of the water depth above the seabed (2-3m). The sensor was heavily weighted in order for it to maintain a constant depth whilst the vessel tracked across the sediment plume. Water depth was measured throughout the survey using a hydrographic echo sounder and positioning was provided by a sub-metre dGPS navigation system.

2. FIELD PROCEDURES AND METHODS

2.1 Equipment List

The following equipment was mobilised to site and utilised during the survey: -

- MV 'BARINTHUS' 13.0m Survey Vessel
- CSI 'Vector' sub-metre differential Global Positioning and heading System
- KNUDSEN 320M Dual Frequency Hydrographic Echo Sounder
- TRIMBLE 'HydroPro' Navigation and Processing Software System
- HYDROLAB DATASONDE 4A Water Quality Monitor
- 4.5l 'Niskin' water sampler.

Technical specifications for each of the major items of equipment can be found in Appendix 2 to this report.

2.2 Survey Vessel

Ocean Marine's own dedicated survey vessel, MV '*Barinthus*' was utilised throughout the survey period. The vessel was based at Barrow for the duration of the survey works. This provided a safe port of operation with 24-hour access and transit time to the area of survey being approximately 30 minutes away.

MV '*Barinthus*' is a 13-metre fast workboat of glass fibre construction, which carries Category 2 certification (60 miles from a safe haven) under the current MCA Code of Practice for Small Workboats and Pilot Boats. A 12-hour operational day is normally adopted aboard the vessel in the interests of Health & Safety.

A vessel offset diagram, showing navigation antenna position relative to the various sensor towing points, is presented in Appendix 1 to this report. In addition, a detailed specification for the vessel can be found in Appendix 2 to this report.

2.3 Personnel

The following personnel were involved during the site and reporting stages of the contract: -

- M.J.Clark - Hydrographic Surveyor
- N Longfield - Vessel Skipper

2.4 Survey Control

2.4.1 Horizontal Control

Primary positioning was provided by the use of a CSI Vector Sensor, sub-metre differential Global Positioning System (dGPS) and GPS gyro. The system utilised differential correction data from the General Lighthouse Authority's (GLA) permanent base station at Point Lynas. A positional check was carried out over a National GPS Network passive station located in Fleetwood, as described in section 2.4.1.1 below.

In addition to providing accurate heading data ($<0.5^\circ$) from its dual antenna moving baseline RTK configuration, the Vector Sensor system also delivers sub-metre positioning accuracy when using differential correction data. The Vector Sensor is able to receive broadcast correction data from the land-based General Lighthouse Authority (GLA) stations and from a Satellite Based Augmentation Systems (SBAS), such as the U.S. Wide Area Augmentation System (WAAS) or the European GPS Navigation Overlay System (EGNOS). Although the EGNOS system is currently functional, it is still in its test phase and is not officially available for commercial use until early 2006. In practice, the observed position differed by $<0.3\text{m}$ when changing between the Beacon and L band EGNOS corrections, although the GLA beacon correction service was utilised throughout the survey period.

In order to allow the navigation computer to display grid co-ordinates in real time, a transformation is applied to the incoming satellite positional data, which is received as a WGS84 (GPS datum) Lat./Long co-ordinate. This transformation is applied by the navigation software (*HydroPro*). WGS 84 positions were used throughout the survey with grid values shown as UTM 30 north values with no shifts applied.

The parameters are as follows: -

WGS84 Datum Parameters

Datum	WGS84
Spheroid	WGS84
Semi-Major	6378137.000
Semi-Minor	6356752.313
Inverse Flattening	298.257

National Grid Projection Parameters

Projection	Transverse Mercator
Central Meridian	03° 00' 00" West
Latitude of Origin	00° 00' 00" North
False Easting	500000m
False Northing	0m
Scale Factor at CM:	0.9996

In conjunction with the navigation computer, 'HydroPro' provides the facility for guiding the survey vessel along pre-determined run lines via a head-up display, whilst logging antenna position, echo sounder depths, compass heading and offset positions for the various sensors at a user defined interval.

2.4.1.1 Calibration Check

In order to calibrate the vessel's navigation system, the mobile dGPS receiver was removed from the vessel and placed over a point of known co-ordinate. This was carried out prior to commencing survey operations on the 18th November 2005. Details of this point were supplied by the Ordnance Survey and are presented in Appendix 2 to this report.

For the calibration, the receiver unit was left in place for a noted period, with readings taken at regular intervals.

2.5 Bathymetry

A Knudsen 320M single beam, dual frequency hydrographic echo sounder was utilised throughout the survey. The Knudsen 320M provides analogue and digital outputs; with the general measurement precision of the instrument given as +/- 0.12% full scale.

The unit was calibrated by the standard 'bar-check' method to ensure that the transducer draft and acoustic velocity were correctly applied to the data. The 'bar-check' calibration involves the use of a rigid steel plate, which is lowered to set depths on a graduated chain beneath the echo sounder transducer. The echo sounder is adjusted to display the real depth of the bar below the water surface, to the maximum working depth or the maximum practical depth achievable.

The echo sounder was interfaced to a DMS 205 motion compensator and operated in dual frequency mode, with the 33kHz and 210kHz transducers working continuously.

2.6 Water Quality Measurements

A Hydrolab Datasonde 4A water quality monitor was deployed at a point approximately 25% of the water depth above the seabed during the operations. The sensor itself was heavily weighted in order to maintain a constant depth. The unit was set to sample and record at its shortest interval of 30 seconds.

In practice the survey boat traversed very slowly across the anticipated sediment plume, gradually moving further down-tide from the jetting operation. A series of water samples were collected using a 'Niskin' bottle water sampler. The samples were taken adjacent to the sensor whilst it was logging data. This allows a direct correlation between the sensor, logging in NTU, and actual sediment loadings in mg/l.

Positioning and water depth data was logged continuously throughout the sampling operation.

3.0 Results and Conclusion

The results are presented as data listings in spreadsheet form and are appended to this report.

The results appear to show that the increase in sediment loading is relatively localised and that any detectable levels remain within 1 to 2 metres of the seabed. Background Turbidity levels are seen to be at approximately 50mg/l during the trials and this is thought to be typical of the water column in this area under normal tidal conditions. It is also likely that natural sediment concentration is higher just above the seabed as some sediment transport will occur during the tidal flow. Tides of up to 1 knot were observed on the site.

Seabed composition at the trial site is believed to be mainly sand and shells with some gravel and this would support the observations that much of the agitated sediment drops out of the water column relatively quickly and generally reaches less than approximately 2.0m above bed level. The third transect detected the highest sediment loading with the sensor deployed only 1 metre or so above the bed. This was noticeable at approximately 300m from the jetting operation but had died away again significantly within the observations some 700m away.

APPENDICES

**APPENDIX 1 - SURVEY CONTROL DATA
VESSEL OFFSET DIAGRAM**

APPENDIX 2 - TECHNICAL SPECIFICATIONS

APPENDIX 1

SURVEY CONTROL DATA

VESSEL OFFSET DIAGRAM

NAVIGATION DATA SCATTER PLOT

SURVEY CONTROL DATA



[Click here for the Ordnance Survey Web Site](#)

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National GPS Network Passive Station

Palm Bay C1TR3771

Type of mark:	Rivet	Last visited by OS:	21/03/2002
Flush Bracket:	Not available	On Landranger sheet:	179
Grid reference:	TR379714	On Explorer sheet:	150
Access to mark:	2WD Vehicle	Permission required:	Yes
Keys required:	No		

Comments available on this station: [Make a comment about this station](#)

No Comments available

Coordinates of this station

Date of observation:	27/11/1997	Coordinates last checked:	21/03/2002
		Planned next check:	26/11/2002

ETRS89 Cartesian

X:	3986920.0661 m
Y:	98758.8075 m
Z:	4960870.8368 m

ETRS89 Geodetic

Latitude:	N 51° 23' 28.6
Longitude:	E 1° 25' 8.279
Ellipsoid height:	58.941 m

National Grid (converted by OSTN97/OSGM91)

Eastings:	637954.584 m
Northings:	171352.938 m
Height:	14.594 m

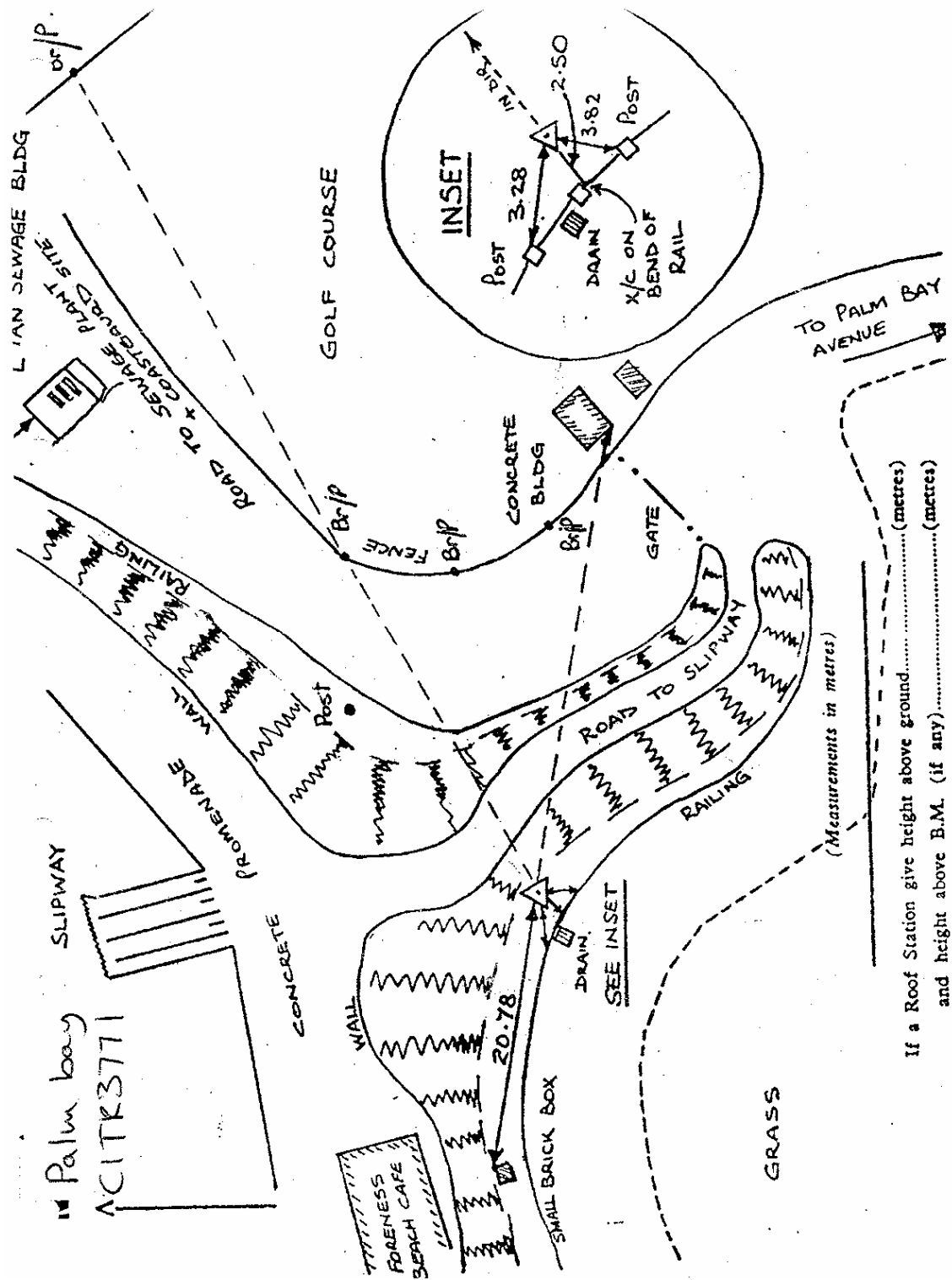
(Orthometric height above MSL, Ordnance Data)

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Land Owner

Land Owner: Not available
Owner's Address: Not available

Owner's Agent: Not available
Agent's Address: Not available



APPENDIX 2

DAILY OPERATIONS REPORTS

APPENDIX 3

TECHNICAL SPECIFICATIONS