
HYDROGRAPHIC AND SITE SURVEY REPORT

Oldany Finfish Pen Site, Sutherland

Prepared for

Loch Duart Ltd

Badcall Salmon House

Scourie

Sutherland

IV27 4TH



TransTech Limited

www.transtechltd.com

Tel: +44 (0)1631 720699

E-mail: mail@transtechltd.com

Caerthann House
Grosvenor Crescent
Connel
Argyll PA37 1PQ

Registered in Scotland, No: SC175087

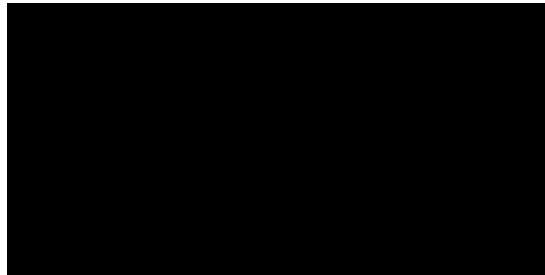
Quality Assurance

The data used in this document and its input and reporting have undergone a quality assurance review which follows established TransTech Ltd procedures. The information and results presented herein constitute an accurate representation of the data collected.

TransTech is registered with SEPA (Scottish Environment Protection Agency) for marine pen site Biomass (Ref: AMMR08v02) and Chemical discharge modelling (Ref: AMMR08v01).

Document Details

Author:



Issue Date: 25 March 2019

Issue No: 2019v1

CONTENTS

1.	Introduction.....	4
2.	Survey Details	4
2.1	Hydrographic Survey	4
2.2	Meteorological Survey	7
2.3	Bathymetric Survey	7
2.4	GPS and Depth Sounder Calibration	7
2.5	Magnetic North to Grid North Conversion	7
3.	Hydrographic Survey	9
3.1	Pitch, Roll and Heading	9
3.2	Gap in Speed and Direction Data	10
3.3	Speed and Direction Data.....	10
4.	Meteorological Data.....	13
5.	Bathymetric Survey.....	15
6.	Discussion and Conclusions	17

List of Figures

Figure 1.	Schematic diagram of mooring array deployed during the survey.	4
Figure 2.	Photograph of ADCP being deployed.	5
Figure 3.	Photograph of ADCP on seabed.	5
Figure 4.	Instrument configuration details.....	6
Figure 5.	BGS Magnetic North to Grid North conversion.	8
Figure 6.	Graphs of ADCP pitch, roll, heading and depth when these parameters differed most during the 90-day period.....	9
Figure 7.	Summary data for sub-surface cell (20.0 m above seabed) during the 90-day period.	11
Figure 8.	Summary data for net-bottom cell (13.0 m above seabed) during the 90-day period.....	12
Figure 9.	Summary data for near-bed cell (3.0 m above seabed) during the 90-day period.....	13
Figure 10.	Depth soundings overlaid onto AutoDEPOMOD gridgen file for current consent.	16

List of Tables

Table 1.	Set-up and deployment details of the ADCP used during survey.	6
Table 2.	Set-up and deployment details of the ADCP used during survey.	9
Table 3.	Current speed during the 90-day period.....	10
Table 4.	Summary data for the 3 cells during the 90-day period.	11
Table 5.	Measured mean wind speed (file containing weather station accompanies this report).....	14
Table 6.	Depth soundings.....	15

List of Abbreviations

ADCP	Acoustic Doppler Current Profiler	MSL	Mean Sea Level
ATT	Admiralty Total Tide	OS	Ordnance Survey
BGS	British Geological Survey	OSGB36	Ordnance Survey Great Britain 1936
CD	Chart Datum	PE	Pen Edge
GMT	Greenwich Mean Time	SEPA	Scottish Environment Protection Agency
GPS	Global Positioning System	WGS84	World Geodetic System 1984
LST	Lowest Spring Tide		

1. Introduction

This report has been produced by TransTech Ltd from hydrographic, bathymetric and meteorological data collected at Loch Duart's Oldany site in Sutherland.

The current meter data are to be used for NewDEPOMOD modelling of potential modifications to the site.

2. Survey Details

2.1 Hydrographic Survey

Surveyed by: Loch Duart Ltd (TransTech Ltd assisted in the deployment on 02/11/18)
Survey dates: 02/11/18 11:00 – 18/01/19 11:20 hrs GMT (full length of record)
18/01/19 13:04 – 31/01/19 23:24 hrs GMT (full length of record)

The data provided in this report have been collected with regard to the recommendations contained within Attachment VIII, Site and Hydrographic Survey Requirements (v2.7, 31 October 2008).

A 300 kHz Teledyne RDI Workhorse ADCP was mounted in a gimballed seabed frame (Figures 2 and 3) and deployed at the Oldany site using a single-point mooring arrangement (Figure 1). The mooring was positioned where local topographic features would not cause spurious data collection.

The instrument was set-up as described in Table 1 and Figure 4. The transducer head was located 0.60 m from the base of the seabed frame.

The position of the ADCP was recorded on meter deployment and on recovery to verify that the meter remained in a fixed position.

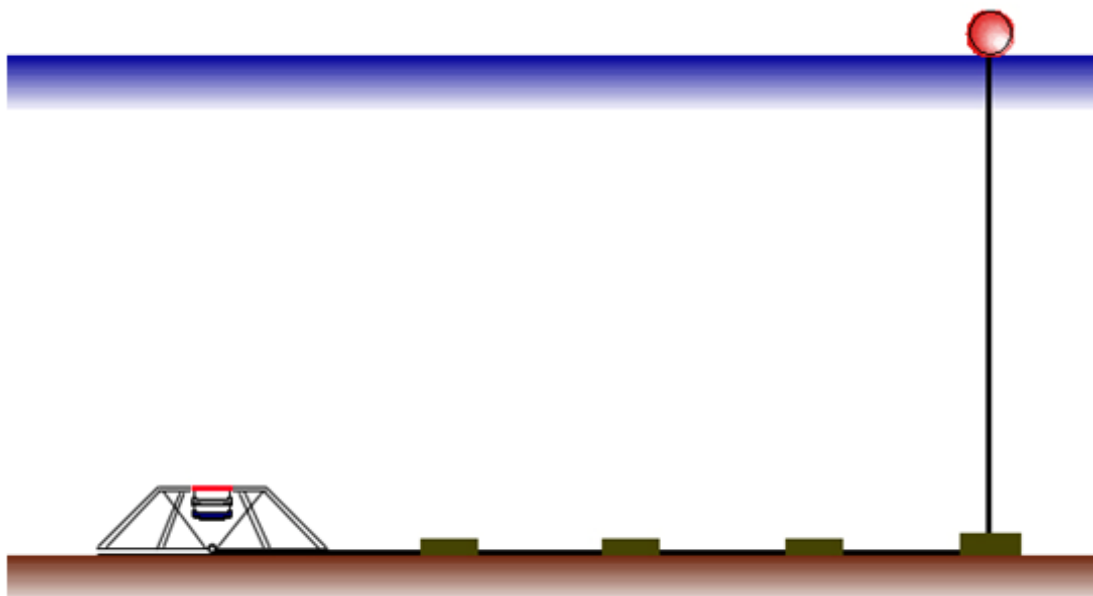


Figure 1. Schematic diagram of mooring array deployed during the survey.



Figure 2. Photograph of ADCP being deployed.



Figure 3. Photograph of ADCP on seabed.

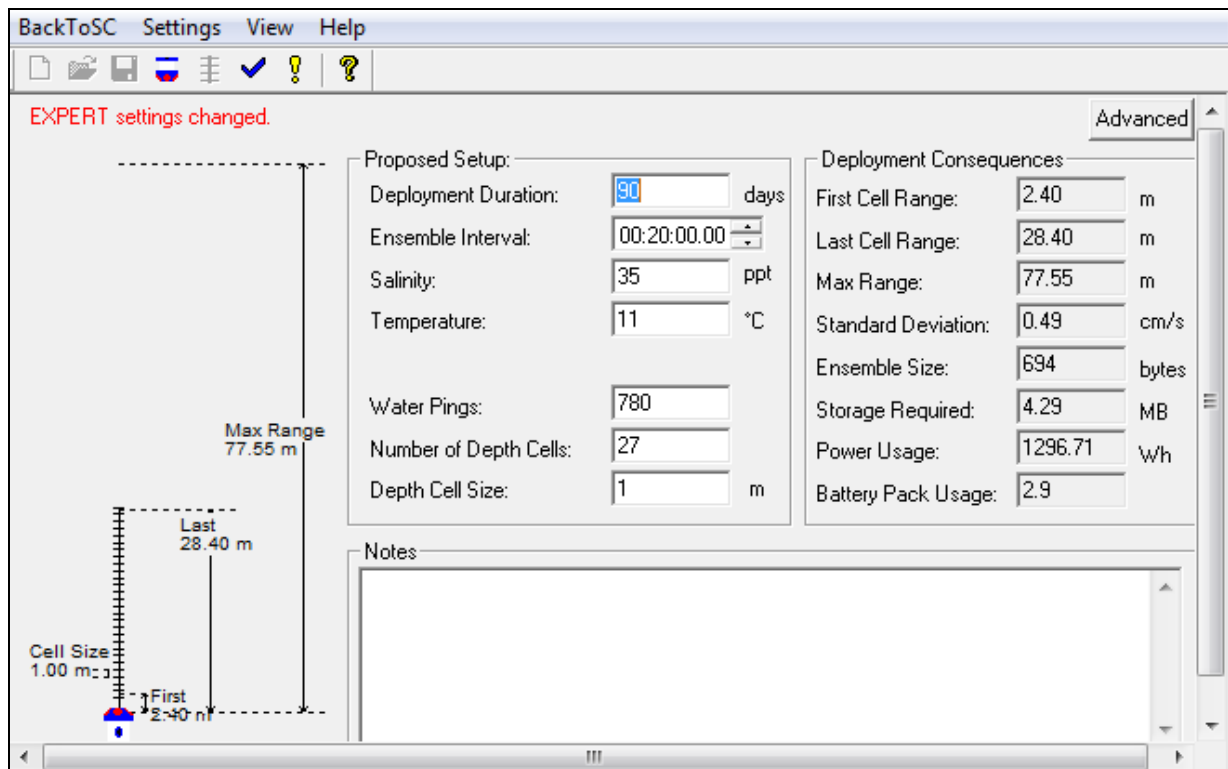


Figure 4. Instrument configuration details.

Table 1. Set-up and deployment details of the ADCP used during survey.

Position of reported cells (m above seabed)	ADCP Deployment Position	Start of Reported Dataset (time in GMT)	End of Reported Dataset (time in GMT)	Measured Depth [†] (mCD)
Sub-Surface: 20.0	208398.2 E, 933522.2 N*	02/11/18 13:20	18/01/19 11:00	25.4
Net-Bottom: 13.0		"gap" in dataset patched (see §3.2)		
Near-Bed: 3.0	208379.1 E, 933506.2 N**	18/01/19 13:44	31/01/19 13:24	24.6

[†] These are the average of measured depths during deployment and recovery (see Table 7)

Positions recorded relative to WGS84 datum:

* N 58° 14.9124', W 05° 15.9920' (Garmin GPSMap 62stc)

** N 58° 14.9033', W 05° 16.0107' (Garmin GPSMap 78s)

OS GridInquest was used to convert the WGS84 coordinates to OSGB36.

In excess of 6481 records were obtained during a period of 90-days for the period 02/11/18 13:20 to 31/01/19 13:24 hrs GMT. On 18/01/19 the ADCP was recovered and the data downloaded by Loch Duart Ltd to ensure that the ADCP was operating as intended. This was found to be the case and the ADCP was redeployed. The recovery and redeployment resulted in a "gap" in valid data of c. 2 hours 20 minutes (7 ensembles).

Hydrographic data are presented below (Tables 2 to 4 and Figures 6 to 9).

Admiralty Total Tide mean sea level at the site is chart datum + 2.6 m and the lowest predicted spring tide during the 90-day dataset was chart datum + 0.8 m.

2.2 Meteorological Survey

Data Source: Scouriemore Weather Station (N 58° 20.933', W 05° 09.950')
Record Used: 02/11/18 13:19 – 31/01/19 11:24 hrs GMT

Wind speed and direction data during the period 02/11/18 13:19 to 31/01/19 11:24 hrs GMT are presented in Table 5 and provided in the accompanying spreadsheet (Scouriemore_Weather_Register.xlsx).

2.3 Bathymetric Survey

Surveyed by: TransTech Ltd/Loch Duart Ltd
Survey date: 02/11/18

The bathymetric survey recorded 6 depths at cardinal positions to the Oldany site (Table 7).

The depths were converted to chart datum using Admiralty Total Tide software.

2.4 GPS and Depth Sounder Calibration

Positions were recorded relative to WGS84 datum using a Garmin GPSMap 62stc or a Garmin GPSMap 78s. Prior to using the GPS units they were checked against a second Garmin GPSMap 78s.

Depth measurements were recorded using one of three available Plastimo handheld digital sonar depth sounders. Prior to the survey taking place the sounders were checked against one another. All sounders gave identical results at varying depths.

2.5 Magnetic North to Grid North Conversion

Current and wind speed direction data were collected in degrees Magnetic North and are reported in this document relative to Grid North.

Magnetic north was approximately 35' (0.5833°) west of Grid North (obtained from http://www.geomag.bgs.ac.uk/gifs/gma_calc.html, Figure 5). The hydrographic data were corrected from Magnetic North to Grid North by subtracting 0.5833° from the magnetic north direction data using SEPA's HG_data_analysis_v7.11.xls tool (rev 12).

Grid Magnetic Angle Calculator Results

Magnetic north is estimated to be 0 deg 35 min west of grid north (British National Grid) at this location in July 2018.

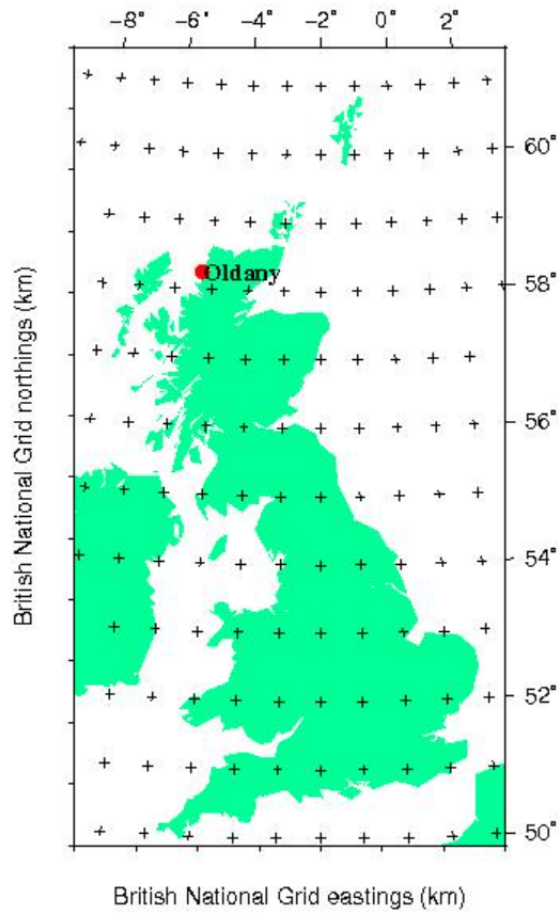


Figure 5. BGS Magnetic North to Grid North conversion.

3. Hydrographic Survey

3.1 Pitch, Roll and Heading

The changes in pitch, roll and heading during the deployments are shown in Table 2.

Table 2. Set-up and deployment details of the ADCP used during survey.

Period of Deployment	Maximum Change in Pitch (degrees)	Maximum Change in Roll (degrees)	Maximum Change in Heading (degrees)
02/11/18 13:20 to 18/01/19 11:00	10.32	9.01	11.95
18/01/19 13:44 to 31/01/19 13:24	3.55	2.66	2.72

The most prominent change to pitch and roll occurred during the first deployment between 07/01/19 14:20 and 07/01/19 19:40 hrs GMT (Figure 6). This was accompanied by an increase in recorded current speeds throughout the water column.

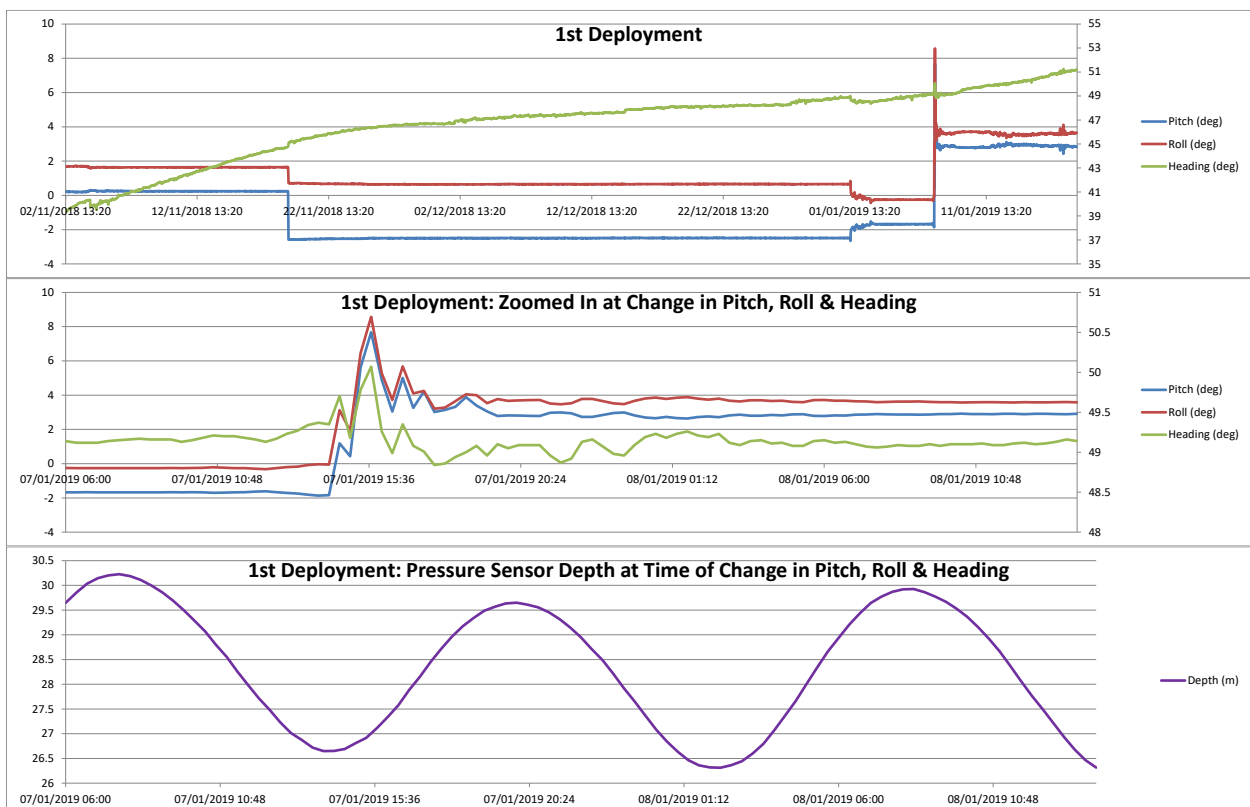


Figure 6. Graphs of ADCP pitch, roll, heading and depth when these parameters differed most during the 90-day period.

Teledyne was consulted on the measured changes in pitch, roll and heading and they commented that:

- The ADCP will auto-correct direction for changes in pitch, roll and heading.
- When an ADCP is placed in a gimballed frame, it is quite common for the instrument to move a little due to the change in the water current speed and direction.

Given the above the measured speed and direction data are considered representative of conditions at the Oldany site during the 90-day period.

3.2 Gap in Speed and Direction Data

On 18/01/19 the ADCP was recovered and the data downloaded by Loch Duart Ltd to ensure that the ADCP was operating as intended. This was found to be the case and the ADCP was redeployed. The recovery and redeployment resulted in a “gap” in valid data of c. 2 hours 20 minutes (7 ensembles).

The gap in the data was “patched” using speeds and directions for the same times in the preceding tidal cycle.

The worksheet used to patch the data is provided in Oldany 2019v1/ProcessedHG/Patched Oldany-08-02-19.xlsx/Patch.

3.3 Speed and Direction Data

The following pages contain tabulated and graphic outputs for the selected 20.0 m, 13.0 m and 3.0 m cells (cells 18, 11 and 1 respectively) for the 90-day dataset.

Table 3 provides mean speed, ranked percentage of the mean current speed and ≤ 0.095 m/s as a ranked percentage within the current speed record for the selected sub-surface, net-bottom and near-bed cells.

Table 3. Current speed during the 90-day period.

Cell Height [above seabed]	Mean speed (m/s)	Percentage ≤ 0.095 m/s	Major Axis (°Grid N)	Amplitude anisotropy	Residual speed (m/s)	Residual Direction (°Grid N)
Sub-Surface [20.0 m] 1 st dataset: 5.38 m <LST 2 nd dataset: 4.70 m <LST	0.03	99%	120	1.21	0.00	208
Net-Bottom [13.0 m] 1 st dataset: 14.98 m <MSL 2 nd dataset: 14.30m <MSL	0.03	98%	315	1.30	0.01	234
Near-Bed [3.0 m]	0.04	95%	245	1.00	0.02	231

Table 4 shows the tidal ellipse major axis used derived from 1^o cells from current direction frequency analysis; the decomposition of easterly and northerly vector components relative to the tidal ellipse major axis; and the tidal current amplitude relative to the tidal ellipse major axis.

Table 4. Summary data for the 3 cells during the 90-day period.

Cell	Tidal ellipse major axis Bearing (°Grid N)	Components of current residual (m/s)		Components of tidal current amplitude (m/s)	
		Parallel (U)	Normal (V)	Parallel (U)	Normal (V)
Sub-Surface [20.0 m]	120	0.000	0.003	0.035	0.029
Net-Bottom [13.0 m]	315	0.002	-0.010	0.037	0.028
Near-Bed [3.0 m]	215	0.023	-0.006	0.046	0.046

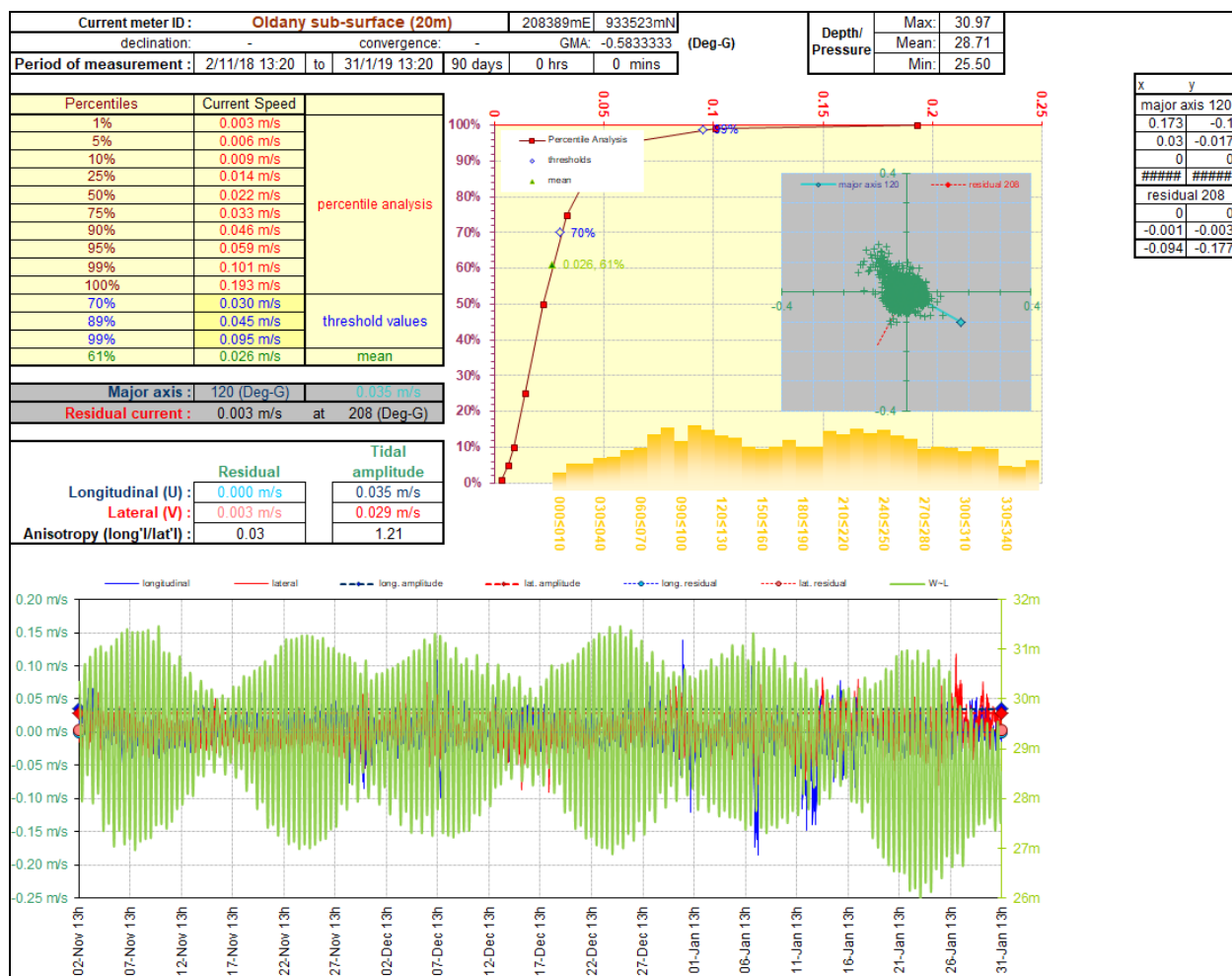


Figure 7. Summary data for sub-surface cell (20.0 m above seabed) during the 90-day period.

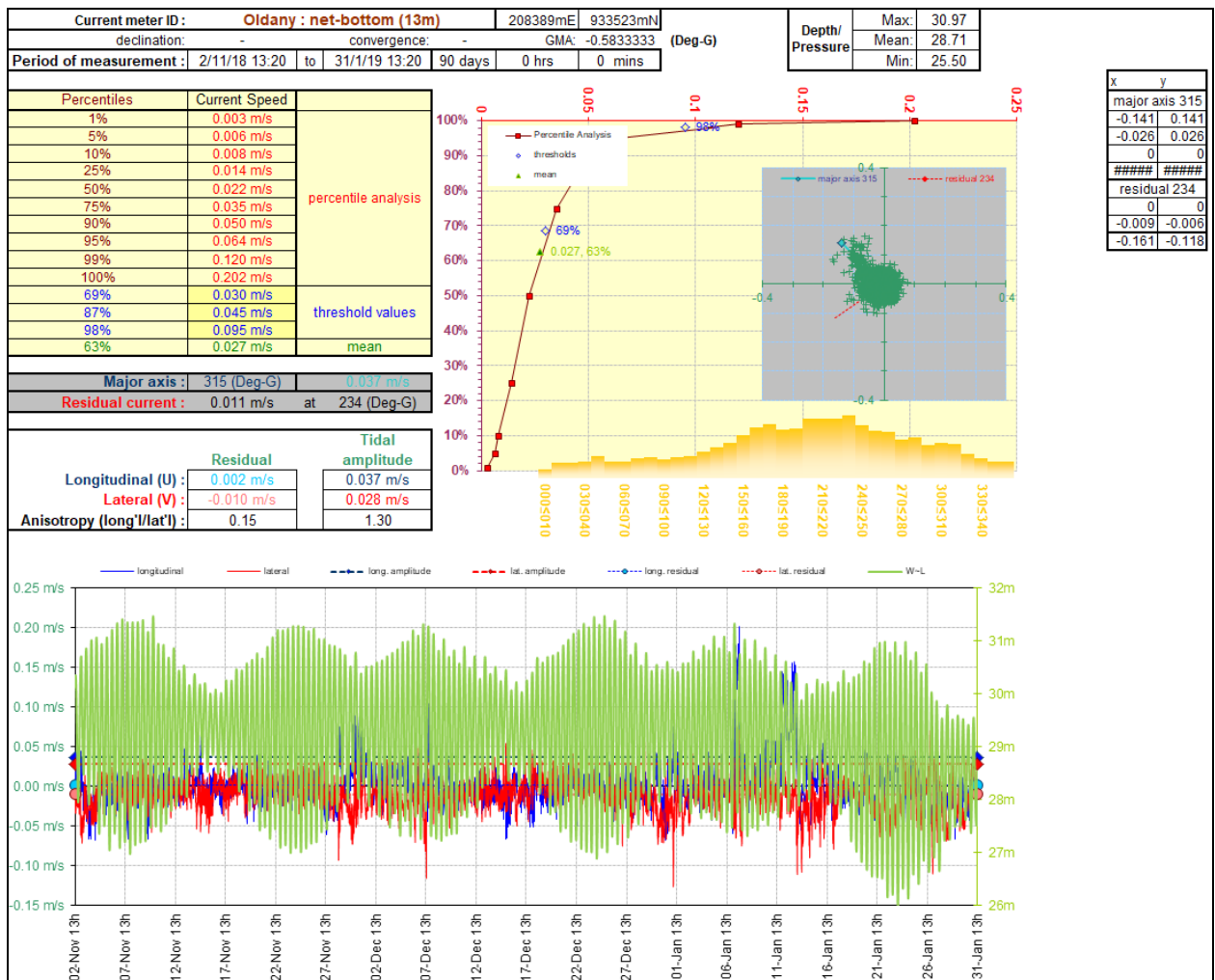


Figure 8. Summary data for net-bottom cell (13.0 m above seabed) during the 90-day period.

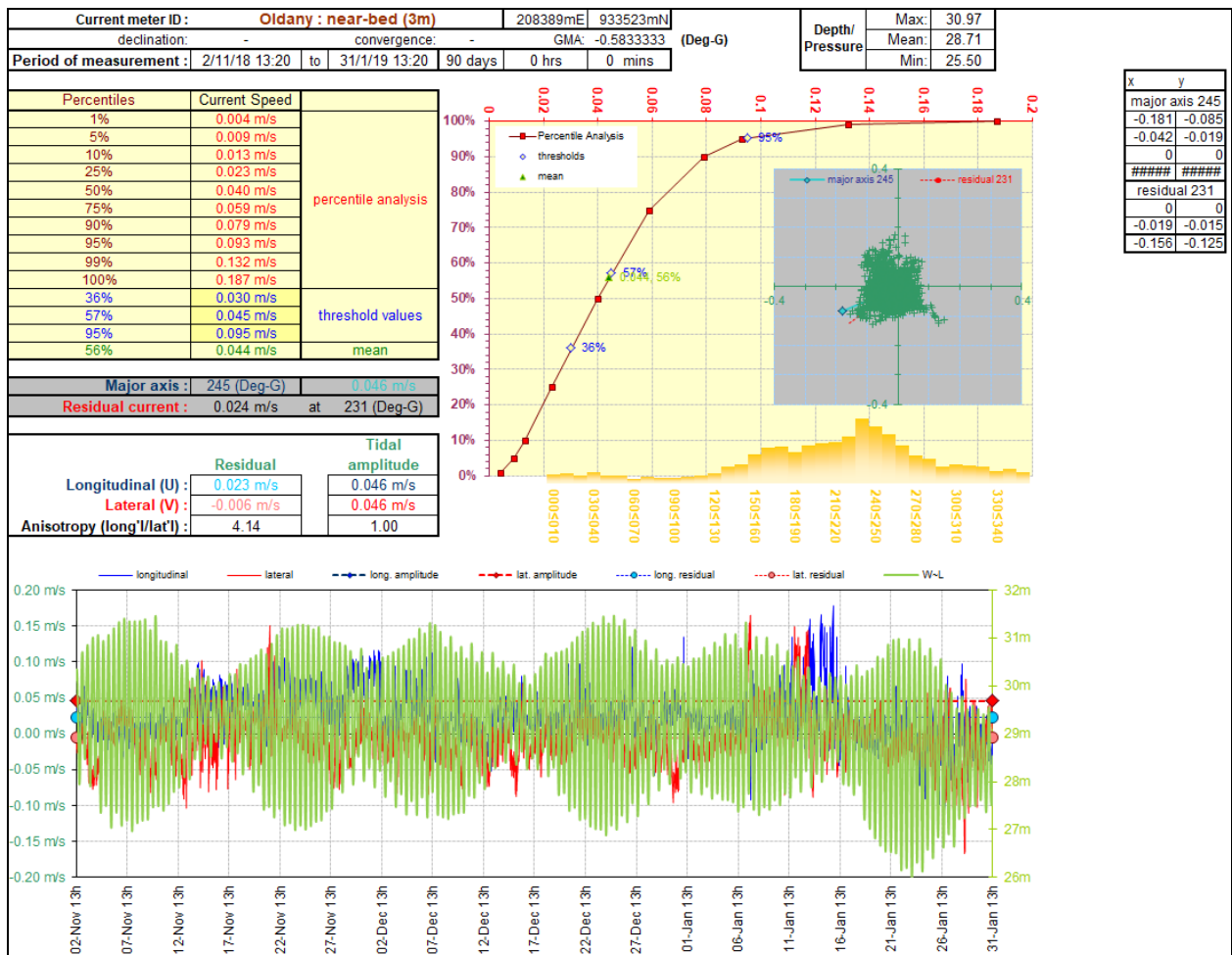


Figure 9. Summary data for near-bed cell (3.0 m above seabed) during the 90-day period.

4. Meteorological Data

The following pages contain tabulated and graphic representations of wind speed and direction during the 90-day ADCP deployment at Oldany. This dataset is from a weather station located in Scourie (Scouriemore) c. ≤ 12.7 km from the deployment locations.

It was necessary to obtain data from the Scouriemore weather station as when the Datahog weather station hired for deployment at the site was recovered it was evident from the lack of data recorded that it was defective.

Table 5 reveals that the mean wind speed recorded at the Scourie weather station remained below 10 m/s for more than 3 consecutive days in compliance with SEPA guidelines. Indeed, on only one day did mean speed reach 10 m/s (15 December 2018) during a low pressure event and for the duration of the deployment it was significantly lower.

Table 5. Measured mean wind speed (file containing weather station accompanies this report).

Date	Mean Speed (m/s)	Date	Mean Speed (m/s)	Date	Mean Speed (m/s)	Date	Mean Speed (m/s)	Date	Mean Speed (m/s)	Date	Mean Speed (m/s)
02-Nov-18	4.1	18-Nov-18	2.9	04-Dec-18	1.8	20-Dec-18	2.6	05-Jan-19	3.6	21-Jan-19	4.8
03-Nov-18	6.0	19-Nov-18	4.1	05-Dec-18	3.1	21-Dec-18	1.0	06-Jan-19	1.3	22-Jan-19	1.6
04-Nov-18	6.4	20-Nov-18	6.0	06-Dec-18	3.6	22-Dec-18	0.9	07-Jan-19	7.3	23-Jan-19	1.7
05-Nov-18	1.6	21-Nov-18	6.1	07-Dec-18	7.4	23-Dec-18	0.1	08-Jan-19	2.8	24-Jan-19	1.3
06-Nov-18	5.6	22-Nov-18	3.2	08-Dec-18	3.5	24-Dec-18	2.2	09-Jan-19	1.7	25-Jan-19	3.3
07-Nov-18	6.0	23-Nov-18	4.1	09-Dec-18	3.3	25-Dec-18	2.7	10-Jan-19	2.1	26-Jan-19	7.0
08-Nov-18	4.1	24-Nov-18	1.9	10-Dec-18	1.3	26-Dec-18	3.1	11-Jan-19	3.3	27-Jan-19	6.8
09-Nov-18	8.6	25-Nov-18	2.5	11-Dec-18	2.5	27-Dec-18	2.2	12-Jan-19	3.4	28-Jan-19	3.0
10-Nov-18	4.1	26-Nov-18	2.1	12-Dec-18	4.3	28-Dec-18	3.4	13-Jan-19	6.6	29-Jan-19	3.1
11-Nov-18	1.4	27-Nov-18	8.1	13-Dec-18	6.0	29-Dec-18	3.1	14-Jan-19	2.5	30-Jan-19	2.6
12-Nov-18	2.1	28-Nov-18	8.2	14-Dec-18	6.2	30-Dec-18	3.3	15-Jan-19	3.4	31-Jan-19	0.9
13-Nov-18	2.6	29-Nov-18	5.9	15-Dec-18	10.0	31-Dec-18	5.1	16-Jan-19	3.7		
14-Nov-18	3.6	30-Nov-18	6.0	16-Dec-18	3.7	01-Jan-19	2.8	17-Jan-19	3.4		
15-Nov-18	4.6	01-Dec-18	3.7	17-Dec-18	5.0	02-Jan-19	1.3	18-Jan-19	2.3		
16-Nov-18	3.2	02-Dec-18	2.4	18-Dec-18	6.1	03-Jan-19	3.4	19-Jan-19	0.5		
17-Nov-18	4.2	03-Dec-18	2.8	19-Dec-18	3.1	04-Jan-19	2.9	20-Jan-19	3.1		

5. Bathymetric Survey

Table 6 provides the depth soundings taken in the vicinity of the Oldany site.

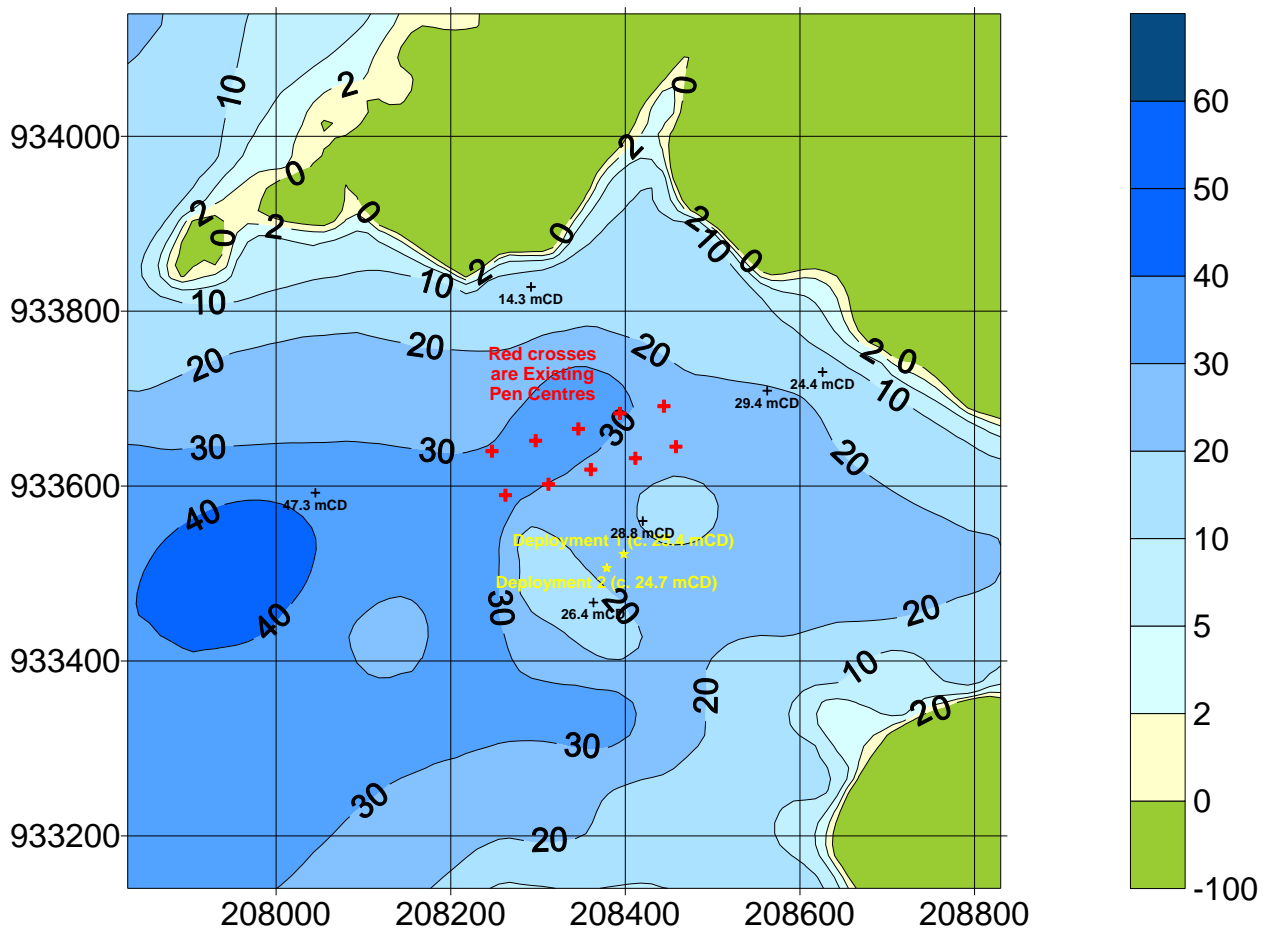
Table 6. Depth soundings.

Location	Date & Time (GMT)	Lat & Long (WGS84)*	Easting (OSG36 m)	Northings (OSG36 m)	Measured Depth (m)	ATT Correction (m)**	Depth (mCD)
ADCP DEPLOYMENT (02/11/18, coordinates and depths taken as frame landed on seabed)							
ADCP	13:08	58° 14.9124' 05° 15.9920'	208398.2	933522.2	28.8	3.5	25.3
	13:08				28.9	3.5	25.4
	13:08				28.8	3.5	25.3
ADCP DEPLOYMENT (18/01/19, coordinates and depths taken as frame landed on seabed)							
ADCP	13:19	58° 14.9033' 05° 16.0107'	208379.1	933506.2	26.9	2.4	24.5
	13:19				27.0	2.4	24.6
	13:20				27.0	2.4	24.6
DEPTH SOUNDINGS							
1	02/11/18 11:58	58° 14.9334' 05° 15.9717'	208420.0	933560.2	31.8	3.0	28.8
2	02/11/18 12:06	58° 14.8818' 05° 16.0247'	208363.5	933467.0	29.4	3.0	26.4
3	02/11/18 12:14	58° 15.0305' 05° 15.7699'	208626.0	933730.6	27.5	3.1	24.4
4	02/11/18 12:17	58° 15.0173' 05° 15.8335'	208562.6	933709.2	32.5	3.1	29.4
5	02/11/18 12:22	58° 15.0741' 05° 16.1156'	208292.0	933827.9	17.4	3.1	14.3
6	02/11/18 12:28	58° 14.9410' 05° 16.3560'	208045.0	933592.5	50.5	3.2	47.3
ADCP RECOVERY (18/01/19, coordinates and depths taken as frame lifted from seabed)							
ADCP	11:16	58° 14.9115' 05° 15.9933'	208396.9	933520.6	27.0	1.5	25.5
	11:17		The small difference (2.1 m) between deployment and recovery coordinates is attributed to boat movement and/or GPS accuracy.		26.9	1.5	25.4
	11:17				27.2	1.5	25.7
ADCP RECOVERY (07/02/19, coordinates and depths taken as frame lifted from seabed, NB: ADCP stopped recording at 23:24 on 31/01/19 when the battery life ended)							
ADCP	11:38	58° 14.9026' 05° 16.0117'	208378.1	933504.9	27.6	3.0	24.6
	11:38		The small difference (1.6 m) between deployment and recovery coordinates is attributed to boat movement and/or GPS accuracy.		27.7	3.0	24.7
	11:38				27.7	3.0	24.7

* Position recorded to WGS84 datum using Garmin GPSMap 62stc (02/11/18) and GPSMap 78s (18/01/19 and 07/02/19).

** Correction is for Admiralty Total Tide predicted tidal amplitude at Badcall Bay.

The positions of the depth soundings, existing pens and the ADCP deployments are shown in Figure 10.



NB: Shown deployment depths are calculated from the pressure sensor record. These differ only marginally from measured depths (Table 7).

Figure 10. Depth soundings overlaid onto AutoDEPOMOD gridgen file for current consent.

The gridgen file above was produced from charted contours and the depth survey indicates that depths are generally deeper than what is shown on charts. Thus, prior NewDEPOMOD modelling of the Oldany site a bathymetric survey will be carried out to define depths within the model domain.

6. Discussion and Conclusions

The pressure sensor's depth record indicates that the ADCP remained undisturbed. There were some short-term changes in pitch, roll and heading during the 90-day dataset but Teledyne has confirmed that the ADCP auto-corrects direction for these changes: As such the dataset is considered representative of conditions at the Oldany site.

The cell heights reported in this document are 3.0 m, 13.0 m and 20.0 m above the seabed. These heights meet the criteria specified in Attachment VIII of SEPA's Fish Farm Manual i.e. ≤ 3 m above the seabed for the near-bed cell, ± 1 m from the bottom of the nets at MSL for the mid-water cell (currently net depth is likely to be 15.0 m), and circa 5 m below LST for the sub-surface cell.

Wind speed was not greater than 10 m/s for 3 consecutive days.

The site and hydrographic survey reported in this document is considered to comply with the requirements of Attachment VIII of SEPA's Fish Farm Manual and the 90-day current speed and direction data are considered representative of the Oldany site.