Sconser Quarry

Hydrographic Data Report: Deployment ID132

5th December 2016 to 6th February 2017

January 2022

Mowi Scotland Limited

[redacted]

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QUALITY ASSURANCE

Mowi Scotland Ltd is ISO9001 and ISO14001 accredited and all project management follows policies designed to ensure that the collection, collation and reporting of information produced in the course of our operations is done to a consistently high standard meeting the requirements of the end user.

1. Introduction

Mowi Scotland Ltd. is preparing an application to the Scottish Environmental Protection Agency (SEPA) for a technical variation to CAR/L/1009643 to modify an existing salmon farm site located on the Isle of Skye, Sconser Quarry. Mowi Scotland Ltd. propose to change the existing site from 12 x 120 m circumference pens held in a 80 m grid (Figure 1) to 7 x 160 m circumference pens with 12 m deep nets, held in a 100 m grid. There will also be an application to increase the consent of Azamethiphos (Salmosan).

Mowi Scotland Ltd have carried out a hydrographic survey at the Sconser Quarry site between 5th December 2016 and 6th February 2017. The purpose of this report is to assess the suitability of the collected hydrographic data for input into a hydrodynamic model of the East Skye and Rassay Sound region.

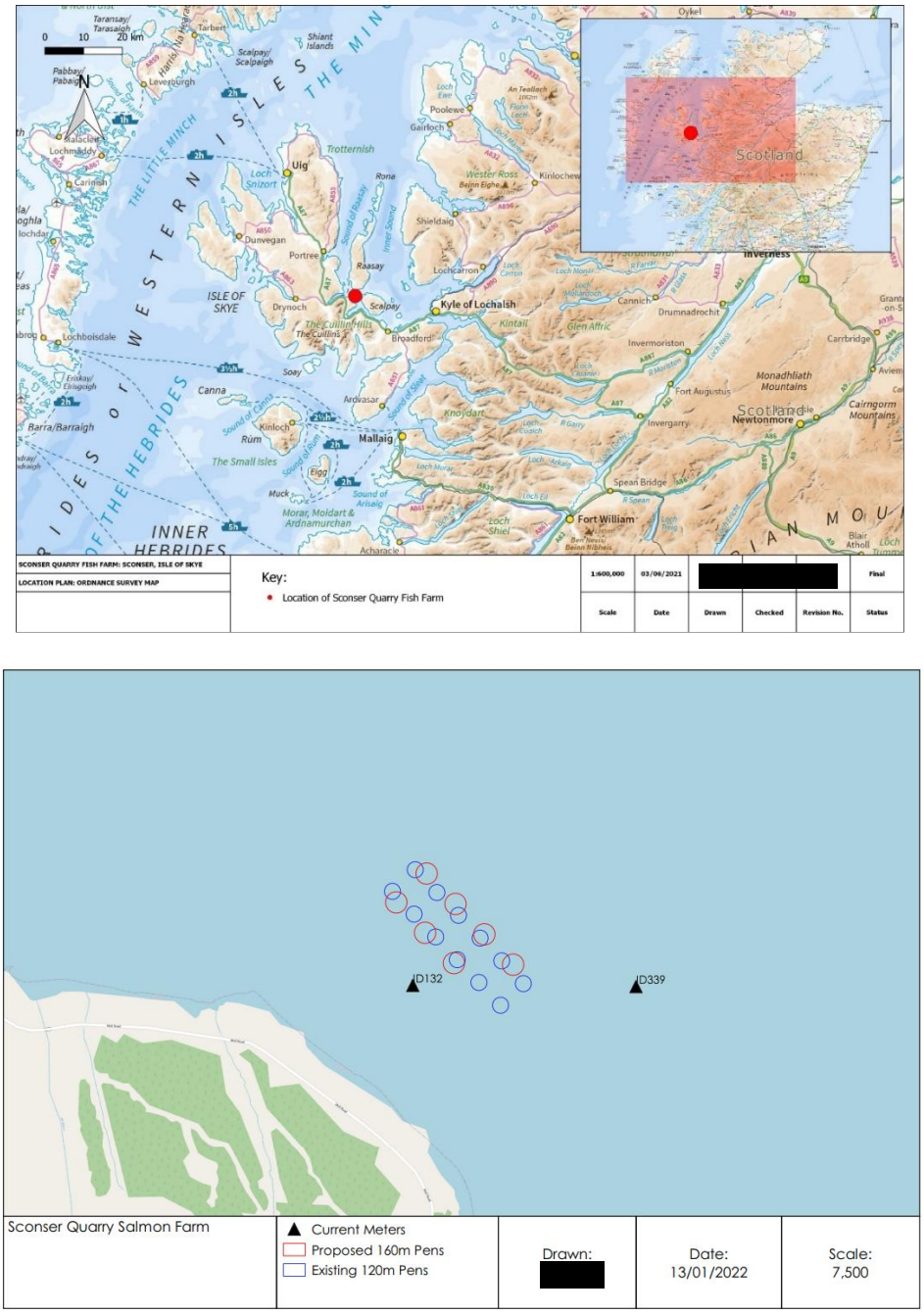


Figure 1. Site location (top) and layout (bottom) and of the salmon farm Sconser Quarry. The current meter deployment location is also marked.

2. Materials & Methods

2.1 Bathymetry

Bathymetry for the study area was taken from the UKHO INSPIRE bathymetry data (http://aws2.caris.com/ukho/mapViewer/map.action).

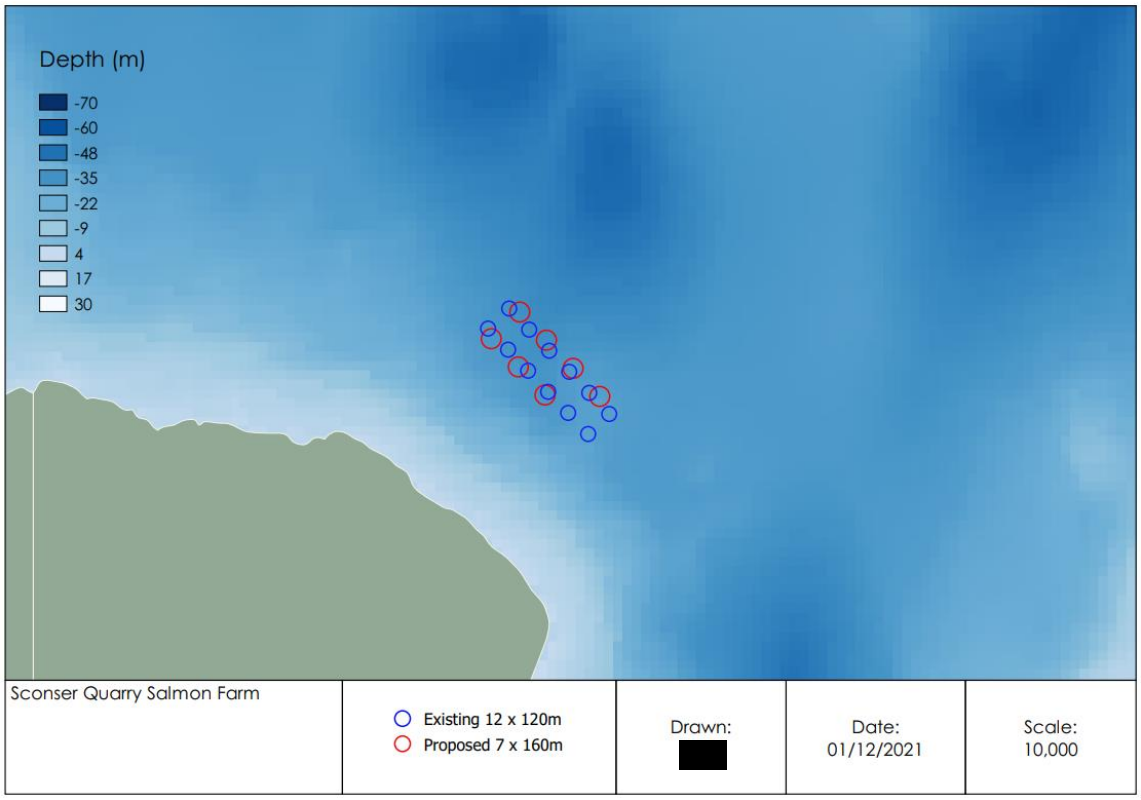


Figure 2. Bathymetry in the area around the Sconser Quarry site.

2.2 Current Data

Mowi staff carried out a hydrographic survey at the site in 2016-2017. The purpose of this hydrographic report is to assess the suitability of the collected hydrographic data for use within a Hydrodynamic model. The data contained in this report were recorded at the site from 5th December to 6th February 2017 (62 days and 23 hours of data; deployment ID132).

The Sentinel V100 (Wide) ADCP (Table 1), within its mooring frame, was positioned at 57.31427'N, -6.05'W (156216E 832119N), which was approximately 280m from the nearest shoreline and approximately 160m from the centre of the proposed cage group (Figure 1). The transducer head was 70 cm from the base of the mooring frame. The mean depth (derived from the pressure sensor) at the Sentinel V100 ADCP position was 39.44 m.

Initial soundings were taken to establish the possible depth the Sentinel V100 ADCP would be situated at during high tide and so that the most appropriate cell size could be determined. The cell size was set at 1.0 m and the number of cells to 40.

Data was automatically written and stored to the internal memory within the Sentinel V100 ADCP main body and then downloaded to computer after completion of the deployment period via WiFi.

2.3 Magnetic Variation

No magnetic variation correction was made to the Sentinel V100 ADCP during deployment, this was undertaken to the data after the instrument was recovered and data downloaded. The magnetic variation used was -3.9°; this was determined using the World Magnetic Model, produced jointly with the US National Oceanographic and Atmospheric Administration's National Geophysical Data center. Further details can be found at http://www.geomag.bgs.ac.uk/navigation.html

2.4 Data Processing

Upon retrieval of the Sentinel V100 ADCP current meter, all data was downloaded to a computer for analysis. The raw data file was opened in Teledyne's "Velocity" software and Matlab. Deployment diagnostic data (beam intensity, correlation, pitch and roll) were analysed to confirm that the deployment was successful with the instrument orientated upright. The heading data were also examined to identify any movement of the Sentinel V100 ADCP mooring frame during the deployment.

The diagnostic data suggested that velocities from the first 30 bins were valid (Figure 3). Calculations were undertaken to identify the cells to be used for surface and middle currents. Surface data was taken at an average depth (derived from the pressure sensor) of 7.72 m (cell 30), and cage-bottom data at 17.72 m (cell 20). Surface and middle cell heights were 31.72 m and 21.72 m from the seabed respectively. The bottom cell (cell 1) was at an average depth of 36.72 m and 2.72 m above the seabed.

Table 1: Sentinel V100 ADCP Specifications.

Depth Cell Size[1]		**V20 (1000kHz)**		**V50 (500kHz)**		**V100 (300kHz)**	
	Depth Cell Size[1]	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow
	0.25m	18.0/22.6	19.2/36.5				
	0.3m	19.3/24.0	11.1/20.8				
	0.5m	20.2/24.9	7.1/13.4	44.1/57.6	19.2/36.5		
	1.0m	22.1/26.9	3.6/6.7	50.5/64.6	7.1/13.5	94.5/120.6	10.9/20.6
	2.0m	24.5/29.4	1.7/3.2	56.0/70.6	3.6/6.7	103.5/130.4	5.5/10.3
	4.0m	26.9/32.0	0.8/1.6	63.1/78.2	1.7/3.2	114.6/142.3	2.7/5.2
	6.0m			67.4/82.8	1.1/2.1	121.7/151.5	1.8/3.3
Communications and Recording	Wireless	802.11b/g/n					
	Internal memory	One 16GB Micro SD Card included					
Profile Parameters	Velocity accuracy	V20/V50: 0.3% of the water velocity relative to the ADCP ±0.3cm/s V100: 0.5% of the water velocity relative to the ADCP ±0.5cm/s					
	Velocity resolution	0.1cm/s					
	Velocity range	±5m/s (default); ±20m/s (maximum)					
	Ping rate	Up to 4Hz					
Echo Intensity Profile	Vertical resolution	Depth cell size					
	Dynamic range	80dB					
	Precision	±1.5dB					
Transducer and Hardware	Beam angle	25°					
	Configuration	4-beam, convex; 5th beam vertical					
	Depth rating	200m					
	Materials	Transducer, housing, and end cap: plastic Connector: metal shell					
Standard Sensors	Temperature (mounted on transducer)	Range -5° to 45°C, precision ±0.4°C, resolution 0.1°					
	Compass (magneto-inductive sensor)	Accuracy 2° RMS, resolution 0.1°, max. dip angle 85°					
	Tilt (MEMS accelerometers)	Pitch range ±90°, roll range ±180°, accuracy 2° RMS, precision 0.05° RMS, resolution 0.1°					
	Pressure sensor (mounted on transducer)	Range 300m, accuracy 0.1%FS					
Power	External DC input	12–20VDC					
	Internal battery voltage	18VDC new					
	Battery capacity; over-the-counter @0°C	100 watt hours (typical)					
	Battery pack @5°C	510 watt hours					
Software	Teledyne RDI's new software included	ReadyV—Pre-deployment (testing, planning, and data recovery)[5] Velocity—Post-processing (data handling, display, and export)[6]					
Environmental	Standard depth rating	200m					
	Operating temperature	-5° to 45°C					
	Storage temperature (without batteries)	-30° to 60°C					
	Weight in air	7.5kg – 16.0kg					
	Weight in water	1.6kg – 6.0kg					
Available Options	External battery case • AC/DC power converter • 5th beam (at time of order only) • Waves processing • Straight or right-angle metal shell connector						
Dimensions	Special configuration drawing available upon request						

1 User's choice of depth cell not limited to the typical values specified.
2 Ranges specified are typical at temperature of 5°C and salinity of 35psu; longer ranges are possible.
3 User selects the bandwidth mode; wide = 25% or narrow = 6%.
4 Standard deviations (Std Dev) are typical values for single ping data
5 Resident in ADCP accessed via a web browser.
6 Windows™ based software program.

Specifications subject to change without

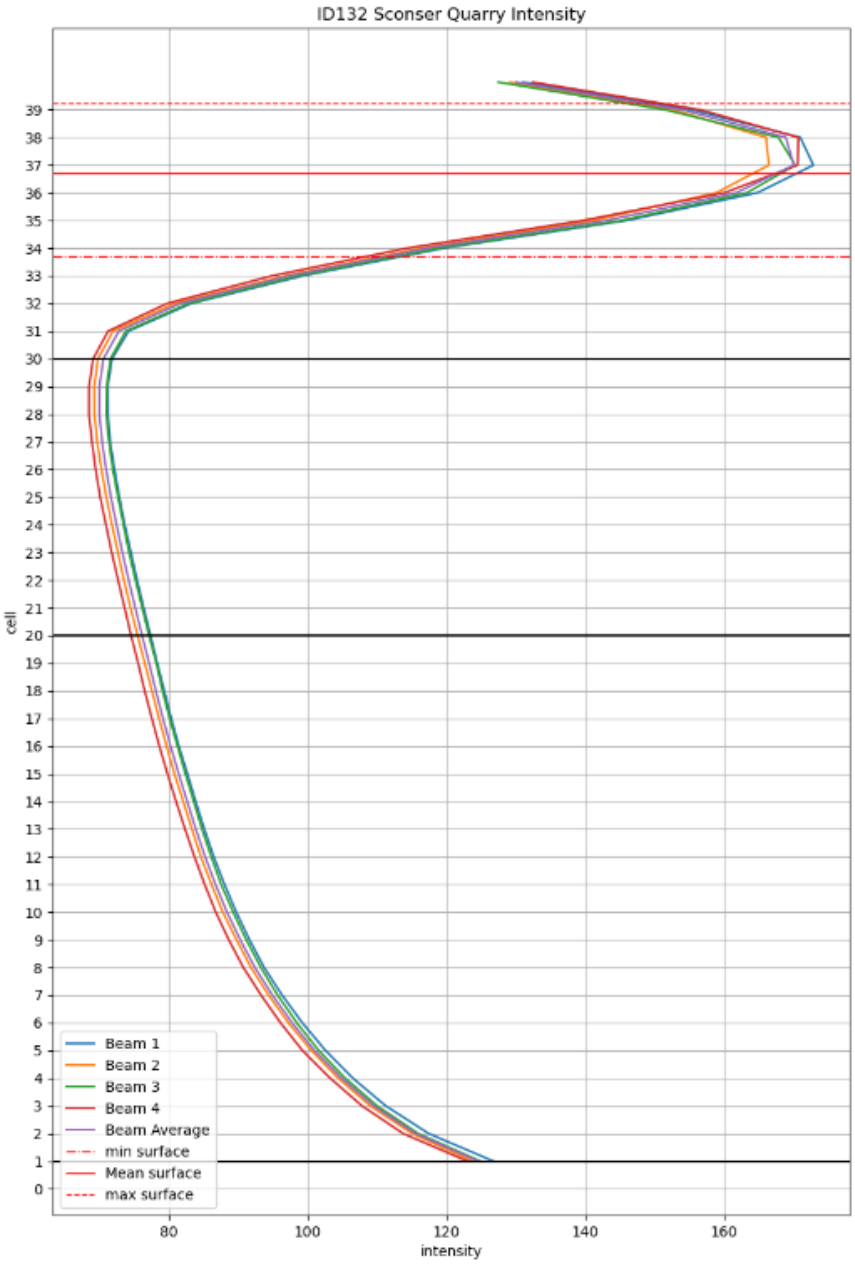


Figure 3. Mean intensity of the ADCP signal for the ID132 dataset plotted by bin number

The 'first cell range' is automatically calculated by the instrument, which is the distance from the transducer head to the first cell. For this deployment, the first cell range was calculated as 2.02 m. This value is then added to the height of the instrument frame (0.7 m) to get the first cell height above the seabed, which equated to 2.72 m

Standard deviation has been assessed throughout the deployment to identify accurate and reliable data for near bed, middle (net depth) and surface cells using the following equation:

$$Cell\ StdDev = \frac{Instrument\ StdDev}{\sqrt{No.valid\ pings}} \qquad (1)$$

The Instrument Standard Deviation (StdDev) in Equation 1 is determined using the deployment settings when the meter is programmed, examples of the StdDev values for different configurations are shown in Table 1. This deployment had a cell size of 1m which equates to an Instrument StdDev of 10.9 cm/s.

The percentage of valid pings used to calculate Cell StdDev is derived using “Percentage Good” data which allows us to relate the StdDev to the actual data gathered. The percent good data is available for 1, 2, 3 and 4 beams which represent the following:

- Percent good 1 = % of good data computed from 3 Beams
- Percent good 2 = % of bad data due to more than 2 Beam bad
- Percent good 3 = % of bad data due to error velocity exceeded
- Percent good 4 = % of good data computed from 4 Beams

The method described has been used to calculate the standard deviation throughout the deployment for the surface, middle and bottom cells; the average StdDev values for the surface, middle and bottom was 0.64cm/s, 0.63cm/s and 0.63cm/s respectively which are all within the SEPA criteria of 2cm/s.

2.5 Meteorological Data

The collection of meteorological data is no longer required to support the assessment process and consequently has not been undertaken. The current data used is collected during longer periods and thus provides a more realistic representation of site conditions than short deployments, thus allowing an assessment of the influence of meterological conditions.

3. Results and Discussion

A summary of the current data is shown in Figure 4 to Figure 12 and in Table 2 to Table 5. Over the period analysed for this report, the near-surface, middle and bottom cells had current speed averages of 7.64 cm/s, 7.19 cm/s and 6.01 cm/s respectively. This gave an overall average of 6.95 cm/s. The orientation of the tidal velocities was north-west – south-east.

The residual current at the surface 300°G was toward the north-west, mid-depth (263°G) was towards the west and near seabed (181°G) was toward the south-east. The magnitude of the residual currents for the surface, middle and bottom cells were moderate, with mean values of 0.011 m/s, 0.027 m/s and 0.007 m/s respectively.

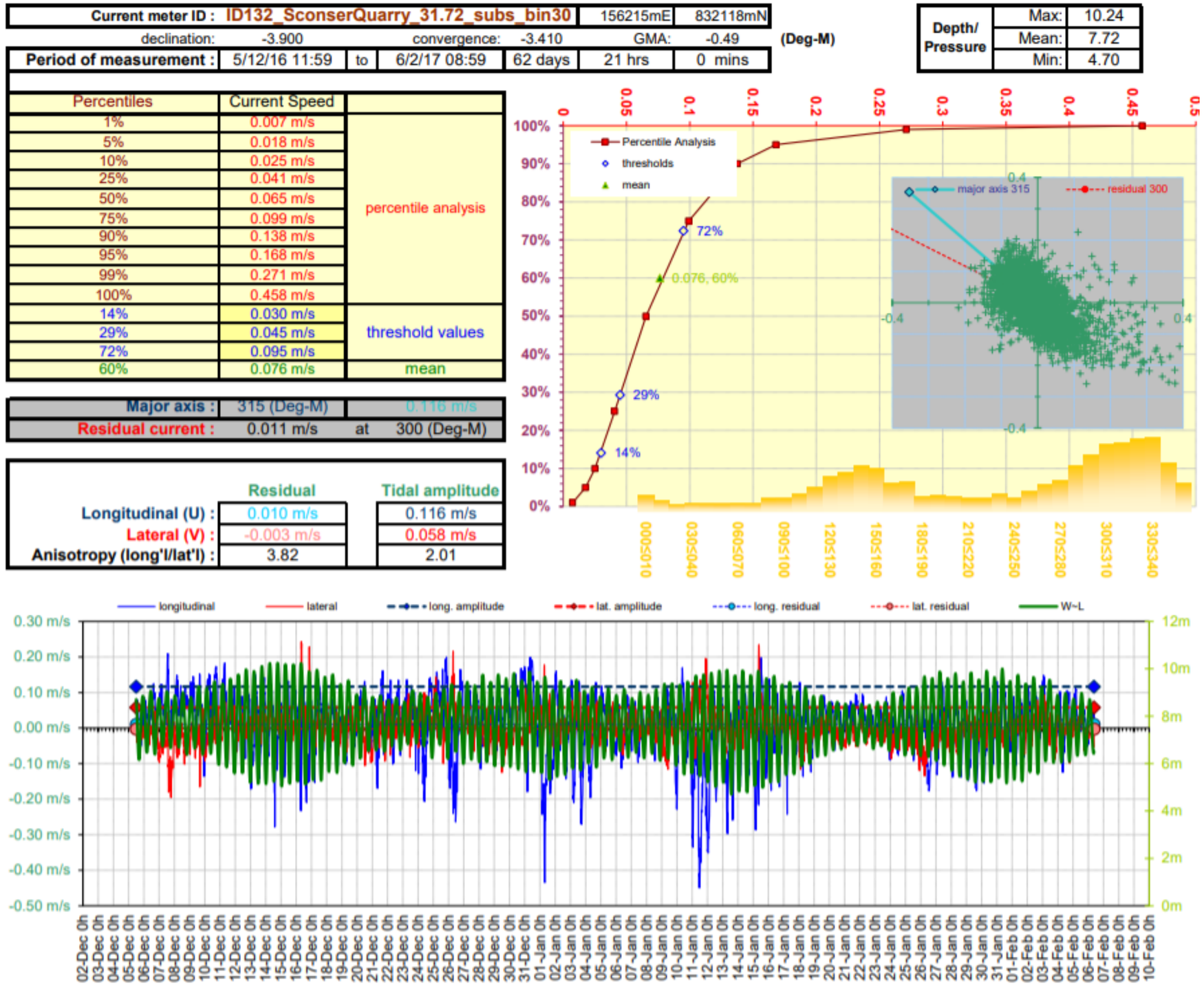


Figure 4. Current Data Summary Sheet for the surface current cell 30, 31.72m from seabed, 5th December 2016 to 6th February 2017 inclusive (ID132).

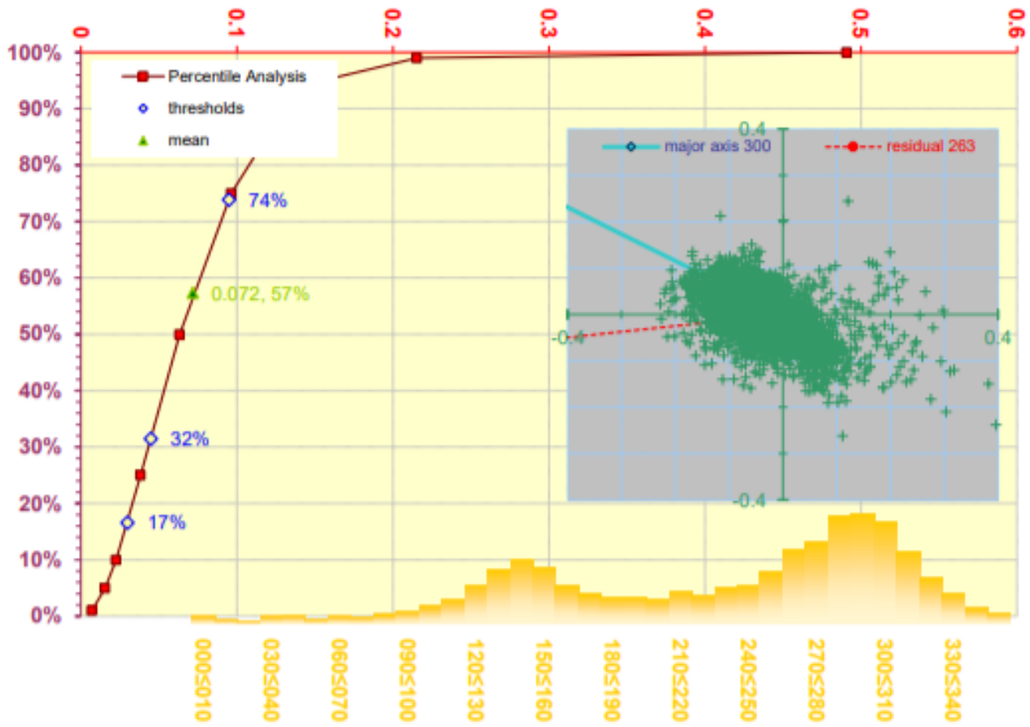
Current meter ID :	ID132_SconserQuarry_21.72m_cbot_bin20			156215mE	832118mN
declination:	-3.900		convergence: -3.410	GMA:	-0.49 (Deg-M)
Period of measurement :	5/12/16 11:59	to	6/2/17 08:59	62 days	21 hrs	0 mins

Depth/ Pressure		
	Max:	20.24
	Mean:	17.72
	Min:	14.70

Percentiles	Current Speed	
1%	0.007 m/s	percentile analysis
5%	0.016 m/s	
10%	0.023 m/s	
25%	0.038 m/s	
50%	0.063 m/s	
75%	0.096 m/s	
90%	0.131 m/s	
95%	0.155 m/s	
99%	0.215 m/s	
100%	0.491 m/s	
17%	0.030 m/s	threshold values
32%	0.045 m/s	
74%	0.095 m/s	
57%	0.072 m/s	mean

Major axis :	300 (Deg-M)		0.101 m/s
Residual current :	0.027 m/s	at	263 (Deg-M)

	Residual	Tidal amplitude
Longitudinal (U) :	0.022 m/s	0.101 m/s
Lateral (V) :	-0.016 m/s	0.053 m/s
Anisotropy (long'l/lat'l) :	1.32	1.93



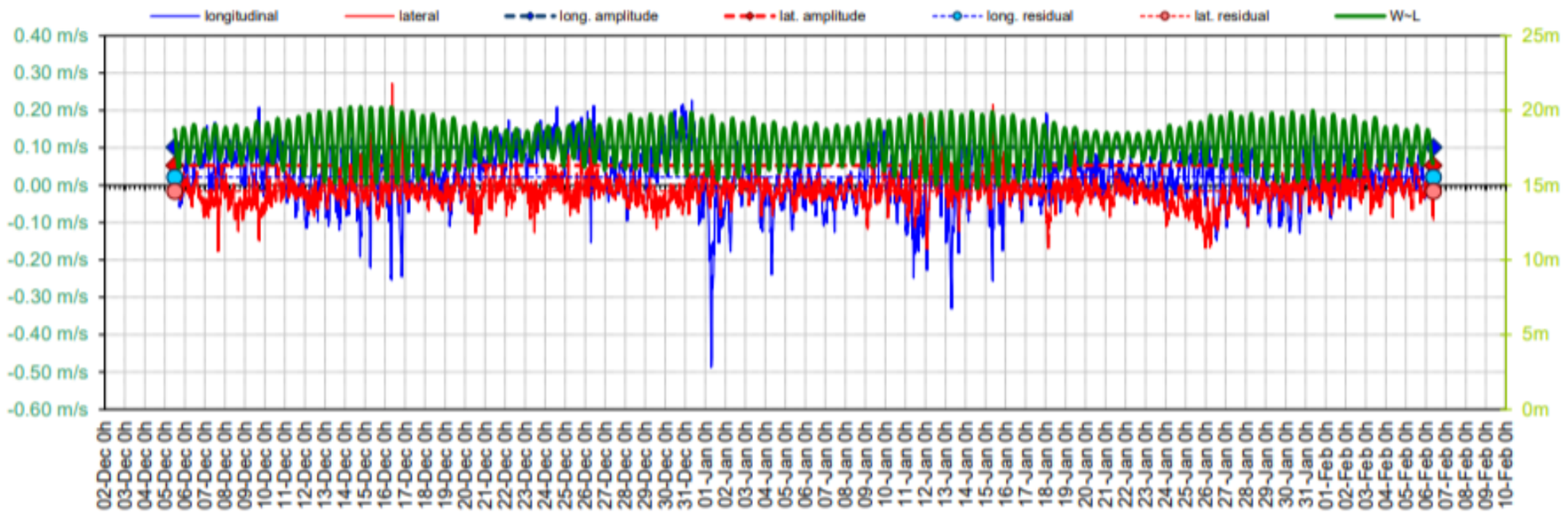


Figure 5. Current Data Summary Sheet for the cage bottom current cell 20, 21.72m from seabed, 5th December 2016 to 6th February 2017 inclusive (ID132).

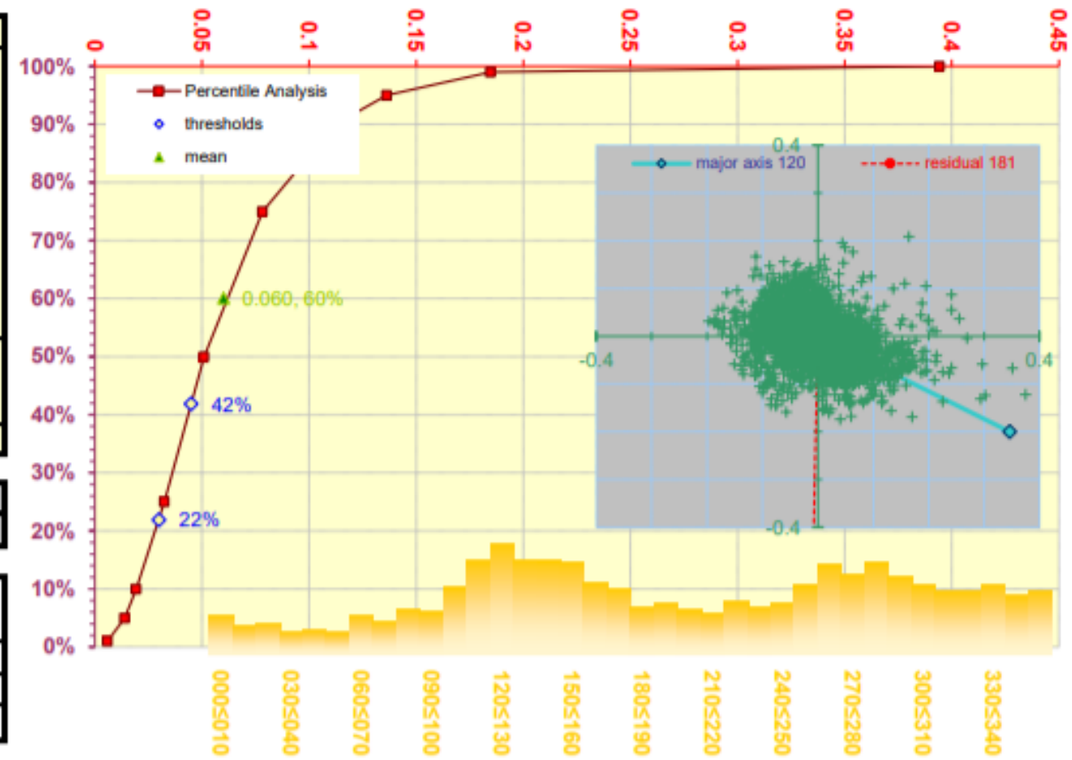
Current meter ID :	ID132_SconserQuarry_2.72m_nrbd_bin01				156215mE	832118mN
declination:	-3.900		convergence:	-3.408	GMA:	-0.49238 (Deg-M)
Period of measurement :	5/12/16 11:59	to	6/2/17 08:59	62 days	21 hrs	0 mins

Depth/ Pressure		
	Max:	39.24
	Mean:	36.72
	Min:	33.70

Percentiles	Current Speed	
1%	0.006 m/s	percentile analysis
5%	0.014 m/s	
10%	0.019 m/s	
25%	0.033 m/s	
50%	0.051 m/s	
75%	0.078 m/s	
90%	0.112 m/s	
95%	0.136 m/s	
99%	0.185 m/s	
100%	0.394 m/s	
22%	0.030 m/s	threshold values
42%	0.045 m/s	
84%	0.095 m/s	
60%	0.060 m/s	mean

Major axis :	120 (Deg-M)		0.085 m/s
Residual current :	0.007 m/s	at	181 (Deg-M)

	Residual	Tidal amplitude
Longitudinal (U) :	0.003 m/s	0.085 m/s
Lateral (V) :	0.006 m/s	0.056 m/s
Anisotropy (long'l/lat'l) :	0.55	1.52



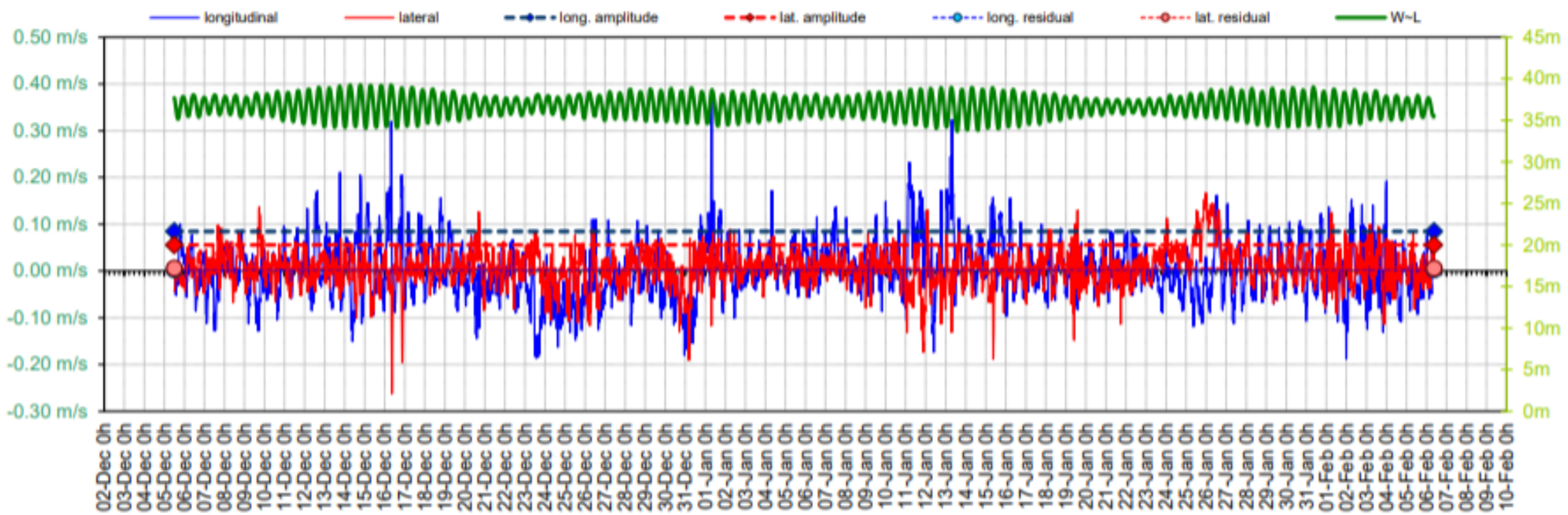


Figure 6. Current Data Summary Sheet for the near bottom current cell 1, 2.72m from seabed, 5th December 2016 to 6th February 2017 inclusive (ID132).

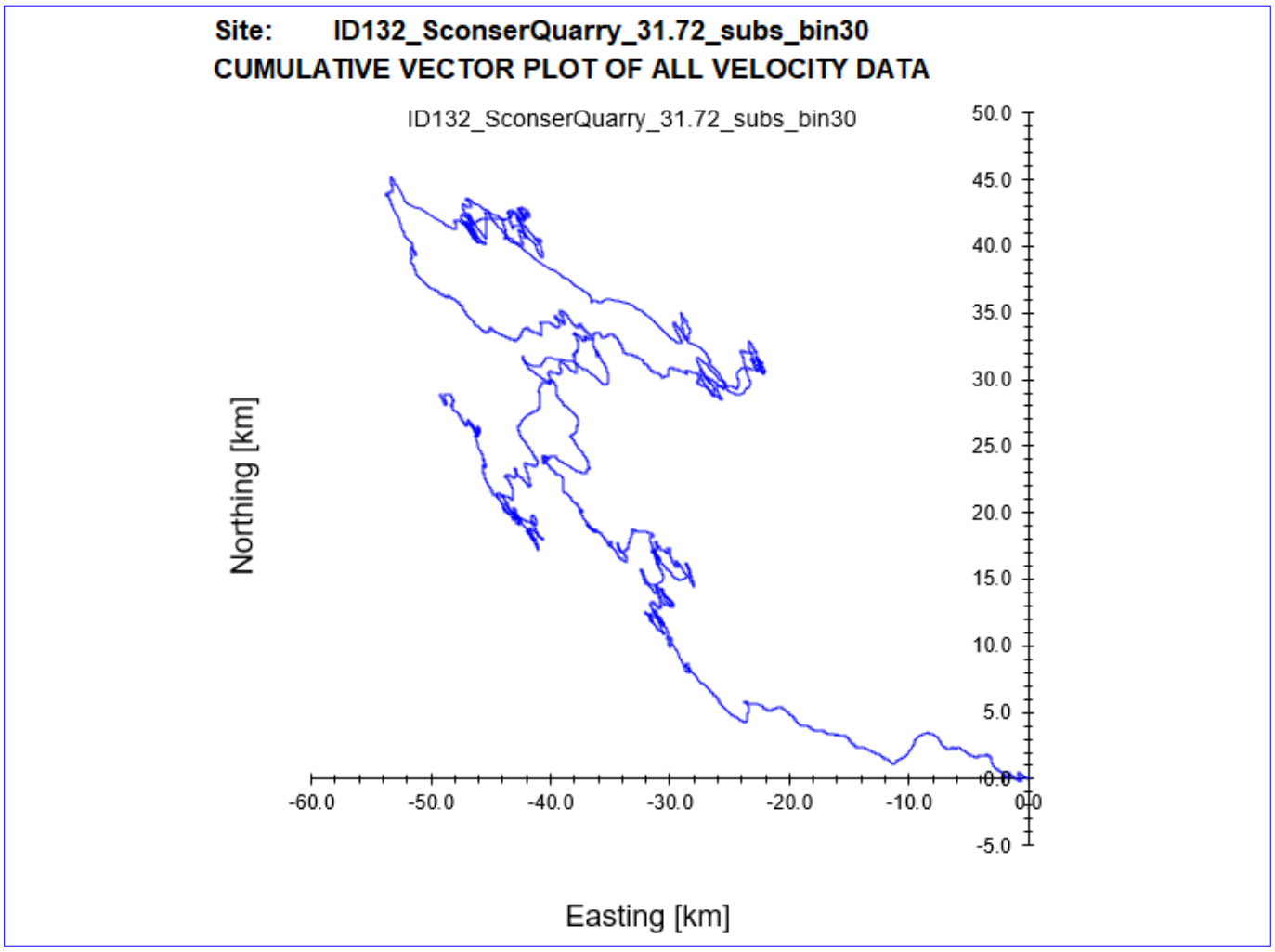


Figure 7. Cumulative Vector Plot of all velocity data from near surface cell for ID132.

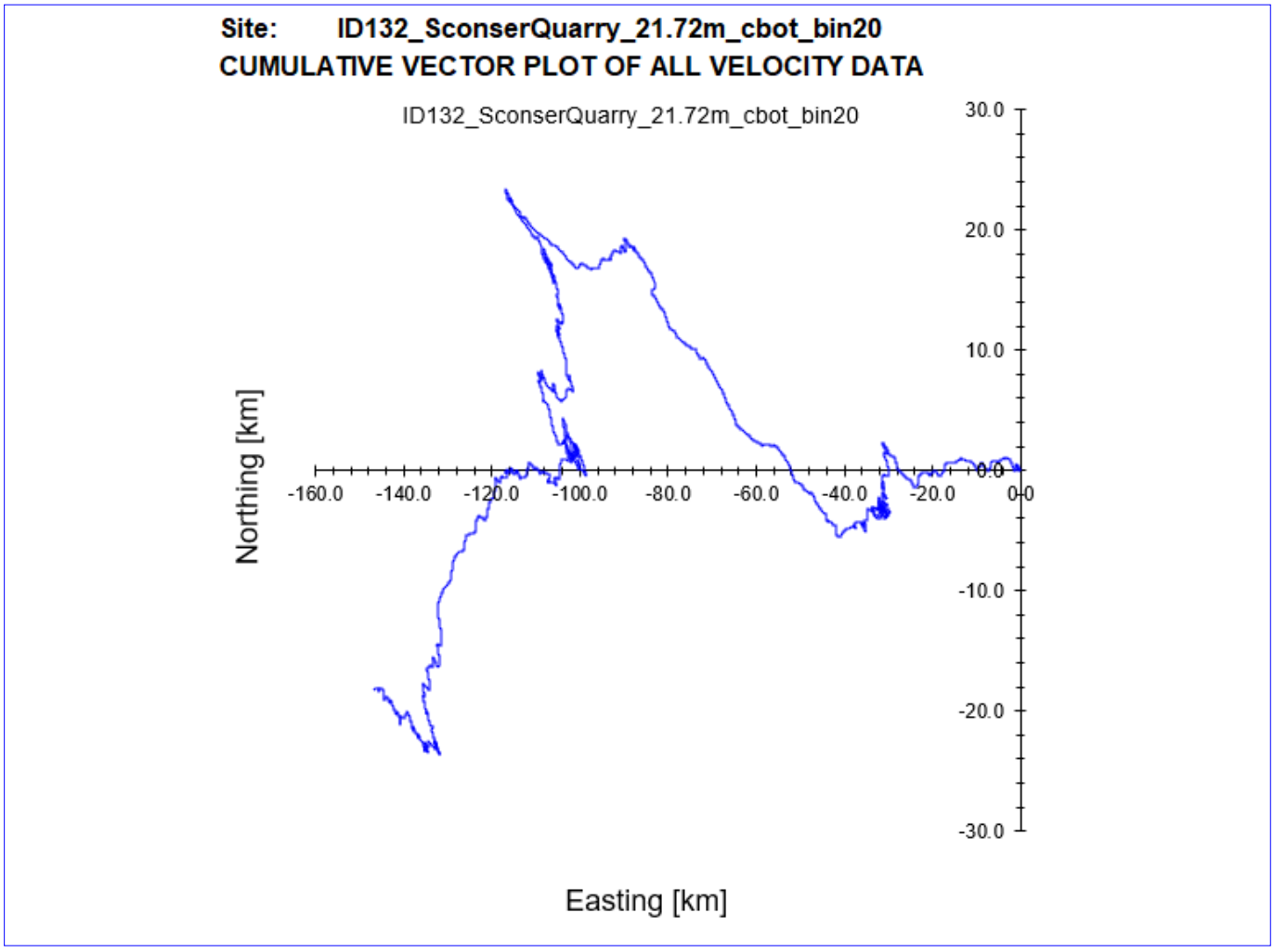


Figure 8. Cumulative Vector Plot of all velocity data from cage bottom cell for ID132.

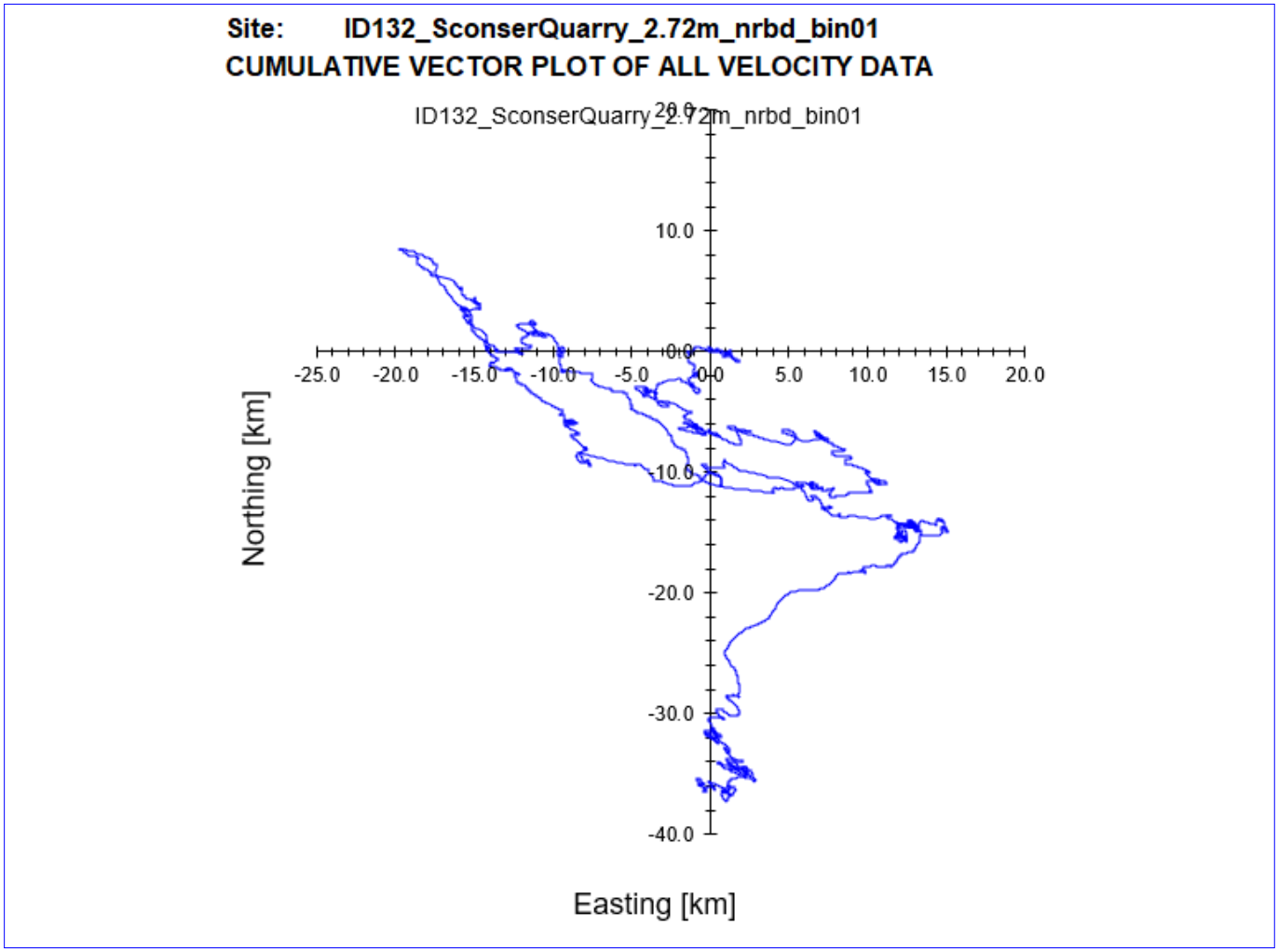


Figure 9. Cumulative Vector Plot of all velocity data from near bottom cell for ID132.

5. Summary of Current Data – ID132

Site Name: Sconser Quarry
Data start date: 05/12/2016
Data end date: 06/02/2017
Mean Water Depth: 39.44m

Table 2. Summary of current meter deployment

	Cell	Depth Below Min Surface (m)	Distance from Seabed (m)	Mean current speed (cm/s)
Near surface:	30	4.7	31.72	7.64
Cage bottom:	20	14.7	21.72	7.19
Near bed:	1	33.7	2.72	6.01
			Average current speed:	6.95

Table 3. Ranked percentiles for current speed at all three depths

Cell	Ranked Percentile (%) for mean speed	≤3cm/s (%)	≥4.5cm/s (%)	≥9.5cm/s (%)
Near surface:	60	14	71	28
Cage bottom:	57	17	68	26
Near bed:	60	22	58	16

Table 4. Major axis

Cell	Major Axis (Deg-G)
Near surface:	315
Cage Bottom:	300
Near bed:	120

Table 5. Mean and residual currents

Cell	Mean Speed (m/s)	Residual Speed (m/s)	Residual Parallel (m/s)	Residual Normal (m/s)	Tidal Amplitude Parallel (m/s)	Tidal Amplitude Normal (m/s)
Near Surface:	0.076	0.011	0.010	-0.003	0.116	0.058
Cage Bottom:	0.072	0.027	0.022	-0.016	0.101	0.053
Near Bed:	0.060	0.007	0.003	0.006	0.085	0.056

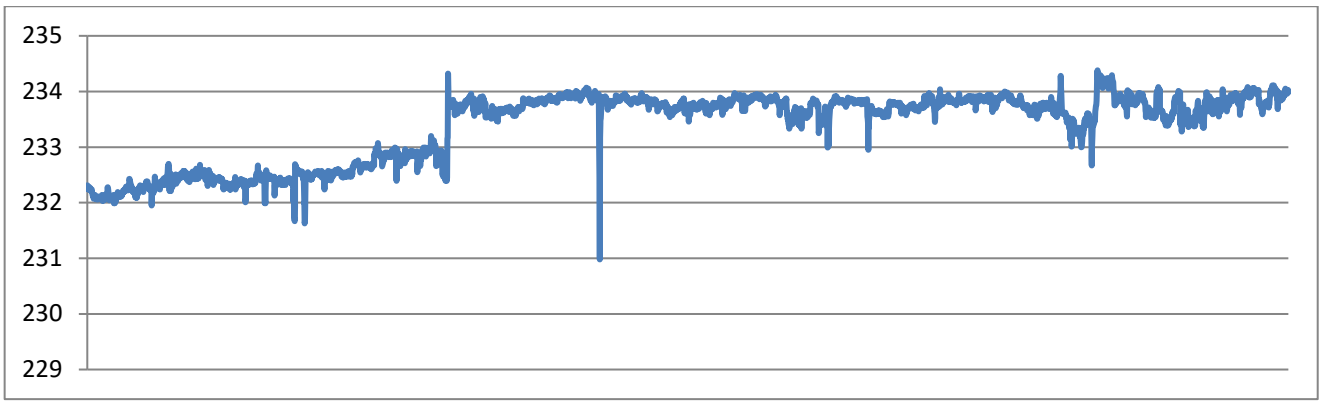


Figure 10. Summary of heading data from deployment ID132.

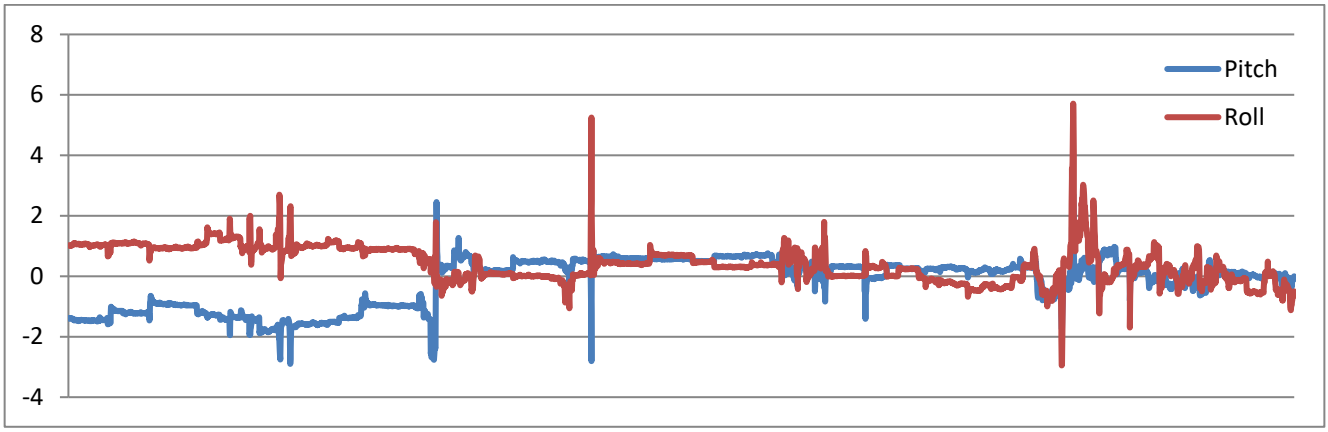


Figure 11. Summary of pitch and roll data from deployment ID132.

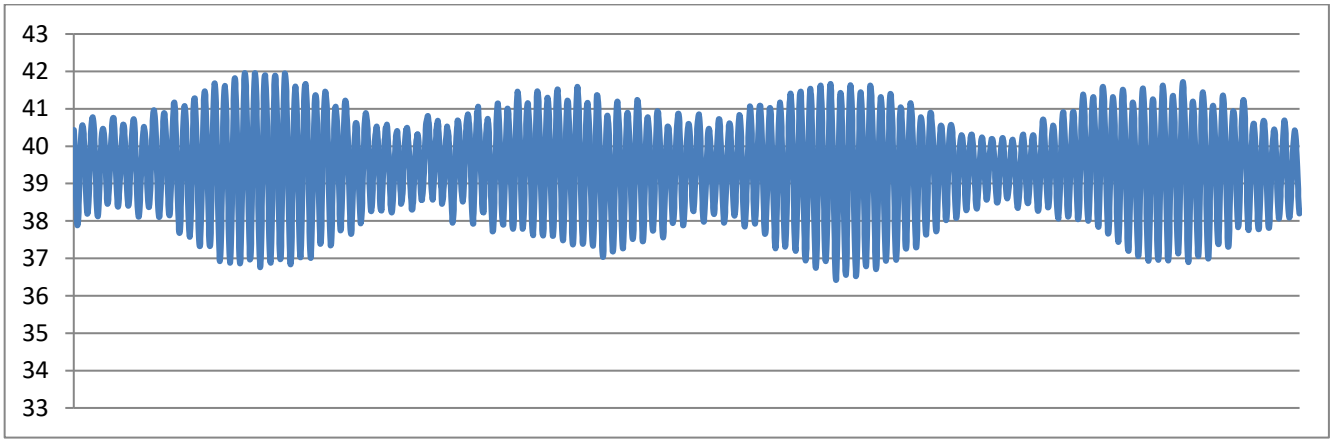


Figure 12. Pressure data from deployment ID132.

6. Conclusion

MOWI has collected and analysed current and bathymetric data for the proposed technical variation at the Sconser Quarry fish farm. The analysed current data for the 62 days and 23 hours period are believed to be reliable and representative of the proposed location. The bathymetric data from the wider-area UKHO bathymetry data provided a coherent bathymetric dataset for the site.

Annex 1. Survey Equipment Deployment Log

Location:	Sconser Quarry
Nearest tidal port:	Broadford Bay, Isle of Skye
Time zone:	UTC
Meter switched on:	11:59 05/12/2016
Meter switched off:	10:00 06/02/2017
Period used for this report:	11:59 05/12/2016 – 08:59 06/02/2017
ADCP serial number:	24616
Meter position:	57.31427'N -6.05'W
	156216 E 832119 N
Minimum water depth:	36.42 m (35.72m measured by ADCP + 0.7 m *)
Water depth (Chart Datum):	35.72 m (minimum water depth - 0.7 m tide timetable)
Mean water depth:	40.14m (39.44 measured by ADCP + 0.7 m *)
Depth of meter from surface:	37.19 m (below mean low water spring to transducer)
Height of meter from seabed:	0.7 m to transducer head
Sounding at deployment:	36 m @ 10:45 on 05/12/2016

Table A1. ADCP meter settings:

Reference:	Transducer
Bin size (m):	1.0
Dist to 1st bin (m):	2.02
Number of bins:	40
Frequency (kHz):	307
Recording interval (mins):	20
No. pings per ensemble:	300
Magnetic correction:	0
Ensemble:	300
Standard Deviation (cm/sec):	0.63
Time/Ping (seconds):	2