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# SCOTTISH SEA FARMS LTD SHUNA 2015(HG) HYDROGRAPHIC REPORT

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| <b>Report To:</b> | Scottish Environment Protection Agency |
| <b>Report No:</b> | H0716-01                               |
| <b>Our Ref:</b>   | RS                                     |
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## 1. Introduction

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Hydrographic data was collected from a site located off the northeast tip of Shuna, Loch Linnhe by Scottish Sea Farms. The survey location is approximately 550 m northwest of the existing Shuna fish farm and has been collected with a view to relocating the site.

Current speed and direction, depth and meteorological data were collected as part of this survey for use with SEPA’s consenting model AutoDEPOMOD to assess this site’s suitability for development.

## 2. Site Location

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The survey location is situated against a short line of straight coast at the northeast end of Shuna. The site is sheltered from prevailing SW winds with the greatest exposure to the wind from northerly directions, and in particular the NE. Admiralty charts indicate that the bathymetry is mostly flat and homogenous with contours following the shoreline of the island.



Figure 1: Locational map showing Shuna 2015 Hydrographic Survey location

## 3. Methods

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A 600 kHz RDI Workhorse ADCP was deployed between 09/04/2015 and 29/04/2015, all of which is presented in this report. A 15 day subset of that data from 14/04/2015 – 29/04/2015 will be used for modelling purposes. Concurrent weather data recorded from a nearby station and a bathymetric survey of the site was also carried out.

### 3.1 Current data

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The ADCP was deployed at the north end of Shuna Island at 56 35.844 N 05 23.043 W (192350, 750182). The meter was mounted in a fiberglass Seaspider frame and deployed in a u-shaped mooring with ground rope running to weights attached to surface buoys.

Current flow and direction were recorded at throughout the water column using 1 m bins with an averaging period of 20 minutes.

Deployment configuration:

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|                       |             |
|-----------------------|-------------|
| Broadband             | 614.4 kHz   |
| Pings/Ens             | 400         |
| Time/Ping             | 00:03.00    |
| First Ensemble Date   | 09/04/2015  |
| First Ensemble Time   | 07:45:51.52 |
| Ensemble Interval (s) | 1200        |
| 1st Bin Range (m)     | 2.1 Bin     |
| Size (m)              | 1           |

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Table 1: ADCP configuration for Shuna 2015 Hydrographic Survey

### 3.2 Bathymetric data

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Spot depths were obtained at the survey site using a Hawkeye Digital Sonar hand-held depth sounder. All depths were later converted to chart datum using predicted tidal heights for Port Appin station obtained from Admiralty Total Tide.

### 3.3 GPS

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Position fixes were obtained using a Garmin GPSmap 76S in WGS84. The GPS position accuracy was compared against a known location and checked for consistency at the end of the survey.

### 3.4 Weather

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Weather data for the survey period was recorded from the weather station located at Oban Airport, Connel approximately 14.5 km south of the survey location.

### 3. Data processing

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#### 3.1 Processing

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All bathymetric data collected was corrected to chart datum using tidal heights taken for Admiralty TotalTide from the Port Appin station.

Three depth cells were selected as outlined in Appendix 8 of SEPA's Fish Farm manual.

Bins 1, 18 and 25 were selected to represent seabed, cage bottom and sub-surface conditions. Several ensembles were removed at both the start and end of the recorded to remove data recorded during deployment and retrieval. Each bin was then checked for missing or erroneous data then analysed using the SEPA tool HGdata\_analysis\_v7. The summaries for each bin can be found in section 4.3.

#### 3.2 QC

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The RDI Workhorse carries out a series of internal checks on each ping as a measure of quality control. If any of the returning pings fail the QC criteria (correlation, echo intensity and error velocity) they are rejected and not included in the averaged ensemble. Rejected pings have an impact on the expected standard deviation of the dataset however this can be calculated by using the percentage of good pings. This has been checked and recalculated to ensure that the standard deviation is within 10% of the mean

##### Depth and Current

Pressure records indicate that the mean depth during the deployment including the height of the frame was 32.5 m, removing the influence of tide gives a depth of 30.25 mCD. This corresponds well with the recorded depth of 34 m (30.7 mCD).

The recorded pressure was also compared with the predicted tidal heights taken from the station at Port Appin (TotalTide). Both range and low water and high water are consistent with those predicted.

Comparison of the pressure record with velocity data shows that speeds are diurnal with some lunar influence. Peak speeds are timed around mid-flood and mid-ebb.

Current direction is consistent with local bathymetry and the speeds recorded are within expected range and are consistent with other sites in the Linnhe region.

The residual currents at the subsurface, mid and bed bins are 37%, 24% and 5% of the mean current speed respectively, while the direction appears consistent with that of a weak residual current.

#### Meter position

Pressure, heading and pitch/roll data show a minor disturbance during the deployment possibly due to the meter settling. However, records show any changes were insignificant with a change of heading of less than 2° and a change of pitch and roll of less than 1° throughout the survey period.

Meter position was recorded during deployment and recover showing that the position of the meter had not changed during the survey.

## **4. Results**

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### 4.1 Bathymetric data

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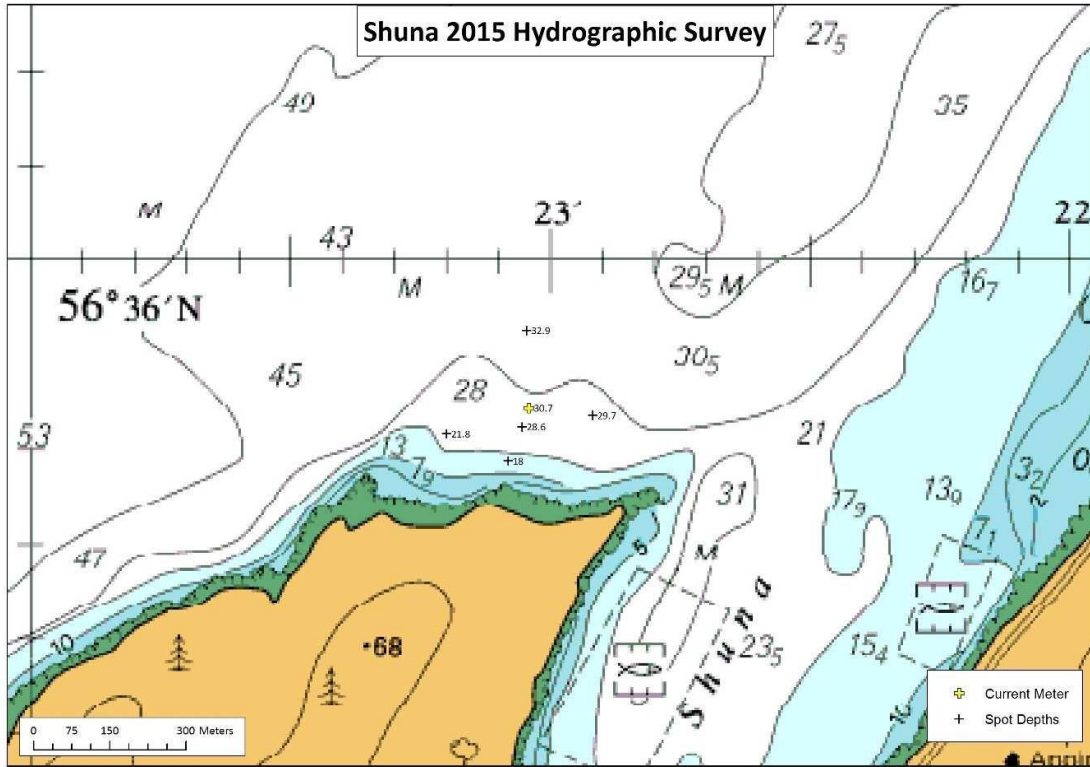


Figure 2: Admiralty chart extract showing ADCP location and spot depths

| DATE AND TIME    | WGS84                   | RECORDED DEPTH (M) | TIDAL HEIGHT | CHART DATUM (M) |
|------------------|-------------------------|--------------------|--------------|-----------------|
| 08/04/2015 07:37 | 56 35.824 N 05 23.056 W | 32.5               | 3.9          | 28.6            |
| 08/04/2015 07:49 | 56 35.817 N 05 23.201 W | 25.7               | 3.9          | 21.8            |
| 08/04/2015 07:52 | 56 35.836 N 05 22.929 W | 33.6               | 3.9          | 29.7            |
| 08/04/2015 07:58 | 56 35.788 N 05 23.083 W | 18                 | 3.8          | 14.2            |
| 08/04/2015 08:02 | 56 35.927 N 05 23.047 W | 36.7               | 3.8          | 32.9            |
| 09/04/2015 09:38 | 56 35.844 N 05 23.043 W | 34                 | 3.3          | 30.7            |

Table 2: Depths recorded during Shuna 2015 Hydrographic Survey

#### 4.2 Meteorological data

Wind speed and direction were recorded using the weather station at Oban airport, Connel approximately 14.5 km south of the survey location. Hourly data for this station is available during the day for most of the survey period however as there are some gaps towards the end of the dataset I have also included the wind speeds recorded at the Tiree weather station for the same period. As can be seen from the figures below at no point did the wind exceed 10 m/s for a period of three days. The predominant wind direction during this period was westerly.

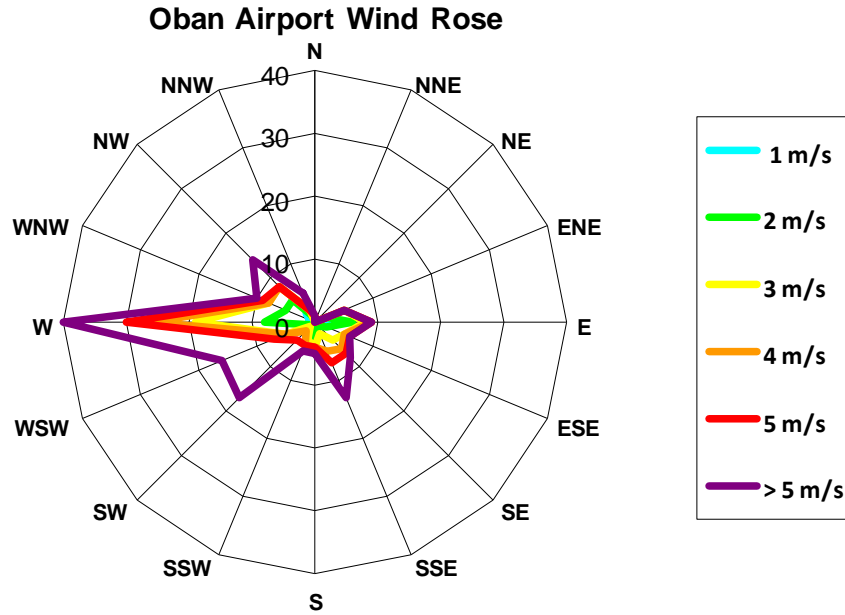


Figure 3: Wind rose of wind speed and direction recorded at Oban Airport, Connel during survey period

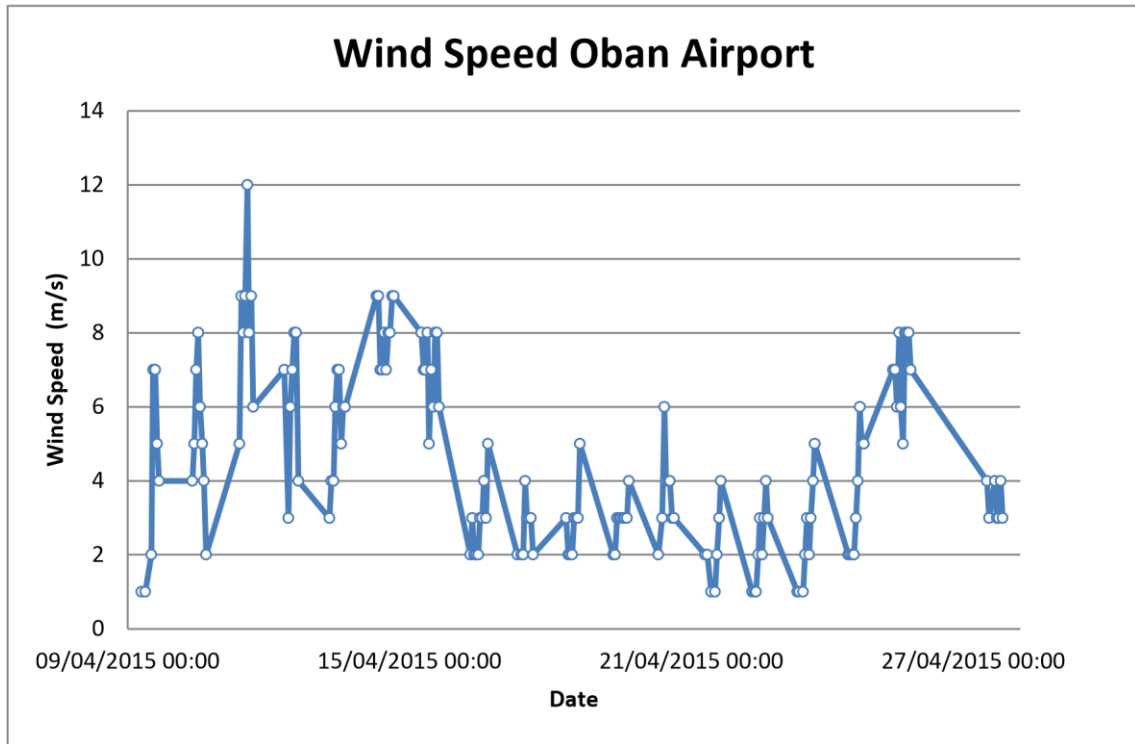


Figure 4: Mean wind speed recorded at Oban Airport 09/04/2015 – 27/04/2015

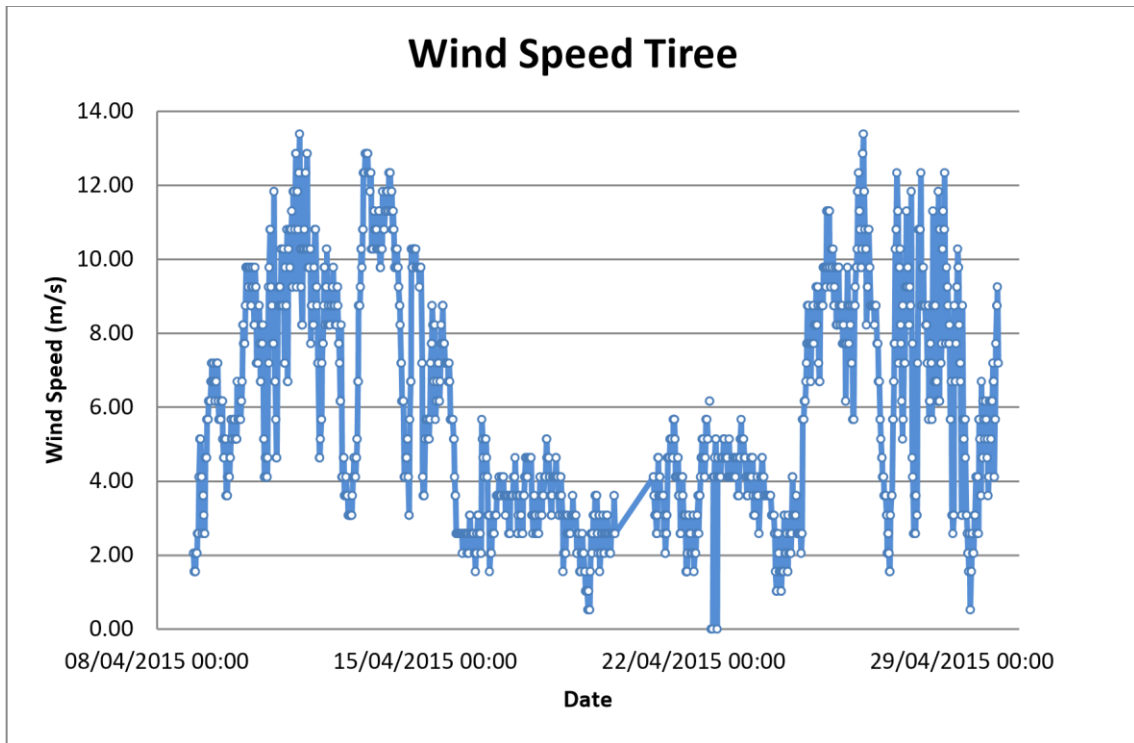


Figure 5: Mean wind speed recorded at Tiree Airport 09/04/2015 – 29/04/2015



### 4.3 Current data

The current speeds and directions recorded at each of the 3 bins are generally agree with each other with current speed decreasing with depth as would be would be expected with some shear with depth. Current speeds are moderate and typical for the region. Maximum current speed recorded during the deployment was  $0.295 \text{ ms}^{-1}$ . Currents at all depths were strongly directional and changes in current speed correspond well with the flooding and ebbing of the tide as indicated by the pressure record. Summaries from the SEPA tool HG\_Analysis for the whole survey period are displayed in the figures below:

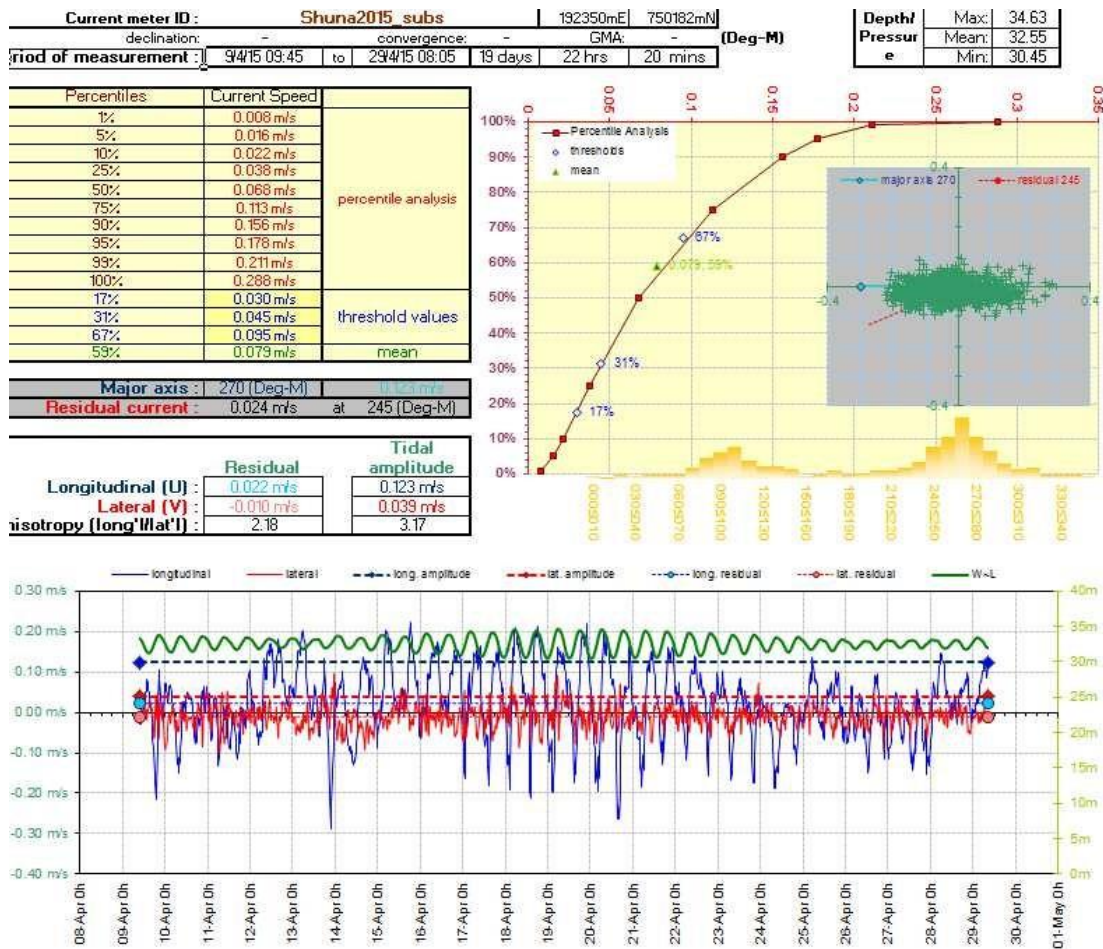


Figure 6: HG\_Analysis summary page Shuna 2015 – subsurface

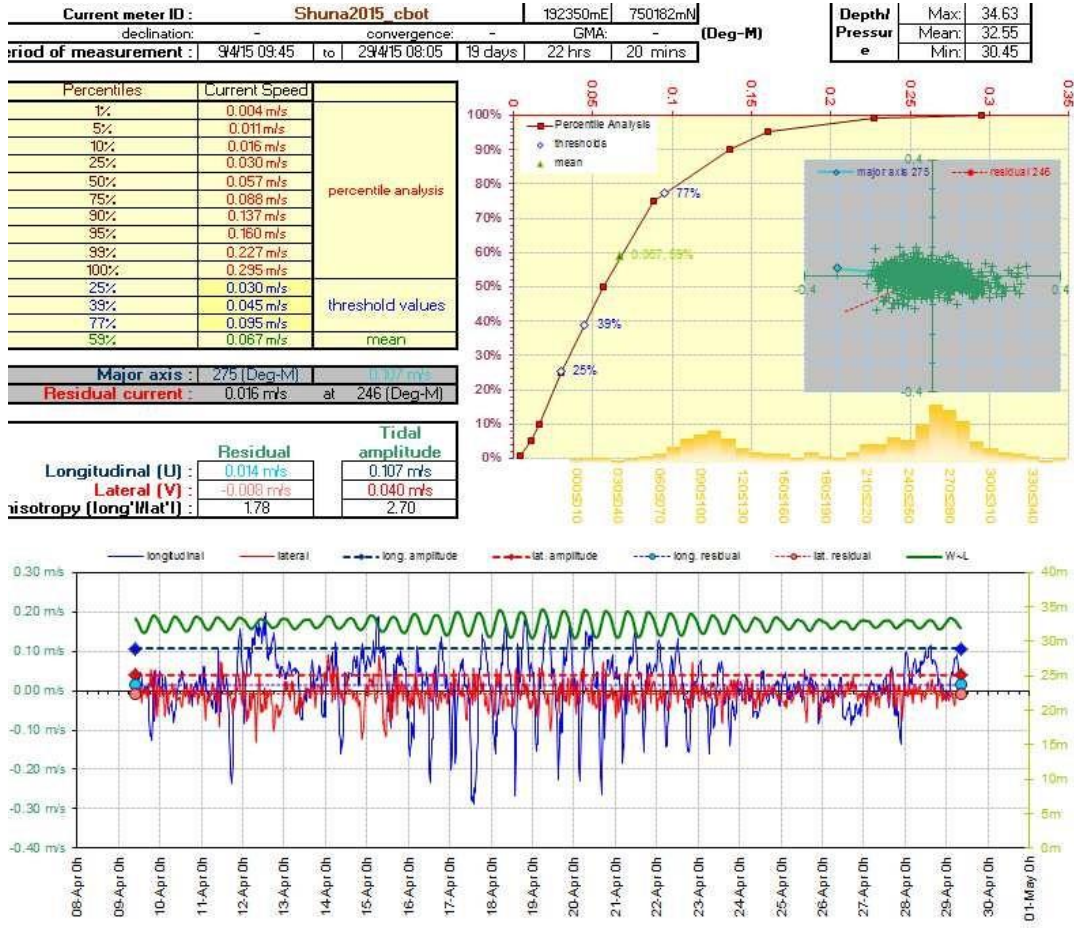


Figure 7: HG\_Analysis summary page Shuna 2015 – cage bottom

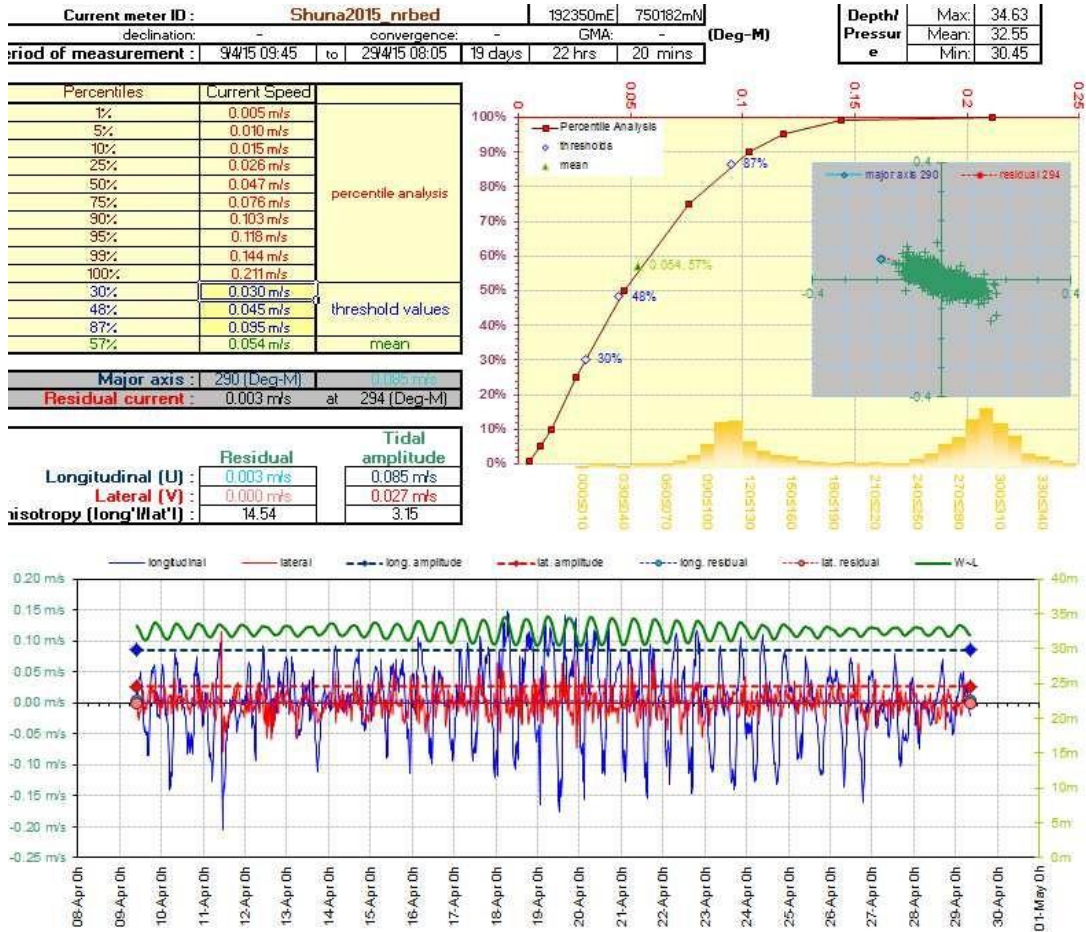


Figure 8: HG\_Analysis summary page Shuna 2015 – bed