APPENDIX B

CONTENTS

APPENDIX B1

Elliston instrument deployment data report

A part of BMT in Energy and Environment

Elliston Instrument Deployment Data Report

R.B17761.001.03.Elliston_Data_Summary.doc

November 2010

Elliston Instrument Deployment Data Report

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Prepared By:	BMT WBM Pty Ltd (Member of the BMT group of companies)

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Title :	Elliston Instrument Deployment Data Report
Author :	Michael Barry
Synopsis :	This report describes hydrodynamic and physical data collected in the open ocean near Elliston, South Australia.

REVISION/CHECKING HISTORY

REVISION NUMBER	DATE OF ISSUE	CHECKED BY		ISSUED BY	
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1	23/06/2010	MEB		MEB	
2	22/10/2010	MEB		MEB	
3	01/11/2010	DAB	[signature]	DAB	[signature]

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BMT WBM Library	PDF	PDF	PDF	PDF

CONTENTS

1 INTRODUCTION

BHP Billiton commissioned BMT WBM to collect hydrodynamic, physical and wave data at Elliston, South Australia. Figure 1-1 shows the vicinity of Elliston.

This report describes the instrument deployment and collected data.

Title:

Elliston, SA - Vicinity Map

Figure: **1-1**

Rev: **A**

N

0km 25 50

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath :

2 SITE DESCRIPTION

Elliston is on the South Australian Coastline on the Eyre Peninsula. The coastline forms abrupt bluffs overlooking the ocean at 20-50 meters elevation above mean sea level (MSL). This coastline is highly exposed to Southern Ocean south-west swell with a mean significant wave heights of about 1.5-2.5 m just offshore (Richardson, et al., 2005).

Elliston’s climate is a Mediterranean, and comprises warm to hot, dry summers and mild, wet winters. The region experiences 426 mm of rainfall per annum (BOM 2010).

3 INSTRUMENTATION

Two banks of instruments were deployed over a four-week period spanning March and April 2010. This dual site deployment was agreed with BHP Billiton to ensure sufficient redundancy in the data collection program. Specifically, deployment and retrieval dates were as follows:

- Deployment: 17/03/2010
- Retrieval: 19/04/2010

Conditions for both events were calm.

Deployments were affected at two locations:

- Site 1: 33° 39.90' S, 134° 53.25' E
- Site 2: 33° 39.90' S, 134° 54.07' E

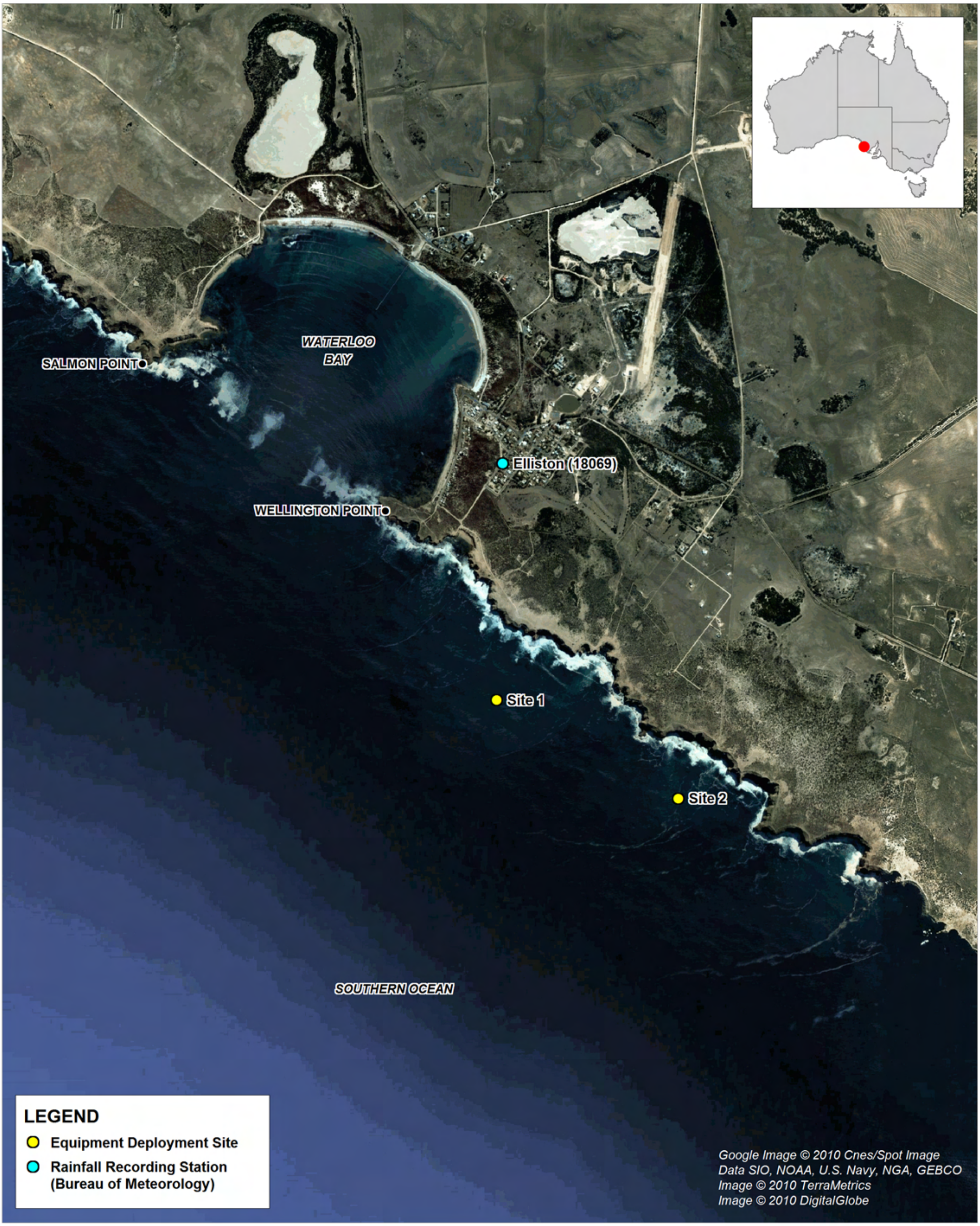
These locations are shown in Figure 3-3. Each deployment location comprised the following:

- An Acoustic Doppler Current Profiler (ADCP) enabled to collect:
    - Current speed with depth;
    - Current direction with depth;
    - Wave data; and
    - Water surface elevation (as a backup data stream only).
- A Conductivity Temperature Depth (CTD) sensor

Images of similar instruments are shown in Figure 3-1 and Figure 3-2.

Figure 3-1 Typical ADCP

Figure 3-2 Typical CTD (Greenspan 2010)



Title: Equipment Deployment Locations	Figure: 3-3	Rev: A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

N

0km 0.8 1.6

Approx. Scale

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Filepath :

The ADCP instruments were both Workhorse Sentinel 600kHz units (manufactured by RD Instruments (http://www.rdinstruments.com/) and were mounted on the seafloor via a seaspider frame arrangement. Deployment was performed by professional divers from Whyalla Diving Services. As agreed with BHP Billiton, both ADCPs were deployed approximately 0.5 kilometres from the shore and approximately 1.5 kilometres apart.

In the bed-mounted configuration, each ADCP was programmed to collect measurements through the water column at regular 0.5 metre thick bins above the instrument. Samples were collected at 6-minute intervals through the deployment period, and each measurement consisted of an ensemble of 100 'pings', which were averaged to provide a single representative current speed and direction measurement within each vertical bin at each time. Each ADCP was equipped with an on-board battery and had sufficient internal memory capacity for a deployment in excess of 90 days.

The ADCPs also collected time-series wave data including period, height, and direction.

The CTD sensors were *Tyco* CTD3100 Multi-parameter Sensors (Appendix A) and sampled at six minute intervals.

In order to supplement the above measurements, meteorological data was also sourced following the deployment from the Bureau of Meteorology's site in Elliston.

The above instrument deployment is summarised in Table 3-1.

Table 3-1 Equipment Deployment Location and Data Type

Measurement Type	Station	Location		Measurement Interval	Measured Variables
		Longitude	Latitude		
Vertical Velocity Profile (ADCP)	Site 1 (~23.8 m depth)	134° 53.25' E	33° 39.90' S	23/03/2010 - 18/04/2010	Current speed and direction, wave height, wave period, wave direction and backup water depth
	Site 2 (~23.6 m depth)	134° 54.07' E	33° 40.27' S	22/03/2010 - 13/04/2010	
Conductivity Temperature and Depth (CTD)	Site 1 (~23.8 m depth)	134° 53.25' E	33° 39.90' S	17/03/2010 - 19/04/2010	Temperature, conductivity (salinity and density), and pressure (depth)
	Site 2 (~23.6 m depth)	134° 54.07' E	33° 40.27' S	17/03/2010 - 19/04/2010	
Meteorological Data	Elliston Station 18069	134° 53.43' E	33° 39.00' S	18/03/2010 - 18/04/2010	Wind speed, wind direction, air temperature (2x daily)

4 DATA

4.1 Meteorological Observations

In order to provide some context for the hydrodynamic and physical measurements made in this deployment, the meteorological conditions spanning the deployment period are first described.

Air temperature and wind speed and direction are the parameters of particular interest for this study due to their potential influence on hydrodynamic and wave conditions. Figure 4-1 summarises the temperature and wind observations for the period concurrent with the field study. Meteorological observations were obtained from the BOM (BOM 2010).

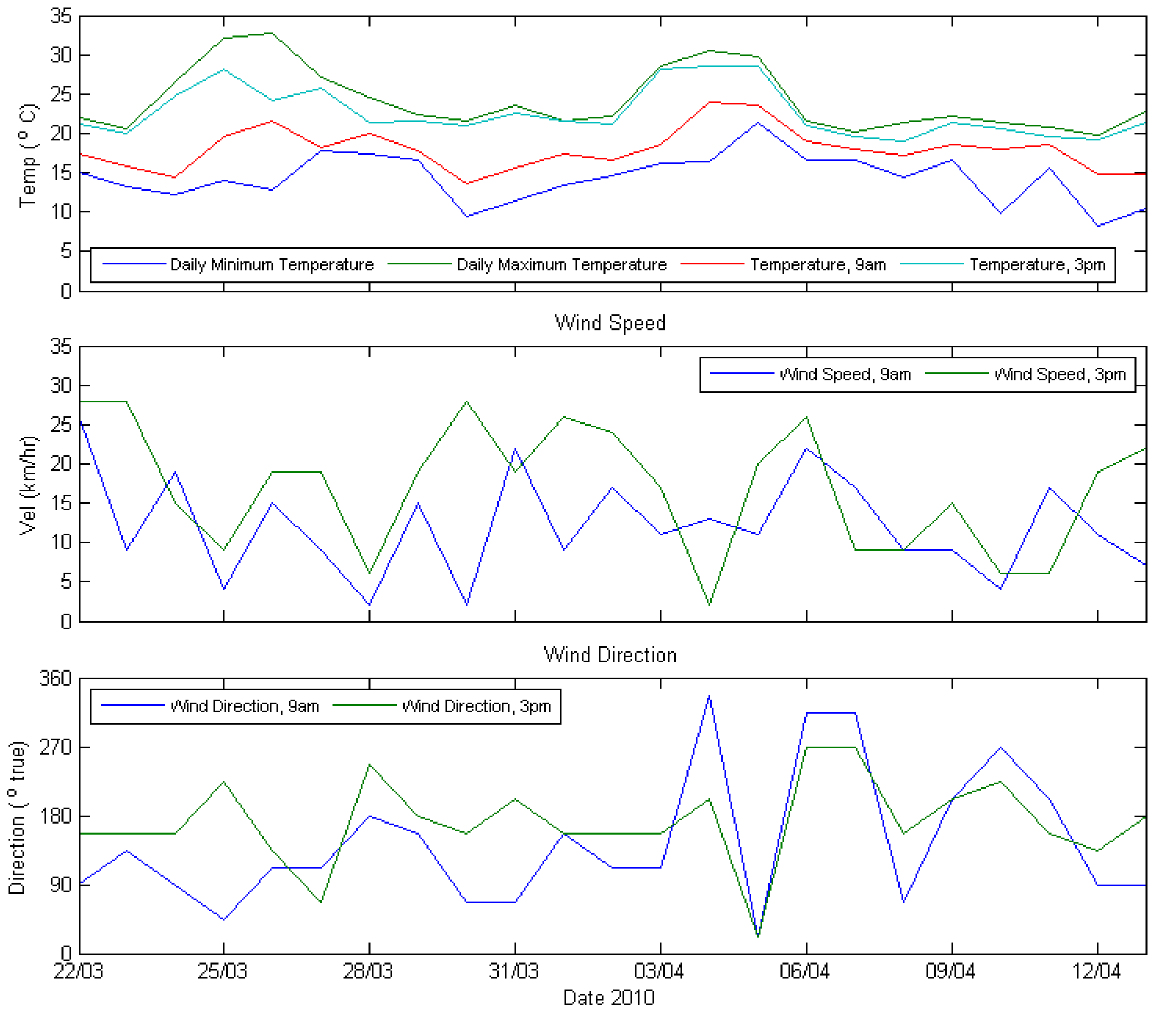

Figure 4-1 Meteorological Observations in Elliston

4.2 ADCP Measurements

4.2.1 Current Speeds and Directions

Time series plots of the vertical profiles for current direction and magnitude for both ADCPs are shown in Figure 4-2 and Figure 4-3. Time and depth and are on the horizontal and vertical axes, respectively, and colours correspond to the key in each colourbar.

The percentile distributions in Figure 4-2 and Figure 4-3 have been computed from all ADCP data (i.e. all time and all depths) at each site for the period where the two sites have a common time series, i.e., from 23/03/2010 to 12/4/2010. This has been done to allow direct comparison. These data include velocity magnitudes and directions for multiple spring-neap tidal cycles.

Measurement statistics (again for all depths and times) are also presented in the figures. These show a mean velocity magnitude of 0.117 m/s at Site 1 and 0.092 m/s at Site 2, as per the data shown on the percentile plots. The tabulated data to the right of the percentile and colour contour plots show that ninetieth percentile velocities of Sites 1 and 2 are 0.219 and 0.185 m/s, respectively, and at both locations, the median velocities are less than the mean.

Currents for both locations move in generally a north western or south eastern direction parallel to the shoreline. At Site 2, however, there appears greater variation of currents toward and away from the shore. For both sites, the data indicate the strongest currents move in the south west direction, although the strongest current velocity period occurs at Site 1 at the surface of the water column and moves in a north western direction. The lack of detailed meteorological data makes it difficult to assess if this is a result of strong winds during this period, however this is the most likely cause of these high surface velocities. Moreover, there does not appear to be a strong correlation between current speed and tidal state (i.e. spring or neap), suggesting that influences other than tides may be responsible for generating currents in the area.

Figure 4-4 presents a comparison of the percentile distributions of current speeds at the two Elliston deployment sites together with those at Pt Lowly (BMT WBM 2009) and Port Stanvac (SA Water 2009). Figure 4-4 only shows velocity distributions at approximately 2.6 to 3.7 metres above the bottom of the sea depending on the location. Additionally, Point Lowly velocities are represented twice: dodge tide velocities only and velocities for the whole time period. The figure demonstrates the contrast in hydrodynamic character across the sites, and in particular that the background currents at Elliston are significantly less energetic than those at Pt Lowly. Table 4-1 displays a subset of information presented in Figure 4-4 as a summary of the maximum and median velocities at Port Stanvac, Point Lowly and Elliston sites. Again, Point Lowly data is represented in the table twice, with dodge tide and all tidal conditions presented separately. Median data is presented as the mean velocity at Port Stanvac is not available.

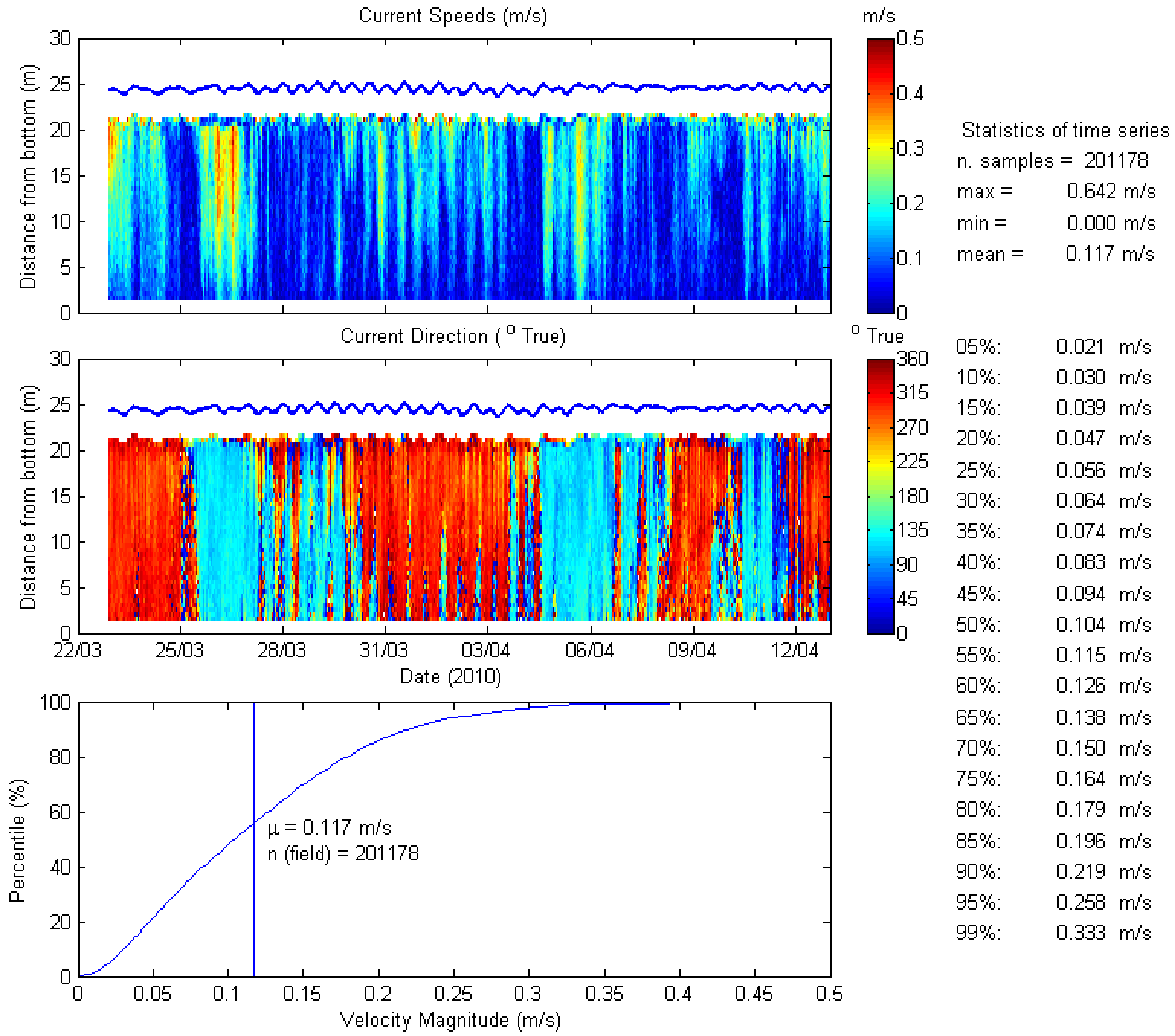

Figure 4-2 ADCP Site 1 Current Magnitude and Direction

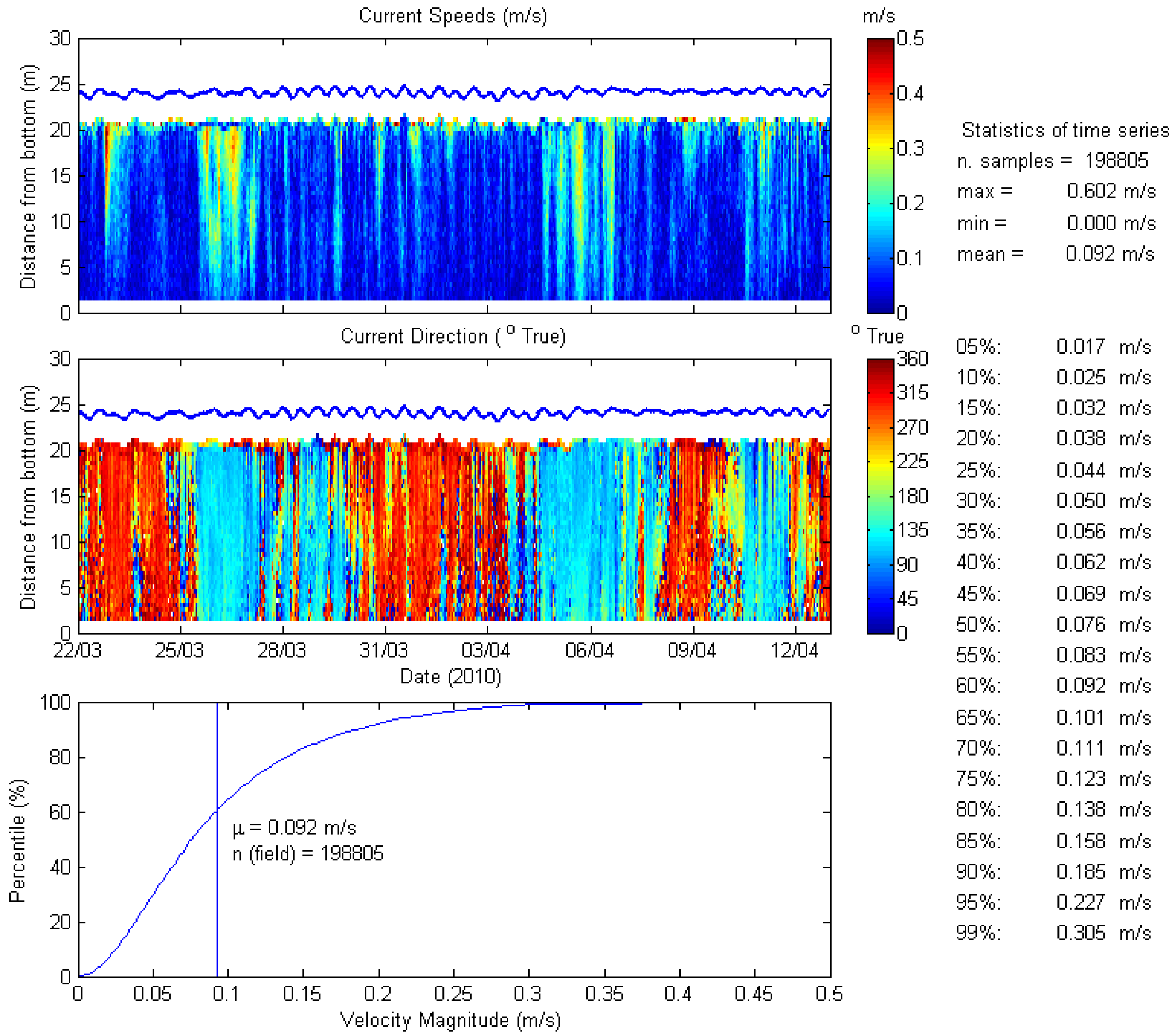

Figure 4-3 ADCP Site 2 Current Magnitude and Direction

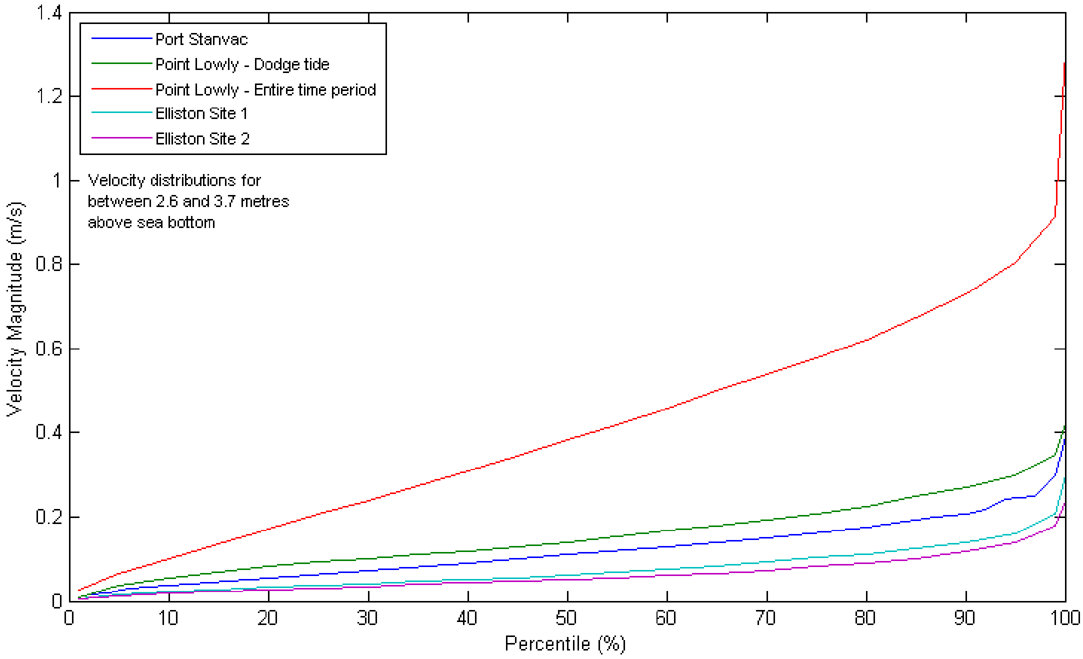

Figure 4-4 Velocity Magnitude Percentile Comparison with Other Locations at Approximately 2.6 to 3.7 metres from the Seabed at all Locations

Table 4-1 Median and Maximum Current Velocities – Approximately 2.6 to 3.7 metres from the Seabed at all Locations

	Port	Point Lowly		Elliston	Elliston
	Stanvac	Dodge Tide	All Conditions	Site 1	Site 2
	m/s	m/s	m/s	m/s	m/s
Median	0.11	0.14	0.38	0.06	0.05
Maximum	0.39	0.42	1.31	0.30	0.24

4.2.2 Wave Climate

Daily significant wave heights and peak periods for both sites are presented in Figure 4-5 and Figure 4-6, together with corresponding directions.

The figures show that, as expected, wave conditions at the two sites are similar. Significant wave heights are approximately 1.0-1.5 meters, although there are episodes of larger wave swells. The average peak period of the waves for both locations is approximately 11-12 seconds. This suggests wave action is largely characterised by swells rather than wind or localised chop. Wave direction is consistently from the south west, i.e. toward land, which is consistent with the passage of Southern Ocean swell.

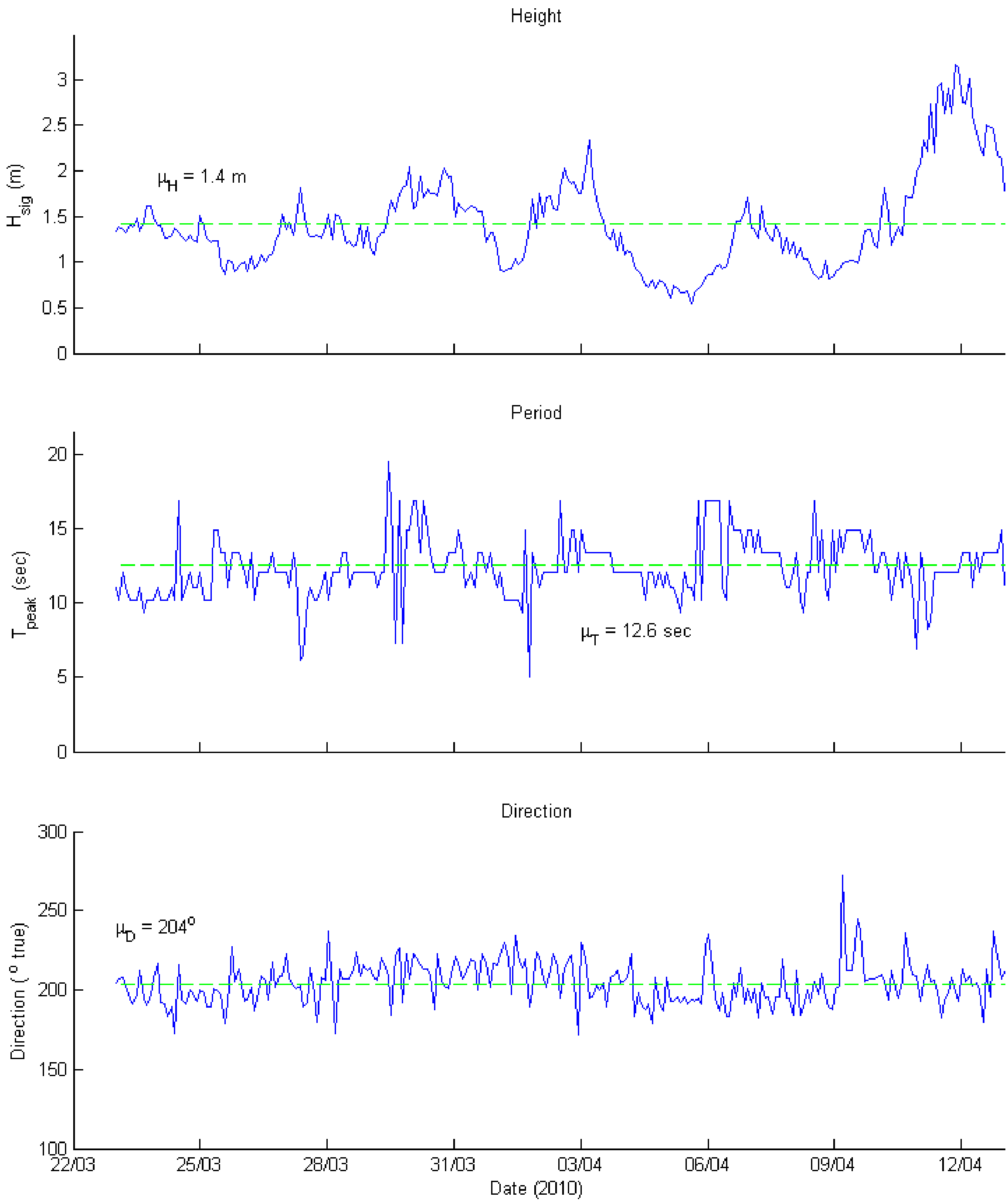

Figure 4-5 ADCP Site 1 Wave Characteristics

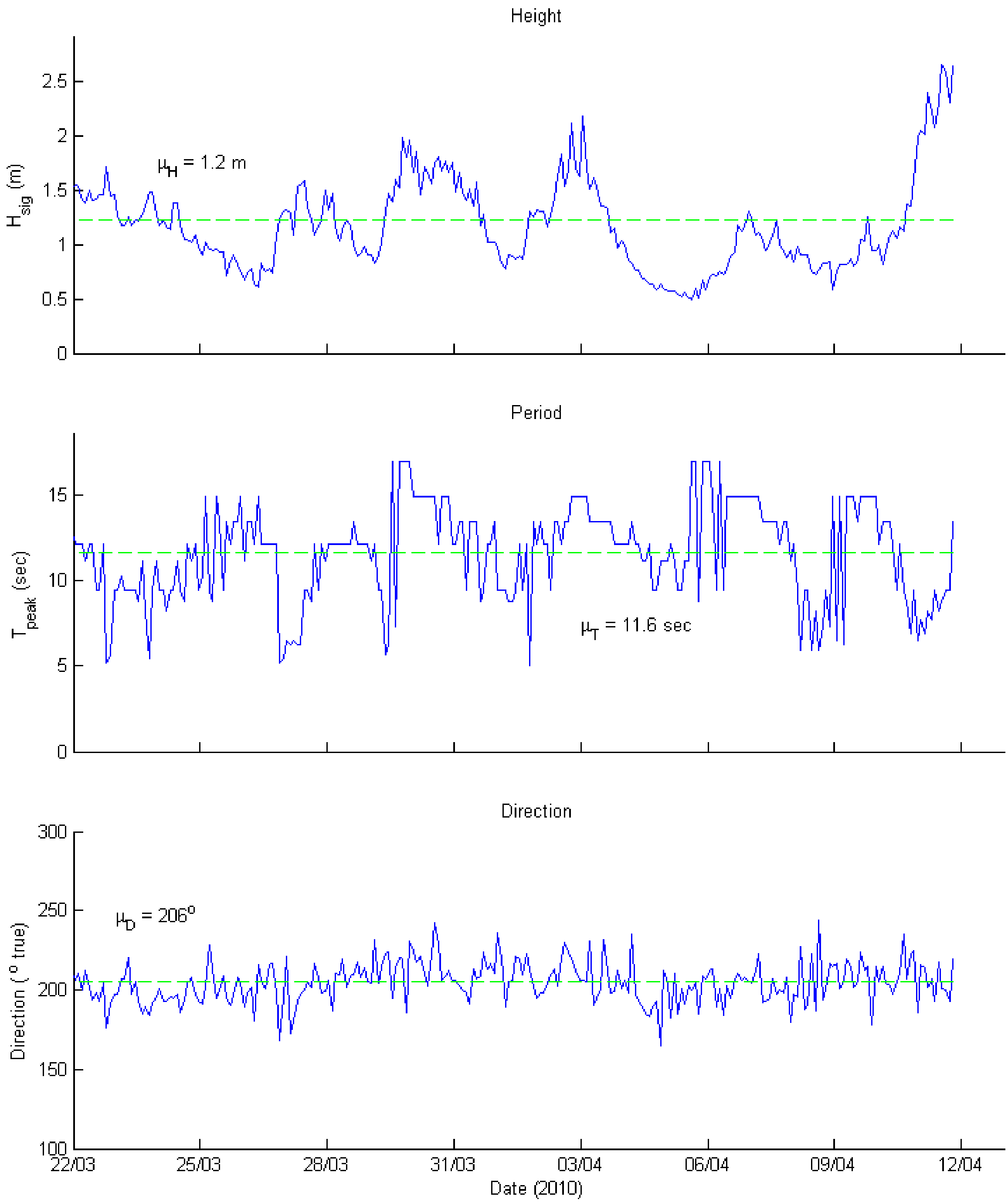

Figure 4-6 ADCP Site 2 Wave Characteristics

4.3 CTD Measurements

Depth (measured as pressure and uncorrected to atmosphere), temperature and conductivity (EC) are plotted against time in Figure 4-7. Computed salinity is also presented.

Depth is presented as a three-hour moving average of the measured pressures taken with the CTD sensor. This was required to remove high frequency signals. From these results, and as expected, it can be seen than the tidal water surface elevation variations at each site are similar in phase, period and amplitude. The median difference in pressure (depth) from Site 1 to Site 2 is 0.3 metres, which represents the difference in deployment depth.

Salinities and temperatures are typical of those expected in open ocean water. Both temperature and salinity, however, present significant low frequency variations. The cause of these is unknown. There is some evidence of potential biofouling on one of the CTD EC sensors, as manifest by the occasional spikey nature of the signal. Notwithstanding this, the spikey behaviour is sometimes temporally coincident across both sensors, which is suggestive of other broader scale influences. These cannot be determined from this study.

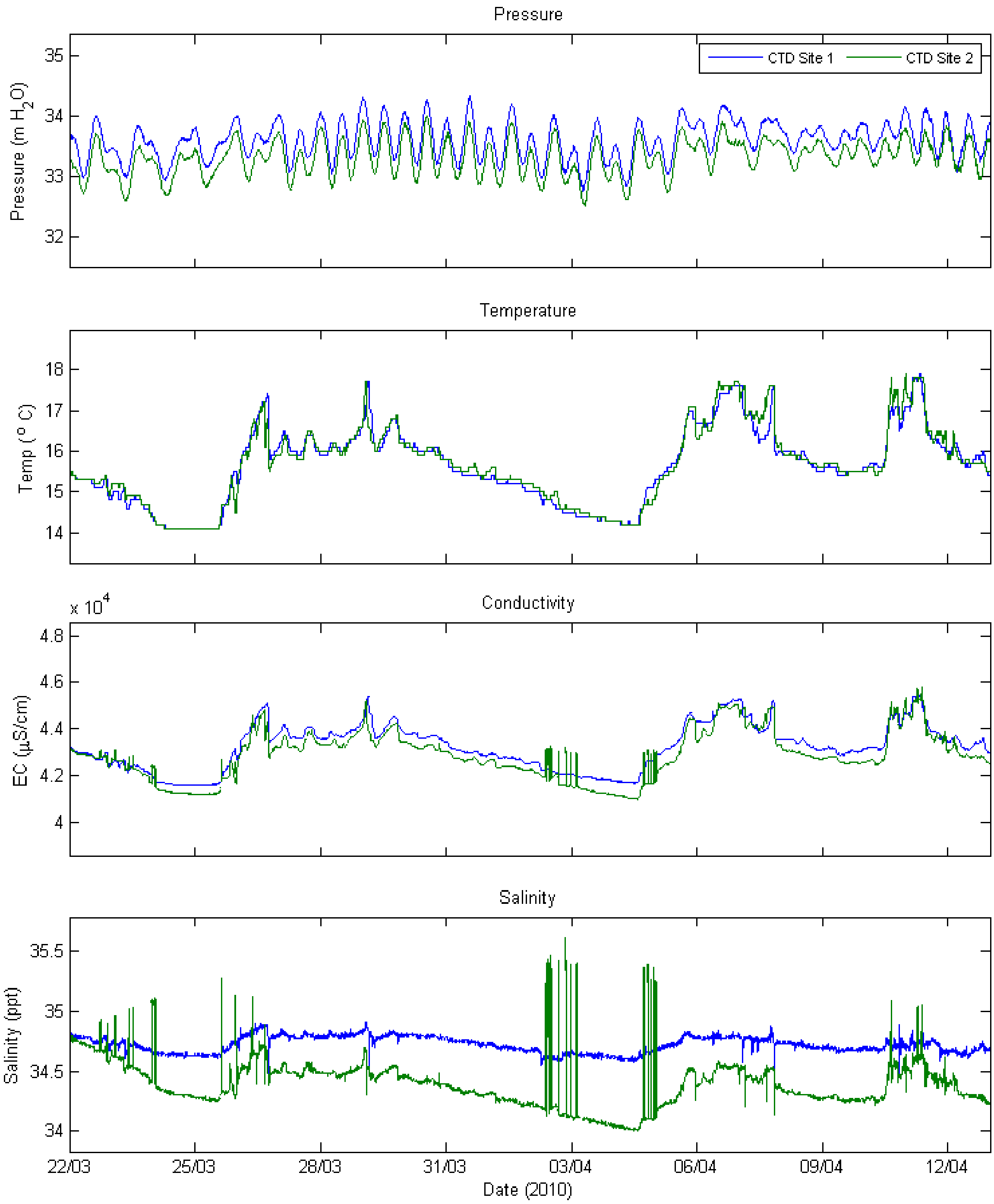

Figure 4-7 Current, Temperature, and Depth Measurements

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SA Water (2009). *Proposed Adelaide Desalination Plant – Environmental Impact Statement. Response Document*. January 2009.

APPENDIX A: CTD SENSOR SPECIFICATIONS AND CERTIFICATION

GREENSPAN ANALYTICAL tyco Flow Control Environmental Systems

CTD3100 Multiparameter Sensor

Conductivity/Temperature /Pressure Sensor

CERTIFICATE of CONFORMANCE

Customer:	BMTWBM
Model No.	CTD3100 Multiparameter Sensor (Tyco Environmental Systems material # 700-5610)
Sales Order Reference:	GRA3736
Serial Number:	023848

Product Information

Range	EC	0 – 70,000 µS/cm
	Temp	0 – 50°C
	Pressure	40mH$_2$0
Pressure Sensor Type	Absolute (delete applicable)	
Linearity & Accuracy	See Note 8	
Cable Length	n/a	
Firmware Version	RC3.12	
Ext Supply Voltage	9 - 30 VDC	
Power	**+ve**	Red
	Gnd	Black
	Shield	Yellow/Green
Output	RS232	
Connection Code	CX9	

For further connection detail please refer to the Connector Chart supplied.

User Notes

1. Do not attempt to dismantle the sensor as it will void the warranty. Contact your agent for technical advice.
2. The sensor is protected against reverse polarity connection.
3. The sensor is fitted with a lightning protector/surge device.
4. The EC sensor is temperature normalised to 25°C over the range 0 - 30° C.
5. AS1376 is used to convert kPa to metres of water. (1kPa = 102.15 mm water) at 20°C.
6. The sensor is compensated for temperature induced errors over the range zero to 50° C.
7. The sensor turn on time is factory set to 5 seconds.
8. Linearity and Accuracy specifications are as follows

Pressure	0.1% Accuracy	0.05% Linearity
EC	1% Accuracy	0.5% Linearity
Temperature	± 0.2°C	

Inspected By: ________________ 4 March, 2010

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