TRANSNET SOC LTD

DCT BERTHS 203 TO 205 – RECONSTRUCTION, DEEPENING AND LENGTHENING

PORT OF DURBAN

REPORT ON WAVE AND CURRENT MEASUREMENTS

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1.0 EXECUTIVE SUMMARY

1.1 Background

The Port of Durban Container Terminal at Pier No 2, Berths 203 to 205, is being upgraded to improve safety, which provides an opportunity for it to be deepened and refurbished to accommodate Post Panamax container vessels up to 9,200 to 12,000 TEU (fully laden) and 14,000 TEU (partially laden). The modern and more fuel efficient vessels of this size are becoming the norm in international trade and South Africa must be able to accommodate them.

This report is one of a series documenting ZAA's appointment for the FEL-3 Feasibility Study for deepening these berths.

1.2 Wave and Current Measurements

As part of ZAA's Scope of Work, wave and current data had to be obtained. These data inform a number of aspects of ZAA's work, including proposals for turbidity control during construction and the mooring analysis of vessels at the new berths.

1.3 Contractor

The work of supplying, deploying and recovering the instrumentation as well as analysing the data, was contracted by ZAA to the Council for Scientific and Industrial Research (CSIR), Coastal and Port Engineering, Stellenbosch. The research Engineer responsible was Mr Eugene Mabille.

1.4 Instrumentation

Five instruments were used in a number of separate deployments. These consisted of three Acoustic Doppler Current Profilers (ADCP), designated ADCP 01, ADCP 02, ADCP 03; a separate Seapac SP2100 electro-magnetic current meter; and a Valeport MIDAS Wave and Tide Recorder (WTR) wave meter.

1.5 Summary

This report provides a summary of the various deployments.

2.0 GENERAL

2.1 Background

The Port of Durban Container Terminal at Pier No 2, Berths 203 to 205, is being upgraded to improve safety, which provides an opportunity for it to be deepened and refurbished to accommodate Post Panamax container vessels up to 9,200 to 12,000 TEU (fully laden) and 14,000 TEU (partially laden). The modern and more fuel efficient vessels of this size are becoming the norm in international trade and South Africa must be able to accommodate them.

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2.2 Wave and Current Measurements

As part of ZAA's Scope of Work, wave and current data had to be obtained. These data inform a number of aspects of ZAA's work, including proposals for turbidity control during construction and the mooring analysis of vessels at the new berths.

2.3 Contractor

The work of supplying, deploying and recovering the instrumentation as well as analysing the data, was contracted by ZAA to the Council for Scientific and Industrial Research (CSIR), Coastal and Port Engineering, Stellenbosch. The research Engineer responsible was Mr Eugene Mabille.

2.4 Instrumentation

Five instruments were used in a number of separate deployments. These consisted of three Acoustic Doppler Current Profilers (ADCP), designated ADCP 01, ADCP 02, ADCP 03; a separate Seapac SP2100 electro-magnetic current meter; and a Valeport MIDAS Wave and Tide Recorder (WTR) wave meter. Some of the instruments were replaced with newer but compatible models during the campaign.

2.4.1 ACDP

An Acoustic Doppler Current Profiler (ADCP) is a hydro-acoustic current meter similar to a sonar, which is used to measure water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column. The instruments contain piezoelectric oscillators to transmit and receive sound signals. The travelling time of sound waves gives an estimate of the distance and the red or blue shift can be converted to a velocity. In order to measure 3D velocities, at least three vector components have to be estimated and thus the instruments have four such units.

Further components of an ADCP are an electronic amplifier, a receiver, a mixer, a clock to measure the travelling time, a temperature sensor and a compass to record the relative rotation. An analog-to-digital converter and a digital signal processor are required to sample the returning signal in order to determine the Doppler shift. A micro processor evaluates the sound velocity at the instrument position using the seawater equation of state, and uses this to estimate the velocities. This procedure assumes that the same density in the water column nearby is mainly determined by temperature, i.e. that the salinity has a pre-configured constant value. Finally, the results are saved on a memory card for subsequent retrieval and analysis.

2.4.2 SeaPac SP2100

The SeaPac 2100 is a compact multi-purpose instrument designed for the coastal ocean environment that operates as a Directional Wave Gauge, a Current Meter, a Tide Gauge, or as a combination Instrument, simultaneously sampling all of these parameters. It stores raw x and y currents or true vector averaged east and north currents and has extra input channels (analog and digital) for interfacing a wide variety of other sensor types. The sensor suite includes electro-magnetic current sensor, digital pressure sensor with temperature compensation, digital compass, and thermistor. A removable memory pack allows quick re- deployment.

2.4.3 Valeport WTR

The Valeport MIDAS Wave and Tide Recorder uses the proven Linear Wave Theory wave analysis method of measurement, employing pressure based data, together with 64 bit data processing.

3.0 DEPLOYMENTS AND RECOVERIES

3.1 Deployment Positions

The instruments were deployed as follows, with the exact location being recorded for each deployment. Refer to Annexure 1 for the full Deployment Reports, providing all the instrumentation and setup details.

ADCP 01	North-north east of the eastern end of Berth 203
ADCP 02	North of Berth 205, in the Berth 203 to 205 Basin
ADCP 03	In the entrance channel of the Port of Durban off the end of the south breakwater
Seapac Current Meter	At the edge of the central sandbank, approximately at the north west end of the Berth 203 to 205 Basin
Valeport WTR	In the Maydon Channel, east of the Fish Wharf

These positions are generally as illustrated below, but due to damage to the Valeport WTR, some re-positioning was decided upon as recorded under the individual deployments.

3.2 Deployment 1

Deployment of the instrumentation took place on 17 May 2012. The following instrumentation was deployed.

Instrument	*Name*	*Serial Number*	*Latitude*	*Longitude*	*Depth (m)*	*Height of Top of ADCP off bottom (mm)*
TRDI 600kHz ADCP (csir)	ADCP 01	3099	29 52.628	031 01.464	14	800
TRDI 600kHz ADCP (Lwa1)	ADCP 02	12880	29 52.706	031 00.885	13	800
TRDI 600kHz ADCP (Lwa2)	ADCP 03	10119	29 51.905	031 03.777	18	800
SEAPAC SP2100	Current meter 1	71079	29 52.566	031 00.906	12	400
VALEPORT WTR	Wave meter 1	34218	29 52.159	031 00.921	12	600

Table 3.2.1. Instrumentation and deployment positions

The recovery for Deployment 1 took place on 19 June 2012. All the instrumentation was recovered. ADCP 01 was found to be off position and lying on its side. The data confirms that on 11 June, between 16h20 and 16h40, something dragged or flipped ADCP 01 over. Fortunately, the long wave data relies on data from the pressure and thus even though the change in attitude resulted in an offset being introduced, the individual burst data (pressure) is not affected, however it was not possible to derive direction for the short period waves and there is no current profile data for the last 7 days. Additional measures were taken during Deployment 2 to ensure that ADCP 02 is not moved from position again. These measures included:

- Divers hammering the anchor pins into the hard clay. Previously the anchor pins were air jetted in (hard clay was not expected).
- An additional 60 kg of anchor chain.

3.3 Deployment 2

Deployment of the instrumentation took place on 21 June 2012. ADCP 02 was not deployed because the dredger, 'Crane', was dredging in close proximity to ADCP 02. It was therefore decided not to deploy ADCP 02 until the dredger had finished its operations in the area.

The settings for ADCP 01 were modified to take advantage of the shallower depth (12 m). The shallower depth allows a reduction in the number of bins, which in turn allows more data to be collected within the constraints of a single battery pack. The time between Wave Bursts was changed from 240 minutes to 180 minutes in an effort to maximise data collection.

The recovery for Deployment 2 took place on 17 July 2012. All the instrumentation was recovered and data was downloaded from all the instrumentation.

3.4 Deployment 3

During the servicing of the Valeport WTR on 18 July it was discovered that the pressure transducer diaphragm had a corrosion pit about the size of a pin-hole which was leaking oil. Consequently the instrument could not be redeployed and was returned to the manufacturer for repairs. It was consequently decided to deploy ADCP 02 at the Wave Meter 1 (Valeport WTR) position so that there would not be a gap in the area under investigation. Current Meter 1 was close enough to the ADCP 02 position to provide data for the area around Berth 205.

The recovery for Deployment 3 took place on 14 August 2012. All the instrumentation was recovered and data was downloaded from all the instrumentation.

3.5 Deployment 4

Deployment of the instrumentation took place on 16 August 2012. Due to the problem discovered with the Valeport WTR (Wave Meter 1) pressure sensor after Deployment 2, Wave Meter 1 was not re-deployed. It was however decided to deploy ADCP 02 in its place so that there would be data continuity in the area around the Sugar Terminal.

At the start of Deployment 4 the three ADCPs used in Deployments 1-3 were replaced with three newer units as two of the ADCPs were sent back to the rental company and the third one was required for the real time current monitoring project in the Port of Durban. All the ADCPs were set up with the same parameters as before.

The recovery for Deployment 4 took place on 11 September 2012. All the instrumentation was recovered and data was downloaded from all the instrumentation. Divers reported that Current Meter1 was found to be lying on its side and that there were fresh holes in the vicinity, indicating that the dredger was operating in the area. No damage to Current Meter1 could be observed.

3.6 Deployment 5

Deployment of the instrumentation took place on 13 September 2012. The Valeport (Wave Meter1) that was sent to the manufacturer in the United Kingdom to have the pressure transducer repaired was shipped back to South Africa in time to be re¬deployed for Deployment 5.

The recovery for Deployment 5 took place on 09 October 2012. All the instrumentation was recovered and data was downloaded from all the instrumentation.

3.7 Deployment 6

Deployment of the instrumentation took place on 13 October 2012.

The recovery for Deployment 6 took place on 20 November 2012. All the instrumentation except for ADCP 03 was recovered. Divers reported that a large amount of sand had moved around the toe of the south breakwater and had covered the ADCP. The depth changes rapidly, (from 18 to 13 m) in the vicinity of ADCP 03. Four separate attempts were made to locate the ADCP but none was successful.

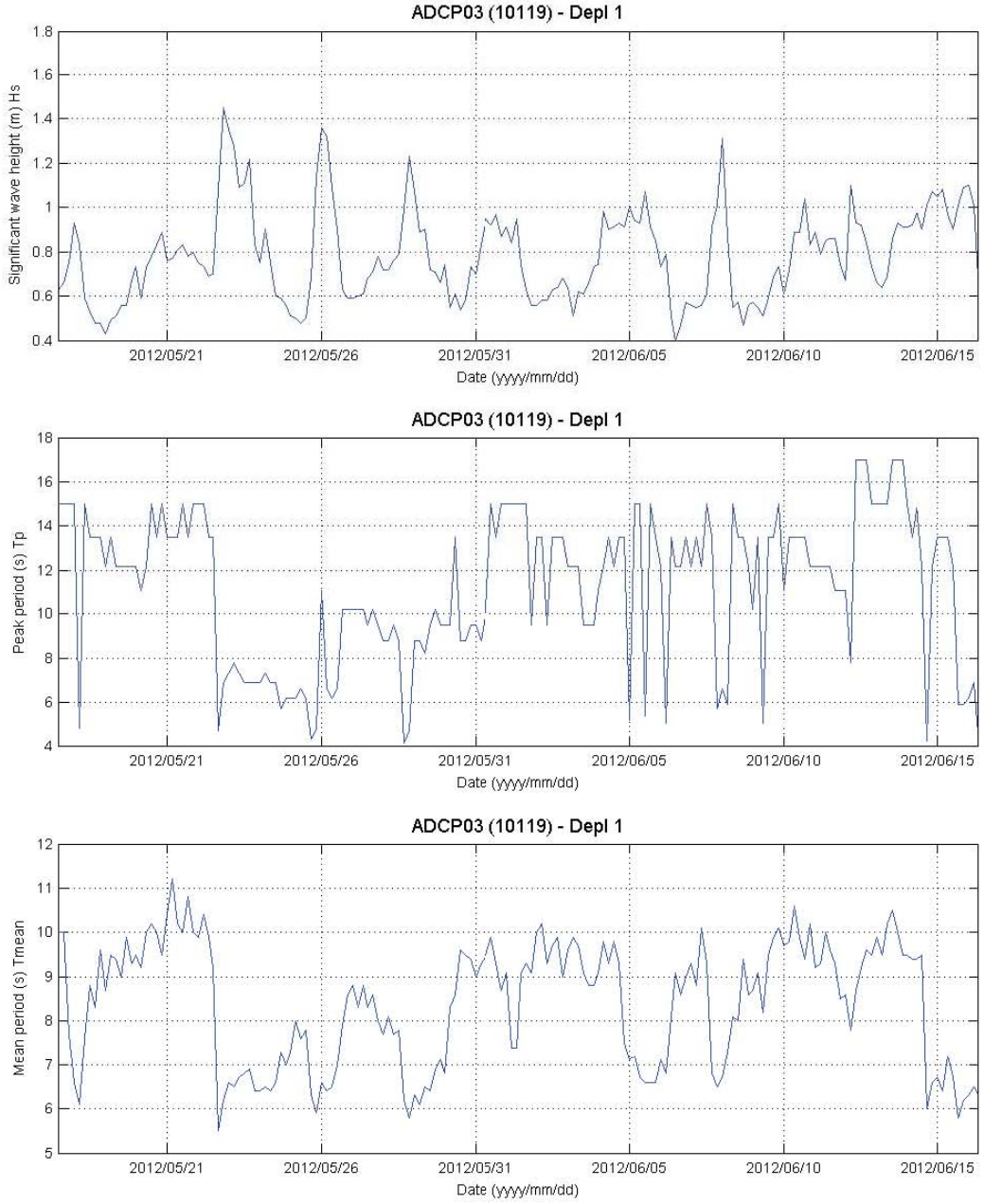
4.0 DATA RECORDS

4.1 Full Records

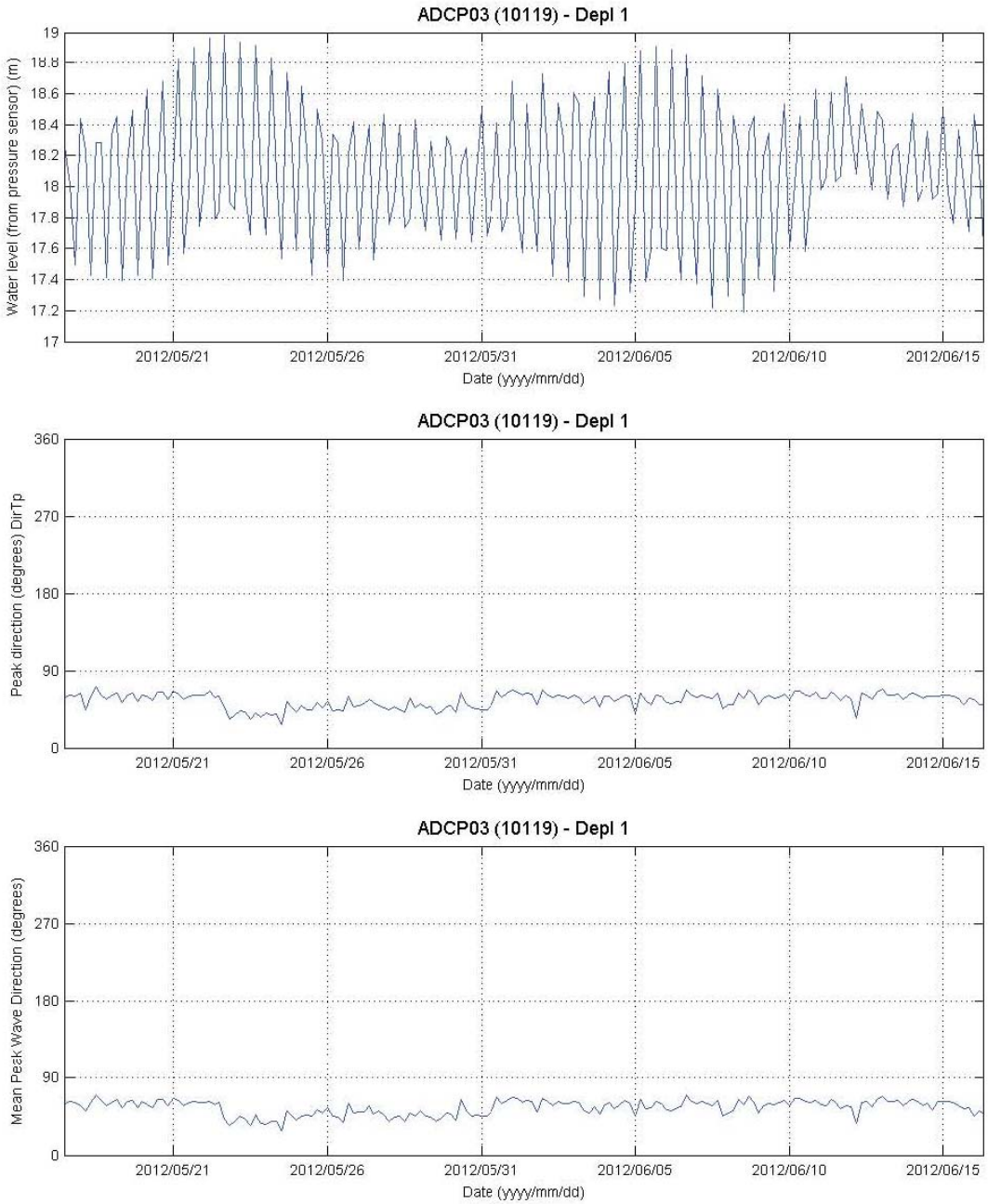
Due to the volume of data records. the full data are recorded on a separate CD to accompany this report.

As illustrations of the type of data analysed, the following are provided for Deployment 1 of ADCP 03.

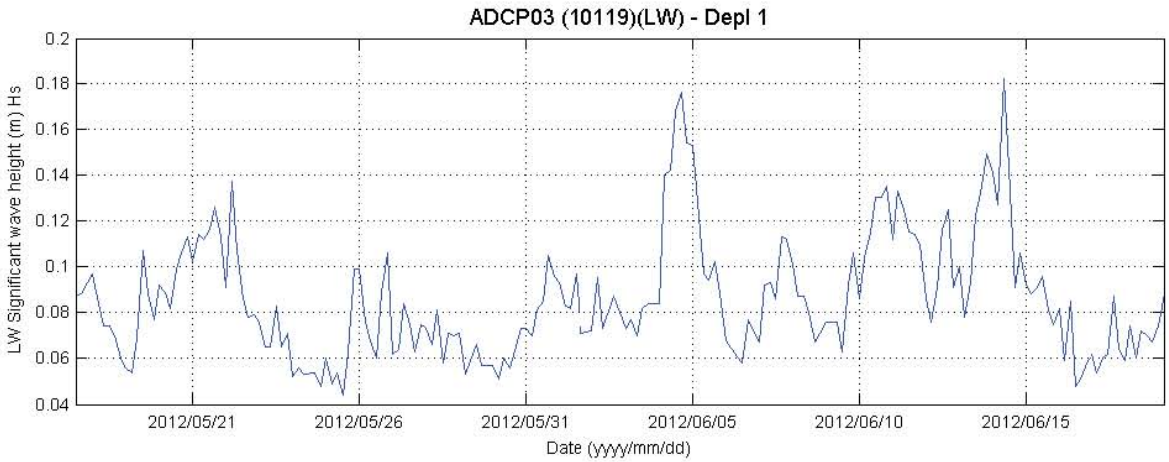
4.2 Significant Wave Height Hs, Peak Period and Mean Period

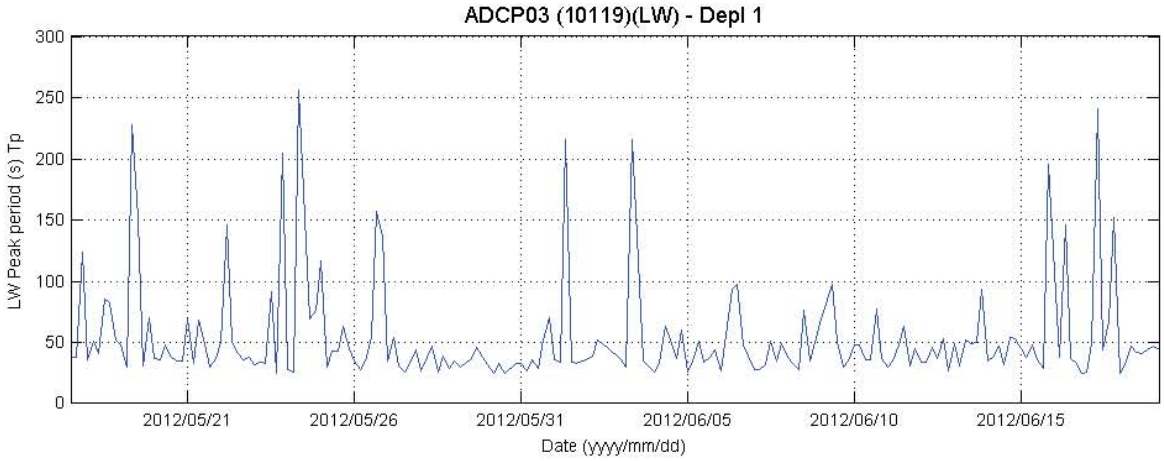


4.3 Water Level, Peak Direction and Mean Peak Wave Direction

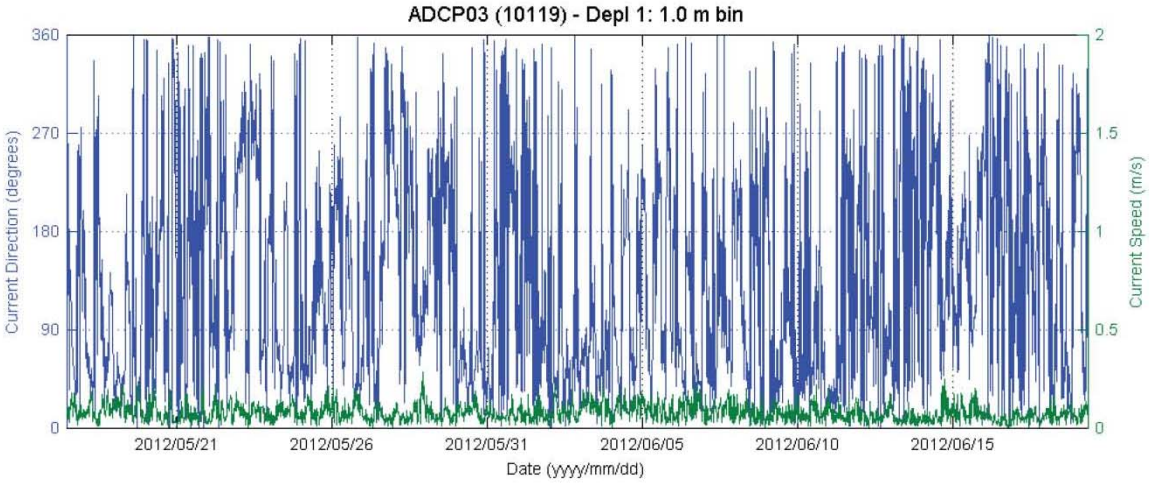


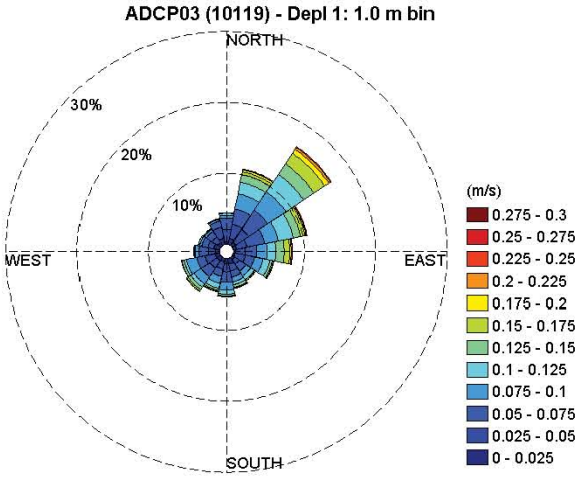
4.4 LW Significant Wave Height, LW Peak Periods



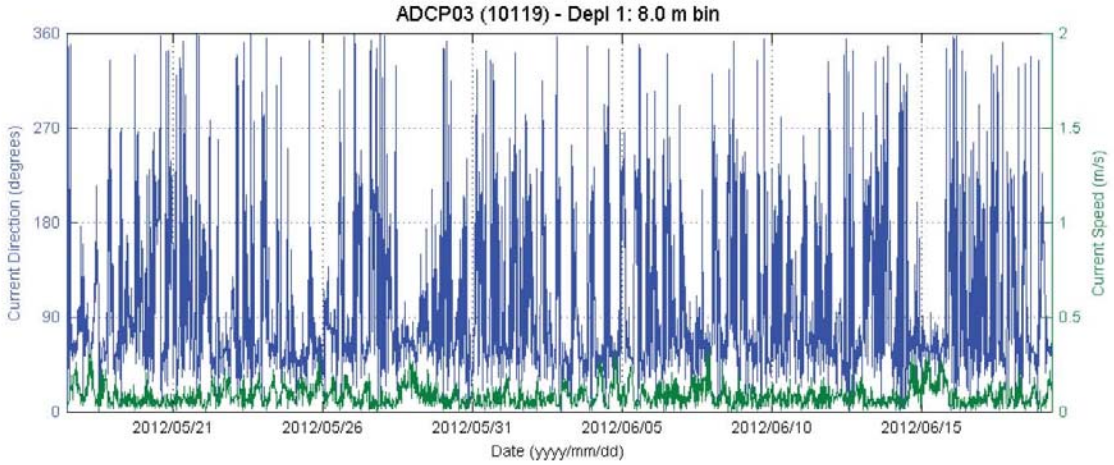


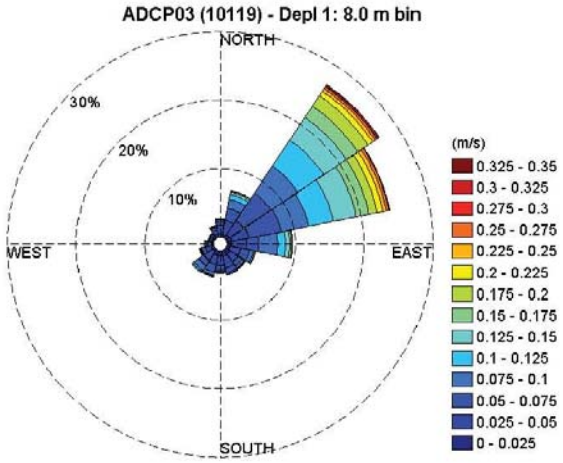
4.5 Current Direction – Graph and Rose - 1.0 m Bin



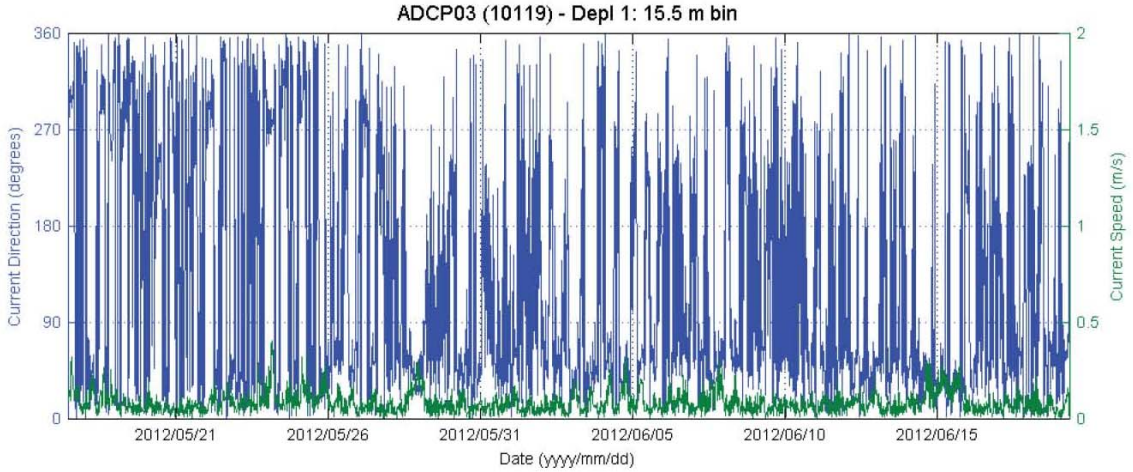


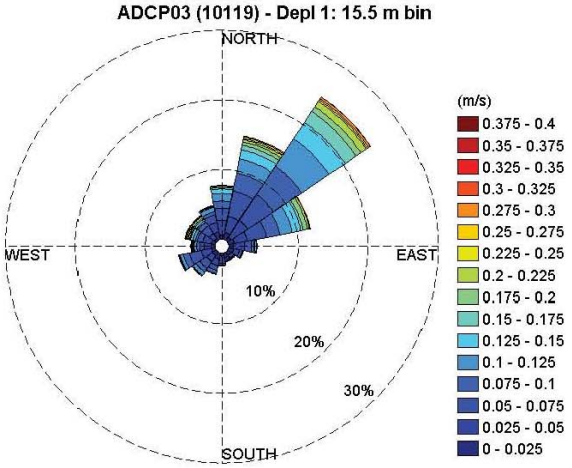
4.6 Current Direction – Graph and Rose - 1.8 m Bin





4.7 Current direction – Graph and Rose - 15.5 m Bin





ANNEXURES

ANNEXURE 1 CSIR DEPLOYMENT REPORTS 1 TO 6

DURBAN MUD FLATS DEPLOYMENT 1

Deployment of the instrumentation took place on 17 May 2012. The following instrumentation was deployed.

Figure 1. Location of monitoring equipment

Table 1. Instrumentation and deployment positions

INSTRUMENT	*NAME*	*SERIAL NUMBER*	*LATITUDE*	*LONGITUDE*	*DEPTH (m)*	*HEIGHT OF PRESSURE SENSOR OFF BOTTOM (mm)*
TRDI 600kHz ADCP (csir)	ADCP01	3099	29 52.628	031 01.464	14	800 (Top of ADCP)
TRDI 600kHz ADCP (Lwa1)	ADCP02	12880	29 52.706	031 00.885	13	800 (Top of ADCP)
TRDI 600kHz ADCP (Lwa2)	ADCP03	10119	29 51.905	031 03.777	18	800 (Top of ADCP)
SEAPAC SP2100	CURRENT METER 1	71079	29 52.566	031 00.906	12	400
VALEPORT WTR	WAVE METER 1	34218	29 52.159	031 00.921	12	600

The tables below detail the setup parameters for each instrument. All the TRDI ADCPs were set up the same, therefore Table 2 is applicable to ADCP01, ADCP02 and ADCP03.

Table2. TRDI ADCPs

PARAMETER	VALUE	UNITS
Profile Pings/Ensamble	120	samples
Depth Cell Size (Bins)	0.5	metres
Ensamble Interval	20	minutes
Ping Interval Currents	1	seconds
Ping Interval Waves	0.5	seconds
Wave Burst Duration	70	minutes
Wave Burst Interval	240	minutes

Table 3. Current Meter1 (Seapac SP2100)

PARAMETER	VALUE	UNITS
Sampling Rate	1	Hz
Wave Burst	4096	samples
Wave Interval	240	minutes
Tide Averaging Interval	3.75	minutes
Current Burst	256	samples
Current Interval	20	minutes

Table 4. Wave Meter1 (Valeport WTR)

PARAMETER	VALUE	UNITS
Sampling rate	1	Hz
Tide Burst Duration	30	seconds
Tide Interval	80	minutes
Wave Burst Duration	4096	samples
Wave Burst Interval	240	minutes

The recovery for Deployment 1 took place on 19 June 2012. All the instrumentation was recovered. ADCP01 was found to be off position and lying on its side. The data confirms that on 11 June, between 16h20 and 16h40, something dragged or flipped ADCP01 over. See Figure 1. Fortunately, the long wave data relies on data from the pressure. Even though the change in attitude resulted in an offset being introduced (Figure 1) the individual burst data (pressure) is not affected. Unfortunately it will not be possible to derive direction for the short period waves and there is no current profile data for the last 7 days. Additional measures were taken during Deployment 2 to ensure that ADCP02 is not moved from position again. These measures included:

i. Divers hammering the anchor pins into the hard clay. Previously the anchor pins were air jetted in (hard clay was not expected).

ii. An additional 60 kg of anchor chain.

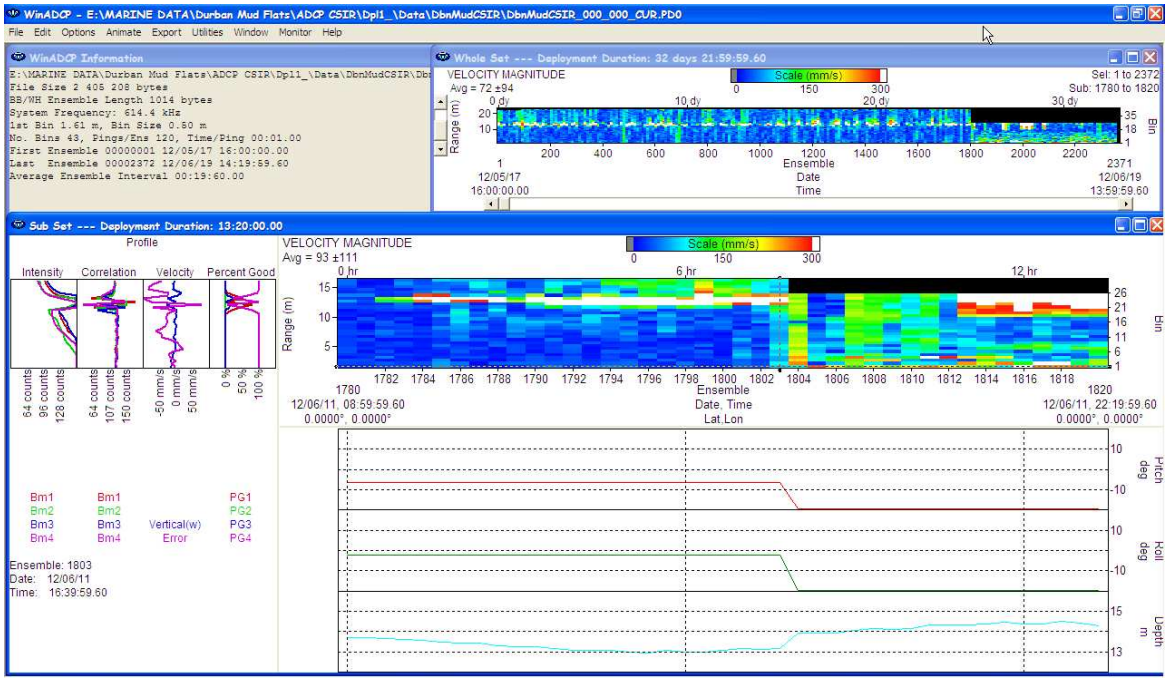


Figure2. ADCP01 data indicating the change in orientation.

Table 5. Data processing settings for short waves (ADCP03 only).

PARAMETER	***VALUE***	***UNITS***
Magnetic Variation	-25	degrees
Method	Vspec	
Frequency Bands	128	
Lower Frequency Threshold	0.03	Hz
Upper Frequency Threshold	0.25	Hz
Small Wave Screening Frequency	0.2	Hz
Small Wave Screening Height	0.1	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 6. Data processing settings for short waves (ADCP01 & ADCP02 only).

PARAMETER	*VALUE*	*UNITS*
Magnetic Variation	-25	degrees
Method	Sspec	
Frequency Bands	128	
Lower Frequency Threshold	0.04	Hz
Upper Frequency Threshold	0.65	Hz
Small Wave Screening Frequency	0.1	Hz
Small Wave Screening Height	0	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 7. Data processing settings for long waves (all instrumentation).

PARAMETER	*VALUE*	*UNITS*
Lower Frequency Threshold	0.00285	Hz
Upper Frequency Threshold	0.04	Hz

Notes:

1. **All directions (currents and waves) are to True North**
2. **The current direction is the direction TO WHICH it is flowing**
3. **Time is SAST.**
4. **The conditions (waves and currents) in the port are considered at the limit of detection by the instruments. Care should be taken when interpreting these results.**
5. **It was not possible to extract meaningful short period waves (2-20 second periods) from the pressure records from Current Meter1 and Wave Meter1 due to the short period and size of the waves at these locations.**
6. **Vessel movements in the vicinity of the instruments do influence the ambient conditions and are recorded as events.**

Figure 3. ADCP being deployed.

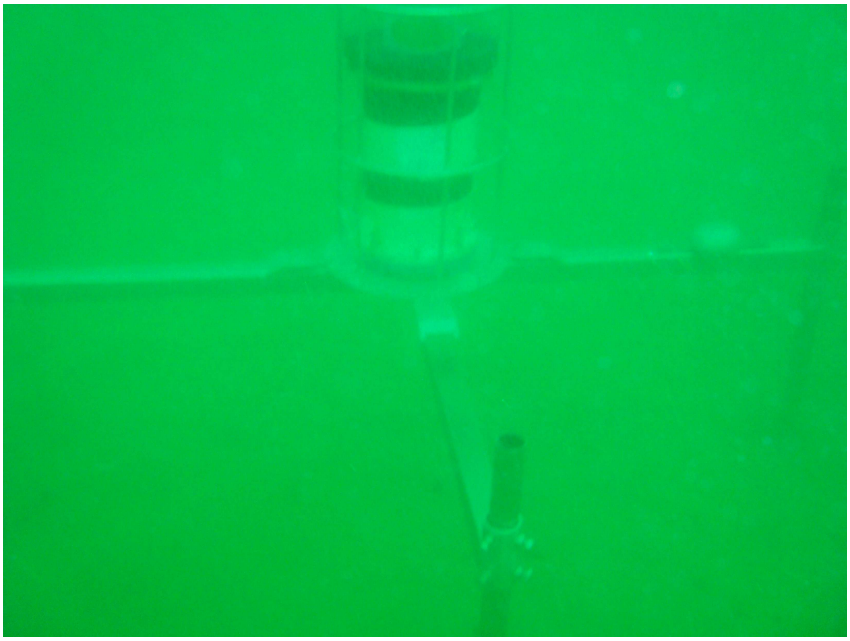


Figure 4. ADCP installed on the sea floor.

Figure 5. Mud packed around the base on the recovered Seapac (Current Meter1).

Figure 6. Mud on the top on the recovered Valeport (Wave Meter1).

DURBAN MUD FLATS DEPLOYMENT 2

Deployment of the instrumentation took place on 21 June 2012. ADCP02 was not deployed because the dredger, '*CRANE*', was dredging in close proximity to ADCP02. It was therefore decided not to deploy ADCP02 until the dredger had finished its operations in the area.

Figure 1. Location of monitoring equipment

Table 1. Instrumentation and deployment positions

INSTRUMENT	*NAME*	*SERIAL NUMBER*	*LATITUDE*	*LONGITUDE*	*DEPTH (m)*	*HEIGHT OF PRESSURE SENSOR OFF BOTTOM (mm)*
TRDI 600kHz ADCP (csir)	ADCP01	3099	29 52.628	031 01.464	14	800 (Top of ADCP)
TRDI 600kHz ADCP (Lwa2)	ADCP03	10119	29 51.905	031 03.777	18	800 (Top of ADCP)
SEAPAC SP2100	CURRENT METER 1	71079	29 52.566	031 00.906	12	400
VALEPORT WTR	WAVE METER 1	34218	29 52.159	031 00.921	12	600

The tables below detail the setup parameters for each instrument.

Table2. ADCP03

PARAMETER	VALUE	UNITS
Profile Pings/Ensamble	120	samples
Depth Cell Size (Bins)	0.5	metres
Ensamble Interval	20	minutes
Ping Interval Currents	1	seconds
Ping Interval Waves	0.5	seconds
Wave Burst Duration	70	minutes
Wave Burst Interval	240	minutes

The settings for ADCP01 were modified to take advantage of the shallower depth (12 metres). The shallower depth allows a reduction in the number of bins, which in turn allows more data to be collected within the constraints of a single battery pack. The time between Wave Bursts was changed from 240 minutes to 180 minutes in an effort to maximise data collection.

Table3. ADCP01

PARAMETER	VALUE	UNITS
Profile Pings/Ensamble	120	samples
Depth Cell Size (Bins)	0.5	metres
Ensamble Interval	20	minutes
Ping Interval Currents	1	seconds
Ping Interval Waves	0.5	seconds
Wave Burst Duration	70	minutes
Wave Burst Interval	180	minutes

Table 4. Current1 (Seapac SP2100)

PARAMETER	VALUE	UNITS
Sampling Rate	1	Hz
Wave Burst	4096	samples
Wave Interval	240	minutes
Tide Averaging Interval	3.75	minutes
Current Burst	256	samples
Current Interval	20	minutes

Table 5. Wave Meter1 (Valeport WTR)

PARAMETER	*VALUE*	*UNITS*
Sampling rate	1	Hz
Tide Burst Duration	30	seconds
Tide Interval	80	minutes
Wave Burst Duration	4096	samples
Wave Burst Interval	240	minutes

The recovery for Deployment 2 took place on 17 July 2012. All the instrumentation was recovered and data was downloaded from all the instrumentation.

Table 6. Data processing settings for short waves (ADCP03 only).

PARAMETER	*VALUE*	*UNITS*
Magnetic Variation	-25	degrees
Method	Vspec	
Frequency Bands	128	
Lower Frequency Threshold	0.03	Hz
Upper Frequency Threshold	0.25	Hz
Small Wave Screening Frequency	0.2	Hz
Small Wave Screening Height	0.1	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 7. Data processing settings for short waves (ADCP01 & ADCP02 only).

PARAMETER	*VALUE*	*UNITS*
Magnetic Variation	-25	degrees
Method	Sspec	
Frequency Bands	128	
Lower Frequency Threshold	0.04	Hz
Upper Frequency Threshold	0.65	Hz
Small Wave Screening Frequency	0.1	Hz
Small Wave Screening Height	0	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 8. Data processing settings for long waves (all instrumentation).

PARAMETER	*VALUE*	*UNITS*
Lower Frequency Threshold	0.00285	Hz
Upper Frequency Threshold	0.04	Hz

Notes:

1. **All directions (currents and waves) are to True North**
2. **The current direction is the direction TO WHICH it is flowing**
3. **Time is SAST.**
4. **The conditions (waves and currents) in the port are considered at the limit of detection by the instruments. Care should be taken when interpreting these results**
5. **It was not possible to extract meaningful short period waves (2-20 second periods) from the pressure records from Current Meter1 and Wave Meter1 due to the short period and size of the waves at these locations.**
6. **Vessel movements in the vicinity of the instruments do influence the ambient conditions and are recorded as events.**

Figure 3. Wave conditions at the head of the south breakwater on 17 July 2012.

DURBAN MUD FLATS DEPLOYMENT 3

Deployment of the instrumentation took place on 19 July 2012. Due to the problem discovered with the Valeport WTR (Wave Meter 1) pressure sensor, Wave Meter 1 was not re-deployed. It was however decided to deploy ADCP02 in its place so that there would be data continuity in the area around the Sugar Terminal. The following instrumentation was deployed.

Figure 1. Location of monitoring equipment

Table 1. Instrumentation and deployment positions

INSTRUMENT	*NAME*	*SERIAL NUMBER*	*LATITUDE*	*LONGITUDE*	*DEPTH (m)*	*HEIGHT OF PRESSURE SENSOR OFF BOTTOM (mm)*
TRDI 600kHz ADCP (csir)	ADCP01	3099	29 52.628	031 01.464	14	800 (Top of ADCP)
TRDI 600kHz ADCP (Lwa2)	ADCP03	10119	29 51.905	031 03.777	18	800 (Top of ADCP)
SEAPAC SP2100	CURRENT METER 1	71079	29 52.566	031 00.906	12	400
TRDI 600kHz ADCP (Lwa1)	ADCP02	12880	29 52.159	031 00.921	12	800

The tables below detail the setup parameters for each instrument.

All the ADCPs were set up with the same parameters, therefore Table 2 represents the settings for ADCP01, ADCP02 and ADCP03.

Table2. ADCP settings

PARAMETER	*VALUE*	*UNITS*
Profile Pings/Ensamble	120	samples
Depth Cell Size (Bins)	0.5	metres
Ensamble Interval	20	minutes
Ping Interval Currents	1	seconds
Ping Interval Waves	0.5	seconds
Wave Burst Duration	70	minutes
Wave Burst Interval	240	minutes

Table 3. Current Meter1 (Seapac SP2100)

PARAMETER	*VALUE*	*UNITS*
Sampling Rate	1	Hz
Wave Burst	4096	samples
Wave Interval	240	minutes
Tide Averaging Interval	3.75	minutes
Current Burst	256	samples
Current Interval	20	minutes

The recovery for Deployment 3 took place on 14 August 2012. All the instrumentation was recovered and data was downloaded from all the instrumentation.

During the servicing of Wave Meter1 (Valeport WTR) on 18 July it was discovered that the pressure transducer diaphragm had a corrosion pit which was leaking oil. The pit was about the size of a pin-hole, see Figure 1. Although the hole was tiny the Valeport could not be redeployed and has been returned to the manufacturer for repairs. It was consequently decided to deploy ADCP02 at the Wave Meter 1 (Valeport WTR) position so that there would not be a gap in the area under investigation. Current Meter 1 is close enough to the ADCP02 position to provide data for the area around Berth 205.

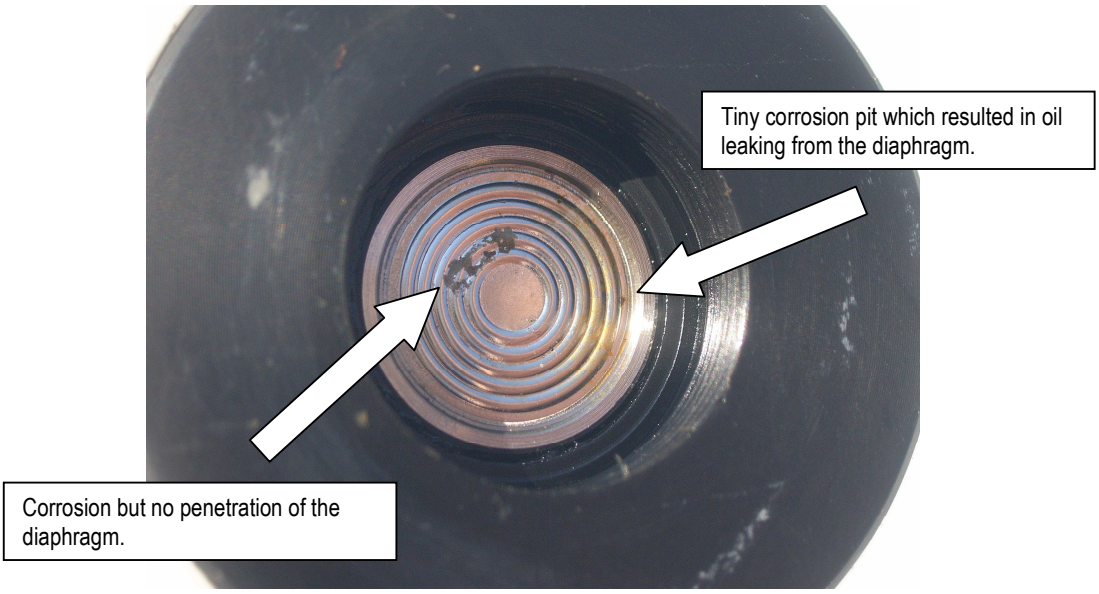


Figure2. Corrosion on the Valeport pressure transducer diaphragm.

Table 4. Data processing settings for short waves (ADCP03 only).

PARAMETER	***VALUE***	***UNITS***
Magnetic Variation	-25	degrees
Method	Vspec	
Frequency Bands	128	
Lower Frequency Threshold	0.03	Hz
Upper Frequency Threshold	0.25	Hz
Small Wave Screening Frequency	0.2	Hz
Small Wave Screening Height	0.1	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 5. Data processing settings for short waves (ADCP01 & ADCP02 only).

PARAMETER	*VALUE*	*UNITS*
Magnetic Variation	-25	degrees
Method	Sspec	
Frequency Bands	128	
Lower Frequency Threshold	0.04	Hz
Upper Frequency Threshold	0.65	Hz
Small Wave Screening Frequency	0.1	Hz
Small Wave Screening Height	0	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 6. Data processing settings for long waves (all instrumentation).

PARAMETER	*VALUE*	*UNITS*
Lower Frequency Threshold	0.00285	Hz
Upper Frequency Threshold	0.04	Hz

Notes:

1. **All directions (currents and waves) are to True North**
2. **The current direction is the direction TO WHICH it is flowing**
3. **Time is SAST.**
4. **The conditions (waves and currents) in the port are considered at the limit of detection by the instruments. Care should be taken when interpreting these results.**
5. **It was not possible to extract meaningful short period waves (2-20 second periods) from the pressure records from Current Meter1 and Wave Meter1 due to the short period and size of the waves at these locations.**
6. **Vessel movements in the vicinity of the instruments do influence the ambient conditions and are recorded as events.**

Figure3. Current Meter1 ready for deployment.

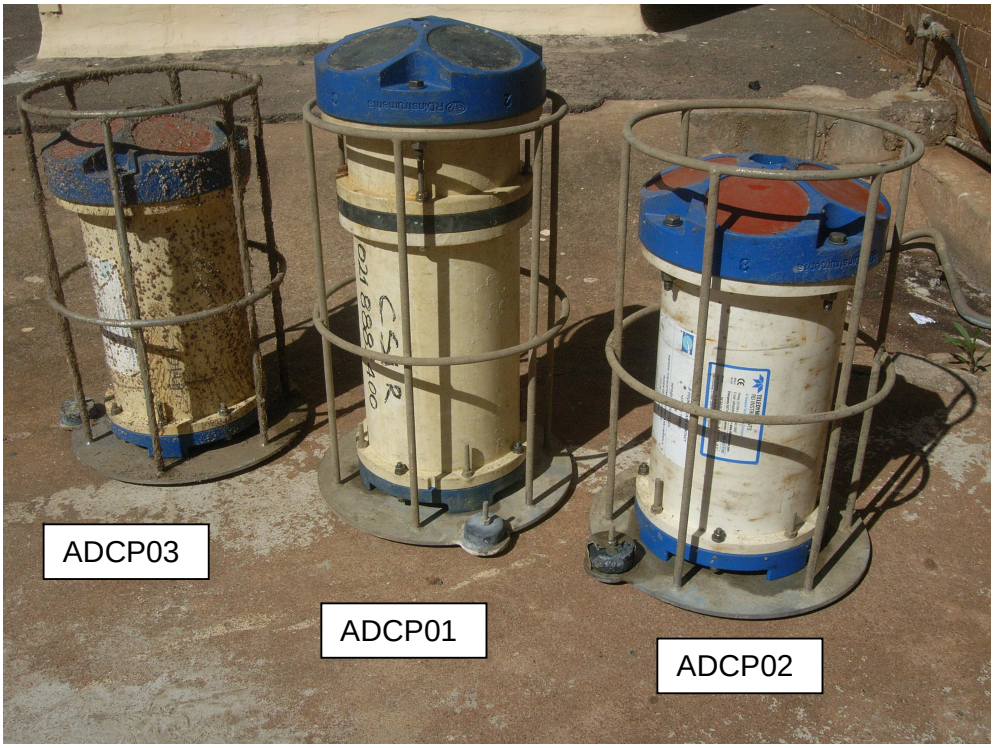


Figure4. The three ADCPs displaying varying degrees of bio-fouling.

Figure5. ADCP03.

DURBAN MUD FLATS DEPLOYMENT 4

Deployment of the instrumentation took place on 16 August 2012. Due to the problem discovered with the Valeport WTR (Wave Meter 1) pressure sensor after Deployment 2, Wave Meter 1 was not re-deployed. It was however decided to deploy ADCP02 in its place so that there would be data continuity in the area around the Sugar Terminal. The following instrumentation was deployed.

Figure 1. Location of monitoring equipment

Table 1. Instrumentation and deployment positions

INSTRUMENT	*NAME*	*SERIAL NUMBER*	*LATITUDE*	*LONGITUDE*	*DEPTH (m)*	*HEIGHT OF PRESSURE SENSOR OFF BOTTOM (mm)*
TRDI 1200kHz ADCP (csir)	ADCP01	18092	29 52.628	031 01.464	14	800 (Top of ADCP)
TRDI 600kHz ADCP (csir2)	ADCP03	18031	29 51.905	031 03.777	18	800 (Top of ADCP)
SEAPAC SP2100	CURRENT METER 1	71079	29 52.566	031 00.906	12	400
TRDI 600kHz ADCP (csir3)	ADCP02	18032	29 52.159	031 00.921	12	800 (Top of ADCP)

At the start of Deployment 4 the three ADCPs used in Deployments 1-3 were replaced with three newer units as two of the ADCPs (#10119 and #) were sent

back to the rental company and the third one #3099 was required for the real time current monitoring project in the Port of Durban.

The tables below detail the setup parameters for each instrument.

All the ADCPs were set up with the same parameters, therefore Table 2 represents the settings for ADCP01, ADCP02 and ADCP03.

Table2. ADCP settings

PARAMETER	***VALUE***	***UNITS***
Profile Pings/Ensamble	120	samples
Depth Cell Size (Bins)	0.5	metres
Ensamble Interval	20	minutes
Ping Interval Currents	1	seconds
Ping Interval Waves	0.5	seconds
Wave Burst Duration	70	minutes
Wave Burst Interval	240	minutes

Table 3. Current Meter1 (Seapac SP2100)

PARAMETER	***VALUE***	***UNITS***
Sampling Rate	1	Hz
Wave Burst	4096	samples
Wave Interval	240	minutes
Tide Averaging Interval	3.75	minutes
Current Burst	256	samples
Current Interval	20	minutes

The recovery for Deployment 4 took place on 11 September 2012. All the instrumentation was recovered and data was downloaded from all the instrumentation. Divers reported that Current Meter1 was found to be lying on its side and that there were fresh holes in the vicinity, indicating that the dredger was operating in the area. No damage to Current Meter1 could be observed.

Figure2. ADCPs ready for deployment

Figure3. Deployment site for Wave Meter 1.

Table 4. Data processing settings for short waves (ADCP03 only).

PARAMETER	*VALUE*	*UNITS*
Magnetic Variation	-25	degrees
Method	Vspec	
Frequency Bands	128	
Lower Frequency Threshold	0.03	Hz
Upper Frequency Threshold	0.25	Hz
Small Wave Screening Frequency	0.2	Hz
Small Wave Screening Height	0.1	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 5. Data processing settings for short waves (ADCP01 & ADCP02 only).

PARAMETER	*VALUE*	*UNITS*
Magnetic Variation	-25	degrees
Method	Sspec	
Frequency Bands	128	
Lower Frequency Threshold	0.04	Hz
Upper Frequency Threshold	0.65	Hz
Small Wave Screening Frequency	0.1	Hz
Small Wave Screening Height	0	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 6. Data processing settings for long waves (all instrumentation).

PARAMETER	*VALUE*	*UNITS*
Lower Frequency Threshold	0.00285	Hz
Upper Frequency Threshold	0.04	Hz

Notes:

1. **All directions (currents and waves) are to True North**
2. **The current direction is the direction TO WHICH it is flowing**
3. **Time is SAST.**
4. **The conditions (waves and currents) in the port are considered at the limit of detection by the instruments. Care should be taken when interpreting these results**
5. **It was not possible to extract meaningful short period waves (2-20 second periods) from the pressure records from Current Meter1 and**

Wave Meter1 due to the short period and size of the waves at these locations.

6. **Vessel movements in the vicinity of the instruments do influence the ambient conditions and are recorded as events.**

Figure4. The three ADCPs displaying varying degrees of bio-fouling.

Figure5. Seapac Wave gauge (Current Meter1).

DURBAN MUD FLATS DEPLOYMENT 5

Deployment of the instrumentation took place on 13 September 2012. The Valeport (Wave Meter1) that was sent to the manufacturer in the United Kingdom to have the pressure transducer repaired was shipped back to South Africa in time to be re-deployed for Deployment 5. The following instrumentation was deployed.

Figure 1. Location of monitoring equipment

Table 1. Instrumentation and deployment positions

INSTRUMENT	*NAME*	*SERIAL NUMBER*	*LATITUDE*	*LONGITUDE*	*DEPTH (m)*	*HEIGHT OF PRESSURE SENSOR OFF BOTTOM (mm)*
TRDI 1200kHz ADCP (csir)	ADCP01	18092	29 52.628	031 01.464	14	800 (Top of ADCP)
TRDI 600kHz ADCP (csir2)	ADCP02	18032	29 52.706	031 00.885	13	800 (Top of ADCP)
TRDI 600kHz ADCP (csir3)	ADCP03	18031	29 51.905	031 03.777	18	800 (Top of ADCP)
SEAPAC SP2100	CURRENT METER 1	71079	29 52.566	031 00.906	12	400
VALEPORT WTR	WAVE METER 1	34218	29 52.159	031 00.921	12	600

The tables below detail the setup parameters for each instrument.
All the ADCPs were set up with the same parameters, therefore Table 2 represents the settings for ADCP01, ADCP02 and ADCP03.

Table2. ADCP settings

PARAMETER	*VALUE*	*UNITS*
Profile Pings/Ensamble	120	samples
Depth Cell Size (Bins)	0.5	metres
Ensamble Interval	20	minutes
Ping Interval Currents	1	seconds
Ping Interval Waves	0.5	seconds
Wave Burst Duration	70	minutes
Wave Burst Interval	240	minutes

Table 3. Current Meter1 (Seapac SP2100)

PARAMETER	*VALUE*	*UNITS*
Sampling Rate	1	Hz
Wave Burst	4096	samples
Wave Interval	240	minutes
Tide Averaging Interval	3.75	minutes
Current Burst	256	samples
Current Interval	20	minutes

Table 4. Wave Meter1 (Valeport WTR)

PARAMETER	*VALUE*	*UNITS*
Sampling rate	1	Hz
Tide Burst Duration	30	seconds
Tide Interval	80	minutes
Wave Burst Duration	4096	samples
Wave Burst Interval	240	minutes

The recovery for Deployment 5 took place on 09 October 2012. All the instrumentation was recovered and data was downloaded from all the instrumentation.

Figure2. Diver preparing to recover WaveMeter 1.

Table 5. Data processing settings for short waves (ADCP03 only).

PARAMETER	***VALUE***	***UNITS***
Magnetic Variation	-25	degrees
Method	Vspec	
Frequency Bands	128	
Lower Frequency Threshold	0.03	Hz
Upper Frequency Threshold	0.25	Hz
Small Wave Screening Frequency	0.2	Hz
Small Wave Screening Height	0.1	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 6. Data processing settings for short waves (ADCP01 & ADCP02 only).

PARAMETER	*VALUE*	*UNITS*
Magnetic Variation	-25	degrees
Method	Sspec	
Frequency Bands	128	
Lower Frequency Threshold	0.04	Hz
Upper Frequency Threshold	0.65	Hz
Small Wave Screening Frequency	0.1	Hz
Small Wave Screening Height	0	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 7. Data processing settings for long waves (all instrumentation).

PARAMETER	*VALUE*	*UNITS*
Lower Frequency Threshold	0.00285	Hz
Upper Frequency Threshold	0.04	Hz

Notes:

1. **All directions (currents and waves) are to True North**
2. **The current direction is the direction TO WHICH it is flowing**
3. **Time is SAST.**
4. **The conditions (waves and currents) in the port are considered at the limit of detection by the instruments. Care should be taken when interpreting these results.**
5. **It was not possible to extract meaningful short period waves (2-20 second periods) from the pressure records from Current Meter1 and Wave Meter1 due to the short period and size of the waves at these locations.**
6. **Vessel movements in the vicinity of the instruments do influence the ambient conditions and are recorded as events.**

Figure3. ADCP01 post recovery.

Figure4. Wave Meter 1 post recovery.

DURBAN MUD FLATS DEPLOYMENT 6

Deployment of the instrumentation took place on 13 October 2012. The following instrumentation was deployed.

Figure 1. Location of monitoring equipment

Table 1. Instrumentation and deployment positions

INSTRUMENT	*NAME*	*SERIAL NUMBER*	*LATITUDE*	*LONGITUDE*	*DEPTH (m)*	*HEIGHT OF PRESSURE SENSOR OFF BOTTOM (mm)*
TRDI 1200kHz ADCP (csir)	ADCP01	18092	29 52.628	031 01.464	14	800 (Top of ADCP)
TRDI 600kHz ADCP (csir2)	ADCP02	18032	29 52.706	031 00.885	13	800 (Top of ADCP)
TRDI 600kHz ADCP (csir3)	ADCP03	18031	29 51.905	031 03.777	18	800 (Top of ADCP)
SEAPAC SP2100	CURRENT METER 1	71079	29 52.548	031 00.881	6	400
VALEPORT WTR	WAVE METER 1	34218	29 52.159	031 00.921	12	600

The tables below detail the setup parameters for each instrument.
All the ADCPs were set up with the same parameters, therefore Table 2 represents the settings for ADCP01, ADCP02 and ADCP03.

Table2. ADCP settings

PARAMETER	*VALUE*	*UNITS*
Profile Pings/Ensamble	120	samples
Depth Cell Size (Bins)	0.5	metres
Ensamble Interval	20	minutes
Ping Interval Currents	1	seconds
Ping Interval Waves	0.5	seconds
Wave Burst Duration	70	minutes
Wave Burst Interval	240	minutes

Table 3. Current Meter1 (Seapac SP2100)

PARAMETER	*VALUE*	*UNITS*
Sampling Rate	1	Hz
Wave Burst	4096	samples
Wave Interval	240	minutes
Tide Averaging Interval	3.75	minutes
Current Burst	256	samples
Current Interval	20	minutes

Table 4. Wave Meter1 (Valeport WTR)

PARAMETER	*VALUE*	*UNITS*
Sampling rate	1	Hz
Tide Burst Duration	30	seconds
Tide Interval	80	minutes
Wave Burst Duration	4096	samples
Wave Burst Interval	240	minutes

The recovery for Deployment 6 took place on 20 November 2012. All the instrumentation except for ADCP03 was recovered. Divers report that a large amount of sand has moved around the toe of the south breakwater and has covered the ADCP. The depth changes rapidly (18-13m) in the vicinity of ADCP03. Four separate attempts were made locate the ADCP but none were successful.

Further attempts to recover ADCP03 were made on 15 and 18 January 2013. Divers reported that there was good visibility (3 metres) on 18 January and that the base of the slope of the sand is still close to the ADCP's position. The ADCP could not be located. Further attempts to locate ADCP03 will be made during ongoing work in the Durban area, weather and time permitting.

Figure2. Current Meter 1 (Seapac) post recovery.

Table 5. Data processing settings for short waves (ADCP03 only).

PARAMETER	***VALUE***	***UNITS***
Magnetic Variation	-25	degrees
Method	Vspec	
Frequency Bands	128	
Lower Frequency Threshold	0.03	Hz
Upper Frequency Threshold	0.25	Hz

Small Wave Screening Frequency	0.2	Hz
Small Wave Screening Height	0.1	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 6. Data processing settings for short waves (ADCP01 & ADCP02 only).

PARAMETER	*VALUE*	*UNITS*
Magnetic Variation	-25	degrees
Method	Sspec	
Frequency Bands	128	
Lower Frequency Threshold	0.04	Hz
Upper Frequency Threshold	0.65	Hz
Small Wave Screening Frequency	0.1	Hz
Small Wave Screening Height	0	m/sqrt (Hz)
Height of first cell (from sea floor)	2.4	metres

Table 7. Data processing settings for long waves (all instrumentation).

PARAMETER	*VALUE*	*UNITS*
Lower Frequency Threshold	0.00285	Hz
Upper Frequency Threshold	0.04	Hz

Notes:

1. **All directions (currents and waves) are to True North**
2. **The current direction is the direction TO WHICH it is flowing**
3. **Time is SAST.**
4. **The conditions (waves and currents) in the port are considered at the limit of detection by the instruments. Care should be taken when interpreting these results.**
5. **It was not possible to extract meaningful short period waves (2-20 second periods) from the pressure records from Current Meter1 and Wave Meter1 due to the short period and size of the waves at these locations.**
6. **Vessel movements in the vicinity of the instruments do influence the ambient conditions and are recorded as events.**

Figure3. Wave Meter1 (Valeport) post recovery.

Figure4. ADCP02 post recovery.