Mercury Bay Coastal Processes Study: Data Report for 2014 & 2015

2015

ERI report number 53

Prepared for Waikato Regional Council

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Table of Contents

1.0 SUMMARY

Two month-long hydrographic and sedimentation field campaigns were conducted from July 15th, 2014 to August 13th, 2014 and from April 9th, 2015 to May 8th, 2015 within the Mercury Bay-Whitianga Inlet-northern Whitianga Estuary system to fulfill the field data needs of the Waikato Regional Council towards the goal of producing a hydrodynamic model of Mercury Bay. The purpose of this data report is to summarize the instrument deployment locations, durations, and settings that were used during the field campaign. This document also aims to aid the modeler (or other Waikato Regional personnel) in the locating of the desired instrument data files from the accompanying data discs. In all cases, the raw data files have been provided for each instrument. In the instance that a raw data file is in a data format that requires proprietary software from the instrument manufacture to process, an export of the data files to a universally-readable file format has been included (*e.g.*, .txt, .dat, .csv, .etc.) or to a MATLAB file format when necessary. Clarification has been provided for instruments that export data files without headers.

2.0 PROBLEM BACKGROUND

Buffalo Beach is part of a prograded barrier system that protects the coastal residential properties of the township of Whitianga. Residential development of the Whitianga coast increased in the 1960s. During the following decades, sections of the beach have experienced periods of both erosion and accretion.

Buffalo Beach is a barrier beach that is bounded by headlands. The beach is predominantly fine grained sand, but is coarsest at the center of the beach where wave energy is most concentrated. Wave conditions at Buffalo Beach typically range from HS = 0.1-1.5m with a wave period of T = 4-9s. Waves generally approach from the east/southeast, but during positive phases of the Pacific Decadal Oscillation approach from the northeast (de Lange, 2001). The southern extent of Buffalo Beach is protected from east/southeast waves by Whakapenui Point and the headlands of Lonely Bay to the east. Buffalo Beach receives the highest wave energies during periods of northeasterly waves, as there are no geomorphic controls protecting the beach from that orientation. Typical wave and sediment data suggests a closure depth of 13m for Buffalo Beach (Cooper, 2003). Sediment transport along the beach is to the south resulting from an off shore circulation cell (Smith, 1980). Attached to the southern extent of Buffalo Beach is a subaqueous ebb tidal delta that protrudes to the northeast. The delta planform changes shape and orientation with time. Previous sediment maps suggest that the delta is composed of fine to coarse sand (Cooper, 2003; Smith, 1980).

Wave refraction studies conducted for Buffalo Beach have found that the highest wave energies are focused onto central Buffalo Beach, and wave energy is more dissipated at the north and south extents. The southern extent of the beach eroded considerably during increased storm activity during the 1960s, while the northern end of Buffalo Beach generally accreted from 1944-1993. From the late 1990s and early 2000s, the beach was found to be generally eroding, and has been reported to be eroding again in the past few years. Beach erosion can negatively impact tourism and the loss of sand from the beach and backset protective dunes can predispose the coastal residential structures to future storm damage.

Buffalo Beach is bounded to the south by the Whitianga Inlet. Whitianga Inlet is to the east of the southern end of Buffalo Beach, and serves as the conduit between Mercury Bay and the Whitianga Estuary. The tidal prism of the inlet consists of 20% of the water volume. Flow through the inlet is dominated by the ebb tidal current. The inlet channel has scoured down to bedrock. The inlet is protected from wave energy to the east by Whakapenui Point. Tides through the inlet are asymmetrical, favoring a stronger ebb tidal flow. A northeast-southwest trending ebb tidal delta exists protruding off the southern extent of Buffalo Beach into Buffalo Bay. The delta is a dynamic feature that changes shape, orientation, length, and is sometimes multiple features rather than one long continuous shoal. The delta has been shown to be a persistent feature from historical photography, and was found to migrate over 100 m to the east and accrete vertically 10 cm yr^{-1} from 1938-1979 (Steeghs, 2007).
An ebb tidal delta acts as a sediment store, typically storing the coarsest fraction of sediment being transported by the inlet jet. As the delta accretes vertically, it can act as a wave break leading to deposition of sediment between the delta and the shore. The delta can also act as a sediment source for the adjacent beach in the same way that an offshore bar can migrate onshore and nourish a beach. It can also act as a sediment sink for sand eroded off the beach. As such, it is necessary to study the nature of the ebb tidal delta and how it reacts to the inlet jet and interacts with the adjacent beach.

3.0 INSTRUMENT PERFOMANCE

Of the nearly 30 instruments that were used during this study during the 2014 deployment, there were 5 instances of instrument underperformance or malfunction. An optical backscatter sensor (OBS) that was deployed at the Whitianga wharf successfully logged 2 weeks of data, but appears to have become fouled on July 25th. An acoustic Doppler velocimeter (ADV) that was deployed in the inlet rotated 180˚ between deployment and retrieval. One of the RBR tide gauges only recorded data for 48 hours after deployment. Lastly, the Scufa turbidity sensor had a battery malfunction 4 days after deployment. All other instruments successfully logged data without incident.

During the 2015 deployment, the optical backscatter sensor deployed at the wharf showed signs of fouling near the end of the deployment. All other instruments appear to have logged successfully.

4.0 INSTRUMENT DEPLOYMENTS 2014

4.1 Configuration 1: 15/7/2014 - 22/7/2014

Figure 1 - Initial deployment locations of marine instruments in Mercury Bay and Whitianga Inlet. (Imagery: Google Earth).

Table 1 – Instrument Settings for Deployment Configuration 1: 15/7/2014 – 22/7/2014. Times in 2400 format.

Instrument Configuration									
Instrument	Configured For	Sample Interval	Start Time (NZST)	Time Deployed (Put in Water)	Time Retrieved	Approx. Depth (m)	Latitude	Longitude	Sensor Height Above Bed
Scufa*	Turbidity	5 min	14/7/2014 1130	15/7/2014 1030	13/8/2014 1418	2.5	-36.85372	175.69774	490 mm
C3	Turbidity	5 min	14/7/2014 1230	15/7/2014 1055	13/8/2014 1438	2.5	-36.84411	175.68774	140 mm (to sensor 3)
OBS**	Sediment Concentration	10 min	1/7/14		13/8/2014		-36.832727	175.708922	0.5m below water surface
Weather Station	Wind, Pressure, Temperature, Precipitation	30 min	1/7/14		13/8/2014		-36.81607	175.70001	
DOBIE911	Waves	2 min every 10 min	15/7/14 1300	15/7/2014 1015	22/7/2014 1600	5	-36.846	175.70306	155 mm (pressure sensor)
RBR13374	Tides	2 min every 20 min; 4Hz	15/7/14 1300	15/7/2014 1030	13/8/2014 1418	2.5	-36.85372	175.69774	490 mm
RBR77677§	Tides and Waves	2Hz	15/7/14 1300	15/7/2014 1055	13/8/2014 1438	2.5	-36.84411	175.68774	175 mm
ADP	Current Velocities	2 min every 5 min	15/7/14 1300	15/7/2014 920	13/8/2014 1536	6	-36.8356	175.70964	435 mm
ADV259§§	Current Velocities	2 min every 10 min	15/7/14 1300	15/7/2014 955	22/7/2014 1528	5.8	-36.84037	175.70862	760.5 mm
S4-1	Current and Waves	18 min every 60 min	15/7/14 0800	15/7/2014 1530	13/8/2014 1155	6	-36.813146	175.725195	950 mm
S4-2	Current and Waves	18 min every 60 min	15/7/14 0800	15/7/2014 1345	13/8/2014 1115	10.5	-36.80608	175.741517	970 mm

Table 1 - Continued

Instrument Configuration (*continued*)									
Instrument	Configured For	Sample Interval	Start Time (NZST)	Time Deployed (Put in Water)	Time Retrieved	Approx. Depth (m)	Latitude	Longitude	Sensor Height Above Bed
S4-3	Current and Waves	18 min every 60 min	15/7/2014 0800 AM	15/7/2014 1540	13/8/2014 1235	8.1	-36.822904	175.761128	960 mm
S4-4	Current and Waves	18 min every 60 min	15/7/2014 0800 AM	15/7/2014 1400	13/8/2014 1050	18	-36.798496	175.762076	1040 mm

***Scufa malfunctioned and stopped logging data on July 18th at 20:25.**
****OBS became fouled on July 25th. Data recorded after July 25th is not useable.**
§ RBR77677 collected high resolution wave and tide data for 48 hours.
§§ ADV259 rotated 180° (from south to north) between deployment and retrieval. Directional data is therefore unreliable, but the magnitude of the velocity is still useable.

4.2 Configuration 2: 23/7/2014 - 24/7/2014

Figure 2 - Moved ADV259 and DOBIE911 out of the inlet and redeployed off of Buffalo Beach. Deployed two additional sets of DOBIEs and ADVs along Buffalo Beach. (Imagery: Google Earth).

Table 2 – Instrument Settings for Deployment Configuration 2: 23/7/2014 – 24/7/2014. Times in 2400 format.

Instrument Configuration									
Instrument	Configured For	Sample Interval	North Transducer Orientation (˚)	Time Deployed (Put in Water)	Time Retrieved	Approx. Depth (m)	Latitude	Longitude	Sensor Height Above Bed
ADV228	Current Velocities and Waves	2 min every 10 min; Waves (4Hz, 1024 burst)	320	23/7/2014 955	24/7/2014 0750	1.4	-36.81735	175.70224	765 mm
ADV252	Current Velocities and Waves	2 min every 10 min; Waves (4Hz, 1024 burst)	340	23/7/2014 1030	24/7/2014 0803	1.4	-36.80785	175.70396	702 mm
ADV259	Current Velocities and Waves	2 min every 10 min; Waves (4Hz, 1024 burst)	210	23/7/2014 0930	25/7/2014 1050	1.4	-36.82667	175.70518	740 mm
DOBIE818	Waves	2 min every 10 min		23/7/2014 1030	24/7/2014 0803	1.4	-36.80785	175.70396	180 mm (pressure sensor)
DOBIE902	Waves	2 min every 10 min		23/7/2014 0930	25/7/2014 1050	1.4	-36.82667	175.70518	180 mm (pressure sensor)
DOBIE911	Waves	2 min every 10 min		23/7/2014 955	24/7/2014 0750	1.4	-36.81735	175.70224	155 mm (pressure sensor)

*** See Table 1 for instrument settings for long-term instrument (e.g. S4s, RBRs, weather station, etc.)**

4.3 Configuration 3: 24/7/2014 - 25/7/2014

Figure 3 - The ADVs were moved from a shore parallel configuration to a shore normal transect. DOBIE 911 and DOBIE 802 were retrieved. All other instruments remained unchanged. (Imagery: Google Earth).

Table 3 – Instrument Settings for Deployment Configuration 3: 24/7/2014 – 25/7/2014. Times in 2400 format.

Instrument Configuration									
Instrument	Configured For	Sample Interval	North Transducer Orientation (˚)	Time Deployed (Put in Water)	Time Retrieved	Approx. Depth (m)	Latitude	Longitude	Sensor Height Above Bed
ADV228	Current Velocities and Waves	2 min every 10 min; Waves (4Hz, 1024 burst)	40	24/7/2014 1115	25/7/2014 1040	0	-36.82698	175.70416	270 mm
ADV252	Current Velocities and Waves	2 min every 10 min; Waves (4Hz, 1024 burst)	40	24/7/2014 1135	25/7/2014 1040	0	-36.82713	175.70396	270 mm
ADV259	Current Velocities and Waves	2 min every 10 min; Waves (4Hz, 1024 burst)	210	23/7/2014 0930	25/7/2014 1050	1.4	-36.82667	175.70518	740 mm
DOBIE902	Waves	2 min every 10 min (1024 burst)		23/7/2014 0930	25/7/2014 1050	1.4	-36.82667	175.70518	180 mm (pressure sensor)

*** See Table 1 for instrument settings for long-term instrument (e.g. S4s, RBRs, weather station, etc.)**

Figure 4 - ADVs in a shore normal array buried on the beach (July 24th, 2014). ADV order from foreground to background: ADV252, ADV228, and ADV259 & DOBIE902 (submerged – marked by buoy). ADV252 and ADV228 cycled between submerged and exposed with the tide.

4.4 Configuration 4: 25/7/2014 - 5/8/2014

Figure 5 - The ADVs and DOBIE902 were retrieved from the shore normal transect. ADV228 and DOBIE902 were redeployed into Whitianga Inlet.

Table 4 – Instrument Settings for Deployment Configuration 4: 25/7/2014 – 5/8/2014. Times in 2400 format.

Instrument Configuration									
Instrument	Configured For	Sample Interval	North Transducer Orientation (˚)	Time Deployed (Put in Water)	Time Retrieved	Approx. Depth (m)	Latitude	Longitude	Sensor Height Above Bed
ADV228	Current Velocities	2 min every 10 min	60	25/7/2014 1225	13/8/2014 1523	4.0	-36.84038	175.70854	750 mm
DOBIE902	Waves	2 min every 10 min		25/7/2014 1215	13/8/2014 1512	4.0	-36.84600	175.70311	180 mm (pressure sensor)

*** See Table 1 for instrument settings for long-term instrument (e.g. S4s, RBRs, weather station, etc.)**

4.5 Configuration 5: 5/8/2014 - 13/8/2014

Figure 6 - CT sensors were deployed at the OBS wharf site and the two RBR sites. All instruments were retrieved on 13/8/2014 ending the 2014 field campaign.

Table 5 – Instrument Settings for Deployment Configuration 5: 5/8/2014 – 13/8/2014. Times in 2400 format.

Instrument Configuration								
Instrument	Configured For	Sample Interval	Start Time (NZST)	Time Deployed (Put in Water)	Time Retrieved	Depth	Latitude	Longitude
CT2826	Conductivity and Temperature	1 sample every 5 min	5/8/2014 1200	5/8/2014 1450	13/8/2014 1418	Just below surface	-36.85372	175.6977
CT2828	Conductivity and Temperature	1 sample every 5 min	5/8/2014 1200	5/8/2014 1440	13/8/2014 1435	Just below surface	-36.84411	175.6877
CT2829	Conductivity and Temperature	1 sample every 5 min	5/8/2014 1200	5/8/2014 1510	13/8/2014 1625	Just below surface	-36.832727	175.7089

*** See Table 1 for instrument settings for long-term instrument (e.g. S4s, RBRs, weather station, etc.)**

5.0 INSTRUMENT DEPLOYMENTS 2015

5.1 Mercury Bay Configuration: 9/4/2015 - 13/5/2015

Figure 7a - Deployment locations of marine instruments in Mercury Bay. (Imagery: Google Earth).

5.2 Whitianga Estuary Configuration: 9/4/2015 - 13/5/2015

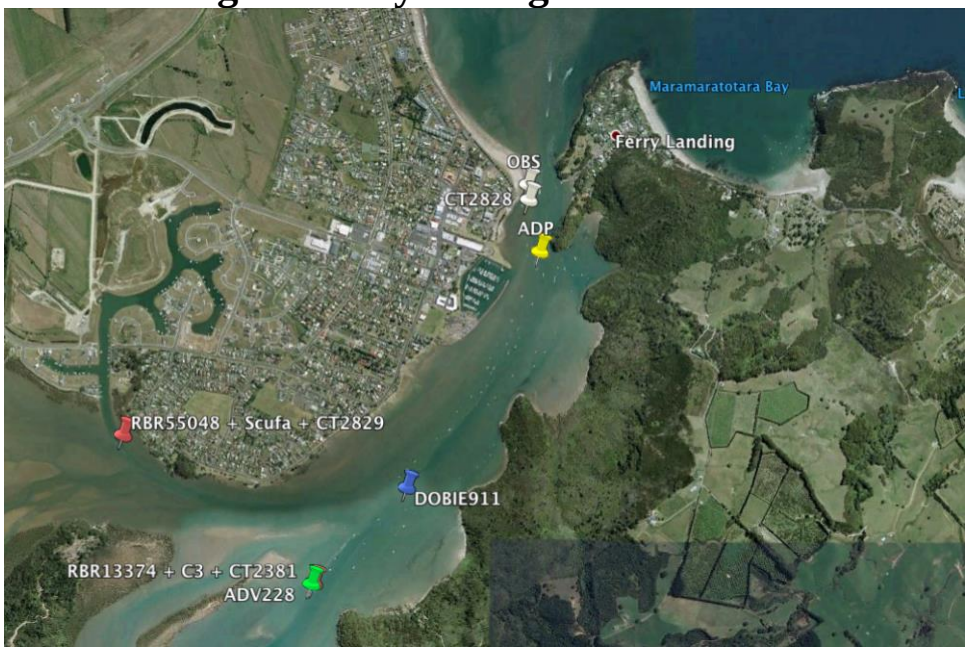

Figure 7b - Deployment locations of marine instruments in Whitianga Estuary. (Imagery: Google Earth).

Table 6 – Instrument Settings for Deployment Configuration 1: 9/4/2015 – 13/5/2015. Times in 2400 format.

Instrument Configuration									
Instrument	Configured For	Sample Interval	Start Time (NZST)	Time Deployed (Put in Water)	Time Retrieved	Approx. Depth (m)	Latitude	Longitude	Sensor Height Above Bed
Scufa	Turbidity	5 min	9/4/2015 0900	9/4/2015 1030	13/5/2015 1340	3.1	-36.84405	175.68771	135 mm
C3	Turbidity	5 min	9/4/2015 0900	9/4/2015 1006	13/5/2015 1400	2.8	-36.85018	175.69823	500 mm
OBS443	Sediment Concentration	10 min	22/4/2015		13/5/2015 1010	Near Surface	-36.832727	175.708922	0.5m below water surface
OBS445	Sediment Concentration	10 min	22/4/2015 1510		13/5/2015 1010	5	-36.832727	175.708922	0.5m above bed
Weather Station	Wind, Pressure, Temperature, Precipitation	30 min	9/4/2015		13/5/2015		-36.81607	175.70001	
DOBIE911	Waves	0.1s for 1024 samples; 10 min interval	9/4/2015 0730	9/4/2015 1119	13/5/2015 1420	5	-36.845984	175.70302	155 mm (pressure sensor)
RBR13374	Tides	Every 5 min; 2Hz	9/4/2015 2015	9/4/2015 1006	13/5/2015 1400	2.8	-36.85018	175.69823	190 mm
RBR55048	Tides	Every 5 min; 2Hz	9/4/2015 2015	9/4/2015 1030	13/5/2015 1340	3.1	-36.84411	175.68774	260 mm
ADP	Current Velocities	2 min every 5 min	9/4/2015 0900	9/4/2015 1100	13/8/2015 0930	6.2	-36.83558	175.70970	435 mm

Instrument Configuration (*continued*)									
Instrument	**Configured For**	**Sample Interval**	**Start Time (NZST)**	**Time Deployed (Put in Water)**	**Time Retrieved**	**Approx. Depth (m)**	**Latitude**	**Longitude**	**Sensor Height Above Bed**
S4-1	Current and Waves	18 min every 60 min	9/4/2015 1300	9/4/2015 1432	13/8/2015 1039	6	-36.81315	175.725205	1010 mm
S4-2	Current and Waves	18 min every 60 min	9/4/2015 1300	9/4/2015 1450	13/8/2015 1136	10.2	-36.80611	175.74158	970 mm
S4-3	Current and Waves	18 min every 60 min	9/4/2015 1300	9/4/2015 1403	13/8/2015 1118	8.1	-36.822885	175.74158	980 mm
S4-4	Current and Waves	18 min every 60 min	9/4/2015 1300	9/4/2015 1340	13/8/2015 1110	18.5	-36.79844	175.76192	990 mm
ADV228	Current Velocities	2 min every 10 min	9/4/2015 0900	15/7/2014 955	13/8/2015 1400	5.8	-36.84037	175.70862	710 mm; x transducer oriented 210°

5.3 Configuration 2: 7/5/2015 – 8/5/2015

Figure 8 – Deployment locations of the surf zone velocimeters (highlighted by the red box). (Imagery: Google Earth).

Figure 9 - Ben Stewart securing a Nortek Vector with anchors into the surf zone on May 7th, 2015. The instrument recorded two full tidal cycles before being removed on May 8th, 2015.

Table 7 – Instrument Settings for Deployment Configuration 3: 7/5/2015 – 8/5/2015. Times in 2400 format.

Instrument	Configured For	Sample Interval	North Transducer Orientation (˚)	Time Deployed (Put in Water)	Time Retrieved	Latitude	Longitude	Sensor Height Above Bed
ADV252	Current Velocities and Waves	1 min every 20 min; Waves (4Hz, 4096 burst)	120 (Seaward)	7/5/2015 1700	8/5/2015 1510	-36.807632	175.703312	420 mm
VECTOR08	Current Velocities and Waves	Continuous; Waves (8Hz, 4096 burst)	60 (Seaward)	7/5/2015 1530	8/5/2015 1510	-36.827130	175.703960	220 mm
VECTOR09	Current Velocities and Waves	Continuous; Waves (8Hz, 4096 burst)	80 (Seaward)	7/5/2015 1610	8/5/2015 1510	-36.817434	175.701162	220 mm

*** See Table 6 for instrument settings for long-term instrument (e.g. S4s, RBRs, weather station, etc.).**

6.0 SURVEYS

6.1 ADCP Survey: 23/7/2014

Figure 10 - ADCP current survey during incoming tide and slack water. (Imagery: Google Earth).

6.2 ADCP Survey 24/7/2014

Figure 11 - ADCP current survey during outgoing tide. (Imagery: Google Earth).

ADCP Survey Raw Data 2014: …\Whitianga July 2014 Deployment Data\ADCP Survey\Raw Data*.000

ADCP Survey Exported Data 2014: …\Whitianga July 2014 Deployment Data\ADCP Survey\Exported Data*.txt

Google Earth KML file: …\Whitianga July 2014 Deployment Data\ADCP Survey\KML Exports*.kml

6.3 ADCP Survey 21/4/2015 - 22/4/2015

Figure 12 - ADCP current survey GPS path encompassing an entire spring tidal cycle taken over the span of 2 days during the 2015 deployment.

ADCP Survey Raw Data 2015: …\Whitianga April 2015 Deployment Data\ADCP Survey\Raw Data*.000

ADCP Survey Exported Data 2015: …\Whitianga April 2015 Deployment Data\ADCP Survey\Exported Data*.txt

6.4 Buffalo Beach RTK GPS Survey: 23/7/2014 & 13/8/2014

Figure 13 - Buffalo Beach RTK GPS survey during low tide on 23/7/2014. GPS reciever was mounted to a quad bike. (Imagery: Google Earth).

Google Earth KML file: …\Whitianga July 2014 Deployment Data\Buffalo Beach RTK Survey\KML Exports*.kml

RTK Beach Surveys 2014: …\Whitianga July 2014 Deployment Data\Buffalo Beach RTK Survey\Beach Surveys*.csv

RTK Beach Surveys 2015 …\Whitianga April 2015 Deployment Data\Buffalo Beach RTK Survey\Beach Surveys*.csv

6.5 CTD Cast Survey: 23/7/2014 - 24/7/2014

Figure 14 - CTD casts taken at the wharf and simultaneously in the estuary from R/V Taitimu (when vessel was available). (Imagery: Google Earth).

CTD Casts from Estuary 2014: …\Whitianga July 2014 Deployment Data\Conductivity Temperature Depth Sensor\CTD Boat*.cnv

CTD Casts from Wharf 2014: …\Whitianga July 2014 Deployment Data\Conductivity Temperature Depth Sensor\CTD Wharf*.cnv

Table 8 - Time log of CTD casts taken during the 2014 deployment.

Instrument	Cast #	Date	Time	Latitude	Longitude
CTD1	1	23/7/2014	1300	-36.832727	175.708922
	2	23/7/2014	1330	-36.832727	175.708922
	3	23/7/2014	1400	-36.832727	175.708922
	4	23/7/2014	1430	-36.832727	175.708922
	5	23/7/2014	1500	-36.832727	175.708922
	6	23/7/2014	1530	-36.832727	175.708922
	7	23/7/2014	1600	-36.832727	175.708922
	8	23/7/2014	1630	-36.832727	175.708922
	9	23/7/2014	1700	-36.832727	175.708922
	10	24/7/2014	0745	-36.832727	175.708922
	11	24/7/2014	0800	-36.832727	175.708922
	12	24/7/2014	0830	-36.832727	175.708922
	13	24/7/2014	0900	-36.832727	175.708922
	14	24/7/2014	0930	-36.832727	175.708922
	15	24/7/2014	1000	-36.832727	175.708922
	16	24/7/2014	1030	-36.832727	175.708922
	17	24/7/2014	1100	-36.832727	175.708922
	18	24/7/2014	1130	-36.832727	175.708922
	19	24/7/2014	1200	-36.832727	175.708922
CTD2	C1	23/7/2014	1448	-36.845940	175.703020
	C2	23/7/2014	1506	-36.845940	175.703020
	C3	23/7/2014	1532	-36.845940	175.703020
	C4	23/7/2014	1559	-36.845940	175.703020
	C5	24/7/2014	0917	-36.845940	175.703020
	C6	24/7/2014	1148	-36.845940	175.703020

6.6 CTD Cast Survey: 22/5/2015 - 23/5/2015

Figure 15 - CTD casts taken at the wharf (CTD1) and within the estuary/bay simultaneously with CTD2 aboard R/V Taitimu. (Imagery: Google Earth).

CTD Casts from Estuary 2015: …\Whitianga April 2015 Deployment Data\Conductivity Temperature Depth Sensor\CTD Boat*.cnv

CTD Casts from Wharf 2015: …\Whitianga April 2015 Deployment Data\Conductivity Temperature Depth Sensor\CTD Wharf*.cnv

Table 9 - Time log of CTD casts taken during the 2015 deployment.

Instrument	Cast #	Date	Time	Latitude	Longitude
CTD1	1	21/5/2015	1130	-36.832727	175.708922
	2	21/5/2015	1200	-36.832727	175.708922
	3	21/5/2015	1230	-36.832727	175.708922
	4	21/5/2015	1300	-36.832727	175.708922
	5	21/5/2015	1330	-36.832727	175.708922
	6	21/5/2015	1400	-36.832727	175.708922
	7	21/5/2015	1430	-36.832727	175.708922
	8	21/5/2015	1500	-36.832727	175.708922
	9	21/5/2015	1530	-36.832727	175.708922
	10	22/5/2015	0700	-36.832727	175.708922
	11	22/5/2015	0730	-36.832727	175.708922
	12	22/5/2015	0800	-36.832727	175.708922
	13	22/5/2015	0830	-36.832727	175.708922
	14	22/5/2015	0900	-36.832727	175.708922
	15	22/5/2015	0930	-36.832727	175.708922
	16	22/5/2015	1000	-36.832727	175.708922
	17	22/5/2015	1030	-36.832727	175.708922
	18	22/5/2015	1100	-36.832727	175.708922
	19	22/5/2015	1130	-36.832727	175.708922
	20	22/5/2015	1200	-36.832727	175.708922
	21	22/5/2015	1230	-36.832727	175.708922
	22	22/5/2015	1300	-36.832727	175.708922
	23	22/5/2015	1330	-36.832727	175.708922
	24	22/5/2015	1400	-36.832727	175.708922
CTD2	C1	21/5/2015	1338	-36.844000	175.687710
	C2	21/5/2015	1410	-36.82801	175.70972
	C3	21/5/2015	1430	-36.80937	175.70552
	C4	21/5/2015	1457	-36.82528	175.71436
	C5	21/5/2015	1530	-36.845940	175.703020
	C6	21/5/2015	1600	-36.84257	175.70619
	C7	21/5/2015	1633	-36.844000	175.687710
	C8	21/5/2015	1656	-36.82528	175.71436
	C9	21/5/2015	1715	-36.845940	175.703020
	C10	22/5/2015	0740	-36.845940	175.703020
	C11	22/5/2015	0804	-36.845940	175.703020
	C12	22/5/2015	0832	-36.83978	175.70921
	C13	22/5/2015	0857	-36.844000	175.687710
	C14	22/5/2015	0918	-36.82528	175.71436
	C15	22/5/2015	0934	-36.845940	175.703020
	C16	22/5/2015	1007	-36.845940	175.703020
	C17	22/5/2015	1041	-36.83978	175.70921
	C18	22/5/2015	1108	-36.80937	175.70552
	C19	22/5/2015	1130	-36.82528	175.71436
	C20	22/5/2015	1200	-36.845940	175.703020
	C21	22/5/2015	1220	-36.845940	175.703020

Table 9 - Continued.

Instrument	Cast #	Date	Time	Latitude	Longitude
CTD2	C22	22/5/2015	1237	-36.83978	175.70921
	C23	22/5/2015	1254	-36.844000	175.687710
	C24	22/5/2015	1316	-36.82528	175.71436
	C25	22/5/2015	1346	-36.845940	175.703020

6.7 Sediment Sampling: 23/7/2014

Figure 16 - Sediment grab sample sites taken on 14/8/2014. SS = Marine sediment sample. BB = Buffalo Beach sediment sample. (Imagery: Google Earth).

Sediment Sample Analysis files 2014: …\Whitianga July 2014 Deployment Data\Sediment Analysis\Raw Data\

Sediment Sample Analysis KML file 2014: …\Whitianga July 2014 Deployment Data\Sediment Analysis\Sampling KMZ*.kmz

6.8 Sediment Sampling: 10/5/2015

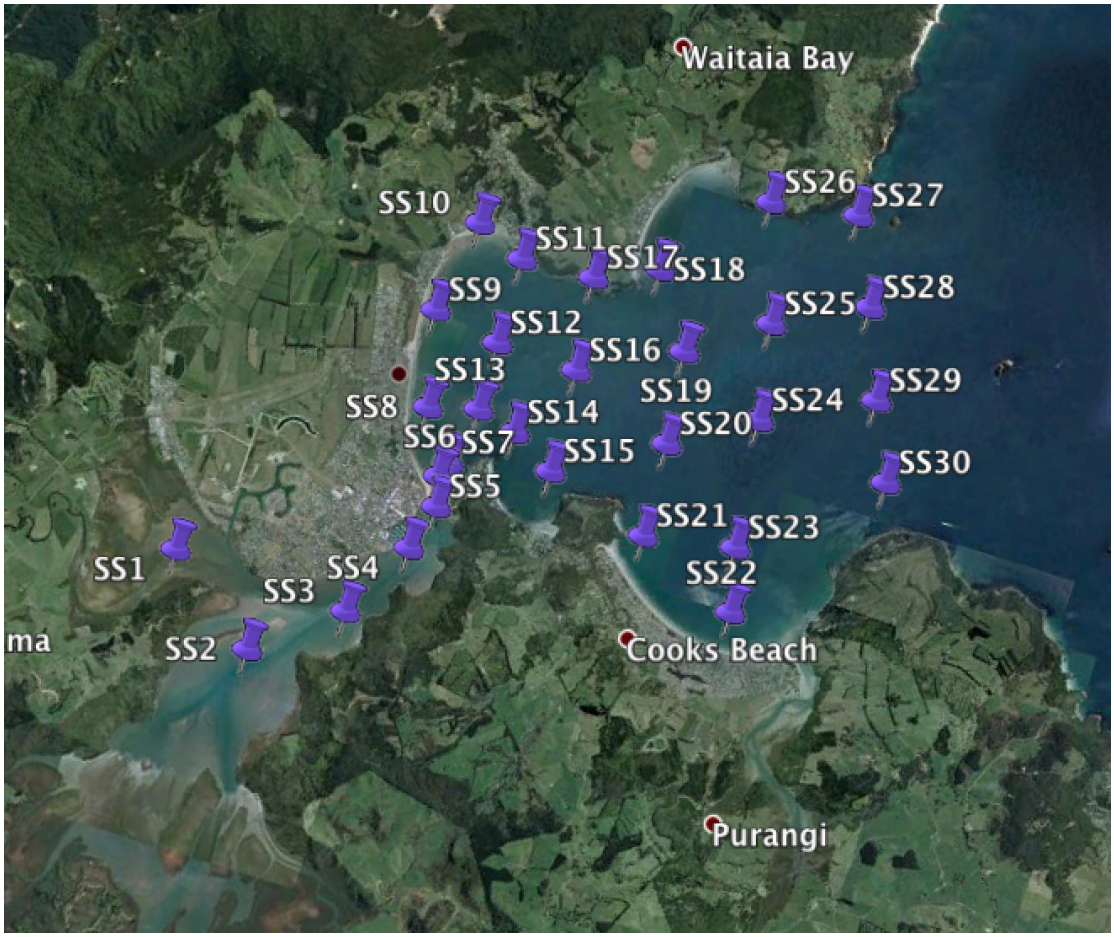

Figure 17 - Sediment grab sample sites taken on 10/5/2015. SS = Marine sediment sample. (Imagery: Google Earth).

Sediment Sample Analysis files 2015: …\Whitianga April 2015 Deployment Data\Sediment Analysis\Raw Data\

Sediment Sample Analysis KML file 2015: …\Whitianga April 2015 Deployment Data\Sediment Analysis\Sampling KMZ*.kmz

6.9 Multibeam Survey: 6/8/2014 - 7/8/2014

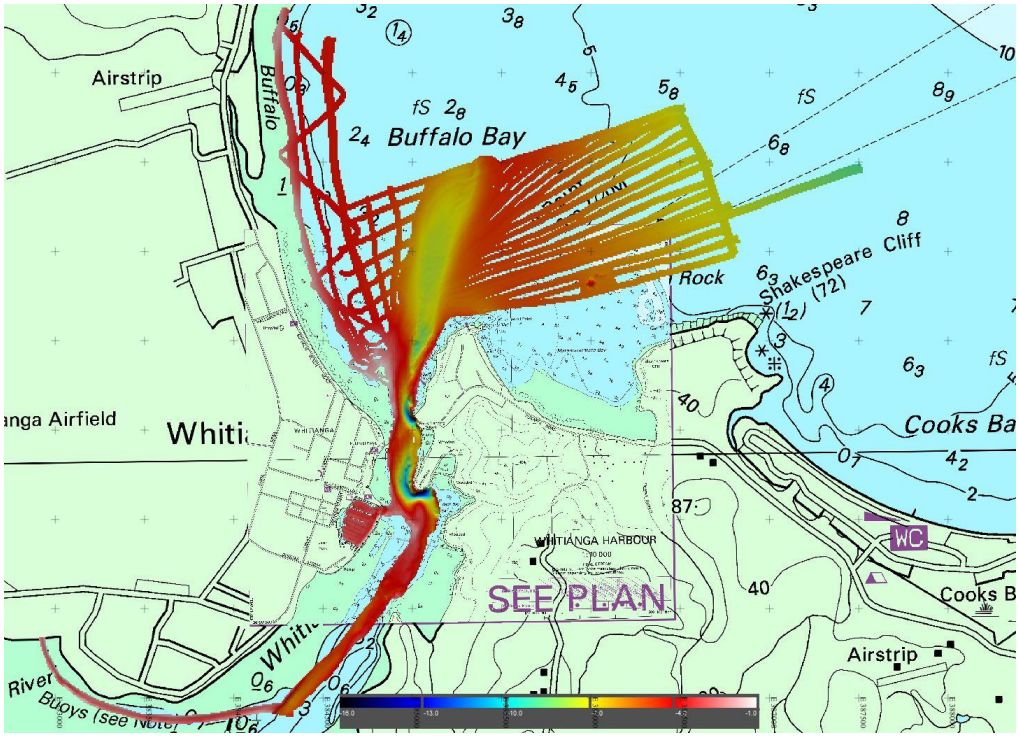

Figure 18 - 2014 multibeam survey of Whitianga Inlet. Raw data is still with the surveyor (DML). (Imagery: Google Earth).

6.10 Multibeam Survey: 8/6/2015 – 9/6/2015

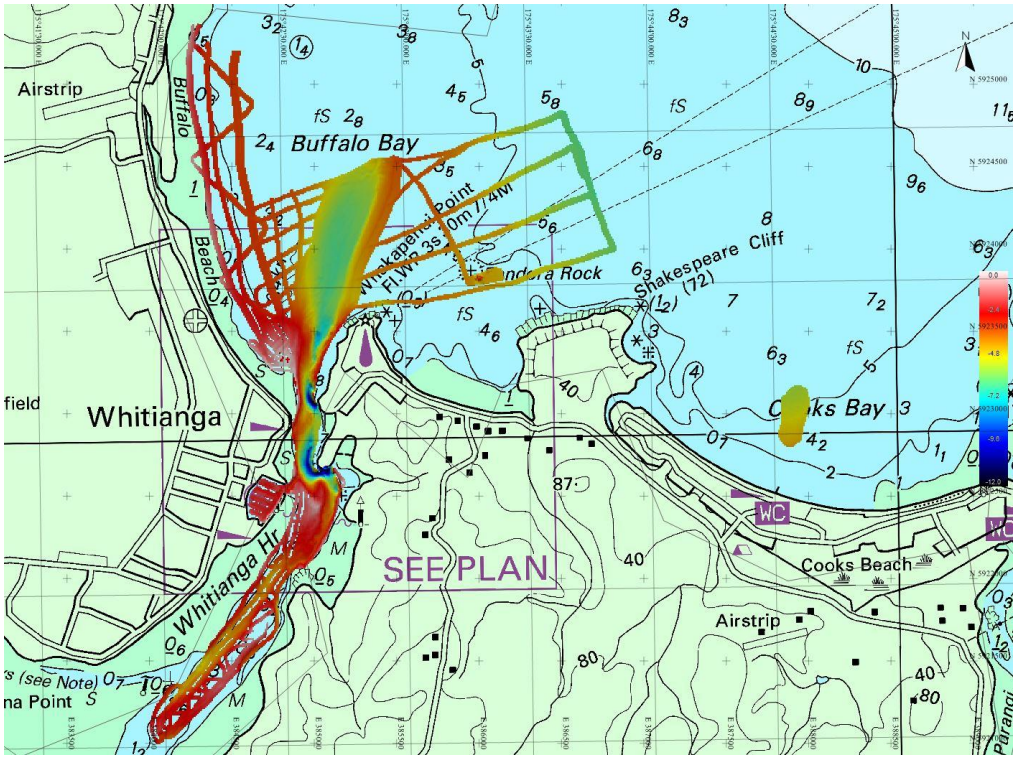

Figure 19 - 2015 multibeam survey of Whitianga Inlet. Raw data is still with the surveyor (DML). (Imagery: Google Earth).

7.0 DATA LOCATIONS

7.1 Acoustic Doppler Profiler (Inlet Deployment)

ADP Raw data 2014: …\Whitianga July 2014 Deployment Data\Acoustic Doppler Profiler\Raw Data\ WHITI001.arg

ADP Exported data 2014: …\Whitianga July 2014 Deployment Data\Acoustic Doppler Profiler\Exported Data\WHITI001.dat

ADP Raw data 2015: …\Whitianga April 2015 Deployment Data\Acoustic Doppler Profiler\Raw Data\ WHI001.arg

ADP Exported data 2015: …\Whitianga April 2015 Deployment Data\Acoustic Doppler Profiler\Exported Data\WHI001.dat

7.2 ADP File Formats

Argonaut ASCII data file Long format is as follows:

Column 1- 6: Year Month Day Hour Minute Second;
Column 7- 9: WaterVel1/X/E WaterVel2/Y/N WaterVel3/Z/U (cm/s)
Column 10-12: VelStDev1/X/E VelStDev2/Y/N VelStDev3/Z/U (cm/s)
Column 13-15: SNR1 SNR2 SNR3 (dB);
Column 16-18: SignalAmp1 SignalAmp2 SignalAmp3 (counts);
Column 19-21: Noise1 Noise2 Noise3 (counts);
Column 22: Ice Detection
Column 23-25: Heading Pitch Roll (deg);
Column 26-28: Standard deviation of the Heading Pitch Roll (deg);
Column 29-30: Mean Tempr (degC) MeanPress (dBar);
Column 31: StDevPress (dBar);
Column 32: Power level (battery voltage) (Volts);
Column 33-34: CellBegin CellEnd (m);
Column 35: Speed (cm/s);
Column 36: Direction (deg);

Flow data file format is as follows:

Column 1- 6: Year Month Day Hour Minute Second;
Column 7: Depth (m)
Column 8: Area (m2)
Column 9: Vx (m/s);
Column 10: V Mean (m/s);
Column 11: Flow (m3/s);

Multi-Cell (Profiling) Data file formats as follows:

Velocity File (*.vel): Sample #, For each individual cell - Velocity X and Y, Speed and Direction;
Standard Error File (*.std) : Sample #, For each individual cell - Standard Error X and Y;
SNR File (*.snr): Sample #, For each individual cell - SNR and Amplitude for each beam;

7.3 ADCP File Formats (ADCP Survey)

Reference: WinRiverII Users Guide from RDI Instruments (page 64-65; http://www.rdinstruments.com/smartlink/wr/support_docs/winriv2ug.pdf).

Row	Field	Description
1	1	ENSEMBLE TIME -Year (at start of ensemble)
	2	- Month
	3	- Day
	4	- Hour
	5	- Minute
	6	- Second
	7	- Hundredths of seconds
	8	ENSEMBLE NUMBER (or SEGMENT NUMBER for processed or averaged raw data)
	9	NUMBER OF ENSEMBLES IN SEGMENT (if averaging ON or processing data)
	10	PITCH - Average for this ensemble (degrees)
	11	ROLL - Average for this ensemble (degrees)
	12	**CORRECTED HEADING** - Average ADCP heading (corrected for one cycle error) + heading offset + magnetic variation
	13	ADCP TEMPERATURE - Average for this ensemble (°C)
2	1	**BOTTOM-TRACK VELOCITY** - East(+)/West(-); average for this ensemble (cm/s or ft/s)
	2	Reference = BTM - North(+)/South(-)
	3	- Vertical (up[+]/down[-])
	4	- Error
2	1	**BOTTOM-TRACK VELOCITY** - GPS (GGA or VTG) Velocity (calculated from GGA String)
		Reference = GGA East(+)/West (-1)
	2	Reference = VTG - GPS (GGA or VTG) North(+)/South(-) Velocity
	3	- BT (up[+]/down[-]) Velocity
	4	- BT Error
	5	**GPS/DEPTH SOUNDER** - corrected bottom depth from depth sounder (m or ft)
		as set by user (negative value if DBT or DBS value is invalid)
	6	- GGA altitude (m or ft)
	7	- GGA Δaltitude (max - min, in m or ft)
	8	- GGA HDOP x 10 + # satillites/100 (negative value if invalid for ensemble)
	9	**DEPTH READING** - Beam 1 average for this ensemble (m or ft, as set by user)
	10	(Use Depth - Beam 2
	11	Sounder = NO) - Beam 3
	12	- Beam 4
	9	**DEPTH READING** - Depth Sounder depth
	10	(Use Depth - Depth Sounder depth
	11	Sounder = Yes) - Depth Sounder depth
	12	- Depth Sounder depth
3	1	**TOTAL ELAPSED DISTANCE** - Through this ensemble (from bottom-track or GPS data; in m or ft)
See	2	**TOTAL ELAPSED TIME** - Through this ensemble (in seconds)
Note	3	**TOTAL DISTANCED TRAVELED NORTH** (m or ft, as set by user)
	4	**TOTAL DISTANCED TRAVELED EAST** (m or ft, as set by user)
	5	**TOTAL DISTANCE MADE GOOD** - Through this ensemble (from bottom-track or GPS data in m or ft)
4	1	**NAVIGATION DATA** -
See	2	- Latitude (degrees and decimal degrees)
Note	3	- Longitude (degrees and decimal degrees)
	4	- invalid
	5	- Fixed value not used.

```
5       1     DISCHARGE VALUES - Middle part of profile (measured); m³/s or
              ft³/s
        2     (referenced to   - Top part of profile (estimated); m³/s or
              ft³/s
        3     Ref = BTM        - Bottom part of profile (estimated); m³/s or
              ft³/s
        4     and Use Depth    - Start-shore discharge estimate; m³/s or ft³/s
        5     Sounder          - Starting distance (boat to shore); m or ft
        6     options)         - End-shore discharge estimate; m³/s or ft³/s
        7                      - Ending distance (boat to shore); m or ft
        8                      - Starting depth of middle layer (or ending
              depth of top layer); m or ft
        9                      - Ending depth of middle layer (or starting
              depth of bottom layer); m or ft
6       1     NUMBER OF BINS TO FOLLOW
        2     MEASUREMENT UNIT - cm or ft
        3     VELOCITY REFERENCE - BT, GGA, VTG, or NONE for current velocity
              data rows 7-26 fields 2-7
        4     INTENSITY UNITS - dB or counts
        5     INTENSITY SCALE FACTOR - in dB/count
        6     SOUND ABSORPTION FACTOR - in dB/m
7-26    1     DEPTH - Corresponds to depth of data for present bin (depth
              cell); includes ADCP depth and blanking value; in m or ft.
        2     VELOCITY MAGNITUDE
        3     VELOCITY DIRECTION
        4     EAST VELOCITY COMPONENT - East(+)/West(-)
        5     NORTH VELOCITY COMPONENT - North(+)/South(-)
        6     VERTICAL VELOCITY COMPONENT - Up(+)/Down(-)
        7     ERROR VELOCITY
        8     BACKSCATTER    - Beam 1
        9                    - Beam 2
        10                   - Beam 3
        11                   - Beam 4
        12    PERCENT-GOOD
        13    DISCHARGE
```

7.4 Acoustic Dopper Velocimeter

ADV Directory 2014: …\Whitianga July 2014 Deployment Data\Acoustic Doppler Velocimeter\

ADV Directory 2015: …\Whitianga April 2015 Deployment Data\Acoustic Doppler Velocimeter\

…\Whitianga April 2015 Deployment Data\Buffalo Beach Wave and Current Sensors\ADV\

Exported Data:

Instrument	Dates	File
ADV228	23/7/2014-25/7/2014	WIT001.dat*
ADV228	25/7/2014-13/8/2014	WIT002.dat
ADV252	23/7/2014-25/72014	WHT001.dat*
ADV259	15/7/2014-22/7/2014	WHI1001.dat
ADV259	23/7/2014-25/7/2014	WHI1002.dat*
ADV228	9/4/2015-13/5/2015	WH001.dat
ADV252	7/5/2015-8/5/2015	WHB15001.dat*

*** Denotes directories with wave data (.amp, .snr, .cor files).**

7.5 ADV File Formats

Triton ASCII data file Long format is as follows:

Column 1- 6: Year Month Day Hour Minute Second;
Column 7- 9: WaterVel1/X/E WaterVel2/Y/N WaterVel3/Z/U (cm/s)
Column 10-12: VelStErr1/X/E VelStErr2/Y/N VelStErr3/Z/U (cm/s)
Column 13-15: SignalAmp1 SignalAmp2 SignalAmp3 (counts);
Column 16: Percent good pings
Column 17-19: Heading Pitch Roll (deg);
Column 20-22: Standard error of Heading, Pitch and Roll (deg);
Column 23-24: Mean Tempr (degC) MeanPress (dBar);
Column 25: StDevPress (dBar);
Column 26: Power level (battery voltage) (Volts);
Column 27: Distance to boundary (m);
Column 28-29: Speed (cm/s) Direction (deg)
Column 30: Noise level (counts);

Triton Signal Amplitude data file (*.amp) format is as follows:

Column 1: Wave Burst Number
Column 2: Wave Series Sample Number
Column 3-5: SignalAmp1 SignalAmp2 SignalAmp3 (counts)

Triton SNR data file (*.snr) format is as follows:

Column 1: Wave Burst Number
Column 2: Wave Series Sample Number
Column 3-5: SNR1 SNR2 SNR3 (dB)

Triton Correlation data file (*.cor) format is as follows:

Column 1: Wave Burst Number
Column 2: Wave Series Sample Number
Column 3-5: Correlation1 Correlation2 Correlation3 (%)

7.6 Nortek Vector

Nortek Vector Directory 2015: …\Whitianga April 2015 Deployment Data\Buffalo Beach Wave and Current Sensors\Nortek Vector*.dat

7.7 Nortek Vector File Formats

VHD file format:

1	Month	(1-12)
2	Day	(1-31)
3	Year	
4	Hour	(0-23)
5	Minute	0-59)
6	Second	(0-59)
7	Burst counter	
8	No of velocity samples	
9	Noise amplitude (Beam1)	(counts)
10	Noise amplitude (Beam2) (	counts)
11	Noise amplitude (Beam3)	(counts)
12	Noise correlation (Beam1)	(%)
13	Noise correlation (Beam2)	(%)
14	Noise correlation (Beam3)	(%)
15	Dist from probe - start (Beam1)	(counts)
16	Dist from probe - start (Beam2)	(counts)
17	Dist from probe - start (Beam3)	(counts)
18	Dist from probe - start (Avg)	(mm)
19	Dist from s.vol - start (Avg)	(mm)
20	Dist from probe - end (Beam1)	(counts)
21	Dist from probe - end (Beam2)	(counts)
22	Dist from probe - end (Beam3)	(counts)
23	Dist from probe - end (Avg)	(mm)
24	Dist from s.vol - end (Avg)	(mm)

DAT file format:

1	Burst counter	
2	Ensemble counter	(1-65536)
3	Velocity (Beam1|X|East)	(m/s)
4	Velocity (Beam2|Y|North)	(m/s)
5	Velocity (Beam3|Z|Up)	(m/s)
6	Amplitude (Beam1)	(counts)
7	Amplitude (Beam2)	(counts)
8	Amplitude (Beam3)	(counts)
9	SNR (Beam1)	(dB)
10	SNR (Beam2)	(dB)
11	SNR (Beam3)	(dB)
12	Correlation (Beam1)	(%)
13	Correlation (Beam2)	(%)
14	Correlation (Beam3)	(%)
15	Pressure	(dbar)
16	Analog input 1	
17	Analog input 2	
18	Checksum	(1=failed)

SEN file format:

1	Month	(1-12)

2	Day	(1-31)
3	Year	
4	Hour	(0-23)
5	Minute	(0-59)
6	Second	(0-59)
7	Error code	
8	Status code	
9	Battery voltage	(V)
10	Soundspeed	(m/s)
11	Heading	(degrees)
12	Pitch	(degrees)
13	Roll	(degrees)
14	Temperature	(degrees C)
15	Analog input	
16	Checksum	(1=failed)

PCK file format:

1	Sample	
2	Distance	mm)
3	Amplitude Beam 1	(counts)
4	Amplitude Beam 2	(counts)
5	Amplitude Beam 3	(counts)

7.8 CTD File Format

Multiple rows of (#) header data
Data:
Column 1: Conductivity [mS/cm]
Column 2: Temperature [ITS-90, deg C]
Column 3: Depth [salt water, m], lat = 0.00
Column 4: flag: 0.000e+00

7.9 CT Sensors

CT Sensor Data 2014:…\Whitianga July 2014 Deployment Data\Conductivity Temperature Sensors*.csv

CT Sensor Data 2015:…\Whitianga April 2015 Deployment Data\Conductivity Temperature Sensors*.csv

7.10 DOBIE

DOBIE Raw Data files 2014: …\Whitianga July 2014 Deployment Data\DOBIE Wave Sensors\###\OFFLOAD.dat

DOBIE Exported Data files 2014: … \Whitianga July 2014 Deployment Data\DOBIE Wave Sensors\###\Exported Data No Correction*.txt

DOBIE Exported Data files with Corrections 2014: …\Whitianga July 2014 Deployment Data\DOBIE Wave Sensors\###\Exported Data Approximate Atmospheric Correction and True Bed Correction*.txt

DOBIE Raw Data files 2015: …\Whitianga July 2014 Deployment Data\DOBIE Wave Sensors\911\OFFLOAD.dat

DOBIE Exported Data files 2015: … \Whitianga July 2014 Deployment Data\DOBIE Wave Sensors\911*.txt

7.11 DOBIE File Format

The ###TIMES.txt file in each DOBIE directory contains the timestamps of each file (wave burst).

Each #######.txt file is a singular wave burst

Header format:
|Burst #|Total Pressure|Depth(m)|X|
A value of 999.900 denotes a corrected value of negative water depth. This can be the result of the DOBIE taking measurements out of the water.

7.12 Fluorimeters (Turbidity Sensor): C3, & Scufa

Fluoremeter Data files 2014: …\Whitianga July 2014 Deployment Data\Fluorometer (Turbidity)*.csv

Fluoremeter Data files 2015: …\Whitianga April 2015 Deployment Data\Fluorometer (Turbidity)*.csv

7.13 OBS Sensor (Wharf)

OBS Data file 2014: …\Whitianga July 2014 Deployment Data\Optical Backscatter Sensor*.dat

OBS Data file 2015: …\Whitianga April 2015 Deployment Data\Optical Backscatter Sensor*.dat

7.14 OBS Data File Format

|Table ID|Year|Day|HH:MM|Program Version|Battery(V)|Data Logger Temp|OBS Sample Point (mV)|OBS Average Reading|OBS Std Dev|

7.15 RBR Tide Gauges

RBR data files 2014: …\Whitianga July 2014 Deployment Data\RBR Tide Gauges\

RBR data files 2015: …\Whitianga April 2015 Deployment Data\RBR Tide Gauges\

Headers are included in the exported data files.

7.16 S4 Wave and Current Meters

S4 Raw Data files 2014: …\Whitianga July 2014 Deployment Data\S4ADW Current Meters\Raw Data

S4 Exported Data (All Points) 2014: …\Whitianga July 2014 Deployment Data\S4ADW Current Meters\Exported Data All Points*.txt

S4 Exported Data (10 pt Average) 2014: …\Whitianga July 2014 Deployment Data\S4ADW Current Meters\Exported Data 10pt Average*.txt

S4 Raw Data files 2015: …\Whitianga April 2015 Deployment Data\S4ADW Current Meters\Raw Data

S4 Exported Data (All Points) 2015: …\Whitianga April 2015 Deployment Data\S4ADW Current Meters\Exported Data*.txt

Headers are included in the exported data files.

7.17 Weather Station Data

Weather Station Data files 2014: …\Whitianga July 2014 Deployment Data\Weather Station*.dat

Weather station data for the 2015 deployment will be provided at a future date.

7.18 Weather Station File Format

Headers:
|Table ID|Year|Day|HH:MM|Empty Vector|Program Version|Data Logger Temp|Battery(V)|Rainfall(mm)|Wind Speed(m/s)|Wind Direction (deg)|Barometric Pressure(hPa/mbar)|

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