PARTRAC

South Tees VMADCP and Water Sampling Campaign

August 2020

DOCUMENT CONTROL

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GLOSSARY

Abbreviation	Definition
ADCP	Acoustic Doppler Current Profiler
CTD	Conductivity, Temperature & Depth
NtM	Notice to Mariners
OSGB	Ordnance Survey of Great Britain - British National Grid
ODN	Ordnance Datum Newlyn
PSU	Practical Salinity Units
VMADCP	Vessel Mounted Acoustic Doppler Current Profiler

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1 Overview

South Tees Development Corporation (STDC) contracted Partrac to collect oceanographic data to support the proposed Tees South Bank development. The collected data is to be used in conjunction with a numerical hydrodynamic model to assess potential impacts of the proposed development, as well as directly informing the design of the works.

This report details the collection of hydrodynamic, water property and water quality data conducted over adjacent spring and neap tides in July 2020. Raw and processed data has been made available separate to this report with ancillary information provided below.

1.1 Scope of Works

The data requirement is divided into five discreet packages based on the measured parameter and the instrumentation used:

- Tidal Elevation
- Current
- CTD
- Water Quality
- Wind

Section 0 and Section 3 of this report detail the collection of current, CTD and water quality data conducted by Partrac over two surveys days in July 2020. Tidal elevation and wind data, which were obtained remotely from instruments permanently installed on site, are introduced in Section (X).

1.2 Survey Location

VMADCP current flow data were collected along three transects used for previous survey operations and studies. The start and end points of each of these transects were provided and are shown in Table 2. The geographic position of the transects is shown in Figure 1.

CTD casts and water sampling were undertaken at the central point of the middle transect (Transect 8)

Table 1. CTD cast position

Survey	CTD cast position (OSGB36)	
	Easting	Northing
Spring	453161	522491
Neap	453161	522491

Table 2: Provided transect locations

Transect	Start of Line (OSGB36)		End of Line (OSGB36)		Length (m)
	Easting	Northing	Easting	Northing	
8	453255.98	522407.69	453066.33	522573.64	252.01
9	452779.73	521863.71	452590.08	522029.66	252.01
11	453629.00	522878.99	453439.35	523044.94	252.01

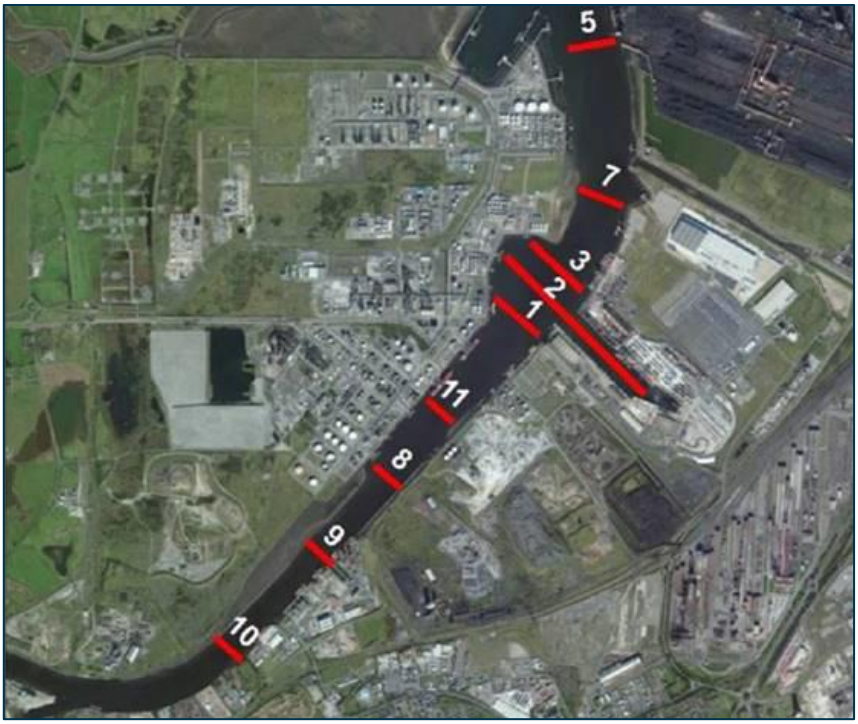

Figure 1: Transect locations.

2 Operations

Data collection was planned to take place in two separate operations, timed to coincide with the spring (22nd-23rd July) and neap (29th-30th July) tidal periods. A day of mobilisation, equipment set up and system testing was scheduled prior to each survey day with much of the equipment remaining in situ between surveys.

The singlebeam survey was conducted on 22nd July. This allowed the equipment to be used and then removed from the small vessel as well as the data acting as a guide for the vessel skipper. The three transects (8,9,11) were each surveyed three times to create a denser dataset from which to plot the bed. No issues occurred during the operation and the data summary is shown in Section 7.4.

The spring survey was planned for 23rd July on a predicted tidal range of 4.2 m. Less than 1 hour into the survey at 07:45 Partrac engineers identified an issue with the navigation software, leading to a divergence in the synchronisation between the position and flow data. Initial attempts to fix the problem between transects failed and the survey was subsequently abandoned. The issue was resolved later the same day, however it was too late to resume the survey or restart.

With a predicted tidal range of 3.9 m the 24th July was initially planned as a contingency day. However, with the previous equipment failure the spring survey was delayed a day and conducted without issue. The survey began at 07:30 (HW-12) and ended at 20:30 (HW+1). In total each transect was surveyed 26 times (total 78 transects) with 26 CTD casts and water samples taken. The order of operations was to start at the southern end of transect 9 and travel north. Next transect 8 was surveyed in a southerly direction and finally transect 11 in a northerly direction. CTD casts were conducted last at the centre of transect 8 during the transit between transect 11 and 9. This order was followed throughout both surveys to ensure data consistency.

The same procedure was followed to undertake the neap survey on 30th July over a predicted tidal range of 2.7 m. The survey began 06:43 (HW-6) and finished at 19:50 (HW+7). In total each transect was surveyed 26 times (total 78 transects) with 26 CTD casts and water samples taken.

An overview of daily operations is presented in Table 3. Further details can be found in Daily Progress Reports found within Appendix A

Table 3: Overview of survey operations.

Date	Operation
22/07/2020	Mobilise Tees Sentinel • Navigation verification • Pre-survey Checks • Moving bed test • System checks • Heading alignment checks • Test Water sampling equipment Complete Singlebeam, Survey

23/07/2020	Attempt spring VMADCP Survey. • Survey abandoned due to time lag in position data. Problem resolved
24/07/2020	Completed 13 hour Spring VMADCP and water sampling survey Demobilise Tees Sentinel
29/07/2020	Remobilise Tees Sentinel • Pre-survey checks • System checks • Heading alignment checks • Water sampling equipment tested
30/07/2020	Completed 13 hour Neap VMADCP and water sampling survey Demobilise Tees Sentinel

3 Equipment

To collect the full complement of data and ancillaries a range of instrumentation was required. A full list of the individual instruments and serial numbers is shown in Error! Reference source not found..

Table 4: List of survey equipment and specific serial numbers.

Instrument	Serial Number
RDI 600KHz ADCP	15263
Trimble MPS865	5910R93520
Hemisphere VS110	AA1046-12738-0011
Xylem EXO3 Sonde	17L103726
Xylem EXO3 Sonde Smart Turbidity Sensor	17D109785
Valeport Mini CTD	46053
Kongsberg Minisounder Single Beam	18812

3.1 Equipment Specifications

3.1.1 Navigation

The primary navigation and positioning data were collected using a Trimble MPS865 dual antenna system, as seen in Figure 2. The technical specifications are detailed in Table 5.

Figure 2: Trimble MPS865

Table 5: Technical specifications of Trimble MPS865.

	Correction and source	Quoted Horizontal accuracy	Quoted Vertical accuracy	Quoted Heading accuracy (@1m Separation)	Update rate
Trimble MPS865	RTK - VRSnow	0.008 m	0.015 m	0.15°	2 Hz

3.1.2 Current Data

Current data were collected using a 600 KHz RDI Workhorse Monitor ADCP, as seen in Figure 3. The quoted accuracies and specification of the ADCP are shown in **Error! Reference source not found.**Table 6.

Figure 3: RDI Workhorse Monitor 600 KHz

Table 6: Technical specifications of RDI Workhorse Monitor.

Parameter	Specification
Vertical Resolution	0.5 m
Standard Deviation	14 cm/s
Velocity accuracy	0.3% of water velocity relative to ADCP
Velocity Resolution	0.1 cm/s
Beam Angle	20°

3.1.3 Turbidity Data

Turbidity data were collected using a YSI EXO2 Multiparameter Sonde, as shown in Figure 4. The technical specifications of the YSI EXO2 Multiparameter Sonde are summarised in Table 7.

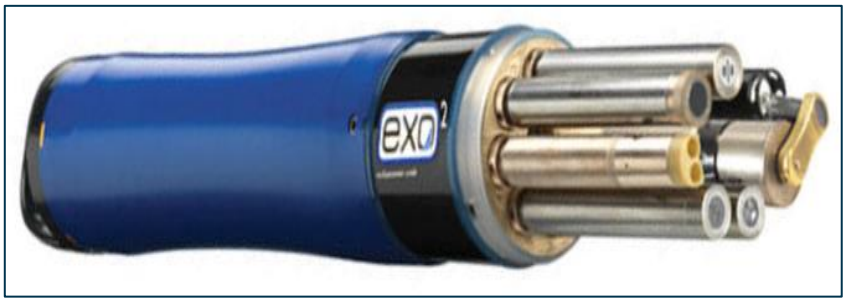

Figure 4: YSI EXO2 Multiparameter Sonde.

Table 7: Technical specifications of YSI EXO2 Smart Turbidity Sensor.

Parameter	Sensor	Range	Accuracy	Response
Turbidity	EXO Turbidity Smart Sensor	0 – 4000 FNU	0.3 FNU	T63 <2s

3.1.4 Conductivity, Temperature, Depth Data

CTD data were collected using a Valeport mini CTD. The technical specification of the mini CTD are summarised in Table 8.

Table 8: Technical specifications of Valeport Mini CTD.

Parameter	Range	Accuracy	Resolution
Conductivity	0-80 mS/cm	0.01 mS/cm	0.001 mS/cm
Temperature	-5°C - +35°C	0.01°c	0.001°C

3.2 Instrument Calibrations and Verifications

3.2.1 VMADCP

The VMADCP verification and functionality tests were completed in three stages. Stages 1-2 were completed during the initial mobilisation, prior to the spring surveys; stage three was completed on the morning of each individual survey:

1. Alongside heading check;
2. At sea repeatability test;
3. ADCP functionality test.

<u>Alongside heading check</u>

The alongside heading check compared the recorded heading from the VMADCP in WinRiver II and the actual heading of the VMADCP. Beam 3 was orientated at +45 ° to the vessel/antenna heading. This test ensured that the correct offset of +45° was applied to the data within WinRiver II.

At sea repeatability test

A transect, orientated perpendicular to the flow, was surveyed in opposite directions. The average flow direction was extracted for each run and cross compared. That these values agreed confirmed that the instrument's heading was aligned correctly.

ADCP functionality Test

WinRiver II allows the user to run a pre-determined ADCP functionality test on the VMADCP system; the test collects information on the instrument's performance and set-up. Functionality tests were performed prior to both the spring and the neap surveys.

3.2.2 Singlebeam Echosounder

The functionality and accuracy of the single beam echosounder was verified by comparing the recorded water depth to a manual depth measurement. The repeatability of the data was checked by repeating transects in opposite directions and at varying speeds.

3.2.3 Turbidity Profiles

The EXO smart turbidity sensor was calibrated on 27th May 2020. The instrument pressure was tared at the start of each survey day.

3.2.4 CTD Profiles

The conductivity, temperature and pressure sensors on the Valeport MiniCTD where calibrated on 28th November 2019. The instrument pressure was tared at the start of each survey day.

3.3 Equipment Configuration

3.3.1 Navigation

The primary navigation unit, Trimble MPS865, was configured to simultaneously output position and heading information to both WinRiver II and Hypack 2019. Within Hypack 2019 an RTK tide file of the vessel position and elevation was also recorded for the duration of the survey.

An overview of the MPS865 outputs are displayed in Table 9: Overview of navigation equipment and software set up for VMADCP/CTD survey.

Table 9: Overview of navigation equipment and software set up for VMADCP/CTD survey.

	Equipment	Output formats and Baud Rate
Positioning	MPS865 Dual antenna with VRSNow RTK corrections	Baud Rate 19200 GGA (2Hz)

	Equipment	Output formats and Baud Rate
		GSV (2Hz) ZDA (2Hz) VTG (2 Hz)
Heading	MPS865 Dual antenna with VRSNow RTK corrections	Baud Rate 19200 HDT (2 Hz) ZDA (2Hz)
Tide	MPS865 Dual antenna with VRSNow RTK corrections	Baud Rate 19200 GGA (2Hz) GSV (2Hz) ZDA (2Hz) VTG (2 Hz)

3.4 Mounting

3.4.1 ADCP and Single beam

An 'over the side' mount, permanently installed on the starboard midship of the Tees Sentinel, was used to mount the ADCP and the single beam. The ADCP was mounted with a fixed heading offset of 45° and a depth below the water line draft of 0.7 m. The single beam was mounted with a draft of 0.5 m.

3.4.2 Navigation

The primary antenna of the dual system was installed at the top of the side mount, directly above the mounting point for the ADCP and the Singlebeam. The secondary antenna was installed forward of the primary antenna, with a separation of 1.1 m.

3.4.3 CTD, Turbidity and Water sampling

The CTD and turbidity sensor where connected to ensure both instruments sensors where aligned at equal heights, this allowed for both instruments to be profiled as one unit. The water sampling hose was connected to the instruments with the intake parallel to the seabed and level with the turbidity sensor. The instruments where lowered and raised on a single rope using the vessels electric winch and davit, whilst the hose and data cables where managed as a separate umbilical.

3.5 Software configuration

3.5.1 ADCP

A summary of the VMADCP settings for both the neap and spring surveys is shown in Table 10. Further details on system configuration can be found in Figure . All configuration settings were consistent across both surveys

Table 10: VMADCP configuration settings.

Overview of settings	
Transducer Depth (m)	0.55 m
Heading offset (°)	+45
Max water depth (m)	18.0
Vertical bin size (m)	0.5
Max water Speed (m/s)	0.75
Max vessel Speed (m/s)	2.5
Bottom Pings per ensemble	10
Water Pongs per ensemble	10
Water mode	12
Bottom mode	5

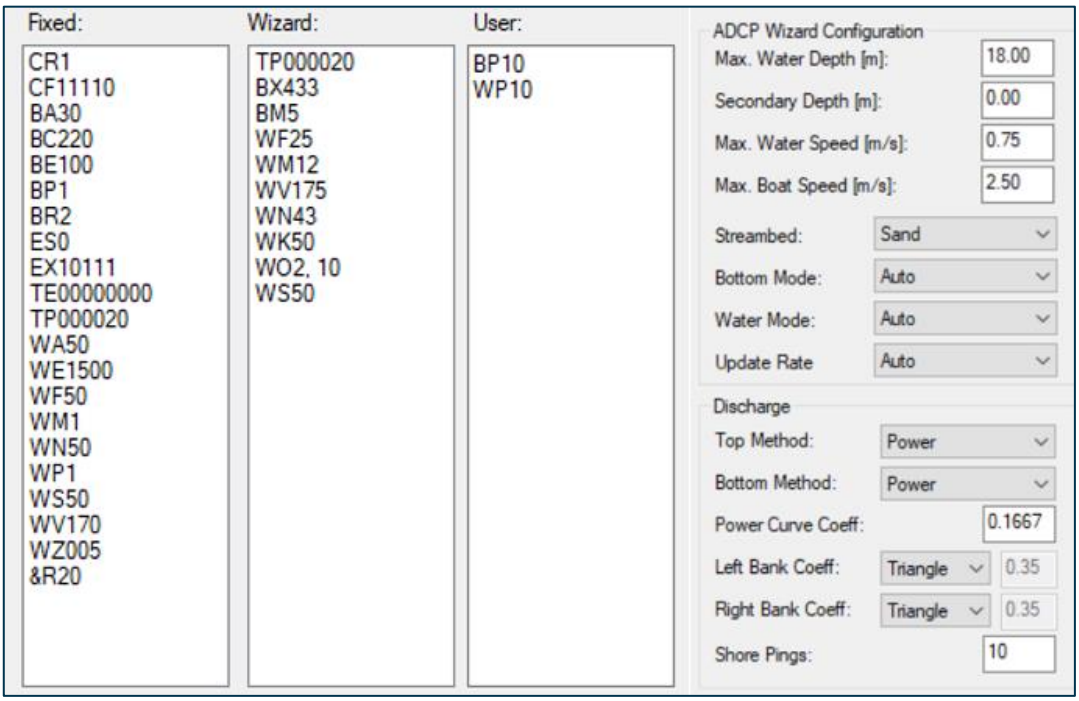

Figure 5: VMADCP WinRiver II configuration.

4 Vessels

The Survey Vessel Tees Sentinel, as seen in Figure 6, was used to complete all survey work. The permanently installed 'over the side' rotating mount arm, winch, davit and opening back deck made the vessel the ideal choice for the operations.

Figure 6: Survey Vessel Tees Sentinel.

5 Licenses/Permits

5.1 Marine Licence

No marine licence was required to complete these works

5.2 The Crown Estate Licence

No licence was required for these operations.

5.3 Notice to Mariners

A notice to Mariners was not deemed a requirement by PD ports

6 HS&E Performance

6.1 Vessel Induction

A vessel induction was given by the skipper on 22nd July 2020 as Partrac joined the vessel. No further induction was required during this service visit.

6.2 Toolbox Talks

Five toolbox talks were undertaken before operations on each of the vessel survey days. Talks were conducted by Party Chief Dan Pitt with additional comments from the vessel skipper.

6.3 Incidents, Accidents and Near Misses

There were no incidents, accidents or near misses during the survey operations. It was observed that safe practices were followed by all, with consistent observation of requirements. The entire team pulled together effectively, ensuring that best practice was strictly adhered to.

7 Data Quality Control and Data processing

7.1 Vessel Mounted ADCP data

The VMADCP data was exported from WinRiver for further analysis. A manual inspection of each transect was performed to identify any anomalous data, generally characterised by a larger than usual change in velocity magnitude between adjacent ensembles. Identified anomalies have been removed. An example of anomalous data displayed in WinRiver (in this case a passing vessel wake) is shown in Figure 7. Where possible data in bin layers above and/or below the anomalous data has been retained, otherwise the entire ensemble has been blanked. Blanked ensembles at the ends of transects have been deleted.

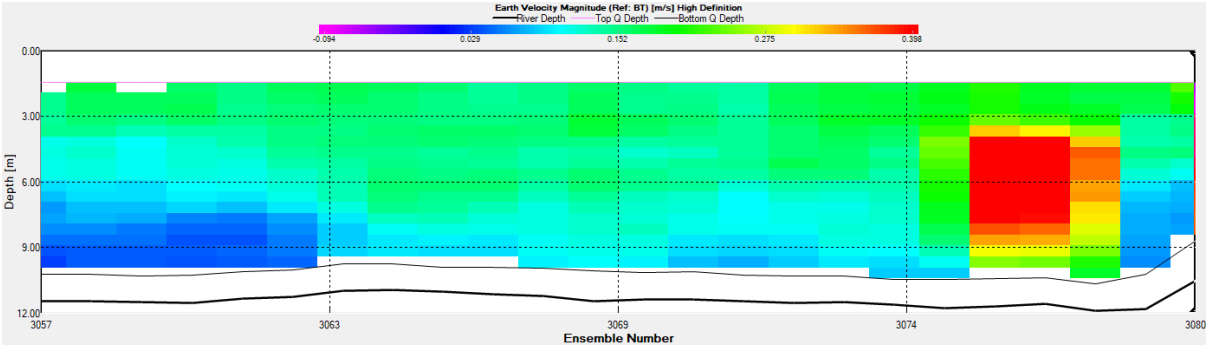

Figure 7: Example vessel wake in transect data.

7.2 CTD and turbidity cast data

An initial inspection of the data identifies a start time for the cast when the sensors had equilibrated with ambient water conditions.

The data processing then follows a quality control method. Each parameter measured during the cast is tested against a range limit and an expected rate-of-change limit These data ranges (as defined in (Table 11) are applied to extract all data which fail the limits and remove these from further processing. Any large changes in data parameters that occur between samples, as defined in Table 10, are identified and flagged. All flagged data identified by the QC routines are further inspected to determine if the data are outliers, which are removed, or if the data are real, in which case the data are retained. Data adjacent to flagged data is also inspected for possible removal.

The last stable data point at the bottom of the cast is also identified and unreliable data found after this point has been removed.

Table 11: Data quality control checks – range and rate parameters.

Parameter	Units	Range Flag		Rate Flag	
		Minimum Value	Maximum Value	Maximum Rate of Change per Sample	Sample Interval
Salinity	PSU	5	40	0.2	0.25 s
Temperature	ºC	0	30	2.0	0.25 s
Turbidity	FNU	0	4000	0.5	0.5 s

7.3 Suspended Sediment Conversion

Following the analysis of the collected water samples and the low turbidity environment found during the surveys; It was decided that a conversion would not have sufficient accuracy to be beneficial. It was therefore removed from the work scope.

7.4 Single beam Data

An initial navigation check is completed, to ensure the vessel position and vessel stability are within suitable limits. The collected datasets are trimmed to remove data outside the survey line limits. Once trimmed a manual inspection of the datasets is completed. This removes erroneous bathymetric artefacts from the final data set. Once the QC is completed, the bathymetry is reduced to ODN using the RTK tide collected during the survey. As each transect has a survey duration of approximately two minutes, a single RTK tide value is used for each transect.

7.5 RTK Tide

The data is filtered using GPS quality. This process, flags and removes any time periods where GPS quality was reduced from 'Fixed RTK' to 'Float RTK'. The total time of Fixed RTK is shown in Table 12

Table 12: QC Data return for RTK tide file.

Survey	Data Return	Fixed RTK Data		
		Counts	Percentage	Total time (hh:mm:ss)
Spring (24072020)	47563	45052	94.7%	12:30:52
Neap (30072020)	46730	42379	90.7%	11:46:19

8 Data

8.1 VMADCP

All 156 VMADCP figures have been sent as a .zip file as per Table 13: Data delivery overview.

8.2 CTD

The four summary figures: Figure 8, Figure 9: Hourly Salinity Profile – Neap.

, Figure 10: Hourly Temperature Profiles – Spring.
and Figure 11 show CTD data for 13 of the 26 profiles completed on each survey.

8.2.1 Temperature

During both surveys, a thermocline forms over the period of the survey day. Surface waters reach temperatures close to 16°C.

During the Neap survey, a stratification between surface warm waters and deeper cooler waters exist at 2-3 m depth. The bottom layer has a variation of ~1°C over the survey. This bottom water is warmest at low water before, cooling as the tide floods and then warming again as the tide ebbs. The surface water continues to warm throughout the day until HW+4, with the HW+5 and HW+6 profiles showing some cooling occurring at the end of the day.

The spring temperature profiles show a similar thermocline., however they do show greater variability in the depth and strength of the stratification throughout the survey. Below 5 m, there is some variability in temperature between profiles; however, there is no tidal signature in this variability.

8.2.2 Salinity

During both surveys a halocline exists between 2-4 m. The surface waters are fresher and show a variation in structure throughout the surveys. The bottom homogenous layer shows very little structural change throughout the surveys.

During the spring survey a tidal signature is present in the surface layer. Greater stratification occurs at LW, whereas at HW, stratification reduces. At evening HW, the entire water column salinity increases, with very little difference (0.5 PSU) between surface and bed values.

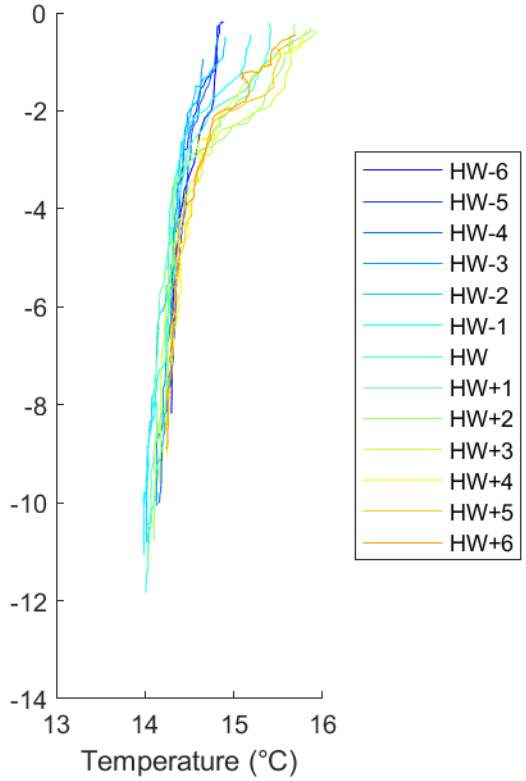

Figure 8: Hourly Temperature Profiles – Neap.

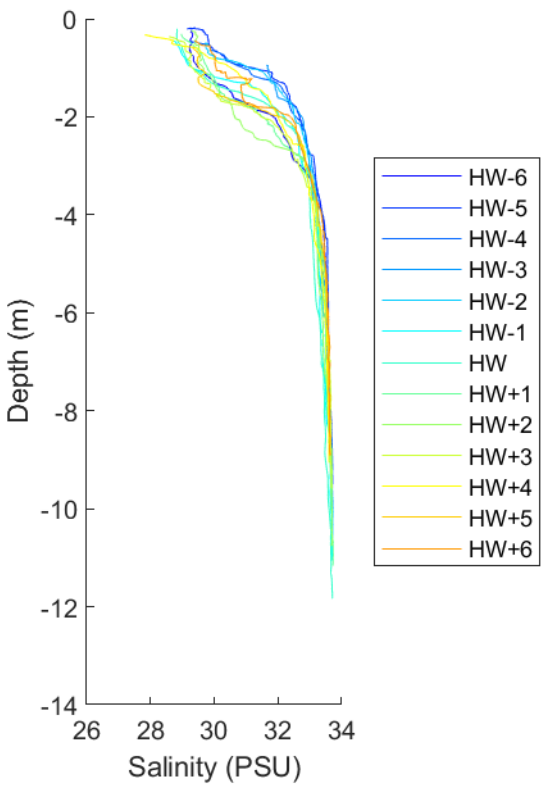

Figure 9: Hourly Salinity Profile – Neap.

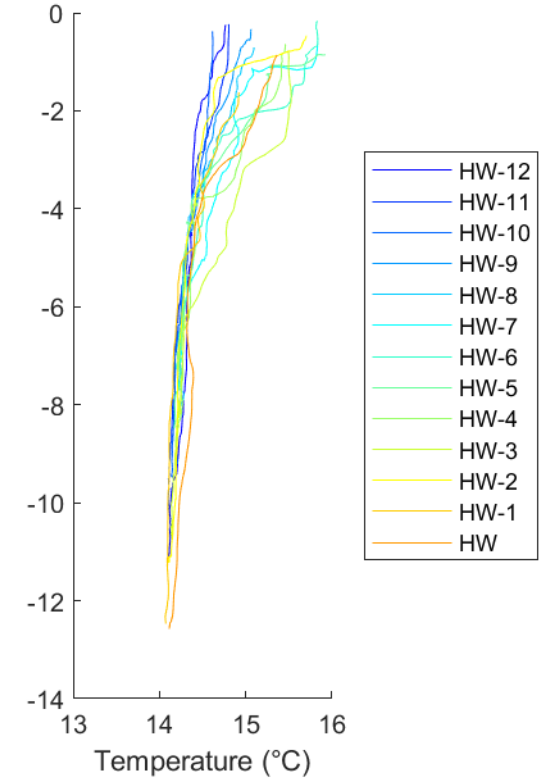

Figure 10: Hourly Temperature Profiles – Spring.

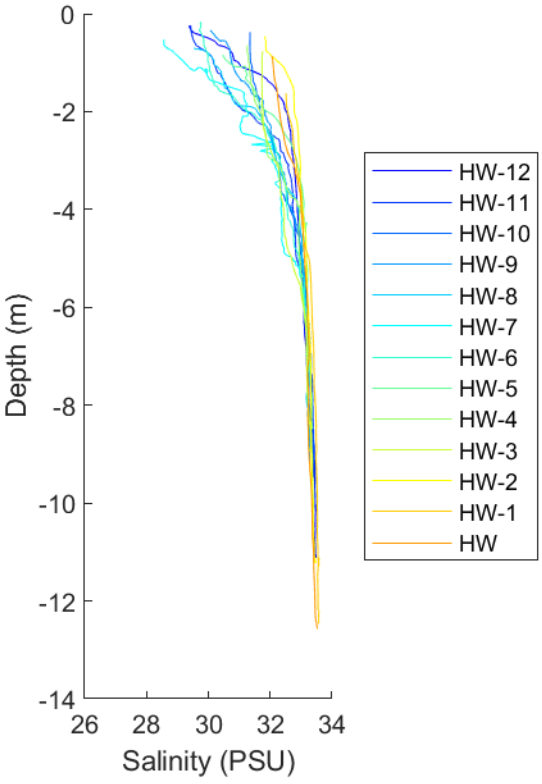

Figure 11: Hourly Salinity Profiles – Spring.

8.3 Turbidity

Two summary plots of Turbidity are presented (**Error! Reference source not found.** and Figure 13); the plots show 13 of the 26 profiles completed on each survey.

A low turbidity water column was present during both surveys. Lowest turbidity values (<5 FTU) were found at the surface, with increasing turbidity at the bed (5-10 FTU).

Some variation between spring and neap tides is evident in the data collected. During the Neap survey, less variation is found in the turbidity values (all data <6 FTU), when compared to Spring survey (all data <10 FTU).

During the spring cycle the surface 4 m layer shows very little variation, 1-4 FTU, whilst the lower half of the water column shows clear temporal variation. Highest turbidity values are found over LW, whereas over high water, the water column has the lowest turbidity and shows very little change in turbidity with depth.

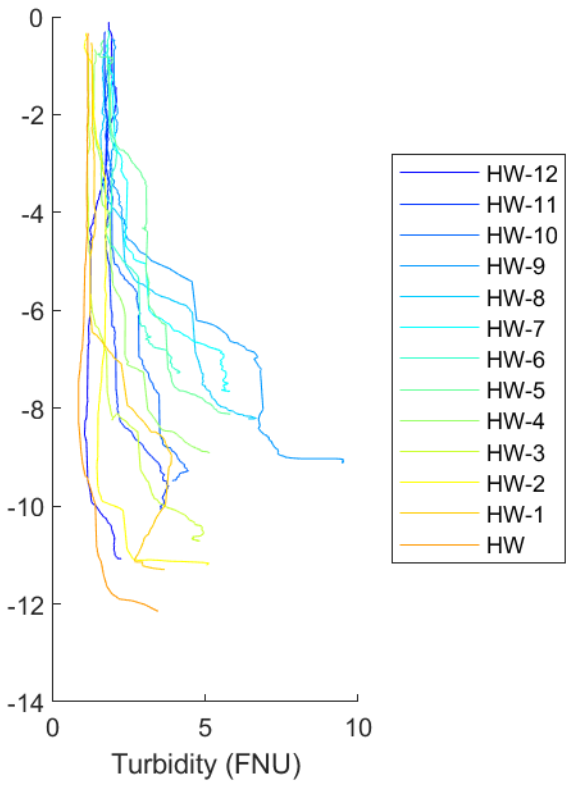

Figure 12: Hourly Spring Turbidity.

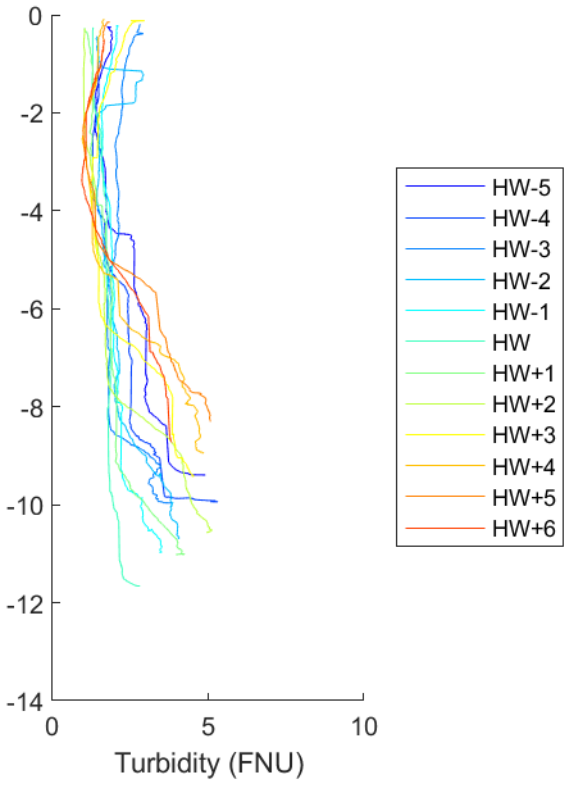

Figure 13: Hourly Neap Turbidity.

8.4 Single Beam Data

All transects have a similar, broadly featureless, bathymetry in the centre of the channel. Transect 9 has the shallowest bathymetry, as seen in Figure 14 and Figure 15, with a shallow bank on the north-western end of the transect. Transect 8, as shown in Figure 16 and Figure 17, and Transect 11, as shown in Figure 18 and Figure 19, have similar profiles, both transects show a defined bank on the south-eastern edge of the transect, with a minimum depth of ~6.7 m.

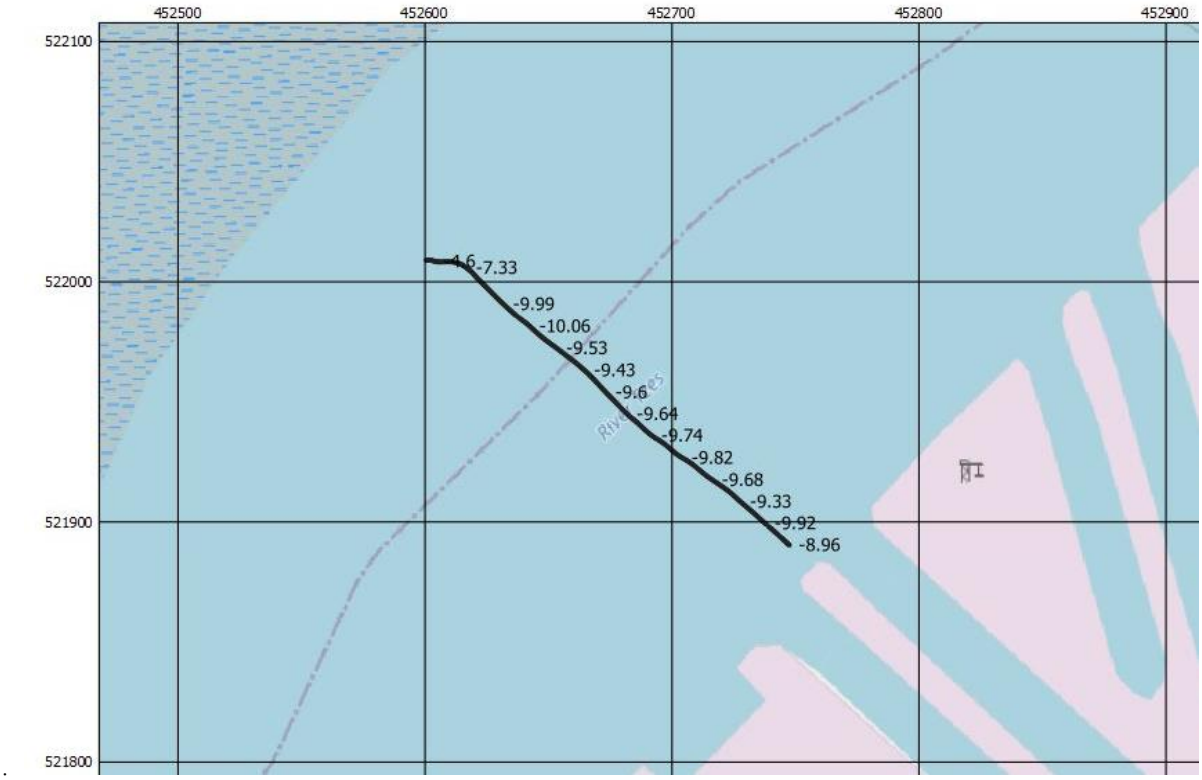

Figure 14: Transect 9 Bathymetry (mODN).

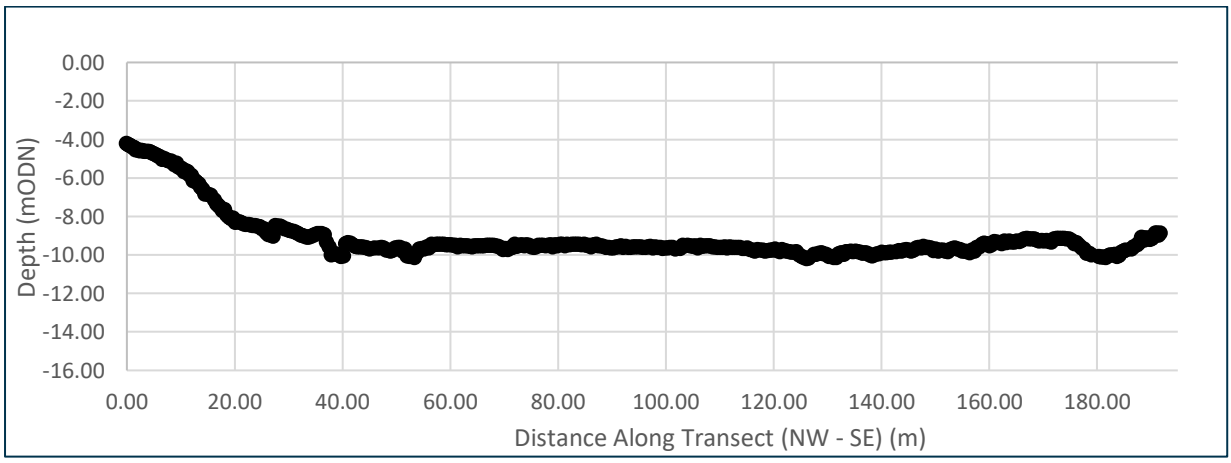

Figure 15: Transect 9 Bathymetry Profile.

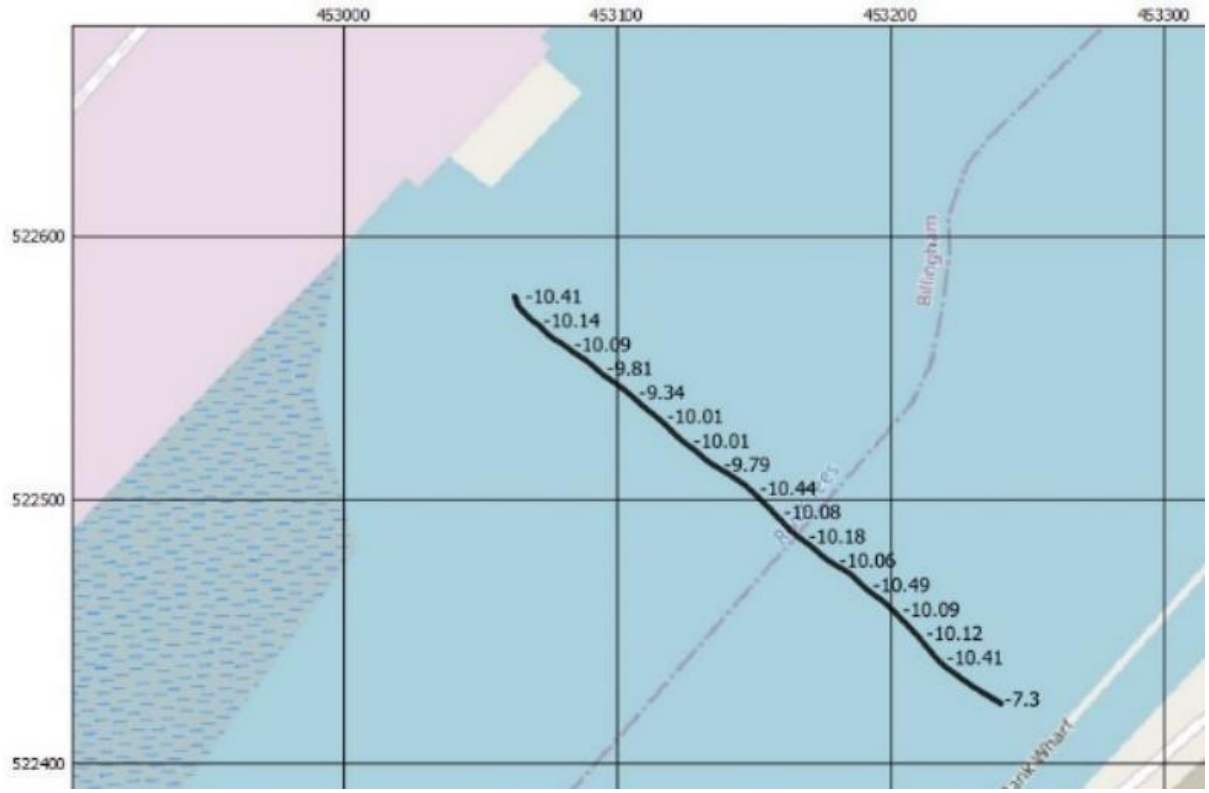

Figure 16: Transect 8 Bathymetry (mODN).

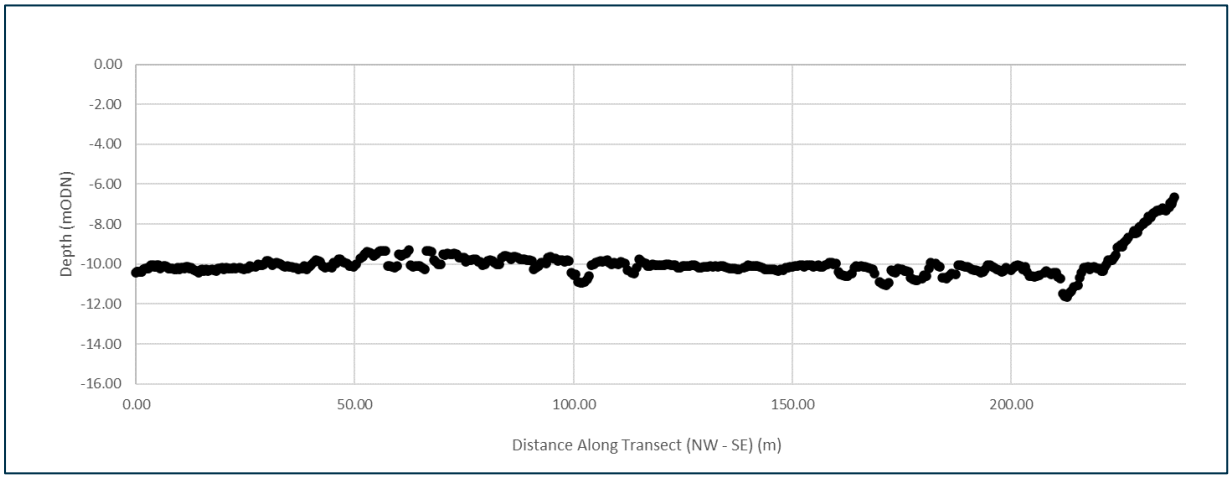

Figure 17: Transect 8 Bathymetry Profile.

Figure 18: Transect 11 Bathymetry(mODN).

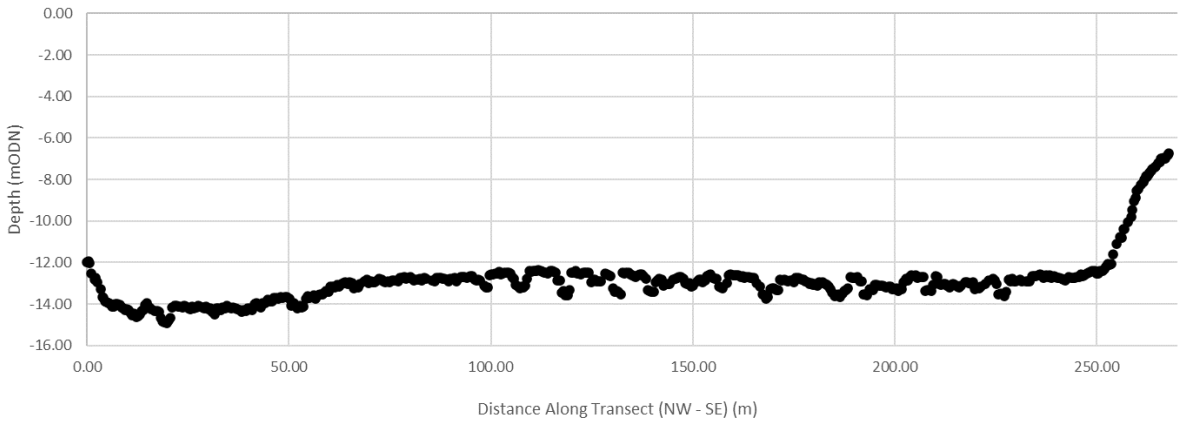

Figure 19: Transect 11 Bathymetry Profile.

8.5 RTK Tide

RTK tide files were collected during both VMADCP surveys. Both data sets show excellent agreement with Tees Port Riverside tide gauge, as shown in Figure 20 and Figure 21.

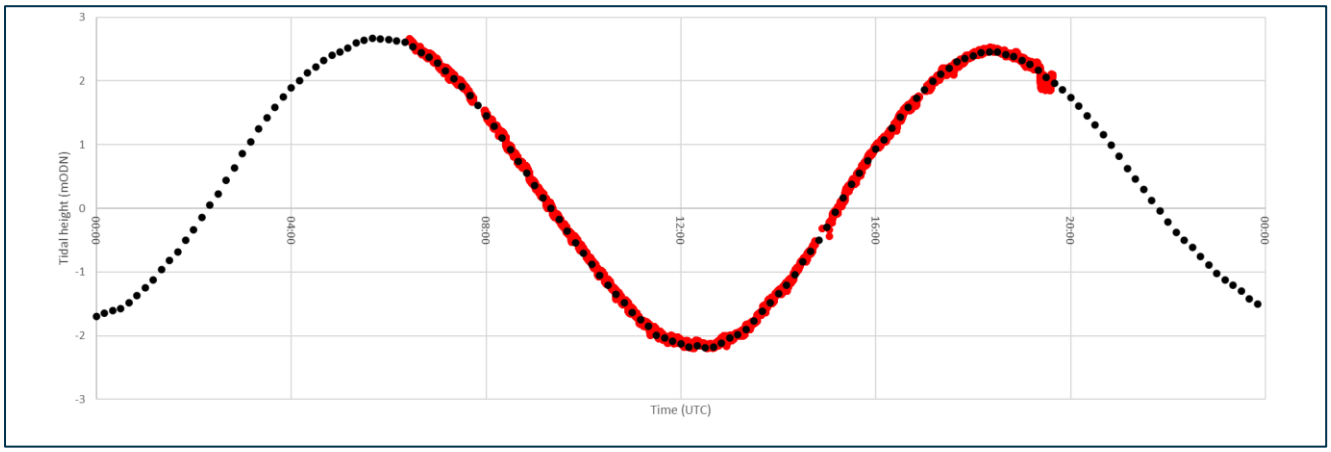

Figure 20: RTK tide (Red) and Tees Port Riverside Tide Gauge (Black) during Spring VMADCP survey, 24/07/2020.

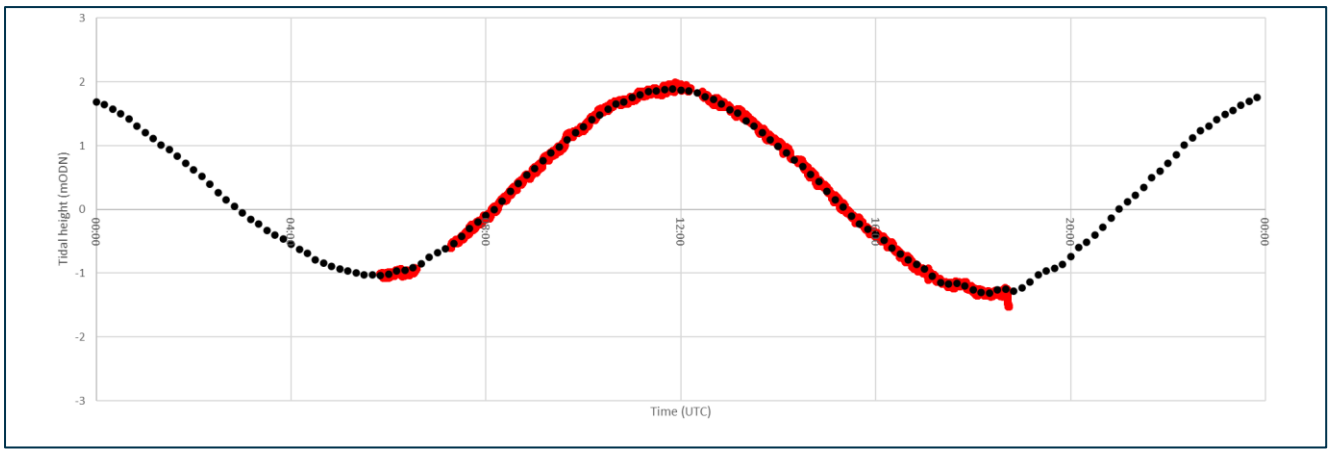

Figure 21: RTK tide (Red) and Tees Port Riverside Tide Gauge (Black) during Neap VMADCP survey, 30/07/2020.

9 Data Delivery

A summary of Data Delivered is given in Table 13. Data delivery was completed on 26th August 2020.

Table 13: Data delivery overview.

Parameter	Data Type	File/folder name	File type
VMADCP	Data tables	P1983.04.06.D10v01 - T11 VMADCP Data_Spring 24072020 P1983.04.06.D11v01 - T8 VMADCP Data_Spring 24072020 P1983.04.06.D12v01 - T9 VMADCP Data_Spring 24072020 P1983.04.06.D13v01 - T9 VMADCP Data_Neap 30072020 P1983.04.06.D14v01 - T8 VMADCP Data_Neap 30072020 P1983.04.06.D15v01- T11 VMADCP Data_Neap 30072020	.xlsx
	Figures	05 - VMADCP Contours_Neap 30072020 06 - VMADCP Contours_Spring 24072020	.zip (.png)
CTD Profiles	Data tables	P1983.04.06.D01v01 - CTD Profile Data_Spring 24072020 P1983.04.06.D02v01 - CTD Profile Data_Neap 30072020	.xlsx
	Figures	01 - CTD Profile Figures_Spring 24072020 02 - CTD Profile Figures_Neap 30072020	.zip (.png)
Turbidity Profiles	Data tables	P1983.04.06.D03v01 - Turbidity Profile Data_Spring 24072020 P1983.04.06.D04v01 - Turbidity Profile Data_Neap 30072020	.xlsx
	Figures	03 - Turbidity Profile Figures_Spring 24072020 04 - Turbidity Profile Figures_Neap 30072020	.zip (.png)
Bathymetry	Data tables	P1983.04.06.D05v01 - Singlebeam_ DateTimeXYZ	.xlsx
Tide	Data tables	P1983.04.06.D06v01 - Tide Data	.xlsx
Meteorological	Data tables	P1983.04.06.D07v01 - Met Data	.xlsx
Suspended Solids	Report	P1983.04.06.D08 - Suspended Solids Lab Results_Spring 24072020 P1983.04.06.D09 - Suspended Solids Lab Results_Neap 30072020	.pdf

Appendix A – Daily Progress Reports

PARTRAC CONFIDENTIAL

Project	Tees VMADCP	Project/Contract No.	P1983
Document No.	P1983.05.01.D01	Revision / Series	S01
Document Title	DAILY PROGRESS REPORT		

Location	Tees Estuary	Vessel	Tees Sentinel
Date	22/07/2020	Personnel	DP MV
Weather	Overcast, light intermittent rain		
Wind speed	5-10 Kts	Sea state	Smooth

LOCAL TIME	OPERATIONS SUMMARY
0900	Arrive at Harbour Conservancy, complete site induction.
0940	Mobilise Tees Sentinel for single beam survey, load VMADCP equipment onboard
1330	Wait for engine maintenance to be completed by vessel engineer
1530	Depart Dry dock – transit to Survey area
1600	Complete CTD cast and convert to Sound velocity
1620	Complete SBES Survey
1710	Return transit to Tees Sentinel mooring berth
1730	Demobilise SBES - Mobilise ADCP to side mount
1750	Run ADCP Tests and check operation
1850	Depart Tees Sentinel

Survey DETAILS	
Instrument	Serial
Kongsberg Minisounder Single Beam RDI Workhorse 600KHz ADCP Trimble Marine Positioning System 865 Valeport Mini CTD Xylem EXO2	18812 15263 5910R93520 46053 17L103726

WORK COMPLETED / COMMENTS / PROBLEMS ENCOUNTERED

1. Completed SBES survey
2. Mobilised VMADCP
3. Mobilised water sampling equipment

WORK PLANNED FOR THE NEXT 24HRS

Complete VMADCP and water sampling survey

HSE

Site induction completed
Vessel induction completed
Vessel audit form completed
COVID Restrictions – maintaining 2m distance from vessel crew where possible. Hand sanitiser available on board and used regularly

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Figure 22: Daily Progress Report 22/07/2020.

PARTRAC CONFIDENTIAL

Project	Tees VMADCP	Project/Contract No.	P1983
Document No.	P1983.05.01.D01	Revision / Series	S02
Document Title	DAILY PROGRESS REPORT		

Location	Tees Estuary	Vessel	Tees Sentinel
Date	23/07/2020	Personnel	DP MV
Weather	Intermittent heavy rain		
Wind speed	5-10 Kts	Sea state	Smooth

LOCAL TIME	OPERATIONS SUMMARY
0600	Arrive at vessel for survey operations
0615	Depart berth to Survey area
0630	Presurvey checks Issue found with GGA feed – bottom tracking seemed good. Problem monitored
0710	Survey started at HW+0. Issue with positioning in Winriver monitored
0730	First CTD and water sample completed
0741	Second run of transect 8, positioning problem diagnosed as issue with WinRiver II timing issue.
0745	Survey paused whilst troubleshooting continues
0930	Fault resolved by re-installing software. Survey would need to restart at 10:10 – finishing at 23:10. Too late for operations. Survey postponed for 24 hours
1010	Leave vessel with working system. Data back up on shore and Single beam survey processing.

Survey DETAILS				
Instrument	Serial			
Kongsberg Minisounder Single Beam RDI Workhorse 600KHz ADCP Trimble Marine Positioning System 865 Valeport Mini CTD Xylem EXO2	18812 15263 5910R93520 46053 17L103726			

WORK COMPLETED / COMMENTS / PROBLEMS ENCOUNTERED

Work completed

1. Started VMADCP survey
2. 1st transect lap took 31 minutes, with increased efficiency 30min laps will be achievable

Problem encountered:
Position and heading shown in winriver II was different to that shown in navigation software, Troubleshooting to find root of problems found WinriverII receiving correct positions but applying a varying time delay of between 15 seconds – 2 minutes to position data and applying to data. When stationary data looks good, when on constant heading on line data looks occasionally good.

Software re-installed, system immediately operates correctly. No time delay. Data checked by driving repeated circles in opposing directions.

OPERATIONS IN NEXT 24 HOURS

Complete VMADCP and water sampling survey

HSE

COVID Restrictions – maintaining 2m distance from vessel crew where possible. Hand sanitiser available on board and used regularly

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Figure 23: Daily Progress Report 23/07/2020.

PARTRAC CONFIDENTIAL

Project	Tees VMADCP	Project/Contract No.	P1983
Document No.	P1983.05.01.D01	Revision / Series	S03
Document Title	DAILY PROGRESS REPORT		

Location	Tees Estuary	Vessel	Tees Sentinel
Date	24/07/2020	Personnel	DP MV
Weather	Clear		
Wind speed	5-10 Kts	Sea state	Smooth

LOCAL TIME	OPERATIONS SUMMARY
0630	Arrive at vessel for survey operations
0640	Depart berth to Survey area.
0700	Complete pre-survey checks of equipment
0730	Begin 13 hour VMADCP and water sampling survey
2020	Complete water sampling. Spring survey complete.
2050	Vessel alongside
2120	Demob complete.

Survey DETAILS				
Instrument	Serial			
Kongsberg Minisounder Single Beam RDI Workhorse 600KHz ADCP Trimble Marine Positioning System 865 Valeport Mini CTD Xylem EXO2	18812 15263 5910R93520 46053 17L103726			
WORK COMPLETED / COMMENTS / PROBLEMS ENCOUNTERED				
Work completed 1. Spring VMADCP survey				
Operations for next 24 hours				
Return travel				
HSE				
COVID Restrictions – maintaining 2m distance from vessel crew where possible. Hand sanitiser available on board and used regularly				
CLIENT ACTIONS REQUIRED				
None				

	Name	Signature
PARTRAC	Dan Pitt	

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Figure 24: Daily Progress Report 24/07/2020.

PARTRAC CONFIDENTIAL

Project	Tees VMADCP	Project/Contract No.	P1983
Document No.	P1983.05.01.D01	Revision / Series	S04
Document Title	DAILY PROGRESS REPORT		

Location	Tees Estuary	Vessel	Tees Sentinel
Date	29/07/2020	Personnel	DP MV
Weather	Clear		
Wind speed	5-10 Kts	Sea state	Smooth

LOCAL TIME	OPERATIONS SUMMARY
1430	Arrive at vessel for mobilisation
1530	Depart berth to complete sea trials of survey equipment
1630	Alongside sea trials complete

Survey DETAILS				
Instrument	Serial			
Kongsberg Minisounder Single Beam RDI Workhorse 600KHz ADCP Trimble Marine Positioning System 865 Valeport Mini CTD Xylem EXO2	18812 15263 5910R93520 46053 17L103726			
WORK COMPLETED / COMMENTS / PROBLEMS ENCOUNTERED				
Work completed 1. Neap mobilisation				
Operations for next 24 hours				
Neap VMADCP and water sampling				
HSE				
COVID Restrictions – maintaining 2m distance from vessel crew where possible. Hand sanitiser available on board and used regularly				
CLIENT ACTIONS REQUIRED				
None				

	Name	Signature
PARTRAC	Dan Pitt	

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Figure 25: Daily Progress Report 29/07/2020.

PARTRAC CONFIDENTIAL

Project	Tees VMADCP	Project/Contract No.	P1983
Document No.	P1983.05.01.D01	Revision / Series	S05
Document Title	DAILY PROGRESS REPORT		

Location	Tees Estuary	Vessel	Tees Sentinel
Date	30/07/2020	Personnel	DP MV
Weather	Clear - sun		
Wind speed	5-10 Kts	Sea state	Smooth

LOCAL TIME	OPERATIONS SUMMARY
0600	Arrive at vessel for survey operations
0610	Depart berth to Survey area.
0630	Complete pre-survey checks of equipment
0643	Begin 13 hour VMADCP and water sampling survey
1950	Complete water sampling. Neap survey complete.
2010	Vessel alongside
2140	Demob complete.

Survey DETAILS				
Instrument	Serial			
Kongsberg Minisounder Single Beam RDI Workhorse 600KHz ADCP Trimble Marine Positioning System 865 Valeport Mini CTD Xylem EXO2	18812 15263 5910R93520 46053 17L103726			

WORK COMPLETED / COMMENTS / PROBLEMS ENCOUNTERED
Work completed 1. Neap VMADCP survey
Operations for next 24 hours
Return travel
HSE
COVID Restrictions – maintaining 2m distance from vessel crew where possible. Hand sanitiser available on board and used regularly
CLIENT ACTIONS REQUIRED
None

	Name	Signature
PARTRAC	Dan Pitt	

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Figure 26: Daily Progress Report 30/07/2020.

Appendix B – VMADCP Data Summary Tables

Table 14: Transect 09 - Spring

Transect 09	Depth Mean Averaged			All Cells	
	Median direction (°)	Min Speed (m/s)	Max speed (m/s)	Min Speed (m/s)	Max Speed (m/s)
Spring_003 (061555)	37.10	0.01	0.13	0.00	0.25
Spring_006 (064523)	44.20	0.06	0.15	0.02	0.37
Spring_009 (071352)	43.40	0.13	0.23	0.06	0.30
Spring_012 (074437)	43.50	0.18	0.24	0.10	0.36
Spring_015 (081548)	44.20	0.21	0.29	0.10	0.42
Spring_018 (084444)	44.40	0.26	0.34	0.11	0.49
Spring_021 (091355)	44.05	0.23	0.35	0.09	0.50
Spring_024 (094512)	43.10	0.22	0.35	0.04	0.49
Spring_027 (101731)	43.55	0.08	0.32	0.04	0.45
Spring_030 (104614)	44.90	0.09	0.32	0.05	0.44
Spring_033 (111400)	45.15	0.05	0.24	0.02	0.33
Spring_036 (114332)	47.60	0.02	0.11	0.01	0.35
Spring_039 (121421)	61.80	0.01	0.07	0.00	0.20
Spring_043 (125046)	225.75	0.05	0.17	0.01	0.24
Spring_046 (131606)	230.70	0.13	0.27	0.02	0.33
Spring_049 (134358)	225.30	0.11	0.29	0.06	0.44
Spring_052 (141555)	224.50	0.17	0.26	0.05	0.37
Spring_055 (144542)	225.10	0.20	0.35	0.09	0.55
Spring_059 (152700)	228.60	0.21	0.37	0.15	0.52
Spring_062 (154626)	227.45	0.13	0.27	0.05	0.39
Spring_065 (161757)	228.20	0.21	0.29	0.12	0.40
Spring_068 (165345)	227.60	0.14	0.21	0.04	0.34
Spring_071 (171823)	235.20	0.03	0.18	0.00	0.29
Spring_074 (174701)	240.30	0.05	0.11	0.02	0.23
Spring_077 (181609)	252.35	0.01	0.10	0.00	0.27
Spring_080 (185051)	40.85	0.04	0.11	0.01	0.25

Table 15: Transect 08 - Spring

Transect 08	Depth Mean Averaged			All Cells	
	Median direction (°)	Min Speed (m/s)	Max speed (m/s)	Min Speed (m/s)	Max Speed (m/s)
Spring_004 (063200)	41.60	0.03	0.10	0.00	0.25
Spring_007 (070200)	41.70	0.07	0.21	0.01	0.31
Spring_010 (073125)	37.30	0.13	0.30	0.03	0.37
Spring_013 (080115)	40.35	0.07	0.29	0.02	0.39
Spring_016 (083111)	42.65	0.06	0.35	0.02	0.47
Spring_019 (090019)	41.60	0.11	0.36	0.03	0.55
Spring_022 (093147)	43.95	0.02	0.39	0.01	0.52
Spring_025 (100411)	50.15	0.04	0.37	0.02	0.49
Spring_028 (103239)	45.20	0.13	0.40	0.02	0.48
Spring_031 (110128)	44.10	0.01	0.34	0.01	0.49
Spring_034 (113037)	55.80	0.03	0.29	0.02	0.41
Spring_037 (120114)	130.20	0.04	0.15	0.01	0.25
Spring_041 (123425)	134.80	0.03	0.10	0.01	0.21
Spring_044 (130155)	207.50	0.05	0.19	0.02	0.28
Spring_047 (132946)	221.40	0.14	0.24	0.07	0.36
Spring_050 (140149)	217.00	0.11	0.26	0.04	0.40
Spring_053 (143452)	218.70	0.19	0.24	0.04	0.44
Spring_056 (150202)	217.75	0.21	0.33	0.10	0.41
Spring_060 (153228)	219.65	0.19	0.29	0.10	0.37
Spring_063 (160223)	220.10	0.13	0.21	0.03	0.31
Spring_066 (164043)	220.00	0.13	0.25	0.06	0.37
Spring_069 (170927)	222.20	0.05	0.16	0.01	0.23
Spring_072 (173226)	216.20	0.06	0.16	0.00	0.32
Spring_075 (180205)	208.80	0.01	0.10	0.00	0.21
Spring_078 (183229)	75.25	0.01	0.06	0.00	0.20
Spring_081 (190222)	41.25	0.05	0.12	0.00	0.25

Table 16: Transect 11 -Spring

Transect 11	Depth Mean Averaged			All Cells	
	Median direction (°)	Min Speed (m/s)	Max speed (m/s)	Min Speed (m/s)	Max Speed (m/s)
Spring_005 (063901)	32.60	0.03	0.16	0.01	0.34
Spring_008 (070818)	31.30	0.08	0.13	0.01	0.36
Spring_011 (073831)	43.40	0.10	0.19	0.02	0.30
Spring_014 (080747)	38.50	0.12	0.27	0.05	0.43
Spring_017 (083846)	40.70	0.16	0.26	0.06	0.36
Spring_020 (090732)	40.85	0.07	0.26	0.01	0.39
Spring_023 (093908)	40.75	0.05	0.29	0.01	0.42
Spring_026 (101111)	39.50	0.04	0.31	0.01	0.43
Spring_029 (104003)	38.50	0.02	0.29	0.01	0.41
Spring_032 (110825)	31.40	0.01	0.25	0.01	0.40
Spring_035 (113715)	28.40	0.04	0.21	0.01	0.35
Spring_038 (120831)	22.70	0.01	0.09	0.01	0.42
Spring_042 (123905)	243.90	0.01	0.06	0.01	0.28
Spring_045 (130917)	220.30	0.05	0.14	0.01	0.24
Spring_048 (133736)	222.75	0.13	0.18	0.01	0.29
Spring_051 (140944)	224.65	0.12	0.21	0.04	0.38
Spring_054 (143913)	226.60	0.16	0.24	0.06	0.34
Spring_057 (151017)	224.70	0.19	0.28	0.11	0.41
Spring_061 (153939)	225.20	0.13	0.22	0.03	0.32
Spring_064 (161052)	225.60	0.09	0.18	0.02	0.28
Spring_067 (164741)	226.30	0.11	0.21	0.01	0.30
Spring_070 (171235)	227.05	0.05	0.14	0.00	0.32
Spring_073 (174051)	227.45	0.05	0.17	0.00	0.34
Spring_076 (180928)	229.30	0.02	0.08	0.00	0.20
Spring_079 (184042)	37.10	0.01	0.05	0.00	0.21
Spring_082 (190919)	40.35	0.03	0.13	0.00	0.26

Table 17: Transect 09 – Neap.

Transect 09	Depth Mean Averaged			All Cells	
	Median direction (°)	Min Speed (m/s)	Max speed (m/s)	Min Speed (m/s)	Max Speed (m/s)
Neap_002 (054540)	139.25	0.01	0.06	0.00	0.21
Neap_005 (060524)	221.90	0.03	0.15	0.01	0.24
Neap_008 (063525)	224.00	0.11	0.23	0.04	0.33
Neap_011 (070545)	225.10	0.06	0.17	0.01	0.31
Neap_014 (073653)	222.80	0.08	0.23	0.00	0.33
Neap_017 (080355)	228.00	0.12	0.24	0.03	0.35
Neap_020 (083538)	226.50	0.09	0.25	0.02	0.35
Neap_023 (090645)	228.40	0.18	0.25	0.09	0.34
Neap_026 (093445)	228.20	0.09	0.22	0.03	0.34
Neap_029 (100500)	228.85	0.05	0.22	0.00	0.36
Neap_032 (103453)	225.30	0.03	0.13	0.00	0.26
Neap_035 (110403)	232.20	0.02	0.14	0.00	0.25
Neap_038 (113439)	236.65	0.01	0.08	0.00	0.23
Neap_041 (121246)	70.70	0.00	0.11	0.00	0.32
Neap_044 (123926)	128.65	0.00	0.09	0.00	0.19
Neap_047 (130638)	43.40	0.04	0.15	0.00	0.27
Neap_050 (133548)	41.40	0.07	0.18	0.00	0.25
Neap_053 (140500)	40.75	0.06	0.15	0.02	0.23
Neap_059 (150537)	40.10	0.15	0.23	0.09	0.36
Neap_056 (143649)	39.7	0.14	0.23	0.07	0.3
Neap_062 (153459)	41.15	0.11	0.20	0.04	0.30
Neap_065 (160505)	40.50	0.05	0.15	0.00	0.25
Neap_068 (163502)	43.45	0.06	0.21	0.02	0.40
Neap_071 (170400)	36.50	0.01	0.12	0.01	0.23
Neap_074 (173439)	231.55	0.01	0.08	0.00	0.28
Neap_077 (180343)	36.70	0.01	0.09	0.01	0.25

Table 18: Transect 08 – Neap.

Transect 08	Depth Mean Averaged			All Cells	
	Median direction (°)	Min Speed (m/s)	Max speed (m/s)	Min Speed (m/s)	Max Speed (m/s)
Neap_003 (055248)	160.25	0.01	0.11	0.00	0.19
Neap_006 (062250)	221.25	0.04	0.13	0.00	0.26
Neap_009 (065302)	217.20	0.11	0.19	0.04	0.31
Neap_012 (072343)	208.10	0.05	0.16	0.02	0.23
Neap_015 (075110)	218.90	0.14	0.21	0.06	0.30
Neap_018 (082301)	220.25	0.13	0.20	0.05	0.31
Neap_021 (085353)	218.80	0.17	0.23	0.07	0.32
Neap_024 (092232)	215.50	0.08	0.17	0.02	0.24
Neap_027 (095236)	216.60	0.12	0.16	0.02	0.26
Neap_030 (102226)	215.85	0.07	0.15	0.01	0.26
Neap_033 (105210)	213.25	0.02	0.11	0.01	0.22
Neap_036 (112236)	215.20	0.04	0.11	0.01	0.21
Neap_039 (120042)	84.00	0.01	0.05	0.00	0.23
Neap_042 (122709)	80.45	0.00	0.04	0.00	0.25
Neap_045 (125339)	45.00	0.01	0.08	0.00	0.38
Neap_048 (132325)	39.50	0.07	0.16	0.02	0.33
Neap_051 (135201)	38.10	0.02	0.19	0.01	0.34
Neap_054 (142358)	42.70	0.01	0.15	0.01	0.31
Neap_057 (145312)	39.70	0.01	0.23	0.00	0.36
Neap_060 (152230)	40.80	0.02	0.22	0.00	0.34
Neap_063 (155212)	47.20	0.01	0.19	0.01	0.37
Neap_066 (162213)	46.50	0.03	0.21	0.01	0.36
Neap_069 (165133)	44.80	0.04	0.20	0.00	0.35
Neap_072 (172131)	47.70	0.02	0.14	0.01	0.30
Neap_075 (175132)	83.10	0.01	0.09	0.00	0.39
Neap_078 (182100)	54.20	0.03	0.11	0.01	0.27

Table 19: Transect 11 – Neap.

Transect 11	Depth Mean Averaged			All Cells	
	Median direction (°)	Min Speed (m/s)	Max speed (m/s)	Min Speed (m/s)	Max Speed (m/s)
Neap_004 (055935)	136.20	0.01	0.11	0.00	0.17
Neap_007 (062925)	218.45	0.03	0.11	0.01	0.19
Neap_010 (065943)	227.80	0.08	0.13	0.00	0.29
Neap_013 (073032)	226.05	0.08	0.13	0.00	0.27
Neap_016 (075805)	221.85	0.13	0.18	0.03	0.34
Neap_019 (083250)	225.35	0.08	0.17	0.03	0.25
Neap_022 (090031)	224.00	0.11	0.17	0.03	0.30
Neap_025 (092854)	233.80	0.05	0.14	0.00	0.32
Neap_028 (095918)	227.90	0.07	0.14	0.01	0.29
Neap_031 (102906)	225.10	0.06	0.16	0.00	0.25
Neap_034 (105824)	236.65	0.02	0.08	0.00	0.30
Neap_037 (112903)	225.05	0.03	0.12	0.00	0.20
Neap_040 (120708)	108.50	0.00	0.04	0.00	0.20
Neap_043 (123348)	38.50	0.00	0.08	0.00	0.20
Neap_046 (130052)	33.00	0.01	0.11	0.01	0.20
Neap_049 (132947)	45.50	0.07	0.17	0.01	0.26
Neap_052 (135906)	45.60	0.04	0.13	0.01	0.27
Neap_055 (143047)	43.20	0.06	0.14	0.01	0.35
Neap_058 (150001)	40.70	0.08	0.17	0.01	0.34
Neap_061 (152911)	42.50	0.07	0.16	0.02	0.33
Neap_064 (155906)	37.20	0.03	0.14	0.01	0.28
Neap_067 (162939)	44.20	0.06	0.15	0.01	0.30
Neap_070 (165820)	46.60	0.02	0.15	0.00	0.33
Neap_073 (172841)	49.00	0.01	0.10	0.00	0.25
Neap_076 (175820)	44.30	0.01	0.07	0.01	0.19
Neap_079 (182758)	38.40	0.01	0.06	0.00	0.36

Appendix C – CTD Profile Statistics

Table 20: CTD data – Spring.

Cast (hhmmss)	Depth (m)	Salinity (PSU)				Temperature (°C)			
	Max	Min	Mean	Max	STD	Min	Mean	Max	STD
(064822)HW-12	11.12	29.37	32.90	33.48	0.80	14.10	14.32	14.77	0.17
(071539)HW-11.5	11.07	30.26	32.65	33.45	0.87	14.11	14.34	14.68	0.16
(074844)HW-11	10.14	29.43	32.84	33.46	0.90	14.10	14.29	14.81	0.20
(081632)HW-10.5	10.06	31.34	32.82	33.45	0.67	14.11	14.30	14.62	0.17
(084529)HW-10	9.48	31.34	32.77	33.39	0.71	14.14	14.32	14.62	0.17
(091529)HW-9.5	9.28	30.31	32.57	33.35	1.05	14.16	14.37	14.85	0.24
(094645)HW-9	9.22	30.07	32.52	33.28	0.89	14.20	14.45	15.06	0.25
(101840)HW-8.5	8.60	30.00	32.15	33.26	1.23	14.21	14.53	15.03	0.31
(104746)HW-8	8.23	29.53	32.48	33.23	1.01	14.23	14.46	15.10	0.27
(111632)HW-7.5	7.87	28.96	32.32	33.21	1.17	14.23	14.53	15.40	0.35
(114607)HW-7	7.71	28.56	32.29	33.24	1.17	14.22	14.57	15.84	0.38
(121705)HW-6.5	7.89	30.20	32.17	33.18	0.92	14.24	14.65	15.29	0.35
(124729)HW-6	7.28	29.71	32.03	33.27	1.30	14.20	14.78	15.84	0.60
(131836)HW-5.5	8.03	30.12	32.31	33.32	1.06	14.19	14.70	15.87	0.53
(134656)HW-5	8.49	30.44	32.67	33.36	0.86	14.17	14.61	15.92	0.47
(141837)HW-4.5	8.57	30.83	32.77	33.33	0.81	14.19	14.54	15.65	0.49
(144821)HW-4	8.94	31.25	32.74	33.32	0.66	14.19	14.54	15.46	0.40
(152156)HW-3.5	9.64	31.73	32.97	33.37	0.56	14.16	14.48	15.52	0.44
(154912)HW-3	10.73	31.73	32.94	33.40	0.57	14.14	14.49	15.53	0.46
(162612)HW-2.5	11.16	31.71	33.01	33.45	0.56	14.12	14.47	15.53	0.45
(165618)HW-2	11.23	31.83	33.11	33.48	0.45	14.11	14.40	15.71	0.41
(172048)HW-1.5	11.66	31.95	33.22	33.50	0.39	14.11	14.35	15.44	0.32
(175006)HW-1	12.47	32.51	33.33	33.59	0.29	14.07	14.25	14.92	0.22
(181938)HW-0.5	12.34	31.93	33.14	33.56	0.46	14.08	14.45	15.58	0.41
(185109)HW	12.57	32.06	33.02	33.53	0.42	14.12	14.51	15.37	0.36
(191740)HW+0.5	11.08	32.01	32.78	33.42	0.46	14.18	14.75	15.44	0.41

Table 21: CTD Profiles Statistics – Neap.

Cast (hhmmss)	Depth (m)	Salinity (PSU)				Temperature (°C)			
	Max	Min	Mean	Max	STD	Min	Mean	Max	STD
(061057)HW-6	8.18	29.22	32.66	33.59	1.47	14.3	14.45	14.84	0.2
(063935)HW-5.5	8.49	29.27	32.97	33.63	1.04	14.28	14.44	14.92	0.2
(070912)HW-5	9.5	29.15	32.22	33.72	1.71	14.18	14.52	14.88	0.24
(073926)HW-4.5	9	27.8	32.93	33.72	1.35	14.17	14.4	14.93	0.21
(080627)HW-4	10	29.22	33.28	33.72	0.84	14.16	14.34	14.83	0.18
(083819)HW-3.5	9.43	30.63	33.04	33.7	0.78	14.17	14.41	14.79	0.17
(091007)HW-3.0	10.07	31.64	33.29	33.7	0.52	14.13	14.3	14.66	0.15
(093735)HW-2.5	10.78	31.05	33.29	33.73	0.6	14.03	14.26	14.78	0.22
(100849)HW-2.0	10.81	29.7	33.18	33.73	0.82	14.02	14.24	14.91	0.24
(103840)HW-1.5	11.53	31.02	33.38	33.71	0.52	13.98	14.17	14.81	0.22
(110758)HW_1.0	11.05	28.75	33.08	33.71	1.09	13.98	14.24	15.2	0.31
(114421)HW-0.5	12.04	27.87	32.89	33.71	1.43	13.97	14.3	15.56	0.4
(121544)HW	11.84	28.83	32.83	33.71	1.29	14.01	14.39	15.42	0.39
(124209)HW+0.5	11.21	29.23	32.87	33.72	1.34	14.01	14.35	15.36	0.42
(130918)HW+1	11.17	28.97	32.95	33.74	1.24	14.03	14.37	15.87	0.44
(133817)HW+1.5	11.09	29.46	32.84	33.72	1.21	14.06	14.48	15.72	0.5
(140943)HW+2	10.76	29.29	32.73	33.7	1.41	14.1	14.49	15.7	0.51
(144031)HW+2.5	10.81	28.69	33.06	33.69	1.1	14.12	14.41	15.91	0.41
(151029)HW+3.0	9.58	28.59	32.61	33.68	1.51	14.17	14.6	15.93	0.56
(153910)HW+3.5	9.96	29.35	33.01	33.67	1.11	14.2	14.48	15.68	0.41
(160830)HW+4.0	9.06	27.83	32.87	33.6	1.07	14.25	14.56	15.84	0.37
(164047)HW+4.5	8.99	29.31	32.56	33.63	1.23	14.23	14.62	15.4	0.38
(170654)HW+5.0	8.55	29.32	32.66	33.65	1.42	14.23	14.63	15.67	0.44
(173716)HW+5.5	8.57	31.17	33.19	33.64	0.62	14.23	14.48	15.22	0.26
(180619)HW+6	8.91	29.39	32.69	33.66	1.29	14.23	14.62	15.71	0.41
(183609)HW+6.5	8.43	27.87	32.65	33.63	1.57	14.22	14.63	16.13	0.52

Appendix D – Turbidity Profile Data

Table 22: Turbidity Profile Statistics - Spring

Cast	Depth (m)	Turbidity (FNU)			
	Max	Min	Mean	Max	Std
(065822) HW-12	11.08	1	2	2	0.4
(072941) HW-11.5	10.97	1	2	4	0.7
(075455) HW-11	10.07	2	2	4	0.7
(082655) HW-10.5	10	1	2	5	1.1
(085605) HW-10	9.48	2	3	4	0.9
(092428) HW-9.5	9.26	2	3	5	1.4
(095541) HW-9	9.12	2	4	10	2.5
(102801) HW-8.5	8.59	2	3	7	1.9
(105707) HW-8	8.22	2	3	7	1.8
(112451) HW-7.5	7.82	2	4	6	1.8
(115346) HW-7	7.66	2	4	6	1.6
(122617) HW-6.5	7.86	2	3	8	1.5
(125845) HW-6	7.28	2	2	4	0.8
(132642) HW-5.5	8.02	1	2	6	1.2
(135439) HW-5	8.12	1	2	6	1
(142701) HW-4.5	8.52	1	3	6	1.5
(145946) HW-3.5	9.59	1	2	5	1.4
(145946) HW-4	8.92	1	2	5	1.1
(155642) HW-3	10.71	1	3	5	1.4
(163253) HW-2.5	10.92	1	3	7	1.7
(170226) HW-2	11.21	1	2	5	1.3
(172717) HW-1.5	11.67	1	2	4	1.2
(175710) HW-1	12.35	1	2	4	1
(182841) HW-0.5	12.43	1	1	3	0.5
(185819) HW	12.41	1	1	3	0.4
(192531) HW+0.5	11.17	1	2	4	1

Table 23: Turbidity Profile Statistics - Neap

Cast	Depth (m)	Turbidity (FNU)			
	Max	Min	Mean	Max	Std
(064642) HW-5.5	8.41	2	3	5	1
(071613) HW-5	9.39	1	2	5	0.7
(074631) HW-4.5	8.92	2	2	4	0.6
(081427) HW-4	9.94	1	3	5	1.2
(084620) HW-3.5	9.43	1	2	3	0.4
(091949) HW-3	9.96	2	2	4	0.6
(095027) HW-2.5	10.7	1	2	4	1
(101735) HW-2	10.69	1	2	4	0.9
(105128) HW-1.5	11.38	1	2	4	0.8
(112045) HW-1	10.97	2	2	4	0.5
(115132) HW-0.5	10.97	2	2	4	0.5
(122213) HW	11.66	1	2	3	0.3
(124853) HW+0.5	11.13	1	3	5	1.3
(131758) HW+1	11.03	1	2	4	1
(134540) HW+1.5	10.87	1	2	5	1.4
(142613) HW+2	10.57	1	2	5	1.4
(145204) HW+2.5	10.52	1	2	5	1.1
(152131) HW+3	9.42	1	2	5	1.1
(154920) HW+3.5	9.52	1	2	4	1.1
(161705) HW+4	8.94	1	3	5	1.5
(164716) HW+4.5	8.72	1	2	4	1.2
(171446) HW+5	8.3	1	2	5	1.4
(174350) HW+5.5	8.44	1	2	4	1.3
(181353) HW+6	8.73	1	2	4	0.9
(184332) HW+6.5	8.27	1	3	6	1.5