Before Commissioner(s)
Delegated by Auckland Council

CST60343373

Under	the Resource Management Act 1991
In the matter of	An application for a coastal permit for sand extraction from the Auckland Offshore Sand Extraction Area, offshore of the Mangawhai - Pakiri embayment
By	**Coastal Processes Expert Caucusing Group**

JOINT WITNESS STATEMENT

COASTAL PROCESSES EXPERT CAUCUSING GROUP

13 DECEMBER 2021

INTRODUCTION

1. This Joint Witness Statement is prepared by the Coastal Processes Expert Caucusing Group ("**CPECG**") at the direction of the Hearing Panel for an application for a coastal permit for sand extraction from the Auckland Offshore Sand Extraction Area, offshore of the Mangawhai - Pakiri embayment.

2. The CPECG comprises the following expert witnesses:

   (a) Ms Ashishika Sharma

   (b) Mr Derek Todd

   (c) MS Jennifer Hart

   (d) Dr Mike Hilton

   (e) Dr Shaw Mead

   (f) Ms Sian John

   (g) Dr Tom Shand.

Code of Conduct

3. We have read the Code of Conduct for expert witnesses in the Environment Court Practice Note 2014 and have complied with it in the preparation of this Coastal Processes Joint Witness Statement.

Background and Involvement in Hearing Process

4. In 2019, an application was lodged with Auckland Council for a coastal permit for sand extraction from the Auckland Offshore Sand Extraction Area, offshore of the Mangawhai - Pakiri embayment. The original applicant was Kaipara Ltd.

5. Following a notification period for public submissions, the application proceeded to a public hearing in May 2021 before a Hearing Panel. Expert evidence given at the hearing identified dredged features on the seabed from a Single Beam Echo Sounder ("**SBES**") survey by eCoast (dated September 2020) and a Multi Beam Echo Sounder ("**MBES**") survey by

Kaipara Ltd (dated March 2021) that were larger than the dredged features previously identified.

6. Expert evidence on coastal processes was provided at the hearing by Mr Todd, Dr Martin Single, Dr Mead, Ms John and Dr Shand for the submitters, and Ms Hart for the applicant. Ms Sharma prepared the officer's report for Auckland Council.

7. Following commentary in submitter's rebuttal evidence regarding the March 2021 survey, the applicant proposed that a more extensive and detailed survey be undertaken by an independent hydrographic surveyor, Mr Greg Cox.

8. The CPECG was formed following a direction from the Hearing Panel dated 23 June 2021. The CPECG comprised the expert witnesses who provided evidence on coastal processes at the hearing.

9. The Hearing Panel's direction of 23 June 2021 also directed that:

(a) Auckland Council shall arrange a suitable and independent person to co-ordinate and chair the expert witness caucusing.

(b) The CPECG shall discuss and determine whether the extent of the proposed survey area was fit for purpose, in the context of Dr Mead's evidence that the March 2021 bathymetric survey did not reliably identify all relevant seabed features.

(c) The CPECG shall discuss and determine the methodology for the survey proposed by Mr Cox, in order that the conduct of the survey is in a manner that results in data that is reliable and fit for purpose.

(d) The CPECG shall be provided with the survey results on completion of the survey.

(e) Caucusing shall take place and a joint witness statement shall be prepared setting out the areas of agreement and disagreement and the reasons behind the opinion of each expert. The joint witness statement shall specifically address the impact of the survey results on the understanding of the coastal processes and, in particular, the understanding of the sediment transportation process associated with the seabed features identified by the survey.

10. The Hearing Panel issued a further direction on 12 July 2021, clarifying the June 2021 direction as follows:

(a) Mr Cox shall provide to the CPECG a copy of his proposed methodology of the bathymetric survey, including details of the survey data output.

(b) The CPECG shall consider the proposed methodology and confirm that, from their perspective, the methodology will result in data that is reliable and fit for purpose, that will enable the CPECG to address the impact of the survey results on the understanding of the coastal processes and in particular of the sediment transportation process associated with the seabed features identified in the survey.

(c) Alternatively, the CPECG will advise Mr Cox of any concerns that they have with the proposed methodology before he finalises the methodology he will employ to undertake the survey.

11. A third direction was issued by the Hearing Panel on 17 August 2021, following lodgement of memoranda by a submitter and the applicant. The Hearing Panel directed that:

(a) Mr Cox can be retained by the applicant, Kaipara Ltd, to undertake the proposed bathymetric survey.

(b) The raw data from the survey and scan be included in the information that Mr Cox will provide to the CPECG.

(c) The methodology proposed by Mr Cox shall include appropriate wording that reflects the provision of the raw data to the CPECG.

(d) Dr Single can be replaced by Professor Hilton as a member of the CPECG.

12. Mr David Hill was appointed by Auckland Council to co-ordinate and chair the caucusing.

13. Mr Cox prepared the proposed survey methodology, comprising a MBES hydrographic survey and MBES backscatter analysis, and enclosed a figure showing the proposed survey area (refer to **Attachment 1**). The methodology and attached figure were provided to the CPECG by Auckland Council's Hearing Advisor on 7 September 2021.

14. The CPECG convened via an on-line meeting on 21 September 2021 to consider the extent of the proposed survey area and the proposed survey methodology. The survey methodology proposed by Mr Cox was agreed by the CPECG, together with a revised survey extent. Refer to **Attachment 2** for a record of the agreement reached at the meeting. The revised survey extent agreed by the CPECG is shown in the figure in **Attachment 2**.

15. The survey was undertaken on 9 to 11 October 2021. Mr Cox provided the following results from the survey to the CPECG on 26 October 2021:

(a) Report of survey (refer to **Attachment 3**)

(b) Area A - Ascii xyz 1m gridded bathymetry surface (Eden 2000)

(c) Reference Surface - Ascii xyz 1m gridded bathymetry surface (Eden 2000)

(d) Fledermaus survey scene

(e) Geotiff image of MBES backscatter at 0.25m grid cell resolution (Eden2000)

(f) 5m contours (dxf)

(g) Reference surface

(h) Selection of images from the Fledermaus survey platform showing a selection of profiles across various trenches within the survey area. (refer to **Attachment 3**).

16. The CPECG held a second caucusing meeting on 5 November 2021. The CPECG formally received and considered the October 2021 survey report and information. The CPECG requested that Mr Cox prepare and provide to the CPECG further survey profiles comparing the October 2021, March 2021, September 2020 and 2018 hydrographic surveys and sketches indicating the locations of the profiles. Refer to **Attachment 4** for a record of the actions agreed including the information requested at that meeting.

17. Mr Cox provided further information to the CPECG on 23 / 24 November 2021:

(a) Report on the survey data comparisons and profiling, including sketches showing the locations of the shore normal and shore parallel profiles, and the shore parallel profiles (refer to **Attachment 5**).

(b) Shore normal profiles comparing the October 2021, March 2021, and September 2020 hydrographic surveys within the area of deeper trenches identified in the October 2021 survey and the extraction exclusion area (refer to paragraph 25). The profiles are included in **Appendix 5**.

(c) Mr Cox's report advised that the 2018 survey data was not able to be compared as it was not available in a consistent format that could be successfully accessed by the data processing software, Qimera.

(d) Mr. Cox's report commented on the accuracy of the September 2020 and March 2021 surveys and the difficulty in comparing profiles between surveys.

(e) A spreadsheet of comparisons of trench depth at each of the shore normal profiles from the September 2020, March 2021 and October 2021 surveys.

18. The CPECG held a third caucusing meeting on 29 November 2021. The CPECG formally received and considered the November 2021 report and information.

Issues Agreed & Reasons

19. The CPECG is working from the best representation of survey data available in terms of the information provided by Mr Cox in October and November 2021.

20. From the profiles presented, the September 2020 survey identified dredged trench features of 0.2m to 2.4m in depth extending approximately 3.4km parallel to the coastline, located 2km to 2.5km offshore. The profiles presented from the October 2021 survey identified dredged trench features over the same area of 0.1m to 1.7m in depth

21. Comparison of the October 2021, March 2021 and September 2020 surveys indicates that the dredged trench features appear to have infilled by between 0.02m and 1.3m over the September 2020 to October 2021 period, however distinct dredged features as described in Paragraph 20 remain evident. The accuracy of the infilling estimate is affected by survey accuracy (potentially a best case vertical accuracy of +/- 0.3m for the September 2020 and +/-0.15m vertical accuracy for the October 2021

survey), vertical and horizontal offsets between the survey data sets, and missing data points in the September 2020 survey.

22. The March 2021 survey indicated that trench infilling has occurred across both the September 2020 – March 2021, and the March 2021 – October 2021 periods.

23. The available information is inconclusive as to the source of and mechanism for infilling, sediment transport processes across the surveyed area, and any long term effects of the trenches on those coastal processes.

24. The available information indicates that sediment is moving in the surveyed offshore area, but it is not possible to draw any conclusions about diabathic or longshore transport. The volume, rate and direction of sediment transport are not able to be inferred from the data available at this time.

25. Mr Todd advised the CPECG that sand extraction has not occurred in the extraction exclusion area since April 2021 based on the information that he was provided with by the extraction operator. The CPECG noted this information and concluded that, on this basis, there is good confidence that changes in the dredged trench features within the extraction exclusion area which are observed between the March 2021 to October 2021 surveys are not due to dredging. There is less confidence about whether dredging has had an effect on changes in dredged trench features in the remainder of the surveyed area and over the September 2020 to March 2021 period.

26. The shore parallel profiles from the October 2021 surveys show notable shore normal features that extend over some distance offshore and which may indicate longshore and diabathic transport within embayment (refer to Figure 15 in the November 2021 survey report in **Attachment 5**).

Issues Not Agreed

27. Nil, noting however that the CPECG members do not necessarily agree on points of interpretation of the historical and present-day body of coastal processes information that are outside the scope of the CPECG's caucusing.

Issues Outstanding

28. The ability of the CPECG to draw conclusions is limited by the lack of high quality, repeat surveys covering the extraction area and would be

enhanced by a time series of hydrographic data (e.g. Digital Elevation Model) covering the complete Mangawhai – Pakiri embayment, including the beach, nearshore and offshore areas.

29. The CPECG considers that a coordinated and sustained monitoring programme needs to be developed, approved and implemented for any sand extraction activities in the Mangawhai – Pakiri embayment, and linked to an adaptive management plan for those sand extraction activities. Such a monitoring programme might include, for example:

(a) A hydrographic survey of the Mangawhai – Pakiri embayment comparable to the October 2021 survey to be undertaken for the area of dredged trench features defined by the October 2021 profiles A1 to C3 (inclusive, as shown in Figure 8 of **Attachment 5**) and the Proposed Northern and Southern Control Areas (as shown in Enclosure 1 in **Attachment 1**), capturing sufficient data to monitor bedforms, and dredged trench features in key areas; such survey to be undertaken in October 2022 and two-yearly thereafter.

(b) Each cycle of survey results to be analysed by a coastal processes specialist to inform an adaptive management plan for all sand extraction activities in the embayment.

Ms Ashishika Sharma
Mr Derek Todd
MS Jennifer Hart
Dr Mike Hilton
Dr Shaw Mead
Ms Sian John
Dr Tom Shand

13 December 2021

Attachment 1 – Proposed Hydrographic Survey Methodology and Extent

Date: 06-09-21 **Survey ID: DML2021_xx**	# METHOD STATEMENT	**Client: Kaipara Ltd**

Location	Project	Survey Area	Survey Class
PAKIRI	Auckland Offshore Sand Extraction Site	Coastal Dredging Area (see Enclosure 1)	**N/A**

Hydrographic Surveyor (Supervising)	Certification
Greg Cox	IHO/FIG CAT A

Hydrographic Surveyor (Field Work/Reporting)	Certification
Declan Stubbing	BSurv, IHO/FIG CAT A, CPHS Level 1

Purpose of Survey

Purpose of Survey	To derive a baseline dataset for the accurate monitoring of future dredge operations of the Auckland offshore sand extraction site located off Pakiri Beach.
Outline Methodology	The survey will be undertaken using one of DML's inshore survey boats purpose built for safe inshore survey operations. The boat will be deployed from Tauranga and based from Leigh. Typically sounding operations will be undertaken during daylight periods but 24hr operations will be possible if sea conditions permit. The vessel crew will comprise two experienced surveyors and qualified commercial launch master. Once the acquisition phase is complete, all data will be processed at DML's office in Tauranga.

Horizontal Positioning **Datum: WGS84**

Connection to Horizontal Datum	MBES data acquired on NZGD2000 datum for post processing of positioning data. Deliverables provided in WGS84 Latitude/Longitude. Datum: NZGD2000 Projection/Circuit: EDEN2000 Ellipsoid: GRS80
Methods of Obtaining Horizontal Position	GNSS Vessel Positioning: Applanix POSMV Wavemaster II INS positioning and motion sensor, integrated with Marinestar G2 WADGNSS correction service. Positioning data recorded and post processed with Applanix pospac to provide optimal relative survey comparison.

Calibration Methods and Calibration Frequency	Full dimensional control of survey vessel completed prior to deployment. Horizontal Position of survey vessel checked against LINZ geodetic database survey marks prior to deployment to survey ground. Horizontal Position checks to be repeated at completion of survey.
Dynamic Calibration of Survey System	Horizontal Position of known seabed feature or target in vicinity of the survey ground as determined during mobilisation phase. A suitable target will be identified and used for checks prior to and on completion of sounding.
Rejection Criteria for Horizontal Position Data	Position data metrics monitored online. Data logging ceased when Hz position exceeds 0.5m. POSMV GNSS Status not 'Pri Fixed' QINSy 3D Position RMS >0.1m PDOP 6 Number of SV's 5 Position Check >0.5m

Vertical Datum	**Datum: Mean Sea Level**
Connection to Vertical Datum	Final depth data will be reduced to local MSL as adopted for previous surveys. Determination of MSL will be via best practise taking into consideration previous methodologies used. Fieldwork will be conducted on the GRS80 ellipsoid and post processed using LINZ CORS reference station data to provide optimal vertical accuracy. A block adjustment applied post acquisition to reduce all data to a common MSL as required. This methodology will be adopted for all future surveys to ensure repeatability of results.
Method of Measuring Tidal Heights	Tide gauge data from Auckland and Marsden Point will be recorded during the survey to assist with accurate MSL determination. This information can be used to provide an ellipsoid/MSL separation model developed for the survey area.
Calibration Methods and Calibration frequency	Vertical elevation of survey vessel checked against LINZ geodetic database survey marks prior to deployment to survey ground. Vertical Position checks to be repeated at completion of survey. A value for the Ellipsoid-MSL offset at the observed site, will be developed, and compared to real time tide gauge readings from the Auckland and Marsden Point Standard Port tide gauges.

Depth Measurement	
Survey Vessel Description	Survey Vessel: TUPAIA Length: 7.8m Beam: 2.4m Type: Purpose Built Senator alloy monohull powered by twin four stroke Mercury 150hp outboard engines. Vessel operated under the Maritime NZ MOSS system
Bathymetric System	RESON T50 R multi beam echo sounder mounted on a purpose built heavy duty pole that is manually raised and lowered through a stern sleeve. Beam Forming: 512 Beams (0.5°Across track x along 1.0° at 400khz, (1°Across track x along 2° at 200khz). Mode: Equidistant Roll Stabilisation: Real time Max Ping Rate: Set to 20hz Depth Resolution: 6mm Max Swath used: 120° Coverage: 100% Seabed Coverage
Echo Sounder Frequency(s)	200-400khz. Fixed 300kHz will be used for consistency of MBES backscatter results should they be required.
Method and Frequency of Echo Sounder Calibration	Patch test of MBES system to calculate Roll, Pitch and Yaw bias completed at Leigh. A further reference surface will be used at the survey site to confirm all system settings. SV determined using AML sound velocity probes. Accuracy of MBES and vessel draught confirmed via bar check during survey calibration. AML SVP used for Sound velocity Profiles and compared to SVS at head of transducer.
Method to Compensate for Transducer Motion	Applanix POSMV Wavemaster V5 Roll and Pitch Accuracy: 0.02° Heading Accuracy: 0.03° Real Time Heave Accuracy: 0.05m or 5% True Heave Accuracy: 0.02m or 2% Integrated Position Correction Service: Fugro MarineStar Position Uncertainty: G2 (<0.20m) Software: POSView – Real time monitoring
Limiting Sea Conditions affecting Survey Quality	Data quality observed in real-time using system QA/QC protocols. Typically sounding operations will be possible within 25kts of wind and a sea not exceeding 1.2m.
Squat of Transducers at Sounding Speed	Eliminated by recording 3D Post processed kinematic (PPK) GNSS vessel positioning for reduction of data.

Seabed Coverage	
Method to Ensure Seabed Coverage Criteria is met	Full seabed coverage (100%) will be achieved. Line spacing will be maintained to achieve a 20-30% overlap between adjacent swathes. QPS Qinsy acquisition software used for navigation control.
Survey Vessel Speed over Ground	6.5kts maximum. Typically, all sounding will be conducted at speeds between 5-6 knots.
Sounding Line Spacing and Orientation	Spacing: As required for sufficient overlap between adjoining swathes. Orientation: Parallel to general seabed contours which will also be parallel to the coastline.
Rejection Criteria for Line Running	Vertical Standard Deviation of more than 0.1m on flat seabed Bad Quality of Data Position out of Tolerance Less than 100% seabed coverage

Sounding Reduction and Data Presentation	
Methods to Reduce Raw Data to Sounding Datum	3D PPK GNSS position, Vessel offsets, Motion and Sound Velocity
Principle and Method used in Sounding Selection	Soundings are selected based on manual cleaning of data and automatic filters applied in QPS QIMERA. A nominal 1 m x 1 m BIN of the average depth in each BIN will be created from the 0.25 m average BIN data for sounding sheets and volume calculations.
Method of Contour Generation	Sounding plans and cross sections contoured at 0.5m intervals, or other intervals as determined by Client.
Deliverables	Raw Data deliverables provided to the caucusing group will include: • Generic Raw Format Files (GSF or ASCII) Processed deliverables provided to Client and caucusing group will include: • 2D depth contour plans/images • 3D Depth Surface (grid) • MBES Backscatter mosaics • Digital Depth Data • Detailed Survey Report • Cross Section and Long Section Data as applicable • 3D Visualisations

Digital Format of Final Depth Data	Average surface ASCII XYZ 1m reduced to MSL.
Data Quality and Retention	
The Method(s) used to Derive the Quality of the Data and Ability to meet the Depth Tolerance as Required in Industry Standards	A-Priori estimates for all potential error sources are assessed prior to survey. Upon completion of the survey a total propagated uncertainty (TPU) analysis of the sounding data will be completed utilising A-Posteriori values for all potential data sources. The final gridded dataset will be assigned TPU values and checked to ensure it meets industry standards. The following final accuracies for depth data are expected: Horizontal Accuracy: Better than +/- 0.5m Vertical Accuracy: Better than +/- 0.35m (30m water depth) The above accuracies meet LINZ Order 1 standards.
The Time Frame(s) and Those Responsible for Retention of Raw Data Gathered during the Survey and the Final Results	DML will retain copies of the project deliverables, including source data files, on its servers for a period of 12 months from completion of the project. The data will then be archived to a digital medium and retained for 7 years. After the initial 12 month period client requests to access and supply project data may incur a fee.

I certify that this Method Statement and the methods described herein conform to accepted industry standards.

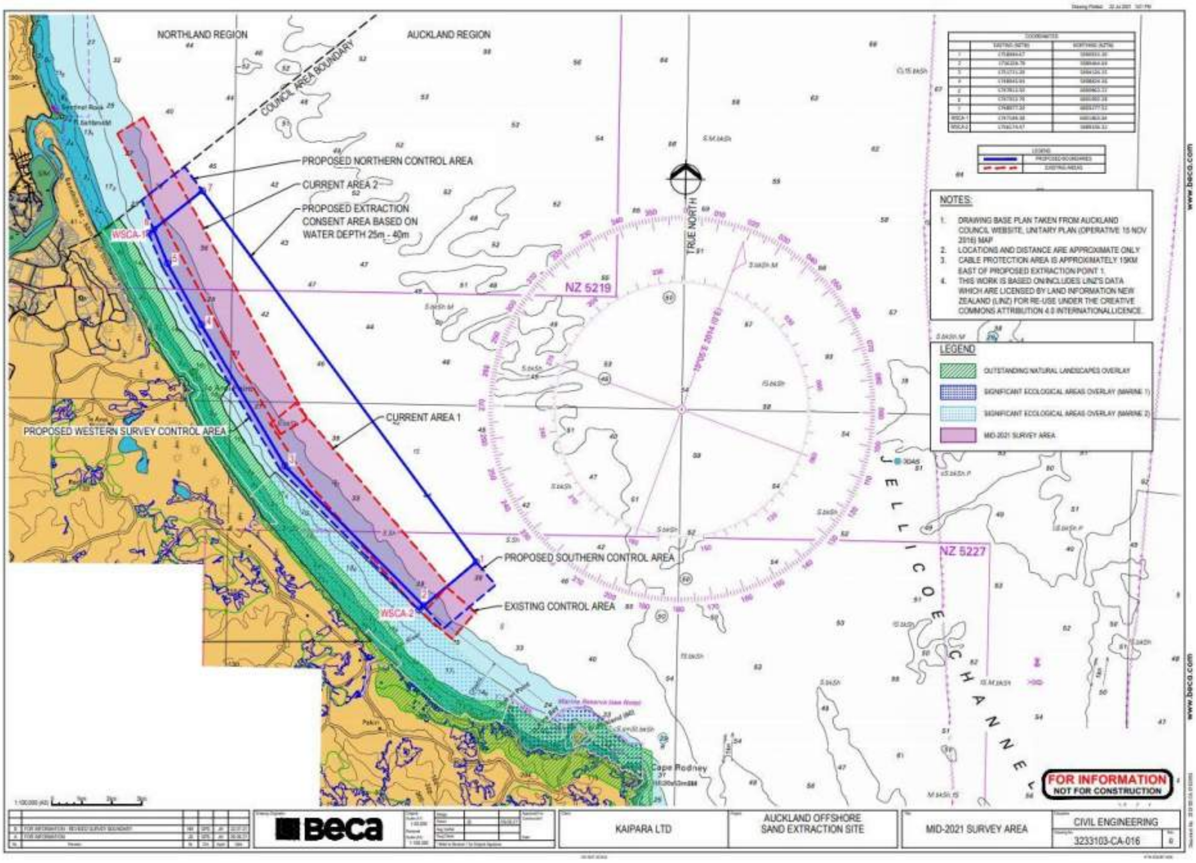
Greg Cox
MNZIS, IHO Cat A

Enclosures:

1. Image of Survey Area
2. Examples of Deliverables

Enclosure 1 – Survey Area

The area to be surveyed is identified by pink shading.



Enclosure 2 – Examples of Deliverables

The following images are provided to illustrate the types of coverage images possible and also to demonstrate the capability of the Reson T50 MBES system in accurately identifying dredge tracks on the seabed. The dredge tracks as depicted in images 2-3 – 2-5 below are from recent dredge operations in Tauranga Harbour. The dredge is a trailer suction type with a 1.6m wide dredge head.

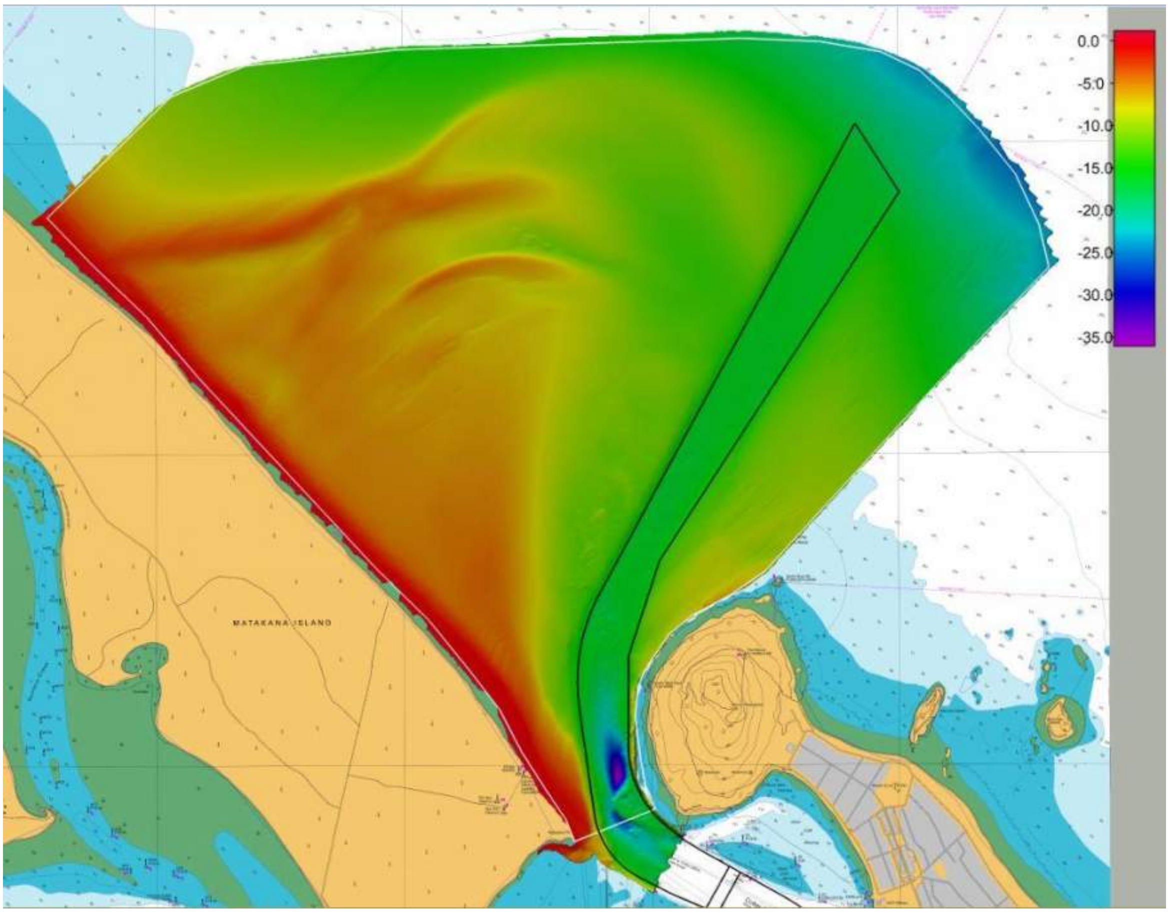


Image 2-1: 2D Depth Coverage Image

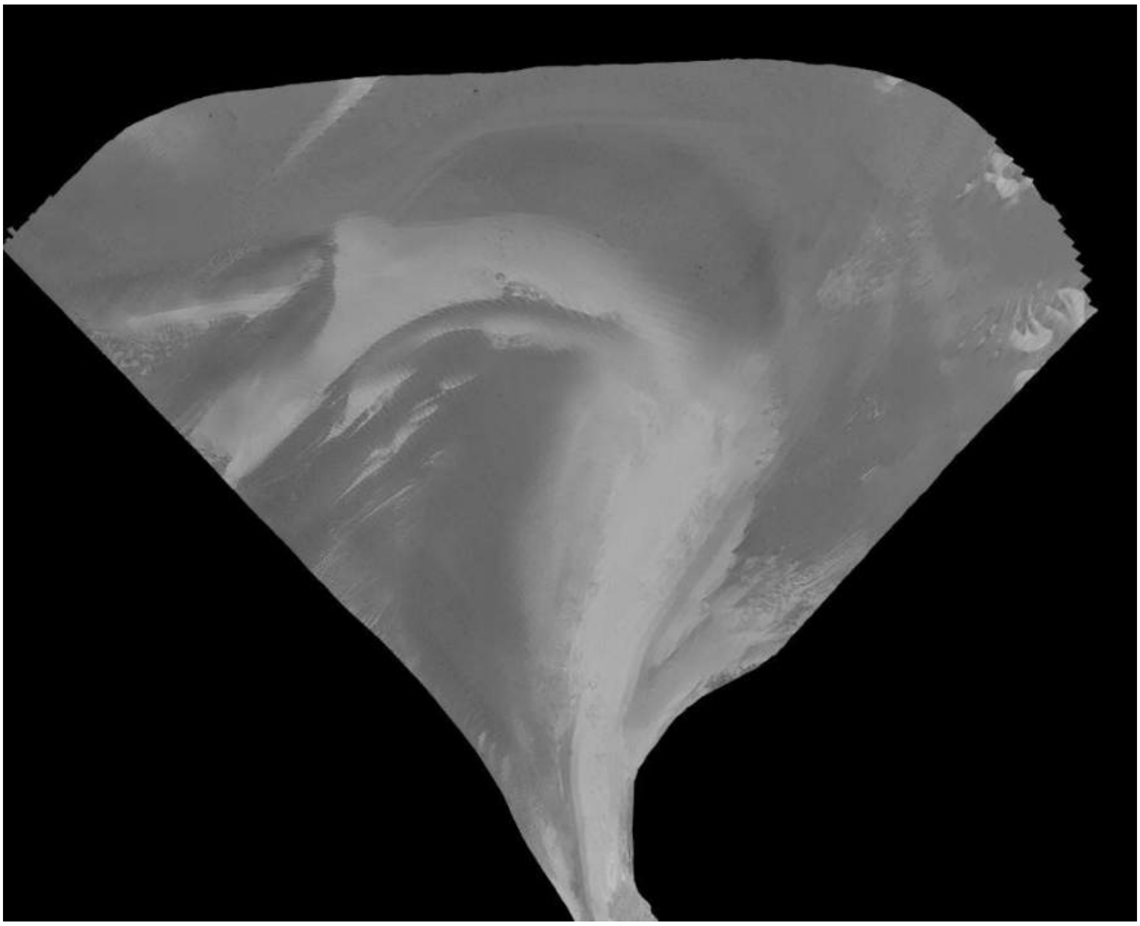


Image 2-2: MBES Backscatter Mosaic depicting differing seabed textures

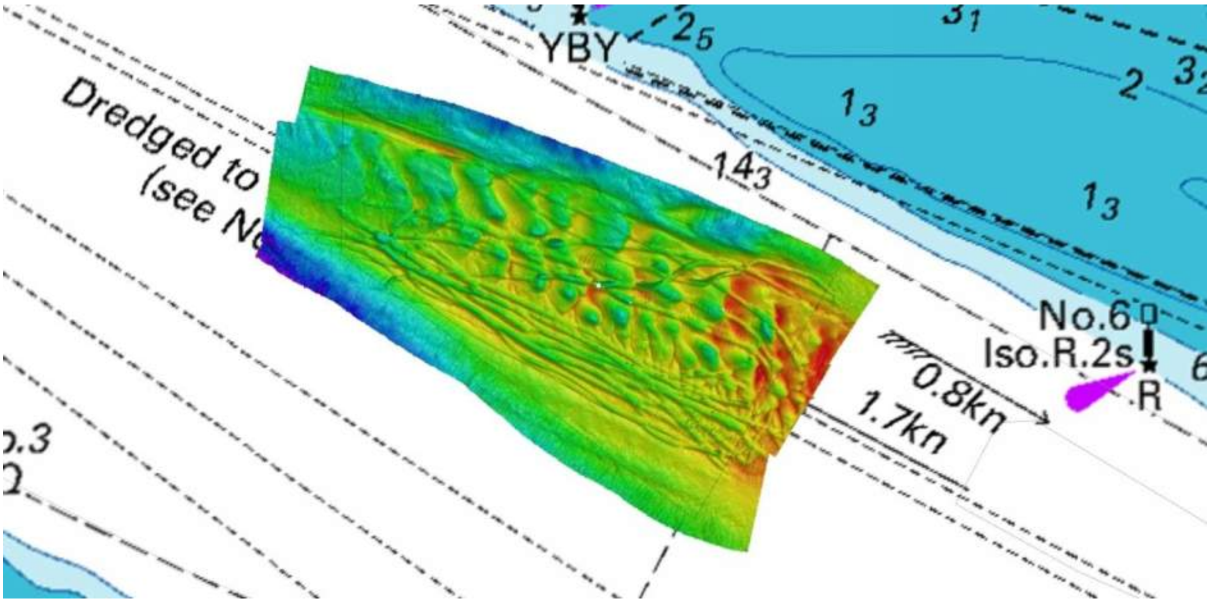


Image 2-3: Plan view of seabed sand waves and dredge tracks

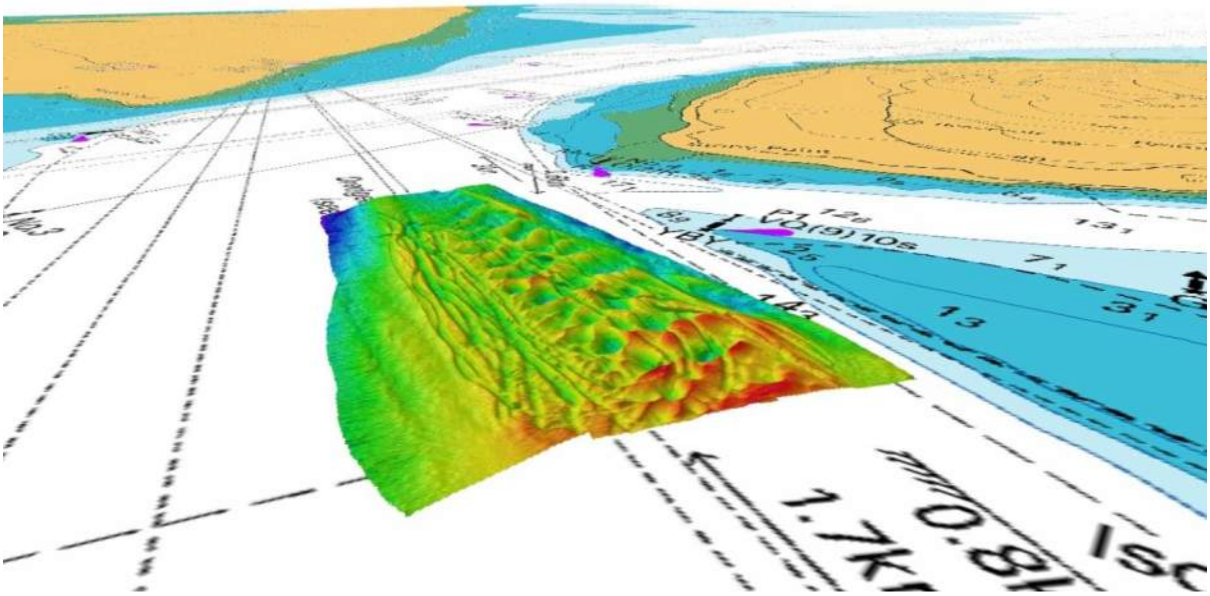


Image 2-4: 3D view of sand wave region and dredge tracks

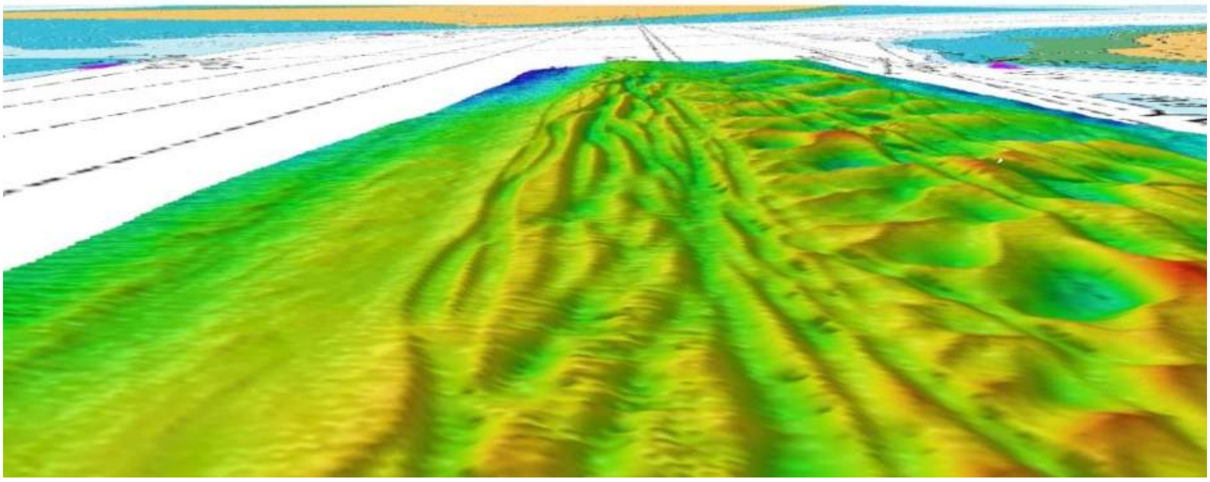


Image 2-5: Close up 3D view of dredge tracks in 20m water depth – Tauranga Harbour

Attachment 2 – First Caucusing Meeting 21 September 2021, Record of Agreement and Revised Hydrographic Survey Extent

Jennifer Hart

From: Jennifer Hart
Sent: Tuesday, 21 September 2021 5:30 PM
To: David Hill; Ashishika Sharma; Todd, Derek; 'Greg Cox'; 'michael.hilton@otago.ac.nz'; 'Shaw Mead'; 'Sian John'; Tom Shand (TShand@tonkintaylor.co.nz)
Cc: Sam Otter
Subject: Sand extraction hearing - Expert caucusing part 1
Attachments: 3233103-CA-016-Rev C.pdf

All

Attached is the survey area drawing updated for the changes to survey extent agreed at today's caucusing:

- Additional survey area to north added
- Deeper water sections of "control areas" removed.
- Note added regarding 25m isobath survey extent.

This email also records the unanimous agreement by the caucusing group that the survey can get underway using the survey methodology put forward by Greg Cox, and that the survey is to include any dredge tracks identified that lead outside the survey area shown in the attached drawing.

Ngā mihi nui

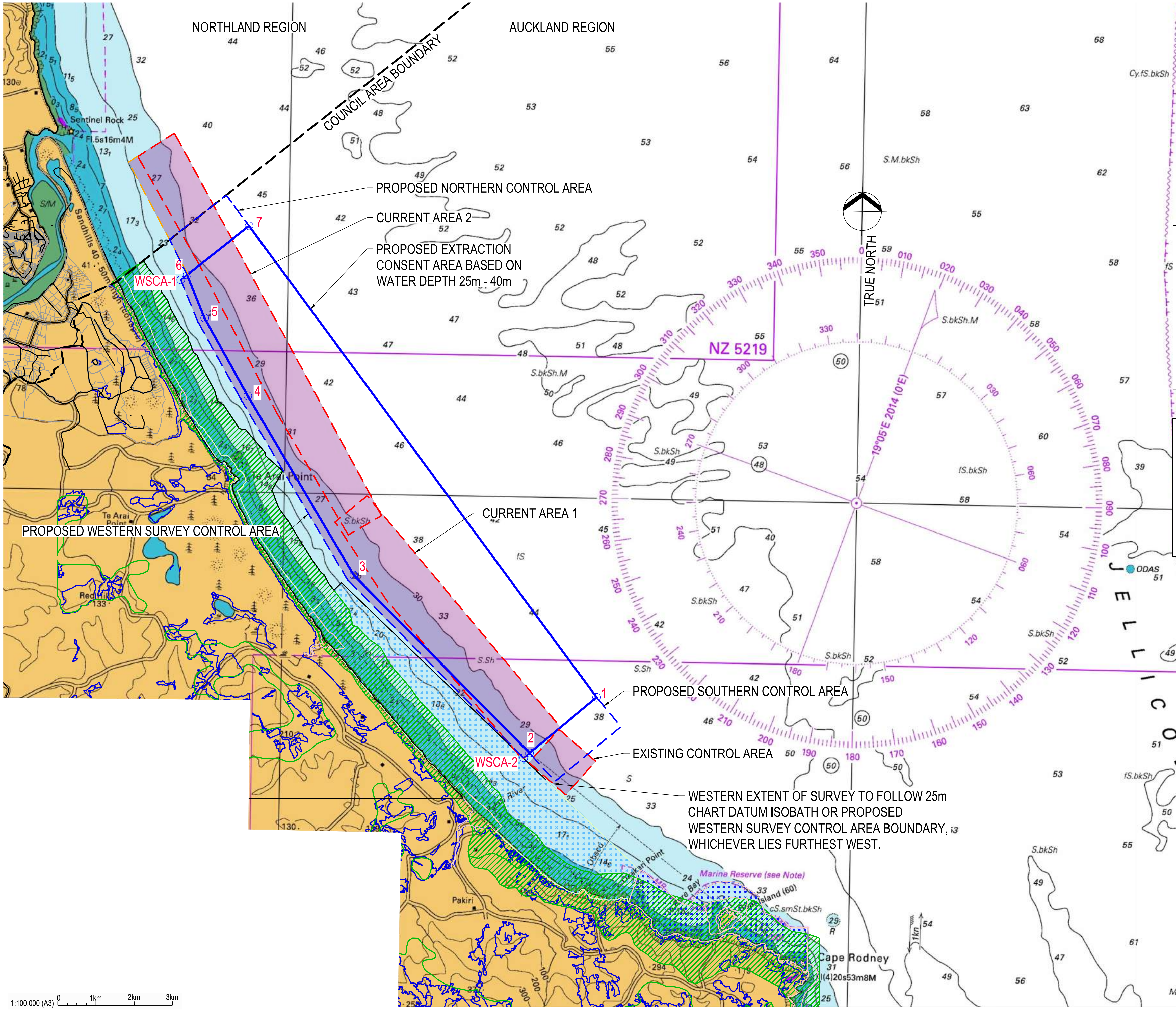
Jennifer
Jennifer Hart
Senior Principal – Transport Infrastructure
Beca
Phone: +64 9 300 9000 Fax: +64 9 300 9300
DDI: +64 9 308 0867 Mobile: +64 (0)27 365 3340
www.beca.com

igniteyourthinking.beca.com

Make flexibility work – if you receive an email from me outside normal business hours, please don't feel you should read it or reply until your normal business hours

Sensitivity: General

Drawing Plotted: 21 Sep 2021 4:29 pm



COORDINATES		
	EASTING (NZTM)	NORTHING (NZTM)
1	1758084.67	5990925.30
2	1756328.79	5989464.69
3	1751721.20	5994126.25
4	1748945.94	5998824.36
5	1747812.50	6000863.22
6	1747352.70	6001992.28
7	1748977.20	6003277.52
WSCA-1	1747189.38	6001863.04
WSCA-2	1756174.47	5989336.32

LEGEND	
(blue line)	PROPOSED BOUNDARIES
(red dashed line)	EXISTING AREAS

NOTES:

1. DRAWING BASE PLAN TAKEN FROM AUCKLAND COUNCIL WEBSITE, UNITARY PLAN (OPERATIVE 15 NOV 2016) MAP
2. LOCATIONS AND DISTANCE ARE APPROXIMATE ONLY
3. CABLE PROTECTION AREA IS APPROXIMATELY 15KM EAST OF PROPOSED EXTRACTION POINT 1.
4. THIS WORK IS BASED ON/INCLUDES LINZ'S DATA WHICH ARE LICENSED BY LAND INFORMATION NEW ZEALAND (LINZ) FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONALLICENCE.

LEGEND

- OUTSTANDING NATURAL LANDSCAPES OVERLAY
- SIGNIFICANT ECOLOGICAL AREAS OVERLAY (MARINE 1)
- SIGNIFICANT ECOLOGICAL AREAS OVERLAY (MARINE 2)
- MID-2021 SURVEY AREA

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR INFORMATION - UPDATED FOR CAUCUSING	HD	SPS	JH	21.09.21
B	FOR INFORMATION - REVISED SURVEY BOUNDARY	NH	SPS	JH	22.07.21
A	FOR INFORMATION	JS	SPS	JH	09.06.21

Drawing Originator: Beca

Original Scale (A1) 1:50,000
Reduced Scale (A3) 1:100,000

Design			Approved For Construction*
Drawn	JS	09.06.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: KAIPARA LTD

Project: AUCKLAND OFFSHORE SAND EXTRACTION SITE

Title: MID-2021 SURVEY AREA

Discipline: CIVIL ENGINEERING

Drawing No. 3233103-CA-016 Rev. C

Document No. 3233103-CA-016.DWG

DO NOT SCALE

IF IN DOUBT ASK.

Attachment 3 – Hydrographic Survey Report October 2021 and Survey Images

REPORT OF SURVEY - AUCKLAND OFFSHORE SAND EXTRACTION SITE

Reference: 2151 – McCallum Bros_Pakiri

25 October 2021

Callum McCallum
Managing Director
McCallum Bros. Ltd
747 Rosebank Road,
Avondale
Auckland 1026

REPORT OF SURVEY - AUCKLAND OFFSHORE SAND EXTRACTION SITE

1. EXECUTIVE SUMMARY

Discovery Marine Ltd (DML) was contracted by McCallum Brothers to conduct a bathymetric survey of the seabed at the Auckland offshore sand extraction site located off Pakiri Beach. The purpose of the survey was to provide a baseline dataset for the accurate monitoring of future dredge operations. The survey extents were defined in drawing number 3233103-CA-016 (Rev C, 21.09.2021) as provided by the expert caucusing panel. The location and extent of the survey area is shaded pink in figure 1 below.

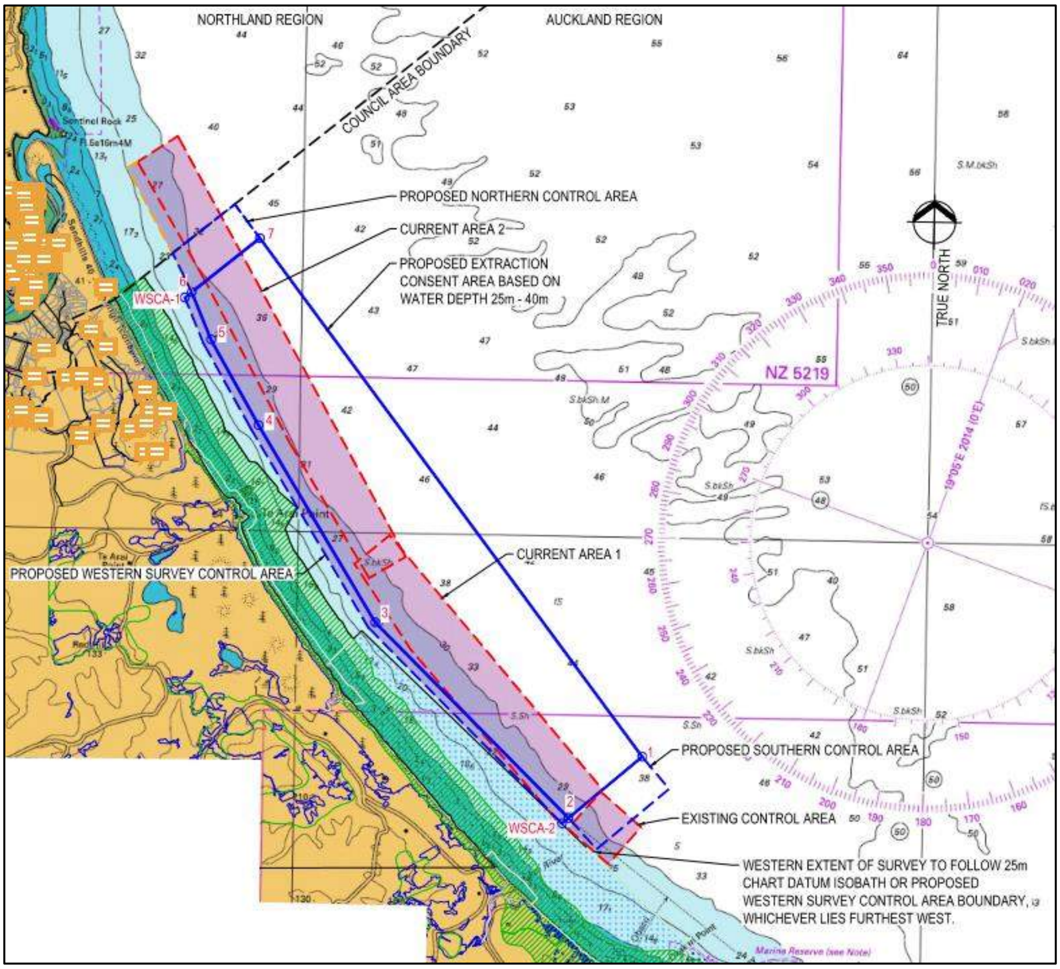


Figure 1: Survey Area (Pink shaded area) from document 3233103-CA-016 Rev C

Vessel setup and calibration was completed in Tauranga between 30/09/21 and 8/10/2021. The vessel was onsite conducting survey operations between 8/10/2021 and 11/10/2021. Data post processing and reporting was completed between 12/10/2021 and 24/10/2021.

The survey coverage achieved is shown in the figure below.

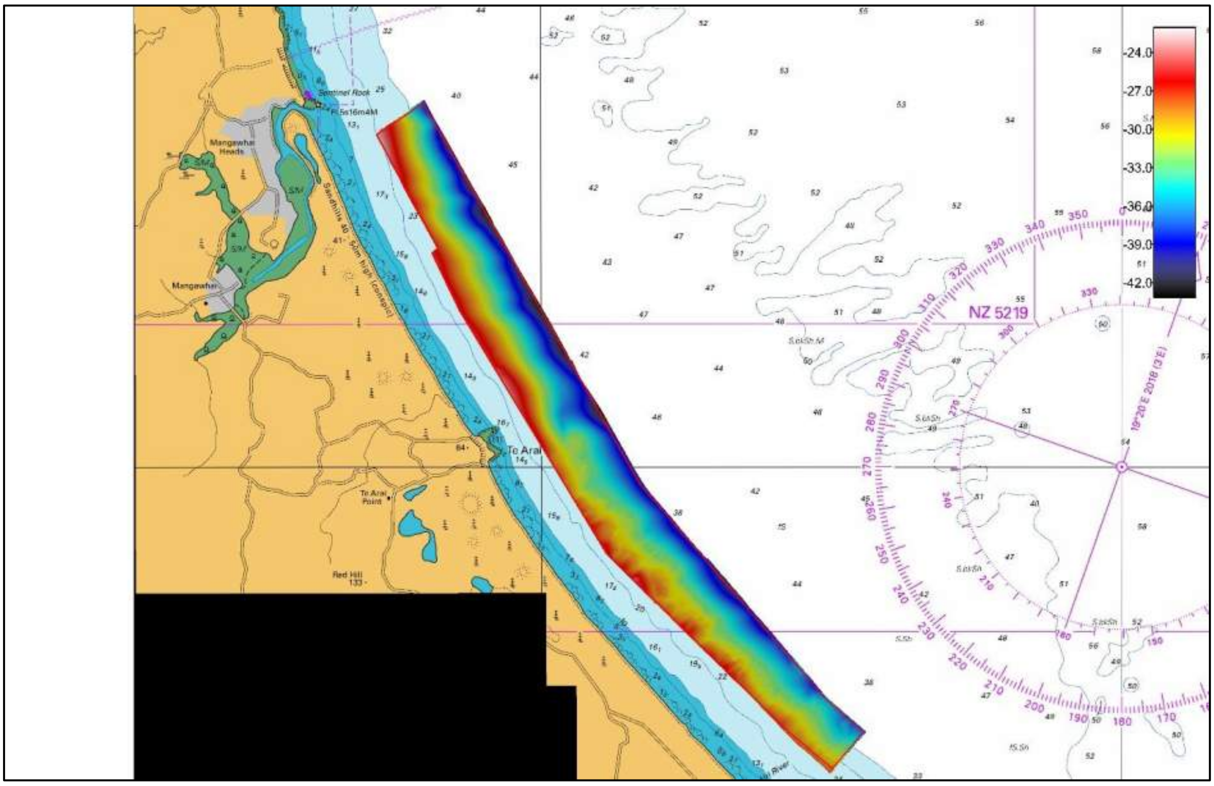


Figure 2: Area A - Midshore Survey Coverage achieved

The Survey was undertaken in accordance with the Maritime New Zealand "Good practice guidelines for Hydrographic Surveys in Ports and Harbours" as well as the hydrographic survey principles and standards outlined in LINZ HYSPEC V 2.0. Weblinks to the two specification guideline docs are provided below.

https://www.maritimenz.govt.nz/commercial/ports-and-harbours/documents/Hydrographic-surveys-guidelines.pdf

https://www.linz.govt.nz/sea/charts/standards-and-technical-specifications-for-our-chart-and-hydrographic-work

2. WEATHER & SEA CONDITIONS

The survey was completed under favourable weather conditions. Light westerly winds with a slight (0.5m) north-east swell were present throughout the duration of the survey.

The tide range between high water and low water averaged 2.3m through the duration of the survey.

The weather and sea conditions experienced have not affected the overall quality of the final survey data.

3. SURVEY VESSEL AND EQUIPMENT

This survey was undertaken using the survey vessel TRANQUIL IMAGE, a 24m workboat owned by Western workboats and operated in accordance with Maritime New Zealand Operator Safety System (MOSS).

Figure 3: Western Workboats Survey Vessel – TRANQUIL IMAGE

The vessel was fitted with a modern survey suite comprising a high accuracy POSMV Wavemaster II positioning and inertial motion system and high-resolution, survey grade, Reson T50 Multi-Beam Echo Sounder (MBES). The inertial motion unit and MBES were mounted on an over the side pole mount as shown below.

Figure 4: MBES Sonar and Motion unit (left) and over the side mount (right)

All data was logged into the QINSy hydrographic acquisition and navigation software package (v9.4.2).

The survey equipment used is tabled below:

EQUIPMENT	MAKE / MODEL /TECHNICAL SETTINGS
Vessel GNSS / Motion compensation system	**Applanix POS MV Wavemaster II**
	Integrated Fugro MarineSTAR G2+ real-time Precise point positioning (0.15m 3D accuracy)
	Inertial aided post processed kinematic (IAPPK) positioning applied during post processing.
	Motion data rate: 100Hz
Multibeam Echo Sounder	**Teledyne RESON SeaBat T50 R Multibeam Echo Sounder**
	Operating Frequency: 400khz
	Operating Depth Range: 2m -500m
	Maximum Swathe Angle: Limited to 120° for this survey
	Beam Forming: 800 beams, 0.5° x 1° beam width at 400khz.
	Mode: Equidistant Sounding Spacing
	Roll Stabilisation: Real-time
	Depth Resolution: 6mm
Speed of sound sensor	**AML -3 SVPT (Sound velocity, pressure, temperature sensors)**
	Resolution: 0.001m/s
	Precision: 0.006m/s

4. SURVEY CONTROL

Horizontal Datum

The survey was completed on the **NZGD2000 datum, MT EDEN meridional circuit** (EDENTM2000, EPSG:2105).

Vertical Datum

Results for the survey are provided as **depths below New Zealand Vertical Datum 2016 (NZVD2016).**

Depths were reduced from the GRS80 ellipsoidal to NZVD2016 in real time using the NZGeoid2016 Geoid separation model applied in the QINSY acquisition software.

NZVD16 is an approximate Mean Sea Level Datum. Noting that previous surveys in the area have been reduced to Chart Datum, it should be noted that Chart Datum (CD) is approximately 1.746m below NZVD16. Therefore, a value of 1.74m needs to be deducted from NZVD16 depths to refer them to Chart Datum.

5. CONDUCT OF SURVEY

Pre-Deployment Calibrations

Calibrations and vessel checks took place in Tauranga between the 4th - 8th October. Calibrations consisted of the following.

- Dimensional Control Survey,
- GAMS/Heading test,
- MBES Patch test,
- Draught checks (Bar check and lead-line check),
- Settlement and squat trials,
- Target detection/Object box in check,
- Positioning/height check against a known LINZ BM ashore,
- MBES Reference surface was surveyed at DML/IXBlue common reference surface at Motiti Island (Results compared against previous surveys).

Field Survey Methodology

TRANQUIL IMAGE departed Tauranga Harbour after midday 8th Oct and arrived onsite at Pakiri beach early morning on the 9th of Oct, and after an initial speed of sound profile, began survey operations. Survey ops ran continuously (24hr day/ops, the survey was completed on mid-morning on 11th Oct.

The survey area was systematically mapped running lines parallel to the general contours. Real-time MBES coverage was generated in Qinsy data acquisition software and displayed for the helmsman, allowing lines to be run based directly off the previous line's swath edge (maintaining at least 25% overlap between adjacent swaths). Survey vessel speed was maintained at approximately 6.5 kts.

Inshore areas were surveyed during daylight hours for safety of navigation purposes, as well as at high water in order to maximise swath coverage and improve overall efficiency in the comparatively shallower waters.

Sound velocity profiles were conducted regularly throughout the survey to account for any geographical or temporal variations of the speed of sound through the water column. Minor differences of up to 2m/s were observed between recorded profiles.

Data quality was observed in real time and rejection criteria for horizontal position data and depth logging were established to cease data logging if data fell below these standards.

On Site Verification and Accuracy Checks

An onsite reference surface was completed in the SE corner of the Area A block as depicted below. The reference surface is located at 399367mE, 872241mN, measures approx. 325m x325m, and has an average depth of 36m (depths below NZVD2016). Swathes were limited to 90 degree opening angle with 200% coverage achieve. The reference surface will be useful for vertical reference checking future bathymetric surveys.

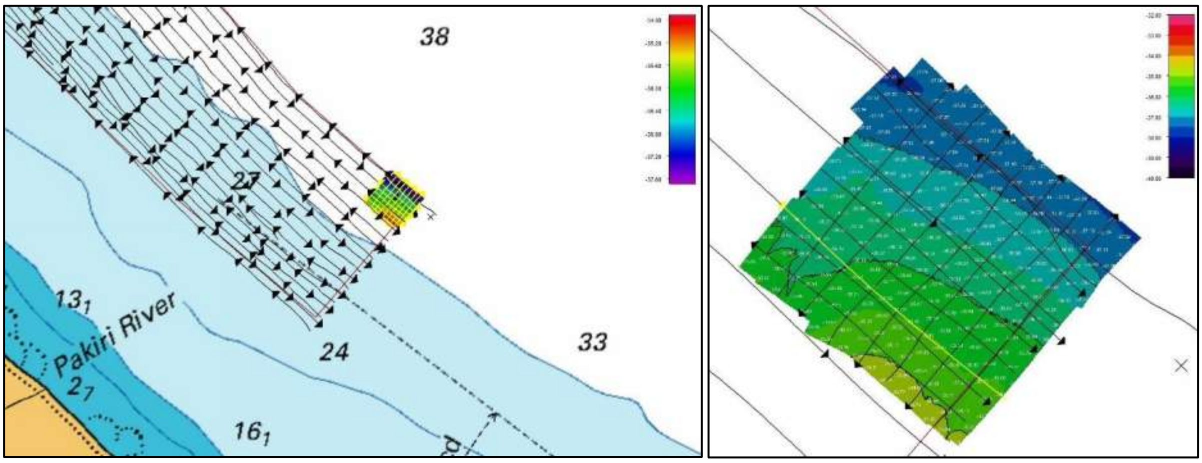


Figure 5: Reference Surface Location and Line Pattern

A series of 9 MBES cross lines were run perpendicular to the main sounding lines at approximately 2000m intervals across the survey area to provide a check on vertical height application and data integrity. A summary of the crossline statistical analysis is provided in the table below. All crosslines passed the test for bathymetry data repeatable within LINZ special order limits.

Table 1: Crossline statistics

Line	Bathy Surface mean depth	Mean Diff. from main bathy Surface	Std. Dev. (X-line to Surface)	2σ Std. Dev. (X-line to Surface)	Difference to Bathy Surface - Range	LINZ Special Order TVU Error Limit	Error Limit PASS or FAIL
Xline_1	-32.50	-0.03	0.04	0.119136	-0.20 to 0.13	0.349003	PASS
Xline_2	-31.96	0.00	0.03	0.061828	-0.25 to 0.33	0.346354	PASS
XLine_3	-29.79	0.00	0.03	0.072506	-0.18 to 0.25	0.335259	PASS
XLine_4	-29.70	0.00	0.03	0.061342	-0.15 to 0.20	0.334829	PASS
XLine_5	-30.01	0.01	0.03	0.074533	-0.13 to 0.18	0.336418	PASS
XLine_6	-23.54	0.02	0.03	0.076660	-0.06 to 0.14	0.306141	PASS
XLine_7	-25.68	0.04	0.04	0.115852	-0.09 to 0.19	0.315748	PASS
XLine_8	-26.72	0.02	0.03	0.074470	-0.08 to 0.12	0.320498	PASS
XLine_9	-24.17	0.00	0.02	0.049672	-0.11 to 0.08	0.308796	PASS

6. DATA POST PROCESSING

Vessel positioning data was post processed by a method known as inertial aided post processed kinematic positioning (IAPPK). The IAPPK processing was completed using Applanix POSPac MMS 8.7. The software utilises real time recorded GNSS positioning, inertial motion, and heave measurements and post processes them using finalised satellite orbits and a network of continuously operating GNSS CORS) reference stations.

The CORS stations utilised in the PPK solution for the Pakiri survey were Whangarei (WHNG), Warkworth (WARK), Auckland (AUCK), Coromandel (CORM) and Hamilton (HAMT) and are depicted below. Positional accuracies achieved by this method are in the order of 5cm 3D. Total survey uncertainty is discussed further in chapter 8.

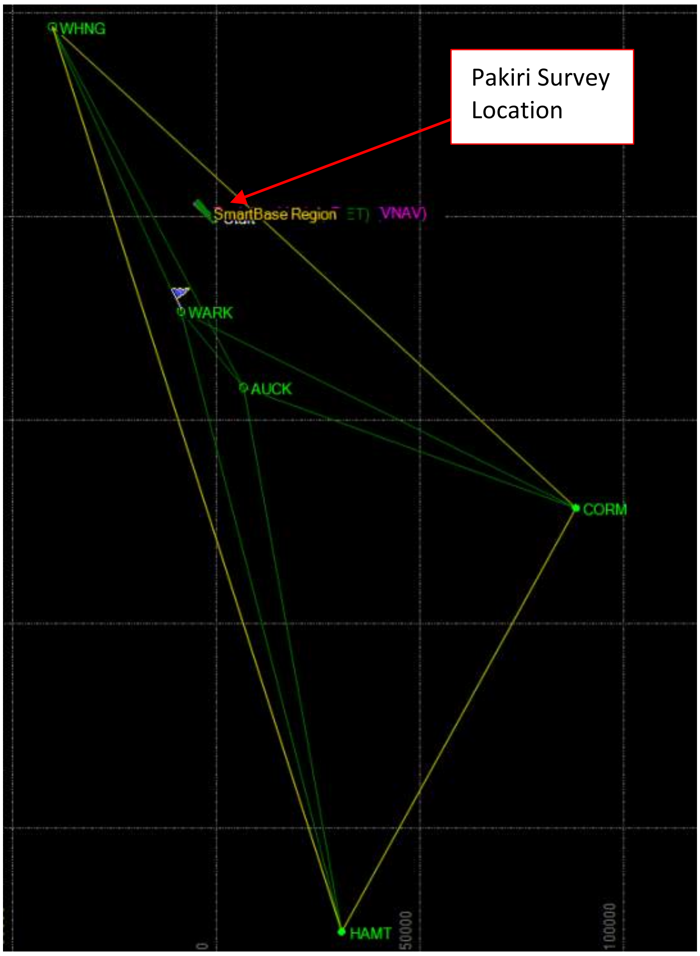


Figure 6: Post Processed Positioning Network Diagram.

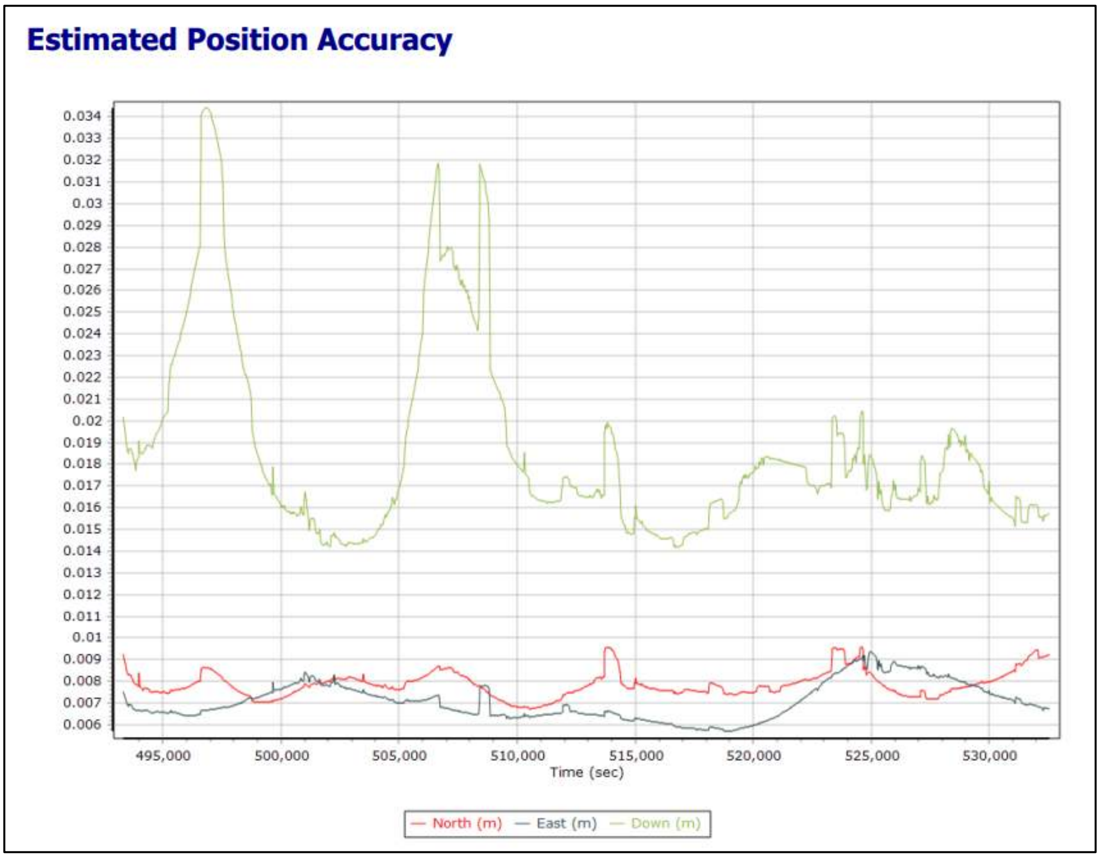


Figure 7: IAPPK post processed positioning - Performance metrics example

Bathymetric data has been processed and validated using Qimera v2.4.2. The final processed MBES bathymetry dataset has been supplied as an 1m x 1m cell resolution (Ascii xyz) average seafloor surface.

MBES backscatter processing was completed using QPS FMGT 7.10.0 The final processed MBES backscatter dataset has been supplied as a 0.25m x 0.25m cell resolution mosaic in Geotiff image format.

The MBES backscatter measures the intensity return of the soundings on the seafloor surface. Softer seafloor material provides less acoustic return and depicts as darker areas in the processed mosaic. Harder seafloor material results in higher acoustic return and depicts as brighter areas in the processed mosaic.

7. DIFFICULTIES ENCOUNTERED

The survey was completed without any major interruptions or difficulties. Minor difficulties/ challenges encountered during the survey were as follows.

- A pod of dolphins was encountered during one night of sounding as well as the occasional school of fish. The schools of fish and dolphins caused some interference and blocking of the sonar signal from obtaining a full seafloor swathe. Infill lines were completed to fill in gaps in the data caused by the fish/dolphins. Although all dolphin interference was able to be removed from the bathymetry surface some residual artifacts (in the form of infrequent dark wavy non-return lines) are still visible in backscatter. An example is depicted below.

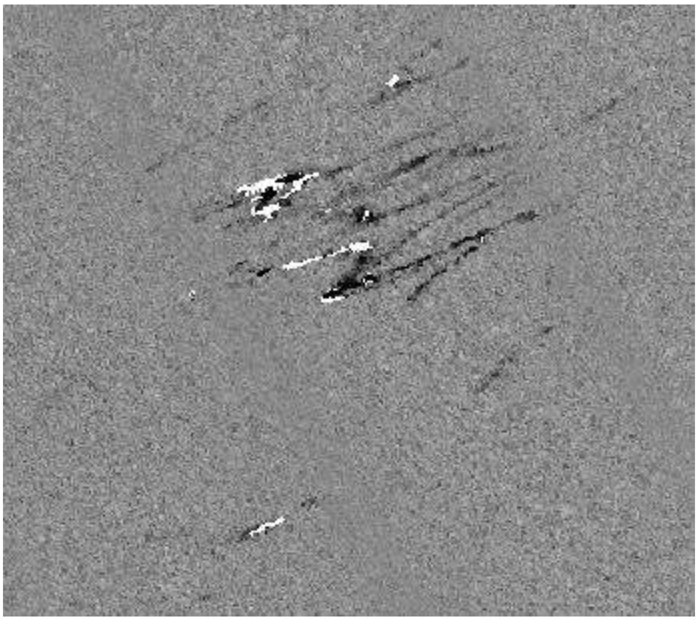


Figure 8: Example of Backscatter artifact Caused by Dolphins.

- There was minor acoustic interference from the vessels port engine with the sonar operating at 400 kHz. This was only present for a narrow engine RPM range 760-780 RPM The solution was to run the engine at around 800 RPM which resolved the interference. The interference has resulted in some minor artifacts in the MBES data in the magnitude 3-4cm and present as small lines perpendicular to the direction of sounding lines as depicted below. This is highlight so they are not interpreted as micro sand waves.

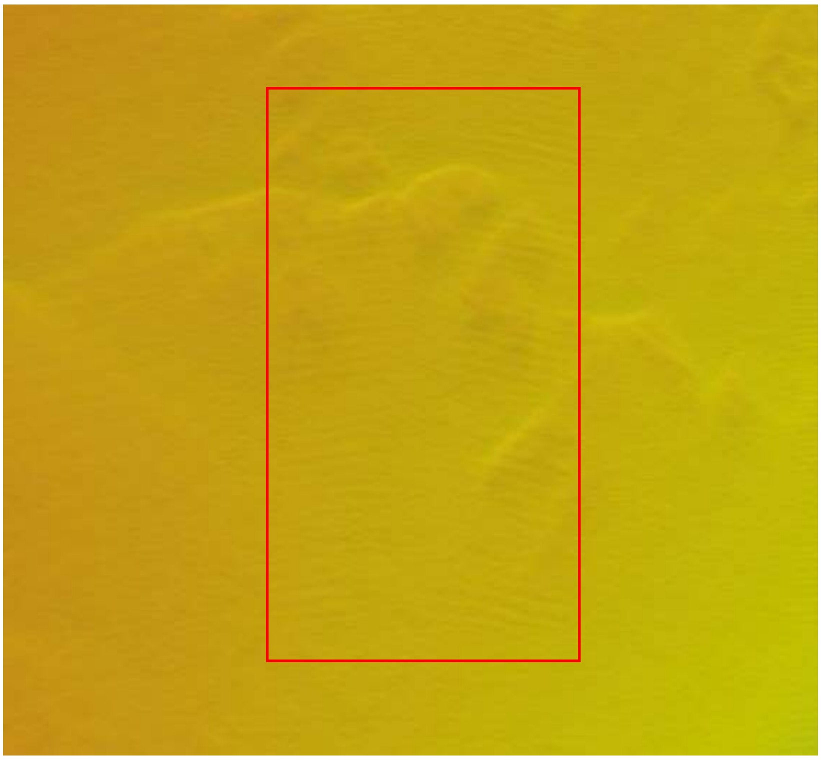


Figure 9: Example of occasional minor harmonic artifact present in bathymetry.

8. TOTAL PROPAGATED UNCERTAINTY

The accuracy of the MBES bathymetry captured for this survey is assessed as +/-0.15m or better.

The uncertainty value was attained by combining all potential systematic and environmental error sources and computing an A posteriori root mean square error assessment. Results of the A posteriori horizontal and vertical total propagated uncertainties are provided below.

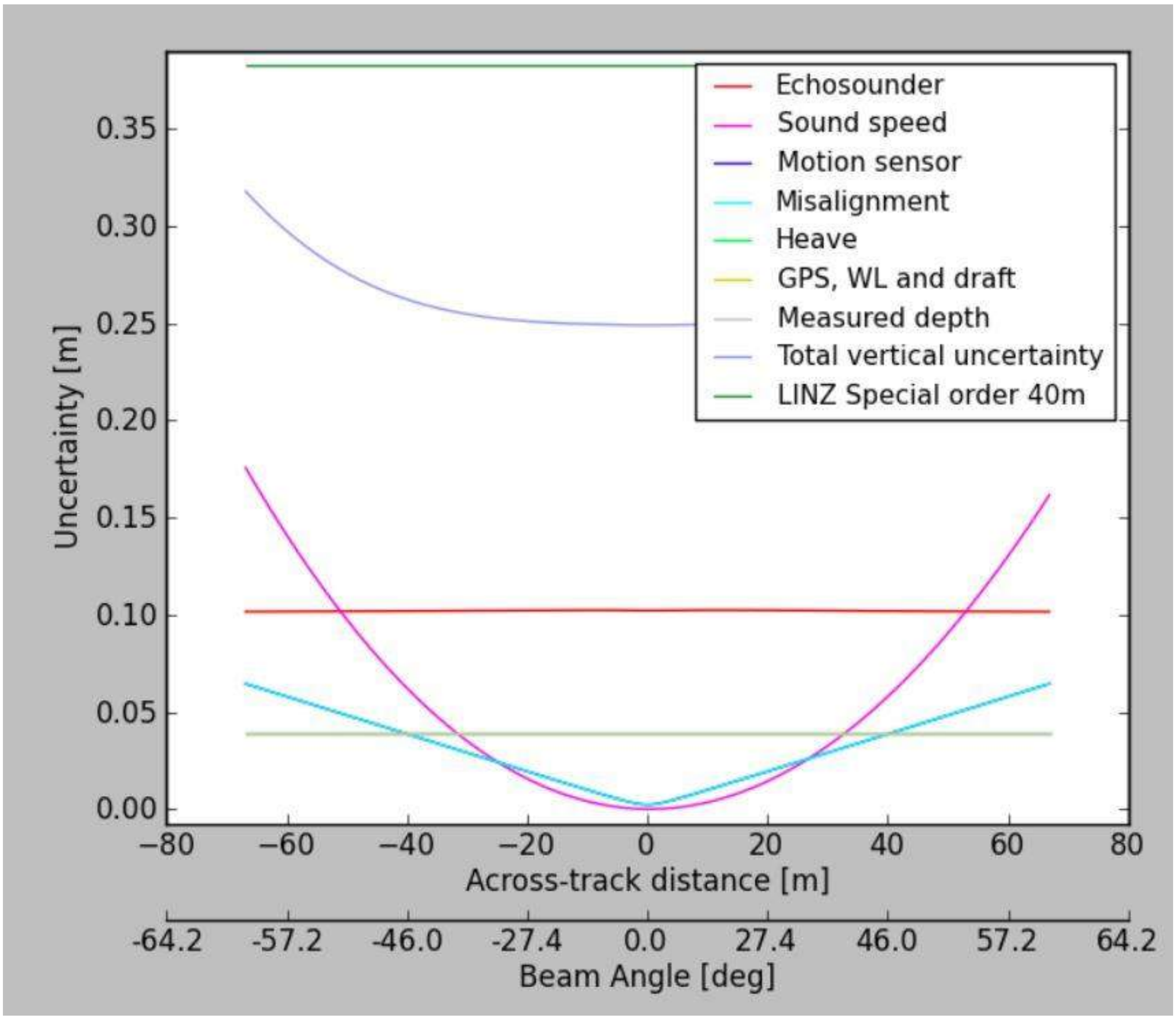


Figure 10: Vertical Uncertainty - A Posteriori TPU

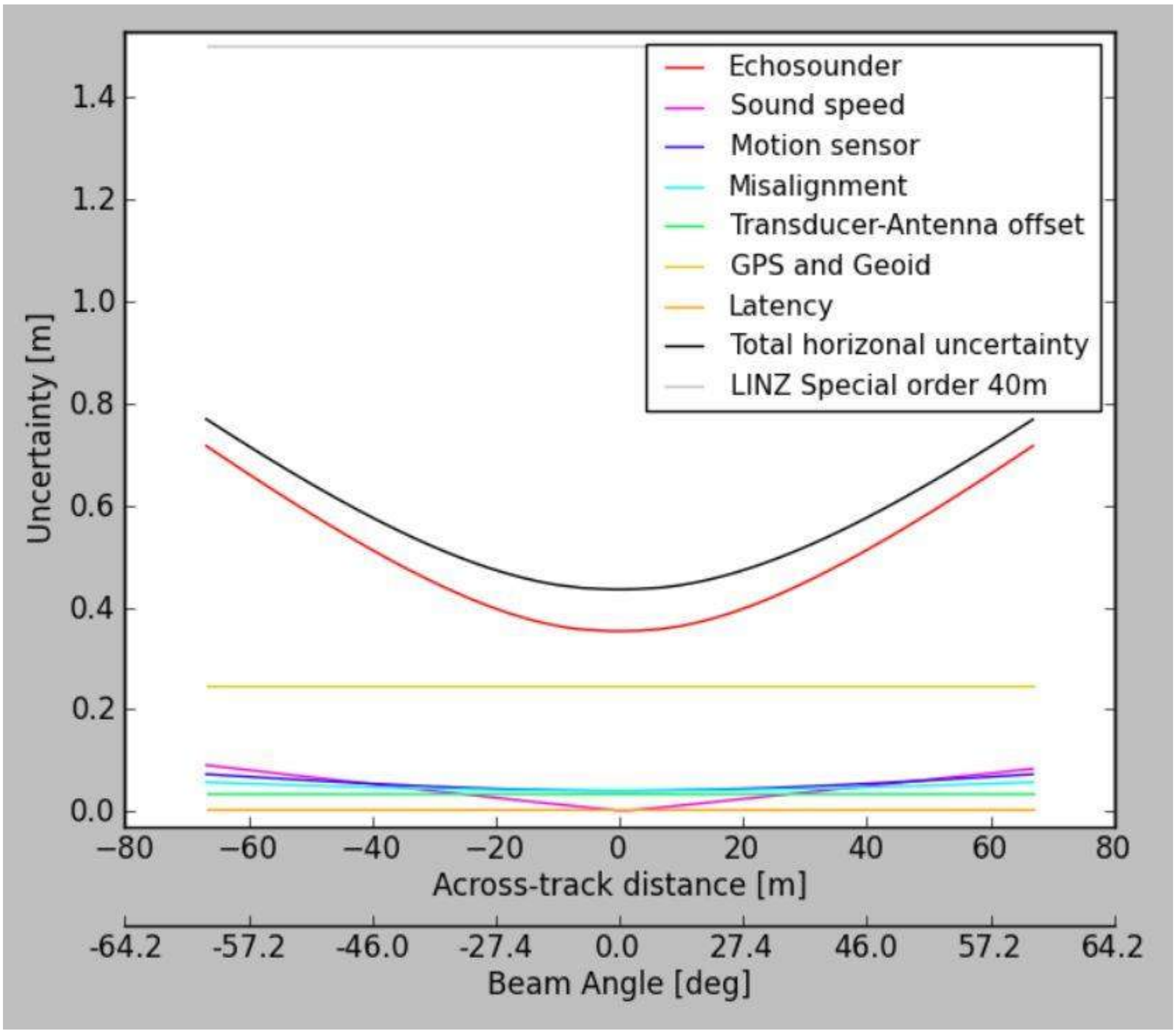


Figure 11: Horizontal Uncertainty - A Posteriori TPU

9. COMMENTS & RESULTS

The MBES bathymetric survey completed all objectives within specification.

The seabed is generally flat with few significant seafloor features. The depth contours gently slope away from the shore.

Where seafloor dredging has occurred, this is visible in the bathymetry and backscatter.

10.RETENTION OF DATA

DML will retain copies of the project deliverables, including source data files, on its servers for a period of 12 months from completion of the project. The data will then be archived to a digital medium and retained for 7 years. After the initial 12-month period client requests to access and supply project data will incur a fee.

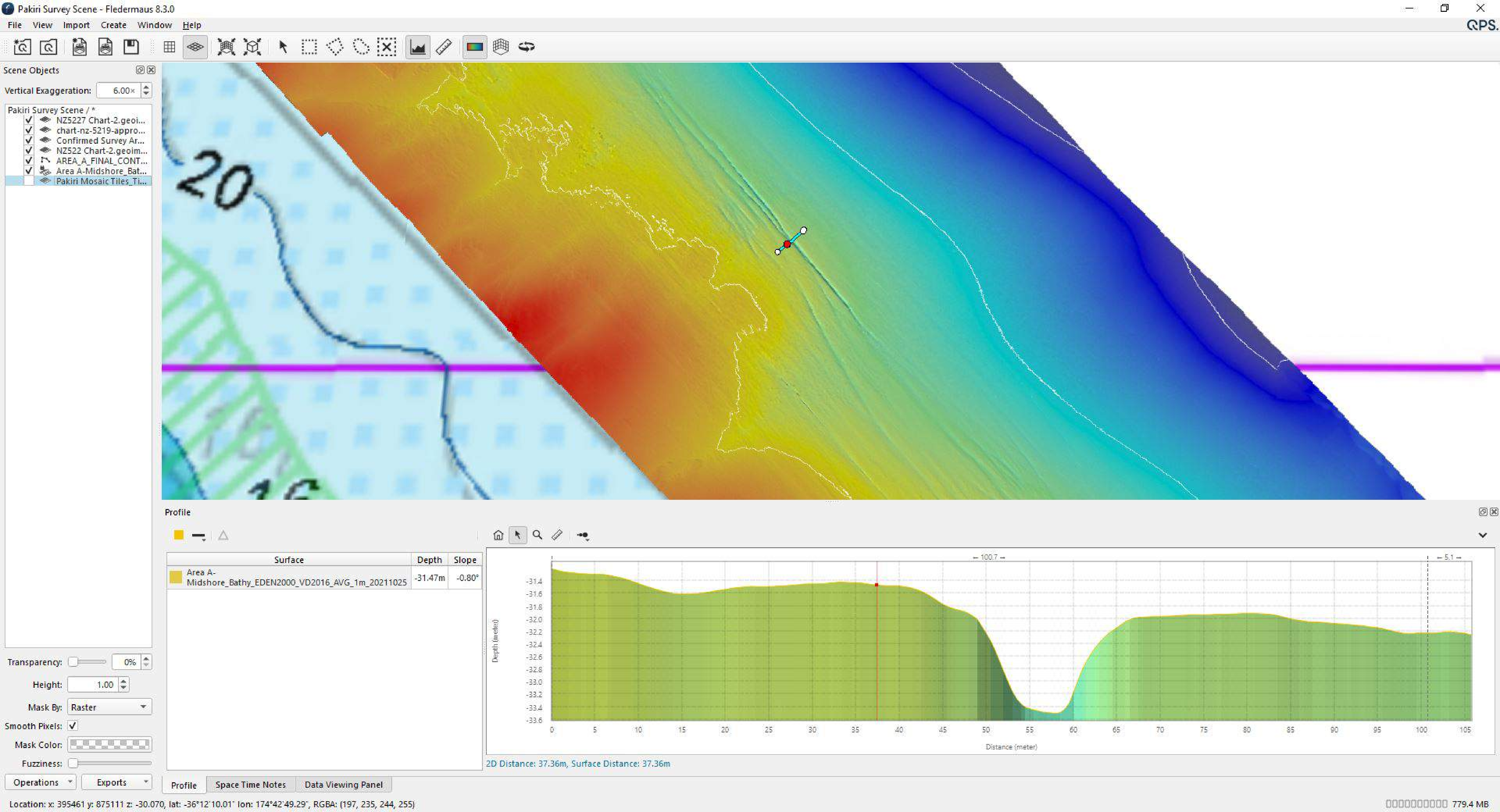
DML wishes to thank McCallum Bros. Ltd for the opportunity to undertake this project and looks forward to working with McCallum Bros. Ltd again in the future.

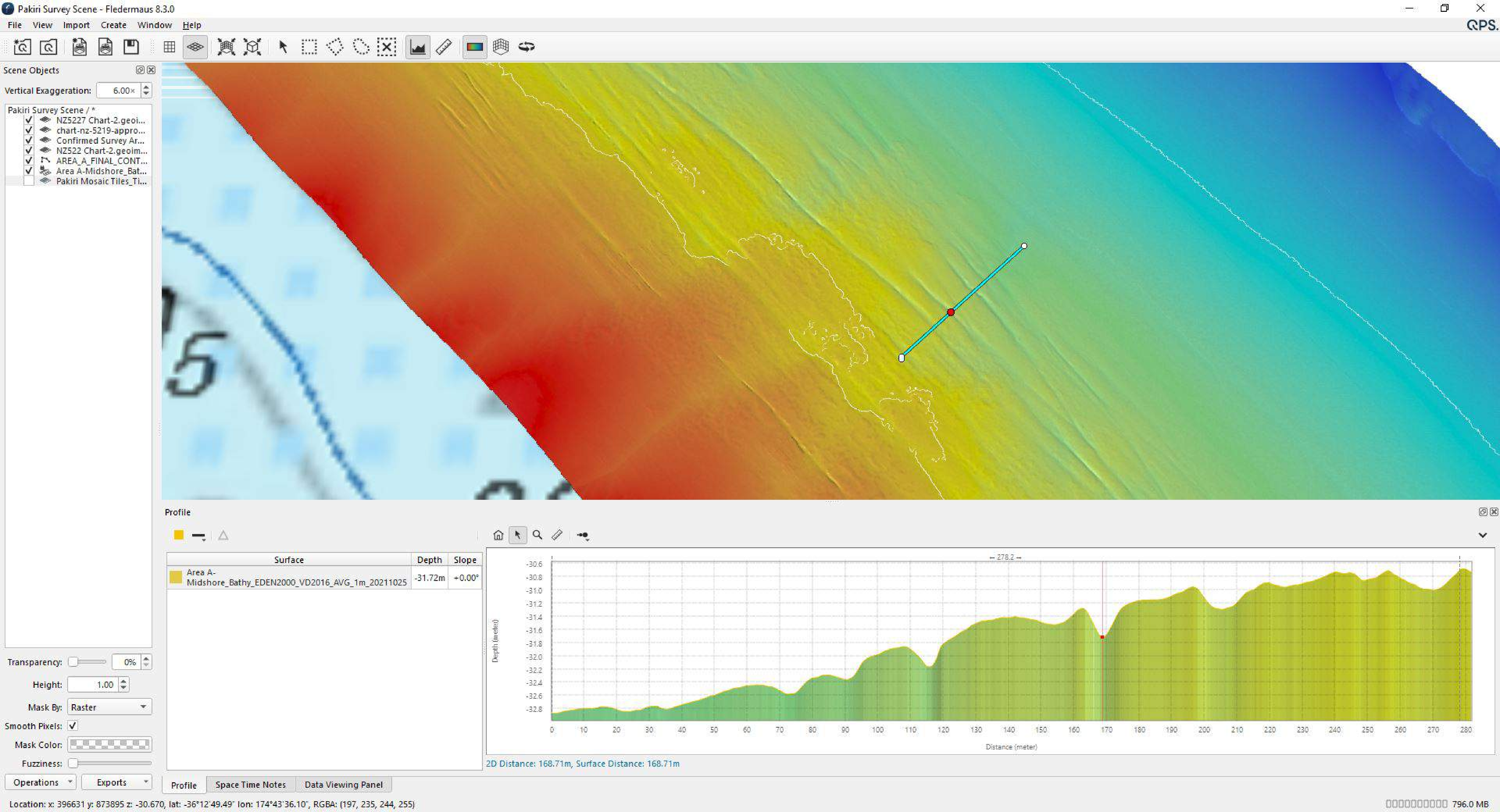
For Discovery Marine Ltd

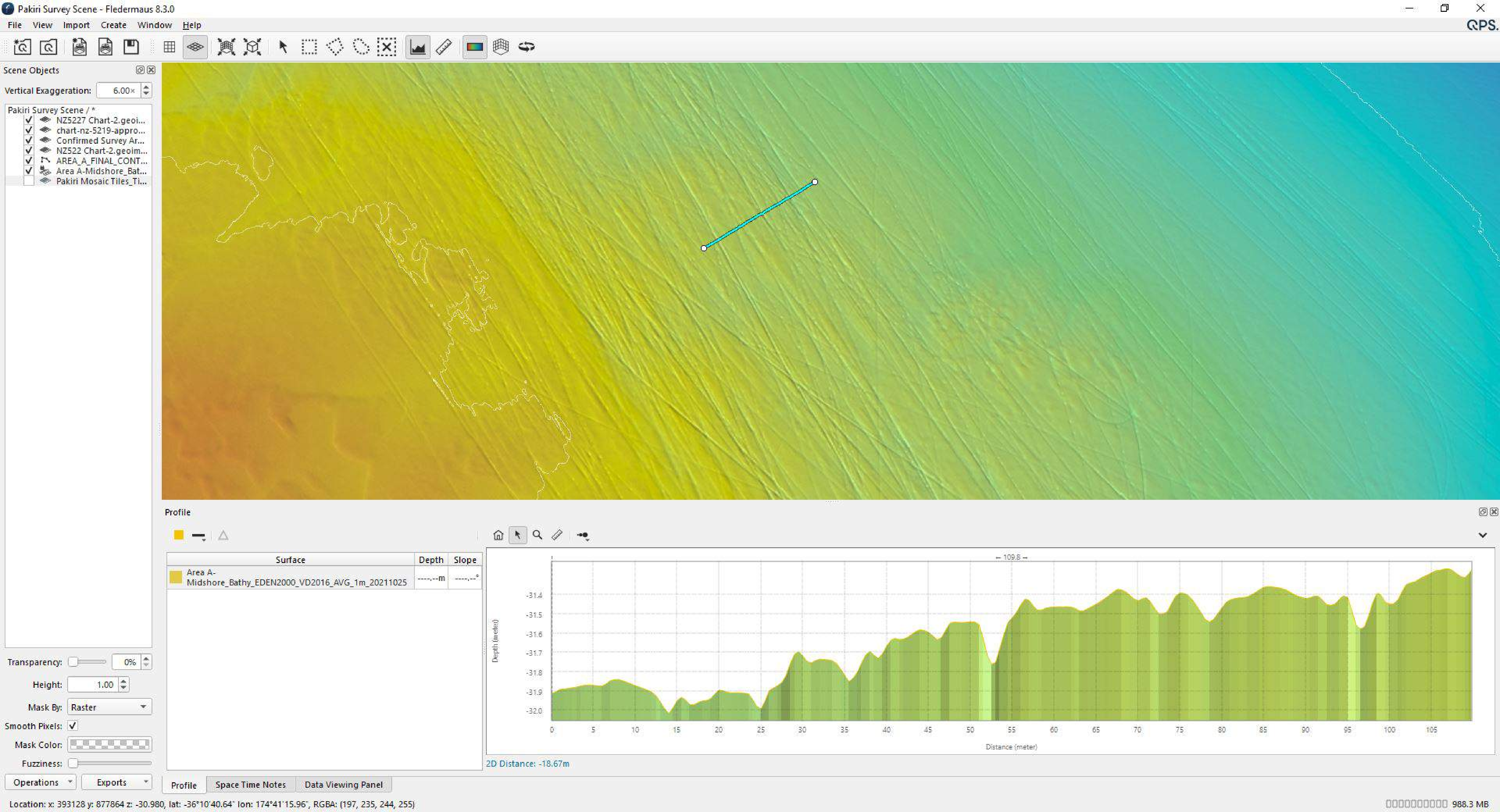
Authored by		Date: 18 October 2021
	Dan Inglis (BSURV, CPHS1)	Senior Surveyor
Approved by		Date: 18 October 2021
	Jimmy Van der Pauw (BSURV, CPHS1)	Operations Manager

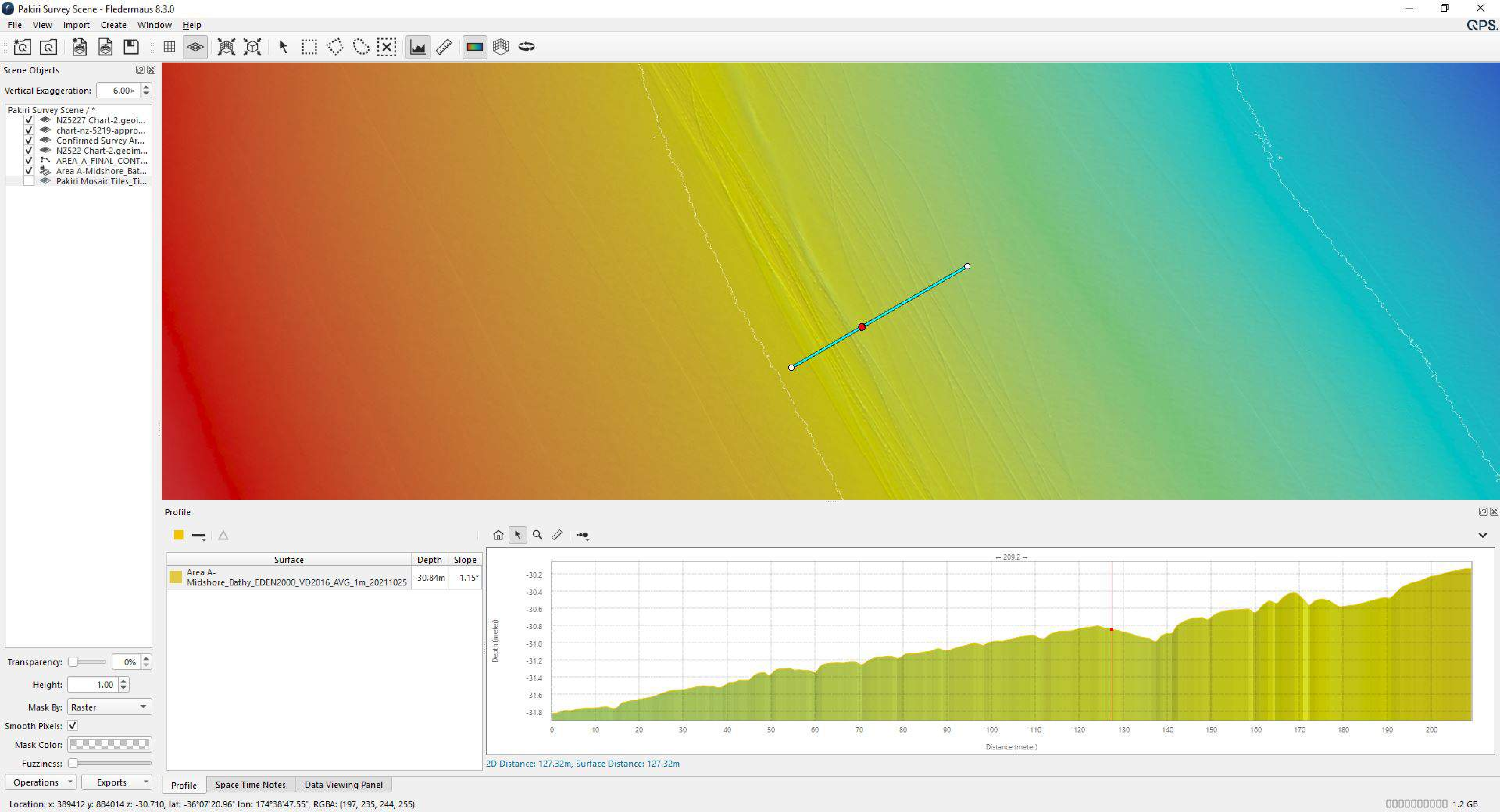
APPENDIX A – METADATA

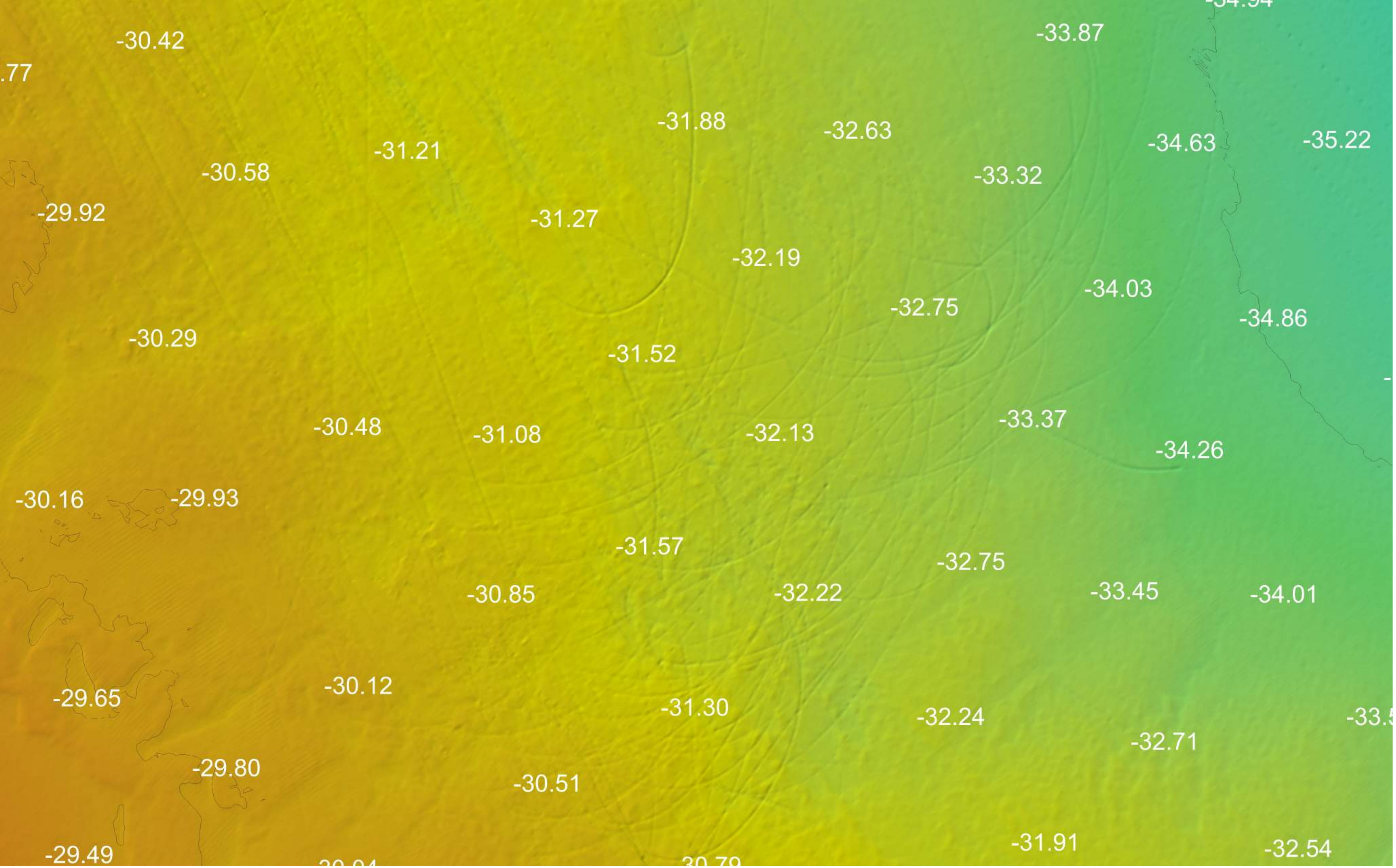
Survey Company	Discovery Marine Ltd		
Project Name	Auckland Offshore Sand Extraction Site		
Project Number	2151		
Location	Pakiri		
Client	McCallum Bros. Ltd		
Contract Number	-		
Survey Start Date	08/10/2021	Survey End Date	11/10/2021
Surveyor In Charge	DJI		
Field Personnel	BEW, DJS, DJI, KMD		
Office Personnel	DJI, ELC, JVP, KMD		
Horizontal Datum and Projection Vertical Datum	EDEN2000 NZVD2016		
Sea Level Reduction	N/A	Tide Stations:	N/A
Origin of Coordinates and Levels	PPK Network solution from CORS reference stations WHNG, AUCK, WARK, CORM, HAMT. Survey referenced utilising ellipsoid to NZVD20216 separation model.		
Survey Vessel	TRANQUIL IMAGE		
Positioning System Sonar System Sonar System Freq.	POSMV + MarineSTAR G2+ real-time PPP. Post processed POSPAC IAPPK Teledyne Reson T50 R MBES 400kHz Fixed Frequency		
Acquisition Software Processing and Delivery Software	Qinsy v9.4.2 POSPac MMS8, Qimera v2.32		
Data Collected	Bathymetry		
Coverage Achieved	Full seafloor		
Accuracy Standard Achieved	Yes		
Bathymetric Gridded Surface Method	Average surface		
Gridded Surface Resolution	1m x 1m		
Seafloor backscatter file type	GSF, processed to 0.25m x 0.25m grid resolution mosaic.		
File Format	GTIFF		
Data Custodian Contact Details	DML		

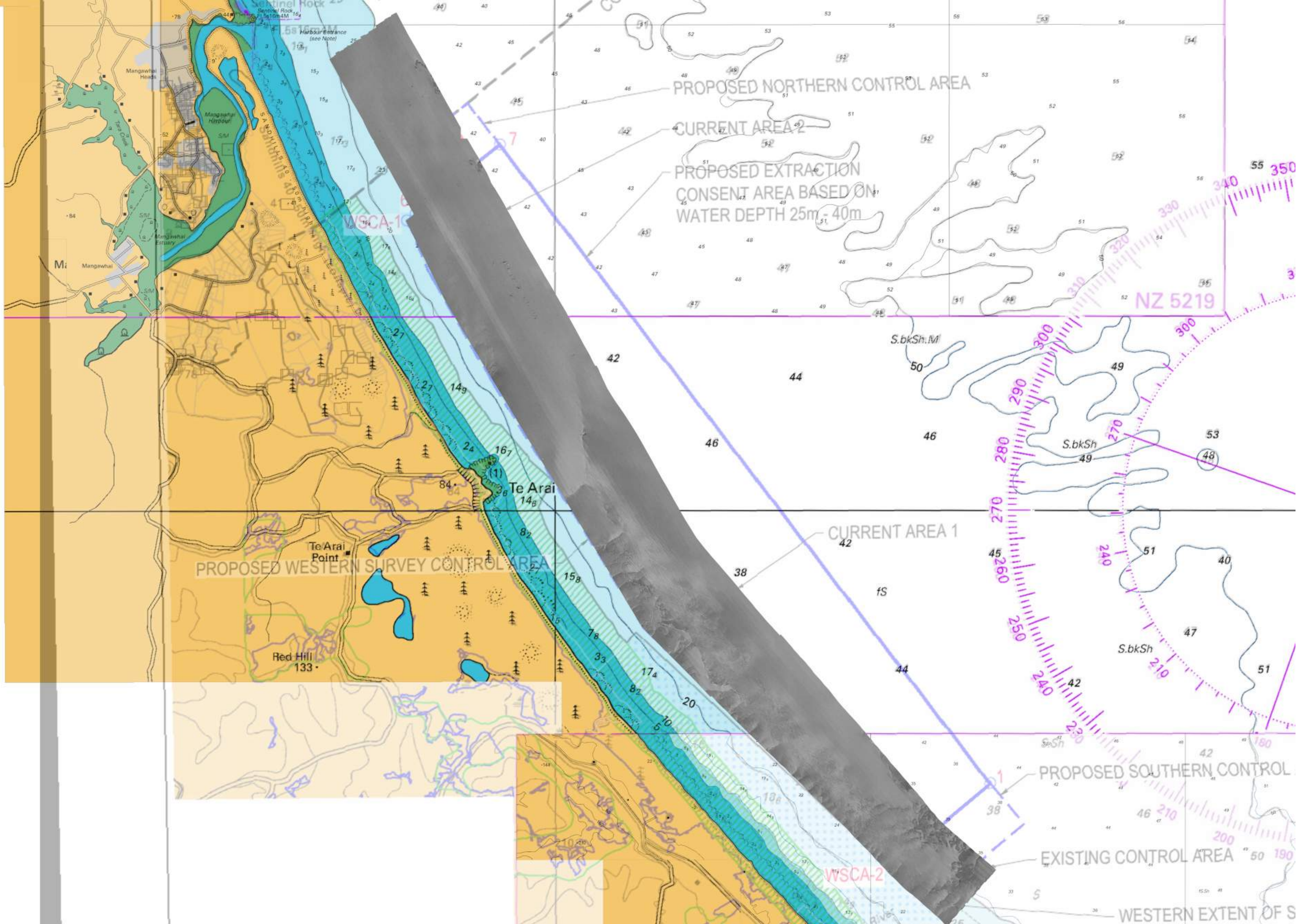

Pakiri Survey Scene - Fledermaus 8.3.0
File View Import Create Window Help
QPS.
Scene Objects
Vertical Exaggeration: 6.00×
Pakiri Survey Scene / *
NZ5227 Chart-2.geoi...
chart-nz-5219-appro...
Confirmed Survey Ar...
NZ522 Chart-2.geoim...
AREA_A_FINAL_CONT...
Area A-Midshore_Bat...
Pakiri Mosaic Tiles_Ti...
20
Transparency: 0%
Height: 1.00
Mask By: Raster
Smooth Pixels:
Mask Color:
Fuzziness:
Operations
Exports
Profile
Surface
Depth
Slope
Area A-Midshore_Bathy_EDEN2000_VD2016_AVG_1m_20211025
-31.47m
-0.80°
100.7
5.1
Depth (meter)
-31.4 -31.6 -31.8 -32.0 -32.2 -32.4 -32.6 -32.8 -33.0 -33.2 -33.4 -33.6
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105
Distance (meter)
2D Distance: 37.36m, Surface Distance: 37.36m
Profile
Space Time Notes
Data Viewing Panel
Location: x: 395461 y: 875111 z: -30.070, lat: -36°12'10.01" lon: 174°42'49.29", RGBA: (197, 235, 244, 255)
779.4 MB


Pakiri Survey Scene - Fledermaus 8.3.0
File View Import Create Window Help
QPS.
Scene Objects
Vertical Exaggeration: 6.00×
Pakiri Survey Scene / *
NZ5227 Chart-2.geoi...
chart-nz-5219-appro...
Confirmed Survey Ar...
NZ522 Chart-2.geoim...
AREA_A_FINAL_CONT...
Area A-Midshore_Bat...
Pakiri Mosaic Tiles_Ti...
Transparency: 0%
Height: 1.00
Mask By: Raster
Smooth Pixels:
Mask Color:
Fuzziness:
Operations
Exports
Profile
Surface
Depth
Slope
Area A-Midshore_Bathy_EDEN2000_VD2016_AVG_1m_20211025
-31.72m
+0.00°
278.2
Depth (meter)
Distance (meter)
2D Distance: 168.71m, Surface Distance: 168.71m
Profile
Space Time Notes
Data Viewing Panel
Location: x: 396631 y: 873895 z: -30.670, lat: -36°12'49.49" lon: 174°43'36.10", RGBA: (197, 235, 244, 255)
796.0 MB


Pakiri Survey Scene - Fledermaus 8.3.0
File View Import Create Window Help
QPS.
Scene Objects
Vertical Exaggeration: 6.00×
Pakiri Survey Scene / *
NZ5227 Chart-2.geoi...
chart-nz-5219-appro...
Confirmed Survey Ar...
NZ522 Chart-2.geoim...
AREA_A_FINAL_CONT...
Area A-Midshore_Bat...
Pakiri Mosaic Tiles_Ti...
Transparency: 0%
Height: 1.00
Mask By: Raster
Smooth Pixels:
Mask Color:
Fuzziness:
Operations
Exports
Profile
Surface
Depth
Slope
Area A-Midshore_Bathy_EDEN2000_VD2016_AVG_1m_20211025
----.--m
----.--°
109.8
-31.4
-31.5
-31.6
-31.7
-31.8
-31.9
-32.0
Depth (meter)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105
Distance (meter)
2D Distance: -18.67m
Profile
Space Time Notes
Data Viewing Panel
Location: x: 393128 y: 877864 z: -30.980, lat: -36°10'40.64" lon: 174°41'15.96", RGBA: (197, 235, 244, 255)
988.3 MB


Pakiri Survey Scene - Fledermaus 8.3.0
File View Import Create Window Help
QPS.
Scene Objects
Vertical Exaggeration: 6.00×
Pakiri Survey Scene / *
NZ5227 Chart-2.geoi...
chart-nz-5219-appro...
Confirmed Survey Ar...
NZ522 Chart-2.geoim...
AREA_A_FINAL_CONT...
Area A-Midshore_Bat...
Pakiri Mosaic Tiles_Ti...
Transparency: 0%
Height: 1.00
Mask By: Raster
Smooth Pixels:
Mask Color:
Fuzziness:
Operations
Exports
Profile
Surface
Depth
Slope
Area A-Midshore_Bathy_EDEN2000_VD2016_AVG_1m_20211025
-30.84m
-1.15°
209.2
-30.2
-30.4
-30.6
-30.8
-31.0
-31.2
-31.4
-31.6
-31.8
Depth (meter)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Distance (meter)
2D Distance: 127.32m, Surface Distance: 127.32m
Profile
Space Time Notes
Data Viewing Panel
Location: x: 389412 y: 884014 z: -30.710, lat: -36°07'20.96" lon: 174°38'47.55", RGBA: (197, 235, 244, 255)
1.2 GB


-30.42
-33.87
-31.88
-32.63
-31.21
-34.63
-35.22
-30.58
-33.32
-29.92
-31.27
-32.19
-34.03
-32.75
-34.86
-30.29
-31.52
-33.37
-30.48
-31.08
-32.13
-34.26
-30.16
-29.93
-31.57
-32.75
-30.85
-32.22
-33.45
-34.01
-30.12
-29.65
-31.30
-32.24
-32.71
-29.80
-30.51
-31.91
-32.54
-29.49



PROPOSED NORTHERN CONTROL AREA
CURRENT AREA 2
PROPOSED EXTRACTION
CONSENT AREA BASED ON
WATER DEPTH 25m - 40m
WSCA-1
NZ 5219
Mangawhai Harbour
Mangawhai Heads
Mangawhai
Mangawhai Estuary
Sentinel Rock
Harbour Entrance (see Note)
Te Arai
Te Arai Point
CURRENT AREA 1
PROPOSED WESTERN SURVEY CONTROL AREA
Red Hill
133
S.bkSh.M
S.bkSh
fS
PROPOSED SOUTHERN CONTROL
EXISTING CONTROL AREA
WSCA-2
WESTERN EXTENT OF S

Attachment 4 – Second Caucusing Meeting 5 November 2021, Record of Agreed Actions

Jennifer Hart

From: Jennifer Hart
Sent: Monday, 8 November 2021 9:50 AM
To: 'Todd, Derek'; Todd, Derek; Greg Cox; Sam Otter; David Hill; Ashishika Sharma; Mike Hilton; Shaw Mead; Sian John; Tom Shand (TShand@tonkintaylor.co.nz)
Subject: Sand extraction hearing - Expert caucusing part 2 - Actions

All

Actions recorded from Friday's session are tabulated below, taking into account Greg's email this morning. There is a post-meeting suggestion included Item 8, which I understand David and Derek are comfortable with.

Item	Action	Person	Tentative Timeframe
1	Advise caucusing panel of timeframe for providing survey outputs as set out below	Greg Cox	Complete
2	Provide 2020 and Mar 2021 ECoast survey information to Greg Cox	Shaw Mead	By 9 Nov
3	Source SurveyWorx survey information for 2018 and Mar 2021 via McCallums	Greg Cox	By 10 Nov (underway)
4	Provide caucusing panel with sketch showing locations of <u>4 shore-parallel profiles</u>, extending between northern and southern limits of Oct 2021 survey area	Mike Hilton	Complete
5	Provide caucusing panel with sketch showing locations of <u>shore-normal profiles:</u> - At 200m intervals, between northern and southern limits of Oct 2021 survey area; and - In the 800m length where the deeper dredge feature is located, additional profiles at 100m intervals; and - In the 800m length where the deeper dredge feature is located, further additional profiles co-located with 2021, 2020, 2018 survey profiles (noting the challenges of this); and - Extending between western (inshore) and eastern (offshore) limits of Oct 2021 survey area	Greg Cox	By 12 Nov (or earlier)
6	Prepare shore-parallel and shore-normal profiles as per Items 4 and 5 above, including "full width" profiles and "zoomed in" views of the deeper dredge features in the profiles.	Greg Cox	By 23 Nov
7	Prepare superimposed profiles of deeper trench features from 2018, 2020, Mar 2021 (ECoast & SurveyWorx), Oct 2021 surveys to allow comparison of features of time	Greg Cox	By 23 Nov
8	Provide ages for dredged features *or most recent dredging date for the areas of the surveyed extent e.g. last date that exclusion areas were dredged; last date that the northern 500m were dredged* [italics are my	Derek Todd	By 23 Nov

	post-meeting suggestion, for caucusing acceptance]		
9	Next expert caucusing session	Derek Todd	29 Nov

Ngā mihi nui

Jennifer

Jennifer Hart
Senior Principal – Transport Infrastructure
Beca
Phone: +64 9 300 9000 Fax: +64 9 300 9300
DDI: +64 9 308 0867 Mobile: +64 (0)27 365 3340
www.beca.com

igniteyourthinking.beca.com

Make flexibility work – if you receive an email from me outside normal business hours, please don't feel you should read it or reply until your normal business hours

Attachment 5 – Hydrographic Survey Report November 2021 and Shore-Normal Profiles

DISCOVERY MARINE LTD

Reference: **DML 2127_3**

24 November 2021

PAKIRI SAND EXTRACTION – SURVEY DATA COMPARISONS

1 INTRODUCTION

As a result of the Caucusing meeting held on 5 November 2021, DML was charged with collating survey data from previous surveys of the Pakiri sand extraction are for the purposes of comparing results with the most recent DML multibeam (MBES) survey, undertaken in October 2021.

The purpose of this most recent survey was to:

- Check the extent and location of the trenches in the offshore area, and
- Check that extraction was not occurring in the area north of the consent beyond the Auckland/northland boundary

A further anticipated outcome of the survey was to determine what Coastal Processes/if any were in play beyond the 25m depth contour and whether there had been sediment transport in deeper water to replenish trenches.

Instructions from the Panel were as follows:

- Source survey data from SurveyWorx of the 2018 and March 2021 surveys
- Source survey data from eCoast for the September 2021 survey (however the SBES survey was actually September 2020)

From the data provided, DML was asked to:

- Provide 4 x shore parallel cross sections/profiles of the seabed from the October 2021 survey
- Provide a series of shore-normal profiles including sections at 200m intervals throughout the Oct 2021 survey area, 100m sections throughout the 800m length of known deep trench area and sections showing comparisons between all data sets for those regions where data overlaps occurred.

2 PREVIOUS SURVEY INFORMATION

To enable survey data comparisons, the QPS Qimera software package was used for importing, inspecting data and creation of cross section images. Engineering style cross sections were compiled using Trimble Terramodel software.

2.1 SurveyworX Survey Data

Previous surveys within the sand extraction site have been carried out in the past by Kaipara Ltd using a WASSP MBES. McCallum Bros Ltd provided DML with various datasets from the 2018 and 2021 surveys. However, the 2018 data was not able to be imported as it was not all exported in a consistent format that could be successfully imported by the Qimera software. Whilst some of the datasets appeared to be in a readable format, many of the files became corrupted during the file decompression process.

Of those files that were able to be imported, issues with spatial reconciliation meant that manipulation of this data was so extensive, that it could not be relied upon. Despite extensive efforts to work with this data, the level of manipulation was deemed to be imprudent given the importance of the task.

Fortunately more success was had with the 2021 survey data. The image below depicts regions surveyed by SurveyworX in 2018 and 2021 as yellow track lines. DML's MBES coverage is in the background. However, not all of the WASSP data could be interrogated as explained above.

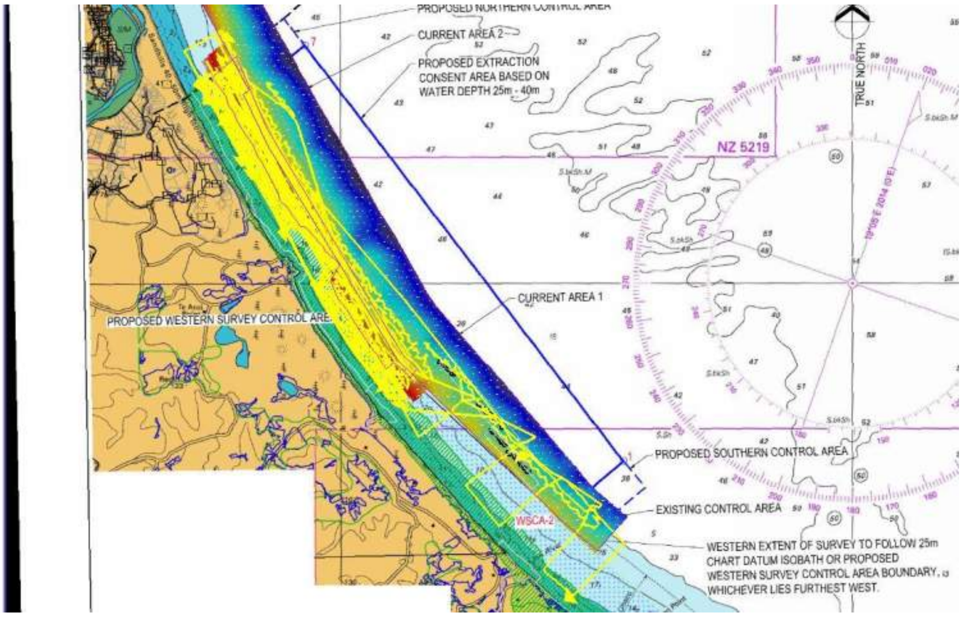


Figure 1 – Location of 2018 and 2021 Kaipara Ltd Surveys

Issues with the WASSP Data

It was noted within the WASSP data, that significant errors occurred in the outer beams due to sound velocity (SV) errors. However, from earlier correspondence with Kaipara Ltd, it was understood in an attempt to minimise errors in data, the survey vessel was usually manoeuvred along the dredge trenches as far as practical. Hence, the vertical error in vicinity of the trenches is accepted as being less than what is seen in the outer beam data.

The image below depicts a typical 'frowning' artefact of adjoining swathes due to SV error having more impact on the outer beams due to increased slant range.

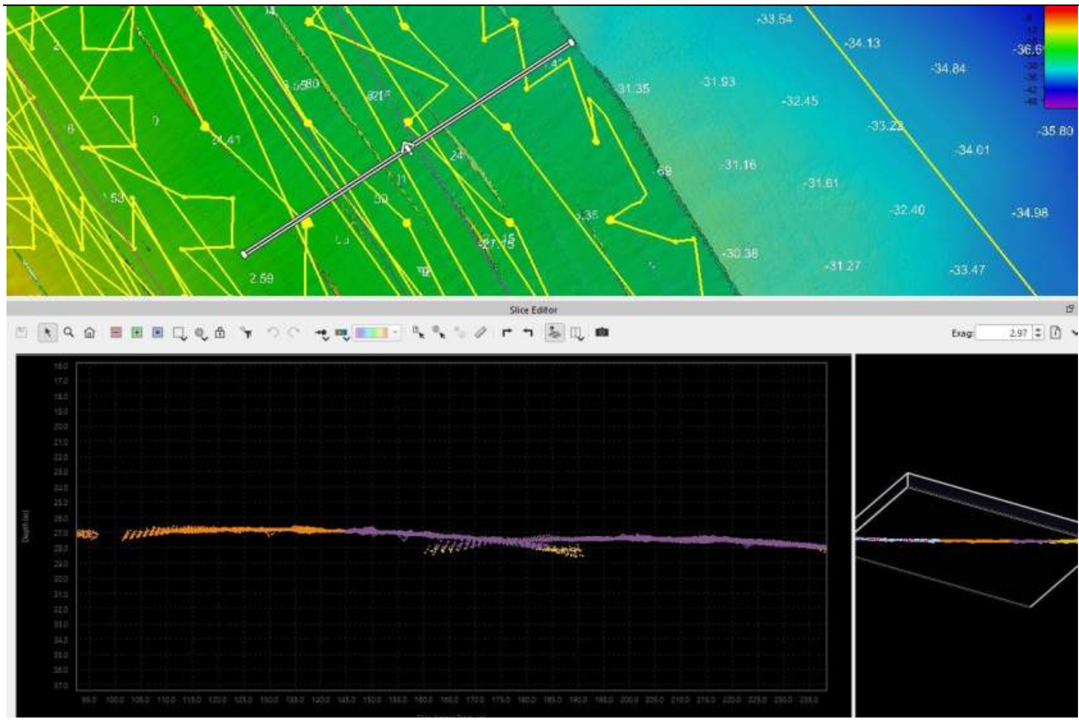


Figure 2 – Screengrab of WASSP MBES swathe overlap

Another issue is that the WASSP data received contains all data points from the surveys and is effectively raw data. It has not been processed, cleaned or thinned which has created difficulties in terms of deriving useful cross section profiles. The image below depicts adjoining swathes showing all seabed returns.

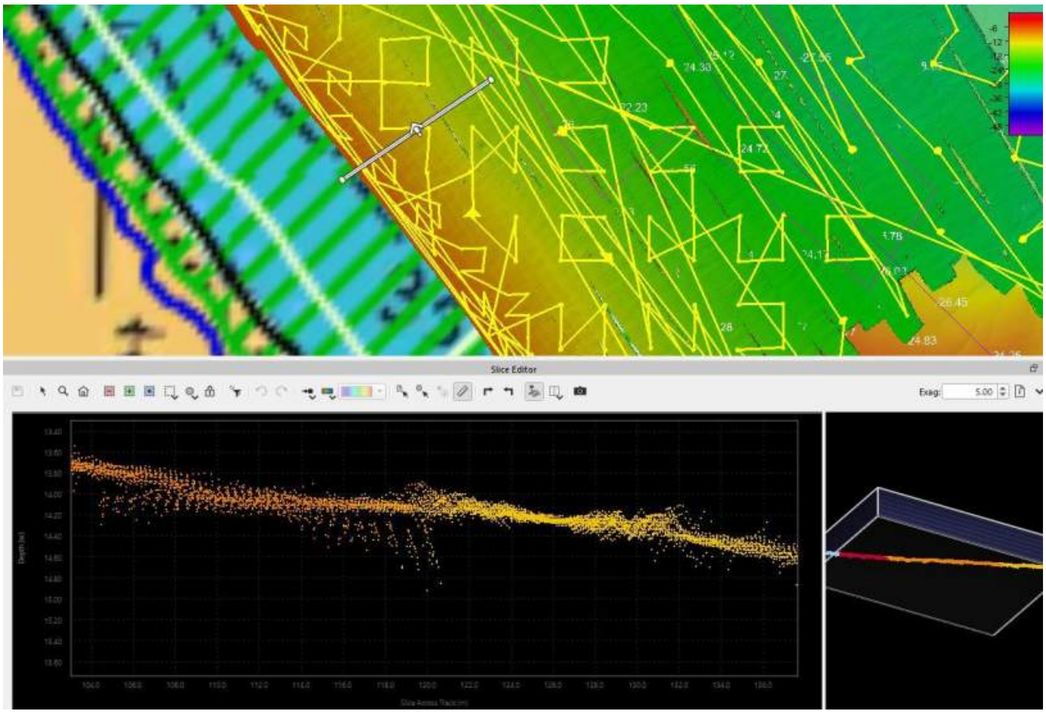


Figure 3 – Screengrab of WASSP MBES point cloud

2.2 eCoast Survey Data

Single Beam Echo Sounder (SBES) data from a September 2020 survey was imported into Qimera and overlaid onto the DML MBES surface.

The images below depict those regions for which SBES was gathered. There are the four distinct groupings which are indicated by the yellow pecked lines and were the areas targeted by eCoast as a result of the trench identification from earlier side scan sonar surveys.

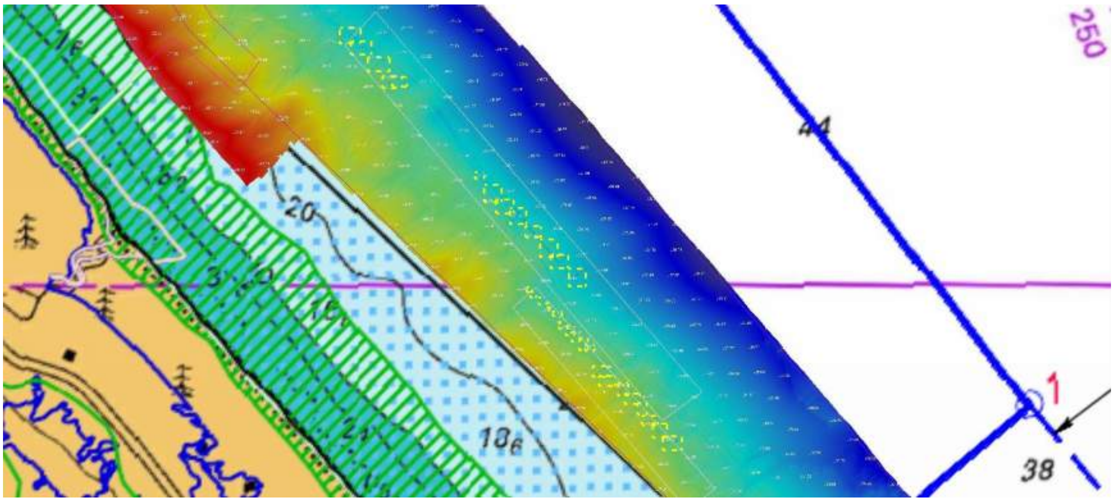
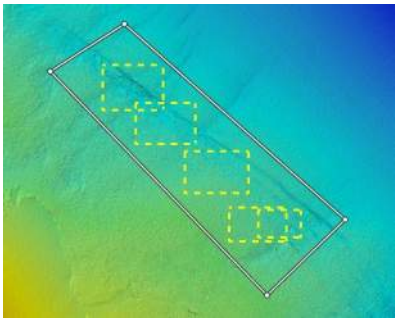
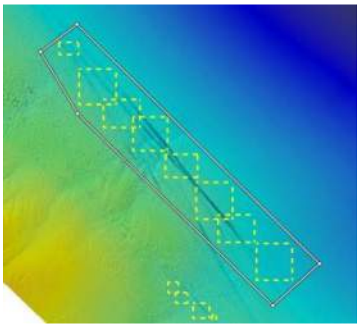


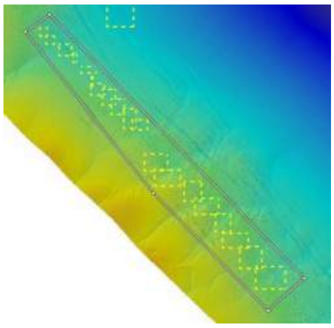
Figure 4 – Location of SBES Surveys



Area A



Area B



Areas C & D

<u>Issues with the SBES Data</u>

Some of the items to note with the SBES data are as follows:

- The survey lines are short lengths and were obviously designed to achieve coverage over main trenches only. Majority of the lines are considered random by nature and do not follow a straight line set which made it difficult to derive robust comparisons with the MBES data.
- The SBES data is quite 'spiky' and there are often gaps in the data where the echo sounder did not achieve consistent seabed returns. Across some of the trenches, the SBES only recorded one or two depths within the trenches and sometimes none at all.
- There appeared to be latency in the SBES data where a time lag in the acquisition system transpires as a horizontal offset or shift in the data. Without relevant calibration information, DML could not make appropriate adjustments for latency.

The image below illustrates the relationship between SBES and DML MBES data with the SBES as the orange profile and DML's MBES data as the yellow profile. The orange SBES profile depicts the intermittent losses of data and the latency offset.

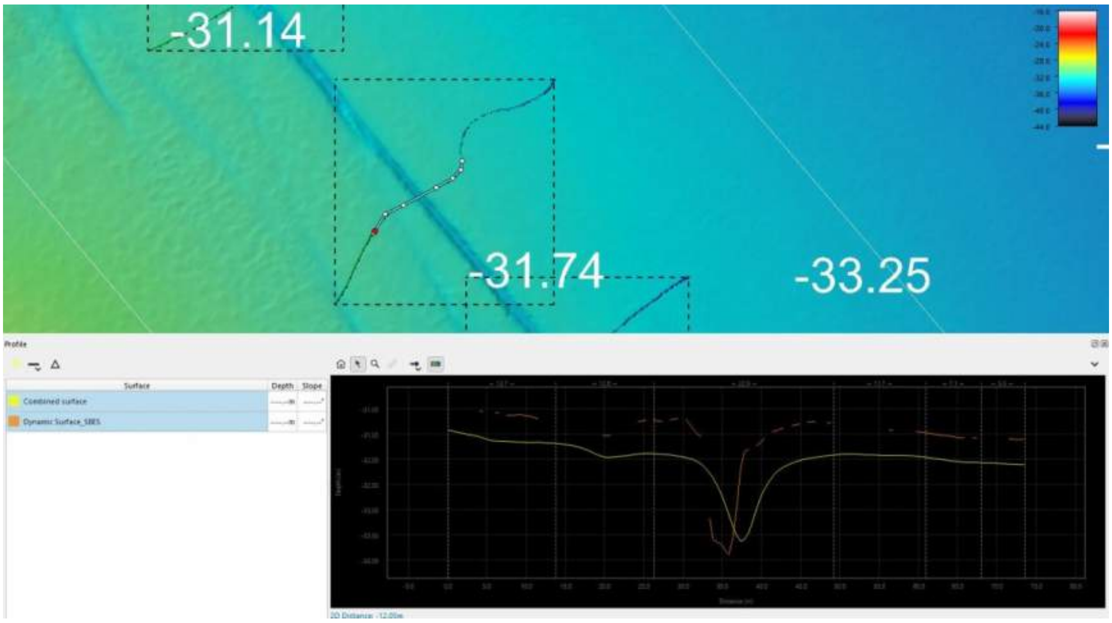


Figure 5 – Latency in SBES Data represented as an offset in the trench location

Figure 6 below depicts one cross section where the SBES failed to attain depths within a second trench. In both Figures 5 and 6, a vertical offset can be seen in the two datasets which is discussed further below.

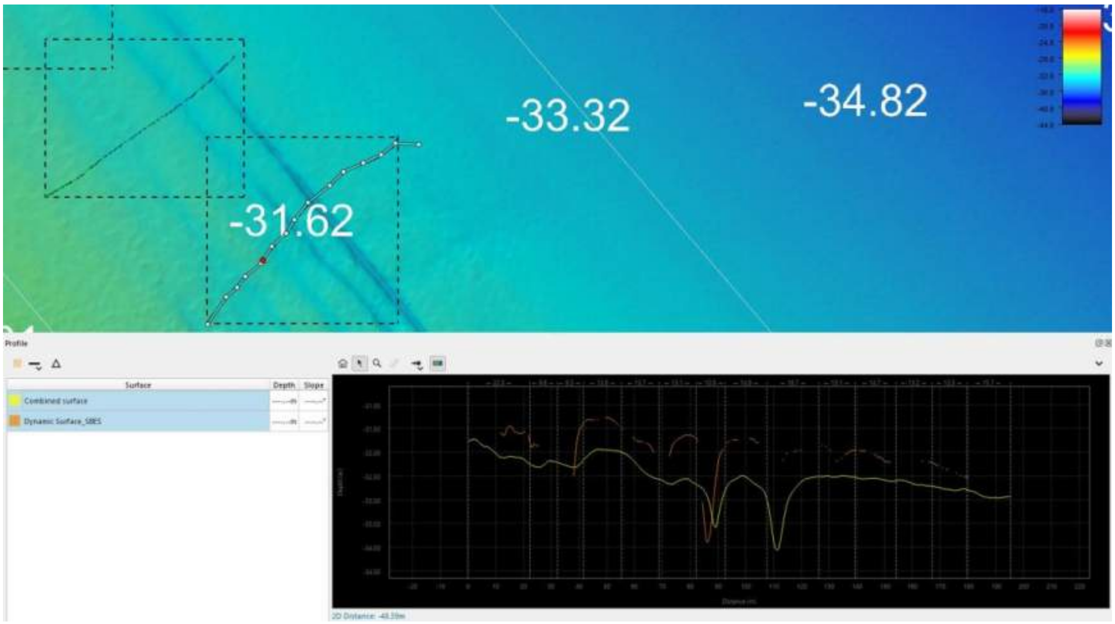


Figure 6 – Latency in SBES Data represented as an offset in the trench location

3 ADJUSTMENTS OF PREVIOUS SURVEY DATA

Adjustments to the WASSP Data:

In order to make comparisons with the DML MBES, the WASSP depth points had to be increased in value by 1.86m to align with the DML data. This is most likely due to a different MSL calculation being used in the WASSP system or a vertical offset error, or a combination of the two. .

The image below depicts the WASSP seabed surface as the red line which clearly lies above the DML seabed.

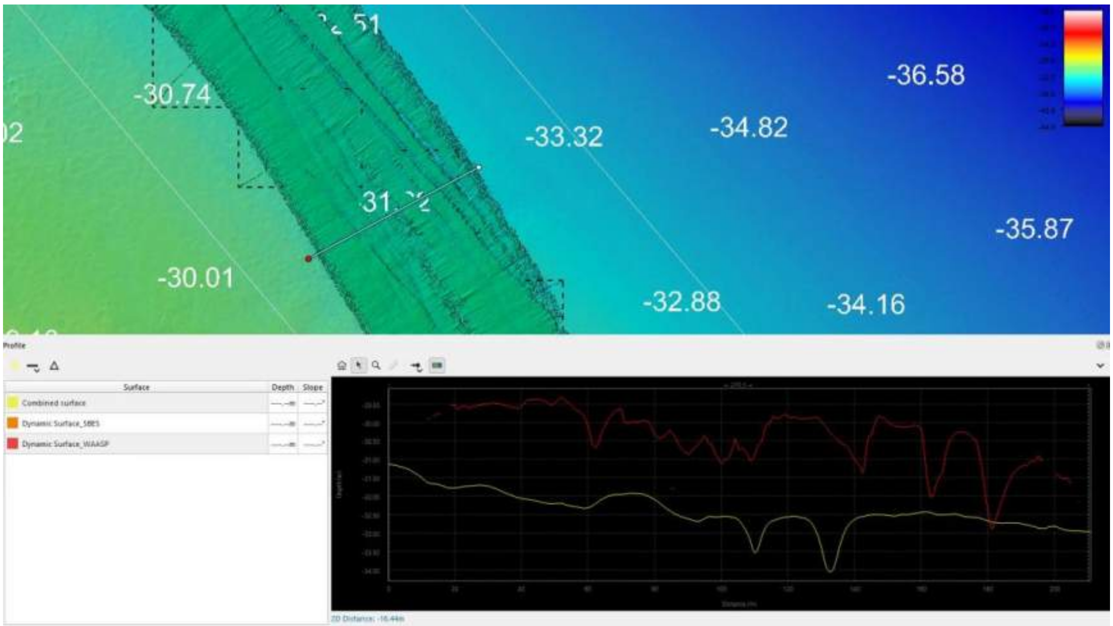


Figure 7 – Vertical Offset in WASSP and DML MBES data sets

In addition, the data had to be horizontally shifted by 65.34m in an orientation of 190^0 (grid). It could not be ascertained why the WASSP data had to be shifted horizontally in this manner however it should be noted that a significant level of adjustment in both the horizontal and vertical had to be applied to the WASSP data in order to 'fit' with the DML survey.

Adjustment to the SBES Data

The eCoast SBES data was found to be shoaler than the corresponding DML MBES data by 0.47m. Hence, this had to be vertically adjusted by 0.47m to align with the DML vertical datum (MSL). Vertical adjustments were via best efforts by comparing the depth points within both datasets across seabed areas where no dredge trenches were seen. By interrogation of several overlapping depth points, an average value was used for the vertical shift.

4 DATA COMPARISONS AND CROSS SCETION PROFILES

Despite the limitations with both the SurveyworX and eCoast datasets, best efforts have been employed to derive useful profile information. From the adjusted datasets, depth points were manually interrogated to ascertain the deepest point across each dredge track. Once cross section profiles were derived, the profiles were cross-referenced against the manually extracted data to ensure that the magnitude of dredge related trenching has been accurately depicted.

4.1 Shore Normal Profiles

In general, the SBES cross section locations have been used as the basis for comparisons across the three datasets for those areas deemed significant in terms of the level of dredging activity. The location of shore-normal profiles is depicted in Figures 8 and 9 below.

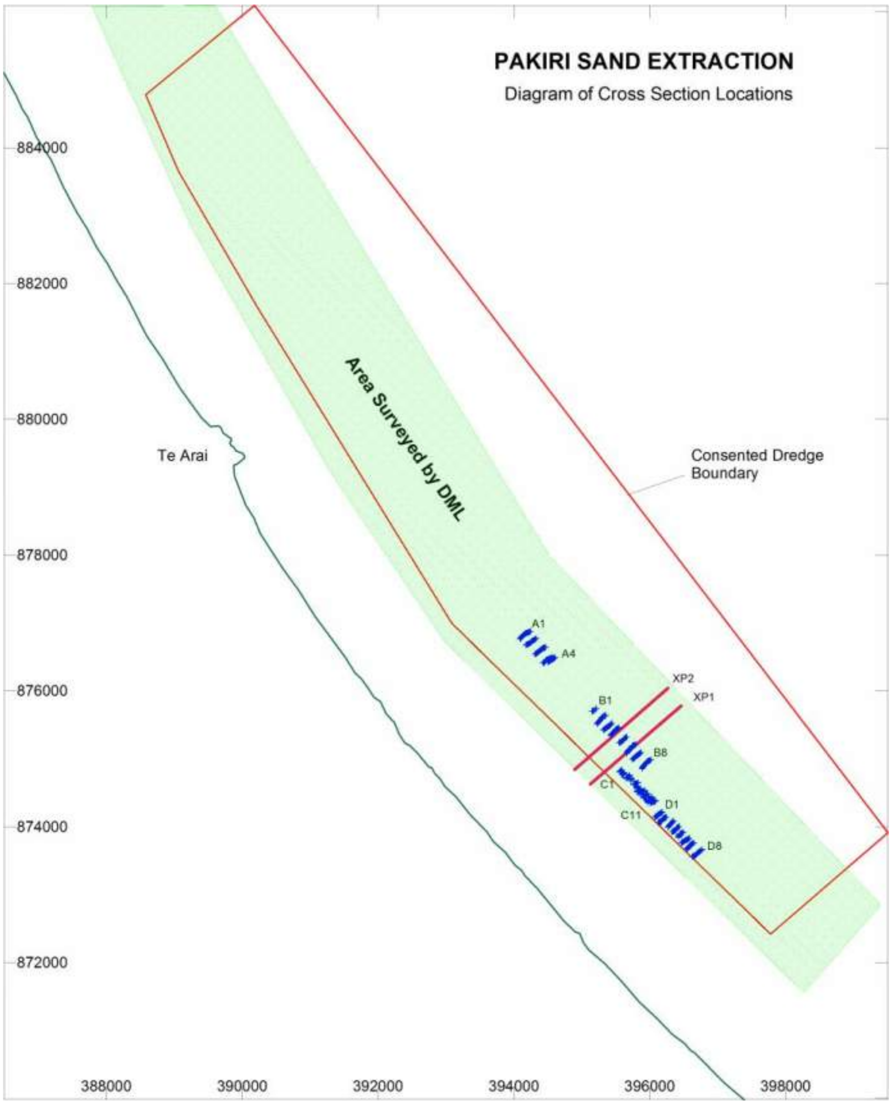


Figure 8 – Location of Shore Normal Profiles

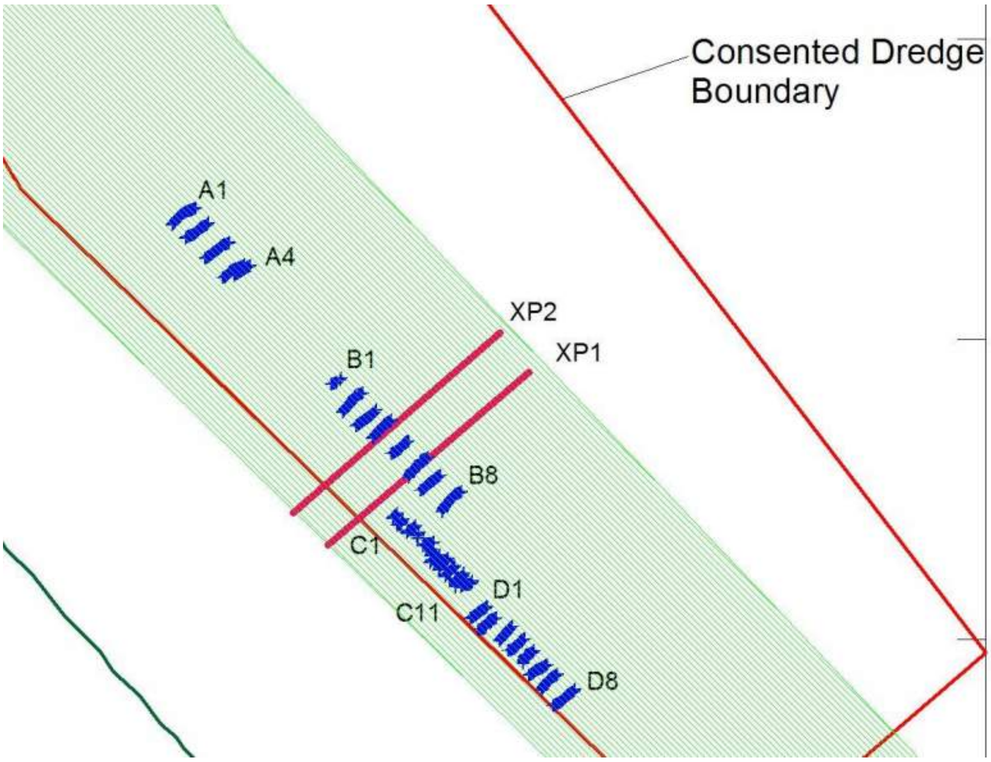


Figure 9 – Identification of Shore Normal Profiles encompassing the three Datasets

The accompanying cross section profiles are therefore labelled according to the four SBES regions surveyed (A, B, C, and D).

It should be noted that the deepest trench viewed in all three datasets has been assigned cross section number B6. This is the trench previously seen in the DML survey data as a length of trenching some 800m in length.

In addition to the cross sections over the trenches of interest, two longer sections (XP1 and XP2) have been provided which is based solely on the DML MBES survey. Section XP1 is also aligned along Section B6 and is also provided in an engineering format cross section.

Sections XP1 and XP2 are depicted below. These have been grossly exaggerated in the vertical scale in order to readily identify the deeper trench areas.

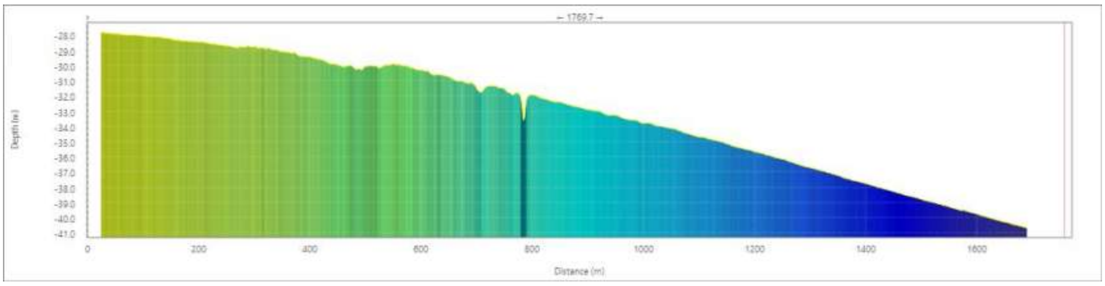


Figure 10 – Long Cross Section XP1

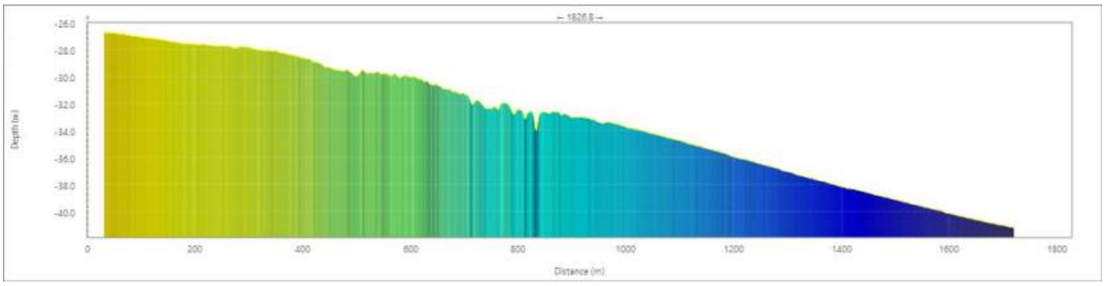


Figure 11 – Profile Image of Long Cross Section XP2

Profile XP1 has also been depicted as an engineering style cross section. This is for the full extent of DML's survey between the Western (shoreward) and Eastern (seaward) limits of the area surveyed. This profile has also been grossly exaggerated in the vertical scale in order to identify the main trenches. However, as can be seen below, the usefulness of this type of cross section for the entire DML survey area is questioned due to the length of the profile. It is felt that the use of the previously supplied 3D Viewer is a far more useful tool for gaining appreciation of the magnitude and extent of dredge trenching or swales.

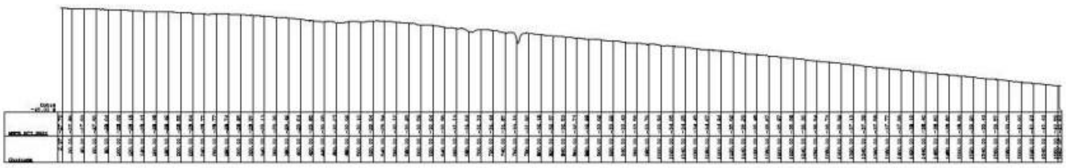


Figure 12 – Long Cross Section XP2

However, for all of the profiles derived from the three datasets over the regions as depicted in Figure 9 above, A3 size PDF engineering style cross sections have been compiled. These have been generated for all those sections where useful data could be derived from the three datasets. An example (Section A2) is provided below:

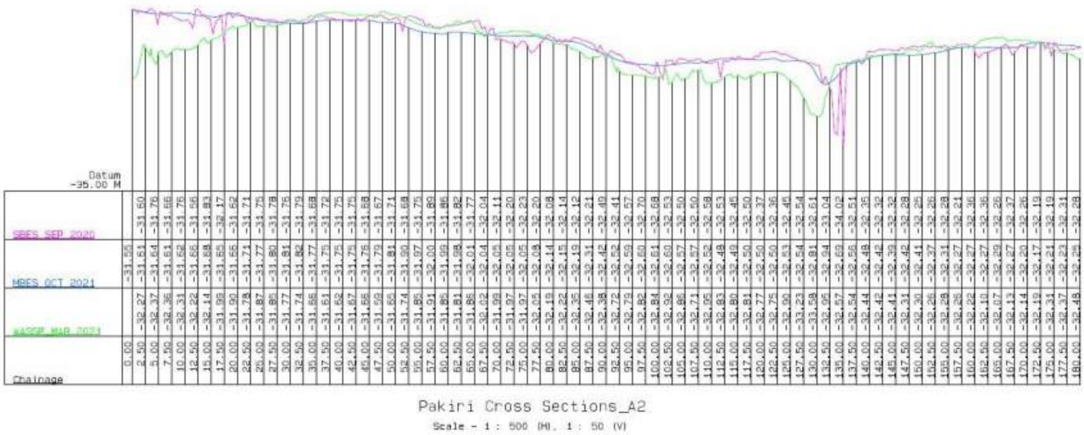


Figure 13 – Example of A3 PDF Profile of Cross Section A2

4.2 Shore Parallel Profiles

From DML's October 2021 dataset, four shore parallel sections have been extracted from the dataset. However, due to the length of these profiles (approximately 16km in total length), the profiles are depicted as profile image as opposed to engineering style cross sections for the same reason as explained above in terms of the shore-normal profiles. However corresponding xyz depth data for each of these shore parallel profiles has been provided should any recipient of this data wish to create their own set of deliverables.

The image below depicts the location of the four shore parallel sections:

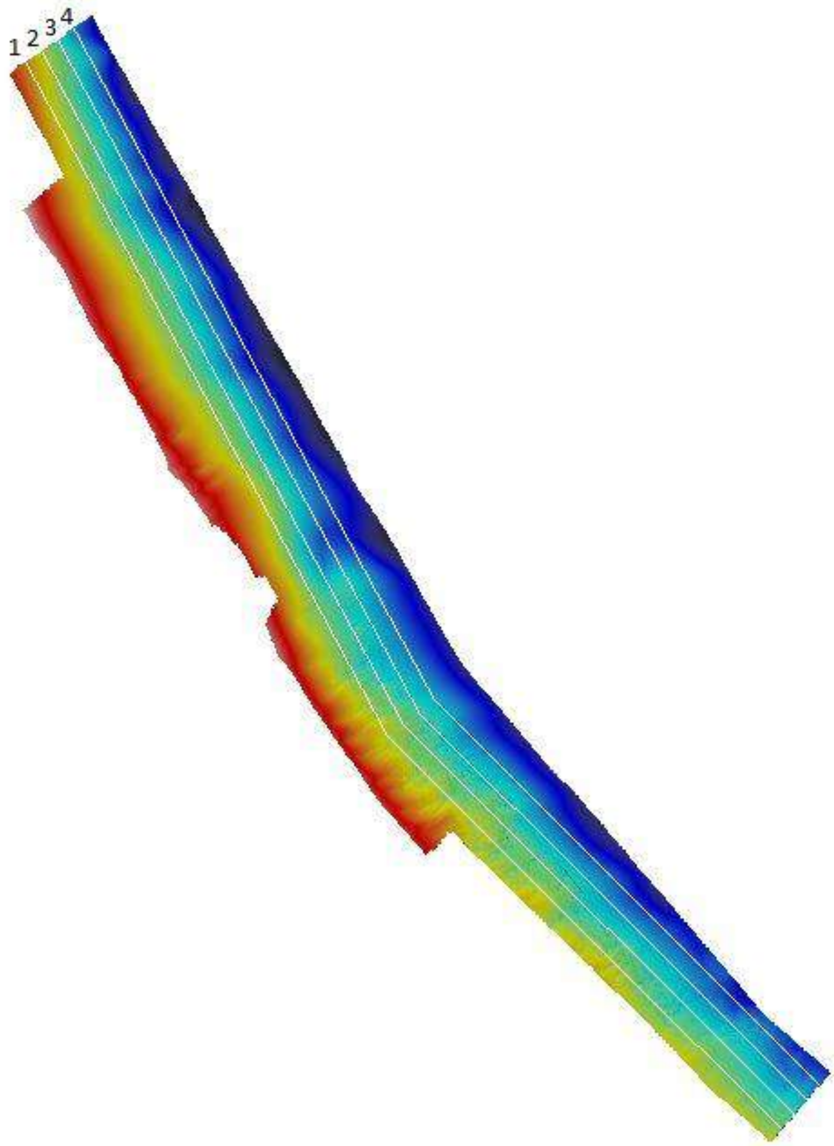


Figure 14 – Location of Shore Parallel Profiles

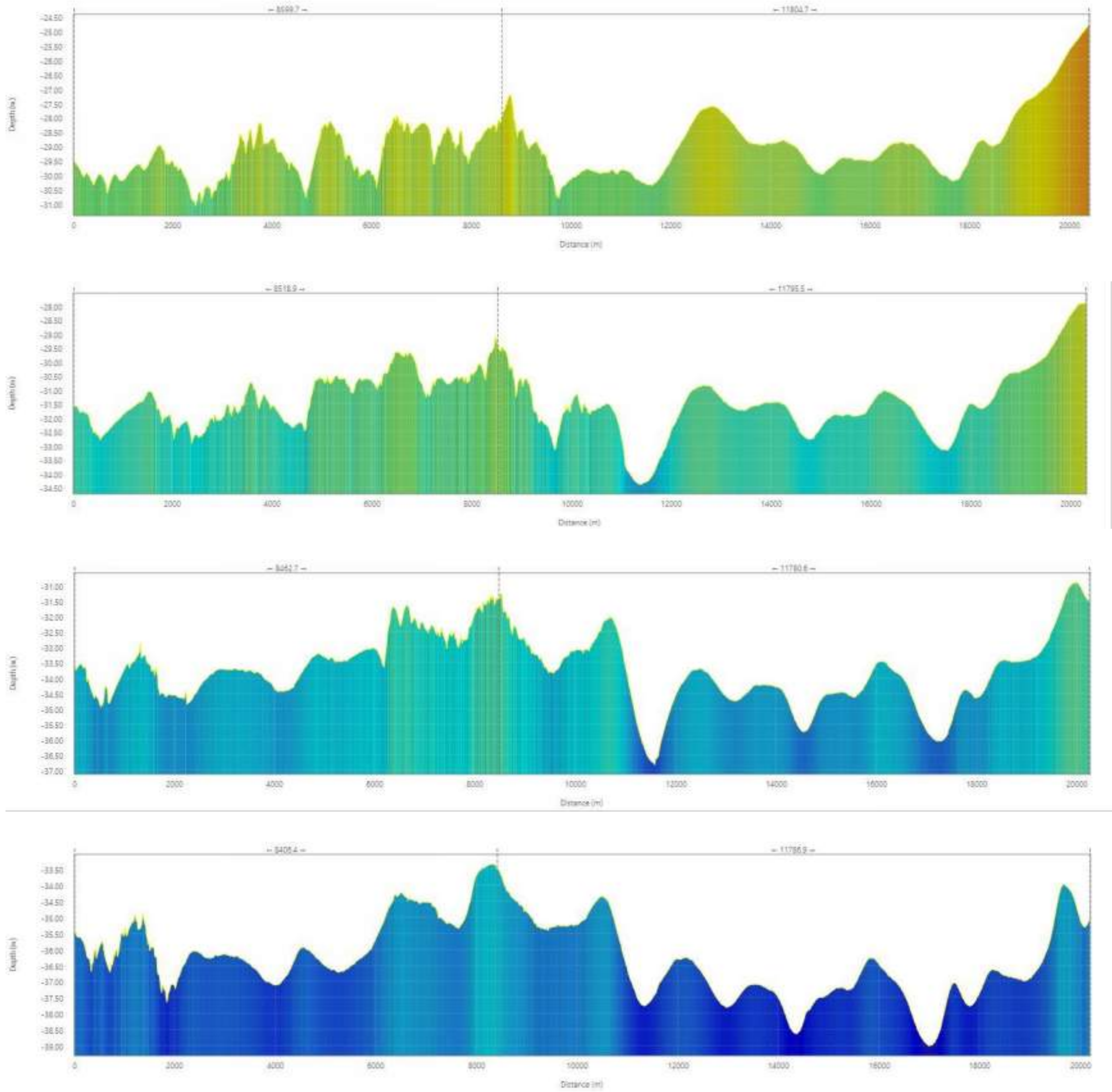


Figure 15 – Shore Parallel profiles 1 – 4. Chainage start is the northern survey limit.

5 SUMMARY

Given the intricacies in analysing individual cross section comparisons and bearing in mind the vagaries in manually adjusting two historic datasets to derive a ‘best-fit’, DML has taken the additional step to interrogate the depth data points and derive a summary table of trench depths.

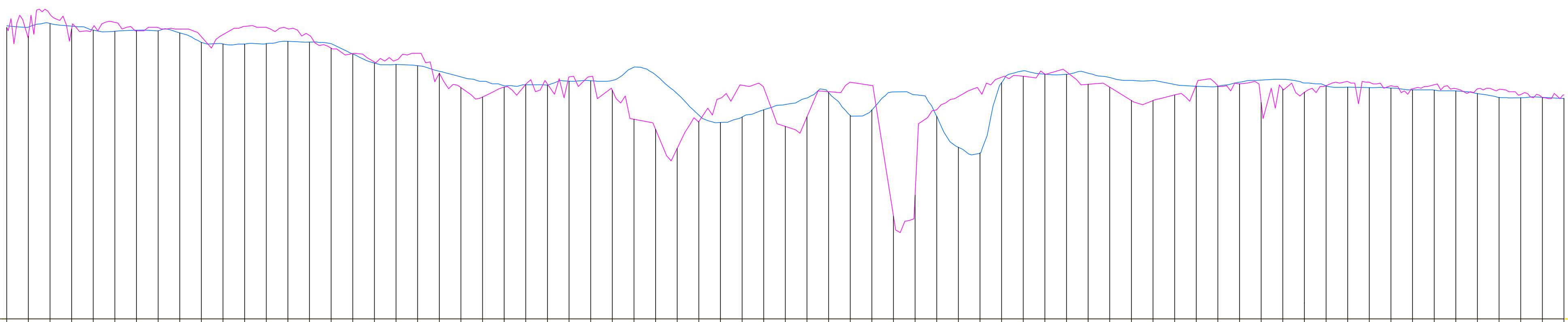
The accompanying MS excel table titled ‘Trench Comparisons’ lists maximum trench depths on each of the sections compared. Given the dates of the surveys, infill rate estimates have been calculated from the trench depth information. This information is based on the assumptions that no seabed modification (dredging) has been undertaken over the seabed areas (or specific trenches) for which the cross sections have been derived.

Based on the trench depth information, there does appear to be a clear trend in terms of the infill rates of the deeper dredged trenches or swales. Between September 2020 and October 2021 the average amount of infill in the deeper offshore trenches (Regions A and B) has been 0.89m. Within Regions C and D which are located closer to the western dredge boundary, the rate of infill has resulted in most trenches filling to a point where some are barely distinguishable in the latest survey. Noting that the dredge tracks within Regions C and D were understood to be between 0.4-0.8m deep according to the eCoast SBES survey data, this would indicate a similar rate of infill as experienced further offshore.

G.J. COX, MNZIS
IHO Cat A

Accompanying Data:

1. MS Excel Spreadsheet Trench Comparisons
2. Zipped Shore Normal Profiles Folder containing 2 x Long Profiles (XP1 and XP2) and Area Cross Section Profiles in PDF format for Regions A-D
3. Zipped Shore Parallel Profiles Folder containing profile images and xyz depth data for Profiles 1-4

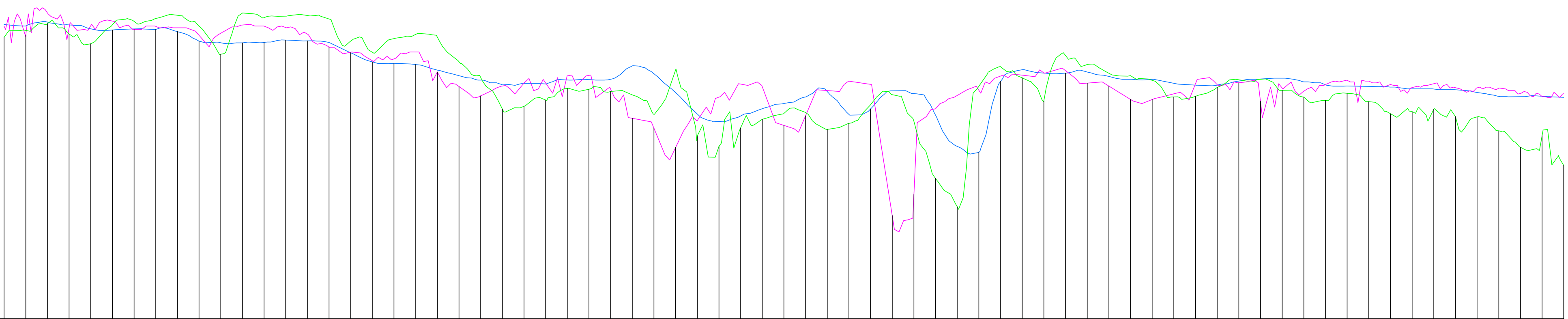


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00	-31.63	-31.61
2.50	-31.73	-31.62
5.00	-31.47	-31.58
7.50	-31.65	-31.61
10.00	-31.62	-31.66
12.50	-31.57	-31.67
15.00	-31.67	-31.66
17.50	-31.63	-31.67
20.00	-31.65	-31.69
22.50	-31.73	-31.80
25.00	-31.71	-31.82
27.50	-31.61	-31.82
30.00	-31.63	-31.82
32.50	-31.64	-31.79
35.00	-31.72	-31.80
37.50	-31.87	-31.82
40.00	-31.93	-31.93
42.50	-32.03	-32.04
45.00	-32.01	-32.06
47.50	-31.93	-32.07
50.00	-32.16	-32.13
52.50	-32.32	-32.20
55.00	-32.43	-32.25
57.50	-32.32	-32.30
60.00	-32.28	-32.29
62.50	-32.28	-32.29
65.00	-32.20	-32.25
67.50	-32.19	-32.24
70.00	-32.35	-32.24
72.50	-32.69	-32.09
75.00	-32.81	-32.18
77.50	-33.03	-32.39
80.00	-32.72	-32.64
82.50	-32.45	-32.73
85.00	-32.30	-32.66
87.50	-32.33	-32.58
90.00	-32.77	-32.52
92.50	-32.66	-32.44
95.00	-32.37	-32.38
97.50	-32.26	-32.65
100.00	-32.30	-32.58
102.50	-33.81	-32.37
105.00	-33.57	-32.41
107.50	-32.58	-32.66
110.00	-32.43	-33.01
112.50	-32.37	-33.08
115.00	-32.20	-32.27
117.50	-32.19	-32.13
120.00	-32.17	-32.17
122.50	-32.14	-32.17
125.00	-32.28	-32.16
127.50	-32.32	-32.21
130.00	-32.47	-32.24
132.50	-32.47	-32.24
135.00	-32.41	-32.29
137.50	-32.29	-32.31
140.00	-32.30	-32.31
142.50	-32.28	-32.26
145.00	-32.50	-32.24
147.50	-32.34	-32.23
150.00	-32.38	-32.27
152.50	-32.30	-32.30
155.00	-32.25	-32.32
157.50	-32.26	-32.32
160.00	-32.30	-32.33
162.50	-32.34	-32.35
165.00	-32.29	-32.35
167.50	-32.34	-32.36
170.00	-32.34	-32.39
172.50	-32.34	-32.44
175.00	-32.40	-32.44
177.50	-32.44	-32.44
180.00	-32.41	-32.45

Pakiri Cross Sections_A1

Scale - 1 : 500 (H), 1 : 50 (V)



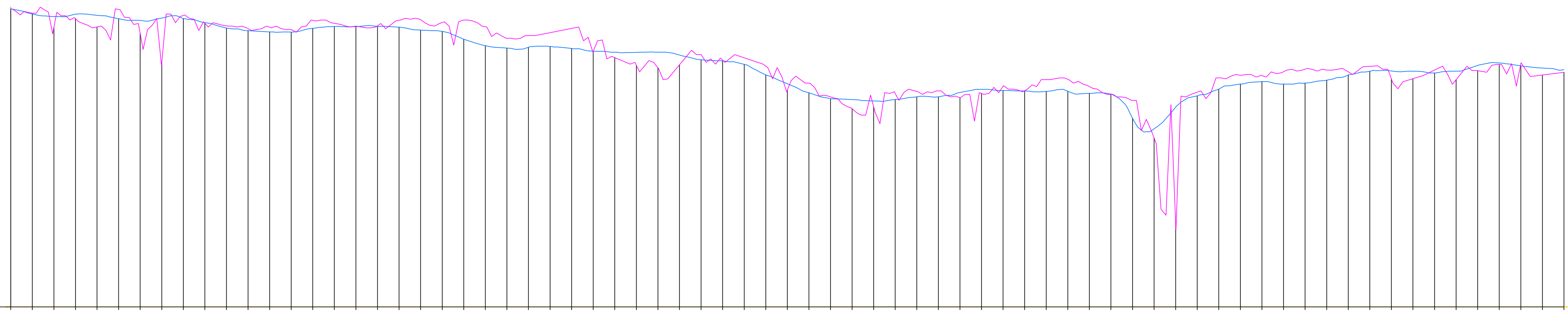
Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021	WASSP_MAR_2021
0.00	-31.63	-31.61	-31.76
2.50	-31.73	-31.62	-31.68
5.00	-31.47	-31.58	-31.60
7.50	-31.65	-31.61	-31.72
10.00	-31.62	-31.66	-31.83
12.50	-31.57	-31.67	-31.61
15.00	-31.67	-31.66	-31.57
17.50	-31.63	-31.67	-31.54
20.00	-31.65	-31.69	-31.50
22.50	-31.73	-31.80	-31.63
25.00	-31.71	-31.82	-31.95
27.50	-31.61	-31.82	-31.48
30.00	-31.63	-31.82	-31.53
32.50	-31.64	-31.79	-31.51
35.00	-31.72	-31.80	-31.50
37.50	-31.87	-31.82	-31.54
40.00	-31.93	-31.93	-31.80
42.50	-32.03	-32.04	-31.93
45.00	-32.01	-32.06	-31.77
47.50	-31.93	-32.07	-31.72
50.00	-32.16	-32.13	-31.75
52.50	-32.32	-32.20	-32.04
55.00	-32.43	-32.25	-32.22
57.50	-32.32	-32.30	-32.58
60.00	-32.28	-32.29	-32.55
62.50	-32.28	-32.29	-32.48
65.00	-32.20	-32.25	-32.35
67.50	-32.19	-32.24	-32.35
70.00	-32.35	-32.24	-32.38
72.50	-32.69	-32.09	-32.42
75.00	-32.81	-32.18	-32.64
77.50	-33.03	-32.39	-32.13
80.00	-32.72	-32.64	-32.90
82.50	-32.45	-32.73	-33.02
85.00	-32.30	-32.66	-32.80
87.50	-32.33	-32.58	-32.70
90.00	-32.77	-32.52	-32.63
92.50	-32.66	-32.44	-32.62
95.00	-32.37	-32.38	-32.82
97.50	-32.26	-32.65	-32.75
100.00	-32.30	-32.58	-32.53
102.50	-33.81	-32.37	-32.42
105.00	-33.57	-32.41	-32.72
107.50	-32.58	-32.66	-33.38
110.00	-32.43	-33.01	-33.71
112.50	-32.37	-33.08	-32.32
115.00	-32.20	-32.27	-32.10
117.50	-32.19	-32.13	-32.22
120.00	-32.17	-32.17	-32.49
122.50	-32.14	-32.17	-31.97
125.00	-32.28	-32.16	-32.07
127.50	-32.32	-32.21	-32.17
130.00	-32.47	-32.24	-32.20
132.50	-32.47	-32.24	-32.25
135.00	-32.41	-32.29	-32.44
137.50	-32.29	-32.31	-32.44
140.00	-32.30	-32.31	-32.33
142.50	-32.28	-32.26	-32.25
145.00	-32.50	-32.24	-32.24
147.50	-32.34	-32.23	-32.37
150.00	-32.38	-32.27	-32.45
152.50	-32.30	-32.30	-32.48
155.00	-32.25	-32.32	-32.40
157.50	-32.26	-32.32	-32.50
160.00	-32.30	-32.33	-32.64
162.50	-32.34	-32.35	-32.61
165.00	-32.29	-32.35	-32.58
167.50	-32.34	-32.36	-32.67
170.00	-32.34	-32.39	-32.67
172.50	-32.34	-32.44	-32.83
175.00	-32.40	-32.44	-33.02
177.50	-32.44	-32.44	-32.89
180.00	-32.41	-32.45	-33.23

Pakiri Cross Sections_A1

Scale - 1 : 500 (H), 1 : 50 (V)

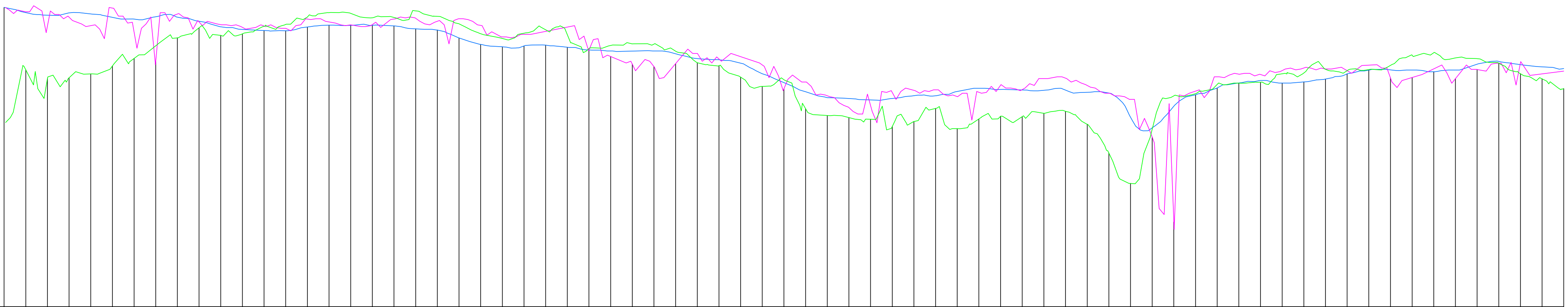
Datum
-35.00 M



Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00		-31.55
2.50	-31.60	-31.61
5.00	-31.76	-31.64
7.50	-31.66	-31.61
10.00	-31.76	-31.62
12.50	-31.56	-31.66
15.00	-31.83	-31.68
17.50	-32.17	-31.65
20.00	-31.62	-31.66
22.50	-31.71	-31.71
25.00	-31.75	-31.77
27.50	-31.78	-31.80
30.00	-31.76	-31.81
32.50	-31.79	-31.82
35.00	-31.68	-31.77
37.50	-31.72	-31.75
40.00	-31.75	-31.75
42.50	-31.75	-31.75
45.00	-31.68	-31.76
47.50	-31.67	-31.79
50.00	-31.71	-31.81
52.50	-31.68	-31.90
55.00	-31.75	-31.97
57.50	-31.89	-32.00
60.00	-31.86	-31.99
62.50	-31.82	-31.98
65.00	-31.77	-32.01
67.50	-32.04	-32.04
70.00	-32.11	-32.05
72.50	-32.20	-32.05
75.00	-32.23	-32.05
77.50	-32.20	-32.08
80.00	-32.08	-32.14
82.50	-32.14	-32.15
85.00	-32.12	-32.19
87.50	-32.21	-32.31
90.00	-32.49	-32.42
92.50	-32.41	-32.52
95.00	-32.57	-32.59
97.50	-32.70	-32.60
100.00	-32.68	-32.61
102.50	-32.53	-32.60
105.00	-32.50	-32.57
107.50	-32.50	-32.57
110.00	-32.58	-32.52
112.50	-32.53	-32.48
115.00	-32.45	-32.49
117.50	-32.50	-32.50
120.00	-32.37	-32.50
122.50	-32.36	-32.50
125.00	-32.45	-32.53
127.50	-32.54	-32.54
130.00	-32.61	-32.81
132.50	-33.04	-32.94
135.00	-34.02	-32.69
137.50	-32.51	-32.56
140.00	-32.35	-32.48
142.50	-32.32	-32.42
145.00	-32.32	-32.39
147.50	-32.28	-32.42
150.00	-32.25	-32.41
152.50	-32.26	-32.37
155.00	-32.28	-32.31
157.50	-32.21	-32.27
160.00	-32.36	-32.27
162.50	-32.36	-32.27
165.00	-32.26	-32.29
167.50	-32.37	-32.27
170.00	-32.26	-32.20
172.50	-32.19	-32.18
175.00	-32.19	-32.21
177.50	-32.31	-32.23
180.00	-32.28	-32.25

Pakiri Cross Sections_A2

Scale - 1 : 500 (H), 1 : 50 (V)

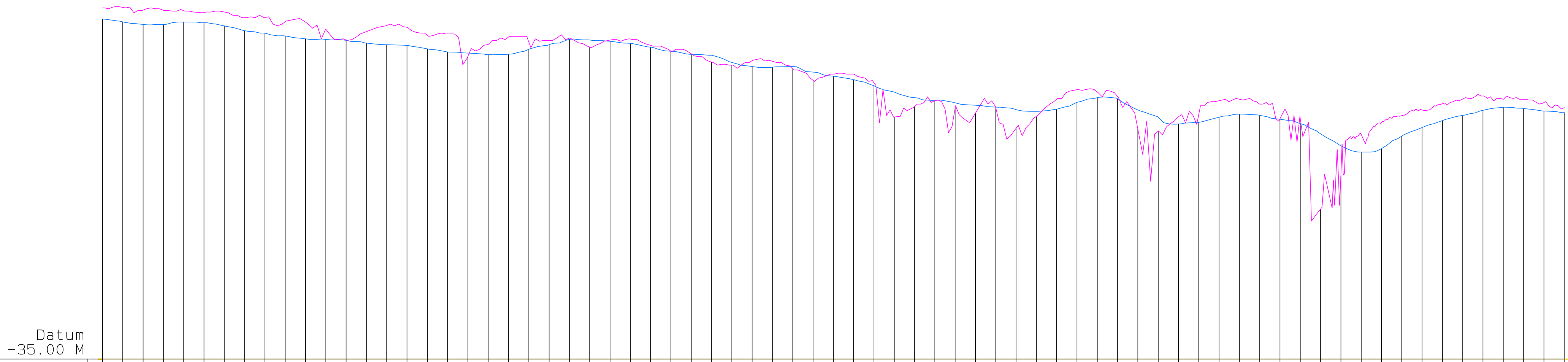


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021	WASSP_MAR_2021
0.00		-31.55	
2.50	-31.60	-31.61	-32.27
5.00	-31.76	-31.64	-32.37
7.50	-31.66	-31.61	-32.36
10.00	-31.76	-31.62	-32.31
12.50	-31.56	-31.66	-32.22
15.00	-31.83	-31.68	-32.14
17.50	-32.17	-31.65	-31.99
20.00	-31.62	-31.66	-31.90
22.50	-31.71	-31.71	-31.78
25.00	-31.75	-31.77	-31.87
27.50	-31.78	-31.80	-31.85
30.00	-31.76	-31.81	-31.77
32.50	-31.79	-31.82	-31.74
35.00	-31.68	-31.77	-31.66
37.50	-31.72	-31.75	-31.61
40.00	-31.75	-31.75	-31.62
42.50	-31.75	-31.75	-31.67
45.00	-31.68	-31.76	-31.66
47.50	-31.67	-31.79	-31.59
50.00	-31.71	-31.81	-31.65
52.50	-31.68	-31.90	-31.74
55.00	-31.75	-31.97	-31.85
57.50	-31.89	-32.00	-31.91
60.00	-31.86	-31.99	-31.85
62.50	-31.82	-31.98	-31.81
65.00	-31.77	-32.01	-31.86
67.50	-32.04	-32.04	-32.02
70.00	-32.11	-32.05	-31.99
72.50	-32.20	-32.05	-31.97
75.00	-32.23	-32.05	-31.97
77.50	-32.20	-32.08	-32.05
80.00	-32.08	-32.14	-32.19
82.50	-32.14	-32.15	-32.22
85.00	-32.12	-32.19	-32.35
87.50	-32.21	-32.31	-32.46
90.00	-32.49	-32.42	-32.38
92.50	-32.41	-32.52	-32.72
95.00	-32.57	-32.59	-32.79
97.50	-32.70	-32.60	-32.82
100.00	-32.68	-32.61	-32.84
102.50	-32.53	-32.60	-32.92
105.00	-32.50	-32.57	-32.86
107.50	-32.50	-32.57	-32.71
110.00	-32.58	-32.52	-32.95
112.50	-32.53	-32.48	-32.83
115.00	-32.45	-32.49	-32.80
117.50	-32.50	-32.50	-32.81
120.00	-32.37	-32.50	-32.77
122.50	-32.36	-32.50	-32.75
125.00	-32.45	-32.53	-32.90
127.50	-32.54	-32.54	-33.23
130.00	-32.61	-32.81	-33.58
132.50	-33.04	-32.94	-32.95
135.00	-34.02	-32.69	-32.57
137.50	-32.51	-32.56	-32.54
140.00	-32.35	-32.48	-32.44
142.50	-32.32	-32.42	-32.42
145.00	-32.32	-32.39	-32.41
147.50	-32.28	-32.42	-32.31
150.00	-32.25	-32.41	-32.30
152.50	-32.26	-32.37	-32.26
155.00	-32.28	-32.31	-32.28
157.50	-32.21	-32.27	-32.26
160.00	-32.36	-32.27	-32.22
162.50	-32.36	-32.27	-32.10
165.00	-32.26	-32.29	-32.07
167.50	-32.37	-32.27	-32.13
170.00	-32.26	-32.20	-32.14
172.50	-32.19	-32.17	-32.19
175.00	-32.19	-32.21	-32.31
177.50	-32.31	-32.23	-32.37
180.00	-32.28	-32.25	-32.48

Pakiri Cross Sections_A2

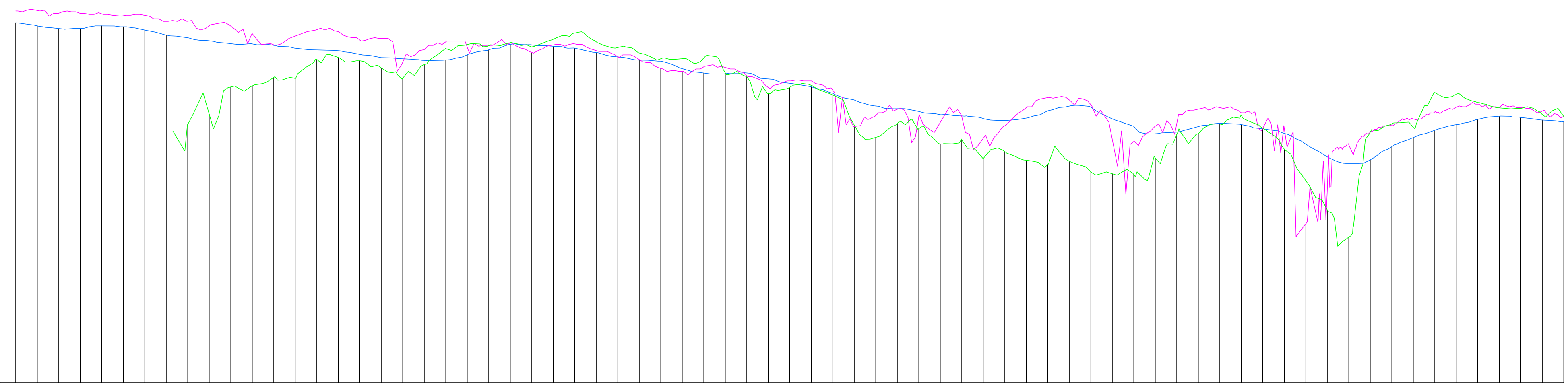
Scale - 1 : 500 (H), 1 : 50 (V)



Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00	-30.68	-30.81
2.50	-30.67	-30.85
5.00	-30.70	-30.88
7.50	-30.71	-30.88
10.00	-30.71	-30.85
12.50	-30.73	-30.86
15.00	-30.73	-30.90
17.50	-30.80	-30.96
20.00	-30.80	-30.99
22.50	-30.85	-31.02
25.00	-30.85	-31.06
27.50	-30.94	-31.06
30.00	-31.07	-31.08
32.50	-30.97	-31.11
35.00	-30.89	-31.13
37.50	-30.92	-31.14
40.00	-31.01	-31.18
42.50	-31.00	-31.22
45.00	-31.27	-31.23
47.50	-31.13	-31.25
50.00	-31.04	-31.25
52.50	-31.10	-31.19
55.00	-31.08	-31.13
57.50	-31.05	-31.07
60.00	-31.16	-31.07
62.50	-31.07	-31.09
65.00	-31.06	-31.11
67.50	-31.14	-31.16
70.00	-31.21	-31.21
72.50	-31.24	-31.25
75.00	-31.34	-31.26
77.50	-31.38	-31.35
80.00	-31.33	-31.40
82.50	-31.33	-31.41
85.00	-31.43	-31.40
87.50	-31.57	-31.47
90.00	-31.49	-31.52
92.50	-31.49	-31.56
95.00	-31.60	-31.63
97.50	-32.02	-31.71
100.00	-31.89	-31.78
102.50	-31.82	-31.81
105.00	-31.91	-31.85
107.50	-31.97	-31.87
110.00	-31.91	-31.90
112.50	-32.16	-31.93
115.00	-32.01	-31.95
117.50	-31.80	-31.92
120.00	-31.68	-31.84
122.50	-31.71	-31.78
125.00	-31.77	-31.80
127.50	-32.17	-31.93
130.00	-32.19	-32.02
132.50	-32.02	-32.11
135.00	-31.99	-32.09
137.50	-31.82	-32.02
140.00	-31.80	-31.98
142.50	-31.86	-32.00
145.00	-32.04	-32.05
147.50	-32.04	-32.10
150.00	-33.15	-32.23
152.50	-32.75	-32.37
155.00	-32.23	-32.45
157.50	-32.09	-32.41
160.00	-32.00	-32.26
162.50	-31.93	-32.15
165.00	-31.85	-32.06
167.50	-31.80	-32.00
170.00	-31.76	-31.94
172.50	-31.80	-31.90
175.00	-31.80	-31.92
177.50	-31.84	-31.95
180.00	-31.90	-31.97

Pakiri Cross Sections_A3

Scale - 1 : 500 (H), 1 : 50 (V)



Datum
-35.00 M

	0.00	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00
SBES_SEP_2020	-30.68	-30.67	-30.70	-30.71	-30.71	-30.73	-30.73	-30.80	-30.80	-30.85	-30.85	-30.94	-31.07	-30.97	-30.89	-30.92	-31.01	-31.00	-31.27
MBES_OCT_2021	-30.81	-30.85	-30.88	-30.88	-30.85	-30.86	-30.90	-30.96	-30.99	-31.02	-31.06	-31.06	-31.08	-31.11	-31.13	-31.14	-31.18	-31.22	-31.23
WASSP_MAR_2021									-32.00	-31.88	-31.56	-31.55	-31.45	-31.46	-31.24	-31.22	-31.26	-31.34	-31.46
Chainage	0.00	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00

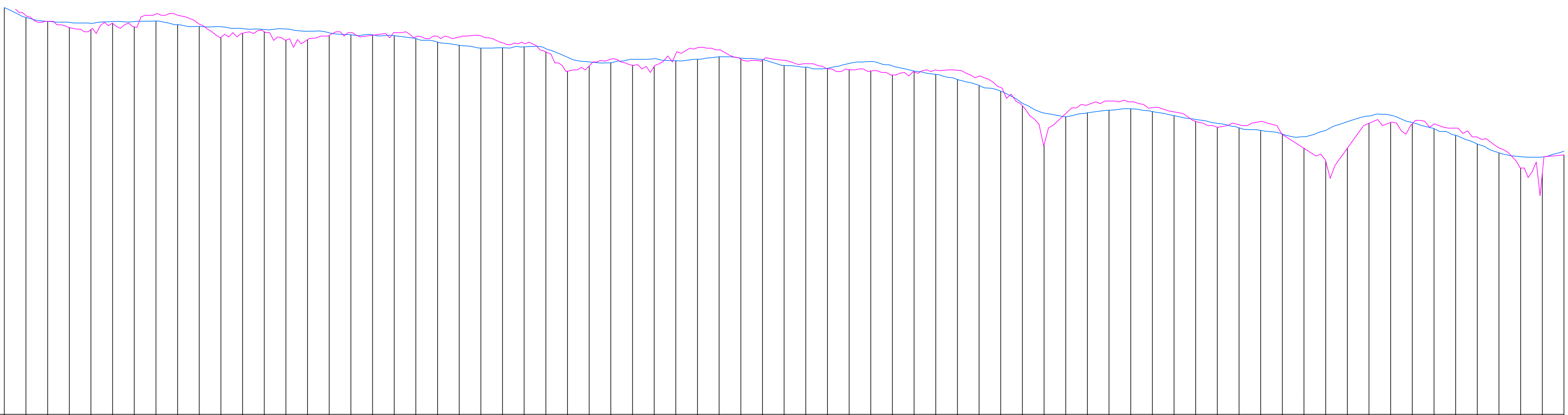
	47.50	50.00	52.50	55.00	57.50	60.00	62.50	65.00	67.50	70.00	72.50	75.00	77.50	80.00	82.50	85.00	87.50	90.00	92.50
SBES_SEP_2020	-31.13	-31.04	-31.10	-31.08	-31.05	-31.16	-31.07	-31.06	-31.14	-31.21	-31.24	-31.34	-31.38	-31.33	-31.33	-31.43	-31.57	-31.49	-31.49
MBES_OCT_2021	-31.25	-31.25	-31.19	-31.13	-31.07	-31.07	-31.09	-31.11	-31.16	-31.21	-31.25	-31.26	-31.35	-31.40	-31.41	-31.40	-31.47	-31.52	-31.56
WASSP_MAR_2021	-31.30	-31.11	-31.07	-31.08	-31.05	-31.09	-31.01	-30.93	-31.04	-31.10	-31.17	-31.23	-31.23	-31.22	-31.40	-31.44	-31.64	-31.56	-31.54
Chainage	47.50	50.00	52.50	55.00	57.50	60.00	62.50	65.00	67.50	70.00	72.50	75.00	77.50	80.00	82.50	85.00	87.50	90.00	92.50

	95.00	97.50	100.00	102.50	105.00	107.50	110.00	112.50	115.00	117.50	120.00	122.50	125.00	127.50	130.00	132.50	135.00	137.50	140.00
SBES_SEP_2020	-31.60	-32.02	-31.89	-31.82	-31.91	-31.97	-31.91	-32.16	-32.01	-31.80	-31.68	-31.71	-31.77	-32.17	-32.19	-32.02	-31.99	-31.82	-31.80
MBES_OCT_2021	-31.63	-31.71	-31.78	-31.81	-31.85	-31.88	-31.90	-31.93	-31.95	-31.92	-31.84	-31.78	-31.80	-31.93	-32.02	-32.11	-32.09	-32.02	-31.98
WASSP_MAR_2021	-31.65	-32.00	-32.15	-31.99	-32.05	-32.22	-32.17	-32.39	-32.31	-32.41	-32.46	-32.42	-32.55	-32.57	-32.58	-32.39	-32.12	-32.10	-31.99
Chainage	95.00	97.50	100.00	102.50	105.00	107.50	110.00	112.50	115.00	117.50	120.00	122.50	125.00	127.50	130.00	132.50	135.00	137.50	140.00

	142.50	145.00	147.50	150.00	152.50	155.00	157.50	160.00	162.50	165.00	167.50	170.00	172.50	175.00	177.50	180.00
SBES_SEP_2020	-31.86	-32.04	-32.04	-33.15	-32.75	-32.23	-32.09	-32.00	-31.93	-31.85	-31.80	-31.76	-31.80	-31.80	-31.84	-31.90
MBES_OCT_2021	-32.00	-32.05	-32.10	-32.23	-32.37	-32.45	-32.41	-32.26	-32.15	-32.06	-32.00	-31.94	-31.90	-31.92	-31.95	-31.97
WASSP_MAR_2021	-31.89	-32.04	-32.29	-32.65	-32.99	-33.31	-32.09	-31.99	-32.03	-31.63	-31.65	-31.74	-31.80	-31.81	-31.88	-31.90
Chainage	142.50	145.00	147.50	150.00	152.50	155.00	157.50	160.00	162.50	165.00	167.50	170.00	172.50	175.00	177.50	180.00

Pakiri Cross Sections_A3

Scale - 1 : 500 (H), 1 : 50 (V)

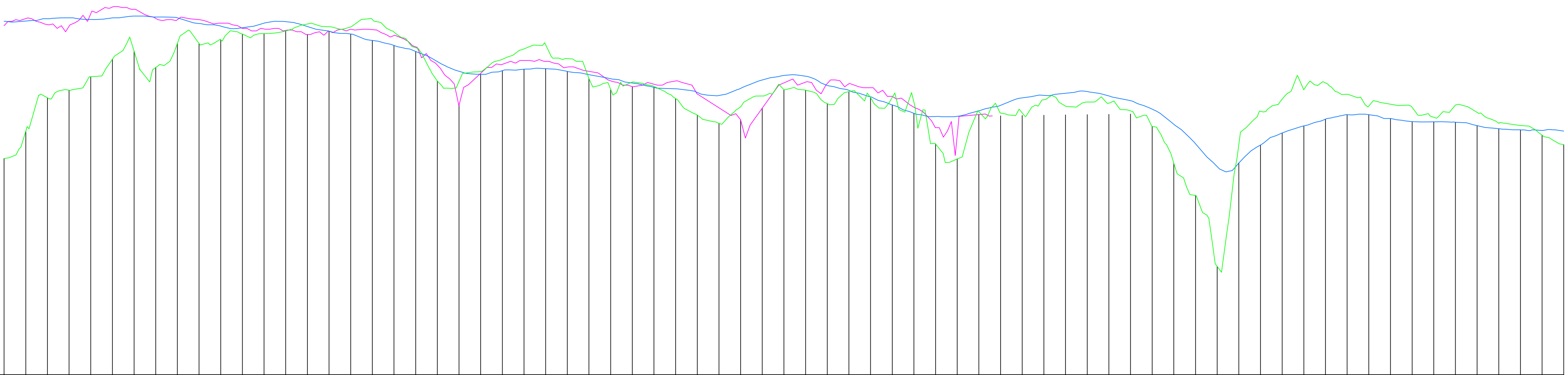


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00		-30.30
2.50	-30.39	-30.42
5.00	-30.46	-30.46
7.50	-30.53	-30.47
10.00	-30.55	-30.48
12.50	-30.48	-30.46
15.00	-30.52	-30.46
17.50	-30.38	-30.46
20.00	-30.39	-30.50
22.50	-30.49	-30.52
25.00	-30.65	-30.52
27.50	-30.60	-30.55
30.00	-30.58	-30.56
32.50	-30.68	-30.55
35.00	-30.67	-30.58
37.50	-30.62	-30.59
40.00	-30.59	-30.62
42.50	-30.62	-30.62
45.00	-30.59	-30.63
47.50	-30.64	-30.66
50.00	-30.63	-30.70
52.50	-30.64	-30.74
55.00	-30.63	-30.77
57.50	-30.71	-30.77
60.00	-30.72	-30.76
62.50	-30.81	-30.78
65.00	-31.04	-30.88
67.50	-30.98	-30.93
70.00	-30.90	-30.94
72.50	-30.97	-30.90
75.00	-30.98	-30.89
77.50	-30.84	-30.92
80.00	-30.77	-30.90
82.50	-30.79	-30.87
85.00	-30.90	-30.89
87.50	-30.91	-30.90
90.00	-30.91	-30.97
92.50	-30.95	-30.99
95.00	-31.01	-31.00
97.50	-31.02	-30.95
100.00	-31.03	-30.92
102.50	-31.08	-30.97
105.00	-31.04	-31.04
107.50	-31.02	-31.07
110.00	-31.03	-31.13
112.50	-31.09	-31.20
115.00	-31.23	-31.27
117.50	-31.44	-31.41
120.00	-31.89	-31.52
122.50	-31.53	-31.56
125.00	-31.43	-31.52
127.50	-31.38	-31.49
130.00	-31.39	-31.47
132.50	-31.46	-31.50
135.00	-31.51	-31.55
137.50	-31.62	-31.59
140.00	-31.68	-31.64
142.50	-31.66	-31.69
145.00	-31.62	-31.72
147.50	-31.77	-31.76
150.00	-31.93	-31.79
152.50	-32.07	-31.72
155.00	-31.93	-31.62
157.50	-31.64	-31.55
160.00	-31.63	-31.54
162.50	-31.64	-31.63
165.00	-31.65	-31.70
167.50	-31.70	-31.78
170.00	-31.80	-31.88
172.50	-31.92	-31.98
175.00	-32.16	-32.02
177.50	-32.22	-32.03
180.00	-32.00	-31.96

Pakiri Cross Sections_A4

Scale - 1 : 500 (H), 1 : 50 (V)

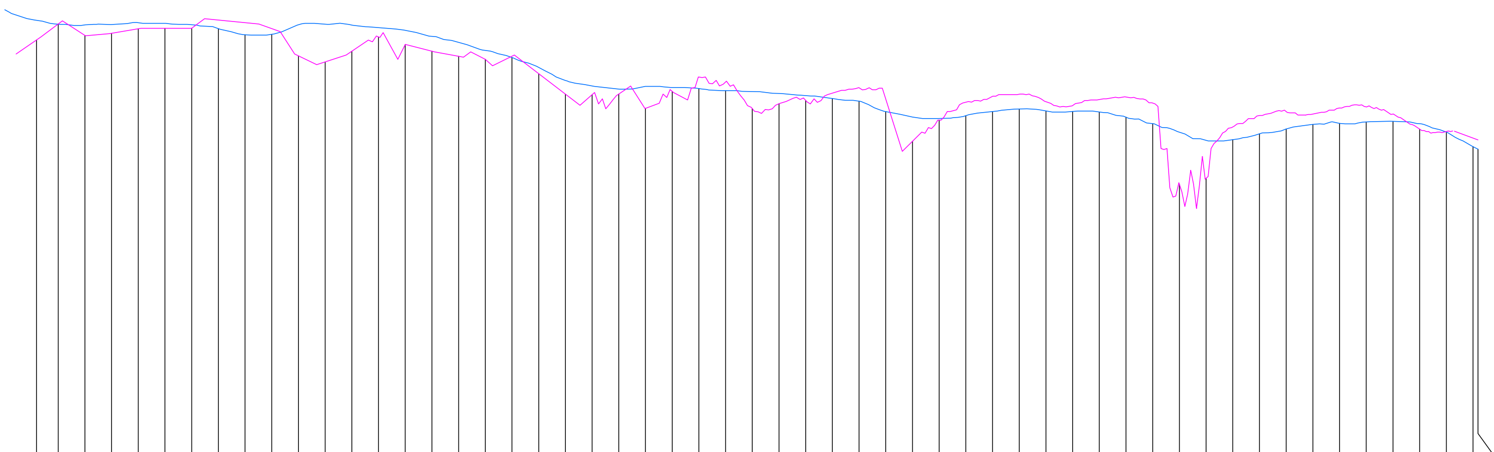


Chainage	SBES_SEP_2020	MBES_OCT_2021	WASSP_MAR_2021
0.00	-30.98	-30.93	-32.51
2.50	-30.90	-30.93	-32.20
5.00	-30.97	-30.90	-31.81
7.50	-30.99	-30.89	-31.72
10.00	-30.84	-30.91	-31.57
12.50	-30.77	-30.89	-31.37
15.00	-30.79	-30.87	-31.27
17.50	-30.90	-30.88	-31.46
20.00	-30.91	-30.89	-31.18
22.50	-30.91	-30.96	-31.19
25.00	-30.95	-30.98	-31.14
27.50	-31.01	-31.00	-31.08
30.00	-31.02	-30.95	-31.07
32.50	-31.04	-30.93	-31.04
35.00	-31.08	-30.99	-30.96
37.50	-31.04	-31.04	-30.99
40.00	-31.02	-31.08	-31.00
42.50	-31.03	-31.15	-30.91
45.00	-31.09	-31.21	-31.05
47.50	-31.22	-31.28	-31.23
50.00	-31.43	-31.39	-31.62
52.50	-31.90	-31.51	-31.62
55.00	-31.53	-31.54	-31.51
57.50	-31.43	-31.50	-31.37
60.00	-31.38	-31.48	-31.25
62.50	-31.39	-31.48	-31.20
65.00	-31.46	-31.51	-31.36
67.50	-31.51	-31.55	-31.59
70.00	-31.62	-31.59	-31.71
72.50	-31.68	-31.64	-31.63
75.00	-31.65	-31.69	-31.68
77.50	-31.62	-31.71	-31.82
80.00	-31.77	-31.75	-32.01
82.50	-31.93	-31.78	-32.11
85.00	-32.06	-31.70	-31.92
87.50	-31.93	-31.61	-31.79
90.00	-31.64	-31.55	-31.72
92.50	-31.63	-31.56	-31.72
95.00	-31.65	-31.67	-31.88
97.50	-31.65	-31.73	-31.74
100.00	-31.70	-31.80	-31.81
102.50	-31.80	-31.89	-31.81
105.00	-31.92	-31.99	-31.86
107.50	-32.16	-32.03	-32.34
110.00	-32.24	-32.02	-32.52
112.50	-32.00	-31.96	-31.97
115.00	-32.02	-31.90	-31.99
117.50		-31.81	-31.99
120.00		-31.78	-31.83
122.50		-31.76	-31.91
125.00		-31.74	-31.86
127.50		-31.79	-31.87
130.00		-31.84	-31.96
132.50		-31.94	-32.14
135.00		-32.12	-32.57
137.50		-32.34	-32.94
140.00		-32.60	-33.75
142.50		-32.56	-32.35
145.00		-32.36	-31.97
147.50		-32.22	-31.83
150.00		-32.14	-31.72
152.50		-32.06	-31.64
155.00		-32.01	-31.77
157.50		-32.01	-31.91
160.00		-32.05	-31.88
162.50		-32.09	-31.92
165.00		-32.09	-32.04
167.50		-32.09	-31.89
170.00		-32.13	-31.98
172.50		-32.17	-32.11
175.00		-32.18	-32.13
177.50		-32.19	-32.24
180.00		-32.19	-32.35

Pakiri Cross Sections_A4

Scale - 1 : 500 (H), 1 : 50 (V)

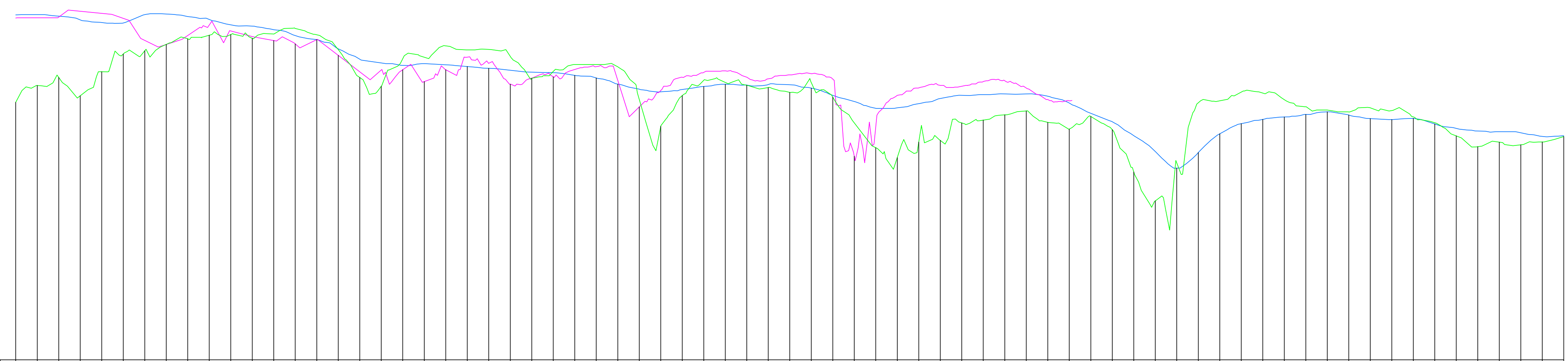
Datum
-35.00 M



Chainage	SBES_SEP_2020	MBES_OCT_2021
2.97	-31.14	-30.95
5.00	-30.99	-30.99
7.50	-31.09	-30.99
10.00	-31.07	-30.99
12.50	-31.03	-30.97
15.00	-31.03	-30.98
17.50	-31.03	-30.99
20.00	-30.95	-31.03
22.50	-30.97	-31.09
25.00	-31.03	-31.08
27.50	-31.28	-30.99
30.00	-31.34	-30.99
32.50	-31.24	-31.00
35.00	-31.11	-31.02
37.50	-31.18	-31.05
40.00	-31.24	-31.10
42.50	-31.29	-31.16
45.00	-31.32	-31.23
47.50	-31.29	-31.30
50.00	-31.45	-31.39
52.50	-31.64	-31.51
55.00	-31.65	-31.57
57.50	-31.64	-31.59
60.00	-31.78	-31.57
62.50	-31.62	-31.58
65.00	-31.48	-31.59
67.50	-31.53	-31.61
70.00	-31.78	-31.62
72.50	-31.73	-31.64
75.00	-31.70	-31.66
77.50	-31.63	-31.68
80.00	-31.58	-31.71
82.50	-31.69	-31.81
85.00	-32.08	-31.86
87.50	-31.89	-31.87
90.00	-31.72	-31.84
92.50	-31.66	-31.80
95.00	-31.64	-31.78
97.50	-31.71	-31.80
100.00	-31.75	-31.80
102.50	-31.69	-31.81
105.00	-31.67	-31.86
107.50	-31.73	-31.92
110.00	-32.49	-32.00
112.50	-32.43	-32.07
115.00	-31.95	-32.07
117.50	-31.84	-32.01
120.00	-31.81	-31.97
122.50	-31.83	-31.93
125.00	-31.77	-31.92
127.50	-31.76	-31.90
130.00	-31.83	-31.90
132.50	-31.97	-31.92
135.00	-31.99	-32.00
137.50		-32.13
137.96		-32.16

Pakiri Cross Sections_A5

Scale - 1 : 500 (H), 1 : 50 (V)

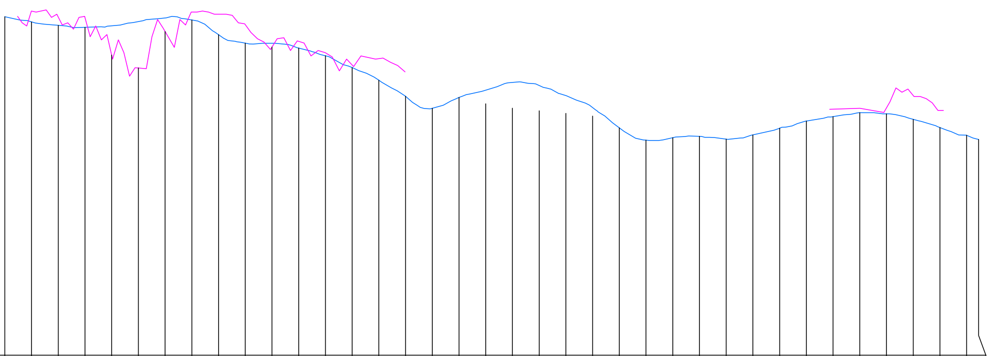


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021	WASSP_MAR_2021
0.00	-31.03	-30.99	-32.01
2.50	-31.03	-30.99	-31.81
5.00	-31.02	-31.01	-31.72
7.50	-30.95	-31.05	-31.93
10.00	-30.98	-31.08	-31.65
12.50	-31.03	-31.09	-31.45
15.00	-31.29	-30.99	-31.41
17.50	-31.34	-30.98	-31.34
20.00	-31.23	-31.01	-31.27
22.50	-31.11	-31.05	-31.23
25.00	-31.18	-31.11	-31.22
27.50	-31.24	-31.12	-31.27
30.00	-31.29	-31.17	-31.22
32.50	-31.33	-31.23	-31.15
35.00	-31.28	-31.28	-31.22
37.50	-31.46	-31.39	-31.40
40.00	-31.65	-31.51	-31.72
42.50	-31.63	-31.55	-31.82
45.00	-31.63	-31.58	-31.50
47.50	-31.77	-31.56	-31.48
50.00	-31.63	-31.57	-31.35
52.50	-31.48	-31.59	-31.40
55.00	-31.55	-31.61	-31.39
57.50	-31.80	-31.64	-31.48
60.00	-31.73	-31.66	-31.73
62.50	-31.71	-31.66	-31.65
65.00	-31.63	-31.70	-31.57
67.50	-31.59	-31.73	-31.57
70.00	-31.75	-31.80	-31.60
72.50	-32.06	-31.86	-31.98
75.00	-31.87	-31.89	-32.29
77.50	-31.72	-31.86	-31.93
80.00	-31.66	-31.83	-31.75
82.50	-31.64	-31.80	-31.78
85.00	-31.72	-31.81	-31.81
87.50	-31.74	-31.80	-31.84
90.00	-31.69	-31.80	-31.89
92.50	-31.68	-31.84	-31.78
95.00	-31.74	-31.93	-31.95
97.50	-32.64	-32.00	-32.25
100.00	-32.29	-32.08	-32.54
102.50	-31.93	-32.07	-32.65
105.00	-31.84	-32.02	-32.47
107.50	-31.81	-31.97	-32.45
110.00	-31.82	-31.93	-32.25
112.50	-31.77	-31.92	-32.22
115.00	-31.76	-31.91	-32.15
117.50	-31.84	-31.91	-32.11
120.00	-31.98	-31.94	-32.24
122.50	-31.99	-32.02	-32.32
125.00		-32.14	-32.17
127.50		-32.23	-32.33
130.00		-32.40	-32.82
132.50		-32.58	-33.15
135.00		-32.77	-32.71
137.50		-32.59	-32.01
140.00		-32.38	-31.99
142.50		-32.26	-31.89
145.00		-32.21	-31.90
147.50		-32.18	-31.98
150.00		-32.15	-32.06
152.50		-32.12	-32.10
155.00		-32.16	-32.12
157.50		-32.20	-32.07
160.00		-32.21	-32.10
162.50		-32.20	-32.18
165.00		-32.26	-32.25
167.50		-32.31	-32.40
170.00		-32.34	-32.52
172.50		-32.35	-32.47
175.00		-32.36	-32.50
177.50		-32.41	-32.47
180.00		-32.40	-32.41

Pakiri Cross Sections_A5

Scale - 1 : 500 (H), 1 : 50 (V)

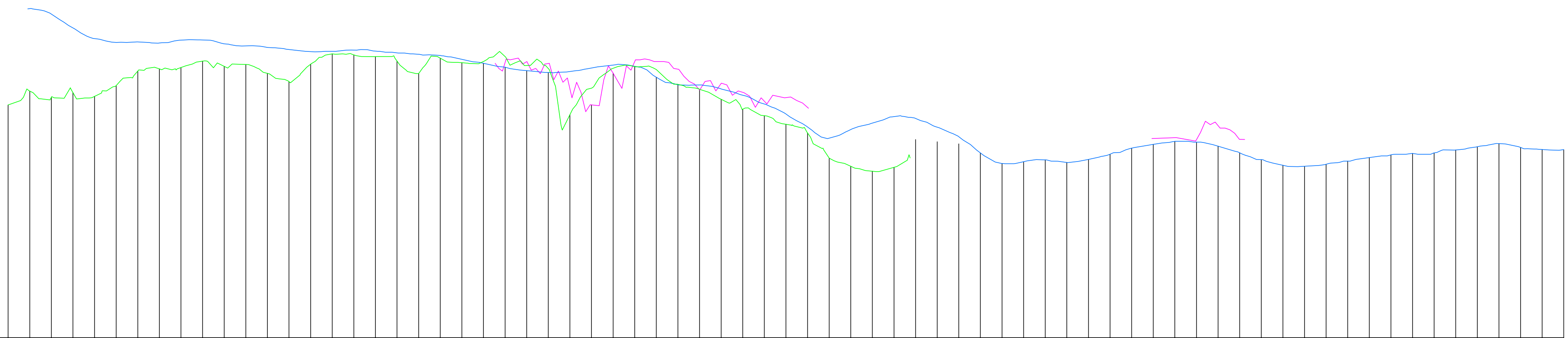


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00		-31.83
2.50	-31.78	-31.88
5.00	-31.83	-31.91
7.50	-31.84	-31.93
10.00	-32.19	-31.92
12.50	-32.31	-31.88
15.00	-31.97	-31.84
17.50	-31.79	-31.86
20.00	-31.81	-32.00
22.50	-31.91	-32.08
25.00	-32.12	-32.08
27.50	-32.06	-32.12
30.00	-32.17	-32.20
32.50	-32.28	-32.31
35.00	-32.22	-32.43
37.50	-32.35	-32.58
40.00		-32.69
42.50		-32.59
45.00		-32.52
47.50		-32.45
50.00		-32.48
52.50		-32.57
55.00		-32.68
57.50		-32.87
60.00		-32.99
62.50		-32.96
65.00		-32.95
67.50		-32.98
70.00		-32.94
72.50		-32.87
75.00		-32.81
77.50	-32.70	-32.77
80.00	-32.69	-32.73
82.50	-32.68	-32.74
85.00	-32.57	-32.79
87.50	-32.71	-32.87
90.00		-32.94
91.12		-32.98

Pakiri Cross Sections_B1

Scale - 1 : 500 (H), 1 : 50 (V)



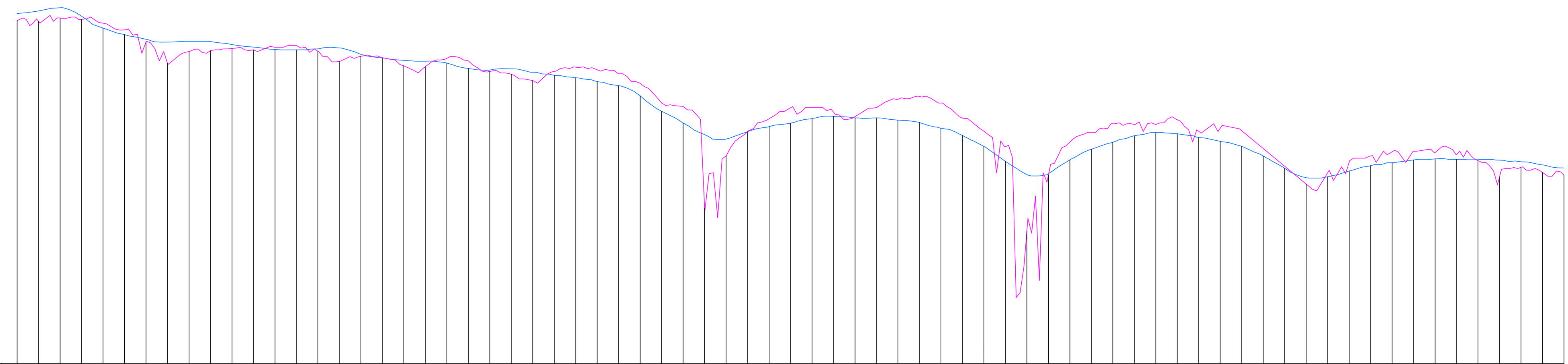
Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021	WASSP_MAR_2021
0.00			-32.31
2.50		-31.20	-32.15
5.00		-31.26	-32.22
7.50		-31.42	-32.17
10.00		-31.54	-32.21
12.50		-31.59	-32.09
15.00		-31.58	-31.92
17.50		-31.59	-31.89
20.00		-31.56	-31.88
22.50		-31.56	-31.80
25.00		-31.60	-31.86
27.50		-31.63	-31.84
30.00		-31.65	-31.94
32.50		-31.67	-32.04
35.00		-31.69	-31.84
37.50		-31.69	-31.72
40.00		-31.68	-31.73
42.50		-31.69	-31.75
45.00		-31.71	-31.80
47.50		-31.72	-31.95
50.00		-31.74	-31.77
52.50		-31.78	-31.82
55.00		-31.83	-31.81
57.50	-31.82	-31.87	-31.75
60.00	-31.81	-31.91	-31.85
62.50	-31.83	-31.93	-31.89
65.00	-32.12	-31.92	-32.42
67.50	-32.31	-31.88	-32.12
70.00	-31.94	-31.85	-31.89
72.50	-31.81	-31.86	-31.87
75.00	-31.81	-31.99	-31.90
77.50	-31.90	-32.08	-32.07
80.00	-32.14	-32.08	-32.13
82.50	-32.06	-32.12	-32.24
85.00	-32.16	-32.20	-32.36
87.50	-32.27	-32.30	-32.43
90.00	-32.23	-32.42	-32.53
92.50	-32.34	-32.57	-32.63
95.00		-32.69	-32.92
97.50		-32.59	-33.02
100.00		-32.52	-33.08
102.50		-32.45	-33.03
105.00		-32.47	
107.50		-32.57	
110.00		-32.68	
112.50		-32.86	
115.00		-32.99	
117.50		-32.97	
120.00		-32.95	
122.50		-32.98	
125.00		-32.94	
127.50		-32.88	
130.00		-32.81	
132.50		-32.77	
135.00	-32.69	-32.73	
137.50	-32.71	-32.74	
140.00	-32.55	-32.79	
142.50	-32.71	-32.86	
145.00		-32.94	
147.50		-33.01	
150.00		-33.02	
152.50		-33.00	
155.00		-32.96	
157.50		-32.92	
160.00		-32.89	
162.50		-32.87	
165.00		-32.86	
167.50		-32.83	
170.00		-32.79	
172.50		-32.76	
175.00		-32.80	
177.50		-32.83	
180.00		-32.83	

Pakiri Cross Sections_B1

Scale - 1 : 500 (H), 1 : 50 (V)

Datum
-35.00 M



	0.00	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50
SBES_SEP_2020	-31.02	-31.03	-30.99	-31.01	-31.05	-31.13	-31.27	-31.51	-31.38	-31.37	-31.34	-31.36
MBES_OCT_2021	-30.94	-30.91	-30.87	-30.97	-31.11	-31.18	-31.24	-31.27	-31.26	-31.26	-31.30	-31.33

Chainage	30.00	32.50	35.00	37.50	40.00	42.50	45.00	47.50	50.00	52.50	55.00	57.50
SBES_SEP_2020	-31.33	-31.31	-31.37	-31.49	-31.43	-31.45	-31.54	-31.56	-31.46	-31.49	-31.61	-31.64
MBES_OCT_2021	-31.35	-31.36	-31.35	-31.34	-31.41	-31.45	-31.48	-31.49	-31.51	-31.58	-31.59	-31.58

Chainage	60.00	62.50	65.00	67.50	70.00	72.50	75.00	77.50	80.00	82.50	85.00	87.50
SBES_SEP_2020	-31.72	-31.61	-31.56	-31.59	-31.64	-31.75	-31.98	-32.02	-33.20	-32.59	-32.31	-32.16
MBES_OCT_2021	-31.62	-31.65	-31.68	-31.73	-31.78	-31.89	-32.07	-32.21	-32.34	-32.40	-32.31	-32.25

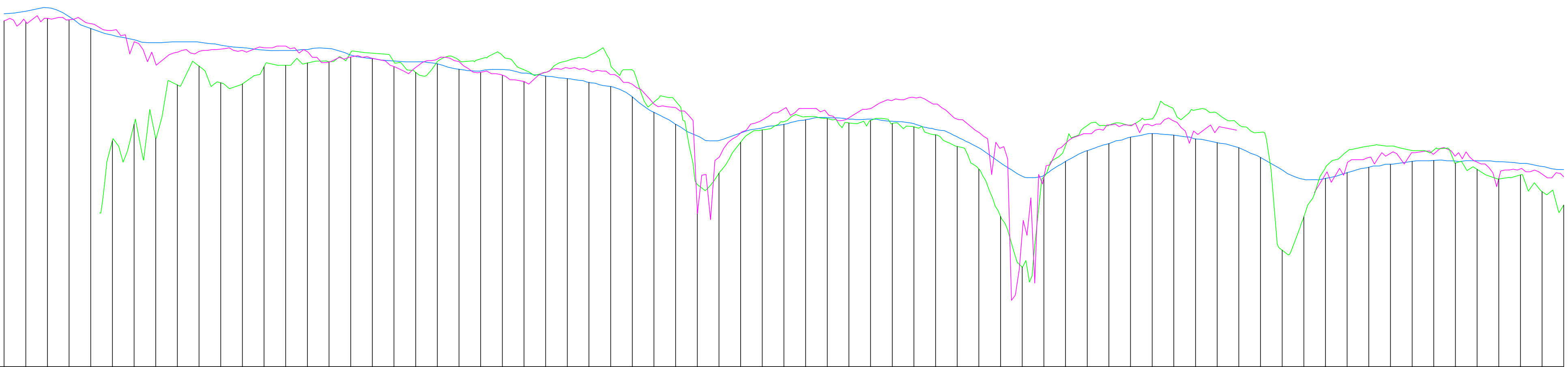
Chainage	90.00	92.50	95.00	97.50	100.00	102.50	105.00	107.50	110.00	112.50	115.00	117.50
SBES_SEP_2020	-32.03	-32.03	-32.08	-32.13	-32.03	-31.93	-31.90	-31.98	-32.15	-32.30	-32.48	-33.46
MBES_OCT_2021	-32.21	-32.16	-32.13	-32.15	-32.15	-32.18	-32.20	-32.27	-32.35	-32.48	-32.65	-32.81

Chainage	120.00	122.50	125.00	127.50	130.00	132.50	135.00	137.50	140.00	142.50	145.00	147.50
SBES_SEP_2020	-32.82	-32.43	-32.32	-32.22	-32.23	-32.23	-32.17	-32.31	-32.27	-32.30	-32.51	-32.71
MBES_OCT_2021	-32.80	-32.64	-32.51	-32.43	-32.36	-32.32	-32.33	-32.38	-32.42	-32.48	-32.59	-32.74

Chainage	150.00	152.50	155.00	157.50	160.00	162.50	165.00	167.50	170.00	172.50	175.00	177.50	180.00
SBES_SEP_2020	-32.92	-32.79	-32.66	-32.59	-32.54	-32.54	-32.55	-32.57	-32.65	-32.84	-32.72	-32.78	-32.82
MBES_OCT_2021	-32.84	-32.83	-32.77	-32.70	-32.67	-32.64	-32.63	-32.63	-32.63	-32.64	-32.66	-32.70	-32.73

Pakiri Cross Sections_B2

Scale - 1 : 500 (H), 1 : 50 (V)



Datum
-35.00 M

SBES_SEP 2020	-31.02	-31.03	-30.99	-31.01	-31.05	-31.13	-31.27	-31.51	-31.38	-31.37	-31.34	-31.36	-31.33	-31.31	-31.37	-31.49	-31.43	-31.45	-31.54
MBES_OCT 2021	-30.94	-30.91	-30.87	-30.97	-31.11	-31.18	-31.24	-31.27	-31.26	-31.26	-31.30	-31.33	-31.35	-31.36	-31.35	-31.34	-31.41	-31.45	-31.48
WASSP_MAR 2021						-32.40	-32.21	-32.37	-31.76	-31.54	-31.73	-31.75	-31.55	-31.53	-31.50	-31.49	-31.38	-31.39	-31.49
Chainage	0.00	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00

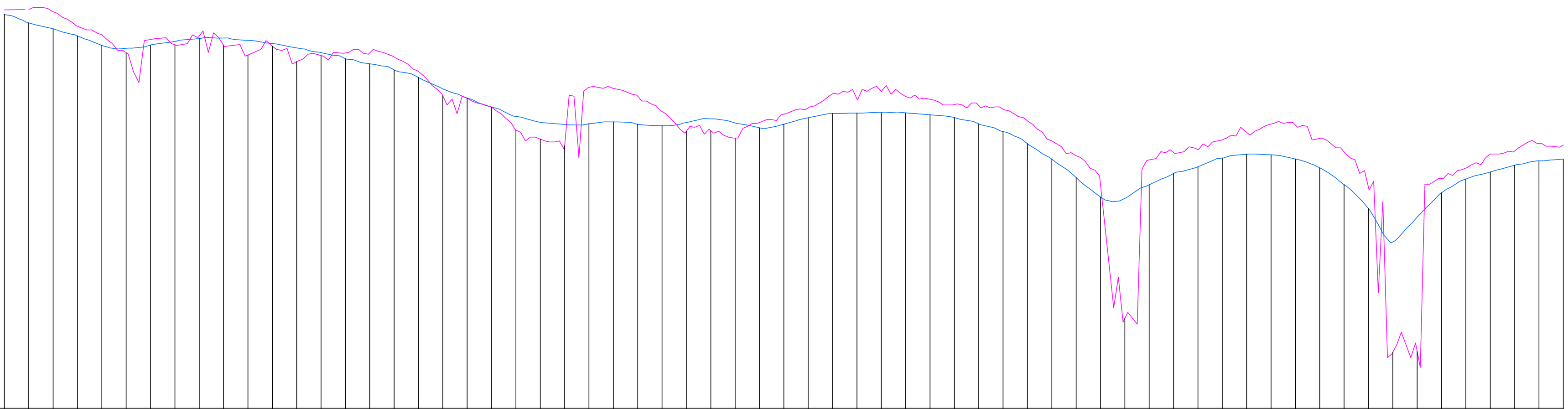
SBES_SEP 2020	-31.56	-31.46	-31.49	-31.61	-31.64	-31.72	-31.61	-31.56	-31.59	-31.64	-31.75	-31.98	-32.02	-33.20	-32.59	-32.31	-32.16	-32.03
MBES_OCT 2021	-31.49	-31.51	-31.58	-31.59	-31.58	-31.62	-31.65	-31.68	-31.73	-31.78	-31.89	-32.07	-32.21	-32.34	-32.40	-32.31	-32.25	-32.21
WASSP_MAR 2021	-31.61	-31.49	-31.47	-31.46	-31.42	-31.58	-31.61	-31.48	-31.42	-31.53	-31.58	-31.95	-31.94	-32.90	-32.77	-32.42	-32.27	-32.18
Chainage	47.50	50.00	52.50	55.00	57.50	60.00	62.50	65.00	67.50	70.00	72.50	75.00	77.50	80.00	82.50	85.00	87.50	90.00

SBES_SEP 2020	-32.03	-32.08	-32.13	-32.03	-31.93	-31.90	-31.98	-32.15	-32.30	-32.48	-33.46	-32.82	-32.43	-32.32	-32.22	-32.23	-32.23	-32.17
MBES_OCT 2021	-32.16	-32.13	-32.15	-32.15	-32.18	-32.20	-32.27	-32.35	-32.48	-32.65	-32.81	-32.80	-32.64	-32.51	-32.43	-32.36	-32.32	-32.33
WASSP_MAR 2021	-32.12	-32.14	-32.19	-32.16	-32.20	-32.24	-32.33	-32.47	-32.73	-33.27	-33.86	-32.82	-32.46	-32.22	-32.22	-32.22	-32.15	-32.04
Chainage	92.50	95.00	97.50	100.00	102.50	105.00	107.50	110.00	112.50	115.00	117.50	120.00	122.50	125.00	127.50	130.00	132.50	135.00

SBES_SEP 2020	-32.31	-32.27	-32.30				-32.79	-32.66	-32.59	-32.54	-32.54	-32.55	-32.57	-32.65	-32.84	-32.72	-32.78	-32.82
MBES_OCT 2021	-32.38	-32.42	-32.48	-32.59	-32.74	-32.84	-32.83	-32.77	-32.70	-32.67	-32.64	-32.63	-32.63	-32.63	-32.64	-32.66	-32.70	-32.73
WASSP_MAR 2021	-32.04	-32.08	-32.21	-32.30	-33.66	-33.28	-32.71	-32.52	-32.46	-32.46	-32.51	-32.51	-32.66	-32.73	-32.84	-32.79	-32.98	-33.14
Chainage	137.50	140.00	142.50	145.00	147.50	150.00	152.50	155.00	157.50	160.00	162.50	165.00	167.50	170.00	172.50	175.00	177.50	180.00

Pakiri Cross Sections_B2

Scale - 1 : 500 (H), 1 : 50 (V)

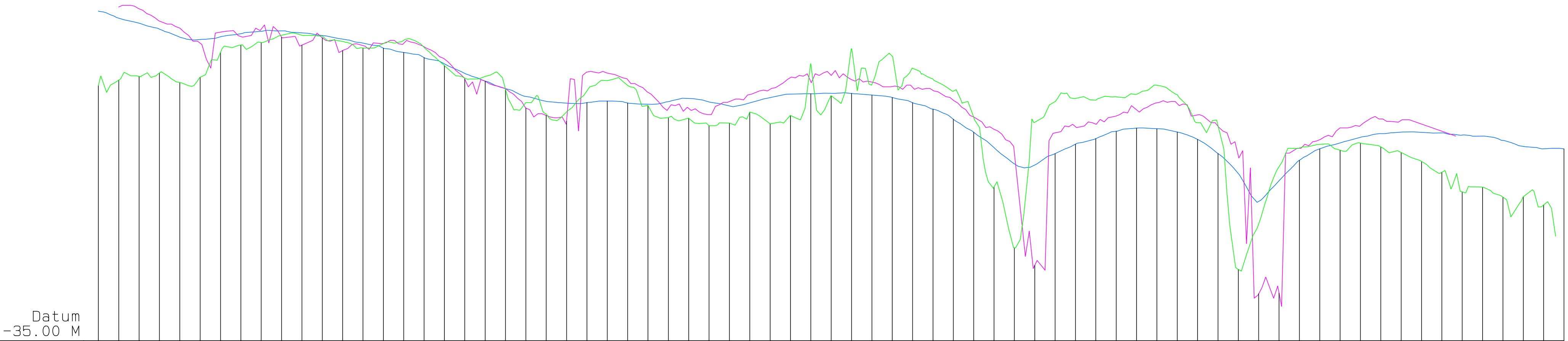


Datum
-35.00 M

Chainage	SBES_ SEP 2020	MBES_OCT_2021
0.00		-30.96
2.50		-31.04
5.00	-30.93	-31.10
7.50	-31.08	-31.18
10.00	-31.17	-31.28
12.50	-31.35	-31.31
15.00	-31.21	-31.27
17.50	-31.27	-31.23
20.00	-31.18	-31.20
22.50	-31.28	-31.20
25.00	-31.37	-31.22
27.50	-31.28	-31.26
30.00	-31.44	-31.30
32.50	-31.38	-31.35
35.00	-31.35	-31.41
37.50	-31.35	-31.46
40.00	-31.39	-31.53
42.50	-31.54	-31.60
45.00	-31.79	-31.72
47.50	-31.82	-31.82
50.00	-31.91	-31.91
52.50	-32.15	-32.00
55.00	-32.24	-32.06
57.50	-32.31	-32.09
60.00	-31.71	-32.08
62.50	-31.72	-32.06
65.00	-31.80	-32.08
67.50	-31.95	-32.10
70.00	-32.15	-32.07
72.50	-32.15	-32.03
75.00	-32.23	-32.07
77.50	-32.07	-32.12
80.00	-31.98	-32.08
82.50	-31.92	-32.02
85.00	-31.77	-31.97
87.50	-31.82	-31.97
90.00	-31.75	-31.97
92.50	-31.80	-31.97
95.00	-31.83	-31.99
97.50	-31.88	-32.02
100.00	-31.89	-32.08
102.50	-31.93	-32.16
105.00	-32.05	-32.28
107.50	-32.26	-32.44
110.00	-32.41	-32.63
112.50	-32.70	-32.83
115.00	-34.08	-32.85
117.50	-32.45	-32.71
120.00	-32.37	-32.59
122.50	-32.34	-32.52
125.00	-32.24	-32.43
127.50	-32.17	-32.39
130.00	-32.08	-32.40
132.50	-32.09	-32.44
135.00	-32.23	-32.53
137.50	-32.37	-32.70
140.00	-32.73	-32.95
142.50	-34.43	-33.29
145.00	-34.42	-33.04
147.50	-32.64	-32.79
150.00	-32.53	-32.65
152.50	-32.39	-32.57
155.00	-32.36	-32.51
157.50	-32.28	-32.46
160.00	-32.30	-32.44

Pakiri Cross Sections_B3

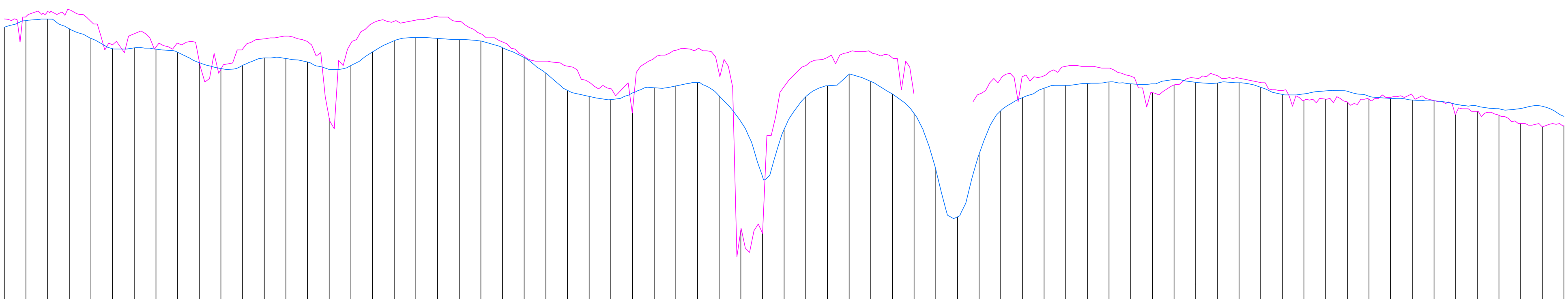
Scale - 1 : 500 (H), 1 : 50 (V)



Chainage	SBES_SEP_2020	MBES_OCT_2021	WASSP_MAR_2021
0.00		-30.96	-31.87
2.50		-31.04	-31.80
5.00	-30.93	-31.10	-31.76
7.50	-31.08	-31.18	-31.72
10.00	-31.17	-31.28	-31.83
12.50	-31.35	-31.31	-31.77
15.00	-31.21	-31.27	-31.46
17.50	-31.27	-31.23	-31.37
20.00	-31.18	-31.20	-31.34
22.50	-31.28	-31.20	-31.25
25.00	-31.37	-31.22	-31.25
27.50	-31.28	-31.26	-31.26
30.00	-31.44	-31.30	-31.33
32.50	-31.38	-31.35	-31.41
35.00	-31.35	-31.41	-31.35
37.50	-31.35	-31.46	-31.32
40.00	-31.39	-31.53	-31.40
42.50	-31.54	-31.60	-31.62
45.00	-31.79	-31.72	-31.78
47.50	-31.82	-31.82	-31.76
50.00	-31.91	-31.91	-31.91
52.50	-32.15	-32.00	-32.08
55.00	-32.24	-32.06	-32.22
57.50	-32.31	-32.09	-32.19
60.00	-31.71	-32.08	-31.94
62.50	-31.72	-32.06	-31.81
65.00	-31.80	-32.08	-31.87
67.50	-31.95	-32.10	-32.11
70.00	-32.15	-32.07	-32.26
72.50	-32.15	-32.03	-32.27
75.00	-32.23	-32.07	-32.36
77.50	-32.07	-32.12	-32.33
80.00	-31.98	-32.08	-32.20
82.50	-31.92	-32.02	-32.34
85.00	-31.77	-31.97	-32.24
87.50	-31.82	-31.97	-31.61
90.00	-31.75	-31.97	-32.00
92.50	-31.80	-31.97	-31.42
95.00	-31.83	-31.99	-31.85
97.50	-31.88	-32.02	-31.51
100.00	-31.89	-32.08	-31.66
102.50	-31.93	-32.16	-31.79
105.00	-32.05	-32.28	-31.94
107.50	-32.26	-32.44	-32.26
110.00	-32.41	-32.63	-33.11
112.50	-32.70	-32.83	-33.86
115.00	-34.08	-32.85	-32.32
117.50	-32.45	-32.71	-32.07
120.00	-32.37	-32.59	-32.03
122.50	-32.34	-32.52	-32.05
125.00	-32.24	-32.43	-32.01
127.50	-32.17	-32.39	-31.98
130.00	-32.08	-32.40	-31.87
132.50	-32.09	-32.44	-31.98
135.00	-32.23	-32.53	-32.33
137.50	-32.37	-32.70	-32.36
140.00	-32.73	-32.95	-34.13
142.50	-34.43	-33.29	-33.57
145.00	-34.42	-33.04	-32.87
147.50	-32.64	-32.79	-32.64
150.00	-32.53	-32.65	-32.59
152.50	-32.39	-32.57	-32.66
155.00	-32.36	-32.51	-32.58
157.50	-32.28	-32.46	-32.62
160.00	-32.30	-32.44	-32.69
162.50	-32.34	-32.44	-32.80
165.00	-32.43	-32.45	-32.93
167.50		-32.48	-33.17
170.00		-32.49	-33.12
172.50		-32.54	-33.24
175.00		-32.62	-33.24
177.50		-32.65	-33.33
180.00		-32.65	

Pakiri Cross Sections_B3

Scale - 1 : 500 (H), 1 : 50 (V)

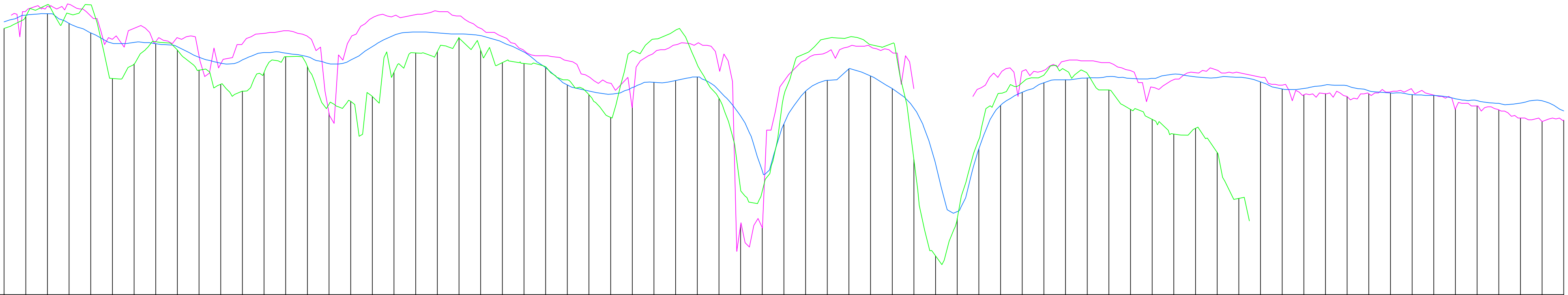


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00	-31.75	-31.85
2.50	-31.73	-31.77
5.00	-31.67	-31.76
7.50	-31.65	-31.87
10.00	-31.78	-31.98
12.50	-32.05	-32.10
15.00	-31.92	-32.09
17.50	-32.08	-32.10
20.00	-32.03	-32.14
22.50	-32.24	-32.26
25.00	-32.33	-32.33
27.50	-32.10	-32.29
30.00	-31.98	-32.20
32.50	-31.95	-32.21
35.00	-32.02	-32.25
37.50	-32.90	-32.34
40.00	-32.03	-32.29
42.50	-31.80	-32.14
45.00	-31.78	-32.00
47.50	-31.77	-31.97
50.00	-31.73	-31.98
52.50	-31.78	-31.99
55.00	-31.93	-32.01
57.50	-32.02	-32.09
60.00	-32.18	-32.20
62.50	-32.24	-32.38
65.00	-32.30	-32.58
67.50	-32.49	-32.65
70.00	-32.56	-32.68
72.50	-32.82	-32.61
75.00	-32.21	-32.55
77.50	-32.12	-32.53
80.00	-32.10	-32.49
82.50	-32.38	-32.64
85.00	-34.20	-32.94
87.50	-34.23	-33.57
90.00	-32.54	-33.03
92.50	-32.29	-32.65
95.00	-32.20	-32.53
97.50	-32.14	-32.39
100.00	-32.14	-32.47
102.50	-32.20	-32.62
105.00	-32.62	-32.85
107.50		-33.49
110.00		-34.04
112.50	-32.62	-33.32
115.00	-32.44	-32.81
117.50	-32.42	-32.66
120.00	-32.41	-32.55
122.50	-32.30	-32.52
125.00	-32.30	-32.50
127.50	-32.32	-32.48
130.00	-32.41	-32.50
132.50	-32.60	-32.50
135.00	-32.52	-32.45
137.50	-32.44	-32.49
140.00	-32.41	-32.49
142.50	-32.44	-32.49
145.00	-32.49	-32.54
147.50	-32.58	-32.63
150.00	-32.69	-32.62
152.50	-32.68	-32.58
155.00	-32.71	-32.59
157.50	-32.68	-32.65
160.00	-32.66	-32.67
162.50	-32.63	-32.69
165.00	-32.70	-32.70
167.50	-32.85	-32.74
170.00	-32.82	-32.76
172.50	-32.87	-32.79
175.00	-32.96	-32.79
177.50	-33.00	-32.76
180.00	-32.99	-32.88

Pakiri Cross Sections_B4

Scale - 1 : 500 (H), 1 : 50 (V)

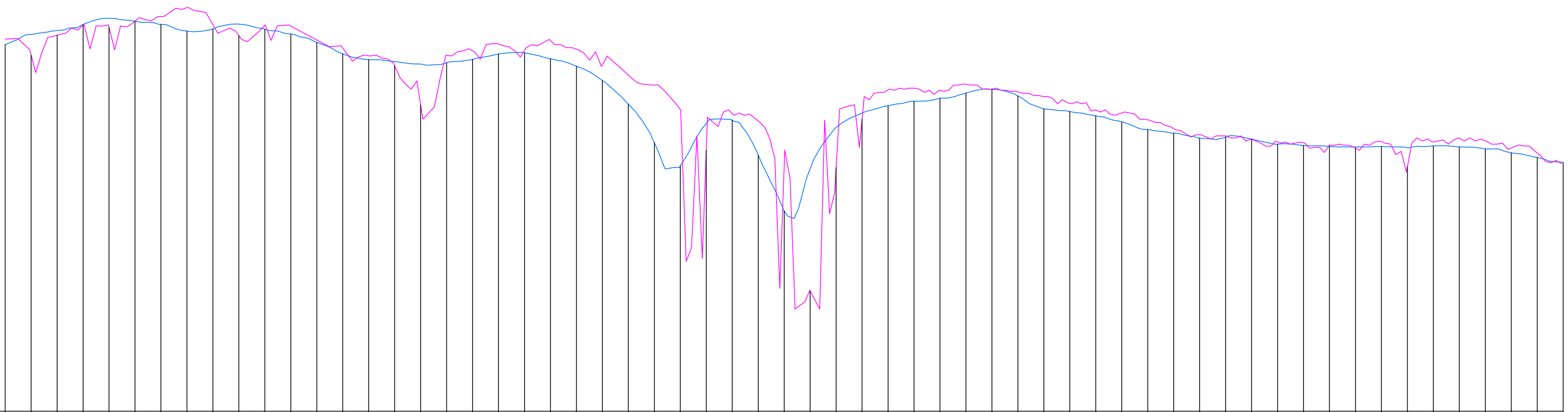


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021	WASSP_MAR_2021
0.00		-31.85	-31.93
2.50	-31.73	-31.77	-31.79
5.00	-31.67	-31.76	-31.65
7.50	-31.65	-31.87	-31.76
10.00	-31.78	-31.98	-31.65
12.50	-32.05	-32.10	-32.50
15.00	-31.92	-32.09	-32.34
17.50	-32.08	-32.10	-32.08
20.00	-32.03	-32.14	-32.18
22.50	-32.24	-32.26	-32.41
25.00	-32.33	-32.33	-32.57
27.50	-32.10	-32.29	-32.65
30.00	-31.98	-32.20	-32.43
32.50	-31.95	-32.21	-32.25
35.00	-32.02	-32.25	-32.37
37.50	-32.90	-32.33	-32.80
40.00	-32.03	-32.29	-32.77
42.50	-31.80	-32.14	-32.71
45.00	-31.78	-32.00	-32.43
47.50	-31.77	-31.97	-32.21
50.00	-31.73	-31.98	-32.19
52.50	-31.78	-31.99	-32.03
55.00	-31.93	-32.01	-32.18
57.50	-32.02	-32.09	-32.32
60.00	-32.18	-32.20	-32.33
62.50	-32.24	-32.38	-32.37
65.00	-32.30	-32.58	-32.52
67.50	-32.49	-32.65	-32.69
70.00	-32.56	-32.68	-32.95
72.50	-32.82	-32.61	-32.19
75.00	-32.21	-32.55	-32.05
77.50	-32.12	-32.53	-31.95
80.00	-32.10	-32.49	-32.34
82.50	-32.38	-32.64	-32.73
85.00	-34.20	-32.94	-33.79
87.50	-34.23	-33.57	-33.80
90.00	-32.54	-33.03	-32.70
92.50	-32.29	-32.65	-32.21
95.00	-32.20	-32.53	-32.04
97.50	-32.14	-32.39	-32.03
100.00	-32.14	-32.47	-32.11
102.50	-32.20	-32.62	-32.10
105.00	-32.62	-32.85	-33.44
107.50		-33.49	-34.55
110.00		-34.04	-34.12
112.50	-32.62	-33.32	-33.21
115.00	-32.44	-32.81	-32.67
117.50	-32.42	-32.66	-32.55
120.00	-32.41	-32.55	-32.46
122.50	-32.30	-32.52	-32.41
125.00	-32.30	-32.50	-32.45
127.50	-32.32	-32.48	-32.64
130.00	-32.41	-32.50	-32.86
132.50	-32.60	-32.50	-32.98
135.00	-32.52	-32.45	-33.15
137.50	-32.44	-32.49	-33.08
140.00	-32.41	-32.49	-33.36
142.50	-32.44	-32.49	-33.89
145.00	-32.49	-32.54	
147.50	-32.58	-32.63	
150.00	-32.69	-32.62	
152.50	-32.68	-32.58	
155.00	-32.71	-32.59	
157.50	-32.68	-32.65	
160.00	-32.66	-32.67	
162.50	-32.63	-32.69	
165.00	-32.70	-32.70	
167.50	-32.85	-32.74	
170.00	-32.82	-32.76	
172.50	-32.87	-32.79	
175.00	-32.96	-32.79	
177.50	-33.00	-32.76	
180.00	-32.99	-32.88	

Pakiri Cross Sections_B4

Scale - 1 : 500 (H), 1 : 50 (V)

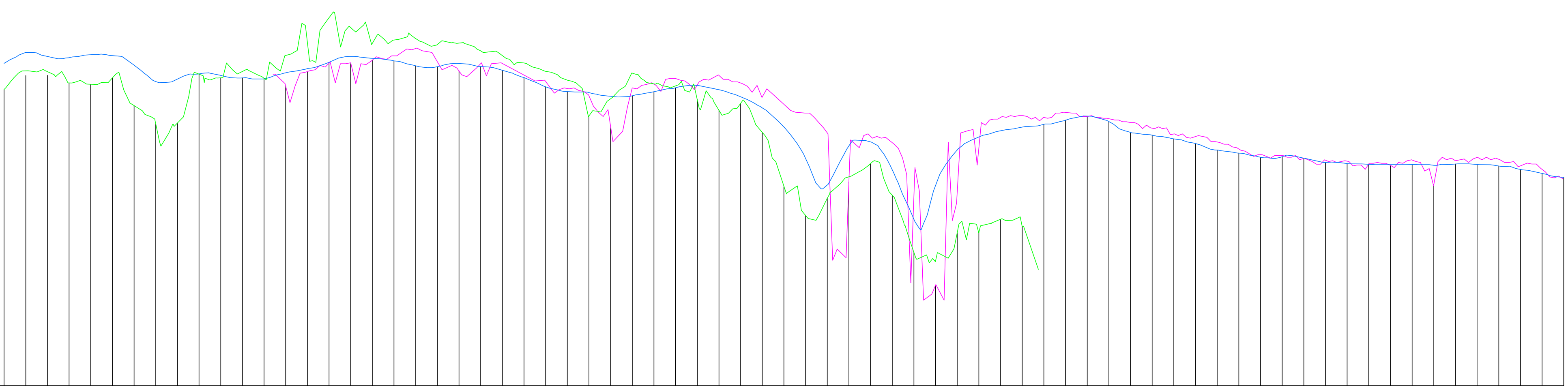


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00	-31.41	-31.47
2.50	-31.57	-31.37
5.00	-31.37	-31.33
7.50	-31.27	-31.27
10.00	-31.30	-31.21
12.50	-31.24	-31.24
15.00	-31.19	-31.27
17.50	-31.11	-31.33
20.00	-31.27	-31.31
22.50	-31.38	-31.27
25.00	-31.28	-31.32
27.50	-31.28	-31.36
30.00	-31.42	-31.44
32.50	-31.50	-31.55
35.00	-31.57	-31.61
37.50	-31.67	-31.63
40.00	-32.05	-31.65
42.50	-31.57	-31.64
45.00	-31.52	-31.61
47.50	-31.46	-31.56
50.00	-31.52	-31.54
52.50	-31.43	-31.60
55.00	-31.51	-31.67
57.50	-31.66	-31.81
60.00	-31.76	-32.04
62.50	-31.85	-32.41
65.00	-32.09	-32.63
67.50	-32.48	-32.22
70.00	-32.13	-32.19
72.50	-32.20	-32.53
75.00	-32.65	-33.07
77.50	-33.84	-32.66
80.00	-32.65	-32.26
82.50	-32.18	-32.12
85.00	-31.90	-32.05
87.50	-31.88	-32.01
90.00	-31.91	-31.98
92.50	-31.85	-31.93
95.00	-31.89	-31.89
97.50	-31.92	-31.96
100.00	-31.96	-32.08
102.50	-32.03	-32.11
105.00	-32.09	-32.15
107.50	-32.12	-32.21
110.00	-32.19	-32.28
112.50	-32.27	-32.32
115.00	-32.33	-32.37
117.50	-32.34	-32.36
120.00	-32.38	-32.37
122.50	-32.40	-32.42
125.00	-32.41	-32.44
127.50	-32.43	-32.45
130.00	-32.46	-32.45
132.50	-32.40	-32.45
135.00	-32.64	-32.46
137.50	-32.40	-32.44
140.00	-32.37	-32.45
142.50	-32.39	-32.47
145.00	-32.46	-32.51
147.50	-32.51	-32.55
150.00		-32.60

Pakiri Cross Sections_B5

Scale - 1 : 500 (H), 1 : 50 (V)

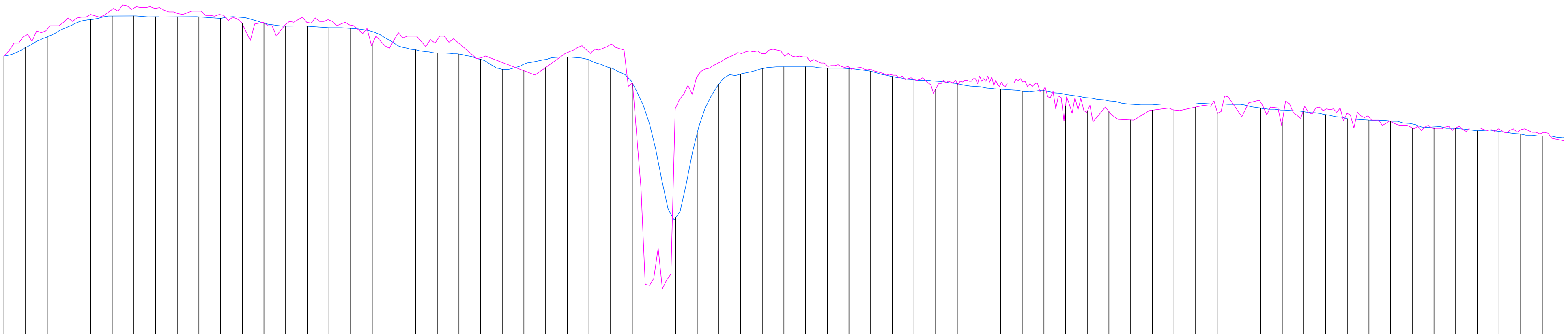


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021	WASSP_MAR_2021
0.00		-31.28	-31.58
2.50		-31.15	-31.37
5.00		-31.20	-31.38
7.50		-31.21	-31.51
10.00		-31.18	-31.45
12.50		-31.19	-31.45
15.00		-31.30	-31.77
17.50		-31.49	-31.98
20.00		-31.46	-31.97
22.50		-31.40	-31.41
25.00		-31.42	-31.45
27.50		-31.45	-31.37
30.00		-31.46	-31.45
32.50	-31.54	-31.39	-31.19
35.00	-31.37	-31.34	-31.04
37.50	-31.28	-31.27	-30.75
40.00	-31.27	-31.20	-30.87
42.50	-31.24	-31.22	-31.05
45.00	-31.19	-31.25	-31.01
47.50	-31.11	-31.31	-30.99
50.00	-31.26	-31.32	-31.06
52.50	-31.37	-31.28	-31.05
55.00	-31.28	-31.32	-31.14
57.50	-31.28	-31.36	-31.19
60.00	-31.42	-31.44	-31.28
62.50	-31.49	-31.55	-31.37
65.00	-31.57	-31.61	-31.47
67.50	-31.65	-31.62	-31.89
70.00	-32.01	-31.66	-31.69
72.50	-31.56	-31.65	-31.39
75.00	-31.52	-31.61	-31.52
77.50	-31.46	-31.56	-31.54
80.00	-31.53	-31.54	-31.70
82.50	-31.42	-31.58	-31.82
85.00	-31.51	-31.67	-31.74
87.50	-31.67	-31.79	-32.08
90.00	-31.75	-32.01	-32.70
92.50	-31.85	-32.38	-33.04
95.00	-32.08	-32.68	-32.84
97.50	-32.65	-32.23	-32.59
100.00	-32.12	-32.19	-32.44
102.50	-32.20	-32.51	-32.80
105.00	-32.83	-33.08	-33.46
107.50	-33.84	-32.69	-33.56
110.00	-32.76	-32.28	-33.23
112.50	-32.25	-32.13	-33.23
115.00	-31.91	-32.06	-33.08
117.50	-31.88	-32.02	-33.16
120.00	-31.90	-31.98	
122.50	-31.85	-31.94	
125.00	-31.89	-31.89	
127.50	-31.92	-31.95	
130.00	-31.96	-32.08	
132.50	-32.03	-32.11	
135.00	-32.10	-32.15	
137.50	-32.13	-32.21	
140.00	-32.19	-32.28	
142.50	-32.27	-32.32	
145.00	-32.33	-32.36	
147.50	-32.34	-32.36	
150.00	-32.37	-32.37	
152.50	-32.40	-32.42	
155.00	-32.41	-32.44	
157.50	-32.44	-32.45	
160.00	-32.46	-32.45	
162.50	-32.40	-32.45	
165.00	-32.68	-32.46	
167.50	-32.40	-32.44	
170.00	-32.37	-32.45	
172.50	-32.39	-32.47	
175.00	-32.46	-32.50	
177.50	-32.50	-32.55	
180.00		-32.60	

Pakiri Cross Sections_B5

Scale - 1 : 500 (H), 1 : 50 (V)

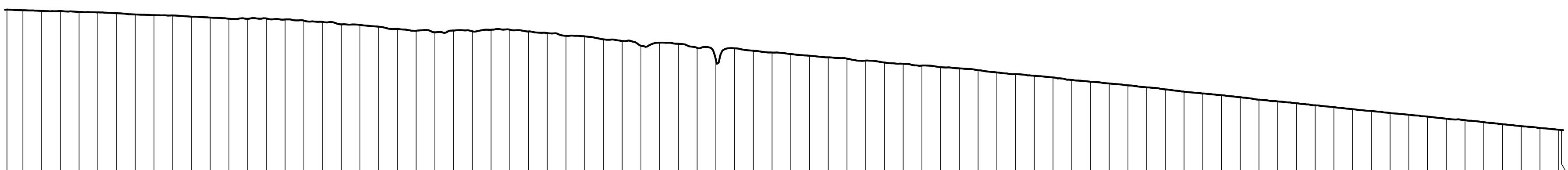


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00	-31.78	-31.77
2.50	-31.54	-31.68
5.00	-31.46	-31.55
7.50	-31.34	-31.43
10.00	-31.30	-31.35
12.50	-31.23	-31.31
15.00	-31.22	-31.31
17.50	-31.22	-31.32
20.00	-31.28	-31.32
22.50	-31.25	-31.32
25.00	-31.30	-31.34
27.50	-31.40	-31.33
30.00	-31.39	-31.40
32.50	-31.41	-31.43
35.00	-31.39	-31.43
37.50	-31.36	-31.45
40.00	-31.42	-31.45
42.50	-31.64	-31.49
45.00	-31.59	-31.62
47.50	-31.54	-31.70
50.00	-31.59	-31.74
52.50	-31.63	-31.75
55.00	-31.80	-31.81
57.50	-31.85	-31.93
60.00	-31.95	-31.87
62.50	-31.91	-31.82
65.00	-31.74	-31.79
67.50	-31.73	-31.82
70.00	-31.64	-31.91
72.50	-32.09	-32.08
75.00	-34.34	-32.77
77.50	-32.38	-33.64
80.00	-32.01	-32.66
82.50	-31.85	-32.10
85.00	-31.74	-31.98
87.50	-31.75	-31.92
90.00	-31.77	-31.90
92.50	-31.79	-31.90
95.00	-31.89	-31.91
97.50	-31.90	-31.92
100.00	-31.93	-31.95
102.50	-31.99	-32.01
105.00	-32.05	-32.05
107.50	-32.16	-32.06
110.00	-32.09	-32.09
112.50	-32.04	-32.13
115.00	-32.10	-32.16
117.50	-32.07	-32.18
120.00	-32.16	-32.18
122.50	-32.35	-32.22
125.00	-32.41	-32.26
127.50	-32.42	-32.29
130.00	-32.51	-32.33
132.50	-32.40	-32.34
135.00	-32.40	-32.33
137.50	-32.37	-32.33
140.00	-32.42	-32.33
142.50	-32.43	-32.33
145.00	-32.31	-32.38
147.50	-32.54	-32.40
150.00	-32.38	-32.42
152.50	-32.39	-32.45
155.00	-32.44	-32.50
157.50	-32.48	-32.52
160.00	-32.53	-32.53
162.50	-32.60	-32.56
165.00	-32.61	-32.59
167.50	-32.61	-32.61
170.00	-32.61	-32.64
172.50	-32.62	-32.65
175.00	-32.63	-32.68
177.50	-32.66	-32.70
180.00	-32.76	-32.72

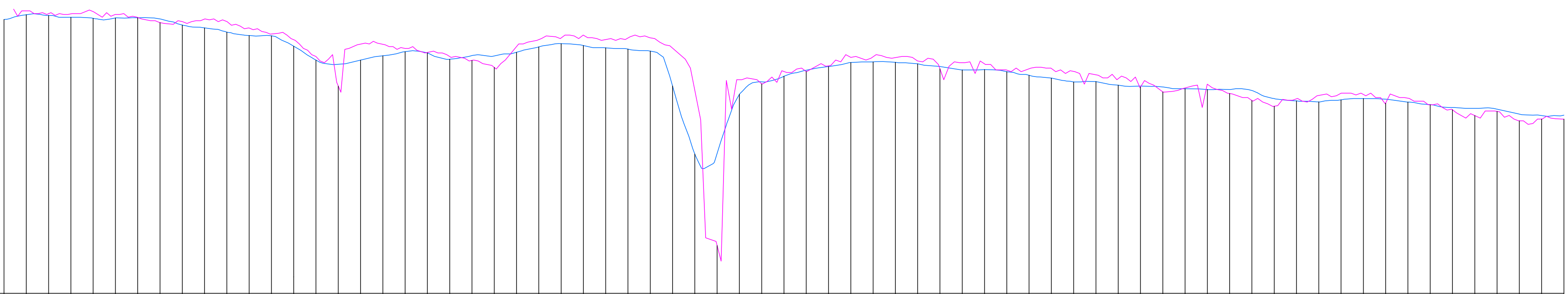
Pakiri Cross Sections_B6

Scale - 1 : 500 (H), 1 : 50 (V)



Datum
-45.00 M

Chainage	MBES_OCT_2021
2.97	-27.79
20.00	-27.86
40.00	-27.93
60.00	-27.95
80.00	-28.04
100.00	-28.09
120.00	-28.18
140.00	-28.31
160.00	-28.38
180.00	-28.42
200.00	-28.55
220.00	-28.64
240.00	-28.77
260.00	-28.77
280.00	-28.74
300.00	-28.85
320.00	-28.97
340.00	-29.11
360.00	-29.36
380.00	-29.42
400.00	-29.61
420.00	-29.85
440.00	-30.05
460.00	-30.21
480.00	-30.02
500.00	-30.10
520.00	-29.94
540.00	-29.94
560.00	-30.12
580.00	-30.29
600.00	-30.59
620.00	-30.64
640.00	-30.96
660.00	-31.13
680.00	-31.64
700.00	-31.31
720.00	-31.44
740.00	-31.87
760.00	-33.16
780.00	-31.92
800.00	-32.18
820.00	-32.37
840.00	-32.53
860.00	-32.71
880.00	-32.88
900.00	-33.02
920.00	-33.22
940.00	-33.43
960.00	-33.56
980.00	-33.76
1000.00	-33.93
1020.00	-34.05
1040.00	-34.25
1060.00	-34.49
1080.00	-34.67
1100.00	-34.84
1120.00	-35.02
1140.00	-35.29
1160.00	-35.48
1180.00	-35.67
1200.00	-35.87
1220.00	-36.08
1240.00	-36.30
1260.00	-36.54
1280.00	-36.73
1300.00	-36.92
1320.00	-37.13
1340.00	-37.39
1360.00	-37.58
1380.00	-37.77
1400.00	-37.99
1420.00	-38.19
1440.00	-38.40
1460.00	-38.60
1480.00	-38.82
1500.00	-38.99
1520.00	-39.20
1540.00	-39.41
1560.00	-39.57
1580.00	-39.79
1600.00	-40.00
1620.00	-40.21
1640.00	-40.41
1660.00	-40.59
1662.97	-40.63

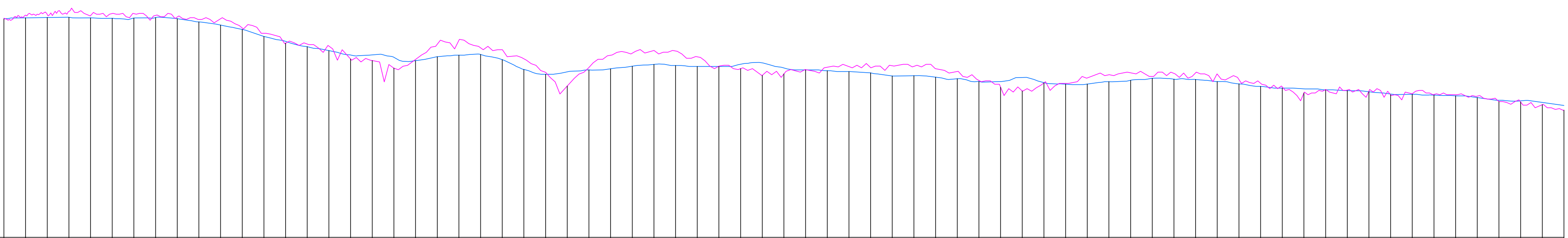


Datum
-35.00 M

Chainage	SEBS_SEP_2020	MBES_OCT_2021
0.00		-31.93
2.50	-31.84	-31.88
5.00	-31.87	-31.89
7.50	-31.87	-31.91
10.00	-31.85	-31.92
12.50	-31.88	-31.92
15.00	-31.91	-31.92
17.50	-31.97	-31.93
20.00	-31.96	-32.00
22.50	-31.93	-32.03
25.00	-31.96	-32.08
27.50	-32.03	-32.11
30.00	-32.10	-32.12
32.50	-32.16	-32.23
35.00	-32.35	-32.39
37.50	-32.68	-32.44
40.00	-32.21	-32.39
42.50	-32.21	-32.34
45.00	-32.26	-32.30
47.50	-32.30	-32.31
50.00	-32.35	-32.38
52.50	-32.39	-32.34
55.00	-32.47	-32.34
57.50	-32.24	-32.30
60.00	-32.16	-32.24
62.50	-32.14	-32.21
65.00	-32.11	-32.23
67.50	-32.16	-32.25
70.00	-32.14	-32.27
72.50	-32.14	-32.29
75.00	-32.26	-32.68
77.50	-32.73	-33.44
80.00	-34.47	-33.43
82.50	-32.61	-32.77
85.00	-32.66	-32.63
87.50	-32.52	-32.57
90.00	-32.52	-32.50
92.50	-32.45	-32.50
95.00	-32.36	-32.46
97.50	-32.35	-32.42
100.00	-32.36	-32.41
102.50	-32.40	-32.41
105.00	-32.49	-32.43
107.50	-32.42	-32.46
110.00	-32.43	-32.50
112.50	-32.50	-32.50
115.00	-32.49	-32.52
117.50	-32.48	-32.56
120.00	-32.52	-32.59
122.50	-32.55	-32.63
125.00	-32.60	-32.63
127.50	-32.69	-32.67
130.00	-32.75	-32.68
132.50	-32.70	-32.69
135.00	-32.66	-32.71
137.50	-32.76	-32.72
140.00	-32.84	-32.72
142.50	-32.91	-32.73
145.00	-32.82	-32.82
147.50	-32.79	-32.85
150.00	-32.76	-32.86
152.50	-32.77	-32.83
155.00	-32.87	-32.82
157.50	-32.82	-32.83
160.00	-32.89	-32.86
162.50	-32.95	-32.89
165.00	-33.01	-32.92
167.50	-32.96	-32.93
170.00	-33.07	-32.94
172.50	-33.05	-32.99
175.00	-33.05	-33.01

Pakiri Cross Sections_B7

Scale - 1 : 500 (H), 1 : 50 (V)

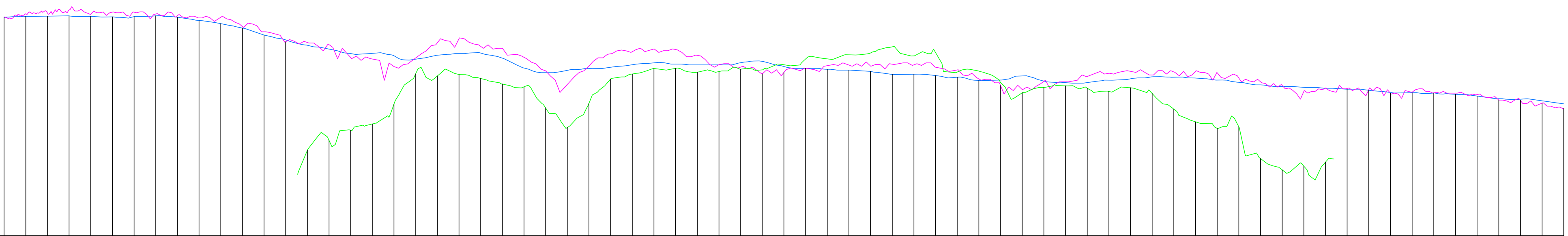


Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00	-32.47	-32.48
2.50	-32.44	-32.47
5.00	-32.43	-32.47
7.50	-32.40	-32.46
10.00	-32.44	-32.47
12.50	-32.42	-32.48
15.00	-32.42	-32.47
17.50	-32.44	-32.47
20.00	-32.46	-32.48
22.50	-32.49	-32.52
25.00	-32.48	-32.55
27.50	-32.59	-32.60
30.00	-32.65	-32.69
32.50	-32.76	-32.74
35.00	-32.77	-32.80
37.50	-32.80	-32.85
40.00	-32.94	-32.90
42.50	-32.96	-32.90
45.00	-33.05	-32.93
47.50	-32.95	-32.96
50.00	-32.77	-32.92
52.50	-32.73	-32.90
55.00	-32.82	-32.89
57.50	-32.84	-32.95
60.00	-32.94	-33.07
62.50	-33.10	-33.12
65.00	-33.26	-33.09
67.50	-33.04	-33.07
70.00	-32.90	-33.06
72.50	-32.88	-33.03
75.00	-32.85	-33.01
77.50	-32.85	-33.02
80.00	-32.92	-33.03
82.50	-33.03	-33.03
85.00	-33.06	-33.01
87.50	-33.13	-32.99
90.00	-33.12	-33.05
92.50	-33.07	-33.07
95.00	-33.04	-33.08
97.50	-33.03	-33.09
100.00	-33.04	-33.10
102.50	-33.02	-33.14
105.00	-33.03	-33.14
107.50	-33.06	-33.15
110.00	-33.09	-33.17
112.50	-33.19	-33.20
115.00	-33.27	-33.20
117.50	-33.31	-33.16
120.00	-33.22	-33.22
122.50	-33.23	-33.23
125.00	-33.16	-33.23
127.50	-33.13	-33.21
130.00	-33.10	-33.19
132.50	-33.15	-33.17
135.00	-33.11	-33.18
137.50	-33.10	-33.18
140.00	-33.12	-33.21
142.50	-33.18	-33.23
145.00	-33.22	-33.26
147.50	-33.27	-33.28
150.00	-33.34	-33.29
152.50	-33.30	-33.30
155.00	-33.30	-33.31
157.50	-33.31	-33.32
160.00	-33.36	-33.35
162.50	-33.34	-33.35
165.00	-33.35	-33.36
167.50	-33.36	-33.37
170.00	-33.37	-33.39
172.50	-33.44	-33.42
175.00	-33.44	-33.43
177.50	-33.47	-33.44
180.00	-33.53	-33.48

Pakiri Cross Sections_B8

Scale - 1 : 500 (H), 1 : 50 (V)

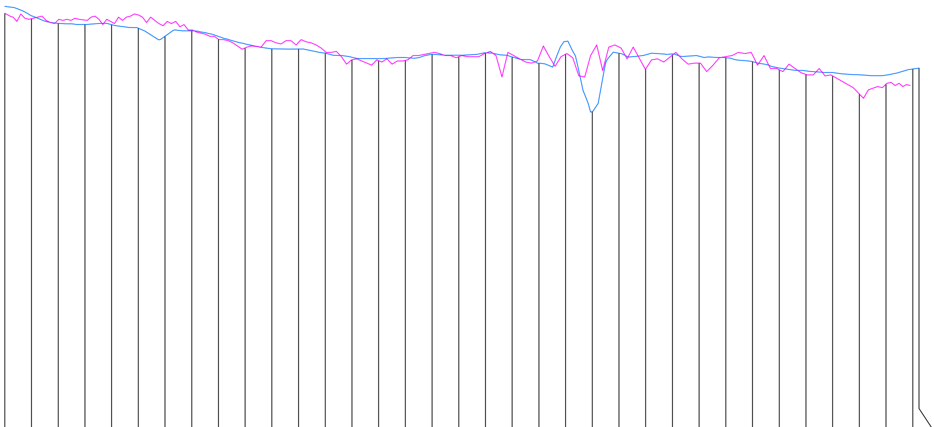


Datum
-35.00 M

Chainage	SBES_SEP 2020	MBES_OCT 2021	WASSP_MAR 2021
0.00	-32.47	-32.48	
2.50	-32.44	-32.47	
5.00	-32.43	-32.47	
7.50	-32.40	-32.46	
10.00	-32.44	-32.47	
12.50	-32.42	-32.48	
15.00	-32.42	-32.47	
17.50	-32.44	-32.46	
20.00	-32.46	-32.48	
22.50	-32.49	-32.52	
25.00	-32.48	-32.55	
27.50	-32.59	-32.60	
30.00	-32.65	-32.69	
32.50	-32.76	-32.74	
35.00	-32.77	-32.80	-34.02
37.50	-32.80	-32.85	-33.90
40.00	-32.94	-32.90	-33.78
42.50	-32.96	-32.90	-33.71
45.00	-33.05	-32.93	-33.48
47.50	-32.95	-32.96	-33.13
50.00	-32.77	-32.92	-33.16
52.50	-32.73	-32.90	-33.14
55.00	-32.82	-32.89	-33.19
57.50	-32.84	-32.95	-33.25
60.00	-32.94	-33.07	-33.28
62.50	-33.10	-33.12	-33.53
65.00	-33.26	-33.09	-33.75
67.50	-33.04	-33.07	-33.47
70.00	-32.90	-33.06	-33.19
72.50	-32.88	-33.03	-33.14
75.00	-32.85	-33.01	-33.07
77.50	-32.85	-33.02	-33.07
80.00	-32.92	-33.03	-33.11
82.50	-33.03	-33.03	-33.11
85.00	-33.06	-33.01	-33.08
87.50	-33.13	-32.99	-33.09
90.00	-33.12	-33.05	-33.03
92.50	-33.07	-33.07	-32.96
95.00	-33.04	-33.08	-32.96
97.50	-33.03	-33.09	-32.91
100.00	-33.04	-33.10	-32.89
102.50	-33.02	-33.14	-32.82
105.00	-33.03	-33.14	-32.92
107.50	-33.06	-33.15	-32.89
110.00	-33.09	-33.17	-33.11
112.50	-33.19	-33.21	-33.10
115.00	-33.27	-33.20	-33.23
117.50	-33.31	-33.16	-33.35
120.00	-33.22	-33.22	-33.29
122.50	-33.23	-33.23	-33.27
125.00	-33.16	-33.23	-33.30
127.50	-33.13	-33.21	-33.34
130.00	-33.10	-33.19	-33.29
132.50	-33.15	-33.17	-33.36
135.00	-33.11	-33.17	-33.54
137.50	-33.10	-33.18	-33.69
140.00	-33.12	-33.21	-33.76
142.50	-33.18	-33.23	-33.75
145.00	-33.22	-33.26	-34.11
147.50	-33.27	-33.28	-34.24
150.00	-33.34	-33.29	-34.20
152.50	-33.30	-33.30	-34.15
155.00	-33.30	-33.31	
157.50	-33.31	-33.32	
160.00	-33.36	-33.35	
162.50	-33.34	-33.35	
165.00	-33.35	-33.35	
167.50	-33.36	-33.37	
170.00	-33.37	-33.39	
172.50	-33.44	-33.42	
175.00	-33.44	-33.43	
177.50	-33.47	-33.44	
180.00	-33.53	-33.48	

Pakiri Cross Sections_B8

Scale - 1 : 500 (H), 1 : 50 (V)



Datum
-35.00 M

Chainage	SBES_SEP_2020	MBES_OCT_2021
0.00	-31.12	-31.05
2.50	-31.17	-31.14
5.00	-31.18	-31.21
7.50	-31.18	-31.22
10.00	-31.20	-31.22
12.50	-31.13	-31.26
15.00	-31.21	-31.33
17.50	-31.27	-31.28
20.00	-31.36	-31.33
22.50	-31.44	-31.40
25.00	-31.38	-31.45
27.50	-31.39	-31.45
30.00	-31.47	-31.49
32.50	-31.55	-31.53
35.00	-31.56	-31.54
37.50	-31.56	-31.53
40.00	-31.49	-31.50
42.50	-31.52	-31.51
45.00	-31.49	-31.49
47.50	-31.50	-31.52
50.00	-31.53	-31.58
52.50	-31.50	-31.38
55.00	-31.48	-32.04
57.50	-31.43	-31.49
60.00	-31.64	-31.50
62.50	-31.51	-31.50
65.00	-31.58	-31.52
67.50	-31.52	-31.53
70.00	-31.51	-31.57
72.50	-31.64	-31.63
75.00	-31.69	-31.65
77.50	-31.70	-31.67
80.00	-31.87	-31.69
82.50	-31.78	-31.69
85.00		-31.64
85.59		-31.63

Pakiri Cross Sections_C3

Scale - 1 : 500 (H), 1 : 50 (V)

Cross Section Comparisons									
	General	**Max Depth**	**Trench Depth**	**Max Depth**	**Trench Depth**	**Max Depth**	**Trench Depth**	**Infill Sep 2020-Oct 2021**	**Comments**
Section	**Seabed Depth**	**SBES**		**S_Worx_MBES**		**DML_MBES**			
A1	32.25	33.97	1.72	33.71	1.46	33.22	0.97	0.75	
A2	32.51	33.94	1.43	33.58	1.07	32.91	0.4	1.03	
A3	31.98	33.13	1.15	33.34	1.36	32.45	0.47	0.68	
A4	31.91			33.76	1.85	32.62	0.71		
A5	31.95			33.26	1.31	32.76	0.81		
								0.89	*Average Infill for Area A*
B1	32.73					33.07	0.34		
B2	32.32	34.18	1.86	33.88	1.56	32.86	0.54	1.32	
B3	32.44	34.48	2.04	34.13	1.69	33.33	0.89	1.15	
B4	32.5			34.58	2.08	34.06	1.56		
B5	32.21	34.01	1.8	33.56	1.35	33.1	0.89	0.91	
B6	**31.93**	**34.37**	**2.44**	**33.16**	**1.23**	**33.65**	**1.72**	**0.72**	Deepest Trench
B7	32.42	34.42	2	33.44	1.02	33.55	1.13	0.87	
B8	32.95	33.3	0.35	33.75	0.8	33.12	0.17	0.18	
								0.99	*Average Infill for Area B*
C1				No Coverage					
C2				No Coverage					
C3	31.62	31.8	0.18	No Coverage		32.11	0.49	-0.31	SBES did not detect bottom of trench
C4				No Coverage					
C5	31.39	32.25	0.86	No Coverage		31.51	0.12	0.74	SBES for Area C erratic in places
C6	31.21	32.52	1.31	No Coverage		31.48	0.27	1.04	
C7	30.95	31.35	0.4	No Coverage		31.22	0.27	0.13	
C8	30.91	31.12	0.21	No Coverage		31.05	0.14	0.07	Was a shallow trench to begin with
C9	30.73	31.56	0.83	No Coverage		30.94	0.21	0.62	
C10	30.51	30.7	0.19	No Coverage		30.68	0.17	0.02	Was a shallow trench to begin with
C11	30.49	30.86	0.37	No Coverage		30.7	0.21	0.16	
								0.40	*Average Infill for Area C*
D1	30.42	31.43	1.01	No coverage		30.57	0.15	0.86	
D2	30.41	31.29	0.88	31.12	0.71	30.37	-0.04	0.92	
D3				No coverage					
D4									
D5			No Trench	Trench lies further to the W					
D6			No Trench	Trench lies further to the W					
D7			No Trench	Trench lies further to the W					
D8			No Trench	Trench lies further to the W					
								0.89	*Average Infill for Area D*
Indicates loss of data or missing data									
Indicates unreliable data									