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**CARRYING OUT SUB-BOTTOM PROFILING SURVEY OFF PARADIP
COAST IN ORDER TO STUDY THE CHARACTERISTICS OF SUB-
SEABED FOR DREDGING AND LAND RECLAMATION FOR
PARADIP PETROCHEMICAL PROJECT.**



**NISVO MARINE SURVEYS LLP
CHENNAI**

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RECLAMATION FOR PARADIP PETROCHEMICAL PROJECT.**

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ABSTRACT NATIONAL TECHNOLOGY CENTRE FOR PORTS, WATERWAYS AND COASTS (NTCPWC), IIT Madras has requested Nisvo Marine Surveys LLP, Chennai to carry out sub-bottom profiling survey off Paradip Coast, covering 11.5km along the coast and 6km into the sea to study the characteristics of sub-seabed for dredging and land reclamation for Paradip Petrochemical Project. Accordingly, the surveys were conducted between 04.01.2024 and 19.01.2024. <i>This report presents various methodologies, instruments used for geophysical data acquisition and results of studies undertaken at site.</i>																
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1. INTRODUCTION

NATIONAL TECHNOLOGY CENTRE FOR PORTS, WATERWAYS AND COASTS (NTCPWC), IIT Madras has requested to Nisvo Marine Surveys LLP, Chennai to carry out a sub-bottom profiling survey off Paradip Coast, covering 11.5km along the coast and 6km into the sea in order to study the characteristics of sub-seabed for dredging and land reclamation for Paradip Petrochemical Project. Accordingly, the surveys were conducted between 04.01.2024 and 19.01.2024. The location map of the survey region is shown in **Fig. 1**. The satellite imagery of the survey region is shown in **Fig. 2**.

This report presents various methodology, instruments used for geophysical data acquisition and results of studies undertaken at site.

1.1. Scope of Work

- To carry out sub-bottom profiling survey by covering an area of 11500m X 6000m at 100m line spacing.
- To analyze /prepare and submit the report/Charts.

1.2. Objectives of Report

This report describes about working methodology, introduction to the instruments, some technical aspects followed oceanographic studies, results derived from the field studies and some site facts to help the client to reach a reliable solution in order to meet the further requirements on dredging solutions.

2. UNITS AND LANGUAGE

The units used are as per SI System i.e., System International Units. The WGS84 spheroid is followed for the surveys and “ENGLISH” language has been used throughout the report and drawings. All calendar dates are referred in Indian style as dd.mm.yy. (eg. 07.02.2024 for 07th February 2024).

3. SURVEY CONTROLS

3.1. Coordinate systems

The WGS-84 coordinate system was followed for the entire data acquisition, data processing, and preparation of reports and drawings.

3.2. Details of geodetic parameters

GEODETTIC PARAMETER DETAILS	
Parameter	Value
Grids	UTM North
Zone	Zone 45 (84E-90E)
Distance Unit	Meter
Depth Unit	Meter
Ellipsoid	WGS-84
Semi Major Axis	6378137.000
Flattening (1/f)	298.257223563
Projection	Transverse Mercator
Central Meridian	87° 00' 00.0000" E
Reference latitude	00° 00' 00.0000" N
Scale Factor	0.9996000000
False Easting (X)	500000.0000
False Northing (Y)	0.0000

3.3. Horizontal positioning system

The survey vessel was equipped with DGPS system for Precise Dynamic Positioning to give the real time position to sub-bottom profiling record. The DGPS system was setup to operate on UTM North Grid, Zone 45, WGS-1984 ellipsoid coordinate.

Mobile Station: The horizontal positioning acquired using Mobile unit TRIMBLE SPS 351 Beacon Receiver. It combines high-performance GPS reception with a DGPS-capable receiver in a lightweight, durable housing and comes with a separate antenna. The unit performs continuous RAIM calculations which enhance the integrity of the position data. The GPS receiver also contains technology enabling SBAS *e.g.*



WAAS and EGNOS or *Beacon* real time differential capabilities. When used with a Real- time Kinematic (RTK) Base station, the GPS receiver provides RTK positioning for high-accuracy, centimeter-level applications. A standard R4 GPS receiver provides the following features:

- 10 Hz (10 positions per second) output rate
- 12 GPS (C/A-code L1, C/A code L2 (for the Omni STAR XP/HP and RTK models)) tracking channels, code carrier channels
- Sub meter differential accuracy (RMS), assuming at least five satellites and a PDOP (Position Dilution of Precision) of less than four (when used with Satellite Based Augmentation Systems (SBAS) correction).

The detailed specification of SPS 351 is presented in Annexure 1.

The system Features

- SBAS such as WAAS (Wide Area Augmentation System) differential correction
- Highly versatile multifunctional display unit
- Beacon differential correction
- Large number of input and output ports to support highly complex and integrated bridge systems
- Channel management capability
- Easy access to standardized and proprietary text messages
- Fully upgradable to support future features
- NMEA-0183 output: GGA, GLL, GRS, GST, GSA, GSV, MSS, RMC, VTG, ZDA (the default NMEA messages are GGA, GSA, VTG, and RMC).

The confidence checks on DGPS systems were performed before commencement and after completion of surveys. The DGPS correction age (latency) and positional Dilution of Precision (PDOP) were confirmed that within allowable limits.

4. METHODOLOGY

4.1. Sub-bottom profiling survey

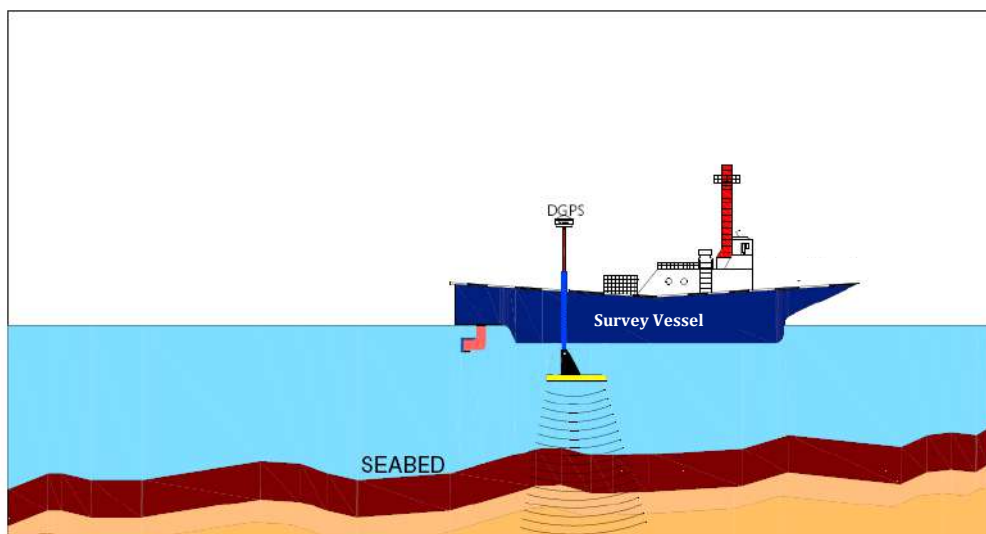
4.1.1. Survey Area

The sub-bottom profiling survey was carried out near Paradip Port Limit covering 11500m X 6000m at a line spacing of 100m by using **SyQwest StrataBox HD 3510 sub-bottom Profiler** manufactured in USA. The planned lines for sub-bottom profiling survey is presented in **Fig. 3**.

Sequence of Survey : During data acquisition, the transducer was mounted at 1m below the water surface on the starboard side. The tow-fish cable was connected to the transmitter unit and the connections between transmitter and receiver were established by co-axial cables. The Stratabox HD Acquisition software was used for data acquisition. The sub-bottom/seismic data was recorded at the reputation pulse of 126 ms with required transmission power and receiving gain and stored in SEG-Y (Society of Exploration Geophysics) format. The DGPS data was also given into the data acquisition system through serial communication (RS 232). The entire system was powered by 100 AH battery reserved on the survey boat.

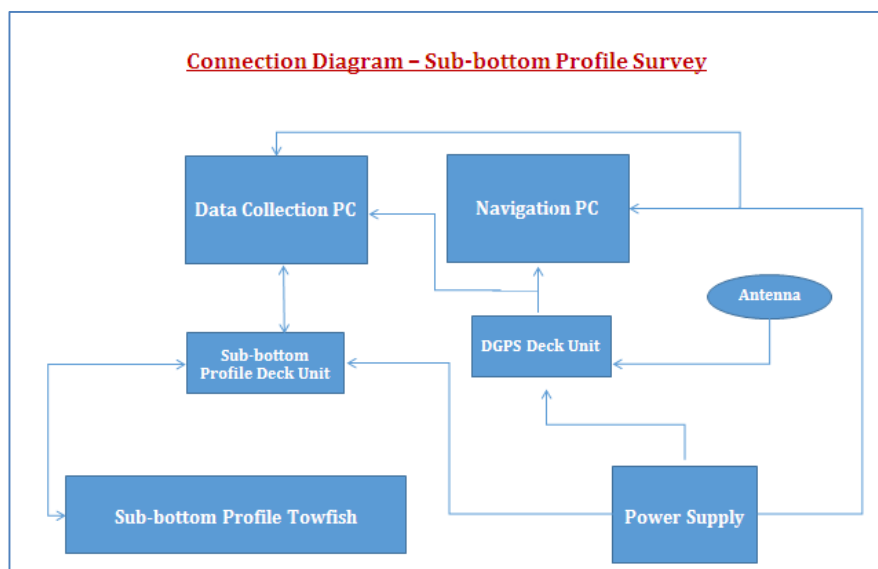
4.1.2. Survey Vessel

The different configuration of instrument installed/towed onboard are shown below.



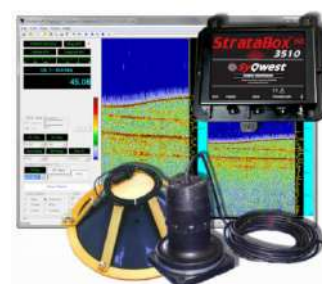
4.1.3. Connection Diagram

The connection diagram of the sub-bottom profile survey, Towfish, deck unit, DGPS, and navigation systems are shown below.



Data processing: CODA SEISMIC PLUS was adopted for entire data processing and data interpretation. The recorded data in the form of SEG-Y was imported to the CODA and seismic records were processed. The sub-bottom layers were interpreted and digitized using several geophysical techniques. The final outputs from the CODA were taken to generate vertical cross-sections and isopach map.

- **SyQwest StrataBox HD 3510 Sub-bottom Profiler:** The StrataBox HD™ 3510 is a portable high-resolution marine sediment imaging instrument capable of delivering 15cm of marine sediment strata resolution with bottom penetration of up to 40 meters. It is designed exclusively for inshore and coastal geophysical marine survey up to 800 meters of water depth.



Specifications

- ◆ **Geographic Position Input:** NMEA Compatible
- ◆ **Depth Accuracy :** +/- 0.5% of depth
- ◆ **Strata Resolution :** 6 cm with up to 40 meters bottom penetration @10Khz
15 cm with up to 40 meters bottom penetration @3.5Khz

- ◆ *Draft Offset* : 0 to 30 feet (10 meters)
- ◆ *Depth Resolution* : 0.1 foot (0.1 meters)
- ◆ *Sound Velocity* : 4600 - 5250 ft/sec (1400 - 1600 mt/sec) 1 mt/sec int.
- ◆ *Data Output* : NMEA 0183; DPT, DBT, PMC; ODEC
- ◆ *StrataBox I/F* : Ethernet via RJ-45
- ◆ *Transmit Rate* : Up to 10 Hz, depth and operator mode dependent
- ◆ *Transmit Output Power* : 300 Watts (pulsed), 1000 Watts capable

*The detailed specification of SyQwest Stratabox HD 3510 is presented in **Annexure 1**.*

5. RESULTS

■ Sub-bottom profiling survey

The sub-bottom profile survey data indicates that the sedimentary formation is the predominant composition of the sub-seabed off Paradip within the surveyed area. The thickness and compactness of the sediment vary at different locations. Based on acoustic impedance and the limitation of multiples, the minimum sediment thickness has been interpreted and mapped between 2.6m and 19.5m. It has been observed that a second layer exists below 1 to 2m from the seabed, starting beyond 3km from the shore and extending towards the seaward end of the survey limit. This second layer may indicate the presence of an ancient seabed. In general, there are no significant hard formations or strata observed within the range of signal penetration.

The Isopach map showing minimum sediment thickness in the surveyed limit is presented in **Fig.4.** *The typical sub-bottom profiling plates are presented in Annexure 2.*

The vertical profiles showing the formation of seabed/sub-seabed layers based on acoustic impedance are presented in **Figs.5 to 14.** The geographical descriptions of each sub-bottom layers/acoustic boundaries and remarks are tabulated below;

Transect 01/CH 01	Along this transect, the seabed varies from 4.97m to 16.65m w.r.t. Chart Datum. The acoustic basement varies from 14.09m to 33.32m. The minimum sediment thickness varies between 8.97m and 17.26m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 02/CH 02	Along this transect, the seabed varies from 4.86m to 16.75m w.r.t. Chart Datum. The acoustic basement varies from 14.7m to 33.13m. The minimum sediment thickness varies between 9.61m and 17.14m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 03/CH 03	Along this transect, the seabed varies from 4.98m to 16.84m w.r.t. Chart Datum. The acoustic basement varies from 15.54m to 33.34m. The minimum sediment thickness varies between 9.98m and 17.01m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 04/CH 04	Along this transect, the seabed varies from 4.97m to 16.77m w.r.t. Chart Datum. The acoustic basement varies from 16.54m to 33.32m. The minimum sediment thickness varies between 10.96m and 17m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 05/CH 05	Along this transect, the seabed varies from 5.25m to 16.82m w.r.t. Chart Datum. The acoustic basement varies from 18.02m to 33.11m. The minimum sediment thickness varies between 11.62m and 16.75m.

	<i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 06/CH 06	Along this transect, the seabed varies from 5.33m to 16.38m w.r.t. Chart Datum. The acoustic basement varies from 20.71m to 33.78m. The minimum sediment thickness varies between 11.59m and 17m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 07/CH 07	Along this transect, the seabed varies from 4.89m to 16.78m w.r.t. Chart Datum. The acoustic basement varies from 21.93m to 33.89m. The minimum sediment thickness varies between 10.99m and 16.64m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 08/CH 08	Along this transect, the seabed varies from 5.19m to 16.81m w.r.t. Chart Datum. The acoustic basement varies from 22.62m to 33.51m. The minimum sediment thickness varies between 9.23m and 16.33m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 09/CH 09	Along this transect, the seabed varies from 4.62m to 16.86m w.r.t. Chart Datum. The acoustic basement varies from 33.51m to 33.06m. The minimum sediment thickness varies between 8.08m and 16.54m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 10/CH 10	Along this transect, the seabed varies from 4.21m to 16.81m w.r.t. Chart Datum. The acoustic basement varies from 13.38m to 33.83m. The minimum sediment thickness varies between 6.02m and 17.42m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 11/CH 11	Along this transect, the seabed varies from 4.07m to 16.70m w.r.t. Chart Datum. The acoustic basement varies from 12.93m to 34.54m. The minimum sediment thickness varies between 8.39m and 17.98m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 12/CH 12	Along this transect, the seabed varies from 3.69m to 16.92m w.r.t. Chart Datum. The acoustic basement varies from 13.99m to 34.3m. The minimum sediment thickness varies between 10.21m and 17.71m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 13/CH 13	Along this transect, the seabed varies from 3.29m to 16.75m w.r.t. Chart Datum. The acoustic basement varies from 15.37m to 34.06m. The minimum sediment thickness varies between 11.04m and 17.66m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 14/CH 14	Along this transect, the seabed varies from 3.15m to 16.95m w.r.t. Chart Datum. The acoustic basement varies from 18.27m to 34.2m. The minimum sediment thickness varies between 11.31m and 17.45m.

	<i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 15/CH 15	Along this transect, the seabed varies from 3.05m to 17.13m w.r.t. Chart Datum. The acoustic basement varies from 19.09m to 34.33m. The minimum sediment thickness varies between 11.72m and 17.58m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 16/CH 16	Along this transect, the seabed varies from 2.91m to 16.85m w.r.t. Chart Datum. The acoustic basement varies from 18.27m to 34.19m. The minimum sediment thickness varies between 10.29m and 17.39m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 17/CH 17	Along this transect, the seabed varies from 3.17m to 17.07m w.r.t. Chart Datum. The acoustic basement varies from 16.81m to 34.06m. The minimum sediment thickness varies between 9.06m and 17.2m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 18/CH 18	Along this transect, the seabed varies from 3.04m to 17.16m w.r.t. Chart Datum. The acoustic basement varies from 19.28m to 34.13m. The minimum sediment thickness varies between 11.11m and 17.45m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 19/CH 19	Along this transect, the seabed varies from 3.29m to 17.04m w.r.t. Chart Datum. The acoustic basement varies from 22.12m to 34.22m. The minimum sediment thickness varies between 12.89m and 17.71m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 20/CH 20	Along this transect, the seabed varies from 3.01m to 16.92m w.r.t. Chart Datum. The acoustic basement varies from 22.71m to 34.08m. The minimum sediment thickness varies between 12.95m and 17.23m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 21/CH 21	Along this transect, the seabed varies from 3.47m to 16.98m w.r.t. Chart Datum. The acoustic basement varies from 23.4m to 33.99m. The minimum sediment thickness varies between seabed and acoustic basement varies between 13.38m and 17.2m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 22/CH 22	Along this transect, the seabed varies from 3.9m to 16.96m w.r.t. Chart Datum. The acoustic basement varies from 24.08m to 33.76m. The minimum sediment thickness varies between 13.11m and 16.97m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 23/CH 23	Along this transect, the seabed varies from 3.97m to 16.95m w.r.t. Chart Datum. The acoustic basement varies from 23.94m to 33.62m. The minimum sediment thickness varies between 13.24m and 16.91m.

	<i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 24/CH 24	Along this transect, the seabed varies from 4.28m to 17.1m w.r.t. Chart Datum. The acoustic basement varies from 22.62m to 33.56m. The minimum sediment thickness varies between 11.94m and 16.9m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 25/CH 25	Along this transect, the seabed varies from 4.63m to 17.06m w.r.t. Chart Datum. The acoustic basement varies from 20.87m to 33.85m. The minimum sediment thickness varies between 10.56m and 17.11m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 26/CH 26	Along this transect, the seabed varies from 4.78m to 17.02m w.r.t. Chart Datum. The acoustic basement varies from 19.99m to 33.11m. The minimum sediment thickness varies between 10.52m and 16.47m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 27/CH 27	Along this transect, the seabed varies from 5.06m to 17.44m w.r.t. Chart Datum. The acoustic basement varies from 18.29m to 32.39m. The minimum sediment thickness varies between 11.07m and 15.84m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 28/CH 28	Along this transect, the seabed varies from 5.21m to 17.59m w.r.t. Chart Datum. The acoustic basement varies from 15.54m to 32.22m. The minimum sediment thickness varies between 8.25m and 15.29m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 29/CH 29	Along this transect, the seabed varies from 4.98m to 17.1m w.r.t. Chart Datum. The acoustic basement varies from 13.39m to 32.18m. The minimum sediment thickness varies between 6.01m and 15.5m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 30/CH 30	Along this transect, the seabed varies from 4.47m to 17.63m w.r.t. Chart Datum. The acoustic basement varies from 13.05m to 32.32m. The minimum sediment thickness varies between 6.76m and 15.22m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 31/CH 31	Along this transect, the seabed varies from 5.05m to 17.49m w.r.t. Chart Datum. The acoustic basement varies from 12.82m to 32.44m. The minimum sediment thickness varies between 7.63m and 15.78m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 32/CH 32	Along this transect, the seabed varies from 5.30m to 17.11m w.r.t. Chart Datum. The acoustic basement varies from 10.26m to 32.36m. The minimum sediment thickness varies between 4.72m and 15.46m.

	<i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 33/CH 33	Along this transect, the seabed varies from 5.27m to 17.01m w.r.t. Chart Datum. The acoustic basement varies from 7.57m to 32.39m. The minimum sediment thickness varies between 1.64m and 15.42m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 34/CH 34	Along this transect, the seabed varies from 5.31m to 17.2m w.r.t. Chart Datum. The acoustic basement varies from 10.38m to 32.72m. The minimum sediment thickness varies between 5.56m and 16.01m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 35/CH 35	Along this transect, the seabed varies from 5.06m to 17.01m w.r.t. Chart Datum. The acoustic basement varies from 14.39m to 33.11m. The minimum sediment thickness varies between 9.93m and 16.35m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 36/CH 36	Along this transect, the seabed varies from 5.09m to 17.53m w.r.t. Chart Datum. The acoustic basement varies from 13.68m to 33.14m. The minimum sediment thickness varies between 9.18m and 16.17m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 37/CH 37	Along this transect, the seabed varies from 5.07m to 17.09m w.r.t. Chart Datum. The acoustic basement varies from 12.95m to 33.18m. The minimum sediment thickness varies between 8.65m and 16.44m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 38/CH 38	Along this transect, the seabed varies from 5.6m to 17.03m w.r.t. Chart Datum. The acoustic basement varies from 11.99m to 33.16m. The minimum sediment thickness varies between 7.33m and 16.3m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 39/CH 39	Along this transect, the seabed varies from 5.52m to 17.45m w.r.t. Chart Datum. The acoustic basement varies from 11.51m to 33.17m. The minimum sediment thickness varies between 6.44m and 16.55m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 40/CH 40	Along this transect, the seabed varies from 5.72m to 17.33m w.r.t. Chart Datum. The acoustic basement varies from 12.51m to 33.73m. The minimum sediment thickness varies between 7.35m and 17.24m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 41/CH 41	Along this transect, the seabed varies from 5.81m to 17.36m w.r.t. Chart Datum. The acoustic basement varies from 14.81m to 34.24m. The minimum sediment thickness varies between 9.38m and 17.51m. <i>Note: No significant hard strata presented between seabed and acoustic</i>

	<i>basement.</i>
Transect 42/CH 42	Along this transect, the seabed varies from 5.8m to 17.36m w.r.t. Chart Datum. The acoustic basement varies from 14.97m to 34.13m. The minimum sediment thickness varies between 8.69m and 17.3m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 43/CH 43	Along this transect, the seabed varies from 5.58m to 17.49m w.r.t. Chart Datum. The acoustic basement varies from 15.23m to 34.09m. The minimum sediment thickness varies between 8.15m and 17.36m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 44/CH 44	Along this transect, the seabed varies from 6.05m to 17.15m w.r.t. Chart Datum. The acoustic basement varies from 18.07m to 34.41m. The minimum sediment thickness varies between 8.66m and 17.32m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 45/CH 45	Along this transect, the seabed varies from 6.29m to 17.21m w.r.t. Chart Datum. The acoustic basement varies from 18.03m to 34.74m. The minimum sediment thickness varies between 8.65m and 17.75m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 46/CH 46	Along this transect, the seabed varies from 6.36m to 17.59m w.r.t. Chart Datum. The acoustic basement varies from 16.23m to 34.67m. The minimum sediment thickness varies between 7.98m and 17.77m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 47/CH 47	Along this transect, the seabed varies from 5.8m to 17.17m w.r.t. Chart Datum. The acoustic basement varies from 12.32m to 34.39m. The minimum sediment thickness varies between 6.37m and 18.06m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 48/CH 48	Along this transect, the seabed varies from 5.45m to 17.25m w.r.t. Chart Datum. The acoustic basement varies from 13.6m to 34.65m. The minimum sediment thickness varies between 7.63m and 17.76m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 49/CH 49	Along this transect, the seabed varies from 5.49m to 17.43m w.r.t. Chart Datum. The acoustic basement varies from 14.9m to 34.79m. The minimum sediment thickness varies between 8.92m and 18.04m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 50/CH 50	Along this transect, the seabed varies from 5.01m to 17.34m w.r.t. Chart Datum. The acoustic basement varies from 15.06m to 35.47m. The minimum sediment thickness varies between 10.19m and 18.62m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>

Transect 51/CH 51	Along this transect, the seabed varies from 5.41m to 17.21m w.r.t. Chart Datum. The acoustic basement varies from 15m to 32.03m. The minimum sediment thickness varies between seabed and acoustic basement varies between 10.19m and 14.98m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 52/CH 52	Along this transect, the seabed varies from 4.89m to 17.4m w.r.t. Chart Datum. The acoustic basement varies from 15.67m to 32.53m. The minimum sediment thickness varies between 8.2m and 15.56m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 53/CH 53	Along this transect, the seabed varies from 4.74m to 17.2m w.r.t. Chart Datum. The acoustic basement varies from 16.35m to 33.47m. The minimum sediment thickness varies between 8.09m and 16.06m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 54/CH 54	Along this transect, the seabed varies from 3.07m to 17.36m w.r.t. Chart Datum. The acoustic basement varies from 16.91m to 34.24m. The minimum sediment thickness varies between seabed and acoustic basement varies between 8.1m and 16.89m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 55/CH 55	Along this transect, the seabed varies from 1.12m to 17.22m w.r.t. Chart Datum. The acoustic basement varies from 17.37m to 34.96m. The minimum sediment thickness varies between 8.3m and 17.65m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 56/CH 56	Along this transect, the seabed varies from 3.36m to 17.29m w.r.t. Chart Datum. The acoustic basement varies from 16.69m to 34.47m. The minimum sediment thickness varies between 7.53m and 17.07m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 57/CH 57	Along this transect, the seabed varies from 5.93m to 17.29m w.r.t. Chart Datum. The acoustic basement varies from 15.78m to 33.68m. The minimum sediment thickness varies between 7.2m and 16.37m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 58/CH 58	Along this transect, the seabed varies from 2.07m to 17.57m w.r.t. Chart Datum. The acoustic basement varies from 13.56m to 33.93m. The minimum sediment thickness varies between 6.44m and 16.48m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 59/CH 59	Along this transect, the seabed varies from 1.27m to 17.14m w.r.t. Chart Datum. The acoustic basement varies from 11.17m to 34.07m. The minimum sediment thickness varies between 5.27m and 16.78m.

	<i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 60/CH 60	Along this transect, the seabed varies from 0.65m to 17.36m w.r.t. Chart Datum. The acoustic basement varies from 7.58m to 34.31m. The minimum sediment thickness varies between 3.92m and 17.3m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 61/CH 61	Along this transect, the seabed varies from 2.18m to 17.53m w.r.t. Chart Datum. The acoustic basement varies from 4.28m to 34.63m. The minimum sediment thickness varies between 1.98m and 17.48m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 62/CH 62	Along this transect, the seabed varies from 2.71m to 17.74m w.r.t. Chart Datum. The acoustic basement varies from 11.09m to 35.07m. The minimum sediment thickness varies between 4.54m and 17.93m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 63/CH 63	Along this transect, the seabed varies from 3.43m to 17.39m w.r.t. Chart Datum. The acoustic basement varies from 5.83m to 34.87m. The minimum sediment thickness varies between 2.29m and 17.65m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 64/CH 64	Along this transect, the seabed varies from 3.57m to 17.39m w.r.t. Chart Datum. The acoustic basement varies from 10.15m to 31.83m. The minimum sediment thickness varies between 4.73m and 15.27m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 65/CH 65	Along this transect, the seabed varies from 4.19m to 17.7m w.r.t. Chart Datum. The acoustic basement varies from 12.96m to 31.92m. The minimum sediment thickness varies between 5.99m and 15.11m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 66/CH 66	Along this transect, the seabed varies from 4.08m to 17.46m w.r.t. Chart Datum. The acoustic basement varies from 11.28m to 32.37m. The minimum sediment thickness varies between 7.15m and 15.58m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 67/CH 67	Along this transect, the seabed varies from 4.25m to 17.27m w.r.t. Chart Datum. The acoustic basement varies from 10.74m to 32.34m. The minimum sediment thickness varies between 7.15m and 15.53m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 68/CH 68	Along this transect, the seabed varies from 4.46m to 17.41m w.r.t. Chart Datum. The acoustic basement varies from 10.42m to 34.64m. The

	minimum sediment thickness varies between 6.02m and 17.48m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 69/CH 69	Along this transect, the seabed varies from 4.72m to 17.47m w.r.t. Chart Datum. The acoustic basement varies from 12.5m to 34.49m. The minimum sediment thickness varies between 7.03m and 17.27m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 70/CH 70	Along this transect, the seabed varies from 4.21m to 17.73m w.r.t. Chart Datum. The acoustic basement varies from 11.41m to 34.8m. The minimum sediment thickness varies between 8.74m and 17.45m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 71/CH 71	Along this transect, the seabed varies from 4.13m to 17.31m w.r.t. Chart Datum. The acoustic basement varies from 10.01m to 34.65m. The minimum sediment thickness varies between 6.56m and 18.26m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 72/CH 72	Along this transect, the seabed varies from 4.71m to 17.65m w.r.t. Chart Datum. The acoustic basement varies from 9.67m to 34.47m. The minimum sediment thickness varies between 7.86m and 18.25m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 73/CH 73	Along this transect, the seabed varies from 4.37m to 17.67m w.r.t. Chart Datum. The acoustic basement varies from 10.55m to 33.35m. The minimum sediment thickness varies between 6.2m and 18.09m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 74/CH 74	Along this transect, the seabed varies from 4.21m to 17.83m w.r.t. Chart Datum. The acoustic basement varies from 9.67m to 35.19m. The minimum sediment thickness varies between 5.33m and 17.59m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 75/CH 75	Along this transect, the seabed varies from 4.55m to 17.71m w.r.t. Chart Datum. The acoustic basement varies from 10.55m to 33.35m. The minimum sediment thickness varies between 5.31m and 16.1m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 76/CH 76	Along this transect, the seabed varies from 4.27m to 17.65m w.r.t. Chart Datum. The acoustic basement varies from 10.98m to 32.23m. The minimum sediment thickness varies between 5.38m and 15.79m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 77/CH 77	Along this transect, the seabed varies from 3.86m to 17.61m w.r.t. Chart

	Datum. The acoustic basement varies from 11.4m to 32.43m. The minimum sediment thickness varies between 5.47m and 16.05m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 78/CH 78	Along this transect, the seabed varies from 4.47m to 17.49m w.r.t. Chart Datum. The acoustic basement varies from 11.58m to 32.54m. The minimum sediment thickness varies between 5.18m and 16.07m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 79/CH 79	Along this transect, the seabed varies from 4.34m to 17.47m w.r.t. Chart Datum. The acoustic basement varies from 11.48m to 32.81m. The minimum sediment thickness varies between 5.15m and 16.07m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 80/CH 80	Along this transect, the seabed varies from 3.85m to 17.39m w.r.t. Chart Datum. The acoustic basement varies from 11.84m to 33.33m. The minimum sediment thickness varies between 6.19m and 16.36m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 81/CH 81	Along this transect, the seabed varies from 3.92m to 17.67m w.r.t. Chart Datum. The acoustic basement varies from 10.23m to 33.18m. The minimum sediment thickness varies between 5.05m and 15.87m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 82/CH 82	Along this transect, the seabed varies from 3.54m to 17.57m w.r.t. Chart Datum. The acoustic basement varies from 10.45m to 32.83m. The minimum sediment thickness varies between 5.08m and 15.84m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 83/CH 83	Along this transect, the seabed varies from 3.72m to 17.75m w.r.t. Chart Datum. The acoustic basement varies from 9.05m to 33.52m. The minimum sediment thickness varies between 4.44m and 15.63m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 84/CH 84	Along this transect, the seabed varies from 3.56m to 17.74m w.r.t. Chart Datum. The acoustic basement varies from 8.3m to 33.77m. The minimum sediment thickness varies between 4.1m and 16.12m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 85/CH 85	Along this transect, the seabed varies from 4.51m to 17.6m w.r.t. Chart Datum. The acoustic basement varies from 10.59m to 32.51m. The minimum sediment thickness varies between 5.81m and 15.15m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 86/CH 86	Along this transect, the seabed varies from 4.1m to 17.63m w.r.t. Chart

	Datum. The acoustic basement varies from 12.17m to 33.84m. The minimum sediment thickness varies between 9.67m and 17.19m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 87/CH 87	Along this transect, the seabed varies from 2.31m to 17.91m w.r.t. Chart Datum. The acoustic basement varies from 12.48m to 34.81m. The minimum sediment thickness varies between 10.13m and 18.22m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 88/CH 88	Along this transect, the seabed varies from 3.68m to 17.6m w.r.t. Chart Datum. The acoustic basement varies from 14.52m to 36.14m. The minimum sediment thickness varies between 10.26m and 18.88m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 89/CH 89	Along this transect, the seabed varies from 3.41m to 17.7m w.r.t. Chart Datum. The acoustic basement varies from 14.76m to 36.5m. The minimum sediment thickness varies between 10.82m and 19.34m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 90/CH 90	Along this transect, the seabed varies from 3.47m to 17.52m w.r.t. Chart Datum. The acoustic basement varies from 14.81m to 36.8m. The minimum sediment thickness varies between 10.82m and 17.92m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 91/CH 91	Along this transect, the seabed varies from 3.29m to 17.92m w.r.t. Chart Datum. The acoustic basement varies from 16.69m to 36.82m. The minimum sediment thickness varies between 10.82m and 17.7m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 92/CH 92	Along this transect, the seabed varies from 2.99m to 17.73m w.r.t. Chart Datum. The acoustic basement varies from 20.58m to 36.28m. The minimum sediment thickness varies between 11.81m and 18.95m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 93/CH 93	Along this transect, the seabed varies from 2.72m to 17.8m w.r.t. Chart Datum. The acoustic basement varies from 23.69m to 35.61m. The minimum sediment thickness varies between 12.17m and 17.94m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 94/CH 94	Along this transect, the seabed varies from 2.54m to 17.99m w.r.t. Chart Datum. The acoustic basement varies from 24.63m to 35.47m. The minimum sediment thickness varies between 12.31m and 17.99m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>

Transect 95/CH 95	Along this transect, the seabed varies from 2.2m to 17.94m w.r.t. Chart Datum. The acoustic basement varies from 24.96m to 35.4m. The minimum sediment thickness varies between 12.37m and 17.53m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 96/CH 96	Along this transect, the seabed varies from 2.1m to 18.29m w.r.t. Chart Datum. The acoustic basement varies from 25.28m to 35.53m. The minimum sediment thickness varies between 12.83m and 17.44m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 97/CH 97	Along this transect, the seabed varies from 2.32m to 17.97m w.r.t. Chart Datum. The acoustic basement varies from 25.32m to 35.62m. The minimum sediment thickness varies between 12.79m and 17.65m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 98/CH 98	Along this transect, the seabed varies from 2.18m to 18.05m w.r.t. Chart Datum. The acoustic basement varies from 25.18m to 34.94m. The minimum sediment thickness varies between 12.68m and 17.32m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 99/CH 99	Along this transect, the seabed varies from 3.74m to 17.76m w.r.t. Chart Datum. The acoustic basement varies from 24.22m to 34.4m. The minimum sediment thickness varies between 12.69m and 17.01m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 100/CH 100	Along this transect, the seabed varies from 3.52m to 17.28m w.r.t. Chart Datum. The acoustic basement varies from 16.76m to 34.07m. The minimum sediment thickness varies between 8.89m and 17.31m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 101/CH 101	Along this transect, the seabed varies from 3.34m to 17.73m w.r.t. Chart Datum. The acoustic basement varies from 9.72m to 33.62m. The minimum sediment thickness varies between 3.46m and 16.49m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 102/CH 102	Along this transect, the seabed varies from 2.78m to 17.92m w.r.t. Chart Datum. The acoustic basement varies from 8.1m to 33.82m. The minimum sediment thickness varies between 2.58m and 16.82m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 103/CH 103	Along this transect, the seabed varies from 2.66m to 17.77m w.r.t. Chart Datum. The acoustic basement varies from 7.25m to 34.05m. The minimum sediment thickness varies between 2.82m and 17.69m. <i>Note: No significant hard strata presented between seabed and acoustic</i>

	<i>basement.</i>
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Transect 104/CH 104	Along this transect, the seabed varies from 2.85m to 17.77m w.r.t. Chart Datum. The acoustic basement varies from 7.05m to 33.55m. The minimum sediment thickness varies between 3.63m and 15.9m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 105/CH 105	Along this transect, the seabed varies from 3.17m to 17.81m w.r.t. Chart Datum. The acoustic basement varies from 6.92m to 34.51m. The minimum sediment thickness varies between 3.93m and 16.73m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 106/CH 106	Along this transect, the seabed varies from 3.65m to 18.25m w.r.t. Chart Datum. The acoustic basement varies from 6.85m to 34.68m. The minimum sediment thickness varies between 3.7m and 16.86m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 107/CH 107	Along this transect, the seabed varies from 4.67m to 17.68m w.r.t. Chart Datum. The acoustic basement varies from 7.32m to 34.57m. The minimum sediment thickness varies between 2.57m and 16.61m. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 108/CH 108	Along this transect, the seabed varies from 4.39m to 17.78m w.r.t. Chart Datum. The acoustic basement varies from 7.35m to 33.88m. The minimum sediment thickness varies between 1.14m and 16.52 <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 109/CH 109	Along this transect, the seabed varies from 4.4m to 17.47m w.r.t. Chart Datum. The acoustic basement varies from 7.26m to 33.64m. The minimum sediment thickness varies between 1.73m and 16.56. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 110/CH 110	Along this transect, the seabed varies from 4.66m to 17.75m w.r.t. Chart Datum. The acoustic basement varies from 7.75m to 33.22m. The minimum sediment thickness varies between 2.07m and 15.87. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 111/CH 111	Along this transect, the seabed varies from 4.39m to 17.9m w.r.t. Chart Datum. The acoustic basement varies from 8.22m to 33.07m. The minimum sediment thickness varies between 2.25m and 15.41. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 112/CH 112	Along this transect, the seabed varies from 4.25m to 17.91m w.r.t. Chart Datum. The acoustic basement varies from 8.72m to 32.83m. The minimum sediment thickness varies between 2.76m and 15.41.

	<i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 113/CH 113	Along this transect, the seabed varies from 4.18m to 17.71m w.r.t. Chart Datum. The acoustic basement varies from 8.66m to 32.73m. The minimum sediment thickness varies between 3.44m and 15.47. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 114/CH 114	Along this transect, the seabed varies from 4.57m to 17.71m w.r.t. Chart Datum. The acoustic basement varies from 8.01m to 32.68m. The minimum sediment thickness varies between 3.41m and 15.44. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 115/CH 115	Along this transect, the seabed varies from 4.44m to 18.11m w.r.t. Chart Datum. The acoustic basement varies from 7.41m to 33.04m. The minimum sediment thickness varies between 3.01m and 15.25. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>
Transect 116/CH 116	Along this transect, the seabed varies from 5.62m to 17.81m w.r.t. Chart Datum. The acoustic basement varies from 9.94m to 32.51m. The minimum sediment thickness varies between 3.94m and 15.46. <i>Note: No significant hard strata presented between seabed and acoustic basement.</i>

The minimum and maximum values of seabed, acoustic basement and sediment thickness is presented below;

CHAIN- AGE	SEA BED		ACOUSTIC BASEMENT		MINIMUM SEDIMENTATION THICKNESS	
	MIN (m)	MAX (m)	MIN (m)	MAX (m)	MIN DIFF. (m)	MAX DIFF. (m)
CH 1	4.97	16.65	14.09	33.32	8.97	17.26
CH 2	4.86	16.75	14.7	33.13	9.61	17.14
CH 3	4.98	16.84	15.54	33.34	9.98	17.01
CH 4	4.97	16.77	16.54	33.32	10.96	17
CH 5	5.25	16.82	18.02	33.11	11.62	16.75
CH 6	5.33	16.38	20.71	33.78	11.59	17
CH 7	4.89	16.78	21.93	33.89	10.99	16.64
CH 8	5.19	16.81	22.62	33.51	9.23	16.33
CH 9	4.62	16.86	21.04	33.06	8.08	16.54
CH 10	4.21	16.81	13.38	33.83	6.02	17.42
CH 11	4.07	16.70	12.93	34.54	8.39	17.98
CH 12	3.69	16.92	13.99	34.3	10.21	17.71
CH 13	3.29	16.75	15.37	34.06	11.04	17.66
CH 14	3.15	16.95	18.27	34.2	11.31	17.45

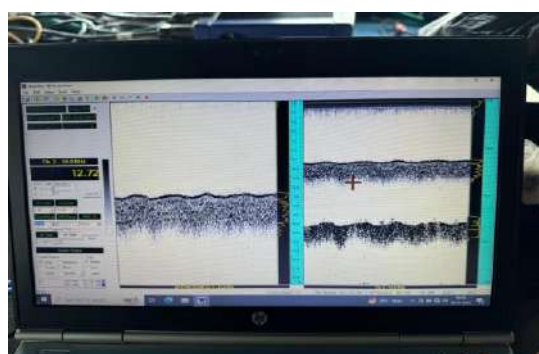
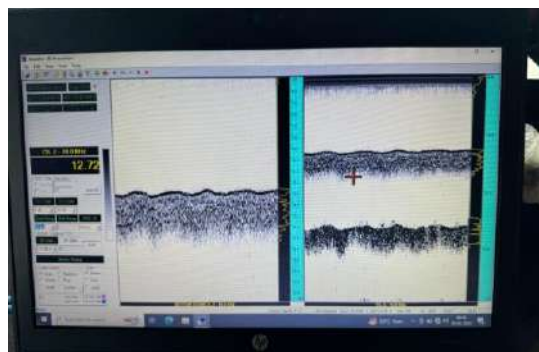
CH 15	3.05	17.13	19.09	34.33	11.72	17.58
CH 16	2.91	16.85	18.27	34.19	10.29	17.39
CH 17	3.17	17.07	16.81	34.06	9.06	17.2
CH 18	3.04	17.16	19.28	34.13	11.11	17.45
CH 19	3.29	17.04	22.12	34.22	12.89	17.71
CH 20	3.01	16.92	22.71	34.08	12.95	17.23
CH 21	3.47	16.98	23.4	33.99	13.38	17.2
CH 22	3.9	16.96	24.08	33.76	13.11	16.97
CH 23	3.97	16.95	23.94	33.62	13.24	16.91
CH 24	4.28	17.1	22.62	33.56	11.94	16.9
CH 25	4.63	17.06	20.87	33.85	10.56	17.11
CH 26	4.78	17.02	19.99	33.11	10.52	16.47
CH 27	5.06	17.44	18.29	32.39	11.07	15.84
CH 28	5.21	17.59	15.54	32.22	8.25	15.29
CH 29	4.98	17.1	13.39	32.18	6.01	15.5
CH 30	4.47	17.63	13.05	32.32	6.76	15.22
CH 31	5.05	17.49	12.82	32.44	7.63	15.78
CH 32	5.30	17.11	10.26	32.36	4.72	15.46
CH 33	5.27	17.01	7.57	32.39	1.64	15.42
CH 34	5.31	17.2	10.38	32.72	5.56	16.01
CH 35	5.06	17.01	14.39	33.11	9.93	16.35
CH 36	5.09	17.53	13.68	33.14	9.18	16.17
CH 37	5.07	17.09	12.95	33.18	8.65	16.44
CH 38	5.6	17.03	11.99	33.16	7.33	16.3
CH 39	5.52	17.45	11.51	33.17	6.44	16.55
CH 40	5.72	17.33	12.51	33.73	7.35	17.24
CH 41	5.81	17.36	14.81	34.24	9.38	17.51
CH 42	5.8	17.36	14.97	34.13	8.69	17.3
CH 43	5.58	17.49	15.23	34.09	8.15	17.36
CH 44	6.05	17.15	18.07	34.41	8.66	17.32
CH 45	6.29	17.21	18.03	34.74	8.65	17.75
CH 46	6.36	17.59	16.23	34.67	7.98	17.77
CH 47	5.8	17.17	12.32	34.39	6.37	18.06
CH 48	5.45	17.25	13.6	34.65	7.63	17.76
CH 49	5.49	17.43	14.9	34.79	8.92	18.04
CH 50	5.01	17.34	15.06	35.47	10.19	18.62
CH 51	5.41	17.21	15	32.03	8.32	14.98
CH 52	4.89	17.4	15.67	32.53	8.2	15.56
CH 53	4.74	17.2	16.35	33.47	8.09	16.06
CH 54	3.07	17.36	16.91	34.24	8.1	16.89
CH 55	1.12	17.22	17.37	34.96	8.3	17.65
CH 56	3.36	17.29	16.69	34.47	7.53	17.07
CH 57	5.93	17.29	15.78	33.68	7.2	16.37
CH 58	2.07	17.57	13.56	33.93	6.44	16.48

CH 59	1.27	17.14	11.17	34.07	5.27	16.78
CH 60	0.65	17.36	7.58	34.31	3.92	17.3
CH 61	2.18	17.53	4.28	34.63	1.98	17.48
CH 62	2.71	17.74	11.09	35.07	4.54	17.93
CH 63	3.43	17.39	5.83	34.87	2.29	17.65
CH 64	3.57	17.39	10.15	31.83	4.73	15.27
CH 65	4.19	17.7	12.96	31.92	5.99	15.11
CH 66	4.08	17.46	11.28	32.37	7.15	15.58
CH 67	4.25	17.27	10.74	32.34	6.55	15.53
CH 68	4.46	17.41	10.42	34.64	6.02	17.48
CH 69	4.72	17.47	12.5	34.49	7.03	17.27
CH 70	4.21	17.73	11.41	34.8	8.74	17.45
CH 71	4.13	17.31	10.01	34.65	6.56	18.26
CH 72	4.71	17.65	9.67	34.47	7.86	18.25
CH 73	4.37	17.67	10.55	33.35	6.2	18.09
CH 74	4.21	17.83	9.67	35.19	5.33	17.59
CH 75	4.55	17.71	10.55	33.35	5.31	16.1
CH 76	4.27	17.65	10.98	32.23	5.38	15.79
CH 77	3.86	17.61	11.4	32.43	5.47	16.05
CH 78	4.47	17.49	11.58	32.54	5.18	16.07
CH 79	4.34	17.47	11.48	32.81	5.15	16.07
CH 80	3.85	17.39	11.84	33.33	6.19	16.36
CH 81	3.92	17.67	10.23	33.18	5.05	15.87
CH 82	3.54	17.57	10.45	32.83	5.08	15.84
CH 83	3.72	17.75	9.05	33.52	4.44	15.63
CH 84	3.56	17.74	8.3	33.77	4.1	16.12
CH 85	4.51	17.6	10.59	32.51	5.81	15.15
CH 86	4.1	17.63	12.17	33.84	9.67	17.19
CH 87	2.31	17.91	12.48	34.81	10.13	18.22
CH 88	3.68	17.6	14.52	36.14	10.26	18.88
CH 89	3.41	17.7	14.76	36.5	10.82	19.34
CH 90	3.47	17.52	14.81	36.8	10.82	17.92
CH 91	3.29	17.92	16.69	36.82	10.82	17.7
CH 92	2.99	17.73	20.58	36.28	11.81	18.95
CH 93	2.72	17.8	23.69	35.61	12.17	17.94
CH 94	2.54	17.99	24.63	35.47	12.31	17.99
CH 95	2.2	17.94	24.96	35.4	12.37	17.53
CH 96	2.1	18.29	25.28	35.53	12.83	17.44
CH 97	2.32	17.97	25.32	35.62	12.79	17.65
CH 98	2.18	18.05	25.18	34.94	12.68	17.32
CH 99	3.74	17.76	24.22	34.4	12.69	17.01
CH 100	3.52	17.28	16.76	34.07	8.89	17.31
CH 101	3.34	17.73	9.72	33.62	3.46	16.49
CH 102	2.78	17.92	8.1	33.82	2.58	16.82

CH 103	2.66	17.77	7.25	34.05	2.82	17.69
CH 104	2.85	17.77	7.05	33.55	3.63	15.9
CH 105	3.17	17.81	6.92	34.51	3.93	16.73
CH 106	3.65	18.25	6.85	34.68	3.7	16.86
CH 107	4.67	17.68	7.32	34.57	2.57	16.61
CH 108	4.39	17.78	7.35	33.88	1.14	16.52
CH 109	4.4	17.47	7.26	33.64	1.73	16.56
CH 110	4.66	17.75	7.75	33.22	2.07	15.87
CH 111	4.39	17.9	8.22	33.07	2.25	15.41
CH 112	4.25	17.91	8.72	32.83	2.76	15.45
CH 113	4.18	17.71	8.66	32.73	3.44	15.47
CH 114	4.57	17.71	8.01	32.68	3.41	15.44
CH 115	4.44	18.11	7.41	33.04	3.01	15.25
CH 116	5.62	17.81	9.94	32.51	3.94	15.46

*The objects/properties identified and mapped are based on sonar **IMAGES**; ground-truth verification is mandatory in order to confirm the findings in terms of hardness/shape/material/geometry and other properties of findings.*

PHOTO GALLERY



FIGURES

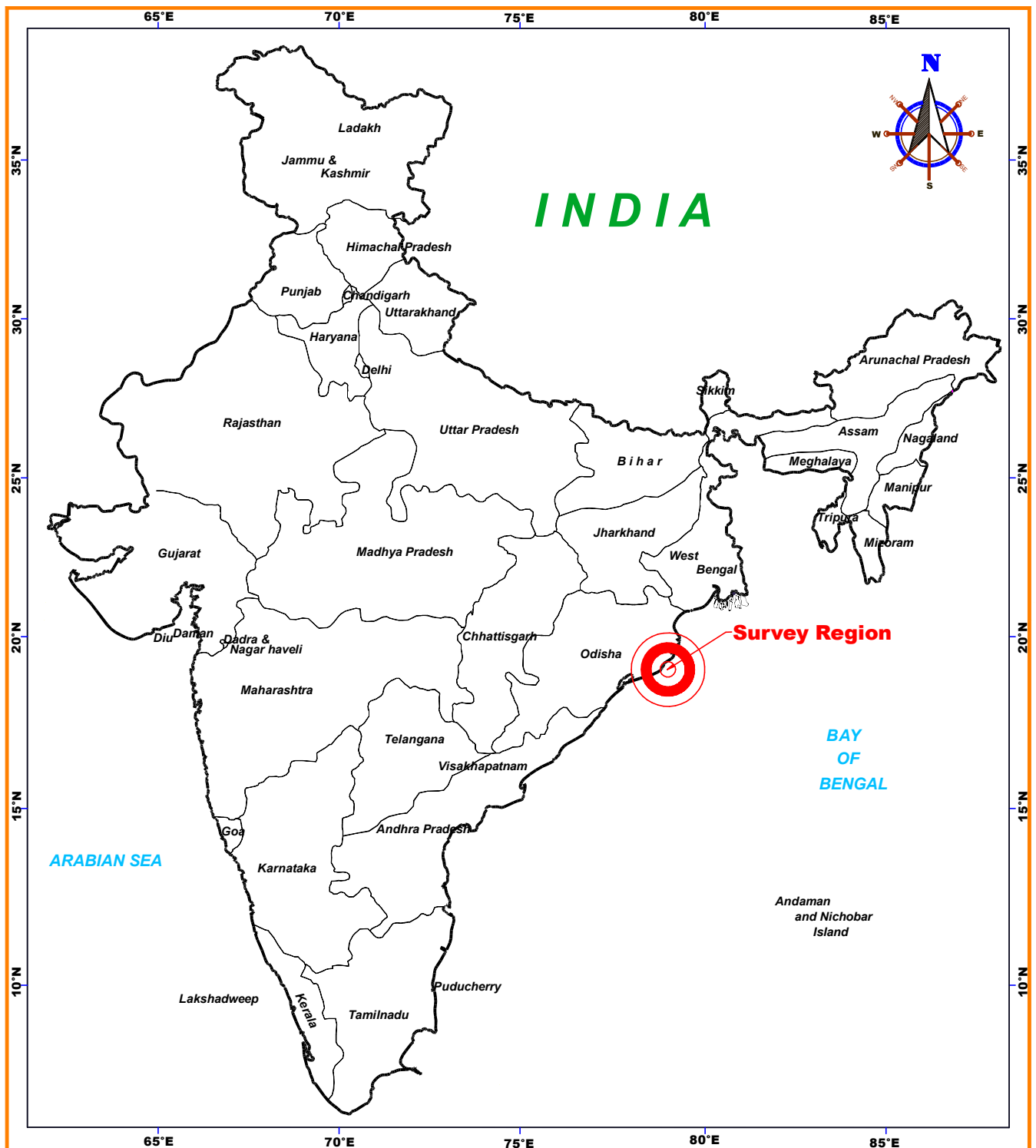


FIG. 1. Location map

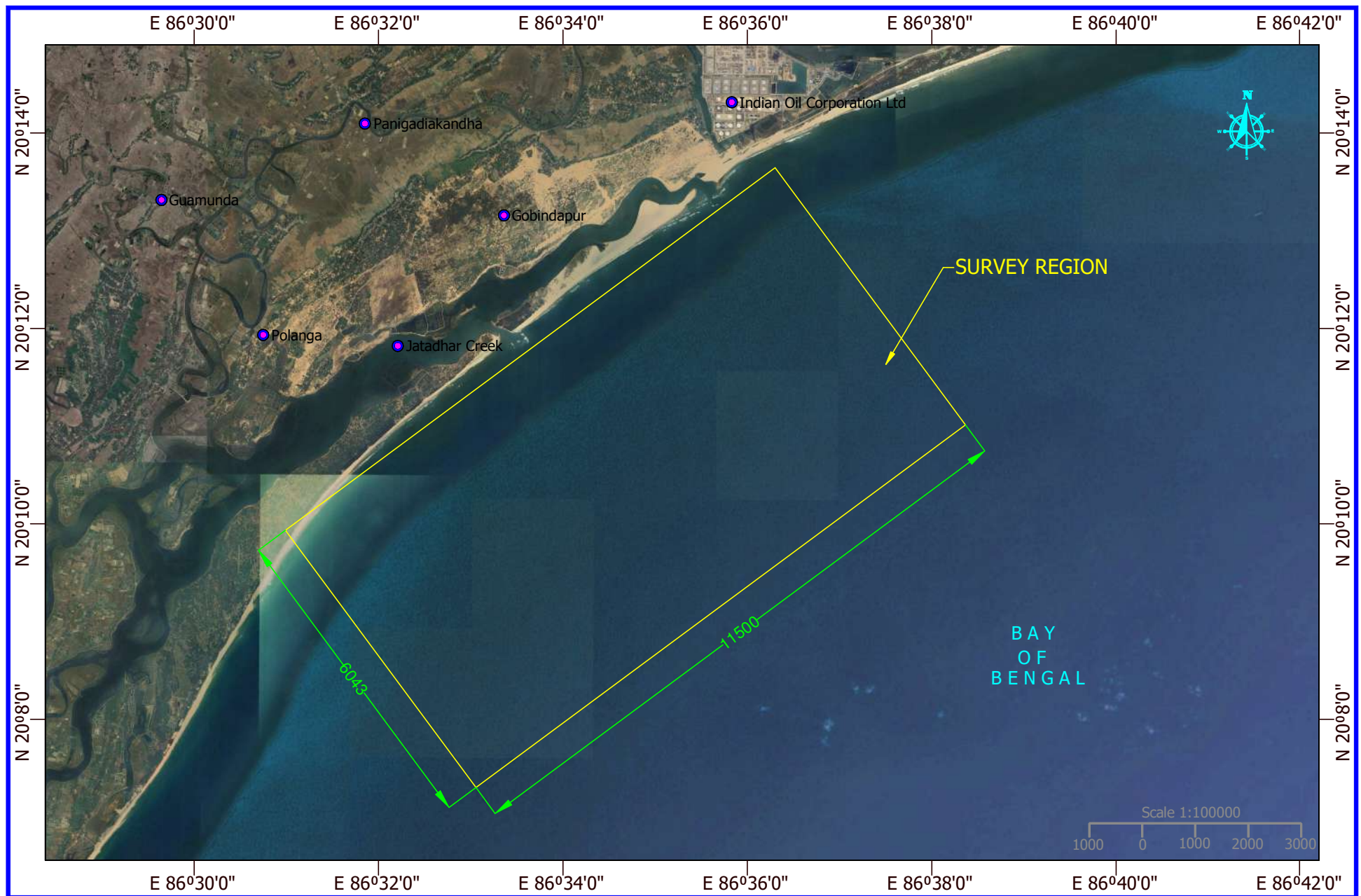


Fig.2. Satellite imagery of survey region

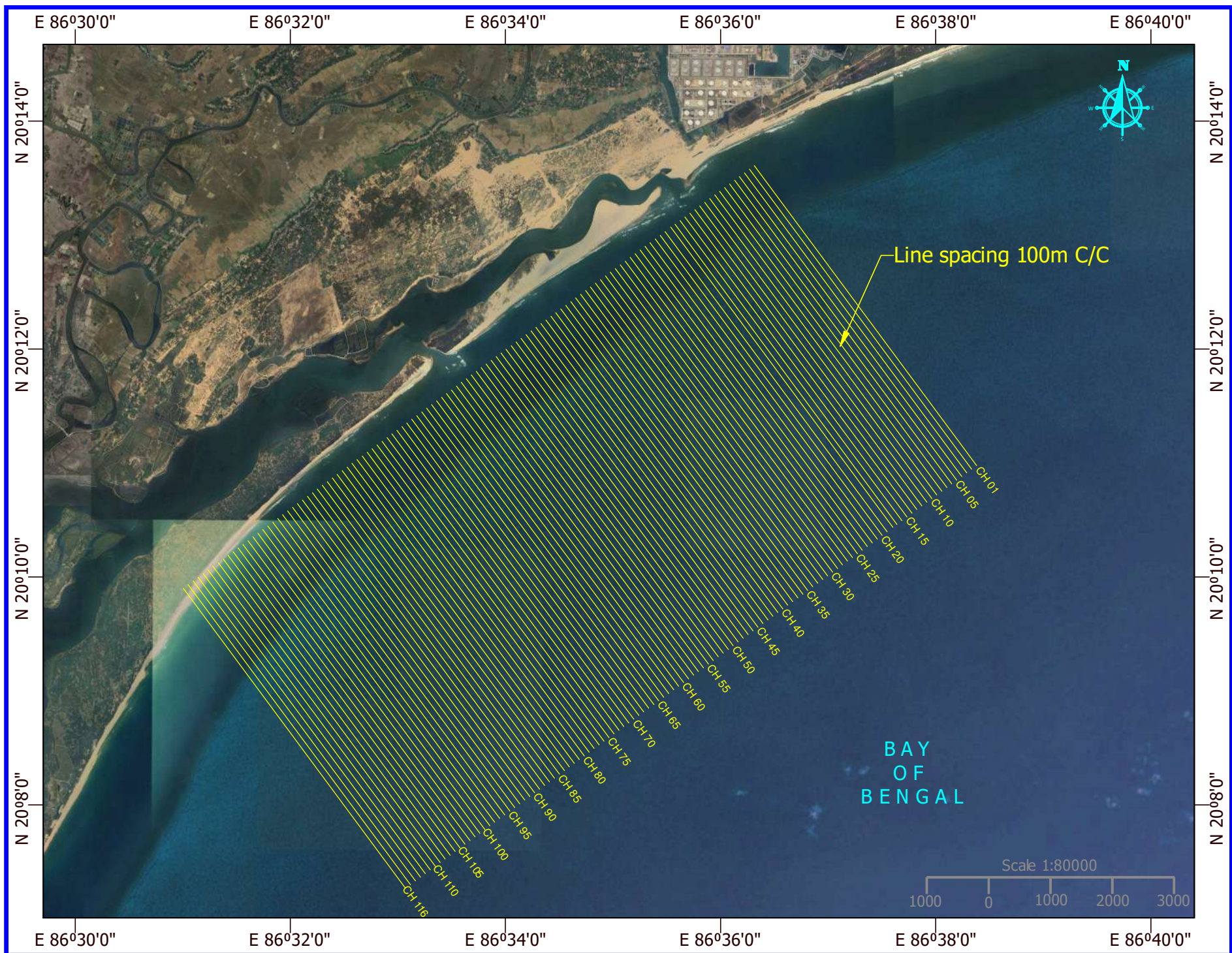
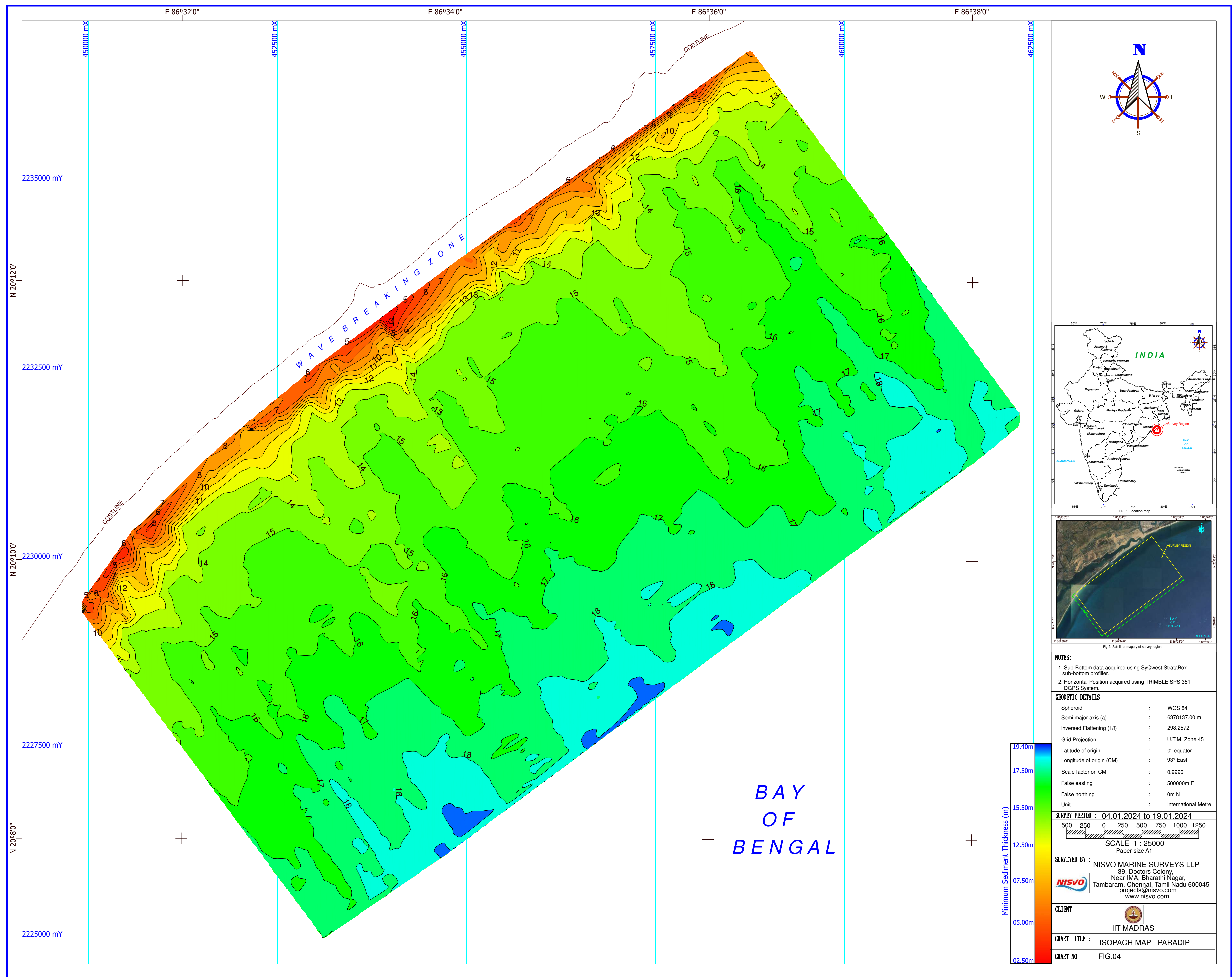
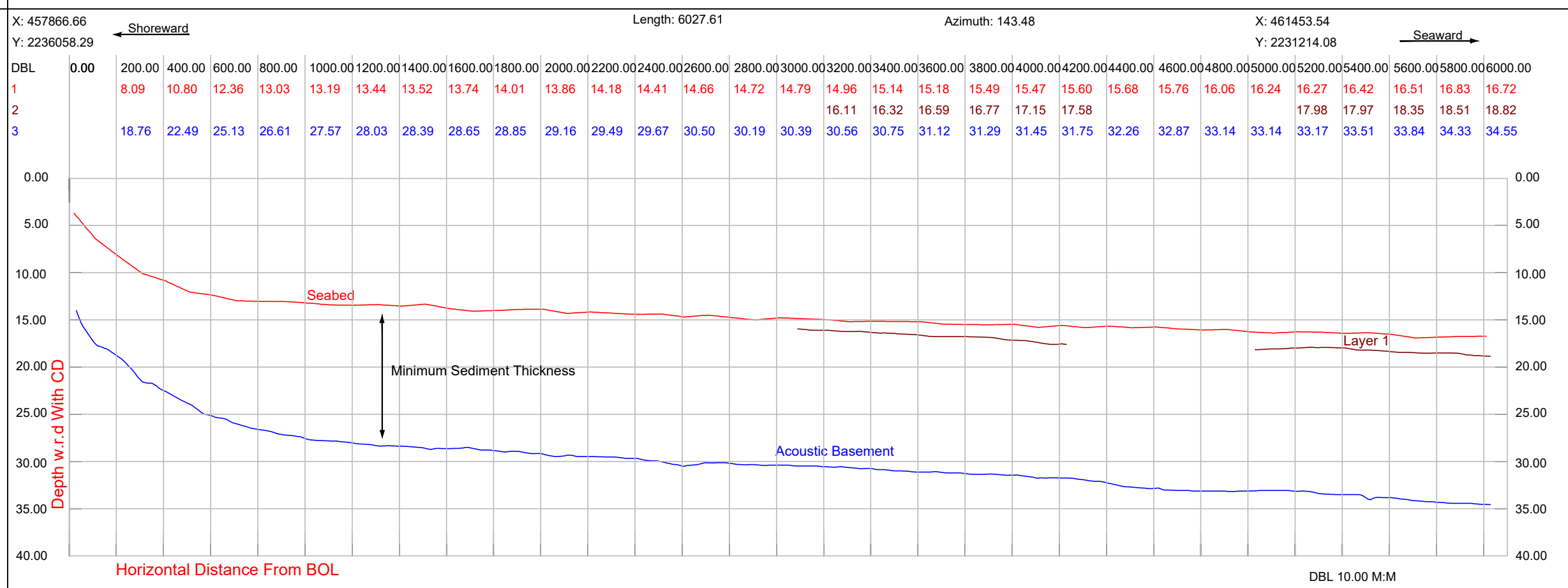
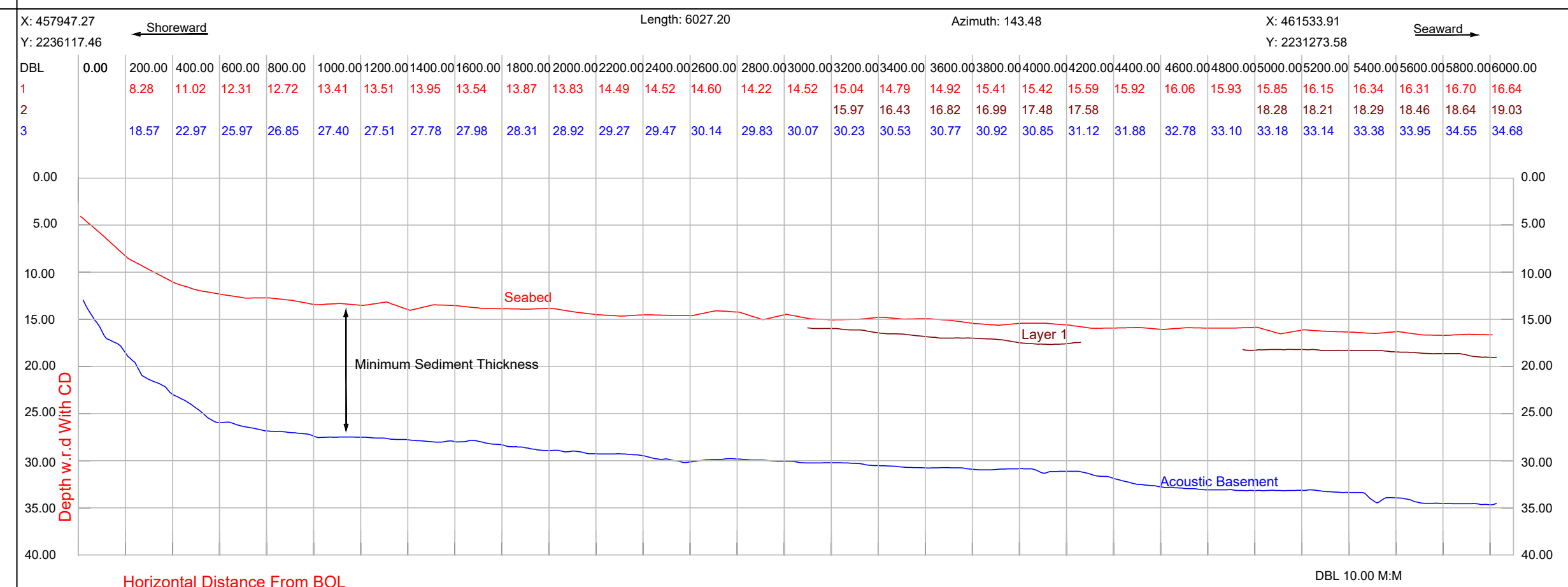
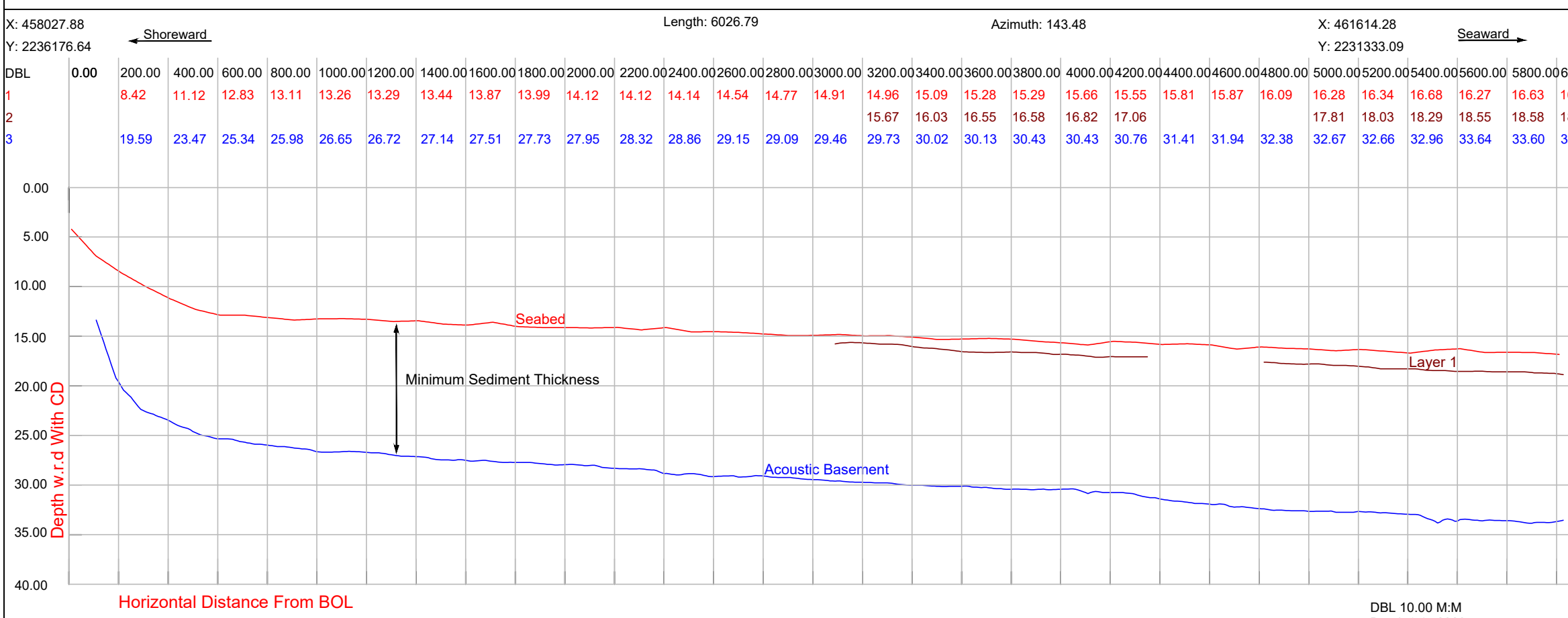
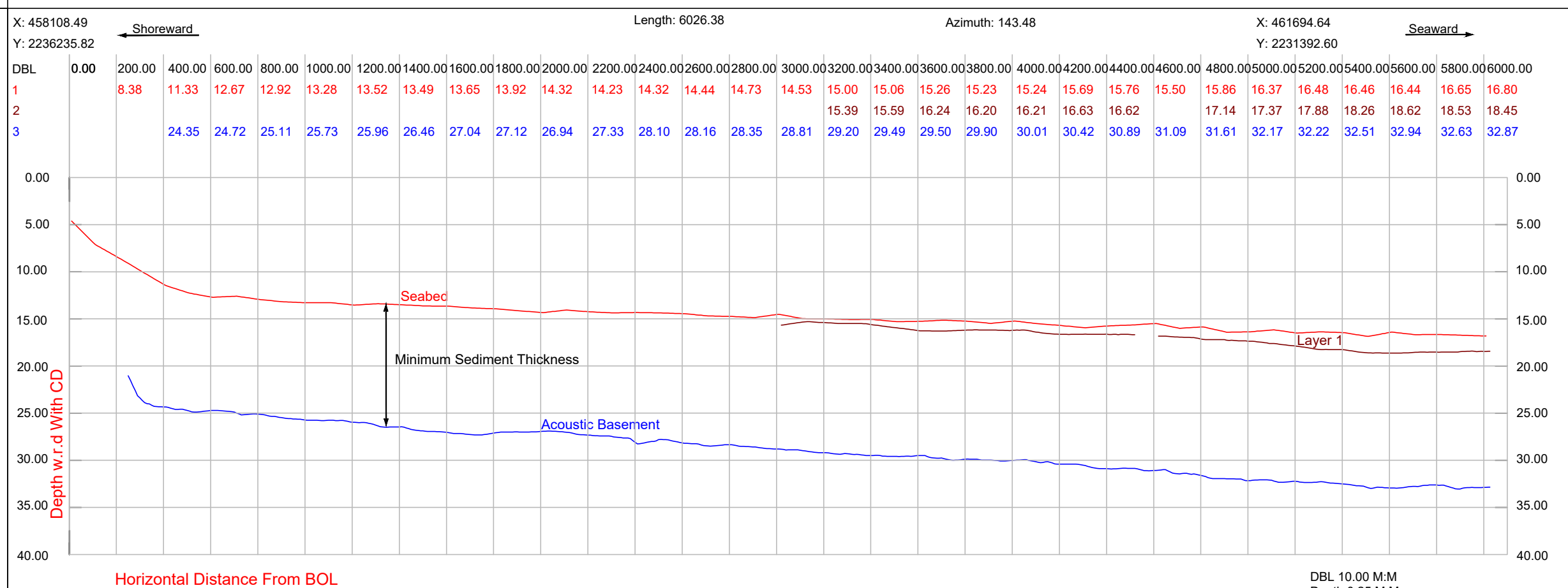
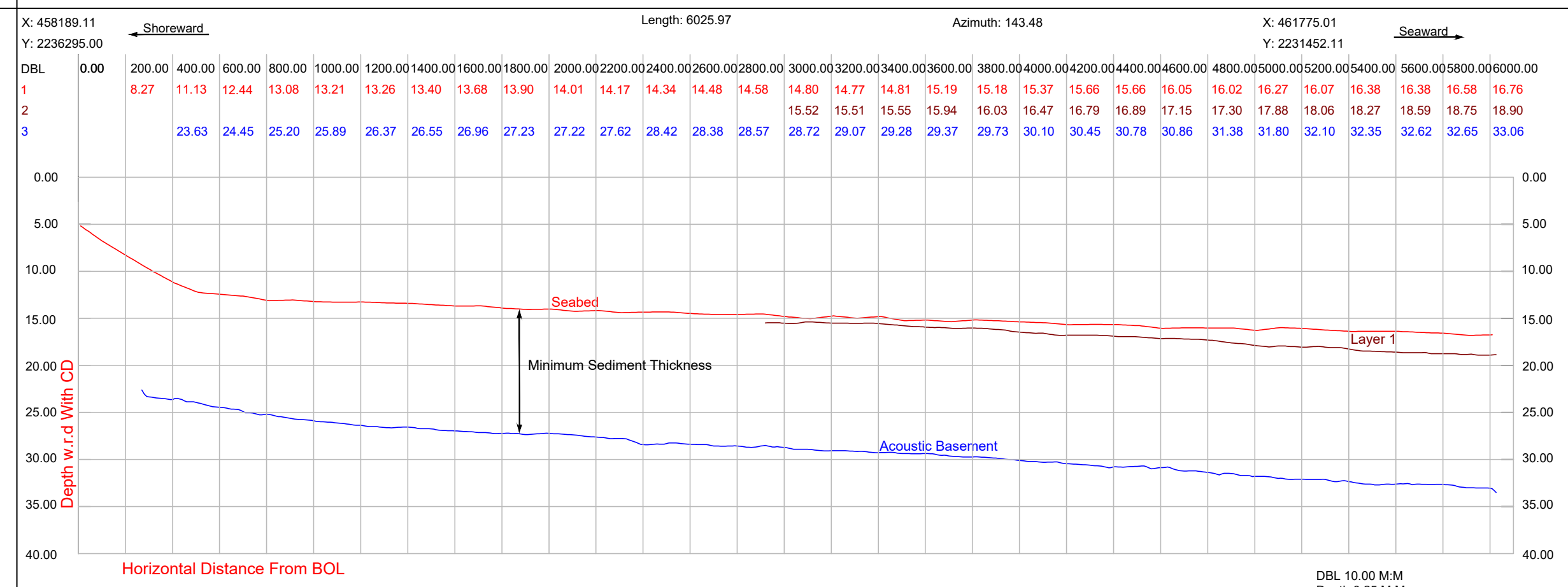
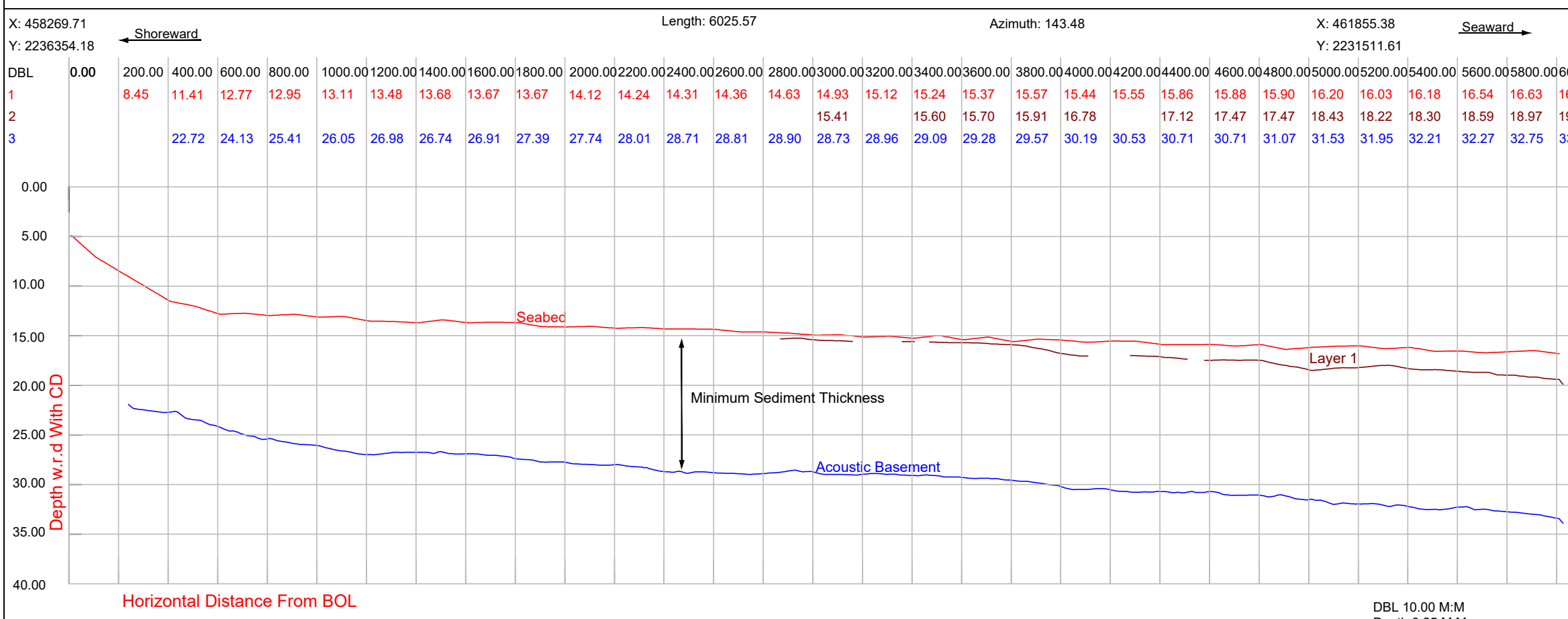
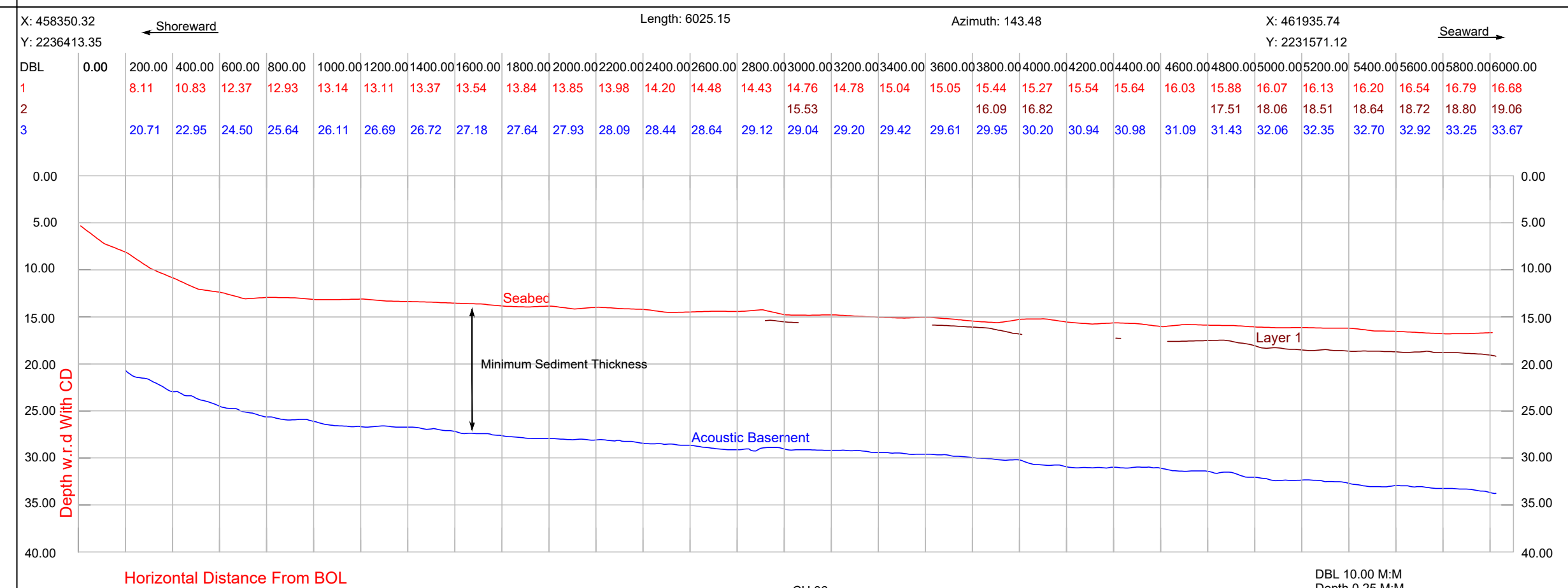
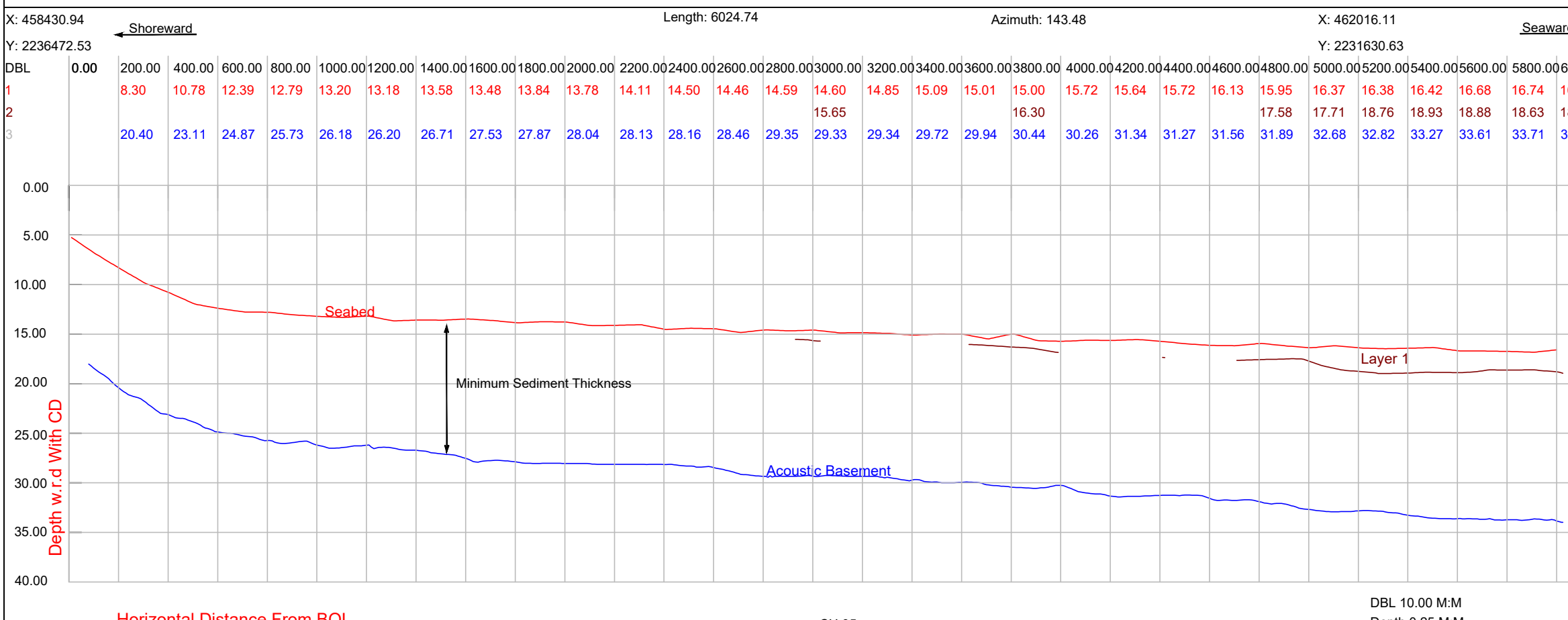
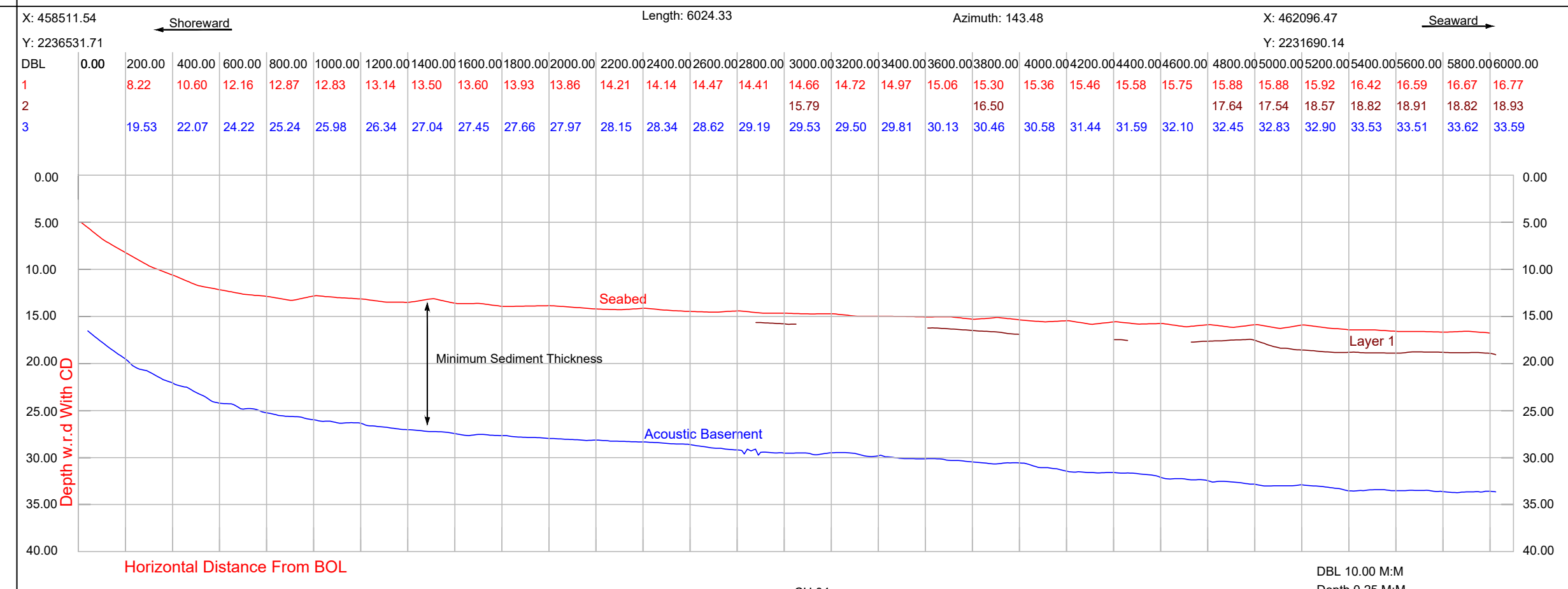
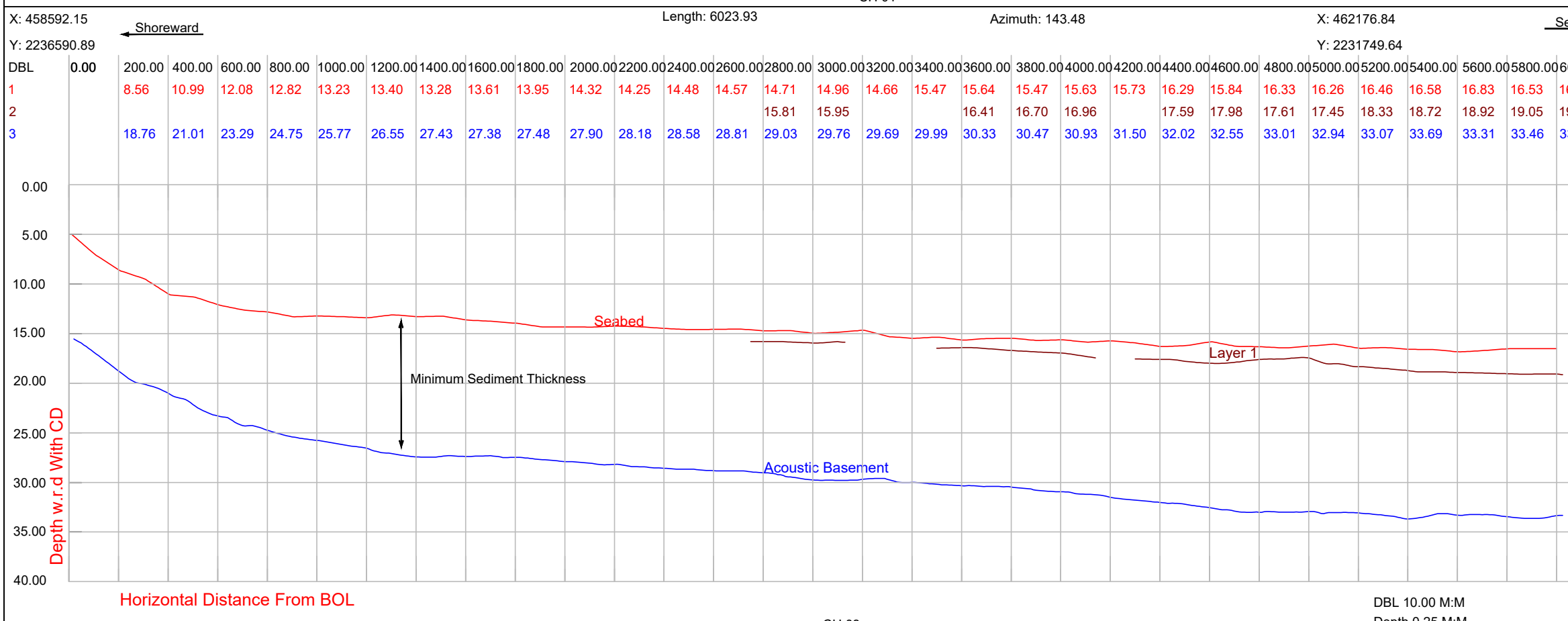
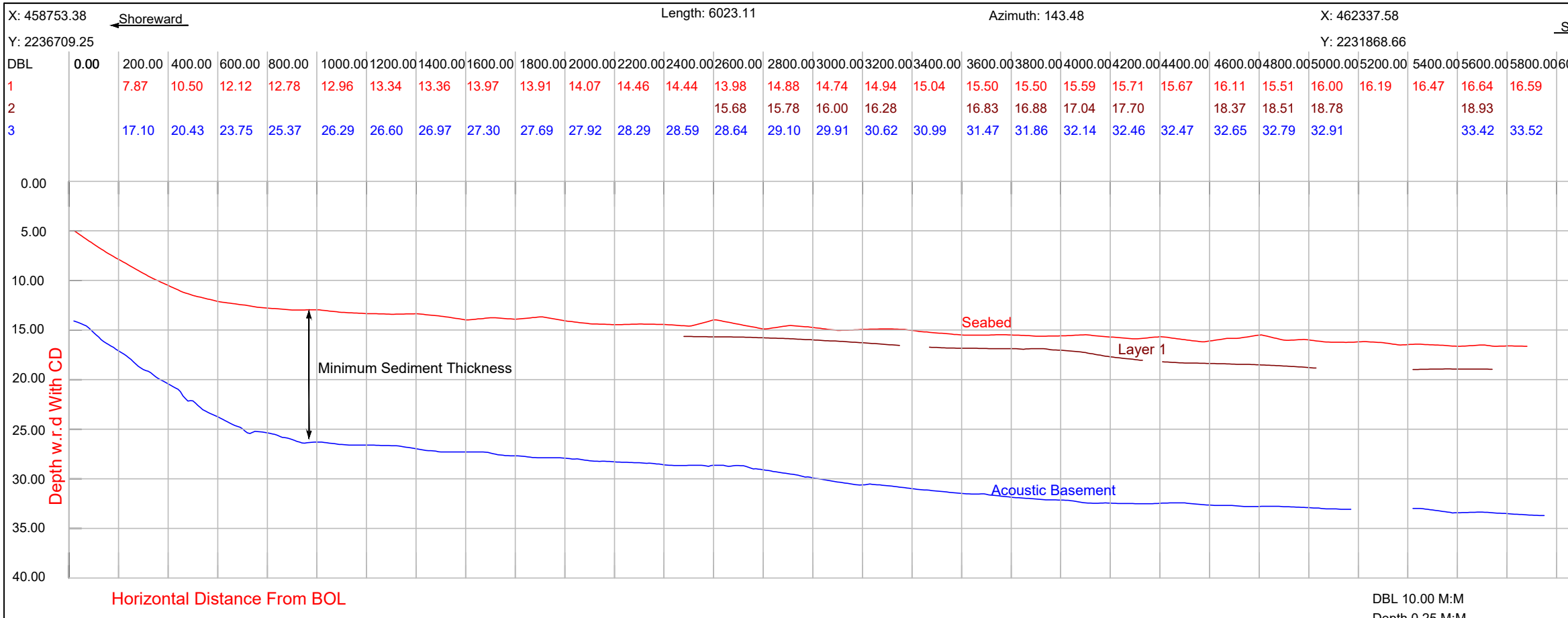


Fig.3. Planned lines for Sub-bottom profiler Survey





CLIENT



PROJECT

SUB-BOTTOM PROFILER SURVEY AT PARADIP

TITLE

CROSS SECTION MAP - PARADIP

CHAINAGE : 01.00 TO 12.00

SURVEYED BY

NISVO MARINE SURVEYS LLP
39, Doctors Colony,
Near IMA, Bharathi Nagar,
Tambaram, Chennai, Tamil Nadu 600045
projects@nisvo.com
www.nisvo.com

SCALE

HOR. 1:10000

VER. 1:250

SEASON

JAN 2024

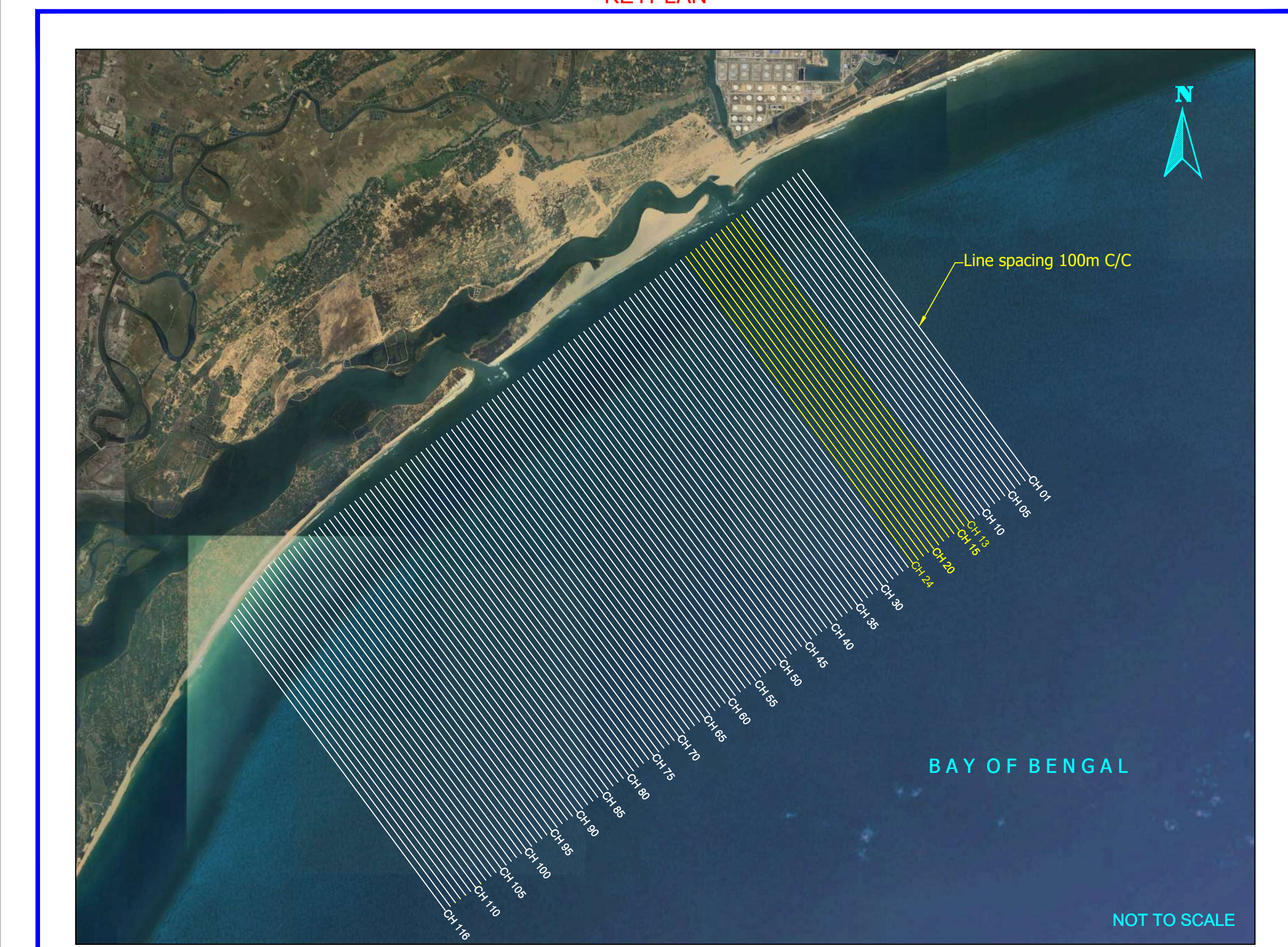
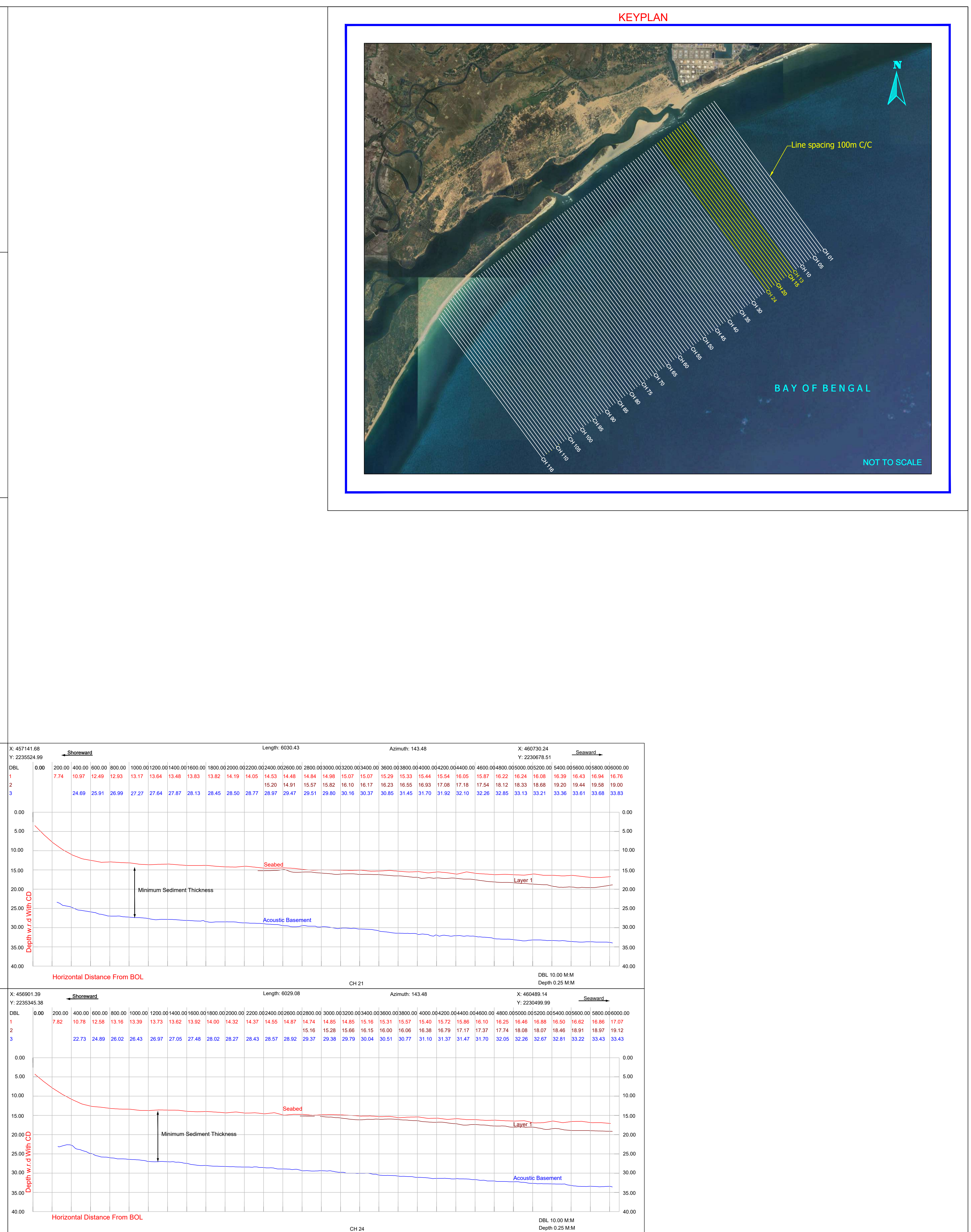
FIG NO.

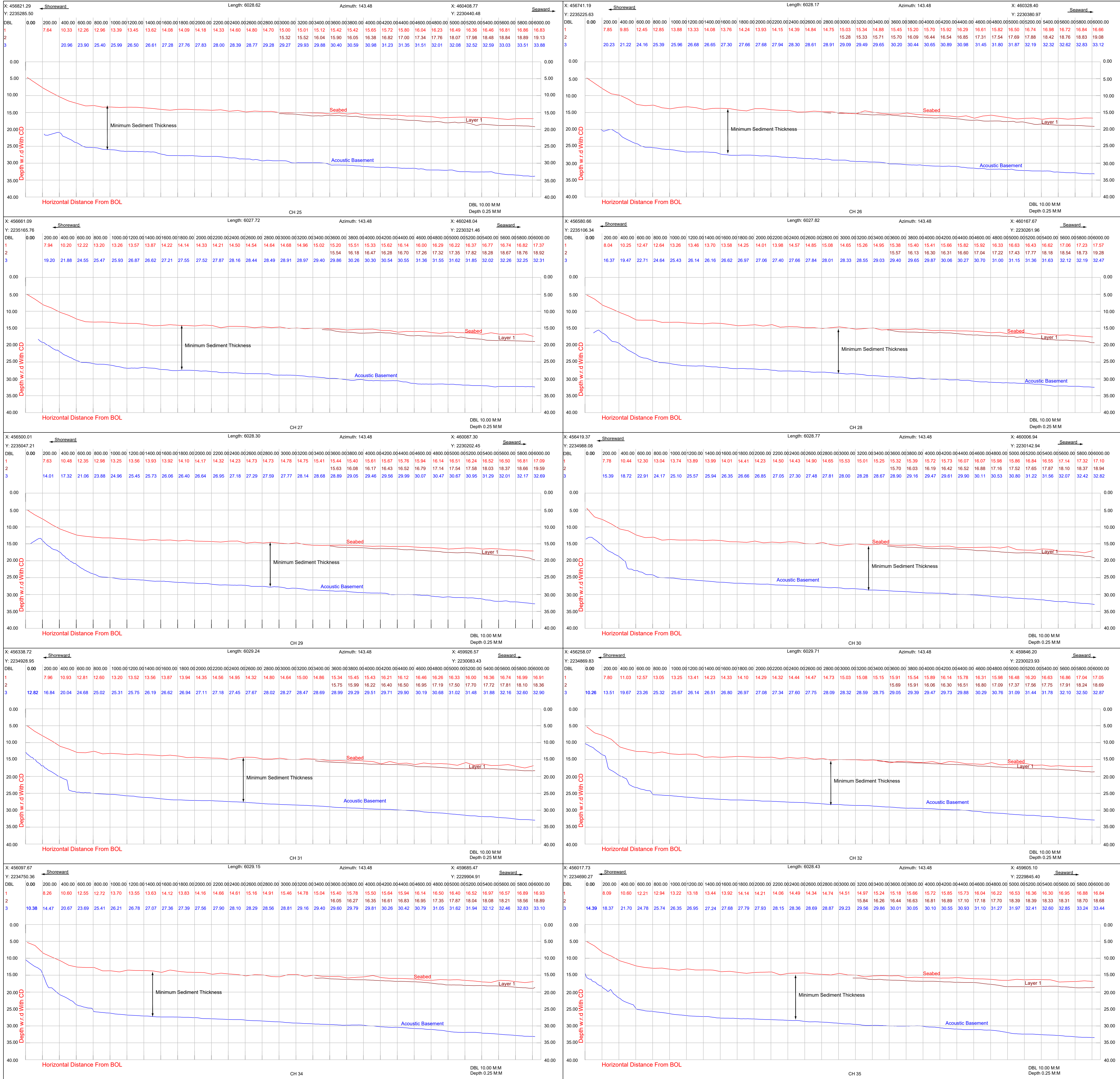
FIG.05

REV.

0

SHEET No. 01 of 10



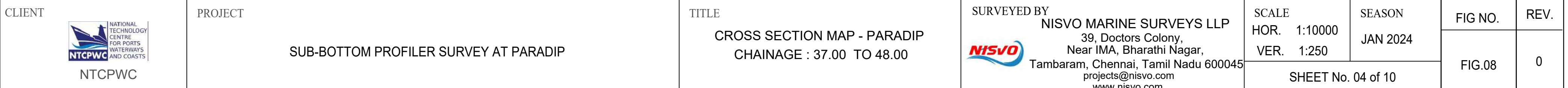


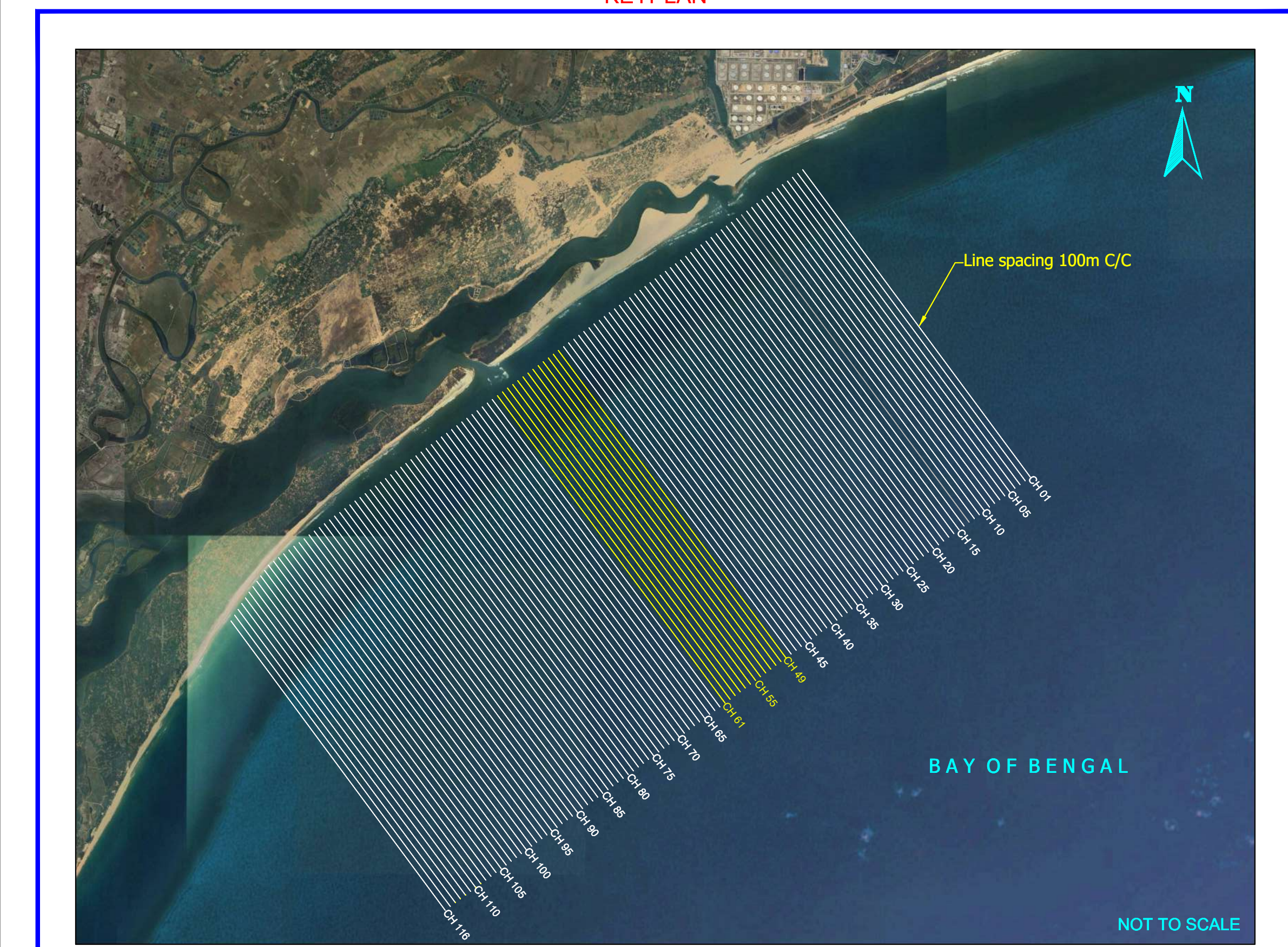
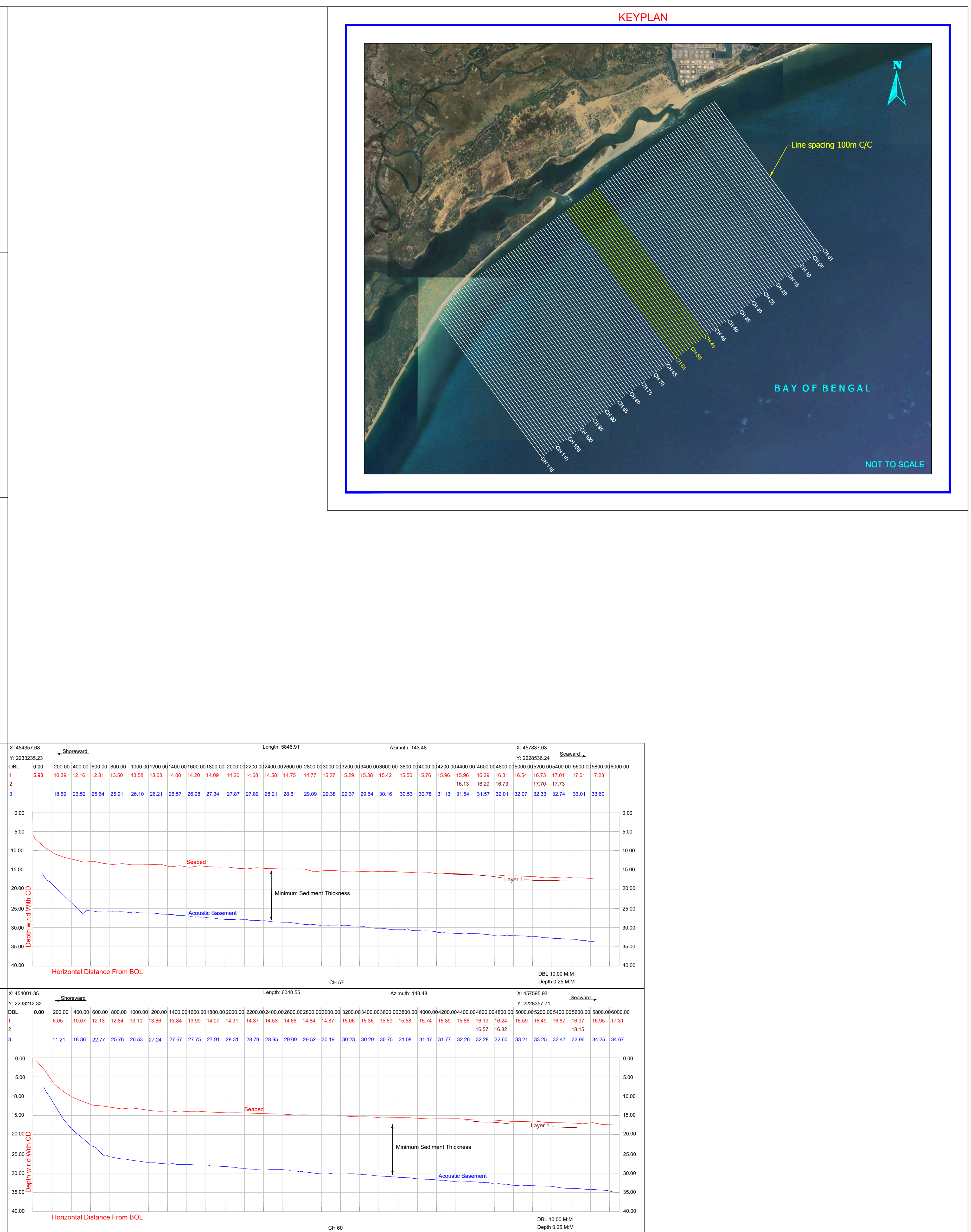
PROJECT
SUB-BOTTOM PROFILER SURVEY AT PARADIP

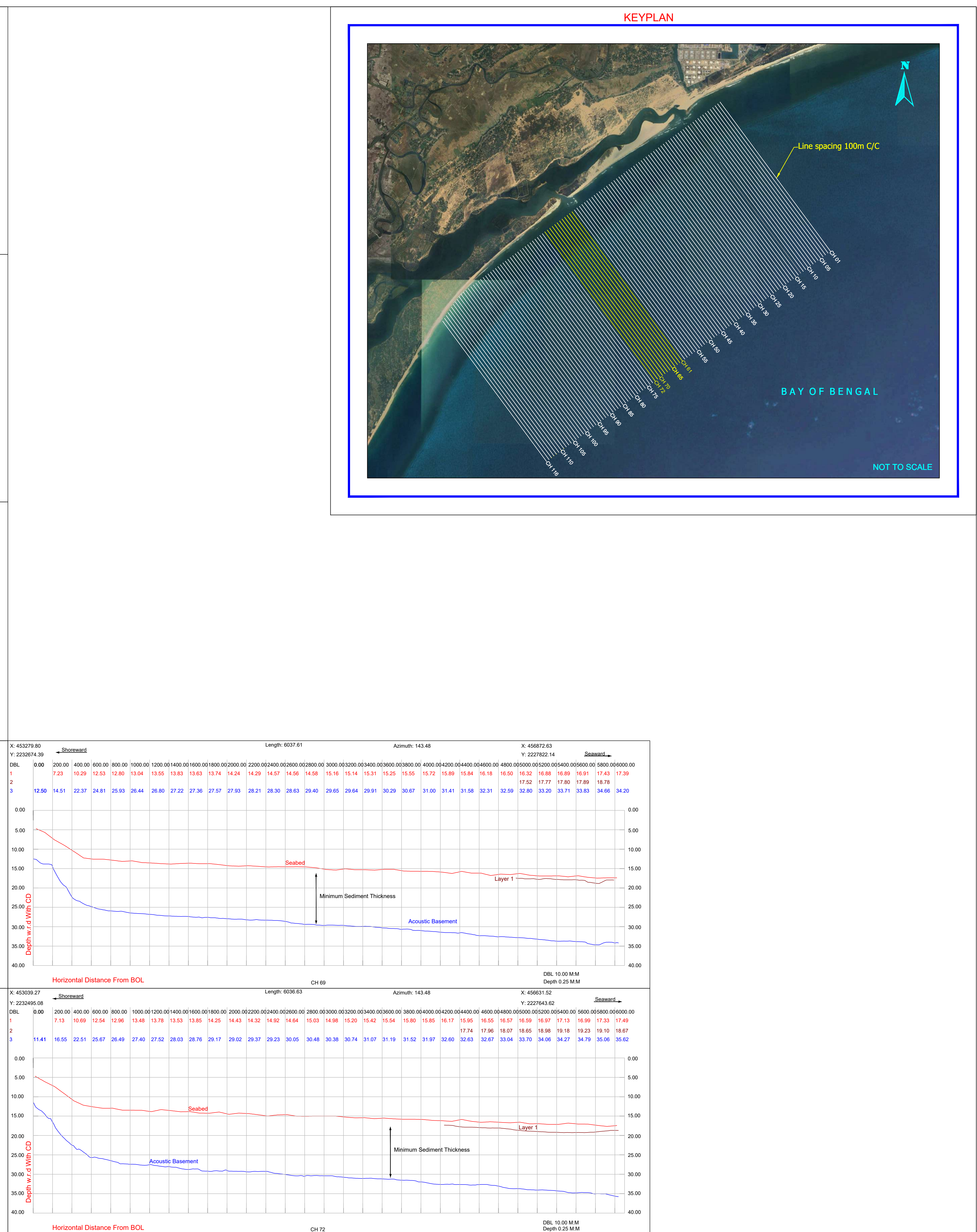
TITLE
CROSS SECTION MAP - PARADIP
CHAINAGE : 25.00 TO 36.00

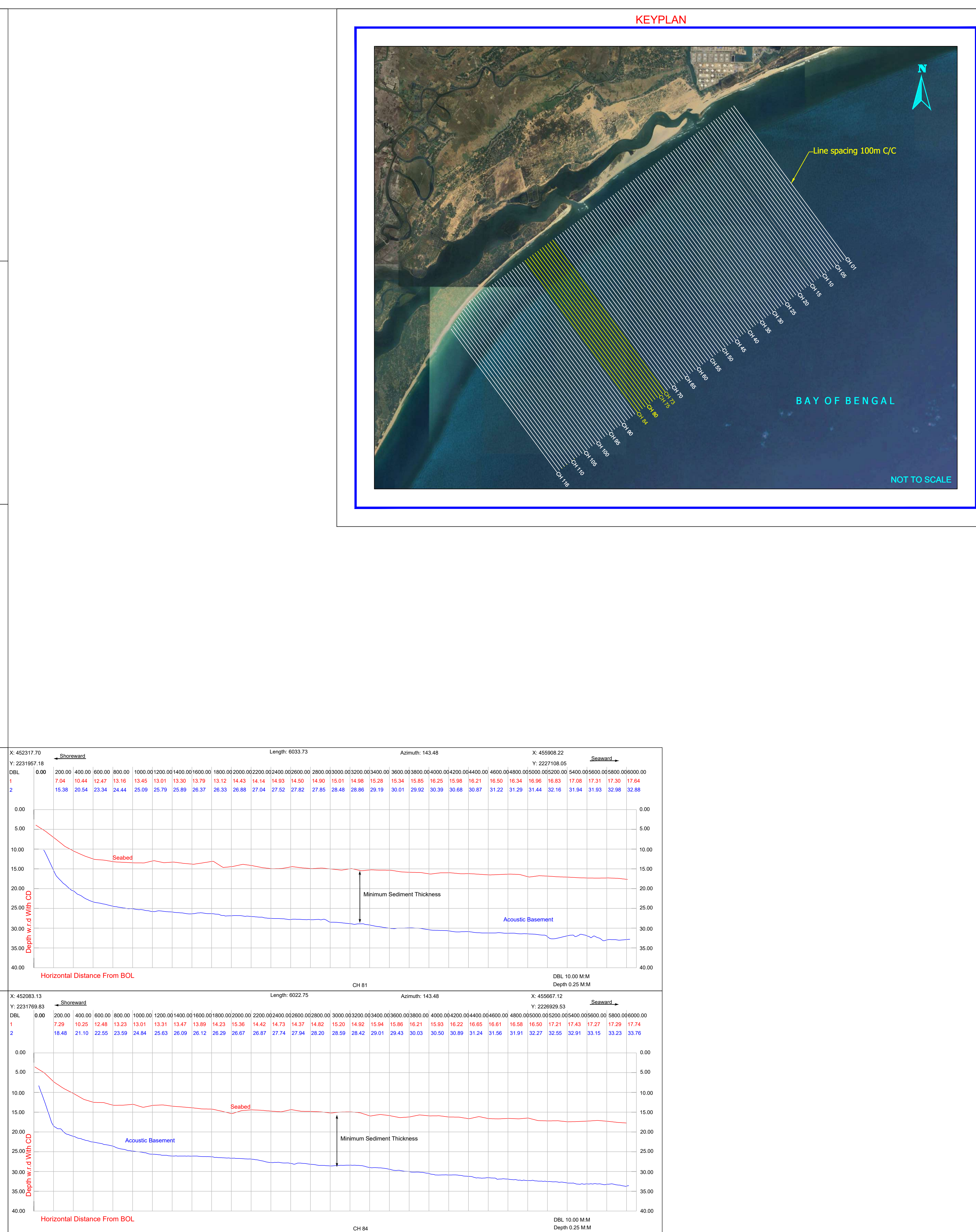
SURVEYED BY
NISVO MARINE SURVEYS LLP
39, Doctors Colony,
Near IMA, Bharathi Nagar,
Tambaram, Chennai, Tamil Nadu 600045
projects@nisvo.com
www.nisvo.com

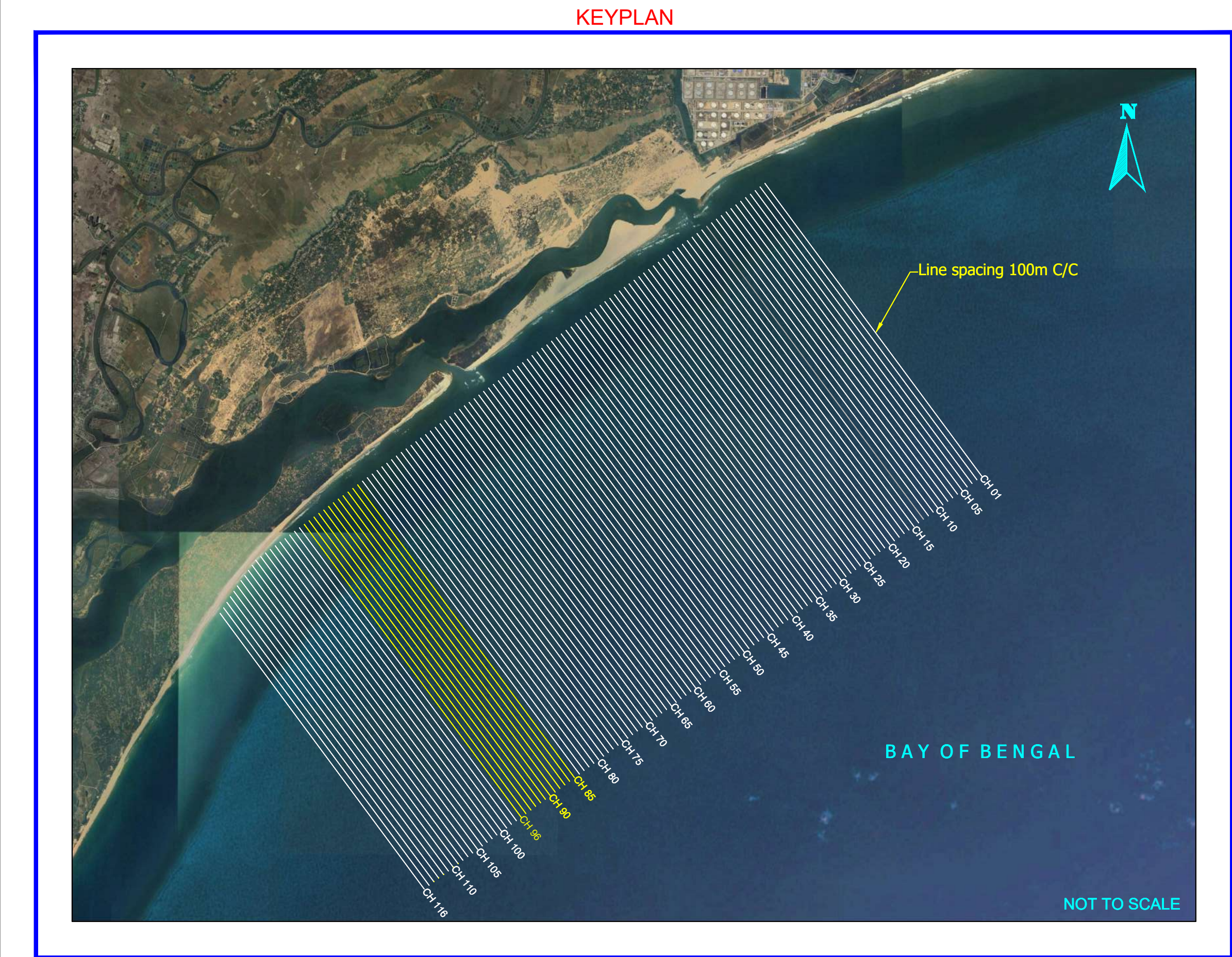
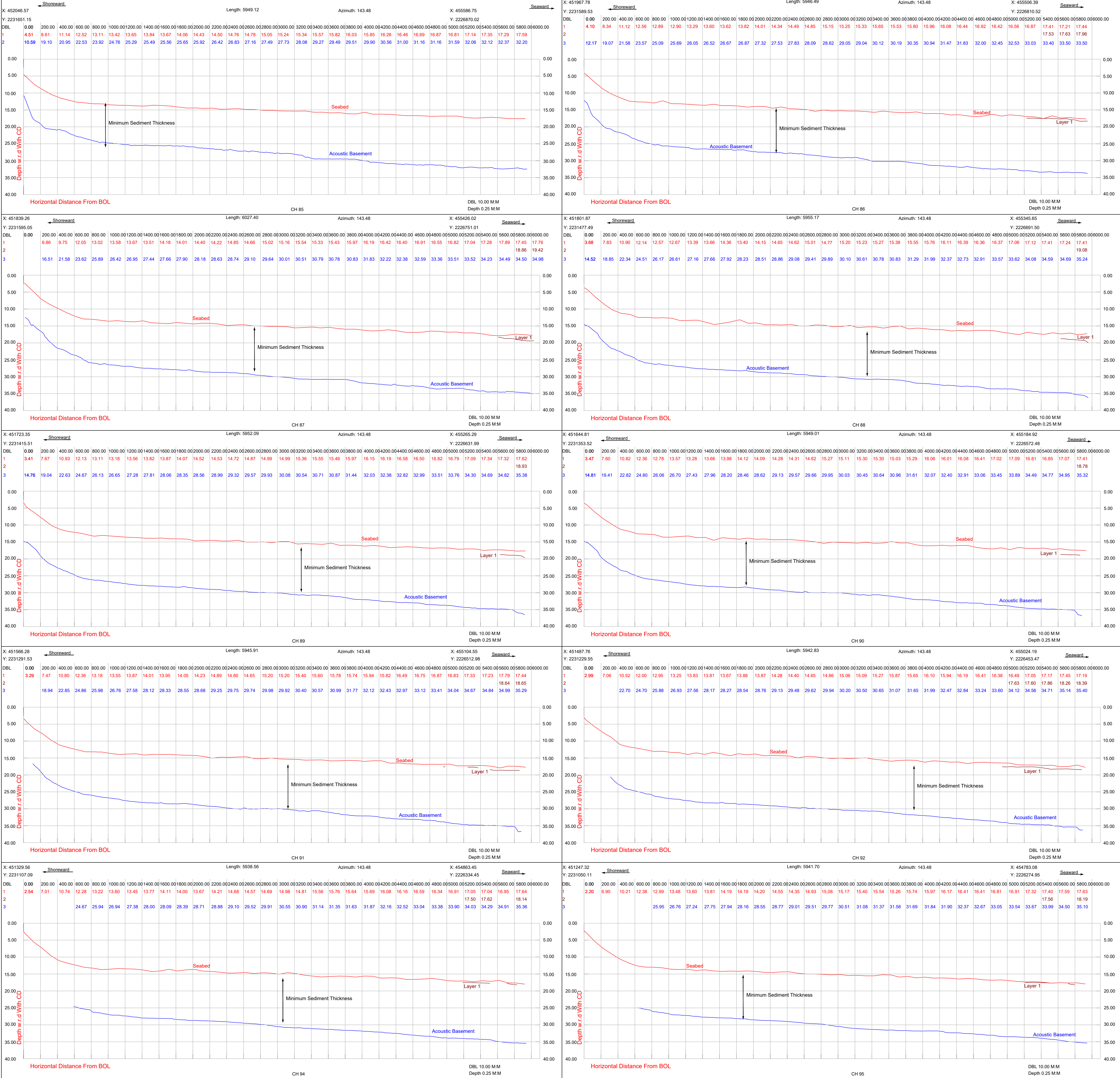
SCALE
HOR. 1:10000
VER. 1:250
SEASON
JAN 2024
FIG NO.
FIG.07
REV.
0



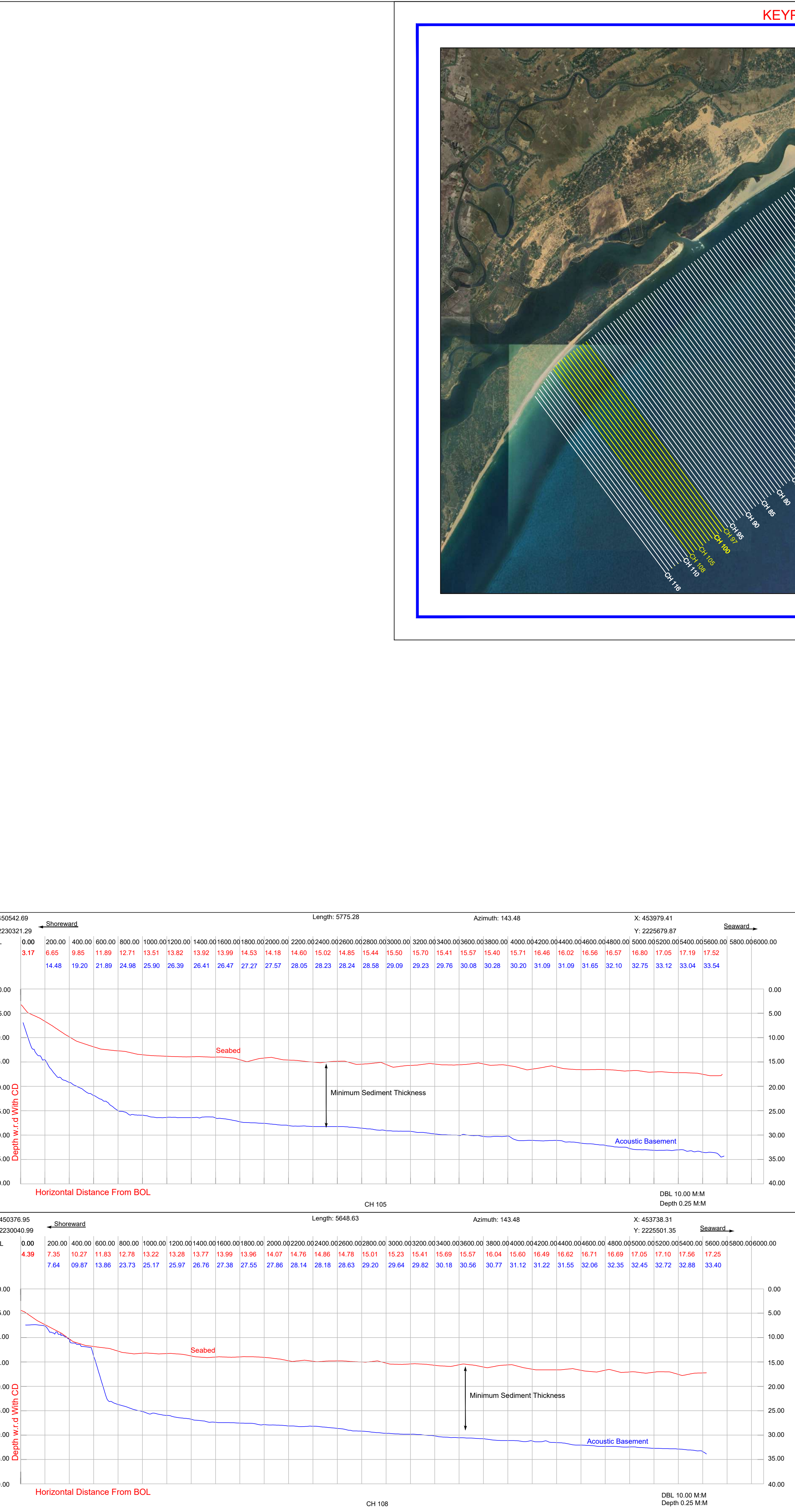
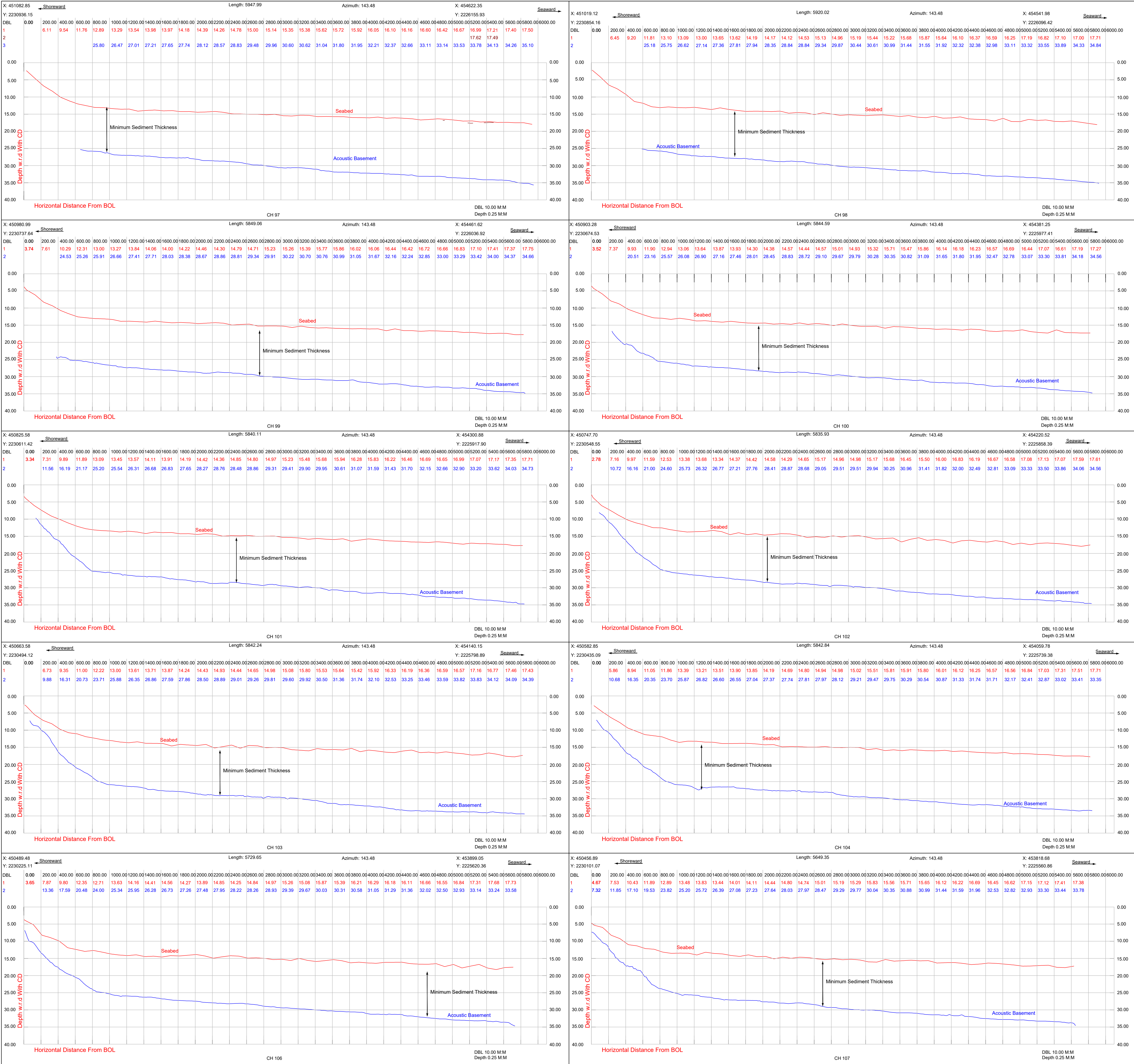








CLIENT  NATIONAL TECHNOLOGICAL PAPERWORK CENTRE FOR MARINE NATURALITIES AND FORESTS NTPCW	PROJECT SUB-BOTTOM PROFILER SURVEY AT PARADIP	TITLE CROSS SECTION MAP - PARADIP CHAINAGE : 85.00 TO 96.00	SURVEYED BY  NISVO MARINE SURVEYS LLP 39, Doctors Colony, Near IMA, Bharathi Nagar, Tambaram, Chennai, Tamil Nadu 600045 projects@nisvo.com www.nisvo.com	SCALE HOR. 1:10000 VER. 1:250	SEASON JAN 2024	FIG NO.	REV.
				SHEET No. 08 of 10		FIG.12	0



CLIENT



PROJECT

SUB-BOTTOM PROFILER SURVEY AT PARADIP

TITLE

CROSS SECTION MAP - PARADIP
CHAINAGE : 97.00 TO 108.00

SURVEYED BY

NISVO MARINE SURVEYS LLP
39, Doctors Colony,
Near IMA, Bharathi Nagar,
Tambaram, Chennai, Tamil Nadu 600045
projects@nisvo.com
www.nisvo.com

SCALE

HOR. 1:10000
VER. 1:250

SEASON

JAN 2024

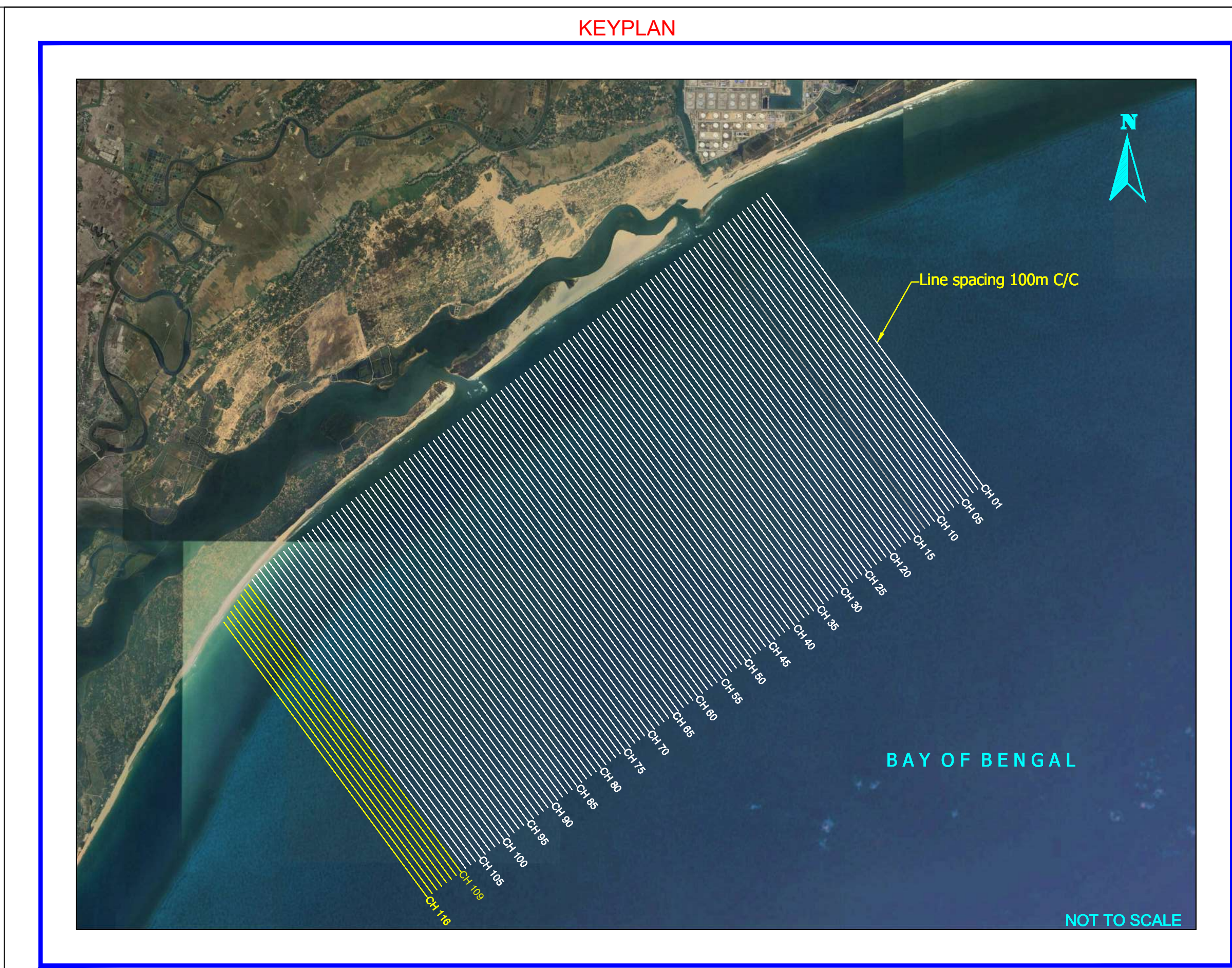
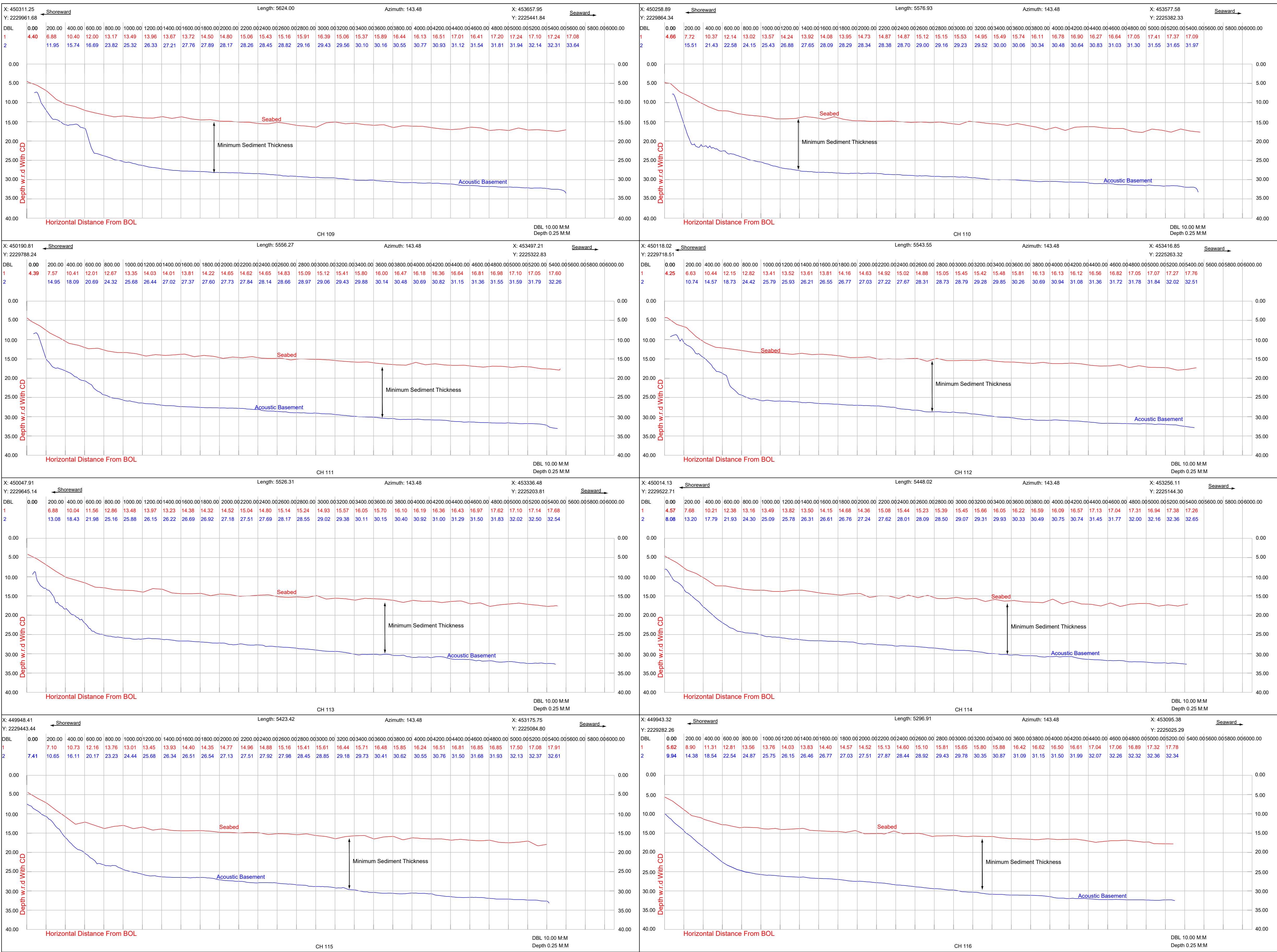
FIG NO.

FIG.13

REV.

0

SHEET No. 09 of 10



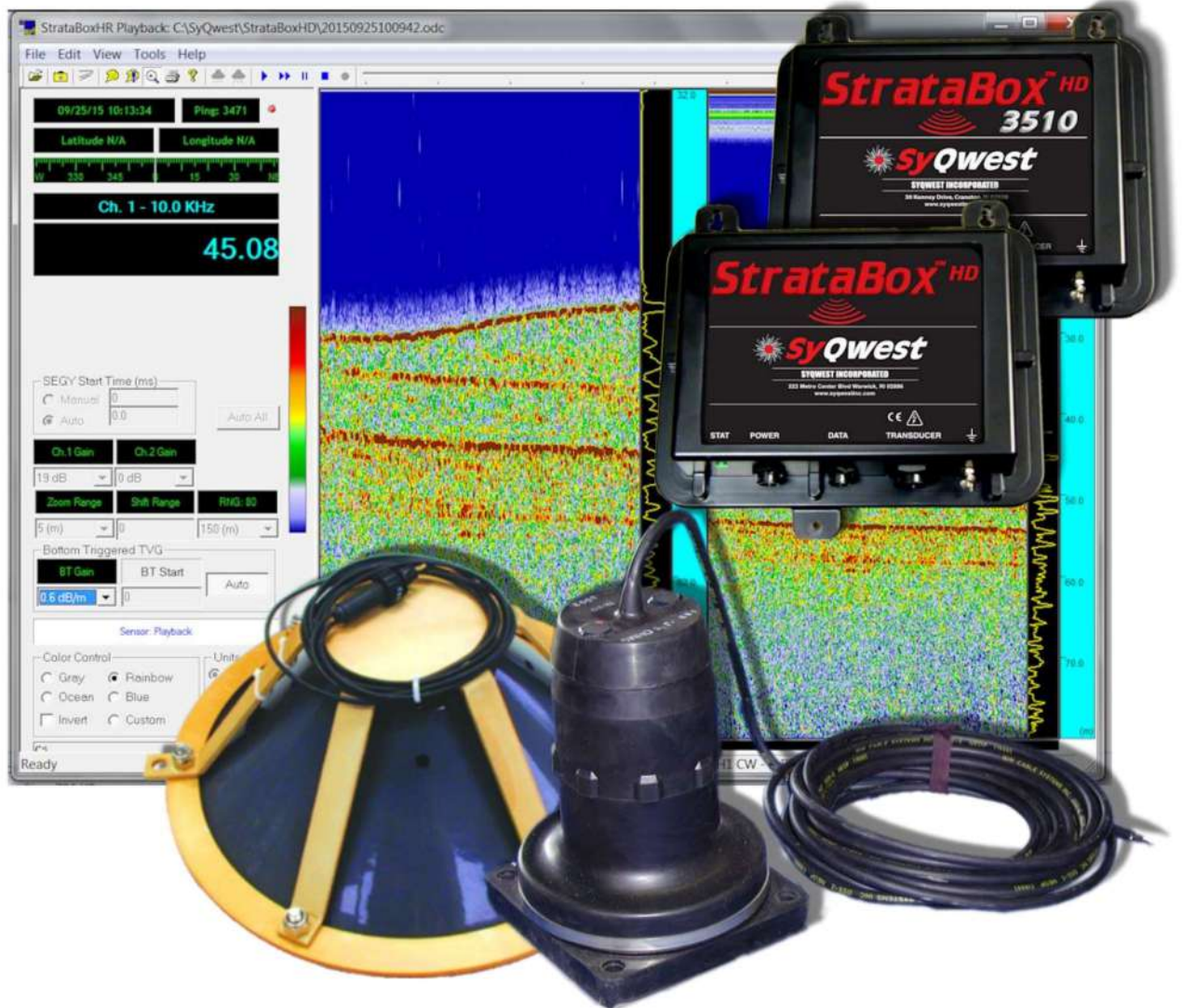
ANNEXURES

ANNEXURE I
(Detailed Specification of Survey Equipment)

SYQWEST INCORPORATED

High Resolution Echo Sounders and Acoustic Systems
For Precision Seafloor Exploration

Stratabox HD™ CHIRP Marine Geophysical Instrument



30 Kenney Drive. * Cranston, Rhode Island 02920

Tel: (401) 432-7129 * FAX: (401) 432-7029

Website <http://www.sygwestinc.com/> Email: <mailto:tech-support@sygwestinc.com>

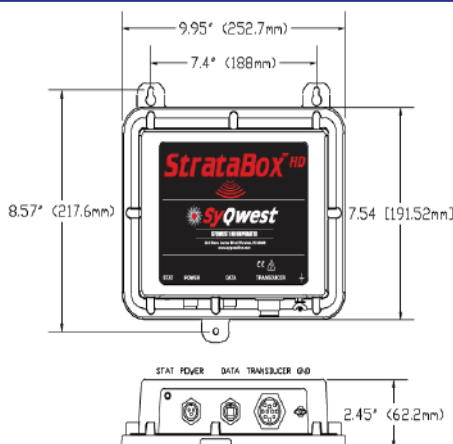
StrataBox HD TM

SPECIFICATIONS

Units:	Feet or Meters
Depth Ranges:	0-15, 30, 60, 120, 240, 450 Feet. 0-5, 10, 20, 40, 80, 150 Meters. Auto-ranging Modes in all units.
Draft Offset:	0 to 30 feet (10 meters)
Manual Gates:	Shallow & Deep, (0.1 ft / 0.1mt resolution)
Shift Range:	1 foot (1meter) increments to bottom of selected range
Zoom Range:	15, 30, 60, 120, 240 feet 5, 10, 20, 40, 80 meters
Zoom Modes:	Bottom Zoom, Bottom Lock, Marker Zoom, Zoom (Playback Only)
Display:	Normal Data, Zoom Data, Selectable Color Palette
Depth Resolution:	0.1 feet (0.1 meters)
Depth Accuracy:	+/-0.5% of depth
Sound Velocity:	4600 - 5250 ft/sec (1400 - 1600 mt/sec) 1 mt/sec int.
Navigation Input:	NMEA 0183, GLL, GGA, RMC, VTG, VHW, HDT. Selectable Baud Rate, RS-232 .
Data Output:	NMEA 0183; DPT, DBT, PMC; ODEC
StrataBox I/F:	Ethernet via RJ-45
Printer Output:	(Parallel Port) interface to Thermal Printers
Heave Input:	TSS1 Format, 9600 Baud Rate
Shallow Water Operation:	<2.5 meters; bottom type dependent
Transmit Rate:	Up to 10 Hz, depth and operator mode dependent.
Eventing:	Manual, Periodic, External (user selectable)
Frequency Output:	10 Khz (standard) 3.5Khz (*optional)
Data File Storage:	External- ODEC Format(8 bit, 800 pixel), SEG-Y Format envelope (16 bit, 96kHz rate), Internal-32 GB SD Flash.
Data File Playback:	Files played back and printed at Normal, Rapid Advance ,or Scroll Bar, with Pause and Zoom
Transmit Output Power:	300 Watts (pulsed), 1000 Watts capable
Input Power:	10-30 Volts DC, Nominal Power 12 watts, Reverse Polarity and Over Voltage Protected.
Dimensions:	25.4 cm (10") Length, 15.876 cm (6.25") Width, and 6.25 cm (2.5") Height. (sensor unit only)
Weight:	1.1 kg (2.4 lbs). (sensor unit only)
Environmental:	25°C to +60°C Operating Temperature (-55°C to +90°C Storage) Water Resistant to EN60529 IP65 EMC meets EN60945 Emissions, CE Compliant

Options:

- Over The Side Mount Kit
- 3.5Khz Operation
- Deep Water transducer
- TDU-850 Thermal Printer
- TDU-1200 Thermal Printer
- SonarWiz
- Hypack
- Triton SB Logger



SyQwest inc

30 Kenney Drive / Cranston, RI 02920

Tel: (401) 432-7129 Fax: (401) 432-7029

Email: sales@syqwestinc.com Web: www.syqwestinc.com

ver 0417

Specifications

Trimble SPS351 Modular GPS Receiver



Receiver Name	SPS351 DGPS/Beacon Receiver
Configuration Option	
Type	Modular
Base and rover interchangeability	Yes
Base operation	SPS351 with DGPS RS option
Rover operation	Yes
Heading and Moving Base operation	N/A
Rover position update rate	1 Hz, 2 Hz, 5 Hz, 10 Hz
Rover maximum range from base	Unlimited
Rover operation within a VRS™ network	RTCM DGPS only
Factory options	DGPS Reference Station
General	
Keyboard and display	VFD display 16 characters by 2 rows On/Off key for one-button startup Escape and Enter keys for menu navigation 4 arrow keys (up, down, left, right) for option scrolls and data entry
Dimensions (L x W x D)	24 cm (9.4 in) x 12 cm (4.7 in) x 5 cm (1.9 in) including connectors
Weight	1.31 kg (2.9 lb) receiver only
Antenna Options	
GA510	L1 GPS, SBAS
GA530	L1 GPS, MSK Beacon, SBAS (included in SPS351 kit)
GA810	L1 GPS, SBAS
L1/Beacon, DSM 232	Not supported
Zephyr™ Model 2	
Zephyr Geodetic™ Model 2	
Zephyr Model 2 Rugged	
Temperature	
Operating	–40 °C to +65 °C (–40 °F to +149 °F) ¹
Storage	–40 °C to +80 °C (–40 °F to +176 °F)
Humidity	MIL-STD 810F, Method 507.4
Waterproof	IP67 for submersion to depth of 1 m (3.3 ft), dustproof
Shock and Vibration	
Pole Drop	Designed to survive a 1 m (3.3 ft) drop onto a hard surface
Shock – Non-operating	To 75 g, 6 ms, saw-tooth
Shock – Operating	To 40 g, 10 ms, saw-tooth
Vibration	Tested to Trimble Survey profile (2.6 g RMS): 5 Hz–350 Hz: 0.15 g/Hz ² 350 Hz to 500 Hz; –6 dB/octave

Specifications

Trimble SPS351 Modular GPS Receiver

Measurements

Advanced Trimble Maxwell™ 5 Custom GPS chip
L1 signal-to-noise ratios reported in dB-Hz

Proven Trimble low elevation tracking technology

12-channel L1 C/A code

EVEREST™ multipath signal rejection
2-channel MSK Beacon
2-channel SBAS (WAAS/EGNOS/MSAS)

Code Differential GPS Positioning²

Correction type	DGPS RTCM 2.x
Correction source	Internal MSK Beacon, DGPS Base via external radio or Internet
Horizontal accuracy	$\pm(0.25\text{m} + 1 \text{ ppm})$ RMS $\pm(0.8 \text{ ft} + 1 \text{ ppm})$
Vertical accuracy	$\pm(0.50\text{m} + 1 \text{ ppm})$ RMS $\pm(1.6 \text{ ft} + 1 \text{ ppm})$

SBAS (WAAS/EGNOS/MSAS) Positioning³

Horizontal accuracy	Typically <1 m (3.3 ft)
Vertical accuracy	Typically <5 m (16.4 ft)

OmniSTAR Positioning

VBS service accuracy	N/A
XP service accuracy	N/A
HP service accuracy	N/A

Location RTK Positioning²

Horizontal accuracy	N/A
Vertical accuracy	N/A

Precise Heading²

Heading accuracy	N/A
2 m antenna separation	
10 m antenna separation	

Power

Internal	N/A
----------	-----

External

Power input on 7-pin 0-shell Lemo connector is optimized for lead acid batteries with a cut-off threshold of 11 V DC

Power input on the 26-pin D-sub connector is optimized for Trimble lithium-ion battery input (P/N 49400) with a cut-off threshold of 10.5 V
11 V DC to 28 V DC external power input with over-voltage protection

Receiver will automatically turn on when connected to external power

Power over Ethernet (PoE)	N/A
---------------------------	-----

Power consumption	4.5 W at 18 V, in rover mode
-------------------	------------------------------

Operation Time on Internal Battery

Rover	N/A
-------	-----



Specifications

Trimble SPS351 Modular GPS Receiver

Base station
450 MHz systems
900 MHz system

N/A

Regulatory Approvals

FCC: Part 15 Subpart B (Class B Device) and Subpart C
Canadian ICES-003. Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.
Canadian RSS-310, RSS-210, and RSS-119.
Cet appareil est conforme à la norme CNR-310, CNR-210, et CNR-119 du Canada.

R&TTE Directive: EN 301 489-3/-17, EN 300 440, EN 300 328, EN 60950, EN 300 330,
ACMA: AS/NZS 4771 approval
CE mark compliance
C-tick mark compliance
Japanese MIC type certification
RoHS compliant
WEEE compliant

Communications

Lemo (Serial)
Modem 1 (Serial)
Modem 2 (Serial)
1PPS (1 pulse-per-second)
Ethernet
Bluetooth wireless technology
Integrated radios (optional)

7-pin 0S Lemo, Serial 1, 3-wire RS-232
26 pin D-sub, Serial 2, Full 9-wire RS-232
26 pin D-sub, Serial 3, 3-wire RS-232
Available using cable (60789-00)
Using multi-port adaptor

Fully-integrated, fully-sealed 2.4 GHz Bluetooth module⁴

Channel spacing (450 MHz)
450 MHz output power
900 MHz output power
Frequency approvals (900 MHz)

External GSM/GPRS, cell phone support

Supported for Trimble IBSS and VRS services – directly using the dip on SNM910 or using the SCS900 software on device with an internet connection

Internal MSK Beacon receiver

Frequency range 283.5–325.0 kHz
Channel spacing 500 Hz
MSK bit rate 50, 100, and 200 bps
Demodulation minimum shift key (MSK)

Supported data formats
Correction Inputs
Correction Outputs

CMR™, CMR+™, CMRx, CMRx, RTCM 2.x
DGPS RTCM 2.x (requires DGPS RS option)

Data Outputs

NMEA, GSOFF, 1PPS Time Tags

Receiver Upgrades

DGPS Reference Station

Notes

1 Receiver will operate normally to –40 °C.



Specifications

Trimble SPS351 Modular GPS Receiver

2 Accuracy and reliability may be subject to anomalies such as multipath, obstructions, satellite geometry, and atmospheric conditions. Always follow recommended practices.

3 Depends on SBAS system performance.

4 Bluetooth type approvals are country-specific. For more information, contact your local Trimble office or representative.

Specifications subject to change without notice.

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+1-937-245-5154 Phone
+1-937-233-9441 Fax
www.trimble.com

Trimble Authorized Distribution Partner



ANNEXURE II

(The typical sub-bottom profiling plates)

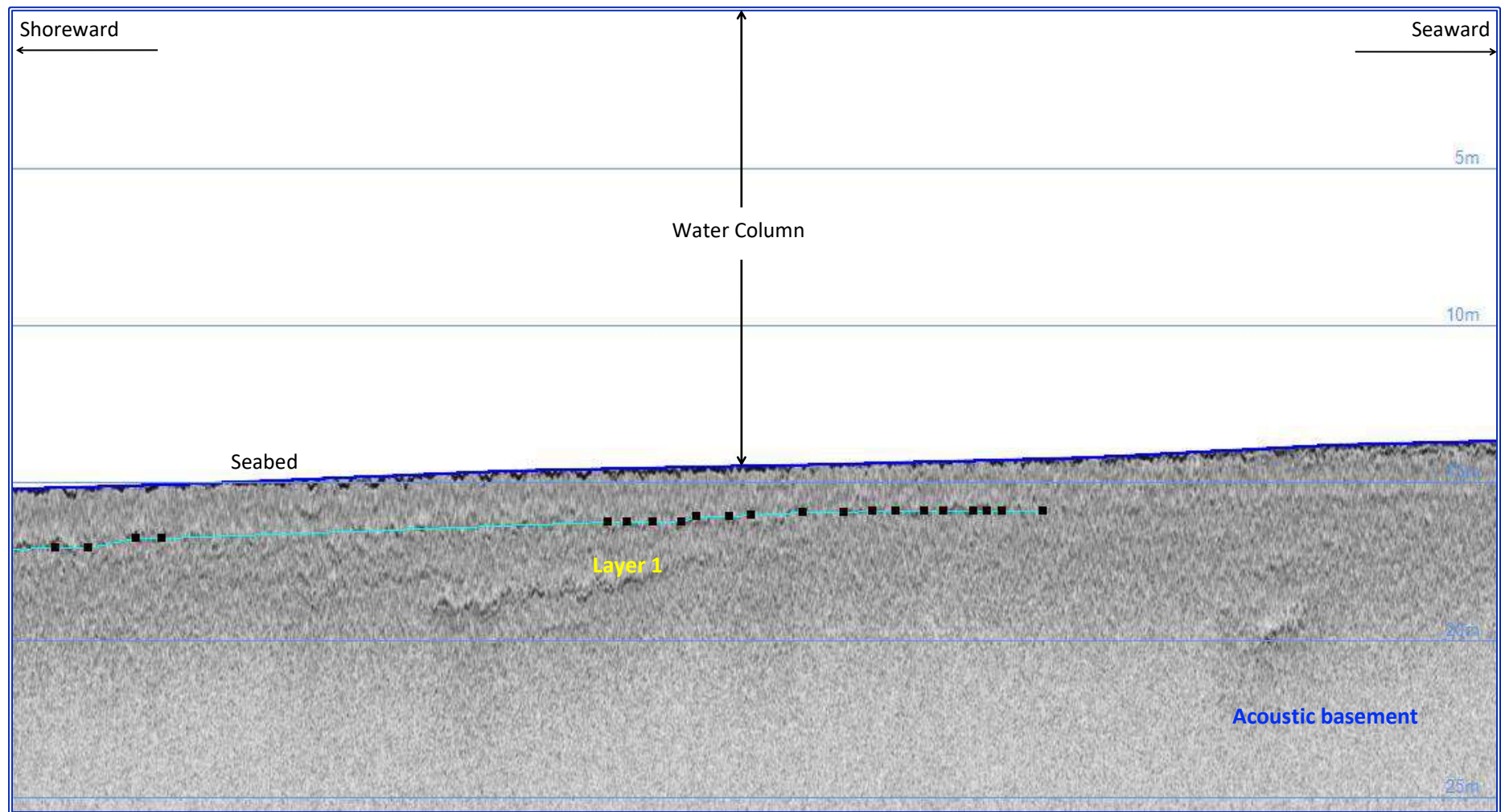


Plate No: 01 - Typical Sub-bottom Profile Record Showing Vertical Sub-tracta Along Line No 07

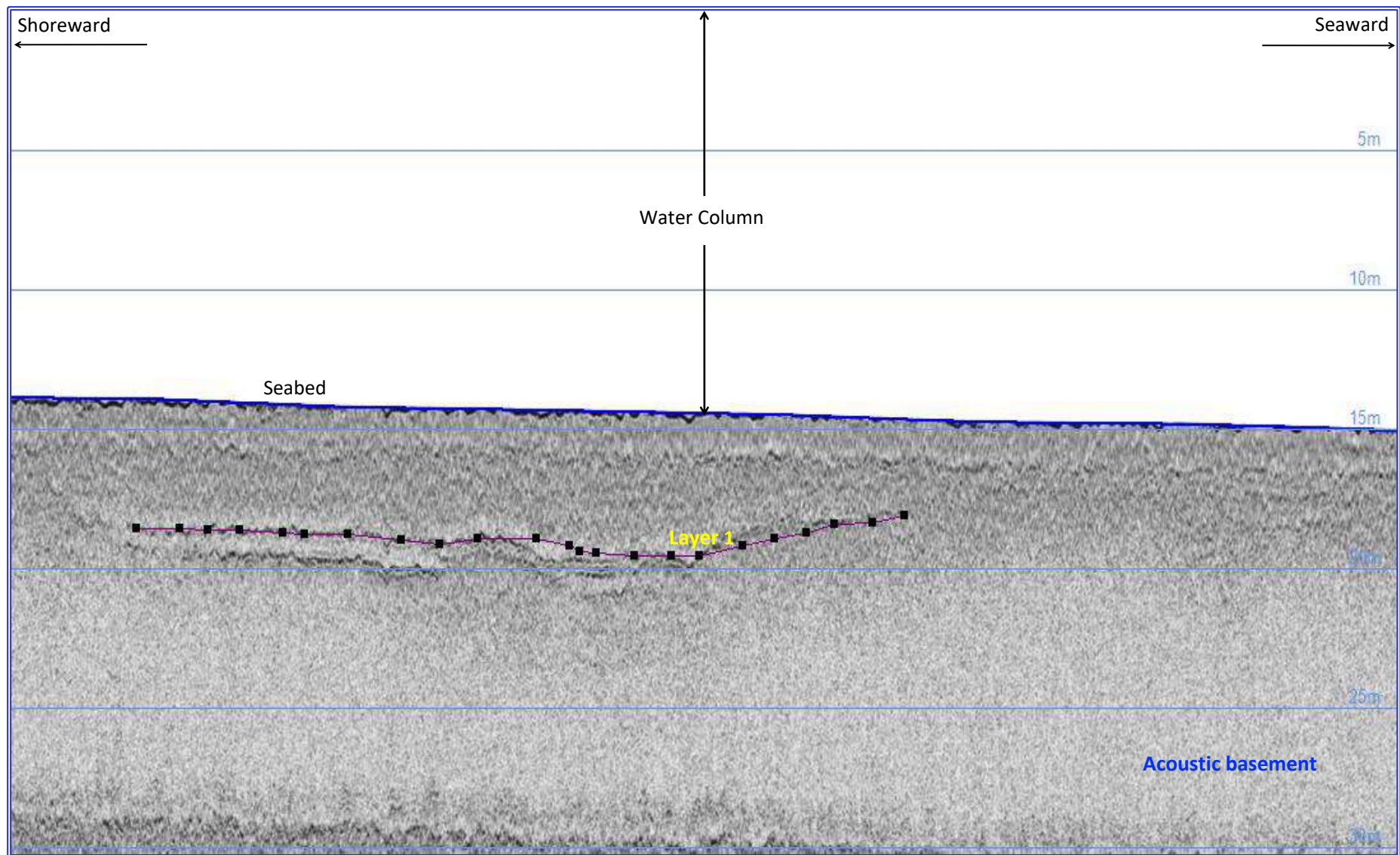


Plate No: 02 - Typical Sub-bottom Profile Record Showing Vertical Sub-tracta Along Line No 25

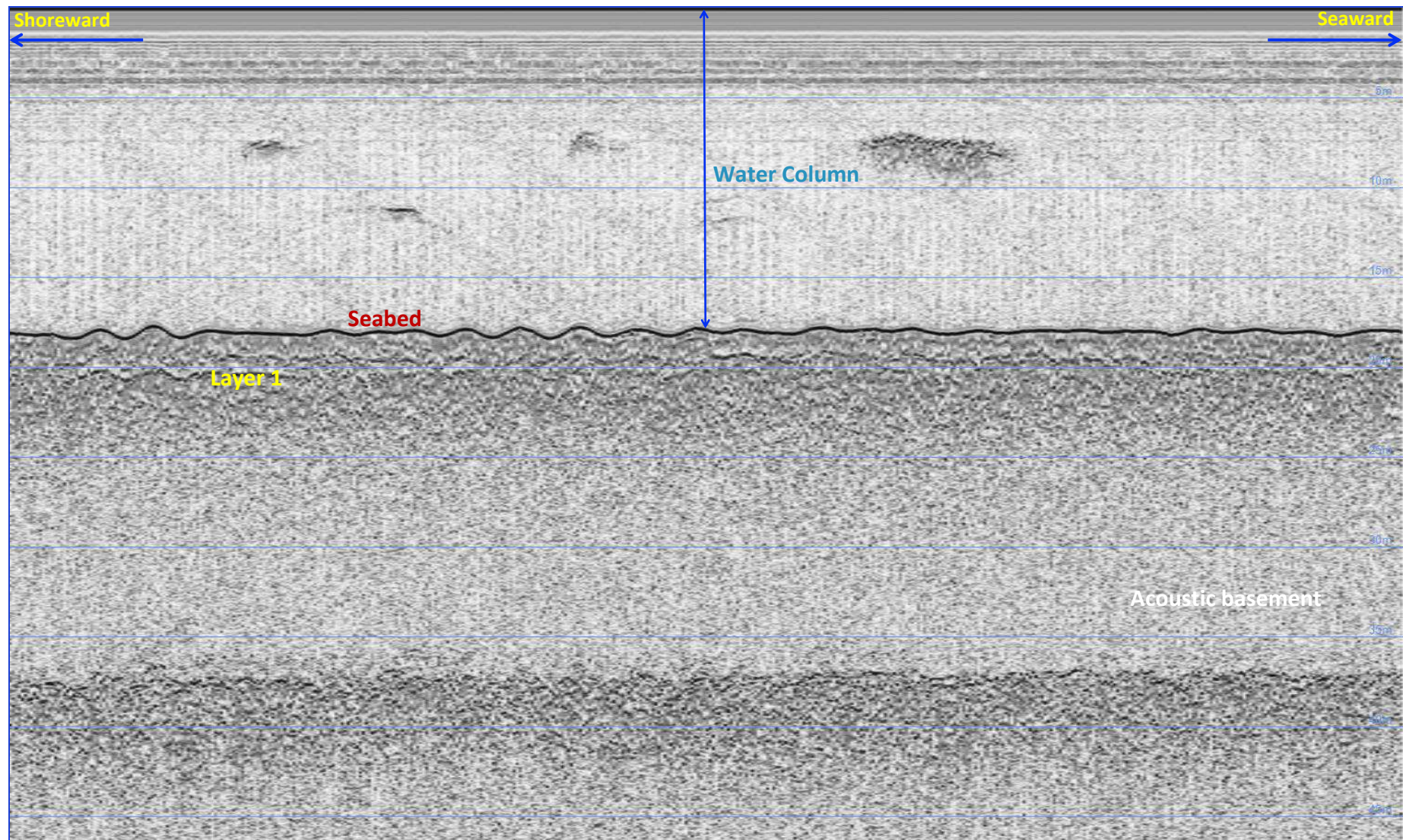


Plate No: 03 - Typical Sub-bottom Profile Record Showing Vertical Sub-straata Along Line No 58

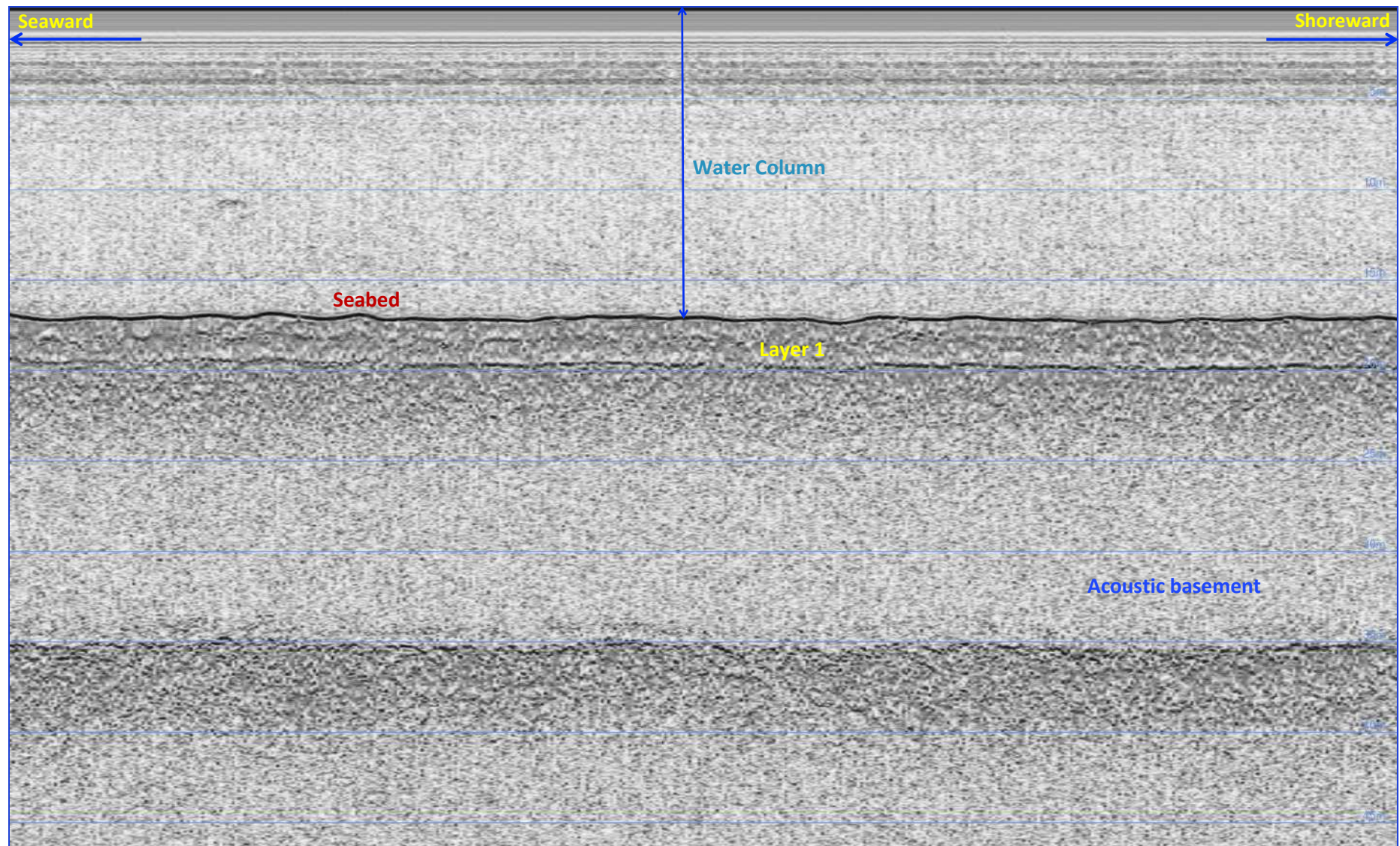
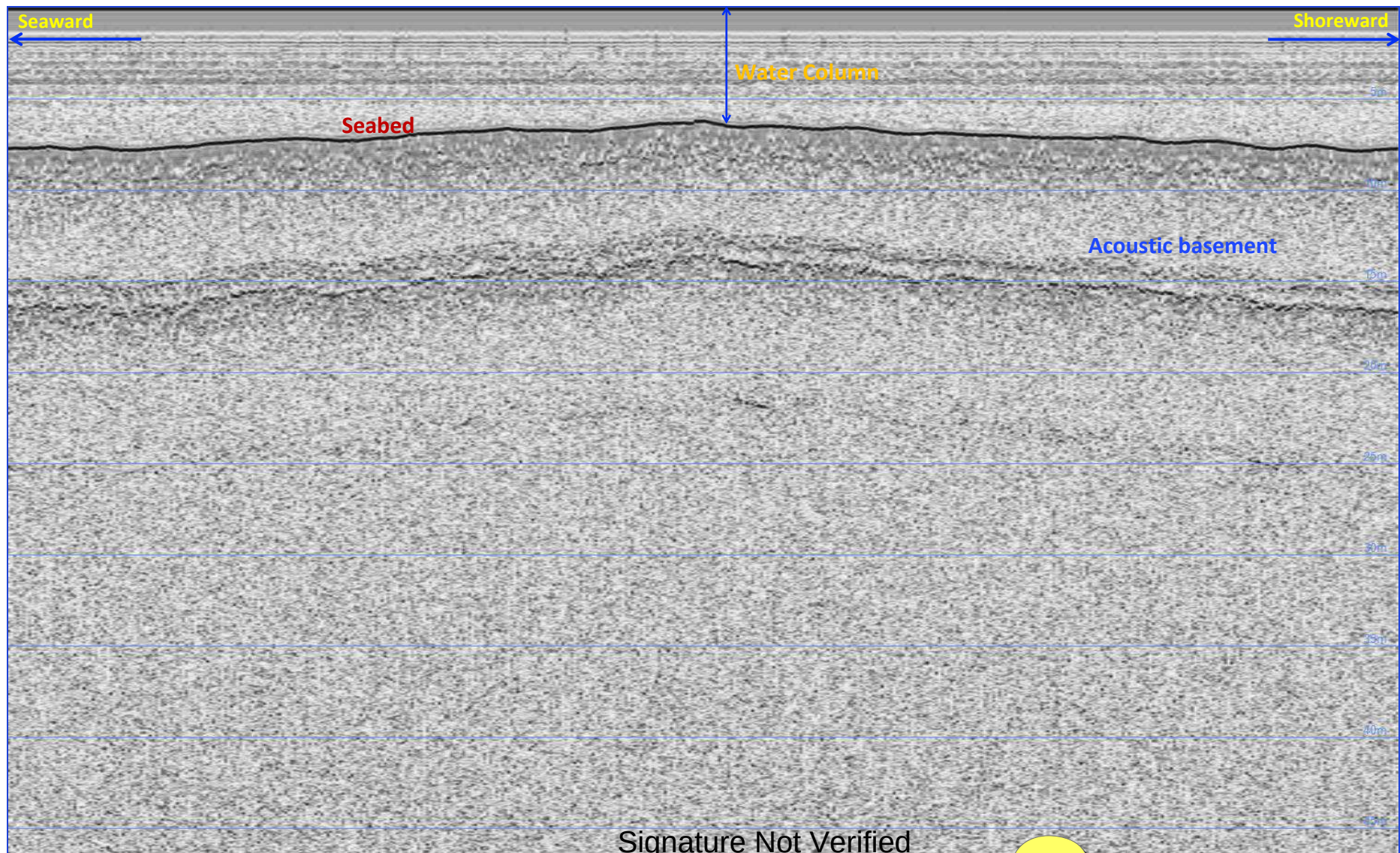


Plate No: 04 - Typical Sub-bottom Profile Record Showing Vertical Sub-structa Along Line No 93



Signature Not Verified

Plate No: 05 - Typical Sub-bottom Profile Record Showing Vertical Sub-structure Along Line No 107
Digitally signed by Sasunali Vishweswara P. Alad
Date: 2026.04.01 13:50:04 IST
Location: eProcure-EPROC

