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Centre for Technology Excellence SARAWAK

HYDROGRAPHIC SURVEY

Hydrographic Field Practical

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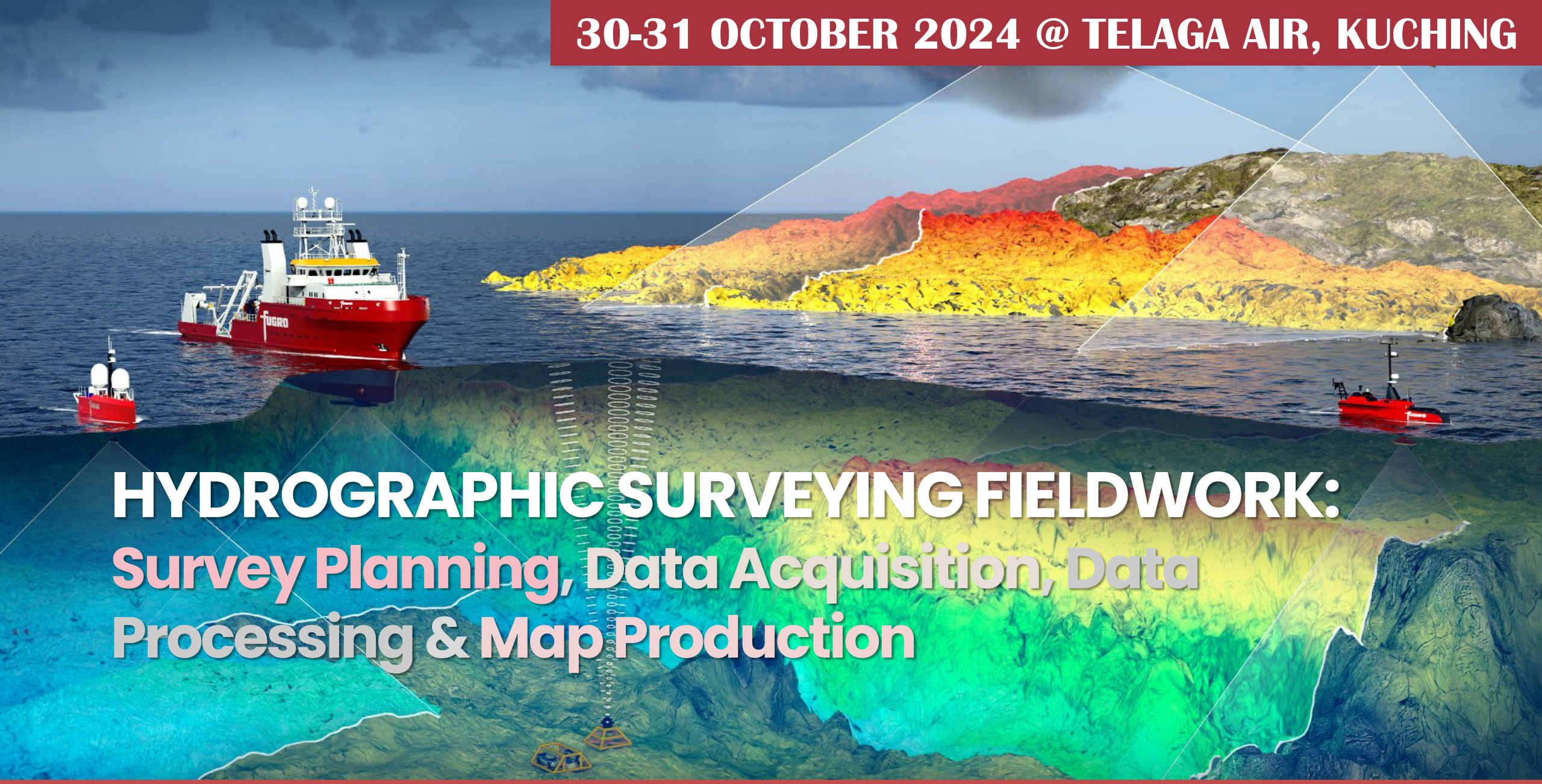
UNIVERSITI TEKNOLOGI MALAYSIA

INNOVATING SOLUTIONS

KUCHING, SARAWAK

30-31 OCTOBER 2024 @ TELAGA AIR, KUCHING



HYDROGRAPHIC SURVEYING FIELDWORK:

Survey Planning, Data Acquisition, Data Processing & Map Production

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Programme Educational Objectives

The aim of this lecture is to produce graduate that is knowledgeable and skillful in the conducting basic hydrographic surveying fieldwork: Planning, Data Gathering, Processing and Analysis.

Programme Learning Outcomes

- Ability to acquire knowledge of science and technology in the field of Hydrographic Surveying
- Ability to plan and execute hydrographic tasks systematically.
- Ability to lead, coordinate and manage hydrographic project professionally.
- Ability to process the collected data to feed the production of the nautical charts or other thematic maps.
- Ability to apply and analyze information using appropriate hydrographic surveying techniques and tools

Hydrography

Hydrography is the branch of applied sciences which deals with the measurement and description of the physical features of oceans, seas, coastal areas, lakes and rivers, as well as with the prediction of their change over time, for the primary purpose of safety of navigation and in support of all other marine activities, including economic development, security and defense, scientific research, and environmental protection. *(14 September 2011, www.iho.int)*

What is Hydrographic Science??

Why Hydrography is Important?

What would be the economic implications if there were no hydrographic services?

Hydrography is the total set of spatial data and information, and the applied science of its acquisition, maintaining and processing, necessary to describe the topographical, physical and dynamical nature of the hydrosphere and its borders to the solid earth, and the associated facilities and structures.

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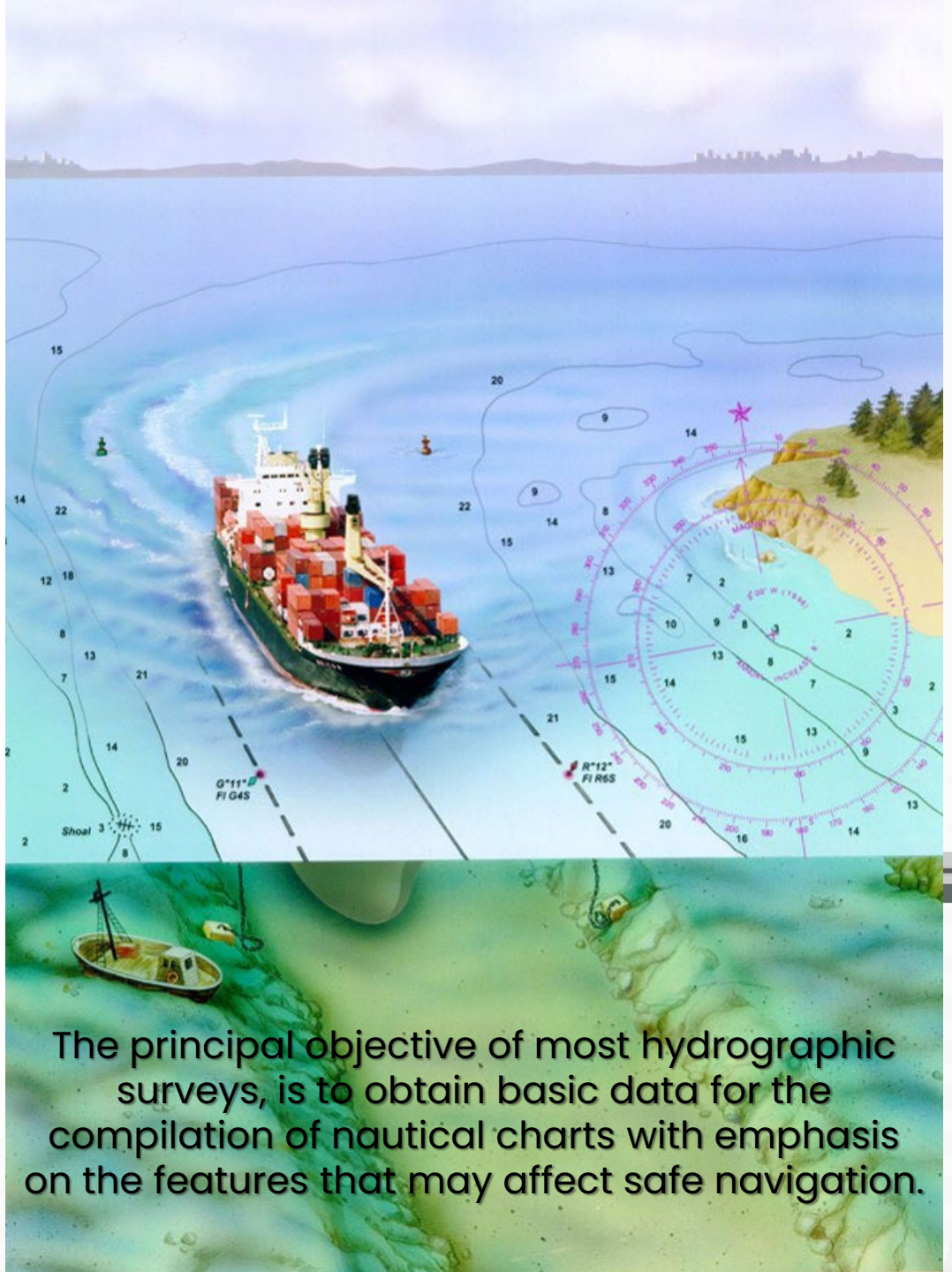

The principal objective of most hydrographic surveys, is to obtain basic data for the compilation of nautical charts with emphasis on the features that may affect safe navigation.

HYDROGRAPHIC

- **Hydrographic Surveys**
  - Depth
  - Position
  - Time
  - Seawater Characteristics
- **Accurately depict the full detail of the seafloor**
- **Location and description of man-made and natural features:**
  - Shoals
  - Wrecks
  - Rocks
  - Coral reefs
- **Meet IHO Standards**
  - C13 – Manual in Hydrography
  - S44 – Standard for Hydrographic Surveys

IHO Standards

S-4: Standard for Nautical Charts

S-5: Competence For Category "B" Nautical Cartographers

S-8: Competence For Category "A" Nautical Cartographers

S-32: Hydrographic Dictionary

S-44: Standards for Hydrographic Surveys

S-52: Standards for systems that display ENCs.

S-57: Standards for Electronic Navigational Charts (ENCs).

S-100: Universal Hydrographic Data Model

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S-44 - Standards for Hydrographic Surveys

Order	Exclusive	Sepcial	1a	1b	2
Description of areas.	Areas where there is strict minimum underkeel clearance and manoeuvrability criteria.	Areas where under-keel clearance is critical.	Areas shallower than 100 metres where under-keel clearance is less critical but features of concern to surface shipping may exist.	Areas shallower than 100 metres where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas generally deeper than 100 metres where a general description of the sea floor is considered adequate.
Maximum allowable THU 95%	1 metre	2 metres	5 metres + 5% of depth	5 metres + 5% of depth	20 metres + 10% of depth
Maximum allowable TVU 95%	a = 0.15 m; b = 0.0075 m	a = 0.25 m; b = 0.0075 m	a = 0.5 m; b = 0.013 m	a = 0.5 m; b = 0.013 m	a = 1.0 m; b = 0.023 m
Full Sea floor Search	200%	100%	100%	Not required	Not required
Feature Detection	Cubic features > 0.5 metre	Cubic features > 1 metre	Cubic features > 2 metre, in depths up to 40 metre; 10% of depth beyond 40 metres	Not Applicable	Not Applicable

IHO S-44: https://iho.int/uploads/user/pubs/standards/s-44/S44_Edition_6.0.0_EN.pdf

summarizes minimum standards for hydrographic surveys; standards vary depending primarily on the importance of the safety of surface navigation

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HYDROGRAPHIC FIELDWORK

PLANNING

Survey Preparation, Planning & Design

- Research/Purpose of Survey
- Desktop Study/Survey Planning
- Site Visit/Recce

DATA GATHERING

Mobilization & Survey Operation

- Establishment of positional control
- Establishment of tide control
- Equipment Installation & Calibration
- On Site & Onboard Survey

DATA PROCESSING

Data Cleaning, Processing and Thinning

- Tidal Data Processing
- SBES Processing
- MBES Processing
- Export to Map

DATA ANALYSIS

Result & Discussion

- Summary

Survey Preparation, Planning & Design

Examine the requirements of the survey task:

- ❑ what is required?
- ❑ for what purpose?
- ❑ in what timeframe?

01

Purpose of Survey

Hydrography, Engineering, Geological Mapping, Military Application, Environmental Mapping, etc.

Survey Planning – Reconnaissance

The success of a survey depends on how well it is planned. Bad plan wastes time, effort and resources and results in poor end product!

02

03

Site Visit/Recce

Assessment of “ground truther" information allows effective alterations to the original plan. Time spent on reconnaissance and planning SAVES time and resources in the field.

Planning Considerations

Timing

Plan reconnaissance in advance

Time in hand to resolve problems

Personnel Arrangement

Tasking assignment & proper brief

Experienced personnel in recon ops

Less experienced personnel for actual observations

Equipment, Logistic & Training

Establishes a list of equipment

Mobilization & demobilization

Ensure trained and skillful personnel

Assembly of documentation

Previous survey reports and records

Port guides & sailing directions

Photographs/ illustrations.

Terrain / Control

Consider the terrain of the survey site and accessibility

Availability of existing control/ transfer datum

Security & Emergency Communication

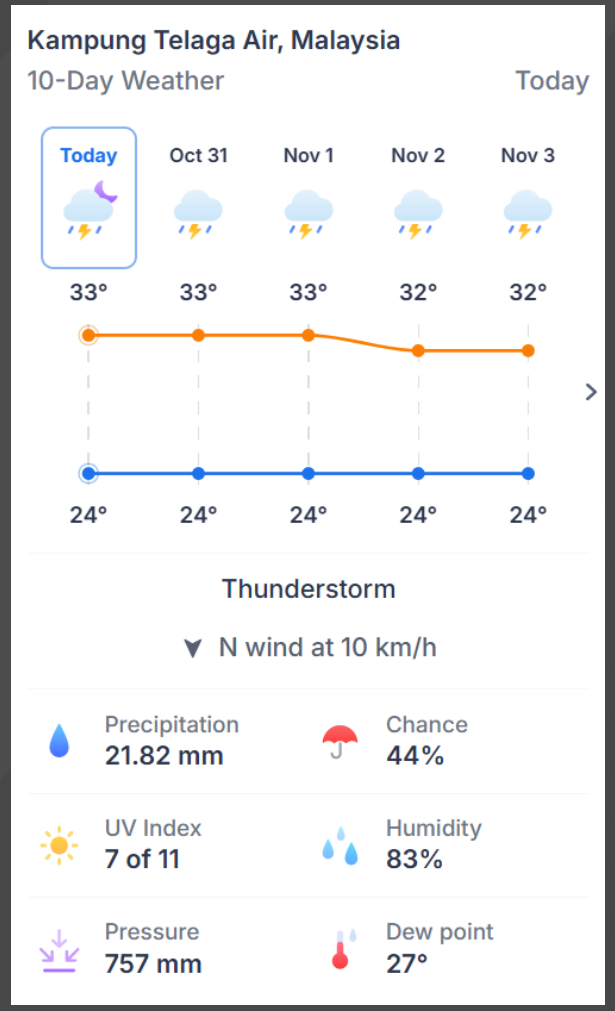
Meteorological Forecast

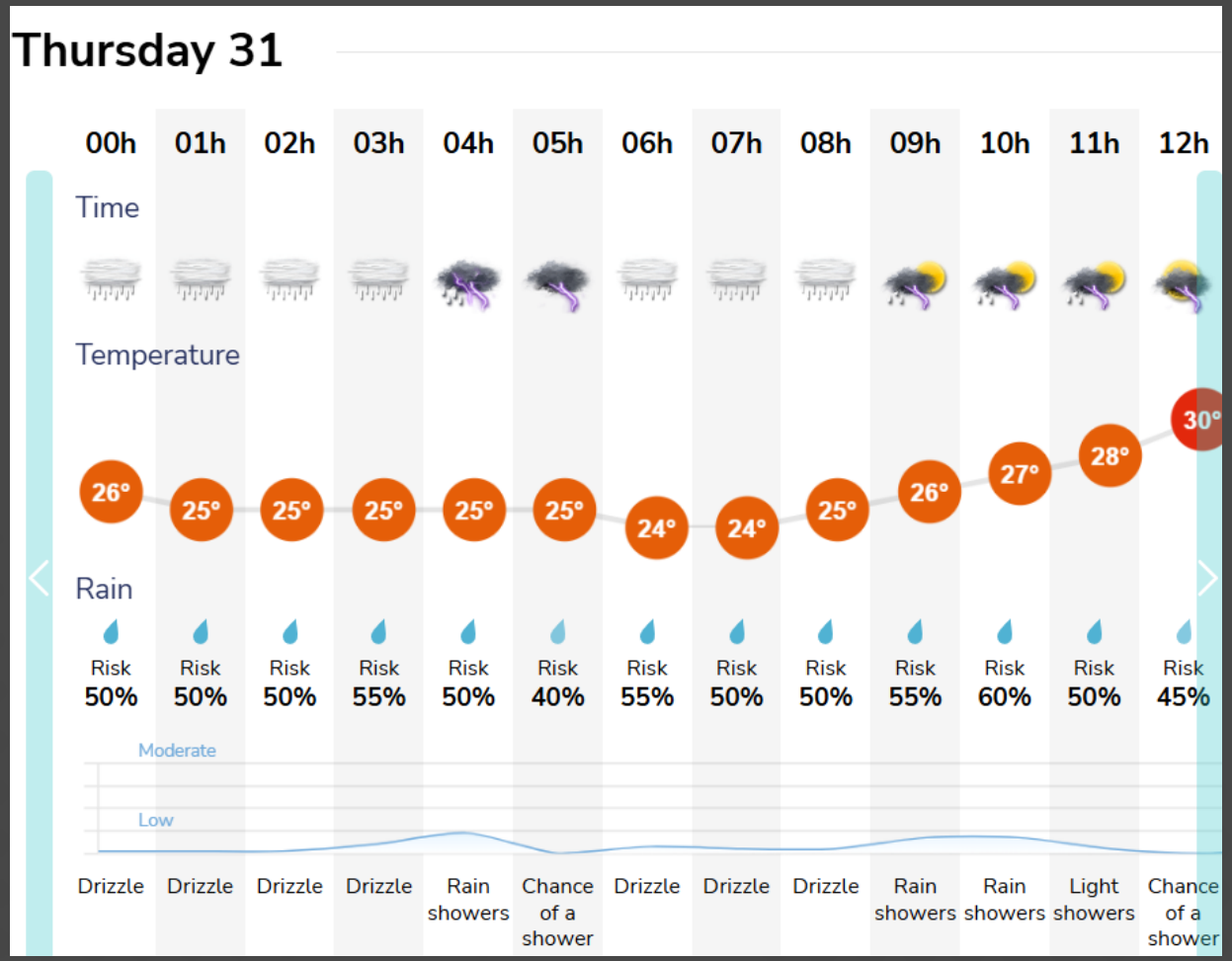
Weather forecast

Tidal Information & prediction

"If You Fail to Plan, You Are Planning to Fail" — Benjamin Franklin

Weather Forecast





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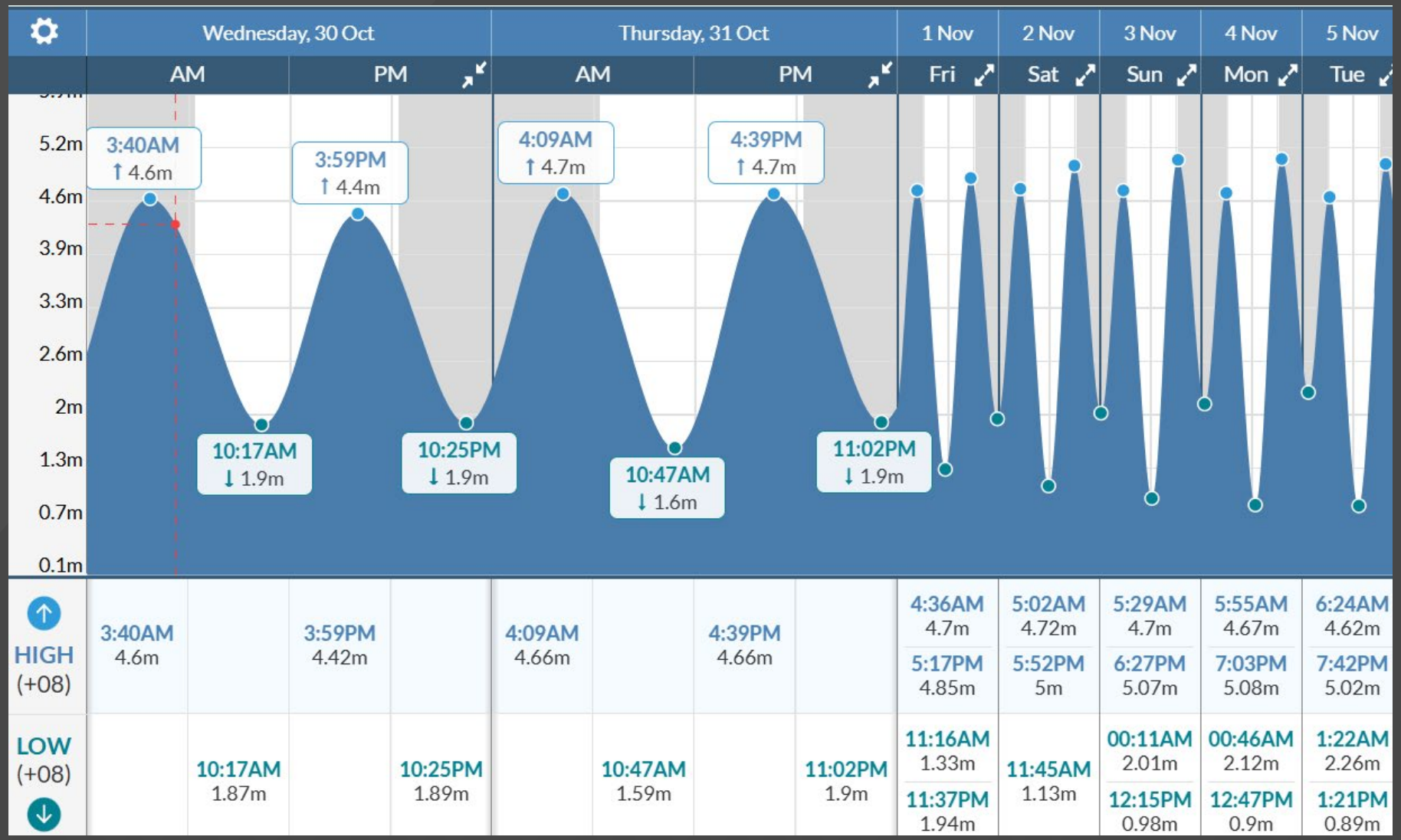
Tidal Time Forecast



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HYDROGRAPHIC SURVEYS PLANNING

Location :

Telaga Air, Kuching, Sarawak

Toolbox Briefing

- **Consortium A, B, C & D** (07:00-07:30am)
- **Equipment Installation & Checking**
- **Tidal Observation & Record**

**Briefing and Surveys Planning for Hydrographic Field Practical has been conducted at CENTEXS.*

"Knowledge allows us to establish our professionalism and build upon it to reflect the level of achievement in our career path".

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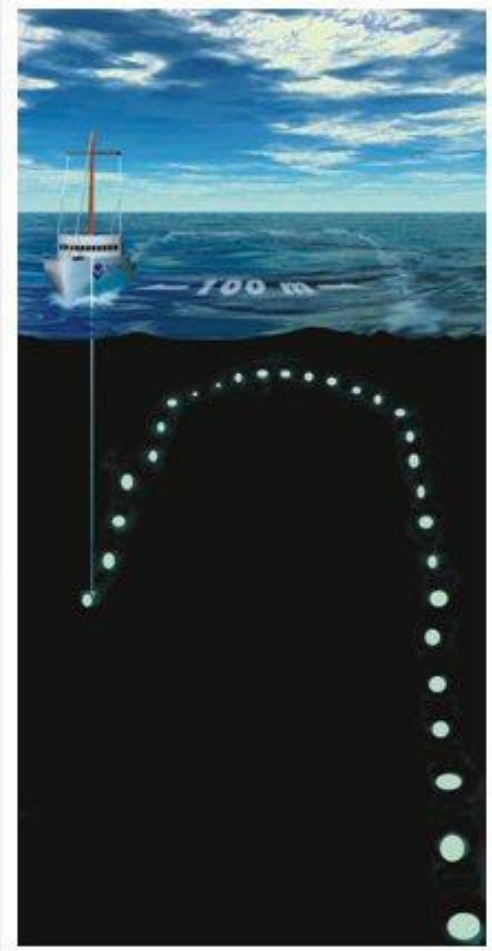
Project Site

"Plans are of little importance, but planning is essential." — Winston Churchill

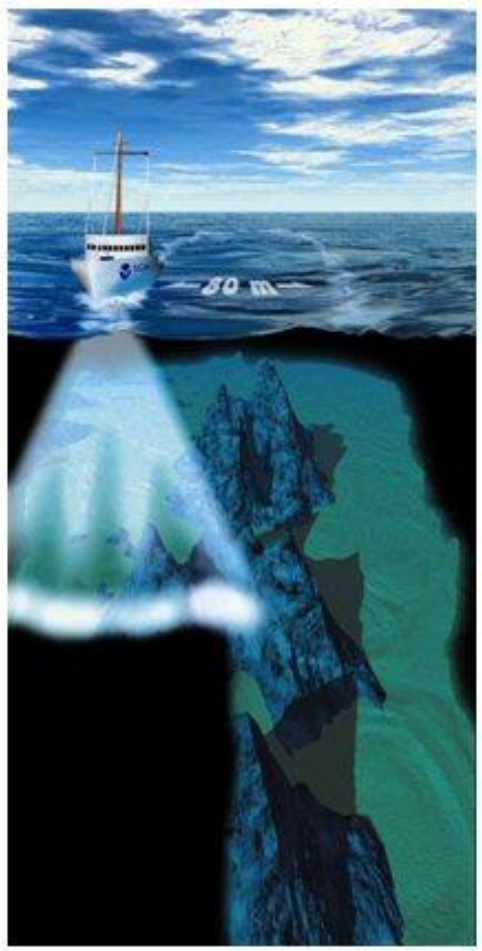
Site Recce

HYDROGRAPHIC SURVEYS



Leadline Surveys

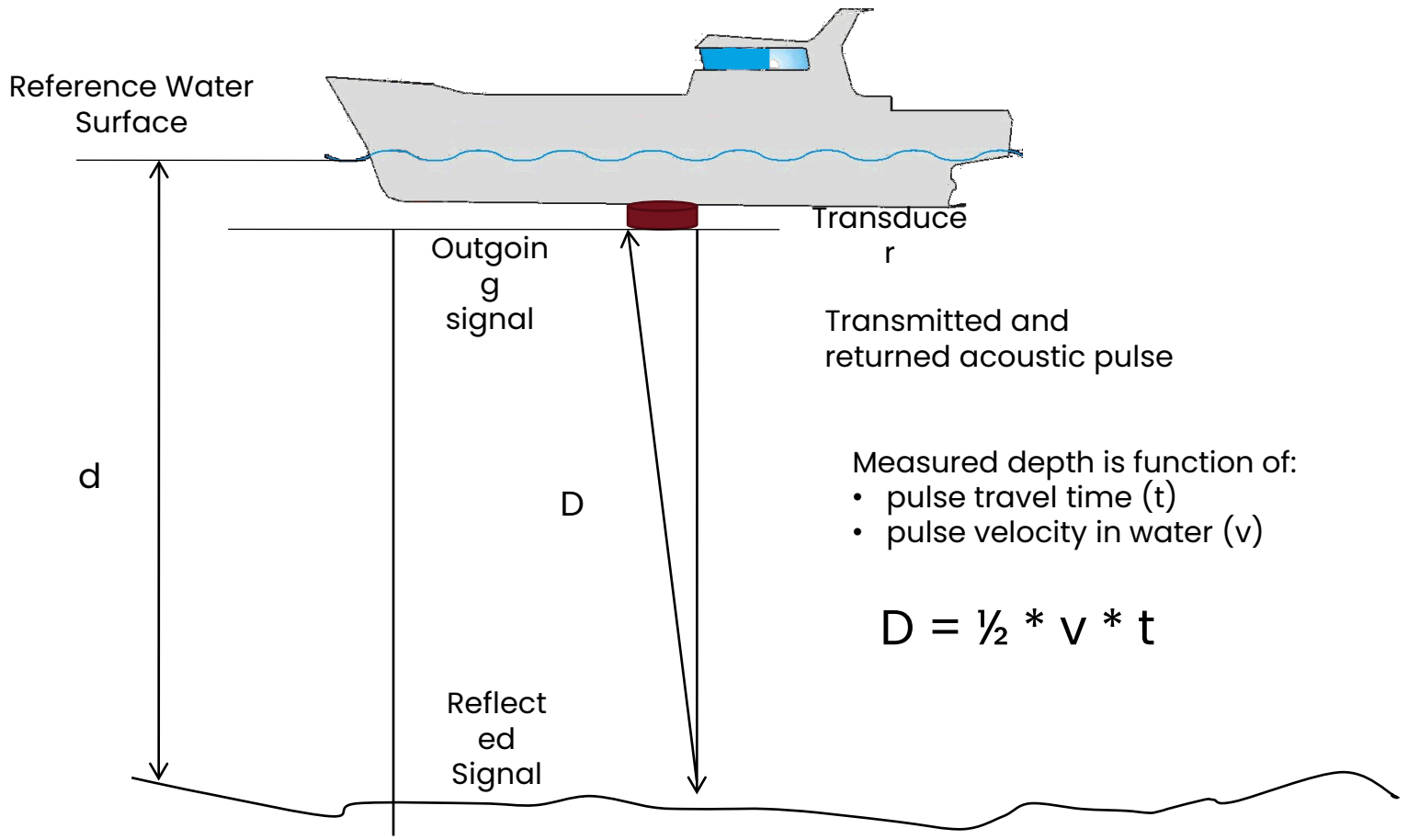
Single Beam Echo Sounder Surveys



Multibeam Full Bottom Coverage

SINGLE BEAM – ODOM HYDROTRAC (200kHz)

Principle of Acoustic Measurement (SBES)

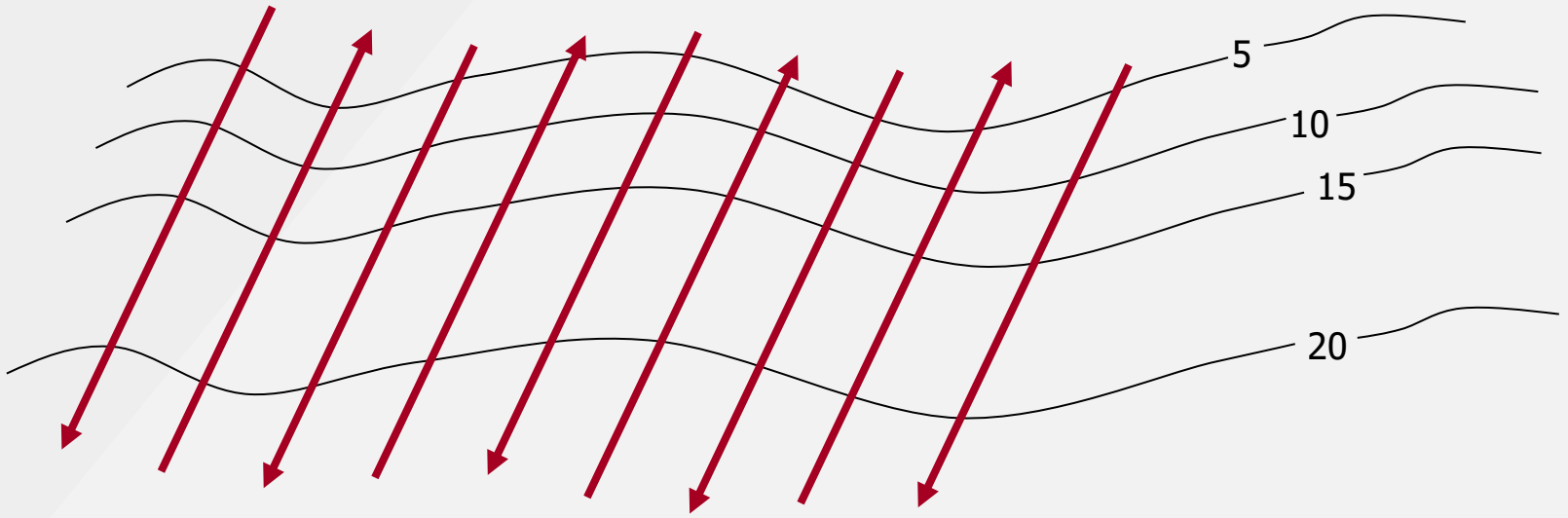


Measured depth is function of:

- pulse travel time (t)
- pulse velocity in water (v)

$$D = \frac{1}{2} * v * t$$

SBES SOUNDING LINE LAYOUT



In single beam surveying, lines are designed to run normal to a slope. Due to the limits of a single beam, details of the slope are better mapped running up and down slope. However, this can lead to problems if the area to be mapped is in very shallow water.

Mobilization & Survey Operation

01

Establish Horizontal Control

A horizontal datum is a reference system for specifying positions on the Earth's surface. Each datum is associated with a particular reference spheroid that can be different in size, orientation and relative position from the spheroids associated with other horizontal datums.

Establish Vertical Control

The vertical component (e.g. depths, drying heights) should be referenced to a vertical reference frame that is suitable for the data type and intended use. This vertical reference frame maybe based on tidal observations (e.g. LAT, MWL, etc), on a physical model (i.e. geoid) or a reference ellipsoid.

02

03

Equipment Installation and Calibration

Find a suitable place to install tide gauge and observe the tide records.
Bar Check calibration for SBES / Patch Test calibration & SVP/CTD for MBES.

On Site & Onboard Surveys

Levelling Survey (e.g. Conventional, RTK or Static GNSS)
Vessel-based echo sounding survey (e.g. SBES, MBES or SSS)

04

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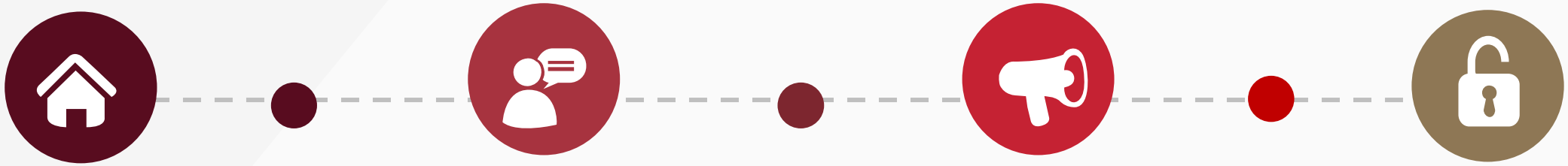
Establishing Survey Datum

The horizontal component (e.g. Lat / Long or Northing / Easting) and vertical component (e.g. depths / heights) should be referenced to a coordinate reference frame that is suitable for the data type and intended use. Generally, a new Horizontal and Vertical Datum need to be established if there is no existing control point available nearby.



SURVEY DATUM

Determine the designated Geographical Coordinate System (WGS84/GDM2000) or Projected Coordinate System (RSO/Cassini-Soldner) for the project

PRECISE LEVELLING

Levelling survey (Auto Level, RTK, Static GNSS) need to be carried out to link the survey data to the designated survey datum (e.g. Chart Datum, MSL).

PRECISE POSITIONING

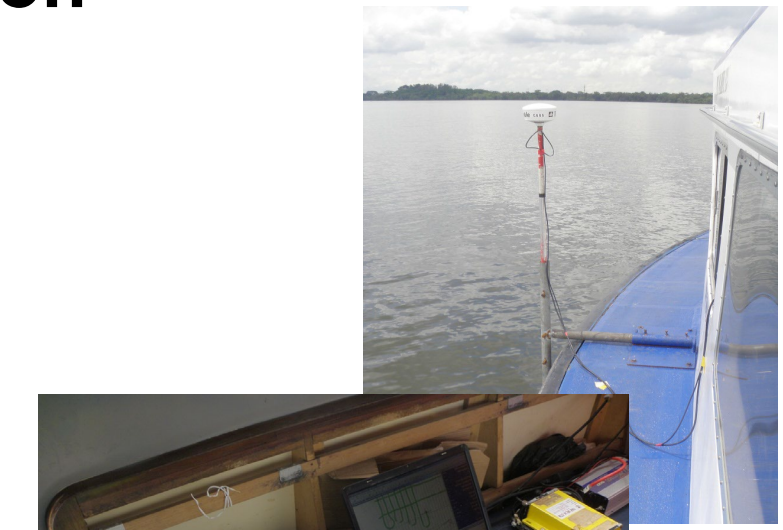
Setting up your own RTK/DGPS reference station or using existing correction signal services (MyRTKnet, IskandarNet, IALA Radio Beacon, etc.) for enhanced positioning.

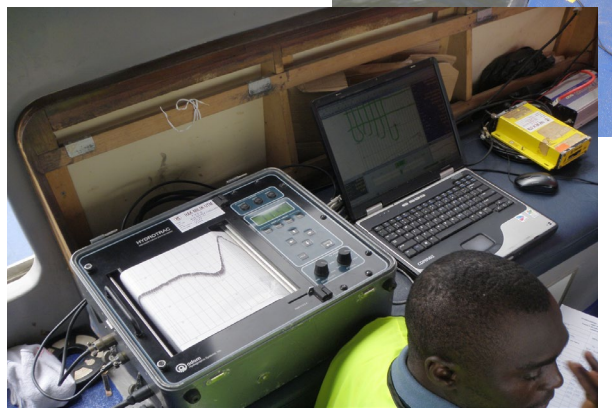
TIDAL OBSERVATION

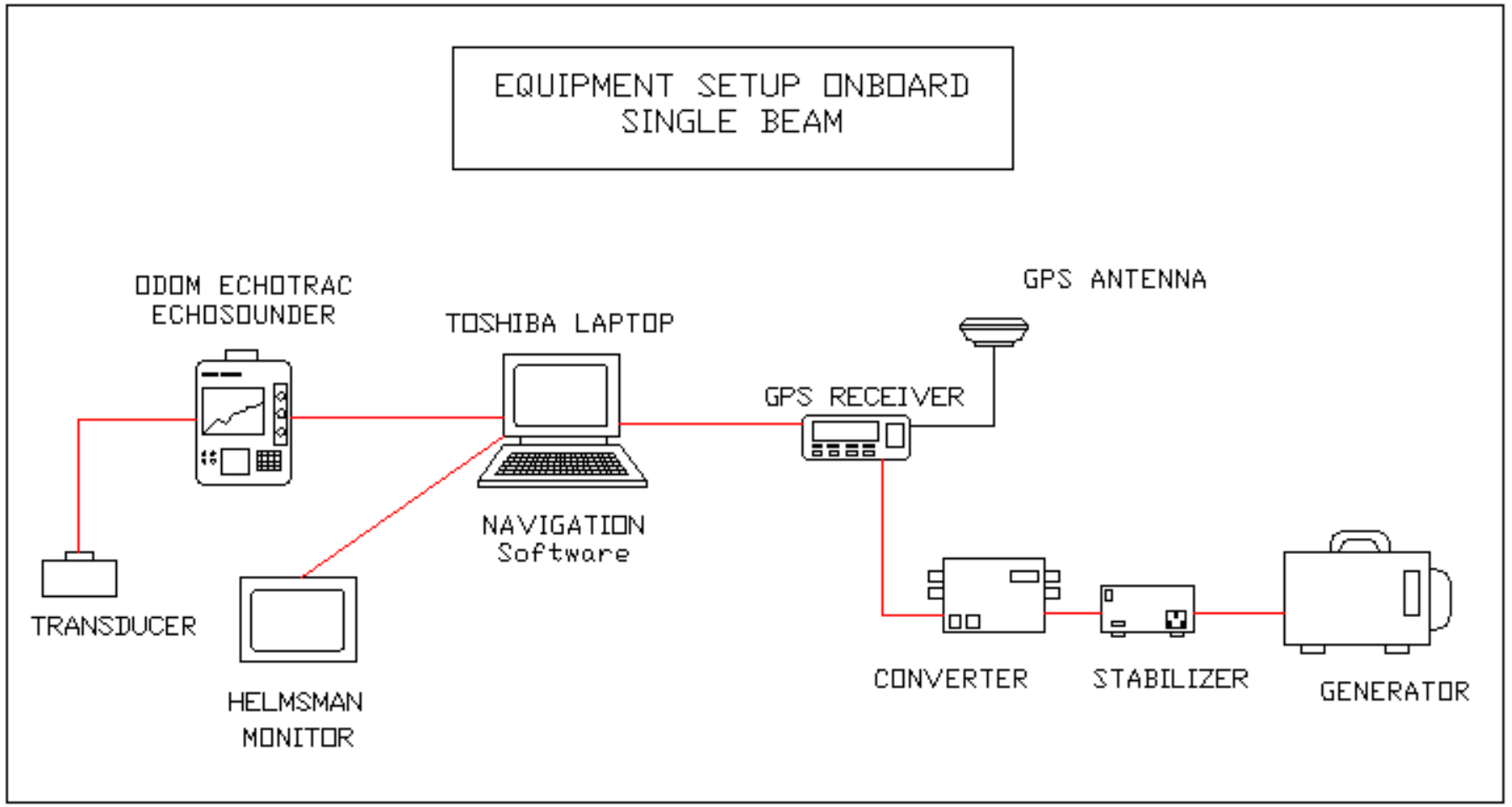
Installation of tide gauge and observe the tide records. Reduced depth can only be obtained after data cleaning and tide reduction using the designated sounding datum.

Survey Vessel Configuration

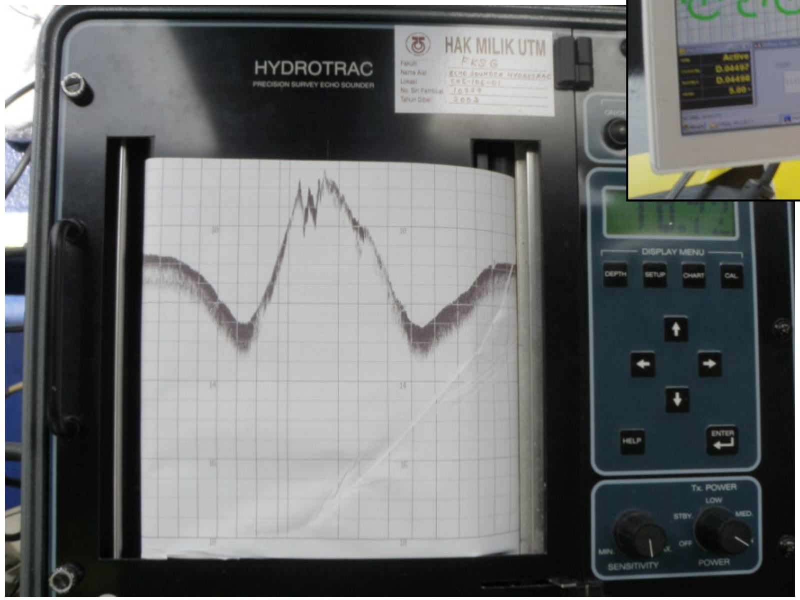
- Odom Single Beam Echo Sounder
- RTK Base & RTK Rover GNSS receiver
- Laptop with Trimble Hydropro software
- Generator or Batteries
- DC to AC power Inverter
- Communication cables
- Chain cum bar plate (for bar check calibration)

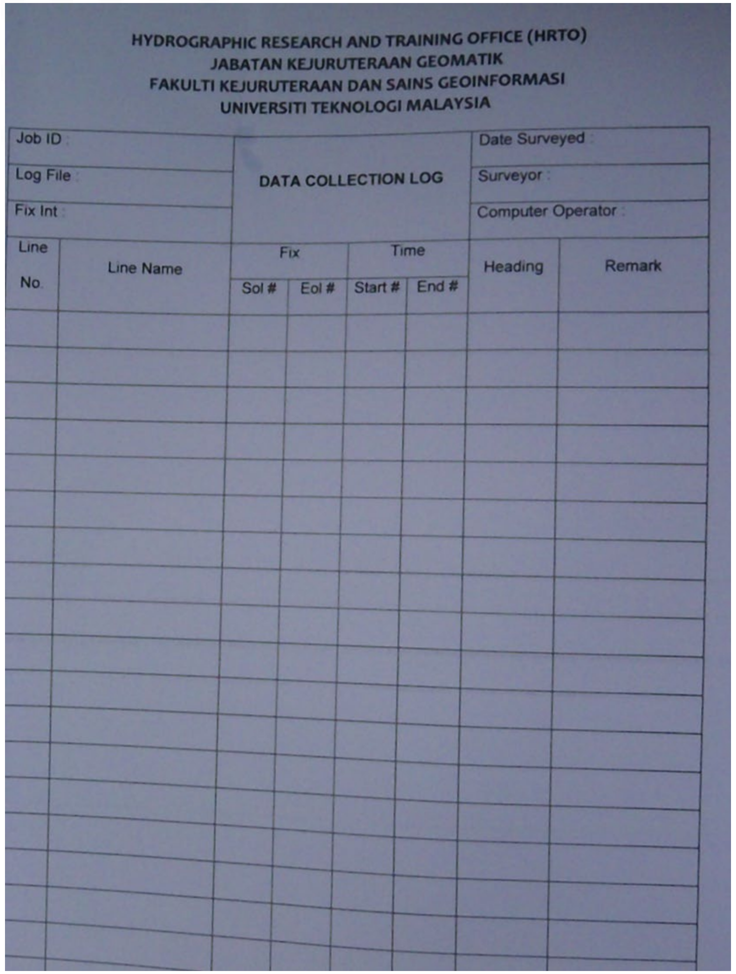






Hydrographic Survey: Field Practical

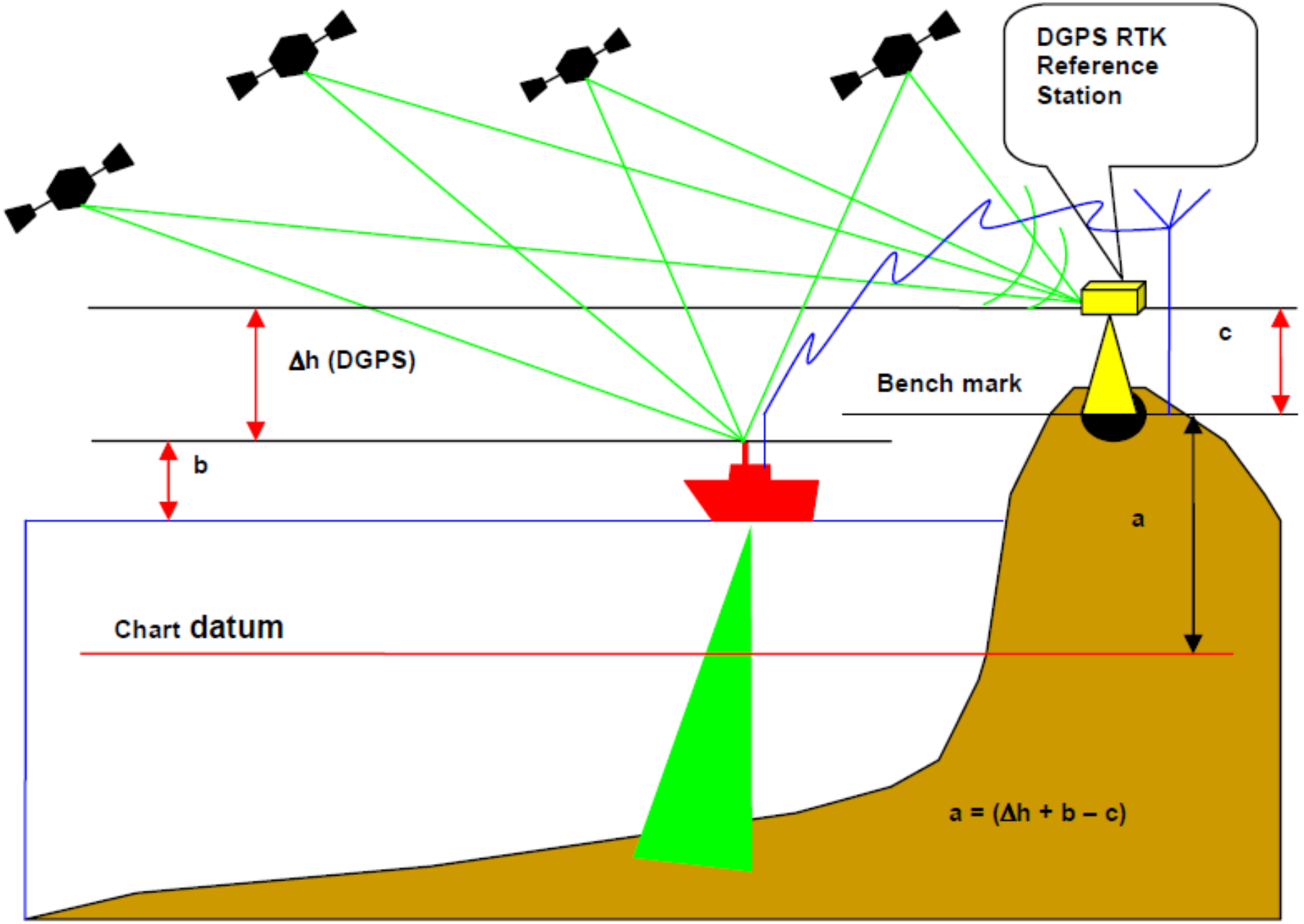


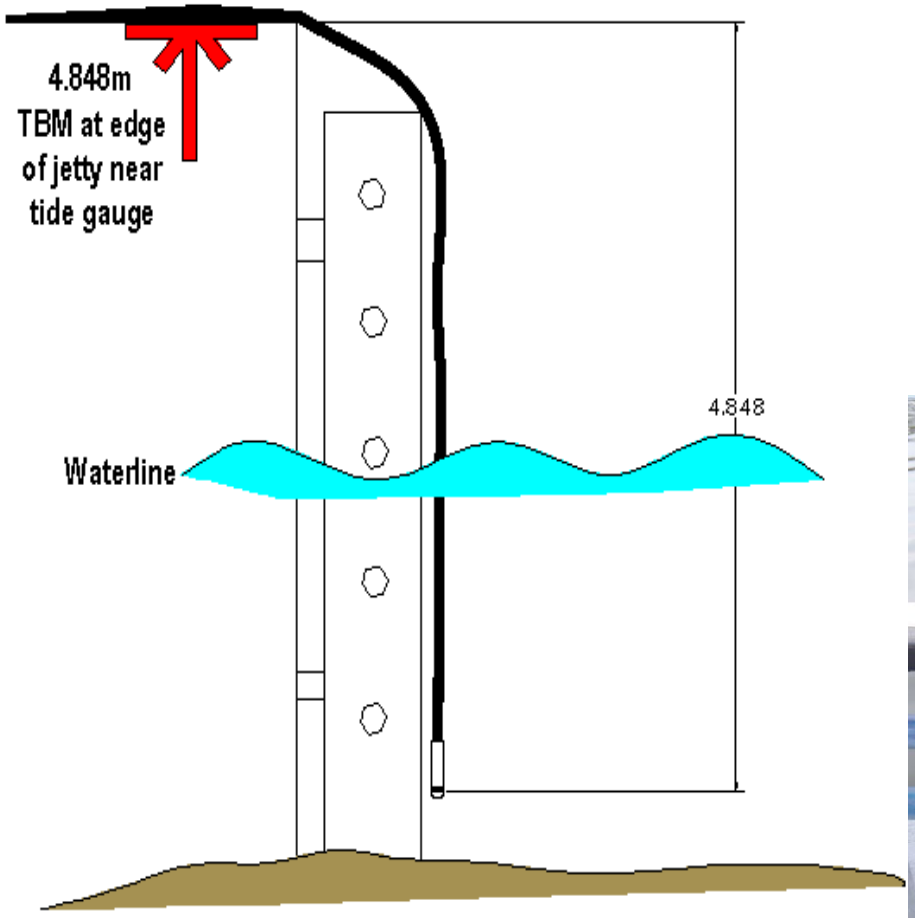


HYDROGRAPHIC RESEARCH AND TRAINING OFFICE (HRTO)
JABATAN KEJURUTERAAN GEOMATIK
FAKULTI KEJURUTERAAN DAN SAINS GEOINFORMASI
UNIVERSITI TEKNOLOGI MALAYSIA

Job ID :	DATA COLLECTION LOG	Date Surveyed :
Log File :		Surveyor :
Fix Int :		Computer Operator :

Line No.	Line Name	Fix		Time		Heading	Remark
		Sol #	Eol #	Start #	End #		


DGPS RTK
Reference
Station
Δh (DGPS)
b
c
Bench mark
a
Chart datum
a = (Δh + b – c)


4.848m
TBM at edge
of jetty near
tide gauge
4.848
Waterline

Tide Times for Kuching (tomorrow): Thursday 31 October 2024

Tide	Time (+08) & Date	Height
High Tide	4:09 AM *(Thu 31 October)*	4.66 m *(15.29 ft)*
Low Tide	10:47 AM *(Thu 31 October)*	1.59 m *(5.22 ft)*
High Tide	4:39 PM *(Thu 31 October)*	4.66 m *(15.29 ft)*
Low Tide	11:02 PM *(Thu 31 October)*	1.9 m *(6.23 ft)*

Sunrise:	Sunset:	Moonrise:	Moonset:
6:20AM	6:24PM	5:13AM	5:30PM

Powered by Tide-Forecast.com

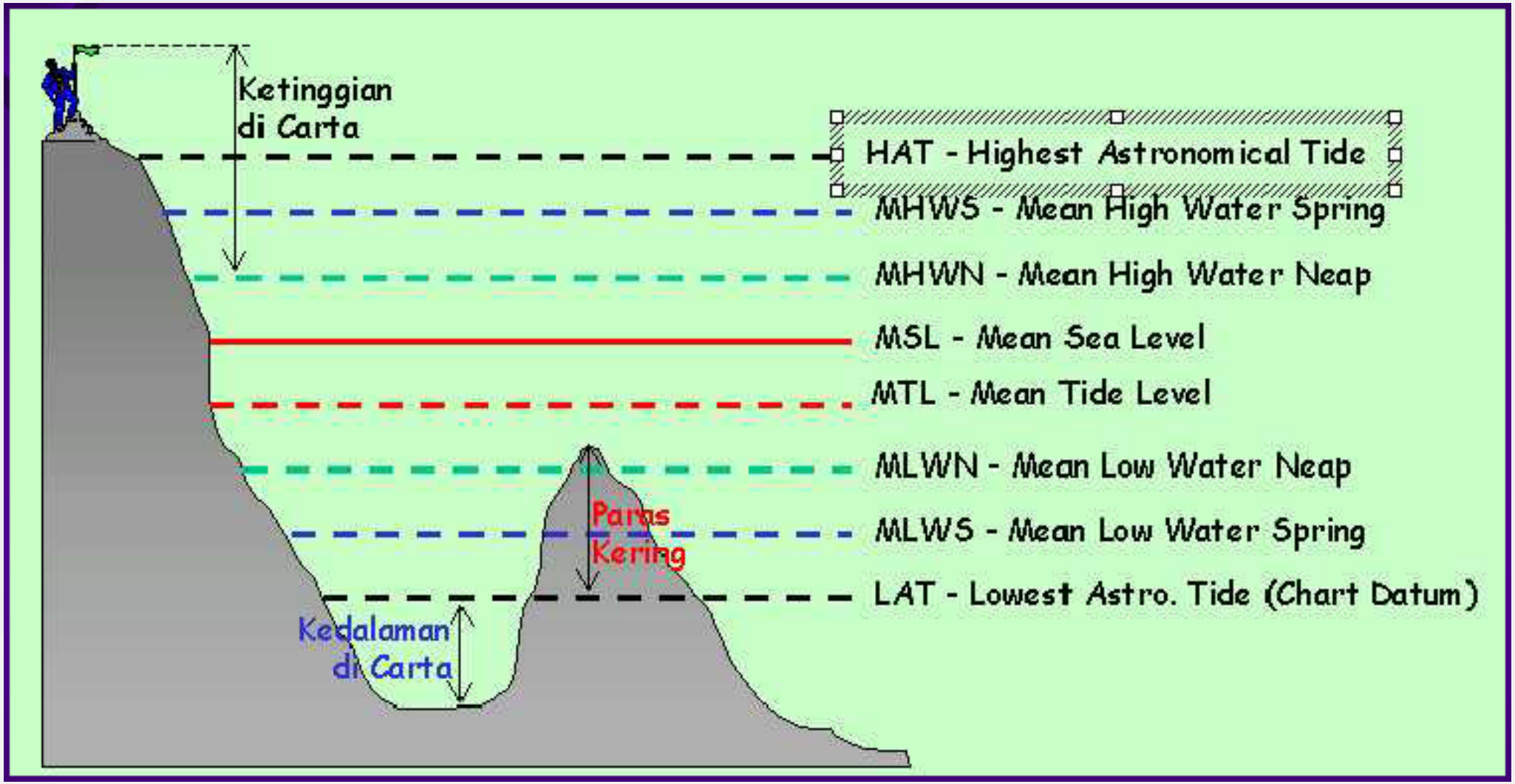
Tide Times for Kuching: Friday 01 November 2024

Tide	Time (+08) & Date	Height
High Tide	4:36 AM *(Fri 01 November)*	4.7 m *(15.42 ft)*
Low Tide	11:16 AM *(Fri 01 November)*	1.33 m *(4.36 ft)*
High Tide	5:17 PM *(Fri 01 November)*	4.85 m *(15.91 ft)*
Low Tide	11:37 PM *(Fri 01 November)*	1.94 m *(6.37 ft)*

Sunrise:	Sunset:	Moonrise:	Moonset:
6:20AM	6:23PM	5:54AM	6:11PM

Powered by Tide-Forecast.com

Type of Sounding Datum



Levelling/Vertical Control

Carry out leveling work from TBM to Tide Pole

- Level instrument - 1 set
- Staff - 2 sets
- Circular bubble - 2 sets
- Tripod - 1 set
- 10m Tape - 1 set

TBM 1 – Transfer Levelling Datum to Tide Pole station.

TBM 2 – Setup for RTK Base station.

Project file data		Coordinate System	
Name:	C:\Users\User\Documents\Trimble Business Center\TELAGA AIR_CENTEX_2024.vce	Name:	Malaysia/Borneo RSO
Size:	96 KB	Zone:	Malaysia
Modified:	6/11/2024 8:35:26 PM (UTC:8)	Datum:	Timbalai 1948 (Malaysia)
Time zone:	Malay Peninsula Standard Time	Global reference datum:	WGS 1984
Reference number:		Global reference epoch:	
Description:		Geoid:	EGM2008 1"
Comment 1:		Vertical datum:	
Comment 2:		Calibrated site:	
Comment 3:			

Point List

ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	Feature Code
SS7063	2056362.1160	5180290.3220	32.9190	
TBM1	2057813.6493	5185347.2303	4.5846	
TBM2	2058041.6379	5185378.6697	4.1891	
TBM3	2057937.3253	5185191.4566	4.4489	

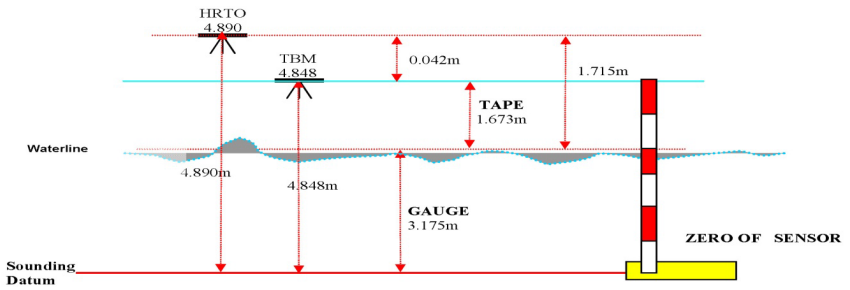
Project Site

"Good coordinate system always starts from good coordination."

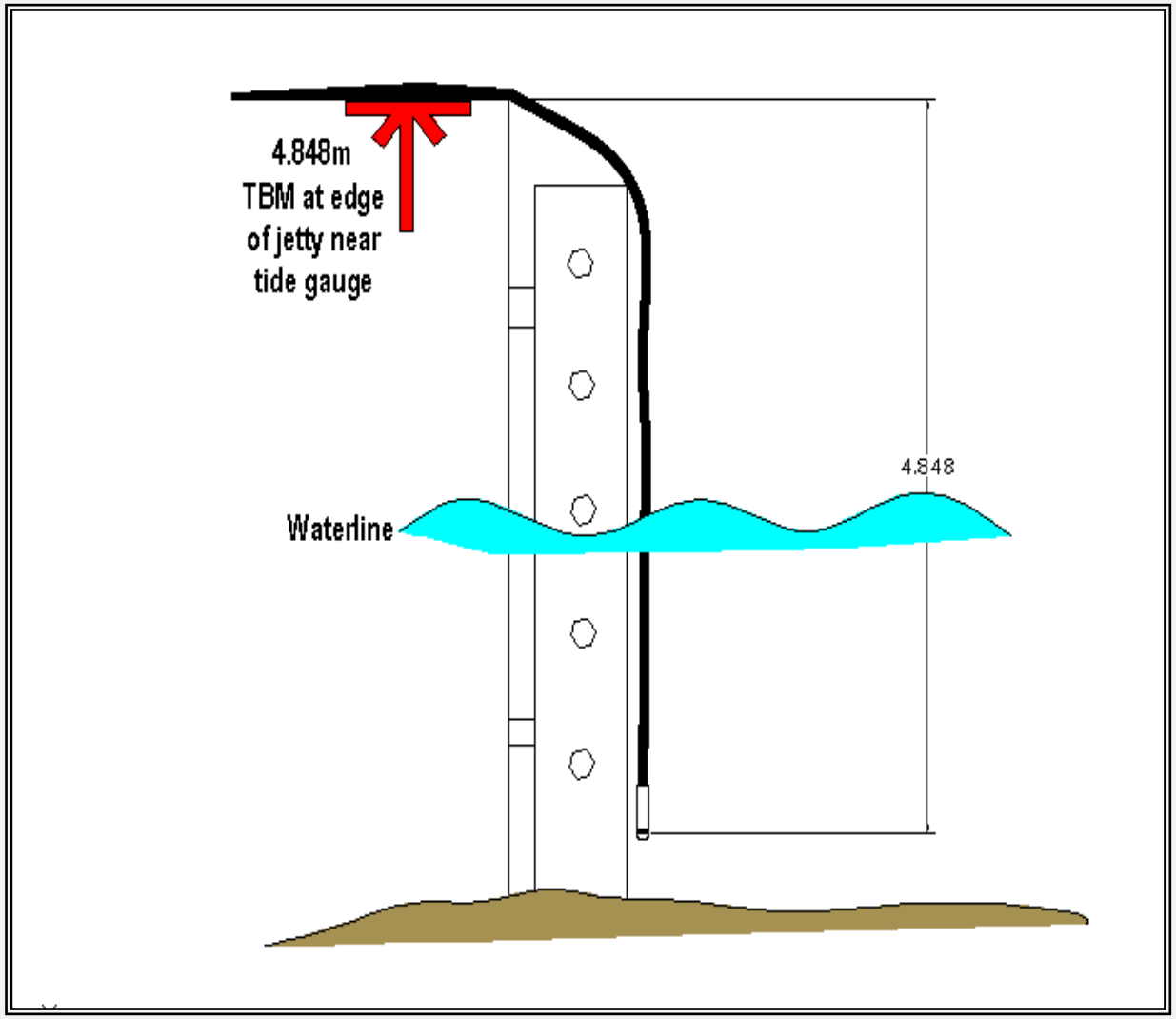
Levelling / RTK Transfer Datum

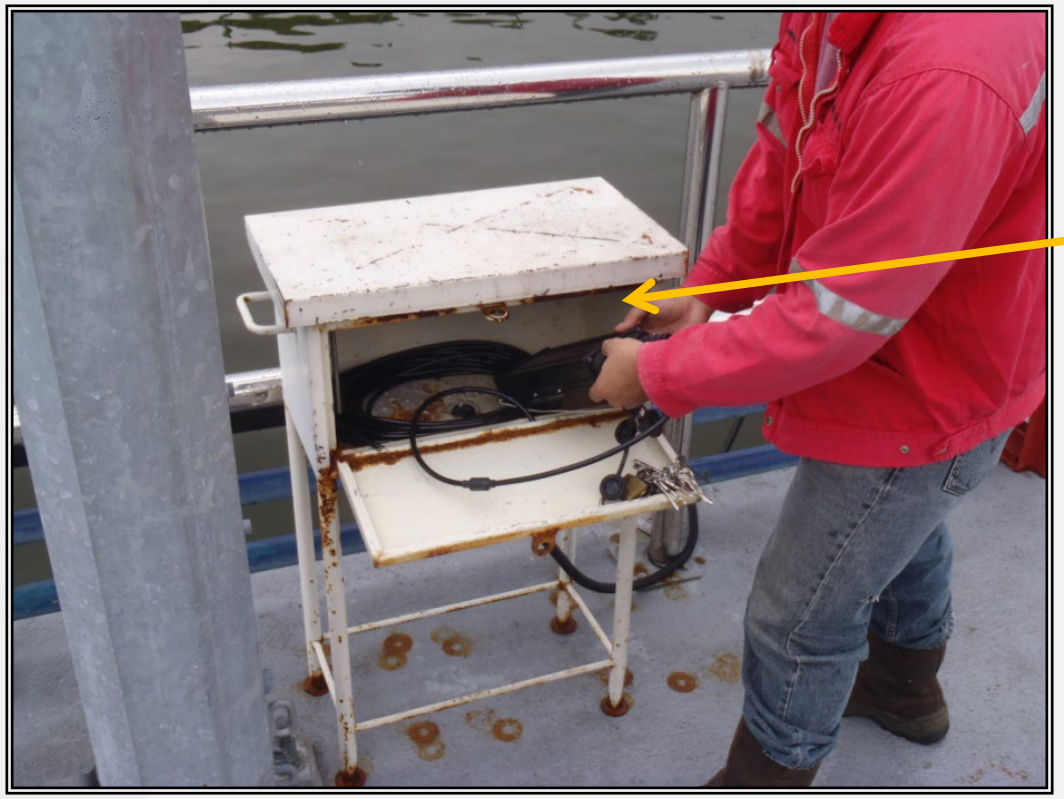
Diagram of connections between sounding datum, benchmark and zero of sensor.

Place	:	Marine Jetty Danga Bay	
Inclusive dates	:	5th October 2010	
Time kept	:	HOTEL	
Reading Interval	:	5 Minutes	
Lat	:	N **161408.899**	**1°27'34.6425"N**
Long	:	E **637888.986**	**103°44'08.5122"E**



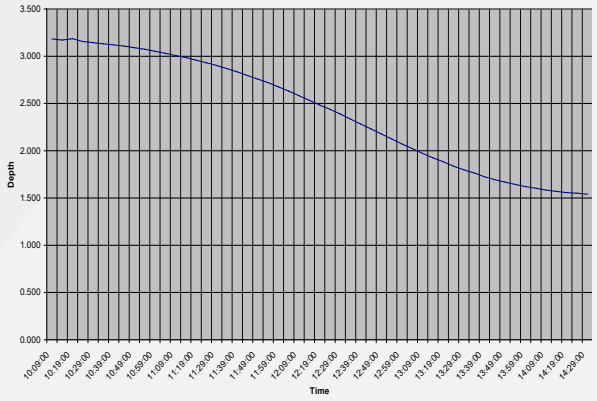
DATE	TIME	GAUGE	TAPE
5/10/2010	8:49:00	3.123	1.725
5/10/2010	8:54:00	3.140	1.708
5/10/2010	8:59:00	3.149	1.699
5/10/2010	9:04:00	3.161	1.687
5/10/2010	9:09:00	3.169	1.679
5/10/2010	9:14:00	3.181	1.667
5/10/2010	9:19:00	3.184	1.664
5/10/2010	9:24:00	3.188	1.660
5/10/2010	9:29:00	3.190	1.658
5/10/2010	9:34:00	3.192	1.656
5/10/2010	9:39:00	3.194	1.654
5/10/2010	9:44:00	3.193	1.655
5/10/2010	9:49:00	3.192	1.656
5/10/2010	9:54:00	3.190	1.658
	TOTAL	44.447m	23.425m
	AVERAGE	**3.175m**	**1.673m**
	TOTAL to TBM	4.848m	
	HRTO Value	4.890m	
	Difference in Height HRTO to TBM	±0.042m	





Tide Gauge Installation

Tide Gauge Station



Tide data download from Tide Gauge

File header created by: TIDELOG on 10/5/2010 2:35:58 PM

Filename: CAL.024

Pressure calibration: P = 12 -1.0531220e-11 +2.0366921e-04 -1.1572080e+00

Battery voltage: 5.79

VLR740 Serial number: 4267

Transducer serial number: 2231954

File number: 24

Burst Cycle Time(mins): 5

Burst Length (secs): 30

filetime :10/5/2010 10:09:00 AM

Site_info: UTM Group B 05102010

Secondary cal type: None

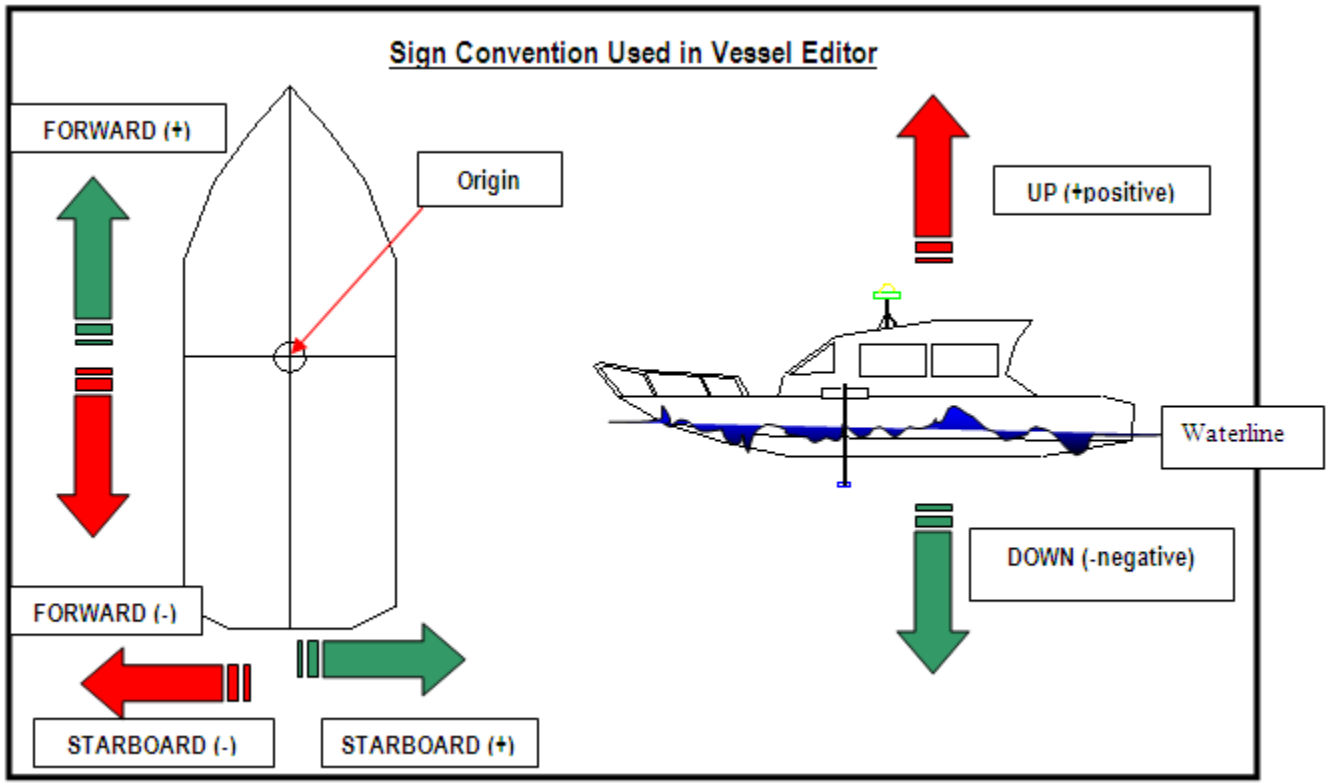
Depth units: Dbar

Secondary Gain coeff: 1

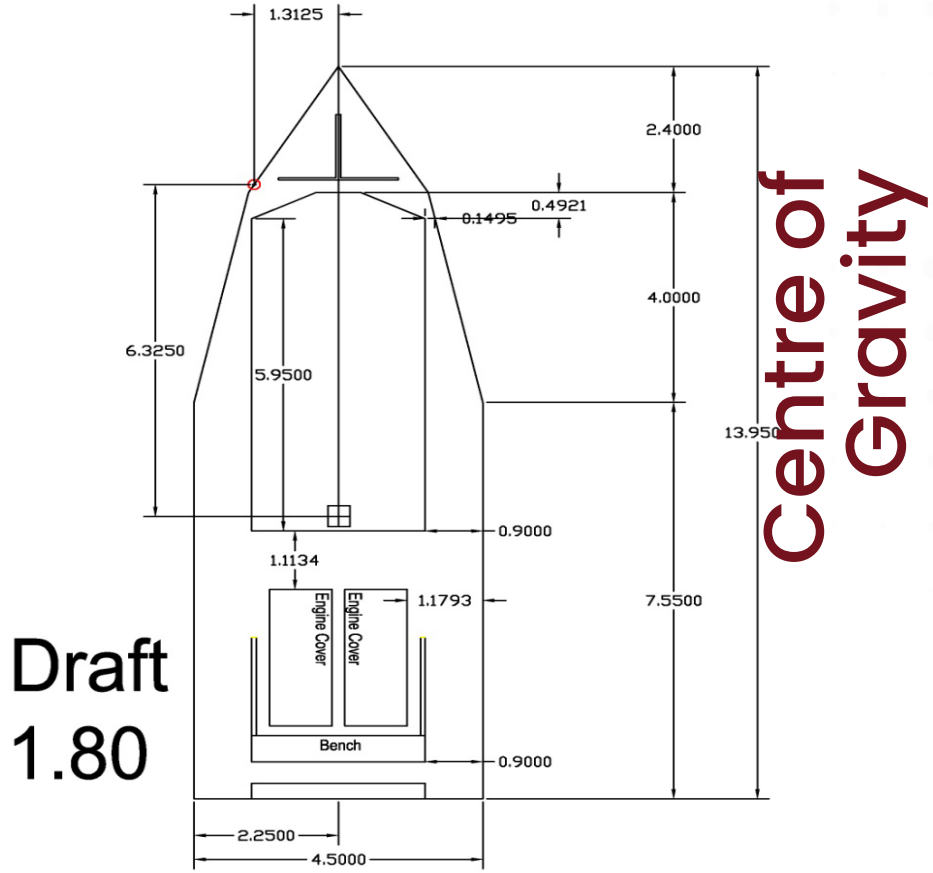
Secondary offset: 0

Date	Time	Pressure Dbar
5/10/2010	10:09:00	3.184
5/10/2010	10:14:00	3.172
5/10/2010	10:19:00	3.186
5/10/2010	10:24:00	3.156
5/10/2010	10:29:00	3.144
5/10/2010	10:34:00	3.131
5/10/2010	10:39:00	3.121

Vessel Configuration



The offsets are of critical importance on a vessel. It is these offset locations that determine where equipment devices are located on the vessel and the positions that are derived for them.

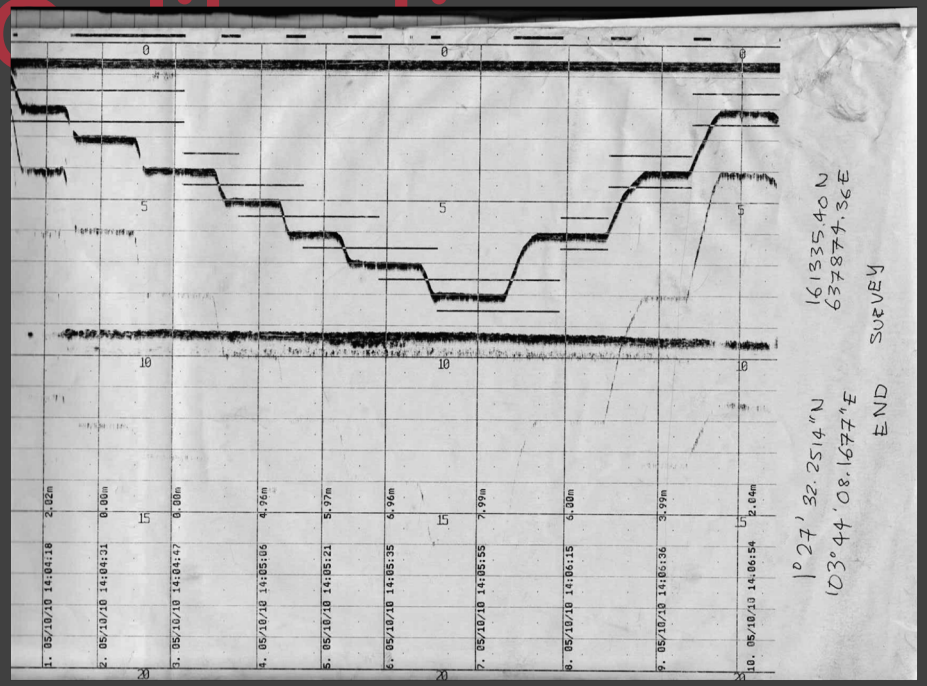


The centre of gravity (COG) is the point of the vessel where the force representing the weight of the vessel exerts its power.

Bar Check Calibration

- to determine the correct sound velocity.
- to determine whether the transducer draft is correct.
- to verify that the transducer draft does not change before and after the survey.
- bar check plate is lowered to the nearest sounded depth in that area.

Bar Check



Sample of the Echo trace recorded for the Bar Check Calibration.

The bar plate was place under the transducer and the 1.0m mark on the bar plate rope was aligned to the transducer draft. It is then lowered to the nearest bottom displayed on the echo trace. See figure 2b.

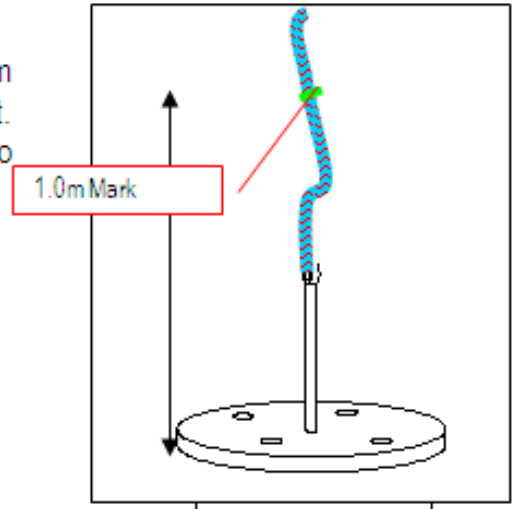


Figure 2a

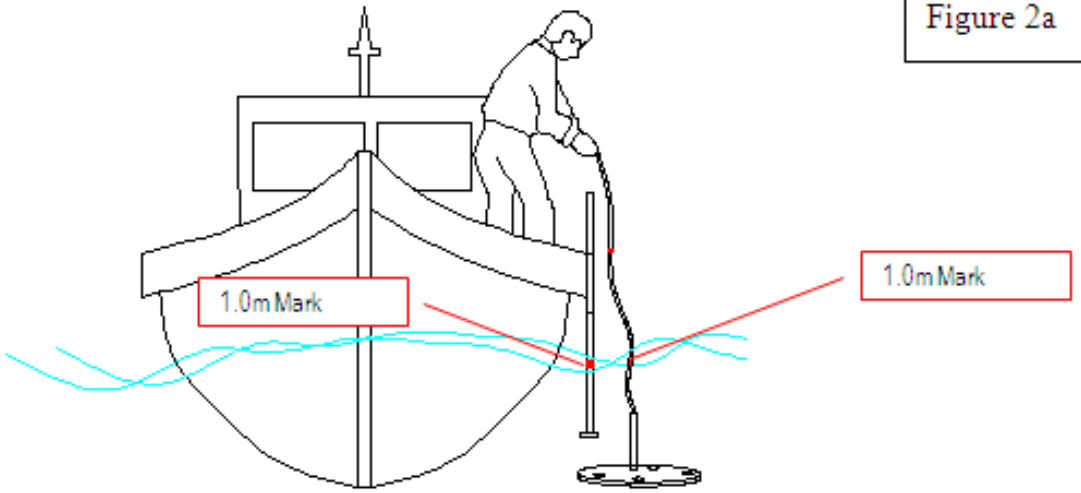
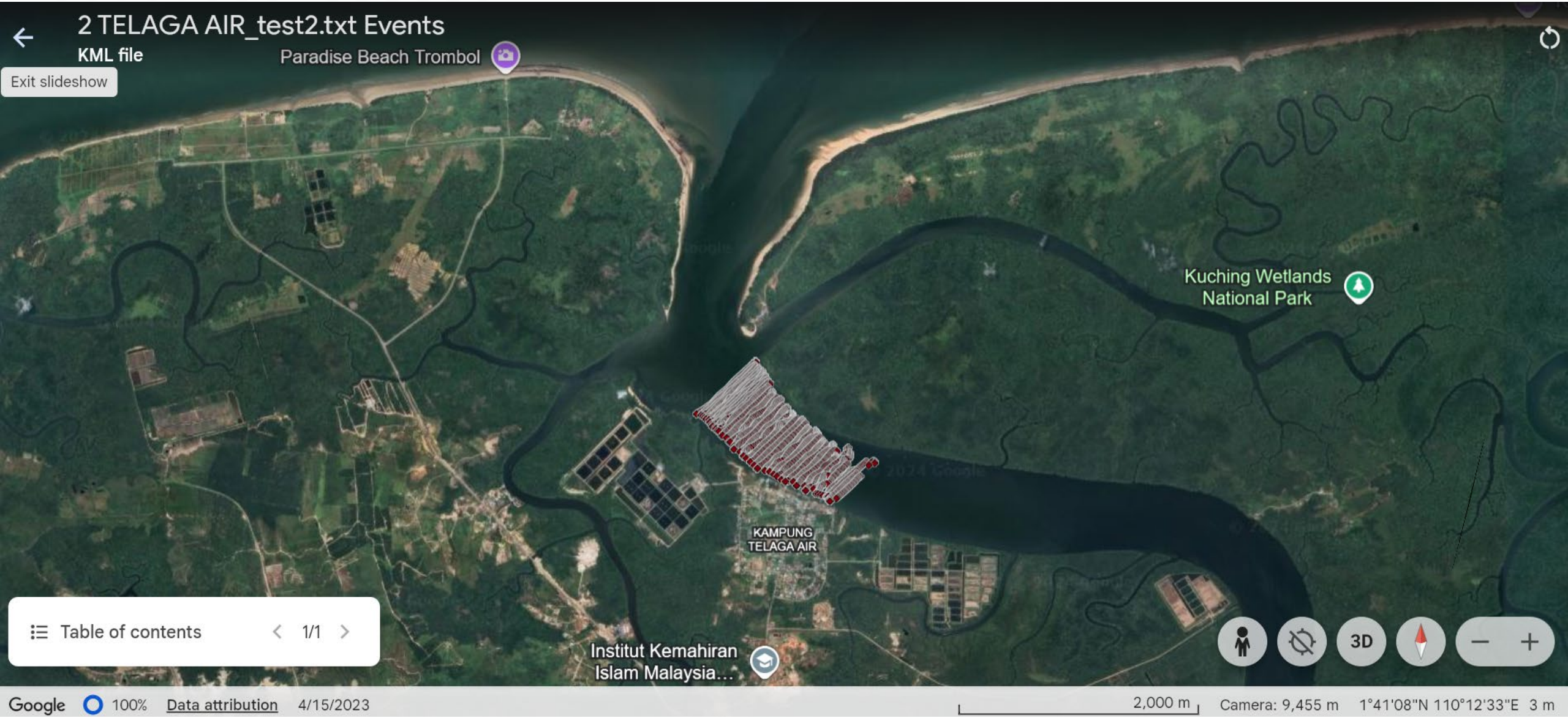
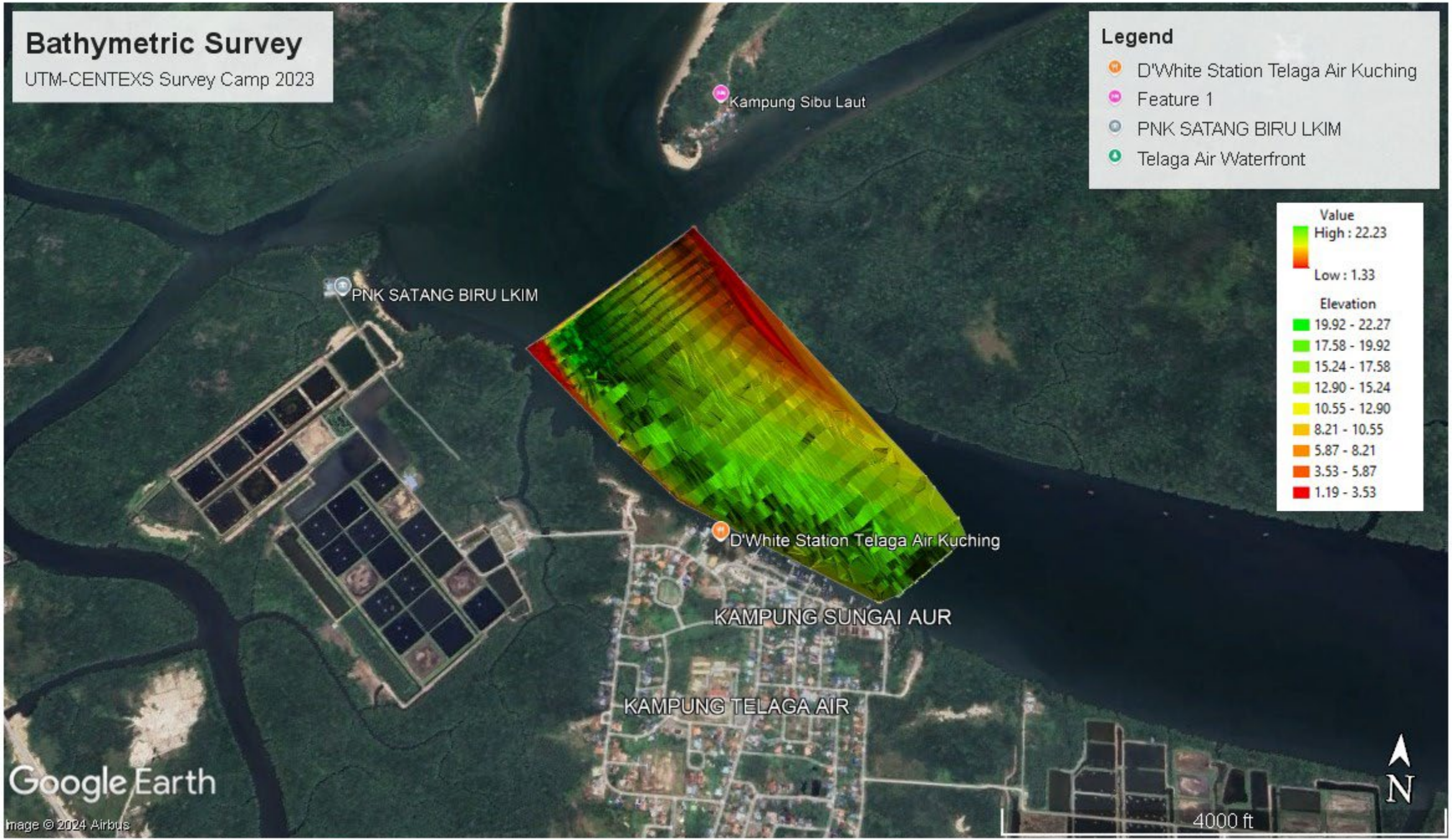


Figure 2b

Telaga Air.kmz




Bathymetric Survey
UTM-CENTEXS Survey Camp 2023
Legend
D'White Station Telaga Air Kuching
Feature 1
PNK SATANG BIRU LKIM
Telaga Air Waterfront
Value
High : 22.23
Low : 1.33
Elevation
19.92 - 22.27
17.58 - 19.92
15.24 - 17.58
12.90 - 15.24
10.55 - 12.90
8.21 - 10.55
5.87 - 8.21
3.53 - 5.87
1.19 - 3.53
Kampung Sibu Laut
PNK SATANG BIRU LKIM
D'White Station Telaga Air Kuching
KAMPUNG SUNGAI AUR
KAMPUNG TELAGA AIR
Google Earth
Image © 2024 Airbus
4000 ft
N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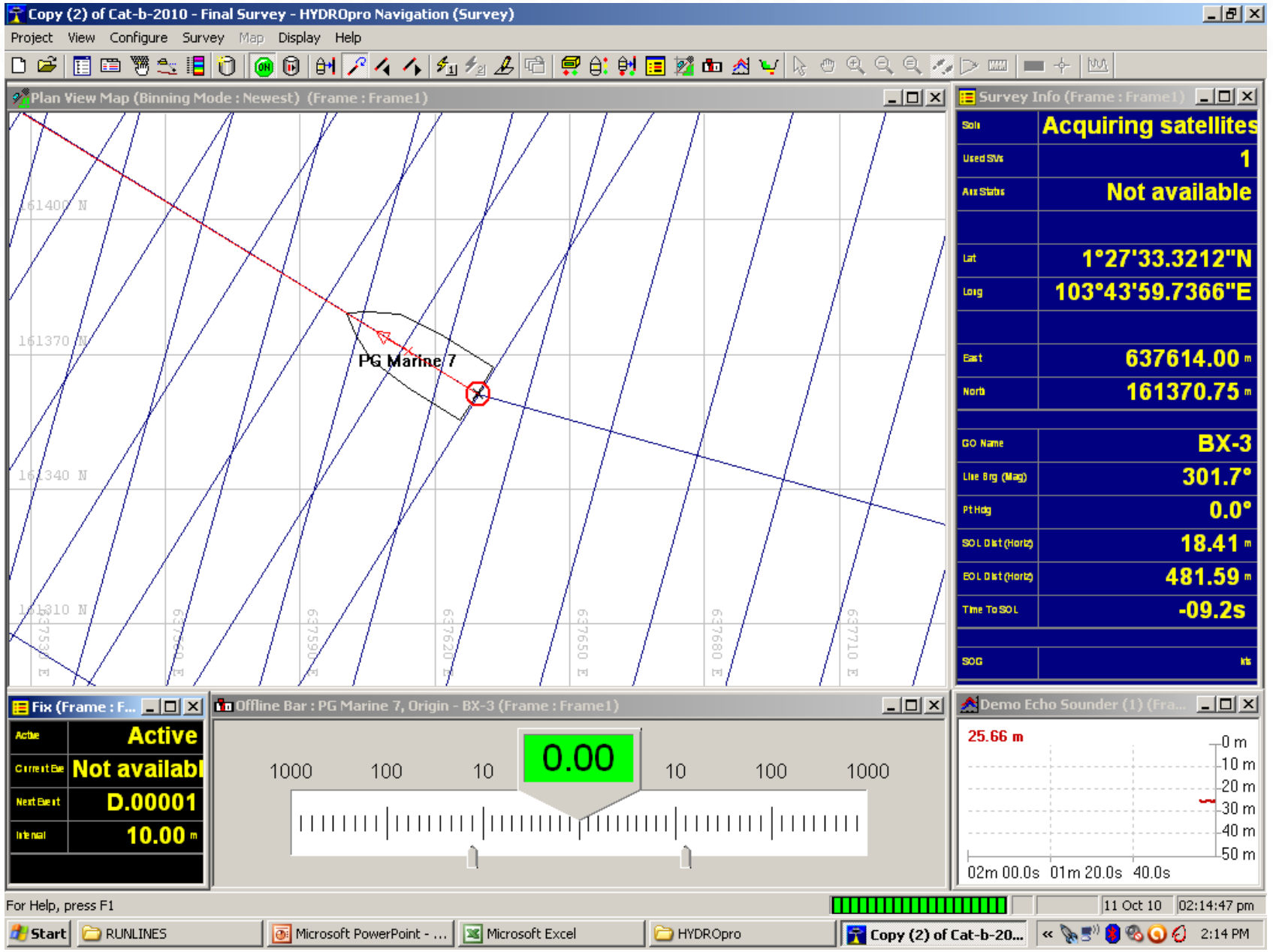
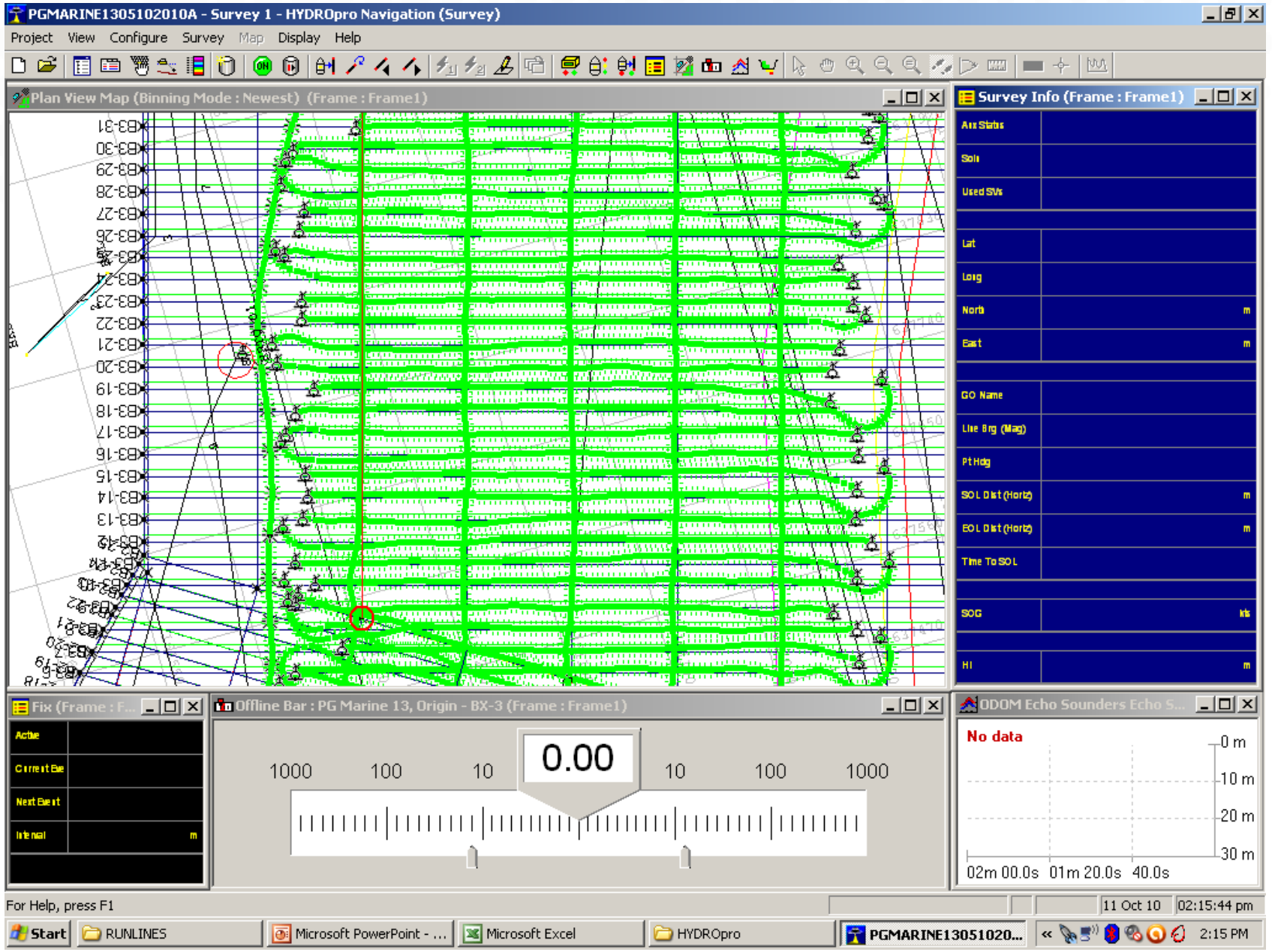
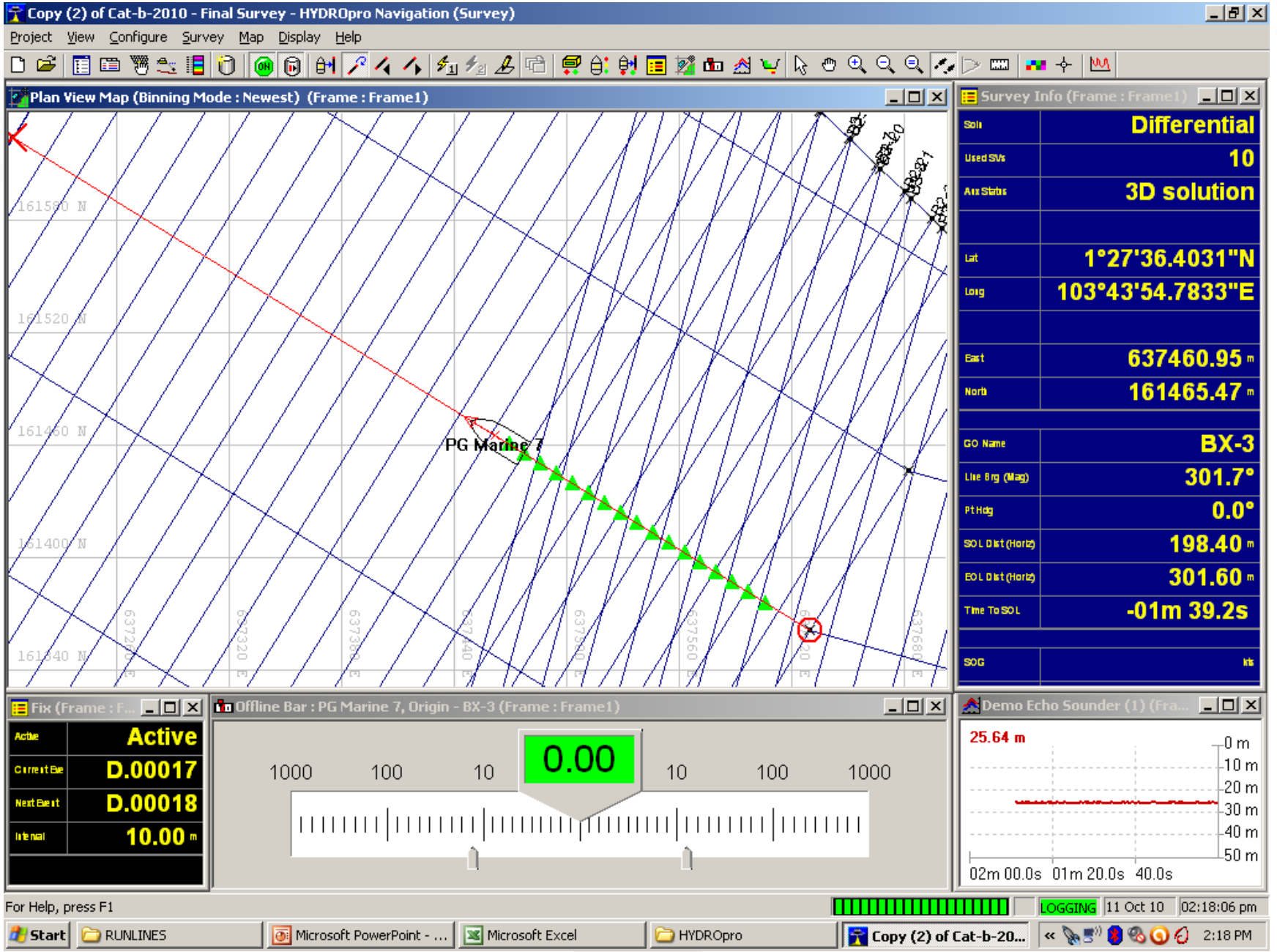
KAMPUNG SUNGAI AUR
KAMPUNG TELAGA AIR
Google Earth
Image © 2024 Airbus
4000 ft
N

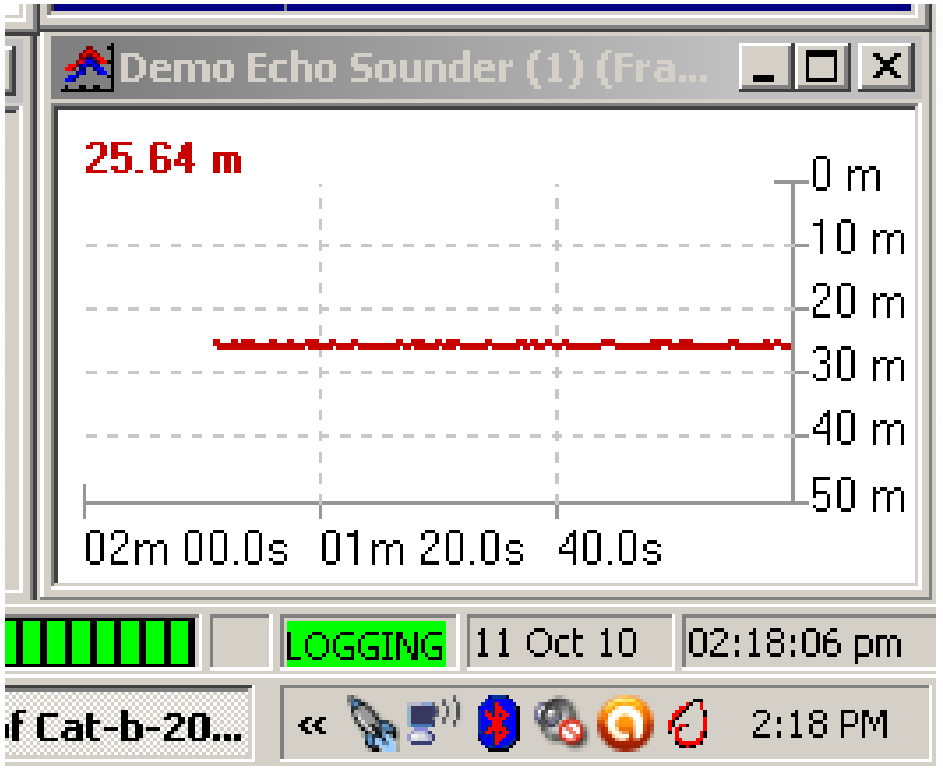
Telaga Air.kmz


Copy (2) of Cat-b-2010 - Final Survey - HYDROpro Navigation (Survey)
Project View Configure Survey Map Display Help
Plan View Map (Binning Mode : Newest) (Frame : Frame1)
PG Marine 7
Survey Info (Frame : Frame1)
Soln Acquiring satellites
Used SVs 1
Aux Status Not available
Lat 1°27'33.3212"N
Long 103°43'59.7366"E
East 637614.00 m
North 161370.75 m
GO Name BX-3
Line Brg (Mag) 301.7°
Pt Hdg 0.0°
SOL Dist (Horiz) 18.41 m
EOL Dist (Horiz) 481.59 m
Time To SOL -09.2s
SOG kts
Fix (Frame : F...
Active Active
Current Ent Not availabl
Next Event D.00001
Interval 10.00 m
Offline Bar : PG Marine 7, Origin - BX-3 (Frame : Frame1)
1000 100 10 0.00 10 100 1000
Demo Echo Sounder (1) (Fra...
25.66 m
0 m 10 m 20 m 30 m 40 m 50 m
02m 00.0s 01m 20.0s 40.0s
For Help, press F1
11 Oct 10 02:14:47 pm
Start RUNLINES Microsoft PowerPoint - ... Microsoft Excel HYDROpro Copy (2) of Cat-b-20... 2:14 PM

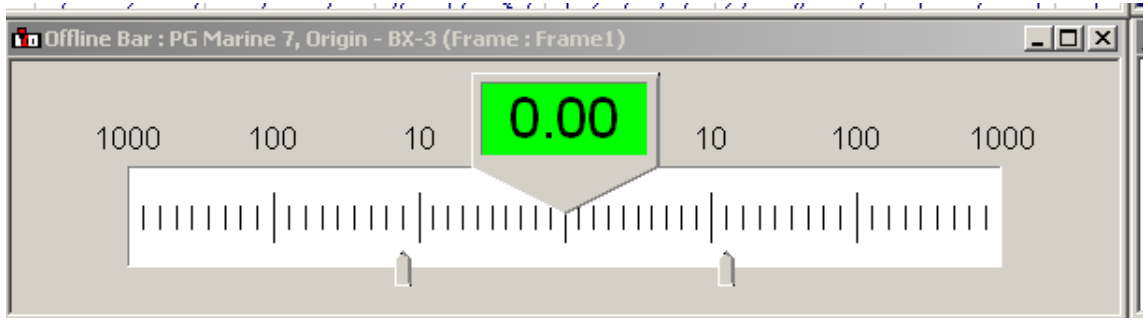

PGMARINE1305102010A - Survey 1 - HYDROpro Navigation (Survey)
Project View Configure Survey Map Display Help
Plan View Map (Binning Mode : Newest) (Frame : Frame1)
Survey Info (Frame : Frame1)
Aux Status
Sols
Used SVs
Lat
Long
North
East
GO Name
Line Brg (Mag)
Pt Hdg
SOL Dist (Horiz)
EOL Dist (Horiz)
Time To SOL
SOG
HI
Fix (Frame : F...
Active
Current Bin
Next Bin
Interval
Offline Bar : PG Marine 13, Origin - BX-3 (Frame : Frame1)
1000 100 10 0.00 10 100 1000
ODOM Echo Sounders Echo S...
No data
0 m
10 m
20 m
30 m
02m 00.0s 01m 20.0s 40.0s
For Help, press F1
11 Oct 10 02:15:44 pm
Start RUNLINES Microsoft PowerPoint - ... Microsoft Excel HYDROpro PGMARINE13051020... 2:15 PM


Copy (2) of Cat-b-2010 - Final Survey - HYDROpro Navigation (Survey)
Project View Configure Survey Map Display Help
Plan View Map (Binning Mode : Newest) (Frame : Frame1)
PG Marine 7
Survey Info (Frame : Frame1)
Soln Differential
Used SVs 10
Ant Status 3D solution
Lat 1°27'36.4031"N
Long 103°43'54.7833"E
East 637460.95 m
North 161465.47 m
GO Name BX-3
Line Brg (Mag) 301.7°
Pt Hdg 0.0°
SOL Dist (Horiz) 198.40 m
EOL Dist (Horiz) 301.60 m
Time To SOL -01m 39.2s
SOG kts
Fix (Frame : F...
Active Active
Current Evt D.00017
Next Event D.00018
Interval 10.00 m
Offline Bar : PG Marine 7, Origin - BX-3 (Frame : Frame1)
1000 100 10 0.00 10 100 1000
Demo Echo Sounder (1) (Fra...
25.64 m
0 m 10 m 20 m 30 m 40 m 50 m
02m 00.0s 01m 20.0s 40.0s
For Help, press F1
LOGGING 11 Oct 10 02:18:06 pm
Start RUNLINES Microsoft PowerPoint - ... Microsoft Excel HYDROpro Copy (2) of Cat-b-20... 2:18 PM

Port Starboard Indicator



Echo Sounder Digital trace



Data Cleaning, Processing & Thinning

01

Data Cleaning

Data cleaning of Multibeam bathymetric datasets is a critical issue. Detailed inspection must be carry out to remove the outliers soundings.

Data Interface and Processing

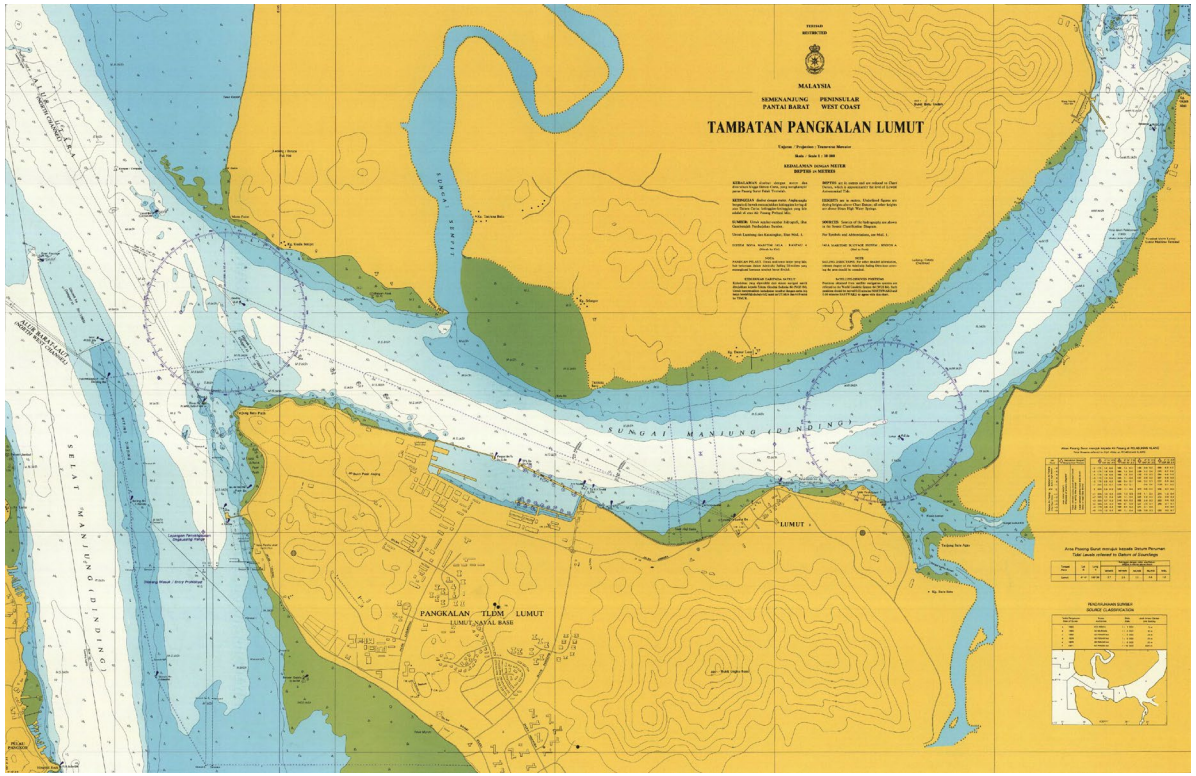
All observations are combined (merged) to produce geo-referenced depths. Tide, draft and other vessel offsets are applied during the merging process.

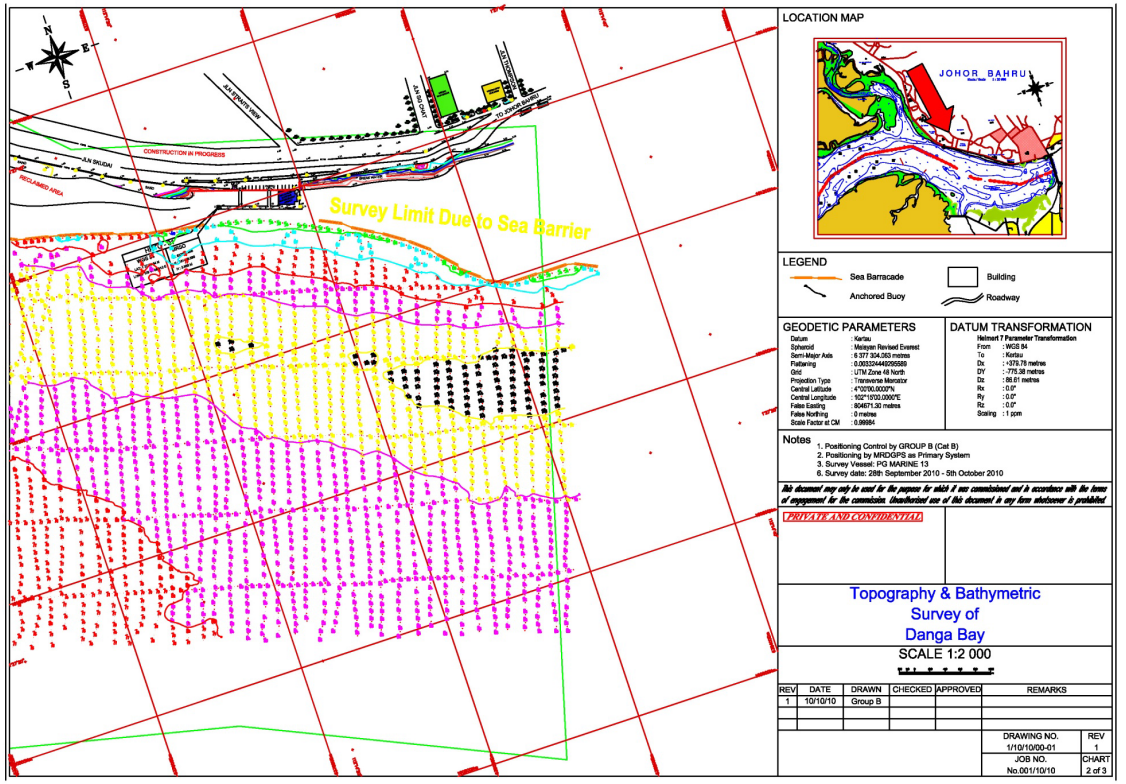
02

03

Data Thinning

A process to reduce the size, to eliminate over sampled or redundancy of MBES data.





THANK YOU

SUMMARY

- Accurate and complete recording of the shape and nature of the seafloor is the central theme of hydrography.
- Although there are a variety of mechanical, electromagnetic and inspection methods which can used in special circumstances, the workhorse of hydrography is the acoustic echo sounder


SAFETY
FIRST

"Safety First"

It's Always Best to Avoid any Unnecessary Risks

THANK YOU

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UNIVERSITI TEKNOLOGI MALAYSIA

In the Name of God for Mankind

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SAFETY COMES FIRST
ARRIVE SAFE • WORK SAFE • GO HOME SAFE