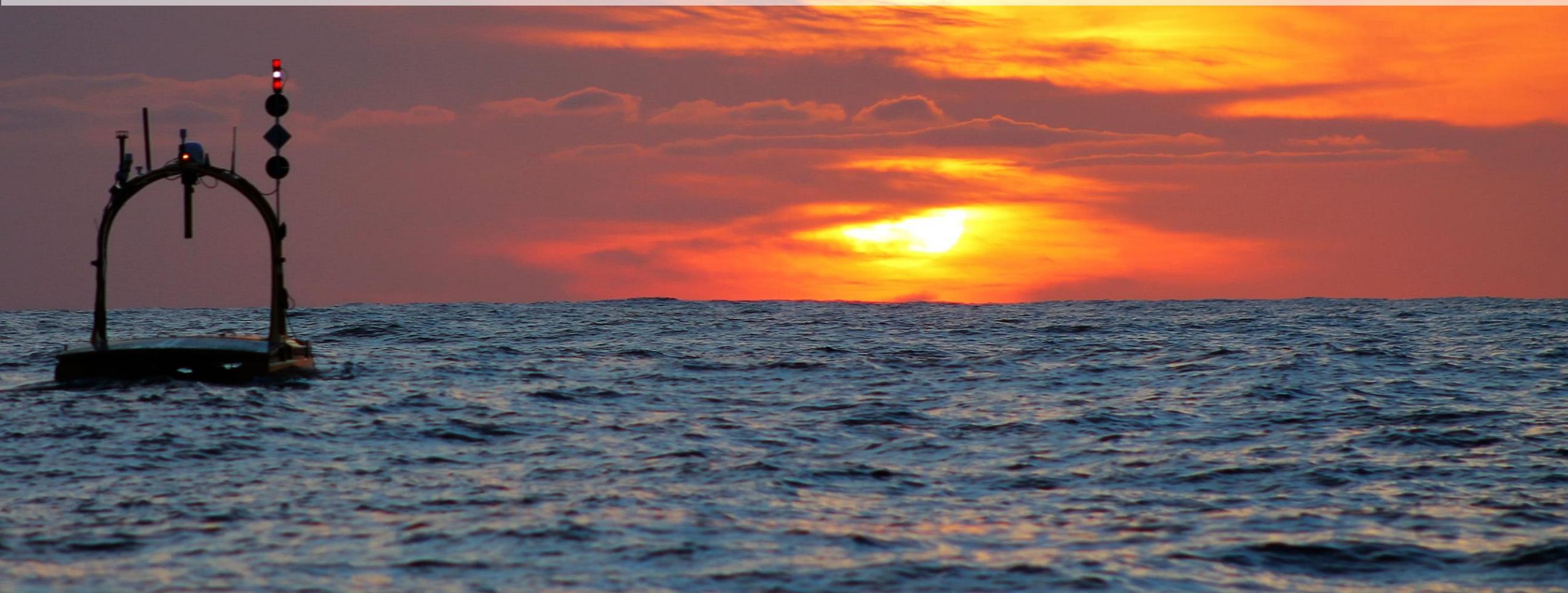
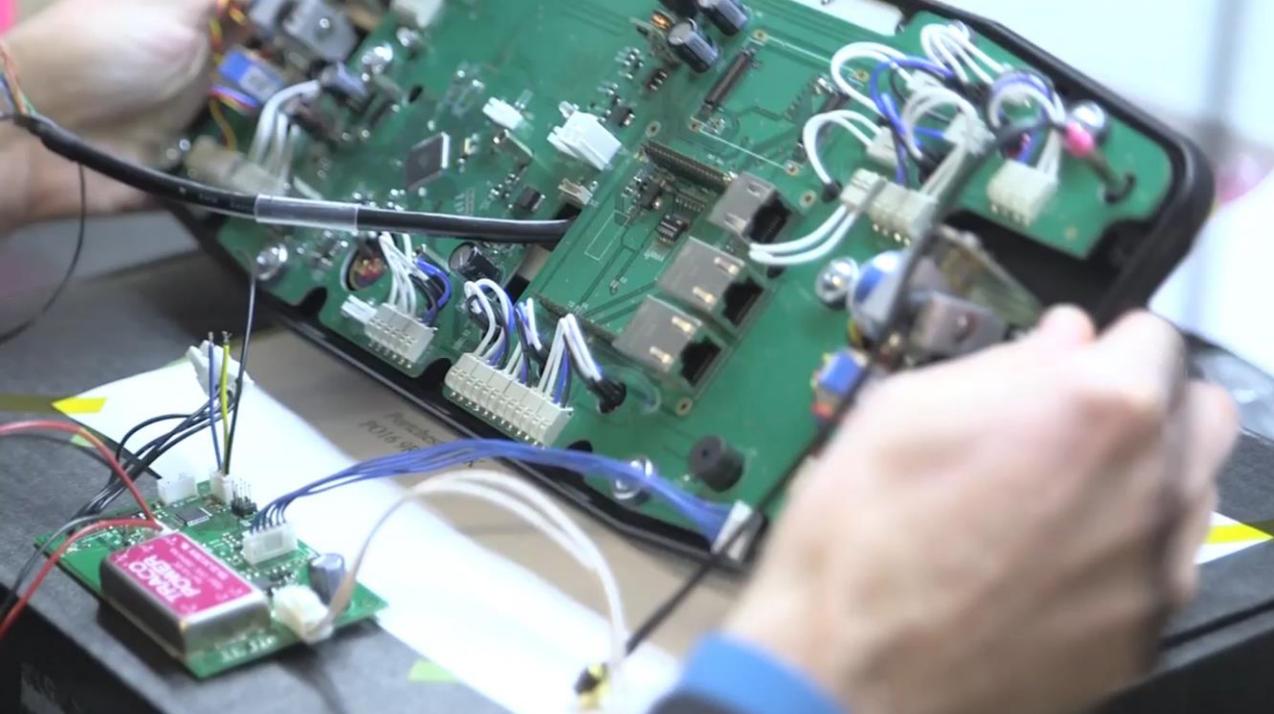
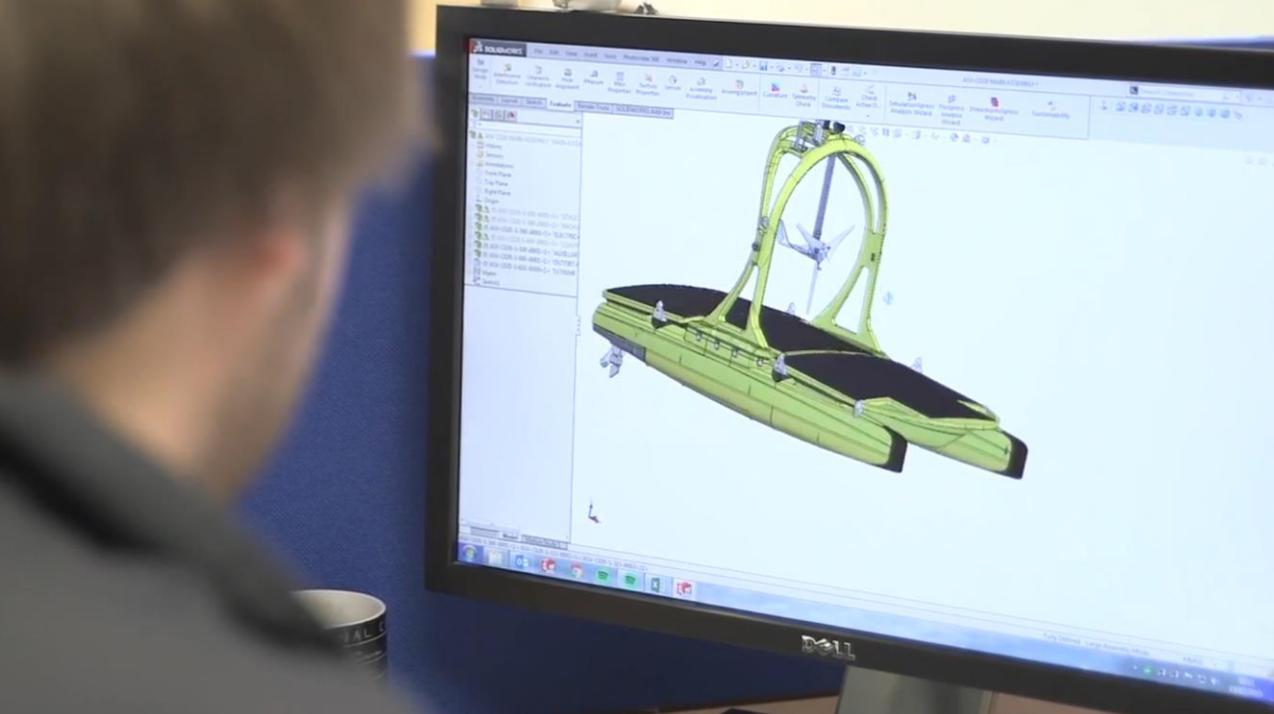


The Operational Relevance of Autonomous Surface Vessels







ASV Development path

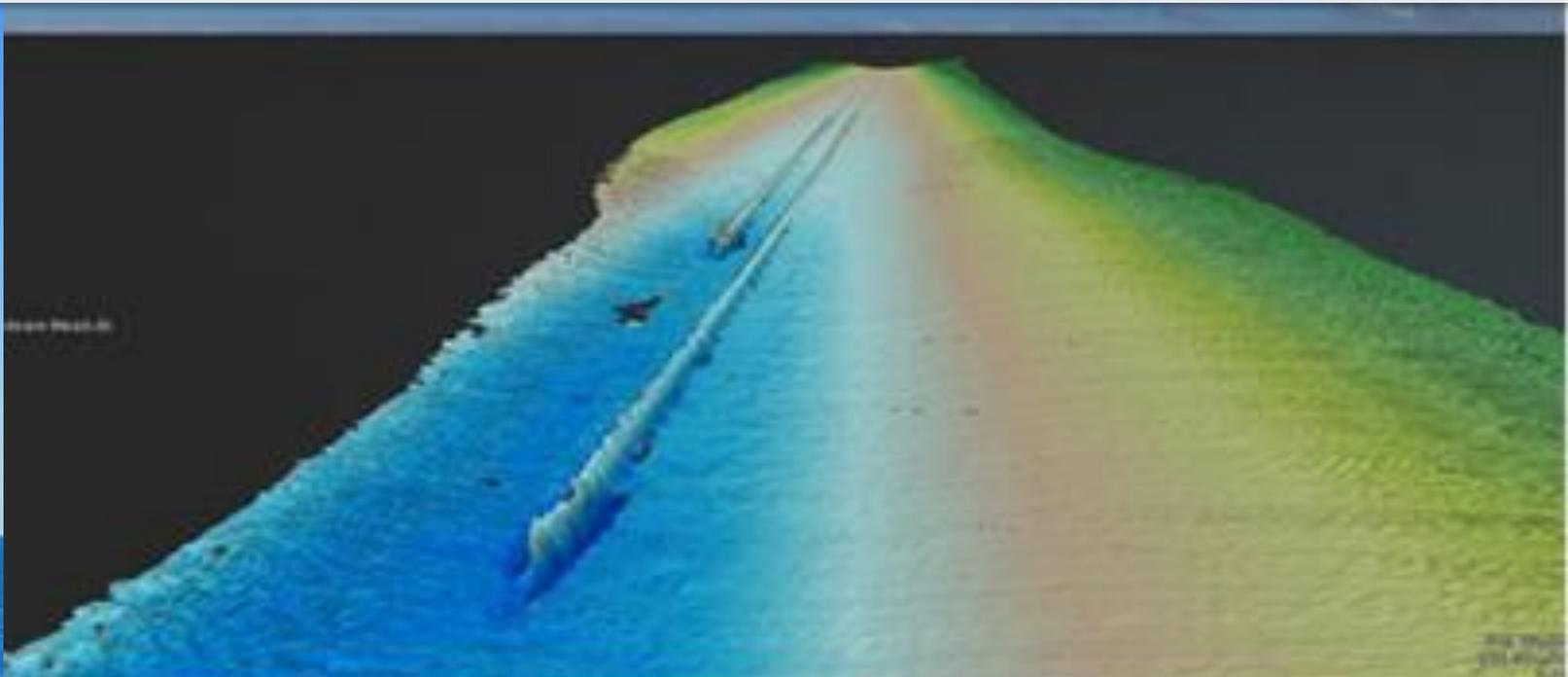


Applications to date:

- **Hydrography** – NOAA and other seabed charting operations
- **Marine construction survey support** - (USBL, TDM/ROV tracking, LBL array setup)
- **Environmental** – Passive acoustics, seep/leak detection, water quality, LiDAR
- **Data Conduit** – Low cost upload from seabed data loggers
- **Security** – Harbor security, 24/7 unmanned monitoring, cameras, IR, other
- **Metocean** – ADCPs, Loop Current monitoring
- **Seismic survey support** – USBL, CTD, PAM, ADCP
- **Military** – Targets, MCM, AUVs/ROVs, surveillance, scouting
- **Deep tow body tracking** (UXO, Geophysical)
- **Conversions** – RHIBs, FRC, Patrol Boats, Crew Boats, Survey Boats



Egypt – SS7 pipeline touchdown monitoring and as-laid surveys





ASV unmanned
marine systems

2005 – 2017

1275 days

of unmanned
operations

C-Worker 5



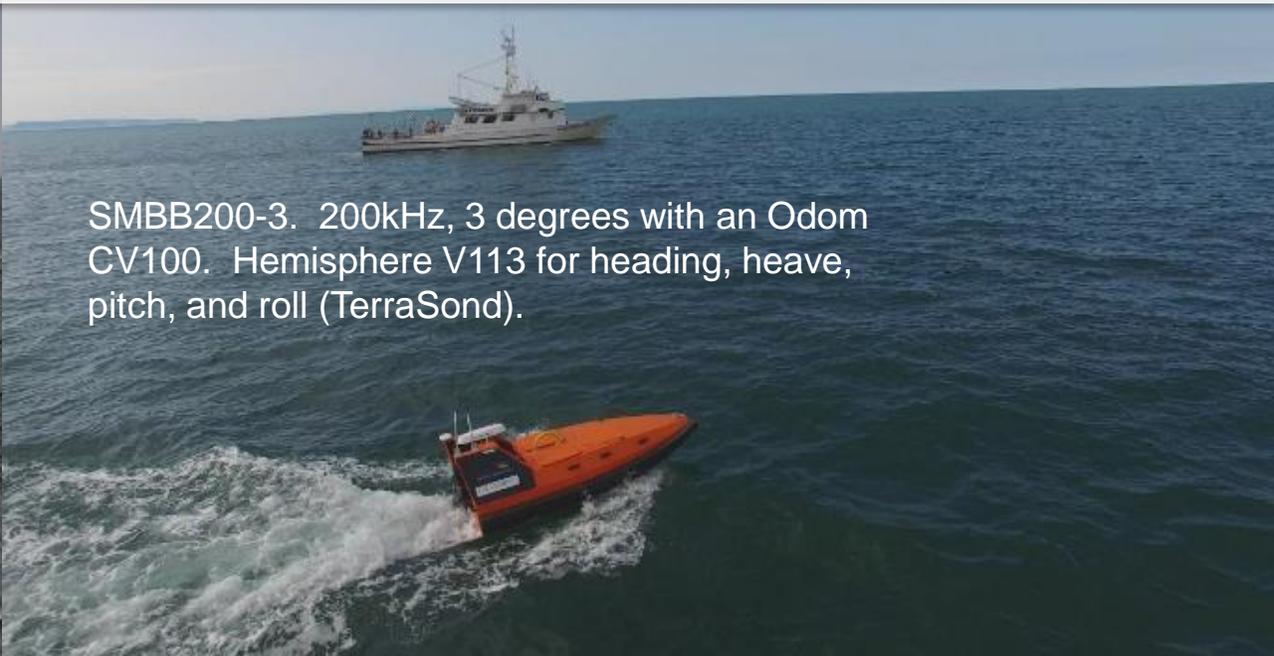


In parallel with DEA vessel
EdgeTech 6205 MPE & Sidescan

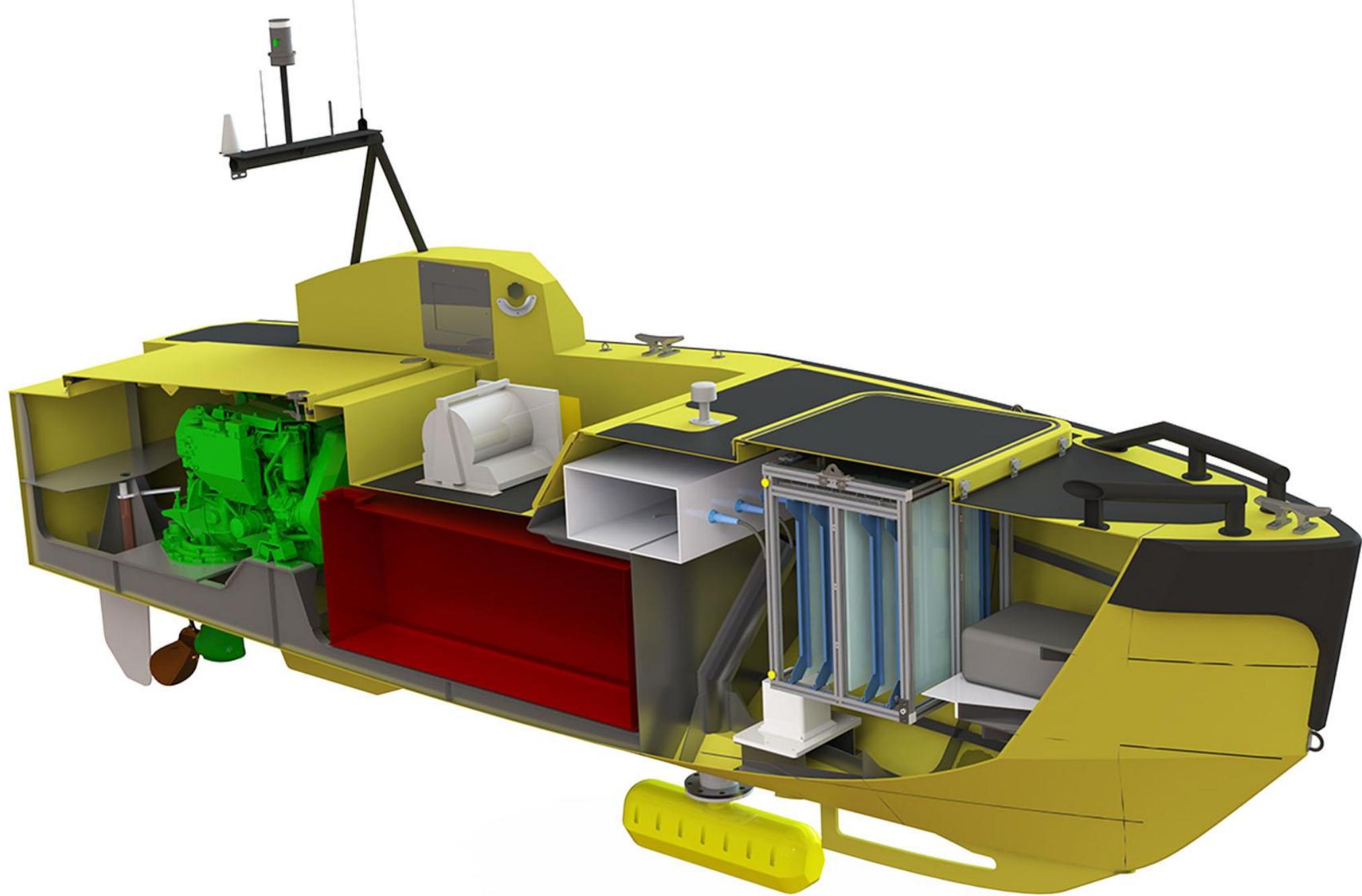
Initial Force multiplier missions



Kongsberg 2040C Multi Beam Bathymetry,
EdgeTech 4125 Sidescan with Tow Fish &
winch, IXSEA Octans 3000 TI IMU (C&C)

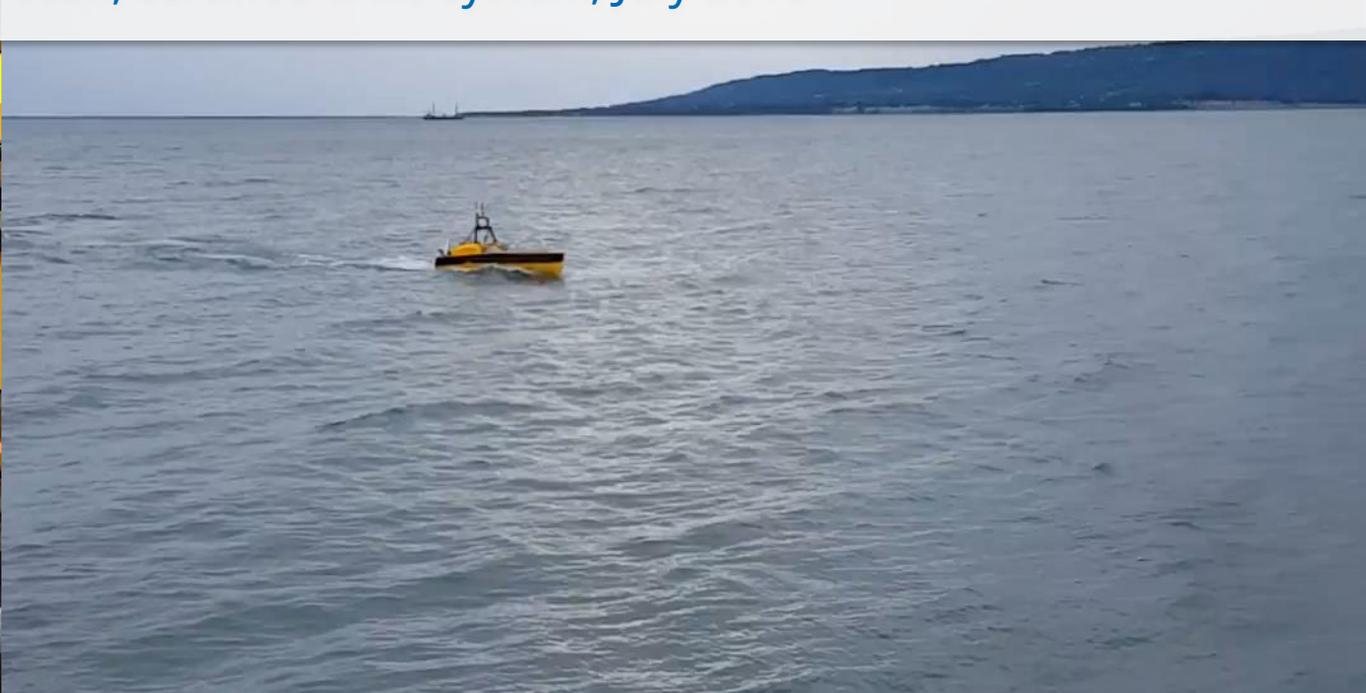


SMBB200-3. 200kHz, 3 degrees with an Odom
CV100. Hemisphere V113 for heading, heave,
pitch, and roll (TerraSond).



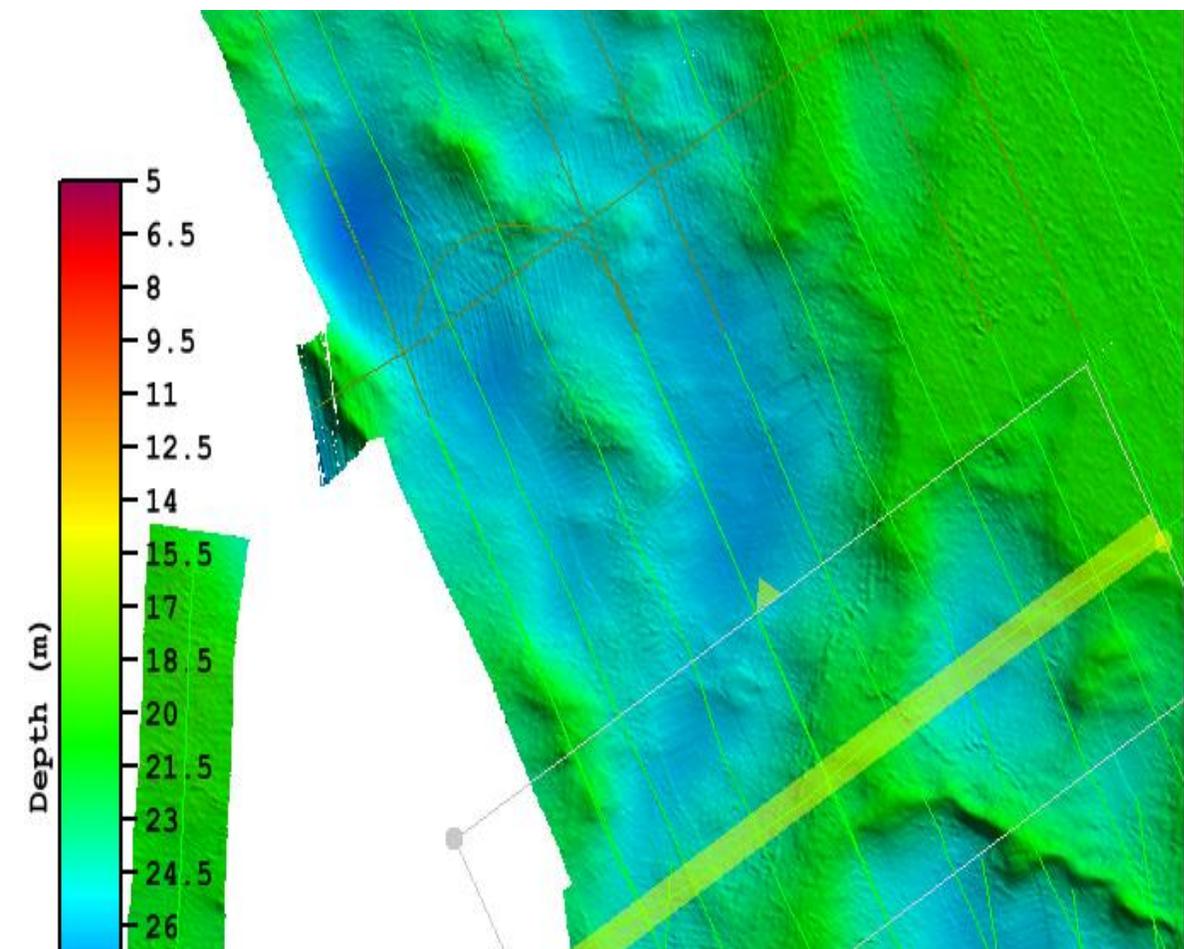


Alaska, MBES with towed side scan, certified LARs system, July 2016



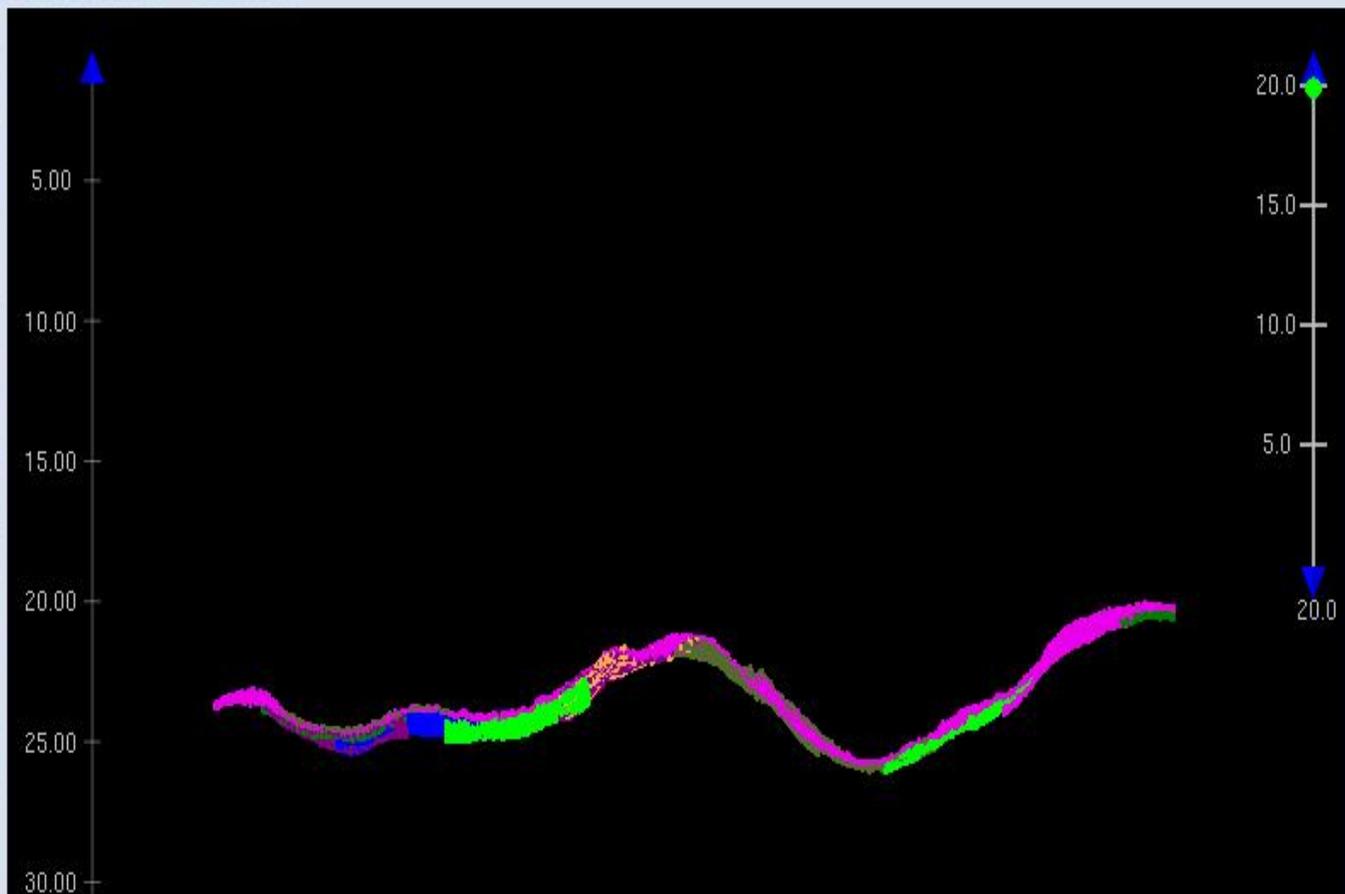


ASV



Crosslines intentionally ran to cross other vessel's lines for QC purposes

Subset Editor - 2D View



**Q105 (purple) crosses ASV and other
Q105 lines On average, agreement within
0.05 m**



Applications Places Camera View: Underwater Wed 16:55

ASView-Bridge

Camera View: Forward

DATE: 2016/08/03 TIME: 03:55:36PM

HEADING 244 ° SOG 3.6 kts POSITION 50°53.324'N 001°23.531'W

Active

C-Worker 5

E-STOP

Propulsion

Engine

| | | | |
|-----------|------------------|---------|-------|
| Automatic | Stop | Start | |
| Automatic | Mode | Running | State |
| 995 | RPM | 0.0 | L/h |
| 76 | °C | 26 | °C |
| 268000 | N/m ² | 13 | Hours |

Gear

| | | | |
|-----------|------|----|--------|
| Automatic | F | N | R |
| Forward | Gear | OK | Status |

Reset Send

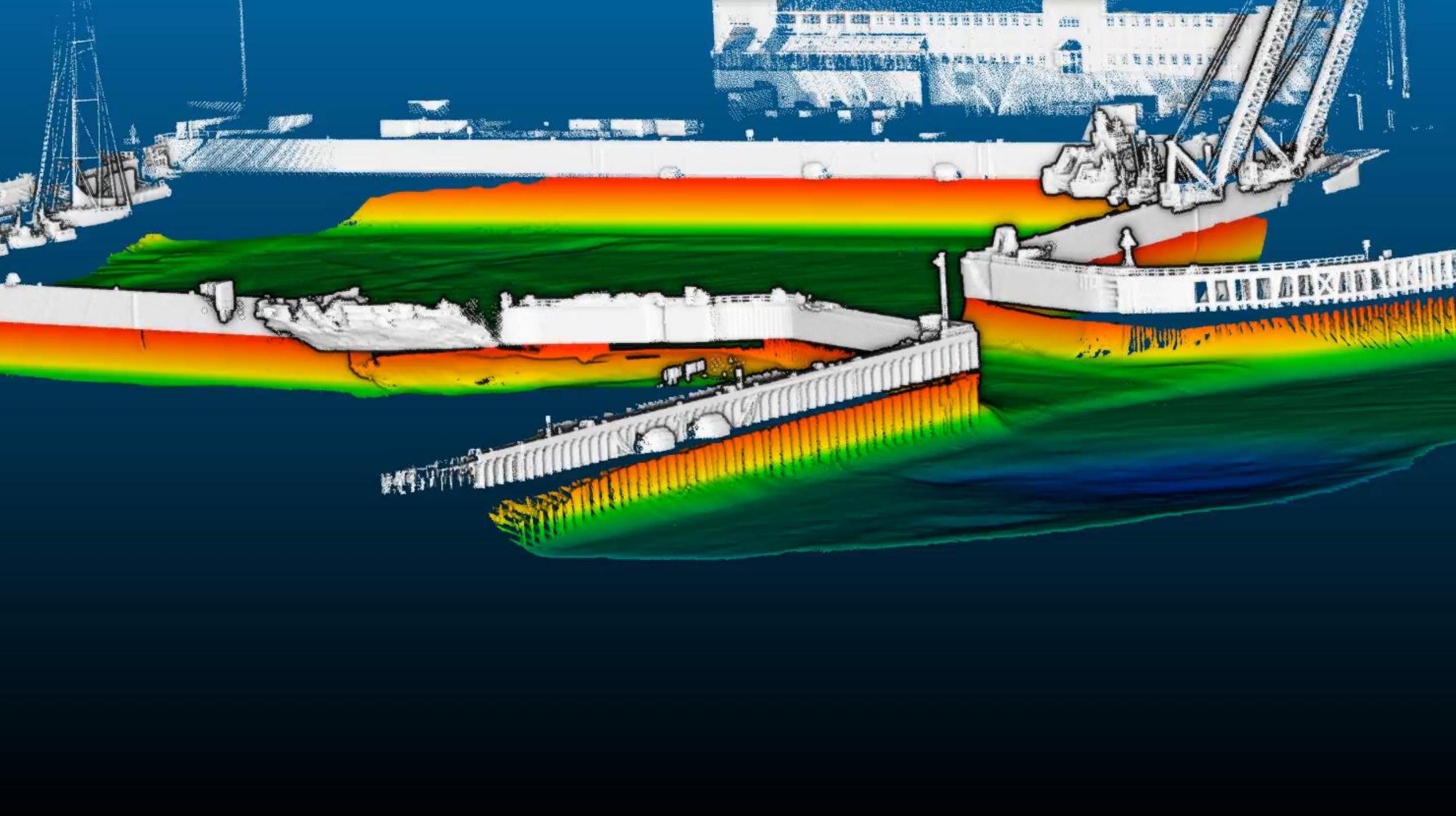
C-Worker 5 Active

HEADING 244 ° SOG 3.6 kts

50°53.085'N 001°23.566'W

how Hel lew cha





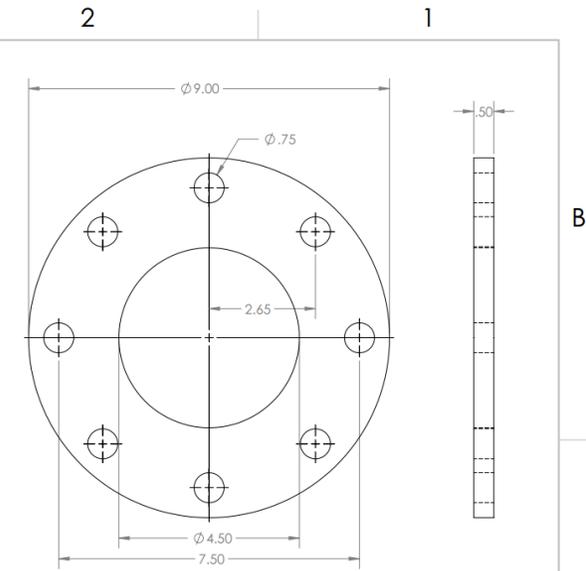
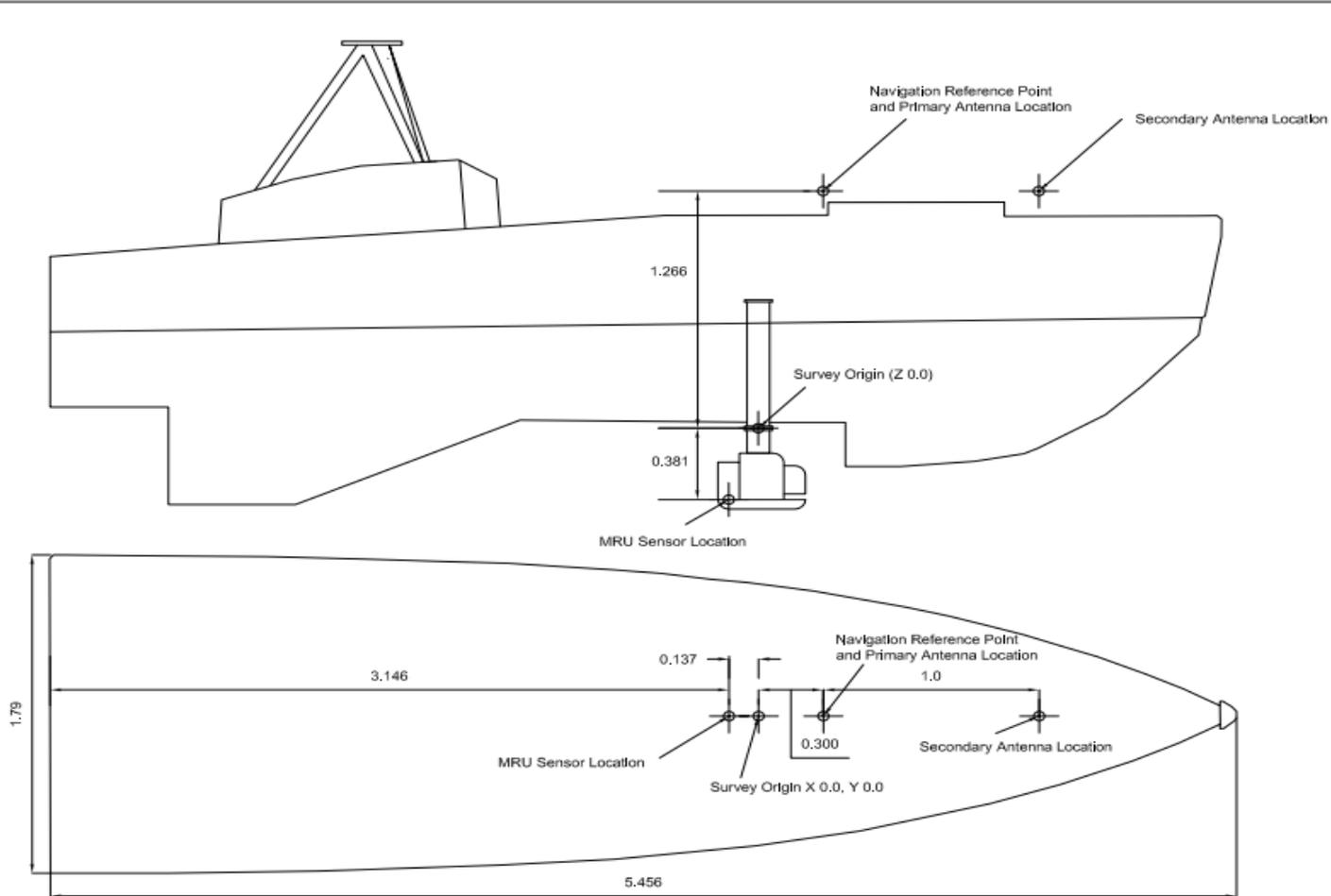


Challenges:

- Mobilisation - Logistics
- Operators and Operator Training
- Payload Integration
- Data Link is critical
- Escort Vessel
- COLREGS
- Full Autonomy
- Trust







| | | | |
|--|--|---|--------------|
| ANY AND CONFIDENTIAL INFORMATION CONTAINED HEREIN IS THE SOLE PROPERTY OF NEPTUNE GEOMATICS. IT IS TO BE KEPT IN CONFIDENCE AND NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF NEPTUNE GEOMATICS. | DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR MATCH ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ± | DRAWN CHECKED ENCL. APPR. D.A. COMMENTS: | NAME DATE |
| NEXT ASSY USED ON APPLICATION | FINISH DO NOT SCALE DRAWING | REV. (DWG. NO.) A FLANGE SCALE: 1:1 INCHES SHEET 1 OF 1 | REV. |



Neptune Geomatics
 A Neptune Marine Services Company
 404 Orrong Rd Welshpool, W.A. 6106
 Phone +61 8 6242 2222
 Fax +61 8 6242 2211
 ABN 47 108 312 787

**ASV OFFSET DIAGRAM
 GEOSWATHE SETUP**

| | |
|----------|---------------|
| REV. NO. | 0 |
| DATE | 20 APRIL 2017 |
| | |
| | |





MRU-6+ 870 24411
KONGSBERG SEATEX

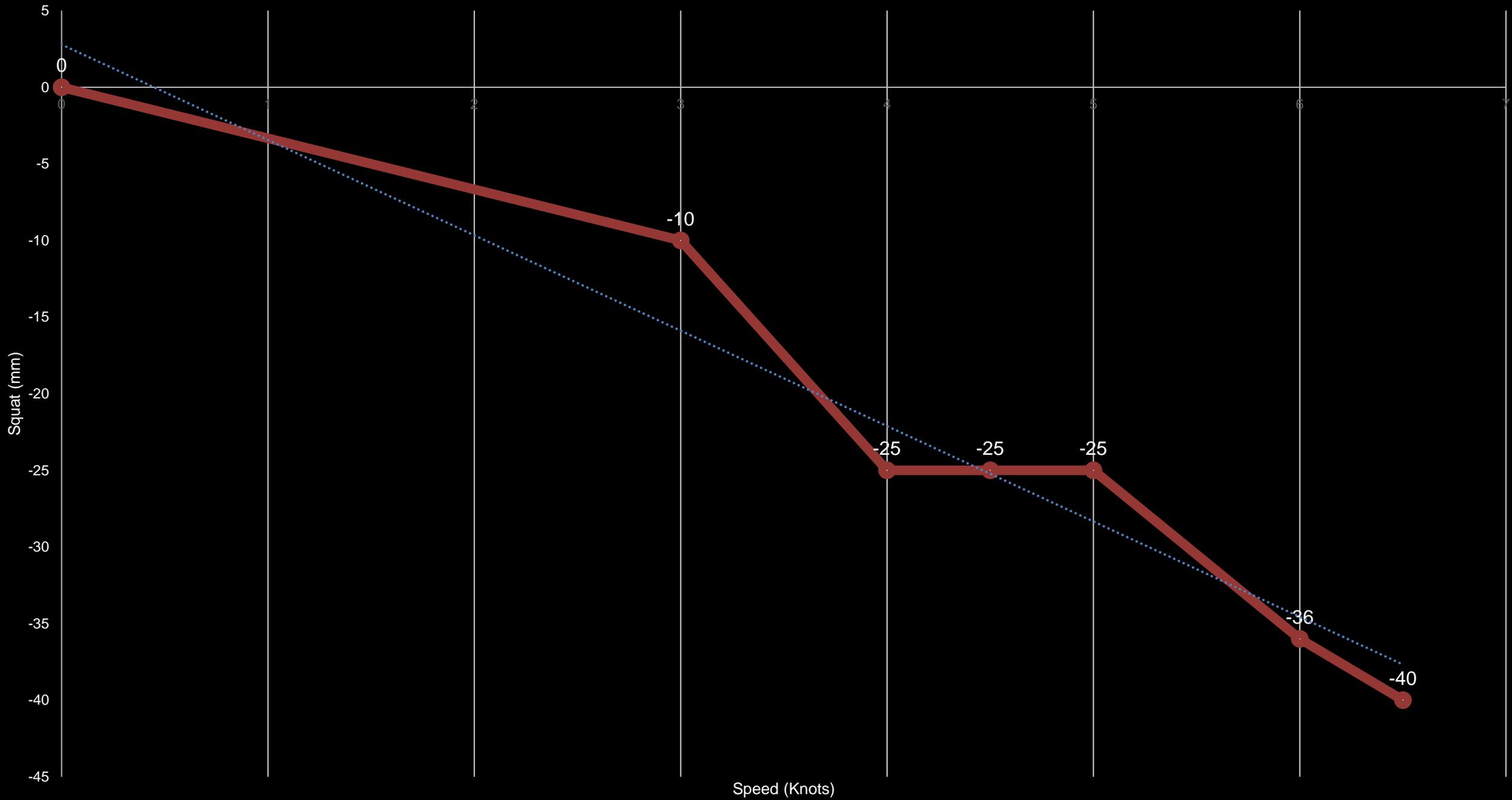


KONGSBERG SEATEX

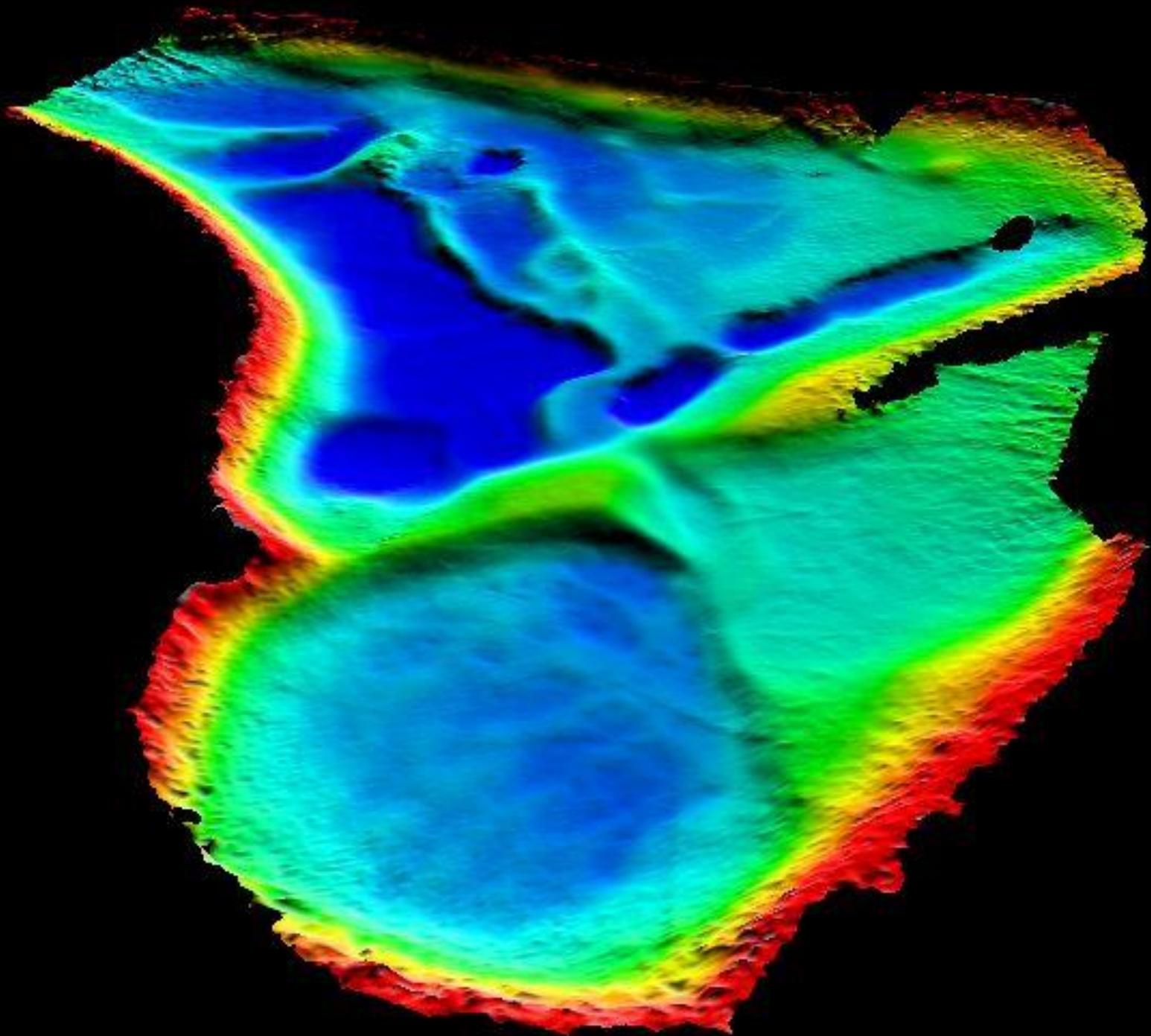
PORT

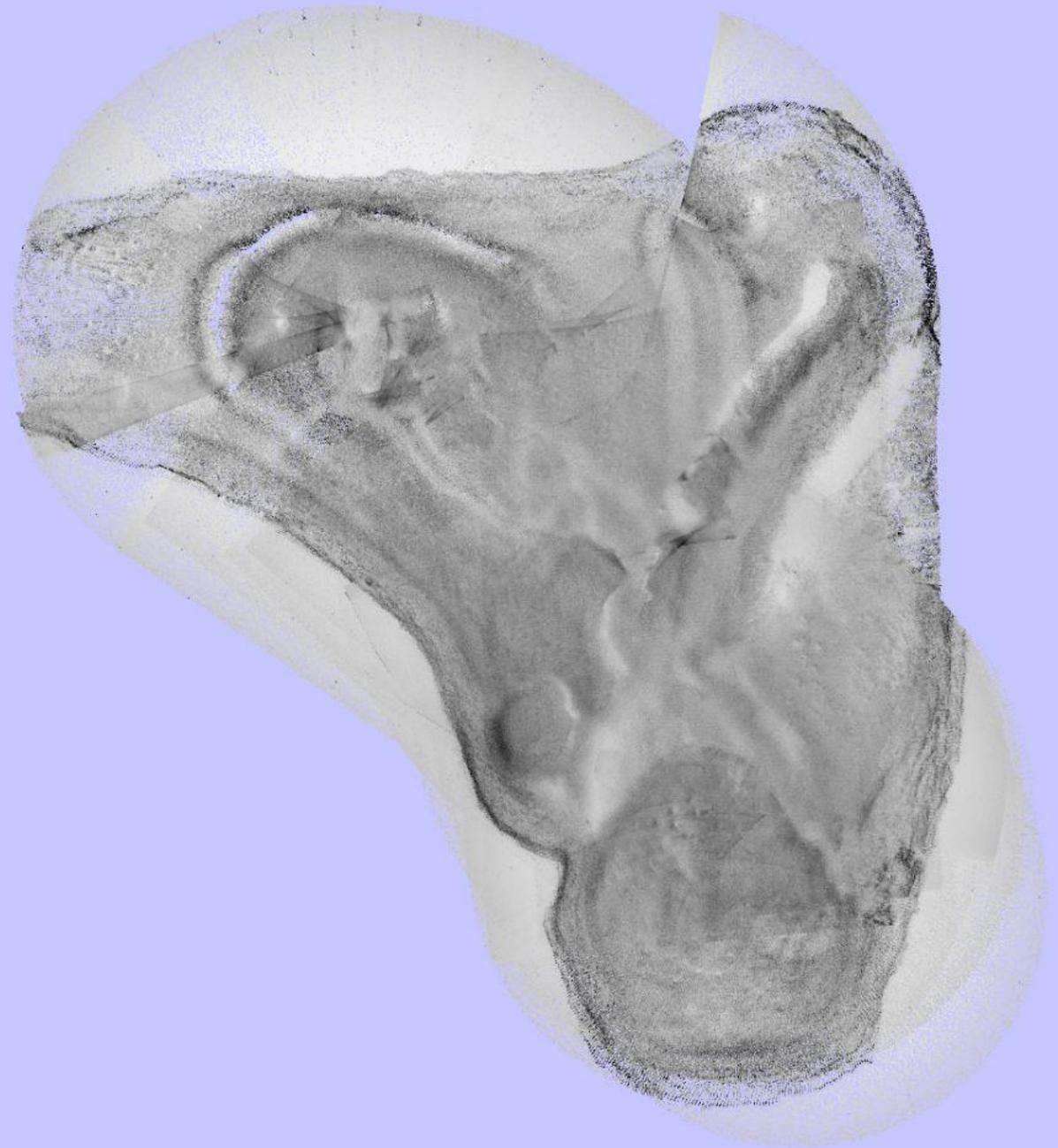
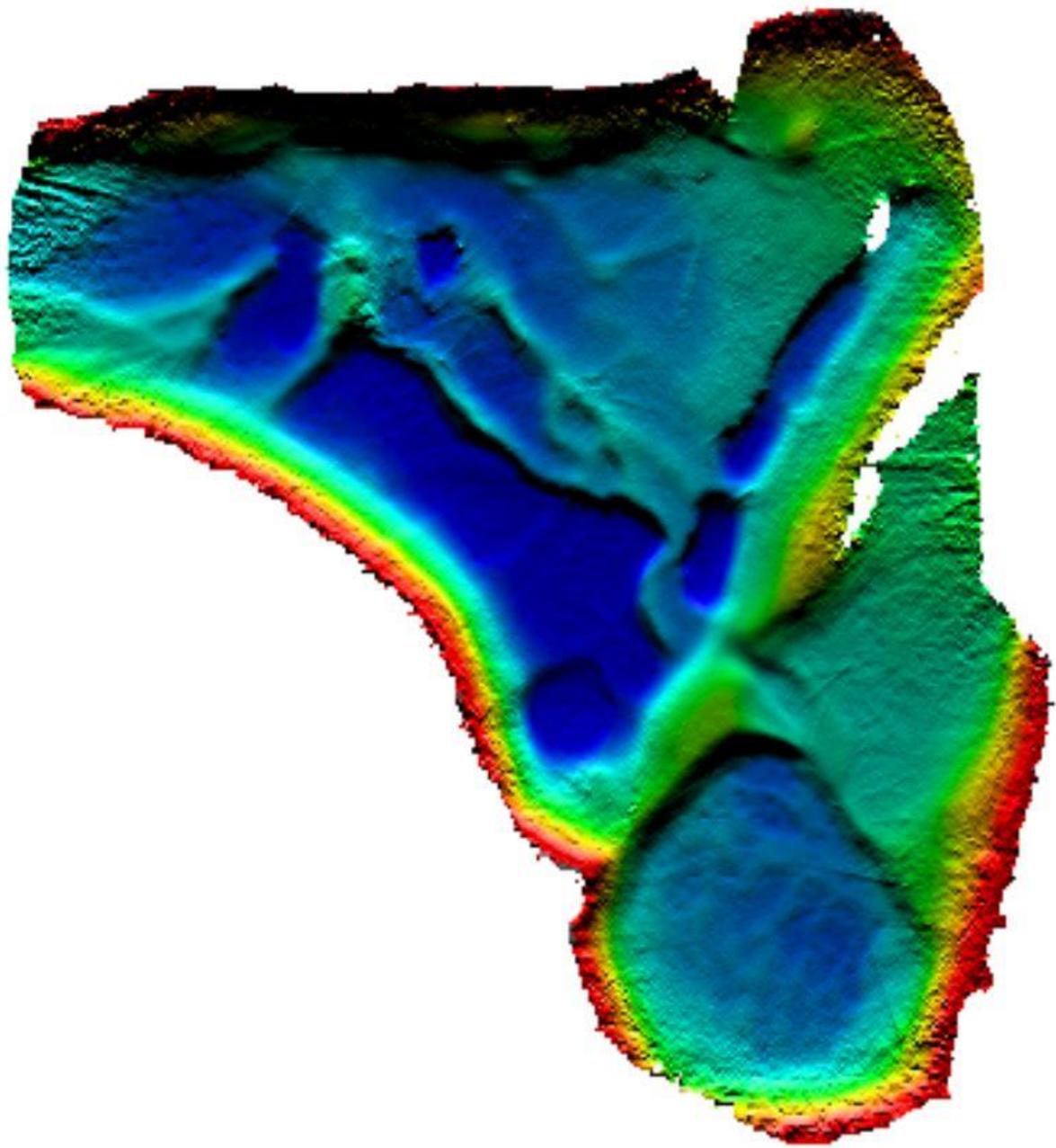


Squat(mm)/Speed(knots)











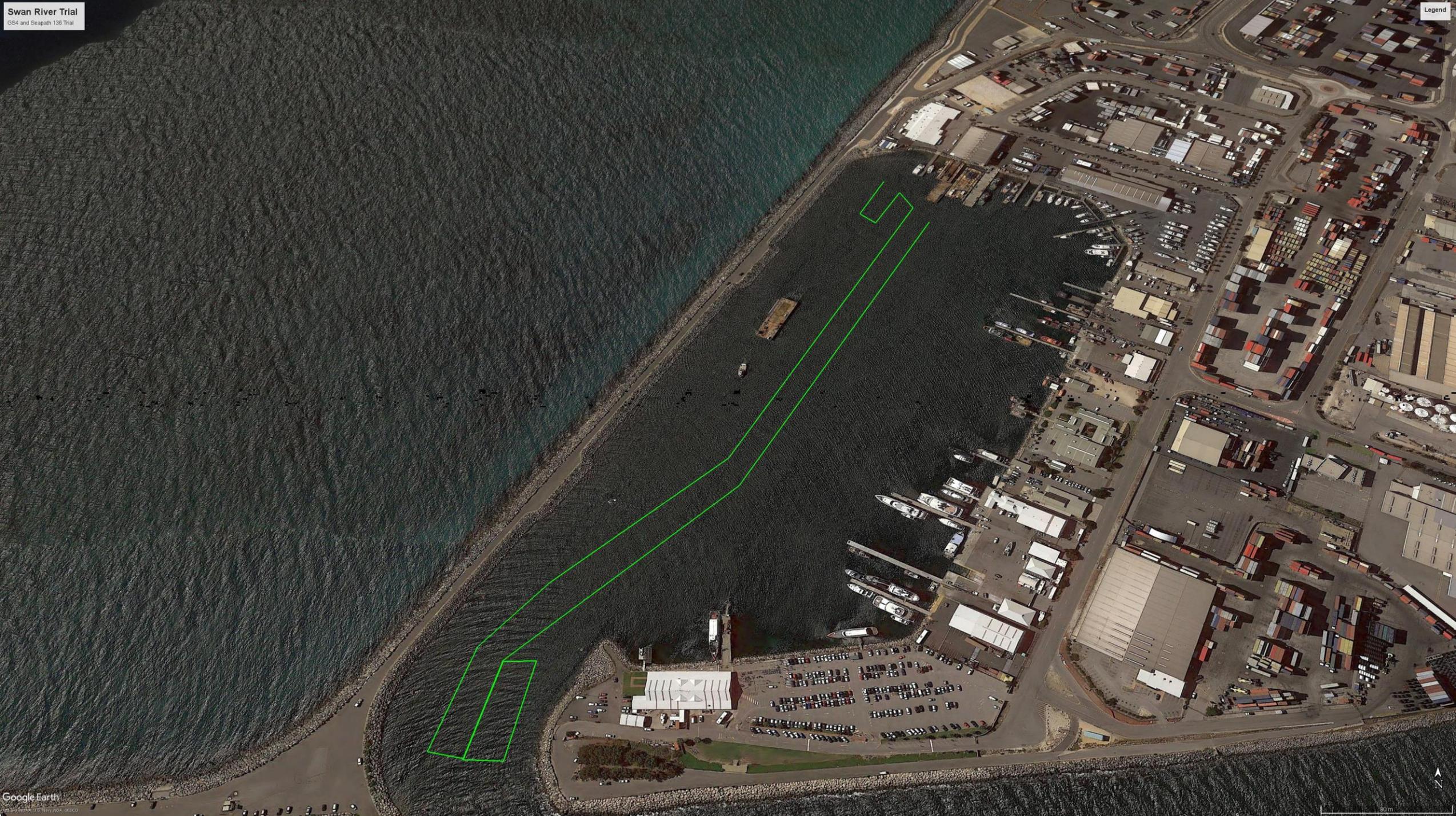


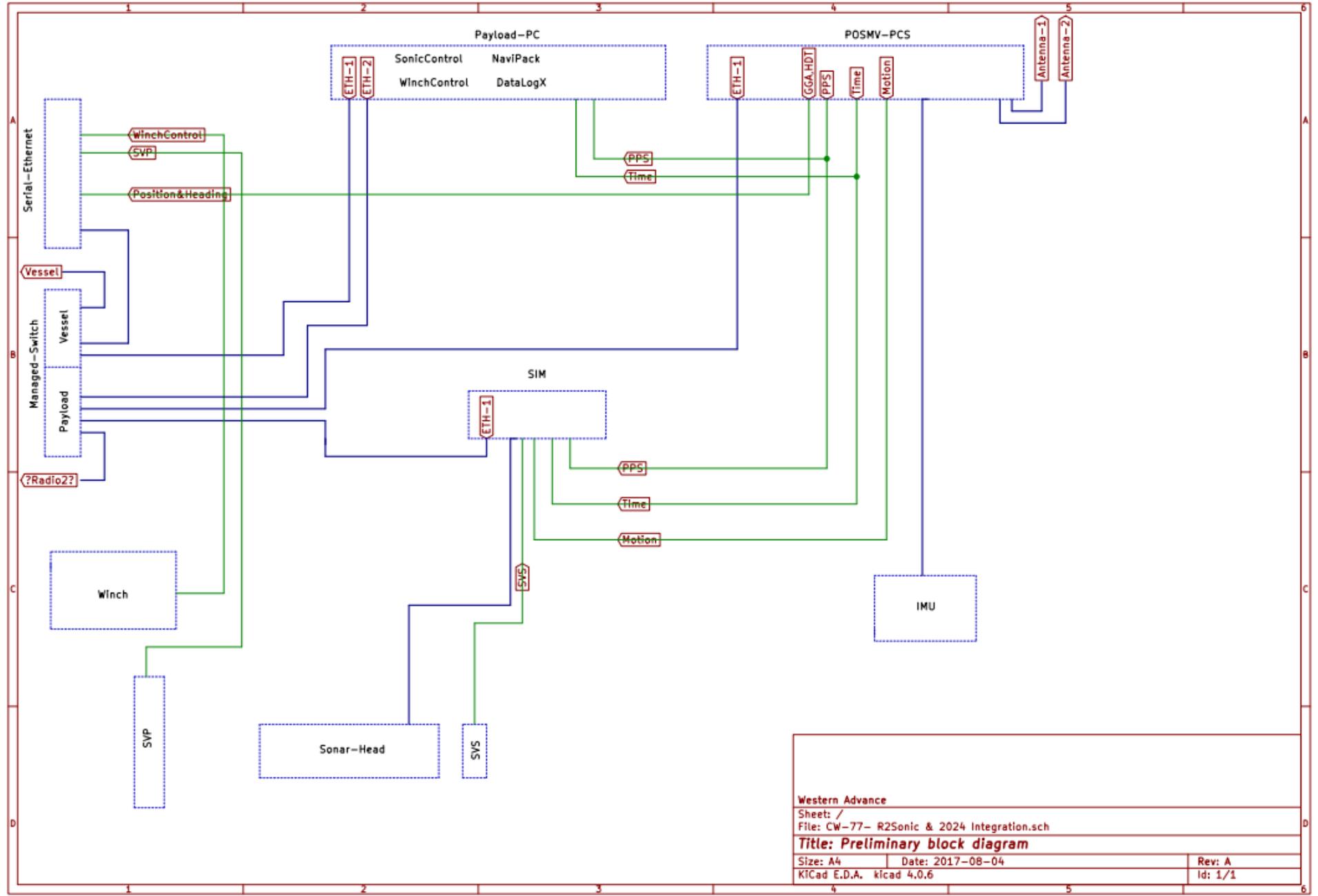


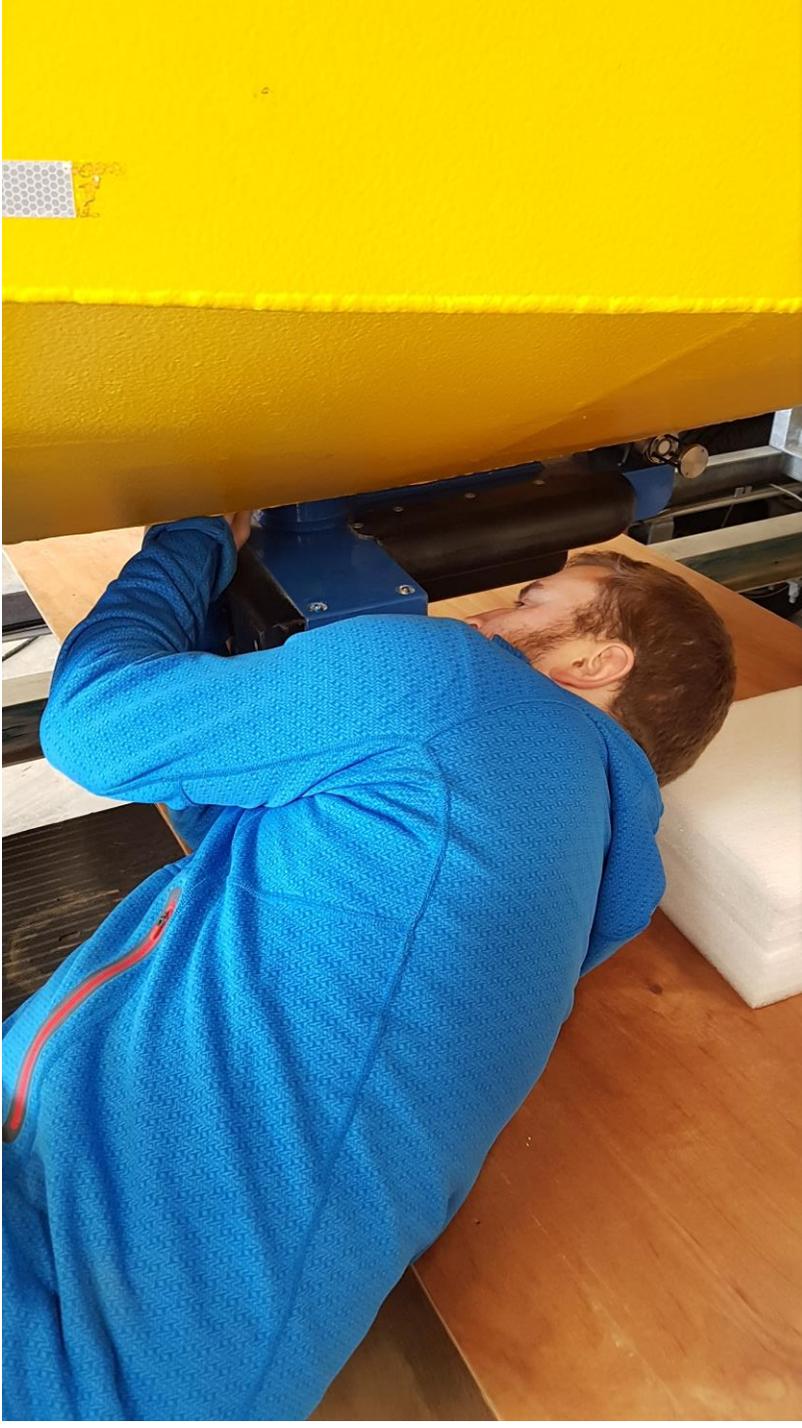
9529

CW77

ASV







Lever Arms & Mounting Angles

Lever Arms & Mounting Angles | Sensor Mounting | Tags, AutoStart

| Ref. to IMU Target | IMU Frame w.r.t. Ref. Frame | Target to Sensing Centre | Resulting Lever Arm |
|--------------------|-----------------------------|--------------------------|---------------------|
| X (m) -0.004 | X (deg) 0.000 | X (m) 0.000 | X (m) -0.004 |
| Y (m) -0.006 | Y (deg) 0.000 | Y (m) 0.000 | Y (m) -0.006 |
| Z (m) -0.120 | Z (deg) 0.000 | Z (m) 0.066 | Z (m) -0.054 |

| Ref. to Primary GNSS Level |
|----------------------------|
| X (m) -0.395 |
| Y (m) -0.007 |
| Z (m) -0.921 |

Notes: 1. Ref. = Reference
2. w.r.t. = With Reference
3. Reference Frame

Ok
In Navigation Mode

Communication Settings

Network | Sensor

| | GPS | Motion | Heading | SVP |
|-----------|-----------------|------------------|---------|--------|
| Interface | RS-232 | RS-232 | Off | RS-232 |
| Baud | 9600 | 115200 | 9600 | 19200 |
| Data Bits | 8 | 8 | 8 | 8 |
| Parity | None | None | None | None |
| Stop Bits | 1 | 1 | 1 | 1 |
| IP | 10 . 0 . 0 . 44 | 10 . 0 . 0 . 145 | | |
| Port | 5606 | 22222 | | |
| PPS Edge | Falling | | | |

Trigger In: Free Run
Trigger Out: Rising Edge

Cancel Apply

Range 50 m Power 0 dB Gate Min 11.6 m Brightness 30 dB
Pulse Width 15 µs Gain 7 Gate Max 27.2 m Gate Slope 3°

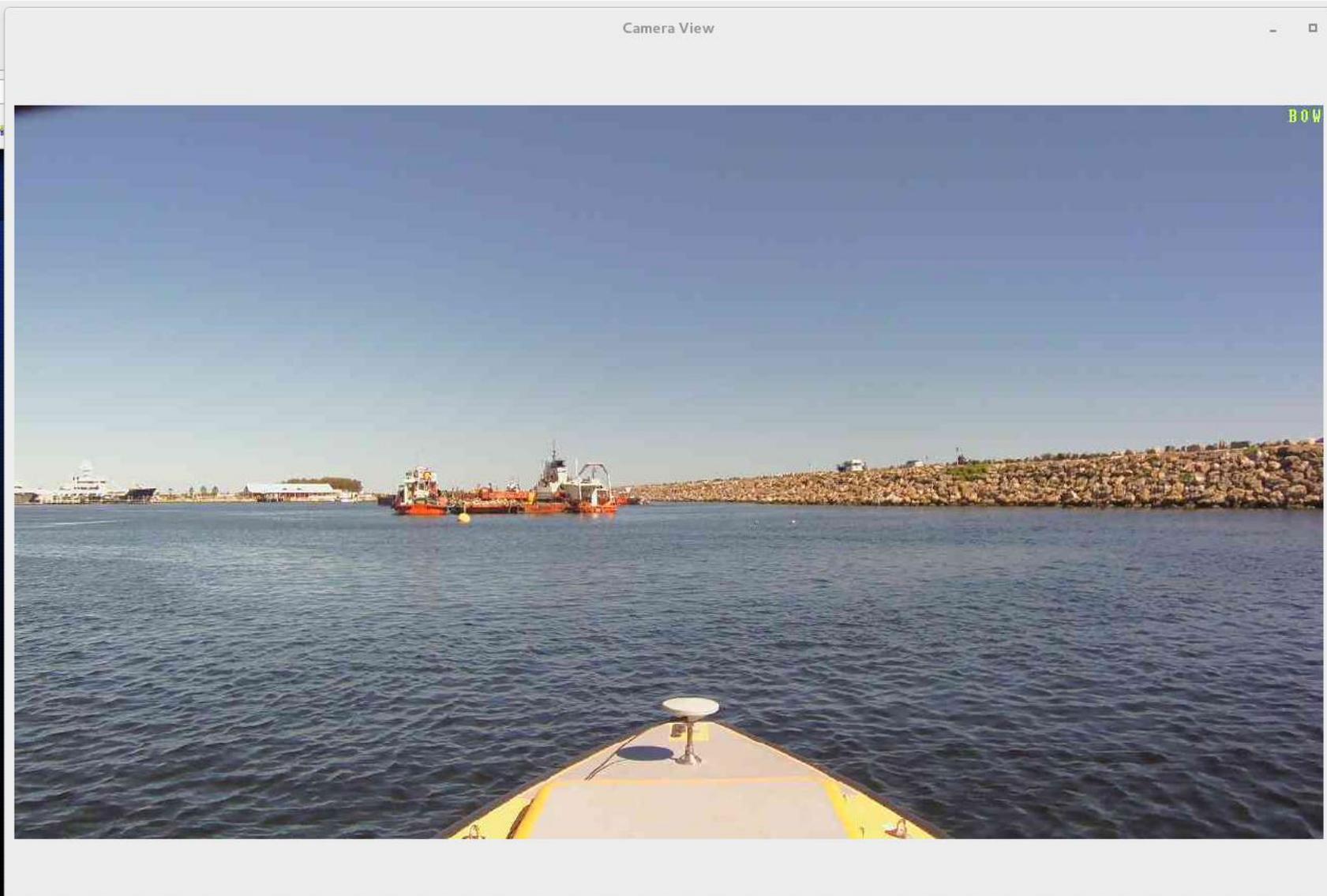
W: 129° f: 400 kHz
T: 0.0° c: 1300.0 m/s
BSM: ea1 PR: 2.0 Hz
D: 25.82 m

PPS MRU SVP TRG Pwr 08/22/2017 07:06:46

ASV-RackModuleRela... x +

192.168.1.151/ProXR/Relays.html

C-Worker 5 Bookma... ▾ Most Visited ▾ Centos



[Navigation Icons: Star, Home, Refresh, Download, Home, Menu]

Transfer

02.SBD, J236N003.SBD, J236N004.SBD,

Control Plan

Pause Resume Abort Execute

Vehicle State

Active Pause Recover Config

Steering

Steering Inactive

Thrust Inactive

Reset Send

Engine

Automatic Force Stop Force Run

| | | | |
|----------------------|------------------|----------------|-------|
| Force Running | Mode | Running | State |
| 998 | RPM | 0.8 | L/h |
| 74 | °C | 24 | °C |
| 292000 | N/m ² | 151 | Hours |

Gear

Automatic F N R

Neutral Gear OK Status

Reset Send

Diagram Propulsion

| | | |
|---------|-------------|-----------------------------|
| COG | SOG | POSITION |
| 249° | 0.5 kts | 32°02.894'S 115°43.876'E |
| HEADING | WATER DEPTH | EMERGENCY STOP |
| 221° | 5.9 m | |

Control Plan

Back Mission 2 [Created 2017-08-24] Li

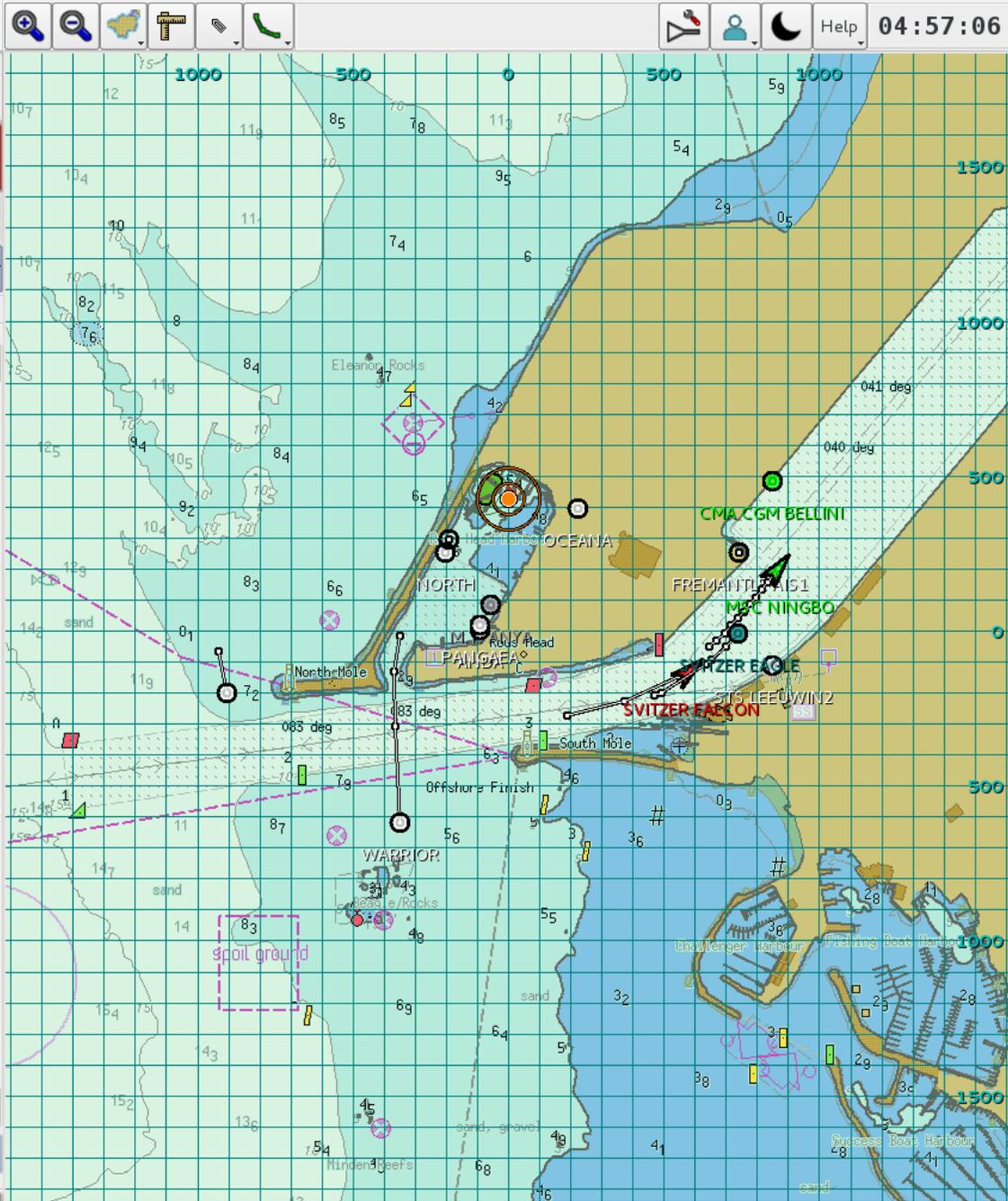
Lines

Line 1

Line 2

Delete Edit Create

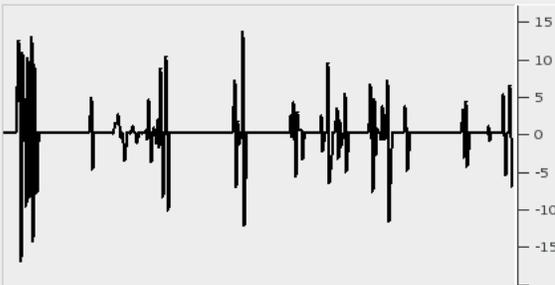
C-Worker 5 Active



Property

- Ripple Voltage
- State of Charge
- State of Health
- Temperature
- Time Remaining
- Voltage
- Control Container
- Devices
- Fuel
- Payload
- Safety Systems
- Vehicle Processor
- Steering Control
- VP State
- scm/vp/timeref
- Filter
- 1PPS Status
- Clock Offset
- Clock Status
- Synchronization Status
- Synchronizer Status
- scm/vs/timeref
- Filter
- 1PPS Status
- Clock Offset
- Clock Status
- Synchronization Status
- Synchronizer Status

Show Help View chart





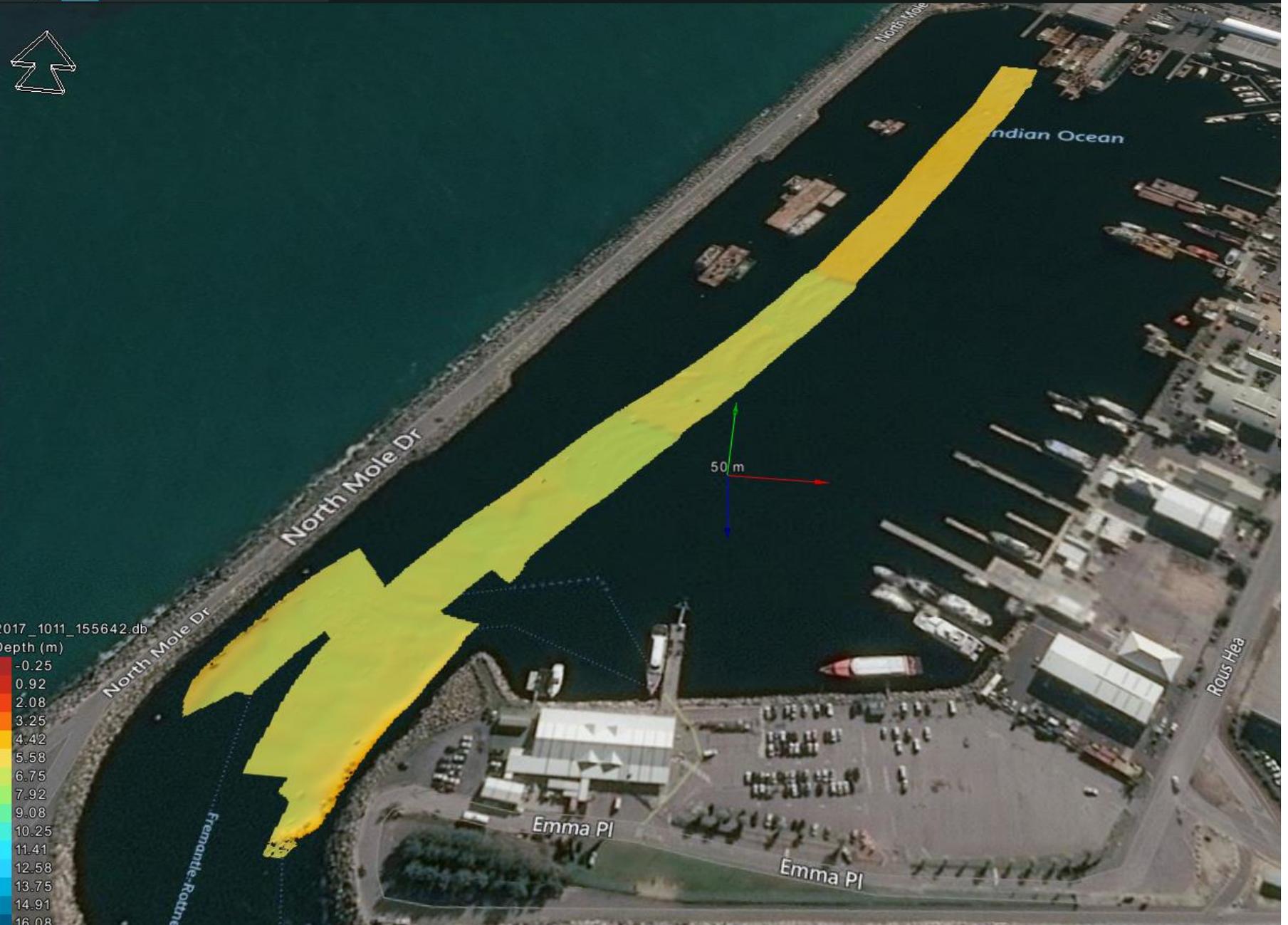
Project Tree

- Project
 - Maps
 - Surveys
 - 2017_1011_155642.db
 - Toppings
 - Pipes
 - Events
 - Waypoints
 - Online
 - Palettes
 - Color modes
 - Camera Path
 - Key frame 1
 - Views

Properties

| | |
|-------------------------|--|
| General | |
| Name | 2017_1011_155642.db |
| Database | |
| Path | I:\12_Suppliers\ASV\CW5\Payload\Sensor Data\ |
| Number of points | 6 809 600 |
| Cell size | 0.20 m |
| External Saving/Loading | <input checked="" type="checkbox"/> False |
| Appearance | |
| Surface Type | Average |
| Color Mode | Depth |
| Opacity | 100 % |
| Profile View | |
| Surface Color | 0, 175, 216 |
| Pen Width | 1 pixels |
| Draw Mode | Line |
| Points Color | 0, 175, 216 |

Name
Name of object



APPLICATION FOR TEMPORARY OPERATIONS EXEMPTION



Australian Government
Australian Maritime Safety Authority

Marine Safety (Domestic Commercial Vessel) National Law Act 2012
EX07 Marine Safety (Temporary operations) Exemption 2016
This form is to be used to apply to the National Regulator for approval under section 503 of the Marine Order 2013 (Certificates of survey-national law) 2013. Approval may only be granted if the relevant criteria stated in EX07 Marine Safety (Temporary operations) Exemption 2016 is met.



Australian Government
Australian Maritime Safety Authority

If you are unsure of any information, or it is not applicable, please leave blank. Please attach a separate sheet if you need additional information.

A. Applicant details

| | | |
|---|--|--------------------------------------|
| Title Mr | Surname McFarlane | Given names Craig Andrew |
| Company name Western Advance Pty Ltd | | |
| ACN / ABN (if applicable) 008 879 767 60008879767 | Vessel name C-Worker 5 (#77) | Unique Identifier GB ASV23 |

B. Provision of information

Are you seeking approval under EX07 Marine Safety (Temporary operations) Exemption 2016 to:

- Operate your vessel while waiting for a certificate of survey to be issued? Y
- Operate your vessel while waiting for a certificate of operation to be issued? Y
- Enable the building, disposing of, fitting out, relocation, removing or repair of the vessel, or for a sea trial? Y
- Operate your vessel in a way that is not authorised by the certificate of operation? Y
- Operate your vessel in a way for which the certificate of survey does not provide? Y

Explain how the permit sought will not jeopardise the safety of the vessel, or other vessels, or people on board (please provide supporting evidence).

Application for class registration is pending with AMSA. Specific exemptions have been requested and are currently under review. See attached explanatory notes.

C. Applicant's declaration and consent

I declare that:

- To the best of my knowledge the information provided by me in this application (and any attachments I have included with this application) is true and correct.
- I consent to the Australian Maritime Safety Authority, as the National Regulator, making all reasonable enquiries in order to obtain the information provided by me in this application (and any attachments I have included with this application) correct.
- I understand and acknowledge that the Australian Maritime Safety Authority, as the National Regulator, may ask that I provide information or document that the National Regulator reasonably considers necessary for consideration of this application.
- I understand and acknowledge that the Australian Maritime Safety Authority, as the National Regulator, may ask another person to provide any information, document or agreement that the National Regulator reasonably considers necessary for consideration of this application.

| | | |
|---------------|--------------------------------|----------------------------|
| Signature | Name Craig McFarlane | Date 13 Feb 2017 |
|---------------|--------------------------------|----------------------------|

Where to lodge: Roads and Maritime Services NSW • Maritime Safety QLD • Transport Safety VIC • Marine and Safety TAS • Department of Planning, Transport and Infrastructure SA • Department of Transport WA • Marine Safety NT.

Privacy Statement
The collection of information requested in this form is required or authorised by Schedule 1 of the Marine Safety (Domestic Commercial Vessel) National Law Act 2012 (the Act). It will be used for purposes related to the Act and may be provided to Commonwealth or State / Territory governments for the purposes of marine safety. Failure to provide the information may result in the transaction not being processed. To contact us, or for more information on how to access or correct your personal information, how to make a privacy complaint, or how your information may be used or disclosed beyond those described in this statement, visit www.amsa.gov.au/privacy

AMSA777 (5)

Reference Number EX2017/A120

SPECIFIC EXEMPTION

Section 143, Marine Safety (Domestic Commercial Vessel) National Law Act 2012

Particulars of vessel

| Name of Vessel | Unique Identifier | |
|-----------------|-------------------|----------------------------------|
| CW-77 | 09529 | |
| Measured Length | Service Category | Vessel Type |
| 5.5 m | 2C | AUTONOMOUS SURFACE VESSEL |

- The Vessel is exempt from the application of sections 8, 10(2)(b) and 12(b) of Marine Order 503 (Certificates of survey-national law) 2013, to the extent that each requires the Vessel to comply with the following required outcome of the National Standard for Commercial Vessels (NSCV) Part C, Section 1:

2.4 Required Outcome – compliance with COLREGS

A vessel must be arranged to enable the person operating the vessel to comply at all times with the person's obligations under COLREGS

- The Vessel is exempt from the application of sections 8, 10(2)(b) and 12(b) of Marine Order 503 (Certificates of survey-national law) 2013, to the extent that each requires the Vessel to comply with a required outcome of the NSCV, and the following deemed to satisfy solutions, or an approved equivalent means of compliance, are not implemented:
 - NSCV Section C1 Clause 6.12.2 for provision of fixed guardrails or bulwarks.
 - NSCV Section C3 Clause 3.2.2 and Table 1, to the extent that the hull stiffener terminations and flange widths must comply with AS1799.5.
 - NSCV Subsection C5A Clauses 6.7.3, 6.8.7.3 and 6.8.7.4, for the carriage of an emergency steering system, rudder neck bearing length, and rudder mainpiece length.
 - NSCV Subsection C5B Clause 5.12 for the provision of an emergency power source for electronic navigational aids, navigation lights, and sound signals.
 - NSCV Subsection C7A Clause 5.3 for the carriage of safety equipment.
 - NSCV Subsection C7B Clause 4.3, for the provision of radiotelephone and satellite communications equipment.

OFFICE USE ONLY

Regulator

- declaration? Yes No N/A
- issued? Yes No N/A
- be issued? Yes No N/A
- the conditions to which it is subject, will not jeopardise the person on board a vessel? Yes No N/A
- if the vessel required? Yes No N/A
- had a report on the condition of the vessel been provided? Yes No N/A
- ? Yes No N/A

Section E

V

to operate the vessel listed below under Marine Safety (Temporary operations) Exemption 2016, the conditions below, and any conditions attached to this exemption.

Approval under Section 6 or section 7 is granted Yes No

| | |
|-------------------|-------------|
| Unique identifier | 9529 |
|-------------------|-------------|

issued for the purposes of trialing the above mentioned autonomous vessel only.

vessel on the private waters of Lake Yakine in Ellenbrook only.

operations. Any persons onboard the vessel are to wear PFD's.

presence of the operator at all times.

take apart from those directly involved in the autonomous vessel trials.

personnel qualified in accordance with NSCV Part D requirements.

| | |
|--------------|--------------------------------------|
| Effective to | 28th February 2017 |
|--------------|--------------------------------------|

| | | | |
|-----------|--|------|---------------------------------|
| Signature | | Date | 15th Feb 2017 |
|-----------|--|------|---------------------------------|



www.amsa.gov.au

Paid \$340.00 14/2/17 Rec: 795149

ASV Locations

