

**ADVANCED  
NAVIGATION**



# **Hydrus Reference Manual**

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# 1 Revision History

Version	Date	Changes
1.2	24 Apr 2024	<p>Updated Introduction, see <a href="#">2 Introduction</a></p> <p>Updated How to Use This Manual, see <a href="#">2.3 How to Use This Manual</a></p> <p>Updated Firmware Changelog, see <a href="#">1.1 Firmware Changelog</a></p> <p>Updated General Safety Precautions, see <a href="#">4.3 Underwater Operation</a></p> <p>Updated Mounting Position, see <a href="#">6.5.3 Mounting Position</a></p> <p>Updated Hardware Specifications, see <a href="#">3.1 Hardware Specifications</a></p> <p>Updated Mission Planning, see <a href="#">7 Mission Planning</a></p> <p>Added Mission Fundamentals, see <a href="#">7.1 Mission Fundamentals</a></p> <p>Updated Mission Planning Process, see <a href="#">7.3 Mission Planning Process</a></p> <p>Updated Mission Map Pane, see <a href="#">7.6.4 Mission Map Pane</a></p> <p>Added Global Mission Parameters, see <a href="#">7.6.1 Global Mission Parameters</a></p> <p>Updated Mapping Enhancements, see <a href="#">7.6.5 Mapping Enhancements</a></p> <p>Updated Bail-out Conditions, see <a href="#">7.6.2 Bail-out Conditions</a></p> <p>Updated Mission Considerations, see <a href="#">7.2 Mission Considerations</a></p> <p>Re-factored Mission Patterns to Mission Task Parameters and Mission Task Profile Examples, see <a href="#">7.6.3 Mission Task Parameters</a> and <a href="#">7.4 Mission Task Profile Examples</a></p> <p>Re-factored Hydrus Operations</p> <p>Added Hydrus Deployment, see <a href="#">8 Hydrus Deployment</a></p> <p>Updated Hydrus Pre-deployment, see <a href="#">8.2 Hydrus Pre-deployment</a></p> <p>Added Hydrus Retrieval, see <a href="#">8 Hydrus Retrieval</a></p> <p>Added Review Last Deployment, see <a href="#">9.1 Review Last Deployment</a></p> <p>Updated Data Download, see <a href="#">9.2 Data Download</a></p> <p>Added Session Playback, see <a href="#">9.3 Session Playback</a></p> <p>Updated Part Numbers and Ordering, see <a href="#">Part Numbers and Ordering</a></p> <p>Added Magnetic Calibration, see <a href="#">10.4 Magnetic Calibration</a></p> <p>Minor editorial changes</p>
1.1	06 Sep 2023	<p>Updated terminology for network credentials, see <a href="#">6.4 Connecting Hydrus</a></p> <p>Added multi-select mode for session deletion functionality in webUI, see <a href="#">9.2.3 Deleting Sessions</a></p> <p>Added capability to enable Low Power Mode functionality for Hydrus in WebUI, see <a href="#">6.3.2 Low Power</a></p>
1.0	02 Aug 2023	Initial Release

Table 1: Revision History

## 1.1 Firmware Changelog

Version	Date	Changes
1.30	15 Apr 2024	<p><b>Note:</b> When using with Subsonus, Subsonus must be running v3.50 or later  <b>Note:</b> Firmware downgrade not supported on this firmware version</p> <p><b>New features and improvements</b>            Various web UI improvements            Added Hydrus standalone mission mode that enables GNSS assisted dead reckoning missions that do not require a Subsonus            Added Station Keeping mission task type for holding a specified position for a specified amount of time, while taking periodic pictures and/or video            Increased maximum allowed forward speed during transit between mission tasks            Added acoustic address validation of Hydrus to mission deployment pre-check to ensure acoustic tracking            Improved mission synchronisation functionality and interoperability across Hydrus and Subsonus            Added user bypassable pre-deployment check for achieved mission synchronisation with Subsonus            Added support for DVL data visualisation and export capabilities            Added functionality for resuming interrupted file downloads in web browsers            Added support for VTT (Web Video Text to Track File) video footage metadata            Changed video file format from MP4 to MKV            Increased timestamp accuracy to milliseconds for image and video filenames            Reduced the safe turn-off timeout for ESC            Various bug fixes</p>
1.25	12 Feb 2024	<p><b>Note:</b> When using with Subsonus, Subsonus must be running v3.40 or later</p> <p><b>New features and improvements</b>            Added options for either immediate resurfacing or maintaining a predefined vertical position upon reaching the recovery location            Added session playback feature allowing playback of recorded sessions            Hydrus will now transit to the recovery location at the transit vertical value specified for the mission            Enhanced object detection capabilities for handling more complex scenarios            Added ANPP packet log            Added functionality for Subsonus to issue acoustic commands and display mission data after mission abort            Added deployment procedure step allowing user to review and change Pause Vertical parameters            Added Review Last Deployment feature for displaying overview of existing mission log            Added support for upload of larger world files and images in map layers</p> <p><b>Changes to Mission Planner</b>            Added support for overlapping periodic image capture and added photogrammetry coverage types in Mission Planner            Added new mission flight path pattern shapes in Mission Planner</p>

Version	Date	Changes
		<p>Added support for specifying the vertical position for the recovery location as bottom altitude in Mission Planner</p> <p>Added user defined "Transit Vertical" parameters in Mission Planner used in transit between mission tasks</p> <p>Added support for specifying Pause Vertical (depth hold at mission start) as bottom altitude in Mission Planner</p> <p>Added additional control over camera settings at both mission and task specific levels in Mission Planner</p> <p>Added support for recording data overlays on top of images</p> <p>Added functionality for selecting and reordering multiple mission tasks in Mission Planner</p> <p>Added backward compatibility for missions planned using older firmware</p> <p><b>UI improvements</b></p> <p>Various web UI improvements</p> <p>Added GNSS fix status to top menu bar</p> <p>Enhanced magnetic calibration tool with user interface feedback for completed calibration and live INS heading value</p> <p><b>Error reporting</b></p> <p>Added additional pre-deployment checks and error reporting</p> <p>Improved mission synchronisation error handling and reporting on Hydrus Deployment page</p> <p>Improved error reporting for acoustic tasks from Subsonus view</p> <p>Added battery pack overvoltage error reporting via EPD</p> <p>Added brownout event recovery feature and error handling</p> <p><b>Bug fixes</b></p> <p>Fixed inability to download session data until all session data has fully loaded</p> <p>Various bug fixes</p>
1.22	13 Nov 2023	<p><b>Note:</b> When using with Subsonus, Subsonus must be running v3.40 or later</p> <p><b>New features and improvements</b></p> <p>Improved INS stability checks</p> <p>Enhanced power monitoring and management capabilities</p> <p>Improved battery charge management</p> <p>Updated vehicle control response to improve stability</p> <p>Added binary logging of acoustic data</p> <p>Enhanced GNSS accuracy</p> <p>Improved networking connectivity when Hydrus is being used on a network with 192.168.0.0/24 IP range</p> <p>Added dialog for viewing and managing mission overlays in the Mission Planner</p> <p>Added support for user defined travel tilt of Hydrus when returning to retrieval point</p> <p>Added functionality for user defined recovery location depth</p> <p>Added mission bailout and automatic resurfacing of Hydrus upon user defined no-communication (acoustic) timeout</p> <p>Added vision module firmware details to the Device Information page</p> <p>Added functionality for reversing the direction of lawnmower and transect (waypoint) tasks in Mission Planner</p> <p>Added mission pre-start warnings for out of bounds mission parameters and offline</p>

Version	Date	Changes
		<p>network communication</p> <p>Added support for magnetic calibration of the Hydrus INS</p> <p>Removed retrieval point surface travel mode and added descent, repositioning, and reascend sequence for retrieval point homing</p> <p>Added user defined orientation of vehicle during depth and altitude pause</p> <p>Changed retrieval point resurfacing to be executed autonomously without explicit commands from Subsonus</p> <p>Added Mission Planner feature that enables user to import a previous mission as a map layer</p> <p><b>UI improvements</b></p> <p>Various web UI improvements</p> <p>Added thumbnail gallery feature in Mission Planner for pre-viewing captured images</p> <p>Added feature in the Map Options dialog allowing creation of map overlay waypoint markers based on image geodata</p> <p>Removed "Acquire GNSS Fix" and "Path To Edge" mission flags from Mission Planner</p> <p>Improved tracking visualisation in Subsonus live view to indicate segments without INS position data due to acoustic outage</p> <p>Updated Hydrus position tracking in Subsonus View to be based on INS positioning instead of acoustic location</p> <p>Added device name in WiFi SSID</p> <p>Added display of AP connections on EPD</p> <p><b>Error reporting</b></p> <p>Improved error handling and reporting in the "Import Mission" feature in Mission Planner</p> <p>Improved error handling and diagnostics in Mission Planner connections tab</p> <p><b>Bug fixes</b></p> <p>Fixed early EPD magnet trigger</p> <p>Fixed firmware boot fail on unsuccessful camera module probe</p> <p>Fixed potential false positive minimum altitude bailout</p> <p>Fixed "Comms failure" triggered by extended period of transceiver inactivity</p> <p>Fixed user set time not persisting on reboot</p> <p>Fixed acoustic communications unwantedly switching from "High Speed" to "High Reliability" in certain cases</p> <p>Various bug fixes</p>
1.10	6 Sep 2023	<p><b>Note:</b> When using with Subsonus, Subsonus must be running v3.30 or later</p> <p>Various web UI improvements</p> <p>INS stability improvements</p> <p>Add "Rebooting" to EPD display when user initiates a reboot</p> <p>Improved battery self test function</p> <p>Factory restore now resets mission_status.log</p> <p>Improve bailout behaviour due to INS instability</p> <p>Enable putting Hydrus in Low Power mode from WebUI</p> <p>Improved Task creation behaviour</p> <p>Recovery actions now accurately reflect waypoint status and reasons</p> <p>Improve import of GeoJSON tasks</p> <p>Improved station holding before commencing mission</p>

Version	Date	Changes
		Add EPD 'recovery mode' screen Add ability to delete individual payload data from a session Fix loss of Subsonus device configuration Fix intermittent issue uploading some KML files Improved mission progress indicator Improve Subsonus event log Fix intermittent false DVL failure status Fix false reporting of IMU sensor failures Reduce acoustic communications dropouts Improve DVL performance Fix failure to detect unsaved changes after loading a mission Improved navigation handling at very low bottom altitudes Fix possible corruption of mission planner waypoints when dragged past the prime meridian Fix possible EPD illumination indicating charging (pulsed) when not placed on a charger Fix incorrect state of Unsaved Changes indicator when updating a Lawnmower Task properties Improve select/focus of mission task upon creation Docker file upload now supports .tar images and no longer supports .zip Improved estimation of battery required to conduct a mission
1.02	26 Jul 2023	Initial release  <b>Note:</b> when using with Subsonus, Subsonus must be running v3.220 or later

Table 2: Firmware Changelog

**Note:** To upgrade the firmware to the latest version, see [10.5 Firmware Update](#)

## 1.2 Hardware Changelog

Version	Date	Changes
1.0	July 2023	Initial release

Table 3: Hardware Changelog

## 2 Introduction

### 2.1 Product Overview

Hydrus is an autonomous underwater vehicle designed for performing underwater data acquisition missions reliably and with ease. With its intuitive online platform accessible via Wi-Fi, users can effortlessly plan and execute underwater survey missions straight out of the box.

Hydrus utilises advanced AI and control algorithms to autonomously navigate, avoiding obstacles and collisions while efficiently collecting data. Its versatility allows for programming complex missions and dynamic adaptation to real-time scenarios.

Equipped with a camera, sonar system, and multiple navigation and data acquisition sensors, Hydrus supports underwater terrain mapping, video and image capture, and environmental data collection. Integrated navigation and communication systems, including a Doppler Velocity Log (DVL), acoustic transponder & modem, and Inertial Navigation System (INS), ensure precise and accurate operation.

Thanks to its innovative combination of high-quality image capture, dynamic lighting, and AI image processing, Hydrus delivers superior georeferenced footage.

Constructed with a fully encapsulated polymer body, Hydrus integrates all its advanced features into a compact, lightweight, and portable design. This enables prompt mobilisation and execution of complex autonomous underwater surveys, manageable by a single person with minimal training.

Hydrus offers mission capabilities in two distinct mission modes: standalone and Subsonus assisted. In standalone mission mode, Hydrus operates independent of external systems or hardware, relying entirely on its state of the art sensors and dead reckoning navigation capability. In standalone mode, Hydrus can be launched directly from shore or a small boat, ideally suited up to depths of approximately 30 metres. In Subsonus assisted mission mode, Hydrus is paired with a Subsonus USBL to provide accurate positioning and real time mission monitoring. This mode is suited to deeper water applications, or missions that require the best accuracy. For example, to conduct an orthomosaic survey in Subsonus assisted mode, the overlap between mows can be more relaxed than for standalone mode, and have lesser chance of gaps in the data.



*Figure 1: Hydrus — by Advanced Navigation*

## 2.2 Key Components and Features

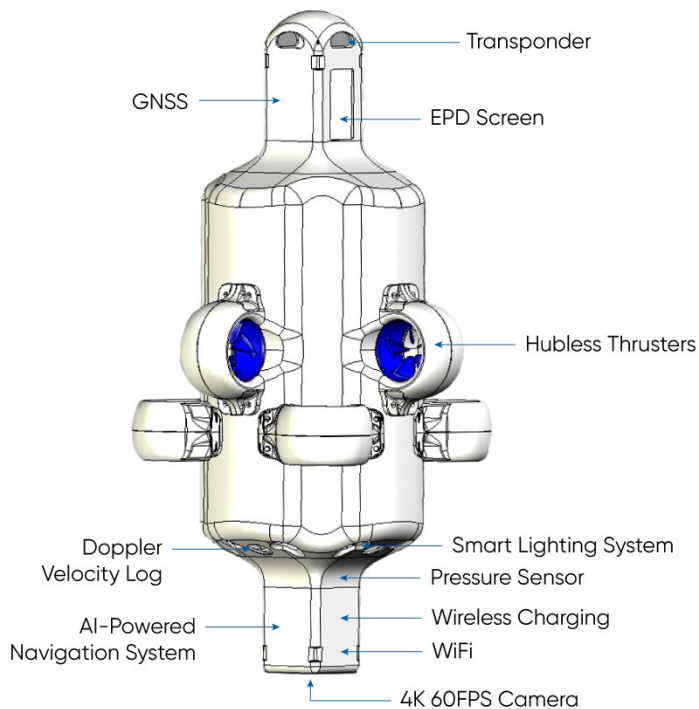


Figure 2: Hydrus Key Components and Features

### 2.2.1 Hubless Thrusters

Hydrus employs hubless magnetic-driven thrusters for its propulsion system. These thrusters enable manoeuvrability and control during autonomous operations. Hydrus' user replaceable thruster system allows for straightforward part replacement without the need to disassemble or modify the central hub of the vehicle.

### 2.2.2 Doppler Velocity Log

The DVL measures Hydrus's velocity relative to the surrounding water by analysing the Doppler shift in acoustic signals. It provides real-time information on speed and direction, allowing Hydrus to estimate its movement underwater. The DVL compensates for the absence of the GNSS signals and helps in dead reckoning navigation, where Hydrus's previous position, velocity, and orientation are used to estimate the current position. The DVL's contribution to ground tracking is that it plays a crucial role in aiding Hydrus's ability to maintain a desired track. The DVL provides real-time information that can be used for closed-loop control algorithms to adjust the trajectory of Hydrus and maintain tight line-keeping.

### 2.2.3 GNSS

Hydrus contains a GNSS (GPS) receiver to enable a position to be established when Hydrus is out of water.

**Note:** The GNSS function is only operational when Hydrus is out of the water.



## 2.2.4 AI-Powered Navigation System

Hydrus is equipped with a variety of sensors such as gyroscopes, accelerometers, magnetometers, pressure sensor, Doppler velocity log (DVL) and Global Navigation Satellite System (GNSS) receiver to provide precise information on position, velocity, and attitude. These sensors form the Inertial Navigation System (INS) for Hydrus. To enhance velocity measurements, the onboard Doppler Velocity Log (DVL) is tightly integrated with the INS. Additionally, the onboard GNSS serves the purpose of obtaining an initial position when the vehicle is above water. When combined with Subsonus, the INS receives continuous position updates through acoustic communication.

**Note:** Note: It is recommended to use Hydrus with a Subsonus USBL when accurate positioning over extended periods of operation are required.

## 2.2.5 Pressure Sensor

The Pressure sensor in Hydrus is used to measure the pressure exerted by the surrounding water whilst in operation. This sub-component plays a vital role in determining the depth of a system. By measuring the pressure, the sensor can calculate the corresponding water depth, which is essential for accurate navigation and localisation in underwater environments.

## 2.2.6 Transponder

When used with a Subsonus USBL, the Hydrus transponder provides acoustic communication for improved positioning and to enable communications whilst Hydrus performs a mission.

Subsonus is a next generation USBL underwater acoustic positioning system that provides high accuracy position, velocity and heading at depths of up to 1000 metres. The system features an industry leading calibrated hydrophone array combined with an internal tightly coupled INS.

Function	Description
Acoustic Positioning	Subsonus uses Ultra-Short Baseline (USBL) acoustic positioning. This technique involves measuring the time it takes for an acoustic signal to travel from a transponder (like the one on the Hydrus) to a receiver (on the Subsonus system). By using multiple receivers, the system can determine the position of the transponder.
Data Transmission	Subsonus can also transmit data acoustically. This is done by modulating the acoustic signal in a way that encodes the data. The transponder on Hydrus can then demodulate this signal to retrieve the data.
Network Link Feature	Subsonus has a network link feature that allows it to communicate with other devices on the same network. This can be used to share data between Subsonus systems or multiple Hydrus vehicles.
Configuration	Subsonus can be configured to track specific devices, use different data protocols, and adjust various other settings. This allows it to be tailored to the specific needs of the operation.

## 2.2.7 Smart Lighting System

Hydrus is equipped with a powerful dynamic LED lighting system that ensures optimal image and video capture in underwater environments.

## 2.2.8 4K 60FPS Camera

Hydrus is equipped with an advanced camera system that provides high-quality imaging and video capabilities.

## 2.2.9 EPD Screen

A pressure tolerant, ultra low power E-ink screen provides clear and concise information to the user.

## 2.2.10 Wi-Fi

Wi-fi is used for configuration, mission planning and data payload download. Hydrus supports two types of Wi-Fi connections:

- Access Point mode - Where a user will connect directly from a laptop, tablet or smart phone to Hydrus. This is recommended for quick and easy configuration and deployment.
- Networked (or Station mode) - Where Hydrus will be configured to connect to an existing Wi-Fi network. The user will then connect to the same network to establish communications. This is the recommended configuration for regular use, and required when used in conjunction with a Subsonus USBL.

## 2.2.11 Power Supply

Hydrus relies on a lithium-ion battery as its primary power source. The lithium-ion battery offers several advantages, including high energy density, lightweight design, and long cycle life. These batteries provide the necessary electrical energy to power the various systems and components onboard Hydrus, including the propulsion system, sensors, communication devices, and computer. It is important to consider the battery capacity and plan missions accordingly to ensure that Hydrus can complete its objectives without exhausting the battery.

## 2.2.12 Wireless Charging

Hydrus utilises the Qi® EPP (Extended Power Protocol) standard for wireless charging. This ensures compatibility and optimal charging performance when using Qi® charging pads or stations. Qi® charging technology allows for wireless charging of the Hydrus lithium-ion battery. This eliminates the need for physical battery access, ensuring integrity and protection against water ingress.

## 2.2.13 Buoyancy

Hydrus is designed to be positively buoyant (floating in water), and is configured to operate in standard ocean conditions (water density of 1.025 kg/L).

**Note:** If you should need to operate Hydrus in liquids of significantly different density, Hydrus may require a modified buoyancy configuration. Contact [support@advancednavigation.com](mailto:support@advancednavigation.com) to discuss your operating conditions such that a suitable modification can be determined.

## 2.2.14 Software Extensibility

With its open software platform architecture, Hydrus is able to integrate your custom software as a payload, offering full access to the camera, sensors, navigation, modems and control.

## 2.3 How to Use This Manual

### 2.3.1 Read the Introduction

Begin by reading the [2 Introduction](#) section of the manual. It provides an overview of Hydrus, its capabilities, and an explanation of the manual's structure. This will help you navigate through the manual more effectively.

### 2.3.2 Follow the Manual Structure

The Hydrus manual is structured in a logical sequence, with sections covering different aspects of the operation of the Hydrus. It is important for the user to follow the manual's structure to ensure no relevant information is missed. If necessary, bookmark or take notes on important sections for future reference.

### 2.3.3 Use Diagrams and Illustrations

The Hydrus manual will include diagrams and other various visual aids. All of these aids are designed to enhance the understanding of the vehicle's architecture and operation.

### 2.3.4 Seek Clarification

If the user comes across complex or unclear information, do not hesitate to seek clarification and reach out to Advanced Navigation Support at [support@advancednavigation.com](mailto:support@advancednavigation.com). The Hydrus support team can provide valuable insights and help interpret the information correctly. To reach the customer support team please go to the Advanced Navigation website, click on Support and click Support Center and Tickets. Here the user will be able to lodge any issue with Hydrus.

### 2.3.5 Software and Manual Updates

New versions of firmware may become available for the Hydrus variant that you are operating. Periodically check the product page on the Advanced Navigation website for firmware updates. Updates to the manual are also made from time to time, especially when new firmware is released. Ensure that you are using the latest reference manual and firmware for your Hydrus variant.

## 2.4 Shipping Hydrus - Dangerous Goods

**Note:** Hydrus contains lithium-ion batteries and is classified as Dangerous Goods UN 3481 (Lithium ion batteries contained in equipment). Hydrus **MUST** be shipped as Dangerous Goods according to IATA regulation Section II of PI967, and follow any relevant local and international shipping regulations.

Hydrus incorporates a battery that has not received certification in line with UN38.3 regulations (a set of standards that govern the safety of lithium and lithium-ion batteries during shipping). Contact Dangerous Goods shipping agents to ensure the safe shipment of Hydrus, in compliance with local and international shipping regulations. See [3.3.1 Battery Power Supply](#) specifications for details of the battery contained within Hydrus.



Figure 3: Sample Dangerous Goods shipping label

# 3 Specifications

## 3.1 Hardware Specifications

### 3.1.1 Physical Dimensions - Hydrus

Specification	Value
Physical dimensions	484 x 264 x 216 mm

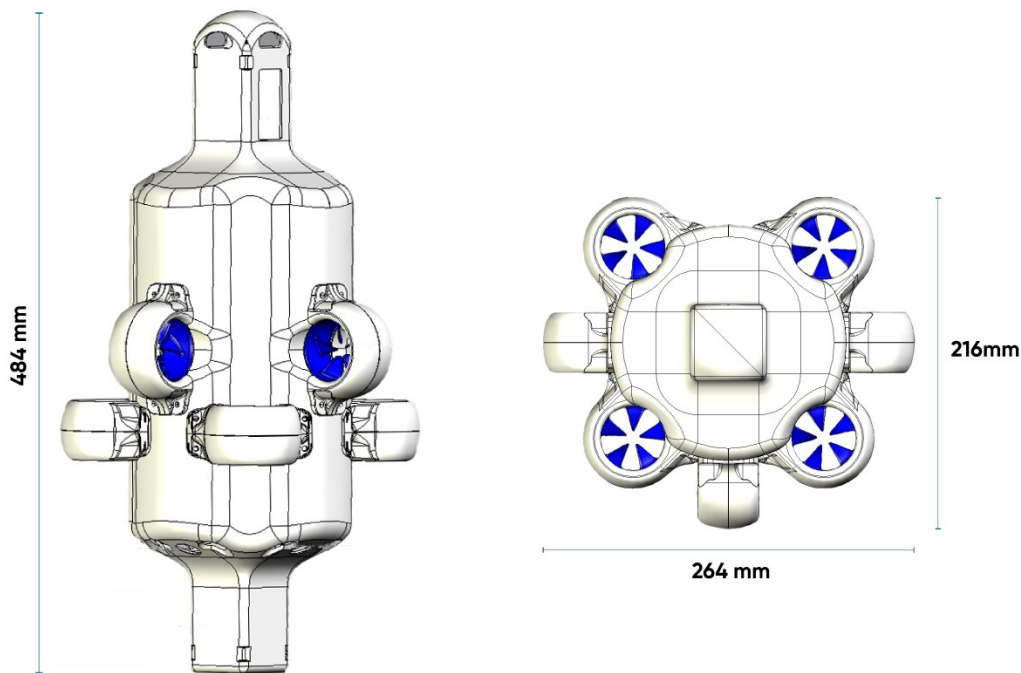


Figure 4: Hydrus Physical Dimensions

### 3.1.2 Weight and Buoyancy

Specification	Value
Weight	6.4 kg
Buoyancy	+170 g in salt water (1.025 kg/L density)
Buoyancy Control	Fixed buoyancy

### 3.1.3 Maximum Operating Depth

Below are the maximum operating depths of the Hydrus. It is important to adhere to these specifications to ensure safe and reliable operation. Going beyond these limits can jeopardise Hydrus, its integrity and functionality.

Model	Value
HYDRUS-300	300 m
HYDRUS-1000	1000 m

### 3.1.4 Operating Temperatures

	Minimum in Celsius (°C)	Maximum in Celsius (°C)
Out of Water Temperature	-5 °C	50 °C
Operating Water Temperature	-5 °C	35 °C
Storage Temperature	-20 °C	60 °C

### 3.1.5 Data Storage

Specification	Value
Memory capacity	256 GB (equates to more than 2 hours of survey data)
Memory type	SD card

### 3.1.6 Temperature Sensor

Specification	Value
Water Temperature Accuracy	0.5 °C

### 3.1.7 User Interface

Type	Description
E-ink (EPD) screen	Onboard information display
Onboard webUI (accessed via WiFi)	Device configuration, mission planner and mission data management

## 3.2 Mission Capability

### 3.2.1 Mission Modes

Mission Mode	Notes
Standalone (GNSS / Dead Reckoning)	Subsonus not required. See <a href="#">7.1.1 Mission Modes</a> .
Subsonus Assisted	Subsonus required. See <a href="#">7.1.1 Mission Modes</a>

### 3.2.2 Mission Depth vs. Mission Runtime

Mission Depth	Maximum Runtime for Mission Tasks	Maximum Range for Mission Tasks	Notes
30 m	120 minutes	1500 m	Based on one continuous mission task with limited horizontal transit between deployment/recovery and mission start/end points.
300 m	90 minutes	1125 m	
1000 m	20 minutes	250 m	

### 3.2.3 Station Keeping Endurance

Parameter	Value	Notes
Station keeping endurance capability in 0.5 knot current	120 minutes	With lights and video capture on
Station keeping endurance capability in 0 knot current	150 minutes	With lights and video capture on

### 3.2.4 Speed

Parameter	Value	Orientation
Maximum survey speed	1.5 knot (0.77 m/s)	Camera facing down, 10° pitch
Maximum transit speed	2 knots (1 m/s)	Camera facing down
Typical vertical speed	0.7 m/s	Camera facing down

### 3.2.5 Position Accuracy

Parameter	Accuracy	Note
Survey operation line keeping	±0.5 m from planned survey line	Assuming DVL bottom lock. Subsonus position aiding with Hydrus positioned 50 m from Subsonus.
Station keeping capability	1 m horizontal 0.5 m vertical	Assuming DVL bottom lock. Subsonus position aiding with Hydrus positioned 50 m from Subsonus.
Hydrus standalone (dead reckoning)	1% of DT (Distance Travelled)	Assuming DVL bottom lock. No Subsonus position aiding.

### 3.2.6 Altitude and Depth Keeping

Capability	Note
Survey operation altitude keeping	While performing survey operations, Hydrus is able to maintain a constant altitude above a sandy/silty seabed between 0.5 and 5 m altitude. (Subject to water induced movements for example, currents, upwellings, and tides.)

Capability	Note
Survey operation depth keeping	Hydrus is able to maintain a constant depth below sea level while performing survey operations (Subject to water induced movements for example, currents, upwellings, and tides.)

### 3.2.7 Acoustic Range

Parameter	Value
Acoustic positioning range (with Subsonus)	Up to 1000 m

### 3.2.8 GNSS Fix

**Note:** A clear view of the sky is a prerequisite for obtaining a GNSS fix.

Hydrus Position	GNSS Fix Capability
Out of the water	Yes
Floating on the water surface	Yes
Submerged in water	No

## 3.3 Power and Propulsion

### 3.3.1 Battery Power Supply

Parameter	Description
Capacity	99 Wh
Battery Life	Survey: 2 h Station keeping: 2.5 h
Charging Interface	Qi® EPP wireless power transfer technology
Recharge time	3.5 h or less
Numbers of Cells per Battery	6
Quantity of Batteries per Hydrus	1
Nominal Voltage	11.1 V
Battery Chemistry	LiPo (lithium-ion polymer)
Dangerous Goods Class	Classified as Dangerous Goods UN 3481 - See <a href="#">2.4 Shipping Hydrus - Dangerous Goods</a>



### 3.3.2 Propulsion System

Parameter	Value
Propulsion Type	Hubless thruster
Thruster Quantity	7
Maximum Thruster Speed	3000 RPM

## 3.4 Navigation and Localisation

### 3.4.1 Inertial Navigation System (INS)

Specification	Value
Roll & Pitch Accuracy	0.1 °
Heading Accuracy (Magnetic)	0.3 °
Dead Reckoning Accuracy	1% DT
Position accuracy with Subsonus, 5 m range	0.25 m
Position accuracy with Subsonus, 100 m range	1.5 m
Position accuracy with Subsonus, 300 m range	5.0 m

### 3.4.2 Global Navigation Satellite Systems (GNSS)

Specification	Value
GNSS Supported Constellations	GPS/ QZSS - L1C/A Galileo - E1B/C
Position Accuracy	2.0 m CEP (Circular Error Probable)
Cold Start Acquisition Time	Up to 2 minutes

### 3.4.3 Pressure Sensor

Specification	Value
Depth Range HYDRUS-300	300 m
Depth Range HYDRUS-1000	1000 m
Depth Accuracy	0.1% FS

### 3.4.4 Doppler Velocity Log (DVL)

Specification	Value
Operating Frequency	2 Mhz
Minimum Altitude	0.3 m
Maximum Altitude	10 m

Specification	Value
Long Term Accuracy	0.1%
Velocity Resolution	0.01 mm/s

## 3.5 Communication

### 3.5.1 Wi-Fi Communication

Parameter	Specification
Wi-Fi Standard	WiFi 4 / 802.11n (Channels 1-11)
Security Standards	WEP, WPA, WPA2-Personal, WPA3-Personal
Frequency Band	2.4 GHz
Bandwidth	20 or 40 MHz
Maximum Data Rate	Up to 150 MB/s
Operating Modes	Access Point (AP) and Networked (Station)
Operating Range	Up to 90 m, recommended 20 m maximum

### 3.5.2 Transponder

Specification	Value
Operating Frequency	30 kHz (broadband)
Range	1000 m
Acoustic Coverage	Omnidirectional
Range Accuracy	0.02 m
Maximum Update Rate	1.3 Hz

## 3.6 Camera and Lighting

### 3.6.1 Camera Specifications

Camera Specifications	Specifications
Video Resolution	4K (3840 x 2160)
Video Frame Rate	Up to 60 fps
Still Resolution	12 MP (4056 x 3040)
Sensor Type	1/2.3" CMOS
Lens Aperture	f/2.5
Lens Focal Length	2.8 mm
Lens Depth of Field	300 mm - infinity

Camera Specifications	Specifications
Field of View	83° horizontal 66° vertical
Real Resolution	3 mm text @ 0.3 m 7 mm text @ 1 m 14 mm text @ 2 m

### 3.6.2 Lighting Features

Lighting Features	Specifications
LED Type	8 x Cree XHP LEDs
Continuous Illumination	20,000 lumens
Colour Temperature	5000K
Colour Rendering Index (CRI)	High CRI >90%

## 3.7 Compliance and Certification

### 3.7.1 Regulatory Compliance

In order to ensure the safe and responsible operation of the Hydrus Autonomous Underwater Vehicle (AUV), users must comply with all local regulations. These regulations encompass various aspects such as remote operation, navigation, communication, traffic separation, collision prevention, and environmental protection, all of which are essential for the efficiency and safety of underwater operations.

### 3.7.2 Certification

Hydrus carries the following certifications:

System	Certification
Wi-Fi module and antenna	Contains FCC ID: SQG-60SIPT Contains IC: 3147A-60SIPT

## 3.8 Software Extensibility

### 3.8.1 Docker Software Extensibility

Hydrus is developed based on the ROS2 standard and utilises Docker compatible containerisation to allow the Hydrus navigation and payload capability to be extended. Within the Hydrus webUI. This function allows the user to manage Docker images and containers, monitor their status, control start up behavior and upload new images for container creation. Contact [support@advancednavigation.com](mailto:support@advancednavigation.com) to discuss your needs around extending the software capabilities of Hydrus.

## 4 General Safety Precautions

### 4.1 Handling of Hydrus

When handling Hydrus outside of water, there are a few important considerations to ensure its safety and proper functioning:

**Always maintain two points of contact:** It is recommended to hold Hydrus using two points of contact. One point of contact should be made with the transponder and the other point of contact should be made with the vision end. This practice helps ensure a secure grip and reduces the risk of dropping or mishandling Hydrus.

**Avoid holding from the thruster guards:** The thruster guards are protective structures surrounding the thrusters of Hydrus. It is advised not to hold the device from these guards to prevent any potential damage or malfunction.

**Avoid contact with eyes during LED operation:** Hydrus incorporates LED lights, which may emit bright light during operation. It is important to take care and avoid direct contact with your eyes when the LED lights are in operation. The light emitted by the LEDs may cause permanent retinal damage during prolonged exposure.

**Positioning on a hard surface:** When placing Hydrus on a hard surface, it is recommended to position it with the non-thruster side down and the EPD screen facing up. This placement helps protect the thrusters from potential damage and keeps the EPD screen easily accessible and viewable.

### 4.2 Electrical Hazards

Electrical hazards require careful consideration and preventive measures to ensure the safety of both the equipment and personnel involved.

#### Desk Charger

- **Water:** Ensure that the desk charger is away from areas where water may accumulate or flow, such as scupper holes, open hatches, or bilge pump outlet. Position the desk charger in an elevated area or on a platform that keeps it above potential water sources, such as deck drainage or areas prone to splashing.
- **Drop Hazard:** Ensure that the charging dock is securely fastened or mounted to the boat to prevent it from moving or toppling over. Use appropriate mounting hardware and techniques suitable for your boat type. Consider the position of the charging dock on the boat, placing it in a stable and secure location to minimise the effects of vessel motion.
- **Drying before Charging:** Before placing Hydrus on the desk charger, ensure that it is thoroughly dried to prevent any water from entering the charging dock. Use absorbent materials or towels to dry Hydrus, paying attention to areas where water may accumulate or get trapped.

## 4.3 Underwater Operation

Risks associated with underwater surveying and Hydrus operations, along with corresponding risk management strategies should be considered:

**Equipment Failure:** Equipment failure, such as the Hydrus propulsion system malfunction or sensor malfunction, can pose a significant risk. Mitigate this risk by conducting regular maintenance and performing thorough pre-deployment equipment checks. Maintain a stock of backup equipment or spare parts to minimise downtime in case of failure.

**Environmental Hazards:** Underwater environments can present various hazards, including strong currents, underwater obstructions, and unpredictable weather conditions. Conduct thorough environmental assessments and monitor conditions closely before and during operations. Implement protocols to suspend or modify operations in the presence of hazardous conditions.

**Unforeseen Obstacles or Hazards:** Despite thorough planning, unexpected obstacles or hazards can arise during underwater operations. Maintain a flexible approach and ensure personnel are trained to assess and adapt to changing conditions. Conduct regular briefings and debriefings to promote situational awareness and foster effective decision-making.

**Restricted Areas:** Always operate Hydrus in accordance with the applicable local, state, federal and international maritime laws and regulations. Unless authorised to do so, do not operate Hydrus in or in the vicinity of restricted areas, including but not limited to:

- military and naval bases or exercise areas
- MPAs (marine protected areas)
- underwater research areas
- commercial shipping lanes
- industrial zones
- underwater archaeological sites or grave sites
- private property

## 4.4 Hazardous Materials

Hazardous materials encompasses a wide range of substances that can pose risks to human health, the environment, and the safe operation of Hydrus, emphasising the importance of proper handling, storage, and disposal protocols.

**Biological and Chemical Hazards:** Underwater environments may contain biological or chemical hazards that can pose risks to both Hydrus and personnel involved. Conduct appropriate assessments of the survey area, including the presence of toxic substances or harmful marine life. Implement safety protocols, such as using protective gear or employing sensor technologies to detect and monitor hazardous substances.

**Identification and Classification:** Thoroughly identify and classify hazardous materials that may be encountered during underwater operations. Understand their properties, potential risks, and appropriate handling procedures. Consult material safety data sheets (MSDS) and regulatory guidelines to ensure compliance.

## 4.5 Hull Breach

If Hydrus is breached in any capacity it is important to address the potential risks associated with lithium fires or chemical burns in the event of hull puncture caused by a propeller strike or accidental drops. Proper safety measures should be implemented to mitigate these hazards. The user should adhere and be familiar with their safety procedures when dealing with lithium fires or chemical spills to ensure the well-being of individuals involved and effectively manage potentially hazardous situations.

**Note:** If a lithium fire occurs, immediately activate fire suppression systems or use appropriate fire extinguishing methods suitable for lithium fires, such as specialised lithium fire extinguishers or Class D fire extinguishing agents.

## 4.6 Transport and Storage

**Note:** Whenever Hydrus is not in use, it should be thoroughly dried and put into [6.3.3 Shipping Mode](#) before storing.

**Temperature:** When transporting and storing Hydrus, it is important to adhere to the specified storage [3.1.4 Operating Temperatures](#). Ensure Hydrus is kept within this approved range to prevent damage to sensitive components, avoid exposing it to extreme temperatures (both hot and cold), as they can negatively impact battery performance, electronics, and overall functionality.

**Moisture:** When transporting and storing Hydrus, it is important to prevent moisture buildup. Ensure that Hydrus is kept within this approved range during storage to prevent damage to sensitive components. Thoroughly dry Hydrus before storage to eliminate any accumulated moisture, and store it in a dry, well-ventilated location to prevent moisture buildup.

## 5 Quick Start Guide

This guide outlines the steps for a basic underwater mission using Hydrus in a controlled environment, such as a pool or an enclosed body of water. It provides users with essential instructions for setting up, operating, and retrieving Hydrus during the mission.

1. Download basic software required for interfacing and operating Hydrus. Refer to [6.1.1 Software and Hardware Prerequisites](#) for detailed instructions and download links.
2. Connect Hydrus to a power source using the provided charging cable. Allow it to charge fully before proceeding. Refer to [6.1.5 Initial Charge](#) for more information on the charging process.
3. Put Hydrus into High Power. See [6.3.1 High Power](#)
4. Access the Wi-Fi settings on the user device and connect to the Hydrus access point. This allows the user to communicate with Hydrus and access its Web User Interface (WebUI). For a step-by-step guide, refer to [6.4.1 Connecting Hydrus Via Access Point](#)
5. Before launching the mission, perform a self-test to ensure Hydrus's systems are functioning correctly. Follow the [6.1.8 Testing and Functional Checks](#)
6. Once connected to Hydrus via the access point, open a web browser and access the Hydrus Web User Interface (web UI). Use the [7.3 Mission Planning Process](#) to create a survey task tailored to your requirements.
7. Customise mission parameters and patterns according to the specific survey task the user wants Hydrus to perform. See [7.6.1 Global Mission Parameters](#), [7.6.3 Mission Task Parameters](#) and [7.4 Mission Task Profile Examples](#) for information on how to set the necessary parameters.
8. When the survey task is ready, the user should select "Run Mission" on the main page of the Hydrus WebUI to initiate the mission.
9. Deploy Hydrus into the water. Follow the [8.3.2 Deploying Hydrus](#) section for safe and effective launch procedures.
10. Wait for Hydrus to complete its mission and return to its recovery point. Once the mission is complete, Hydrus will return to its designated recovery point automatically.
11. Safely retrieve Hydrus from the water, following the [8.5 Retrieving Hydrus from the Water](#) for a smooth recovery process.
12. Rinse the Hydrus unit with fresh water to remove any salt or debris from its surface. Allow Hydrus to dry completely before further handling. For detailed instructions, see the [10.2.1 Cleaning](#) section.
13. Access the WebUI to download the data collected during the mission. Use the [9.2 Data Download](#) for step-by-step instructions.
14. To prepare for storage or transportation, set Hydrus to Shipping Mode. Follow the [6.3.3 Shipping Mode](#) section to properly prepare Hydrus for its next use or storage.

## 6 Getting Started

### 6.1 Initial Set-Up

Below is a step-by-step overview of the initial set-up process for Hydrus.

#### 6.1.1 Software and Hardware Prerequisites

Some basic hardware and software are required for interfacing and operating Hydrus. The following prerequisites before interfacing or configuring:

- A laptop, tablet or computer with Wi-Fi connectivity
- Ensure Firefox or Chrome is installed (recommended web browsers for the Hydrus and Subsonus webUI)
- If using Windows, install zeroconf (Apple Bonjour) from one of the links below:
  - <https://www.advancednavigation.com.au/Bonjour.msi> (32-bit installer)
  - <https://www.advancednavigation.com.au/Bonjour64.msi> (64-bit installer)
- If using Subsonus, connectivity to a local network with Ethernet AND Wi-Fi, such as a Wi-Fi router. DHCP is required, a basic switch on its own is not suitable.

#### 6.1.2 Safety Precautions for handling Hydrus out-of-water

##### Always Maintain Two Points of Contact

- When handling Hydrus, make sure you have two points of contact to maintain stability. These points of contact should be the transponder and the vision end of Hydrus. This will help prevent accidental drops or mishandling.

##### Avoid Holding Hydrus from Thruster Guards

- It is important to avoid holding Hydrus from the thruster guards. The thruster guards are designed to protect the thrusters and should not be used as a handle. Holding Hydrus from the thruster guards can cause damage to the device and compromise its functionality.

##### Caution with LED Lights

- When the LED lights on Hydrus are in operation, avoid making direct contact with your eyes. The LED lights can be bright and may cause discomfort or temporary vision impairment. Ensure you are aware of the LED light status and take appropriate precautions to protect your eyes.



### Placing on a Hard Surface

- When placing Hydrus on a hard surface, follow these steps:
  - Ensure the non-thruster side of Hydrus is facing down as seen below. This will prevent accidental slippage or unbalanced placement.
  - Place Hydrus with the EPD screen facing up to protect the display and allow for easy visibility.



*Figure 5: Hydrus Placement Top Down View*

## 6.1.3 Unpacking and Inspection

### Check for damage

- Carefully inspect the exterior of Hydrus for any visible signs of damage, such as dents, scratches, or cracks.
- If any damage is detected, document it immediately and contact Advanced Navigation support for further guidance

### Verify quantity and equipment

- Cross-reference the items listed on the [10.1 Part Numbers and Ordering](#) with the physical contents of the package.
- Ensure that all the expected components and equipment are present and accounted for.

### Documentation

- Retain all packaging materials, invoices, and documents related to the delivery for future reference or potential warranty claims.

## 6.1.4 Power and Charging

### Plug in the Desk Charger

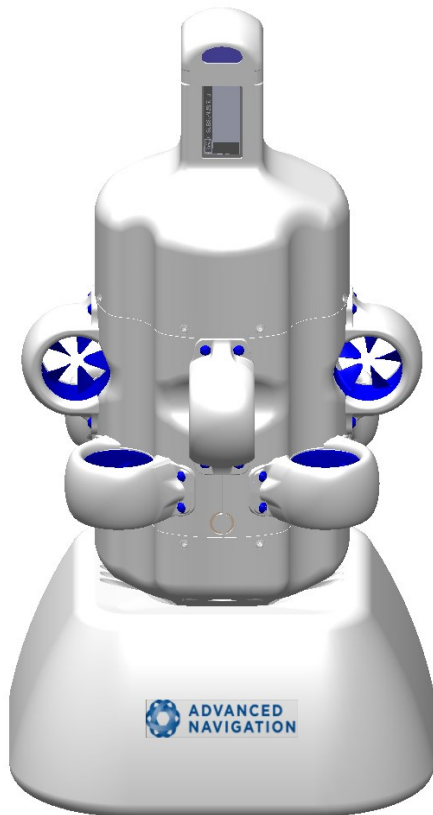
- Connect the charger to a suitable power source, ensuring it is compatible with the voltage requirements of the charger.

**Note:** The Desk Charger is designed to only operate in a dry environment.

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### Insert Hydrus into Desk Charger

- Align the Hydrus EPD screen with the Advanced Navigation label located on the front of the charger, ensure the EPD screen is facing the user and carefully insert it into the charging dock as shown.



### 6.1.5 Initial Charge

- Hydrus is delivered in a power state called shipping mode, this power state is used for the transport and extended shelf storage. In order to continue with the initial set-up, Hydrus must be taken out of shipping mode and charged. The steps for this is as follows:
- Place Hydrus into the Desk Charger, this will automatically take Hydrus out of shipping mode and will put the device into Low Power, this will be displayed on the EPD screen. Below is what should be seen on the EPD screen of Hydrus.

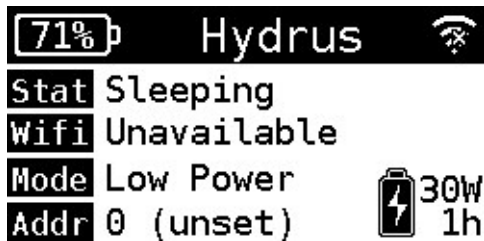


Figure 6: EPD Sleeping Status

- Leave Hydrus connected to the charger until it reaches a full charge of 100%.

**Note:** Ensure Hydrus is dry before inserting it into the Desk Charger.

### 6.1.6 Putting Hydrus from Low Power to High Power

Hydrus is now in Low Power and will need to be put into High Power to continue the initial set-up. The steps for this is as follows:

- Verify that Hydrus is currently in Low Power.

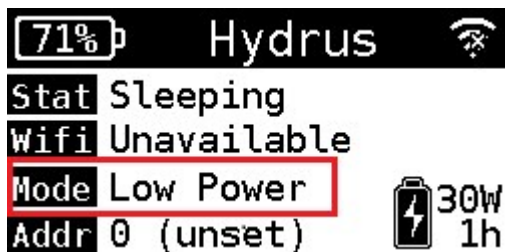


Figure 7: EPD Sleeping Status Verified

- On the EPD screen, tap the magnet once. If the state prompt (image below), does not appear, it could indicate a false contact. In such cases, continue tapping the screen until the state prompt becomes visible.



Figure 8: High Power State Prompt

- Tap the screen again, in response to the prompt mentioned above. Hydrus will move into a Booting Status this is confirmed by the EPD screen below:

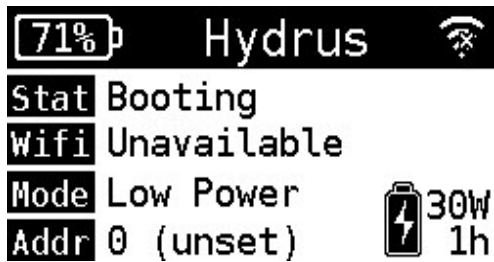


Figure 9: Booting Status

- Verify the mode to confirm that High Power has been successfully selected.

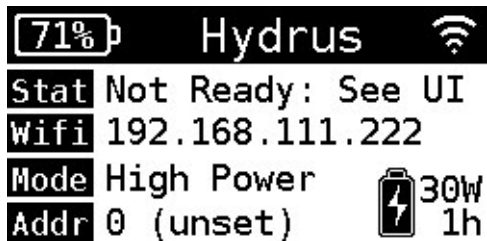


Figure 10: High Power Not Ready

- Hydrus is now in High Power and able to be accessible via Wi-Fi.

For more information on Power States see [6.3 Power States](#)

## 6.1.7 Device Connection

### Connect to Hydrus access point

- Ensure Hydrus is in High Power.
- Access the Wi-Fi settings on a user device (e.g., laptop, smartphone, tablet) and search for available networks.
- Locate and connect to Hydrus access point.

### Hydrus webUI via a browser

- Launch a web browser on your device and navigate to the Hydrus webUI (User Interface) at <http://192.168.0.1> for configuration and control.

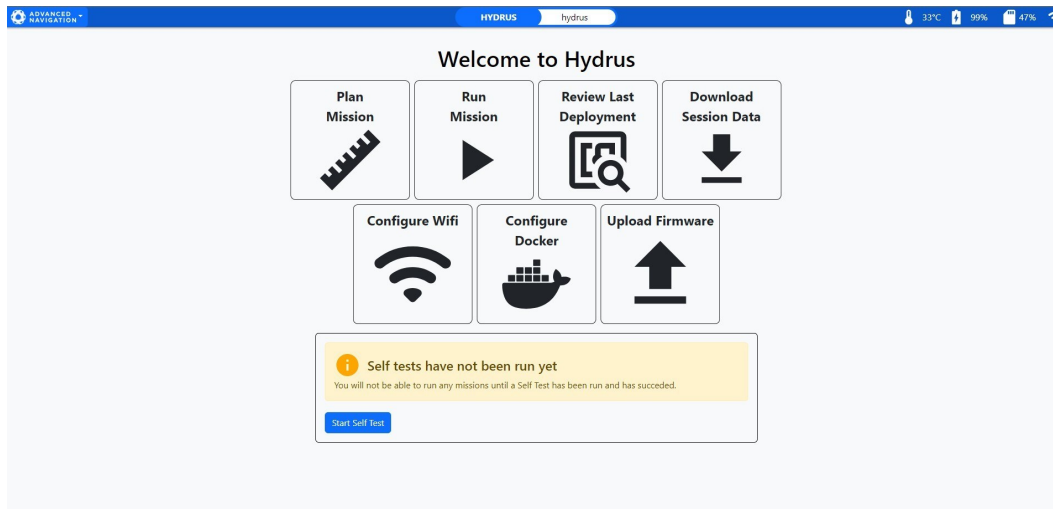


Figure 11: Hydrus WebUI Main Page

**Note:** For difficulties connecting to the Hydrus access point or network, refer to [6.4 Connecting Hydrus](#)

## 6.1.8 Testing and Functional Checks

### Conduct a self-test

- Ensure that Hydrus is powered on and connected to the network or access point as described in the previous steps.
- Open a web browser on a user device and enter the appropriate IP address or URL to access the Hydrus webUI.
- Navigate to the self-test section, there is a shortcut for this located at the bottom of the landing page of the webUI.

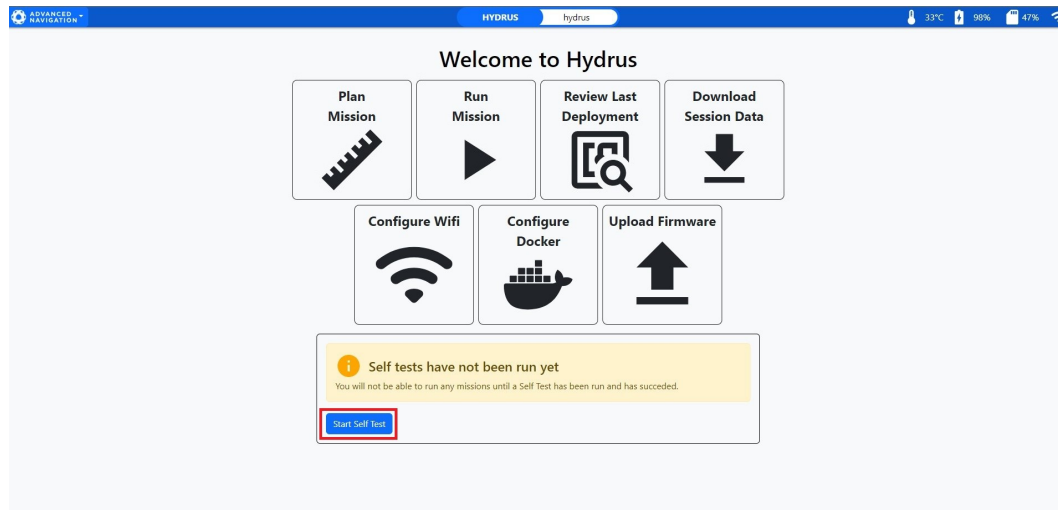


Figure 12: Start Self -Test

- Initiate the self-test process as guided by the instructions provided in the webUI.

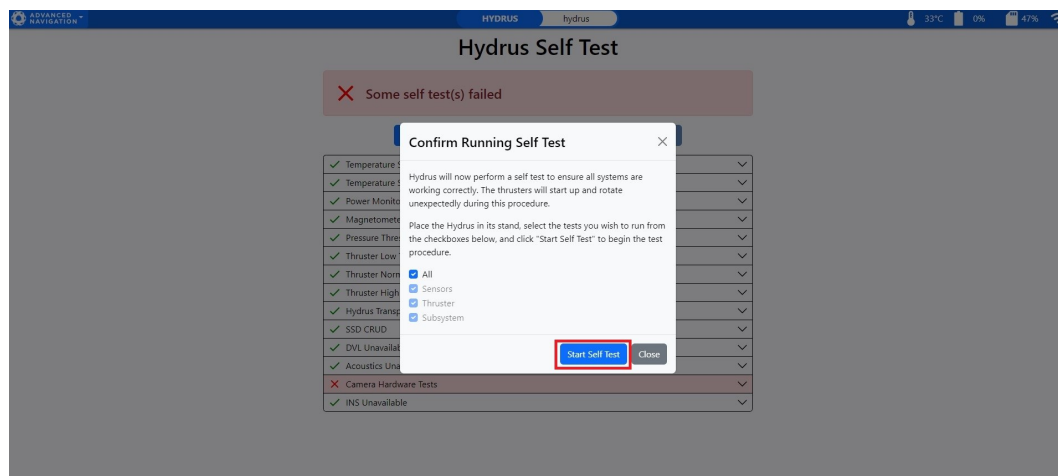


Figure 13: Self -Test Confirmation

- Pay attention to any error messages, warnings, or indications provided by the self-test process.

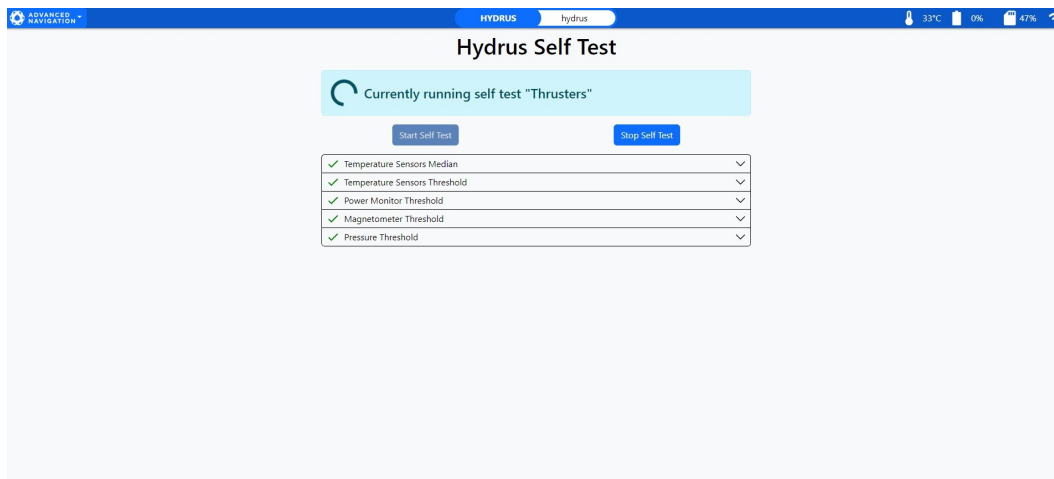


Figure 14: Self -Test Running

- The self-test will come up as complete, if the self-test identifies any issues or malfunctions, contact [support@advancednavigation.com](mailto:support@advancednavigation.com).

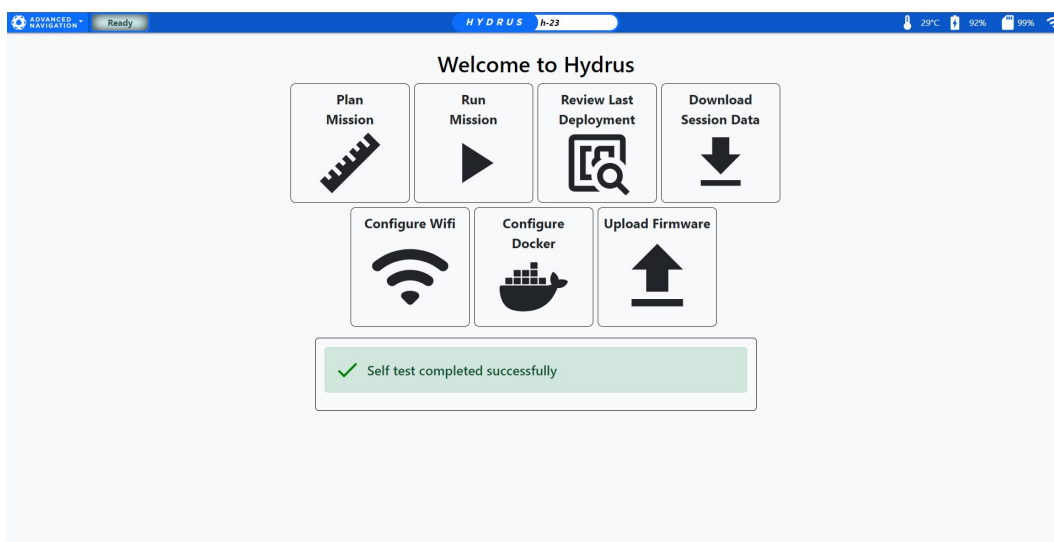


Figure 15: Successful Self -Test

**Note:** Performing a self-test **MUST** be completed before running or planning any missions with the Hydrus. Hydrus will not proceed without a self test.

## 6.1.9 Subsonus

If using Subsonus with Hydrus follow the steps in [6.5.1 Installation Checklist](#) for the necessary connection steps.

**Note:** After completing the initial set-up, proceed to [7.3 Mission Planning Process](#)

## 6.2 User Interface Overview

The user interface controls and monitors the operation of the Hydrus. The interface provides real-time monitoring capabilities displaying crucial information.

### 6.2.1 Hydrus EPD (Electronic Paper Display) Screen

The EPD (Electronic Paper Display) screen located on the transponder end of the Hydrus, it serves as a user interface, offering control and information to be displayed. The EPD screen enables easy interaction with the system and provides access to important information, It provides connectivity information, offering real-time updates on network connections and enabling users to monitor the system's connectivity status.

#### 6.2.1.1 Normal Operation Screen Overview

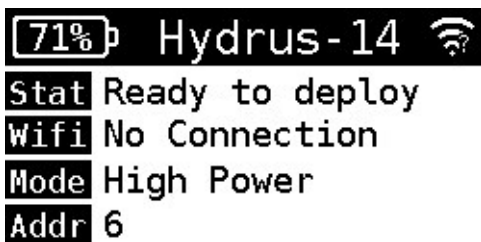


Figure 16: Normal Operation Screen

The Normal Operations Screen of the Hydrus device serves as a comprehensive interface that provides users with essential information about the device's current status and operational conditions. This screen is designed to facilitate effective monitoring and management of the device during regular use.

Indicator	Description
Top Indicator Bar	<p>The Top Indicator Bar on an Electronic Paper Display (EPD) screen serves as a visual representation of important status information. It displays three key indicators: battery status, the device name, and the Wi-Fi connectivity level.</p> <ul style="list-style-type: none"> <li>• <b>Battery Status:</b> The battery status indicator on the Top Indicator Bar provides information about the remaining charge or power level of the device. It helps users quickly assess how much battery life is available and whether they need to recharge the device. The indicator consists of a graphical representation being a battery icon with a textual representation indicating the battery percentage.</li> <li>• <b>Device Name:</b> The device name indicator displays the name or identifier of the Hydrus itself. This is particularly useful when multiple devices are connected or when managing a network of devices. The device name helps users identify and distinguish one device from another, especially in settings where multiple devices are in use simultaneously, such as Subsonus and GNSS.</li> <li>• <b>Wi-Fi Connectivity Level:</b> The Wi-Fi connectivity level indicator provides information about the strength of the Wi-Fi connection of the Hydrus. It shows the current signal strength, represented by a set of bars. This indicator allows users to determine the reliability and stability of their Wi-Fi connection, helping them troubleshoot</li> </ul>



Indicator	Description
	connectivity issues if necessary.
Status Indicator Bar	The Status Indicator Bar is a visual display element that provides users with important status information about the system or device. The bar indicates operational states and conditions of the system.
Wifi Indicator Bar	The Wifi indicator bar provides information about the IP (Internet Protocol) address assigned to the device, it indicates the specific address assigned to the device by the network's DHCP (Dynamic Host Configuration Protocol) server.
Mode Indicator Bar	The Mode Indicator Bar is a visual display which includes text and icons that indicates the different power states Hydrus is currently in. Power states that are displayed are High Power and Low Power.

### 6.2.1.2 Alert Notification Screen Overview



#### Alert Notification Screen

The Alert Notification Screen on the Hydrus device serves as a crucial interface for communicating important status information and advisories to the user.

Indicator	Description
Top Indicator Bar	This is located at the top of the screen and displays the name of the device, in the example above, "Hydrus 14". This helps users identify the specific device, especially useful when multiple devices are in use.
Main Alert Notification	This is the main alert notification displayed prominently in the middle of the screen. It comes with an icon for immediate recognition. The above example warning is triggered when the device's temperature exceeds its safe operating range, indicating a potential risk or issue that needs immediate attention.
Advisory	This is an accompanying statement that provides the user with critical instructions on what needs to happen next and what actions should be avoided. In the example above, it informs the user that the Hydrus device needs to cool down before it can be used again and that it should not be deployed in its current state.

## 6.2.2 Hydrus Web User Interface (webUI)

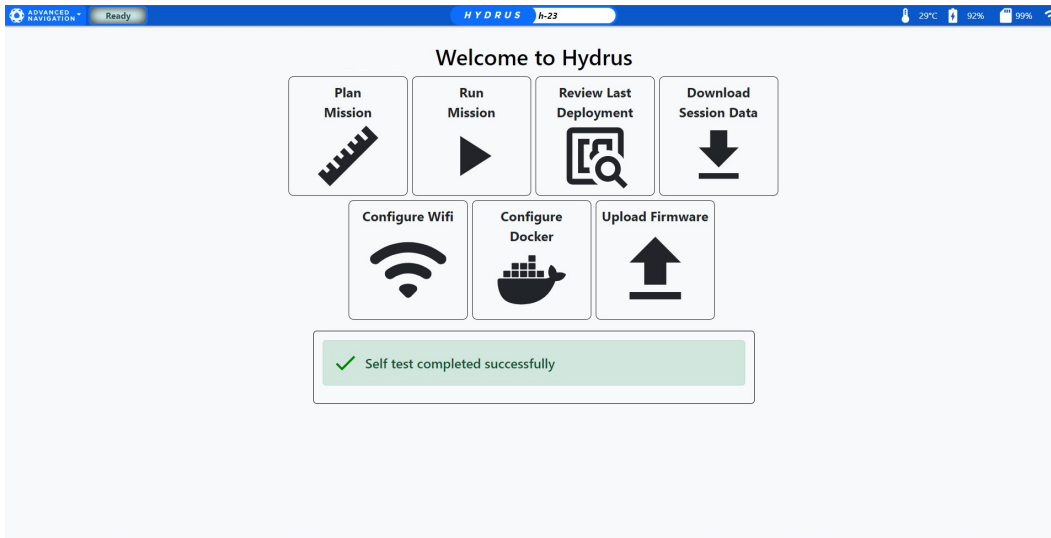









Figure 17: Hydrus WebUI Main Page



Figure 18: Hydrus WebUI Top Tab

The Hydrus Top Tab will be identified in the table below from left to right.

Menu Item	Description
	The Advanced Navigation drop down menu provides a collection of tools and functionalities to perform specific actions and commands within the webUI for Hydrus. These tools are designed to assist users in managing and interacting with Hydrus.
	The Main Page shortcut button within the webUI serves as a convenient way to quickly navigate back to the landing page or home page of the Hydrus application. By clicking on this button, users are immediately directed to the main page, which typically serves as the starting point or central hub of the application.
	The Device Name indicator within the webUI, identifies the Hydrus that the user is interacting with.
	The Internal Temperature indicator within the webUI provides information about the internal temperature of Hydrus. This feature is designed to monitor and report the temperature conditions within the vehicle's internal compartments.
	The Battery Remaining indicator within the webUI provides valuable information about the remaining charge or capacity of the internal battery in the Hydrus. This feature is designed to monitor and report the battery level, allowing users to assess the power status of the Hydrus.
	The Internal Storage Space indicator within the webUI provides important information about the remaining available storage space in the Hydrus. This feature allows users to monitor and assess the storage capacity of the

Menu Item	Description
	Hydrus internal storage system
	The Wi-Fi Configuration button within the webUI provides convenient access to various Wi-Fi settings and options for the Hydrus. This feature allows users to configure and manage the vehicle's Wi-Fi connectivity.

### 6.2.2.1 Advanced Navigation Drop Down Menu

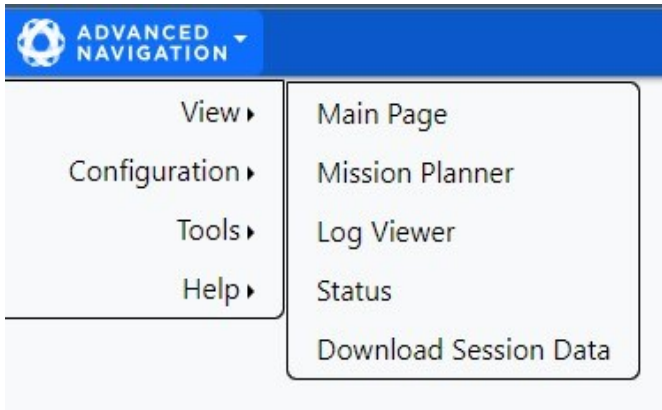
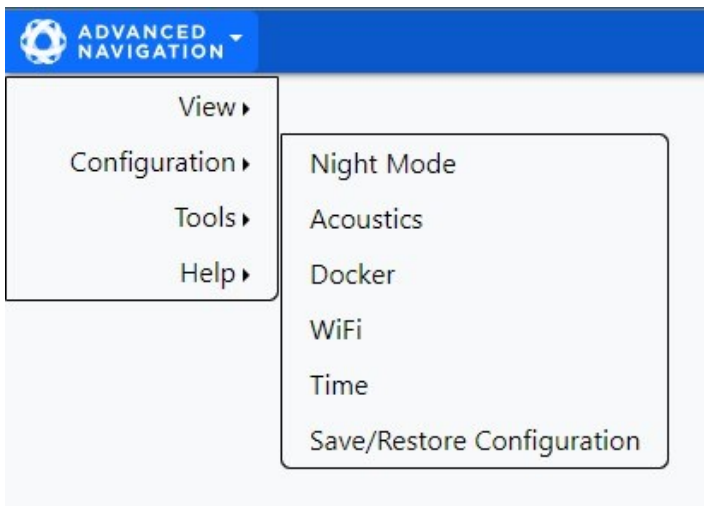


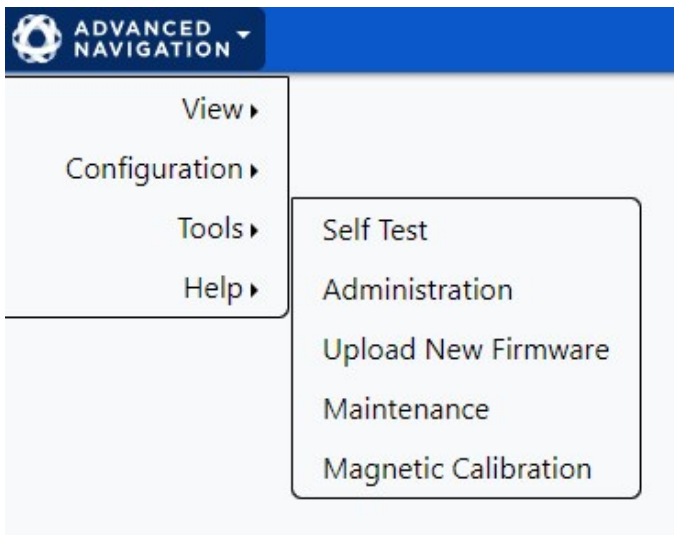
Figure 19: Advanced Navigation Drop-down Menu Options within "View"

Drop-down Menu Item	Description
Main Page	Returns users to the home page of Hydrus.
Mission Planner	Enables users to plan, edit, import, and export missions.
Log Viewer	Allows users to review the completed mission patterns in Hydrus.
Download Session Data	Provides access to download data from a specific mission in the form of a ZIP file.
Device Status	Displays the current system status of Hydrus.



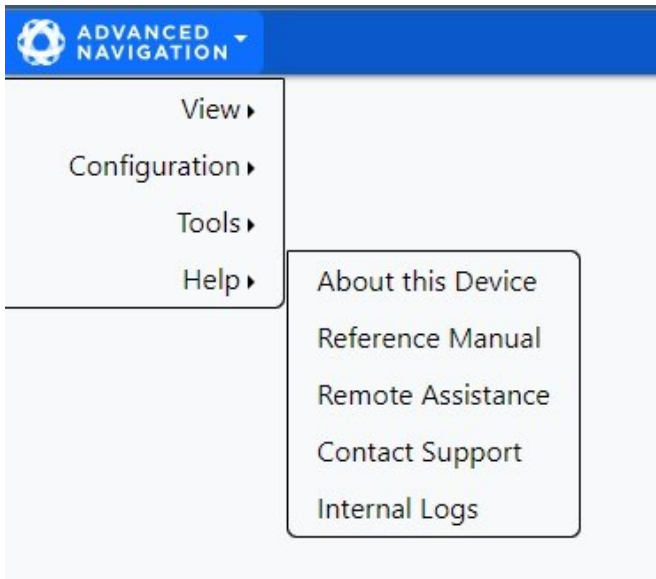
Advanced Navigation Drop-down Menu Options within "Configuration"

Drop-down Menu Item	Description
Night Mode	Activates the dark mode theme for the webUI, providing a visually appealing interface in low-light environments.
Acoustics	Provides settings for connecting and configuring a Subsonus with Hydrus.
Docker	This allows the user to run their own AI payloads or applications as a docker container
WiFi	Provides a shortcut to the Wi-Fi configuration settings, simplifying the process of managing Wi-Fi connectivity for Hydrus.
Time	Selects the time source and servers.
Save/Restore Configuration	Saves the current configuration or restores a previously saved configuration, facilitating easy setup and migration of Hydrus' settings.



Advanced Navigation Drop-down Menu Options within "Tools"

Drop-down Menu Item	Description
Self Test	Initiates a comprehensive self-test for Hydrus, which verifies the functionality and performance of its systems.
Administration	Provides access to administrative functions for Hydrus such as <a href="#">6.3.4 Restarting Hydrus</a> and sending Hydrus to <a href="#">Shipping Mode</a> .
Upload New Firmware	<a href="#">10.5 Firmware Update</a> enables users to upload and install a new firmware version (ANFW file) to update and enhance Hydrus' capabilities.
Maintenance	Provides access to the <a href="#">10 Maintenance</a> page with Rinse Mode that slowly spins the thrusters for 60 seconds. Rinsing should be done after every use with the Hydrus submerged in clean, fresh water.
Magnetic Calibration	Access to <a href="#">10.4 Magnetic Calibration</a> of the magnetometers.



Advanced Navigation Drop-down Menu Options within "Help"

Drop-down Menu Item	Description
About this Device	Provides detailed information about Hydrus, including hardware and software specifications, version information, and other relevant details.
Reference Manual	Accesses the comprehensive reference manual for Hydrus, which contains detailed instructions, guidelines, and technical information on operating, configuring, and maintaining the device.
Remote Assistance	Allows users to initiate a remote assistance session with technical support or experts. This feature enables real-time collaboration and troubleshooting to resolve any issues or provide guidance for optimal device performance.
Contact Support	Provides contact information for support services. Users can reach out to the support team through email to seek assistance, report issues, or request additional information or guidance.
Internal Logs	Provides access to the internal logs generated by Hydrus. These logs contain valuable information about system events, errors, and diagnostics, which can be helpful for troubleshooting and analysis purposes.

## 6.2.3 Subsonus Web User Interface (webUI)

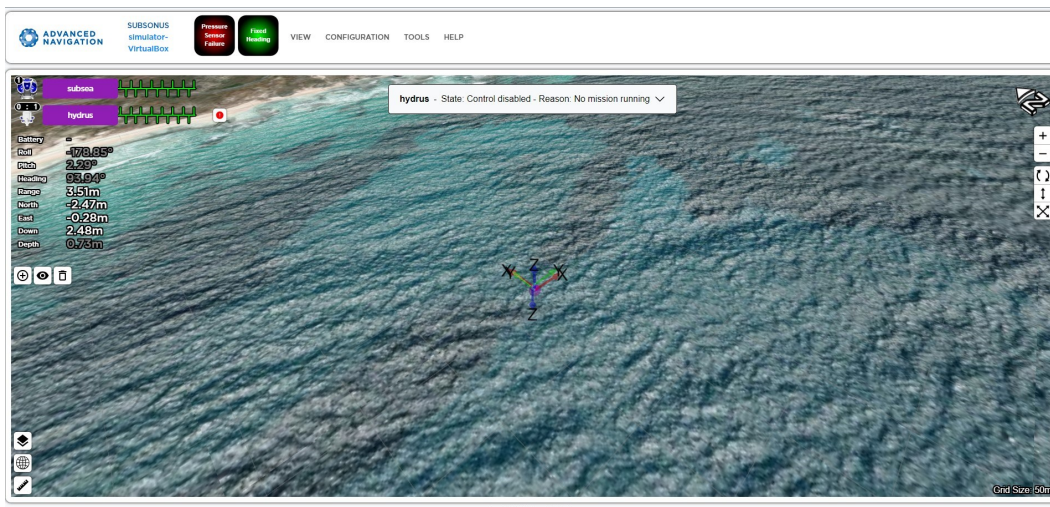


Figure 20: Subsonus WebUI Main Page

### 6.2.3.1 Device List

The device list within the Subsonus webUI provides information about the connected devices, particularly the Hydrus device that is being tracked acoustically underwater by the Subsonus USBL (Ultra Short Baseline) system.

**Note:** Click on the device to see Live Data for each device.

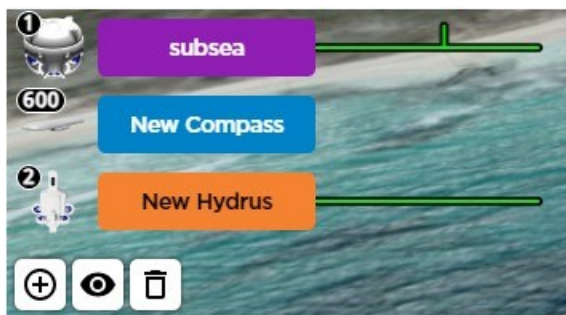


Figure 21: Subsonus Devices

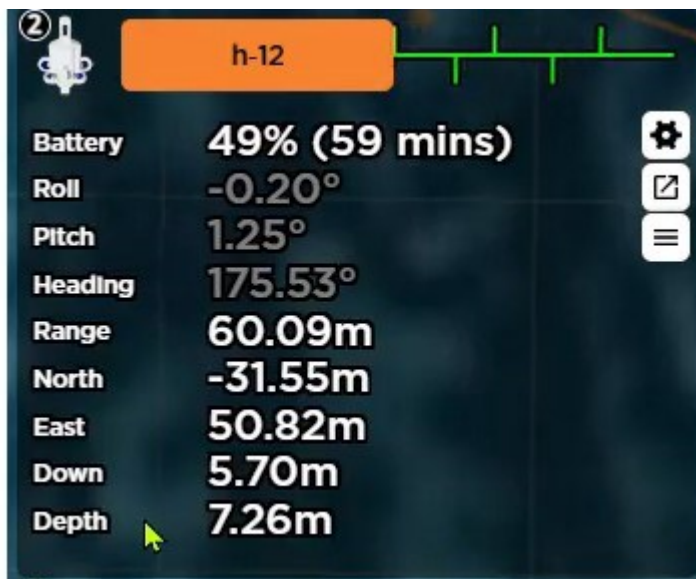


Figure 22: Device List

Indicator	Description
Battery	This indicator shows the remaining time and charge of the battery on Hydrus. It provides information about the power status of Hydrus.
Roll	This indicator displays the rotation about the forward axis of Hydrus. It indicates the degree of tilt or rotation around the device's front-to-back axis.
Pitch	This indicator represents the rotation about the starboard axis of Hydrus. It indicates the degree of tilt or rotation around the vehicles side-to-side axis.
Heading	This indicator shows the rotation about the downward axis of Hydrus. It indicates the device's orientation or heading with respect to the downward direction.
Range	This indicator provides the acoustic distance from the Subsonus USBL system to Hydrus. It indicates the measured distance between the two devices using acoustic signals.
North	This indicator displays the distance northward from the Subsonus USBL system to Hydrus. It indicates the measured distance in the north direction between the two devices.
East	This indicator represents the distance eastward from the Subsonus USBL system to Hydrus. It indicates the measured distance in the east direction between the two devices.
Down	This indicator shows the distance downward from the Subsonus USBL system to Hydrus. It indicates the measured distance in the downward direction between the two devices.
Depth	This indicator provides the depth below sea level, taking into account the pressure correction derived from the pressure sensor on Hydrus. It accurately determines the depth below the sea surface



### 6.2.3.2 Open Device Configuration

When the user right-clicks on the device list in the Subsonus webUI and select "Open Device Configuration", a dialog box will open with various options and information related to the Hydrus device.

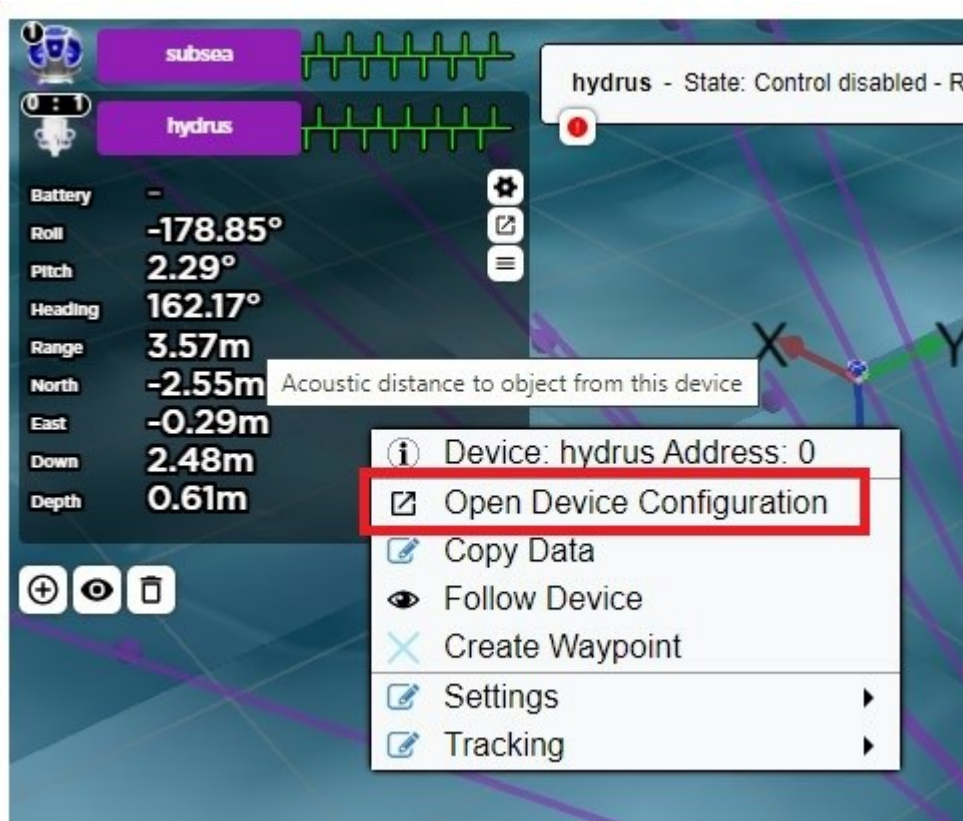


Figure 23: Open Device Configuration

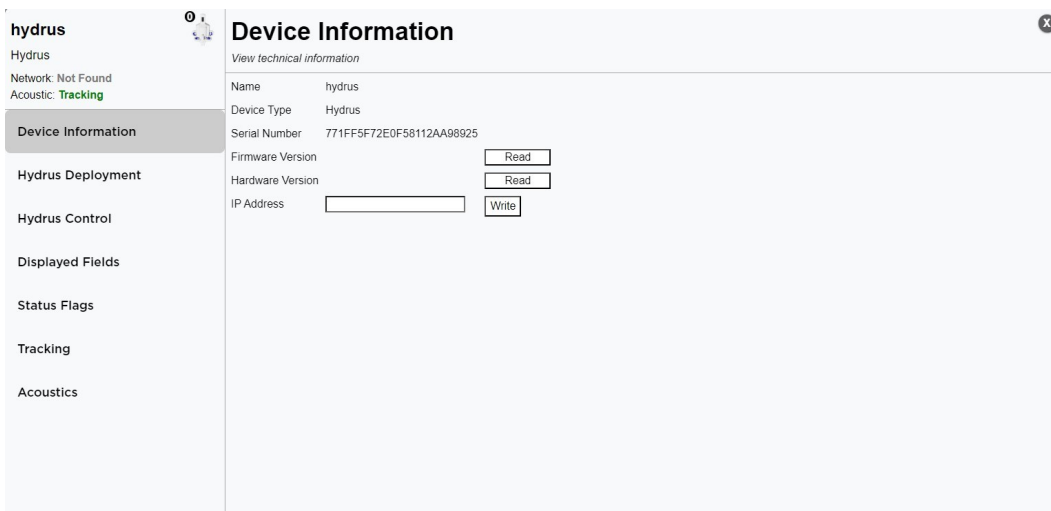


Figure 24: Hydrus Deployment

Indicator	Description
Device Information	This section displays specific information about the Hydrus, including its name, device serial number, firmware version, hardware version,

Indicator	Description
	and IP address. These details help identify and differentiate the Hydrus unit.
Hydrus Deployment	This section allows the user to deploy Hydrus on a mission, guiding the user through mission selection, review or important mission parameters, running Hydrus self tests and final deployment.
Hydrus Control	This section enables remote control of the Hydrus over acoustics. It provides a means to operate and control the Hydrus' functionalities from a remote location using acoustic communication.
Displayed Fields	In this section, the user can configure which fields are displayed on the view. It allows the user to customise the information and data that are visible on the user interface for better visualisation and monitoring.
Status Flags	This section allows the user to view the current alarms, warnings, and state of the Hydrus. It provides information about any active alerts or status indicators that may require attention or action.
Tracking	This section enables configuration of the local tracking settings for the Hydrus. The user can set parameters and preferences related to the tracking functionality, such as tracking mode, accuracy, or specific tracking algorithms.
Acoustics	In this section, The user can remotely set the device acoustic address and view live acoustic data. It provides options to manage the acoustic communication settings and monitor real-time acoustic data received from the Hydrus.

### 6.2.3.3 Hydrus Command Dialog Box

The Hydrus command dialog box serves as an integral part of the Subsonus webUI, providing a comprehensive interface for the remote operation of Hydrus. Divided into four key quadrants, this dialog box offers real-time device monitoring, mission tracking, command execution feedback, and dynamic user control options. This allows the user to monitor the current state of the device, its battery percentage, and ongoing mission status, to controlling its operations and directing its tasks acoustically.

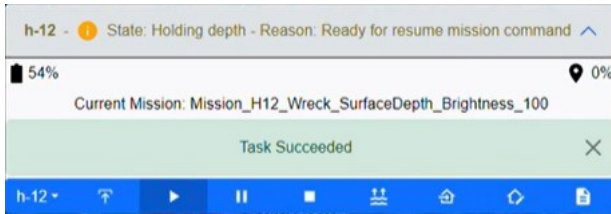


Figure 25: Hydrus Command Dialog Box

Quadrant	Identifier	Description
1	Device Information	This quadrant shows factual details about the Hydrus device. It includes the 'Device Name', which is the unique identifier for each Hydrus unit. The 'Device State' indicates the current operational status. The 'Reason for Device Being in This State' provides technical insights behind the device's current state.
2	Mission and Battery Status	This quadrant provides information about the device's power and mission status. The 'Battery Percentage' indicates remaining power. The 'Current Mission Running' displays the file name of the active mission. The 'Percentage of Mission Complete' represents the progress made on the mission.
3	Command Status	This quadrant informs about the outcomes of the commands. The 'Command Status' will read 'Task Succeeded' for successful commands or 'Task Failed' for unsuccessful ones.
4	User Controls	This quadrant contains options for user controls. <b>'Change Device'</b> lets users switch to another Hydrus device. <b>'Open Hydrus Deployment Interface'</b> lets users access the interface to conduct Hydrus operations. <b>'Continue Mission'</b> , <b>'Pause Mission'</b> , and <b>'Abort Mission'</b> control the status of the current mission. <b>'Return to Surface'</b> and <b>'Go to Recovery Location'</b> directs the device to different locations. <b>'Set Recovery Location'</b> enables users to update the predetermined home location for Hydrus. <b>'Show Mission Reports'</b> in this quadrant refers to the record of Hydrus's past activities and future tasks once the unit has been deployed. It's important to note that 'Mission Reports' here is specific to the acoustic commands and provides crucial insights into what Hydrus has been doing during its mission.

## 6.3 Power States

This section describes the three power states of Hydrus: High Power, Low Power, and Shipping Mode. Detailed are the activation and selection processes for each state, in addition to associated safety precautions required for maintaining optimal performance. Proper understanding and management of these power states are vital to the functioning and operation of Hydrus in different underwater environments.

### 6.3.1 High Power

#### Overview

When set to High Power, Hydrus is fully functional and gives users complete access to all its applications. When operating in water, Hydrus **MUST** be in this power state.

**Activation/Selection** - To transition Hydrus into High Power, follow the step-by-step procedure outlined below:

1. Verify that Hydrus is currently in low power.
2. On the EPD screen, tap the wand once. If the state prompt does not appear, it could indicate a false contact. In such cases, continue tapping the screen until the state prompt becomes visible.
3. Look for a prompt on the screen that says "Tap to enter High Power." Once this prompt is seen, proceed to the next step.



Figure 26: Tap to Enter High Power

4. Tap the screen again, in response to the prompt mentioned above.
5. Verify the mode to confirm that High Power has been successfully selected.

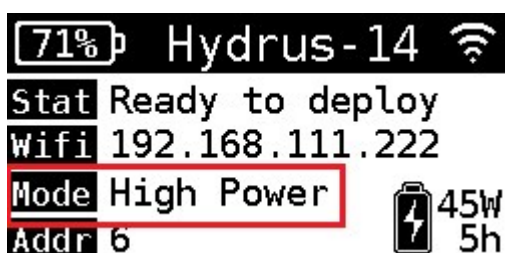


Figure 27: High Power

**Note:** Exercise caution while tapping the wand on the EPD screen. Apply gentle pressure and avoid excessive force to prevent any damage to the screen or internal components. Exerting too much pressure or using sharp objects can potentially result in the screen getting scratched or the device getting damaged.

## 6.3.2 Low Power

**Overview** - In Low Power, the Hydrus manages its power resources by prioritising critical functions and reducing power to non-essential systems. In this state the Hydrus is non-operational.

**Activation/Selection** To transition Hydrus into Low Power, follow the step-by-step procedure outlined below:

1. Verify that Hydrus is currently in High Power.
2. Ensure Hydrus is connected via Access point or Network and open the webUI see [6.4 Connecting Hydrus](#)
3. Navigate to the Advanced Navigation drop-down menu and select Tools> Administration > Send Hydrus to Low Power Mode.

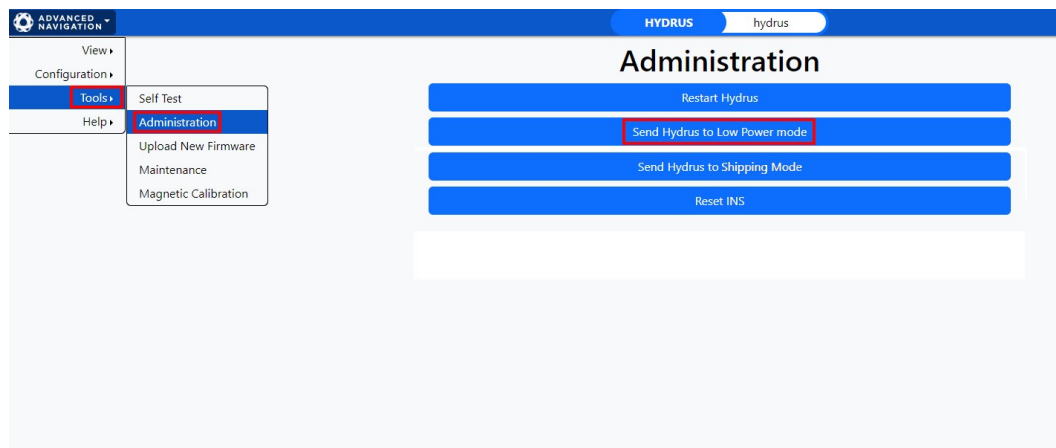


Figure 28: Navigate to Low Power WebUI

4. Read the confirmation dialogue box before selecting and sending Hydrus into a Low Power state.

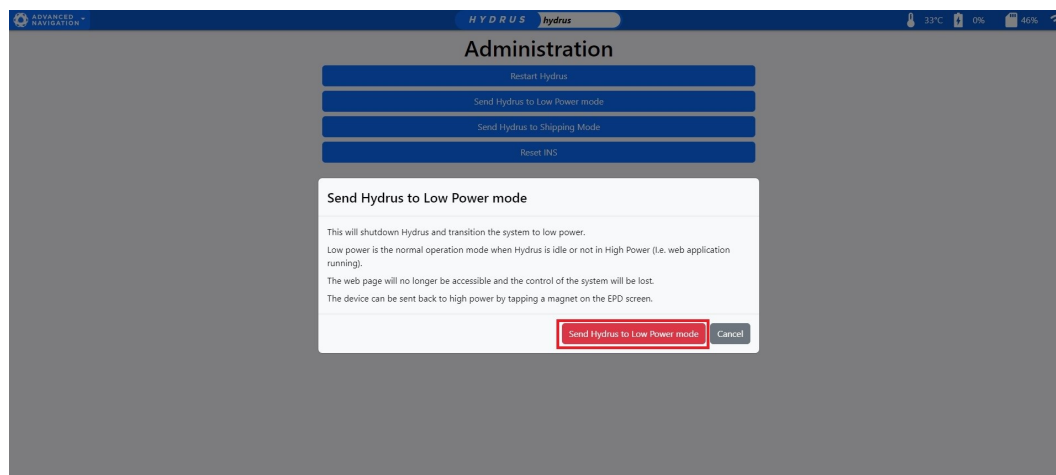


Figure 29: Confirmation to Low Power

5. Wait for confirmation of Low Power on the EPD screen of the Hydrus.

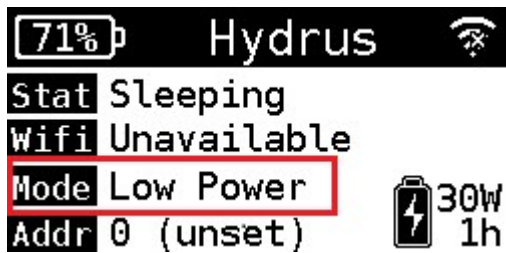


Figure 30: Low Power

**Note:** The user can exit the Low Power state by tapping the Hydrus wand see [6.3.1 High Power](#)

Alternatively, Hydrus can be put in Low Power manually on Hydrus by following the steps outlined below:

**Activation/Selection** To transition Hydrus into Low Power, follow the step-by-step procedure outlined below:

1. Verify that Hydrus is currently in High Power.
2. On the EPD screen, tap the wand once. If the state prompt does not appear, it could indicate a false contact. In such cases, continue tapping the screen until the state prompt becomes visible.
3. The prompt on the screen that will appear will say "Tap to enter Low Power." Once this prompt is seen, proceed to the next step.

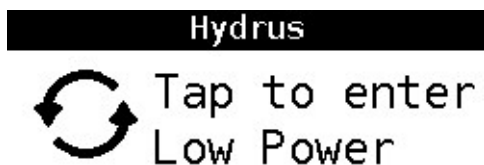


Figure 31: Tap to Enter Low Power

4. Tap the screen again, in response to the prompt mentioned above.
5. Verify the mode to confirm that Low Power has been successfully selected.

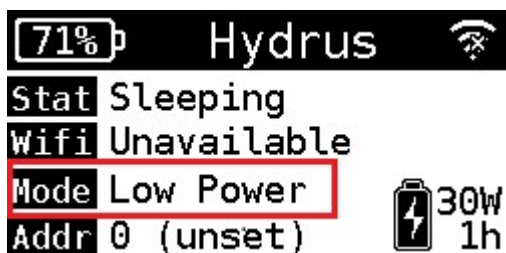


Figure 32: Low Power

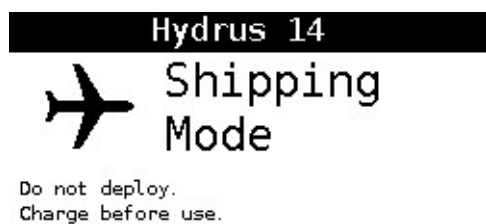
**Note:** Hydrus must be in High Power in order to transition into Low Power.

### 6.3.3 Shipping Mode

**Overview** - Shipping mode is specifically designed to safely transport Hydrus during shipping, including air transportation. By activating shipping mode, Hydrus systems and components are configured to ensure its integrity and protection during transit or extended periods of inactivity.

**Activation/Selection** - To transition Hydrus into Shipping Mode, follow the step-by-step procedure outlined below

1. Open the Hydrus webUI and select the Advanced Navigation Drop down menu see [6.2 User Interface Overview](#)
2. Click on Tools > Administration> Send Hydrus to Shipping Mode
3. From here the user will be view a dialog box prompting for confirmation to enable shipping mode
4. Wait for Hydrus to confirm Shipping mode confirmation on the EPD screen.



*Figure 33: Shipping Mode*

---

**Note:** To exit Shipping mode, connect Hydrus to the Desk Charger.

---

Alternatively, Hydrus can be put in Shipping Mode manually on Hydrus by following the steps outlined below:

1. Tap the wand on the EPD screen and hold for 25 seconds, then take the wand off for 25 seconds.
2. Repeat Step 1 a further 3 times, Shipping mode will then appear on the EPD screen.

---

**Note:** If Shipping Mode doesn't appear on the EPD screen restart the manual process until Shipping mode appears.

---

### 6.3.4 Restarting Hydrus

If there is a need to restart Hydrus, please follow the following steps:

1. Navigate to the Hydrus webUI and select the Advanced Navigation Drop Down Menu, Select "Tools" and then "Administration".

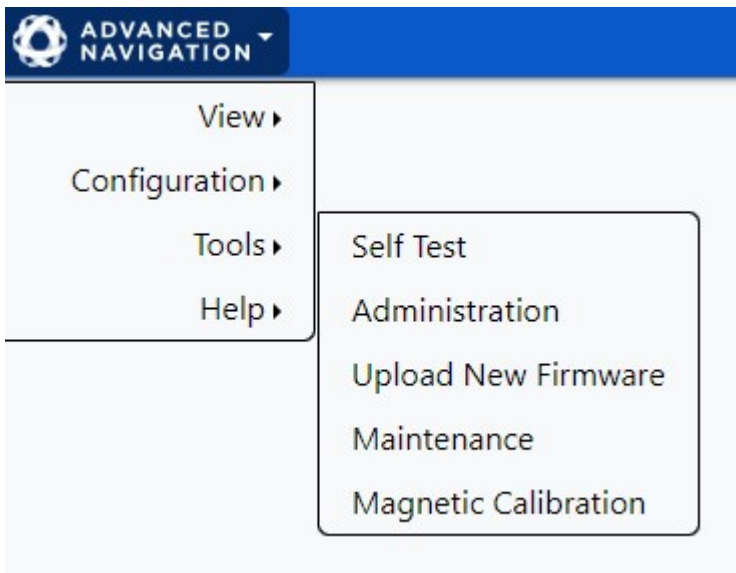


Figure 34: Advanced Navigation Drop Down Tools

2. In the Administration page, Select "Restart Hydrus"

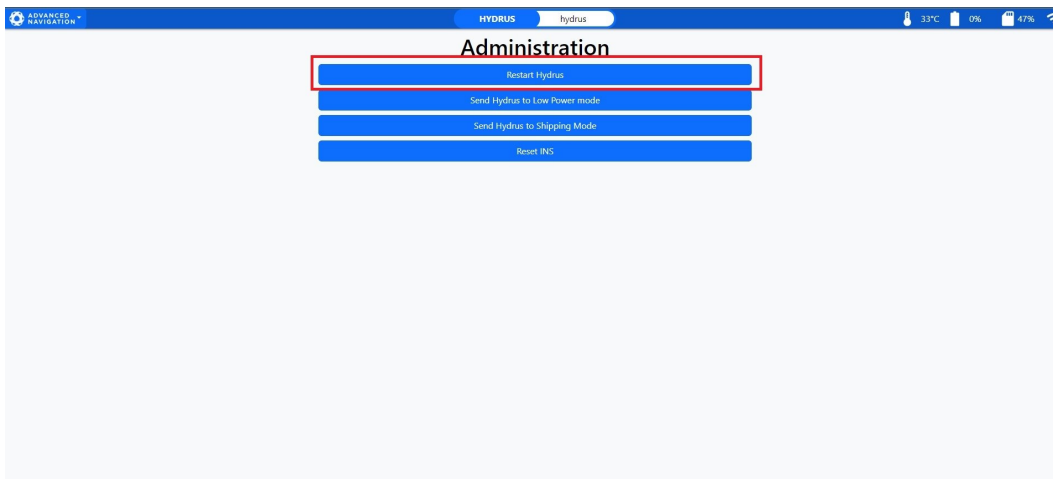


Figure 35: Hydrus WebUI Administration



3. Confirm Restart by selecting "Restart Hydrus".

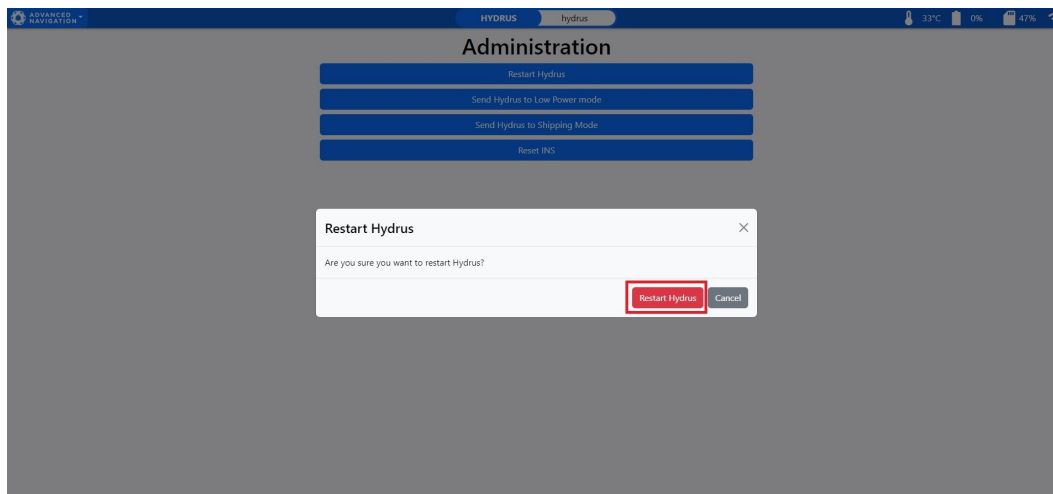


Figure 36: Restart Hydrus

4. Hydrus will indicate that it is restarting, click "ok" and return to the EPD screen and wait till Hydrus reboots

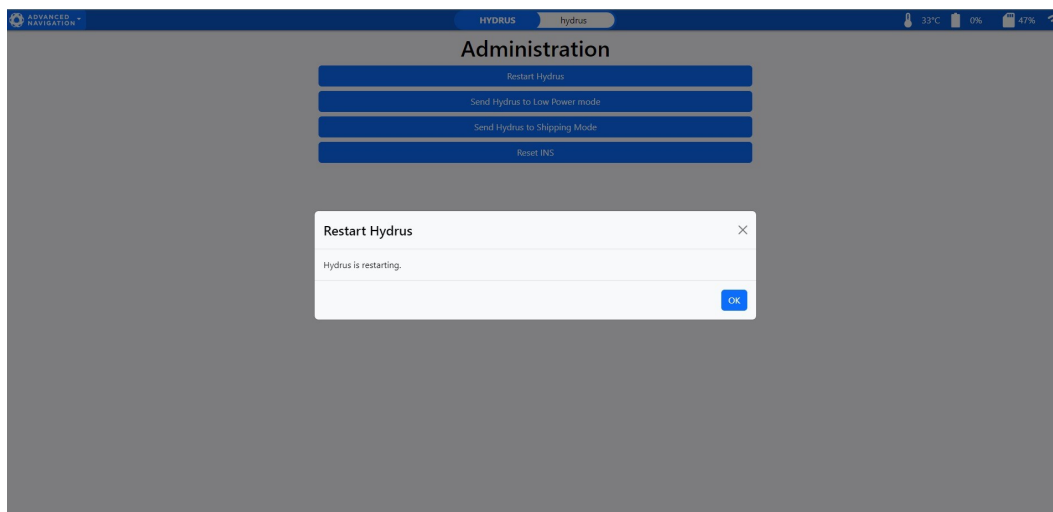


Figure 37: Hydrus Restarting

## 6.4 Connecting Hydrus

### 6.4.1 Connecting Hydrus Via Access Point

1. **Turn Hydrus ON:** Start by turning on Hydrus device. To do this, The user will need to switch Hydrus into 'High Power Mode'. If the user is unsure how to do this, see [6.3 Power States](#).
2. **Wait for Wi-Fi Status:** After turning Hydrus on, wait for 1-2 minutes. Pay attention to Hydrus's EPD screen. The Wi-Fi status should change to 'No Connection: See UI'. This indicates that Hydrus is ready to connect.

3. **Connect to Hydrus' Network:** On the users Wi-Fi-enabled device, open the Wi-Fi settings and look for available networks. Hydrus should appear in the list of available Wi-Fi networks. It will be listed as a serial number, for example: '002F00075652501620383055'. Select it and connect using the password '**anhydrus**'.

When connecting to the Hydrus Access Point (AP), Windows may display a warning because the Hydrus AP does not provide an internet connection. This is expected behavior and does not indicate a problem with the connection.

- If the device asks whether the user wants to stay connected to the Hydrus AP despite the lack of internet connection, the user should click "Accept" or the equivalent option on the device.
  - The user should ensure that the device has not automatically connected to another network without the user's knowledge. Some devices may switch to a known network with internet access.
  - If the device is connecting to another network, the user may need to "forget" that network in the device's settings. This action will force the device to connect to the Hydrus AP, even though there is no internet connection.
4. **Access Hydrus' Interface:** Once connected, open an internet browser. In the address bar, type in '192.168.0.1'. The user will see a screen that represents Hydrus's user interface. From here, the user can manage Hydrus.

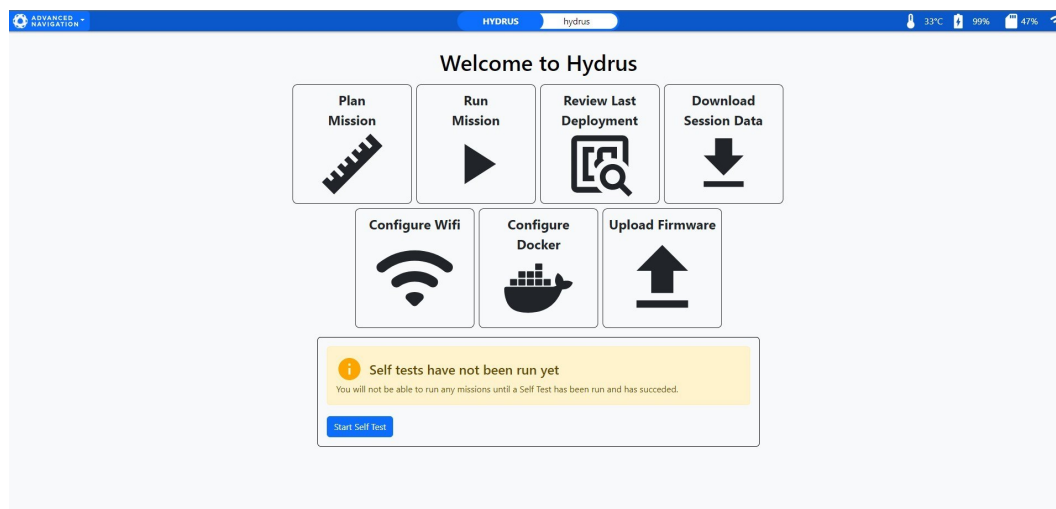


Figure 38: Hydrus WebUI Main Page

**Note:** Remember to follow each step carefully and ensure your device is connected to Hydrus's network before trying to access the user interface. If you encounter any issues, refer to the troubleshooting section of your Hydrus manual or contact Hydrus support.

## 6.4.2 Connecting via Network

1. **Connect to Hydrus:** Start by connecting Hydrus device as described above in Connecting Hydrus via Access Point.
2. **Access the Main Page:** Once connected to the Main Page, click on Configure Wi-Fi.

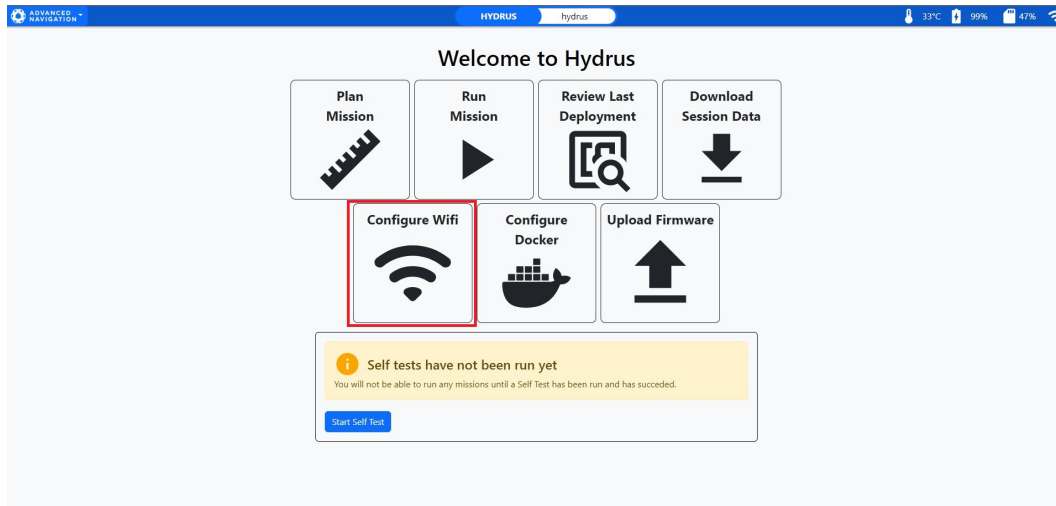


Figure 39: Wi-Fi Icon

3. **Add Network:** Under known Wi-Fi Networks select Add Network.

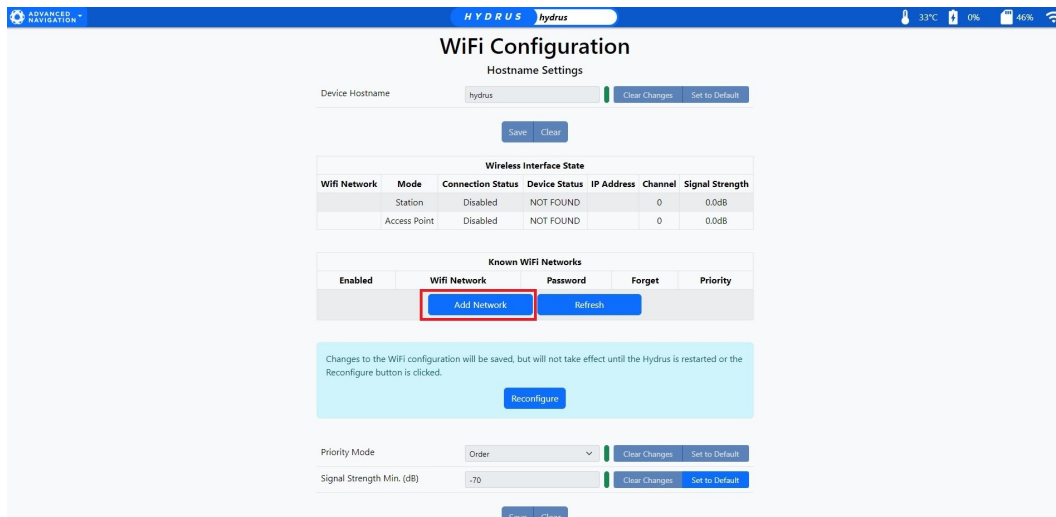


Figure 40: Add Network

4. **Run Scan:** Click Run Scan for Hydrus to initiate its run scan function to search for the network the user requires.

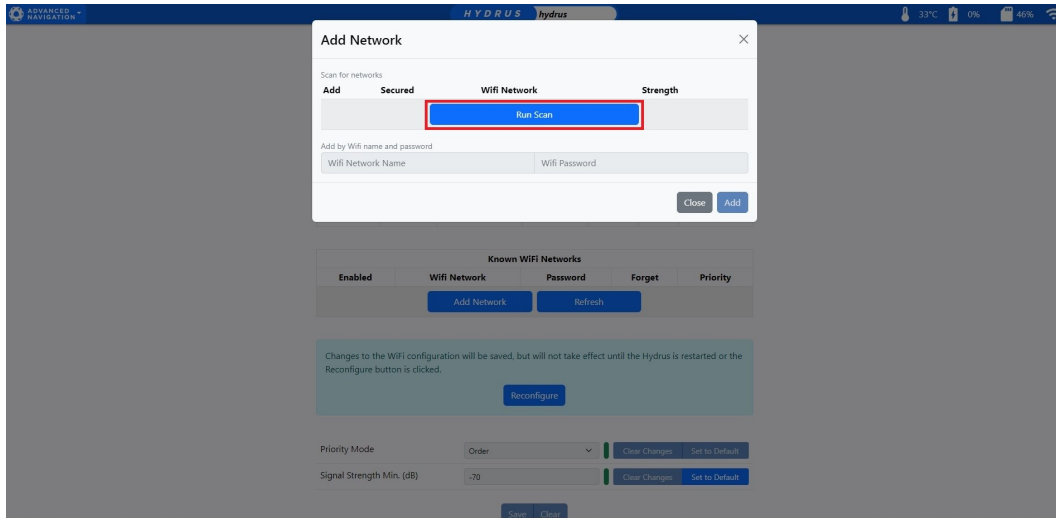


Figure 41: Wi-Fi Configuration Run Scan

- Select Network** : After Hydrus completes the network scan, the user will choose their preferred network. Upon selection, a new dialog box will emerge, prompting the user to enter the network's Wi-Fi Password.

**Note:** Alternately the user can manually input the Wi-Fi network and the Wi-Fi Password.

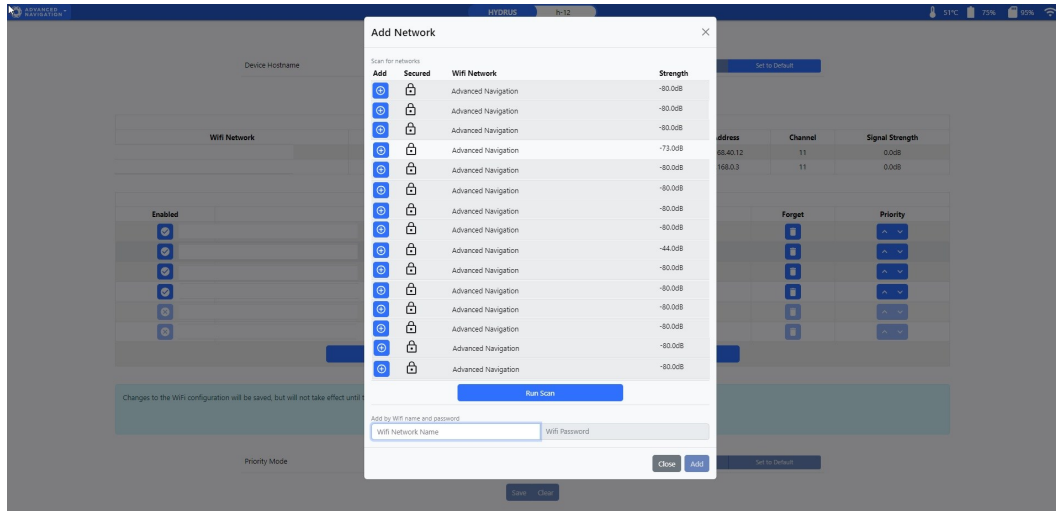


Figure 42: Wi-Fi Configuration Network

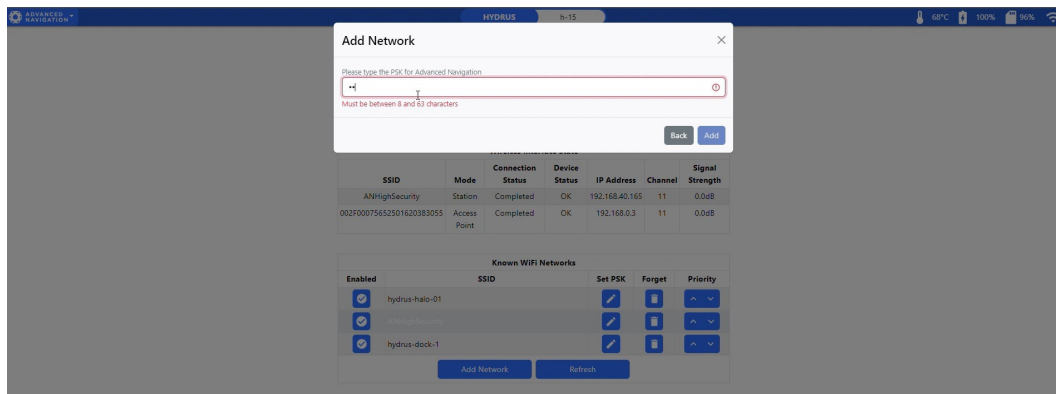


Figure 43: Wi-Fi Configuration Password

- Set Priority** : The user has the option to select the priority of the networks Hydrus can connect to.

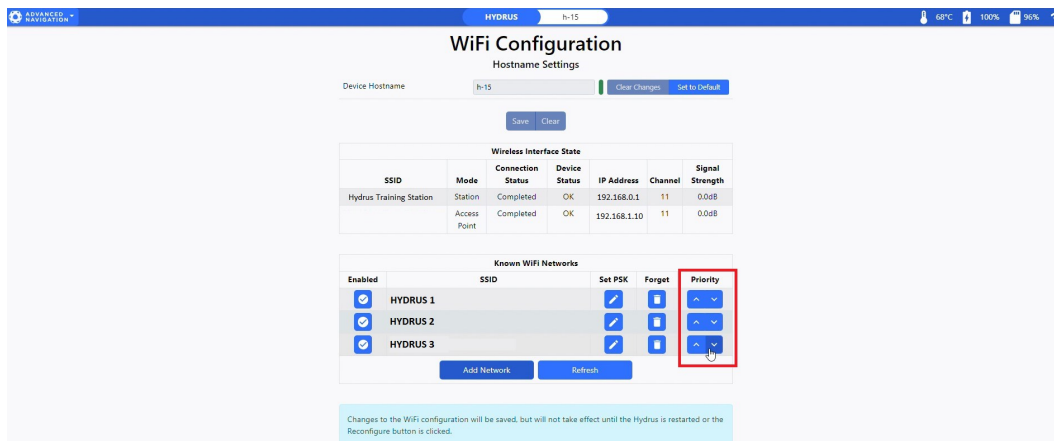


Figure 44: Wi-Fi Configuration Priority

- Reconfigure** : Modifications to the WiFi settings will be stored, but they won't be implemented until either the Hydrus system is rebooted or the 'Reconfigure' button is selected.

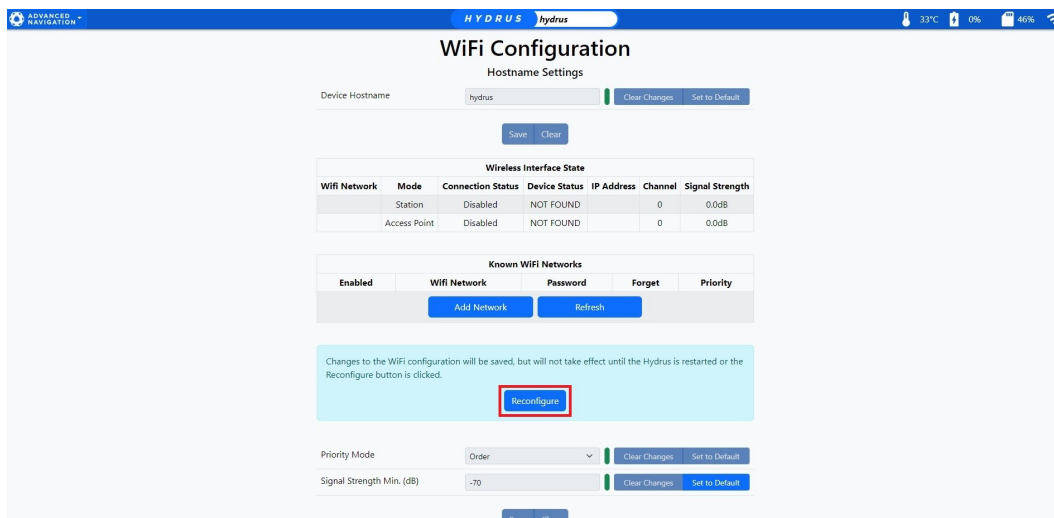


Figure 45: Wi-Fi Configuration Reconfigure

## 6.5 Installing Subsonus

### 6.5.1 Installation Checklist

The following checklist provides the basic steps for connecting, mounting and configuring a Subsonus unit.

#### 6.5.1.1 Subsonus Surface Installation Checklist

1. Ensure all prerequisites are met, see [6 Getting Started](#).
2. Mount the surface unit following the guidelines in [6.5.3 Mounting Position](#).
3. Set up the reference data source, see [6.5.4 Surface Unit Reference Source](#). It is crucial that the surface unit reference source and surface Subsonus unit are aligned as closely as possible to the vessel bow-stern axis, and that any alignment offsets are accurately measured once mounted. These offsets must be later entered during configuration.
4. Install and set up any external aiding devices, such as a DVL, according to the instructions provided with the device. Ensure that any position and alignment offsets between Subsonus and the DVL are accurately measured once mounted. These offsets must be later entered during configuration.
5. Install cables to the unit and make sure the connector is mated correctly and the jacket is screwed on hand tight.
6. Connect the Subsonus cables to PoE injectors and the PoE injectors into a local network (with DHCP). Power everything on. When the PoE injectors are delivering power to Subsonus the LED indicator will change from orange to white.
7. Open your web browser and type in the address <http://surface.local/> to connect to the Subsonus unit. The trailing forward slash is required on some web browsers.  
If you cannot connect to the Subsonus at this address, see Interfacing with Subsonus in the Subsonus Reference Manual.
8. Ensure that the offset between the surface Subsonus and the GNSS Compass has been accurately measured and entered in the Web UI. See [Offset Measurement](#) for directional information when measuring the offset.
9. The system is now ready for further configuration and deployment.
10. Once configured, the devices are ready to deploy. Monitor the system from the surface Subsonus Web UI. Click on the main page to see the status. It may take a couple of minutes to initialise after which time the location of the unit will appear.

## 6.5.2 Connection Diagrams

This connection diagram shows the connections required to set up position aiding for a Surface Subsonus using the Advanced Navigation GNSS Compass.

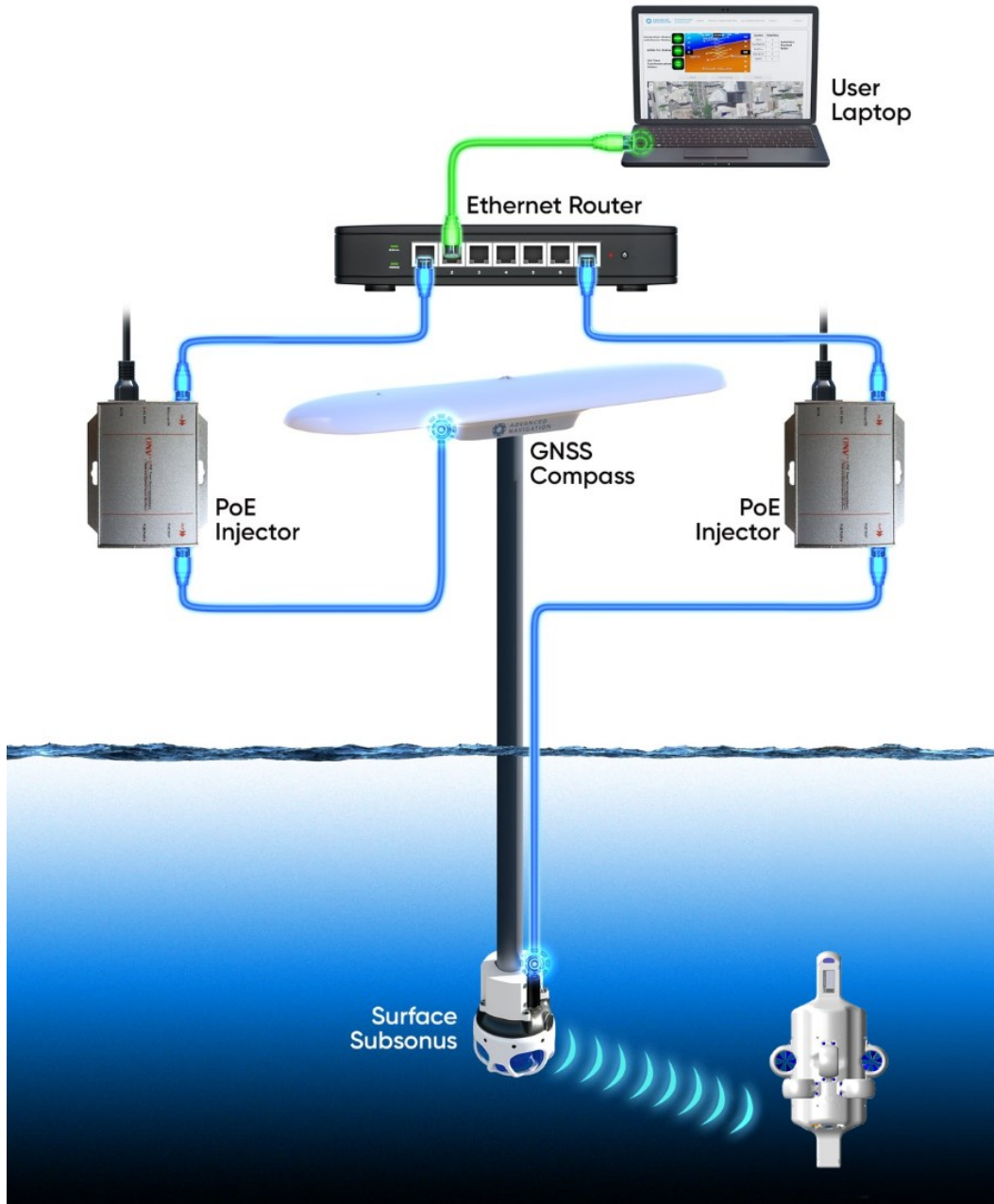
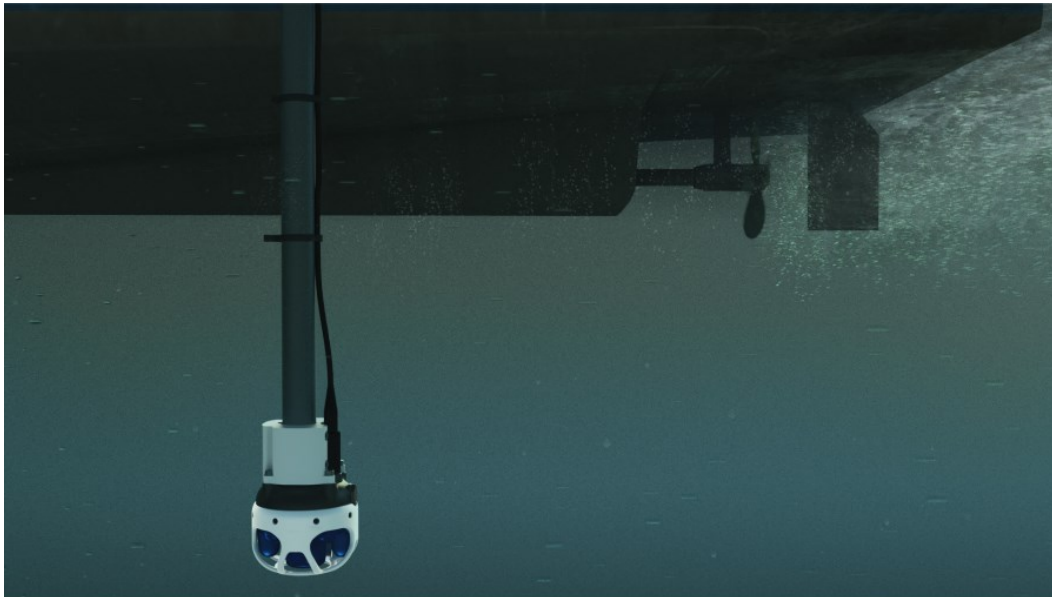


Figure 46: Connection Diagram



### 6.5.3 Mounting Position

The surface Subsonus unit is typically mounted on a pole that is attached to the side of a ship and pointing down into the water, see [Figure 47: Typical Subsonus Surface Mounting](#).



*Figure 47: Typical Subsonus Surface Mounting*

Mounting goals with the surface unit are:

1. Insulation between the Subsonus unit and the pole is required to avoid ground loops.
2. The Subsonus unit should be mounted with the hydrophone array and cage pointing directly down into the water.
3. The connector blanking bolt on the side of Subsonus must be aligned so that it is pointing in the backwards direction of the vessel, opposite to the direction of travel. There is an arrow on the underside of the unit - this arrow must point toward the front of the vessel when the Subsonus is mounted.
4. The Subsonus unit should be mounted at least 1 metre under the surface of the water, and at least 0.5 m below the vessel keel. The surface unit should be deep enough that it never comes out of the water.
5. The Subsonus unit should be mounted at least 1 metre away from the boat hull or jetty.
6. The Subsonus unit should be mounted away from propellers and thrusters. It should be mounted in a position where it will have minimal air bubbles passing over or below the hydrophones.

### ***Pole Mount Bracket***

Advanced Navigation stocks a reinforced acetal plastic pole mount bracket for Subsonus that allows customers to quickly mount the surface unit to a 15-35mm diameter pole, as shown below.



*Figure 48: Subsonus Pole Mount Bracket*

The surface Subsonus unit can also be mounted to fixed structures such as jetties or buoys, where the same mounting goals apply except that in this scenario the connector alignment does not matter.

## **6.5.4 Surface Unit Reference Source**

The surface Subsonus unit requires a source of time, position, velocity and heading data to function. This data can be provided by either a GNSS Compass or a GNSS/INS. There are three options available for the reference source.

1. [6.5.4.1 Advanced Navigation GNSS Compass](#)
2. [6.5.4.2 Advanced Navigation GNSS/INS](#)
3. [6.5.4.3 Third Party GNSS/INS or GNSS Compass](#)

The recommended source is the Advanced Navigation GNSS Compass which will give the best results. Many survey ships will have an existing high accuracy GNSS/INS in which case they can use either an Advanced Navigation GNSS/INS or Third Party GNSS/INS or GNSS Compass option.

When the Advanced Navigation GNSS Compass is used as the reference source, Subsonus operates in full GNSS/INS mode. When a third party GNSS/INS or GNSS Compass is used, Subsonus will operate in AHRS mode and not perform any further processing on the reference data.

### 6.5.4.1 Advanced Navigation GNSS Compass



*Figure 49: Advanced Navigation GNSS Compass*

Advanced Navigation manufactures an all in one GNSS Compass system powered using PoE (Power over Ethernet) that is an ideal reference source for Subsonus. The Advanced Navigation GNSS Compass is supplied with the Subsonus Evaluation Kit. For detailed installation instructions, refer to the [Advanced Navigation GNSS Compass Reference Manual](#).

**Mounting Options**

The GNSS Compass accepts a standard 5/8" survey mount or 4 x M8 panel mount bolts, see [Figure 50: Advanced Navigation GNSS Compass mechanical drawing](#) for mechanical details.

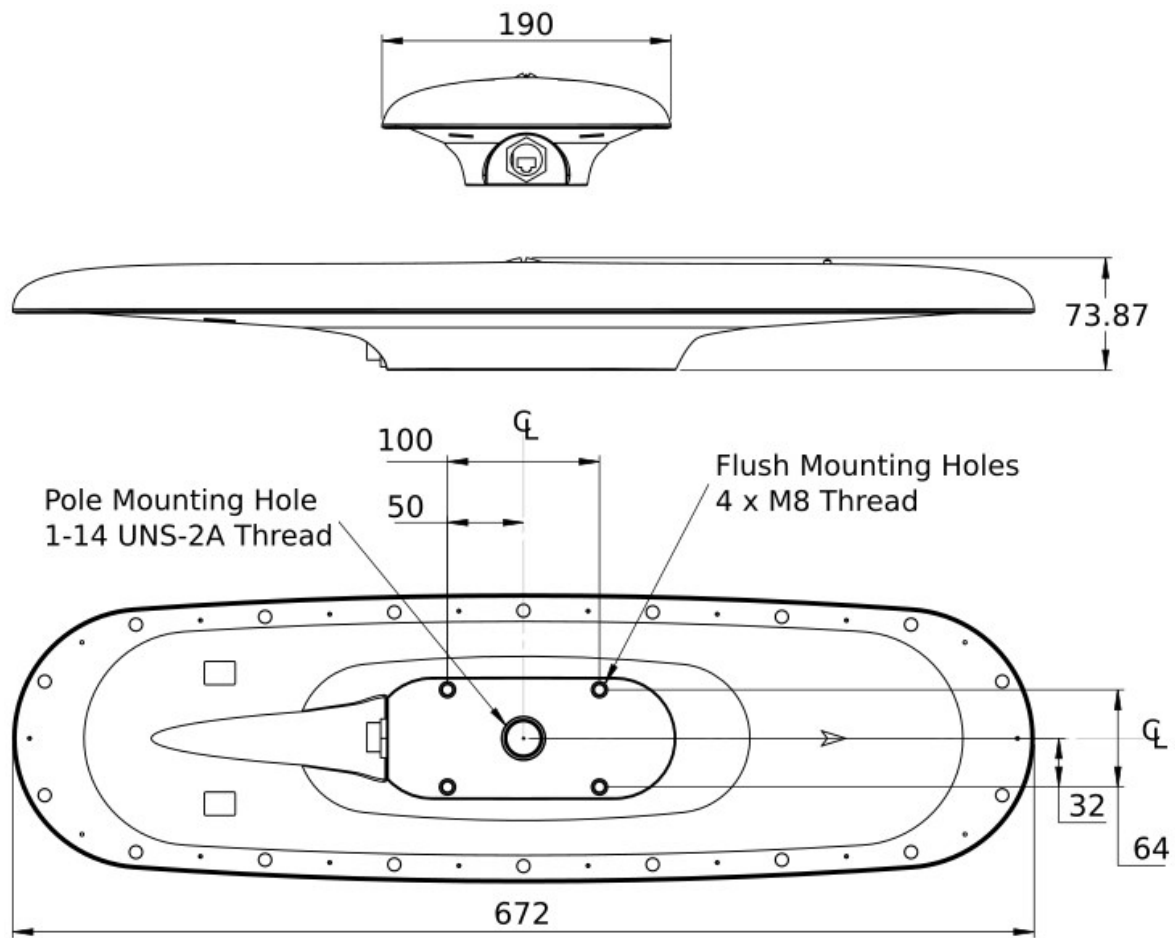
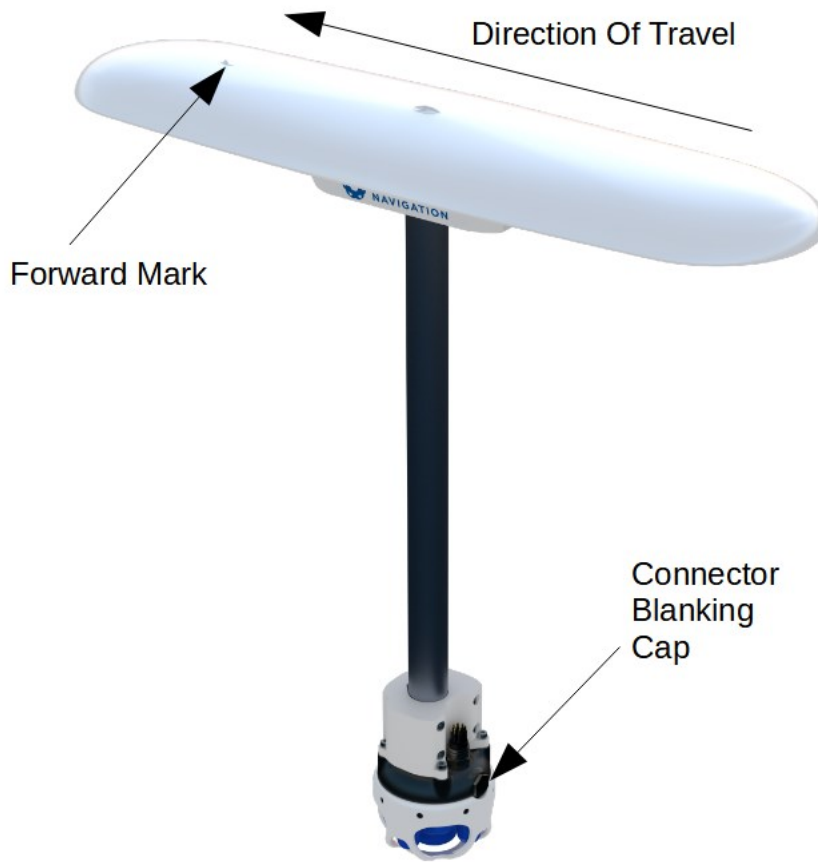


Figure 50: Advanced Navigation GNSS Compass mechanical drawing

The ideal mounting position for the GNSS Compass is on top of the surface Subsonus pole. The mounting alignment between the Subsonus and the GNSS Compass is extremely important, see [Figure 51: Advanced Navigation GNSS Compass mounting](#)



*Figure 51: Advanced Navigation GNSS Compass mounting*

### Mounting Position

When planning a mounting location for GNSS Compass, refer to [Mounting location example](#), and be mindful of the following recommendations.

- Mount the unit in clear view of the sky
- Mounting the unit at least 3m from transmitting devices, otherwise they may degrade heading performance due to interference.
- Mount the unit in an area that will not exceed the rated temperature range, and with minimal temperature fluctuations.
- Mount the unit away from high levels of vibration where possible.
- Mount the unit at least 10 cm away (and preferably as far as possible) from sources of dynamic magnetic interference such as high current wiring or large motors for best performance.

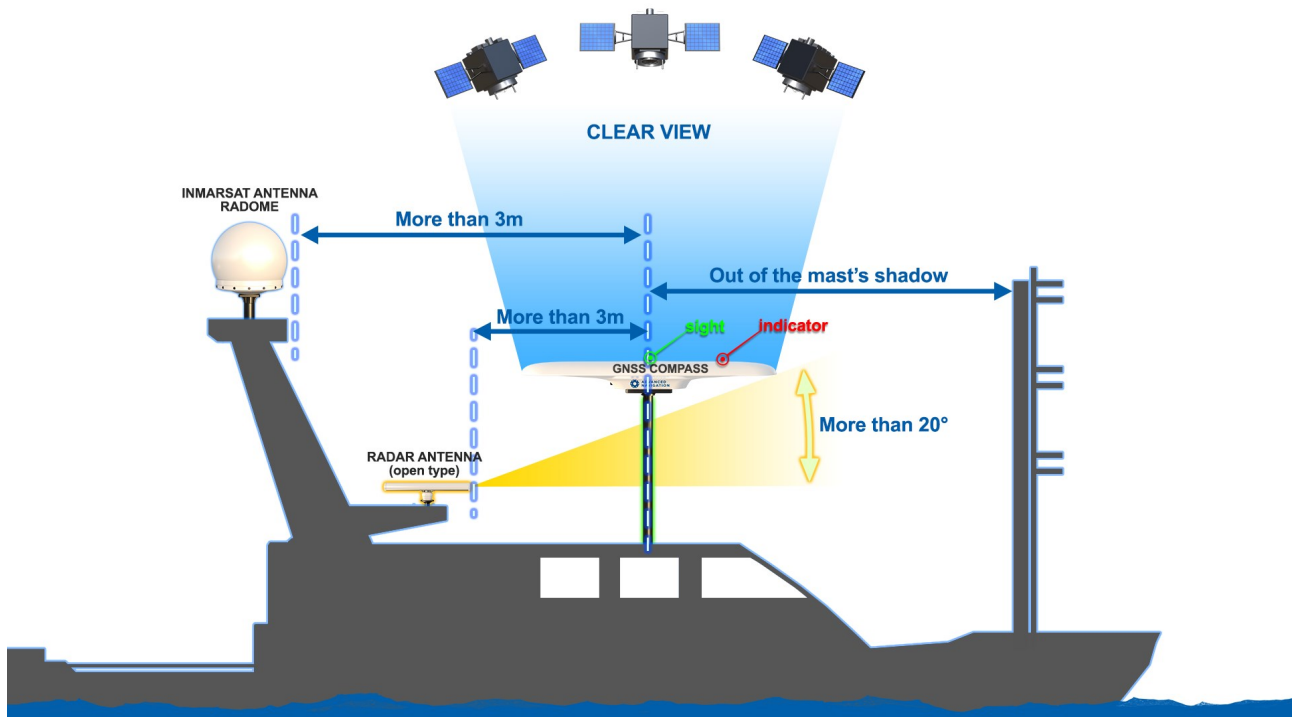


Figure 52: Mounting location example

### Mounting Alignment

The GNSS Compass should be mounted with its forward indicator pointed in the direction of travel of the vessel. The connector blanking cap on Subsonus should be pointing in the opposite direction of the GNSS Compass forward indicator, see [Figure 51: Advanced Navigation GNSS Compass mounting](#). It is critical to accurately align the GNSS Compass with Subsonus, and also to align the GNSS Compass unit with the forward direction of the vessel, see [Figure 53: GNSS Compass Alignment](#).

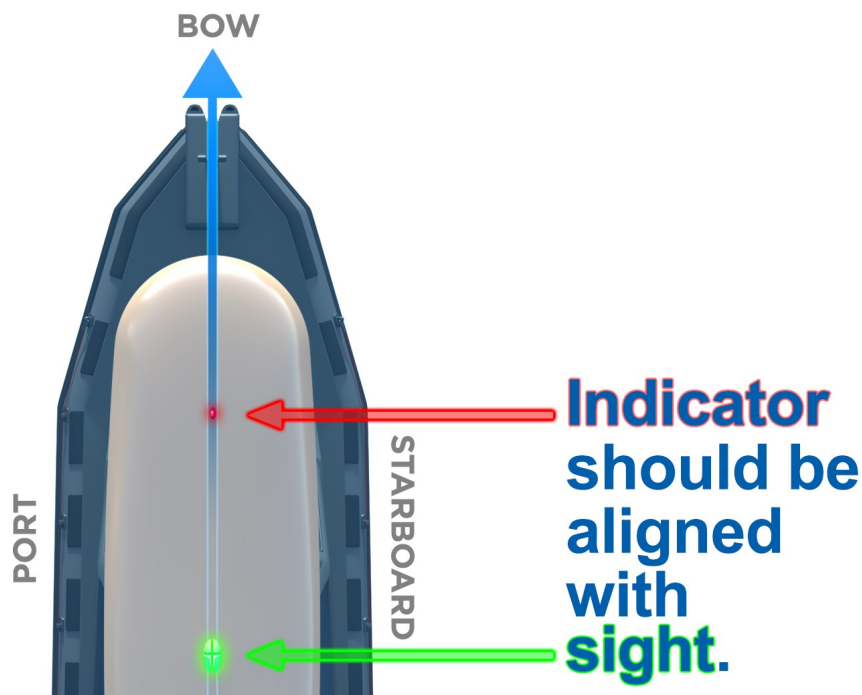


Figure 53: GNSS Compass Alignment

**Note:** The Subsonus will not function correctly if the GNSS Compass is not correctly aligned to the Subsonus unit. The Subsonus will also not function correctly if the GNSS Compass is not correctly aligned to the vessel. It is extremely important to accurately measure any offsets encountered.

### Offset Measurement

Regardless of whether the recommended mounting has been performed, there will be a position offset (lever arm) between the GNSS Compass and Surface Subsonus.

In order to calculate the lever arm between the GNSS Compass for positioning of the Subsonus, the position offset data must be entered during system configuration. Without this information, the position data for the Subsonus will be incorrect. See [Device Configuration](#).

Once both units are mounted to the vessel, the offset **from** the Subsonus **to** the base of the GNSS Compass must be accurately measured. If Subsonus and GNSS Compass share a pole for mounting, there will only be an offset in the Z direction.

Toward the bow of the vessel is positive X, to the starboard is positive Y and up is negative Z. See [The Sensor Co-ordinate Frame](#) and [Figure 54: GNSS Compass and Subsonus Offset direction](#) for more information.

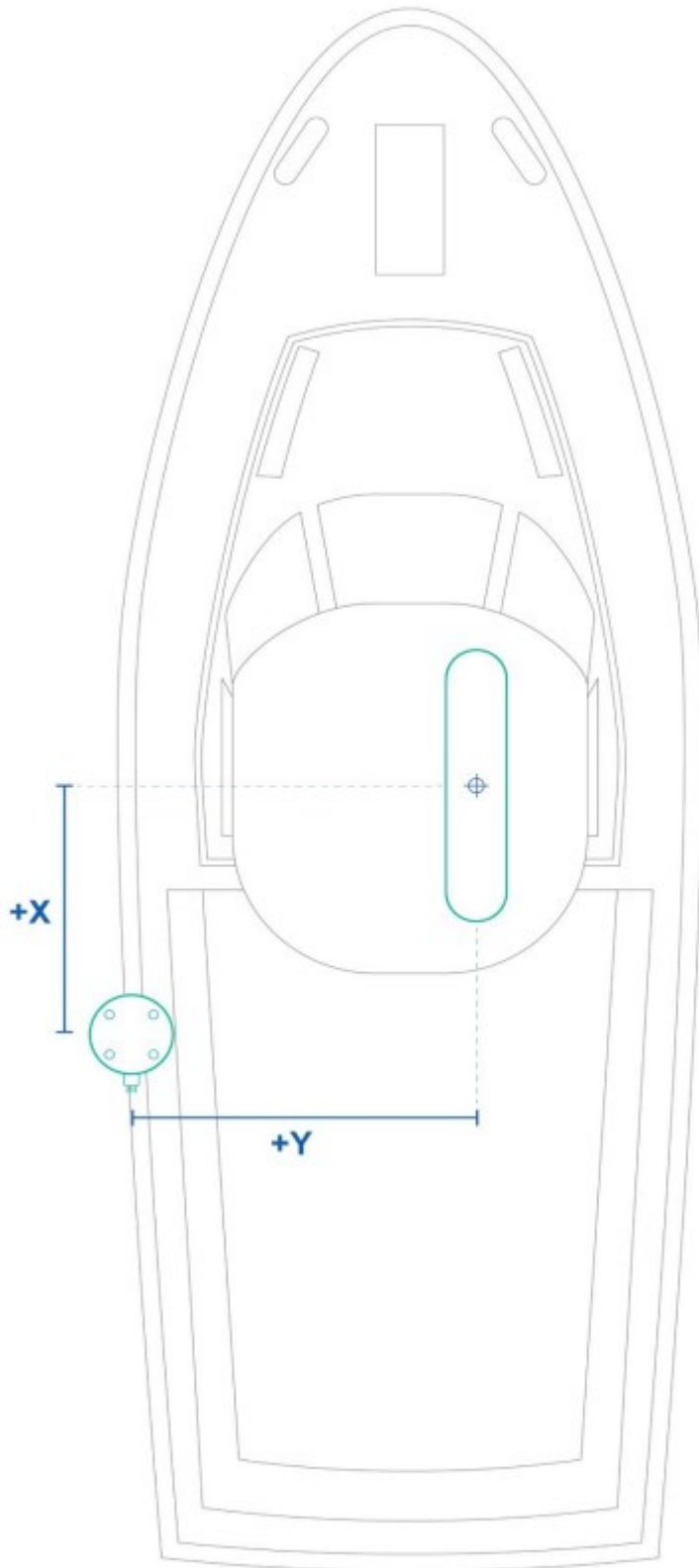


Figure 54: GNSS Compass and Subsonus Offset direction



**Configuration**

Once plugged into the same network, Subsonus will automatically recognise the presence of an Ethernet GNSS Compass, as surface Subsonus units are automatically configured to look for the GNSS Compass data stream using the ANPP. To confirm that the surface Subsonus has recognised and configured the GNSS Compass, open the Subsonus webUI. On the main view, the GNSS Compass should be visible on the Device list on the left hand side of the map. See [Figure 55: GNSS Compass shown in device list](#).

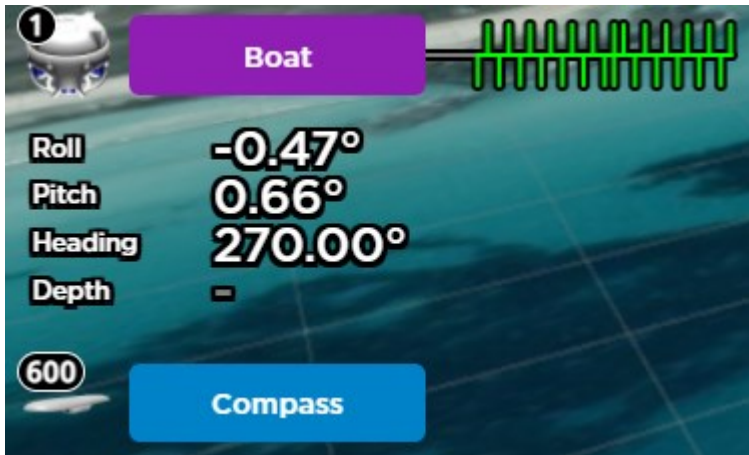


Figure 55: GNSS Compass shown in device list

The GNSS Compass will also appear under “Configuration”→“Devices”. See [Figure 56: GNSS Compass appearing in active devices](#)

If the GNSS Compass does not appear in Active Devices, it must be manually configured. See [Device Configuration](#) for information on how to add a new device.

**Active Devices**

Name	Type	Network	Acoustic Communications	Actions
Boat (This Device)	Subsonus	-	-	<input type="button" value="Configuration"/>
<a href="#">Compass</a>	GNSS Compass	Connected Aiding	-	<input type="button" value="Configuration"/> <input type="button" value="Delete"/>

Figure 56: GNSS Compass appearing in active devices

**6.5.4.2 Advanced Navigation GNSS/INS**

Subsonus supports any of Advanced Navigation's GNSS/INS products. Subsonus will automatically detect the Advanced Navigation device as it does with an Advanced Navigation GNSS Compass. An operator will be required to configure offsets between the devices before use, see [Device Configuration](#).

### 6.5.4.3 Third Party GNSS/INS or GNSS Compass

Third party GNSS/INS and GNSS Compass systems work with Subsonus if they can output NMEA messages GPZDA, GPGGA, GPVTG and GPHDT. It is recommended that the third party system is able to output NMEA messages at 10Hz, although slower speeds are possible.

If the third party system has an Ethernet interface, it should be configured to send the NMEA messages to Subsonus over a TCP port, please see Interfacing with Subsonus in the Subsonus Reference Manual.

**Note:** It is recommended to synchronise the third party device and Subsonus with a PTP or NTP time server

## 6.5.5 Hydrus Device Addresses

It is possible to track as many targets as required from a single surface Subsonus unit (which comes at a compromise of interrogation frequency per device). Every Hydrus being operated within a 3km radius must have a unique address otherwise communication collisions will occur. If only one Hydrus is to be tracked, this section can be disregarded as the factory default unit addresses will work out of the box.

For information on how to assign a device address, see Device Address Configuration in the Subsonus Reference Manual.

### 6.5.5.1 Device Address Identification

To determine the Subsonus device address, the unit must be powered and connected to the Subsonus Web UI.

1. Open the local Subsonus web interface
2. Navigate to “Configuration”→”Devices”
3. The number next to the device is the device address. For example, the following Subsonus has a device address of 1:


Active Devices				
Name	Type	Network	Acoustic Communications	Actions
 <a href="#">Boat (This Device)</a>	Subsonus	-	-	<input type="button" value="Configuration"/>

Figure 57: Device Address Identification

If there are any other devices configured to be tracked by the surface Subsonus, these devices will also appear on this page, with their respective device addresses.

# 7 Mission Planning

## 7.1 Mission Fundamentals

A Hydrus mission consists of one or more mission tasks. There are many user configurable parameters that can be set on both mission level and mission task level. This section covers the structure of a Hydrus mission, its subcomponents and various mission parameters and features of the Hydrus that you need to be aware of.

### 7.1.1 Mission Modes

There are two types of missions or mission modes available:

- Subsonus Assisted - This mission mode requires a Subsonus USBL
- Standalone (GNSS / Dead Reckoning) - This mission mode allows for missions to be carried out with a standalone Hydrus unit.

#### 7.1.1.1 Subsonus Assisted Mission Mode

In Subsonus Assisted mission mode Hydrus is used in conjunction with Subsonus. The integration of the Hydrus and Subsonus systems enables highly accurate positioning and mid-water vehicle tracking, even in the presence of varied bottom currents. By utilising the Subsonus acoustic positioning capabilities, a precise location of Hydrus can be determined and monitored in real-time. This ensures that Hydrus stays on track during missions, even in challenging conditions. In case of prolonged acoustic communication outage, Hydrus will autonomously enter dead reckoning navigation mode and navigate independently.

In addition to tracking, the Subsonus also facilitates acoustic communication during the mission. This allows for two-way communication between Hydrus and a surface vessel or a control station via the Subsonus webUI. Acoustic communication is required for transmitting mission instructions, receiving status updates, and making any necessary adjustments to the course or operations of Hydrus.

#### 7.1.1.2 Standalone Mission Mode

Standalone (GNSS / Dead Reckoning) Hydrus missions are very quick and easy to set up and deploy. They are ideal for rapid, on the fly mission planning and execution, or when a Subsonus is not available or when it is not feasible to use Subsonus.

In Standalone (GNSS / Dead Reckoning) mission mode, without the aid of a Subsonus, Hydrus will acquire a GNSS fix at the surface, and then carry out the mission based on dead reckoning navigation, with the autopilot relying on the sensor data from the INS and DVL. At regular intervals throughout the mission, or when accuracy is deemed poor, the unit will resurface in order to acquire a GNSS fix. This will give Hydrus an exact position reference and will enable the system to make any navigation adjustments if required.

Upon completion of the mission, Hydrus will return to the planned recovery location and automatically surface at that location. Once at the surface, it will utilise its thrusters to stay directly above the recovery location based on its current GNSS position. In case Hydrus is tipped upside down while at the surface, it will dive down, correct its orientation and then resurface again.

Standalone (GNSS / Dead Reckoning) missions are:

- Suitable for shallow waters and locations that are difficult or impossible to reach with a boat equipped with Subsonus.

- Suitable for mission depths up to 30 metres. Deeper missions are possible, however, the deeper the mission in standalone mode, the more drift prone the accuracy is. If available, consider Subsonus assisted mission mode for deeper missions.
- Suitable when launching missions from shore, a jetty, small boat.
- Not recommended in open water scenarios with large swell or choppy conditions.

Apart from the absence of Subsonus functionality, the process of planning missions in Standalone (GNSS / Dead Reckoning) mission mode remains the same. Note that at the end of a mission, Hydrus will go straight to the surface in the specified recovery location. Consequently, it is important that the area around the retrieval point is clear of overhead obstacles, for example a jetty or a boat.

## 7.1.2 Mission Tasks

This section describes the three standard mission tasks types that can be carried out by the Hydrus.

### 7.1.2.1 Lawnmower Survey

The Lawnmower survey is the path planning strategy that allows for efficient coverage of an area of interest. This survey pattern type is named after the back-and-forth movement of a lawnmower across a lawn, as the Hydrus follows a similar pattern while surveying underwater areas.

The lawnmower survey orientation refers to the direction in which Hydrus will traverse during the survey. It can be set at any angle, and the consideration for choosing a survey orientation is the direction of the current at the survey site. Hydrus is most effective when its long lines are aligned with the current direction, allowing it to handle being pushed from the front or back rather than sideways. The lawnmower orientation plays a crucial role in determining the path Hydrus will follow to collect data and achieve optimal survey results.

### 7.1.2.2 Transect Survey

The Transect survey is a systematic data collection approach that involves surveying along predefined linear paths or transects. This survey method is widely used in underwater research and mapping to ensure comprehensive coverage of an area of interest.

During a transect survey, Hydrus follows a predetermined course along the transect lines, collecting data at regular intervals. Transects can be designed in a grid-like pattern or in a specific configuration based on survey objectives and desired data resolution.

Transect surveys enable accurate documentation of underwater features, habitats, and environmental parameters. They provide a structured approach to data collection, allowing for efficient analysis, comparison, and monitoring over time. The systematic nature of transects ensures that important areas are adequately covered, facilitating in-depth analysis and interpretation of the collected data.

### 7.1.2.3 Station Keeping

In a station keeping mission task, Hydrus maintains a designated position for a predetermined period of time, ensuring precise and consistent imagery capture. The physical location, orientation of the Hydrus unit and capture parameters are all configurable for this mission task type.

Station keeping mission tasks are versatile and can be applied across various domains. Some suitable use cases include mapping and surveying, environmental monitoring, aquaculture monitoring and infrastructure inspection.

## 7.1.3 Recovery Location

One crucial aspect of the mission planning process is setting a recovery location for Hydrus to return to once it has completed its mission. There are a few options available for specifying this recovery location.

### 7.1.3.1 Relative to Subsonus

**Note:** This recovery location type is only available in Subsonus Assisted mission mode.

Hydrus is equipped with a transponder that communicates with Subsonus. When the user selects the Subsonus option in the web UI, it instructs Hydrus to return relative to the Subsonus unit.

To determine the precise location for Hydrus to return to, the user sets a bearing. The bearing is an angle measured counterclockwise from the forward direction of the Subsonus unit that controls Hydrus. The default setting for this bearing is 90 degrees.

This option is particularly useful when deploying and recovering Hydrus from a boat. By using USBL, Hydrus will always return to the boat's location, even if the boat is moving. For example, if the Subsonus unit is mounted on the side of the boat, a relative recovery location of 90° and 2 metres means that Hydrus will return to a location 2 metres to the right of the boat, regardless of the boat's orientation, turns, or changes in position. This ensures consistent and accurate recovery, regardless of dynamic marine conditions.

### 7.1.3.2 Launch Location

**Note:** This recovery location type is only available in Standalone GNSS / Dead Reckoning mission mode.

In Standalone GNSS / Dead Reckoning mission mode, this recovery location type will instruct Hydrus to return to the same location from where it was deployed.

### 7.1.3.3 Geodetic Location

The recovery location can be set to a geodetic location in all mission modes. In this case, the user can select a specific point on a map by inputting the longitude and latitude coordinates. The geodetic coordinates represent the exact location where Hydrus should return after completing its mission. This recovery location type is suitable when you need Hydrus to complete the mission and resurface at a specific location, such as a jetty or wharf.

## 7.1.4 Mission Bail-out

A mission bail-out is a mission scenario where the mission is aborted either by the user or Hydrus itself. This typically occurs when unforeseen circumstances or critical issues arise that jeopardise the success of the mission. Hydrus is equipped with a comprehensive set of protocols to address various mission abort scenarios — it can be instructed what to do in case certain bailout conditions are met during a mission. For example, if the storage space is running low, the unit can be configured to either abort the mission and resurface, or carry on with the mission.

On a fundamental system level, Hydrus is programmed to autonomously abort missions and resurface based on several variables, conditions and triggers. However, to provide mission flexibility, bailout conditions and bailout event commands are all configurable as per the preferences of the user. See [7.6.2 Bail-out Conditions](#) for more information on how to configure bail-out conditions for a mission.

## 7.1.5 Sessions

A session is a recorded dataset of an executed Hydrus mission. A session contains all logged data from the mission can be reviewed and played back using the Log Viewer in the Hydrus WebUI. All sessions are recorded regardless if the mission was aborted or successfully completed.

Sessions can be accessed either on a storage device (if previously downloaded) or directly on the Hydrus via the WebUI. See [9.2 Data Download](#) for more information.

## 7.2 Mission Considerations

When planning a mission with Hydrus, there are many factors need to be taken into consideration to ensure its success. Mission considerations encompass various aspects that directly impact the performance and outcomes of Hydrus operations.

### 7.2.1 Safety First

Keeping people and the environment safe is the highest priority and the most important Hydrus mission consideration. For safety related information, see [4 General Safety Precautions](#)

### 7.2.2 Environmental Considerations

Environmental considerations to be taken into account when operating Hydrus are described as follows.

#### 7.2.2.1 Water Temperature

Hydrus is designed to operate within its designed [3.1.4 Operating Temperatures](#). Extreme temperatures can affect the performance and efficiency of its components, including batteries and sensors. Hydrus may require additional cooling mechanisms for example the cooling fan on the desk charger for Hydrus when out of water an in high-temperature environments, while very low temperatures may impact its mobility and potentially lead to freezing of sensitive equipment.

#### 7.2.2.2 Water Density

Hydrus is optimised for standard ocean density of 1025 kg/m<sup>3</sup> and may require adjustments or considerations for operation in different water densities.

**Note:** If the user wishes to operate in water densities such as fresh water, other than standard ocean density, please contact Advanced Navigation

#### 7.2.2.3 Currents and Tides

Currents and tides can affect the navigation and path-keeping ability of Hydrus. Understanding the impact of currents on energy consumption is important for mission planning, as navigating against strong currents may require additional power. Proper knowledge of local tidal patterns and current profiles is crucial for effective operation.

#### 7.2.2.4 Visibility

Water clarity and visibility influence Hydrus's ability to use optical sensors effectively. Poor visibility can limit the effectiveness of the camera, impacting tasks such as mapping, object recognition, and obstacle avoidance. Considering the expected visibility conditions is important for selecting appropriate sensor systems and planning missions for Hydrus.

### 7.2.2.5 Biological Considerations

Hydrus users should consider potential impacts on marine life and ecosystems. The impellers or thrusters on Hydrus are designed to minimise harm to marine organisms. Care should be taken to avoid disturbing sensitive habitats like coral reefs or seagrass beds. Users should operate Hydrus with awareness of the presence of protected or endangered species.

### 7.2.2.6 Protected Areas

Some marine areas may be designated as protected zones due to their ecological significance or conservation status. When operating Hydrus in these areas, it is important to adhere to specific regulations and guidelines. Prior knowledge of protected areas helps avoid unauthorised entry and potential damage to sensitive habitats.

### 7.2.2.7 Marine Life Interaction

Hydrus may encounter marine life during its operations. Minimising negative impact on marine organisms is crucial. Hydrus should avoid close encounters, disturbances, or collisions with marine life. Operators should be aware of potential interactions with large marine animals, ensuring the safety of both Hydrus and the animals.

## 7.2.3 Hydrus Range and Endurance

There are numerous mission parameters and environmental variables that can impact the outcome of a mission. Hydrus has built-in functionality that alerts users in case a mission is not likely to be successfully completed due to mission parameters that exceed the estimated range of the unit based on the current battery charge level. Despite this, it is very difficult to foresee and compensate for unpredictable environmental conditions, particularly current speeds and directions.

By carefully aligning mission objectives with the capabilities of Hydrus, users can ensure optimal performance and successful mission executions. It is important to carefully factor in all mission parameters and environmental variables in order to plan missions within the capability limitations of the vehicle. This includes considering the estimated range of the Hydrus based on its current battery charge level.

## 7.2.4 Altitude

The altitude at which Hydrus operates affects the following:

- **Navigation:** For Hydrus to navigate effectively throughout a mission, it relies on achieving and maintaining bottom lock, a condition where its Doppler Velocity Log (DVL) establishes a clear acoustic connection with the seafloor, enabling Hydrus to accurately calculate its velocity relative to the seabed. To maintain bottom lock, Hydrus needs to operate within a range of approximately 0.5 - 5 metres from the seabed. To achieve this, Hydrus travels to the [7.2.5 Pause Vertical Position](#) that positions it within the bottom lock distance range when necessary. By doing so, Hydrus avoids spending unnecessary time in mid-water without the bottom lock aiding the DVL, ensuring optimal navigation and data acquisition during underwater operations. By setting the pause vertical at an appropriate depth or altitude, Hydrus can descend directly at mission start and acquire DVL bottom lock. Thus minimising the adverse impact of surface currents in terms of positioning accuracy.
- **Risk of Collision:** As Hydrus operates at lower altitudes, the image resolution improves because the camera can capture finer details. However, operating too low can lead to a potential collision with the seafloor or other obstacles. The altitude should be optimised to balance resolution and safety.
- **Image quality:** Operating at altitudes that puts Hydrus closer to objects, structures or the sea floor generally results in better image quality. Turbidity (the level of water turbidity or cloudiness) reduces

image quality, the closer Hydrus is to the target, the less distortion and blurring occur due to light scattering and other factors. Reduced ambient light, and effect of LED light illumination is reduced under various conditions. Choose an appropriate altitude to achieve high-quality images.

## 7.2.5 Pause Vertical Position

**Note:** Pause vertical is only available in Subsonus Assisted Mission Mode.

Considerations for pause vertical are important when planning missions. This parameter can be defined as either depth from the surface or bottom altitude.

If specified as depth from the surface, Hydrus utilises its depth sensor to measure the distance from the water's surface and maintains its position at the designated depth. When the bottom altitude option is chosen, Hydrus relies on its Doppler Velocity Log (DVL) to measure its altitude from the seabed.

At the very start of a Subsonus assisted mission, Hydrus descends down to the predetermined pause vertical position. This initial dive serves several purposes:

- Avoiding strong surface currents and swells,
- Establishing communications with Subsonus,
- Stabilising the Inertial Navigation System (INS) before mission commencement,
- Acquiring DVL bottom lock.

Prior to configuring the pause vertical parameter, it is advisable to consult nautical charts and sonar data for depth information at the mission site. Whether depth from the surface or bottom altitude is chosen, it is imperative to adhere to two conditions:

- Ensuring the depth remains within Hydrus' maximum limit, and
- Verifying that the water is not too shallow to accommodate the specified parameter.

## 7.2.6 Hydrus Transit Between Tasks

Hydrus is capable of performing multiple mission tasks sequentially. If a mission involves multiple tasks, the vehicle will automatically transition between the end and start points of each task at the specified vertical position, as defined in the global mission parameters. This vertical position can be specified as either depth from the surface or bottom altitude. Upon completing a mission task, Hydrus ascends to the designated vertical depth or altitude, then horizontally manoeuvres to the starting point of the next task. This default transit behaviour applies to travel between all mission tasks in the mission.

To override the automatic transit behaviour, you can manually insert a transect task, which acts as a "bridge" between the preceding and succeeding mission tasks. When adding a transit task manually, set the Type parameter under Coverage to None in order to conserve storage space and battery power. Utilising transect mission tasks for transit between missions is advisable in situations where known obstructions, such as underwater infrastructure (e.g., jetties, pipes, or netting), can be avoided by guiding Hydrus to take shortcuts between the obstacles. This can save both time and battery power as avoiding obstructions autonomously can take longer and use up more energy.

It is recommended to leverage available data and prior knowledge of the site when planning missions. Utilising previously acquired data, such as depth profiles or the locations of obstacles and reference points, can significantly enhance the efficiency of mission planning.



## 7.2.7 Bluewater Missions

Blue water missions, where Hydrus operates in depths deeper than 50 metres, require careful attention to the power and propulsion capabilities of Hydrus. Its thrusters are designed to counteract the effects of water currents, allowing the vehicle to maintain its desired course and altitude even in challenging conditions. However this may not be possible for long periods of time without recharging the unit.

## 7.2.8 Using Hydrus in Standalone Mission Mode

During standalone missions, in Standalone (GNSS / Dead Reckoning) mission mode, Hydrus operates without a Subsonus. Missions in this mode are executed without an established communication link until the Hydrus has been reconnected to WiFi upon retrieval. This means there is no feedback to the user about the mission status for the entire duration of the mission. To safeguard the unit and ensure mission success, a designated lookout / spotter, ideally equipped with binoculars, should be assigned to monitor the water surface throughout the mission. This individual should actively scan the water surface within the mission area and stand by to visually locate Hydrus in case of mission abort due to a bailout or other unforeseen circumstances. See [7.1.1 Mission Modes](#) for more information.

## 7.2.9 Retrieval Location

Strong wind, swell and surface current are all factors that can cause Hydrus to drift when floating on top of the surface after reaching the retrieval location. When retrieving Hydrus from an anchored vessel, it is advisable to set the retrieval point upstream and upwind. This location should typically be directly ahead of the boat. By establishing a home point in this position, especially during windy conditions or when facing strong surface currents, you ensure ample time for locating and retrieving the unit without the need to weigh anchor.

**Note:** In Subsonus assisted mission mode, Hydrus can be commanded to stand-by for a resurface command at a specified vertical position upon reaching the retrieval point. This is a good option for avoiding prolonged surface time in challenging surface conditions.

## 7.2.10 Battery Recharge Downtime

During mission planning, considerations should be made to allocate sufficient time for recharging the battery using the Desk Charger in between mission runs. The charging infrastructure and its availability at the deployment location should be assessed to ensure safe, uninterrupted and efficient charging during Hydrus downtime.

## 7.3 Mission Planning Process


The mission planning process entails a series of steps to effectively prepare for a mission. By following this guide, users can navigate through each action, from initiating the mission planner and establishing device connections to configuring survey parameters and saving the mission.

### 7.3.1 Subsonus Prerequisites

If using Hydrus with Subsonus, it is important to review the prerequisites provided to establish the necessary context. Understanding the prerequisites beforehand ensures a comprehensive understanding of the mission planning process and allows for smoother execution of the steps outlined in the accompanying table. These assumptions outline the initial conditions for planning a mission on a boat using Hydrus with Subsonus and GNSS Compass (as provided in [10.1.4 Hydrus Subsonus Surface Kit](#)) and setup as per [6.5.1.1 Subsonus Surface Installation Checklist](#).

Prerequisite	Notes
Subsonus is installed on the boat and is submerged in the water	The Subsonus device, which is part of the mission planning process, is installed as per <a href="#">6.5.1.1 Subsonus Surface Installation Checklist</a>
GNSS Compass is installed on the boat	Optional: GNSS Compass is installed on the boat as per <a href="#">6.5.4.1 Advanced Navigation GNSS Compass</a>
Subsonus and GNSS Compass are connected to a Wi-Fi router or network	There is a DHCP enabled router or network available on the boat including a Wi-Fi access point.
The Hydrus, GNSS Compass, and the Subsonus are connected to the same network	All the devices involved in the mission planning process, including Hydrus, GNSS Compass, and Subsonus, are connected to the same network.
The offsets have been entered from the Surface Subsonus to the GNSS Compass	<a href="#">Offset Measurement</a> values between the Surface Subsonus and the GNSS Compass have been entered into the system for accurate positioning.

## 7.3.2 Mission Planning Procedure

Step	Actions	Notes
<b>Create New Mission</b>		
1.	Navigate to the <b>Main Page</b> and click <b>Plan Mission</b>	See <a href="#">7.5 Mission Management</a>
2.	Click the <b>Create New</b> button on the <b>Mission planner - Welcome</b> dialog	
<b>Set Global Mission Parameters</b>		
3.	Click <b>Mission</b> at the top of the left hand panel	
4.	Select the desired <b>Mission Mode</b>	See <a href="#">7.1.1 Mission Modes</a>
5.	Set <b>Bailout Conditions</b> to suit the current mission	See <a href="#">7.6.2 Bail-out Conditions</a>
6.	Set <b>Pause Vertical</b>	See <a href="#">7.6.1 Global Mission Parameters</a>
7.	Set the desired parameters for <b>Travel</b> between mission tasks	
8.	Set the global <b>Default Capture Parameters</b> and <b>Media Overlay Parameters</b> for the mission	
<b>For Subsonus Assisted Mission Mode - Connect Hydrus to Subsonus</b>		
9.	Click the <b>Open Device Configuration</b> dialog button	Located next to the Menu drop-down 
10.	Type in the IP address and port number of Subsonus inside the IPv4 Address space in the format (IP Address):(Port), and click connect.	To locate the IP address of Subsonus, access the Subsonus webUI and Navigate to Configuration > Ethernet. The port number is <b>[16718]</b>
11.	Click in the view space of the map, double tap the space bar to zoom in on the map and confirm the Subsonus is present as indicated by seeing the 3D	

Step	Actions	Notes
	model of Subsonus.	
<b>Add Mapping Layers (Optional)</b>		
12.	Add one or several mapping layers to your mission to help plan the mission.	See <a href="#">7.6.5 Mapping Enhancements</a> for further reference
<b>Add a Mission Task</b>		
13.	Click the <b>Add New Task</b> button in the <b>Mission Planner</b>	
14.	Select a mission task type <b>Lawnmower / Transect Survey / Station Keeping</b>	
15.	Click on the map to create a new region, point or path where the survey is to be conducted	Ensure the map zoom level is set so the location of the survey can be identified
16.	Orientate, move or resize the survey polygon	See <a href="#">7.6.4 Mission Map Pane</a> for further reference
17.	Select mission task you created from the left hand panel.  Give the mission task a name and set the required parameters specific to the mission task.	See <a href="#">7.6.3 Mission Task Parameters</a> and <a href="#">7.4 Mission Task Profile Examples</a> for further reference
18.	Set the <b>Capture Parameters</b> for the mission task. These settings are specific to the mission task and will override the global mission level capture parameters.	See <a href="#">7.6.6 Capture Parameters</a> for further reference
<b>Set Recovery Location</b>		
19.	Click on <b>Recovery Location</b> from the left hand panel	See <a href="#">7.6.1.6 Recovery Location</a>
20.	Select <b>Home Point Type</b>  If Relative to Subsonus is selected, set: <ul style="list-style-type: none"> <li>• When Reaching Recovery Location command</li> <li>• Bearing</li> <li>• Distance</li> <li>• Vertical Mode</li> <li>• Vertical</li> </ul> If Geodetic location is selected set: <ul style="list-style-type: none"> <li>• Latitude</li> <li>• Longitude</li> </ul>	Recovery location - either Relative to Subsonus or a Geodetic location.  Bearing - bearing of the recovery location in degrees. The default bearing is set to 90 degrees.  Vertical - Distance, in metres, along the Bearing previously entered.
<b>Save Mission</b>		
21.	Click <b>Menu</b> from the left hand panel and click <b>Save</b>	

Step	Actions	Notes
	<b>Mission As</b>	
22.	Name the mission and click <b>Save</b>	Note: Spaces are not allowed in the mission name.

**Note:** The next steps for Hydrus to be deployed can be found in [8.2 Hydrus Pre-deployment](#)

## 7.4 Mission Task Profile Examples

If the user seeks specific survey results tailored to different objectives, we recommend considering the following Lawnmower Survey examples: Sparse Lawnmower, Dense Lawnmower, Super Dense Lawnmower and Transect Survey. Each example is designed to address distinct survey requirements and offers optimised settings to achieve the desired outcomes.

### 7.4.1 Sparse Lawnmower Survey

If the user's goal is to conduct reconnaissance and gather bathymetric data without image overlap, the Sparse Lawnmower variant is ideal. With a focus on high-altitude operation and capturing distinct images, this variant enables detailed bathymetry observation for in-depth analysis and mapping.

Setting	Value
Name	Sparse Lawnmower
<b>Path Generation</b>	
Lawnmower Orientation	0 - 360°
<b>Coverage</b>	
Type	Image (Fixed Distance)
Overlap Lateral	50%
Mow Width	10.0 m
Distance	1.0 m
<b>Capture</b>	
Pitch	0°
Vertical	<b>Mode</b> Bottom Altitude  <b>Value</b> 4.00 m

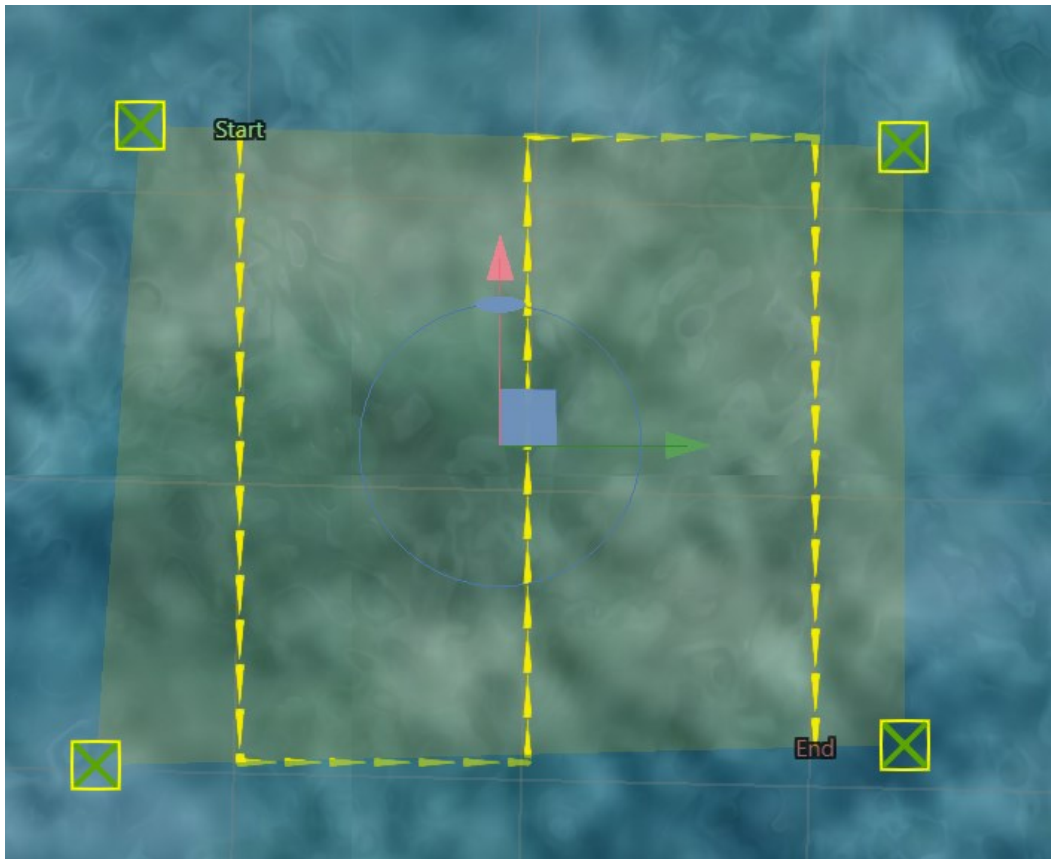


Figure 58: Sparse Lawnmower Survey Path Visualisation

## 7.4.2 Dense Lawnmower Pattern

The Dense Lawnmower pattern is designed to achieve high-resolution mapping objectives. It is employed when there is a reasonably accurate understanding of the bathymetry in the survey area. The pattern incorporates a minimum of 20% image overlap to ensure comprehensive coverage of the seabed and capture detailed data for mapping purposes.

Setting	Value
Name	Dense Lawnmower
<b>Path Generation</b>	
Lawnmower Orientation	0° - 360°
<b>Coverage</b>	
Type	Image (Camera Coverage)
Overlap Forward	30%
Overlap Lateral	50%
<b>Capture</b>	
Pitch	0°
Vertical	<b>Mode</b>

Setting	Value
	Bottom Altitude / Surface Depth / Geodetic Height
	<b>Value</b> Bottom Altitude 0.5 - 8 m Surface Depth 0 - 300 m Geodetic Height - to +

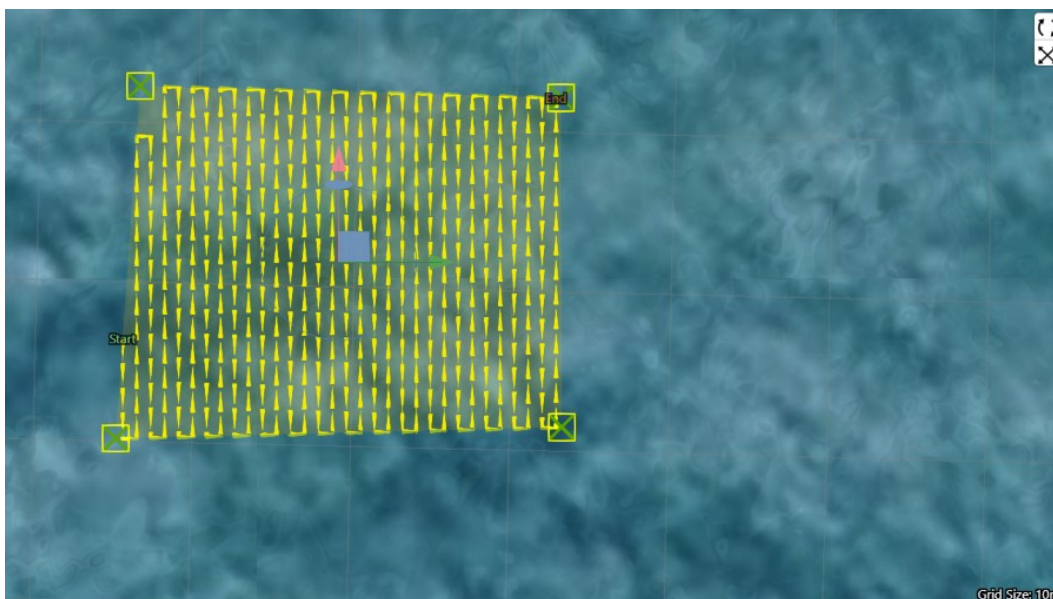


Figure 59: Dense Lawnmower Survey Path Visualisation

### 7.4.3 Super Dense Lawnmower Pattern

The Super Dense Lawnmower pattern is specifically designed for achieving precise 3D photogrammetry reconstruction. It is employed when the objective is to capture an extensive level of detail in a known location. The pattern incorporates a 50-80% overlap of images and involves multiple super dense surveys conducted at different orientations to ensure comprehensive coverage and capture the necessary detail for reconstruction. In certain cases where photogrammetry is intended to be performed on the resulting imagery, it is advised to repeat the same lawn mower pattern at a 90 degree rotation to the first lawn mower task to ensure adequate feature definition.

Assistance from contour information can enhance the accuracy and effectiveness of the pattern. For information on uploading of contour information files or seabed infrastructure files see [7.6.5 Mapping Enhancements](#).

Setting	Value
Name	Super Dense Lawnmower
<b>Path Generation</b>	
Lawnmower Orientation	0° - 360°
<b>Coverage</b>	
Type	Image (Camera Coverage)

Setting	Value
Overlap Forward	50%
Overlap Lateral	80%
<b>Capture</b>	
Pitch	0°
Vertical	<p><b>Mode</b> Bottom Altitude / Surface Depth / Geodetic Height</p> <p><b>Value</b> Bottom Altitude 0.5 - 8 m Surface Depth 0 - 300 m Geodetic Height - to +</p>

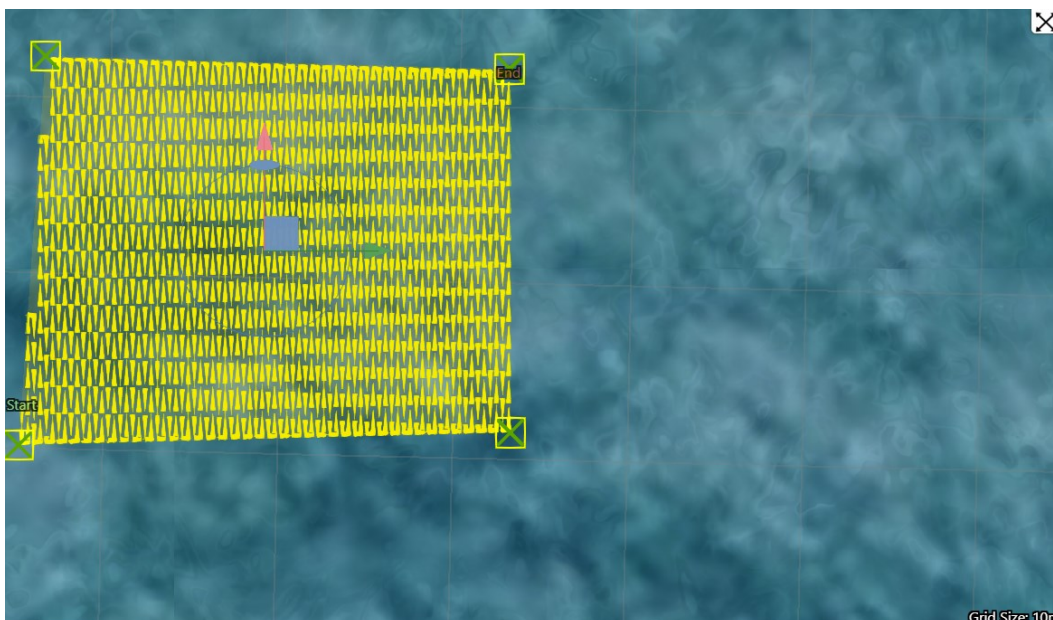


Figure 60: Super Dense Lawnmower Pattern Visualisation

### 7.4.4 Transect Survey

The transect Survey is to systematically survey and document a designated area of interest, collecting data along predefined transects. This mission profile is commonly used for various applications, including habitat mapping, environmental monitoring, and scientific research.

Setting	Value
Name	Transect Survey
<b>Path Generation</b>	
Lawnmower Orientation	0
<b>Coverage</b>	
Type	Image (Camera Coverage)

Setting	Value
Overlap Forward	80%
<b>Capture</b>	
Vertical	<p><b>Mode</b> Bottom Altitude / Surface Depth / Geodetic Height</p> <p><b>Value</b> Bottom Altitude 0.5 - 8 m Surface Depth 0 - 300 m Geodetic Height - to +</p>



Figure 61: Transect Survey Visualisation



## 7.5 Mission Management

The Hydrus WebUI provides comprehensive mission management capabilities, This overview will cover three key aspects of mission management within the Hydrus webUI:

- [7.5.1 Creating New Missions](#)
- [7.5.2 Editing Existing Missions](#)
- [7.5.3 Importing and Exporting Missions](#)

### 7.5.1 Creating New Missions

Creating new missions in the Hydrus webUI is a straightforward process that allows users to plan and customise their Hydrus missions. Users can define waypoints, set mission parameters, and tailor mission details to meet their specific needs. See [7.3 Mission Planning Process](#) for more information.

### 7.5.2 Editing Existing Missions

Editing a mission in the Hydrus webUI allows users to make adjustments to a pre-planned mission, whether it's to change waypoints, or adjust other parameters. For example where the user may need to adjust the line heading for the current or altitude.

### 7.5.3 Importing and Exporting Missions

The Hydrus webUI also supports importing and exporting missions, providing flexibility in managing the users mission data. This functionality is particularly useful for sharing missions with other users, reusing previously run missions, or accessing pre-defined mission catalogues created by mission specialists.

#### 7.5.3.1 Import Procedure

1. Open the Hydrus webUI.

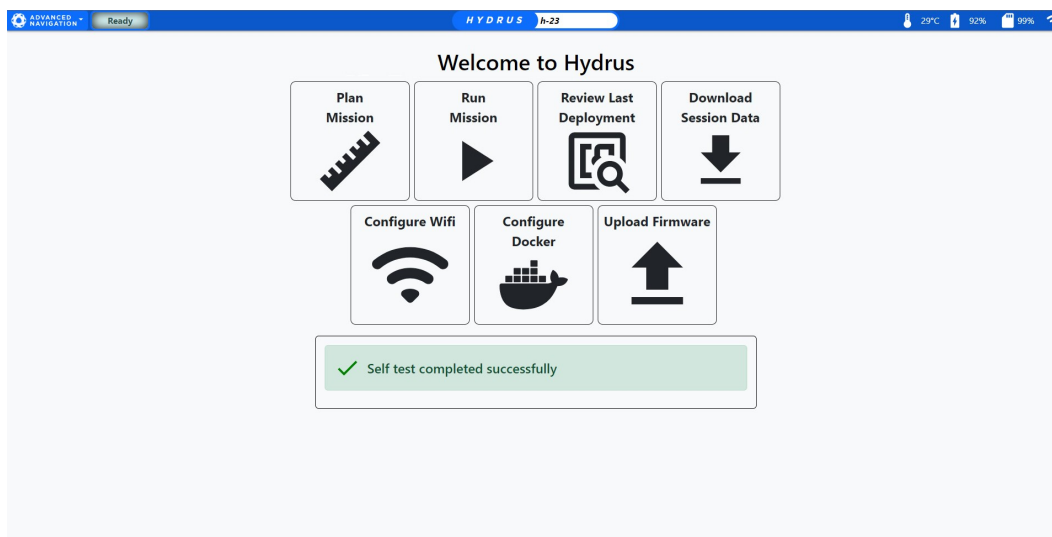


Figure 62: Hydrus WebUI Main Page

2. Click "Plan Mission", this will take the user to the Mission Planner.

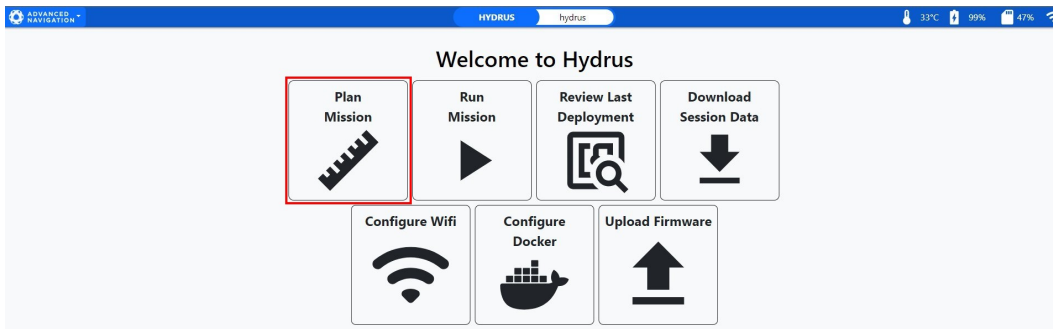


Figure 63: Plan Mission

3. In the Mission Planner Welcome dialogue, click "Import Mission".

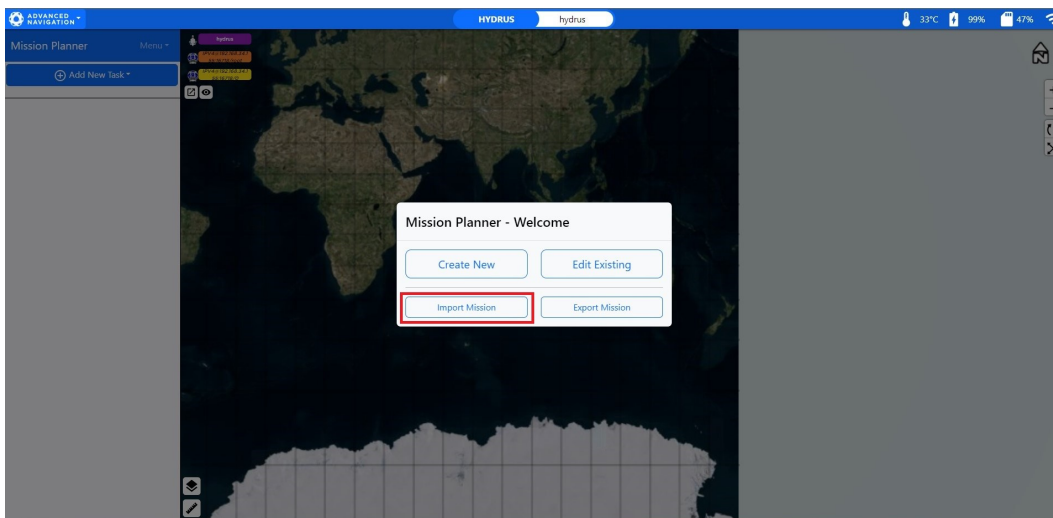


Figure 64: Welcome Planner Import Mission

4. The local drive dialogue box will appear for the user to pick which mission they would like to import, select the mission.

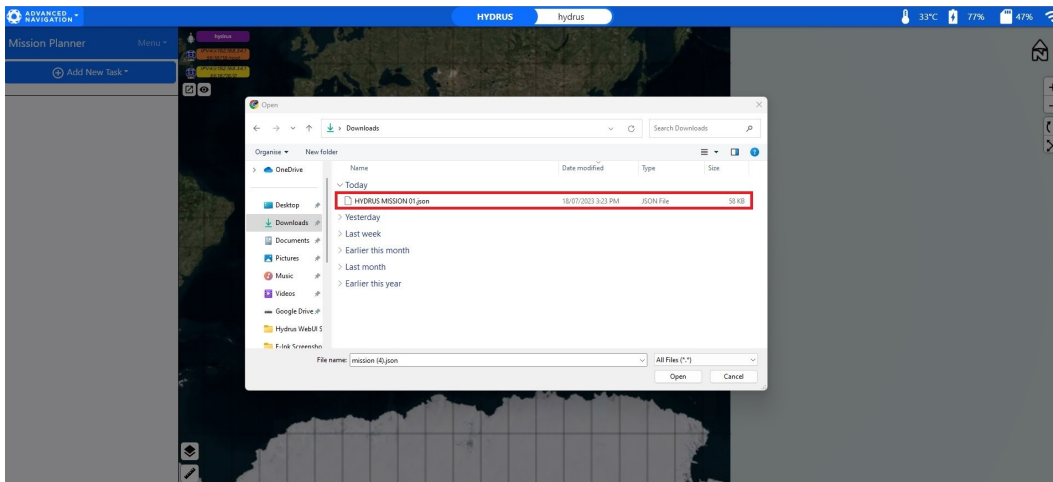


Figure 65: Hydrus Import Mission Local Drive

**Note:** Ensure the correct file type is selected when importing mission from the local drive being a (.json) file only.

5. Once the mission is selected the user will see the mission appear on the view screen it is recommended if there is any adjustments made to the mission parameters that the user conducts a 'save as' to save the mission with the changes.

### 7.5.3.2 Export Procedure

1. Open the Hydrus webUI.

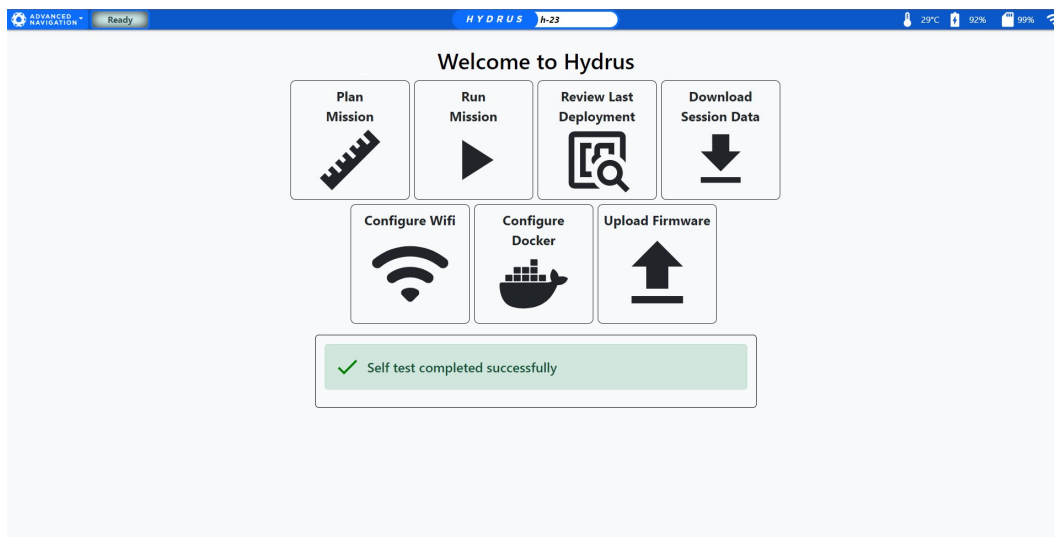


Figure 66: Hydrus WebUI Main Page

2. Click "Plan Mission", this will take you to the Mission Planner.

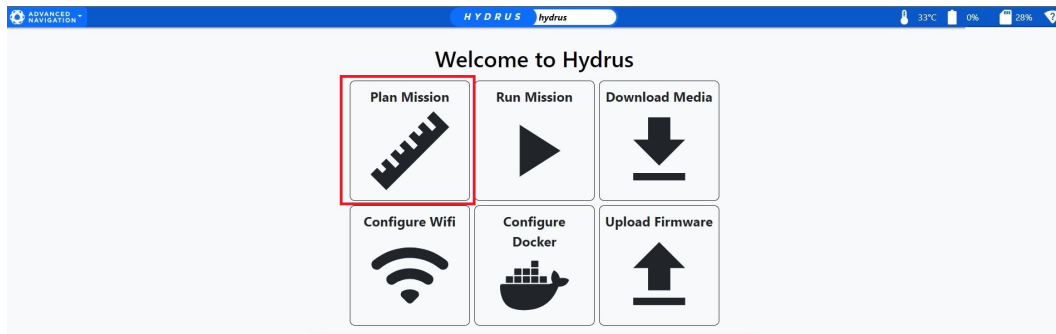


Figure 67: Plan Mission

3. In the Mission Planner Welcome dialogue, click "Export Mission".

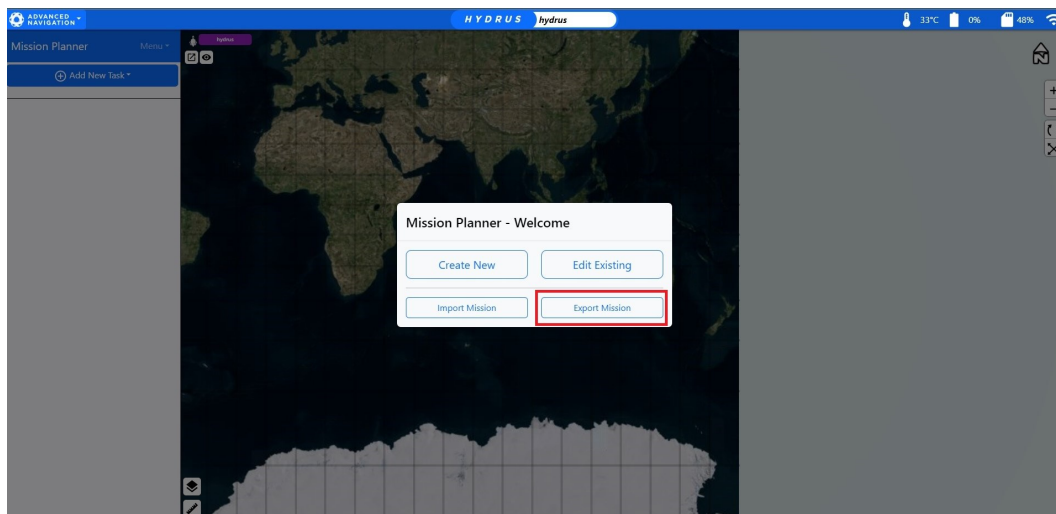


Figure 68: Mission Planner Welcome

- The sessions dialogue box will appear for the user to pick which mission they would like to export, select the mission.

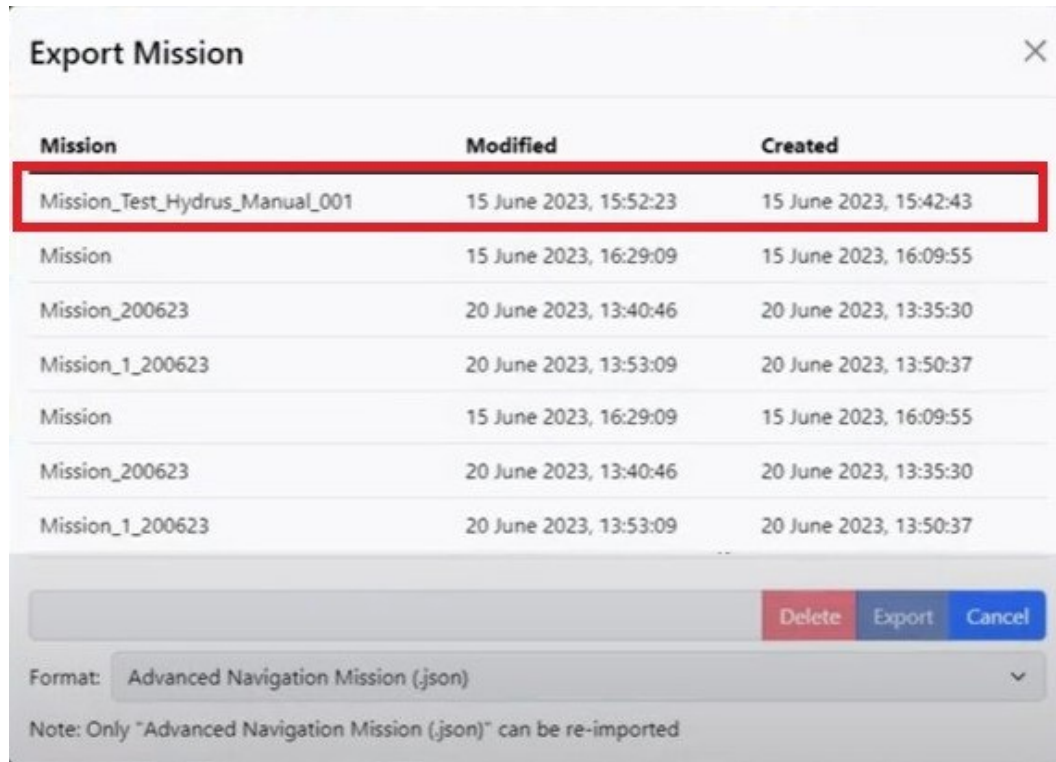


Figure 69: Session Dialog Box

- Click "Export" in the session dialogue, the mission file will then be downloaded to the user's local drive.

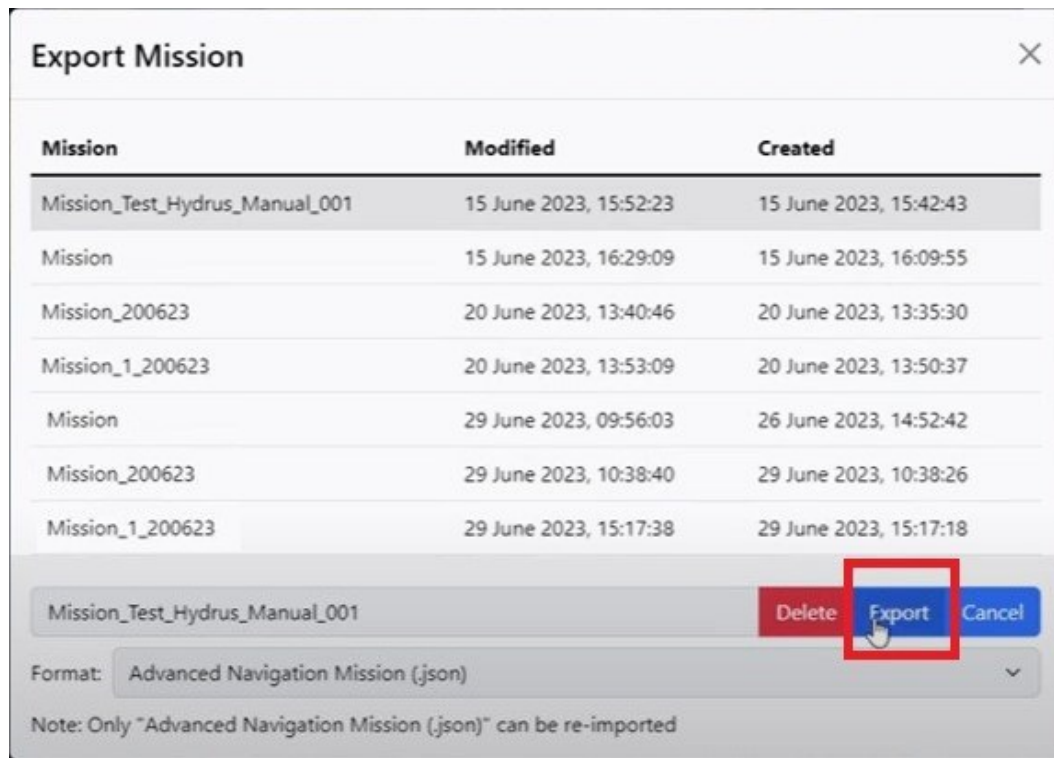


Figure 70: Export and Download Mission

## 7.6 Mission Planner

### 7.6.1 Global Mission Parameters

Global mission parameters apply to the entire mission and all its mission tasks. However, whilst some parameter settings are inherited from the global configuration, certain mission task specific parameters can be configured independently and will override the global parameters during the execution of a mission task.

The global mission parameters can be accessed by clicking the mission name at the top of the Mission Planner pane to the left.

#### 7.6.1.1 General

**Mission Mode** - There are two mission modes available — **Subsonus Assisted** and **Standalone (GNSS / Dead Reckoning)**. The former mission mode requires a Subsonus whereas the latter allows for missions to be carried out with a standalone Hydrus unit. See [7.1.1 Mission Modes](#) for more information.

**Name** - Name of the mission plan. Allows for easy identification, reference and traceability.

**Created** - Mission plan creation date (system generated).

**Modified** - Mission plan last modified date (system generated).

#### 7.6.1.2 Conditions

**Bail-out conditions** - See [7.6.2 Bail-out Conditions](#) for more information.

### 7.6.1.3 Pause Vertical

**Note:** Pause vertical is only available in Subsonus Assisted Mission Mode.

The Pause Vertical parameter defines the vertical position to which the Hydrus descends at mission start. See [7.2.5 Pause Vertical Position](#).

- **Vertical Mode** - Determines the vertical reference point and method of measuring the vertical position during Pause Vertical.
- **Vertical** - Distance in metres between the specified vertical mode reference and the Hydrus when starting the mission.

### 7.6.1.4 Travel

- **Travel Tilt** - Specifies the travel tilt (pitch) of the Hydrus during travel between mission tasks.

Travel tilt is a global mission parameter that determines the tilt of the Hydrus along the direction of travel and serves to enhance obstacle detection and altitude mode. As Hydrus moves forward, it utilises the DVL beam to look slightly ahead, aiding in obstacle detection and maintaining the appropriate altitude.

When executing transect survey mission tasks, upon arrival at a designated picture-taking point, Hydrus adjusts its orientation to 0° or "look down" and captures the image. This enables it to obtain the desired visuals from a downward perspective.

When executing lawnmower survey mission tasks, the Hydrus adjusts its orientation to the user specified pitch and captures the image.

**Note:** Hydrus's travel tilt is limited to 30 degrees. This means that the camera angle can be adjusted within a range of -30 degrees to +30 degrees from the vertical position. Exceeding this limit may result in compromised data quality or operational issues. Exceeding 30 degrees of pose may result in loss of bottom tracking on the DVL, and reduce navigation performance.

#### *Vertical*

- **Vertical Mode** - Determines the vertical reference point and method of measuring the vertical position during transits between mission tasks.
- **Vertical** - Distance in metres between the specified vertical mode reference and the Hydrus when it is necessary for Hydrus to reacquire a navigation reference (DVL bottom lock) during the mission.

### 7.6.1.5 Capture

**Default Capture Parameters** - Global default camera settings. These settings will be inherited to all mission tasks unless they are overridden at mission task level. See [7.6.6 Capture Parameters](#) for details.

#### **Media Overlay Parameters**

Text overlays can be added to both images and video that are recorded during the mission. This is a global setting and applies to all mission tasks. The following metadata is recorded for both images and videos:

- System time
- User comment, if set by user
- Mission name, if enabled

- Heading
- Latitude
- Longitude
- Depth / Altitude
- **Image Overlay Mode - Integrated Text Overlay** - In this mode, a burned watermark with the above-listed is added to every photo.
- **Video Overlay Mode** - If this parameter is set to **Subtitle File (.vtt)**, data (time and location) recorded alongside with videos will be written to a vtt subtitle file. These subtitles are synchronised with the recorded footage and can easily be shown or hidden from the footage.
- **User Comment** - Free text field that will be included in the media overlay, unless it is left empty.
- **Record Mission Name** - When this setting is enabled, the mission name will be included in the media overlay.

### 7.6.1.6 Recovery Location

#### Home Point Type

- **Launch Location** - In Standalone (GNSS/ Dead Reckoning) mission mode, this setting will instruct Hydrus to return to the same location from where it was deployed.
- **Geodetic Location** - This home point type allows you to define the recovery location as geodetic coordinates (longitude and latitude).
- **Relative to Subsonus** - In Subsonus Assisted mission mode, the recovery location can be specified as a **Bearing** and **Distance** of the Hydrus relative to the position of the Subsonus. If the position of the Subsonus changes during the mission, the recovery location will change accordingly.

#### When Reaching Recovery Location

- **Go to Surface** - Hydrus will navigate to the recovery location and resurface directly. Hydrus will then utilise its thrusters to counteract any surface currents to remain in position.
- **Hold Position** - Upon reaching the specified recovery location Hydrus will hold a vertical position as per the **Vertical Mode** and **Vertical** settings.

#### Vertical Mode

- **Bottom Altitude** - This mode allows the user to set a height above the seafloor. Hydrus will maintain this altitude while following the lawnmower/transect pattern during the survey.
- **Surface Depth** - This mode allows the user to define the depth of the Hydrus from the water surface. In this mode, the depth is measured in metres below the water surface. By setting a specific surface depth value, Hydrus will maintain a consistent depth below the water surface while following the survey path. This mode is useful when the focus is on capturing data at a specific depth level, such as conducting surveys near the water surface or targeting specific water layers.
- **Geodetic Height** - This mode allows Hydrus to be set of a geodetic height, which is a measure of vertical distance above or below a specific geodetic reference point, such as the Earth's ellipsoid. By setting a specific geodetic height value, Hydrus can maintain a consistent altitude relative to the chosen reference datum throughout the survey. This mode is particularly useful when conducting surveys that require



precise geospatial positioning and referencing, such as mapping, geodetic measurements, or integration with external geodetic datasets.

**Note:** Geodetic height only works in Subsonus Assisted mission mode and requires a GNSS fix from an external source e.g. a GNSS Compass.

**Vertical** - This setting determines the vertical position for the recovery location. It is define as a distance in metres between the Hydrus and the vertical reference point determined by the **Vertical Mode** setting.

## 7.6.2 Bail-out Conditions

### 7.6.2.1 On Battery Depletion

Specifies how Hydrus will react when its remaining battery power drops below the specified battery charge percentage level thresholds. Regardless of this setting, Hydrus will autonomously abort the mission and shut-off non-critical systems when its remaining battery power is critically low.

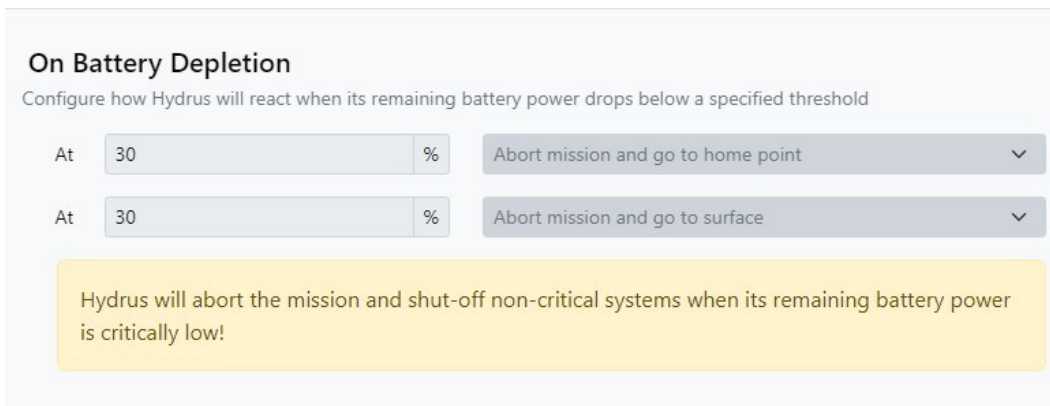


Figure 71: Battery Depletion

Selection / Action
<p>Abort mission and go to Recovery Location.</p> <ul style="list-style-type: none"> <li>When the battery percentage is selected, the user is configuring Hydrus to take action when the remaining battery power drops below the specified threshold.</li> <li>Hydrus will then navigate autonomously to a recovery location defined from the <a href="#">7.1.3 Recovery Location</a> set during mission planning.</li> <li>For example, if a user sets the threshold to 20%, it means that when the remaining battery power drops below 20%, the action will be triggered to abort mission and return itself to the recovery location.</li> </ul>
<p>Abort mission and go to surface.</p> <ul style="list-style-type: none"> <li>When the battery percentage is selected, the user is configuring Hydrus to take action when the remaining battery power drops below the specified threshold</li> <li>Hydrus will ascend to the water surface autonomously, allowing for retrieval.</li> <li>For example, if a user sets the threshold to 20%, it means that when the remaining battery power drops below 20%, the action will be triggered to abort mission and return itself to the surface.</li> </ul>

### 7.6.2.2 On Loss of Acoustic Communication

Specifies how Hydrus will react when acoustic communication has been lost for a specified period of time expressed in seconds. Upon bailout event trigger, Hydrus will abort the mission and go straight to the surface.

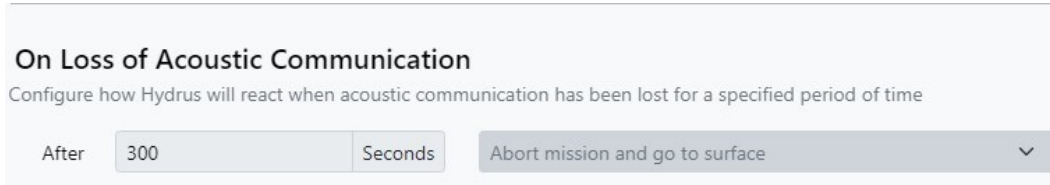


Figure 72: Loss of Acoustic Communication

#### Selection /Action

Abort mission and go to surface (for use with Subsonus).

- When the time (in seconds) is selected, the user is configuring Hydrus to take action when the loss of acoustic communication has been lost for the determined period of time .
- Hydrus will ascend to the water surface autonomously, allowing for retrieval.
- For example, if a user sets the threshold to 300 seconds, it means that when Subsonus pings Hydrus for acoustic connectivity and is not successful for a period of 300 seconds, the action will be triggered to abort mission and return itself to the surface.

### 7.6.2.3 Maximum Surface Depth

Specifies how Hydrus will react when its depth below the water's surface exceeds a specified threshold. Upon bailout event trigger, Hydrus can be instructed to:

- abort the mission and go to the recovery location, or
- abort the mission and go straight to the surface.

**Maximum Surface Depth**  
Configure how Hydrus will react when its depth below the water's surface exceeds a specified threshold

At  Metres

Figure 73: Maximum Surface Depth

Selection /Action
<p>Abort mission and go to recovery location.</p> <ul style="list-style-type: none"><li>• When the specified depth (in metres) is selected, the user is configuring Hydrus to take action when Hydrus drops below the specified depth threshold.</li><li>• Hydrus will then navigate autonomously to a home point defined from the recovery location parameters set during mission planning.</li><li>• For example, if a user sets the depth threshold to 300 metres, it means that if Hydrus descends below the specified depth, the action will be triggered to abort mission and return itself to the recovery location.</li></ul>
<p>Abort mission and got to surface.</p> <ul style="list-style-type: none"><li>• When the desired depth (in metres) is selected, the user is configuring Hydrus to take action when Hydrus drops below the specified depth threshold.</li><li>• Hydrus will then navigate autonomously to a home point defined from the recovery location parameters set during mission planning.</li><li>• For example, if a user sets the depth threshold to 300 metres, it means that if Hydrus descends below the specified depth, the action will be triggered to abort mission and return itself to the surface</li></ul>

### 7.6.2.4 Minimum Bottom Altitude

Specifies how Hydrus will react when its altitude above the seafloor exceeds a specified threshold. Upon bailout event trigger, Hydrus can be instructed to:

- abort the mission and go to the recovery location, or
- abort the mission and go straight to the surface, or
- carry on with the mission.

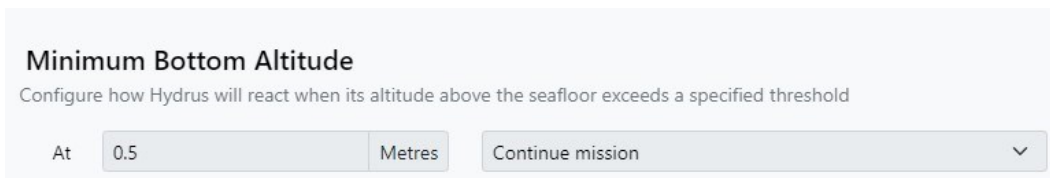


Figure 74: Minimum Bottom Altitude

Selection /Action
<p>Continue Mission</p> <ul style="list-style-type: none"> <li>• When the specified altitude (in metres) is selected, the user is configuring Hydrus to take action if Hydrus drops below the specified altitude threshold.</li> </ul>
<p>Abort mission and go to Recovery Location.</p> <ul style="list-style-type: none"> <li>• When the specified (in metres) is selected, the user is configuring Hydrus to take action if Hydrus drops below the specified altitude threshold.</li> </ul>
<p>Abort mission and got to surface.</p> <ul style="list-style-type: none"> <li>• When the specified altitude (in metres) is selected, the user is configuring Hydrus to take action if Hydrus drops below the specified altitude threshold.</li> <li>• Hydrus will then navigate autonomously to a home point defined from the recovery location parameters set during mission planning.</li> <li>• For example, if a user sets the altitude threshold to 1 metres, it means that if Hydrus comes closer to the seabed by less than 1m, the action will be triggered to abort mission and return itself to the surface</li> </ul>

### 7.6.2.5 Low Storage Space

Specifies how Hydrus will react when its remaining storage space is critically low. Upon bailout event trigger, Hydrus can be instructed to:

- abort the mission and go to the recovery location, or
- abort the mission and go straight to the surface, or
- carry on with the mission (with risk of filling up the memory and having to stop recording data).

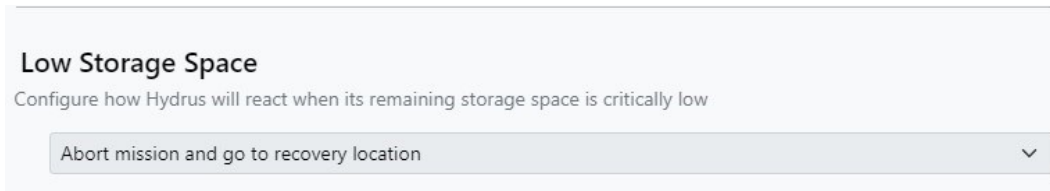


Figure 75: Low Storage Space

Selection/Action
<p>Continue Mission</p> <ul style="list-style-type: none"> <li>• Hydrus will proceed with its current mission even if the remaining storage space becomes critically low.</li> </ul>
<p>Abort Mission and Go to Recovery Location</p> <ul style="list-style-type: none"> <li>• When the remaining storage space drops below the specified threshold, Hydrus will immediately abort its current mission.</li> <li>• Hydrus will then navigate to a designated recovery location.</li> </ul>
<p>Abort Mission and Go to Surface</p> <ul style="list-style-type: none"> <li>• With this option, when the remaining storage space reaches a critically low level, Hydrus will abort its current mission and ascend to the water surface.</li> </ul>

## 7.6.3 Mission Task Parameters

### 7.6.3.1 Waypoint Task Parameters

#### **Name**

All mission tasks can be renamed for easy reference and management. By default, a mission task will be given a name based on the mission task type when added to the mission task list in the mission planner pane.

#### **Path Generation**

**Reverse Path Direction** - This toggle button allows you to reverse the mission flight direction of the Hydrus. This toggle also inverts the start and end points of the polygon.

#### **Coverage**

These settings allow for configuration of image and video capture settings, including options for camera coverage with overlap, fixed distance capture, or no capture. The coverage types are as follows:

**Image (Camera Coverage)** - This Coverage Type enables the Hydrus to capture images during the survey while determining their location and the mow width based on specific parameters.

- **Altitude Definition** - The user needs to define the altitude at which the images will be taken. This altitude setting influences the size of the image footprint on the seabed, determining the level of detail captured in each image.
- **Overlap Forward** - The user also specifies the desired amount of overlap between consecutive images. This parameter determines the degree of redundancy and ensures comprehensive coverage of the survey area. The overlap helps in stitching the images together for seamless mapping and analysis.
- **Overlap Lateral (for lawnmower polygon tasks only)** - For lawnmower survey tasks there is a configurable lateral image overlap parameter for the horizontal overlap between adjacent lawnmower sweeps.

Based on the defined altitude and overlap parameters, Hydrus calculates the appropriate mow width between each lawnmower pattern. This calculation ensures that the images captured during the survey have the desired overlap and are evenly spaced

- **Calculated Mow Width** - This parameter represents the estimated width (in metres) covered by Hydrus during each mow or sweep while capturing images. Hydrus utilises its camera's field of view and overlap parameters to determine the location of each image it captures along the survey path. This ensures systematic coverage of the survey area.
- **Calculated Image Interval** - This parameter represents the estimated distance in metres between image capturing.

**Image (Fixed Distance)** - This setting allows Hydrus to capture still images at regular intervals while following the survey path. The distance between each picture location is explicitly specified by the user. Additionally, there is an option to record video while performing this task.

**Note:** That when operating in this mode, Hydrus will likely operate at slower speeds than when purely recording video.

- **Also Record Video** - Along with capturing still images, there is an option to enable video recording during the survey. This allows for continuous video footage to be recorded while Hydrus follows the survey path.
- **Distance** - User configurable travel distance in metres along the survey path between captured images.

**Video (Camera Coverage)** - This setting enables Hydrus to capture video footage during the survey while determining the image capture interval based on the camera's field of view and overlap parameters.

- **Video Capture** - Hydrus records video footage as it follows the survey path, allowing for continuous documentation of the survey area.
- **Calculated Image Interval** - Auto-calculated distance between image capture waypoints based on input.

**Video (Fixed Distance)** - Hydrus records video footage while following the survey path, providing continuous documentation of the survey area.

## **Capture**

### *Vertical Parameters*

This setting determines the vertical position in metres of the Hydrus while it moves along the survey path during the mission task. This parameter is defined as either depth from surface, height above the sea floor or geodetic height in metres.

### **Vertical Mode**

- **Bottom Altitude** - This mode allows the user to set a height above the seafloor. Hydrus will maintain this altitude while following the lawnmower pattern during the survey.
- **Surface Depth** - This mode allows the user to define the depth of the Hydrus from the water surface. In this mode, the depth is measured in metres below the water surface. By setting a specific surface depth value, Hydrus will maintain a consistent depth below the water surface while following the survey path. This mode is useful when the focus is on capturing data at a specific depth level, such as conducting surveys near the water surface or targeting specific water layers.
- **Geodetic Height** - This mode allows Hydrus to be set of a geodetic height, which is a measure of vertical distance above or below a specific geodetic reference point, such as the Earth's ellipsoid. By setting a specific geodetic height value, Hydrus can maintain a consistent altitude relative to the chosen reference datum throughout the survey. This mode is particularly useful when conducting surveys that require precise geospatial positioning and referencing, such as mapping, geodetic measurements, or integration with external geodetic datasets.

**Note:** Geodetic height only works in Subsonus Assisted mission mode and requires a GNSS fix from an external source e.g. a GNSS Compass.

**Vertical** - Distance between Hydrus and vertical positioning reference in metres. Depending on the selected Mode, this can be depth from surface, height above the sea floor or geodetic height.

**Use Mission Capture Parameters** - If this setting is enabled, the global capture parameters set at mission level are inherited by the mission task. If this setting is disabled, the **Capture Parameters** dialog will be accessible.

**Capture Parameters** - In case the mission task requires other capture parameters than the ones set at mission level, mission task specific capture parameters can be configured by clicking this button. Once Hydrus starts the mission task, the global capture parameters will be overridden for the duration of the mission task. See [7.6.6 Capture Parameters](#) for details.

### 7.6.3.2 Lawnmower Task Parameters

#### **Name**

All mission tasks can be renamed for easy reference and management. By default, a mission task will be given a name based on the mission task type when added to the mission task list in the mission planner parameters pane.

#### **Path Generation**

**Reverse Path Direction** - This toggle button allows you to reverse the mission flight direction of the Hydrus. This toggle also inverts the start and end points of the polygon.

**Lawnmower Orientation** - To control the rotation of the Lawnmower Survey within the defined polygon, the user has two options. Firstly, the user can input a specific value in degrees to indicate the desired rotation angle. This allows for precise control over the orientation of the lawnmower pattern. Alternatively, the user can use the Transform Handle in the webUI to manually rotate the lawnmower to the desired degree, see [7.6.4 Mission Map Pane](#)

#### **Coverage**

These settings allow for configuration of image and video capture settings, including options for camera coverage with overlap, fixed distance capture, or no capture. The coverage types are as follows:

**Image (Camera Coverage)** - This Coverage Type enables the Hydrus to capture images during the survey while determining their location and the mow width based on specific parameters.

- **Altitude Definition** - The user needs to define the altitude at which the images will be taken. This altitude setting influences the size of the image footprint on the seabed, determining the level of detail captured in each image.
- **Overlap Forward** - The user also specifies the desired amount of overlap between consecutive images. This parameter determines the degree of redundancy and ensures comprehensive coverage of the survey area. The overlap helps in stitching the images together for seamless mapping and analysis.
- **Overlap Lateral** - For lawnmower survey tasks, there is a configurable lateral image overlap parameter for the horizontal overlap between adjacent lawnmower sweeps.

Based on the defined altitude and overlap parameters, Hydrus calculates the appropriate mow width between each lawnmower pattern. This calculation ensures that the images captured during the survey have the desired overlap and are evenly spaced

- **Calculated Mow Width** - This parameter represents the estimated width (in metres) covered by Hydrus during each mow or sweep while capturing images. Hydrus utilises its camera's field of view and overlap parameters to determine the location of each image it captures along the survey path. This ensures systematic coverage of the survey area.
- **Calculated Image Interval** - This parameter represents the estimated distance in metres between image capturing.

**Image (Fixed Distance)** - This setting allows Hydrus to capture still images at regular intervals while following the survey path. The distance between each picture location is explicitly specified by the user. For lawnmower survey tasks, mow width is also a user configurable parameter. Additionally, there is an option to record video while performing this task.

**Note:** That when operating in this mode, Hydrus will likely operate at slower speeds than when purely recording video.

- **Overlap Lateral** - For lawnmower survey tasks there is a configurable lateral image overlap parameter for the horizontal overlap between adjacent lawnmower sweeps.
- **Mow Width and Distance** - The user defines both the mow width and the distance between image locations in metres. The mow width represents the coverage width of the survey path, while the distance determines the spacing between consecutive image locations.
- **Also Record Video** - Along with capturing still images, there is an option to enable video recording during the survey. This allows for continuous video footage to be recorded while Hydrus follows the predefined mow width and distance settings.

**Video (Camera Coverage)** - This setting enables Hydrus to capture video footage during the survey while determining the mow width based on the camera's field of view and overlap parameters.

- **Video Capture** - Hydrus records video footage as it follows the survey path, allowing for continuous documentation of the survey area.
- **Mow Width Determination** - The mow width, which represents the coverage width of the survey path, is determined based on the camera's field of view and overlap parameters. These parameters ensure sufficient coverage and overlap between adjacent lawnmower sweeps.
- **Overlap Lateral** - The user can input the desired coverage overlap in percentage. This parameter defines how much the images should horizontally overlap between consecutive lawnmower sweeps. It ensures the necessary redundancy and comprehensive coverage for effective analysis and mapping.



Once these sub-settings are selected, the lawnmower survey algorithm generates the following calculated parameters:

- **Calculated Mow Width** - Estimated width (in metres) covered by Hydrus during each mow or sweep while capturing video footage.
- **Capture Distance** - Approximate distance (in metres) covered by Hydrus between successive video captures.
- **Calculated Image Interval** - Auto-calculated distance between image capture waypoints based on input.

**Video (Fixed Distance)** - Hydrus records video footage while following the survey path, providing continuous documentation of the survey area. For lawnmower survey tasks, the mow width (i.e. the horizontal width between adjacent lawnmower sweeps) can also be specified.

- **Mow Width (lawnmower polygon tasks only)** - The mow width represents the horizontal width between adjacent lawnmower sweeps. This parameter determines the proximity of the sweeps and influences the level of coverage overlap.

### **Capture**

- **Pitch** - The pitch angle of Hydrus whilst performing the task, specified in degrees.

### *Vertical*

This setting determines the vertical position in metres of the Hydrus while it moves along the survey path during the mission task. This parameter is defined as either depth from surface, height above the sea floor or geodetic height in metres.

### **Mode**

- **Bottom Altitude** - This mode allows the user to set a height above the seafloor. Hydrus will maintain this altitude while following the lawnmower pattern during the survey.
- **Surface Depth** - This mode allows the user to define the depth of the Hydrus from the water surface. In this mode, the depth is measured in metres below the water surface. By setting a specific surface depth value, Hydrus will maintain a consistent depth below the water surface while following the survey path. This mode is useful when the focus is on capturing data at a specific depth level, such as conducting surveys near the water surface or targeting specific water layers.
- **Geodetic Height** - This mode allows Hydrus to be set of a geodetic height, which is a measure of vertical distance above or below a specific geodetic reference point, such as the Earth's ellipsoid. By setting a specific geodetic height value, Hydrus can maintain a consistent altitude relative to the chosen reference datum throughout the survey. This mode is particularly useful when conducting surveys that require precise geospatial positioning and referencing, such as mapping, geodetic measurements, or integration with external geodetic datasets.

**Note:** Geodetic height only works in Subsonus Assisted mission mode and requires a GNSS fix from an external source e.g. a GNSS Compass.

**Value** - Distance between Hydrus and vertical positioning reference in metres. Depending on the selected Mode, this can be depth from surface, height above the sea floor or geodetic height.

**Use Mission Capture Parameters** - If this setting is enabled, the global capture parameters set at mission level are inherited by the mission task. If this setting is disabled, the **Capture Parameters** dialog will be accessible.

**Capture Parameters** - In case the mission task requires other capture parameters than the ones set at mission level, mission task specific capture parameters can be configured by clicking this button. Once Hydrus starts the mission task, the global capture parameters will be overridden for the duration of the mission task. See [7.6.6 Capture Parameters](#) for details.

### 7.6.3.3 Station Keeping Task Parameters

#### **Name**

All mission task can be renamed for easy reference and management. By default, a mission task will be given a name based on the mission task type when added to the mission task list in the mission planner pane.

#### **Position**

- **Latitude** - Latitudinal coordinate for station keeping position.
- **Longitude** - Longitudinal coordinate for station keeping position.
- **Vertical** - Distance in metres between Hydrus and the vertical positioning reference point during station keeping.
- **Vertical Mode**
  - **Bottom Altitude** - This mode allows the user to set a height above the seafloor. Hydrus will maintain this altitude during the mission task.
  - **Surface Depth** - This mode allows the user to define the depth of the Hydrus from the water surface. In this mode, the depth is measured in metres below the water surface. By setting a specific surface depth value, Hydrus will maintain a consistent depth below the water surface.
  - **Geodetic Height** - This mode allows Hydrus to be set of a geodetic height, which is a measure of vertical distance above or below a specific geodetic reference point, such as the Earth's ellipsoid.

#### **Orientation**

- **Roll** - Roll angle of Hydrus, specified in degrees, during station keeping.
- **Pitch** - Pitch angle of Hydrus, specified in degrees, during station keeping.
- **Yaw** - Yaw angle of Hydrus, specified in degrees, during station keeping.

#### **Capture**

- **Capture Mode** - The capture mode can be set to Images, Video or Off.
- **Station Keeping Duration** - The duration of the station keeping task, specified in seconds.
- **Image Capture Interval** - If capture mode is set to images, this setting determines the time interval in seconds between each captured still image.
- **Media Capture Parameters** - Capture parameters for the station keeping task can be configured by clicking this button. Once Hydrus starts the mission task, the global capture parameters will be overridden for the duration of the mission task. See [7.6.6 Capture Parameters](#) for details.

## 7.6.4 Mission Map Pane

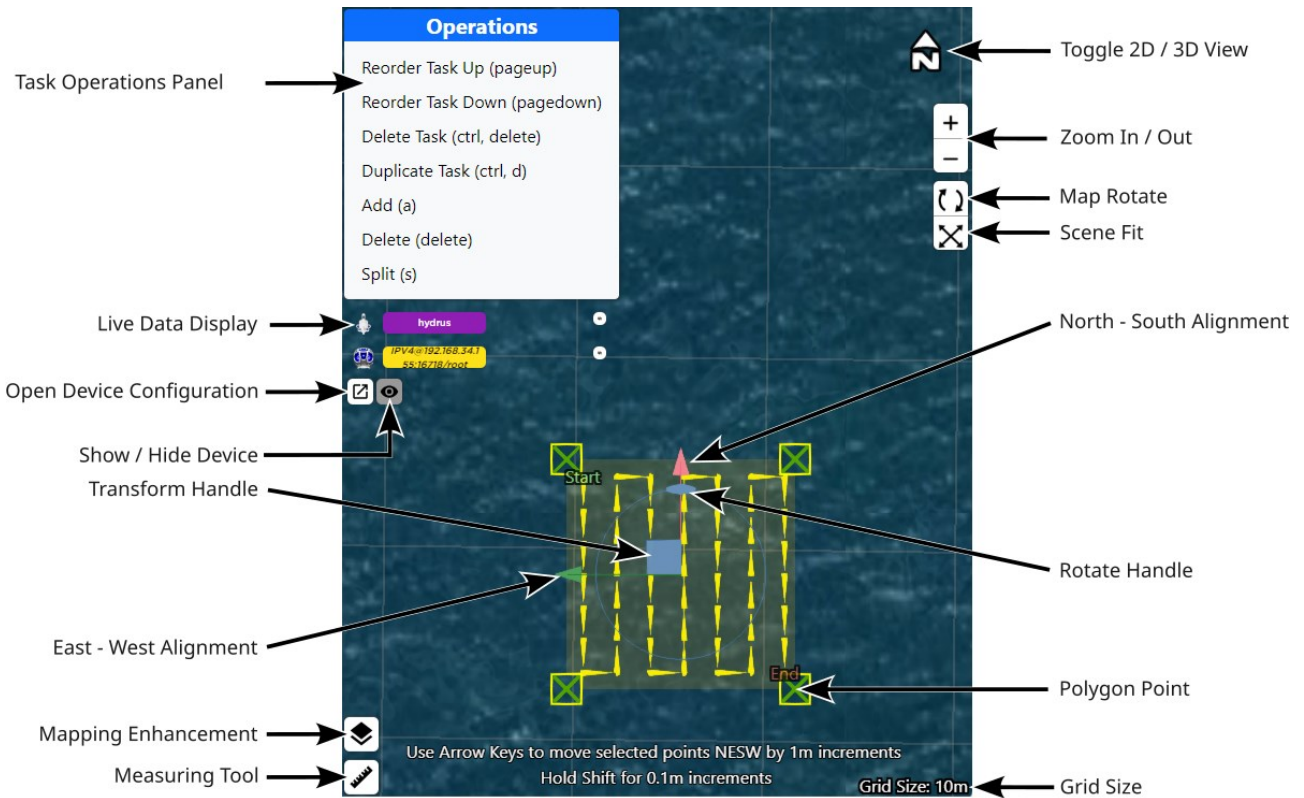


Figure 76: Mission Planning Mapping Overview

### 7.6.4.1 Map Navigation Controls

**Scene Fit:** This tool adjusts the view so that the entire mission scene fits within the viewport. This can also be done by double tapping the space-bar key.

**Zoom In/Out:** Use these tools for zooming in or zooming out the map view. The mouse roller wheel can also be used for zooming.

**Toggle 2D/3D View:** This tool switches the view modes between 2D view and 3D view. The 3D view is recommended to get a better sense of the terrain when utilising any mapping enhancements.

**Grid Size:** Displays the grid scale that overlays the map based on the current zoom level.

### 7.6.4.2 Device Tools

These tools are related to device configuration and data display.

**Show and Hide Devices:** Shows or hides the corresponding devices on the map. This can help reduce clutter and focus on specific devices.

**Live Data Display:** This feature displays live data from the devices, including roll, pitch, heading, latitude, longitude, and height. This data can help monitoring the status and position of the devices in real time.

**Open Device Configuration:** This button opens a panel where device settings can be changed, including adding or removing devices and more.

### 7.6.4.3 Task and Waypoint Tools

The Mission Map Pane offers a set of tools for creating, moving, rotating and resizing mission tasks and waypoints.

**Transform Handle:** With this tool it is possible to adjust the position of transect survey tasks and their individual waypoints. For lawnmower tasks, this tool can be used to move the position of the entire task, or change the shape and size of the selected task by selecting and moving its polygon points.

---

**Note:** To use the Transform Handle, first select the task in the Mission Planner pane in order for the rotate handle to appear.

---

**Waypoints and Polygon Points:** These are the vertices of the mission task. These points can be moved by using the transform handle in order to resize or reshape mission tasks. By selecting multiple polygon points (Ctrl + Click), the transform handle can be used to move several points at the same time. When selecting a single point, its geodetic coordinates are displayed in the **Selected Point** section of the Mission Planner pane.

**Rotate Handle:** This tool is used to change the orientation of the selected mission task. By clicking and dragging the oval shaped handle, the task can be rotated around its centre. For lawnmower mission tasks, the orientation can be set manually in the Lawnmower Orientation field in the Path Generation section of the Mission Planner pane.

---

**Note:** To use the Rotate Handle, first select the task in the Mission Planner pane in order for the rotate handle to appear.

---

**East/West (Green Arrow) Alignment:** This tool allows polygon point realignment along the east-west axis by clicking a point, holding and dragging the green arrow.

**North/South (Red Arrow) Alignment:** This tool allows polygon point realignment along the north-south axis by clicking a point, holding and dragging the red arrow.

#### 7.6.4.4 Task Operations Panel

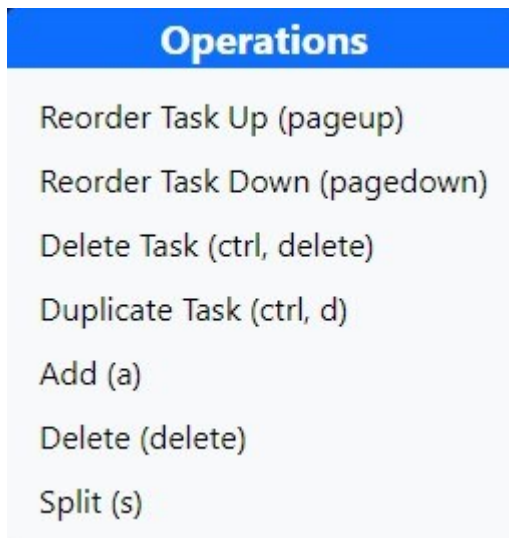


Figure 77: Task Operations Panel

**Reorder Task Up (Page Up):** This command moves the task up by one step in the list and repositions the task earlier in the execution sequence.

**Reorder Task Down (Page Down):** This command moves the task down by one step in the list and repositions the task later in the execution sequence.

**Delete Task (Ctrl + Del):** This command removes the entire mission task that is currently selected.

**Note:** Exercise caution when using this function. Deleting a mission task cannot be undone.

**Duplicate Task (Ctrl + D):** This function creates a copy of the selected task directly over the polygon selected for duplication. This is useful when creating similar tasks and speeds up the workflow.

**Add (A):** This command adds a new polygon point to the selected task. If the user selects the add button from the Task Operations Panel, the new polygon point will appear in the centre of the screen. However, if the user presses the 'A' key on the keyboard, the new point will appear wherever the cursor is currently located.

**Delete (Del):** This command allows the user to remove a selected polygon point. It's useful when it is needed to adjust the shape of the polygon or transect task by removing unnecessary points.

**Split (S):** This function enables the user to add a polygon point between two previously selected polygon points. Pressing 'S' on the keyboard will achieve the same outcome as selecting Split in the Task Operations Panel.

**Note:** To select multiple polygon points, hold down the Ctrl key on your keyboard and click the polygon points.

### 7.6.4.5 Measuring Tool

**Measuring Tool:** This tool allows the user to measure distances on the map. There are two ways to use this tool:

- Click and drag: By clicking and dragging across the map, the exact distance between two points on the map can be determined.
- Click once for point A, then click once for point B: Distances can also be measured and displayed by clicking once to set point A, then clicking again to set point B.

The bearing shown is relative to north, providing directional context for the measurement. Additionally, a circle is drawn around the two points, with the radius of the circle representing the measured distance from point A to point B. This visualises the spatial relationship between the two points and can be used for reference purposes.

### 7.6.4.6 Mission Summary

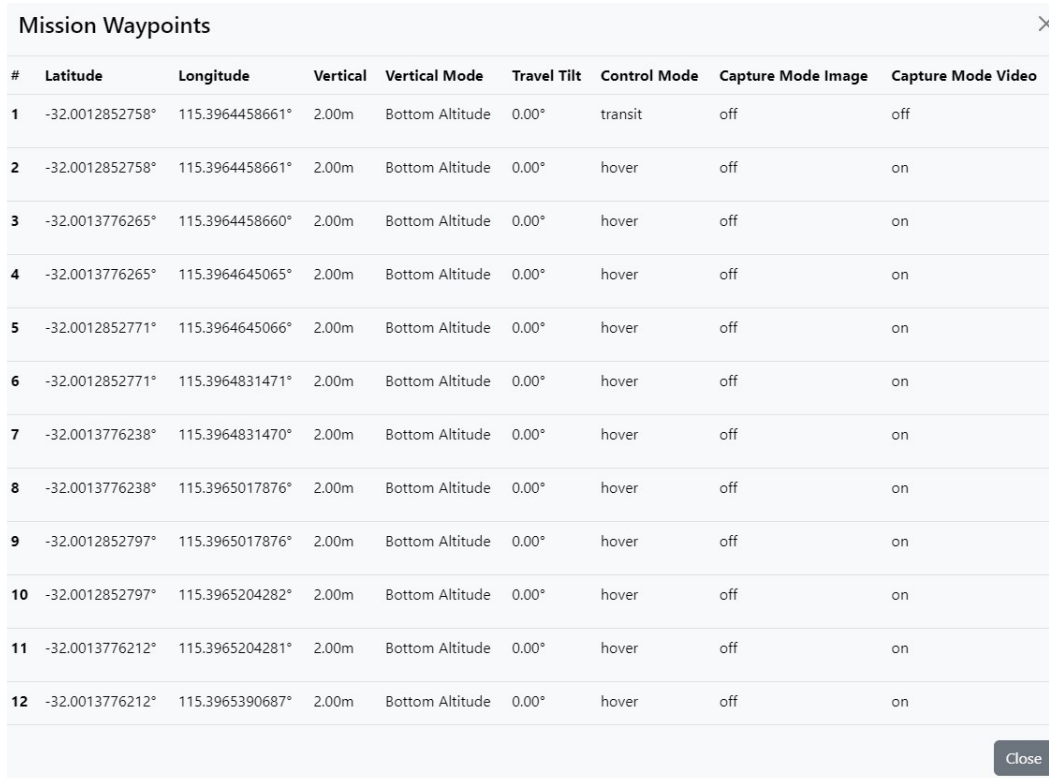
The **Mission Summary** dialog is a useful tool when planning missions. It gives you an overview of the estimated mission travel distance, battery usage and mission duration. To access the **Mission Summary** dialog, navigate to **Mission Planner** → **Menu** → **View Mission Summary....**

#	Task Name	Distance	Battery Use	Storage Use	Mission Time
START	Mission Start	0 m	0 %	0 MiB	0 h, 0 m
1	Lawnmower Polygon Task	72 m	6 %	0 MiB	0 h, 9 m
END	Mission End	72 m	6 %	0 MiB	0 h, 9 m

Figure 78: Mission Planner - Mission Summary

### 7.6.4.7 Mission Waypoints

The **Mission Waypoints** dialog provides an overview of all waypoint coordinates and other mission task parameters for the entire mission. This can be used for reference during mission planning and review. To access the **Mission Waypoints** dialog, navigate to **Mission Planner** → **Menu** → **View Execution Waypoints...**



#	Latitude	Longitude	Vertical	Vertical Mode	Travel Tilt	Control Mode	Capture Mode Image	Capture Mode Video
1	-32.0012852758°	115.3964458661°	2.00m	Bottom Altitude	0.00°	transit	off	off
2	-32.0012852758°	115.3964458661°	2.00m	Bottom Altitude	0.00°	hover	off	on
3	-32.0013776265°	115.3964458660°	2.00m	Bottom Altitude	0.00°	hover	off	on
4	-32.0013776265°	115.3964645065°	2.00m	Bottom Altitude	0.00°	hover	off	on
5	-32.0012852771°	115.3964645066°	2.00m	Bottom Altitude	0.00°	hover	off	on
6	-32.0012852771°	115.3964831471°	2.00m	Bottom Altitude	0.00°	hover	off	on
7	-32.0013776238°	115.3964831470°	2.00m	Bottom Altitude	0.00°	hover	off	on
8	-32.0013776238°	115.3965017876°	2.00m	Bottom Altitude	0.00°	hover	off	on
9	-32.0012852797°	115.3965017876°	2.00m	Bottom Altitude	0.00°	hover	off	on
10	-32.0012852797°	115.3965204282°	2.00m	Bottom Altitude	0.00°	hover	off	on
11	-32.0013776212°	115.3965204281°	2.00m	Bottom Altitude	0.00°	hover	off	on
12	-32.0013776212°	115.3965390687°	2.00m	Bottom Altitude	0.00°	hover	off	on

Figure 79: Mission Planner - Mission Waypoints

### 7.6.5 Mapping Enhancements

Mapping enhancements are overlay files that contain additional data to supplement and enrich the existing Hydrus mapping system. Mission enhancements are appended to missions as individual layers that can be shown or hidden. Mapping layers are essentially spatial datasets that can include information such as contours, underwater infrastructure, and known obstructions.

Adding a mapping layer with to a mission plan can help you and optimise mission task survey paths by taking the most direct transit path between known points of interest and by pro-actively avoiding known underwater features or obstructions.

Mapping layers makes it possible to leverage previously acquired data by importing spatial datasets from multiple sources into the same mission plan. For example, data from a prior reconnaissance mission conducted with Hydrus could be combined with a dataset obtained from a side scan sonar survey. This data integration functionality facilitates efficient planning for subsequent missions, allowing targeted exploration of specific areas of interest with ease, thus maximising the value of existing data.

The following industry standard GIS data formats are supported for custom mapping layers:

- GeoJSON (used for defining georeferenced waypoints, lines, polygons and simple geometries)
- KML/KMZ (standard GIS format for spatial information and metadata)

- ESRI shape world files for non-topological geometry vectors: .wld, .pgw, .pngw, .jgw, .jpgw, .bgw, .bmpw
  - Supported image file types associated with world files: .jpg, .png, .bmp

**Note:** If required and to enable data interoperability, various third-party software tools are available for converting proprietary file formats to the above-mentioned, supported interchangeable formats.

All mapping enhancements functionalities are available in both the **Mission Planner** and the **Log Viewer**.

### 7.6.5.1 Mapping Layers

The default mapping layers are shown at the top of the **Mapping Layers** pane:

- **Water** - Water surface animation layer (for visualisation purposes).
- **Satellite** - Satellite image layer. Enabling this layer can be useful for identifying and using geographical references and landmarks.
- **Seafloor** - This mapping layer visualises the seafloor as per the **Seafloor Depth** settings found in the **Map Options** dialog.

User configurable, custom mapping layers are shown underneath the default mapping layers. To add custom mapping layers, see [7.6.5.2 Map Options](#).

Click the **Mapping Layers** button in either **Mission Planner** or **Log Viewer** to the access **Mapping Layers** pane.

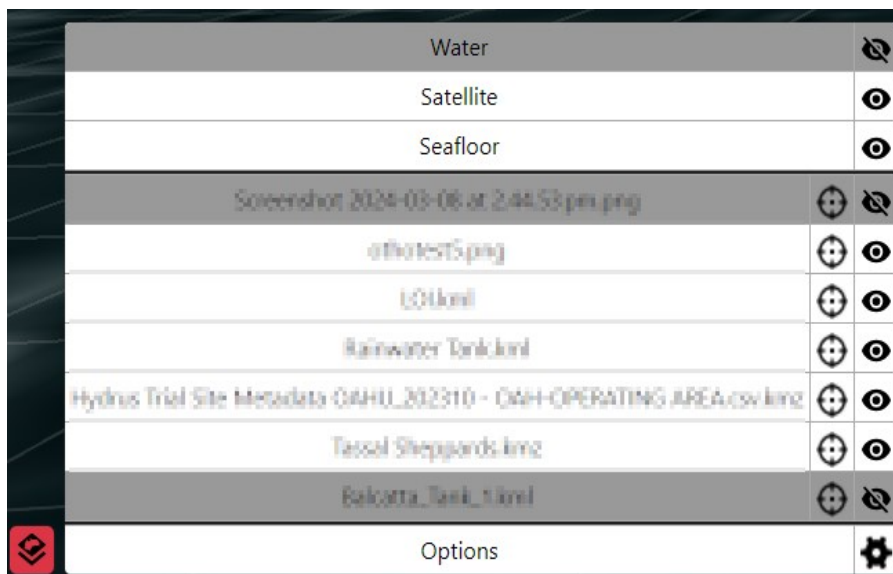


Figure 80: Mapping Layers Pane

### 7.6.5.2 Map Options

The following procedure outlines how to customise the map options, including how to upload custom mapping layer files to your mission or a recorded session:

1. Ensure your Mapping Enhancement files are prepared and saved in a supported format. Take note of the file's location on your computer for easy access during the upload process.
2. Enter the Hydrus WebUI and navigate either to the **Mission Planner** or the **Log Viewer**.



3. Click on the **Mapping Layers** button. Then click **Options**.

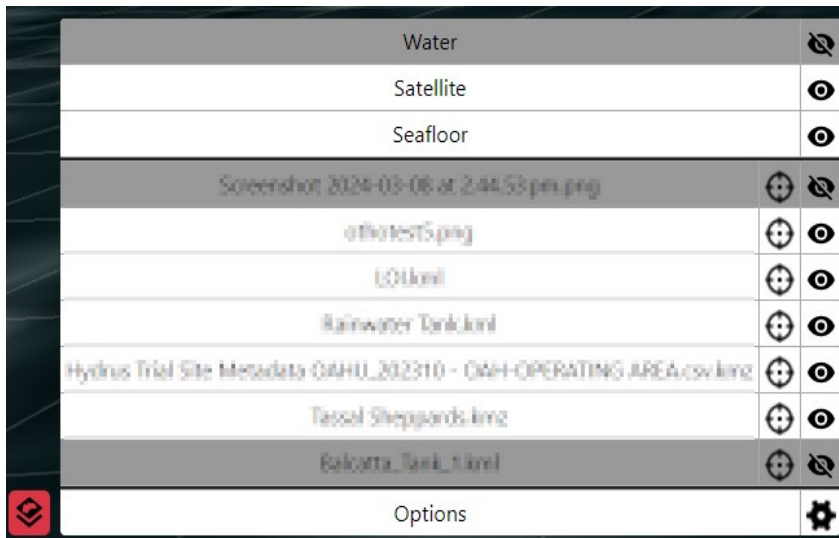


Figure 81: Mapping Layers Pane

4. Set the **General** tab settings as per your preference:

- Show Absolute Grid - Toggles the absolute grid in the map view
- Show Geodetic Grid - Toggles the geodetic grid (longitude and latitude) in the map view
- Use High-Contrast Grid - Toggles the high-contrast grid in the map view (increases the grid contrast for better visibility)

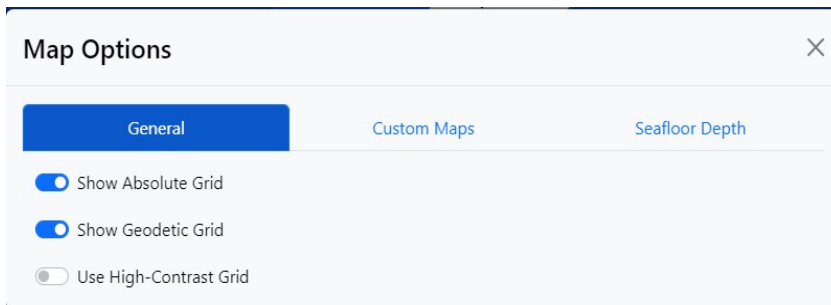


Figure 82: Map Options - General

5. In the **Custom Maps** tab, click **Add New Map Layer**.

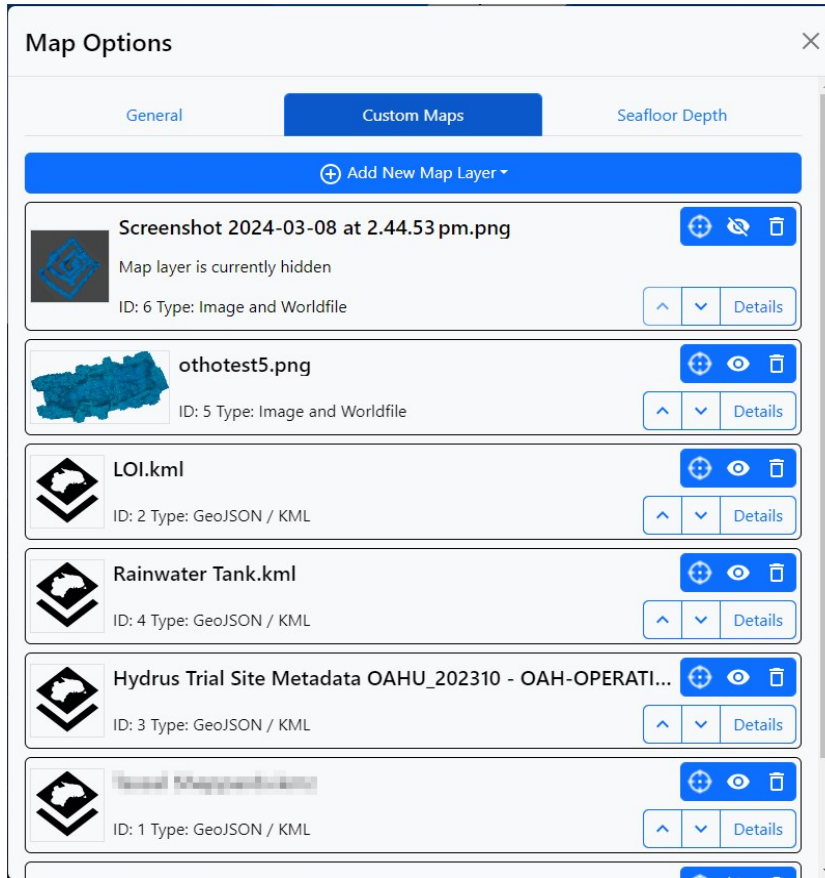


Figure 83: Map Options - Custom Maps

6. Add a **GeoJSON** layer:
  - Click **Choose file** and browse to the GeoJSON file to be uploaded.
  - Configure your import preferences:
    - Import Points
    - Import Lines
    - Import Polygons
  - Click **Upload**.

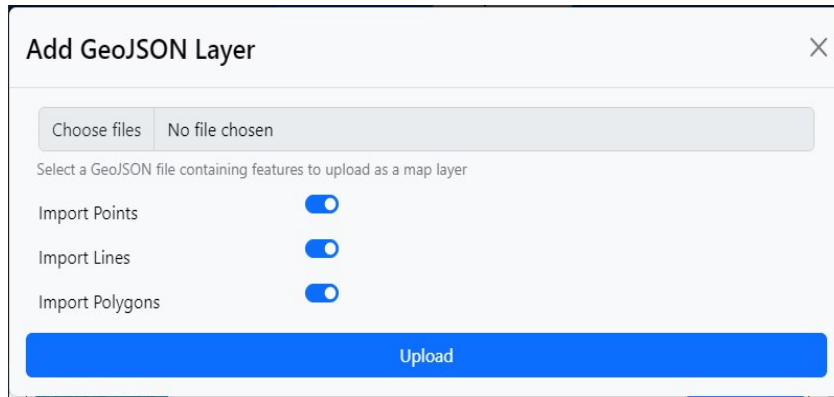


Figure 84: Map Options - Custom Maps - Add GeoJSON Layer

7. Add a **KML/KMZ** layer:

- Click **Choose file** and browse to the KML/KMZ file to be uploaded.
- Configure your import preferences:
  - Import Points
  - Import Lines
  - Import Polygons
- Select a Height mode from the dropdown list (EGM96 or WGS84).

**Note:** The altitude model that coordinate heights will be positioned relative to. The KML specification requires EGM96, but some KML files may be defined with heights relative to the WGS84 ellipsoid instead.

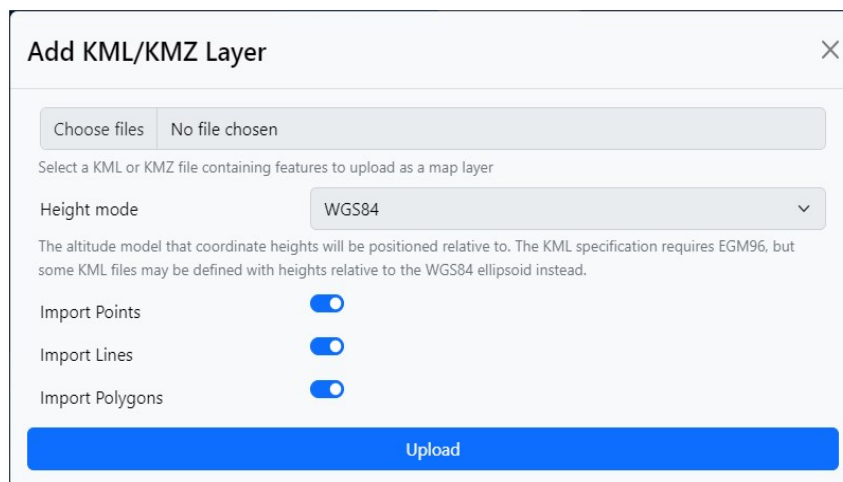


Figure 85: Map Options - Custom Maps -Add KML/KMZ Layer

8. Add **Image and Worldfile** layer:

- Click **Choose file** and browse to the ESRI-compatible world file (.wld, .pgw, .pngw, .jgw, .jpgw, .bgw, .bmpw)

- Click **Open** and then click **Upload**
- Click **Choose file** and browse to the image file associated with the world file (.jpg, .png, .bmp)
- Click **Open** and then click **Upload**

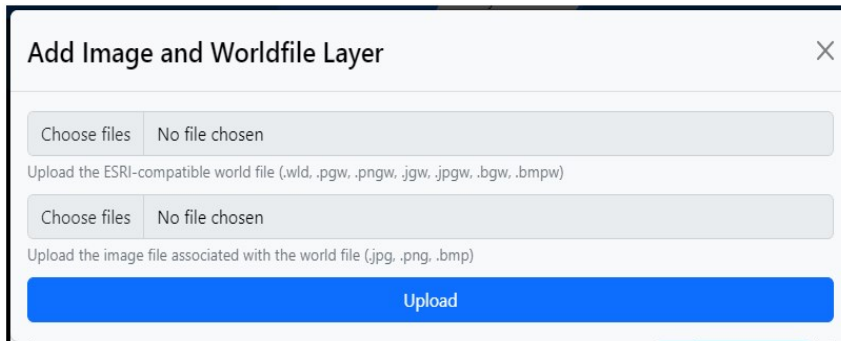


Figure 86: Map Options - Custom Maps - Add Image and Worldfile Layer

9. Add **Previous Mission Session** Layer

- Search and choose a session
- Click **Create Map Layer**

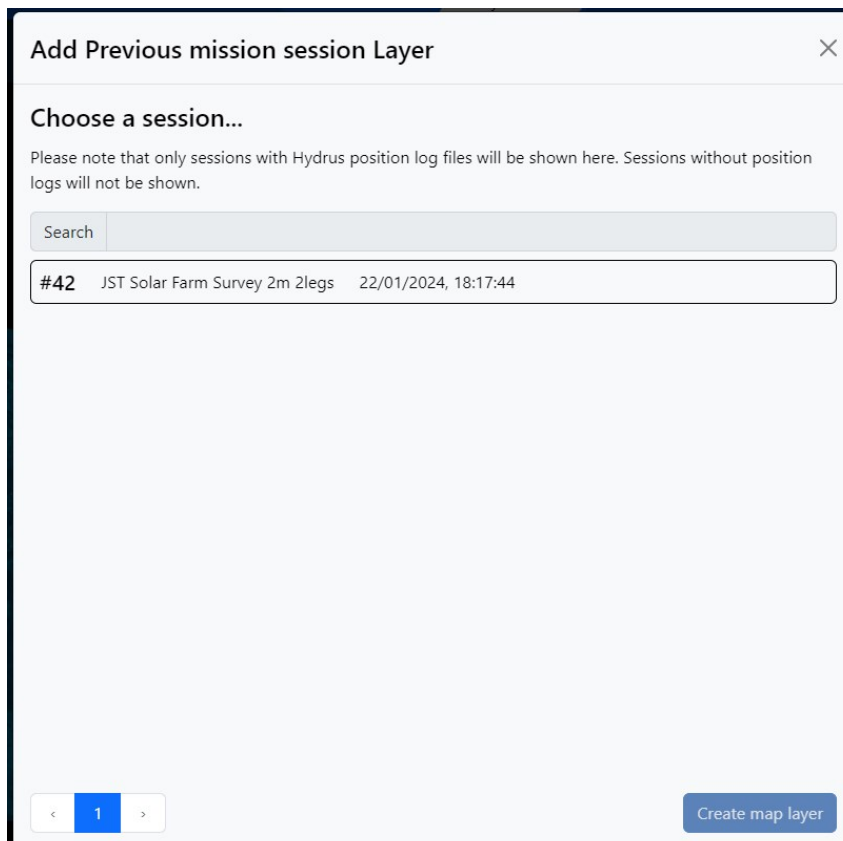


Figure 87: Map Options - Custom Maps - Add Previous Mission Session Layer

10. Using the mapping layer controls:

- Cross-hair icon button - Moves the camera in the map pane to the centre of the layer
- Eye icon button - Shows and hides the layer in the map pane
- Bin icon button- Deletes the layer from the mission / session
- Up / down arrows - Change the order of the layer in the mapping layer stack
- Details button - Opens the **Details** dialog for the layer



Figure 88: Map Options - Custom Maps - Layer Buttons

The **Details** view for GeoJSON / KML type layers offers preview of metadata and allows for file downloads.

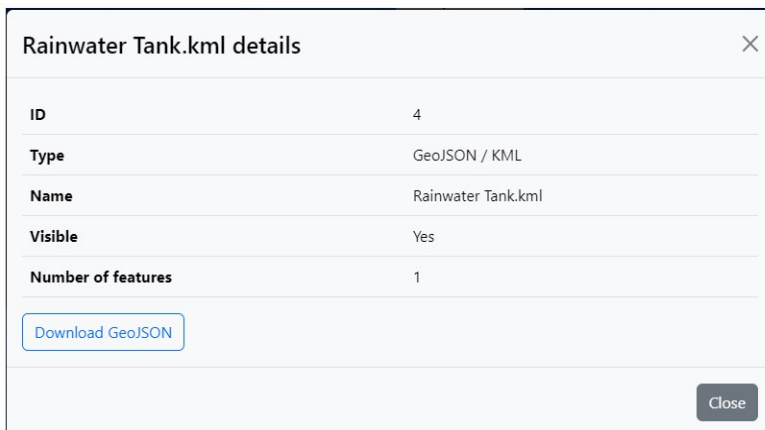


Figure 89: Map Options - Custom Maps - Layer Details GeoJSON / KML

For Image and Worldfiles type layers, the detail dialog offers users to edit the worldfile contents in a text field.

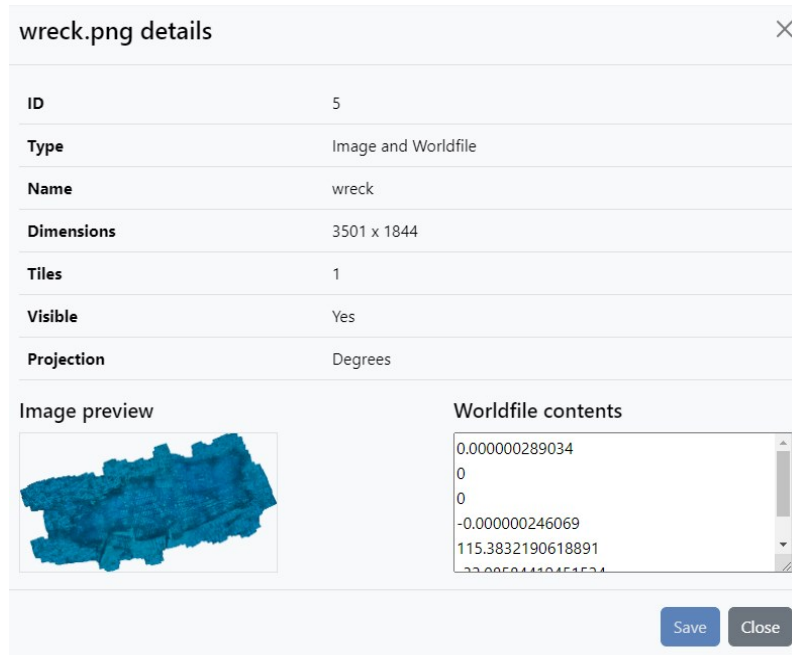


Figure 90: Map Options - Custom Maps - Layer Details Image and Worldfile

11. In the **Seafloor Depth** tab, configure your preferences for the Seafloor layer:

- **Depth Mode**

- *Fixed depth below the water's surface*

- Objects positioned relative to the water's surface may appear below the seafloor
    - Objects positioned relative to the seafloor may appear above the water's surface

- *Relative depth below the water's surface or deepest object*

- Objects positioned relative to the seafloor may appear above the water's surface
    - Objects positioned relative to the seafloor may infinitely lower the seafloor

- *Sticky depth below the deepest object*

- Objects positioned relative to the seafloor may appear above the water's surface
    - The seafloor will never be raised, only lowered

- **Depth Below Surface (metres)**

- **Depth Below Deepest Device (metres)**

### Map Options

General Custom Maps **Seafloor Depth**

Depth Mode  
Sticky depth below the deepest object

Depth Below Surface: 30.00 Metres  
Depth Below Deepest Device: 10.00 Metres

- Objects positioned relative to the seafloor may appear above the water's surface
- The seafloor will never be raised, only lowered

Figure 91: Map Options - Seafloor Depth

### 7.6.5.3 Custom Map Examples

The following figures illustrate custom mapping layers integrated into a mission using the **Mission Planner**. These visuals not only showcase the functionality but also highlights the advantages of an iterative data acquisition process using Hydrus. By conducting successive missions and analysing the recorded data in between mission runs, users can make informed decisions based on cumulative and regenerative insights. This approach enables mapping strategies based on real-world data, resulting in more accurate and actionable insights with each completed mission. Hydrus is well-suited for iterative data acquisition thanks to its ease of operation, portability and reliability.

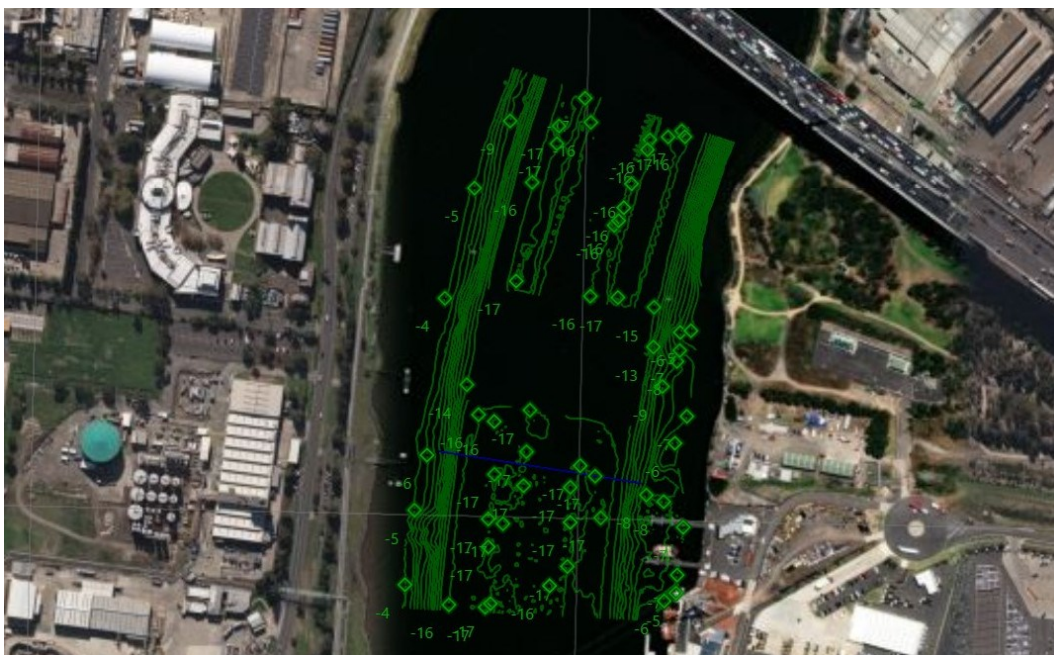


Figure 92: Map Layer Shown in Map Pane of Mission Planner - 2D View

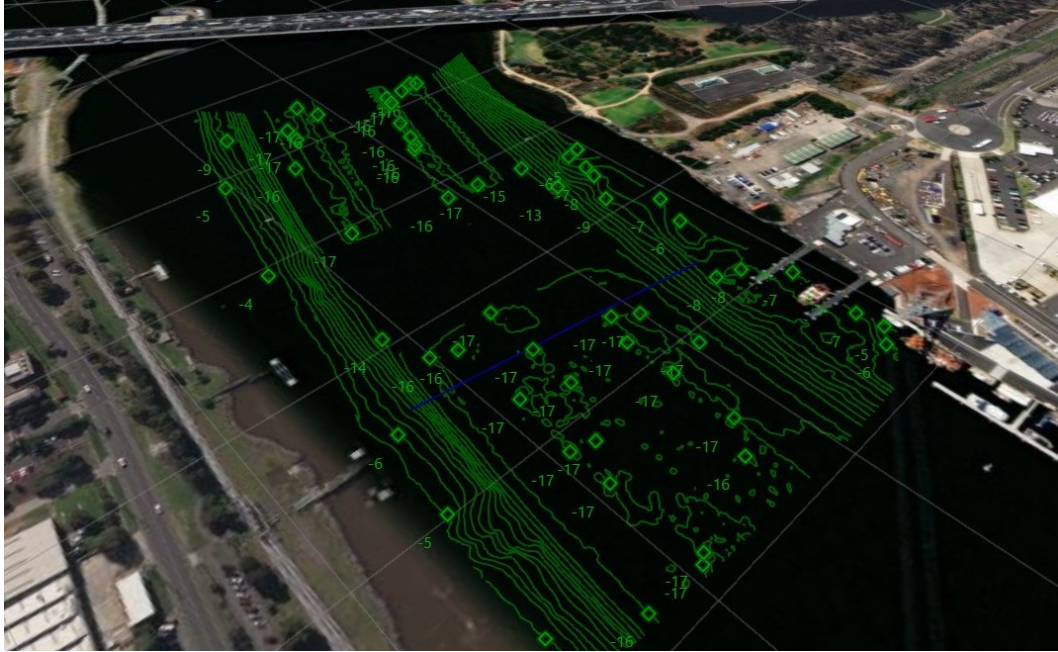


Figure 93: Map Layer Shown in Map Pane of Mission Planner - 3D View

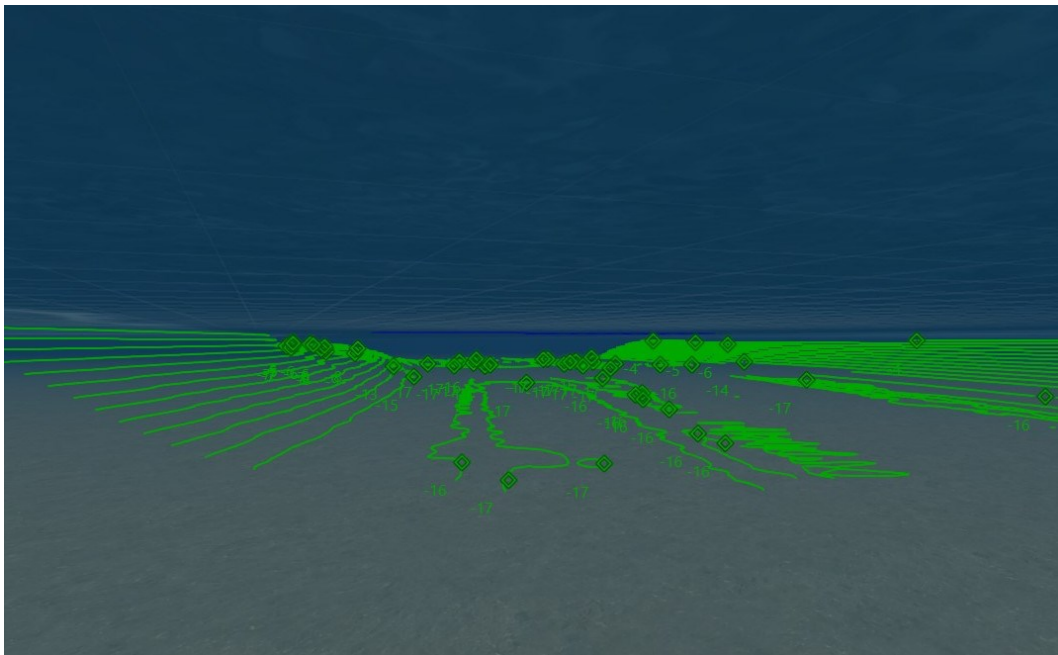


Figure 94: Map Layer Z Component



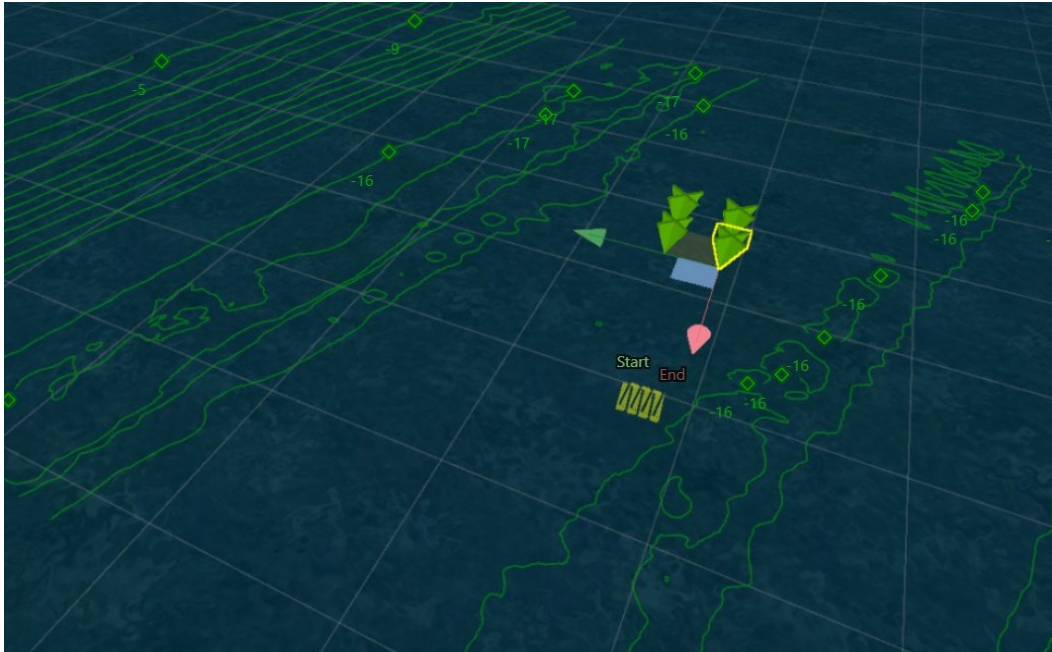


Figure 95: Map Layer and Lawnmower Mission Task

## 7.6.6 Capture Parameters

### 7.6.6.1 Overview

When capturing images using the camera, it is important to consider the various camera parameters to ensure optimal results. These parameters include focus, exposure, white balance, ISO sensitivity, and resolution. Each parameter plays a role in determining the quality, clarity, and overall visual appeal of the captured images.

### 7.6.6.2 Exposure Settings

Exposure settings determine the amount of light that enters the camera sensor and affect the brightness and clarity of the captured images. The exposure can be set to one of the following modes:

Mode	Description
Auto Mode	In Auto mode, the camera automatically adjusts the exposure settings based on the detected lighting conditions. This mode is suitable for most situations where the user wants the camera to handle the exposure settings on its own. The shutter speed and ISO are adjusted automatically while the aperture remains fixed.
Manual Mode	Manual mode allows the user to take full control over the shutter speed and ISO sensitivity. The user can manually adjust the shutter speed anywhere between 0.001 to 0.3 seconds, and the ISO to achieve the desired exposure. This mode provides maximum flexibility but requires a good understanding of exposure principles. The chosen shutter speed directly impacts the video frame rate. For instance, if a user has selected 60 FPS video but also selected a 0.3s shutter speed, the video frame rate will be around 3.3fps, not 60fps. To maintain the chosen frame rate, the selected shutter speed should not be slower than the inverse of the desired frame rate. Please note that the aperture remains constant in this mode.

Mode	Description
Shutter Priority Mode	This mode allows the user to set the desired shutter speed, and the camera automatically adjusts the ISO sensitivity accordingly to achieve the optimal exposure. This mode is useful when the user specifically wants to control motion blur or freeze the action in the images.
ISO Priority Mode	ISO Priority mode enables the user to select the desired ISO sensitivity while the camera adjusts the shutter speed to achieve the best possible exposure. This mode is useful when the user needs to control the camera's sensitivity to light in different lighting conditions, or when the user wants to emphasize or minimize the presence of image noise.

### 7.6.6.3 Lighting Settings

Lighting settings impact the ability to achieve well-lit and balanced images. These settings optimise the camera's performance under different lighting conditions.

Mode/Description	Function
Lighting Mode	<b>On:</b> Hydrus will utilise its LED lighting to provide additional illumination for capturing images or videos.
	<b>Off:</b> Hydrus' LED lighting system will be disabled and the scene will be captured using ambient light only.
Brightness Mode	<b>Auto:</b> The camera automatically adjusts the brightness level based on the detected lighting conditions. This mode is suitable for most situations where the user wants the camera to handle the brightness adjustments on its own
	<b>Manual:</b> The user can manually adjust the brightness level according to the users preferences or specific requirements.

#### **Brightness Level**

The brightness level setting allows the user to fine-tune the brightness of the captured images when the brightness mode is set to manual. The available options range from 0 to 100 in a numerical scale. Adjusting the brightness level higher increases the brightness, while reducing it lowers the brightness.

### 7.6.6.4 Correction Settings

Correction settings help to compensate for colour accuracy in the captured images.

Mode	Description
White Balance Mode	The white balance mode allows the user to adjust the camera's colour temperature to compensate for different lighting conditions underwater. It ensures accurate colour reproduction in captured images and videos.

### 7.6.6.5 Image Settings

Image settings allows the user to control various aspects of the captured images, such as resolution, format, and quality.

Mode	Description
JPEG	JPEG (Joint Photographic Experts Group) is a widely used image format that offers high compression, resulting in smaller file sizes. It is suitable for general use and sharing images easily. JPEG images have a standard level of compression applied, which can result in some loss of image quality.
TIFF	TIFF (Tagged Image File Format) is another type of image format that is known for its flexibility and its use of lossless compression, which means it retains all the image data during compression. TIFF images offer high quality and are often used in professional settings such as publishing, photography, and graphic design.

### 7.6.6.6 Video Settings

Video settings are specifically relevant when capturing underwater videos. The video mode determines the resolution and frame rate of the recorded video. The available video mode options include:

Mode	Description
4K@60fps	This video mode allows the user to capture videos in 4K resolution at a frame rate of 60 frames per second (fps). 4K resolution provides high levels of detail, while the higher frame rate of 60fps ensures smooth and fluid motion in the recorded videos, however can result in large file sizes.
4K@30fps	This video mode enables the user to capture videos in 4K resolution at a frame rate of 30fps. 4K resolution provides excellent detail, while the lower frame rate of 30fps is suitable for capturing standard motion
4:3 2K@60fps	This video mode allows the user to capture videos in a 4:3 aspect ratio and 2K resolution at a frame rate of 60fps. The 4:3 aspect ratio is beneficial for certain applications, while the higher frame rate of 60fps ensures smooth motion in the recorded videos
4:3 2K@30fps	This video mode enables the user to capture videos in a 4:3 aspect ratio and 2K resolution at a frame rate of 30fps. The 4:3 aspect ratio is suitable for specific requirements, while the lower frame rate of 30fps is ideal for capturing standard motion.
FHD@60fps	This video mode allows the user to capture videos in Full HD (FHD) resolution at a frame rate of 60fps. FHD resolution provides high-definition quality, while the higher frame rate of 60fps ensures smooth and fluid motion in the recorded videos.
FHD@30fps	This video mode enables the user to capture videos in Full HD (FHD) resolution at a frame rate of 30fps. FHD resolution provides high-definition quality, while the lower frame rate of 30fps is suitable for capturing standard motion.

**Note:** Selecting high-quality capture mode may result in very large file sizes.

## 8 Hydrus Deployment

### 8.1 Hydrus Deployment Training

This section of the manual provides comprehensive guidelines for the deployment and launching of Hydrus, ensuring that all operators are well-prepared to conduct safe and effective operations with Hydrus.

#### 8.1.1 Hydrus Test Clip Attachment

Before deploying Hydrus for live missions, it is essential to train and familiarise users with Hydrus Deployment techniques. The Hydrus Test Clip plays a crucial role in this process.

The Hydrus Test Clip is designed to allow the attachment of a tether to the Hydrus device during training exercises. This tether will help users practice controlling and maneuvering Hydrus before actual deployments.



Figure 96: HydrusTest Clip

## 8.1.2 Attachment of Hydrus Test Clip

**Position Hydrus:** Position the Desk Charger so that the transponder end of Hydrus can be placed upright and aligned properly.

**Using the Test Clip:** Take the Test Clip in hand and examine its design. Note that it has concave extrusions on each side that will line up with the extrusions on Hydrus.

**Aligning the Test Clip with Hydrus:** Hold the Test Clip with the concave extrusions facing upwards, and carefully position it on top of the transponder end of Hydrus.



*Figure 97: Test Clip Fitting*

**Locking the Test Clip in Place:** With your index finger and thumb, firmly grip the Test Clip on either side. While holding the Test Clip in place, gently turn it clockwise to lock it securely onto Hydrus.



*Figure 98: Test Clip Locking In*

**Note:** Ensure that the Test Clip is tightly attached to prevent any accidental dislodging during operations.

**Attaching the Tether Clip:** Take the tether clip that will be used to connect the tether to Hydrus. Hook the tether clip onto the Test Clip. There is space designated for attachment points between the transponder and the Test Clip for this purpose.

**Conducting a Controlled Lift Test:** Before proceeding with the actual deployment, it is crucial to ensure that the Test Clip can hold the weight of Hydrus securely.

**Note:** Observe and check if the Test Clip remains stable and properly attached to Hydrus during the lift.

**Deployment Readiness:** Once the Test Clip is confirmed to be securely holding the weight of Hydrus, the device is ready for deployment. Proceed with the controlled throwing technique, see [8.3 Hydrus Deployment](#) to launch Hydrus into the water.

### 8.1.3 Suggested Tether

For this purpose, it is recommended to use a fishing line rated to withstand the weight and force of Hydrus. Alternatively, a fixed line with tether connection clips attached to the Hydrus Test Clip can also be employed.



*Figure 99: Suggested Tether*

## 8.1.4 Safety Precautions

Safety is of utmost importance during Hydrus deployment. Operators must be aware of potential hazards and take necessary precautions to avoid accidents.

- **Communication:** If deploying Hydrus from a boat, employ communication best practices and establish communication protocols to make sure everyone on the vessel is aware of any changes in relation to the deployment and retrieval of the Hydrus. If applicable, follow the safety briefings and instructions given by the relevant authorised personnel that are in charge of deck operations. Always make sure that permission for deployment and retrieval is obtained before proceeding.
- **Tether Management:** Pay close attention to the tether at all times to prevent it from getting tangled or caught in the thrusters of Hydrus.
- **Boat Propeller Safety:** If deploying Hydrus from a boat, ensure that the tether is kept away from the boat's propellers to avoid entanglement.
- **Emergency Tether Release:** Establish a quick and reliable method for emergency tether release to free Hydrus in case it gets snagged or caught during deployment.

## 8.1.5 Controlled Launch Technique

For first-time users or those undergoing training, it is highly recommended to use the tether and a controlled throwing technique for launching Hydrus.

- Securely attach the tether to the Hydrus Test Clip, ensuring a strong connection.
- Using a controlled throwing motion as stated in [8.3 Hydrus Deployment](#), release Hydrus gently into the water, allowing the tether to unwind smoothly.

## 8.1.6 Testing and Familiarisation

After the initial launch, it is recommended to allow users to practice controlling Hydrus with the tether in a controlled environment. This phase will help users become comfortable with the device's movements, responsiveness, and underwater navigation. Encourage operators to perform various maneuvers, ensuring they can confidently handle Hydrus during real missions.

## 8.1.7 Live Mission Deployment

Once users have demonstrated proficiency with the tethered control of Hydrus, they can progress to live mission deployments without the tether, if deemed appropriate.

---

**Note:** Always follow specific mission protocols and safety procedures when deploying Hydrus for actual operations.

---

## 8.2 Hydrus Pre-deployment

### 8.2.1 Standalone Mission Mode

The pre-deployment process for missions running in Standalone (GNSS / Dead Reckoning) mission mode is outlined in the following steps. See [7.1.1 Mission Modes](#) for more information.



The pre-deployment process ensures a smooth transition from mission planning to deployment. This involves a series of steps that allow you to review the mission plan prior to deployment, and prepare the Hydrus device for its intended mission.

1. Open the Hydrus webUI and navigate to the **Main Page**. Then click **Run Mission**. See [6.2.2 Hydrus Web User Interface \(webUI\)](#).

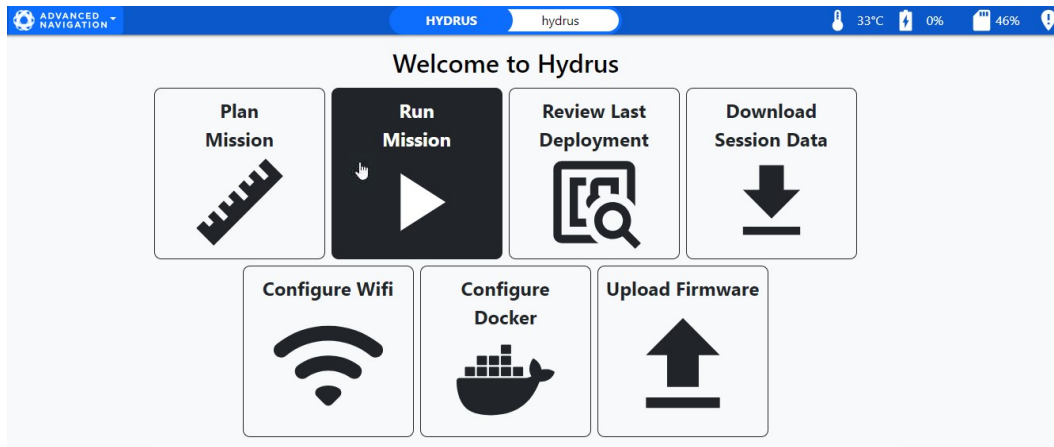


Figure 100: Hydrus WebUI Main Page - Run Mission

2. In the **Run Mission** window, click the **Deploy GNSS Mission** button.

**Note:** If Subsonus is available and you wish to run the mission from the Subsonus interface, change the mode to Subsonus Assisted by clicking the **Change Mode** button and selecting **Subsonus Assisted** in the dropdown menu, see [8.2.2 Subsonus Assisted Mission Mode](#).

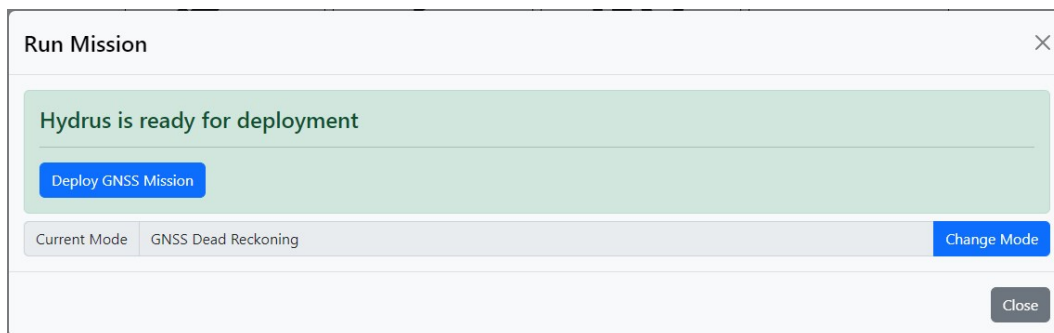
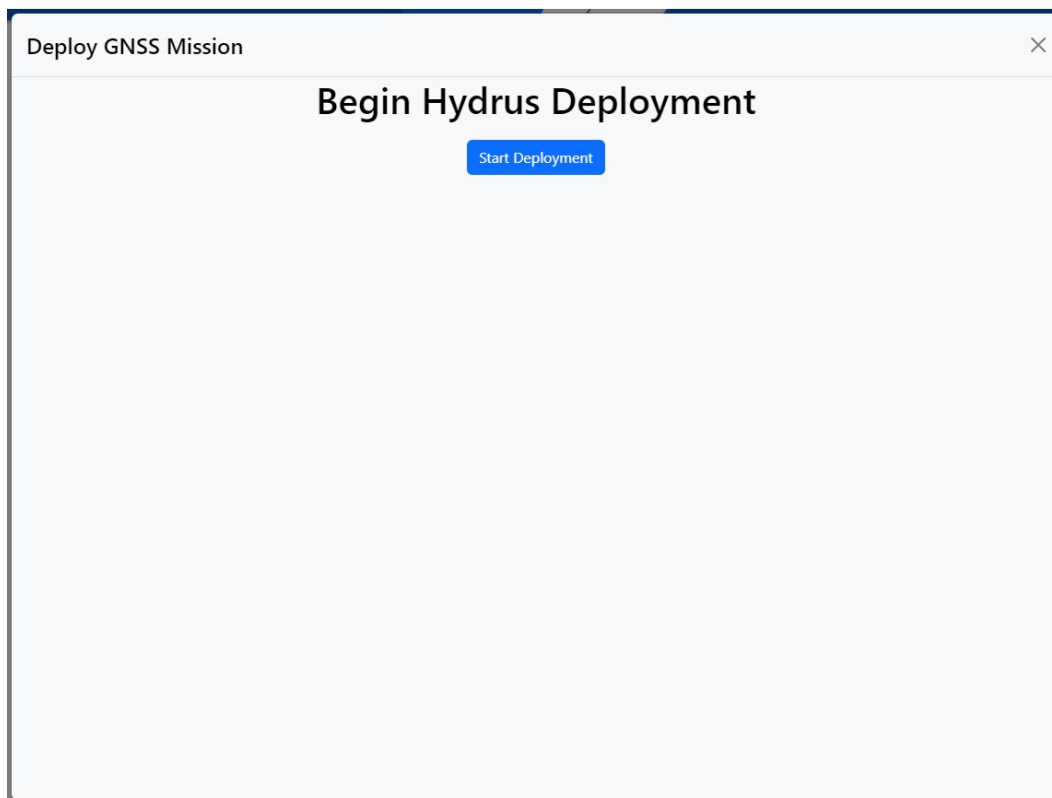


Figure 101: Hydrus Pre-deployment - Select Mission Mode

3. Click the **Start Deployment** to start the pre-deployment review.



*Figure 102: Hydrus Pre-deployment - Start Pre-deployment Review*

- Select a mission and review the estimated duration, distance, battery and storage use for the mission you wish to run. Select the mission from the list and click the **Next** button. Check the **Show Only Missions that are Achievable** check-box to filter out missions that can be carried out based on the current battery level and other limitations of the Hydrus.

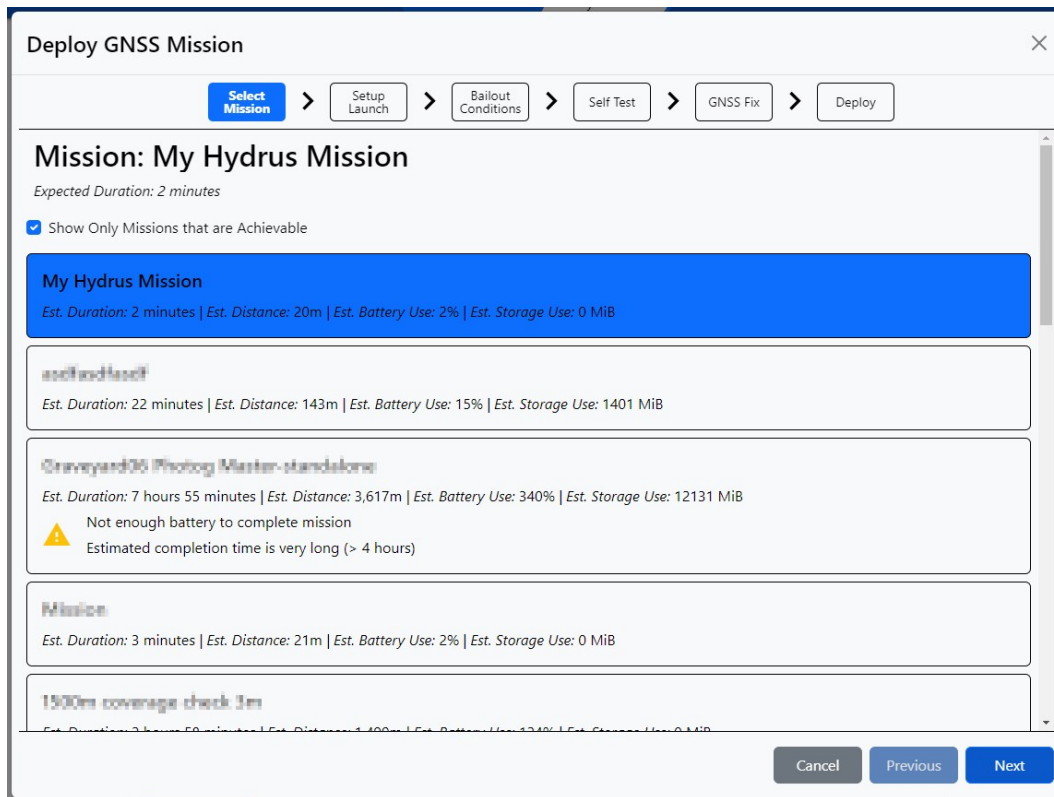


Figure 103: Hydrus Pre-deployment - Select Mission

5. Review the **Home Point** settings for the mission and change them as required, then click the **Next** button.

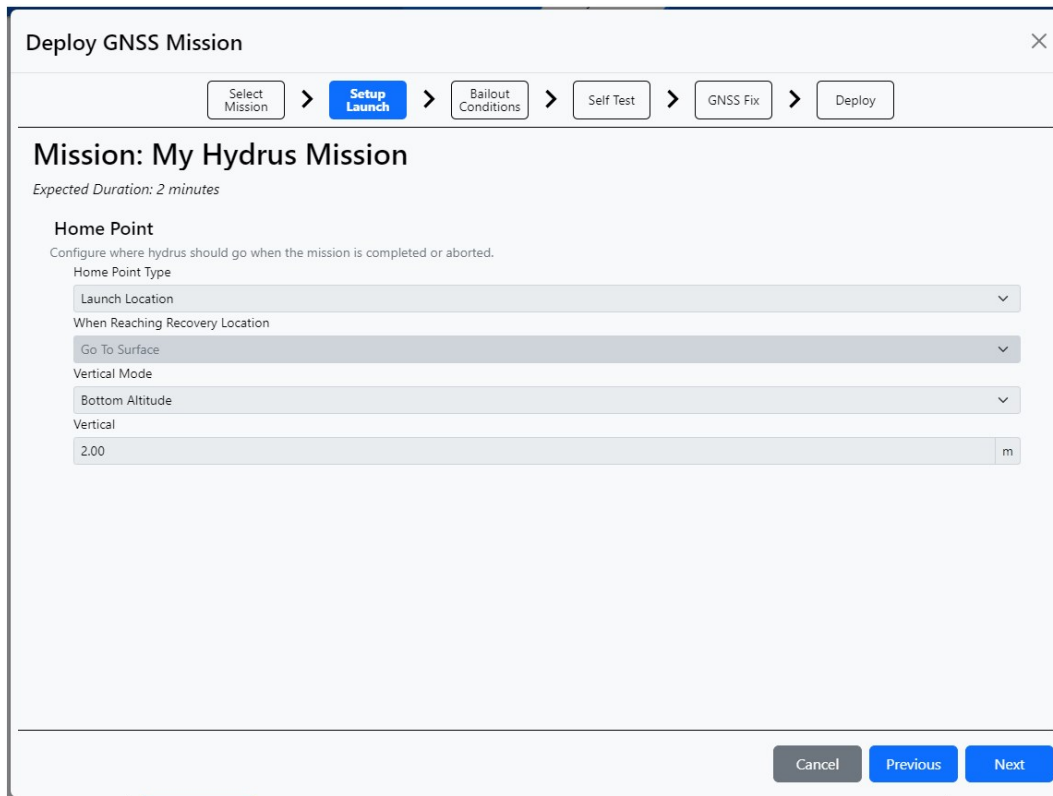


Figure 104: Hydrus Pre-deployment - Review Home Point Settings

- 6. Review the mission settings for **Bailout Conditions** and change them as required, then click the **Next** button.

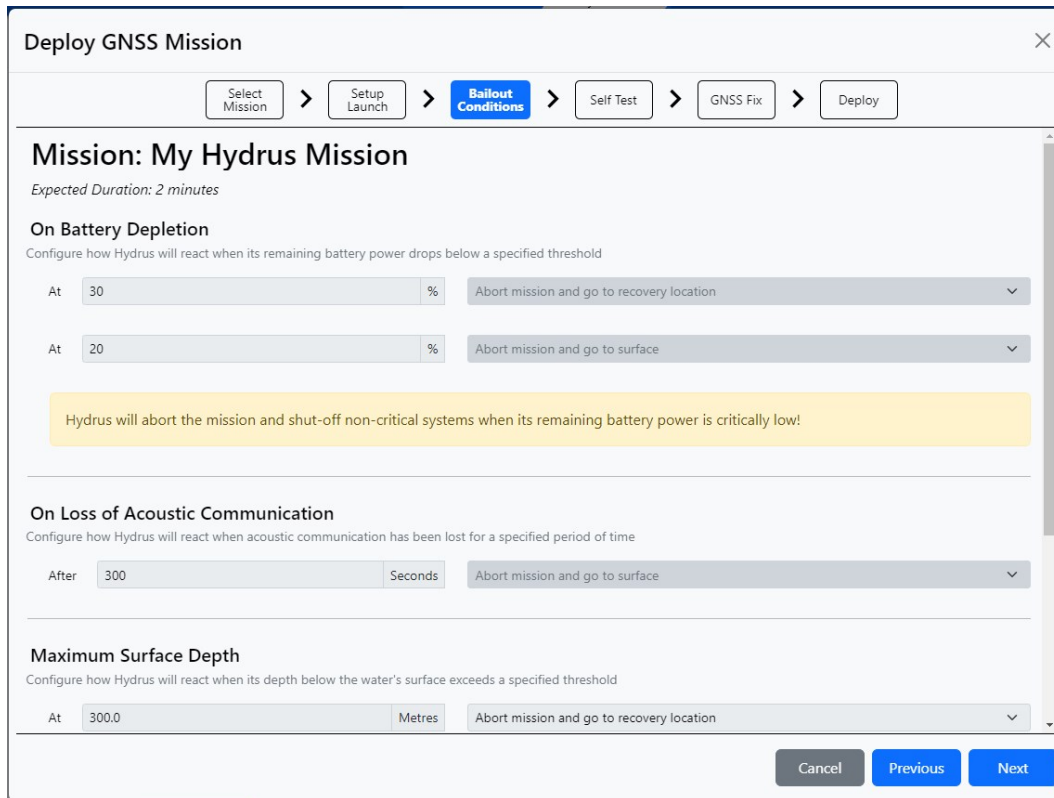


Figure 105: Hydrus Pre-deployment - Review Bailout Condition Settings

7. Click **Start Self Test** to carry out an optional pre-deployment self test, otherwise click **Skip Self Test**. Click the **Next** button to proceed with the pre-deployment setup.

**Note:** When Hydrus performs a self test, ensure Hydrus is on a flat surface and fingers are kept clear of the spinning thrusters.

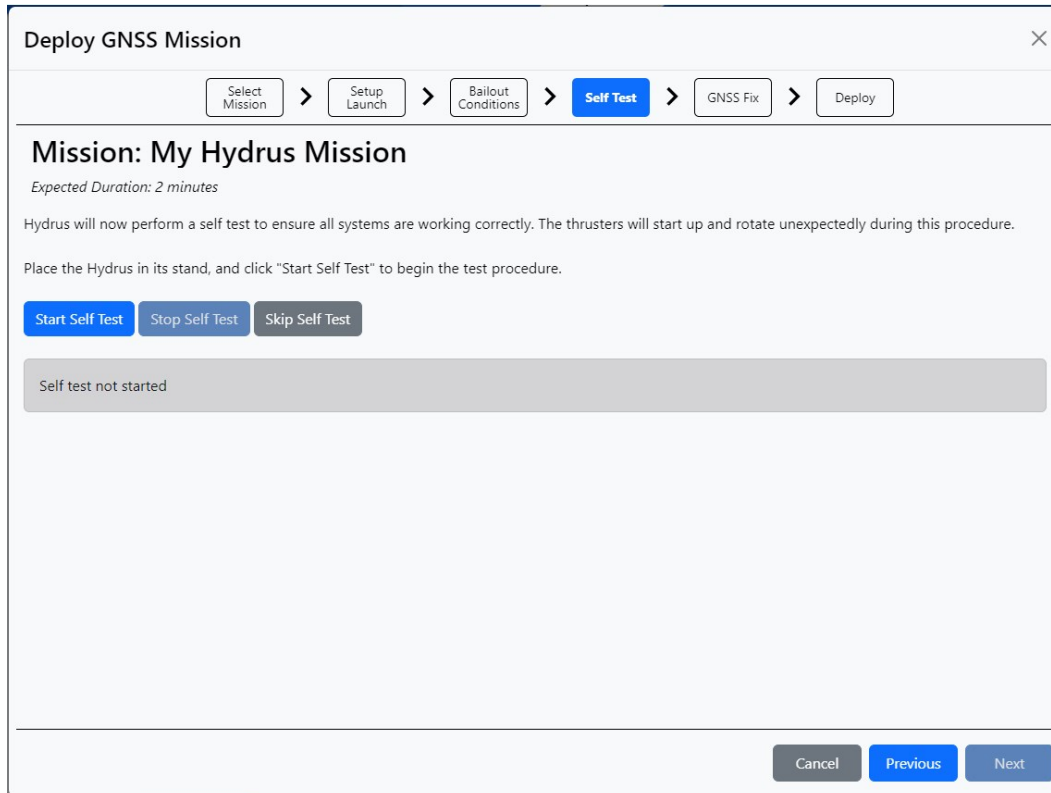


Figure 106: Hydrus Pre-deployment - Self Test

8. Make sure Hydrus has a clear view of the sky and wait for a GNSS fix to be established. If this is not possible, click **Skip Waiting for GNSS Fix** to skip this step and Hydrus will acquire a GNSS fix after it has been placed in the water. Click the **Next** button to proceed with the pre-deployment setup.

**Note:** Post-deploy GNSS acquisition may be slow or fail, requiring recovery and redeployment. It's recommended that a GNSS fix is acquired before deployment. Failure to do so may result in longer times to acquire GNSS after launch. If Hydrus is unable to acquire a GNSS fix while in water, it will abort its mission.

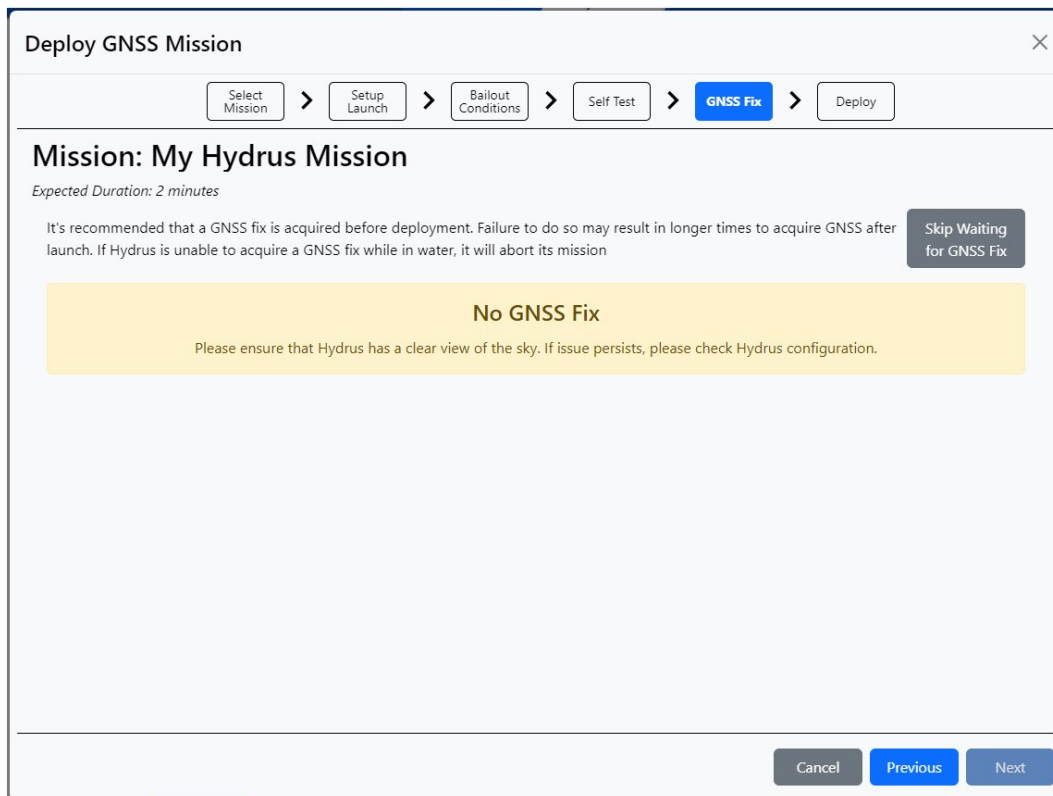


Figure 107: Hydrus Pre-deployment - GNSS Fix

- Click the **Deploy** button to initiate the mission.

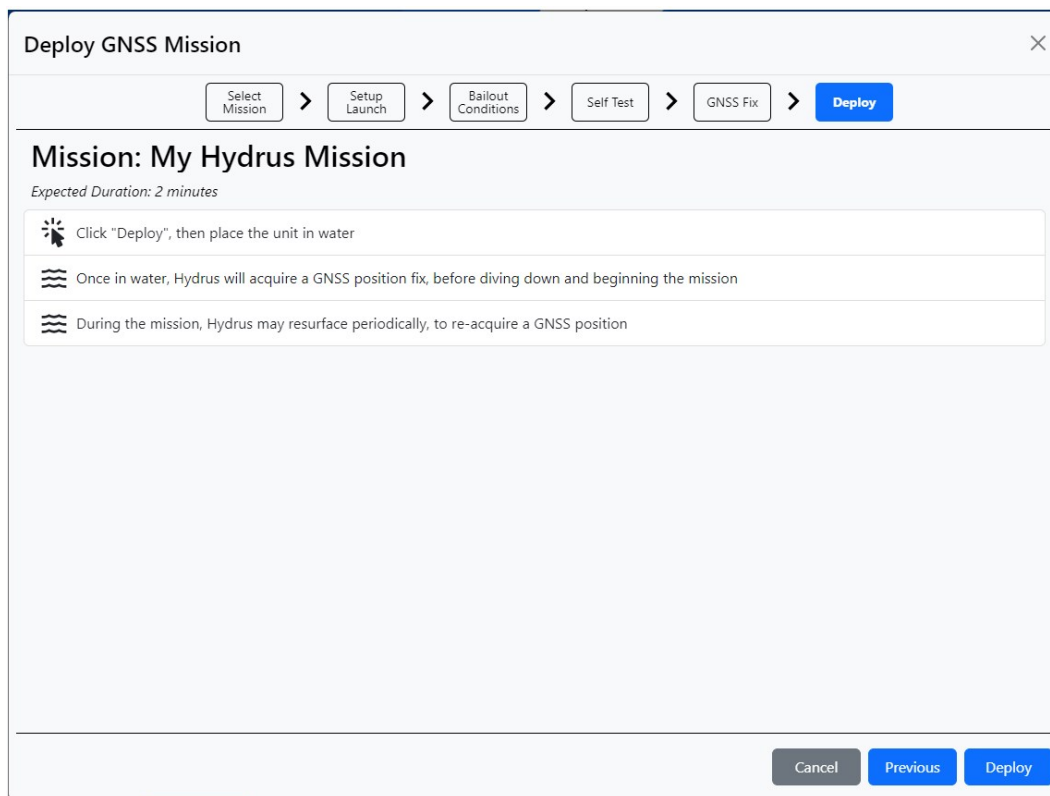


Figure 108: Hydrus Pre-deployment - Deploy

- When the message **Hydrus is running a mission, please deploy unit** is displayed on the **Main Page**, get ready to deploy the Hydrus unit into the water.

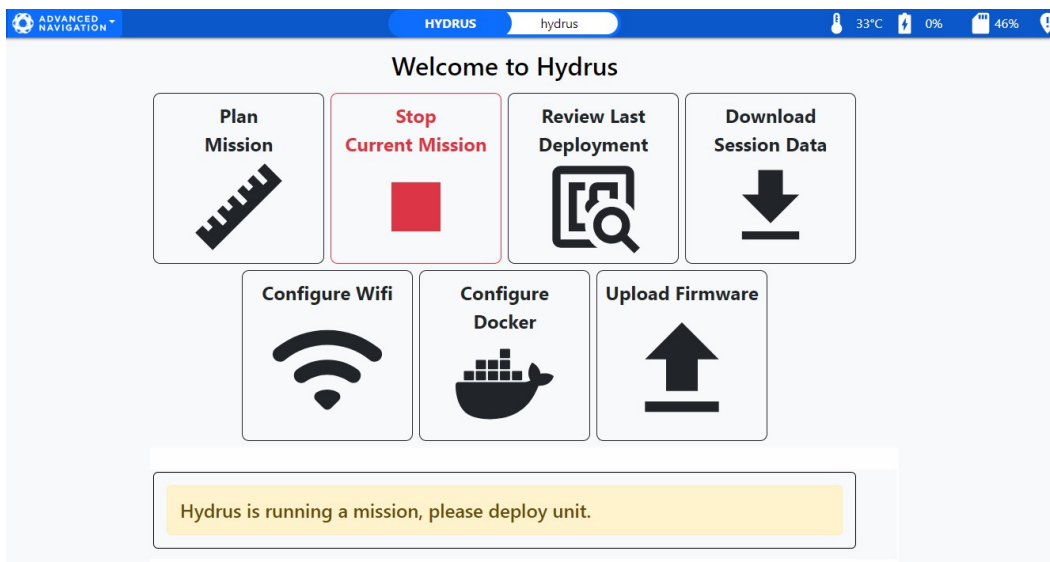


Figure 109: Hydrus Web UI Main Page - Mission Initiated



- Wait for the thrusters to start and the EPD message **Put Unit In Water** before deploying Hydrus. For details, see [8.3 Hydrus Deployment](#).

```

71%  Hydrus  [Wi-Fi]
Stat Put Unit In Water
Wifi 192.168.111.222
Mode High Power  [Battery] 30W
Addr 0 (unset)   [Battery] 1h

```

Figure 110: Put Unit In Water EPD Message

## 8.2.2 Subsonus Assisted Mission Mode

The pre-deployment process for missions running in Subsonus Assisted mission mode is outlined in the following steps. See [7.1.1 Mission Modes](#) and refer to the Subsonus Reference Manual for more information.

The pre-deployment process ensures a smooth transition from mission planning to deployment. This involves a series of steps that allow you to review the mission plan prior to deployment, and prepare the Hydrus device for its intended mission.

- Type in the Subsonus IP address to open the Subsonus webUI. See [6.2.3 Subsonus Web User Interface \(webUI\)](#).

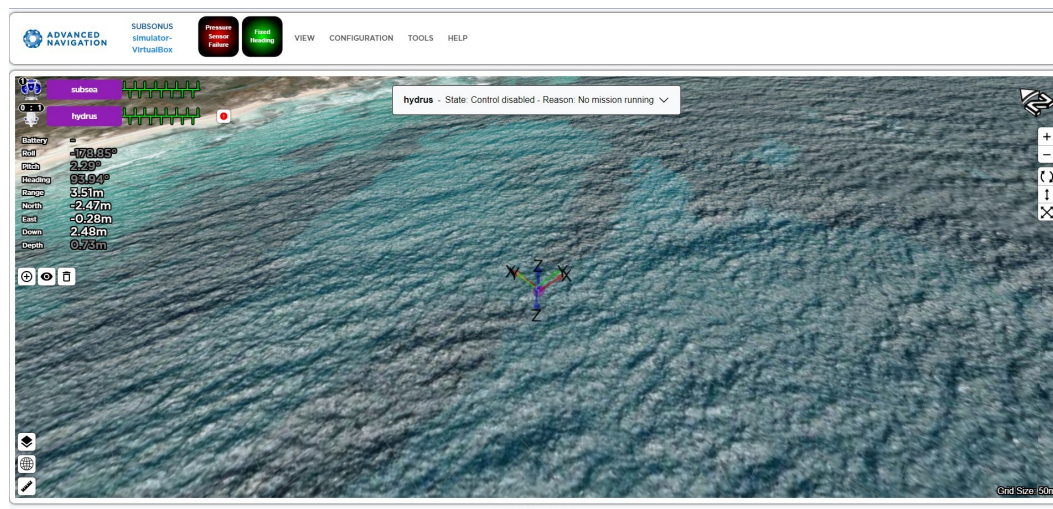


Figure 111: Subsonus Hydrus WebUI

- In the **Configuration** menu, click **Devices**

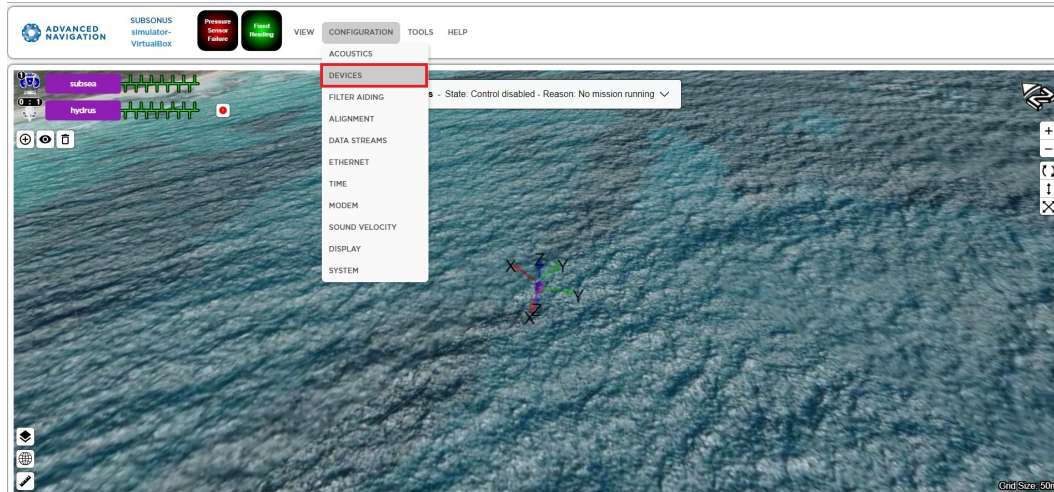


Figure 112: Configuration Devices

- Under **Discovered Devices**, Hydrus will appear, click **Add Device**.

**Note:** Hydrus will automatically appear under Discovered Devices if it is on the same network as the Subsonus.

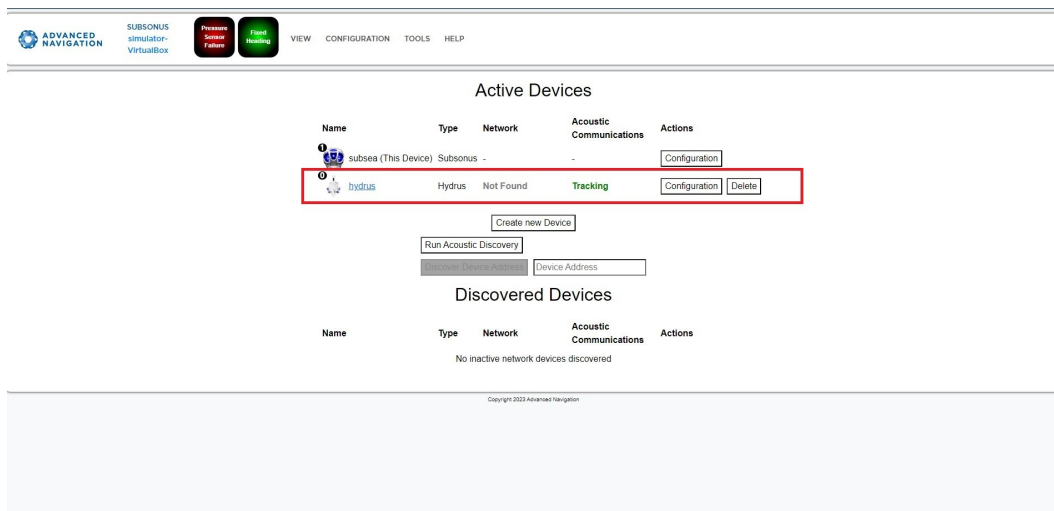


Figure 113: Active Devices

- Click **View** in the top menu bar. Select the Hydrus in the devices list and click **Open Device Configuration**.

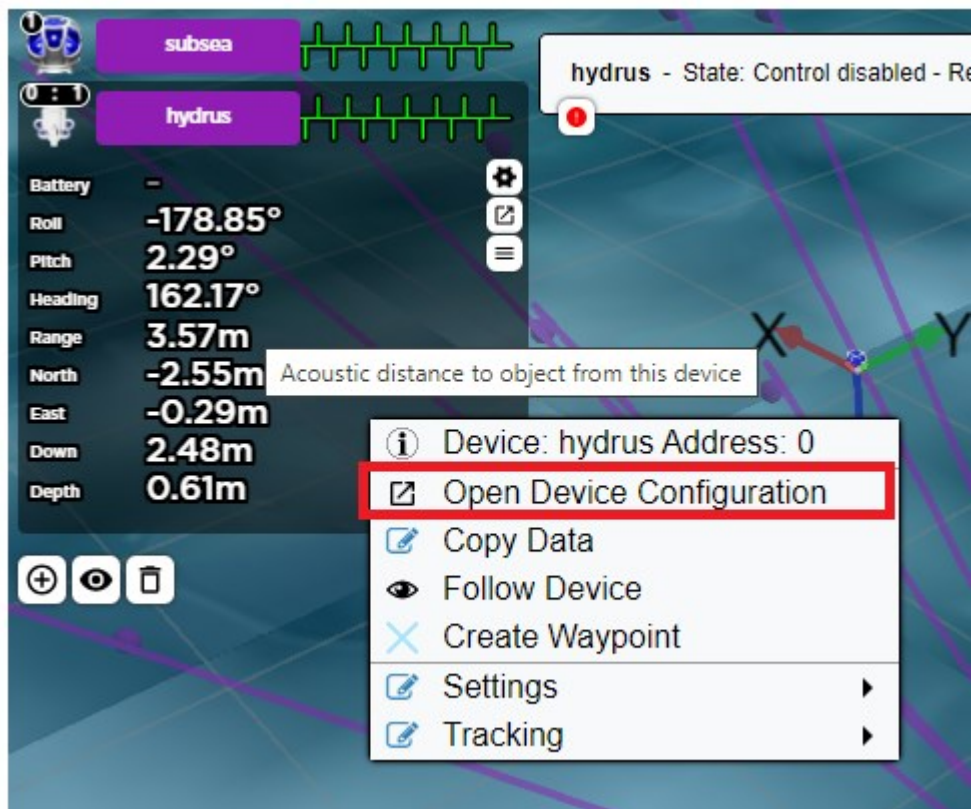


Figure 114: Open Device Configuration

5. In the left column, click **Hydrus Deployment**, then click **Start Deployment**.

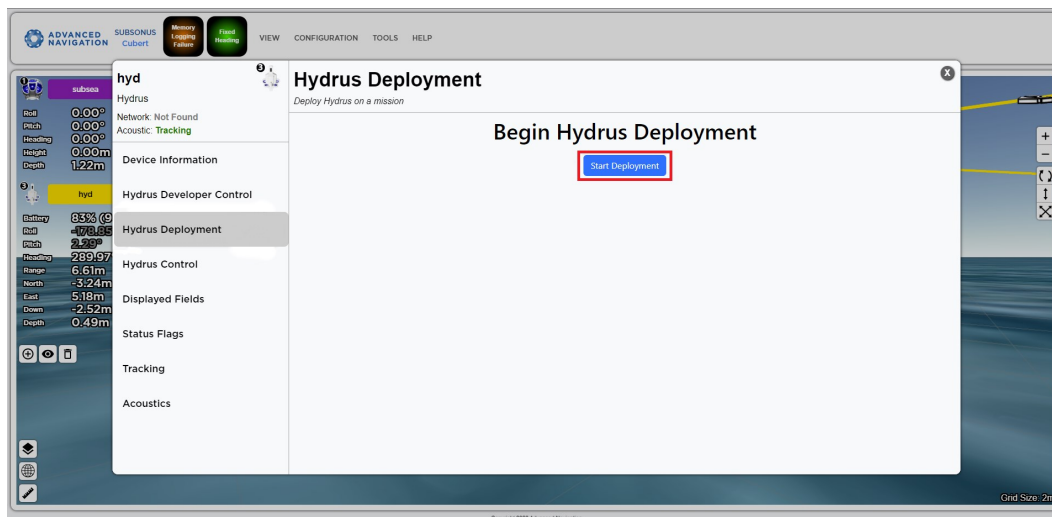


Figure 115: Start Deployment

6. Select the mission that you wish to run. Then click **Next**.

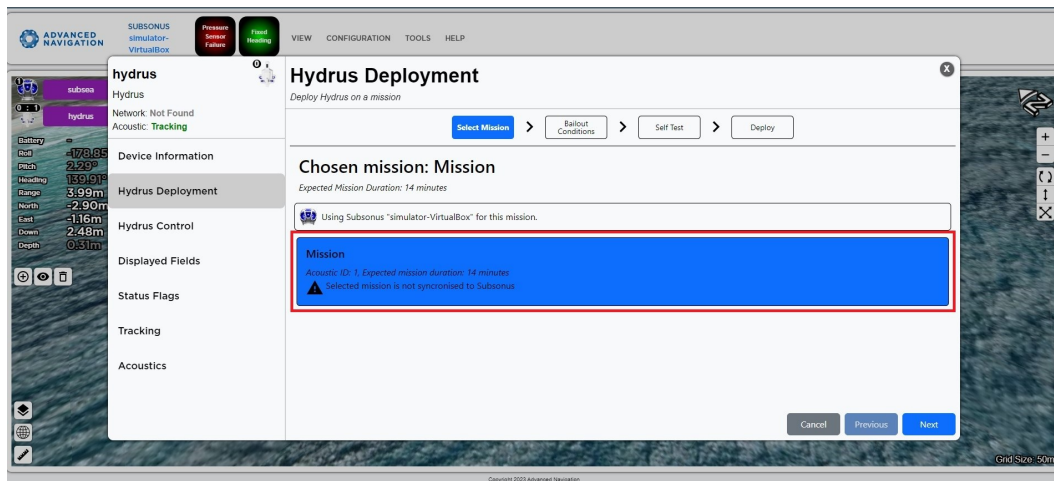


Figure 116: Hydrus Deployment Dialog

7. Click **Next** and confirm bailout conditions are correct, then click **Next** again.

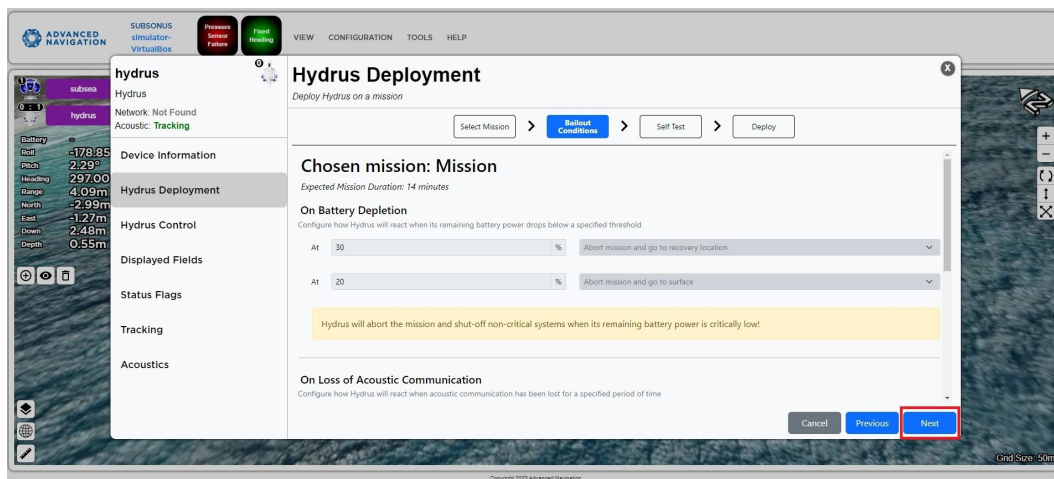


Figure 117: Hydrus Deployment Dialog Bailout Conditions

8. Click **Start Self Test**.

**Note:** Hydrus will perform a self test, ensure Hydrus is on a flat surface and fingers are kept clear of the spinning thrusters.

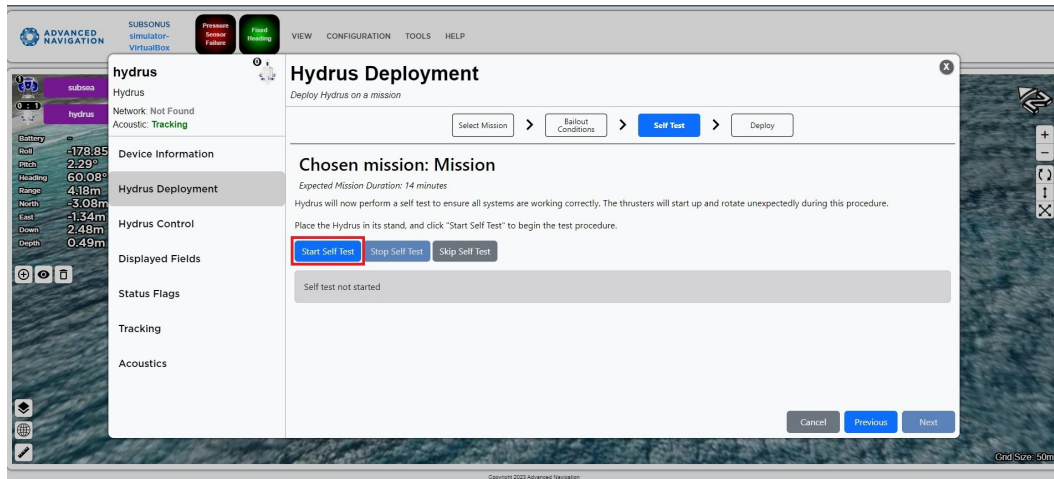


Figure 118: Hydrus Deployment Dialog Self-Test

9. Before deployment is it important for the user to be aware of the following:

- Once in the water, Hydrus will dive to the selected pause depth selected from mission planning for acoustic connection to Subsonus.
- Once acoustic communication is established the user will be able to start the mission from the Hydrus command dialog box
- Whilst in the water, the Wi-Fi connection will be lost and this Hydrus Deployment dialog box will stop working.
- If acoustic communication is not established within 10 minutes, the Hydrus will automatically return to the surface.

Once the unit is ready to deploy, Click **Deploy** and return to the Hydrus Command Dialog Box.

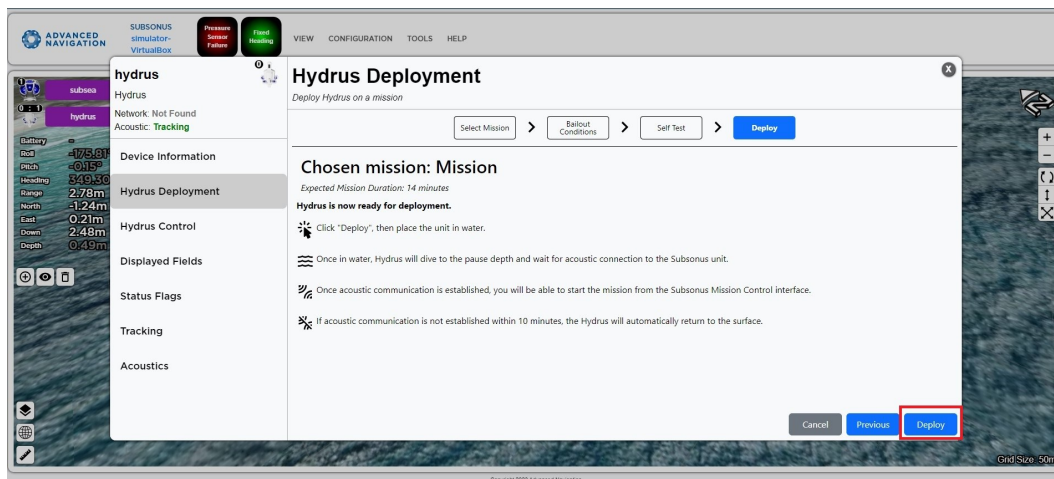


Figure 119: Hydrus Deployment Dialog Deploy

10. Wait for the EPD message **Put Unit In Water** before deploying Hydrus. A 10 second timer is initiated before the control system and the thrusters start. It is recommended to wait until this has started prior to deploying Hydrus. For details, see [8.3 Hydrus Deployment](#).

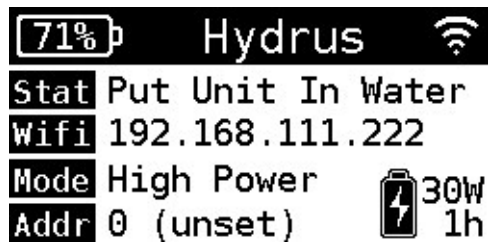


Figure 120: Put Unit In Water

## 8.3 Hydrus Deployment

### 8.3.1 Launching and Recovering

Launching and recovering Hydrus in the water requires careful attention to safety protocols. Here are some suggested safety precautions to consider:

Precaution	Consideration
Safety Briefing	Before launching or recovering Hydrus, conduct a safety briefing with all personnel involved. Ensure everyone understands their roles, responsibilities, and the potential hazards associated with the operation.
Protective Gear	Provide and enforce the use of appropriate personal protective equipment (PPE) for all involved personnel. This may include life jackets, helmets, gloves, and safety glasses.
Check Weather and Water Conditions	Ensure the launch and recovery area is clear of any obstructions, debris, or personnel not directly involved in the operation. Maintain a safe distance from Hydrus during launch and recovery.

### 8.3.2 Deploying Hydrus

Use a controlled throwing technique to launch Hydrus. Ensure a smooth, level trajectory and avoid excessive force or angles that could cause Hydrus to spin or tumble in the air. The following procedure is the suggested throwing technique.

Step	Action	Description
1.	Preparing for the Throw	Secure grip of the transponder end and main body to hold onto while throwing.
2.	Positioning and Grip	Stand facing the water with your feet shoulder-width apart, ensuring a stable stance. Hold Hydrus securely, gripping it firmly but not too tightly to allow for a controlled release.
3.	Aiming	Select a target area in the water where you want to throw Hydrus. This could be a specific point or an open space. Visualise the trajectory you want Hydrus to follow, aiming for a smooth, level path without excessive height or angle.
4.	Initiating the Throw	Begin the throwing motion by smoothly bringing your throwing arm back, extending it behind your body while maintaining a relaxed and fluid motion. As you swing your arm forward,

Step	Action	Description
		transfer the energy from your body to Hydrus, gradually increasing the speed and momentum of the throw.
5.	Releasing Hydrus	Just before your arm reaches its forward extension, release Hydrus with a controlled and fluid motion. Ensure that the release is clean and precise, avoiding any sudden jerks or excessive force that may cause Hydrus to spin or tumble.
6.	Following Through	Allow your arm to follow through the throwing motion, extending it fully forward and then naturally swinging it downward to maintain balance. Keep your eyes on Hydrus as it travels through the air, adjusting your body posture if necessary to ensure a smooth, level trajectory.
7.	Hydrus Landing	Observe Hydrus as it lands in the water, ensuring it enters smoothly without any abrupt impacts or collisions.
8.	Vessel movement	When deploying Hydrus from a vessel coordinate to ensure vessel movement post deployment cannot impact Hydrus and good acoustic coverage is maintained.



Figure 121: Visual Representation of suggested throwing technique

## 8.4 Hydrus Mission Monitoring with Subsonus

**Note:** The information in this section is applicable when using Subsonus together Hydrus and running missions in Subsonus Assisted mission mode, see [7.1.1 Mission Modes](#).

### 8.4.1 Mission Initiation

Once Hydrus is deployed in the water, it requires a short period of time for the INS to stabilise. During this stabilisation process, Hydrus adjusts its position and orientation to ensure accurate navigation.

Once the INS has successfully stabilised, Subsonus will report the state of the Hydrus through the Subsonus webUI as "**Holding Depth - Ready for resume mission command.**" This indicates that Hydrus has reached a desired depth and is ready to receive further instructions to continue its mission.

**Note:** If the user has specified a Pause Depth (Pause Vertical) in the mission planner, this is where Hydrus will be holding depth.

To resume the planned mission, press resume indicated by the play button. See [6.2.3.3 Hydrus Command Dialog Box](#) for information on command dialog controls. Resuming the mission will initiate the next phase of the mission and allow the Hydrus to carry out its planned tasks.

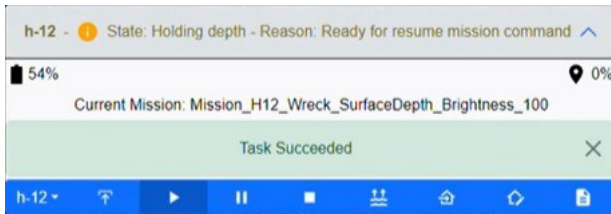


Figure 122: Command Dialog Box with Hydrus Holding Depth State

### 8.4.2 Mission Running

Once Hydrus has received the command to resume the mission, Subsonus command dialog box will provide an indication of its state as **Going to next waypoint - Reason: mission running**

During this time, Hydrus will start traveling from its holding/pause depth position to the initial waypoint of the survey path. The survey path is predetermined and created through a mission planning procedure that was completed earlier see [Mission Planning Process](#).

As Hydrus follows the survey path, its progress and tracking can be observed on the Subsonus webUI. The webUI will display the vehicles position along the survey path, allowing the user to monitor its movements.

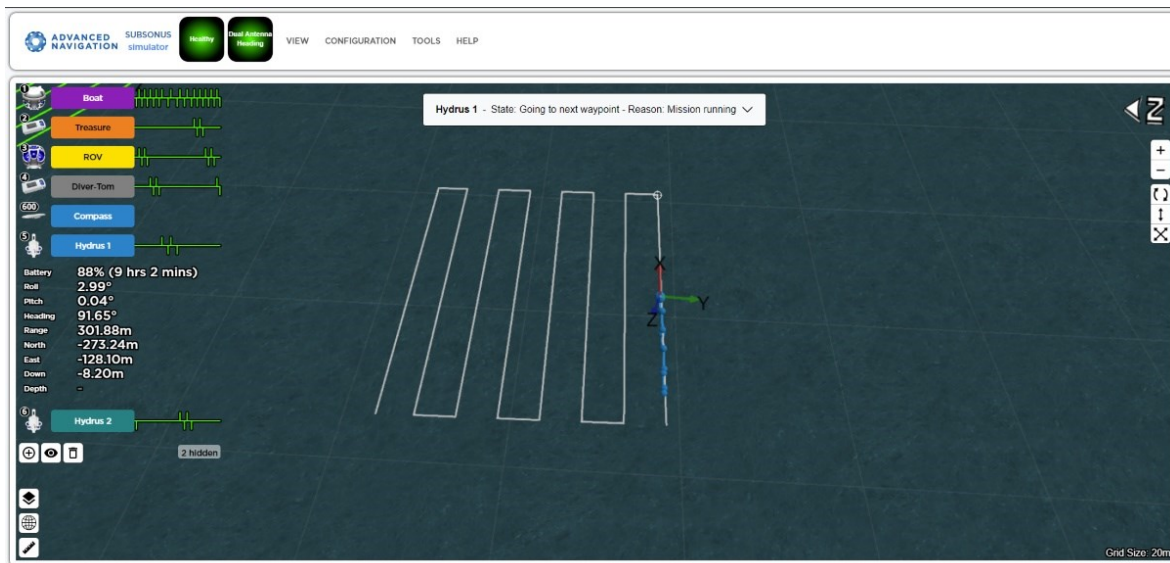


Figure 123: Screenshot of Hydrus on Planned Path of Survey Mission

Hydrus will continue executing the survey, completing the planned tasks as it reaches each waypoint along the survey path. It will collect data or perform any other assigned actions according to the mission objectives.



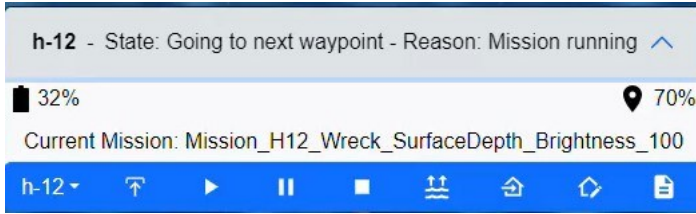


Figure 124: Command Dialog Box with Hydrus Going to Next Waypoint

### 8.4.3 Mission Complete

After Hydrus has completed its survey task, Subsonus will provide an update indicating that Hydrus has finished its mission. The state reported by Subsonus will be **Going to Recovery Point - Reason: Mission Complete**.

At this stage, Hydrus will start moving towards the designated recovery point, which was selected during the mission planning phase. The recovery point is a predetermined location where the Hydrus will be retrieved from the water.

Once Hydrus reaches the recovery point, Hydrus will either hold and report "At Recovery Point, waiting for return to surface command", or resurface automatically depending on mission parameter settings.

**Note:** That the depth of the Recovery point is the same as the hold depth programmed at the start of the mission.

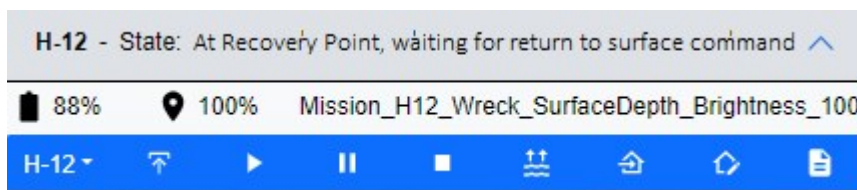


Figure 125: Command Dialog Box with Hydrus Waiting at Recovery Point

During the journey towards the recovery point, Hydrus progress can be tracked and monitored through the Subsonus webUI. The webUI will display its position as it moves towards the recovery point.

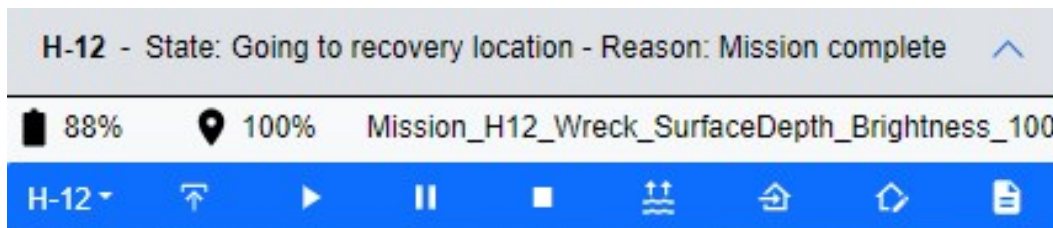


Figure 126: Command Dialog Box with Hydrus Mission Complete

**Note:** The recommended way to immediately halt Hydrus's mission during deployment and have it return to the surface is by choosing 'Abort Mission' in the Hydrus command dialog box.

After Hydrus has been retrieved and Hydrus has re-established it's Wi-Fi connection the Post deployment section within the Hydrus deployment dialog box will become available to use.

Finish the current deployment by selecting 'Finish Deployment'.

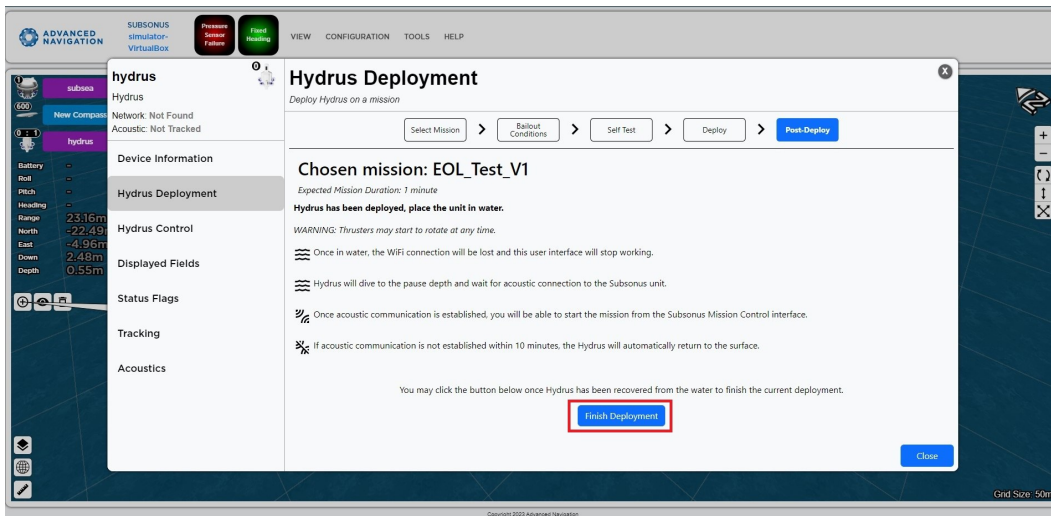



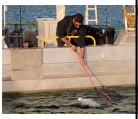


Figure 127: Hydrus Deployment Dialog Finish Deployment

## 8 Hydrus Retrieval

### 8.5 Retrieving Hydrus from the Water

**Note:** The thrusters may still be running when Hydrus is removed from the water, take care to avoid contact

**Note:** The suggested method for retrieval will necessitate the user's manipulation of a net with a load capacity of 10 kilograms.

Action	Description	Example
Assess the Environment	Assess the environment: Evaluate the water conditions, including the current, depth, and any potential obstacles or hazards that could affect the retrieval process. Avoid areas with strong currents or underwater obstructions that could damage Hydrus or pose a safety risk during retrieval	
Boat Approach	Maneuver the boat slowly and carefully towards Hydrus to avoid disturbing or damaging the surrounding environment. Maintain control over the net's position and movement to prevent entanglement or unintended contact with other objects or marine life.	
Position the Net	Properly position the net in the water, ensuring that it is fully open and ready to receive Hydrus. The net should be submerged sufficiently to prevent Hydrus from bouncing out or causing damage during capture. Be mindful of Hydrus and its delicate components and sensors, ensuring they are not damaged during the capture process.	
Lift with Care	Once the Hydrus is captured in the net, lift it slowly and steadily to avoid sudden movements or jolts. Ensure that the net is properly secured and the weight is evenly distributed to prevent Hydrus from slipping out.	
Secure Hydrus Onboard	Once Hydrus is safely on board, secure it in a designated area to prevent any accidental falls or damage.	

### 8.6 Post Retrieval Actions

Once Hydrus has been retrieved from the water as stated in [8.5 Retrieving Hydrus from the Water](#), a number of post retrieval actions should be completed.

**Note:** The thrusters may still be running when Hydrus is removed from the water, take care to avoid contact

Action	Description
Extraction	With Hydrus securely in the net, handle the net gently ensuring not to

Action	Description
from Net	jostle Hydrus. Using both hands, carefully remove Hydrus from the net.
Placement on Flat Surface	Once Hydrus is free from the net, place it gently on a flat and sturdy surface. Avoid placing Hydrus on surfaces that could potentially harm its exterior.
Network Connection	At this stage, Hydrus should automatically connect to its default Wi-Fi network. The user should wait 2-5 minutes if Hydrus doesn't connect, The user will need to manually connect Hydrus to its access point. Follow the connection procedure as previously provided in the <a href="#">6.1 Initial Set-Up</a> section of this manual.
Command Stop Mission	Navigate to either the Subsonus webUI or the Hydrus webUI. <ul style="list-style-type: none"><li>• For Subsonus, the user can select 'Finish Deployment' within the Hydrus deployment dialog box as seen in <a href="#">8.2 Hydrus Pre-deployment</a>.</li><li>• For Hydrus, click the 'Stop Current Mission' button on the Main page of the Hydrus webUI.</li></ul>
Fresh Water Rinse	Rinse Hydrus thoroughly with fresh water. This is a critical step as it helps to remove any salt residue that could lead to corrosion over time. Particular attention should be paid to the pressure sensor, and thruster assemblies. See <a href="#">10.2 Routine Inspection and Cleaning</a>
Thruster Inspection	Post-rinse, inspect the thrusters for any visible damage or obstructions. If there's an issue, refer to the <a href="#">10.3 Impeller Maintenance</a> section of this manual.
Desk Charger Placement	Once Hydrus has been cleaned and inspected, ensure it is dry and place it back into the desk charger for safe stowage. Make sure to align Hydrus correctly with the charger docking station to ensure proper contact.
Payload Data Download	To download the payload data, follow the <a href="#">9.2 Data Download</a> in the manual. Make sure to save the data in a secure location for future analysis.

# 9 Post-Mission

## 9.1 Review Last Deployment

The **Review Last Deployment** tile opens up the **Mission Review** dialog that shows a summary of the last recorded session.

1. Open the Hydrus webUI **Main Page**.

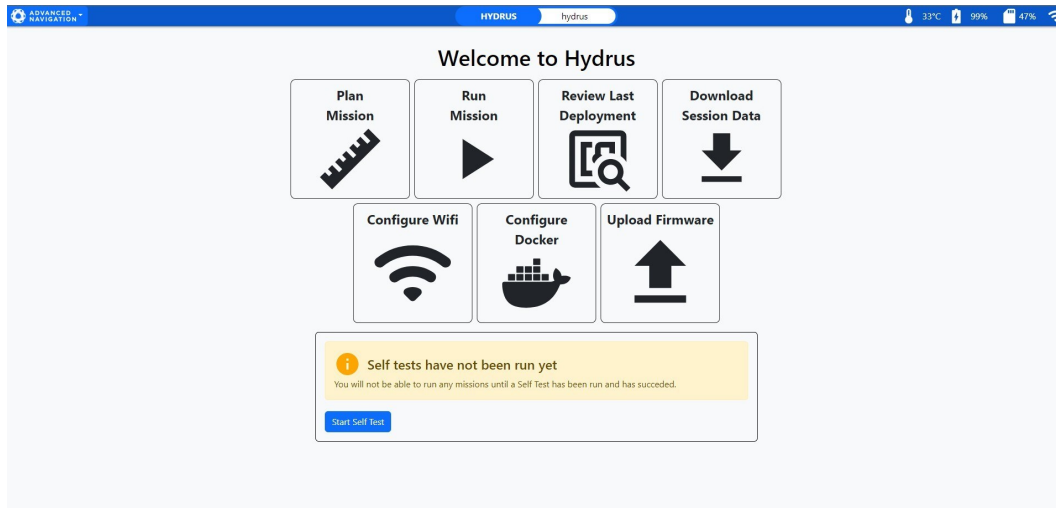


Figure 128: Hydrus webUI Main Page

2. Click **Review Last Deployment**.

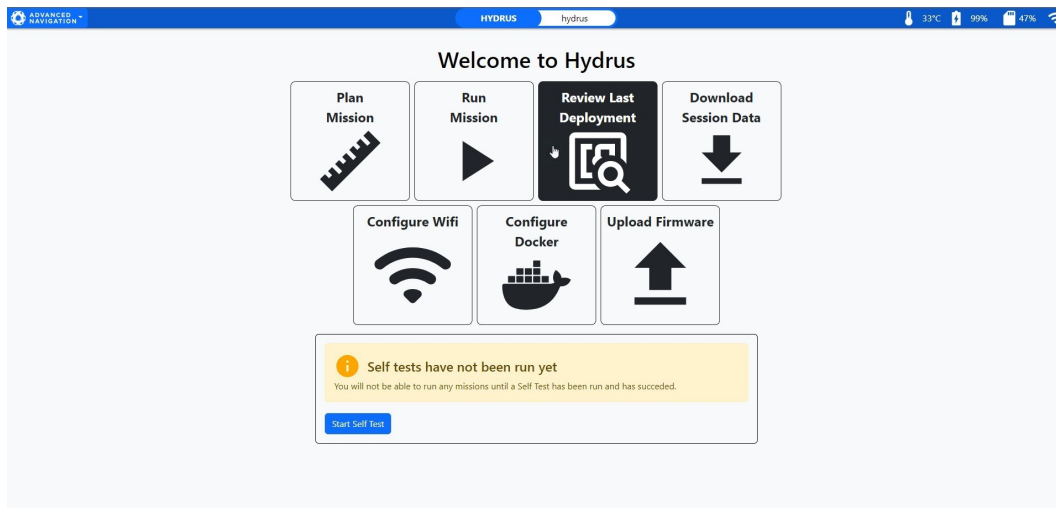


Figure 129: Hydrus webUI Review Last Deployment Selection

3. Review the status log of the most recent session in the **Mission Review** dialog. From this dialog you can:

- download session data for the latest session,
- review footage recorded in the latest session,
- navigate to the **Sessions Page**,
- navigate to the **Log Viewer** and play back the latest session.

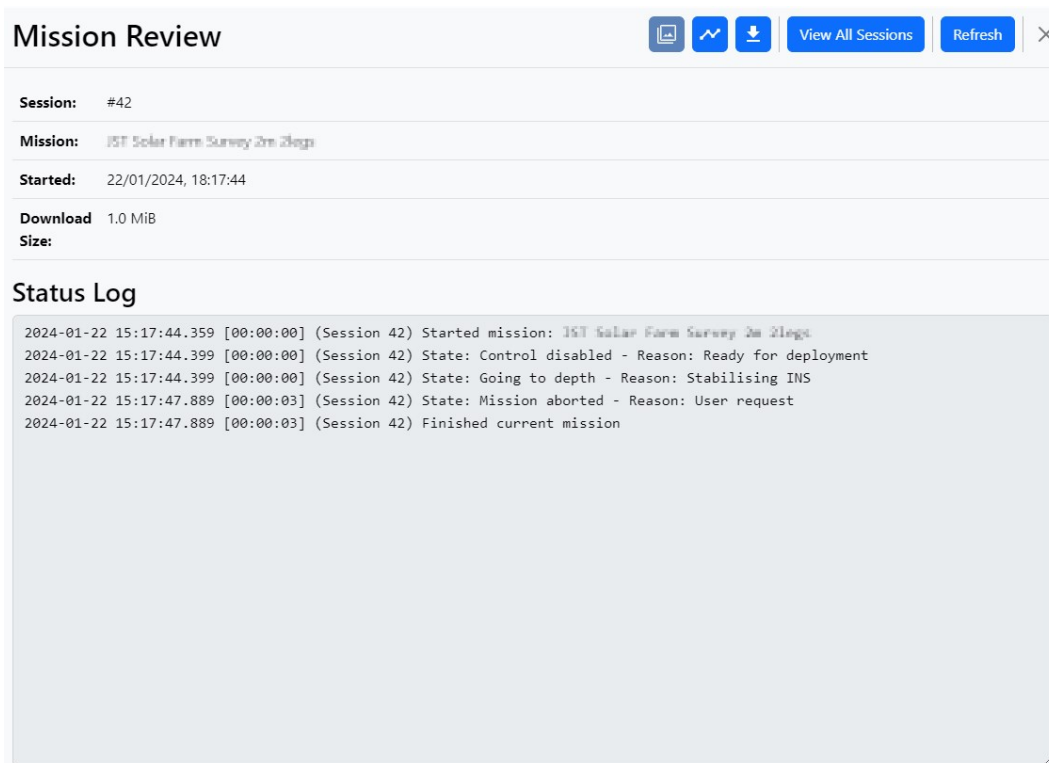


Figure 130: Hydrus webUI Review Last Deployment Dialog

## 9.2 Data Download

The Data Download feature in the Hydrus webUI is a critical tool for accessing and managing the data captured by Hydrus during each mission. This feature allows users to download a variety of data types, including mission parameters, system logs, video recordings, and images, directly to their local drive.

## 9.2.1 Session Payload Breakdown

Session payload data is organised into separate categories: ANPP Data, Configuration, Logged Data, Mission Data, Video Recordings and Image Captures. This allows for quick and easy identification and download of the specific data is required for analysis, troubleshooting, mission replication, or review.

Payload	Description
ANPP Data	<p>The Advanced Navigation Packet Protocol (ANPP) is a binary protocol that is designed to provide high error checking, efficiency, and safe design practices. It is used across all existing and future Advanced Navigation products. The ANPP data folder contains information related to the Battery Management System (BMS), INS Components, and Setpoints.</p> <ul style="list-style-type: none"> <li>• <b>BMS Data:</b> This data provides information about the battery's state, including its charge level, temperature, and overall health.</li> <li>• <b>INS Components:</b> This data includes information about the Inertial Navigation System (INS) components, such as accelerometers, gyroscopes, and magnetometers, which are used to determine the device's position and orientation.</li> <li>• <b>Setpoints:</b> These are the target values or ranges for system controls. For example, a setpoint might be a specific speed or altitude that the Hydrus device is programmed to maintain.</li> </ul>
Configuration	<p>This folder contains mission data recorded from the parameters set by the user during mission planning. This data can be downloaded and reused for other missions or sent to other Hydrus units. The configuration data can include:</p> <ul style="list-style-type: none"> <li>• <b>Mission Parameters:</b> These are the specific settings and instructions inputted by the user for a particular mission. They can include things like waypoints, altitude settings, speed settings, and more.</li> <li>• <b>User Preferences:</b> These are settings related to the user's preferences for how the Hydrus device operates, such as display settings, alert settings, etc.</li> </ul>
Logged Data	<p>This folder contains .bin files which are not relevant to the customer. These files record data for Advanced Navigation to investigate in case of faults or stoppages with the Hydrus device. The logged data can include:</p> <ul style="list-style-type: none"> <li>• <b>System Logs:</b> These are records of system events, such as system startups, shutdowns, errors, and other significant events.</li> <li>• <b>Diagnostic Data:</b> This data can help identify any issues or malfunctions with the Hydrus device. It can include things like sensor readings, system statuses, and error codes.</li> </ul>
Mission Data	<p>This folder contains a text log file with status logs of what happened</p>



Payload	Description
	<p>during the mission, the mission name, start times, and the mission programmed json file. The mission data can include:</p> <ul style="list-style-type: none"> <li>• <b>Mission Logs:</b> These are detailed records of the mission, including start and end times, waypoints reached, and any significant events that occurred during the mission.</li> <li>• <b>Mission Programmed JSON File:</b> This is a file in JSON format that contains the programmed instructions for the mission. It can be used to review the planned mission or to replicate the mission on another Hydrus device.</li> </ul>
Video Recordings	<p>This folder contains images and videos from the mission, available for download in MP4 format. The video recordings can include:</p> <ul style="list-style-type: none"> <li>• <b>Flight Footage:</b> This is video footage captured by the Hydrus device during the mission. It can be used for review, analysis, or sharing.</li> </ul>
Image Captures	<ul style="list-style-type: none"> <li>• <b>Still Images:</b> These are individual images captured during the mission. They can be used for analysis, reporting, or sharing.</li> </ul>

## 9.2.2 Download Procedure

1. Open the Hydrus webUI **Main** page.

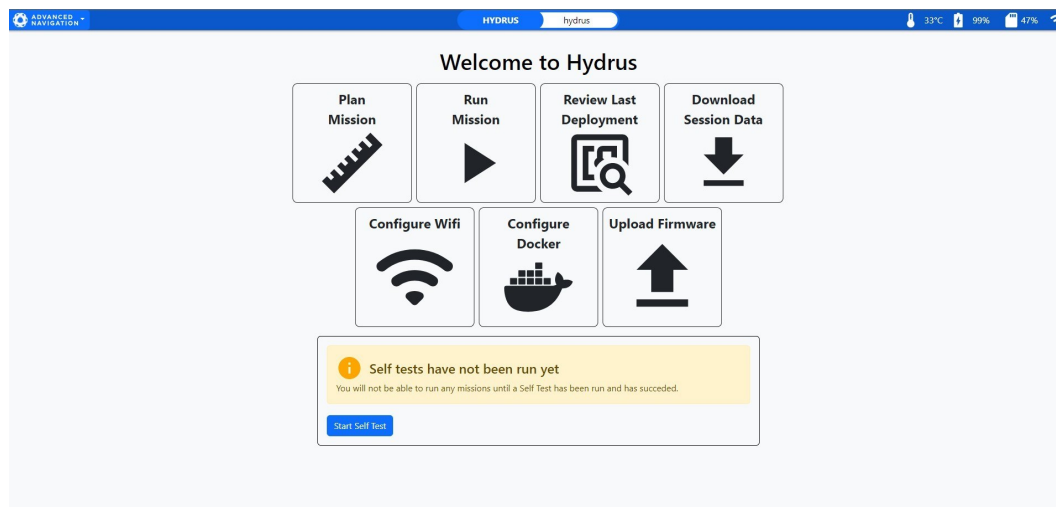


Figure 131: Hydrus webUI Main Page

2. Click **Download Session Data**.

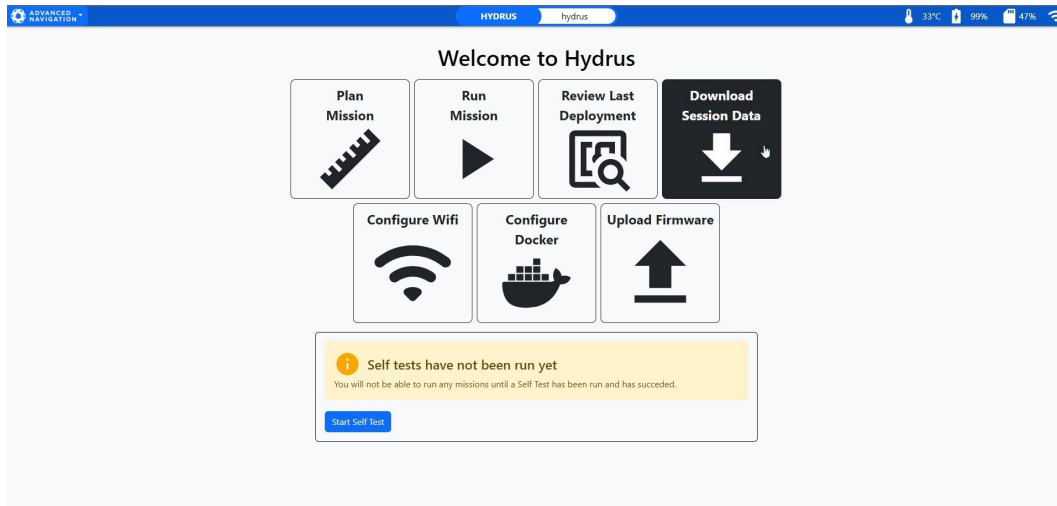


Figure 132: Hydrus webUI Download Media Selection

- On the **Sessions** page, click the session to be downloaded in order to expand it. Then proceed with downloading data according to the following options:
  - Download all session data:** If you wish to download all the data for a specific session, click the **Download** button on the corresponding row of the session.
  - Partial download:** If you wish to download only a portion of the session data (ANPP Data, Configuration, Logged Data or Mission Data), click the **Download** button on the corresponding row.
  - Download selected assets:** If you wish to download one or more individual log assets only, first click on the data category to expand it and show its contents. Then check the checkboxes next to the assets that you wish to download followed by the **Download Selected Assets** button.

The screenshot displays the 'Sessions' interface. At the top, there are buttons for 'Delete Multiple', 'Delete All', 'Refresh', and 'Open Session Marker Overlay Editor'. Below this, a session entry for '#59 My Hydrus Mission' is shown with a total size of 53.4 MiB. The session is expanded to show a breakdown of data categories: ANPP Data (3.3 MiB), Configuration (38.3 KiB), Logged Data (50.0 MiB), and Mission Data (7.4 KiB). The Configuration section is further expanded to show a list of assets with checkboxes and sizes. One asset, 'session\_0059/configs/device\_information.json' (2.4 KiB), is selected. A 'Download Selected Assets' button is visible below the asset list. At the bottom of the session entry, there is a 'Delete Session' button.

Asset	Size
<input type="checkbox"/> <a href="#">session_0059/configs/config.json</a>	35.8 KiB
<input checked="" type="checkbox"/> <a href="#">session_0059/configs/device_information.json</a>	2.4 KiB

Figure 133: Session Data Download - Payload Breakdown

### 9.2.3 Deleting Sessions

**Note:** Deleting a session will permanently remove all data associated with the session and cannot be undone. Make sure to double-check your selections before confirming deletion.

**Deleting Individual Sessions:** To delete a specific session, locate the session to be removed in the list and click on the **Delete** option next to it. A confirmation dialog will appear, asking you to confirm the deletion.

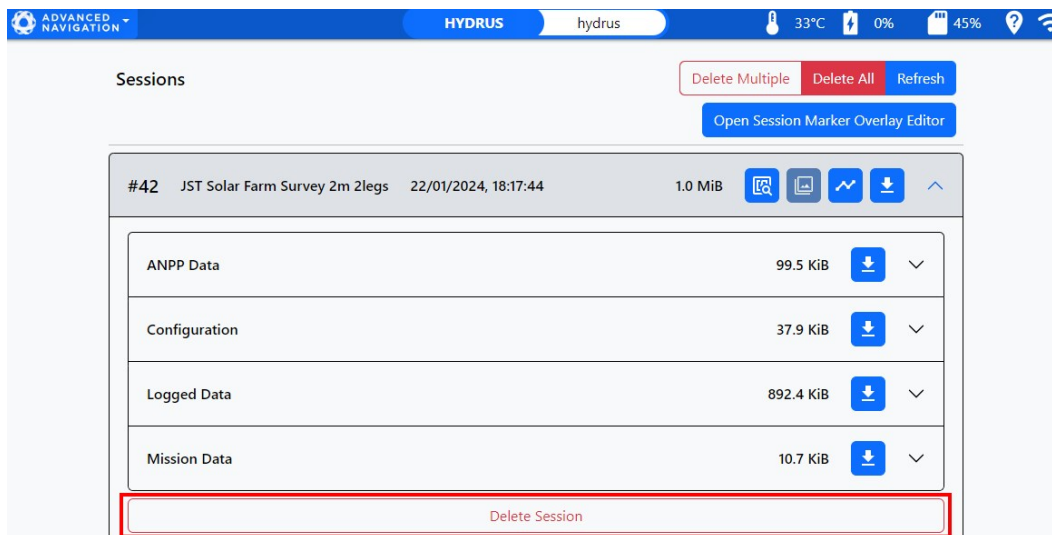


Figure 134: Deleting Selected Sessions

**Deleting All Sessions:** To delete all sessions, navigate to the top of the session list and click the **Delete All** button. A confirmation dialog will appear, asking you to confirm the deletion. Note that this action cannot be undone, ensure all necessary data has been backed up before proceeding.



Figure 135: Deleting All Sessions

**Note:** It's important to be aware that if the storage capacity of Hydrus is reaching capacity, it could potentially lead to an unsuccessful mission. Therefore, it's recommended that older session data be cleared out before initiating new missions.

**Deleting Multiple Sessions:** The multi-select feature allows for efficient management and deletion of multiple sessions.

1. Click the **Delete Multiple** button to enable multi-select mode.



Figure 136: Delete Multiple Sessions

2. Once multi-select mode is activated, checkboxes will appear on the left side of each listed session.

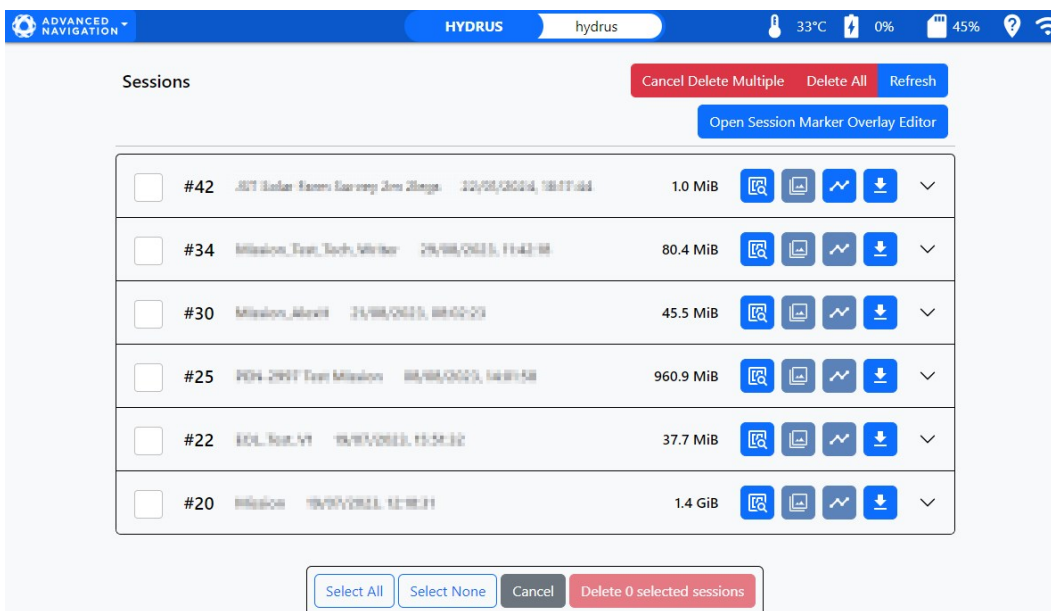


Figure 137: Session Selection

3. Click the checkboxes corresponding to the sessions you wish to delete. To select all sessions, click the **Select All** button. To deselect all sessions, click the **Select None** button.
4. After making selections, scroll down to the bottom of the page and click the **Delete** button. A confirmation dialog will appear, asking you to confirm the deletion of the selected sessions.

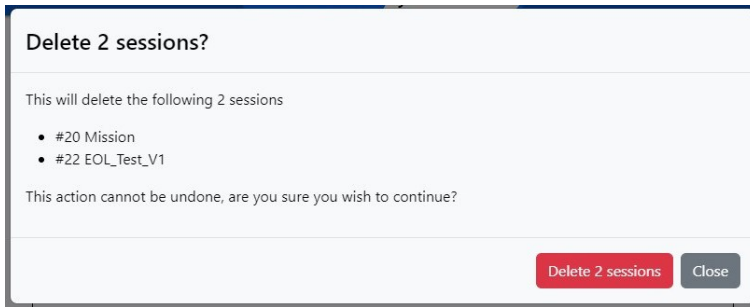


Figure 138: Confirm Deletion of Multiple Sessions

## 9.3 Session Playback

The **Log Viewer** offers session data visualisation and playback functionalities enabling you to review and study mission runs in great detail. This feature utilises all the recorded logs and session data and renders an animated visual representation of the entire session. Similar to a video player, the session playback feature allows you to play, pause, slow down or speed up the animated sessions.

### 9.3.1 Session Playback Pane Overview

Figure 139: The Log Viewer page and its session playback pane is accessed by via **Main Menu** → **View** → **Log Viewer**.



#### Session Playback Pane

1. Device position and orientation data
2. Mapping Layers and Map Options
3. Bottom Toolbar
4. Hydrus visualisation
5. Map display area
6. Map View Controls

### 9.3.2 Session Playback Controls

The session playback controls are accessed via the toolbar at the very bottom of the session playback pane. This bar shows or hides automatically when moving the cursor over or away from it. Refer the following illustration for a description of the session playback controls and their functions.

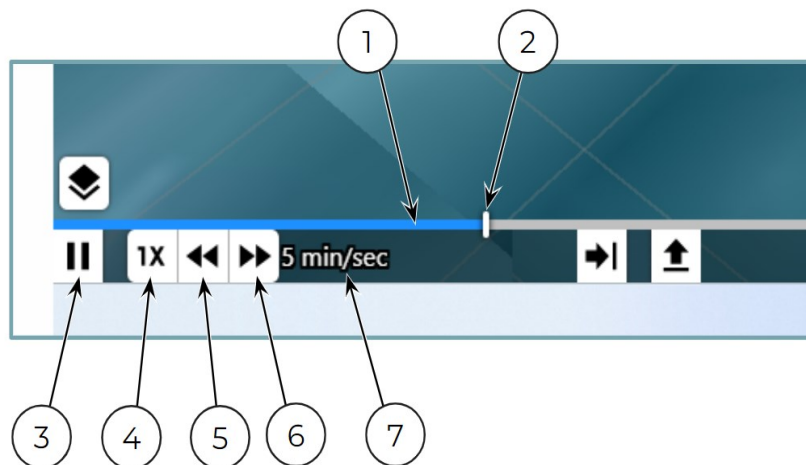


Figure 140: Session Playback Controls

1. Session progress bar
2. Scrubber for time seeking
3. Resume / Pause playback - Keyboard shortcut: P
4. Reset playback speed to 1x (real-time) - Keyboard shortcut: \
5. Slow down or reverse playback, hold Shift + click to increase increments- Keyboard shortcut: [
6. Speed up or unreverse playback, hold Shift + click to increase increments - Keyboard shortcut: ]
7. Current playback speed

### 9.3.3 Load Session Data

Session data is required to be loaded before playing back a session. Proceed as follows:



1. Open the Hydrus webUI. From the **Main Menu** navigate to **View** → **Log Viewer**.

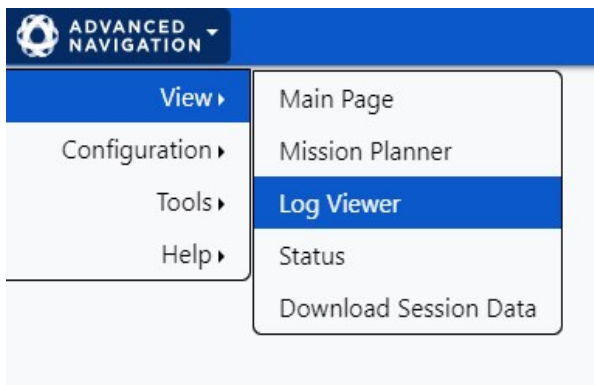


Figure 141: Hydrus webUI View Menu

2. **Loading session data from Hydrus Storage:**

- In the **Load Log(s)** dialog, select **Hydrus Storage** in the **Select source** drop down menu to load session data.
- Click the **Refresh** button.
- Click the session you wish to load in the list.

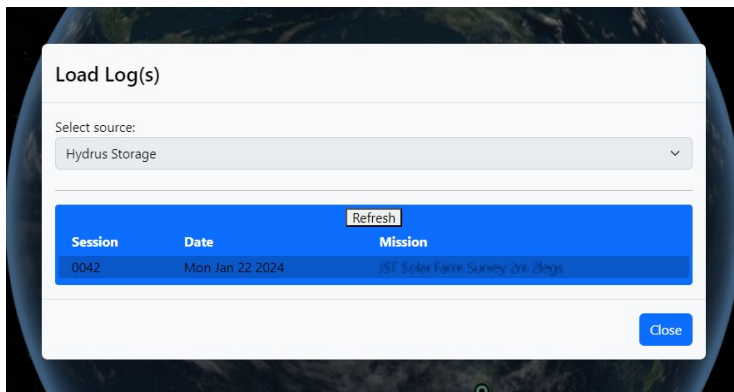


Figure 142: Hydrus webUI Load Session Data from Hydrus Storage

3. **Loading session data from Your Computer:**

- In the **Load Log(s)** dialog, select **Your Computer** in the **Select source** drop down menu to load session data.
- Tick the **Clear log viewer** check box to clear any session log data currently loaded.
- Select the applicable ANPP log type in the **Log Type** dropdown menu.
- Click the **Choose Files** button and browse to the ANPP log file and open it.
- Click **Upload**.

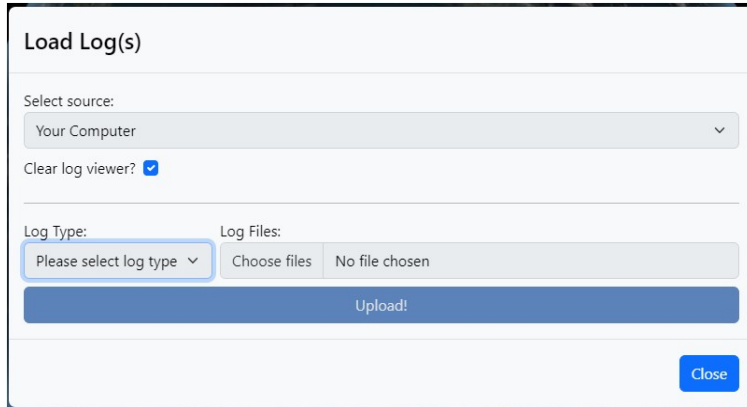


Figure 143: Hydrus webUI Load Session Data from Your Computer

4. A confirmation dialog will show once the log has been successfully loaded. Click **Close** to dismiss the dialog.

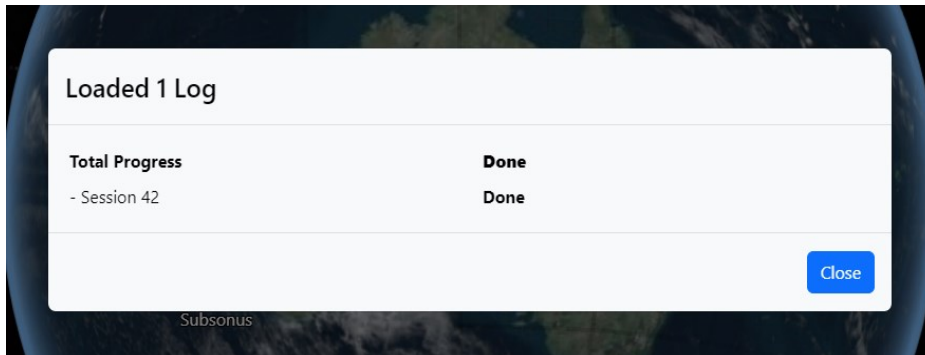


Figure 144: Hydrus webUI Load Session Data Confirmation

### 9.3.4 Playing Back a Session

1. Open the Hydrus webUI. From the **Main Menu** navigate to **View** → **Log Viewer**.
2. Open the **Mapping Layers** dialog and configure map overlays and options as required.
3. Click the **Scene Fit** button or hit the space bar on your keyboard to fit the mission in the mission playback pane.
4. Move the cursor to the bottom of the session playback pane to show the toolbar with playback controls. Then click the **Resume / Pause playback** button.

### 9.3.5 Convert and Export Log to CSV Format

1. Open the Hydrus webUI. From the **Main Menu** navigate to **View** → **Log Viewer**.

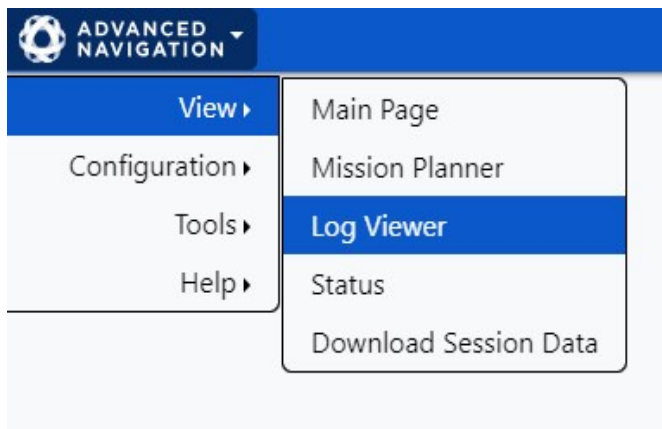


Figure 145: Hydrus webUI View Menu

2. Move the cursor to the bottom of the session playback pane to show the bottom toolbar. Then click the **Convert logs to CSV** button.



Figure 146: Hydrus webUI Session Playback Bottom Toolbar

1. Convert logs to CSV button
3. Follow the prompts to export the session log to a CSV file in the **Convert CSV dialog**.

# 10 Maintenance

## 10.1 Part Numbers and Ordering

This topic covers information about part numbers for:

- [10.1.1 Standalone Units and Packs](#)
- [10.1.2 Accessories and Spare Parts](#)
- [10.1.3 Hydrus Pack](#)
- [10.1.4 Hydrus Subsonus Surface Kit](#)

### 10.1.1 Standalone Units and Packs

Part Number	Description	Notes
HYDRUS-300	Hydrus AUV 300 m standalone unit	Hydrus AUV 300 m standalone unit <b>Unit only</b> , does not include charger, transport case or spares.
HYDRUS-1000	Hydrus AUV 1000 m standalone unit	Hydrus AUV 1000 m standalone unit <b>Unit only</b> , does not include charger, transport case or spares.
HYDRUS-300-PCK	Hydrus AUV 300 m Pack	Hydrus AUV 300 m Pack Contains everything required to start operating Hydrus as a standalone unit, or an additional unit with an existing Subsonus. See <a href="#">10.1.1 Standalone Units and Packs</a> for list of contents.
HYDRUS-1000-PCK	Hydrus AUV 1000 m Pack	Hydrus AUV 1000 m Pack Contains everything required to start operating Hydrus as a standalone unit, or an additional unit with an existing Subsonus. See <a href="#">10.1.1 Standalone Units and Packs</a> for list of contents.
HYDRUS-300-SUBSONUS-KIT	Hydrus AUV 300 m Kit with Subsonus and GNSS Compass	Hydrus AUV 300 m Kit with Subsonus and GNSS Compass Contains everything required to start operating Hydrus with subsea acoustic positioning and communications. Includes Hydrus AUV, Subsonus and GNSS Compass. See <a href="#">10.1.4 Hydrus Subsonus Surface Kit</a> for list of contents.
HYDRUS-1000-SUBSONUS-KIT	Hydrus AUV 1000 m Kit with Subsonus and GNSS Compass	Hydrus AUV 1000 m kit with Subsonus and GNSS Compass Contains everything required to start operating Hydrus with subsea acoustic positioning and communications. Includes Hydrus AUV, Subsonus and GNSS Compass. See <a href="#">10.1.4 Hydrus Subsonus Surface Kit</a> for list of contents.

Table 4: Hydrus Pack Part Numbers

## 10.1.2 Accessories and Spare Parts

Part Number	Description	Notes
<b>Hydrus Sales Accessories</b>		
HYDRUS-CHARGER	Hydrus Qi® Desktop Charger	Hydrus Qi® Desktop Charger 30W
HYDRUS-CASE-HD	Rugged transport case for Hydrus	Rugged transport case with insert that holds: 1 x Hydrus unit 1 x Hydrus Qi® desktop charger 1 x Thruster starter pack
HYDRUS-WAND	Hydrus Wand	Magnetic on/off tool
HYDRUS-TESTCLIP	Hydrus Test Clip	Attachment clip for testing Hydrus on safety line
<b>Spare Part Packs</b>		
HYDRUS-THRUSTER-STARTER-PCK	Spare Thruster Starter Pack	Hydrus AUV HW V1.0 Spare Thruster Starter Pack comprising:  1 x Thruster Impeller, clockwise 1 x Thruster Impeller, counter-clockwise 4 x thruster bearing, ceramic 1 x vertical thruster guard 1 x horizontal thruster guard 8 x guard mounting screws 1 x 2.5mm hex key
HYDRUS-IMPELLOR-PCK	Spare Impeller Pack	Spare Impeller pack comprising:  3 x Thruster Impeller, clockwise 4 x Thruster Impeller, counter-clockwise
HYDRUS-THRUSTER-GUARD-PCK	Spare Thruster Guard Pack	Spare thruster pack comprising:  3 x vertical thruster guard 4 x horizontal thruster guard 28 x guard mounting screws 1 x 2.5mm hex key
HYDRUS-BEARING-PCK	Spare Bearing Pack	Spare bearing pack comprising:  14 x thruster bearing, ceramic
<b>Sales Licenses</b>		
HYDRUS-LIC-OP	Hydrus open platform license	Hydrus open platform software license (per unit)
HYDRUS-LIC-SDK	SDK Development License	Hydrus SDK development site license
<b>Sales Services</b>		
WARRANTY-	Hydrus additional 2 year	Hydrus additional 2 year warranty (3 year total)

Part Number	Description	Notes
EXTENSION	warranty	
<b>Subsonus Accessories</b>		
SUBSONUS-V	Subsonus with connector installed in vertical port	Subsonus USBL for underwater acoustic positioning and communications to Hydrus
SS-10M-CABLE	Subsonus 10 metre RJ45 cable	Subsonus 10 metre cable, RJ45 Ethernet connector to MCIL8F connector with cap
SS-3M-EXCABLE	Subsonus 10 metre extension cable	Subsonus 3 metre extension cable, MCIL8M connector to MCIL8F connector with caps
SS-20M-EXCABLE	Subsonus 10 metre extension cable	Subsonus 20 metre extension cable, MCIL8M connector to MCIL8F connector with caps
SUBSONUS-CASE	Plastic carrier case	Carrier case with insert to hold Subsonus as well as accessories
SS-POLE-BRACKET	Subsonus Surface Pole Mount Bracket	Subsonus Surface Pole Mount Bracket
CABLE-ETHER-2M	2 metre Ethernet cable	2 metre CAT6a Network Cable
ROUTER-4PORT	4 Port Ethernet Router	Network Wi-Fi Router for Subsonus Kit with universal AC/DC adapter
GC2-POE	GNSS Compass Ethernet Variant	GNSS Compass Ethernet variant Power over Ethernet interface Supports GPS, GLONASS, Galileo & BeiDou constellation L1/L2 10mm RTK Supports DGPS and SBAS Does not support L band No cables included
GC-POE-CABLE-20M	20m Ethernet cable for GNSS Compass	20m CAT5e Ethernet cable with RJ45 Compatible with Ethernet units only (GC2-POE) IP67 environmentally sealed connector
POE-INJECTOR-DC	DC PoE Injector	24V DC PoE Injector 25W 802.3at Type 2 "PoE+" Requires 12/24V DC power supply (SUPPLY-24V or similar)
SUPPLY-24V	24 V power supply	100-240 V AC Mains to 24 V DC Power Supply (DC jack) Includes 2-pin plug types A/C/G/I
SS-CONNECTOR-CAP	Female connector cap	Protective cap for Subsonus connector (MCDC8F)
SS-CABLE-CAP	Male connector cap	Protective cap for connector on Subsonus cable (MCDC8M)

Table 5: Accessories Part Numbers

## 10.1.3 Hydrus Pack

### Shipping Information

Specification	Value
Length	520 mm
Width	440 mm
Height	850 mm
Weight	28 kg

**Note:** Hydrus must be shipped as Dangerous Goods. See [2.4 Shipping Hydrus - Dangerous Goods](#).

### Hydrus Pack Contents

The HYDRUS-300-PCK and HYDRUS-1000-PCK standalone packs contain the following items:

Part Number	Description	Qty
HYDRUS-300 or HYDRUS-1000	Hydrus 300 m / 1000 m standalone unit	1
HYDRUS- CHARGER	Hydrus Charger	1
HYDRUS-CASE-HD	Hydrus Case - HD	1
HYDRUS-THRUSTER-STARTER-PCK	Hydrus AUV HW V1.0 Spare Thruster Starter Pack comprising: <ul style="list-style-type: none"> <li>1 x Thruster Impeller, clockwise</li> <li>1 x Thruster Impeller, counter-clockwise</li> <li>4 x thruster bearing, ceramic</li> <li>1 x vertical thruster guard</li> <li>1 x horizontal thruster guard</li> <li>8 x guard mounting screws</li> <li>1 x 2.5mm hex key</li> </ul>	1
HYDRUS-WAND	Hydrus Wand	1
HYDRUS-TESTCLIP	Hydrus Test Clip	1



Figure 147: Hydrus Pack



## 10.1.4 Hydrus Subsonus Surface Kit

The HYDRUS-300-SUBSONUS-SURFACE (Hydrus 300 m variant) and HYDRUS-1000-SUBSONUS-SURFACE (Hydrus 1000 m variant) kits contain all items listed in [10.1.3 Hydrus Pack](#) plus the following items:

Part Number	Description	Qty
SUBSONUS-V	Subsonus with connector installed in vertical port	1
SUBSONUS-CASE	Rugged Case	1
POE-INJECTOR-DC	24V DC PoE (Power over Ethernet) power supply injector	2
SUPPLY-24V	24V DC power supply	2
SS-POLE-BRACKET	Subsonus universal mounting bracket	1
SS-10M-CABLE	Subsonus connector to RJ45 connector 10 metre cable	1
GC2-POE	GNSS Compass Ethernet Variant	1
GC-POE-CABLE-20M	20m CAT5e Ethernet cable with RJ45 for GNSS Compass	1
ROUTER-4PORT	4 port network Wi-Fi router with DHCP server	1
CABLE-ETHER-2M	2m CAT6a ethernet cable	2

**Note:** Additional accessories or optional components may be included depending on your specific purchase. Please refer to the documentation provided with those accessories for further instructions.

It is recommended to keep the original packaging materials in case you need to transport or store Hydrus in the future.

## 10.2 Routine Inspection and Cleaning

Routine inspection and cleaning are essential for maintaining optimal performance and prolonging the lifespan of equipment. This section provides an inspection and cleaning plan with a schedule for daily and monthly tasks. Adhering to this plan will ensure the equipment remains in good condition and minimizes the risk of breakdowns or malfunctions.

Task	Action	Hydrus Component	Additional Notes
Daily	Inspect	Camera	Camera lens to be checked for smudges, scratches, fogging on inside
	Inspect	DVL Transducers	Carefully examine each transducer dot to ensure there are no visible cracks, chips, or signs of physical damage.
	Inspect	LED lights	Look for any signs of physical damage, such as cracks, broken housings or clear lens material.
	Inspect Clean	Thrusters/Impellers	Begin by visually examining the thruster and impeller bolts. Look for any visible signs of damage, such as stripped threads, cracks, or deformation.

Task	Action	Hydrus Component	Additional Notes
			<p>Inspect the plastic housing surrounding the thruster and impeller bolts. Look for any cracks, splits, or indications of stress.</p> <p>Spin the thrusters checking for debris and grit, ensure impeller spins with ease of motion.</p> <p>Clean as per the guidance provided below and conduct a Rinse cycle through the Hydrus webUI.</p>
	Inspect	EPD Control Panel	Inspect the panel for any physical damage, such as cracks or scratches.
	Inspect	Acoustic Transponder	Look for any visible signs of physical damage, such as cracks, dents.
	Inspect	Hydrus Desk Charger	<p>Inspect the charger for any visible signs of physical damage, such as cracks, dents, or loose components.</p> <p>Verify that the desk charger is properly connected to a power source and that the power supply is functioning correctly. Check the power cable, plug, and any other connections to ensure they are secure and undamaged.</p> <p>If the charger or Hydrus becomes excessively hot, it may indicate a malfunction or compatibility issue. Check battery levels and charging status.</p> <p>Ensure the EPD screen is aligned with the Advanced Navigation logo when placed in the charger.</p>
	Inspect	Hydrus Main Body	Check the main body for damage, abrasions and cracks.
	Clean	Hydrus Main Body	Clean any debris or fouling from the external surfaces.
	Functional Test		Conduct a self test.
Monthly	Inspect		Verify the tightness of fasteners and bolts, ensuring they are properly secured.
	Clean		Clean Hydrus as per cleaning instructions, and conduct a Rinse cycle through the webUI.
	Functional Test		Conduct a functional test of the Hydrus systems and sensors.

**Note:** Note: The frequency and specific tasks mentioned above are examples and may vary depending on the Hydrus model and manufacturer's recommendations. Adjust the plan to suit the specific requirements and guidelines provided by Advanced Navigation.

## 10.2.1 Cleaning

### **Fresh Water Hose Cleaning** (5-10 minutes):

- Spray fresh water over the entire surface of the vehicle, paying special attention to the pressure sensor vent hole and thrusters.
- Ensure the water pressure is moderate to avoid damaging sensitive components.
- Continue spraying for 5-10 minutes to thoroughly rinse off any dirt or debris.

### **Fresh Water Soak** (30 minutes):

- Fill a container or tank with fresh water.
- Submerge Hydrus in the water, ensuring that all components are covered.
- Allow Hydrus to soak for 30 minutes to remove any stubborn contaminants.
- During the soak, gently agitate the water around Hydrus to help dislodge any dirt or grime.

### **Avoid Chemicals and Compressed Air:**

- Do not use any chemicals or solvents to clean Hydrus, as they can damage sensitive components.
- Avoid the use of compressed air to clean thrusters or any other part of the vehicle, as it can introduce moisture or debris.

### **Non-Abrasive Material:**

- When wiping Hydrus, use only non-abrasive materials such as soft microfiber cloths or sponges.
- Avoid rough or abrasive materials that can scratch or damage the vehicle's surface.

## 10.2.2 Thruster Specific Cleaning

**Rinse Mode** -The Rinse Mode function serves a critical role in the maintenance of Hydrus. This mode allows for the manual operation of its thrusters outside of mission parameters, specifically for cleaning purposes. Operating at a slow RPM setting of approximately 200 RPM, Rinse Mode enables the effective removal of any debris or biofouling that may have accumulated post-mission. This process necessitates the manual rotation of the thrusters, ensuring a comprehensive cleaning. This function can be used in two primary scenarios: to remove excess water and to hose down Hydrus with fresh water, both of which contribute to the optimal performance and longevity of Hydrus.

- **Preparation:** Ensure that Hydrus is in a High Power
- **Navigating to Rinse Mode:** From the main screen of the webUI, go to the "Advanced Navigation" dropdown menu. From there, choose "Tools", then "Maintenance", and finally "Rinse Mode".

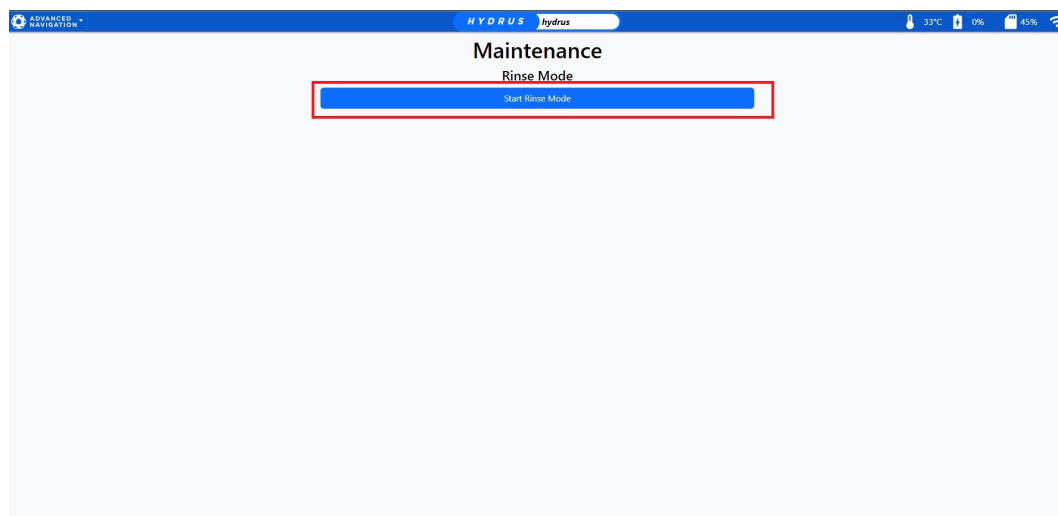


Figure 148: Start Rinse Mode

- **Understanding Rinse Mode:** Upon selecting "Rinse Mode", a dialog box will appear with the following message: "This will make Hydrus slowly spin its thrusters for 60 seconds. Are you sure you want to start Rinse Mode?" The options available will be "Cancel" or "Start Rinse Mode".

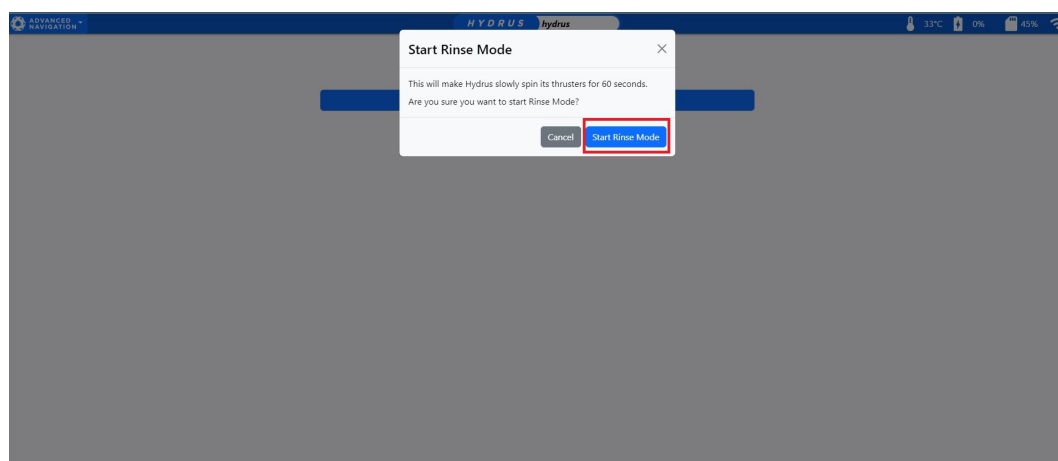


Figure 149: Rinse Mode Duration

- **Preparation for Rinse Mode:** Before the user initiates Rinse Mode, ensure that Hydrus is properly positioned.s
- **Initiating Rinse Mode:**The user should press "Start Rinse Mode" on the WebUI. The thrusters will then begin to spin at approximately 200 RPM for 60 seconds. This function can be used to remove excess water from the thrusters or can be used while hosing Hydrus.

**Note:** If the Rinse function need to be stopped over the duration, the user can click 'Stop Rinse Mode' at anytime to immediately stop the thrusters.

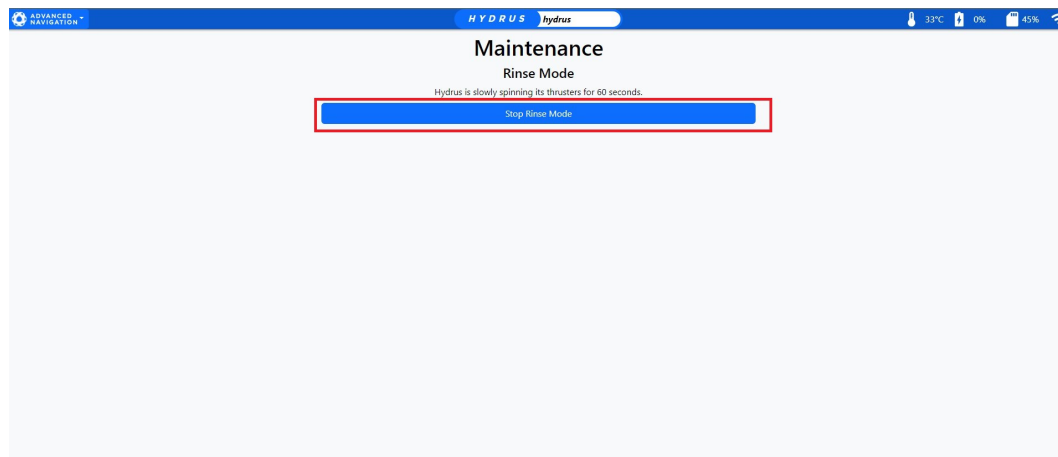


Figure 150: Stop Rinse Mode

- **Observation and Repeat:**The user should observe for any signs of debris or biofouling being expelled from the thrusters. If necessary, repeat the Rinse Mode operation until the user is satisfied that the thrusters are clean and free of debris.
- **Completion:** Once the thrusters are clean, the user should ensure that Hydrus is dry.
- **Impeller Maintenance:**For detailed instructions on Impeller maintenance, refer to [10.3 Impeller Maintenance](#)

## 10.3 Impeller Maintenance

This section of the manual provides a comprehensive guide on Impeller maintenance. It covers safety precautions, the tools and materials needed, detailed procedures for thruster change-outs and cleaning and inspection guidelines. By following these guidelines, operators can ensure Hydrus continues to perform at its best in all underwater operations.

### 10.3.1 Thruster Assembly Exploded

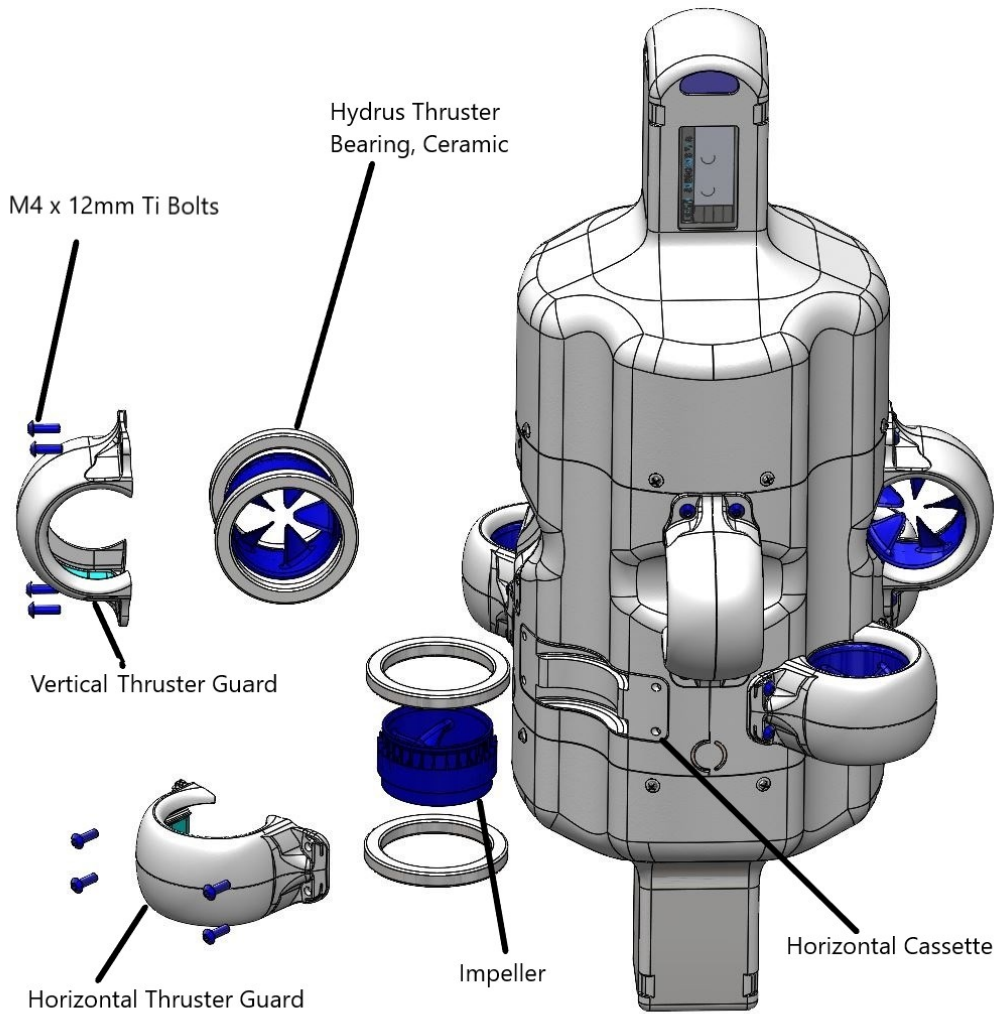


Figure 151: Thruster Assembly Exploded

## 10.3.2 Thruster Layout

### Clockwise (CW) Rotor

The CW Rotor can be denoted by a white ribbon around its surface and the base of the rotor blade inclines towards the left.

**Note:** The CW Impeller can be inserted into the thruster guard either way up (white line up or down), there is no significance.

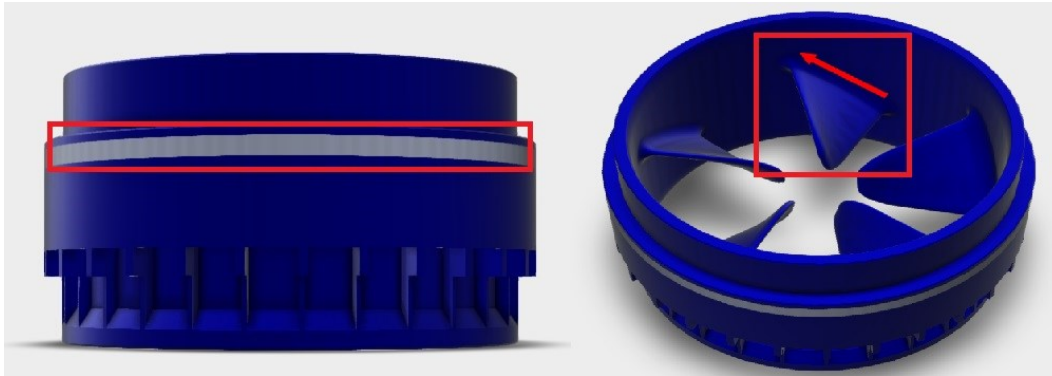


Figure 152: CW Top View Side View

### Counter Clockwise (CCW) Rotor

The CCW Rotor can be denoted by no ribbon on the surface of the rotor and the rotor blade base leans outwards towards the right.

**Note:** The CCW Impeller can be inserted into the thruster guard either way up, there is no significance.

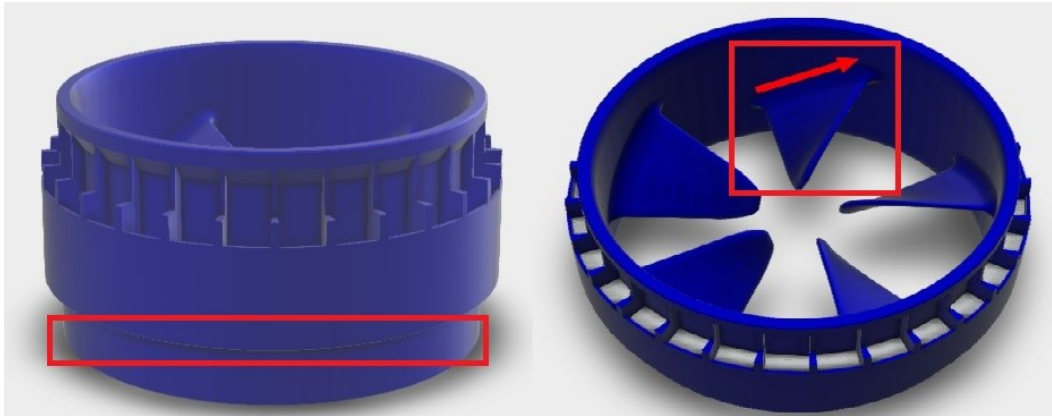
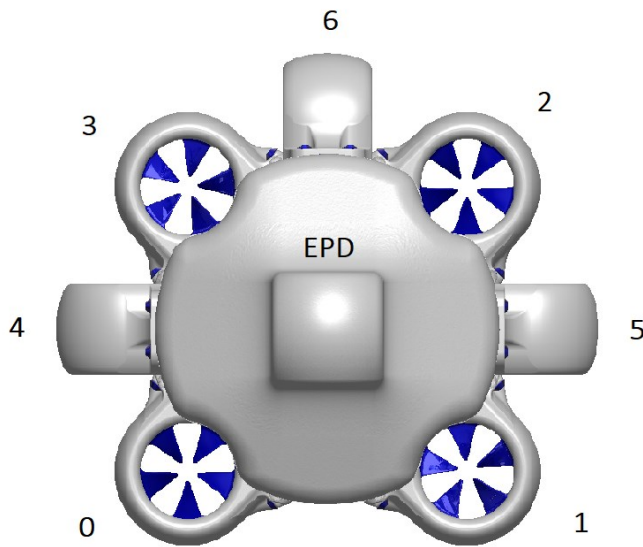


Figure 153: CCW Top View Side View

**Thruster Layout Complete**



Top View

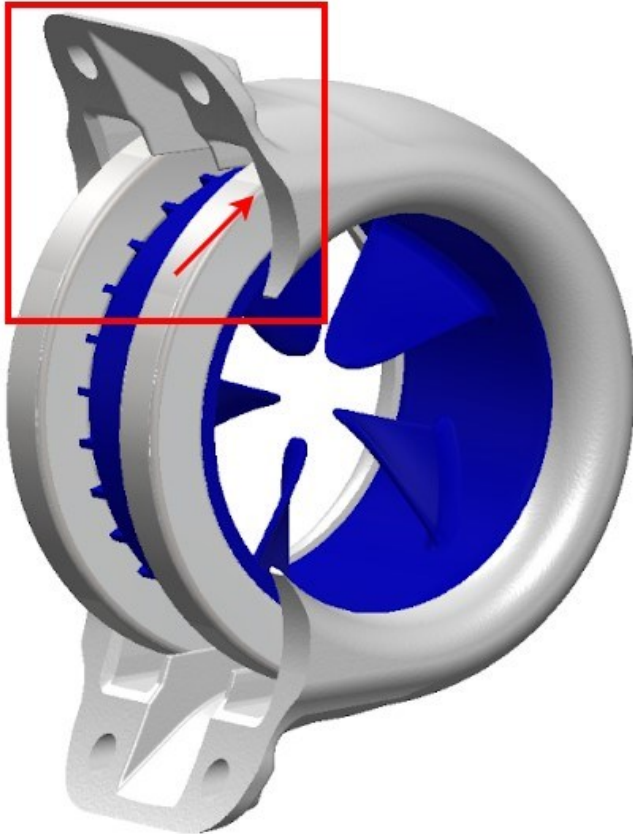
Figure 154: Thruster Layout Complete

Thruster Number	Rotor Direction	Guard Type
0	Counter Clockwise (CCW)	Horizontal Guard
1	Clockwise (CW)	Horizontal Guard
2	Counter Clockwise (CCW)	Horizontal Guard
3	Clockwise (CW)	Horizontal Guard
4	Clockwise (CW)	Vertical Guard
5	Counter Clockwise (CCW)	Vertical Guard
6	Counter Clockwise (CCW)	Vertical Guard



### Horizontal Thruster Guard

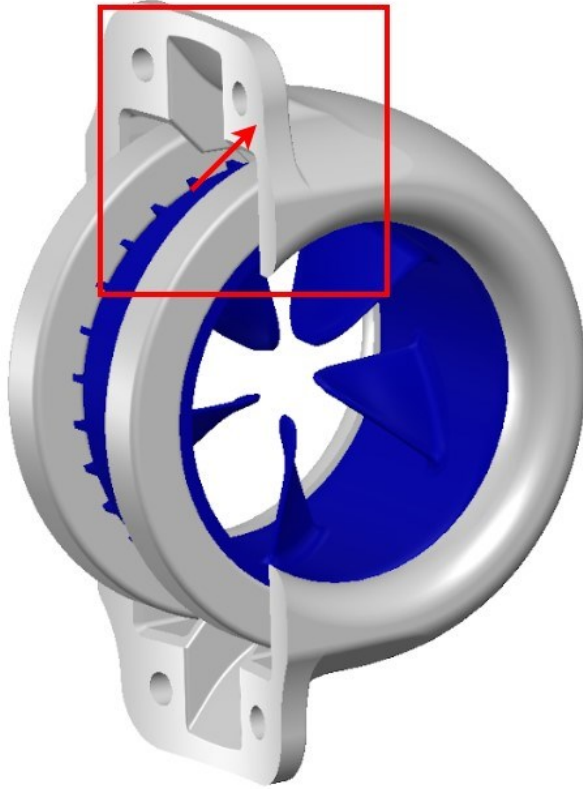
The Horizontal Thruster Guard is a protective component designed to prevent damage to the thrusters of the Hydrus. The Horizontal Thruster Guard is characterised by a curvature of the base of the guard that aligns with the main body of Hydrus, the guard will house in the shallow cassette on the Hydrus which is depicted in the illustration below.



*Figure 155: Horizontal Thruster Guard*

### Vertical Thruster Guard

The Vertical Thruster Guard's design is distinct from the Horizontal Thruster Guard. While the Horizontal Thruster Guard is characterised by a curvature that aligns with the main body of Hydrus, the Vertical Thruster Guard has a base that is near straight and will sit in the deeper cassette on the Hydrus main body. see below for illustration.



*Figure 156: Hydrus Flat Surface*

## Ceramic Bearings

The ceramic bearing is a disc-shaped assembly composed of a hollow ceramic ring. This ring includes an inner and outer raceway that encapsulates extremely hard and smooth ceramic balls. Each thruster assembly requires two of these ceramic bearings. They are positioned on either side of the rotor and are fit between the thruster guard and the thruster cassette.



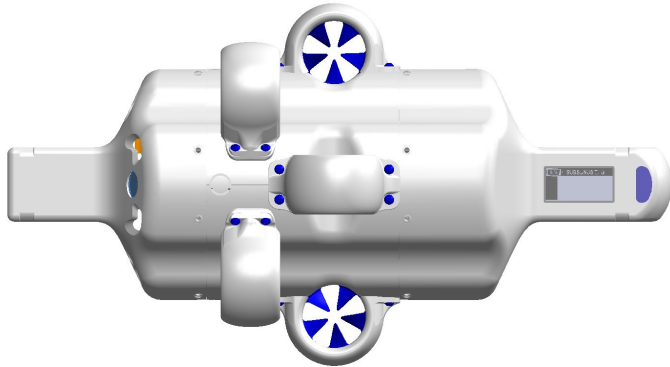
*Figure 157: Ceramic Bearing*

### 10.3.2.1 Tools and Materials Needed

Item	Quantity
2.5mm Hex Head	1
Horizontal / Vertical Guard	1
Clockwise (CW) / Counterclockwise (CCW) Rotor	1
M4 x 12mm Bolts	4
Hydrus Thruster Bearing, Ceramic	2

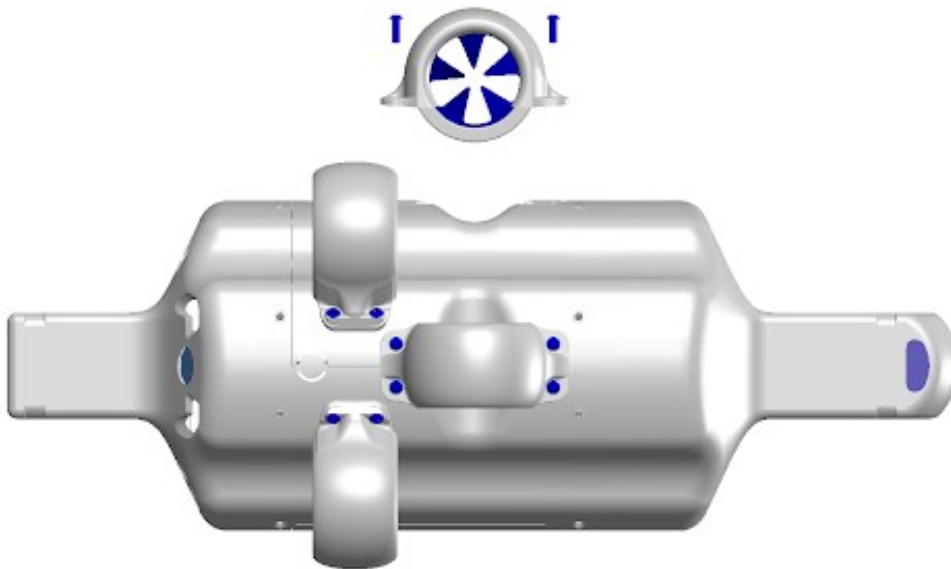
### 10.3.2.2 Thruster Change Out Procedure

Preparation: Position the Hydrus on a flat, stable surface to ensure it remains secure throughout the procedure.



*Figure 158: Hydrus Flat Surface Top View*

**Thruster Guard Removal:** Using the 2.5mm hex key, carefully unscrew the four M4 x 12mm Ti thruster guard screws. Keep these screws in a safe place for reassembly.



*Figure 159: Hydrus Vertical Thruster Removal*

**Thruster Removal:** Gently detach the thruster guard from the main body of the Hydrus. This should require minimal force. The rotor and the ceramic bearing are housed within the thruster guard.

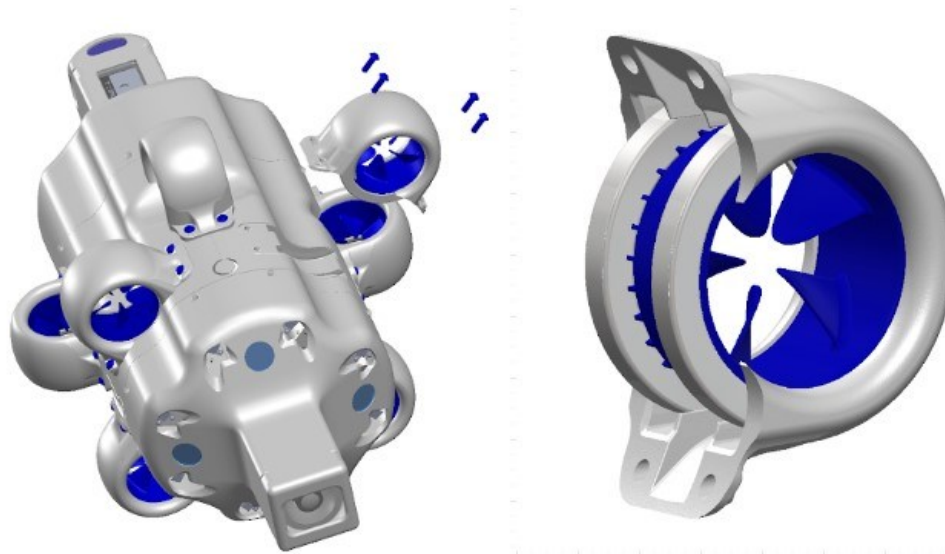


Figure 160: Thruster removal

**Component Separation:** Separate the rotor and the ceramic bearing located inside the thruster guard. Further dismantle the two ceramic bearings from the rotor by gently pulling around the collar of the bearing



Figure 161: Rotor Assembly Separated

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**Note:** Thoroughly inspect the thruster guard, the two ceramic bearings, thruster guard and the rotor for any signs of damage. Replace any components as necessary.

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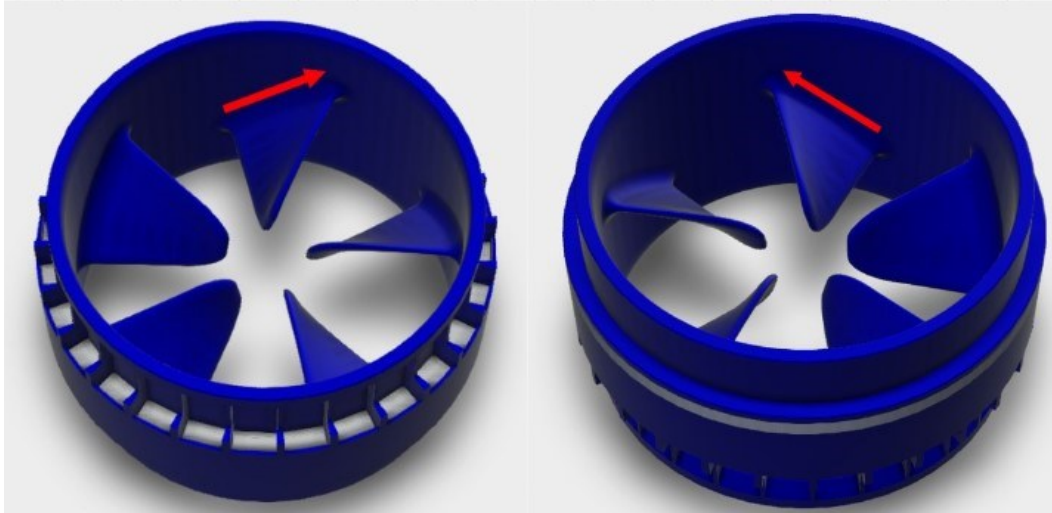
**Note:** It's crucial to handle ceramic bearings with care, as dropping them could result in damage, potentially rendering them unusable.

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**Note:** Exercise caution to avoid applying any pressure on the impeller blades while extracting the bearings.

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**Rotor Identification:** Determine whether the rotor being replaced is a CW (Clockwise Rotor) or a CCW (Counter Clockwise Rotor).



*Figure 162: Rotor Identification*

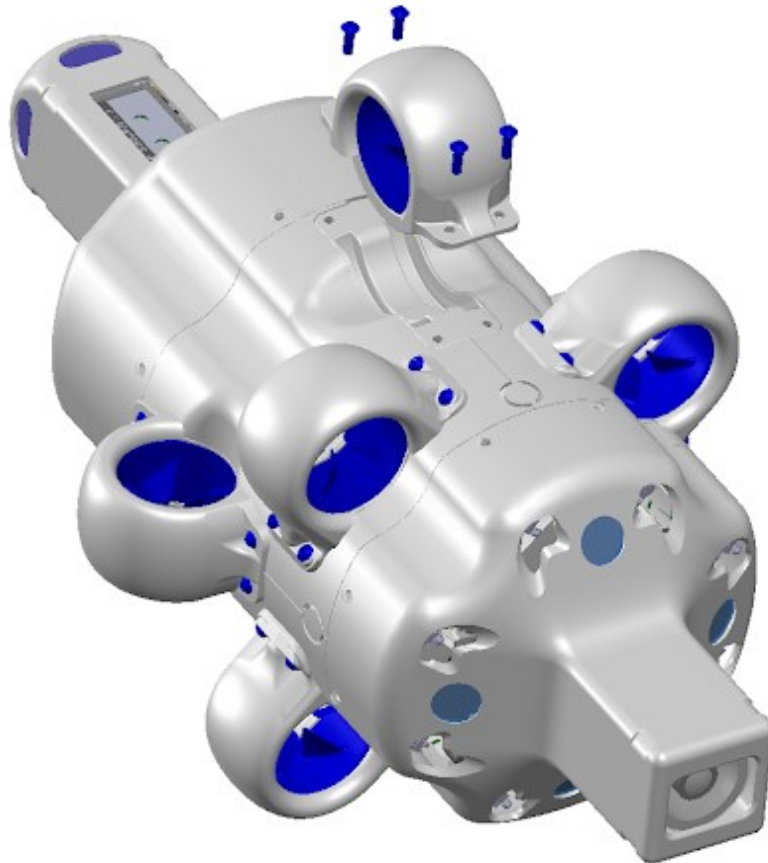
**Reassembly:** Reattach the two ceramic bearings to the rotor and slide the assembly back into the thruster guard.



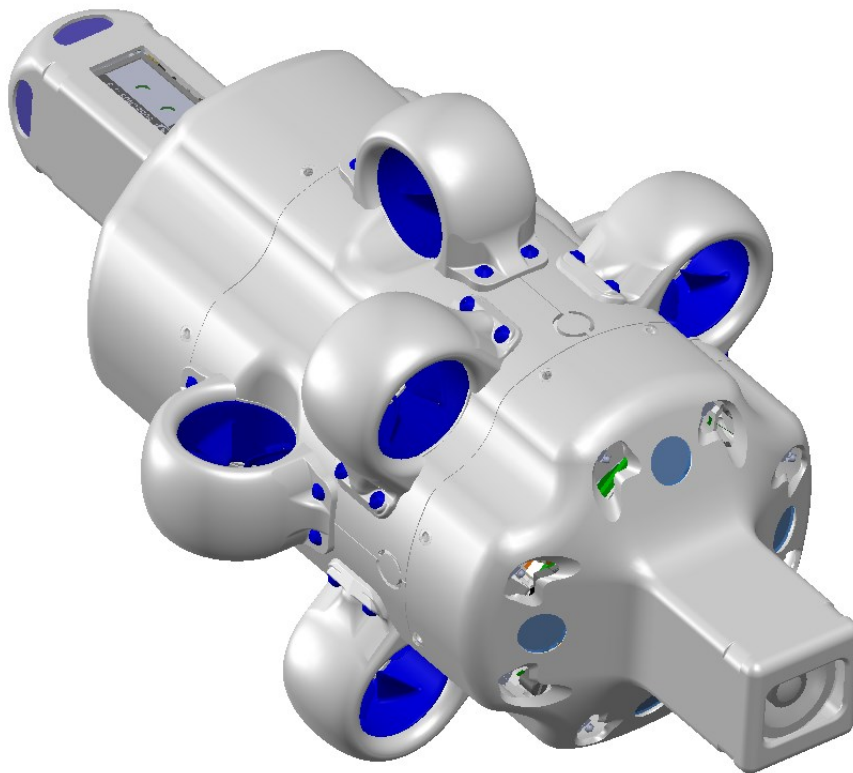
*Figure 163: Thruster Re Assembly*

**Thruster Replacement:** Carefully align and reattach the thruster guard to the main body of the Hydrus. Ensure that the thruster assembly is properly seated in the cassette. Insert and hand-tighten the thruster guard screws. By hand, test spin the newly mounted thruster assembly to ensure smooth and free rotation. If required, adjust tension on the mounting bolts to ensure on cross-torque is being applied to the guard that may prevent the Impeller from spinning.

**Note:** Adjust the torque on the mounting bolts as needed to prevent the force on the guard from obstructing the impeller's spin.



*Figure 164: Thruster Replacement*



*Figure 165: Hydrus Complete*

**Note:** Self-Test: After the thruster has been replaced and secured, conduct a [6.1.8 Testing and Functional Checks](#) to ensure the new thruster is functioning correctly.

## 10.4 Magnetic Calibration

For the best heading accuracy possible, magnetic calibration is recommended to be carried whenever the magnetic signature of the surrounding environment has changed. For example, when the Hydrus unit has been transported a long distance (more than 100 km) to a new geographic location, it should be recalibrated. The following sections cover how to verify magnetic calibration and how to calibrate the unit using the two different methods available; 3D calibration and setting HSI offset values manually.

### 10.4.1 Magnetic Calibration Verification

To assess if recalibration is needed, perform magnetic calibration verification:



1. In the **Main Menu**, navigate to **Tools** → **Magnetic Calibration**.
2. Wait for the Hydrus to obtain a GNSS fix.
3. Hold the Hydrus with the camera facing down and point the e-ink screen towards north.
4. Check the **Current Heading** field, it shows the current heading as reported by the INS.
5. Cross-check the heading reading against that of an analogue compass or other accurate and reliable heading source. If the calibration is valid, the heading value should display a value close to 0 when Hydrus is pointing to the north. If the heading is not accurate, it is necessary to re-calibrate the unit.

## 10.4.2 3D Calibration

Before commencing magnetic calibration:

- Hydrus needs a GNSS position fix. To obtain a GNSS position fix, take the Hydrus outside to a place with a clear view of the sky.
- Magnetic calibration should always be done outdoors, away from any large metal objects, high current cables or other sources of magnetic fields that may impact . It is strongly recommended not to perform magnetic calibration whilst onboard a vessel.

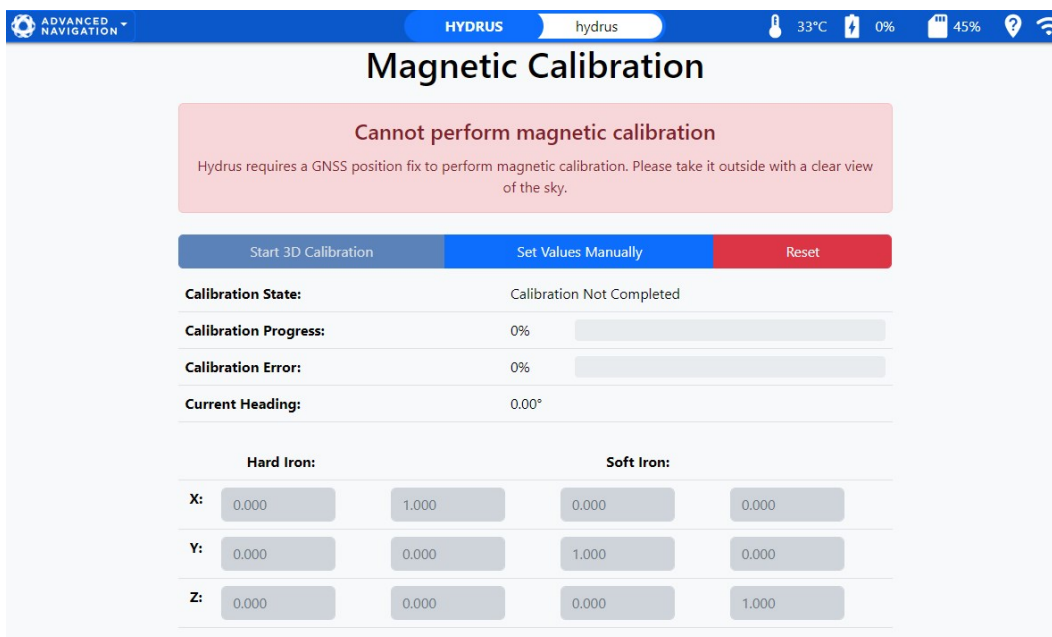


Figure 166: Hydrus WebUI Magnetic Calibration Page

1. In the **Main Menu**, navigate to **Tools** → **Magnetic Calibration**.
2. Wait for the Hydrus to obtain a GNSS fix.
3. Click **Reset**.
4. Click **Start 3D Calibration** and pick up the Hydrus unit and hold it with both hands.
5. Until the **Calibration State** changes to "**Completed**" and the **Calibration Progress** bar reaches 100%, do the following:

- a. Rotate the Hydrus unit one full rotation around its centre point along the X-axis.
  - b. Rotate the Hydrus unit one full rotation around its centre point along the Y-axis.
  - c. Rotate the Hydrus unit one full rotation around its centre point along the Z-axis.
  - d. Rotate the Hydrus unit around its centre point along all axes in a random fashion.
6. Click **Save** once the calibration is complete.
  7. Verify the heading accuracy of the calibrated unit by cross-checking the heading reading against that of an analogue compass or other accurate and reliable heading source.

### 10.4.3 Set HSI Offset Values Manually

For use cases that require custom calibration offsets to be compensated for, HSI offset values can be set manually.

**Note:** All HSI offset values are in milli Gauss (mG).

1. In the **Main Menu**, navigate to **Tools** → **Magnetic Calibration**.
2. Click **Reset**.
3. Click **Set Values Manually**.
4. Enter the hard iron offset correction values for X, Y and Z.
5. Enter the soft iron calibration values in the 3x3 matrix.
6. Click **Save** once the calibration is complete.
7. Verify the heading accuracy of the calibrated unit by cross-checking the heading reading against that of an analogue compass or other accurate and reliable heading source.

## 10.5 Firmware Update

### 10.5.1 Upgrading Hydrus

This section provides guidelines for performing software and firmware updates for Hydrus. Regular software and firmware updates are crucial to ensure optimal performance, security enhancements, bug fixes, and the availability of new features for Hydrus.

Before proceeding with any software or firmware update, it is essential to follow these preparatory steps:

1. **Backup:** Take a backup of all critical data, configurations, and settings related to the users Hydrus. This backup will serve as a safeguard in case of any unexpected issues during the update process.
2. **Review Release Notes:** Carefully read the release notes provided. Release notes contain valuable information about the changes, improvements, and known issues associated with the software or firmware update.
3. **Network Connectivity:** Ensure that Hydrus is connected to a stable and reliable network connection. Unstable or intermittent connectivity may lead to update failures or incomplete installations.

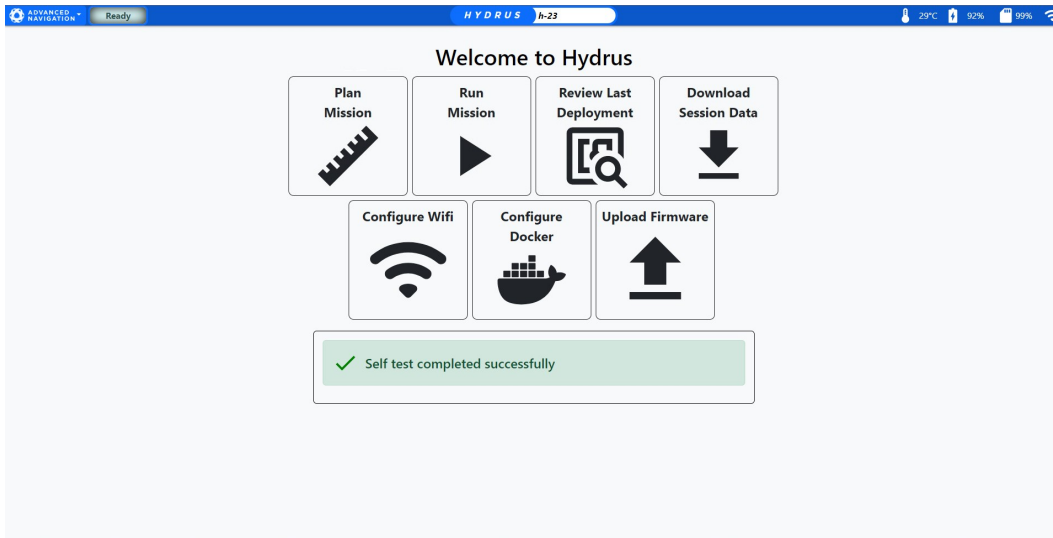


Figure 167: Hydrus webUI Main Page

2. Select Upload Firmware

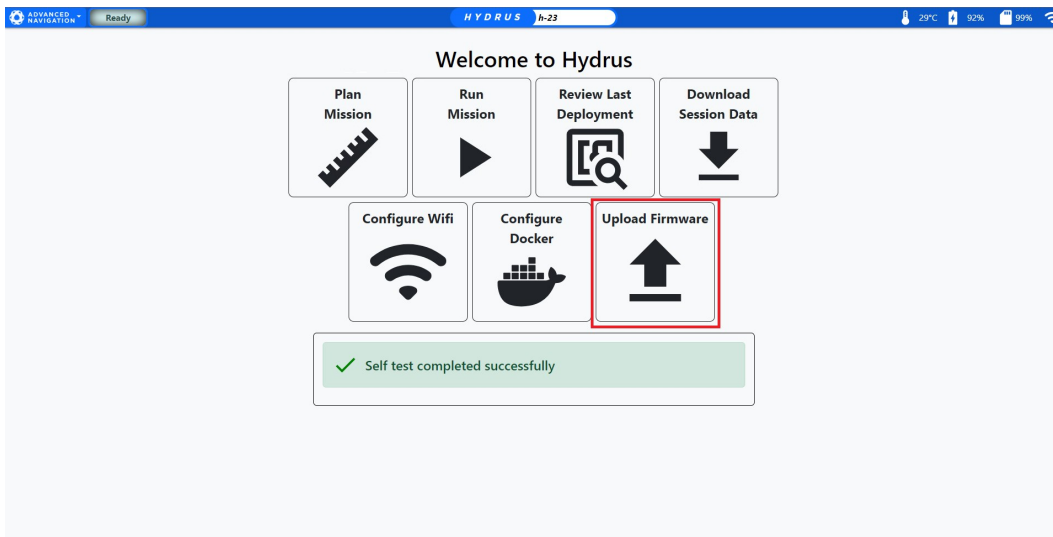


Figure 168: Upload Firmware

3. Click on the "Upload" button to select a new firmware file to upload to the Hydrus unit



Figure 169: New Firmware File

4. Select the previously downloaded file.

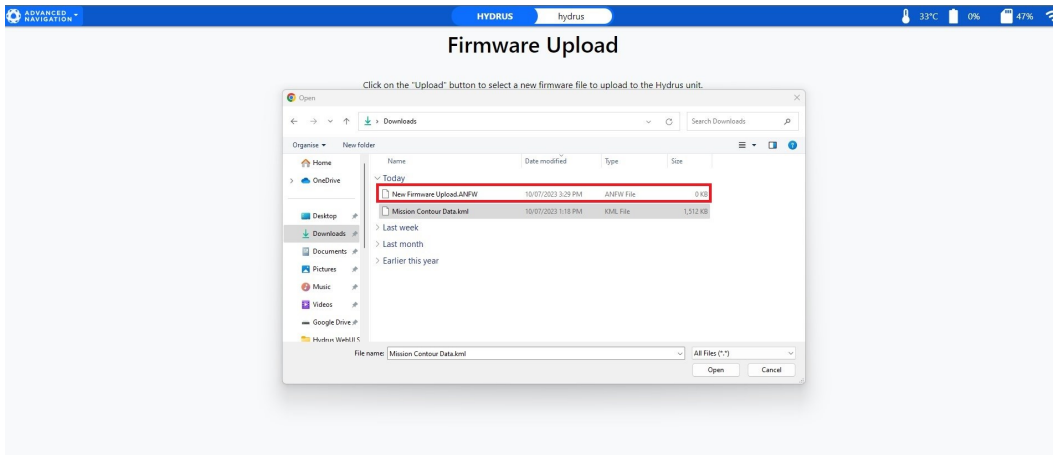


Figure 170: Firmware Upload File Selection

5. Click "Confirm"

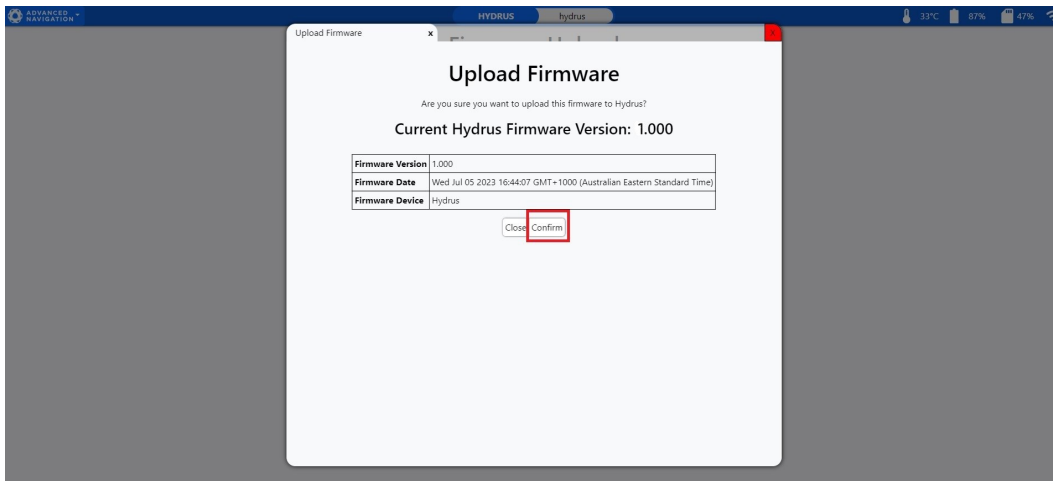


Figure 171: Firmware Confirm

6. Wait for Hydrus to complete upgrade and navigate back to main menu.

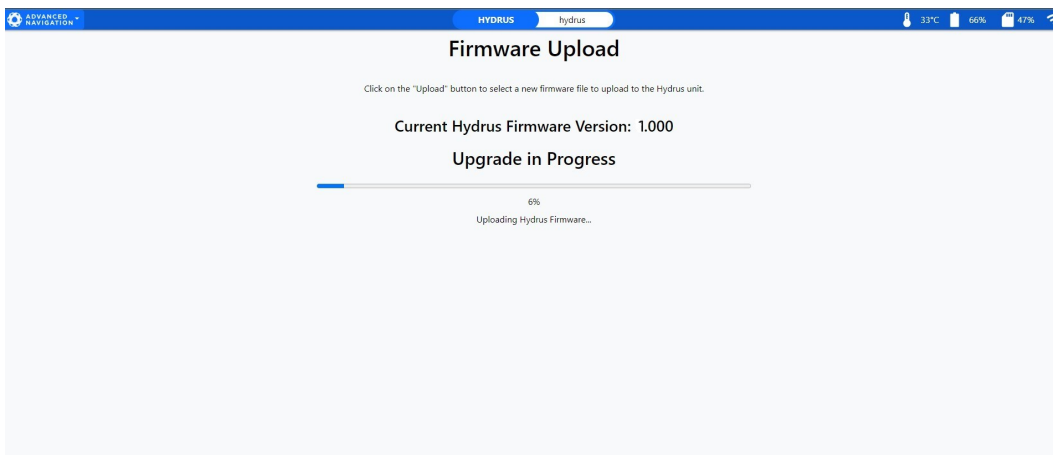


Figure 172: Upgrade in Progress.

**Note:** The Hydrus system will initiate a restart to implement the update, a process that may take some time. A notification will appear on the page to confirm the successful completion of the update. It is recommended that the user remains on the page and refrains from navigating away during this process.