![Advanced Navigation logo]

Hydrus
Reference Manual

Contents

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For more information, contact technical support via email at **support@advancednavigation.com**.

1 Revision History

Version	Date	Changes
1.1	06 Sep 2023	Updated terminology for network credentials, see **6.4 Connecting Hydrus** Added multi-select mode for session deletion functionality in webUI, see **10.1.2 Deleting Sessions** Added capability to enable Low Power Mode functionality for Hydrus in WebUI, see **6.3.2 Low Power**
1.0	02 Aug 2023	Initial Release

Table 1: Revision History

1.1 Firmware Changelog

Version	Date	Changes
1.1	6 Sep 2023	**Note:** When using with Subsonus, Subsonus must be running v3.30 or later Various webUI improvements INS stability improvements Add "Rebooting" to EPD display when user initiates a reboot Improved battery self test function Factory restore now resets mission_status.log Improve bailout behaviour due to INS instability Enable putting Hydrus in Low Power mode from WebUI Improved Task creation behaviour Recovery actions now accurately reflect waypoint status and reasons Improve import of GeoJSON tasks Improved station holding before commencing mission 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 detects 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 **Note:** 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 **11.4 Firmware Update**

1.2 Hardware Changelog

Version	Date	Changes
1.0	July 2023	Initial release

Table 3: Hardware Changelog

2 Introduction

Hydrus is an autonomous underwater vehicle designed for underwater missions. It contains an integrated DVL (Doppler Velocity Log), acoustic transponder & modem and INS (Inertial Navigation System). Hydrus provides obstacle detection and collision avoidance. Users can plan and execute missions in 3D using the online platform. Hydrus is equipped with a camera, sonar system, and sensors for data acquisition. It supports underwater terrain mapping, video and still image capture, and collects environmental data.

Hydrus autonomously navigates, avoids obstacles and collects data through the use of AI and advanced control algorithms. Hydrus can be programmed for complex missions and adjusts based on real-time data analysis.

2.1 Using the Manual

2.1.1 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.

2.1.2 Follow the manuals 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.

2.1.3 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.

2.1.4 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. 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,

2.1.5 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.

2.2 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 **3.5.1 Battery Power Supply** specifications for details of the battery contained within Hydrus

Figure 1: Sample Dangerous Goods shipping label

3 Specifications

For details, review the following specifications for Hydrus:

- **3.1 Hardware Specifications**
- **3.2 Compliance and Certification**
- **3.3 Navigation and Localisation**
- **3.4 Communication**
- **3.5 Power and Propulsion**
- **3.6 Camera and Lighting**
- **3.7 Software Extensibility**

3.1 Hardware Specifications

3.1.1 Physical Dimensions

Model	Dimensions
HYDRUS-300	484 x 264 x 216 mm
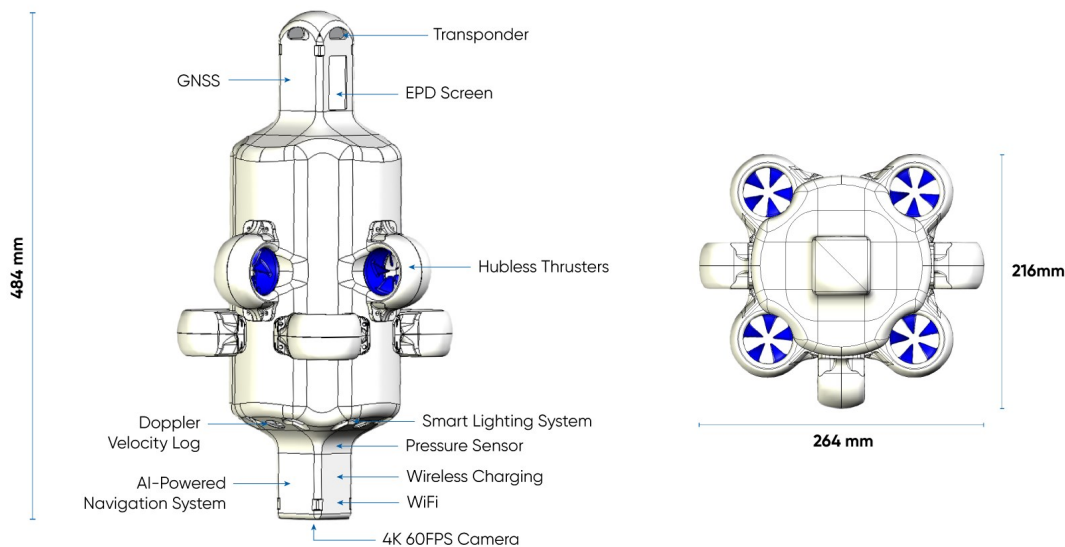
Figure 2: Hydrus Dimensions

3.1.2 Weight and Buoyancy

Hydrus is designed to be positively buoyant (float), and is configured to operate in standard ocean conditions (Water density of 1.025 kg/L). If users wish to operate Hydrus in liquids of significantly different density, Hydrus may require a modified buoyancy. Contact support@advancednavigation.com to discuss your operating conditions such that a suitable configuration can be determined

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

3.1.3 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

3.1.4 Operating Depth and Pressure Resistance

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

Model	Maximum Operating Depth (meters)	Pressure Resistance (bar)
HYDRUS-300	300	30

3.1.5 Storage Capacity

Model	Storage Capacity
HYDRUS-300	256 GB

3.2 Compliance and Certification

3.2.1 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.

3.2.2 Certification

Hydrus carries the following certifications:

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

3.3 Navigation and Localisation

There are a number of subsystems that contribute to the navigation and localisation processes that are essential to determining Hydrus's position and orientation accurately. A comprehensive description of the various components that contribute to the navigation and localisation capabilities is provided in this section.

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

3.3.1 Inertial Navigation System (INS)

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.

Specification	Value
Roll & Pitch Accuracy	0.1 °
Heading Accuracy (Magnetic)	0.3 °
Water Temperature Accuracy	0.5 °C
Dead Reckoning Accuracy	1 % distance travelled
Position accuracy with Subsonus Position Accuracy	0.25 m - 5 m range 1.5 m - 100 m range 5.0 m - 300 m range

3.3.2 Global Navigation Satellite Systems (GNSS)

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

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

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

3.3.3 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.

Specification	Value
Depth Range	300 m
Depth Accuracy	0.2 m

3.3.4 Doppler Velocity Log (DVL)

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.

Specification	Value
Operating Frequency	2 Mhz
Minimum Altitude	0.3 m
Maximum Altitude	10 m
Long Term Accuracy	0.1%
Velocity Resolution	0.01 mm/s

3.3.5 Transponder

When used with a Subsonus USBL, the Hydrus transponder provides acoustic communication for determining position and data transfer.

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

3.4 Communication

Hydrus is designed as a hybrid communications system that incorporates both Acoustic for underwater operations and Wi-Fi for above water communication.

3.4.1 Wi-Fi Communication

Wi-fi is used for configuration, mission planning and data payload download.

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

3.4.2 Wi-Fi Connection

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.

3.4.3 Subsonus USBL

Hydrus can be used with a Subsonus USBL 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.

Subsonus uses acoustics for positioning and data transmission.

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.

3.5 Power and Propulsion

The power and propulsion system of Hydrus is a crucial component that enables its autonomous navigation and underwater operation. This section of the manual provides an overview of the power source and propulsion mechanism utilised in Hydrus, highlighting their functions and considerations.

3.5.1 Battery 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.

Parameter	Description
Capacity	99 Wh
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 **2.2 Shipping Hydrus - Dangerous Goods**

3.5.2 Propulsion System

Hydrus employs hubless magnetic-driven thrusters for its propulsion system. These thrusters enable maneuverability and control during autonomous operations. Hydrus interchangeable thruster system allows for straightforward replacement. When following the step-by-step instruction provided in the **11.3 Impeller Maintenance** section of the manual the user will be able to interchange the thrusters without the need to disassemble or modify the central hub of the vehicle.

Parameter	Value
Propulsion Type	Hubless thruster
Thruster Quantity	7
Maximum Thruster Speed	3000 RPM
Hydrus Maximum Survey Speed	1 knot
Hydrus Maximum Transit Speed	2 knots

3.6 Camera and Lighting

3.6.1 Camera Specifications

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

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
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

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

Lighting Features	Specifications
LED Type	8 x Cree XHP LEDs

Lighting Features	Specifications
Continuous Illumination	20,000 lumens
Colour Temperature	5000K
Colour Rendering Index (CRI)	High CRI >90%

3.7 Software Extensibility

3.7.1 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 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 th 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.

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 Breech

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 **3.1.3 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 (webUI). Use the **8.1.2 Mission Planning Procedure** to create a survey task tailored to the user's requirements.

7. Customise mission parameters and patterns according to the specific survey task the user wants Hydrus to perform. Follow the **8.5 Mission Patterns** section 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 **9.3.2 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 **9.5.1 Steps to retrieve and secure Hydrus** 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 **11.2.1 Cleaning** section.

13. Access the WebUI to download the data collected during the mission. Use the **10.1 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 3: 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 **11.1 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.

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.
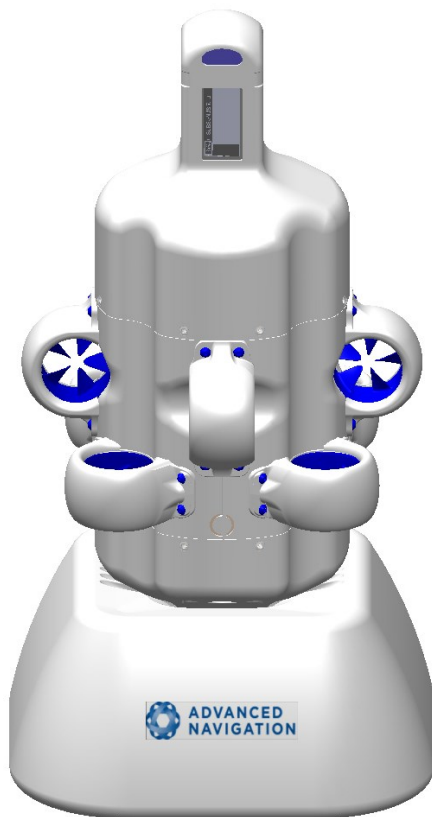
6.1.5 Initial Charge

- 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.
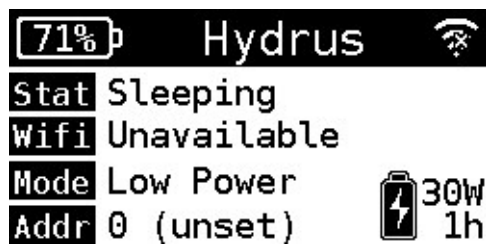
Figure 4: EPD Sleeping Status

- 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.
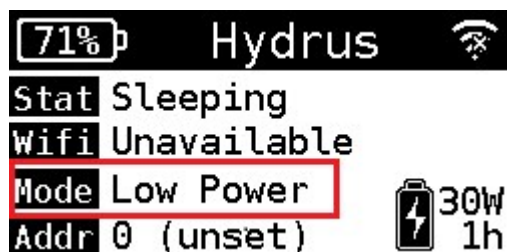
Figure 5: EPD Sleeping Status Verified

- 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.
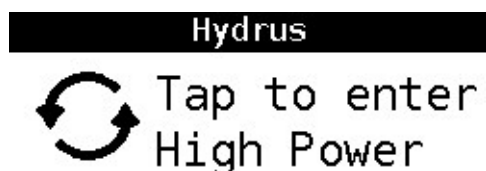
Figure 6: High Power State Prompt

- Tap the screen again, in response to the prompt mentioned above. Hydrus will move into a Booting Status this is confimed by the EPD screen below:
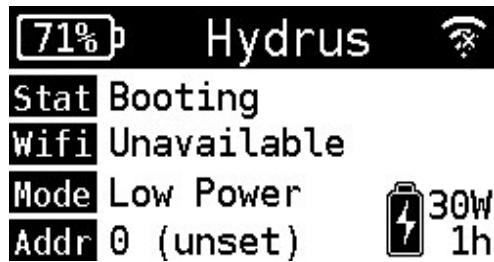
Figure 7: Booting Status

- Verify the mode to confirm that High Power has been successfully selected.
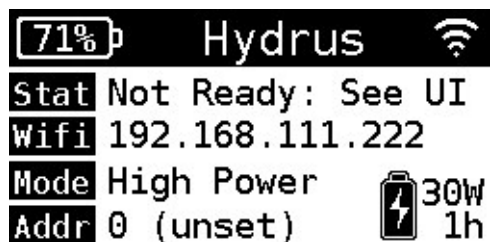
Figure 8: High Power Not Ready

- 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.
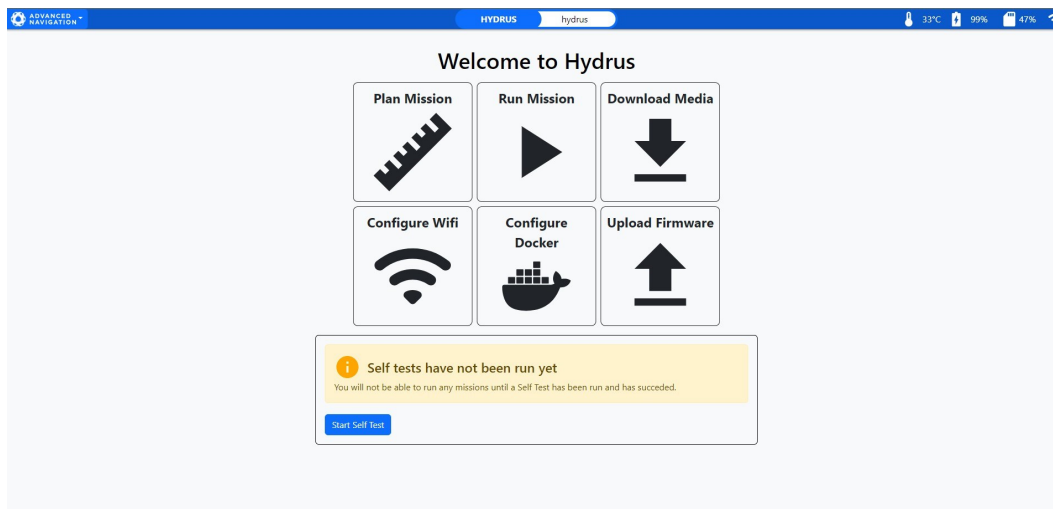
Figure 9: Hydrus WebUI Main Page

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.
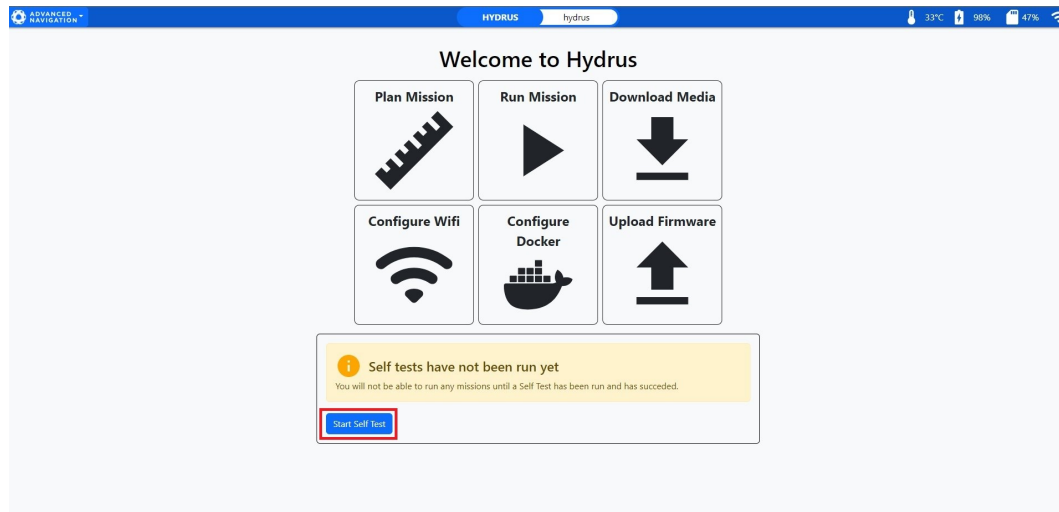
Figure 10: Start Self -Test

- Initiate the self-test process as guided by the instructions provided in the webUI.
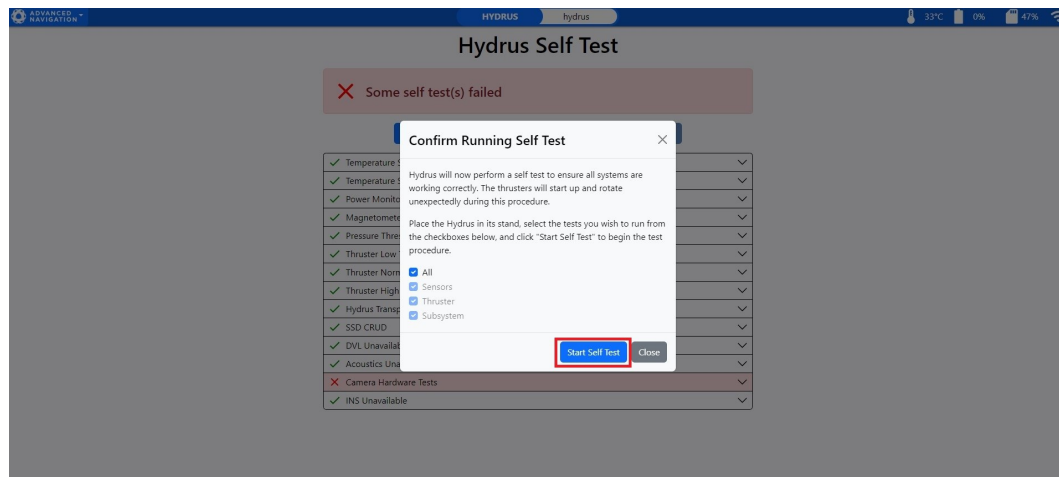
Figure 11: Self -Test Confirmation

- Pay attention to any error messages, warnings, or indications provided by the self-test process.
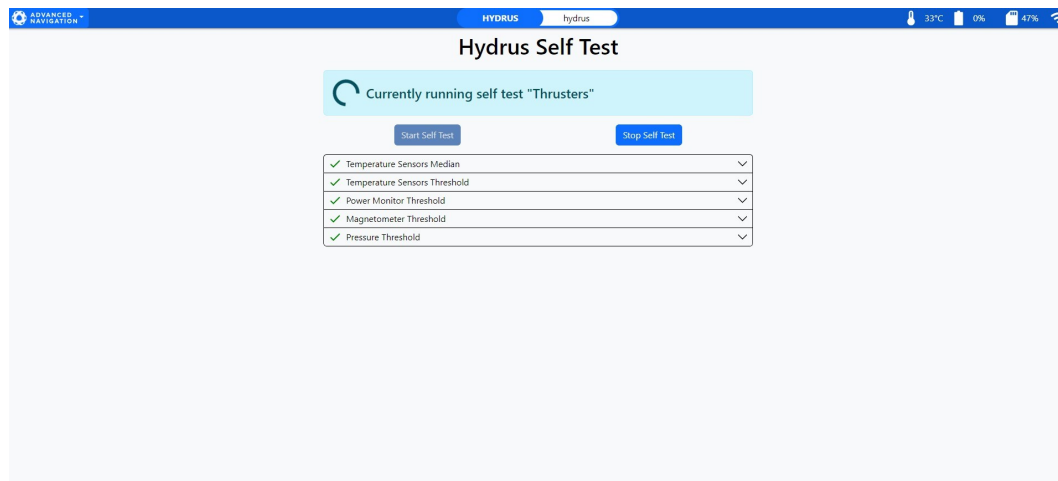
Figure 12: Self -Test Running

- The self-test will come up as complete, if the self-test identifies any issues or malfunctions, contact support@advancednavigation.com.
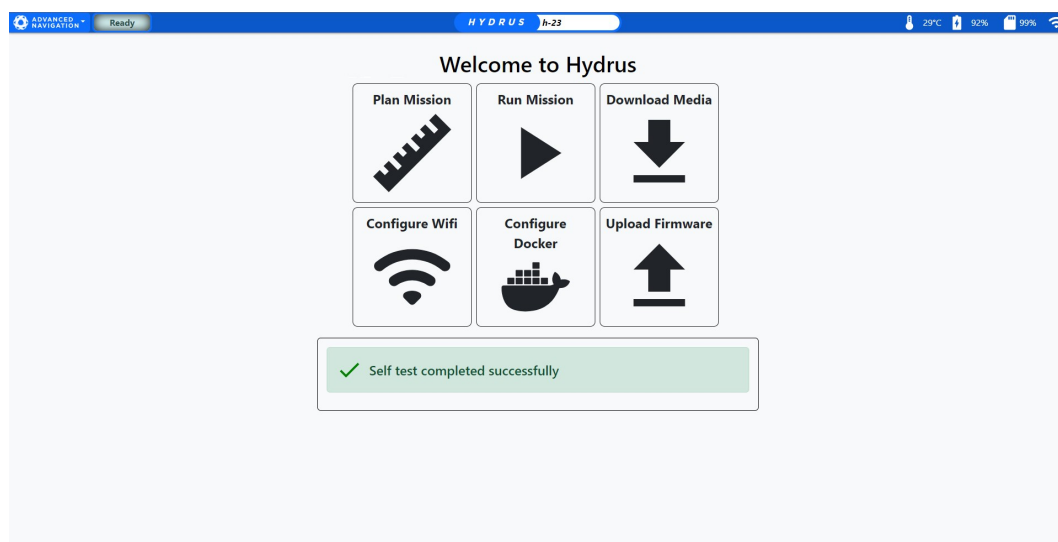
Figure 13: Successful Self -Test

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 **8.1 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


```
┌71%┐) Hydrus-14  �︵
Stat Ready to deploy
Wifi No Connection
Mode High Power
Addr 6
```

Figure 14: 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.

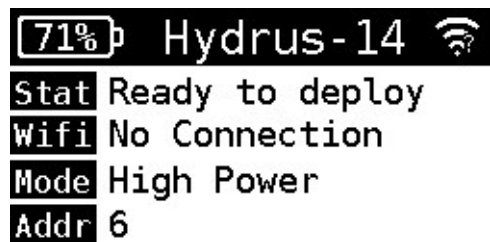| Indicator	Description
Top Indicator Bar	The Top Indicator Bar on an Electronic Paper Display (EPD) screen serves as a visual representation of important status information. It displays three key indicators: battery status, the device name, and the Wi-Fi connectivity level. • Battery Status: The battery 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. • Device Name: 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. • Wi-Fi Connectivity Level: 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 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.

Indicator	Description
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)
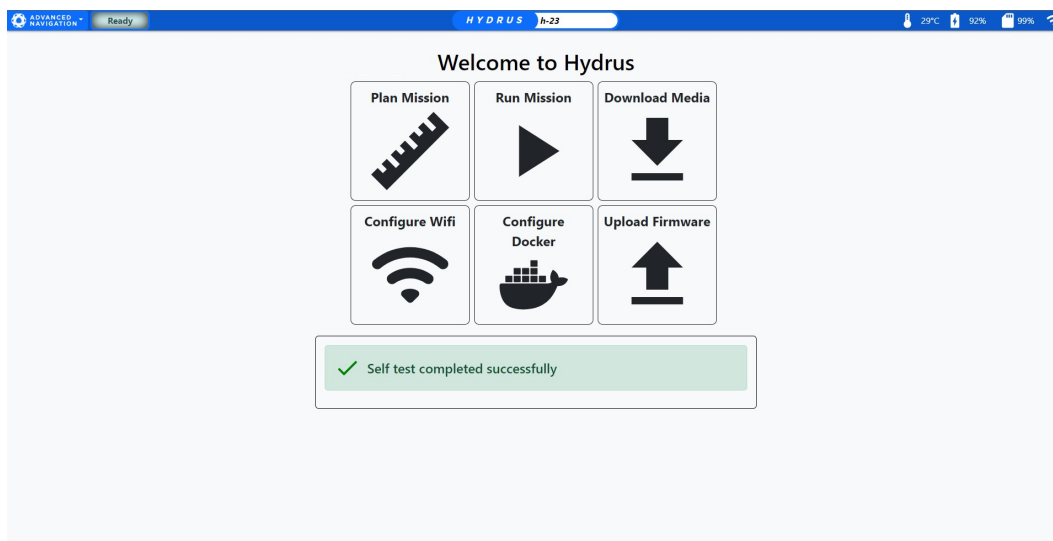
Figure 15: Hydrus WebUI Main Page

Figure 16: 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 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
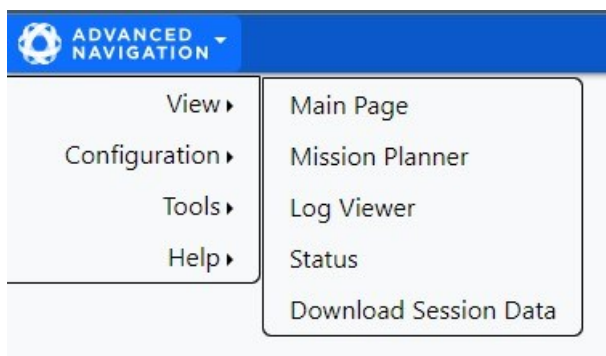
Figure 17: Advanced Navigation Drop-down Menu Options within "View"

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.
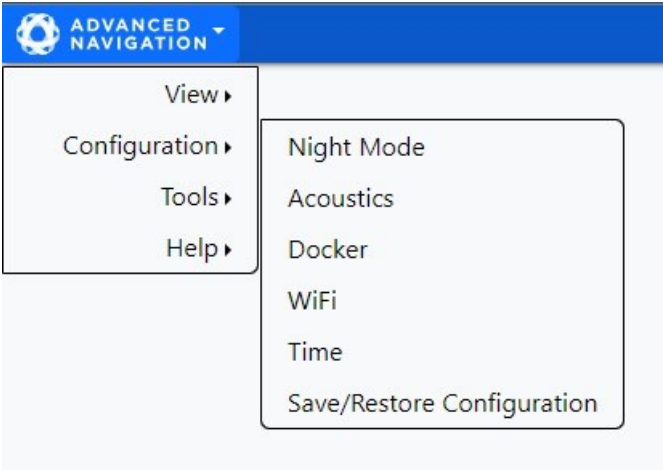
Advanced Navigation Drop-down Menu Options within "Configuration"

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 a comprehensive set of settings and options for connecting and configuring an 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.
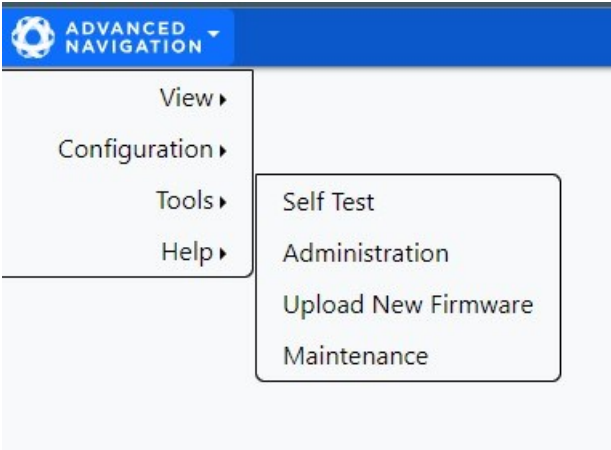
Advanced Navigation Drop-down Menu Options within "Tools"

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 Restarting Hydrus, Sending Hydrus to shipping mode and Resetting the INS
Upload New Firmware	Enables users to upload and install a new firmware version (ANFW file) to update and enhance Hydrus' capabilities.
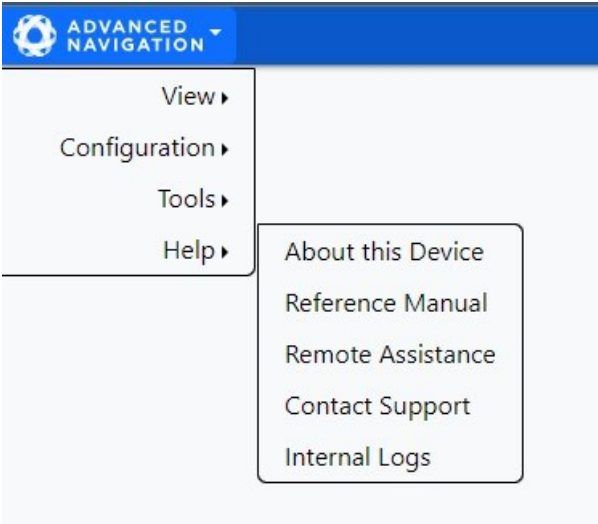
Advanced Navigation Drop-down Menu Options within "Help"

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, phone, or other available channels 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)
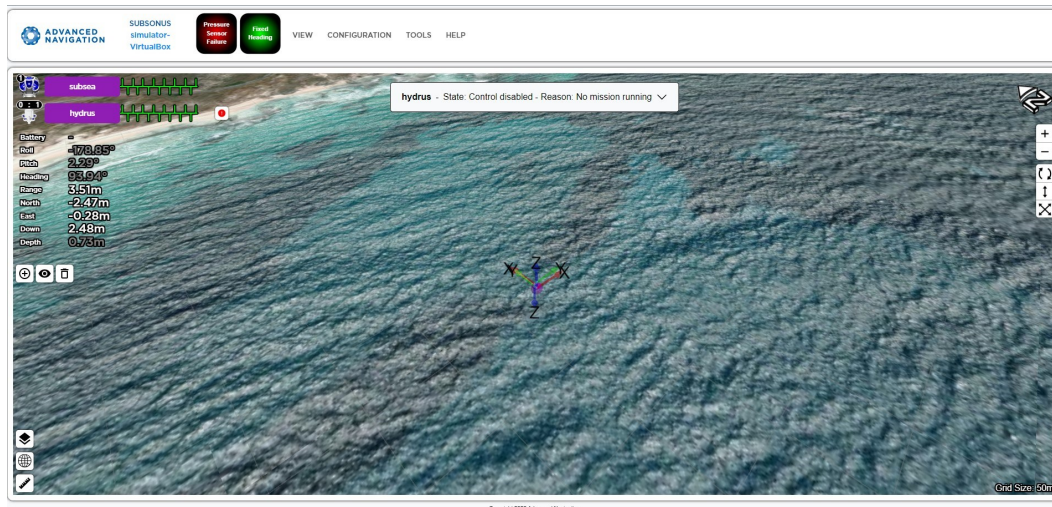
Figure 18: Subsonus WebUI Main Page

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.
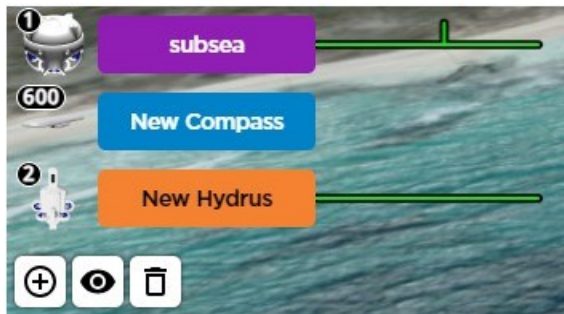
Figure 19: Subsonus Devices
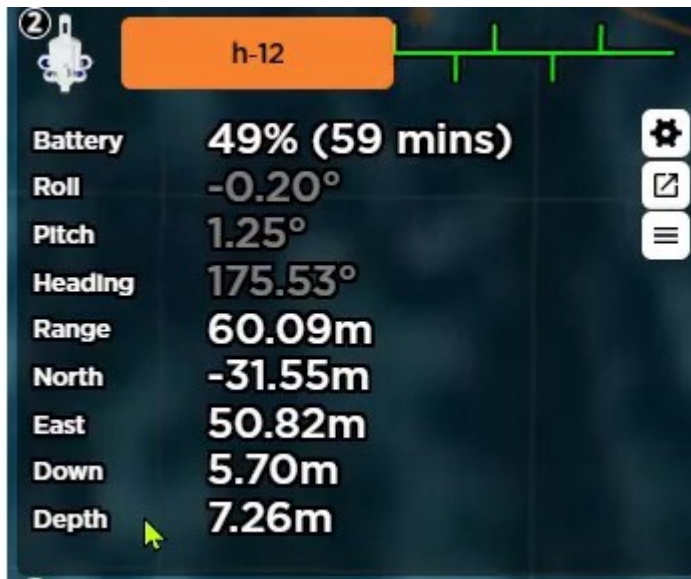
Figure 20: Device List

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.
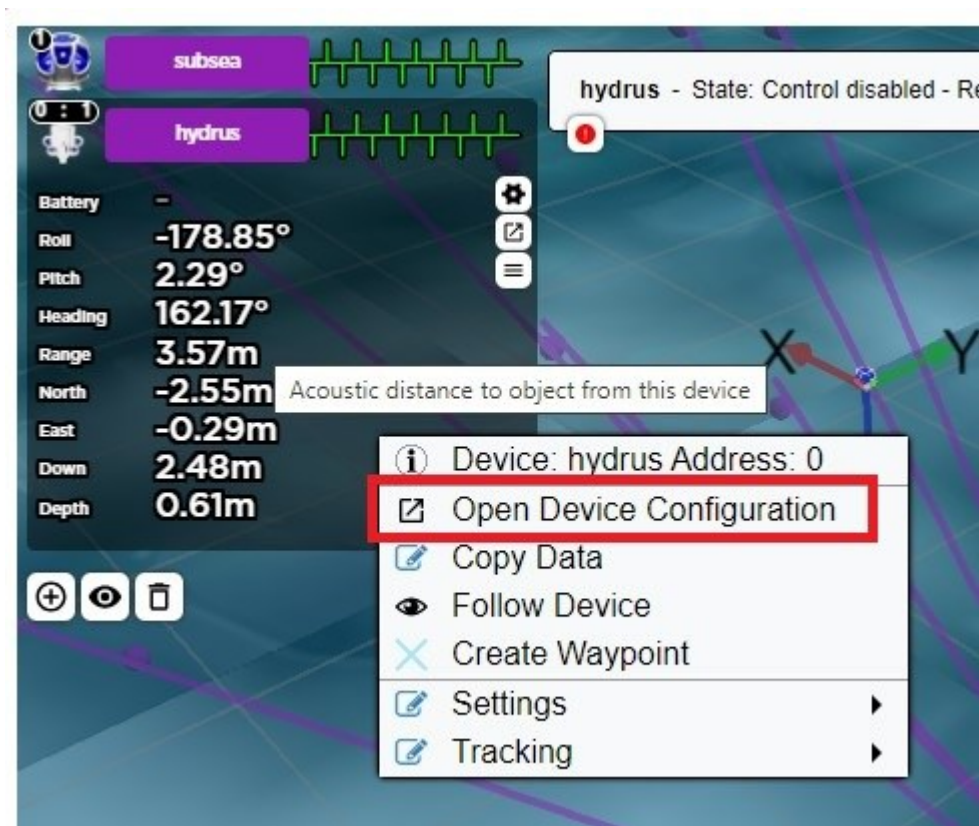
Figure 21: Open Device Configuration
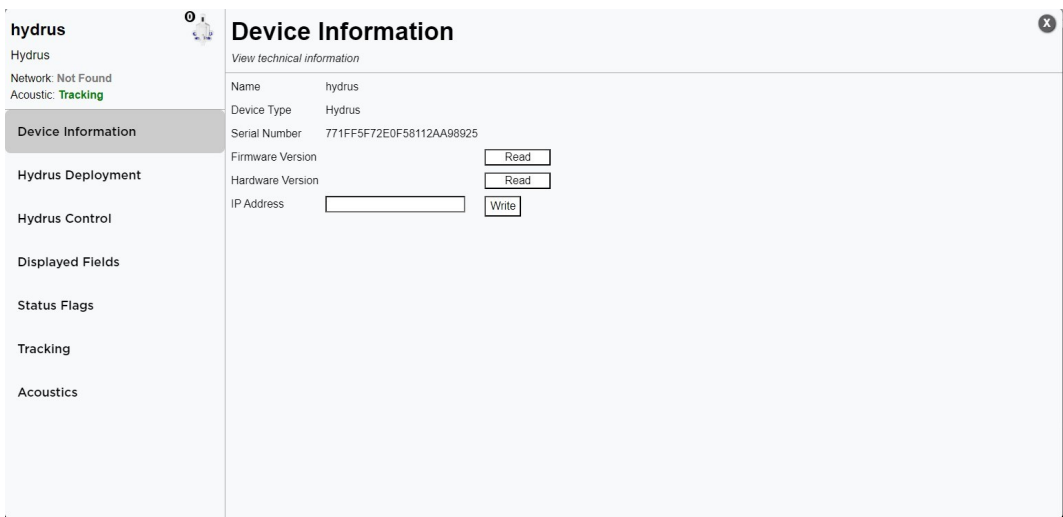
Figure 22: Hydrus Deployment

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.
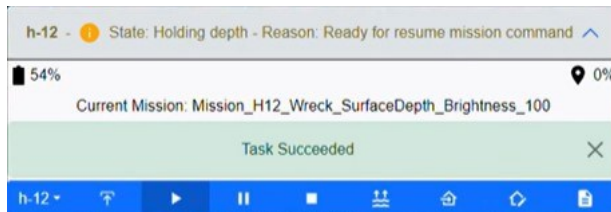
Figure 23: Hydrus Command Dialog Box

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. '**Change Device**' lets users switch to another Hydrus device.'**Open Hydrus Deployment Interface**' lets users access the interface to conduct Hydrus operations. '**Continue Mission**', '**Pause Mission**', and '**Abort Mission**' control the status of the current mission. '**Return to Surface**' and **'Go to Recovery Location'** directs the device to different locations.'**Set Recovery Locaton**' enables users to update the predetermined home location for Hydrus.'**Show Mission Reports**' 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 24: 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.
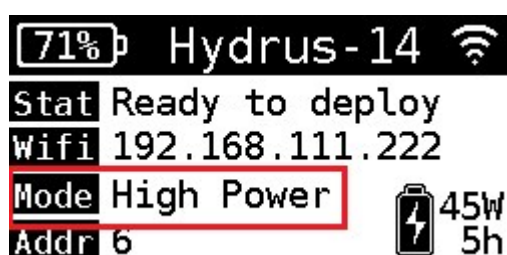
Figure 25: High Power

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.
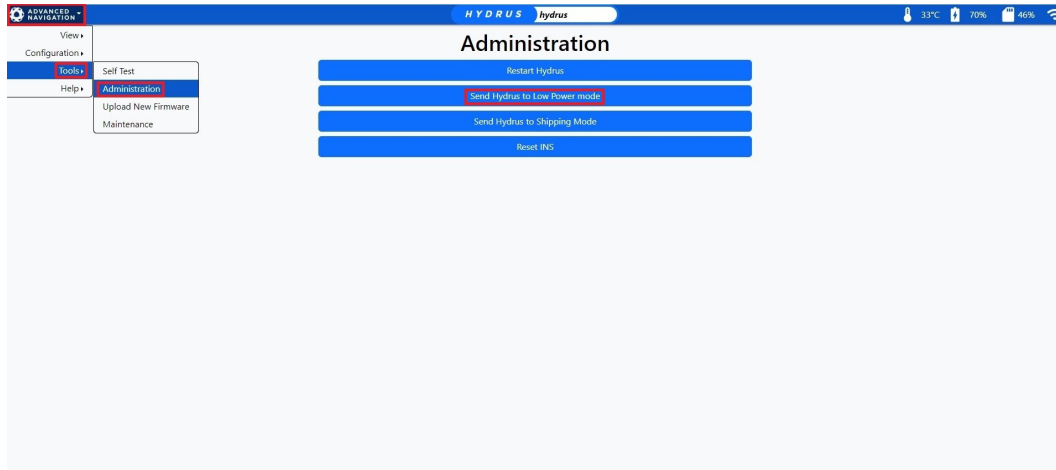
Figure 26: Navigate to Low Power WebUI

4. Read the confirmation dialogue box before selecting and sending Hydrus into a Low Power state.
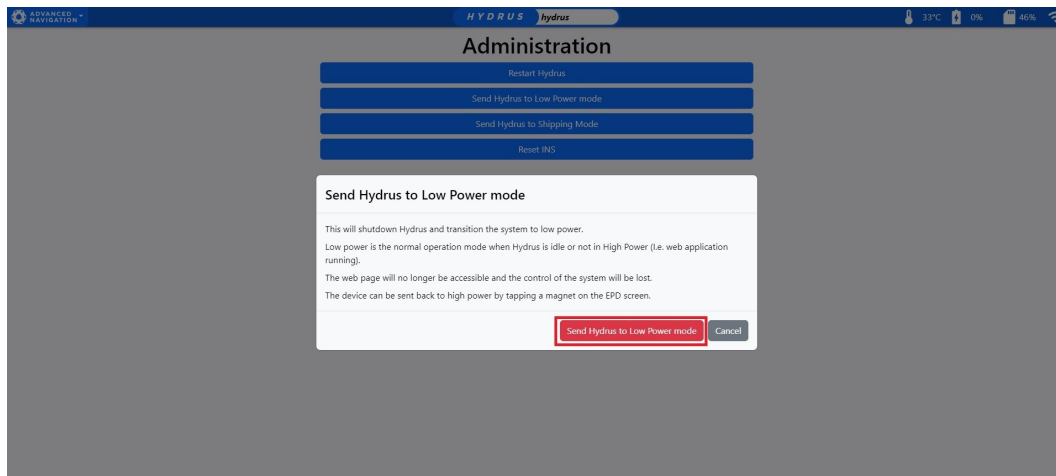
Figure 27: Confirmation to Low Power

5. Wait for confirmation of Low Power on the EPD screen of the Hydrus.
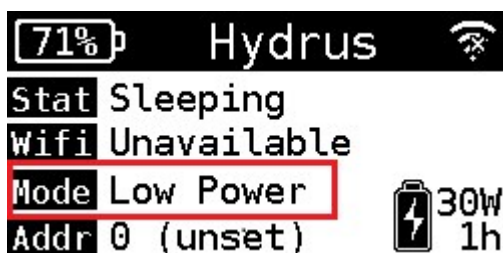
Figure 28: Low Power

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.
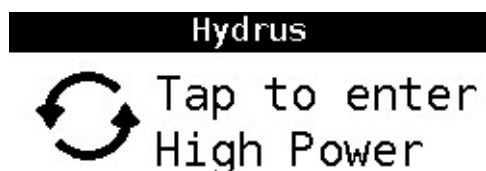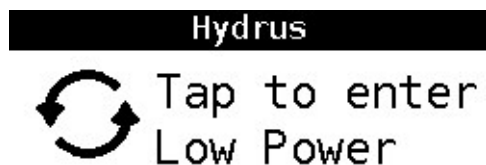

Figure 29: Tap to Enter Low Power

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.
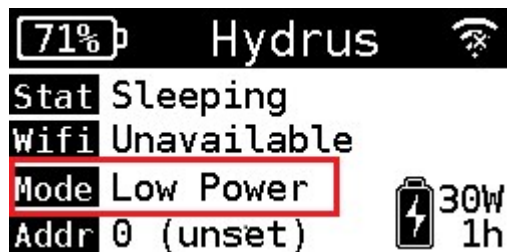

Figure 30: Low Power

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 31: 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".
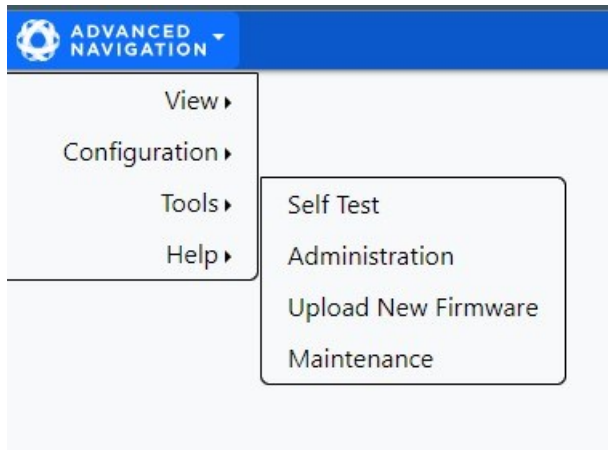
Figure 32: Advanced Navigation Drop Down Tools

2. In the Administration page, Select "Restart Hydrus"
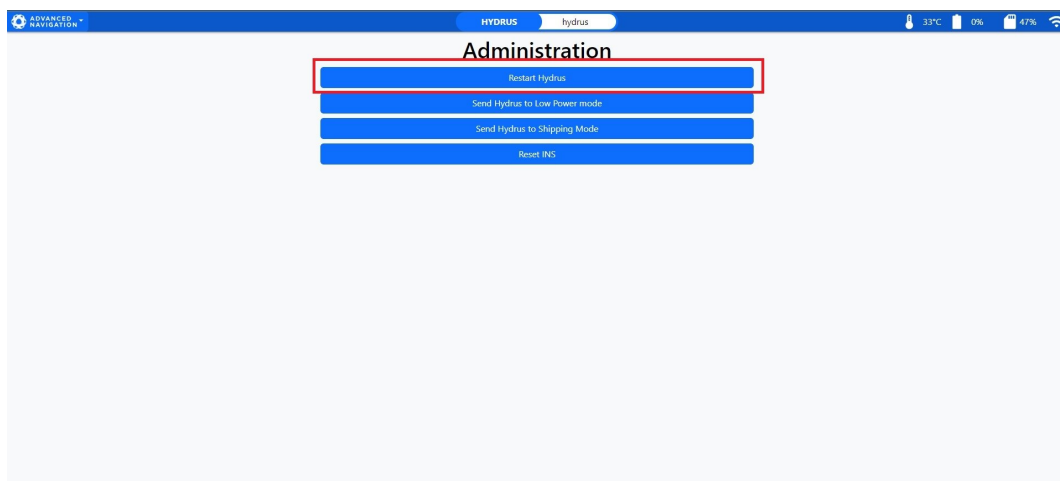
Figure 33: Hydrus WebUI Administration

3. Confirm Restart by selecting "Restart Hydrus".
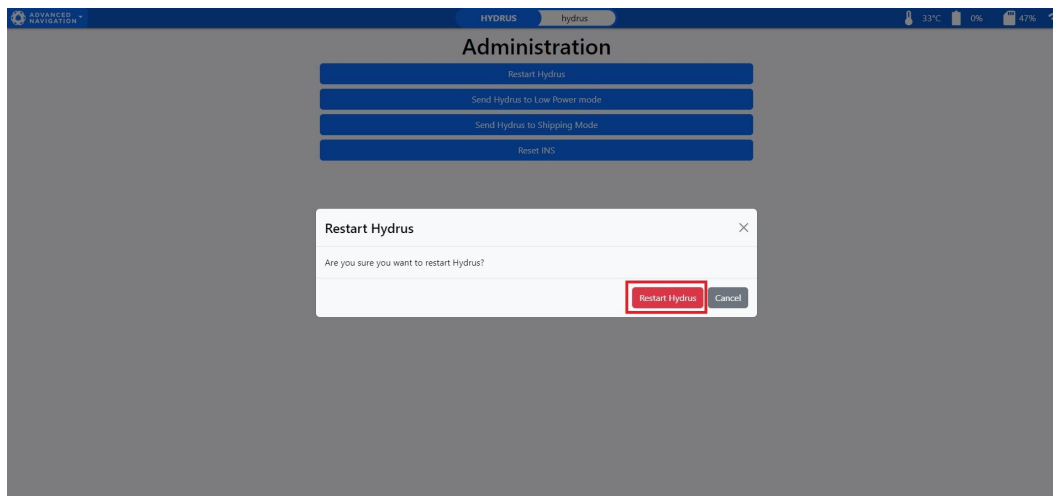
Figure 34: Restart Hydrus

4. Hydrus will indicate that it is restarting, click "ok" and return to the EPD screen and wait till Hydrus reboots
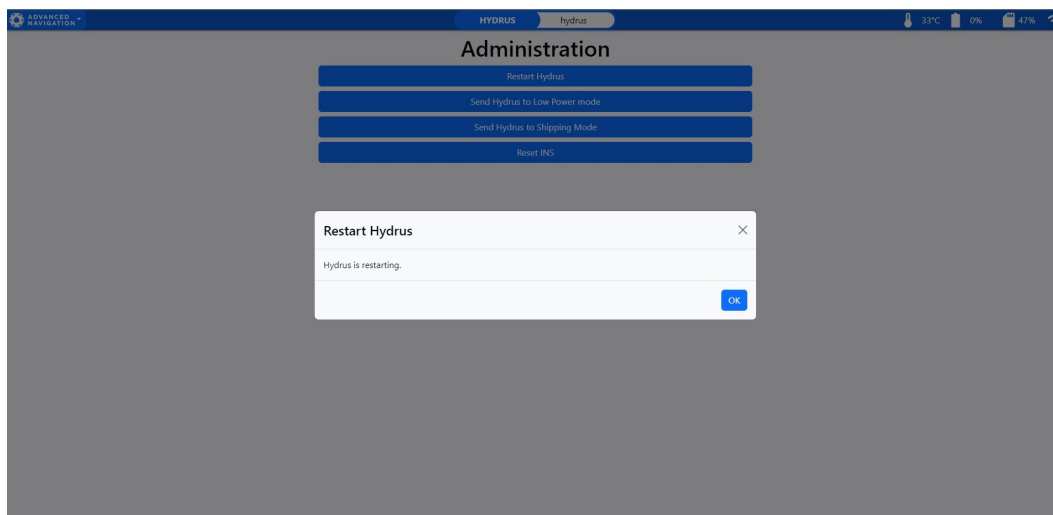
Figure 35: Hydrus Restarting

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's 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's Interface**: Once connected, open an internet browser. In the address bar, type in '192.168.0.1'. The user will see a screen the that represents Hydrus's user interface. From here, the user can manage Hydrus.
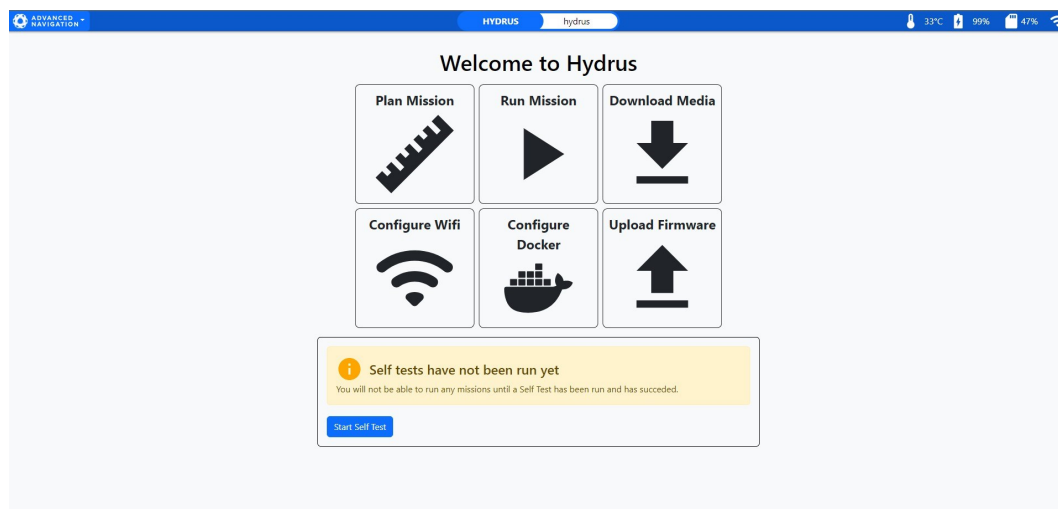
Figure 36: Hydrus WebUI Main Page

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.
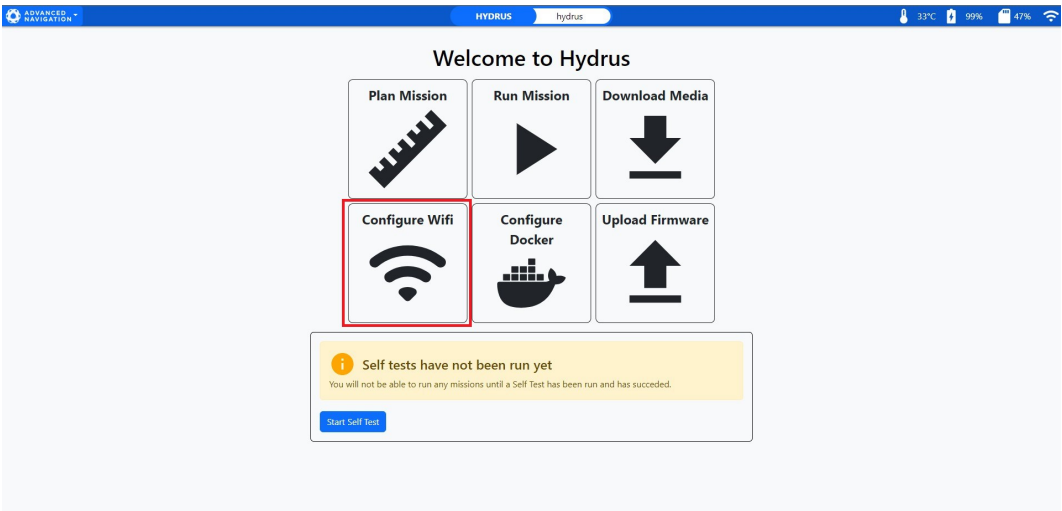
Figure 37: Wi-Fi Icon

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

Figure 38: Add Network

4. **Run Scan**: Click Run Scan for Hydrus to initiate its run scan function to search for the network the user requires.
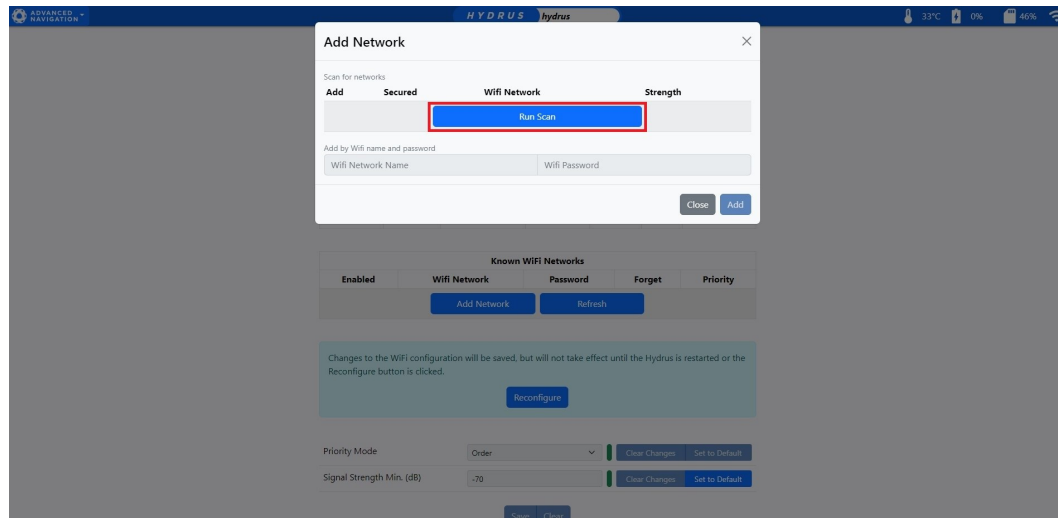
Figure 39: Wi-Fi Configuration Run Scan

5. **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.
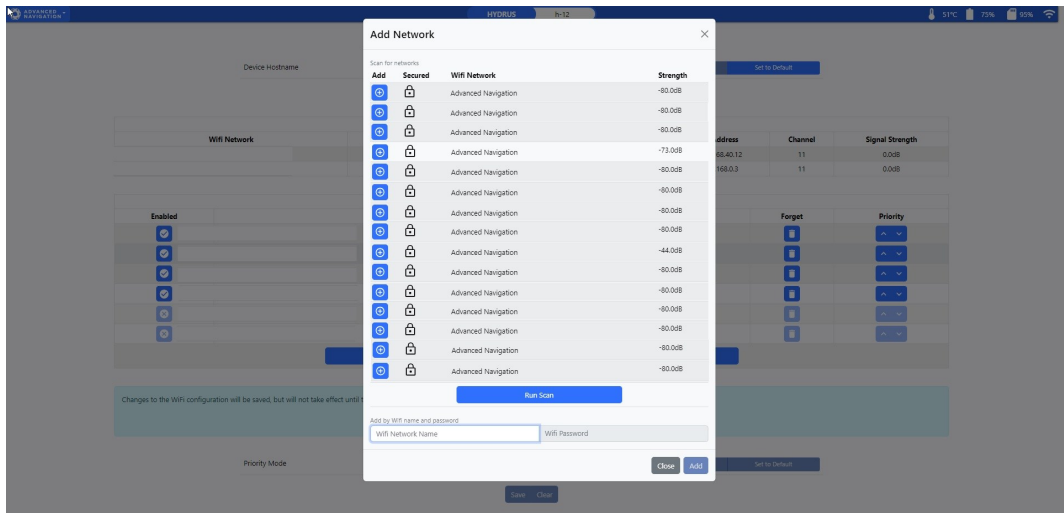
Figure 40: Wi-Fi Configuration Network
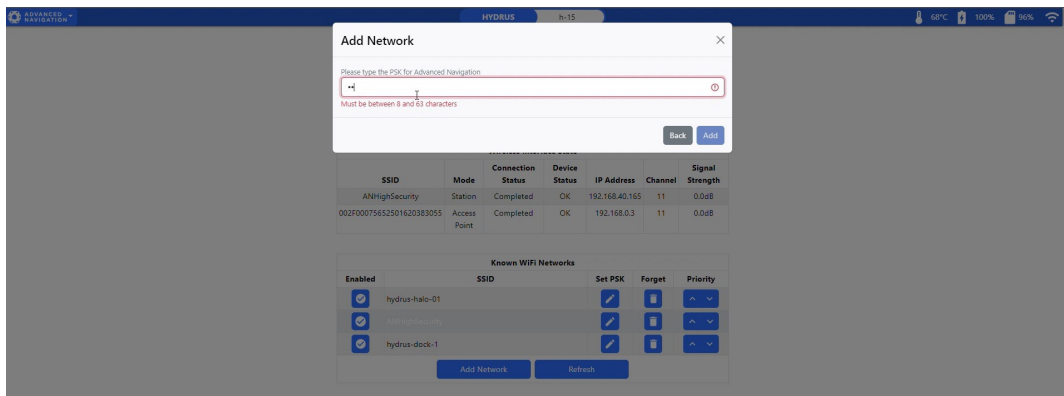
Figure 41: Wi-Fi Configuration Password

6. **Set Priority** : The user has the option to select the priority of the networks Hydrus can connect to.
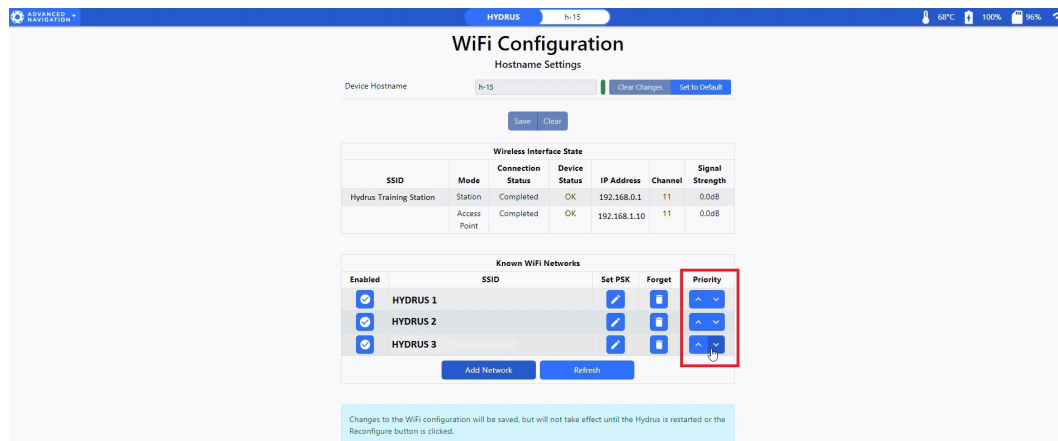
Figure 42: Wi-Fi Configuration Priority

7. **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.
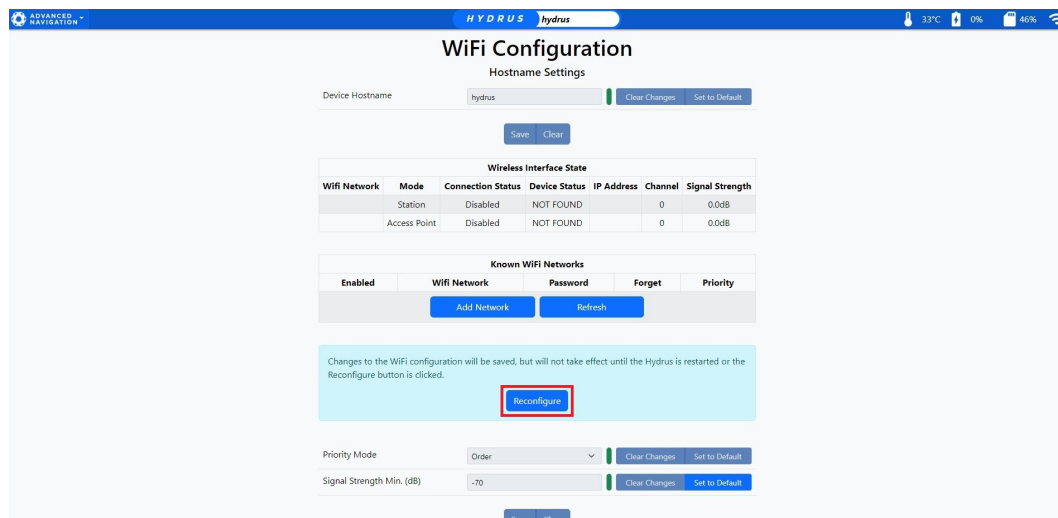
Figure 43: Wi-Fi Configuration Reconfigure

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 **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**

8. Add the GNSS compass as an aiding device for the surface Subsonus. 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 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 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.
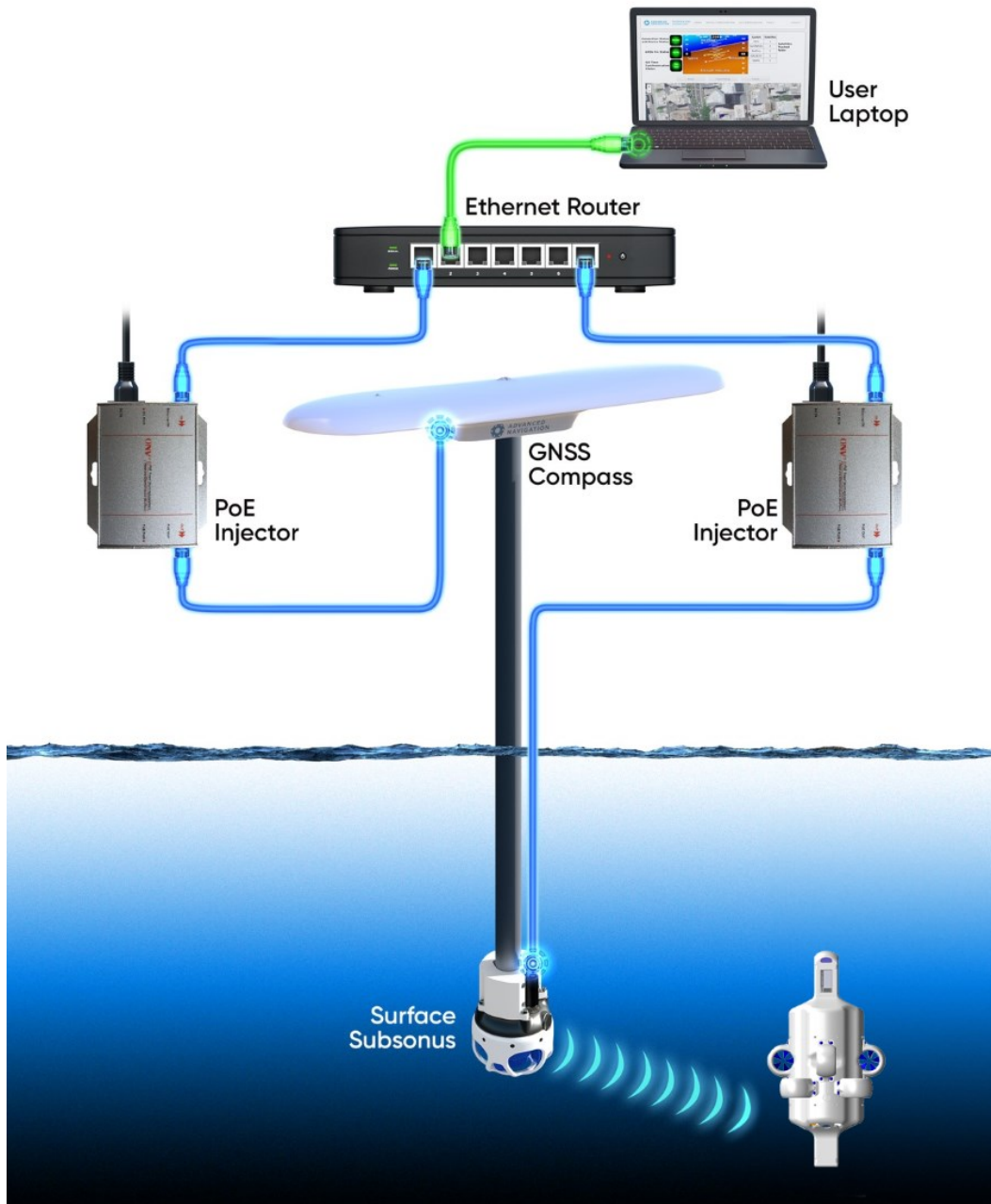
Figure 44: Connection Diagram

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 45: Typical Subsonus Surface Mounting**.
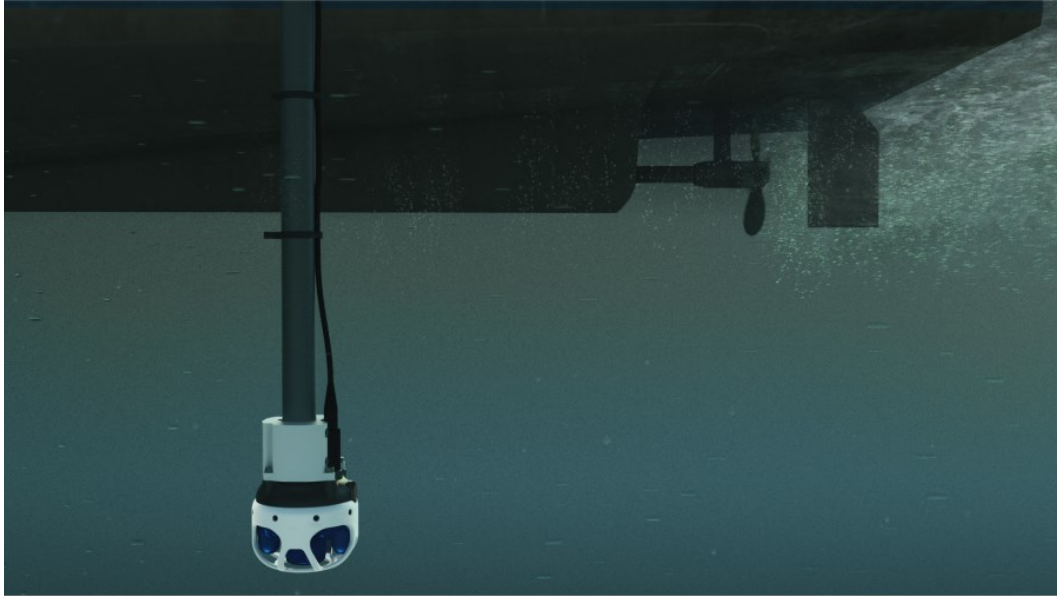
Figure 45: Typical Subsonus Surface Mounting

Mounting goals with the surface unit are:

1. The Subsonus unit should be mounted with the hydrophone array and cage pointing directly down into the water.
2. 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.
3. 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.
4. The Subsonus unit should be mounted at least 1 metre away from the boat hull or jetty.
5. 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 46: 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 47: 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 48: Advanced Navigation GNSS Compass mechanical drawing** for mechanical details.
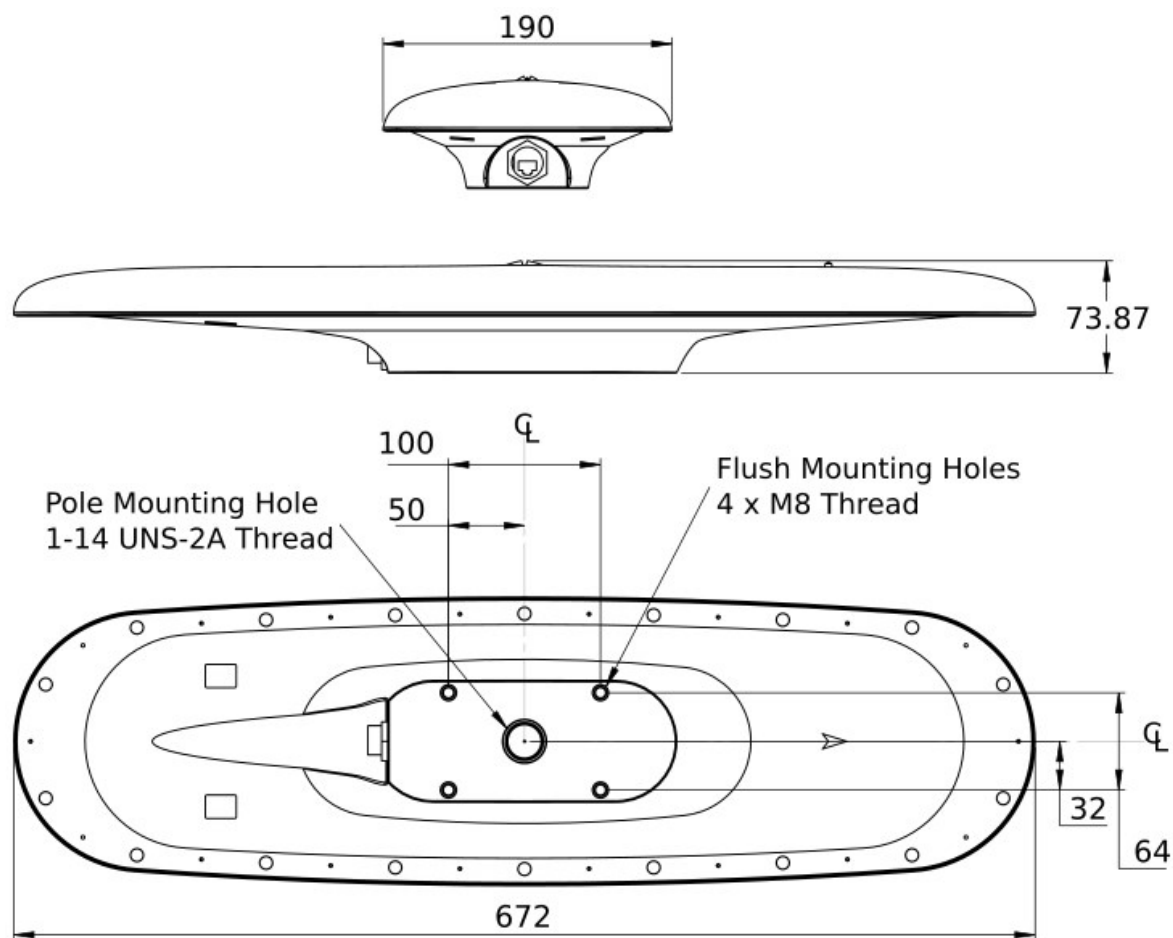
Figure 48: Advanced Navigation GNSS Compass mechanical drawing

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 49: Advanced Navigation GNSS Compass mounting**
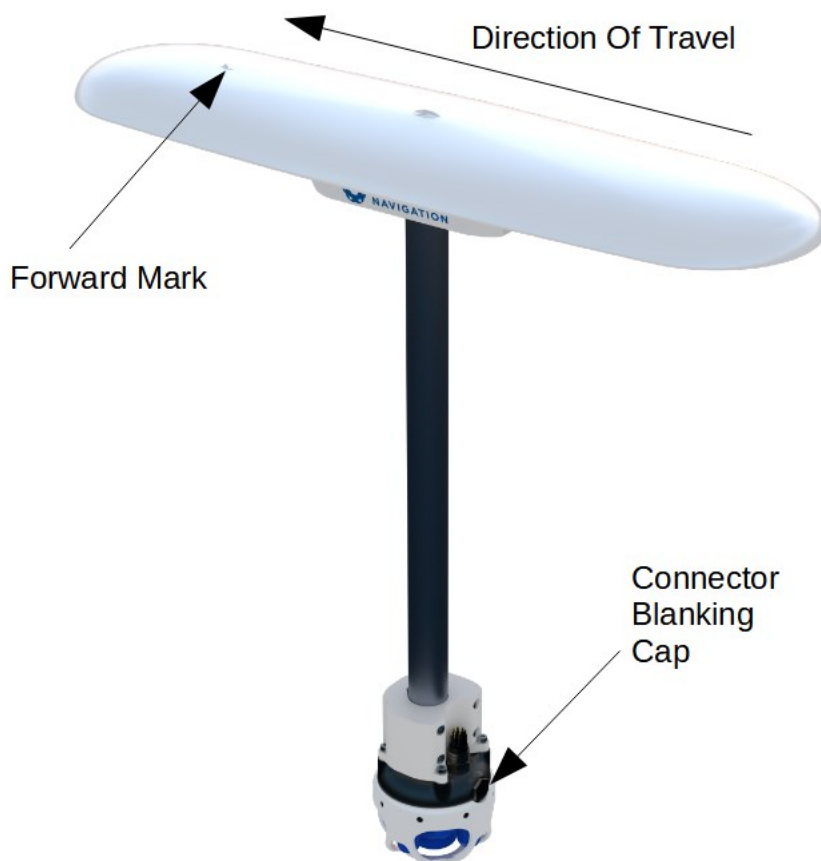
Figure 49: Advanced Navigation GNSS Compass mounting

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.
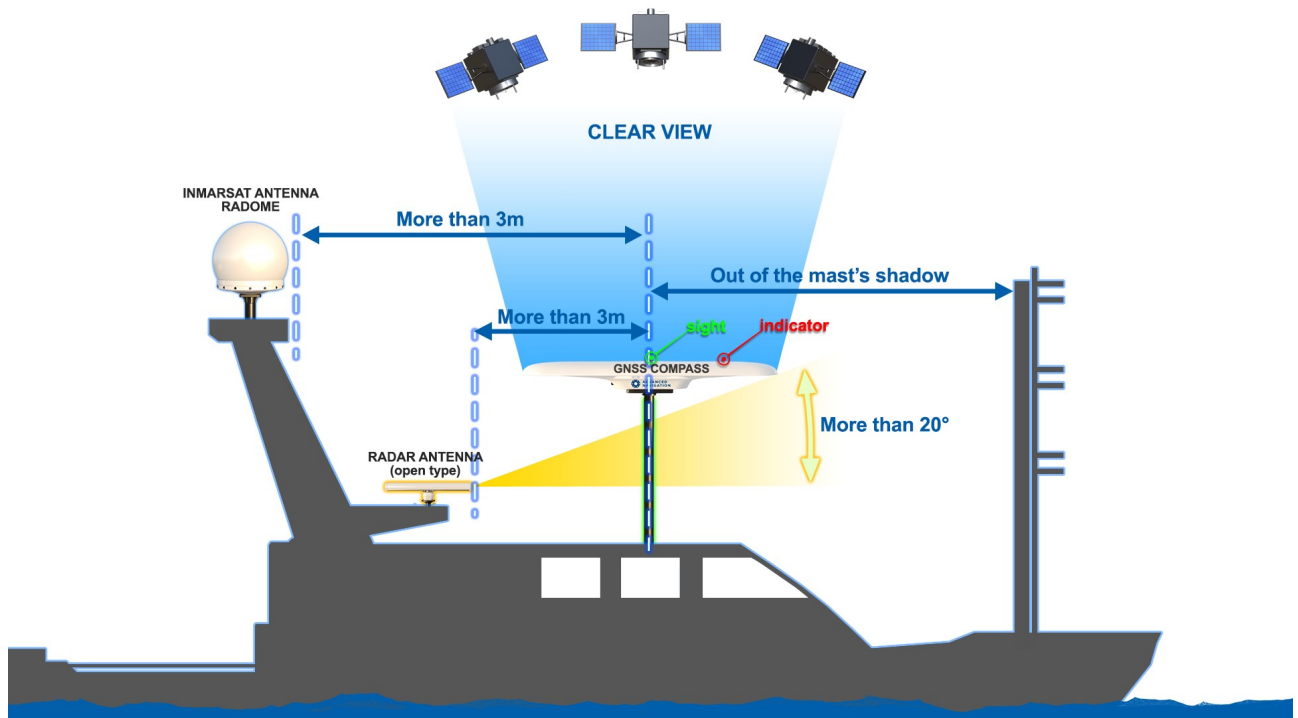
Figure 50: Mounting location example

Mounting Alignment

The GNSS Compass should be mounted with its forward indicator pointed in the direction of travel of the vehicle. The connector blanking cap on Subsonus should be pointing in the opposite direction of the GNSS Compass forward indicator, see **Figure 49: 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 51: GNSS Compass Alignment**.
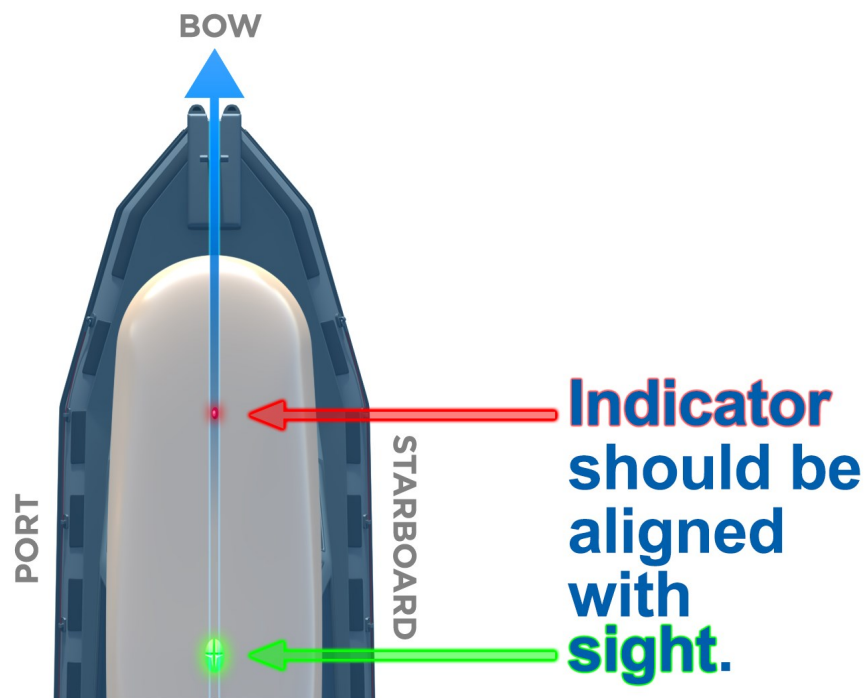
Figure 51: GNSS Compass Alignment

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 52: GNSS Compass and Subsonus Offset direction** for more information.
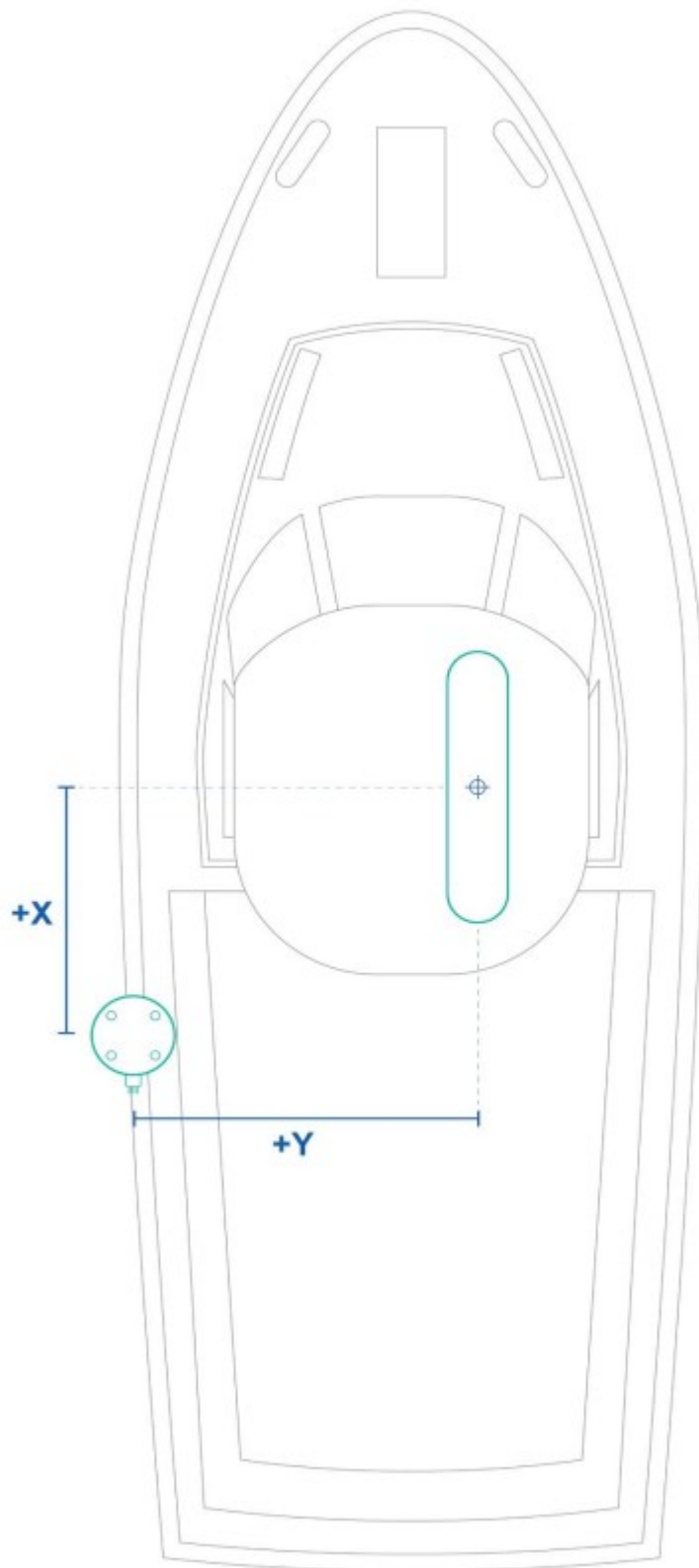
Figure 52: GNSS Compass and Subsonus Offset direction

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 53: GNSS Compass shown in device list**.
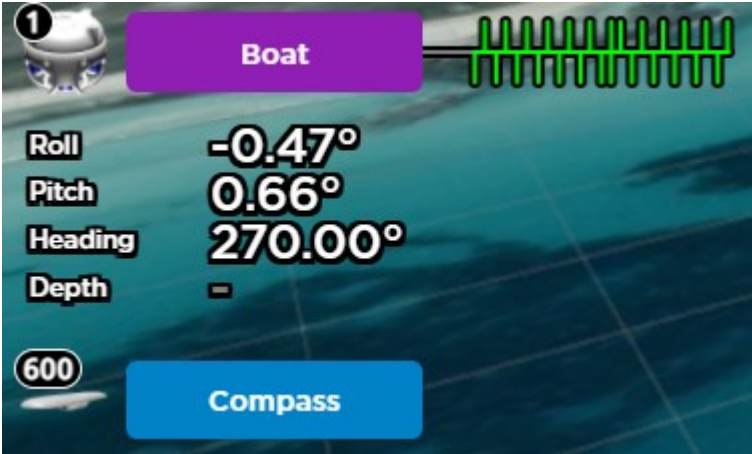
Figure 53: GNSS Compass shown in device list

The GNSS Compass will also appear under "Configuration"→"Devices". See **Figure 54: 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.

Figure 54: 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 Hydrus**.

> **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 addresses, see **Device Address Configuration**

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
❶ Boat (This Device)	Subsonus	-	-	Configuration

Figure 55: 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 Considerations

7.1 Environmental Considerations

This section is to provide guidance on the environmental consideration to be taken into account when operating Hydrus.

7.1.1 Water Temperature

Hydrus is designed to operate within its designed **3.1.3 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.

7.1.2 Water Density

Hydrus is optimised for standard ocean density of 1025 kg/m³ 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

7.1.3 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 tidal patterns and current profiles is crucial for effective operation.

7.1.4 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.

7.1.5 Biological Considerations

Hydrus's operations should consider potential impacts on marine life and ecosystems. Its impellers or thrusters 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.

7.1.6 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.

7.1.7 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 Power Management and Endurance

7.2.1 Charging

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

Note: 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.

8 Mission Planning

8.1 Mission Planning Process

The mission planning process entails a series of steps to effectively prepare for a mission. It is important to review the assumptions provided to establish the necessary context. These assumptions outline the initial conditions for planning a mission on a boat using Hydrus with Subsonus and GNSS Compass (as provided in **11.1.4 Hydrus 300 Subsonus Surface kit**) and setup as per **6.5.1.1 Subsonus Surface Installation Checklist**. Once familiar with the assumptions, by following the **8.1 Mission Planning Process**, users can navigate through each action, from initiating the mission planner and establishing device connections to configuring survey parameters and saving the mission.

8.1.1 Assumptions

Understanding the assumptions beforehand ensures a comprehensive understanding of the mission planning process and allows for smoother execution of the steps outlined in the accompanying table.

Assumption	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 **6.5.1.1 Subsonus Surface Installation Checklist**
GNSS Compass is installed on the boat	Optional: GNSS Compass is installed on the boat as per **6.5.4.1 Advanced Navigation GNSS Compass**
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	**Offset Measurement** values between the Surface Subsonus and the GNSS Compass have been entered into the system for accurate positioning.

8.1.2 Mission Planning Procedure

Step	Actions	Notes
1.	Click **Plan Mission** on the home page	See **8.2 Mission Management**
2.	Click the **Create New** button on the Mission planner - Welcome dialog box	
Connect Hydrus to Subsonus		
3.	Click the Open Device Configuration dialog button	Located next to the Menu drop-down
4.	Type in the IP address and port number of Subsonus inside the IPv4 Address space in the format (IP	To locate the IP address of Subsonus, access the Subsonus webUI and

Step	Actions	Notes
	Address):(Port), and click connect.	Navigate to Configuration > Ethernet. The port number is [**16718**]
5.	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 model of Subsonus.	
Add a Survey Task		
6.	Click the **Add New Task** button	
7.	Click **Add new Lawnmower / Transect Survey**	
8.	Click on the map to create a new region or path where the survey needs to be conducted	Ensure the map is zoomed out enough so the location of the survey can be identified
9.	Select the **Lawnmower Polygon Task** or **Waypoint Task** from the left hand panel	
10.	Orientate or move the survey polygon to the desired position	See **8.3 Mission Planning Tools** for further reference
11.	Set required parameters specific to the task	See **8.5 Mission Patterns** for further reference
12.	Set the Media Capture type	Hover over each media capture preference to define its meaning or see **8.5.4.2 Media Capture**
13.	Set **Camera Parameters** for the task	See **8.7 Camera Parameters** for further reference
Recovery Location		
14.	Click on **Recovery Location** from the left hand panel	
15.	Select Home Point Type	This is the recovery location, either Relative to Subsonus or a Geodetic location.
	If Relative to Subsonus is selected, set Bearing Angle and Distance	The bearing, in degrees, from the port direction of the Subsonus unit that is controlling Hydrus. The default is set to 90 degrees. The Distance, in meters, along the Bearing Angle previously entered
	If Geodetic location is selected set a Latitude and Longitude	
Mission Parameters		
16.	Click **Mission** from the left hand panel	
17.	Click **Acquire GNSS Fix** checkbox	This will instruct Hydrus to get GNSS fix prior to the mission starting.
18.	Set **Bailout Conditions** to suit the current mission	See **8.8 Bail-out Conditions** for further reference

Step	Actions	Notes
19.	Set **Pause Depth**	Used during deployment and recovery, Hydrus will pause at the depth defined
20.	Click **Menu** from the left hand panel and click **Save Mission As**	
21.	Name the mission and click Save	Note, spaces are not allowed in the mission name.

Note: The next steps for Hydrus to be deployed can be found in **9.2 Hydrus Pre-deployment**

8.2 Mission Management

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

- **8.2.1 Creating New Missions**
- **8.2.2 Editing Existing Missions**
- **8.2.3 Importing and Exporting Missions**

8.2.1 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 **8.1 Mission Planning Process** for more information.

8.2.2 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.

8.2.3 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 catalogs created by mission specialists.

8.2.3.1 Import Procedure

1. Open the Hydrus webUI
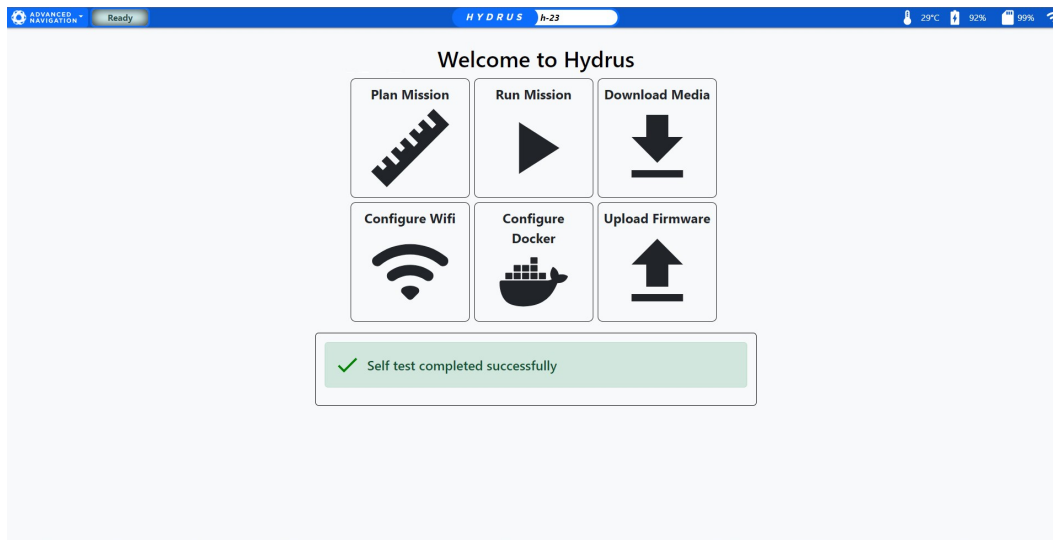
Figure 56: Hydrus WebUI Main Page

2. Click "Plan Mission", this will take the user to the mission planning section.
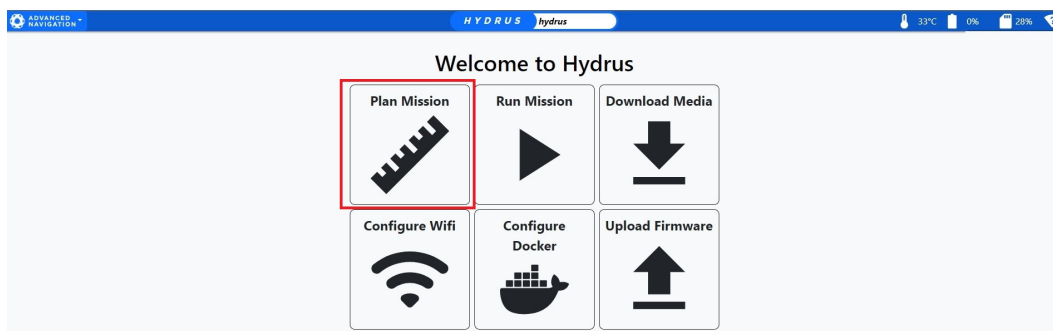
Figure 57: Plan Mission

3. In the Welcome Planner click "Import mission"
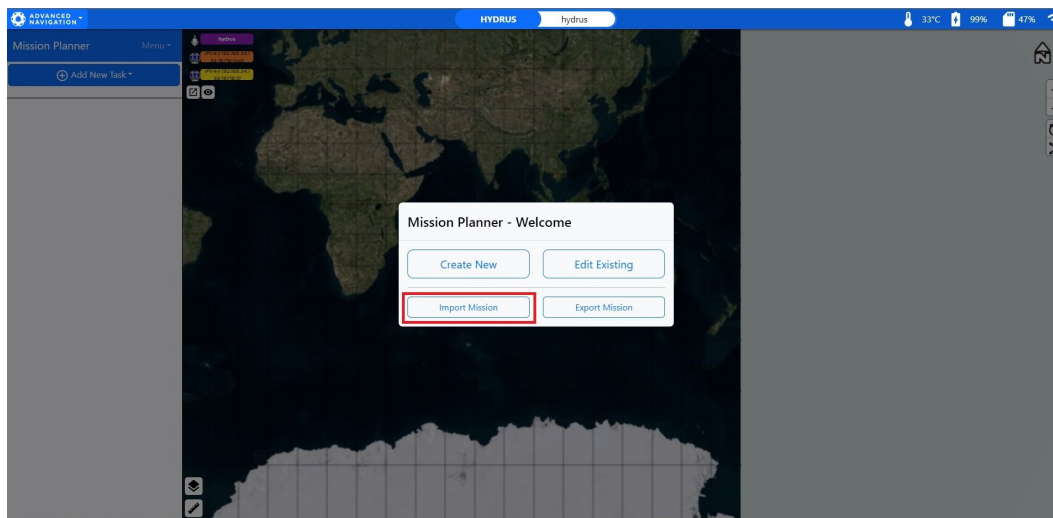
Figure 58: Welcome Planner Import Mission

4. The local drive dialog box will appear for the user to pick which mission they would like to import, select the mission
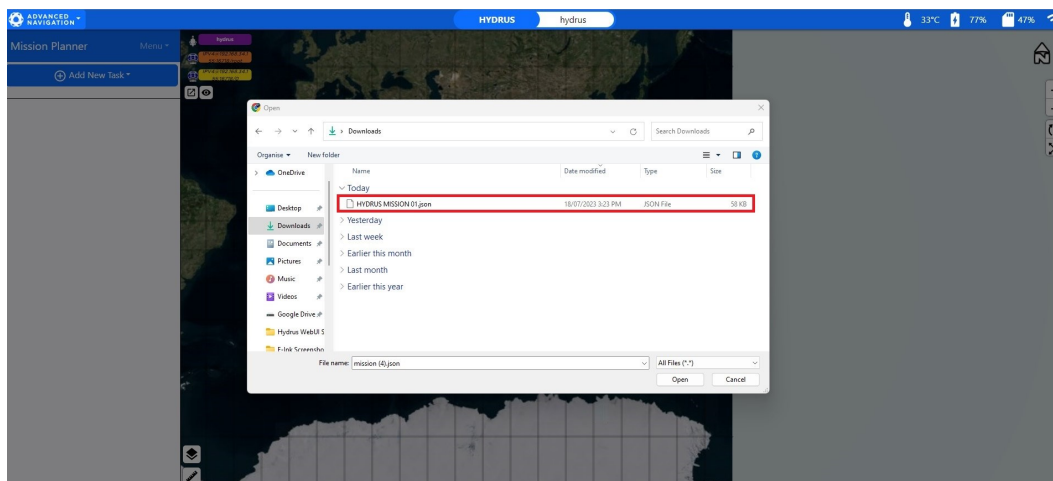
Figure 59: Hydrus Import Mission Local Drive

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.

8.2.3.2 Export Procedure

1. Open the Hydrus webUI
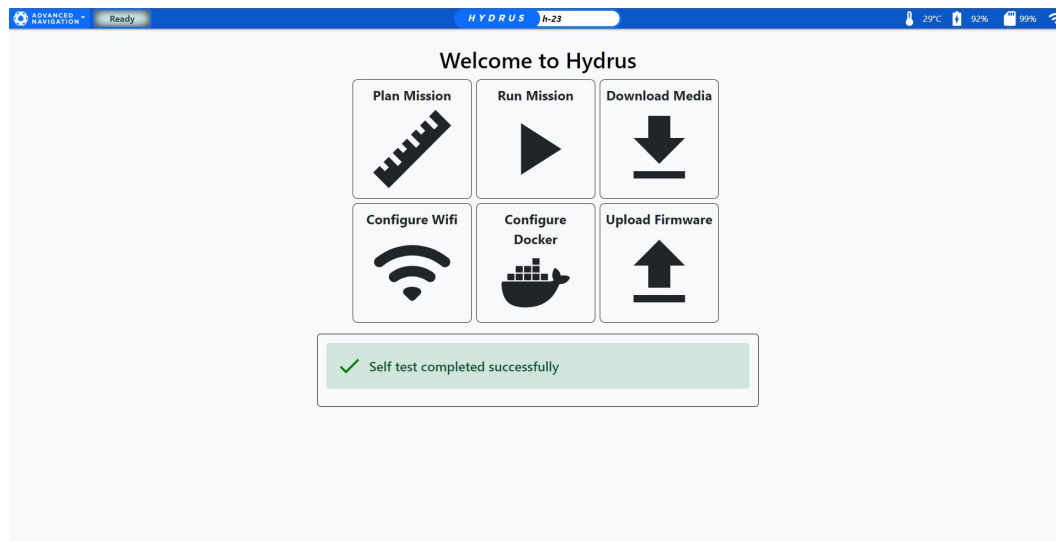
Figure 60: Hydrus WebUI Main Page

2. Click "Plan Mission", this will take the user to the mission planning section.
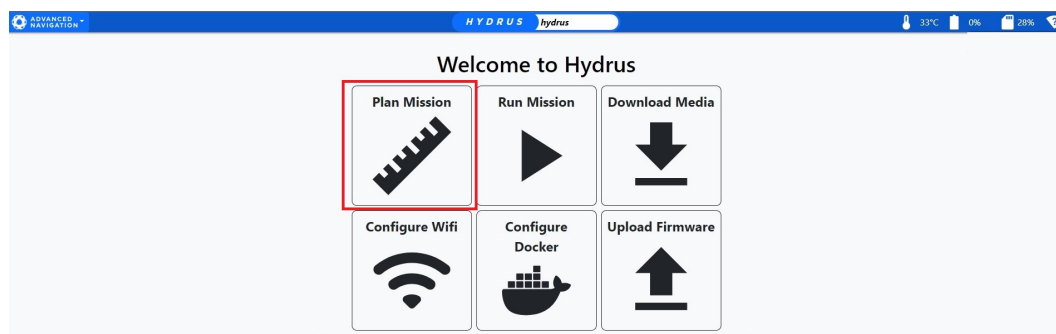
Figure 61: Plan Mission

3. In the Welcome Planner click "Export mission"
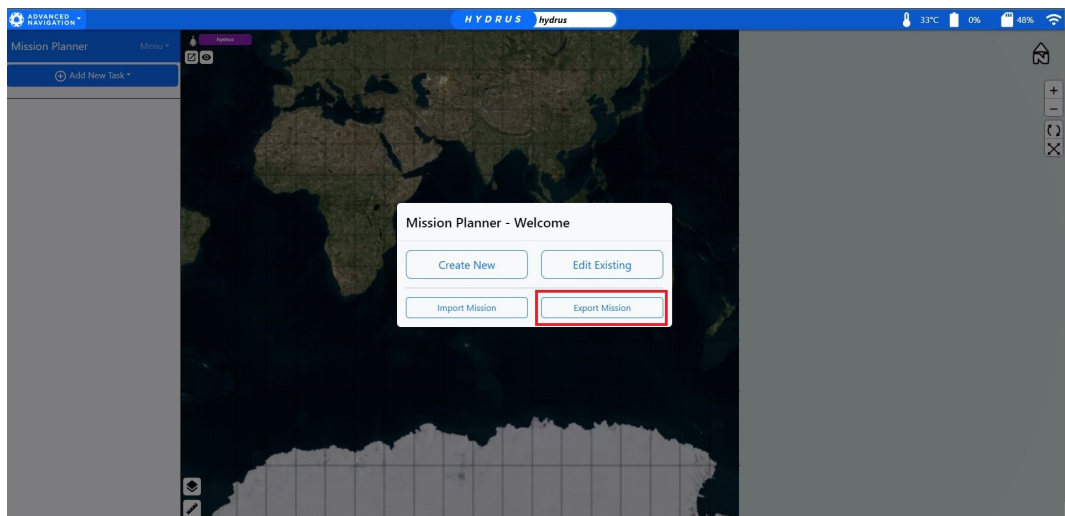
Figure 62: Mission Planner Welcome

4. The sessions dialog box will appear for the user to pick which mission they would like to export, select the mission
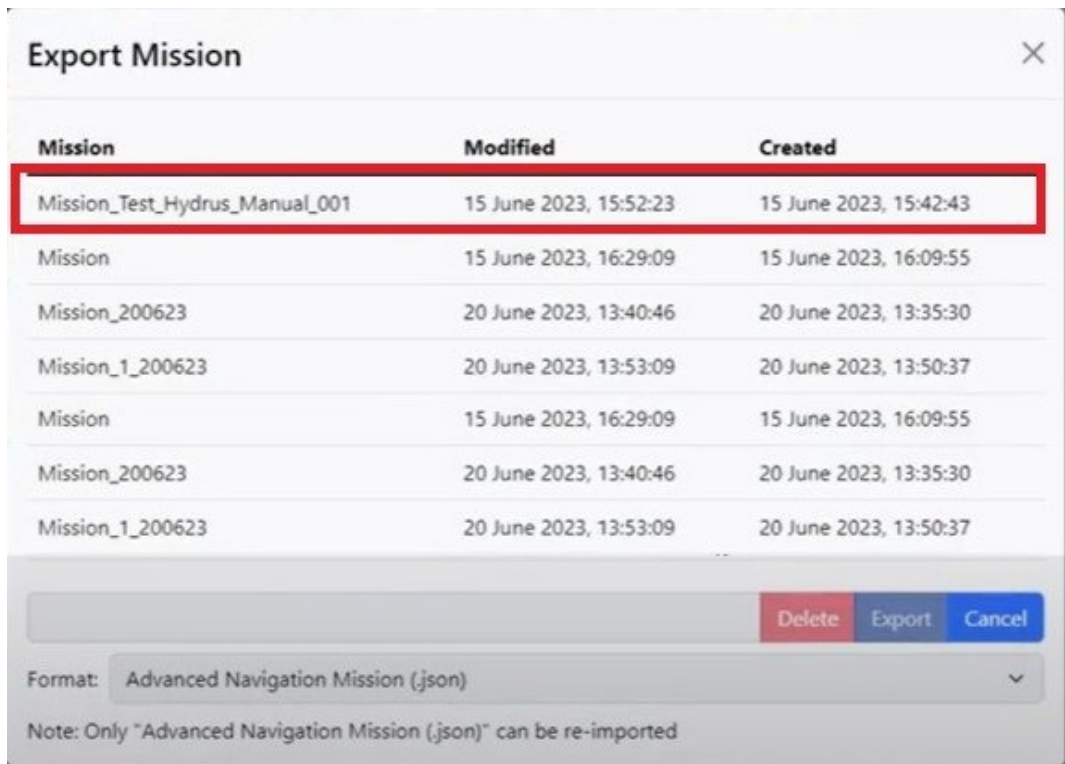
Figure 63: Session Dialog Box

5. Click "Export" in the session dialog box, the mission file will then be downloaded to the user's local drive.
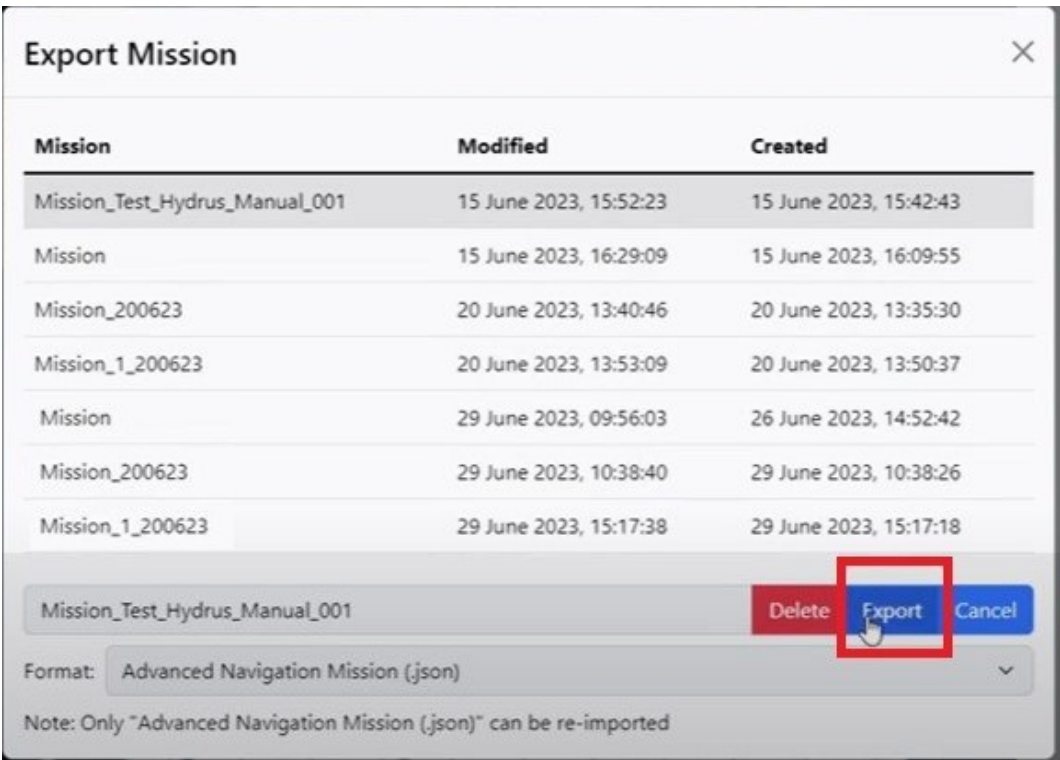
Figure 64: Export and Download Mission

8.3 Mission Planning Tools

These tools encompass basic interaction and maneuverability tools such as transform and rotate handles, the Polygon Operations Panel for detailed modifications, and mapping enhancements for improved interaction. Additional features include Hydrus Live Data display , survey tools for detailed area examination and polygon adjustment.
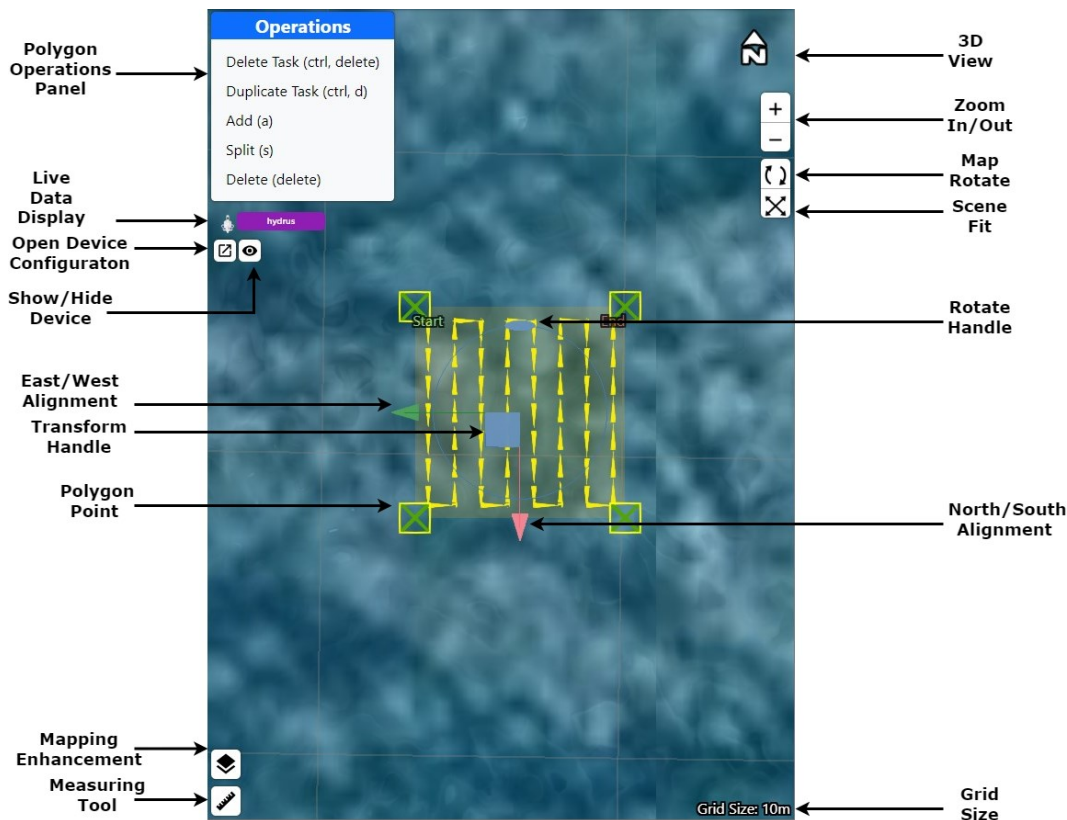
Figure 65: Mission Planning Mapping Overview

8.3.1 Basic Interaction of the Polygon

The basic interaction of polygon pattern involves using maneuverability tools to move around the 3D space. The transform handle allows for the adjustment of the model's position and scale, while the polygon points provide a more detailed level of manipulation. The rotate handle is used to change the orientation of the model.

8.3.2 Polygon Operations Panel
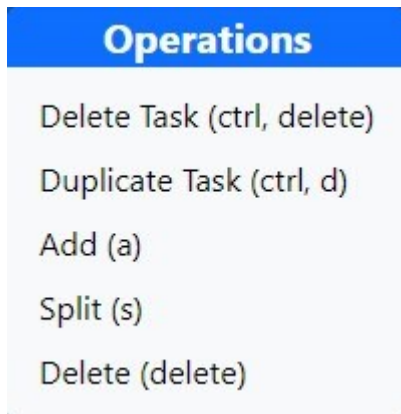
Figure 66: Polygon Operations Panel

Delete Task (Ctrl + del): This command removes the entire polygon or transect task that is currently selected.

> **Note**: Exercise caution while utilising this function, as it will irreversibly delete the chosen task.

Duplicate Task (Ctrl + d): This function creates a copy of the selected task directly over the polygon selected for duplication. It's useful when the user wants to create similar tasks.

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

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 Polygon Operations Panel.

> **Note**: Please note that the user must hold the Ctrl key while selecting two polygon points for this function to work.

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

8.3.3 Polygon Tools

These tools are specifically designed for manipulating polygons within the Hydrus WebUI.

Transform Handle: This tool allows the user to adjust the position and scale of the selected polygon.

> **Note**: To use the Transform Handle the user must select the task in the mission planner menu for the rotate handle to appear.

Polygon Points: These are the vertices of the polygon. The user can direct these points by using the tranform handle to adjust reshape the polygon according to their needs. When selecting multiple Polygon Points, The user can use the Transform Handle to adjust and resize the Polygon.

Rotate Handle: This tool allows the user to change the orientation of the selected polygon. By clicking and dragging the handle, the user can rotate the polygon around its center. Alternatively the orientation can be inputted in the Lawnmower Orientation within the task planning parameters (Path Generation).

> **Note**: To use the Rotate Handle the user must select the task in the mission planner menu for the rotate handle to appear.

East/West (Green Arrow) Alignment: This tool allows the user to align the polygon along the east-west axis. By clicking and dragging the green arrow, the user can adjust the alignment of the polygon.

North/South (Red Arrow) Alignment: This tool allows the user to align the polygon along the north-south axis. By clicking and dragging the red arrow, the user can adjust the alignment of the polygon.

8.3.4 Map Tools

These tools are used for enhancing the map view and interaction.

Mapping Enhancements: These are various tools and settings that improve the user's ability to interact with the map, see **8.9 Mapping Enhancements**.

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 user can see the exact distance between two points.

- Click for point A then click for point B: The user can also measure distance by clicking once to set point A, then clicking again to set point B. The distance between these two points will be displayed.

The bearing given is relative to north, providing the user with 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 visual representation helps the user better understand the spatial relationship between the two points.

Scene Fit: This tool adjusts the view so that the entire map fits within the viewport. This is useful when the user wants to see the whole map at once. This can also be done by double tapping the Space-bar key.

Zoom In/Out: These tools allow the user to zoom in for a closer look at a specific area of the map, or zoom out to see a larger area.

3D View: This tool switches the view mode to 3D, allowing the user to see the map from different angles and get a better sense of the terrain. This view is recommended when utilising any mapping enhancements such as contour lines.

Grid Size: This tool displays size of the grid that overlays the map. The user can make the grid larger or smaller depending on their needs by using the roller on their mouse.

8.3.5 Device Tools

These tools are related to device configuration and data display.

Show and Hide Devices: These commands allow the user to control the visibility of 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 the user monitor the status and position of the devices in real time.

Open Device Configuration: This command opens a panel where the user can adjust the settings of the devices. This includes Adding/Removing devices and more, see **8.1.2 Mission Planning Procedure**

8.4 Mission Considerations

When planning a mission with Hydrus, several 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.

8.4.1 Altitude

The altitude at which Hydrus operates affects the following:

- **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.

8.4.2 Pause Depth Considerations

The pause depth is an important parameter when planning Hydrus missions, especially to avoid surface currents and ensure bottom lock.

- **Surface currents:** It is recommended to avoid surface currents greater than 1 knot as they can affect Hydrus's stability and control. By setting the pause depth at an appropriate level, Hydrus can minimise the impact of surface currents on its operations.

- **Bottom lock and pause depth**:

  For Hydrus to navigate effectively, 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 at a depth where it can maintain a clear acoustic signal with the seafloor. This means that the DVL must be within a range of approximately 10 meters from the seabed, allowing it to calculate the velocity of Hydrus relative to the seabed accurately. To achieve this, Hydrus needs to be programmed to dive to a pause depth that positions it within the bottom lock range when necessary. By doing so, it avoids spending unnecessary time in midwater without the bottom lock aiding the DVL, ensuring optimal navigation and data acquisition during underwater operations.

8.4.3 Bluewater Missions

Blue water missions, where Hydrus operates in depths deeper than 50 meters, 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 of the vehicle.

8.4.4 Hydrus Transit Between Tasks

Hydrus is capable of performing multiple survey tasks in a sequential manner. If multiple tasks are selected for the mission, the vehicle will directly transit to the next survey task after completing the previous task. There may be situations where there are known obstructions, such as underwater infrastructure like a jetty, pipes, or netting, that the Hydrus needs to avoid.

To address this, it is necessary to configure and additional task to avoid obstructions. To achieve this, create a transect task as a "bridge" between the previous and next tasks, allowing Hydrus to navigate around the obstruction. In the mission parameters, set the media coverage parameter to none.

To illustrate this process consider the following example:

- Task 1: Lawnmower pattern task A - Media capture - Video (Fixed Distance)

- Task 2: Lawnmower pattern task B - Media capture - Image (Camera Coverage)

- Task 3: Lawnmower pattern task C - Media capture - Image (Camera Coverage)

Suppose Hydrus is traveling directly between task A and task B, and there is an obstruction located 40 meters between the task A endpoint and the task B start point that will not allow Hydrus to direct transit between the two. In this case, the user will need to insert a transect task to avoid the obstruction. This transect task will have the media capture set to none since its purpose is simply to navigate around the obstruction.

The modified task order will be as follows:

- Task 1: Lawnmower pattern task A - Media capture - Video (Fixed Distance)

- Task 2: Transect Pattern Task A - Media capture - None

- Task 3: Lawnmower pattern task B - Media capture - Image (Camera Coverage)

- Task 4: Lawnmower pattern task C - Media capture - Image (Camera Coverage)

By including the transect task (Task 2) between Task 1 and Task 2, The user will ensure that Hydrus avoids the obstruction. The transect task will start at the endpoint of Task 1, navigate around the obstruction, and end at the starting point of Task 2. This allows for a continuous and uninterrupted mission, even in the presence of obstacles.

8.4.5 Using Subsonus with Hydrus

The integration of the Hydrus and Subsonus systems enables 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 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 webUI. Acoustic communication is required for transmitting mission instructions, receiving status updates, and making any necessary adjustments to the course or operations of Hydrus.

Both Hydrus and Subsonus offer an intergrated webUI for mission monitoring and control. These web-based interfaces provide users with a user-friendly platform to monitor Hydrus's progress, view collected data files, and adjust mission parameters as needed.

8.5 Mission Patterns

8.5.1 Lawnmower Survey

The Lawnmower survey is the path planning strategy that allows for efficient coverage of an area of interest. This survey pattern 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.

8.5.2 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.

8.5.3 Preferences in Lawnmower/Transect Surveys

Below is an overview of the settings involved in Lawnmower/Transect Surveys for Hydrus.

> **Note**: Lawnmower and Transect surveys do not use the same preferences, it is important that the correct mission is selected for the desired application of Hydrus.

8.5.3.1 Name

This refers to the identification or label given to the specific Lawnmower survey task for easy reference and management.

8.5.3.2 Path Generation

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 **8.3 Mission Planning Tools**

Path to Edge - Selecting this option generates a path that fills up to the edges of the polygon, ensuring complete coverage of the designated area. The generated path aligns with the boundaries of the polygon, this is selected to ensure the entire region of interest is adequately covered by Hydrus.

8.5.4 Travel Pose

The travel pose of Hydrus denotes its tilt 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 Hydrus arrives at a designated picture-taking point, it adjusts its orientation to 0° or "look down" and captures the image. This enables it to obtain the desired visuals from a downward perspective.

Note: Hydrus's travel pose has a maximum limit of 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.

8.5.4.1 Vertical

This setting determines the depth or height above the sea floor of Hydrus sensors while it moves along the survey path during the mission.

Modes:

- **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 meters 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.

8.5.4.2 Media Capture

This setting allows for selecting and customising image and video capture settings, including options for camera coverage with overlap, fixed distance capture, or no capture.

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

- **Picture Location and Mow Width**: 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.

- **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 Specification**: 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.

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 meters) covered by Hydrus during each mow or sweep while capturing images.

- **Capture Distance**: This parameter indicates the approximate distance (in meters) covered by Hydrus between successive image captures.

Image (Fixed Distance) - This setting allows Hydrus to capture images during the survey while explicitly specifying the distance between picture locations and the mow width. 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.

- **Picture Capture**: Hydrus captures still images at regular intervals while following the survey path. The distance between each picture location is explicitly specified by the user.

- **Mow Width and Distance**: The user defines both the mow width and the distance between image locations in meters. The mow width represents the coverage width of the survey path, while the distance determines the spacing between consecutive image locations.

- **Video Recording Option**: 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 Parameter**: 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**: This parameter represents the estimated width (in meters) covered by Hydrus during each mow or sweep while capturing video footage.

- **Capture Distance**: This parameter indicates the approximate distance (in meters) covered by Hydrus between successive video captures.

Video (Fixed Distance) - This setting allows Hydrus to capture video footage during the survey while explicitly specifying the mow width, which represents the horizontal width between adjacent lawnmower sweeps.

- **Video Capture**: Hydrus records video footage while following the survey path, providing continuous documentation of the survey area.

- **Mow Width Specification**: The user explicitly defines the mow width, which represents the horizontal width between adjacent lawnmower sweeps. This parameter determines the proximity of the sweeps and influences the level of coverage overlap.

8.5.5 Mission Profiles

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.

8.5.5.1 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.

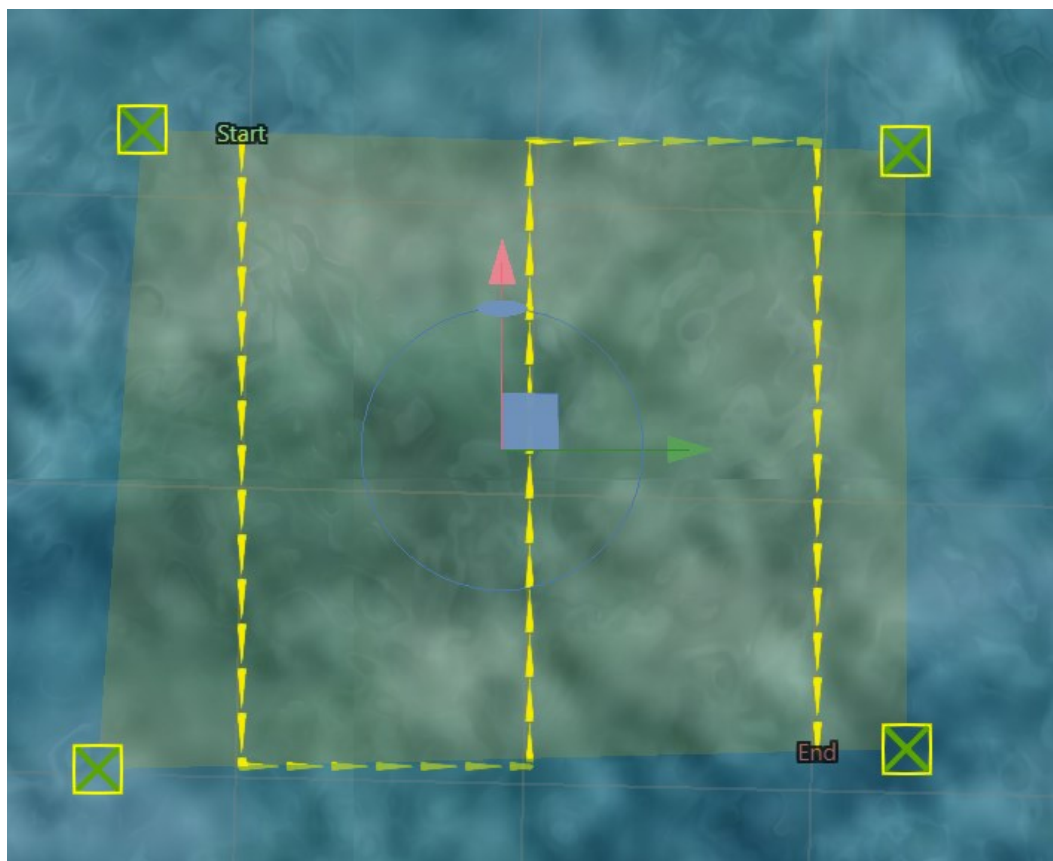| Setting	Value
Name	Sparse Lawnmower
Path Generation	
Lawnmower Orientation	0 - 360°
Path to Edge	Ticked / Unticked
Travel Pose	
Pitch	0°
Vertical	
Mode	Bottom Altitude
Value	4.0 m
Coverage	
Media Capture	Image (Fixed Distance)
Also Record Video	Ticked / Unticked
Mow Width	10.0 m
Distance	1.0 m

Figure 67: Sparse Lawnmower Survey Path Visualisation

8.5.5.2 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
Path Generation	
Lawnmower Orientation	0° - 360°
Path to Edge	Ticked / Unticked
Travel Pose	
Pitch	0°
Vertical	
Mode	Bottom Altitude / Surface Depth / Geodetic Height
Value	Bottom Altitude 0.5 - 8 m Surface Depth 0 - 300 m

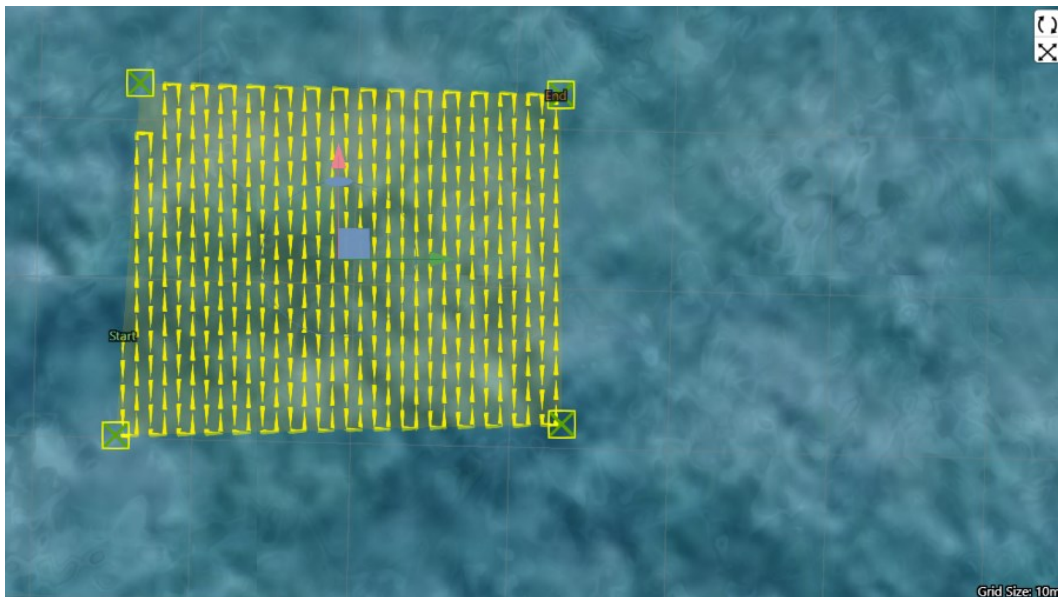| Setting	Value
	Geodetic Height - to +
Coverage	
Media Capture	Image(Camera Coverage)
Also Record Video	Ticked / Unticked
Overlap Forward	30%
Overlap Lateral	50%

Figure 68: Dense Lawnmower Survey Path Visualisation

8.5.5.3 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 lawnmower pattern at a 90 degree rotation to the first lawnmower 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 **8.9 Mapping Enhancements**.

Setting	Value
Name	Super Dense Lawnmower
Path Generation	
Lawnmower Orientation	0° - 360°
Path to Edge	Ticked / Unticked

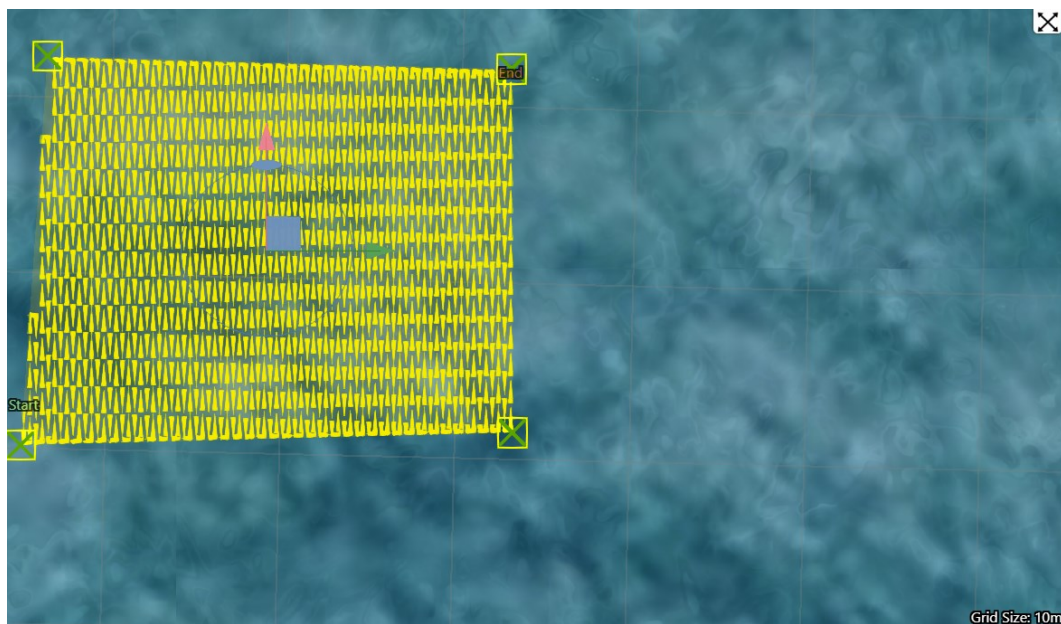| Setting	Value
Travel Pose	
Pitch	0°
Vertical	
Mode	Bottom Altitude / Surface Depth / Geodetic Height
Value	Bottom Altitude 0.5 - 8 m Surface Depth 0 - 300 m Geodetic Height - to +
Coverage	
Media Capture	Image(Camera Coverage)
Also Record Video	Ticked / Unticked
Overlap Forward	50%
Overlap Lateral	80%

Figure 69: Super Dense Lawnmower Pattern Visualisation

8.5.5.4 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
Path Generation	
Lawnmower Ori-	0

Setting	Value
entation	
Path to Edge	No
Travel Pose	
Pitch	0
Vertical	
Mode	Bottom Altitude / Surface Depth / Geodetic Height
Value	Bottom Altitude 0.5 - 8 m Surface Depth 0 - 300 m Geodetic Height - to +
Coverage	
Media Capture	Image (Camera Coverage)
Also Record Video	Ticked / Unticked
Overlap Forward	80%

Figure 70: Transect Survey Visualisation

8.6 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:

8.6.1 Relative to Subsonus

Hydrus is equipped with a transponder that communicates with Subsonus. When the user selects the Subsonus option in the webUI, 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 meters means that Hydrus will return to a location 2 meters 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.

8.6.2 Geodetic Location

The second option for setting a recovery location is through a geodetic location. 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 is the alternate selection if Subsonus is unavailable for the user, or the user requires Hydrus to complete the mission at a specific location, such as a jetty or wharf.

8.7 Camera Parameters

8.7.1 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.

8.7.2 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 60FPS 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.

8.7.3 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	**On**: Hydrus will utilise its LED lighting to provide additional illumination for capturing images or videos.
	Off: Hydrus' LED lighting system will be disabled and the scene will be captured using ambient light only.
Brightness Mode	**Auto**: 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
	Manual: The user can manually adjust the brightness level according to the users preferences or specific requirements.

8.7.3.1 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.

8.7.4 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.

8.7.5 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.

8.7.6 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.

8.8 Bail-out Conditions

8.8.1 On Battery Depletion

Figure 71: Battery Depletion

Selection / Action
Abort mission and go to Recovery Location. • When the battery percentage is selected, the user is configuring Hydrus to take action when the remaining battery power drops below the specified threshold. • Hydrus will then navigate autonomously to a recovery location defined from the **8.6 Recovery Location** set during mission planning. • 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.
Abort mission and got to surface. • When the battery percentage is selected, the user is configuring Hydrus to take action when the remaining battery power drops below the specified threshold • Hydrus will ascend to the water surface autonomously, allowing for retrieval. • 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.

8.8.2 On Loss of Acoustic Communication

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.

8.8.3 Maximum Surface Depth

Figure 73: Maximum Surface Depth

Selection /Action
Abort mission and go to recovery location.   • When the specified depth (in meters) is selected, the user is configuring Hydrus to take action when Hydrus drops below the specified depth threshold.   • Hydrus will then navigate autonomously to a home point defined from the recovery location parameters set during mission planning.   • For example, if a user sets the depth threshold to 300 meters, 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.
Abort mission and got to surface.   • When the desired depth (in meters) is selected, the user is configuring Hydrus to take action when Hydrus drops below the specified depth threshold.   • Hydrus will then navigate autonomously to a home point defined from the recovery location parameters set during mission planning.   • For example, if a user sets the depth threshold to 300 meters, it means that if Hydrus descends below the specified depth, the action will be triggered to abort mission and return itself to the surface

8.8.4 Minimum Bottom Altitude

Minimum Bottom Altitude

Configure how Hydrus will react when its altitude above the seafloor exceeds a specified threshold

| At | 0.5 | Metres | Continue mission | ∨ |

Figure 74: Minimum Bottom Altitude

Selection /Action
Continue Mission • When the specified altitude (in meters) is selected, the user is configuring Hydrus to take action if Hydrus drops below the specified altitude threshold.
Abort mission and go to Recovery Location. • When the specified (in meters) is selected, the user is configuring Hydrus to take action if Hydrus drops below the specified altitude threshold.
Abort mission and got to surface. • When the specified altitude (in meters) is selected, the user is configuring Hydrus to take action if Hydrus drops below the specified altitude threshold. • Hydrus will then navigate autonomously to a home point defined from the recovery location parameters set during mission planning. • For example, if a user sets the altitude threshold to 1 meters, 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

8.8.5 Low Storage Space

Low Storage Space

Configure how Hydrus will react when its remaining storage space is critically low

Abort mission and go to recovery location   ∨
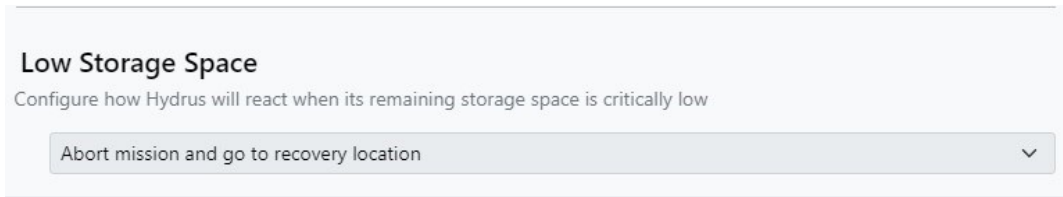
Figure 75: Low Storage Space

Selection/Action
Continue Mission • Hydrus will proceed with its current mission even if the remaining storage space becomes critically low.
Abort Mission and Go to Recovery Location • When the remaining storage space drops below the specified threshold, Hydrus will immediately abort its current mission. • Hydrus will then navigate to a designated recovery location.
Abort Mission and Go to Surface • 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.

8.9 Mapping Enhancements

Mapping Enhancements are overlay files that contain additional data to supplement the existing Hydrus mapping system. The data, presented in either JSON or KML format, can include information such as contours, underwater infrastructure, and known obstructions. To upload these files, follow the steps below:

1. Ensure your Mapping Enhancement files are prepared and saved in the proper JSON or KML format. Note the file's location on your computer for easy access during the upload process. Enter the Hydrus WebUI URL into your preferred web browser.
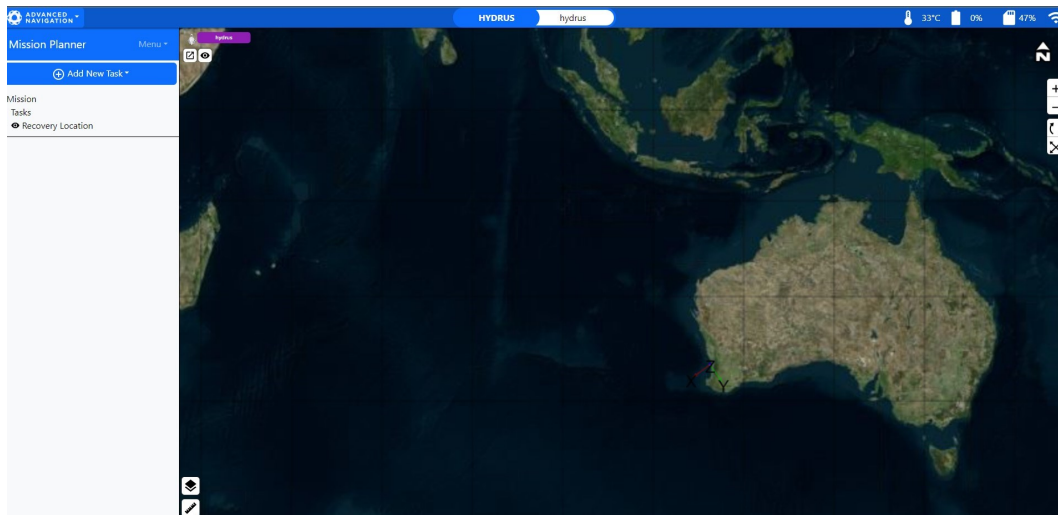
Figure 76: Mapping Enhancements Main Page

2. On the homepage, locate the navigation panel (typically on the left side of the interface). Click on the "Mapping Layers" icon. Then click "Options"
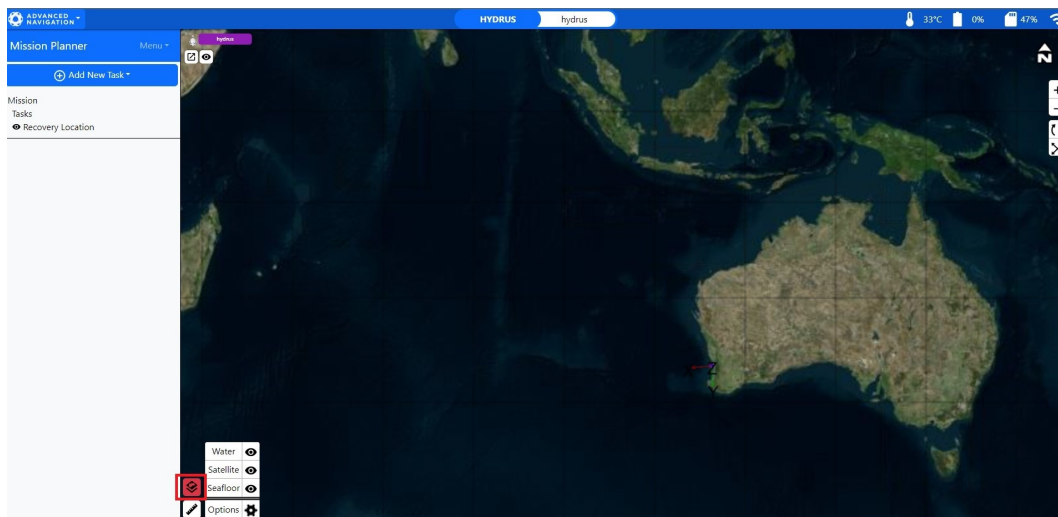
Figure 77: Mapping Enhancements Layer Options

3. Hover over the Add icon and click the JSON/KML file type
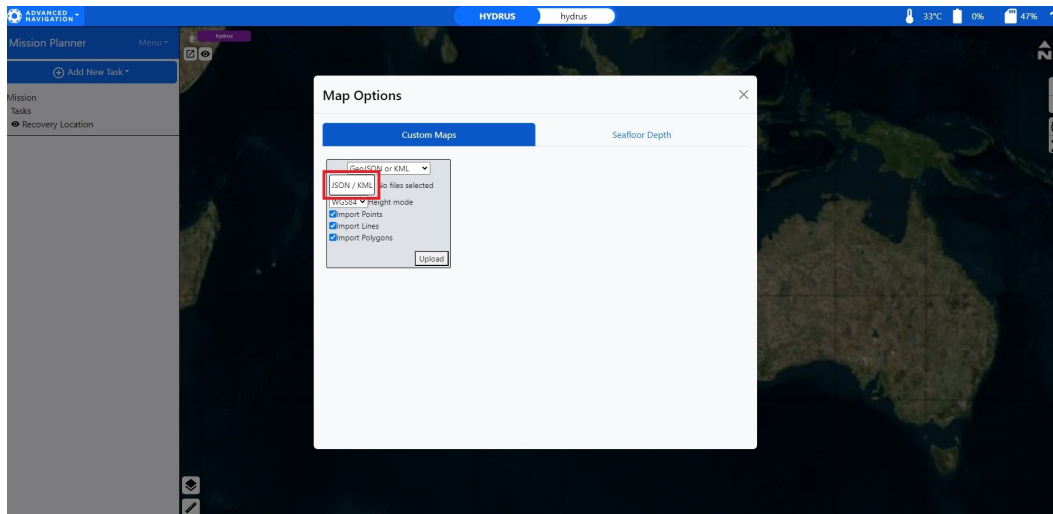
Figure 78: Mapping Enhancements File Selection

4. Select the desired file and ensure its either a JSON (geoJSON) file or a KML file and press open.
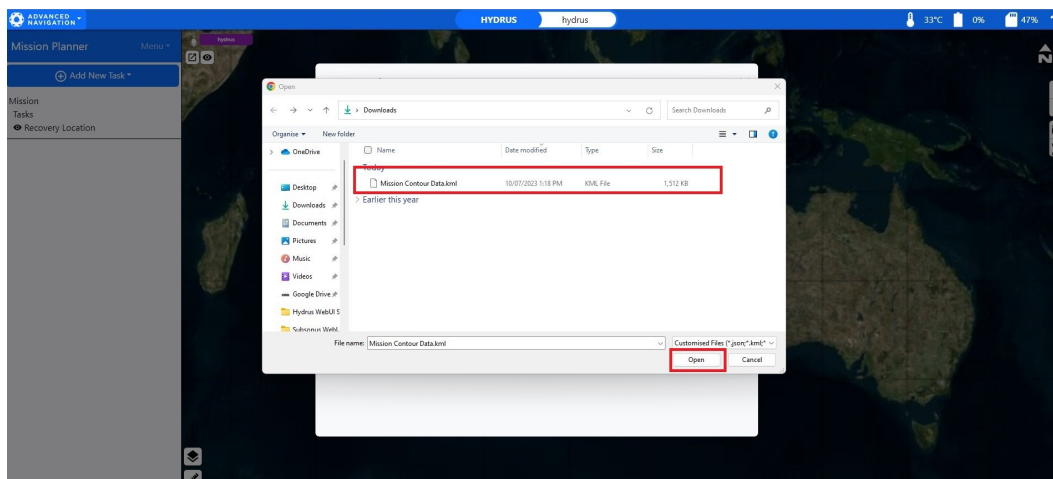
Figure 79: Mapping Enhancements Open File

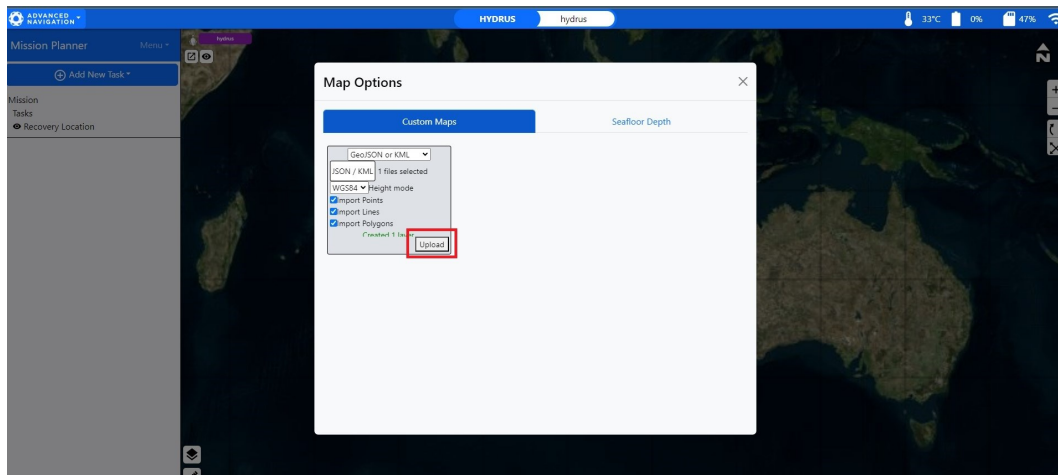**5**. The dialog box will then display "Created 1 Layer" in green writing. Confirm this then click Upload.

Figure 80: Mapping Enhancements Upload

6. Verify the successful upload by noting the new file in the "Map Options" dialog box.

Note: It may take some time to render large files.
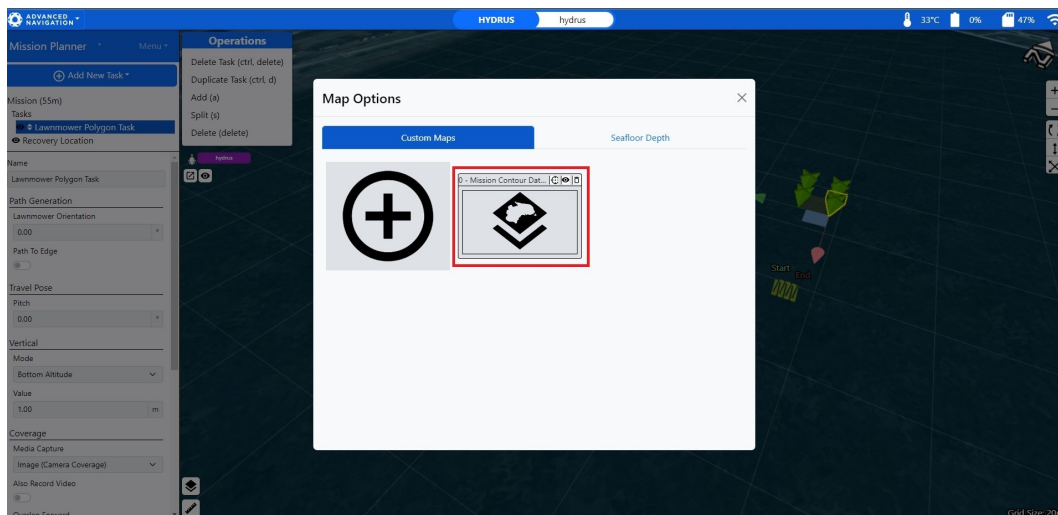
Figure 81: Mapping Enhancements Upload Confirmation

7. Close the Map Options dialog box and move the map to the relevant map area.
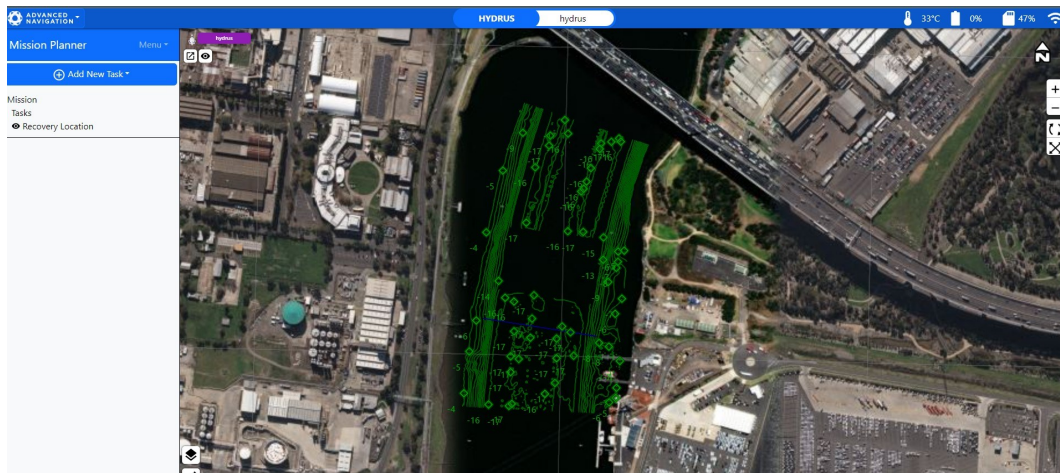
Figure 82: Mapping Enhancements Top View

8. Choose the best perspective for viewing the new overlay. This could be a top-down view or a 3D view, depending on your requirements.
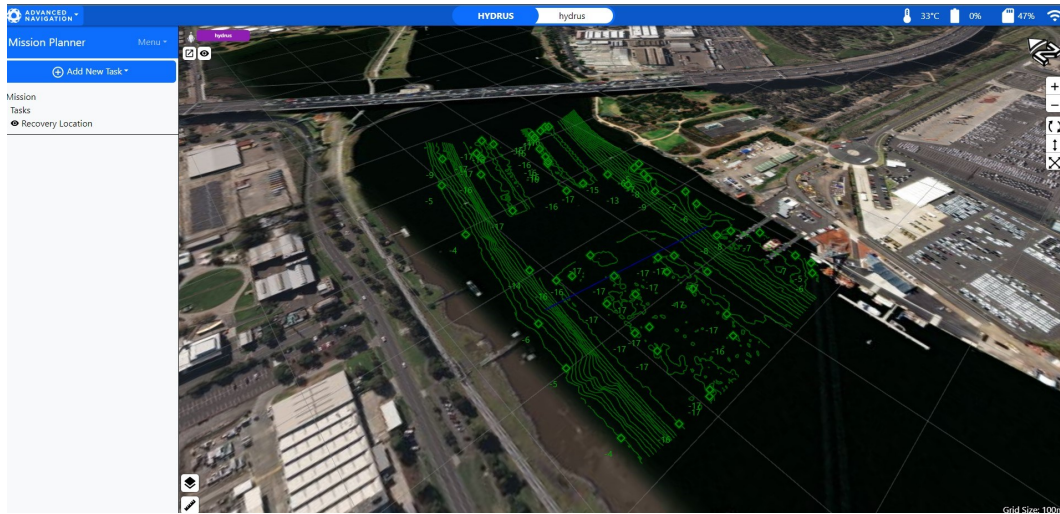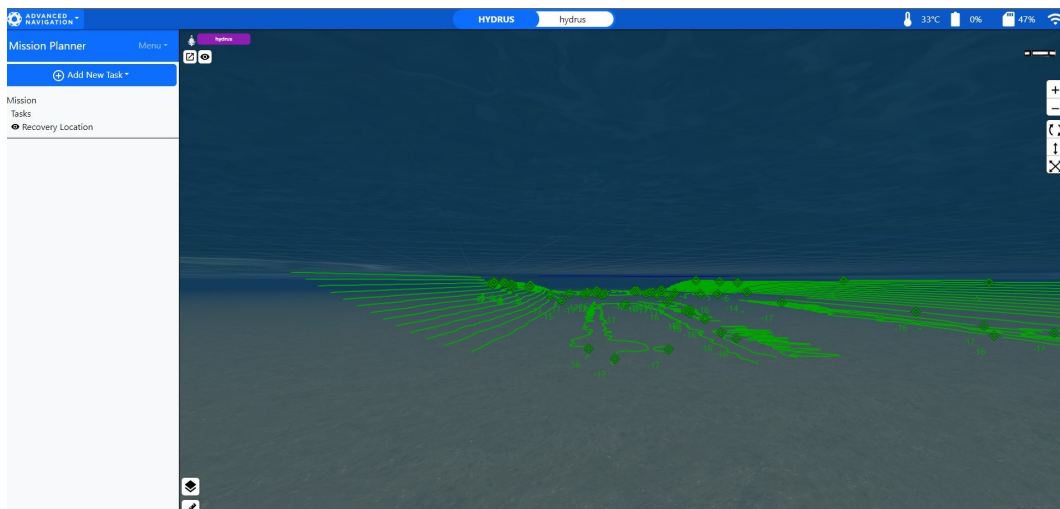

Figure 83: Mapping Enhancements 3D View

Figure 84: Mapping Enhancements Z Component

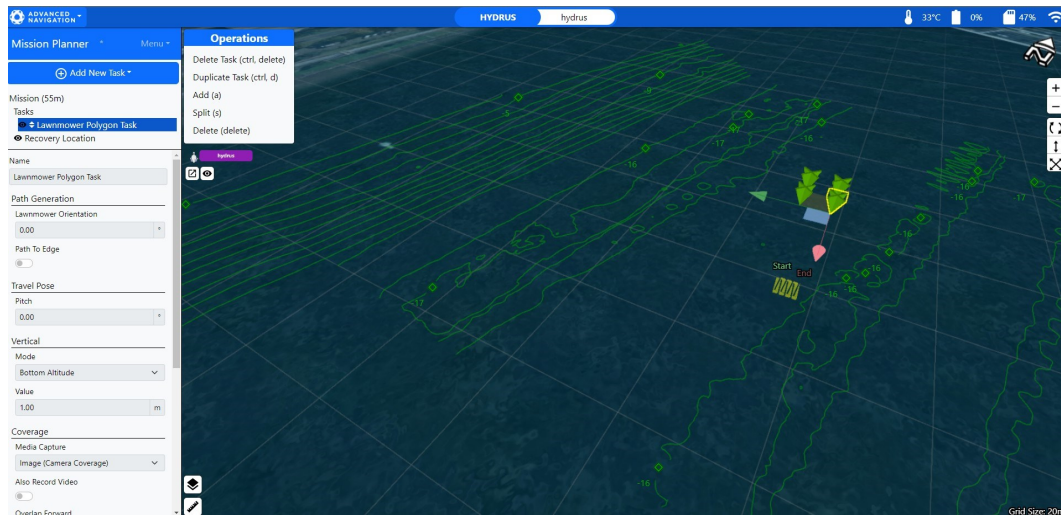**9**. Proceed with the mission task as outlined in your mission planning process.

Figure 85: Mapping Enhancements with Lawn Mower Pattern

9 Hydrus Operations

9.1 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.

9.1.1 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 86: HydrusTest Clip

9.1.2 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 87: 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 88: 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 Testt: 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 **9.3 Hydrus Deployment** to launch Hydrus into the water.

9.1.3 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 89: Suggested Tether

9.1.4 Safety Precautions

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

- **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.

9.1.5 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 **9.3 Hydrus Deployment**, release Hydrus gently into the water, allowing the tether to unwind smoothly.

9.1.6 Testing and Familiarisation

After the initial launch, Its 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.

9.1.7 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.

9.2 Hydrus Pre-deployment

The Hydrus pre-deployment process ensures a smooth transition from mission planning to actual deployment. This crucial stage involves a series of steps that prepare the Hydrus device for its intended mission. Beginning with accessing the Subsonus webUI and configuring the devices, the process progresses to deploying the Hydrus based on the saved mission parameters. Once the deployment process is completed, Hydrus is ready to be placed in the water, marking the transition from planning to active mission execution. The following steps and considerations provide a clear framework for executing the pre-deployment process smoothly and efficiently.

9.2.1 Hydrus Pre-Deployment Procedure

1. Type in the Subsonus IP address to open the Subsonus webUI, See **Interfacing with Hydrus**
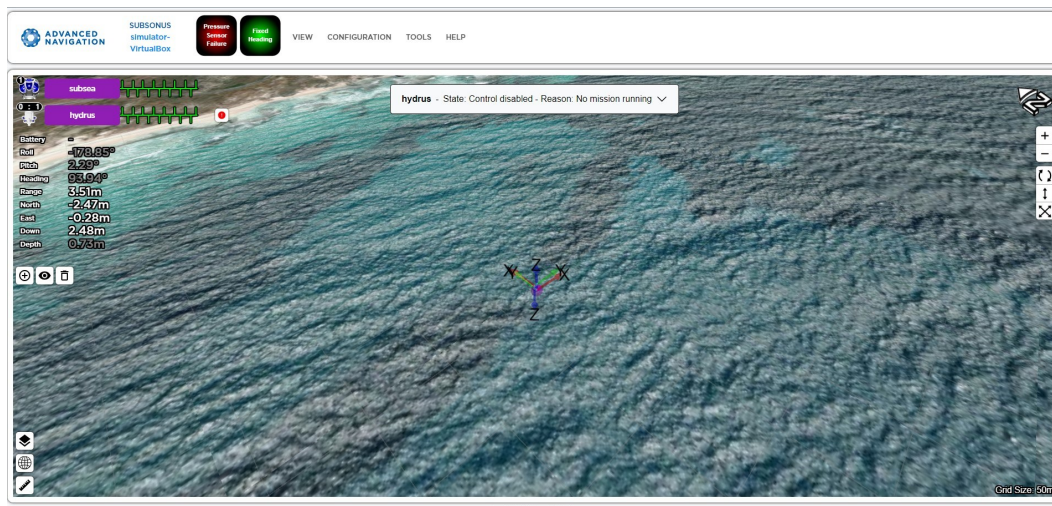
Figure 90: Subsonus Hydrus WebUI

2. Click on the configuration tab and click on devices
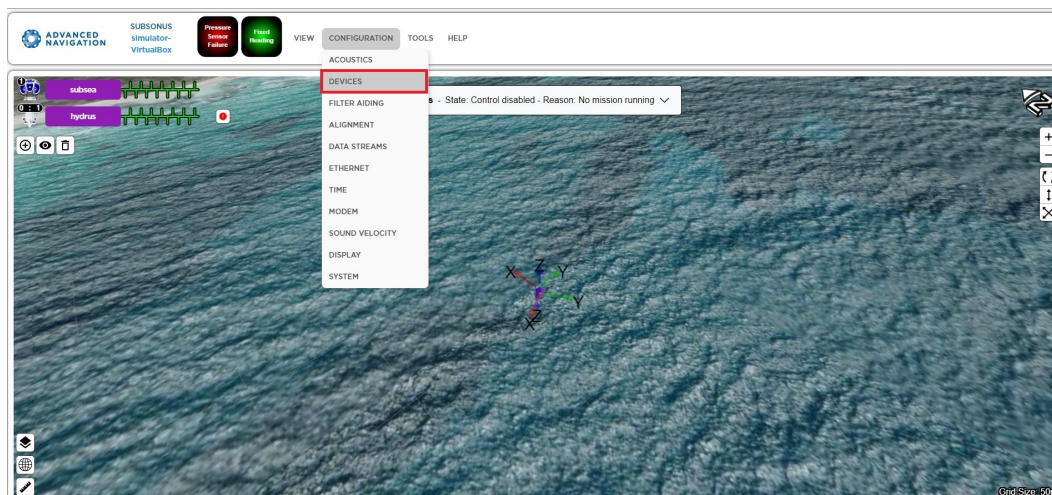

Figure 91: Configuration Devices

3. 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.
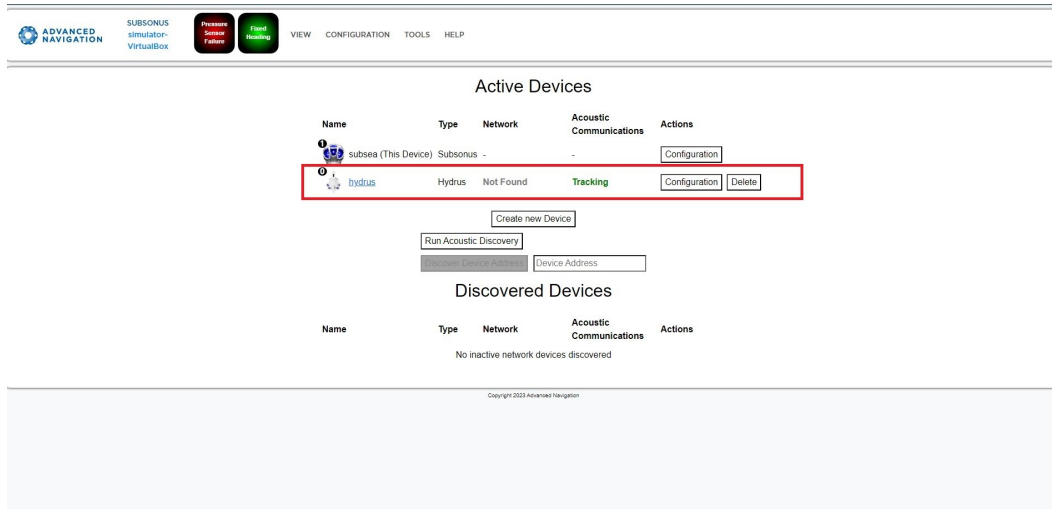

Figure 92: Active Devices

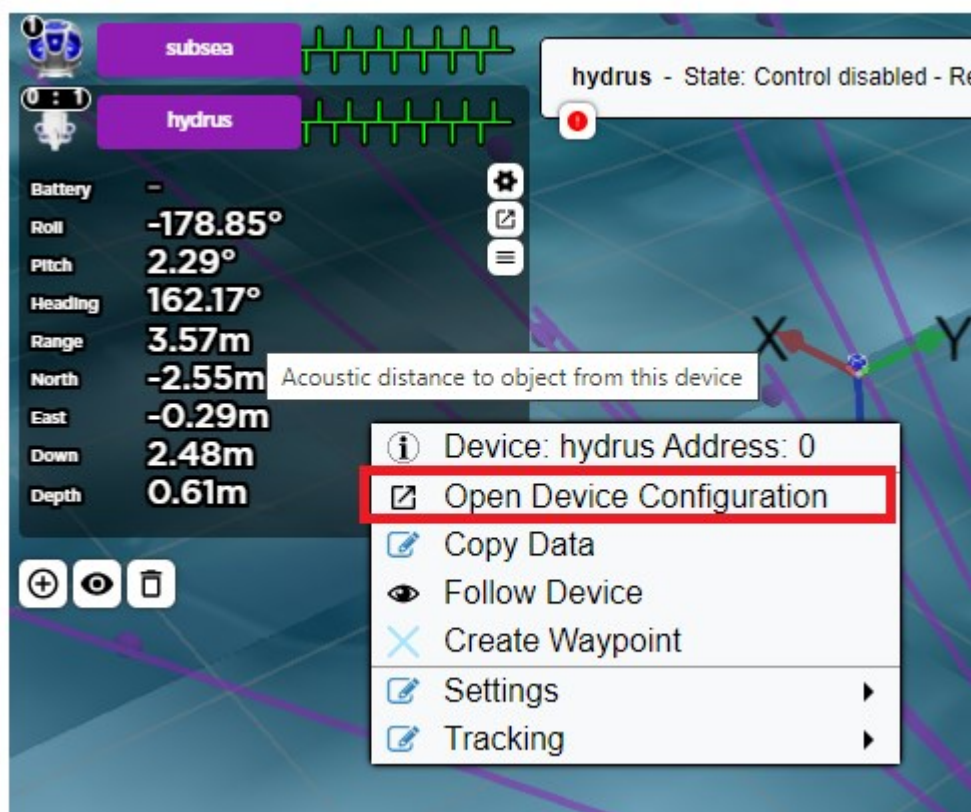4. Exit out of the main view dialog by clicking view on the top tab. Click the Hydrus in the devices list and select the Open device configuration dialog button.

Figure 93: Open Device Configuration
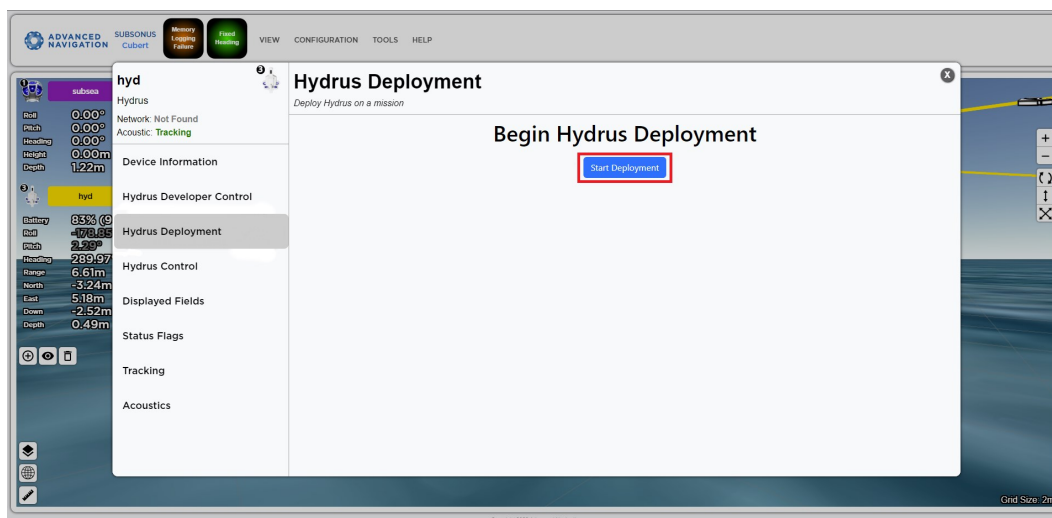
5. Click Hydrus Deployment, Click Start Deployment

Figure 94: Start Deployment

6. Select the mission that was previously saved
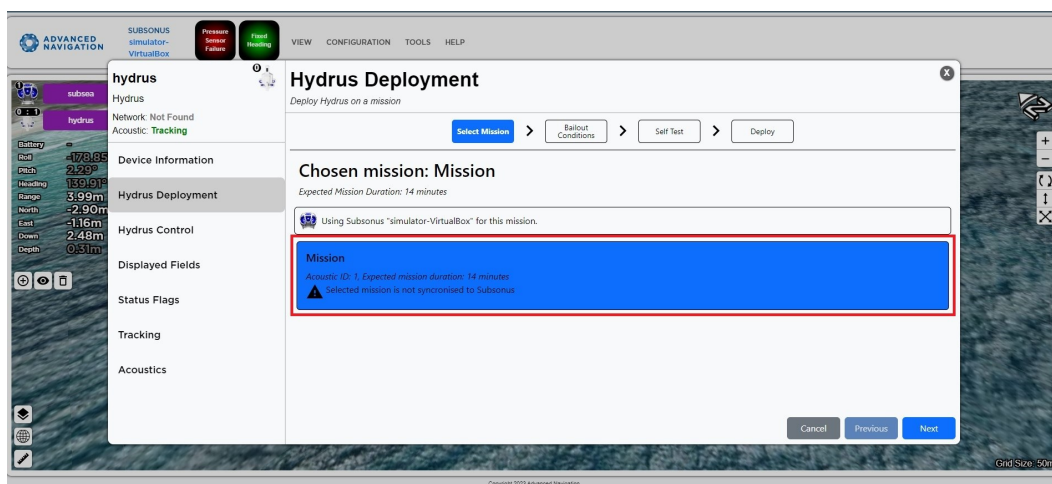

Figure 95: Hydrus Deployment Dialog

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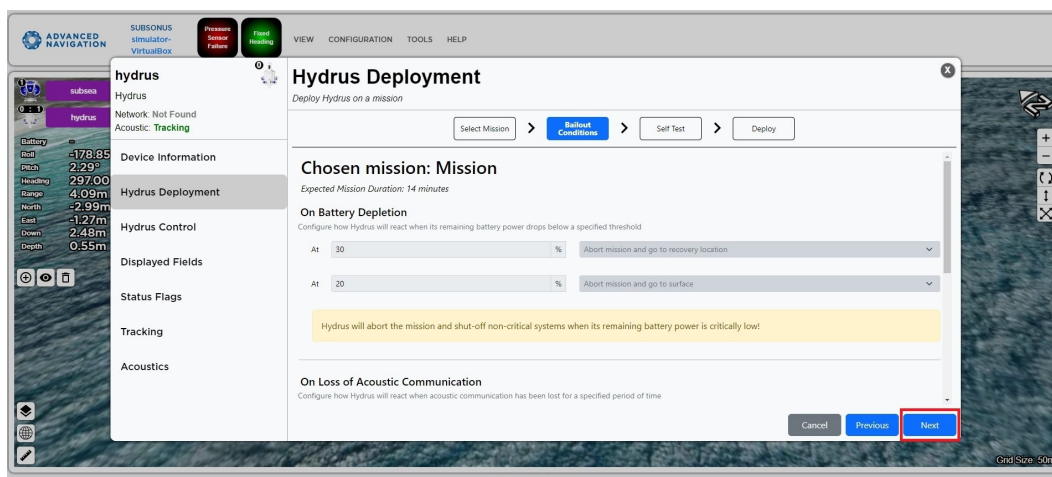

Figure 96: Hydrus Deployment Dialog Bailout Conditions

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.
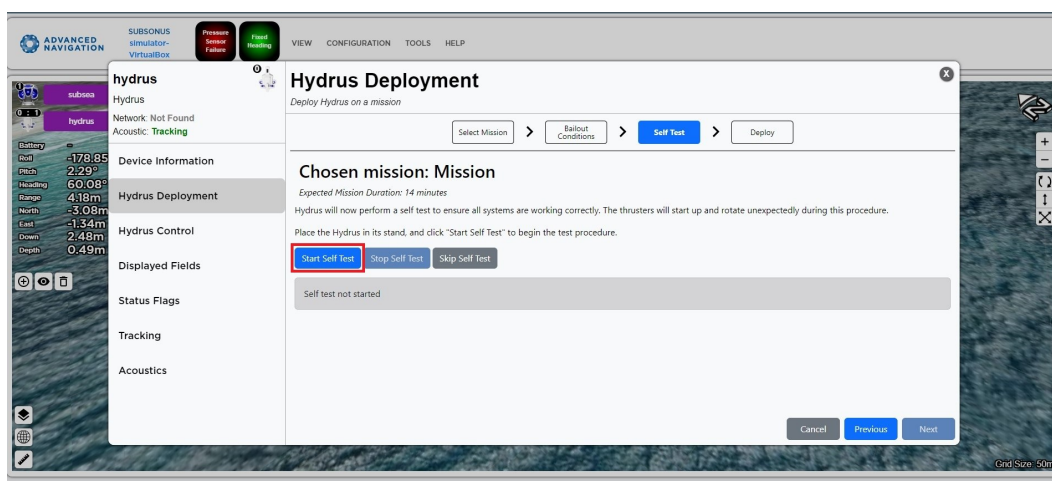

Figure 97: Hydrus Deployment Dialog Self-Test

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 is ready to deploy, Click 'Deploy' and return to the Hydrus Command Dialog Box.

Note: Once Deploy is selected a 10 second timer is initiated before the control system and the thrusters begin. It is recommended that waits till this has started prior to deploying Hydrus.
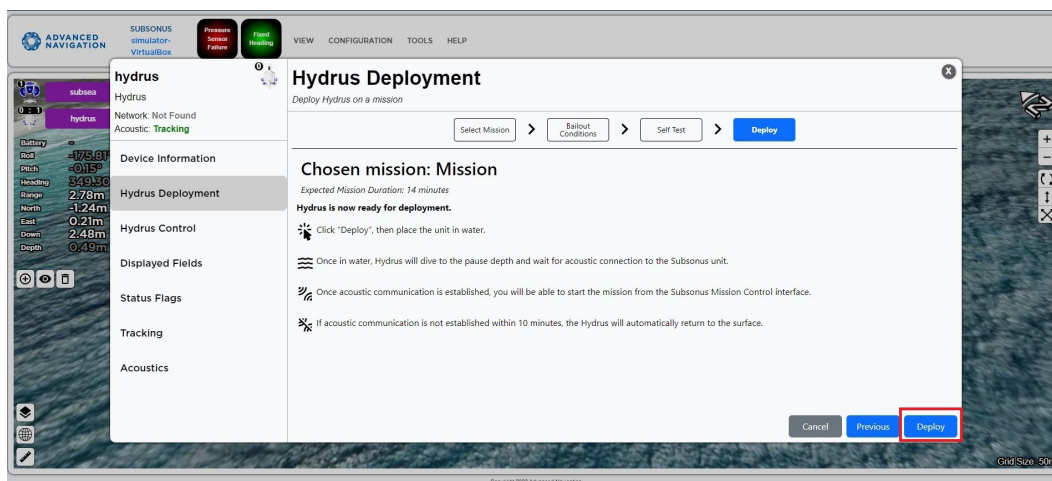

Figure 98: Hydrus Deployment Dialog Deploy

10. Wait for the EPD to Direct the user to place Hydrus in the water. Place it in the water. For detail, see **9.3 Hydrus Deployment**.
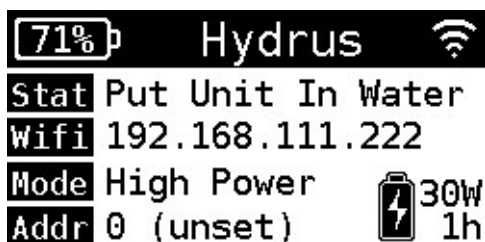

Figure 99: Put Unit In Water

9.2.1.1 Post Deployment

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.

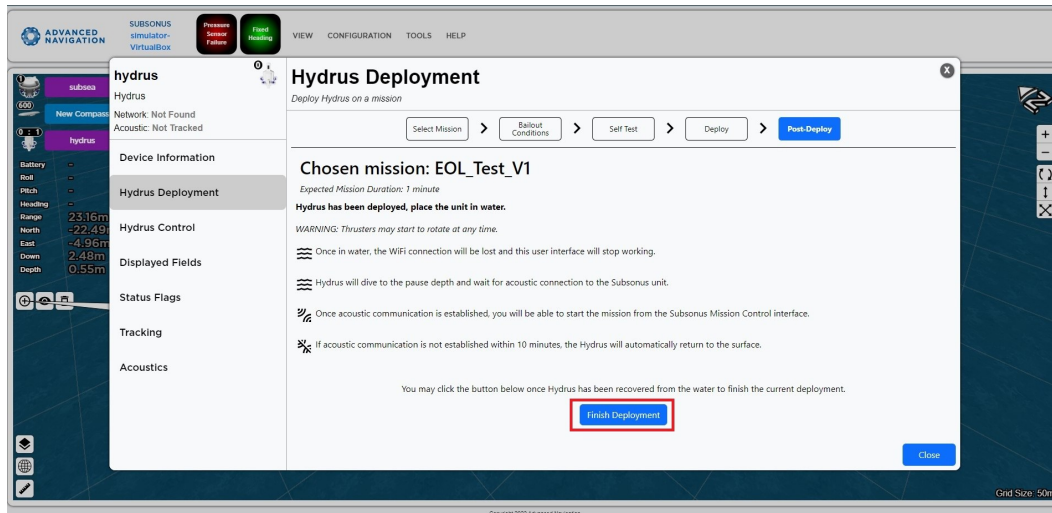The user, can finish the current deployment by selecting 'Finish Deployment'

Figure 100: Hydrus Deployment Dialog Finish Deployment

9.3 Hydrus Deployment

9.3.1 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.

9.3.2 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, 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 101: Visual Representation of suggested throwing technique

9.4 Hydrus Monitoring

9.4.1 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 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 dialogs controls. Resuming the mission will initiate the next phase of the mission and allow the Hydrus to carry out its planned tasks.
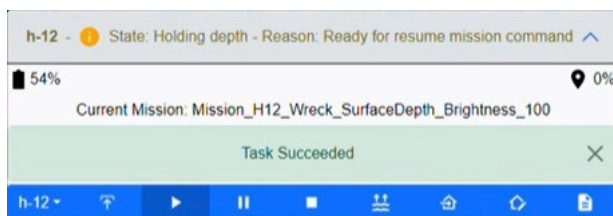

Figure 102: Command Dialog Box with Hydrus Holding Depth State

9.4.2 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.
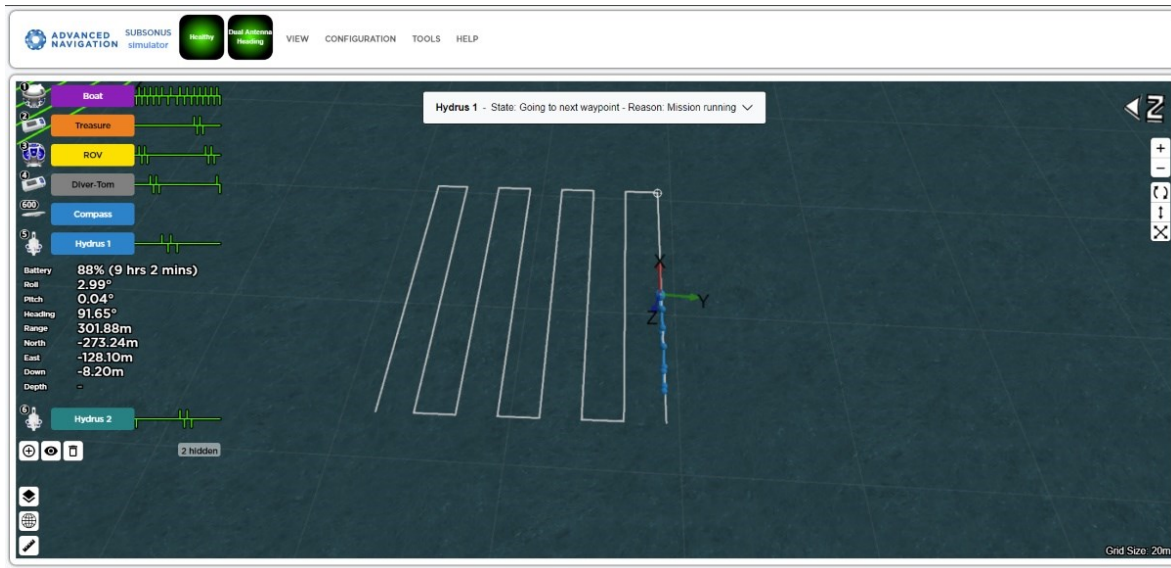
Figure 103: Screenshot of Hydrus on Planned Path of Survey Mission

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.
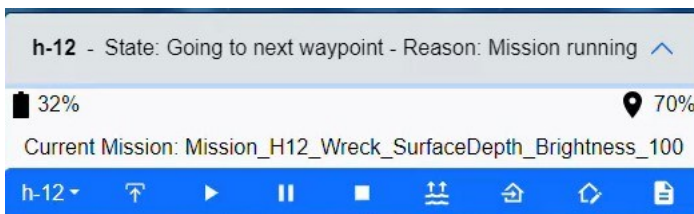

Figure 104: Command Dialog Box with Hydrus Going to Next Waypoint

9.4.3 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 hold and report "At Recovery Point, waiting for return to surface command"

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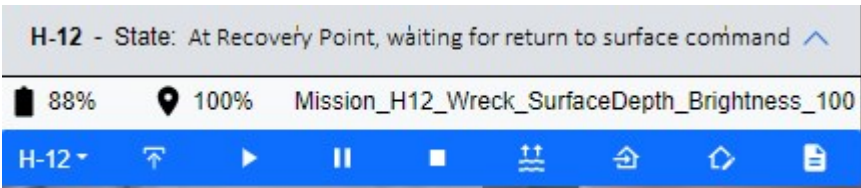

Figure 105: Command Dialog Box with Hydrus Waiting at Recovery Point

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.
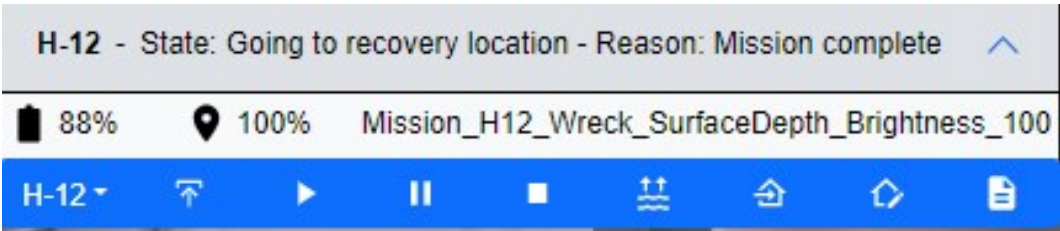

Figure 106: Command Dialog Box with Hydrus Mission Complete

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

9.5 Hydrus Retrieval

9.5.1 Steps to retrieve and secure Hydrus

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	Assess the environment: Evaluate the water conditions, including the cur-	

Action	Description	Example
Environment	rent, 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 Hyrdus from bouncing out or causing damage during capture. Be mindful of Hydrus and it's 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.	

9.6 Post Retrieval Actions

Once Hydrus has been retrieved from the water as stated in **9.5 Hydrus Retrieval**, 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 from Net	With Hydrus securely in the net, handle the net gently ensuring not to 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 **6.1 Initial Set-Up** section of this manual.
Command Stop Mission	Navigate to either the Subsonus webUI or the Hydrus webUI. • For Subsonus, the user can select 'Finish Deployment' within the

Action	Description
	Hydrus deployment dialog box as seen in **9.2.1.1 Post Deployment**. • For Hydrus, click the 'Stop Current Mission' button on the Main page of the Hydrus webUI.
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 **11.2 Routine Inspection and Cleaning**
Thruster Inspection	Post-rinse, inspect the thrusters for any visible damage or obstructions. If there's an issue, refer to the **11.3 Impeller Maintenance** 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 **10.1 Data Download** in the manual. Make sure to save the data in a secure location for future analysis.

10 Post-Mission

10.1 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.

The data is organised into specific categories for easy navigation: ANPP Data, Configuration, Logged Data, Mission Data, and Video Recordings. This organisation allows users to quickly locate and download the specific data they require for analysis, troubleshooting, mission replication, or review.

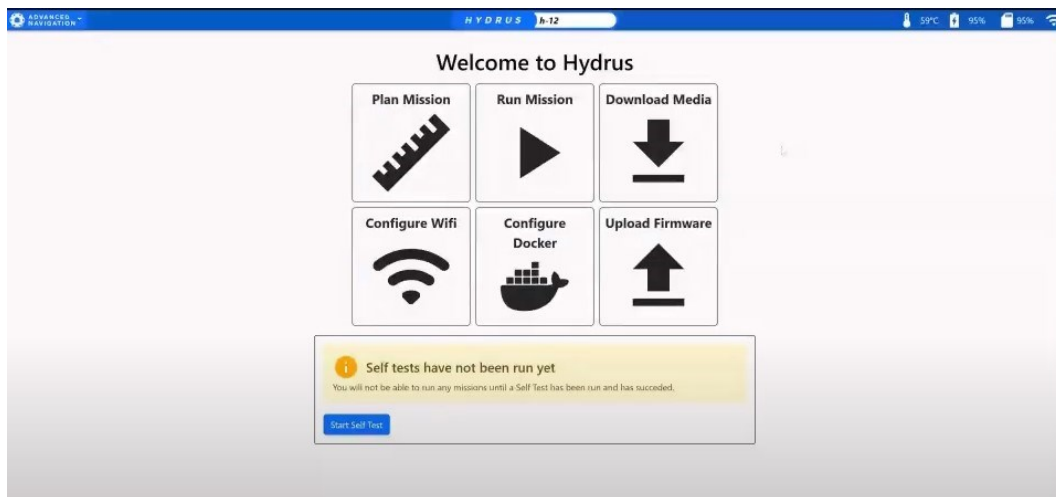### 10.1.1 Download Procedure

1. Open the Hydrus webUI.

Figure 107: Hydrus webUI Main Page
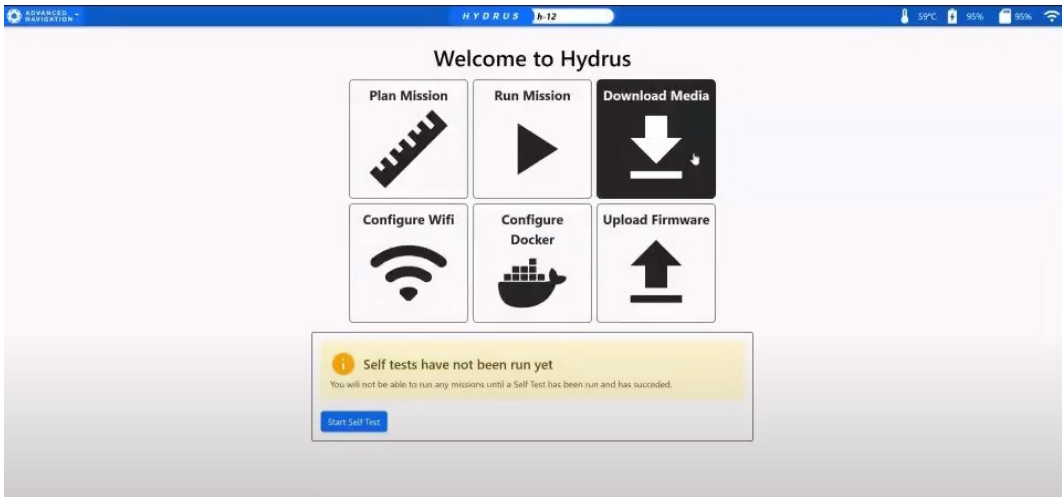
2. Click on the "Download Media" option.

Figure 108: Hydrus webUI Download Media Selection

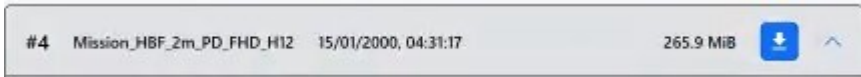3. Select Mission on the session page that will be downloaded

Figure 109: Session Line

4. Review Payload and download data

- Partial Downloads: If the user wishes to download only a portion of the data, select the specific files or categories needed instead of opting for a complete download. This can be done by checking the boxes next to the desired files or categories.

- Complete Downloads: If the user wishes to download all the data from a mission, select the "Download All" option

Figure 110: Payload Breakdown

10.1.2 Deleting Sessions

Deleting Individual Sessions: To delete a specific session, the user should locate the session to be removed and click on the "Delete" option next to it. A confirmation pop-up window will appear, and the user should confirm the decision.

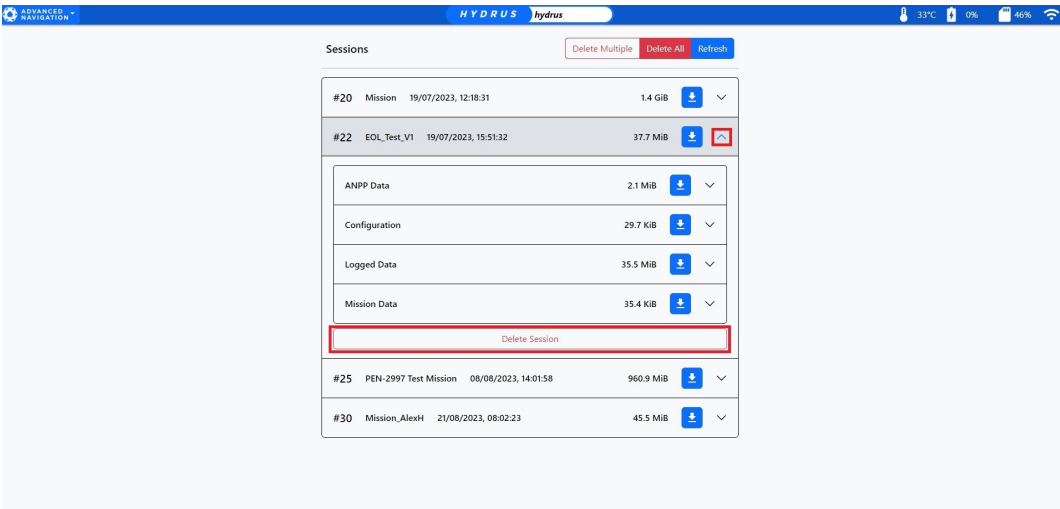*Figure 111: Deleting Selected Sessions*

Deleting All Sessions: To delete all sessions, the user should navigate to the top of the session list and click on the "Delete All" option. A confirmation pop-up window will appear, and the user should confirm the decision. It's important to note that this action is irreversible, so the user should ensure all necessary data has been saved before proceeding.

Figure 112: Deleting All Sessions

Note: It's important to be aware that if the storage capacity of Hydrus is nearing its limit, it could potentially lead to mission failures. 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.

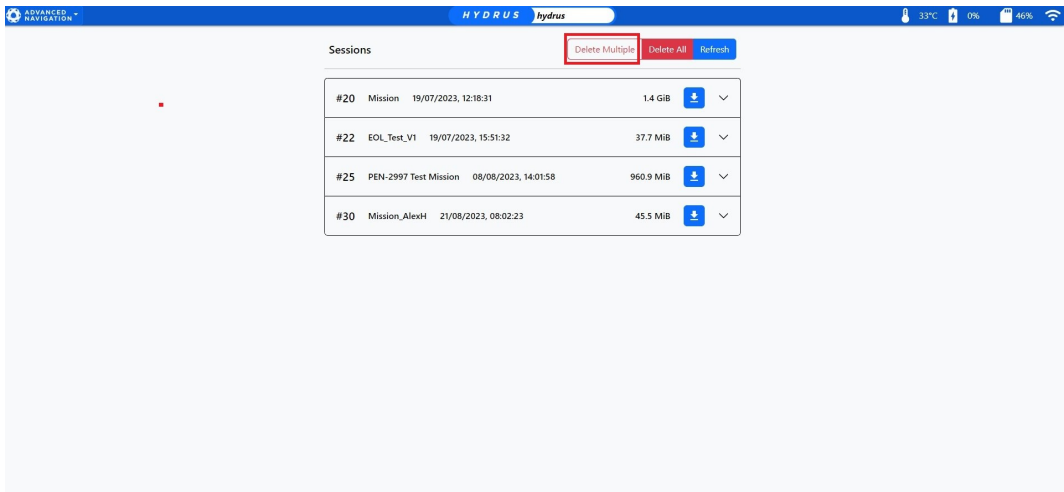1. Select the 'Delete Multiple' to enable multi-select mode.

Figure 113: Delete Multiple Sessions

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

Figure 114: Session Selection

3. Click the checkboxes corresponding to the sessions the user wishes 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 the user to confirm the deletion of the selected sessions.

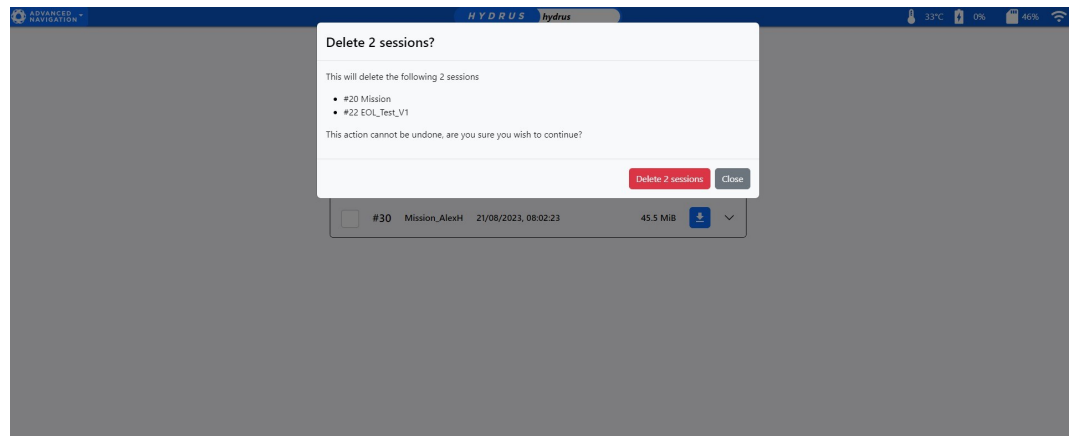

Figure 115: Confirmation to Delete Multiple Sessions

Note: Deleting a session is irreversible and will permanently remove all data associated with the selected missions. Make sure to double-check selections before confirming the deletion.

10.1.3 Session Payload Breakdown

Payload	Description
ANPP Data	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. • BMS Data: This data provides information about the battery's state, including its charge level, temperature, and overall health. • INS Components: 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. • Setpoints: 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.
Configuration	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: • Mission Parameters: 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. • User Preferences: These are settings related to the user's preferences for how the Hydrus device operates, such as display settings, alert settings, etc.
Logged Data	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: • System Logs: These are records of system events, such as system startups, shutdowns, errors, and other significant events. • Diagnostic Data: 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.
Mission Data	This folder contains a text log file with status logs of what happened during the mission, the mission name, start times, and the mission programmed json file. The mission data can include: • Mission Logs: These are detailed records of the mission, including start and end times, waypoints reached, and any

Payload	Description
	significant events that occurred during the mission.
	• Mission Programmed JSON File: 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.
Video Recordings	This folder contains images and videos from the mission, available for download in MP4 format. The video recordings can include: • Flight Footage: This is video footage captured by the Hydrus device during the mission. It can be used for review, analysis, or sharing.
Image Captures	• Still Images: These are individual images captured during the mission. They can be used for analysis, reporting, or sharing.

11 Maintenance

11.1 Part Numbers and Ordering

This topic covers information about part numbers for:

- **11.1.1 Standalone Units and Packs**

- **11.1.2 Accessories and Spare Parts**

- **11.1.3 Hydrus 300 Pack**

- **11.1.4 Hydrus 300 Subsonus Surface kit**

11.1.1 Standalone Units and Packs

Part Number	Description	Notes
HYDRUS-300	Hydrus AUV 300 m standalone unit	Hydrus AUV 300 m standalone unit. **Unit only**, 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 **11.1.1 Standalone Units and Packs** for list of contents.
HYDRUS-300-SUBSONUS-KIT	Hydrus AUV 300m Pack with Subsonus	Hydrus AUV 300 m Pack 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 **11.1.4 Hydrus 300 Subsonus Surface kit** for list of contents

Table 4: Hydrus Pack Part Numbers

11.1.2 Accessories and Spare Parts

Part Number	Description	Notes
Hydrus Sales Accessories		
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
Spare Part Packs		
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-IMPERLLOR-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
Sales Licenses		
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
Sales Services		
WARRANTY-	Hydrus additional 2 year	Hydrus additional 2 year warranty (3 year total)

Part Number	Description	Notes
EXTENSION	warranty	
Subsonus Accessories		
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

11.1.3 Hydrus 300 Pack

The HYDRUS-300-PCK standalone pack contains the following items:

Part Number	Description	Qty
HYDRUS-300	Hydrus 300	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: 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	1
HYDRUS-WAND	Hydrus Wand	1
HYDRUS-TESTCLIP	Hydrus Test Clip	1

Figure 116: Hydrus Pack

11.1.4 Hydrus 300 Subsonus Surface kit

The HYDRUS-300-SUBSONUS-SURFACE contains all items list in **11.1.3 Hydrus 300 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

Please ensure that all the listed components are present. If any component is missing or damaged, please contact support@advancednavigation.com.

> **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.

11.2 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.

Task	Action	Hydrus Component	Additional Notes
	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. Inspect the plastic housing surrounding the thruster and impeller bolts. Look for any cracks, splits, or indications of stress. Spin the thrusters checking for debris and grit, ensure impeller spins with ease of motion. Clean as per the guidance provided below and conduct a Rinse cycle through the Hydrus webUI.
	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	Inspect the charger for any visible signs of physical damage, such as cracks, dents, or loose components. 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. If the charger or Hydrus becomes excessively hot, it may indicate a malfunction or compatibility issue. Check battery levels and charging status. Ensure the EPD screen is aligned with the Advanced Navigation logo when placed in the charger.
	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.

11.2.1 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.

11.2.2 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".
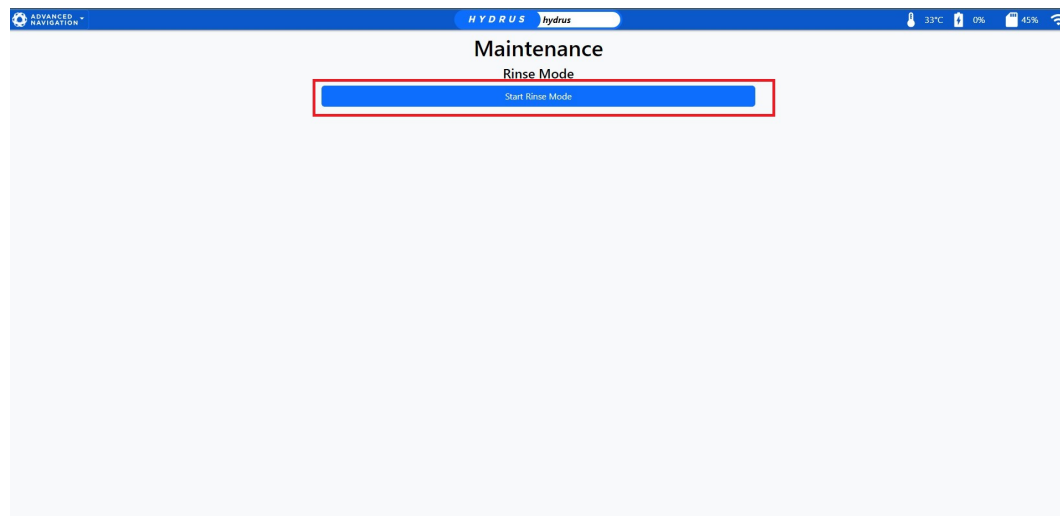
Figure 117: Start Rinse Mode

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".
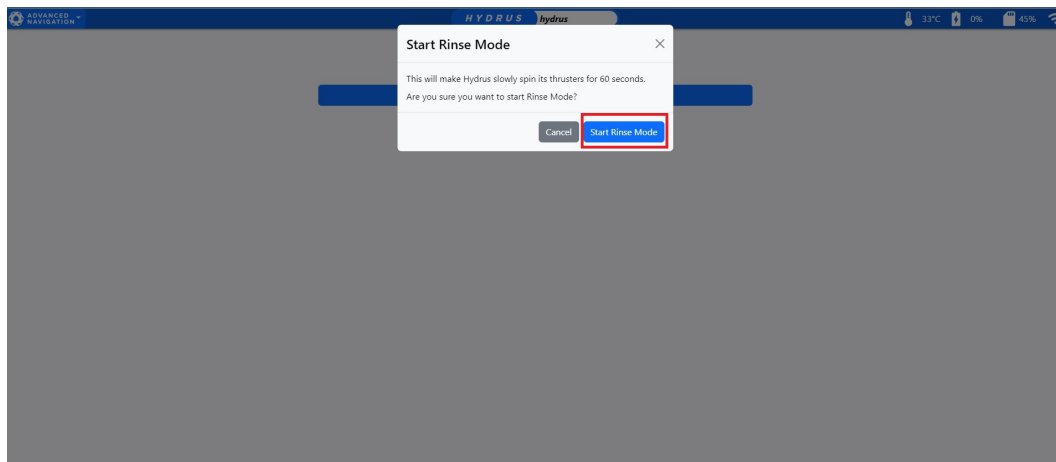
Figure 118: Rinse Mode Duration

Preparation for Rinse Mode: Before the user initiates Rinse Mode, ensure that Hydrus is properly positioned.

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.
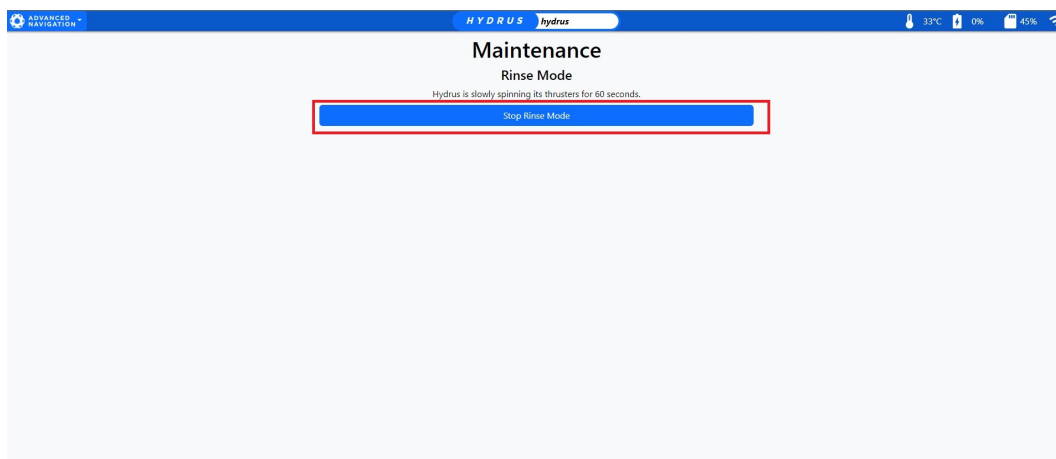
Figure 119: Stop Rinse Mode

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 **11.3 Impeller Maintenance**

11.3 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.

11.3.1 Thruster Assembly Exploded
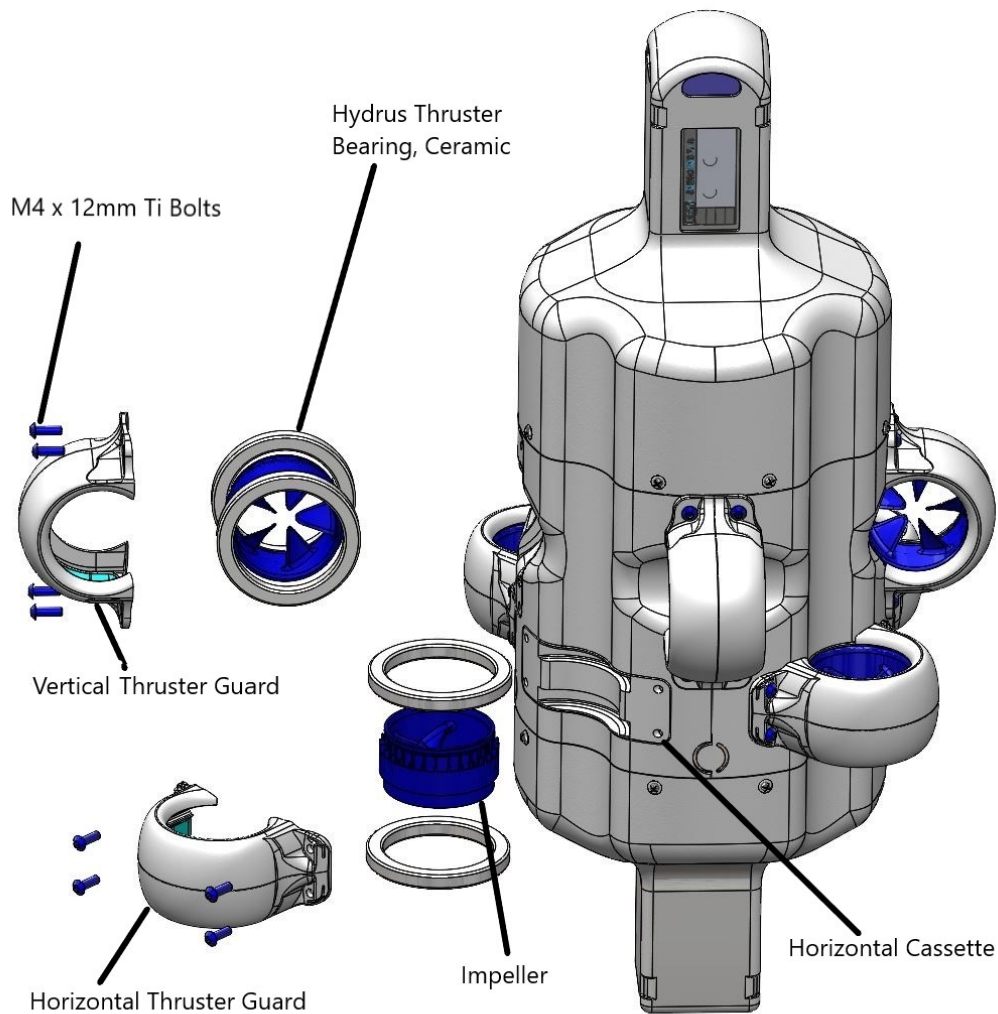
Figure 120: Thruster Assembly Exploded

11.3.2 Thruster Layout

Clockwise (CW) Rotor

The CW Rotor can be denoted by a white ribbon around it's 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.
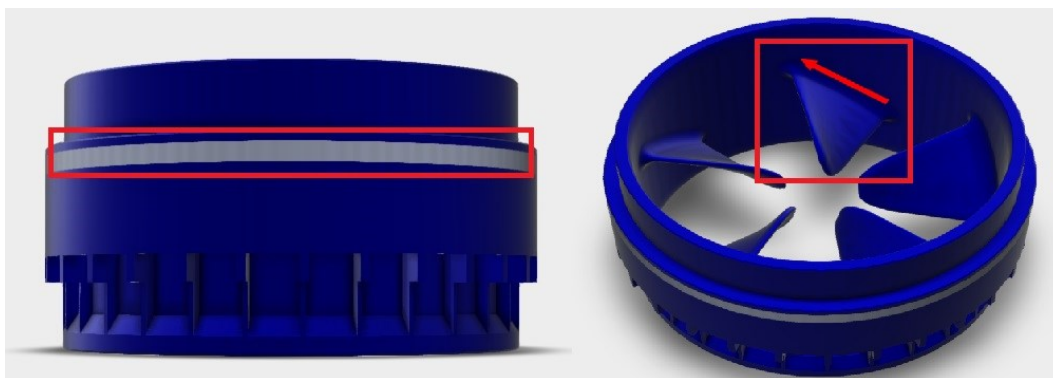
Figure 121: CW Top View Side View

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.
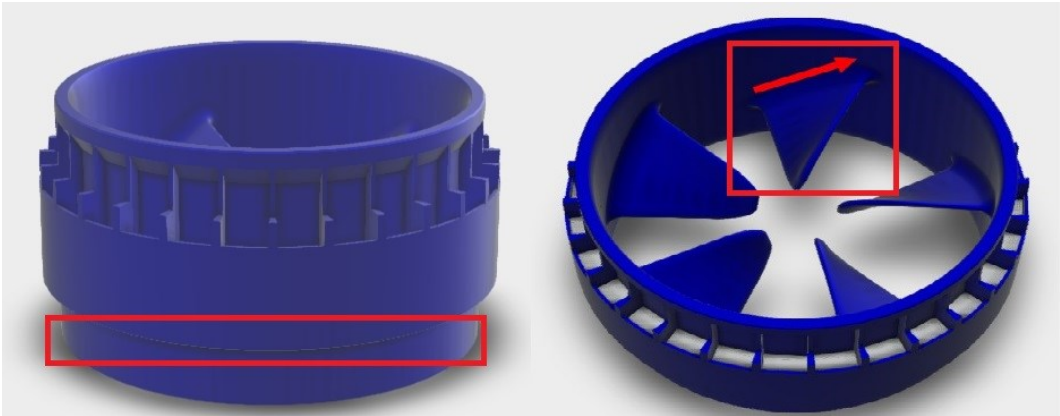
Figure 122: CCW Top View Side View

Thruster Layout Complete
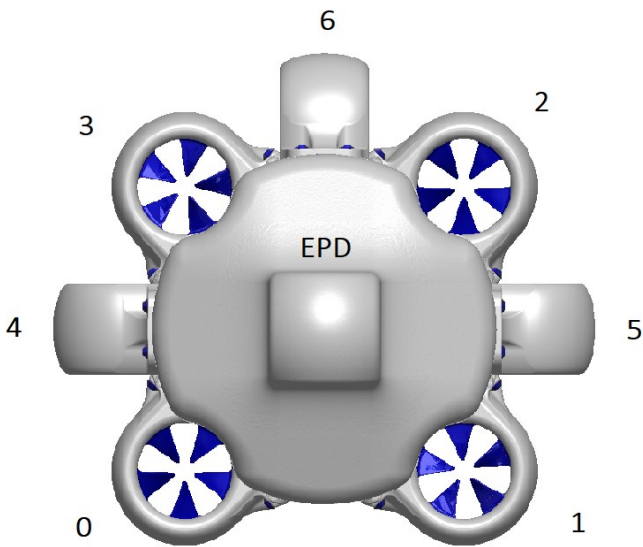
Top View

Figure 123: 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.
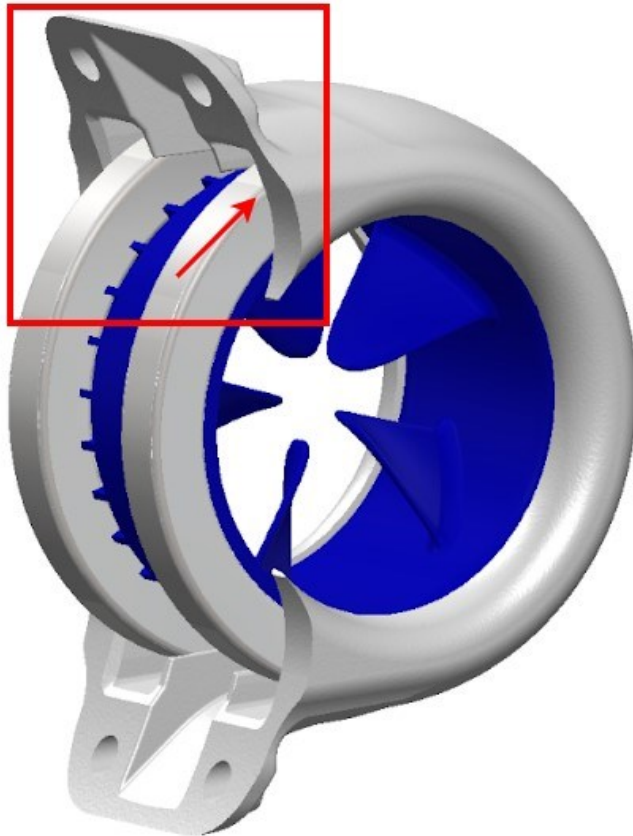
Figure 124: Horizontal Thruster Guard

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.
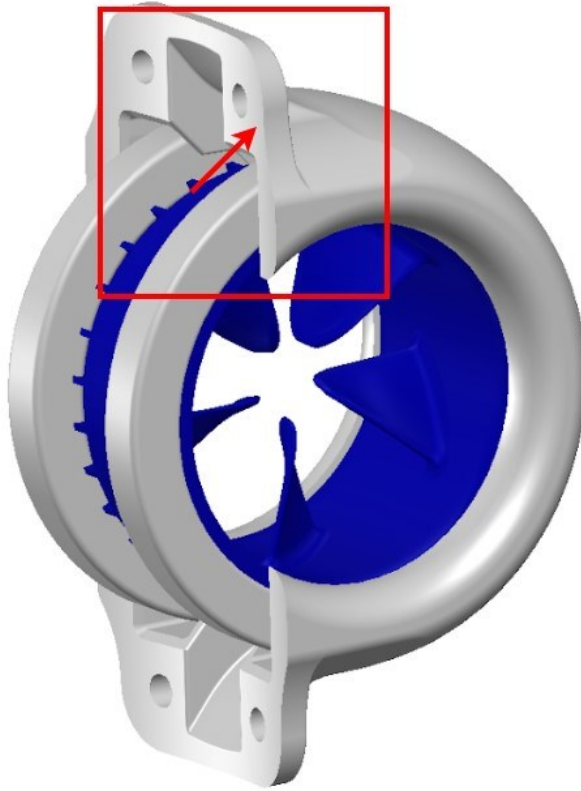
Figure 125: Hydrus Flat Surface

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 126: Ceramic Bearing

11.3.2.1 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

11.3.2.2 Thruster Change Out Procedure

Preparation: Position the Hydrus on a flat, stable surface to ensure it remains secure throughout the procedure.
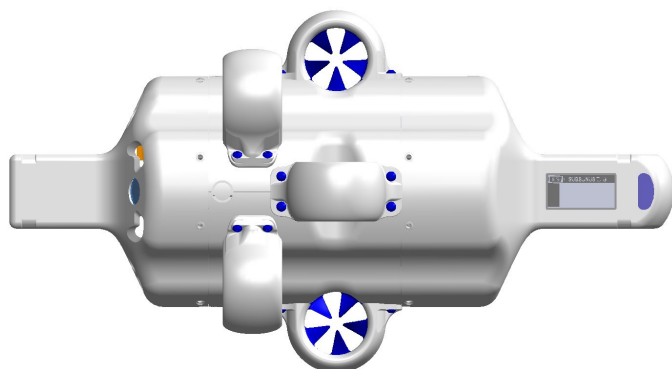
Figure 127: Hydrus Flat Surface Top View

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.
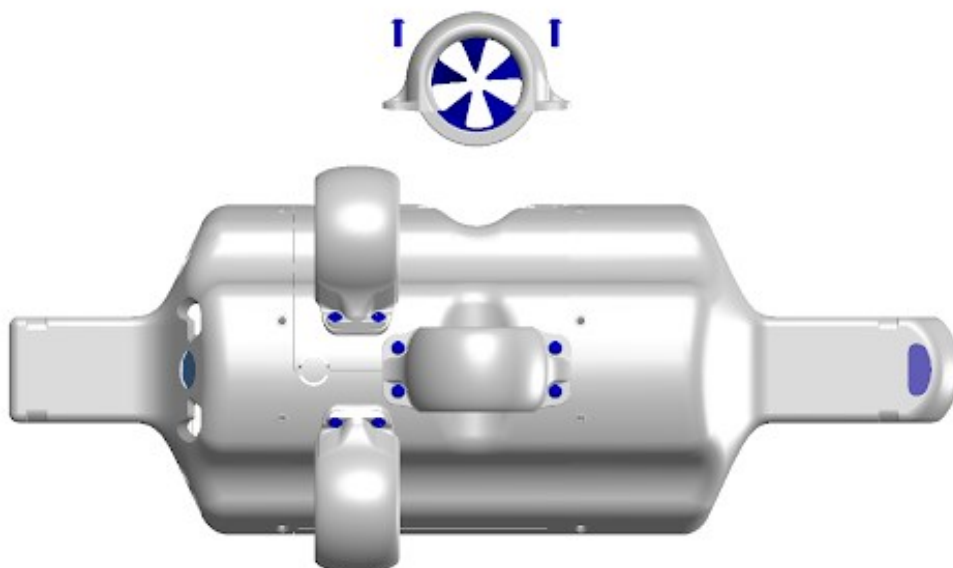
Figure 128: Hydrus Vertical Thruster Removal

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.
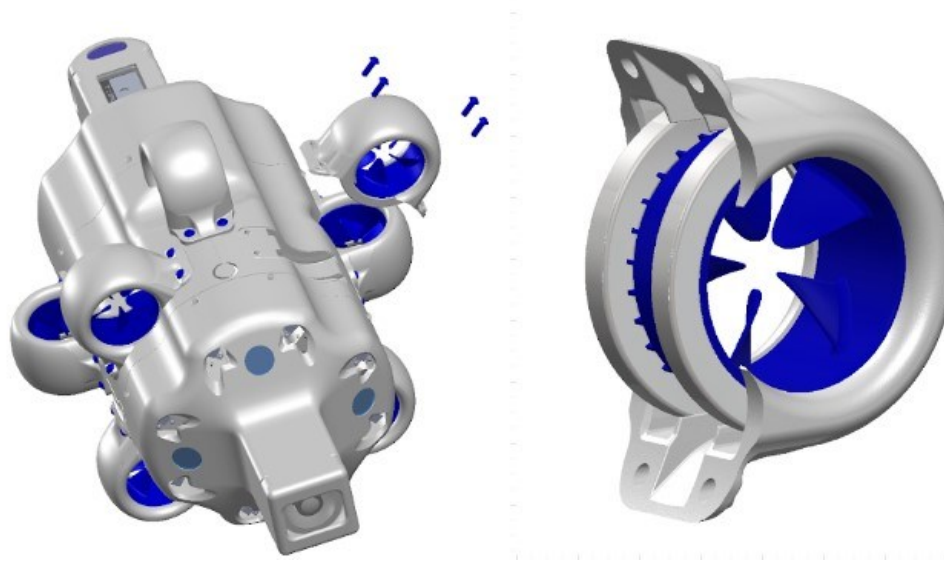
Figure 129: Thruster removal

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 130: Rotor Assembly Separated

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.

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

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

Rotor Identification: Determine whether the rotor being replaced is a CW (Clockwise Rotor) or a CCW (Counter Clockwise Rotor).
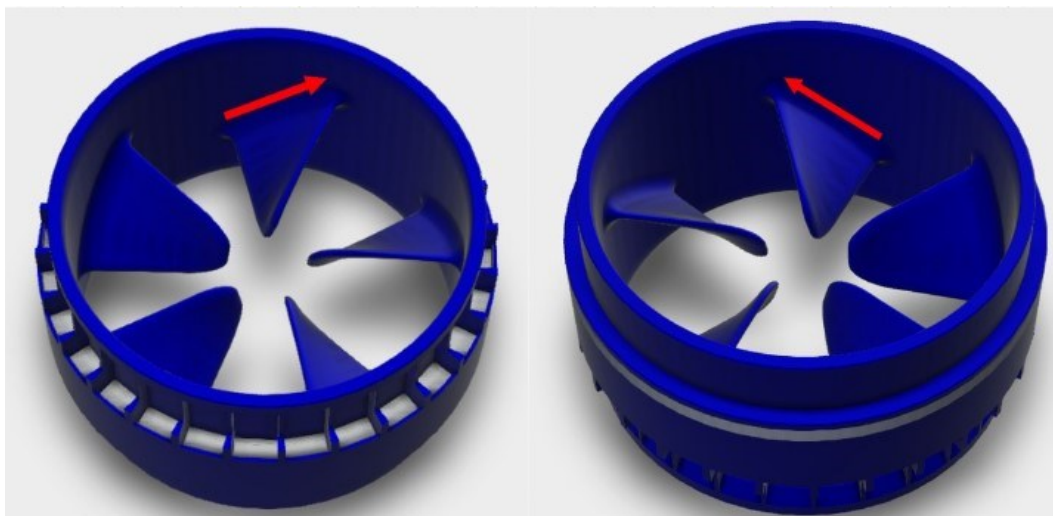
Figure 131: Rotor Identification

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


Figure 132: 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.
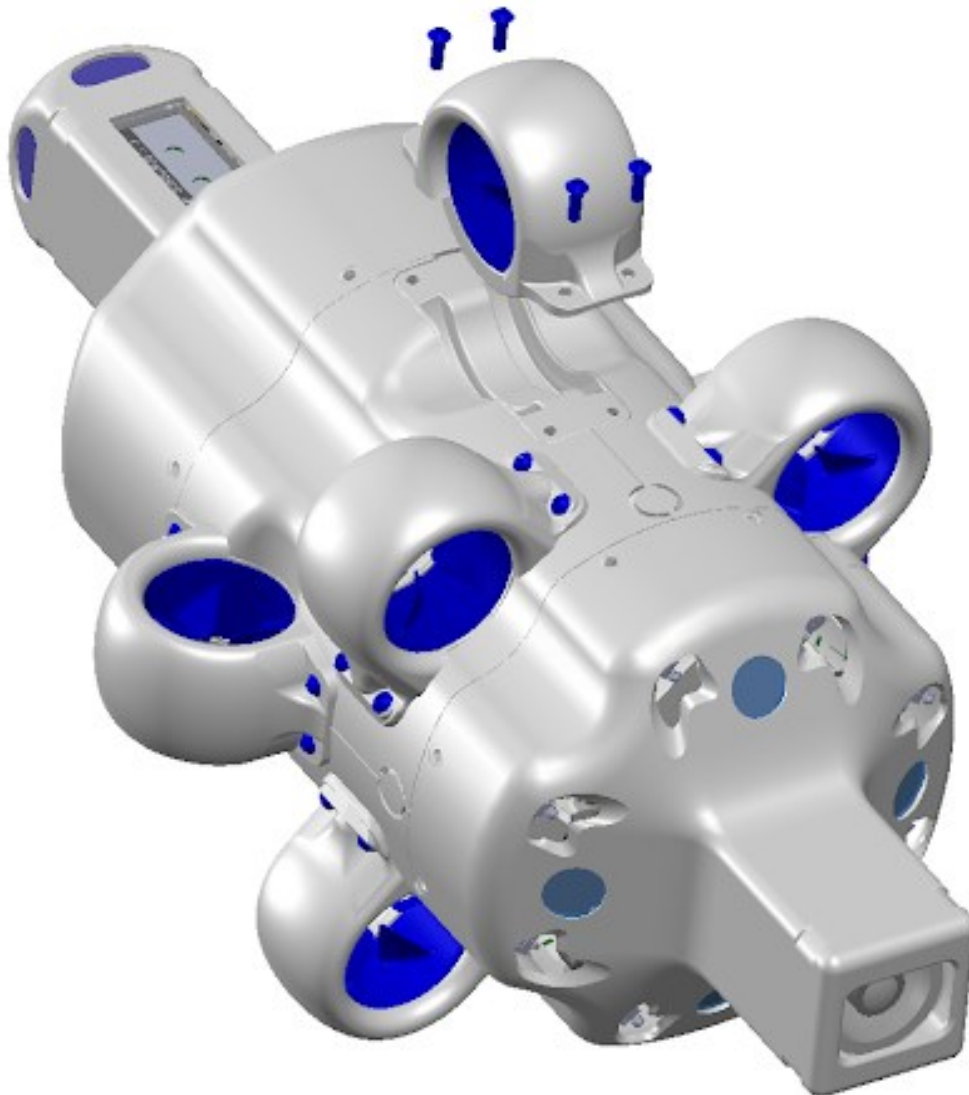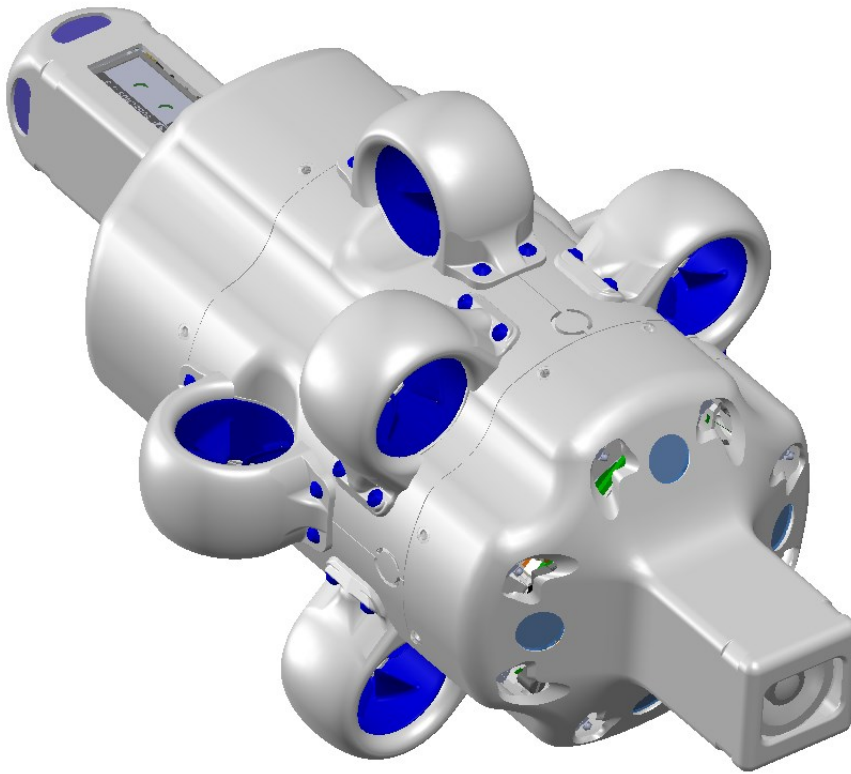

Figure 133: Thruster Replacement

Figure 134: 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.

11.4 Firmware Update

11.4.1 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.
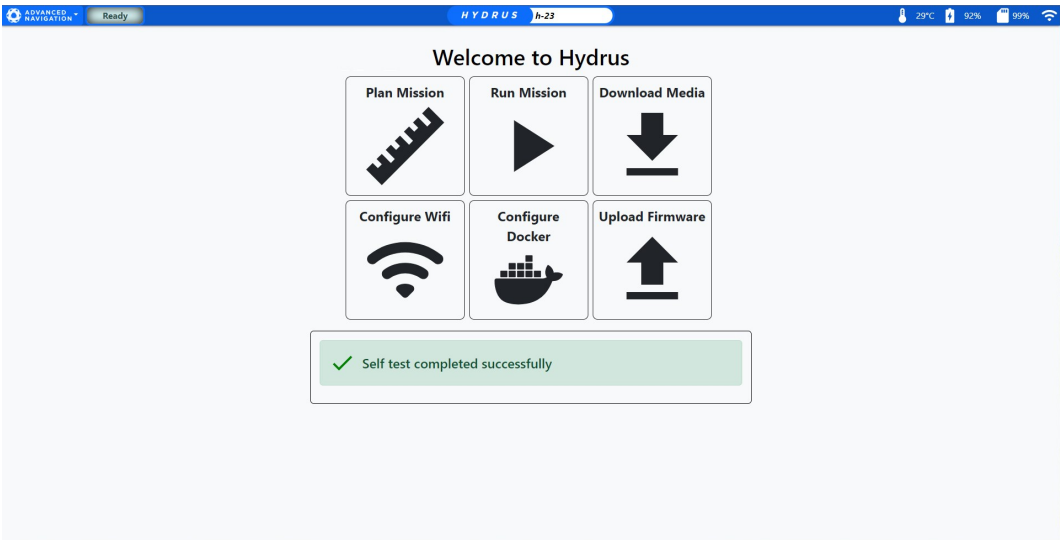
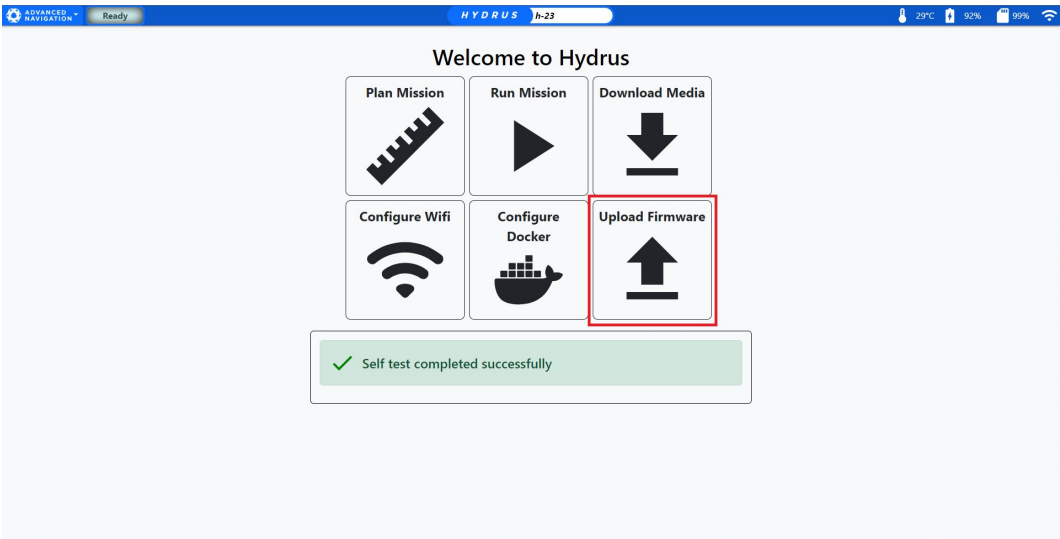*Figure 135: Hydrus webUI Main Page*

2. Select Upload Firmware

Figure 136: Upload Firmware

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

Figure 137: New Firmware File

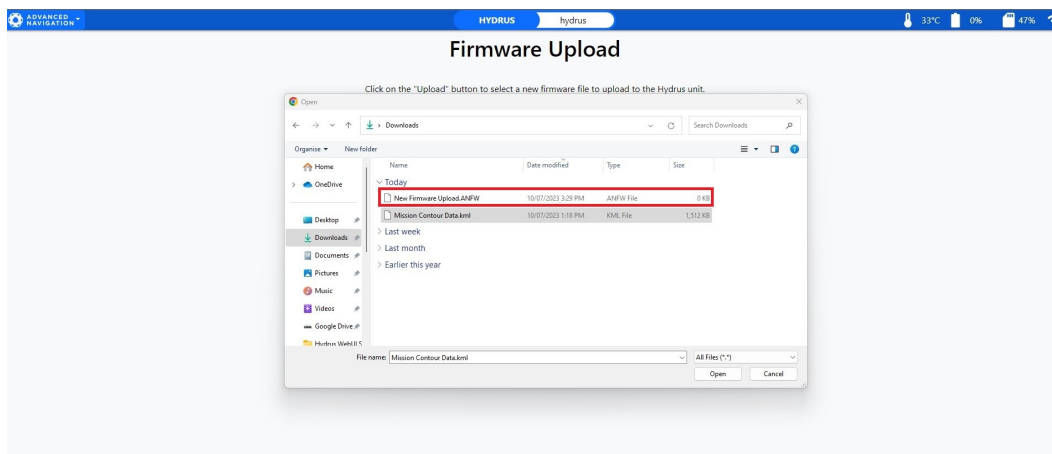4. Select the previously downloaded file.

Figure 138: Firmware Upload File Selection
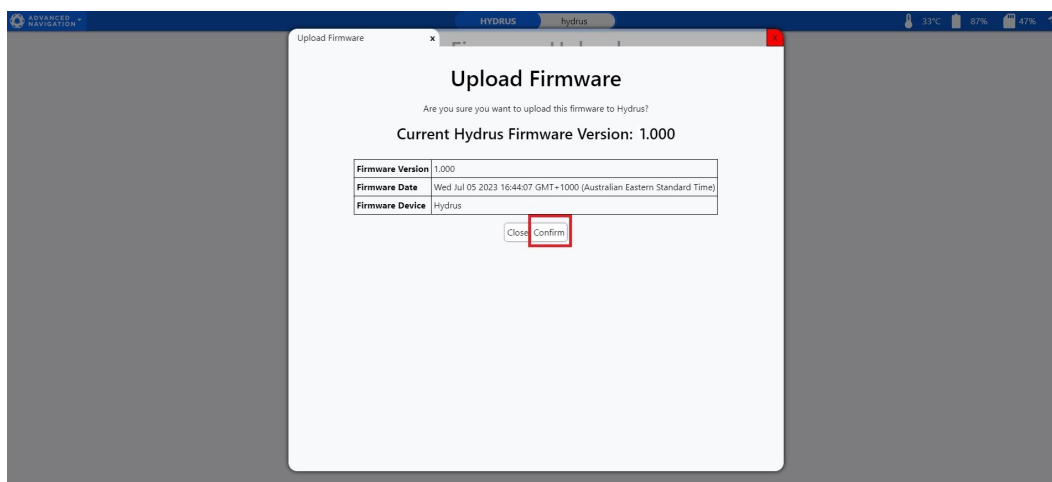
5. Click "Confirm"

Figure 139: Firmware Confirm

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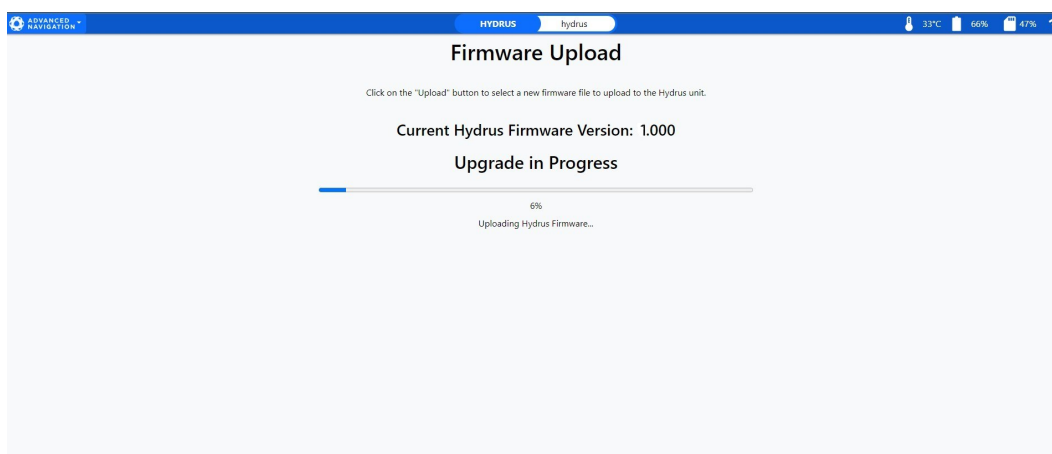

Figure 140: Upgrade in Progress.

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.