



# Survey Vehicle Platforms

YOUR VEHICLE TO BETTER DATA AND BETTER DECISIONS

# Why Would You Use a Vehicle Platform?



## Data Quantity

Collect exponentially more data than you can in a boat or with point sampling.



## Mission Control

Pre-program your mission for autonomous operation, or stay in full command with remote control, or use both!



## Data Quality

Xylem's industry-leading sensors are used with top-quality sonar and positioning technologies.



## Safety

Spend less time on boats and exposed to the elements by replacing days of manual profiling with a single vehicle mission.



## rQPOD

- Surface-only for low seastate environments, such as canals, low-wind and wave reservoirs
- Remote control & autonomous module and thrusters; multiple board options to accommodate sensors
- Sensors can include any YSI EXO water quality sonde; SonTek-M9 and SonTek-RS5 current profilers; Side Scan Sonar (SSS)
- 1.5 m/s maximum speed, with 3-4 hours on one battery charge (speed-dependent)



## HYCAT

- Surface-only, stable catamaran design for low-to-moderate seastate environments, such as medium to large lakes, estuaries, and coastlines
- Remote control or fully autonomous missions, with 5.8 GHz Radio for real-time data acquisition
- Supports YSI EXO2<sup>s</sup> sonde, SonTek-M9, and YellowFin SSS, with optional multibeam sonar, and onboard camera
- 2 m/s maximum speed with 6-10 hours on one battery charge (speed-dependent)



## i3XO EcoMapper

- Surface and underwater, with undulation option for low-to-high seastate environments, including Great Lakes, coastal and ocean environments
- Remote control or fully autonomous missions with acoustic communications to monitor vehicle status during mission, with unique inertial navigation system (INS), WiFi for easy data acquisition
- Uniquely modified EXO1 sonde, Advanced Doppler Velocity Log (ADVL), EdgeTech SideScanSonar and multibeam, optional magnetometer, optional port for additional sensor payload
- 2 m/s maximum speed with 6-10 hours on one battery charge (mission-dependent)

# What Will You Do With a YSI Vehicle?

YSI has worked with global experts to design vehicle platforms for our customers' applications, ranging from pure environmental research to drinking water reservoir management to search and rescue missions. Almost any outdoor application requiring a YSI or SonTek sensor can be completed faster and with less operational expense, and the value only increases with sensor combinations.

Vehicle Comparison				
	Description	rQPOD	HYCAT	i3XO EcoMapper
Key Sensor Options	YSI EXO1 Water Quality Sonde (4 ports)	No	No	Yes
	YSI EXO2 Water Quality Sonde (7 ports)	Yes	Yes	No
	SonTek-M9 & SonTek-RS5	Yes	Yes	No
	Advanced Doppler Velocity Log	No	No	Yes
	Magnetometer	No	No	Yes
	Side Scan Sonar	Yes	Yes	Yes
Key Features	Autonomous Operation	Yes	Available through HYPACK MAX	Available through VectorMap
	Remote Control	Yes	Yes	Yes
	Underwater Operation	No	No	Yes
	Undulating Missions	No	No	Yes
	Inertial Navigation System	No	No	Yes
	Real-time Data Acquisition	Yes, within BlueTooth range	Yes, within 5.8 GHz Radio range	Vehicle health only, through Acoustic comms
	Onboard Camera	No	Yes	No
	Field-swappable Battery	Yes	Yes	Yes, with spare tail section
	Single-person Deployability	Yes	No	No
	Sensor Expansion Ports	No	No	Yes
Run Time on One Battery Charge (at survey speed)	4-6 hours	6-8 hours	8-14 hours	

# rQPOD



## Cost-Effective, Flexible, and Innovative Surveying Tool

The **rQPOD** is a compact and light weight remote controlled or autonomous vehicle that can easily be deployed in remote locations with just one operator. This compact motor propulsion system can be incorporated into our unique family of **Torrent Boards (DUO, TB, and the TBX)**. The rQPOD is perfect for smaller lakes, ponds, reservoirs, and hard-to-access areas where a larger vehicle can't access.

### Features available as standard or options include:



Flexible sensor options: EXO 1, 2, or 3; SonTek-M9 or SonTek-RS5; side scan sonar.



Rugged Torrent Board withstands harsh water quality and moderate flow conditions.



Removable thrusters and batteries for field installation and serviceability.



Its small size and low draft makes this our most nimble vehicle platform.



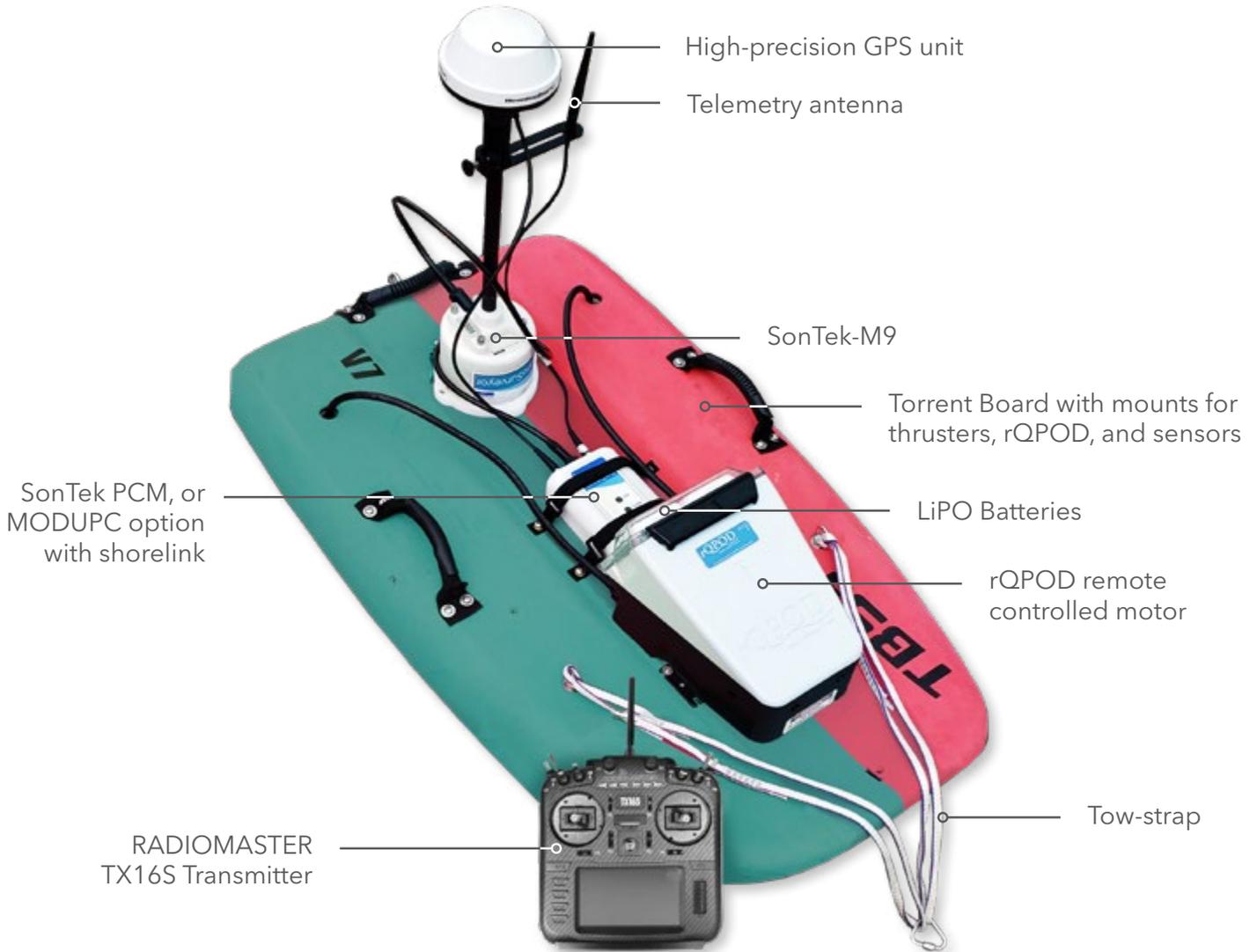
Patent-pending rQPOD motor is adaptable to other floating platforms.



At less than 26 lb (12 kg) and with the supplied backpack, system can be carried, assembled, and deployed by one person.

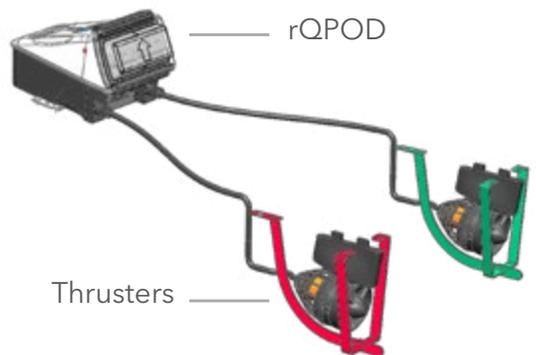


# Vehicle Overview



## rQPOD Module Specifications

Top Speed	1.5 m/s (5 ft/s)
Weight	4.54 kg (10 lb)
Battery Duration	4 to 6 hours @ 1.4 kts
Temperature Range	-10°C to +40°C (14°F to 104°F)
Batteries	2x LiPO
Transmitter	RADIOMASTER TX16S
IP Rating	IP67



## Torrent Board Options



DUO



TB



TBX



# Remote Bathymetric Survey

*in Kalgoorlie Mine Pits, Australia*

CASE  
STUDY

Norton Gold Fields Limited operates a gold mining and processing operation in Kalgoorlie, Australia. Impounded waters are an integral part of gold mining from the development of mining pits and dewatering operations.

Previously, Norton Gold Fields conducted volume surveys of impounded waters in pit lakes using Total Station positioning. Soundings were taken from a boat on the lake, which required up to four people for the survey. This process was labor-intensive and posed safety concerns associated with working on the water in boats. Kellie Carter, Senior Environmental Advisor, reached out to Xylem to explore possible solutions to make this process more efficient.

**“The rQPOD allowed researchers to stay safely ashore while collecting large data sets. The small, multiparameter vehicle is easy to transport and deploy by a single person.”**

Xylem was hired to conduct bathymetric surveys at three Pit Lakes in Norton Gold Fields after successfully surveying a pond in Tropicana Mining Lease with a radio-controlled boat.



**Learn More Norton Gold Fields**

[Nortongoldfields.com.au](http://Nortongoldfields.com.au)



In January 2018, surveys were conducted at three mining pits over a span of two days. Data was collected by the remote-controlled **rQPOD** with a **SonTek-M9 Doppler Profiler**. Corrections for the speed of sound in water were made using the **SonTek CastAway-CTD**.

The entire survey, including preparation, surveying, processing, and output generation, was managed through **HYPACK software**.

The survey assignment was unique, with a large and very shallow lake (maximum depth 1.6 m) followed by a deep, steep-walled mining pit (maximum depth 56 m). The final lake (maximum depth of 6 m) was a steep-walled figure-eight pit. This meant the rQPOD had to be operated from up to 362 meters away.

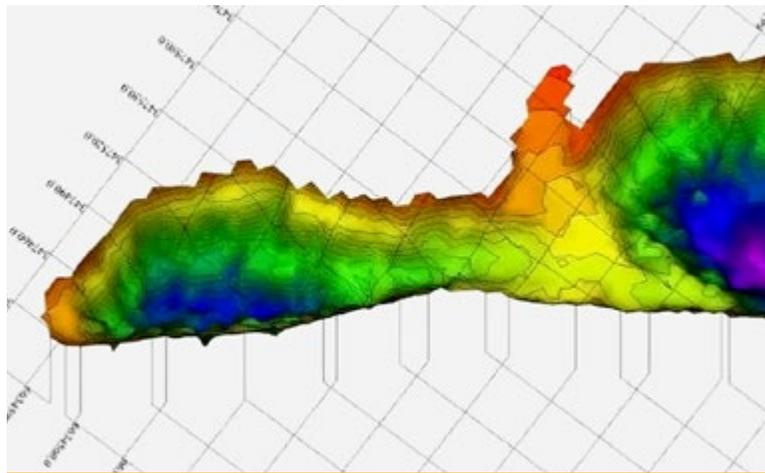
## Key Statistics from the Survey

Furthest distance rQPOD operated	362 m
Maximum depth	56 m
Total distance surveyed	18,000 m
Total area surveyed	175,000 m <sup>2</sup>

The bathymetric data obtained from the survey is used to build a model of the area. This model helps in determining the accurate volume of the impounded water, which is key to meeting environmental reporting requirements. Carter also mentioned that she could see the value in quickly and safely determining the volumes required for dewatering. This ensures that the correct pumping capacities and suction placement can be assessed.



▲ Survey preparation, data processing, and outputs were managed with HYPACK software.



▲ Bathymetric data is used to build a model of the surveyed area.



# HYCAT



## Multiple Sensors, One Complete Solution.

The **HYCAT** is a unique Autonomous Surface Vehicle (ASV) that allows for the collection of water quality, current profiling, bathymetry, discharge, and side scan data, all simultaneously and in real time. The HYCAT is perfect for use in near coastal environments. The catamaran design allows it to cut smoothly through the water, providing the most stable data possible. It fits into most trucks and SUVs for easy transport and deployment. The HYCAT-PRO model offers multibeam sonar capability.

### Features available as standard or options include:



The most sensor-rich platform available: YSI EXO2<sup>s</sup>, SonTek-M9, Side Scan Sonar in one system!



Easily switch between autonomous and remote-controlled modes with the rugged handheld.



Real-time data for real-time decisions.



Onboard camera gives you a unique look at your study site.



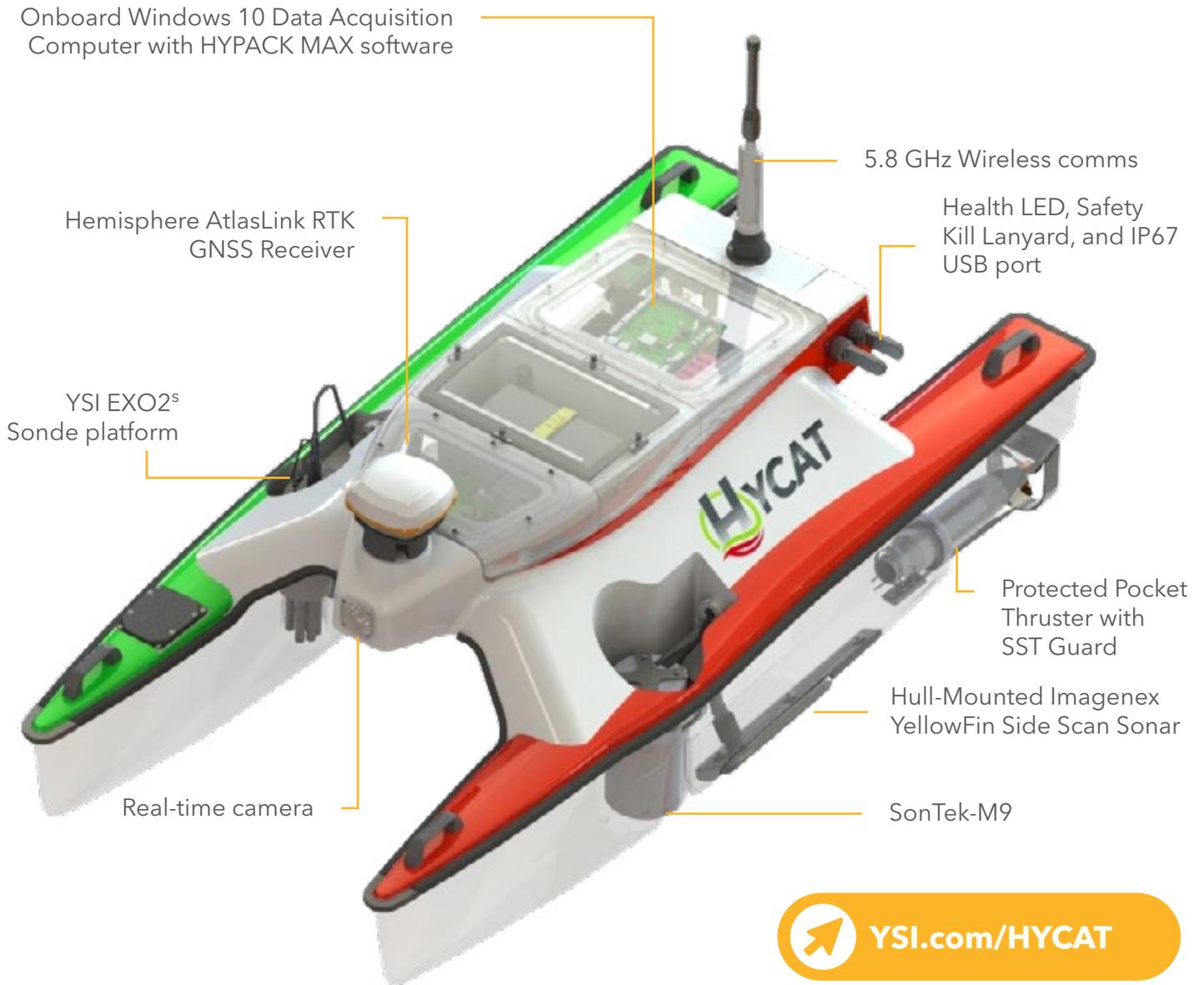
Field-swappable Li-ion battery keeps you operating all day.



Intuitive HYPACK MAX software for mission planning and analysis.



# Vehicle Overview



 [YSI.com/HYCAT](https://www.ysi.com/HYCAT)

HYCAT Specifications	
<b>Dimensions:</b>	Length: 1.8 m (5.9 ft), Draft (antenna down): 0.15 m (0.5 ft), Beam: 0.86 m (2.83 ft)
<b>Weight</b>	53 kg (115.5 lbs)
<b>Battery Duration</b>	8.0 hrs @ 2 kts, 6.0 hrs @ 3 kts, 2.7 hrs @ 4 kts
<b>Temperature Range</b>	Air Temperature: -20°C to +45°C (-4°F to 113°F) Water Temperature: +4°C to +32°C (39°F to 90°F)
<b>Batteries</b>	1 x 1500 Whr 24VDC nom UN38.3 rated Li-ion Battery. Field swappable.
<b>Transmitter</b>	Ruggedized operator control unit with joysticks and softkeys. Can easily switch between autonomous and RC control modes.
<b>Software</b>	HYPACK MAX, SonTek HydroSurveyor, Kor Software

# For the Love of Charles

## Famous “Dirty Water” is on the Rebound

## CASE STUDY

“Charles River Watershed Association was formed in 1965 by a group who was disgusted by the state of the river and wanted to clean it up,” says Lisa Kumpf, an aquatic scientist who heads up the association’s field science programs. “Since then, we’ve been cleaning up the river by working with the cities and towns in our watershed to get combined sewers separated, to make sure that stormwater that is going into the river is clean. We also have advocacy and law branches of our organization to advocate for laws around stormwater and sewage.”

Improvements in water quality in the Charles have been documented by the U.S. Environmental Protection Agency. EPA began issuing an annual “report card” grade for the lower reach of the river in 1995 based on water quality data collected by the association’s volunteers.

“We still have a lot of work to do, but in 1995 the basin was estimated to have a grade of D and now, in 2018, the most recent grade was a B,” Kumpf says. “We have come a long way, but there is still work to do.”

CRWA has been monitoring harmful algal blooms in the Charles since 2006, and is still discovering important details about them.

CRWA got a unique opportunity to explore algal blooms in the Charles when Kumpf and her team partnered with YSI to deploy two of the company’s new robotic systems—the **HYCAT Autonomous Surface Vehicle (ASV)** and the **i3XO EcoMapper Autonomous Underwater Vehicle (AUV)**—in a section of the Charles that includes a popular swimming area.

The HYCAT ASV is a six-foot-long, foam-filled catamaran designed to collect water quality, bathymetry and flow data at once, says YSI Integrated Systems and Services Product Manager Tom Goucher.

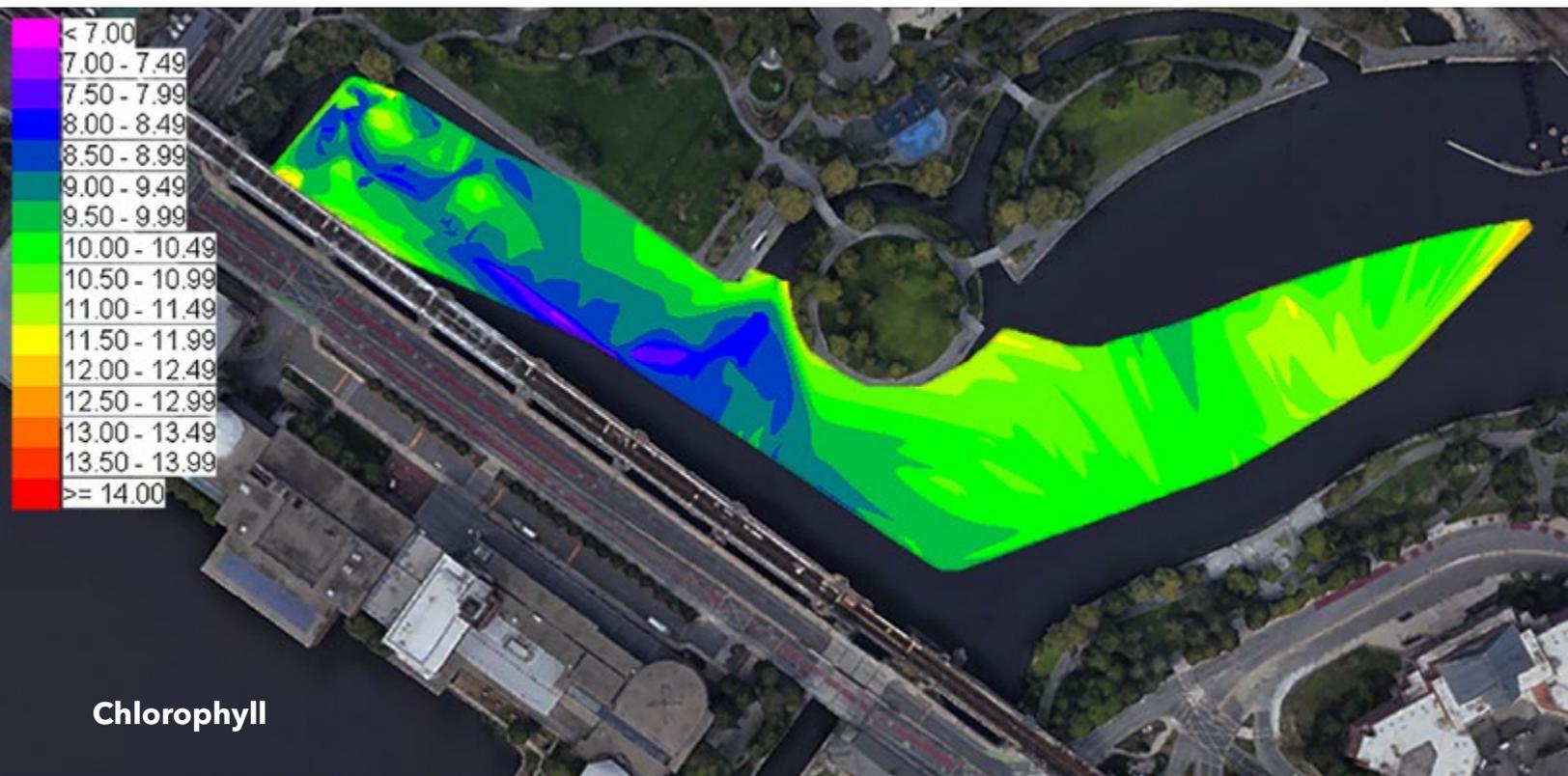
The 115-pound vessel houses a **YSI EXO2<sup>s</sup> sonde** with **seven ports for water quality sensors**; a **SonTek-M9 acoustic Doppler current profiler (ADCP)** to collect data on current direction, flow and discharge throughout the water column; a **side scan sonar for habitat mapping**; a **real-time camera**; an onboard computer and **5.8 GHz wireless communications**.

Using a georeferenced image of the study area, the HYCAT operator used **HYPACK software** to set a single GPS waypoint and pulled on a set of polygons to chart a “lawnmower grid” for the ASV to follow as it methodically gathered its data. The same software package provided real-time data visualization and post-processing.

Beneath the surface, the i3XO EcoMapper followed its own “lawnmower grid,” gathering up to eight water quality parameters with its nose-mounted EXO1 sonde and charts of the banks and bed with its bottom-mapping system and side scan sonar. Together, the two new autonomous systems provided detailed insights into the river that exceeded anything that had been collected in nearly four centuries.

“YSI developed these integrated systems in response to the growing need for algal bloom research and monitoring,” says Goucher, whose office, conveniently, is in Massachusetts. “The Charles River provided an outstanding opportunity to test how well we could map chlorophyll and other parameters, as well as physical characteristics of the river system, using the HYCAT and the EcoMapper.

“We are seeing remarkable versatility with these vehicles in real-world situations like the Charles, operating in currents up to 6 knots,” he adds. “These are going to be extremely powerful tools for people like Lisa and Max who are studying rivers, ponds,



## Chlorophyll

▲ Innovative software allows the technician to plot a course for the autonomous systems using a georeferenced image of the study area. In one day, detailed insights were gained that exceeded anything that had been collected in nearly four centuries prior.

estuaries, and near-shore systems.” In addition to sales of HYCAT or EcoMapper units, YSI has developed new [service-based programs](#).

This was a baselining activity, when there was not an active bloom. Kumpf is eager to put the HYCAT back to work during a bloom, to compare results.

Max Rome of Northeastern University works with the Charles River Conservancy. Rome was around in 2017, when it was learned that blooms in the Charles are dominated by Aphanizomenon, a commonly

studied species. This type of pre-bloom baselining will help to identify what conditions may stimulate blooms of Aphanizomenon in the future.

“Being able to get the HYCAT or the EcoMapper into the water during a bloom would be so incredible because it would give us a chance to see the profile and the cell density throughout the whole basin,” says Rome. “That’s a really big question right now that nobody has the answer for.”

**The HYCAT Autonomous Surface Vehicle helps CRWA researchers generate high-resolution water quality, bathymetry, and flow data at once along the river.**



 **Learn More About HYCAT**  
[YSI.com/HYCAT](https://www.ysi.com/HYCAT)

# i3XO EcoMapper



## Survey-Grade Autonomous Underwater Vehicle

The **i3XO EcoMapper** is YSI's most sophisticated vehicle, and our only autonomous underwater vehicle (AUV), that can reach depths of up to 100 meters with various sensor payloads. With an **EXO1** integrated into the nose of the EcoMapper, it can collect water quality data at depth using any of the available EXO sensors from YSI. It breaks down for easy shipping and carrying, and allows you to generate high-resolution, geo-referenced, three-dimensional maps of water quality, currents, and sonar images. Designed in partnership with Ocean Server (owned by L3 Harris) this is YSI's flagship vehicle.

### Features available as standard or options include:



Inertial Navigation System (INS) tracks global position: 97% accuracy over 10,000 meters!



Forward object avoidance to protect your vehicle.



Nose-mounted EXO1 sonde adapted specifically to this platform.



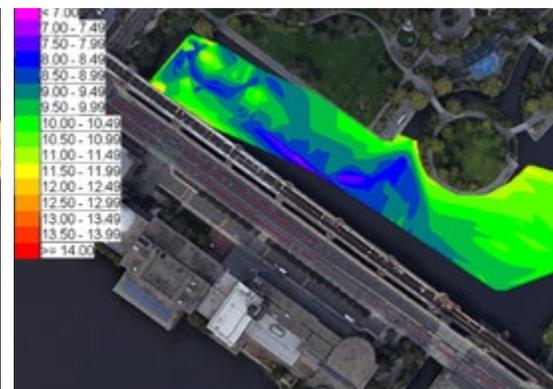
Point-and-click mission planning with intuitive VectorMap software.



Acoustic communications system for mission changes on-site.



Easy-to-use touch-screen handheld for full control in the field.



# Vehicle Overview



 [YSI.com/EcoMapper](https://www.YSI.com/EcoMapper)

i3XO EcoMapper Specifications	
<b>Dimensions:</b>	Length: 1.5-2.1 m (60-85 in); Tube Diameter: 0.15 m (5.8 in)
<b>Weight</b>	Weight: 26.8-38.6 kg (59-85 lbs)
<b>Depth Rating</b>	100m (328 ft)
<b>Battery Duration</b>	8-14 hours at 2.5 knot speed; configuration dependent
<b>Batteries</b>	800 WHrs of rechargeable Lithium-Ion batteries, (swappable section)
<b>Transmitter</b>	Touch-screen remote with joystick for surface control (300 meter + range)
<b>Software</b>	Vector Map: Mission Planning and Data Viewing Sonar Mosaic: Processes sonar records for overlay to Vector Map Bathymosaic: Creates GeoTiff images of a side scan records and KMZ files for Google Earth Underwater Vehicle Console (uvc) : Operation, run, mission, remote control

# Scientists Rely on AUVs

*Instrumentation Enables Real-Time Mapping, Sensing*

## CASE STUDY

**Autonomous Underwater Vehicles like the i3XO EcoMapper are the go-to solution when multiple types of sensor data are required to study or manage a system.**

Similar to the way that cell phones and other portable electronic devices have advanced over the past decade, the **i3XO EcoMapper** is possible because of instrumentation that is smaller, more robust, and more affordable. It's also possible because of a years-long relationship between YSI and OceanServer Technology, Inc., which today is part of L3 Harris, Inc. This perfect pairing of YSI's sensor and application expertise with OceanServer's AUV expertise has made both the i3XO EcoMapper and its predecessor, the EcoMapper, the most exciting unmanned water monitoring technology available.

### **Cutting-Edge Technology that Respects the Field Experience**

Compared to our industry-changing EcoMapper, the i3XO EcoMapper has even more technology and an even deeper respect for what the Field Engineer needs on site.

An excellent example is the optional **Inertial Navigation System (INS)**. Older AUVs handled positioning with a method known as dead reckoning, which relies on the compass and **Doppler Velocity Logs (DVLs)** to estimate the vehicle's speed and positioning. The typical accuracy for dead reckoning is roughly 1% distance traveled. So for every 1000 m traveled underwater, one would see an error around 10 m in positioning when the AUV resurfaces. This could cause issues ranging from poorly mapped data to lost vehicles.

With INS, the i3XO EcoMapper is able to get an accuracy of 0.3% distance traveled! This allows the vehicle to stay underwater for an extended period without having to come to the surface for a positional adjustment using GPS. The user will experience less lost time for resurfacing, and more time to actually run the survey. Overall the cost per data point may be reduced by as much as 10 times with this new technology!



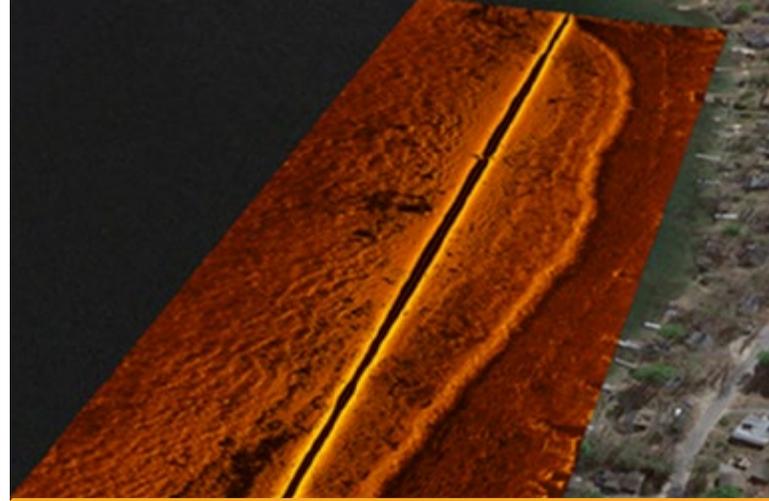
The i3XO EcoMapper also has up to 3 different location identifiers so that the end-user always knows the exact GPS coordinates of the unit, and the vehicle can notify the user of its whereabouts when in mission mode. Those identifiers include a location pinger with a specific frequency and ping sequence, an acoustic communications unit for underwater updates, and an Iridium modem for location updates on the surface. These tools enable the user to track the vehicle the entire time, whether it's on the surface or underwater, to ensure it's on path and error-free.

The INS optimizes performance of the sonar instrument available with the i3XO EcoMapper, and which supports both **Multibeam** and **Side Scan Sonar (SSS)**. Improved object detection with dual frequency allows the i3XO EcoMapper to quickly identify targets and obstructions on the sea or lake floor, in high resolution. This makes the i3XO EcoMapper an excellent tool for search and recovery missions or identification of unexploded ordnances (UXOs). The multibeam portion enables swath bathymetry, previously reserved for those with military-level budgets, is now available to everyone..

This technology allows the user to cover up to 12 times compared to the less than 1:1 coverage of a single beam. With a single beam running at 10 m from the bottom, the overall coverage one can obtain is less than 10 m. With the multibeam running at that same height, coverage of up to 120 m is possible. This translates to fewer runs to cover the same ground, saving time and money.

Military-grade technology is even brought to i3XO EcoMapper users with the Getac computer that doubles as a notebook, and is IP67 rated. This is an option with every i3XO EcoMapper and is one way to communicate with the i3XO EcoMapper via wireless, or with some of the onboard sensors via Bluetooth.

Other field-minded features of the i3XO EcoMapper are that it can be mission-programmed for up to 6-10 hours, and has a Li-Ion battery that supports long missions and a quick recharge. A key upgrade relative to the EcoMapper is that the i3XO EcoMapper battery compartment and propulsion system module can be hot-swapped in the field. With an extra battery on hand a day of surveying can be extended from dusk to dawn.



◀ With INS the i3XO EcoMapper is able to get an accuracy of 0.3% distance traveled!

## Who Uses i3XO EcoMapper?

The i3XO EcoMapper is used by leading scientists in the world, including some at the United States Geological Survey and the U.S. Army Corps of Engineers. The vehicle is a workhorse in the field, helping these agencies reduce hours for their people on the water, while collecting more data than ever before possible.

The i3XO EcoMapper is also a favorite of educational institutions, where a single vehicle is often shared by multiple departments or programs, and even used in teaching. In all cases, YSI's i3XO EcoMapper provides critical data without the tedious hours of human observation that would otherwise be required. With improvements in portability, plug-and-play sensors, and intuitive user interfaces, the vehicles are used in many applications across the globe.

Whether it's with your own vehicle, or with YSI at your side providing vehicle-related services, the i3XO EcoMapper can transform your data collection like it has for these scientists.

 **Learn More About EcoMapper**  
[YSI.com/EcoMapper](https://www.ysi.com/EcoMapper)

# Survey Vehicle Services



# Maximize Your Water Monitoring. Minimize Your Effort.

A Vehicle Platform with all its sensors is a significant commitment, and we want to ensure everyone has access to this technology. By utilizing the **Survey Vehicle Services** provided by YSI, you can have all the benefits that the latest technology offers without a large purchase and subsequent maintenance required when owning your own equipment.



Full-service packages where our experts run the technology for you—without a big purchase!



Avoid risk on a boat, and safely operate vehicles from the shore.



Maintenance contracts for all of your sensors.



Refresher training or training for new users.



Industry experts with the latest technology at their finger tips.



# Our Lineup of Survey Vehicles Has You Covered



Bathymetry, Discharge &  
Current Profiling



Water Velocity



Depth Measurement



Remote Data Acquisition



Source Water Mapping



Point Source and Nonpoint Source  
Mapping



Water Quality



Imaging with Side Scan Sonar



Real-Time Positioning



Baseline & Bottom Monitoring



And more!

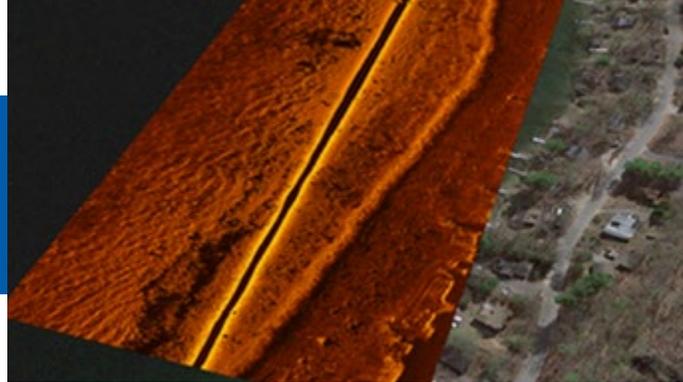


# Let YSI Bring the Operator and Vehicle to You!

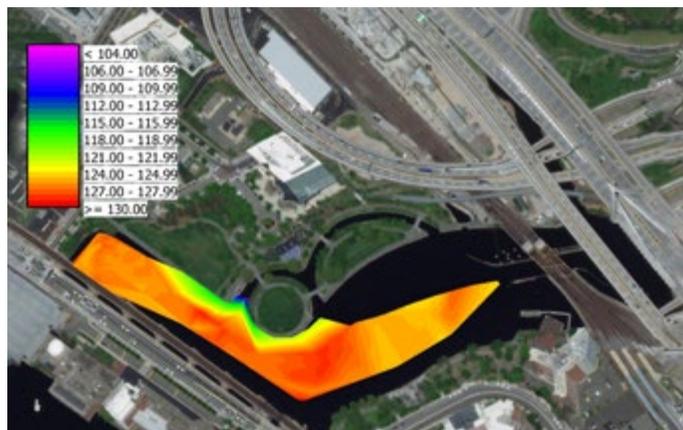
A contract with YSI allows you to get all the benefits of our unique Autonomous Vehicles without a purchase, such as those needing a bathymetry survey for a special event like dredging or equipment installation.

## Take these 5 Steps to get all the benefits of our unique Autonomous Vehicles:

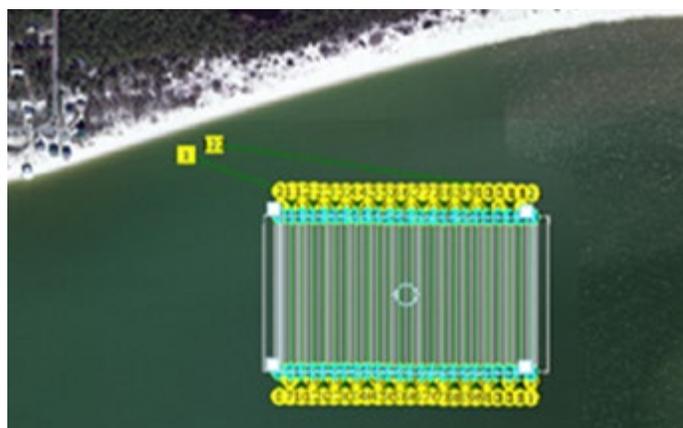
- 1 Contact your YSI Representative to discuss your project.
- 2 Place your order and schedule the desired service date.
- 3 Plan your vehicle mission with a YSI application expert.
- 4 Our expert will arrive with a fully-loaded, calibrated vehicle to execute the mission.
- 5 The data and reports will be delivered as defined by your order.



Side Scan Sonar



Water Quality Monitoring



Vector Mapping & Custom Waypoints



## YOU'RE DATA-DRIVEN Let YSI Drive

 [YSI.com/Vehicles](https://www.ysi.com/Vehicles)

# Xylem |'zīləm|

- 1) The tissue in plants that brings water upward from the roots;
- 2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

**For more information on how Xylem can help you, go to [www.xylem.com](http://www.xylem.com)**

# Who's Minding the Planet?®



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