



Aquatic Environmental Unmanned Services



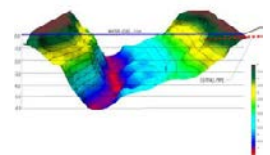
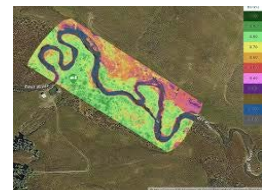
Water Body Type	River, Lake, Reservoirs, Harbor
Client Category	B2I, B2G, B2B
Client Type	Agricultural, Forestry, Environment, Irrigation, Public Works, Governmental Institutions
Services	Water River Environmental Survey, Monitoring and Mapping, sampling
UST Technology	Combined UUV (ROV) and UAS (Fixed Wing , VTOL)

A full water body environmental investigation ranges from mapping to cleaning the water bodies. Monitoring water quality, sampling and mapping is critical to understand and protect the source of life.

1. Water Bodies Mapping

Mapping consists of combined aerial and aquatic operations, according to client’s requirement, however, the mapping/survey can be independently carried out (e.g. Aerial Mapping/Survey, Water Survey)

- Aerial Mapping** consists of flying at low altitude along a river’s trajectory allowing its mapping and that of its immediate banks providing 2D, 3D, orthomosaic and NDVI map resolutions and bathymetry to assess the water body, depth measurements is optional. The mapping covers the rivers trajectory, water body perimeters and immediate vicinity of riverbank/ shore. The shore strip/riverbank width mapping is dependent on the client requirements and on the flight (altitude) and sensor capacity. For narrow riverbank strips $\leq 500m$, a low flight altitude is recommended, while the larger the strip is higher flight altitude will be considered, however resolution will be dependent on sensor capacity thus the higher one flies, the less detailed output is achieved. Flight altitude is also dependent on Aviation Authority regulations; therefore the altitude may not be customisable.
- Orthomosaic, 2D and 3D Mapping** allows for the identification of the river trajectory by providing detailed information with high resolution imageries of river trajectory, riverbanks status, its vegetation, help identifying riverbank portions subject to corrosion, spot and map legitimate and not legitimate activities such as: fisheries, constructions, water works, water inlet, wastewater discharges, waste dumping, illegal activities etc...
- Normalized Difference Vegetation Index (NDVI)** mapping of a river trajectory allows concerned stakeholders to visualize the vegetation cover and status providing relevant information on the river environment condition such as area with no, or poor, vegetation being prone to soil erosion for example when a rivers banks burst. When combined with other technique the NDVI provide information on agriculture exploitation around river bank.
- Aerial Bathymetry** with UAS¹ is relatively new and it can be achieved using specific LiDAR technology with specific UAS, in some case it can be combined with photogrammetry, allowing with one operation, topography and bathymetry outcome. UAS bathymetry is best fit for shallow river and water bodies that maybe difficult to access with conventional methods, or for fast and quick mapping following a calamity (floods, pollutions, etc...).
- Aquatic Bathymetry** allows river and water body mapping using high end equipment such a side sonar or LiDAR mounted in specific underwater ROV or Unmanned (Aquatic) Surface Vehicle. The later are the suitable UST for rivers, as they can operate in current $\geq 2 m/s$ large river and lake, fully autonomous for long hours with predefined navigation rout. The technology used for underwater bathymetry are sonar and / or LiDAR.



¹ Aerial bathymetry using conventional aircrafts and satellites has been used for decades.



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- **Coastal Mapping.** Near shore seabed and shallow water reef mapping are critical to environmental investigation, to monitor coral reef bleaching to degradation caused human activity such as intense diving / snorkeling, to industrial / maritime activities. Using high definition camera ROV combine or not with side sonars, it is now possible to map coastal environment any time, technique that was only affordable with high military grade underwater drone, is now accessible.

The first mapping exercise would provide the base reference map and flight plan for future routing monitoring or ad-hoc intervention. Further investigation will be based on the predefined map and flight plan. Identified points of interest requiring a regular surveillance can also be included in separate flight schedules according to requirements. Once the base map is defined, additional surveys in preferential areas could be carried out to monitor the evolution of the area.

2. Aquatic environmental investigations, assessment and issue mitigation

The aquatic investigation of a river focuses on investigating the aquatic environment as whole including water quality, bathymetry (depth mapping), sampling of water at various depths and locations, riverbed sampling of physical parameter such as temperature. According to the investigation requirement different underwater and surface drone will be used to perform the tasks from “eyes in the water” to data gathering, from mapping to sampling.

- **Visual Inspection (Reconnaissance):** This is what we define as “*Eyes in the Water*” It is a simple operation using an entry level category underwater ROV with enhanced video and photography and basic information such as temperature and depth measurement. This operation allows viewing of the underwater environment, inspection of water inlet, water spout and waste water outlets. *Eyes in the Water* can be used to do a preliminary investigation to inform decision maker on other specific investigation and / or specific interventions, assessing beforehand the risk and the environment where specific response/survey ought to be carried out, saving both time and money. For example, *Eyes in the Water* helps spot area of important algae growth suggesting high fertilizer pollution. 
- **Water quality:** Using specific underwater ROV's equipped with high standards water quality probes sensor allowing to record Temperature, Turbidity, TDS, pH, COD, NO₂ among others², at different depth. In addition, video and photo images will be always recorded. This is of interest to assess the river status and map the water quality for environmental, research and drinking water quality assessment. Water quality can also be assessed using autonomous USV however this is limited to the surface water quality. 
- **Sampling:** Using specific underwater ROV's equipped with water or sediment sampling equipment allowing multiple or single sampling of water at different depth, and sediment sampling at different locations. Combined with the water quality monitoring sampling will provide invaluable information for environmental investigation. In case of (chemical) pollution this technique allows for sampling in any part of the water body including and the river bed. Combined with aerial investigation this technique allows mapping of the extent of the pollution and the pollution plume. 

3. Aquatic Cleaning

Inland water and sea pollution, ranging from plastic to oil spill is a reality in our world. Environment protection is a moral responsibility and Drone Solutions is engaged in providing solutions. Using state of the art autonomous surface vehicle, the WasteShark, plastic, oil spill and algae can be collected with minimum to no impact on the environment (zero carbon emission), wildlife friendly, providing a secure and safe environment preventing labor to be exposed to possible harmful elements and working in risk environments.



² Additional parameter are: conductivity, depth, ORP, dissolved oxygen, ammonium, chloride, nitrate, ORP, Resistivity, chlorophyll, algae.



Aquatic Environmental Unmanned Services



Aerial Business, Rates & Requirements

Description	Where	Charge	Requirement
Sale of UAS no camera	FOB	Rate + commissioning + training	For overseas delivery Customer responsible for custom clearance
Sale of UAS with camera	FOB	Rate + commissioning + training	
Rental (FOB SG)	Daily	Rate + insurance + deposit ³	Customer responsible for Flight permit, prove of trained and certified pilot, pilot records, third party insurance liability For overseas delivery, IATA carnet
Rental (delivered)	Daily	Rate + IATA + insurance + mobilization & demobilization + deposit	
Dry Leasing ⁴ (≥ 3 months)	Delivered	Rate	Customer responsible for operation, data, and permits, fuels
Wet Leasing ⁵ (≥ 6 months)	Delivered	Rate	
Full service No data analysis (min acres/km applies)	In situ	Rate Geographical area determined: acre/ km	Flight permit
Full service with data analysis	In situ	Rate Geographical area determined: acre/ km	Flight permit

Notice:
Drone Solution Services Pte Ltd reserve the right to change, amend, or cancel any part of its Aerial Business Services at any time without prior notice. The example above is purely indicative and strictly non-binding.

UAS VTOL Model

Model	DSS A300GCS	
UAS Type	VTOL	Fully automatic
Flight mode	BVLOS	
Endurance	180 minutes	
Range	30 Km	
Camera	Sony R*1Rm2 42Mp 35mm F2	
Flight Control	Ground Communication Systems	
Flight Automation	Fully automatic	
Power	Lithium	
Safety	Low Battery protection, Geo Fencing RTL	
Payload	3.5 KG	



Customization for specific services/requirements		
LiDAR		Third party
NDVI		Optional
Dual zoom camera		Optional
IR / Thermal		Optional

Notice: The models shown in this factsheet are examples of Drone Solutions UAS/USV/ROV listing. Picture strictly non-binding

³ Deposit is evaluated on a cases by cases including pilot certification, experience and records (accidents)
⁴ Dry Leasing includes 2 UAS with all its equipment, maintenance, insurance, excluding fuels for the UAs or to recharge batteries
⁵ Wet Leasing includes 2 UAS with all its equipment, maintenance, insurance, personnel, excluding fuels for the UAS and/or power to recharge batteries



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Aquatic Business, Rates & Requirements

Description	Where	Charge	Requirement
Sale of ROV / USV	FOB	Rate + commissioning + training	For overseas delivery Customer responsible for custom clearance
Rental (FOB SG)	Daily	Rate + insurance + deposit ⁶	Customer responsible for permit, prove of trained and certified pilot, pilot records, third party insurance liability For overseas delivery, IATA carnet
Rental (delivered)	Daily	Rate + insurance + mobilization & demobilization + deposit	
Dry Leasing ⁷ (≥ 3 months)	Delivered	Rate	Customer responsible for operation, data, and permits, fuels
Wet Leasing ⁸ (≥ 6 months)	Delivered	Rate	
Full service No data analysis (min tariff per day applies)	On situ	Rate depending on services	Permits
Full service with data analysis	On situ	Rate depending on services	Permits
ROV sensors (sell)	On demand	Rate depending on sensor(s) Type	
Service			
Water quality	Hourly	No data analysis	
Water sample	Sample	Sample + mobilization / demobilization. NOTE: In the event of sampling in polluted environment/waters, additional price for HES PPE will be charged to the clients NOTE: no sampling handling, no sampling analysis, no sampling logistics.	Customer responsible for sampling handling (logistic, laboratory, analysis etc...)
Sediment sampling	Sample		
Bathymetry	Area	Rate depending on used technology	
Infrastructure	Area/Hourly	Rate Depending on infrastructure	

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ROV Model

Model	DSS U100SD	
ROV Type/Use	Eyes in the Water	
Speed	1.5 s/m	
Endurance	4 hours	
Depth	100 meters	
Camera	4K, 12 MP	
Navigation Control	Smart device	
Navigation Automation	Motion lock, depth lock, 360°	
Power	Li Ion Battery	
Safety	ROV breaking point 80 kg	



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⁶ Deposit is evaluated on a cases by cases including pilot certification, experience and records (accidents)

⁷ Specific models only: info@dronesolutionservices.com

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