



# Drone Procurement



## A Report for Authority Members

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## Version control

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## 1. Introduction

The use of drones is now commonplace across many agencies, not just in the detection of crimes and the evidencing of offences but also for asset management, intertidal surveys and habitat mapping. Aside from Devon and Severn IFCA (D&S IFCA) and Cornwall IFCA (CIFCA), all other IFCAs are now utilising drones for both compliance and enforcement and their science and research sides. Drones can be used in dynamic environments, as a fast response to monitor, record and evidence illegal activity that may not otherwise be seen, as well as being used for routine observations and checks. For use in law enforcement, drone features such as GPS, thermal imaging and zoom functions, can help prove offences were committed along with the precise location of that activity. Owing to the high-quality cameras fitted to the drones it is a valuable form of evidence that would otherwise be unlikely to obtain often due to the difficulty of access. When used in fisheries enforcement, drones may assist with the detection of fisheries offences, by providing officers a closer view of a vessel or activity from an angle or location not accessible by foot or patrol vessel, while also allowing the offence to be recorded for use as evidence. In addition to the detection and evidencing of offences, a drone may also support fisheries management with the monitoring of Marine Protected Areas (MPAs) or closed areas and intertidal surveys.

## 2. Drones – An Overview

### 2.1 What are they?

Drones are Small Unmanned Aircrafts (SUA), within Unmanned Aerial Systems (UAS) as defined by the Civil Aviation Authority. They are also widely known as UAVs (Unmanned Aerial Vehicles), but commonly described as Drones. Drones are typically miniature aircraft controlled from the ground by a pilot; they can have various camera attachments and have recording capabilities.

### 2.2 What do they cost?

They range in price from £20 to £200,000 and upwards. A reasonable quality drone that uses GPS and autonomous technology can be obtained for a little as £500. Additional costs apply for the procurement of batteries, additional cameras, safety equipment etc.

### 2.3 What imagery capability do they have?

Drone cameras can capture still and video images, up to 4k quality (a horizontal display resolution of around 4,000 pixels). Some cameras have additional features such as thermal imaging, laser range finding, GPS positioning, considerable zoom functions, tracking functions and mapping functions, all of which can be monitored live stream, recorded and playback.

## 3. Drones – Flight and Use

### 3.1 How are they flown?

Drones are controlled remotely by a pilot on the ground using a handheld viewing device and a controller. The pilot can control the flight of the drone and monitor the drone camera's view, in addition to recording videos or photos. An observer must also present with the pilot for the duration of the flights in order to increase viewing capabilities and reduce risks of collisions. The role of the observer is to assist the pilot, paying attention to the environment and the surroundings around the drone, whereas the pilot will monitor the live footage from the drone. In some more complicated deployments, more than one spotter may be required, e.g. in high-risk areas, or for night flights.

### **3.2 How does a pilot learn to fly a drone?**

A drone pilot has to pass a theory exam and practical flight test under the Civil Aviation Authority (CAA) regulations. The theory exam tests the pilot's knowledge of basic aeronautical knowledge, similar to some of that required by a conventional pilot. The difficulty level of learning to fly a drone varies depending on the person and what type of drone they are flying. For example, if a person has good sensorimotor skills and hand-eye coordination, then learning to fly a drone may not seem very difficult to them. In addition, learning to fly a high-end drone may be easier than learning to fly on a cheaper drone; this is because more expensive drones usually have many built-in flight assistance features e.g. Collision avoidance.

### **3.3 D&S IFCA Drone Use**

All drone flights will require a qualified pilot and an observer, the observer role does not require any additional qualifications as their role is to maintain visual contact with the drone and to monitor and report any potential risk. The drone pilot will use a handheld control device and screen to view the live stream from the drone camera, whereas the observer's role would be to observe and monitor the location, environment and surroundings that the drone is flying in and assessing any new or identified risk. D&S IFCA would use a drone from land to observe fishing activities within estuaries, inshore sea areas, or landing activities within harbours. D&S IFCA will develop a Drone Policy, in order to support IFCOs' drone use, in addition to researching and receiving information from partner agencies with drone capabilities.

### **3.4 Compliance**

Compliance activities carried out by fisheries officers may be assisted by the use of a drone, which can enable a large area of sea or land to be viewed and monitored in a short space of time with much reduced resource. Additionally, areas, vessels, vehicles or persons of interest, may be singled out and viewed closer using the camera's zoom features, even tracked/followed automatically allowing activities to be monitored and recorded as required along with providing live information allowing more efficient deployment of resources. When dealing with inshore fishing activities there are occasions where a patrol vessel may not be able to access the areas due to tidal restraints, or the patrol vessel being sighted while some distance away which provides opportunity to stop the illegal fishing activity, discard, or the concealment of any illegal catch.

Areas of interest would include:

- Estuaries
- Bass Nursery Areas
- Inshore fishing activities of all varieties
- Ports/harbours/quays/fish landing areas etc.
- MPAs
- Any areas associated with previous non-compliance

### **3.5 Enforcement**

In addition to aiding D&S IFCA's compliance activities, a drone will assist IFCOs in their enforcement activities, by observing and recording offences, which otherwise may not be seen or evidenced be. In addition, the use of drones will provide live information allowing effective direction of other assets both on land and sea if necessary and available. The use of a drone will enhance both the detection and evidencing of offences, therefore, developing and

improving D&S IFCA's enforcement capabilities. A drone could provide supporting evidence when offences are detected using other monitoring systems, such as IVMS, or comprehensive stand-alone evidence in the case of illegal netting activities within estuaries, including at night. Deployment of a drone would allow the monitoring of activities with reduced time and cost when compared to the deployment of the patrol vessel and could be utilised alongside officers on the ground ensuring resources deployed in the correct areas. For example, vessels can land at multiple points and areas within harbour and estuaries, which means that a significant amount of time is taken in reaching these vessels by foot or in vehicles.

### **3.6 Fisheries Management and Other Use**

A drone could also assist enforcement officers with monitoring MPAs, all fishing activities managed under the D&S IFCA Byelaws or areas of environmental concern that are being researched in the development of byelaws and permit conditions. Improved distribution of enforcement effort and monitoring as a result of drone use may also feed into the production of more effective and higher resolution fishing effort data.

Better fishing effort and distribution data can contribute to the production of more accurate MPA assessments, impact assessments and other reports detailing fishing practices, improving the evidence base on which the authority makes decisions. A drone may also be used in joint working operations, to target a number of factors simultaneously. When working with partner agencies, such as the MMO, EA, GLAA or harbour authorities, a drone could improve the teams' capabilities, by providing the best situational overview of any event or incident, and all elements of interest to each organisation can be targeted and monitored.

Drones are currently used by the Environment Team to undertake intertidal surveys in particular crab tile surveys across the D&S IFCA's District's estuaries. Currently this work is outsourced. However, if there is in-house capacity this work could be done alongside other intertidal annual and biennial bivalve shellfish surveys and any other future intertidal survey work that may be required to inform D&S IFCA's decision making.

## **4. Drones – Capabilities & Considerations**

There are a number of specifications to consider in the procurement of a drone and ancillaries for fisheries compliance and enforcement activities. The following questions were considered when officers reviewed different operational parameters that the drones would need to fulfil:

### **4.1 The Drone**

- Range/distance – can the drone cover a desired area?
- Speed – can the drone travel from land to observe an activity at sea within its maximum flight time?
- Battery life – can the drone travel to a desired location, record and return within its battery life?
- Weather/waterproof – is it necessary for the drone to be resistant to weather conditions, e.g. rain, wind?
- Redundancy/Safety systems
- Auto-navigation – can the drone automatically return to 'home' or navigate obstacles?

## 4.2 Camera

- Camera and video quality – what quality is required for the desired use?
- Recording capability – can the camera record or only live-stream footage?
- Storage and memory – is there enough storage for the desired recording quantity?
- Security of footage
- Weatherproof – is the camera resistant to weather conditions, if necessary?
- Zoom function – what distances may be required?
- Thermal imaging function – will the camera be used at night?

## 4.3 What conditions can a drone fly in?

### **Weather:**

This depends upon the type of drone – the smaller and lower cost drones are often only suitable for use in dry and calmer weather. All drones will have weather limitations, smaller drones are more susceptible to wind, larger drones have greater operating parameters however that has to be balanced against transportability.

### **Day vs. Night:**

Drones can fly at night, although flying in darkness can pose greater risk. Officers will be familiar with the areas of operation, almost all flights would be from designated sites identified within the D&S IFCA's Operations Manual. There may be occasions where a rapid deployment may be required from an alternative site, qualified pilots will be proficient at conducting dynamic risk assessments and pre-flight checklists. The capabilities of thermal imaging cameras are extensive, thermal imaging camera would be paramount for operations during darkness but also offer benefits during some daylight conditions.

## 4.4 Where can drones fly, how high and how long?

### **Over the sea:**

Drones can fly over the sea; however, sea spray is corrosive, and sea water would cause damage to the electrics, so a drone should stay well above the water to avoid this. Whilst it is possible to launch and recover drones from a platform at sea, D&S IFCA's RIB *David Rowe* is not suitable due to limited deck space. . Therefore, considerations of procurement are based on their land-based launching and recovery. The cameras would enable the majority of inshore sea areas to be monitored at a greater resolution than is currently possible.

### **Drone Flight Altitude:**

The maximum altitude would very much depend on the drone. Similarly to weather limitations larger drones generally offer increased range and altitude. Most consumer drones have an operational ceiling between 500-1000 meters, although in the UK, the Civil Aviation Authority (CAA) guidelines say you shouldn't fly higher than 120 metres from ground level. At this altitude, the field of vision depends entirely on camera specifications, obstructions, weather conditions and visibility. With clear visibility, many drone cameras are able to view a great distance, but the image detailing will be limited by the camera quality and zoom capabilities. The CAA altitude restrictions for flying a drone are unlikely to affect the drone's field of vision when being used by the coast, as there are generally few obstructions when looking out to sea from land and the main limitations will result from the capabilities of the camera itself.

**Range:**

The main limitation regarding the range of drones is the CAA (Civil Aviation Authority) regulations, which require a pilot qualified to GVC (General Visual line of sight Certificate) to maintain visual line of sight (or 500m) with the drone during the entirety of the flight. Therefore, a drone of a larger physical size will be able to fly a greater distance from the pilot (up to 500m) whilst still in line of sight. Most available drones are capable of far exceeding this. Although the drone must stay within line of sight, the benefits a drone offers is determined by the limitations of the camera equipment carried. A long-range camera at altitude can provide a significant field of vision. Some higher spec drones can have multiple pilots, transfer of control can take place in flight meaning this range can be increased.

**Flight time:**

Drones may have a flight time of up to an hour, although, this is dependent on environmental factors, such as wind and temperature, and the payload. A heavier payload tends to increase the energy demand on the drone, leading to reduced duration. Spare batteries can be used to extend flying time, although this means the drone must be landed in order to change the battery. With sufficient batteries and the addition of a charging station, aside landing to change the batteries, continuous flight would be possible.

## 5. Training

There are a number of CAA regulations that apply to drone users, both recreationally and commercially. Drone pilots must be trained under CAA regulations and pass an exam before using drones. Through consultation with industry leaders Heliguy™ the appropriate qualification most suitable for enforcement officers would be obtaining a General Visual Line of Sight Certificate (GVC) which consists of 20 hours online based (LMS) theoretical course followed by a three-day practical examination followed by the production of an Operations Manual. The GVC is valid for five years; to maintain skills a pilot is required to log two hours of flight every three months.

It is expected the training cost for the GVC to be around £1300 per pilot, this cost will vary depending on the location of the course and the numbers involved. It is envisaged that the Authority will train two officers. The drones will be new assets to D&S IFCA, and new standard operating procedures and risk assessments will be established.

## 6. Choice of Equipment

There is a plethora of drones available, and identifying the most suitable equipment is vital to ensure best return on the investment. Whilst a larger drone offers benefits such as multiple and interchangeable payloads the process and preflight checks are more in depth and time consuming. Having consulted Heliguy™ industry leaders and experts on commercial drone use and considered the drones used by other IFCA's it is recommended the procurement of the following drones which is also in line with several other IFCA's:

**Officers' Recommendation:**

1. DJI M350 RTK – Primary enforcement drone for both day and night operations, and
2. DJI MAVIC 3M – Small cost-effective compact drone, used for maintenance hours of pilots, equipped with RTK camera allowing accurate georeferenced mapping and survey work. Simple rapid deployment, small and transportable.



## 6.1 Overview of Recommended Equipment

### 1. DJI M350 RTK

The DJI M350RTK Flagship Enterprise drone with increased flight time, interchangeable payloads and multi payload support.

Fitted with a single Zenmuse H20-T camera. The drone has a maximum flight time of 55 minutes, a maximum speed of 23 m/s and can fly in wind speeds of up to 33 mph. The DJI 350 RTK is rated to IP55 meaning its fully weather proof and can be unpackaged, prepared and undertake flights during rain.

The Zenmuse H20-T is a quad-sensor camera with a 20 MP zoom camera with 200 x Digital zoom, 12 MP wide camera, 1200m Laser Range Finder and Thermal Camera allowing it to capture images and video footage during the day and night. To provide context, the digital zoom enables a vehicle number plate to be read from a distance of 500 meters at an altitude of 100 meters. Payloads could be changed for cameras more suitable for mapping and survey applications depending on requirements. There are a number of other payloads available e.g. search/spot lights, RADAR, loudspeakers and more depending on applications.

#### Safety Features

- **Arm Lock indicator:** Ensures the drones arms are locked in position prior to take off.
- **Six Directional Sensing & Positioning:** Helps to keep the aircraft and the mission safe, even in complex operating environments.
- **Night-Vision FPV Camera:** This FPV camera delivers more impressive light-sensing capability, allowing pilots to observe their surroundings vividly and clearly, even at night, and ensure greater levels of flight safety.
- **Four-antenna OcuSync 3 Enterprise transmission:** Ensures a strong redundancy, and it supports LTE link backup, in the face of complex terrain and working conditions
- **ACD:** Aircraft detection feature that will alert the pilot of the presence of another aircraft
- **Return to Home:** The drone will automatically return to home (launch site) on the press of a button and if batteries are depleted below a preset value
- **High wind warning:** This provides a visual alarm to alert the pilot during flight of the high winds at flight altitude.

### 2. DJI MAVIC 3M Drone

The DJI Mavic 3 Multispectral is designed for precision environmental monitoring equipped with a multispectral imaging system.

The Mavic 3M includes an RTK module that achieves centimetre-level positioning with accurate georeferenced footage.

The Mavic 3 Multispectral is a highly portable drone: It's foldable design and 951g weight means it can be carried in a bag to ensure ease of operations. It has 43 minutes of flight time



and can complete the surveying and mapping operations of an area as vast as two square kilometres in a single flight.

The Mavic 3M has four 5MP multispectral cameras. Its built-in camera array combines Green, Red, Red Edge, and Near Infrared sensors.

- **Near Infrared:** 860 nm  $\pm$  26 nm
- **Red:** 650 nm  $\pm$  16 nm
- **Red Edge:** 730 nm  $\pm$  16 nm
- **Green:** 560nm  $\pm$  16 nm

### Safety Features

- **ACD:** Aircraft detection feature that will alert the pilot of the presence of another aircraft
- **Return to Home:** The drone will automatically return to home (launch site) on the press of a button and if batteries are depleted below a preset value
- **High wind warning:** This provides a visual alarm to alert the pilot during flight of the high winds at flight altitude.
- **Six Directional Sensing & Positioning:** Helps to keep the aircraft and the mission safe, even in complex operating environments.
- **Three-propeller emergency landing**
- **Four-antenna OcuSync 3 Enterprise transmission:** Ensures a strong redundancy, and it supports LTE link backup, in the face of complex terrain and working conditions.

## 7. Costs and Purchase

Whilst this report is tailored to the purchase of assets, there is an alternative approach of hiring equipment just for the time its required. Heliguy™ offer the full range of drones for hire, other suppliers will also be available. Hiring would be unsuitable for Enforcement and Compliance applications given the notice required to ensure the equipment is available when its required.

An alternative consideration could be to purchase a drone for Enforcement and Compliance applications and hire the equipment for programmed work like surveying and mapping.

### 7.1 Estimated Costs

- DJI M350 RTK incl. Camera £20,000
- DJI MAVIC 3M £3,800
- Training £1,300 per officer
- The cost of insurance is estimated at this stage at £2,000 per annum (if per annum)(Based on cost to SIFCA).

### 7.3 Investment by the Authority

The preferred method of financing these acquisitions would be through grant funding, a suitable bid has been submitted to Defra that would provide the funding for the purchase of the DJI M350RTK and the DJI MAVIC 3M totalling circa £23,800.

An alternative to grant funding would be to self-finance from capital reserves.

## 8. List of embedded information (Hyperlinks)

- Product link to DJI M350 RTK on Heliguy™ website <https://www.Heliguy.com/collections/dji-matrice-350>
- Link to DJI Mavic 3M on Heliguy™ website <https://www.Heliguy.com/products/dji-mavic-3-multispectral>
- Comparison of the H20T camera on the larger M300 drone and the smaller M30T drone [Side-by-side Camera Comparison: DJI M30T vs DJI M300 RTK & H20T – Heliguy™™](#)

**End.**