University of BRISTOL

UAS
Operations Manual

Version 4.61
25th October, 2023

Operator ID: **GBR-OP-YF7VVQ4KM3J6**
CAA Ref Number: **835**

N.B.
The above operator ID is the only ID that is permitted for use and must be displayed on every UAV operated by UOB.

PART 1.

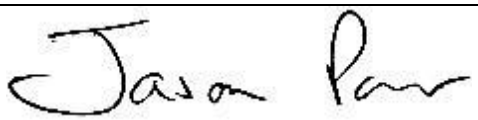
1.1 Foreword

This document sets out the safety and operational procedures that must be adhered to by any user of an unmanned aerial system (UAS) undertaking flight operations as part of study or research at the University of Bristol or its subsidiary companies.

All operators and remote pilots at the University of Bristol must continue to review, and will comply, with any new or amended regulation published by the CAA as described in this operations manual.

1.2 Accountable manager

The University of Bristol is committed to operating Unmanned Aircraft Systems (UAS) safely in UK airspace in line with this operations manual and any CAA authorisations granted. The University of Bristol will ensure that operating procedures and equipment are fit for purpose and used appropriately. University of Bristol will ensure that all personnel are appropriately trained before being allowed to operate UAS.

Signed		Date	25th Nov 2023

Contact: Accountable manager
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Document Revision Record

Version	Date	Author	Change Description
V1.1	01/09/2009	Dr T. Richardson	Original UoB UAS Operations Manual
V1.2	01/10/2013	Dr T. Richardson	Revised in line with CAA guidance
V1.3	20/03/2015	Dr T. Richardson	Modifications related to personnel and operations
V1.4	28/03/2015	Dr T. Richardson	Minor modifications for CAA submission
V2.0	10/11/2016	Mr B. Schellenberg	Modifications & updates for BNUC/CAA submission
V2.1	13/12/2016	Mr B. Schellenberg	Revised in line with EuroUSC Guidance
V2.2	21/02/2018	Mr B. Schellenberg	Minor modifications, including addition of aircraft
V2.3	23/03/2018	Mr B. Schellenberg	Update of wording, including CAP 393 Articles and references to aerial work and commercial operation.
V2.4	05/11/2018	Mr R. Clarke	Minor modifications: addition of aircraft, update PfCO. Inclusion of CAP1687 changes.
V2.5	27/11/2018	Mr R. Clarke	Update insurance certificate. Add night operations
V2.6	6/12/2018	Mr R. Clarke	Additional pilot certificates
V2.7	5/2/2019	Mr R. Clarke	Addition of Titans. Addition of NAA for overseas
V2.8	1/3/2019	Mr R. Clarke	Update to reflect ANO changes as per CAP1763
V2.9	31/10/2019	Mr A. McConville	Updated personnel details and remove out of date certificates.
V2.10	08/01/2019	Mr A. McConville	Additional 5 remote pilots added (sans COPSU numbers). Updated reference documents list, removed all mention of Pilot-in-Charge and replaced with Remote Pilot.
V3.0	16/06/2020	Mr D. Hine	Change of nominated personnel (1.62)
V3.0	16/06/2020	Mr D. Hine	Addition of requirements for Operator number and flyer ID (section 1.6.6)
V3.0	16/06/2020	Mr D. Hine	Added details of Fenswood Farm test facility (section 5)
V3.0	16/06/2020	Mr D. Hine	Note added about forthcoming EU regulations (Section 1.5)
V3.0	16/06/2020	Mr D. Hine	Remove reference to Wiki and replace with flight lab SharePoint group.(section 1.6)
V3.0	16/06/2020	Mr D. Hine	Revised front page (to meet brand guidelines)
V3.1	16/06/2020	Mr D. Hine	Addition of pre departure risk assessment and method statement form RAMS v1.0 (section 7.2.1)
V3.2	28/09/2020	Mr D. Hine	Accountable manager name and signature changed.
V4.0	19/08/2021	Mr D. Hine	Remove reference to “commercial operations” – Restructure for an operational authorisation
V4.0	19/08/2021	Mr D. Hine	Update roles and responsibilities
V4.0	19/08/2021	Mr D. Hine	Change of accountable manager
V4.0	19/08/2021	Mr D. Hine	Add in example Quick Ref Handbook
V4.1	13/09/2021	Mr D. Hine	UAS regulatory statement added Section 2.12
V4.1	13/09/2021	Mr D. Hine	Remove references to deleted articles (CAP393 articles 94 & 95)

V4.1	13/09/2021	Mr D. Hine	Document version date and manager signature date made to be the same
V4.1	13/09/2021	Mr D. Hine	Replace “UAS Operator” with “UAS operator”
V4.2	16/09/2021	Mr D. Hine	Operator number changed
V4.3	25/09/2021	Mr D. Hine	Operator number example label changed
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V4.31	04/02/2022	Mr D.Hine	Broken hyperlinks to external resources updated.
V4.32	03/03/2022	Mr D.Hine	Addition of appendices – Letter of Agreement Bristol Airport(NATS)
V4.4	12/09/2022	Mr D.Hine	Update internal training requirements Section 2.13
V4.4	12/09/2022	Mr D.Hine	Update list of pilots and qualification documents
V4.5	26/09/2022	Mr D.Hine	Section 2.4 update referenced document version numbers
V4.5	26/09/2022	Mr D.Hine	Section 2.4 add link to CAA publications search tool
V4.5	26/09/2022	Mr D.Hine	Remove reference to PFCO in contents table (replace with PDRA01)
V4.5	26/09/2022	Mr D.Hine	Replace all mentions of SUA, SUAS, SUAS with “Unmanned aircraft” or “UAS”
V4.6	18/09/2023	Mr D.Hine	Update list of remote pilots
V4.6	18/09/2023	Mr D.Hine	Update insurance cover certificate
V4.6	18/09/2023	Mr D.Hine	UAS list updated to ONLY show aircraft used within the specific category
V4.61	25/10/2023	Mr D.Hine	Amend publication dates -Referenced Documents table (Section 2.4)
V4.61	25/10/2023	Mr D.Hine	Add specific procedure for abnormal environmental conditions (High wind, Rain and low temperatures) (Section 5.3.1)
V4.61	25/10/2023	Mr D.Hine	Declare adherence to the AMC Section 2.1.2
V4.61	25/10/2023	Mr D.Hine	Add requirement for remote pilots to fill In tech log (Section 3.6)
V4.61	25/10/2023	Mr D.Hine	Amend maintenance and inspection section to include requirements for tech log entries. (Section 3.2)

CONTENTS

PART 2. GENERAL

2.1 Introduction

This document covers both the Safety and Operational procedures that are required to conduct operations under a CAA issued Operational Authorisation (OA). The contents include the University of Bristol UAS structure, personnel, aircraft systems, procedures and operations.

The information provided within this document is intended to complement that which is provided by the CAA and it is the responsibility of the UAS operator to ensure that they familiar with and comply with the latest information, guidance and requirements of the CAA. Please refer to:

https://www.caa.co.uk/consumers/remotely-piloted-aircraft/

The overriding responsibility of the UAS operator and remote pilot is to ensure that all UAS operations are conducted safely and legally at all times.

2.1.1 Operations

This manual applies to all UAS operated by the University of Bristol. It is to be used for all operations conducted in any country but has been specifically written to meet the UK CAA requirements. For operations in additional territories, it is the responsibility of the UAS operator and remote pilot to ensure that all additional local legal requirements are satisfied.

2.1.2 Safety

The primary objective of UAS operation for the University of Bristol is that of safety, and a safety conscious environment is encouraged for all. Adherence to this manual is no guarantee of safe operation, and all UAS operators must ensure that all personnel are competent and provided with adequate training, briefing and debriefing. In addition, UAS operators and remote pilots must ensure that:

- All flights are logged in accordance with this operations manual
- Regular maintenance and inspection is carried out for all University of Bristol UAS
- All personnel are familiar with and trained on the UAS to be flown
- All personnel are fully briefed on the mission objectives, flight requirements, and safety cases, prior to operation
- Any incidents are investigated, reported, and appropriate lessons learned noted.

All Operations will be carried out in accordance with the issued Operational Authorisation PDRA01 and abide by the requirements of ANO2016 as amended and UAS Implementing Regulation 2019/947 (as retained in UK Law) AND its Acceptable Means of Compliance AMC.

2.1.3 Training

All University of Bristol remote pilots and associated personnel MUST undergo training appropriate to the operations they are intending to undertake. Any remote pilot intending to operate any UAS with MTOW >250g should undertake a full GVC theory course and practical assessment. The University of Bristol will keep a record of who has received training, and the type and extent of the training that they have received. To request a place on a GVC course please contact the Drone Safety Group.

2.2 Definitions

Accountable Manager (AM)	Has the authority for ensuring that all activities are carried out in accordance with the applicable requirements and is responsible for establishing and maintaining an effective Management System
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ANO	Air Navigation Order
ANO	Air Navigation Order
ATC	Air Traffic Control
ATZ	Air Traffic Zone
Authorised Representative (AR)	The first point of contact with the CAA
BVLOS	Beyond Visual Line of Sight
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
Congested Area	Any area which is substantially used for residential, industrial, commercial or recreation activities.
DA	Danger Area
ECCAIRS	European Co-ordination Centre for Accident and Incident Reporting Systems
ERF	Emergency Restriction of Flying
EVLOS	Extended Visual Line Of Sight
EVLOS	Extended Visual Line of Sight
FOP	Flight Operations Policy
GCS	Ground Control Station
MOR	Mandatory Occurrence Reporting
MTOW	Maximum Take-off Weight
NAA	National Aviation Authority
NOTAM	Notice to Airmen
OA	Operational Authorisation
Observer/Crew (OC)	An individual, deemed competent by the Remote Pilot, whose main role is to assist the RP to maintain VLOS on the UAS
Operations Manager (OM)	Responsible for the day-to-day planning of flight operations
Remote Pilot (RP)	An individual who is responsible for the safe operation of the UAS
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
UAS Operator	The legal entity that is responsible for the management of the UAS.
Technical Manager (TM)	Has responsibility for maintaining the UAS in an airworthy state
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
VFR	Visual Flight Rules
VLOS	Visual Line of Sight
VMC	Visual Meteorological Conditions

2.3 Document control and amendment process

All operators and remote pilots at the University of Bristol must continue to review, and will comply with, any new or amended regulation published by the CAA.

A nominated person within the university shall hold the master electronic copy of this document. Any changes in procedure or legislation will be reflected in new issues of this operations manual and will be distributed to all operators and remote pilots once approved by the accountable manager. A copy of the amended document will be sent to the CAA as required.

It is the responsibility of every University of Bristol UAS remote pilot to ensure that they have an up-to-date version of this manual prior to any flight operations.

The latest version can be found here: **https://uob.sharepoint.com/teams/grp-dronesafety/**

2.4 Referenced Documents

The following documents may be referenced and should be referred to for full statutory text.

Reference	Full Title	Issue Number & Date of Issue
CAP 382	Mandatory Occurrence Reporting Scheme	July 2021 link
CAP 1789A	The UAS Implementing Regulation	V7.0 2 Dec 2022 link
CAP 1789B	The UAS Delegated Regulation	V3.0 2 Dec 2022 link
CAP 2013	ANO 2020 amendment guidance for UAS	V1.0 17 Dec 2020 link
CAP 403	Flying Displays and Special Events	V20 – 16 March 2023 link
CAP 722	Unmanned Aircraft Systems Operations in UK Airspace – Guidance	V9.1 22 Dec 2022 link
EU2015/2018	EU MOR Guidance	29 June 2016 link

To find additional documents please use the CAA Publications search tool here

2.5 Structure of the organization and nominated personnel

The University of Bristol is a large organisation, and it is expected that there will be numerous user groups within it who would like to regularly fly UAS for research or teaching purposes.

Current nominated personnel have been listed in the section below. The University of Bristol will keep an updated record of all personnel involved with UAS work.

A Bristol UAS 'drone safety' advisory group has been established. This is a group of people, with technical, operational and safety backgrounds, who will meet on a regular basis to monitor Bristol UAS operation to ensure safety and compliance with all statutory requirements.

Operational information and flight logging is available via the drone safety SharePoint page (accessible to internal staff/students only)

2.5.1 Nominated personnel

Name	Roles (see 2.2 for definitions)
	OM, TM, RP, PO, OC
Jason Parr	Accountable Manager
Fred Hale	Safety Advisor
Duncan Hine	Operations Manager, Authorised Representative, Chief Pilot

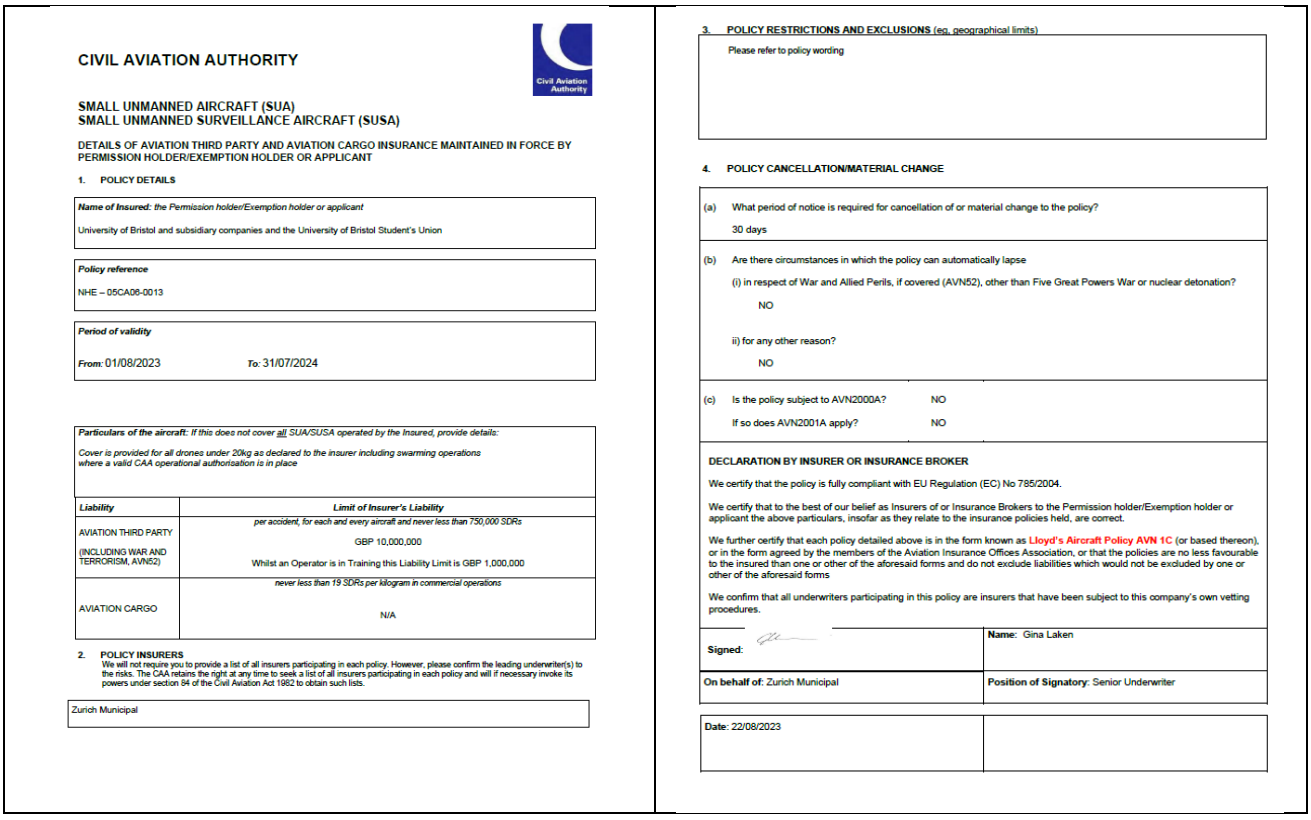
2.5.2 Remote Pilots (RP)

Remote Pilot (RP)	GVC Category	Flyer ID
Duncan Hine	Multirotor / FixedWing	GBR-RP-4BPDTDL9PHYR
Thomas David	Multirotor / FixedWing	GBR-RP-R6P4MVG7PR8R
Hirad Goudarzi	Multirotor	GBR-RP-K6F4NRX94MS9
Mickey Li	Multirotor	GBR-RP-RQGNFM6SV6CJ
Ewan Woodbridge	Multirotor	GBR-RP-HBFJH27FHM47
Yannick Verbelen	Multirotor	GBR-RP-D7VLS9P864VF

2.5.3 Insurance cover

The operation of UAS by the University of Bristol is covered by the University insurance policy, the relevant part of which is attached to this Operations Manual. It is the responsibility of the UAS operator to ensure that all activities undertaken fall within the remit of this policy. Additional information can be obtained by contacting the University of Bristol Insurance Officer.

This insurance covers employees and students whilst engaged in connection with **authorized** University activities **only**. This also applies to any person volunteering to assist, or co-opted to assist, the University in its business.



CIVIL AVIATION AUTHORITY

SMALL UNMANNED AIRCRAFT (SUA)
SMALL UNMANNED SURVEILLANCE AIRCRAFT (SUSA)

DETAILS OF AVIATION THIRD PARTY AND AVIATION CARGO INSURANCE MAINTAINED IN FORCE BY PERMISSION HOLDER/EXEMPTION HOLDER OR APPLICANT

1. POLICY DETAILS

Name of Insured: *the Permission holder/Exemption holder or applicant*

University of Bristol and subsidiary companies and the University of Bristol Student's Union

Policy reference

NHE – 05CA06-0013

Period of validity

From: 01/08/2023 ***To:*** 31/07/2024

Particulars of the aircraft: *If this does not cover all SUA/SUSA operated by the Insured, provide details:*

Cover is provided for all drones under 20kg as declared to the insurer including swarming operations where a valid CAA operational authorisation is in place

Liability	*Limit of Insurer's Liability*
AVIATION THIRD PARTY (INCLUDING WAR AND TERRORISM, AVN52)	*per accident, for each and every aircraft and never less than 750,000 SDRs* GBP 10,000,000 Whilst an Operator is in Training this Liability Limit is GBP 1,000,000
AVIATION CARGO	*never less than 19 SDRs per kilogram in commercial operations* N/A

2. POLICY INSURERS
We will not require you to provide a list of all insurers participating in each policy. However, please confirm the leading underwriter(s) to the risks. The CAA retains the right at any time to seek a list of all insurers participating in each policy and will if necessary invoke its powers under section 84 of the Civil Aviation Act 1982 to obtain such lists.

Zurich Municipal

3. POLICY RESTRICTIONS AND EXCLUSIONS (eg. geographical limits)

Please refer to policy wording

4. POLICY CANCELLATION/MATERIAL CHANGE

(a) What period of notice is required for cancellation of or material change to the policy?
30 days

(b) Are there circumstances in which the policy can automatically lapse
(i) in respect of War and Allied Perils, if covered (AVN52), other than Five Great Powers War or nuclear detonation?
NO

ii) for any other reason?
NO

(c) Is the policy subject to AVN2000A? NO
If so does AVN2001A apply? NO

DECLARATION BY INSURER OR INSURANCE BROKER

We certify that the policy is fully compliant with EU Regulation (EC) No 785/2004.

We certify that to the best of our belief as Insurers of or Insurance Brokers to the Permission holder/Exemption holder or applicant the above particulars, insofar as they relate to the insurance policies held, are correct.

We further certify that each policy detailed above is in the form known as **Lloyd's Aircraft Policy AVN 1C** (or based thereon), or in the form agreed by the members of the Aviation Insurance Offices Association, or that the policies are no less favourable to the insured than one or other of the aforesaid forms and do not exclude liabilities which would not be excluded by one or other of the aforesaid forms

We confirm that all underwriters participating in this policy are insurers that have been subject to this company's own vetting procedures.

Signed:	**Name**: Gina Laken
On behalf of: Zurich Municipal	**Position of Signatory**: Senior Underwriter
Date: 22/08/2023	

2.5.4 Responsibilities and duties of the Operator

The overriding responsibility of the operator is to ensure that all flights are conducted legally and safely. To ensure that this is the case, the UAS Operator must be familiar with the operational requirements of the vehicle(s) they are responsible for and must be operating in accordance with CAA or relevant NAA regulations. The operator may manage one or multiple remote pilots and shall delegate some responsibilities to them. Note that the UAS Operator might also be the Remote Pilot, and that primary responsibility for the aircraft will always lie with the Remote Pilot.

Please Note: No matter who is directing UAS operations, the final decision to fly and final responsibility for the safety of the airframe and the environment remains with the Remote Pilot.

2.5.5 Responsibilities and duties of the Remote Pilot

The UAS Remote Pilot has ultimate responsibility for checking that:

- the flight can safely be made, taking into account the latest information available regarding the route, the weather reports and forecasts available and any alternative course of action which can be adopted in case the flight cannot be completed as planned.
- all relevant NOTAMS have been checked and abided by.
- all relevant land owner permissions have been sought and established.
- all equipment to be carried in the circumstances of the intended flight is in a fit condition for use and has been fully maintained.
- the aircraft and ground control equipment is in every way fit for the intended flight, and that where certification is required to be in force, it is in force and will not cease to be in force during the intended flight operations.
- the payload carried by the aircraft is of such weight, and is so distributed and secured, that it may safely be carried on the intended flight.
- a sufficient and suitable power source is carried for the intended flight, and that a safe margin has been allowed for contingencies.
- an UAS specific pre-flight check system has been established by the operator, briefed, and complied with by all ground personnel.
- before take-off, all reasonable steps have been taken so as to be satisfied that it is capable of safely taking off, reaching and maintaining a safe height and making a safe landing at the place of intended destination without any obstructions on the intended route.
- all required local authority permissions have been sought and established.
- where required, local authority and police liaisons have been established.
- all associated personnel have had the appropriate training.

2.5.6 Responsibilities and duties of support personnel

The following is a list of possible support personnel. It is the responsibility of the UAS Operator to make sure there are sufficient personnel present to operate safely:

- The **Remote Pilot** is responsible for the safe completion of each flight and is **legally responsible for the safe operation of their aircraft**. They may pilot the aircraft during takeoff, landing, or during emergency procedures, and are responsible for primary pre-flight checks of the airframe.
- An **Observer** assists the Remote Pilot and is responsible for crowd control and perimeter safety.
- The **GCS Operator** and/or **Payload Operator** is trained to operate the GCS and monitor the flight. Additional responsibilities will include data gathering and payload operation, however these are secondary to the safe operation of the aircraft. These roles may be performed by a single person or by multiple people depending on the mission requirements.

2.5.7 Legal obligations for each Remote Pilot

Flyer ID
It is a legal requirement for each remote pilot to obtain a CAA flyer ID number via the dronesafe website. This should be in date before any flights take place.

https://register-drones.caa.co.uk/individual

Your flyer ID number should be given to the flight operation manager before any flight commences for logging in the electronic logbook system.

Flight Logs
It is a legal requirement to log all flights. The university provides a logging system for this purpose.

Flight logging system: **https://uob.sharepoint.com/teams/grp-dronesafety/**

UOB Operator Number
It is a legal requirement for each UAS to have the UOB operator ID number affixed to the outside before commencing flight operations. The university has a single operator number. No other operator number shall be used in relation to work or teaching undertaken by staff or students.

Example UOB operator number sticker. Displaying the UOB operator number along with the individually assigned aircraft ID number.

PART 3. AIRCRAFT AND OPERATONAL CONTROL

3.1 UAS technical descriptions and roles

The following is a summarized list of University of Bristol UAS and their primary roles. Technical details of these vehicles can be found in the Appendix.

N.B. Historically all UOB UAVs were listed here.
From Sept 2023 this list contains only those UAVs that will be used within the specific category.
If you wish to add a UAV to the specific category list please contact the drone safety group.
grp-dronesafety@groups.bristol.ac.uk

Aircraft name	UOB -ID number	Type
Wingtra1 HR	UOB-80	Fixed Wing VTOL
Wingtra1 FL	UOB-81	Fixed Wing VTOL
M600 HR	UOB-32	Multirotor
M600 IAC	UOB-11	Multirotor
M300	UOB-42	Multirotor
Minion1	UOB-34	Multirotor
Minion 2	UOB-35	Multirotor
Minion 3	UOB-36	Multirotor
Minion 4	UOB-37	Multirotor
Minion 5	UOB-38	Multirotor
BUDDI	UOB-96	Fixed Wing
Goliath	UOB-14	Multirotor

3.1.1 Area and types of operation

Types of operation will include some or all of the following:

- Aerial archaeology
- Aerial inspection
- Aerial mapping & surveying
- Aerial photography & cinematography
- Platform research & development
- Remote sensing
- Scientific missions
- Search & rescue
- Surveillance

Operating areas will include open countryside, roads, building sites, and limited-built-up areas where safe and legal operation is possible. All necessary permissions must be sought before operations and must be carried out in line with CAA or relevant NAA regulations.

3.1.2 Operating limitations and conditions

Current overall limitations on all UAS operations at the University of Bristol are given in the following table. Further limitations will apply depending on the platform being flown. It is the responsibility of the UAS Operator to ensure that both regulation and platform limitations are adhered to for all UAS operations. Please see appendices for specific platform limitations.

Item	**Limitations**
Operational Envelope	• VLOS: 400ft AGL, 500m from RPA Pilot
Operational endurance	Platform specific reductions apply
Maximum airspeed at mean sea level	70 kts – platform specific reductions apply
Maximum environmental operating temperature	+45 degrees Celsius
Minimum environmental operating temperature	-20 degrees Celsius
Maximum operational wind speed	Platform specific reductions apply
Maximum operational ceiling	5000ft AMSL, operating VLOS in special cases from the top of mountains. Possible extension with special permission. Platform specific performance limitations.

3.1.3 Night flying operations

Prior to any night time operations (where night time is defined as the time from half an hour after sunset until half an hour before sunrise, sunset and sunrise being determined at surface level), a daylight reconnaissance and site safety assessment including aircraft flightpaths within the surrounding area, shall be undertaken to identify, address and record any hazards, restrictions and obstacles. The launch site shall be provided with adequate illumination and the aircraft shall be equipped with adequate lighting. Flights shall only commence when the weather conditions and visibility of the UAS are suitable for continuous VLOS operations.

3.2 Maintenance and repairs

All University of Bristol aircraft must be maintained to the highest standards and must be fully inspected prior to flight by the Remote Pilot.

Before each deployment, as the UAV is taken from storage it should be inspected by a suitably qualified remote pilot, familiar with the AUV, and an entry logged in the tech log stating that the UAV is complete and ready to fly.

Any modifications, repairs or damage should be noted in the tech log for that UAV.

Any repairs or modifications that are beyond the design intent for the specific UAV should be referred to the drone safety group for support and guidance before being undertaken.

3.2.1 Software and firmware update policy

University of Bristol UAS operators must ensure that they update all software and firmware whenever any new, robust, and verified versions become available. The Remote Pilot will take responsibility for testing all updates in a controlled environment before any flights commence. Any software updates should be logged in the relevant UAV tech log.

3.3 Supervision of UAS operations

Primary responsibility for each UAS operation lies with the remote pilot and it is their responsibility to plan and carry out safely all UAS operations. For any significant intended changes in types of operations or area of operation, the remote pilot must discuss their intentions with the operations manager/drone safety group in the first instance.

3.4 Accident prevention and Flight Safety programme

Safety is the primary objective of and UAS activity conducted by the University of Bristol. It is the responsibility of all personnel to ensure that they contribute to a culture of safety and participate fully in identification and notification of hazards and risks. No unnecessary risks must be taken and all personnel must be in full agreement that a safe flight can take place before operations commence.

If any incident takes place, however small, the UAS remote pilot is responsible for establishing the circumstances of the incident and reporting it to the drone safety group, operations manager and to the CAA and other relevant authorities where appropriate. Information included must include the date, time, description of the incident, weather, and any other relevant information.

Examples of minor incidents may include:

- a near miss with a fixed object, building or tree that does not endanger other air users or ground based third parties.
- where a safety area of a flying site has an incursion by unauthorized persons or animals that may endanger the safety of the site.
- a small equipment or machinery failure on the RPAS that does not immediately affect the performance of the aircraft and allows for a safe landing.

The intent is to learn from incidents such that they cannot occur again. No punishment or blame will be attributed to those reporting incidents.

3.4.1 Mandatory Occurrence Reporting

Mandatory Occurrence Reporting (MOR) shall apply when the following incidents occur:

- Loss of control/datalink – where that loss resulted in an event that was potentially prejudicial to the safety of other airspace users or third parties (including flyaways)
- Automatic Navigation failures (waypoints)
- Display failures (Ground station issues) and Crew Resource Management (communication) failures/confusion
- Structural damage/heavy landings
- Significant flight programming errors
- Major injury, impact with third parties

MOR will occur as required by the appropriate NAA, via the formal channels. For example, when operating in an EU country the ECCAIRS European Reporting Portal will be used:

www.aviationreporting.eu

3.5 Flight team composition

The remote pilot will plan and direct the safe flight operation. **The safety of the flight will always remain the legal responsibility of the Remote Pilot**.

In addition to the Remote Pilot and UAS operator, for specific missions there will also be Observers and Payload Operators. It is the responsibility of the remote pilot to ensure that all members of the team are fully briefed and technically competent for their respective roles.

3.5.1 Operation of multiple types of UAS

The University of Bristol operates a variety of UAS types. Appropriate training must be given to personnel before operating a new type.

University of Bristol operations can include multiple UAS operating simultaneously. The UAS remote pilots and support personnel must ensure that there no radio conflictions, clear communications are established, and that specific flight-plans have been agreed in advance. A full RA-MS should be submitted to the operations manager before such a flight takes place.

3.5.2 Qualification requirements

All University of Bristol personnel operating UAS under the Operational Authorisation must have had appropriate training as required by their roles. The Remote Pilot must hold a recognized national qualification or equivalent. An example of this is:

- ~~Legacy PFCO qualification~~ No Longer acceptable.
- A2CofC
- GVC

If any University of Bristol remote pilots are unsure of what qualifications they require for their intended operations they should contact the operations manager in the first instance.

3.5.3 Crew health

All remote pilots, operators and support personnel must ensure that they are in a fit state to carry out the planned operation. All injuries and illness must be reported to the University of Bristol and no operations must be undertaken until the affected personnel have been medically cleared for operations.

No UAS pilots, operators or support personnel shall commence a Flying Duty Period (FDP) with a blood alcohol level in excess of 20 mg of alcohol in 100 ml of blood. This level is one quarter of the United Kingdom legal driving limit. No members of the UAS team shall consume alcohol less than eight hours prior to the specified reporting time for flight duty.

No UAS pilots, operators or support personnel shall take medicines or drugs prior to operations that have not been prescribed by a doctor who is aware of the individual's flight duties. If any doubt exists as to the effects of a particular medicine or drug, the team member concerned shall consult a specialist in aviation medicine.

A contingency plan must always be included in the pre-flight briefing should the pilot suddenly become incapacitated. This may include a brief introduction to the necessary flight controls for a safe landing of the aircraft. A useful pre-flight pneumonic is “I’M SAFE”:

Illness - Is the pilot suffering from any illness which might affect them in flight?
Medication - Is the pilot currently taking any drugs (prescription or over-the-counter)?

Stress - Is the pilot overly worried about other factors in his life?
Alcohol - The pilot should consider their alcohol consumption within the last 8-24 hours.
Fatigue - Has the pilot had sufficient rest and/or sleep?
Eating - Has the pilot had adequate nutrition and/or nourishment?

3.6 Logs and records

Remote pilot logs

It is the responsibility of the remote pilot to ensure that the details of each flight are logged within the university logging system.

Each individual flight should be added as a discreet entry. Do not concatenate flights into single entries.

Flights can be logged on the drone safety group app here

Refer to AMC1 to UK Regulation (EU) 2019/947, UAS.SPEC.050(1)(d).

UAV maintenance and tech logs

It is the responsibility of the remote pilot to ensure that the UAV tech log is filled in.
Events that must be logged:

- Periodic inspections
- Defects and their repairs
- Modifications
- Firmware/software updates

Tech events can be logged on the drone safety group app here

PART 4. FLIGHT PLANNING AND PREPARATION

4.1.1 Determination of intended tasks and feasibility

The key to any successful UAS operation is careful planning. Ideally this must be done well in advance of any flights, and a pre-flight visit to the operational site is highly recommended. Careful discussions must be undertaken with potential clients and all members of the UAS team must be clear on all aspects of the proposed mission. These include, and are not limited to, the following sections.

4.1.2 Operating site location and assessment

Ideally an on-site survey will be carried out prior to operation days, however at a minimum, current and up to date Aeronautical Charts, Google Earth and/or Ordnance Survey maps will be used to establish the presence of the following (where applicable):

- Types of airspace, e.g. controlled airspace
- Any additional aircraft operations (local airfields or operating sites)
- The presence of Hazards such as live firing, gas venting & high intensity radio transmissions etc.
- Any local bye-laws
- Obstructions (wires, masts, buildings etc.)
- Extraordinary restrictions such as segregated airspace around prisons & nuclear establishments (permissions must be obtained if required for operation)
- Urban and recreational areas
- Assessment of public access
- Permission from Landowner
- Likely operating and alternative sites
- Weather conditions for the planned event
- https://notaminfo.com/ukmap for latest NOTAM information

4.1.3 Risk management

A full risk assessment must be undertaken before any operations. This must include both standard University of Bristol risk assessments as well as flight specific Risk Assessments. It is the responsibility of the UAS Operator to ensure that all team members are aware of the contents of these and has contributed fully to them.

Please Note: No matter who is in charge of UAS operations, the final decision to fly, and the responsibility for the safety of the airframe and the environment, remains with the Remote Pilot.

4.1.4 Communications

It is the responsibility of the UAS mission operator to ensure that all required communications channels are open and working. These may include, and are not limited to:

- local authorities
- local airfields
- contacts at sites of special interest
- contacts at the perimeter of any cordons or roadblocks in place
- any additional flight operations
- any other teams that are in the vicinity or third parties that are working with the UAS operations

A list of emergency contact numbers must be drawn up and be made available on site, which will include key personnel to be contacted in the case of any incident or emergency.

There must be an agreed time schedule for testing bespoke lines of communications and these must be tested as agreed, with the results logged. Any failure in communications must be investigated and operations must cease until the cause has been established.

A contact number in case of emergency must be provided to all interested parties and must be monitored at all times during operations.

4.1.5 Pre-notification

If the flight is to be performed within an Aerodrome Traffic Zone (ATZ), or near to any aerodrome or aircraft operating site, then their contact details should be obtained and notification of the intended operation should be provided prior to take-off.

It may also be necessary to inform the local police of the intended operation to avoid interruption or concerns from the public.

4.1.6 Site permissions

All relevant landowners' permissions must be obtained and documented prior to carrying out UAS operations – and it is the responsibility of the UAS operator ensure that the landowners are aware of the full UAS flight operations planned.

Agreement from landowners in itself is no guarantee that UAS operations on a particular site is legal, and it is the responsibility of the UAS operator to ensure that **all** legal requirements are met before flight operations commence.

4.1.7 Weather

Weather forecasts must be obtained prior to UAS operations and suitable consideration for the air vehicle limitations must be made. Flight planning must be made based with full knowledge of the vehicle performance and flight times adjusted for wind conditions. No flight must be undertaken in conditions which are beyond the limits stated in the vehicle technical specifications.

Weather forecasts can be obtained from the Met office (or equivalent) prior to operations using:

- www.Metoffice.gov.uk
- www.bbc.co.uk/weather
- A Smartphone ‘WeatherPro’ App

Note: local weather in some areas can change dramatically in short periods of time, and forecasts must only be used for planning purposes. A local weather survey onsite carried out shortly before operations must also be recorded.

4.1.8 Preparation and serviceability of equipment and UAS

Key to successful operations is preparation and serviceability of the system. All required maintenance must be carried out prior to departure for operations, and the maintenance log for the specific airframe must be up to date and checked.

Pre-use checks must also be carried out prior to departure and all parts of the system must be verified as working. This includes, but is not limited to:

- airframe
- ground control station
- transmitter
- communications equipment
- spare equipment and tools
- safety equipment
- documentation

Note: on return from operations, it is the responsibility of the UAS operator to ensure that all the equipment is in a serviceable state. If any maintenance, repairs, or replacements are required, the UAS must inform the required parties and clearly label any equipment as such.

PART 5. OPERATING PROCEDURES

5.1 Pre-flight procedures

5.1.1 Site Survey

An initial desktop assessment is invaluable when planning operations. This can be done using Google Maps (www.google.co.uk/maps), Google Earth, https://notaminfo.com/ukmap etc.

Onsite, the UAS Operator and the Remote Pilot (if they are not the same person), must carry out a full visual check of the operating area and identify any potential hazards. The on-site checklist (see appendices) must be filled out and a full briefing given to the UAS team.

If there are any third parties on site, or with knowledge of the surroundings, a full briefing of the planned flights must be given to them and any concerns raised must be acted on. If the site is one that will be flown at regularly, the site survey must be made available to all UoB UAS operators.

5.1.2 Selection of operating areas and Alternates

The operating area should be carefully chosen and be as open as possible to allow full, uninterrupted views throughout the flight. Access routes must be identified and all vehicles and people other than those required for operations must be excluded.

The take-off and landing zone must be in an exclusion zone, at least 30m from any publicly accessed space or hazardous objects such as trees. The operation zone must be 50m from the public and hazards. Additional requirements will vary depending on the platform being used:

Rotary wing: a solid, safe and flat landing platform must be provided. Local weather conditions must be considered, and any possible adverse wind conditions must be identified. Loose gravel or debris which could become airborne is not suitable, and if required, an artificial landing mat might be used. This must be securely fastened to the ground.

The egress and ingress routes must be identified as clear, and the landing zone for automatic 'home' return should be identified and kept clear at all times.

Fixed wing: a solid, safe and flat landing area must be identified for any fixed wing operations. If a catapult launch is used, this must be fixed securely to the ground and located a clear distance away from the landing zone. Wind direction must be taken into account for all flight operations, in particular the take-off and landing directions for fixed wing aircraft.

The take-off and landing area must be sufficient to allow an aborted take-off with clear, secure areas leading up to, and away from, the take-off location. The egress and ingress routes must be clear of any obstructions and hazards.

For emergency purposes an area of operation not directly above, but in clear view of, the Remote Pilot must be identified for orbiting purposes.

Alternate: the Remote Pilot must identify an alternate site for recovery of the vehicle if the proposed landing site becomes unavailable at any point during the flight operation. This should not require any additional preparation and all operational flight members must be aware of, and agree with, the choice of site.

5.1.3 Crew briefing

Prior to each flight, the UAS Operator should brief the whole team on all aspects of the operation. This will include, but is not limited to:

- planned operation and objectives
- individual responsibilities & tasks
- flight plan & alternatives available in the case of incident or emergency
- emergency procedures
- identified hazards
- crowd control measures

The UAS Operator should obtain agreement in person from each individual that they have understood their individual responsibilities & tasks and ensure that they are given ample opportunity to raise any concerns that they have. All concerns must be treated with respect, and addressed, prior to any operations.

5.1.4 Cordon procedure

Separation criteria should be ensured at all times during flight operations. Should the Remote Pilot deem it necessary, a taped-off cordon will be established to keep all uncontrolled public outside the operating space.

5.1.5 Communications

All member of the UAS team must be able to communicate with each other at all times. This will be audible when within range, however beyond this, two-way radios should be used. The UAS operations director is responsible for ensuring that these are charged and available on the day.

If operating near to adjacent air operations, contact must have been made prior to flight and if requested a direct (cell or satellite) number must be open at all times. See Section 4.1.4 for communications requirements.

NOTAMs must be issued if appropriate, well in advance, and through the relevant authorities.

5.1.6 Weather checks

Weather forecasts will have been obtained prior to the day of operations. On arrival, these will be updated with on-site weather checks including, but not limited to:

- wind speed (handheld anemometer)
- wind direction
- cloud cover
- cloud base
- local air pressure
- precipitation

For each flight, at least the wind speed and direction must be recorded. The Remote Pilot must also carry out a visual inspection of the weather conditions immediately prior to flight, and this must be recorded.

No flying must take place outside of the capability or permissions of either the UAS personnel or the air vehicle itself. It is the responsibility of the Remote Pilot to ensure that this is the case.

5.1.7 Charging and fitting batteries (Refuelling)

This manual currently only covers the operation of electric aircraft, both fixed wing and rotary wing. Before the operation of an IC aircraft, this manual must be updated and relevant permissions established. All batteries must be stored and charged in line with best practice. This will include, but not be limited to, the following:

- batteries must always be numbered and stored in LiPo safe bags
- a log must be kept of all batteries, including charging and use - see appendix
- charging must only take place at an approved charging station, and must be monitored at all times by a present person
- appropriate emergency equipment must be present and available at all times
- after use, all batteries must be stored at an appropriate storage voltage
- if any unexpected incident occurs with a battery - including impact, damage, or overuse - it must immediately be removed from operation and disposed of safely
- all batteries must be disposed of through an approved University of Bristol route

5.1.8 Loading of equipment

All equipment used onboard University of Bristol UAS must be within the approved list of payloads and must not result in the MTOW of the aircraft being exceeded. Contact Dr Tom Richardson for any questions related to approved payloads.

For approval to attach new equipment, a case must be made that considers all of, but not limited to the following:

- the overall aircraft mass and the MTOW
- power requirements & power supply options
- safety implications on the existing power system – i.e. noise in the system
- RF interference
- Magnetometer calibration
- GPS reception
- possible interference with the existing autopilot through communications or otherwise
- health and safety requirements
- the ability to secure the payload to the airframe securely
- fail-safe operations which preclude operator errors impacting the safety of the flight

All new approved payloads must be updated and recorded by the University of Bristol and made available to the CAA on a regular basis and on demand.

5.1.9 Preparation and correct assembly of the UAS

It is the responsibility of the Remote Pilot to ensure that the UAS has been correctly assembled and prepared for flight. For information on COTS systems, the manual for each must have been downloaded and read prior to operations and followed throughout to ensure safe operations. A paper version of the technical and instruction manuals must be taken to the flying site and must be available throughout flight operations.

For bespoke UoB aircraft which have been designed and assembled in house, the Remote Pilot must ensure that they are fully aware of all aspects of their operations prior to flight. A paper copy of all elements must be available at the flying site including the autopilot, communications equipment, radios, GCS etc. The Remote Pilot must clarify any outstanding questions with Dr Tom Richardson prior to flight operations.

5.1.10 Pre-flight checks on UAS and equipment

As above, it is the responsibility of the Remote Pilot to ensure that all Pre-flight checks have been carried out prior to flight operations. For COTS equipment, these can be found in the online manuals and technical instructions, for bespoke University of Bristol these must be taken from the paper copy of all individual elements, e.g. autopilot. It is the responsibility of the Remote Pilot to ensure that they are fully aware of all required Pre-flight checks for the aircraft being flown. The Remote Pilot must clarify any outstanding questions with Dr Tom Richardson prior to flight operations.

Note: The Remote Pilot will carry out a full pre-flight inspection of the vehicle prior to every flight, but there will also be elements contained within the pre-flight checklist.

5.2 Flight procedures

With all previous sections complete, a full test plan will be created and executed for each flight. This will include confirmation of the following, but is not limited to:

- all relevant permissions have been sought for the area of operation
- site and weather assessments have been carried out
- operations are in accordance with CAA or relevant NAA rules and regulations
- sufficient insurance is in place
- a qualified safety pilot is available and will be fully briefed
- all other required personnel have been identified and fully briefed
- a person has been identified who has overall responsibility for operations. This may be the pilot or a ground controller – **Note: The Remote Pilot retains responsibility for the aircraft safety at all times**
- the aircraft is airworthy and has undergone relevant pre-flight checks
- the area is secure and suitable for flight operations including primary take-off and landing sites, and alternate areas
- all onboard payloads and systems are operating correctly
- A suitable operator number is affixed to the aircraft.
- emergency procedures and contact numbers are known and available
- correct flight procedures are adhered to at all times
- all relevant logs and records for the aircraft are maintained
- any accidents or incidents are documented and reported

All documentation must be filled out and completed by the appropriate person. **Prior to the commencement of any flight, an appropriate checklist must be created and agreed upon by all members of the team.** This must be updated after each flight, and at the end of each set of operations, **a copy of this checklist and all documentation associated with the flight operations must be sent to Dr Tom Richardson**.

5.2.1 Start

The Remote Pilot will have carried out a full inspection of the airframe and systems, and once satisfied, will connect the power, and the ground support crew will test the onboard and off-board systems to ensure that all parameters are within limits. This must be done via a checklist, examples of which can be found in the appendices, and verbal confirmation must be obtained for each element.

Fail-safe modes and operation must have been agreed upon prior to flight and these must be tested without power to the motors to ensure that the flight controllers enter the correct modes and waypoint requirements on demand and on loss of radio link.

Just prior to Take-off, there must be a verbal confirmation of Go/No-go from each member of the operations team. **The final decision on Take-off remains with the Remote Pilot**.

5.2.2 Take-off

The Remote Pilot will confirm with the crew that they are happy for him to take-off and will advise as necessary. Observers will remain in verbal contact with the Remote Pilot at all times throughout the flight and advise him of any possible incursions, either on the ground or in the air. Operations for rotary and fixed wing aircraft will be:

Rotary wing: the Remote Pilot will take off and hover the aircraft at a safe distance from the ground operations to ensure that all systems are working correctly. They will also check the different modes available, e.g. Loiter.

Once the Remote Pilot has confirmed verbally with the ground control operator that all systems are operating nominally then they will continue with the mission.

Fixed wing: a power check must be carried out just prior to take-off in an agreed safe and controlled manner. A final check on the control surfaces must be made for correct sense and deflection limits. Take-off may be by catapult, a fully briefed and trained operator for hand launch, or using the undercarriage on a suitable runway (see previous Section 5.1.2). Once airborne the Remote Pilot must confirm correct flight operations in an appropriate circuit away from UAS operators and check the available flight modes. Once the Remote Pilot has confirmed verbally with the ground control operator that all systems are operating nominally then they will continue with the mission.

5.2.3 In-flight

Constant communication must be always maintained between the UAS operations team. Communications with the Remote Pilot must be kept brief and succinct to avoid distraction, and any changes to the flight plan must be communicated immediately and clearly.

In the event of an early termination of the flight plan, this must be communicated in a pre-arranged manner to the **Remote Pilot, who retains overall responsibility for the aircraft and can terminate the mission at any point**.

The Remote Pilot must also ensure that the following requirements are met:

- they must not cause or permit any article or animal (whether or not attached to a parachute) to be dropped from a UAS so as to endanger persons or property
- they must maintain direct, unaided visual contact with the aircraft sufficient to monitor its flight path in relation to other aircraft, persons, vehicles, vessels and structures for the purpose of avoiding collisions – unless permissions have been given to operate non-line-of-sight. Irrespective of this however, at all times though they must ensure that there is no danger of collision
- they must not fly the aircraft:
    - in Class A, C, D or E airspace unless the permission of the appropriate air traffic control unit has been obtained
    - within an aerodrome traffic zone during the notified hours of watch of the air traffic control unit (if any) at that aerodrome unless the permission of any such air traffic control unit has been obtained
- they must not fly the aircraft at a height of more than 400ft from the surface unless permission of the CAA or relevant NAA has been obtained, or the ATC unit in any flight restriction zone
- they must not fly the aircraft within the flight restriction zone of a protected aerodrome either: during any ATC unit's hours of watch unless permission of the ATC unit has been obtained; or outside any ATC unit's hours of watch unless permission of the aerodrome operator has been obtained.
- the flight restriction zone consists of the ATZ of a protected aerodrome, the runway protection zones and any additional boundary zones.

The Remote Pilot must not fly a UAS in any of the following circumstances except in accordance with a permission issued by the CAA or relevant NAA:

a) over or within 150 metres of any congested area

b) within 50 metres of any vessel, vehicle or structure which is not under the control of the UAS Operator; 30m during take off and landing

Relevant information, such as a risk of collision, low battery voltage or reduced radio strength, must be made available to the Remote Pilot at all times, and brought to his attention in a succinct way with a verbal confirmation.

5.2.4 Landing

The Remote Pilot must alert the UAS operations team that he is landing, with sufficient time to allow for observers to check the landing site and ensure that all personnel and public are at a safe distance.

If appropriate, GCS operators can keep the Remote Pilot updated with relevant flight parameters to aid landing; this must be done clearly and succinctly to avoid distraction.

Rotary wing: the Remote Pilot will slowly bring the aircraft into a hover over the landing site and check for correct operation through to touch down where they will reduce the throttle to zero.

Fixed wing: the Remote Pilot may choose to fly a circuit prior to touch-down to check for correct operation of the aircraft, and will aim to touch down, into wind, approximately one quarter of the way along the runway. After touch-down the Remote Pilot may choose to slowly taxi the aircraft back to their position, but they must make their intentions clear to all UAS personnel prior to movement. Once in position they will reduce the throttle to zero.

5.2.5 Shutdown

Upon landing, the Remote Pilot will ensure that all motors are disarmed. After this, on agreement with the GCS operator, the Remote Pilot will approach the aircraft and disconnect the power from the motors. The aircraft will then be safely removed from the landing site.

The purpose of the agreement with the GCS operator is to ensure that no onboard systems are shut down prematurely, however the Remote Pilot can disconnect the power at any point if they deem it necessary.

5.3 Emergency procedures

5.3.1 Appropriate to the UAS and control system

Loss of Primary Control

If the Remote Pilot loses primary control they should:

- alert the UAS operations team and if available, ask for confirmation of link strength
- check that the transmitter is still switched on and that there is sufficient battery power
- switch the transmitter off and then back on again if control is not regained.
- if the aircraft remains unresponsive they should then switch off transmitter.
    - **Rotary wing aircraft**: Failsafe RTH will be initiated and the aircraft will return to home and land after a pre-specified time period. The Remote Pilot will issue warnings to those present and monitor the aircraft visually as it returns.
    - **Fixed wing aircraft**: Agreement will have been made prior to the flight operations for appropriate Failsafe RTH behaviour, depending on the operational environment and proposed mission. This will be included in the pre-flight plan. Possible behaviours might include anything from full control deflections and zero throttle to ensure rapid descent through to an automatic landing at a pre-defined landing zone. The Remote Pilot will issue warnings to those present and monitor the aircraft during the remainder of the flight.
- Following recovery, it is the responsibility of the Remote Pilot to document circumstances of the incident and notify both the University of Bristol and the relevant authorities where appropriate.

Loss of propulsion

Rotary wing with redundancy, e.g. Octocopter or Fixed wing: If power is lost to one motor, the Remote Pilot must immediately land the aircraft in a safe location. They must alert the UAS operations team with audible warnings and make all personnel aware of an impending landing.

Fixed wing: In the event of a loss of propulsion on a fixed wing aircraft the following action must be taken.

- On Launch:
    - If safe to do so, land ahead
    - If unsafe to land ahead, turn the aircraft into wind where possible to minimise ground speed, and aim for the pre-appointed alternate. Maintain appropriate speed to prevent loss of control.
    - Under no circumstances direct the aircraft towards people or property.

- In flight:
    - Trim the aircraft for best glide, select an appropriate area to touch down (into wind, clear of obstacles). Aim for a fully held off landing.

In the event of a complete loss of control it is necessary to alert bystanders to the danger. In the event of a crash, secure the crash site and contact the appropriate emergency services. In the event of a flyaway, immediately inform local ATC and local Police.

Rotary wing without redundancy, e.g. quadrotor, or loss of multiple motors: the Remote Pilot must immediately endeavour to regain control using throttle, arm, disarm. If the aircraft is likely to experience an uncontrolled landing, they must alert the UAS operations team with audible warnings and make all personnel aware of an impending landing.

For both types of incidents all data and evidence should be collected and documented by the Remote Pilot and submitted to the University of Bristol and to the CAA or relevant NAA as necessary.

Aircraft battery failures

If a battery fails or appears to fail during flight, the Remote Pilot must treat it as a loss of power and follow the procedures given for loss of propulsion above. Once recovered the battery must be safely removed and disposed of in accordance with the procedure for any battery that has demonstrated abnormal performance.

Batteries that have been identified as such should immediately be labelled so they are not used in subsequent flights.

Transmitter or transmitter battery failure

The transmitter battery level should be monitored as part of the pre-flight checklist. If the Remote Pilot becomes aware of low transmitter battery level or abnormal transmitter behaviour at any point during the flight, they should immediately attempt to land the aircraft in a safe and controller manner and alert the UAS operations team as to the problem and their intentions.

The Remote Pilot will then power down the aircraft as normal and identify the cause of the problem. No further flights will take place until the Remote Pilot and UAS operations team are satisfied that they have identified and rectified the cause of the problem.

For complete failure of the transmitter, the Remote Pilot will follow the procedures given above for Loss of Primary Control and alert the UAS operations team with audible warnings.

GCS failure

If any member of the UAS operations team becomes aware of a GCS failure, then the Remote Pilot should immediately be made aware in a clear and succinct manner. The Remote Pilot should verbally confirm that they have received the notification and immediately bring the aircraft in to land safely.

Before any further flights, the cause of the failure should be established and rectified to the satisfaction of all. A full report with all relevant information should be made to both the University of Bristol and the CAA or relevant NAA where relevant.

Malicious or accidental interference with control frequency

If the Remote Pilot becomes aware of any interference to the aircraft through the radio link or the aircraft is behaving in a suspicious manner, or not responding to control inputs, they shall attempt to land the aircraft immediately. The source of the interference will be thoroughly investigated and the aircraft shall not fly again until the Remote Pilot is satisfied that it is safe to do so. A report of the incident will also be sent to the University of Bristol and to the CAA or relevant NAA where it is deemed necessary.

Aircraft incursion

If another air user enters the VLOS operational area of the UAS, the Remote Pilot will immediately land the aircraft. If possible, they shall investigate who is in control of the other aircraft and warn them of UAS operations in the area. An AIRPROX report shall be made to the University of Bristol and CAA, or relevant authorities, in any incident where it is deemed necessary.

Fly away

Should a fly away occur, i.e. the aircraft moves away without any command being possible or any control input from the Remote Pilot then they must:

- note the aircraft's flight path, height and speed
- inform the Police and local ATC
- attempt to trace and recover the aircraft
- submit a written report to the CAA or relevant NAA and University of Bristol providing all relevant information

Abnormal Environmental conditions - Unexpected Precipitation

Should the weather conditions change during flight such that the weather limits of the UAV being operated are likely to be exceeded then the flight should be ended as soon as possible. If possible the remote pilot should land the UAV back at the take off location. In extreme situations they may choose to land anywhere safe within the flight operation area. A UAV that has been subjected to heavy rain should be inspected for water ingress before further flight.

Abnormal Environmental conditions - Unexpected high winds or turbulence

Should the weather conditions change during flight such that the weather limits of the UAV being operated are likely to be exceeded then the flight should be ended as soon as possible. If possible the remote pilot should land the UAV back at the takeoff location. In extreme situations they may choose to land anywhere safe within the flight operation area. In high wind situations a reduced altitude may enable a greater ground speed.

Abnormal Environmental conditions - Unexpected low temperature

Should the weather conditions change during flight such that the weather limits of the UAV being operated are likely to be exceeded then the flight should be ended as soon as possible. If possible the remote pilot should land the UAV back at the take off location. In extreme situations they may choose to land anywhere safe within the flight operation area. Specific note should be taken to consider crew performance in unusually cold conditions as well as reduced performance of batteries and propulsion units.

5.3.2 Fire

For all fire incidents, the primary concern is the safety of all personnel. Appropriate firefighting equipment must be on site at all times and must be available immediately to safeguard personnel. No attempt should be made to tackle fires unless absolutely necessary, and the UAS Operator should act quickly and efficiently to evacuate the area and immediately alert the relevant emergency services.

Once all personnel are safe, a full report must be made to the University of Bristol providing all the relevant information.

5.3.3 Accidents

It is the responsibility of the UAS Operator to identify the first aid trained members of the team prior to flight operations. There must be at least one member of the team who is trained in basic first aid, and emergency numbers must be made available to all.

In the event of an accident, flight operations must cease immediately and the Remote Pilot must land the aircraft. The primary concern of the UAS team must be the health and well-being of all team members and emergency medical aid must be sought immediately when required.

As soon as possible, a full report with all the relevant information must be submitted to the University of Bristol and when appropriate to the CAA or relevant NAA.

5.3.4 Pilot incapacitation

Prior to take off, all members of the UAS team must have been briefed on the basic controls of the transmitter and the operation of the aircraft. If the Remote Pilot becomes incapacitated due to illness or any other reason whilst the aircraft is in flight, another member of the UAS operations team will take over and land the aircraft.

If manual control is not possible, the designated UAS team member will initiate the failsafe process for RTH if **Rotary wing** or the agreed behaviour if **Fixed wing**.

As soon as possible, a full report with all the relevant information must be submitted to the University of Bristol and where appropriate to the CAA or relevant NAA.

Please Note: All elements of this UAS Operations Manual must be adhered to at times. If any member of the UAS team becomes aware of any errors or omissions, it is your responsibility to immediately report them to Dr Tom Richardson.

PART 6. Fenswood Farm Field Robotics Centre

6.1.1 Introduction:

To support the wealth of research that uses UAS the Flight Research Laboratory has established the field robotics centre at Fenswood Farm, Long Ashton. At this facility it is possible to conduct test-flights as part of research or to undertake pre-deployment training.

Accessible to authorised UOB remote pilots only.

This unique resource is made available with the kind support of the farm manager, any abuse of the site could have detrimental repercussions for everyone involved in UAS research. For clarification on any detail, queries should be directed towards the flight operations manager.

6.1.2 Proximity to Bristol International Airport

Fenswood Farm sits outside the North Eastern edge of the Bristol ATCZ. The flight research lab has a working relationship with the airport. Notification to the airport is NOT required for standard flights below 500ft AGL conducted inline with the UOB flight operations manual.
Operation up to 1000ft AGL is currently NOT PERMITTED

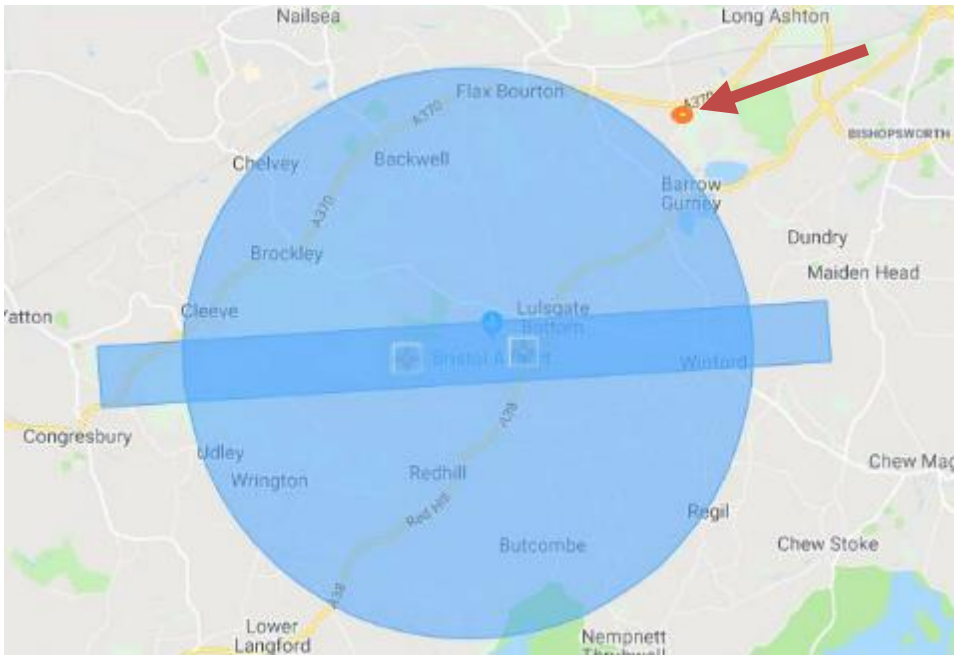


Figure 1 - Bristol Airport drone exclusion zone and location of Fenswood Farm

6.1.3 How to use Fenswood Farm – New user

1. Contact the UAS operations manager to discuss your requirements in advance.
2. Depending on your requirements, complete a RA or use the generic one if applicable. (Ops. manager will advise)
3. Undertake an induction and initial flight at the farm under supervision.
4. Be added to the list of authorised users.
5. Before each intended flight day, notify the operations manager and farm manager of your intent to fly.

6.1.4 Upon arrival

1. Park on the gravel carpark near the runway. Do not drive on the grass under any circumstances.
2. Complete the arrival checklist (see operations manual)
3. Setup equipment on the edge of the runway.
4. All spectators or non-involved people should stand a safe distance back on the carpark behind the crowd line.
5. Ensure the area is clear of walkers before commencing flight.
6. Observe no fly zones (Roads, railway etc) at all times.

All operators and remote pilots using the facility should familiarise themselves with the procedures laid out in the operations manual and pay specific note to the hazards and restrictions. A map of the site showing the restricted areas and hazards can be seen here: LINK

6.1.5 Fenswood Farm Contact Details

Initial enquiries to book and use the flight testing facilities should be directed towards the flight research lab.

Flight Research Lab and Operations management

Mr Duncan Hine
Technical Specialist (UAS) - Flight Operations Manager
Department of Aerospace Engineering
Email: duncan.hine@bristol.ac.uk
Phone: +44 (0) 7931 407 140

Dr Tom Richardson
Senior Lecturer, Flight Dynamics and Control
Department of Aerospace Engineering
Email: thomas.richardson@bristol.ac.uk
Phone: +44 (0) 7803 012 862

Emergency contact details

Mr Andrew Hughes
Farm and Glasshouse Manager, Fenswood Farm.
Email: Andrew.hughes@bristol.ac.uk
*Phone: +44 (0) 1275 394201*Supporting Documents

6.2 Current Operational Authorisation PDRA01 (26th Oct 2023 – 26th Oct 2024)

Civil Aviation Authority

UNMANNED AIRCRAFT - OPERATIONAL AUTHORISATION

SPECIFIC CATEGORY – UKPDRA01

1.	AUTHORITY RELEASING THE AUTHORISATION
1.1. State	United Kingdom
1.2. Issuing Authority	United Kingdom Civil Aviation Authority
1.3. Authorising Signatory Point of Contact	SSC Technical Services 0330 022 1908 uavenquiries@caa.co.uk
2.	**UAS OPERATOR INFORMATION**
2.1. Operator Registration No. CAA Reference.	GBR-OP-YF7VVQ4KM3J6 UAS 835
2.2. UAS Operator Name	University of Bristol
2.3. Operational Point of Contact/ Accountable Manager Name Telephone E-MAIL	 Mr Duncan Hine 07931407140 duncan.hine@bristol.ac.uk
2.4. Authorisation Number	8
2.5. Operations manual	4.61 25/10/2023
3.	**UAS INFORMATION**
3.1. Manufacturer	N/A
3.2. Model	Any fixed wing and/or rotary wing Unmanned Aircraft with an MTOM /flying weight of less than 25kg.

4.	LIMITATIONS AND CONDITIONS FOR THE UAS OPERATION
4.1. **Type of operation**	a) VLOS as per the definition given in UK Regulation (EU) No. 2019/947, Article 2(7). b) Flights within **150m** of Residential, Commercial, Industrial or Recreational Areas.
4.2. **Operating times/periods**	24 hrs. Night operations **must** be carried out in accordance with the procedures in the OM at section 2.5.
4.3. **Location(s) of operation**	Any location within the United Kingdom subject to the airspace restrictions detailed in 4.4.
4.4 **Airspace**	a) Flights **must not** be conducted within the Flight Restriction Zone (FRZ) (See note 1) of a protected aerodrome, or within any Restricted, Prohibited, or Danger Area, unless the appropriate clearance or permission to enter has been obtained. b) Remote Pilots **must** ensure ANSP notification is completed in accordance with the procedures in the OM at section 2.5.
4.5. **Operating heights/altitudes/levels**	a) The unmanned aircraft **must** be maintained within **120 metres (400ft)** from the closest point of the surface of the earth. b) Obstacles taller than 105m **may** be overflown by a maximum of **15m** under the following conditions: i. The person in charge of the obstacle **must** have requested this; and, ii. The unmanned aircraft **must** not be flown more than 50m horizontally from the obstruction.
4.6. **Maximum operating range**	a) Flights **must** be conducted within VLOS as per the definition given in UK Regulation (EU) No. 2019/947, Article 2(7) and **must not** exceed **500m** from the Remote Pilot. b) When operating within VLOS as per the definition given in UK Regulation (EU) No. 2019/947, Article 2(7), the Remote Pilot **may** be assisted by a competent observer who **must** be co-located with the Remote Pilot and able to communicate with them clearly and effectively. If present, the observer **must** maintain VLOS as per the definition given in UK Regulation (EU) No 2019/947, Article 2(7) at all times.

4.7. **Separation from uninvolved persons**	a) Flights **must not** be carried out within **50m** of uninvolved persons, except during take-off and landing, where this separation **may** be reduced to **30m**. b) Any overflight of uninvolved people **must** be kept to a minimum (See note 12). c) Flights **must not** be carried out within **50m** horizontal separation of assemblies of people. Any overflight of assemblies of people **must not** be conducted. i. Lone Remote Pilots (See note 4) **must** have an appropriately set maximum allowed distance from launch/pilot and an appropriately set minimum Return To Home (RTH) battery level. d) Horizontal separation between the Unmanned Aircraft and assemblies of people **must not** be less than the height of the Unmanned Aircraft (i.e., the 1:1 rule).
4.8. **Security of loads/equipment**	a) The remote pilot **must** ensure that any load carried by, or equipment on, the unmanned aircraft is properly secured and that the aircraft is in a safe condition for the specific flight. b) Articles **must not** be dropped. c) Dangerous Goods **must not** be carried.
4.9. **Remote Pilot requirements**	a) Remote Pilots **must**: i. be employed or contracted by the UAS Operator. ii. hold a valid UK Flyer ID. iii. hold a valid GVC or, until the 1st of January 2024, hold an NQE 'full recommendation' obtained prior to the 31st of December 2020 iv. follow the requirements of UK Reg (EU) 2019/947 point UAS.SPEC.060. v. be qualified as per the requirements of the OM at section 2.5.
4.10. **UAS operator requirements**	a) The UAS operator **must**: i. comply with the responsibilities set out in UK Regulation (EU) No. 2019/947, point UAS.SPEC.050. ii. maintain records of each flight made under this authorisation. iii. make such records available to the Civil Aviation Authority on request as per UK Regulation (EU) No. 2019/947, point UAS.SPEC.090.

4.11. **Occurrence reporting Requirements**	a) Any occurrences that take place while operating under this authorisation **must** be reported in accordance with UK Regulation (EU) No 376/2014 and the requirements set out in CAP 722 section 2.7. b) Any accidents that take place while operating under this authorisation **must** be reported in accordance with UK Regulation (EU) No. 996/2010 to the UK AAIB.
4.12. **Insurance**	Insurance cover meeting the requirements of regulation (EC) 785/2004 **must** be held.
4.13. **Relevant/Other Comments**	a) The Unmanned Aircraft **must** be equipped with a mechanism that will cause it to land in the event of a disruption to, or a failure of, any of its control systems, including the C2 Link. b) The Remote Pilot **must** ensure that this mechanism is in working order before any flight is commenced. c) The UAS Operator **must** ensure that the radio spectrum used for the C2 Link and for any payload communications complies with the relevant Ofcom requirements and that any licences required for its operation have been obtained. d) The UAS Operator **must** ensure high energy devices are appropriately stored and transported. e) The UAS Operator ID listed at section 2.1 **must** be displayed on every aircraft flown under this Operational Authorisation. f) Flights **may** be conducted within **150m** of any Residential, Commercial, Industrial, and/or Recreational Areas. g) The Remote Pilot **must not** be operating a moving vehicle whilst operating the Unmanned Aircraft. If the Remote Pilot operates the Unmanned Aircraft from a moving vehicle as a passenger, the speed and stability of the vehicle **must** be sufficient for the Remote Pilot to maintain VLOS and control of the Unmanned Aircraft at all times.
5.	**VALIDITY**
5.1. **Duration of the Authorisation**	This operational authorisation is valid: **From:** 26/10/2023 **To:** 26/10/2024 Unless otherwise suspended or revoked.

5.2. **Regulation references**	This operational authorisation is: **Issued under:** Article 5 of Regulation (EU) No. 2019/947 as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018.
6.	**AUTHORISATION SIGNATURE**
6.1. **Signature / Stamp**	
	The UAS operator detailed in section 2 is authorised to conduct UAS Operations with the UAS defined in Section 3, and according to the conditions and limitations in Section 4, provided that they comply with this authorisation, Annex IX to Regulation (EU) 2018/1139 and its implementing rules. **This operational authorisation must be carried by the remote pilot during the operation.**
6.2. **Date**	26/10/2023

Note 1: The "Flight Restriction Zone" of a protected aerodrome can be determined by reference to the table contained within ANO 2016 Article 94A, Paragraph 7 and is described in CAP 722.

Note 2: UAS operators and remote pilots should be aware that the collection of images of identifiable individuals, even inadvertently, when using surveillance cameras mounted on an unmanned aircraft may be subject to the General Data Protection Regulation and Data Protection Act 2018. Further information about these regulations and the circumstances in which they apply can be obtained from the Information Commissioner's Office and website: https://ico.org.uk/for-the-public/drones/

Note 3: UAS operators and remote pilots must be aware of their responsibilities regarding operations from private land and any requirements to obtain the appropriate permission before operating from a particular site. They must ensure that they observe the relevant trespass laws and do not unwittingly commit a trespass whilst conducting a flight.

Note 4: A lone Remote Pilot is when a remote pilot does not have any support crew (Observer/ Payload Operator) positioned alongside the remote pilot for the duration of the flight.

Note 5: UAS operators must ensure that the appropriate aircraft radio licence has been obtained for any transmitting radio equipment that is installed or carried on the aircraft, or that is used in connection with the conduct of the flight and that operates in an aeronautical band.

Note 6: 'Night' means the time from half an hour after sunset until half an hour before sunrise (both times inclusive), sunset and sunrise being determined at surface level.

Note 7: The following editorial practices are used throughout the authorisation above:

MUST or **SHALL** denotes a mandatory requirement.

SHOULD implies a strong obligation. If the Operator does not follow such an obligation, the Authority would expect a clear justification.

MAY indicates a discretionary practice.

Note 8: Any reference to UK Reg (EU) No. 2019/947 should be taken to refer to Regulation (EU) No. 2019/947 as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018.

Note 9: Any reference to UK Regulation (EU) No. 376/2014 should be taken to refer to Regulation (EU) No. 376/2014 as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018.

Note 10: Any reference to UK Regulation (EU) No. 996/2010 should be taken to refer to Regulation (EU) No. 996/2010 as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018.

Note 11: Any reference to UK Regulation (EU) No. 785/2004 should be taken to refer to Regulation (EC) No. 785/2004 as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018.

Note 12: The guidance in CAP 722 (section 2.1.5.1) must be followed, within the volume 1 operational procedures.

PART 7. Pre deployment RAMS guidance

7.1.1 UAS Pre-deployment Risk Assessment and Method Statement (RAMS)

This form is to be filled in before departure and will aid you in planning a safe and legal flight.

No flight is permitted until the RAMS has been signed by the relevant H&S advisor.

UAS Pre-deployment RAMS

Risk Assessment & Method Statement

Date:	Assessed by: (competent person)	Checked by: (supervisor, PI, manager)	Assessment ref no:	Review date:

Flight Team Composition			
Registered Operator:		**Operator number:**	
Remote Pilot:		**Flyer ID number:**	
GCS Operator:		**Other Crew:**	

UAS Details						
UAV Model:					**U.O.B Registration:**	
Type of UAS:	Multirotor		Fixed Wing		**M.T.O.M (KG):**	
Intended payload:						

Operating Site Location							
Site Name			**Nearest address:**				
Site Owner/representative			**Owner contact details:**				
Site Lat/Long			**Altitude (AMSL) (m)**				
Has permission been granted?	**YES**		**NO**				
Is the site within a geo-restricted area, or in proximity to an airport or other sensitive zone?				No		Yes	

Google Earth map URL:	
Maximum altitude AGL:	
Flight area drawn on screenshot of map (google earth or valid aviation chart):	

What is the objective or purpose of the flights at this location

e.g. Gathering dust samples for volcano modelling.

Describe the flight operations that will be conducted to meet the above objectives.

e.g. number of flights, intended duration, flight profile, site specific requirements etc.

General assessment of risks

Identify and provide mitigations against all risks specific to the location and operation you have outlined. Use multiple pages if required.

Description of hazard	Potential outcome	Control measures to be put in place	A	B	Risk Rating (A) x (B)	Comments/actions

Key for Risk Assessment table

Score to be allocated:	3	2	1
A – Severity of incident:	Major injury, death or damage to property	Injury or damage requiring medical treatment	Minor or no injury/damage
B – Likely occurrence	Regular exposure	Occasional exposure	Exposure very rare.

Resultant risk rating (AxB)	Response required
<3	No real change in procedure required.
3-4	Provide additional training, supervision and monitoring.
6	Critically examine the areas of exposure to risk in the operation and investigate alternative locations or operating conditions to reduce risk rating.
9	Operation can not go ahead until controls to reduce risk are agreed.

Method Statement

Describe detailed steps on how to complete the tasking and avoid the risks identified. IE. How will you complete your objectives safely and within the law.
For any points in the risk assessment where you feel further clarity is required you should expand on your proposed “control measure to be put in place”. Outline precisely how you will conduct your operations being specific about processes and procedures you are putting in place to fully mitigate that risk.

Signatures of acceptance

By signing here you acknowledge the risks outlined above and agree to abide by the approved risk mitigations. Additionally you agree to abide by the UOB flight operations manual and all laws as laid out in the ANO at all times. If in doubt you agree to seek guidance before commencing any flight.

	Name(s)	Job Title/status	Signature	Date
Registered Operator				
Remote Pilot				
Advisor				
H&S representative				
Technical manager (if lab based)				

7.2 Checklists and useful documents

It is recommended that each aircraft have its own quick reference handbook (QRH), this should contain all of the relevant information about aircraft limits, procedures and safety systems. An example of a DJI Mavic QRH is attached along with a set of generic examples of checklists and procedures to aid Remote Pilots to plan their flights.

7.2.1 Quick Reference Handbook DJI Mavic 2 Pro

Section	Content
F	**Field File**
F1	Brief description of UAS
F2	Link to full specification and manual
F3	Operational envelope
F4	Likely outcome of failure of motor, propeller or ESC
F5	Battery Management
F6	Pre-deployment checklist
F7	Pre-flight procedures
F8	Flight procedures
F9	Post-flight procedures
F10	Emergency procedures
F11	Incident management
M	**Maintenance File**
M1	Full aircraft specification
M2	Remote Controller LCD Screen Menu Information
M3	Aircraft-specific maintenance details

Section F: Field File

This document is intended for quick reference during operations. Any Remote Pilot (RP) operating the DJI Mavic 2 Professional must ensure they are fully familiar with manufacturer operating manuals and the capabilities of the UAS.

F1: Brief description of UAS

The DJI Mavic 2 Pro is produced by DJI. It is piloted using a dedicated transmitter in conjunction with either manufacturer or third-party apps that may be accessed using an Android or iOS phone. Thanks to its foldable design the Mavic is smaller, lighter, and easier to carry. Its OcuSync transmission system has a longer transmission range and 1080p resolution.

F2: Link to full specification and manual

Full aircraft specifications

DJI Mavic 2 Pro: https://www.dji.com/mavic-2/info

User Manuals

DJI Mavic 2 Pro: https://www.dji.com/mavic-2/info#downloads

F3: Operational envelope

Parameter	Limitations
Maximum wind speed	8 to 10.6m/s - 18 to 23.6mph- 15.7 to 20.5kt
Maximum service altitude	19,685 feet AMSL (6000m)
Maximum aircraft speed	20m/s – 44.7mph – 38.9kt (Sport mode)
Operating temperature range	-10°C to +40°C
Maximum ascent rate	16.4 ft/s (5 m/s) in Sport mode 13.1 ft/s (4 m/s) in Positioning mode
Maximum descent rate	9.8 ft/s (3 m/s) in Sport mode 9.8 ft/s (3 m/s) in Positioning mode
Operating frequency	2.4-2.483 GHz
Maximum take-off mass (MTOM)	907g
Flight time	Approx. 31 minutes

F4: Likely outcome of failure of motor, propeller or ESC

The DJI Mavic 2 Pro a quadcopter. As a result, there is no redundancy in the event of propeller or ESC failure and the aircraft is likely to enter uncontrolled vertical descent.

F5: Battery Management

Battery details for the DJI Mavic 2 Pro are as follows:

Item	Detail
Battery type	Intelligent lithium polymer battery
Number required for flight	1
Battery capacity	3850mAh
Battery voltage	15.4V
Watt hours	59.3Wh
Charger type	DJI smart charger
Charge instructions	Sit the charger in a safe location on a non-flammable surface. Attach batteries to smart charger. Observe batteries initially to ensure that charge initiates.
Additional instructions	Batteries must be periodically discharged to below 5% as directed within the DJI app. The charger should only be set up by a crew member who is familiar its use and the battery being charged should be monitored. Lithium-polymer batteries can become unstable. The two main causes of this are damage during a crash and improper charging. Any battery that is noticeably swelling should be placed in a safe place. There have been occasions when lithium polymer batteries have burst into flame. If a battery is involved in a crash, it should not be used for the remainder of the operation until it has been checked by the Technical Manager even if it appears undamaged and the UAS is operational.

F6: Pre-deployment checklist

Item	Check
UAS	All components in case – no open defects in log
Spare propellers	Present
Batteries	All present and charged
Chargers	All present
Camera(s)	All present including filters
Media Cards	All present, functional and formatted
Tablet/phone	Present, charged, correct APPs installed and functional
USB cable	Present, functional
Laptop	Present if appropriate and charged
PPE	Present
Cordon equipment	Present if appropriate
Anemometer	Present
Fire extinguisher/blanket	Present and functional
First aid kit	Present and stocked where needed

F7: Pre-flight procedures

Stage	Item	Check
1	Ensure all crew members and participants are briefed	
2	Attach tablet/phone to transmitter	
3	Unfold arms and ensure secure	
4	Insert aircraft battery – ensure secure	
5	Ensure SD card inserted	
6	Check airframe for damage	
7	Check sonar sensors and optical flow system clean	
8	Check motors for resistance and bearing damage	
9	Unfold propellers and check for damage and stress lines	
10	Remove camera cover and retainer	
11	Power transmitter and ensure app initiates	
12	Move aircraft to launch location	
13	Call “**power on**”	
14	Power aircraft	
15	Check command and control link	
16	Carry out compass calibration if necessary	
17	Check camera control and settings	
18	Check flight mode (T, P, S)	
19	Check GPS strength (app)	
20	Check Tx and AV signal strength (app)	
21	Check battery level, cell balance and low battery settings (app)	
22	Check home point is correct (app)	
23	Check failsafe and geofencing set appropriate to operation (app)	
24	Ensure all crew members and participants are ready	

F8: Flight Procedures

Stage	Item
	Start-up procedures
1	Call “starting motors”
2	Final 360 check, call “**taking off**”
3	Use combined stick command or auto take off to start motors
4	Ensure motors are all running
	Take-off procedures
5	Raise throttle and settle aircraft at 2 metres height
6	Check UAS response to all stick movements
7	Commence operational flight
	Flight procedures
8	Maintain VLOS at all times
9	Monitor aircraft for position relative to structures and people
10	Monitor aircraft status
11	Monitor flight time
	Landing procedures
12	At a safe altitude, return to landing point.
13	Call “**landing**”
14	Check landing point is clear
15	Slowly descend UAS to land
16	Hold throttle down to cut motors
	Shut-down procedures
17	Ensure propellers are static
18	Turn off UAS
19	Call “**safe**”

F9: Post-flight Procedures

Stage	Item	Check
1	Check propellers for damage and fold	
2	Check airframe for damage	
3	Remove (and back up) SD card if required	
4	Replace camera retainer and cover	
5	Remove aircraft battery if necessary	
6	Ensure all components are turned off	
7	Repack components and UAS	
8	Check site is clear and left as found	

F10: Emergency Procedures

RPs should take the time to review this section before flight and to understand the procedures to implement in different emergency situations.

10.1: Mitigation Measure - DJI failsafe

This UAS uses the DJI failsafe return-to-home system. In the event of Tx signal loss it will carry out the following:

1. hover for 3 seconds
2. ascend to user defined height (or remain at current height if already above defined height)
3. move to a position over the “home” point
4. descend at a rate of 0.5 m/s and auto-land
5. Switch off motors after 3 seconds

The UAS can then be shut-down.

This procedure can also be initiated from the APP or by holding the return-to-home (RTH) button on the Tx.

10.2: Mitigation Measure – DJI geofencing

All DJI systems can be restricted to preset distance limits to reduce the risk of fly-away. It is recommended that the distance and height limit are set to the minimum distance required to carry out each project.

10.3: Crew warning

If at any time the craft descends in an uncontrolled measure the RP should shout “HEADS” to warn crew members. The briefing should include what action any crew should take on hearing the shout. The response may vary by operation.

10.4: Responses to emergency situations

Loss of primary control frequency including Transmitter battery failure
In the event of loss of control frequency, including Tx failure or Tx battery failure, the aircraft will enter failsafe as described above. At this point it is the responsibility of the RP/crew to maintain the take-off area clear.
Malicious or accidental interference with control frequency
In the event of interference with the control frequency, it is highly likely that the aircraft will enter failsafe and return to base. If that is not the case then the incident should initially be treated as a fly-away as described below. Once the aircraft is safely recovered, the cause of the interference should be investigated and reported appropriately.

Loss of power or aircraft battery failure
In the event of power loss to the flight controller or motors, the aircraft may crash, normally vertically. As a result it is important that the area below the aircraft is maintained clear and that people in the area are aware of the potential risk. If possible the "**HEADS**" warning should be given.
Remote Pilot incapacitated
In the event of the RP becoming incapacitated whilst the UAS is in flight the aircraft will remain in hover and descend vertically to land under low battery voltage. If crew or observer are used, instructions can be given on how to initiate RTH in the event of RP incapacitation.
Aircraft incursion
If another aircraft is seen and appears to be entering or approaching the operating area the RP should descend the UAS until it is clear there is no risk and may then continue the operation or land in the take-off area and wait if necessary. If possible "**AIRCRAFT**" warning should be given.
Propeller or motor failure
On loss of a propeller or motor it is likely the UAS will enter uncontrolled descent. In this case the priority is the safety of the public, client and crew so the key mitigation is avoiding the presence of crew or public immediately below the flight path. If possible the "**HEADS**" warning should be given.
Total electronic failure
If this occurs it is likely that the UAS will enter uncontrolled descent. If possible the "HEADS" warning should be given. If injury occurs it should be ascertained if emergency services are needed and first aid carried out as necessary. As soon as is appropriate the UAS must be made safe by disconnecting the flight battery. Once the situation has been dealt with the incident must be logged and reported appropriately.

“Fly-away”
Fly away is heavily mitigated by the distance limiting feature of the DJI flight controller. The RP should ensure that an appropriate maximum distance and height are programmed for each operation up to a maximum of 500m horizontally and 400 feet (122m) from the surface. In the event of a “fly-away” the RP should attempt to regain control: 1) Attempt atti mode flight if GPS has been lost 2) Attempt RTH 3) Attempt to force failsafe by turning off transmitter 4) Turn transmitter back on and if appropriate attempt to cut motors (CSC) If above fails, log the direction, speed, altitude and estimated flight time of the UAS and immediately contact the Police and local ATC to inform them. If safe to do so the UAS should be tracked until it lands under second-level low battery protection.
Fire in the air
If control is still possible, attempt to land the aircraft away from crew and on a non-flammable surface. Follow procedures below.
Fire on the ground
Allow the battery fire to burn out. Prevent the spread of flame if necessary, using the fire extinguisher/blanket. Avoid smoke inhalation as the smoke is toxic. If necessary, contact fire services.

F11: Incident management

In the event of an incident the RP should follow the procedures below. In the event of injury, the casualty is the priority. If necessary, emergency services should be contacted.

In the event of an incident causing injury or fatality		
Stage	**Item**	**Check**
1	Make the UAS safe by removing flight battery if possible	
2	Administer first aid as necessary	
3	Contact emergency services if necessary	
4	Any injured person remains the priority until they are stabilized and if necessary, paramedics have taken control	
5	Take witness statements if appropriate	
6	Photograph the scene to show position of the UAS	
7	Ensure any footage is retained to show as evidence	
8	Repack components and UAS	
9	Log the details of the accident and report as necessary	

In the event of an incident not causing injury or fatality		
Stage	**Item**	**Check**
1	Make the UAS safe by removing flight battery if possible	
2	Monitor flight battery for swelling and/or fire	
3	Take witness statements if appropriate	
4	Photograph the scene to show position of the UAS	
5	Ensure any footage is retained to show as evidence	
6	Log the details of the accident and report as necessary	

After any accident or incident, the RP should ensure that all appropriate logs are completed and that, if appropriate, the incident is reported. No further flights should be carried out until the cause of the incident is established and any risk of re-occurrence is mitigated.

A mandatory occurrence report can be raised online at:

http://www.aviationreporting.eu/

Section M: Maintenance File
M1: DJI Mavic 2 Pro - Full specification

Specifications

Aircraft	
Takeoff Weight	907 g (Mavic 2 Pro); 905 g (Mavic 2 Zoom)
Dimensions	Folded: 214×91×84 mm (length×width×height) Unfolded: 322×242×84 mm (length×width×height)
Diagonal Distance	354 mm
Max Ascent Speed	5 m/s (S-mode), 4 m/s (P-mode)
Max Descent Speed	3 m/s (S-mode), 3 m/s (P-mode)
Max Speed	72 km/h (S-mode) (near sea level, no wind)
Max Service Ceiling Above Sea Level	6000 m
Max Flight Time	31 minutes (at a consistent 25 kph) (no wind)
Max Hovering Time	29 minutes (no wind)
Overall Flight Time	25 minutes (In normal flight, 15% remaining battery level)
Max Flight Distance	18 km (at a consistent 50 kph) (no wind)
Max Wind Speed Resistance	29–38 kph
Max Tilt Angle	35° (S-mode, with remote controller), 25° (P-mode)
Max Angular Velocity	200°/s
Operating Temperature Range	-10°C - 40°C
GNSS	GPS+GLONASS
Hovering Accuracy Range	Vertical: ± 0.1 m (when vision positioning is active) ± 0.5 m (with GPS positioning) Horizontal: ± 0.3 m (when vision positioning is active) ± 1.5 m (with GPS positioning)
Operating Frequency	2.400 - 2.4835 GHz; 5.725 - 5.850 GHz
Transmission Power (EIRP)	2.4 GHz FCC: ≤26 dBm; CE: ≤20 dBm; SRRC: ≤20 dBm; MIC: ≤20 dBm 5.8 GHz FCC: ≤26 dBm; CE: ≤14 dBm; SRRC: ≤26 dBm
Internal Storage	8 GB
Gimbal	
Mechanical Range	Tilt: -135 to 45°, Pan: -100 to 100°, Roll: -45 to 45°
Controllable Range	Tilt: -90 to 30°, Pan: -75 to 75°
Stabilization	3-axis (tilt, roll, pan)
Max Control Speed (tilt)	120°/s
Angular Vibration Range	±0.01° (Mavic 2 Pro) ; ±0.005° (Mavic 2 Zoom)

Sensing System		
Sensing System	Omnidirectional Obstacle Sensing	
FOV	Forward: Horizontal: 40°, Vertical: 70°; Backward:Horizontal: 60°, Vertical: 77°; Downward: Front and Back: 100°, Left and Right: 83° Lateral: Horizontal: 80°, Vertical: 65°	
Obstacle Sensing Range	Forward: Precision Measurement Range: 0.5 - 20 m Detectable Range: 20 - 40 m Effective Sensing Speed: ≤ 14m/s Backward: Precision Measurement Range: 0.5 - 16 m Detectable Range: 16 - 32 m Effective Sensing Speed: ≤ 12m/s Upward: Precision Measurement Range: 0.1 - 8 m Downward: Precision Measurement Range: 0.5 - 11 m Detectable Range: 11 - 22 m Sides: Precision Measurement Range: 0.5 - 10 m Effective Sensing Speed: ≤ 8 m/s	
Operating Environment	Surface with clear pattern and adequate lighting (lux > 15) Detects diffuse reflective surfaces (>20%) (walls, trees, people, etc.)	
Velocity Range	≤31mph (50 kph) at 6.6 ft (2 m) above ground	
Altitude Range	0.1 - 11 m	
Operating Range	0.3 - 50 m	
Camera	Mavic 2 Pro	Mavic 2 Zoom
Sensor	1" CMOS Effective Pixels: 20 million	1/2.3" CMOS Effective Pixels: 12 million
Lens	FOV: about 77° 35 mm Format Equivalent: 28 mm Aperture: f/2.8–f/11 Shooting Range: 1 m to ∞	FOV: about 83° (24 mm); about 48° (48 mm) 35 mm Format Equivalent: 24-48 mm Aperture: f/2.8 (24 mm)–f/11 (48 mm) Shooting Range: 0.5 m to ∞
ISO Range	Video: 100-6400 Photo: 100-3200 (auto) 100-12800 (manual)	Video: 100-3200 Photo: 100-1600 (auto) 100-3200 (manual)
Shutter Speed	Electronic Shutter: 8–1/8000s	Electronic Shutter: 8–1/8000s
Still Image Size	5472×3648	4000×3000
Still Photography Modes	Single shot Burst shooting: 3/5 frames Auto Exposure Bracketing (AEB): 3/5 bracketed frames at 0.7 EV Bias Interval (JPEG: 2/3/5/7/10/15/20/30/60s RAW: 5/7/10/15/20/30/60s)	Single shot Burst shooting: 3/5/7 frames Auto Exposure Bracketing (AEB): 3/5 bracketed frames at 0.7 EV Bias Interval (JPEG: 2/3/5/7/10/15/20/30/60s RAW: 5/7/10/15/20/30/60s)
Video Resolution	4K: 3840×2160 24/25/30p 2.7K: 2688x1512 24/25/30/48/50/60p FHD: 1920×1080 24/25/30/48/50/60/120p	4K: 3840×2160 24/25/30p 2.7K: 2688×1512 24/25/30/48/50/60p FHD: 1920×1080 24/25/30/48/50/60/120p

Color Mode	Dlog-M (10-bit), support HDR video (HLG 10-bit)	D-Cinelike
Max Video Bitrate	100 Mbps	100 Mbps
Supported File System	FAT32: ≤ 32 GB exFAT: > 32 GB	FAT32: ≤ 32 GB exFAT: > 32 GB
Photo Format	JPEG / DNG (RAW)	JPEG / DNG (RAW)
Video Format	MP4 / MOV (MPEG-4 AVC/H.264, HEVC/H.265)	MP4 / MOV (MPEG-4 AVC/H.264, HEVC/H.265)
Supported SD Cards	Micro SD Supporting Micro SD with capacity up to 128 GB and R/W speed up to UHS-I Speed Grade 3	Micro SD Supporting Micro SD with capacity up to 128 GB and R/W speed up to UHS-I Speed Grade 3
Operating Temperature Range	-10°C to 40°C	-10°C to 40°C
HDR	Enhanced HDR, 14 EV	HDR, 13 EV
Hyperlight	8dB SNR	8dB SNR
Panorama	Pano (3×1): 4000×6000 (40°×80°) W (3×3)): 8000×6000 (113°×80°) 180° (3×7)): 8192×2840 (240°×76°) Sphere (3×8+1)): 8192×4096 (360°×126°, 360°×180°)	Pano (3×1)): 4000×6000 (41°×93°) W (3×3)): 8000×6000 (117°×93°) 180° (3×7)): 8192×2840 (249°×87°) Sphere): (3×8+1) 8192×4096 (360°×126°, 360°×180°) Super Resolution): 8000×6000 (24 mm equivalent FOV)
Remote Controller		
Operating Frequency	2.400 - 2.4835 GHz; 5.725 - 5.850 GHz	
Max Transmission Distance	FCC: 8000 m; CE: 5000 m; SRRC: 5000 m; MIC: 5000 m (unobstructed, free of interference)	
Operating Temperature Range	0°C - 40°C	
Battery	3950 mAh	
Transmission Power (EIRP)	2.400 - 2.4835 GHz FCC: ≤26 dBm; CE: ≤20 dBm; SRRC: ≤20 dBm; MIC: ≤20 dBm 5.725 - 5.850 GHz FCC: ≤26 dBm; CE: ≤14 dBm; SRRC:≤26 dBm	
Operating Current/Voltage	1800 mA @ 3.83 V	
Supported Mobile Device Size	Max length: 160 mm; max thickness: 6.5 – 8.5 mm	
Supported USB Port Types	Lightning, Micro USB (Type-B), USB-C	
Charger		
Input	100-240 V, 50/60 Hz, 1.8 A	
Output	Main: 17.6 V ⎓ 3.41 A or 17.0 V ⎓ 3.53 A USB: 5 V ⎓ 2 A	
Voltage	17.6±0.1 V or 17.0 V±0.1 V	

Rated Power	60 W
Intelligent Flight Battery	
Capacity	3850 mAh
Voltage	15.4 V
Max Charging Voltage	17.6 V
Battery Type	LiPo 4S
Energy	59.29 Wh
Net Weight	297 g
Charging Temperature Range	5°C - 40°C
Max Charging Power	80 W
APP	
Video Transmission System	OcuSync 2.0
Name	DJI GO 4
Live View Quality	Remote Controller: 720p@30fps / 1080p@30fps DJI Goggles: 720p@30fps / 1080p@30fps DJI Goggles RE: 720p@30fps / 1080p@30fps
Latency (depending on environmental conditions and mobile device)	120 - 130 ms
Required Operating System	iOS 9.0 or later Android 4.4 or later

M2: DJI Mavic 2 Pro - Remote Controller LCD Screen Menu Information

Remote Controller LCD Screen Menu Information

Remote Controller Status	
BAT xx PCT	Remote Controller battery level.
SHUTDOWN_	Remote controller is powering off.
CHARGING_	Remote controller is charging.
USB PLUGGED	Mavic 2 has been connected to a computer.
FC U-DISK	Flight Controller is reading data.
UPGRADING	Upgrading.
BINDING	Aircraft is binding with the remote controller.
Before Flight	
CONNECTING_	The remote controller is connecting to the aircraft.
SYS INITING	System is initiating.
READY TO GO	Ready to take off.
Flight Mode	
BEGINNER	In Beginner Mode.
GPS MODE	In P-GPS Mode.
OPTI MODE	In P-OPTI Mode.
ATTI MODE	In P-ATTI Mode.
SPORT MODE	In Sport Mode.
Flight Status	
TAKING OFF	Taking off.
LANDING	Landing.
GOING HOME	Returning to Home.

NAV GOHOME	Returning to home.
NAV LANDING	Landing.
MAX ALT.	Aircraft has reached maximum altitude.
MAX RADIUS	Aircraft has reached maximum radius.
OBSTACLE	Obstacle detected.
NO FLY ZONE	Aircraft is in a No Fly zone.
Intelligent Flight Mode Status	
TRIPOD	In Tripod Mode.
ACTIVETRACK	Using ActiveTrack.
TAP FLY	Using TapFly.
COURSE LOCK	In Course Lock Mode
HOME LOCK	In Home Lock Mode
POI MODE	In Point of Interest Mode
WAY POINT	In Waypoints Mode.
FOLLOW ME	In Follow Me Mode.
TERRAIN	In Terrain Follow Mode.
System Waning and Error Information	
SYS WARNING+CHECK APP	System Warning. See DJI GO 4 app for more information.
UNACTIVATED+CHECK APP	Aircraft not Activated. See DJI GO 4 app for more information.
MAG INTERF+CHECK APP	Compass Error. See DJI GO 4 app for more information.
BATTERY ERR+CHECK APP	Battery Error. See DJI GO 4 app for more information.
SD ERR+CHECK APP	Micro SD Card Error. See DJI GO 4 app for more information.
CALIBRATING	IMU Calibrating/Did not restart aircraft after calibration is complete.
STICK ERR+RE-CTR STCK	Control stick is not centered. Re-center it.
WHEEL ERR+RE-CTR WHEL	Left Dial on the remote controller is not centered. Re-center it.
STICK ERR	Control stick error. Calibrate the control sticks in the DJI GO 4 app.
MECH ERR	Remote Controller Error. Calibrate the remote controller in the DJI GO 4 app. If this problem persists, contact DJI support.
STICK EMI3+AUTO RTH	Control Sticks are experiencing severe electromagnetic interference and cannot function. The aircraft will return to home and land immediately.
STICK EMI2+MANUAL RTH	Control Sticks are experiencing electromagnetic interference and may not function. Use Smart RTH and land the aircraft as soon as possible.
STICK EMI1	Control Sticks are experiencing slight electromagnetic interference, fly the aircraft to another location.
SD FULL	Micro SD Card is full.
NO PROP	No propellers attached.
BAT TEMP HI	Intelligent Flight Battery is too hot.
BATTERY ERR	Intelligent Flight Battery error.
BAT TEMP LO	Intelligent Flight Battery is too cold.
LOW BATTERY	Intelligent Flight Battery low battery.
RC LOW BAT	Remote Controller low battery.
NO RC SIGNL	Remote Controller signal lost.
RC TEMP HI	Remote Controller too hot.
NO RTH	Aircraft cannot Return to Home.

M3: Aircraft-Specific Maintenance details

Following the maintenance instructions of most DJI quadcopters, Remote Pilots must ensure that the aircraft continues to offer optimal performance and to ensure flight safety. It is recommended that comprehensive maintenance be performed after every 200 flights or 50 flight hours.

This manual is intended to help users maintain their aircraft and maximize its continued reliability.

Battery checks	**Checked**
Check battery for damage or deformities	
Check battery connections are clean	
Check Mavic internal power connectors are clean	
Check battery casing	
Check inside battery compartment for damage and debris	
Check battery health using appropriate app	

Airframe checks	**Checked**
Confirm all screws are adequately tightened	
Check airframe for cracks or damage	
Visually and gently tug check exposed wiring	
Clean airframe if appropriate	

Motor and propeller checks	**Checked**
Check motor screws are tight	
Check for bearing movement (clicking when moving motor bell)	
Remove propellers and run motors. Check there is no excessive vibration	
Check motor bell for deformities	
Check propellers for chips, stress lines and tip wear	

IMU check	Checked
Use the DJI Go App to check IMU calibration	
Place the aircraft on a flat, stable surface and run advanced IMU calibration	

Control and Video transmission system checks	Checked
Check antennae in landing gear are secure & free from bending or damage	
Check transmitter antennae for damage	
Check all sticks and switches are secure and functional	
Clean transmitter if necessary	

Camera and gimbal checks	Checked
Check rubber mounts and retainers	
Check gimbal	
Check for resistance to movement when unpowered	
Confirm gimbal self-stabilises fully when powered	
Ensure camera lens is clean and free from dust	

Vision positioning system checks	Checked
Check and clean collision avoidance cameras	
Check and clean IR collision sensors	
Calibrate vision positioning system if required	

7.2.2 Example Arrival Checklist

Date: _____ Time: _____

Arrival Checklist

Activity Details	
Site Name:	
Pilot In Command:	
Person In Charge:	
Ground Control:	

Item	Action To Complete	Findings
Site Survey	Carry out Site Survey with at least one other member of the flight team. Complete?	YES / NO
Briefing	Confirm flight plan(s) and brief crew/observers.	YES / NO
Airframe	Unload/prepare and check for damage/airworthiness.	YES / NO
Camera/Payload	Attach to airframe and check safety case. Safe?	YES / NO
Calibration	Use non-flight battery if power is required. Is Magnetometer/IMU/payload calibrated?	YES / NO
Ground Station	Set up, switch on and configure/test. Working?	YES / NO
Crew Identification	If required, do the crew have ID badges/clothing?	Tick:
Hats/Jackets	If required, do crew have hard hats and reflective jackets?	Tick:
Cordons & Signs	If required, are cordons and signs in place?	Tick:
Radios	If required, are 2-way radios charged, on, and distributed?	Tick:
First Aid Kit	Is there a First Aid Kit easily accessible? Location known by all present?	YES / NO
Fire Extinguisher	Is there a Fire Extinguisher easily accessible? Location known by all present?	YES / NO
Spotters/Observers	Positioned as required for safe operational area?	YES / NO
Flight Battery	Record expected low-level battery minimum voltage.	Volts

Notes:

7.2.3 Example Post-Arrival Site Survey

Date: _____ Time: _____

Post-Arrival Site Survey

Flight Team Composition	
Pilot In Command:	
Person In Charge:	
Ground Control Commander:	

Weather	
Wind Speed (kts):	
Wind Direction:	
Temperature (°C):	
Cloud/Precipitation (%):	

Item	Action to Complete	Findings
Obstructions	Masts/Power Lines, Buildings, Train Tracks, Trees, Lakes, Rivers, Canals?	
Visual Limitations	Anything that may impair vision to <5km?	
Cordon	Cordon required? Extra staff required?	
Livestock	And animals or wildlife nearby?	
Terrain	Flat, Rough, Sloped, Wet, Dry, Trees?	
Permission	Land Owner's permission?	
Public	Public rights of way - footpaths, gates	
Air Traffic	Do we need & have clearance?	
Communication	Are radios required? Are they charged?	
Proximity	Are we far enough away from buildings?	
Take-Off Area	Where is the safest position, >30m away from the public?	
Landing Area	Where is the safest position, >30m away from the public?	
Operational Zone	Any Hazards or Obstructions? >50m away from public?	
Emergency Area	Safest convenient location?	

Contact Details	
Pilot In Command:	
Person In Charge:	
Ground Control Commander:	
Local Police:	
Local Hospital:	
Local ATC:	
Notes:	

7.2.4 Example Pre-Flight Checklist

Date: _____ Time: _____

Pre-Flight Checklist

Aircraft:		Flight Number:	
Location:			
Pilot In Command:			
Person In Charge:			
Ground Control:			

Mission Plan			
Planned Altitude AGL:		Maximum Altitude AGL:	
Mission Objective:			

Item	Action To Complete	Findings		
Weather	Within flight envelope? No approaching squalls or rain?	YES / NO		
Airframe	Secure connections? Secure props? Cables all connected? On platform?	YES / NO		
Flight Battery	Note battery number. Check battery voltage (>90%). Fit battery to airframe.	Batt. ID:		
		Batt. Voltage:	%	V
Transmitter(s)	Transmitter is on. Voltage sufficient? Sticks at zero-position? In GPS-Atti Mode?	YES / NO	Volts	
RF Noise	All local RF noise sources on?	YES / NO		
Flight Battery	*"Clear Props"* called? Battery connected?	YES / NO		
Ground Station	GCS connected? Altimeter within 10m of ground? Suitable telemetry link?	YES / NO		
GPS	Verify connection strength. Number of Sats?	Weak (<6) / Normal / Good (>12)		
Payload	Payload attached/connected? Suitable (micro)SD cards used? Recording?	YES / NO		
Air Traffic	Visual Airspace check? If needed, clearance requested?	YES / NO		
People	Crew/Public in suitable & safe positions?	YES / NO		
Final System Check	Battery health/voltage good? GPS health good? Sensors functioning?	YES / NO		
Go/NoGo	Final check for those present. Suitable separation from aircraft achieved? In good communication?	Ground Control:	**Go / NoGo**	
		Person In Charge:	**Go / NoGo**	
		Pilot In Command:	**Go / NoGo**	
Power Up	Call *"Taking Off"*. Arm Aircraft. Throttle up and/or initialise mission on GCS.			
Time	Note take-off time & start stopwatch.	___:___		

7.2.5 Example Logbook Entry

Date	Flight Number	Start/End Time	Aircraft Model	Aircraft Weight (kg)	Pilot & Capacity	Crew & Assignment	Flight Duration (mins)	Type of Flight	Total Time (hrs: mins)	Comments & PiC Signature
15/09/2015	1	11:58/12:09	DJI Phantom 2	1.1	J. Smith, Pilot in Command	J. Doe, Payload Operator	11	VFR, VLOS, GPS	2:11	*John Smith*

7.2.6 Example Incident Report Form

Date: _____ Time: _____

Incident Report Form

Flight Team Composition	
Pilot In Command:	
Person In Charge:	
Ground Control:	
Payload Operator:	
Spotter(s):	
UAV Model/Registration:	

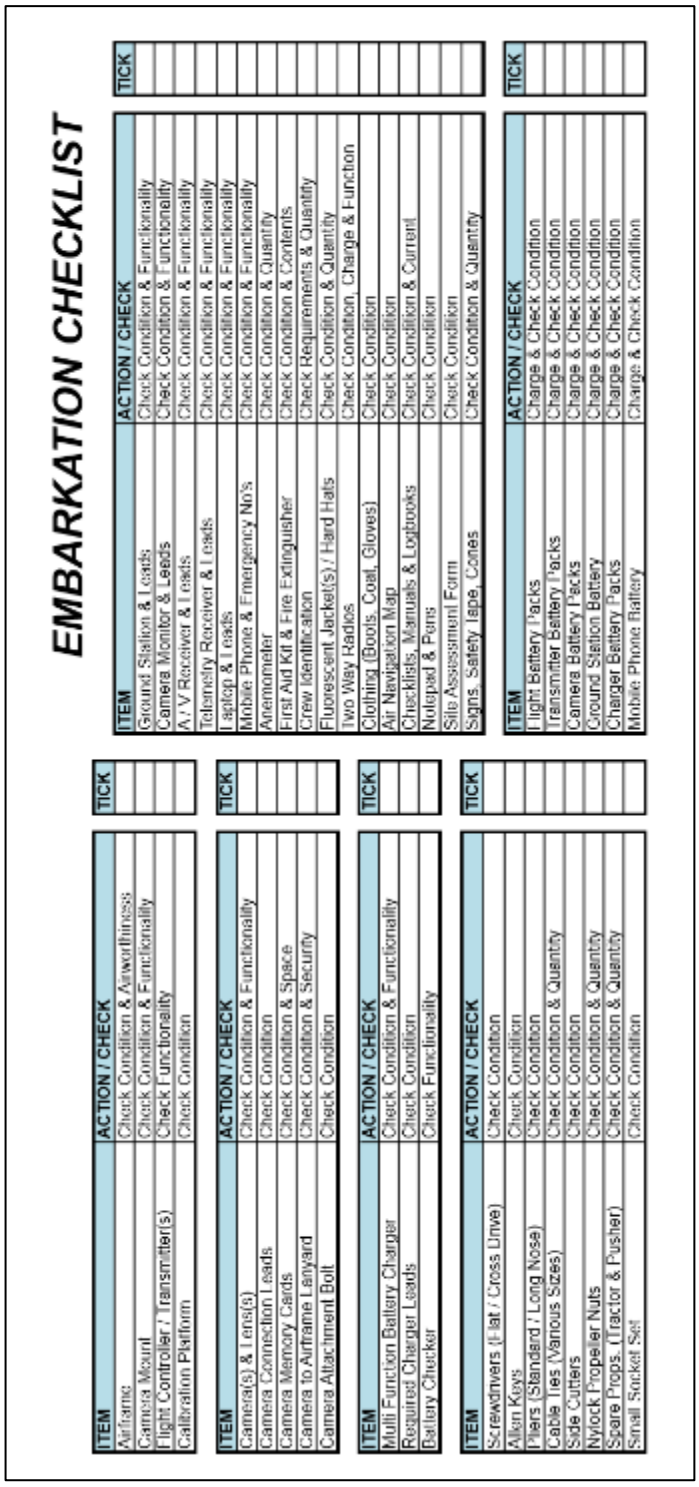
Operating Site Location	
Site Name:	
Latitude/Longitude:	
Altitude AMSL (m):	

Incident Details			
Incident Date:		Incident Time:	
Injuries/Damage Incurred:			
Action taken/Incident Report:			
Notes/Comments	I.e. Ongoing/Closed Investigation. Reported?		

Person Completing Form	
Name:	
Signed:	

7.3 Other Forms

7.3.1 Example Embarkation Checklist



EMBARKATION CHECKLIST

ITEM	ACTION / CHECK	TICK
Airframe	Check Condition & Airworthiness	
Camera Mount	Check Condition & Functionality	
Flight Controller / Transmitter(s)	Check Functionality	
Calibration Platform	Check Condition	

ITEM	ACTION / CHECK	TICK
Camera(s) & Lens(es)	Check Condition & Functionality	
Camera Connection Leads	Check Condition	
Camera Memory Cards	Check Condition & Space	
Camera to Airframe Lanyard	Check Condition & Security	
Camera Attachment Bolt	Check Condition	

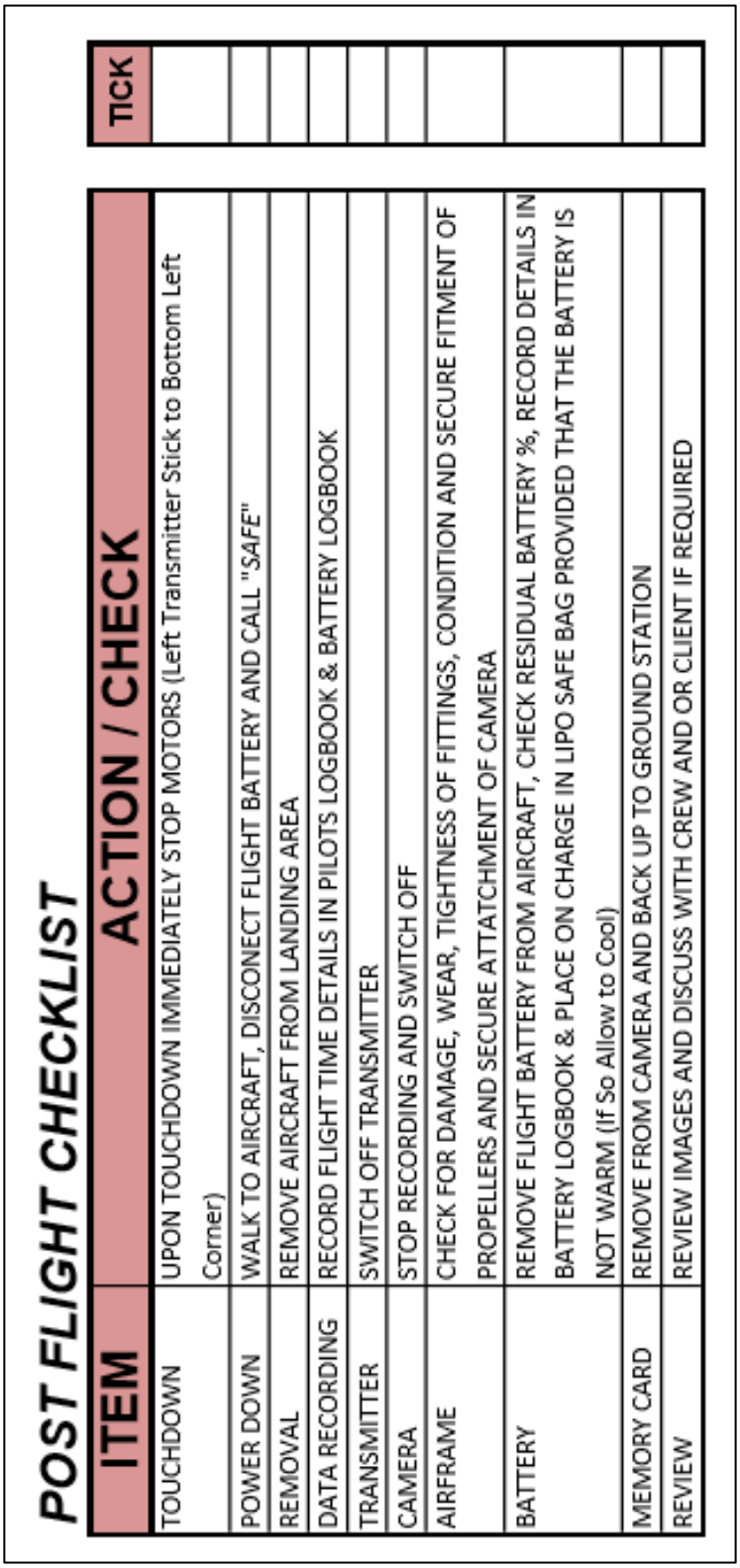
ITEM	ACTION / CHECK	TICK
Multi Function Battery Charger	Check Condition & Functionality	
Required Charger Leads	Check Condition	
Battery Checker	Check Functionality	

ITEM	ACTION / CHECK	TICK
Screwdrivers (Flat / Cross Drive)	Check Condition	
Allen Keys	Check Condition	
Pliers (Standard / Long Nose)	Check Condition	
Cable Ties (Various Sizes)	Check Condition & Quantity	
Side Cutters	Check Condition	
Nylock Propeller Nuts	Check Condition & Quantity	
Spare Props. (Tractor & Pusher)	Check Condition & Quantity	
Small Socket Set	Check Condition	

ITEM	ACTION / CHECK	TICK
Ground Station & Leads	Check Condition & Functionality	
Camera Monitor & Leads	Check Condition & Functionality	
A / V Receiver & Leads	Check Condition & Functionality	
Telemetry Receiver & Leads	Check Condition & Functionality	
Laptop & Leads	Check Condition & Functionality	
Mobile Phone & Emergency No's	Check Condition & Functionality	
Anemometer	Check Condition & Quantity	
First Aid Kit & Fire Extinguisher	Check Condition & Contents	
Crew Identification	Check Requirements & Quantity	
Fluorescent Jacket(s) / Hard Hats	Check Condition & Quantity	
Two Way Radios	Check Condition, Charge & Function	
Clothing (Boots, Coat, Gloves)	Check Condition	
Air Navigation Map	Check Condition	
Checklists, Manuals & Logbooks	Check Condition & Current	
Notepad & Pens	Check Condition	
Site Assessment Form	Check Condition	
Signs, Safety Tape, Cones	Check Condition & Quantity	

ITEM	ACTION / CHECK	TICK
Flight Battery Packs	Charge & Check Condition	
Transmitter Battery Packs	Charge & Check Condition	
Camera Battery Packs	Charge & Check Condition	
Ground Station Battery	Charge & Check Condition	
Charger Battery Packs	Charge & Check Condition	
Mobile Phone Battery	Charge & Check Condition	

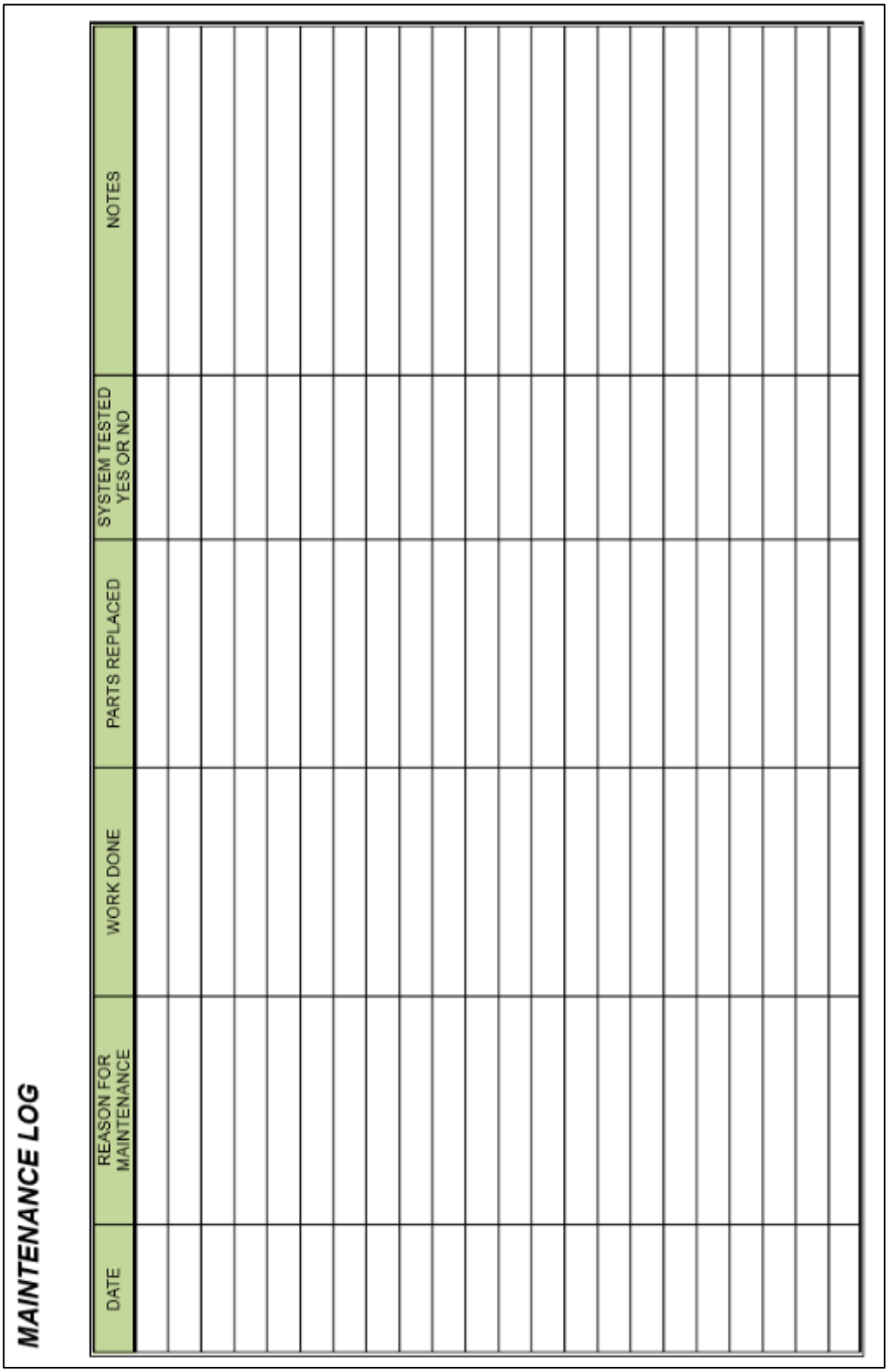
7.3.2 Example Post-Flight Checklist



POST FLIGHT CHECKLIST

ITEM	ACTION / CHECK	TICK
TOUCHDOWN	UPON TOUCHDOWN IMMEDIATELY STOP MOTORS (Left Transmitter Stick to Bottom Left Corner)	
POWER DOWN	WALK TO AIRCRAFT, DISCONECT FLIGHT BATTERY AND CALL "*SAFE*"	
REMOVAL	REMOVE AIRCRAFT FROM LANDING AREA	
DATA RECORDING	RECORD FLIGHT TIME DETAILS IN PILOTS LOGBOOK & BATTERY LOGBOOK	
TRANSMITTER	SWITCH OFF TRANSMITTER	
CAMERA	STOP RECORDING AND SWITCH OFF	
AIRFRAME	CHECK FOR DAMAGE, WEAR, TIGHTNESS OF FITTINGS, CONDITION AND SECURE FITMENT OF PROPELLERS AND SECURE ATTATCHMENT OF CAMERA	
BATTERY	REMOVE FLIGHT BATTERY FROM AIRCRAFT, CHECK RESIDUAL BATTERY %, RECORD DETAILS IN BATTERY LOGBOOK & PLACE ON CHARGE IN LIPO SAFE BAG PROVIDED THAT THE BATTERY IS NOT WARM (If So Allow to Cool)	
MEMORY CARD	REMOVE FROM CAMERA AND BACK UP TO GROUND STATION	
REVIEW	REVIEW IMAGES AND DISCUSS WITH CREW AND OR CLIENT IF REQUIRED	

7.3.3 Example Maintenance Log



MAINTENANCE LOG

DATE	REASON FOR MAINTENANCE	WORK DONE	PARTS REPLACED	SYSTEM TESTED YES OR NO	NOTES

7.4 Qualifications & Certificates

Duncan Hine

Thomas David

Hirad Goudarzi

Yannick Verbelen

Ewan Woodbridge

Mickey Li

7.5 University Aircraft Details

X-8 Octocopter

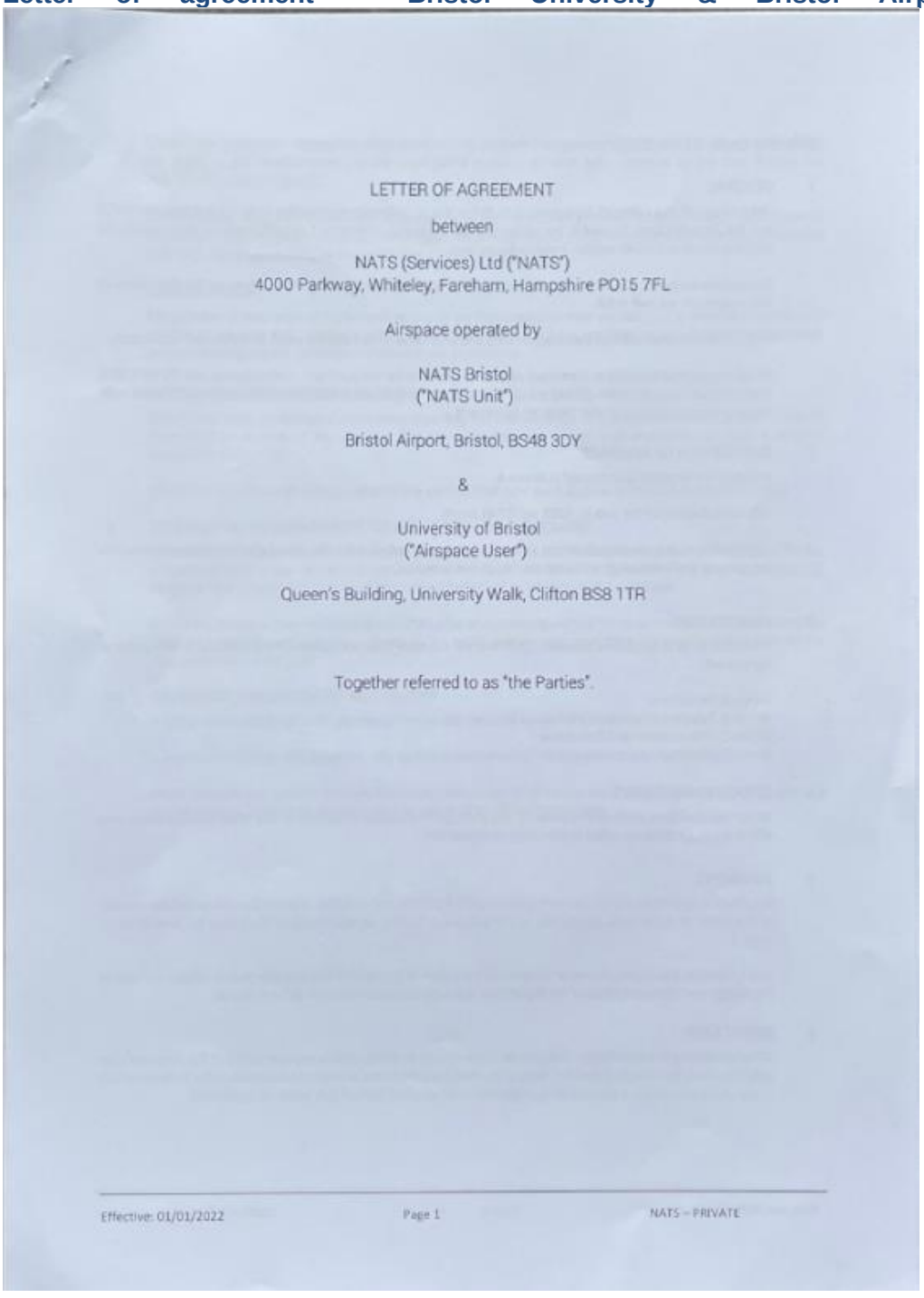
UAS Name	X-8 Octocopter		
UoB Registration	BU-001	BU-002	BU-003
LUASS Registration	UAV2599	UAV1333	UAV2600
Type	Eight rotor multirotor, four arm coaxial motor configuration		
Manufacturer	University of Bristol		
Distributer	N/a		
Airframe Model	Ascension X-8 Octocopter Mk1		
Autopilot	Pixhawk by 3D Robotics		
Wing/rotor span (m)	1.07		
Length (m)	1.07		
Manual control link details	Frsky L9R "Long range" 2.4Ghz 100mw		
GCS link details	Ubiquiti 5Ghz		
Video link details	Not installed by default		
Fuel / battery details	22.2v, 6 cell Lithium Polymer, 8000-24000mAh		
Number of engines	8		
Engine(s)	T-Motor MN3515-15 400KV Brushless Motor		
Airframe empty weight (kg)	4.5		
MTOW (kg)	10		

UoB Heavy-Lift Octocopter

UAS Name	X-8 Octocopter
UoB Registration	BU-013
LUASS Registration	Pending
Type	Eight rotor multirotor, four arm coaxial motor configuration
Manufacturer	Foxtech
Distributer	Foxtech FPV
Airframe Model	X-8 Octocopter Mk2
Autopilot	Pixhawk by 3D Robotics
Wing/rotor span (m)	1.3
Length (m)	1.3
Manual control link details	Frsky X8R 433MHz 100mw
GCS link details	--
Video link details	Not installed by default
Fuel / battery details	22.2v, 6 cell Lithium Polymer, 8000-24000mAh
Number of engines	8
Engine(s)	T-Motor Brushless Motor
Airframe empty weight (kg)	7
MTOW (kg)	18

7.6 Appendices

7.6.1 Letter of agreement – Bristol University & Bristol Airport (NATS)



LETTER OF AGREEMENT

between

NATS (Services) Ltd ("NATS")
4000 Parkway, Whiteley, Fareham, Hampshire PO15 7FL

Airspace operated by

NATS Bristol
("NATS Unit")

Bristol Airport, Bristol, BS48 3DY

&

University of Bristol
("Airspace User")

Queen's Building, University Walk, Clifton BS8 1TR

Together referred to as "the Parties".

Effective: 01/01/2022 Page 1 NATS – PRIVATE

Effective Date: 01/01/2022

1 GENERAL

The purpose of this Letter of Agreement is to define the co-ordination procedures to be applied between NATS and the Airspace User, to permit the Airspace User operating Unmanned Aircraft Systems flying within the airspace as set out within section 2 of this Agreement.

The signatories to this Agreement are accountable for ensuring that the obligations set out by the Procedures in this Agreement are met in full.

This Agreement shall start on the Effective Date and shall be reviewed every 2 years for safety and applicability.

Where segregated airspace in controlled airspace is required for the purposes of compliance with EU 923/2012 Standardised Rules of the Air, (SERA), the Civil Aviation Authority has authorised NATS to create and operate such airspace in accordance with this Letter of Agreement.

2 DESCRIPTION OF AIRSPACE

A Map of the Airspace is contained in Annex A.

The vertical extent of the area is: 400ft agl (570ft amsl).

Any revision to the lateral and vertical extent of the segregated airspace described above, additionally requires approval by the CAA (Safety and Airspace Regulation Group).

3 PROCEDURES

The procedures to be applied between NATS and the Airspace User, are detailed in the Annexes to this Letter of Agreement.

Annex A: Procedures
Annex B: Telephone Communications
Annex C: Abbreviations and Definitions
Annex D: Checklist

4 OPERATIONAL STATUS

All parties shall keep each other advised of any changes to operational facilities or any other matters which may affect the procedures specified in this Letter of Agreement.

5 REVISIONS

Any revision to the Letter of Agreement, excluding the Appendix and Annexes, requires the mutual written consent of the Letter of Agreement signatories or the successor to their position/roles and requires the LoA to be re-signed.

Any revision to the Appendix and/or Annexes of the Letter of Agreement requires the mutual written consent of the designated representatives of the signatories but does not require the LoA to be re-signed.

6 DEVIATIONS

When necessary the appropriate Operational Supervisor(s) and responsible representative of the Airspace User may introduce, by mutual agreement, temporary modifications to the procedures laid down in the Annexes to this Letter of Agreement for a specific time period within the existing term of this Letter of Agreement.

[Delete if not applicable – segregated airspace only: Any temporary change which would have the effect of increasing the lateral and/or vertical extent of the segregated airspace requires prior approval by the CAA (Safety and Airspace Regulation Group).]

Instances may arise where incidental deviations from the procedures specified in the Annexes to this Letter of Agreement may become necessary. Under these circumstances air traffic controllers are expected to exercise their best judgement to ensure the safety and efficiency of air traffic.

7 CANCELLATION

Cancellation of this Letter of Agreement by one of the Signatories (or their successors) is possible at any time in relation to ongoing and significant safety related matters which have not been remedied within a reasonable period following regular consultation between the Signatories.

8 INTERPRETATION AND SETTLEMENT OF DISPUTES

Should any doubt or diverging views arise regarding the interpretation of any provision of the present Letter of Agreement or in case of dispute regarding its application, the parties shall endeavour to reach a solution acceptable to them all.

Should no agreement be reached, each of the parties shall refer such dispute to the CAA for determination.

9 REQUESTING AN AMENDMENT TO THE LETTER OF AGREEMENT

Access to the Airspace is granted to the Airspace User by NATS as the designated authority responsible for the airspace detailed in this Agreement, on the terms set out in this Letter of Agreement. It is the responsibility of Airspace User to seek NATS' agreement to any amendment of this Letter of Agreement.

Where the Airspace User wishes to amend the Letter of Agreement with NATS for access to the Airspace then the Airspace User will send a written request to the NATS unit no later than three (3) months notice prior to the proposed amendment date.

10 REVIEWING THE LETTER OF AGREEMENT

It is the responsibility of all the parties to review this Letter of Agreement at least every 2 years.

A review of the Letter of Agreement may be requested by any of the Signatories and at any time.

When changes are made to the LoA, the appropriate footer of either the main body, Appendix or Annex affected will be updated. In addition, Annex D shall be updated to reflect the changes.

SIGNED

Name: Steve O'Donoghue

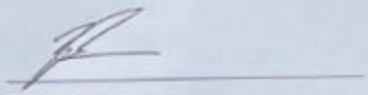
Position/Role: General Manager

Unit: NATS Bristol

NATS (Services) Ltd

DATE: 10/02/2022

SIGNED



Name: Professor Thomas Richardson

Position/Role: Professor of Aerial Robotics

Organisation: University of Bristol

DATE: 3/3/2022


Effective: 01/01/2022
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[Delete if not applicable]

APPENDIX

EXPLANATORY NOTE FOR SEGREGATED AIRSPACE ARRANGEMENTS

Effective: [01/01/2022]

App.1 This Letter of Agreement allows the aircraft operated by the Airspace User specified in paragraph 1 of the Letter of Agreement, which in accordance with SERA.6001 and Appendix 4 would be prohibited or restricted to fly in the airspace specified in paragraph 2 of the Letter of Agreement, to instead fly in accordance with the rules as specified in the Annexes to this Letter of Agreement during periods of segregated operations.

App.2 For flight in Class A and Class C airspace, the Visual Meteorological Conditions to be complied with are those at SERA.5001 VMC visibility and distance from cloud minima Table S5-1:

1. At and above 10,000ft AMSL:
   a. Flight visibility: 8 km
   b. Distance from cloud: 1,500m horizontally, 1,000ft vertically

2. Below 10,000ft AMSL and above 3,000ft AMSL, or above 1,000ft above terrain, whichever is the higher:
   a. Flight visibility: 5 km
   b. Distance from cloud: 1,500m horizontally, 1,000ft vertically

App.3 For flight in Class D airspace below 10,000ft AMSL and above 3,000ft AMSL, or above 1,000ft above terrain, whichever is the higher, the Visual Meteorological Conditions to be complied with are those at SERA.5001 VMC visibility and distance from cloud minima Table S5-1:

   a. Flight visibility: 5 km
   b. Distance from cloud: 1,500m horizontally, 1,000ft vertically

App.4 For flight in Class D airspace at and below 900 m (3 000 ft) AMSL, or 300 m (1 000 ft) above terrain, whichever is the higher, the Visual Meteorological Conditions to be complied with are those at SERA.5001 VMC visibility and distance from cloud minima Table S5-1:

   a. Flight visibility: 5 km
   b. Distance from cloud: 1,500m horizontally, 1,000ft vertically

Alternatively, in Class D airspace, for aircraft other than helicopters, flying at 140 kts IAS or less:

   a. Flight visibility: 5 km
   b. Clear of cloud and with the surface in sight

Alternatively, in Class D airspace, for helicopters, flying at 140 kt IAS or less:

   a. Flight visibility: 1500m
   b. Clear of cloud and with the surface in sight

App.5 'SERA' means 'Standardised European Rules of the Air Regulation' Commission Implementing Regulation (EU) No 923/2012 of 26th September 2012 laying down the common rules of the air and operational

provisions regarding services and procedures in air navigation as amended by (EU) 2015/340 and (EU) 2016/1185.

App.6 The requirements of Commission Regulation (EC) 2150/2005 with respect to the segregation of the activity defined in this Letter of Agreement are deemed to be satisfied as follows:

Article 4 Strategic airspace management (level 1):
1a. CAP740
1b-e. LoA review process
1f. CAP740, LoA, AIP
1g. LoA
1h-k. not applicable
1l. Competent Authority
1m. LoA process
1n. LoA/ACN processes, ANSP/airspace user

Article 5 Pre-tactical airspace management (level 2):
a. AMC (as necessary), AAA AR (through ACN process), LoA/MoU activation process

Article 6 Tactical airspace management (level 3):
1-3. LoA/ACN process
4. Not applicable

Article 7 Safety Assessment
APSA, Supporting procedures applicable to the Letter of Agreement published in MATS Part 2

ANNEX A

PROCEDURES

Effective: [01/01/2022]

A.1 Map of the Airspace

Figure 1 – Position of Fenswood Farm in relation to Bristol Airport

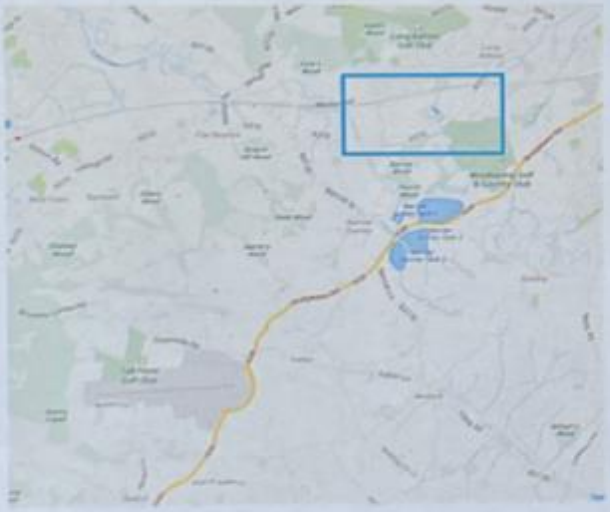

Figure 2 – Fenswood Farm site

A.2 General

The University of Bristol will operate UAS within the Fenswood Farm (Long Ashton) site boundary shown in Figure 2, in accordance with CAP722 "Unmanned Aircraft System Operations in UK Airspace". NATS Bristol agree that this airspace activity can take place within the CTR, without prior notification, subject to the procedure below. The Operator shall ensure that all flights take place in accordance with ANO Articles 137, 138, 166 and 167 of the Air Navigation Order and that the Operator is responsible for avoiding all other aircraft at all times. This agreement for airspace access does not absolve the Operator from acquiring any necessary CAA permissions for aerial or surveillance work.

A.3 Procedures

Aircraft shall only fly in daylight hours.

Aircraft shall remain within 1nm of the site.

Aircraft shall not be operated without the use of a safety pilot.

Aircraft shall not be operated beyond the visual range of the safety pilot.

Aircraft flight operations shall cease immediately whilst any other aircraft activity is observed within 1nm of the site below 1000 ft AGL.

Flight operations up to 400 ft AGL do not require prior permission from ATC.

The Operator shall cease UAS operations immediately at this site if requested by NATS Bristol ATC.

ANNEX B

TELEPHONE COMMUNICATIONS

Effective: [01/01/2022]

NATS Bristol ATC	Telephone - 01275 473712/3
Prof Tom Richardson	Telephone - 07803 012862

ANNEX C

ACRONYMS AND DEFINITIONS

Effective: [01/01/2022]

Acronym	Definition
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ANO	Air Navigation Order
CTR	Control Zone
UAS	Unmanned Aircraft Systems

ANNEX D

CHECKLIST

Section	Effective Date	Review Due by
Front Part	01/01/2022	01/01/2024
Appendix	01/01/2022	
Annex A	01/01/2022	
Annex B	01/01/2022	
Annex C	01/01/2022	
Annex D	01/01/2022	

