Edinburgh Napier University
1. UAS Operating Safety Case

Version 2.2 (14 Jun 2024)

1.1 Purpose

The purpose of this site is to record the key data associated with the safe operation of unmanned aircraft systems (UAS) by those working on behalf of Edinburgh Napier University (ENU).

1.2 Scope

This document is a combined Safety and Operations Manual, compliant with Volume 1 – Operations Manual as set out in CAP722A, covering all aspects of ENU's use of remotely piloted aircraft (RPA) or drones in accordance with the requirements of the UK Civil Aviation Authority's Operational Authorisation UKPDRA-01.

Edinburgh Napier University's core business is education and research. UAS will be used in relation to teaching and research projects that require

- Aerial surveys with visual light cameras and other sensors
- Use of a mobile network node for ad-hoc communications
- Inspection of remote locations and facilities
- Aerial photography and videography as required for research and teaching purposes
- Intelligent control of autonomous vehicles

1.3 Overarching Strategy

Edinburgh Napier University's strategy, Driving Distinctiveness, sets out an overall goal of delivering high quality education and research to add value to the social, cultural and economic capital of our communities and shape their development. To achieve this, we will

- Build careers
- Grow our networks
- Advance knowledge
- Grow sustainably

1.4 Safety Statement

Safety is paramount and ENU has put essential safeguards in place to maintain a safe environment for all involved or connected to UAS operations. This Operations Manual describes the organisation, aircraft systems, personnel, flight operations and procedures by which ENU carries out its Unmanned Aircraft System operations.

ENU is committed to the safe conduct of all its unmanned aircraft system operations and will ensure that the systems deployed are maintained and prepared in accordance with industry best practice. All operations will be carried out in accordance with the issued operational authorisation PDRA01 and abide by the requirements of Assimilated Regulation (EU) 2019/947, its AMC (Acceptable Means of Compliance) and ANO 2016/765 or ANO 2016 as amended.

It is accepted that the contents of this document do not override the necessity of reviewing and complying appropriately with any new or amended regulation published from time to time by the CAA addressed by this document.

1.5 Document Control and Amendment Process

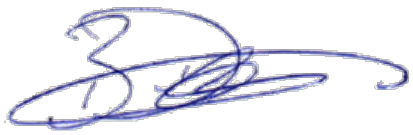
All amendments to this Operations Manual are to be made by Brian Davison or other suitably qualified person and will be recorded on the Change Log Page. Each amendment is identified with a new version number, an amendment date, and a list of the major amendments incorporated. All amendments will be signed off by the Accountable Manager, Brian Davison.

The CAA will be informed of all major updates such as new aircraft or pilots.

All personnel working on behalf of ENU will be informed of any changes to this Operations Manual and they must ensure they have access to a current up-to-date version either in electronic or paper format.

An online version of this manual is available at https://bdavison.napier.ac.uk/opsman/.

Brian Davison
14 Jun 2024
b.davison@napier.ac.uk



2. Safety Policy

2.1 Policy

Safety is the priority in all ENU activities. The University is committed to implementing, developing, and improving strategies, management systems and processes to ensure that all its aviation-related activities uphold the highest level of safety performance and meet national and where appropriate international standards.

The ENU commitment is to:

1. Comply with and, wherever possible, exceed legislative and regulatory requirements and standards.
2. Develop and embed a safety culture in all aviation-related activities that recognises the importance and value of effective aviation safety management and acknowledges that safety is always paramount.
3. Minimize the risks associated with aircraft operations to a point that is as low as reasonably practicable and achievable.
4. Ensure that externally supplied systems and services that impact upon the safety of operations meet appropriate safety standards.
5. Ensure that sufficient skilled and trained resources are available to implement safety strategy and policy.
6. Establish and measure safety performance against realistic objectives and/or targets.
7. Continually improve its safety performance
8. Conduct safety and management reviews and ensure that relevant corrective action is taken.
9. Clearly define for all relevant personnel their accountabilities and responsibilities for the development and delivery of the company's aviation safety strategy and performance.
10. Ensure that all personnel are provided with adequate and appropriate aviation safety information and training, are competent in safety matters and only undertake tasks commensurate with their skills.
11. Ensure that enough skilled and trained resources are available to implement safety strategy and policy
12. Actively develop and improve safety processes to conform to world-class standards.

2.2 Safety Management System

ENU has implemented the rudiments of a full safety management system, using CAP1059 as appropriate guidance.

The internal safety objectives are:

- Encouraging an environment whereby safety has top priority and is second nature, and
- Increasing the knowledge on safe operations and practices on the part of all stakeholders.

2.3 Safety Targets

It is ENU's goal to operate aircraft without harm, injury or damage to any persons or property. The remote pilot will comply with all the safety requirements and limitations granted by the UK CAA to Edinburgh Napier University.

The safety target is *No Accidents*.

3. Organisation

3.1. Main details

Name:	Edinburgh Napier University
Country of Registration:	Scotland
CAA Operator ID:	GBR-OP-5H57G5DHWW9P

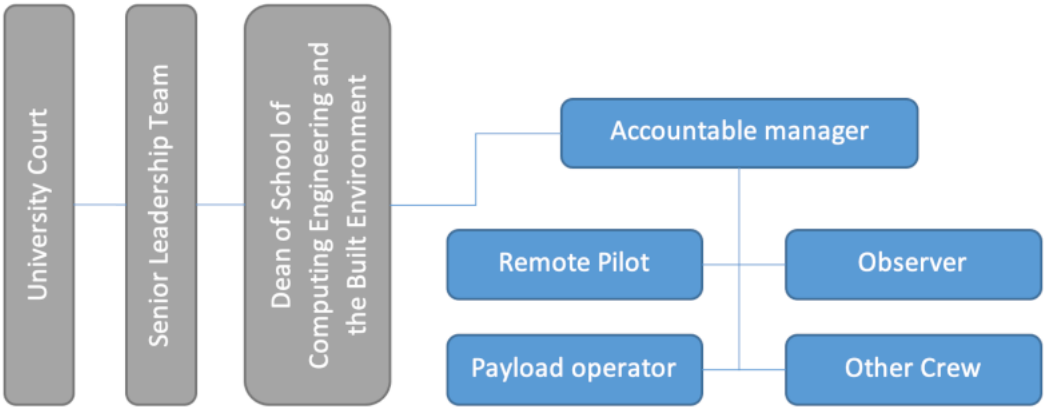
ENU is insured by U.M. Association Limited (Policy number: UM176/17).

ENU operates the RPAs described in the UAS section on p. 36

3.2 Structure of Edinburgh Napier University

Edinburgh Napier University is a publicly funded higher education institution providing a full range of degree qualifications and undertaking funded research. The School of Computing, Engineering and the Built Environment (SCEBE) is responsible for UAS operations. SCEBE's physical location is the University's Merchiston Campus.

The chart below shows the relevant structures and lines of responsibility



3.3 Nominated Personnel

Permanent personnel are named in the table below. Other crew are recruited on an ad-hoc basis for specific missions. They are fully briefed on the contents of this operations manual in advance of live operations.

NAME	FLYER ID	ROLE	NQE/RAE ISSUED CERTIFICATES	ACCEPTABLE MEANS OF COMPLIANCE (IF APPLICABLE)
Brian Davison	GBR-RP-LDP6DZ4QDVWV	**Accountable manager** Remote pilot	GVC	N/A
Daniel Barreto	GBR-RP-2RCFXP935T9N	Remote Pilot	GVC	N/A
James Leak	GBR-RP-RPMYSFGTW2NQ	Remote Pilot	GVC	N/A

3.4 Responsibilities

Where possible, a remote pilot will be accompanied by an observer. If an observer is not assigned to a mission, then the remote pilot will adopt the observer's responsibilities as detailed below.

Remote pilot

- Supervise the UAS operation
- Plan each flight in advance and ensure the right resources are available when required
- Complete the pre-flight risk assessment and mitigate any risks where possible
- Have confidence that the flight can be conducted safely and the competence to perform that flight
- Ensure that the aircraft used is airworthy by completing the pre-flight checklist
- Brief all crew members prior to a flight to ensure they understand their responsibilities
- Communicate with collaborators and other stakeholders as required to understand the required task
- Ensure that the welfare of themselves or others is not compromised by any planned operations
- Operate the aircraft within the stated limitations for that aircraft
- Ensure that he or she is of sound body and mind to operate the aircraft
- Complete all required paperwork such as pilot & aircraft hours, battery log etc. after a flight

Observer

- Act as a link between the remote pilot and other crew members
- Ensure the remote pilot is aware of all relevant developing situations
- Maintain constant look out for ground and air incursions
- Ensure the position of the UA is always known
- Keep the remote pilot updated with battery status
- Be prepared to activate the 'failsafe' function on the aircraft when required
- Brief the pilot after a flight using threat and error management techniques to help the pilot improve his or her competency

Payload Operator

- Ensure the camera or sensor is operational (fully charged, empty memory card fitted, lens clean)
- Ensure the camera or sensor is securely mounted (the remote pilot must confirm this also)
- Ensure the camera or sensor is switched on and operating correctly before activation of the aircraft
- Ensure the camera or sensor is switched off and images saved after the aircraft is made safe
- Ensure operational safety: it is every crew member's responsibility to alert the observer to any changing situation which may cause threat to any aircraft, property, or person present
- Ensure the camera or sensor is rotated to the stored position for take-off and landing procedures

3.5 Areas of Operation

Operations will be carried out in UK airspace, mainly within class G airspace but also potentially including class D airspace.

3.6 Types of Operation

The anticipated types of operation are:

- Aerial surveys with visual light cameras and other sensors
- Implementation of a mobile network node for ad-hoc communications
- Inspection of remote locations and facilities

- Aerial photography and videography as required for research and teaching purposes
- Experimentation in intelligent control of autonomous vehicles

Operations that are conducted during daylight will be within standard VLOS limitations of 400 ft above surface level and at a maximum distance from the remote pilot of 500 metres provided the remote pilot can see the RPA in good visual meteorological conditions.

Prior to all 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 flight-paths 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 RPA are suitable for continuous VLOS operations.

The minimum separation from uninvolved persons will be 50 metres in flight. Overflight of uninvolved people will never be planned and will happen only if it is unplanned.

3.7 Supervision of UAS Operations

The remote pilot present during each operation will be responsible for the supervision and safe conduct of that operation.

The remote pilot will seek clearance from the accountable manager in advance of a flight where a risk is identified as not being in the low or moderate categories and cannot be easily mitigated.

An observer, if present, will be charged with pointing out to the remote pilot any unobserved threat or risk that manifests itself during a flight using threat and error management techniques.

Any safety issue that arises will be brought to the attention of the accountable manager as soon as practicable after the incident has been recorded.

3.8 Accident Prevention and Flight Safety Programme

ENU will comply with the requirements of CAP382, Mandatory Occurrence Reporting.

In the event of any occurrence, the severity will first be assessed, and reported as shown in the flowchart below.

The definitions in this section are from Regulation (EU) 376/2014 and Regulation (EU) 996/2010.

Occurrence

Any safety-related event which endangers or which, if not corrected or addressed, could endanger an aircraft, its occupants or any other person and includes an accident or serious incident. Accidents and serious incidents are classifications of occurrence

Accident

An occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down, in which:

1. a person is fatally or seriously injured as a result of:
    - being in the aircraft, or
    - direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or,
    - direct exposure to jet blast, except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or
2. the aircraft sustains damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component, except for engine failure or damage, when the damage is limited to a single engine, (including its cowlings or accessories), to propellers, wing tips, antennas, probes, vanes, tires, brakes, wheels, fairings, panels, landing gear doors, windscreens, the aircraft skin (such as small dents or puncture holes) or minor damages to main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike, (including holes in the radome); or
3. the aircraft is missing or is completely inaccessible.

Serious Incident

An incident involving circumstances indicating that there was a high probability of an accident and is associated with the operation of an aircraft, which in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down.

Fatal Injury

An injury which is sustained by a person in an accident and which results in his or her death within 30 days of the date of the accident.

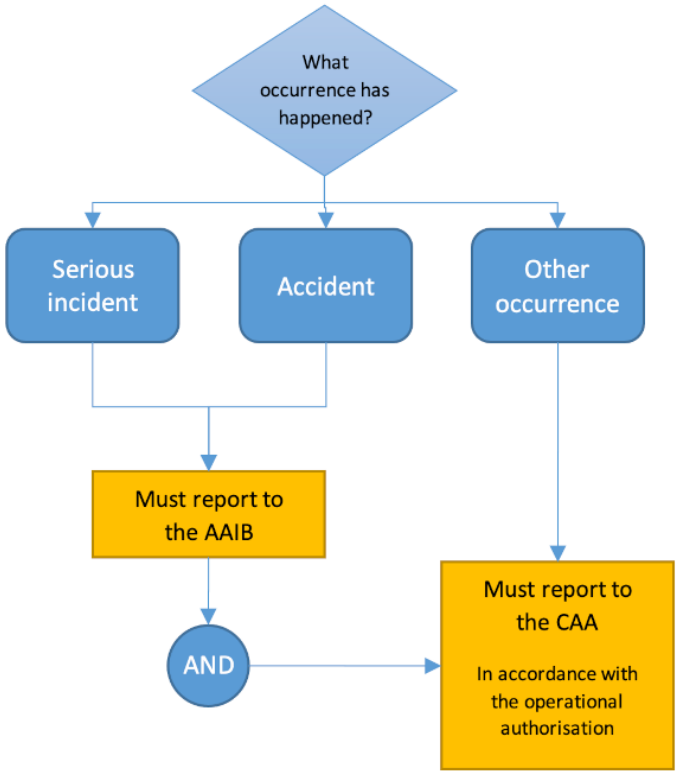
Serious Injury

An injury which is sustained by a person in an accident and which involves any of:

1. hospitalisation for more than 48 hours, commencing within 7 days from the date the injury was received

2. a fracture of any bone (except simple fractures of fingers, toes, or nose)
3. lacerations which cause severe haemorrhage, nerve, muscle or tendon damage
4. injury to any internal organ
5. second- or third-degree burns, or any burns affecting more than 5 % of the body surface
6. verified exposure to infectious substances or harmful radiation

The following workflow will be used to determine reporting requirements in the Specific Category under PDRA-01:



The ECCAIRS Central Hub should be used to report incidents to both the AAIB and CAA.

Incident Logging

All incidents will be logged in the aircraft operating hours log as well as the ENU Incident Log. Upon noting a minor incident, the logbook should be checked for similar occurrences. If a minor incident occurs three times, then an investigation should be initiated to identify the cause and consider implementing steps to reduce the likelihood of this incident occurring again.

All accidents and serious incidents require an investigation as outlined in the investigation procedure section. The incident log should also be updated.

Investigation Procedure and Report

Any investigations undertaken by ENU will follow the procedure shown below to generate an investigation report with the following contents:

INTRODUCTION

The introduction contains the context for the Incident and confirms the major facts as to the companies and people involved, why they were present and the reason for the flights being carried out.

DESCRIPTION OF EVENTS

This is a factual account of the events leading up to and immediately after the incident as well as the incident itself. Its aim is to provide an agreed basis upon which the analysis is carried out.

Importantly any assumptions should be clearly stated, and all data provided should have its authenticity and derivation stated. If there are doubts, then these should also be clearly articulated so that future analysis can take this into account.

ANALYSIS

The analysis of events sets out to find explanations for what is described in the description of events. Wherever possible the analysis draws upon known concepts, models, and physical understanding to ensure that the events as described have a logical explanation.

The analysis should set the scene for any conclusions and provide traceability from the facts to the conclusions in a logical and auditable way.

CONCLUSIONS

The conclusions are derived from the analysis, which themselves are based upon the facts in the description of events or the facts as they pertain to concepts, models and physical understanding exposed within the analysis. A strong conclusion is one where this traceability is good and can stand up to scrutiny.

RECOMMENDATIONS

> The aim of a recommendation is to provide the organisations or personnel identified for the report with those items and actions that can lead to a safer operation and which address the shortcomings highlighted through the investigation process.

3.9 Flight Team Composition

The flight team will be designed around the requirements of the mission. In simple cases such as the conduct of aerial surveys in rural locations that are well away from buildings, people and livestock, the remote pilot may operate alone. It should be noted, however, that the inclusion of an observer is preferred where possible.

In more complex situations, such as urban or industrial locations, the crew will include sufficient members to ensure the safety of the crew themselves as well as uninvolved persons nearby. The crew composition will be detailed in the mission plan.

3.10 Operation of Multiple Types of UAS

The remote pilot will ensure they are fully competent with the operating limitations associated with the aircraft class, weight, and manufacturer they intend to operate with – especially when multiple aircraft are used. The UAS operated by ENU are listed on p. 36

3.11 Qualification Requirements

ENU will ensure that all its remote pilots hold a UAS pilot competency assessment or qualification recognised by the CAA and compliant with the category they intend to operate within.

All remote pilots intending to operate within the open category must ensure they comply with the relevant qualification requirements. For example, they must have completed the DMARES assessment and hold a valid Flyer ID.

All remote pilots intending to operate within the specific category must ensure they hold the relevant qualification requirements for the intended PDRA, in the case of UKPDRA-01, a GVC is required.

3.12 Crew Health

All remote pilots and other crew members working on behalf of ENU will be introduced to the *IMSAFE* mnemonic and will be trained to use it as a proactive self-assessment tool.

IMSAFE

The *IMSAFE* mnemonic helps to remember six factors that could impair a crew member's ability to carry out their responsibilities safely.

I: Illness

M: Medication

S: Stress

A: Alcohol

F: Fatigue

E: Eating

It is the responsibility of the individual to determine if they are in a physically and mentally fit condition to participate in operations on behalf of ENU.

All crew members must be capable of clearly reading a vehicle registration number plate from twenty metres.

Crew members shall not attend a flight operation if they are under the influence of alcohol.

ENU also has a strict no drugs policy. All flight crew members taking prescription drugs should seek professional guidance and advise the remote pilot.

Any crew member who begins to feel unwell and is unable to continue with their assigned responsibilities should advise the remote pilot immediately.

Crew members shall not perform duties when they are unfit to perform tasks due to injury, fatigue, medication, sickness or other causes.

3.13 Logs and Records

ENU will maintain up-to-date information and operational logbooks for:

- Aircraft and Pilot Operating Hours
- Battery Charge
- Aircraft Maintenance
- Incidents / Accidents

ENU maintains a subscription with AirData.com which allows flight data to be uploaded directly and automatically from DJI UAS. AirData provides a compliant logging service for pilots, UAS, flights and batteries.

3.14 Operator Training Programmes

All remote pilots working on behalf of ENU will be subject to regular assessment by the accountable manager on a regular basis for competency and currency, with emphasis on emergency procedures and non-GPS assisted flight manoeuvres.

To maintain currency, the remote pilot should have completed a minimum 2 hours' flight time in the previous 90 days.

3.15 Operational Authorisation

A copy of operational authorisation 20221230 issued to ENU by the CAA can be found here.

4. Operations

This section provides a descriptive perspective of ENU operations. For a time-oriented perspective, please consult the Procedures section.

4.1 Role training and currency

All remote pilots working on behalf of ENU will have to hold a pilot qualification recognised by the CAA for the relevant UAS operations and will be assessed by the Accountable Manager as being knowledgeable and competent to fly ENU's RPA in ENU's potential operating environments.

All pilots will be expected to maintain flying skills currency through hands-on flying with ENU aircraft, aircraft they have access to or appropriately configured simulators. Regular practice will include emergency procedures and flying in all operating modes offered by the aircraft.

4.2 Area of operation

The anticipated areas of operation will be determined by the specific requirements of each mission and these in turn will follow from the terms of the related teaching or research project.

It is anticipated that a broad range of locations from remote rural to urban will be used falling into airspace categories G and D.

UAS operations conducted in UK airspace will be assessed in advance using comprehensive site risk assessment forms (see appendix) and procedures (see section 5).

4.3 Operating limitations and conditions

ENU operations will be primarily conducted within the limitations stipulated within UKPDRA-01 or as stipulated in the operational authorisation issued by the CAA to the University.

Operations may take place within the Open Category. If so, the remote pilot will ensure that the compliant aircraft and competency requirements are held to operate in the specific subcategory.

All operations will be carried out in accordance with the issued Operational Authorisation PDRA-01 and abide by the requirements of Assimilated Regulation (EU) 2019/947, its AMC (Acceptable Means of Compliance) and ANO 2016/765 or ANO 2016 as amended.

All remote pilots are required to sign up to CAA Skywise portal to ensure they remain up to date with legislation, information notices and temporary airspace restriction or changes.

4.4 Methods to determine the intended tasks and feasibility

For all ENU UAS operations, the designated remote pilot will assess the intended task in stages according to ENU procedures (see section 5). Preparation is documented using ENU standard forms (see appendix).

Flight documentation will be retained for at least one year for future reference if required.

The designated remote pilot will be responsible for determining the method of operation for the intended task, identifying resources and assessing the task's feasibility. If he or she has any reservations he will discuss the reservations with accountable manager before proceeding with the task.

4.5 Operating site planning and assessment

As part of the research into task feasibility, the remote pilot will use whatever tools and facilities deemed necessary and available to them such as those listed in the references section.

The task will only go ahead if the remote pilot is satisfied the necessary controls and safeguards can be put in place for a safe operation within the operational area of flight.

As part of the planning process, the remote pilot will develop a site checklist (see appendix) specifically tailored for the location and the task. This checklist will be completed on arrival at the site.

4.6 Communications

Contact telephone numbers for the following will be recorded on the pre-flight site evaluation form (see appendix) as required before departure to the site:

- Landowner(s)
- Observer and Crew
- Client Contact
- Local Police Station
- Local Hospital
- Local Air Traffic Control (ATC)
- Local Air User Clubs

Where possible, contact will be made with the landowner(s) and the ATC before any physical site survey in conducted.

ATC Phone numbers can be found according to the type of the ATZ:

- Civil > AD2 > Aerodrome Name
- Military > IAP > AD > AD2 > Aerodrome Name > Textual Data

4.7 Pre-notification

Permission is required if a planned flight operation is to take place within the flight restriction zone or runway protection zone of a protected aerodrome. The remote pilot will contact the ATC at least twenty-four hours before the planned flight. If operating in controlled airspace the remote pilot will make the decision on whether to contact ATC and notify them of the planned flight in the interests of safety. Contact details for the tower will be recorded on the relevant site survey form.

If there is a local air user club nearby the remote pilot will endeavour to contact the club and enquire about any likely activity on the day of the proposed flight operation.

If the planned flight operation is to take place in areas where there is likely to be members of the public, the remote pilot will inform the local police. The contact and telephone number will be recorded on the site evaluation form.

If the flight operation is to take place in a highly populated area, such as a housing estate, a leaflet drop, and/or a door-to-door advisory campaign will be considered at least seven days in advance to advise members of the public of proposed flight operations.

All relevant crew members will be sent a call sheet for the planned flight operation at least twenty-four hours in advance.

Some ATCs will require a non-standard flight (NSF) approval via the NATS portal.

Applications for NSFs should be made with a minimum of 21 days' notice. Applications submitted less than 7 days in advance of the flight may not be processed.

4.8 Site permissions

The designated remote pilot will obtain permission from all relevant landowners or land occupiers where flight operations are to be conducted. Where possible, permission will be sought in writing. Where it is available in writing a copy of the permission will be carried on site. No flight operations will commence without permission, either written or verbal, from the relevant landowners or occupiers for the main take-off and landing site.

4.9 Weather

In the week leading up to any flight operation the designated remote pilot will obtain long, medium and short-range weather forecasts. Twenty-four hours before the proposed flight operations the remote pilot will determine whether the planned flight operations will go ahead.

Weather and other forecasts, such as solar activity, will be obtained using readily available resources such as those in the references section.

4.10 On-site procedures

Printed flight documentation will be used on site in case an internet connection is not available (see procedures section).

Before setting up on-site in accordance with the site checklist (see appendix) the remote pilot or a designated crew member will carry out the following observations:

- Windspeed at surface level, using a handheld anemometer
- Immediate weather conditions
- Presence of uninvolved persons
- Unexpected factors that could affect mission safety

If the remote pilot feels confident that the proposed flight operations can be safely carried out, then the operation can progress, and the remote pilot can complete the on-site arrival checklist.

The remote pilot will then complete the site checklist (see appendix) to familiarise him or herself with the local geography of the site. This will be completed by physically walking

around the site to identify any previously unidentified hazards that will be manually added to the environment diagram in section 2.4 of the site evaluation form. Where an observer is present, the observer will accompany the remote pilot.

The remote pilot must be satisfied that all risks identified are acceptable and will sign off the site checklist before proceeding to the next stage.

4.11 Assembly and functional checks

The UAS will be assembled and checked in accordance with the relevant UAS assembly checklist (see UAS section on p. 36).

The remote pilot will check the day prior to the flight operation that all necessary software and firmware updates have been completed on the RPA to be flown and if necessary a test flight has been conducted.

4.12 Pre-flight checks

The UAS will be prepared for flight by the remote pilot following the pre-flight checklist (see appendix).

4.13 Flight Procedures

When the remote pilot is satisfied the RPA is ready for launch, they will follow the take-off protocol (see procedures section).

During flight, the remote pilot will conduct situational awareness updates with the observer if present. Situational awareness updates will include:

- RPA position and responsiveness
- RPA battery status
- Horizon scans and airspace assessments
- Landing site incursions
- Alternate landing site incursions
- Air incursions (air users / birds)
- Potential adverse weather changes
- Ground incursions, dangers to the remote pilot

Prior to landing, the remote pilot will follow the landing protocol (see procedures section).

4.14 Post-flight and between-flight checks

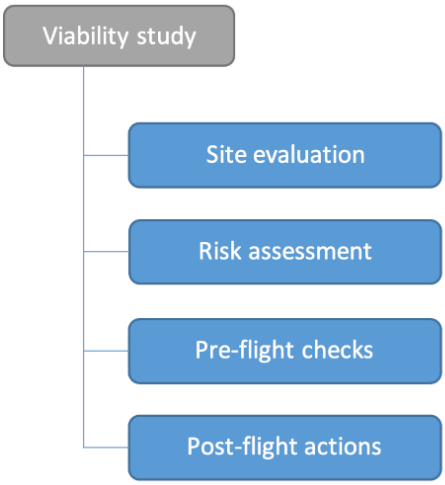
The RPA will be shut down, made safe and checked in accordance with the post-flight actions checklist (see appendix).

4.15 Emergency Procedures

ENU emergency procedures are set out on the emergency procedures section on p. 27.

5. Procedures

Flight documentation is recorded in the form of Word documents that are stored in a central location. This page documents the procedures to be followed at each stage of a project. In overview, the sequence of events is shown in the diagram below. These main stages are broken down further in the timeline below.



Important note

Multiple sources should be used to check key information e.g. airspace, NOTAMs, weather etc. This is to avoid incorrect/missing information affecting the legality/safety of a flight. The references page provides links to resources categorised according to how they may be used; however, this information is not exhaustive. Please use all relevant sources as appropriate and inform the accountable manager is the list of references needs to be updated.

Flight codes

Each operation requires a unique flight code that is entered onto all relevant forms. A new flight code can be generated by entering the basic data for the operation into the flight codes spreadsheet

General procedure

The general procedure for planning an executing an operation is captured in the timeline. Details of specific stages of the process along with relevant template documents are provided on the relevant pages.

Special operations

As well as the generic procedures described in the timeline, templates are provided for certain types of operation:

- Outdoor operations on University premises
- Indoor operations on University premises
- Training sessions at Craiglockhart campus
- Practice sessions at Craiglockhart campus

University premises: outdoors

The three main University campuses are outside the flight restriction zone for the airport. However, they are all in built-up areas that may require special measures and permissions. Careful attention must be given to the planning of any operations on University premises. Template documents are provided below to facilitate repeat events. The final authority with respect to operations on University premises is the University's Health and Safety Office.

The main requirements are:

- The session must be led by a member of staff holding a GVC qualification.
- Forms must be completed at least two weeks in advance of the event.
- The leader must review the template documents to ensure that all requirements are met.
- An incident number must be obtained from Police Scotland in advance of the session

When completing the template documents, all text in red must be replaced by the relevant details.

When completing the risk assessment, the leader must double-check the risk items before initialling them.

Procedure

1. Obtain a flight code using the flight codes spreadsheet
2. Download the template documents
3. Update the viability study template
4. Visit the site
5. Update the site evaluation
6. Update the risk assessment
7. Complete and circulate the unusual events form

Important

The steps above are designed to speed up the process but it is still the operation leader's responsibility to ensure that the operation complies with all legal and safety requirements. Check the timeline for guidance.

University premises: indoors

Flying a drone inside a building has obvious additional risks. On the other hand, certain considerations when flying outdoors do not apply. The final authority with respect to indoor operations is the University's Health and Safety Office.

Important

Only drones below a take-off mass of 250g will be allowed to fly indoors. They must also be equipped with appropriate safety features such as rotor guards.

The main requirements for indoor operations are:

- The operation must be carried out or supervised by a member of staff holding a GVC qualification.
- Forms must be completed at least two weeks in advance of the event.
- The leader must review the template documents to ensure that all requirements are met.

When completing the template documents, all text in red must be replaced by the relevant details.

When completing the risk assessment, the leader must double-check the risk items before initialling them. Sufficient attention must be given to the nature of the space, the potential hazards and possible interactions with people. For example, access to the area designated for the flight must be restricted by appropriate means.

Procedure

1. Obtain a flight code using the flight codes spreadsheet
2. Download the template documents
3. Update the viability study template
4. Visit the room
5. Update the site evaluation
6. Update the risk assessment
7. Complete and circulate the unusual events form

Important

The steps above are designed to speed up the process but it is still the operation leader's responsibility to ensure that the operation complies with all legal and safety requirements. Check the timeline for guidance.

Craiglockhart training

Craiglockhart campus has a convenient area of grass suitable for training and practice sessions. Template documents are provided below to facilitate repeat events. the main requirements are:

- The session must be led by a member of staff holding a GVC qualification.
- Forms must be completed at least one week in advance of the event.
- The leader must review the template documents to ensure that all requirements are met.
- An incident number must be obtained from Police Scotland in advance of the session

When completing the template documents, all text in red must be replaced by the relevant details.

When completing the risk assessment, the leader must double-check the risk items before initialling them.

Procedure

1. Obtain a flight code using the flight codes spreadsheet
2. Download the template documents
3. Update the viability study template
4. Update the site evaluation
5. Update the risk assessment
6. Complete and circulate the unusual events form

Important

The steps above are designed to speed up the process but it is still the operation leader's responsibility to ensure that the operation complies with all legal and safety requirements. Check the timeline for guidance.

Craiglockhart practice

Craiglockhart campus has a convenient area of grass suitable for training and practice sessions. Template documents are provided below to facilitate repeat events. the main requirements are:

- The session must be led by a member of staff holding a GVC qualification.
- Forms must be completed at least one week in advance of the event.
- The leader must review the template documents to ensure that all requirements are met.
- An incident number must be obtained from Police Scotland in advance of the session

When completing the template documents, all text in red must be replaced by the relevant details.

When completing the risk assessment, the leader must double-check the risk items before initialling them.

Procedure

1. Obtain a flight code using the flight codes spreadsheet
2. Download the template documents
3. Update the viability study template
4. Update the site evaluation
5. Update the risk assessment
6. Complete and circulate the unusual events form

Important

The steps above are designed to speed up the process but it is still the operation leader's responsibility to ensure that the operation complies with all legal and safety requirements. Check the timeline for guidance.

Timeline

Depending on the nature of the flight and its location, certain checks will need to be carried out and permissions obtained. The timeline below summarises the preparations required in advance of a flight and immediately afterwards.

The remote pilot is responsible for ensuring that all relevant actions are completed. For the items to be done in advance of the flight day, the times shown should be treated as the minimum. Some adjustments may be required - for example, if the flight requires an NSF application, other relevant planning actions should be brought forward to allow the application to be submitted in good time.

Flight documentation should be printed the day before the flight. This is to ensure that the relevant information is available on site even when an internet connection is not available.

28 days in advance

- Apply for non-standard flight permission if required

7 days in advance

- Complete viability study
- Complete site evaluation
- Complete risk analysis
- Submit NOTAM if appropriate
- Carry out a leaflet drop and/or a door-to-door advisory campaign if the flight operation is to take place in a highly populated area, such as a housing estate
- Inform the local police if the planned flight operation is to take place in areas where there is likely to be members of the public
- If there is a local air user club nearby, contact the club and enquire about any likely activity on the day of the proposed flight operation
- Obtain written permission from the relevant landowners or occupiers for the take-off and landing zones
- Monitor the weather at the site
- Customise the loading list

24 hours in advance

- Check that relevant contact numbers are recorded on the site evaluation form
- Contact ATC if the flight operation is to take place within the flight restriction zone or runway protection zone of a protected aerodrome
- Make go/no-go decision for the flight based on available weather information
- Review the loading list
- Prepare and send crew call sheets
- Configure UAS if required (e.g. add expansion bays, prepare custom payloads, etc.)
- Check UAS firmware is up to date

- Conduct a test flight if necessary
- Check that the operator id is clearly displayed on the RPA
- Charge flight batteries, controller(s) and mobile device(s)
- Customise the site checklist
- Print flight and UAS documentation as required
    - Permissions and contacts
    - Emergency procedures
    - Customised loading list
    - Customised site checklist
    - UAS assembly instructions
    - Crew briefing notes
    - Pre-flight checklist
    - Post-flight actions checklist

Day of flight

- Ensure relevant account is logged in (e.g. DJI operator)
- Pack equipment using the loading list
- Check for NOTAMs
- Complete site checklist (including a physical tour of the area)
- Make go/no-go decision for the flight based on windspeed, weather, presence of uninvolved persons and any unexpected factors
- Assemble the UAS using model-specific checklist
- Complete crew briefing
- Complete pre-flight checks
- Complete post-flight actions
- Disassemble the UAS using model-specific checklist and pack equipment

Incidents and emergencies

- Report an incident through ECCAIRS
- Report an AIRPROX

Viability study

In order to assess a job is viable in the first instance, the remote pilot must make a quick high level assessment to identify serious barriers before going into any more detail. Use the links provided on the reference page to evaluate

- Airspace
- Ground hazards
- Weather

The viability study form is included as item 1 in the appendix.

Site evaluation

If the initial viability study concludes that there are no serious barriers to prevent the flight going ahead, and that any required permissions can be feasibly obtained, the next step is to conduct a more detailed evaluation of the site using information from the sources listed on the references page.

This is followed by a site visit to confirm the desk research and to identify any unexpected factors that could impact the safety of the flight.

The site evaluation form is included as item 2 in the appendix.

Risk analysis

Using the information gathered in the site evaluation and from any other sources, describe each risk associated with the flight and estimate its severity and probability. Bear in mind that some risks will always be present and some will be site-specific.

The flowchart below shows the steps to be followed. Note that severity and probability are estimated twice. The first time it is assumed that only standard safety measures will be in place. After that, additional safety measures are designed specifically for this flight and the severity and probability are re-estimated.

Severity and probability are both evaluated on a scale of 1 to 5 where the meanings of these values are as follows.

VALUE	SEVERITY	PROBABILITY
1	No Injury, Property damage	Extremely Unlikely
2	Minor Injury	Remotely Possible
3	Reportable Injury	Will Possibly Occur
4	Major Injury / Single Fatality	Will Probably Occur
5	Multiple Fatalities	Almost Certain

Risk is calculated as **severity x probability**. This is done automatically by the risk analysis form.

A risk value below 6 is considered low and may be accepted. It should still be reviewed to see whether the risk can be further mitigated.

A risk value between 6 and 12 is considered medium and the flight should only proceed with special measures such as specialist personnel and/or a safety team. Further measures to mitigate the risk must be explored.

A risk value above 12 is considered high and the flight should not proceed unless the risk can be sufficiently mitigated.

The risk assessment form is included as item 3 in the appendix.

Flight protocols

Crew briefing

The remote pilot is responsible for ensuring that the crew are fully briefed so that they can carry out their roles competently and safely. The crew briefing will follow the structure set out in the crew briefing template (see appendix). This document is tailored for the site and the nature of the flight during the flight planning process.

If there are uninvolved persons present, one option is to recruit them to the team by giving them a role. This brings them under the control of the remote pilot. In that case, they should be included in the crew briefing.

Situational awareness

The remote pilot and the crew will maintain a high level of situational awareness at all times. This primarily means monitoring the ground area and airspace for potential hazards.

The remote pilot is further responsible for the safe operation of the UAS and will use the scan technique to

- monitor ground/airspace
- monitor battery levels
- monitor changes in weather
- check blind spot

If the safety of the operation appears to be compromised at any time, the remote pilot will land the RPA and make it safe. If possible, this will be done by following the normal procedure and landing at the primary TOLZ. If the primary TOLZ is not available, the secondary TOLZ will be used, and if the situation requires it, emergency procedures will be invoked (see p. 27).

The primary responsibilities of the crew are to

- monitor ground/airspace
- provide situational updates to the remote pilot
- control situations that might distract the remote pilot such as incursions by uninvolved persons
- be familiar with emergency procedures

Take-off protocol

Immediately before take-off, the remote pilot will

- ensure that the crew is in position
- ensure that any uninvolved persons are at safe distance
- ensure that the ground area and airspace are clear
- ask the crew to retreat 5m to the rear of the RPA

At the point of take-off, the remote pilot will call *Clear*. A designated crew member will reply with *Clear*. This exchange provides a double check on the safety of the operational area, and also tells the remote pilot that the crew are fully engaged with the operation.

The remote pilot then calls *Aircraft taking off*

Following take-off, the remote pilot will perform basic flight checks at 5m ASL including

- Pitch
- Yaw
- Roll
- LED operation
- Payload operation

Landing protocol

Immediately before initiating the landing, the remote pilot will

- ensure minimum safe distance for uninvolved people
- ensure that the landing zone is free from foreign objects
- ask the crew to retreat 5m from the landing point

As with the take-off, the remote pilot calls *Clear* before landing, to which a designated crew member replies with *Clear*. This exchange provides the same benefits as during take-off.

The remote pilot then lands the RPA and disarms it using the facilities provided by the specific model of RPA being used. After disarming, the remote pilot will approach the RPA and power down the batteries, after which they call *Aircraft safe*.

Emergency procedures

This page describes the emergency situations that may arise and how they should be dealt with. The procedures set out actions for both the remote pilot and the crew. These measures will be recapped during the crew briefing before a flight and all crew members will have access to full instructions during an operation.

Pilot incapacitation

Pilot action

Activate RTH (Return to Home) or BL (Back Landing) if possible.

Crew action

- Pick up controller.
- Confirm launch area clear.
- Monitor video display (if still functioning).
- Initiate Return to Home procedure OR land the RPA if trained to do so.
- Administer First Aid to pilot as appropriate
- Call Emergency Services if required

Notes

Administer first aid to pilot.

When Return to Home is initiated: If below 20m the RPA will climb to 20m (if already above 20m the RPA will stay at the same height)

The RPA will return directly to the launch position, hover for 15 seconds then gradually descend until it lands, and the motors will automatically disarm.

Report to appropriate bodies as identified in section 3.8.

Airspace incursion

Pilot action

- Climb or descend as appropriate.
- Alert crew to issue.
- When location of other air user has been identified move directly away, land if safe to do so.

Crew action

- Prioritise the identification of the location of the other air user.
- Keep pilot informed.
- Ensure landing location is clear.

Notes

Record any relevant information relating to the airspace incursion for UK AIRPROX Board.

Report to appropriate bodies as identified in section 3.8.

Ground incursion

Pilot action

- Climb and move RPA as appropriate and achieve suitable separation.
- Alert crew to issue.
- When location of people has been identified move away, land if safe to do so.

Crew action

- Prioritise identification of the location of the person.
- Keep pilot informed.
- Confirm launch/landing area clear

Loss of control data link

Pilot action

- Alert crew to issue.
- Attempt to regain control of the RPA by changing flight mode from its current mode to an alternate and back.

Crew action

- Ensure landing location is clear.
- Monitor video display (if still functioning).
- Provide pilot with appropriate updates on status.

Notes

RPA will enter a 'failsafe' mode in this situation after 3 seconds.

When failsafe is initiated: If below 20m the RPA will climb to 20m (if already above 20m the RPA will stay at the same height)

The RPA will return directly to the launch position, hover for 15 seconds then gradually descend until it lands, and the motors will automatically disarm.

If RPA re-acquires link at any time the pilot can change the flight mode to regain control of the RPA by cycling the flight mode switch.

Pilot must land the RPA as soon as it is safe to do so to investigate the issues.

Report to appropriate bodies as identified in section 3.8.

Rogue RPA

RPA flying without response from remote pilot and uncontrollable

Pilot action

- Alert crew to issue.
- Attempt to regain control of the RPA by changing flight mode switch.
- Attempt to initiate Return to Home using switch.
- Turn off Pilot Controller to attempt to force a failsafe. If this does not work turn controller back on again and try to regain control.
- If control regained, bring RPA home and land.
- If control not regained, prepare for crash landing.
- Call "CLEAR"
- Proceed to crash site if possible
- Inform local ATC if required
- Inform emergency services if required

Crew action

- Identify a landmark on the horizon to assist with identifying direction of flight, from launch area or mark location.
- Monitor video display (if still functioning). Provide pilot with appropriate updates on status.
- Take a bearing of the direction of flight.
- Inform local ATC if required
- Inform emergency services if required

Notes

Dependent on outcome possibly inform the relevant agencies and personnel.

Report to appropriate bodies as identified in section 3.8.

Loss of power (RPA)

Pilot action

- Alert crew to impending crash.
- Attempt to regain control by changing flight mode switch.
- If control regained, bring RPA home and land.
- If control not regained, prepare for crash landing.
- Call “CLEAR”
- Proceed to crash site if possible
- Inform local ATC if required
- Inform emergency services if required

Crew action

- Identify a landmark on the horizon to assist with location of RPA.
- Monitor video display (if still functioning).
- Provide pilot with appropriate updates on status.
- Proceed to crash site if possible
- Inform local ATC if required
- Inform emergency services if required

Notes

Carry out post-crash management procedure.

Report to appropriate bodies as identified in section 3.8.

Loss of power (ground control equipment)

Symptoms

- Tablet screen extinguished.
- Green connection light and / or white power lights on RC extinguish.
- RPA shows fast flashing amber lights.

Pilot action:

- Alert crew to the loss of control.
- Ensure landing site is cleared.
- Watch behavior of machine to ensure failsafe is operating correctly. If not initiate Rogue RPA procedure.

Crew action

- Monitor video display (if still functioning).
- Provide pilot with appropriate updates on status.

Notes

If RPA experiences control data loss for more than 3 seconds it will enter failsafe mode.

When failsafe is initiated: If below 20m the RPA will climb to 20m (if already above 20m the RPA will stay at the same height)

The RPA will return directly to the launch position, hover for 15 seconds then gradually descend until it lands, and the motors will automatically disarm.

If RPA re-acquires link at any time the pilot can change the flight mode to regain control of the RPA.

Pilot must land the RPA as soon as it is safe to do so to investigate the issues.

Report to appropriate bodies as identified in section 3.8.

Unexpected behaviour in flight

Pilot action

- Alert crew to the loss of control.
- Ensure landing site is cleared.
- Pilot must land the RPA as soon as it is safe to do so to investigate the issues.

Crew action

- Monitor video display (if still functioning).
- Provide pilot with appropriate updates on status.

Notes

Report to appropriate bodies as identified in section 3.8.

Lithium polymer battery fault

Symptoms

- Swelling of battery or overheating, for example from impact damage following aircraft crash, dropping of battery, or charging malfunction

Pilot action

- Alert crew to the fault.
- Call “CLEAR”
- If RPA is in flight and still under control land immediately in a safe area away from public.
- Inform emergency services as required.
- Cordon off area 30m radius from battery/RPA.
- If necessary and safe to do so use extinguisher.

Crew action

- Keep location of fire clear.
- Inform emergency services as required.
- Cordon off area 30m radius from battery/RPA.
- If necessary and safe to do so use extinguisher.

Notes

LiPo batteries are highly dangerous and can explode

Keep distance until safe to approach

First on scene of RPA: approach battery with extreme caution, wearing PPE (goggles, fire resistant gloves), LiPo bag and with fire extinguisher to hand.

Dispose of battery in accordance to safety guidelines OR safely discharge battery.

Report to appropriate bodies

RPA fire

Pilot action

- Alert crew to the fire.
- Call “CLEAR”
- If RPA is in flight and still under control land immediately in a safe area away from public.
- Inform emergency services as required.
- Cordon off area 30m radius from battery/RPA/crash site.
- If safe to do so use extinguisher.

Crew action

- Keep location of fire clear.
- Inform emergency services as required.
- Cordon off area 30m radius from battery/RPA/crash site.
- If necessary and safe to do so use extinguisher.

Notes

LiPo batteries are highly dangerous and can explode

Keep distance until safe to approach

First on scene of RPA: approach battery with extreme caution, wearing PPE (goggles, fire resistant gloves), LiPo bag and with fire extinguisher to hand.

Dispose of battery in accordance to safety guidelines.

Report to appropriate bodies as identified in section 3.8.

Loss of GNSS signal

NB: Return to Home function will not operate if GNSS signal is lost

Symptoms

- Loss of GPS mode in-flight
- Aircraft fails to hold position lock
- Visual warning on iOSD
- Aircraft may switch to a non-GPS assisted mode (i.e. ATTI / OPTI)
- Aircraft status light may change

Pilot action

- Immediately switch to non-GPS assisted mode.
- Land at the nearest suitable TOLZ.
- In the event that pilot is unable to regain control, follow procedure for Rogue RPA

Crew action

- Clear operational area of all personnel
- Identify clear TOLZ
- Provide pilot with appropriate updates on status.

Notes

Operation should be aborted until GPS can be established UNLESS it is safe to continue the flight without the use of GPS and the functionality it provides (e.g. GPS RTH)

Report to appropriate bodies as identified in section 3.8.

Compass error

NB: Return to Home function will not operate in case of a compass error

Symptoms

- Loss of GPS mode in-flight
- Aircraft fails to hold heading
- Visual warning on iOSD
- Aircraft may switch to a non-GPS assisted mode (i.e. ATTI / OPTI)
- Aircraft status light may change
- Aircraft may fail to keep commanded heading

Pilot action

- Land at the nearest suitable TOLZ.
- Consider changing to ATTI mode if available
- If aircraft begins to yaw uncontrollably, consider landing underneath flight path provided safe to do so
- In the event that pilot is unable to regain control, follow procedure for Rogue RPA

Crew action

- Clear operational area of all personnel
- Identify clear TOLZ
- Provide pilot with appropriate updates on status.

Notes

Operation should be aborted until compass error is rectified.

Refer to pre-flight documents to reassess any electromagnetic interference or distortion risks.

Report to appropriate bodies as identified in section 3.8.

Consider servicing aircraft for further investigation

Abnormal environmental conditions

Symptoms

- Abnormal environmental conditions and C2 link loss/loos of control of the aircraft
- UAS losing control in mid air due to bad weather (high winds/precipitation)
- Magnetic interference (fly with caution) warning

Pilot action

- Alert crew to issue
- Attempt to land if RP still has relative control over the aircraft
- If pilot loses complete control, thus resulting in the UAS falling to the ground, shout *CLEAR* to ensure people exit the area of potential incursion
- Check KP index before operation and calibrate compass before operation if needed

Crew action

- Ensure landing location is clear
- If UAS is falling out of the air, also shout *CLEAR* to alert anyone nearby

Notes

Before the pilot loses complete control, they should have noticed the UAS becoming less stable and attempt to land the UAS at their primary launch site, or secondary if this is not available.

If the above option is not available, the pilot and the crew must shout *CLEAR* if the UAS starts to fall to the ground after loss of control.

6. UAS in use

DJI Matrice 350 RTK

Type: Quadcopter

MTOM: 9.2kg

Control frequency: 2.4GHz, 5.1GHz, 5.8GHz

Serial No: 1581F6GKB23960040077

[Placeholder image]

Reference material

- Product page
- User guide (Technical spec ... p. 66)

Matrice 350 RTK assembly

This checklist assumes that the UAS hardware has been configured in advance as required for the flight. The steps listed below are those that need to be done on site.

Installing the landing gear

Insert the landing gear after aligning the red marks with the mounting position, slide the gear lock to the end of the landing gear, then rotate it until the red mark is in sync with the alignment mark.

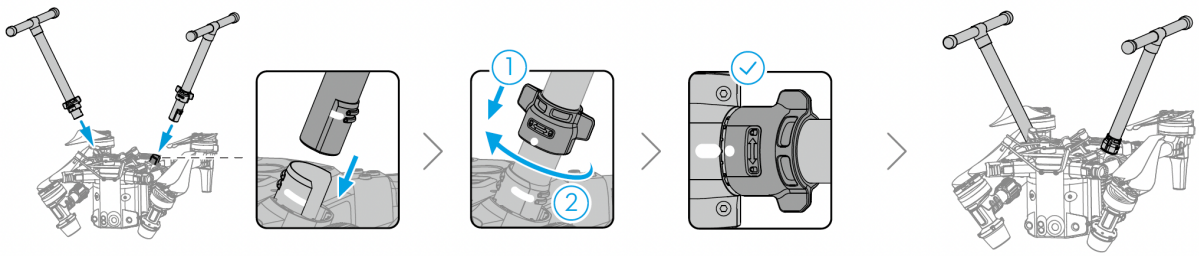


Figure 1: Installing the landing gear (Matric 350 RTK manual p. 11)

Unfolding the aircraft

a. Unfold the front frame arms and then the rear frame arms.
b. Lock the frame arms and unfold the propellers.

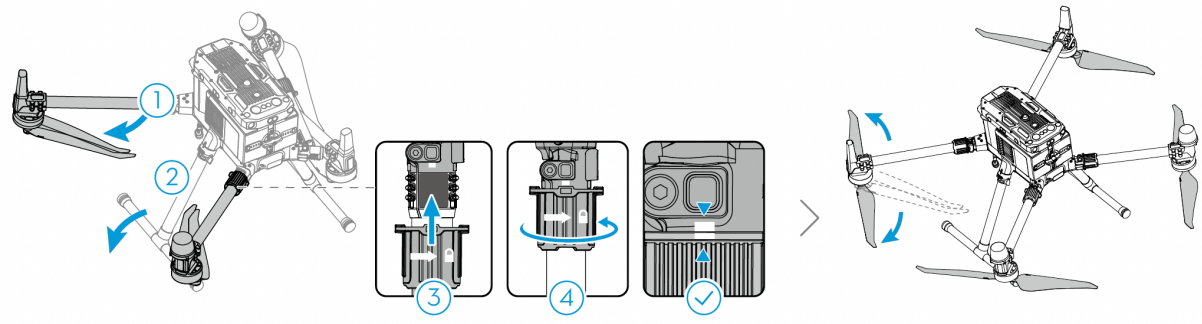
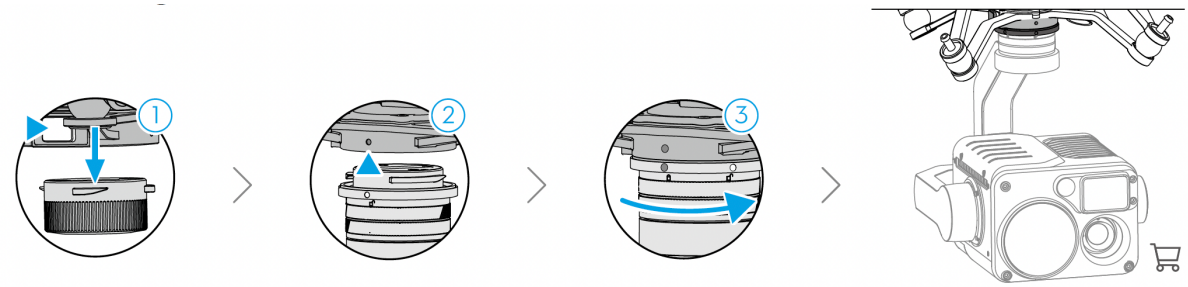


Figure 2: Unfolding the aircraft (Matrice 350 RTK manual p. 11)

Mounting the gimbal camera



Press the gimbal detachment button to remove the cover.

Align the white and red dots and insert the gimbal.

Rotate the gimbal lock to the locked position.

Figure 3: Mounting the gimbal camera (Matrice 350 RTK manual p. 12)

- After installation, make sure that the gimbal lock is locked in place.
- Make sure to press down the gimbal detachment button when rotating the gimbal lock to remove the gimbal camera. The gimbal lock should be fully rotated when removing the gimbal for the next installation.

Mounting the intelligent flight batteries

Insert a pair of batteries and lock the battery release toggle.

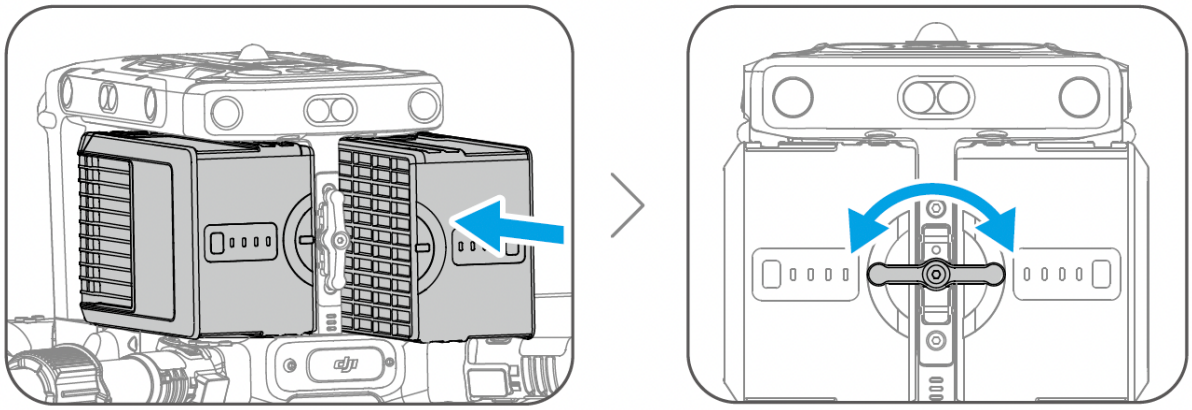


Figure 4: Mounting the batteries (Matrice 350 RTK manual p. 12)

Check battery level: press the battery level button once.

Power on/off: press and the press and hold the power button to power on/off the aircraft.

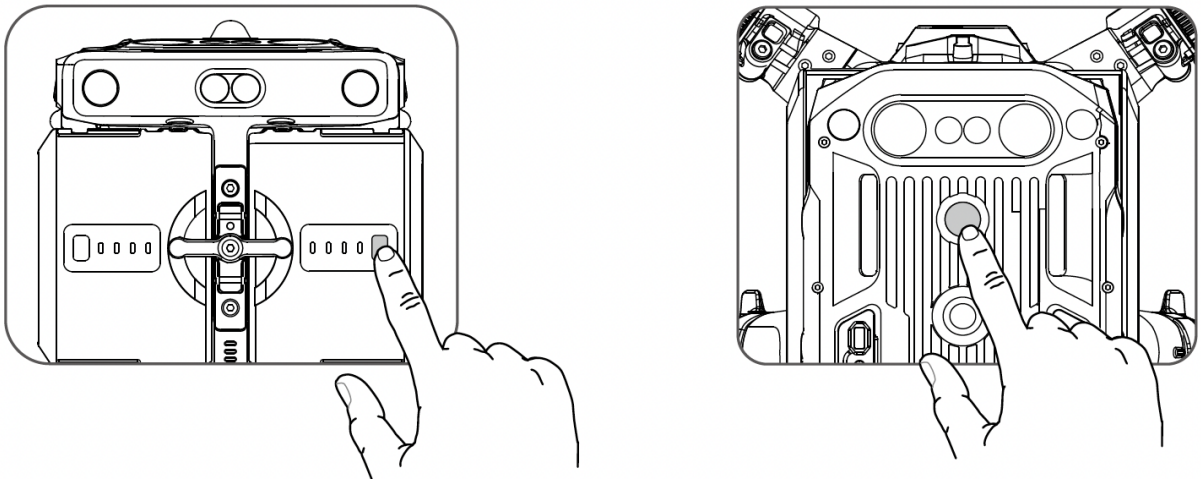


Figure 5: Operating the power button (Matrice 350 RTK manual p. 12)

DJI Mini 3 Pro

Type: Quadcopter

MTOM 249g

Control frequency: 2.4 GHz

Serial No: 1581F4XFC233L007X6WX

Reference material

- Product page
- User guide (Technical spec ... p. 66)

Mini 3 Pro assembly

This checklist assumes that the UAS hardware has been configured in advance as required for the flight. The steps listed below are those that need to be done on site.

All aircraft arms are folded for storage and transport. Follow the steps below to unfold the aircraft.

1. Remove the gimbal protector from the camera

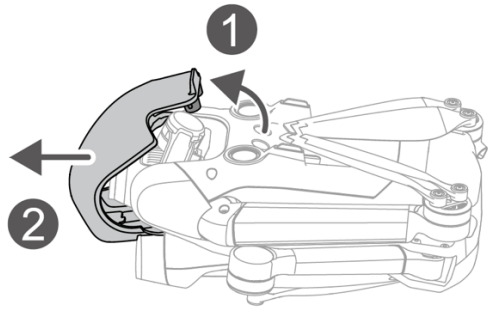


Figure 6: Removing the gimbal protector (Mini 3 Pro user manual, p. 7)

2. Unfold the rear arms, followed by the front arms, and then all of the propeller blades

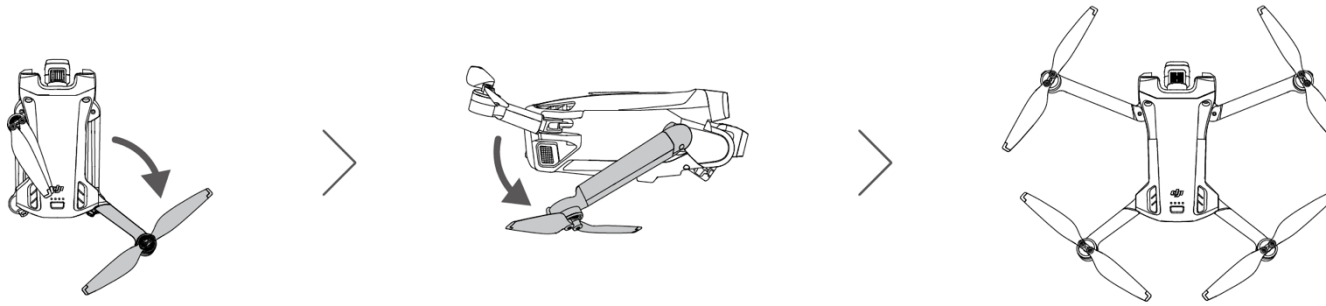


Figure 7: Unfolding the arms (Mini 3 Pro user manual, p. 7)

Disassembly

To disassemble, follow the steps above in the opposite order.

To attach the gimbal protector, first rotate the camera to make it horizontal and forward-facing as show in Figure 8.

While attaching the gimbal protector, make sure that the camera fits into the protector first, then insert the latch on the upper part of the protector onto the opening on the aircraft. Lastly, insert the two locating pins into the holes on the bottom of the aircraft.

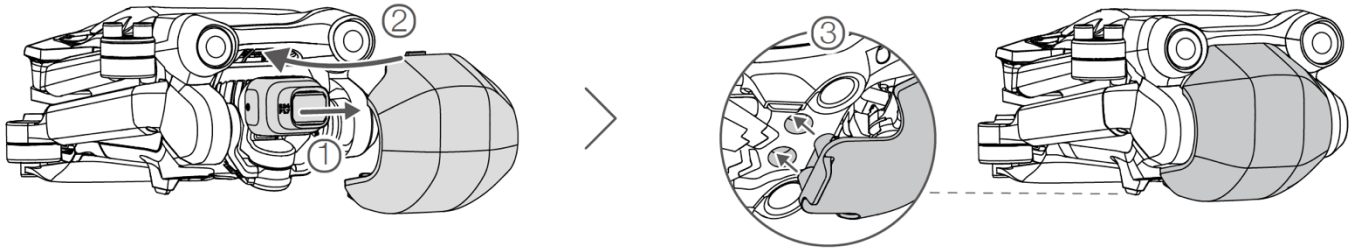


Figure 8: Attaching the gimbal protector (Mini 3 Pro user manual, p. 7)

While packing the aircraft, check the equipment for signs of wear or damage and note these for maintenance before the next flight.

Pack the equipment carefully to avoid damage in transit.

DJI Mavic 3E

Type: Quadcopter

MTOM 1050g

Control frequency: 2.4 GHz

Serial No: 2022AP11055

Reference material

- Product page
- User guide (Technical spec ... p. 96)

Mavic 3E assembly

This checklist assumes that the UAS hardware has been configured in advance as required for the flight. The steps listed below are those that need to be done on site.

All aircraft arms are folded for storage and transport. Follow the steps below to unfold the aircraft.

1. Remove the gimbal protector from the camera

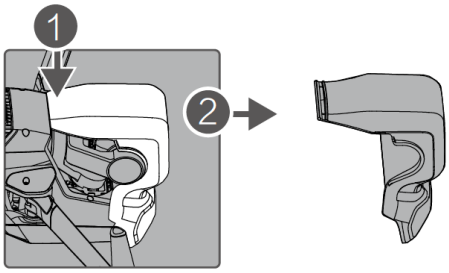


Figure 9: Removing the gimbal protector (Mavic 3E user manual, p. 8)

2. Unfold the front arms before unfolding the rear arms

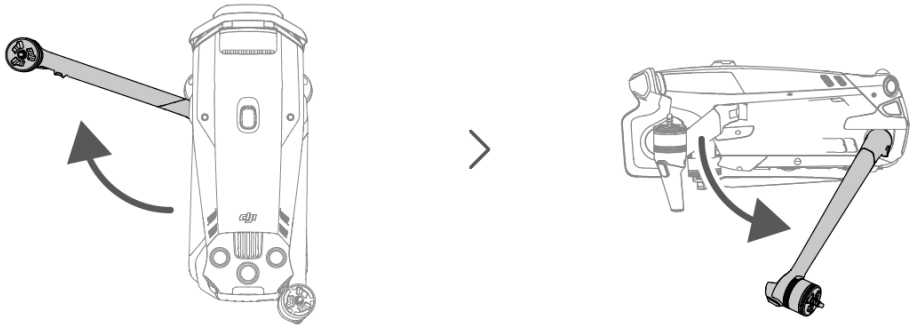


Figure 10: Unfolding the arms (Mavic 3E user manual, p. 8)

3. Attach the propellers

   Propellers with and without marks indicate different directions of rotation. Attach the propellers with marks to the motors with marks and the unmarked propellers to the motors without marks. Hold the motor, press the propeller down and rotate in the direction marked on the propeller until it pops up and locks in place. Unfold the propeller blades.

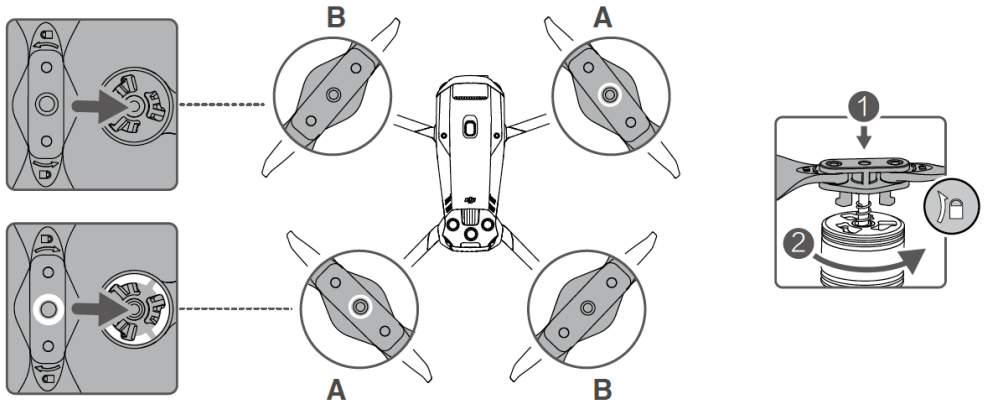


Figure 11: Attaching the propellers (Mavic 3E user manual, p. 8)

Disassembly

To disassemble, follow the steps above in the opposite order.

To attach the gimbal protector, first rotate the camera to make it horizontal and forward-facing as show in Figure 8 then cover the vision system with the protector. Align the positioning holes and then press the buckle to complete the installation.

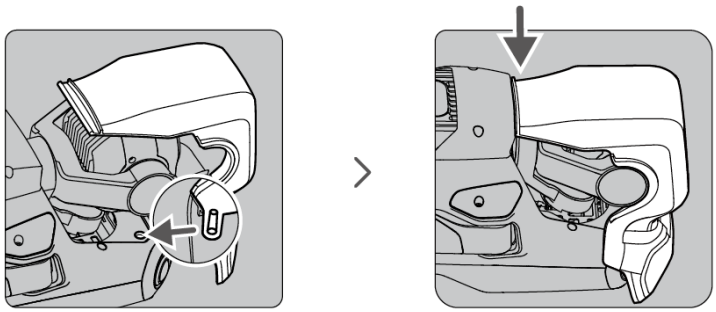


Figure 12: Attaching the gimbal protector (Mini 3 Pro user manual, p. 7)

While packing the aircraft, check the equipment for signs of wear or damage and note these for maintenance before the next flight.

Pack the equipment carefully to avoid damage in transit.

Change log

Version	Date	Comments
2.2	14 Jun 2024	Update nominated personnel section Update UAS details section Added procedures for operations on University property and for onsite and offsite practice and training
2.1	9 Jan 2024	Replace references to "Regulation (EU) 2019/947 as retained (and amended in UK domestic law)" with “Assimilated Regulation (EU) 2019/947” according to the advisory notes from the CAA.
2.0	14 Dec 2023	Updated §1.4 to include AMC statement. Updated §3.2 to remove historical reference to the Computational Sustainability Lab Updated §3.6 to include statement on overflight of uninvolved persons. Updated §3.12 to include statement on remote pilot unfitness due to injury, fatigue, medication, sickness or other causes. Updated §4.3 to include AMC statement. Updated emergency procedures section to include abnormal environmental conditions procedure Updated operations timeline to show 28 days as the lead time for non-standard flight permissions rather than 21 Updated operations timeline to include logging into relevant operator account Updated UAS details to remove M100 and include additional devices
1.1 FINAL	20 Dec 2022	Updated text to refer to the whole university and not just the Computational Sustainability Lab. Updated the use of abbreviations for consistency Updated organisation details to include new operator id Updated referenced document versions
1.0 FINAL	18 Aug 2022	Final confirmation of content from Coptrz
0.2	28 Jul 2022	Minor updates based on initial feedback comments from Coptrz

0.1	18 Jul 2022	Original version

Acronyms and abbreviations

TERM	INTERPRETATION
AAIB	Air Accidents Investigation Branch
AIRPROX	A situation in which, in the opinion of a pilot or air traffic services personnel, the distance between aircraft, as well as their relative positions and speed, have been such that the safety of the aircraft involved may have been compromised.
ATC	Air Traffic Controller
ATTI MODE	*Attitude mode*: UAS operational mode where GPS positioning is not used/available
ATZ	Aerodrome Traffic Zone
CAA	UK Civil Aviation Authority
CAP722	Civil Aviation Publication 722
CTR	Controlled Traffic Region
DMARES</SPAN	Drone and Model Aircraft Registration and Education Scheme
ECCAIRS	European Co-ordination Center for Accident and Incident Reporting Systems
FRZ	Flight restriction zone (around a protected aerodrome)
MOR	Mandatory Occurrence Reporting
MTOM	Maximum take-off mass
METAR	METeorological Aerodrome Report
NSF	*Non-standard flight*: An aerial task that is wholly contained within Controlled Airspace and does not follow published routes or notified procedures
OP-AUTH	Operational Authorisation
PDRA	Pre-Determined Risk Assessment
RPZ	Runway protection zone
REMOTE PILOT	An individual responsible for safely conducting the flight of an unmanned aircraft by operating its flight controls, either manually or, when the unmanned aircraft flies automatically, by monitoring its course and remaining able to intervene and change the course at any time
RPA	Remotely piloted aircraft
STS	Standard Scenario
TAF	Terminal Area Forecast
TOLZ	Take-off and landing zone
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UNMANNED AIRCRAFT DELEGATED REGULATION	Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems
UNMANNED AIRCRAFT IMPLEMENTING REGULATION	Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft
VLOS	Visual Line of Sight

References

Documents referred to in this manual are listed on this page. It also provides links to useful sources of information and reporting services. Sources of information may be listed more than once if they are relevant to more than one category.

Legislation

REFERENCE	FULL TITLE	ISSUE NUMBER	DATE OF ISSUE
AIR NAVIGATION ORDER 2016/765	Air Navigation Order 2016 SI 2016 No 765	N/A	13 April 2022
CAP 382	Mandatory Occurrence Reporting Scheme	N/A	July 2021
CAP 722	Unmanned Aircraft System Operations – Guidance	Version 9	7 December 2022
CAP 722A	Unmanned Aircraft System Operations in UK Airspace – Operating Safety Cases	Version 2	7 December 2022
CAP2013	Air Navigation Order 2020 Amendment – Guidance for unmanned aircraft system users	Version 1	17 December 2020
CAP1059	Safety Management Systems: Guidance for small, non-complex organisations	Version 1	June 2013
CAP1789A	The UAS Implementing Regulation; UK consolidated text	Version 7	2 December 2022
UAS IR	Commission Implementing Regulation (EU) 2019/947	N/A	24 May 2019

UAS

REFERENCE	FULL TITLE	ISSUE NUMBER	DATE OF ISSUE
M100 USER GUIDE	DJI Matrice 100 User Guide	Version 1.6	Mar 2016
MINI 3 PRO USER GUIDE	DJI Mini 3 Pro User Guide	Version 1.6	Apr 2023
P3 USER GUIDE	DJI Phantom 3 User Guide	Version 1.4	Jul 2017
MAVIC3E USER GUIDE	DJI Mavic 3E User Guide	Version 1.6	Sep 2023

Airspace, aeronautical information and reporting

- CAA: Integrated Aeronautical Information Package – United Kingdom
- IAIP: NATS Aeronautical Information Publication
- NOTAMinfo.com to confirm NOTAMs
- CAA Skywise
- ECCAIRS Incident reporting
- Airspace Notification of UAS Submission of NOTAM
- NOTAM Info
- UK AIRPROX Board

Maps

- SkyDemonLight
- Altitude Angel
- NoFlyDrones
- Google Maps Flight Restriction Zonez
- UK Grid Reference Finder
- DEFRA Magic Map Government information for checking sensitivities
- What3Words
- NOTAM Info
- Topography

Contact information

- Civil aerodromes > AD2 > Aerodrome Name
- Military aerodromes > IAP > AD > AD2 > Aerodrome Name > Textual Data

Ground hazards

- Google Maps
- Bing Maps OS overlay
- Drone Safety Map
- Google Earth Pro

Weather

- XC Weather
- UAV Forecast
- The Met Office
- MetCheck
- Windy

- METAR & TAF Decoder
- NetWeather

Tools

- Altitude Angel mobile apps
- DroneDesk
- DroneLogBook
- AirData
- PhotoEphemeris - natural light visualisation
- Google MapDevelopers - map tools such as circle drawing, elevation calculator, etc.

Appendix

This section lists all the documents and forms maintained by ENU that are mentioned elsewhere in this manual.

1. Viability study
2. Site evaluation
3. Risk assessment
4. Call sheet
5. Loading list
6. Site checklist
7. Crew briefing
8. Pre-flight checklist
9. Post-flight actions

1. Viability study

1.1	Flight information
Fight code:	Leave blank – this is allocated by the accountable manager if the flight is viable. Red text should be removed before submitting the form
Summary:	Describe the proposed flight
Date of flight:	
Latitude & longitude	Use degrees minutes seconds
Google maps link:	
Viable:	YES / NO Delete as appropriate
Prepared by:	
Prepared date:	

1.2	Airspace
Airspace class:	
Observations:	List any factors that need to be taken into account such as the proximity to other aeronautical activities
Sources:	List the sources used

1.3	Ground hazards
Observations:	List any factors that need to be taken into account such as the proximity to other aeronautical activities
Sources:	List the sources used

1.4	Weather

Observations:	Describe the expected weather conditions
Sources:	List the sources used

2. Site evaluation

2.1	Flight details
Flight code:	Copy from completed viability study. Red text should be removed before submitting the form.
Date of flight:	
Remote pilot:	
Date completed:	

Adapt as appropriate (e.g. add/remove items).

2.2	Pre-site visit
Location information:	• Latitude/longitude in DMS (Degrees minutes seconds) • Elevation in feet above mean sea level • 6-figure grid reference • Address including postcode • What3words could be useful in some instances
Description:	
Sensitivities:	This could include things like schools, cemeteries, government buildings where flying a drone in the vicinity could cause issues or concerns with the public. This may help you to decide if it would be worth informing the police via 101
Airspace:	Example 1 – No ATC Permission required Class G airspace uncontrolled Example 2 – No ATC Permission required, ATC Notification if deemed necessary Class D airspace Leeds Bradford CTR – Surface – 4500ft amsl Example 3 – ATC Permission required Leeds Bradford Flight restriction zone
Restrictions:	This is specifically looking at restricted, danger and prohibited airspace e.g. restricted airspace 5km northwest of operating area (HMP Wakefield Prison) This will be useful to identify and additional permission needed if looking to operate within.

Terrain:	Brief overview of what the location is like to assist with planning and risk assessment (Ordnance survey maps can offer insight via contour information)
Aviation Proximities:	What is the distance and direction to places where people non under your control could be found? You will want to look at least as far as you could fly e.g 500m but further is wise to help assess issues if you have a “exit from operations area” issue during flight. e.g. residential housing estate 450m to the north west, industrial estate 200m to south This would be a brief overview of any other airspace proximities; you will want to look 360 Degrees around your location and a minimum distance of how far your craft could fly.
Permissions:	Do you have permission to operate from that location you should be aware of any issues around byelaws and trespass. You would want to include the details of your point of contact and any other constraints e.g. dates, times and geographical constraints
NOTAMS:	e.g. NOTAMS checked at 13.00pm 24/09/2022 No NOTAMS in effect within 10km Are there any temporary restricted areas or temporary danger areas identified by NOTAM?
PPE Requirements:	Your/client minimum PPE requirements in line with OM e.g. Client requests pilot to wear a high visibility jacket
Livestock:	Is there a potential for livestock, birds etc at the purposed flight location?
People:	What is the distance and direction to places where people non under your control could be found? You will want to look at least as far as you could fly e.g 500m but further is wise to help assess issues if you have a “exit from operations area” issue during flight. e.g. residential housing estate 450m to the north west, industrial estate 200m to south
Hazards:	e.g. Transmitters, Power Pylons etc. This is not only to identify collision risk but also potential sources of interference that could affect the safety of a flight, also consider HIRTA’s (High Intensity Radio Transmission Areas) in regards to airspace
Footpaths:	OS maps will provide information on Public footpaths, right of ways and Bridleways, this is useful information showing potential for public access to locations that may not be visible on satellite imagery

Vehicle access:	1 – where is the parking for the pilot 2 – can members of the public access the flight area by vehicles
Mobile phone coverage:	

2.3	**Emergency contact details**
Local Police:	Local police number include address/postcode If you were to log a flight via 101 this is where you could write down the case number for reference if needed
Local ATC:	Direct line to ATC is what you will want to obtain if possible. **This is obtained via the NATS AIS Website > EAIP link > Part 3 > AD2** This can be obtained through dronesafetymap.com in some instances by clicking on the FRZ for the airport/aerodrome/heliport and viewing the airspace information.
Military Low flying booking cell	0800 515544 Will safety be improved by logging your flight?
Local Hospital	Local A&E include address/ postcode could be useful to obtain and have to hand in the event of incident or accident if unfamiliar with the location.

2.4	Airspace and Environment diagrams

Insert screenshot/drawing of airspace (dronesafetymap.com or equivalent tool)

+

Insert screenshot/drawing of local environment (gridreferencefinder.com or equivalent tool)

Adding annotations to drawing/screenshots can be useful during briefings and operations planning, information like;

- ATC Details
- Wind direction and speed
- Distances and direction to hazards
- Identifying primary and secondary take-off and landing sites
- Restrictions on flying either legal (FRZ, D,R,P areas etc) or self-imposed operational limitations

2.5	Site Survey
Confirm info at 2.2	Date/ Time
Obstructions:	Masts, Wires, Buildings, Train lines, Trees, Lakes, Rivers etc. Any changes that might need to be considered within the planned flight or updated within the risk assessment
People:	Cordon requirement, Crowd Control. Any changes that might need to be considered within the planned flight or updated within the risk assessment
Livestock:	Farm animals, Dogs, Wildlife. Any changes that might need to be considered within the planned flight or updated within the risk assessment
Proximity:	Public, Road Users. Any changes that might need to be considered within the planned flight or updated within the risk assessment
Primary TOLZ:	Needs to comply with applicable legislation around separation distances
Secondary TOLZ:	Needs to comply with applicable legislation around separation distances
Comms:	Communications required by ops team If deploying additional human resources do you need to use radio or other means of communications? If so what band/Frequency and any associated protocol to ensure effective
Other:	Any other factors that might affect the safety of the flight

3. Risk assessment

Edinburgh Napier UNIVERSITY | Computational Sustainability

Flight code:	
Flight date:	
Completed by:	
Date completed:	

				Risk before mitigation				**Risk after mitigation**		
Id	**Hazard**	**At risk**	**Existing control measures**	**Severity**	**Probability**	**Risk**	**Further control measures**	**Severity**	**Probability**	**Risk**
1	EXAMPLE Air incursion with Manned aircraft leading to collision with RPA	All	Flight to be conducted within VLOS Flight to be conducted under 400ft ASL NOTAMs to be checked prior to flight Pilot to maintain active scan technique throughout flight.	5	2	10	Maximum flight height to be conducted at 50m Spotters to be deployed and briefed on alerting pilot to low flying aircraft Low flying booking cell number to be called and flight logged	5	1	5

4. Call sheet

Flight information	
Fight code:	
Date of flight:	
Prepared by:	
Prepared date:	

Adapt as appropriate. Remove red text before sending

Purpose:	
Timing:	Start and end times.
Site information:	Copy location and description from site evaluation.
Travel:	e.g. shared vehicles, pickup time, parking on site
Clothing & PPE:	e.g cold weather, wet underfoot, strong sun, hi vis, hard hat, safety glasses, boots, gloves, etc.
Other equipment:	e.g. mobile phone, radio, rucksack, torch, etc.
Food & drink:	

5. Loading lists

Flight information	
Fight code:	
Date of flight:	
Prepared by:	
Prepared date:	

Adapt as appropriate (e.g. add/remove items). Remove red text before saving

Crew

Name	Role	Contact number	Email	Called

Equipment

Item	Action	Tick
Food (Snacks & Drink)	Check Condition & Contents	
Two Way Radios	Check Condition/Charge	
Clothing (Boots, Coat, Gloves)	Check Condition	
Air Navigation Map	Check Condition	
Checklists, Manuals & Logbooks	Check Condition	
Notepad & Pens	Check Condition	
Transmitter Battery Packs	Charge & Check Condition	
Camera Battery Packs	Charge & Check Condition	
Monitor Battery packs	Charge & Check Condition	
Charger Battery Packs	Charge & Check Condition	
Camera Mount	Check Condition & Functionality	
Camera(s) & Lens(s)	Check Condition & Functionality	

Camera Connection Leads	Check Condition & Functionality	
Camera to Airframe Lanyard	Check Condition & Functionality	
Camera Attachment Bolt	Check Condition & Functionality	
Multi-Function Battery Charger	Check Condition & Functionality	
Required Charger Leads	Check Condition	

Maintenance Kit

Item	Action	Tick
Spare props	Check Condition & Quantity	
Spare cables	Check Condition	
Allen keys	Check Condition	
Screwdrivers	Check Condition	
Calibration platform	Check Condition	

Safety Kit

Item	Action	Tick
First aid kit	Check Condition	
Fire extinguisher	Check Condition	
PPE	High Vis, Hard hat, Safety glasses, Boots, gloves	
Anemometer	Check Condition	
Landing pad	Check Condition	
Cones	Check Condition	
Radios	Check Condition	
Mobile phone	Charge & Check Condition	

Ground Equipment

Item	Action	Tick

6. Site checklist

Flight information	
Fight code:	
Date of flight:	
Prepared by:	

Pre-prepared checks

Adapt as appropriate (e.g. add/remove items). Tick to indicate that the result is acceptable. Remove red text before saving

Item	Results	Tick
Windspeed at TOLZ		
Wind direction at TOLZ		
Temperature		
Visibility		
Precipitation		
Uninvolved persons		
Birds/animals		

Unexpected factors

Factors observed on arrival

Item	Description	Tick

Decision

Go / no-go Delete as appropriate

7. Crew briefing

Flight information	
Fight code:	
Date of flight:	
Prepared by:	

Glossary

ASL = above surface level
RP = remote pilot
TOLZ = take-off and landing zone

Before briefing

- Place outer cordon if required
- Place cones at TOLZ plus landing pad if required
- Identify location for first aid and fire equipment
- Identify crew positions as required

Normal operation

- Recap mission purpose and parameters
- Issue equipment as required:
    - PPE
    - Radios
- Set out crew role during normal operations
    - Airspace incursion
    - Ground incursion
    - Other hazard
    - Recap RP's responsibility for safety and final decisions
- Operational area
    - Point out primary and secondary TOLZ
    - Point out location of first aid and fire equipment
    - Allocate crew positions as required
- Take-off procedures
    - Crew in position
    - Public at safe distance
    - Ground area and airspace are clear
    - Retreat 5m to the rear of the RPA
    - RP calls *Clear*
    - Designated crew member replies *Clear*
    - RP calls *Aircraft taking off*
    - Following take-off, RP will perform basic flight checks at 5m ASL.

- Landing procedures
    - Ensure minimum safe distance for uninvolved people
    - Landing zone free from foreign objects
    - Retreat 5m
    - RP calls *Clear*
    - Designated crew member replies *Clear*
    - RP lands the RPA
    - RP disarms and powers down the RPA
    - RP calls *Aircraft safe*

Emergency procedures

- Point out location of printed emergency procedures
- Recap main crew responsibilities
    - Protect the public
    - Maintain situational awareness
    - Keep RP informed
    - Assume control of RPA if required
    - Assume responsibility for reporting incidents if required
- RP incapacitation
    - Pick up controller
    - Confirm launch area clear
    - Monitor video display (if still functioning)
    - Initiate Return to Home procedure OR land the RPA if trained to do so
    - Administer first aid to pilot as appropriate
    - Call emergency services if required
- Loss of control
    - Identify a landmark on the horizon to assist with identifying direction of flight, from launch area or mark location
    - Monitor video display (if still functioning)
    - Provide pilot with appropriate updates on status
    - Take a bearing of the direction of flight
    - Inform local ATC if required
    - Inform emergency services if required
- Ground/airspace incursions
    - Prioritise identification of the location of the incursion
    - Keep pilot informed
    - Confirm launch/landing area clear

8. Pre-flight checklist

Flight information	
Fight code:	
Date of flight:	
Prepared by:	

Before power-up

Item	Tick
No issues arising from UAS assembly	
All batteries charged	
Area of operations within expected parameters	
No adverse weather conditions	
RTH height set to appropriate value for site	
Geofence setting disabled or set to appropriate value for site	

After power-up

Item	Tick
Mobile device connected to controller	
Data link established between controller and RPA	
Telemetry is displayed successfully via controller/mobile interface	
GPS coverage is sufficient	
Correct flight mode is selected at the controller	
RPA self-diagnostic sequence completes successfully	

At take-off

Item	Tick
All crew are in position	
Ground area and airspace are clear	
Pilot calls *Clear*	
Designated crew member confirms by replying *Clear*	
Pilot calls *Aircraft taking off*	
Pilot takes RPA to 5m ASL	
Pilot checks pitch, roll, yaw and payload operation	
LEDs working correctly	

9. Post-flight actions

Flight information	
Fight code:	
Date of flight:	
Prepared by:	

Landing

Item	Tick
No crew within 5m of landing point	
TOLZ free of foreign object and debris	
Uninvolved persons at required separation distance	
Pilot calls *Clear*	
Designated crew member replies *Clear*	
Pilot lands RPA	
Pilot disarms RPA	
Pilot approaches RPA and powers down	
Pilot calls *Aircraft safe*	

After landing

Item	Tick
Disassemble UAS using model-specific checklist	
Record any maintenance actions	
Ensure log data is correctly uploaded to AirData.com	
Manually record flight data if there is any problem uploading	
Debrief crew to capture any lessons learned	
Collect and check off any equipment used by the crew	

Reporting

Item	Tick
Report any incidents	
Report any AIRPROX	