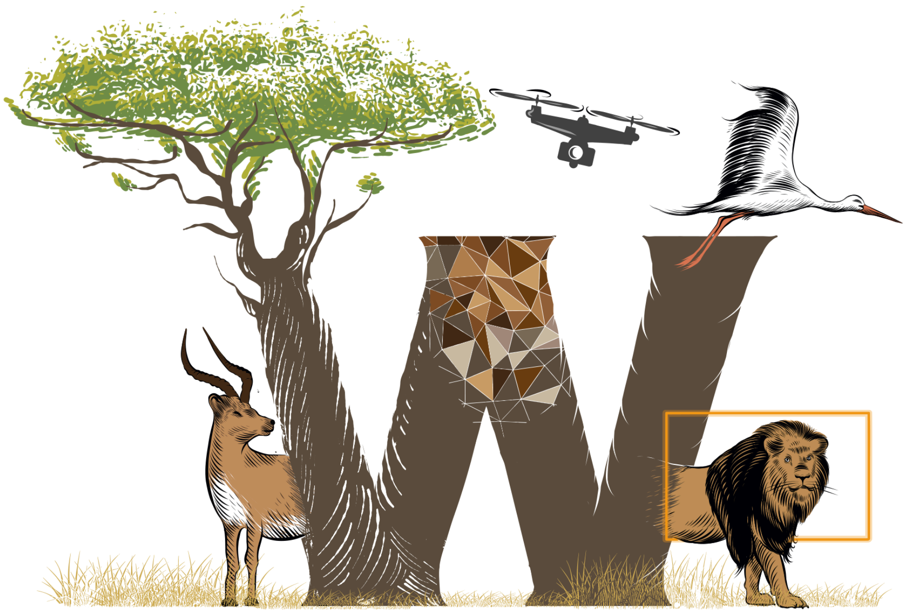


WildDrone
Ol Pejeta trials

UAS BVLOS permit request to the Kenya Civil Aviation Authority

Applicant: WildDrone.eu

Date: February 2024

Dear Sir or Madam,

We, the WildDrone.eu team, an EU-funded project dedicated to transforming wildlife conservation through Uncrewed Aircraft Systems (UAS) technology, are partnering with the Ol Pejeta Conservancy to support their wildlife conservation efforts. We seek your assistance in obtaining permits for safe UAS operations in the Ol Pejeta Conservancy.

We are requesting a Beyond Visual Line of Sight (BVLOS) permit for July 2024 to enable WildDrone to safely execute UAS operations for the purpose of wildlife conservation.

This document details the proposed operations, the proposed UAS platforms, and radio links. and the identified risks and mitigations for both the ground and air risks. The last section of the document outlines our specific requirements for the requested permits. Finally, appendixes are included, featuring a risk analysis based on the EU Specific Operation Risk Analysis (SORA) framework and background information.

We look forward to getting your feedback on this document,

Yours sincerely,

Ulrik Pagh Schultz Lundquist

Professor, Head of Center, SDU UAS, University of Southern Denmark
WildDrone.eu project manager

Background

The proposed operations at the Ol Pejeta Conservancy aim to advance wildlife conservation through the integration of UAS technology. This enables us to monitor wildlife populations, track movements, and effectively manage human-wildlife conflicts.

We will focus on monitoring various wildlife species, including hippos, impalas, zebras, and more. We aim to capture diverse animal behaviours, such as escaping, hunting, or migrating, contributing valuable insights to wildlife ecology.

Requested Permits

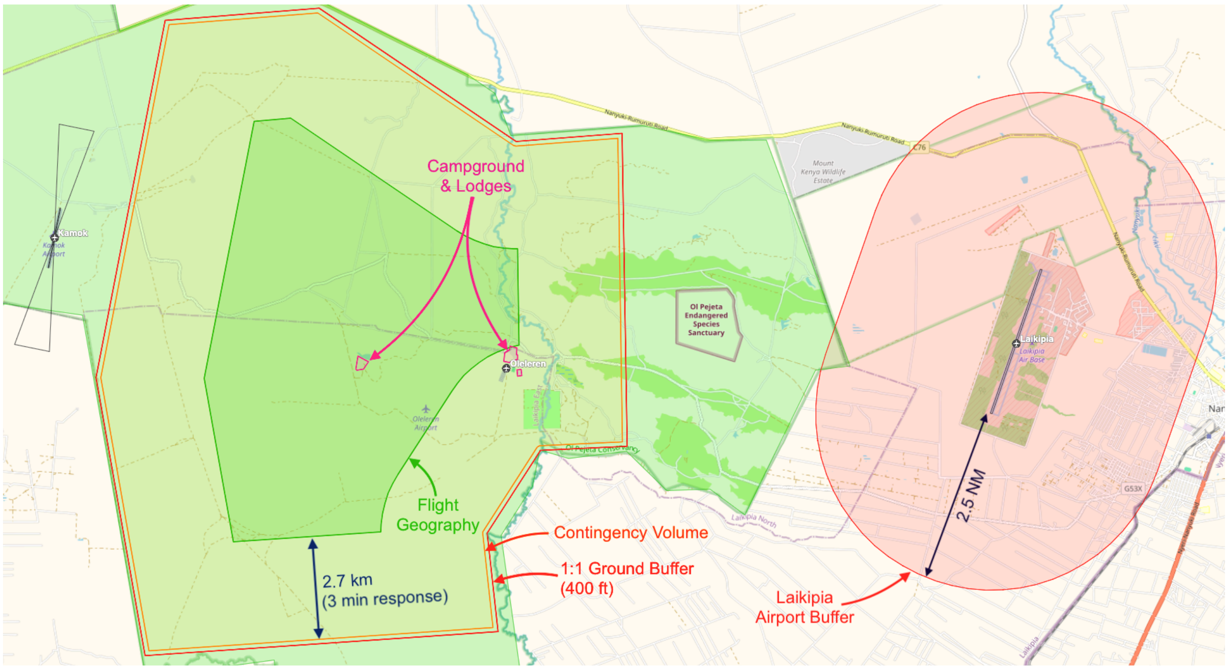
We kindly request the Kenya Civil Aviation Authority (KCAA) to grant the necessary permits to facilitate our UAS operations within the Ol Pejeta Conservancy. Specifically, we seek:

Beyond Visual Line of Sight (BVLOS) permit to complete UAS operations in Ol Pejeta Conservancy for Wildlife Monitoring 3 weeks in June - July 2024. The definitive dates will be confirmed closer to the event.

We are committed to working collaboratively with the KCAA to adhere to all regulatory requirements and safety protocols throughout our operations.

We are mindful that our UAS operations may potentially disturb existing aviation operations. Our team will aim to minimise this disturbance by closely coordinating with the military Air Traffic Control (ATC) and the Ol Pejeta Conservancy. This may involve prioritising flights outside of peak hours, at night, or even during weekends.

Proposed Operations Map



The Flight Geography (green polygon) is where the UAS will remain under normal operations. Operations will be planned within this Flight Geography, with a maximum distance of 2 km between the UAS remote pilot.

The Contingency Volume (yellow polygon) is a safety buffer 2.7 km which provides the team a minimum of 3 minutes to respond to any emergency that might happen during the operation. (This includes coordinating with ATC).

The Ground Buffer (red polygon) represents a ground safety buffer with a 1:1 ratio and has a width of 400 ft which corresponds to the maximum UAS altitude.

The Operational Volume encompasses the flight geography, contingency volume, and ground buffer.

In the Operational Volume, two purple polygons show campgrounds and lodges, which have a slightly higher ground risk. No flights will be planned within a 400 ft buffer around them.

Finally, a 2.5 NM safety buffer has been drawn around the Laikipia airport to visualise that our operations do not interfere with the airport operations.

Proposed UAS platforms & Telecoms

The team plans to use the following UAS platforms for testing in July 2024.

Drone Platforms:

- DJI Mavic
    - Type: Quad-copter
    - MTOW: 1000 g
    - Max Ascent Speed: 10 kt (5 m/s) (limited)
    - Max Horizontal Speed: 30 kt 15 m/s (limited)
    - Max Flight Time: 43 minutes
    - Max Transmission Distance: 8 NM (15 km)

- DJI Mini
    - Type: Quad-copter
    - MTOW: 249 g
    - Max Ascent Speed: 10 kt (5 m/s)
    - Max Horizontal Speed: 23 kt (12 m/s)
    - Max Flight Time: 34 minutes
    - Max Transmission Distance: 5.4 NM (10 km)

Telecommunication & Radio Links

Our operations rely on radio links for communication and control between the UAS and the remote pilot.

The following frequency bands are used for **transmission**:

DJI C2 Link: 433MHz (ISM[1]) - 2.4GHz (ISM[1] - WiFi) - 5.8GHz (ISM[1] - WiFi)
Video Feedback: 2.4GHz (ISM[1] - WiFi) - 5.8GHz (ISM[1] - WiFi)
Cellular Networks: 4G LTE - 5G
VHF Airband - for communication with ATC (with RTF License)

The following frequency bands are utilised for **receiving** purposes only:

ADS-B: 1090MHz (Aeronautical Radionavigation Band[1])

[1] https://repository.ca.go.ke/handle/123456789/281

Ground Risks and Mitigations

Outlined below is an analysis of the ground risks, accompanied by the mitigations that we will implement.

In our risk assessment of the operational area surrounding the Ol Pejeta Conservancy, we have identified two primary **ground risks**:

- **Tourists:** Tourists frequently visit the park. While touring they are obligated to stay inside cars that only drive on roads. Most safaris are conducted during the day, and few are conducted shortly after nightfall. Some tourists opt to stay at camping grounds or lodges within the park.
- **Park Staff:** Park rangers and other staff carry out tasks around the park day and night. They will be briefed about general safety measures and about current operations. They will be in constant radio contact with the Ol Pejeta radio room which is in contact with the remote pilot.

To minimise the probability of harm to the park staff and tourists, we have implemented the following **mitigations**:

- **Strategic Operational Location:** Our flight geography will predominantly be on the western side of the Ewaso river, an area with fewer tourists. This ensures a safer operational environment.
- **Road Overflight Minimisation:** We will minimise flying along nearby roads and aim to cross them perpendicularly to minimise the risk of endangering tourists.
- **Safeguarding Campground and Lodges:** To prevent interference with tourists and ensure their privacy, we will not plan flight paths near campgrounds and lodges: we will establish a ground buffer of 1:1 ratio around these areas in our flight plans

By implementing these targeted mitigations, we aim to ensure the safety of both tourists and park staff, promoting a safe environment for all stakeholders.

Air Risk and Mitigations

In our assessment of air risks within the operational airspace surrounding the Ol Pejeta Conservancy, two key elements have been identified:
Airports and Airstrips:

- Laikipia Airport
- Kamok and Ol Pejeta (by the Stables) Airstrips that are under the control of Ol Pejeta Conservancy

To minimise the potential risks associated with these airspaces and to other aircraft in the lower airspace, we have implemented the following targeted mitigations:

- **Flight Routes Limit:**
  All flight routes will be planned inside the Flight Geography with a maximum distance of 2km from the remote pilot.
- **Vertical Operational Limit:**
  The vertical limit of the Operational Volume will be 400 ft Above Ground Level (AGL).
- **Contingency Volume:**
  The proposed Contingency Volume is defined by a minimum response time of 3 minutes. This is equivalent to a horizontal distance of 2.7 km for the DJI Mavic 3 multi-rotor UAS.
- **Segregated Airspace:**
  We propose that a segregated airspace be put in place for our operations that would encompass our operational volume (flight geometry + contingency volume). We suggest a vertical buffer of 1,000 ft from the highest point in the operational area (up to 6,300 ft AMSL). This calculated buffer raises the segregated airspace height to 1,400 ft AGL of the highest point in the operational area (up to 7,700 ft AMSL).
- **NOTAM:** We suggest that Advanced Notice to Airmen (NOTAMs) be issued in advance to inform aircraft of our operations.
- **Kamok Airstrip:** The Kamok Airstrip is a small air strip within the Ol Pejeta Conservancy. We will coordinate with the military ATC concerning to receive early notices of incoming aircraft, facilitating seamless coordination.

- **Ol Pejeta airstrip by the Stables:** This airstrip is located adjacent to The Stables lodge. This airstrip will be shut down during our operations in agreement with the Ol Pejeta Conservancy.
- **Laikipia Airport Buffer:** On the map below a 2.5 NM buffer has been placed around the Laikipia airport to ensure that the Operational Volume of the UAS is set away from the airport.
- **Radio Line of Sight (RLOS) Operations:**
  All missions will be conducted within Radio Line of Sight (RLOS) to avoid loss of command and control (C2) connectivity, enabling continuous monitoring and control.
- **Return-to-Home (RTH) Configuration:**
  All UAS will have Return-to-Home (RTH) configured as a failsafe, enabling a controlled return in the event of unexpected situations such as loss of C2 connectivity.
- **Continuous Communications with Military ATC:**
  Communication will be established with the military ATC using Airband VHF and mobile phone to facilitate real-time coordination and to minimise disturbance to their operations.
- **ADS-B Monitoring:**
  The ADS-B frequency 1090 MHz will be monitored to provide the location of ADS-B out enabled aircraft. This is to add additional airspace situational awareness and to test the reliability for future BVLOS operations.

BVLOS Operational Guidelines

When planning BVLOS operations, the remote pilot will coordinate with the military ATC and the Ol Pejeta Conservancy on suitable operation time slots to ensure operational safety and minimise disturbance to regional aviation and park activities.

All remote pilots will have the European Union A1, A2, A3 remote pilot certificates (or equivalent) and have completed a minimum of 2.5 hours of VLOS flights within the last 6 months before flying BVLOS.

Additionally, all flights will follow our Standard Operational Procedures, and all flights will be added to the Flight Logs according to agreements with Kenya Flying Labs.

The team will communicate with ATC both before and after each flight, providing notifications at the commencement and conclusion of operations. Throughout the operation, the team will vigilantly monitor the radio frequency to ensure swift response to any ATC requests.

Appendix A - Key Points of Contact

Ulrik Pagh Schultz Lundquist

WildDrone coordinator,
Head of SDU Drone Center,
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University of Southern Denmark
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Phone: XXXXXXXXXXXXXXX

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Phone: XXXXXXXXXXXXXXX

Appendix B - The WildDrone team

The WildDrone team comprises a dynamic collaboration of 19 partners spanning Europe and Africa, each contributing unique expertise to elevate our project with complementary skills and knowledge.

Figure 2: Wilddrone consortium partners spanning Europe and Africa

BVLOS Expertise:

Our team has extensive Beyond Visual Line of Sight (BVLOS) experience, garnered from involvement in notable projects such as:

- BVLOS HealthDrone project (SDU)
- The GENIUS project (SDU)
- Square Meter Farming project (SDU)
- BVLOS CASCADE project (Bristol)

This proficiency is not confined to a single region, as our BVLOS operations have extended globally, including missions in Denmark, Montserrat, Guatemala, Italy, Chile, Papua New Guinea, and Ukraine.

Additionally, David Guerin, a prominent member of our team, has actively participated in the Lake Kivu Challenge and the Lake Victoria Challenge of the African Drone Forum, as Operations Manager and Safety Lead, demonstrating our commitment to pushing the boundaries of UAS technology in challenging environments.

Our team brings **over 500 UAS flight hours** of hands-on experience showcasing a profound understanding of UAS operations and technology, and holds notable certifications, including 5 A1, A2, A3 certified remote pilots and 5 GVC certified remote pilots.

Appendix C - Stakeholder Benefits

KCAA (Kenya Civil Aviation Authority):

The KCAA will gain from this international collaboration the opportunity to facilitate safe trials of Beyond Visual Line of Sight (BVLOS) operations using cutting-edge UAS technology. The insights gained from these trials will contribute to the advancement of aviation safety standards and potentially enhance regulatory frameworks. WildDrone will make relevant documentation openly accessible for use in future operations by local stakeholders.

Ol Pejeta Conservancy:

The Ol Pejeta Conservancy will experience substantial advantages by gaining access to new tools for acquiring high-quality data. These tools, facilitated by the WildDrone project, will empower the conservancy in its wildlife conservation efforts. The ability to monitor wildlife populations, track movements, and manage human-wildlife conflicts with precision will enhance the effectiveness of conservation strategies.

WildDrone Project:

For the WildDrone project, the collaboration signifies an opportunity to promote sustainability and conservation through advancements in Uncrewed Aircraft Systems, Computer Vision, and research in Biology. By leveraging these technologies, the project aims to not only contribute to wildlife conservation practices but also to drive progress in the UAS industry, aligning with broader sustainability goals and promoting the responsible use of UAS technology.

Kenya Flying Labs:

Through this collaboration, Kenya Flying Labs and WildDrone will acquire further expertise in conducting BVLOS operations within the context of conservation. This knowledge will be documented and made accessible for use in future commercial BVLOS initiatives, serving as a resource for individuals and organisations undertaking similar operations in conservation settings.

Appendix D - SORA Framework

This appendix includes a Specific Operation Risk Analysis that follows the SORA framework and template.

Specific Operations Risk Analysis (based on SORA 2.5)

<table>
<tr><th colspan="2">1. Specific Operations Risk Analysis</th></tr>
<tr><th colspan="2">Step #1 Operations Manual</th></tr>
<tr><td>#1.1 Description of proposed operation including the locations</td><td>Drone Operational Volume:
S 0° 02' 20", E 36° 54' 05"
S 0° 02' 41", E 36° 49' 03"
N 0° 01' 17", E 36° 48' 21"
N 0° 06' 21", E 36° 49' 20"
N 0° 06' 32", E 36° 51' 32"
N 0° 04' 38", E 36° 54' 20"
N 0° 04' 45", E 36° 55' 51"
N 0° 00' 18", E 36° 55' 56"
N 0° 00' 15", E 36° 54' 41"
S 0° 00' 56", E 36° 53' 56"
S 0° 02' 20", E 36° 54' 05"

Altitude: GND-7,700 ft AMSL (GND-1,400 ft AGL)</td></tr>
<tr><td colspan="2">Short description of proposed operation:
e.g., transport, inspection, filming, testing, etc...
Wildlife conservation (monitoring), and UAS academic testing (UTM, ADS-B, UAS corridor)</td></tr>
<tr><td>#1.2 Dimensions of the operational volume and the adjacent volume
(Rounded up to first decimal place)</td><td>Height of the flight geography H_{FGmax} __400___ ft
Height of the contingency volume H_{CVmax} __1400___ ft
Width of the contingency volume S_{CVmax} __8860__ ft
Width of the ground risk buffer S_{GRBmax} __400__ ft

Height of the adjacent volume H_{AV} __1400__ ft
Width of the adjacent volume S_{AV} __8860__ ft

Please provide a list with these informations if there are multiple locations.</td></tr>
<tr><th colspan="2">Step #2 UAS intrinsic ground risk class</th></tr>
<tr><td>#2. Type of operational areas on the ground</td><td>☐Controlled ground area
☒Sparsely populated area
☐Populated area
☐Assembly of people</td></tr>
<tr><td>#2.2 Specify the intrinsic ground risk class</td><td>4</td></tr>
</table>

Step #3 Final ground risk class determination	
#3. Specify the applied ground risk mitigations (if applicable)	**M1** Strategic mitigations for ground risk <u>Specify the level of robustness:</u> ☐None ☒Low ☐Medium ☐High
	M2 Effects of the ground impact are reduced <u>Specify the level of robustness:</u> ☐None ☒Low ☐Medium ☐High
	M3 An emergency response plan (ERP) is in place, the UAS operator is validated and effective <u>Specify the level of robustness:</u> ☐None ☒Low ☐Medium ☐High
#3.2 Specify the final ground risk class	**3**

Step #4 Initial air risk class		
#4.1 Classification of the airspace where the operation is intended to be conducted (multiple answers possible)	☐A ☐B ☐C ☐D ☐E ☐F ☐G	
	☒Restricted area (ED-R) ☐Danger area (ED-D)	
	☐TMZ ☐RMZ ☐ATZ	
#4.2 Specify the initial air risk class and the reasoning for choosing it	**Operational volume**	**Adjacent airspace**
	☐ARC-a ☒ARC-b ☐ARC-c ☐ARC-d	☐ARC-a ☒ARC-b ☐ARC-c ☐ARC-d
Step #5 Strategic air risk mitigations and final air risk class		
#5.1 Specify, if strategic mitigations of the air risk class were applied	☒Yes	☐No
#5.2 Residual air risk class (after strategic mitigation)	☒ARC-a ☐ARC-b ☐ARC-c ☐ARC-d	
Step #6 TMPR and robustness level		

#6 Tactical mitigations performance Requirements	☐VLOS ☒BVLOS ☒No requirement (ARC-a) ☐Low (ARC-b) ☐Medium (ARC-c) ☐High (ARC-d)

Step #7 SAIL determination	
#7 Specific Assurance and Integrity Level	☐SAIL I ☒SAIL II ☐SAIL III ☐SAIL IV ☐SAIL V ☐SAIL VI
Step #8 Identification of operational safety objectives (OSOs)	
#8 Operational safety objectives	As per identified SAIL from Step #7
Step #9 Adjacent area / airspace considerations (choose #9.1 **OR** #9.2!)	
#9.1 Enhanced containment (if one of the checkboxes is ticked, enhanced containment measures apply)	The adjacent areas ☐ contain assemblies of people ☐ are ARC-d If the operational volume is in a populated area: ☐ The M1 mitigation was applied. ☐ The operating area is a controlled ground area
#9.2 Basic containment (only applicable if no checkboxes in #9.1 are ticked)	☒ Enhanced containment measures do not apply

UAS Details (based on SORA 2.5)

Specific Operational Risk Analysis overview for UAS operations			
0. Data of authorised UAS and operation			
0.1	**UAS operator identification**	**Kenya Flying Labs**	
0.2	**Manufacturer or type certificate holder**	**DJI**	
0.3	**Model name**	**DJI Mavic**	
0.4	**Type of UAS configuration**	☐Conventional airplane ☐Helicopter ☒Multirotor ☐Hybrid/VTOL ☐Lighter than air ☐Other, please specify:	
0.5	**Is the UAS tethered during the operation?**	☐Yes	☒No
0.6	**Maximum characteristic dimension** (including propellers)	0.35	m
0.7	**Maximum take-off mass (MTOM)** (indicated by the operator equal to or less than the manufacturer's specification)	1.0	kg
0.8	**Maximum operational speed** (maximum speed flown within the scope of the intended operation)	15 (limited)	m/s
0.9	**Type of propulsion system**	☒Electric ☐Combustion ☐Hybrid, specify type: ____ ☐Other, please specify: ____	
0.10	**Transport of dangerous goods**	☐Yes	☒No
0.11	**Type of operation**	☐Visual line of sight (VLOS) ☐Extended visual line of sight (EVLOS) ☒Beyond visual line of sight (BVLOS)	
0.12	**Does the remote pilot control more than one UA simultaneously?**	☐Yes	☒No

0. Data of authorised UAS and operation		
0.1	**UAS operator identification**	**Kenya Flying Labs**
0.2	**Manufacturer or type certificate holder**	**DJI**
0.3	**Model name**	**DJI Mini**
0.4	**Type of UAS configuration**	☐Conventional airplane ☐Helicopter ☒Multirotor ☐Hybrid/VTOL ☐Lighter than air ☐Other, please specify:
0.5	**Is the UAS tethered during the operation?**	☐Yes ☒No
0.6	**Maximum characteristic dimension** (including propellers)	0.24 m
0.7	**Maximum take-off mass (MTOM)** (indicated by the operator equal to or less than the manufacturer's specification)	0.249 kg
0.8	**Maximum operational speed** (maximum speed flown within the scope of the intended operation)	10 m/s
0.9	**Type of propulsion system**	☒Electric ☐Combustion ☐Hybrid, specify type: ______ ☐Other, please specify: ______
0.13	**Transport of dangerous goods**	☐Yes ☒No
0.14	**Type of operation**	☐Visual line of sight (VLOS) ☐Extended visual line of sight (EVLOS) ☒Beyond visual line of sight (BVLOS)
0.15	**Does the remote pilot control more than one UA simultaneously?**	☐Yes ☒No