Version 1.3, 2026-03-03

AERIAL EVOLUTION ASSOCIATION OF CANADA 2026 STUDENT COMPETITION

CONCEPT OF OPERATION (CONOPS) DOCUMENT

This CONOPS document is in the form of a Request for Proposal (RFP) from the fictitious Big City Fire Department (BCFD) for an aerial urban firefighting system. Student teams will act as industry bidders to create concepts, design a firefighting Unmanned Aerial System (UAS), write design papers in the format of proposal responses to the RFP, and compete in a sub-scale assessment of their designs.

Note that references to 'BVLOS' in the document refer to the inability of the flight line crew to see the UAS; competition staff will act as on-site spotters such that actual BVLOS will not be performed.

Refer any comments on this document to the Competition Chief Judge, Katrina Cecco, at katrina.cecco@aerialevolution.ca.

RECORD OF AMENDMENTS

Amendments are highlighted.

Version #	Date	Comments/Changes
1.0	2025-09-14	Initial issue
1.1	2025-10-15	Registration info added, minor task clarifications, teams Q&A
1.2	2025-11-28	Task 2 target details and Big City SOPs (Appendix F) added, insurance requirements confirmed, teams Q&A
1.3	2026-03-03	Member registration deadline moved up, finalized per-member fee, RPAS pilot recency requirements, flight termination/FRR details, updated doorway size for Task 2, teams Q&A

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1. Overview

This is a competitive Call for Proposals for design, development, and assessment of an urban firefighting UAS.

1.1. Background

Big City Fire Department, having heard of recent experimental successes in the use of UAS in fire first response, is eagerly seeking a firefighting UAS suitable for use in their downtown core. The city already hosts a successful urban air mobility (UAM) corridor network and is looking to integrate aerial firefighting services into the existing unmanned air traffic infrastructure. BCFD is soliciting proposals for a UAS that has capabilities to reconnoitre and stage a site in preparation for firefighters' arrival, as well as to extinguish small blazes near and inside buildings.

1.2. Assessment Format

The competition comprises three main deliverables: the Phase 1 Proposal, the Phase 2 Flight Demonstration, and Phase 3 Mission Report. Details on each assessment can be found in Section 5: Assessments.

There will be separate awards for each Phase. All bidders must complete Phase 1 by submission of a Proposal to be eligible to participate in Phase 2. Participation in Phase 2 is required to be eligible for participation in Phase 3.

1.3. Phase 1: Proposal

Bidders will submit a proposal in response to the RFP detailing the specifications of their system, their development process, and their proposed mission strategy. Phase 1 will occur virtually.

1.4. Phase 2: Flight Demonstration

Bidders will participate in a simulated urban firefighting mission to demonstrate the capabilities of their subscale prototype. Phase 2 will take place 2026-05-22 to 2026-05-24 at Area XO in Nepean, Ontario, and will be hosted by Invest Ottawa. Eligibility for Phase 2 is determined by the ranking achieved by bidders in Phase 1.

1.5. Phase 3: Mission Report

Following the flight demonstration, bidders will submit a mission report debriefing their system's performance. Phase 3 will occur virtually.

2. Schedule and Deliverables

The competition requires the submission of multiple administrative and assessment deliverables; a deliverables summary is shown in Table 1. Teams are encouraged to contact the competition organizers with any question regarding the deliverables – well in advance of the deadlines – to ensure correct and timely submissions

All deliverable deadlines are at 2359 in the Eastern time zone (ET) unless otherwise stated. It is each team's responsibility to ensure they submit materials on time, including adjustments for their local time zone. Some of the deliverables include multiple steps. All components of each deliverable must be complete by the stated deadline.

Upon expression of interest, teams will be provided with a shared Google Drive to upload their deliverables; all deliverables are to be uploaded to a team's shared Google Drive unless otherwise stated. The time of upload reported on Google Drive will be taken as the submission time.

It is critical that the administrative deadlines are met to ensure your team's participation in the competition.

Table 1: *Schedule and Deliverables Summary*

Event	Date
CONOPS Published	2025-09-14
Team Registration	2025-11-28
Phase 1 Proposal	2026-01-15 1700 ET
Flight Window Selection	2026-03-02
Members Registration	2026-03-12
FRR Documents	2026-05-04
FRR Safety Demonstration	before first flight window
Phase 2 Flight Assessment	2026-05-22 to 2026-05-24
Phase 3 Mission Report	2026-06-03 1700 ET

2.1. CONOPS Published 2025-09-14

The CONOPS may be updated at any time without notice. The latest version is available at https://www.aerialevolution.ca/annual-student-competition/.

Registered teams or teams who have expressed interest will receive CONOPS update notifications through their team contact email.

2.2. Team Registration 2025-11-28

First, teams must express their interest in participating in the competition by sending an email to competition@aerialevolution.ca with the following information: university name, team name, team contact email, and team Google Drive compatible email.

A Google Drive compatible email is an email linked to a Google account. Google accounts can be created for free at https://accounts.google.com/signupwithoutgmail. Teams will be given access to a Google Drive folder for submission of the required deliverables.

Second, teams must submit the following information and documents: captain contact information, estimated number of team members attending Phase 2, team description document, and team logo.

Lastly, teams must submit their team payment at https://www.aerialevolution.ca/join/#join.

All the information above and the team payment must be submitted before the 2025-11-28 deadline.

2.3. Phase 1 Proposal 2026-01-15 1700 ET

The criteria for the proposal are outlined in Section 5.1: Phase 1 Proposal.

Teams will be notified of the complete Phase 1 participant rankings by 2026-02-27. Phase 1 submissions will be made publicly available to all competitors following the completion of Phase 2, and will be available to all future competitors in the following year.

2.4. Flight Window Selection 2026-03-02

The Phase 1 participant rankings determine the Phase 2 flight order. Teams will select their Phase 2 flight window one at a time, starting with the team that ranked first place in Phase 1, and ending with the team that ranked last in Phase 1.

The Phase 2 flight schedule will be divided into morning and afternoon time slots, see Section 2.8: Phase 2 Flight Assessment. Each team will select a flight window in the morning or the afternoon time slot, and their order within that time slot (e.g. 4th in the morning).

The flight window selection process will start on 2026-03-02. Teams will receive instructions by email on how to choose their flight window.

The flight schedule depends on the number of teams participating and will be communicated to teams before 2026-03-02. The committee reserves the right to change the flight schedule; however, teams will be guaranteed to fly in the morning or afternoon time slot as per their selection.

Judges will decide how to allocate flight windows to unresponsive teams on a case-by-case basis. In the event that a team chooses a Phase 2 flight window and later fails to meet the Phase 2 requirements, the flight window they chose will be forfeited. Other teams' flight window selections will remain unchanged.

2.5. Members Registration 2026-03-12

First, teams must submit the following information and documents: Phase 2 team list and insurance proof (see Section 4.9: FRR Documents).

Second, teams must submit their per member payments.

All the information above and the per member payments must be submitted before the 2026-03-12 deadline.

2.6. FRR Documents 2026-05-04

Teams must submit all the Flight Readiness Review (FRR) documents listed in Section 4.7: FRR Document.

Following the deadline, judges will review all components of the FRR and may request amendments to ensure compliance. All aspects of the FRR must be completed and approved by judges before teams are permitted to fly at Phase 2.

2.7. FRR Safety Demonstration before first flight window

Teams must do all the FRR safety demonstration items listed in Section 4.10: FRR Safety Demonstration.

It is each team's responsibility to schedule and perform the FRR safety demonstration to a judge before their flight window. The preference will be given to teams in order of flight window.

2.8. Phase 2 Flight Assessment 2026-05-22 to 2026-05-24

The high-level schedule for Phase 2 is shown in Table 2. A finalized detailed schedule will be provided to teams by email on Thursday evening for the entire event.

Table 2: Phase 2 *Schedule*

	Fri 2026-05-22	**Sat 2026-05-23**	**Sun 2026-05-24**
Morning	Safety briefing, Bidder presentations, FRR	Task 1 mission demonstration (10 slots)	Task 2 mission demonstration (10 slots)
Afternoon	Task 1 mission demonstration (10 slots), FRR (ongoing)	Task 2 mission demonstration (10 slots)	Site cleanup and team photo
Evening			Award banquet

Teams will do their presentations on Friday morning in the same order as their flight window, determined by the flight window selection process outlined in Section 2.4: Flight Window Selection.

Teams will have one flight window for each of the two Tasks, each of which will be approximately 30 minutes. The actual amount of time allotted will be announced prior to the start of the assessment flights; the allocated time is subject to the number of registered bidders and uncontrollable factors such as weather. Expect that the window length may vary from this initial estimate.

The flight order will be the same for Tasks 1 and 2, so that each team has a roughly 24-hour gap between their Task 1 and Task 2 flights. Task 1 will be flown on Friday afternoon and Saturday morning, and Task 2 will be flown on Saturday afternoon and Sunday morning.

2.9. Phase 3 Mission Report 2026-06-03 1700 ET

The criteria and submission information for the mission report is outlined in the Phase 3 Mission Report section.

3. Logistical Requirements

Teams must meet the following requirements and the administrative deadlines to be eligible for participation. Teams will be accepted at the discretion of the Chief Judge.

3.1. Team Composition

All team members must be enrolled part-time or full-time at a Canadian college or university for the fall 2025 and/or the winter 2026 semesters. Teams may be organized internally at the discretion of their members and may include graduate and undergraduate students.

There is no restriction on the number of teams from any one institution; however, no individual member may be on more than one team, and proposals from different teams at the same institution must be substantially different.

Joint teams consisting of students from more than one institution are permitted; for example, a joint university-college team is allowed.

3.2. Team Size

There is no minimum or maximum team size, any number of members may contribute.

The maximum team size for on-site participation at Phase 2 is capped at 8 members due to logistical constraints.

3.3. Registration Fees

A single non-refundable team registration fee of $650+HST must be paid to participate in Phase 1. The team registration fee is due 2025-11-28. To pay the team registration fee, select “AEAC Student UAS Competition Teams Registration” at https://www.aerialevolution.ca/join/#join.

A per-member non-refundable registration fee of ~~approximately~~ $330+HST ~~(fee TBC)~~ must be paid to participate in Phase 2. The per-member fee is due 2026-03-12.

There is no registration fee to participate in Phase 3.

3.4. Phase 2 Accommodations and Travel

The Phase 2 member registration fee includes the following onsite accommodations for all participants from Thursday 2026-05-21 to Monday 2026-05-25 inclusively:

- Lodging from Thursday to Monday
- Breakfast and lunch from Friday to Sunday
- Sunday awards banquet access, including dinner

By default, each team will be given 4 rooms, each lodging 2 members.

If team members have specific accommodation needs or requests (accessibility, allergies, rooming preference—single-gender or other) please let us know along with your team list.

Teams are responsible for their own costs, including travel to and from the Phase 2 site, and the meals not included (Friday and Saturday dinner).

Teams are responsible for their transportation between the airport, accommodations, award banquet, flight line and workspace.

Phase 2 ends at about 2200 after the awards banquet on Sunday night. Departing immediately following the banquet is *not* endorsed by AEAC; teams should plan to leave on Monday to ensure safe travels home.

3.5. Team Capacity

There is no maximum number of teams that may participate in Phase 1.

A maximum of 20 teams may participate in Phase 2 due to logistical constraints. Only the top 20 Phase 1 ranked teams will be eligible to participate in Phase 2.

Teams ranked 21st and below for Phase 1 will be placed on the Phase 2 participation waitlist. If a spot opens up, teams on the waitlist will be contacted in order by email until the spot is filled.

3.6. Uncooperative Conduct

Conduct deemed uncooperative to the safety or fairness of the event will not be tolerated and will result in the termination of your team's participation. Examples of uncooperative conduct include, but are not limited to:

- Arguing with judges or disobeying judges' calls
- Cheating, including seeking prior knowledge about flight task setup before attempting the task
- Sharing information about a flight task setup with another team who has not yet attempted the task

4. Operational Requirements

Teams must meet the following operational requirements to be eligible to fly at Phase 2. Teams will be accepted at the discretion of the Chief Judge.

4.1. Statement on Regulatory and Safety Compliance

All flying, including flight testing at local test sites and at the Phase 2 venue, is to be performed under the Canadian Aviation Regulations (CARs) Part IX regulations for Remotely Piloted Aerial Systems (RPAS). Participants are responsible for maintaining operational compliance with the CARs at all times. Judges will never request an action from the flight crew that is not compliant with the CARs.

Furthermore, it is imperative that participants follow all operational requirements outlined in this document. All requirements have been carefully selected to ensure safe operation.

Judges reserve the right to make judgement calls on the safety of the operation, which may result in pausing or terminating the flight window. **Participants must obey the Air Program Director's commands, even if it means the termination of their UAV and/or the loss of their flight window.**

4.2. Flight Safety

During flight, a ground control station (GCS) must always show the aircraft's real-time location and the competition flight area. When multiple UAVs are used, each UAV must have a separate GCS display with the above information.

All UAVs must remain inside the flight boundaries at all times and in all modes (manual, autonomous, return to home, etc.). Flight boundaries will be given as waypoints that form a polygon which may be non-convex. If the aircraft leaves the soft flight boundary (including altitude boundary), the operator will be required to bring it back within the boundary. If the operator is unable to do so, they will be ordered to activate the flight termination system. If the aircraft leaves the hard boundary, it must be terminated immediately.

All anomalies with respect to the Global Positioning System (GPS), data link, radio control (RC) and flight boundaries must be reported to the Air Program Director.

Teams may turn on transmitters at the start of their flight window. Teams must turn their transmitters OFF after their flight window has elapsed. NO transmissions of any sort are allowed outside the flight window, including Wi-Fi hotspots, cellular, and the like. The sole exception to this will be when judges have given teams authorization to transmit during their FRR; teams must await the judges' instructions before they begin any wireless transmissions as part of the FRR.

4.3. Flight Crew

Bidders will designate a 'flight crew' consisting of maximum five members. Only the flight crew may be present on the flight line during the flight window. The flight crew members may not communicate with other team members during their flight window.

Each individual vehicle must have a separate pilot while being flown or moved, i.e., concurrent operation of vehicles requires separate pilots.

All members of the flight crew must remain at the flight line for the duration of the tasks and may not access the flight area unless given permission by the Range Safety Officer.

4.4. Pilot and RPAS Licencing

Area XO is within controlled airspace, and consequently each pilot (not each team member, only pilots) must hold an Advanced RPAS Pilot Certificate. To be clear, the Basic operator certificate is not sufficient. It is recommended to initiate this process as soon as possible, as a relatively difficult online exam, in addition to a flight review at a UAV training school, must be passed successfully to obtain the Advanced Operator Certificate. A copy of the Advanced RPAS Pilot Certificate for each pilot must be provided to the Air Program Director as part of the FRR and must meet the recency requirements of the Canadian Aviation Regulations.

Each RPAS must be registered in accordance with Part IX regulations. It is best if registration is done by a Canadian citizen, under the name of the university, through the Transport Canada portal. For each RPAS to be flown, the registration certificate must be provided to the Air Program Director as part of the flight readiness review.

To confirm: No Special Flight Operation Certificate (SFOC) is required by teams with Canadian citizen pilots. Instead, all pilots and UAVs must conform to Part IX. AEAC will independently apply for a Special Aviation Event Certificate; no action is required from the teams.

A foreign pilot or operator (not a Canadian citizen or permanent resident) acting as RPAS pilot at the competition must take and approve the Transport Canada online RPAS Advanced exam. Non-Canadians must also pass a flight review, to obtain their Advanced pilot certificate. Non-Canadian citizens will then apply for a SFOC in their name; for testing, training and operations for AEAC 2025 competition. There is no fee, but the process takes 30 business days, see the Transport Canada website.

If you need any assistance with regulatory approval, please contact competition@aerialevolution.ca as soon as possible.

4.5. Flight Termination System

All UAVs must be equipped with a safety flight termination system that can be activated either automatically or remotely (kill switch). For fixed-wing flight, this consists of shutting down the engine and performing aerodynamic termination, which corresponds to full aileron, elevator up, full rudder and

no motor. Circling down is not acceptable. For rotary-wing (vertical) flight, a quick vertical descent of a minimum of 2 m/s and touchdown must be performed.

The flight termination mechanism must be operational at all times. If the flight termination method is not working, the aircraft must terminate the flight itself automatically and rapidly. In other words, if unable to kill the aircraft, the aircraft should have already killed itself. Under no possible situation should the UAV be in flight with the crew unable to activate a kill mechanism. This is valid for all flight modes. For instance, losing the command and control (C2) link while in auto mode should cause the aircraft to terminate itself.

Aircraft must be in termination mode within 5 seconds of the termination function being activated. If an aircraft crosses the flight boundary, its flight termination system should activate automatically.

The flight termination mechanism will be validated during the FRR check for each aircraft, including loss of C2 link and geofence-based automatic flight termination. In previous years, one way that teams achieved this successfully was ensuring their RC controller has sufficient range and configuring the system so that the aircraft is killed automatically if the RC link is lost. Test Flights

Rehearsal flights are not permitted on-site unless specifically authorized by the judges. Test flights are not included in the event schedule.

4.6. Mission Requirements

There will be one flight window per task for each bidder, as detailed in Section 2.8: Phase 2 Flight Assessment. Within each flight window, the UAS may operate as many times as bidders wish to achieve the requirements of the relevant Tasks. Task 1 will be conducted during the bidder's first flight window, and Task 2 during the second.

The UAS design may include any desired combination of aircraft capabilities (e.g., rotary wing, fixed wing, hybrid, or other); different vehicles may be used for Task 1 and Task 2.

Up to two UAVs are permitted for Task 1. Only one UAV is permitted for Task 2. UAVs may be different or the same design, but each individual aircraft must meet the design and safety requirements.

4.7. UAS Design Constraints

All UAS are subject to the following design constraints:

a. All UAVs intended to be flown concurrently must have a maximum collective takeoff weight of 15 kg including payload.
b. There is no size restriction.
c. Only electric propulsion may be used (including solar cells, batteries and fuel cells).
d. Equipped with a flight termination system as defined in Section 4.9: Flight Termination System.
e. Parachutes are not permitted for any aircraft type.
f. Data links can be by radio, infrared, acoustic or other means so long as no tethers are employed.

g. UAS may operate autonomously, semi-autonomously, or under manual control at the discretion of the bidders.
h. Radio frequency usage in Canada is defined by Innovation, Science and Economic Development Canada (ISED). If a licensed band is used, the licence must be obtained and provided to the judges before being allowed to fly.
i. This is an Unmanned Aerial System design competition: using completely off the shelf UAVs (e.g. DJI Phantom) is not allowed. Individual off-the-shelf components may be used; this includes airframe kits only if they do not include non-structural components such as motors, wiring, etc.
j. Aircraft must have an electrical or mechanical way of preventing propellers from accidentally spinning when the aircraft is not in takeoff position and ready for takeoff (i.e. when working on the aircraft).

4.8. FRR Documents

The FRR includes the following documents/proofs of completion:

a. RPAS Registration Certificate for each aircraft;
b. RPAS Safety Assurance Declaration for each model of aircraft, (check 922.04 Operations in Controlled Airspace);
c. RPAS Pilot Certificate for each participating pilot, including proof of recency requirements if they have had their licence for more than 24 months;
d. Additionally, SFOC for Non-Canadian RPAS pilots if applicable;
e. ISED radio licence as applicable, if licenced frequency bands are intended to be used;
f. Proof of general and aviation liability insurance;
g. Proof-of-flight video; and
h. Flight checklists that will be used in the flight operations.

The proof-of-flight video must include the following, for each aircraft to be flown in the competition:

a. Takeoff;
b. Fly by, circle, and (if applicable) hover to demonstrate the stability of the vehicle;
c. Flight at an ‘appropriate’ cruising speed;
d. Approach; and
e. Full-stop landing.

Insurance requirements include $5 million in aviation liability and $5 million in commercial general liability insurance. Registered teams will receive a link to the full insurance requirements documentation. Teams are also advised to check with their post-secondary institution to ensure compliance with any of their internal insurance requirements.

4.9. FRR Safety Demonstration

The FRR includes the following safety demonstration items:

a. All aircraft intended to be flown concurrently must collectively weigh under 15kg with maximum

payload for each task (intended firefighting equipment mass will be added to the empty weight; aircraft will also be weighed with a full load of water*);

b. The water carrying system must not spill water on critical aircraft systems when loaded with full water payload and the Unmanned Aerial Vehicle (UAV) is inclined +-90 degrees in pitch and roll*;
c. The flight termination system is functional at all times and in all flight modes. Propellers should have been removed already. Make the motor(s) spin, and show that at all times, it is possible to kill the aircraft in all flight modes. Also show this kill mechanism has already been activated if the datalink for the kill switch is lost (this is often the RC controller, based on previous years) and if it crosses a pre-programmed geofence boundary;
d. All participating pilots have signed AEAC's SFOC; and
e. The RPAS registration number is present on each aircraft and compliant with regulation.

*Water-based FRR requirements must be demonstrated before attempting Task 2, but are not required to attempt Task 1.

The team performing the FRR safety demonstration will be temporarily allowed to turn on their transmitters for the purpose of demonstrating the flight termination system.

5. Assessments

The competition is scored with three assessments. Each assessment is scored and awarded separately.

5.1. Phase 1 Proposal

The objective of Phase 1 is for bidders to document the technical and operational design of their UAS to the judging team. Proposals may be submitted in English or French. All Phase 1 submissions will be made public to fellow competitors following the conclusion of Phase 2.

Proposals are due 2026-01-15 1700 ET. They must be uploaded to your team's Google Drive folder in PDF format. 10% will be deducted from the score for each day late or portion thereof. Proposals are limited to 15 pages total, including any appendices, title page, table of contents, list of figures, etc. Only references are not counted in the page limit. Pages above the 15-page limit will be ignored in the scoring.

The Proposal will be evaluated according to the criteria in Table 3. Each criterion is awarded either 0, 4, 7 or 10 points, and each category of criteria is weighted as shown, for a maximum score of 120 points.

To streamline the evaluation process, bidders are required to adhere to a specified document structure. The English and French versions of the required top-level headings are listed below. Any information outside of these top-level headings will receive zero points. Within these headings, information may be organized at the bidders' discretion.

- Introduction / Introduction
- Aircraft Design / Conception d'aéronef
- Payload Design / Conception de charge utile
- Mission Strategy / Stratégie de mission
- System Integration / Intégration de système
- Project Management / Gestion de projet

Table 3: *Phase 1 Proposal Scoring Criteria*

Criteria	Score
Introduction / Introduction	5
Team Introduction: Give a brief introduction of your team ***Executive Summary:*** Provide an outline of your report and the main information the client needs to know about your system.	
Aircraft Design / Conception d'aeronef	15
Analysis of Alternate Solutions: How did you choose the vehicle type and other key aircraft design features? ***Airframe Design:*** Configuration of your selected aircraft frame.	

UAV Subsystem Design: Design features of auxiliary systems such as flight control, power systems, propulsion, etc.	
Payload Design / Conception de charge utile	25
Visual Inspection and Mapping System: Describe the design and operation of your target detection and mapping systems. ***Equipment Transport System:*** Describe the design and operation of your firefighting equipment transportation system: how will equipment be attached, carried, and released? ***Fire Extinguishing System:*** Describe the design and operation of your fire extinguishing system: water loading, targeting and water release.	
Mission Strategy / Stratégie de mission	20
Analysis of Alternate Solutions: How did you choose the flight strategy? ***Approach to Mission Requirements:*** Explain your overall strategy for accomplishment of the Tasks, and the individual strategy for each Task. How is your strategy optimal, reliable, and novel?	
System Integration / Intégration de système	20
Single Point Failure Modes: Given your technical solution, what failure modes are you anticipating and how will you address them? ***System Level Testing:*** What testing will you do throughout the development of your UAS to ensure all systems work as intended? How will you check that systems work together to satisfy the mission requirements?	
Project Management / Gestion de projet	15
Project Schedule: Gantt chart of all significant activities in UAS development and planning for the Phase 2 Assessment. ***Risk Management Plan:*** Identify some technical, safety, and programmatic risks, including severity, likelihood, and overall risk level. How will you mitigate or respond to these risks? ***Proposed Budget:*** Funding revenues and expenses, including logistics.	
Proposal Quality (Graded Throughout Report)	10
Spelling and Grammar: Error-free, formal writing in the chosen official language. ***Use of Technical References:*** Provide some! They may be technical, operational, etc… as long as they are reputable and relevant. ***Use of Figures and Charts:*** Visuals are appropriately labelled, referenced from the text, of sufficient size/resolution, and enhance the reader's understanding. ***Quality of Presentation:*** Information is presented in a clear, professional manner. ***Client Confidence:*** Would BCFD be confident in your solution?	
Total Possible Score	**120**

5.2. Phase 2 Flight Assessment

5.2.1. Scenario and Site

The Phase 2 Flight Assessment will include two Tasks:

a. Task 1 – Fire Reconnaissance
b. Task 2 – Fire Extinguishing

Both Tasks will be conducted at the Area XO site shown on the map in Figure 1. Coordinates for this outline are given in Appendix C: Area XO Flight Boundary GPS Coordinates and accessible at this link: https://www.google.com/maps/d/u/1/edit?mid=1IIgV4ZB21Wg-QXVhOCWoF_zKQW79UdA.

The flight area will be a subset of the entire site. Precise flight boundaries will be given to bidders at the start of Phase 2 in the form of a Google Maps link (same format as above), as well as an altitude limit no greater than 400ft.

Two sets of flight boundaries will be given: a soft boundary (yellow in Figure 1 example) and a hard boundary (red in Figure 1 example). Bidders will receive a warning to turn around if their UAV goes outside the soft boundary. Bidders are required to ~~kill their~~ have their UAV auto-terminate if it goes outside the hard boundary. Task 1 and Task 2 may have different flight boundaries. Expect the possibility of high winds, such as 10kts with gusts to 20kts, and precipitation.

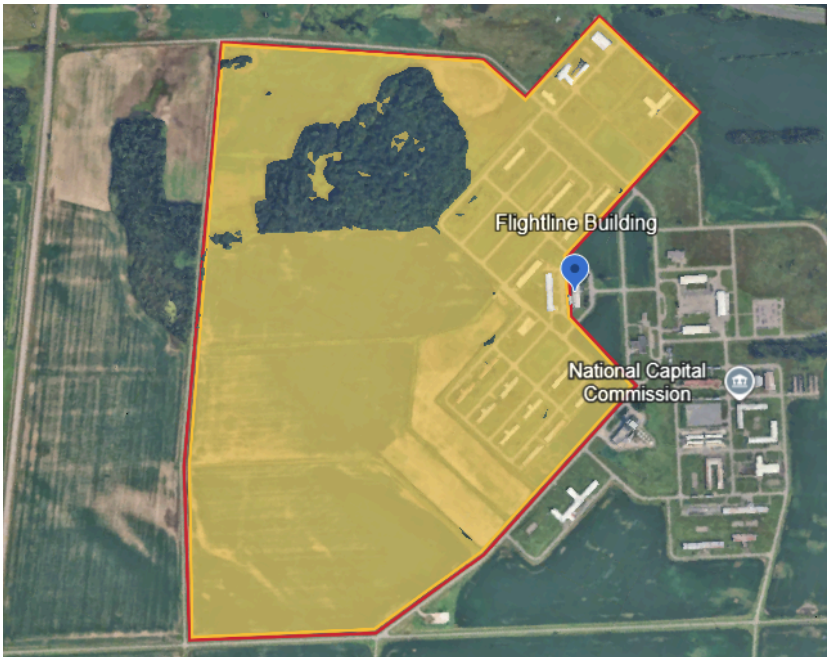


Figure 1. Area XO Flight Task Site

5.2.2. Bidder's Presentation

Bidders will make a sales pitch and engineering assessment to all other bidders and the assessment judges. Presentations should include:

a. Expertise of the bidder team;
b. UAS Design, including:
    i. How it evolved to become the final design;
    ii. Details of the final design; and
c. How each Task will be executed.

The length of this presentation should not exceed 6 minutes. This time limit will be strictly enforced. You may give your presentation in English or French; whichever language is chosen, there must be at least one slide presented in the other language.

Presentations are to be uploaded to the provided Google Drive link by 2400 on 2026-05-21 2359 (Thursday night).

Presentations will be scored on the criteria in Table 4.

Table 4: *Bidder's Presentation Scoring*

Bidder's Presentation	**Score**
Presentation is well organized; both official languages are used. The presentation is clear and understandable, with limited jargon or technical terms; good speaking quality.	10
The evolution of the design from proposal to final is logical and well-explained.	15
The task execution is logical, well-explained, and seems to offer likely success.	10
Big City Fire Department would be convinced this is the right team and UAS design.	5
Total Possible Score	**40**

5.2.3. Task 1: Fire Reconnaissance

In Task 1, bidders will perform reconnaissance and equipment staging at the scene of a fire, in preparation for firefighters' arrival. The points will be allocated as shown in Table 5.

1. Bidders will be given GPS coordinates of a building on fire as well as the dimensions of the building, by 2026-05-21 2359 (Thursday night). The scene of the fire comprises the volume within 15m of the perimeter of the building, up to 10m AGL.

2. At the flight line, bidders will select a combination of the following firefighting equipment to carry to the scene of the fire:

a. Handheld radio: up to 500g and 7.5x7.5x20cm.
b. Oxygen tank: cylinder, up to 1kg and 15x15x30cm. Note: This is a simulated tank. There will be no pressurized gas inside.
c. Ladder: up to 3kg and 15x60x120cm.

Only one item of each type of equipment will be provided. Any combination of equipment may be carried. Bidders will manually attach the equipment to their UAV(s) at the flight line during their flight window. All equipment must be carried in a single run; UAVs cannot return to the flight line to pick up more equipment.

3. UAV(s) must fly to the simulated distant scene by performing laps of a given course between 400m to 1km in length. Bidders may choose how many laps, if any, to attempt. For clarity, the UAVs may fly directly to the delivery location or via any number of laps of the course. Laps will only be counted on the way to the scene, not returning from the scene. Waypoints for the lap course will be given by 2026-05-21 2359 (Thursday night) alongside the flight boundaries.

4. At the scene, each item of equipment must be dropped off at one of the safe staging areas. Each item of equipment may be dropped at any of the staging areas, but each staging area can only receive one item. Staging areas will be identifiable with 32-inch diameter drone landing pads and must be located by bidders upon arrival. Dropping equipment from the air is not permitted: equipment must be touching the ground and/or the UAV must have landed before equipment is released from the UAV. To be counted as delivered, the equipment must be fully released from the UAV and no part of the UAS may be left behind.

5. Bidders must detect and report back the location of targets.

    a. The targets will be visually detectable. Each will be a circle between 5 to 30cm diameter and of one of the following colours: black, white, red, yellow, blue, green.
    b. There will be an unknown number of targets. All will be within the scene of the fire (see Para 1).
    c. Targets may be inclined or partially obstructed. No targets will be indoors for Task 1.

6. Firefighters are seeking a text-based description of the location of the targets, including position in 3D space and colour of the target. It is up to bidders to determine a system for describing the exact location of the targets within the environment, according to the following principles:

    a. The text-based description should use landmarks found in the environment as reference points to describe the target's relative location (see examples in Appendix D: Sample Task 1 Target Localization). This allows firefighters to navigate the scene without any absolute map of the environment.
    b. Relative locations can only be expressed up to decimetre accuracy.
    c. GPS or other purely numerical coordinate systems (e.g. "target is [-5.5, 0.5, 0.7]m from the origin") may not be used.

d. If a target location description is too ambiguous to locate that target in 3D space, no points will be given for that target.
e. Either French or English may be used to describe the location of the targets.
f. The list of target locations must be provided in a single .txt file, uploaded to the bidder's own Google Drive folder, by the end of the flight window with the title "Task_1_<your_team_name>_targets.txt".

7. Batteries may not be swapped during this task.

8. Up to two UAVs are permitted for this task.

Table 5: *Fire Reconnaissance (Task 1) Scoring*

Criteria	**Score**
Target detection location accuracy: ● Each target is nominally worth 25 pts / number of targets ● Each target score is individually multiplied by the following: ○ <=0.5m radius = x100% ○ >0.5m, <=1m radius = x75% ○ >1m, <=1.5m radius = x50% ○ More than 1.5m = x0% ● And multiplied again by the following: ○ Correct colour = x100% ○ Incorrect or missing colour = x50%	25
Equipment Delivery: ● Each item of equipment is worth some nominal points: ○ Small payload: handheld radio = 5 pts ○ Medium payload: oxygen tank = 5 pts ○ Large payload: ladder = 10 pts ● Each item of equipment score is individually multiplied by an accuracy factor: ○ Item safely delivered to the scene, <=2m from a staging point = x100% ○ Item safely delivered to the scene, >2m from a staging point = x50% ○ Item is airdropped, not delivered, or is damaged = x0% ● Multiple items delivered to the same staging point: only the closest will be counted.	20
Distance Flown: ● Highest number of full laps completed = 30 pts ● Lowest number of full laps completed = 10 pts ● Other points allocated linearly in proportion to ranking relative to other bidders. ● Any ties in number of laps will be resolved by ranking bidders according to the time to complete the number of laps, shortest to longest time elapsed, as measured from the start of their respective flight windows.	30

Note: Bidders that do not fly at least one complete lap will receive zero points for this criterion and will not be included in the linear scale. If multiple UAVs are used and different numbers of laps are flown by each, the lower number of laps will be used in scoring.	
Payload Fraction: ● Points given according to the formula: *MIN(PF, 0.35)/0.35 x 20pts* *PF = (weight of payload)/(total takeoff weight including payload)* ● UAVs must lift payload entirely off the ground to get payload fraction points. ● If multiple UAVs are used, the payload fraction will be applied cumulatively to the entire system.	20
Safe Landing at Flight line: ● All UAVs are landed safely at flight line at the end of the flight window = 5pts	5
Total Possible Score	**100**

5.2.4. Task 2: Fire Extinguishing

In Task 2, bidders will extinguish outdoor and indoor fires while demonstrating system autonomy and compliance with Big City RPAS Traffic Management (RTM) protocols. The points will be allocated as shown in Table 6.

1. Big City's RTM SOPs Bidders must comply with the SOPs at all times during their flight window. The SOPs can be found in Appendix F. The flight line location will be considered a registered vertiport for the purposes of these SOPs.

2. At the beginning of the flight window, bidders will receive GPS coordinates of a building on fire in Big City's downtown, as well as a verbal briefing of the search volume boundaries (around and above building) for the fire. This information will be provided by Big City emergency dispatch according to the RTM SOPs.

3. UAVs will begin the flight window without water loaded. Bidders will load their UAV with water at the flight line. The loading may be done manually by operator(s) or automatically by the UAS, and any amount of water may be loaded. There is no limit to the number of subsequent water loadings or total quantity of water loaded within the flight window.

4. Bidders will fly their UAV to the building on fire and extinguish targets by wetting them with water.

    a. The number of targets will not be known to the bidders. All targets will be contained within the search volume boundaries given at the start of the flight window.
    b. Targets may be indoors, outdoors, vertical, horizontal, inclined, or partially obstructed. Targets will not be mounted on the ceiling.
    c. Indoor targets will be accessible through an approximately 3.5m x 3m open doorway.

d. Targets will be represented by circles of paper of diameter between 5cm to 30cm. They will be mounted on a white plastic backing.
e. To count as extinguished, the targets must be wetted with water by the UAS across a 2cm wide area, and the operators must declare the target extinguished and provide visual confirmation of this to the flight line judges in the form of a photo in real time. At the end of the flight window, judges will confirm which targets have been extinguished.
f. Teams must submit photos of the extinguished targets to their team Google Drive folder. Photos should be titled "Task_2_<team_name>_target_<target#>" where target numbers go in order of extinguishing.
g. Only water can touch the targets. No part of the UAS can touch the targets.
h. The targets will be dyed in pH-sensitive red cabbage juice and the water provided at flight line will have some baking soda mixed in to make it slightly basic. The targets will be purple in colour, and will turn blue once wetted with the baking soda solution. The purple/blue colours persist in the rain, but lose saturation. Sample images are shown in Figure 2. To replicate these results, boil a red cabbage in water for 5-10 minutes and, when cool, dye paper in the resulting solution.

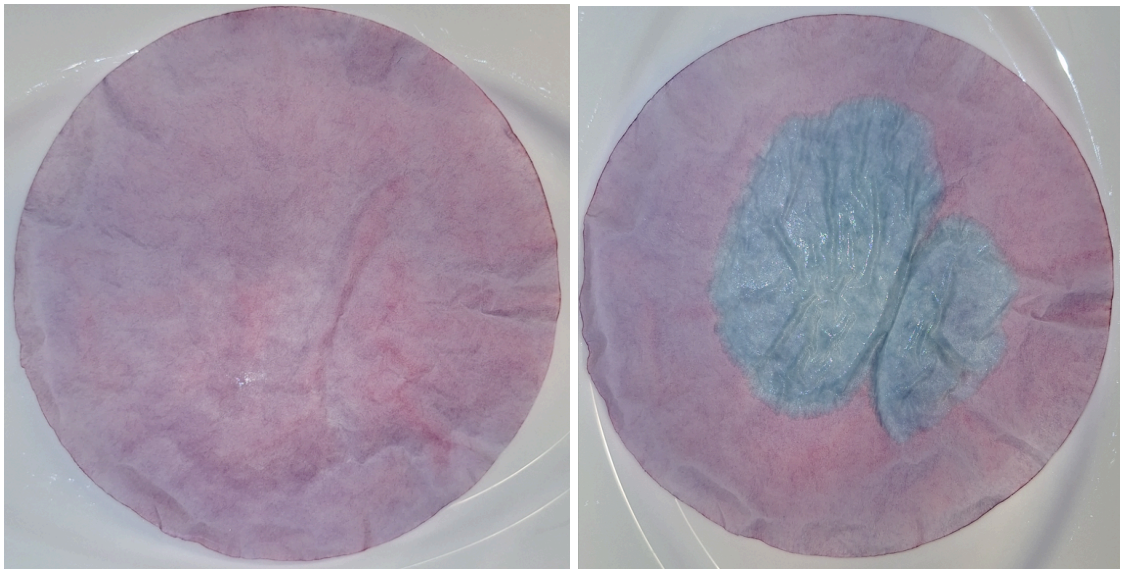
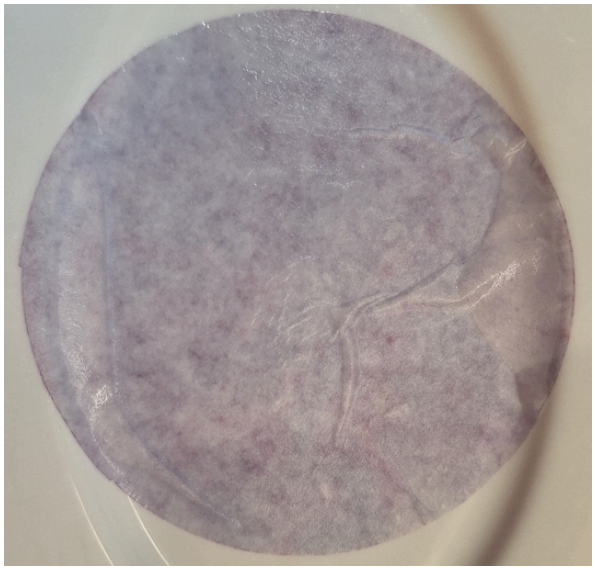
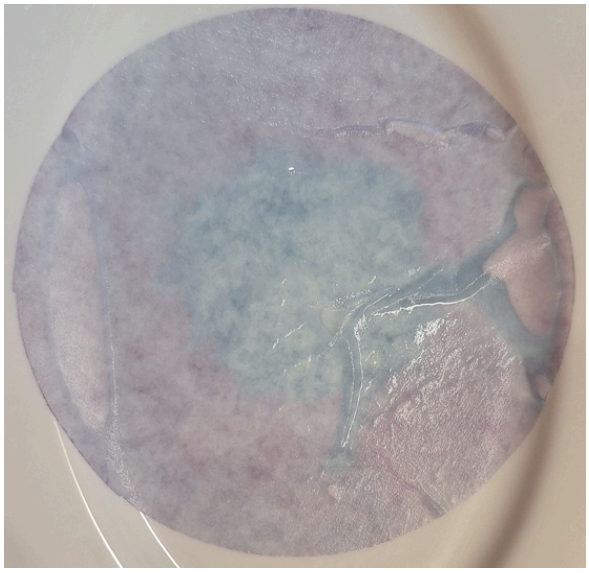


Figure 2. a) Dry target, b) Baking soda solution applied to target,



c) Target wet in the rain (just water),



d) Baking soda solution applied to target in the rain

5. Only one UAV is permitted for this task.

Table 6: *Fire Extinguishing (Task 2) Scoring*

Criteria	**Score**
Target Extinguishing: ● Nominal points per target ○ Points per indoor targets: *PI = 40 pts/total number of indoor targets* ○ Points per outdoor targets: *PO = 30 pts/total number of outdoor targets* ● If *NI* indoor targets and *NO* outdoor targets are extinguished, then the total score for this criterion will be as follows: *Score = PI*NI + PO*NO* ● False declarations: Each target declared as extinguished by the operator that turns out to not have met the requirements will receive no points and will incur a penalty: ○ -*PI* pts, if indoor ○ -*PO* pts, if outdoor ○ Penalties cannot make this criterion go below 0 pts.	70
Flight Autonomy: ● Autonomous takeoff from flight line = 5 pts ● Autonomous target extinguishing* = 20 pts ● Autonomous landing at flight line = 5 pts Note: A single successful demonstration will be sufficient to earn points for that criterion. *Autonomous target extinguishing requires all of the following to be demonstrated and they all must be done autonomously: all approach/positioning of the UAV starting from	30

more than 2m away from the target in directions parallel to the plane the target, the aiming (any type of target tracking/locking on) of the water, and a successful target extinguishing including image capture and upload.	
Compliance with Big City RTM SOPs: ● Complete compliance = 15 pts ● One error = 10 pts ● Otherwise = 0 pts	15
Safe Landing at Flight line: ● UAV is landed safely at flight line at the end of the flight window = 5 pts	5
Total Possible Score	**120**

5.2.5. Flight Preparation

Teams will be scored on their preparation according to the criteria in Table 7. Teams will be assessed on the criteria separately for each flight window. For each criterion, the minimum score of the two attempts will be taken.

Table 7: *Flight Preparation Scoring*

Criteria	**Score**
Team is on the flight line with all required equipment 30 minutes before their flight window, and ready to fly at the start of the flight window.	10
Team is well organized, with an obvious and effective leader, obvious tasks for team members, good cooperation between team members, and good problem solving. ● All characteristics observed = 10 pts ● Some disorganization, lack of leadership or cooperation = 5 pts ● Disorganized, no real leader, arguing, poor problem solving = 0 pts	10
UAS is designed for easy set-up, with easily assembled components, use of switches rather than connectors at flight line, logical and efficient set-up/initialization procedures, etc. ● All characteristics observed = 10 pts ● Some flaws in design for easy set up, but overall well designed = 5 pts ● Easy set up clearly not part of the design = 0 pts	10
Checklists are used for flight preparation: ● Effective and organized use of checklists = 10 pts ● Ad-hoc semi-use of checklists = 5 pts ● No checklists = 0 pts	10
Total Possible Score	**40**

To summarize, the total score available for Phase 2 is shown in Table 8:

Table 8: *Overall Phase 2 Scoring*

Criteria	**Score**
Presentation	40
Task 1 – ***Fire Reconnaissance***	100
Task 2 – ***Fire Extinguishing***	120
Flight Preparation	40
Total Possible Score	**300**

5.3. Phase 3 Mission Report

Phase 3 provides an opportunity for bidders to summarize their performance in Phase 2 and reflect on lessons learned. The Mission Report is due 2026-06-03 1700 ET, after the completion of Phase 2. Submit the Mission Report to your team's Google Drive folder. Note: Bidders will not be scored on their flight performance in this report; only on the quality of their analysis.

The report is limited to 5 pages and may be submitted in French or English. Any contents past 5 pages will not be read. Points will be allocated as shown in Table 9:

Table 9: *Mission Report Scoring*

Mission Report	**Score**
Mission Performance: Summarize the events of your team's attempts at the flight tasks. What went according to plan? Did your system and strategy perform as intended?	20
Lessons Learned: How did you address any problems that arose, and how would you mitigate them in the future? How could your UAS and/or operational approach be improved?	25
Spelling and Grammar Clarity of Organization	5
Total Possible Score	**50**

Appendix A: Abbreviations

Abbreviation	Definition
AEAC	Aerial Evolution Association of Canada
AGL	Above ground level
BCFD	Big City Fire Department
BVLOS	Beyond visual line of sight
CARs	Canadian Aviation Regulations
CONOPS	Concept of operations
C2	Command and control
ET	Eastern time (zone)
ISED	Innovation, Science and Economic Development Canada
FRR	Flight readiness review
GCS	Ground control station
GPS	Global Positioning System
RC	Radio control
RFP	Request for proposal
RPAS	Remotely piloted aircraft system
RTM	RPAS traffic management
SOP(s)	Standard operating procedure(s)
SFOC	Special flight operation certificate
UAM	Urban air mobility
UAS	Unmanned aerial system
UAV	Unmanned aerial vehicle

Appendix B: Contact List

Purpose	**Contact**
Administrative questions	Sue Chapman, Process Manager sue.chapman@aerialevolution.ca Alexandre Panneton, Student Coordinator alexandre.panneton@aerialevolution.ca
CONOPS and rules	Katrina Cecco, Chief Judge katrina.cecco@aerialevolution.ca
All other inquiries	competition@aerialevolution.ca

Appendix C: Area XO Flight Boundary GPS Coordinates

These GPS coordinates are given as an example only. The actual coordinates for the flight boundaries for Task 1 and Task 2 will be given at the start of Phase 2.

Table C1: Example Soft Flight Boundary GPS Coordinates

Long	Lat
-75.7554276757985	45.32367641417768
-75.75962293828579	45.32458685710282
-75.76056991480061	45.32221014356596
-75.76227668005403	45.32253485097251
-75.76991841610813	45.32021578068866
-75.76488369382488	45.31148085668646
-75.7622660971596	45.30816385788635
-75.75720409117234	45.3101579403477
-75.75529985697551	45.31275849919756
-75.75339424242847	45.31759975636428
-75.75617813167629	45.3183086427325
-75.75711137146315	45.3194451302148
-75.7554276757985	45.32367641417768

Table C2: Example Hard Flight Boundary GPS Coordinates

Long	Lat
-75.75552497233609	45.32364675545762
-75.75957476995694	45.32452461472617
-75.76051834049628	45.32215057992719
-75.7622761838046	45.32248132616257
-75.76982191199021	45.32018798540605

-75.76728763194127	45.31585084970293
-75.76474928813522	45.31156228860443
-75.76223157962352	45.30825077607238
-75.75730181710476	45.31021851143839
-75.75541551834813	45.31278978823779
-75.75354179308553	45.31754354139652
-75.75622827279575	45.31825403277738
-75.75722443932128	45.3194404642641
-75.75552497233609	45.32364675545762

Appendix D: Sample Task 1 Target Localization

Figure D1 shows a sample target localization for targets A (blue), B (yellow), and C (red).

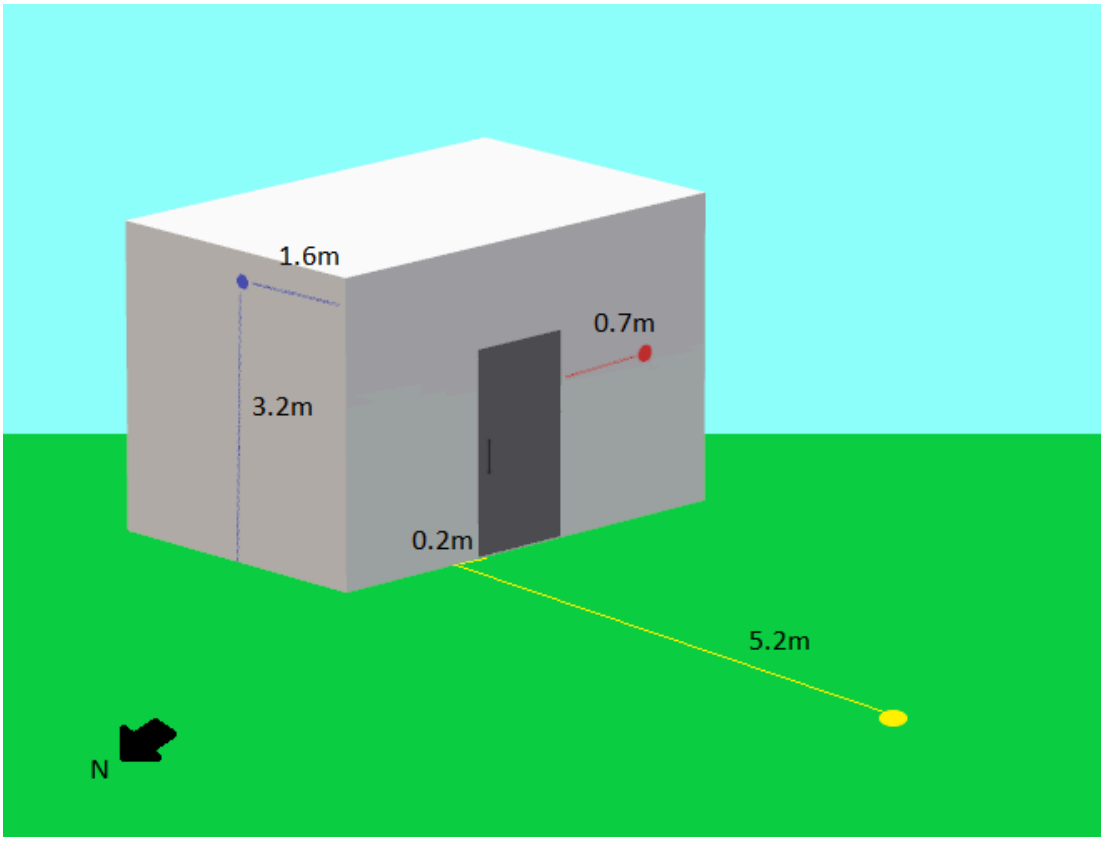


Figure D1. Sample Task 1 Firefighting Target Layout

Below are some examples of corresponding descriptions, and an evaluation of their ambiguity in 3D space:

"Target A is on the north face of the building, 3.2m above ground and 1.6m from the western wall. The colour is blue." **Correct - location is fixed in 3D, colour is correct**

"Target B is on the ground, 5.2m away from the west face of the building and 0.2m left of the door when facing it from the outside. The colour is green." **Partially correct - location is fixed in 3D, but colour is incorrect**

"Target C (red) is on the west face of the building, 0.7m right of the door when facing it from outside." **Partially correct - Colour is correct, but location is ambiguous in height dimension**

Appendix E: How to Maximize Your Success!

This section includes some (non-binding) tips based on teams' past experiences.

Winning a competition is like doing well on an exam; the results reflect the effort that was spent preparing for the event. By the time the teams arrive at the competition site, development work should be complete and systems tested and backed up. The actual competition should be an extension of the ongoing proof of your system design. Teams must apply proven project management techniques and procedures that will allow them to manage both time and resources effectively. The following are comments based on experience from previous competitions; ignore them at your peril!

Planning

The first and most important suggestion: Read the CONOPS! Understand exactly what you must accomplish and how much each component of each Task is worth! Deliver the results that are asked for!

Monitor Key Dates closely for timely submission. Set up your team's workflow to ensure everyone is comfortable in their task with clear expectations and timelines. Complete all documentation accurately and on time. Allow more time than you planned on, particularly where personal information is involved. Don't hesitate to contact Sue Chapman: sue.chapman@aerialevolution.ca

Now would be a good time to develop a schedule with clearly identified milestones that will serve as go/no-go points. Regularly review the schedule and adjust the timelines. This will allow the team to change direction before additional effort is expended working on a suboptimal solution and ensure effort will not be concentrated at the end of the academic year.

Implement a sound risk management process. As a first step, create a risk register that will serve as a basis for the initial risk assessment, evaluating risks based on probability and impact. Revisit the risk analysis to reassess items and identify new risks. Many of the failures observed at the competition could have been avoided had the team used a more disciplined project management approach during their system development process.

System Design

Create a design that is simple to prepare and operate. Have access panels that are easy to operate… and then have them completely closed before the flight window. In previous competitions, it was amazing how much time was wasted by teams, either in the tent or on the runway, hooking things up, soldering, and taping panels, etc., during their flight window! Make sure your design makes it easy to swap key components, like, say, batteries!

Think about the flow for setting up and conducting the flight, and how your design can minimize the time required once the flight starts. You should have everything ready to go and tested well before your

flight window, such that when your flight window opens and you're able to transmit, you can quickly check to confirm things you already know are working are still working… then get airborne.

Consider off-the-shelf components, where possible, in the design. For example, teams may consider the use of a carbon fibre frame kit as the basic airframe with custom propulsion and avionics, or they may choose to use a small-scale commercial autopilot in a custom designed airframe. Remember that using fully off-the-shelf UAVs is prohibited.

Preparation at Home

As the competition date approaches, conduct a risk management process specific to the venue and event. This is critical because there are certain risks – high winds, for example – that could easily make requirements other than UAV performance the deciding factor in winning the competition. Prepare contingency plans.

Prepare PRINTED procedures and checklists, and PRACTICE using them.

Make sure you have a leader… who can orchestrate all activities in a calm manner according to procedures you've planned… and who understands the systems and people to make calm decisions when things don't go according to plan.

Consider potential failure modes and crash breakage and create a 'medical kit' of extra parts and supplies to enable you to get back in the air as soon as possible.

Conduct extensive testing of all aircraft and other systems, including all integrated together.

Be ready to fly in all weather/wind conditions! One year, the entire weekend had howling winds and most teams crashed at least once. Look up and understand 'dynamic rollover' – in high winds you need to transition the UAV from solidly on the ground to away from the ground quickly… and the reverse on landing.

Conduct actual flight trials simulating the entire competition from start to finish, including set up and initiation of systems within the flight window. Make sure every member of the team knows exactly what they are supposed to do and when they're supposed to do it. Make sure the required technical and flight procedures are known by EVERY member of the team.

Just a suggestion: Skydivers practice 'dirt diving', where a jump is rehearsed on the ground so everyone is clear on the sequence of the formations, the grips they need to take, etc. Use the Dirt Dive concept to prepare for the competition; get your whole team together and mentally run through the entire scenario, from arrival at the set-up site to completion of the mission, including every action that every member of the team must take, talking through it in as close to real time as possible.

On the Flight Line

Arrive on the flight line no later than 60 minutes before your flight time.

Use your checklists to make sure everything gets done in the proper sequence! Use cables to test all telemetry/RC if possible, as you cannot transmit outside your window.

Have all equipment ready to fly at least 10 minutes before your flight window.

Move the aircraft to a location where it can be immediately moved onto the field at the start of your flight window. Many teams in previous years did final checks in the tent and then wasted time moving the system out to the field.

At the start of your flight window, establishing wireless communications between components and confirmation that they all work should take no more than a minute. There should be no hooking up of connectors at this point! If you must connect, assemble, close or tape anything during your flight window, you screwed up your system design or your pre-flight preparations.

Papers and Presentations

When the judges are scoring your Phase 1 Papers, they are looking for the requirements outlined in this document... the easier it is for them to find the requirements in your paper, the better!

The Pre-Flight Presentation is intended for an audience of clients… they're not interested in a lot of technical detail. They need to be told exactly how you're going to accomplish their mission and how you're going to meet their requirements. The presentation should not mention the competition! In essence, play the game – it's important to embrace your role as the service provider of a drone solution and pretend that you're actually conducting the briefing to a client.

The Mission Report should include an analysis of your team's performance in the flight tasks and/or preparation throughout the year, as appropriate. Judges are looking not just for a summary of what happened, but a critical evaluation of your team's organization/design/flight strategy/effort, as well as some lessons learned.

Appendix F. Big City RTM SOPs - Notice to Operators

1.0 Callsigns

1.1 Callsign Formatting

Each aircraft must be registered with a callsign of the following format:

<aircraft model OR manufacturer name> 111A

where As represents letter(s) and 1s represent number(s) of the operator's choice. For example, an aircraft with the model name Firefighter may be registered as Firefighter 406K.

1.2 Callsign Registration

Callsigns must be registered with Big City in advance of any flight.

1.3 Callsign Abbreviation

The first time the operator says their callsign as part of an exchange with Air Traffic Control (ATC), they must use their full callsign. For subsequent radio calls within the same exchange (i.e. continuous back-and-forth with ATC), the operator has the choice to use their abbreviated callsign with just the last numbers and letter. For example, Firefighter 406K becomes 406K. After the exchange with ATC ends, the operator must use their full callsign again at the start of the next exchange.

2.0 Communication Protocols

2.1 Radio Link

Radio link must be maintained with ATC for the duration of the flight.

2.2 Radio Equipment

a) One handheld radio per aircraft will be provided to operators. The radio will be tuned to the ATC frequency. *(*Note: this is a simulated ATC on an unlicenced radio frequency. No radio operator licence will be required).*
b) Substitutions of radio equipment are not permitted.
c) The radio operator must not be the pilot-in-command.

2.3 Test Communication

a) Upon receiving their ATC radio, operators will issue a test communication with their callsign "<callsign> to base, radio check."
b) ATC will reply with ratings indicating the operator's signal strength and clarity, 1 to 5 with 5 being excellent. E.g. "Five by five."

2.4 Open Frequency

Operators should expect ATC to be communicating with multiple aircraft and should listen for their own callsign.

2.5 Letters and Numbers

When read aloud, letters and numbers must be stated using the ICAO phonetic alphabet conventions. For example, the callsign “Firefighter 406K” would become “Firefighter Four-Zero-Six-Kilo.”

2.6 Headings

a) Headings will be reported in degrees, using three digits even if there are leading zeros. For example, 50 degrees becomes “Zero-Five-Zero”; operators need not state “degrees” since it is implied.
b) In all cases, headings will be reported clockwise from magnetic north, not true north.
c) A heading of north will be reported as “Three-Six-Zero”, not “Zero-Zero-Zero.”

2.7 Dispatch Communications

a) Big City emergency dispatch supports briefing first responders on emergency scenarios (e.g., the nature of the emergency, building locations, search volumes) over radio. The dispatcher will transmit “Dispatch to <callsign>, acknowledge.”
b) The operator will reply “<Callsign> to dispatch, go ahead.”
c) The dispatcher will give the briefing of the emergency.
d) The operator may ask the dispatcher to repeat information or ask questions to confirm their understanding. Once the operator has finished receiving the briefing and is ready to respond to the emergency, they will transmit “<Callsign> Wilco.”

3.0 Standard Flight Procedures

3.1 Takeoff Clearance

a) When taking off from a Big City registered vertiport, operators must request a takeoff by broadcasting “<Callsign> to base, request takeoff.”
b) ATC will reply “<Callsign> you are clear for takeoff.”
c) The operator must acknowledge: “Cleared to takeoff, <callsign>”, after which point the operator may take off.
d) Once the operator has taken off, they must transmit: “<Callsign> takeoff complete.”
e) If the operator fails to take off within 5 minutes of receiving clearance, they must transmit “<Callsign> to base, takeoff delayed,” and begin again from step a).

3.2 UAM Corridor

a) All RPAS air traffic will be restricted to the UAM corridor altitude range, between 20m to 35m, except when close to their takeoff point and destination.

b) After taking off from a registered vertiport, aircraft must enter the UAM corridor and stay in it for at least 30 seconds.
c) Upon entering the UAM corridor, the operator must transmit “<Callsign> entering corridor.”
d) Upon departing the UAM corridor, the operator must transmit “<Callsign> has left the corridor.”
e) If the aircraft enters or departs from the UAM corridor as the result of an emergency maneuver, the operator will make the appropriate transmission in c) or d) as soon as they are able. Priority will be given to emergency radio calls.
f) If the aircraft departs from the UAM corridor as the result of an emergency maneuver, it must rejoin the corridor when it is safe to do so.

3.3 First Responder Approaching Building

a) Operators of first responder aircraft attending to a call within a given search volume around a building must transmit “<Callsign> operating near the building” when they enter the search volume boundary.
b) This transmission does not need to be repeated again during the same flight.
c) If the operator lands and then begins a new flight from a Big City registered vertiport, step a) must be repeated when appropriate.

3.4 Landing Clearance

a) When landing at a Big City registered vertiport, operators must request to land by broadcasting “<Callsign> to base, request landing.”
b) ATC will reply “<Callsign> you are clear for landing.”
c) The operator must acknowledge: “Cleared to land, <callsign>”, after which point the operator may land.
d) Once the operator has landed, they must transmit: “<Callsign> landed.”
e) If the operator fails to land within 5 minutes of receiving clearance, they must transmit “<Callsign> to base, takeoff delayed,” and begin again from step a).

4.0 Emergency Procedures

4.1 Airspace Deconfliction

a) ATC will alert the operator “Base to <callsign>, traffic inbound from heading <TRAFFIC_HDG>, altitude <TRAFFIC_ALT>; correct course.”
b) The operator must transmit “Correcting course, <callsign>.”
c) The operator will determine a course correction based on the following:
    i) The operator will select a new heading +/- 90 degrees from the heading TRAFFIC_HDG. For example, if TRAFFIC_HDG is given as 050, the operator may select either 140 or 320.

ii) The operator will select an altitude that is at least 15m from TRAFFIC_ALT. The operator's aircraft must not cross through TRAFFIC_ALT unless there is no other way to achieve the 15m safe altitude buffer. For example, if TRAFFIC_ALT is 70m and the operator's aircraft is at 80m, the operator may select any altitude 85m or greater.

d) The operator must make the heading correction, fly along that heading for at least 10m, and report "Flying heading <NEW_HDG>, <callsign>."
e) After the heading correction is made, the operator must make the altitude correction and report "Climbing/descending to <NEW_ALT>, <callsign>", as appropriate.
f) The emergency procedure is concluded when ATC transmits "Base to <callsign>, traffic avoided."

4.2 Yield to Medevac

a) ATC will alert the operator "Base to <callsign>, priority flight inbound, fly <DISTANCE> <DIRECTION>, climb to 50m." <DIRECTION> may be given either as a heading (e.g. "fly 50m heading 090") or cardinal direction (e.g. "fly 50m east").
b) The operator will reply: "Confirm fly <DISTANCE> <DIRECTION>, climb to 50m, <callsign>."
c) The operator will move their aircraft from its current position to a new position at least <DISTANCE> away in the given direction, and to an altitude of 50m.
d) Once part c) has been completed, the operator will transmit "<Callsign> to base, yielded."
e) ATC will reply "<Callsign> affirmative, hold position."
f) The operator will keep their UAV outside of the safe radius and at 50m altitude until ATC transmits "Base to <callsign>, continue mission."

4.3 Ground All

a) ATC will transmit "Base to all, land immediately."
b) The operator will immediately conduct a landing in a safe place.
c) When landed, the operator will transmit "<Callsign> to ATC, landed."
d) The operator must keep their aircraft grounded until ATC transmits "Base to all, resume flights", at which point they may take off and continue their mission.

Appendix G: Teams Q&A

1. For task 1, Conops explains that the minimum number of laps between the possible 2 UAVs will be taken as your number of laps, we were wondering if this applies only to UAVs carrying equipment or any UAVs being flown? If only one UAV were to carry equipment and fly laps, while another completes another aspect of the challenge, would the second UAV's 0 laps overrule the laps flown with equipment?

> The lowest lap count is taken irrespective of what the UAVs are carrying. Imagine it as deploying your UAV(s) from a common starting point to the scene: you are trying to demonstrate how far away the scene could be to get your whole system there.

2. Are there any partial points for autonomous target extinguishing if parts of the described sequence are done autonomously and others are not?

> No partial autonomy points are given for fire extinguishing.

3. We noticed that there are rules surrounding "seeking prior knowledge about flight task setup before attempting the task", does this rule mean we can't watch the teams before us fly the task?

> You may watch other teams and cheer them on from the flight line. The details of the task setup will be equally visible to all teams from the flight line, so this is not considered cheating.
>
> You may not, e.g., drive alongside the property to try and look at the scene up-close, or ask other teams how many targets they found/where things were at the scene/etc. before you fly. These are the sort of actions we are discouraging with the uncooperative behaviour clause.

4. Phase 3 is new this year, but since it is due over a week after competition, does this mean that the final competition rankings will not be released at the awards banquet as per usual? How will this work?

> Phase 3 is a separate ranking, just like Phase 2 is separate from Phase 1. Phase 3 rankings will be announced sometime after the banquet - TBD. We don't give an "overall" score for all phases combined.

5. Will the circular targets be the same between task 1 and task 2, specifically, will the paper circles be the same between tasks? Task 1 outlines a variety of colours the targets could be, will this apply to task 2 as well?

> The circular targets used in task 2 will be different than task 1. Task 2 will have targets of a single solid colour, depending on what we can source.

6. What will the format of the building coordinates be? In particular: at what point of the building will the coordinates represent (center, corner, etc)? Will any altitude be included in this coordinate?

> The coordinates will be given as a single lat/long pair for the building, with no altitude. They are not intended to represent any particular part of the building (centre, corner, wall) - they are only

to let you know which of the buildings at Area XO is the one of interest for the task. This applies for task 1 and task 2, which may be different buildings.

7. Will any information such as door location be provided or just the general building dimensions?

For task 1, all critical building dimensions will be provided so that you could re-construct a 3D model of the building exterior from the dimensions. No other information on scene landmarks (doors, windows, paths/roadways or other features) will be given. For task 2, no information about building dimensions or landmarks will be given. Also see previous answer for info on building coords and what they do/do not include.

8. Can the UAVs land during equipment deliveries for task 1?

Yes, UAVs may land to deliver equipment for task 1.

9. Can anything other than water be left behind in the building for task 2 (such as LED beacons)?

Nothing aside from water should be left behind.

10. Would an autonomous approach where the pilot takes manual control up to 2.5 meters away from the target and then the vehicle automatically initiates wetting without moving earn the full set of autonomous points?

Aiming has to be done autonomously to get full autonomy points ("aiming" will look different for each UAS but is intended to encompass any type of target tracking/locking on). Positioning the UAV manually and auto-starting your water system in place fails with respect to this criterion. Auto positioning within 2m of the target in directions parallel to the plane of the target is also required to get full autonomy points. Note: for clarity, Table 6 has been updated with the highlighted change.

11. Does a landed UAV unloading its payload by gently dropping it a few centimeters off the ground constitute a proper delivery? Is there a requirement that the mechanism for releasing the payload must make contact with the ground before it is fully ejected?

Good question--dropping from the ground will not be counted as airdropping the equipment, so it is permitted. If you're dropping from some small elevation from a landed UAV, just make sure that you do not damage the payload. There is no requirement for the mechanism itself to touch the ground. We are just trying to ensure our payload survives as many flight attempts as possible!

12. If a fixed wing aircraft were used for day one and it were to land slightly away from the target location, then taxi over to deposit the payload, would the payload count as deposited where it was released from a vehicle or where the vehicle initially landed before it started taxiing?

The equipment delivery will be scored at the point where the equipment finally comes to rest and you stop making adjustments to its position. You can use whatever aircraft type/positioning strategy to position the equipment.

13. While completing laps on day one, if we're using multiple vehicles, can one vehicle carry the other through the laps and then both vehicles can separate from one another once the laps are completed?

This is permitted.

14. Would compressed gas - such as small CO2 cartridges, be permitted on the drone for Task 2?

See answer for Question 19.

15. Will the objects for task 1 be standard shapes (rectangular prisms and cylinders) with the dimensions given, or will they be the shape of an actual radio, ladder, and CO2 tank? Will these objects have a smooth or rough surface?

The task 2 payload will be actual objects within the size range mentioned, not simplified cylinder/prism "custom" payload. Be prepared to accept a variety of geometries - the ambiguity is part of the challenge of this task. The surface roughness will also vary.

16. How the paper targets for task two will be held in place? What happens if our extinguishing method moves and/or rips the paper, will this still count as extinguished?

Targets will be pinned or taped down around the perimeter so they don't flap in the wind. We will try to have them sturdy enough that they don't break when wet, but if they rip or break that is ok as long as we can see that they have been wet by your system first.

17. Currently the ladder is listed as being "up to 3kg and 15x60x120cm". We were wondering if more specific details about the ladder will be posted in the future (i.e. exact dimensions, rung distances, weight) or if this is an intended ambiguity. The most preferable thing for our team would be if the exact ladder model could be linked once it is decided so that we can purchase one ourselves for testing.

The equipment models are being kept ambiguous on purpose! We will not be releasing an exact model of the ladder, etc. that we will use, so you can expect anything up to the max weight/size range.

18. Is there any way we could get some more detailed specifications of what the building might look like for task 1 and 2 (i.e. what the shape of the building might be, how many rooms there could be, where a door might be located/how many doors there could be)? Again, this may be an area where ambiguity is intended but if not we would appreciate some more details once they become available.

Since Area XO is an active test site for all kinds of university experiments, we have been refraining from giving details on the selected buildings to ensure fairness to all teams. However: for Task 2, we will only be using one entrance door, and its dimensions are given in the CONOPS. We will not ask you to pass your system through any doorways/openings smaller than that door.

19. Are we allowed to build water pressure within an onboard tank during our task 1 flight (similar to how a typical water gun would function)? We have tried to find information on whether this is allowed in the CARS but haven't been able to find a clear answer.

Compressed gases will be permitted subject to the CARs and appropriate regulations. The competition committee will not impose additional restrictions above CARs/TDG.

For compressed air, check TDG 2.14.1/Schedule 1/Schedule 3 to ensure your payload is not considered hazardous according to TDG. Transportation of Dangerous Goods Regulations, see 12.1. For questions about compliance, please contact Transport Canada.

Note: Question 14's answer has been amended with respect to this response.

20. Based on our interpretation of the CARs, it is permitted to place a laser pointer on an RPAS in controlled airspace provided its output power is less than 1 mW. We plan on using a Class 1 laser that has an output power less than 0.5 mW, which is eye-safe even with a direct hit. Additionally, we will set up the laser pointer(s) so they are only active when pointing at the ground, and never shone into navigable airspace. Could you please confirm if using these low-power laser pointers under these strict operational conditions is permitted?

Class 1 lasers are compliant with CARs if used in the manner you described. For lasers in the visible spectrum, the committee will enforce that these may be used as long as they are pointed straight down.

21. We wanted to confirm the mass of the ladder specified in the rules. We have spent considerable time searching but were unable to find a ladder matching both the specified mass and size. The closest we could find is the same size but approximately 30% heavier than the mass listed. Could you clarify if the specified mass implies a specialized material (e.g., carbon fiber), or if we should anticipate the final provided ladder being smaller than the specified size?

The ladder will not be a specialized material. It may be lighter or smaller than the specifications given in the CONOPS -- those are maximums.

22. How does the weigh-in for the Day 1 payload fraction score work? Specifically, regarding the selection of batteries: If we win Phase 1 and decide to go last, could we switch batteries? Or, must we lock in the specific battery and confirm its mass during our flight readiness review, regardless of our assigned flight order?

The payload fraction will be scored using the mass measured during the FRR. As always, once the FRR weighing is done, you are locked in to that takeoff weight (and therefore payload fraction). If you make any modifications that change the mass of your UAV between the FRR and your flight window, you will have to redo the FRR weigh-in again before you fly. In this case, the new weigh-in will be used for the payload fraction calculation. However, this new weigh-in will need to be done during your flight window, because we will not be running FRR all weekend.

23. If we are allowed to drop equipment a few centimeters, can this be performed while the RPAS is airborne (e.g., in a hover) or only after the RPAS has landed?

Read the CONOPS re: airdrop.

24. Can you provide any information regarding the ability of the various communication links teams will be using to pass through the building walls? Specifically: Will the ~~4x4m~~ entrance be oriented such that signals can simply pass through it for all indoor operations? Is the difficulty of achieving acceptable link quality through the building walls intended to be one of the challenges for this year's competition?

> Yes, link quality is meant to be a challenge/risk for Task 2 this year. We cannot provide information on the transparency of the walls to certain communication links. The ~~4x4m~~ entrance will be open to the outside; however, it may not be pointed in a clear line-of-sight to the flight line.

25. Concerning the section 5.2.4 of the document, the point 4.a mentions that targets may be inclined but not on the ceiling, does that mean no targets will be over the drone (for purposes of the fire extinguishing design). Is there a possibility that a target will be located above the drone flight path (e.g. near the ceiling, or even inclined, but not quite on said ceiling)?

> Yes, there is a possibility the targets will be higher than the flight path. However, the task will be designed so the targets will not be straight above the UAV, i.e. you should not have to fly directly below the target and shoot water upwards.

26. How reflective we should expect the Task 1 targets to be?

> We are intending to use solid-colour plastic, so they should not be especially reflective. We will not be trying to make them reflective as a challenge.

27. Task 2: Wouldn't the puddles of water left by prior teams affect later teams? Of course, it wouldn't be a problem if the ground dries in time, but I'm not sure if that will happen.

> This is a good insight! Patches of baking soda solution with a non-neutral pH can easily be diluted by having the judges splash more water on them. As mentioned in the townhall, we are planning to put targets on a white plastic backing which should prevent contact of the target paper with any puddles in any case.

28. Would a specialized transponder UAV be accepted for task 2? I understand that the CONOPS permits only one UAV for task 2, but we're afraid that we'll lose connection / broadband video capabilities within the metal shed (it should be a faraday cage). The mission would be impossible if we couldn't communicate with the drone.

> We are unable to allow 2 UAVs for Task 2. Yes, indoor target extinguishing will be extremely difficult and a high-risk task, and we are expecting some creative solutions. However, to balance this out, we have added lots of ways to earn points in the tasks this year. Teams are always encouraged to attempt the tasks that they find most feasible and/or motivating.

29. For the live confirmation of targets being extinguished, may it come from an FPV camera that is distinct from the autonomous image-acquisition system used to save and upload images. Could we use an FPV system to show the judge the extinguished targets and separately save the images with another

camera and onboard computer before uploading them? Is a video sufficient or does it need to be a still image?

> You may use an FPV and/or separate camera system as needed. A short video or a video frame (still image) would be accepted to show the target is extinguished; we just need minimum one video frame that shows the target has been extinguished. For autonomy points, all the criteria in 5.2.4 4e) must be done autonomously by your system, including deciding and declaring that the system extinguished.

30. For the autonomous upload, how autonomous does this have to be? Are we able to plug into the drone once it's landed to initiate the upload or does it have to be fully wireless and autonomous within the flight window?

> 5.2.4 4e) stipulates real-time for uploads, because judges will be checking for extinguished targets at the end of the window. As per the definition of "real time", we will accept some lag between the target extinguishing and the image upload because there will necessarily be some latency for onboard processing and then uploading. However, we will be looking to see that the whole extinguishing pipeline, complete with upload, is finished before carrying on to the next part of the mission (i.e. moving to the next target). To count as autonomous, the upload process should not require human intervention including plugging things in, pressing buttons, or running scripts.

31. The actual demonstration and declaration of the target being extinguished can be done by the operator as long as the drone is also deciding itself what is extinguished and saving that image autonomously? The final tally will count the number of extinguished targets and compare it against what the drone has saved as extinguished? What happens if the drone and operator say different numbers? Is one held as ground truth?

> For autonomy points: All points of the extinguishing pipeline need to be done autonomously. This means the UAS should be able to display the image and a confirmation that the target has been extinguished (text, a sound, etc.) - something to draw the attention of operators/judges.
>
> For ground truth: we will be checking each target individually, and confirming that each individual target you claim was extinguished is actually done properly. Incorrectly extinguished targets will incur penalties as per the CONOPS. If you are demonstrating autonomy, it should be the UAS and not the human operator who declares the target(s) extinguished. So even if you so a mix of manual and autonomous extinguishing, there should be only one declaration per target - drone and operator should not be in conflict over any given target.

32. Does each component for task 1 need to touch the ground before being removed/let go of by the drone or does the drone need to land at that is fine? If the parts need to touch first what constitutes the part where they mention "close enough" to the ground to count?

The equipment must touch the ground and/or the drone must have been landed before it is released. So if the drone has landed, that is fine. But any damage to the equipment will result in 0 points - see CONOPS.

33. Can we clip on and off the safety mechanism for the propellers to put it in place?

Yes, the propeller safety mechanism must be used whenever your team is working near the propellers.

34. For task 1, particularly the dropping off equipment part. When it's time to land the drone, can we have a human pilot use the RC transmitter (the joysticks) to land the drone and then a physical button is used to trigger the esp32 to move the servo and 'drop' the equipment. This seems like the straightforward solution that fits the requirements.

There is nothing in this strategy that is not permitted by the rules!

35. In the CONOPs for the upcoming competition at Area X.O., we noticed that there is a flightline building. Will we be restricted to keep all our equipment and antenna tripod within the building, or would it be possible to set up outside in front of the building?

We will have a very large enclosed tent for all teams to work under at once (the "hangar" tent), and 3-4 smaller tents at the flightline for the teams actively flying or prepping.

36. We would like to get more details on how the laps will be calculated. How will the distance be counted? Do we need to keep the left or right of GPS coordinates like for instance in boat racing? Will it be visual flags? Do we need to pass in between 2 GPS coordinates? Is a lap counted as a full closure, or can we do one and a half lap and still get partial points?

We will be counting only # of complete laps of the course, not distance. The CONOPS details what happens in the event of a tie in # of laps. The course will be given as GPS waypoints and we will identify the order you need to fly around each waypoint. Typically when we do this, we let you fly along the path so that you pass *through or around the outside* of each waypoint - i.e. no cutting corners. It depends on the shape of the course that we set; we will let everyone know these details when they get the waypoints at Phase 2.

37. How much time will we have to send files for Task 1 and Task 2? Do we have to send them during the flight window or do we have a buffer time after?

This is already answered in the CONOPS for both tasks.

38. We are wondering how you plan on quantifying “damage” [to the firefighters’ equipment] during the competition, and what amount of damage would be disallowed. Our team plans on landing the drone before dropping the payload. However, the payload items will drop about 30cm from the drone to the ground. Is this allowable?

We want to ensure that our payload gets delivered safely without compromising firefighters' ability to use it at the scene, or equivalently, that subsequent teams can use it for their mission without having its properties greatly changed. In the spirit of this, we will permit scuffs and scratches. We will not allow dents, cracks, bent material, or any other damage that changes the shape of the equipment. Dropping from 30cm is allowed, as long as the above damage can be avoided.