AERIAL EVOLUTION ASSOCIATION CANADA 2025 STUDENT COMPETITION

CONCEPT OF OPERATION (CONOPS) DOCUMENT

To enhance realism in the 2025 competition scenario, this CONOPS document is in the format of a 'Request for Proposal (RFP)' from a mythical Ministry of Forests who wishes to assess concepts for a wildfire detection and response capability. Student teams will act as industry bidders to create concepts, design a firefighting Unmanned Aerial System (UAS), and compete in a sub-scale assessment of their designs. Their Phase 1 'design papers' will be in the form of Proposals in response to the Ministry of Forests RFP.

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	September 11, 2024	Initial issue
1.1	October 9, 2024	Task 2 scoring details changed, confirmed registration fees (team and per-student), team Q&A additions
1.2	January 3, 2025	Adjustment of Phase 1 and Phase 2 scoring to account for increased number of participants. Team size cap added. Team Q&A additions
1.3	February 10, 2025	Details on insurance requirements, RPAS Safety Assurance declaration. Site survey tour and limitations on flightline access times during tasks. Teams Q&A.

AEAC 2025 Student Competition

Contents

- This Document 3
- Background 3
- Assessment Format 3
- Eligibility and Administrative Requirements 3
- Key Dates 3
- Scenario 4
- Mission Requirements 4
- Phase 2 Assessment Schedule 5
- Task 1 – Hotspot Detection and Mapping 5
- Task 2 – Water Transport 7
- UAS Design Constraints 8
- Flight Schedule 9
- Flight Crew 9
- Evaluation Criteria 9
- Phase 1 Proposal 9
- Phase 2 Bidder's Presentation 11
- Task 1 – Hotspot Detection 12
- Task 2 – Water Transport 13
- Flight Preparation 14
- Post-Flight Report 15
- Overall Flight Assessment Scoring 15

Annex A – Eligibility and Administrative Requirements 17
- General 17
- Team Size and Composition 17
- Number of Teams 17
- Applications and Registration 17

Annex B – Safety Requirements 17

Annex C – GPS Coordinates 21

Annex D – Sample Task 1 KML File 22

Annex E - Questions from Teams 23

Annex Z. How to Maximize Your Success! 25
- Planning 25
- System Design 25
- Preparation at Home 26
- On the Flight Line 26
- Papers and Presentations 26

CALL FOR PROPOSALS

WILDFIRE DETECT-AND-RESPOND SYSTEM

PROTOTYPE DEVELOPMENT AND EVALUATION

Conducted as the 2025 Aerial Evolution Association of Canada Student Competition

This Document

1. This is a competitive Call for Proposals for design, development, and assessment of a drone-based wildfire detect-and-respond system.

Background

2. Following Canada's worst wildfire season ever recorded in 2023, the Ministry of Forests is looking to automate first response to small-scale wildfires with Unmanned Aerial Systems (UAS). Bidders are invited to propose their design for a system to meet the criteria specified below, construct a subscale prototype, and participate in head-to-head flight assessments.

Assessment Format

3. This solicitation will result in two activities:
   a. Phase 1 Proposal, in which proposals for the design and execution of the UAS are presented based on the requirements below, due 15 January 2025 at 1700 EST; and
   b. Phase 2 Flight Assessment, in which competing sub-scale prototype systems will conduct 'operational' flights according to the requirements detailed below. Phase 2 will take place 9-11 May 2025 at the Medicine Hat RC'ers Club Site at Len Young Memorial Field in Medicine Hat, AB; the assessment schedule is in Para 14.
4. All bidders must complete Phase 1 by submission of a Proposal to be eligible to participate in Phase 2. There will be separate awards for each Phase.

Eligibility and Administrative Requirements

5. Due to governmental procurement regulations, the eligibility and administrative requirements for bidders are unusual. Bidders are cautioned to pay attention to Annex A, which contains relevant details.

Key Dates

6. The following are the key deadlines for the response:
   a. 28 November 2024 at 1700 EST – Submit expression of interest to competition@aerialevolution.ca and complete online registration, which includes paying the $600+HST team registration fee.
   b. 15 January 2025 at 1700 EST – Submit Phase 1 Proposal.
   c. 2 April 2025 ~~(TBC)~~ – Submit team list and pay $330+GST fee for each onsite participant. Proof of Insurance due, as described in Annex B Para 17.
   d. 21 April 2025 – Submit video proof of successful flight, as described in Annex B Para 11. Submit RPAS Safety Assurance declaration (see Annex B Para 15).
   e. 9-11 May 2025 – Attend Phase 2 Flight Assessment.

It is critical that the above administrative deadlines are met to ensure your team's place at competition.

Scenario

7. The UAS will operate in a firewatch training site, doing hotspot detection and water transport.

Mission Requirements

8. The Phase 2 Flight Assessment will include two Tasks:
    a. **Task 1 – Hotspot Detection and Mapping.** Detect hotspots (represented by LED IR emitters), visually inspect the environment to identify the source of the fire, and rapidly generate a KML file.
    b. **Task 2 – Water Transport.** Deliver as much water as possible to targets (represented by tanks).
9. Both Tasks will be conducted at the Medicine Hat RC'ers Club Site at Len Young Memorial Field and over the adjacent field to the north (shown on Map in Figure 1). Bidders note: expect the possibility of high winds, such as 10-15kts with gusts to 25kts.

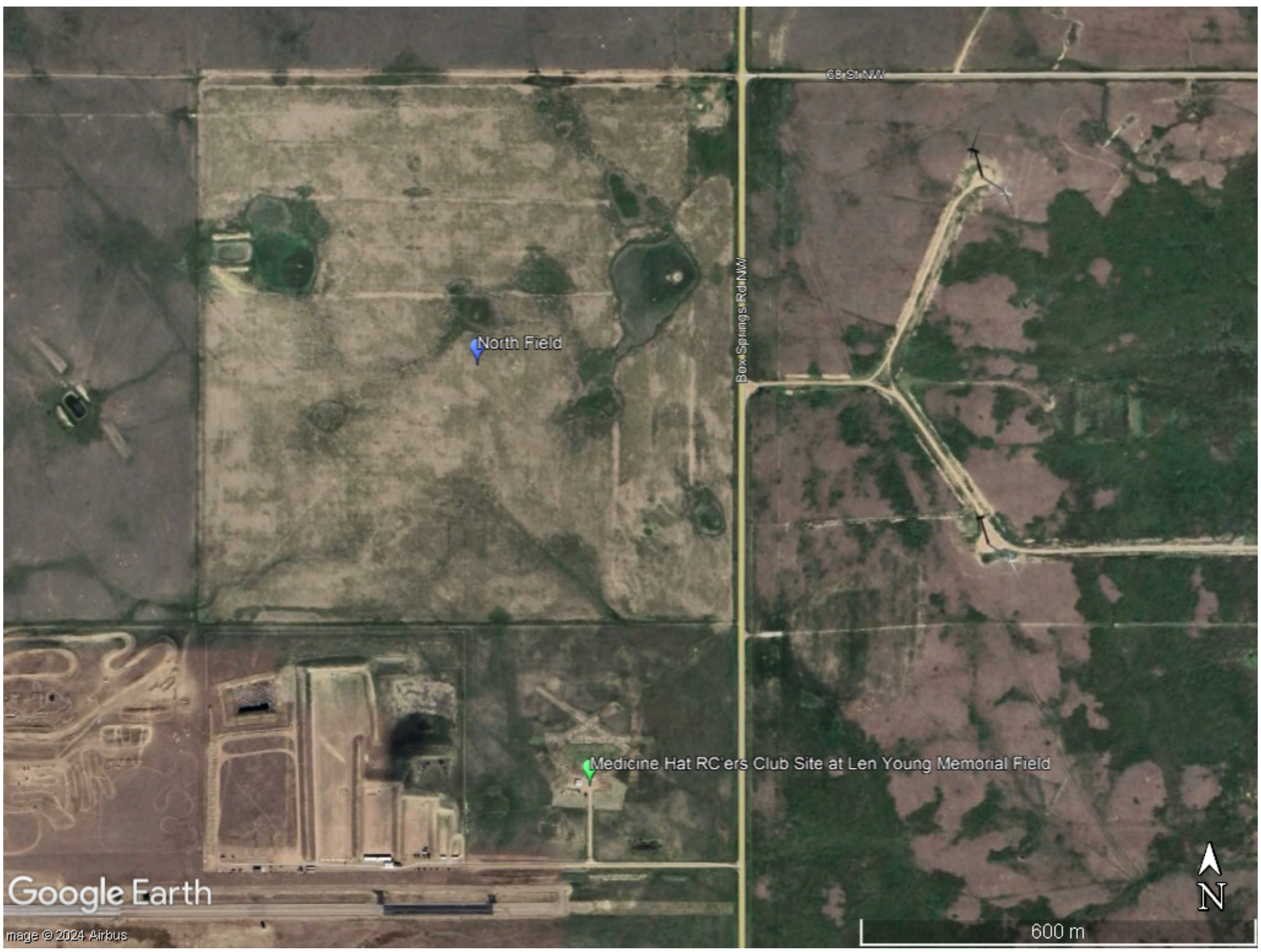

Figure 1: Map of Medicine Hat RC'ers Club Site at Len Young Memorial Field and the adjacent field

10. There will be one flight window for each bidder on each day of Phase 2, with Task 1 on Saturday and Task 2 on Sunday. Within each flight window, the UAS may operate as many times as bidders wish to achieve the requirements of the relevant Tasks. However, bidders may not attempt Task 2 on Saturday, or redo Task 1 on Sunday.
11. The UAS design may include any desired combination of aircraft capabilities (eg, rotary wing, fixed wing, hybrid, or other); different vehicles may be used for Task 1 and Task 2**.**
12. Unmanned aerial vehicles (UAVs) must be no heavier than 15 kg when fully loaded (including a full payload of water) for safety, and there is no size restriction. Multiple UAVs are permitted for both tasks. UAVs may be different or the same design, but each individual aircraft must meet the design and safety requirements.
13. To protect against accidental damage to the aircraft, the water carrying system used for Task 2 must not spill water on the aircraft; see Annex B Para 4 for details.

Phase 2 Assessment Schedule

14. The schedule for Phase 2 is shown below; detailed timings and order of the teams will be provided by email on the Thursday evening prior to the Assessment weekend.
    a. Thursday evening – Bidders upload their presentation to the designated online cloud location by 2400. Bidders receive an email with the order of bidders for the presentation and the two Tasks;
    b. Friday morning – Starting at 0800, bidders conduct a 6-minute scored oral presentation to present their team and their plan for conducting the Tasks. All bidders must attend all presentations;
    c. Friday following the presentations – Bidders conduct Flight Readiness Review (FRR) to demonstrate compliance with aircraft safety requirements per the FRR Checklist in Annex B Para 4;
    d. Friday following FRR – 30-minute site survey of flight area (1 member per team, may bring equipment/gather data as long as site is left undisturbed). Optional test flights;
    e. Saturday – Bidders conduct Task 1;
    f. Sunday – Bidders conduct Task 2; and
    g. Sunday evening – Bidders' Conference and dinner, and awarding of prizes.

Task 1 – Hotspot Detection and Mapping

15. Bidders are provided in this document with flight boundaries. The coordinates are available in Annex C. Flight boundaries can be viewed from this link: https://www.google.com/maps/d/u/2/edit?mid=1pX1Q-1K0rUGIESKGk_kLibJQnlJ0Vmk&usp=sharing, and are shown in Figure 2. Bidders will receive a warning to turn around if they go outside the soft boundary. Bidders are required to kill their UAV if it goes outside the hard boundary.

Figure 2: Task 1 and 2 Boundaries

16. Bidders must meet the following Task 1 requirements:
    a. Visually identify the sign of fire to get a general heading for the location of the hotspots. The sign of fire is simulated with a vertical line of 30cm-diameter red helium balloons, spaced 1m apart in height, up to 5m off the ground. It will be in direct line of sight of the flight line.
    b. Take off and fly towards the sign of fire.
    c. Identify as many hotspots as possible
        i. There are between 2 and 8 lit hotspots within a radius of 100 m of the sign of fire
        ii. Some hotspots may be partially physically obstructed by obstacles, such that they can only be seen from a certain angle. No hotspot will be completely obstructed.
        iii. Hotspots are simulated with 940nm IR emitters, see https://www.aliexpress.com/item/1005002747414491.html
        iv. All hotspots to be identified will be lit up.
    d. Visually identify what started the fire. The source of the fire is within a radius of 100 m of the sign of fire. There is only one source and it is not an IR emitter.
    e. Fly back to the takeoff point and land safely.

f. Submit a KML file of the hotspots and fire source:
    i. Bidders must deliver a KML file containing the required information (see below) to the provided Google Drive link. The link will be sent by email on Friday. Refer to Annex D – Sample Task 1 KML File for an example.
    ii. Generate a placemark for each identified hotspot. Identify every hotspot with a unique number ID starting at 1. Name the placemark "Hotspot ID#", e.g. "Hotspot 1", "Hotspot 2", etc. Add a point with the coordinates.
    iii. Generate a placemark for the source of the fire and name it "Source". Identify what the source of the fire is in the description field of your source placemark (e.g. "crashed drone"). Add a point with the coordinates.
    iv. The KML file can be submitted anytime during the flight window (before or after landing) or up to one hour after the end of the flight window. KML files submitted after the flight window ends will not receive any points for speed of KML file creation. KML files submitted later than one hour after the flight window ends will not be evaluated. If multiple KML files are submitted, only the last submission will be evaluated.

g. Batteries may be swapped during this task.

17. Bidders will be scored on the following, see Para 38 for scoring:
    a. Hotspot and source detection accuracy
    b. KML file creation speed
    c. Autonomous KML file creation
    d. General flight autonomy

Task 2 – Water Transport

18. Bidders are provided in this document with flight boundaries. The flight boundaries for Task 2 are the same as for Task 1. The coordinates are available in Annex C. Flight boundaries can be viewed from this link: https://www.google.com/maps/d/u/2/edit?mid=1pX1Q-1K0rUGIESKGk_kLibJQnlJ0Vmk&usp=sharing, and are shown in Figure 2.

19. Bidders must meet the following Task 2 requirements:
    a. Bidders will aerially transport as much water as possible to multiple target tanks by picking up water from the source tank, flying the water to one or more target tanks, and releasing the water into the target tanks.
    b. The UAV must fly between any of the takeoff/landing point, source tank, and target tanks. Ground transport is not permitted for loaded or unloaded aircraft.
    c. All water payload manipulation (loading, transport, release) must be done without any physical human intervention on the aircraft. Manual actions not on the aircraft that support water payload manipulation, such as flipping a switch on a controller, are permitted.
    d. To load water from the source tank, the UAV may land on the ground or on the tank, or attempt an aerial loading.
    e. Water release into the target tanks must be done while airborne; no contact is allowed between the UAV and ground, target tank, or other object.
    f. Water must be released on its own onto the targets, i.e., water may not be dropped within a vessel, and nothing else should come off the aircraft besides the water.

g. One source tank of the following description will be provided:
    i. The source tank GPS coordinates will be provided by email to teams on Saturday night.
    ii. The size of the tank is roughly: 58.4cm outer diameter, 91.4cm height
    iii. The source tank will be solid blue.
    iv. The source tank will be weighted with enough water to ensure it doesn't tip over.
    v. Teams are permitted to land their aircraft on the source tank rim.
    vi. The source tank will be filled with about 200L of water.
    vii. The source tank will be a standard 55 gallon (208L) barrel, such as: https://www.homedepot.com/p/EarthMinded-55-Gal-Open-Top-Plastic-Industrial-Drum-with-Lid-and-Lock-band-Off-color-PFR55-OC/302608907
h. Target tanks will be of the following description:
    i. Target locations will be at some or all of the hotspot (IR emitter) locations from Task 1. Target GPS coordinates will be provided by email to teams on Saturday night.
    ii. The size of the target tanks is roughly: 31cm diameter, 37cm height.
    iii. The colour of the target tanks is unknown, but they will all be the same colour.
    iv. Target tanks will be secured to the ground to keep them from tipping over.
    v. The target tanks will be standard 5 gallon (19L) buckets, such as: https://www.canadiantire.ca/en/pdp/canadian-tire-plastic-food-grade-safe-bucket-5-gal-19-l-0581060p.html
i. There is no limit (minimum or maximum) on the capacity of water of the UAV(s), as long as each aircraft meets the design constraints. Bidders may attempt any number of transport runs within their flight window.
j. Batteries may be swapped at any time, only at the flightline.

20. Bidders will be scored on the following, see Para 39 for scoring:
    a. Total volume of water moved to targets
    b. Delivering the same amount of water to each target
    c. Loading water without landing UAV
    d. General system autonomy

UAS Design Constraints

21. The following design restrictions will be verified at the FRR:
    a. Max weight 15 kg including payload (aircraft will be weighed with a full load of water);
    b. Only electric propulsion (including solar cells, batteries or fuel cell).
    c. Flight termination system as defined in Annex B Para 3. Parachutes are not permitted for any aircraft type.
    d. Data links can be by radio, infrared, acoustic or other means so long as no tethers are employed. UAS may operate autonomously, semi-autonomously, or under manual control at the discretion of the bidders.
    e. Radio frequency usage in Canada is defined by ISED. If a licensed band is used, the licence must be obtained and provided to the judges before being allowed to fly.
    f. This is an Unmanned Aerial System design competition. Using completely off the shelf UAVs (e.g. DJI Phantom) is not allowed.

Flight Schedule

22. Bidders will have one flight window for each of the two Tasks, each of which will be approximately 30-45 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.
23. The schedule for bidder presentations and two flight windows will be determined by random lottery. The schedule will be provided to the teams by email on Thursday evening. Teams will be permitted to access the flightline no earlier than 30 minutes prior to the start of their flight window, and are required to remove all equipment from flightline no later than 30 minutes after the end of their flight window.
24. After their last flight window of the competition, bidders have 90 minutes to upload their report to the provided URL. The URL will be provided by email on Thursday evening.

Flight Crew

25. 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.
26. Pilots must remain at the launch point for the complete Task. Pilots must hold an Advanced Pilot certificate.

Evaluation Criteria

27. All bidders must complete Phase 1 to be eligible to participate in Phase 2. Phase 1 and 2 are scored and awarded prizes separately.
28. A summary of the Phase 2 scoring is shown in Table 9.

Phase 1 Proposal

29. The Phase 1 Proposal will describe the technical and programmatic details of a bidder's wildfire response UAS development and demonstration. Proposals may be submitted in English or French.
30. The Proposal will be evaluated according to the criteria in Table 1. Each criterion is awarded either 0, 4, 7 or 10 points, and each category of criteria are weighted as shown, for a maximum score of 100 points.

Table 1: Phase 1 Proposal Scoring Criteria

PROPOSAL	Score
Days Late	
Proposal Quality	15
Grammar/Spelling Meets Proposal Structure Use of Figures/Charts References	
System Capabilities	50
Analysis of Alternate Solutions	

Approach to Mission Requirements *IR Detection & Visual Inspection* *Mapping System* *Water Transport System* *Novel Elements*	
System Integration	25
Single Point Failure Modes *System Level Testing*	
Project Management	10
Schedule for Prototype Design/Construction *Risk Management Plan* *Proposed Budget*	
Total Possible Score	**100**

31. The following clarifies content for each evaluation criteria. Give each criteria its own heading in the report. The report must be organized by headings that match those italicized in Table 1, or else they will not be graded. The headings may be in any order.
    a. Days Late – Score reduced by 10% for each day late, starting at 1701 EST on 15 January 2025.
    b. Grammar/Spelling – Self-explanetary. :)
    c. Proposal Structure – Done in the structure of a proposal, including common proposal elements; see the internet for examples.
    d. Use of Figures/Charts – Visuals are appropriately labelled, referenced from the text, and of sufficient size/resolution.
    e. References - Provide some! May be technical, operational, etc…
    f. Analysis of Alternate Solutions – How did you choose the vehicle type, the flight methodologies, etc?
    g. Approach to Mission Requirements – Explain how your overall strategy for accomplishment of the Tasks, and the individual strategy for each Task, are novel.
    h. IR Detection & Visual Inspection – Describe the design and operation of your hotspot detection and visual inspection systems.
    i. Mapping System – Describe how you're going to accurately find the coordinates of important features and generate the KML file.
    j. Water Transport System – Describe the design and operation of your water payload system: water loading, transportation, and release.
    k. Novel Elements – Novel technology solutions in the overall System. What does your UAS have that makes it novel in the execution of the Tasks?
    l. Single Point Failure Modes – Given your technical solution, what failure modes are you anticipating and how will you address them?

m. 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?
n. Schedule – Including Gantt chart of all significant activities in UAS development and planning for the Phase 2 Assessment.
o. Risk Management Plan – During design and development of your UAS, what risks may affect your ability to compete, and how are you addressing the risks? Risk categories should include technical, programmatic, budget, and/or others. Risk planning must include:
    a. Identification of the risk.
    b. Likelihood that the risk will happen.
    c. Impact on the project if the risk occurs.
    d. Measures you will take to reduce the likelihood of the risk and to mitigate its effects if it does happen.
p. Budget – Funding Including travel.

32. Proposals are due 15 January 2025 at 1700 EST to competition@aerialevolution.ca and katrina.cecco@aerialevolution.ca in PDF format. 10% will be deducted from the score for each day late.
33. Proposals are limited to 15 pages total, including any appendices, title page, table of contents, list of figures, etc. Pages above the 15-page limit will be ignored in the scoring.

Phase 2 Bidder's Presentation

34. Bidders 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:
        a. How it evolved to become the final design;
        b. Details of the final design; and
    c. How you will execute each Task.
35. 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.
36. Presentations in Microsoft PowerPoint are to be uploaded to the provided Google Drive link by 2400 on 8 May 2025 (Thursday).
37. Presentations will be scored on the criteria in Table 2.

Table 2: Bidder's Presentation Scoring

Criteria	Score
Presentation is well organized; both 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
The Ministry of Forests would be convinced this is the right Team and UAS design.	5

Total Possible Score	40

Task 1 – Hotspot Detection

38. An overview of the Task requirements is in Para 15. Bidders will be scored on the criteria shown in Table 3:

Table 3: Hotspot Detection (Task 1) Scoring

Criteria	Score
Speed of KML file creation: timed by when the KML file is uploaded to Google Drive. ● Fastest KML file creation = 20 pts ● Slowest KML file creation = 5 pts ● Other points allocated linearly in proportion to ranking relative to other bidders ● KML file submitted after flight window ends = 0 pts Note: Points will only be given for this criterion if teams manage to actually make it to the hotspots site, observe at least one hotspot or the source of the fire in the environment and mark it in the KML file.	20
Autonomy: Points per autonomous action: ● Takeoff = 2.5 pts ● Each autonomous hotspot detection (UAV must autonomously detect hotspot and generate coordinates without operator intervention) = 25 / (number of hotspots) pts ● Generating and formatting the KML file. (Submitting the finished KML file to Google Drive does not have to be autonomous) = 5 pts ● Landing = 2.5 pts Note: Judges will determine in the event of pilot/operator intervention whether each individual autonomous action was achieved.	35
KML file formatting: ● The KML file should be importable and readable in Google Earth ● The name field for each hotspot marker is labelled uniquely and numbered correctly: “Hotspot 1”, “Hotspot 2”, etc… ● The name field for the source placemark is “Source” ● The placemark named “Source” has a non-empty description field Any point not respected = deduct 5 pts Note: KML file submissions later than one hour after the flight window ends will result in zero points for this criterion.	5
Hotspot detection accuracy (scored via coordinates submitted in the KML file): ● Each hotspot is nominally worth 40 pts / number of hotspots, multiplied by the following: ● <=3m radius = 100%	40

• >3m, <=6m radius = 50% • More than 6m = 0% Note: KML file submissions more than one hour after the flight window ends will result in zero points for this criterion.	
Fire source location and identification • Coordinates accuracy <= 5m radius = 5 pts • Accurate text description = 5 pts	10
Total Possible Score	**110**

Task 2 – Water Transport

39. An overview of the Task requirements is in Para 18. Bidders will be scored on the criteria shown in Table 4:

Table 4: Water Transport (Task 2) Scoring

Criteria	Score
Total water volume transported to target tanks: • Highest total volume moved to the target tanks = 50 pts • Lowest total volume = 10 pts • Other points allocated linearly in proportion to ranking relative to other bidders Note: Bidders that move no water will not be included in the linear point scale.	50
Multi-target precision delivery: • At least 500 mL water must be delivered to all targets to score any points for this section or else = 0 pts • Scored according to sample variance across all tanks • Lowest variance of the volumes across all target tanks = 30 pts • Highest variance of the volumes across all target tanks = 15 pts • Other points allocated linearly in proportion to ranking relative to other bidders Note: Bidders that get 0 pts for this criterion will not be included in the linear point scale.	30
Autonomy: • Takeoff = 2.5 pts • At least one water loading (get into position and load the water without operator intervention) = 25 pts • At least one water release (get into position and drop the water without operator intervention) = 10 pts	40

• Landing = 2.5 pts Note: "Getting into position" begins when any part of the UAS (including water payload system) is maneuvered below 5m height above and within 5m radius of the respective source or target tank.	
Loading water without landing: Demonstrate at least one instance of loading any volume of water from the source tank onto the aircraft while keeping the aircraft airborne (no touching the ground or source tank) = 10pts	10
Total Possible Score	**130**

Flight Preparation

40. Teams will be scored on their preparation, according to the criteria in Table 5:

Table 5: 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.	5
Team is well organized, with an obvious and effective leader and obvious tasks for team members, good cooperation between team members, 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 = 5 pts • Ad-hoc semi-use of checklists = 2 pts • No checklists = 0 pts	5

Total Possible Score	30

Post-Flight Report

41. Bidders must submit a report no later than 90 minutes following the close of their last flight window, submitted to the specified URL. The report will be scored according to the criteria in Table 8, which includes how well it is written and how clearly the results are presented. Actual performance of the Tasks is evaluated in other criteria and will not be scored in this report.
42. The report should contain the following information at a minimum:
    a. Title Page.
    b. Overview of the required Tasks.
    c. Detailed results of each Task, eg, how technology worked, detection accuracy, water transport mechanism performance, etc.
    d. Overall comments on the flights – how well things went, lessons learned, etc.
    e. Conclusion.
43. The Report may be in English or French.

Table 6: Post-Flight Report Scoring

Criteria	Score
Content: ● All required information is present and thoughtful comments are made about the Tasks = 5 pts ● Information is missing or comments are lacking = 2 pts ● Majority of information is missing or no comments = 0 pts	5
Presentation: ● The report is well formatted, with good grammar, effective presentation of the results = 5 pts ● Some formatting or grammar issues; results presentation is not effective = 2 pts ● Report is poorly formatted, grammar is difficult to understand, results are difficult to understand = 0 pts	5
Total Possible Score	**10**

Overall Flight Assessment Scoring

44. To summarize, the total score available for Phase 2 is 310, weighted as shown in Table 7:

Table 7: Overall Phase 2 Scoring

Criteria	**Score**
Presentation	40
Task 1 – ***Hotspot Detection***	110
Task 2 – ***Water Transport***	130
Flight Preparation	30
Post-Flight Report	10
Total Possible Score	**320**

Annex A – Eligibility and Administrative Requirements

General

45. All team members must be enrolled part- or full-time at a Canadian College or University for Fall 2024 and/or Winter 2025.

Team Size and Composition

46. Traditionally, there is no maximum or minimum Team size and no maximum crew size in the preparation area, but a maximum of five people in the flight-line crew. Availability of accommodations may limit the number of team members allowed to attend Phase 2. Any such limitation will be communicated as soon as possible.
47. Teams may be organized internally at the discretion of their members and may include graduate and undergraduate students. Joint teams consisting of students from more than one institution are permitted; for example, a joint university-college team is allowed.
48. Team size at Phase 2 will be capped at a maximum of 10 members. There is no limitation on the number of members who may contribute outside of Phase 2.

Number of Teams

49. There is no restriction on the number of teams from any one institution; however, no individual student may be on more than one team, and proposals from different teams at the same institution must be substantially different. Teams will be accepted at the discretion of the Chief Judge. Depending on registrations and accommodation, it may be necessary to limit institutions to one team, or to limit the number of teams in the competition.

Applications and Registration

50. Teams must send an email indicating their interest to competition@aerialevolution.ca and complete the online registration at https://www.aerialevolution.ca/join, including paying the team registration fee of $600+HST. To register, select the "AEAC Student UAS Competition Teams Registration" as the membership level, enter your team's name under the Name field and the team captain's name under the Contact Person field. This registration needs to be completed only once per team. Registration is non-refundable. Once fully registered, teams will have access to more information. The registration deadline is 28 November 2024 at 1700 EST.
51. Teams are responsible for their own costs, including travel to/from and during the Phase 2 competition. The onsite participant cost is $330+GST and includes most meals and lodging. Accommodations will be arranged by Community Futures Entre-Corp. Food will be provided most days, excluding Saturday evening.
52. The administrative deadlines detailed in Para 6 require accurate and timely submission. Review these again and ensure they are met on time! Failure to comply means you will not fly.

Annex B – Safety Requirements

1. The competition ends at about 2200 hrs after the awards banquet on Sunday night. Departing immediately following the banquet is NOT endorsed by AEAC; plan to leave on Monday to ensure safe

driving home. Ensure all drivers on a rental car have a full driver's licence in good standing. Teams are responsible for their transportation between the airport, accommodation, and awards banquet.

2. Each individual vehicle must have a separate operator while being flown or moved, e.g, concurrent operation of vehicles requires separate operators. **All UAV pilots <u>must</u> hold an Advanced Pilot certificate.**
3. All UAVs must be equipped with a safety flight termination system that can be activated either automatically or remotely (kill switch). For fixed wing, 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, 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 C2 link while in auto mode shouldn't remove the capability to kill the aircraft. Aircraft must be in termination mode within 10 seconds of the termination function being activated. The flight termination mechanism will be validated during the Flight Readiness Review (FRR) check. 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. Parachutes are not permitted for any aircraft type.
4. The Flight Readiness Review performed on the Friday is represented in the Table B1:

Table B1: FRR Checklist - AEAC Student Competition

Provided a copy of the Advanced RPAS pilot certificate for Canadians?
Provided copies of: Advanced RPAS pilot certificate (a), and SFOC (b) for Non-Canadian RPAS Pilots?
Provided a copy of the RPAS registration for each aircraft?
Provide a copy of the email where the proof of flight was submitted to AEAC.
Weight under 15 kg including maximum water payload.
For UAVs used in Task 2: Demonstrate that the water carrying system does not spill water on the aircraft when loaded with full water payload and the UAV is inclined +-90 degrees in pitch and roll.
Demonstrate that 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).
Demonstrate operation of the Flight Readiness Button – drone must not be capable of operating until the button is pushed.

5. 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 wireless transmissions of any sort are allowed outside the

flight window, including Wi-Fi hotspots, cellular, and the like. Wired transmissions are permitted at any time.

6. During flight, the GCS must always show the aircraft and the competition flight area.
7. Rehearsals are not permitted unless specifically authorized by the judges.
8. If the aircraft leaves the flight boundaries (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 asked to activate the kill mechanism.
9. All anomalies with respect to the GPS, Datalink, RC and flight boundaries must be reported to the Air Program Director.
10. Teams 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).
11. Video proof of previous successful flight of the aircraft in the configuration planned for the competition must be presented to judges (competition@aerialevolution.ca) by 21 April 2025. It must show at least the following elements:
    a. Takeoff;
    b. Fly by, circle, and (if applicable) hover to demonstrate the stability of the vehicle;
    c. Flight at an 'appropriate' cruising speed to the limits of VLOS and return;
    d. Approach; and
    e. Full-stop landing.
    f. Include relevant flight checklists as a pdf.
12. All flying, including flight testing at local test sites and at the competition, is to be performed under Part IX regulations for RPAS.
13. The site is in Class E 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 flight readiness review.
14. 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. Additionally, an RPAS Safety Assurance declaration must be submitted for your aircraft and proof of completion must be provided to AEAC with the proof-of-flight video. (https://tc.canada.ca/en/aviation/drone-safety/help-drone-safety-partners-manufacturers/submit-drone-safety-assurance-declaration)
15. To Confirm: No SFOC is required by teams. Instead, all pilots and UAVs must conform to Part IX – for which a high level overview is provided above. AEAC will independently apply for a Special Aviation Event Certificate; no action is required from the teams.
16. 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 advance 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. Reference: https://tc.canada.ca/en/aviation/drone-safety/drone-pilot-licensing/get-permission-special-drone-operations/get-permission-fly-drone-foreign-pilot-operator

17. Insurance requirements for flying in Medicine Hat have been sent to teams as part of the captain's package. Please refer to the captain's package for details. A summary is provided here:
    a. Liability insurance of a minimum of 5 million dollars is required to cover the activities of this event. AEAC as well as the participating teams must all be covered by liability insurance covering all RPAS operations.
    b. Please make sure that all your requirements for documentation, RPAS registration and pilot certification are in order before commencing operations, as each team (and their educational institution) has different insurance requirements to protect themselves and their students in the event of an accident or incident.
    c. In all cases, proof of the coverage and the value of liability insurance acquired by AEAC and/or each of the teams must be provided to the Competition Committee for approval by **2 April 2025**. Please forward your proof of insurance to competition@aerialevolution.ca.
    d. If any team has any issues or questions regarding insurance, please contact Declan Sweeney at declan@aerialevolution.ca.
18. If you need any assistance with regulatory approval, please contact us as soon as possible.

Annex C – GPS Coordinates

1. Flight boundaries for Task 1 and Task 2 are the same. GPS coordinates for the soft flight boundary are provided in Table C1 and GPS coordinates for the hard flight boundary are provided in Table C2.

Table C1: Task 1 and 2 Soft Flight Boundary GPS Coordinates

Lat	Long
50.0971537	-110.7329257
50.1060519	-110.7328869
50.1060793	-110.7436756
50.1035452	-110.7436555
50.0989139	-110.7381534
50.0971788	-110.7381487

Table C2: Task 1 and 2 Hard Flight Boundary GPS Coordinates

Lat	Long
50.0970884	-110.7328077
50.1061216	-110.7327756
50.1061482	-110.7437887
50.1035232	-110.7437798
50.0988785	-110.7382540
50.0971194	-110.7382533

Annex D – Sample Task 1 KML File

1. The following is the content of a sample KML file. It is properly formatted and can be opened with software such as Google Earth. All the placemarks have the correct name and the “Source” placemark has a description.

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
    <Document>
        <Placemark>
            <name>Source</name>
            <description>Crashed Drone</description>
            <Point>

<coordinates>-71.63514798156478,48.5023953873602,0</coordinates>
            </Point>
        </Placemark>
        <Placemark>
            <name>Hotspot 1</name>
            <Point>

<coordinates>-71.63460305159317,48.50263986774272,0</coordinates>
            </Point>
        </Placemark>
        <Placemark>
            <name>Hotspot 2</name>
            <Point>

<coordinates>-71.6354718451306,48.50305044975033,0</coordinates>
            </Point>
        </Placemark>
        <Placemark>
            <name>Hotspot 3</name>
            <Point>

<coordinates>-71.6353428479224,48.50203386030815,0</coordinates>
            </Point>
        </Placemark>
    </Document>
</kml>
```

Annex E - Questions from Teams

Responses are indented. *CONOPS amendments resulting from team Q&A are italicized.*

1. Is there a limit on how many RPA flying at a time (in both tasks)?

> There is no limit on the number of aircraft for either task, but each aircraft must be piloted by a licenced RPAS pilot as per CONOPS/CARS. *Amended Para 12 and Table B2 to clarify.*

2. What is the lowest altitude AGL our RPA can go for phase 2 task 1?

> No lowest altitude limit will be set by the judges. Teams are responsible for designing a safe operation.

3. For phase 2 task 1, could you give us an example of the obstruction?

> The obstructions will be physical (i.e. something blocking a portion of the emitter, not a filter of any type) and static. However, no emitter will be 100% obstructed - there will always be some light showing. *Amended Para 16cii) to clarify.*

4. Phase 2 task 2 scoring on page 8 says "loading without landing" scores points but is not reflected on the table (page 13).

> We will be giving 10pts to teams that can demonstrate at least one water loading while keeping the UAV totally airborne. *This has been added to Table 4 and subsequent scoring tables.*

5. Should we assume that the IR emitters in Para 16ciii) are the ones that will be used in the competition or could the IR emitters used in the competition be any IR emitter described as 940nm?

> You can assume that we will be keeping this emitter for the competition. If for some (very unlikely) reason we need to change the emitter, we will keep it as close as possible to the 940nm wavelength, and we would be announcing that well in advance of Phase 2.

6. The document also says that the IR emitters "may be obscured by obstacles, such that they can only be seen from a certain angle." Do you have any information on the range of angles that the IR emitters could be obscured from? For an extreme example, could there be a case where the IR emitter is obscured from all angles above and can only be seen by a low flying drone side on?

> We will not be specifying an angle range for IR emitter obstruction. Prepare for whatever you think is reasonable based on the scenario description…

7. Can we have an example purchase link for the red helium balloons?

> See balloon specs: they are a standard size so we will not provide a link.

8. Will there be precisions on the type of obstacles that will be present on the field (could help us understand what kind of communications could pass through them)?

> We don't usually specify obstacles unless something presents a big safety hazard. We have not currently identified any hazards worth specifying.

9. Will there be a precision on how many red helium balloons will be on the vertical line?

See existing CONOPS details - this has been specified.

10. Does a team get extra points for popping the balloons?

There are no points associated with the balloons. Please avoid flying into them for safety, and so we don't have to set up more of them.

11. Is there a defined maximum height for the hotspots? Is there any chance they will be hosted by drones themselves or directly in the ground?

Hotspots will not be moving. There is no maximum height for hotspots.

12. Is there a defined maximum height for the source of the fire? What are the chances of something crazy like a drone (still flying) that threw a firebomb (no land evidence)?

There is no maximum height for the source of the fire. It will be clearly visually identifiable, and it will not be moving. There should not be anything crazy like flyaway drones or firebombs unless bidders produce those effects.

13. Task 2, 19. b. Isn't it supposed to say "The UAV must fly between any of the Takeoff (& landing) waypoint, source tank, and target tanks." since flying from the flight line would be out of boundaries?

Good catch. *Para 19b has been amended to reflect this update.*

14. Will the source tank be refilled after each team's attempt to the defined 200L?

The source tank and all other equipment will be reset after the end of each team's flight window. The source tank will not be refilled during the window.

15. Will there be a precision as to how the target tanks will be secured?

For now, assume there will be nothing inside the target tanks and everything securing them will be on the outside of the tanks (which you shouldn't be flying into, anyway).

16. What will be considered as a completely off the shelf drone? Does a development drone like the Holybro X650 count in that category? Do modifications of this development drone make it acceptable or must it be mechanically designed from the ground up?

The Holybro X650 development kit you have listed would not be permitted for the competition. It looks like it includes all major on-board components (airframe including wiring, flight controller, transmitter), so the only design element left is the payload for Task 1 and 2. It isn't in the spirit of the competition to just add a payload system on top of an existing drone, however, we would permit an off-the-shelf airframe that doesn't come with all the other components: the selection and integration should be part of the work that your team does. So you don't necessarily need to do ground-up mechanical design of the frame either.

17. We would like to know the chances of cellular coverage and what kind of noise sources will be present such as regional communication antennas, etc. If cellular coverage is available on that region, we would also like to know what providers would work.

There are two (2) Telus Cell towers nearby the MH RC'ers launch location that will provide the students that require it excellent cellular service. They are located as follows:

Telus Cell Tower: Latitude: 50.034500° Longitude: -110.703210°. Located 3.03 KM SW from student launch location

Telus Cell Tower (mounted on top of COOP Centre): Latitude: 50.034500° Longitude: -110.703210°. Located 3.46 KM South of student launch location

There are no other known communications towers/antenna in the area that could cause noise interference.

A quick online search shows 5G coverage on the field.

18. Are there points for autonomously flying to the sign of the fire? There are no points awarded in the autonomy section for identifying and flying towards the sign of fire. If we perform an autonomous takeoff, manually fly to the sign of fire, and then trigger the KML generation program, are we still awarded maximum points?

You are correct that there are no points (autonomy or otherwise) associated with the sign of fire. It's intended to be a visual marker to help you locate the survey area more easily.

19. The KML file should be autonomously generated but also needs to include a description for the source of fire. Is there a list of possible objects that are the source of the fire so that we can train a model to detect those objects?

We will not be providing a list of possible fire sources.

20. Would manually adding the location of the source of fire to the KML file after generation still be worth autonomy points for generating and formatting the KML file?

"Generating and formatting KML file" in Table 3 includes inputting all required information into the KML file format.

21. Would manually adding a descriptor to the autonomously generated location of the source of fire after generation still be worth autonomy points for generating and formatting the KML file?

See answers above, plus: Note that observing the features of interest (i.e. the actual survey) is not included in "Generating and formatting KML file" in Table 3. You can store the info from the survey in any form and as long as it is input into the KML without human intervention, that counts as autonomous for this category.

22. Batteries may be swapped at the flight line for Task 2. What safety procedures are required when swapping batteries? The vehicle's props should be disarmed, but are there any other requirements?

No other requirements will be specified by the judges. Each team should know their system and when it will be safe to approach and swap batteries.

23. We were curious about why the competition was moved back to early May despite what appeared to be good feedback for late May last time. We would appreciate some explanations though we understand the change of location is likely the cause.

> This is a limitation of the availability of the new site in Medicine Hat for 2024. Most teams did enjoy the late-May competition so we will continue to have that as our preferred scheduling in future years.

24. We have concerns regarding the competition's intention to use 940nm emitters to simulate fires. Since receiving the CONOPS, we have done research, reached out to industry professionals, and conducted experiments with the emitter linked in the CONOPS. Although we understand that this could just be another design challenge for teams to innovate and overcome, we cannot help but wonder if the use of the 940nm wavelength will cause significant hurdles that AEAC may not have intended. It is our understanding that the competition this year aims to simulate remote fire sensing. It would be easy to assume that optical or thermal imaging would be the best solution for this scenario, and that IR emitters would serve as a good stand-in for real fires. However, based on our research so far, the wavelength selected (940nm) poses significant problems which may take away from this intended scenario. I have simplified our findings into a bullet-point list below:

Industry-standard thermal imaging systems detect IR emissions by searching for IR wavelengths in the LWIR (Longwave IR) range. The 940nm wavelength selected by AEAC to simulate fires is completely outside of this range, thus rendering all typical fire sensing technologies unviable.

940nm is commonly used to give security cameras and other devices "night vision", as security camera sensors can capture this wavelength and the human eye cannot.

The issue lies in the fact that this wavelength is intended for use during the night; the sun appears to severely overpower this wavelength during the day, which makes the selected emitters much more difficult to detect in sunlit environments

The emitter selected by AEAC caused us some issues before getting it working. Mainly, it has a finicky light sensor which must be obstructed before the emitter turns on. It also draws a non-insignificant amount of power, which may prove challenging to operate in the middle of a field over the length of a day.

The emitter is extremely small. When combined with the previous problems and the necessity to observe the emitters from the air, this only makes things worse.

After connecting with industry professionals (which initially surfaced this concern when we mentioned 940nm in daylight), we have found what seems to be a gap in the market for sensors/cameras that effectively detect this wavelength. From our findings so far, the options seem to be either a sensor working well under any adequate operational efficiency, or trying to acquire an incredibly expensive sensor, the likes of which have only just entered the market.

Considering the aim of the competition is to simulate fire sensing, and that thermal cameras are a reasonable requirement for such a task, we fear that the use of the 940nm emitters could diminish the capacity to compete for all teams. We suggest alternatives below. If the competition chooses to stick to 940nm, we would like a comprehensive answer as to why this decision is made so we can better understand the competition's intent.

> Thanks for looking into this. I can tell you that the judges acquired and tested the specified IR emitter before including it in the CONOPS, and it met our requirements. There are no plans to change it at this time. We provide a link to the selected emitter so that teams do not have to make many assumptions when developing their systems. For the light sensor - you can assume we will be covering it up to keep the emitter on constantly.

25. Table 4, p.14 - Water Transport (Task 2) : Scoring, Loading Water Without Landing : If the water transport system comes in contact with the target tank does that count in the attempt?

> The target tank should never be touched by any part of your system. Remember, it is supposed to be on fire! However, the "loading without landing" is satisfied once you fly away from the source tank with some water, having not touched the source tank. The points for this are not affected by what happens at the target tanks.

26. Table 4, p.14 - Water Transport (Task 2) : Scoring, Loading Water Without Landing : Can the drone and/or water transport system land on water for the water loading process?

> Technically this is not prohibited by the rules, but I have a hard time imagining how it could be done in a way that ensures the safety of the operation.

27. Mission Requirements 19.h, p.7-8 (Task 2) : Could there be multiple targets at any designated hotspot or does each hotspot have a maximum of only one target?

> Only one target (tank) per hotspot.

28. Table B1, p.18 (FRR Checklist) : If the water transport system is not directly attached to the UAV, such as with a rope, will the water transport system be inclined with the UAV or be left to sway independently during the demonstration for the task 2 UAVs.

> Great question! FRR is only concerned about safety, so we will only be tilting the UAV body and ensuring no water spills on the UAV body itself. If there is some kind of tethered water transport system, we will let it sway, and we don't care if water spills on it, unless that would impact flight safety for some reason.

29. Mission Requirements 19.h, p.8 (Task 2): Water Transport : Will the colour of the target tanks be disclosed or visible before our flight window begins, or will it remain unknown until it starts?

> The colour of the target tanks is unlikely to be disclosed before Phase 2 in May.

30. Will the IR emitter and obstacles from task 1 still be there for task 2 (next to a target tank) even if doesn’t need to be detected?

> No, we will be removing task 1 equipment for task 2.

31. Do we need a safety switch (power from motors remotely killed electrically or mechanically instead of just software)?

> Any means of safety switch that can remotely kill the power per CONOPS specifications is fine.

32. Will the obstacles in task 1 be in the 100m radius?

> Yes.

33. Will the target tanks in task 2 be contained in a 100m radius or not necessarily?

> Read the CONOPS :)

34. Could you provide the inner and outer diameters of the 55-gallon barrels used for Task 2?

We haven't purchased the barrels yet, so we cannot give a more exact dimension. However, there are outer diameter specs given in the sample tank in the CONOPS, and these 55 gallon barrels are standard size. That's about the level of specificity we can give at this point, so go forward with your best engineering assumptions.

35. Will there be a restriction on how close the IR emitters are to each other (i.e. a minimum distance between emitters)?

No such restriction.

36. How will we be weighing the drone for Task 2 to ensure it stays within the 15kg limit after collecting water? Would we have to, say, fill the onboard tank as far as it'll go and then weigh it?

Read the CONOPS :)

37. It's noted in the CONOPS that the hot spots/target tanks will be placed within a 100-metre radius from the helium balloons. Is there also a minimum clearance between the hot spots/target tanks from the balloons? Our team was concerned that the balloon strings may interfere with the UAS rotors while positioning over nearby target buckets.

We haven't specified a minimum clearance between balloons and targets. However, our team will ensure that there is a safe margin based on environmental conditions (wind). You should not have to fly very close to the balloons.

38. It was mentioned at the first town hall meeting that a safety test would be performed where the drone is filled with water and flipped upside down to check for leaks. Specifically, would it be acceptable if water were to leak externally (by design) provided it does not come into contact with any electronic components? For instance, if the on-board water tank has a venting hole.

Yes, we will permit water leaking onto non-critical components. We won't be flipping the drone entirely upside-down (by that point, we are assuming you have crashed), only to the specifications listed in the CONOPS. However, as with all components of the FRR, if we see anything we consider could pose a safety hazard, we will ask teams to remedy it.

39. After the last CONOPS update we were left worried about our current setup. What are the limitations for using existing components, specifically we currently have an old drone that we are planning to use for the competition, but we have completely removed the old controller, GPS system, radios and camera systems, but only keeping the structure and motors? We don't believe it's opposite to the spirit of the competition, since we are also building another drone from scratch.

Yes, we permit teams to reuse their previous UAV platforms. We just don't want someone using a completely off-the-shelf UAV, e.g. buying a frame that comes with motors, avionics, wiring etc. already installed. If there's still any doubts, feel free to email katrina.cecco@aerialevolution.ca.

40. Will there be a town hall for a general overview after the phase 1 submissions are corrected?

> Yes, we typically have a second townhall in March or April to cover the administrative aspects of Phase 2 and briefly discuss the design papers.

41. We would need some clarification on this point from the competition document: "Target locations will be at some or all of the hotspot (IR emitter) locations from Task 1. Target GPS coordinates will be provided by email to teams on Saturday night.", does this mean that the Target GPS coordinates we will receive by email will only contain locations with target tanks or, will they simply be the coordinates of the hotspots that can or not contain tanks?

> We will give coordinates for only those locations with target tanks. Task 2 is not intended to have a search component.

42. Since we will be flying in a restricted airspace, does each drone require a RPAS Safety Assurance declaration?

> Yes, we follow all the CARS requirements for Advanced operations, including the Safety Assurance.

43. Target Tank GPS Accuracy: How precise will the GPS coordinates of the Target Tanks be? What measurement tools or methods are being used to establish their positions?

> We are having a local ground survey company come in to give us the ground truth coordinates of the emitters/tanks. I am unsure what method they will use, but you can expect a level of precision a couple orders of magnitude higher than the 3m scoring precision in the CONOPS.

44. Fire Source Identification & KML Submission. Regarding the fire source identification criteria: “Fire source location and identification: Coordinates accuracy ≤ 5m radius = 5pts, Accurate text description = 5pts, Visually identify what started the fire. The source of the fire is within a radius of 100 m of the sign of fire. There is only one source, and it is not an IR emitter.”

For clarity, are we required to use an autonomous system to identify the fire source, or is human inspection from an FPV feed sufficient for KML file submission?

For example, if we observe a crashed drone in the FPV feed and manually enter “crashed drone” as the fire source, including its coordinates, would this be valid? Or must an onboard or ground-based system autonomously analyze the video feed, identify the source, determine coordinates, and generate the KML file?

> The portion of the CONOPS you have quoted does not include any points for autonomy: a manual approach could get full points for this quoted section. As for autonomy, read that part carefully: the source of the fire is not considered a hotspot or emitter.

45. Autonomous Hotspot Detection. Regarding the following criteria:

“Each autonomous hotspot detection (UAV must autonomously detect hotspot and generate coordinates without operator intervention) = 25 / (number of hotspots) pts”

As a contingency, we plan to have an operator manually control the gimbal during flight. However, the operator would not be responsible for detecting or generating hotspot coordinates only for adjusting the camera orientation.

Given that no human intervention would be involved in detection or coordinate generation, would this setup still comply with the competition's autonomy requirements?

> In my interpretation of your proposed strategy: Seeing as though the operator would be acting as the "eye" of the system and forcing the UAV to "look at" a hotspot that the operator has already detected (seemingly to within the 6m precision for scoring), this would not be considered a full autonomous detection.

46. Will the competition organizers set up a temporary geodetic marker at the flying field that competitors will be allowed to use?

> No.

47. If not, will teams be permitted to establish their own reference point? For instance, could teams operate their GNSS receiver for 4+ hours the day before the competition and submit the collected data to the Canadian Spatial Reference System Precise Point Positioning (CSRS-PPP) service using the ultra-rapid correction method?

> Teams are permitted to do whatever setup they are able to accomplish within the competition constraints. During Saturday and Sunday, teams will be permitted at flightline no more than 30mins before their flight window (due to space constraints). Check the CONOPS for when transmissions are permitted. On Friday, however, we will have a 30min tour of flightline in which one member of your team is able to attend and survey the site/setup equipment/etc. as long as the site is not altered in any way by your actions. There is no requirement for radio silence on Friday until the practice flights begin in the afternoon (exact time to be announced in upcoming captain's package; will commence after the site tour).

Annex Z. How to Maximize Your Success!

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

1. 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

2. 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!
3. 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
4. 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.
5. 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

6. 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!
7. 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.
8. Consider off-the-shelf components, where possible, in the design. For example, teams may consider the use of an "almost ready to fly" radio-controlled system as the basic airframe with custom 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

9. 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.
10. Prepare PRINTED procedures and checklists, and PRACTICE using them.
11. 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.
12. 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.
13. Conduct extensive testing of all aircraft and other systems, including all integrated together.
14. Be ready to fly in all weather/wind conditions! One year, the entire weekend had howling winds and most teams crashed at least once. Google 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.
15. 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.
16. 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

17. Arrive on the flight line no later than 60 minutes before your flight time.
18. 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.
19. Have all equipment ready to fly at least 10 minutes before your flight window.
20. 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.
21. 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

22. 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!

23. 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.