Version 1.2, 14 March 2024

AERIAL EVOLUTION ASSOCIATION CANADA

2024 STUDENT COMPETITION CONCEPT OF OPERATION (CONOPS) DOCUMENT

To enhance realism in the 2024 competition scenario, this Conops document is in the format of a 'Request for Proposal (RFP)' from a mythical Big City who wishes to assess concepts for an Urban Air Mobility (UAM) capability. Student teams will act as industry Bidders to create concepts, design a UAM System, 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 Big City 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 or questions regarding this document to the Competition Chief Judge, Mark Espenant, at mark.espenant@gmail.com.

RECORD OF AMENDMENTS

Amendments since the previous version are highlighted in the text.

Version #	Date	Comments/Changes
1.0	12 September 2023	Initial issue
1.1	17 November 2023	Response to student questions, update with Task 2 dimensions, etc
1.2	14 March 2024	Insurance information, responses to questions, Task 2 altitudes, etc.

AEAC 2024 Student Competition

Contents

CALL FOR PROPOSALS

BIG CITY URBAN AIR MOBILITY SYSTEM (UAMS)

PROTOTYPE DEVELOPMENT AND EVALUATION

Conducted as the 2024 Aerial Evolution Association Canada Student Competition

This Document

1. This is a competitive Call for Proposals for design, development, and assessment of a drone-based Urban Air Mobility System (UAMS) for Big City.

Background

2. Big City would like to improve the efficiency and effectiveness of downtown passenger transit, and requests bids to develop and demonstrate a UAMS sub-scale prototype. Bidders are invited to propose their design for a system to meet the criteria specified below, construct a subscale prototype, and participate in competitive 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 UAMS are presented based on the requirements below, due 15 January 2024 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 24-26 May 2024 at the Centre d'excellence sur les drones (CED) in Alma QC; the assessment schedule is in Para 16.
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 Big City 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 2023 at 1700 EST – Submit expression of interest to competition@aerialevolution.ca and complete online registration, which includes paying the $624+tax team registration fee.
    b. 15 January 2024 at 1700 EST – Submit Phase 1 Proposal.
    c. 12 April 2024 – Submit team list and pay $312+tax fee for each onsite participant.
    d. 11 April 2024 – Submit video proof of successful flight, as described in Annex B Para 11.
    e. 24-26 May 2024 – Attend Phase 2 Flight Assessment.

Scenario

7. The UAMS will operate in the overall Big City Urban Area (BCUA), transporting four passengers with cargo. The UAMS must have an excellent combination of performance characteristics and ability to do 'instrument' approaches to difficult landing sites.

Mission Requirements

8. The Phase 2 Flight Assessment will include two Tasks:
    a. **Task 1 – Vehicle Performance Assessment.** Transport four passengers (represented by dolls) and cargo over a long-distance route, safely delivering the passengers while demonstrating optimum vehicle performance.
    b. **Task 2 – Urban All-Weather Landing Trial.** Transport four passengers and cargo performing an instrument approach to a selected landing pad while maintaining contact with Air Traffic Control (ATC).
9. Both Tasks will be conducted within 5 km of the centre of the Alma airfield. Task 1 will be conducted over the runway. Task 2 will be conducted at the Qualia test site (shown on Map in Figure 1).

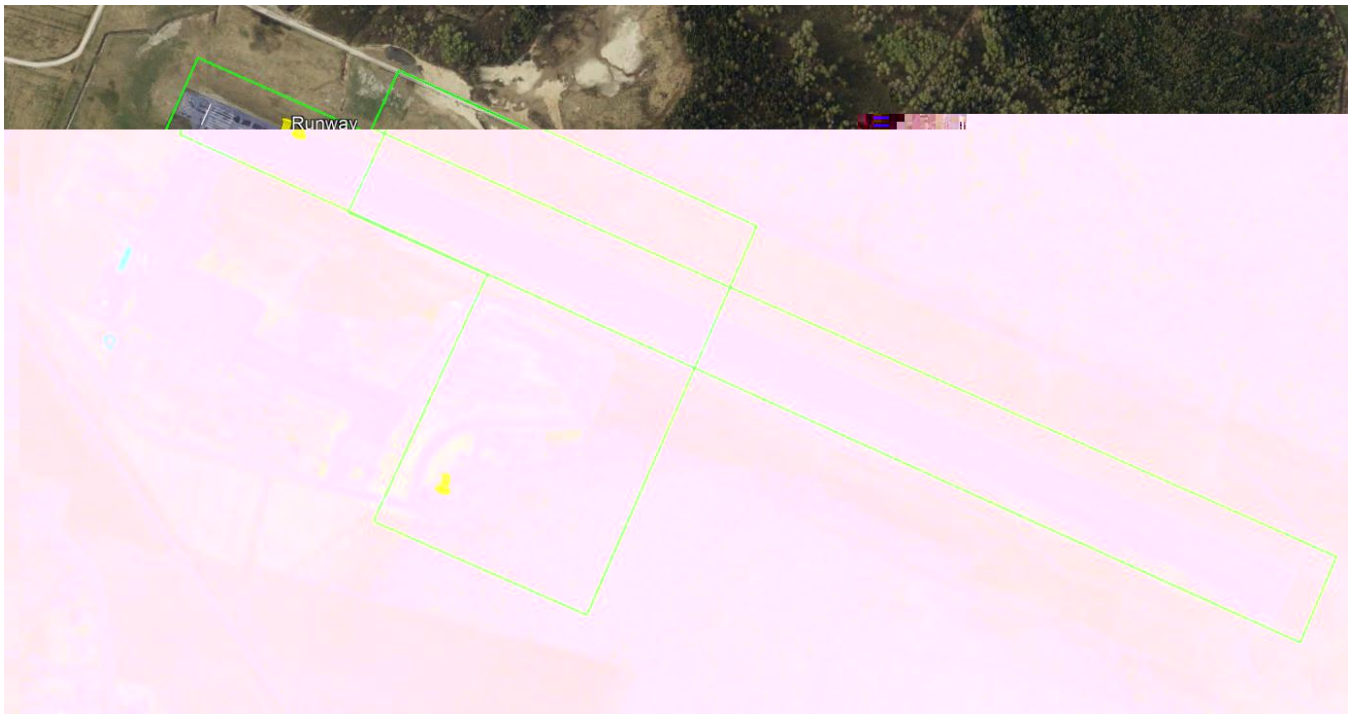

Figure 1 Map of the Qualia site

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. During each flight window, the UAMS 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 UAMS design may include any desired combination of aircraft capabilities (eg, rotary wing, fixed wing, hybrid, or other); however, there can be only a single UAMS vehicle, and **the SAME VEHICLE must be used for Task 1 and Task 2**[1]
12. UAMS vehicles must be no heavier than 15 kg for safety; there is no size restriction.
13. A GPS tracking device will be provided by the judges for both tasks. The UAMS must provide a flat location 2 inches square on the top of the bodywork. The weight of the device will not exceed 50g. An affixing method will be provided by the judges, likely stick-on Velcro. The device will most likely be an i-gotU GT-120B, see https://canadagps.ca/collections/top-5-sellers/products/i-gotu-gt-120b-gps-gnss-data-logger-water-resistant-21g-only-2022-edition.
14. One handheld radio will be provided by the judges for Task 2.
15. The vehicles must look like real air taxis...which will be scored. This includes such aspects as:
    a. Streamlined and integrated cabin design without exposed wires or flight components

[1] For clarity – you may have a back-up UAMS, so a different physical vehicle could fly the second day, but it must be identical to the primary vehicle.

b. Accessible seating with window view and space for cargo, with door/ramp
c. Labelling, ie, company name, vehicle logo, badges, placards, etc

Phase 2 Assessment Schedule

16. The schedule for Phase 2 in Alma 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 order of teams for the presentation and for the two Tasks, the landing window time for Task 2, and Call Sign for Task 2;
    b. Friday morning – Starting at 0800, Bidders conduct a 10-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 afternoon at 1500 hrs – Bidders conduct Prototype Realism Reviews (PRR), where the realism of their prototype is scored by other Bidders and by the judges. **All Bidders must attend the review, bringing with them their UAMS.** This represents a design freeze point, ie, the configuration of vehicles **may not be changed after the PRR** – this will be checked at the start of each Task;
    e. Friday following PRR – Tour of the Qualia site, where Bidders are shown the Task 2 landing zones; at least one representative of each team must attend. Optional test flights may be possible during this period. Confirm time synchronization, see Para 21a;
    f. Saturday – Bidders conduct Task 1;
    g. Sunday – Bidders conduct Task 2; and
    h. Sunday evening – Bidders' Conference and dinner, and awarding of prizes.

Task 1 – Vehicle Performance Assessment

17. Bidders are provided in this document (Figure 2) with the waypoints and route to be flown, as well as the flight boundaries. The coordinates can be downloaded from this link: https://www.google.com/maps/d/edit?mid=1O9_n5UxFsyEuO7xP3grHd-_UQ0yz92E. Note that a lap starts and ends at the same waypoint, waypoint Alpha. One lap is 3 km long.

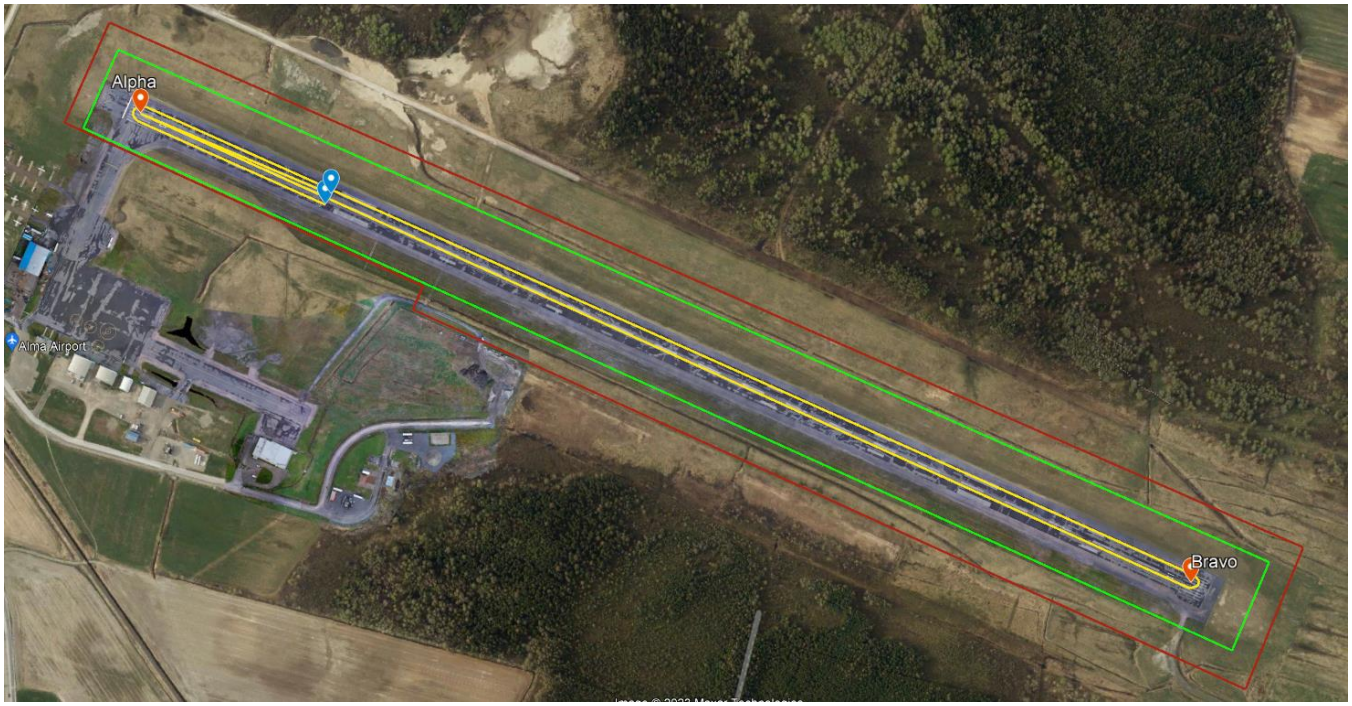

Figure 2: Task 1 waypoints, route, and boundaries

18. Bidders must meet the following Task 1 requirements:
    a. Load passengers and cargo into the UAMS vehicle on the takeoff pad. Passengers will be male and female 11.5 inch 'Made to Move' Barbie dolls, having 11 or 22 joints (they come in the two types). The cargo will be four rectangular boxes, each with dimensions up to 5 cm x 5 cm x 10 cm, with a total weight up to 500g. Four passengers must be carried. The following considerations apply:
        i. The passenger cabin will be scored during the Prototype Realism Review, see Para 41 for design guidelines and requirements.
        ii. The UAMS cannot be picked up or moved during loading.
        iii. Only one team member may load and secure the passengers and cargo.
        iv. Once the passengers and cargo are loaded and all doors are secured, there must be a Flight Readiness Button to activate flight mode. The operation of this button will be verified in the FRR.
    b. Take off and climb as quickly as possible to Waypoint Alpha at or above 100m. The UAMS must be within 10 m of the given coordinates and above 100m altitude to be considered to have reached the waypoint.
    c. Fly back and forth between Waypoints Alpha and Bravo (see Para 17) as many times as possible. The exact route to be flown is at the discretion of the Bidder; however, the UAMS must go around each waypoint. After the initial climb to Waypoint Alpha, the altitude for the remainder of the Task is at the Bidder's discretion (but no higher than 400 ft – any lap that the UAMS is above 400' will not count).

d. Fly back to the takeoff point and land safely. Landing anywhere else restarts the lap count.[2]

19. Bidders will be scored on the following, see Para 43 for scoring:
    a. Weight of the UAMS, less is better.
    b. Distance – The number of laps flown (One lap = Alpha to Bravo and return to Alpha) without cutting a waypoint.
    c. Autonomy – Points for things done without human input after activation of flight mode.
    d. Landing – Land safely at takeoff point.
    e. Security – Passengers in place in their seats and cargo secured after flight.
    f. Elapsed Time – Takeoff to Waypoint Alpha at or above 100m.

Task 2 – Urban All-Weather Landing Trial

20. The landing zones and flight boundaries coordinates can be found at this link: https://www.google.com/maps/d/u/2/edit?mid=1vuMpgsABoftWKPEvqLQlQ-f060NHn4w&usp=sharing. The waypoints have an altitude component and can be found in Annex C – Approach Waypoints for Task 2. Figure 3 shows an overview of the approach. The approach follows a direct line from waypoint to waypoint, both horizontally and vertically.

Figure 3: Task 2 waypoints, approach, and boundaries.

[2] To be clear, you must complete the final lap by going to Alpha before landing or the lap doesn't count.

21. Bidders must meet the following Task 2 requirements:
    a. In the email on Thursday evening, Bidders will be given a specific time window to land (see Para 16.c). The time window will be at least 1 min long. The time will be based on the NRC time clock at https://nrc.canada.ca/en/web-clock/.
    b. Load passengers into the UAMS vehicle on the takeoff pad, see Para 18.a. The loading process is the same as in Task 1.
    c. Maintain radio communication with ATC (the judges) by reporting the following events: Initial call specifying callsign and intended LZ; Takeoff; Start of the approach; Landing completed. Bidders must use the given callsign (see Para 16.c) as in this example: "Alpha-Echo-Charlie-Two-Four commencing approach".
    d. Take off, fly to the initial waypoint (specified location and altitude, see Para 20).
    e. Fly the specified approach. Cross each waypoint within 5 m radius, straight line between waypoints within 5 m of airway. The approach will be tracked by a judge-provided GPS tracker, per Para 13. Stop at the Approach End waypoint and hover until you can go directly to the landing pad to land in the designated time window.
    f. Landing Zones: There are four landing zones, see Figure 7. Bidders choose which landing zone to use. Landing zones are not visible from the launch point (but, as stated, legally VLOS) unless stated otherwise. Each landing zone has only one landing pad. The landing pads will be 32-inch drone landing pads, with the blue side facing up. There will be no obstacles on the LZs; however, the 4 LZs will have varying degrees of difficulty and successful landing will result in different scores.
        i. **LZ Null (Ground):** The landing pad is on the ground, at least 8 m from the closest building.
        ii. **LZ A (Roof):** The landing pad is on the flat part of the roof centered between the two railings. There is 2.5 m between the center of the landing pad and each railing. There is 4.22 m between the center of the landing pad and the closest edge of the building. There is 1.82 m between the center of the landing pad and the edge of the angled wooden obstacle.
        iii. **LZ B (Open Side):** The landing pad is 1.26 m from the side of a building, on the raised stoop. The next closest building is 4.8 m away. The stoop is 2.4 m wide and 2.52 m deep. This landing zone is BVLOS.
        iv. **LZ C (Overhang):** The center of landing pad is 1.2 m from the side of a building, on the raised stoop. The stoop is 2.56 m wide and 2.4 m deep. The landing pad is under a 2.63 m tall overhang.

Figure 4: LZ Null and LZ B

Figure 5: LZ A

Figure 6: LZ C

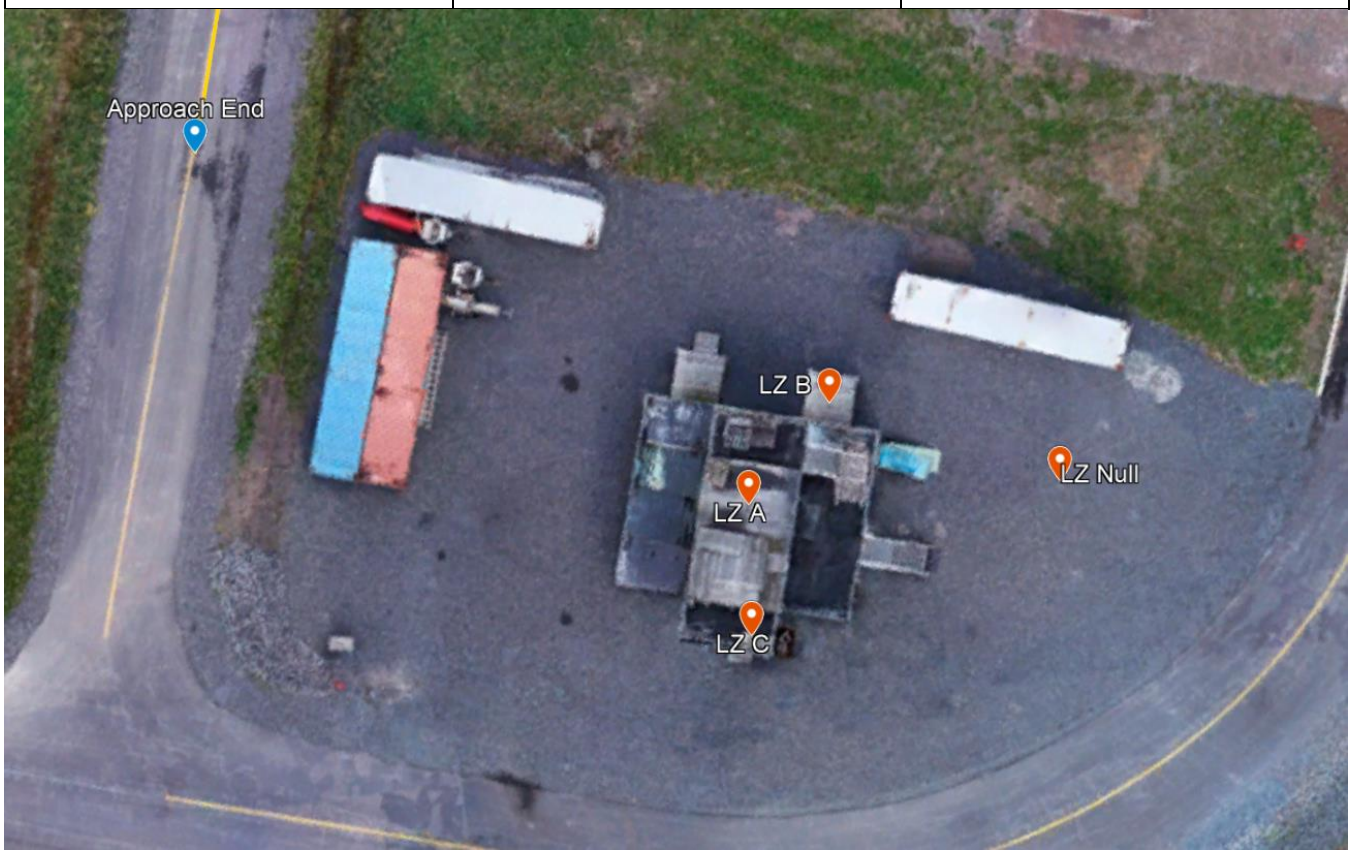

Figure 7: Overhead view of the landing zones

g. Landing Procedure: The UAMS may not obstruct the landing zone until its designated landing time window (ie, you can't hover over the pad and land at the designated time, you must leave room for another mythical UAMS to land during their hypothetical time window). The UAMS must fully land on the LZ, with all landing gear on the LZ, and remain with rotors stopped for 15 seconds. There is no requirement to have any or all landing gear on the pad itself, or in fact for the UAMS to have any positional relationship to the pad.

h. Retry: Bidders may retry the whole Task if there is time remaining in the flight window. The UAMS must fly back to the starting position before the next attempt begins. Bidders can then choose different parameters (different LZ, autonomous instead of manual takeoff/approach/landing, etc). Batteries may be swapped between attempts. If more than one attempt is successful, the highest scoring landing (only) will count.

22. Bidders will be scored on:
    a. Approach – Approach accuracy.
    b. Autonomy – Points for things done without human input after activation of flight mode.
    c. Successful Landing – The higher the level of difficulty of the landing zone, the more points will be given.
    d. Timing – The closest to the specified landing time range, the more points will be given.
    e. Communication – Correctly reporting all events.

UAMS Design Constraints

23. The following design restrictions will be verified at the FRR:
    a. Max weight 15 kg;
    b. Only electric propulsion (including solar cells, batteries or fuel cell).
    c. Flight termination system as defined in Annex B Para 3.
    d. Data links can be by radio, infrared, acoustic or other means so long as no tethers are employed. Unmanned Systems 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 license must be obtained and provided to the judges before being allowed to fly.

Flight Schedule

24. Bidders will have one 30-45 minute flight window for each of the two Tasks. 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.
25. 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.
26. After their last flight of the competition, Bidders have 90 minutes to upload their report to the provided URL.

Flight Crew

27. 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.
28. Pilots must remain at the launch point for the complete Task. Pilots must hold an Advanced Pilot certificate.

Evaluation Criteria

29. All Bidders must complete Phase 1 to be eligible to participate in Phase 2. Phase 1 and 2 are scored and awarded prizes separately.
30. The individual scoring criteria are detailed in the following paragraphs, and a summary of the Phase 2 scoring is shown in Table 9.

Phase 1 Proposal

31. The Phase 1 Proposal will describe the technical and programmatic details of a Bidder's UAMS development and demonstration. Proposals may be submitted in English or French.
32. 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	
System Capabilities	50
Analysis of Alternate Solutions Passenger Safety and Acceptance Vehicle Design Elements Approach Execution Methodology Landing Selection/Execution Methodology	
Technical Innovation and Novelty	25
Novel Approach to Mission Requirements Novel Elements	
Project Management	10
Risk Management Plan Schedule for Prototype Design/Construction Proposed Budget	

33. The following clarifies content for each evaluation criteria:
    a. Days Late – Score reduced by 10% for each day late, starting at 1701 EST on 15 Jan 23.
    b. Grammar/Spelling – Self-explanatory.
    c. Proposal Structure –Done in the structure of a proposal, including common proposal elements; see the internet for examples.
    d. Analysis of Alternate Solutions – How did you choose the vehicle type, the passenger cabin design, the flight methodologies, etc?
    e. Passenger Safety and Acceptance – How does your design ensure the safety of the passengers, and make them feel good about the safety of their flight?
    f. Vehicle Design Elements – Explain the plans for seating, overall cabin shape, integration with the flight system, etc.

g. Approach Execution Methodology – How will your vehicle get from the takeoff point to the start of the approach, then execute the approach within the required parameters?
h. Landing Selection/Execution Methodology – Details of how you'll select the landing pad and execute the landing, including any automation or computer vision.
i. Novel Approach to Mission Requirements – Explain how your overall strategy for accomplishment of the Tasks, and the individual strategy for each Task, are novel.
j. Novel Elements – Novel technology solutions in the overall System. What does your UAMS have that makes it novel in the execution of the Tasks?
k. Risk Management Plan – During design and development of your UAMS, what risks may affect your ability to compete in Alma, 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.
l. Schedule – Including Gantt chart of all significant activities in UAMS development and planning for the Phase 2 Assessment.
m. Budget – Funding Including travel.

34. Proposals are due 15 January 2024 at 1700 EST to competition@aerialevolution.ca and mark.espenant@gmail.com in PDF format. 10% will be deducted from the score for each day late.
35. Proposals are limited to 15 pages total, including any appendices, title page, table of contents, list of figures, etc. Pages past the 15-page limit will be ignored in the scoring.

Phase 2 Bidder's Presentation

36. Bidders make a sales pitch and engineering assessment to all other Bidders and the Assessment Judges. Presentations should include:
    a. Composition and expertise of the Bidder Team;
    b. UAMS Design, including:
        a. Design as expressed in the proposal, and how it evolved to become the final design;
        b. Details of the final design; and
    c. How you will execute each Task.
37. The length of this presentation should not exceed 10 minutes. 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.
38. Presentations in Microsoft PowerPoint are to be uploaded to the provided storage site by 2400 on 23 May 2024 (Thursday).
39. Presentations will be scored on the criteria in Table 2.

Table 2: Bidder's Presentation Scoring

Criteria	Score
Presentation is well organized; most team members participate; other language is 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 would be convinced this is the right Team and UAMS design.	5
Total Possible Score	**40**

Phase 2 Prototype Realism Review

40. Bidders' UAMS realism will be evaluated on objective and subjective criteria.
41. Objective criteria will be evaluated by the judges according to Table 3. Each criterion is awarded points individually and weighted equally within its category, for a maximum score of 15 points.

Table 3: Prototype Realism Review Objective Criteria Scoring

Criteria	Score
Seating: ● One seat per passenger (seat arrangement and type up to the bidders) ● Passengers are suitably restrained (velcro or other fastening materials like glue, tape, etc may not be used) ● Passengers are in a realistic sitting position (degree of recline up to the bidders) – no yoga poses…	4
Cabin Design: ● Window view for each passenger ● No exposed wires from the point of view of the passengers (inside the cabin) ● No flight components visible inside the cabin ● At least one non-functional label (company name/logo, badge, etc.)	6
Accessibility: ● Realistic passenger walking entry, with door, ramp, etc as required/applicable ● At least one clear and visible signage/instructions/placard for accessibility features	5
Total Possible Score	**15**

42. Subjective criteria will be evaluated by other bidders according to Table 4. Each category evaluated as a whole, by whatever method desired for each evaluation (must be consistent), for a maximum score of 20 points.

Table 4: Prototype Realism Review Subjective Criteria Scoring

Criteria	Score

Would You Get In This?: ● Appeal: How visually appealing is the vehicle? ● Comfort: Is the vehicle designed for a comfortable ride? ● Functionality: Does the vehicle appear to meet its intended purpose? ● Safety: Does the vehicle instill confidence in its safety measures?	10
Coolness Factor: ● Originality: How unique and innovative is the design compared to conventional vehicles? ● Standout features: Does the vehicle have distinct features that set it apart? ● Boldness: Does the design take creative risks and avoid a standard “boxy" appearance? ● Artistic Expression: Does the vehicle showcase artistic elements in its design? ● Wow Factor: Does the vehicle elicit excitement and admiration?	10
Streamlined and Integrated Cabin Design: ● Interior Layout: How well is the interior space utilized and organized? ● Cargo Accessibility: Is the cargo space easily accessible and well-designed? ● Connectivity: Does the cabin integrate technology and connectivity effectively? ● User Experience: Is the cabin designed with user comfort and convenience in mind?	5
Total Possible Score	**25**

Task 1 – Vehicle Performance Assessment

43. An overview of the Task requirements is in Para 18. Bidders will be scored on the criteria shown in Table 5:

Table 5: Vehicle Performance Assessment (Task 1) Scoring

Criteria	Score
Time: ● UAMS with quickest time to first waypoint (Takeoff to first waypoint) = 15 pts ● UAMS with slowest time to first waypoint (or doesn’t get there) = 0 pts ● Other points allocated in proportion	15
Distance: ● UAMS with the highest number of completed laps[3] = 30 pts ● UAMS with lowest number of completed laps = 0 pts ● Other points allocated in proportion	30
Empty weight of UAMS:	10

[3] A ‘lap’ is defined as starting at first waypoint, rounding second waypoint, back to 1st. ‘Cutting’ of a waypoint is a deduction of one lap.

• UAMS with the lightest empty weight[4] = 10 pts • UAMS with highest empty weight = 0 pts • Other points allocated in proportion	
Autonomy: Points per autonomous action: • Takeoff = 5 pts • Waypoints following = 10 pts • Landing = 5 pts Note: Judges will determine in the event of pilot intervention whether each individual autonomous action was achieved.	20
Landing: • Land safely at the takeoff point after at least one completed lap = 5 pts	5
Passenger & Cargo Security: • All passengers in place after flight = 10 pts • Cargo in place after flight = 10 pts	20
Total Possible Score	**100**

Task 2 – Urban All-Weather Landing Trial

44. An overview of the Task requirements is in Para 21. Bidders will be scored on the criteria shown in Table 6:

Table 6: Urban All-Weather Landing Trial (Task 2) Scoring

Criteria	Score
Approach following: • UAMS remains within 5m of approach centreline at all times (including altitude) = 20 pts • Each excursion beyond 5m = deduct 2 pts • Each error in approach (eg, misses waypoint) = deduct 8 pts • Deductions can reduce 'Approach Following' score to zero, not negative	20
Autonomy: Points per autonomous action: • Takeoff = 5 pts • Waypoints following = 5 pts • Landing = 10 pts Note: Judges will determine in the event of pilot intervention whether each individual autonomous action was achieved.	20

[4] Including batteries, but not passengers or cargo. To be measured at the Flight Readiness Review.

Landing: ● Land safely at LZ Null = 0 pts ● Land safely at LZ A = 30 pts ● Land safely at LZ B = 30 pts + 15 ● Land safely at LZ C = 30 pts + 40	30 + LZ Bonus
Time: ● Land during the specified time window = 20 pts ● For every 30 sec earlier or later than the specified time window = deduct 2 pts ● Deductions can reduce 'Time' score to zero, not negative	20
Communication: ● Event reported at the right time using the call sign = 2.5 pts / event ● The four events to be reported in order are: Initial Call specifying intended LZ, takeoff, start of the approach, landing completed.	10
Total Possible Score	**100 pts + LZ bonus**

Flight Preparation

45. Teams will be scored on their preparation, according to the criteria in Table 7:

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.	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
UAMS 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	5

● Ad-hoc semi-use of checklists = 2 pts ● No checklists = 0 pts	
Total Possible Score	**30**

Post-Flight Report

46. 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.
47. 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, the success of optimization, route planning and diversion, etc.
    d. Overall comments on the flights – how well things went, lessons learned, how well the engineering design changes from the design paper turned out, etc.
    e. Conclusion.
48. The Report may be in English or French.

Table 8: 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

49. To summarize, the total score available for Phase 2 is 315, weighted as shown in Table 9:

Table 9: Overall Phase 2 Scoring

Criteria	Score
Presentation	40
Prototype Realism Review	40
Task 1 – ***Long-Distance Passenger Transport***	100
Task 2 – ***Urban Passenger Transport***	100 + bonus
Flight Preparation	30
Report	10
Total Possible Score	**320 + bonus**

Annex A – Eligibility and Administrative Requirements

General

50. All team members must be enrolled part- or full-time at a Canadian College or University for Fall 2023 and/or Winter 2024.

Team Size and Composition

51. 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. However, it is possible that COVID-19 considerations will limit the number of team members allowed to attend Phase 2. Availability of accommodation may also limit numbers. Any such limitation will be communicated as soon as possible.
52. 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.

Number of Teams

53. 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 Procurement Authority. 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

54. Teams must send an email indicating their interest to competition@aerialevolution.ca, and complete the online registration on www.aerialevolution.ca, including paying the team registration fee of $600+tax. Registration is non-refundable. Once fully registered, teams will have access to more information. The registration deadline is 28 November 2022 at 1700 EST.
55. Teams are responsible for their own costs, including travel to/from and during the Phase 2 competition. The onsite participant cost is $300+tax and includes most meals and lodging. Accommodations will be arranged by Alma, and teams are not allowed to stay other than in the provided rooms. Food will be provided most days, excluding Saturday evening.

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 license 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 must 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 could consist of using a parachute, or 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.
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: proof of training (a), flight review (b), and SFOC(c) for Non-Canadian RPAS Pilots?
Provided a copy of the RPAS registration?
Provide a copy of the email where the proof of flight was submitted to AEAC.
Empty weight ready to fly (not including pax or cargo) under 15 kg, pass list of weights to Chief Judge
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 may 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 transmissions of any sort are allowed outside the flight window, including Wi-Fi hotspots and the like.
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, the operator will be asked 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 by 11 April 2024. 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.
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. Alma Airport is a certified airport, 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.
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 AEC 2024 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. Information about required insurance was provided in a separate document by email, and is included at the end of this document. If more information is required, contact Declan Sweeney – Executive Director (AEAC) at declan@aerialevolution.ca or call 1 (613) 526 5487.
18. If you need any assistance with regulatory approval, please contact us as soon as possible.

Annex C – Approach Waypoints for Task 2

1. The approach may be previewed in this Google Maps link: https://www.google.com/maps/d/u/2/edit?mid=1vuMpgsABoftWKPEvqLQlQ-f060NHn4w&usp=sharing.
2. Table C1 contains the list of waypoints for the Task 2 approach.

Table C1: Approach Waypoints for Task 2

Name	Latitude	Longitude	Altitude (feet AGL)
Approach Start – direct line to	48.50964	-71.64507	350
Step 2 – direct line to	48.50918	-71.64346	250
Step 3 – curved line following road to	48.50769	-71.64443	200
Approach End	48.50696	-71.64726	100

Annex D – Responses to Questions

As required, amendments have been made to the Conops based on these questions:

- **18.c.** : Is the vehicle allowed to cross the centerline between the two waypoints?
- **18.c.** : Does "outside the waypoints" mean past a line perpendicular to the line segment connecting the 2 waypoints?
- **18.d.** : How close to the takeoff point does the vehicle need to land (i.e.: what is the acceptance radius)?
- **18.d.** : is it correct to assume that once the vehicle is landed, the lap count is final (i.e.: cannot land at takeoff point, then takeoff again?)
- **18.f.** : what is the maximum height of the obstacles from the ground (i.e.: building and containers)?
- **20.** : How close will the physical landing pads be to the provided landing zone coordinates? (i.e.: what is the expected error?)
- **21.a.** : Will we be provided a means to synchronize our clock with the official clock?
- **21.a.** : Is the vehicle allowed to finish the approach early and hover over a landing pad until the start of the landing time window?
- **21.f.** : Which side fo the landing pad will be facing upwards? (blue, orange ,both?). Will the landing pads be the same as the ones used in the 2023 AEAC Student UAS competition?
- **21.g.** : how close to the landing pad does the vehicle need to land (i.e.: what is the acceptance radius),
- **21.g.** : When is the vehicle landing time taken? For example:
    - The moment it touches down (as soon as rotors have been stopped for 15 seconds)
    - 15 seconds after the rotors stop.
    - Landing completed reported to ATC
    - otherwise
- **Table 6, "Time"** : Ware the deductions for discrete increments of 30 seconds or continuous? (i.e. 0.2 point deduction for 3 seconds)
- **General:** Are we allowed to survey the landing pads prior to the competition? (i.e. updating satellite imagery)
- **21.g.**: We just need approximate estimates (days vs weeks vs months for):
    - What is the time frame for flarifying the missing values X?
    - What is the time frame for clarying the altitude limitations?
- **FRR:** Is realism a scale (i.e. highest scoring team receives all points, lowest scoring team receives none), or can multiple teams receive maximum points?
- **ATC Interaction** : Are there points for doing ATC interaction autonomously?

- 'The exact route to be flown is at the discretion of the Bidder'. We don't care where you go as long as you go around the waypoints.
- Watch a slalom ski race sometime - UAMS must go around the waypoints.
- We're not going to set a specific distance - safe landing nearby is fine.

- Correct, and you'll receive the score based on the number of laps completed. Reminder that, per 18d, if you land somewhere else you now have zero laps and would have to restart from 18b.
- You mean 21f, I assume. Not sure, we have to do a detailed mapping of the landing pad site, as mentioned in 21f.
- We'll give you a physical layout referenced to a GPS coordinate, more to follow.
- Good point; yes, we'll do a time-synchronization sometime on Friday after the FRR, and specify the time reference for the rest of the weekend.
- New text added to conops: The UAMS may not obstruct the landing zone until its designated landing time window (ie, you can't hover over the pad and land at the designated time, you have to leave room for another mythical UAMS to land during their hypothetical time window).
- Blue. Yes.
- There is no positional relationship between the pad itself and the UAMS, see 21g. You just have to stick the landing on the LZ...hence the 15 second requirement to see if it falls off!
- Touch down.
- Discrete, per the text.
- If you like, you can get on a plane and go to Alma and look at them in person :). We will provide an accurate drawing, dimensions, GPS reference, and photos, however.
- When we get it done. If you or other teams have specific design decision reasons why you need specific dimensions at a specific time, let me know.
- FRR is individual scores.
- No.

FLIGHT OPERATIONS RISK & INSURANCE:

Compliance with Canadian Aviation Regulations (SOR/96-433) (CARS) Part IX is imperative for RPAS flight operations in the competition. Familiarize yourself with these requirements **here**. A Special Flight Operations Certificate (SFOC) for Remotely Piloted Aircraft Systems (RPAS) will be issued, and its copy is on-site for team reference.

CARS Link: **https://lois-laws.justice.gc.ca/eng/regulations/SOR-96-433/FullText.html#s-900.01**

Before commencing RPAS operations, ensure your documentation, RPAS registration, and pilot certification align with the CARS and SFOC requirements. While the CARs and SFOC may not explicitly mandate insurance, responsibility for injuries, accidents, or claims lies with the Pilot in Command/Team/University. Each team should obtain insurance coverage tailored to their unique needs to safeguard themselves and their students. **Please see the section on Insurance requirements for full details below.**

SFOC

A Special Flight Operations Certificate (SFOC) for Remotely Piloted Aircraft Systems (RPAS) will be issued for the competition. The SFOC copy is on-site and will be shared with the teams.

Ensure your documentation, RPAS registration, and pilot certification meet all the CARS and SFOC requirements before commencing RPAS operations.

FLIGHT OPERATIONS SAFETY

Understanding roles and responsibilities during flight operations is crucial. If any team member perceives a compromise in safety, operations should halt immediately. Address concerns promptly with the Pilot in Command, CED's Flight Safety Officer, and competition judges. Safety protocols will be covered in the team safety briefing, with experienced RPAS operators available for assistance.

Team Insurance Requirements:

The City of Alma mandates liability insurance for events on its territory. Proof of insurance meeting CIDAL's requirements for operations at Alma airport is mandatory. Participating teams must secure liability insurance with a minimum coverage of $2 million (recommended: $5 million) before engaging in RPAS operations at CED - Alma.

Insurance Policy Details:

RPAS Specific Liability Insurance: Minimum CAD$2 million (Recommended: CAD$5 million if possible).

Named Insured: Include UAS Center of Excellence / Centre d'excellence sur les drones (CED) **and** City of Alma / Ville d'Alma as co-insured on the policy.

Proof of Insurance:

Teams must provide proof of coverage and the value of liability insurance to CED for approval by the City of Alma before the competition begins. **Submit proof of coverage and insurance value to info@cedalma.com by the insurance deadline of May 10, 2024.**

Insurance Options

Explore potential brokers/insurers familiar with RPAS insurance:

Skywatch.AI: https://www.skywatch.ai/ca/home

Coverdrone: https://www.coverdrone.com/ca/

Magnes: https://magnesgroup.com/commercial-insurance/insurance-by-industry/rpas-drone-insurance/

HUB International - Contact Brad Borle

Brad Borle, C.A.I.B., RIBO

Account Executive, HUB International Limited

Office: 403-309-3770

Mobile: 403-358-1033

Email: brad.borle@hubinternational.com

For insurance-related queries, contact Declan Sweeney – Executive Director (AEAC) at declan@aerialevolution.ca or call 1 (613) 526 5487.