U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

July 14, 2015

Exemption No. 12036
Regulatory Docket No. FAA–2015–1376

Dr. Stephen Kwan
Northwest Hydraulic Consultants
16300 Christensen Road, Suite 350
Tukwila, WA 98188

Dear Dr. Kwan:

This letter is to inform you that we have granted your request for exemption. It transmits our decision, explains its basis, and gives you the conditions and limitations of the exemption, including the date it ends.

By letter dated May 1, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Northwest Hydraulic Consultants (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct aerial photography.

See Appendix A for the petition submitted to the FAA describing the proposed operations and the regulations that the petitioner seeks an exemption.

The FAA has determined that good cause exists for not publishing a summary of the petition in the Federal Register because the requested exemption would not set a precedent, and any delay in acting on this petition would be detrimental to the petitioner.

Airworthiness Certification

The UAS proposed by the petitioner are the eBee SenseFly; DJI Phantom 2; and 3DR Iris+.

The petitioner requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*. In accordance with the statutory criteria provided in Section 333 of Public Law 112−95 in reference to 49 U.S.C. § 44704, and in consideration of the size, weight, speed, and limited operating area associated with the

aircraft and its operation, the Secretary of Transportation has determined that this aircraft meets the conditions of Section 333. Therefore, the FAA finds that the requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*, and any associated noise certification and testing requirements of part 36, is not necessary.

The Basis for Our Decision

You have requested to use a UAS for aerial data collection[1] . The FAA has issued grants of exemption in circumstances similar in all material respects to those presented in your petition. In Grants of Exemption Nos. 11062 to Astraeus Aerial (*see* Docket No. FAA−2014−0352), 11109 to Clayco, Inc. (*see* Docket No. FAA−2014−0507), 11112 to VDOS Global, LLC (*see* Docket No. FAA−2014−0382), and 11213 to Aeryon Labs, Inc. (*see* Docket No. FAA−2014−0642), the FAA found that the enhanced safety achieved using an unmanned aircraft (UA) with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UAS operation enabled by this exemption is in the public interest.

Having reviewed your reasons for requesting an exemption, I find that—

- They are similar in all material respects to relief previously requested in Grant of Exemption Nos. 11062, 11109, 11112, and 11213;
- The reasons stated by the FAA for granting Exemption Nos. 11062, 11109, 11112, and 11213 also apply to the situation you present; and
- A grant of exemption is in the public interest.

Our Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, Northwest Hydraulic Consultants is granted an exemption from 14 CFR §§ 61.23(a) and (c), 61.101(e)(4) and (5), 61.113(a), 61.315(a), 91.7(a), 91.119(c), 91.121, 91.151(a)(1), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b), to the extent necessary to allow the petitioner to operate a UAS to perform aerial data collection. This exemption is subject to the conditions and limitations listed below.

[1] Aerial data collection includes any remote sensing and measuring by an instrument(s) aboard the UA. Examples include imagery (photography, video, infrared, etc.), electronic measurement (precision surveying, RF analysis, etc.), chemical measurement (particulate measurement, etc.), or any other gathering of data by instruments aboard the UA.

Conditions and Limitations

In this grant of exemption, Northwest Hydraulic Consultants is hereafter referred to as the operator.

Failure to comply with any of the conditions and limitations of this grant of exemption will be grounds for the immediate suspension or rescission of this exemption.

1. Operations authorized by this grant of exemption are limited to the eBee SenseFly; DJI Phantom 2; and 3DR Iris+ when weighing less than 55 pounds including payload. Proposed operations of any other aircraft will require a new petition or a petition to amend this exemption.

2. Operations for the purpose of closed-set motion picture and television filming are not permitted.

3. The UA may not be operated at a speed exceeding 87 knots (100 miles per hour). The exemption holder may use either groundspeed or calibrated airspeed to determine compliance with the 87 knot speed restriction. In no case will the UA be operated at airspeeds greater than the maximum UA operating airspeed recommended by the aircraft manufacturer.

4. The UA must be operated at an altitude of no more than 400 feet above ground level (AGL). Altitude must be reported in feet AGL.

5. The UA must be operated within visual line of sight (VLOS) of the PIC at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses, as specified on the PIC's FAA-issued airman medical certificate or U.S. driver's license.

6. All operations must utilize a visual observer (VO). The UA must be operated within the visual line of sight (VLOS) of the PIC and VO at all times. The VO may be used to satisfy the VLOS requirement as long as the PIC always maintains VLOS capability. The VO and PIC must be able to communicate verbally at all times; electronic messaging or texting is not permitted during flight operations. The PIC must be designated before the flight and cannot transfer his or her designation for the duration of the flight. The PIC must ensure that the VO can perform the duties required of the VO.

7. This exemption and all documents needed to operate the UAS and conduct its operations in accordance with the conditions and limitations stated in this grant of exemption, are hereinafter referred to as the operating documents. The operating documents must be accessible during UAS operations and made available to the Administrator upon request. If a discrepancy exists between the conditions and

limitations in this exemption and the procedures outlined in the operating documents, the conditions and limitations herein take precedence and must be followed. Otherwise, the operator must follow the procedures as outlined in its operating documents. The operator may update or revise its operating documents. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator or any law enforcement official upon request. The operator must also present updated and revised documents if it petitions for extension or amendment to this grant of exemption. If the operator determines that any update or revision would affect the basis upon which the FAA granted this exemption, then the operator must petition for an amendment to its grant of exemption. The FAA's UAS Integration Office (AFS−80) may be contacted if questions arise regarding updates or revisions to the operating documents.

8. Any UAS that has undergone maintenance or alterations that affect the UAS operation or flight characteristics, e.g., replacement of a flight critical component, must undergo a functional test flight prior to conducting further operations under this exemption. Functional test flights may only be conducted by a PIC with a VO and must remain at least 500 feet from other people. The functional test flight must be conducted in such a manner so as to not pose an undue hazard to persons and property.

9. The operator is responsible for maintaining and inspecting the UAS to ensure that it is in a condition for safe operation.

10. Prior to each flight, the PIC must conduct a pre-flight inspection and determine the UAS is in a condition for safe flight. The pre-flight inspection must account for all potential discrepancies, e.g., inoperable components, items, or equipment. If the inspection reveals a condition that affects the safe operation of the UAS, the aircraft is prohibited from operating until the necessary maintenance has been performed and the UAS is found to be in a condition for safe flight.

11. The operator must follow the UAS manufacturer's maintenance, overhaul, replacement, inspection, and life limit requirements for the aircraft and aircraft components.

12. Each UAS operated under this exemption must comply with all manufacturer safety bulletins.

13. Under this grant of exemption, a PIC must hold either an airline transport, commercial, private, recreational, or sport pilot certificate. The PIC must also hold a current FAA airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

14. The operator may not permit any PIC to operate unless the PIC demonstrates the ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from persons, vessels, vehicles and structures. PIC qualification flight hours and currency must be logged in a manner consistent with 14 CFR § 61.51(b). Flights for the purposes of training the operator's PICs and VOs (training, proficiency, and experience-building) and determining the PIC's ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption are permitted under the terms of this exemption. However, training operations may only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights, all persons not essential for flight operations are considered nonparticipants, and the PIC must operate the UA with appropriate distance from nonparticipants in accordance with 14 CFR § 91.119.

15. UAS operations may not be conducted during night, as defined in 14 CFR § 1.1. All operations must be conducted under visual meteorological conditions (VMC). Flights under special visual flight rules (SVFR) are not authorized.

16. The UA may not operate within 5 nautical miles of an airport reference point (ARP) as denoted in the current FAA Airport/Facility Directory (AFD) or for airports not denoted with an ARP, the center of the airport symbol as denoted on the current FAA-published aeronautical chart, unless a letter of agreement with that airport's management is obtained or otherwise permitted by a COA issued to the exemption holder. The letter of agreement with the airport management must be made available to the Administrator or any law enforcement official upon request.

17. The UA may not be operated less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC.

18. If the UAS loses communications or loses its GPS signal, the UA must return to a pre-determined location within the private or controlled-access property.

19. The PIC must abort the flight in the event of unpredicted obstacles or emergencies.

20. The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough available power for the UA to conduct the intended operation and to operate after that for at least five minutes or with the reserve power recommended by the manufacturer if greater.

21. Air Traffic Organization (ATO) Certificate of Waiver or Authorization (COA). All operations shall be conducted in accordance with an ATO-issued COA. The exemption holder may apply for a new or amended COA if it intends to conduct operations that cannot be conducted under the terms of the attached COA.

22. All aircraft operated in accordance with this exemption must be identified by serial number, registered in accordance with 14 CFR part 47, and have identification (N−Number) markings in accordance with 14 CFR part 45, Subpart C. Markings must be as large as practicable.

23. Documents used by the operator to ensure the safe operation and flight of the UAS and any documents required under 14 CFR §§ 91.9 and 91.203 must be available to the PIC at the Ground Control Station of the UAS any time the aircraft is operating. These documents must be made available to the Administrator or any law enforcement official upon request.

24. The UA must remain clear and give way to all manned aviation operations and activities at all times.

25. The UAS may not be operated by the PIC from any moving device or vehicle.

26. All Flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures unless:
    a. Barriers or structures are present that sufficiently protect nonparticipating persons from the UA and/or debris in the event of an accident. The operator must ensure that nonparticipating persons remain under such protection. If a situation arises where nonparticipating persons leave such protection and are within 500 feet of the UA, flight operations must cease immediately in a manner ensuring the safety of nonparticipating persons; and
    b. The owner/controller of any vessels, vehicles or structures has granted permission for operating closer to those objects and the PIC has made a safety assessment of the risk of operating closer to those objects and determined that it does not present an undue hazard.

    The PIC, VO, operator trainees or essential persons are not considered nonparticipating persons under this exemption.

27. All operations shall be conducted over private or controlled-access property with permission from the property owner/controller or authorized representative. Permission from property owner/controller or authorized representative will be obtained for each flight to be conducted.

28. Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA must be reported to the FAA's UAS Integration Office (AFS−80) within 24 hours. Accidents must be reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB Web site: www.ntsb.gov.

If this exemption permits operations for the purpose of closed-set motion picture and television filming and production, the following additional conditions and limitations apply.

29. The operator must have a motion picture and television operations manual (MPTOM) as documented in this grant of exemption.

30. At least 3 days before aerial filming, the operator of the UAS affected by this exemption must submit a written Plan of Activities to the local Flight Standards District Office (FSDO) with jurisdiction over the area of proposed filming. The 3-day notification may be waived with the concurrence of the FSDO. The plan of activities must include at least the following:
    a. Dates and times for all flights;
    b. Name and phone number of the operator for the UAS aerial filming conducted under this grant of exemption;
    c. Name and phone number of the person responsible for the on-scene operation of the UAS;
    d. Make, model, and serial or N−Number of UAS to be used;
    e. Name and certificate number of UAS PICs involved in the aerial filming;
    f. A statement that the operator has obtained permission from property owners and/or local officials to conduct the filming production event; the list of those who gave permission must be made available to the inspector upon request;
    g. Signature of exemption holder or representative; and
    h. A description of the flight activity, including maps or diagrams of any area, city, town, county, and/or state over which filming will be conducted and the altitudes essential to accomplish the operation.

31. Flight operations may be conducted closer than 500 feet from participating persons consenting to be involved and necessary for the filming production, as specified in the exemption holder's MPTOM.

Unless otherwise specified in this grant of exemption, the UAS, the UAS PIC, and the UAS operations must comply with all applicable parts of 14 CFR including, but not limited to, parts 45, 47, 61, and 91.

This exemption terminates on July 31, 2017, unless sooner superseded or rescinded.

Sincerely,
/s/
John S. Duncan
Director, Flight Standards Service

Enclosures

nhc
northwest hydraulic consultants

1 May 2015

U. S. Department of Transportation
Docket Management System
1200 New Jersey Ave., SE
Washington, DC 20590

Dear Sir/ Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the Reform Act) and 14 C.F.R. Part 11, Northwest Hydraulic Consultants (NHC), hereby applies for an exemption from the listed Federal Aviation Regulations ("FARs") to allow commercial operation of sUASs (small Unmanned Aircraft System), so long as such operations are conducted within and under the conditions outlined herein or as may be established by the FAA as required by Section 333.

As described more fully below, the requested exemption would permit the operation of small, unmanned and relatively inexpensive sUAS under controlled conditions in airspace that is 1) limited; 2) predetermined; 3) controlled as to access.

Name and Address of the applicant is

Dr Stephen Kwan
Northwest Hydraulic Consultants
16300 Christensen Road, Suite 350
Tukwila
WA 98188
Tel: 206 241 6000
Email: skwan@nhcweb.com

Relevant Qualifications

Commercial Pilot (3664987) with the following ratings:

1. Airplane Single Engine Land
2. Rotorcraft Helicopter
3. Instrument Airplane
4. Instrument Helicopter
5. Certified Flight Instructor (Helicopter)

Total Flying time: 1100 hours

About The Petitioner

NHC is a specialty consulting engineering firm focused exclusively in the area of water resources. We are experts in flood control, water management, water supply, irrigation, river restoration and many other water related fields. NHC requires topographic survey and imagery of geographical areas to help us in environmental projects that include identifying potential areas of flooding, developing hydraulic models of rivers to predict areas of bank erosion and improve areas of fish habitat. NHC wishes to use sUASs to

perform topographic and imagery acquisition in order to significantly reduce the cost for our clients (who in most cases are government agencies) and so that we have the most up-to-date terrain data available to conduct our work.

Proposed Commercial Uses

NHC plans to use the following sUAS:

- eBee SenseFly
- DJI Phantom 2
- 3DR Iris

The sUAS will be fitted with a digital camera to take aerial photos of river banks which can be used for the following purposes:

1. Flood plain mapping
2. Determining areas of potential erosion/ sedimentation
3. Design of flood control and habitat restoration projects
4. Creating Digital Elevation Maps
5. Examining areas damaged by flooding or landslides

We need to use a sUAS because:

1. Access to portions of some sites is not possible due to terrain, fast river flows, or other hazards.
2. River banks are constantly changing and we need to create up to date terrain data using aerial photos.
3. We can access both sides of the river bank efficiently and safely.
4. Creating Digital Elevation Models (DEM) from aerial photos is much more efficient and economical than using manned aircraft. We will subsequently be able to pass this cost saving to our clients.

We have no intention of selling photos for commercial purposes.

We have not yet performed any work in this field to ensure compliance with any applicable FARs regarding the use of UAS for commercial operations.

Intended Operational Use of sUAS

- Operation altitudes: 50 – 400 ft AGL
- Estimated Survey Area: 0.5 – 600 acres
- Flight Time: multiple 15 min flights as necessary to cover area. Typical project flight time estimated to be about 1 hour.
- Airspace: Class G

Figure 1 shows a typical scenario illustrating the flight path over a stretch of river.

Figure 1. Typical flight path of UAS (shown in Red)

NHC will be bound by the following limitations when conducting its sUAS operations under an FAA exemption:

1. The sUAS will weigh less than 55 lbs.
2. Flights will be operated within line of sight of a pilot and/or observer.
3. Maximum total flight time for each operational flight will be 15 minutes. Flights will be terminated at 20% battery power reserve should that occur prior to the 15 minute limit.
4. Flights will be operated at an altitude of no more than 400 ft AGL.
5. Flight operations will occurring during daylight hours under VFR or Marginal VFR conditions.
6. Minimum crew for each operation will consist of the sUAS Pilot and the Visual Observer.
7. sUAS PIC will be an FAA licensed airman with at least a private pilot's certificate and third class medical. (Dr Stephen Kwan is a certified flight instructor and in addition holds a commercial and

instrument rating for both helicopter and airplanes. He understands regulations, requirements and flight rules governing airspace).

8. The PIC may train other pilots in the use of the sUAS during the survey.
9. The sUAS will operate within an area that has been determined to be safe and at least 200 ft away all persons who are unaware of the survey. The operator will obtain written consent of all persons involved or in the area of the survey.
10. The sUAS will operate at least 100 ft away from buildings in urbanized areas.
11. A briefing will be conducted in regard to the planned sUAS operations prior to each survey. It will be mandatory that all personnel who will be performing duties within the survey area to be present for this briefing
12. The operator will file a FAA Form 7711-1, or its equivalent, as modified in light of the requested exemption, with the appropriate Flight Standards District Office.
13. Pilot and observer will be trained in operation of sUAS generally and receive up-to-date information on the particular sUAS to be operated.
14. Observer and pilot will at all times be able to communicate by voice and/or text.
15. Written and/or oral permission from the relevant property holders will be obtained.
16. All required permissions and permits will be obtained from territorial, state, county or city jurisdictions, including local law enforcement, fire, or other appropriate governmental agencies.
17. If the sUAS loses communications or loses its GPS signal, the sUAS will have capability to return to a pre-determined location and land.
18. The sUAS will have the capability to abort a flight in case of unpredicted obstacles or emergencies.

How our request would benefit the general public

One of NHC's major area of expertise is floodplain mapping to determine the extent of flooding in the event of a major flood. If we are granted an exemption to use a sUAS for aerial surveying, the benefits to the public will be:

1. Areas of potential landslides and flooding can be easily identified;
2. Accurate mapping of potential areas of flooding;
3. Increased efficiency and reduced cost of river restoration and flood control projects for our clients (usually Government agencies).

Regulations from which the exemption is requested:

14 C.F.R. Part 21;
14 C.F.R. 91.7 (a)
14 C.F.R. 91.9(b)(2) & (c)
14 C.F.R. 91.103
14 C.F.R. 91.109:
14 C.F.R. 91.119;14
14 C.F.R. 91.121
14. C.F.R. 91.151(a)
14 C.F.R. 91.203(a) & (b)

14 C.F.R. 91.405(a)
14 C.F.R. 91.407(a)(1)
14 C.F.R. 91.409(a)(2)
14 C.F.R. 91.417(a).

Description of Specific Regulations

We require an exemption in accordance with Section 333 AND a civil Certificate of Waiver or Authorization (COA) to operate unmanned aircraft in the National Airspace System (NAS) for commercial use in a low-risk, controlled environment.

14 C.F.R. Part 21: (Aircraft certification requirements) & 14 C.F.R. 91.203(a) & (b); (Maintenance inspections)

Under 14 C.F.R. § 91.203, all U.S.-registered aircraft are required to have a certificate of airworthiness issued by the FAA. Part 21, Subpart H of the FAA's regulations establishes the procedural requirements for the issuance of airworthiness certificates by the FAA.

Equivalent level of safety analysis: The strict operational limitations under which NHC will conduct flights for commercial sUAS applications (e.g., daylight operations, use of Class G airspace, all flights within line-of-sight of the operator) are at least as restrictive as the limitations that apply to the operation of limited or restricted category, experimental or provisionally-certificated aircraft. The sUAS does not carry a pilot or any other passengers and their small size and electric motor reduce the danger that any collisions with the ground or structures will involve anything more than the loss of sUAS. Automatic descent of the sUAS upon loss of the data link with its control station eliminates the potential for "fly away" incidents. The concerns behind the need for the certification of an aircraft's airworthiness are mitigated by the sUAS's limited operational range, small dimensions and the use of lightweight materials in their construction, all of which reduce the risk of damage to surrounding structures.

14 C.F.R. 45.23(b): "N" numbers and markings

This regulation requires the display of an "N" registration mark on any U.S.-registered aircraft. Additional markings are required for limited or restricted category aircraft, experimental aircraft or provisionally-certificated aircraft on the entrance to the cabin, cockpit or pilot station.

Equivalent level of safety analysis: The FAA has yet to indicate whether sUAS aircraft will be subject to its aircraft registration requirements. The FAA's Integration of Civil Unmanned Aircraft Systems in the National Airspace System (NAS) Roadmap published in November 2013 is silent on this point. As sUAS aircraft are not currently required to be registered with the FAA, it is not necessary for NHC's sUAS aircraft to be marked with an "N" registration number. The surface area of the sUAS is not large enough to contain any of the markings required by the FAA for limited or restricted category aircraft, experimental aircraft or provisionally-certificated aircraft. One of the purposes served by these markings is to caution passengers on board such an aircraft (including any pilot) that it does not meet all of the FAA's requirements for a standard category certificate of airworthiness. As the sUAS will not carry any

passengers, and otherwise will operate in accordance with strictly-controlled flight parameters, the absence of such a warning on the sUAS will not result in any reduction in the overall safety of the operation. NHC is willing to include any markings that may be required by the FAA in connection with its commercial UAS operations, with the understanding that the surface area of the sUAS will not permit lettering that is larger than 1 inch in height. In addition, if requested by the FAA, NHC can place markings on each of the control stations used to operate NHC's sUAS aircraft.

14 C.F.R. 91.7 (a): (Civil aircraft airworthiness)

The regulation requires that no person may operate a civil aircraft unless it is in airworthy condition. As there will be no airworthiness certificate issued for the aircraft, should this exemption be granted, no FAA regulatory standard will exist for determining airworthiness. Given the size of the aircraft and the requirements contained in the User Guide for maintenance and use of safety checklists prior to each flight an equivalent level of safety will be provided.

14 C.F.R. 91.9(b)(2) & (c): (Flight manuals, placards)

This regulation requires that an approved flight manual, manual material, markings, placards or some combination thereof be placed on board the aircraft. The sUAS does not have a configuration suitable for compliance with this requirement.

Equivalent level of safety analysis: The sUAS is linked to a computer that serves as the control station. The instruction manual for the sUAS can be downloaded to the computer and accessed by the operator, in much the same way that pilots of commercial airliners are able to access flight manuals on tablet devices that serve as "electronic flight bags." All manual material, markings and placards relevant to the operation of the sUAS can be displayed on the screen of the computer that serves as the control station, as required. The instruction manual for the sUAS will therefore be just as accessible as a flight manual carried onboard a commercial jet.

14 C.F.R. 91.103: (pre-flight)

This regulation requires each pilot in command to take certain actions before flight to ensure the safety of flight. As FAA approved rotorcraft flight manuals will not be provided for the aircraft an exemption will be needed.

Equivalent level of safety analysis: The PIC will take all actions including reviewing weather, flight battery requirements, landing and takeoff distances and aircraft performance data before initiation of flight.

14 C.F.R. 91.109: (Dual controls for instruction)

Section 91.103 provides that no person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls. sUASs and remotely piloted aircraft, by their design do not have fully functional dual controls. Flight control is accomplished through the use of a control box that communicates with the aircraft via radio communications. The FAA has approved exemptions for flight training without fully functional dual controls for a number of aircraft and for flight instruction in experimental aircraft.

Equivalent level of safety analysis: Neither a pilot nor passengers will be carried in the aircraft. The requirement for dual flight controls on an aircraft used for training purposes is mitigated by the sUAS's limited operational range, small dimensions and the use of lightweight materials in their construction, all of which reduce the risk of damage to surrounding structures in the event of an operator error that results in the loss of the aircraft.

14 C.F.R. 91.119: (Safe altitudes over obstacles)

This regulation specifies the minimum altitude in various flight environments below which aircraft are not allowed to operate. NHC will conduct the commercial services it proposes to operate below the FAA-specified minimum of 500 ft above the surface and closer to vessels and structures than the minimum separation of 500 ft mandated by the FAA.

Equivalent level of safety analysis: The operation of the sUAS aircraft exclusively in Class G airspace (i.e., below 1200 ft) is intended as a safety measure to provide a level of separation between NHC's commercial UAS operations and the operation of manned aircraft at altitudes above 1200 ft. In this case, limiting the sUAS to flights below the 500 ft minimum will enhance safety rather than compromise it. NHC will need to operate the sUAS closer than 500 ft to structures in order to conduct the inspections that will comprise a major part of NHC's commercial sUAS services. However, NHC's flight procedures include the company's own requirements regarding the minimum level of separation between sUAS and any nearby structures or facilities. In addition, the risk of damage to any nearby structures or facilities is reduced by sUAS's limited operational range, small dimensions and the use of lightweight materials in its construction.

14 C.F.R. 91.121: Altimeter Settings

This regulation requires each person operating an aircraft to maintain cruising altitude by reference to an altimeter that is set "...to the elevation of the departure airport or an appropriate altimeter setting available before departure." As the sUAS may not have a barometric altimeter, but instead a GPS altitude read out, an exemption is needed.

Equivalent level of safety analysis: The operator, pursuant to the Manual and Safety Check list, will confirm the altitude of the launch site shown on the GPS altitude indicator before flight.

14 C.F.R. 91.151(a): (Fuel minimums)

FAA regulations require that a rotorcraft operating under VFR conditions have sufficient fuel to fly to the first point of intended landing and, assuming normal cruising speed, to fly for at least an additional 20 minutes. The sUAS has a maximum operating time of 20 minutes.

Equivalent level of safety analysis: The FAA's regulations require sufficient reserves of additional fuel to enable a rotorcraft to find the nearest suitable landing zone if the intended landing facility is not available. The additional time that a rotorcraft is required to be able to operate is less than the time required to allow fixed-wing aircraft to find a suitable landing field (30 minutes during the day, 45 minutes at night) reflecting the relative scarcity of landing fields for aircraft versus landing zones suitable for rotorcraft. By similar logic, the additional fuel required for sUAS aircraft should be dramatically less

than for rotorcraft, as the sUAS is small enough to land virtually anywhere. Because the sUAS initiates an automatic spiral descent upon any loss of power, there is no need to require additional flying time for the sUAS to find a suitable landing zone. The concerns behind the FAA's surplus fuel requirement for rotorcraft are mitigated by the sUAS's limited operational range, small dimensions and the use of lightweight materials in its construction, all of which reduce the risk of damage to surrounding structures.

14 C.F.R. 91.203(a) & (b): (Maintenance inspections)

The regulation provides in pertinent part:
(a) Except as provided in § 91.715, no person may operate a civil aircraft unless it has within it the following:
(1) An appropriate and current airworthiness certificate. . . .
(b) No person may operate a civil aircraft unless the airworthiness certificate required by paragraph (a) of this section or a special flight authorization issued under §91.715 is displayed at the cabin or cockpit entrance so that it is legible to passengers or crew.

The UAS fully loaded weighs no more than 55 lbs and is operated without an onboard pilot. As such, there is no ability or place to carry certification and registration documents or to display them on the sUAS.

Equivalent level of safety analysis: An equivalent level of safety will be achieved by keeping these documents at the ground control point where the pilot flying the sUAS will have immediate access to them, to the extent they are applicable to the sUAS.

14 C.F.R. 91.405(a) & 14 C.F.R. 91.407(a)(1): 14 C.F.R. 91.409(a)(2): 14 C.F.R. 91.417(a): (Maintenance related)

FAA regulations impose various requirements regarding the maintenance of civil aircraft, including periodic inspections, approval for return to service by a qualified mechanic following maintenance or repair, an airworthiness inspection and certain rules concerning maintenance record keeping. NHC's maintenance of the sUAS aircraft will not satisfy these requirements.

Equivalent level of safety analysis: NHC will maintain the sUAS in accordance with the manuals and operating handbook provided by the manufacturer. Because of the sUAS's small size and lightweight construction, NHC will be able to subject it to top-to-bottom examination after every flight. All pre- or post-flight maintenance, equipment failures, charge cycle logs, fault/repair logs, inspections and general maintenance records will be kept on file for a minimum of three years. NHC has developed a lengthy pre/post-flight checklist; any aircraft which is unable to meet all the requirements for safe operation will be removed from service immediately and will not return to service until any defects have been remedied. Moreover, if mechanical issues arise, the sUAS can land immediately as they will be operating at an altitude no higher than 500 ft.

The manufacturers periodically update parts and software for sUAS aircraft. When a

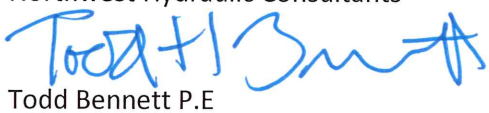
UAS is tested in the office, NHC will check for the most recent stable software issued by the manufacturer (NHC will not use Beta software). NHC will ensure its sUAS aircraft have the most recent equipment and software. The number of hours that a sUAS is in operation will be logged by NHC to ensure proper life of components as well as the flight packs that provide power.

Summary

This application seeks an exemption from the FARs set forth above to allow commercial operations of a small unmanned aircraft system to conduct precision aerial surveys for the benefit of the general public.

Yours sincerely

Dr Stephen Kwan CFI
River Engineer
Northwest Hydraulic Consultants



Todd Bennett P.E
Branch Manager
Northwest Hydraulic Consultants