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## **Submission on the proposed restricted area – Alexandra, Central Otago**

This submission is on behalf of the General Aviation Advocacy network. The GAA is a voluntary social network for people involved in New Zealand General Aviation. It has more than 2000 registered supporters.

### **Allocation of restricted airspace – the history**

For the benefit of those within the CAA who may not have been employed in the restricted airspace consultation process 19 years ago, we consider it important to examine the history of this issue.

The genesis of the granting of restricted airspace to commercial entities is the 2000 America's Cup regatta in Auckland. That ended up having to be enacted by Parliamentary statute, but the upshot was that the event organiser was granted control of airspace for commercial purposes. The Aviation Industry Association and local users presented to a Select Committee and received undertakings that it wouldn't set a precedent. This is on the record. Ray Wilson appeared for the Auckland users and we believe Tom Riddell for the AIA.

GAA has obtained the presentation notes of the address given on 24 January 1999 to the Transport and Environment Committee on the Civil Aviation Amendment Bill.

The points raised by the Auckland Airspace User Group are as relevant today as they were 19 years ago.

- The commercial charging for entry into restricted areas is setting a very dangerous precedent, which will lead to the proliferation of operators of restricted airspace using this as a method to collect revenue.
- The areas are to be operated under Civil Aviation Authority Rules, which makes the Director responsible for compliance and direct oversight. The control of these areas must not be vested in an operator for the purposes of commercial gain.
- The group concluded its notes by saying, succinctly, that it did not wish to see "Airspace for Sale" in the future.

The Transport and Environment Committee, in its report of March 1999, noted that the submitters had expressed concern that the provisions in Part 2 of the Civil Aviation Amendment Bill were very general

and did not provide any specific detail on the following:

- What criteria would be used by the Director of Civil Aviation in deciding whether to specify the person nominated as the controlling authority?
- Who would check and approve the accreditation system?
- What criteria would be used by the Director to decide on how large the designated airspace will be?

### **Assessing the value of airspace**

As introduced, clause 14 (d) of the Civil Aviation Amendment Bill required applications for the appointment as the event organiser to include “an assessment by the applicant of the right to control access to the proposed airspace”.

Submissions suggested that this paragraph should be omitted from clause 14, as it required information that is unrelated to safety and could be used in the future to charge for the access to the proposed airspace. Any move to put a value on airspace would be vigorously opposed by the aviation industry.

The Transport and Environment Committee expressed its concern that the bill **should not be seen as a precedent for charging for access to airspace in the future** and emphasised that the sunset clause reinforces that intention.

We note that, with respect to the current Hokianga and Alexandra restricted airspace applications, there appears to be no sunset clause disclosed either by the operators or by the CAA. Nor, for that matter, has the CAA disclosed how it intends to police restricted airspace to ensure that the controlling authority is not inviting other UAV operators to use the airspace and then subsequently charge them for the use of it.

### **Exclusion of aircraft from restricted airspace**

The Ministry of Transport has produced a draft UA Integration Paper in which it states that the objective is to safely integrate UA into the New Zealand aviation system and ultimately into an integrated transport system. By integration, the Ministry means all aircraft (manned and unmanned) operating safely and seamlessly together, and seamlessly with other transport options.

The Ministry goes on to say that successful integration would see our aviation system provide opportunities for UA to operate beyond the visual line of sight (BVLOS) of the pilot or operator. Before widespread BVLOS operations can occur, UA and other aviation technologies need to demonstrate to the CAA that they can operate alongside other aircraft while ensuring the continued safety of all aviation users, as well as people and property on the ground.

The Director has the regulatory power to impose conditions on such airspace. At the moment, the airspace applicants have been seeking exclusion of all other aircraft, to enable their operations.

For a GA aircraft to access TM (transponder mandatory) airspace, it must have a serviceable transponder. This is not unreasonable, because it can then be seen by ATC and separated from other traffic.

A mindset adjustment is needed. The CAA must be required to administer the airspace so that aircraft wishing to enter uncontrolled airspace can do so and be advised of the location of any UA within the area. A UA applicant should be told that if they want access to airspace, they'd better be prepared to provide technology to facilitate integration and separation from other airspace users. This is in line with the Ministry's stated objective above.

### **Exclusion of GA aircraft from a restricted area is not integration. This message needs to be understood.**

In uncontrolled airspace, pilots separate themselves on a “see and be seen” principle. If a pilot cannot reasonably expect to see a small UA, operating BVLOS, then it must be incumbent upon the UA operator

to maintain separation from other traffic by providing a technological solution before being permitted to operate in that environment.

A direct comparison of the impact on the recreational use of the Hokianga airspace by aviators could be made if we consider the maritime environment. If, for example, the 874 sq kms (543 sq miles) of the Hokianga Harbour was placed off limits to recreational fishing, for the purposes of a commercial fishing company carrying out "research", we are fairly confident that the local iwi would voice their objections in a forceful manner.

The key element in the Hokianga and the Alexandra applications for restricted airspace is segregation. Manned are being required to be separated from unmanned, and in both cases the UAV operators are seeking the prohibition of manned aircraft.

### **The Alexandra restricted airspace application**

From the outset, the GAA wishes to have it placed on record that we consider the proposed restricted airspace area in Central Otago is not fit for purpose, for several reasons.

#### **Impact on local airspace users**

We concur with the CAA's initial assessment that has identified the following VFR operations that would be directly affected:

- Glider and tugs circuit at Alexandra aerodrome
- Standard overhead join procedure at Alexandra aerodrome
- Low flying zone NZL970, Galloway, is almost entirely within one of the proposed restricted areas

In the CAA's proposed airspace consultation document, it was stated that it is unknown as to if, or how many, uncharted aerodrome or heliports lie within the proposed areas. We can inform the Authority that there are at least 21 identified airstrips within the proposed area. Private owners and agricultural companies use these airstrips. Some of the airstrips have hangars for private aircraft and others are in scenic locations and are used by private aircraft owners for recreational flying.

Flying on and off these airstrips would normally be done in light wind conditions - the same conditions that the UAV operator has stated as being one of the reasons for choosing Alexandra as a location. We therefore have a situation whereby the UAV operator and the local GA pilots will find themselves wanting to fly in similar weather. If the airspace is placed under the control of the UAV operator, the potential exists for GA aircraft operators to be locked out of the airspace on the very days that they may wish to fly.

The gliding fraternity will also be affected by having their access blocked to the superb gliding conditions generated along the Raggedy Range and North Rough Ridge.

#### **Size of requested restricted airspace**

"CAR 71.151 requires the Director to ensure that each portion of special use airspace designated is as small as practicable consistent with the activities for which the area is required. The need for restricted airspace must be justified and, if necessary, a lesser volume of airspace than that requested could be designated if the request is excessive."

The proposed area at Alexandra encompasses 500 sq kms of airspace over the Central Otago countryside. We consider this to be an excessive area and, although smaller than the 874 sq kms which was previously granted to a commercial UAV operator at Hokianga, we have seen no justification from the CAA as to why it granted such a huge area to that particular Hokianga UAV operator. It seems to us that the process is not entirely transparent.

## **Public safety aspects - vulnerability to fires**

The proposed airspace in Central Otago is above large areas of often tinder-dry tussock country which is vulnerable to fires. A fire started by a crashed UAV up on these hills can only be fought by helicopters with monsoon buckets. In places, the nearest water source is miles away and the helicopters will probably need to come from either Wanaka or Queenstown.

In somewhat similar circumstances, on June 21 2017, a US Air Force Hawk drone crashed into the Inyo National Forest in California. The accident touched off a forest fire and was believed to have happened when the drone lost contact with its ground station and flew off course.

Skybase Chief Executive Michael Read and CAA General Manager GA Steve Moore suggested at the consultation meeting in Alexandra that conditions could be imposed on Skybase's operation, such as only operating at night.

It would appear that neither of these two spokesmen from Skybase and the CAA have considered the risks involved in a fire starting as a result of a UAV crash at night, and how far it would spread before helicopters could fight it with monsoon buckets after dawn.

The link below shows the result of a fire started by a model aircraft on 28 December 2017, in a similar Central Otago location. The fire quickly got out of control, but fortunately it was in an area that was reasonably accessible to fire crews.

<https://www.odt.co.nz/regions/central-otago/blaze-sparked-model-plane>

The smaller UAVs with which the operator plans to begin will likely contain high-capacity Lithium-ion or Lithium-polymer batteries. Batteries of this type can cause fires. Electrical systems should be designed so that all components operate within their specified voltage and current ratings and there is no possibility of electrical short-circuits.

Events such as discharging too quickly, overcharging, punctures and internal short-circuits can all cause a battery to fail this way. Lithium-polymer batteries are very similar to Lithium-ion batteries as far as safety is concerned. They operate with almost the same chemistry, but one uses a gel rather than a liquid.

Thermal runaway, normally caused by an electronic error or mechanical damage, is a typical fire scenario for Li-ion batteries and accumulators. It starts in relatively unspectacular fashion. The oxidation of the electrolyte heats the interior of the battery to around 80°C, causing gas and steam to appear in the cell. If this process is not stopped, it triggers a chain reaction. At around 120°C, the separator between the anode and cathode melts. This causes a short-circuit and thermal decomposition of the cathode. This releases oxygen which, combined with the heat energy, ignites the materials in the anode, cathode and electrolyte (mainly organic solvents, light metals and graphite). At this stage, temperatures can reach up to 1000°C.

We consider that there is a high probability of a fire being started due to impact damage to Li-ion or Li-po batteries sustained in the event of a UAV crashing. In the interests of public safety, the Director must satisfy himself that the battery packs of UAVs operated commercially over private and public land are contained in such a manner that has been proved to withstand crashes and not pose a risk of starting a fire.

In our view, it is imperative that the CAA carries out inspections and airworthiness safety checks of electrical circuitry if it is intended to operate these UAVs over private property and public land.

It was reported, at the Alexandra consultation meeting, that the company considers the technology not to be "experimental". However, it was disclosed that the company had already lost two UAVs. If a Part 91, 135, or 121 operator lost two aircraft, we are certain that it would be subjected to intense scrutiny.

## **Public safety – informed consent of landowners**

AC 102-1 states that, under part 101, operators are required to avoid using airspace above people, unless they have the consent of people below the flight. This requirement applies to private property as well as public land and public spaces.

The AC goes on to say that, generally, operating above people without their consent is likely to be a hazardous activity.

In deciding whether to relax or remove the requirement to obtain consent, relevant considerations will be reviewed by the Director. These considerations would include:

- the weight and size of the aircraft involved; and
- the configuration of the aircraft (fixed-wing vs multi-rotor or airship) – (things such as the glide capability of the aircraft and whether rotor blades are closed/covered will be particularly relevant); and
- reliability of the aircraft; and
- reliability of the control system (and any related system); and
- mitigations in place in the event of any system failure, including “return home” functionality; and
- system redundancy (such as an acceptable automatic recovery parachute); and
- the geographical area where the aircraft is intended to be used; and
- the height(s) at which the aircraft will be operated; and
- consideration of the hazard register to establish the operator’s understanding of their operation and safety management.

It is our view that newspaper advertising, letter drops or signs affixed in a particular area or at the entry to an area of intended operation do not constitute informed consent. A bland public notice to the effect that BVLOS operation of unmanned aircraft will be taking place does not constitute or imply the informed consent of landowners.

Landowners must be given sufficient information by the operator and the CAA, which is the ultimate controlling authority. Information provided to landowners must contain explanations covering the nine considerations as detailed above. Names and addresses of all property owners within the restricted airspace can be obtained from public records and the UAV operator must be required to contact these owners.

Just telling someone by way of a letter drop about something any party would like to or intends to do does not mean the recipient of that letter drop has given consent. Consent is something the receiver of the notice needs to consider and form his/her opinion as to whether or not he/she would like that event to occur on or over his/her land. Any and all consents by landowners must be made and given in writing to avoid any later dispute as to the fact.

If the UAV operator states that it has the consent of landowners, what measures will the CAA adopt to establish the veracity of such a claim?

## **Public safety – Training of UAV operators and degraded modes of operation**

In April 2006, an Unmanned Aerial Vehicle crashed near Nogales, Arizona. This incident is of interest because it triggered one of the most sustained studies into the causes of failure involving a UAV. The National Transportation Safety Board, together with the US Customs and Border Protection agency under the Department of Homeland Security, worked to identify lessons learned from this mishap. The crash at Nogales is also of interest because it illustrates an irony of UAV operations: the increasing reliance on autonomous and unmanned operations is increasing the importance of other aspects of human-system interaction in the cause of major incidents.

The report showed how human intervention played a critical role in emergency response even after the UAV went into fully autonomous flight. The lack of coordination and emergency planning between the CBP, Air Traffic Management and organisations including the Western Area Defence Sector was exposed in the minutes after contact was lost. Not only was it difficult for ATM personnel to identify the risks of possible incursions as the UAV strayed beyond the TFR zone; the pilot had insufficient knowledge about the lost link profile and could not provide the detail that they needed. This mishap revealed a pressing need for safety management structures to be used beyond the design phases involved in UAV construction. It revealed the importance of adequate incident reporting and of accurate maintenance logs during operational service. It also illustrated the need for structured risk assessment techniques to inform detailed mission planning, in particular to guide the identification of 'crash zones' within lost link profiles.

Further work needs to focus on two key areas – degraded modes of operation and contingency planning. 'Degraded modes of operation' describes failures of critical components that can gradually erode safety margins but which need not prevent an application from being used to achieve its intended function. In other words, operators can find 'work-arounds' that get the job done but which may also threaten the safety of operators and the general public. In contrast, contingency operations refer to the response that organisations plan for the total failure of a safety-critical control system. It can be argued that because UAVs do not carry aircrew, there has been a temptation to find work-arounds that would never be allowed within other areas of aviation.

The Nogales incident was caused primarily by the 'hot swapping' of a failed circuit board between operational avionics systems. This is not recommended practice in most airlines but has been described in several UAV incidents. Similarly, it might be argued that an undue level of complacency has also undermined contingency planning within these operations.

Too little thought is often given to the coordination that is needed when large, unmanned or autonomous flying vehicles unintentionally stray from controlled airspace. This scenario needs to be carefully considered by the CAA when deliberating on the request for restricted airspace at Alexandra, because the operator wants to start commercially testing unmanned aircraft with wingspans from between 2.4m to 5m, but within a year wants to be flying aircraft with a wingspan of 12.8m.

This larger aircraft is likely to be an unmanned PAC P-750 UAV, on which the Chinese AT 200 UAV is based. The PAC P-750 has a maximum take-off weight of 3.4 tonnes, carries a fuel load of 1256 Litres, and has a range of 1179 NM with 45 minutes reserve.

Quite how the operator and the CAA intend to deal with the problem of a UAV with the range and endurance of a PAC P-750 "going rogue", such as happened in the Nogales, Arizona, UAV crash, has not been explained. This possibility is something the CAA needs to be cognisant of, when determining the risk to the public.

### **Alternative airspace areas**

The University of Canterbury is the operating authority for restricted airspace granted for UAV testing at Kaitorete Spit, along the southern side of Banks Peninsula. This area was established with the cooperation of the Canterbury Airspace User Group and, because of its location, has had minimal (if any) effect on GA flying in Canterbury. It was reported at a recent CAUG meeting that the use of the restricted airspace was offered to the Alexandra UAV operator but that offer was declined on the basis that the area didn't have a sealed runway and associated infrastructure such as hangars and so on.

We observe that Rocket Labs didn't have a readymade launching pad or infrastructure at Mahia Peninsula. It went ahead and built all that as a commercial cost of establishing its business.

The GAA believes that any UAV testing site must have an ocean boundary so that in the event of a loss of autonomous control of the UAV for whatever reason, or an engine shut-down, it can be programmed to fly out to sea before it eventually crashes. In the Alexandra case, and in a worst-case scenario, the Director must ultimately consider whether the only large bodies of water nearby – lakes Wakitipu, Wanaka, Hawea and Dunstan – are acceptable as potential crash areas.

Control of a UAV will be lost at some point. The US military experience is testament to that. Below is a link to just one of these events.

[https://www.youtube.com/watch?v=bthw8os5QNY`](https://www.youtube.com/watch?v=bthw8os5QNY)

Yet another US military incident has been reported, involving a UAV of similar wingspan to that which has been proposed by the Alexandra operator – 2.4m to 5m. This incident is described below:

### **US military drone goes AWOL, ends up crashing into tree 623 miles away Army baffled as Shadow goes invisible**

By [Iain Thomson in San Francisco](#) 2 Mar 2017 at 20:45



*"Who knows what evil lurks in the hearts of men? The Shadow knows!"*

The US Army is investigating how one of its drones took an unplanned 623-mile excursion and ended up stuck in a tree two states away.

The Shadow RQ-7 drone was launched by soldiers from the 2nd Stryker Brigade of the 7th Infantry Division during a training mission in Arizona at 17:16 local time. It was supposed to provide the troops with imaging support; however almost immediately after launch it lost contact with its ground station.

Losing communications with a drone isn't uncommon – the machine's software is supposed to either return it to its launch site automatically or have it loiter and try to reestablish contact. Instead, the \$1.5m drone pulled a sharp right turn and headed off into New Mexico before turning north.

Lieutenant Colonel John Henderson, vice-commander of the Civil Air Patrol's National Radar Analysis Team, [told Stars and Stripes](#) that they tracked the drone for the first 500 miles of its trip but then lost it in the mountains along the southern border of Colorado. He estimated that the drone would have had to fly at over 12,000 feet to get across the mountains in one piece.

The team then considered the Shadow lost, but ten days later it was found by a hiker near the town of Evergreen, just west of the Colorado state capital of Denver. The Shadow had crashed into a tree and was missing a wing as a result.

The drone, one of the newer v2 types, is launched from a catapult and it carried two cameras (one TV and one infrared), a laser pointer, and comms gear to maintain encrypted communications with its ground station. It's supposed to land on an arrestor hook for refuelling and reuse, not go walkabout.

The range of the drone under normal conditions isn't known. Paul Scharre, director of the Future of Warfare Initiative at the Center for a New American Security think tank, said the distance to the crash site was achievable and the 20-foot aircraft would also have benefited from strong tailwinds over Colorado.

Scharre noted that the case illustrated some of the problems with deploying semi-autonomous systems in comparison to manned military units.

"Without a person on board, even with a good link, you're not going to have the same level of cognitive awareness," he said. "And if you lose signal link, you may have a limited ability to re-assert control over the aircraft. This would not happen with a person unless they went crazy or defected. That's pretty rare.

"Imagine a soldier on Fort Huachuca getting lost doing land navigation," Scharre added. "He's not going to keep going and wander into Colorado."

The Shadow has been used by the US military for nearly 15 years and this isn't the first time one of them has gone rogue. In 2009, a Shadow drone went [out of control](#) and crashed into the Mosul offices of a major Iraqi Islamist political party. No one was hurt and the Army said the crash site was "a coincidence."

In 2014 another Shadow, operated by the Pennsylvania National Guard, crashed near a local school during an exercise. After the crash, the drone was then run over by a car, although thankfully no one was hurt.

In all of these cases, the Shadow drone was armed with nothing more deadly than a camera – however, the platform has been trialled as a weapon delivery system by the US Marine Corps.

## Conclusion

- The proposed airspace at Alexandra is not fit for purpose for the reasons that we have described.
- It will have a major effect on general aviation within the proposed area.
- The use of airspace for BVLOS operations raises safety management concerns from technical and human factors perspectives, if autonomous operation of a UAV should fail.
- Before **ANY** area is designated for the purpose of UAV testing, further work needs to focus on two key areas – degraded modes of operation and contingency planning.
- It must be incumbent upon the UAV operators to formulate ways and means to safely integrate their operations into uncontrolled airspace without requiring exclusion of other users from that airspace.
- There is an identifiable risk, based on overseas experience, that the safety of the public and land owners may be compromised if there is an accident.
- Informed consent for UAV operations must be gained from all landowners within a restricted area.

14 October 2018