



Australian Government
Civil Aviation Safety Authority

OFFICE OF THE CHIEF EXECUTIVE OFFICER

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Committee Secretary
Senate Committee on Rural and Regional Affairs and Transport
PO Box 6100
Parliament House
CANBERRA ACT 2600

Dear Sir/Madam

Senate Committee on Rural and Regional Affairs and Transport Inquiry into regulatory requirements that impact on the safe use of Remotely Piloted Aircraft Systems, Unmanned Aerial Systems and associated systems

Please find attached a submission from the Civil Aviation Safety Authority (CASA) addressing those terms of reference for this Inquiry relevant to CASA. The purpose of this submission is to set out for the Committee the legal framework currently in place to regulate the operation of Remotely Piloted Aircraft Systems (RPAS). CASA's intent in developing these regulations has been to manage the risks which may be involved in the operation of these aircraft, but to do so in a manner which, while focussing on safety, does not necessarily discourage innovation or impose unnecessary regulatory costs on either commercial operators or recreational users.

There is no doubt that the technology involved in this industry will expand the uses of RPAS in many different fields and increase the demand for their greater deployment on such tasks within the community. The effects of this expansion pose a safety challenge recognised and faced by all aviation regulators world-wide. CASA intends to learn from overseas experience and from best practice within the Australian RPAS industry to continue to develop regulations that meet the above criteria in terms of preserving safety and encouraging innovation, while avoiding unnecessary red tape. Among the issues for RPAS that CASA sees as likely to arise in the future and where regulatory provision may be necessary include developments in Beyond Visual Line of Sight capabilities, operation in Instrument Flight Rules, lift and carry issues and integration into the air traffic management system.

It should be noted that a number of the terms of reference for this Inquiry such as the importation on RPAS, state and local government regulations, privacy, insurance requirements and national security fall outside of CASA's remit.

CASA would be happy to provide more information on its role in relation to RPAS at the appropriate time.

Yours sincerely

Shane Carmody
Acting Chief Executive Officer and
Director of Aviation Safety

**Senate Standing Committee
on Rural and Regional Affairs and Transport
Inquiry into regulatory requirements that impact on the safe use of
Remotely Piloted Aircraft Systems, Unmanned Aerial Systems and
associated systems**

**SUBMISSION OF THE
CIVIL AVIATION SAFETY AUTHORITY**

Introduction

1. More than 15 years ago, Australia was one of the first countries in the world to introduce comprehensive legislation governing the operation of 'Unmanned Aerial Vehicles' (UAV)—recognised even at the time as an emerging 'new class of aircraft'¹, with promising 'potential use in littoral surveillance, communications, survey, law enforcement, hazardous area operation and aerial photography.'²
2. Part 101 of the Civil Aviation Safety Regulations 1998 (CASR) was introduced in December 2001, in response to the need for an effective and appropriate regulatory framework within which the development of new applications for this rapidly evolving technology could progress without compromising the safety of other airspace users and people and property on the ground.³
3. In more recent years, the unmanned aircraft sector in Australia has experienced exponential growth driven by advancements in technology that continue to fuel consumer market demand, and the ready availability of sophisticated devices at relatively low cost. Indicatively, when the Civil Aviation Safety Authority (CASA) addressed the House of Representatives Standing Committee on Social Policy on Legal Affairs Inquiry into 'Drones and the Regulation of Air Safety and Privacy' (*Eyes in the sky*) in February 2014, CASA had issued 70 Remotely Piloted Aircraft operator certificates. As at 12 December 2016, CASA had issued 850 Remotely Piloted Aircraft operator certificates (ReOC), with 118 applications waiting to be assessed, 2,466 people have completed the excluded category notification system and CASA has issued 4,159 Remotely Piloted Aircraft (RPA) pilot licenses.
4. Meeting the expectations of the Australian community to provide a rational, fair and effective regulatory framework within which optimal safety outcomes can be achieved in the face of these unprecedented developments is challenging for aviation safety regulators around the world. In response to the magnitude and pace of change we are witnessing today, and in anticipation of the changes we can expect to see in the future, CASA's measured efforts to achieve these objectives are paying safety dividends, without impeding responsible growth and development in this burgeoning field of innovation and enterprise.
5. CASA welcomes the opportunity to make this submission to the Senate Standing Committee on Rural and Regional Affairs and Transport Inquiry into regulatory requirements that impact on the safe use of Remotely Piloted Aircraft Systems, Unmanned Aerial Systems and associated systems. The Inquiry's Terms of Reference cover a range of issues with which CASA has been actively engaged for more than 15 years, and in respect of which we believe our input can inform the Committee's deliberations.

¹ Explanatory Statement for *Civil Aviation Amendment Regulations 2001 (No. 4)*, SR 2001 No. 349.

² Regulatory Impact Statement (RIS 0016) for Civil Aviation Safety Regulation Part 101 (14 March 2001).

³ *Civil Aviation Amendment Regulations 2001 (No. 4)*, SR 2001 No. 349 (20 December 2001), commencing on 1 July 2002.

6. It is not CASA's intention to address matters that do not fall within the reach of our statutory functions, namely, issues related specifically to security, privacy, insurance and broader questions involving the social and economic impact of proliferating Remotely Piloted Aircraft Systems (RPAS) technologies and applications. Recognising, however, that aspects of those issues do intersect with critical features of CASA's functions we stand ready to respond to questions concerning those issues.

Regulatory requirements

7. CASA's primary responsibility under the *Civil Aviation Act 1988* is to conduct the safety regulation of Australian civil air operations.⁴ In keeping with that obligation, CASR Part 101 was introduced in 2001 to govern the operation of unmanned aircraft. Prior to this, a disparate array of regulations dealt unevenly with what were essentially regarded as toys with only a marginal impact on conventional civil aviation activities and safety.⁵
8. Amendments to Part 101 (the amendments),⁶ which commenced on 29 September 2016, significantly enhance the existing safety framework, introducing new provisions which serve at once to:
 - *strengthen and clarify the requirements and limitations* governing the safe operation of unmanned aircraft; and
 - *expand the range of, and loosen the restrictions on,* activities in which unmanned aircraft may safely be operated without unnecessarily burdensome administrative constraints.
9. The amendments reflect a balanced response to existing and emerging safety risks, without imposing unnecessary costs or unnecessarily hindering participation in aviation and its capacity for growth.⁷

CASR Part 101 (as amended with effect from 29 September 2016)

10. Today, all Australian unmanned aircraft are covered by the regulations set out in:
 - CASR Subpart 101.A—⁸
 - containing *preliminary* provisions describing the applicability of Part 101;
 - dis-applying in some cases the regulations governing the marking and registration of certain unmanned aircraft;
 - exempting certain unmanned aircraft from various provisions of the Civil Aviation Regulations 1988;
 - defining the term populous area as it applies to operations covered by CASR Part 101;
 - providing for the issue of a Part 101 Manual of Standards (MOS);⁹

⁴ See subsection 9(1).

⁵ See Explanatory Statement for *Civil Aviation Amendment Regulations 2001 (No. 4)*, SR 2001 No. 349: 'The previous legislation governing pilotless aircraft . . . resided in various areas of the Civil Aviation Regulations . . . and in the Civil Aviation Orders. . . provid[ing] limited guidance to CASA and operators . . . other than a general prohibition on the activity except in accordance with the express permission of CASA. The result of the deficiencies in the previous legislation was a varied interpretation of CASA's requirements with respect to unmanned aerial activities and a non standard approach by CASA to the approval of such activities.'

⁶ *Civil Aviation Legislation Amendment (Part 101) Regulation 2016*.

⁷ See DAS Directive 01/2015, *The Development and Application of Risk-Based and Cost-Effective Aviation Safety Regulations* (Revised, January 2016)

⁸ CASR 101.005 to CASR 101.035.

⁹ Manuals of Standards are documents which support the Regulations by providing detailed technical materials, such as technical specifications or standards. As legislative instruments, MOSs are subject to registration and disallowance under the *Legislation Act 2003*. See the note to CASR 11.265.

- providing for CASA's approval of geographic areas within which unmanned aircraft may be operated (under circumstances different to those generally governing their operation); and
- explaining how information a person is required to provide to CASA is to be provided.
- CASR Subpart 101.B—specifying *general prohibitions* on the unsafe operation of all unmanned aircraft, irrespective of such prohibitions as may apply under other provisions of the regulations in respect of particular types of unmanned aircraft and/or unmanned aircraft engaged in particular kinds of operations; and¹⁰
- CASR Subpart 101.C—specifying *operational limitations* applicable to unmanned aircraft generally.¹¹

Generally applicable safety-related limitations on the operation of unmanned aircraft

11. Safety is CASA's primary consideration in the performance of its regulatory functions.¹² Consistent with this overarching statutory obligation, the regulations contain explicit requirements, restrictions and limitations governing the operations of unmanned aircraft. These include provisions expressly prohibiting:
- (a) the operation of an unmanned aircraft in a way that creates a hazard to another aircraft, another person, or property;¹³
 - (b) the unauthorised operation of an unmanned aircraft in or over a prohibited or restricted area;¹⁴
 - (d) the unauthorised operation of an unmanned aircraft above 400 feet above ground level (AGL) in controlled airspace;¹⁵
 - (e) the unauthorised operation of an unmanned aircraft in controlled airspace otherwise than in accordance with such requirements as may be prescribed in the Part 101 MOS;¹⁶
 - (f) the unauthorised operation of an unmanned aircraft beyond the visual line of sight of the person operating the aircraft;¹⁷
 - (g) the unauthorised operation of an unmanned aircraft within 3 nautical miles (5.5 kilometres) of an aerodrome;¹⁸
 - (h) the unauthorised operation of an unmanned aircraft above 400 feet AGL;¹⁹
 - (i) the dropping or discharge of a thing from an unmanned aircraft in a way that creates a hazard to another aircraft, person or property;²⁰
 - (j) the unauthorised operation of an unmanned aircraft in or into cloud, at night or in other than visual meteorological conditions;²¹ and
 - (k) the unauthorised launch or release of an autonomous unmanned aircraft.²²

¹⁰ CASR 101.050 to CASR 101.101.055.

¹¹ CASR 101.060 to CASR 101.097. Subpart 101.C does not apply to: (a) control-line model aircraft; (b) model aircraft operated indoors; (c) unmanned airships operated indoors; (d) small balloons within 100 metres of a structure and not higher than the top of the structure; (e) unmanned tethered balloons that remain below 400 feet above ground level; and (f) firework rockets not capable of rising more than 400 feet above ground level. CASR 101.005(3).

¹² See subsection 9A(1) of the Civil Aviation Act.

¹³ CASR 101.055(1).

¹⁴ CASR 101.065(1).

¹⁵ CASR 101.070(1).

¹⁶ CASR 101.072.

¹⁷ CASR 101.073.

¹⁸ CASR 101.075.

¹⁹ CASR 101.085.

²⁰ CASR 101.090.

²¹ CASR 101.095.

²² CASR 101.097. An *autonomous aircraft* is an aircraft that does not allow pilot intervention during all

Penalties for breaching the rules governing the operation of unmanned Aircraft

12. In most cases, a breach of any of these regulatory requirements constitutes a strict liability offence, the penalty for which may involve a fine of up to \$9,000 (imposed by a court on conviction), or the issuance of an infringement notice by CASA requiring the payment of an administrative penalty of up to \$900 (in default of which the matter may be referred for prosecution).
13. The reckless operation of an unmanned aircraft so as to *endanger the life* of another person, or otherwise *to endanger* another person or another person's property, are serious offences under the Civil Aviation Act. On conviction by a court, a person may be sentenced to a period of up to 5 years in prison for endangering another person's life, and up to 2 years for otherwise endangering another person or another person's property.²³

Modernising the regulatory framework for unmanned aircraft operations

14. Under the current regulations, unmanned aircraft, also known as Remotely Piloted Aircraft (RPA) are categorised, and the operations in which RPA may be engaged are classified, in ways that better reflect the contemporary environment. These changes have been designed to facilitate the development and use of new technologies and applications, while ensuring appropriate safety requirements are maintained.

Categorising unmanned aircraft by size and weight

15. The regulations now identify five types of RPA based on the size and weight of the aircraft. These include:²⁴
 - *micro RPA*—an RPA with a gross weight of *100 g or less*.
 - *very small RPA*—an RPA with a gross weight of *more than 100 g but less than 2 kg*.
 - *small RPA*—an RPA with a gross weight of *at least 2 kg but less than 25 kg*.
 - *medium RPA*—
 - (a) an RPA with a gross weight of *at least 25 kg, but not more than 150 kg*; or
 - (b) a remotely piloted airship with an envelope capacity of *100 m³ or less*;
 - *large RPA*—
 - (a) a remotely piloted aeroplane with a gross weight of *more than 150 kg*;
 - (b) a remotely piloted powered parachute with a gross weight of *more than 150 kg*;
 - (c) a remotely piloted rotorcraft with a gross weight of *more than 150 kg*;
 - (d) a remotely piloted powered-lift aircraft with a gross weight of *more than 150 kg*;
 - (e) a remotely piloted airship with an envelope capacity of *more than 100 m³*.

Operating model aircraft

16. Model aircraft are defined in the regulations as *aircraft used for sport or recreation* and which cannot carry a person.²⁵
17. Beyond the requirements generally applicable to the operation of all unmanned aircraft, the operation of model aircraft weighing *less than 100 grams* is not subject to any other regulatory limitations.

stages of the flight of the aircraft.

²³ Sections 20A and 29 of the Civil Aviation Act.

²⁴ CASR Dictionary, Part 1.

²⁵ CASR Dictionary, Part 1.

18. The operation of model aircraft weighing *100 grams or more*, however, is also governed by the provisions set out in Subpart 101.G, which specify additional limitations to help ensure the safe operation of these model aircraft. In summary, these requirements provide that:²⁶
- (a) a person may only operate a model aircraft if the visibility at the time is good enough for the person operating it to be able to see it continuously;
 - (b) a person may operate a model aircraft at night only in accordance with the written procedures of an approved administration organisation;
 - (c) a person must not operate a model aircraft over a populous area at a height less than the height from which, if any of its components fails, it would be able to clear the area;
 - (d) subject to certain exceptions, the person operating a powered model aircraft must ensure that, while the aircraft is in flight, landing or taking off, it remain at least 30 metres from anyone not directly associated with its operation; and
 - (e) a model aircraft may only be operated outside an approved area at an altitude above 400 feet AGL if the person operating it keeps it in sight and clear of any populous areas.
19. Specific regulations govern the operation of *giant model aircraft* (defined as model aircraft having a take-off mass (excluding fuel) of more than 25 kilograms, but not more than 150 kilograms)²⁷ as well as the conduct of model aircraft flying displays.²⁸

Operating RPA for other than sport or recreational purposes

20. As a general rule, the operation of very small, small and medium RPA for other than sport or recreational purposes—and the operation of large RPA for *any* purpose—is governed by Subpart 101.F.²⁹ In particular, Division 101.F.2 within that Subpart provides that:
- (a) subject to certain exceptions, a person must not operate an RPA within 30 metres of a person who is not directly associated with the operation of the RPA;³⁰
 - (b) the Part 101 MOS may prescribe areas within which certain RPA may be operated and requirements governing the operation of RPA in those prescribed areas with which a person must comply;³¹
 - (c) very small, small and medium RPA may only be operated outside an approved area at a height of above 400 feet AGL with CASA's approval, and only if the RPA remains clear of any populous areas.³²

Requirement to hold an RPA pilot licence (RePL)

21. In addition to the operational limitations and generally applicable requirements, and subject to certain exclusions discussed below, a person operating a very small, small, medium or large RPA *for purposes other than sport or recreation* must hold an RePL authorising those operations.³³
22. Requirements governing eligibility and application for, the imposition of conditions on and the cancellation of an RePL are set out in Division 101.F.3 of the regulations.³⁴

²⁶ CASR 101.385 to CASR 101.400.

²⁷ CASR 101.380.

²⁸ CASR 101.410.

²⁹ CASR 101.235.

³⁰ CASR 101.245.

³¹ CASR 101.247.

³² CASR 101.250.

³³ CASR 101.252.

³⁴ CASR 101.290 to 101.320.

Requirement to hold an RPA operator's certificate (ReOC)

23. In addition to the licensing requirements and subject, in some cases, to the exclusions discussed below, the conduct of operations *for purposes other than sport or recreation* in a very small, small, medium or large RPA requires that the person conducting those operations hold a ReOC.³⁵
24. Requirements governing eligibility and application for, the imposition of conditions on, compliance requirements and the cancellation of, a ReOC are set out in Division 101.F.4 of the regulations.³⁶

Certification and maintenance requirements for large RPA

25. A person may operate a large RPA only if an airworthiness certificate in the restricted or experimental category has been issued for that aircraft.³⁷
26. Continuing airworthiness responsibilities for large RPA involve the application of those provisions in the Civil Aviation Regulations 1988 setting out certain maintenance-related requirements for Class B aircraft.³⁸ CASA may authorise persons to carry out maintenance on large RPA in accordance with the terms of their authorisation.³⁹
27. Airworthiness and maintenance related provisions for other RPA operated under a ReOC are included in CASA's template operations manual.⁴⁰

Liberalising the regulation of certain RPA operations

28. In recent years, demand has grown for a liberalised regime under which certain operations involving RPA being used *for other than sport and recreational purposes* might be undertaken safely, but without necessarily requiring the full complement of the licensing and certification requirements.
29. In response, the amendments to Part 101 introduced new provisions in Subpart 101.F allowing selected operations of this kind to proceed without the need to comply with those requirements, *subject to appropriate safety enhancements*.

Operation of very small RPA for hire or reward

30. Now, under Division 101.F.5, very small RPA may be operated for hire or reward *without requiring the operator to hold a RePL or a ReOC*, subject only to certain notification requirements.⁴¹
31. At least *5 business days before* the first operation of a very small RPA for hire or reward occurs, the person must notify CASA, in writing, of their intention to conduct such an operation.⁴² The information required to be provided includes details about the identity of the

³⁵ CASR 101.270.

³⁶ CASR 101.330 to CASR 101.370.

³⁷ CASR 101.255.

³⁸ CASR 101.260. As defined in the *Civil Aviation Regulations 1988* (CAR), a *Class B aircraft* is an Australian aircraft that is *not* certificated as a transport category aircraft and/or is *not* being used, or to be used, by the holder of an Air Operator's Certificate authorising the use of the aircraft for regular public transport operations. See CAR 2(1).

³⁹ CASR 101.265.

⁴⁰ <https://www.casa.gov.au/files/sampleoperationsmanualdocx>

⁴¹ CASR 101.371.

⁴² CASR 101.372. Persons conducting operations in very small or another type of RPA in accordance with the terms of an existing ReOC need not provide this kind of notification to CASA. Information about the nature and circumstances of those operations will already have been provided to CASA in connection with their application for their ReOC.

operator, the kind of very small RPA involved, the nature of the operations involved and the area in which the operations will be conducted.⁴³

32. A person conducting such operations must do so in accordance with the applicable safety requirements, including the *standard operating conditions* described below, and any other instructions or directions CASA may give.

Operation of 'excluded RPA'

33. The regulations now also include a category of *excluded RPA*, specifying the type of RPA eligible for measured relief from otherwise applicable operational requirements. As explained below, excluded RPA may be operated without the operator being required to hold certain licences and other permissions.⁴⁴

34. The following RPA are identified as 'excluded RPA' on the basis of their size and weight and, in most cases, the operations in which they may be engaged:

- A micro RPA.
- A very small RPA if it is being operated
 - for sport or recreational purposes; or
 - in the standard RPA operating condition.
- A small RPA if it is being operated:
 - by or on behalf of the owner of the RPA; and
 - over land owned or occupied by the owner of the RPA; and
 - in the standard RPA operating conditions; and
 - for the purpose of one or more of the following:
 - aerial spotting;
 - aerial photography;
 - agricultural operations
 - aerial communications retransmission;
 - the carriage of cargo;
 - any other activity that is similar to an activity mentioned above;

for which no remuneration is received by the operator or the owner of the RPA, the owner or occupier of the land or any person on whose behalf the activity is being conducted.
- A small or medium RPA if it is being operated for sport or recreational purposes.
- A small or medium RPA if it is being operated in the standard RPA operating conditions by:
 - a person for the sole purpose of meeting certain experience requirements for the grant of remote pilot licence; or
 - the holder of a remote pilot licence for the sole purpose of gaining competency in the operation of an RPA.
- A medium RPA if it is being operated:
 - by or on behalf of the owner of the RPA; and
 - by a person who holds a remote pilot licence that authorises the person to operate the RPA; and
 - over land owned or occupied by the owner of the RPA; and
 - in the standard RPA operating conditions; and
 - for the sole purpose of one or more of the following:
 - aerial spotting;
 - aerial photography;
 - agricultural operations;

⁴³ The information required to be provided is specified in the approved notification form, which is available on CASA's public website at <https://www.casa.gov.au/standard-page/commercial-unmanned-flight-remotely-piloted-aircraft-under-2kg>.

⁴⁴ CASR 101.237.

- aerial communications retransmission;
 - the carriage of cargo;
 - any other activity that is similar to an activity mentioned above;
- for which no remuneration is received by the operator or the owner of the RPA, the owner or occupier of the land or any person on whose behalf the activity is being conducted
- An RPA is an excluded RPA if it is being operated:
 - by a person solely for the purpose of the person receiving training from an RPA operator who holds an operator certificate authorising the conduct of operations using the RPA; and
 - in accordance with the operator's documented training procedures.
35. The designation of an RPA as an excluded RPA operates to dis-apply the provisions of the regulations requiring a person to hold a RePL⁴⁵ or a ReOC.⁴⁶

Standard RPA operating conditions

36. Part 101 now specifies a set of *standard RPA operating conditions* under which:
- (a) the RPA is operated within the visual line of sight of the person operating it; and
 - (b) the RPA is operated at or below 400 feet above ground level (AGL) by day; and
 - (c) the RPA is not operated within 30 metres of a person who is not directly associated with its operation; and
 - (d) the RPA is not operated:
 - (i) in a prohibited area or in specified restricted areas; or
 - (ii) over a populous area; or
 - (iii) within 3 nautical miles of the movement area of a controlled aerodrome;
 - (e) over an area where a fire, police or other public safety or emergency operation is being conducted, without the approval of the person in charge of the operation; and
 - (f) the person operating the RPA is only operating that RPA.⁴⁷
37. Guidance and advice on requirements governing the operation of excluded RPA (other than model aircraft), including very small RPA and small or medium RPA, is available in CASA Advisory Circular AC 101-10⁴⁸ and on the CASA website.⁴⁹

The Part 101 amendments consultation process

38. CASA consulted with the public and industry on the amendments that are now in effect between 14 May 2014 and 16 June 2014. Revisions to the draft regulations were endorsed by the UAS Standards Sub-committee (UASSC), which includes representatives from the RPAS industry as well as CASA, Airservices Australia and major Australian airlines.⁵⁰ In developing the amendments to Part 101, CASA commissioned two research studies by Monash University—
- (a) *Potential damage assessment of a mid-air collision with a small UAV*.⁵¹ This report

⁴⁵ CASR 202.252(1).

⁴⁶ CASR 101.270(1).

⁴⁷ CASR 101.238.

⁴⁸ *Remotely Piloted Aircraft Systems – Operation of Excluded RPA (other than Model Aircraft)*, v.1.2 (September 2016). See <https://www.casa.gov.au/files/ac10110pdf>.

⁴⁹ See <https://www.casa.gov.au/aircraft/landing-page/flying-drones-australia>.

⁵⁰ A list of members is available on the CASA website at <https://www.casa.gov.au/standard-page/unmanned-aircraft-systems-uas-standards-sub-committee>.

⁵¹ <https://www.casa.gov.au/files/potential-damage-assessment-mid-air-collision-small-rpapdf>

analysed the damage potential to manned aircraft from a mid-air collision with a small unmanned aircraft. The scenarios of engine ingestion and impacts into fuselage and cockpit windscreen were considered.

- (b) *Human injury model for small unmanned aircraft impacts.*⁵² This report described an injury prediction model for the impact of small Remotely Piloted Aircraft (RPA) into a person on the ground. The model provides estimates of injury severity as a function of the RPA's mass and impact velocity.
39. CASA took studies such as these into account in developing the amendment regulations including the *Standard RPA Operating Conditions*. CASA considers the regulations, supported by published guidance and safety educational material, assist in minimising the likelihood of a person or another aircraft being hit by an unmanned aircraft.
40. CASA also took account of the model aircraft hobbyists and the propriety of applying to relatively low-risk flight activities requirements of a kind better suited to higher risk flight activities.
41. In formulating the regime established by the amended regulations, CASA responded to government that, in so far as practicable, consistent with the interests of safety, 'red-tape' and other unnecessary administrative burdens, including cost, should be eliminated or reduced. CASA believes the amended regulations responsibly strike this rational balance, with the introduction of the excluded RPA category—which CASA has estimated will reduce costs for this category in excess of \$5,000—without any measurable increase in safety risk.
42. Some concerns have been expressed about the amendments creating unacceptable safety risks by allowing certain commercial operations previously requiring a RePL and/or a ReOC to be conducted now by people who hold neither of these authorisations. It is important to recognise that:
- (a) only a limited range of operations for hire or reward may lawfully be conducted without a RePL or a ReOC;
 - (b) those operations may only be conducted in very small RPA; and
 - (c) the conduct of those operations is subject, in all cases, to strict operational requirements, including compliance with the standard operating conditions.

The future regulatory environment

43. CASA anticipates a growing demand for new regulatory policies and practices to support previously unforeseen applications of RPA technology, such as aerial home delivery, high altitude operations, operations beyond visual line of sight (BVLOS) in controlled airspace and large UAV operations. Many potential uses for RPAS have been identified in different industries, including emergency services, agriculture, mining, cinematography, scientific research, cargo transport, the delivery of medical supplies and aerial survey work traditionally conducted using manned aircraft.
44. Since the amendments to Part 101 were made, the CASA UASSC has formed a taskforce to focus on the future development of Part 101 with a view to this expanding its range of activities. The principal aim of the taskforce is to develop a roadmap—a strategic plan, setting out the objectives of future regulation in Australia. The roadmap will identify potential operations (e.g. autonomous agricultural operations; BVLOS operations in controlled airspace; high-altitude, long-endurance operations) and determine the regulatory, technological and procedural steps necessary to facilitate the safe introduction of these kinds of operations. This work will also consider international developments.
45. Although the BVLOS operation of RPA is generally prohibited,⁵³ CASA may approve such operations, subject to any conditions that may be necessary to ensure they are conducted

⁵² <https://www.casa.gov.au/files/human-injury-model-small-unmanned-aircraft-impactspdf>

⁵³ See CASR 101.073(1).

safely.⁵⁴ Naturally, extensive BVLOS RPA operations in airspace used by manned aircraft will require certainty that such operations involve an acceptable level of risk, equivalent to the risk exposure to other aircraft, people and property posed (and accepted) today in connection with conventional aviation activities. With these considerations in mind, CASA is closely following, and encouraging research in support of the technological developments necessary to achieve this outcome such as 'detect and avoid' (DAA) systems and 'command and non-payload communications' radio links.

46. Contemplating further amendments to CASR Part 101, CASA and the UASSC have identified areas in which safety enhancements can be advanced in conjunction with the assurance of flexible regulatory 'spaces' in which research and development, as well as innovative trial commercial applications, can proceed safely. Some of the proposals currently under consideration include:
- (a) reducing the restriction on the distance RPAs must be operated from people who are protected by barriers/structures (e.g. a small RPA operating near a person inside a house);
 - (b) developing an appropriate and suitable remote pilot training syllabus for BVLOS operations;
 - (c) developing comprehensive RPAS (aircraft and ground station) certification standards, as such standards would provide a necessary level of confidence in the safety of operations in integrated airspace and over populated areas;
 - (d) making provision for personal 'follow-me' RPA;
 - (e) creating a requirement for aircraft marking and/or non-destructible identification plates (potentially allowing easy identification of an RPA involved in an accident);
 - (f) introducing appropriate age, medical, ongoing proficiency and recency RPA pilot requirements, with a particular view to higher risk operations;
 - (g) providing a concept of 'shielded operations' where RPA are flown below the height of surrounding terrain/buildings;
 - (h) providing some facilitative opportunities for operators using proven geo-fencing software;
 - (i) investigating the merits of adopting (in whole or in part) appropriate airworthiness framework models being developed by other aviation authorities;
 - (j) developing standards for the specification of prescribed airspace for training remote pilots and testing RPAS.
47. CASA is also working to approve a number of areas in Australia for the test and development of RPAS technologies. Ideally these areas would be established in restricted airspace to minimise the impact on the community, utilise downtime, provide a large degree of built-in risk mitigation and provide a range of different surface and airspace environments.

Overseas developments, including work by the International Civil Aviation Organization

48. The International Civil Aviation Organization (ICAO) is the principal international agency with responsibility for harmonising technical and operational safety requirements globally. ICAO promulgates international Standards and Recommended Practices, which States are expected to adopt (and adapt), in accordance with their own national legislative processes.
49. At the 39th ICAO Assembly held between 27 September and 6 October 2016, 13 working papers were presented on RPAS by various States. There was considerable divergence in approach including advocacy of strict registration requirements, differences in categorisation and whether RPAS should be treated in the same, or an entirely different, manner as manned aircraft.

⁵⁴ See CASR 101.073(2) and CASR 101.029.

50. The Assembly agreed that further work on the development and harmonisation of RPAS standards should focus more on UAS operations outside the international instrument flight rules framework—which is to say, the proliferation of operational activities within rather than between States—taking into account current developments at the national, as well as the regional and international levels.⁵⁵ CASA has already had preliminary discussions with the ICAO Secretariat on aspects of this approach, and the then only very recently introduced amendments to CASR Part 101 were provided to ICAO for consideration.
51. Australia is involved in the development of ICAO guidance through membership of the ICAO RPAS Panel. CASA considers ICAO should prioritise the development of provisions that would support the establishment of the legal framework for the operation of RPAS in ICAO Member States. Furthermore, there is a need to ensure, as far as is possible, global coherence of provisions that are adopted by Member States.
52. Larger National Aviation Authorities (including the United States Federal Aviation Administration (FAA), the European Aviation Safety Agency (EASA), Transport Canada, the Civil Aviation Authority of the United Kingdom, the Brazilian Agência Nacional de Aviação Civil and the Civil Aviation Authority of China) and smaller authorities alike (including CASA and the Civil Aviation Authority of New Zealand) have been working independently and together, on bilateral bases and in multi-lateral forums, including ICAO and the Joint Authorities for Rulemaking on Unmanned Systems (JARUS).⁵⁶ CASA is actively engaged in this work, and is well recognised for its valuable contributions.
53. CASA published a *Discussion Paper, UAS Airworthiness Framework*, (1529US)⁵⁷ proposing an airworthiness framework closely following the model currently being developed by JARUS and EASA. The period for public and industry comment on this paper closed in August 2016 and a summary of responses is being prepared. Seventy comments were received and the proposals were generally supported by industry.
54. Considering the comments received on this Discussion Paper, and having regard to related developments, it is expected that the UASSC and its working groups will be proposing new rules and progressive refinements to existing risk-based, cost effective regulations conducive to the development and expansion of UAS activities.

Current and future options for improving regulatory compliance and public safety in UAS operations

Education and training

55. Education and awareness continue to be a key part of CASA's approach to fostering safety and encouraging regulatory compliance. Since 2013, CASA has had an ongoing and comprehensive communication campaign using our communication channels, including CASAs website, social media, as well as targeted print and digital advertising, to raise awareness of safety issues in relation to RPA activities. The focus has been on recreational use by those members of the community identified as most likely to be engaging in these kinds of activities, and less likely to have aviation experience or knowledge.

⁵⁵ *Report of the Technical Commission on the General Section of its Report and on Agenda Items 32 and 33*, Assembly Working Paper A39-WP/512 (4 October 2016), para 33.14.

⁵⁶ JARUS is a group of experts from National Aviation Authorities and regional aviation safety organisations. Its purpose is to recommend a single set of technical, safety and operational requirements for the certification and safe integration of Unmanned Aircraft Systems (UAS) into airspace and at aerodromes. The objective of JARUS is to provide guidance material aiming to facilitate each authority to write their own requirements and to avoid duplicate efforts. At present 46 countries, including Australia, as well as the European Aviation Safety Agency and EUROCONTROL, participate in JARUS's work.

⁵⁷ <https://www.casa.gov.au/standard-page/dp-1529us-uas-airworthiness-framework>

56. Social media is a particularly effective communication channel, with CASA's Facebook drone safety posts and videos reaching views in the millions. Targeted social media and video campaigns in the lead-up to Christmas and at the beginning of the bushfire season with the tagline '*If you fly, they can't*' have reached large audiences in the past and continue for the 2016-17 season.
57. A dedicated link on CASA's website provides information about the safety risks inherent in conducting unauthorised RPAS activities in the vicinity of firefighting and other emergency situations. CASA also provides specific information on RPAS in emergency situations.⁵⁸ CASA's educational material and website also includes links to authoritative sources of information on privacy-related issues.
58. The CASA website has links to a range of educational and advisory material, access to which has proven to be very popular with users. Four of the top 10 pages viewed on or through the CASA website now deal specifically with RPA.⁵⁹
59. CASA has also developed guidance material to help existing and prospective operators understand the new regulations. Important information is available online as an e-learning package, focusing on the safe operation of all categories of RPA.⁶⁰
60. The Part 101 MOS will include a syllabus in accordance with which approved training organisations will be required to develop and deliver their training programs. CASA expects to release a consultation draft of the Part 101 MOS for public and industry comment in early 2017.

Enforcement

61. One of the important ways in which CASA is empowered to conduct the safety regulation of Australian civil air operations is by '*developing effective enforcement strategies to secure compliance with aviation safety standards*'.⁶¹
62. CASA's approach to enforcement is set out in its Enforcement Manual, which has been amended to better reflect the principles of CASA's Regulatory Philosophy.⁶² In exercising its enforcement powers, the Enforcement Manual provides:

CASA will make responsible enforcement decisions having regard to the nature of the identified breaches and the safety risk they give rise to. In particular:

- CASA's first priority is to protect the safety of passenger transport operations, and operations in which passengers and others exposed to higher levels of risk are not in a position to make informed judgements and effective decisions about the risks to which they are exposed.
 - CASA will take strong action against those who persistently and/or deliberately operate outside the civil aviation law.
 - CASA will first consider education, training or supervision for those who demonstrate a lack of proficiency but show a willingness to comply with the civil aviation law. It is not proper to regard actions of this nature as punitive or disciplinary in character.
63. CASA reviews reports involving RPA-related events received from the Australian Transport Safety Bureau (ATSB), Airservices Australia's Corporate Integrated Reporting and Risk Information System (CIRRIS) and, of course, reports received directly from members of the Australian community.

⁵⁸ <https://www.casa.gov.au/standard-page/remotely-piloted-aircraft-emergency-situations>.

⁵⁹ <http://www.casa.gov.au/drone>; <https://www.casa.gov.au/aircraft/standard-page/remotely-piloted-aircraft-system-frequently-asked-questions>.

⁶⁰ http://services.casa.gov.au/elearning/casa_101/

⁶¹ *Civil Aviation Act 1988*, paragraph 9(1)(d).

⁶² The current version of CASA's *Enforcement Manual* and CASA's Regulatory Philosophy are available on CASA's website (<https://www.casa.gov.au/>).

Accident and incident reports involving RPA received in the period 2013 to 2016 are shown in the table below:

	ATSB Reports	CIRRIIS Reports	Total
2013-14	4	11	15
2014-15	10	30	40
2015-16	13	56	69
2016-17 (to September 16)	1	27	28
Total			152

Table 1: RPAS accident/incident reports

64. When CASA is able to identify the RPA operator, CASA will take further appropriate steps (such as a warning letter or initiating a formal investigation) where:
 - (a) the conduct involved an unacceptable risk to safety; and/or
 - (b) an apparent contravention of the applicable civil aviation legislation.
65. It is important to recognise, however, that in the vast majority of cases reported to CASA, it is often extremely difficult to identify who was responsible for the alleged conduct, and challenging to obtain sufficient evidence to support any enforcement action.
66. If CASA has determined that a breach of the civil aviation legislation has occurred, enforcement action can be taken consistent with the policy reflected in the Enforcement Manual and CASA's Regulatory Philosophy. This may include:
 - (a) counselling the person involved about their conduct;
 - (b) safety-related administrative action to vary, suspend or cancel a person's RPA- authorisation(s);
 - (c) issuing an Aviation Infringement Notice requiring the payment of a fixed monetary penalty of between \$110 and \$900 for each offence, depending upon the regulation breached;
 - (d) referral of the matter to the Commonwealth Director of Public Prosecutions for criminal prosecution.
67. Since 2012, CASA has taken enforcement action in 40 matters involving a breach of the Civil Aviation Safety Regulations.
68. An Unsafe Drone Operations complaint form is available on CASA's website, which allows anyone to report unsafe and potentially unlawful unmanned aircraft operations.⁶³ The form makes it clear that CASA is not authorised to investigate or enforce privacy-related matters and that safety breaches may only be investigated where there is sufficient information available to warrant the pursuit of an investigation—including most importantly, information or evidence on the basis of which the identity of the person responsible for the conduct can be identified.

Regulatory approaches by state, territorial and local government agencies and law enforcement authorities

69. CASA is aware that some state and local government agencies have used their planning powers to limit or prohibit the use of RPA in particular places. CASA is engaging with representatives of state and local government agencies, and with federal, state and territorial law enforcement authorities, with a view to:
 - (a) sharing information about the safe and lawful uses of RPA;

⁶³ See <https://www.casa.gov.au/webform/unsafe-drone-operations-complaint-form>

- (b) facilitating the dissemination of CASA's safety-related materials and educational information through those agencies to local community members; and
 - (c) developing relationships and workable arrangements to better enable people conducting unsafe and unlawful RPA operations to be identified and, where necessary, apprehended and sanctioned accordingly.
70. It is clear that local law enforcement authorities are generally in a better position than CASA's operational and investigative officers to respond in a timely way to actual, apparent and alleged contraventions of the safety regulations governing the operation of RPA. Consequently, CASA has developed template forms for use by those law enforcement officers to facilitate the referral of matters for investigation by CASA, and to better ensure that necessary information and sufficient evidence is available on which CASA might act.
71. To support local efforts to manage the proliferation and safe conduct of RPA activities in those jurisdictions, CASA is exploring the development of tenable bases on which appropriate enforcement actions involving contravention of the civil aviation legislation might be investigated and pursued for further action (including issuing Infringement Notices and mounting criminal prosecutions) directly by other federal, state and territorial law enforcement authorities.

The use of current and emerging RPA-related technologies to enhance aviation safety

72. There are several emerging technologies that may serve to help mitigate some of the issues presented by RPAs. For example, the following technologies could be considered potentially significant enablers of safe operation in non-segregated airspace. These are Detect and Avoid (DAA) systems, Command and Control (C2) systems, including spectrum allocation and management (although aspects of the latter do not fall within CASA's regulatory remit) and geo-fencing.

Detect and avoid

73. Separation and collision avoidance involves many safety layers, including airspace, flight planning and rules of the air, amongst other things. The full integration of RPAS with conventional manned aviation activities would require RPAS to have a capability equivalent to that in use by manned aircraft to maintain separation and avoid collisions. Sensors on board a RPA designed to perform these functions are part of what is known as the DAA system.
74. Restricting RPA to visual-line-of-sight operations so that the remote pilot can see and avoid other aircraft, limits the kinds of operations for which RPA can be used. A major challenge, therefore, is to develop adequate DAA technology to allow for expansion of the range of BLVOS operations. The minimum operational performance specifications (MOPS) for DAA for a range of operations are currently being developed by the Radio Technical Commission for Aeronautics (RTCA) and JARUS. Once confirmed, it is expected that these safety performance levels may form the basis for the development of international standards for, and harmonised international regulation of, DAA.

Command and Control

75. C2 of a RPAS is a complex system that could fail, causing potentially significant hazards to other airspace users and people and property on the ground. Minimum operational performance specifications for the C2 provide a mechanism that can be used to ensure the likelihood of the loss of link (partial or full loss) meets the necessary safety standards and assures robust communication between the remote pilot, the RPA and air traffic control. The RTCA and JARUS are working on MOPS for C2 systems.

Geo-fencing

76. Geo-fencing is an adaptable and scalable DAA process and can be passive or active depending on the supporting software. Passive is a pre-programmed series of coordinates that will not allow the RPA to fly even if commanded to do so. The database is set before flight and is hardwired, however this is not a fully proven and reliable system as yet. Active involves 'real time' updates so is considered a more advanced system than the Passive system. The 'real time' updates are passed to the RPA to provide emerging restrictions e.g. fire perimeter and natural disaster. This would require not just a database but effectively a datalink to the RPA. However, a datalink system currently does not exist but industry is considering how to leverage existing communications networks where possible as well as how to operate in austere locations.

Concluding remarks

77. CASA faces significant challenges to provide an effective regulatory framework within which the development and implementation of rapidly advancing RPA technological and operational capabilities can progress apace, while ensuring that the safety risks inherent in these activities are effectively managed. This is a challenge faced by aviation safety regulators around the world; and together, we are all working to strike the balances necessary to achieve these objectives.
78. There is much work yet to be done on many fronts, and we are confident that, by working collaboratively with the Australian industry, public, other agencies and organisations, and our counterpart agencies around the world we will build a strong, productive and above all safe RPAS sector for all Australians.
