Australian Government
Civil Aviation Safety Authority

AU-STS 4: Applicant Response

BVLOS Operations in a Remote Area and within 3 NM of a Certified Non-controlled Aerodrome

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Responsible Area Manager	Senior RPAS Specialist
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Reference material

Document type	Title
Publication	JARUS SORA version 2
Regulation	Part 101 Manual of Standards
Guidance Material	Standard Scenario Application and Documents – Guidance Material

Forms

Form Nº.	Title
Form 101-09	Application for RPA flight authorisation

Revision history

Revisions to this manual are recorded below in order of most recent first.

Version Nº.	Date	Parts / sections	Details
1.0	August 2021	All	First issue

Glossary

Acronyms and abbreviations

Acronym / abbreviation	Description
ABS	Australian Bureau of Statistics
ADS-B	Automatic Dependent Surveillance-Broadcast
AEC	Airspace Encounter Category
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ARC	Air Risk Class
ATC	Air Traffic Control
AU-STS	Australian Standard Scenario
BVLOS	Beyond Visual Line of Sight
CASA	Civil Aviation Safety Authority
C2	Command and Control
C3	Command, Control and Communication Link
CONOPS	Concept of Operations
CRM	Crew Resource Management
CTR / CTZ	Control Zone
DAA	Detect and Avoid
EMS	Emergency and Medical Service
ERP	Emergency Response Plan

Acronym / abbreviation	Description
EVLOS	Extended Visual Line of Sight
FLARM	Flight and Alarm
ft	Feet
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HLS	Helicopter Landing Site
HMI	Human Machine Interface
ICAO	International Civil Aviation Organisation
J	Joules
JARUS	Joint Authorities for Rulemaking of Unmanned Systems
kJ	Kilojoules
km	Kilometre
LTE	Long Term Evolution. LTE is a 4G wireless communications standard.
m	Metres
MC	Maintenance Controller
MTOM	Maximum Take-off Mass
NM	Nautical Miles
OEM	Original Equipment Manufacturer
OSO	Operational Safety Objective
Part 101 MOS	Part 101 (Unmanned Aircraft and Rockets) Manual of Standards 2019
ReOC	RPA Operator's Certificate
RP	Remote Pilot
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft Systems
RPIC	Remote Pilot in Command
RPS	Remote Pilot Station
SAIL	Specific Assurance and Integrity Level
SORA	Specific Operation Risk Assessment
TMPR	Tactical Mitigation Performance Requirements
VMC	Visual Meteorological Conditions
VLOS	Visual Line of Sight

Definitions

Term	Definition
Active Participants	Those persons directly involved with the operation of the RPA or fully aware that the RPA operation is being conducted near them. They are fully aware of the risks involved with the RPA operation and have accepted these risks. Active participants are informed on and able to follow relevant effective emergency procedures and / or contingency plans.
Approach and Departure Paths	As defined in section 9.05 of MOS Part 101.
Atypical Airspace	Airspace where the unmitigated risk of an encounter between an RPA and a conventionally piloted aircraft is acceptably low. This can be: • restricted airspace (e.g. segregated / restricted areas) • airspace designated 'atypical' by the competent authority • airspace where conventionally piloted aircraft do not routinely fly (e.g. within 120 m from buildings) • airspace characterisation where the collision risk between an RPA and conventionally piloted aircraft is not greater than the target level of safety of 1E-7 Mid Air Collisions (MAC) per flight hour.
Beyond Visual Line of Sight (BVLOS)	An RPAS operation whereby the RPIC is not able to maintain visual unaided contact with the aircraft at all times.
Dangerous Goods	Articles or substances listed as dangerous goods in the ICAO Technical Instructions, or which are classified according to those instructions.
Extended Visual Line of Sight (EVLOS)	An RPAS operation whereby the RPIC maintains an uninterrupted situational awareness of the airspace and ground environment in which the RPA operation is being conducted via visual airspace surveillance through one or more human observers, possibly aided by technology means.
Improbable	For the purpose of this assessment, this refers to a 'qualitative' interpretation i.e. "unlikely to occur in each RPAS during its total life but which may occur several times when considering the total operational life of a number of RPAS of this type."
Probable	For the purpose of this assessment, this refers to a 'qualitative' interpretation i.e. "anticipated to occur one or more times during the entire system / operational life of an item."

Term	Definition
Relevant Airspace	Areas and airspace within the no-fly zone of an aerodrome or helicopter landing site, as defined in MOS Part 101. In general terms, for an aerodrome these areas include: • areas and airspace within 3 NM of the movement area of the aerodrome, where the movement area includes areas used for the surface movement of conventionally piloted aircraft, manoeuvring areas and aprons • the approach and departure paths of the aerodrome. For a helicopter landing site, this is the area inside a cylinder with a 1.5 NM diameter and 400 ft height centred on the helicopter landing site.
Relevant Event	occurs when a conventionally piloted aircraft is within relevant airspace, including when an aircraft is landing, taking off, or manoeuvring on the movement area, of the aerodrome or helicopter landing site.
Remote Australian Airspace	Airspace defined by CASA as being located in areas which have very low population density and negligible air activity so that these areas can be considered suitable for consideration for RPA BVLOS operations utilising mitigations agreed with CASA.
Remote Pilot in Command (RPIC)	is responsible for the flight and all actions conducted by the operating crew in support of the flight. For BVLOS operations, the RPIC must hold an IREX or CASA approved BVLOS examination pass. Under Exemption CASA EX46/21, the RPIC does not have to be the RP controlling the RPA.
Shielded Operations	An operation of an RPA within a specified distance, typically 120 metres from, and below the top of, a natural or man-made object.
Sparsely Populated Area	For this scenario, an area with: • average population density of < 10 persons / km^2, and • no towns or settlements of > 100 dwellings.
Visual Line of Sight (VLOS)	An RPA is being operated within the visual line of sight of the person operating the aircraft if the person can continually see, orient and navigate the aircraft to meet the person's separation and collision avoidance responsibilities, with or without corrective lenses, but without the use of binoculars, a telescope or other similar device.

1 Introduction

For this standard scenario (AU-STS 4), CASA has undertaken a SORA assessment for a predefined Concept of Operations (CONOPs) for a Beyond Visual Line of Sight (BVLOS) operation in a remote area within 3 NM of a registered or certified non-controlled aerodrome including a helicopter landing site. Mitigations and the required documentation to show compliance are specified in this document to achieve an acceptable level of safety. CASA has determined the outcome of this SORA assessment to be a SAIL II.

CASA initiated a pilot program utilising the SORA methodology, where CASA defined 'atypical-like' airspace in rural areas and developed a template of prerequisites for operations in Class G airspace, which was classified as the Remote Australian Airspace (RAA) standard scenario. This standard scenario draws on the success of that pilot program and adopts similar principles, but complements that standard scenario in providing guidance on how BVLOS operations can be conducted in the vicinity of remote non-controlled registered or certified aerodromes. This standard scenario may be used alongside an application that includes other phases such as Remote Australian Airspace BVLOS, VLOS or EVLOS operations or as a standalone application for a specific site within 5 NM of an aerodrome.

The following assumptions have been made in the development of this scenario:

(1) The RPA(s) will not be fitted with a DAA system.
(2) No RPA Traffic Management system will be in operation.
(3) RPA to RPA conflicts are not considered.
(4) A minimum of a 1:1 buffer will be applied to the operation.
(5) The applicant will have an Emergency Response Plan (ERP).

Before proceeding with the BVLOS Standard Scenario Application (AU-STS 4), refer to the Standard Scenario Application and Documents – Guidance Material.

Although not mandatory, it may also assist to be familiar with the basic SORA concepts and terminology. The SORA package can be downloaded from the JARUS website.

This STS has not been endorsed by JARUS and is applicable to BVLOS operations in Australian airspace only.

2 Scope

This document is intended to be used as part of the safety case application for a BVLOS approval to conduct BVLOS operations in a remote area within 3 NM of certified non-controlled aerodrome including a helicopter landing site. This standard scenario does not consider RPA operations from or to the aerodrome or RPA operations over the movement area of an aerodrome. It is intended that this standard scenario can also be used for applications for BVLOS operations within 5 NM of a certified non-controlled aerodrome, including a helicopter landing site as part of a Remote Australian Airspace BVLOS application (AU-STS 6 and AU-STS 7).

The safety case assessment has two distinct phases:

(1) The development of the CONOPS and ensuring that the planned operation complies with this standard scenario. If the CONOPS does not meet the requirements of the standard scenario, there is no benefit in moving on to the second phase.
(2) Development of the procedures and documentation to support the proposed operation.

Figures 1 and 2 below provide a visual overview of the ground and airspace attributes for RPAS operations covered within this scenario. These are explained in further detail in Table 1.

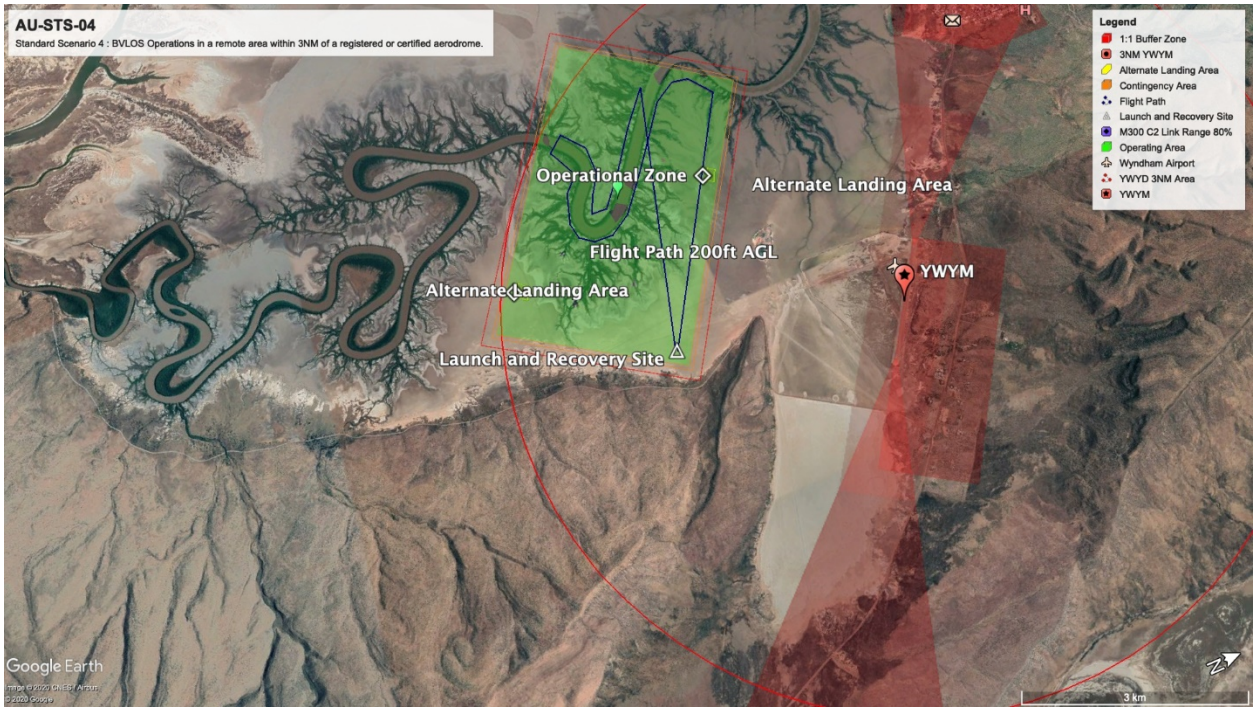


Figure 1: Attributes of AU-STS 5 Ground Area

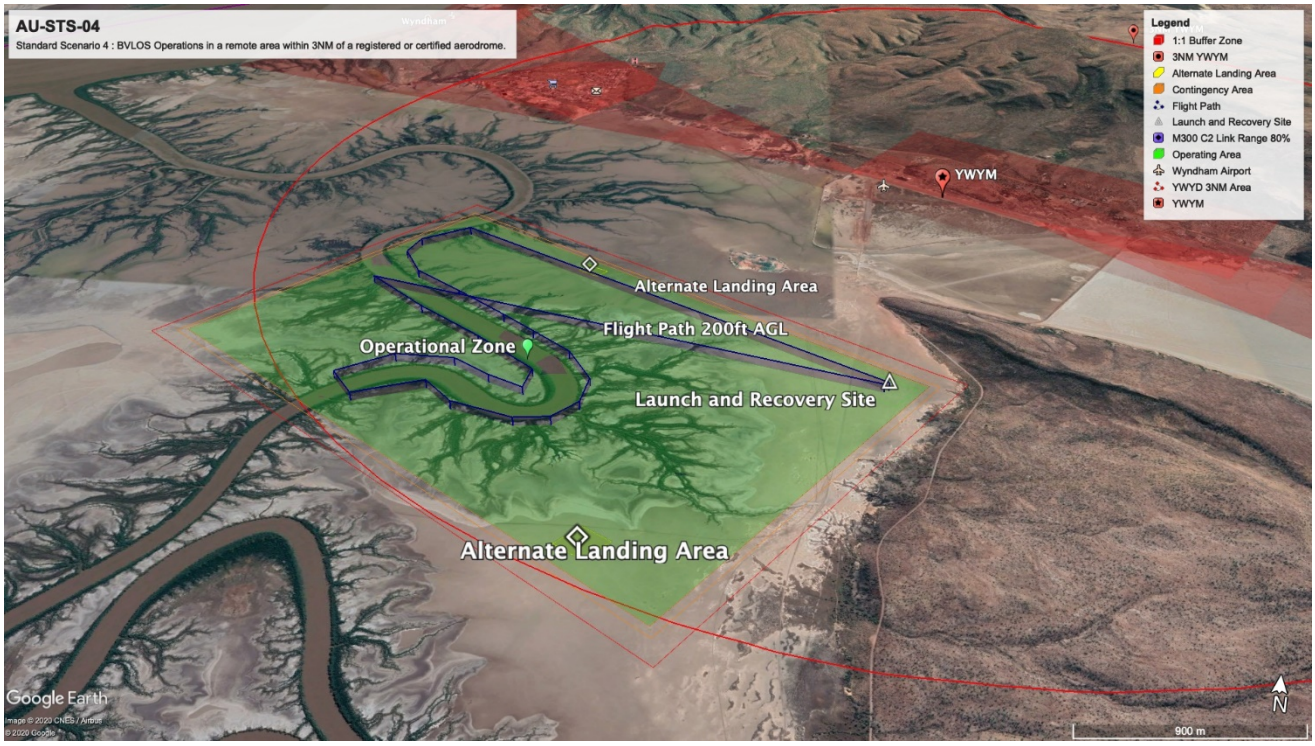


Figure 2: Attributes of AU-STS 5

After reviewing the following information, if the decision it to proceed with an application, review and complete sections 3 and 4 to build a safety case.

2.1 Standard Scenario Characterisation and Provisions

Table 1: Summary of CONOPS Assumptions for BVLOS AU-STS 4

RPA operations – within 3 NM of a certified non-controlled aerodrome	
Ground risk characteristic – Sparsely Populated	
Geographic area – Remote Australian Airspace	
Operational characterisation (scope and limitations)	
Level of human intervention	• No autonomous[1] operations: the remote pilot must always be able to intervene during normal operations • The remote pilot must only operate one RPA at a time • Handover of control of the RPA from 1 pilot to another is permitted.
Range limit from remote flight crew	• RPAS is operated at a maximum distance of 80% of OEM stated or proven C2 link range from the controller.
Overflown areas	• Sparsely Populated Area
RPAS limitations	• Max. characteristic dimension (e.g. wingspan or rotor diameter / area): 3 m • Typical kinetic energy up to 34 kJ
Flight height limit (AGL)	• Within 100 ft of a vertical object (atypical airspace), shielded operations or not above 400 ft AGL, or

[1] An operation during which an unmanned aircraft operates without the remote pilot being able to intervene.

	• Operations over an open pit mine must be defined so that the 400 ft AGL is measured from the mine edge (i.e. this is atypical airspace) as conventionally piloted aircraft would not enter the mine.
Airspace	• Class G.
Other	• No items may be dropped which cause a hazard • No dangerous goods may be carried unless that item forms part of the RPA itself (e.g. LiPo battery) • Not in the approach or departure path unless the airfield is closed.
Weather	• 5 km visibility (forecast) • 1000 ft vertically clear of actual cloud base • Not operated within 5 km of thunderstorms or showers.

Operational mitigations	
Operational Volume	The operational volume comprises the flight geography and the contingency volume. To determine the operational volume, the applicant must consider the position-keeping capabilities of the RPA in 4D space (latitude, longitude, height and time). In particular, the accuracy of the navigation solution, the flight technical error of the RPA, as well as the path definition error (e.g. map error) and latencies must be considered and addressed in this determination. If the RPAS leaves the operational volume, emergency procedures must be activated immediately.
Ground Risk	For this standard scenario, sparsely populated areas are defined as: • average population density of < 10 persons / km^2, and • no towns or settlements of > 100 dwellings. The applicant must demonstrate by on-site survey and / or analysis of imagery that an average population density of < 10 persons / km^2 exists within the proposed operational volume during the proposed times / days of operation. The applicant may wish to utilise the Australian Bureau of Statistics (ABS) data to determine the population density of an area. A ground risk 1:1 buffer must be established to protect third parties on the ground outside the operational volume. **Note:** 1:1 buffer would mean that if the RPA is planned to operate at 120 m height, the ground risk 1:1 buffer should at least be 120 m. The operational volume and the 1:1 ground risk buffer must be in sparsely populated environment. The applicant must have documented practices and procedures that detail how BVLOS operations are planned and conducted including how overflight of identified dwellings is avoided.

Air Risk	The operation volume must be in Class G airspace. If adjacent areas are Class C or D airspace or a military CTR, an air risk buffer must be applied. The applicant must detail how they will ensure that the BVLOS operation will not occur during a relevant event. Applicants should consider the application and suitability of strategic and tactical mitigations, for example: (1) Restriction by time of exposure. (2) Restriction by chronology. (3) Restriction by operation volume / boundary. (4) ADS-B IN fitted to the RPA or ground receiver. (5) Aeronautical VHF radio monitoring / transmissions. (6) Closing the airfield. (7) Issuing a NOTAM for BVLOS operations. (8) Stakeholder engagement conducted with aerodrome users. (9) RPA fitted with high intensity strobes. (10) RPAs painted a high contrast colour.
Operator Provisions	
ReOC holder	A CASA ReOC and its associated Operations Manual already cover a substantial amount of the procedural / organisational mitigations required by SORA. The applicant must however develop and document the procedures and processes required to support the specific BVLOS operation. Where required, the applicant may need to demonstrate the efficacy of those procedures to CASA.
RPA operations	The applicant must document the following procedures or policies in their Operations Manual: • Task-specific BVLOS operational procedures • Handover procedures from BVLOS to EVLOS / VLOS and vice versa (if required). • Handover procedures between RPs (if required). • Task-specific RPA operational limitations. • Tas- specific Emergency Response Plan (ERP). • Limitations of the external systems supporting RPA for safe operations. • Weather / environmental conditions required for a safe operation. • How the remote crew can declare themselves fit to operate before conducting any operation. • How the remote crew is assessed as current and competent. • An up-to-date list of remote crew members authorised to carry out BVLOS operations. The adequacy of the contingency and emergency procedures must be proven through: • dedicated flight tests • simulations, provided the representativeness of the simulation means is proven for the intended purpose with positive results, or

	• any other means acceptable to CASA. A template of BVLOS procedures and sections, which may be included in an Operations Manual, is provided in Appendix A of Standard Scenario Application and Documents – Guidance Material.
RPAS maintenance	All RPAs used for BVLOS operations must be maintained, as a minimum, in accordance with the OEM documentation. Maintenance records and technical logs for all RPAs to be used for BVLOS operations must be kept in accordance with the Part 101 MOS regardless of size or weight.
External Services	If the applicant relies on any external services, such as LTE (4G / 5G), Internet services etc., the applicant must demonstrate that the performance and availability of the service is adequate for the intended operation. The applicant must document the effects of any degradation or loss of services on the safety of flight and how these will be managed (e.g. operations cease, VLOS / EVLOS only etc.). If the provision of the external service requires specific contracts or arrangements to be entered into, roles and responsibilities between the applicant and the external service provider must be defined. If the applicant is using a standard commercial contract, this is not required (e.g. a mobile phone / data / internet contract).
Remote crew	The applicant must document, as a minimum, the following training procedures or policies in their Operations Manual: • Theoretical training syllabus. • Mission planning syllabus. • Practical training syllabus. • BVLOS check flight profile and assessment criteria. • Approved BVLOS trainers' qualifications and experience requirements. • Internal training syllabus for BVLOS trainers. • ERP training syllabus. For all BVLOS operations, the remote pilot in command must hold a pass in the IREX or CASA approved examination (CASR 101.300(4)(a)). All remote pilots involved in a BVLOS operation must hold an appropriate aeronautical radio qualification. At a minimum, all remote pilots in command must have at least 20 hours' RPA experience with at least two hours' experience on the type and model of RPA. Applicants should assess whether higher experience levels are required based on the complexity of their RPAS. A record of all relevant qualifications, experience and / or training completed by the remote crew must be established and kept up to date. A template outlining BVLOS training elements, which may be included in an Operations Manual, is provided in Appendix B of Standard Scenario Application and Documents – Guidance Material.

Technical Provisions	
General	In their Operations Manual, the applicant must document how critical parameters are to be monitored. As a minimum, the applicant must document how: • RPA position, height or altitude, ground speed or airspeed and tracking are monitored • RPA position reference areas and dwellings to be avoided • how the RPA height reference to the vertical object(s) and aerodrome reference height will be verified • RPA height will be monitored with reference to terrain • RPA tracking reference to the aerodrome movement area will be maintained • geo-fences will be used • RPA energy status (fuel, batteries etc.) • status of critical functions and systems; as a minimum, for services based on RF signals (e.g. C2 Link, GNSS etc.), means must be provided to monitor the adequate performance and triggering an alert if level is becoming too low • detecting interference with C2 or other RPA systems.
Human Machine Interface	The applicant must conduct an evaluation of the RPAS considering and addressing human factors to determine the HMI is appropriate for the BVLOS operations. An HMI assessment proforma is provided in Appendix D of Standard Scenario Application and Documents - Guidance Material. The applicant can either use the template provided as guidance, or put forth an alternative methodology.
Command, Control links (C2) and communication	Any RPA used for BVLOS operations must comply with the appropriate requirements for radio equipment and the use of RF spectrum. In the Operations Manual, the applicant must document the maximum operating range of the RPA from the control station. This can be either 80% of the OEM declared operating range, or a maximum operating range proven by flight operations. In the Operations Manual, the applicant must document how to conduct a visibility / viewshed analysis to demonstrate that the C2 and communication links will not be adversely affected by terrain i.e. electronic line of sight will be maintained throughout the operating area. A copy of the analysis must be attached to all operational releases and provided to CASA as part of any application. The remote pilot must have a reliable and continuous means of two-way radio communication with other air users or ATC if required. The RPICs mobile / satellite phone number and frequency being monitored during flight must be published in the NOTAM for RPA BVLOS operations to allow coordination with conventionally piloted aircraft and another RPA operator.

Tactical mitigation	The RPA is being operated in an aerodrome environment so it is required that the applicant documents how they will manage any relevant events that occur.
Containment	To ensure a safe recovery from a technical issue involving the RPA, or external system supporting the operation, the applicant should assess and describe the effects of the following probable failures: (1) Ability of RPA to continue to fly or make a safe landing with at least one motor inoperative (i.e. the RPA remains controllable). (2) Intermittent or degraded C2 link particularly at the maximum operating range and / or around vertical obstacles. (3) Indications, RPA response and crew procedures and actions in the event of a permanent loss of the C2 link. (4) Total or partial failure of the remote pilot station affecting such systems as electronic displays, video feeds, internet, manual control interfaces, etc. caused by software, hardware or power failures. (5) Identify any possible single point failures in the RPAS which are critical to the containment of the RPA. (6) Navigation system failures, including degradation or total loss of GPS, IMUs, sensors or cameras, that may result in a reduction in navigation accuracy and / or a loss of available navigation modes. The applicant should then ensure that: • no probable failure of the RPA or any external system supporting the operation will lead to operation outside of the operational volume • it will be reasonably expected that a fatality will not occur from any probable failure of the RPA or any external system supporting the operation. The applicant must then provide a technical assessment that demonstrates, at a minimum: • design and installation features (independence, separation and redundancy) • particular risks (e.g. hail, ice, snow, electro-magnetic interference etc.) relevant to the CONOPs.
Additional Notes	VLOS / EVLOS procedures may be utilised to establish the RPA area of operation. Take-off and landing can be conducted either VLOS / EVLOS or BVLOS, provided the applicant has suitable documented practices and procedures. If operations above 400 ft AGL are required, the applicant must request this approval. The applicant must assess the adjacent air and ground risk to ensure these areas meet the requirements of the standard scenario.

3 Application

The following sections provide applicants with guidance about the minimum information and evidence required to support an application for BVLOS operations according to the standard scenario AU-STS 4.

CASA considers these the minimum requirements for applications under this scenario, and applicants should assess whether higher levels of safety are required based on the complexity of the operation.

3.1 Concept of Operations (CONOPs)

The applicant must provide an outline of the proposed concept of operations, including, at least:

- proposed activity(ies) to be conducted
- RPAs that will be utilised
- confirmation that the Remote Pilot will only fly one RPA at a time
- minimum crew composition and qualifications
- details of flight operational area including contingency area, 1:1 buffer and flight heights
- explanations as to how the flight operational area will be conducted in a sparsely populated area
- explanations as to how the flight will remain clear of approach and departure paths
- confirmation that the applicant has an applicable emergency response plan (ERP) in place.

CONOPS must be attached as a separate document.

3.2 Ground Risk Considerations

For this standard scenario (AU-STS 4), the operational volume and the 1:1 ground risk buffer must be located in a sparsely populated environment.

The applicant must have documented practices and procedures that detail how BVLOS operations are planned and conducted including how overflight of identified dwellings is avoided.

The applicant must demonstrate that the area is sparsely populated, the maximum aircraft characteristic dimension is less than three metres, and the typical kinetic energy of the aircraft is < 34 kJ.

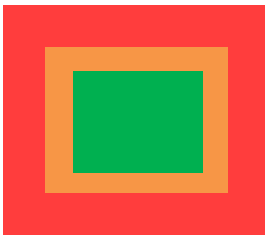
Step 1: Plan the operation including heights, operational volume and apply a 1:1 buffer. Ensure that the flight route is clear of the approach and departure paths unless the aerodrome is closed. Flight area must include an area for an RPA issue called a contingency area.

The operational flight volume must include a volume for the remote pilot to complete contingency actions / procedures within after the RPA enters an undesired state (e.g. an abnormal situation / issue / failure). This volume is between that in which the flight is planned, and the buffer and is known as the contingency volume. This volume provides the RPIC sufficient time to bring the RPA back into a nominal state for any probable malfunctions /

failures from which it can return to the normal task or be landed before it reaches the 1:1 buffer. If the RPA reaches the buffer, the RPA must be immediately landed or terminated. The applicant is also required to consider the ability of the RPA to remain within the operational volume, referred to in Step 9 as containment. The requirement of containment is that no probable failure will lead to the RPA flying outside the operational volume and posing a risk to adjacent areas. The applicant should ensure that the size of the contingency volume is sufficient to ensure the RPA is contained within the operational volume for all likely malfunctions / failures, such as reduced navigation performance, loss of C2 etc.

Figure 3: Flight operational volume

Flight operational volume includes:



- Nominal Flight path / area
- Contingency area
- A 1:1 buffer must then be applied

The outcome is that an identified flight operational volume (nominal flight area and contingency area) and the risk buffer will be identified.

Note: 1:1 buffer would mean if the RPA is planned to operate at 120 m height, the ground risk buffer should at least be 120 m. An example of this can be seen in section 3 of Standard Scenario Application and Documents - Guidance Material.

Table 2: 1:1 Buffer

1:1 Buffer	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
The Operations Manual must highlight how a 1:1 Buffer is maintained, including: • how settlements and dwellings are to be avoided • how the 1:1 buffer will not be adjacent to any open-air gatherings.	
A geographic data file (e.g. a kml / kmz readable in Google Earth), including: • RPA Flight heights • flight operational volume • 1:1 Buffer • identification of any critical infrastructure or sensitive areas (e.g. environmentally sensitive).	

1:1 Buffer	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
An example of this is in section 3 of Standard Scenario Application and Documents – Guidance Material.	

Step 2: Using the identified flight operation area and 1:1 risk buffer, determine that the number of people in this area will be less than 10 persons / km^2. Also, identify dwellings and update the flight route to avoid these dwellings. Finally, avoid overflight of any towns or settlements.

Assess the areas bordering the 1:1 buffer and make sure there are no locations where regular large gatherings take place e.g. sporting event, playgrounds etc.; if any such areas are identified, document how the operation will take place outside of the times of gatherings. The outcome is an updated KML file or image of the flight area, and 1:1 buffer that shows the population density in the intended area.

Table 3: Sparsely Populated Area

Sparsely Populated Area	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Demonstrate by on-site survey and / or analysis of imagery that an average population density of < 10 persons / km^2 exists within the proposed operational volume during the proposed times / days of operation. Australian Bureau of Statistics (ABS) data can be utilised to determine the population density of an area.	

Step 3: Calculate the kinetic energy of all the RPAs intended for use in this operation. Click on Table 4, which will open an Excel spreadsheet. Items in yellow must be completed. Record the results for each RPA in Table 5.

For an RPA to be used in this standard scenario, it must have the following characteristics:

- max. characteristic dimension (e.g. wingspan or rotor diameter / area): 3 m
- typical kinetic energy: up to 34 kJ.

Any RPAs that exceed these maximums cannot be included in this application. If their use is essential, use a different STS or make a full SORA application.

The outcome of this step is a list of RPAs seeking approval for this operation.

For each category of RPA, the maximum characteristic dimension is determined on:

- FIXED-WING AIRCRAFT / POWERLIFT = wingspan
- MULTICOPTERS = maximum dimension

- ROTORCRAFT = rotor diameter.

For the purposes of calculating the typical kinetic energy expected of an RPA, the following formula can be used:

$$KE = \frac{1}{2}\, m\, V^2$$

Where:

- *KE* is the typical kinetic energy (J)
- *m* is the mass of the RPA (kg) – the Maximum Take-off Mass (MTOM) of the RPA is to be used in this case
- *V* is the velocity of the RPA (m/s) – the maximum cruise velocity of the RPA is to be used in this case.

Table 4: Determination of RPA Kinetic Energy

Mass		kg
Maximum dimension		m
Aircraft Type		
Make		
Model		
Speed to use	Cruise	
Speed*		m/s
KE		J

Table 5: RPA Characteristics and Typical Kinetic Energy

RPA Characteristics and Typical Kinetic Energy		
RPA Type	**Characteristic Dimension (m)**	**Kinetic Energy (kJ)**

3.3 Air Risk Considerations

Step 4: As the BVLOS operation is planned to take part in the relevant airspace of a non-controlled aerodrome, the next step is to understand the air users of the aerodrome, traffic patterns and aerodrome facilities. Additionally, review the airspace around the flight operation area to identify whether any adjacent areas contain any controlled airspace, or military CTR.

The applicant should consult and utilise the stakeholder engagement process outlined in Standard Scenario Application and Documents – Guidance Material to identify traffic patterns, aerodromes users and other considerations.

The outcome of this step is to provide an analysis of the air operations taking place from / to and in the vicinity of the aerodrome.

Table 6: Air Risk Considerations

Air Risk Considerations	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Provide an analysis of the air operations taking place from the aerodrome and airspace that flight operational area falls into. The stakeholder engagement template may also be used.	

Step 5: Now that the traffic and uses of the aerodrome are understood, develop suitable measures to reduce the risk of the BVLOS operation to conventionally piloted aircraft. the applicant should consider if any of the following or combination of the following mitigations can be used to lower the air risk:

(1) Restriction by chronology

(a) Can the airfield be closed for the period of the planned RPA operation?
(b) Can the RPA operation take place at night?
(c) Can the RPA operation take place outside of RPT / scheduled traffic that poses the highest risk?

(2) Restriction by operation volume / boundary

(d) Can the operation be restricted to a shielded operation?
(e) Can the operation be restricted to atypical airspace?
(f) Can the operation be restricted to areas where conventionally piloted aircraft are known to rarely operate?
(g) Can the operation avoid the approach and departure path?
(h) Can the operation avoid the visual circuit pattern?
(i) Can the operation be separated from instrument approach procedures?
(j) Can the operating height be reduced to minimise the risk to conventionally piloted aircraft?

(3) Restriction by time of exposure

(k) Can the route be planned to reduce the time in the relevant airspace?
(l) Can sensors or cameras be used to increase the RPA range from the airfield?

(4) Mitigations by common structures and rules

(m) NOTAM informing other air users of the BVLOS operation and its route or area, contact details for the operator and frequencies that the RPA operator will be monitoring.

(n) ADS-B IN receiver fitted to the RPA or a ground-based ADS-B IN receiver with display available to the RPIC. IFR aircraft should be using ADS-B and its use is encouraged for VFR aircraft.
(o) Monitor aeronautical VHF radio as all aircraft should make radio calls prior to take off and from 10 NM inbound on the CTAF.

Once identified which of these mitigations will be applied, continue to develop the safety case to demonstrate that the resultant air traffic density likely to be encountered is similar or lower than that which would be typically encountered below 500 ft AGL in rural areas (SORA ARC-b). This would result in the final air risk being lowered.

The applicant should now document how the RP is going to land the aircraft or be able to clear the relevant airspace if a relevant event occurs or is about to occur. If, at the end of this assessment, it is concluded that lowering the air risk is not feasible, the applicant may consider the use of VLOS or EVLOS (if the applicant is approved for EVLOS) procedures to operate in the relevant airspace. The BVLOS application will then become a multiple segment application if other areas are being applied.

Step 6: The last step to complete in the air risk mitigations and procedures is to document the crew procedures for how they will:

(1) detect aircraft in or entering the relevant airspace
(2) Decide the appropriate action to take.
(3) command the RPA to complete this action and that it can respond to this command within five seconds
(4) the RPA will commence and complete the command within < 60 seconds
(5) the RPIC has a means of ensuring that the initial command has been actioned within 10 seconds of the command being sent and completed within 10 seconds of the manoeuvre being finished.

The outcome of this step is to have documented procedures for the crew to follow in the event of an aircraft entering the relevant airspace or where an aircraft is about to enter the relevant airspace. Additionally, the applicant must provide documents that show:

(1) latency of command system, i.e. how long it takes for a command to be sent and actioned by the RPA
(2) ability of the RPA to complete the manoeuvre within 60 seconds
(3) displays or system for the RPIC to confirm that the RPA is correctly responding to a command within 10 seconds of a command being sent to the RPA.

These three items can be established based on OEM documentation, analysis of the RPA system or demonstrated by flight tests with suitable evidence.

All equipment used to support step 6 (i.e. radios, displays, ADS-B receivers etc.) must be commercially available equipment from a recognised OEM. The applicant must document any maintenance procedures and training to operate the equipment in the operational procedures' library. The use of any 'amateur-built' or 'home-built' equipment is considered outside the scope of this standard scenario and will require separate assessment by CASA.

Table 7: Air Risk Mitigations and Procedures

Air Risk Mitigations and Procedures (Steps 5 and 6)	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Documented procedures for crew to follow if a relevant event occurs in the relevant airspace.	
Provide documents or data to show: • latency of command system • the means for the RPIC to confirm that the RPA is correctly responding to a command within 10 seconds of a command being sent • the RPA can complete manoeuvres within 60 seconds.	
Provide a list of equipment being used to support steps 5 and 6 (e.g. ADS-B IN). This should also show it is of a commercial grade.	
For the list of equipment, include any OEM maintenance procedure(s).	
For the list of equipment, provide appropriate procedures for training of personnel to operate the equipment.	

3.4 Confirmation

Step 7: The previous steps assessed the proposed BVLOS operation against this standard scenario.

If the answer is YES to the following questions with supporting evidence, the applicant should complete the next three sections and provide supporting documents.

Table 8: AU-STS 4 checkpoint

Check Points	Yes	No
Is the proposed operation within the relevant airspace of a non-controlled aerodrome and clear of approach and departure paths?		
Does the proposed flight plan route avoid all dwellings?		
Is a 1:1 ground buffer applied?		
Is the operational area and 1:1 buffer sparsely populated?		
Are the adjacent areas clear of large gatherings?		
Are the RPA characteristics less than 3 m and kinetic energy less than 34 kJ?		

Check Points	Yes	No
Does the traffic analysis document all scheduled flights and aerodrome air users?		
Have air mitigations been applied that reduce the anticipated air encounter rate to the same level as in a rural area below 500 ft AGL?		
Have procedures been documented to respond to a relevant event?		
Has evidence of system latencies and RPA performance been provided?		
Is all supporting equipment to manage the air risk commercial grade equipment?		

If the answer is NO to any of the questions above, the applicant must either:

- amend the planned operations to fit the operational characteristics of this standard scenario
- check the planned operations against a difference standard scenario, or
- complete a full BVLOS SORA application. More information on this process can be obtained from rpas@casa.gov.au.

4 Additional Supporting Materials

4.1 Operational Procedures

Step 8: Provide the following operational procedures and documentation:

(1) An updated Operations Manual for BVLOS operations including BVLOS procedures, training and record keeping.
(2) An Emergency Response Plan.
(3) A completed HMI assessment of all RPAs and RPS.
(4) A completed stakeholder engagement plan for aerodromes (if not already completed at step 4).

To assist in developing these documents, examples are provided in Standard Scenario Application and Documents – Guidance Material.

4.2 Additional Mitigations

Step 9: Document additional mitigations and provide references for any evidence being provided as support for the application. This is divided into three sections, and all must be completed:

- Operator Provisions.
- Training Provisions.
- Technical Provisions.

The outcome of this step is a safety case that supports the application.

Table 9: Additional mitigation - Operator provisions

Operator Provision	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Chief pilot record keeping must be updated to include items for BVLOS in accordance with MOS Part 101, including: • RPAS operational release • RPAS operational log • Remote Pilot log.	
A list of remote crew members authorised to carry out BVLOS operations which must be current.	
Schedule 1 must be current and also list RPAs that are authorised for this BVLOS standard scenario. Refer to Standard Scenario Application and Documents – Guidance Material.	
Provide provisions or policy in the Operations Manual defining how the remote crew can	

Operator Provision	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
declare themselves fit to operate before conducting any operation.	
Provide documented procedures for accepting a new RPA into BVLOS operational use. Refer to Standard Scenario Application and Documents – Guidance Material.	
Minimum of OEM pre- / post-flight checks documented or referenced in Operations Manual.	
Operational procedures for BVLOS which cover: • flight planning • weather • normal and emergency procedures • occurrence reporting • any relevant RPA operational limitations.	
Radio line of sight viewshed analysis or C2 electronic LOS for the operating area.	
Operational procedures library contains documented procedures for operation of flight critical support equipment.	
Record of ERP validation (tabletop exercise).	

Table 10: Additional mitigations - Training

Training	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Type training including the acceptance of RPAs into operation (product inspection / conformity) to be added to the Operations Procedures for all RPA that will be utilised in this standard scenario.	
ERP training syllabus must be available. An example is provided at Appendix B of Standard Scenario Application and Documents – Guidance Material. A record of internal ERP training completed by the relevant staff must be established and kept up to date. Training records mut be kept in accordance with MOS Part 101.	

Training	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
All RPs hold RePL with appropriate RPA operating privileges (Category / Weight Class).	
Training and procedures for multi crew operations are documented in Operations Manual.	
Operations Manual documents training and for operation of flight critical support equipment.	

Table 11: Operational mitigations – Technical

Technical	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Demonstrate the RPA will be operated within 80% of the specified OEM range and determine the RF spectrum usage and environmental conditions for C3 links are adequate to safely conduct the intended operation, including: • detailed procedures in Operations Manual • RPA range is listed in Schedule 1 of Operations Manual. The applicant may also illustrate expected RPA operating range in the geographic data file (readable in Google Earth).	
Show that all RPAs used for BVLOS operations will be maintained in accordance with the OEM documentation. Maintenance records and technical logs for all RPAs to be used for BVLOS operations must be kept in accordance with MOS Part 101 regardless of size or weight. If the RPA is to be operated in the vicinity of high intensity radio transmissions or similar, the applicant must detail how RPA operations will be safely conducted within this environment.	
A self-declared HMI assessment is attached as part of this submission. It includes equipment that has been reviewed and considered fit for purpose. HMI assessment completed in accordance with Appendix D Standard Scenario	

Technical	
Evidence Required	**Evidence Location (include page number, section, appendix or attached file name)**
Application and Procedures – Guidance Material.	
If required, how external services are used and assured is documented in the Operations Manual.	
Provide maintenance procedures for any flight critical support equipment.	
In Operations Manual, document how weather limits are defined and how these are monitored.	

4.3 RPA Containment

Step 10: To ensure a safe recovery from a technical issue involving the RPA, or external system supporting the operation, the applicant should assess and describe the effects of the following probable failures:

(1) Ability of RPA to continue to fly or make a safe landing with at least one motor inoperative (i.e. the RPA remains controllable) where applicable.
(2) Intermittent or degraded C2 link particularly at the maximum operating range and / or around vertical obstacles.
(3) Indications, RPA response and crew procedures / actions in the event of a permanent loss of the C2 link.
(4) Total or partial failure of the remote pilot station affecting such systems as electronic displays, video feeds, internet, manual control interfaces etc. caused by software, hardware, or power failures.
(5) Identify any possible single point failures in the RPAS which are critical to the containment of the RPA.
(6) Navigation system failures including degradation or total loss of GPS, IMUs, sensors or cameras that may result in a reduction in navigation accuracy and / or a loss of available navigation modes.
(7) Flight planning failures that could result in a loss of containment (i.e. incorrect setting of waypoints / RTH function).

Outcome: Provide an analysis of the RPAS which demonstrates that:

- no probable failure of the RPA or any external system supporting the operation will lead to operation outside of the flight operational area and 1:1 buffer
- it will be reasonably expected that a fatality will not occur from any probable failure of the RPA or any external system supporting the operation.

Attach supporting evidence and documentation.

5 Submitting an Application

The completed BVLOS application package should include:

(1) completed application for RPA flight authorisation (CASA Form 101-09).
(2) completed AU-STS 4 Applicant Response document with all supporting attachments including KML files, maps, images, analysis, ERP plans, HMI Assessments and stakeholder engagements, and
(3) updated CASA Operations Manual Suite.

The completed BVLOS application, including all supporting documentation, should be submitted to rpas@casa.gov.au. If the total file size exceeds 18 MB, contact the RPAS Team first to make alternative arrangements for submitting the application.

On receipt of a completed application, CASA will calculate and issue an estimate of the cost to process the application. The estimate must be paid before any assessment can be undertaken.

Due to the high volumes of BVLOS applications submitted to CASA, ensure completed applications are lodged well in advance of the operation's proposed start date.