Liverpool Plains Deer Survey, 24-27 February 2020

Background:

- Deer populations in the Liverpool Plains LGA were surveyed in May 2018 and February 2019.
- The surveys were broken into four separate blocks to provide separate density estimates for each (Figure 1).
- The SHOOT block was subjected to two week-long shooting operations after the first survey in 2018, which was estimated to have removed about 30% of the initial population.
- The population was estimated to have recovered by about 16% between the 2018 shoot and the 2019 survey.
- Another two week-long shooting operations after the second survey in 2019 were estimated to have removed about 26% of the population.
- There has been sufficient time for the population to recover due to births and immigration following the 2019 shooting operations.

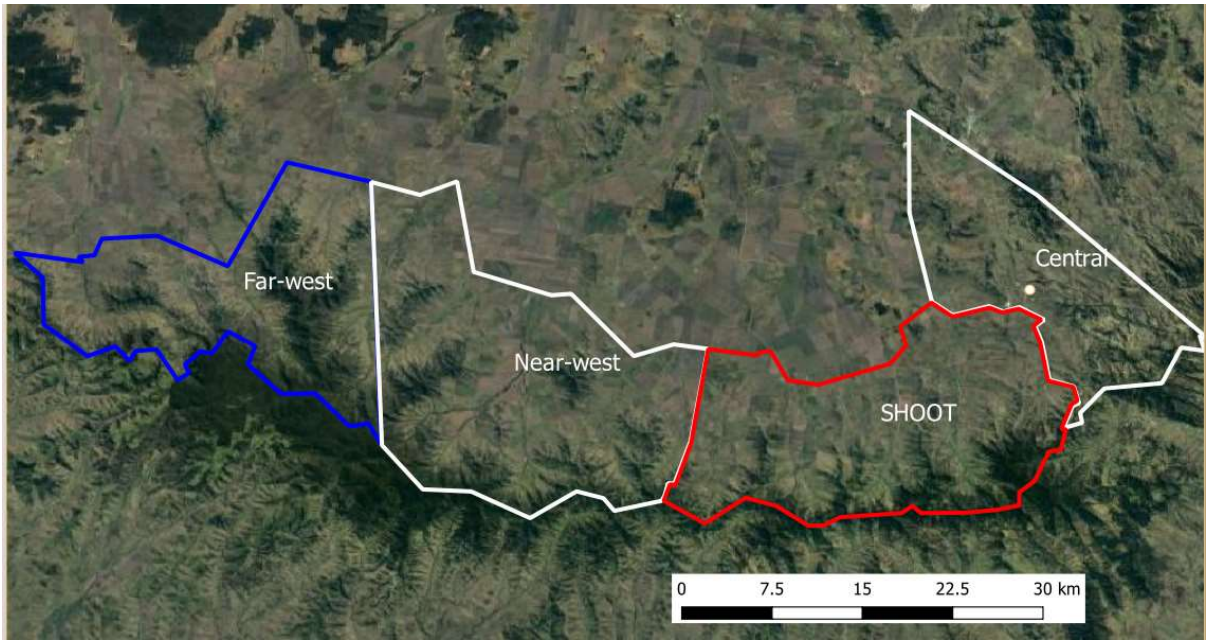

Figure 1: Survey blocks at the Liverpool Plains study site.

Aim: This survey will aim to estimate current deer densities in the Far west and Shoot blocks, to estimate population recovery in the Shoot block and contrast it with population changes in the Far-west block. Pig density will also be estimated.

Task: Conduct an intensive survey of deer and pig populations in the Far west and Shoot blocks.

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Methods:

Plans will need to be flexible, to allow for adverse weather or adaptation to unforeseen constraints or opportunities. The intent is to survey each block three times, using alternating sets of transects.

We'll use a similar aircraft setup as we did in 2018 and 2019; a Jet Ranger with doors removed and vertical sighting bars with five distance classes marked with coloured tape:

- 0 – 20 m (yellow)
- 20 – 40 m (green)
- 40 – 70 m (blue)
- 70 – 100 m (red)
- 100 – 150 m (black)

Data will be recorded using tablets temporarily secured to the helicopter frame using RAM mounts, with an external GPS and x-box controller attached to each tablet (Figure 2).

Figure 2: Sighting bars mounted beneath the aircraft allow distance to be estimated. Observations are recorded using a game controller feeding into a RAM-mounted tablet.

The aircraft will be flown at about 150 feet above ground level at 45 knots (46 m agl at 85 km/hr). Each survey's flight path will follow one of four sets of designated transects. Other aircraft operations will follow the Aviation Task Profile – Aerial Surveys of Wildlife (Attachment 2).

We'll calibrate sighting bars on the afternoon of the first day at Quirindi Airport, refuel and then fly all transects on Transect Set 1 on the Far-west block once before returning to Quirindi. We'll then alternate between sites and transect sets, as outlined in the table in the admin and logistics section.

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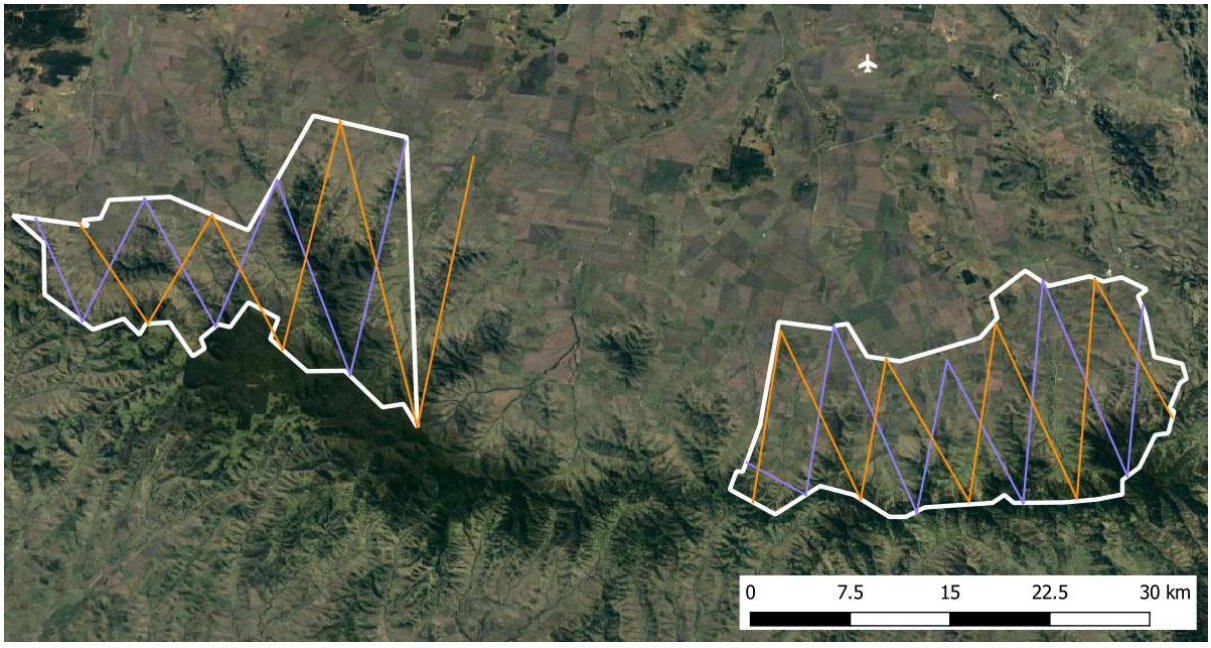

Figure 3: Far-west (left) and Shoot (right) survey blocks. Transect Set 1 is overlaid in orange. Transect Set 2 is purple. Quirindi Airport is shown as a white plane.

Survey blocks include wooded, hilly country and a small margin of grazing or cultivated land. Total transect length for each combination of survey block and transect set is:

Shoot, Set 1 = 65.0 NM (120.3 km)

Shoot, Set 2 = 66.5 NM (123.1 km)

Far-west, Set 1 = 57.4 NM (106.3 km)

Far-West, Set 2 = 46.9 NM (86.8 km)

Both survey areas contain power distribution lines, and a series of transmission lines running north-south lie immediately to the east of the Shoot block (Figure 4). Locations of transects and power lines within the survey blocks will be provided as .gpx files.

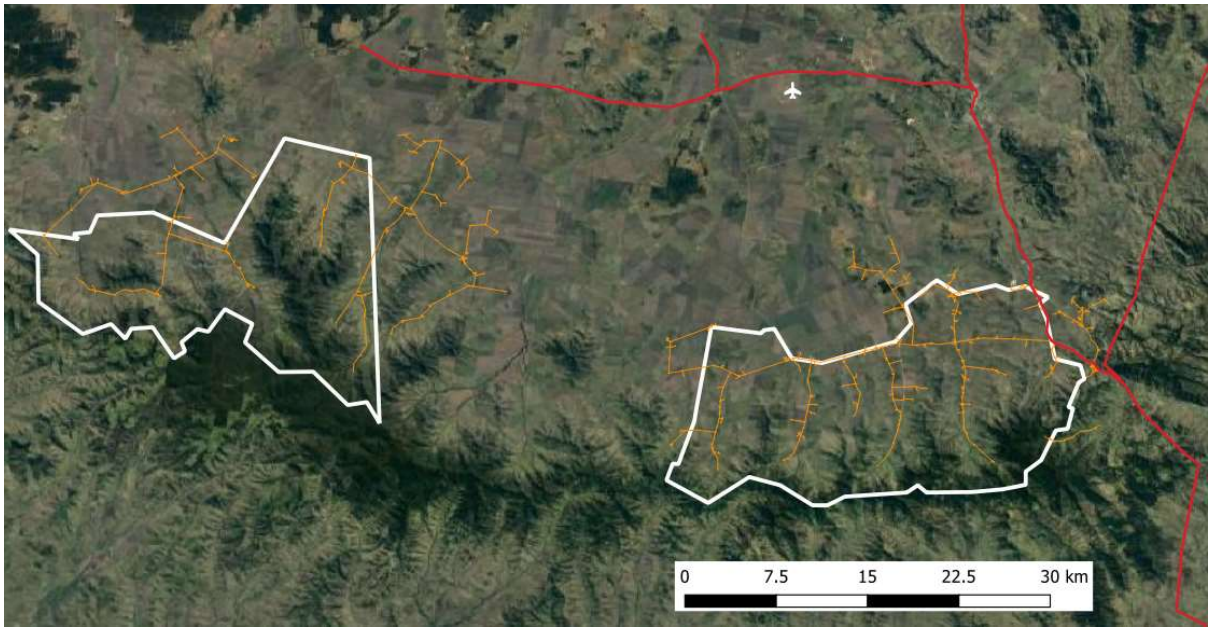

Figure 4: Locations of power distribution (orange) and transmission (red) lines on or near survey blocks.

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Data entry:

Observations will be recorded on a HP x2 tablet running Windows 10, using a data logging program that takes input from an x-box controller. Each observer will have a controller and a tablet, which will be secured to the aircraft using a mounting cradle (Figure 3). Each observer will also carry a voice recorder to use as backup if their data logger fails or is impractical.

This arrangement allows observations to be georeferenced using an external GPS, which provides great advantages for extracting information later. Observations should be recorded in the following order:

1. Species
2. Number
3. Distance class colour
4. Habitat (open, timbered)

The observation is georeferenced as soon as species information is entered, so it's most important to get this part of the order correct.

The current setup allows for five deer species and three other species (pigs, goats, grey kangaroos) to be recorded. Only deer, pigs and goats should be recorded.

The number of individuals in a group should be counted using subtising. The controller will accept inputs of 1,2,3,4 or 10 individuals. For example, Fallow, 3,3,1, Blue, Timbered will be read as 7 fallow in distance class blue, under trees.

Groups of animals spread across more than one distance class or habitat type should be treated as a single observation. The distance class and habitat type should be the logged according to the first animal in the group seen. Only 'open' and 'timbered' habitat types should be used (i.e. disregard 'cropping').

Data entry errors can be corrected in one of two ways:

1. If the wrong number of individuals is entered, start over again with species, number, distance, habitat. The absence of distance information in the initial incorrect entry will signal that this entry is incomplete and it will be discarded. For example, *Red deer, 3, Red deer, 2, Blue, Open* will be read as 2 red deer in distance class blue in the open.

2. If the wrong species, distance class or habitat type is entered, just enter the correct information immediately after. The last piece of information for any of these categories will be taken as the correct item. E.g.:
    - *Fallow, Chital, 3, 2, Yellow, Open* will be read as five chital in distance class yellow in the open.
    - *Fallow, 3, 2, Yellow, Green, Open, Timbered* will be read as five fallow in distance class green under timber.

The layout of the controller is detailed in Attachment 2.

The start and end of each transect will be announced by the pilot and these must be recorded by all observers using the 'start' button on the controller.

It's important that search effort is spread across all distance classes, not just the classes closest to the aircraft. Concentrating effort close to the aircraft can lead to a peak in the detection function (Fig 5a), rather than a gradual shoulder (Fig 5b), which makes it difficult or impossible to calculate meaningful density estimates and inflates the variance.

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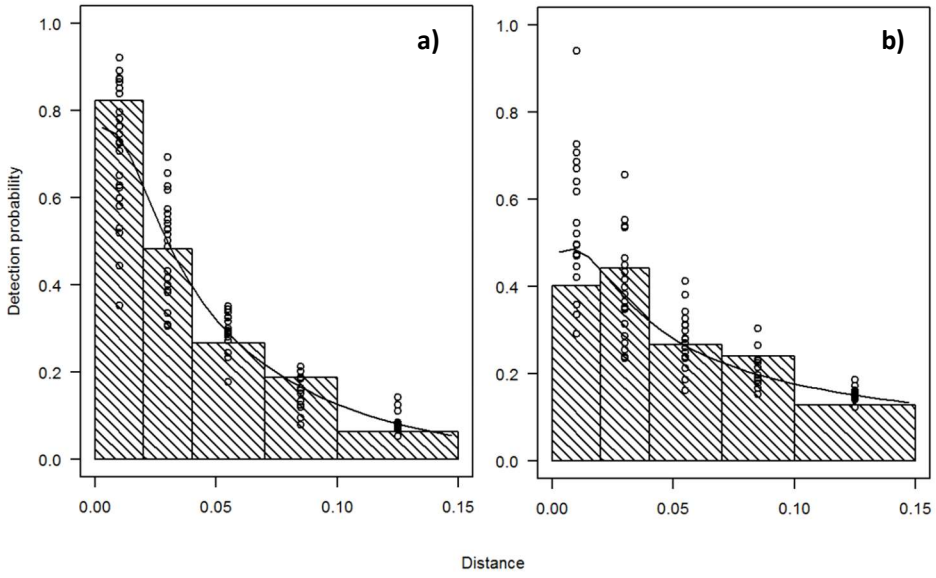

Figure 5: Two detection curves showing a) a strong peak in detections close to the aircraft, and b) a more gentle shoulder in the detection curve that is more consistent with the shape criterion assumption of distance sampling.

Admin and Logistics:

Pilot: TBD, Commercial Helicopters

Observers: Andrew Bengsen, Dave Forsyth, Sean Freney

Machine: Jet Ranger, likely FB269

We'll operate out of Quirindi Airport or another local LZ as advised by Commercial. A fuel trailer will be on-site. Three rooms are booked at Henry's in Qurindi for the 24th to the 27th.

Predicted light times –

First light: 0620

Sunrise: 0645

Sunset: 1935

Last light: 2000

Proposed sequence of events –

Prior to Day 1:

- AB to liaise with Commercial to work out timings etc
- AB to provide power and transmission line data in gpx format.

Day 1, Monday 24 Feb:

- AB, DF and SF will leave Orange at 1030 am on Monday the 24rd, allowing for a 5 hour drive before meeting the pilot at the airport no later than 4 pm to calibrate sighting bars. Calibration will involve a couple of bouts of hovering at a fixed position for a short time, so refueling after the ferry to Quirindi may need to wait until after calibration. Calibration shouldn't take more than an hour.
- Seating will be as follows: AB front, DF left rear, SF right rear.
- The first survey of transects on the Near-west block will commence after calibration and refueling, aiming to depart at 1715 and be back on the ground by 1945.

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Day 2, Tuesday 25 Feb:

- The second survey, targeting transects on the SHOOT block, will commence on the morning of Monday the 24th, as soon as visibility is acceptable.
- The third survey will commence on Monday afternoon, flying all transects on the Far western block. Departure time to be arranged with pilot, allowing for a return to the airport close to sunset at 1935.

Day 3, 4:

- Continue morning and afternoon surveys, alternating between am and pm and Transect Set 1 and 2 for each block. Ideal block and transect set order as follows (Block, Transect Set):

	Mon 24	**Tue 25**	**Wed 26**	**Thu 27**
am	- calibration	S, 2	S, 1	FW, 1
pm	S, 1	FW, 1	FW, 2	

Depart for Mudgee at conclusion of final survey or on the morning after.

A survey of the Mudgee shoot area may be scheduled for Friday morning, in which case, the sighting bars will need to be returned to Mudgee with the helicopter on the Thursday afternoon.

Tarnya Cox will drive to Mudgee on Thursday and Sean can take that car back to Orange.

Tarnya will replace Sean as observer for the Mudgee survey.

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Responsibilities –

Pilot:

- Operate aircraft, identify hazards and maintain hazard clearance, navigation, communication, responsible for safety of the aircraft and crew/passenger, pre-flight and in-flight briefings.
- Adjust flight path as necessary to avoid built up areas, houses, horses and commercial poultry sheds.

Observers:

- Assist the pilot in hazard identification and avoidance and communication.
- Manage batteries, ensuring that their tablets and voice recorders are sufficiently charged before each survey.

Prior to the aircraft leaving the ground, each observer is to ensure that:

- Voice recorders are synchronized with each other and a GPS track logger (AB to organise)
- Their tablet is working, adequately charged and not in flight mode
- Observer, Time and Position information is entered into the *Deer Aerial Survey Logger*
- The external GPS is plugged into the main USB port (HP tablets)
- The controller is plugged in to the USB-C port (HP tablets) or main USB port (ALGIZ tablet)
- GPS is operating and accuracy is <10 m (bottom left of logger screen)
- Tablets, external GPS and other equipment are secured in the aircraft

Andrew B: Manage data, including collating after each survey and checking for problems.

Equipment -

Survey (AB)

- 3 x Data logging pack, including:
    - Tablet,
    - Controller,
    - Mounting bracket,
    - Charger,
    - Carry bag
    - External GPS
    - Stylus and thumb drive
- Cable ties
- Electrical tape, black, yellow, green, blue, red
- Voice recorders and batteries
- Calibration markers
- Measuring tape/wheel
- Orange marker cones

PPE

- Helmets, flight suits (AB)
- Cotton / wool clothes (All)
- Leather boots (All)

Other

- Laptop and power cable (AB)
- External hard drive (AB)
- Research diary (AB)
- Power board (AB)
- Camera (AB)
- iPad: PDF site maps loaded into Avenza, waypoints into Motion-X (AB)

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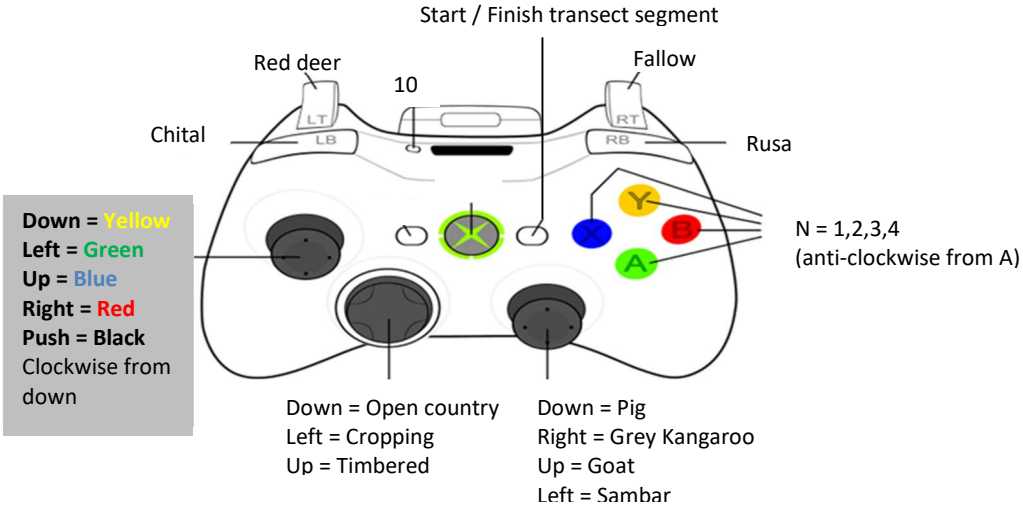
Attachment 1: Controller layout



Key	Data entered	Notes
A (green)	1	Same as fixed wing
B (red)	2	
Y (yellow)	3	
X (blue)	4	
Right trigger	Fallow	Triggers/Bumpers Main Species
Left trigger	Red deer	
Right bumper	Rusa	
Left bumper	Chital	
D-pad Down	Open	Vegetation
D-pad Up	Timbered	
D-pad Left	Cropping	
D-pad Right		
Back	10	
Start	Start and end of transect	
Right stick – Press		Other species
Right stick – Down	Pig	
Right stick – Up	Goat	
Right stick – Left	Sambar	
Right stick – Right	Grey kangaroo	
Left Stick – Down	0-20 (Yellow)	Bins (clockwise from 6 o'clock)
Left Stick – Left	20-40 (Green)	
Left Stick – Up	40-70 (Blue)	
Left Stick – Right	70-100 (Red)	
Left stick - Press	100-150 (Black)	

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Attachment 2:

Aviation Task Profile - Aerial Surveys of Wildlife

This plan outlines the identified hazards associated with Aerial Surveys of Wildlife operations by helicopter and fixed wing aircraft. Wildlife here includes pest animals, other wildlife and flora. Failure to utilise the practical controls to those hazards identified in this plan will unnecessarily raise the risk profile of the task.

This plan can be used to develop standards and/or to provide a reference for auditing and assessment by identifying the controls that are in place, assessing the risk and then determining what extra (if any) controls should be utilised.

Compliance with aviation and state WHS regulations, as well as any other applicable regulations, are implied and are to be considered and complied with in addition to the controls identified in this assessment.

Task Profile Name	Aerial Surveys of Wildlife
Objectives of Task	To undertake aerial counts and drop-offs for ground surveys in remote areas of target pest animal, other wildlife and flora (aerial surveys of wildlife) from fixed wing aircraft and helicopters to fulfil contractual research obligations.
Description of task	The task involves planned aerial wildlife and flora counts and aerial insertions into remote areas. Heights and speeds flown need to be commensurate with the ability of observers to identify target species and align with current best practice methods for aerial flora and wildlife surveys of the target species. For waterfowl, the aircraft will be flown along a pre-defined transect at a height of 500ft between waterbodies. When a waterbody is counted, the aircraft will be lowered to 100-150ft and a ground speed of 167-204km.h^{-1} (90-110 knots) for fixed-wing and 40km.h^{-1} (22 knots) for helicopters. For medium-large mammal surveys (e.g. kangaroos, goats, deer, feral pigs), fixed-wing aircraft will be flown along transects at a height of 250ft (76m) and a ground-speed of 185km.h^{-1} (100 knots), helicopters at a height of 150ft (46m) and a ground speed of 93km.h^{-1} (50 knots)
CASA permit/approval	Air Operating Certificate (AOC) endorsed for aerial work with low-level approval/exemption and using pilots with appropriate experience and low level flying permissions. Operations conducted within the parameters permitted by the Civil Aviation Regulations, associated orders and relevant advisory publications.

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Aircraft Type	Fixed-wing or helicopters may be used. Fixed-wing aircraft may have either piston or turbine engine(s). Helicopters must be turbine powered. The fixed-wing aircraft shall be high-winged and must be capable of operating normally straight level and manoeuvring safely straight and level at speeds down to 100km.h^{-1} (55 knots). The helicopters are to be certified and equipped with wire strike protection kits. All aircraft operating over water bodies should be equipped with radar altimeters with selectable height audio warning.
Number of engines	single or multi-engine
Task profile (sequence)	• Planning include map reconnaissance for hazards • Briefing including update of hazards as shown on appropriate map, flight following procedures, weather, task objectives, target area, communications and aerial risk assessment. • Fuelling when required • Conduct Crew Brief • Start/Taxi/Takeoff • Transit to area of operation not below 500 feet (ft) Above Obstacles (AO). • Conduct aerial hazard survey and pre-descent brief prior to descent below 500ft AO • Conduct low-level survey at 100-150ft (for waterfowl and helicopter surveys of mammals) or 250ft (for fixed wing aircraft for medium to large mammals) over target area or transect. • Communicate with LCC or Operator (as approved) for flight following and task update. • Land at appropriate area at least every 2-3.5 hours to minimise fatigue. The recommended maximum time if the task is generally low level is 2 hours. • Transit to next survey transect at a safe transit height (> 500ft). • Conduct further hazard reconnaissance and route identification prior to descent to conduct low level operations as above. • Transit to operating base/fuelling area. Conduct pre-landing brief. • Land / Shut Down. • Debrief and report.

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Task conditions or technical aspects	The aerial surveys and insertions will be conducted in day visual conditions only in low to medium turbulence at a speed commensurate with safe operations in the environmental conditions being experienced. Helicopters shall operate with a minimum 5% power margin based on Out of Ground Effect power requirements (nil wind). Consideration shall also be made of extreme environmental heat and cold on the safety of aircraft operations and its effect on crewmembers. Maps may be provided to assist aerial inspection crews, but these should not be relied on for the identification of hazards and therefore the reconnaissance of operating areas before descent is essential. The survey will follow a pre-defined transect line, involving the use of GPS units for navigation. Although 500ft has been nominated as the safe level of operations, it should be noted that wires may be strung between hills at higher levels and therefore constant vigilance by pilots and crew is required. Descent below 500ft is essential for completing the task and a pre-descent reconnaissance must be completed. For surveys of waterbodies, the entire area that the aircraft operates below 500ft shall have been fully pre-assessed for hazards. The area should be continually assessed during the descent and operations below 500ft. It should be noted that wires are often strung across bodies of water and therefore the pre-descent survey and ongoing vigilance is essential. Low sun angles or haze over bodies of water are a significant risk and should be avoided. Bird strike is also a high risk, therefore all crew are to wear helmets with clear visors down to protect head and eyes from impact. For over water body operations, all crew shall wear life jackets and should be HUET qualified. Ideally, helicopters should be equipped with floats. Landings by fixed wing aircraft and helicopters should be made to pre-inspected Aircraft Landing Areas and Helicopter Landing Sites respectively. Such landings require prior arrangement with, and area description from the landowner/manager. Ideally the landing areas should conform to CAAP 92 recommendations. In all cases, a complete pre-landing survey is required to ensure that no obstacles may impinge on the safe operation of the fixed wing aircraft or helicopter. Aircraft are not to be operated with any part of the aircraft extending into vegetation (e.g. long grass which may be hiding fences, ant hills or posts).
Time of Year	Operations are year-round

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Terrain description	The areas of operations will encompass all types of terrain including paddocks, hills, urban areas and over waterbodies. The high terrain areas can experience low air density, which can adversely affect aircraft performance. Also, the terrain can experience severe downdraughts and turbulence as a result of the strong winds. Cloud can roll in quickly. Lower areas and water bodies can experience extensive areas of fog, mist or smog, which can limit visibility. Low flying over bodies of water is hazardous when there is nil wind due to lack of depth perception. The areas can be extensively wooded and/or populated with domestic structures in close proximity to power lines. Fences may be hidden in long vegetation.

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Limitations	The survey is conducted in day visual conditions only in low to medium turbulence at a speed commensurate with safe operations in the environmental conditions being experienced. The survey is preceded by an appropriate risk assessment including aerial aviation hazard identification and assessment, and an assessment of environmental risks. Descent below a safe height (clear of all known and potential obstacles - generally 500 ft AO) is not to be conducted until the pilot confirms a low level of risk factoring in the route and area of operations, aircraft performance, aerial hazard and obstacle survey, environmental conditions and has conducted a low level flying pre-descent brief. This must be conducted for each descent below a safe height. Personnel working for or on behalf of NSW DPI are considered crew. All persons on board aircraft operating on behalf of NSW DPI must have a designated essential role in the performance of the aircraft task. Doors would normally be fitted to the helicopter, but for this task their removal (for the surveyor) is identified as essential to conduct the task and considered in the risk assessment process. When doors are removed, all items of recording equipment (e.g. laptops and keypads) shall be attached to the operators or the aircraft to preclude any objects leaving the aircraft and potentially damaging the aircraft or controls. The greatest threat is loose clothing impacting the tails of aircraft with a consequent loss of control of the aircraft. All loose seat cushions and loose equipment (including any clothing such as jackets not worn) shall be removed from the cabin or placed in on-board lockers. Helicopters require Wire Strike Protection System where it can be installed. Landings at appropriate areas should be planned approximately every 2-3.5 hours to minimise fatigue. The recommended maximum time if the task is generally low level is 2 hours. Sterile Cockpit Procedures shall be implemented when the aircraft is operating below 500ft AO.
Height restrictions	As a general rule, flights are to be conducted at the highest altitudes commensurate with the task objectives. It is recommended that the aircraft be flown at a safe transit height (500ft AO) between target areas. Surveys over the target areas will be undertaken at 100-150ft or 250ft, depending on the survey design protocols, observation requirements for different plants and animals, terrain topography and maximum height of vegetation.
Minimum height above obstacles	500ft is generally accepted as the minimum operating height for safe transit between surveyed areas. This operating height may need to be raised commensurate with the terrain and potential obstacles such as power lines. During waterfowl counts, the aircraft may be flown at 100-150ft. For medium to large mammals, the aircraft may be flown at 150ft (helicopter) or 250ft (fixed-wing).

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Operating times	Nominally 2 hours per session with a maximum of four sessions or two sessions (if flying 3.5 hours per session) in any one day and consistent with the Operators' fatigue management plan or CASA industry exemptions (whichever represents the greater restriction). Restricted to daylight hours and due consideration to visibility. If three sessions are undertaken per day, a minimum half day- rest is required after two days of survey, and if two sessions are undertaken per day, a minimum half day- rest is required after three days of survey. Operations over bodies of water should take place when the sun angle is high to avoid glare and loss of depth perception. Additionally, operations of bodies of water may be impacted by early morning fog or mist.
Operating Company Requirements	Company must have: - an AOC and CASA authorisations suitable to the task - a demonstrably functioning Safety Management System - fatigue management, or CASA approved flight and duty time, system - been audited and assessed as being suitable and capable of conducting NSW DPI Aerial Surveillance operations - detailed and documented training system - a minimum 5-year history general operations with no accidents indicating a trend in poor oversight or safety management - proper and detailed maintenance records of the aircraft to be used
Crew composition	4 to 6 - person crew; Pilot and aviation aware air survey officers. Crew numbers, given the hazardous nature of low level operations are to be kept to the absolute minimum required to complete the task.
Qualification / Training of each crew member	**Pilot –** CASA licenced, medically current, appropriate approvals and experience (see EOI), Fly the Wire (mandatory), HUET (highly recommended) **Air Surveillance Officer –** Crew Resource Management, GPS and map reading skills, medically suitable, Work Safety Around Aircraft, Fly the Wire (highly recommended), HUET (highly recommended)
Role of each crew member	**Pilot** – Identify hazards and maintain hazard clearance, operate aircraft, navigation, communication, responsible for safety of the aircraft and crew/passenger, pre-flight and in-flight briefings. **Air Survey Officer** – Assist the pilot in hazard identification and avoidance and communication. Responsible for identifying and recording target species. Advises where to start survey and where to end.
Landing zone details	Landings should be conducted to low risk (CAAP 92-2) Helicopter Landing Site (HLS), Aircraft Landing Areas (ALAs) (CAAP 92-1) or aerodromes. It should be noted that CAR 92(1) puts the responsibility on the pilot to ensure that the place is suitable for use as an aerodrome; and having regard to all conditions of the proposed landing or takeoff (including prevailing weather conditions), that the aircraft can land at, or takeoff from, the place safely. Where ALA information is provided by a person other than the pilot, it is still the pilot's responsibility to ensure that the facility is suitable for the intended aircraft operations.

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Communication requirements	The communications requirements for flight following purposes shall be detailed during the pre-flight briefing. It should be noted that the communications management may reside with the Operator but the LCC shall be responsible for ensuring that the flight following is being conducted. Communications need to be maintained at all times between the pilot and the air survey officers in relation to hazard and target identification. Sterile cockpit procedures apply when operating below 1000ft. Communications should also be established and maintained between the aircraft and the ground crew element as appropriate in order to facilitate the communication of operational and hazard related information. Communications are to be established and maintained with other low flying aircraft in the immediate vicinity.
SAR requirements	Flight-following shall be conducted by either the LCC or Operator (as agreed using 30-minute reporting schedules (which may be extended to 60 minutes once the designated operating has been reached) and through the use of satellite-based tracking systems showing real time information with at a minimum location and height reports not exceeding 5 minutes. Planned flight departure and arrival times and any changes shall be communicated to the LCC (which may be communicated via the Operator).
PPE	• Appropriate flying helmet (equipped with clear visor) worn by each helicopter crew member. 'Curly' pigtail communications leads are not to be used. • Donned life jacket when to be worn by each crewmember when operating over water. • Flammable resistant clothing worn by each crew member and passenger • Enclosed leather footwear (hardened toe and supported heel preferred) • Cotton or wool underclothing, socks • Aviation standard gloves (recommended)

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