



**EQUATORIAL  
LAUNCH  
AUSTRALIA**

# ASC Flight Hardware Recovery Plan

ELA-000029

VERSION: 02 **DRAFT**

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## APPROVAL HISTORY

CR Number	Title	Date
CR-0000050	LFL Baseline Addition	07/02/2023

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## 1 PURPOSE

This plan describes the general practices that ELA follows to locate, remove, and transport flight hardware from impact areas back to the ASC following a launch. It is not intended to provide details of specific recovery operations, as these will be situation specific and dependent on multiple factors including weather, location of the hardware, hazardous payload systems, and other factors.

## 2 SCOPE

This plan follows the four subsequent sections:

1. Role Definitions
2. Recovery Approaches
3. Safety
4. Recovery Equipment

## 3 REFERENCES

### 3.1 EXTERNAL REFERENCES

Serial	Title	Author	Version
A	Civil Aviation Safety Regulations 1998 (Cth)	Commonwealth of Australia	2023
B	Marine Safety (Domestic Commercial Vessel) National Law Act 2012 (Cth)	Commonwealth of Australia	2018
C	Marine Safety (Domestic Commercial Vessel) National Law Regulations 2013 (Cth)	Commonwealth of Australia	2023
D	Navigation Act 2012 (Cth)	Commonwealth of Australia	2019
E	Navigation Regulations 2013 (Cth)	Commonwealth of Australia	2015
F	Space (Launches and Returns) (General) Rules 2019 (Cth)	Commonwealth of Australia	2019

### 3.2 ELA DOCUMENTS

Serial	DIN	Title	Version
G	ELA-000040	ASC Helicopter Operations Plan	1.0
H	ELA-000117	ASC Principles for Land Access and Vehicle Recovery	1.0
I	ELA-000118	ASC Launch and Recovery Register	1.0
J	ELA-000025	ELA Communication Plan	1.0
K	ELA-000024	ELA Information Management Plan	1.0
L	ELA-000021	ELA Operations Manual	1.0
M	ELA-000015	ELA Organisation Plan	1.0
N	ELA-000031	ELA Terms and Definitions	1.0
O	ELA-000039	ELA Waste Management Plan	1.0

### 3.3 DEFINITIONS AND ACRONYMS

Definitions and acronyms applicable to this document may be listed in ELA-000031, ELA Terminology and Definitions (reference N).

## 4 ROLE DEFINITIONS

Refer to ELA Organisation Plan at reference M for details on ELA roles. The following roles and responsibilities are defined to remove ambiguity in recovery-oriented decision-making.

### 4.1 AIRCRAFT PILOT

Responsible for the safety of any given flight and abides by all applicable CASA regulations (reference A). The pilot holds the final go/no-go decision authority for any flight based on flight safety, both at base and in the field. The pilot operates in accordance with the ASC Helicopter Operations Plan at reference G.

### 4.2 SHIP CAPTAIN

Responsible for the safety of any given sea expedition and abides by all applicable marine regulations (reference C). The captain holds the final go/no-go decision authority for any sea operation based on marine safety.

### 4.3 RECOVERY TECHNICIAN

Responsible for assisting the Recovery and Range (Air and Sea) Manager during the execution of recovery activities in accordance with this plan.

The Recovery Technician may

1. act as the Recovery and Range (Air and Sea) Manager if required,
2. be responsible for overseeing any payload or motor making safe procedures in the field and
3. has the final authority to declare flight hardware safe to approach, rig, and transport.

### 4.4 PAYLOAD OR MOTOR TECHNICIAN

Responsible for making safe a motor or payload when required. If the Recovery Technician is not present, this technician will assume final responsibility for the safety of hazardous payload or motor systems.

### 4.5 ADDITIONAL FIELD PERSONNEL

Additional field personnel such as aerial observers serve in an advisory role only and are not expected to make final decisions about recovery activities.

### 4.6 TRADITIONAL OWNERS

Traditional Owners serve in an advisory role to ELA when they have jurisdiction at the expected recovery site(s).

For operations suspected to be within a sacred site, consultation with the appropriate TOs is undertaken as to the best approach to minimise disturbance to the site.

## 5 RECOVERY APPROACH

Recovery and remediation will be conducted in accordance with the ELA Operations Manual at reference L. Typical recovery operations follow the five main steps:

1. Locate hardware,
2. Operational planning for recovery Execution of recovery and remediation activities,
3. Handover (and disposal of) recovered hardware,
4. Reporting on recovery operations,

Recovery operation begins, at the determination of ELA and Land Owners and/or Land Managers (if required), with an aerial search to locate flight hardware. The recovery operation concludes when the Recovery and Range (Air and Sea) Manager (RASM) discontinues recovery sorties, and all recovered hardware has been handed over to or disposed of as agreed with the client.

Detailed recovery plans will be developed for each launch campaign based on key ASC range recovery work instructions:

1. Payload Recovery and Remediation
2. Land-Based Debris and Remediation Recovery

3. Sea-Based Debris Recovery
4. Client Reusability Recovery
5. Debris Handover
6. Recovery Briefing/Debriefing
7. Recovery Personnel Checklist

ELA is committed to maintaining a “clean range” whereby all launch related hardware that can be effectively located and identified on downrange lands or waters is removed when deemed practical by ELA and the Land Owners and/or Land Managers.

As such, ELA aims to undertake recovery operations immediately following launch activities, where the debris primarily consists of suborbital components (e.g., first stage of orbital vehicles, sounding rockets).

## 5.1 RECOVERY ZONES

Table 1 identifies and defines five zones and the planned recovery commitment within each zone. Launch trajectories are planned to avoid debris (e.g., stage 1 motors) falling in National Park or Marine Park areas within these zones; however, recovery may be required from these areas in the event of unforeseen circumstances or flight termination of faulty stages over such areas.

As part of each Australian Launch Permit, ELA will develop a plan in consultation with appropriate Regulatory Authorities to address this. Figure 1 shows Zone A in green, Zone B in orange and Zone C in red. A detailed list of recovery areas and their considerations is managed in ASC Launch and Recovery Register (reference I).

*Table 1: Recovery Zone Definitions*

Zone	Scope	Frequency
A	Mainland Australia and within 3km of mainland Australia's coastline	Plan to recover after every launch (where practicable)
B	Gulf of Carpentaria (marine only)	Plan to recover after every launch (where practicable)
C	Waters >3km off mainland Australia and within 200 nautical miles (EEZ boundary) of Australia's coastline	Plan to recover after every launch (where practicable)
D	Great Barrier Reef / PNG Waters	Plan to avoid
E	International waters outside of Australia's EEZ	Not recovered

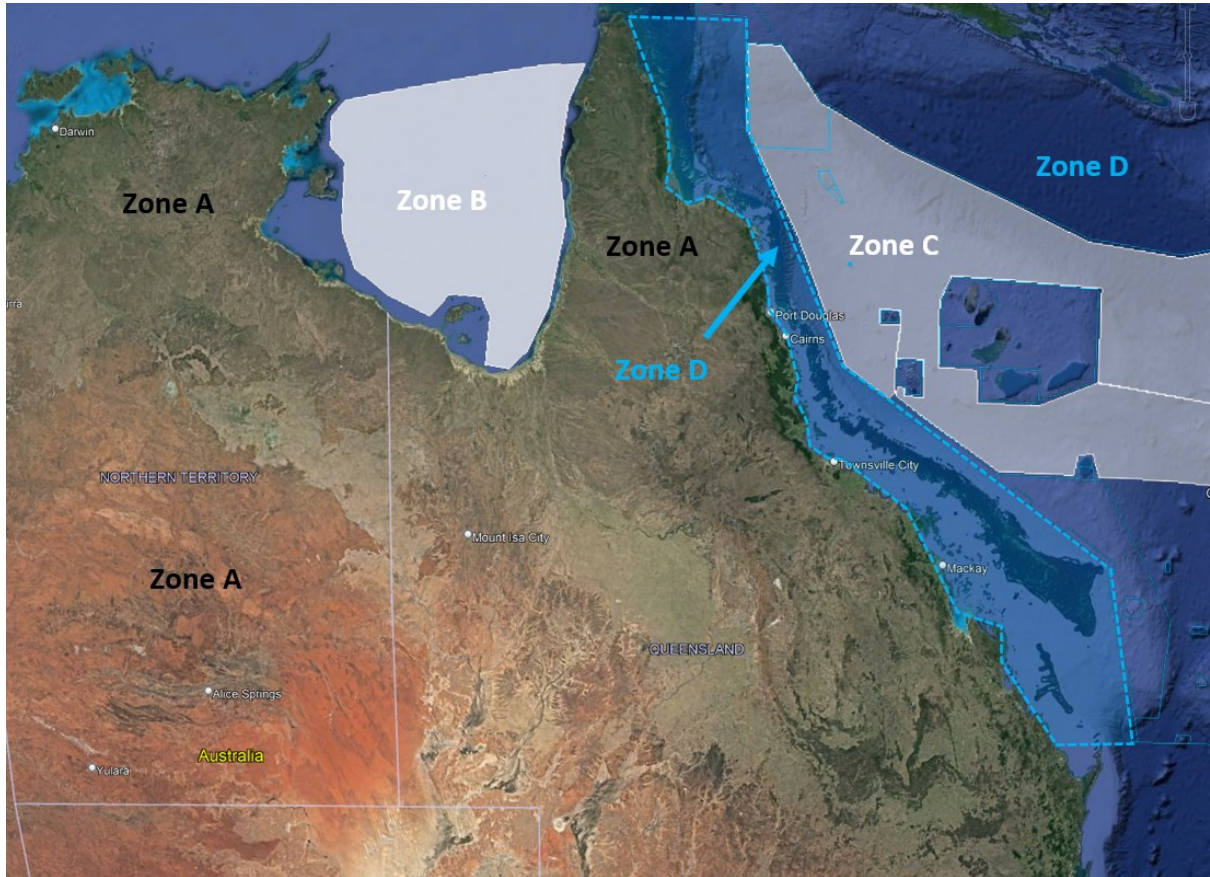


Figure 1 - ASC Recovery Zones

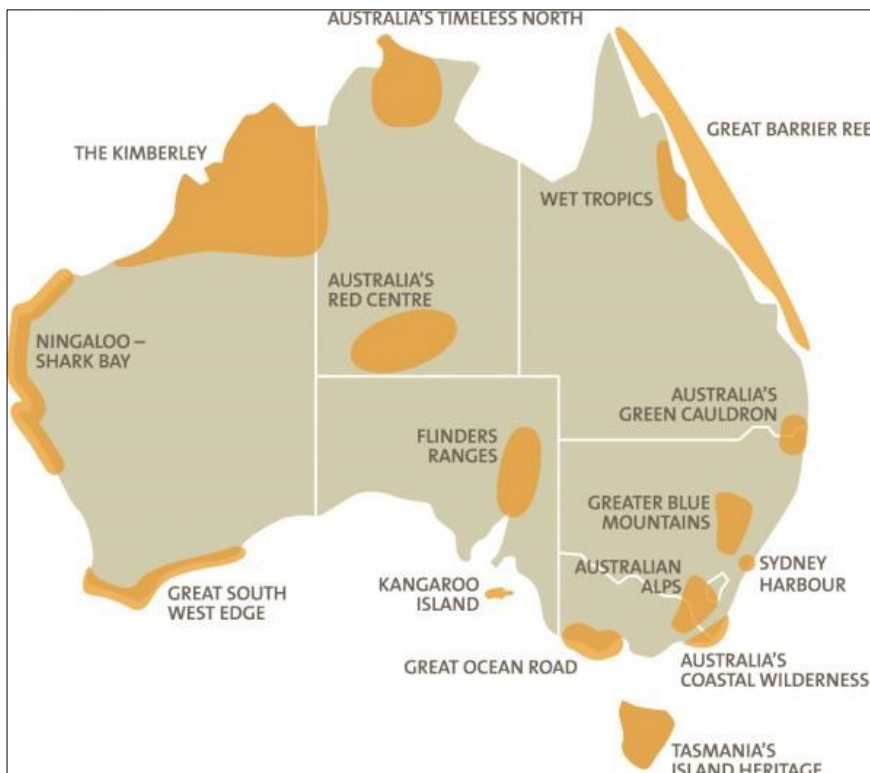


Figure 2: Zone D (Australian National Parks and Areas of Significance)



## 5.2 PRE-LAUNCH ACTIVITY

Trajectory mapping of the launch vehicle is utilised to determine impact zones for flight hardware. This is undertaken as part of the risk hazard analysis for the client's Australian Launch Permit (reference F) and serves as a guide to the potential impact sites of flight hardware.

## 5.3 RECOVERY WINDOWS AND DURATIONS

Recovery sorties are managed in accordance with the ELA Operations Manual (reference L) and the zoning criteria outlined in Section 5.1 and are undertaken in accordance with the appropriate Civil Aviation Safety Authority (CASA) and Australian Maritime Safety Authority regulations (references A and C).

Recoveries continue until all flight hardware has been recovered, or the LOM discontinues recovery activities.

Any recoveries requiring land access approvals will be undertaken in accordance with the appropriate area Work Instruction.

## 5.4 BRIEFING AND DEBRIEFING

Prior to any recovery operation, the recovery team receives a recovery briefing which includes, but is not limited to, a safety briefing provided by the pilot/captain, environmental safety issues (sun exposure, heat stress, wildlife hazards etc.) and recovery operations briefing by the Recovery and Range (Air and Sea) Manager. At the conclusion of a recovery operation, ELA performs a recovery debriefing. These are done in accordance with the Recovery Briefing/Debriefing Work Instruction.

## 5.5 POST-LAUNCH ACTIVITY

### 5.5.1 LAND OPERATIONS

Recovery operations are planned in accordance with the ASC Operations Manual such that an aerial search of the predicted impact zones are conducted as soon as practicable after launch. The search is focused on zones identified in pre-launch trajectory mapping, and these search zones are expanded if the rocket hardware is not found within the primary zones.

### 5.5.2 SEA OPERATIONS

For componentry impacting water, the scouting phase and recovery phase is combined into a single event. Recovery occurs on the same day as launch, scheduled at the time of 'splash down' (or conducted as soon as practicable after launch).

### 5.5.3 COMMUNICATIONS

Recovery communications are to be conducted in accordance with protocols described in the ASC Communication Plan at Reference J.

## 5.6 PRINCIPLES AND PROTOCOLS FOR LAND ACCESS AND VEHICLE RECOVERY

Land access will be required to facilitate the recovery of ELA and/or Client rocket vehicle assets following some launches and ELA wants to ensure that this process is undertaken in genuine partnership and cooperation with Land Owners and/or Land Managers (including Ranger groups) in the most respectful and appropriate way possible.

While recovery will be managed in accordance with the ASC Operations Manual procedures and this plan, ELA will also assure adherence to the set of principles in Reference H, which are aimed to ensure the appropriate steps are taken when ELA and Launch Clients are accessing land for retrieval purposes.

The principles covered in Reference H include:

- Communication to Land Managers
- Access processes to up-range and down-range recovery sites
- Site impact remediation
- Recovery operations safety and emergency



## 5.7 CONTINGENCY OPERATIONS

Due to the nature of rockets, hazardous systems they may occasionally malfunction, therefore presenting a potential safety hazard on the ground. ASC and ELA endeavour to ensure no acutely hazardous hardware is unaccounted for follow such an unplanned event. For example, through either interpretation of telemetry data or visual inspection, it may be evident that either a high-pressure gas system did not vent its contents, or a pyrotechnic device did not perform its intended function (i.e., deploy a door). In these cases, the Client provides a trained technician to be deployed to the impact site, in a joint effort with ELA, to restrain and "safe" the electronically activated pyrotechnic system or to manually vent the contents of the high-pressure gas system.

Furthermore, in some cases it may be necessary to immediately initiate recovery to mitigate a particular hazard. In such cases, Land Owners and/or Land Managers are notified as soon as practicable and apprised of the situation and the proposed action to recover the item. Further coordination is implemented as dictated by the situation.

## 5.8 RECOVERED HARDWARE

All recovered hardware is taken to the ASC storage facility (client specific building or ELA shared facility), becoming the responsibility of GM-ASC or delegate, where it is recorded and temporarily stored until it is either handed back to the client or proper disposal is undertaken. Export controlled technology is dealt with in accordance with the appropriate export requirements and procedures.

## 5.9 DISPOSAL

The disposal of recovered hardware is managed by ASC in accordance with the Waste Management Plan at Reference O.

## 5.10 HANDOVER TO CLIENT

The handover of hardware to the client will be undertaken as per the Debris Handover Work Instruction.

## 5.11 RECORDKEEPING AND REPORTING

### 5.11.1 LAUNCH AND RECOVERY DATABASE

The Recovery and Range (Air and Sea) Manager maintains a Launch Database of rockets launched and the locations at which each component returns to earth. This database, as well as all digital imagery, notes and files will be managed in accordance with the Information Management Plan at Reference K.

### 5.11.2 RECOVERY REPORT

A comprehensive report on all recovery operations for a given campaign is generated by the Recovery and Range (Air and Sea) Manager as required.

## 6 SAFETY

### 6.1 QUALIFICATIONS, FITNESS AND TRAINING

All Recovery Team members must meet the requirements outlined in the Recovery Personnel Checklist. Personnel weight limits may be applicable for aerial operations and are advised of by the pilot. At least one member of the Recovery Team is to be certified as a Wilderness First Responder or have an equivalent level of first-aid training.

Where required, specialised training for the different stages of the recovery will be provided. This training could include (but is not limited to):

1. Training for specific helicopter activities such as hot entry/exit and sling loading.
2. Training for specific marine activities such as marine salvage operations and diving.
3. Use of hazardous equipment such as gas saws and power tools.
4. Overland travel hazard and appropriate remote survival training.
5. Payload making safe activities.
6. Helicopter marine incident training.

## 6.2 REST AND PREPAREDNESS

Recovery Team members must be well rested, fed, and hydrated before each operation. The Recovery and Range (Air and Sea) Manager (RASM) is responsible for managing team member fatigue, safety equipment and survival kits during recovery operations. Any Recovery Team member requiring medication will notify the RASM and ensure that the appropriate medication is included in their survival kit when participating in recovery sorties.

The RASM does not have an active role in launch operations to ensure they are ready and available to undertake recovery operations when they arise.

## 6.3 SURVIVAL GEAR

### 6.3.1 AERIAL OPERATIONS

Emergency and survival gear listed in Annex A to this document are carried on all flights. Each Recovery Team member carries a satellite tracker and on-person survival kit on his or her person while away from ASC or other populated areas and whenever airborne.

Team members dress in preparation for possible survival situations, wearing clothing appropriate to the climate and possible environmental hazards. Clothing made of materials to reduce risk of burn injury in a post-crash fire will be provided.

### 6.3.2 SEA OPERATIONS

Emergency and survival gear listed in Annex B to this document are carried on all sea expeditions. Each Recovery Team member carries a satellite tracker and lifejacket with reflective tape on his or her person whilst at sea.

Team members dress in preparation for possible survival situations, wearing clothing appropriate to the climate and possible environmental hazards.

## 6.4 SEASONAL RECOVERY PROVISIONS

Due to the varying weather conditions experienced at ASC, the work instructions for recovery operations contain provisions for extreme weather conditions (e.g., heat). It is the responsibility of the RASM and Launch Safety Manager (LSM) to determine when these provisions are implemented for a given recovery operation.

## 6.5 HELICOPTER SAFETY

All helicopter recovery activities are managed in accordance with the Helicopter Operations Plan at Reference G.

## 6.6 VESSEL SAFETY

All sea operations are undertaken in accordance with Australian Maritime Safety Authority regulations. The captain is responsible for ensuring safe and efficient operation of the vessel. An informed and educated recovery team ensures that each team member understands and supports the captain's weather-related decisions.

## 7 RECOVERY EQUIPMENT

The equipment that may be required for a given recovery operation is situational and will differ depending upon the nature of the recovery task(s). Detailed lists can be found in the appropriate work Instruction (i.e. Payload Recovery and Remediation Work Instruction, Land-Based Debris Recovery and Remediation Work Instruction).

It is the responsibility of LSM or delegate for overseeing the acquisition, maintenance, and distribution of all recovery equipment.

## 8 ANNEXES

- A. Land recovery (Flight) Survival Gear
- B. Marine Recovery (Sea) Survival Gear

## ANNEX A

## LAND RECOVERY (FLIGHT) SURVIVAL GEAR

Earplugs - pair of	4
Glasses - safety - pair of (for doors-off flight)	2
Glasses - safety - pair of	2
Gloves - Fuelling - pair of	2
Gloves - Cut resistant - pair of	2
Hard hat	1
Hi-Vis Vest	2
Cat hole kit - Trowel	1
Cat hole kit - Toilet Paper (roll of)	1
Cat hole kit - Disposable butane lighter	1
Cat hole kit - Dry sack	1
Survival Blanket	2
Signal Mirror	2
Rescue Whistle	2
Fire Striker	2
Waterproof tinder	4
Compass	2
Duct tape	2
Fishing supplies	2
Sewing supplies	2
Torch flame lighter	2
Water purification tablets	16
Water purification tablets (1 litre)	20
Satellite Tracking device	2
First Aid Kit	1
Water bladder (6 litre minimum)	1
Emergency food ration (3600 Kcal)	3
Flares - aerial signal	4
Flares - smoke	2
Hatchet - lightweight	1
Handsaw - folding	1
Lighter - disposal butane	2
Manual - Outback Survival	1
Tent - Lightweight with bug mesh	1
Bivouac Sack	2
Sleeping pad - Inflatable thermal	2
Sleeping pad - repair kit	2
Insect repellent - sealed bottle	2
Duffel to pack - items not carried elsewhere	1

## ANNEX B

## MARINE RECOVERY (SEA) SURVIVAL GEAR

Earplugs - pair of	4
Glasses - safety - pair of	2
Glasses - safety - pair of	2
Gloves - Cut resistant - pair of	2
Hard hat	1
Hi-Vis Vest	2
Life Jacket	1
Cat hole kit - Toilet Paper (roll of)	1
Cat hole kit - Disposable butane lighter	1
Cat hole kit - Dry sack	1
Survival Blanket	2
Signal Mirror	2
Rescue Whistle	2
Compass	2
Duct tape	4
Fishing supplies	2
Sewing supplies	2
Torch flame lighter	2
Water purification tablets	2
Water purification tablets (1 litre)	2
Satellite Tracking device	16
First Aid Kit	20
Water bladder (6 litre minimum)	2
Emergency food ration (3600 Kcal)	1
Flares - aerial signal	1
Flares - smoke	3
Bivouac Sack	1
Sleeping pad - Inflatable thermal	1
Sleeping pad - repair kit	2
Insect repellent - sealed bottle	2
Duffel to pack - items not carried elsewhere	2