

# **ELA Phase 2 Expansion of the Arnhem Space Centre, Referral Document to NT EPA**

**Prepared for:**

**Equatorial Launch Australia**

**September 2023**

**FINAL**

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### Document Control

**Deliverable #:** D22099-3

**Title:** ELA Phase 2 Expansion of the Arnhem Space Centre, Referral Document to NT EPA

**Version:** FINAL

**Client:** Equatorial Launch Australia

**Document reference:** D22099-3 ELA Referral to NT EPA (FINAL).docx

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17/09/2023

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## Glossary

<b>Term</b>	<b>Definition</b>
AAPA	Aboriginal Areas Protection Authority
ASC	Arnhem Space Centre
BBIX	Black Brant 9 (type of Launch Vehicle)
DCCEEW	Department of Climate Change, Energy, the Environment, and Water (Cwth)
DES	Department of Environment and Science (Qld)
DEW	Department of Environment and Water (SA)
DIPL	Department of Infrastructure, Planning, and Logistics
DISR	Department of Industry, Science, and Resources (Cwth)
DPWS	Department of Environment, Parks, and Water Security
EPA	Environmental Protection Authority
ELA	Equatorial Launch Australia
FTS	Flight Termination System
ha	Hectare
HTP	High Test Peroxide
IPA	Indigenous Protected Area
LEO	Low Earth Orbit
LOX	Liquid Oxygen
LPG	Liquid Petroleum Gas
LV	Launch Vehicle e.g., rocket motor, drogue, payload, nose cone
NASA	National Aeronautical and Space Agency (USA)
RP-1	Refined Petroleum (kerosine) aka Rocket Propellant
SCS	Site of Conservation Significance
TFHC	Department of Territory Families, Housing, and Communities

## EXECUTIVE SUMMARY

Equatorial Launch Australia (ELA) has made this referral for the Phase 2 expansion of the Arnhem Space Centre (ASC) to the Northern Territory Environment Protection Agency (NT EPA) under s48 of the *Environment Protection Act 2019* (EP Act) and the *Environment Protection Regulations 2020* (EP Regulations). ELA seeks a decision from the Minister for Environment on whether an environmental impact assessment is required for the proposal and, if so, which assessment method applies.

ELA considers that the environmental and social effects of activities conducted in association with Phase 2 of the ASC will not be significant and can be managed through compliance with regulatory approvals requirements, AS/NZ standards, and an approved Environmental Management Plan (EMP).

ELA is making a concurrent referral to the Commonwealth Department of Climate Change, Energy, the Environment, and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* and considers that the Project will not be a controlled action.

ELA has an obligation to apply the principles of environment protection and management and a general duty to apply the principles of ecologically sustainable development, the environmental decision-making hierarchy, and the waste management hierarchy. It will do this through:

- Purposeful engagement with the legitimate representatives of the Traditional owners of the land of northeast Arnhem Land (Miwatj)
- Coordination with the NT EPA and other relevant Territory, State, and Commonwealth governments
- Application of the precautionary principle to decisions regarding activities that could lead to significant environmental damage
- Application of best available scientific and technical evidence to ensure environmental protection and sustainable operation of the ASC in the NT
- Ensuring that activities associated with operation of the ASC do not affect the health, diversity, or productivity of the environment, so that the opportunities for present and future generations are not adversely impacted
- Ensuring that vegetation clearance for site construction is permitted, that the least area possible is cleared, and that cleared vegetation is available for Traditional landowner use or applied to the site as mulch or ground habitat
- Ensuring that rocket launches and retrievals do not adversely affect the biological diversity and ecological integrity of areas outside of the ASC
- Negotiation of a fair market rate for the lease of the site from the Traditional owners
- Development of an Environmental Management Plan that applies the environmental decision-making hierarchy in accordance with the EP Act
- Applying the waste management hierarchy to reduce waste production and ensure recycling of materials where practicable. Options such as repurposing suitable waste materials for local artistic or economic use will be explored with the local community
- Establishment of standard operating procedures as required to reduce risks caused by the current and changing climate
- Purposeful consultation and engagement with the Traditional owners of the land.

There is the potential for low environmental impact on seven (7) of the fourteen environmental factors identified by the NT EPA if activities were unmitigated. ELA has proposed and will commit to management measures to avoid significant impact on:

- Terrestrial environmental quality

- Terrestrial ecosystems
- Hydrological processes
- Inland water environmental quality
- Aquatic ecosystems
- Air quality
- Atmospheric processes.

Finally, there is the potential for a positive impact on the local community and economy through the current and proposed activities associated with the ASC. These will be developed through purposeful engagement with the Traditional owners and special interest groups, e.g., education.

# 1. INTRODUCTION

## 1.1 Purpose

Equatorial Launch Australia (ELA) is planning for the Phase 2 expansion of the Arnhem Space Centre (ASC) and is making this referral to the Northern Territory Environment Protection Agency (NT EPA) under s48 of the *Environment Protection Act 2019* (EP Act) and the *Environment Protection Regulations 2020* (EP Regulations). ELA is seeking a decision from the Minister for Environment on whether an environmental impact assessment is required for the proposal and, if so, which assessment method applies.

Phase 1 was assessed under the *Environmental Assessment Act 1982* where the decision was made that the “potential environmental impacts and risks of the proposed action are not so significant as to warrant environmental impact assessment by the NT EPA under provisions of the EA Act at the level of a Public Environmental Report or Environmental Impact Statement”<sup>1</sup>.

ELA considers that the environmental and social effects of activities conducted in association with Phase 2 of the ASC will not be significant and can be managed through compliance with regulatory approvals requirements, AS/NZ standards, and an approved Environmental Management Plan (EMP).

## 1.2 The Proponent

ELA was founded in 2015 to develop multi-user commercial space launch capacity in Australia. ELA’s mission is to be the pre-eminent multi-user, commercial space launch company providing world-class equatorial spaceport services, supporting test, launch, and recovery of space vehicles and payloads flown to and from all space orbits. Contact details of the proponent and the author of this document are provided in Table 1.

**Table 1 Contact Details**

	<b>Proponent</b>	<b>Environmental Consultant</b>
Company Name	Equatorial Launch Australia Pty Ltd	Katestone Environmental Pty Ltd
Postal Address	Suite 2.2, Stone and Chalk, Marnirni-Apinthi Building, Lot Fourteen, North Terrace, Adelaide SA 5000	Level 4, 154 Melbourne Street, South Brisbane, Qld 4101
Phone	(08) 8246 5485	(07) 3369 3699
Contact Person: Name	Ben Tett	Simon Welchman
Contact Person: Title	GM, Operations and Launch	Director
Contact Person: Email	<a href="mailto:ben.tett@ela.space">ben.tett@ela.space</a>	<a href="mailto:simon.welchman@katestone.com.au">simon.welchman@katestone.com.au</a>

A premium site was selected in the Northern Territory and a 40-year lease was signed in 2017 with Gumatj Corporation and the Northern Land Council. Construction of Stage 1 of the ASC commenced in mid-2021. A Launch

<sup>1</sup> [https://ntepa.nt.gov.au/\\_\\_data/assets/pdf\\_file/0008/743687/decision\\_statement\\_reasons\\_arnhem\\_space\\_centre.pdf](https://ntepa.nt.gov.au/__data/assets/pdf_file/0008/743687/decision_statement_reasons_arnhem_space_centre.pdf)

Facility License (LFL) and an Australian Launch Permit (ALP) were granted by the Commonwealth Minister of Industry, Science and Resources and the Australian Space Agency (ASA) in May 2022. The inaugural launch of three NASA BBIX Launch Vehicles (LV) took place in June – July 2022.

### 1.3 Project Overview

The ASC is located on the Dhupuma Plateau, approximately 20 km due south of Nhulunbuy, in the East Arnhem region of the Northern Territory (Figure 1, Figure 2). The site is 12°S from the equator, meaning that it can efficiently provide launches of small and medium sized rockets and their payload (Launch Vehicles (LV)) into equatorial low earth orbit, geosynchronous equatorial orbit, lunar orbit, and deep space.



**Figure 1** Location of the Arnhem Space Centre, Northern Territory

Several structures were constructed at the ASC as part of Phase 1 of development, including a launch pad, temporary mission support buildings (i.e., Launch Control, Mission Control, Range Control, Administration), Vehicle Assembly Building, Payload Integration Facility, staff accommodation, amenities, and a caretaker's accommodation.

Phase 2 will expand the ASC to the area that was previously the Gulkula South Mine and the Gulkula North Mine and will develop the final and preferred primary launch site on a total lease area of 630 ha. The final affected (usable) area (including Phase 1 site) will be approximately 250-300 ha of land where the majority has been previously mined and partially rehabilitated by Gulkula Mine (Figure 4). An additional 14 Launch Pads and supporting infrastructure, including mission support buildings, fuel storage and pumping facilities, and water storage for the launch deluge system, will be constructed (see section 3).

The ASC will be a multi-user commercial spaceport that can provide a comprehensive suite of services to support the launching of modern small to medium sized LV (up to 4000 kg payload) (see section 3.2).



**Figure 2** Location of the Arnhem Space Centre, Gove Peninsula

## 1.4 Publication Statement

The following personnel from Katestone were involved in the preparation of this EP Act Referral:

- Simon Welchman (Director) – B.Eng. (Environmental) (Hons)
- Dr Craig Miller (Team Leader Climate Change and Greenhouse Gases) – BSc (Zoology), MSc (Zoology) (Hons), PhD (Forestry)
- Natalie Shaw (Team Leader Approvals) – BAppSci (Chemistry), MAppSci (Chemistry)
- Oliver Stockdale (Environmental Consultant) – BAdvSci (Physics) (Hons), MPhil (Physics).

## 2. REGULATORY APPROVALS

The material regulatory approvals that are required for development and operation of Stage 2 of the ASC are listed in Table 2. The operation of the ASC is also required to comply with a range of other State and Commonwealth legislation but does not require regulatory approval for these.

**Table 2 Key Regulatory Approvals**

Approval	Legislation	Agency	Status
Northern Territory Approvals			
Environmental Approval	<i>Environment Protection Act 2019</i>	EPA	<p>The <i>Environment Protection Act 2019</i> (EP Act) and <i>Environment Protection Regulations 2020</i> (EP Regulations) establish a framework for assessing the potential environmental impacts of development projects. Actions with the potential to have a significant impact on the environment require referral to the NT EPA under the EP Act and EP Regulations.</p> <p>The NT EPA will use the information in the EP Act referral to determine whether environmental impact assessment is required and, if required, the level of assessment that must be undertaken. An Environmental Approval from the Northern Territory Minister for the Environment is required if an action requires environmental assessment.</p>
Works Approval	<i>Heritage Act 2011</i>	TFHC	The <i>Heritage Act 2011</i> provides for the identification, declaration, conservation and protection of places and objects of cultural and natural heritage. All sites on the NT Heritage Register and archaeological sites are protected under this Act.
Authority Certificate	<i>Northern Territory Sacred Sites Act 1989</i>	AAPA	The <i>Northern Territory Sacred Sites Act 1989</i> provides for the protection and registration of sacred sites by the traditional owners or the custodians of land.
Licence	<i>Water Act 1992</i>	DPWS	The <i>Water Act 1992</i> provides for the investigation, allocation, use, control, protection, and management of surface water and groundwater resources, as well as the administrative process for licensing these activities. Part of the ASC occurs on the southern boundary of the Gove Water Control District. A water extraction licence may be required for harvesting of surface water during the wet season.
Approval or licence	<i>Waste Management and Pollutions Control Act 1998</i>	EPA	The <i>Waste Management and Pollutions Control Act 1998</i> provides for the protection of the environment by encouraging effective waste management and pollution prevention and control practices. The Act establishes the activities that require environmental protection approvals or licences. ELA will not undertake any activities listed in Schedule 2 of the Act.
Development Consent	<i>Planning Act 1999</i>	DIPL	The <i>Planning Act 1999</i> establishes a system for facilitating planning for the orderly use and development of land. Development consent is required to subdivide land and clear vegetation.

Approval	Legislation	Agency	Status
Australian Government Approvals			
Approval	<i>Environment Protection and Biodiversity Conservation Act 1999</i>	NT EPA/ DCCEEW	The <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) is the Australian Government's key environmental legislation. Approval under the <i>EPBC Act</i> may be required for any proposed action likely to have a significant impact on a matter protected by that Act. The environment assessment and approvals process of the <i>EPBC Act</i> aims to protect Matters of National Environmental Significance (MNES), as well as the environment in general where actions proposed are on, or will affect Commonwealth land, and/or where Commonwealth agencies are proposing to take an action.
Launch Facility Licence Launch Permit	<i>Space (Launches and Returns) Act 2018</i>	DISR	The <i>Space (Launches and Returns) Act 2018</i> establishes a regulatory framework for space activities carried on from Australia or by Australian nationals outside of Australia. The ASC will require a Launch Facility Licence to operate as a space launch facility, and each launch will require an Australian Launch Permit.
Queensland Approvals			
Permit	<i>Environmental Protection Act 1994</i>	DES	The <i>Environmental Protection Act 1994</i> seeks to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).  ELA will consult the DES to determine whether a permit is required if a LV stage is planned to land in Queensland.
South Australia Approvals			
Permit	<i>Environment Protection Act 1993</i>	DEW	The <i>Environment Protection Act 1993</i> provides the regulatory framework to protect South Australia's environment, including land, air, and water.  ELA will consult the DEW to determine whether a permit is required if a LV stage is planned to land in South Australia.

## 3. PROPOSAL DESCRIPTION

### 3.1 Location and Regional Context

The ASC is located on the Dhupuma Plateau, Gove Peninsula, northeast Arnhem Land (Miwatj) (Figure 2) approximately 35 km by road from the township of Nhulunbuy and approximately 15 km by road from the Gove airport. The peninsula lies on the western side of the Gulf of Carpentaria.

#### 3.1.1 Land Ownership

The ASC is located within the Dhimurru Indigenous Protected Area (IPA) which comprises approximately 550,000 hectares of Yolngu land and sea country in northeast Arnhem Land. The IPA is managed by the Dhimurru Aboriginal Corporation.

The site is freehold Aboriginal Land (Portion 1646) held by the Arnhem Land Aboriginal Land Trust and administered by the Northern Land Council (Table 3). ELA holds a 40-year lease for 60 ha, and this will expand to cover a total of 630 ha, with activity occurring on 250-300 ha of land where the majority has been previously mined and partially rehabilitated.

**Table 3 Summary of location and context of ASC site**

Aspect	Description
Latitude	-12.387608°
Longitude	136.797118°
Area	630 ha
Tenement details	N/A
Street address	Central Arnhem Rd, Nhulunbuy, 0880
Parcel description	Freehold Aboriginal Land (Portion 1646)
Zoning	Unzoned
Tenure	Freehold Aboriginal Land held by the Arnhem Land Aboriginal Land Trust and administered by the Northern Land Council.  40-year lease for the area of Phase 1 of the ASC held by ELA
Local Government Area	East Arnhem Regional Council
Emergency services	Nhulunbuy and Gove Airport

#### 3.1.2 Natural Features of the Project Area

The Dhupuma Plateau is a narrow irregular plateau of lower Cretaceous sandstone and claystone, ranging in height from 85–115m above sea level. It has a gentle southerly slope with steep breakaways on the northern and southern

sides including tributaries draining respectively to the Latram River and Dalywuy Bay and Port Bradshaw. Bauxite and lateritic boulders cover most of the Plateau, and soils are very shallow or non-existent. The soils have very low nutrient content and very low biological activity.

There are no World Heritage Sites, National or Marine Parks, Sites of Botanical Significance, Wetlands of International Importance, or public/private reserves proximate to the project area. However, the project area is within the Gove Peninsula and northeast Arnhem coast Site of Conservation Significance (SCS)<sup>2</sup> which stretches 150 km from north to south and covers approximately 2280 km<sup>2</sup>. The SCS is considered of international significance, and includes the following ecological values:

- A largely intact and weed-free savanna woodland and dune system.
- The SCS is especially significant for the high density of nesting of Green Turtles. Flatback, Hawksbill and Olive Ridley Turtles have also been confirmed nesting on mainland beaches and some islands.
- Islands within the SCS support internationally significant breeding populations of Bridled and Roseate Terns, as well as significant numbers of other seabirds.
- A total of 18 threatened species have been recorded within the SCS.
- Several endemic plant and animal species are found here.

Surveys conducted for the adjacent Dhupuma Plateau Bauxite Mine have determined that Darwin stringybark (*Eucalyptus tetradonta*) shrubby woodlands with tussock grass understory are the dominant vegetation community (Mitchell, 2015). These woodlands are subject to periodic disturbance by cyclones and fires and are regenerating in areas subject to both natural and human disturbance (Wills and Annandale, 2017). Some 300 native plant species were identified during these surveys; none of these species are listed as threatened under NT or Commonwealth legislation.

Targeted surveys for listed threatened species in potential habitat failed to find any in the proposed mining area or in adjacent areas (Mitchell, 2015).

The area has a low incidence of significant environmental weeds; however, Gamba grass (*Andropogon gayanus*) (Class A) and nine other Class B declared weeds have been recorded in the wider area. Gamba grass is of particular concern because infestations can increase the intensity of bushfires. The area immediately surrounding the ASC has had fewer than 4 bushfires between 2000 – 2020; however, the wider region has experienced bushfires in as many as 16 of the 20 years in question.

The area leased by ELA is a greenfield site except for the area used for Phase 1; however, Phase 2 will be developed on land that was previously mined and rehabilitated by Gulkula Mining Company. Gulkula Mining Company is Australia's first Indigenous owned and operated bauxite mine.

### 3.1.3 Site Selection and Alternatives

The location of the existing ASC was chosen by ELA for the following reasons:

- Australia is politically and economically stable
- Launches from near the Equator deliver 20% to 40% more payload-to-orbit than from higher latitudes with the same amount of fuel as they receive a boost from the rotation of the Earth
- East Arnhem Land – at 12.5° South – is the best location in Australia for launching rockets
- The area has the most suitable weather conditions in northern Australia for establishing a commercial spaceport

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<sup>2</sup> <https://territorystories.nt.gov.au/10070/532069/0/0>

- The Gulf of Carpentaria is an ideal impact area for payloads and spent stages as it has very little maritime activity, and most notably has no oil or gas rigs
- The Gulf of Carpentaria is shallow with a flat seabed – two factors that work in favour of payload and spent stage recovery
- The southwest range (~250km SW from ASC) is ideal for land recovery of scientific sounding rockets
- There is significant existing infrastructure and support services, e.g., deep water port with roll-on/roll-off facilities, quality airport with long runway, fully functioning airport with emergency services, fibre optic cabling to site
- The region has access controlled by permit because it is Aboriginal Land (limiting the likelihood of security breaches)
- The site is elevated with a clear and unpopulated launch azimuth to the east and south/south west
- The site has previously been disturbed by mining
- There is a comprehensive knowledge of the existing environment because of Yolngu/Gumatj knowledge of their country and past studies for the Gulkula Mining Company.

The alternate solution to build Phase 2 in another location was not considered due to the following reasons:

- Substantial research was conducted in the Phase 1 to justify the strategic and operational strengths of locating ASC in East Arnhem region
- The success of phase 1 NASA launches proved the area is safe (low population in the area, good weather) and effective (strong local support on providing the right amenities and supplies in time)
- An opportunity presented to expand into previously mined area, limiting impact to native vegetation.

Through continued strong stakeholder engagement of Gumatj, NTG and NLC, ELA assessed the risk of expanding the lease areas to reuse Gulkula mined areas as low.

## 3.2 Key Components of Phase 2

### 3.2.1 Site Layout

The likely final Phase 2 lease area (green) and final affected area (blue) are depicted in Figure 3.

The components of Phase 2 that are material to this Referral to the NT EPA are shown in Figure 4 and are detailed in Section 3.2.2 (construction) and Section 0 (operations). Phase 1 of the development of the ASC (within dark green outline in Figure 4), including the inaugural launch, has already occurred.

### 3.2.2 Construction

The general layout of the ASC has been determined (Figure 4); however, the detailed design of infrastructure is still being completed (Figure 5).

Phase 2 of the development is intended to expand ELA's capacity to provide an additional 14 Launch Pads and supporting infrastructure (Table 4). This phase will take part in Phase 2A and 2B as access to Gulkula mining areas (South and North) become available. The final Phase 2 area will be the preferred and primary launch site for the future of the ASC and will occur on 250-300 ha of partially rehabilitated land previously mined by Gulkula Mining Company.

Phase 2A will provide additional permanent and temporary facilities at the original site and develop initial infrastructure, the initial tranche of Launch Complexes, and permanent support facilities (Figure 5). Phase 2B will develop the remaining tranche of Launch Complexes and associated infrastructure, further permanent supporting infrastructure, and the decommissioning of temporary support infrastructure.

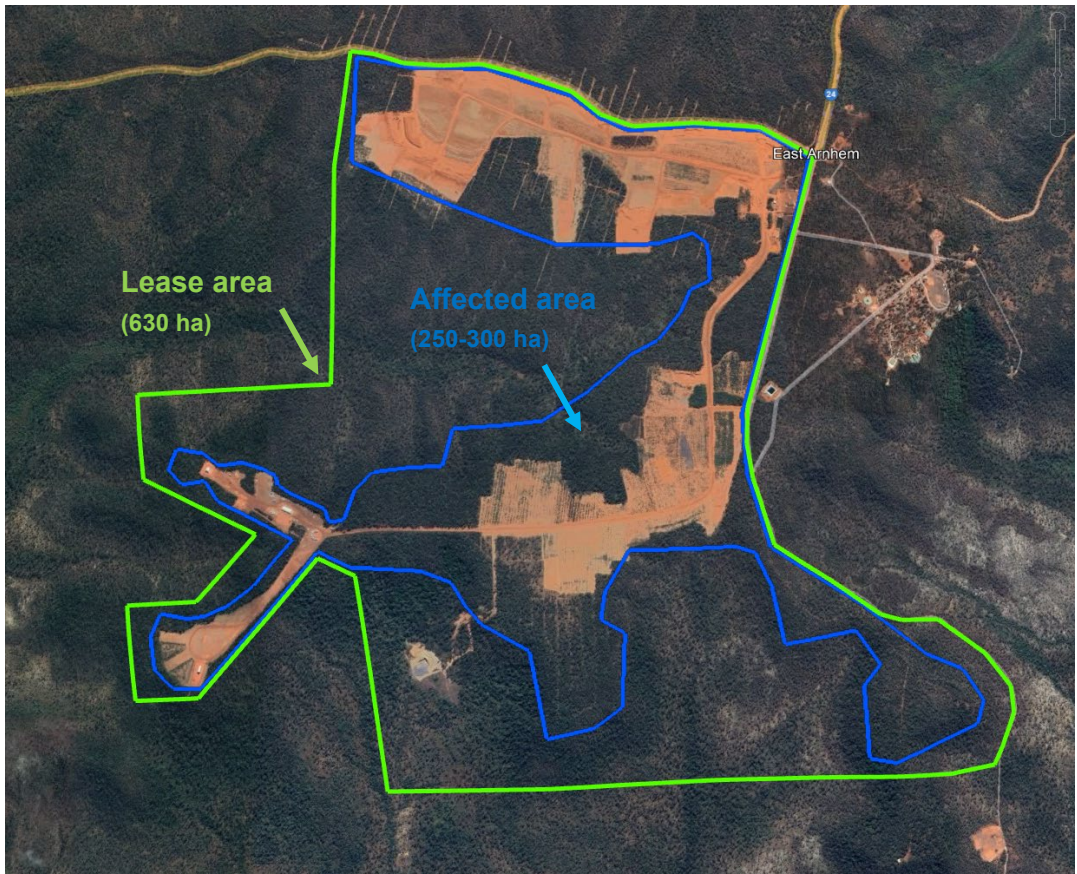


Figure 3 Likely Phase 2 final lease and affected areas

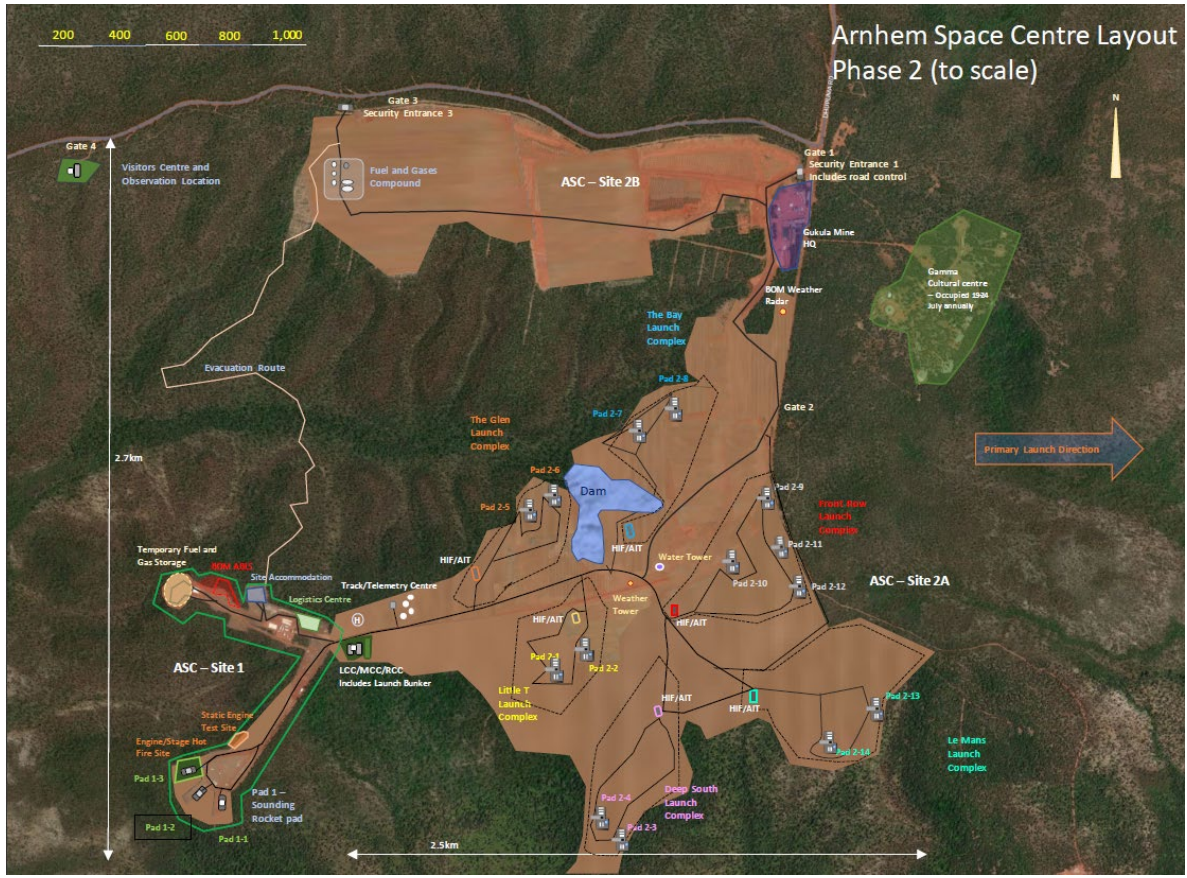
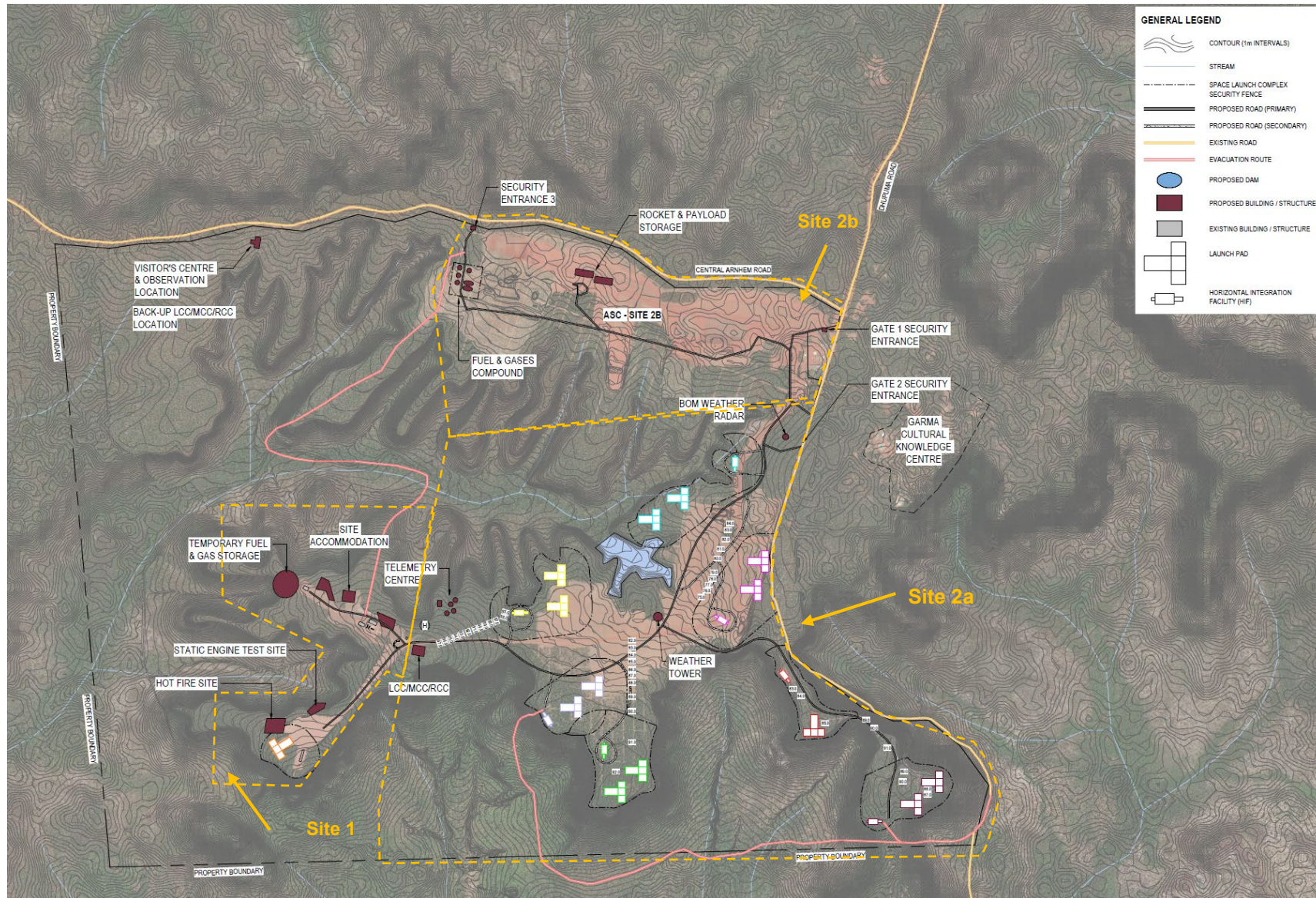


Figure 4 ASC and proposed Phase 2 site layout



**Figure 5** Provisional layout of Site 1, Site 2A, and Site 2B of the ASC

**Table 4 Development plan for Site 1, Site 2a, and Site 2b of the ASC**

Phase 2A – Site 1	Phase 2A – Site 2A	Phase 2B – Site 1, Site 2A	Phase 2B – Site 2B
<ul style="list-style-type: none"> <li>• New support facilities including:</li> <li>• Static engine test site</li> <li>• Engine hot fire site</li> <li>• Associated services infrastructure:               <ul style="list-style-type: none"> <li>○ HV and LV electrical networks</li> <li>○ ICT/communications networks</li> <li>○ Lightning protection</li> <li>○ Hydraulics services</li> </ul> </li> <li>• Site accommodation</li> <li>• BOM ABLs</li> <li>• Temporary fuel and gas storage</li> <li>• Temporary logistics centre (LV storage)</li> </ul>	<ul style="list-style-type: none"> <li>• Space Launch Complexes               <ul style="list-style-type: none"> <li>○ 1 (Magenta)</li> <li>○ 2 (Violet)</li> </ul> </li> <li>• Primary road network and road access to Space Launch Complexes 1 &amp; 2</li> <li>• Minimum associated infrastructure to support operations at Space Launch Complexes 1 &amp; 2               <ul style="list-style-type: none"> <li>○ HV and LV electrical networks</li> <li>○ ICT/communications networks</li> <li>○ Lightning protection</li> <li>○ Hydraulics services</li> </ul> </li> <li>• Launch Control Centre</li> <li>• Mission Control Centre</li> <li>• Range Control Centre</li> <li>• Mobile lightning protection for launch pads</li> <li>• Telemetry and Tracking Centre</li> <li>• HeliPad</li> <li>• Road network               <ul style="list-style-type: none"> <li>○ Site accommodation</li> <li>○ BOM ABLs</li> <li>○ Security Gate 2 upgrade</li> <li>○ Emergency egress route</li> <li>○ Water infrastructure</li> <li>○ Weather tower</li> </ul> </li> <li>• BOM weather radar (possible)</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of earthworks for permanent fuel and gas storage</li> <li>• Remaining Space Launch Complexes</li> <li>• Remaining secondary roads</li> <li>• Emergency egress routes</li> <li>• Remaining associated services infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Fuel and gases compound</li> <li>• Rocket and payload storage</li> <li>• Road infrastructure</li> <li>• Site services infrastructure</li> <li>• Visitor Centre and backup LCC, MCC, RCC and associated supporting services:               <ul style="list-style-type: none"> <li>○ HV and LV electrical networks</li> <li>○ ICT networks</li> <li>○ Lightning Protection</li> <li>○ Hydraulic services</li> </ul> </li> <li>• LOX manufacturing plant (possible)</li> </ul>

Two construction activities are material to this NOI to the NT EPA:

- 250-300 ha of primarily regrowth vegetation will be cleared (see section 6.1 and section 6.3). A Development Consent will be obtained under the *Planning Act 1999* for this activity (Table 2).
- A dam will be constructed to capture and store stormwater and overland flow (see section 6.4). The dam level is also likely to be maintained during the dry season from a local bore. The projected volume of this dam will be approximately 1.5 million m<sup>3</sup> and the water will be used to supply the launch deluge system, firefighting system, and other non-potable uses on site. A license will be sought under the *Water Act 1992* for this purpose (Table 2).

### 3.2.3 Operations

It is projected that there will be eight to twenty overlapping launch campaigns per year of about three weeks' duration, with one to three launches per campaign. Consequently, there will be between 16 and 60 launches per year when Phase 2 of the ASC is fully operational.

#### 3.2.3.1 Types of Launch Vehicle

The ASC will have the facilities and capacity for launching a range of small and medium sized LV (Table 5). These include sub-orbital hypersonic and research sounding rockets (such as NASA Black Brant rockets assessed in the NOI for the first phase of the ASC development and operation), and Low Earth Orbit (LEO) and Geosynchronous orbit (GEO) mission rockets supporting both small and large satellites into global orbits. Large scale cis-lunar<sup>3</sup> and inter-planetary launches may be possible in the future.

**Table 5 Representative launch vehicles and their general characteristics**

LV name	Type	Stages	Dry mass (kg)	Gross lift-off weight (kg)	Length (m)	Max. payload (kg)	Propellant category
Dorado 1	Suborbital	1	N/A <sup>4</sup>	356	6.5	25	Hybrid
BBIX	Suborbital	2	~268	~1,270	22	440	Solid
Delta Velos Orbiter	Orbital - Scramjet	1	N/A	N/A	12	50	Liquid
RS1	Orbital	2	3,200	~35,500	26.82	1,350	Liquid
Hapith V	Orbital	3	22,186	44,000	20	390	Hybrid
Launcher	Orbital	2	7,700	90,000	30	1,500	Liquid

<sup>3</sup> This side of the moon

<sup>4</sup> N/A = Not available

### 3.2.3.2 Types of Propellant

Rocket propellants are a combination of either solid, liquid, or hybrid (e.g., solid + gas or solid + liquid) fuel plus an oxidising agent (Table 5, Table 6).

Sounding rockets such as the BBIX use solid-fuel propellants, i.e., highly stable solid chemical substances (fuel and oxidisers) (Table 6) which are self-contained in the rocket motor and combusted to create propulsion. The propellant used in the first stage is of the nitrocellulose/nitroglycerine family, with added lead compounds. The propellant used in the second stage is of the ammonium/perchlorate/aluminium/plastic binder type, with small amounts of carbon black, iron, and sulphur. Three successful launches and recovery of NASA BBIX occurred at the ASC in 2022 (Figure 6, Figure 7).

Liquid propellants include typical formulations such as RP-1 (a highly refined form of kerosene) plus liquid oxygen (LOX), and LPG plus LOX (Table 6). Liquid methane (CH<sub>4</sub>) is showing promise over other conventional fuels such as liquid hydrogen, RP-1, and the highly toxic hydrazine (N<sub>2</sub>H<sub>4</sub>) (van Schyndel *et al.*, 2022). The ASC will not launch rockets fueled with hydrazine or its variants, such as unsymmetrical dimethylhydrazine.

Hybrid propellants provide some advantages over solid and liquid propellants, including that the rockets tend to be mechanically simpler, safer, can be more easily throttled, and may be cheaper than the other fuel types (DeLuca *et al.*, 2012).

Material Safety Data Sheets (MSDS) are available for all fuel types (Table 6). Several of the propellants may be toxic to freshwater and marine organisms if they reach waterways and if the concentration and rate of exposure is high enough (Table 6).

The ASC will preferentially launch rockets that use propellants that are environmentally safer than those used in legacy rockets. For example, solid propellants derived from ammonium dinitramide do not use chlorines and will break down to a nitrogen-based fertiliser when exposed to ultraviolet light.

### 3.2.3.3 Hazardous Goods Transport and Storage

Fuelled and unfuelled LV rocket motors, rocket fuel, and diesel for electricity generation will be transported by barge to Nhulunbuy, then transported by truck to the ASC. Transport of these hazardous goods is strictly regulated under the *Australian Dangerous Goods Code* and the *Australian Code for the Transport of Explosives by Road and Rail*.

Solid-fuel rocket motors will be transported directly to the ASC for storage or assembly. Solid rocket fuels do not explode and will only combust if combined and ignited. The storage requirements for fuels and oxidisers for liquid and hybrid rocket motors differ by material type and these will be stored in accordance with relevant Australian Standards to ensure human, environmental, and infrastructure safety:

- AS 1842 The storage and handling of non-flammable cryogenic and refrigerated liquids (1997)
- AS 1940 The storage and handling of flammable and combustible liquids (2017)
- AS 3833 The storage and handling of mixed classes of dangerous goods in packages and intermediate bulk containers (2007)
- AS 4326 The storage and handling of oxidising agents.

**Table 6 Propellant types and environmental considerations**

Propellant category	Fuel type	Oxidiser type	Environmental information	Primary emissions
<b>Solid</b>	Hydroxyl-terminated Polybutadiene (HTPB)	Aluminium/ Ammonium perchlorate (Al/NH <sub>4</sub> ClO <sub>4</sub> )	HTPB is unlikely to be hazardous to aquatic organisms <sup>5</sup> . Al/NH <sub>4</sub> ClO <sub>4</sub> may be hazardous to crustacea <sup>6</sup> .	Carbon soot, H <sub>2</sub> O, CO <sub>2</sub> , HCl, Al <sub>2</sub> O <sub>3</sub> , CO, NOx, N <sub>2</sub> , H <sub>2</sub>
<b>Liquid</b>	RP-1 (C <sub>12</sub> H <sub>24</sub> )	Liquid oxygen (LOX (O <sub>2</sub> ))	RP-1 is a refined form of kerosene. It may be hazardous to aquatic organisms <sup>7</sup> . Some components of kerosene may bioaccumulate in fish and aquatic organisms and strongly adsorb to sediment and suspended organic matter. The material is expected to biodegrade.  It is not considered a marine pollutant under the International Maritime Dangerous Goods (IMDG) Code.  RP-1 is less toxic than diesel, Jet-A1, and petrol	Carbon soot, H <sub>2</sub> O, CO <sub>2</sub> , CO, H <sub>2</sub> , O <sub>2</sub> , OH, sulphur compounds
	Jet-A1 (C <sub>11</sub> H <sub>22</sub> )	LOX (O <sub>2</sub> )	Jet-A1 is a refined form of kerosene. It may be hazardous to aquatic organisms on an acute and chronic basis <sup>8</sup> . Some components of kerosene may bioaccumulate in fish and aquatic organisms and strongly adsorb to sediment and suspended organic matter. The material is expected to biodegrade.	Carbon soot, H <sub>2</sub> O, CO <sub>2</sub> , CO, H <sub>2</sub> , O <sub>2</sub> , OH, sulphur compounds
	Jet-A1 (C <sub>11</sub> H <sub>22</sub> )	High-test peroxide (HTP (H <sub>2</sub> O <sub>2</sub> ))	As above for Jet-A1. High-test hydrogen peroxide is toxic to aquatic organisms in high concentrations <sup>9</sup> . It is readily biodegradable and does not bioaccumulate.	Carbon soot, H <sub>2</sub> O, CO <sub>2</sub>

<sup>5</sup> [https://d11fdyfhxcs9cr.cloudfront.net/templates/170652/myimages/htpb\\_sds.pdf](https://d11fdyfhxcs9cr.cloudfront.net/templates/170652/myimages/htpb_sds.pdf)

<sup>6</sup> <https://pubchem.ncbi.nlm.nih.gov/compound/Ammonium-perchlorate#section=US-EPA-Regional-Removal-Management-Levels-for-Chemical-Contaminants>

<sup>7</sup> [https://www.haltermannsolutions.com/uploads/files/Rocket\\_Propellant.pdf](https://www.haltermannsolutions.com/uploads/files/Rocket_Propellant.pdf)

<sup>8</sup> [https://www.globalp.com/wp-content/uploads/2019/10/SDS\\_Kerosene\\_Final1.pdf](https://www.globalp.com/wp-content/uploads/2019/10/SDS_Kerosene_Final1.pdf)

<sup>9</sup> <https://shop.chemsupply.com.au/documents/hl0011ch35.pdf>

Propellant category	Fuel type	Oxidiser type	Environmental information	Primary emissions
	Methane (CH <sub>4</sub> )	LOX (O <sub>2</sub> )	Methane is non-toxic and readily biodegradable <sup>10</sup> . It is a greenhouse gas with a 20-year global warming potential (GWP) of 84 and a 100-year GWP 28 <sup>11</sup> .	Carbon soot, H <sub>2</sub> O, CO <sub>2</sub> , CO, H <sub>2</sub> , O <sub>2</sub> , OH, NO <sub>x</sub>
	Propane (C <sub>3</sub> H <sub>8</sub> )	LOX (O <sub>2</sub> )	No known ecological damage is caused by propane <sup>12</sup> . Propane is readily biodegradable.	Carbon soot, H <sub>2</sub> O, CO <sub>2</sub> , CO, H <sub>2</sub> , O <sub>2</sub> , OH
	BioLPG (N/A)	LOX (O <sub>2</sub> )	No known ecological damage is caused by biopropane <sup>13</sup> . Biopropane is readily biodegradable.	Carbon soot, H <sub>2</sub> O, CO <sub>2</sub> , CO, H <sub>2</sub> , O <sub>2</sub> , OH
	Ethanol (C <sub>2</sub> H <sub>6</sub> O)	LOX (O <sub>2</sub> )	Ethanol is readily biodegradable and is unlikely to bioaccumulate	Carbon soot, H <sub>2</sub> O, CO <sub>2</sub> , CO, H <sub>2</sub> , O <sub>2</sub> , OH
	Green hydrogen (H <sub>2</sub> )	LOX (O <sub>2</sub> )	Hydrogen is highly volatile. It is non-toxic and will not bioaccumulate <sup>14</sup> . Hydrogen is an indirect GHG with a GWP of 5.8	H <sub>2</sub> O, NO <sub>x</sub> , H <sub>2</sub> , O <sub>2</sub>
<b>Hybrid</b>	Styrene-butadiene Rubber (SBR)	Nitrous oxide (N <sub>2</sub> O)	SBR is non-toxic and will not contaminate water or soil <sup>15</sup> . N <sub>2</sub> O is non-toxic and will not bioaccumulate. It is a GHG with a GWP of 265.	NO <sub>x</sub> , CO <sub>2</sub> , CO
	Paraffin	LOX (O <sub>2</sub> )	Paraffin is stable in water and can be mechanically separated <sup>16</sup> . It can be toxic to fish at high concentrations over 96 hours <sup>17</sup> .	H <sub>2</sub> O, CO <sub>2</sub> , CO

<sup>10</sup> <http://docs.airliquide.com.au/MSDSCalgaz/50006.pdf>

<sup>11</sup> <https://www.cleanenergyregulator.gov.au/NGER/About-the-National-Greenhouse-and-Energy-Reporting-scheme/global-warming-potentials>

<sup>12</sup> [https://www.boc-gas.com.au/en/images/Propane-LPG%20SDS\\_tcm351-496571.pdf](https://www.boc-gas.com.au/en/images/Propane-LPG%20SDS_tcm351-496571.pdf)

<sup>13</sup> <https://cdn.calorgas.ie/-/media/sites/ireland/cg-sds-002-propane-biolpg-safety-data-sheet.pdf>

<sup>14</sup> [https://www.boc-gas.com.au/en/images/Hydrogen%20SDS\\_tcm351-496575.pdf](https://www.boc-gas.com.au/en/images/Hydrogen%20SDS_tcm351-496575.pdf)

<sup>15</sup> [http://www.mtixtl.com/sds/Styrene-butadiene\\_SDS.pdf](http://www.mtixtl.com/sds/Styrene-butadiene_SDS.pdf)

<sup>16</sup> <https://shop.chemsupply.com.au/documents/PL0431CH4V.pdf>

<sup>17</sup> <https://www.sigmaaldrich.com/AU/en/sds/sial/18512>

Fuels and oxidisers for liquid and hybrid rocket motors will be stored in facilities protected against lightning strikes, overheating, and cyclonic winds:

- Bulk storage in tanks and other containers for energetic liquids
- Rest storage for transporters and portable containers and tanks
- Ready storage for fueling rockets prior to launch.

### 3.2.3.4 Launch

All future launch pads will have the following human and environmental safety measures:

- Flame deflector
- High-pressure industrial water deluge system.

The water deluge system provides fire, thermal, and acoustic suppression for each launch, and also captures ignition exhaust emissions. The system covers the entire pad, nozzle exit area and flame deflector and trench area, and is supplied by header tanks and pumped at high pressure to the launch pad. Nozzle exit sprinklers and water cannon (located within 20m of the pad) can supply more than 33,750 litres of water at 1,125 litres/s and can be controlled remotely.

The first stage rocket fires at launch to propel the whole LV upwards. The first stage detaches when all propellant is consumed, and it falls to earth (Figure 6) between 1km and 1000km down range. The second stage then fires and takes the vehicle to the required altitude. The second stage detaches, and it then falls to earth, burns up in atmosphere or attains orbit. For example, the first stage of the BBIX has a burn time of 5 seconds, launches the rocket to 2 km in altitude, and falls within 1 km of the launch site (Figure 6). The second stage burns for approximately 32 seconds, taking the second stage and payload to 5-44 km in altitude, and falling within 80 km from the launch site. The suborbital or orbital payload is released, and suborbital payloads return to earth under a parachute (Figure 7).

### 3.2.3.5 Emissions to air

The main air pollutants likely to be generated by the combustion of rocket fuel are carbon monoxide, hydrogen chloride, nitrogen dioxide, and aluminium oxide (Katestone, 2023a). Aluminium oxide is likely to be in the form of particulate matter with a diameter less than 10 micrometres (PM<sub>10</sub>) while the others are gases. Particulate carbon is also likely to be produced and this may be regarded as a pollutant. Lead may be present in some fuels, and this would be regarded as a pollutant in emissions.

Only emissions from Stage 1 rockets are expected to contribute to levels of air pollutants at ground-level, based on the mixing height characteristic of the ASC area (Katestone, 2023a). Stage 2 emissions typically occur many kilometres above the ground.

The Northern Territory has not enacted legislation that specifies air quality criteria or guidelines to be applied to industrial facilities; however, the Northern Territory Ambient Air Quality Monitoring Reports summarises air quality in terms of compliance with the *National Environmental Protection (Ambient Air Quality) Measure* (Air NEPM) standards. These standards and standards from relevant jurisdictions have been used to derive maximum allowable pollutant emission rates for different sized rockets (Table 7) and for static tests (Table 8).

The maximum allowable pollutant emission rates for launches (Table 7) are derived from the maximum allowable ground-level concentration over an entire year that will not exceed published air quality criteria at sensitive receptors. The rates for carbon monoxide and hydrogen chloride are based on the 1-hour criterion.

**Table 7 Emissions envelope for typical launches (Katestone 2023a)**

Parameter	Example 1	Example 2	Example 3
<b>Rocket parameters</b>			
Initial Mass (kg)	1,189	36,000	90,000
Thrust (N)	65,200	600,000	1,100,000
Burn Rate (kg/s)	61	97	370
<b>Maximum allowable pollutant emission rates</b>			
CO (kg/s)	472.9	183.3	109.2
HCl (kg/s)	2.2	0.9	0.5
NO <sub>x</sub> (kg/s)	2.6	1.0	0.6
Al <sub>2</sub> O <sub>3</sub> (as PM <sub>10</sub> ) (kg/s)	11.4	4.4	2.6

The maximum emissions from static tests in any 1-hour period represent the limit that will ensure pollutant levels at sensitive receptors are not exceeded (Table 8).

**Table 8 Emissions envelope for static tests (Katestone 2023a)**

Maximum emission in 1-hour	CO (kg)	HCl (kg)	NO <sub>x</sub> (kg)	Al <sub>2</sub> O <sub>3</sub> (as PM <sub>10</sub> ) (kg)
	59,778	279	327	1,435

The modelling that was conducted for the Emissions Protocol considered air quality criteria with 24-hour and 1-hour (or shorter) averaging periods. Due to the infrequent nature of launches, the facility's contribution to longer-term average concentrations of air pollutants will be negligible.

This was validated by ELA undertaking comprehensive air and soil monitoring for 2 of the 3 NASA launches in aim to compare to the initial air emission modelling done for the original NOI. The results from this confirmed that there were negligible traces of both air and soil contaminants.

Launches are likely to average once a week at peak operations and never at the same time and consequently, there is no risk of air pollutants from more than one launch combining. Consequently, a monitoring trigger based on an annual number of launches will not be meaningful.

As required for each Australian Launch Permit, ELA intends to review and determine whether any launch is likely to exceed the acceptable air quality limits by either:

- Comparing known or observed emission rates of an LV to the maximum allowable emission rates
- Calculating emission rates of pollutants by mass of fuel combusted per second and % composition of CO, HCl, NO<sub>x</sub>, and Al<sub>2</sub>O<sub>3</sub>, and comparing them to the maximum allowable emission rates.

The closest sensitive receptor to the ASC is the Gulkula Festival site, which is 2.8km away. This site hosts up to 2,000 people once a year over a long weekend in July/August and is otherwise unoccupied. The next three nearest sensitive receptors are between 10 and 15 km away and include the Gove airport.

Diesel use for electricity generation and by vehicles has been the largest source of Scope 1 greenhouse gas (GHG) emissions in the first two years of operation of the ASC (Katestone, 2023b). This is projected to increase under Phase 2 as activity at the site increases. However, the projected increase in rocket launches between 2024 and 2027 will see rocket fuel become the largest source of Scope 1 emissions with the combustion of RP-1/LOX expected to be the main source of these emissions.

Liquid and hybrid propellants that are expected to be used at ASC include liquid hydrogen, high-test peroxide (HTP), cryogenic fuel liquid methane, and paraffin-based and styrene-butadiene rubber fuels, all of which produce fewer emissions than the common LOX/RP-1 propellant combination. Long term, ELA is also considering a LOX production facility at the ASC which will require diesel combustion for electricity.

There is significant uncertainty about GHG emissions from some of the rocket fuels due to their proprietary composition, but this will be resolved over time as more data is made available or collected. Based on current projections, ELA will not have NGER or NT Government reporting obligations (Katestone, 2023b).

### **3.2.3.6 Trajectory**

Stage/component drop zones are planned to avoid populated areas or environmentally sensitive areas/reefs. Any flight over the Northern Territory will clear any potential drop zone interaction with traditional owner sensitive/sacred site areas. ELA has been engaged with the Aboriginal Areas Protection Agency (AAPA) since 2016 and works closely with them regarding respect and access to traditional owner lands. Papua New Guinea overfly would only ever be contemplated/planned with the approval of the PNG Government, as would other territorial ocean drop zones.

### **3.2.3.7 Recovery**

ELA intends to undertake recovery operations of all launch related suborbital hardware, e.g., first stage, sounding payload, etc, where deemed practicable by ELA and the landowners and/or land managers, and/or required by Regulators (Figure 6, Figure 7).

For orbital launches, recovery is mainly focused on the booster or first stage motor as other discarded objects such as second stage, fairings and nose cone doors are burnt up in the atmosphere or land far down range in international waters. Recovery zones and the frequency of recovery of hardware proposed by ELA are identified in Table 9 and Figure 8.

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 (section 3.2.3.9) over such areas. As part of each Australian Launch Permit, ELA will develop a protocol in consultation with appropriate Regulatory Authorities (Table 2) to address this.

LV are tracked via several mechanisms including:

- GPS
- Telemetry and Radar systems
- Radio locators
- Real time on-board video
- Telescopes.



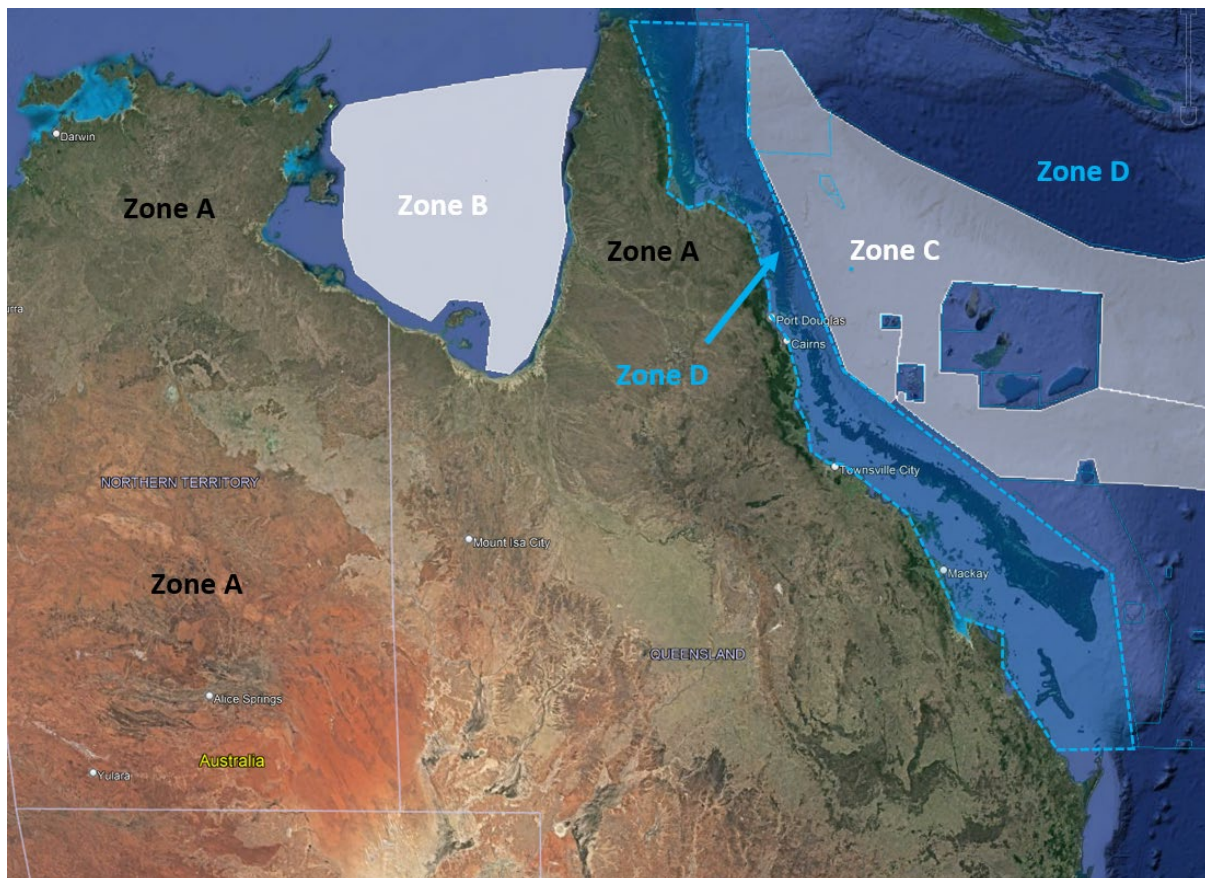
**Figure 6** Recovered first stage of BBIX launched from ASC (note lack of damage to vegetation and ground)



**Figure 7** Recovered payload and parachute from BBIX launched from ASC

**Table 9 Proposed recovery zones<sup>18</sup>**

Zone	Area	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 8 Proposed Recovery Zones**

<sup>18</sup> A concurrent referral has been made to the Commonwealth Department of Climate Change, Energy, the Environment, and Water (DCCEEW) under the EPBC Act proposing that the dropping and potential non-recovery of spent stages in Zone B and Zone C are not controlled actions requiring assessment under the Act.

### 3.2.3.8 Launch Failure

Launch failure is an uncommon occurrence, particularly in solid propellant rockets, due to the maturity of the technology. For example, BBIX rockets have been launched 308 times since they were first used in 1982, with only 7 launch failures.

The most common cause of a launch failure in sounding rockets such as BBIX is ‘fin fracture’ whereby, during the early moments of a launch, one of the stabilising fins breaks and the LV is unable to maintain its planned trajectory. The rocket will begin to move erratically, and the onboard computer will prevent the firing of further stages so that the rocket will continue until it runs out of propellant. A parachute is typically deployed, and the unspent stages and payload return to earth, usually within the vicinity of the launch facility.

For liquid rocket engines, “loss of liquid engine thrust” is the most common cause of mission failures for space launches<sup>19</sup>. More specifically, most failures involve the propulsion system, followed by the separation and attitude control systems. Causes for propulsion system failure range from debris infiltrating the propulsion feeding system, pressure rises and thermal stresses resulting in seizing of the rotor, to design flaws and degradation of materials<sup>20</sup>. In most cases, such failures lead to immediate catastrophic failures or enforced flight termination using Flight Termination Systems.

A less common type of launch failure occurs if a rocket motor over-pressurises and then explodes. If this occurs on the launch pad/rail, all debris is contained within the launch safety zone on facility site. Although classed as explosive, solid propellant does not act as an explosive – instead, the thrust comes from the burning propellant exiting a nozzle at high pressure. If uncontained, ignited solid propellant will flare and burn, but will not explode.

ELA has emergency procedures that will be implemented, including external interaction with local NT EMS, in the event of a LV anomaly, incident and failure. These procedures, including down range emergency procedures are reviewed by Australian Space Agency (ASA) and their sub-contracted engineering technical assessor as part of each Australian Launch Permit application.

### 3.2.3.9 Launch aborted

A flight termination system (FTS) will be installed on all orbital LV operated from the ASC (sounding rockets do not require these as they do not travel as far). The FTS is active throughout the whole flight and can terminate the flight in the case of a critical deviation from the planned trajectory. The FTS can be used to cause the vehicle to self-destruct, but in most cases cut off engine thrust and purge oxidiser tanks (e.g., LOX tank).

In the event of delay and scrub (cancelled launch procedure) the LV will be de-fueled at ASC and re-set for repeat countdown the following day (pending weather and resolution of any system issues).

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<sup>19</sup> <http://thespacereview.com/article/2208/1>

<sup>20</sup> Fernández, L.A., Wiedemann, C. & Braun, V. *Analysis of Space Launch Vehicle Failures and Post-Mission Disposal Statistics*. Aerotec. Missili Spaz. 101, 243–256 (2022). <https://doi.org/10.1007/s42496-022-00118-5>

## 4. APPLICATION OF PRINCIPLES OF ENVIRONMENT PROTECTION AND MANAGEMENT

ELA has an obligation to apply the principles of environment protection and management (Part 2 EP Act) and a general duty (section 43) to apply the principles of ecologically sustainable development, the environmental decision-making hierarchy, and the waste management hierarchy. These are discussed in Table 10.

**Table 10 Principles of environment protection and management applied to the ASC**

Section 43 General duty	Comment
<p><i>The following principles of ecologically sustainable development must be taken into consideration in the design of the proposed action</i></p>	
<p>Decision-making principle</p>	<p>The EP Act notes, in relation to the decision-making principle, that:</p> <ul style="list-style-type: none"> <li>• Decision making processes should effectively integrate both long term and short term environmental and equitable considerations</li> <li>• Decision making processes should provide for community involvement in relation to decisions and actions that affect the community</li> </ul> <p>ELA continues to purposefully engage with legitimate representatives of the Traditional owners of the land of northeast Arnhem Land (Miwatj), including Gumatj Aboriginal Corporation, Dhimurru Aboriginal Corporation, Laynhapuy Aboriginal Corporation and the Northern Land Council (see section 5), to ensure that decisions regarding the establishment and operation of the ASC do not adversely impact the community or country and that it adds to community economic wellbeing and social outcomes.</p> <p>ELA continues to coordinate with the NT EPA and Commonwealth environmental agencies to ensure that decisions regarding the construction and operation of the ASC will meet all required environmental considerations.</p>
<p>Precautionary principles</p>	<p>The EP Act explains in relation to the precautionary principle that:</p> <ul style="list-style-type: none"> <li>• If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</li> <li>• Decision making should be guided by: <ul style="list-style-type: none"> <li>○ A careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; and</li> <li>○ An assessment of the risk weighted consequences of various options.</li> </ul> </li> </ul> <p>ELA continues to evaluate the potential environmental damage that could occur through actions or activities associated with the ASC in the design, construction, or operational phases. ELA will not undertake any activity where there is a threat of serious or irreversible environmental damage and would support scientific enquiry where there is the potential for serious or irreversible environmental damage before seeking to undertake that activity.</p>

Section 43 General duty	Comment
Principle of evidence-based decision-making	<p>The EP Act explains, in relation to the principle of evidence-based decision making, that decisions should be based on the best available evidence in the circumstances that is relevant and reliable.</p> <p>ELA is committed to ensuring that the design, construction, and operation of the ASC is based on the best available scientific and technical evidence to ensure environmental protection and sustainable operation of the facility in the NT.</p>
Principle of intergenerational and intragenerational equity	<p>The EP Act explains, in relation to the principle of intergenerational and intragenerational equity, that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.</p> <p>ELA is committed to the principle of intergenerational and intragenerational equity and will ensure that its activities do not affect the health, diversity, or productivity of the environment. ELA continues to engage with legitimate representative of the Indigenous owners of the land to ensure protection of the environment for this purpose.</p>
Principle of sustainable use	<p>The EP Act explains, in relation to the principle of sustainable use, that natural resources should be used in a manner that is sustainable, prudent, rational, wise, and appropriate.</p> <p>Development of Phase 2 of the ASC will require the clearance of a defined amount of native regrowth vegetation. Cleared vegetation will be made available for use by the Traditional landowners or be used for rehabilitation (by mulching) or ground habitat (woody debris) purposes on site by agreement and Development Approval.</p>
Principle of conservation of biological diversity and ecological integrity	<p>The EP Act explains, in relation to the principle of conservation of biological diversity and ecological integrity, that biological diversity and ecological integrity should be conserved and maintained.</p> <p>ELA understands that the vegetation community within the ASC leasehold area has a conservation rating of “least concern” under the <i>Territory Parks and Wildlife Conservation Act 2000</i> because of its extent and capacity for recovery following damage. ELA also understands that there are unlikely to be critical habitats for threatened species within the area to be developed. Nevertheless, ELA will ensure that the least possible vegetation will be cleared.</p> <p>ELA understands that biological and ecological values outside of the ASC are significant and will ensure that its rocket launches and retrievals do not adversely affect their conservation and maintenance.</p>
Principle of improved valuation, pricing, and incentive mechanisms	<p>The EP Act explains, in relation to the principle of improved valuation, pricing, and incentive mechanisms, that environmental factors should be included in the value of assets and services, and that persons who generate pollution and waste should bear the costs of containment, avoidance, and abatement. It also explains that users of goods and services should pay prices based on the full life cycle costs of providing the goods and services, and that established environmental goals should be pursued in the most cost-effective way.</p>

Section 43 General duty	Comment
	<p>ELA has negotiated the lease of the area from its freehold owners and is contractually bound to paying a fair market rate for the lease over its term.</p> <p>Where appropriate, ELA will revegetate disturbed areas with appropriate native species where these areas do not have a necessary function in the operation of the ASC, and where vegetation will not be a hazard (e.g., bushfire risk) to human or environmental safety.</p> <p>ELA will be responsible for the containment of all fuels used onsite and for environmental repair in the event of a catastrophic spillage of liquid or solid fuel onsite.</p>
<p><i>The following management hierarchies must be taken into consideration in the design of the proposed action</i></p>	
<p>Environmental decision-making hierarchies</p>	<p>In making decisions regarding the design, construction, and operation of the ASC, ELA will, in accordance with the EP Act:</p> <ol style="list-style-type: none"> <li>1. Ensure that actions are designed to avoid adverse impact on the environment</li> <li>2. Identify management options to mitigate adverse impacts on the environment, where these are identified and unavoidable, to the greatest extent practicable</li> <li>3. Provide environmental offsets for residual adverse environmental impacts where these cannot be avoided or mitigated.</li> </ol> <p>An environmental management plan has been developed for the ASC (ELA-000035).</p>
<p>Waste management hierarchy</p>	<p>ELA will apply the waste management hierarchy as far as is practicable given the remote location of the ASC. A waste management plan has been developed for the ASC (ELA-000039).</p> <p>Priority will be given to avoiding the generation of waste through procurement decisions where possible. Back loading of waste packaging to equipment and material suppliers for recycling will be explored. Hazardous waste, if generated, will be contained, and transported securely to a licenced waste disposal facility elsewhere in the Northern Territory. Organic waste produced onsite will be composted. The aim is to treat wastewater on site and where not able to be treated, disposed of appropriately to approved disposal facility elsewhere in local area. Options for repurposing of suitable waste materials for local artistic or economic use will be explored with the local community.</p>
<p><i>Other Section 43 considerations</i></p>	
<p>Has climate and climate change been accounted for in the proposal?</p>	<p>Current and projected weather patterns and the increased likelihood of extreme conditions may pose a material risk to the successful and safe operation of the ASC.</p> <p>The site is in a tropical monsoonal area of Australia and has a defined wet season and dry season. Tropical cyclones are common during the wet season and during the transition to and from the wet season, and many have formed</p>

Section 43 General duty	Comment
	<p>and tracked within 400 km of the ASC in recent history. ASC operations are anticipated to be focused during the dry season, however, launch campaigns are expected to be planned for wet season. Typical dry season weather conditions are unlikely to have a material impact on the operation of the ASC if operations and infrastructure are designed and managed appropriately. Wet season operations will need to account for increased logistical challenges due to road closures and manage LV weather thresholds, but as demonstrated at international space ports, this can be done safely.</p> <p>Climate change projections suggest that there may be material risks to human health, infrastructure, and successful operations of the ASC that will need to be managed. For example, extreme heatwave conditions may impact:</p> <ul style="list-style-type: none"> <li>• Launch and fuel infrastructure</li> <li>• Launch operations</li> <li>• Human health and well being.</li> </ul> <p>Similarly, more intense tropical storms and cyclones may impact:</p> <ul style="list-style-type: none"> <li>• Launch and fuel infrastructure</li> <li>• Launch operations</li> <li>• Human health and well being</li> <li>• Critical offsite infrastructure and supply chain.</li> </ul> <p>ELA will:</p> <ul style="list-style-type: none"> <li>• Establish extreme weather warning systems and procedures</li> <li>• Ensure that infrastructure is designed and constructed to cope with extreme temperatures and withstand projected tropical storms and cyclonic conditions</li> <li>• Develop standard operating procedures to ensure capacity to cancel and pack down a launch in progress, and safely defuel rockets, in the event of a rapidly developing storm</li> <li>• Ensure that facilities are available to ensure human health and well-being during extreme weather conditions or events</li> <li>• Cooperate with Dhimurru Aboriginal Corporation, East Arnhem Regional Council, local emergency services, and NT Government in the event of a climate emergency requiring a coordinated and/or collaborative response.</li> </ul>
<p>Have communities that may be affected by the proposed action been provided with information and opportunities for consultation?</p>	<p>ELA has purposefully consulted with the Indigenous community through legitimate representatives and has established a process for information and knowledge sharing.</p>
<p>Has consultation with affected communities, including Aboriginal communities' been undertaken in a culturally appropriate manner?</p>	<p>ELA has purposefully consulted with the Indigenous community through legitimate representatives and seeks to be always culturally appropriate. Opportunities for cultural awareness training of staff and clients will be explored in consultation with the Indigenous community.</p>

Section 43 General duty	Comment
<p>Has community knowledge and understanding (including scientific and traditional knowledge and understanding) of the natural and cultural values of areas that may be impacted by the proposed action been sought and documented?</p>	<p>ELA has made use of scientific and traditional knowledge generated and documented as part of the approvals process for the Gulkula Mine. ELA will continue to work with Indigenous Rangers and landowners to ensure that natural and cultural values that may potentially be impacted by ASC activities are avoided or managed appropriately.</p>
<p>Have Aboriginal values and the rights and interests of Aboriginal communities' been addressed in relation to areas that may be impacted by the proposed action?</p>	<p>ELA has purposely engaged with legitimate representatives of the Indigenous Owners of the land leased for the ASC to ensure that their rights and interests are not adversely impacted by ASC activities.</p>

## 5. CONSULTATION AND STAKEHOLDER ENGAGEMENT

ELA has successfully consulted and engaged with a range of stakeholders since project inception and in obtaining the original lease from the Aboriginal owners via Northern Land Council and original NOI from NT EPA. Table 11 provides a summary of the people and organisations that have been consulted as well as the method/s, frequency, and key outcomes from these consultations.

Following on from the successful NOI assessment, there have been limited key matters raised through the ongoing forums (Table 11). These are summarised below:

- Will ELA to continue to meet required regulatory approvals, apply all necessary AS/NZ standards?
  - ELA in progress with Australian Space Agency to re-scope the Launch Facility Licence to support wider Phase 2 to launch operations (wider range of vehicles, fuel types and trajectories)
  - ELA plans conform to all AS/NZ standards as required
- Does ASC have environmental approval and will ELA continue to apply the principles of environmental protection and management, and implement environmental management plans to avoid or mitigate impact on significant environmental factors?
  - Updated and detailed Air emissions analysis and climate risk review as well as lessons learned from NASA (air monitoring conducted), and feedback through consultations guided updated NT EPA Referral and EPBC Referrals, currently in progress
- Will anything land on a Sacred Site?
  - Protocols created as part of NASA launch campaign remain in place and are supported by TO groups
- Will anything land on people / are we safe?
  - Each launch must pass and conform to the public safety review of the Australian Space Agency regulatory review of Australian Launch Permit for each launch to proceed

Of importance, there was very strong positive feedback from local TO groups in ELA's approach in conducting the recurring Safety and Retrieval Committee. This regular meeting focusing on how launch may impact local TO groups, incorporates the key local Traditional Owner groups and during each launch campaign is extended to the impacted down range (impact area) stakeholders. ELA also conducts regular visits to Darwin and Gove to purposefully engage and update key stakeholders and agency groups above on company progress and next launch planning.

**Table 11 Stakeholder Engagement**

Stakeholder	Consultation Method/s - Frequency	Option/s for feedback	Key Improvements Made as Result
<b>Northern Land Council, including community consultation at a regional level</b>	<ol style="list-style-type: none"> <li>1. Lease workshops – once off face to face and virtual</li> <li>2. Standing invite to ASC Safety and Retrieval Committee – recurring bi-monthly to weekly into launch</li> <li>3. ELA visits to Darwin to update on operations and future lease considerations – every 6 months</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>• Through meetings and workshop forums</li> <li>• Direct to Gumatj and ELA if required</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive regional engagement and consultation on new/updated lease and ELA proposed operations</li> </ul>
<b>Traditional Owners</b> <ul style="list-style-type: none"> <li>• <b>Gumatj Aboriginal Corporation</b></li> <li>• <b>Dhimurru Aboriginal Corporation</b></li> <li>• <b>Laynhapuy Homelands Aboriginal Corporation</b></li> <li>• <b>Rirratjingu Aboriginal Corporation</b></li> <li>• <b>Mimal Aboriginal Corporation</b></li> <li>• <b>Afura Swamp Rangers</b></li> </ul>	<ol style="list-style-type: none"> <li>1. Lease consultations (facilitated by NLC with Gumatj, ELA support where required) – one off face to face and virtual</li> <li>2. Standing invite to ASC Safety and Retrieval Committee – recurring bi-monthly to weekly into launch</li> <li>4. ELA visits to Nhulunbuy and local TO group head offices – every 6 months and more frequently as required leading into launches</li> <li>5. ELA visit to down range impacted areas (e.g. Numbulwar) to present at Annual IPA Meetings, Board Meetings or to Rangers – as required/requested leading into launch</li> <li>6. Hosted Senior Rangers attending at ASC before and during NASA launches for helping increase knowledge and understand what ELA is doing – as required/requested</li> <li>7. Invited to local awareness 'open day' at ASC or in Nhulunbuy as new Client launches become known – as required</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>• Through meetings and workshop forums</li> <li>• Direct to ELA if required</li> <li>• Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Through workshops with this stakeholder group, ELA created and improved down range land access and recovery protocols.</li> <li>• ELA employed Mimal Rangers to support NASA launch campaign</li> <li>• Visit to Numbulwar for SEAL IPA Annual Meeting helped share info and create positive support for access to down range for NASA recovery</li> <li>• All TO Groups supportive of ELA business</li> <li>• Planned adjustments to ELA launch schedule to not impact Garma Festival</li> </ul>

Stakeholder	Consultation Method/s - Frequency	Option/s for feedback	Key Improvements Made as Result
<ul style="list-style-type: none"> <li>Southern East Arnhem Limited (SEAL) IPA Aboriginal Corporation</li> </ul>			
<b>Nhulunbuy Town Board</b>	<ol style="list-style-type: none"> <li>Lease consultations (facilitated by NLC with Gumatj, ELA support where required) – once off face to face and virtual</li> <li>ELA visits to Nhulunbuy – as required during lead up to launch</li> <li>Membership as required at Community Launch Coordination Working Group (facilitated in partnership with DEAL) – as required leading into new Launch campaigns</li> <li>Invited to local awareness ‘open day’ at ASC as new Client launches become known – as required</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>Through Launch coordination meetings</li> <li>Direct to ELA if required</li> <li>Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>Awareness and support of ELA plans and launches</li> <li>Town readiness support for ELA and Launch Client accommodation, transport, and hospitality needs</li> </ul>
<b>Electorate Nhulunbuy</b>	<ol style="list-style-type: none"> <li>Lease consultations (facilitated by NLC with Gumatj, ELA support where required) – once off face to face and virtual</li> <li>By direct invite by ELA to ASC for briefing on ELA operations – as required/requested during lead up to launch</li> <li>Invited to local awareness ‘open day’ at ASC as new Client launches become known – as required</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>Direct to ELA if required</li> <li>Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>Awareness and support of ELA plans and launches</li> </ul>
<b>East Arnhem Land Tourism Association</b>	<ol style="list-style-type: none"> <li>Lease consultations (facilitated by NLC with Gumatj, ELA support where required) – once off face to face and virtual</li> <li>ELA visits to Nhulunbuy – as required during lead up to launch</li> <li>Membership as required at Community Launch Coordination Working Group (facilitated in partnership with DEAL) – as required leading into new Launch campaigns</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>Through Launch coordination meetings</li> <li>Direct to ELA if required</li> <li>Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>Awareness and support of ELA plans and launches</li> <li>Town readiness support for ELA and Launch Client accommodation, transport and hospitality needs</li> </ul>

Stakeholder	Consultation Method/s - Frequency	Option/s for feedback	Key Improvements Made as Result
	4. Invited to local awareness 'open day' at ASC as new Client launches become known – as required		
<b>East Arnhem Regional Council – local authorities in Yirrkala and Gunyangara</b>	<ol style="list-style-type: none"> <li>1. Lease consultations (facilitated by NLC with Gumatj, ELA support where required) – once off face to face and virtual</li> <li>2. By direct invite by ELA to ASC for briefing on ELA operations – as required/requested during lead up to launch</li> <li>3. Invited to local awareness 'open day' at ASC as new Client launches become known – as required</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>• Direct to ELA if required</li> <li>• Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness and support of ELA plans and launches</li> </ul>
<b>Regional Economic Development Committee</b>	<ol style="list-style-type: none"> <li>1. Lease consultations (facilitated by NLC with Gumatj, ELA support where required) – once off face to face and virtual</li> <li>2. ELA visits to Nhulunbuy – as required/requested by Committee during lead up to launch</li> <li>3. Membership as required at Community Launch Coordination Working Group (facilitated in partnership with DEAL) – as required leading into new Launch campaigns</li> <li>4. Invited to local awareness 'open day' at ASC as new Client launches become known – as required</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>• Through Launch coordination meetings</li> <li>• Direct to ELA if required</li> <li>• Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness and support of ELA plans and launches</li> <li>• Town readiness support for ELA and Launch Client accommodation, transport and hospitality needs</li> </ul>
<b>ARDS Aboriginal Corporation</b>	<ol style="list-style-type: none"> <li>1. Engaged to translate ELA Launch information (FAQs, Radio script, posters) into Yolŋu Matha</li> <li>2. Engaged to release radio announcements in Yolŋu Matha to East Arnhem area with launch information</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>• Through design and building of ELA TO native language materials</li> </ul>	<ul style="list-style-type: none"> <li>• Wider spread awareness of ELA plans and launches</li> <li>• Strong local TO support for ELA</li> <li>• ELA staff participate in online cultural awareness program</li> </ul>
<b>Dean Balach, Consultant Space Launch Range Safety Officer</b>	<ol style="list-style-type: none"> <li>1. Initial engagement as part of original NOI consultation</li> </ol>	N/A – report helped inform initial NOI consultations	<ul style="list-style-type: none"> <li>• Analysis supported viability of ELA business plan for spaceport in East Arnhem</li> </ul>

Stakeholder	Consultation Method/s - Frequency	Option/s for feedback	Key Improvements Made as Result
<b>NASA SRPO Range Safety Assessor</b>	1. Initial engagement as part of original NOI consultation	N/A – report helped inform initial NOI consultations	<ul style="list-style-type: none"> <li>• Analysis supported viability of ELA business plan for spaceport in East Arnhem</li> </ul>
<b>NT EPA</b>	1. ELA visits to Darwin to update on operations and future Environmental considerations - every 6 months	Yes: <ul style="list-style-type: none"> <li>• Guidance through meetings</li> <li>• Direct to ELA via NOI or Referral processes</li> </ul>	<ul style="list-style-type: none"> <li>• Guidance supported shaping of updated NT EPA Referral and also EPBC Referral</li> </ul>
<b>Aboriginal Authority Protection Agency (AAPA)</b>	1. Lease Authority Certificate consultations– once off face to face and virtual 2. ELA visits to Darwin to update on operations and future landing area launch and Sacred Site considerations - every 6 months/as required for launch	Yes: <ul style="list-style-type: none"> <li>• Guidance through meetings</li> <li>• Direct to ELA via Authority Certificate processes</li> </ul>	<ul style="list-style-type: none"> <li>• Refined process to seek an Authority Certificate for when launch vehicle debris may land in the NT</li> </ul>
<b>Northern Territory Seafood Council</b>	1. N/A – report helped inform initial NOI consultations	<ul style="list-style-type: none"> <li>• N/A – report helped inform initial NOI consultations</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness and support of ELA plans and launches</li> </ul>
<b>Gove Airport</b>	1. By direct invite by ELA to ASC for briefing on ELA operations – as required/requested during lead up to launch 2. Invited to local awareness 'open day' at ASC as new Client launches become known – as required	Yes: <ul style="list-style-type: none"> <li>• Direct to ELA if required</li> <li>• Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Supported helicopter recovery coordination</li> </ul>
<b>Gulkula Mine</b>	1. By direct invite by ELA to ASC for briefing on ELA operations – as required/requested during lead up to launch 2. Invited to local awareness 'open day' at ASC as new Client launches become known – as required 3. Emergency planning and support – as required	Yes: <ul style="list-style-type: none"> <li>• Direct to ELA if required</li> <li>• Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Supported site access and</li> <li>• lending of key machinery during Phase 1 construction</li> </ul>
<b>Rio Tinto Gove Operations</b>	1. By direct invite by ELA to ASC for briefing on ELA operations – as required/requested during lead up to launch	Yes: <ul style="list-style-type: none"> <li>• Direct to ELA if required</li> </ul>	<ul style="list-style-type: none"> <li>• Supported lending of key machinery during Phase 1 construction</li> </ul>

Stakeholder	Consultation Method/s - Frequency	Option/s for feedback	Key Improvements Made as Result
	2. Invited to local awareness 'open day' at ASC as new Client launches become known – as required	<ul style="list-style-type: none"> <li>• Open day feedback</li> </ul>	
<b>Developing East Arnhem Land (DEAL)</b>	<ol style="list-style-type: none"> <li>1. Lease consultations (facilitated by NLC with Gumatj, ELA support where required) – once off face to face and virtual</li> <li>2. ELA visits to Nhulunbuy – as required/requested by DEAL during lead up to launch</li> <li>3. Lead role and support at Community Launch Coordination Working Group (facilitated in partnership with ELA) – as required leading into new Launch campaigns</li> <li>4. Invited to local awareness 'open day' at ASC as new Client launches become known – as required</li> </ol>	<p>Yes:</p> <ul style="list-style-type: none"> <li>• Through Launch coordination meetings</li> <li>• Direct to ELA if required</li> <li>• Open day feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness and support of ELA plans and launches</li> <li>• Town readiness support for ELA and Launch Client accommodation, transport and hospitality needs</li> </ul>
<b>NT Worksafe</b>	1. By direct invite by ELA to ASC for briefing on ELA operations and ELA's Work Health and Safety System – as required/requested during lead up to launch	<p>Yes:</p> <ul style="list-style-type: none"> <li>• Direct to ELA if required</li> </ul>	<ul style="list-style-type: none"> <li>• Review and feedback on ELA's WHS documentation and procedures.</li> </ul>

## 6. ENVIRONMENTAL FACTORS AND OBJECTIVES

The NT EPA has identified 14 environmental factors categorised under five themes that may be impacted by a proposed action. An environmental objective has been developed for each factor that reflects the expected outcomes for these parts of the environment. Assessment of a proposed action against these factors and objectives is used to determine if there is a potential for significant impact on these factors. These are summarised in Table 12 and discussed further in the following sections.

**Table 12 Environmental factors and potential impact**

Theme	Factor and Objective	Potential for impact	Significance of impact
LAND	<b>Landforms</b> Conserve the variety and integrity of distinctive physical landforms	There are no distinctive landforms within the project footprint. Refer section 6.1.	Nil
	<b>Terrestrial environmental quality</b> Protect the quality and integrity of land and soils so that environmental values are supported and maintained	There is the potential for localised impact through: <ul style="list-style-type: none"> <li>erosion of exposed soil</li> <li>contamination of soil by water from launch deluge system</li> <li>contamination of soil by spilt fuel.</li> </ul> Refer section 6.1.	Low
	<b>Terrestrial ecosystems</b> Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity, and ecological functioning	There is the potential for localised impact on terrestrial vegetation through: <ul style="list-style-type: none"> <li>land clearing for site expansion</li> <li>direct hit from failed rocket launch causing crushing, fire, or fuel spill</li> <li>introduction of weeds and pests by construction and operational activities</li> <li>fire ignited through operational activities.</li> </ul> Refer section 6.3.	Low
WATER	<b>Hydrological processes</b> Protect the hydrological regimes of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are maintained	There is the potential for localised impact on surface water hydrological processes through: <ul style="list-style-type: none"> <li>harvesting of storm water during the wet season for use in the launch deluge system and other onsite uses.</li> </ul> Refer section 6.4.	Low
	<b>Inland water environmental quality</b> Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are maintained.	There is the potential for localised impact on inland water quality through: <ul style="list-style-type: none"> <li>liquid fuel spills entering intermittent waterways during the wet season</li> <li>contaminated water from launch deluge system entering intermittent waterways during the wet season.</li> </ul> Refer section 6.5.	Low
	<b>Aquatic ecosystems</b> Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	There is the potential for localised impact on aquatic ecosystems through: <ul style="list-style-type: none"> <li>liquid fuel spills entering intermittent waterways during the wet season</li> <li>contaminated water from launch deluge system entering intermittent waterways during the wet season.</li> </ul> Refer section 6.6.	Low
SEA	<b>Coastal processes</b> Protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained.	Project activities will not interact with coastal processes. Refer section 6.7.	Nil
	<b>Marine environmental quality</b> Protect the quality and productivity of water, sediment, and biota so that environmental values are maintained.	There is no potential for localised impact on marine environmental quality. Refer section 6.8.	Low

Theme	Factor and Objective	Potential for impact	Significance of impact
	<b>Marine ecosystems</b> Protect marine habitats to maintain environmental values including biodiversity, ecological integrity, and ecological functioning	There is no potential for localised impact on marine ecosystems. Refer section 6.9.	Low
AIR	<b>Air quality</b> Protect air quality and minimise emissions and their impact so that environmental values are maintained	There is the potential for impact on air quality through: <ul style="list-style-type: none"> <li>exhaust emissions from combustion of rocket fuel.</li> </ul> Refer section 6.10.	Low
	<b>Atmospheric processes</b> Minimise greenhouse gas emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050	There is the potential for impact on the NT Government's goal of net zero greenhouse gas emissions through: <ul style="list-style-type: none"> <li>combustion of diesel for construction activities and generation of electricity</li> <li>combustion of rocket fuels.</li> </ul> Refer section 6.11.	Low
PEOPLE	<b>Community and Economy</b> Enhance communities and the economy for the welfare, amenity, and benefit of current and future generations of Territorians.	There is the potential for a positive local impact on the community and economy of the region through: <ul style="list-style-type: none"> <li>Engagement with the local indigenous community in economic, educational, and social activities</li> <li>Creation of new high technology industry in a remote area of the Northern territory</li> <li>Leasing of land from the Arnhem Land Aboriginal Land Trust</li> <li>Working with schools and other educational institutions.</li> </ul> Refer section 6.12.	Med
	<b>Culture and heritage</b> Protect culture and heritage	There will be no impact on the culture and heritage of the Yolngu/Gumatj indigenous community of the region because: <ul style="list-style-type: none"> <li>Positive engagement and community consultation in development of the original ASC</li> <li>Agreement to lease land from the Gumatj Corporation and the Northern Land Council</li> <li>Ongoing consultation and engagement with the indigenous community.</li> </ul> Refer section 6.13.	Nil
	<b>Human health</b> Protect the health of the Northern territory population	There will be no impact on the health of the Northern Territory population as: <ul style="list-style-type: none"> <li>Standard operating procedures minimise likelihood of population contact with vehicle and rocket fuels</li> <li>Project activities do not involve meaningful sources of radiation (very small sources may be used in scientific instrumentation).</li> </ul> Refer section 6.14.	Low

## 6.1 Landforms

The purpose of this section is to conserve the variety and integrity of distinctive physical landforms.

### 6.1.1 Environmental Values

The Dhupuma Plateau is a distinctive physical landform on a regional scale. Bauxite and lateritic boulders cover most of the Plateau, and soils are very shallow or non-existent.

### 6.1.2 Potential Direct Impacts

Construction and operation of the ASC will not have any direct impact on distinctive physical landforms within the site boundary (landscape scale) as the majority of the area has previously been mined and rehabilitated.

### 6.1.3 Potential Cumulative Impacts

Construction and operation of the ASC will not have any cumulative impact on distinctive physical landforms within the site boundary (landscape scale) as most of the area has previously been mined and rehabilitated.

### 6.1.4 Environment Protection and Management

ELA will ensure that appropriate permits for earthworks are obtained under the *Planning Act 1999* and that earthworks will be controlled to minimise disturbance to landforms at the landscape scale.

## 6.2 Terrestrial Environmental Quality

The purpose of this section is to ensure that the quality and integrity of land and soil is protected so that environmental values are supported and maintained.

### 6.2.1 Environmental Values

The soils of the Dhupuma Plateau are very shallow or non-existent. Soils, where they occur, are a thin A-horizon with low organic content, very low nutrient content, and very low biological activity. The soils are characterised by hydrated oxides of iron and aluminium which remain following leaching of other elements.

The Plateau is covered with bauxite and lateritic boulders, and lateritic bauxite deposits underlie the surface in some areas.

### 6.2.2 Potential Direct Impacts

The potential for direct impact on the soil and land is considered low because of the low occurrence of soil in the area. However, where soils occur, they could:

- Be subject to erosion following rainfall or wind events if exposed by vegetation clearance or construction activities
- Be contaminated by accidental diesel or other liquid fuel spills
- Be contaminated by accidental overflow from the launch deluge system.

### 6.2.3 Potential Cumulative Impacts

The potential for cumulative impact on the soil and land is considered low because of the low occurrence of soil in the area. However, contaminants from diesel and the launch deluge system could build up in the soil if accidental spillage is not avoided or remediated.

### 6.2.4 Environment Protection and Management

ELA will ensure that:

- A site erosion control plan is developed
- Native vegetation clearance will occur only as permitted and the extent of clearance will be minimised

- Soil cleared for construction activities will be stockpiled and used for remediation and revegetation where appropriate
- Open site drainage channels will feed into the dam rather than ephemeral channels leading offsite
- Diesel and liquid fuel tanks will be constructed on an impermeable surface and be surrounded by a low bund to contain spills during fueling and refueling
- Seals and connection points between diesel tanks and generators, and other liquid fuel tanks, are inspected periodically and maintained to avoid leakage
- A fuel spill remediation kit is maintained on site
- The launch deluge system is designed as a contained reticulating system with filtration to remove dissolved products of combustion, and periodic clearance of contaminated sediment for removal and disposal at an approved facility.

## 6.3 Terrestrial Ecosystems

The purpose of this section is to protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity, and ecological functioning.

### 6.3.1 Environmental Values

Surveys conducted for the adjacent Dhupuma Plateau Bauxite Mine have determined that the endemic Darwin stringybark (*Eucalyptus tetradonta*) shrubby woodlands with tussock grass understory are the dominant vegetation type, with a community of some 300 native plant species (Mitchell 2015, Wills and Annandale 2017). Darwin stringybark is classified as “least concern” under the *Territory Parks and Wildlife Conservation Act 2000*. None of the species recorded in the area are listed as threatened under NT or Commonwealth legislation.

Ninety-seven native fauna species have been recorded in the area in surveys conducted for the adjacent Dhupuma Plateau Bauxite Mine (EcoSmart Ecology 2015). Two of these, the Gove Crow Butterfly, and the Black-footed Tree-rat, are listed as threatened under the EPBC Act.

The area is subject to periodic disturbance by cyclones and fires and swathes of woodland are regenerating in areas subject to both natural and human disturbance.

The area has a low incidence of significant environmental weeds.

### 6.3.2 Potential Direct Impacts

The potential for direct impact on terrestrial habitats is localised and may occur through:

- Vegetation clearing for site expansion
- Introduction of weeds and pests by construction and operational activities
- Fire ignited through operational activities
- Direct hit from failed rocket launch causing crushing, fire, or fuel spill.

### 6.3.3 Potential Cumulative Impacts

The potential for cumulative impact on terrestrial habitats is considered low because:

- Vegetation clearance will be limited
- Periodic disturbance is a feature of the landscape and ecosystem, and the surrounding vegetation is in a constant state of regeneration

- Weed control can prevent the establishment of weeds of significance
- On-site fire control will prevent accidental fires spreading off-site
- The incidence of failed rocket launches is likely to be very low and provision will be made for any remediation required where appropriate.

### 6.3.4 Environment Protection and Management

ELA will ensure that:

- Native vegetation clearance will occur only as permitted and the extent of clearance will be minimised
- Consultation with local Indigenous Rangers and other experts if required is undertaken to identify if critical habitat for Gove Crow Butterfly and the Black-footed Tree-rat occurs onsite
- Vegetation to be cleared is clearly defined to ensure that clearance of critical habitat and clearance of excess vegetation is avoided
- A weed control strategy is developed and implemented
- A fire response and control strategy is developed and implemented
- Agreement is reached with the Dhimurru Aboriginal Corporation and Northern Land Council if required regarding the appropriate response and remediation required in the event of a failed rocket launch leading to vegetation damage.
- ELA will notify the EPA if LV debris is left behind through the Section 14 reported incidents process, if required.

## 6.4 Hydrological Processes

The purpose of this section is to protect the hydrological regimes of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are maintained.

### 6.4.1 Environmental Values

The Dhupuma Plateau is a watershed for several catchments, including waterways that drain into the Latram and Giddy Rivers, and which drain into Melville Bay and the Gulf of Carpentaria. The project area is located within the Gulkula water catchment (~ 8,500 hectares) flowing south into Port Bradshaw. There are no drainage lines in the project area or formally named streams in the vicinity of the project area. Surface water sheds off the plateau in sheet flows or via ephemeral channels.

Annual average rainfall is 1,450 mm as measured at Gove Airport (BoM station 14508). This equates to 5,075 – 5,800 ML falling on the ASC Phase 2 site per annum, and ~ 123,250 ML falling in the watershed per annum, mainly during the wet season.

Surveys conducted for the adjacent Dhupuma Plateau Bauxite Mine have determined that groundwater occurred 17–19 m below the surface in one area but was generally >40 m below the ground surface. Drainage from these groundwater sources tends to reflect topography and is assumed to recharge rivers at lower levels.

### 6.4.2 Potential Direct Impacts

ELA intends to harvest and store approximately 1,700 ML of rainwater during the wet season to supply the reticulated launch deluge system. A license will be sought under the *Water Act 1992* as appropriate for this purpose. The volume of water to be harvested relative to the volume of water dropped on the Plateau during the rainy season is negligible. Therefore, the harvesting of water is unlikely to have a measurable or significant effect on the hydrology of receiving waterways.

### 6.4.3 Potential Cumulative Impacts

The volume of water to be harvested relative to the volume of water dropped on the Plateau during the rainy season is negligible. Therefore, the harvesting of water is unlikely to have a measurable or significant cumulative effect on the hydrology of receiving waterways.

### 6.4.4 Environment Protection and Management

ELA will ensure that a licence is obtained to harvest and store rain and stormwater during the rainy season and extract water from a bore when necessary, during the dry season.

## 6.5 Inland Water Environmental Quality

The purpose of this section is to protect the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are maintained.

### 6.5.1 Environmental Values

The Dhupuma Plateau is a watershed for several catchments, including waterways that drain into the Latram and Giddy Rivers, and which drain into Melville Bay and the Gulf of Carpentaria. Natural drainage channels from the ASC site are largely non-existent, flowing only during the wet season after heavy rainfall. These waterways are likely to have water of relatively high quality due to their lack of modification.

### 6.5.2 Potential Direct Impacts

The potential for direct impact on groundwater and surface water is localised and could occur through:

- Spilt liquid fuels entering ephemeral waterways during the wet season
- Contaminated launch deluge water entering ephemeral waterways during the wet season.

### 6.5.3 Potential Cumulative Impacts

The potential for cumulative impact is low as an event causing contaminants to enter waterways would be discrete and would be halted immediately.

### 6.5.4 Environment Protection and Management

ELA will ensure that Standard Operating procedures and containment systems for diesel and other liquid fuels and the launch deluge system are designed to:

- Capture spillage occurring during the dry season (see section 6.2.4)
- Cope with high water flows during the wet season.

## 6.6 Aquatic Ecosystems

The purpose of this section is to protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity, and ecological functioning.

### 6.6.1 Environmental Values

The Dhupuma Plateau is a watershed for several catchments, including waterways that drain into the Latram and Giddy Rivers, and which drain into Melville Bay and the Gulf of Carpentaria. Natural drainage channels from the

ASC site are ephemeral or intermittent, flowing only during the wet season after heavy rainfall. These waterways are likely to provide habitat of high quality due to their lack of modification.

### **6.6.2 Potential Direct Impacts**

The potential for direct impact on aquatic ecosystems and habitats is localised and could occur through:

- Spilt liquid fuels entering ephemeral waterways during the wet season
- Contaminated launch deluge water entering ephemeral waterways during the wet season.

### **6.6.3 Potential Cumulative Impacts**

The potential for cumulative impact is low as an event causing contaminants to enter waterways would be discrete and would be halted immediately.

### **6.6.4 Environment Protection and Management**

ELA will ensure that Standard Operating Procedures and containment systems for diesel fuel and the launch deluge system are designed to:

- Capture spillage occurring during the dry season (see Section 6.2.4)
- Cope with high water flows during the wet season.

## **6.7 Coastal Processes**

This section is to protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained.

### **6.7.1 Potential Direct Impacts**

This project will not have any direct impact on coastal geophysical and hydrological processes.

### **6.7.2 Potential Cumulative Impacts**

This project will not have any cumulative impact on coastal geophysical and hydrological processes.

### **6.7.3 Environmental Protection and Management**

No management action is required by ELA.

## **6.8 Marine Environmental Quality**

This section is to protect the quality and productivity of water, sediment, and biota so that environmental values are maintained.

### **6.8.1 Environmental Values**

The Gulf of Carpentaria is one of the few remaining near-pristine marine environments in the world (DSEWPac, 2012). It supports many pelagic fish species including planktivorous and schooling fish, and top predators such as shark, snapper, tuna, and mackerel, and is an important migratory route for seabirds, shore birds and marine turtles. The soft sediments of the basin are characterised by moderately abundant and diverse communities of

epifauna dominated by polychaetes, crustaceans, molluscs, and echinoderms, and primary productivity is primarily driven by cyanobacteria that fix nitrogen.

### **6.8.2 Potential Direct Impacts**

There is unlikely to be any residual liquid or solid rocket fuel left in the recoverable first stage of LV launched from the ASC as it is rapidly and fully combusted. Stages 2 and 3 of liquid fueled LV are not recovered as they will have gone orbital (and will burn up if they return through the atmosphere).

There is potential for localised impact on marine environmental quality through contamination with some types of residual liquid fuel (Table 6) in spent rocket stages that fall into the ocean. This is likely to be short-lived because:

- The quantities of residual fuel will be negligible and still contained within the fuel tank
- Small quantities of residual fuel will be rapidly diluted and decomposed
- Failed stages will be commanded to self-destruct above land, or have engines terminated and oxidizer ejected
- Rocket stages will be retrieved from the Gulf of Carpentaria and other priority marine environments as soon as is required or practicable (Table 9).

ELA have made a concurrent referral to the DCCEEW under the EPBC Act that there will be no impact on Matters of National Environmental Significance (MNES), which includes the Gulf of Carpentaria, and recommends that this is not a controlled action.

### **6.8.3 Potential Cumulative Impacts**

There is low potential for cumulative impact on marine environmental quality through contamination with residual liquid fuel in spent rocket stages that fall into the ocean because:

- The quantities of residual fuel will be limited and likely to be still contained within the fuel tank
- Small quantities of residual fuel will be rapidly diluted
- Failed stages will be commanded to self-destruct above land, or have engines terminated and oxidizer ejected
- Rocket stages will be retrieved from the Gulf of Carpentaria and other priority, or sensitive marine environments as soon as is practicable or required (Table 9).

ELA have made a concurrent referral to the DCCEEW under the EPBC Act that there will be no impact on MNES, which includes the Gulf of Carpentaria, and recommends that this is not a controlled action.

### **6.8.4 Environment Protection and Management**

ELA will seek to protect the quality and productivity of water, sediment, and biota so that their environmental values are maintained through Standard Operating procedures that:

- Favour rocket fuels that have minimal environmental impact because they are non-toxic, do not bioaccumulate, or because they rapidly decompose in the marine environment
- Aim to command failed stages to self-destruct over land where practicable; however, ELA recognises that this is LV dependent and different for every launch client
- Ensure that rocket stages are retrieved from the Gulf of Carpentaria and other priority, or sensitive marine environments as soon as is practicable or required.

## 6.9 Marine Ecosystems

This section is to protect marine habitats to maintain environmental values including biodiversity, ecological integrity, and ecological functioning.

### 6.9.1 Environmental Values

The Gulf of Carpentaria is one of the few remaining near-pristine marine environments in the world (DSEWPaC, 2012). The Gulf of Carpentaria basin is defined as a key ecological feature of regional importance for its biodiversity, endemism, and aggregations of marine life. These values apply to both the benthic and the pelagic habitats within the feature. The marine and benthic environment is characterised by gently sloping soft sediments and water varying in depth from around 45–80 metres. The Gulf supports many pelagic fish species including planktivorous and schooling fish, and top predators such as shark, snapper, tuna, and mackerel, and is an important migratory route for seabirds, shore birds and marine turtles. The soft sediments of the basin are characterised by moderately abundant and diverse communities of epifauna dominated by polychaetes, crustaceans, molluscs, and echinoderms, and primary productivity is primarily driven by cyanobacteria that fix nitrogen.

### 6.9.2 Potential Direct Impacts

There is unlikely to be any residual liquid or solid rocket fuel left in the recoverable first stage of LV launched from the ASC as it is rapidly and fully combusted. Stages 2 and 3 of liquid fueled LV are not recovered as they will have gone orbital (and will burn up if they return through the atmosphere).

There is potential for localised impact on marine ecosystems through contamination with some types of residual liquid fuel (Table 6) in spent rocket stages that fall into the ocean. This is likely to be short-lived because:

- The quantities of residual fuel will be limited and likely to be still contained within the fuel tank
- Small quantities of residual fuel will be rapidly diluted and decomposed
- Failed stages will be commanded to self-destruct above land, or have engines terminated and oxidizer ejected
- Rocket stages will be retrieved from the Gulf of Carpentaria and other priority marine environments as soon as is required or practicable (Table 9).

ELA have made a concurrent referral to the DCCEEW under the EPBC Act that there will be no impact on MNES, which includes the Gulf of Carpentaria, and recommends that this is not a controlled action.

### 6.9.3 Potential Cumulative Impacts

There is unlikely to be any residual liquid or solid rocket fuel left in the recoverable first stage of LV launched from the ASC as it is rapidly and fully combusted. Stages 2 and 3 of liquid fueled LV are not recovered as they will have gone orbital (and will burn up if they return through the atmosphere).

There is low potential for cumulative impact on marine ecosystems through contamination with residual liquid fuel in spent rocket stages that fall into the ocean because:

- The quantities of residual fuel will be limited and likely to be still contained within the fuel tank
- Small quantities of residual fuel will be rapidly diluted
- Failed stages will be commanded to self-destruct above land, or have engines terminated and oxidizer ejected
- Rocket stages will be retrieved from the Gulf of Carpentaria and other priority, or sensitive marine environments as soon as is practicable or required (Table 9).

ELA have made a concurrent referral to the DCCEEW under the EPBC Act that there will be no impact on MNES, which includes the Gulf of Carpentaria, and recommends that this is not a controlled action.

## 6.9.4 Environment Protection and Management

ELA will seek to protect the quality and productivity of water, sediment, and biota so that their environmental values are maintained through Standard Operating procedures that:

- Favour rocket fuels that have minimal environmental impact because they are non-toxic, do not bioaccumulate, or because they rapidly decompose in the marine environment
- Failed stages will be commanded to self-destruct above land, or have engines terminated and oxidizer ejected
- Ensure that rocket stages are retrieved from the Gulf of Carpentaria and other priority, or sensitive marine environments as soon as is practicable or required.

## 6.10 Air Quality

Protect air quality and minimise emissions and their impact so that environmental values are maintained.

### 6.10.1 Environmental Values

The relatively good air quality at the site is largely controlled by maritime winds that disperse salt spray and dust, and the low population density in the region. Local air quality may be affected by particulate matter including aluminium oxide arising from local bauxite mining, and by emissions from the Gove airport.

### 6.10.2 Potential Direct Impacts

The potential for direct impacts on air quality from LV emissions at sensitive receptors is low if launches or static tests do not exceed the maximum allowable emissions per launch (Table 7, Table 8). These limits are unlikely to be exceeded by any LV expected to be launched or static tested at the ASC.

### 6.10.3 Potential Cumulative Impacts

The potential for cumulative impacts on air quality from LV emissions at sensitive receptors is low if launches do not exceed the maximum allowable emissions per launch (Table 7, Table 8). These limits are unlikely to be exceeded by the number of LV projected to be launched or static tested at the ASC.

### 6.10.4 Environment Protection and Management

ELA will ensure that air quality is protected by minimising emissions and their impact on the environment through:

- Favouring rocket fuels that have minimal environmental impact because their combustion results in fewer pollutants than legacy fuels
- Monitoring fuels used and combustion parameters for LVs to determine emissions profile
- Controlling the number and type of launches to ensure that proposed air quality standards will be met
- Monitoring air quality at sensitive receptors if the number of launches or type of LV changes significantly from projected values

## 6.11 Atmospheric Processes

Minimise greenhouse gas emissions to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.

### 6.11.1 Environmental Values

Total GHG emissions in the NT in 2020 were 17.3 Mt CO<sub>2</sub>e<sup>21</sup>, driven by fugitive emissions from fossil fuel extraction and emissions from stationary energy production. The NT Climate Change Response provides a strategy to achieve the target of net zero emissions by 2050<sup>22</sup>. This includes a large emitters policy which places expectations on emitters meeting an emissions threshold to actively reduce their emissions<sup>23</sup>.

### 6.11.2 Potential Direct Impacts

GHG emissions from the ASC are unlikely to meet reporting thresholds established under the NGER Act or the NT Government's large emitters policy in the next five years (Katestone, 2023b). This may change depending on the number and type of rocket launch over time and whether a LOX production plant is installed.

### 6.11.3 Potential Cumulative Impacts

GHG emissions over time will contribute to the total GHG emissions from the NT and Australia and will affect net zero targets. The total amount of emissions is expected to be significantly lower than from large NT extractive industries and potentially on a par with the Gove airport.

### 6.11.4 Environment Protection and Management

There are limited options for ELA to reduce ALS GHG emissions given the site activity and the remoteness of the site. Direct emissions from diesel combustion for electricity can be minimised through actions such as:

- Generator control systems to match supply with load
- Load management and energy efficiency measures
- Back up batteries to store excess generator supply
- Solar PV and batteries
- Use of biodiesel.

ELA will explore options to offset its emissions, including through the NT GHG Offsets scheme<sup>24</sup>.

ELA and its clients may also support research into and monitoring of the pollutants including GHGs released by the combustion of different types of rocket fuels in different types of engines, and/or promote research into the development of low GHG fuels.

## 6.12 Community and Economy

Enhance communities and the economy for the welfare, amenity, and benefit of current and future generations of Territorians.

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<sup>21</sup> <https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions>

<sup>22</sup> [https://depws.nt.gov.au/\\_data/assets/pdf\\_file/0005/904775/northern-territory-climate-change-response-towards-2050.pdf](https://depws.nt.gov.au/_data/assets/pdf_file/0005/904775/northern-territory-climate-change-response-towards-2050.pdf)

<sup>23</sup> [https://depws.nt.gov.au/\\_data/assets/pdf\\_file/0008/1041938/ntq-large-and-expanding-emitters-policy-2021-version-1.1.pdf](https://depws.nt.gov.au/_data/assets/pdf_file/0008/1041938/ntq-large-and-expanding-emitters-policy-2021-version-1.1.pdf)

<sup>24</sup> <https://depws.nt.gov.au/environment-information/northern-territory-offsets-framework/greenhouse-gas-emissions-offsets-policy>

### **6.12.1 Social and Economic Values**

The East Arnhem region is owned and occupied by the Yolngu people who have been living on country for many thousands of years. Nhulunbuy, established as a special purpose mining town, is one of two major population centres in the region. Mining and mining associated activities are a significant contributor to the local economy. The estimated resident population of the East Arnhem local government area (LGA) is 14,599, with a population density of 0.44 people per km<sup>2</sup>.

### **6.12.2 Potential Direct Impacts**

ELA leases the land that the ASC occupies from the local traditional owner Gumatj Corporation and the Northern Land Council. ELA is developing the ASC in partnership with the Gumatj Corporation and the Northern Territory Government, and will provide training and education, support job creation, drive innovation and development of new technologies, and attract new investment to the region.

### **6.12.3 Potential Cumulative Impacts**

ELA and its partners anticipate that the continued existence of the ASC will provide for sustainable economic development and opportunities in the region.

### **6.12.4 Social and Economic Enhancement**

ELA will continue to work in partnership with the Gumatj Corporation and the NT Government to provide economic and educational opportunities to the community of East Arnhem Land.

## **6.13 Culture and Heritage**

Protect culture and heritage.

### **6.13.1 Environmental Values**

East Arnhem Land has a rich cultural heritage based on the many thousands of years that this country has been occupied by the Yolngu people.

### **6.13.2 Potential Direct Impacts**

The ASC will have no direct impact on the culture and heritage of the Yolngu people.

### **6.13.3 Potential Cumulative Impacts**

The ASC will have no cumulative impact on the culture and heritage of the Yolngu people.

### **6.13.4 Culture and Heritage Protection and Management**

ELA will work with the Gumatj Corporation and the NT Government to ensure that its activities do not have an adverse impact on the culture and heritage of the Yolngu people.

## **6.14 Human Health**

Protect the health of the Northern Territory population.

### 6.14.1 Environmental Values

The East Arnhem region is classified as very remote with high levels of disadvantage amongst the predominantly Aboriginal population<sup>25</sup>. The rate of potentially preventable hospitalisations is higher in the region than in the Northern Territory with heart disease, diabetes, lung cancer, and suicide being the greatest causes of mortality.

### 6.14.2 Potential Direct Impacts

Activities at the ASC are unlikely to have any direct impact on the individual or population health of East Arnhem residents. Emissions to air that could have an impact on respiratory health will be lower than maximum allowable limits. The ASC is a secure site and potentially toxic fuels, including diesel, will be safely contained. ASC and Australian Space Agency regulatory procedures for launches ensure all public risk is reduced to extremely low levels in accordance with the Flight Safety Code. The Flight Safety Code provides the methodology to assess that certain launch and return activities are safe (public health) under the *Space (Launches and Returns) Act 2018* and the associated legislative instruments, specifically the *Space (Launches and Returns) (General) Rules 2019* and the *Space (Launches and Returns) (High Power Rocket) Rules 2019*.

### 6.14.3 Potential Cumulative Impacts

Activities at the ASC are unlikely to have any cumulative impact on the individual or population health of East Arnhem residents. Emissions to air that could have an impact on respiratory health will be lower than maximum allowable limits. The ASC is a secure site and potentially toxic fuels, including diesel, will be safely contained.

### 6.14.4 Environment Protection and Management

The ASC will operate with a strong focus on applying proven standards for the health and wellbeing of staff and the residents of the East Arnhem region. ELA understands its obligations for duty of care under the *Work Health and Safety (National Uniform Legislation) Act 2011*, including the adoption of all necessary regulations and AS/NZ standards for safe handling and storage of hazardous materials. ELA has commissioned and will implement a Protocol to ensure that LV exhaust emissions are below maximum allowable limits for human health at sensitive receptors.

ELA will ensure that public safety is maintained through:

- Adherence to the Flight Safety Code where every launch requires assessment of public safety through the Australian Launch Permit process governed by the Australian Space Agency.

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<sup>25</sup> [https://www.ntphn.org.au/wp-content/uploads/2021/06/East-Arnhem-Regional-Data-Profile\\_FINAL.pdf](https://www.ntphn.org.au/wp-content/uploads/2021/06/East-Arnhem-Regional-Data-Profile_FINAL.pdf)

## 7. SUMMARY AND CONCLUSION

Equatorial Launch Australia (ELA) has made this referral for the Phase 2 expansion of the Arnhem Space Centre (ASC) to the Northern Territory Environment Protection Agency (NT EPA) under s48 of the *Environment Protection Act 2019* (EP Act) and the *Environment Protection Regulations 2020* (EP Regulations). ELA seeks a decision from the Minister for Environment on whether an environmental impact assessment is required for the proposal and, if so, which assessment method applies.

ELA is making a concurrent EPBC Act Referral for the consideration of down range impacts of LV hardware in Commonwealth Marine Areas and considers that these are not controlled actions requiring assessment by EIS.

ELA considers that the environmental and social effects of activities conducted in association with Phase 2 of the ASC will not be significant and can be managed through compliance with regulatory approvals requirements, AS/NZ standards, and an approved Environmental Management Plan (EMP).

ELA has an obligation to apply the principles of environment protection and management and a general duty to apply the principles of ecologically sustainable development, the environmental decision-making hierarchy, and the waste management hierarchy. It will do this through:

- Purposeful engagement with the legitimate representatives of the Traditional owners of the land of northeast Arnhem Land (Miwatj)
- Coordination with the NT EPA and other relevant Territory, State, and Commonwealth governments
- Application of the precautionary principle to decisions regarding activities that could lead to significant environmental damage
- Application of best available scientific and technical evidence to ensure environmental protection and sustainable operation of the ASC in the NT
- Ensuring that activities associated with operation of the ASC do not affect the health, diversity, or productivity of the environment, so that the opportunities for present and future generations are not adversely impacted
- Ensuring that vegetation clearance for site construction is permitted, that the least area possible is cleared, and that cleared vegetation is available for Traditional landowner use or applied to the site as mulch or ground habitat
- Ensuring that rocket launches and retrievals do not adversely affect the biological diversity and ecological integrity of areas outside of the ASC
- Negotiation of a fair market rate for the lease of the site from the Traditional owners
- Development of an Environmental Management Plan that applies the environmental decision-making hierarchy in accordance with the EP Act
- Applying the waste management hierarchy to reduce waste production and ensure recycling of materials where practicable. Options such as repurposing suitable waste materials for local artistic or economic use will be explored with the local community
- Establishment of standard operating procedures to reduce risks caused by the current and changing climate
- Purposeful consultation and engagement with the Traditional owners of the land.

There is the potential for low environmental impact on seven (7) of the fourteen environmental factors identified by the NT EPA if activities were unmitigated. ELA has proposed and will commit to management measures to avoid significant impact on:

- Terrestrial environmental quality

- Terrestrial ecosystems
- Hydrological processes
- Inland water environmental quality
- Aquatic ecosystems
- Air quality
- Atmospheric processes
- Marine Environmental Quality
- Marine Ecosystems
- Human Health.

Finally, there is the potential for a positive impact on the local community and economy through the current and proposed activities associated with the ASC. These will be developed through purposeful engagement with the Traditional owners and special interest groups, e.g., education.

## 8. REFERENCES

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