EQUATORIAL LAUNCH AUSTRALIA

Additional Information to the SER

[NTEPA Reference EP2023-031]

ELA-000183

VERSION 1

Handling Instruction: COMMERCIAL – IN – CONFIDENCE Information

VERSION APPROVAL

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General – Launch Facility and Downrange Areas (activities, extent and limitations)

1 Confirm (or otherwise provide additional assessment information)

a. 60 launches per year (same as phase 1) is proposed

We confirm that there will be between 16 and 60 launches per year when Phase 2 of the ASC is fully operational (ref: ELA Phase 2 Expansion of the Arnhem Space Centre, Referral Document to NT EPA, September 2023, FINAL, Section 3.2.3, page 12)

b. Liquid Oxygen (LOX) manufacturing plant is not part of the proposed action

We confirm that a LOX manufacturing plant is not part of the proposed action. (ref: ELA Phase 2 Expansion of the Arnhem Space Centre, Referral Document to NT EPA, September 2023, FINAL, Section 6.11.2, page 43)

c. Fuels containing mercury will not be used in the proposed action

We confirm that mercury will not be used as a rocket propellant and is banned by the United Nations. ELA will not host nor authorise launch vehicles with fuels containing mercury.

d. Landfill is not required and not part of the proposed action

We confirm that a landfill is not required and is not part of the proposed action.

e. No wastewater will be discharged to the environment

We confirm that wastewater will not be discharged to the environment.

f. Groundwater extraction is not part of the proposed action

We confirm that groundwater extraction is not part of the referred proposed action, and will be sought at a later date should we decide to extract groundwater.

g. Proposal activities do not Involve potential significant impacts from radiation.

We confirm that proposal activities do not involve potential significant impacts from radiation.

Launch facility water balance and quality

2 Annual water demand and annual supply for the proposed action

Confirm (or advise otherwise) the proposed annual water demand and annual supply for the proposed action, accounting for:

a. variability with different phases of the proposed action e.g. construction phase, operation phase, decommissioning and rehabilitation phase

b. potable (including drinking water) for the accommodation facility and personnel onsite

c. dust suppression and landscaping (if applicable)

d. functionality of the deluge system during launches and static tests

e. other water uses for example, an emergency conflagration event

f. water treatment options for recovered deluge water and domestic water.

We confirm that the proposed annual water demand and annual supply for the action, accounting for a) to f) above, will be as described in :

Table 1: Annual water demand and annual supply for the proposed action

	2024-25	2025-26	2026-27	Ongoing
Total litres per year (est'd)	**6,782,500**	**7,885,000**	**11,002,500**	**10,002,500**
a) Variation of attribution over time of the proposed action				
i. Construction	*6,104,250 (90%)*	*4,731,000 (50%)*	*3,300,750 (30%)*	*500,125 (5%)*
ii. Launch Operations	*678,250 (10%)*	*3,154,000 (40%)*	*7,7017,50 (70%)*	*9,502,375 (95%)*
	As the site is constructed the water usage will shift from being majorly used for construction through to majorly being used for potable water and launch support			
b) potable (including drinking water) for the accommodation facility and personnel onsite	*1,597,500 25% imported 75% captured and filtered rainwater*	*3,450,000 10% imported 90% captured and filtered rainwater*	*6,192,500 100% Captured and filtered rainwater*	*6,192,500 100% Captured and filtered rainwater*
	Potable water will be provided by filtering rainwater from the roofs of the various support facilities being constructed at the ASC. This water will be stored in rainwater tanks, then filtered and treated as required throughout the year, should rainwater prove insufficient additional water will be purchased in Nhulunbuy.			
c) dust suppression, concrete batching and landscaping	*5,000,000 10% Captured Rainwater 90% Imported*	*4,000,000 100% from Tarn*	*4,000,000 100% from Tarn*	*3,000,000 100% from Tarn*
	Dust suppression will be conducted as required but due to low traffic within the construction site this is expected to be minimal or near zero usage. *Landscaping water requirements will be minor as the aim is to maintain local shrubs or utilise native species with no upkeep requirements other than during establishment. A portion of landscaping water requirements will be met through grey water reuse and the remainder from the tarn once constructed.*			
d) functionality of the deluge system during launches and static tests	*125,000 100% imported*	*375,000 100% from Tarn*	*750,000 100% from Tarn*	*750,000 100% from Tarn*
	The water deluge system provides fire, thermal, and acoustic suppression for each static test and 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. Water (other than the 25% converted to steam) is recovered and recycled to tanks after filtering.			
e) other water uses	*60,000*	*60,000*	*60,000*	*60,000*
	ELA will have a small fire truck with 15,000L capacity. This will be for small spot fires, some water usage for testing and maintenance of the truck is expected up to a maximum of 60,000L per year.			
f) water treatment options for recovered deluge water and domestic water	*Used deluge water reused for deluge, grey water for landscaping*	*Used deluge water reused for deluge, grey water for landscaping*	*Used deluge water reused for deluge, grey water for landscaping*	*Used deluge water reused for deluge, grey water for landscaping*
	Deluge water is captured and returned in a contained system (pumped from the capture bath back up to poly tanks), with an estimated 25% steam loss rate per launch. Treatment, when required, will be conducted on-site and the water will be filtered before recycling to the tank. Wastewater, if necessary, will be disposed of through local and approved disposal methods. Some grey water recovery will occur and be used to support local landscaping.			

As groundwater extraction is not part of the referred proposed action, as confirmed in Direction 1(f) above, there should be no potential significant environmental impacts from groundwater extraction.

2.1 Source of Water and Water Management During the Dry Season

At completion of site construction (all facilities) potable water will be harvested from 13053m^2 of roof space yielding a surplus of 15ML of rainwater annually. 2.25ML of rainwater storage will be constructed to enable sufficient potable water throughout the dry season. A table demonstrating the generation and usage rates can be found below. The water capture rate is based on a conservative 80% of mean rainfall based on the most recent 20 years of BOM data. Should a shortfall occur, additional water will be purchased and imported to meet demands or upon completion water may be treated and filtered from the proposed dam.

Table 2: Ongoing Long Term Roof Capture and Potable Usage Rates

Ongoing Long Term Roof Capture and Potable Usage Rates					
Potable					
Month	**Rain Collected (L)**	**Max Tank Capacity (L)**	**Water Usage (L)**	**Volume at End of Month (L)**	**Overflow to environment(L)**
January	2,918,651	2,250,000	516,042	2,250,000	1,184,692
February	2,852,864	2,250,000	516,042	2,250,000	5,189,686
March	2,860,173	2,250,000	516,042	2,250,000	5,204,305
April	2,489,468	2,250,000	516,042	2,250,000	4,462,895
May	990,984	2,250,000	516,042	2,250,000	1,465,926
June	291,343	2,250,000	516,042	2,025,301	66,644
July	176,477	2,250,000	516,042	1,685,736	0
August	64,743	2,250,000	516,042	1,234,437	0
September	79,362	2,250,000	516,042	797,758	0
October	109,645	2,250,000	516,042	391,362	0
November	382,192	2,250,000	516,042	257,512	0
December	1,918,269	2,250,000	516,042	1,659,739	1,328,008
Total	**15,134,170**				

2.2 Additional analysis of BOM data to support calculations

For the purpose of calculating the capture quantities above the following monthly rainfall rates were utilised. The table below includes a conservative estimate of the expected potential rainfall that could be captured for usage from roofing.

Table 3: Additional analysis of BOM data

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Rainfall (mm)	223.6	218.56	219.12	190.72	75.92	22.32
Potential Roof Capture (L)	2918651	2852864	2860173	2489468	990984	291343

Month	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Rainfall (mm)	13.52	4.96	6.08	8.4	29.28	146.96
Potential Roof Capture (L)	176477	64743	79362	109645	382192	1918269

2.3 Clarification on possible dam usage

Should the dam be utilised, it would be supplied by a minimum catchment of 162,500m^2 yielding an annual mean volume of rain in surplus of 227ML. The dam is to only have a capacity of 100ML and would slowly be filled over a 3-year period harvesting approximately 25% of the wet season rainfall while releasing dry season rain captured to sustain natural levels of flow downstream during the dry season from June to November. Over the years 2025 –2026 the dam would be filled to 50% capacity, reaching 100% capacity early in the 2028 wet season.

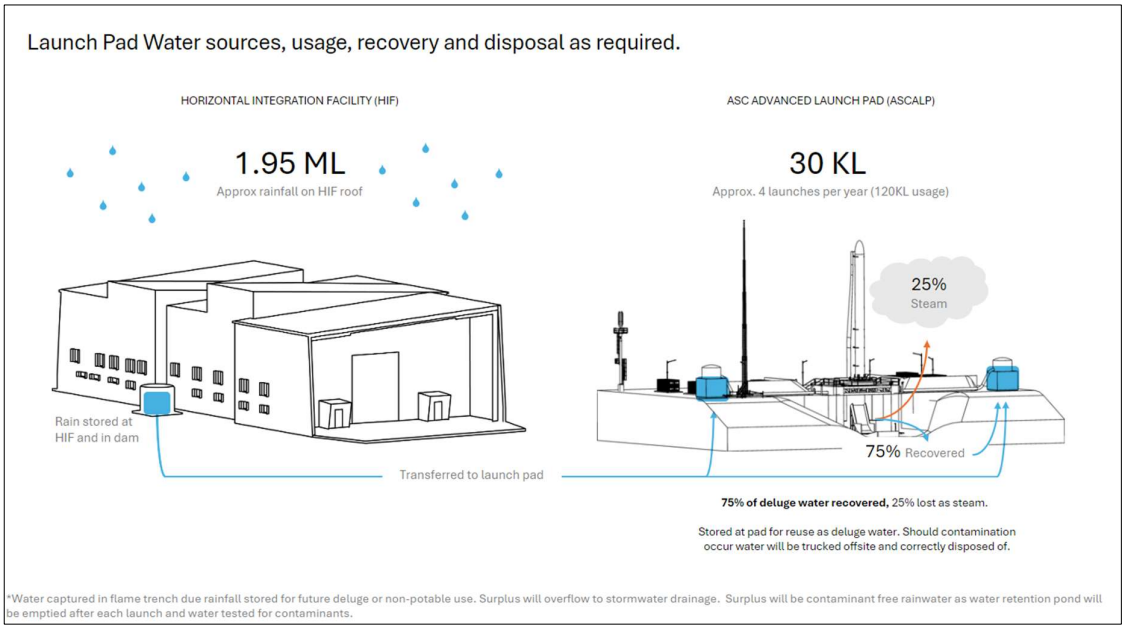
As the total demand for the ASC does not exceed 12ML per year or 5% of the total rainfall captured this would not have a significant impact on vegetation downstream as the remainder of the water flow would be preserved and be allowed to flow downstream at similar to natural rates.

2.4 Water usage for deluge system at the Launch Pad including recapture

The water to conduct deluge will either be sourced from the rainwater captured on the roof of the HIF or be supplied by the on-site dam. It is important to note that 75% of the water used at the launch pad for deluge will be recaptured, tested and pumped back into storage tanks at the launch pad for future use as deluge water again. Should the water be contaminated it will be carted offsite and disposed of correctly.

Excess rainfall trapped within the flame trench will either be captured as future deluge water or be released to stormwater systems. This water should be contaminant free as the water in the trench is tested after each launch and if it is within safe and permitted limits than the risk of excessive rainwater being contaminated is negligible. Please see below for a graphic demonstrating this process:

Figure 1: Water usage for deluge system



General – Down Range Areas Mission Optimisation Process

3 Describe the process to define and identify the inhabited areas that would be avoided (in NT jurisdiction)

When a launch client confirms a mission, we begin by plotting the launch trajectory in industry approved tool ASTOS, including the anticipated location for the return of the first stage motor. Our process integrates population databases within the landing area to assess and identify any inhabited

areas that could be affected. If any populations are detected within the projected landing area, the trajectory is adjusted to ensure these areas are avoided. This process also incorporates review and impact assessment in relation to Environmental approvals in NT and QLD and Commonwealth, including Heritage and Sacred Sites.

This process is detailed in ELA's updated *Mission Optimisation Process*, as outlined in Attachment C.

4 Define the methods to identify whether areas of high ecological value are present

Please refer to ELA's updated *Mission Optimisation Process* (Attachment C, Section 4), which details the procedure to identify whether areas of high ecological value are present.

The methods to assess the impact of a proposed launch trajectory on all relevant environmental matters, including areas of high ecological value, are as follows:

a. Desktop review and online searches including Protected Matters Search Tool and Northern Territory Vegetation Database.
b. Consultation with local landowners.
c. Consultation with local park managers (land or water).
d. Engagement of a third-party environmental consultant to conduct or review an Environmental Self-Assessment, if required (e.g., if the intended action is likely to breach any State or Federal environmental approvals).

5 Describe the action ELA will take where consultation and analysis of spatial information indicates physical surveys need to be undertaken in order to identify environmentally important areas

If engagement with local landowners, park managers, or spatial database searches (such as the Protected Matters Search Tool) identifies potential environmental risks, ELA will organise physical surveys as required under applicable laws. The decision to conduct any survey will be risk-based and guided by the advice of our environmental consultants, in consultation with downrange landowners and park managers. These surveys, if deemed necessary, would be conducted by qualified local environmental specialists to confirm and provide evidence to support the Self-Assessment referenced in the updated *Mission Optimisation Process* (Attachment C).

It's important to note that, given the minimal physical footprint of a 10m x 2m launch vehicle first stage and the controlled nature of recovery operations, and as demonstrated through the NT EPA and EPBC referrals, the likelihood of significant environmental impact is extremely low, if not non-existent. As such, we aim to avoid unnecessary actions that could impose significant costs and delays, ensuring that any surveys conducted are strictly necessary and legally mandated.

General – Consultation

6 Describe how relevant stakeholders (e.g. Aboriginal landholders, pastoral lessees) (particularly down range) will be identified, contacted and informed that they may be potentially impacted land managers

Please refer to the updated *ASC Stakeholder Engagement Plan* in Attachment D.

Identified: As the mission optimisation process progresses and is finalised approximately 12 to 9 months before the launch, the final downrange landing and recovery areas will become clear. At this stage, ELA conducts an internal impact assessment to identify downrange key stakeholders, using a tiered engagement approach:

- **Level 1 Stakeholders – Lease holders, partners, investors, space regulator:**
  - Northern Territory Government (NTG)
  - Australian Space Agency (ASA)
  - Gumatj Corporation

- **Level 2 Stakeholders – Key conduits:**
  - Safety and Retrieval Committee (SRC)
  - Aboriginal Areas Protection Authority (AAPA)
- **Level 3 Stakeholders – Directly impacted (up-range / downrange):**
  - Land Councils
  - Emergency Services (fire, police, ambulance/hospital)
  - Local Governments
  - Landowners (Aboriginal/Traditional Owners/others)
  - Environmental stakeholders (EPA, EPBC, Heritage)
  - Civil Aviation Safety Authority (CASA)
  - Air Services
  - Parks Australia
  - Australian Defence Force
  - Maritime Safety Office
- **Level 4 Stakeholders – Community groups / wider groups:**
  - Nhulunbuy and East Arnhem
  - Downrange Towns
  - General Aviation
  - Export Imports stakeholders (EXIM)
  - Family Outstations, Homeland Communities
- **Level 5 – Individuals:**
  - Nhulunbuy and East Arnhem
  - Downrange Towns
  - Local Service Providers

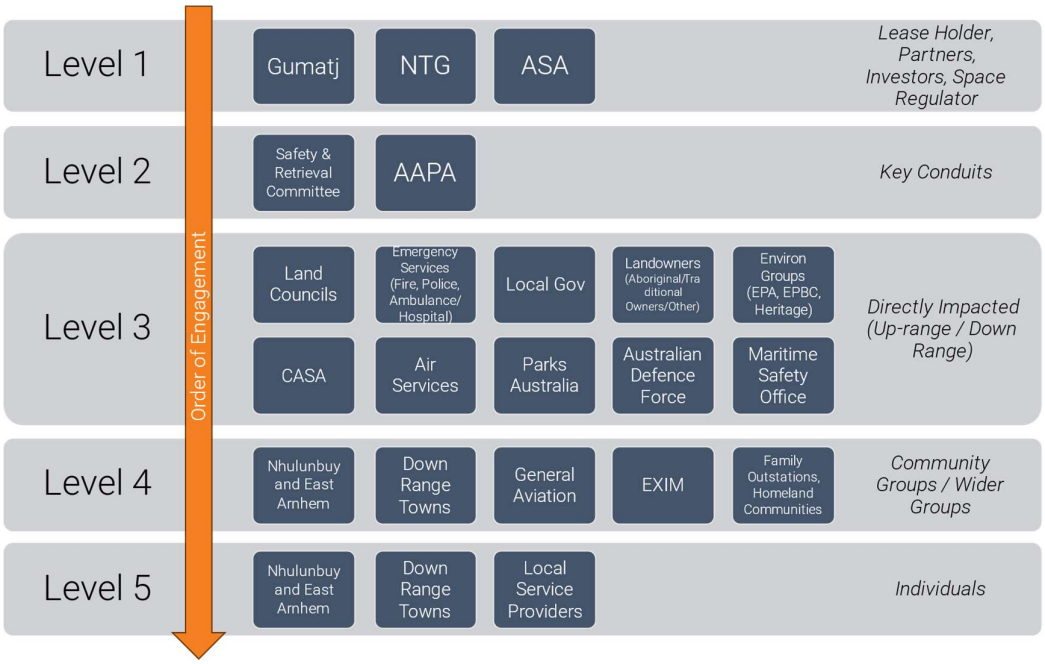


Figure 2: Prioritised stakeholder engagement levels

This tiered approach ensures that we engage effectively with all relevant parties, starting with higher-level government and regulatory bodies, followed by direct engagement with landowners, Traditional Owners, and other local stakeholders. The stakeholder engagement process will be consistent with our updated Stakeholder Engagement Plan.

Contacted: Through established contacts at the Government, local council, and Traditional Owner levels, as well as through other organisations such as the AAPA, ELA will gather contact information and reach out directly or indirectly through networks. A key part of this process is working closely with Land Councils, specifically the Northern Land Council (NLC) and the Central Land Council (CLC), who play a central role in identifying and facilitating engagement with the appropriate Traditional Owner representatives. These Land Councils assist ELA in ensuring that all engagement with Traditional Owners is conducted respectfully and in accordance with cultural protocols. Additionally, ELA proactively engages with other important organisations, such as the Anindilyakwa Land Council (ALC), to identify any further stakeholders, gather contact information, and ensure that all potentially impacted parties are informed. The purpose of engaging with the CLC, NLC, and ALC is to leverage their knowledge and networks to identify the right Traditional Owner representatives and other stakeholders who may be affected by downrange activities.

Informed: ELA will then make contact to describe the process and reasons for engagement. This communication is conducted via phone, virtual meetings, or in-person visits. Stakeholders are informed of potential impacts from the proposed action and, as required, invited to participate in the Safety and Retrieval Committee (SRC).

Consulted: Through their inclusion in the SRC, stakeholders have the opportunity to provide feedback, which ELA will address as part of our engagement process.

In the Northern Territory, this process may also be triggered in parallel through the AAPA Authority Certificate process. Identified stakeholders, including Aboriginal landholders and pastoral lessees, will then be invited to participate in the SRC forum, where they will remain involved until after the launch. Furthermore, engagement with downrange stakeholders, including First Nations people, is required under the EPBC Act and forms part of our Australian Launch Permit due diligence.

Failure Procedure alignment: In the event of a Launch Failure (accident), ELA executes the operational procedure "LAUNCH VEHICLE / PAYLOAD ACCIDENT (DURING LAUNCH OR RETURN)". This procedure initiates execution of a tailored failure (accident) response plan. The ASC Master contact list—reviewed and updated through the Mission Optimisation and the Launch Project Planning processes—is used to inform and manage stakeholders in a prioritised manner. This contact list will include all impacted stakeholders at all levels to ensure a seamless response in the unlikely event of an accident.

7 Provide supporting evidence that potentially affected stakeholders (particularly down range) have already been consulted and/or involved rather than informed only

ELA has commenced consultations with key Land Councils (CLC, ALC) and the AAPA. In May/June 2024, we sent letters to these stakeholders to engage them and share our plans for potential landing and recovery operations in their areas. These letters introduced the project and outlined the proposed hardware recovery process (see Attachments E and F). We received a response from AAPA, confirming our mutual understanding of the process for obtaining sacred site clearances for downrange areas in the NT (Attachment G). However, we have not yet received responses from the CLC and ALC and will continue to actively seek their feedback.

The process for future engagement is documented in the updated *ASC Stakeholder and Engagement Plan* (Attachment D). Per answer to Direction No 4 above, the updated *Mission Optimisation Process* allows us to narrow in on who is impacted and through that engagement refine and produce our specific recovery plans (which is directed by our ASC Flight Hardware Recovery Plan). The method to conduct the recovery operations follows our *ASC Principles and Protocols for Land/Sea Access* (Attachment H). This document, developed in collaboration with the Northern Land Council, will be updated based on feedback from the SER submission, including input from the Heritage Branch.

ELA's current timeline for engagement, focusing on the next launch scheduled for July 2025, is as follows:

a. September 13: Launch trajectories provided by client and launch Expression of Interest (EOI) submitted to Australian Space Agency (ASA).

b. September-October: Mission Optimisation analysis to determine the effect of the trajectories, landing sites for booster motors, and identification of relevant stakeholders.
c. October: SRC meeting held for up-range stakeholders for the upcoming launch (July 2025).
d. October: Direct engagement (face-to-face meetings) with downrange stakeholders through councils, park agencies, and AAPA.
e. November: SRC meeting held for both up-range and affected downrange stakeholders in NT and QLD.
f. November-July: ongoing monthly SRC meetings with up-range and downrange stakeholders as land access permits and approvals progress

Communications are drafted in simple and plain language and also translated into Yolŋu Matha, building on previous work with NASA and Gumatj and six other Traditional Owner groups.

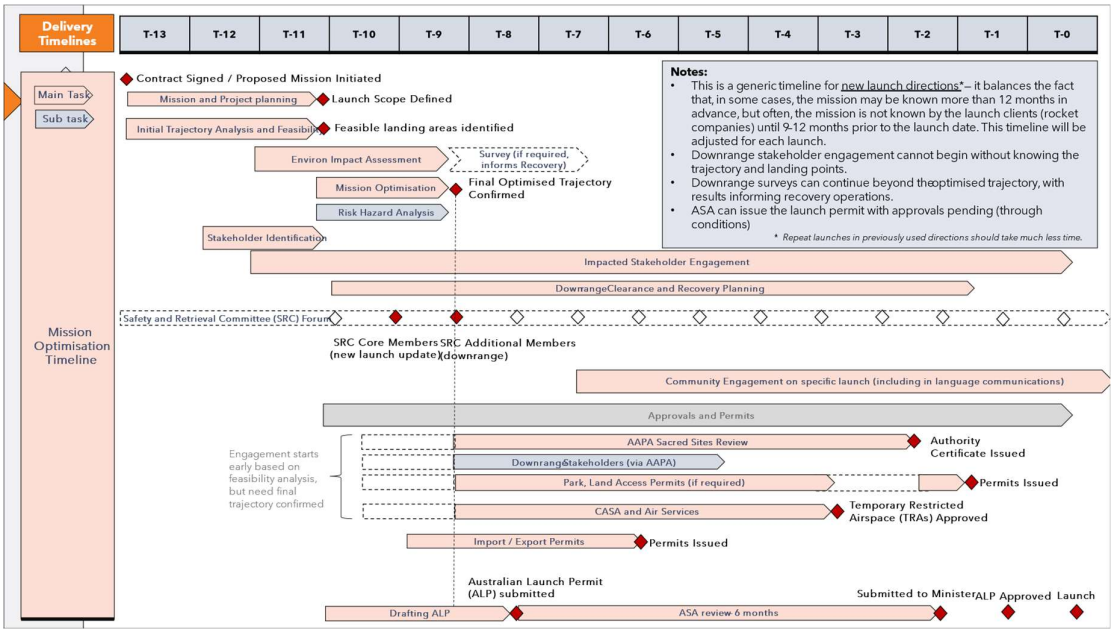


Figure 3: Launch Stakeholder Engagement Timeline

8 Describe the process, regulatory framework (e.g. access or permits required under other NT or Commonwealth legislation) and timeframe that may be required to permit access to potentially impact land managers

ELA follows a comprehensive and structured process to ensure compliance with all relevant regulatory frameworks and to secure the necessary permits for launch operations. This process aligns with the requirements of both NT and Commonwealth legislation and is integrated into ELA's *Mission Optimisation Process* (Attachment C) to ensure that all access and engagement activities are completed in a timely and thorough manner, and the rights and interests of stakeholders are respected throughout the launch mission:

1. Launch Mission and Trajectory Determination

Once a launch mission and trajectory are defined, typically 12 to 9 months before the launch, ELA initiates an internal impact assessment to identify the regulatory requirements, permits, and approvals that must be secured. This includes identifying any potentially impacted land managers or stakeholders downrange.

2. Regulatory Assessment and Permit Identification

ELA conducts a comprehensive review of all applicable NT and Commonwealth regulations to identify the necessary permits and approvals. Key legislation considered includes, but is not limited to:

- The Space (Launches and Returns) Act 2018 (Cth)

- The Northern Territory Aboriginal Sacred Sites Act 1989 (NT)
- The Aboriginal Land Rights (Northern Territory) Act 1976 (Cth)
- The Environment Protection and Biodiversity Conservation (EPBC) Act 1999 (Cth)
- Relevant Work Health and Safety (WHS) legislation
- Export and Import regulations under the Customs Act 1901 (Cth) and associated controls

The review involves cross-referencing with spatial databases, Natural Resources maps, the Protected Matters Search Tool, and heritage registers to identify any permits required for access to land managed by Aboriginal landholders, pastoral lessees, local councils, and other stakeholders. ELA also consider additional regulations, such as hazardous materials handling, biosecurity, and environmental management, as applicable.

All identified permits and approvals are documented as part of ELA's Australian Launch Permit (ALP) application.

3. ALP Application Process

ELA submits an **ALP** application to the Australian Space Agency (ASA) as required under the Space (Launches and Returns) Act 2018 (Cth). The ALP process includes a detailed assessment of environmental and safety considerations, as well as stakeholder engagement strategies.

During this process, ELA must demonstrate that all necessary permits and approvals are in place and that proactive engagement with both up-range and downrange stakeholders is ongoing. This ensures that the launch mission aligns with regulatory expectations.

4. Engaging with Regulatory Bodies and Stakeholders

Where the proposed launch has the potential to impact land managed by Aboriginal groups or other land managers, ELA engages with relevant bodies, including the NLC, CLC, AAPA, and local government authorities. Engagement is conducted in accordance with ELA's *ASC Stakeholder Engagement Plan* (Attachment D).

For launches that may affect sacred sites, ELA works with the AAPA to obtain an Authority Certificate. This process can take up to six months, and ELA commits to initiating this request 6 to 9 months before the planned launch to ensure compliance. ELA has already confirmed this timeline with AAPA in correspondence and includes this step in the Mission Optimisation Process.

5. Consultation and Engagement Process

Throughout the Mission Optimisation Process, ELA maintains active engagement with all relevant stakeholders, including traditional landowners, pastoral lessees, and government agencies, to ensure their concerns and requirements are addressed. The Safety and Retrieval Committee (SRC) is a key forum for this engagement, where stakeholders are informed of the launch plans, and their input is incorporated into the decision-making process.

ELA's stakeholder engagement process is aligned with the requirements of the EPBC Act, ensuring that all engagement activities meet Commonwealth standards.

6. Timeframe and Ongoing Compliance

ELA ensures that the permit acquisition process begins as soon as the launch mission is confirmed, allowing sufficient time (typically 9-12 months) for all regulatory requirements to be met. This includes allowing a minimum of 6 months for the AAPA Authority Certificate process and accounting for other NT, States or Commonwealth permits that may be required. Refer to Annex B of *ASC Stakeholder Engagement Plan* (Attachment D).

ELA's regulatory compliance team continuously monitors the progress of permit applications and engagement activities to ensure all necessary approvals are secured in advance of the launch.

9 Clarify why the safety and retrieval committee membership does not include down range area stakeholders

The composition of the Safety and Retrieval Committee (SRC) is carefully considered based on the specifics of each launch to ensure effective communication and decision-making:

- The SRC does include downrange stakeholders when a launch is expected to affect them. This ensures that those directly impacted are involved in the planning and safety processes for that specific launch.
- This model and approach were developed and applied for the NASA launches in 2022, demonstrating its effectiveness in managing complex operations with multiple stakeholders.
- The potential number of downrange stakeholders across all possible launch scenarios could easily reach into the hundreds, given the significant variability in potential landing areas. Including all these stakeholders as permanent members of the SRC would be impractical and would likely hinder the committee's ability to operate efficiently.
- Instead, each SRC is formed with a focused group of affected stakeholders relevant to the specific launch. This approach keeps the committee to an appropriate and manageable size, ensuring that it remains effective while still addressing all necessary concerns.

Please refer to the *Safety and Retrieval Committee Charter* in Attachment I.

10 Demonstrate that the proposed timing for execution of the consultation processes accounts for the identification of environmentally sensitive areas, feedback from potentially affected stakeholders and changing launch trajectories to avoid potential significant impacts

See above and updated *Mission Optimisation Process* (Attachment C) and Annex B of *ASC Stakeholder Engagement Plan* (Attachment D) for timeline.

ELA has implemented a comprehensive process to ensure that the timing of our consultation and environmental assessment activities effectively addresses the identification of environmentally sensitive areas and incorporates stakeholder feedback:

- Extensive analysis, conducted through the NT EPA and EPBC referrals, has already established that the downrange risk to land and marine environment is non-existent to low.
- To manage any residual risks, ELA's strategy focuses on proactive engagement with local landowners, ensuring they are well-informed and that our operations adhere to our *Environment Policy* (Attachment R) and *ASC Principles and Protocols for Land/Sea Access* (Attachment H) commitment. These principles were developed in collaboration with both up-range and downrange stakeholders, including Aboriginal groups, the NLC, AAPA, and the NT Government, during our work with NASA.
- Recognising the impracticality of conducting extensive environmental surveys for every potential area, our approach emphasises upfront risk assessment and continuous collaboration with local stakeholders. This allows us to respect specific environmental concerns without the need for unnecessary work and delays.
- ELA has a stop-work procedure in place, ensuring that if any environmental concerns are identified during downrange recovery, operations can be paused immediately.
- Under the Space (Launches and Returns) Act 2018 (Cth), all necessary approvals must be secured before any launch proceeds. Should any approvals be pending, the launch will be postponed until all requirements are fully met.

This approach ensures that while we prioritise environmental protection and stakeholder engagement, we avoid imposing impractical burdens that could unnecessarily delay operations without enhancing safety or environmental outcomes.

11 Provide documents G - R mentioned in section 3.2 of Appendix 1 – ASC Flight Hardware Recovery Plan of the SER

Please refer to the links to the requested references in Attachments B. These documents are confidential and commercially sensitive, and we respectfully request that they not be released to the public.

Air model

12 Clarify how the consideration of the model accounted for the proximity and effect of Dhupuma plateau, and the resultant level of confidence, supported by sensitivity analysis of the air quality modelling results and assessment

The air quality modelling undertaken for the action was intentionally conservative and will overestimate the ground concentration levels of the regulated pollutants CO, NO_x, HCl, and Al_2O_3 (as PM_{10}) in all scenarios. The elevated location on the Dhupuma Plateau and its climate were explicitly spatially modelled in TAPM.

TAPM predicts the flows important to regional and local scale meteorology, such as sea breezes and terrain-induced flows from the larger-scale meteorology, provided by synoptic analyses. TAPM solves the fundamental fluid dynamics equations to predict meteorology at a mesoscale (20 km to 200 km) and at a local scale (down to a few hundred metres) and includes parameterisations for cloud/rain micro-physical processes, vegetation canopy and soil, and radiative fluxes.

TAPM (version 4.0.5) was configured as follows:

- Modelling period for one representative year from 1 January 2018 to 31 December 2018
- 30 x 30 grid point domain with an outer grid of 30 km and nesting grids of 10 km, 3 km, and 1 km
- 25 vertical levels representing rocket height (and emissions source) over time from launch
- Grid centred at the site (latitude –12.383°, longitude 136.800°)
- Grid centre point (695695 m E, 8630398 m S)
- Geoscience Australia 9 second DEM terrain data
- Land cover data default
- Default options selected for advanced meteorological inputs.

Consequently, TAPM accurately accounts for the unique topographical features, including the 100-metre elevation of the Dhupuma Plateau above the valley floor.

The assumption that the location is flat for AERMOD purposes is correct for the plateau as it is an elevated surface, and the source is not a static smokestack contained within a valley (which would affect dispersion and dilution of pollutants).

The model consequently overestimates the ground level concentration of pollutants in the slopes and valleys below the plateau. This overestimation is made even more conservative by the temperature of the exhaust plume which exits at ~ 1,500 °C and is therefore significantly more buoyant than the ambient air, allowing for dispersion higher in the air column and greater dilution before it reaches ground level. As demonstrated in the dispersion models, this dispersion and dilution rapidly reduces concentrations against regulated levels to the point where they will be below detection at a short distance from the ASC (see Attachment J, Figures 1 to 98).

Pollutants of concern, Magnitude of impact including cumulative, Whole of environment

13 Describe and map the area of potential air quality impacts resulting from the four potential pollutants of concern at each of the 14 proposed launch pads (particularly the launch pads 2-9 and 2-11 (pink launch pads shown on Figure 5 of the referral) (or provide the sensitivity of modelled concentrations for all launch pad locations)

The assessment of potential air quality impacts from the four identified pollutants—carbon monoxide, nitrogen dioxide, hydrogen chloride, and aluminium oxide (as PM_{10})—has been thoroughly conducted for each launch pad cluster location for each relevant air quality criterion and averaging period (see Attachment J, Figures 1 to 98).

At full capacity there will be 60 launches a year, or one launch per six days on average. In the early stages there may be as few as 16 launches per year, or one launch per 23 days. Each launch will be

producing exhaust emissions below the mixing height for 15–60 seconds maximum. There are not projected to be many static tests as clients will have conducted these in their country of origin to demonstrate that the technology works. Static tests are short in duration; for example, a wet dress and pre-launch static test may last 5 to 10 seconds, while a full static test may last up to 60 seconds.

Exhaust emissions will rapidly disperse and dissipate, i.e., not accumulate in the environment, given the elevated position of the ASC, and the frequency and duration of emissions.

- The levels of CO are likely to be overestimated as a significant proportion of this will be further oxidised to CO_2 due to the afterburner effect in the exhaust plume.
- Nitrogen dioxide will not accumulate in the atmosphere and will therefore not lead to smog, acid fog, or acid rain. There may be some wet and dry deposition of particulate NO_3^- and NH_4^+, but this will be widely dispersed, not lead to acid formation, and will be subsumed within ambient nitrogen cycling levels.
- Hydrogen chloride will not accumulate in the atmosphere and will therefore not lead to smog, acid fog, or acid rain. There may be some wet deposition of particulate Cl^- in the immediate location of the launch pad in deluge steam, but wet and dry deposition of Cl^- will not be at concentrations that cause harm to cultural, heritage, or environmental values. There will be ambient levels of Cl^- in the atmosphere due to the proximity to the coast.
- The Australian PM_{10} standard applied to Al_2O_3 refers to human respiratory health. Ontario, Canada, has an explicit environmental criterion for Al_2O_3 of 120 µg/m³ for a 24-hour average, which is significantly less strict than the criterion applied in our modelling and may be more appropriate in an environment where a large fraction of the soil is comprised of Al_2O_3 (see response to Direction 18).

ELA is committed to continuous monitoring and adjusting launch operations as necessary to ensure compliance with air quality standards. Additionally, ELA's Environmental Management Plan includes measures for air quality monitoring during launch events.

14 Discuss/justify the necessity of the launch pad proposed closest to the Garma Festival site

On initial request for land from Gumatj for Site 1, Gumatj suggested the location of ASC. The proximity of the launch pad to the Garma Festival site is the result of careful planning and safety considerations while maximising the number of clients and launch pads at ASC. The launch pads have been strategically spaced to ensure ground hazard safety zones are sufficient for the range of launch vehicles that ELA plans to launch from the ASC.

A rigorous master planning process, conducted in May 2023 in collaboration with Jacobs and their USA subject matter experts, who work on the Kennedy Space Center Master Plan, confirmed that the proposed layout optimally balances operational safely with ELA's multi-user business plan. This configuration is essential to maintain the safe operation of the site while supporting the diverse launch requirements of ELA's clients.

ELA is in close and constant communication with Gumatj in relation to both Gulkula operations as well as Garma site events, including Garma Festival in July/August every year.

15 Provide the predicted level of sulfur compounds from the proposed action

Dispersion of SO_x was not explicitly modelled. Sulphur and sulphur compounds are considered undesirable elements in rocket propellant due to their potential to react with critical copper components. As a result, the concentrations of sulphur in the fuel are kept very low. For instance, the concentration of sulphur in RP-1 rocket fuel is approximately 20 to 30 ppm, which is significantly lower than in aviation fuels such as Jet A1, which contains 400 to 800 ppm of sulphur and sulphur compounds.

Additionally, ongoing refinements in the production of RP-1 and RP-2 fuels are further reducing sulphur levels. Unlike NO_x with atmospheric nitrogen, the only source of sulphur in this context is the fuel itself. Consequently, SO_x emission rates and resultant ground concentration levels will be significantly lower than those of NO_x.

Maximum allowable SO_x emission rates that would be 50% of the relevant air quality criterion at the nearest sensitive receptor were calculated for the initial Air Quality protocol and are provided here:

- 3.4 kg/s (44 kg over the entire 13 s launch time)
- 1.3 kg/s (131 kg over the entire 100 s launch time)
- 0.8 kg/s (156 kg over the entire 200 s launch time)

The emission rates can be calculated for any launch vehicle once its propellant and technical specifications are known.

This rationale supports the decision not to model SO_x emissions, as the levels produced by the proposed action will be minimal and well within acceptable limits.

16 Demonstrate there is no potential significant impact from sulfur compound emissions

Both SO_x and NO_x create air pollution issues when the source is continuous, e.g. power station chimneys or urban vehicle exhaust emissions, and atmospheric conditions mean that it can accumulate causing smog and acid fog/rain to form. Neither of these are the case for the action or the Dhupuma Plateau environment.

17 Using the new maps requested in item 13 above, to be able to visually compare ground level concentrations in proximity to values, show:

a. ground level concentration contours in uq/m3 and include a contour for the criteria limit,

b. the boundary of the ASC

c. location of human sensitive receptors

d. location of environmental values such as sacred site, culturally significant sites, sensitive vegetation/ high biodiversity and water bodies.

Figures 99 to 102 in Attachment J show the 99.9% predicted 1-hour ground level concentration for HCl (140 µg/m3) for four launch pads at the extremities of the ASC and including the launch pad closest to the Garma Cultural Knowledge Centre**. It is important to note that these dispersion contours do not represent the spread or concentration of emissions per launch, rather they indicate where emissions at that ground level concentration could occur depending on the wind conditions at that time.**

These emissions will not disperse in concentrations that could reach or adversely affect environmental values:

- The AAPA Authority Certificate confirms that there are no sacred sites on lease area or within proximity to the ASC lease boundary area. Please refer to the *ASC AAPA Certificate 202*4 for details (Attachment K).
- There is no possibility of measurable emissions from the ASC occurring at culturally significant sites in the wider region (Attachment J, Figure 99 - Figure 102).
- Monsoon vine thicket vegetation is highly resilient to transient atmospheric changes and is able to quickly regenerate following disturbance. The location of the thickets near the ASC and the prevailing meteorological conditions further reduces the likelihood of any significant impact from launch vehicle emissions.
- Wet or dry deposition of NO_3^-, NH_4^+, or Cl^- into water bodies, i.e., rivers, will not occur at levels that could have a measurable effect on pH.
- Al_2O_3 is an inert compound that is a significant component of local soils. Its deposition as particulate matter will have no impact on environmental values.

18 Discuss any potential impact to water quality from aluminium oxide particulate matter and demonstrate that Australian drinking water and freshwater and marine water quality guidelines will be met.

Katestone's original Air Quality dispersion modelling report for ELA (2019) incorrectly applied the Australian Drinking Water Guidelines and Australian and New Zealand Guidelines for Fresh and Marine Water Quality for (acid soluble) aluminium to aluminium oxide.

Australia's drinking water guidelines note that the specifications for the supply of drinking water treatment chemicals, such as alum, will have a required level of aluminium, which can be expressed as equivalent aluminium oxide (Al_2O_3), but does not regulate aluminium oxide.

Aluminium oxide (Al_2O_3) is an inert, water-insoluble compound that does not bioaccumulate and is of low acute toxicity to aquatic organisms. It should not be confused with aluminium, which is toxic at low and high pH, or alum (aluminium sulphate), which is used to floc drinking water.

Aluminium oxide is a major component of Northern Territory soils and is mined as bauxite on the Dhupuma Plateau for aluminium production. Consequently, sediment runoff to waterways in this region will naturally contain aluminium oxide. There will be no impact of aluminium oxide particulate matter on any water body or potable water source.

19 Confirm dioxins and furans will not be produced by the proposed action

The potential for dioxins and furans formation has been assessed and we confirm they will not be produced by the proposed action. These compounds typically form at lower combustion temperatures (250°C to 800°C) and are destroyed at temperatures above 900°C. Since rocket engine combustion chambers operate at approximately 3,000°C, with exhaust temperatures ranging between 1,000°C and 1,500°C, the formation of dioxins and furans during launch is highly unlikely. Furthermore, any that might form would be rapidly destroyed due to the high exhaust temperatures.

20 Update the assessment of impacts from air quality with any relevant new information identified in addressing this Direction from the NT EPA such as proximity to sacred sites or monsoon vine thicket

Figures 1 to 102 (Attachment J) present the predicted ground level concentrations of the four pollutants for the respective averaging periods. **It is important to note that these dispersion contours do not represent the spread or concentration of emissions per launch, rather they indicate where emissions at that ground level concentration could occur depending on the wind conditions at that time.**

These emissions will not disperse in concentrations that could reach or adversely affect environmental values:

- The AAPA Authority Certificate confirms that there are no sacred sites on lease area or within proximity to the ASC lease boundary area. Please refer to the *ASC AAPA Certificate 2024* for details (Attachment K).
- There is no possibility of measurable emissions from the ASC occurring at culturally significant sites in the wider region (Attachment J, Figures 99 to 102).
- Monsoon vine thicket vegetation is highly resilient to transient atmospheric changes and is able to quickly regenerate following disturbance. The location of the thickets at and near the ASC and the prevailing meteorological conditions further reduce the likelihood of any significant impact from launch vehicle emissions.
- Wet or dry deposition of NO_3^-, NH_4^+, or Cl^- into water bodies, i.e., rivers, will not occur at levels that could have a measurable effect on pH.
- Al_2O_3 is an inert compound that is a significant component of local soils. Its deposition as particulate matter will have no impact on environmental values.

To further monitor the accurate assessment of air quality, ELA has obtained permission to establish a monitoring station across the road from the Garma facility. This station will collect data on air quality, providing us with valuable insights as we ramp up to 60 launches per year.

Land Terrestrial Ecosystems –The proposed action Sensitive vegetation

21 Confirm the area (in hectares, on a map and shp files), and vegetation types proposed to be:

a. Cleared for the Proposed Action

- Area: ~120ha as per the shape file in reference below.
- References:
  - ASC Map of project area showing clearing footprint (Attachment L)
  - ASC Map showing significant vegetation and weeds. Note the green hatched area is the Monsoon vine forest buffer, not the actual forest (Attachment M)
  - ASC_spatial_data_PDPv4.zip (Attachment Q) for shape files

b. Affected / impacted (but not by clearing)

The initially estimated affected area was based on preliminary assessments prior to the completion of detailed land clearing planning on July 25. Following this planning, the affected area will now mirror the land clearing area, meaning it will be the same ~120 hectares as outlined in the clearing plan.

Land Terrestrial Ecosystems –The proposed action Threatened species

22 Provide a map and shp files of areas of monsoon vine forest within 250 m of the proposed extent of clearing (as identified by an appropriately qualified person, using appropriate methodology), and the extent of proposed buffers

Please refer to Project Development Plan (Application for Land Clearing Permit), *ASC Map showing significant vegetation and weeds* (Attachment M).

23 Where the monsoon vine thicket cannot be avoided, provide survey results of the extent to be cleared and determine the potential impacts (including on threatened fauna species as per the DEPWS submissions)

No clearing of the monsoon vine thicket is planned or permitted.

The project area shown in the *ASC Vegetation and habitat assessment* (Attachment N) is larger than the clearing area shown in the Project Development Plan (application for Land Clearing Permit). The latter demonstrates that no clearing is proposed within the monsoon vine thicket.

The buffer zones, as outlined in the Executive Summary and Section 7.1.2 of the SER, remain intact, ensuring that the monsoon vine thicket is protected with a non-clearing buffer of at least 50 meters in most areas, only decreasing to 30 meters in one location as it was previous cleared of vegetation and due to constraints on road and unsealed hard stand constructability.

Further, ongoing monitoring and assessment will be conducted to ensure compliance with these commitments, and any necessary adjustments will be made to protect the thicket and associated habitats, especially concerning any threatened flora and fauna species.

24 Undertake an assessment of the value of all monsoon forest identified within, and adjacent to, the project area and implement an appropriate buffer, as required by the NTPS Land Clearing Guidelines

The value of the monsoon forest within and adjacent to the project area has been assessed as part of a recent vegetation and habitat survey conducted by EcOz, a local NT environmental consultancy. This assessment was further supported by botanist David van den Hoek (EcOz 2017) during a land clearing application for Phase 1 of the ASC.

The monsoon forest was determined to have limited / low conservation or habitat value due to the absence of springs, the relatively small area compared to other monsoon forest patches in the

bioregion, and the lack of any known threatened or restricted-range species within it. Further details are provided in Section 5.4 of the Project Development Plan (application for Land Clearing Permit).

ELA is committed to adhering to the 50-meter buffer requirement as stipulated by the NTPS Land Clearing Guidelines. However, in one specific area, an extant cleared patch consisting of a road and hard stand approaches no closer than 30 meters. ELA fully understands this requirement and will aim to increase the minimum distance wherever possible to reduce the level of incursion within the buffer. Where encroachment does occur signage and procedures will be utilised to restrict access off formed roads and eliminate any unessential traffic or passage.

Please refer to Attachment N, *ASC Vegetation and habitat assessment* for more detailed information.

25 Should implementing the recommended buffer as per the NTPS Land Clearing Guidelines not be achievable, the alternative must be justified

Should implementing the recommended 50-meter buffer as per the NTPS Land Clearing Guidelines not be achievable in specific areas, ELA will provide a clear justification for any deviations.

Impacts to the monsoon forest will be mitigated through the *ASC Vegetation and Weed Management Plan* (Attachment S), which outlines strategies to protect and manage the integrity of the monsoon vine forest during and after the construction activities. (see below)

Description of significant or sensitive vegetation community	Co-ordinate position and datum (e.g. GDA94)	Land Clearing Guidelines recommended buffer	Proposed buffer
Monsoon vine thicket	136.801322, -12.388989; 136.819383, -12.394944; 136.79411, -12.39405; 136.80640, -12.39244 (WGS84: EPSG4326)	50m	50m
Drainage depression	136.8094381316, -12.3831398336 (WGS84: EPSG4326)	25m	None

26 Describe ongoing monitoring, inspection and reporting of impacts on monsoon vine thicket to ensure its protection

Ongoing monitoring, inspection, and reporting of impacts on the monsoon vine thicket will be conducted as part of the *ASC Vegetation and Weed Management Plan* (Attachment S).

The plan includes regular measurement and tracking of any changes to the monsoon forest patch closest to the launch site. Monitoring will occur at six monthly intervals to ensure early detection of any potential impacts from launch events.

Should any adverse impacts be identified, the plan provides clear triggers for further action, ensuring that appropriate mitigation measures are implemented promptly to protect the monsoon vine thicket.

Land Terrestrial Ecosystems – Threatened fauna species

27 Review and revise the conservation status of threatened species listed in Table 3-2 and Table 5-1 of the 'Vegetation and habitat assessment' (Appendix 2 of SER)

Updated report now includes these. Refer to *ASC Vegetation and habitat assessment*, Attachment N.

28 Provide revised assessments for threatened species considering the correct threatened species conservation status, monsoon vine thicket surveys and any new or updated information in addressing this Direction

Updated report now includes these. Refer to *ASC Vegetation and habitat assessment,* Attachment N.

People – Community and economy

29 Provide further information that identifies and demonstrates that affected communities and individuals have been consulted on:

a. Potential social and economic impacts, including impacts on

ELA has ongoing consultation with affected communities and individuals to assess the potential social and economic impacts of the proposed action. Engagement is carried out through regular meetings (held quarterly to bi-annually during quieter periods) with the NT Government, the CEO of Developing East Arnhem Land (DEAL), the CEO of Gumatj, and through local Economic Forum presentations.

- Services to Medical, and Logistical Services to the Region From Increased Demand / Use

  ELA recognises the potential strain that increased demand may place on local services. As part of the NASA collaboration and during the commencement of Phase 2 planning, ELA proactively engaged with local service providers, including medical, fire, and logistical services, to ensure they are aware of activities at ASC and that adequate support is in place. This engagement included coordinating with local hospitals and emergency services to prepare for any potential increase in demand due to launch activities.

  This process involved meetings in town as well as on-site tours. ELA has updated several key plans to support the transition into Phase 2 operations. The ASC Training Plan directs ELA to conduct dry runs and dress rehearsals with local EMS services. This engagement will commence shortly, leading up to the next launch in July 2025, and will also include the latest updates to these stakeholders on site and launch plans.

- Users of the Gulkula Ceremonial Site (includes the Garma Institute and Garma Cultural Knowledge Centre)

  ELA recognises the cultural significance of the Gulkula site. ELA has close and continuous communication with Gumatj who administer the Garma site. ELA meets weekly with Gumatj on all Phase 2 planning and up-coming launches. ELA will continue to engage with the relevant stakeholders to ensure that the Garma site users are fully informed of any activities that may affect their use of the site and that any concerns are adequately addressed.

- Individuals, Other Businesses Particularly During Peak Visitor Periods

  ELA acknowledges the potential impact on individuals and businesses, especially during peak visitor periods. ELA informs the public via its website, social channels, and town communications when a specific launch is planned (using radio, posters in English and Yolŋu). Future engagement efforts will include targeted consultations with local businesses to discuss potential impacts and explore opportunities for collaboration. ELA will also engage with community members to understand their concerns and integrate their feedback into planning and operations.

  For example, ELA held a supplier open day in November 2023. We have also raised accommodation issues with The Walkabout, Gove Peninsula Hotel, and NTG several times. DEAL is also aware and assisting ELA in sourcing local accommodation for staff and clients when they travel.

- Community Cohesion

  ELA values the cohesion of the local community and is committed to working with community leaders to identify any concerns. We have a close working relationship with DEAL, Gumatj, the NT Government, the Economic Forum, and the NLC Regional Council. We will continue to nurture these relationships to support the social fabric of the region, ensuring that our operations contribute positively to the local economy and society.

  For example, we establish a Community Working Group for launches (a template created during the NASA collaboration), facilitated by DEAL, to help the town prepare for upcoming activities.

- Recreational and Cultural Activities

  ELA is committed to ensuring that the proposed actions do not disrupt recreational and cultural activities. Consultations will continue to focus on understanding the community's needs and identifying any potential conflicts, with the goal of finding mutually acceptable solutions. For example, members of the SRC include close Traditional Owner groups who administer the recreational and cultural activities in the area.

b. Broader potential positive and negative impacts of the proposed action, including details of the process used to identify these perspectives

Table 4: Potential positive and negative impacts of proposed action

Direct Jobs to NT over 5 years					
	2023/24	**2024/25**	**2025/26**	**2026/27**	**2027/28**
Contractors					
Earthmoving in Nhulunbuy	1	2	1	1	1
Construction Services in NT	10	12	12	8	8
Construction in Nhulunbuy	5	10	10	5	5
ASC Support services	1	5	7	10	10
Permanent Local ASC Staff					
Nhulunbuy	2*	5*	15	25	30
Yolngu positions (10%)	10%*	10%*	2	3	3
Indigenous positions (10%)	10%*	10%*	2	3	3
Launch Clients					
Visiting / year	25	375	600	775	1125
Avg / month	2	31	50	65	94
Staying (in town) / month	1	16	25	32	47
Staying (at site) / month	1	16	25	32	47

**Crucially dependent on talent required for key roles to scale ELA quickly to profitability and regular operational launch cadence.*

ELA presented to the NLC Regional Council meeting in July 2024, where the project was met with resounding support, with members expressing that this is a great opportunity that must happen to support the future of their children.

An early concern was raised by the local Members of Mulka, who initially did not support the project. This was addressed through an invitation and a visit from the Member after the NASA collaboration, as well as an ELA visit to their office in Darwin in early 2024. The issues raised were:

1. Consultation Process: The Members emphasised the importance of thorough consultation for the lease. ELA fully agrees and has ensured that the consultation process is being conducted with the utmost care and thoroughness. The NLC is leading this process, engaging comprehensively with all stakeholders to ensure that all voices are heard, and concerns are addressed. This thorough consultation is expected to be completed by the end of October, ensuring that the community is fully informed and supportive of the project. Feedback from the Gumatj COO on 26 September 2024 indicated that no issues have been raised, with only minor clarification points regarding the length of road closures being asked.

2. Safety Concerns and Military Target: The Members expressed concerns that the ASC could potentially become a military target, posing a danger to the community. ELA understands these concerns and reassured the community that the ASC is a commercial spaceport, not a military facility. The primary focus of the ASC is on commercial and scientific launches, which do not pose any greater risk than other infrastructure projects in the region. Additionally, ELA explained its commitment to maintaining the highest safety standards and working closely with local and national authorities to ensure the ongoing safety and security of the community.

How we identify perspectives:

The *ASC Stakeholder Engagement Plan* (Attachment D) provides a structured and systematic approach to identifying and assessing the potential positive and negative impacts of the proposed action on affected communities and individuals. The process is designed to be comprehensive, culturally sensitive, and responsive to the needs of all stakeholders:

1. Stakeholder Mapping: ELA employs a tiered system for stakeholder identification, as outlined in the *ASC Stakeholder Engagement Plan*. This involves mapping all potentially affected stakeholders, including those who may experience indirect impacts. By leveraging established relationships and existing forums, ELA ensures that the full range of perspectives, from Level 1 stakeholders (e.g., government agencies, lease holders) to Level 5 stakeholders (e.g., individuals), is considered.

2. Information Dissemination: Detailed information about the proposed action, its potential impacts, and mitigation strategies is communicated to stakeholders. This dissemination follows the plan's principles of using culturally appropriate and accessible communication methods, ensuring that all stakeholders, including Traditional Owners, are fully informed and understand the implications.

3. Feedback Collection and Integration: ELA actively seeks feedback from stakeholders through ongoing engagement activities, such as Safety and Retrieval Committee meetings, community forums, and direct consultations. The feedback collected is integrated into decision-making processes, with adjustments made to project planning as needed. ELA documents how this input influences project outcomes, demonstrating our commitment to being adaptive and responsive.

ELA is committed to maintaining transparent, inclusive, and responsive engagement practices with affected communities and individuals. This engagement is an ongoing process, continually refined to address all social, economic, and cultural impacts, in alignment with the principles and procedures outlined in the *ASC Stakeholder Engagement Plan* (Attachment D*)*.

People – Culture and heritage

30 In consultation with the Heritage Branch, (formerly Department of Territory Families, Housing and Communities, now Department of Lands, Planning and Environment), provide evidence that ELA has:

a. conducted a search for known archaeological places located within the subject site on the Heritage Branch archaeological database

b. conducted a search for known archaeological places located within the proximity of the subject site on the Heritage Branch archaeological database

c. determined the extent of pre-existing ground disturbance

d. determined the scale and nature of the work proposed (major, moderate or minor)

e. identified areas excluded from the work footprint (e.g. riparian buffers)

f. conducted an assessment of the likelihood of unrecorded archaeological places existing within the subject site, based on landscape features, known archaeological places in the vicinity, and other predictive tools.

On 6 September 2024, ELA submitted a Request for Information to the Heritage Branch to seek advice on the need for, and scope of, an archaeological survey concerning the proposed action. In response (see *ELA-NT Heritage-Request for Information Response*, Attachment O), the Heritage Branch undertook the following actions:

- A search of the Northern Territory Heritage Register;
- A search for known archaeological places located within the subject site on the Heritage Branch archaeological database;

- A search for known archaeological places located within the proximity of the subject site on the Heritage Branch archaeological database;
- The extent of pre-existing ground disturbance;
- The scale and nature of the work proposed (major, moderate or minor);
- Areas identified as being excluded from the work footprint e.g. riparian buffers; and
- An assessment of the likelihood of unrecorded archaeological places existing within the subject site, based on landscape features, known archaeological places in the vicinity, and other predictive tools.

The search found that there are no known Aboriginal or Macassan archaeological places and objects within the subject site. However, the likelihood of possible unrecorded Aboriginal or Macassan archaeological places has been assessed as possible. The extent of pre-existing disturbance and the nature of the work itself has also been considered. The Heritage Branch recommended conducting an archaeological survey and developing a cultural heritage management plan to identify and mitigate any potential impacts on Aboriginal or Macassan archaeological places and objects (see below).

Additionally, the search confirmed that there are no nominated, provisionally declared, or declared heritage places or objects within the subject area.

On 19 September 2024, ELA and Heritage Branch met and agreed on a comprehensive approach to ensure that potential archaeological impacts are identified and addressed in compliance with the regulatory framework:

1. Archaeological Survey: ELA has engaged with the Heritage Branch to develop a scope of works for a detailed archaeological survey of all undisturbed areas within the project footprint. The survey will include a 50m buffer around these areas to identify any risks to archaeological sites or objects, in line with the Heritage Branch's recommendations. The complete area to be surveyed can be seen in Attachment P.

2. Collaboration with Traditional Owners: The survey will be conducted with the support and involvement of appropriate Traditional Owners to ensure that cultural heritage values are respected (Gumatj Corporation will support ELA and an archaeologist will be utilised to implement the Heritage Branch's recommendations and advice). Detailed engagement logs will be maintained to document discussions, knowledge sharing, and participant selection processes.

3. Systematic Data Collection: The survey will follow a structured process, using transect spacing not exceeding 25m, to ensure thorough coverage. All identified archaeological sites will be recorded with detailed spatial data, site descriptions, features, environmental context, and management considerations.

4. Compliance with Reporting Requirements: In the event of discovering archaeological places or objects, ELA will report these findings to the Heritage Branch within seven days, in accordance with Provision 114 of the Heritage Act 2011. The final survey report, including all findings and spatial data, will be submitted to the Heritage Branch, as well as relevant Aboriginal Corporations or Land Councils. Any finds during the survey will be acting on accordingly in the continued development of the site either avoiding the finds where possible or engaging in required processes to relocate any artifacts prior to commencement of works in the affected area.

5. Ongoing Engagement: ELA commits to ongoing engagement with the Heritage Branch and other stakeholders throughout the project. Any changes to the scope of work or proposed activities will be communicated to the Heritage Branch to obtain updated advice as needed.

This approach ensures that ELA's operations at the ASC will proceed with a thorough understanding and respect for the region's cultural and archaeological heritage, demonstrating compliance with all legislative requirements.

31 Provide further information that Identifies potential impacts, including cumulative impacts, from rocket emissions on potential archaeological sites (and if these impacts differ in the wet season and the dry season). Identify measures that will be implemented to avoid, or mitigate these impacts

See answer to Direction 20 above. There is no possibility of measurable rocket emissions from the ASC occurring at culturally significant sites, sacred sites, restricted works areas, or other areas of high biodiversity and environmental value. The change in prevailing wind direction during the wet and dry season will not add to the likelihood of impact.

People – Culture and heritage – Launch Failures

32 Provide the process to ensure potential impacts on underwater heritage will be avoided

ELA takes the protection of underwater heritage seriously and has implemented a process to ensure that our operations do not negatively impact these important sites. The Gulf of Carpentaria does indeed contain a number of registered shipwrecks and aircraft wrecks, primarily located near reefs and rock outcrops. However, through our updated *Mission Optimisation Process* (Attachment C), we will be able to identify these areas of risk early and make specific plans to manage this during recovery activities.

It's important to note that the vast majority of the Gulf is free from such heritage concerns, and the probability of an object descending and hitting a known site is almost 0%. Additionally, all LVs landing in the Gulf of Carpentaria are promptly retrieved, further mitigating any potential risks.

ELA is committed to ensuring that our activities are conducted responsibly, and the measures we've implemented provide a high level of confidence that underwater heritage will remain unaffected by our operations.

For more detailed information, refer to the *ELA Mission Optimisation Process* (Attachment C), which outlines our approach to safeguarding both the environment and heritage sites.

33 In the event of a failed launch, demonstrate how impacts to cultural heritage are addressed

ELA places the highest priority on safety, including the protection of cultural heritage, and we mitigate risks as much as possible through:

- Selecting launch clients who are technically competent and have established, rigorous processes.
- Conducting thorough due diligence on each client before entering into contracts and prior to every launch campaign.
- The *Mission* Optimisation *Process* (Attachment C) is designed to ensure that launches not only meet mission requirements but also minimise risks to environmental, cultural heritage, or public safety.
- The ASA also reviews all aspects of the launch process, including safety and heritage protection, with the support of a third-party System Engineering company before issuing an ALP.

In the unlikely event of a launch failure, ELA has a well-structured approach to address any impacts on cultural heritage:

1. Controlled Failure Protocols: Our safety protocols are designed to ensure that any launch failure occurs in a safe, controlled manner. As required by the Space Act, ELA will work closely under the direction of the ASA, along with the launch client and relevant local agencies, to make the area safe and to swiftly remove any debris and remediate any damage, including impacts on cultural heritage sites. This coordinated approach ensures that potential impacts are addressed promptly and effectively.

2. Stakeholder Communication: As part of our procedures outlined in the ELA Operations Manual, ELA issues pre-launch, post-launch and post-recovery and remediation communiqués to key stakeholders, including the NT Government.

In the event of a Launch Failure (accident), ELA executes the operational procedure "LAUNCH VEHICLE / PAYLOAD ACCIDENT (DURING LAUNCH OR RETURN)". This procedure initiates execution of a tailored failure (accident) response plan.

The ASC Master contact list—reviewed and updated through the Mission Optimisation and the Launch Project Planning processes—is used to inform and manage stakeholders in a prioritised manner. This contact list will include all impacted stakeholders at all levels to ensure a seamless response in the unlikely event of an accident.

3. Stop-Work Procedure for Unexpected Finds: During recovery operations, if any unexpected finds, including cultural heritage items are discovered, ELA enforces a stop-work procedure to protect these areas until appropriate measures are taken.

People – Noise and Vibration

34 Provide the predicted noise level (dBA) at the project boundary and nearest sensitive receptors during rocket launches

The distance to centre of Garma from nearest launch Pad is ~1000 metres. At this distance and using the closest pad to nearest sensitive receptor, the predicted noise rating will be ~90dBA. As this pad is next to the boundary, the predicted noise at the boundary will be ~130dBA.

The maximum possible projected noise level at 10 metres from an igniting and launching LV is 130 dBA, which is equivalent to a large jet aircraft taking off. For comparison, Gee et al. (2023) measured the acoustics of the Space Launch System launch (SLS) launch vehicle (LV) for the Artemis-I mission. This super heavy lift LV is the most powerful rocket successfully launched, exceeding the Saturn V, which was built to send people to the moon. The SLS had post lift off maximum sound levels ranging from 127 to 136 dB between 1 and 5 km from the launch site.

LV launched from the ASC will be significantly smaller and quieter than such rockets. The LV is propelled rapidly upwards, faster than the speed of sound within seconds, and can reach > 10 km in altitude within 15 – 75 seconds from launch. There is no sonic boom during the launch due to the vertical ascent of the LV.

Unabated noise attenuation over distance follows the inverse square law, i.e., the observed "intensity" of a noise is inversely proportional to the square of the distance from the source of that noise. This can be represented as:

$$Lp(R2) = Lp(R1) - 20 \cdot \log10(R2/R1)$$

Where:

Lp(R1) = Known sound pressure level (dBA) at the first receptor location (R1)

Lp(R2) = Unknown sound pressure level (dBA) at the second receptor location (R2)

R1 = Distance from the noise source to location of known sound pressure level

R2 = Distance from noise source to the second location

Table 1 demonstrates the natural attenuation, i.e., without buffering by vegetation, topography, prevailing wind, or a deluge system, of possible noise levels from an LV launched from the ASC out to the east Arnhem coastline where there are colonies of nesting or resident migratory and shore bird species. The noise at 1,000 m from the site would be roughly equivalent, for the same distance, to an aircraft taking off at the nearby Gove airport. The noise from the loudest possible LV would be 71.9 dBA by the time it reaches the coastline, a level approximately equivalent to loud or shouted conversation. The sound will also diminish as the LV rapidly climbs and attains altitude.

Table 5: Natural attenuation of noise (dBA) over distance from its source

10 m	1,000 m	5,000 m	8,000 m

130 dBA	90 dBA	76 dBA	71.9 dBA
120 dBA	80 dBA	66 dBA	61.9 dBA
110 dBA	70 dBA	56 dBA	51.9 dBA

Static LV tests will radiate more noise than an LV in flight, however these will also be of short duration (i.e., ≤ 60 seconds), will only occur during daytime, and will be in a bunkered environment. Static tests produce less thrust and therefore less noise than a launching vehicle.

For comparison, Safe Work Australia lists the following common noise sources and their typical sound levels[1]:

- **140 dBA** – jet engine at 30 m
- **130 dBA** – rivet hammer
- **120 dBA** – rock drill
- **110 dBA** – chainsaw
- **100 dBA** – sheet-metal workshop
- **90 dBA** – lawnmower
- **85 dBA** – front-end loader
- **80 dBA** - heavy traffic
- **70 dBA** - loud conversation
- **60 dBA –** normal conversation
- **40 dBA** – quiet radio music

There will be temporary and infrequent impacts on local wildlife species because of noise from LV launches or static tests. These impacts are likely to be limited to a searching or startle response at most. Listed threatened wildlife species at the coast are unlikely to respond significantly to the noise of a static test or launch because the noise will have attenuated over the distance between the ASC and the coast.

35 Discuss the potential noise impacts from the operation of the helipad (and assumptions such as the frequency of use of the helipad and flight path near the community)

Helicopter operations will be infrequent and primarily serve specific operational needs, such as supporting up-range clearance and recovery sorties for certain launches. The helipad is also a critical asset for emergency medical evacuations, ensuring the safety and well-being of all personnel.

Given the limited frequency of helicopter use—especially when compared to regular activities like bauxite mining and the operations at Gove airport—the associated noise impact will be minimal and short-lived. Helicopters, when used, will follow designated flight paths that avoid populated areas as much as possible, further reducing any potential noise disturbance to the nearby community.

36 Discuss potential impacts from noise and vibration to the community and terrestrial fauna

Noise levels and potential impacts have been thoroughly assessed as part of this proposal. As highlighted in Direction 34 above, the maximum projected noise level at a distance of 10 metres from an igniting and launching vehicle is ~130 dBA, which is comparable to the noise level of a large jet aircraft taking off. However, due to the nature of rocket launches, this intense noise level is extremely brief as the launch vehicle rapidly ascends, surpassing the speed of sound within seconds and reaching altitudes over 10 km within 15 to 60 seconds. Notably, the vertical ascent ensures there is no sonic boom, which further mitigates potential noise impacts on the surrounding area.

The noise levels decrease significantly with distance, following the inverse square law. For example, an observer located 1,000 metres from the launch of the largest vehicle would experience noise levels around 90 dBA, equivalent to the sound of a lawnmower. Sensitive coastal areas, including colonies of threatened and migratory seabirds, would experience noise levels no higher than 70 dBA, which is

[1] https://www.safeworkaustralia.gov.au/sites/default/files/2022-09/nswm22_noise_infographic.png <accessed 02/02/2024>

comparable to a loud conversation. These levels are not only brief but also fall well within acceptable thresholds, ensuring minimal disruption. In comparison, commercial jets taking off, such as those at the nearby Gove Airport, tend to have a noise range of 120–140 dBA or about 80 dBA when heard from 150 metres away. The duration of noise from a rocket launch will be shorter than that of a commercial jet taking off, and the flight path over coastal areas will occur in a near vacuum, meaning that coastal species will experience very low noise during this time.

Additionally, the design and operational measures at the launch site further reduce noise impact. A water deluge system, which is activated at ignition, serves to suppress fire, thermal effects, and acoustics. Surrounding vegetation also plays a role in attenuating noise during ignition and initial lift-off. As a result, noise from the launch is heard for a maximum of 60 seconds after lift-off and rapidly diminishes as the vehicle ascends.

While rocket launches produce significant noise, the short duration, rapid attenuation, and mitigation measures ensure that noise impacts at the project boundary and on sensitive receptors remain within acceptable limits.

37 Identify mitigation measures proposed to reduce noise and vibration impacts

See answer to Direction 36 above. The design and operational measures at the launch site reduce noise impact. A water deluge system, activated at ignition, serves to suppress fire, thermal effects, and acoustics.

Surrounding vegetation also plays a role in attenuating noise during ignition and initial lift-off.

As a result, noise from the launch is heard for a maximum of 60 seconds after lift-off and rapidly diminishes as the vehicle ascends.