ntepa Northern Territory Environment Protection Authority

Statement of Reasons

EQUATORIAL LAUNCH AUSTRALIA – ARNHEM SPACE CENTRE

PROPOSAL

Equatorial Launch Australia (the Proponent), submitted a Notice of Intent (NOI) for the Arnhem Space Centre (the Proposal) to the Northern Territory Environment Protection Authority (NT EPA) on 5 October 2018 for consideration under the Environmental Assessment Act 1982 (EA Act).

Further information, primarily about air emissions and their ground level concentration, was requested on 12 November 2018, 20 February 2019, 7 June 2019 and 2 August 2019 to inform the NT EPA's decision. The Proponent provided air emission modelling results and ground level concentration information on 21 August 2019. The responses to the further information requests form part of the NOI.

The Proposal is to construct, develop and manage a multi-user, commercial space launch centre on the Dhupuma Plateau, located approximately 30km south of Nhulunbuy in the Northern Territory (Figure 1).

The closest areas of human activity (sensitive receptors) to the Proposal area include:

- Central Arnhem Road, approximately 2km north (of the Proposal area)
- Gulkula mine, 2.7km north-east
- Gulkula festival (also known as Garma festival) site 2.8km north-east
- Yirrkala community, 20km to the north-east
- Nhulunbuy community, 30km to the north.

The facility will be used to launch multi-stage solid-propellant rockets carrying different types of cargo (called payloads) such as satellite or scientific instruments, in a vertical arc towards the Gulf of Carpentaria. At a pre-determined time, the payload separates from the final stage of the rocket and spends a few minutes in micro-gravity collecting scientific data before being drawn back to Earth by gravity.

The Proposal footprint includes:

- the launch area / project area (the proportion of land planned for clearing and the location of launch infrastructure)
- the flight zone (the area of land and sea over which rockets fly and where rockets may land in the event of a launch failure)
- the landing zone (the area of land or sea within which a spent rocket stage or payload is likely to land).

The Proposal is located within the Arnhem Coast bioregion[1], which consists primarily of coastal ecosystems – including woodlands, mangroves, saline flats, heathlands and floodplain and wetland areas. The vegetation in the bioregion is characterised by Eucalyptus woodlands, monsoon vine-

[1] Department of Environment and Energy (2008) Arnhem Coast bioregion, online at: https://www.environment.gov.au/system/files/resources/a8015c25-4aa2-4833-ad9c-e98d09e2ab52/files/bioregion-arnhem-coast.pdf

forest and coastal communities. The Proposal is also located within the Gove Peninsula and north-east Arnhem coast Site of Conservation Significance[2]. No significant perennial freshwater courses are located within 1.5km of the launch site.

Landing zones are determined prior to launch and selected to avoid dropping objects near the coastline (approximately 9km to the east) aiming to avoid potential impacts to marine turtles, shorebirds and fishing activities. The first stage of the Black Brant IX (BBIX) rocket lands within 1km to 2km of the launch pad with the second stage landing approximately 80km east within the Gulf of Carpentaria. The Black Brant VC (BBVC) landing zone is located approximately 80km to 200km from the launch pad, also within the Gulf of Carpentaria. Payloads return somewhere near the landing zone of the final stage of the rocket.

In order to recover spent stages, the Proponent would maintain a track between the project area and the terrestrial landing zone. Tracks into the land based drop zone would be situated within ready access of existing roads and tracks. Once debris has been removed, each impact site and the track created would be subject to soil sampling and remediation. Any impact crater would be filled, any contaminated soil removed, substrate returned and the site rehabilitated based on the vegetation community affected.

Evaluation of this NOI is based on the project area, the terrestrial landing zone and the flight zone that is within the Northern Territory's jurisdiction. The second stage and payload landing zone has not been included in the NT EPA's evaluation because it lies within Commonwealth waters.

Construction of the Proposal will require:

- approximately 5.3ha of clearing to facilitate the development of three launch pads (approximately 5m x 25m) (Figure 2)
- a solar storage micro grid
- launch control centre
- access roads
- accommodation buildings and other supporting compounds.

Construction of facilities and infrastructure would be completed in two to three months. Up to 10 people will be employed during construction activities.

Operation of the Proposal will include:

- between 16 and 60 rocket launches per year (launches will occur in campaigns of four to 10 launches over a period of about three weeks. Four to six campaigns are expected per year in conditions where there is no rain, lightning and low wind)
- recovery of spent rocket stages and payloads by helicopter, boat and/or car
- remediation works at impact sites (when required).

Approximately 10 to 20 people will be employed during campaigns. In between campaigns, the site will be dormant with a caretaker and landscape maintenance personnel attending to the site. The Proponent indicates in the order of 1.5ML per year of water would be required for washdown purposes however the total Proposal water demand is not clear and the water source is identified as being from Galkula mine bore.

[2] Northern Territory Government (2009) Gove Peninsula and north-east Arnhem coast, online at: http://www.territorystories.nt.gov.au/bitstream/handle/10070/254298/24_gove.pdf

CONSULTATION

The NOI and further information has been reviewed as a notification under the EA Act in consultation with Northern Territory Government advisory bodies (listed in Attachment 1) in accordance with clause 8(1) of the Environmental Assessment Administrative Procedures 1984 (EAAP).

The Proponent has been consulting with the Gumatj Corporation, the Northern Territory Government and Developing East Arnhem Limited since 2016. The NOI indicates the Northern Land Council has also conducted consultation with Traditional Owners to identify and address key concerns raised by the community. The NOI states that the main concerns raised by the community were in relation to noise, pollution and direct impact, land owner consent and benefit, land and sea management (including sacred site management) and Proposal information (about space, rockets, site location and size).

The Australian Government Department of Industry, Innovation and Science (DIIS) Australian Space Agency (ASA) is responsible for authorising Australian space activities under the Space Activities Amendment (Launches and Returns) Act 2018 (SAALR Act), and administering the Space Activities Regulations 2001. There is provision under this Act for the responsible Australian Government Minister to grant a licence for a launch facility and be satisfied that all necessary environmental approvals are obtained and an adequate environmental plan for construction and operation of the launch facility has been made. For launches above 100km altitude, the ASA issues a Space Licence for the site and a Space Permit for each launch. The NT EPA has provided a copy of this statement of reasons to the Australian Government Minister for Industry, Science and Technology.

JUSTIFICATION

Having regard to the NOI and further information, the NT EPA evaluated the potentially significant environmental impacts and risks associated with the Proposal in line with the NT EPA's environmental factors and objectives, and in accordance with the requirements under the EA Act. The NT EPA identified four environmental factors (Table 1) that could potentially be significantly impacted by the Proposal. The NT EPA considered the importance of other environmental factors during the course of its assessment, however those factors were not identified as being potentially significantly impacted.

Table 1: Key environmental factors

Theme	Environmental factor	Objective
Air	Air Quality and Greenhouse Gases	Maintain air quality and minimise emissions and their impact so that environmental values are protected.
Water	Inland Water Environmental Quality	Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.
Land	Terrestrial Environmental Quality	Maintain the quality of land and soils so that environmental values are protected
Sea	Marine Flora and Fauna	Protect marine flora and fauna so that biological diversity and ecological integrity are maintained.
People and Communities	Social, economic and cultural surroundings	Protect the rich social, economic, cultural and heritage values of the Northern Territory.

1. Air quality and greenhouse gases

Objective: Maintain air quality and minimise emissions and their impact so that environmental values are protected.

Ambient air quality at the Proposal site is generally good. Bauxite mining in the region may contribute to ambient levels of particulate matter, including aluminium oxide. Smoke from distant and local vegetation burning during the dry season contributes to regional emissions. The Proposal has the potential to generate air emissions through its construction (from dust, diesel powered vehicles and generators) and operational phases (from launch emissions and diesel powered vehicles).

The NT EPA is satisfied that potential impacts and risks associated with dust generating activities (during construction works and vehicle movements) will be mitigated through the dust suppression measures identified in the NOI.

The NOI presents modelling and scenarios for two rocket types: BBIX the 'worst case scenario' and 'oldest technology' solid propellant rocket; and BBVC, the rocket most likely to be used at the facility. During operation, air emissions of concern likely to be generated from rocket launches are:

- carbon monoxide
- aluminium oxide
- hydrogen chloride.

These emissions to air are expected to be at high concentrations in the immediate vicinity of the launch pad immediately after launch. The Proponent undertook dispersion modelling using the United States Environment Protection Authority (US EPA) regulatory model AERMOD, with ambient air quality assessment criteria adopted from the National Environment Protection (Ambient Air Quality) Measure (Air NEPM), New South Wales, Victoria and Ontario[3].

The Proponent stated modelling results are conservative (higher than expected in actual operation) due to limitations of a suitable model for rocket launches and variability in applicability of the emission criteria. The Proponent described AERMOD as a steady state dispersion model that assumes constant emissions and meteorological conditions for each modelled hour and that model outputs are approximate and may still be overestimated.

The modelling results indicate that under the worst-case conflagration (large destructive fire) scenario, ground-level concentrations of carbon monoxide, aluminium oxide and hydrogen chloride are predicted to meet NSW Approved Methods criterion at the nearest sensitive receptors. The modelling results indicate that under a normal launch scenario, ground-level concentrations of carbon monoxide and aluminium oxide are predicted to comply with the NSW Approved Methods criterion at the nearest sensitive receptors.

Modelled ground-level concentrations of hydrogen chloride (one hour average) exceed (not comply with) NSW Approved Methods criterion by 22µg/m^3 or 0.01 parts per million at the Garma festival site. The Proponent has committed to no launches occurring when there is a significant number of people at the festival site. The Proponent has also committed to fixed and mobile monitoring stations within the site boundary and offsite (within 3km of the launch pads) to monitor air quality during operations. The air monitoring devices would include multi-gas and particle detectors for industry

[3] The relevant policies and standards referenced in the Proponent's assessment is as follows:

- National Environmental Protection (Ambient Air Quality) Measure (Air NEPM) standards
- Approved methods for the modelling and assessment of air pollutants in NSW (NSW EPA, 2016) (Approved Methods)
- State Environment Protection Policy (Ambient Air Quality) (Victorian Government Gazette No. S19) (EPA Victoria, 1999)
- State Environment Protection Policy (Air Quality Management) (Victoria Government Gazette No. S240) (EPA Victoria, 2001)
- Ontario's Ambient Air Quality Criteria (Standards Development Branch Ontario Ministry of the Environment, 2012)

environmental monitoring purpose (human safety as well as local ecosystem loads and thresholds). Immediately prior to launch, air monitoring stations would be activated to measure launch emissions of carbon monoxide, hydrogen chloride and particulates.

Potential impacts on air quality from hydrogen chloride emissions during a normal launch scenario are expected to be localised, limited to each launch, and will be quantified and managed through the implementation of the Proponent's environmental management commitments. The NT EPA acknowledges that the model used has limitations related to the type of proposed activity, may generate conservative estimate outputs, that the nearest sensitive receptor is approximately 2.8km from the launch facility, and that each launch will be a very short duration of about 30 seconds, rather than an ongoing activity generating constant emissions. The Proponent's commitments in the NOI include no launches occurring when there are a significant number of people at the festival site, monitoring and ongoing consultation.

When hydrogen chloride is in contact with water, hydrochloric acid is formed. The Proponent acknowledged that it was unable to quantify the amount of hydrochloric acid produced as a result of launch activities, or its fate in the environment. However the Proponent has committed to conducting ongoing monitoring and appropriate environmental management responses in its NOI including air and water monitoring. The NT EPA is satisfied that the environmental management responses are appropriate to prevent significant impacts resulting from hydrogen chloride emissions and deposition.

The Proposal is not expected to produce significant greenhouse gas emissions. In a worst case scenario the Proposal will produce approximately 92t of CO_2-e emissions per year. This is not a significant component of the Northern Territory's annual CO_2-e emissions, which were approximately 16.6 Mt CO_2-e[4] in 2017.

The NT EPA supports the Proponent's commitment to undertake air monitoring throughout the life of the Proposal to ensure monitoring correlates with modelled emission concentrations and meets air quality criteria.

Further, the NT EPA supports the Proponent's use of modern and greener propellants which are expected to have less environmental impact.

The NT EPA considers that the Proposal is highly likely to meet its objective for air quality and greenhouse gases.

2. Inland water environmental quality and Terrestrial environmental quality

Objective: Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.

Objective: Maintain the quality of land and soils so that environmental values are protected.

The Proposal has the potential to impact inland water environmental quality and terrestrial environmental quality through soil contamination (and subsequent impact to water values) released during launches, spent stages and failed launches.

The Proponent has committed to developing and implementing an Erosion and Sediment Control Plan (ESCP) during construction and operation of the Proposal. The ESCP would be prepared by a suitably qualified and experienced professional in erosion and sediment control planning; and be reviewed and approved by a Certified Professional in Erosion and Sediment Control (CPESC).

[4] https://www.environment.gov.au/system/files/resources/917a98ab-85cd-45e4-ae7a-bcd1b914cfb2/files/state-territory-inventories-2017.pdf

Dispersion modelling predict the deposition rate of aluminium oxide, based on a normal launch and worst case conflagration scenario, indicate that:

- the estimated concentration of aluminium in water is predicted to comply with the Australian Drinking Water Quality Guideline of 0.2mg/L at all locations under the normal launch scenario
- the estimated concentration of aluminium in water is predicted to comply with the Australian and New Zealand Guidelines for freshwater quality guideline of 0.8µg/L beyond approximately 1.5km from the launch site under the normal launch scenario
- the estimated concentration of aluminium in water is predicted to exceed the Australian Drinking Water Quality Guideline of 0.2mg/L within approximately 3km from the launch site under a worst-case conflagration scenario.

While ammonium perchlorate and aluminium have the potential to be toxic in high concentrations, these propellants are contained within a plastic matrix, and so dissolve slowly. In the event of a launch failure or unplanned landing, personnel will be deployed to recover debris using debris modelling. At each site where debris is found (greater than 500g), contaminated soil will be removed and soil sampling undertaken for analyses of potential contaminates. Follow up soil sampling will be undertaken after the first significant rainfall following the event. The NOI concludes that given the low likelihood of perchlorates being released into the environment (i.e. only due to a failed launch and assuming that some fragments of solid fuel are not found), the slow release into the environment, and therefore the low likelihood for concentrations or accumulations to occur, a significant impact to the quality of land and soils is not predicted.

The Proponent states that significant impacts to water quality from a conflagration event are unlikely given:

- there is less than a 2% chance of rocket failure
- the full BBIX (or equivalent emissions profile) is unlikely to be delivered as soiled fuel pieces are expected to be recovered
- the groundwater extraction point used for the Garma festival and Gulkula mine site is outside the likely peak concentration area
- modelling identified that winds tend away from the groundwater extraction point
- none of the mapped towns, communities or homelands are located within 3km of the launch site
- monitoring locations have been proposed to track and respond to potential emissions. These include water testing at the launch site and air monitoring to the north-east of the launch site, with a view to enable early detection of potential threshold issues and opportunities to notify authorities.

Modelling indicates deposition rates will be highest close to the launch pads. To mitigate impacts to the soil, water and the surrounding environment, the launch pads will be contained within cleared areas (25m x 100m) which have a 0.4m berm around the perimeter with a gentle slope to direct surface water run-off into a concrete lined impoundment. Captured run-off evaporates and any remaining solids will be disposed of in accordance with waste requirements (subject to analysis of water quality). Captured water will be treated using a buffer solution (e.g. sodium bicarbonate) if pH adjustments are required before discharge to the environment.

After each campaign / series of related launches at a launch pad, the Proponent has committed to soil monitoring at all soil sites and testing the water within the impoundment for nitrogen and aluminium/chlorine compounds, as well as pH to indicate the levels of hydrogen chloride. With the implementation of the proposed run-off containment and treatment at launch pads, the NT EPA does not anticipate significant impacts to freshwater quality as a result of stormwater run-off. Water monitoring locations have been identified and monitoring is planned to be conducted twice per year. With the implementation of proposed monitoring and management program, the NT EPA anticipates that exceedances to water quality parameters would be identified and addressed to prevent significant impacts to freshwater quality.

The NOI outlines adaptive management processes to assess and mitigate site soil and stormwater contamination following construction and operation of the facility. Where warranted, the process for remediation of the site and surrounds is provided through the National Environment Protection (Assessment of Site Contamination) Measure[5].

The NT EPA considers that the Proposal is highly likely to meet its objectives for inland water environmental quality and terrestrial environmental quality.

Further, the NT EPA notes that once debris has been removed, each impact site and the track created will be subject to soil sampling and remediation in accordance with the EMP as well as requirements for environmental management and monitoring under Space Activities Regulations 2001.

3. Marine flora and fauna

Objective: Protect marine flora and fauna so that biological diversity and ecological integrity are maintained.

Evaluation of this factor is based on the coastal waters within the Northern Territory's jurisdiction, and applies to rockets that experience launch failure and unplanned landings in Northern Territory waters.

The coastal and marine environments of the Gulf of Carpentaria are known to support large numbers of nesting waterbirds and migratory shorebirds, extensive seagrass beds that are important foraging grounds for green turtles and dugongs, and waters that support listed species such as freshwater sawfish, seahorses and pipefish.

Direct hit of spent stages and payloads has the potential to be fatal to marine fauna. Although the probability of a direct hit is low, the Proponent has designated landing zones that do not coincide with known threatened or migratory species congregations and avoid the coastline (to avoid impacting marine turtles, shorebirds and dugong habitat) to further reduce the risk of a direct hit. The Proponent has committed to inspection and documentation of stage landing for each launch.

The Proponent states that falling stages and payloads would produce a momentary impact-type sound as they land on the water surface. This is unlikely to impact marine flora due to a combination of the low number of descending stages and payloads (maximum of 60 per year), their wide spatial dispersion and that it is unlikely any individual animals would be in proximity to more than one descending item during its lifetime.

Trace amounts of solid propellant may be present in fallen stages and payloads and if not recovered, has potential to corrode and introduce metal ions into the water column. This could potentially impact on marine flora and fauna by reducing water quality. The Proponent expects that in the unlikely event that a stage is not recovered, the volume of water available for dilution, the low levels and decomposition rates of perchlorate in water and the low likelihood of fuel being present in the fallen stages, means that impacts to marine flora and fauna will be minimal.

Timely recovery of stages and payloads from Gulf waters will be essential. If not retrieved within a short timeframe, parachute assisted payloads present a risk of entanglement for marine megafauna. The Proponent has committed to minimising the exposure of spent stages and payloads in the marine environment by recovering debris within 24 hours of launch. The Gulf of Carpentaria is also shallow with a flat sea bed which will increase the chance of successful recovery. The Proponent proposes to incorporate use of the NSW National Parks and Wildlife Service rescue training practices to respond to wildlife emergencies if required (e.g. marine megafauna' entanglement). The DENR

[5] http://nepc.gov.au/nepms/assessment-site-contamination

Flora and Fauna Division is satisfied with the retrieval measures proposed in the NOI and considers the risk of significant impact to marine flora and fauna to be low.

The NT EPA considers that the Proposal is highly likely to meet its objective for marine flora and fauna.

4. Social, economic and cultural surroundings

Objective: Protect the rich social, economic, cultural and heritage values of the Northern Territory.

The Proposal is situated within Aboriginal freehold land and within the Arnhem Land Aboriginal Land Trust. The Proposal is also located within the Dhimurru Indigenous Protected Area (IPA) which comprises approximately 550,000ha of Yolngu land and sea country. The lands surrounding the Proposal support Indigenous use and conservation, mining, residential, recreation and tourism.

ELA committed to obtaining an Authority Certificate from the Aboriginal Areas Protection Authority (AAPA). The Proponent's discussion with Traditional Owners indicate that they are aware of the location of the sacred sites which, in the region, are small and localised. There are no sacred sites within the terrestrial landing zone. In the unlikely event rocket debris falls within a sacred site, Traditional Owners are ready to mobilise and assist with recovery.

The Department of Tourism, Sport and Culture Heritage Branch is satisfied that all historical and non-Indigenous heritage and archaeological issues have been adequately addressed by the Proponent.

There is potential for spent stages or failed launches to hit people or property, or hit or disrupt commercial airspace. The Proponent states, however, that launch failure that results in one or more stages disintegrating above ground is an unlikely event. The BBIX rocket for example, has a 98% success rate. The Proposal area is remote (less than one person per square kilometre) and flight zones do not include any human dwellings or activity spots (besides recreational fishing). The Proponent is working collaboratively with the NT Seafood Council to ensure that there are long lead times for launches so that they do not negatively impact fishing operations in the area. Prior to launching, a Notice to Airmen from the Civil Aviation Safety Authority (CASA) and Notice to Mariners from the Australian Hydrographic Office will be issued advising of when the launch window opens and where to avoid flying/sailing. Community notices will also be broadcast via radio stations, newspapers and social media. These measures provide some transparency to the community.

Noise from a rocket launch is expected to be intense but short (1 to 2 seconds). The NOI states that although rockets reach supersonic speeds after only a few seconds, they generally would not generate a sonic boom noticeable on the ground. Noise is estimated to be 111dBA at 1km, decreasing to 95dBA at 3km and 74dBA at 11km. Spent stages or incoming payloads traveling at subsonic speeds would produce a characteristic whistling sound, followed by a momentary impact-type sound as they land on the water surface. The Proponent states that launches will not occur when there are significant numbers of people at the Garma site. Noise during construction and outside of launch times is expected to be minimal.

The Proponent states that the Proposal activities do not involve sources of radiation.

The Proponent has committed to developing a Social Impact Analysis and Social Impact Management Plan for the Proposal.

Due to the limited launches, short duration of each launch, frequency of launches, the sparse population density and commitments from the Proponent, the NT EPA is satisfied that the Proposal will meet its objective for social, economic and cultural surroundings.

Conclusion

The NT EPA considers that with the implementation of the Proponent's commitments including the Environmental Management Plan in the NOI and adaptive management processes, the potential

environmental impacts and risks of the Proposal will be mitigated to such an extent that they are not significant.

The Proposal would be regulated by the Australian Government under Space Activities Amendment (Launches and Returns) Act 2018 and Space Activities Regulations 2001.

Comments from Northern Territory Government advisory bodies have been provided to the Proponent and the responsible Australian Government Minister. The NT EPA has provided advice to the Proponent to ensure that potential impacts and risks to the environment are minimised and responsibilities under the legislation can be met.

DECISION

The proposed action, which was referred to the NT EPA by Equatorial Launch Australia, has been examined by the NT EPA and preliminary investigations and inquiries conducted. The NT EPA has decided 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. Environmental management of the potential environmental impacts is the responsibility of Equatorial Launch Australia through preparation and implementation of procedures and management plans specified in the NOI.

This decision is made in accordance with clause 8(2) of EAAP, and subject to clause 14A the administrative procedures under the EA Act are at an end with respect to the proposed action.

DR PAUL VOGEL AM MAICD

CHAIRMAN

NORTHERN TERRITORY ENVIRONMENT PROTECTION AUTHORITY

14 OCTOBER 2019

Figures

Figure 1: Location of the Proposal (Source: Conceptual Stormwater Management Strategy)

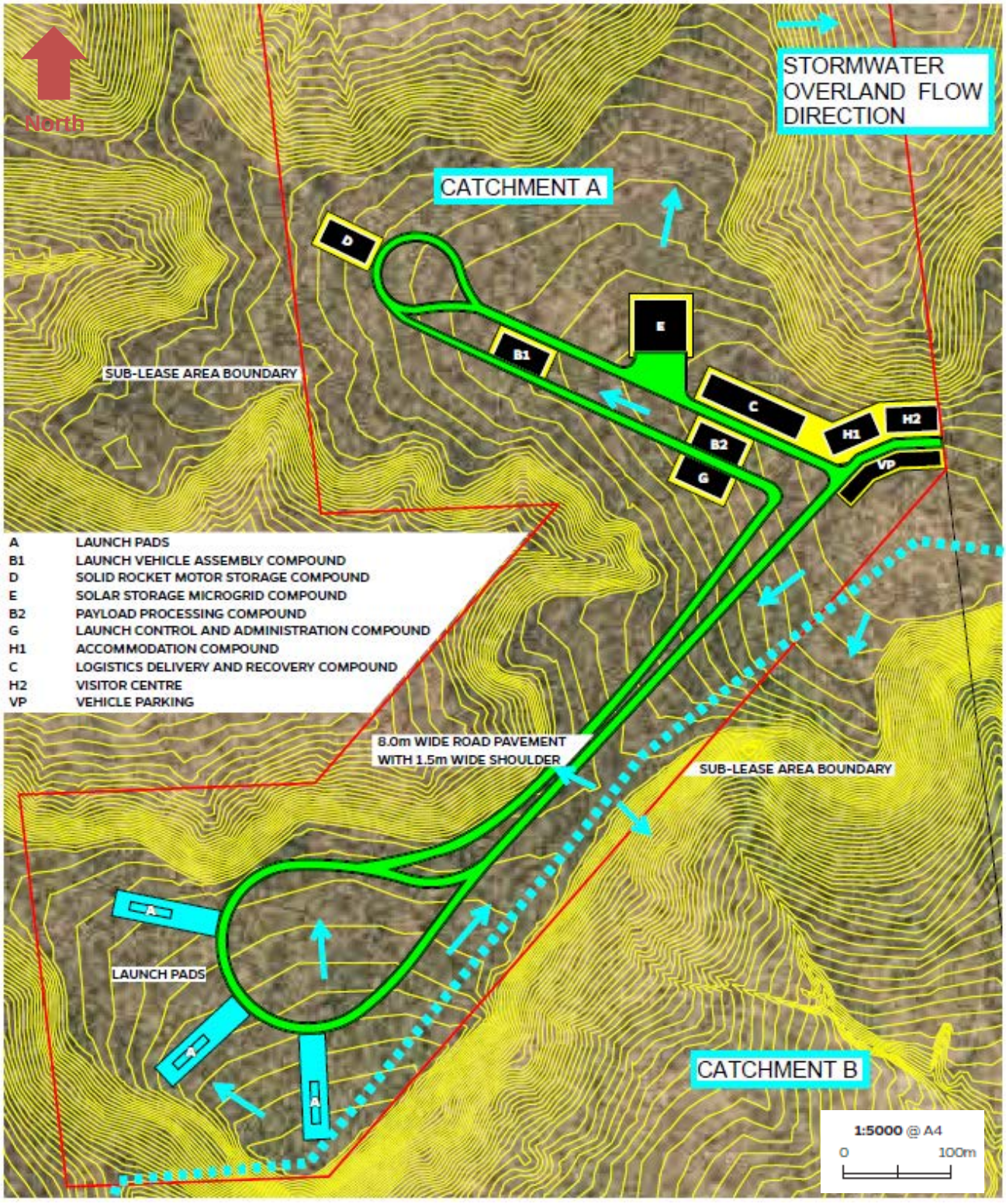

Figure 2: Site layout (Source: Conceptual Stormwater Management Strategy)

Attachment 1: Northern Territory Government Advisory bodies consulted on the Notice of Intent

Department	Division
Department of Environment and Natural Resources	Flora and Fauna Water Resources Weeds Environment Bushfires NT Rangelands
Department of Infrastructure, Planning and Logistics	Lands Planning Infrastructure Transport
Department of Primary Industry and Resources	Fisheries Mining Compliance Petroleum Primary Industry
Department of Tourism, Sport and Culture	Heritage Tourism NT Arts and Museums Parks and Wildlife
NT Police, Fire and Emergency Services	Business Improvement and Planning
Department of Health	Environmental Health Medical Entomology
Department of Trade, Business and Innovation	Economics and Policy Strategic Policy and Research
Department of Local Government, Housing and Community Development	Maintenance Planning Housing supply
Power and Water Corporation	
Aboriginal Areas Protection Authority	Technical
Department of the Attorney-General and Justice	Commercial Division NT Worksafe
Land Development Corporation	
Department of the Chief Minister	Economic and Environmental Policy