

Comments in response to the public consultation on Assessment of Environmental Effects: SaxaVord Spaceport by Drone Wars UK

Drone Wars UK (www.dronewars.net) welcomes the opportunity to provide feedback on the Assessment of Environmental Effects (AEE) for the SaxaVord Spaceport on the island of Unst. We are a UK based non-government organisation which undertakes critical research into the use of armed unmanned systems, commonly known as drones, and other emerging military technology. We scrutinise the increasing use of technology for security purposes, undertaking research, education, and campaigning on these issues, and advocating a human security approach. Our recent work has broadened to include analysis of the UK's rapidly accelerating military space programme.

The government's environmental objectives for spaceflight are to:

- Minimise emissions contributing to climate change resulting from spaceflight activities
- Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities
- Protect people and wildlife from the impacts of noise from spaceflight activities
- Protect the marine environment from the impact of spaceflight activities.

We are concerned that, in a number of respects, the AEE for the SaxaVord spaceport does not fully address these objectives.

Impacts on the local community

Shetland spaceport predicts significant beneficial local effects from the SaxaVord spaceport through:

- employment associated with operation of the Spaceport;
- demand for goods and services to support the operation of the spaceport;
- hosting temporary workers from the launch companies who will utilise local shops, hospitality and other amenities; and,
- attracting tourists who will visit to watch launches and/or explore the Proposed Project (including outside the current summer tourism season).

They estimate that employment associated with the proposed level of activity will generate:

- £4.9 million GVA and 139 jobs in Unst;
- £7.5 million GVA and 209 jobs in The Shetland Islands; and,
- £9.3 million GVA and 255 jobs in Scotland.

A detailed breakdown of how these figures have been calculated should be provided, including the assumptions behind them.

We are concerned that the impacts on the local community appear to have been assessed principally in economic terms, with little consideration of broader socioeconomic factors. Experience at other spaceports (notably in the US) indicates that the predicted advantages

to local communities anticipated by developers frequently do not actually materialise, while sociological impacts can be significant.

Issues which require further consideration in the AEE include the following matters:

- What type of jobs might be offered to local residents and will any training be provided to residents? If so, then where will that take place and to what accredited standards?
- What wage range can locally recruited employees expect to be paid at?
- What proportion and numbers of employees will be locally recruited and what proportion are expected to migrate to the locality?
- What impact is the migration of employees from outside the Shetlands expected to have on local housing availability and local prices?
- Are any new commercial retail outlets to be provided at or in association with the spaceport to accommodate increased demand?
- How many temporary workers are expected to work at the site during the construction phase; from where will these workers be drawn, and what measures will be taken to ensure that a large influx of workers from outside will not have an undue impact on the local community?
- What steps will be taken to ensure that the anticipated economic benefits are distributed equitably among the local community and do not disrupt current livelihoods and economic activities?
- What agreements do the developers expect to enter into with local authorities to provide an equitable contribution to local infrastructure and services to meet demand from the spaceport and its employees?

The AEE should clarify how space launch activities at SaxaVord will relate to those at other planned space ports – i.e. in Sutherland, Wales, and Cornwall. Will the spaceports be in competition with each other, will they cooperate or will each site specialise in some way? If they are acting in competition it is entirely possible that the anticipated economic benefits for the SaxaVord spaceport may not fully materialise as a result of business being attracted to an alternative location. This may result in fewer economic benefits than anticipated.

To ensure that emerging environmental and social issues can be addressed as they arise, the spaceport should be required, as a condition of its license, to establish a site stakeholder group, with membership including local authorities and relevant public authorities, and local community, voluntary sector, and environmental groups. The group should meet regularly to discuss activities and impacts associated with the spaceport and should provide a forum allowing local communities to scrutinise and hold the spaceport operators to account. All meetings should be open for members of the public and the press to attend and ask questions.

Tourism

A more detailed tourism impact assessment is required as part of the environmental assessment process for the spaceport. This should address the following factors, among others:

- How many tourists are expected to visit the spaceport, and at what times?

- How will tourists travel to visit the spaceport?
- Car hire arrangements are limited and private motor transport has a relatively high carbon footprint. What additional public transport facilities will be established to allow tourists and employees to travel to the spaceport?
- How long will tourists visit the area for, and where are they expected to stay?
- What additional local services and infrastructure will be needed to meet tourist demand, and what arrangements will the spaceport be making with local authorities to contribute to the costs?

Wildlife

The AEE predicts that the construction and continued operation of the spaceport is likely to have a significant residual effect on the otter population. The assessment does not predict any other likely significant ecological residual effects associated with the proposed project. Our view is that this is not feasible, and that impacts likely to affect otters are likely to have an impact on other wildlife. Specific arrangements for mitigating and compensating the impact on otters and other wildlife should be set out in the AEE in adequate detail.

The AEE did highlight that some of the local wildlife was “particularly sensitive to sudden noise events” and suggestions have been made that sound-proofed boltholes be built for the animals such as otters to take shelter in.¹

Ornithology

Unst is a home to protected bird species which are rare but have a stronghold in Shetland. We note that the Royal Society for the Protection of Birds (RSPB) still has some concerns regarding the AEE. RSPB points out that the developer will also need to provide information on how they will avoid disturbing breeding birds, and submit a breeding birds protection plan, and also states that there is potential for impacts on the nearby Hermaness, Saxa Vord and Valla Field Special Protected Areas, which are about 3.79km from one of the proposed launch pads. This internationally designated site is protected for its populations of breeding seabirds; fulmar, gannet, great skua, guillemot, puffin, kittiwake, red-throated diver and shag. The SPA overlaps two nationally designated Sites of Special Scientific Interest (SSSIs): Hermaness SSSI and Saxa Vord SSSI, which are also protected for their seabirds.

We share RSPB's concerns and consider that a detailed bird protection plan should be submitted as part of the AEE, covering not just the site of the development but the impact further afield.

Flora

There is no mention in the report of the flora which may be disrupted. Edmonston's Chickweed is a rare flower which is endemic to Unst. The AEE should state whether

¹ Kieren Williams, Soundproofed boltholes planned for UK otters after launch of 'vertical' spaceport, Daily Mirror, 14 November 2022, <https://www.mirror.co.uk/news/uk-news/soundproofed-boltholes-planned-uk-otters-28490347>

spaceport activities may impact upon this species, and if so, such activities should be prohibited by license conditions given the fragile status of this species.

The development has significant potential to allow for enhancements of the local environment with the objective of conserving and improving biodiversity. The AEE should identify opportunities for such work and commit to undertaking them.

Pollution

The effects of project-generated traffic and generator emissions on air quality are predicted to be of negligible significance. Associated noise effects of non-launch activities are also assessed to be insignificant. However, there will be noise during engine tests and launches at levels that will exceed the criterion for community annoyance associated with aircraft noise. Although this may not cause visible damage it is likely to be annoying and inconvenient. The CAA should impose license conditions restricting noise limits to below a certain ceiling at sensitive receptor sites, and limiting the hours of the day over which these may take place and the total number of hours per week over which these may take place.

There will also be significant night time lighting during the construction and operational phases of the site. There is no impact statement on how this might affect local insect life (e.g. bees, moths, etc) – an area of growing importance.² A light pollution impact assessment should therefore be prepared by the developer before the AEE is approved by the CAA.

Details of hazardous materials which may be stored on the site are not disclosed in the AEE. An inventory of hazardous materials and potential pollutants should be prepared by the developer as part of the AEE. A protocol setting out measures for preventing and dealing with spills of hazardous substances should also be prepared to match best practice and meet the requirements of the Scottish Environmental Protection Agency (SEPA) and the local fire and rescue service. All discharges from the site to the atmosphere and the water environment must be consented by SEPA.

Launch Vehicles

Sub-orbital launches will involve the dumping of spent launch vehicles in the sea. The AEE states that it is 'expected' that they will all be recovered. This position is unacceptably vague. Full details of measures to recover spent launch vehicles should be provided before the CAA approves the AEE, and it should be a licence condition that launch vehicles will be recovered for responsible disposal and materials recovery in all but extreme circumstances.

An exclusion zone will likely be implemented around the launch vehicle impact zones which may be a problem for the local fishing and leisure industries. A full assessment of the impacts of launches on fishing and leisure should be provided before the AEE is approved by the CAA.

² "Light pollution is key 'bringer of insect apocalypse'" by Damian Carrington, The Guardian, 22 November 2019 - <https://www.theguardian.com/environment/2019/nov/22/light-pollution-insect-apocalypse>

Greenhouse Gas Emissions

No assessment has been provided on the effects of greenhouse gas emissions during construction and operational phases. This omission should be rectified, and a full life-cycle analysis of greenhouse gas emissions should be provided by the operator before the AEE is approved. The operator should indicate how these emissions will be offset to ensure that the development remains carbon neutral over its lifetime, and the CAA should in due course apply licence conditions to ensure the mitigation measures are mandatory.

In addition, the disruption of large areas of peat will have a significant environmental impact. The presence of peat is important for many reasons³ – it regulates water flows and sequesters greenhouse gases (especially methane) while preserving a historical archive of the past and protecting unique plant and animal species. Disruption of peat deposits has the potential to have a significant climate change impact. The AEE should not be approved by the CAA until the climate impacts on peat deposits have been assessed and credible proposals for minimising and mitigating impacts have been submitted

Rocket Fuels and Damage to Upper Atmosphere

There is no mention of effects of orbital launches on the upper atmosphere. This is a significant omission as recent research indicates that rockets travelling through the upper atmosphere can damage the ozone layer and contribute to climate change. Approximately two-thirds of the rocket exhaust from the burning fuel are released into the stratosphere and mesosphere, and the exhaust particles are so small that they stay there and accumulate for 3-4 years.⁴

It is not clear what types of rocket fuel will be used at the site but the combustion emissions common to all types of rocket propellants include water vapour (H₂O) and nitrogen oxides (NO_x, NO + NO₂), and other pollutants include black carbon (BC or soot) from carbon-based solid and hypergolic fuels and kerosene, and alumina particles (Al₂O₃) and gaseous chlorine (Cl) from solid fuels.⁵ Rockets inject these pollutants directly into all atmospheric layers. Space objects re-entering the atmosphere through the mesosphere also emit thermal NO_x from the vaporisation process.⁶

These pollutants have a number of harmful effects on the atmosphere. For example, the nitrogen oxides, alumina and chemicals produced from the breakdown of water vapour,

3 “Shetland’s peat bogs – how important are they?” by The James Hutton Institute, 16 November 2017 -

<https://www.hutton.ac.uk/news/shetland%E2%80%99s-peat-bogs-%E2%80%93-how-important-are-they>

4 Eloise Marais, ‘Space tourism: rockets emit 100 times more CO₂ per passenger than flights – imagine a whole industry’, *The Conversation*, 19 July 2021 - <https://theconversation.com/space-tourism-rockets-emit-100-times-more-co-per-passenger-than-flights-imagine-a-whole-industry-164601>

5 J.A. Dallas, S. Raval, J.P. Alvarez Gaitn, S. Saydam and A.G. Demspeter, “The environmental impact of emissions from space launches: A comprehensive review”, *Journal of Cleaner Production*, 255, 28 January 2020 - <https://www.sciencedirect.com/science/article/pii/S0959652620302560>

6 See for example, Park, C. & Rakich, J. V. ‘Equivalent-cone calculation of nitric oxide production rate during spaceshuttle re-entry’, *Atmospheric Environment*, Vol 14, No 8, 1967, pp 1-972

convert the ozone present into oxygen, which diminishes the ozone layer, and its shielding of dangerous solar UV radiation from the Earth's surface. The water vapour present also produces stratospheric clouds that further speed up the ozone removal process by providing a surface for the reaction to take place. Research at University College London found that rocket pollution had the potential to undermine ~20% of the gains made by the Montreal Protocol to protect the ozone layer by phasing out the many substances that have been causing its depletion. They also found that black carbon emissions at these very high altitudes produce substantial global warming effects, around 500 times more than surface and aviation sources.⁷ It has been calculated that solid-fuelled rockets have emitted over 1,400 tons of alumina particles into the stratosphere.⁸

Space travel's contribution to global warming comes from the release of significant amounts of CO₂, alumina particles, black carbon and water vapour into the stratosphere. The amounts of each pollutant are dependent on the type of propulsion used.⁹

Failure to address this issue represents a major omission from the AEE. The spaceport operator should provide a detailed assessment of these impacts and measures to minimise, mitigate, and offset these impacts in order to ensure that space launches from the site have no climate change and upper atmosphere impacts. This should be a make or break issue in terms of licensing the spaceport and launches from the site. If the operator is not able to demonstrate convincingly that climate change impacts have been eliminated then the development should not be permitted to go ahead.

Until a lot more is known about the environmental effects of space launches, the best way to proceed would be to adopt the precautionary approach:

*"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."*¹⁰

7 R. G. Ryan, E. A. Marais, C. J. Balhatchet, S. D. Eastham, 'Impact of rocket launch and space debris air pollutant emissions on stratospheric ozone and global climate', *Earth and Space Open Archive*, 12 February 2022 - <https://doi.org/10.1002/essoar.10510460.1>

8 M.N. Ross and D.W. Toohey, 'The Coming Surge of Rocket Emissions', *Eos*, 24 September 2019 available at <<https://eos.org/features/the-coming-surge-of-rocket-emissions>> Last visited 24 February 2022. and Marc E.J. Stettler, Adam M. Boies, Andreas Petzold and Steven R.H. Barrett, 'Global Civil Aviation Black Carbon Emissions', *Environ. Sci. Technol.*, Vol 47, No 18, 2013, pp 10397-10404 - <https://pubs.acs.org/doi/abs/10.1021/es401356v>

9 'How much air pollution do rocket launches cause?' *Breeze Technologies*, 22 October 2021 - <https://www.breeze-technologies.de/blog/how-much-air-pollution-do-rocket-launches-cause/>

10 Science for Environment Policy, 'The precautionary principle: decision-making under uncertainty', *European Commission*, Issue 18, September 2017 - https://ec.europa.eu/environment/integration/research/newsalert/pdf/precautionary_principle_decision_making_under_uncertainty_FB18_en.pdf

This approach was adopted by the 1992 Rio Declaration (also the first international instrument to include a definition of the precautionary principle),¹¹ should be used as widely as possible; otherwise, the richest few will continue to endanger the survival of the poorest many.

Accidents

Ignition events have the potential for significant damage to human and wildlife in terms of health and even loss of life. Previous experiences from existing sites (in the US) indicate that accidents can be catastrophic and result in lengthy site closures. This may have the potential to influence the economic case for the spaceport and reduce the claimed economic benefits.¹²

The AEE should explain how major accidents will be mitigated and should include an assessment of feasible major accident scenarios and detailed onsite and offsite plans for preventing and responding to major accidents. The spaceport should not rely on local emergency services to respond to accidents and licensing conditions should require the spaceport to maintain a full suite of emergency equipment and adequate numbers of suitably qualified and experienced personnel to cope with credible accident scenarios.

Space junk

Space (and in particular Low Earth Orbit) is becoming overcrowded. The European Space Agency estimates that as of 5 January 2022, about 6,170 space launches have taken place (excluding failures) since 1957, with 12,470 satellites being placed into Earth orbit. Of those, some 7,840 are still in space and 5,100 are still functioning.¹³ In addition, they estimate that there are over 1,036,500 pieces of space debris greater than 1 cm in size. This poses hazards to future space launches and also hinders scientific research into space. Astronomers are concerned that long exposure images of the night sky required for scientific study are being ruined by satellite trails.¹⁴

The AEE should address these concerns and the CAA should work with the UK Space Agency to ensure that policy and licensing addresses this issue, and considers how will the SaxaVord spaceport and other proposed spaceports take space overcrowding into consideration when deciding on space launches, and how will all satellites placed in orbit be removed once their useful lifetime has been reached.

11 Jose Felix Pinto-Bazurco, 'The Precautionary Principle' *IISDO Earth Negotiations Bulletin*, October 2020 - <https://www.iisd.org/system/files/2020-10/still-one-earth-precautionary-principle.pdf>

12 George Chambers, Kodiak Island spaeport reopens following 2014 launch failure, NASASpaceflight.com, 25 August 2016, <https://www.nasaspaceflight.com/2016/08/kodiak-spaceport-reopens-2014-failure/>

13 'Space debris by numbers', *European Space Agency*, 5 January 2022 https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers> Last visited 24 February 2022.

14 Richard S. Wright, Satellites Begone! Remove Trails From Your Astrophotography, 10 June 2019, <https://skyandtelescope.org/astronomy-blogs/imaging-foundations-richard-wright/satellites-begone-how-to-remove-satellite-trails-from-your-astrophotography/>

The militarisation of space

Public opinion over the purpose to which launches from the SaxaVord spaceport are put is a legitimate area of socio-economic concern and so warrants attention in the context of the AEE and licensing process.

Drone Wars UK and other civil society organisations are concerned about the increasing militarisation of space. Lockheed Martin, involved in the spaceport development partnership, is a well-known aerospace corporation whose main interest is in military applications of technology.

The UK government has also expressed a serious interest in becoming more involved in the militarisation of space.¹⁵ The growing activities of the military in space and concerns of an arms race in space have been of some international concern for a long time,¹⁶ and the effects of these activities on the use of space could be very significant.

The CAA should clarify the following matters when licensing the SaxaVord spaceport and other space activities:

- Will the ethical and moral implications of launches be a consideration for spaceport licensing?
- How will the purpose and use of the satellites to be launched from the site be publicized?
- What actions will the spaceport take to address ethical concerns about the use of space and adherence to the Outer Space Treaty?
- Will there be any restrictions on the type of satellites to be launched from the site?
- How many of the launches from Unst will be for military use?

Continued Monitoring of Environmental Effects

It will be important to ensure that there is ongoing assessment of environmental impacts caused by the SaxaVord spaceport if it is given permission to operate.

The AEE should provide information on what ongoing monitoring and survey work will be conducted by the operators to assess impacts. This should include environmental and impact monitoring, annual reporting on the numbers and purposes of launches from the

15 Peter Burt and Dave Webb, “For Heaven’s Sake – Examining the UK’s Militarisation of Space”, 6 September 2022 - <https://dronewars.net/2022/06/09/new-briefing-for-heavens-sake-examining-the-uks-militarisation-of-space/>

16 See for example: S. Ghoshroy (Ed), ‘Missile Defense Systems and Weapons in Space – Serious Consequences for Global Peace and Security’, *The International Network of Engineers and Scientists*, October 2021- <http://inesglobal.net/2021/10/06/international-group-of-scientists-and-academics-issues-urgent-call-to-ban-missile-defense-and-space-weapons/>

spaceport, and annual carbon accounting reports. The spaceport should also report and account for the status of all objects it has launched into space over the lifetime of these objects.

These reports should be accessible to the general public and should be discussed with the local site stakeholder group for the site. The site stakeholder group should be given the opportunity to be involved in designing impact monitoring programmes for the spaceport.