Appendix 4 - Principal Responses

Orange: Response by Gravitilab (GL)

N/A: Not Answered/Not Applicable

Question 1 - ALL: How can we design our airspace volume (both lateral and vertical) to minimize impact on your activities?

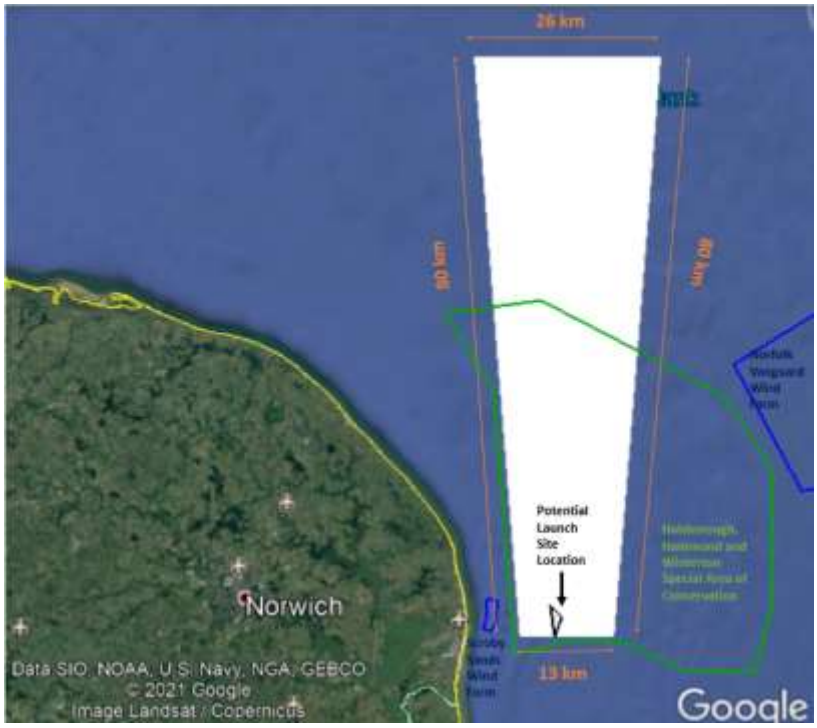
(Equinor)

- What kind of data will the rockets be collecting?

GL: There are two types of data the rocket will enable to collect. The first ones are telemetry data (required to know the rocket status at all time i.e. position, velocity, temperature, pressure, etc.) and the other ones are scientific data (satellite customers will use our launch vehicle for various types of experiments and the resulting data are based on their payload design).

- We need to understand from which area in specific you plan to launch the rockets. The map attached in your proposal does not tell us exactly the proximity to the windfarms.

GL: The area you can see in our proposal is not the final one. Please find below the current area we are envisaging but bear in mind that this one will be refined as we move forward in the ACP. The coordinates are the following:
53°19'43.35"N 1°38'01.35"E
53°21'15.18"N 2°00'55.24"E
52°38'13.83"N 2°02'11.04"E
52°37'27.66"N 1°50'41.40"E
53°19'43.35"N 1°38'01.35"E



- We need to understand the area that will be impacted when the launch occurs (which geographical area will be impacted, and how will it be impacted – e.g., is it simply an access

route that other marine operations can continue to access, or are there any hazards that mean the area would be blocked off to other neighbouring marine users during a launch?)

GL: The area you can see on the image above is well bigger than the area we'll need to operate in normal flight conditions. The current area accounts for rocket failures and 3-sigma dispersion. Rocket failure means that in the event of a failure any debris from the rocket would end up in this delimited area. 3-sigma dispersion accounts for all the disturbances that would deviate the rocket from its nominal trajectory i.e. thrust misalignment, change in thrust magnitude, wind conditions, etc., thus resulting in an area of impact points rather than a sinGL:e splashdown point.

GL: To account for the worst-case scenarios, Gravitilab will activate different "hazard" areas at different operational times. During pre-launch operations, only a "debris hazard area" around the jack-up barge (where the launch pad stands) will be activated. During launch operations (from rocket ignition to splashdown), a well-defined corridor will be blocked off to other neighbouring marine users. We'll make sure of course, that this corridor does not overlap emergency access routes, etc. Also bear in mind that this area will be activated only for few minutes with a very low frequency equivalent to 12 times per year (by the 2nd year of operations).

- What will be your access routes? We are concerned this could impact our vessels' operational routes.

GL: We need to understand where the vessels' operational routes are and from there, we'll be able to start the planning of our operations. Would you be able to provide any relevant chart please?

- What are the effects of the launch to objects in the area in proximity to the launch? Do these launches have any impact on wave or wind conditions

GL: The only impacts the rocket can have in the area in proximity to the launch are: (minimal) environmental disturbances as well as debris impact in case of rocket failure (very unlikely that this will occur considering that we'll make sure that no fixed platform are in the "launch corridor" mentioned previously and we'll build a robust communication plan to ensure no vessels are accessing this corridor for the few minutes of rocket launch).

GL: Considering the size of the activity, the rocket launch will not impact the wave and wind conditions, however we'll need to account for the weather conditions on the day of launch that will impact the rocket trajectory obviously thus the splashdown area.

- Will the launch affect anything or anyone onshore, base, offices, people etc?

GL: No.

- What kind of hazards have you experienced in the past during your operations or similar operations by competitors?

GL: So far, we've been operating from the land, and we never encountered particular technical issues that could endanger Gravitilab personal and third parties. For sea launch, the only hazards I can see right now will result from a bad communication plan, this is why we're engaging soon with all the impacted stakeholders to build a robust strategy that could work for all.

- How well controlled are these flights expected to be, and what data can be shared on this from historic flights to provide confidence in the risk level / safety? (e.g., how much uncertainty is there in the flight positioning of these rockets, what is the risk of loss of control?)

GL: We're operating unguided sounding rockets which means that we don't have any active control on the rocket itself. We'll have control by predicting the rocket behaviour and tracking it on the day of launch. Firstly, we can predict with a high level of confidence the rocket trajectory and splashdown area using robust simulation tools. Secondly, there will be active tracking of the rocket during the launch operations using services from a third-party range control service provider (QinetiQ is a possibility).We'll communicate more about this in the future.

- Since the rockets descend with the assistance of a parachute how do you obtain control in where they land? Are they programmed to land offshore or onshore or do they randomly land anywhere? At which speed do they land?

GL: With a parachute recovery system, we do not have control on a precise landing point, but based on simulations, we can define with a high degree of fidelity a splashdown area. The landing speed is kept inferior to 10 m/s.

- How should the rocket be handled if caught in our operations?

GL: The only risk of recovering our rocket is to approach a (low) pressurized system, in order to float on water. We'll make sure to always take the required actions to not cause any trouble to third parties.

- What clearance space is needed during these launch activities? We note section 4. Of the Project Brief highlights a 1 km radius of retreat by Gravitilab staff.

GL: To be refined. The retreat of 1km was usually guessed considering the FAA guidance for suborbital rocket launches suggesting a clearance area of 1 nautical mile (1.8km) radius around the launch pad. The size of our activity is way smaller than this massive suborbital sounding rocket in the US so we reduced the size of this clearance area accordingly.

- Will you be performing any test launching before going fully operational? If yes where, when and for how long do you plan to do that?

GL: Yes we plan to do de-risk launches from Spaceport 1 in UK and/or Spaceport America in US, before going fully operational.

- Where do you see this business going in the future? What are your long-term plans? (How frequently do you expect flights to occur, and how will this change over time? How will the size of rockets you envisage using change in future?)

GL: Flights will begin with 2 or 3 in the early years, increasing to one a month after that.

- We also need to understand all the potential safety impacts and considerations in that respect

- How fragile is the rocket when it lands? Could it break, explode etc?

GL: With our parachute recovery system, no risk of break and explosion at landing. The impact velocity is well reduced to attenuate the landing shock.

(AB Ports)

Use of airspace in proposed offshore are should not impact port operations at Lowestoft.

(DAATM (MOD))

- To launch rockets, we are assuming that some form of special use area (SUA), i.e. an area that was reserved for only this activity to take place, will likely be required. Clearly this will preclude military (and civil) activity for the period that the SUA is activated. How big will the airspace volume be? The MOD, in line with the CAA's SUA Policy, would request that the minimum amount of airspace is utilised for this activity, for the minimum possible time and that any airspace conforms to the current flexible use of airspace (FUA) principles and has robust airspace management (ASM) procedures and protocols attached to it to ensure safety and efficiency for all airspace users (see relevant CAA Policies on this). This should be highlighted in your Design Principles, potentially as follows (taken from a similar space launch ACP – look on the CAA ACP portal for specifics):

- Minimise the impact on other aviation stakeholders, including MOD activity.
- Airspace design will be of the smallest volume to safely segregate activities from other airspace users.
- Use FUA principles to integrate airspace design into extant ASM procedures.

GL: The airspace volume we have currently chosen is actually a prediction as of now and have hugely overcompensated considering the size of launch area. This is because we want to give stakeholder the upper limits of the area we expect the operations to take place, so there are no surprises in the future. This area is going to be continually refined throughout the 7 stages of the ACP process, so we expect this area to have shrunk significantly and will be more defined in terms of its location, as we move through the process and have more to consider through stakeholder responses.

- How many launches will there be per year? What will the schedule look like, i.e. what is the frequency and periodicity? The MOD cannot accurately determine the scale of impacts to our operation until we know the answer to this question. It may be that there are certain times of the day or week (weekends, public holidays, overnight on certain occasions?) where there will be no confliction with military activity, but this will only be known once we have more information.

GL: In terms of the number of launches we looking to undertake throughout the year, initially we are looking to launch 8 rockets from the spaceport per year, but this is also subject to change based on governance and stakeholder responses. We will find the optimal number of launches that will help develop our spaceport and help grow the space industry within the UK, whilst also making sure the activity of other airspace users is affected as minimally as possible.

(Natural England)

N/A

(Maritime and Coastguard Agency)

Discuss options for a Navigation Risk Assessment in the early stages with the Maritime and Coastguard Agency

(Trinity House)

Activities should be kept away from the major shipping lanes off East Anglia and any debris to fall into areas clear of shipping, Oil and Gas infrastructure, and Trinity House aids to navigation to avoid damage to marine structures/users

(RSPB)

RSPB would object to any activity on or over land and sea which would have a likely significant effect on protected sites and protected species. Away from protected sites, which includes a buffer zone surrounding each sites there would likely be less impact, but often birds use both protected sites and non-designated land - pink footed goose is a good example as it often feeds on harvested sugar beet in fields.

Question 2 - ALL: How can we plan our launch activities (e.g. frequency, launch time) to best accommodate your operations?

(Equinor)

This depends on answers from question 1

GL: How often the vessels' operational routes are active. Would you be able to provide any relevant information on this please?

(AB Ports)

Should make no difference

(DAATM (MOD))

- Will there be opportunity for a Danger Area Crossing Service (DACS) to be provided for times when the airspace is active but not being utilised for a rocket launch? Provision of a DACS would ensure that there would be less impact to other airspace users, particularly the military.

GL: In order to keep track of the airspace networks, we need to liaise with range control organisations eg. NATS, Eurocontrol etc. to determine safe flight regions so we can effectively integrate our operations. Most of our analyses have predicted that launches and subsequent recovery would all operate within the London Flight Information Regions (FIR), however it may also be useful to look at FIRs within close proximity as well. These include the Scottish FIR and the Amsterdam FIR. Therefore, we are looking to keep in regular contact with our contacts at the various organisations, aswell as the CAA, to ensure all airspace users are notified at all times, even if launch does not occur while our window is active.

(Natural England)

N/A

(Maritime and Coastguard Agency)

This would be considered as part of the safety case / Navigation Risk Assessment

(Trinity House)

N/A

(RSPB)

Same answer as for Q5. Consideration must be given to species migrating and their preferred flight routes. Breeding species are active anytime between February and August, and numbers of birds wintering start to increase from mid-September. Birds are affected by non-regular stimuli, most often sound and light, and any change from a presumed 'normal' pattern.

Question 3 - AVIATION: How can we maintain communications with you to plan our flight trajectories around Free Route Airspaces?

(Equinor)

- Continuous communication to inform on the progress of your application and business plan.

- Continuous communication with our operations team to inform and agree planned activities before and during the launch

- The frequency and nature of communication will need to be agreed depending on the proximity of your operations to our windfarms and vessels.

- All mandatory official channels should be used.

(AB Ports)

I would not anticipate this to be a requirement given distance of launch site from Lowestoft.

(DAATM (MOD))

Please keep the MOD informed (via myself and the cc'd personnel) and involved throughout the process and we look forward to working alongside you on this ACP so that everyone can safely achieve their aims within the airspace.

(Natural England)

Natural England can provide more detailed advice through the discretionary advice service particularly once there is more depth of information available to fully assess the project and any likely significant effects on protected sites and features. This may need to include how the features used the launch site area.

(Maritime and Coastguard Agency)

N/A

(Trinity House)

N/A

(RSPB)

This question is hard to answer without knowing launch locations and frequency. As indicated in the answers to questions 5 and 6 RSPB would strongly object to any activity which would have a likely significant effect on any of our nature reserves and any protected site and/or species or group of species. Our concerns would be passed on to Natural England as the statutory organisation.

Question 4 - ALL: How would you prefer to communicate with us about our scheduled activities once the launch site is operational? What details would you require and with what notice period?

(Equinor)

- Continuous communication to inform on the progress of your application and business plan.

- Continuous communication with our operations team to inform and agree planned activities before and during the launch

- The frequency and nature of communication will need to be agreed depending on the proximity of your operations to our windfarms and vessels.

- All mandatory official channels should be used.

(AB Ports)

Best practice would be to provide +24hrs notice of scheduled launches so that mariners proceeding to/from Lowestoft can be informed (via notice to mariners)

(DAATM (MOD))

Early notification of launches, planned well in advance, so as to fulfil the aforementioned FUA and ASM requirements will be required so as to deconflict with planned military activity. This is likely to be at least 3 months for impacts on the route network to take place but deconfliction against military exercises may need to be completed at least a year in advance.

(Natural England)

N/A

(Maritime and Coastguard Agency)

MCA has guidance which we can share with you.

(Trinity House)

Through email and any communications to the MCA

(RSPB)

Again this question is hard to answer without knowing proposed launch locations and frequency. We are already working to remove existing sources of disturbance (low-flying aircraft, construction, speeding boats, wildfowling etc.) adjacent to our sites and protected areas. Often the issues relates to in-combination impacts from a number of disturbance sources, not just a single event.

Question 5 - ALL: In case of emergency, where access to our exclusion zone is required, how would we be informed in order to pause our operations?

(Equinor)

The first thing is to inform the MCA / Coastguard which will contact other Emergency Services and others. We consider contacting relevant stakeholders depending on the incident and based on our Company's governing documents according to the relevant regulations.

(AB Ports)

N/A

(DAATM (MOD))

The MOD is responsible for National Security and other Air Policing type events. These are typically no-notice, high urgency events and we already have protocols and agreements to access all UK airspace at any time. 19 Sqn (ASACS) and 78 Sqn (Swanwick Military) are the relevant ANSPs that provide air traffic services and tactical control to the Quick reaction Alert (QRA) aircraft that are launched to undertake these tasks. To that end, direct communications, via landline or radio, with launch control will be required in order to initiate "check fires" procedures in the event of QRA operations or inadvertent / unauthorised airspace infringement by either air systems under ASACS control, or by other air systems being tracked by UK ASACS or Swanwick Military, but not conforming to UK Air Traffic Regulations and/or not in communications with UK ATC. It is likely that to enable this? Some form of operational agreement would be required.

GL: Gravitilab will always give the upmost priority to all emergency vehicles needing our airspace at the time of launch for as long as they need and will ensure we will establish communications to be informed when required. Rocket launches are normally planned many months in advance. Initially the "launch window" may be as large as a month to cater for many potential delays e.g. payloads not being ready etc. However, as the launch comes closer a more definitive "window" becomes clear and is reduced to a week. This then becomes further defined to a specified day and time (3-hour window), depending on weather forecasts eg. No cloud coverage, wind speeds, wind direction etc. Other air users require as much notification as possible of any restrictions in airspace to minimise the impact upon their operations. However, activating airspace so early that the timing and duration are unsure would lead to disruption that could be avoided. For example, early notification of launches, planned well in advance, so as to fulfil the aforementioned FUA and ASM requirements will be required so as to deconflict with planned military activity.

(Natural England)

N/A

(Maritime and Coastguard Agency)

Emergency response and communications will be an essential part of our discussion.

(Trinity House)

How do you intend controlling the marine environment or placing exclusion zones/ I assume we will discuss this at the planned meeting.

(RSPB)

As with previous questions this question is hard to answer without knowledge of launch locations and frequency and without additional information on your term 'access to our exclusion zone.' Can I suggest you provide some background information to help respondents answer your questions?

Question 6 - ENVIRONMENTAL: What potential environmental impacts do you see arising from this activity?

(Equinor)

- Noise pollution impacting humans and sea mammals.

- Water and air pollution from debris.

- Impacts to fisheries from potential vibrations.

- Sea bird collision or induced collisions.

- Benthic survey results could be impacted due to debris.

- Do these launches have any impact on wave or wind conditions?

- Why do you recommend a 1 km exclusion zone / retreat after launch? What are the safety considerations / concerns that have led to this exclusion zone, and what is the uncertainty in this range under strong wind conditions?

- Do you have any references from your current operations in other areas or references from your competitors?

(AB Ports)

Will need to contact Natural England and/or other environment agencies

(DAATM (MOD))

N/A

(Natural England)

- It is important to note that the areas outlined for launch, recovery and failure are situated within the following nationally and internationally designated sites of conservation importance, and that there is a functional link to onshore sites designated for seabirds:

  - Southern North Sea SAC

- Haisborough Hammond and Winterton SAC
- Outer Thames estuary SPA
- Greater Wash SPA
- Great Yarmouth North Denes SPA, SSSI

- We have reviewed [Natural England's Advice on Operations regarding marine activities] and identified the following pressures that potentially (but not limited to) could result from this type of activity taking place in the areas roughly identified in the engagement document supplied:

- Above water noise
- Abrasion/ disturbance of the substrates on the surface of the sea bed
- Air quality
- Disturbance of protected features
- Introduction of light
- Pollution
- Underwater noise changes
- Vibration
- Visual disturbance
- Water quality

- In consideration of the sensitivity of the designated sites and features within the zone of influence of this project we advise that an environmental impact assessment (EIA) will be required to fully address the pressures identified and to consider the scope and significance of likely effects, and mitigation measures intended to avoid or reduce any likely harmful effects, alone and in combination, on the European sites.

(Maritime and Coastguard Agency)

N/A

(Trinity House)

N/A

(RSPB)

Disturbance of breeding and wintering birds using freshwater habitats - as a result of noise (both from new sources and as an additional source in combination with other sources. Disturbance of wintering birds using marine habitats, especially in favoured feeding areas. The impact from light and any chemicals associated with operations.

Question 7 - ALL: What concerns do you have for your operations, if any, that would result from our launch activities?

(Equinor)

- What kind of data will the rockets be collecting? Which interferences can be expected?

- Proximity of the launch to the windfarms and vessels

- Descent of the rockets in the area of the windfarms and vessels

- Potential damages to the turbines which will lead to downtime and large financial losses

- Vessel collision between your vessel and our vessels

- Human injuries and fatalities.

- Potential impact on wave and wind conditions

(AB Ports)

None

(DAATM (MOD))

- Having looked at the Initial Presentation on the CAA Portal, it suggests that the only military airspace in that area is the East Anglian Military Training Area (EAMTA). This is a false representation of the airspace; it is a much more complex picture than that would suggest, as military aircraft operate across the entire UK Flight information Region (FIR), both within, and outside of, Controlled Airspace (CAS) and are not just limited to MTAs. The immediate and surrounding areas that your proposal is located within is one of the busiest portions of UK airspace for military air activity. Numerous combat air squadrons from both the Royal Air Force (RAF) and United States Air Force in Europe (USAFE) operate 24/7 in that area. The area off the Norfolk coast contains the following airspace, all of which military activity can, and does, take place in:

- Class G airspace from surface up to FL195.
- Class C airspace that is a temporary reserved area (TRA) for the military (but can still be accessed by civil) at certain times of the day/week between FL195 and FL245 - TRA 003.
- EAMTA Low (FL245 to FL285) and EAMTA High (FL285 to FL660).
- Outside of the EAMTA is Class C up to FL660.
- Lakenheath Aerial Tactics Area (ATA) from FL60 to FL245.
- Please refer to the UK Civil AIP for exact details, timings and locations of the above. Further engagement will be required (through DAATM) with all those MOD stakeholders that utilise these areas so that detailed analysis of potential impacts can occur.

- Additionally, depending on the size of the area, if it extends further north than the proposal currently states then it may impact on the heavily utilised D323 Managed Danger Area (MDA) complex, numerous Air to Air Refuelling Areas (AARAs) and UK Orbit Areas. From our experiences dealing with other rocket launches, if a 'splashdown zone' will be required it may extend the size of the area you have indicated in your proposal. This will undoubtedly increase the list of impacted airspace elements that the military use, as well as introducing more stakeholders. This can be evaluated as you move through the process and provide design options and more detail as to the volume of the proposed airspace.

- There are many considerations regarding ASM, such as suppression of other SUAs and airspace, cancellation of airspace that isn't required any longer, notification to other airspace users and many other nuances that require to be understood, with procedures in place to ensure there is minimal impact on other airspace restrictions and users but also not compromising on safety. Liaison with the Airspace Management Cell (AMC), with both the Civil and Military Airspace Managers (CAM and MAM respectively), will be required to work through these areas.

- How do you intend to deconflict from other space launch sites around the UK, as well as

military danger area activations? Already the military have strict activation protocols on which danger areas and other airspace restrictions can be activated simultaneously, so as not to block or restrict the civil route network unnecessarily. This ACP will need to understand and fit in with these FUA and ASM principles, processes and protocols. The cumulative impact on the route network may have implications on what areas the military can activate at the same time as your proposal; therefore more information and engagement will be required along these lines.

GL: In terms of deconflicting with other space launch activities and any MOD activities, the duration that any special use airspace (SUA) is active should be kept to a minimum and the airspace returned to other air users as soon as possible. This will minimise the impact on other aviation stakeholders, including military activity. We will find out whether any airspace we use, conforms to the current flexible use of airspace (FUA) principles and integrates airspace design into the extant airspace management (ASM) procedures and protocols to ensure efficiency for all airspace users.

(Natural England)

N/A

(Maritime and Coastguard Agency)

The potential impact on the safety of navigation and emergency response. Debris / payloads splashdown in high density shipping areas, debris left floating on the surface, large debris on the seabed effecting underkeel clearance. Appropriate risk mitigation measures must be discussed with the MCA.

(Trinity House)

Damage to our assets from falling debris is a small possibility which would then have implications on general marine safety.

(RSPB)

Answer provided for previous questions.

Question 8 - ENTERPRISE: What issues and/or opportunities would our sea launch activities provide for local industry?

(Equinor)

We welcome new industries in the area which may provide opportunities for job creation locally as well as research and development prospects while we are committed to continuing safe and efficient operations in our assets

(AB Ports)

Business for the port related to marine craft requirements for project mobilisation

(DAATM (MOD))

N/A

(Natural England)

N/A

(Maritime and Coastguard Agency)

N/A

(Trinity House)

N/A

(RSPB)

Again it is hard to answer this question without specific information. In order to get useful responses can I suggest you provide more information. This is the first time in any question that the phrase 'sea launch' has been used, but there is no corroborative information to enable RSPB to offer comment.

Question 9 - ALL: What potential benefits to you do you see arising from this project?

(Equinor)

We welcome new industries in the area which may provide opportunities for job creation locally as well as research and development prospects while we are committed to continuing safe and efficient operations in our assets. We therefore need more information about and understanding of the project.

(AB Ports)

Positive coverage (Local press) for port

(DAATM (MOD))

N/A

(Natural England)

N/A

(Maritime and Coastguard Agency)

We fully support the Governments ambitions for spaceflight in the UK

(Trinity House)

N/A

(RSPB)

None.

Question 10 - ALL: Can you recommend any other stakeholders who might better answer our questions or who might have an interest in this activity?

(Equinor)

- We expect during the early stages of your planned development you will discuss with the relevant authorities to obtain the necessary approvals and consents.

- Discussions with stakeholders in the area of your operations like fisheries, oil and gas developers, windfarms in operation and development, vessels, port etc

(AB Ports)

- Natural England + Environment Agency

- Also MMO + MCA

(DAATM (MOD))

- As your proposal deals with rocket launching, as well as liaison through the DSA, from an operational perspective, engagement with the UK Space Operations Centre (UK SpOC) will need to be undertaken for the following reasons. The UK SpOC is responsible for monitoring and reporting of all UK space launch activities. The UK SpOC require information on numerous elements of a launch and subsequent activity, including but not limited to; notification of upcoming launches, launch area, drop and abort zones, mission profiles, tracking data, frequencies and understanding go/no go criteria. This information will be used to enable the UK SpOC to Detect, Track, Characterise and Report (DTCR) UK space launches.

- Other considerations that the military are aware of, but do not directly impact the MOD, include:
    - Proximity to London TMA approaches.
    - Proximity to Amsterdam delegated airspace.
    - Y70 'airway' to the north (if area likely to be larger than currently defined in the engagement material).
    - Impact on civil routes
    - Liaison with civil ANSPs (i.e. NATS) will be able to shed more light on the above.

(Natural England)

The Marine Management Organisation (MMO) will be required to undertake a habitat regulations assessment and appropriate assessment, under the provisions of the habitat regulations, and in accordance with regulation 63 of the regulations, as the competent authority, and the EIA will form the basis for these assessments. Natural England is a statutory consultee on the appropriate assessment stage of the habitats regulations assessment process.

(Maritime and Coastguard Agency)

There will be a variety of navigation stakeholders who will need to be consulted as this project progresses. Please discuss further with the MCA and we can point you in the right direction.

(Trinity House)

N/A (RSPB) Natural England. MMO, EoN and other wind array operators. NNDC, GYBC.