Design Principles Report – DEFINE Gateway Submission

Contents

List of Abbreviations

Abbreviation	Meaning
GL	Gravitilab Aerospace Services
CAP	Civil Aviation Publication
DP	Design Principle
ACP	Airspace Change Proposal
DP	Design Principle
ANSP	Air Navigation Service Provider
NATS	National Air Traffic Services
DAATM	Defence Airspace and Air Traffic Management
MMO	Marine Management Organisation
MCA	Maritime and Coastguard Agency
UKSA	United Kingdom Space Agency
MOD	Ministry of Defence
CAA	Civil Aviation Authority
EIA	Environmental Impact Assessment
UKHO	United Kingdom Hydrographic Office
UAV	Unmanned Aerial Vehicle
ALARP	As Low As Reasonably Practicable
FUA	Flexible Use Airspace
SUA	Special Use Airspace

Executive Summary

Gravitilab Aerospace Services (GL) is developing the Sea Launch rocket launch site, subject to planning consent, a few miles east off the Norfolk coast. Initially, the purpose of the site is to enable the safe operation of sub-orbital flight. These rocket launches will pose hazards to other airspace users and in GL's case, marine users also and therefore, it is necessary to segregate these activities accordingly. In order to do this, a change in airspace around the immediate vicinity is necessary. This vertical launch spaceport will allow small sounding rockets to be launched in a northward direction from the proposed launch area in the North Sea. These activities will be segregated appropriately to protect other airspace users and the general public from these rocket launches.

As described in the Civil Aviation Publication (CAP) 1616 process, step 1b, the airspace change sponsor, in this case, GL, is required to conduct a detailed stakeholder analysis to ensure engagement with all potential stakeholders and to consequently develop Design Principles (DPs) that will ultimately be used to support and underpin the Airspace Change Proposal (ACP). The DPs developed are based upon a combination of safety, environmental, operational, and regulatory factors, as well as taking into consideration socio-economic impact. They are developed through consultation and engagement with both aviation and non-aviation stakeholders. Not just those directly involved in aviation but anyone who could possibly be affected by the ACP. Including but not limited to, GL reached out to: Air Navigation Service Providers (ANSPs) such as National Air Traffic Services (NATS) and EUROCONTROL; due to high military activity in the area, the Defence Airspace and Air Traffic Management (DAATM), local councils, Natural England, regional and international airlines who make use of that airspace, marine stakeholders such as the Marine Management Organisation (MMO), Trinity House and the Maritime and Coastguard Agency (MCA). Once established, these connections can then be used to appropriately assess our airspace design options in further stages.

GL conducted most of their engagement with potential stakeholders via a series of emailed questionnaires, with a few stakeholders also submitting their thoughts regarding the request via an online form (Microsoft forms) that was created to collect their responses. Other engagements undertaken involved stakeholders emailing GL directly, being contacted over the telephone and via Microsoft Teams meetings. Each time GL contacted a stakeholder for response, GL not only asked for their point of view on the matter but also asked if they knew any other potential stakeholders who may have an interest in the activities being planned, allowing the continual improvement of the list of stakeholders and acquire more feedback, further defining the requirements for the proposal.

The ACP is only one part of the regulatory engagement that GL will need to undertake. Other tasks include planning applications through the necessary councils in Norfolk, the MMO and the chosen port authorities, in addition to applying for a Spaceport and Range operator's license through the CAA. All of the regulatory engagements will have some overlap and will still involve regular public and community engagement. Therefore, although these interactions do not fall entirely under the ACP process, the responses received were considered during the refinement of the DPs.

Although only a small proportion of the contacted stakeholders responded during the second phase of the DP refinement, the responses received (see Appendix 7) suggested that they were satisfied with most of the 11 DPs GL arrived at to guide the planning and design of the ACP. However, the qualitative feedback they provided was detailed and this was considered. Changes

were applied based on suggestions by NATS, Trinity House and the Ministry of Defence's (MOD) DAATM to clarify the wording and purpose of the DPs. GL valued the highly detailed feedback from NATS; GL will work closely with NATS at every stage of the ACP. After removing two DPs, the final set contains 9 different principles. The refined DPs are forwarded to the Civil Aviation Authority (CAA) for approval.

1 Introduction

Throughout Step 1b of the ACP process, GL has identified and established communications with stakeholders across a range of relevant industries and bodies whom the organisation believe may wish to contribute to the DPs; which are to be decided to facilitate the most agreeable airspace change.

1.1 Categorisation of Stakeholders

When defining the list of stakeholders, it was crucial to GL that a full distribution of interested parties, both aviation and non-aviation related, was collected. To streamline communications with these stakeholders, the stakeholders are divided up into four lists corresponding with each stage of GL's DP refinement process. The four listed groups are:

1) Initial Stakeholders – The CAA, NATS and Natural England whom we discussed GL's intentions with during scheduled meetings to understand the core requirements, and to obtain the ideal set of principal stakeholders. Natural England was contacted from the very start because the Environmental Impact Assessment (EIA) must be completed concurrently with the progression through the ACP stages.

2) Principal Stakeholders – Around 10 organisations who each represented an important player in their respective fields, for example airspace, environmental management, marine licensing, etc. These groups also pointed out additional interested parties who could be included in our next set of stakeholders. This 2nd selection expanded to 17, though not all of these responded to GL's communication (see Appendix 2).

3) Comprehensive Stakeholders – A much larger list of relevant national and international organisations. This includes airports, marine users, environmental organisations, local enterprise, local politicians, natural resources, regulatory bodies and more, who could offer quantitative feedback on the DPs. This list is inclusive of the principal stakeholders, for example Trinity House took part in advisory meetings while also later filling out GL's questionnaire for comprehensive stakeholders (see Appendix 5).

4) Responsive Stakeholders – A list containing only those stakeholders who responded to communication from GL. This communication includes those who interacted via the 1st or 2nd questionnaire, both, and by other means (meetings, phone calls, etc.). This allows GL to work closely with these entities in future and avoid unnecessary engagement with those not interested sharing their voice on the project. This is not a finalised list and can be added to if additional stakeholders are found or pointed out.

1.2 Questionnaires

We generated two surveys:

- 1st Questionnaire: 'Investigative Questionnaire' (see Appendix 3)
- 2nd Questionnaire: 'Design Principles Justification Questionnaire' (see Appendix 6)

The first was sent to the principal stakeholders to scope out any concerns they might have and provide advice with which we developed the first set of proposed DPs. The second was provided to comprehensive stakeholders, seeking feedback on the specific wording and intent of these proposed DPs.

The first questionnaire was qualitative, seeking detailed explanations of any issues or suggestions these stakeholders had with each element we were considering. This questionnaire had 10 questions, with the enquiry directed any interested stakeholders to identify any potential concerns that could arise with GL's proposed operations which could consequently affect their own operations.

The second questionnaire was quantitative, asking the comprehensive stakeholders to answer a YES/NO question for the inclusion of each DP, along with a rank from A to E denoting its importance (A = Highest and E = Lowest). However, the option was left open for written qualitative responses in this second questionnaire as GL did not want to miss any insight that could prove useful in the futureproofing of the plans. Unlike the first questionnaire this directly asked about each specific DP. These surveys enabled the refinement of the DPs and helped identify the importance of each DP.

Both questionnaires were sent along with a 'launch project briefing' (see appendix 1).

1.2 Feedback Collection

Most questionnaire-based feedback was collected via email through relevant experts at each responding organisation/body. Some were collected using online forms or by phone call. At the beginning of the process with 'initial' and 'principal' stakeholders, some information was provided in Microsoft Teams meetings, for example a joint meeting containing representatives of the MMO, (United Kingdom Hydrographic Office) UKHO and Trinity House.

Some contacts responded in both the principal and the comprehensive part of the process, which was much appreciated. Due to a strong amount of interaction during the principal phase, GL expanded its principal stakeholder list above the 10 starting choices. Some recipients of the 'design principles justification questionnaire' chose to offer feedback via email instead of completing the questionnaire, and this was also considered where applicable.

2 Design Principles

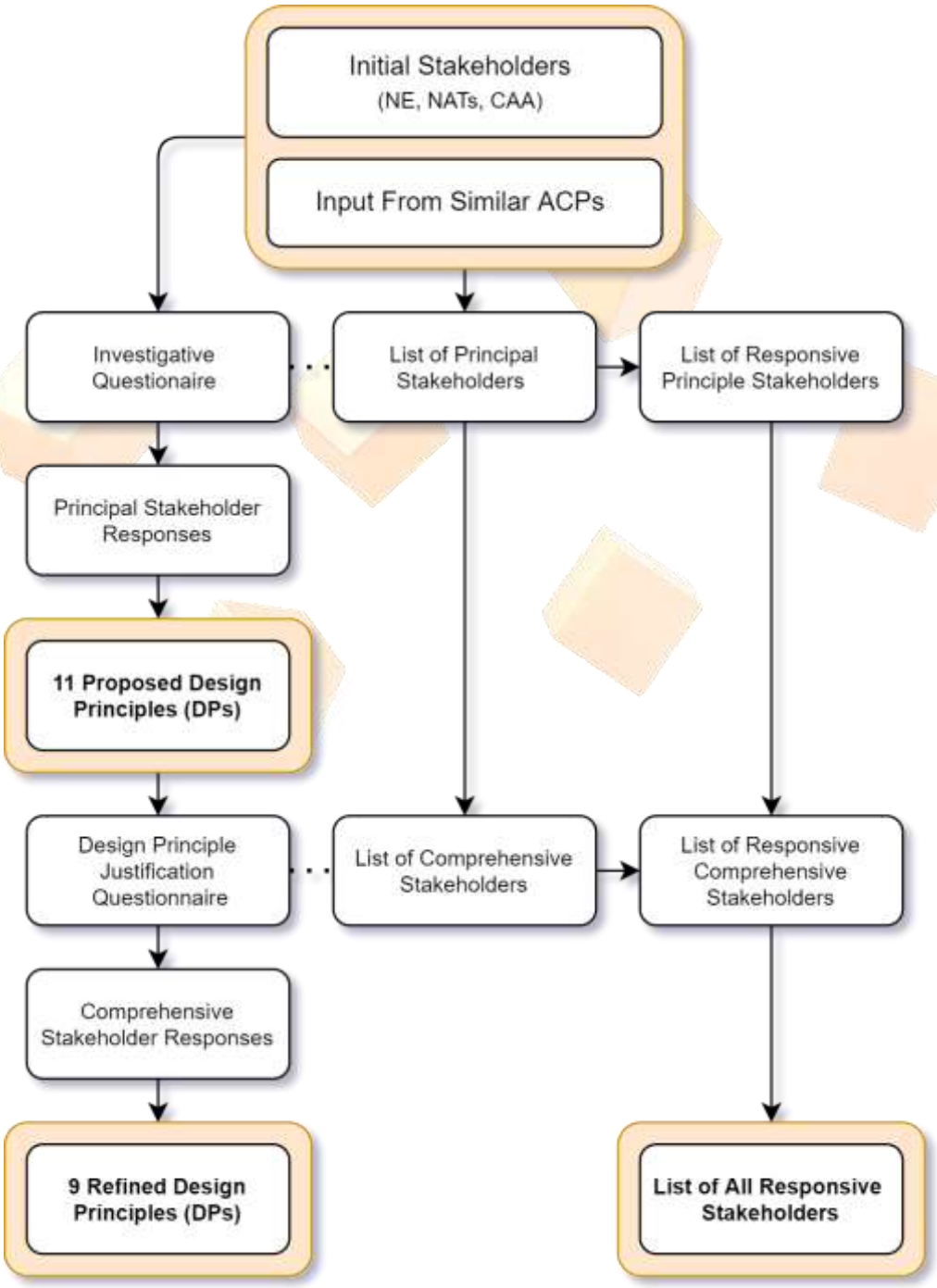
2.1 Design Principles Methodology

The generation of GL's final, refined DPs was divided into stages in a concurrent process with the method for accruing the list of responsive stakeholders. This was to ensure as many viewpoints could be included as possible, and to avoid overlooking any critical considerations. Irrespective of the stakeholder responses, the safety of both the launch operators (GL) and GL's neighbours will always be the top priority of the ACP. The two stages of DP development are:

1) Proposed Design Principles – Based on engagement with whoever was identified as the most important stakeholders for this project, responses received and analysed from the first questionnaire which highlighted any stakeholders' concerns, and as advised by the CAA, inspiration attained through the review of the processes of other ACP reports proposing similar operations to that of GL.

2) Refined Design Principles – Ranked in terms of importance based on feedback to our proposed DPs from comprehensive stakeholders. Edited from previous DPs based on additional qualitative feedback. Rounded up so that 1 A and 1 B = 1 A.

The flowchart below is an overview of the DP methodology:



2.2 Proposed Design Principles Development

The following section lists which principal stakeholders responded to each question in the investigative questionnaire (see Appendix 4 for full response detail). This feedback, combined with study of other ACP requests (and some additional communication via meetings & email) allowed GL to propose DPs that reflected the concerns and requirements of those impacted by the airspace change.

Question 1: Equinor, AB Ports, DAATM (MOD), MCA, Trinity House

Question 2: Equinor, AB Ports, DAATM (MOD), MCA

Question 3: Equinor, AB Ports, DAATM (MOD)

Question 4: Equinor, AB Ports, DAATM (MOD), MCA, Trinity House

Question 5: Equinor, DAATM (MOD), MCA, Trinity House

Question 6: Equinor, AB Ports, Natural England

Question 7: Equinor, AB Ports, DAATM (MOD), MCA, Trinity House

Question 8: Equinor, AB Ports

Question 9: Equinor, AB Ports, MCA

Question 10: Equinor, AB Ports, DAATM (MOD), Natural England, MCA

2.3 Proposed Design Principles

Design Principle	Category	Description
DP1	Safety	Ensure the safety of launch operators and neighbours at all phases of the launch procedure
DP2	Safety	Airspace design will be of the smallest possible volume to safely segregate activities from other airspace users. Airspace volume should be designed to minimise impact on air traffic
DP3	Operational	Gravitilab will design the trajectory such that risk and disturbance to marine and air users are effectively minimised at both the landing area and launch pad exclusion zone are minimised
DP4	Operational	Factors such as launch frequency and time of day will be chosen to best accommodate existing airspace users. The duration of the airspace activation should be kept to a minimum
DP5	Operational	Give priority to all emergency vehicles needing the airspace for as long as possible and establish communications to be informed where needed. This requires the ability to halt launch operations at any point during countdown
DP6	Environmental	Gravitilab will investigate and produce a report on the noise and environmental impacts resulting from regular operation of our sea launch platform in the North Sea
DP7	Operational	A system should be established to inform all air and marine users of our launch windows far in advance of the launch, and a confirmation of launch time a few hours before. They should be timely and accurate with an established method for rapid notification
DP8	Regulatory	Gravitilab will continue to monitor all changes to airspace policies and, if needed, adapt operations accordingly
DP9	Safety	Gravitilab will ensure launch and recovery operations will not affect other organisations assets in anyway and will design the activity area accordingly to avoid this
DP10	Operational	Gravitilab will look to increase job opportunities in and around Norfolk to help local communities as well as the UK economy
DP11	Operational	Gravitilab will analyse the future potential of the business and keep in regular contact with everyone involved to ensure the potential of our growth can be approved without presenting further issues

2.4 Refined Design Principles Development

As shown on the flowchart in section 2.4, Gravitilab came up with 9 refined design principles which are an upgraded version of the 11 initial design principles proposed by Gravitilab. In total, 3 organisations provided highly detailed (written) answers to the Design Principle Justification Questionnaire:

- NATS
- MOD
- Trinity House

Some other organisations like MCA, HSE, Equinor have received the questionnaire but they didn't provide official responses. MCA and HSE being safety regulators, it is considered outside of their remit to approve/comment on Gravitilab launch design principles.

The 11 proposed design principles has been refined based on NATS, MOD and Trinity House feedbacks as follows:

DP1

Original
"The Safety of other airspace users and the public is the paramount design principle that ensures the safety of launch operators and neighbours at all phases of the launch procedure."

Stakeholders Feedback
- NATS: YES to design principle
- MOD: YES to design principle
- Trinity House: YES to design principle

New
"The Safety of other airspace users and the public is the paramount design principle that ensures the safety of launch operators and neighbours at all phases of the launch procedure."

DP2

Original
"Airspace design will be of the smallest possible volume to safely segregate activities from other airspace users. Airspace volume should be designed to minimise impact on air traffic."

Stakeholders Feedback
- NATS:
  - YES to design principle
  - Segmentation to allow for activation of only the relevant zones
- MOD:
  - YES to design principle
  - 'Air traffic' is a phrase which suggests commercial aviation, should modify to be more inclusive of MOD
- Trinity House: No comment N/A

New

"Airspace design will be of the smallest possible volume **for each major segment of the flight path** to safely segregate activities from other airspace users. Airspace volume should be designed to minimise impact to **other airspace users**."

DP3

Original

"Gravitilab will design the trajectory such that risk and disturbance to marine and air users are effectively minimised."

Stakeholders Feedback

- NATS:
  - YES to design principle
  - Segmentation to accommodate the different trajectories allowing for activation of only the relevant zones (see DP2)
- MOD: YES to design principle
- Trinity House: YES to design principle

New

"Gravitilab will **optimise** the trajectory **of each launch vehicle type** such that risk and disturbance to marine and air users are effectively minimised."

DP4

Original

"Factors such as launch frequency and time of day will be chosen to best accommodate existing airspace users. The duration of the airspace activation should be kept to a minimum."

Stakeholders Feedback

- NATS:
  - YES to design principle
  - More important aspect is to keep duration of airspace activation down vs being completely flexible regarding time of day and launch frequency
- MOD: YES to design principle
- Trinity House: No Comment N/A

New

"**As a priority**, the duration of the airspace activation should be kept to a minimum. Additional factors such as launch frequency and time of day will be **considered** to best accommodate existing airspace users."

DP5

Original

"Give priority to all emergency vehicles needing our airspace for as long as possible and establish communications to be informed where needed. This requires the ability to halt launch operations at any point during countdown."

Stakeholders Feedback

- NATS:
  - YES to design principle

    - Aircraft/vehicles in emergency situations (i.e. engine loss) may need to enter the airspace at very short notice as well as emergency services, communications must cover this possibility
- MOD: YES to design principle
- Trinity House:
    - YES to design principle
    - Needs to consider marine emergency vessels as well

New

"**Immediate priority shall be given** to all emergency vehicles/vehicles in a state of emergency/**SAR vehicles** needing our airspace for as long as **is required.** This requires the ability to halt launch operations at any point during countdown **as well as the possibility for Gravitilab to establish communications with all relevant stakeholders operating/intending to operate in the airspace in an emergency."**

DP6

Original

"Gravitilab will investigate and produce a report on the noise and environmental impacts resulting from regular operation of our sea launch platform in the North Sea."

Stakeholders Feedback

- NATS:
    - NO to design principle
    - Study of environmental effects should be focussed on launch vehicle and travel emissions from other vessels/planes, not launch platform
    - Split into more specific design principles for environmental and economic?
    - EIA report (CAP1616A) is a must-have part of the ACP process, so isn't exactly a design principle as design principles must have the end goal of producing a shape for the changed region of airspace
- MOD: YES to design principle
- Trinity House: No comment N/A

New

"Gravitilab will seek to minimise detrimental economic and environmental effects due to increased fuel burn from commercial air travel in addition to emissions from their own operations."

DP7

Original

"A system should be established to inform all air and marine users of our launch windows far in advance of the launch, and a confirmation of launch time a few hours before. They should be timely and accurate with an established method for rapid notification."

Stakeholders Feedback

- NATS:
    - NO to design principle
    - Launch windows times/dates are difficult to keep consistent, so focus on excellent engagement with the relevant parties
    - Systems of notification need to be very clear so that activity can be managed right up to the launch window
- MOD:

    - YES to design principle
    - Acknowledge that systems such as FUA (Flexible use of Airspace), AIRAC cycle are already in place
- Trinity House: YES to design principle

New

"Safe, efficient and standardised management, timely and rapid notification, and activation of airspace, utilising Flexible Use of Airspace (FUA) principles and Special Use of Airspace (SUA) will be used. Information will be sent to stakeholders regarding potential launch activity at least 3 months before the intended date."

DP8

Original

"Gravitilab will continue to monitor all changes to airspace policies and, if needed, adapt operations accordingly."

Stakeholders Feedback

- NATS:
    - NO to design principle
    - If official CAA guidance is changed, Gravitilab must ensure their ACP is in accord with that guidance
    - Similar point to DP 11
- MOD: YES to design principle
- Trinity House: No comment N/A

New

"Gravitilab will ensure their ACP is always in accord with the most up-to-date CAA guidance documentation when changes occur. Stakeholders will be consulted on all changes."

DP9

Original

"Gravitilab will ensure launch and recovery operations will not affect another organisations assets in anyway and will design the activity area accordingly to avoid this."

Stakeholders Feedback

- NATS: NO to design principle
- MOD: YES to design principle
- Trinity House:
    - YES to design principle
    - Any strategies toward avoiding damage to marine assets very welcome

New

"Gravitilab will ensure launch and recovery operations will not affect another organisations assets (using safety-focused recovery methods) and will design the activity area accordingly to avoid this."

DP10

Original

"Gravitilab will look to increase job opportunities in and around Norfolk to help local communities as well as the UK economy."

Stakeholders Feedback

- NATS:
  - NO to design principle
  - This is more focused on business strategy instead of airspace change
- MOD:
  - YES to design principle
  - Ranked the least
- Trinity House: No comment N/A

New
[DESIGN PRINCIPLE REMOVED]

DP11

Original
"Gravitilab will analyse the future potential of the business and keep in regular contact with everyone involved to ensure the potential of our growth can be approved without facing issues."

Stakeholders Feedback
- NATS:
  - NO to design principle
  - This is more focused on business strategy instead of airspace change
  - If new the change in business strategy required a new ACP anyway, this DP is irrelevant
- MOD:
  - YES to design principle
  - Ranked the least
- Trinity House:
  - YES to design principle
  - Ranked the least

New
[DESIGN PRINCIPLE REMOVED]

2.5 Refined Design Principles

The refined design principles are based on the 11 initial design principles proposed by Gravitilab and contained some updated information based on the feedbacks received by NATS, MOD and Trinity House. The final list contains 9 design principles (2 have been deleted because they were not relevant to the ACP) which are ranked from A to D depending on their importance. Note that the ranking is completely based on stakeholders feedbacks and we will make sure to prioritize design principles with the highest score namely DP1, DP2, DP4, DP5.

The rank of the design principles has been obtained by averaging the 3 scores given by NATS, MOD and Trinity House for each of them. For instance, referring to Appendix 6, DP3 has been ranked twice "B" and once "A". Based on the majority of votes and Gravitilab judgment, it is estimated that DP3 gets a score of "B". For most of the DPs, we received similar rankings which facilitated our final decision on the order of importance of the 9 DPs.

Design Principle	Category	Description	Rank
DP1	Safety	The Safety of other airspace users and the public is the paramount design principle that ensures the safety of launch operators and neighbours at all phases of the launch procedure	A

DP2	Safety	Airspace design will be of the smallest possible volume for each major segment of the flight path to safely segregate activities from other airspace users. Airspace volume should be designed to minimise impact to other airspace users	A
DP3	Operational	Gravitilab will optimise the trajectory of each launch vehicle type such that risk and disturbance to marine and air users are effectively minimised	B
DP4	Operational	As a priority, the duration of the airspace activation should be kept to a minimum. Additional factors such as launch frequency and time of day will be considered to best accommodate existing airspace users	A
DP5	Operational	Immediate priority shall be given to all emergency vehicles/vehicles in a state of emergency/SAR vehicles needing our airspace for as long as is required. This requires the ability to halt launch operations at any point during countdown as well as the possibility for Gravitilab to establish communications with all relevant stakeholders operating/intending to operate in the airspace in an emergency	A
DP6	Environmental	Gravitilab will seek to minimise detrimental economic and environmental effects due to increased fuel burn from re-routing commercial aviation, in addition to any emissions from their own operations	B
DP7	Operational	Safe, efficient and standardised management, timely and rapid notification, and activation of airspace, utilising Flexible Use of Airspace (FUA) principles and Special Use of Airspace (SUA) will be used. Information will be sent to stakeholders regarding potential launch activity at least 3 months before the intended date	B
DP8	Regulatory	Gravitilab will ensure their ACP is always in accord with the most up-to-date CAA guidance documentation when changes occur. Stakeholders will be consulted on all changes	D
DP9	Safety	Gravitilab will ensure launch and recovery operations will not affect other organisations assets (using safety-focused recovery methods) and will design the activity area accordingly to avoid this	B

3 Conclusion and Next Steps

This document will be submitted to the CAA as evidence to support Stage 1, Step 1B of the CAP 1616 airspace change process. This documentary evidence is provided to inform the CAA's decision to sign off the DEFINE Gateway at the gateway assessment meeting. Sign off will enable ACP-2020-093 to proceed to Stage 2 of the process.

4 Responsive Stakeholder List

MMO: Responsible for the determination of a Marine License for the Proposed Development

MCA: The Maritime and Coastguard Agency is responsible for producing legislation and guidance on maritime matters and for working to prevent the loss of life on the coast and at sea

Trinity House: Responsible for safeguarding shipping and seafarers; hold a statutory duty as General Lighthouse Authority to deliver a reliable aid to navigation service for all mariners.

New Anglia LEP: New Anglia Local Enterprise Partnership works with businesses, education and local authority partners to drive growth and enterprise in Norfolk and Suffolk. Responsible for securing public and private investment to deliver a range of programs and initiatives with partners to improve infrastructure, skills and business support.

Norfolk Wildlife Trust: The Norfolk Wildlife Trust (NWT) is the oldest of 46 wildlife trusts covering Great Britain, Northern Ireland, Isle of Man and Alderney. Norfolk Wildlife Trust plays a very important part in protecting our natural heritage. It gives conservation advice to individuals and organisations, provides educational services to young people on field trips and organises events across numerous nature reserves to raise awareness.

Natural England: The government's adviser for the natural environment in England. Help to protect and restore our natural world.

UKHO: The UK Hydrographic Office (UKHO) is a world-leading center for hydrography, specialising in marine geospatial data to support safe, secure and thriving oceans.

Airtask: Provide bespoke mission-based aviation solutions to government and commercial clients around the world. Services include the provision of host aircraft, operating protocols, mission systems, role equipment, modification design, manufacture, installation, testing and certification.

DAATM: The DAATM acts as the MOD representative organization, in close collaboration with the CAA, within Europe. The DAATM interacts with NATO, European Aviation Safety Agency (EASA) and the European Defense Agency to ensure that legislative developments regarding Airspace, ATM and Communication, Navigation and Surveillance requirements are known.

HSE: The Health and Safety Executive is a UK government agency responsible for the encouragement, regulation and enforcement of workplace health, safety and welfare, and for research into occupational risks in Great Britain. HSEprovides information on how to carry dangerous goods by road or rail and reduce hazards such as fire, explosion and environmental damage.

NATS: The National Air Traffic Services provides air traffic control services to aircraft flying in UK airspace and over the eastern part of the North Atlantic. It is the main air navigation service provider in the United Kingdom.

Equinor: Equinor is an energy company with more than 21000 employees developing oil, gas, wind and solar energy in more than 30 countries