

7 August 2026

Invercargill City Council  
Attn: Emma Spalding  
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Dear Emma

## **MIC/2025/20 – SPACE OPERATIONS NEW ZEALAND LIMITED – RESPONSE TO COUNCIL ENGINEERING REVIEW**

### **Introduction**

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We have reviewed Council's Engineering Review prepared in relation to Notice of Requirement MIC/2025/20. The matters raised in the review are addressed below, together with responses intended to assist both Council (including the technical reviewer) and its technical reviewer in their consideration of the proposal.

### **Responses**

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#### **1. Scope of the -154 dBW/MHz restriction**

The reviewer accepts that the -154 dBW/MHz threshold is contained in the November 2020 RSM decision but considers that it applies only to:

- terrestrial radiocommunication services;
- within the 2200–2290 MHz protection band; and
- services that came into operation after the RSM decision.

The reviewer considers that the application has framed the protection too broadly by applying the threshold to any activity generating electromagnetic emissions. Proposed condition 3 of the Designation is as follows:

*All terrestrial services within a 2km radius of the Awarua Satellite Ground Station, as shown on the Designation Plan (enter reference) shall not produce electromagnetic emissions greater than -154 dBW/MHz at frequencies used for the reception of radio signals from spacecraft at Awarua Satellite Ground Station as set out in the Table of Radio Spectrum Usage in New Zealand (PIB 21) Issue 11, dated June 2021 and produced by the Ministry of Business, Innovation & Employment – New Zealand Government, and any subsequent amendments and/or updated to this document. For completeness, the restriction only applies to radio frequencies set out in Radio Spectrum Management's radio bandplan that are used for the reception of radio signals from space. Common domestic items such as cellphones, personal locator beacons and domestic scale satellite dishes that are utilised for internet connections, do not transmit*

*on this radiofrequency and are therefore not affected or prohibited by this designation.*

The proposed condition does not impose a blanket restriction on all electromagnetic emissions or all electrical equipment within the 2km area. The proposed wording is expressly limited to “terrestrial services” which create emissions at radio frequencies used by the Awarua Satellite Ground Station for reception of signals from space. Common electrical or industrial equipment is not captured merely because it may produce incidental electromagnetic emissions.

However, to make it as clear as possible, we suggest rewording condition 3 as follows and to split the conditions into parts a) to c) inclusive.

- a. Within the Electromagnetic Interference Limitation Area shown on the Designation Plan, no terrestrial service shall produce electromagnetic emissions greater than -154 dBW/MHz at frequencies used for the reception of radio signals from spacecraft at the Awarua Satellite Ground Station, as identified in the Table of Radio Spectrum Usage in New Zealand (PIB 21), Issue 11 (June 2021), published by the Ministry of Business, Innovation and Employment, or any subsequent replacement or amendment.*
- b. For the purposes of this condition, a terrestrial service means a radiocommunication service operating between points on or near the Earth's surface that intentionally transmits or receives radiofrequency signals. This includes, but is not limited to, licensed radio communication systems, point-to-point microwave links, fixed wireless services, radio telemetry, SCADA radio communications, broadcasting services and other terrestrial radiocommunication services.*
- c. For the avoidance of doubt, this condition does not apply to buildings, structures, electrical infrastructure or electrical equipment that do not constitute, or include as a component, a terrestrial service, including (without limitation) wind turbines, solar panels, generators, transformers, substations, inverters, switchgear, battery storage systems or other electrical equipment that generate only incidental electromagnetic emissions as a by-product of their operation.*

A terrestrial service should be distinguished from buildings, structures, industrial activities or electrical equipment that may generate incidental electromagnetic emissions as a by-product of their operation. Activities such as wind farms, solar farms, substations, transformers, generators and industrial plant are not, in themselves, terrestrial services. However, to the extent that any such developments may incorporate ancillary terrestrial services, such as licensed radio communication systems, microwave links, telemetry or communications equipment used for monitoring and operational control, then those may be captured by condition 3. It is those radiocommunication services only, rather than the primary activity itself, that would fall within the scope of condition 3 (and only where they produce electromagnetic emissions exceeding the threshold specific in the condition)..

The engineering review appears to assess the proposed designation primarily by reference to the protection afforded under the Radiocommunications Act 1989 and the associated Radio Spectrum Management (RSM) decision. While the RSM decision provides important technical context, the designation is not being sought under the Radiocommunications Act. Rather, Space Operations New Zealand is exercising its statutory powers as a Requiring Authority under the RMA to seek protection for the ongoing operation of a nationally significant infrastructure asset that has been established.

The purpose of the designation is not simply to duplicate the protections available under the Radiocommunications Act, but to provide a complementary land use planning mechanism that manages activities capable of adversely affecting the ongoing operation of the Awarua Satellite Ground Station. This includes both electromagnetic interference, and the protection of the low-angle line of sight required for satellite communications from built form.

The statement in the engineering review that *"Space Ops is entitled to the protection that the -154 dBW/MHz limit and the general interference provisions of the Act and the regulation actually provide. It has not, however, shown that the much broader protection sought in the application is within its rights"* appears to proceed on the assumption that the designation can only provide the same level of protection as that available under the Radiocommunications Act. It is noted that this is not the relevant legal test under the RMA. As a Requiring Authority, SpaceOps is entitled to seek such designation provisions as are reasonably necessary to achieve the purpose for which the designation is sought. The issue is therefore whether the proposed controls are appropriate and reasonably necessary to protect the ongoing operation of the satellite ground station, rather than whether they are identical to the protections available under the Radiocommunications Act.

While the RSM decision provides a technical benchmark for the electromagnetic interference threshold, the designation seeks to establish a planning framework that enables those operational requirements to be recognised and managed through the resource management process. It is therefore unsurprising that the proposed designation is broader in scope than the existing spectrum management regime, as the two statutory frameworks serve different purposes.

Without this framework of protection being included within the designation (and therefore not necessarily relevant in a resource management consenting context) there is less certainty that extraneous legislation / the RSM decision would be given weight under the consenting framework, which instead focusses on effects and the relevant RMA planning instruments, under s 104 RMA.

## 2. Whether the 2km EILA is justified

The reviewer notes the 2km is justified.

## 3. Existing activities

The designation is primarily intended to manage new activities and changes to existing activities following confirmation of the designation.

It is not intended to retrospectively prohibit lawfully established activities solely because they predate the RSM decision or the designation.

#### 4. Cumulative Interference

The reviewer considers that several individually compliant sources could cumulatively result in interference above -154 dBW/MHz. The report says the existing radiocommunications regime does not effectively address cumulative interference. This concern arguably supports the need for a Designation. Once again the reviewer seems to be relying on existing protections under the Radiocommunications Act. The purpose of this Designation is to restrict individual new activities that will result in a terrestrial services producing emissions greater than -154 dBW/MHz at frequencies used for the reception of radio signals from spacecraft. Therefore the proposed Designation does not have the effect of cumulatively adding activities in such a way that would subsequently breach condition 3. Rather, condition 3 applies to each individual activity.

#### 5. Generic EMC Standards

The reviewer says compliance with ordinary EMC standards does not guarantee that equipment will not interfere with the highly sensitive Awarua receivers. The standards are generic and are not calibrated to a receiver operating at the -154 dBW/MHz threshold.

It is accepted that compliance with generic EMC standards does not, by itself, conclusively establish that equipment will not affect a highly sensitive satellite receiver. Nevertheless, compliance with applicable EMC standards remains an important first-level indicator that equipment has been appropriately designed and manufactured.

#### 6. The basis for the 5 degree horizon mask

The reviewer says that:

- the Radiocommunications Act and RSM decision do not address physical obstruction;
- no analysis has been provided explaining how the 5° degree surface was derived; and
- further information is needed about the ground station's minimum operational elevation.

If Applicant accepts that the proposed horizon mask is not derived from the November 2020 RSM decision and was never intended to be.

The RSM decision addresses electromagnetic interference. The horizon mask addresses a separate operational effect: physical obstruction of the line of sight between the ground station antennas and orbiting satellites.

The Awarua site was selected because of its unusually low horizon, flat surrounding terrain and ability to acquire and track satellites at low elevation angles. Preserving that low horizon is fundamental to the operational efficiency of the ground station. A structure projecting into the required elevation envelope may delay initial acquisition of a satellite, shorten the available communications window, interrupt telemetry, tracking or command activities, and reduce the range of satellite missions that can be serviced from Awarua.

The 5 degree surface represents the minimum low elevation operational envelope that Space Ops seeks to retain. The surface begins 2m above the designation boundary and rises outward so that the restriction reduces rapidly with distance. At greater distances, the height permitted beneath the surface substantially exceeds permitted building heights.

The Applicant has further conveyed the following technical detail on the necessity of these restrictions sought:

- *The antennas at Awarua Satellite Ground Station primarily communicate with spacecraft in low Earth orbit. These spacecraft are between 400 and 800 km above the Earth and orbit the Earth every 1½ hours or so. The spacecraft can only communicate with ground stations that are in line of sight with it. At best the spacecraft will traverse the sky immediately above the ground station, starting at the horizon some 2500 kilometres away. In these cases, the satellite "pass" (the period the spacecraft can communicate with the ground station) will be a little over 8 minutes' duration. Spacecraft that do not travel immediately overhead may only be visible for a few minutes, and they may never get much above the horizon.*
- *Because a low Earth orbiting spacecraft will only be able to communicate with a few – perhaps only one – ground stations each orbit, it is important for the spacecraft operator to maximise the time the spacecraft can communicate with the ground station during a pass. The lower to the horizon the antenna can point, the longer the pass time that can be accomplished. Because of the possibilities of interfering with terrestrial services and the effects of the atmosphere on radio propagation, spacecraft operators generally accept that 5° elevation mask is a world-wide limit and design their missions accordingly. Lower elevations are desirable and Radio Spectrum Management will allow ground stations to transmit down to 3° elevation. For rocket launches, it is important to be able to maximise the pass period. For launches, it is usual to start tracking the rocket at close to 0° elevation.*
- *Space Ops is seeking 5° elevation mask protection only because a 0.5° or 3° elevation mask would have very far-reaching impact on the surroundings and would be impracticable.*

7. Starting the horizon mask 2m above the boundary

Similar to the above, the reviewer has questioned how the 2m commencement point for the horizon mask was derived.

The 2m starting height avoids applying an impractical ground-level plane at the boundary and recognises that ordinary low level land use, fencing, stock and vegetation should not be affected.

It also provides a practical reference height from which the operational limitation surface can be surveyed and mapped.

8. Why the horizon masks extends for 3km

The reviewer has questioned the basis of the horizon mask extending for 3km.

The 3 km extent is the outer limit of the physical obstruction control. It does not impose a uniform height limit across the full area. As detailed in point 6 above, the Awarua site was selected due to its low horizon. It is this low horizon which we are seeking to protect by way of this NOR.

The permitted height beneath the 5 degree surface increases progressively with distance from the ground station. By the outer edge of the designation, the surface is approximately 260m above the starting elevation.

As a result of this, anticipated rural and industrial buildings are only materially constrained close to the ground station. For adjacent land within the Rural Zone, which has a maximum permitted height of 10 metres, this height is able to be achieved at approximately 90m away from the edge of the Space Ops site. Buildings between 2m and 10m in height would be allowed within varying distances between the boundary of the site and 90m from the subject site. For land within the nearby Industrial 4 zone, the maximum height of 35 metres can be achieved at approximately 380 metres from the edge of the Space Ops site. At greater distances, only exceptionally tall structures, such as large wind turbines, very tall stacks or major masts, would be capable of penetrating the horizon mask surface.

The 3km extent provides a clear and readily administered outer boundary while avoiding unnecessary controls beyond the area in which physical obstruction could realistically affect low-elevation satellite communications.

9. Wind turbines

The report considers concerns about wind farms valid but says no technical evidence has been provided showing whether the equipment would cause harmful EMI.

The Requiring Authority does not contend that all wind turbines necessarily generate harmful electromagnetic interference.

Any EMI effects would depend on the specific turbines and any associated terrestrial services that the turbines utilise.

The principal issue for large wind turbines is their potential to penetrate the horizon mask and physically obstruct low-elevation satellite tracking. To this end, the exact proposed location of any such proposal is of key importance.

A wind farm below the limitation surface would not require approval under the height control conditions of the designation. Any EMI assessment should be limited to terrestrial service installations where there is a credible risk of interference.

#### 10. Solar panels and inverters

The Requiring Authority agrees that solar panels themselves should not be treated as inherently interfering equipment.

Similarly, associated electrical equipment such as inverters, switched-mode power supplies, induction motors and pulse width modulated control systems are not terrestrial services and are not captured by Condition 3 merely because they may generate incidental electromagnetic emissions. However, utility scale solar installations may incorporate ancillary terrestrial services, such as licensed microwave links, radio telemetry or SCADA communications used for monitoring and operational control. It is those ancillary terrestrial services, rather than the solar installation or its electrical infrastructure itself, that may fall within the scope of Condition 3.

#### 11. Electrical distribution networks and substations

The reviewer identifies electrical networks, switchgear and similar infrastructure as potential interference sources but says actual harmful interference must be demonstrated rather than assumed.

Properly operating electrical distribution infrastructure, including substations, transformers, switchgear and associated electrical equipment, is not intended to be regulated by the designation, as these are not terrestrial services. However, electrical network infrastructure may incorporate ancillary terrestrial services, including licensed radio communications, microwave links and SCADA radio systems used for network monitoring and control. It is those terrestrial radiocommunication services, rather than the electrical infrastructure itself, that may be subject to Condition 3.

Normal construction, operation, maintenance and upgrading of electrical networks should therefore remain able to occur.

#### 12. Virtual fencing and agricultural technology

The reviewer accepts these as legitimate matters for consideration but says there is no evidence establishing that they would breach the threshold.

The Requiring Authority does not seek to prohibit ordinary virtual fencing or agricultural technology.

All such devices operate at frequencies outside the protected satellite receiving bands and at low power.

These activities are therefore identified as generally unaffected, unless a particular installation uses a protected frequency or is demonstrated to cause harmful interference.

### 13. Mitigation at the SpaceOps site

The reviewer says the application focuses on restricting surrounding activities and has not adequately considered onsite mitigation measures such as filtering, shielding, raising antenna elevations, and management of existing background interference.

Space Ops always uses appropriate, industry-standard receiver hardware, well-engineered equipment configurations and operational management as part of its normal activities.

The designation forms one component of a broader interference management approach rather than replacing reasonable mitigation at the ground station.

With specific regard to onsite mitigation measures, filtering cannot remove interference occurring within the same frequency as the desired satellite signal, shielding cannot be applied in a way that blocks terrestrial interference without also obstructing low elevation satellite signals, and raising antennas would not usefully preserve low angle visibility, would make the antenna more susceptible to distant interfering sources and may introduce structural/operational implications. Space Ops, to date, has implemented all practical mitigation measures that it can and will continue to do so in the future.

Preserving a low and unobstructed horizon is a fundamental operational requirement of the ground station. While onsite mitigation measures such as receiver filtering, shielding or equipment upgrades may assist in managing certain sources of electromagnetic interference, they do not address physical obstruction of the line of sight between the ground station antennas and orbiting spacecraft. Tall buildings, wind turbines, telecommunications masts and vegetation that penetrate the required horizon mask cannot be mitigated through onsite engineering solutions. Once an obstruction exists within the satellite acquisition and tracking envelope, it has the potential to delay or prevent satellite acquisition, reduce available communication windows, and compromise the operational capability of the ground station.

Therefore, preserving the low horizon is a necessary outcome that can only be effectively achieved through land use controls, such as the proposed designation.

### 14. Suggested Conditions

The reviewer says there is insufficient information to recommend conditions. We believe the conditions, as promoted within the NOR (and amended further as part of

this information) are sufficient. We would welcome discussions around any additional potential conditions.

## **Conclusion**

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We trust the above responses address the matters raised in Council's Engineering Review and provide further clarification regarding the intent and operation of the proposed designation.

Should Council require any further clarification regarding the matters discussed above, we would be pleased to provide additional information.

Yours Sincerely

A handwritten signature in blue ink, appearing to read 'A. Dunn'.

Alex Dunn

**SOUTHERN PLANNING GROUP**