

EXPERT WITNESS REPORT

Barrytown Minerals Project

Lighting, light pollution, glare and potential effects on nocturnal wildlife, including the Westland petrel / tāiko

Prepared for: Coast Road Resilience Group Incorporated (CRRG)

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Expert: Mike Geddis

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This document has been prepared for review in connection with CRRG's proposed submissions on the Barrytown Minerals Project. No applicant lighting design has been supplied. The purpose of this prospective report is to establish the design brief, safeguards and information requirements that should guide the detailed lighting design and its later independent review by a suitably qualified and experienced lighting professional.

Document control

Item	Detail
Matter	CRRG submission on the Fast-track Barrytown Minerals Project
Applicant	Tāiko Critical Minerals Limited
Project	Barrytown Minerals Project
Instructing party	Coast Road Resilience Group Incorporated
Instructing solicitor	Ana Coculescu
Expert	Mike Geddis
Subject	Lighting design guidance and recommendations to minimise light pollution, glare and effects on nocturnal wildlife
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1. Declaration and expert duty

1.1 Duty to the Panel

1.1.1 I have read the Code of Conduct for expert witnesses in Schedule 4 of the High Court Rules 2016, version as at 1 May 2026. I acknowledge that Code and agree to comply with it.

1.1.2 My overriding duty is to assist the Expert Panel impartially on matters within my area of expertise. I understand that I am not an advocate for CRRG, the party that engaged me.

1.1.3 I have prepared this report using my independent professional judgment. I have not been asked to withhold or avoid agreement with another expert. If directed to confer with another expert, I will identify areas of agreement and disagreement and the reasons for any disagreement.

1.1.4 I have identified in this report the facts and assumptions on which my opinions are based, the material relied upon, the investigations undertaken, and the limitations affecting the opinions.

1.2 Status of this document

1.2.1 This is a report prepared to assist CRRG's submissions. No applicant lighting design has been supplied. Accordingly, this report does not purport to assess whether a particular applicant design complies with the relevant standards or is suitable. Its purpose is to establish the lighting principles, information requirements, controls and draft conditions that, in my opinion, should guide the detailed design and its later independent review by a suitably qualified and experienced lighting professional.

1.2.2 My present opinion is therefore limited to:

- the lighting and environmental issues that should be addressed;
- the information that is necessary to assess the proposal properly;
- the lighting and control principles that should be applied;
- the foreseeable pathways by which artificial light at night may affect the Westland petrel / tāiko and other ecological receptors; and
- recommended consent conditions, monitoring and adaptive-management measures.

1.2.3 Because no applicant design has been provided, I cannot give a conformance opinion or quantify residual ecological risk for a particular lighting scheme. That is not a conclusion that a future design will be unsuitable. It is a limitation on the type of opinion that can properly be given at this stage; this report is intended to set the design tone and guidance that should precede and govern detailed design.

2. Qualifications and experience

2.1 Current role and relevant experience

2.1.1 I am employed as National Outdoor Lighting Specialist with Energylight Group. I have 16 years' experience in the lighting industry. My professional work concerns outdoor and commercial lighting, including the selection, specification and application of luminaires and lighting controls.

2.1.2 I hold a Postgraduate Certificate in Science and Technology — Lighting from Massey University and am a Technical Member of the Illuminating Engineering Society of Australia and New Zealand. My relevant experience for this report includes professional consideration of outdoor lighting performance, glare, light distribution, obtrusive light, lighting controls, lighting standards and the relationship between lighting design and the night-time environment. I have also developed a particular professional interest in dark skies, ecological lighting and the potential effects of artificial light at night on seabirds and other wildlife. My evidence is intended to provide a practical lighting design brief for the suitably qualified lighting professional who undertakes the project-specific design.

2.2 Limits of expertise

2.2.1 I am qualified to give an opinion on lighting design, lighting controls, light distribution, glare, spill light, skyglow, lighting standards and practical lighting mitigation.

2.2.2 I am not presenting myself as a marine ornithologist, ecologist or population biologist. I do not give a species-population viability opinion, a population trend opinion, or an opinion on the conservation status of the Westland petrel beyond reporting the material reviewed.

2.2.3 Any final assessment of petrel abundance, colony use, flight paths, fledging timing, breeding output, rescue data or population-level consequences should be undertaken or confirmed by an appropriately qualified ornithologist or ecologist. The lighting assessment and ecological assessment should be integrated rather than treated as substitutes for one another.

3. Instructions and scope

3.1 Instructions

3.1.1 I was instructed by Ana Coculescu, acting for CRRG, in relation to the proposal by Tāiko Critical Minerals Limited under the Fast-track Approvals Act 2024.

3.1.2 The written scope update dated 09/09/2026 asks me to prepare an expert report on the suitability of the proposed lighting design and controls to minimise light pollution and impacts on nocturnal wildlife such as the Westland petrel. As no applicant design has been provided, I address that instruction by setting out the design principles, safeguards, information requirements and draft conditions that should guide the detailed design.

3.1.3 CRRG's intended use of this report is to assist the Panel in setting the tone and guidance for the lighting design to be undertaken by a suitably qualified and experienced lighting professional, rather than to obtain a retrospective assessment of a design that has already been supplied.

3.2 Issues addressed

This report addresses the following issues within my lighting expertise:

- the environmental effects that should be considered when artificial lighting is introduced into a dark rural or coastal environment;
- direct light, light spill, light trespass, glare, over-illumination, upward light and skyglow;
- the potential for artificial light to affect nocturnal wildlife, particularly burrow-nesting petrels during fledging;
- the interaction between ordinary road-lighting performance and ecological risk;
- appropriate lighting design, optics, spectrum, mounting, shielding, controls, operating periods and maintenance;
- the information required to prepare and later assess the detailed design;
- an appropriate risk-assessed and adaptive-management framework; and
- proposed lighting-related consent conditions.

3.3 Issues outside the present scope

This report does not assess any other effects or the overall merits of the project. It does not determine the legal interpretation of the Fast-track Approvals Act 2024 or any resource consent.

4. Materials reviewed and information relied upon

4.1 Primary instructions and procedural material

I reviewed:

1. The letter from Ana Coculescu to me dated 09/09/2026, “CRRG submission on the Fast Track Barrytown Minerals Project — Updated scope of report and timing”.
2. Appendix-P1-Resource-Consent-Conditions-District-and-Regional-Council.pdf
3. Appendix-M2-Avian-Management-Plan.pdf
4. Appendix-L4-Ecological-Effects-Assessment.pdf
5. Appendix-L4A-Statement-of-Evidence-Dr-Bramley-Terrestrial-Ecology.pdf
6. Appendix-K-Maps-and-plans.pdf
7. Barrytown-Minerals-Project-Southern-Block-Substantive-Application.pdf
8. Schedule 4 of the High Court Rules 2016, version as at 01/05/2026, Code of Conduct for expert witnesses.

4.2 Standards and technical guidance

I reviewed the following material supplied to me:

1. AS/NZS 1158.3.1:2020, Lighting for roads and public spaces, Part 3.1: Pedestrian area (Category P) lighting.
2. AS/NZS 1158.1.1:2022, Lighting for roads and public spaces, Part 1.1: Vehicular traffic (Category V) lighting — Performance and design requirements.
3. AS/NZS 4282:2023, Control of the obtrusive effects of outdoor lighting.
AS/NZS 1680.2.4:2017, Interior and workplace lighting, Part 2.4: Industrial tasks and processes.
4. Department of Climate Change, Energy, the Environment and Water, National Light Pollution Guidelines for Wildlife, Version 2.0, May 2023.
5. Kerry Lukies, Literature Review — Lighting adjustments to mitigate against deck strikes / vessel impacts, MIT2019-03, Department of Conservation material supplied as “alan-presentation.pdf”.
6. Guidelines for Ecologically Responsible Lighting, supplied as “Guidelines-for-Ecologically-Responsible-Lighting compressed.pdf”.
7. Cieraad, E. and Farnworth, B., “Lighting trends reveal state of the dark sky cloak: light at night and its ecological impacts in Aotearoa New Zealand”, New Zealand Journal of Ecology, 47(1), 3559, published 12/12/2023.

4.3 Other material

The applicant’s detailed lighting plans, lighting assessment, luminaire schedule, photometric files, site-wide operating profile and project-specific ecological assessment were not included in the material supplied to me at the time of preparing this report.

5. Investigations undertaken and information required for future design

5.1 Investigations undertaken

My work to date has consisted of document review and technical analysis of the supplied standards and guidance. I have not yet:

- visited the Barrytown site at night;
- viewed the project area from the Westland petrel colony, the coastline, likely flight paths or nearby residences;
- undertaken baseline measurements of illuminance, luminance, skyglow, spectral power distribution or visible light sources;
- inspected the applicant’s proposed luminaires or control system;
- conducted photometric modelling or independent calculations;
- reviewed the applicant’s final ecological or ornithological assessment;
- examined the available Community Petrel Patrol rescue-point data; or
- conferred with an applicant lighting expert, ecologist, ornithologist, the Department of Conservation or the road-controlling authority.

5.2 Information required to prepare and later assess the detailed design

The following information should be supplied to the suitably qualified lighting professional who prepares the detailed design and retained for the later independent review. It is set out in Appendix A. In summary, I require:

- a scaled site plan and GIS information showing the full project footprint, mine areas, processing plant, stockpiles, workshops, offices, roads, access points, water bodies, coastline, residences, vegetation and ecological areas;
- the lighting layout for permanent, temporary, mobile, construction, maintenance and emergency lighting;
- a complete luminaire schedule, including manufacturer, model, wattage, lumens, optics, mounting height, tilt, aiming, shielding, CCT and spectral power distribution;
- IES or EULUMDAT / LDT photometric files and the calculation software, version and assumptions used;
- predicted values for horizontal and vertical illuminance, luminance, glare, threshold increment, upward light and obtrusive-light parameters;
- operating hours, shift patterns, maintenance periods, traffic assumptions, curfews, dimming states and emergency overrides;
- the proposed construction-lighting methodology;
- the applicant's ecological, ornithological and Westland petrel assessments;
- all relevant existing consent conditions, including those in the [2024] EnvC238 Environment Court consent order for the central block; and
- an independent site inspection and baseline monitoring plan.

6. Project and receiving environment

6.1 Project information presently available

6.1.1 The engagement brief identifies the proposal as the Barrytown Minerals Project, lodged by Tāiko Critical Minerals Limited under the Fast-track Approvals Act 2024.

6.1.2 I understand that the proposal may involve a mining and processing operation with associated roads, plant, buildings, work areas, vehicle movements, security lighting, construction lighting and maintenance or emergency lighting. The actual components and operating profile must be confirmed from the application.

6.2 Receiving environment

6.2.1 The application describes a rural and coastal environment on the West Coast, adjacent to the foothills and coastline associated with the Westland petrel / tāiko.

6.2.2 The relevant receiving environment is not limited to the operational footprint. It includes:

- the foothills and breeding habitat;
- the coastline and beach areas where grounded birds may be found;
- the airspace and likely flight paths between the breeding grounds and the sea;
- road corridors and other locations where a grounded bird may be exposed to vehicle strike;
- rivers, wetlands, vegetation and other ecological receptors that may receive spill light or skyglow; and
- nearby residences and public roads where glare, nuisance light or driver impairment may occur.

6.2.3 The night-time receiving environment should be established by site inspection and baseline monitoring. It should not be characterised solely by daytime photographs, a satellite image or a general land-use label.

6.3 Environmental zone

6.3.1 AS/NZS 4282:2023 defines environmental zones by ambient light conditions. Zone A0 is intrinsically dark; Zone A1 is dark and includes relatively uninhabited rural, marine, aquatic and coastal areas; and Zone A2 is low district brightness and includes sparsely inhabited rural and semi-rural areas.

6.3.2 I cannot select the final environmental zone without a site assessment, relevant planning information and confirmation of the ambient light environment.

6.3.3 For preliminary design and risk assessment, I recommend that the applicant assess the relevant coastal, foothill and ecological receivers on a conservative basis no less protective than A1, with consideration of A0 where the existing environment is intrinsically dark or is managed for wildlife, dark-sky or ecosystem protection. The operational footprint may require a separate zone assessment, but the zone applicable to an abutting environmentally sensitive area must also be assessed.

6.3.4 The final consent should require the applicant to identify the environmental zone for each lighting system and each affected environmentally sensitive area, supported by a site assessment and relevant authority confirmation.

7. Lighting and ecological effects

7.1 Artificial light at night

Artificial light at night (ALAN) can alter the natural light-dark cycle through direct point sources, reflected light, light spill and skyglow. The relevant impact is not simply the number of watts installed or the lighting category stated in a road-lighting design. It includes what is visible from a sensitive receptor, when it is visible, the direction and intensity of the light, the spectrum, the weather, the moon phase, the surrounding terrain and the cumulative contribution of other sources.

The DCCEE National Light Pollution Guidelines state that natural darkness has conservation value and recommend that lighting should start from natural darkness, be added only for a specific purpose, be used only when needed, be directed and shielded, use the lowest appropriate intensity, avoid reflective surfaces and use light sources with reduced or filtered blue, violet and ultraviolet wavelengths where appropriate.

7.2 Direct light, spill, glare and skyglow

The potential pathways relevant to Barrytown include:

- **Direct view of a luminaire:** a bright point source visible from a colony, flight path, road or residence.
- **Light spill or trespass:** light falling outside the area or object intended to be lit.
- **Upward light:** direct light emitted above the horizontal, which contributes to skyglow.
- **Reflected light:** light reflected from pale, wet, glossy or water surfaces.
- **Skyglow:** diffuse light scattered by the atmosphere, aerosols, moisture and clouds. Blue-rich light scatters more strongly than longer-wavelength light.
- **Glare:** excessive luminance or contrast that causes discomfort, disability or loss of visual performance. For road users this includes glare affecting visibility and threshold increment; for wildlife it may cause dazzle, attraction or disorientation.
- **Over-illumination:** using more light, more luminaires or longer operating periods than are necessary for the task.

The absence of direct spill onto the ground does not establish that a project has no ecological effect. A luminaire can be shielded from ground-level view yet contribute to skyglow, and a low-level or reflected light source may remain visible to a flying bird.

7.3 Seabirds and petrels

The reviewed seabird literature identifies a well-established risk pathway for nocturnally active petrels and shearwaters. Artificial light can override natural navigation cues, attract or disorient birds, cause circling and exhaustion, result in collisions or grounding, and leave grounded birds exposed to predation, dehydration, starvation and vehicle strike.

The DCCEEW guidelines identify fledglings as particularly vulnerable because of the naivety of their first flight, their developing visual system and the synchronised exodus from burrows. The guidelines state that fledglings may be affected by lights up to 15 km away and recommend considering important seabird habitat within 20 km as a precautionary screening measure. Those distances are not a New Zealand statutory threshold, a guaranteed exclusion zone or a substitute for a site-specific assessment. They are relevant evidence that the assessment should not stop at the project boundary.

The DCCEEW guidance also identifies intensity and colour as important physical aspects of light, while cautioning that intensity may be more important than colour in some situations. Petrels are reported as sensitive to short-wavelength blue light, but seabirds can respond to other wavelengths and a bright source of any colour may be attractive. Accordingly, changing to amber or red light is not, by itself, a guarantee of no effect.

7.4 Westland petrel / tāiko

The New Zealand Journal of Ecology review by Cieraad and Farnworth records that fallout and deck-strike effects have been observed in several New Zealand seabirds, including Westland petrels. Its literature table identifies a general observation from Wilson (2016) of Westland petrel fallout associated with lights at Punakaiki, Westport, Greymouth and Hokitika. That is relevant local evidence, but it is not a controlled species-specific threshold study and should not be used to claim that a particular illuminance or distance is safe.

7.5 Other ecological receptors

The project may affect more than the Westland petrel. Artificial light can alter nocturnal insects, bats, terrestrial fauna, freshwater and marine organisms, vegetation, predator-prey relationships and ecological connectivity. The reviewed guidance describes effects on aquatic systems, including changes to plankton movement, fish behaviour, invertebrate activity and food-web processes. Light directed onto water, wetlands or wet surfaces should therefore be treated as a specific design risk.

The final ecological assessment should identify other sensitive receptors and should not assume that a design that reduces petrel risk has no effect on other taxa. Conversely, the use of an amber or red spectrum that may reduce effects on some taxa may affect other species or plants differently. Spectrum selection should therefore be species-informed and monitored.

8. Applicable standards and guidance

8.1 AS/NZS 4282:2023

AS/NZS 4282:2023 provides a framework for controlling obtrusive outdoor lighting and expressly recognises environmental receivers, including plants, animals and ecosystems. It states that conformity with the technical limits will provide general environmental benefit but will not necessarily address protected species or ecological communities. It also states that there are no agreed light thresholds that guarantee no significant effect on protected species and that a risk-assessed and adaptive-management approach should be used where protected species or ecological communities may be affected.

The standard is therefore an important minimum design and assessment tool, but it is not a species-specific ecological assessment and should not be relied on as a safe-harbour standard for tāiko.

Relevant principles include:

- assess affected environmentally sensitive areas separately from the lighting system where appropriate;
- apply the lower curfew limits at all times where the affected property is or includes an environmentally sensitive area;
- use light only where needed, only when needed and at the lowest amount needed;

- use appropriate optics, shielding, mounting and aiming;
- avoid directing light onto reflective or wet surfaces and water bodies;
- prefer low-blue sources and generally prefer CCT 3000 K or lower unless there is a safety reason for 4000 K; and
- provide sufficient design information, including photometric files, luminous flux, mounting heights, aiming angles, calculations, control functionality and a declaration of conformance.

The standard also notes that CCT and CRI do not fully describe a source's spectral power distribution. The applicant must therefore provide the SPD rather than relying on a CCT number alone.

8.2 AS/NZS 1158.3.1:2020 — Category P

AS/NZS 1158.3.1:2020 recognises that spill light from roads and pathways may negatively affect wildlife sensitive to light. It directs users to limit spill where habitat or migratory pathways are adjacent or nearby and refers to AS/NZS 4282 for further guidance.

For solid-state lighting, the standard includes a maximum UWLR of 1% for local roads and 3% for public-space applications. It also contains requirements for luminous intensity and discomfort glare. Those figures are road and public-space performance criteria; they do not establish a Westland petrel threshold.

The standard recognises adaptive lighting, but every dimming level must meet the relevant lighting-category requirements and the control system must be failsafe. It also states that CCT and CRI do not fully define source characteristics and that SPD should be considered.

8.3 AS/NZS 1158.1.1:2022 — Category V

AS/NZS 1158.1.1:2022 requires road lighting to minimise compromise of the general environment, identifies upward light as a source of skyglow and includes glare, upward waste light ratio and energy minimisation among the principal design objectives.

The standard supports adaptive lighting through central management systems. Each selected lighting level must conform to the relevant lighting subcategory and the control system must be failsafe. V4 is identified as the minimum subcategory recommended for application in New Zealand. The New Zealand UWLR value in Table 3.1 is 1% for Category V luminaires.

The choice of V4 or another subcategory must be justified by road-safety and traffic conditions. The ecological objective is not to select a lower road category without evidence; it is to avoid unnecessary light while maintaining safety. The applicant should demonstrate why any higher category, continuous operation or all-night lighting is necessary.

8.4 National Light Pollution Guidelines for Wildlife and related guidance

The DCCEE guidelines are Australian guidance and are not New Zealand legislation. They are nevertheless relevant technical and ecological guidance, particularly because AS/NZS 4282:2023 refers to the CMS wildlife-lighting framework and the DCCEE guidelines are based on that framework.

The DCCEE process requires the proponent to:

1. describe the project lighting and existing light environment;
2. describe the wildlife, habitat, behaviour, life stages and seasonality;
3. undertake a case-specific risk assessment;
4. prepare an artificial-light management plan; and
5. undertake biological and light monitoring, auditing and review through adaptive management.

The guidelines emphasise that conventional lux and luminance measurements are weighted to human vision and may not represent what wildlife perceives. Monitoring should account for direct sources, skyglow, the horizon, the whole sky, spectral distribution and relevant viewing perspective.

8.5 AS/NZS 1680.2.4:2017 — Industrial tasks and mine surface buildings

AS/NZS 1680.2.4:2017 is relevant to the interior lighting of industrial tasks and processes, including mine and quarry surface buildings. It is intended to be read with AS/NZS 1680.1 and provides task-based recommendations for maintained illuminance, colour rendering and glare. Table E1 includes examples for mine and quarry surface-building activities such as preparation plants, picking belts, lamp rooms, materials handling, transfer houses, sampling towers, bagging plants, winding houses, conveyors and gantries.

The standard does not cover outdoor tasks. It should therefore not be used alone to set requirements for open mine areas, external conveyors and gantries, yards, stockpiles, haul or access roads, external security lighting, mobile light towers or other external mine lighting. Those elements require the applicable outdoor workplace or road-lighting provisions, including AS/NZS 1680.5 where relevant and AS/NZS 1158 for roads, together with AS/NZS 4282 and the project-specific ecological assessment.

For a mine project, the future lighting professional should separate the design into interior workplace tasks, outdoor work areas, roads, emergency and safety lighting, and hazardous or special environments. The design should also address the equipment and safety matters identified in AS/NZS 1680.2.4, including hazardous-area requirements (AS/NZS 60079 series), enclosure protection (AS 60529), emergency evacuation lighting (AS 2293.1), safety and standby lighting, industrial dust, corrosion, temperature, vibration, flicker, stroboscopic effects and maintenance. Compliance with these workplace and equipment requirements does not, by itself, demonstrate that ecological effects or obtrusive-light effects are acceptable.

9. Design brief and assessment framework for future lighting

9.1 Lighting purpose and necessity

This section is intended to operate as a design brief for the future lighting professional and as the framework against which the completed design should later be reviewed. It is not a finding that an applicant design has failed to meet these requirements.

The applicant should identify every external and externally visible internal light source, its purpose, location, operating hours and consequence of not using it. The starting point should be natural darkness. Each source should be justified against one of the following purposes:

- road or pedestrian safety;
- worker safety or a defined task;
- emergency response;
- security detection, preferably supported by non-light-based detection; or
- another specific purpose accepted by the relevant authority.

Amenity, convenience or general visibility should not be accepted as sufficient justification for continuous lighting in a sensitive rural or coastal environment.

9.2 Lighting design and optics

The design should demonstrate that:

- the target area is lit and areas outside it remain dark;
- luminaires are mounted as low as practicable without compromising safety;
- the optical distribution has a sharp cut-off and controlled run-back;
- direct upward light is eliminated or minimised;
- shields, louvres or baffles prevent direct view from the colony, coast, flight paths, roads and residences;
- luminaires are correctly aimed and cannot be tilted beyond the approved position;
- light is not directed onto water, wetlands, wet ground, pale surfaces or reflective buildings; and
- maintenance will preserve the approved aiming, shielding and optical performance.

Full cut-off is a useful design description but should be supported by photometric data and installed-position verification. A statement that a fitting is “full cut-off” without the luminaire photometric file and installed tilt is not enough.

9.3 Light levels and category selection

The design should use the lowest justified Category P or Category V subcategory. Where roads are proposed to be lit, the applicant should provide:

- the road hierarchy and traffic data;
- design speed, vehicle and pedestrian activity assumptions;
- the reason for any lighting at all;
- the reason for the selected subcategory;
- the potential for a lower subcategory during off-peak periods; and
- the safety assessment supporting continuous lighting during the petrel fledging period.

For industrial areas, the applicant should not use a road-lighting category as a substitute for an industrial lighting assessment. Plant, yards, stockpiles, conveyors, workshops and security areas should be assessed under AS/NZS 4282 and the project-specific risk assessment.

9.4 Spectrum and spectral power distribution

The applicant should provide a spectral power distribution curve for every luminaire type and state the proportion of short-wavelength output relevant to the ecological assessment. CCT alone is not adequate.

The design should use sources at 2200 K or lower, with PC amber preferred, particularly for lighting that may be visible from sensitive habitat or flight paths. 4000 K and other blue-rich white LED sources should not be used where they can be seen from sensitive habitat or flight paths.

A filtered or amber source may be considered where compatible with safety, colour recognition and the sensitivity of the species present. The applicant should not claim that amber, red or any other colour is universally wildlife-safe. Brightness, direction, duration and visibility remain important.

9.5 Timing, curfews and adaptive control

The preferred mitigation hierarchy is:

1. do not install the light;
2. switch it off when the task is not occurring;
3. use a low lighting state when activity is low;
4. use motion or presence controls for short-duration tasks;
5. use a lower-impact spectrum and tight optics; and
6. retain higher-output task lighting only for defined tasks, emergencies or safety-critical situations.

During the local Westland petrel fledging period, non-essential external lighting should be extinguished. For preliminary planning, a seasonal window from early November to mid-January should be considered. The final seasonal window should be set by an appropriately qualified ornithologist or the relevant authority using local fledging data. It should be capable of being extended where monitoring shows that fledging has started earlier, continued later or has been affected by unusual weather.

The plan should also include weather-responsive controls. Fog, low cloud, rain and overcast conditions may increase the visibility and ecological effect of artificial light. During those conditions, non-essential lights should be off or reduced to the lowest safe state.

9.6 Glare and road-user safety

The applicant must separately address:

- discomfort glare and disability glare for workers and residents;
- threshold increment and visibility for road users;
- direct view of high-luminance sources from approaching drivers;
- glare from temporary lighting towers and vehicle headlights;
- glare from wet pavement, water, pale stockpiles or metal surfaces; and
- glare from emergency and maintenance lighting.

A design that reduces ecological light spill but creates a road-safety hazard is not acceptable. Conversely, a design that meets a road-lighting glare metric is not necessarily ecologically acceptable.

9.7 Cumulative light

The assessment should identify existing and reasonably foreseeable sources, including public-road lighting, residences, accommodation, processing facilities, vehicle headlights, construction plant, mobile light towers and any lighting associated with transport or coastal operations. The applicant should model and visually assess the combined night-sky and horizon effect rather than treating every lighting system as isolated.

10. Preliminary risk implications and expert opinions

Issue	Potential pathway	Consequence if realised	Current likelihood	Information needed
Fledgling petrel attraction or disorientation	Direct source, skyglow, reflected light or light visible along the flight path	High: grounding, collision, exhaustion, predation, dehydration, starvation or vehicle strike	Cannot be quantified; potentially material where the source is visible from habitat or flight path	Lighting geometry, line-of-sight assessment, petrel flight information, seasonal monitoring
Adult petrel disturbance	Light visible at colony, during colony attendance or on approach to burrows	Potentially material: altered attendance or behaviour	Unknown	Ecological assessment, colony observations, night-time viewing
Glare to road users	High-intensity sources, poor aiming, wet surfaces or temporary lights	High where visibility or hazard recognition is compromised	Unknown	TI/glare calculations, night inspection, road-safety review
Spill into habitat, wetlands or water	Horizontal or vertical spill and reflected light	Material ecological effects, including disturbance and altered food webs	Unknown; likely if no sensitive-receiver modelling is provided	Vertical illuminance, direct-view and reflection assessment
Skyglow and cumulative effects	Upward light, blue-rich spectrum, clouds and multiple sources	Regional ecological and dark-sky effects	Potentially material for a large long-term development	ULRS/ULRL, SPD, all-sky baseline and cumulative assessment
Construction and emergency lighting	Temporary high-output lights, vehicle headlights and unplanned operation	Acute localised disturbance or grounding	Unknown	Construction method, controls, weather and incident procedures

Issue	Potential pathway	Consequence if realised	Current likelihood	Information needed
Control-system failure	Uncontrolled full-output or all-night operation	Could materially increase exposure during sensitive periods	Unknown	CMS specification, alarms, fallback state, maintenance and response times

10.1 Opinion 1 — this report is prospective design guidance

In my opinion, a project-specific suitability opinion cannot properly be given because no applicant lighting design and operating profile has been supplied. This report is therefore prospective: it sets out the design brief, safeguards and assessment information that should be required before a detailed design is approved or commissioned.

10.2 Opinion 2 — ordinary standards compliance is not enough

In my opinion, compliance with the relevant light technical parameters in AS/NZS 1158.1.1:2022, AS/NZS 1158.3.1:2020 or AS/NZS 4282:2023 would not, by itself, demonstrate that the project will avoid adverse effects on the Westland petrel / tāiko. The standards provide necessary design controls and general environmental benefit, but AS/NZS 4282:2023 expressly recognises that there are no agreed thresholds guaranteeing no significant impact on protected species or ecological communities.

10.3 Opinion 3 — the future design should be treated as a high-consequence ecological risk

In my opinion, the potential consequence of a project-attributable interaction with a fledgling Westland petrel is high because the available evidence identifies a plausible pathway from artificial light to disorientation, grounding and subsequent mortality risk. The likelihood cannot be quantified without the lighting geometry, distance, visibility, spectrum, intensity, operating period, weather response and local petrel data.

The combination of a potentially dark coastal/rural environment, a reported nearby breeding area and a long-term mining and processing operation justifies a precautionary, risk-assessed and adaptive-management approach.

10.4 Opinion 4 — the consent should require avoidance before mitigation

In my opinion, the consent framework should require avoidance and minimisation at the design stage rather than relying primarily on a rescue patrol after birds have grounded. Rescue is important, but it is a response to an adverse effect and does not prevent disorientation, exhaustion, collision or loss of breeding opportunity.

10.5 Opinion 5 — a lighting management plan should guide design and be a precondition to commissioning

In my opinion, no permanent lighting should be commissioned, and no construction lighting should be used at night other than defined safety-critical lighting, until a suitably qualified and experienced lighting professional has prepared a project-specific Lighting and Artificial Light Management Plan in consultation with an appropriately qualified ornithologist or ecologist, and that plan has been approved under the consent framework.

11. Recommendations and proposed consent conditions

The detailed proposed conditions are in Appendix B. The principal recommendations are:

1. Require a project-wide Lighting and Artificial Light Management Plan before construction or commissioning.

2. Require a complete lighting inventory covering permanent, temporary, mobile, construction, maintenance, emergency, vehicle and building lighting.
3. Require the applicant to demonstrate necessity for every external light and to retain naturally dark areas and corridors.
4. Require the lowest practicable lighting output and the lowest justified road-lighting subcategory.
5. Require full photometric data, installed aiming, mounting height, tilt, glare calculations, upward-light calculations and sensitive-receiver modelling.
6. Require low-glare, downward-directed and shielded luminaires with no direct view from sensitive habitat or flight paths where practicable.
7. Require the SPD for every source and a documented preference for low-blue sources; do not allow CCT alone to be used as the ecological assessment.
8. Require a seasonal fledgling-period lighting restriction, including switch-off of non-essential external lighting and a procedure for extending the restriction.
9. Require weather-responsive controls for fog, low cloud, rain and other high-risk conditions.
10. Require construction, maintenance, emergency and temporary lighting to meet the same ecological objectives as permanent lighting.
11. Require baseline, construction and operational monitoring of light and petrel interactions.
12. Require immediate notification, investigation and corrective action following any suspected project-related petrel grounding, collision or other wildlife interaction.
13. Require independent annual review during the first operational years and during the fledgling season.
14. Require adaptive management with enforceable triggers, deadlines and a hierarchy of responses, including dimming, shielding, spectrum change, curtailment and switch-off.
15. Require the applicant to maintain a public or Panel-accessible register of lighting incidents, wildlife interactions, non-compliances and corrective actions, subject to appropriate protection of sensitive ecological locations.

12. Monitoring, incident response and adaptive management

12.1 Baseline monitoring

Baseline monitoring should occur before construction and before any change to existing lighting. It should include, as appropriate:

- night-time visual inspection from the petrel colony, foothills, coast, beaches, roads and nearby residences;
- photographs or calibrated wide-angle imagery of the horizon and sky;
- measurements of sky brightness and relevant spectral information, with the limitations of the instruments recorded;
- identification and mapping of visible point sources;
- weather, cloud cover, visibility, rainfall, wind direction and speed;
- moon phase and astronomical conditions;
- petrel observations, flight direction and activity from an appropriately qualified ornithologist; and
- collation of available rescue-point information, including recorded date and location, with any limits in search-effort or control-location data identified.

The monitoring should include clear repeatable locations and methods. Measurements should be taken from a biologically relevant perspective and repeated after construction under comparable conditions.

12.2 Operational monitoring

Operational monitoring should include:

- as-built verification of each luminaire, including model, location, height, tilt, aiming, shielding and control state;
- a night-time lighting audit from sensitive receptors;
- photometric and, where practicable, biologically relevant spectral monitoring;
- review of control-system logs and failed-operation alarms;
- monitoring during the local fledgling period, including night patrols or other suitable methods; and

- monitoring of construction and temporary lighting separately from permanent lighting.

The Community Petrel Patrol's records should be incorporated where suitable, but the monitoring design, data quality and interpretation should be overseen by an appropriately qualified ornithologist or ecologist. The lighting conditions at the time of each interaction should be recorded sufficiently to support causal analysis.

12.3 Trigger events

The following should be treated as trigger events requiring investigation:

- any grounded, injured or dead Westland petrel within the agreed project search area where the project could plausibly have contributed;
- any bird collision with project infrastructure or plant;
- any direct view of an unapproved luminaire or light source from the colony, known flight path, coastline or other agreed sensitive receptor;
- any measured or modelled exceedance of the approved light technical parameters;
- any control-system failure that causes unapproved output, operating hours or spectrum;
- any repeated observation of birds circling, approaching or avoiding the project lighting; and
- any substantial increase in fallout, adjusted for search effort, breeding output, weather and other relevant variables.

A trigger should not be dismissed merely because a species-specific numerical threshold has not been established. The absence of a threshold is a reason for structured investigation and adaptive management, not a reason to treat the interaction as acceptable.

12.4 Response hierarchy

The consent should require the following response hierarchy, subject to immediate safety requirements:

1. make the lighting safe and stop any unapproved or unnecessary source;
2. notify the consent authority and nominated ecological contacts;
3. preserve control-system logs, weather information and relevant camera or monitoring data;
4. investigate the likely pathway, including direct view, spill, skyglow, spectrum, intensity and operating state;
5. implement temporary controls, including dimming, shielding, curtailment or switch-off;
6. obtain independent lighting and ecological advice;
7. amend the Lighting and Artificial Light Management Plan; and
8. resume the affected lighting only after the corrective action has been verified and accepted under the consent process.

13. Conclusions

13.1 Artificial light at night is a credible environmental risk associated with the Barrytown Minerals Project. The risk arises through direct light, glare, spill, reflected light, upward light, skyglow, spectrum, timing, weather conditions and cumulative sources.

13.2 The reviewed evidence establishes that burrow-nesting petrels and fledglings are particularly vulnerable to artificial light. New Zealand evidence identifies fallout and deck-strike effects in several seabirds, including Westland petrels. Available information from the local Community Petrel Patrol about rescue activity and grounding locations is potentially important and should be incorporated into the formal assessment, subject to independent review.

13.3 The relevant standards provide an essential basis for lighting design, but they are not a species-specific guarantee. AS/NZS 4282:2023 expressly recognises that protected-species effects require a risk-assessed and adaptive-management approach.

13.4 No applicant lighting design was provided to me. Accordingly, I do not offer a conformance or suitability opinion on a particular scheme. My evidence is intended to set the design tone and guidance for the detailed lighting design to be undertaken by a suitably qualified and experienced lighting professional.

13.5 Before any lighting design is approved or commissioned, the applicant should provide a complete Lighting and Artificial Light Management Plan, project-specific photometric and spectral information, sensitive-receiver modelling, baseline data, seasonal controls, construction-lighting controls, monitoring and enforceable adaptive-management conditions.

13.6 The objective should be to maintain natural darkness wherever practicable, prevent direct light and glare from reaching sensitive habitat and flight paths, use the minimum light necessary for a defined safety or operational purpose, and ensure that any adverse interaction is detected and acted upon promptly.

14. Declaration and signature

I, Mike Geddis, declare that:

1. I have read the Code of Conduct for expert witnesses in Schedule 4 of the High Court Rules 2016 and agree to comply with it.
2. I understand that my overriding duty is to assist the Expert Panel impartially on relevant matters within my area of expertise.
3. I am not an advocate for CRRG or any other party.
4. The opinions in this report are within my area of expertise, subject to the qualifications and limitations stated in the report.
5. I have identified the facts, assumptions, literature, material and investigations on which the opinions are based.
6. I have identified where the evidence is incomplete and where an opinion is not concluded because project-specific data are unavailable.

Signed:



Mike Geddis - TechIES

Date: 27-09-2026

Appendix A — Information required to prepare and later assess the detailed design

Information category	Minimum information required
Project geometry	Scaled plans and GIS showing project boundary, mine areas, plant, buildings, roads, yards, water, coastline, foothills, residences and ecological receptors
Luminaire schedule	Manufacturer, model, lumens, wattage, optics, mounting height, tilt, aiming, shielding, CCT, SPD and control type for every source
Photometry	IES/EULUMDAT files, photometric report, maintenance factors, calculation software and version, calculation grids and assumptions
Operating profile	Shift times, operating hours, seasonal operation, curfews, dimming levels, motion-sensor settings and emergency overrides
Road lighting	Road classification, traffic data, design speed, selected Category P/V subcategory and safety justification

Information category	Minimum information required
Industrial lighting	Task descriptions, target illuminance, areas to remain dark, security approach and inspection lighting procedures
Construction	Temporary light towers, night-work schedule, vehicle and mobile-light controls and shutdown procedure
Sensitive receptors	Confirmed colony and habitat locations, flight paths, coastline and beach search areas, wetlands, waterways, residences and public roads
Ecology	Applicant ecological and ornithological assessments, species data, fledging period, baseline behaviour and monitoring design
Existing consents	2024 consent conditions and any proposed conditions relating to tāiko, lighting, monitoring, reporting and review
Community data	Available Community Petrel Patrol rescue-point data, including recorded date and location; identify any data limitations and whether additional search-effort or control information is available.
Site inspection	Night-time viewing and measurements from relevant ecological, residential and road-user perspectives

Appendix B — Proposed lighting-related consent conditions

The following are draft conditions for consideration by the Expert Panel. They are intended to set the design tone and minimum safeguards for the future lighting professional and should be checked against the final project description, the applicable consenting instrument and the advice of an ecologist, ornithologist, road-controlling authority and lighting practitioner.

B1. Lighting and Artificial Light Management Plan

1. No permanent external lighting or externally visible internal lighting associated with the project shall be installed or commissioned until a suitably qualified and experienced lighting professional has prepared a Lighting and Artificial Light Management Plan (LAMP), in consultation with an appropriately qualified ornithologist or ecologist, and the LAMP has obtained the required written approval.
2. The LAMP and detailed lighting design shall be prepared by a suitably qualified and experienced lighting professional and reviewed by an appropriately qualified ornithologist or ecologist.
3. The LAMP shall cover construction, commissioning, operation, maintenance, emergency response, temporary lighting, mobile lighting, vehicle headlights, building interiors visible externally, security systems and any other project-related artificial light.
4. The LAMP shall state the purpose, location, output, spectrum, operating period, control state and justification for every lighting system.
5. The LAMP shall identify areas that must remain dark and shall include a plan showing all sensitive ecological and residential receivers.

B2. Design and performance

6. Lighting shall be used only where required for a defined safety, security or operational purpose and shall be limited to the minimum amount required for that purpose.
7. Luminaires shall be selected and installed to prevent direct upward light and to minimise spill beyond the intended target area.
8. Luminaires shall be shielded, louvred or baffled where necessary to prevent direct view from sensitive ecological receivers, the coastline, known flight paths, public roads and residences.
9. The consent holder shall provide full photometric files, installed aiming angles, mounting heights, tilts, control states, luminous flux, maintenance factors and calculated light technical parameters before commissioning.

10. The design shall demonstrate conformance with the applicable requirements of AS/NZS 1158 and AS/NZS 4282, but shall also provide a species-specific risk assessment under the LAMP.
11. The design shall avoid directing light onto water bodies, wetlands, wet ground, pale stockpiles, reflective surfaces or other surfaces likely to increase reflected light.
12. A design requirement for CCT 2200 K or lower shall be applied, with PC amber preferred, particularly where light may be visible from sensitive habitat or flight paths.
13. Road lighting shall use the lowest justified Category P or Category V subcategory. Any use of a higher category shall be supported by a safety and traffic assessment.

B3. Seasonal and weather controls

14. During the local Westland petrel fledging period, all non-essential external lighting shall be switched off from nautical dusk to nautical dawn, subject to lighting required for immediate safety or emergency response.
15. The initial fledging restriction shall operate from early November to mid-January each year, or for another period approved on the advice of an appropriately qualified ornithologist and the relevant authority, provided the period encompasses the local fledging season.
16. The LAMP shall include a process for extending or bringing forward the seasonal restriction where monitoring, weather, breeding output or local observations indicate that fledging is occurring outside the nominated period.
17. During fog, low cloud, heavy rain or other conditions identified in the LAMP as increasing light visibility or wildlife risk, non-essential external lighting shall be switched off or reduced to the lowest safe state.
18. Any lighting required during the seasonal or weather restrictions shall be task-specific, shielded, directed away from sensitive receptors and subject to the shortest practicable operating period.

B4. Controls and failure response

19. The lighting control system shall support scheduled operation, dimming, manual isolation and, where appropriate, motion or presence detection.
20. Each dimming state shall comply with the applicable lighting-performance requirements. The control system shall be failsafe in accordance with the relevant road-lighting standard.
21. Any fallback state that results in increased or continuous lighting shall generate an alarm and require notification, investigation and repair within the timeframe specified in the LAMP.
22. Control-system logs, alarms, overrides, outages and manual interventions shall be retained and made available for audit.

B5. Construction, maintenance and emergency lighting

23. Construction lighting shall not be used at night unless the consent holder demonstrates that it is necessary for safety or environmental protection and that no practicable alternative exists.
24. Mobile lighting towers shall be fully shielded, aimed downwards and positioned so that direct light is not visible from sensitive ecological receivers or public roads.
25. Vehicle headlights, work lights and personal torches shall not be directed across the coastline, foothills, colony, waterways or other identified sensitive areas except where required for an emergency.
26. Maintenance and emergency procedures shall identify how lighting is to be minimised during the petrel fledging period and in high-risk weather.

B6. Monitoring and reporting

27. Baseline lighting and wildlife monitoring shall be completed before construction and before any material change to project lighting.
28. The consent holder shall undertake as-built lighting audits and night-time inspections from relevant ecological and residential viewpoints before commissioning.
29. Biological monitoring shall be designed, overseen and interpreted by an appropriately qualified ornithologist or ecologist. Lighting monitoring shall be undertaken by a competent lighting practitioner.
30. Monitoring shall record lighting state, direct visibility, skyglow, spectrum where practicable, weather, cloud, rainfall, wind, moon phase, search effort, petrel observations, grounded birds, injuries, collisions and other relevant wildlife interactions.
31. Monitoring shall include the local fledging period for at least the initial operational years and shall continue for the period specified by the approved LAMP.

32. The consent holder shall report monitoring results to the consent authority and nominated ecological contacts within the timeframes specified in the LAMP.

B7. Triggers and adaptive management

33. Any suspected project-related petrel grounding, collision, injury or death shall trigger an investigation and temporary review of the relevant lighting.
34. Direct visibility of an unapproved source, exceedance of approved lighting parameters, or a control-system failure causing unapproved operation shall trigger immediate corrective action.
35. The LAMP shall specify a hierarchy of responses, including shielding, aiming changes, dimming, spectrum change, curtailment and switch-off.
36. Lighting shall not resume at the affected output or operating period until the corrective action has been verified and accepted under the consent process.
37. The LAMP shall be reviewed at least annually during the initial operating period, following any trigger event, after a material change to lighting or operations, and whenever monitoring indicates that the ecological objectives are not being met.
38. The consent authority shall retain the ability to require additional mitigation or review of conditions where interactions continue despite implemented mitigation.

Appendix C — References and source material

C1. Primary documents supplied for this report

- Ana Coculescu, “CRRG submission on the Fast Track Barrytown Minerals Project — Updated scope of report and timing”, 09/09/2026.
 - Barrytown-Minerals-Project-Southern-Block-Substantive-Application.pdf
 - Appendix-K-Maps-and-plans.pdf
 - Appendix-L4A-Statement-of-Evidence-Dr-Bramley-Terrestrial-Ecology.pdf
 - Appendix-L4-Ecological-Effects-Assessment.pdf
 - Appendix-M2-Avian-Management-Plan.pdf
- Appendix-P1-Resource-Consent-Conditions-District-and-Regional-Council.pdf
- High Court Rules 2016, Schedule 4, Code of conduct for expert witnesses, version as at 01/05/2026.
- AS/NZS 1158.3.1:2020, Lighting for roads and public spaces, Part 3.1: Pedestrian area (Category P) lighting.
- AS/NZS 1158.1.1:2022, Lighting for roads and public spaces, Part 1.1: Vehicular traffic (Category V) lighting — Performance and design requirements.
- AS/NZS 4282:2023, Control of the obtrusive effects of outdoor lighting.
 - AS/NZS 1680.2.4:2017, Interior and workplace lighting, Part 2.4: Industrial tasks and processes.
- Department of Climate Change, Energy, the Environment and Water, National Light Pollution Guidelines for Wildlife, Version 2.0, May 2023.
- Kerry Lukies, Literature Review — Lighting adjustments to mitigate against deck strikes / vessel impacts, MIT2019-03.
- Guidelines for Ecologically Responsible Lighting, supplied PDF. This is informative material from a seabird-conservation context outside New Zealand and is not treated as New Zealand law.
- Cieraad, E. and Farnworth, B. 2023, “Lighting trends reveal state of the dark sky cloak: light at night and its ecological impacts in Aotearoa New Zealand”, New Zealand Journal of Ecology, 47(1), 3559, DOI: 10.20417/nzjcol.47.3559.

C2. External material supplied by link

- Department of Conservation / Kerry Lukies presentation downloaded from the supplied DOC URL.
- Department of Climate Change, Energy, the Environment and Water, National Light Pollution Guidelines for Wildlife, downloaded from the supplied Australian Government URL.

C3. Copyright and quotation approach

The AS/NZS standards are copyrighted and were supplied under single-user licences. This report paraphrases the relevant principles and identifies clauses and tables where appropriate. It does not reproduce substantial portions of the standards.