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Via Email

Kia ora Mary

Response to statements of Brian Boyle and Marc Simpson

Below I respond to the statements of Brian Boyle and Marc Simpson regarding the response to Request for Information 8 (RFI 8).

Mr Boyle notes that I have described the characteristics of mobile vehicle lighting but not the quantity or frequency/duration of use of mobile lighting.

Lighting effects are commonly modelled in three ways:

1. Illuminance (the amount of light falling on a surface).
2. Luminance (the intensity of light viewed in a particular direction).
3. Upward Waste Light Ratio or UWLR (the ratio of light emitted above the horizontal compared with below the horizontal).

Mr Boyle suggests “how many” lights and “how often” they are used must be known in order to calculate the amount of reflected light. He states that “approximately 10% of all light will be reflected into the sky.” While the total amount of luminous flux can be estimated, the amount that light will be reflected into the sky will be highly variable depending on the reflectivity and nature of the surfaces. If an attempt was made to estimate the amount of reflected light that was likely, I do not know how this would be used to assess effects.

Mr Boyle notes that at the Macraes mine that terrain shielding is present, “and it still has a major light dome”. I have not visited the Macraes mine so I do not know what fixed light sources are present and their characteristics. There may be many uncontrolled light sources other than vehicle lights contributing to upward light spill and as such making a direct comparison is unlikely to be valid.

Illuminance

I have demonstrated in my modelling provided in the response to RFI 8 that **illuminance** levels at the site boundaries can meet the required standards including the total luminous flux requirements of the CODC Dark Sky policies (noting that the project site is not within a dark sky precinct).

In my RFI 8 response I explain why illuminance cannot be calculated for moving vehicles without including all the variables including the point or points at which illuminance is to be calculated. Knowing illuminance at a variety of points will not assist in determining effects in my opinion.

Luminance

To calculate luminance one would need to know the intensity of every light source, in every direction when viewed from every location which is impractical. Luminance can be measured with a luminance meter which will provide the level of candela received by the luminance meter at a particular location. Luminance will vary as the vehicle moves, as beam angle changes and as the observer location changes. Luminance calculations and measurements, even if practical, would not provide any useful data to assess effects of light when viewed from a distance in my opinion.

Upward Waste Light Ratio (UWLR)

To calculate UWLR for mobile vehicle lighting, one would need to know the photometric characteristics of every vehicle light, the slope angle which the vehicle is operating on and the reflectivity of the surface. Because of the nature of vehicle lighting, which is designed to be 'dipped' and the highly variable parameters, I do not consider it practical to attempt to calculate UWLR for vehicle mounted lighting.

Unless shielded by, earthworks, obstacles or terrain, vehicle lights are likely to be visible beyond the site, similar to farm vehicles and machinery lights can be seen from many miles away now. A component of light from vehicles will also be directed upwards at times (i.e. driving uphill) and some will be reflected off surfaces. The effect of such lights will depend on the perspective of the observer, ground conditions and atmospheric conditions at the time of observation.

Assessment of Sky Quality

Assessment of sky quality (using a Sky Quality Meter) or observation (using the Bortle Scale) is relatively straightforward. Predictive modelling of effects on sky quality is not.

Mr Simpson raises the issue of the visibility of the light. "Visibility" is influenced by intensity and direction more so than illuminance. i.e. a strong light source light facing downward or away from the observer will not appear as visible as a weak light source pointing towards the observer.

Mr Simpson requests that the panel commission "full photometric and skyglow modelling for fixed and mobile lighting, night-time visual simulations from key viewpoints, and assessment of cumulative effects across all project stages". I believe modelling mobile light sources would be impractical, if not impossible, due to the almost infinite number of randomly

orientated light reflecting surfaces and mobile nature of the lights. The modelling of light sources completed to date is appropriate for the consenting stage, meets the requirements of NZS/AS 4282: Control of the effects of obtrusive light and demonstrates effects can be appropriately managed.

Mr Simpsons own evidence relies on observation with no metrics, other than illuminance to support his findings. In paragraph 29. of Mr Simpsons evidence he notes the limitation of using photography to illustrate the environmental effects of lights...

“Viewing conditions assessed by the naked eye indicated a clear and substantial disruption to both the night sky and the surrounding terrain. Accurately capturing these effects using standard photographic equipment is inherently challenging. Moreover, the human eye and camera sensors respond differently under low-light conditions: the eye adapts through scotopic and mesopic vision, allowing it to perceive subtle variations in low-contrast environments that cameras typically fail to replicate without long exposures or specialised settings. As a result, the level of light pollution observed during field testing can be reliably assessed only in situ by an observer on the ground.”

I am not aware of any accepted methodology to reliably predict and model skyglow currently. Site specific modelling of skyglow, including that generated by moving light sources, is currently within the realm of academic research.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Paul Wilson', with a stylized, flowing script.

Paul Wilson
Director