17th March 2022

Golf Strategy Group
60 Clearwater Avenue
Christchurch 8051

Attention: David Moore

Dear David,

RE: MURIWAI GOLF PROJECT
LIGHTING EFFECTS ASSESSMENT

As requested, we have assessed the concept lighting design for the proposed Muriwai Golf Project in terms of potential environmental effects. This report is a lighting effects assessment (**LEA**).

1 SITE DESCRIPTION

The site is described in detail in the Assessment of Environmental Effects prepared by Mitchell Daysh (**AEE**).

In general terms, the site is located at 451-697 Muriwai Road. It is currently known as Muriwai Downs and has primarily been operated as a farm. The site straddles Muriwai Road.

The Project will include a golf course and associated facilities, a luxury lodge, a clubhouse, a sports academy including a driving range and tennis courts, helipads, a golf and property maintenance complex, access roads and car parking.

The site and all adjacent properties are zoned "Rural Production".

2 LIGHTING PROPOSAL

2.1 Lighting Principles

The proposed exterior concept lighting design includes the following features for the Project:

- General Lighting Principles:
  - Have no upward tilt or include screening to mitigate
  - Have no direct upward light output. There is a possible exception to this principle: the Academy Driving Range (if lit) and selected tree uplighting. However, both exceptions will be determined once a Bat Detection Survey has been completed for the property.

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  - Be kept to the practical minimum required for safe use of the facility
  - A colour temperature of 3000K for sports lighting (driving range and tennis) and 2700K elsewhere

- Specific Elements:
  - Golf Academy Driving Range: If illuminated: Dusk-10pm. Approximately 50 lux vertical at 3m above ground along the length of the range to EN 12193:2007.[1]
  - Golf course: Nil
  - Maintenance Complex: Security lights on sensor
  - Tennis Courts: Dusk-10pm. Recreational level to AS 2560.2:2021
  - Sports Academy: Security lights on sensor
  - Clubhouse: Security lights on sensor
  - Lodge buildings: Security lights on sensor
  - Access roads: Dusk-Dawn. Bollard guidance lighting
  - Pathways: Dusk-Dawn. Bollard and/or concealed strip lighting - guidance lighting
  - Carparks: Dusk-Dawn Bollard guidance lighting
  - Helipad: Nil
  - Farm: Security lights on sensor
  - Other areas: Nil

2.2 Typical luminaires and effects

The images below are indicative of the style of luminaires envisaged by the concept lighting design.

Bollards (Figs. [left to right] 1 & 2):

Approximately 1m-1.2m high. No direct upward light.

[1] We understand that a Bat Detection Survey will be undertaken and interpreted by an ecologist with bat experience. If the ecologist determines a presence of bats sufficient to be of concern if the range is lit, then the range will not be lit.

Striplights (Figs. [left to right] 3 & 4):

Concealed from direct view. Typically at low level under nosings, seats and the like. No direct upward light.

Wall lights (Figs. [left to right] 5, 6 & 7):

Typically up to 3m high, but no more than 4m. No direct upward light.

Tennis Court lighting (Figs. 8 [top], 9 [lower left] & 10 [lower right]):

Approximately 8m high. Installed with zero or minimal tilt, with no direct upward light. The courts will be sunken by approximately 3m and bordered by a 2m high bund. The lights will be approximately 3m higher than the top of the bund, but the light source will be effectively concealed from direct view beyond the site. This will be achieved through a combination of the sunken courts, bunds, luminaire selection, installation tilt angle, surrounding buildings, foliage & topology.

Academy Driving Range Lighting (Fig. 11 to 16):

It is proposed that the Academy Driving Range will not be lit. At the time of writing this report, the applicant is intending to undertake a Bat Detection Survey. Should that survey result in a conclusion that identifies there are no specific lighting effects constraints recommended in relation to the national critically endangered New Zealand Long-tailed bat (**LTB**), then it is proposed that the driving range will be lit. The completion of the Bat Detection Survey is expected in the next couple of months.

The figures below inform the typical features of the proposed lighting (if considered appropriate following the Bat Detection Survey). In particular, numbering the figures left to right, top to bottom;

- Figures 11 & 12: Typical roof edge mounted floodlights
- Figures 13 & 14: Typical effect of roof edge floodlighting
- Figures 15 & 16: Ground level floodlighting down range

The final solution may comprise either of these approaches or include a blend of the two technologies.

3 AUCKLAND UNITARY PLAN

The proposed concept lighting design has been assessed against the Auckland Unitary Plan Operative in Part (updated 12 November 2021) (**AUP**). The lighting rules applicable to the site are those in Chapter E24.

Chapter E24 – Lighting

The key objectives and policies under the AUP relating to lighting are:

E24.2. Objectives [rcp/dp]

(1) Artificial lighting enables outdoor activities and the security and safety of people and property.

(2) The adverse effects of outdoor lighting on the environment and safety of road users are limited.

E24.3. Policies [rcp/dp]

(1) Provide for appropriate levels of artificial lighting to enable the safe and efficient undertaking of outdoor activities, including night time working, recreation and entertainment.

(2) Control the intensity, location and direction of artificial lighting to avoid significant glare and light spill onto adjacent sites, maintain safety for road users and minimise the loss of night sky viewing.

(3) Use area or activity specific rules where the particular functional or operational needs of the area or activity make such rules appropriate.

All permitted activities under Table 24.4.1 of the AUP must comply with the following [relevant] standards:

E24.6.1 – General Standards

We have addressed each of the standards below;

AUP STANDARD	**ASSESSMENT**
(1) Lighting limits must be measured and assessed in accordance with Standard AS 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting, except for building façade lighting that complies with Standard E24.6.1(10). In the event of any conflict between Standard AS 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting and the lighting standards set out below, the lighting standards set out below shall prevail.	Our assessment is based on this premise.
(2) Any calculation for the purposes of these standards must be based on a maintenance factor of 1.0 (i.e. no depreciation).	Our assessment is based on this premise.
(3) For the purposes of Standard E24.6.1(2) and Standard E24.6.1(9) the lighting category classification for each zone in Table E24.6.1.1 lighting category classifications will apply. Where a development is located on a site which adjoins or is directly across a road from a different lighting category, the most sensitive classification of the two categories will apply.	In Table E24.6.1.1, the category that applies to Rural – Rural Production Zone is "Lighting Category 3 (Medium brightness)".
(4) Where measurements of any illuminance above background levels from the use of artificial lighting cannot be made because the artificial lighting cannot be turned off, measurements may be made in areas of a similar nature that are not affected by the artificial lighting. The result of these measures may be used for determining the effect of the artificial lighting.	This is not applicable in this instance.
(5) For the purposes of these standards, the curfew time is 10pm - 7am and the pre-curfew time is 7am – 10pm.	Our assessment is based on this premise.
(6) The added illuminance from the use of any artificial lighting on any site must not exceed either:	The sports lighting (i.e. Academy Driving Range and tennis courts) will not be used after 10pm and as such, the pre-curfew limits apply to that lighting. The remaining lighting may be used dusk-dawn and as

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(a) The levels in Table E24.6.1.2 Horizontal and vertical illuminance at a boundary, when measured at the boundary of any adjacent site containing a lawfully established dwelling. The illuminance limit will apply horizontally and vertically at any point on the boundary and at any height; ***or***

Table E24.6.1.2 Horizontal and vertical illuminance at a boundary

Time	*Illuminance Limit*
Pre-curfew	*100 lux above the background level*
Curfew	*10 lux above the background level*

(b) The vertical illuminance limits in Table E24.6.1.3 Vertical illuminance at a window, when measured or calculated at the windows of habitable rooms of a lawfully established dwelling.

Table E24.6.1.3 Vertical illuminance at a window

Time	*Vertical illuminance limit for Lighting Category*
	Category 3
Pre-curfew	*10 Lux*
Curfew	*2 Lux*

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such, the curfew limits apply to that lighting.

The majority of lighting proposed will be 'resort style' – low intensity, aimed downwards, low height (typically less than 4m high) and designed to provide a minimalist approach with guidance lighting rather than functional uniform area lighting. Luminaires such as bollard lights and domestic style wall lights would be the norm, with measurable illuminance unlikely to extend further than approximately 10m. The closest site boundary with an adjacent rural property is approximately 200m distant from any such lighting. Hence, there will be no measurable spill light at the site boundaries.

Compliance is required under either rule 6(a) or 6(b). We have assessed the proposed lighting under standard 6(b).

The only lighting expected to have a functional intensity will be the floodlighting associated with the Academy Driving Range (if lit – as discussed earlier in the report) and the tennis courts. The lighting proposed for these activities will be carefully selected and controlled to ensure compliance with this standard and with the minimum height needed to provide safe and useful light. Measurable illuminance is unlikely to extend more than 50m from the site boundaries. The closest site boundary with an adjacent rural property is approximately 500m distant from any such lighting. Hence, there will be no measurable spill light at the windows of any residence beyond the site.

In summary, the spill light limits under Standard 6(b) will be readily achieved.

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(7) Outdoor artificial lighting operating on any site between sunset and sunrise must not exceed the threshold increment limit stated in Table E24.6.1.4 Threshold Increment, on

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The closest public road relevant to this rule is Muriwai Road which passes through the site. The only lighting that could potentially be relevant would be the Academy Driving Range floodlighting as the proposed driving

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any public road, calculated within each traffic lane in the direction of travel.

Table E24.6.1.4 – Threshold Increment

Light Technical Parameter	*Threshold increment limit for Lighting Category 3*
Threshold Increment (TI)	*15% (based on adaption luminance of 2 cd/m²)*

range will be adjacent and parallel to Muriwai Road.

The proposed driving range lighting (if it is lit – refer earlier comments), will consist of downward directed luminaires mounted on the driving range roof and/or ground mounted floodlights oriented to direct light away from the road.

The offset, distance, mounting height and optic selection will ensure that the Threshold Increment (i.e. Glare to motorists) will be no more than 15%.

The only other lighting of potential relevance in this respect would be the tennis court lighting. However, the location, height (including the sunken nature of the courts), intensity and optic selection will readily enable compliance.

Hence, compliance with Standard (7) will be readily achievable.

(8) The exterior lighting on any property adjacent to a road or adjacent to land on which there is a dwelling must be selected, located, aimed, adjusted and/or screened to ensure that glare resulting from the lighting does not exceed the pre-curfew or curfew limits outlined in Table E24.6.1.5 Pre-curfew luminous intensity limits or Table E24.6.1.6 Curfew luminous intensity limits.

Table E24.6.1.5 Pre-curfew luminous intensity limits

Intentionally illuminated area		*Pre-curfew luminous intensity for Lighting Category 3*
Size of Area (based on the controlling dimensions)	*Controlling dimension (Refer to Note 1)*	
Large	*>75m*	*10,000 cd*

<u>Pre-curfew</u>

The proposed lighting used for the driving range (if lit) and tennis court will operate until no later than 10pm, so the pre-curfew limits apply to this lighting.

The lighting will only be energised when there is a need.

The tennis court lighting light source (i.e. the LED's) will not be directly visible from any residential building beyond the boundary. Hence, the luminous intensity at any such location will be nil.

The Academy Driving Range (if lit) will be such that the lights will be directed to avoid aiming any intense light towards a residential building beyond the site. This will enable the lighting be designed to ensure compliance with standard (8).

Medium	*≥25m ≤75m*	*10,000 cd*
Small	*<25*	*7,500 cd*

Note 1: The controlling dimension is the maximum dimension from any light source to the furthest point of the intentionally illuminated area in the direction of maximum intensity.

Table E24.6.6 Curfew luminous intensity limits

Curfew luminous intensity limit for each lighting category			
Lighting category 1	*Lighting category 2*	*Lighting category 3*	*Lighting category 4*
0 cd	*500 cd*	*1,000 cd*	*2,500 cd*

The driving range size of area is "large", so the pre-curfew luminous intensity limit is 10,000 cd.

The most affected residential properties that may possibly have a view of the lighting columns are located to the south/south-west (in the vicinity of Motutara Road and Coster Road), more than 1km distant from the driving range, and at least 20m higher in elevation. The distance and relative height of the lights in relation to the residential properties will ensure that the pre-curfew limits on Table E24.6.5 of Standard (8) can be readily achieved.

Curfew

The remaining (i.e. 'non-sports') lighting could operate from dusk to dawn, so the curfew limits will apply.

The site is deemed "lighting category 3" as noted above under Standard (3), so the curfew luminous intensity limit is 1,000 cd.

The most affected residential properties are the same as above. Since the non-sports lighting luminaires will all be mounted at a lower height than the residential properties and aimed down with no direct upward light output, the residential properties will have no visibility of the light sources. Hence, the luminous intensity experienced at the residential properties will be nil. Hence, the pre-curfew limits on Table E24.6.6 of rule (8) can be readily achieved.

Hence, compliance with Standard (8) will be achieved.

(9) The average surface luminance measured in candelas per square metre (cd/m2) for an intentionally artificially lit building façade shall not exceed any one of the following:

(a) 0 cd/m2 in lighting category 1;

(b) 5 cd/m2 in lighting category 2;

Not applicable – The building facades will not be intentionally illuminated.

(c) 10 cd/m2 in lighting category 3; or *(d) 25 cd/m2 in lighting category 4.*	
(10) The limits may be determined by calculation or measurement in accordance with CIE 150:2003 Guide on the limitation of the effects of obtrusive light from outdoor lighting installations – International Commission on Illumination ISBN 3 901 906 19 3.	Not applicable – This standard relates to standard (9). The building facades will not be intentionally illuminated.

4 OTHER CONSIDERATIONS

4.1 Sky Glow

Sky glow is mainly caused by light emitted directly to the sky.

The majority of the proposed luminaires will be selected to ensure that they have no direct upward light. They will either have zero upward tilt or include optics and/or integral shielding to ensure that this is achieved. The light beam will be directed below the horizontal and oriented in such a manner that the light will only spread towards the ground being illuminated, not emitting any light directly towards the sky.

If the Bat Detection Survey determines that there is a need to address effects to the LTB, then there will be no upward directed light. The Academy Driving Range would not then be lit and there would be no other upward directed lighting.

If the Bat Detection Survey determines that there is no particular need to address lighting effects for the LTB, then the Academy Driving Range may be lit as described earlier. There may also then be a minimal number of trees uplit to enhance amenity. However, with any such lighting (i.e. driving range and trees), the design will minimise the overall site waste upward light to the night sky.

Reflected light is unavoidable in outdoor lighting as any type of surface will reflect a certain amount of light depending on its colour and texture. The majority of the illuminated area will consist of grass/vegetation and to a lesser degree road/paving. These surfaces in aggregate will reflect an estimated of 15-25% of the total luminous flux.

Sky glow is subjective and varies depending on weather conditions, the quantity of dust, water and gas in the atmosphere and the viewer position. The apparent effects also depend on location. In a city such as Auckland, there is a significant background sky glow from artificial lighting used throughout the city.

The sky glow effects from Auckland will be reduced at this location as it is in a rural area, remote from the CBD and intensified development, but there will still be a portion of that sky glow present. The proposed lighting is such that the additional contribution to sky glow will be less than minor in our opinion.

In our opinion on balance, the added sky glow effects with respect to night sky viewing conditions will be less than minor.

4.2 Bats

The project Ecology team have noted that the national critically endangered New Zealand native long-tailed bat (**LTB**) may potentially be present in the vicinity of the site. They are known to frequent the Waitakere Ranges and as such may transit, forage and/or roost in the vicinity of the site. The presence of the LTB is yet to be confirmed. However, we understand that a bat survey will be undertaken to clarify the situation.

Hence, the project team have elected to exercise an abundance of caution and treat the adjacent forested areas as potential bat habitat at this stage. Should the bat survey determine that there is no particular concern re lighting effects to the LTB, then "Option 2" will apply.

Option 1 (LTB environmental lighting measures warranted)

There has been no definitive research undertaken to date in New Zealand regarding the light sensitivity of the LTB, nor mitigation measures that may be appropriate to apply. However, current practice has typically been to reference either of the following documents which have similar recommendations;

- Eurobats publication no. 8: Guidelines for consideration of bats in lighting projects – 2018 – Voigt et al – A UNEP/EUROBATS publication
- ILP Guidance Note 8: Bats and artificial lighting in the UK – 2018 – A joint Bat Conservation Trust & ILP publication

Hence, the following lighting mitigation measures are proposed;

- All exterior lighting to;
  - Have no upward tilt or include screening to mitigate
  - Have no direct upward light output
  - Be kept to the practical minimum required for safe use of the facility
  - A colour temperature of ≤2700K (per Eurobats publication no. 8 – 2018 – Voigt et al), with 3000K for sports lighting[2] [*]
- Added light spill at the forested site boundary ≤0.1 lux (consistent with Environment Court decision[3]
- No uplights[4]

[2] 2700K is not commonly available for sports lighting. 3000K is readily available and there is only a modest increase in the blue light content which is likely in our opinion to be the principle reason that 2700K is preferred in overseas guidelines. Hence, in the case of the driving range and the tennis courts, 3000K is proposed. The availability of 2700K for the remaining lights will require further investigation. Again it is not commonly used, but is understood to be available to special order.

[3] Amberfield Subdivision, Hamilton] no. Decision [2021] NZEnvC 111.

[4] Since current best practice regarding the LTB in our opinion is to avoid upward directed lighting. Uplighting (e.g. for selected trees) would not be consistent with best practice.

Option 2 (LTB environmental lighting measures not warranted)

If the Bat Detection Survey determines that no lighting constraints are warranted in relation to the LTB, then the Academy Driving Range may be lit and a small number of trees may be uplit.

4.3 Migratory seabirds

While there may be a potential for migratory seabirds to fly over the site, they also fly over more populated areas of Auckland with much greater lighting effects than will be experienced at this site.

Hence, in our opinion, the proposed lighting and mitigation measures outlined in the previous section will suffice to ensure that lighting effects to migratory seabirds will be less than minor.

4.4 Night sky protection

The proposed concept lighting design has been developed with protection of views of the night sky in mind. The majority of the luminaires will be low level, low intensity luminaires designed in a minimalist way for safe movement and security.

We recommend that the applicant works together with Iwi in keeping with their expessed wishes which include a “darkness sensitive design that incorporates our tikanga, and limits the degree of light pollution generated".

In this regard, we note that the majority of the proposed lighting will be similar in scale to residential style lighting in the vicinity of the buildings. The majority of the site will not be lit. The tennis courts and driving range, if lit, will be limited until no later than 10pm and then only operated on nights when needed.

The sports lighting and the Academy Driving Range in particular by its nature, will have an impact on night time views for people in the immediate vicinity but this will diminish rapidly with distance. In our opinion, any effects are likely to be less than minor for a person viewing the night sky from any existing surrounding residential location.

In addition, the sports lighting will be turned off by 10pm and as such will not persist during prime evening night sky viewing periods.

On balance, we consider any effects on nocturnal biota such as insects, bats and birds and effects on the visibility of the night sky will be negligible.

5 CONCLUSIONS

- With respect to spill light and glare on the surrounding environment the proposed installation will comply with the permitted activity standards for lighting under the AUP.
- In our opinion, the added effects from the proposed lighting will be less than minor.

6 PROPOSED CONDITIONS

Lighting

1. *Prior to construction, a detailed lighting design shall be submitted with sufficient detail to prove compliance with the conditions of consent*

2. *The lighting design shall satisfy the rules in Chapter E24 of the Auckland Unitary Plan*

3. *All luminaires shall be selected, designed, shielded and/or mounted in such a manner to ensure that they emit no direct light above the luminaire*

4. *Luminaires used for lighting the Academy Driving Range and tennis courts shall have a maximum CCT of 3000K*

5. *All other luminaires shall have a maximum CCT of 2700K*

6. *The added spill light calculated, vertically or horizontally at 1.5m above ground at the site boundaries adjoining other rural zoned land shall not exceed 0.1 lux [Note: 'Added' meaning additional to existing ambient light]*

7. *Within 1 month of completion, a report shall be provided by a suitably experienced lighting practitioner confirming that the lighting has been installed in accordance with the conditions of consent*

Yours faithfully,

LDP Limited

LDP Leading Design Professionals

John Mckensey

Executive Engineer MIES