Boffa Miskell

Memorandum

Christchurch
Level 1
141 Cambridge Terrace
Christchurch 8013
PO Box 110
Christchurch 8140

+643 366 8891

Whangarei 15 Porowini Avenue, Morningside, Whangarei 0110 +649 358 2526
Auckland PO Box 91250, Auckland 1142 +649 358 2526
Hamilton PO Box 1094, Hamilton 3240 +647 960 0006
Tauranga PO Box 13373, Tauranga 3141 +647 571 5511
Wellington PO Box 11340, Wellington 6142 +644 385 9315
Nelson 51 Halifax Street, Nelson 7010 +643 548 8551
Queenstown PO Box 1028, Queenstown 9348 +643 441 1670
Dunedin 49 Water Street, Dunedin 9016 +643 470 0460

Attention:	Campbell McMath
Company:	KeaX Limited
CC:	Claire Kelly, Senior Planner | Senior Principal, Boffa Miskell
Date:	7 July 2023
From:	Dr Jaz Morris (Ecologist | Senior Professional)
Message Ref:	Brookside Solar Array – Ecological Impact Assessment Memo
Project No:	BM210727D

Note: this Memo is based upon an earlier Memo dated 14 December 2021 that related to a different (larger) KeaX solar farm proposal at the same location. Changes made to this Memo reflect changes made to the proposal. However, in preparing this updated version, all source material has been checked for updates or otherwise re-evaluated.

1. Introduction and Scope

KeaX Limited (KeaX) proposes to construct a new solar array (or solar farm) on a c.111 ha site in the Brookside area, approximately 10 km north of Leeston in mid-Canterbury. Once operational, the solar array will be capable of generating up to approximately 70 MW of renewable electricity. This will be fed back into the electricity network via the Brookside Substation located in the northwest corner of the site. It is understood the land would be leased by KeaX, who will independently operate the solar farm.

Boffa Miskell Limited (Boffa Miskell) were engaged by KeaX to undertake a desktop terrestrial ecological assessment of the proposed solar farm site and to provide a high-level Ecological Impact Assessment (EcIA) Memo to accompany the necessary resource consent applications for the proposed solar farm. Land use at the site is high-producing pastoral farmland that is predominantly irrigated (via centre-pivot) and grazed by dairy cattle. On this basis, neither a detailed EcIA report nor site investigations were considered necessary in the context of this proposal. This Memo has been prepared largely out of a need to assess the project's compliance with relevant Selwyn District Plan rules in terms of indigenous vegetation[1] clearance.

The scope of this Memo is to describe the existing terrestrial ecological environment at the solar farm site (including indigenous vegetation if any), to assess the ecological significance and ecological value of the existing terrestrial ecological environment, and to assess the ecological effects of construction and operation of the proposed solar farm on terrestrial ecology values. This assessment is based on what could be determined from desktop information and our previous experience preparing impact assessments for large-scale solar farm proposals.

[1] In the operative Selwyn District Plan, 'indigenous vegetation' means "*a plant community in which species indigenous to that part of New Zealand are important in terms of coverage, structure and/or species diversity. For these purposes, coverage by indigenous species or number of indigenous species shall exceed 30% of the total area or total number of species present, where structural dominance is not attained. Where structural dominance occurs (that is indigenous species are the tallest stratum and are visually conspicuous) coverage by indigenous species shall exceed 20% of the total area.*"

In the proposed Selwyn District Plan, 'indigenous vegetation' means "*naturally occurring flora containing plant species that are native to the area."*

2. Project Description

A detailed project description is contained in the project's Assessment of Effects, to which this Memo is attached. A brief summary is included below.

KeaX proposes to construct a 111 ha solar farm on the site which will have a generating capacity of 70 MW on completion. The solar farm will comprise tables of panels, with the solar panels situated between 0.7 and 2.9 m above ground level. Each table comprises 26 modules. The proposed design will ensure that there is sufficient space between the tables to accommodate roading within the site to allow access for construction and maintenance. Also, sheep grazing will occur underneath the panels to manage the growth of grass across the site and to maintain primary production. The matters potentially relevant to ecology include:

- *Site preparation works* - to prepare the site for the installation of panels, internal fencing and structures will be removed, including shelterbelt plantings. An outer security fence will be installed.
- *Earthworks* - KeaX will complete the piling required to install each module / panel with piling machines, which do not require extensive excavation of the site. Earthworks are required to install the cable trenches; these will be backfilled once the cables are in place. Trenches will also be needed to install the cables for the inverters and to connect to the Orion network (the Brookside Substation is located adjacent to the north-eastern corner of the site). Detailed construction arrangements are to be confirmed.
- *Buildings* - We understand the project includes construction of 13 inverters, a moveable container-style building (site office), and possibly moveable 40 ft containers (on site storage).

3. Methods

Boffa Miskell undertook a desktop study to obtain existing information on ecological values in the vicinity of the proposed solar farm site. This study was informed primarily by a detailed assessment of the site and surrounds at a 1:1,000 scale using the most recent publicly available imagery of the site (from Canterbury Maps, Google Earth, and Google Street View (the latter is available for perimeter roads)), by a review of site photos taken during a landscape assessment, and by analysis of GIS (spatial) databases including:

- Environment Canterbury 'Canterbury Wetlands' and 'Canterbury Regional Wetlands' GIS layer[2];
- DOC Recommended Areas for Protection GIS layer;
- Threatened Environment Classification[3] GIS layer;
- Proposed Selwyn District Plan Mudfish Habitat Overlay and Significant Natural Area Overlay; and
- Canterbury herpetofauna (lizard) records held in an internal database[4].

The following additional information sources were also reviewed:

- New Zealand Freshwater Fish Database (NZFFD, accessed August 2021);
- Bird records for the general area on the New Zealand Bird Atlas[5]; and
- Flora and fauna records from the citizen science tool iNaturalist[6] (records within c. 5 km of the site).

[2] These data are no longer publicly available but were obtained by Boffa Miskell from Environment Canterbury in May 2019.

[3] The Threatened Environment Classification (Walker et al. 2015) is a combination of three national databases: Land Environments of New Zealand, Land Cover Database (Version 2) and the Protected Areas Network. The Threatened Environment Classification shows how much indigenous vegetation remains within land environments, how much is legally protected, and how the past vegetation loss and legal protection are distributed across New Zealand's landscape.

[4] These data were obtained from DOC for a previous study. DOC herpetofauna records are generally not publicly available.

[5] Bird information for this report was compiled from survey records from NZ Bird Atlas grid square CZ46 (https://ebird.org/atlasnz/block/blkCZ46, accessed 6 July 2023), which includes the entire solar farm site. In addition, bird records from surrounding NZ Bird Atlas grid squares were reviewed. All bird species from CZ46 and surrounding squares were included in Table 1 where habitat for those species is or may be available at the solar farm site.

[6] Accessed 6 July 2023.

The assessment of ecological values, magnitude of effect, and level of ecological effect of the proposal are based on the EIANZ EcIA methodology (Roper Lindsay et al. 2018; see Appendix 1).

4. Ecological Values

4.1. Site Context

The proposed solar farm site lies to the north of Leeston township and is bordered by Buckleys Road to the north, Branch Drain Road to the west, Grahams Road to the south, and Caldwells Road to the east. It is located within the Canterbury Plains Ecological Region and the Low Plains Ecological District (ED). The original vegetation of the Low Plains ED has been substantially depleted by human induced fire and land clearance for agriculture and settlement. Nearly all the ED is intensively farmed or built, and only 0.5% of the ED is still covered in indigenous vegetation (McEwen 1987, Ecroyd and Brockerhoff 2005, Harding 2009). The entire solar farm site is located on a so-called acutely threatened land environment, where only 10% or less indigenous vegetation remains (Walker et al. 2015); this means that indigenous vegetation, if it were present, would be of national priority for protection (MFE 2007).

The proposed solar farm site is within a c.111 ha area spread across two land parcels (see Appendix 2, Figure 1). The land is currently used for dairy farming and, as with much of the Canterbury Plains, appears quite obviously from aerial imagery to have been fully cleared of all naturally occurring indigenous vegetation. It contains several irrigated areas, dwellings, farm buildings, shelterbelts, and other small groups of exotic trees. Analysis of aerial imagery and GIS databases clearly suggests that the site does not contain any wetlands, indigenous vegetation, or waterways. Indigenous vegetation remnants on the Canterbury Plains are well-known (and there are none nearby). Despite the lack of site investigation to confirm this assumption, it is considered that the possibility that this site contains any small areas of remnant indigenous vegetation is extremely remote. In this part of the Plains, unexpected / unknown indigenous remnants are usually found on sites such as road, rail, and waterway corridors, or on land that has been continuously owned by utilities or public entities that are not engaged in intensive land uses. In contrast, the solar farm site has a long history of intensive pastoral farming.

Several water races / drains are located outside the perimeter of the site, including along Buckleys Road, and Branch Drain Road. In many places these waterways have been fenced and the riparian area planted with various native plants or exotic trees.

The following sections summarise the existing terrestrial ecological values of the solar farm site that can be determined from the desktop information available.

4.2. Terrestrial Vegetation

The proposed solar farm site is entirely contained within an area of land that is intensively grazed, irrigated and cultivated. The bulk of the site is grazed exotic pasture grass and short-rotation cropland irrigated by centre pivot irrigators. It is understood that sheep will be able to continue grazing under the solar panels, but the site would no longer be grazed by dairy cattle. Internal and external shelterbelts of pines, eucalypts, gorse, and various other exotic species are present; some shelterbelts along drains at the perimeter of the site comprise planted indigenous species.

In terms of the definitions of indigenous vegetation in the operative and proposed Selwyn District Plan, it is extremely unlikely that any area of the proposed solar farm site contains *a plant community in which species indigenous to that part of New Zealand are important in terms of coverage, structure and / or species diversity*, excluding shelterbelt areas that have been deliberately planted and as such are not *naturally occurring* and do not have ecological value in terms of an effects assessment.

In terms of the EIANZ EcIA methodology (Roper Lindsay et al. 2018; see Appendix 1), it is considered highly likely that the ecological value of all vegetation at the solar farm site is **Negligible**.

4.3. Fauna

Avifauna

Bird species (including exotic species) considered likely or possibly using these three habitat types (pasture, shelterbelts, adjacent drains) at the site are listed in Table 1. Exotic species are generally not considered further in this assessment. Based on the habitat types present and New Zealand Bird Atlas records from the area, it is likely that small numbers of common indigenous bird species of general farmland habitats would use or forage across pastures at the site from time to time. Such species most likely present are pūkeko, paradise shelduck, spur-winged plover, welcome swallow, and swamp harrier (all classified as Not Threatened, Robertson et al. 2017), and it is possible but far less likely that New Zealand pipit (At Risk – Declining) is also occasionally present. Other highly mobile indigenous bird species including southern black-backed gull (Not Threatened), white-faced heron (Not Threatened), black-billed gull (At Risk – Declining), black-fronted tern (Threatened, Nationally Endangered), red-billed gull (At Risk – Declining) and South Island pied oystercatcher (SIPO, At Risk – Declining) may on occasion or opportunistically use pasture areas of the site for temporary feeding. Depending on the species, this is most likely following cropping, or in winter following rain events and / or when soils have been recently tilled / disturbed and soil invertebrates are accessible to probing.

Common and widespread indigenous forest bird species may be present in shelterbelt areas in small numbers (e.g., silvereye, fantail, and grey warbler, all are Not Threatened), though the solar farm site does not provide habitat for these species beyond the shelterbelt areas. Other nearby records exist of various indigenous waterfowl species; while the solar farm site does not provide habitat for these species, they may use nearby drains / waterways.

Although various braided river bird species (such as wrybill and banded dotterel), as well as numerous wetland / estuarine bird species (including Australasian bittern, cormorant species, and royal spoonbill) have been recorded in the wider area (e.g., at the Selwyn River and at Te Waihora / Lake Ellesmere), there is no potential habitat for these species at the solar farm site and they have not been included in Table 1. However, we note that they may at times overfly the solar farm site, and as a result, any possibility of general effects to these sorts of species is discussed further in Section 5.2.

Due to the frequent disturbance at the site, including from stock, cultivating machinery and irrigation, exotic pasture within the solar farm site would not provide important breeding habitat for any indigenous bird species. It is possible that the common and widespread forest bird species referred to above may breed in shelterbelts within the site, and waterfowl species may breed along drains outside the site. It is also possible that species such as spur-wing plover or SIPO may breed in pasture areas (breeding pairs of these species are known to opportunistically establish nests on farm paddocks from time to time); however, modified and frequently disturbed sites such as this do not provide high quality nesting habitat for these species.

In terms of the EIANZ methodology (Roper Lindsay et al. 2018; see Appendix 1), black-fronted tern (Threatened) is of **Very High** ecological value, and New Zealand pipit, red-billed gull and SIPO (At Risk) are of **High** ecological value. Other Not Threatened indigenous bird species are of **Low** ecological value. Exotic species are of **Negligible** ecological value.

Other Terrestrial Fauna

In the absence of indigenous vegetation, and in the context of the site's land use, it is considered extremely unlikely that any ecologically important populations of indigenous invertebrate or lizard species occur at the solar farm site. Intensively grazed and irrigated exotic pasture would not support lizards, and there appears to be no areas of high-quality lizard habitat (indigenous vegetation, rock outcrops, areas of rank grassland etc.) at the site. Possibly, denser shelterbelts and unmown drain edges may provide some lizard habitat. There were no lizard records from near the site (within 20 km) in an internally held database of DOC lizard records.

Freshwater Fauna

While a freshwater ecology assessment was beyond the scope of this Memo (because, as we understand it, only existing crossings of waterways would be used during site construction and operation), we do wish to note for the sake of completeness the presence of a population of Canterbury mudfish (classified as Threatened – Nationally Critical, Dunn et al. 2018). This population is known to inhabit the waterway around the intersection of Buckleys Road and Drain Branch Road, and along Drain Branch Road.

Table 1. Bird species likely to occur within and adjacent to the solar farm footprint. Species are sorted by indigenous / exotic status and their threat status (Robertson et al. 2021) and ecological value (Roper Lindsay et al. 2018; see Appendix 1) is provided. Their inclusion is based on NZ Bird Atlas data as described in Section 3. Likely habitat use is indicated by an 'X' – species less likely to use habitats at the site are indicated by a '?'

Common Name	Scientific Name	Threat Status	Ecological Value	Potential Habitat Use		
				Pasture	Shelterbelts	Adjacent Drains*
Indigenous Species						
Australasian harrier	*Circus approximans*	Not Threatened	Low	X	X	X
Australasian shoveler	*Anas rhynchotis*	Not Threatened	Low			?
Bellbird	*Anthornis melanura melanura*	Not Threatened	Low		?	
Black-fronted tern	*Chlidonias albostriatus*	Threatened – Nationally Endangered	Very High	?		
Black-gilled gull	*Chroicocephalus bulleri*	At Risk - Declining	High	X		
Grey teal	*Anas gracilis*	Not Threatened	Low			?
Grey warbler	*Gerygone igata*	Not Threatened	Low		X	
New Zealand pipit	*Anthus novaeseelandiae*	At Risk - Declining	High	?		
Paradise shelduck	*Tadorna variegata*	Not Threatened	Low	X		X
Pied stilt	*Himantopus himantopus leucocephalus*	Not Threatened	Low	?		
Pūkeko	*Porphyrio melanotus*	Not Threatened	Low	X		X
Red-billed gull	*Larus novaehollandiae*	At Risk - Declining	High	?		
Sacred kingfisher	*Todiramphus sanctus*	Not Threatened	Low	?	?	?
Silvereye	*Zosterops lateralis*	Not Threatened	Low		X	
South Island fantail	*Rhipidura fuliginosa fuliginosa*	Not Threatened	Low		X	
South Island pied oystercatcher (SIPO)	*Haematopus finschi*	At Risk - Declining	High	X		
Southern black-backed gull	*Larus dominicanus*	Not Threatened	Low	X		
Spur-winged plover	*Vanellus miles*	Not Threatened	Low	X		X
Welcome swallow	*Hirundo tahitica neoxena*	Not Threatened	Low		X	X
White-faced heron	*Ardea novaehollandiae*	Not Threatened	Low	X		X
Exotic Species						
Australian magpie	*Gymnorhina tibicen*	Introduced and Naturalised	Negligible	X	X	
Blackbird	*Turdus merula*	Introduced and Naturalised	Negligible		X	
California quail	*Callipepla californica brunnescens*	Introduced and Naturalised	Negligible	X	X	
Canada goose	*Branta canadensis maxima*	Introduced and Naturalised	Negligible	X		?
Chaffinch	*Fringilla coelebs*	Introduced and Naturalised	Negligible	X	X	
Common pheasant	*Phasianus colchicus*	Introduced and Naturalised	Negligible	X	X	
Dunnock	*Prunella modularis*	Introduced and Naturalised	Negligible		X	

Common Name	Scientific Name	Threat Status	Ecological Value	Potential Habitat Use		
				Pasture	Shelterbelts	Adjacent Drains*
Goldfinch	*Carduelis carduelis*	Introduced and Naturalised	Negligible	X	X	
Greenfinch	*Carduelis chloris*	Introduced and Naturalised	Negligible	X	X	
House sparrow	*Passer domesticus*	Introduced and Naturalised	Negligible	X	X	
Little owl	*Athene noctua*	Introduced and Naturalised	Negligible		?	
Mallard	*Anas platyrhynchos platyrhynchos*	Introduced and Naturalised	Negligible	X		X
Redpoll	*Carduelis flammea*	Introduced and Naturalised	Negligible	X	X	
Rock pigeon	*Columba livia*	Introduced and Naturalised	Negligible	X		
Skylark	*Alauda arvensis*	Introduced and Naturalised	Negligible	X		
Song thrush	*Turdus philomelos*	Introduced and Naturalised	Negligible	X	X	
Starling	*Sturnus vulgaris*	Introduced and Naturalised	Negligible	X	X	
Yellowhammer	*Emberiza citrinella*	Introduced and Naturalised	Negligible	X	X	

* Species listed only as using adjacent drains may occur in the vicinity of the solar farm site but are unlikely to occur within the site.

4.4. Site Significance

Based on the desktop findings above[7], the solar farm site is not considered to meet any of the criteria for determining significant indigenous vegetation and significant habitat of indigenous biodiversity, as listed in Appendix 3 of the Canterbury Regional Policy Statement (CRPS; Environment Canterbury 2013). As such, **the site is not significant in terms of the CRPS**. Drains that surround the site that support Canterbury mudfish are significant in terms of the CRPS.

5. Assessment of Effects

5.1. Terrestrial Vegetation

Clearance: Installation of solar panels across a large area, trenching works, and clearance of some internal shelterbelts will lead to the modification and loss of some existing vegetation, but as no wide-scale clearance of the site is required the site will remain essentially similar (exotic pasture). While we are aware of the potential for solar panel arrays to affect plant growth beneath panels (due to shading, soil moisture and sheltering effects, see IUCN: Bennun et al. 2021), this would only affect exotic pasture species. We presume that trenches once backfilled would be resown in exotic pasture grasses.

The proposal will not result in the clearance of indigenous vegetation and hence there is no ecological effect of the proposal in terms of indigenous vegetation. Effects to exotic pasture, if any, are not of ecological importance.

5.2. Avifauna

Habitat Loss: The permanent loss of habitat at the site to construct buildings and clear shelterbelts would affect a very small proportion of the site, which in general offers only very low quality and largely occasional or temporary feeding habitat for a limited range of indigenous and exotic bird species. Existing shelterbelts may have some function as connecting habitat for indigenous forest bird species, and these species would be unlikely to use cleared areas or solar panel arrays as habitat.

Permanent habitat modification across a much larger area will arise via installation of solar panel arrays, and this may reduce habitat availability for those bird species that use pasture areas of the site. For birds that presently use the site transiently, the panels themselves may possibly make the site less attractive for landing, feeding, or for flocking of large numbers of birds. On the other hand, it is likely that the sorts of

[7] While acknowledging the possibility that indigenous bird species including At Risk species such as SIPO or NZ pipit may feed or even breed at the site, we do not feel that it is appropriate to determine that the intensively farmed solar farm site is ecologically significant (in terms of either criterion 4 or 10 of the Canterbury RPS) purely on this basis. Were we to make such a determination, essentially the entire Canterbury Plains could be deemed 'significant' and the term would be rendered meaningless. We note our approach is consistent with guidance on this matter provided in Wildlands (2013).

indigenous bird species that may use the site for longer periods would continue to do so during solar farm operation. Species such as pūkeko would likely habituate to the presence of the static solar panel structures. Because the site will remain largely in pasture, generally similar feeding opportunities for birds will be maintained, particularly in the open spaces between panel arrays.

In the context of the quality of the habitat that would be modified, and the very large extent of surrounding similar habitat in the immediate area and in the wider ED, the magnitude of effect to all bird species is **Negligible** (in terms of the EIANZ assessment methodology of Roper Lindsay et al. 2018; see Appendix 1). A **Negligible** magnitude of effect on bird species with ecological values ranging from **Negligible** to **Very High** constitutes a **Very Low** level of effect.

Disturbance During Construction: The small number of bird species that may be present (foraging, roosting etc.) at the site during the construction period are mobile species that will likely disperse readily into surrounding similar habitats if disturbed. However, clearance of shelterbelts and construction of the solar panel arrays should ideally occur outside the main bird breeding season (September – January) to avoid any possible effects to nesting forest bird species (if any, this would likely only apply to very small numbers of Not Threatened species), and to species that may possibly nest at the site in open pasture areas (such as SIPO and spur-winged plover). The magnitude of ecological effect of solar farm construction in terms of bird disturbance is expected to be **Negligible**. A **Negligible** magnitude of effect on bird species with ecological values ranging from **Negligible** to **High** constitutes a **Very Low** level of effect.

Disturbance During Solar Farm Operation: It has been recognised internationally that bird deaths from trauma due to collision with solar photovoltaic structures (panels) may be possible (Kagan 2014, Bennun et al. 2021). It is thought that birds may mistake reflected light from solar panel arrays for a lake, attempt to land on the solar panels, and suffer trauma injuries as a result. The deaths of c.20 birds were recorded (over an unknown period) at a c.1600 ha solar farm site in California; in that study, it was noted that this effect appeared to largely affect species attracted by large ponds at the site's desert location, and may have arisen because of the uniformly shaped layout and dense panel arrays possibly appearing as an uninterrupted water feature (Kagan 2014). We note that there are no large ponds at or near this proposed solar farm site, but that Te Waihora / Lake Ellesmere, which supports a very wide range of water bird species, is c.7 km away. Hence, in terms of this possible effect, we have considered that overflights of the site by a broad range of bird species (i.e., including species other than those listed in Table 1) are possible, and so we have considered the possibility of trauma / death to a range of birds. However, we also note that the site is irregularly shaped and interrupted by many access corridors among the panel arrays, and the site is somewhat distant from river corridors that are likely to be the main flight pathways for many birds. Site screening would render any lake-like reflection less visible at the oblique angle of view of birds flying at low to moderate elevations at much distance from the site (and any reflection would not be seen by birds flying above Te Waihora, due to the angle of the panels). High-flying species (which could be more likely to see and be attracted to the site from afar) would most likely be exotic Canada geese that are not of ecological concern. Hence, the site may be less likely to be seen (and if seen may be less likely to be perceived as a lake by birds) than the California site noted above.

Importantly, the existence of a 'lake effect' presumes reflection from solar panels. Because panels are designed to absorb rather than reflect light, peak reflection for typical modern fixed solar modules (that are usually treated with an antireflective coating) is understood to occur only late in the day when incident sunlight angles are highest; the 'lake effect' presumably cannot occur at night, or in cloudy conditions. This means that the conditions that may lead to the 'lake effect' are inherently limited: it requires specific lighting conditions (low angle light) at certain times of the day, and a bird or group of birds to fly past, at that time, and at a particular height / angle (so as to perceive the reflection).

Whether the possible effect of bird strike would occur at this site is not known, nor whether indigenous species would be more or less susceptible than exotic species, but it appears likely (based on the above information) that it would affect only a small number of indigenous birds, if any at all. Taking a precautionary approach, we consider that this effect may be possible, but that the magnitude of ecological effect to any bird species (in terms of impact to its local or national population, or habitat range) due to bird strike would be **Negligible**. A **Negligible** magnitude of effect on bird species with ecological values ranging from **Negligible**

to **High** (or **Very High**, if a nationally Threatened species were to overfly the site and suffer collision) constitutes a **Very Low to Low** level of effect.

5.3. Other

The reflection of polarised light from solar panels has been speculated to have potential adverse effects to some emerged (adult) freshwater invertebrate taxa (particularly mayflies, stoneflies, and dipterans) that are naturally attracted to the similar light refraction properties of water (ponds). Invertebrates may therefore lay eggs on solar panels, thinking it to be ordinary pond habitat, leading to breeding failure (Horvarth et al. 2010). In the context of this proposal, this possible effect is considered unlikely to be of any ecological concern, as it is (as noted above) unlikely that any important populations of indigenous invertebrates are present at the site. It is particularly unlikely that the site supports important populations of particularly vulnerable taxa such as indigenous mayflies or stoneflies due to their general habitat requirements for fast-flowing clean waterways (these habitats are absent from the site and immediate surrounds).

We have been advised by KeaX that the footprint of works (piling, trenching, and other similar land disturbance) associated with the solar farm development is entirely within the existing farmed area, and have therefore assumed that the proposal will not have any effects on surrounding waterways that support Canterbury mudfish.

6. Recommendations

Recommendations required for impact management

- We understand and have assumed for the purposes of this assessment that existing waterway crossings will be used for site access (without modification), and hence no direct effects to waterways would arise from the proposal. However, we recommend that trenching works are carried out with a suitable setback from waterways (e.g., at least 10 m, or other setback distances as may be required to avoid triggering further resource consent requirements such as under the National Environmental Standards – Freshwater 2020), and / or are carried out in conjunction with a suitable erosion and sediment control plan. Such measures are important if the proposal is to avoid possible adverse ecological effects to freshwater fauna.
- Where internal shelterbelts are to be cleared, this should occur outside of the main bird breeding season (September – January) to avoid any risk of impacts to nesting protected indigenous birds.
- Construction of solar panel arrays should occur outside of the main bird breeding season (September – January), to avoid adverse effects to breeding indigenous birds in general, but particularly because there is some chance that an At Risk species (e.g., South Island pied oystercatcher, SIPO) may breed in pasture areas of the site[8]. Alternatively, a pre-construction survey of the solar farm site could be carried out by a suitably qualified ecologist / ornithologist with over five years of experience conducting bird surveys (SQE), in order to:
    a. Determine whether SIPO (or other bird species observed during the survey deemed of conservation concern by an SQE) are breeding within the solar farm footprint. Subsequently;
        - If breeding SIPO (or other species of conservation concern) are absent, works could proceed within the breeding season; or
        - If breeding SIPO (or other species of conservation concern) are present within the solar farm footprint, works could proceed subject to setbacks from nests or other similar measures to avoid or otherwise manage impacts to breeding birds, as advised by an SQE.

Recommendations not required for impact management

- Although not required in respect of highly uncertain but at worst Very Low-Low adverse effects, we recommend that KeaX considers monitoring bird strike with panel arrays (as noted in Section 5.2, we

[8] This possibility and resulting recommendations are based on desktop assessment and are therefore considered precautionary.

are uncertain whether this effect would arise, due to site circumstances and screening). This monitoring would most cost-effectively involve the funding / facilitation of a postgraduate research project, which could also incorporate similar monitoring and findings from any other solar farms that may be built. Such a study would inform future proposals by enabling an improved understanding of whether this phenomenon exists or not.

- We understand that some additional plantings may be required for site screening and that fast-growing exotic species will generally be used, to enable more rapid site screening. While this is not preferred from an ecological perspective, we have no concerns with this option in the site's context. Ideally exotic plantings would be supplemented (or replaced over time) with indigenous eco-sourced[9] plants where possible. Where indigenous plantings are used, these may provide an improved habitat for a greater range or number of indigenous forest birds than currently use the solar farm site, particularly if their extent is greater than that of existing shelterbelt areas.

7. Conclusion

The solar farm site is a highly modified area that is intensively cultivated. No indigenous vegetation is likely to be present, no wetlands occur anywhere within the site, and it contains **Negligible** ecological values in terms of vegetation and habitats. The c.111 ha site proposed to be developed for the solar farm likely generally supports widespread and common indigenous bird species; while it may on occasion provide opportunistic feeding or resting habitat for a bird species of **High** or even **Very High** ecological value, adjacent and extensive similar habitat is available in the surrounding area and in areas between solar panel arrays. We have considered the possibility of ecological impacts due to habitat loss, construction disturbance, and effects due to the presence of the panels; all are considered to amount to **Negligible** magnitudes of ecological effect, if any (in terms of the EIANZ methodology used in this assessment).

Overall, the level of effect of the construction and operation of the proposed solar farm on ecological values is generally expected to be **Very Low**. However, on a precautionary basis the level of effect could possibly be **Low** if bird strike to some indigenous species were to occur; monitoring of this possible effect could be considered.

8. References

Bennun, L., van Bochove, J., Ng, C., Fletcher, C., Wilson, D., Phair, N., Carbone, G. (2021). *Mitigating biodiversity impacts associated with solar and wind energy development. Guidelines for project developers*. Gland, Switzerland: IUCN and Cambridge, UK: The Biodiversity Consultancy.

Dunn et al. (2018). Conservation status of New Zealand freshwater fishes, 2017. *New Zealand Threat Classification Series* 24. Department of Conservation, Wellington. 15p.

Ecroyd, C. E., Brockerhoff, E.G. (2005). Floristic changes over 30 years in a Canterbury Plains kanuka forest remnant, and comparison with adjacent vegetation types. *New Zealand Journal of Ecology* 29 (2): 279-290.

Environment Canterbury (2013). Canterbury Regional Policy Statement 2013. Environment Canterbury.

Harding, M. A. (2009). Canterbury Land Protection Strategy: A Report to the Nature Heritage Fund Committee. Wellington: Nature Heritage Fund.

Horváth, G., Blahó, M., Egri, Á., Kriska, G., Seres, I., Robertson, B. (2010). Reducing the maladaptive attractiveness of solar panels to polarotactic insects. *Conservation Biology*, 24(6), 1644-1653.

Kagan, R.A., Viner, T.C., Trail, P.W. and Espinoza, E.O. (2014). Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis. *National Fish and Wildlife Forensics*.

McEwen, W. M. (Ed). (1987). Ecological Regions and Districts of New Zealand. Third revised edition in four 1:50,000 maps. Booklet to accompany Sheet 3. New Zealand Biological Resources Centre. Publication No. 5. Department of Conservation, Wellington.

[9] I.e., using plants sourced from natural populations in the Low Plains Ecological District, or, if this is not practicable, the Canterbury Plains Ecological Region, Canterbury Foothills Ecological Region, or Banks Ecological Region.

Ministry for the Environment, & Department of Conservation. (2007b). *Protecting our places: Information about the Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land (ME No. 805)*. Wellington, Ministry for the Environment & Department of Conservation.

Robertson, H. A., Baird, K. A., Elliott, G. P., Hitchmough, R. A., McArthur, N. J., Makan, T., Miskelly, C. M., O'Donnell, C. J., Sagar, P., M., Paul Scofield, R., Taylor, G. A., Michel, P. Conservation status of birds in Aotearoa New Zealand, 2021. *New Zealand Threat Classification Series* 36. Department of Conservation, Wellington. 43 p.

Roper-Lindsay, J., Fuller, S.A., Hooson, S., Sanders, M.D., Ussher, G.T. (2018). *Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems.* 2nd edition.

Walker, S., Cieraad, E., and Barringer, J. (2015). *The Threatened Environment Classification for New Zealand 2012: a guide for users.* Landcare Research, 27 p. Landcare Research New Zealand Ltd, Dunedin.

This ecological impact assessment follows the Environmental Institute of Australia and New Zealand's (EIANZ) Ecological Impact Assessment (EcIA) guidelines (Roper-Lindsay et al., 2018).

In summary, the EcIA method requires **ecological values** to be assigned (Table 2 to Table 4) and the **magnitude of effects** identified (Table 5) in order to determine the overall **level of effect** of the proposal (Table 6).

The EIANZ guidelines (Roper-Lindsay et al., 2018) note that the level of effect can then be used as a guide to the extent and nature of the ecological management response required (including the need for biodiversity offsetting). For example:

- **'Very high'** represents a level of effect that is unlikely to be acceptable on ecological grounds alone (even with compensation proposals). Activities having very high adverse effects should be avoided.
- **'High' and 'Moderate'** represents a level of effect that requires careful assessment and analysis of the individual case. Such an effect could be managed through avoidance, design, or extensive offset or compensation actions.
- **'Low'** and **'Very low'** should not normally be of concern, although normal design, construction and operational care should be exercised to minimise adverse effects. If effects are assessed taking impact management measures developed during project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure low or very low-level effects.
- **'Very low'** level effects can generally be classed as 'not more than minor' effects.

Table 2. Attributes to be considered when assigning ecological value or importance to a site or area of vegetation / habitat / community for terrestrial ecosystems (Roper-Lindsay et al., 2018).

MATTERS	ATTRIBUTES TO BE CONSIDERED
Representativeness	Criteria for representative vegetation and aquatic habitats: - Typical structure and composition - Indigenous species dominate - Expected species and tiers are present - Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: - Species assemblages that are typical of the habitat - Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	Criteria for rare/distinctive vegetation and habitats: - Naturally uncommon, or induced scarcity - Amount of habitat or vegetation remaining - Distinctive ecological features - National priority for protection Criteria for rare/distinctive species or species assemblages: - Habitat supporting nationally Threatened or At Risk species, or locally uncommon species - Regional or national distribution limits of species or communities - Unusual species or assemblages - Endemism
Diversity and pattern	- Level of natural diversity, abundance and distribution - Biodiversity reflecting underlying diversity - Biogeographical considerations – pattern, complexity - Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	- Site history, and local environmental conditions which have influenced the development of habitats and communities - The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA) - Size, shape and buffering

MATTERS	ATTRIBUTES TO BE CONSIDERED
	- Condition and sensitivity to change - Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material - Species role in ecosystem functioning – high level, key species identification, habitat as proxy

Table 3. Scoring for sites or areas combining values for four matters in Table 2 and Table 3 (Roper-Lindsay et al., 2018).

VALUE	DESCRIPTION
Very High	Area rates High for 3 or all of the four assessment matters listed in Table 2 and Table 3. Likely to be nationally important and recognised as such.
High	Area rates High for 2 of the assessment matters, Moderate and Low for the remainder; or Area rates High for 1 of the assessment maters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates High for one matter, Moderate and Low for the remainder; or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder. Likely to be important at the level of the Ecological District.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder.

Table 4. Factors to consider in assigning value to species for EcIA (Roper-Lindsay et al., 2018). ZOI: zone of impact.

DETERMINING FACTORS	
Nationally Threatened species found in the ZOI either permanently or seasonally	Very High
Species listed as At Risk – Declining, found in the ZOI, either permanently or seasonally	High
Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally	Moderate
Locally uncommon (in ED) or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

Table 5. Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018).

MAGNITUDE	DESCRIPTION
Very High	Total loss of, or very major alteration to, key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature

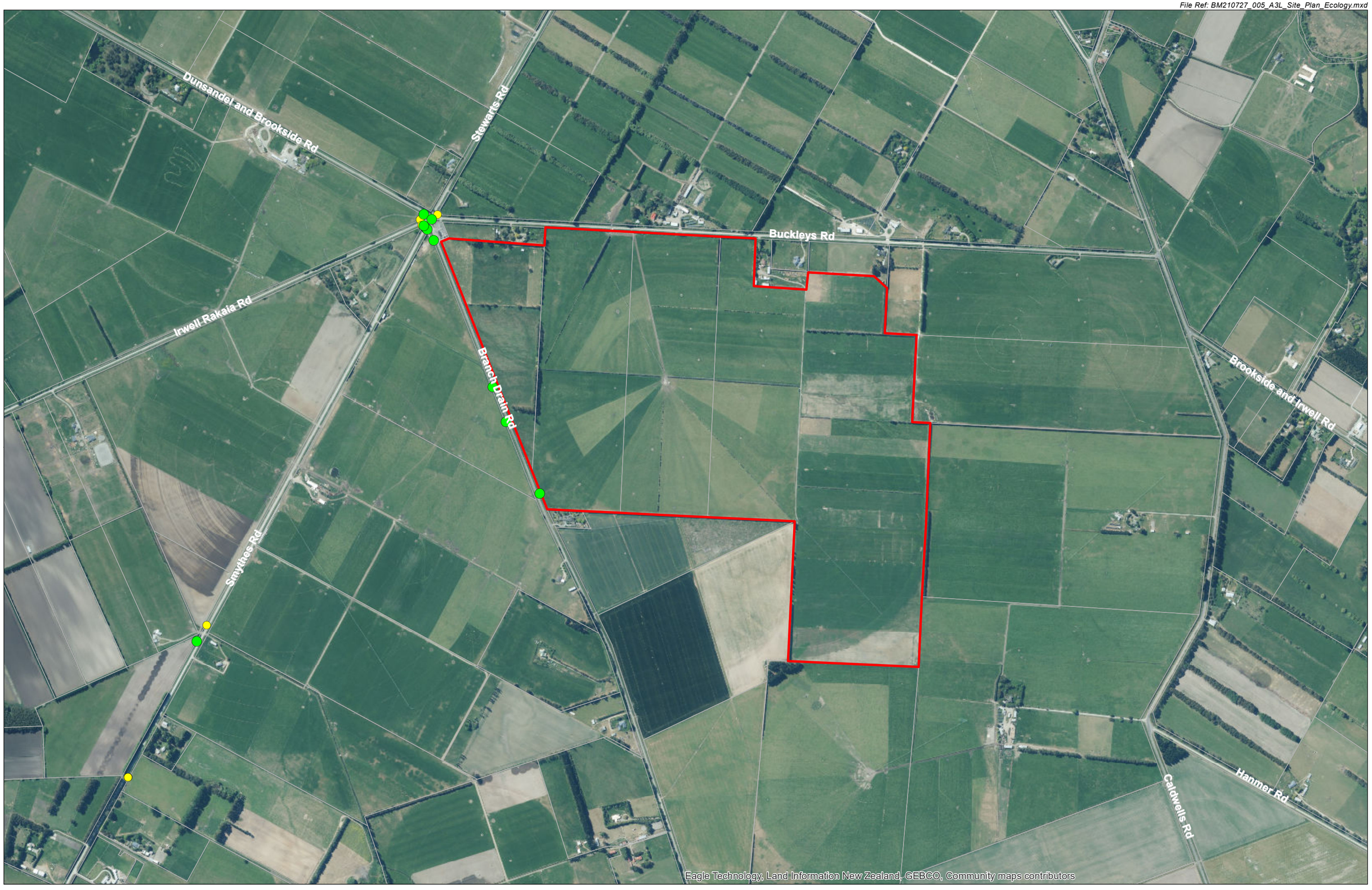
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature

Table 6. Criteria for describing level of effects (Roper-Lindsay et al., 2018).

		ECOLOGICAL VALUE				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
MAGNITUDE	**Very High**	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very low
	Moderate	High	High	Moderate	Low	Very low
	Low	Moderate	Low	Low	Very Low	Very low
	Negligible	Low	Very Low	Very Low	Very Low	Very low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

Appendix 2. Site Map and Nearby Ecological Features

File Ref: BM210727_005_A3L_Site_Plan_Ecology.mxd



Boffa Miskell

www.boffamiskell.co.nz

0 300 m

1:10,000 @ A3

Data Sources:
LINZ Data Service, Eagle Technologies

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Site Boundary
- Cadastre
- Canterbury Mudfish
- Other Fish Records

BROOKSIDE SOLAR FARM

Site Boundary and Nearby Ecological Features

Date: 6 July 2023 | Revision: 1

Plan prepared for KeaX Limited by Boffa Miskell Limited

Project Manager: claire.kelly@boffamiskell.co.nz | Drawn: JMo | Checked: CKa

Figure 1