

**BEFORE AN EXPERT PANEL  
HALDON SOLAR**

**FTAA-2508-1097**

Under the FAST-TRACK APPROVALS ACT 2024

In the matter of an application for resource consent approvals for the Haldon Solar project

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**STATEMENT OF EVIDENCE OF RACHEL KATHERINE MCCLELLAN  
FRESHWATER BIRDS**

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**Royal Forest and Bird Protection Society of New Zealand**

Solicitor Acting:

T C T Williams



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## **Introduction**

1. My full name is Rachel Katherine McClellan.
2. I have been asked by the Royal Forest and Bird Protection Society to provide expert evidence on the freshwater bird values that are potentially affected by the construction and operation of the Haldon Solar Farm, Mackenzie Basin.

## **Qualifications and experience**

3. I am a self-employed consultant specialising in bird ecology.
4. I have the qualifications of PhD in Zoology from Otago University for research on the ecology and management of tarāpuka | black-billed gull in Southland (2009), a Master of Conservation Science from Victoria University for research on the breeding biology of toanui | flesh-footed shearwater on Karewa Island, Bay of Plenty (1996), and degrees in both plant and animal ecology (1994).
5. I have been a consultant since 2009. I was Office Manager and Senior Ecologist with Wildland Consultants in Christchurch, and later, Principal Ecologist based in Wellington. I have been self-employed since 2022. I have worked for BirdLife International, in Cambridge, UK, where I was a researcher, co-author, and sub-editor for the book 'Threatened Birds of the World', published in 2000. I have worked for the Department of Conservation in Northland and the West Coast.
6. I have considerable experience with braided river and wetland birds. My doctoral research on black-billed gull examined population trends, impacts of introduced and native predators, nesting habitat availability and the threat of weed infestation on gravel-bedded rivers, and the species' relationship with agricultural systems. I have presented evidence at the Oreti River and Ngaruroro River Conservation Order tribunals, and at the Environment Court hearing for Meridian Energy's North Bank Tunnel proposal for the Waitaki River. I had a guest advisory role on the Department of Conservation's Braided River Technical Advisory Group. I have co-authored a braided river management plan for the Waimakariri River Regional Park, and an analysis of population trends of black-billed gulls in the South Island from 1962-2014. I was part of a team that developed ecological significance criteria for significant indigenous vegetation and significant habitat of indigenous biodiversity. Most recently, I have provided evidence at the Environment Court hearing for the reconsenting of the Waitaki Power Scheme, and under the Fast-Track Approvals Act 2024 for reconsenting of the Tekapo Power Scheme.
7. I have experience assessing the interactions of bird species with infrastructure, in particular, bird strike at multiple wind farms in New Zealand for power generators, councils, and as a member of an expert panel reviewing collision monitoring results. Work for developers has included designing collision monitoring protocols. I have also provided evidence for councils at hearings on district plans regarding bird strike at

Wellington, Rotorua, and Christchurch international airports. More recently, I have provided advice on the impacts of solar power installations on birds.

8. I am a member the Ornithological Society of New Zealand (Birds New Zealand).
9. In preparing this statement of evidence I have reviewed the following documents where they apply to my area of expertise:
  - Mitchell Daysh 2025: The Substantive Application for Approvals under the Fast Track Approvals Act 2024. Prepared for Lodestone Energy Limited. 155p. Referred to as the Substantive Application.
  - AgScience Limited 2025: Haldon Solar Project – Ecological Impact Assessment. Prepared for Lodestone Energy Limited. 52p. Referred to as the Ecological Assessment.
10. I have also taken into consideration the findings of the following documents:
  - Wildland Consultants 2023: Assessment of ecological effects for the proposed solar farm between the lower reaches of the Tekapo and Twizel rivers, Mackenzie District. Contract report No. 6621c. Prepared for Far North Solar Farms Ltd. 56p.
  - O'Donnell C. 2024: Initial briefing – potential impacts of proposed 'The Point' solar farm near Twizel on threatened birds. Department of Conservation unpublished report.
  - Evidence filed by the Department of Conservation in relation to the Glorit Solar Farm Fast Track consenting process<sup>1</sup>.

### **Code of Conduct**

11. I have read the code of conduct for expert witnesses contained in the Environment Court's Practice Note 2023 (the Code). I have complied with the Code when preparing this written statement of evidence. The data, information, facts, and assumptions I have considered in forming my opinions are set out in my evidence. Unless I state otherwise, this evidence is within my sphere of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

### **Scope**

12. I have been asked by the Royal Forest and Bird Protection Society to provide expert evidence on indigenous birds in response to the application by Lodestone Energy

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<sup>1</sup> <https://www.epa.govt.nz/fast-track-consenting/nbea-fast-track-projects/glorit-solar-farm/>

Limited under the Fast-track Approvals Act 2024 for resource consents for a photovoltaic solar farm in the Mackenzie Basin.

13. This evidence addresses the potential effects of the proposed Haldon Solar farm on indigenous bird species.

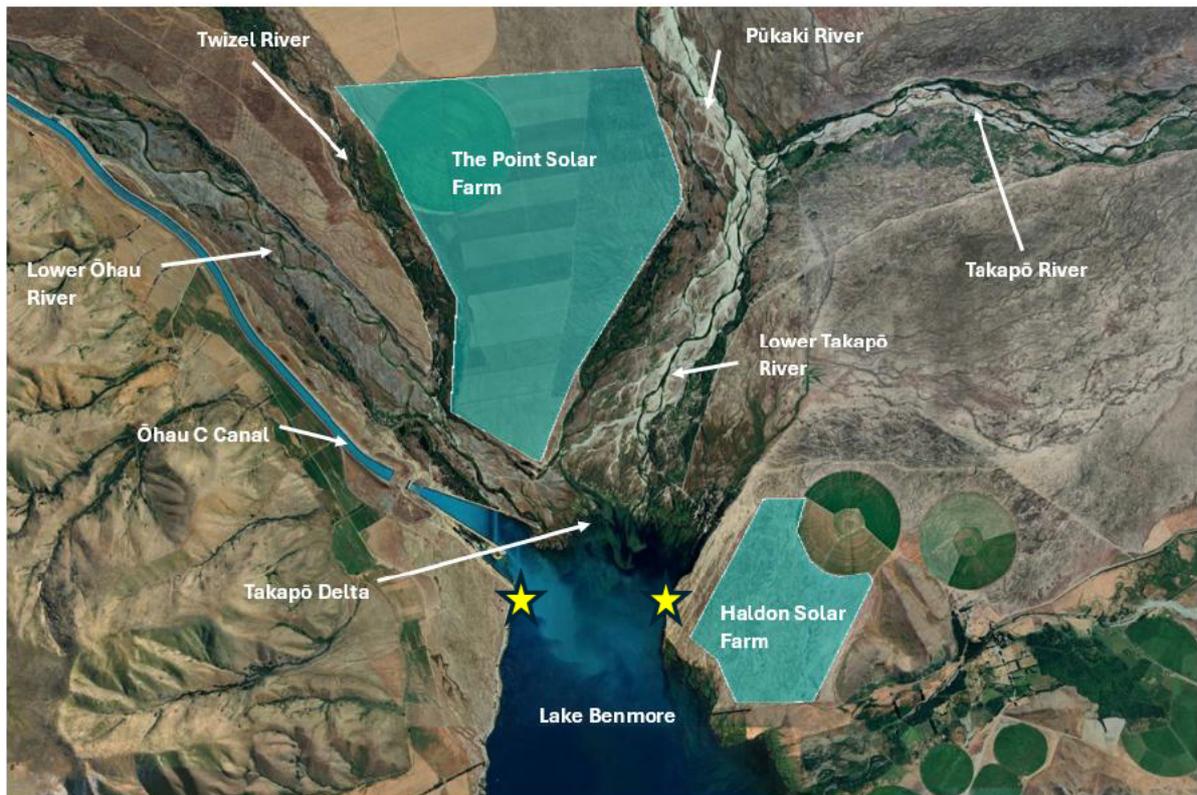
### **Summary**

14. The proposed 320 ha Haldon Solar Farm is in the Mackenzie Basin at the head of Lake Benmore, next to the river delta where the Takapō, Pūkaki and Ōhau rivers enter the lake. These rivers and others in the Mackenzie Basin are a stronghold for Nationally Threatened and At Risk braided river species such as black stilt, black-fronted tern, wrybill, black-billed gull, banded dotterel, and South Island pied oystercatcher. Black stilt, one of the world's rarest bird species numbering some 140 birds, is now restricted to the Mackenzie Basin.
15. A total of 33 Nationally Threatened and At Risk bird species has been recorded from the Takapō delta and immediate surrounds, directly adjacent to the proposed solar farm. In addition to black stilt, two other Nationally Critical bird species – white heron and Australasian bittern – have been recorded in this location.
16. The Takapō River and the Ōhau River regularly support more than 5% of the national population of black-fronted tern, and possibly over 10% in some years. Recent research has demonstrated that the delta is used as an overnight roost by hundreds of black-fronted terns during the breeding season.
17. The proposed solar farm will be located on the Takapō-Haldon outwash which comprises terrestrial habitats that endemic braided river bird species use for nesting and foraging. Banded dotterel, South Island pied oystercatcher, and New Zealand pipit will breed and forage at the site, and black-billed gull, black-fronted tern, and black stilt will use the site for foraging.
18. During the breeding season, hundreds if not thousands of bird movements are occurring next to, and sometimes within or over, the site of the proposed solar farm. Out of the breeding season, black stilt will continue to forage across the landscape.
19. The Applicant's assessment of effects on birds is of considerable concern. Field methods were non-standard, were inadequate to survey the species expected to be present, were extremely restricted in timing, and did not survey seasonal variation. One At Risk species was almost certainly misidentified. No attempt was made to document Threatened and At Risk bird species that were potentially missed by the field survey, or those using adjacent habitats.
20. Further, the ecological significance of the site for birds was assessed inaccurately, and the potential effect of mortality due to interactions with solar panels and other infrastructure was omitted altogether.

21. The site of the proposed solar farm site is ecologically significant for birds as it supports multiple Threatened and At Risk bird species and is inextricably connected to the adjacent nationally important braided rivers. If construction and operation of the solar farm causes vegetation changes at the site, bird use of the site will almost certainly alter, with effects varying by species.
22. Overseas evidence demonstrates that birds are killed by colliding with solar panels, or indirectly, for example by landing and being predated. Most data come from the southwest United States where a proportion of the species killed are waterbirds. Almost all the 33 Threatened and At Risk waterbird species found in the location of the Haldon Solar Farm are from bird families that have experienced collision mortality in overseas photovoltaic solar farms. However, no information is available on the vulnerability of New Zealand species.
23. Solar farms should not be permitted within such ecologically significant ecosystems in the absence of evidence that demonstrates the risk to Threatened and At Risk species is negligible. Solar farms in the Mackenzie Basin present a novel threat for multiple bird species already threatened by introduced predators, extensive modification of rivers by hydrological management, and ongoing weed invasion of rivers and development of terrestrial habitats. Additional mortality caused through interactions with the proposed solar farm would be potentially catastrophic for kakī and compound the challenge to reverse population declines for other Threatened and At Risk species.

#### **Haldon Solar Farm location and proposal**

24. The location of the proposed Haldon Solar Farm is at the head of Lake Benmore in the Mackenzie Basin (Figure 1). The Lower Ōhau, Pūkaki, and Takapō rivers all enter Benmore at this point, forming a delta across the northern end of the lake that I will refer to as the Takapō delta (it is referred to by multiple names including Ōhau delta, Takapō/Benmore delta etc.).
25. The Ōhau, Pūkaki, and Takapō rivers were large, braided river ecosystems but are now fully diverted as part of catchment-wide hydroelectric schemes. Lake Benmore is one of several hydro lakes created by the multiple dams located through the mid and lower Waitaki Catchment.
26. Despite vast, landscape-level hydroelectric modification and widespread agricultural use, the braided rivers and dryland ecosystems of the Mackenzie Basin support nationally significant bird populations and have been the subject of decades of research and conservation work.



**Figure 1:** Aerial photograph of the head of Lake Benmore and the mid-Waitaki catchment rivers showing the approximate locations of the proposed Haldon Solar Farm and The Point Solar Farm. The distance between the two yellow stars is approximately 1.8 km (Google Earth).

27. The Substantive Application states that “The exact dimensions and type of the solar modules to be installed onsite and the spacings between those modules will be determined at the detailed design stage.” The proposed single-axis tracking panels will have a maximum height of approximately 2.6 m when the panel is tilted at the maximum 60-degree angle but may reach up to 3 m in height depending on topography (p46). Earthworks of up to 132,000 cubic metres is expected and will involve smoothing landforms and cut and filling. Approximately 7 km of deer fence 2 m in height will be installed with rabbit fencing along the lower portion.

#### **Adequacy of information on bird populations and bird habitats**

28. Mr Nicholas Head provides detailed descriptions of the nationally important Takapō-Haldon outwash ecosystem in his evidence which includes the area proposed for development<sup>2</sup>. Indigenous bird species nest and forage in these dryland habitats and have done so for thousands of years.
29. The Applicant’s ecologist has undertaken a single set of bird observations at 10 points located on two transects through the site. Observations were completed in both the “early morning and late evening” on an undocumented day sometime during October

<sup>2</sup> Evidence of Mr Nicholas Head, Terrestrial Ecology, 2 February 2026.

or November 2024. Observations lasted from 3-5 minutes each, equating to a maximum of one hour and 40 minutes of targeted observations for birds. This is entirely inadequate to describe the indigenous bird community that uses the proposed site.

30. This has led to the assessment almost certainly missing the presence of breeding pohowera | banded dotterel. Recent Masters research on the breeding of banded dotterels in the Takapō-Haldon outwash (specifically the Maryburn and Ōhau Downs Conservation Areas) illustrates the effort required to find nesting pairs of this relatively cryptic species. Nest searches involved multiple people walking and biking transects from October to December, amounting to 182 hours of search effort in total<sup>3</sup>.



**Figure 2:** Photographs taken from Katie Gray’s (2024) Masters thesis (p66) showing typical vegetation in the outwash plains of the Maryburn Conservation Area (left) and the Ōhau Downs Conservation Area (right) that were searched for banded dotterel nests.

31. A recent visit to the proposed site by ecologists for Department of Conservation and Environment Canterbury in November 2025 observed a banded dotterel. This was despite the focus of the assessment being habitats and flora, and the brief visit being restricted to five hours. This compounds my concern regarding the quality of the Applicant’s ecological assessment for birds<sup>4</sup>.
32. The Applicant’s ecologist found a total of 16 species at the site, including one Nationally Threatened bird species – a black-fronted tern flying over the site – and seven further native or endemic bird species which the assessment listed as Not Threatened (Table 1). Remaining observations were of introduced bird species.
33. One species was described as tōrea pango | variable oystercatcher, an almost exclusively coastal species, and was incorrectly listed as Not Threatened; variable oystercatcher is At Risk-Recovering. However, it is very unlikely that the species

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<sup>3</sup> Gray K.E. 2024: Movements and habitat use of black-fronted terns and banded dotterels in the Mackenzie Basin. Master of Science (Ecology), University of Otago. 159p.

<sup>4</sup> Harding M. Nov 2025: Haldon Station solar array site – vegetation assessment. Unpublished report prepared for the Department of Conservation.

observed was variable oystercatcher and was much more likely to have been tōrea | South Island pied oystercatcher. This species is At Risk-Declining, and breeds in the Mackenzie Basin. While rare observations of black oystercatchers are sometimes made inland, an ecologist undertaking an assessment of bird values should be expected to be able to identify and report unusual occurrences.

34. The ecological assessment made no attempt to provide a list of bird species that could potentially use the site but had not been recorded as present during site visits. It also did not provide a list of bird species that use the Takapō River and delta and Lake Benmore, both immediately adjacent to the proposed site, or other rivers and wetlands in the wider area.
35. In the Applicant Response to Panel Minute 1 dated 12 December 2025, the Panel asked the Applicant specifically to “provide further information on the suite of nationally threatened or at-risk flora or fauna that are potentially present but that were not detected.” The Applicant did not address birds in their response.
36. However, the Applicant’s response to a different question (the Panel’s question 25) was “The solar site contains no suitable habitat for black stilt or other braided-river specialists. No stilts were recorded during surveys”. This is incorrect. The Applicant’s ecologist found evidence of breeding for poaka | pied stilt (Not Threatened) and considered that tarāpirohe | black-fronted tern probably foraged at the site.
37. In addition, banded dotterel (At Risk-Declining) nests at the site, and will forage at the site, and pīhoihoi | New Zealand pipit (At Risk-Declining) and South Island pied oystercatcher (At Risk-Declining) are also likely to breed and forage at the site. Black-fronted tern, tarāpuka | black-billed gull (At Risk-Declining) and kakī (Threatened-Nationally Critical) are likely to forage at the site, the latter particularly in times of high rainfall when ponding may occur. Foraging habits of black-billed gulls are not well understood in the Mackenzie, however, birds are likely to forage in most grassland habitats as they do in other regions in the South Island.
38. The Panel also questioned the adequacy of the survey methodology. The applicant responded with a quote, that the baseline ecology survey was “one of the most intensive dryland surveys undertaken”. This is not a quote from the ecological assessment. Regarding bird surveys, it is clearly incorrect. The methods employed to detect bird use of the proposed site were highly deficient; standard bird survey techniques such as five-minute bird counts were not used, survey was restricted to a single day rather than repeated seasonal and annual counts, and no nest searches were undertaken during the breeding season. The Applicant response refers to “systematic walking searches across the site”; I can find no such thing in the ecological assessment. The response notes “the assessment adopts a precautionary

approach and does not assume absence where habitat is marginally suitable”; however, it has clearly not applied this process for bird species.

39. In all, the information on bird populations potentially affected by the proposal is seriously lacking, inaccurate, and demonstrates poor understanding of habitat use by bird species that use braided rivers and the ecologically connected dryland ecosystems of the Mackenzie Basin. This has obvious implications for the assessment’s overall environmental impact assessment (p47). The assessment makes no attempt to describe the bird communities that use the adjoining rivers and lake and does not address the significance of bird populations of the Mackenzie Basin in general. I will discuss all these issues in more detail.

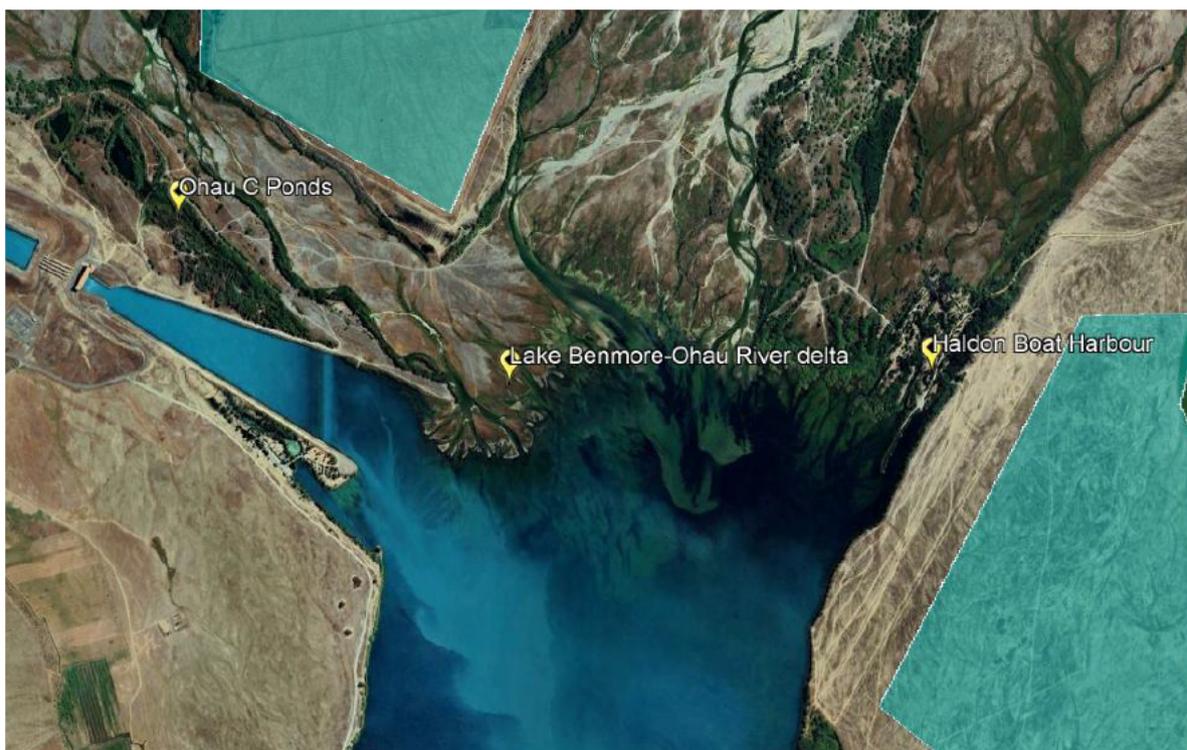
### **Indigenous bird populations of the Mackenzie Basin**

40. The eight indigenous bird species detected by the applicant’s ecologist at the site represent a fraction of the species known to use the dryland habitats, adjacent braided rivers and associated wetlands, and Lake Benmore.
41. For example, the publicly available global bird database eBird<sup>5</sup> has three ‘Hotspots’<sup>6</sup> within a few kilometres of the site (Figure 3). The closest Hotspot is ‘Lake Benmore-Haldon Boat Harbour’ which is within a few hundred metres of the edge of the site. Five checklists have been uploaded for this Hotspot. The ‘Lake Benmore-Ōhau River delta’ Hotspot has 38 checklists, and the ‘Ōhau C ponds’ Hotspot has 223 checklists.

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<sup>5</sup> eBird is an online global database of bird lists obtained by citizen scientists (both amateurs and environmental professionals alike) into which ~100 million bird sightings are uploaded annually. Over 800,000 checklists have now been submitted for New Zealand birds. The data are an immensely valuable resource that can be used to better understand distributions and abundances of many species. However, eBird data comes with biases and possible inaccuracies, and should be used with care.

<sup>6</sup> eBird Hotspots are designated locations frequently visited by observers. Hotspots are only supposed to be used when an entire checklist was obtained within that hotspot’s area.



**Figure 3:** Aerial photography of the head of Lake Benmore showing the approximate locations of the proposed Haldon Solar Farm (right) and The Point Solar Farm (top). Yellow markers show the locations of the three closest eBird 'Hotspots' (Google Earth).

42. Table 1 summarises the indigenous bird species observed by the applicant at the proposed solar farm site and those observed at the three nearest Hotspots. In comparison to the applicant's observations of eight indigenous species, including one Nationally Threatened and one At Risk species, the three Hotspots have lists of 30-33 indigenous species, including 12-13 Nationally Threatened and At Risk species.

**Table 1:** Native and endemic bird species recorded during ecological assessments at Haldon Solar Farm and recorded at three nearby eBird hotspots. An asterisk denotes a species record obtained since the beginning of 2022; a hyphen denotes older records within the last 10 years. Two species marked with a double asterisk are from a separate eBird checklist (see text). Species and Te Reo Māori names are provided in Appendix 1.

Species	Threat Classification	Haldon Solar Farm	Haldon Boat Harbour	Ōhau Delta	Ōhau C Ponds
<b>Waterfowl</b>					
Australasian crested grebe	Nationally Vulnerable		*	*	*
Australasian little grebe	Coloniser		-		
Black swan	Not Threatened		*	*	*
Grey Duck	Nationally Vulnerable		*		*
Mallard/grey duck hybrid	Not Threatened		-	-	*

Species	Threat Classification	Haldon Solar Farm	Haldon Boat Harbour	Ōhau Delta	Ōhau C Ponds
Grey teal	Not Threatened		*		*
Australasian shoveler	Not Threatened		*	*	-
Paradise shelduck	Not Threatened	*	*	*	*
New Zealand scaup	Not Threatened		*	*	*
<b>Shags</b>					
Black shag	Relict			*	*
Pied shag	Recovering			*	
Little shag	Relict		*	*	*
<b>Hérons and spoonbills</b>					
Australasian bittern	Nationally Critical				*
White heron	Nationally Critical		**		
Royal spoonbill	Naturally Uncommon		**		
White-faced heron	Not Threatened	*	*	*	*
<b>Rails and coots</b>					
Australian coot	Not Threatened		*	*	-
Marsh crake	Declining			*	*
Pūkeko	Not Threatened		*	-	*
<b>Waders</b>					
Kakī	Nationally Critical		-	*	*
Hybrid kakī	Not Threatened			-	
Pied stilt	Not Threatened	*	*	*	*
South Island pied oystercatcher	Declining	*	*	-	*
Wrybill	Nationally Increasing				*
Banded dotterel	Declining		*	*	*
Spur-winged plover	Not Threatened	*	*	*	*
<b>Gulls and terns</b>					
Karoro   black-backed gull	Not Threatened	*	*	*	*
Black-billed gull	Declining		*	*	*
Black-fronted tern	Nationally Endangered	*	*	*	*
Caspian tern	Nationally Vulnerable			-	
<b>Non-wetland species</b>					
Australasian harrier	Not Threatened	*	*	*	*
New Zealand falcon	Declining		-		
New Zealand pipit	Declining		-	*	*
Grey warbler	Not Threatened		*	*	*
Shining cuckoo	Not Threatened		*		*
Sacred kingfisher	Not Threatened			*	*
Silveryeye	Not Threatened		*	*	*
South Island fantail	Not Threatened		*	*	*
Welcome swallow	Not Threatened		*	*	*
Kereru	Not Threatened				*
<b>Total indigenous bird species</b>		<b>8</b>	<b>31</b>	<b>30</b>	<b>33</b>
<b>Threatened species</b>		<b>1</b>	<b>5</b>	<b>4</b>	<b>6</b>
<b>At Risk species</b>		<b>1</b>	<b>7</b>	<b>8</b>	<b>7</b>

43. This disparity is in part due to obvious differences in habitats between the proposed site – outwash ecosystem – and the three Hotspots which are rivers or ponds. However, several of the Hotspot species could be expected to use the proposed site for breeding and/or foraging given its proximity within a few hundred metres. This includes kakī, black-fronted tern, black-billed gull, banded dotterel, and pipit.
44. In addition to the bird records made at the three hotspots, hundreds more checklists have been obtained around the same immediate area but have been uploaded at unique locations. For example, Dr Colin Miskelly, Curator Vertebrates at Te Papa Tongarewa, uploaded incidental observations and photographs of a flock of 12 kōtuku ngutupapa | royal spoonbills (At Risk-Naturally Uncommon) and one kōtuku | white heron (Threatened-Nationally Critical) at ‘Haldon Arm’ on 4 March 2023<sup>7</sup>. These species have been listed in Table 2 under the Haldon Boat Harbour Hotspot as it is the same area.
45. Species such as pūteketeke | kāmana | Australasian crested grebe will never use terrestrial habitats, and many other species listed in Table 2 may be rare visitors to areas of terrestrial dryland habitats such as those present at the proposed solar farm. However, all 33 indigenous bird species known from the immediately adjacent habitats will undertake flights over or near the solar farm, and this is critical for the assessment of the potential effects of the proposal.

#### *Braided river birds*

46. Six indigenous Threatened and At Risk bird species are characteristic of braided rivers and are a feature of the Mackenzie Basin. Kakī, black-fronted tern, ngutuparore | wrybill, banded dotterel, black-billed gull, and South Island pied oystercatcher breed on the adjacent Takapō River. All are impacted by a complex, interrelated suite of threats in the Mackenzie Basin including introduced mammalian predators, degradation of nesting and foraging habitats by invasive weeds, hydroelectric modification of rivers, and predation by the native karoro | black-backed gull.

#### *Wrybill*

47. Wrybill (Threatened-Nationally Increasing) is the only one of the six species that does not regularly use terrestrial habitats and is unlikely to use the proposed solar farm except perhaps during floods. Its sideways curved bill, unique in the bird world, is perfectly adapted to search for invertebrates under riverbed stones. The Mackenzie Basin is a species stronghold. Over 20 years of intensive predator control in the Tasman River valley is maintaining numbers but has not turned the tide for the

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<sup>7</sup> Checklist and photographs can be viewed at <https://ebird.org/checklist/S130882849>.

species in this location<sup>8</sup>. The overall trend in Mackenzie Basin rivers is of a decline, in contrast to the national trend, which is thought to be increasing.

48. Wrybill pairs breed solitarily on bare gravels during the breeding season, and after breeding, fly north to overwinter in upper North Island harbours and estuaries. The national population may number approximately 5,000 birds. Several hundred birds may nest in the alpine rivers of the Tasman, Cass, and Godley, but numbers are very low in the mid catchment rivers of the Mackenzie Basin, including the Takapō and highly modified Ōhau rivers<sup>9</sup>. Movements are poorly understood, except for one known flyway to and from wintering sites parallel to the Waikato west coast, both overland and offshore<sup>10</sup>. Local movements, in breeding habitats like the Mackenzie Basin, are unknown. In my opinion, though the species is unlikely to use the solar farm site, it will regularly fly around the associated braided river habitats, most likely flying over the solar farm on occasion.

### *Kakī*

49. Kakī (Threatened-Nationally Critical) is one of the rarest bird species in the world. The population numbers approximately 140 wild birds, which includes only 40 or so breeding pairs. The species is largely restricted to the Mackenzie Basin, though once nested more widely including in the North Island.
50. Though kakī primarily nest on rivers, Department of Conservation rangers have also observed breeding on farms<sup>11</sup>. Kaki forage in terrestrial dryland habitats in wet areas such as small permanent or ephemeral ponds. I have observed five feeding together in a paddock in approximately 4 m<sup>2</sup> of standing water on the edge of Lake Takapō.
51. The Department of Conservation has had a captive rearing facility for the species near State Highway 8, approximately 12 km from the proposed solar farm, for over 40 years. In recent years, over 100 juveniles are usually released annually. This intensive management maintains a relatively stable population that may be increasing slowly, but the mortality rate of juveniles remains very high.
52. Many observations of kakī and kakī-pied stilt hybrids have been observed around the Takapō delta from Haldon Arm in the east to the mouth of the Ōhau River in the west (eBird data). Birds may both breed and forage in this location. Species movements

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<sup>8</sup> Population analyses of all waterbird species in the Waitaki Catchment in: Whitehead A., Hoyle J. Bind J. and Sykes J. 2023: Freshwater birds and riverbed vegetation in the Waitaki catchment – Current state of knowledge. NIWA Client Report No. 2020122CH. Prepared for Meridian Energy. 171p.

<sup>9</sup> I have approximated population sizes using graphs provided in Whitehead *et al.* (2023) showing linear densities by transforming recent data by the length of the various rivers.

<sup>10</sup> Schlesselmann A.K.V., Monks A., Innes J., McArthur N. and Walker S. 2024: Conservation challenges in mobile birds. *New Zealand Journal of Ecology* 48: 1-15. This knowledge was obtained from the use of avian radar employed to assess the potential adverse impacts of the Hauāuru mā raki wind farm.

<sup>11</sup> Driver G. 2023: One egg at a time - Bringing kakī back from the brink. North and South magazine <https://northandsouth.co.nz/2023/05/29/saving-black-stilt-from-extinction/> accessed January 2026.

have not yet been investigated using GPS tracking technology and our understanding of fine scale movements within the landscape is limited. However, a study using old tracking technology indicated juvenile kakī regularly flew across the Mackenzie Basin<sup>12</sup>. In my opinion, kakī are likely to forage at the site on occasion and will regularly fly around and over it.

53. Unlike the other five braided river birds, most kakī remain in the Mackenzie Basin year round, with small numbers dispersing widely over winter. Birds will be undertaking movements year round in the Mackenzie.

#### *Banded dotterel*

54. Banded dotterel (At Risk-Declining) is in decline in most rivers in the mid to upper Waitaki Catchment including the Takapō, Pūkaki, and Ōhau rivers. Numbers have increased in the Tasman, probably in response to intensive predator control<sup>13</sup>. In addition to braided rivers, the species nests in other habitats that comprise bare or sparsely vegetated gravels, such as the Mackenzie Basin dryland ecosystems.
55. Banded dotterels nesting in the Maryburn Conservation Area, part of the Tekapo-Haldon outwash ecosystem described by Mr Head, to the north of the proposed solar farm, have been studied using GPS trackers as part of Masters research<sup>14</sup>. The habitat in the Maryburn area is classified as ‘depleted grassland’ in the New Zealand Land Cover Database (LCDB ver.6), as is the location of the proposed solar farm. The LCDB defines depleted grassland as “Areas, of mainly former short tussock grassland in the drier eastern South Island high country, degraded by over-grazing, fire, rabbits and weed invasion among which Hieracium species are conspicuous. Short tussocks usually occur, as do exotic grasses, but bare ground is more prominent.”<sup>15</sup>
56. Data were obtained from seven dotterels, which showed that birds flew up to 8.7 km from their nesting territory to forage. The author analysed habitat types within the area used by dotterels and found that ‘depleted grassland’ was the most utilised habitat and, along with river habitats, was preferentially selected by dotterels (Figure 4). The study found that ‘high producing exotic grassland’ was only used when grass length was very short, for example, after harvesting.

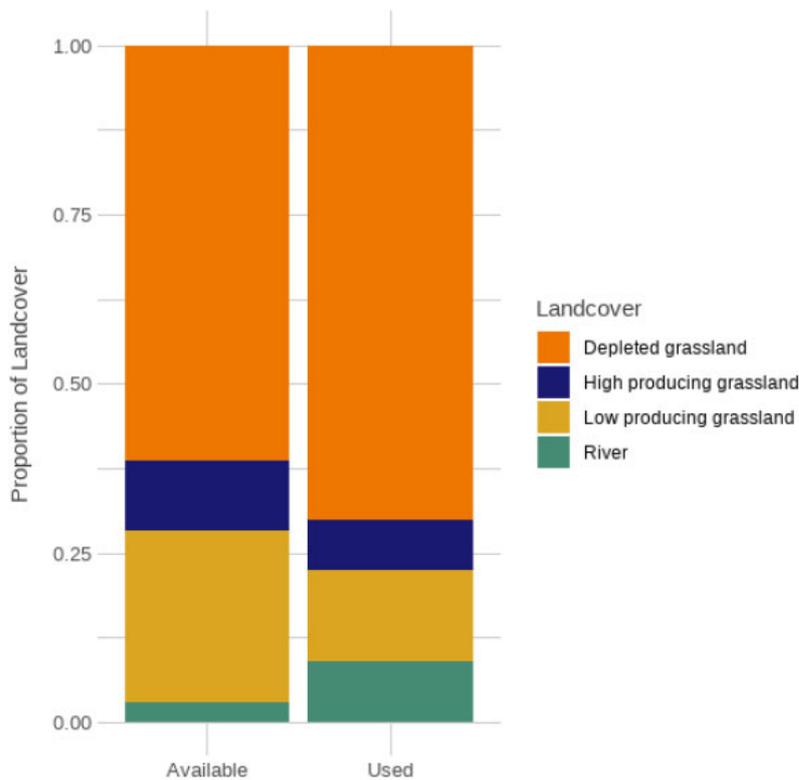
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<sup>12</sup> Van Heezik Y., Maloney R.F. and Seddon P.J. 2009: Movements of translocated captive-bred and released Critically Endangered kaki (black stilts) *Himantopus novaezelandiae* and the value of long-term post-release monitoring. *Oryx* 43: 639-647.

<sup>13</sup> Whitehead A., Hoyle J. Bind J. and Sykes J. 2023: Freshwater birds and riverbed vegetation in the Waitaki catchment – Current state of knowledge. NIWA Client Report No. 2020122CH. Prepared for Meridian Energy. 171p.

<sup>14</sup> Gray K.E. 2024: Movements and habitat use of black-fronted terns and banded dotterels in the Mackenzie Basin. Master of Science (Ecology). University of Otago 159p.

<sup>15</sup> Manaaki Whenua Landcare Research 2025: New Zealand Land Cover Database (LCDB) classes at version 6. Downloaded from the LRISPortal.



**Figure 3:** Difference in proportions of habitat types available within the 99% contour of banded dotterel utilisation distributions compared to proportions used by banded dotterels (Figure 3.9 in Gray 2024).

57. The applicant’s ecologist did not find breeding or foraging banded dotterels at the proposed site, almost certainly a reflection of the inadequate survey methodology for indigenous bird species. It is very likely to breed and forage at the proposed solar farm site as the outwash ecosystems of the Mackenzie Basin are known breeding habitats, and a recent site visit by botanists recorded the presence of a dotterel.

*South Island pied oystercatcher*

58. South Island pied oystercatcher is an endemic bird species that is largely restricted to the South Island when breeding. After nesting, birds disperse widely to coastal areas as far as Northland. It is relatively flexible in its choice of nesting location, breeding inland in braided rivers and farmland, but also most other open habitats from the coast to high altitude locations. Population trends have been variable over decades, but it is presently considered to be in decline. Oystercatchers will almost certainly breed at the proposed solar farm site, using both the dryland habitats and adjacent rivers for foraging.

*Black-fronted tern*

59. Black-fronted tern (Threatened-Nationally Endangered) nests in colonies on bare gravels in braided riverbeds. Usually, these colonies establish in different locations

each breeding season as the distribution of gravels changes with freshes and floods between years. The Ōhau River (upper) and Takapō River each regularly support over 5% of the national population of black-fronted terns.

60. Black-fronted terns dip for aquatic invertebrates or dive for fish in river channels. They also forage extensively on invertebrates in pasture. I often observed individuals hunting lizards over depleted grassland that was once farmed near the upper Ōhau River (where I used to regularly stay); a population in Fiordland specialises in hunting skinks.
61. Multiple recent tracking studies of black-fronted terns in the Mackenzie Basin have been completed; two of these were Masters research projects. Of these, the first, in the 2020-21 breeding season, obtained data from 33 terns from the Tern Island colony on the Upper Ōhau River and from a colony on the Cass River, which flows into Lake Takapō<sup>16</sup>. The second, in both the 2022-23 and 2023-24 seasons obtained data from 54 terns tagged in one colony in the Ahuriri River, two colonies in the Tasman River, three colonies in the Takapō River, and one in a tributary, Irishman Creek<sup>17</sup>.
62. Both studies demonstrated that terns spent most time within braided river habitats but foraged in terrestrial habitats. Of these, the second study showed a preference for 'low producing grassland', followed by 'high-producing exotic grassland', and 'lakes or ponds', then 'depleted grassland' (LCDB v5.0 habitat classifications). In contrast the first study showed a strong preference for 'high producing exotic grassland'.
63. Both studies discovered that terns travelled extensively at night, including the previously unknown behaviour of terns roosting away from the colony overnight, particularly on river deltas. The first study found that, of the 24 tagged Ōhau terns, 22 used the Takapō delta, as did one of the Cass colony terns, while most Cass terns used the Cass River delta. The second study showed that terns roosted 1-50 km from their colony (traveling up to 81 km), even during incubation and chick-rearing, including at sites in different catchments. Multiple nocturnal roost sites were identified, including two at the Takapō delta.
64. Counts were undertaken at one of these roosts as terns arrived after sunset or departed at dawn on four occasions; 290, 0, 170 and 350 terns were recorded (Gray 2024). More were likely to have arrived or departed in darkness as tracking data showed that birds generally stopped arriving around 2-3am and mostly left when it became light (though some birds left throughout the night).

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<sup>16</sup> Gurney F.E. 2022: Breeding movements and post-breeding dispersal of black-fronted terns/ tarāpirohe (*Chlidonias albostrigatus*) in the Mackenzie Basin. Master of Science, Lincoln University. 87p.

<sup>17</sup> Gray K.E. 2024: Movements and habitat use of black-fronted terns and banded dotterels in the Mackenzie Basin. Master of Science (Ecology), University of Otago. 159p.

65. The findings of the GPS tracking studies of banded dotterels and black-fronted terns are highly relevant to the assessment of potential effects of the solar farm. Firstly, they demonstrate the major limitations of our knowledge of the movements of bird species. Kaki, wrybill, black-billed gull, and South Island pied oystercatcher have not been studied using GPS tags, and it is very possible that similar studies on these species may demonstrate previously unknown levels of local and regional movements and habitat use. Secondly, they demonstrate that banded dotterel and black-fronted tern both use the outwash ecosystems (or 'depleted grasslands'). Third, the Takapō delta adjacent to the proposed solar farm is a significant roost site for hundreds of black-fronted terns with birds traversing the edges of the proposed site from dusk until dawn throughout the breeding season.
66. These braided river bird species are one of the key foci of intensive restoration and conservation efforts in the Mackenzie Basin, up into the valley sides of the Tasman, Cass, Godley and Macaulay rivers. In addition to the Department of Conservation's kakī recovery programme which has been operational for over 40 years, Project River Recovery has been undertaking landscape scale weed control throughout the region for over three decades, including the Takapō delta, and intensive predator control in the Tasman Valley and at the Ōhau River tern island colony for approximately two decades. Te Manahuna Aoraki Project launched in 2018, its project area encompassing a further 310,000 ha. One of the charitable company's goals is that existing populations of threatened species have been protected and are flourishing. Working alongside these agencies is the volunteer group Predator Free Aoraki who service traplines in the valleys. In addition, the Department of Conservation and mana whenua launched Tū Te Rakiwhānoa Drylands in 2020, to protect the lower altitude significant habitats in the Mackenzie and Waitaki basins.
67. In all, it is likely that millions of dollars are spent annually working towards protecting and enhancing the habitats, flora and fauna of this nationally unique environment.

#### *Australasian bittern*

68. Matuku hūrepo | Australasian bittern is the only one of New Zealand's 18 Nationally Critical bird taxa that breeds throughout the mainland. The size of the population is poorly understood but is thought to be less than 1,000 mature individuals. Recent estimates are as low as 30-50 birds in Canterbury<sup>18</sup>. The species has suffered from extensive wetland clearance throughout the country and now, the ongoing deterioration and modification the wetlands that remain, in addition to threats posed by mammalian predators.
69. Discrete wetlands within the Mackenzie Basin are unlikely to support a permanent pair of bitterns. Birds are more likely to use multiple wetlands through the year and travel between them regularly to forage. Recent data from new generation GPS tags

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<sup>18</sup> <https://www.ecan.govt.nz/get-involved/news-and-events/2024/backing-the-bittern-the-bird-on-the-brink>

shows that males regularly move distances of more than 100 km over the year between wetlands, and sometimes between regions<sup>19</sup>. Breeding locations in the Mackenzie Basin are unknown. The Department of Conservation bittern database contains 106 bittern records from the Mackenzie Basin, including many sightings around the Ōhau, Twizel, Pūkaki and Takapō rivers<sup>20</sup>. eBird data provide recent evidence of bittern in the district, including an observation by a group of people at dawn who saw four individuals fly out of the Ōhau C ponds Hotspot.

70. Bittern will use vegetated farm drains to forage, and if these habitats are available at the proposed solar farm site, they may occasionally be used by bittern. Individuals almost certainly fly over the proposed site on occasion as they move between wetlands in the Mackenzie Basin.

#### *Australasian crested grebe*

71. Pūteketeke | kāmana | Australasian crested grebe (Threatened-Nationally Vulnerable) is also found in Australia where it is likewise very rare. It is a subspecies of the great crested grebe and is believed to have been in New Zealand for several thousand years. The species was once present in the North Island also, but numbers had declined to approximately 200-300 birds in the South Island only by about the 1980s. Since then, the population has been steadily increasing. Birds are mostly present on high country lakes in Canterbury and Otago.
72. Australasian crested grebe movements are not well understood. They appear to move between lakes within areas such as the Mackenzie Basin, but some individuals may also move greater distances between lakes<sup>21</sup>, or from high country lakes to the coast<sup>22</sup>. Birds generally fly at night.
73. A recent national survey for Australasian crested grebe was completed in January 2024, following previous national surveys in 1980, 2004, and 2014. One hundred and eight lakes were surveyed; grebes were counted on 53. The largest populations were found on Lakes Wanaka (160), Alexandrina (129), Hayes (110) and Benmore (89). Results indicate the total adult population is 970-980 individuals; almost half the population was found in the Mackenzie and Waitaki lakes. The 89 adults recorded on Lake Benmore compares to none recorded in 1980, 15 in 2004 and 77 in 2014. Within the lake, 68 adults and juveniles were found in the Haldon Arm, 38 in the Ahuriri Arm, and 4 in the Benmore Gorge/Dam section<sup>23</sup>.

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<sup>19</sup> Willams E.M. 2024: Conservation management of the critically endangered matuku-hūrepo /Australasian bittern. Science for Conservation 341. Department of Conservation. 64p.

<sup>20</sup> Colin O'Donnell 2024: Initial briefing – potential impacts of proposed 'The Point' solar farm near Twizel on threatened birds. Unpublished advice, 12 March 2024.

<sup>21</sup> Sagar P.M. and O'Donnell C.F.J. 1982: Seasonal movements and population of the southern crested grebe in Canterbury. *Notornis* 29: 143-149.

<sup>22</sup> O'Donnell, C.F.J. 2013 [updated 2022]. Australasian crested grebe | pūteketeke. In Miskelly, C.M. (ed.) *New Zealand Birds Online*. [www.nzbirdsonline.org.nz](http://www.nzbirdsonline.org.nz)

<sup>23</sup> Unpublished data, R. Snoyink and colleagues, in prep.

74. Australasian crested grebes avoid land, and birds will not use the proposed solar farm. However, individuals will fly around and across Lake Benmore and will likely traverse the site on occasion when moving between waterbodies.

#### **Assessment of ecological significance**

75. The Applicant's ecologist has assessed the ecological significance of the proposed solar site using criteria set out in the Environmental Institute of Australia and New Zealand's (EIANZ) ecological impact assessment guidelines.<sup>24</sup> The assessment shows a very poor understanding of the application of ecological significance criteria.
76. I have used the criteria for determining significant indigenous vegetation and significant habitat of indigenous biodiversity in Appendix 3 of the Canterbury Regional Policy Statement (2013, updated 2021). These criteria are set out below, each followed by my comments. These are the same four criteria that are used in the EIANZ guidelines but have slightly different definitions. It should be clear that the site meets criteria for avifauna alone.

#### **77. Representativeness**

- a. Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.
  - b. Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.
78. The assessment ranks representativeness as Very Low. However, Mr Head describes the vegetation of the proposed site in detail, highlighting its representativeness, though degraded (summarised in his paragraph 23). The inadequate surveys for birds have underestimated the use of the site by indigenous bird species. In my opinion, the site will support the breeding and foraging of multiple indigenous bird species. Populations may be low and seasonal (for some species), but this is characteristic of the dryland habitats of the Pukaki Ecological District and Mackenzie Ecological Region.

#### **79. Rarity/Distinctiveness**

- a. Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the region, or relevant land environment, ecological district, or freshwater environment.

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<sup>24</sup> Roper-Lindsay J., Fuller S., Hooson S., Sanders M. and Ussher G. 2018: Ecological Impact Assessment (EclA) – EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems, 2<sup>nd</sup> Edition. Environmental Institute of Australia and New Zealand, Melbourne, Australia.

- b. Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.
  - c. The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.
  - d. Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combinations of factors.
80. The assessment ranks rarity/distinctiveness as Low. However, the proposed site supports multiple Threatened or At Risk bird species. These include breeding banded dotterel and most likely South Island pied oystercatcher and New Zealand pipit. Other species that will use the site for foraging include black-fronted tern, black-billed gull, and kakī. This is an association of indigenous bird species found only in the Mackenzie Ecological Region.

**81. *Diversity and Pattern***

- a. Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.
82. The assessment ranks diversity and pattern as Very Low. However, it is likely that this criterion is met when all indigenous taxa are assessed together (plant, bird, invertebrates, lizards).

**83. *Ecological Context***

- a. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.
  - b. A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.
  - c. Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.
84. The assessment ranks ecological context as Very Low. However, the site borders the Takapō River – the river and its delta are 200-300 m from the edge of the solar farm. Prior to diversion, the Takapō had a mean flow of approximately 80 cumecs. The historical channels of the river and its tributaries are visible throughout the site in aerial photographs. The Takapō River has been identified as internationally important

for birds<sup>25,26</sup>. The ecological connection between the river and the adjacent land is obvious; birds nesting at the site will forage in both the site and the river, and birds nesting in the river will forage in both the river and the site. This has been demonstrated using GPS tracking for banded dotterel and black-fronted tern elsewhere in the Ecological District.

85. Together, the Takapō, Pūkaki, and Ōhau rivers have been assessed as an Important Bird Area or IBA (NZ071 – Ohau Pukaki Tekapo Rivers; Table 2)<sup>27</sup>. Important Bird Areas are sites identified as being internationally significant for the conservation of birds, based on a set of standardised, data-driven criteria<sup>28</sup>. Over 13,000 Important Bird Areas worldwide have been identified to date. The table below has been taken from one of the three reports produced for New Zealand Important Bird Areas. The three rivers and Lake Benmore are all sites of natural significance in the Mackenzie District Plan.

**Table 2:** Ohau Pukaki Tekapo Rivers (NZ071) Important Bird Area showing the five trigger species (species listed as Threatened using IUCN Red List criteria) and their estimated local population sizes for the period shown.

Populations of IBA trigger species:						
Species	Season	Period	Population estimate (pairs)	IBA criteria	IUCN cat.	NZ Threat Class.
Black-billed Gull	Breeding	2009-2012	35-45	A1, A4i	EN	Nationally Critical
Black-fronted Tern	Breeding	2009-2012	218-517	A1, A4i	EN	Nationally Vulnerable
Black Stilt	Resident	1991-1994	C.10	A1, A4i	CR	Nationally Critical
Wrybill	Breeding	1991-1994	C.21	A1	VU	Nationally Vulnerable
Australasian Bittern	Resident		Present	A1	EN	Nationally Endangered

**Ornithological information:** Besides the trigger species the following species are confirmed or likely to be breeding: Australasian Crested Grebe, Black Shag, Little Shag, White-faced Heron, Black Swan, Canada Goose, Paradise Shelduck, NZ Shoveler, Grey Teal, Mallard, Grey Duck, NZ Scaup, Australasian Harrier, Marsh (Baillon's) Crake, Pukeko, Australian Coot, South Island Pied Oystercatcher, Pied Stilt, Banded Dotterel, Spur-winged Plover, Southern Black-backed Gull, Caspian Tern, Rock Pigeon, Californian Quail, NZ Kingfisher, Welcome Swallow, NZ Pipit, Shining Cuckoo, South Island Fantail, Silvereye, Skylark, Hedge-sparrow, Blackbird, Song Thrush, Yellowhammer, Chaffinch, Greenfinch, Goldfinch, Redpoll, House Sparrow, Starling, Australian Magpie. Other species recorded: Chukor.

<sup>25</sup> Hughey K., O'Donnell C., Schmechel F. and Grant A. 2010: Native Birdlife: Application of the river significance assessment method to the Canterbury region. LEaP Report No.24B, Lincoln University.

<sup>26</sup> Forest & Bird 2016: New Zealand Seabirds: Sites on Land, Rivers, estuaries, coastal lagoons & harbours. The Royal Forest & Bird Protection Society of New Zealand, Wellington, New Zealand.

<sup>27</sup> Forest & Bird 2016: New Zealand Seabirds: Sites on Land, Rivers, estuaries, coastal lagoons & harbours. The Royal Forest & Bird Protection Society of New Zealand, Wellington, New Zealand.

<sup>28</sup> <https://datazone.birdlife.org/about-our-science/ibas>.

## Assessment of effects

86. The Substantive Application states that the effects on bird species are negligible, and that this is because surveys revealed no nesting birds on site (this is incorrect as the ecological assessment states that spur-winged plover and pied stilt were observed breeding), and because birds are anticipated to continue using the habitat for foraging, between and under the solar arrays.
87. However, the methods to survey birds were not standard, were limited to a day, were inaccurate, and nesting birds were not specifically searched for. I have little confidence in the results.
88. I consider that the potential effects of the proposed solar farm are:
- Disturbance and displacement of nesting and foraging bird species during construction, including possible injury and mortality.
  - Loss of habitat due to construction.
  - Alteration and degradation of habitats due to site operation leading to changes in use by Threatened and At Risk bird species that nest and forage at the site.
  - Ongoing injury and mortality of birds, in particular, Threatened and At Risk bird species, through collisions with solar farm panels and other infrastructure at the site including fences and transmission lines.
  - Negative consequences for national and regional population stability for impacted species.

I will discuss these in following paragraphs.

### *Effects of construction*

89. Construction of the farm will modify a percentage of habitat on site. The ecological assessment states that this is approximately 13 ha of the 320 ha site (p8). If correct, this is a relatively limited area of direct habitat loss. However, Threatened and At Risk birds nesting in areas intended for construction could be disturbed, and nests and chicks destroyed. Further, some species or individuals of species may choose to avoid the area during construction – this is a short-term effect.

### *Post-construction habitat changes*

90. The ecological assessment states that the proposed solar farm will include deer fencing and rabbit fencing of the entire site, and that the cessation of over 150 years

of pastoral farming will occur. The solar arrays will have a maximum ground cover of approximately 40% when panels are horizontal.

91. Despite this, the Substantive Application states that birds will continue to use the solar farm habitats, and that “The proposal is not expected to significantly change the baseline site vegetation”.
92. However, the report also states “Overseas studies suggest that the main environmental effects of shading from solar arrays are reduced incident radiation, reduced wind ground speed, reduced vapour pressure deficits and increased soil moisture. Drawing on studies undertaken in a fescue tussock grasslands environment on the west of Lake Tekapo, the imposition of artificial shade is anticipated to increase total species richness and cover...” (p85). Mr Head describes the potential habitat changes further in his paragraphs 54, and 101-102.
93. The extent of changes to baseline vegetation caused by construction and operation of the solar farm is fundamental to determining potential effects of the solar farm on birds that nest and forage on the site. If vegetation changes, lizard and invertebrate populations may change. Also possible are increases in terrestrial predators if the availability of cover and shelter increases and sources of food – birds, lizards, and invertebrates – change. The ecological assessment’s singular statement in relation to these changes is “The proposed rabbit fencing will also promote recovery of indigenous species reduced by historical browsing and grazing. This could result in an increase in indigenous biodiversity in the solar site” (p45). This is a simplistic assessment of potential changes in vegetation composition and structure, bird breeding and foraging habitats, lizard and invertebrate populations, and associated changes in terrestrial predator populations.
94. Changes in habitat and food sources within the proposed solar farm site will affect Threatened and At Risk bird species that use the site to breed or forage differently. For example, increases in vegetation cover and structure will reduce use of the site by banded dotterel which select open, sparsely vegetated habitats for nesting and foraging. In contrast, black-fronted tern foraging may increase at the site as the species prefers more developed grasslands for foraging.
95. Variability in species responses to habitat alterations caused by solar farms was highlighted by a review on solar facility impacts on fauna<sup>29</sup>. The paper reported on studies that compared bird diversity and abundance within solar facilities and adjacent reference sites from four states in the United States, South Africa, Japan, United Kingdom, Slovakia, and Poland. Results were highly variable, from little change in species diversity between the solar farm and unaffected sites, to similar levels of diversity but altered bird communities, through to increased species diversity.

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<sup>29</sup> Fleming P.A. 2025: All that glitters – review of solar facility impacts on fauna. *Renewable and Sustainable Energy Reviews* 224: DOI: 115995.

Reviewed studies reported lower overall abundances of birds within solar farms, unchanged numbers, and greater abundances. However, the review's conclusion was that increases in species richness and abundance were associated with facilities constructed in degraded habitats, probably due to the creation of novel habitat and increases in generalist species.

96. The ecological assessment describes the proposed site as degraded. However, Mr Head refutes this (e.g. paragraphs 112-113) noting the considerable number of Threatened and At Risk plant species present at this site; use by Threatened and At Risk bird species has also been underestimated. Habitat changes due to the presence of the solar farm that result in increased diversity and /or abundance of introduced bird species at the site does not constitute an improvement.

#### *Collisions with solar panels*

97. The applicant's assessment of ecological effects has completely omitted the potential for adverse effects from birds colliding with solar panels and other related infrastructure. This is despite many published papers and grey literature on this subject available online.
98. Almost certainly to address this omission, the Substantive Application raises this potential effect, and refers to an assessment of ecological effects for a separate solar farm application at Darfield. It summarises the conclusions of this document:
- "Solar PV panels are not transparent, and reflectivity is intentionally reduced for power generation efficiency, two factors which reduce the risk of bird strike. Only birds using the site as habitat either permanently or temporally are potentially exposed to a risk of incidental collision;
  - The 'lake effect' whereby birds collide with solar panels having mistaken them for water bodies does not appear to be the dominant driver of bird strike as the most commonly affected species are those which do not associate with water; and
  - It is difficult to assess the likelihood or magnitude of this potential effect in New Zealand in general, however it is likely to be lower than bird strike mortality from other sources."
99. I will discuss the potential adverse effect on birds of collision with solar panels in detail, but briefly, in response to these three statements:
- Several Threatened and At Risk bird species use the site either permanently or seasonally and will be at risk of incidental collision. Further, it is wrong to state that only birds using the site are at risk of collision; multiple overseas studies

have shown that many species not previously known from the solar site have been found dead, including migratory birds that have originated from hundreds of kilometres away.

- Waterbirds are not the most affected group of species, but that does not negate the fact that they are affected.
- I agree that it is most definitely difficult to assess the likelihood and magnitude of adverse effects on New Zealand Threatened and At Risk bird species as no monitoring exists. This is precisely why the Department of Conservation and organisations such as Forest and Bird are concerned at the multiple proposals for solar farms in the Mackenzie Basin, a stronghold for endemic braided river birds, and the only location for the world's population of kakī. The extent of bird strike mortality from other sources is irrelevant. What is relevant is the potential for solar farms to create a novel and significant adverse effect on bird species already threatened by predation, hydroelectric development, habitat degradation and loss, and disturbance.

#### Why do birds collide with solar panels?

100. Photovoltaic solar panel installations can directly cause deaths of birds through impact trauma resulting from collisions, mostly with panels but also with other site infrastructure including transmission lines and fences. Indirect mortality is also thought to occur, possibly due to birds becoming disoriented, landing, and then being unable to resume flight or forage, or potentially being predated.
101. The exact causal mechanisms of collision and disorientation are not known and remain largely untested theories.
102. In the recent avifauna hearing for the Glorit Solar Farm on the Kaipara Harbour, the Department of Conservation provided five experts on birds. Associate Professor Dr Kristal Cain provided evidence on the possible mechanisms of bird collision with solar panels as an expert on the biology of bird vision and sensory ecology<sup>30</sup>. She discussed how the vision of birds differs considerably from humans in multiple ways. One of these is the sensitivity of birds to polarised light. I have summarised her paragraphs 56-64:
  - Sunlight is partially polarised when it enters our atmosphere forming predictable patterns across the sky which both birds and other animals can use for navigation, even when the sun is obscured.

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<sup>30</sup> Evidence of Associate Professor Kristal Cain, Integrative Organismal Biologist, on behalf of the Director-General of Conservation, 28th July 2025. For the applications for resource consents by Glorit Solar P LP for activities associated with the Glorit Power Scheme.

- The main source of horizontally polarised light is from light reflected off water. Solar panels reflect as much, or more than waterbodies.
  - We still do not understand exactly how different groups of birds perceive and use polarised light, although we know, for example, that migratory birds use it during migration for navigation, particularly at dawn and dusk, and when it is cloudy.
103. The Lake Effect Hypothesis was proposed by researchers over 10 years ago to explain the high frequency of waterbird mortality from southern United States solar farms <sup>31</sup>. It was considered that the polarisation caused by solar panels caused birds to mistake the solar farm for water, resulting in collisions.
104. However, species from almost all bird families have been found dead in photovoltaic facilities. The Lake Effect Hypothesis is not relevant to most songbirds, which represent most species recorded in mortality estimates.
105. Another possibility is that diurnal aquatic insect species are attracted to the polarised light reflected by solar panels. Nano-coatings have been shown to significantly reduce the attractiveness of panels for these insect groups. Insectivorous bird species may use the arrays as foraging opportunities. Management of vegetation at the solar facility may also reduce or increase invertebrate populations.
106. Research is presently being conducted by the Argonne National Laboratory, owned by the United States Department of Energy, into bird use of solar facilities. The research uses AI technology to detect bird interactions but may have limited utility as camera footage is only obtained during daylight, and cannot account for bird behaviour at night or during poor weather. Work is yet to be published.
107. The reality is, we do not fully understand the causal mechanisms for collisions.

#### Data limitations

108. Mortality data obtained from solar farms have limitations that we need to be cognisant of, which I discuss further below. These include that:
- Most data come from the southwestern United States.
  - The quality of carcass monitoring methods and analysis can vary considerably between facilities.

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<sup>31</sup> Walston J.L.J., Rollins K.E., LaGory K.E., Smith K.P. and Meyers S.A. 2016: A preliminary assessment of avian mortality at utility-scale solar energy facilities in the United States. *Renewable Energy* 92: 405-414.

- Only a sample of the area within a facility is usually surveyed on each occasion.
  - A large proportion of carcasses are not identified to species as they are too decomposed.
  - The cause of death is not determined for most carcasses, either because they are too decomposed, and/or an autopsy is not undertaken.
109. The greatest limitation to our understanding of potential adverse effects of solar farms on bird populations is lack of data. Globally, most mortality data come from the dry inland habitats of the southwestern United States as several facilities in this region were sited on public lands and subsequently triggered that country's National Environmental Act process<sup>32</sup>.
110. However, a recent presentation at a symposium in Washington compared data from 12 photovoltaic facilities in Albert, Canada, to the data from southwestern United States. The abstract of the presentation states that species composition differed between countries, and was variable between facilities within countries, but that overall, Canadian fatality estimates fell within the range found from the US facilities, the different "ecoregions"<sup>33</sup>. However, these data have not yet been published, and I cannot review the information further.
111. On top of this, the quality of available data is variable. For example, carcass monitoring protocols differ in multiple ways:
- The extent to which seasonal and annual variation in mortality is assessed.
  - The percentage area of the facility that is surveyed on each occasion, how this is selected, and if it changes on each occasion. The minimum area surveyed in the southwest United States facilities was 3.3% of the ground area<sup>34</sup>. One review of three of these facilities (a mix of solar types) stated "...it is difficult to know the true scope of avian mortality at these facilities. The numbers of dead birds are likely underrepresented, perhaps vastly so"<sup>35</sup>.

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<sup>32</sup> Renewable Energy Wildlife Institute 2023: Solar Energy Interactions with Wildlife and Their Habitats: A Summary of Research Results and Priority Questions. Downloaded from <https://rewi.org/resources/> on 14 January 2026.

<sup>33</sup> Riser-Espinoza D., Russell K., Bartok N., Sullivan J. and Kosciuch K. 2024: Emerging trends in bird mortality at photovoltaic solar in the United States and Canada in Meeting Proceedings. Presentation given at the Solar Power and Wildlife/Natural Resources symposium. Renewable Energy Wildlife Institute, Washington.

<sup>34</sup> Smallwood K.S. 2022: Utility-scale solar impacts to volant wildlife *Journal of Wildlife Management* 86: [doi.org/10.1002/jwmg.22216](https://doi.org/10.1002/jwmg.22216).

<sup>35</sup> 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, Unpublished report. National Fish and Wildlife Forensic Laboratory.

- How the survey is conducted, for example, using people or using handlers with trained dogs, the latter of which detect a significantly greater percentage of carcasses. The rate at which ‘searchers’ detect carcasses that are present can be tested using ‘searcher efficiency trials’ which may or may not be undertaken. Several of the southwest United States facilities were searched by car<sup>36</sup>.
- The frequency at which surveys are conducted. The greater the interval between surveys, the more likely a dead bird will decompose or be scavenged, leaving little or no remains. The rate at which carcasses disappear from the environment can be tested using ‘carcass persistence trials’ which may or may not be undertaken. I suspect that search intervals that are too long is a key reason why such large proportions of carcasses are not identified to species.
- Ideally, searcher efficiency and carcass persistence trials are performed in each of the main habitat types present at the site (if more than one is present) as these variables may differ between habitats.
- Lastly, the way data are analysed can vary, and the use of searcher and carcass persistence trials to transform data (that is, address bias in the data from observers varying in their ability to detect carcasses, and intervals between searches). This can result in different fatality estimates from the same dataset.

112. The issue of large numbers of unidentified carcasses has been recently addressed through the use of mitochondrial genetic data to identify the remains to species.<sup>37</sup> Eight utility-scale solar farms in the southwestern United States were included in the study, five photovoltaic facilities, two solar trough facilities and one power tower facility. A total of 4,383 carcasses or parts of carcasses had been collected from surveys at these facilities, of which 792 (18.1%) specimens had never been identified to species. The study demonstrated that waterbirds comprised 13% of the total identified samples via morphology alone, but 20% of specimens that were identified using DNA analysis. Overall, at the five photovoltaic installations, 24% were waterbirds.

113. Lastly, the cause of death of a large proportion of carcasses is not determined. The detection of broken bones and internal haemorrhage is difficult to achieve in the field. For example, Kagan *et al.* (2014) specified that field necroscopies were undertaken for a sample of birds to determine if birds showed injuries indicative of

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<sup>36</sup> Smallwood K.S. 2022: Utility-scale solar impacts to volant wildlife *Journal of Wildlife Management* 86: [doi.org/10.1002/jwmg.22216](https://doi.org/10.1002/jwmg.22216).

<sup>37</sup> Gruppi C., Sanzenbacher P., Balekjian K., Hagar R., Hagen S. and Rayne C. 2023: Genetic identification of avian samples recovered from solar energy installations. *PLoS ONE* 18(9): e0289949. [doi.org/10.1371/journal.pone.0289949](https://doi.org/10.1371/journal.pone.0289949)

collisions<sup>38</sup>, but it is unclear how many other monitoring programmes did this, or if monitors were suitably qualified to do this. Long intervals between searches risks allowing carcasses to decompose or be scavenged further complicates such assessments. Sending hundreds or more carcasses for autopsy may have been avoided due to expensive.

#### Waterbird mortality

114. Clearly, extrapolation of mortality estimates to different habitats and regions, let alone different countries and species, is fraught. However, if we are to attempt to assess the risk to New Zealand bird species, overseas data are all that is available.
115. The relevance of the Lake Effect Hypothesis was reviewed very recently by Kosciuch *et al.* (2025). The paper demonstrated that it was a single photovoltaic solar facility in the southwestern United States – Desert Sunlight – that caused a very high percentage of waterbird deaths (44% of all birds), including grebes, cormorants, herons, and stilts, and that results from this facility have been referred to in multiple papers since, in essence, amplifying the significance of the waterbird mortality from this farm<sup>39</sup>.
116. This being so, it remains useful to look at this single case in more detail. Arguably, the most unusual mortality at the Desert Sunlight solar facility were the deaths of small numbers of three species of grebes. Grebes are a group of species that cannot easily walk on land as their legs are placed far back on their body, generally take off from water, and would not be expected to try to land in a solar farm. The authors who originally assessed mortality at this site theorised that the waterbirds found dead had been attracted to an existing pond at the site and were disorientated by the polarisation caused by the panels<sup>40</sup>.
117. This is relevant to the assessment of risk at the proposed site as the Australasian crested grebe is resident throughout the Mackenzie Basin in small numbers and within a few hundred metres of the proposed solar farm. The Applicant has not provided information on the layout of the panel arrays – particularly the spacings between lines of arrays which may influence collision rates – or the antireflective coating on the panels. Kosciuch *et al.* (2025) pointed out the issues with extrapolating

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<sup>38</sup> 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, Unpublished report. National Fish and Wildlife Forensic Laboratory.

<sup>39</sup> Kosciuch K., Riser-Espinoza D. and Mitchell M. 2025: Lake effect or data mirage? How accounting for technology differences at utility scale solar energy facilities can change data interpretation. *Environmental Research Letters* 20: <https://doi.org/10.1088/1748-9326/ae1e91>

<sup>40</sup> 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, Unpublished report. National Fish and Wildlife Forensic Laboratory.

results from the Desert Sunlight solar facility, which used fixed tilt panels and did not use antireflective technology, to photovoltaic facilities in general. However:

- There are no international data on the effectiveness of antireflective coatings at reducing collision risk.
- We have no information on the spacings between arrays of panels at the proposed Haldon solar farm.
- The proposed farm is within a few hundred metres of Lake Benmore.
- Australasian crested grebes are resident in the lake and in other lakes throughout the Mackenzie Basin, and many other Threatened and At Risk waterbird species regularly use the lake for foraging, including black-fronted tern.

118. Further, a review of nine solar facilities in the southwest United States (seven in the Sonoran and Mojave Deserts, one in the Great Basin, and one in coastal California) found that taxa within the grebe family were found dead at five of the inland facilities and the coastal California facility<sup>41</sup>.

119. Kosciuch *et al.* (2025) also reanalysed mortality data from the southwest United States photovoltaic facilities, and separated data into those obtained from fixed-tilt panel facilities and tracker-type panel facilities, including the transition to anti-reflective coatings, which were assumed to be absent prior to 2015, and present after 2017<sup>42</sup>. The authors found that tracked solar panels were associated with significantly less mortality of waterbirds than fixed panels.<sup>43</sup> This provides some optimism that the newer technology of tracked panels may reduce the mortality of waterbirds. However, based on the data presented in their paper, waterbirds still accounted for 4.1-11.2% of mortality in tracked panel facilities.

120. Kosciuch *et al.* (2025) grouped those waterbirds into two classes, obligate waterbirds and birds associated with water. Water associates were species that rely primarily on aquatic habitats for foraging, reproduction, and/or roosting and could be present in the study areas based on their known range. These species can walk on and take off

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<sup>41</sup> Kosciuch K., Riser-Espinoza D., Gerringer M., Erickson W. and Zhang J. 2020: A summary of bird mortality at photovoltaic utility scale solar facilities in the Southwestern US *PLoS One* 15 e0232034.

<sup>42</sup> Kosciuch K., Riser-Espinoza D. and Mitchell M. 2025: Lake effect or data mirage? How accounting for technology differences at utility scale solar energy facilities can change data interpretation. *Environmental Research Letters* 20: <https://doi.org/10.1088/1748-9326/ae1e91>

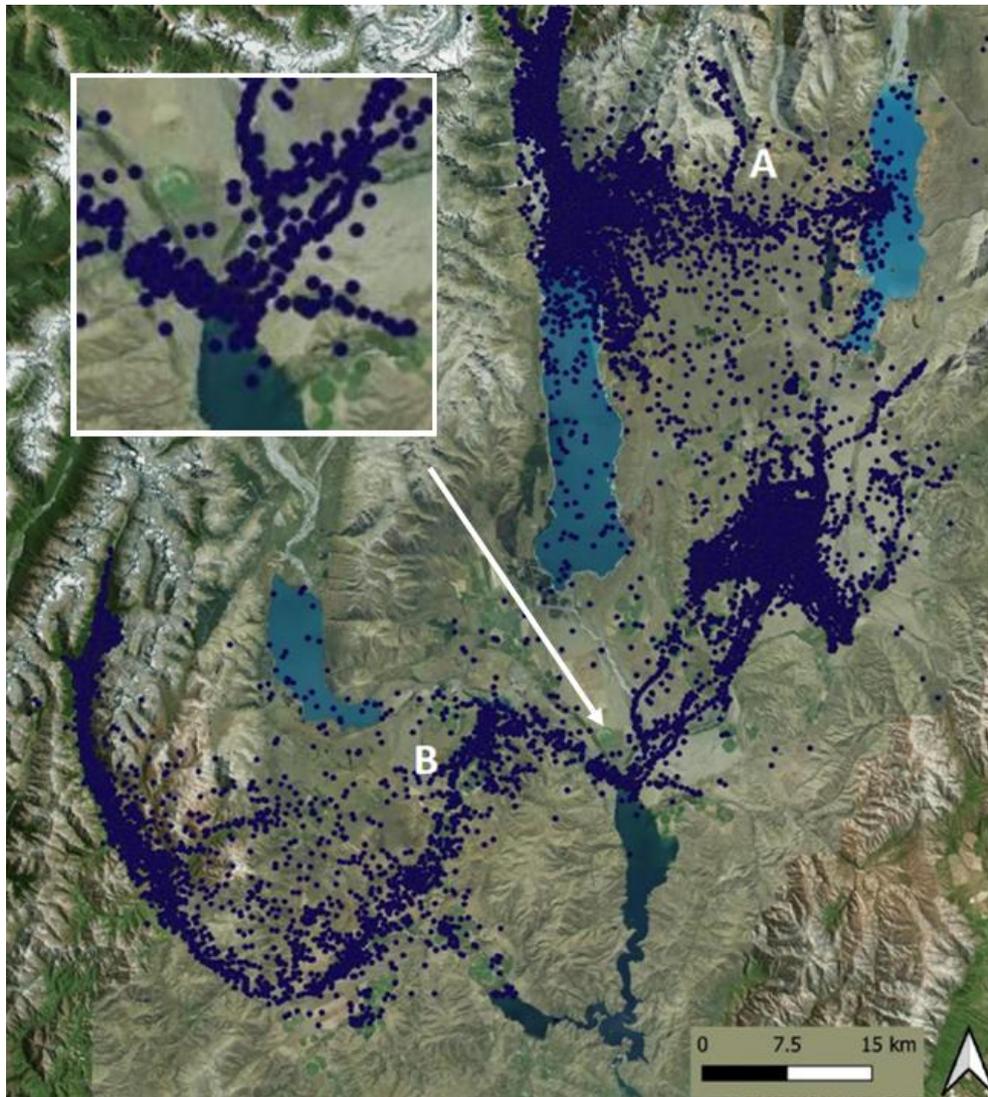
<sup>43</sup> This review is notably limited in scope. Authors were only able to review data published in two previous papers, Kosciuch *et al.* (2020) and Smallwood (2022) as these were the only papers that distinguished between fixed and tracker panel facilities, and where the authors could determine whether data likely came from pre or post ARC technology. Kosciuch *et al.* (2020) contained data from 10 facilities, and Smallwood (2022) covered 11 facilities. Neither paper contained data post 2017, though data from a small number of facilities were available over the ARC transition period of 2015-2017.

from land, and included most species of ducks, swans, herons, bitterns, coots, rails, plovers, stilts, gulls, and terns. Water obligate species were those that rely on water for landing or taking off, and included grebes, cormorants/shags, and diving ducks. All the Threatened and At Risk bird species present in and around the proposed site fall into these species groups.

The risk of collisions at the proposed solar farm

121. This brings us back to the proposed Haldon Solar Farm. The solar farms described in the previous paragraphs have been constructed in areas well away from important bird habitats including, as far as I am able to tell, habitats of threatened bird species. In contrast, this proposal is for a facility situated a few hundred metres from the edge of Lake Benmore and the Takapō River and river delta. Two Threatened and four At Risk bird species are likely to use the site itself, and immediately adjacent habitats support at least six Nationally Threatened and eight At Risk species. These species will almost certainly be traversing over or near the site, during the day, at dusk, dawn, and during the night, and in fine and bad weather.
122. All the waterbird species found at and around the proposed site come from bird groups that have been found dead at photovoltaic facilities in the southwest United States, including grebes, cormorants/shags, waders similar to black stilt, banded dotterel, South Island pied oystercatcher, and wrybill, rails similar to marsh crake, bitterns, large herons, gulls and terns, and a pipit.
123. Black-fronted terns are the only species for which we have detailed movement data in this location. The Applicant's response to the Panel's question on cumulative effects was to reproduce graphs taken from O'Donnell's (2024) advice on the potential impacts of The Point solar farm. These are of unpublished GPS tracking data obtained by Department of Conservation staff and clearly show individual terns traversing the proposed site for The Point solar farm. Unlike the two Masters research projects, they also show considerable use of Lake Benmore.
124. The Applicant's interpretation of the graphs is that "there is no plausible cumulative pathway for displacement or collision risk". I take this to mean that the graphs have been assumed to provide evidence that black-fronted terns do not fly over the proposed site, but only the adjacent proposed site for The Point. This should not be assumed; the data are from a sample of terns from certain, unspecified colonies during a particular point in time. All three black-fronted tern GPS datasets differ from each other; it is very possible that terns from a different colony in a different year may demonstrate different flight paths and habitat use. One constant feature, however, is the use of the overnight roost at the Takapō delta.

125. The data on which O'Donnell's graphs are based are not publicly available. Instead, I have provided a graph from the Gray (2024) Masters thesis of all black-fronted tern GPS fixes (Figure 5). I have created the inset to show more detail of the Takapō delta and proposed solar farm site. The GPS trackers in this project recorded a location fix every four hours, except when batteries were at high charge, when fixes were made every 10 minutes. Therefore, they do not show every route or foraging location. They also represent the movements of a sample of terns, not the hundreds of terns that use the delta. The data do show the presence of birds around the edges of the proposed site. The proximity of this activity to the solar farm is measured in metres, not in kilometres. Birds are almost certainly flying over the site on occasion, will be able to clearly see it when flying around the site, and will forage there, though perhaps infrequently.



**Figure 5:** GPS locations (navy dots) plotted for all tracked black-fronted terns. Data show frequently used flight paths between the Tasman and Cass Rivers (A) and between the Ahuriri and Ōhau Rivers (B), and up and down rivers.

126. In addition, tracking studies have not addressed weather conditions during data collection; we do not know how roosting and foraging behaviour is affected by severe weather and if birds continue to forage and roost away from colonies in gales or rain. We do not know how black-fronted terns locate themselves while flying and foraging in the dark.
127. Terns may collide with panels which stand a maximum of 3 m above the ground, or with deer fences surrounding the solar farm, or with new transmission lines; all bird species are vulnerable to collision with infrastructure to varying degrees. Terns may find the site more attractive for foraging as vegetation changes in response to stock removal and shading, altering food sources. Terns may be attracted to the site if the polarisation of the panels attracts aquatic invertebrates, a key prey item. Terns may be attracted to the solar farm themselves through the polarisation caused by the panels, both during the day and at night<sup>44</sup>. We cannot predict exactly how black-fronted terns will be affected by the proposed solar farm, or to what extent. Nevertheless, the risk of collision clearly exists.
128. Black-fronted tern is just one of the 14 Threatened and At Risk bird species that are present in or adjacent to the proposed site, and that will fly next to or over the solar farm. We have no GPS tracking data for the remaining 13 species in the vicinity of the solar farm. It is not possible to quantify the risk of collision for each species, and it is likewise not possible to confidently state that there will be no adverse effects on each species. What we do know is that an average of 29 bird species were found dead in 11 photovoltaic facilities in the southwest United States, with an overall combined total of ≥192 different bird species from 14 facilities (including three non-photovoltaic solar facilities)<sup>45</sup>.
129. How do we predict the risk of mortality for the Threatened and At Risk bird species that live in and around the solar farm? The fact is, we cannot. The data do not exist for any of these species, nor do comprehensive data from tracked solar facilities using anti-reflective panel coatings exist overseas. To my knowledge, no data are available from any solar facility placed this close to internationally important bird areas. In my opinion, the risk is very real, even just from the placement of novel infrastructure in

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<sup>44</sup> The Applicant has not provided information on panel lay-out or mitigation options such as stowing the panels at night and does not specifically address anti-reflective coatings (but touches on this issue on p86).

<sup>45</sup> Smallwood K.S. 2022: Utility-scale solar impacts to volant wildlife *Journal of Wildlife Management* 86: [doi.org/10.1002/jwmg.22216](https://doi.org/10.1002/jwmg.22216).

the environment – transmission lines, high fences and panels – that may cause incidental collisions at night or in poor weather.

130. Mortality of even small numbers of Threatened bird species could have regional and national population effects. Most at risk of population effects is kakī. Restricted to the region, and numbering only some 40 breeding pairs, regular deaths of one or two birds annually, particularly adults, would almost certainly impact the fragile stability of the population. The numbers of Australasian bittern pairs will be considerably lower in the region; the loss of single individuals will impact the regional population. Even the At Risk black-billed gull, numbering well over 100,000 birds in the South Island, has a very small population in the Mackenzie Basin.
131. The potential for regional and national population effects from the proposed solar farm is in stark conflict to the huge investment put into managing these species in the Mackenzie Basin.

#### *Cumulative effects*

132. A second Fast Track solar farm proposal is being assessed for a site on the western side of the Takapō River, adjacent to the Haldon Solar Farm. The Point Solar Farm is larger and, I understand, situated in more modified habitats. Despite this, the ecological assessment considers that the site has nesting and foraging habitat for a similar suite of Threatened and At Risk species as I have identified at the proposed Haldon Site. The Point ecological assessment has determined the level of effect of bird collisions with panels at “a conservative level” at more than minor in the absence of mitigation (p31). However, the assessment does not discuss the risk of bird collisions, citing the lack of a finalised layout of the solar arrays as justification.<sup>46</sup>
133. The Haldon solar farm is 320 ha, and The Point solar farm is 670 ha. In essence, the greater coverage of the area with solar panels simply compounds the risk.
134. There is little evidence to suggest that one location presents less risk than the other. The only data available are black-fronted tern GPS tracking movements obtained by the Department of Conservation which showed regular flight paths directly over The Point site, but not Haldon. However, as I have previously mentioned, those data are from a sample of birds of one species from a particular set of colonies over a certain period. It is insufficient evidence for me to be able to say if one site presents less risk than the other.

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<sup>46</sup> Wildland Consultants 2023: Assessment of ecological effects for the proposed solar farm between the lower reaches of the Tekapo and Twizel rivers, Mackenzie District. Contract Report No. 6621c. Prepared for Far North Solar Farms Ltd.

135. The Applicant's response to the Panel's question on the consideration of cumulative effects is, regarding ecology, "Cumulative ecological effects are negligible because the ecological value systems differ, and pathways for compounding effects do not exist."<sup>47</sup> I strongly disagree. Despite differences in the habitats present within both proposed sites, the indigenous bird species present, including Threatened and At Risk species, are very similar. Both sites are situated within a few hundred metres of Lake Benmore and the Takapō River and its delta and, in the absence of more data on bird movements within the landscape, can only realistically be assumed to have similar levels of collision risk.

### **Management of effects**

136. The Applicant states that its siting methodology follows four steps, the first of which is "Site well – prioritise locations that are naturally screened, low visibility, and low value ecologically"<sup>48</sup>. This approach appears to adhere to the mitigation hierarchy of Avoid, Minimise, Remedy/Restore, Offset/Compensation. However, the proposed site itself has high bird values, and is on the edge of nationally and internationally important bird areas. In my opinion, the site should have been avoided altogether, given its proximity to nationally important bird habitats.

137. The fourth step in Applicant's siting methodology is "Mitigate/manage only where needed. There are no mitigation measures proposed for birds.

138. In contrast, The Point's ecological assessment states that the risk of bird strike has been determined conservatively to be a more than minor effect in the absence of mitigation. Only a single mitigation action is recommended; "Providing clear areas between solar panel arrays will allow birds to navigate the access corridors and avoid bird strikes when landing or departing from the site" (p43). This is unproven and is not relevant to bird species that do not use the site. Overseas data indicate that often, most mortality is of bird species that are not resident year round or seasonally, for example, most waterbird species.

139. As I have previously mentioned, the transition to tracked panel photovoltaic facilities from the early fixed tilt facilities may help to reduce fatalities although data are very limited. No research into the efficacy of anti-reflective coatings at reducing fatalities exists. The fact remains that birds are still found dead at more modern photovoltaic

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<sup>47</sup> Applicant's written response to Panel Minute 1, dated 12 December 2025. FTAA\_2508\_1097.

<sup>48</sup> Applicant's written response to Panel Minute 1, dated 12 December 2025. FTAA\_2508\_1097.

facilities, and the extent of mortality is highly variable between facilities, almost certainly due to site-specific factors.

140. Leaving significant breaks between lines of arrays is suggested to reduce the 'lake-like' appearance of the solar facility to a bird flying nearby or overhead. However, most species found dead at facilities overseas do not associate with water – there are clearly other factors at play.
141. It is possible that the closer solar panels are to the lake, and possibly the Takapō River, the greater the risk that birds intending to feed or land on the lake (e.g. Australasian crested grebe and black-fronted tern) will mistake panels for water. However, there is no information to suggest what kind of setback might be appropriate, or if indeed any setback is sufficient to avoid risk.
142. Other mitigation options have been suggested. As part of the Glorit Solar Farm hearing, experts for the Applicant and Department of Conservation experts discussed mitigation measures during caucusing for the Joint Witness Statement. I have compiled their suggestions below<sup>49</sup>:
- Site layout and landscaping to break up continuous profile
  - Panel arrangement, height and spacing
  - Minimising the time panels spend in the horizontal position
  - Stowing at 60 degrees overnight
  - Stowing at 90 degrees overnight
  - Anti-reflective coating
  - No bare wiring, and the use of appropriate insulators
  - Minimising light at night
  - Dynamic bird flappers on transmission lines.

However, it was pointed out that none of the suggestions regarding the panels themselves have been tested for their ability to reduce collisions at solar farms specifically.

143. Mammalian predator control could be undertaken within the solar farm site, and more widely within Haldon Station, in addition to the proposed rabbit control. This would likely increase the nest success of species vulnerable to predation such as banded dotterel, South Island pied oystercatcher, and New Zealand pipit. However,

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<sup>49</sup> Joint Statement of Experts: Ecology (Avifauna), 21 May 2025. For the applications for resource consents by Glorit Solar P LP for activities associated with the Glorit Power Scheme.

improvements could be confounded if these species were confirmed to be affected by collisions.

144. A landscape scale predator control programme could be established as compensation elsewhere, for example, through the Takapō-Haldon outwash, either side of the Takapō River, and including the delta. This would extend the protection for Threatened and At Risk bird species nesting and roosting throughout these nationally significant ecosystems.

### Conditions

145. The Applicant has proposed a consent condition that requires the development of an Avifauna Monitoring Plan that sets out the protocols to monitor bird interactions with the solar installation, both positive and negative (Condition 31, Appendix 2), and indicates that this plan should be reviewed and evaluated throughout the life of the project. It is not clear why the Applicant has proposed this given no indigenous birds were considered to nest at the site, and the effects on birds were said to be Negligible (p85, Substantive Application).
146. If this proposal is consented, this condition needs considerably more detail and should also require review and sign-off of the collision monitoring protocols by the Department of Conservation.
147. It is imperative that a monitoring protocol must be able to detect the mortality of a single individual kakī, the most vulnerable species based on rarity, year-round presence, and restriction to the Mackenzie Basin. To that end, the whole facility must be regularly searched at intervals sufficiently short to minimise the potential for carcass loss through decomposition or predation/scavenging.
148. The most effective way to conduct searches, as well as the most time and cost efficient, is using trained dogs. Dogs have been shown to have a much higher rate of detecting carcasses at wind and solar facilities overseas. The use of dogs was recommended by Bull *et al.* (2013)<sup>50</sup> for searches at wind farms, but dogs have still not been utilised in New Zealand despite the obvious expertise in training conservation dogs in this country. A dependence on people only for searching will lead to higher numbers of carcasses being missed, and the possibility that a death of an individual of a rare species will not be detected.

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<sup>50</sup> Bull L.S., Fuller S. and Sim D. 2013: Post-construction avian mortality monitoring at Project West Wind. *New Zealand Journal of Zoology* 40: 28-46.

149. The condition refers to potential positive interactions. I also recommend monitoring the community of birds that use the solar farm itself for nesting and foraging, as well as a reference site that will allow comparisons as well as determining the level of background mortality. Ideally this would follow on from more detailed surveys prior to construction to establish a baseline from which changes can be detected.
150. No other conditions refer to birds, even though Condition 31 refers to both positive and negative interactions. If negative interactions occur, what does the Applicant intend to do?

### **Conclusions**

151. The proposed Haldon Solar Farm will be located on the edge of nationally and internationally important bird habitats. Lake Benmore, the Takapō River and delta, and associated wetlands support 33 indigenous bird species, of which six are Nationally Threatened and eight are At Risk. The site itself is likely to provide nesting and/or foraging habitat for two Threatened and three At Risk bird species. One species, kakī, is one of the rarest bird species in the world and restricted to this region for breeding.
152. All 33 species will undertake movements over and around the proposed solar farm; for some species, these movements will be frequent, and for many, flights will occur at night as well as during the day.
153. We do not know the extent of the risk posed by the Haldon Solar Farm to each of the Threatened and At Risk species present at this locality. But we do know that utility-scale photovoltaic solar installations have resulted in the mortality of many bird species overseas, a proportion of which are waterbirds. It follows that the proximity of the Haldon Solar Farm to Lake Benmore and the Takapō River, and within an area supporting so many Threatened and At Risk species, may have unintended and significant consequences for these populations of birds. From an ecological perspective, the introduction of a novel threat to species which are already severely impacted by a range of human-induced threats should be avoided. Two solar farms in the same general location increases the risk of significant adverse effects.
154. Once the solar farms are built, realistically there is no going back, and the efficacy of mitigation options is untested.

Rachel McClellan  
2 February 2026

## Appendix 1

Common, te reo Māori, and species names of birds mentioned in the text.

Common name	Te reo Māori	Species Name	Threat Classification
Australasian bittern	Matuku-hūrepo	<i>Botaurus poiciloptilus</i>	Nationally Critical
White heron	Kōtuku	<i>Ardea modesta</i>	Nationally Critical
Black stilt	Kakī	<i>Himantopus novaeseelandiae</i>	Nationally Critical
Black-fronted tern	Tarāpirohe	<i>Chlidonias albostratus</i>	Nationally Endangered
Australasian crested grebe	Kamana / pūteketeke	<i>Podiceps cristatus cristatus</i>	Nationally Vulnerable
Grey duck	Pāpera	<i>Anas superciliosa</i>	Nationally Vulnerable
Caspian tern	Taranui	<i>Hydroprogne caspia</i>	Nationally Vulnerable
Wrybill	Ngutu pare	<i>Haematopus finschi</i>	Nationally Increasing
Marsh crane	Kotoreke	<i>Porzana pusilla affinis</i>	Declining
South Island pied oystercatcher	Tōrea	<i>Haematopus finschi</i>	Declining
Banded dotterel	Pohowera	<i>Charadrius bicinctus bicinctus</i>	Declining
Black-billed gull	Tarāpuka	<i>Larus bulleri</i>	Declining
New Zealand falcon	Karearea	<i>Falco novaeseelandiae</i>	Declining
New Zealand pipit	Pihoihoi	<i>Anthus n. novaeseelandiae</i>	Declining
Pied shag	Kāruhiruhi	<i>Phalacrocorax varius varius</i>	Recovering
Royal spoonbill	Kōtuku ngutupapa	<i>Platalea regia</i>	Naturally Uncommon
Black shag	Māpunga	<i>Phalacrocorax carbo novaehollandiae</i>	Relict
Little shag	Kawaupaka	<i>Phalacrocorax melanoleucos brevirostris</i>	Relict
Black swan	Kakīānau	<i>Cygnus atratus</i>	Not Threatened
Mallard/grey duck hybrid		<i>Anas superciliosa x platyrhynchos</i>	Not Threatened
Grey teal	Tētē moroiti	<i>Anas gracilis</i>	Not Threatened
Australasian shoveler	Kuruwhengi	<i>Anas rhynchos</i>	Not Threatened
Paradise shelduck	Pūtangitangi	<i>Tadorna variegata</i>	Not Threatened
New Zealand scaup	Pāpango	<i>Aythya novaeseelandiae</i>	Not Threatened
White-faced heron	Matuku moana	<i>Egretta novaehollandiae</i>	Not Threatened
Australian coot		<i>Fulica atra australis</i>	Not Threatened
Pūkeko		<i>Porphyrio melanotus melanotus</i>	Not Threatened
Pied stilt	Poaka	<i>Himantopus himantopus leucocephalus</i>	Not Threatened
Spur-winged plover		<i>Vanellus miles novaehollandiae</i>	Not Threatened
Black-backed gull	Karoro	<i>Larus dominicanus dominicanus</i>	Not Threatened
Australasian harrier	Kāhu	<i>Circus approximans</i>	Not Threatened
Grey warbler	Riroriro	<i>Gerygone igata</i>	Not Threatened
Shining cuckoo	Pīpīwharaua	<i>Chrysococcyx lucidus lucidus</i>	Not Threatened
New Zealand kingfisher	Kōtare	<i>Halcyon sancta</i>	Not Threatened
Silvereye	Tauhou	<i>Zosterops lateralis lateralis</i>	Not Threatened
South Island fantail	Piwakawaka	<i>Rhipidura fuliginosa fuliginosa</i>	Not Threatened
Welcome swallow	Warou	<i>Hirundo neoxena neoxena</i>	Not Threatened
Kererū		<i>Hemiphaga novaeseelandiae</i>	Not Threatened
Australasian little grebe	Tokitokipio	<i>Tachybaptus n. novaehollandiae</i>	Coloniser