Appendix X – Department of Conservation Engagement

Contents:

1. Engagement Summary – Page 2
2. Engagement Log – Page 3
3. DoC letter DOCCM-7507754 24 November 2023 - Page 5
4. FNSF Response to Department of Conservation letter DOCCM-7507754 - 24 November 2023 – Page 11
5. DoC Letter DOC-7556520 - 01 February 2024 – Page 14
6. DoC Letter DOCCM-7689122 12 July 2024 – Page 16
7. Kakī / black stilt recovery programme 2024–2025 - Funding proposal for replacement of aviary B – Page 19
8. DoC Black Stilt proposal – Page 27
9. DoC Meeting minutes and correspondence – 22 July 2024 – Page 29
10. Design notes for an indigenous invertebrate habitat reserve within the proposed Far North Solar Farm, Mackenzie Basin. Page 34
11. Initial briefing – potential impacts of proposed 'The Point' solar farm near Twizel on threatened birds – Page 48

1. **The Point Solar Farm - DoC Engagement Summary**

Engagement with the Department of Conservation (DoC) began in March 2023 and has, at the time of writing, totalled more than 65 separate interactions including emails, phone calls, online meetings, in-person meetings at DoC offices in both Twizel and Christchurch, as well as several site visits to the application site with specialist DoC staff.

Engagement and consultation with DoC remains active and ongoing and good working relationships have been formed with key members of the DoC team. All technical documents related to the Assessment of Environmental Effects (AEE) have been shared with DoC, including the Landscape and Visual Impact Assessment report (LVIA) and Ecological Enhancement Plan (EEP).

DoC has had a significant impact on the philosophical and practical development of the EEP to the extent that it now directly incorporates DoC recommendations. Consultation has resulted in the following being accommodated within the development of the solar farm and the EEP:

(a) Visual screening and restoration around the entire circumference of the application site has changed to the adoption of an adaptive management approach around selected areas of the 89ha restoration area in line with DoC's preference, as well as responding to DoC's desire to prioritise avifauna support.
(b) Support of DoC's Mackenzie Basin Kakī Recovery Programme agreed in principle as mitigation for any potential avifauna impact.
(c) Expansion of pest control regime to the river and delta areas immediately adjacent to both sides of the application site to support avifauna. Design and implementation of the pest control regime is to be carried out by DoC.
(d) Creation of an invertebrate reserve inside the boundary of the application site is to be funded by the Applicant and managed by DoC.

Engagement has also occurred in relation to access to the application site which crosses the Bendrose Stream managed by DoC and LINZ. The Applicant has a current concession application file (Reference 118964-OTH) and is advised that the proposed easement is being assessed.

2. Engagement Log

Date	How	Involved stakeholders	Project Reps	Summary	Follow-up actions (if any)
13-Mar-23	Email	[redacted]	Laila Alkamil, RH, AE	Laila writes to DoC to introduce FNSF and the Ohau project. We are very keen to engage with DoC as we develop the concept plan. Ask if they would like to meet to discuss.	
6-Apr-23	email	Herb Familton	Laila Alkamil	Herb writes to ask Laila to call to discuss today. Laila calls and runs Herb through the proposal	
8-May-23	email	Herb Familton	Laila Alkmil, RH, GH	Laila writes to say "As signalled in our discussion, you were going to send through some comments / questions regarding the application. Just wondering how you are progressing with that and whether you would like to arrange a meeting?" Herb replies and says he can get on a call on 12 May.	
12-May-23	video call	Herb Familton, Ursula Paul [redacted]	Laila Alkamil, Tracey Morgan, GH, RH, JA	Introductory call to go over team and project in general and to seek comments from DoC.	
26-May-23	email	Herb Familton, Ursula Paul [redacted]	Laila, GH, RH	Laila writes to share link to download Ecological Assessment and Visual Assessment.	
30-May-23	email	Herb Familton, Ursula Paul [redacted]	Laila, GH, RH, JA	Herb sent a desktop assessment of the most significant effects of the application from his assessment. Also attached some maps	
19-Jun-23	email	Herb Familton, Ursula Paul [redacted]	RH, JA, Laila, GH	Laila write to advise the application has been lodged with Mackenzie District Council and that public notification will be sought. Far North Solar Farm Ltd has asked the iwi groups they are liaising with, as well as Forest & Bird, if they would be available for a site visit on Tuesday 4 July. Would DoC be interested in joining this site visit too?	
6-Sep-23	email	Herb Familton	Laila, GH, RH	Laila sends Herb a link to download the AEE	
12-Sep-23	email	Herb Familton	Laila	Herb writes to say a site visit would be good and can she arrange. Laila passes this over to GH. I wrote the next day to propose 5th or 6th of October. Herb replies and says he'll get back to me.	
18-Sep-23	email	Herb	GH	wrote to Herb asking if the team is still considering the 5th or 6th for a site visit. Shared a report about mitigating risk to birds.	
25-Sep-23	email	Herb	GH	Herb writes to say 6th Oct would be good or site visit. Greg replies and confirms.	
4-Oct-23	email	Herb	GH	Herb confirms 6 Oct meeting at 10am DOC Twizel.	
6-Oct-23	site visit	Herb Familton Tayla Hooker Warren Chinn Richard Ewans Mariane Marmote Chris Rendell	GH, RH	Met at DOC Twizel and travelled onto site. Drove around and stopped at various locations. Spoke about the ecology and apparent lack of value due to farming. Looked at various areas on border and how they could be suitable for invertebrates. Discussed the potential to work together to create grasshopper reserves inside the farm. Agreed to work together more to refine the plan around ecology.	
9-Oct-23	email	Herb Familton	GH	Herb wrote to say the site visit "was highly useful from our perspective". Herb advised he will be briefing DoC decision makers about our visit in the near future.	
21-Nov-23	online meeting	Warren Chinn	GH, RH	Met with Warren and talked about what we could do to support efforts to create invertebrate sanctuaries, particularly Brachispis Robustus. We conveyed we were willing to really try hard to make the idea work. Asked Warren to think about what exactly he would need and then present tht to us so we could see how we deisgn it into the plans etc. Warren said he would do this and have somethign to us before end of the year.	
23-Nov-23	email	Herb Familton	GH, Laila Alkamil	Herb sent a document with some comments as requested on the proposed solar farm.The documentv stated it was technical in nature and did not reopresenta final position of the department on the proposal. It gave us a lot of feedback on the Wildlands report, as well as feedback on observations from the site visit.	
1-Feb-24	email	Herb Familton (DOC) ECan, MDC	GH, RH, LA	A neutral submission on the Point Solar farm from the Director- General of Conservation. .	
7-Feb-24	email	Herb, Ceri, Trevor (DOC)	GH	wrote to ask if DOC were ok with us including the sentiment in their submission in a media release. They were not so we dropped the idea.	
4-Mar-24	email	Herb	GH	Herb confirms DOC can meet for a workshop to discuss EEP on 14th March.	
7-Mar-24	email	Herb	GH, LAila Alkamil	Herb wrote to say they have been gathering more information on birds in the locality. Its fair to say it is adjacent to two significant bird sites either side and the black stilt breeding hide is very close to the west. Herb shared a PV Magazine article on Vertical bifacial vs. stilted agrivoltaics as a potential solution to bird collision.	
14-Mar-24	meeting at DOC Chch	Herb, Colin O'Donnell, Twizel staff, Warren Chinn	GH, RH, DK, Morgan Tracey	Half day meeting to discuss EEP. DoC also shared a paper prepared by Colin which outlined concerns held about bird safety and solar farms.	
23-Apr-24	email	Ceri (DOC), Herb, Geoff Deavoll	GH & RH	Ceri wrote to enquire if we had any response to Colin's bird paper. Also to encourage us to meet with Warren to discuss his invertebrates proposal. Shared a paper on Black Kaki explaining the work that they want to do, researching Kāki flightpaths in the area. Asked if we could consider whether and how we might support this initiative. We replied same day: It would be helpful to have some indications on what level of resourcing would be required for separate areas of activity/priorities with regard to Kakī so we can evaluate everything that will be required in the Ecological Enhancement Plan (EEP) associated with the development	no response as at 29 May 24
30-Apr-24	online meeting	Warren Chinn	GH & RH	Reviewed Warren's proposal for invertebrate reserve. Confirmed our preference is for Option 2 of his design proposals - which is to have the reserve outside of the array area completed. Warren would now go and do a detailed scope of work and budget required to support so it could be included in the EEP.	
7-May-24	email	Richard Ewans, Ceri Warnock, Herb Familton, Tayla Hooker (all DOC) + several of our consultants	RH	Richard wrote to provide a species list for the landscape screening and ecological restoration planting components of the project. Richard suggested Tayla and/or I may be able to assist with site suggestions and potentially meet up to discuss on site. DOC view is that it could be a great project but more clarity on long-term vision is needed.	respond
24-May-24	email	Richard Ewans, Ceri Warnock, Herb Familton, Tayla Hooker (all DOC) + several of our consultants	GH, RH	wrote to thank DOC for the species list and for the continued involvement. Suggested a field trip in July. Both Richard and Tayla replied to say they'd be keen for a site visit to discuss.	
10-Jun-24	email	Richard Ewans, Ceri Warnock, Herb Familton, Tayla Hooker (all DOC) + several of our consultants	GH, RH	Wrote to suggest 16 or 17 July for site visit to discuss species selection. Wildlands to join us. Richard wrote to say he couldn't make it but would talk with Tayla to discuss some good example spots we could visit to be informed about what a good restoration could look like etc. 17th July gets confirmed. Warren Chinn also joining DOC party.	
25-Jun-24	phone call & email	Herb	GH	Herb and I speak. Heb tells me a journalist from the press has been in touch with them and requested Colin's paper on risk to birds. They have provided it. Just wanted to let me know so we could prepare, said that the journalist had said he'd get in touch with us. Herb also sends an email copy of what was provided to the journalist as a DOC statement. Basically said DOC were neutral on the submission but that Colin was not around when the submissions was made and has since raised concerns about birds. DOC stated they are working with us and the general tone was that they are happy with the engagement and supportive of our ecological restoration work	asked Herb if he could provide the name and contact of the journalist so we could contact them directly.
26-Jun-24	email	Herb	GH	Herb supplies name of the journalist	
9-Jul-24	email	Herb	GH	I supply Herb with the peer reviews of Colin's paper on bird risk. Confimred we are meeting with Tayla and Warren on 17th and looking forward to next steps together etc.	
10-Jul-24	email	Tayla, warren	GH	Tayla writes to inform on agenda for the site visit day. We'll go to sites including Bendhu scientific reserve, then Ruatanwiha wetlands and drylands and Pūkaki flats. Warren writes also to say he wants to fly the drone and take some pics at the actual site to assist his invertebrate reserve work.	

Engagement Log

Date	How	Involved stakeholders	Project Reps	Summary	Follow-up actions (if any)
10-Jul-24	[phone	Herb	GH	Herb and I speak after he sends an email asking me to call. Herb tells me that there will be a formal letter coming from DOC outlining how they wish to proceed with engagement.The local point of contact will now be Di Finn, Operations manager at Twizel office. said the letter will outline where they think restoration efforts should be prioritised and that this was on birds mainly. DOC want to formalise an agreement with us so that if the project does go ahead we have a formal arrangement in place.	
12-Jul-24	pdf letter	Jo Macpherson, DOC Director of Operations for Eastern South Island region	GH	Jo writes to set out DOC's priorities for environmental compensation restoration in relation to the project ahead of the site visit. States their primary concern in relation to this project is the risk to endangered braided riverbed birds, particularly Black Stilt / Kakī. Jo says she is 'happy to make myself available to discuss potential agreements that FNSF could enter in to with DOC'. Advises that all engagement going forwrd should go through Twizel Operations Manager Di Finn.	
15-Jul-24	Email	Di Finn, Operations Manager in Twizel	GH, RH	Greg writes to Di to thank Department for the guidance on their priorities. Suggested we meet on the 17th to discuss matters further. Di replies same day to agree and says Dean Nelson – Senior Ranger (Biodiversity) will also join us	
17-Jul-24	meeting at DOC Twizel	Di Finn & Dean Nelson	GH, RH	Met with Di and Dean and discussed the request to support the Kaki breeding programme, notably the rebuilding of a destroyed aviary to the tune of [redacted]. We agreed we would do this if the project went ahead. We also talked about pest control and agreed to expand pest control beyond the site boundary to encompass the adjacent river areas. This would be work scoped and done by DoC but paid for by the project.	
17-Jul-24	site visit to Bendhu Station and The Point		GH, RH	FNSF's ecological consultants Wildlands and a DOC team including biodiversity ranger Tayla Hooker and ecologist Warren Chinn. We looked at the types of vegetation that might be suitable for any ecological restoration at The Point site. All parties on the site visits agreed that an adaptive management approach should now be taken to the ecological and vegetation restoration elements of the development. This will likely see smaller areas of the site restored and monitored to see the effectiveness of the management regime rather than restoration of the larger 89ha area all at once. This approach will also allow for the redeployment of resources to support avifauna, as requested	get agreed recommendations into the EEP
22-Jul-24	email	Di Finn & Dean Nelson	GH, RH	Provided a summary our discussion on the 17th as minutes via email. Stated the Department wishes FNSF to place more importance on protecting endangered braided riverbed birds in the area of the proposed solar farm development at The Point, and in particular efforts to assist Kakī, rather than vegetation and invertebrate restoration efforts as had previously been proposed. We discussed the Kakī recovery programme and in particular a funding proposal for the replacement of aviary B which was destroyed by snow some years ago and is seen as crucial to the ongoing successful management of Kakī. The estimated cost of this replacement is circa [redacted]. The Department also asked if pest control efforts planned for the site could be expanded to include the braided riverbed and delta systems of the Ohau and Pukaki rivers which border the site. We look forward to receiving more detailed information about the scale, operation and estimated cost associated with this activity. We agreed in principle with all of the above if the project went ahead.	followup
26-Jul-24	email	Di Finn & Dean Nelson	GH, RH	Di wrote to say 'We look forward to working with you more closely on this and will provide you with more detailed costings for work that make a tangible difference to our ability to grow the population and better protect them in the wild. This will include providing a plan and costings for trapping in the riverbeds surrounding the site in order to better protect a range of values rather than trapping on the solar farm site itself'	
14-Aug-24	email	Di Finn & Dean Nelson	GH, RH	wrote to Di: Just checking in again to see how things are progressing with regards to the costsing/specifics for the Kakī Recovery Programme, as well as the pest control in the surrounding riverbed areas as we discussed. Is there any indication of when we'll be in a position to review any formal agreements. Di replies same day to say: 'We are just working through a few details and hope to have something with you next week to give you a good indication.'	
29-Aug-24	email	Di Finn & Dean Nelson	GH, RH	Di writes to say: "I have also been asked to make you aware that we will need to undertake korero with iwi about this. Ngāi Tahu are partners in the Kakī Recovery Programme and have a vested interest in its operation and future. The Director General will have to consider the matter before we can present the terms of any agreement, and then we'll be able to have an agreement drafted. So, we are looking at least a month or so until we will be in a position to present a draft agreement."	
11-Oct-24	email	Di Finn & Dean Nelson	GH, RH	Di writes to say they 'discussed an appropriate way forward with our Treaty partners and the DOC Senior Leadership team'. 'We note that The Point has now been included in Schedule 2 of the Fast-track Approvals Bill and we understand that DOC is likely to be expected to provide formal comments to the Panel convened to hear the application through that statutory process. It seems that we're not able to enter into any form of (separate) agreement for your support of the Kāki Recovery Programme now, and so we thought the best way forward was to consider what conditions may help to mitigate, offset, or compensate for any adverse-affects from the development, particularly on Kāki, in the event consents were to be granted. These conditions would include your support for growing the Kāki population through the Aviary re-build etc'. Di said these conditions would likely form part of their formal response to the Expert Panel and if we were agreeable they could start working on them.	

Department of Conservation
Te Papa Atawhai

DOCCM-7507754

24 November 2023

Greg Hay
Far North Solar Farm Ltd
Level 1 Office
65 Main Road
Kumeu
AUCKLAND 0810

Dear/Tena koe Greg

The Point Proposed Solar Farm, Twizel

Thank you for the opportunity to visit the proposed solar farm on Friday the 6th of October and your letter of 1 November seeking comments on the proposed restoration approach with regards to native planting, invertebrate management, and fencing. Our team really appreciated the opportunity to visit and discuss issues in the field with you and your team.

Please note that these comments are technical in nature and do not at this stage represent the Department's view on any final proposal under the RMA as we understand the application is still being developed.

As discussed on site, the Department's main concern in this proposal lies in the protection of threatened land environments, indigenous species and ecosystems, and the management of protected species under the Wildlife Act 1956.

General Comments

Our technical advisors consider that birds striking the panels and landscape impacts will likely be the major issues for the proposal. It is clear the site has been fully mechanically "worked over "and from a native plant perspective is depauperate.

The proposed solar farm has the potential to create one, or several reserves and refugia for native plants, lizards, invertebrates, and their associated ecological communities. Some parts of the inter-array and peripheral land could be available for habitat restoration.

Our technical experts have read the relevant parts of the AEE and tend to disagree with the peripheral planting design, which appears to be primarily focused on the use of planting as a screening tool rather than an ecological restoration programme. The peripheral planted native vegetation could instead reflect more original vegetation communities. The location of the array is well east in the Mackenzie Basin, an area that has significantly lower rainfall than say Mt Stevenson, directly to the north. DOC would advocate for expert workshopping or

Department of Conservation *Te Papa Atawhai*
Policy and Regulatory Group
RMA Shared Services
Private Bag 4715, Christchurch Mail Centre, Christchurch 8140
www.doc.govt.nz

conferencing to better refine an ecologically appropriate suite of species for ecological restoration but could also provide an expanded species list. There are plenty of available references and people who can furnish this list thoroughly, but the key theme in our view is to use the array area to replicate and restore ecologically appropriate plants, in a way that mimics the historical character of the lower Mackenzie Basin. These plants are better adapted to the soils and climate in any case, so they probably should establish well in this setting.

The landscape values that will be impacted by this proposal will need addressing in the AEE. The area is also visible from the Benmore range hiking area where there is a public easement for access. There will be landscape implications that flow from the Mackenzie Basin's status as an Outstanding Natural Landscape.

Our experts do not think a wall of native vegetation around the array is needed. A revised configuration could have woody plants in the terraces and sloped ground (shadier and damper), and with tussock / festuca featuring between arrays.

General Ecology Comments

The Ecological Enhancement Plan (EEP) is no doubt a unique opportunity for ecological restoration in the Basin, if, and only if, it is done well. DOC is of the view that the Wildlands crew still need some guidance and specific Mackenzie Basin ecology expertise to refine the EEP design.

The EEP is proposed to be undertaken in two zones – Enhancement Zone (to be representative of original glacial outwash gravels vegetation), and Visual Screening Zone (40m strip of locally native trees and shrubs ***at least*** 3m high).

The application needs to be clear about what is ecological restoration and what is landscape mitigation. Just planting native trees, even if the plants are native to the Ecological District, is not ecological restoration but rather constitutes proposed landscape mitigation (Visual Screening Zone). Visually, it may be better without a great big row of tall shrubs and trees around the panels which doesn't exist elsewhere in the landscape. Our point is that the landscape mitigation shouldn't be counted as ecological restoration at this point.

A narrow peripheral stretch for planting design has a reduced ecological function and would be better served with an equivalent area all in one large patch. It is suggested that peripheral vegetation could be wider or that more plants of the same species be established as a 'core' reserve – to increase the core-to-edge ratio, as a large area is ecologically more effective. Buffering from shade extent is a live issue for solar farms, noting that the solar panels will track the sun so their shadow moves. Consequently, buffering from shade extent around populations may be needed, particularly for occurrences of the offsite but closely adjacent Threatened – Nationally Critical *Lepidium solandri*, which the design should avoid.

The *Lepidium solandri* (and other rare dryland terrace natives) *should* be safe from panel shading effects with a 100m-200m buffer of native vegetation as proposed, but it would be nice to see some shade modelling so we can see how close some of the *Lepidium* plants are, and better assess the risk from shading and potential irrigation edge effects. We have only seen *Lepidium* occur in full sun, or at the very least partial shade if it is situated on an open slope. Irrigation of the native revegetation areas to get the plants established could lead to the spread of rusts, viruses, and other diseases that could have effects on the *Lepidium*. We would need to understand this risk and (possibly) irrigation should not be allowed within a certain distance of those plants.

For the EEP, we potentially have issues about planting design, some species choice, biosecurity from nursery raised plants and eco-sourcing based on the conversations on the day. It may be difficult to do, but there is a consensus amongst botanists in Canterbury that the Mackenzie Basin is its own ecotype and is likely to have differing genetic variation in common plants (i.e., coprosmas) than other areas. It is then important for this project to maintain this integrity and eco source from nearby populations. A current paper by Peter Heenan reasons for large eco-sourcing regions and discusses sourcing from ecotypes. As discussed, this factor is relevant in the Mackenzie Basin as it has its own eco-type with climatic variations.

There is also a wetland that is nationally significant within 100 metres of the site. Under the Mackenzie District Plan, any works should be 100 metres away from such an area (Australasian Bittern have been recorded in such habitats as this wetland) and it's not clear if the buffer around the solar farm will mean that construction is an appropriate distance from this wetland.

Specific Comments on the EEP

Pg 29 EEP: we are not clear as to where the removal of at-risk plant flora would need to occur or is it proposed that removal is fully avoided? The report says they could be removed under "Clearance of At-Risk Plants," so there is a need for clarity about this issue.

The set back distance suggested for 'high value areas' (see page 34 – 12.1), that protects the lizard habitat in the form of stone fields that are found throughout the site, needs to be defined. A map of the locations of the stone field drylands and lizard habitats would be useful, alongside the GPS tracks and waypoints for locations and observations of threatened or at-risk species. This would have allowed for a visualisation of these areas and how best to protect them (i.e., are they scattered and isolated patches or do they occur closely together and could they therefore be avoided as one).

The species listed for the EEP (see p. 41 of the Wildlands AEE) are mostly fine but the lists are not comprehensive for dryland terrace restoration or specific enough for clarity (e.g., *Carex* and *Hebe* species, - which specific ones need to be defined. There are many to choose from, and many are not native to the Mackenzie).

EEP point 12.8.4: "Permanent habitat creation through restoration of the outwash plain and stone field grassland will provide breeding habitat for Threatened and At-Risk species – lists birds." It needs to be said that restoration of outwash plains hasn't really occurred in the past, especially in an area so modified. The native flora and fauna that are unique and threatened to this area need open habitat that often has bare ground cover (say approx. 30%) for them to thrive. It is then hard to restore this ecosystem on a site that is currently 100% exotic grass cover. Therefore, the restoration suggested in the EEP is for a different and more historic kind of habitat that doesn't pertain to the typical 'dryland' environment which currently host numerous threatened and at-risk birds, lizards, insects, and plants. There is an opportunity to provide a refuge for native species and an 'insurance' population, at least for future translocations to elsewhere in the Basin to retain their faunal and floristic character.

This is not to undermine a planting effort where an environment is completely modified, but it's not 'restoring' what was there before it's development into pasture, rather restoring vegetation which is historic to before human arrival. It may be easier to plant and achieve, but thought should be given to the following question: Would that planting be beneficial for

the native species that live on open habitats? We do believe, however, that pest management (rabbit/ hedgehog control) is a beneficial form of enhancement.

Birds

We have some potential concerns about the location of Far North Solar Farm, as it is adjacent to the confluence of the Pukaki/Twizel Rivers and Benmore delta, which is a high use and critical area for many threatened bird species. It is classified as an Important Bird Area (IBA). The location is surrounded by riparian habitat (rivers and wetlands) where many aquatic insects thrive.

According to Leroy J. Walston Jr. *, Katherine E. Rollins, Kirk E. LaGory, Karen P. Smith, Stephanie A. Meyers[1]: "*The nature and magnitude of impacts to bird populations and communities is generally related to the following three primary project-specific factors [10,14]: location, size, and technology. Bird abundance and activity at local and regional scales varies by the distribution of habitat and other landscape features (e.g., elevation) in the environment [15e19]. Therefore, the location of a solar energy project relative to bird habitats, such as migration flyways, wetlands, and riparian vegetation, could influence avian mortality risk.*" More research needs to be done to understand the potential impact the choice of location may have on birds.

Studies overseas[2] have also shown that anti-reflective coated solar panels still attract aquatic invertebrate species. But these would avoid nonpolarizing white borders and white grates. These aquatic insects are a great food source for braided river birds, so the potential impact on the birds could not only be loss of foraging habitat but also impact their food source and increase the risk of bird strike. This is not discussed in the AEE.

On the day, banded dotterels (*Charadrius bicinctus bicinctus*) (Threatened- Nationally Vulnerable), New Zealand pipit (*Anthus novaeeseelandiaee*) (At Risk-Declining) and black fronted terns (*Chlidonias albostriatus*) (Threatened-Nationally Endangered) were observed. Banded dotterels and New Zealand pipit are using the current site for nesting and foraging. Black fronted terns are known to forage extensively over tussock grassland and shrub areas, especially when nearby rivers are in flood. For example, O'Donnell and Hoare (2009)[3] showed that terns made extensive use of the valley floor grasslands adjacent to waterbodies for feeding on skinks and this behaviour was observed elsewhere. The adjacent wetland provides habitat for threatened species such as marsh crake, bitterns, pied stilt, kakī, banded dotterels.

Additional evidence that adds to our concerns is an internal analysis of the movement of tagged Black fronted terns which shows that 27 black fronted tern movements fall within the solar farm boundary. This demonstrates that the proposed site is well-used, and the movement of birds are directly over or within the site.

Because of the proximity to important feeding and nesting sites of many threatened species (including kakī/black stilt (*Himantopus novaezelandiae*) (Threatened-Nationally critical), the applicant needs to ensure that the construction noise/vibration doesn't affect feeding and

[1] **A preliminary assessment of avian mortality at utility-scale solar energy facilities in the United States**

[2] **Reducing the Maladaptive Attractiveness of Solar Panels to Polarotactic Insects**, GABOR HORV ´ ATH, ´ ∗ MIKLOS BLAH ´ O, ´ ∗ AD ´ AM EGRI, ´ ∗ GYORGY KRISKA,† ISTV ¨ AN SERES,‡ ´AND BRUCE ROBERTSON

[3] O'Donnell C.F.J. and Hoare J.M. 2011. Meta-analysis of status and trends in breeding populations of black-fronted terns (*Chlidonias albostriatus*) 1962-2008. *New Zealand Journal of Ecology* 35: 30-43.

nesting birds in the wild (close by rivers, wetlands) or the kakī/black stilt captive facilities closer to SH8, that contain captive breeding pairs which play a big part in the genetic diversity of the kaki wild population.

The AEE and associated documentation mentions reducing the risk of bird strike, discusses using UV paint (Flock Off Ultra Violet Paint 1 Gallon for Bird Control – Flock Free Bird Control Systems and Services LLC). On site, Dr Morgan Tracy-Mines (from Wildlands) mentioned that 'normal' paint would be used. It would be good to clarify this point - as the use of UV paint made sense from a bird control perspective. Also, some thought on how often the paint would need to be re-applied would be useful. The Mackenzie sun and weather conditions are very harsh, so the paint could fade very quickly.

Invertebrate Reserve

Warren Chinn, (our invertebrate ecologist) believes the solar farm proposal potentially lends itself well to protecting and restoring populations of threatened and locally endemic invertebrates.

If possible (prior to array installation), some of the surface could be prepared for translocation of grasshopper species including *Brachaspis robustus, Sigaus minutus,* and *Sigaus australis.* A blend of stone cobble ground (mimicking old stable riverbed) with *Raoulia australis* and *Muehlenbeckia axillaris, Epilobium* and *Leucopogon* and the like, growing sparsely across the cobble could be created.

The key issue is how to mimic or maintain the optimally aged surface for the grasshoppers to oviposit into, feed, and survive. Warren Chinn can advise on how to achieve this surface.

There was minimal discussion of likely *B. robustus* habitat in the AEE. We have a study which shows the 2004 locations of the grasshopper from old surveys. Warren thinks it would be well worth undertaking a re-survey of these locations from which we can design a collection / translocation project. The 2004 study shows the area proposed for the array was (once) surrounded with *B. robustus* populations.

Warren is of the view that the area could maintain populations of *Sigaus minutus, Hemiandrus* Weta, burrowing spiders (*Notocosa bellicosa, Cantauria* sp. *Hexathele* sp.), *kikihia* and *Maoricicada* cicada species. It would be fantastic if we could have the Canterbury knobbled weevil in the array area as well – a long shot, but possible. Speargrass will need to be grown for the weevils. Moths and butterflies could also be hosted in the array along with their host plants, such as *Kiwaia* and *Orocrambus* etc.

Matters to address:

Based on the above discussions, should the proposal be consented, it would seem to us that conditions would be needed in the following areas:

- Standards for eco-sourcing;
- Use of eco-sourced plants native to the Ecological District;
- Use of Threatened flora species in the restoration.
- DOC consultation on EEP;
- Meeting Mackenzie District Plan buffer conditions for wetlands;

- Monitoring of native planting success;
- Monitoring of native planting data made publicly available;
- Treatment of surfaces where proposed for invertebrate management
- Study/research collaboration with the Department to develop a monitoring programme to record avian mortality which will help better understand the potential impact of solar farms on birds.
- Ensuring no effect on adjacent dryland terraces especially *lepidium*, monitoring is needed to demonstrate this issue;
- We recommend a condition that construction work be only undertaken outside of bird breeding season, between something like February to July (breeding season is from Late August until late January);
- The paddocks contain reasonable rabbit numbers so undertaking night shooting/ control and maintaining a defined appropriate MacLean's scale score would be beneficial given there is no rabbit netting along the boundary fence;
- A predator proof fence was discussed on our visit, we would recommend constructing a rabbit proof fence as well as it also works well against hedgehogs, which are a huge problem here. This should also help secure and protect the proposed native plantings,
- Use of UV paint and the frequency of repainting;
- Nonpolarizing white borders and white grates solar panels to deter aquatic invertebrates;
- Removing the wilding pine trees onsite and those immediately adjacent;
- Managing biosecurity risks.

I hope these comments are of use to you and your team. Should you wish to discuss this or any other related matters, please contact me [redacted]

Kind regards/Naku noa, na

Di Finn
Operations Manager
Te Manahuna/Twizel

cc

Janine Sidery
Issues Manager
Eastern South Island

7 December 2023

Di Finn

Operations Manager

Department of Conservation

Te Manahuna/Twizel

Re: Response to Department of Conservation letter DOCCM-7507754 - 24 November 2023

Dear Di

Thank you for your letter. It was encouraging to see such a thorough response to the solar farm proposal and we look forward to working with the Department to achieve conservation outcomes that provide significant national benefit, outside of renewable energy generation itself.

In addition to the detailed assessment of the proposal and the Assessment of Ecological Effects as prepared by Wildlands, we note the specific points at the end of your letter and the view that should the proposal be consented, conditions would be needed to address these. We happily agree to investigate how these conditions, and other suggestions, can all be integrated into a final Ecological Enhancement Plan (EEP). Please see below for responses to the individual points raised.

The Resource Consent application for the proposal is now notified and our aim is to provide a final EEP as a condition of consent.

We feel confident that through the suggested collaboration with the Department we will be able to achieve the desired outcomes shared by both of us.

To that end, can I suggest that we begin the mahi required to form the EEP itself and that we reach out to the Department's team who undertook the site visit to begin this process. It may also be appropriate in the early new year to gather for a hui to workshop and refine progress prior to finalisation.

As you may be aware, we have already had an online conversation with Warren Chinn about how we can use the solar farm area to protect and restore populations of threatened and

locally endemic invertebrates, so work to some extent is already underway. We are looking forward to his guidance on what might be needed to support these aspirations so that the required elements can be integrated into the detailed design of the proposal.

We are genuinely excited at the ongoing partnership opportunity to develop this site into an exemplar of responsible solar development.

Response to recommended consent conditions:

1. **Standards for eco-sourcing** – yes, we can establish and state standards for ecosourcing. This may include collecting and growing seeds from within the region, if we cannot access them through local nurseries.
2. **Use of eco-sourced plants native to the Ecological District** – Same as above.
3. **Use of threatened flora species in restoration –** This is already a part of the EEP plan but we are happy to work with the Department to define an appropriate list of suitable species..
4. **DOC consultation on EEP** – Yes, we agree and we hope to proceed as outlined above if agreeable.
5. **Meet Mackenzie District Plan buffer conditions for wetlands** – We believe this was addressed in the initial AEE Wildlands prepared but we will ensure all conditions are met.
6. **Monitoring native plant success** – Monitoring is already included in the long term EEP design, but this could be extended to include any plantings in between the arrays.
7. **Make monitoring native plant data publicly available** – Agree. We could produce an annual report as well.
8. **Treatment of surfaces where proposed for invert. Management** – We will rely on Warren's input as to what is required and expect this information to become an integral part of the EEP.
9. **Study/research collaboration with the Department to develop a monitoring programme to record avian mortality** – We agree this is an excellent idea, as there is currently a knowledge gap on the risks of bird strike from solar farms in New Zealand.
10. **No effect on adjacent dryland terraces, esp. Lepidium. –** Particular care should be taken in the EEP to ensure there are no negative impacts on this species. This can be included in the monitoring programme.
11. **Construction works only be undertaken outside of breeding season for birds** – All 'noisy' works such as driving the piles on which the racks of panels sit will be done outside of breeding season. However, the large nature of the site should make it possible to shift work to 'clear' areas of the site with appropriate setbacks from avifauna to avoid any instances of disruption outside of these times. To ensure this, avifauna surveys will be conducted no more than 7 days before work begins, to ensure no nesting birds are present. More detailed information will be provided in an avifauna management plan prepared by an avifauna ecologist.
12. **Night shooting for rabbits** – This is already included as one of our recommendations.

13. **Predator and rabbit proof fence** – This is also currently one of the recommendations of the AEE. We need to define which animals we are able to practically exclude and again wish to refine this with the Department's assistance.
14. **Use of UV paint and frequency of repainting on panels to help deter birds** – We can look at applying UV borders (material TBC) either as part of the manufacturing or installation process.
15. **Nonpolarizing white borders and white grates on solar panels to deter aquatic invertebrates (and subsequently feeding birds)** – We can look to ensure the suitable panels are used in the design, no problem.
16. **Removing wilding pines onsite** – This is already included in our recommendations.
17. **Managing biosecurity risks** – yes, we believe this is standard to include and we can develop methodology with the Department.

Kind regards

Greg Hay

Communications and Engagement Lead

Far North Solar Farm

Department of Conservation
Te Papa Atawhai

DOC-7556520
RC2764

01 February 2024

Greg Hay / Liala Alkami
Far North Solar farms
Level 1 Office
68 Main Road
Kumeu
AUCKLAND 0810

Kei te rangatira, tēnā koe,

Far North Solar Farms Applications

I refer to the application by Far North Solar farms to install and maintain a 420 MW(Peak) solar photovoltaic solar farm on a triangular site where the Ohau and Pukaki Rivers flow into Lake Benmore and their associated land use and discharge applications to your councils.

The Director-General is supportive of the proposed activity *in principle* and is willing to work collaboratively with the applicant to better understand and address the adverse effects associated with the proposal, including supporting an appropriate effects management package, including conditions, the environmental effects management plan, and any other associated measures required to address residual adverse effects of the plan.

However, the Director-General's submission identifies concerns and the potential for adverse effects on indigenous biodiversity, including the following matters:

- Vegetation eco-sourcing,
- Restoration, enhancement planting, and monitoring of dryland flora,
- The potential loss of threatened bird breeding habitat for species such as banded dotterel,
- Risk of bird strike and bird deterrence, and disturbance,
- Effects of solar panels on dryland habitats, including the associated water discharge effects,
- Weed and Pest control and managing biosecurity risks,
- Considering Ngāi Tahu's interests.

Please contact Herb Familton (RMA Planner) in the first instance if you wish to discuss any of the matters raised in this submission (phone [redacted]

Nāku noa, nā

Jo Macpherson
Director Operations, Eastern South Island
Department of Conservation *Te Papa Atawhai*

Copy: for Councils

Consent Managers
MacKenzie District Council
Fairlie
Canterbury Regional Council
CHRISTCHURCH

Department of Conservation
Te Papa Atawhai

DOCCM-7689122

12 July 2024

Greg Hay
Far North Solar Farm Ltd
Level 1 Office, 65 Main Road
Kumeu
AUCKLAND 0810

Email: [redacted]

Tēnā koe Greg,

THE POINT SOLAR FARM

Thank you for your willingness to engage and work closely with DOC in relation to The Point solar farm project. We appreciate your desire to pro-actively address environmental issues and look forward to continuing to work with you over the coming months to ensure the best environmental outcomes are achieved.

Prior to the forthcoming site meeting between DOC, Far North Solar Farm Ltd, and Wildlands in Twizel on 17th July, I would like to set out DOC's priorities for environmental compensation/ restoration in relation to the project. Stressing the DOC priorities at this stage may help us in reaching agreement as to how best avoid, mitigate, or remedy potential adverse effects of the solar farm.

Avifauna

Our ***primary*** concern in relation to this project is the risk to endangered braided riverbed birds, particularly Black Stilt / Kakī. As you will be aware, Kakī are critically threatened (classified nationally critical – the highest threat status category) with c. 41 breeding pairs[1] left in the wild. Kakī are intensively managed by DOC, who are working hard to grow the population. Our Principal Science Advisor, Dr Colin O'Donnell CNZM, notes the risks to mobile wetland bird species — including Kakī — from the solar farm project in his paper dated 12th March (that we have previously shared with you). I am of the view that minimising risks to Kakī and other threatened avifauna species should be the primary focus of any compensation / mitigation agreement.

I have enclosed a short paper on Kakī and the DOC Kakī Recovery Programme that you may find of interest. Enhancement of the Kakī population constitutes urgent work. Support for the Kakī recovery programme, and the provision of aviary facilities to hatch and raise Kakī, are key tools to ensure the survival of the species. In my view, growing the population of Kakī (and if possible, in

[1] 41 pairs for the 2023-24 Summer (Source: DOC Black Stilt Recovery Programme)

the longer term, establishing a second secure population in a different location) may help to minimise risks in the present context.

I would welcome discussions with you as to how best to avoid risks to avifauna —including how those risks may be managed by growing the Kakī population— and the significant advantages to all parties that could be leveraged through such an agreement. You may be interested to learn about the recent (2022) Waitaki Hydro-Electric Power agreement between the Director-General and Genesis and Meridian Energy in the area (which was a hybrid arrangement, constituting both a partnership agreement and Augier conditions). DOC staff can explain to you the process underpinning that agreement, if that would assist.

I note that you have recently forwarded advice on avifauna matters from EcoLogical Solutions and Green Inc (John Craig), and that several additional suggestions are made in those reports for minimising risks to endangered avifauna. The DOC team will consider those recommendations closely and revert to you in due course.

Vegetation

In relation to proposed vegetation and invertebrate restoration efforts, I am of the view that these should be ***secondary*** to the primary objective of mitigation of risks to avifauna and Kakī restoration.

I understand that the proposed site constitutes over sown and top-dressed grassland that is largely exotic, and that you propose to rehabilitate parts of the site with the aim of achieving a more natural, pre-1840 vegetation. This approach was discussed at a meeting held on 14th March 2024 between Wildlands, DOC, and yourselves. I note some degree of sheep grazing may still be required, and some 'adaptive' responses may be necessary given the experimental nature of the proposal. Note also that based on our experience with the Tekapo Reserve, it may take decades to see any ecological changes.

Invertebrates

In terms of invertebrates, I note that Warren Chinn has shared a paper with you, suggesting three possible options for invertebrate restoration. Warren's paper provides an excellent platform for considering the impacts on and restoration of invertebrates. To undertake any of the options suggested, I note the ground surface would need to be treated with appropriate substrate size and the plans integrated into the potential plant restoration efforts.

Taking matters forward

Greg, I am happy to make myself available to discuss potential agreements that FNSF could enter in to with DOC. In the interim, and for all other matters, please note my key point of contact for this process will be Di Finn, Operations Manager in Twizel [redacted]
If you could address all relevant correspondence to Di, she will liaise with me and all necessary DOC staff as appropriate.

Thank you again for your willingness to engage with DOC. I look forward to making progress in this matter and agree that we can (as per your 9 July email), "work towards achieving the best possible ecological and conservation outcome at The Point."

Nāku noa, nā

Jo Macpherson
Director Operations, Eastern South Island
Department of Conservation *Te Papa Atawhai*

Encl. 1: Kakī / Black Stilt Recovery Programme Funding Proposal Attachment

cc:

Di Finn, DOC Operations Manager, Twizel	Janine Sidery, DOC Eastern South Island Regional Issues Manager, Christchurch	Trevor Ellis, DOC RM Regulatory Delivery Manager, Christchurch

7

Kakī / black stilt recovery programme 2024–2025

Funding proposal for replacement of aviary B

Department of Conservation
Te Papa Atawhai

Te Kāwanatanga o Aotearoa
New Zealand Government

Two young recently banded subadult-kakī. *Photo: Kate Lawrence*

Introduction

Endemic to New Zealand, the kakī / black stilt is a critically endangered wading bird found only in the braided rivers and wetlands of the Mackenzie Basin / Te Manahuna. Having previously been more widespread throughout much of New Zealand, their last remaining stronghold is the beautiful but particularly harsh environment that the basin provides. The species' survival relies on an intensive management programme that includes captive breeding and rearing kakī in specialised aviaries for wild release.

Kakī are one of the few critically endangered birds restricted to mainland New Zealand because no suitable habitat is available on any predator-free offshore islands.

While that makes their protection more challenging, it also helps make the species more highly visible to New Zealanders and international visitors on a major South Island tourist route.

Release of kakī subadults, Godley River, 2017. *Photo: Liz Brown*

Species on the brink – the world's rarest wading bird

Conservation management of kakī began in 1981, when numbers in the wild had fallen to 23 birds. The captive breeding and rearing programme at Twizel in the Mackenzie District is integral to the species' recovery.

Population modelling indicates that without captive breeding the species would become extinct within 6–8 years, due mainly to predation of eggs, chicks and/or adults incubating eggs by feral cats, mustelids, rats and hedgehogs. At least 100 kakī are needed to be released into the wild population each year, to maintain the population.

Recovery has been slow, but the current population is 169 known adults in the wild, and 41 wild pairs nested and produced eggs this season (2023/24). Ninety-eight per cent of all wild adults were raised in captivity and released to the wild.

The basis for the captive management programme is to collect as many eggs as possible from four captive pairs (two in Twizel and two at a private facility in Christchurch owned and run by the Isaac Conservation and Wildlife Trust) and all known wild pairs.

The eggs are incubated and hatched, and the chicks are held until they reach about 9 months of age (known as the subadult stage) then released to the wild. Any chicks produced that exceed aviary-holding capacity during the captive rearing season are returned to the wild as 3-month-old juveniles.

Despite this effort to safely raise subadults for release, the survival rate through to the adult breeding population (recruitment rate) is still only 30%. Given the average annual mortality rate for adults over the past 22 years is 24.5%, ensuring as many subadults as possible can be reared and released is crucial to the recovery of the population.

Photo: Liz Brown

Two Kakī chicks in hand. *Photo: Liz Brown*

Newly hatched kakī chick. *Photo: Liz Brown*

Where the magic happens

The captive management programme for kakī occurs at two sites: the Department of Conservation-managed facility in Twizel and the Isaac Conservation and Wildlife Trust in Christchurch. Twizel is the only site with facilities to hatch and raise kakī chicks and has three aviaries.

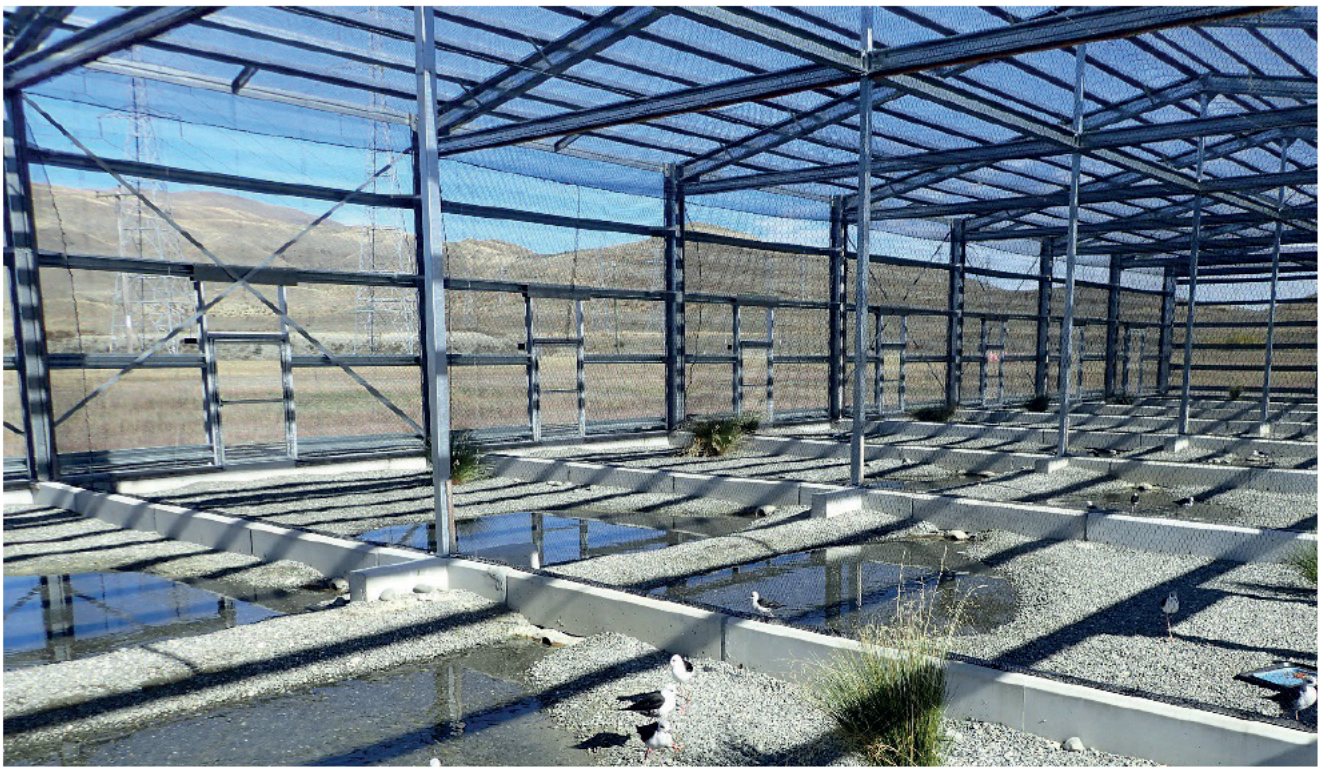
Aviary ‘C’ is a steel portal construction built in 2007 to replace an aviary that collapsed under heavy snow in June 2006.

In June 2015, the two laminated timber arch aviaries (‘A’ and ‘B’) in Twizel were damaged in a heavy snowfall event. Aviary A completely collapsed and was demolished, being replaced with a new steel portal aviary (a similar design to aviary C) in 2017. This new structure was funded by Global Wildlife Conservation, now called Re:wild.

Aviary B suffered significant damage but was repaired, and all arches had steel props installed. However, due to the ongoing deterioration of the laminated wooden arches, it has been declared unsafe for further use and needs replacement. If it is not replaced, the capacity of the captive rearing programme will be significantly reduced. All birds have now been removed from the aviary.

Aviary A collapse following heavy snowfall in 2015. *Photo: Dean Nelson*

Aviary B under heavy snow in 2015, showing distortion to the wooden arches.



The new aviary A, funded by Global Wildlife Conservation (now Re:wild) ***Photos: Dean Nelson***

Kakī in flight. ***Photo: Kate Lawrence***

Emerging threat

A new risk to the kakī recovery programme is the possible introduction to New Zealand of highly pathogenic avian influenza (HPAI), which has been spreading around the world and recently reached the Antarctic peninsula and Australia.

HPAI or other future diseases have the potential to have a significant impact on the wild and/or captive populations of kakī. It is essential that the captive facility maintains its capacity to produce the maximum number of chicks possible for release and also retains genetic diversity, in case of population declines.

Black Stilt/Kakī Transmitter Project Sponsorship Proposal

Background

Black stilt/kakī are a critically endangered wading bird species that is unique to New Zealand. Once widespread across both the North and South Island, their range decreased throughout the 20th century. By the 1950s, kakī were only found in Canterbury and Otago, and this range was diminished further to South Canterbury/North Otago by the 1970s. By the 1980s, the birds only existed within the Mackenzie Basin. In 1981, the total population reached a low of 23 birds and 4 known breeding pairs, and this resulted in the Kakī Recovery Programme being set up by the Department of Conservation in 1984.

Kakī need bodies of water to survive and are therefore found feeding and nesting on braided rivers, near wetlands, and ponds. They feed on insects, small fish, crustaceans, and worms, and can feed at night. They begin to breed at 2 to 3 years of age and live on average 6 to 8 years (although a few birds are more than 20 years old). They breed from September until January, and are unique in that they remain in the Mackenzie District year-round. As many eggs as possible are collected from the wild each year and brought to the Captive Facility near Twizel where they are hatched and the chicks raised until they are released again as sub-adults in August at the age of approximately 9 months. Eggs take approximately three weeks to hatch, and chicks are unable to fly for about 45 days. Kakī parents cannot directly feed their chicks which means that chicks need to find their own food as soon as they hatch. Eggs and chicks in the wild are readily depredated by mammals (cats, hedgehogs, stoats) and avian predators (harriers and black-backed gulls). Rearing chicks in captivity therefore increases survival by protecting them from predators. Other major threats that continue to pose challenges in the wild are habitat loss and modification and human disturbance.

DOC's intensive recovery programme has resulted in an increase in the adult population to 169 adults and approximately 40 pairs, but there is much left to learn. While eggs and chicks in the Captive Facility are safe from threats, the challenges the birds face in the wild still remain. Since 98% of the total population has been raised in the aviaries, each individual bird is banded. It is therefore possible to keep track of each individual while knowing its entire history and relatedness to other birds. Re-sighting banded birds has provided much data on survival, pair bonds, and movement around the basin. However, the finer details about precise movements between river catchments and the use of wetlands throughout the year are poorly understood. Food availability across the landscape and seasonal and annual fluctuations are also not understood. This lack of data makes it difficult to improve survival in the wild.

Proposal

Questions to be answered

In order to gather finer scale data to help understand how kakī use the landscape and the food sources within, how this fluctuates seasonally and annually, over which areas they fly, and potential night roosing sites, the use of transmitters is proposed. These data are critical to understanding how habitat changes will affect the population, how food availability influences breeding frequency and productivity, and if individuals are roosting outside of trapped areas at night and are therefore more vulnerable to predation. Every individual is significant in a small population like the one of kakī, and detailed data are therefore vital in the recovery of this species.

Devices proposed and cost

To capture the variety of movements between individuals, 40-50 transmitters need to be deployed. These devices are mounted on the back of the bird with a harness system and would weigh approximately 5g. The proposed devices are developed by Druid and are the MINI 4G units. The data would be immediately available as the devices connect to cellphone towers and download when the bird is in reception. Each transmitter costs $1100 USD and also has a $135 USD data service fee.

Battery life of the transmitter varies – it has a solar panel that allows recharging during sunny days, and if the number of location fixes are limited, it would transmit for months or years. This would allow data to be collected during both the breeding and non-breeding months.

Capture method and timing

Breeding adult kakī would be targeted for device deployments because birds can only be caught on the nest. Breeding occurs between September and January, and approximately 30 pairs are found nesting each year thereby allowing up to 60 individuals to be trapped. A clap trap is set up over the nest after eggs have been taken to the Captive Facility (and fake eggs placed in the nest), the bird is captured, fitted with the transmitter, and immediately released again. The fake eggs are then removed to encourage laying of more eggs. Birds would be recaptured after the device stops working to remove it, or the weak link in the harness used to attach the transmitter would eventually result in it falling off.

Sponsorship of Kakī Recovery Programme

Currently, the Kakī Recovery Programme relies on direct funding from DOC and indirectly from Project River Recovery which funds the cost of predator trapping in the Tasman Valley. This funding covers the bare minimum to keep maintain the Captive Facility (food supplies for birds in aviaries, cleaning supplies, general maintenance of the facilities), and for 3 permanent staff and 1 temporary staff member. It also ensures one permanent staff member for the wild component (collecting eggs and monitoring the wild population) and two seasonal wild staff. It does not allow for any additional means to gather data to improve the survival of birds in the wild, to conduct in-depth data analyses, or to promote education or knowledge about the programme. Other endangered species in New Zealand receive key sponsorship from companies thereby allowing increased protection from introduced predators and enhancing habitats for re-introduction into the wild. For example, Fulton Hogan signed a 5-year partnership worth $1 million for the Takahē Recovery Programme, Genesis supports whio, and Meridian provides sponsorship to kākāpō. Air New Zealand grants $1 million per year to the Conservation Dogs Programme. Sponsorship to the Kakī Recovery Programme would provide an invaluable opportunity to expand the programme and make important improvements needed to further grow the population.

Gmail Greg Hay [redacted]

meeting summary

Greg Hay [redacted] 22 July 2024 at 11:05
To: Diane Finn [redacted]>
Cc: Richard Homewood [redacted]
Bcc: John Telfer [redacted]

Hello Di

It was lovely to meet yourself and Dean last week, thank you again for your warm hospitality. We place great importance on our constructive relationship with the Department and are looking forward to formalising this and assisting with the valuable mahi your local Twizel team carries out.

To summarise our discussion, the Department wishes FNSF to place more importance on protecting endangered braided riverbed birds in the area of the proposed solar farm development at The Point, and in particular efforts to assist Kakī, rather than vegetation and invertebrate restoration efforts as had previously been proposed.

We discussed the Kakī recovery programme and in particular a funding proposal for the replacement of aviary B which was destroyed by snow some years ago and is seen as crucial to the ongoing successful management of Kakī. The estimated cost of this replacement is crica [redacted]

The Department also asked if pest control efforts planned for the site could be expanded to include the braided riverbed and delta systems of the Ohau and Pukaki rivers which border the site. We look forward to receiving more detailed information about the scale, operation and estimated cost associated with this activity.

We remain committed to developing an invertebrate reserve within the fenced boundary of the solar farm and working with the Department to achieve this.

FNSF confirms it will fully support this mahi, including the replacement of aviary B, should the project receive resource consent and successfully proceed to construction.

As you're aware, a site visit to Ben Dhu Station scientific reserve and The Point took place following our meeting. This was carried out by FNSF's ecological consultants Wildlands and a DOC team including biodiversity ranger Tayla Hooker and ecologist Warren Chinn. We looked at the types of vegetation that might be suitable for any ecological restoration at The Point site.

We discussed that in response to the Department's guidance and preference to focus on avifauna support, the intended 89ha ecological restoration project which was being developed would need to be significantly altered and scaled back.

All parties on the site visits agreed that an adaptive management approach should now be taken to the ecological and vegetation restoration elements of the development. This will likely see smaller areas of the site restored and monitored to see the effectiveness of the management regime rather than restoration of the larger 89ha area all at once. This approach will also allow for the redeployment of resources to support avifauna, as requested.

A detailed ecological plan which outlines this approach will be shared once completed by Wildlands.

We look forward to receiving a formal proposal and partnership agreement from the Department with regard to the aviary B funding proposal and pest control efforts as described above.

regards,

Greg Hay.
Communication & Engagement Lead
E. [redacted] | **W.** fnsf.co.nz

FNSF

Far North Solar Farm LtdLevel 1 Office, 65 Main Road,
Kumeu, Auckland 0810

Diane Finn [redacted] 26 July 2024 at 15:56
To: Greg Hay [redacted]
Cc: Richard Homewood [redacted] Dean Nelson [redacted]

Kia ora Greg

Thanks to both you and Richard for taking the time to visit with us here in Twizel – especially in the frozen fog!

We really appreciate your desire to ensure the best long-term outcomes for our Kakī Recovery Programme. We look forward to working with you more closely on this and will provide you with more detailed costings for work that make a tangible difference to our ability to grow the population and better protect them in the wild. This will include providing a plan and costings for trapping in the riverbeds surrounding the site in order to better protect a range of values rather than trapping on the solar farm site itself.

Ngā mihi nui

Di Finn

Operations Manager *Pou Matarautaki*

Twizel *Te Manahuna*

Department of Conservation -*Te Papa Atawhai*
Twizel, Mackenzie District

Ph [redacted]

[Quoted text hidden]

Greg Hay [redacted] 29 July 2024 at 10:08
To: Chamanthie Sinhalage-Fonseka [redacted]

Hi Chamanthie

FYI on the thread below r.e discussion

Greg Hay [redacted] 14 August 2024 at 15:47
To: Diane Finn [redacted]
Cc: Richard Homewood [redacted], Dean Nelson [redacted]

Kia ora Di

Hope you are well. Just checking in again to see how things are progressing with regards to the costsing/specifics for the Kakī Recovery Programme, as well as the pest control in the surrounding riverbed areas as we discussed. Is there any indication of when we'll be in a position to review any formal agreements? We're keen to formalise things so we can allocate resources within the ecological restoration budget.

regards
Greg
[Quoted text hidden]

Diane Finn [redacted] 14 August 2024 at 16:54

To: Greg Hay [redacted]
Cc: Richard Homewood [redacted] Dean Nelson [redacted]

Kia ora Greg

Thanks for getting in touch. We've been busy with our annual Kakī release, so that has taken priority in the last few weeks. Looks like our successful season has been picked across several media platforms: Bumper kakī release season in Mackenzie Basin | Stuff

We are just working through a few details and hope to have something with you next week to give you a good indication.

[Quoted text hidden]
[Quoted text hidden]

Diane Finn [redacted] 29 August 2024 at 09:08
To: Greg Hay [redacted]
Cc: Richard Homewood [redacted] Dean Nelson [redacted]

Kia ora Greg

Just touching base with you. I hope the recent wild and wet weather up there hasn't been too disruptive.

We've had some capacity issues due to illness etc so have not been able to progress those indicative costings for you as promised.

I have also been asked to make you aware that we will need to undertake korero with iwi about this. Ngāi Tahu are partners in the Kakī Recovery Programme and have a vested interest in its operation and future. The Director General will have to consider the matter before we can present the terms of any agreement, and then we'll be able to have an agreement drafted. So, we are looking at least a month or so until we will be in a position to present a draft agreement.

Ngā mihi nui

Di Finn

Operations Manager *Pou Matarautaki*

Twizel *Te Manahuna*

Department of Conservation -*Te Papa Atawhai*
Twizel, Mackenzie District

Ph [redacted]

From: Greg Hay [redacted]
Sent: Wednesday, August 14, 2024 3:47 PM

[Quoted text hidden]

[Quoted text hidden]
[Quoted text hidden]

Greg Hay [redacted] 3 September 2024 at 12:30
To: Diane Finn [redacted]
Cc: Richard Homewood [redacted], Dean Nelson [redacted]

Kia ora Di

Thanks for the email and update. Please let us know if there is anything we can do to assist. We remain committed to making a meaningful contribution to conservation in the area through the mahi we plan to undertake.

We'll look forward to receiving further updates and the draft agreement in due course.

thanks
Greg
[Quoted text hidden]

Greg Hay [redacted] 1 October 2024 at 16:11
To: Diane Finn [redacted]
Cc: Richard Homewood [redacted] Dean Nelson [redacted]

Kia ora Di

I hope this finds you well. Warmer weather beckons and I'm sure that will be welcome to most down your way!

We're reaching out again to see if there has been any movement with regard to consultation with Ngāi Tahu in relation to our proposed support for the Kakī Recovery Programme, as well as adopting wider pest control measures as per our kōrero in July. Is the intention still to present a draft agreement that outlines the nature of our support and collaboration?

Our ecological enhancement planning in relation to the development is really now at the stage where we need to know if we are allocating resources to what we've spoken about above, or if we should redirect them elsewhere.

Looking forward to hearing from you.

Thanks
Greg
[Quoted text hidden]

Diane Finn [redacted] 2 October 2024 at 09:22
To: Greg Hay [redacted]
Cc: Richard Homewood [redacted], Dean Nelson [redacted]

Kia ora Greg

All is well in the beautiful Mackenzie Basin as we welcome Spring.

Your email is timely – along with our Regional Operations Director, Deana and I are meeting with Ngāi Tahu representatives today.

We will advise the outcome of those discussions as soon as we can.

[Quoted text hidden]
[Quoted text hidden]

Diane Finn [redacted] 11 October 2024 at 16:31
To: Greg Hay [redacted]
Cc: Richard Homewood [redacted] Dean Nelson [redacted]

Kia ora Greg

Thanks for your patience while we discussed an appropriate way forward with our Treaty partners and the DOC Senior Leadership team. We note that The Point has now been included in Schedule 2 of the Fast-track Approvals Bill and we understand that DOC is likely to be expected to provide formal comments to the Panel convened to hear the application through that statutory process. It seems that we're not able to enter into any form of (separate) agreement for your support of the Kāki Recovery Programme now, and so we thought the best way forward was to consider what conditions may help to mitigate, offset, or compensate for any adverse-affects from the development, particularly on Kāki, in the event consents were to be granted. These conditions would include your support for growing the Kāki population through the Aviary re-build etc.

It is likely that we will be including these proposed conditions in our formal Fast-track comments to assist the Panel in the event that consents were granted, and so we would like to discuss them with you and give you the opportunity to support them. If you are happy with this approach, we'll get our planning team and technical experts to suggest some proposed conditions and forward them to you.

Ngā mihi nui

Di Finn

Operations Manager *Pou Matarautaki*

Twizel *Te Manahuna*

Department of Conservation -*Te Papa Atawhai*
Twizel, Mackenzie District

Ph [redacted]

Design notes for an indigenous invertebrate habitat reserve within the proposed Far North Solar Farm, Mackenzie Basin.

Warren Chinn

Technical advice, invertebrate ecology

March 2024

Introduction

Far North Solar Farms (FNSF) are proposing to build a 670hectare solar array in the Mackenzie Basin, Waitaki catchment, South Canterbury (figure 1). The array would be situated between the Ohau and Pukaki Rivers, at the northern of Lake Benmore and some 8.5kms from Twizel township. Currently, the land is being grazed (primarily cattle) and parts of it intensively irrigated. Following an October 2023 site visit between FNSF ('the applicant') and ecologists from Wildlands and Department of Conservation, ideas for an 'indigenous invertebrate reserve' were discussed, as part of the array application. The opportunity to combine a development initiative with an effort to reduce the decline of native invertebrates in the Mackenzie Basin seems worthwhile. Among the rare and threatened invertebrates existing in the Mackenzie Basin, those most at risk of habitat modification include; the Nationally Endangered grasshopper *Sigaus robustus* (was *Brachaspis robustus*, see Trewick *et al*. 2022; 2023), ground wētā, beetles, moths and spiders.

Ecological context

The Mackenzie Basin is the largest of several post-glacial intermontane basins on the eastern side of the Southern Alps. These places are high, dry and ecologically isolated from wetter coastal environments. The basins have an extreme climate, controlled primarily by frequent westerlies blowing over the alps (inducing a rain shadow) and, in winter, periods of snow followed by clear skies dropping temperature to as low as -10^{o}C. Under these conditions, an indigenous biota has adapted, often in isolation with remarkably high proportions of endemic species.

The characteristic Mackenzie Basin landscape with its tall-tussock habitats were substantially modified by the construction of hydroelectric power infrastructure and agricultural intensification (particularly from the 1950s onward). Although rabbits were a notorious problem and an ecological catastrophe during the depression years, it has been the introduction of disturbance-adapted exotic plant species (intentionally or unwittingly) particularly in the late 1950s, that has set the Mackenzie Basin on its present ecological trajectory.

Competition by exotic plant species has resulted in the decline of native vegetation communities, a situation that is generally irreversible. Several exotic plant species are responsible for out-competing indigenous flora, including; pines, lupins, Hawkweed (*hieracium pilosella*) and willows (associated with waterways). Tough, successful weed species are not the only ecological problem in the Mackenzie basin; there is a continuous supply of introduced

animals, similarly well-adapted to dry conditions and the introduced plant communities of the basin. Stoats, Hedgehogs, rodents, cats, possums, rabbits, hares and some birds, are serious predators and herbivores of indigenous species, collectively applying pressure on the native Mackenzie Basin biota.

Today, a more insidious ecological change is underway with the rise of large-scale pivot irrigation. High volume, intense watering of the basin represents an abrupt local climatic change within soil horizons and associated organisms. The 'invisible' native invertebrate biota has, arguably, been the most severely hit with the steady conversion of dryland surfaces into intensively irrigated green ryegrass cattle-scapes. In response, a new suite of exotic invertebrates, better suited to the wetter soils, are colonising these modified habitats.

Nevertheless, there several locations throughout the basin that retain much of the pre-european (and earlier) biota, including invertebrates. The braided river systems maintain the Nationally Endangered grasshopper *Sigaus robustus* (was *Brachaspis robustus*), similarly, *Sigaus minutus* a small grasshopper persists in areas such as the Tākapo Scientific Reserve where a viable population of the Data Deficient ground wētā *Hemiandrus* '*furoviarius*' is relatively stable. Rare spiders survive on lightly grazed short-tussock surfaces and several species of large beetle can be found within indigenous communities. Tussock and shrublands also support native moth and butterfly species.

Invertebrates generally have modest real estate needs, therefore establishing invertebrate reserves and strongholds within the Mackenzie basin should not be too difficult and opportunities to do so, not overlooked. Terrestrial invertebrates are not discriminating of landscape values, all they require is appropriate environmental and biotic conditions to persist. To that extent, many invertebrates could be kept within these biodiversity reservoirs.

This summary paper outlines three options (or combinations) for including an invertebrate reserve within a portion of the proposed Far North Solar Farm array, between the Pukaki and Ohau rivers. For a detailed study of changes to indigenous habitats in the Mackenzie Basin Dr Susan Walker of Landcare Research has tracked the shift and her findings have been used in several high-profile hearings available from the Mackenzie District Council (https://www.mackenzie.govt.nz/ the media: https://www.stuff.co.nz/environment/89425177/the-battle-for-the-mackenzie-basin ; https://www.nzgeo.com/stories/how-to-fix-the-mackenzie-basin/) and papers (e.g. Brower *et al*. 2020).

Site visit

The proposed solar array site was visited on October 6, 2023. It was immediately apparent that the current surface is ecologically depauperate, particularly for indigenous invertebrates and plants. The surface had been cultivated, over sown, irrigated and has had substantial cattle trampling resulting in few, if any, indigenous organisms persisting in the area.

However, the peripheral surfaces have fared better and maintain remnant surfaces and organisms typical of the less disturbed and some of these, or portions, could be incorporated in an invertebrate reserve. The proposed array area is likely to be the largest in New Zealand, if completed (figure 2) and the opportunity to combine indigenous Mackenzie Basin species and their habitats with the solar array seems viable.

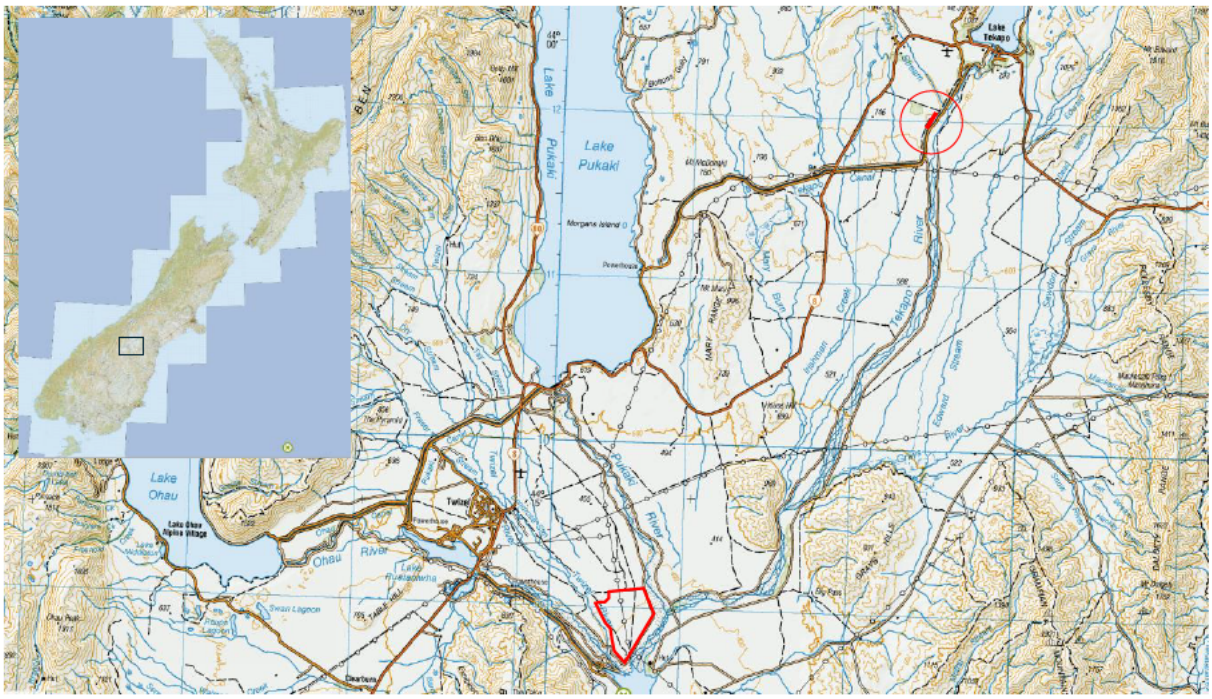


Figure 1. Location of proposed Far North Solar Farm solar array (red-coloured irregular polygon), between the Ohau and Pukaki Rivers, immediately north of Lake Benmore, bottom of image. The red circle (upper right) marks the location of the existing *Sigaus robustus* grasshopper reserve (small red oblong).

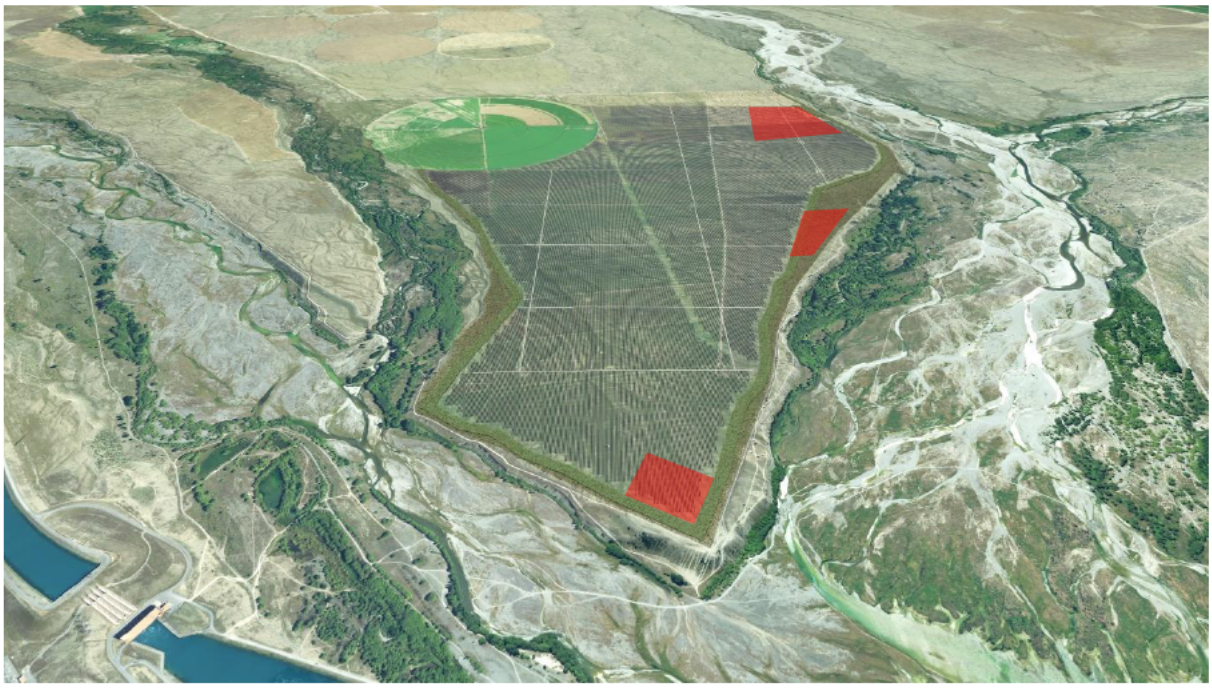


Figure 2. Google earth rendered mock-up of the array, view looking north. Potential invertebrate reserves are marked as three red polygons. The green irrigated circle at top right is proposed to remain in-situ, as an agreement between the FNSF and the current landowner.

Reserve proposals

Three locations are considered for an invertebrate reserve, or a combination of each. The first area would occupy the northeast corner of the array at about 4.5 ha, with 1ha covered by array panels (figure 3). The balance of the area (3.5ha) would be bare ground available for reserve habitat. The available inter-array strips would then be divided into thirds of differing habitat (figure 4). The 'thirds reserve' would comprise:

Strip 1: Semi-bare, stoney ground specifically intended for *Sigaus robustus*. Prostrate herbs and mat forming plants (*Roulia*, *Epilobium* willowherb, *Racomictrium* moss, etc). See Appended mock-up image suggesting panel and gravel arrangement.

Strip 2: Dryland, short sward tussock and mat plants for other grasshopper species (*S. minutus*, *S. australis*), ground weta (*Hemiandrus* '*furoviarius*'), moths, butterflies with herbs, *Leucopogon* low-stature shrub species could divide strips two and three. Perhaps manage with limited sheep grazing.

Strip 3: Bands of shrub species bordering a second tussock corridor. Taller tussock, speargrass, prostrate herb species, with a periphery of woody species including *Muehlenbeckia* spp., *Dracophyllum* sp. possibly *Podocarpus nivalis*? No higher than 400mm.

Approximately 25 arrays would fit into 200m (including the four-metre gap between arrays). Each solar array covers about two meters of surface. Total array cover is about 10,000m2 (1 hectare, 2.5 acres), leaving 3.5 hectares for invertebrate habitat. Even if these values are incorrect, the estimate is about available surface for invertebrate habitat.

The benefit of using the north-east corner of the array is three-fold; A) The corner is at an appropriate distance from the present pivot irrigator system – from which there will be considerable over-spray, which is antagonistic to the aim of replicating a semi-arid invertebrate habitat, characteristic of this region of the Mackenzie Basin. B) the corner is accessible by a rough road, allowing for establishing, maintaining and monitoring the reserve. C) That portion of the array is close to the Pukaki River and a potential source population for *Sigaus robustus* grasshopper while simultaneously at an appropriate distance from Lake Benmore (and the potential for predation by birds).

Figure 3. Approximate location of a proposed invertebrate reserve No. 1, within the north eastern corner of the planned North Point Solar array. Old river braids are discernible in this part of the landscape and this is a benefit for the reserve as it means the surface is little modified form a pre-human state, and likely to be suitable for dryland invertebrate species.

Option 2:

This area to the east of the array surface was visited during the October 2023 site inspection. The location is conveniently peripheral to the proposed array and on closer inspection the area appeared highly suitable for *Sigaus robustus* grasshoppers, although none were seen at the time. A shallow outwash gully has down-cut into the Pukaki River bed providing a degree of surface relief and differential shading. This feature could be exploited for varying vegetation types. Currently, the scattered (but sparse) vegetation included Rose hip (*Rosa rubiginosa*), *Melicytus alpinus*, *Roulia australis*, occasional Matagouri (*Discaria toumatou*), short-stature tussock and a considerable number of wilding pines. The pines would need to be eradicated. Nevertheless, minimal effort would be required to prepare the surface for grasshopper occupancy however, erecting a predator fence would be necessary with a perimeter of at least one km, covering an area of 3-4ha (figures 5 & 6).

Figure 4. Concept for a triple-tiered invertebrate habitat reserve located in the north eastern corner of the solar farm proposal, Mackenzie Basin. The grasshopper reserve (top 'panel'), will require considerable design detail and substrate manipulation (as stoney ground) to provide the best possible environment for *Sigaus robustus* to survive. A predator fence will also be required, no higher than 1.2 m. The middle panel will have a higher density of vegetation (compared to the grasshopper habitat), primarily short tussock and low-stature herbs. The aim being to encourage local species of moth, butterfly, flies, beetles grasshoppers, weta and spiders. The lower panel will have higher and denser vegetation with the aim of encouraging a rich lepidoptera, orthoptera, beetle and spider fauna. In all cases, the habitats will necessarily be a 'corduroy' system as the arrays will occupy two-thirds of each pair of array rows. Arrays are omitted from the lower panel for simplicity.

Approximately 25 arrays will fit into 200m (including the four metre gap between arrays). Each solar array covers about 2 meters of surface. Total array cover is about 10,000m2 (1 hectare, 2.5 acres), leaving 3.5 hectares for invertebrate habitat. Even if these values are incorrect, the estimate is about available surface for invertebrates and habitat.

Option 3. South-east corner. This option has the advantage of being situated well away (diametrically opposite) from the centre pivot irrigator to the north west (Figure 7). It is also well placed to access *Sigaus robustus* habitat for grasshopper recruitment, a potential source-sink situation. An identical or similar habitat configuration to option 1 could be employed here, or a single habitat type. One disadvantage might be the road distance to service the reserve and monitor invertebrates (figure 8).

Figure 5. Invertebrate reserve area, option two on the eastern flank of the cultivated surface, adjacent to the true right bank of the Pukaki River. Comprising relatively undisturbed gravels and small stones, the area offered appropriate habitat for *Sigaus brachaspis* grasshoppers.

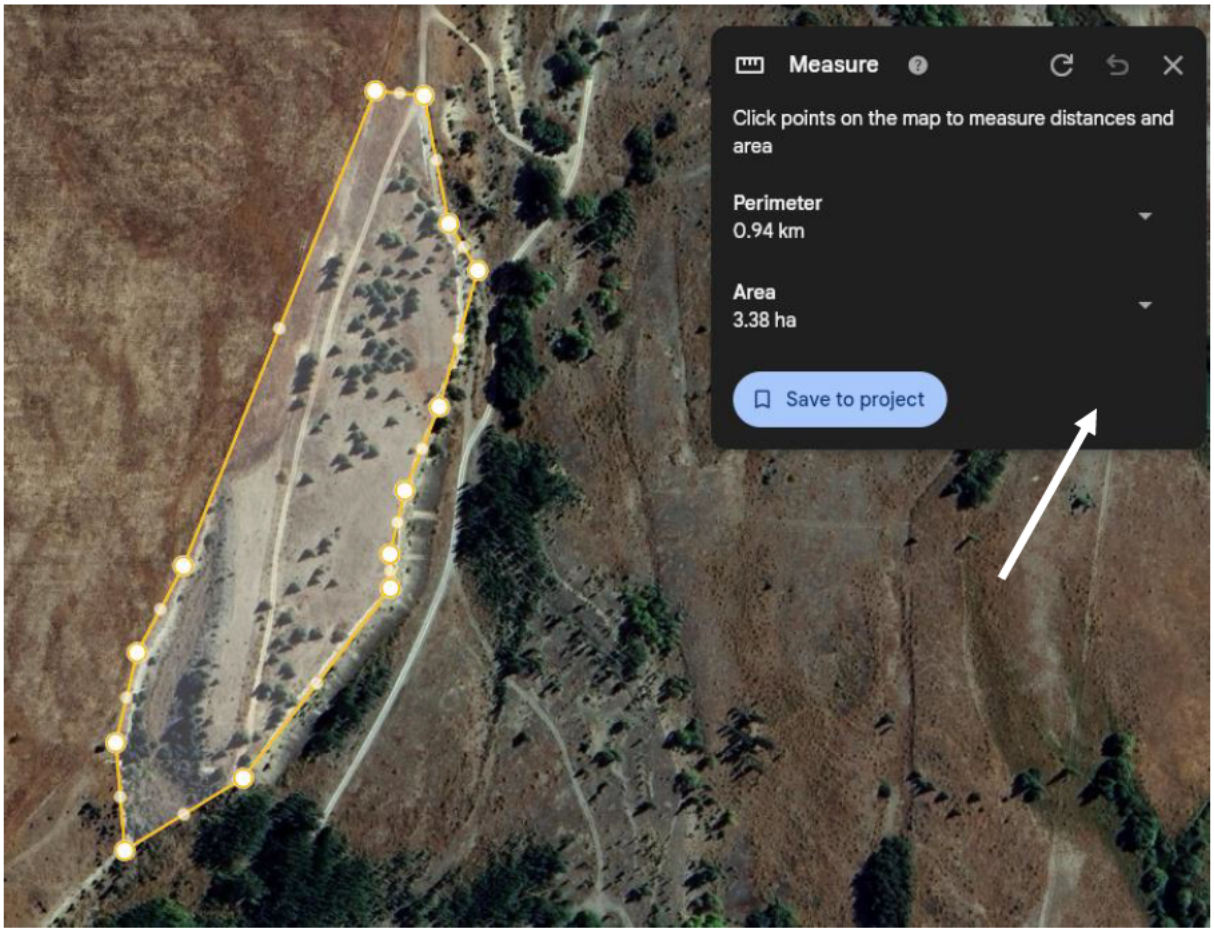


Figure 6. Google Earth close-up clip showing rough outline of the second area suitable for a *S. robustus* reserve. The outwash gully can be seen in the lower portion of the enclosed area.

Figure 7. Invertebrate reserve option 3: South-east corner, at the confluence of the Pukaki and Ohau rivers.

Figure 8. Detail of the south-east corner location with reserve overlay.

The Paterson's Terrace grasshopper reserve.

Any effort to establish an invertebrate reserve at the proposed NPSF site will need to draw on experience and knowledge acquired from the 0.6hectare Patersons Terrace grasshopper reserve, some 34 kms away near Lake Tekapo/Tākapo. Built in November 2018, the details are: a 1.2m high predator exclusion fence (Central Fencing LTD) using 1.8 m x 150mm diameter, uniformly turned posts (tanalised), 2m spacing. Steel mesh of 1.6mm, welded rather than woven with a 6.3mm aperture – i.e. 4.7mm between wires. A ground skirt, 400mm wide of mesh buried 100mm deep at posts and 160mm deep at outer edge (i.e. a sloping surface). Capping – 1.2m Z600 galvanised steel (0.9mm is ideal). The Patersons terrace fence costs came to $287.00 / metre, approximately $132,020.00 in 2019 (Figures 9 and 10).

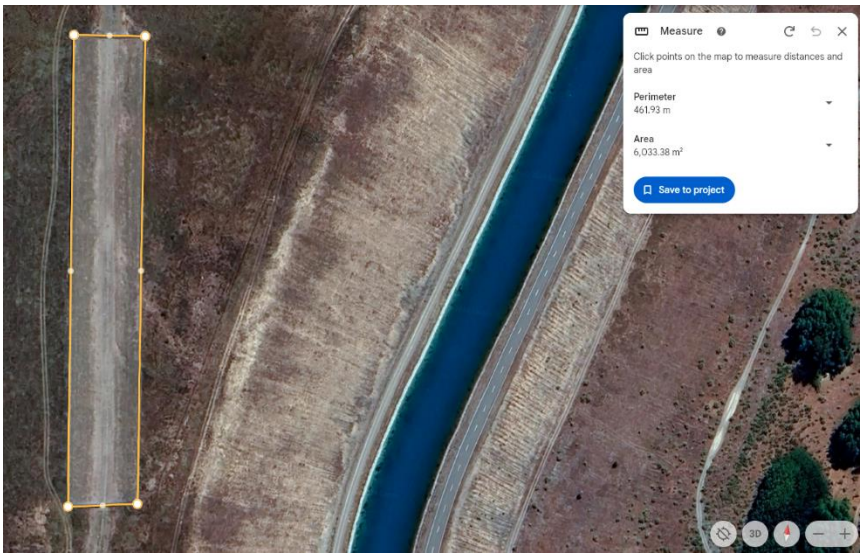


Figure 9. Layout of the Patersons Terrace Sigaus robustus grasshopper reserve, near Tekapo/Tākapo.

Figure 10. The 0.6ha Patersons Terrace *Sigaus robustus* grasshopper reserve predator-exclusion fence, near the Tākapo River. Photo: Phil Tisch, DOC.

The ability of the Patersons Terrace fence to prevent pest incursions has been successful however birds, specifically Magpies and Starlings are able to fly in and prey on the grasshoppers (and other invertebrates that may be present). This is an ongoing issue and may require either wires to prevent the bird alighting on the fence cap or possibly a more elaborate bird-scarer system (McIver 2020).

Reserve design considerations

The design and configuration of an invertebrate reserve will rely heavily on information from the following key studies:

Jennifer Schori (population methods) (Schori 2019 *et al*., Schori *et al*. 2020a, b & c)

Liam McIver 2020 (MSc thesis on Patersons Terrace grasshopper enclosure)

Rebecca Clements 2021 (MSc thesis on grasshopper translocation site selection criteria).

The biotic and abiotic factors associated with population survival of the Robust grasshopper (and other invertebrates) within a reserve, are provided in Table 1. I have listed the ecological criteria of importance, the optimal state (per criterion) and the known and proposed responses to these factors.

Table 1. Abiotic and biotic factors associated with the *Sigaus robustus* grasshopper and other native invertebrates, relevant to the construction and monitoring of a reserve.

Abiotic factors

Criterion	Optimal state / System	Action
Reserve area	At least 0.6hectare for a population density of at least 0.5 hoppers /m ^{2}.	Scale reserve accordingly. Hopper density will depend on many variables. Initial season; low with annual increase.
Substrate	Semi-spherical local stones (river bed) between 10-100mm diam.	Source from several river bed locations in the basin, or screen existing gravels on site
Structures	Predator-proof fencing for robust grasshopper at least. Potentially install artificial cover objects for weta, beetles and spider (cement design)	As per McIver (2020). This will be the most complex and expensive aspect of an invertebrate reserve. Considerable time and thought will be required to devise an optimal predator-exclusion system amongst the solar arrays. Not necessarily a post fence per se. Array pedestals could substitute for fence posts.
Environmental	A climate station will be necessary to monitor conditions (at and above ground level) and be solar powered (ironically!)	Researching and costing an appropriate climate station.
Climate change	Cool winters necessary for grasshopper egg diapause. Risk of fewer cold nights.	Collect ground temps under arrays and in direct sunlight. Monitor differences (if present). Exploit shaded/open surface differential. Correlate array climate with regional climate. Determine year at which critical threshold reached. Consider alternative (cooler) reserve locations.

Biotic factors

Criterion	Optimal state	Action
Source population(s)	Ideally acquire robust grasshoppers from a wild population within the Mackenzie Basin.	Fork Stream and Snowy River fan are candidate sites. Translocation protocols necessary (DOC SOP currently exists in DOC files), determine age cohort, sex ratio, initial numbers, monitoring regime, mating and oviposition success, egg counts, nymph hatching, tracking pop through time.
Diet	Provide appropriate plants and density for grasshoppers. *Raoulia*, *Epilobium*, lichens.	Determine ratio of plant : bare surface ratio for hoppers. Translocate plants and/or propagate plants to establish in reserve.
Predation	Nil predators.	Remove and exclude all lizards from grasshopper enclosure (s). Exotic bird control systems required - wires on fence capping etc.

Oviposition substrate	Ideal conditions for egg laying and nymph development	Mimic existing grasshopper 'hot spots'. Silty soil, sands, fine stones, sparse vegetation.
Inbreeding	Minimal to nil inbreeding risk.	Consider harvesting F2 – 3 progeny and replacing with equivalent number from (ideally) wild populations or Patersons Terrace. Consider periodic genetic tracking of heterozygosity markers.
Hybridisation	Crossing between *Sigaus nivalis* and *S. robustus* may occur.	Ensure grasshopper donor population is morphologically *S. robustus*. Periodically screen recipient population (enclosure) for *S. nivalis*. This is a very unlikely risk.
Temperatures	Equivalent to wild populations (determine those parameters from wild or Patersons Terrace population)	Monitor invertebrate enclosure for equivalent thermal regime as wild populations
Relative humidity	As above	Monitor R/H in the reserve(s).
Pre-release survey	Ensure grasshopper enclosure is free of exotic animals including invertebrate predators, including; hymenoptera, White tailed spiders, *Steatoda* spiders (false katipo, *Badumna* sp.).	Tracking tunnels, trail cams, Onduline ACO's for lizards, potentially pheromone traps and pitfall traps (removed after a withholding period).
Meso-predation	No predation on grasshopper by Birds or lizards after mammal exclusion	Exclude skinks from the enclosure. Establish tracking tunnels and mammal traps peripheral to the enclosures or open reserves.

Conclusion

The prospect of establishing a new reserve, exclusively for native dryland invertebrates, in the Mackenzie Basin is an exciting, but challenging one. Awareness of ecological values has increased in the last few decades and the ability of developers to incorporate conservation concepts into their projects builds on previous engineering and landscape efforts within the Basin. This proposal will be pioneering at all steps and may best be achieved by taking a piecemeal approach, perhaps over several years until fully realised.

The success of the proposal will be the measurable increases of invertebrates within the reserve, to the extent that re-wilding of natural populations is achievable alongside targeted returns of the solar power array. The trial will be a test case in many respects and has the potential to yield knowledge for other arrays in semi-arid environments.

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Appendix. Concept image of small-sized ‘grasshopper gravels’ between solar arrays. Gravels would probably extend under each array and afford some differential thermal properties to the surface.

Initial briefing – potential impacts of proposed 'The Point' solar farm near Twizel on threatened birds

Dr Colin O'Donnell
Principal Science Advisor
Department of Conservation
Private Bag 4715, Christchurch 8140

12 March 2024

1. Background

- Worldwide, the installation of photovoltaic power systems as solar farm facilities has increased exponentially in recent years (Dhar et al. 2020).
- The currently available evidence regarding the effects of photovoltaic installations on biodiversity is still scarce (Lafitte et al. 2023) and much of it is geographically limited mainly to the south-western United States (Lovich & Ennen 2011; Hernandez et al. 2015; Smith & Dwyer 2016; Dhar et al. 2020; Kosciuch et al. 2020;).
- It has long been recognised that mortality of birds through collisions with solar farms, electrocution, and secondary predation of injured or stunned birds is a serious impact of operating solar farms (e.g. McCrary et al. 1986; Kagan et al. 2014; Walston et al. 2016; Jeal et al. 2019; Kosciuch et al. 2020, 2021; Penniman & Duffy 2021; Conkling et al. 2023).
- For example, Smallwood (2022) estimated >260,000 fatalities in the State of California per year, and (Gruppi et al. 2023) showed that deaths were under-estimated markedly because many birds were removed by scavengers before they were identified.
- **In New Zealand, collisions with solar panels pose a serious and unresolved risk, especially to mobile wetland species, and because of the relatively high proportion of threatened bird species at some proposed solar farm sites.**

2. Potential risks to birdlife of proposed 'The Point' solar farm

The facility will cover c.650 ha of habitat used by indigenous birds for feeding and breeding and as a flyway between feeding, breeding and roosting areas. Potential impacts include:

A. Construction Phase

- Displacement because of disturbance and habitat transformation associated with the construction of the solar PV facility and associated infrastructure.

B. Operational Phase

- Continued displacement due to loss of breeding and feeding habitats.
- Collisions with the solar panels, fatalities and injuries
- Electrocution.

3. At Risk Species

- The Wildlands (2023) Assessment of Ecological Effects (their Table 2) lists 33 *indigenous* species recorded at or near the solar fam site, all of which are at risk in some form from building and/or operation of the proposed solar farm.
- In addition, I add New Zealand falcon (Nationally Vulnerable) to the list of vulnerable species. It is a highly mobile bird of prey that has been recorded regularly in surrounding farmland areas, and birds may be attracted to the solar farm to scavenge on killed or injured birds.
- **18 of these species at-risk from the solar farm's operation are threatened**, and thus, the risks of displacement, mortality or injury constitute a significant risk (Table 1).
- Beyond those species resident in the area (Table 1), solar farms are also known to impact migratory species (Chock et al. 2021). Thus, shorebirds migrating to and from breeding areas in Otago and Southland may represent additional risks.
- Based on extrapolating from the overseas literature, non-threatened species, including songbirds are equally at risk.
- Of the species I identify in Table 1, three are likely to lose breeding habitats (NZ pipit, banded dotterel, SI pied oystercatcher), although it is possible other species might be affected. The survey done by the applicant's consultants was very short-lived and occurred after the core breeding season of the species mentioned. The applicants have not attempted to measure the quantum of potential loss.
- Five species I identify in Table 1, are likely to lose feeding habitats (black-fronted tern banded dotterel, SI pied oystercatcher, NZ pipit, black-billed gull), although its possible other species might be affected. The survey done by the applicant's consultants was very brief. The applicants have not attempted to measure the quantum of potential loss.
- 18 species are at risk of collisions, which may include injury or death, both through collision trauma or because of an inability to take off from the ground (the case with the crested grebe).
- These species include 3 very rare Nationally Critical species (kakī/black stilt, matuku hūrepo/Australasian bittern, kōtuku/white heron) If collisions occur, as they have in similar species overseas, this could have a significant impact on their small, vulnerable populations.
- Given that almost the entire world population of 30-40[1] breeding pairs of kakī/black stilt live and nest in close proximity to the proposed solar farm (including their captive rearing centre, just 6-7 km from the northern edge of the site), if collisions occur, this would have a significant impact on population viability.
- Kakī/black stilt are highly mobile, and so are likely to traverse the solar farm site frequently, putting them at risk. For example, Van Heezik et al. (2009) commonly recorded hundreds of movements among wetlands across the Mackenzie basin over a two-year period.
- Similarly, matuku hūrepo/Australasian bittern, are highly mobile among networks of wetlands (Dr E.M. Williams, DOC Science Advisor, pers. comm.). My database contains 106 records of matuku hūrepo/Australasian bittern from the Mackenzie Basin, which

[1] 41 pairs during the 2023-24 summer, which was a record.

include s many sightings around the Ohau, Twizel, Pukaki and Tekapo Rivers (O'Donnell & Robertson 2016). Most bittern fly at night.

Table 1. Threatened species at risk from construction and operation of the proposed 'The Point' solar farm.

Scientific name	Common name	Primary habitat type	Threat category	Loss of breeding habitat	Loss of feeding habitat	Potential collision	Mortality of equivalent species in overseas studies
Ardea modesta	Kōtuku/white heron	Lake/Wetland/Riverine	Nationally Critical			Y	Y
Botaurus poiciloptilus	Matuku/Australasian bittern	Wetland/Riverine	Nationally Critical			Y	Y
Himantopus novaezelandiae	Kakī/black stilt	Lake/Wetland/Riverine	Nationally Critical			Y	Y
Chlidonias albostriatus	Tarapirohe/black-fronted tern	Lake/Wetland/Riverine /Dryland	Nationally Endangered		Y	Y	Y
Anas superciliosa	Pārera/grey duck	Lake/Wetland/Riverine	Nationally Vulnerable			Y	Y
Falco novaeseelandiae novaeseelandiae	Kārearea/eastern falcon	Dryland	Nationally Vulnerable			Y	Y
Hydroprogne caspia	Taranui/Caspian tern	Lake/Riverine	Nationally Vulnerable			Y	Y
Podiceps cristatus australis	Pūteketeke/Australasian crested grebe	Lake/Wetland/Riverine	Nationally Vulnerable			Y	Y
Anarhynchus frontalis	Ngutu parore/wrybill	Riverine	Nationally Increasing			Y	Y
Anthus novaeseelandiae novaeseelandiae	Pīhoihoi/NZ pipit	Dryland	Declining	Y	Y	Y	Y
Charadrius bicinctus bicinctus	Tūturiwhatu/banded dotterel	Riverine/Dryland	Declining	Y	Y	Y	Y
Haematopus finschi	Tōrea/South Island pied oystercatcher	Riverine/Dryland	Declining	Y	Y	Y	Y
Larus bulleri	Tarāpuka/black-billed gull	Lake/Wetland/Riverine /Dryland	Declining		Y	Y	Y
Porzana pusilla affinis	Koitereke/marsh crake	Wetland/Riverine	Declining			Y	Y
Porzana tabuensis	Pūweto/spotless crake	Wetland/Riverine	Declining			Y	Y
Phalacrocorax carbo	Māpunga/black shag	Lake/Wetland/Riverine	Relict			y	y
Microcarbo melanoleucos	Kawaupaka/little shag	Lake/Wetland/Riverine	Relict			y	y
Fulica atra	Australian coot	Lake/Wetland/Riverine	Naturally uncommon			Y	Y

4. Collison risk

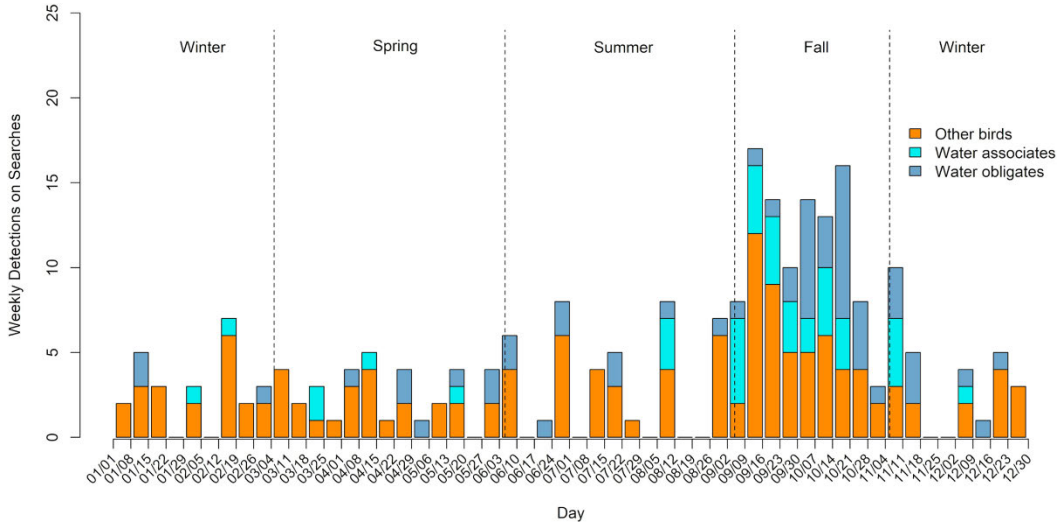
- I am not aware of any solar farms in New Zealand that have been monitoring bird mortality; most have been operating for a short time.
- The Wildlands (2023) Assessment of Ecological Effects does not appear to deal with collision risks to birds in any substantive way, although this is a known global phenomenon.
- However, based on examination of the overseas literature, collisions are common at solar farms. In addition, collisions of species similar to those that are most at risk at 'The Point' have been recorded as fatalities at numerous solar farms.
- Fatalities of bitterns, shags, egrets and herons, shorebirds, terns and gull, grebes, coots, waterfowl and birds of prey, all birds that have the same flight behaviours to the aquatic

species I identify as of risk from collisions, have all been recorded at solar farms overseas.

  - For example, Conkling et al. (2023) recorded fatalities at 7 solar farms, which included 5 tall-legged shorebird species (similar to kakī/black stilt which is at risk from this proposed farm), 8 species of heron and egret (similar to kōtuku/white heron), 2 species of bittern (similar to matuku hūrepo/Australasian bittern), 5 grebe species (similar to pūteketeke/crested grebes), 22 waterfowl species (similar to grey duck), 1 coot species (similar to Australian coot), 10 rail species (similar to marsh and spotless crakes), 9 short-legged shorebirds (similar to banded dotterel and wrybill), 5 gull species (similar to black-billed gulls, Caspian tern and black-fronted terns), 1 shag species (similar to black and little shag), 3 species of falcon (similar to NZ falcon) and 1 pipit species (similar t NZ pipit). I could not find any records of oystercatcher colliding with solar farms, although American oystercatchers don't tend to occupy the sites that Conkling et al. studied).
  - Similarly, Kosciuch et al. (2021) also noted fatalities of similar species to those at risk at 'The Point', such as white heron, mallard duck, western grebe *Aechmophorus occidentalis* and sora *Porzana carolina*.

- Estimates of mortality in the literature vary. For example, McCrary et al. (1986) estimated 1.9–2.2 individual bird deaths per week at one solar farm whereas Kosciuch et al. 2020 estimated fatalities of up to 11 water birds/week alone, especially in autumn (see Figure 1 below).
- There are numerous other examples in the overseas literature of species fatalities of ecological equivalents to the vulnerable species that occur in and around 'The Point'.
- **Even low mortality rates can incrementally add significantly to the extinction risk of rare and threatened species.**

Figure 1. Mortality rates of aquatic birds at 7 sites from January 1, 2013, to September 1, 2018 in the Sonoran and Mojave Deserts and Great Basin Bird Conservation Regions (from Kosciuch et al. 2020).



5. **Why do birds collide with solar farms?**
    - Overall, there is a paucity of research on why birds collide with solar farms.
    - There is confusion in the literature about the reasons for collisions, partly because the frequency of bird fatalities varies considerably among individual solar farms and researchers have not figured out which sites are more vulnerable (Walston et al. 2016).
    - In some cases, it has been hypothesised that there is a "lake effect" whereby birds, and their insect prey, mistake the solar farms as areas of open water, crashing into them to feed, rest or drink. Such an effect potentially occurs day or night.
    - Figure 2 and solar panel exemplar images provided by the applicants; Appendix C of EIA) illustrate just why birds might confuse solar farms with high densities of horizontal panels as water bodies.
    - The high percentage of waterbird mortalities at the Desert Sunlight PV facility in California (44%) (Kragan et al. 2014) may support the "lake effect" hypothesis. In this case, the proximity of nearby ponds may act as an additional risk factor, because birds were already attracted to water features in the area and habituated to the presence of an accessible aquatic environment (CVR Consulting 2022).
    - However, regardless, of the cause, bird mortalities at solar farms overseas are a major issue, regardless of whether it is the "lake effect" driving that mortality or not (Ahmed 2022; Kosciuch 2021).

Figure 2. Example of a solar farm that may be perceived as a water body by flying birds (AC Energy Corporation's 63 MW GigaSol Palauig solar farm in the Phillipines; AC Energy's 63 MW GigaSol Palauig Solar Farm Now Operational - SolarQuarter)

6. **Flyway risk at 'The Point'**
    - Of the 3 solar farms I have gave advice on in the last year, all were in highly developed agricultural landscapes in the North Island, and not in areas with exceptionally busy bird flight paths nor the location of so many threatened species in high numbers as is the case with the proposed 'The Point' solar farm.
    - The proposed farm is at one of the busiest known bird flyways in the Mackenzie basin; being located adjacent to numerous breeding birds on the Twizel, Pukaki, Tekapo and Ōhau Rivers, and comprising a complex mosaic of wetlands and braided river breeding habitats, often within 100 m of site (AEE Section.3.5.3).
    - DOC only has detailed data on frequency of movements of one of the threatened species present in the area (black-fronted tern). It is highly likely that there are similar, numerous bird movements back and forward across the site performed by the other species listed in Table 1.

7. **Flyway risk for black-fronted terns (Nationally Endangered)**
    - Figure 3 illustrates the collective movements of 49 black-fronted terns, which have had new generation GPS trackers attached to them in the Mackenzie Basin in summers of 2020-21 (Sam Krouse, Emma Williams DOC). These new generation trackers can provide minute-by-minute accurate locations, altitudes, timing, flight speeds and flight paths of overall movements. Until recently, this technology has not been available.
    - This snapshot of black-fronted tern activity (Figure 3) clearly shows high activity levels over the proposed wind farm site in the summer breeding season. These movements constitute both feeding activity and flights to and from their night roost on the Tekapo River delta.
    - The Figure overlays numerous tracks for individual birds, so Figures 4 & 5 provide examples of tracks of two induvial birds to demonstrate the intensity of flights at an individual level.
    - However, these are just brief snapshots of activity, as the power supplies of these trackers is short lived (Average number of days a transmitter collected data (at least one location) = 34 (1-147 days).
    - Thus, activity over the site will be much higher than this. For example, we know that >350 birds roost each night at the Tekapo River delta from different nesting colonies from the Ahuriri, Ohau, Pukaki and Tekapo Rivers at least.
    - This figure is likely a big underestimate, because most birds re active at the site in the middle of the night when observers cannot count them (Figure 6).
    - The terns using major roost sites like this begin to arrive at dusk and continue to arrive after dark into the small hours of the morning. Departures start before dawn and continue until approximately an hour after it gets light. Most terns arrive and depart roost sites in flocks of 3-30 birds, but there are some pairs and individuals and also some flocks of up to 50. Therefore, movement data from tracking one bird is likely to indicate multiple birds flying to/from the roost on that path at that time (Katie Gray, University of Otago).

Figure 3. Tracks of 49 black-fronted terns (Nationally Endangered) overlapping the proposed solar farm site (red hatched polygon; black hatched polygon = 1 km buffer around site)

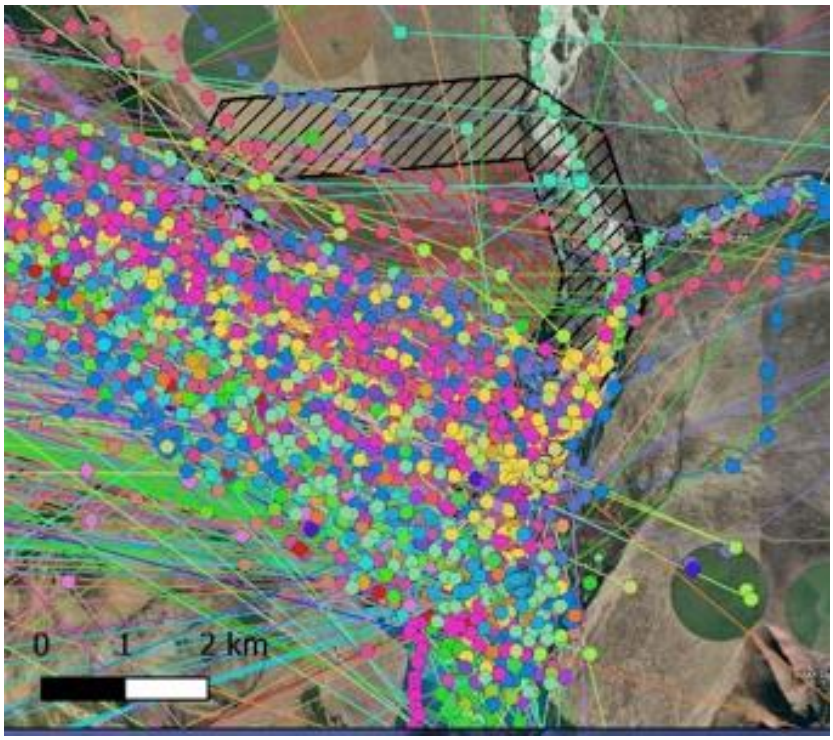


Figure 4. Track black-fronted tern TAG 9451 over the proposed solar farm site (INSET - red hatched polygon; black hatched polygon = 1 km buffer around site).

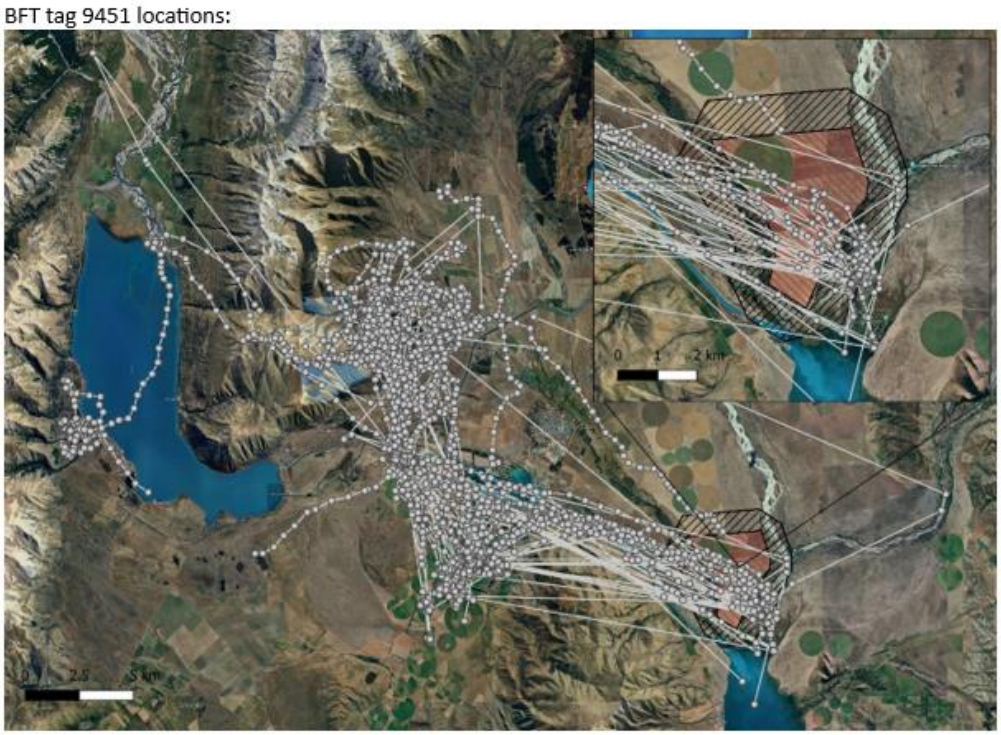


Figure 5. Track black-fronted tern TAG 9404 over the proposed solar farm site (INSET - red hatched polygon; black hatched polygon = 1 km buffer around site)

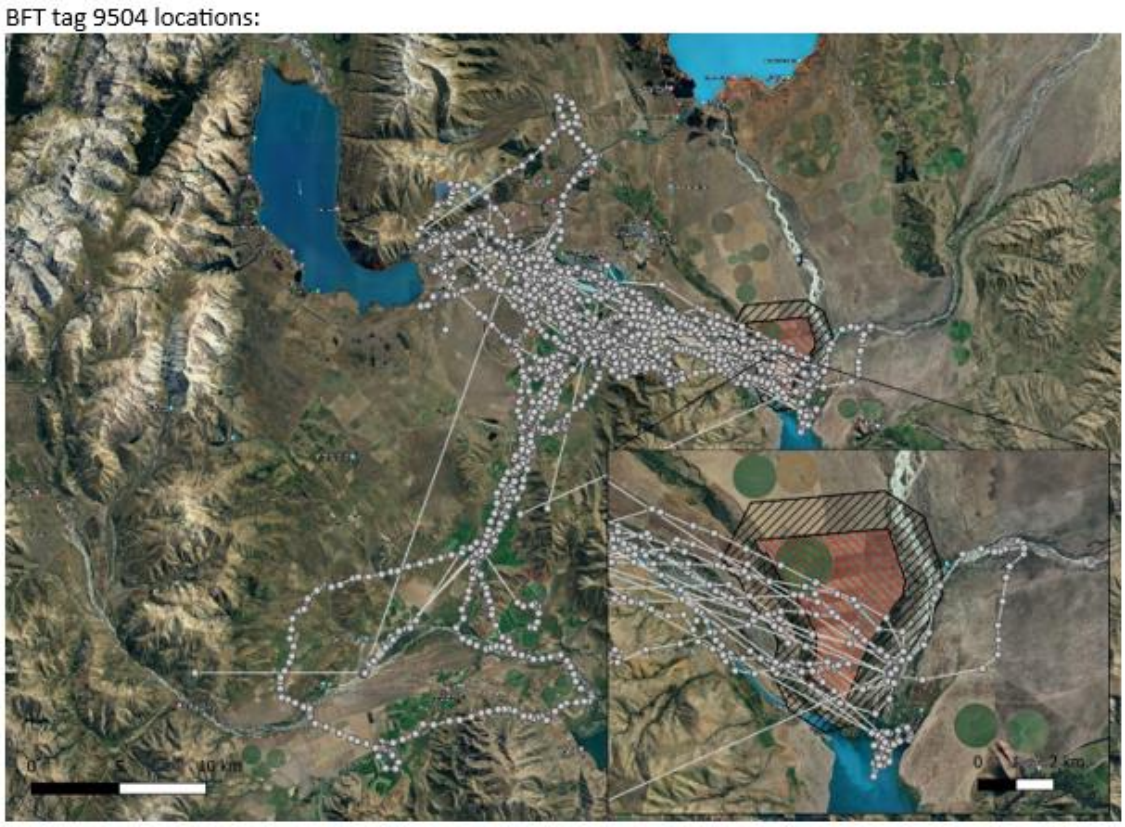
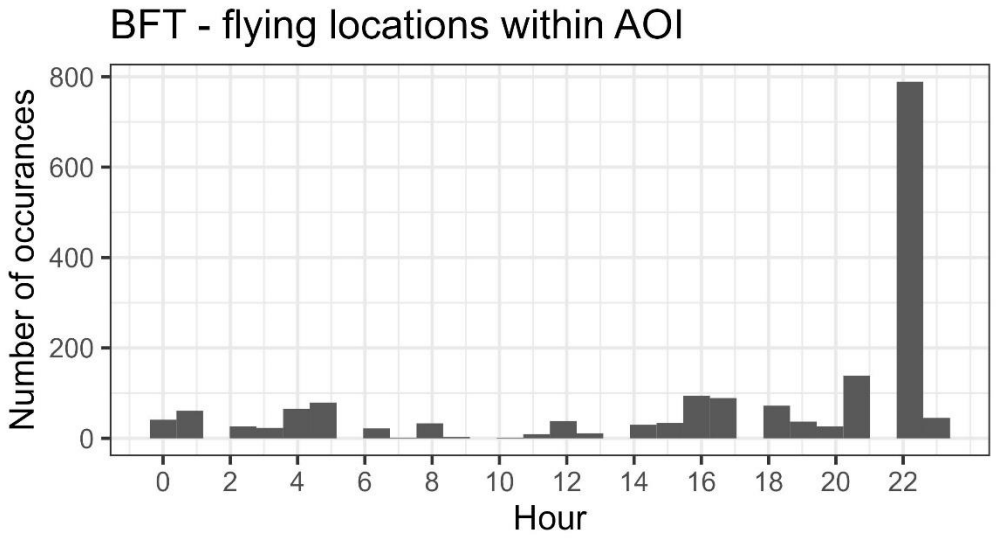
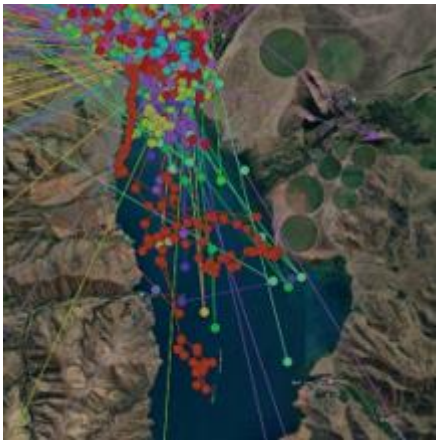


Figure 6. Time of day of black-fronted tern tracks over the proposed solar farm site.



8. **Will black-fronted terns and other threatened species be attracted to the solar farm?**
    - It is unknown if water birds will be attracted to 'The Point' solar farm and mistake it for another water body. The applicants do not appear to have investigated this at all.
    - DOC's data show that black-fronted terns commonly fly, feed and rest over lakes in the Mackenzie basin (Figure 7), a factor which is thought may predispose water birds towards colliding with solar farms in North America.

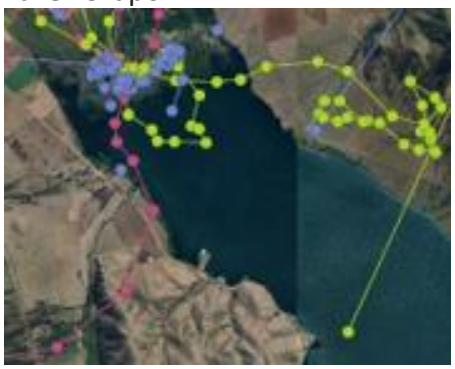
Figure 7. Examples of black-fronted terns feeding or resting over ort on Mackenzie basin lakes.



Haldon Arm, Lake Benmore

Lake Tekapo

Lake Pukaki



Ahuriri Arm, Lake Benmore

9. **Potential methods that may reduce bird collision**s
    - The diversity of birds dying at solar facilities overseas, and the differences among sites, suggest that there is no simple 'fix' to reduce avian mortality.
    - There are several techniques available that may reduce the risk of fatalities:
        1. Use vertically configured bifacial solar panels (i.e. at right angles to a horizontal plane) to minimise the continuous visual stimulus of looking like a water body).
        2. Position panels vertically at night, which might reduce the reflective profile for nocturnal flying species (Figure 8).
        3. Create significant gaps among sets of panels – so that to minimise the continuous visual stimulus of looking like a water body (Figure 8).

4. Raise heights of panels and combine with large gaps to ‘break the visual profile’ even further.
5. Apply anti-reflective coating in the **hope** it will reduce glare off panels.
6. Use appropriate insulators and have no bare wiring to reduce electrocution risk.
7. Minimise lighting at night, to reduce potential attractiveness.

- Having noted these possibilities, although there are now well-researched economic advantages of these approaches for both energy capture and agricultural production, I am unaware of any of these potential mitigation techniques being tested for reducing bird collisions in New Zealand (or elsewhere).

Figure 8. Examples of a solar farms demonstrating the use of vertical panels and creation of gaps among panel groups (From scientific paper by Willockx et al. 2023 -top and Krexner et al. 2024 - bottom)

10. Monitoring and adaptive management

- Actions like those postulated in (9) above are likely to reduce, but not eliminate fatalities; by what quantum is unknown.
- Given the complete uncertainty about magnitude of effects, especially on Nationally Critical Threatened species, allowing a solar farm like this go ahead would be potentially catastrophic to the long-term viability of these species, even if small numbers are killed regularly.
- Applying a rigorous monitoring programme to record the existence and magnitude of fatalities would certainly provide knowledge on the true risks of a solar farm such as that proposed at te Point, to be applied to future developments.
- However, if there were catastrophic effects, it would be unlikely that there would be an appropriate adaptive management response beyond decommissioning the farm and entering an expensive recovery phase for the species in question.

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