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Draft Terrestrial Invertebrate Management Plan for the Point Solar Farm at Twizel, Canterbury

Contract Report No. 6621h-ii

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Draft Terrestrial Invertebrate Management Plan for the Point Solar Farm at Twizel, Canterbury

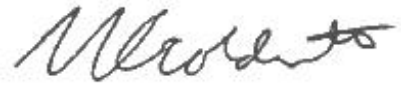
Contract Report No. 6621h-ii

February 2026

Project Team:
Vikki Smith – Report author and technical adviser
Nick Goldwater – Report review

Prepared for:
Far North Solar Farms Ltd
Level 1, Unit 17
11D Factory Road
Waimauku Village Centre
Auckland, 0812

Reviewed and approved for release by:



Nick Goldwater
Senior Principal Ecologist
Wildland Consultants Ltd
20/02/2026

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Cite this report as follows:

Wildland Consultants. (2026). *Terrestrial Invertebrate Management Plan for the Point Solar Farm at Twizel, Canterbury*. Wildland Consultants Contract Report No. 6621h-ii. Prepared for Far North Solar Farms Ltd. 31pp.

Christchurch Office
238 Annex Road, Middleton, PO Box 9276, Tower Junction, Ph 03-338-4005

Head Office
99 Sala Street, PO Box 7137, Te Ngae, Rotorua Ph 07-343-9017 Email: rotorua@wildlands.co.nz

www.wildlands.co.nz

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1.0 Introduction

Far North Solar Farms Ltd (FNSF) are preparing an application for approval under the Fast Track Approvals Act (2024) for a proposed solar farm located near the township of Twizel in the Mackenzie Basin (referred to as 'the proposed development'). The proposed development comprises a footprint of approximately 687 hectares of flat cultivated land ('the site') on a river terrace, bounded by farmland to the north and braided rivers on the eastern (Pukaki River) and western (Twizel River) boundaries.

Wildland Consultants Ltd (Wildlands) has previously prepared an Ecological Enhancement Plan (EEP, Wildlands 2025) which identified important ecological values at the site, including the potential for Threatened and At Risk invertebrates, specifically at the edges of the site bordering the braided rivers. The EEP also identified a need for specific management plans to manage effects on indigenous flora and fauna at the site, and to inform future management strategies in the context of the development.

This Terrestrial Invertebrate Management Plan (**TIMP**) outlines the measures recommended for minimising the impacts on indigenous invertebrates at the site.

1.1 Project site and context

The site covers 738 hectares and is located approximately 10 kilometres to the southeast of Twizel in the Mackenzie Basin, within the wedge that forms the Ōhau Tekapo Delta (Figure 1). The Mackenzie Basin is known to hold important invertebrate values, including many species endemic to the local area (Wakelin et al. 2024).

The proposed solar farm site is mostly flat and underlain with alluvial gravels. Most of the site is currently grazed farmland, and part of it is cultivated and cropped seasonally. The entire site was cultivated in 2018.

1.2 Summary of surveys

Wildlands has previously prepared several reports for this site, including the EEP, which identified the potential presence of Threatened and At Risk invertebrate species at the site. Grasshoppers and wētā (order Orthoptera) values were expected to be of relevance to the site, specifically along the eastern and western edges.

A walkthrough field survey was undertaken in February 2023 to search for notable invertebrates and their habitat. The only notable[1] invertebrate found was the New Zealand blue butterfly (*Zizina oxleyi*; Not Threatened as per Hoare et al. 2017). However, values for several At Risk and Threatened grasshopper species were suspected at the edges of the site. Further surveying was recommended.

[1] Notable invertebrate species are either listed as At Risk or Threatened, protected under the Wildlife Act, short-range endemics, naturally rare, large-bodied and vulnerable to habitat loss or predation by introduced species, or believed to be declining by experts (Wildland Consultants 2025).

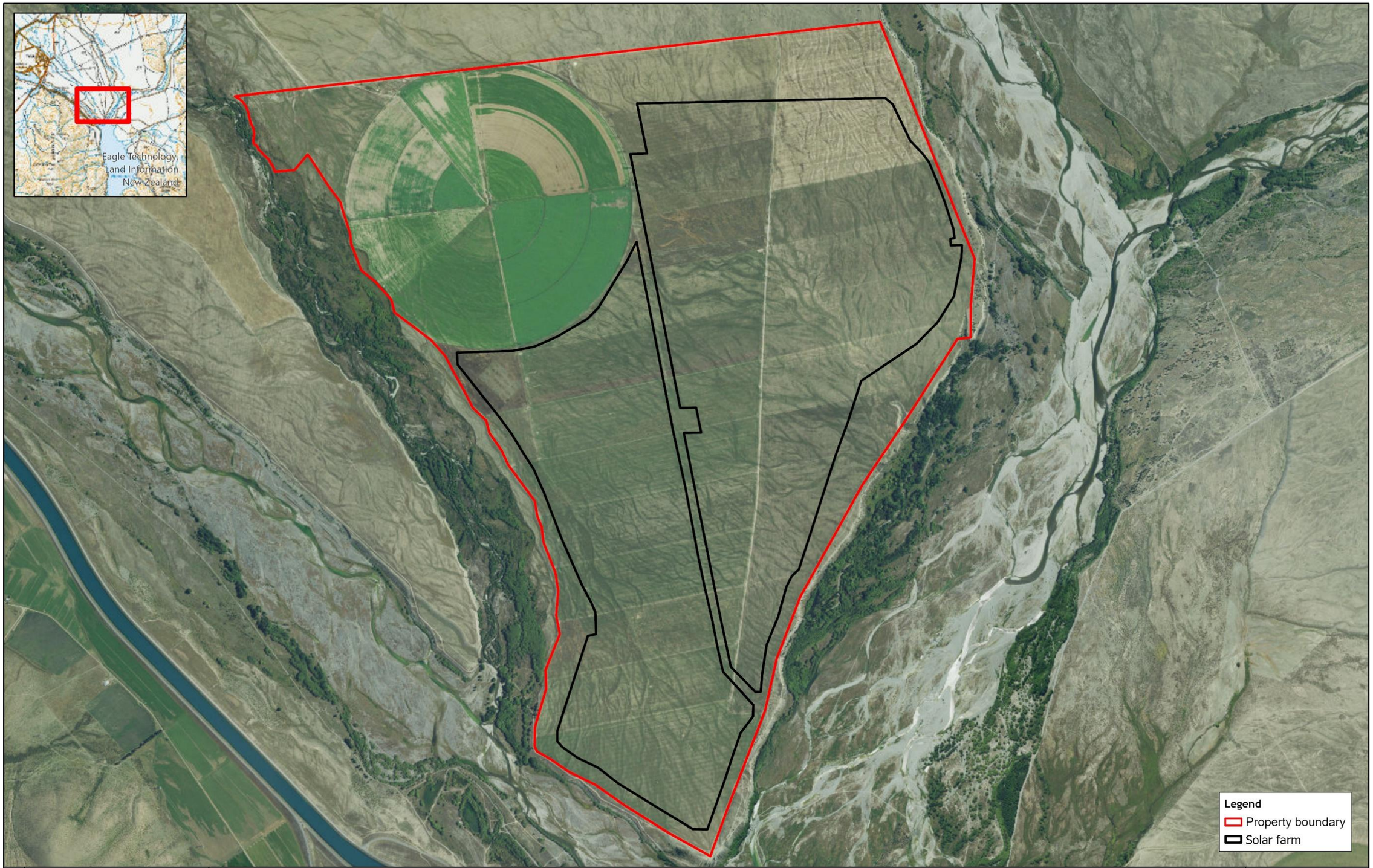

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Figure 1. Location of the proposed Point Solar Farm, MacKenzie Basin

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A survey in February 2026 focused more heavily on the edges of the site, where the highest invertebrate values were predicted. This survey found Threatened and At Risk grasshoppers, although only one At Risk species was found within the site.

Survey results are presented in Section 3.0.

2.0 Implementation of the plan

The previous Assessment of Ecological Effects (**AEE**) for the site undertaken by Wildlands includes the following reports:

- Wildland Consultants (2023). *Ecological Assessment for Two Solar Farm Sites in the Mackenzie District, South Canterbury*. Wildland Consultants Contract Report No. 6621. Prepared for Far North Solar Farms Ltd. 45pp.
- Wildland Consultants (2025a). *Assessment of Ecological Effects for the Proposed Solar Farm Between the Lower Reaches of the Tekapo and Twizel Rivers, Mackenzie District.* Wildland Consultants Contract Report No. 6621c. Prepared for Far North Solar Farms Ltd. 57pp.

The TIMP intended to be implemented in conjunction with the following management plans:

- Wildland Consultants (2026a). *Draft Lizard Management Plan for The Point Solar Farm, Twizel.* Wildland Consultants Contract Report No. 6621h-v. Prepared for Far North Solar Farms Ltd. 45pp.
- Wildland Consultants (2026b). *Draft Pest Mammal Management Plan for The Point Solar Farm, Twizel.* Wildland Consultants Contract Report No. 6621h-iv. Prepared for Far North Solar Farms Ltd. 28pp.
- Wildland Consultants (2026c). *Draft Vegetation Management Plan for The Point Solar Farm, Twizel.* Wildland Consultants Contract Report No. 6621h-iii. Prepared for Far North Solar Farms Ltd. 21pp.

3.0 Ecological Values for Terrestrial Invertebrates

3.1 Overview

The Mackenzie District is a rare and highly valuable habitat for New Zealand's invertebrate fauna, supporting many At Risk, Threatened, and locally endemic species (Wakelin et al. 2024). The proposed solar farm site presents a highly modified portion of dryland terrace habitat. The east side of the site features a field with dry, gravelly and stony soil that was last cultivated in 2018, after which it has reverted to short, dry grass with patches of short-stature herbfield and bare earth and rock. These conditions are preferred habitat for some species of Threatened and At Risk grasshopper and wētā. Similar values are found near the western edge of the site, but most of the central and western portion of the site is farmed and has dense, moist, green exotic vegetation and long dry grass, which is not favoured habitat for grasshoppers. Leguminous plants, primarily introduced clovers and brooms, are found throughout the site and provide habitat for New Zealand blue butterfly.

3.2 2023 survey results

A walk-through and sweep net survey of the site was undertaken in February 2023 (Wildlands 2024). The site was considered to be lacking in invertebrate values, both in terms of habitat and species detected during the field survey. However, four species of interest were identified as possibly being

present: Tekapo ground wētā (*Hemiandrus fabella*; Threatened - Nationally Endangered as per Trewick et al. 2022), robust grasshopper (*Sigaus robustus*[1]; Threatened - Nationally Endangered), Otago short-horned grasshopper (*Phaulacridium otagensis*; At Risk - Declining), and minute grasshopper (*Sigaus minutus*; Threatened – Nationally Vulnerable). One notable species was confirmed present: New Zealand blue butterfly.

3.3 2026 survey results

In February 2026, a walkthrough survey was undertaken to specifically target potential grasshopper habitat in the eastern field and the eastern and western edges of the site. Figure 2 shows the area surveyed and the results. New Zealand blue butterfly was found throughout the site in relatively large numbers. Many Otago short-horned grasshoppers were found even in relatively poor-quality habitat. Minute grasshopper were found off-site close to the western edge of the site (Plate 1), along with a small strip of habitat that could potentially support robust grasshopper.

A gully in the eastern field has steep gravel sides, which could possibly support robust grasshopper although the steepness makes it unlikely to be present. No other robust grasshopper habitat was identified on site. Despite ideal conditions, no robust grasshopper were found there or anywhere else on site.

Plate 1 – Minute grasshopper found outside the western boundary of the site of the proposed solar farm.

Various species of ground beetle and indigenous short-range endemic moths are found within the local area and may also be present on site. A breakdown of all invertebrate taxa confirmed or potentially on site, their notability, and their preferred habitats is presented in Table 1.

Table 1 – Notable species found or suspected to be present at the site of the proposed solar farm.

[1] Previously known as *Brachaspis robustus*, but recently placed in the genus *Sigaus* (Trewick, Koot, and Morgan-Richards 2023)

Species Common Name	Presence On Site	Notability	Ideal Habitat
New Zealand blue butterfly	Confirmed	Suspected to be declining	Open, sunny rocky areas with leguminous plants (such as *Carmichaelia* spp.) nearby as a larval food source
Minute grasshopper	Likely	Threatened – Nationally Vulnerable	Dry, open, sunny areas with bare soil or rocks, and short- stature herbfield plants (e.g. *Raoulia australis*) to feed upon.
Tekapo ground wētā	Possible	Threatened – Nationally Endangered	Braided river terraces. Requires suitable soil for burrowing. Habitat constraints are not well-understood.
Robust grasshopper	Unlikely	Threatened – Nationally Endangered; protected under the Wildlife Act.	Dry, open, sunny braided riverbeds with a large cover of gravel and rocks, and sparsely distributed short-stature herbs such as *Raoulia australis*.
Otago short-horned grasshopper	Confirmed	At Risk - Declining	Dry, open, sunny areas with bare soil or rocks, and short-stature herbfield plants to feed upon.
Notable ground beetles	Possible	Many are short-range endemics, vulnerable to predation and habitat loss	Differs depending on species, but dry rocky areas and indigenous vegetation suit most local species.
Short-range endemic moths	Possible	Many are short-range endemics, vulnerable to predation and habitat loss	Differs depending on species, but indigenous plants including grasses, herbfield species, and shrubs suit most local species.

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Figure 2. 2026 invertebrate survey and results at The Point Solar Farm

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Date: 18/02/2026
Cartographer: HM
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3.3.1 Survey limitations and knowledge gaps

The Point is a large site which could not be entirely searched within the time available. While the distribution and abundance of notable species on site can partially be inferred from the data collected so far, a greater resolution of the distribution and abundance of habitat could be gained using aerial imagery from an unmanned aerial vehicle (UAV). While inferring grasshopper habitat from UAV imagery is not a standard method and would be experimental, ground-truthing the data would be simple from the 2026 survey results, resulting in more robust conclusions about the locations of grasshopper habitat.

Tekapo ground wētā may be present on site, but to find them would require a Tekapo ground wētā survey using tracking tunnels and/or live-capture pitfall traps. These orthopterans are nocturnal and live in burrows during the day. They are considered possible on site, but not likely, since the site was cultivated in 2018 and would likely have removed any burrows present. Any local population may expand onto the site, although this would occur slowly.

Some invertebrate species, including the robust grasshopper, have well-studied habitat requirements. However, ground beetles, the Tekapo ground wētā, and most other invertebrates are not well-understood. Invertebrate enhancement at The Point Grasshopper Reserve will present potential avenues for scientific research into invertebrate habitat requirements, helping to fill in the gaps in our knowledge.

4.0 Potential Effects on Invertebrates

4.1 Habitat removal

Construction of roads, buildings, infrastructure and panels will require removal of a relatively small amount of habitat compared to the size of the site. The site contains few small patches of poor-quality habitat for minute and robust grasshopper which are mostly outside the panel area, but the panel area includes large patches of good quality habitat for New Zealand blue butterfly, and variable quality habitat for Otago short-horned grasshopper and other invertebrate species. Therefore, the amount of high-quality habitat to be removed is relatively small and mostly impacts New Zealand blue butterfly and Otago short-horned grasshopper. The level of effect without management is likely to be **minor.**

4.2 Mortality and disturbance

Earthworks are likely to disturb and kill notable invertebrates (primarily New Zealand blue butterfly and Otago short-horned grasshopper). Dust and vibration from vehicles are likely to cause stress and increase incidence of disease and mortality rates. Vehicle strikes will cause mortality of invertebrates. Effects are limited to where earthworks and construction will occur but may travel some distance and impact nearby areas. Robust grasshopper habitat off site, and the small amount on site but outside the panel area, may be impacted by these effects, for example by dust being blown into the habitat.

Effects of mortality and disturbance are likely to be **minor** without management.

4.3 Habitat modification

Shading from solar panels is likely to alter the microhabitat beneath the panels. Grasshoppers and other invertebrates (including New Zealand blue butterflies) require sun to bask, and reducing the amount of sunlight reaching the ground will be detrimental to these species. The shading will likely also increase moisture and encourage exotic plants to grow, leading to tall exotic vegetation replacing dryland herbfield and open areas of bare earth and rock. This will lead to the disappearance of Otago

short-horned grasshopper habitat within the panel area. This effect will be **minor** throughout most of the site, but in the eastern field and the western edges of the site, where important grasshopper habitat is clustered, it will be **significant** due to the large amount of Otago short-horned grasshopper habitat lost, which may also support minute grasshopper.

4.4 Creation of concrete and gravel areas

The solar farm development will require roads and an increase in the amount of concrete on site. Concrete provides a warm, flat surface for basking, which may benefit New Zealand blue butterflies and grasshoppers. Where areas of concrete are created and interspersed with short-stature indigenous herbfield plants, this may create new habitat and result in a **net positive** effect.

4.5 Significance of effects

The level of ecological effects on indigenous invertebrates **without** mitigation actions taken are presented in Table 2.

Table 2 - Potential level of effects on terrestrial invertebrates and their habitats without mitigation.

Effect	Expected Level of Effect Without Management
Habitat removal	Minor
Mortality and disturbance	Minor
Habitat modification	Minor/Significant
Creation of concrete and gravel areas	Net positive

4.6 Management of effects

4.6.1 Overview

This section sets out the methods that will be used to avoid or minimise potential adverse effects on notable invertebrate biodiversity, but particularly grasshoppers, New Zealand blue butterfly, and wētā. This TIMP defines 'notable invertebrates' as any species that meets at least one of the following criteria:

- Protected under the Wildlife Act (1953); or
- Threatened or At Risk, having been assessed under the New Zealand Threat Classification System; or
- Locally endemic[1]; or
- Large-bodied and reliant on a specific indigenous habitat type.

This TIMP is designed to be implemented alongside the Lizard (LMP), Avifauna (AMP), and Vegetation (VMP) Management Plans. The approach to management invokes the effects management hierarchy, which is to avoid, remedy or mitigate adverse environmental effects as outlined in the Resource Management Act.

[1] Locally endemic generally means restricted to an ecological district, though the species' range must be considered in the context of its dispersal ability.

4.6.2 Avoidance of important habitat

Where possible, construction should avoid indigenous broom plants (*Carmichaelia* spp.) to retain habitat for New Zealand blue butterfly.

Habitat for minute and robust grasshopper has been avoided by the panel layout, as it is only present around the edges. Some of the Otago short-horned grasshopper habitat in the eastern field close to the centre of the site could potentially support minute grasshopper, but it is unlikely. Otago short-horned grasshopper habitat cannot be entirely avoided.

4.6.3 Dust and vibration management

Managing dust and vibrations will avoid its impact on indigenous invertebrates. In dry weather or if traffic is travelling at high speed, some dust effects may occur, primarily during the construction period but to a lesser extent throughout the life of the project. A dust management plan is recommended. Dust management measures should include:

- Monitoring dust levels visually while travelling along tracks and reporting high levels of dust indicated by large plumes, or dust travelling more than 20 metres from the track.
- Using water trucks to dampen dusty tracks before and during use if high levels of dust are reported.
- Implementing and enforcing speed limits. The speed limits should be decided based on dust levels caused by vehicles moving at different speeds.
- Avoiding work during particularly dry weather if work sites cannot manage dust using other methods.

Vibration management methods should include:

- Implementing and enforcing speed limits throughout the site.
- Avoiding driving on or near restored areas of habitat or known grasshopper habitat.

4.6.4 Creation of a pest mammal-free invertebrate enclosure

A 13.8-hectare pest mammal-free enclosure (here in referred to as 'The Point Grasshopper Reserve' or 'the reserve') is planned to be erected on site, encompassing good quality Otago short-horned grasshopper habitat on site outside the panel area (Figure 3). This habitat will be enhanced for Otago short-horned grasshopper, minute grasshopper, robust grasshopper, and New Zealand blue butterfly among other invertebrates. Placing the reserve adjacent to robust grasshopper habitat on the braided riverbed will increase the likelihood of robust grasshopper entering and inhabiting the reserve. Excluding pest mammals will promote the recovery of Tekapo ground wētā if they are present on site, or if populations are nearby.

Enhancement for the habitat within The Point Grasshopper Reserve will be as follows (Warren Chinn, pers. comm.):

- Topsoil will be removed and replaced with locally-sourced pebbles and gravel.
- Weeds and shrubs will be removed without spraying, such as mechanically or by hand. Any indigenous shrubs will be left in place.
- The reserve will be planted sparsely with indigenous short-stature herbfield species (Table 3). At the western end of the reserve, plantings can become more dense to provide food and shelter

towards increased invertebrate diversity, but at the eastern end of the reserve, grasshoppers will be the focal species for restoration.

- Eradicate all mammalian pests within the reserve (refer to the Pest Mammal Management Plan; PMMP; Wildlands 2026).

4.6.5 Restoration planting

Although measures described in this section cannot be implemented within the footprint of the solar farm development and may therefore technically be considered as compensation, they are designed to benefit populations of invertebrates currently living elsewhere on site. Restoring large areas of habitat for invertebrates on site but outside the footprint of the development could potentially be of great benefit to invertebrate populations on site, more so than attempting to enhance habitat underneath solar panels that may no longer be suitable for invertebrates within the solar farm footprint. Therefore, enhancement planting within the site but outside the footprint of the development is considered to be remediation rather than compensation.

Before operation of the solar farm commences, invertebrate-friendly plants should be installed to increase the complexity of the habitat and provide more habitat for minute and Otago short-horned grasshopper. Planting should be undertaken by a suitably qualified contractor funded by Far North Solar Farms.

Throughout the site, outside the panel area, restoration planting will be undertaken to benefit terrestrial invertebrates and lizards. Many of the plants used to restore habitat for lizards will also provide habitat for invertebrates. However, to restore grasshopper habitat, short-stature plants from Table 3 should be prioritised, as grasshoppers require flat sunny surfaces for basking. Irrigation must not be used to help establish plants, instead watering sparingly and only watering individual plants until they are established in the drylands.

Additional recommendations for indigenous plantings to benefit invertebrates are provided in Tables 4 and 5. Kānuka and mānuka, although historically part of the successional scrub communities in the Mackenzie Basin, have not been selected due to the high flammability of these species[1].

4.6.6 Habitat types to create for terrestrial invertebrates

The plantings in Tables 3-5 should be used to create three kinds of habitat:

Dryland herbfield (highest priority for invertebrates; Table 3)

Dryland herbfield species are generally low-growing ground cover and mat-forming species that can easily be displaced by exotic weeds and grasses. Therefore, they should be established in dryland zones with skeletal soils, as this will limit the competition from exotic grasses and weeds. Within this planting treatment are several Threatened species and species that can be difficult to establish or not often used in restoration. Their success can be monitored to improve understanding of their needs and to focus future efforts on species that can be successfully established. While these species are difficult to establish, creating dryland herbfield habitat is vital to restoration efforts for grasshoppers, as they cannot survive in habitat with tall vegetation such as dense grasses, upright shrubs, or trees. Accordingly, The Point Grasshopper Reserve should be exclusively planted with dryland herbfield species.

[1] Refer FENZ: https://www.fireandemergency.nz/farms-rural-properties-and-rural-businesses/landscaping-with-low-flammability-plants/

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Figure 3. Location of the proposed grasshopper reserve, The Point Solar Farm, Twizel

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Table 3: Indigenous species suitable for selected dryland herbfield enrichment planting within The Point Grasshopper Reserve[1]. Grasshoppers, wētā, crickets, and moths will benefit from all these plantings. ** requires seed sourcing or propagation and is not currently offered by nurseries.

Species	Common Name	Form (Threat status*)	Notes
Carmichaelia petriei	Desert broom	Trees & Shrubs At Risk – Declining	Plant very sparingly. Dwarf native broom that grows on river terraces, terrace risers, and disturbed soils.
Carmichaelia crassicaulis subsp. *crassicaulis*	Coral broom	Trees & Shrubs At Risk – Declining	Plant very sparingly. Native broom found in upland and subalpine grassland, scrub and rock. Propagation is easy from fresh seed. Can be grown with some difficulty from semi hardwood cuttings. Dislikes humidity and once established should not be moved.
*Carmichaelia vexillata***	Dwarf broom	Trees & Shrubs At Risk – Declining	Plant very sparingly. Dwarf native broom that grows on moraines, alluvium, river terraces, terrace risers, disturbed soils, and soils derived from schist parent material. Propagation is easy from fresh seed and semi hardwood cuttings. Threats: At threat from weeds and browsing animals which inhibit flowering and fruit set. However, it must be recognised that without browsing animals many of the habitats occupied by this broom would vanish due to weed regrowth. The species' survival depends on allowing limited browsing to control weeds while avoiding levels that damage or kill it.
*Coprosma petriei***	Turfy coprosma	Trees & Shrubs	Plant sparingly. Mat-forming coprosma found at open, well-drained or rocky sites in tussock grassland or on moraine or gravel river flats. Once established can form extensive mats.
*Lepidium solandri***	Maniototo peppercress	Herbs - Dicotyledons other than Composites Threatened – Nationally Critical	Experimental planting. Plant very sparingly, a small herb of short and tall tussock grassland, bare hillsides, salt pans, grey scrub and other poorly vegetated ground. Propagation is easy from fresh seed. Threats: Less than 1,000 plants are known in the wild. Few sites protected. All sites threatened by weed competition, animal browsing, and for most sites changes in land-use management.
Muehlenbeckia axillaris	Creeping pōhuehue, creeping muehlenbeckia	Lianes & Related Trailing Plants	Plant generally. Hardy, Tolerant of hot, dry conditions.

[1] Not all species listed need to be planted and species substitutions can be made provided they are ecological suitable and meet the eco-sourcing requirements.

Species	Common Name	Form (Threat status*)	Notes
Muehlenbeckia ephedroides	Leafless pōhuehue,	Lianes & Related Trailing Plants	Plant very sparingly. A ground cover species of river flats, outwash gravels and river terraces, also found in grey scrub. Favouring open, dry, free-draining but fertile sites, usually on gravel and sandy soils, in habitats naturally free from other taller plants. Propagation is easy from fresh seed, rooted pieces and semi-hardwood cuttings. Does not like much shade. Once established very drought tolerant.
*Raoulia australis***	Mat daisy	Herbs - Dicotyledonous composites At Risk – Declining	Plant sparingly, mat daisy/cushion plant of drylands, riverbeds, open places, rocky ground, in grassland and fellfield. Threats: Habitat loss/modification through weed invasion and agricultural development (particularly irrigation and fertilisation of dryland habitats).
*Raoulia parkii***	Celadon mat daisy	Herbs - Dicotyledonous composites At Risk – Declining	Plant sparingly, mat daisy/cushion plant of upland to subalpine open places, rocky ground, in grassland and fellfield. Propagation easy from rooted pieces. Likes freely draining soil and hot sunny conditions. Intolerant of humidity.
*Senecio dunedinensis***		Herbs - Dicotyledonous composites Threatened – Nationally Endangered	Experimental planting. Plant very sparingly (or supplementary planting). Prefers shaded sites, under cover or amongst boulders, but has been gathered from open grassland. Propagation easy from fresh seed, best treated as an annual. Prefers semi-shade. Threats: Never common with an apparently naturally sporadic distribution.
*Styphelia nesophila***	Pātōtara, dwarf mingimingi	Trees & Shrubs - Dicotyledons	Plant very sparingly. Low growing prickly sub-shrub ground cover species.

*Threat status from de Lange et al. (2024) is included where applicable

Table 4: Indigenous species suitable for tussock and shrubland mosaic planting within The Point Grasshopper Reserve[1]. Butterflies, moths, flies, grasshoppers, crickets (including wētā), beetles, and spiders will benefit from all these plantings.

Species	Common Name	Form (Threat status*)	Notes
Aciphylla aurea	Golden spaniard, golden speargrass	Herbs - Dicotyledons other than Composites	Plant generally. Large herb. Hardy, prefers dry well drained site. Tolerates rocky areas and frost/wind exposure.
Aristotelia fruticosa	Mountain wineberry	Trees & Shrubs	Plant sparingly. Slow growing, small tree, can reach 9 meters tall though often is shrublike. Tolerates wide range of soils and exposed site conditions but establishes better with some cover.
Austroderia richardii	Toetoe	Grasses	Plant generally. Hardy, prefers full sun or partial shade and well-drained soil, but grows well in riparian zones. Propagation easy from fresh seed and division of established plants.
Chionochloa rigida subsp. *rigida*	Narrow-leaved snow tussock	Grasses	Plant sparingly. Large tussock, medium growth rate, tolerant of a wide range of conditions but prefers a well-drained soil. Other *Chionochloa* species (e.g. *C. macra, C. rubra,* and *C. flavescens*) could be trialled. Propagation of these species is easy from fresh seed and the division of whole plants. However, can be slow growing and harder to establish, than *C. rigida.*
Clematis marata	Clematis	Lianes	Plant sparingly (or supplementary planting). Vine, restricted to river terraces, rock outcrops and dry hillsides and scrub habitats.
Coprosma dumosa	Mikimiki	Trees & Shrubs	Plant generally. Hardy, small shrub, can grow in range of conditions, but does best with some cover and deeper soil. Propagation easy from fresh seed, and semi-hardwood cuttings.
Coprosma propinqua var. *propinqua*	Mikimiki	Trees & Shrubs	Plant widely. Very hardy shrub, can grow in wide range of conditions.
Corokia cotoneaster	Korokio	Trees & Shrubs	Plant widely. Very hardy to drought, wind and cold and can grow in rocky places. Widely cultivated species.
Discaria toumatou	Matagouri, tūmatakuru	Trees & Shrubs At Risk – Declining	Plant widely. Medium growth rate. Shrub growing to 2-3 m but can get taller. Propagation easy from seed. Fixes atmospheric nitrogen, making it available for other plants. Threats: under threat throughout the North Island, but stable in much of its South Island range.
Festuca novae-zelandiae	Fescue tussock, hard tussock		Plant widely. Tussock, very hardy, tolerates poor soils and dry conditions. Commonly sold by retail plant nurseries.

[1] Not all species listed need to be planted and species substitutions can be made provided they are ecological suitable and meet the eco-sourcing requirements

Species	Common Name	Form (Threat status*)	Notes
Halocarpus bidwillii	Bog pine	Trees & Shrubs - Gymnosperms	Plant sparingly (or supplementary planting). Small tree or shrub, very slow growing. Mostly found in wetland margins, bogs, poorly draining heathland, but also dry, stony ground and tussock grassland. Propagation easy from seed but can be fickle. Not widely propagated or planted.
Muehlenbeckia axillaris	Creeping pōhuehue	Lianes & Related Trailing Plants	Plant generally. Hardy, Tolerant of hot, dry conditions.
Muehlenbeckia complexa var. *complexa*	Small-leaved pōhuehue, wire vine	Lianes & Related Trailing Plants	Plant widely. Climbing plant. Hardy, can grow in wide range of conditions. Provides habitats of insects and lizards
Olearia odorata	Scented tree daisy	Trees & Shrubs - Dicotyledons	Plant generally. Shrub, medium growth. Very hardy, withstanding wind and drought conditions. Commonly sold by retail plant nurseries
Olearia nummulariifolia		Trees & Shrubs - Dicotyledons	Plant generally. Shrub, medium growth. Very hardy, colonising species, withstanding wind and drought conditions.
Ozothamnus vauvilliersii	Mountain tauhinu, cottonwood	Trees & Shrubs	Plant widely. Shrub, medium growth. Very hardy. Colonising species of dry, exposed sites.
Phormium cookianum	Whararikī, mountain flax	Grasses	Plant generally. Large grass, rapid growth. Hardy, remarkable tolerance to dry, cold, and exposed conditions. Commonly sold by retail plant nurseries.
Pimelea prostrata subsp. *prostrata*	Pinātoro, New Zealand daphne, Strathmore weed	Trees & Shrubs - Dicotyledons	Plant sparingly (or supplementary planting). Small shrub grows in well drained sites, open scrub, and low grassland, Propagation easy from semi-hardwood cuttings and rooted pieces. Seed is difficult to germinate.
Poa colensoi	Blue tussock	Grasses	Plant sparingly, small grass. Hardy, exposure tolerant, but highly palatable. Beneficiaries: moths
Poa cita	Silver tussock	Grasses	Plant widely. Large tussock, rapid growth. Hardy and resilient, grows particularly well in dry, exposed sites and can adapt to poor soils.
Sophora microphylla	Small-leaved kōwhai	Trees & Shrubs - Dicotyledons	Plant generally. Tree, slow growth, can grow in deep soils or in rocky habitats. Propagation is easy from seed, also widely sold by retail plant nurseries.
Sophora prostrata	Prostrate kōwhai	Trees & Shrubs - Dicotyledons	Plant sparingly, slow growing divaricating shrub. Hardy, very tough, grows on exposed, cold, dry sites.
Veronica rakaiensis	Hebe	Trees & Shrubs - Dicotyledons	Plant sparingly. Shrub, medium growth. Hardy, prefers well-drained soils. Commonly sold by retail plant nurseries.
Veronica odora	Hebe	Trees & Shrubs - Dicotyledons	Plant generally. Shrub, medium growth. Hardy, prefers well-drained soils. Commonly sold by retail plant nurseries.

*Threat status is included where applicable.

Table 5: Indigenous species suitable for treeland and scrub planting (and visual screening) within The Point Grasshopper Reserve[1]. Butterflies, moths, grasshoppers, crickets (including wētā), beetles, and spiders will benefit from these plantings.

Species	Common Name	Form (Threat Status*)	Notes
Aristotelia fruticosa	Mountain wineberry	Trees & Shrubs	Plant sparingly. Slow growing, small tree, can reach 9 m tall though often is shrublike. Tolerates wide range of soils and exposed site conditions but establishes better with some cover. Beneficiaries: skinks and geckos. Some passerine bird species will also benefit.
Chionochloa rigida ssp. *rigida*	Narrow-leaved snow tussock	Grasses	Plant sparingly. Large tussock, medium growth rate, torrent of a wide range of conditions, but prefers a well-drained soil. Beneficiaries: skinks, moths.
Austroderia richardii	Toetoe	Grasses	Plant generally. Hardy, prefers full sun or partial shade and well-drained soil, but grows well in riparian zones. Propagation easy from fresh seed and division of established plants. Beneficiaries: skinks, geckos, moths and beetles.
Coprosma dumosa	Mikimiki	Trees & Shrubs	Plant generally. Hardy, small shrub, can grow in range of conditions, but does best with some cover and deeper soil. Propagation easy from fresh seed, and semi-hardwood cuttings. Beneficiaries: skinks and geckos.
Coprosma propinqua var. *propinqua*	Mikimiki	Trees & Shrubs	Plant widely. Very hardy shrub that can grow in wide range of conditions. Beneficiaries: moths, spiders, beetles, flies, skinks and geckos. Some passerine bird species will also benefit.
Corokia cotoneaster	Korokio,	Trees & Shrubs	Plant widely. Very hardy to drought, wind and cold and can grow in rocky places. Widely cultivated species. Beneficiaries: skinks and geckos. Some passerine bird species will also benefit.
Discaria toumatou	Matagouri, tūmatakuru	Trees & Shrubs At Risk – Declining	Plant widely. Medium growth rate. Shrub growing to 2-3 m but can get taller. Propagation easy from seed. Fixes atmospheric nitrogen, making it available for other plants. Threats: under threat throughout the North Island, but stable in much of its South Island range.

[1] Not all species listed need to be planted and species substitutions can be made provided they are ecological suitable and meet the eco-sourcing requirements.

Species	Common Name	Form (Threat Status*)	Notes
			Beneficiaries: moths.
Festuca novae-zelandiae	Fescue tussock, hard tussock	Grasses	Plant widely. Tussock, very hardy, tolerates poor soils and dry conditions. Commonly sold by retail plant nurseries. Beneficiaries: moths, skinks.
Muehlenbeckia complexa var. *complexa*	Small-leaved pōhuehue, scrub pōhuehue, wire vine	Lianes & Related Trailing Plants	Plant widely. Climbing plant. Hardy, can grow in wide range of conditions. Provides habitats of insects and lizards Beneficiaries: moths, butterflies, beetles, flies, spiders, skinks and geckos.
Olearia odorata	Scented tree daisy	Trees & Shrubs - Dicotyledons	Plant generally. Shrub, medium growth. Very hardy, withstanding wind and drought conditions. Commonly sold by retail plant nurseries
Ozothamnus vauvilliersii	Mountain tauhinu, Cottonwood	Trees & Shrubs	Plant widely. Shrub, medium growth. Very hardy. Colonising species of dry, exposed sites.
Poa cita	Silver tussock	Grasses	Plant widely. Large tussock, rapid growth. Hardy and resilient, grows particularly well in dry, exposed sites and can adapt to poor soils. Beneficiaries: moths, skinks.
Sophora microphylla	Kōwhai	Trees & Shrubs - Dicotyledons	Plant generally. Tree, slow growth, can grow in deep soils or in rocky habitats. Propagation is easy from seed, also widely sold by retail plant nurseries. Important food source for indigenous birds. Beneficiaries: some bird species will benefit.
Veronica odora	Hebe	Trees & Shrubs - Dicotyledons	Plant generally. Shrub, medium growth. Hardy, prefers well-drained soils. Commonly sold by retail plant nurseries.

*Threat status is included where applicable.

Tussock shrubland mosaic (medium priority; Table 4)

This is broad mosaic habitat that combines shrubs, tussocks and grasses with scattered herbs and trees. These plantings will combine species and vegetation type clumping (e.g. swards of grasses/tussocks and clumps of shrubs planted together), with scattered intermixed planting. Leguminous plants should be included to provide a larval food source for New Zealand blue butterfly. These plantings should be established where dryland herbs cannot be established, in areas with topsoil and abundant exotic grass cover to help suppress these weeds.

Treeland and scrub (lowest priority; Table 5)

Treeland and scrub planting aims to establish taller vegetation, but within the confines of the historic vegetation cover of the site. In areas where dryland and shrubland vegetation are not suitable for planting, clusters of taller vegetation will be planted, with species clumped together (e.g. groups of kōwhai or mountain toatoa) with shrubs and tussocks around the outside or occasionally intermixed. Leguminous plants should be included to provide a larval food source for New Zealand blue butterfly. In general, to help suppress weeds this planting mix should be established on the convex bars with deeper soils and abundant exotic grass cover.

The habitat values that are important for invertebrates within The Point Grasshopper Reserve (W. Chinn pers. comm) and are summarised in Table 7.

Table 7 – Invertebrate microhabitats to restore at The Point Grasshopper Reserve using the plant species recommended in this report.

Invertebrate Microhabitat	Invertebrates that Benefit Most	Vegetation Characteristics	Physical Characteristics that Benefit Invertebrates in this Habitat
Dryland herbfield	Grasshoppers and butterflies, that need open spaces to bask.	Short and sparse grasses and dryland herbs, mosses and lichens. Low plant density.	Open, sun-exposed areas with bare gravel, soil, and/or rock.
Tussock shrubland mosaic	Butterflies, moths, flies, common grasshoppers, crickets (including wētā), beetles, and spiders.	Grasses and prostrate shrubs. Legumes and creeping pōhuehue. Medium to high plant density.	A mixture of sun and shade, plants and bare rocks. Rock stacks to provide hides for predators such as beetles and spiders.
Treeland and scrub	Butterflies, moths, beetles, and spiders.	Taller grasses and shrubs, trees, legumes and creeping pōhuehue. Medium to high density.	A mixture of sun and shade, plants and bare rocks. Rock stacks to provide hides for predators such as beetles and spiders.

A suitably qualified invertebrate ecologist should be consulted before the planting plan is finalised to ensure that sufficient invertebrate habitat will be created.

4.6.7 Spray-free pest plant management

Woody weeds must be controlled where necessary to allow plantings to grow. Herbicide sprays must not be used, as grasshoppers are sensitive to chemical sprays. Instead, hand weeding, mechanical removal, and cut and paste should be used.

4.6.8 Pest mammal control and monitoring

The PMMP will be followed to control and monitor mice, rats, rabbits, hares, mustelids, possums, feral cats, and hedgehogs throughout the site. All pest mammal species must be eradicated (every last individual removed) from The Point Grasshopper Reserve except for mice, which should be eliminated (removed to the extent that they are functionally no longer impacting indigenous species). Outside the reserve, mustelids, feral cats, possums, rabbits, and hares should be suppressed throughout the site, with pockets of mouse, rat, and hedgehog control focused on grasshopper habitat and restored vegetation.

4.6.9 Creation of rock piles

In the medium-stature and tall-stature microhabitats, piles of larger rocks (more than 10 centimetres in at least one dimension) will be constructed to provide hides for beetles and spiders. Rock piles should mimic those found in typical outwash plains and can be integrated with requirements for lizards. For invertebrates, 10-20 rock piles should be sufficient, depending on habitat availability throughout the site. Rock piles are unlikely to be used by grasshoppers. Rock piles may attract mice, so mouse control should be increased around them (refer to the PMMP). Rock piles should not be placed within The Point Grasshopper Reserve. Rock piles may also provide habitat for lizards.

4.6.10 Continuation of grazing

Grazing by sheep may be beneficial to indigenous dryland grasslands and herbfields, keeping vegetation short, which also benefits fauna such as minute and robust grasshoppers. Grazing should be limited to spring and summer to prevent rank grass from establishing while minimising the risk of sheep grazing on indigenous vegetation in winter. Seasonal grazing is also likely to be necessary within The Point Grasshopper Reserve to retain the short-stature, open character of the habitat.

Unplanted areas, including under the solar panels, are recommended to be periodically grazed (spring and summer) to suppress exotic grasses. These grazed areas should be monitored to identify the impacts and benefits of grazing, and the learnings from this monitoring used to inform grazing management within the planted areas. Monitoring should be undertaken by a suitably qualified ecologist.

4.6.11 Salvage and translocation

Salvage of Otago short-horned grasshopper should be undertaken throughout their known range on site (Figure 2). The objective of the salvage is to remove as many individuals as possible from the panel area and place them into restored or enhanced habitat suitable for grasshoppers.

Minute grasshoppers may need to be salvaged and translocated if populations are found within the panel area (see Incidental discovery protocol, IDP, below). Robust grasshoppers are unlikely to be on site, and disturbance or handling of robust grasshoppers would require a Wildlife Approval. In the unlikely event that a robust grasshopper is discovered on site, all work must cease near where it was found and the Department of Conservation consulted for advice.

The effects of salvage and translocation are not well-studied for invertebrates (Sherley, Stringer, and Parrish 2010), except for giant wētā (*Deinacrida* spp.) and giant land snails (*Powelliphanta* spp.). Therefore, salvage and translocation of Otago short-horned grasshopper will be experimental. However, combined with research into the viability and potential methods of salvage and translocation (see Compensation below), it would have the potential to significantly reduce effects of habitat modification by bolstering populations at release sites. The Salvage and Translocation Protocol (Appendix 1) will need to be followed.

4.6.12 Incidental Discovery Protocol

During construction, populations of minute grasshopper or Tekapo ground wētā may be discovered. Robust grasshopper may also be discovered, but its discovery is unlikely anywhere where it will be impacted by the development. It is important, however, that any observation of robust grasshopper on site is investigated. If minute grasshopper, Tekapo ground wētā, or robust grasshopper are observed, work must be stopped and the IDP followed (Appendix 2).

4.6.13 Monitoring and adaptive management

Monitoring of Otago short-horned grasshopper and (if discovered or released on site) minute and robust grasshopper and Tekapo ground wētā should be undertaken annually for the first three years following the onset of construction, then once every three years thereafter for twelve years. Monitoring should use transects for hand-searching both within and outside the panel area, including in The Point Grasshopper Reserve. Transect methodology should be adapted from robust and minute grasshopper monitoring protocols (Schori, Steeves, and Murray 2020). If Tekapo ground wētā are found on site at any time, live-capture pitfall trapping should also be undertaken, as well as monitoring large wētā tracks in the tracking tunnels used to monitor rodents (refer to the PMMP). Methods must be consistent between monitoring rounds.

Monitoring results are unlikely to be statistically robust due to small sample sizes. However, they may indicate a decline in Otago short-horned grasshopper numbers in areas where the habitat is altered by the solar panels in the eastern field. Monitoring is also likely to detect minute and robust grasshopper populations if they are present, or become present, on site. However, predicting the effects on Tekapo ground wētā (if present) is difficult given limited knowledge of their ecology and threats. Monitoring results should indicate a gradual increase in Otago short-horned grasshopper in the enhanced areas of the site. Due to limited knowledge of the impacts of effects management on invertebrate populations, monitoring is critical to assess efficacy of effects management for this project.

Management should be adapted to monitoring results where possible. For example, if grasshopper numbers are dropping within the solar panel area and mouse numbers are high, additional mouse control may help arrest the population's decline. If grasshopper numbers are declining in the restored dryland areas, then more planting, plant care, or manual weed control may be needed.

Additional compensation in the form of research funding may be necessary if, despite adaptive management, four or more consecutive monitoring periods indicate one or more of the following:

- No increase in the number of Otago short-horned grasshopper within the restored areas.
- Minute or robust grasshopper are discovered on site during at least two consecutive monitoring rounds but then decline in the numbers observed or are not found again.
- Tekapo ground wētā populations (if present) are found to decline in abundance and/or their known distribution on site shrinks.

If any of these scenarios occur, results of monitoring should be compared with any available monitoring results from relevant invertebrate populations off site (for example, robust grasshopper monitoring at the Paterson's Terrace Reserve) to see if population declines are limited to the solar farm. If no monitoring results are available for comparison, or there is only evidence of population declines on site, additional compensation may be considered as an option to compensate for the biodiversity loss.

4.6.14 Basic compensation: data communication and facilitation of research

Overview

The following compensation is strongly recommended for this project to address the inherent uncertainty in habitat restoration and salvage and translocation of grasshoppers. However, effects on robust grasshopper, if any, are likely to be managed by avoidance, minimisation and remediation. Based on current information, compensation is not anticipated to be required for this project, as it should be possible to adequately manage effects on Threatened and protected species using the above measures.

Sharing of monitoring results with relevant researchers

Monitoring results should be willingly shared with researchers and entomologists (for example, the Entomological Society of New Zealand) to help understand the responses of Threatened and At Risk grasshoppers and wētā to effects management.

Invitation to students to study salvaged and translocated populations

Students should be invited and allowed to study salvaged and translocated populations on site through a university programme. A small grant of $10,000 per year for three years should be offered as an incentive to a university programme that enables study to be undertaken, such as an undergraduate field course, consecutive Masters students, or a single PhD student. Studying salvaged populations will facilitate improvements to their management as well as helping to monitor the populations.

The grant and the suggested programme should be advertised at least six months before salvage or translocation begins to institutions including (at a minimum) Lincoln and Canterbury Universities, Canterbury Museum, and the Entomological Society of New Zealand. A single university programme should be selected via an application process, based on the suitability of the programme for the solar farm project, in consultation with a suitably qualified ecologist. If no university applies, then the $30,000 should instead be allocated to research funding.

4.6.15 Additional compensation: research funding

Additional compensation is recommended if results from monitoring (refer to Section 4.6.13 above) show that other effects management has unexpectedly not been sufficient to manage all the detrimental impacts.

The efficacy of salvage and translocation alone (refer to Section 3.6.11 above) in managing the effects of habitat modification and mortality of invertebrates is unknown. However, combined with research into its viability and potential methods, salvage and translocation would improve effects management for grasshoppers and their close relatives to benefit biodiversity not limited to the site.

Assessing trends in monitoring data would be extremely helpful in understanding the impacts of land-use changes on invertebrates in the Mackenzie Basin. This research would help to understand effects management and help in the overall conservation of the species impacted by this project.

A one-off grant of $15,000, plus access to the site for research purposes, would help to initiate a PhD-level research project. The funds would be needed to ensure the research project is able to happen. The student would then be able to use the grant to compare grasshopper population sizes and continue the monitoring started by the ecology team. If no student takes the grant after the third year of offering it, the money should be donated to the New Zealand Entomological Society specifically to use for conducting research into Mackenzie Basin dryland ecosystem conservation ecology, with a preference for studies investigating effects mitigation.

4.7 Invertebrate effects before and after management

Table 6 shows the level of effects before and after management is implemented as outlined in this TIMP.

Table 6 - Potential significance of effects to grasshoppers and wētā and their habitats with and without effects management.

Effect	Level of Effect Without Management	Level of Effect With Management
Habitat removal	Minor	Negligible
Mortality and disturbance	Minor	Negligible
Habitat modification	Minor throughout most of the site; significant in the eastern field and the western edges of the site	Less than minor
Creation of concrete and gravel areas	Net gain	Net gain

4.8 Schedule for effects management on terrestrial invertebrates

Table 8 shows the approximate schedule for implementing invertebrate effects management.

Table 8 – Approximate schedule for implementation of effects management.

Task	Approximate timing
Avoidance of important habitat	During construction planning.
Dust and vibration management	During construction planning, throughout the construction period, and during any time of high traffic along tracks and over the site for the life of the project.
Creation of a pest-mammal-free invertebrate enclosure (The Point Grasshopper Reserve)	At least six months before salvage and translocation begin.
Restoration planting	At least six months before salvage and translocation begin.
Spray-free pest plant management	Beginning during restoration and continuing throughout the life of the project.
Pest mammal control and monitoring	Beginning at least six months before salvage and translocation begin, and continuing for the life of the project, with a review once every five years as detailed in the PMMP.
Creation of rock piles	After construction begins, before construction finishes; rocks removed during construction may be used to create the piles.
Continuation of grazing	Throughout the life of the project, seasonally (spring and summer), depending on the condition of the habitat within the restored areas and the grasshopper reserve (i.e. if exotic vegetation is beginning to impact the habitat, grazing is needed, but if no exotic vegetation is found within the habitat then grazing is not necessary).
Salvage and translocation	No more than two weeks before construction begins.
Incidental Discovery Protocol	Any time prior to and during construction.
Monitoring and adaptive management	Throughout the life of the project.
Basic compensation: data communication and research facilitation	Advertise programme at least six months prior to salvage and translocation beginning. Continue data communication and research facilitation throughout the life of the project, as researchers are available.
Additional compensation: research funding (if needed)	In response to an unfavourable monitoring result (see conditions in Section 4.6.13)

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Appendix 1

Salvage and translocation protocol

Prior to Any Work Commencing

Relevant contractors, the Project Engineer, Construction Contractor, and any other relevant personnel will undertake an induction to be briefed on the following:

- Where to look out for minute grasshopper, Tekapo ground wētā, or Otago short-horned grasshopper, and what they look like (refer to Appendix 2).
- The Incidental Discovery Protocol (refer to Appendix 2).
- Where habitat restoration will be undertaken.
- The timeframe for associated works.

At each site where Otago short-horned grasshopper have been detected during previous surveys and are likely to be impacted by the panels, salvage will begin before landscaping and construction commences. Salvage of minute or robust grasshopper, or Tekapo ground wētā is not necessary unless they are discovered during construction.

Pre-clearance Salvage

Salvage of Otago short-horned grasshopper will use daytime transects.

While searching for Otago short-horned grasshopper, minute grasshopper may also be found since it has similar habitat requirements. If minute grasshopper is found at any time during salvage, follow the Incidental Discovery Protocol (Appendix 2).

Transects

Daytime transects (OSG)

Ten 100 m long transects will be set up on site, where Otago short-horned grasshopper was previously found (Figure 2). Transects should be at least 100 m apart and target suitable habitat for Otago short-horned grasshopper (Section 3.3 and Appendix 2).

Transects will be walked at a slow walking pace, with the walker moving their foot side to side slowly across the surface of the ground, as described by Schori *et al.* (2020). As Otago short-horned grasshopper move, they will be collected. Great care must be taken, when setting up for a transect walk, and when leaving or returning to the transect after collecting an Otago short-horned grasshopper, not to allow any shadow to fall along the transect.

Initially, the transects will be walked twice daily for seven consecutive days in sunny weather above 13°C in the appropriate season (early December and early February). Every Otago short-horned grasshopper spotted during the walk will be captured (see Collection and Transportation below).

Transects will be walked for a minimum of seven consecutive days. If numbers of Otago short-horned grasshopper caught over the course of seven days decline, with fewer than Otago short-horned grasshopper captured on day seven, trapping will cease.

If the same or high numbers of Otago short-horned grasshopper are still found at day seven (fewer than individuals per day), transects may continue for another three days depending on numbers caught and the weather, at the discretion of the Project Entomologist. After a total of 10 days, salvage

will cease. The objective of the salvage is to remove as many individuals as possible from the panel area and place them into restored or enhanced habitat suitable for grasshoppers, not to salvage every individual.

Data Collection

Data recorded upon capture will include age/sex class (male, female, or juvenile). Each stage of salvage will be recorded, including start/stop date and time, GPS coordinates, and a habitat description for the capture location. Weather conditions will be recorded during and at the beginning and end of each salvage event. Data collected will be shared with the research student(s) (refer to Section 4.6.14).

Collection and Transportation

Shade will need to be created for Otago short-horned grasshopper through the construction of temporary shelters, such as beach tents. Alternatively, an air-conditioned vehicle or suitably furnished chilly bin[1] will suffice for animal storage.

All captured Otago short-horned grasshoppers will be temporarily placed in clean individual containers, in a relatively cool place[2]. A small amount of vegetation from the capture site will be placed inside the containers to provide cover and prevent dehydration. Any Otago short-horned grasshopper captured will be handled and held carefully and as little as possible, with particular care taken not to damage their legs. They must not be held by a single leg under any circumstances. All individuals salvaged will be released as soon as practicable (and within 12 hours) to the pre-selected release area.

Relocation

Salvaged individuals will be released within The Point Grasshopper Reserve if 100 or fewer are captured. If more than 100 individuals are captured, additional individuals will be released outside the reserve but within restored dryland herbfield areas, outside of the panel area.

[1] An ice pack can be used to keep the chilly bin cool, although it should be well-insulated by wrapping in layers of towelling or bubble wrap so that animals inside the chilly bin are not subjected to harmful rapid temperature changes.

[2] Temperature extremes or sudden temperature changes should be avoided, but Otago short-horned grasshoppers should not be left out in the sun.

Appendix 2

Incidental discovery protocol

Overview

Incidental discovery protocols (IDP) are set out below and are to be followed if any minute grasshopper, Tekapo ground wētā, or robust grasshopper are discovered during development.

Identifying minute grasshopper, Tekapo ground wētā, and robust grasshopper

Identifying minute grasshopper, Tekapo ground wētā, and robust grasshopper is very difficult (Plates 2-4), as they look similar to other non-threatened species to which they are closely related. Species diagnosis is best left to an expert. However, any ground wētā found on site is likely to be Tekapo ground wētā. Any small (<10 mm body length) grasshopper, or any robust-looking grasshopper with a wide body and bumpy-looking tegument (surface of the exoskeleton), found in dry, open habitat should be assumed to be minute grasshopper. Colouration is highly variable within grasshopper species and should not be relied upon for identifying minute grasshopper. Table A2.1 summarises the most useful characters for identifying potential minute grasshopper, Tekapo ground wētā, and robust grasshopper in the field.

Plate 2 – Robust grasshopper.

Plate 3 – Minute grasshopper.

Plate 4– Tekapo ground wētā.

Table A2.1 – Identification characters of minute grasshopper, Tekapo ground wētā, and robust grasshopper.

Identification Character	Minute grasshopper	Tekapo ground wētā	Robust grasshopper
Habitat	Open, dry areas with short-stature vegetation and patches of bare ground, rocks, lichen and mosses.	May be found in most habitats. Unlikely to be near wetlands.	Dry, open, sunny braided river beds with a large cover of gravel and rocks, and sparsely distributed short-stature herbs.
Size	Up to 16 mm (males are less than 10 mm long; females are larger and relatively wide)	Up to approximately 35 mm	17-44 mm long
Body appearance	Robust, widest where the thorax and abdomen join	Wide, cylindrical	Robust, wide-bodied
Tegument (exoskeleton surface) appearance	Bumpy, resembling lichen	Smooth, polished	Bumpy
Colouration or markings	Highly variable, commonly stone-grey or coloured to resemble lichen, usually well-camouflaged	Pale tan or straw-coloured with darker head and chocolate-brown markings along the back	Usually mottled grey; well-camouflaged

Where minute grasshopper, Tekapo ground wētā, and robust grasshopper might be found

See Section 3.3 and Table A2.1 for habitat characteristics associated with minute and robust grasshopper. Some suitable habitat has been identified in Figure 2; minute grasshopper may be found in good Otago short-horned grasshopper habitat as their habitat requirements overlap. Habitat requirements of Tekapo ground wētā are not well-understood, and they may be found throughout the site. They are likely to be in their burrows during the day near the surface of the soil, so may be unearthed during construction activities.

This IDP should be applied throughout construction anywhere on site, but particularly in patches of suitable robust or minute grasshopper.

Protocol Upon Discovering minute grasshopper, Tekapo ground wētā, and robust grasshopper

If a suspected minute grasshopper, Tekapo ground wētā or robust grasshopper is discovered:

1. Stop work in the immediate location. Send a photograph to the Project Entomologist and seek their advice.
2. Capture the specimen carefully in a hard plastic container such as a lunch box or jar. Place some vegetation in with the insect and put the container in a cool place, out of the sun, such as an air-conditioned vehicle or in the shade. No ventilation is needed for oxygen but the container should not have any wet spots inside it.
3. Await further instructions from the Project Entomologist. Salvage and relocation may be necessary. If robust grasshopper are found within the panel area (highly unlikely), the Department of Conservation will need to be contacted and a Wildlife Approval may need to be obtained before work can continue near to the observation.
4. Do not continue work in the immediate location until further instructions from the Project Entomologist have been received.

Call Free 0508 WILDNZ
Ph +64 7 343 9017
Fax +64 7 349018
ecology@wildlands.co.nz

99 Sala Street
PO Box 7137, Te Ngae
Rotorua 3042, New Zealand

Regional Offices located in Auckland; Christchurch;
Dunedin; Hamilton; Invercargill; Queenstown; Tauranga;
Wānaka; Wellington; Whangārei.

wildlands.co.nz

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