



Terrestrial Invertebrate Assessment

Haldon Solar Farm

Lodestone Energy Limited

Auckland

Prepared by:

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Basis of Report

This report has been prepared by SLR Consulting New Zealand Limited (SLR) on the instructions of our Client, in accordance with the agreed scope of work. It is intended to support the Client's application under the Fast Track Approvals Act 2024 and may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While SLR has exercised due care in preparing this report, it does not accept liability for any use of the report beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.



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Acronyms and Abbreviations

DOC	Department of Conservation
GBIF	Global Biodiversity Information Facility
GCR	Ground Coverage Ratio
MfE	Ministry for the Environment
NPS-REG	National Policy Statement for Renewable Electricity Generation
NZOR	New Zealand Organisms Register
NZTCS	New Zealand Threat Classification System
RMA	Resource Management Act



1.0 Introduction

Lodestone Energy Limited (“Lodestone”) is applying for resource consent under the Fast-track Approvals Act 2024 for the proposed 320 ha Haldon Solar Farm site located on Haldon Station between Haldon Arm Road and Lake Benmore (Figure 1).

A terrestrial invertebrate survey for the Haldon Solar Farm site is required to meet the requirements of the Fast Track application and to provide additional information as suggested during engagement with Environment Canterbury and the Department of Conservation (DOC).



Figure 1: Location of the proposed Haldon Solar Farm.



2.0 Site Context

The proposed solar farm site is located on an old glacial alluvial outwash plain, with terraces and stream channels of gravels and shallow soils. A terrace about 3 m high runs along the western edge of the pivot irrigated area to the north, before continuing south/southwest (Photo 1, left), and then splitting into smaller terraces about three-quarters of the way to the lake. East of this terrace is a relatively flat upper terrace (Photo 1, right). The north-western corner of the site is also relatively flat, but the remainder of the site contains sinuous undulations of short and shallow ridges and valleys (Photo 2). Former water courses are likely to have deposited different sized gravels in different areas depending on stream morphology and water velocity, while silts and wind-blown soils will have accumulated in sheltered areas. These variations influence the type of vegetation present, which in turn will influence invertebrate community composition.



Photo 1: Left: Terrace landform. Right: Flat area east of the terrace, December 2025.



Photo 2: The southern end of the site contains short and shallow ridges and valleys, December 2025.



3.0 Methods

3.1 Liaison

SLR liaised with Warren Chinn from DOC to understand DOC's questions and requirements for field assessments of terrestrial invertebrates on the site, including timing for survey work, and have used this information, along with reference to the biodiversity inventory and monitoring toolbox for invertebrates (DOC 2025a), to assist with preparing the survey methodology. The methodology used also includes consideration of recently reported terrestrial invertebrate survey protocols (Wildland Consultants 2025).

3.2 Desktop Assessment

A comprehensive desktop review was conducted primarily using Wakelin et al. (2024) (which lists 3,052 taxa from the MacKenzie area) but also including information from the Global Biodiversity Information Facility (GBIF), New Zealand Organisms Register (NZOR), DOC Threatened Species Database, and iNaturalist.

The intention of this invertebrate survey was not to record all taxa present within the Haldon Solar Farm site, as this would be a huge undertaking and include introduced, invasive and vagrant species not relevant to the assessment. Instead, the focus was on identifying species known from nearby areas with similar habitats (such as outwash plains) to those present in the site. Note that the assessment includes freshwater invertebrates, since adults may use terrestrial habitats.

Satellite imagery was examined to assess the likelihood of any notable invertebrate habitats (e.g., boulder fields) being present at the site.

3.3 Field Survey

A range of methods were used in order to ensure a range of invertebrate fauna were sampled, with targeted surveys for the taxa of conservation interest (i.e., threat classifications of Threatened, At Risk, or Data Deficient, in accordance with the New Zealand Threat Classification System (NZTCS)) identified in the desktop assessment.

Light trapping was not undertaken because of the low diversity of moths expected during the early summer sampling period and the site's flat, open habitats which would potentially attract night flying moths from outside the project area and therefore not provide applicable data to the site. Day flying moths such as the threatened *Orocrambus* sp. 'Mackenzie Basin', *O. fugitivellus*, *O. sophiistes*, and *Loxostege* sp. 'salt pan' are most active during late summer and will have been targeted by sweep sampling.

Targeted Fauna Surveys

Field surveys involved targeted searches for:

- Robust grasshopper (*Brachaspis robustus*; Nationally Endangered¹).
- Minute grasshopper (*Sigaus minutus*; Nationally Vulnerable).
- Otago short-horned grasshopper (*Phaulacridium otagoense*; At Risk – Declining)
- Tekapo ground wētā (*Hemiandrus furoviarius*; Nationally Endangered).

¹ Threat classifications for wētā, crickets and grasshoppers from Trewick et al. (2022).



- Other species identified in the literature review (e.g., beetles: *Artystona lata* and *Holcaspis* species; flies: *Anabarhynchus* species; and moths: *Orocrambus* species and *Loxostege* sp. "salt pan").

Pitfall Trapping

Fifty 1.5 L pitfall traps (14 cm diameter) were deployed in five 20 × 20 m plots located in representative habitats throughout the project footprint (i.e., within the northwestern, northeastern, southwestern, southeastern, and central parts of the site), with 10 traps at each plot (Table 1, Photo 3, Figure 2). Minimum trap depth was 14 cm, with traps containing preservative solution.

Table 1: Details of pitfall trap arrays. December 2025.

Array	Number of traps	NZTM coordinates	Habitat
1	10	E1379508 N5086019	Soft silty soils, no stones
2	10	E1380200 N5085231	Flat, gravelly, hieracium, stones 5-15cm diameter
3	10	E1379136 N5085228	Gravels up to 10cm diameter, grading to soil with rabbit diggings 10cm deep
4	10	E1379339 N5084591	Pebbly, 2-5cm diameter, rising to silty soil ridge, rabbit diggings, hare and sheep droppings
5	10	E1379942 N5084606	Slight rise with more grass and briar, silty soft soil to 15cm deep, <i>Lepidium</i> on NW trap



Photo 3: Pitfall trap array 4, December 2025.



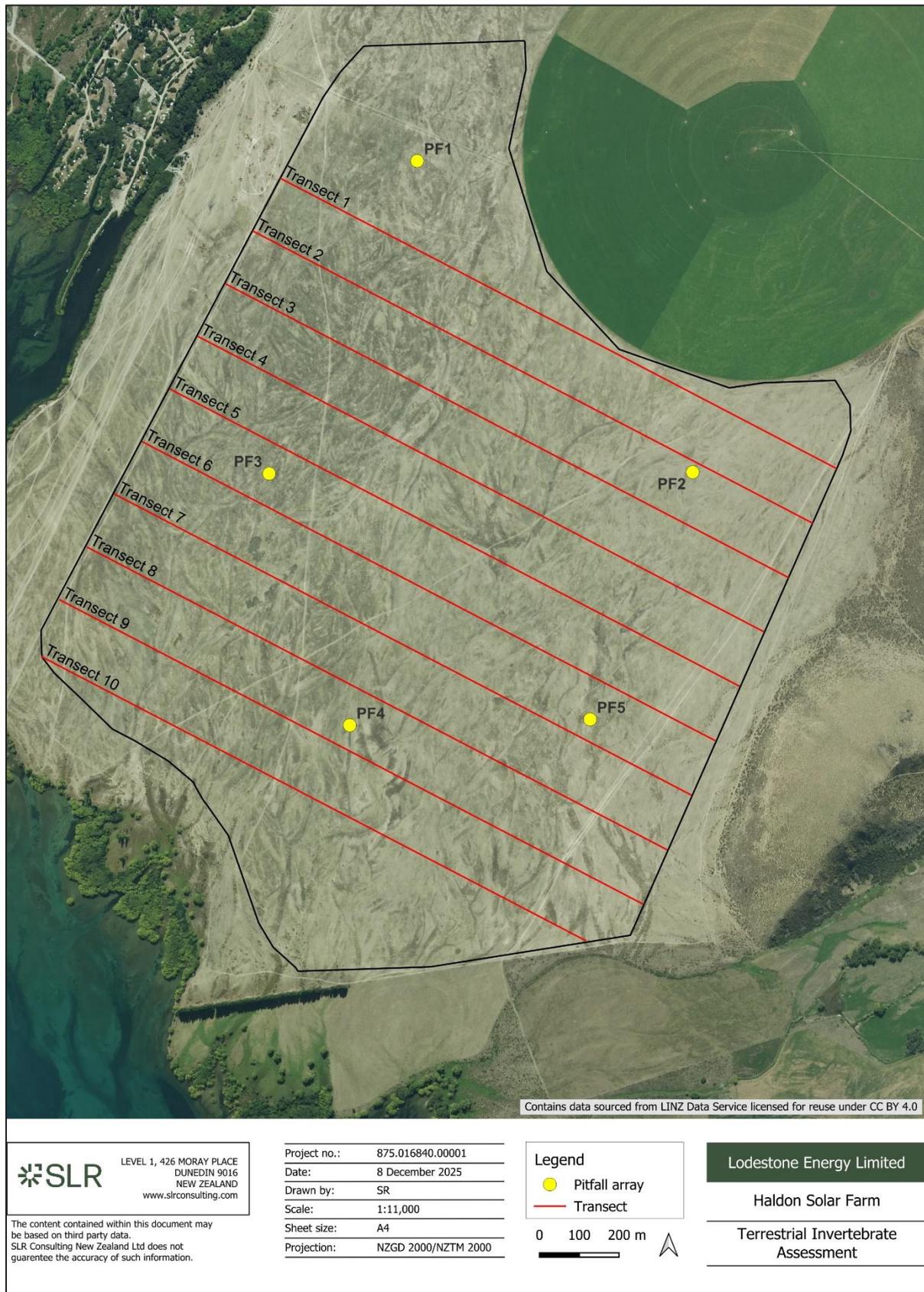


Figure 2: Pitfall trap array locations and minute grasshopper transects, Haldon Solar Farm site, December 2025.



Grasshopper Survey

Ten parallel transects located 100 m apart were established running east-to-west across the project footprint (Figure 2) with a 1 m² quadrat placed approximately every 100 m along each transect. Counts (to determine presence and abundance) of minute grasshopper were undertaken in each quadrat. Due to the low counts within quadrats, the methods were adapted onsite to include counts of minute grasshopper while walking between each quadrat, in a band approximately 1 m wide along the transect. Counts were undertaken during similar weather conditions and at a similar time on each day.

Habitat data was collected for each minute grasshopper sighting by estimating percent groundcover of exposed gravels (EG), exposed soil (ES), hawkweed (H), lichens, moss, herbs, and *Raoulia* (LMR), grasses (GS), and briar (B) in each quadrat.

A total of 204 quadrats were sampled along transects.

Table 2: Details of grasshopper transects, December 2025.

Transect	Date sampled	Number of quadrats	Conditions	Direction sampled	NZTM coordinates	
					Western end	Eastern end
1	9/12/2025	13	Overcast, warm	W to E	E1379166 N5085974	E1380560 N5085241
2	9/12/2025	13	Overcast, warm	E to W	E1379097 N5085841	E1380501 N5085103
3	10/12/2025	13	Sunny, hot, breezy	E to W	E1379027 N5085708	E1380439 N5084965
4	10/12/2025	14	Sunny, hot, breezy	W to E	E1378958 N5085575	E1380380 N5084825
5	10/12/2025	13	Sunny, hot, breezy	E to W	E1378889 N5085441	E1380316 N5084691
6	10/12/2025	13	Sunny, hot, breezy	W to E	E1378819 N5085308	E1380255 N5084553
7	11/12/2025	12	Overcast high cloud, cool no wind becoming hot sun by 1030	E to W	E1378750 N5085175	E1380195 N5084415
8	11/12/2025	12	Sunny with high cloud. Cool breeze off lake	W to E	E1378680 N5085041	E1380135 N5084276
9	11/12/2025	12	Sunny, hot, some cloud, cool breeze from Lake Benmore	E to W	E1378611 N5084908	E1380074 N5084139
10	11/12/2025	12	Sunny warm slight breeze few clouds	W to E	E1378566 N5084764	E1379931 N5084046

Sweep Netting

A net was swept along the ground and through vegetation while moving on foot around the site and between pitfall trap arrays. This form of sampling is opportunistic and non-systematic but was used to increase the range of species collected.



Visual Encounter Surveys

Opportunistic observations of invertebrates were recorded while moving on foot around the site and between pitfall trap plots. This included hand searching and targeted searching of key areas (e.g., digging into wētā burrows, turning over stones for beetles).

Identification of Key Invertebrate Habitats

While completing the field surveys, any potential areas within the project footprint with notable terrestrial invertebrate habitat values (e.g., boulder fields) were identified and their GPS coordinates recorded. These areas were photographed and described.

Laboratory Processing

The processing of samples and identification of specimens collected on site commenced immediately upon collection.

Field Survey Timing

The timing of field surveys is summarised in Table 3 below. The surveys planned for 2026 are to determine if other invertebrate taxa that are active later in summer are present. Results from these surveys will be compiled into an addendum to this report.

Table 3: Timing of invertebrate sampling, December 2025.

Sampling type	2025	2026 (planned)
Pitfall trap installation	8-9 December	
Pitfall trap retrieval	14-15 December	
Minute grasshopper survey	9-11 December	2-3 days in February
Sweep netting	9-14 December	2-3 days in February
Visual encounter surveys	8-14 December	2-3 days in February

4.0 Invertebrate Results

4.1 Desktop Assessment

A list of invertebrate taxa potentially occurring at the Haldon Solar Farm site was prepared and included 1,418 invertebrate taxa. From this list, 97 taxa of conservation concern (threat classifications of Threatened, At Risk, and Data Deficient) were identified and are listed in Appendix A. Twelve of the taxa are classified as 'Threatened - Nationally Critical', eleven taxa as 'Threatened - Nationally Endangered', and six taxa as 'Threatened - Nationally Vulnerable'.

4.2 Species Recorded at the Site, December 2025

A total of 92 taxa were caught in pitfall traps and by sweep netting and observed during hand searches at the site (see Appendix B). For pitfall traps, 2,148 specimens were caught from which 53 different taxa were identified. The commonest taxa in pitfall traps were collembola (25% of total individuals), the seed bug *Nysius huttoni* (24%), the Anthicid stone beetle *Pseudocyclodinus otagensis* (5%), the Arawa leafhopper (8%), the ant *Chelaner antarcticus* (6%), and spiders (5%).



Threatened and At Risk invertebrate species are discussed further in the sections below. However, it should be noted that although no threatened species of stiletto flies, wolf spiders, tiger beetles, darkling beetles, and grass moths were found in the survey, the presence of related species (Appendix B) suggests that they could occur.

4.3 Grasshopper Survey

4.3.1 Minute Grasshopper

Three minute grasshoppers (Photo 4) were counted within quadrats, and 94 were counted while walking between plots along the transects (Table 4, Figure 3). Observations were spread over the entire site but were more common in the northern and eastern parts of the site.



Photo 4: Male and female minute grasshoppers at NZTM E1378865 N5084645, December 2025.

Table 4: Counts of minute grasshoppers within quadrats and while walking along transects, December 2025.

Transect	Number of quadrats	Quadrat counts	Walking counts	Combined counts
1	13	1	11	12
2	13		9	9
3	13		18	18
4	14	1	10	11
5	13		20	20
6	13		7	7
7	12	1	7	8
8	12		8	8



Transect	Number of quadrats	Quadrat counts	Walking counts	Combined counts
9	12		1	1
10	12		3	3
Total	127	3	94	97
Mean/transect		0.3	9.4	9.7

Using the mean number of minute grasshoppers found per 1 m wide transect (9.7 grasshoppers), and with an estimated north-south length of the site of 1.44 km (conservative due to the shape of the site), the site could therefore support approximately 14,000 minute grasshoppers. This is only approximate as the survey was not undertaken to quantify the number of grasshoppers on site, and the distribution of grasshoppers is not consistent across the site.

Habitat data collected in quadrats is summarised in Table 5. The mean covers of hawkweed, grasses, and briar were lower in quadrats where minute grasshopper was recorded compared to where it was absent. The mean covers of Lichens/moss/herbs/*Raoulia* and exposed gravels and soil were higher in quadrats where minute grasshopper was recorded.

Table 5: Percent groundcover recorded in quadrats, December 2025.

Parameter	All quadrats			Minute grasshopper present			Minute grasshopper absent		
	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
Exposed gravels	15.5	0	80	16.4	0	80	13.8	0	50
Exposed soil	27.4	0	70	28.6	0	70	25.1	0	50
Hawkweed	30.9	10	70	29.5	10	50	33.5	10	70
Grasses	8.48	0	60	7.01	0	30	11.2	0	60
Lichens/moss/herbs/ <i>Raoulia</i>	17.2	0	70	18.5	0	70	14.8	0	50
Briar	0.45	0	40	0	0	0	1.31	0	40

4.3.2 Robust Grasshopper

Five robust grasshoppers were recorded at three sites in the western part of the solar farm site, with a shed robust grasshopper skin also seen at one of those sites (Photo 5, Figure 3). This species prefers stony habitats (White 1994).

As robust grasshoppers were only detected in low numbers across the site, and not consistently along transects, it is difficult to estimate approximate numbers of robust grasshoppers within the site. However, based on the low number detected and the habitats observed, the number present could be estimated to be no more than 50 individuals.



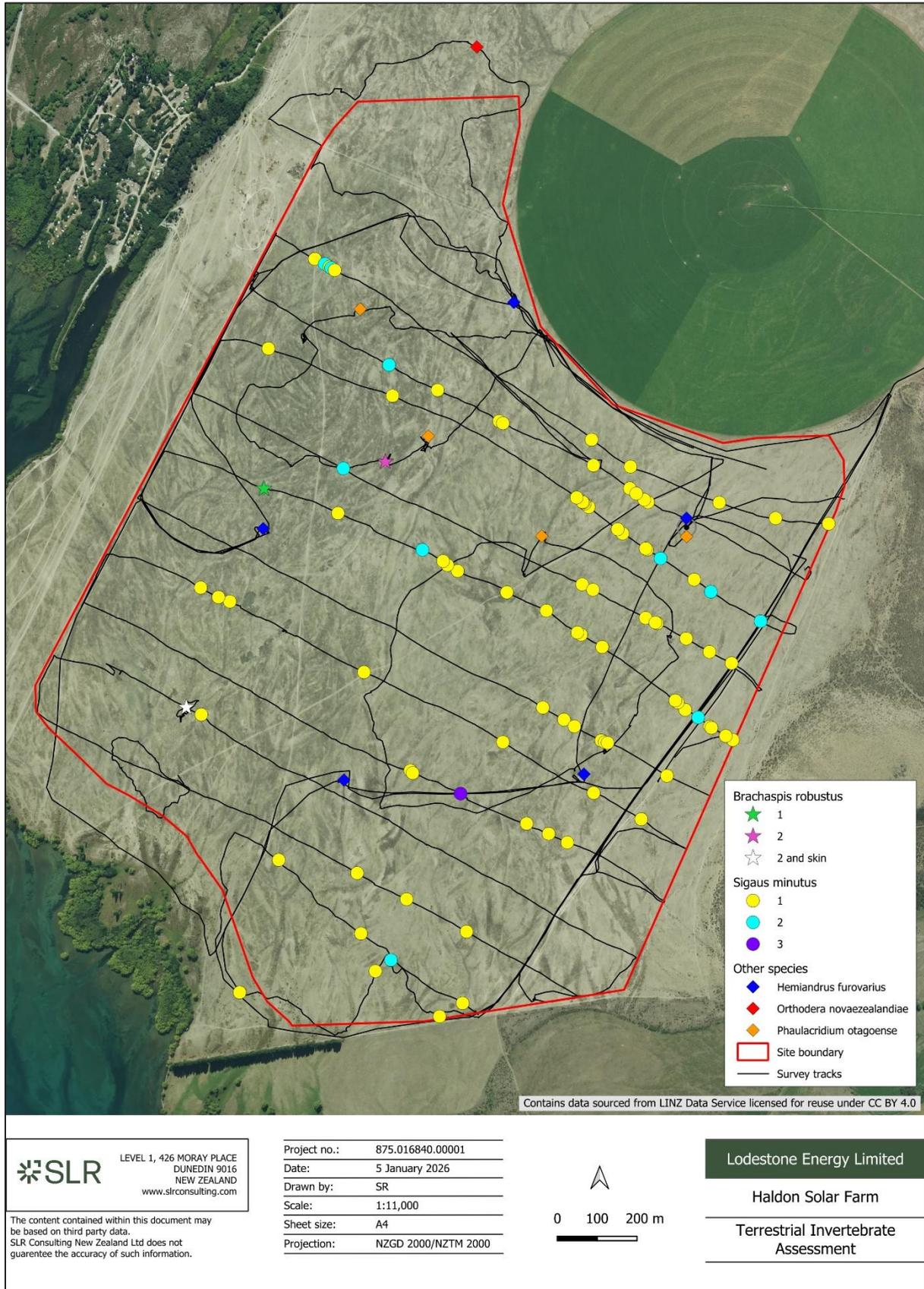


Figure 3: Threatened and At Risk invertebrate species records, December 2025.





Photo 5: Robust grasshopper at NZTM E1379138 N5085329, December 2025.

4.3.3 Otago Short-Horned Grasshopper

Individuals of Otago short-horned grasshopper (*Phaulacridium otagoense*; classified as At Risk – Declining) were positively identified at four sites (Photo 6, Figure 3) but are likely to be much more widespread as juvenile grasshoppers could not be identified to species.

The estimated potential numbers of these grasshoppers at the site is provided in section 4.3.4 below.

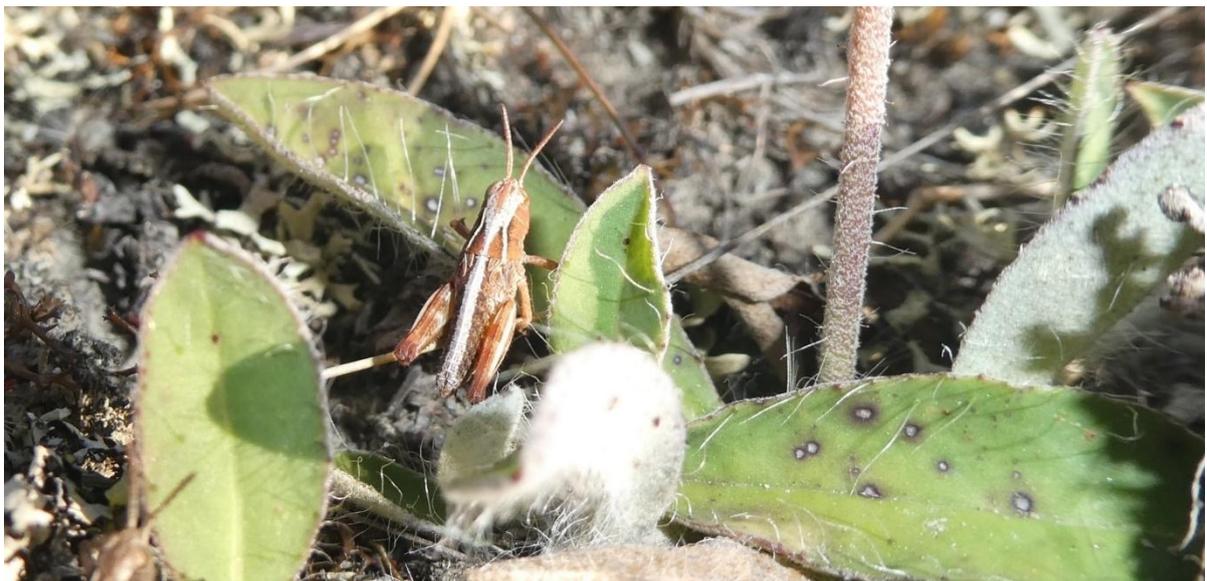


Photo 6: Reddish *Phaulacridium otagoense* at NZTM E1379380 N5805784, December 2025.



4.3.4 Unidentified Grasshoppers

Many grasshoppers encountered along the minute grasshopper survey transects were not identifiable to species. Eleven unidentified grasshoppers were recorded in quadrats, while 139 were recorded while walking along transects (Table 6).

Using the same approach as for minute grasshoppers, with the mean number of grasshoppers found per 1 m wide transect across the site (15.0 unidentified grasshoppers), and with an estimated north-south length of the site of 1.44 km (conservative due to the shape of the site), the site would therefore support approximately 21,600 unidentified grasshoppers. Of these juveniles, it is estimated that approximately 80% were Otago short-horned grasshoppers (approximately 17,300 individuals), 10% were minute grasshoppers (approximately 2,150 individuals), and 10% were other grasshopper species (approximately 2,150 individuals). These estimates are only approximate as the survey was not undertaken to quantify the number of grasshoppers on site, and the distribution of grasshoppers is not consistent across the site.

Table 6: Counts of unidentified grasshoppers within quadrats and while walking along transects, December 2025.

Transect	Number of quadrats	Quadrat counts	Walking counts	Combined counts
1	13	2	36	38
2	13	4	24	28
3	13	1	21	22
4	14	2	17	19
5	13	0	14	14
6	13	1	4	5
7	12	0	9	9
8	12	0	0	0
9	12	1	7	8
10	12	0	7	7
Total	127	11	139	150
Mean/transect		1.1	13.9	15.0

4.4 Tekapo Ground Wētā

Eleven Tekapo ground wētā (*Hemiandrus furovianus*; Threatened-Nationally Endangered) were found in pitfall traps (none at site 1, three at site 2, three at site 3, four at site 4, and one at site 5; Figure 3). Evidence of wētā burrows was seen where there were patches of soil.

As ground wētā were detected in pitfall traps, with evidence of burrows seen where soil was present, it is difficult to estimate approximate numbers within the site. As the wētā require soil for burrowing, the soil habitats would be the limiting factor for their abundance across the site.

4.5 New Zealand Praying Mantis

One New Zealand praying mantis (*Orthodera novaezealandiae*; At Risk – Declining) was seen just north of the site (Figure 3).



4.6 Invertebrate Community Summary

Based on the results of the December 2025 survey, the invertebrate community of the Haldon site is estimated to include approximately 16,150 minute grasshoppers, less than 50 robust grasshoppers, 17,300 short-horned grasshoppers (noting the uncertainty with identifications due to a large number of juveniles present), and an unknown number of Tekapo ground wētā whose abundance will be influenced by the presence of soil for burrowing. An individual New Zealand praying mantis was seen just north of the site and the site could also support low numbers of these species.

As the December 2025 survey was undertaken to sample a range of invertebrate fauna, with targeted surveys for the taxa of conservation interest, it is expected that the site also supports populations of a diverse range of other invertebrates, in addition to the threatened species described above.

5.0 Wildlife Act 1953

Brachaspis robustus Bigelow 1967 (robust grasshopper) is listed in Schedule 7 of the Wildlife Act 1953 (Version as at 27 November 2025) and is therefore absolutely protected under the Act. A Wildlife Act Authority will be required to disturb or kill this species.

6.0 Vertebrate Fauna

The droppings of European hedgehog (*Erinaceus europaeus*), one McCann's skink (*Oligosoma maccanni*), and 13 bird species (8 exotic, 5 native) were recorded on the proposed solar farm site during the invertebrate survey in December 2025 (Table 7). None of these species are classified as Threatened or At Risk.

Hedgehogs, cats (White 1994), and stoats (<https://www.doc.govt.nz>) are known predators of robust grasshoppers. Three of four hedgehog droppings that were collected during the site survey contained wētā (probably Tekapo ground wētā).

Table 7: Vertebrate fauna recorded during the invertebrate survey, December 2025.

Group	Species	Common name	Threat classification ¹
Exotic mammals	<i>Erinaceus europaeus</i>	European hedgehog (droppings)	
	<i>Oryctolagus cuniculus</i>	European rabbit	
Native lizards	<i>Oligosoma maccanni</i>	McCann's skink	Not Threatened
Exotic birds	<i>Alauda arvensis</i>	Eurasian skylark	
	<i>Branta canadensis</i>	Canada goose	
	<i>Chloris chloris</i>	European greenfinch	
	<i>Fringilla coelebs</i>	Chaffinch	
	<i>Gymnorhina tibicen</i>	Australian magpie	
	<i>Passer domestica</i>	House sparrow	
	<i>Sturnus vulgaris</i>	Common starling	
	<i>Turdus merula</i>	Eurasian blackbird	
Native birds	<i>Circus approximans</i>	Australasian harrier	Not Threatened
	<i>Himantopus himantopus</i>	Pied stilt	Not Threatened
	<i>Larus dominicanus</i>	Black-backed gull	Not Threatened
	<i>Tadorna variegata</i>	Paradise shelduck	Not Threatened
	<i>Vanellus miles</i>	Spur-winged plover	Not Threatened

¹ Hitchmough et al. 2021 (reptiles); Robertson et al. 2021 (birds).



7.0 Threatened and At Risk Plant Species

Two plant species recorded during the field survey, and that have not been recorded previously at the site, are classified as Threatened and At Risk in de Lange et al. (2024):

- Maniototo peppergrass (*Lepidium solandri*) is classified as Threatened – Nationally Critical. This species was recorded at one site (Photo 7, Figure 4), but due to its cryptic nature, is likely to be present elsewhere within the proposed solar farm site.
- Tussock bindweed (*Convolvulus verencundus* f. *verencundus*) is classified as At Risk – Declining. It is scattered throughout the proposed solar farm site (Photo 7, Figure 4).

Also of interest is one plant of porcupine shrub (*Melicytus alpinus*; Not Threatened) recorded at E1379724 N5085874 in the northwestern part of the site near the pivot irrigator, which was the only native shrub observed within the solar farm site.



Photo 7: Left: Maniototo peppergrass (*Lepidium solandri*). Basal leaves (arrowed) and dry seed pods. Right: Tussock bindweed (*Convolvulus verencundus* f. *verencundus*) flower. Leaves (arrowed) are partially hidden by hawkweed. December 2025.



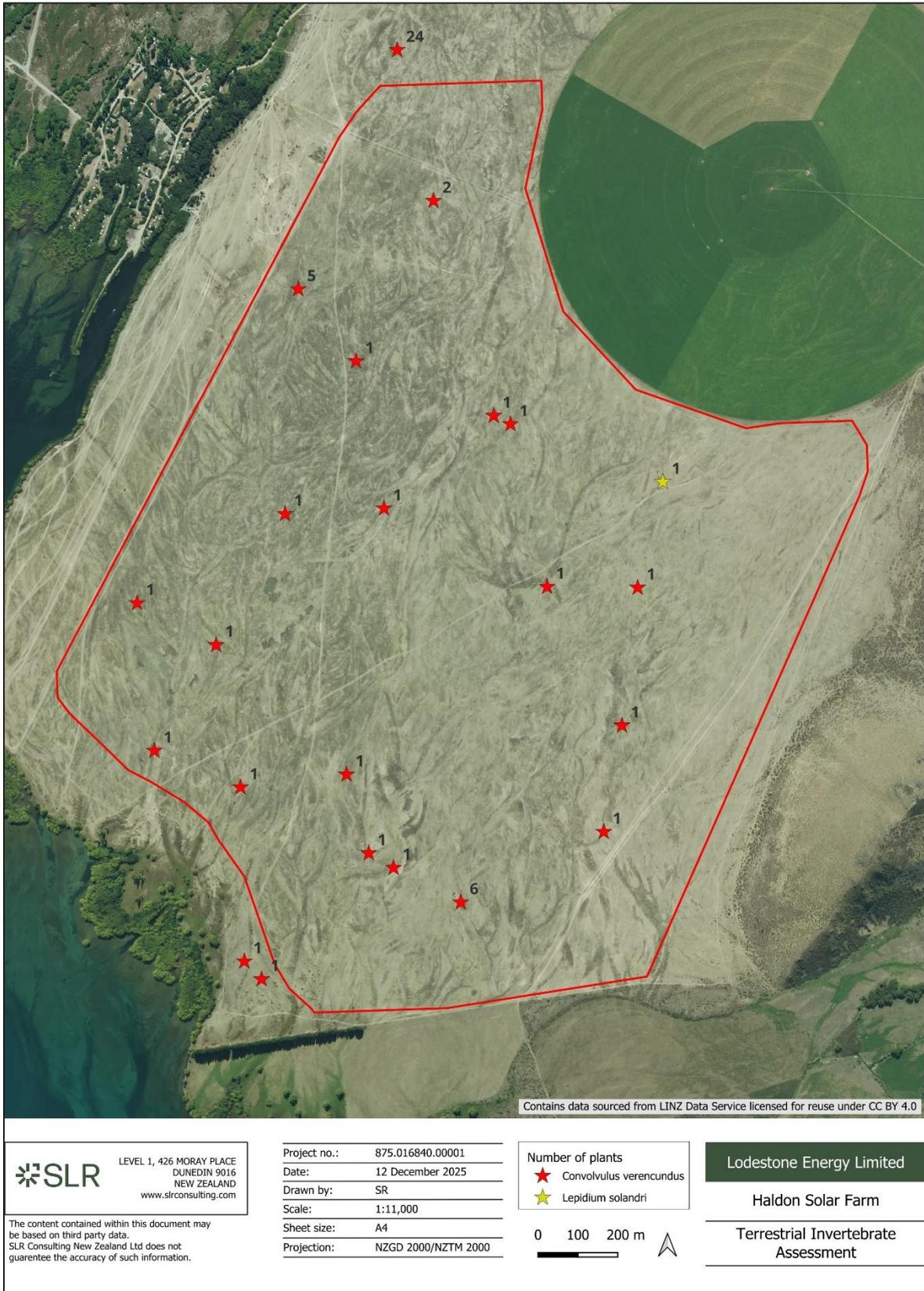


Figure 4: Recorded locations and number of plants of tussock bindweed (*Convolvulus verencundus f. verencundus*) and Maniototo peppergrass (*Lepidium solandri*), December 2025.



8.0 Potential Effects on Invertebrates

8.1 Proposed Works and Operation

The proposed Haldon Solar Farm will include solar panels, underground cables, a substation, and internal roads. Potential effects on invertebrates could include direct mortality of invertebrates and/or alteration of invertebrate habitats due to construction and operation of the solar farm. These potential effects are discussed below.

Construction Traffic

For the Haldon Solar Farm, the main volume of construction traffic will be along the roads. There will be pile driving machines that install the piles required to support the solar panels, that move slowly across the site with a single pile drive taking around 2-3 minutes. Further traffic will be required for installation of the solar panels, wiring and connections, and trenching.

Earthworks

During construction, earthworks will be required for the construction of new roading, trenching for cables, and foundations for the Medium Voltage Stations and the grid connection. Total earthworks are expected to comprise up to approximately 32,000 bank m³ of cut, approximately 51,000 m³ of fill and approximately 21,500 m³ of imported fill, with a total surface area of approximately 132,000 m²; this constitutes approximately 5% of the area of the proposed solar farm site.

Preparatory earthworks will be phased to minimise the extent of the exposed ground at any time. The project design will aim to balance cut and fill. All materials excavated will be reused within the solar farm site to achieve levels and form roadways.

Construction of the raised platform for the substation, together with foundations for access roads and trenching works, will require the importation of aggregate / fill material.

All earthworks will be subject to appropriate erosion and sediment controls consistent with the best-practice principles and guidance provided in an appropriate erosion and sediment control toolbox.

Operation of the Solar Farm

Following construction, the solar farm would include the array of panels, underground cables, and a substation. Traffic movements around the site would be minimal, however traffic would be required for maintenance to the panels and other structures within the site.

8.2 Construction Effects on Invertebrates

Direct Invertebrate Mortality and Injury

Earthworks and other construction activities such as pile driving and vehicle movements have the potential to kill and injure invertebrates. Direct mortality or injury could be due to having vehicles moving over invertebrates on the ground surface or by having equipment (e.g., piles) driven into the ground at sites where the invertebrates were burrowing.

Alteration of Invertebrate Habitats

The proposed construction works have the potential to damage or reduce the extent of invertebrate habitats at the site. This could be through earthworks, creation of compacted road surfaces, and construction of building pads that would have direct disturbance of and alter the existing habitat.



The earthworks extent is relatively small in the context of the site (approximately 5% of the solar farm site). It is not known whether remediation of earthworks areas would result in recolonisation by invertebrates, how long recolonisation might take, or whether other effects such as shading would discourage recolonisation.

8.3 Post-Construction and Operational Effects on Invertebrates

Shading of Invertebrate Habitats

Once the solar farm is constructed, shading of the ground by the solar panels will likely reduce incident solar radiation at ground level leading to changes in microclimatic conditions such as soil moisture levels, humidity, snow retention period, and temperature. These changes can directly affect invertebrate activity, behaviour, metabolism, reproduction, and life stage survival and indirectly affect the quality of habitat for invertebrates (e.g., by altering the vegetation).

There is no existing research on the effects of solar farm shading on terrestrial invertebrates and their habitats in New Zealand, including within the dryland habitats present at the proposed Haldon Solar Farm site. Nevertheless, it is likely that shading during the solar farm operation would have potential adverse effects on grasshoppers and other invertebrates due to the exposed and un-shaded nature of the existing dryland habitat present at the site.

Direct Invertebrate Mortality and Injury

There will be very little traffic required on site during the operation of the solar farm, with most traffic using roads unless maintenance is required on panels, structures, inverter, or grid connection. However, such movements have the potential to result in some direct mortality and injury to terrestrial invertebrates.

9.0 Potential Mitigation of Adverse Effects on Invertebrates

9.1 National Policy Statement for Renewable Electricity Generation 2011

Policy F of the National Policy Statement for Renewable Electricity Generation 2011 (NPS-REG; Amended December 2025) concerns “Enabling and managing the effects of REG assets and activities on the environment”:

- (1) *Decision-makers must enable REG assets and activities in all locations and environments.*
- (2) *Where REG assets and activities are proposed to locate in or are likely to have adverse effects on environments and values provided for in section 6 of the Act, the provisions of this policy must be read alongside other relevant national direction, regional policy statements and regional and district plans.*
- (3) *Where (2) does not apply, the adverse effects of REG assets and activities must be, where practicable, avoided, remedied or mitigated.*
- (4) *Decision-makers must have particular regard to the use of adaptive management measures.*
- (5) *When considering any residual adverse effects of REG assets and activities that cannot be avoided, remedied or mitigated, decision-makers shall have regard to offsetting measures or environmental compensation, including measures or compensation that benefit the local environment and community affected.*



Section 6 of the Resource Management Act (RMA) 1991 (Version as at 17 December 2025) states:

6 Matters of national importance

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

...

- (c) *the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:*

...

Due to the presence of a range of nationally Threatened and At Risk terrestrial invertebrates, we consider the site to be significant habitat of indigenous fauna under the RMA.

Measures to address potential adverse effects on invertebrates are discussed below.

9.2 Mitigation Undertaken or Proposed by the Applicant

Avoidance

The applicant has excluded some areas of land from the development footprint to ensure there are adequate setbacks from the lakeshore (200 m+) and other areas. These excluded areas have the potential to support habitat for grasshoppers and other invertebrates. However, only a small part of these areas has been surveyed for invertebrate values and it is therefore not known whether these areas provide potential invertebrate habitat. Parts of the excluded areas are located along the margins of Lake Benmore and adjacent to the existing pivot irrigator, where habitats are damper and more vegetated than the drier and more exposed invertebrate habitats within the solar farm site, and therefore may be less suitable for grasshoppers and other indigenous invertebrates than the surveyed areas within the solar farm site.

As such, although the large areas of land excluded from the solar farm site have the potential to support invertebrate habitats, there is still likely to be residual adverse effects of the solar farm on the Threatened and At Risk invertebrates, and their habitats, identified within the solar farm site. Potential mitigation options that could be used to address residual effects are discussed below.

Minimisation

In an effort to minimise potential effects of construction and shading on invertebrate habitat within the solar farm site, Lodestone has advised that the spacing between solar panels has been maximised within the design parameters. The panel spacing and operation of the solar farm, as proposed, will result in a Ground Coverage Ratio (GCR) of 41%, meaning panels will cover 41% of the available land when in a horizontal position (midday sun). As the panels move throughout the day and the time of year changes, the degree of shading of the land also changes (Naomi Humbles, Lodestone Energy, pers. comm.; Table 8).



Table 8: Percentage of land shaded by panels each month. Provided by Lodestone Energy.

Month	Percentage of land shaded per month
January	34.7
February	34.5
March	36.4
April	41.7
May	49
June	57
July	52.1
August	44.9
September	36.9
October	34.6
November	34.7
December	34.5

Offset/Compensation

The applicant is proposing protection of ‘conservation zones’ across the site, with monitoring proposed to understand potential effects of the works activities on invertebrates at the site and with adaptive management processes in place in the case of population changes as a result of the works. These areas and monitoring are discussed further below in context with the invertebrate community.

9.3 Potential Mitigation Options

Options to avoid, minimise, remedy, offset, and compensate potential adverse effects on invertebrates are presented below and their advantages/disadvantages are summarised in Table 9. These options are not recommendations but are provided for completeness.

Avoidance

- Complete avoidance of the site by not building the solar farm.
- Complete avoidance of the site by building the solar farm in another area where there is highly modified land with low ecological values. Lodestone have advised this is not a feasible option.

Minimise

- Further reduce the extent of the solar farm e.g., only build the eastern half to protect robust grasshopper habitat, or only build the western half to protect what appears to be better quality minute grasshopper habitat. Due to the cost of connecting to the 220 kV transmission lines needing a minimum project footprint, Lodestone have advised this is not a feasible option.
- Further reduce shading e.g., increase the width of the spacing between lines of panels. Lodestone have advised this is not a feasible option.



- Reduce the potential during construction for invertebrates to be driven over by vehicles moving across the site, either to install piles or to move equipment around site, by ensuring moving vehicle speeds remain as low as possible (e.g., 5-10 km/h), potentially allowing some invertebrates to move out of the vehicle path. Effects from vehicles could be further reduced by minimising the number of paths used by vehicles across the site.
- During pile driving, site staff walking ahead of the pile driving equipment could be used to detect and move any detected invertebrates or potentially disturb invertebrates from the path of the vehicles/equipment.
- Capture of threatened invertebrates prior to construction activities in the solar farm site (e.g., within the vicinity of several rows of panels at a time) and relocation to areas already or not yet affected by construction activities, or to the area within the transmission corridor.

Remedy

- Areas where earthworks have occurred (excluding roads and permanent structures) could be remedied to maintain/provide invertebrate habitat (e.g., addition of gravel/cobble material to provide potential habitat for invertebrates).
- Areas within the solar panel array could be remedied following construction to maximise potential habitat available in the areas expected to have the lowest levels of shading across the site.

Offset/Compensation

On-site or off-site reserve or offset / compensation area that would likely include:

- Investigation of potential sites in similar nearby habitats.
- Pre-works habitat mapping and baseline invertebrate surveys to determine existing values.
- Creation of an invertebrate reserve for robust grasshopper, minute grasshopper, Otago short-horned grasshopper, Tekapo ground wētā, and potentially other species. Would need to include a predator-proof fence, preparation of gravel substrates, planting of suitable species (sparse *Raoulia*, *Muehlenbeckia axillaris*, etc.), ongoing monitoring and maintenance.
- Restoration planting, including host-specific food plants for threatened and uncommon invertebrates and other species favoured by invertebrates, and ongoing maintenance and monitoring.
- Pest plant management e.g., woody species such as sweet briar and herbaceous species such as Russell lupin.
- Research project/s e.g., invertebrate translocation; preparation of gravel substrates for grasshoppers; monitoring of vegetation, abiotic conditions, and invertebrate communities prior to and following solar panel installation.

These options relating to offset / compensation have been incorporated into the section below where more information is provided regarding the 'conservation zones' and monitoring proposed by the applicant.



Table 9: Advantages and disadvantages of each potential mitigation option.

Effects Management Hierarchy	Option	Advantages	Disadvantages
Avoidance	Solar farm not constructed	<ul style="list-style-type: none"> Protection of dryland ecological values at Haldon site 	<ul style="list-style-type: none"> No solar farm
	Solar farm located elsewhere		<ul style="list-style-type: none"> Difficulty of finding a suitable site (other areas of non-productive land in the Mackenzie Basin are also likely to have moderate to high ecological values)
Minimisation	Reduce the extent of the solar farm	<ul style="list-style-type: none"> Part of site left undisturbed. Protects some Threatened and At Risk invertebrate habitat. Reduces effects on threatened plants. 	<ul style="list-style-type: none"> Still likely to have adverse effects. Solar Farm not commercially viable?
	Reduce shading		
	Reduce vehicle speeds/paths, and move invertebrates ahead of pile driving vehicles/ equipment	<ul style="list-style-type: none"> Potentially reduces number of invertebrates affected by construction vehicle movements. 	<ul style="list-style-type: none"> Uncertain how effective disturbance prior to vehicle movements would be in reducing mortality.
	Capture / relocation of invertebrates prior to construction	<ul style="list-style-type: none"> Reduce number of invertebrates affected by construction activities. 	<ul style="list-style-type: none"> Habitat alteration due to solar farm not addressed. Uncertain how effective relocation of invertebrates would be in the dryland environment.
Remedy	Remedy of construction areas to provide invertebrate habitats	<ul style="list-style-type: none"> Increase habitats for invertebrates within the solar farm following construction. Potential for habitats to also support plants and/or lizards. 	<ul style="list-style-type: none"> Uncertain how effective the habitat would be for invertebrates. Uncertain how effective the habitat would be for plants and/or lizards. Uncertain whether shading would reduce effectiveness of habitats for invertebrates.
	Remedy areas within array with limited shading to maximise invertebrate habitats	<ul style="list-style-type: none"> Increase quality of less shaded habitats for invertebrates within the solar farm following construction. 	<ul style="list-style-type: none"> Uncertain how effective the habitat would be for invertebrates. Uncertain whether shading would reduce effectiveness of habitats for invertebrates.



Effects Management Hierarchy	Option	Advantages	Disadvantages
Offset / compensation	On-site or off-site reserve / enhancement site	<ul style="list-style-type: none"> • Full extent (or near full extent) of solar farm is built. • Protection of habitats for threatened species. 	<ul style="list-style-type: none"> • Not avoidance or minimisation. • Minimisation and remedy also likely required. • Suitable off-site area difficult to find? • High cost and ongoing costs. • Creation of grasshopper habitat / translocation, monitoring of success difficult. • Substantial work needed to quantify adverse effects. • Difficult to demonstrate no net loss of ecological values.

10.0 Proposed ‘Conservation Zones’

Lodestone Energy are proposing a series of ‘conservation zones’ across the site, with 26.55 ha identified for protection across five ‘zones’ (Figure 5).

10.1 Habitats and Invertebrate Communities

Zone 1 (12.5 ha) is located outside the proposed solar farm site so was not thoroughly surveyed for invertebrates in December 2025. The zone is within a degraded area, being adjacent to public road access to the nearby campground and subject to off-road vehicle use. The area is relatively uniform, with flat short grassland on rabbit excavated soils. This area is probably better suited to supporting Otago short horned grasshoppers and crambid moths. However, there were minute grasshopper, Tekapo ground wētā, and New Zealand praying mantis present. No robust grasshopper habitat was seen in this area. Tussock bindweed was also seen in this area.

Zone 2 (1.15 ha) is located outside of the proposed solar farm site and includes the farm access point so has multiple roads diverging across it. The area is tucked between the pivot-irrigated field and Mount Maggie beside an area of lush grass and sweet briar shrubland. The habitat present is relatively flat, short grassland, which is probably suited to Otago short-horned grasshoppers and crambid moths. Minute grasshoppers were present, and the roads provided habitat for sun-basking species such as tiger beetles, stiletto flies, and native bees.

Zone 3 (2.5 ha) is located outside the proposed site, at the base of Mount Maggie. The area east of the access road is increasingly long grass and sweet briar shrubland habitat so was not targeted in the December 2025 survey. The area contained some patches of low-stature grasses and some minute grasshoppers.

Zone 4 (1.2 ha) is located largely outside the proposed site, adjacent to a shelter belt. The terrain is more varied than the other zones, with channels and ridges with longer grass and sweet briar scrub. Cattle pats, old wood and trash provided habitat for various invertebrates, although more of these were introduced species than at less modified sites. Minute grasshoppers were patchily distributed.

Zone 5 (9.2 ha) is located within the transmission corridor through the centre of the site and currently has a mosaic of upper terrace flat and lower outwash plain ridges and valleys, with short herbs, longer grass, and some sweet briar shrubland. The results from the December



2025 survey indicate that this zone likely contains most of the threatened species found within the wider site.

Summary

Overall, the proposed conservation zones are spread around the site and are therefore fragmented from each other. The zones generally support 'edge' habitats, that are near fences or roads where there is potential influence from adjacent land and/or vegetation differences due to activities such as irrigation, compared with the more open and less constrained habitats within the majority of the site.

For supporting invertebrate communities, the habitats currently within zones 2, 3, and 4 are not ideal for the threatened invertebrates and the zones are not large enough to accommodate the requirements of different species. The triangular shapes mean that there are large areas within the long, narrow points that would not support diverse habitats. These zones are also located in proximity to condition-altering features such as the slope of Mount Maggie, shelter belts, irrigation fields, sweet briar shrubland, and the solar panels.

Of the five zones, zone 5 is the second largest and supports habitats found across the site (as the zone extends the full width of the site) and therefore has the most potential from an invertebrate perspective. However, this zone is also the transmission corridor and will require ongoing vehicle access to allow maintenance of the transmission line; protection and enhancement of this zone would therefore need to be balanced with the access demands of the site, which could compromise conservation actions without careful management.

Zone 1 is the largest zone, is the most compact zone (and therefore minimises edge effects, and allows invertebrates to move more easily within the reserve), and contains the most similar habitats to those found across the site; however, the December 2025 survey showed the quality of invertebrate habitat is generally poorer in this zone than in the rest of the site, with few grasshoppers recorded. Maintaining the habitat currently present within this zone could be sufficient for protecting the threatened invertebrates there, following fencing the perimeter (e.g., to prevent vehicle access) and controlling pests (e.g., hedgehogs, weeds).

Of note is that the robust grasshopper was not found (in December 2025) within any of the five zones, and the habitats observed in the zones are not considered suitable for robust grasshoppers. For the zones to support robust grasshoppers, habitat would need to be created (which would likely require ongoing monitoring and maintenance), with translocation of robust grasshoppers to the zones being a final, but not preferred, option (given the uncertainty related to the potential success of translocation of this species). This species is also listed in Schedule 7 of the Wildlife Act, and a Wildlife Act Authority is required for any disturbance of this species.

Lastly, the conservation areas comprise 26.55 ha, while the solar farm site fence encompasses 282.09 ha, within which there are an estimated 16,150 minute grasshoppers, up to 50 robust grasshoppers, and 17,300 short-horned grasshoppers (total 33,500 grasshoppers). Therefore, the proposed conservation areas have enough land at current grasshopper densities to protect only a tenth of the grasshoppers (total 3,153) potentially affected by the development, and probably less given the lower quality habitat.

Alternative Conservation Zone

Five small conservation zones have been proposed; however, a better ecological alternative would be to create a single, potentially larger reserve on the western boundary of the site. This area includes known habitats for all the target grasshopper species, including robust grasshopper. Ideally it would be made contiguous with the transmission corridor, thus providing a greater area of contiguous habitat. While minute grasshopper densities appear to



be lower in the western part of the site, this may also provide the opportunity to enhance minute grasshopper habitat and thereby provide further potential to mitigate any adverse effects. Creation of this reserve would require removal of an area of solar panels, however this could be balanced by panels being installed within the smaller areas proposed as conservation zones. Lodestone have advised this is not currently a feasible option.



Figure 5: Proposed ‘conservation zones’ at the Haldon solar farm site.

10.2 Options for Enhancing Invertebrate Habitats in ‘Conservation Zones’

The protection of the five conservation zones has the potential to protect some habitats for invertebrates found within the wider site. However, protection of these zones will not be sufficient on its own to support invertebrate communities and further activities will be required to improve the habitats for invertebrates.

The protection requirements for the threatened invertebrate species will be the same in each of the five zones: essentially the maintenance of climatic, soil, vegetation, resource and predator conditions for each species.



Fencing

Fencing of the zones will be required to prevent all vehicle access across each zone, to ensure any habitats and/or invertebrates within each zone are protected from damage. Fencing will also be required to prevent pest animals, particularly hedgehogs and cats, from entering each zone. Fencing to prevent rodents (e.g., rats, mice) could be investigated, however ideally any fencing should allow for movements by invertebrates so any individuals outside the zones can enter if required.

The specific fencing requirements will need to be determined in consultation with fencing requirements for protection of lizards. It is also understood that fencing the perimeter of the whole solar farm is intended, and the specifics of fencing around the zones can therefore be designed to ensure sufficient protection of the zones in collaboration with the site fencing.

Within zone 5, across the transmission corridor, as there will be ongoing vehicle access, specific areas could be fenced to completely isolate the fenced areas from disturbance. Fencing of these areas will essentially create smaller zones within the wider zone 5, and consideration should therefore be given to creating the largest extent of fenced areas as possible to maximise the diversity of habitats present. This will need to be balanced with the access requirements for the corridor, but the larger the fenced areas can be, the better protection of habitats within these areas.

Pest Animal and Plant Management

Depending on the fencing constructed, and which pest animals are prevented from accessing each zone, management of pest animals is recommended following fence construction and ongoing to ensure invertebrate predators are prevented from preying on the invertebrates within each zone.

Pest plant management is also recommended within each zone, to remove woody species such as sweet briar and herbaceous species such as Russell lupin.

Grazing Management

It is recommended that limited and controlled grazing by sheep is trialled to ensure the vegetation is kept suitable for invertebrates. For the same reason, it may also be beneficial to allow rabbits into invertebrate reserves, although this will need to be balanced against the need to exclude hedgehogs and cats.

Enhancement of Substrates and Vegetation

Techniques that could be used to enhance habitats for invertebrates include:

- For robust grasshopper, provision of suitable gravel substrates e.g., by scraping back soil and vegetation or by bringing in gravels from off-site.
- For grasshoppers, maintenance and establishment of suitable plant species (sparse *Raoulia*, *Muehlenbeckia axillaris*, etc.).
- For host-specific invertebrates, planting of food plants.
- For wētā, provision of suitable soil substrates to allow burrowing.

Translocations

Should suitable habitats be present and created for each target species (robust grasshopper, minute grasshopper, Otago short-horned grasshopper, and Tekapo ground wētā) within the difference zones, consideration could be given to translocating these species into the zones.



11.0 Monitoring and Adaptive Management Options

11.1 Conservation Zones

Ongoing monitoring is required to determine the effectiveness of the works undertaken in the conservation zones to protect and enhance invertebrate habitats.

To establish a baseline against which future monitoring can be assessed, it will be necessary to undertake pre-works habitat mapping and invertebrate surveys for at least two years to determine existing values, to quantify invertebrate communities within each zone, and to provide some indication of the natural variability within the site. Monitoring should be focussed on understanding and quantifying habitats and numbers of the target species (robust grasshopper, minute grasshopper, Otago short-horned grasshopper, and Tekapo ground wētā).

Any grazing management undertaken would require monitoring of vegetation and habitats to determine if grazing could be beneficial to invertebrate populations.

All habitat enhancement works will need to be monitored for success. This would include ongoing persistence of the created habitats, as well as determining the effects of the enhancements on numbers of target invertebrates.

Ongoing monitoring would also be required to determine the success of translocations, to determine if further translocations are possible or required, and to determine whether habitat parameters necessary for invertebrate persistence are present and/or maintained within the zones.

Pest animal and plants will need to be monitored both pre- and post-control operations.

Any pest-proof fences will need to be monitored for any breaches by pest animals.

11.2 Solar Farm Site

As for the conservation zones, pre-works habitat mapping and invertebrate surveys will need to be undertaken to determine baseline values, and to quantify invertebrate communities. Monitoring should be focussed on quantifying numbers of the target species (robust grasshopper, minute grasshopper, Otago short-horned grasshopper, and the Tekapo ground wētā). Ideally, baseline surveys should be undertaken annually for at least two years before works are undertaken to provide some indication of the natural variability within the site.

Transects should be established which align with the solar arrays to ensure the same transects can be traversed and assessed prior to and following solar farm construction. These transects should be located throughout the solar farm in areas beneath solar panels (i.e., directly shaded), between solar panels (i.e., expected to have less shading), along access tracks (i.e., where vehicles are expected to traverse), and around the perimeter of the site. The target invertebrate species should be counted along the transects.

As Tekapo ground wētā are only likely to be present at localised sites where there is suitable habitat, and are best sampled by pitfall trapping, it will likely be necessary to monitor these sites separately. Pitfall trap arrays should be maintained at sites where Tekapo ground wētā have been recorded pre-works.

To determine the potential effects of solar panel shading on invertebrate habitats, environmental parameters such as air temperature, soil temperature, soil moisture, and light levels should be measured at ground level pre- and post-works using automated data loggers. In addition, ground cover variables should be recorded in quadrats at the site of



each data logger, e.g., the percentage cover of each vascular plant species, moss, lichen, bare soil, and stones/gravel (in different size classes).

To ensure that any changes in invertebrate abundance/presence and environmental parameters can be attributed to (or not) the establishment of the solar panels, all monitoring sites should have paired control sites located away from the solar farm. In addition, it will be necessary to have sufficient replicates to account for the likely variability in the data collected.

Monitoring of invertebrates and environmental parameters should initially be undertaken annually and, following each monitoring event, comparisons should be made with the baseline data set. This will require sufficient confidence in baseline data to allow accurate comparison and to help determine if adaptive management options could be required. Based on the findings of the monitoring, the frequency of the monitoring may be able to be decreased in the future. Monitoring should continue until pre-determined closure criteria are reached, e.g., no net loss of invertebrate values has been achieved for 5 years.

Adaptive management approaches could include that if the populations of any of the targeted invertebrate species reduce by at least 10% from baseline levels within the solar farm site after two years of the solar farm being in operation, then additional areas of suitable habitat for the species are created within the solar farm site. For example, additional gravel substrates could be provided in appropriate open sites where robust grasshoppers have been found, to provide further habitat above those already present. Ongoing monitoring would be required to determine if any improvement in population numbers was detected. Such an approach could require the creation of further open spaces within the solar farm, or require avoidance of certain areas (e.g., removal of access tracks or a row of solar panels).

If the populations of any of the targeted invertebrate species further reduce by 10% within the solar farm site after another two years, then remaining populations within the solar farm could be translocated to the conservation zones with habitat enhancement² and a subsequent improvement in invertebrate numbers required to compensate for the observed loss. For this to be a viable option, robust monitoring of invertebrate numbers and habitat parameters prior to, and following, any translocations would be required to ensure the populations within the conservation zones have not reduced and to ensure invertebrates being translocated to the conservation zones have been/can be released into suitable habitats. If population numbers decline within the zones, even following translocations, further areas of protection (e.g., additional conservation zones) may be required to ensure ongoing protection of the threatened species. This could require the protection of additional land away from the solar farm site, if sufficient land within the site cannot be determined for suitable protection of the relevant species.

If further monitoring detects continuing decline of any of the invertebrate populations (i.e., beyond the initial 10% and subsequent 10% reductions described above) within the solar farm site, further conservation areas could be required to ensure appropriate protection of the species overall, irrespective of the solar farm site. Such an approach could include creation of a larger reserve within the Mackenzie Basin where threatened invertebrates have been found. Note that as the NPS-REG requires mitigation of any adverse effects on significant habitats of indigenous fauna, any required reserve will need to be much larger than the area of habitat affected because no new habitat or populations will be created to compensate for the loss and the uncertainty of success of any habitat enhancements.

² If sufficient habitat, both in quality and in scale, is not available within the conservation zone, there should be no translocation into the zones.



If the populations of any of the targeted invertebrate species reduce by greater than 10% from baseline levels within the solar farm site after two years of the solar farm being in operation, a combined management approach using the options provided above could be required to ensure appropriate protection of the species overall. For example, if any of the targeted invertebrate species reduce by greater than 20%, then both habitat enhancement and translocation should be considered. If any of the targeted invertebrate species reduce by greater than 30%, then a combination of habitat enhancement, translocation, and creation of further conservation areas should be considered.

12.0 Summary and Conclusions

A terrestrial invertebrate survey for the Haldon Solar Farm site was undertaken in December 2025 using a range of techniques, but focussing on Threatened and At Risk species that may be present at the site.

It was found that the Haldon Solar Farm site provides habitat for:

- Robust grasshopper (*Brachaspis robustus*; Nationally Endangered).
- Minute grasshopper (*Sigaus minutus*; Nationally Vulnerable).
- Otago short-horned grasshopper (*Phaulacridium otagoense*; At Risk – Declining).
- Tekapo ground wētā (*Hemiandrus 'furoviarius'*; Nationally Endangered).
- A range of other invertebrate species.

The New Zealand mantis (*Orthodera novaezealandiae*; At Risk – Declining) was also recorded near the solar farm site and is also likely to be present.

Due to the presence of a range of nationally Threatened and At Risk terrestrial invertebrates, we consider the site to be significant habitat of indigenous fauna under the RMA.

Habitats important to invertebrates in the dryland area include areas of gravels and low, sparse vegetation (robust grasshopper and minute grasshopper), shallow soils (Tekapo ground wētā), and areas with indigenous plants such as *Muehlenbeckia axillaris* which host *Lycaena* butterflies. These habitats are distributed throughout the proposed solar farm site, forming a mosaic with other vegetation.

There is some uncertainty on the effects of the solar farm due to a lack of research and because few solar farms have been constructed in New Zealand and none in the Mackenzie Basin. However, the construction and operation of the solar farm will likely result in mortality and injury of terrestrial invertebrates and damage invertebrate habitats at the site, while the solar panels will shade the ground which is likely to result in changes to the vegetation and the quality of invertebrate habitats.

The NPS-REG (MfE 2025) requires all adverse effects on significant habitats of indigenous fauna to be mitigated. A range of mitigation options are presented that may be able to be used to address potential adverse effects on terrestrial invertebrates from construction and operation of the solar farm. It is likely that, following avoidance, minimisation, and remediation, an offsetting or compensation approach will be required to fully offset adverse effects on invertebrates. This will require significant effort to fully demonstrate no net loss of significant indigenous biodiversity values. Any mitigation options could be combined with those required, if any, for plants and/or lizards, and it is worthwhile considering combined options considering the nature of the dryland habitats within the solar farm site.



Lodestone Energy have proposed the creation, and ongoing enhancement and monitoring of conservation zones within the solar farm site. Potential options for an adaptive management approach for terrestrial invertebrates within the solar farm site has been provided and will require ongoing monitoring to determine if any reductions in invertebrate populations occur. Reductions of populations could require further habitat protection/enhancement, possible translocation of invertebrates (and ongoing maintenance to determine success of the translocations), and creation of further protected areas for preservation of the threatened invertebrates found within the solar farm site.

In addition, robust grasshopper is listed in Schedule 7 of the Wildlife Act 1953 and is therefore absolutely protected under the Act. A Wildlife Act Authority will be required to disturb or kill this species.

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14.0 Closure

Sincerely,

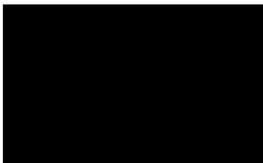
SLR Consulting New Zealand Limited



Mike Wakelin
Invertebrate Ecologist

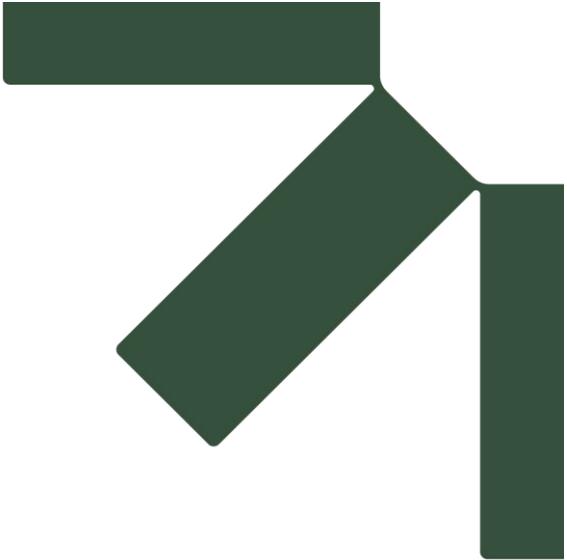


Steve Rate
Senior Ecologist



Ben Ludgate
Principal Ecologist





Appendix A Threatened, At Risk, and Data Deficient Invertebrate Species Potentially Present at the Haldon Solar Farm site

Terrestrial Invertebrate Assessment

Haldon Solar Farm

Lodestone Energy Limited

SLR Project No.: 875.016840.00001

10 February 2026

Table A-1: Invertebrate species classified as Threatened, At Risk, or Data Deficient in the New Zealand Threat Classification System (NZTCS) that are potentially present at the Haldon Solar Farm site. Threatened Nationally Critical (T-NC), Threatened Nationally Endangered (T-NE), Threatened Nationally Vulnerable (T-NV), At Risk Naturally Uncommon (AR-NU), At Risk Declining (AR-D), At Risk Relict (AR-R), Data Deficient (DD).

Group	Family	Taxon	NZTCS
Aranae	Gnaphosidae	<i>Matua festiva</i>	DD
	Idiopidae	<i>Cantuaria ?cognata</i>	DD
	Linyphiidae	<i>Megafroneta gigas</i>	DD
	Lycosidae	<i>Anoteropsis arenivaga</i>	AR-NU
		<i>Anoteropsis lacustris</i>	AR-NU
	Micropholcommatidae	<i>Rayforstia mcfarlanei</i>	DD
	Salticidae	<i>Clynotis saxatilis</i>	DD
Coleoptera	Carabidae	<i>Zecicindela tekapoensis</i>	(T-NC?)
		<i>Holcaspis abdita</i>	T-NC
		<i>Holcaspis bathana</i>	T-NC
		<i>Holcaspis bidentella</i>	T-NC
		<i>Holcaspis falcis</i>	AR-D
		<i>Holcaspis</i> n. sp.	T-NC
		<i>Megadromus fultoni</i>	AR-NU
		<i>Megadromus</i> sp. 11 "Benmore"	DD
	Tenebrionidae	<i>Artystona lata</i>	AR-NU
		<i>Mimopeus costellus?</i>	AR-NU
Diptera	Asilidae	<i>Neoitamus smithii</i>	AR-NU
	Chloropidae	<i>Diplotoxa knighti</i>	DD
	Lauxaniidae	<i>Trypetisoma tenuipenne</i>	DD
	Therevidae	<i>Anabarhynchus albipennis</i>	DD
		<i>Anabarhynchus atratus</i>	DD
		<i>Anabarhynchus grossus</i>	AR-NU
		<i>Anabarhynchus harrisi</i>	AR-NU
		<i>Anabarhynchus indistinctus</i>	DD
		<i>Anabarhynchus simplex?</i>	DD
Hemiptera	Lygaeidae	<i>Lepiorsillus tekapoensis</i>	DD
		<i>Nysius liliputanus</i>	AR-NU
		<i>Rhypodes brevipilis</i>	DD
		<i>Rhypodes triangulus</i>	DD
	Miridae	<i>Pimeleocoris roseus</i>	T-NC
		<i>Romna cuneata</i>	DD
		Hymenoptera	Braconidae
Encyrtidae	<i>Zelencyrtus latifrons</i>		DD
Lepidoptera	Crambidae	<i>Gadira</i> "black brown EGW"	AR-NU
		<i>Loxostege</i> sp. "salt pan"	AR-R
		<i>Orocrambus fugitivellus</i>	T-NC
		<i>Orocrambus</i> "Mackenzie Basin"	T-NV
		<i>Orocrambus sophistes</i> (?cyclopicus)	T-NV
		<i>Orocrambus sophronellus</i>	DD

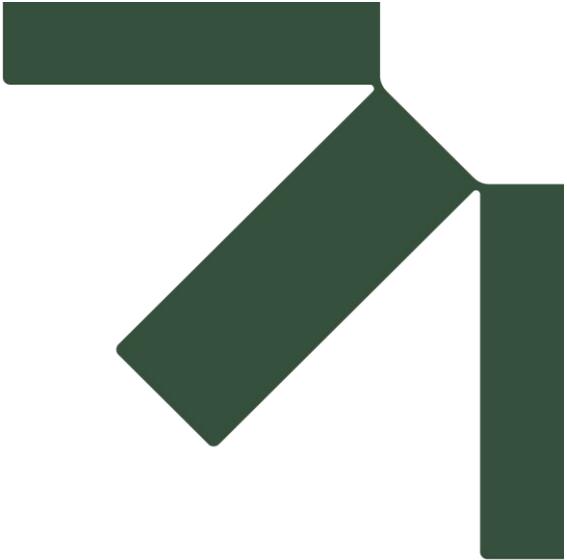


Group	Family	Taxon	NZTCS
	Elachistidae	<i>Elachista helonoma</i>	AR-R
	Gelechiidae	<i>Kiwaia pumila</i>	T-NV
	Geometridae	<i>Asaphodes stinaria</i>	T-NV
		<i>Dasyuris partheniata</i>	AR-D
		<i>Dasyuris ensyii</i>	AR-NU
		<i>Declana toreuta</i> grey populations	T-NV
		<i>Helastia angusta</i>	AR-R
		<i>Helastia clandestina</i>	AR-R
		<i>Paranotoreas fulva</i>	AR-R
		" <i>Pseudocoremia</i> " <i>cineracia</i>	T-NV
		<i>Pseudocoremia</i> sp. "Knobby Range"	T-NE
		<i>Theoxena scissaria</i>	T-NV
		<i>Theoxena</i> sp. "non-pectinate"	DD
		<i>Xanthorhoe bulbulata</i>	T-NC
		<i>Xanthorhoe lophogramma</i>	AR-NU
	Noctuidae	<i>Australothis volatilis</i>	T-NC
		<i>Graphania tetrachroa</i>	T-NV
		<i>Meterana exquisita</i>	AR-R
	Oecophoridae	<i>Izatha psychra</i>	T-NE
	Pyralidae	<i>Sporophyla oenospora</i>	T-NC
Stathmopodidae	<i>Stathmopoda</i> sp. "Olearia"	T-NV	
Tortricidae	<i>Eurythecta robusta</i>	AR-NU	
Orthoptera	Acrididae	<i>Sigaus australis</i> 'central arid'	T-NV
		<i>Sigaus campestris</i>	AR-D
		<i>Sigaus minutus</i>	T-NV
		<i>Sigaus (Brachaspis) nivalis</i>	AR-D
		<i>Sigaus (Brachaspis) robustus</i>	T-NE
		<i>Phaulacridium otagoense</i>	AR-D
	Anostostomatidae	<i>Hemiandrus furovianus</i> '	T-NE
		<i>Hemiandrus</i> "Mt George"	DD
The following are aquatic taxa			
Crustacea	Daphniidae	<i>Daphnia tewaipounamu</i>	DD
	Notostraca	<i>Lepidurus apus viridis</i>	T-NE
Coleoptera	Dytiscidae	<i>Antiporus femoralis</i>	DD
	Elmidae	<i>Hydora</i> sp.	DD
	Hydraenidae	<i>Orchymontia dilatata</i>	DD
		<i>Podaena mariae</i>	DD
		<i>Deleatidium magnum</i>	AR-NU
Ephemeroptera	Leptophlebiidae	<i>Deleatidium insolitum</i>	T-NE
Plecoptera	Gripopterygidae	<i>Megaleptoperla grandis</i>	AR-NU
		<i>Zelandobius macburneyi</i>	DD
Trichoptera	Hydrobiosidae	<i>Psilochorema folioharpax</i>	DD
	Hydroptilidae	<i>Paroxyethira kimminsi</i>	DD
		<i>Paroxyethira pounamu</i>	AR-NU
		<i>Paroxyethira hintoni</i>	AR-NU



Group	Family	Taxon	NZTCS
The following are found in grey shrublands			
Annelida	Acanthodrilidae	<i>Eodrilus montanus</i>	DD
Coleoptera	Anthribidae	<i>Cerius otagensis</i>	T-NC
	Curculionidae	<i>Hadramphus tuberculatus</i>	T-NC
		<i>Lyperobius carinatus</i>	AR-NU
	Scarabaeidae	<i>Prodontria matagouriae?</i>	AR-NU
		<i>Prodontria minuta</i>	AR-NU
<i>Prodontria</i> sp. 1 "Ben Ohau"		DD	
Gastropoda	Charopidae	<i>Allodiscus godeti</i>	AR-NU
		<i>Phacussa fulminata</i>	AR-NU
		<i>Flammocharopa montana</i>	AR-NU
	Punctidae	Punctidae sp. 37 (NMNZ M.123669)	AR-R
Hemiptera	Cicadellidae	<i>Matatua montivaga</i>	AR-NU
Mantodea	Mantidae	<i>Orthodera novaezealandiae</i>	AR-D





Appendix B Invertebrate Taxa Recorded at the Haldon Solar Farm site, December 2025

Terrestrial Invertebrate Assessment

Haldon Solar Farm

Lodestone Energy Limited

SLR Project No.: 875.016840.00001

10 February 2026

Table B-2: Invertebrate taxa recorded at the Haldon Solar Farm site, December 2025.

Group	Family	Species	Notes
Acari	Crotonioidea mite	sp.	
	orobatid mite	sp.	
	Trombidiformes mite	sp.	
Araneae	Theridiidae	<i>Cryptachaea veruculata</i>	
		<i>Steatoda truncata</i>	
	Lycosidae	<i>Notocosa bellacosa</i>	
		<i>Anoteropsis hilaris</i>	
		<i>Anoteropsis aerescens</i>	
		juv.	
	Linyphiidae	<i>Erigone prominens</i>	
		sp.	
	Gnaphosidae	<i>Anzacia gemmea</i>	
		sp.	
Juv sp.	juv.		
Corinnidae	<i>Nyssus coloripes</i>	Introduced	
Salticidae	<i>Holoplatys</i> sp.		
Opiliones	Phalangidae	<i>Phalangium opilio</i>	Introduced
Chilopoda	Geophilomorpha	sp.	
Pseudoscorpiones	sp.	sp.	
Collembola	Entomobryidae sp.	sp.	
	Symphyleona	?Sminthuridae	
Coleoptera	Coccinellidae	<i>Coccinella undecimpunctata</i>	Introduced
		larvae	
		<i>Coccinella leonina</i>	Endemic
		<i>Adalia bipunctata</i>	Introduced
	Chrysomelidae	<i>Chrysolina hyperici</i>	Introduced
	<u>Cicindelidae</u>	<i>Neocicindela dunedensis</i>	
	Staphylinidae	Aleocharinae sp.	
	Anthicidae	<i>Pseudocyclodinus otagensis</i>	
	Dytiscidae	<i>Rhantus</i> sp.	
	Dermestidae	<i>Dermestes maculatus</i>	Introduced
	Scarabaeidae	<i>Costelytra giveni</i>	
	Tenebrionidae	<i>Mimopeus ?opaculus</i>	
	Curculionidae	?Baeosomus sp.	
		Entiminae sp.1	
Entiminae sp.2			
Diptera	<i>Austrosimulium</i>	sp.	
	Cecidomyiidae	sp.	
	Culicidae	sp.	
	Culicidae	sp.	
	Keroplastidae	sp.	
	Phoridae	sp.	

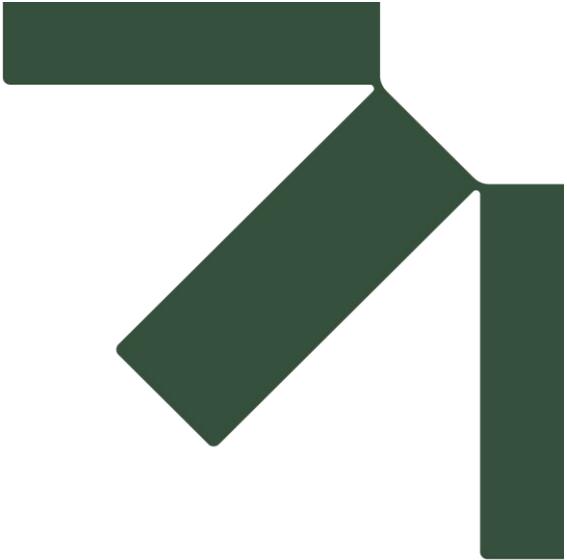


Group	Family	Species	Notes
	Sciaridae	sp.	
	Empididae	sp.	
	Ephydroidea	sp.	
	Tachinidae	sp.	
	Tachinidae	<i>Heteria ?appendiculata</i>	
	Therevidae	<i>Anabarhynchus</i> sp. big	
		<i>Anabarhynchus</i> sp. medium	
		<i>Anabarhynchus</i> sp. small	
		<i>Sidarena micans</i>	
	Asilidae	sp.	
	Asilidae	<i>Sarapogon hudsoni?</i>	
Syrphidae	<i>Melangyna novaezealandiae</i>		
Hemiptera	Aphididae	sp.	
	Cicadellidae	<i>Arawa</i> sp.	
	Cercopoidea	sp.	
	Miridae	<i>Megaloceroea recticornis</i>	Introduced
	Lygaeidae	? <i>Nysius</i>	
		<i>Nysius huttoni</i>	
<i>Rhypodes anceps</i>			
	<i>Rhypodes</i> sp.		
Hymenoptera	Apidae	<i>Apis mellifera</i>	Introduced
		<i>Bombus terrestris</i>	Introduced
		<i>Bombus</i> sp.	Introduced
	Colletidae	<i>Leioproctus fulvescens</i>	
		<i>Leioproctus</i> sp.	
	Megachilidae	<i>Anthidium manicatum</i>	Introduced
	Crabronidae	? <i>Podagritys</i> sp.	
		<i>Podagritys albipes</i>	
	Chalcid'sp.	sp.	
	Ichneumonidae	sp.	
Formicidae	<i>Chelaner antarcticus</i>		
Pompilidae	<i>Priocnemis conformis</i>		
Lepidoptera	Lycaenidae	<i>Lycaena boldenarum</i>	
	Crambidae	sp.	
		<i>Orocrambus</i> sp.	
	Hepialidae	larvae	
Lepidoptera	larvae		
Odonata	Zygoptera	sp.	
		<i>Xanthocnemis</i> sp.	
	Anisoptera	<i>Uropetala</i> sp.	
Orthoptera	Tettigoniidae	<i>Conocephalus bilineatus</i>	
	Trigonidiidae	<i>Bobilla</i> sp.	
	Anostomatidae	<i>Hemiandrus 'furovarius'</i>	Nationally Endangered



Group	Family	Species	Notes
	Acrididae	<i>Phaulacridium otagoense</i>	At Risk - Declining
		<i>Sigauss minutus</i>	Nationally Vulnerable
		<i>Sigauss robustus</i>	Nationally Endangered
Mantodea	Mantidae	<i>Orthodera novaezealandiae</i>	At Risk - Declining
Plecoptera	Stonefly sp.	sp.	
Thysanoptera	Thrip sp.	sp.	
Trichoptera	Caddis fly sp.	sp.	





Appendix C Bibliography

Terrestrial Invertebrate Assessment

Haldon Solar Farm

Lodestone Energy Limited

SLR Project No.: 875.016840.00001

10 February 2026

This bibliography lists additional publications and databases used during the desktop invertebrate assessment and in the assessment of mitigation options.

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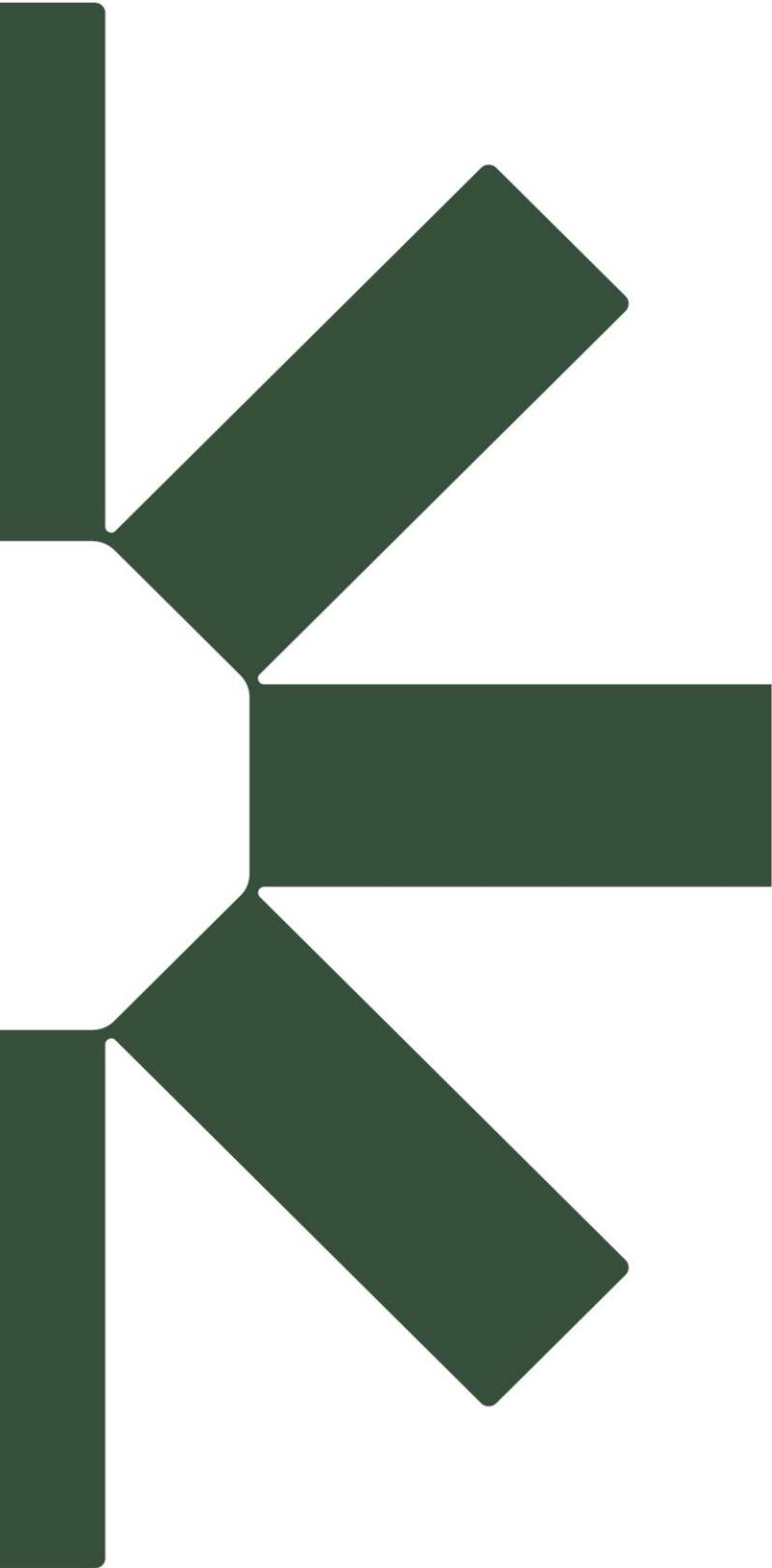
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