Additional lizard, vegetation, and invertebrate surveys of a proposed Twizel solar farm

Contract Report No. 6986

Providing outstanding ecological services to sustain and improve our environments

Wildlands

Additional lizard, vegetation, and invertebrate surveys of a proposed Twizel solar farm

Contract Report No. 6986

April 2024

Project Team:

Vikki Smith – Field work and report author
Lydia Metcalfe – Field work and report author
Cameron Thorp – Field work and report author
Justyna Giejsztowt – Report author

Prepared for:

Nova Energy
95 Customhouse Quay
PO Box 3142
Wellington 6141

Reviewed and approved for release by:

5/04/2024
Justyna Giejsztowt
Senior Ecologist – Ecology Team Leader
Wildland Consultants Ltd

Cite this report as follows:

Wildland Consultants (2024). *Additional lizard, vegetation, and invertebrate surveys of a proposed Twizel solar farm.* Wildland Consultants Contract Report No. 6986. Prepared for Nova Energy. 36pp.

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 Fax 07-343-9018 Email: rotorua@wildlands.co.nz

www.wildlands.co.nz

Contents

Executive summary

Surveys were undertaken in the 2022-2023 field season, on a proposed solar farm site on outwash plains between the Ohau and Twizel Rivers, south of Twizel in the Mackenzie Basin. The surveys found the site to be largely cultivated and heavily modified, but important ecological values had been identified, triggering targeted surveys.

Targeted ecological surveys of vegetation, lizards, and terrestrial invertebrates were undertaken over the 2023-2024 field season. The following ecological values (identified in previous surveys) were further investigated:

-One plant species (*Convolvulus verecundus* f. *verecundus*)

-Five lizard species

-Three terrestrial invertebrate species.

Tekapo ground wētā was discovered on-site. Further surveying is recommended to assess its distribution.

Most ecological values are around the margins of the site, indicating that they can be avoided based on current conceptual plans for the solar farm that are available at the time of writing. Advice is provided to enable avoidance of most potential ecological effects in subsequent drafts of the solar farm plan.

1.0 Introduction

Nova Energy Ltd is proposing to develop a solar energy farm east of Twizel township in the Mackenzie Basin (Figure 1) and previously commissioned Wildlands Consultants Ltd (**Wildlands**) to provide an assessment of the site's ecology and an Assessment of Ecological Effects (**AEE**) for the project[1]. The assessment of ecological values present at the site was undertaken using a combination of both desktop and field-based methods (Wildlands 2023). Potential ecological effects associated with the proposed solar farm were presented in that report, based on a development area provided by Nova Energy. Measures were also developed by which to avoid, remedy, mitigate, offset or compensate for potentially adverse effects, as well as methods for future monitoring.

The AEE recommended that further surveys were required to accurately assess potential ecological effects resulting from the installation and ongoing function of the proposed solar farm. This report summarises additional vegetation, lizard, and invertebrate surveys[2] that were undertaken after being identified as a requirement for the completion of an accurate AEE.

This report is intended to supplement the AEE.

2.0 Project scope

Targeted ecological surveys were conducted to provide further information regarding the potential ecological values, and therefore potential ecological effects, at the proposed solar farm site. These surveys were targeted at the knowledge gaps identified in the initial AEE:

- Targeted *Convolvulus verecundus* f. *verecundus* surveys throughout suitable habitat across the site, specifically rocky scarps running along the east and western boundaries of the site.
- Surveys for lizard abundance across the site. Notable areas of lizard habitat surveyed included areas of rank grass (e.g., along fence lines) and talus piles (e.g., at the base of scarps).
- Targeted minute grasshopper surveys using hand-searching and live pitfall trapping to determine distribution across the site.
- Targeted short-horned grasshopper surveys using hand-searching and live pitfall trapping to determine presence at the site.
- Targeted Tākapo/Tekapo ground wētā surveys using pitfall traps to determine presence at the site.

Relevant potential effects were reassessed against the data from these surveys, and suggestions for avoidance, remediation, mitigation, offsetting, or compensation to address any adverse effects were modified accordingly. The assessment of ecological significance against relevant policy in the Mackenzie District Plan and Canterbury Regional Policy Statement were reviewed and updated as required.

This scope encompasses most outstanding targeted surveys that are required for an accurate and comprehensive AEE of the project[3]. A ground wētā survey using tracking tunnels is scheduled to take place in April 2024. After the ground wētā survey has been completed, and once a detailed project design becomes available, the full AEE for the project will be able to be completed. The outcomes of

[1] Wildland Consultants 2023: Assessment of potential Ecological Effects of the proposed Nova Energy Solar Farm near Twizel. Wildland Consultants Ltd Contract Report No. 6620. Prepared for Nova Energy. 67 pp.

[2] The initial avifauna surveys provided sufficient information to assess potential ecological impacts.

[3] This report does not encompass tracking tunnel Tekapo ground wētā surveys, which are the only surveys remaining to be completed.

the proposed surveys will facilitate thoughtful project design that avoids ecological impacts where possible.

2.1 Species of interest

Plant species of interest

The primary focus of the additional vegetation survey detailed in the following report is to better understand the distribution of *Convolvulus verecundus* f. *verecundus* (Threatened – Nationally Vulnerable) across the site. A number of populations were detected in initial surveys in 2022 and further surveys were required to gain an accurate understanding of abundance and distribution across the entire site.

Lizard species of interest

The abundance of lizards within different vegetation and habitat types was assessed, to determine the likelihood of presence of any species not previously detected on-site. Three lizard species were previously detected on-site during the survey in February-March 2023. These species were southern grass skink (*Oligosoma* aff. *polychroma* Clade 5; At Risk – Declining[4]), McCann's skink (*Oligosoma maccanni*; Not Threatened) and Southern Alps gecko (*Woodworthia* "Southern Alps"; At Risk – Declining).

Two additional species, Lakes skink (*Oligosoma* aff. *chloronoton* "West Otago"; Threatened – Nationally Vulnerable) and scree skink (*Oligosoma waimatense*; Threatened – Nationally Vulnerable) are also known from the surrounding region. Potential habitat for these species was identified on-site, specifically an area of old river terrace along the southern-central edge of the site.

Invertebrate species of interest

Terrestrial invertebrate species to be surveyed for were minute grasshopper (*Sigaus minutus*; Threatened – Nationally Vulnerable), Otago short-horned grasshopper (*Phaulacridium otagoense*; At Risk – Declining), and Tekapo ground wētā (*Hemiandrus* "furoviarius"; Threatened – Nationally Endangered). Differences between grasshopper species are subtle, requiring close examination.

Summary of species of interest

Species of interest are summarised in Table 1 below.

Table 1: Species of interest present, or suspected to be present, on-site.

Species category	Species name	Common name	Threat status	Presence on site	Purpose of survey
Vegetation	*Convolvulus verecundus* f. *verecundus*	Tussock bindweed	Threatened – Nationally Vulnerable	Confirmed	Abundance and distribution assessment
Lizard	*Oligosoma* aff. *polychroma* Clade 5	Southern grass skink	At Risk – Declining	Confirmed	Abundance and distribution assessment

[4] Lizard species Threat Classifications are from Hitchmough *et al.* 2021.

Species category	Species name	Common name	Threat status	Presence on site	Purpose of survey
Lizard	*Oligosoma maccanni*	McCann's skink	Not Threatened	Confirmed	Abundance and distribution assessment
Lizard	*Woodworthia* "Southern Alps"	Southern Alps gecko	At Risk – Declining	Confirmed	Abundance and distribution assessment
Lizard	*Oligosoma* aff. *chloronoton* "West Otago"	Lakes skink	Threatened – Nationally Vulnerable	Possible	Presence assessment
Lizard	*Oligosoma waimatense*	Scree skink	Threatened – Nationally Vulnerable	Possible	Presence assessment
Terrestrial invertebrate	*Sigaus minutus*	Minute grasshopper	Threatened – Nationally Vulnerable	Confirmed	Distribution assessment
Terrestrial invertebrate	*Phaulacridium otagoense*	Otago short-horned grasshopper	At Risk – Declining	Possible	Presence and distribution assessment
Terrestrial invertebrate	*Hemiandrus* "furoviarius"	Tekapo ground wētā	Threatened – Nationally Endangered	Possible	Presence assessment

3.0 Methods

3.1 Vegetation

Field surveys for *Convolvulus verecundus* f. *verecundus* were undertaken over three days, beginning on the 19 December 2023. *Convolvulus verecundus* f. *verecundus* was detected on the 19 December, but only vegetative material was present. The field surveys were postponed by a month to increase the likelihood of flowers being present. A second site visit was undertaken on 23 and 24 January 2024, again no flowers were present and the search was undertaken through the identification of vegetative material only.

The entire site was searched for *Convolvulus verecundus* f. *verecundus* using walk-though surveys. A hand-held GPS was used to track travel[5] and areas searched. The search area was concentrated around potential habitat, such as stony scarps at the edges of the site (Appendix 3). These areas were searched at a fine scale by walking lines 30-50 metres apart. A broader search was undertaken though areas which were mapped as improved pasture by Wildland Consultants (2023). Search effort was reduced by zig-zagging through the improved pasture areas between lines approximately 500 metres apart to reflect the lower probablity of *Convolvulus verecundus* f. *verecundus* occupying these areas. All locations of populations were recorded on a hand-held GPS unit and any observations of other Threatend or At Risk vascular plants were recorded.

[5] A track log is available on request.

3.2 Lizards

A site visit was undertaken between 3-4 October 2023 to set up 120 Onduline Artificial Cover Objects (**ACO**s) at the site. ACOs were set up along the east-west fence line through the centre of the site, in browntop-sweet vernal-clover grassland and hares foot trefoil herbfield (Figure 2).

A lizard survey was subsequently undertaken between 18-23 December 2023 using the ACOs, as well as Gee's minnow (funnel) traps and visual and manual searching. 25 funnel traps were set up on 18 December, and an additional 25 traps were set up on 19 December. Traps were set up in an area of old river terrace and talus, at the base of an area of scarp herbfield and grassland (Figure 2). During the previous lizard survey of the site, lizards were detected in this area in high abundance, and it was deemed possible that Lakes skink may be present in this habitat. Therefore, funnel traps were set up partially buried within rock piles (Plate 1), to increase the likelihood of capturing Lakes skink. All funnel traps were baited with Berry Bliss (The Natural Confectionery Co.) and grass was added to protect any lizards caught from predation and desiccation. A funnel trap without bait, grass, or camouflage is shown in Plate 2 for reference.

Funnel traps and ACOs were checked daily over five days in hot conditions (*c.* 25°C) between 19-23 December and removed on 23 December 2023. ACOs were checked between 8:00 am and 1:00 pm to avoid the hottest part of the day. Limited manual and visual searching was undertaken in areas of rock piles. Visual searching consisted of slowly walking through the habitat looking for basking skinks. Manual searching consisted of lifting rocks or other debris (e.g., pieces of wood) to detect lizards within refuges.

Plate 1 — Funnel trap setup (outlined in red, with associated yellow tag), showing trap partially buried within rock pile.

Plate 2 — Close-up of a funnel trap prior to adding grass and bait, and covering the trap.

3.3 Grasshoppers and wētā

Standard methods for detecting the presence of any of the species of interest have not yet been developed, so methodology was based on the robust grasshopper population monitoring protocol developed by Schori *et al.* (2020), with guidance from T. Murray (pers. comm.), adapted for presence-only detection. Live-capture pitfall traps were used to detect presence of Tekapo ground wētā (Plate 3).

On hot days, grasshoppers move quickly. Handling small specimens was avoided due to the risk of harming them. If a specimen could not be identified before it was lost, its suspected species was noted as a tentative identification.

Plate 3 — Live-capture pitfall trap setup, showing rocks under corners to allow more room for wētā to pass underneath.

Fifteen transects were established on-site on the 19 and 20 December 2023. Transects were approximately 100 m long, estimated using the GPS receiver. Transects were distributed throughout potential grasshopper habitat.

Each transect was walked three times in weather conditions suitable for robust grasshopper activity (temperature exceeding 14°C, winds below gale-force, no precipitation; Schori *et al*. 2020). Weather conditions were recorded for each transect. Each transect took approximately 10 minutes to walk. Any habitat patches encountered between transects were briefly searched.

Three sets of five live-capture pitfall traps were deployed to detect Tekapo ground wētā. Traps consisted of the typical standard lidded cup design used for invertebrates, with a hole drilled in the bottom of each cup and baited with a small piece of canned pear. Each trap was left out for two nights and checked every day.

If minute grasshoppers were found in any transect, or if Tekapo ground wētā were found in any line of pitfall traps, that transect or line of pitfall traps would be discontinued as presence of Threatened species had been determined.

3.4 Assessment of ecological significance

The assessment of ecological significance provided in Wildland Consultants (2023) were updated in light of the findings of these additional ecological surveys.

4.0 Results

4.1 Vegetation

Locations of Threatened and At Risk plants have been mapped across the site (Figure 1). Several additional populations of *Convolvulus verecundus* f. *verecundus* were detected at the site (Plates 4 and 5). Most notably, populations were detected along the northern fence line in the east of the site and along the southern fence line in the centre and west of the site. *Convolvulus verecundus* f. *verecundus* was detected on areas mapped as scarp herbfield and grassland or along the fencelines, outside of areas which have been used for productive pasture or cropping.

On Figure 1, a point represents a cluster of individalus ranging from 1 to 100 individual plants, and newly identified populations are presented together with existing known populations.

Two additional Threatened or At Risk species were detected on the site during field surveys that were not detected in the 2022 survey (Table 2):

- *Pimelea sericeovillosa* subsp. *pulvinaris* (Threatened – Nationally Vulnerable) was detected in a scarp herbfield and grassland near the southern fence line in the centre of the site. An additional plant was detected on the scarp in the west of the site.
- A small indigenous grass, *Rytidosperma exiguum* (At Risk – Declining), was detected on a scarp along the northern fence line (Plates 6 and 7).

Table 2: Threatend and At Risk vascular plant species present on the site. Newly-identified species are in bold.

Species	Common Name	Plant Type	Threat Ranking
Carex kaloides	-	Sedge	At Risk – Declining
Carmichaelia petriei	Desert broom	Shrub	At Risk – Declining
Carmichaelia vexillata	Dwarf broom	Shrub	At Risk – Declining
Convolvulus verecundus f. verecundus	-	Herb	Threatened-Nationally Vulnerable
Discaria toumatou	Matagouri, tūmatakuru	Shrub and tree	At Risk – Declining
Pimelea sericeovillosa* subsp. *pulvinaris		**Herb**	**Threatened – Nationally Vulnerable**
Raoulia australis	Common mat daisy	Herb	At Risk – Declining
Rytidosperma exiguum		**Grass**	**At Risk – Declining**

The known distributions of other plants listed as At Risk – Declining, *Carmichaelia petriei, Carmichaelia vexillata* and *Raoulia australis,* were also expanded during the search of the site.

N

Data Acknowledgment
Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0

Report: 6986
Ref: 11028
Client: Nova Energy
Name: Veg_Figures_Additional.aprx
Path: E:\gis\Twizel_SolarFarm_DN.mxd\

Figure 1. Locations of Threatened and At Risk vascular plants at the Nova energy proposed solar farm site

0 500 1,000 m

Wildlands
www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:21,000
Date: 5/04/2024
Cartographer: LW
Format: A3R

Plate 4 — Cluster of *Convolvulus verecundus* f. *verecundus* plants.

Plate 5 — *Convolvulus verecundus* f. *verecundus* plants growing on open scarp, showing the challenges of searching for vegetative material only.

Plate 6: *Rytidosperma exiguum* plant with old flower head.

Plate 7: Cluster of *Rytidosperma exiguum*.

4.2 Lizards

Lizard detections at the site are indicated in Figure 2 and survey effort and findings are summarised in Table 3. One hundred and sixty-two McCann's skinks and 18 Southern Alps geckos were observed or captured during the surveys. No other lizard species were detected on-site. Following the intensive survey effort undertaken, no additional lizard species are considered likely to be present on site.

Table 3: Summary of lizard survey effort and weather conditions at the site. 'ph' refers to 'person hours'.

Date	Site	Weather	Activity and Effort	Number and Species of Lizards Detected
3-4 October 2023	Centre fence	Not recorded	120 ACOs installed	N/A
18 December 2023	River terrace	Sunny, hot, light breeze, 24.8-24.5°C, 36.3-38% RH	25 Gee's minnow traps installed 0.5 ph visual and manual searches	N/A
19 December 2023	River terrace	Sunny, hot, calm, 22.9-28.1°C, 48.1-24.3% RH	25 Gee's minnow traps checked and an additional 25 Gee's minnow traps installed 0.5 ph visual and manual searches	30 McCann's skinks 2 Southern Alps geckos
	Centre fence		120 ACOs checked	None
20 December 2023	River terrace	Sunny, hot, calm, 27.2-30.7°C, 30.5-34% RH	50 Gee's minnow traps checked 0.5 ph visual and manual searches	45 McCann's skinks (1 recapture) 1 Southern Alps gecko
	Centre fence		120 ACOs checked	None
21 December 2023	River terrace	Sunny, hot, calm, 26.3-26.8°C, 37.5-36.2% RH	50 Gee's minnow traps checked 0.5 ph visual and manual searches	32 McCann's skinks (4 recaptures) 10 Southern Alps geckos 1 mouse (dead)
	Centre fence		120 ACOs checked	1 McCann's skink 3 McCann's skinks (incidental)
22 December 2023	River terrace	Overcast turning sunny in afternoon, warm-hot, light breeze, 15.1-28.1°C, 64-33.1% RH	50 Gee's minnow traps checked 0.5 ph visual and manual searches	27 McCann's skinks (6 recaptures) 3 Southern Alps geckos (1 recapture) 2 McCann's skinks (incidental)
	Centre fence		120 ACOs checked	4 McCann's skinks
23 December 2023	River terrace	Sunny with intermittent cloudy periods, warm-hot, light breeze, 19-24°C, 53.8-48.2% RH	50 Gee's minnow traps checked and removed 0.5 ph visual and manual searches	34 McCann's skinks (6 recaptures) 3 Southern Alps geckos
	Centre fence		120 ACOs checked and removed	1 McCann's skink
Total		**Temperature range 15.1-30.7°C**	**225 Gee's minnow trap nights** **600 ACO checks** **3 ph visual and manual searches**	**179 McCann's skinks (17 recaptures)** **19 Southern Alps geckos (1 recapture)** **1 mouse (dead)**

4.2.1 Central southern river terrace

One hundred and fifty-one McCann's skinks, and all Southern Alps geckos, were captured in funnel traps in the area of the old river terrace (at the central southern edge of the property; Figure 2). Two McCann's skinks were seen basking or actively moving throughout the terrain, but were not captured.

Lizards were observed in abundance at the river terrace, reflecting the high quality habitat available (a surplus of refuges and food source). The low proportion of recaptures (17 recaptures of McCann's skink and one recapture of Southern Alps gecko) over five days of surveying suggests there is a very large population of McCann's skinks and a moderate population of Southern Alps geckos in this area.

One mouse was found dead in a funnel trap during the survey period. This suggests there is a very small population of mice in the area of old river terrace rock piles, although the mouse population is likely to fluctuate seasonally and mice may be present in higher abundance at other times of year (e.g. during grass seeding and cropping).

4.2.2 Central fenceline

Six McCann's skinks were detected under ACOs along the fenceline running from west to east along the centre of the site. This species was observed in moderate abundance in the area of rock piles at the western end of the fenceline (Plate 8). This is likely due to the relatively complex protective ground cover provided by the rock piles. Both McCann's skinks and sign were also detected under ACOs in areas with minimal ground cover (Plate 9), such as around small amounts of dense vegetation or small groupings of loose rocks, indicating that McCann's skink are likely present across the site in low densities (even in low-quality habitat).

Lizard sign (scat) was identified on or under an additional ten ACOs where lizards were not observed, indicating lizard presence in these areas. McCann's skink is considered to be the only species present along the fenceline, due to the dry, exposed habitat, and shallow retreat site availability.

Plate 8 — The area of rock pile at the western end of the central fenceline, where McCann's skinks were detected in higher abundance than the remainder of the fenceline.

Plate 9 — An ACO in the centre of the site along the east-west fence line where lizard sign was detected, with marginal lizard habitat.

4.3 Grasshoppers and wētā

Weather conditions throughout the surveying period were generally close to optimal for grasshopper detection. Winds were often high, but never gale-force. Only five grasshopper transect runs were completed due to weather constraints, as rain set in at the end of the survey period. We were intending to complete six transect runs, but for the purposes of this survey five are considered adequate, as the purpose was to detect presence rather than to monitor numbers.

Tekapo ground wētā were detected in two out of the three sets of pitfall traps (within the concept panel area, near the western edge; Plate 10). Two individuals were caught. The hardness of the ground prevented more than 15 live-capture pitfall traps from being set. Running the traps for 2-3 nights increased the sample size, and succeeded in detecting Tekapo ground wētā presence on-site, but does not provide much information concerning their distribution.

Minute grasshoppers were found on the old river terrace at the central-southern edge of the property (outside the concept panel area), in approximately the same location as they were found previously (Figure 3). They were not found elsewhere despite available habitat. The area of river terrace in the southern-central part of the site, where minute grasshoppers were found, is the best quality grasshopper habitat on-site, with the highest abundance and diversity of grasshoppers present.

The western third of the property has patches of grasshopper habitat that are highly degraded with exotic grass, but Otago short-horned grasshopper was frequently detected there and on the same terrace on the southern edge as the minute grasshoppers (Figure 3). Within these areas, Otago short-horned grasshopper appears to be relatively abundant.

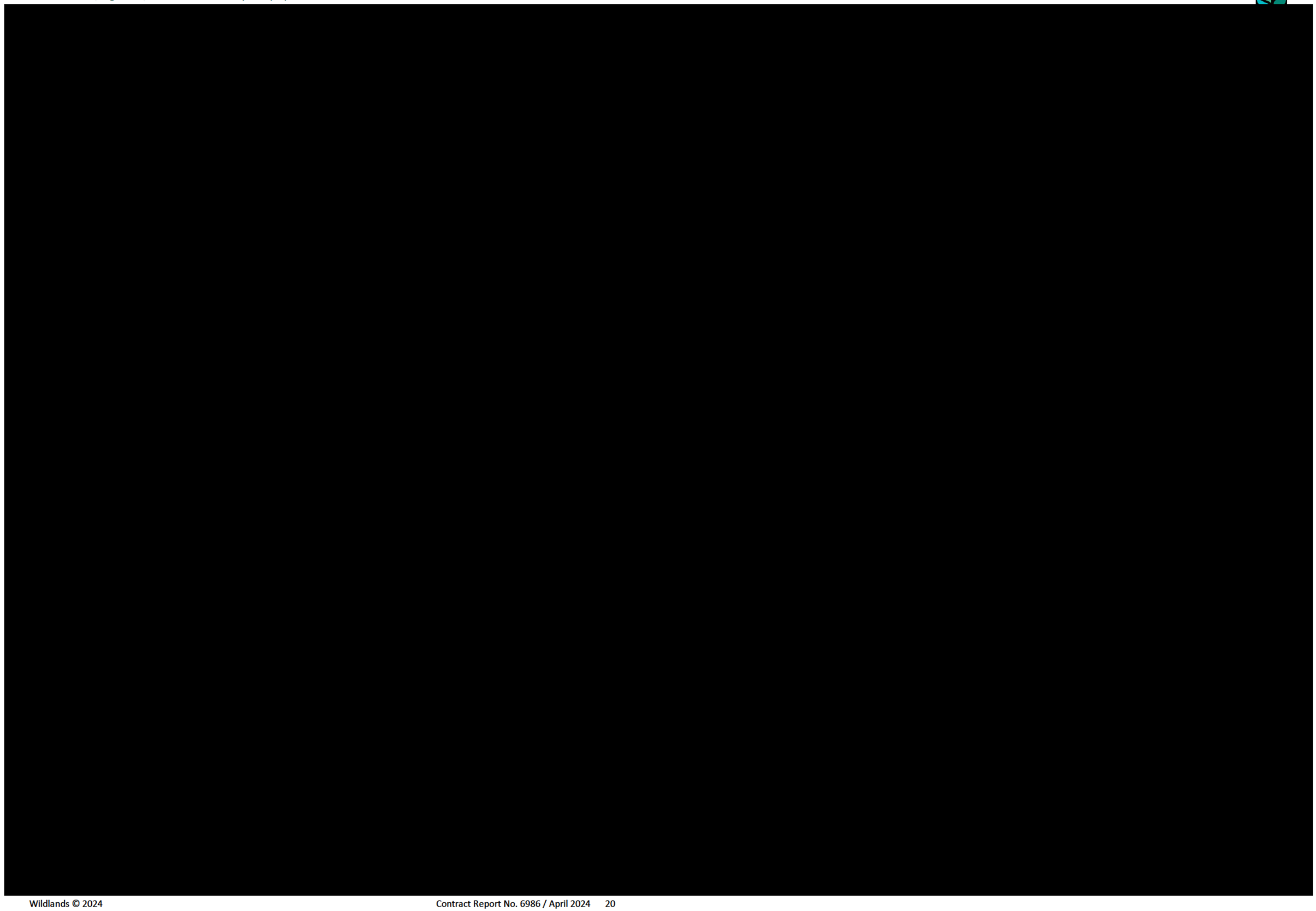
In the central portion of the property, particularly south of the road, there are patches of apparently excellent habitat for grasshoppers. Some areas have been ploughed and are therefore not suitable habitat. Neither Otago short-horned nor minute grasshoppers were found in this part of the property despite numerous transects and searching between transects. This may be due to farming practises such as ploughing or spraying, or the presence of a predator or competitor, such as tiger beetles, which were seen on-site. There may be other factors involved, as the habitat requirements of these species are not fully understood.

The western end of the site where Otago short-horned grasshoppers and Tekapo ground wētā were found appears to be of high value for grasshoppers and wētā. Minute and Otago short-horned grasshopper are unlikely to be present in the central or eastern terrace portions of the site, though their possible presence in undetectable numbers cannot be ruled out in suitable habitat. The distribution of Tekapo ground wētā on-site cannot yet be determined.

At the very eastern tip of the site is a field planted with barley. Due to the shading effect from the barley, there is no habitat in the field that would support the grasshopper species of interest.

Plate 10 — Tekapo ground wētā caught in a live-capture pitfall trap on-site.

Plate 11 — Otago short-horned grasshopper found in a transect.



5.0 Implications for project impacts on ecological values

5.1 Overview

The findings of the additional surveys detailed in this report have minor influence on the interpretation of the existing AEE. This includes minor changes to the assessment of ecological significance against the Canterbury Regional Policy Statement Appendix 3 criteria (Appendix 1). Further, some levels of effects provided in the AEE have been altered.

5.2 Vegetation

The survey results have increased the known distribution of *Convolvulus verecundus* f. *verecundus* at the site. The distribution of *Carmichaelia petriei*, *Carmichaelia vexillata* and *Raoulia australis* has also been expanded at the site and two additional Threatened and At Risk species were detected, *Pimelea sericeovillosa* subsp. *pulvinaris* and *Rytidosperma exiguum.*

Threatened and At Risk vascular species are present along the edges of the site, particularly within one metre of the boundary fence, along scarps and in wetland areas on the site. Threatened and At Risk species were not detected within the interior of the site and are absent from areas mapped as improved pasture.

The vegetation survey results therefore do not warrant a change in the assessment of ecological significance. Further, the results will cause **no change to the level of adverse ecological effects** on flora present on the site.

Recommendations

Wildland Consultants (2023), Section 13.1 recommended that ecologically significant indigenous vegetation is avoided as well as notable plant locations. The current layout mostly excludes these areas. However, some indigenous vegetation and Threatened plants are covered by the current concept panel area (Figure 1). All Threatened plants and significant vegetation marked in Figure 4 should be avoided. A buffer should be left surrounding indigenous vegetation habitats and wetlands, excluding them from the development to ensure that Threatened and At Risk plants will not be impacted through vegetation clearance or shading. The necessary buffer distance depends on the values to protect, and should be decided in consultation with a suitably-qualified ecologist before the panel area design has been finalised. The completed design for the site should be reviewed by a suitably-qualified ecologist before it is finalised.

5.3 Lizards

The survey results show that McCann's skinks are present in low densities across the site even in areas with minimal habitat, such as the central fenceline. This species is considered likely to be using small holes in the ground as refuges, such as burrows made by Tekapo ground wētā.

The area of river terrace with talus in the southern-central part of the site is considered to be the highest quality lizard habitat on-site, with the highest abundance and diversity of lizards present. This is likely due to the large amount of complex habitat available for lizard refuges.

No additional species were discovered during surveys. The high quality habitat provides sufficient habitat for Lakes skink, but this species is now not considered to be present at the project site, or if so, is present at undetectable levels.

Overall, the results of this survey indicate there is **no change to the levels of adverse ecological effects on lizards** detailed in Wildlands 2023 from the proposed development works (Appendix 2).

The results indicate one change in the Ecological Significance Criteria detailed in Appendix 2 of Wildlands 2023 (Appendix 1 of this report). This is that **Ecological Context Criterion 10. is met for improved pasture**, due to this vegetation type providing important habitat for indigenous species (McCann's skink). The habitat was previously identified as ecologically significant due to the presence of other ecological values, this alteration adds depth to this previous assessment.

Recommendations

High-quality habitat areas (all lizard and habitat values in Figure 4) should be avoided by the proposed solar farm development. These areas could be set aside as protected areas and habitat enhancement and restoration, such as indigenous vegetation plantings and the creation of additional rock piles, could be undertaken, along with connective planting between habitats.

5.4 Grasshoppers and wētā

Overall, the results of this survey indicate changes in the levels of adverse ecological effects on terrestrial invertebrates (Appendix 2). Final ecological effects will depend entirely on the layout of the solar panels.

Over most of the site, where notable grasshopper species were not found, effects of habtat reduction have been **reduced from significant to more than minor**. Tekapo ground wētā is likely to be less sensitive to habitat modification as the result of solar panels than grasshoppers, as it is thought to have historically been a forest species (Van Wyngaarden 1995).

Mortality and disturbance to invertebrates is **reduced from more than minor to minor**. Works during the day will mainly affect grasshoppers, but only in the areas where they are found. Earthworks may still cause mortality of Tekapo ground wētā.

Over the southern riverside terrace, and the western paddocks where grasshoppers and wētā were found, shading from solar panels are likely to cause a significant effect due to the loss of basking habitat and the change in vegetation. This is **no change** from the previous report (Wildlands 2023). Excluding these areas from the solar panel plans would remove these effects.

If effects management actions detailed in Wildlands (2023) are implemented, effects of mortality to invertebrates would be **reduced from minor to less than minor**, and reduction in habitat quality due to shading would be **reduced from minor to less than minor**. These effects reductions are due to the indication from the surveys that notable grasshoppers are not present throughout most of the site, but Tekapo ground wētā are. Currently, Tekapo ground wētā are assumed to be found throughout the site, though this may change if further surveying is undertaken.

The results indicate no change in the Ecological Significance Criteria detailed in Appendix 2 of Wildlands 2023 based on wētā or grasshopper results.

Recommendations

No further surveying for grasshoppers is necessary at this stage. Further surveying for Tekapo ground wētā is scheduled for April 2024 to further understand their distribution on-site.

The previous Wildlands report (2023) detailed potential effects of dust on invertebrates. These effects can be reduced to **less than minor** if a dust management plan is prepared that considers invertebrate activity. Grasshoppers and New Zealand blue butterflies are most active on warm, sunny days, and

ground wētā are nocturnal. Therefore, dust effects will be greatest at these times. Dust management should be stepped up in the evening, and in areas where grasshoppers have been found during warm, sunny weather.

Avoiding all populations of Otago short-horned grasshopper and Tekapo ground wētā is likely unfeasible as they cover a large area. If solar panels are to be erected where grasshopper populations have been found, residual effects will persist after avoidance, minimisation, and restoration have been implemented. However, the residual effects could be balanced using compensation, by funding research into habitat requirements, ecology, and distribution of minute and Otago short-horned grasshoppers, and Tekapo ground wētā. Monitoring of on-site populations during habitat changes resulting from the solar farm will greatly contribute to this research and our understanding of invertebrate effects management.

6.0 Conclusions

Additional field surveys have provided valuable insight into the distributions of Threatened and At Risk vascular plants, lizards, wētā and grasshoppers. Additional locations of Threatened and At Risk vascular plants were detected on the site, primarily within indigenous vegetation habitats or along the boundary of the site. McCann's skink was detected within improved pasture in the interior of the site and within the old river terrace. Southern Alps gecko was detected in the old river terrace habitat, no additional species were detcted on site and Lakes skink is either not present on the site or present at undetectable levels. Tekapo ground wētā and Otago short-horned grasshopper were detected in the west of the site (within the panel area) and within the old river terrace outside the panel area.

The level of effects associated with habitat reduction for grasshoper and invertebrate mortality have been reduced as a result of this survey. All other invertebrate effects identified by Wildlands (2023) are retained. The lizard survey results and plant surveys have not resulted in any changes to the level of adverse ecological effects outlined by Wildlands (2023).

The identification of McCann's skink within improved pasture along the central fenceline has elevated the ecological significance of improved pasture, although this habitat was already identified as ecologically significant in the previous assessment.

The development is recommended to exclude areas of significant indigenous vegetation, wetland habitats, Threatened or At Risk plant populations, and areas of high quality lizard habitat. These areas are identified in Figure 4. Ideally, the solar farm design would avoid area where grasshopper populations were detected.

References

Hitchmough, R.A.; Barr, B.; Knox, C.; Lettink, M.; Monks, J.M.; Patterson, G.B.; Reardon, J.T.; van Winkel, D.; Rolfe, J.; Michel, P. 2021: Conservation status of New Zealand reptiles, 2021. *New Zealand Threat Classification Series 35*. Department of Conservation, Wellington. 15 pp.

Schori J.C., Steeves T.E., and Murray T.J. 2020: Designing monitoring protocols to measure population trends of threatened insects: A case study of the cryptic, flightless grasshopper *Brachaspis robustus*. *PLoS One. 15*(9):e0238636. doi: 10.1371/journal.pone.0238636. PMID: 32970696; PMCID: PMC7514004.

Van Wyngaarden, F. 1995: The ecology of the Tekapo ground wētā (*Hemiandrus* new sp., Orthoptera: Anostostomatidae) and recommendations for the conservation of a threatened close relative. Unpublished thesis; University of Canterbury.

Wildland Consultants 2023: *Assessment of potential ecological effects of the proposed Nova Energy Solar Farm near Twizel*. Wildland Consultants Ltd Contract Report No. 6620. Prepared for Nova Energy. 67 pp.

Appendix 1

Re-evaluation of the ecological significance of vegetation and habitats using the Canterbury Regional Policy Statement Appendix 3 criteria

The table provides the existing assessment as per Wildland Consultants (2023); where the assessment has been updated cells are highlighted in green.

Ecological Significance Criteria	Indigenous Habitat							Exotic Habitats			
	Ephemeral wetland	**Flood channel shrubland**	**Tall fescue-rautahi marsh**	**Scarp herbfield and grassland**	**[Wilding conifer]/scarp herbfield and grassland**	**Old river terrace**	**Sweet vernal-mouse-ear hawkweed herbfield and grassland**	**Improved pasture** (Browntop-sweet vernal-clover grassland, Alluvial grassland, Hares foot trefoil herbfield, Hares foot trefoil-sweet vernal grassland)	**Sweet briar shrubland**	**Crack willow forest**	**Alder forest**
Representativeness											
1. Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
2. Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
Rarity/Distinctiveness											
3. Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, ecological district, or freshwater environment.	**Criterion met**. Land use intensification and pastoral development have resulted in an estimated loss of 90% of wetlands in Canterbury	This criterion is not met	**Criterion met**. Land use intensification and pastoral development have resulted in an estimated loss of 90% of wetlands in Canterbury	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	**Criterion met**. Land use intensification and pastoral development have resulted in an estimated loss of 90% of wetlands in Canterbury	**Criterion met**. Land use intensification and pastoral development have resulted in an estimated loss of 90% of wetlands in Canterbury
4. Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is Threatened, At Risk or uncommon, nationally or within the relevant ecological district.	**Criterion met**. Indigenous avifauna may use this site to forage, including kotoreke/marsh crake (*Zapornia pusilla affinis*, At Risk – Declining), and Māpunga/black shag (*Phalacrocorax carbo novaehollandiae,* At Risk –Relict) and kawaupaka/little shag (*Microcarbo melanoleucos brevirostris,* At Risk – Relict) and pārera/grey duck (*Anas superciliosa*, Threatened – Nationally	**Criterion met**. Tūmatakuru (At Risk- Declining; is present.	**Criterion met**. *Carex kaloides* (At Risk-Declining) is present. Indigenous avifauna may use this site to forage and breed, including kotoreke/marsh crake (*Zapornia pusilla affinis*, At Risk – Declining).	**Criterion met**. *Convolvulus verecundus f. verecundus* is present. Indigenous avifauna may use this site to forage and breed. At Risk indigenous lizard species (southern grass skink and Southern Alps gecko) are found in this habitat. New Zealand blue butterfly are found in this habitat. At Risk and Threatened invertebrates (minute and Otago short-horned grasshopper, and possibly Tekapo ground wētā) are	**Criterion met**. Three species listed as At-Risk Declining, *Carmichaelia vexillata, Raoulia australis, and Carmichaelia petriei* (all At Risk-Declining), are present within this vegetation type. At Risk indigenous lizard species (southern grass skink) are found in this habitat. At Risk and Threatened invertebrates may be present in this habitat. Indigenous avifauna may use this site to forage and breed.	**Criterion met**. *Convolvulus verecundus f. verecundus* (Threatened-Nationally Vulnerable) is present. Indigenous avifauna may use this site to forage and breed. At Risk indigenous lizard species (southern grass skink) and invertebrates (minute and Otago short-horned grasshopper) are likely to be found in this habitat.	**Criterion met**. *Carmichaelia petriei and Convolvulus verecundus f. verecundus are* present. At Risk indigenous lizard species (southern grass skink and Southern Alps gecko) are found in this habitat. Indigenous avifauna may use this site to forage and breed.	**Criterion met.** Tōrea/South Island pied oystercatcher (*Haematopus finschi,* At Risk – Declining) is present and possibly breeding, and other avifauna may use this site to forage and breed. Otago short-horned grass hopper (At Risk - Declining) and Tekapo ground wētā (Threatened – Nationally Endangered) are present in the west of the site and may be present elsewhere.	This criterion is not met	This criterion is not met	This criterion is not met

Ecological Significance Criteria	Indigenous Habitat							Exotic Habitats			
	Ephemeral wetland	**Flood channel shrubland**	**Tall fescue-rautahi marsh**	**Scarp herbfield and grassland**	**[Wilding conifer]/scarp herbfield and grassland**	**Old river terrace**	**Sweet vernal-mouse-ear hawkweed herbfield and grassland**	**Improved pasture** (Browntop-sweet vernal-clover grassland, Alluvial grassland, Hares foot trefoil herbfield, Hares foot trefoil-sweet vernal grassland)	**Sweet briar shrubland**	**Crack willow forest**	**Alder forest**
	Vulnerable) within the pond area.			present in this habitat.							
5. The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
6. Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combination of factors.	**Criterion met**. Ephemeral wetlands are listed as rare ecosystems	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
Diversity and Pattern											
7. Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
Ecological Context											
8. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.	Criterion not met	Criterion not met	Criterion not met	**Criterion met.** This habitat provides important connectivity within the site	**Criterion met.** This habitat provides important connectivity within the site	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met
9. A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met
10. Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.	**Criterion met.** This habitat type provides important year-round habitat for indigenous avifauna.	**Criterion met.** This habitat type provides important year-round habitat for indigenous avifauna	**Criterion met.** This habitat type provides important year-round habitat for indigenous avifauna.	**Criterion met.** This habitat type provides important year-round habitat for indigenous lizard species (McCann's skink, southern grass skink and Southern Alps gecko). This habitat type provides important seasonal habitat for indigenous avifauna.	**Criterion met.** This habitat type provides important year-round habitat for indigenous lizard species (McCann's skink and southern grass skink). This habitat type provides important seasonal habitat for indigenous avifauna.	**Criterion met.** This habitat type provides important year-round habitat for indigenous lizard species (McCann's skink, southern grass skink and Southern Alps gecko). This habitat type provides important year-round habitat for indigenous avifauna.	**Criterion met.** This habitat type provides important year-round habitat for indigenous lizard species (McCann's skink, southern grass skink and Southern Alps gecko). This habitat type provides important seasonal habitat for indigenous avifauna.	**Criterion met.** This habitat type provides important habitat for indigenous lizard species (McCann's skink).	Criterion not met	Criterion not met	Criterion not met

Appendix 2

Summary of updated effects compared to effects in Wildlands (2023)

Effect	Before Management		After Management	
	Rating in Wildlands (2023)	Updated rating in this report	Rating in Wildlands (2023)	Updated rating in this report
Clearance of significant vegetation	More than minor	More than minor	Less than minor	Less than minor
Modifications to wetland habitat	Less than minor	Less than minor	Less than minor	Less than minor
Microclimatic changes beneath solar panels, resulting in changes to vegetation	More than minor	More than minor	Less than minor	Less than minor
Loss of At Risk, Threatened, and rare plants	More than minor	More than minor	Less than minor	Less than minor
Risk of introduction of pest plants	More than minor to minor	More than minor to minor	Less than minor	Less than minor
Loss of avifauna habitat	More than minor	More than minor	Less than minor	Less than minor
Disturbance to indigenous breeding avifauna during construction	More than minor	More than minor	Less than minor	Less than minor
Death of injury to indigenous breeding avifauna during construction	More than minor	More than minor	Less than minor	Less than minor
Ongoing disturbance to avifauna	More than minor	More than minor	Less than minor	Less than minor
Risk of bird strike with panel arrays	More than minor	More than minor	Minor	Minor
Disturbance (including death and injury) and harm to lizards	More than minor	More than minor	Minor	Minor
Loss of lizard habitat	More than minor	More than minor	Less than minor	Less than minor
Fragmentation of lizard habitat	Minor	Minor	Less than minor	Less than minor
Reduction of lizard habitat quality due to shading	Minor	Minor	Minor	Minor
Ongoing disturbance to lizards	Minor	Minor	Less than minor	Less than minor
Disturbance to lizards during earthworks	Minor	Minor	Minor	Minor
Breeding failure/displacement to lizards	Less than minor	Less than minor	Less than minor	Less than minor
Reduction in invertebrate habitat	Significant	More than minor	Minor	Minor
Mortality to invertebrates	More than minor	Minor	Minor	Less than minor
Disturbance to invertebrates during works	More than minor	Minor	Less than minor	Less than minor
Reduction in invertebrate habitat quality due to shading	More than minor	More than minor	Minor	Less than minor
Dust-related disturbance to invertebrates	More than minor	More than minor	Not assessed	Less than minor

Effect	Before Management		After Management	
	Rating in Wildlands (2023)	Updated rating in this report	Rating in Wildlands (2023)	Updated rating in this report
Ongoing invertebrate disturbance	More than minor	More than minor	Less than minor	Less than minor
Sedimentation of nearby rivers	More than minor	More than minor	Less than minor	Less than minor
Ongoing weed management impacts on all biodiversity types	Not assessed	Not assessed	Not assessed	Not assessed

Appendix 3

Vegetation and habitat map

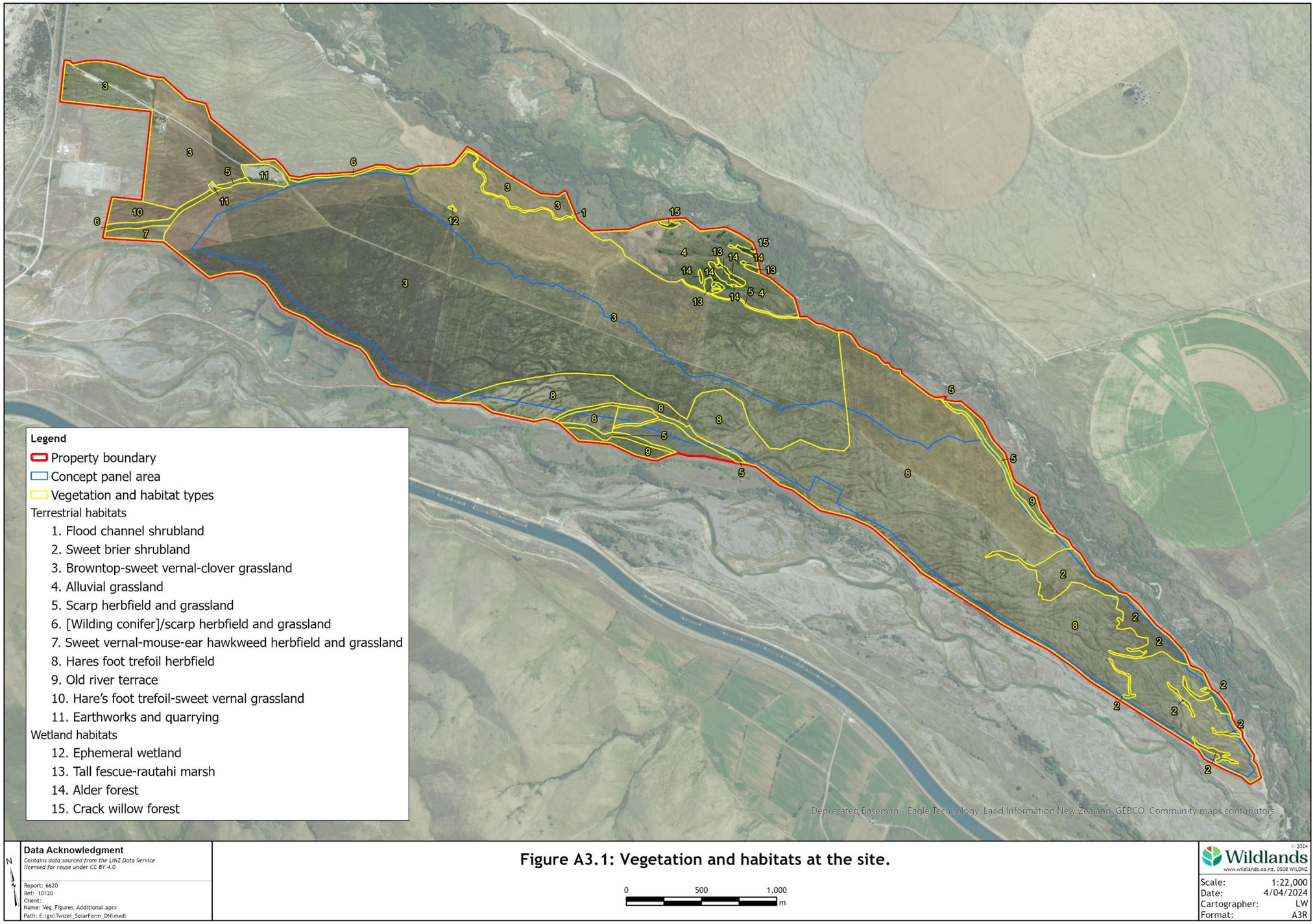


Figure A3.1: Vegetation and habitats at the site.

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; Whakatāne; Whangārei.

wildlands.co.nz

Wildlands