Viewpoint Location Photographs - Falston Road

Viewpoint Location Photograph 13: Located along Falston Road, north of shelterbelt located along the western side of the road. This photo illustrates the view over the top end of Lake Benmore towards the site and the surrounding mountains, with the solar farm being 1.9kms aways.

Viewpoint Location Photographs - Haldon Road

Viewpoint Location Photograph 14: Located along Haldon Road at the western end of Little Pass. This photo illustrates the first time a road user gains a view over this part of the basin when travelling along this road, with the solar farm being 9.8kms aways.

Viewpoint Location Photograph 15: Located near the intersection of Haldon Road and Haldon Arm Road. This photo illustrates the view over the dryland outwash plain towards the site and enclosing mountains, with the solar farm being 6.3kms away, on the far side of the Pukaki / Tekapo Rivers.

Viewpoint Location Photographs - Haldon Road

Viewpoint Location Photograph 16: Located along Haldon Arm Road. This photo illustrates the view over the dryland outwash plain towards the site and enclosing mountains, with the solar farm being 3.3kms away, on the far side of the Pukaki / Tekapo Rivers.

Viewpoint Location Photograph 17: Located along Haldon Arm Road, near the Tekapo River terrace edge. This photo illustrates the view over the dryland outwash plain towards the site and enclosing mountains, with the solar farm being 2.2kms away, on the far side of the Pukaki / Tekapo Rivers.

Viewpoint Location Photographs - Haldon Arm Road

Viewpoint Location Photograph 18: Located along the four-wheel drive track section of Haldon Arm Road, immediately west of Haldon Arm Campground. This photo illustrates the limited long range views gained from these four-wheel-drive tracks alongside the Pukaki and Tekapo Rivers.

Viewpoint Location Photograph 19: Located along the four-wheel drive track west Haldon Arm Road, heading towards Old Iron Bridge. This photo illustrates the limited long range views gained from these four-wheel-drive tracks alongside the Pukaki and Tekapo Rivers.

Viewpoint Location Photographs - Haldon Arm Road

Viewpoint Location Photograph 20: Located on the eastern side of Old Iron Bridge. This photo illustrates the view along the Tekapo River towards the site and the Benmore Range.

Viewpoint Location Photograph 21: Located in the middle of Old Iron Bridge. This photo illustrates the view along the Tekapo River towards the site, which cannot be seen, and the Benmore Range.

ROUGH MILNE MITCHELL
LANDSCAPE ARCHITECTS

Christchurch
Level Two, 69 Cambridge Terrace
Christchurch 8013
PO Box 3764 Christchurch 8140

info@rmmla.co.nz
+64 3 366 3268

Auckland
Level Two, 139 Victoria Street West
Auckland CBD, Auckland 1010

info@rmmla.co.nz

Dunedin
42 Stuart Street, Dunedin 9054

info@rmmla.co.nz
+64 3 477 2030

Wānaka
Level One, 24 Dungarvon Street,
Wānaka 9305
PO Box 349, Wānaka 9343

info@rmmla.co.nz
+64 3 974 7940

Nelson
Level One, 3 Haven Road,
Nelson 7010

info@rmmla.co.nz

RMM

rmmla.co.nz

RMM

ROUGH MILNE MITCHELL
LANDSCAPE ARCHITECTS

Proposed Solar Farm - The Point, Mackenzie Basin
Appendix 2: Visual Simulations

25 May 2023

Virtual View

Photo Simulation Methodology

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

METHODOLOGY FOR THE PREPARATION OF A PHOTO SIMULATION

1. The main objective of a photo simulation is to provide an image that, as realistically as possible, conveys the modification or change of a proposed activity. The most appropriate technical methodology has been applied to ensure the accuracy of what is depicted, in terms of its relative position, elevation, scale, and appearance. Photo simulations can never replace the real experience of being at a location, but they are a useful tool to assist in the decision-making process.

2. To achieve a photo simulation, a 3D model is rendered into a series of 2-dimensional photographs.

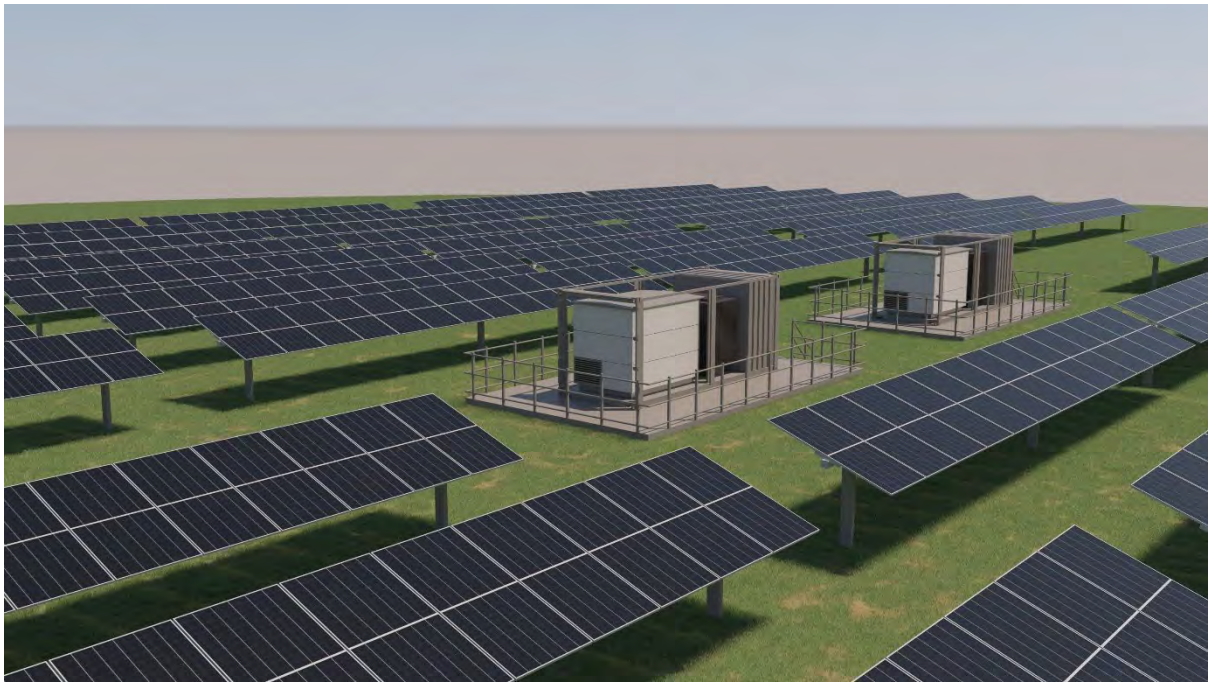
3. Viewpoint locations were chosen by Paul Smith from Rough Milne Mitchell Landscape Architects Ltd (RMM) and taken by Virtual View Ltd. A full frame Canon 5D mk2 with a 50mm lens was used to take the photo panoramas from the designated positions.

4. The photo simulation positions, and corresponding reference points were survey marked by Virtual View Ltd using a Lecia GS18 RTK Rover.

5. The photos were then colour matched to ensure consistency throughout the image and manually stitched together to form a photo panoramic.

6. To achieve a photo simulation Virtual View Ltd firstly created a digital terrain model of the existing landform. A 3D model of the solar panel system was created to supplied specifications and duplicated across the site to match the site layout plan. Landscaping was then added to the model to supplied heights and locations. Simulations 09, 12 and 25 include proposed landscaping at years 2 and 5. All other simulations only include proposed landscaping at year 5 due to it being on the southern side of the site and less visible.

Overview of 3D model showing digital terrain model with solar panel layout and landscaping.



Close-up view of 3D model solar panel layout components.

7. A series of 3D computer cameras within the simulation software are then created. They were positioned accurately to the corresponding survey marked photo position from which the photos were taken. The camera used depicts a real-world camera, including matching the focal length of the 50mm lens.

8. To duplicate the view through the real-world camera, it was necessary to match the landform data and reference points to the respective physical objects in the photo – thus ensuring an accurate horizontal and vertical alignment.

9. A sunlight system was then created which uses light in a system that follows the geographically correct angle and movement of the sun over the earth at a given location. Location, date, time, and compass orientation can be chosen. The simulations Virtual View Ltd prepared, depict the proposed development at the same, time and date as specified, and are simulated to resemble the natural lighting.

10. The solar panels have been rotated horizontally to match the sun angle and azimuth at the corresponding time of day.
    0 degrees = Parallel to the ground surface.
    Negative degrees = Facing east.
    Positive degrees = Facing west.
    Below are the angles for each viewpoint:
    - Viewpoint 03 = -40 degrees
    - Viewpoint 07 = -50 degrees
    - Viewpoint 08 = -30 degrees
    - Viewpoint 09 = -5 degrees
    - Viewpoint 12 = -20 degrees
    - Viewpoint 16 = +35 degrees
    - Viewpoint 23 = +52 degrees
    - Viewpoint 25 = 0 degrees

11. Within the 3D software, the new image was then rendered containing the accurately positioned 3D model over top of the original photograph.

12. Existing foreground vegetation was overlaid using photo-editing software and was then checked against aerial photography from the site to ensure correct placement.

13. For the resulting photo simulations, the viewing scale is 50cm from the eye when printed at full scale A3. This scale produces an image that is 240mm high and was chosen as it is a comfortable distance to hold at approximately an arm's length, to appreciate what the view would be at scale in real life. (Refer to Figure 1 below for viewing scale).

14. Viewing on screen should be done tentatively as there are numerous variables such as screen size, zoom level and the application being used, that can affect the scale of what would be seen by the naked eye.

15. All photo simulations comply with the New Zealand Institute of Landscape Architects document: Visual Simulations Best Practice Guide 10.2.

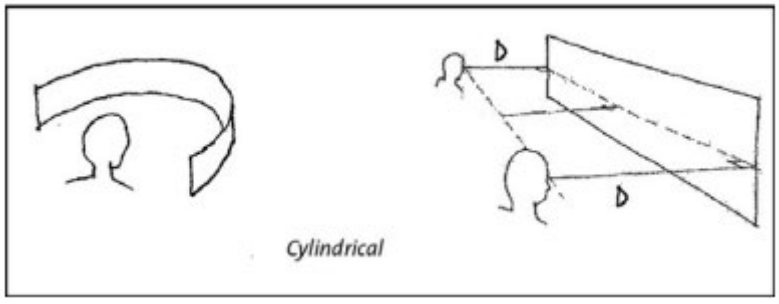
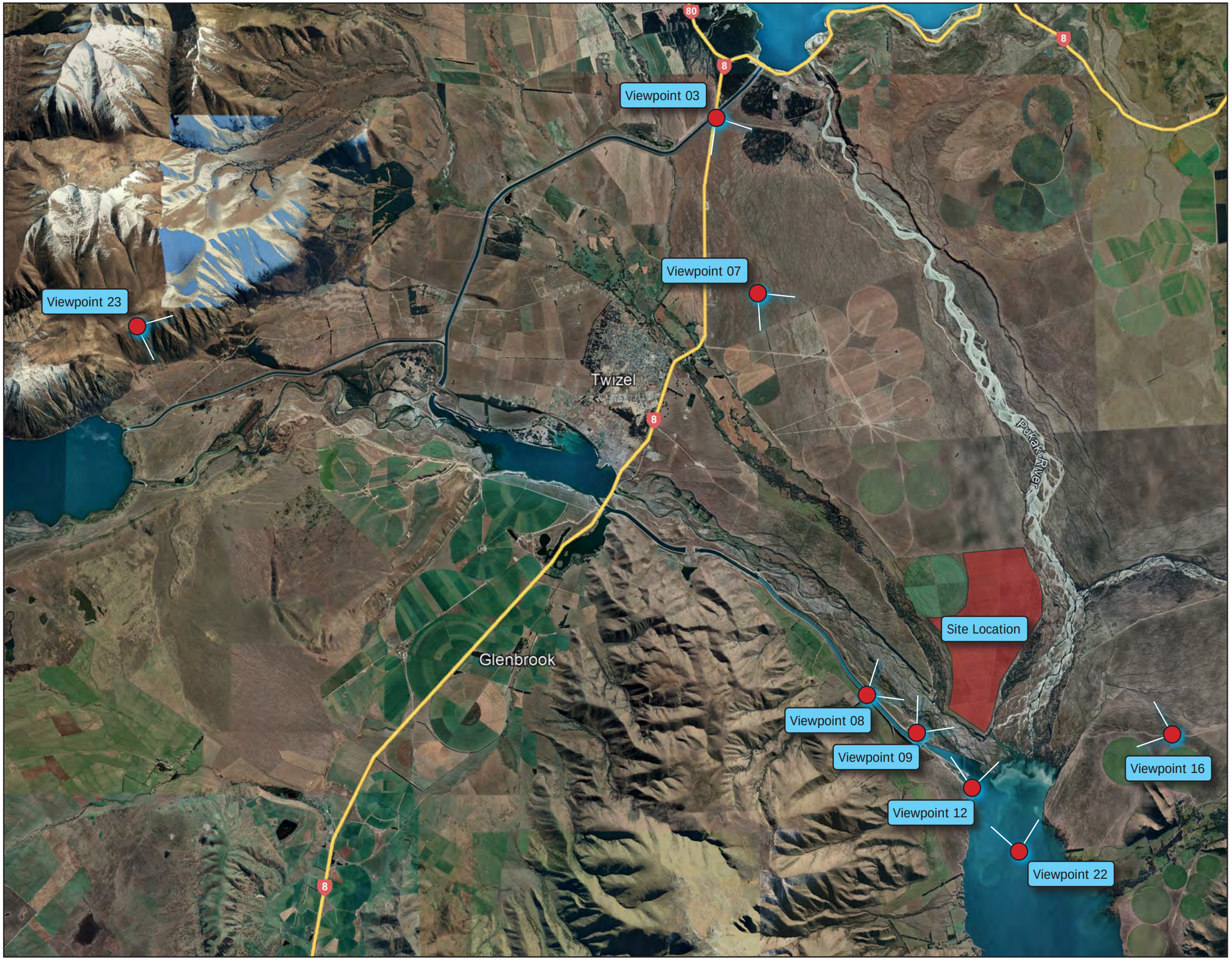


Figure 1: Viewing scale for Photo Simulations

Viewpoint Location Map



Far North Solar Farm Ltd
Ohau C

- Viewpoint 03
  Pukaki-Ohau Canal Bridge
  (E)325079.674 (N)821851.055
- Viewpoint 07
  Alps 2 Ocean Cycle Trail
  (E)326193.695 (N)817334.755
- Viewpoint 08
  McAughtries Road
  (E)328893.156 (N)807397.243
- Viewpoint 09
  McAughtries Road
  (E)330081.513 (N)806497.075
- Viewpoint 12
  Falston Road
  (E)331419.215 (N)805168.442
- Viewpoint 16
  Haldon Arm Road
  (E)336283.141 (N)806562.820
- Viewpoint 22
  Lake Benmore
  (E)332530.098 (N)803795.977
- Viewpoint 23
  Greta Track
  (E)310818.826 (N)816197.524

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Date Printed : 17-05-2023

Viewpoint 03 - Existing

Viewpoint 03 - Proposed

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 325079.674
Northing: 821851.055
Elevation : 521.628m
Height of Camera : 1.4m
Orientation of View : SE
Date of Photography : 08 Feb 2023
Time of Photography : 16:08pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 03 - Pukaki-Ohau Canal Bridge

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 03 - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 325079.674
Northing: 821851.055
Elevation : 521.628m
Height of Camera : 1.4m
Orientation of View : SE
Date of Photography : 08 Feb 2023
Time of Photography : 16:08pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 03 - Pukaki-Ohau Canal Bridge

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 03 - Proposed

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 325079.674
Northing: 821851.055
Elevation : 521.628m
Height of Camera : 1.4m
Orientation of View : SE
Date of Photography : 08 Feb 2023
Time of Photography : 16:08pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 03 - Pukaki-Ohau Canal Bridge

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 07 - Existing

Viewpoint 07 - Proposed

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 326193.695
Northing: 817334.755
Elevation : 466.593m
Height of Camera : 1.4m
Orientation of View : SE
Date of Photography : 08 Feb 2023
Time of Photography : 17:11pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 07 - Alps 2 Ocean Cycle Trail

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 07 - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

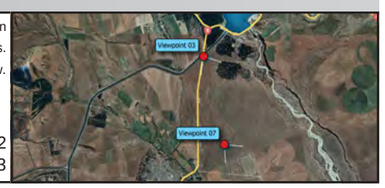
Easting: 326193.695
Northing: 817334.755
Elevation : 466.593m
Height of Camera : 1.4m
Orientation of View : SE
Date of Photography : 08 Feb 2023
Time of Photography : 17:11pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 07 - Alps 2 Ocean Cycle Trail

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023



Viewpoint 07 - Proposed

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

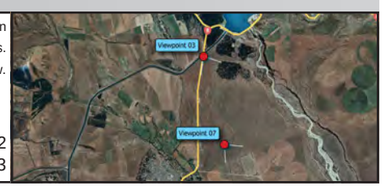
Easting: 326193.695
Northing: 817334.755
Elevation : 466.593m
Height of Camera : 1.4m
Orientation of View : SE
Date of Photography : 08 Feb 2023
Time of Photography : 17:11pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 07 - Alps 2 Ocean Cycle Trail

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023



Viewpoint 08 - Existing

Viewpoint 08 - Proposed

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 328893.156
Northing: 807397.243
Elevation : 411.732m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 15:28pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 08 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 08a - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 328893.156
Northing: 807397.243
Elevation : 411.732m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 15:28pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 08 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 08a - Proposed

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 328893.156
Northing: 807397.243
Elevation : 411.732m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 15:28pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 08 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 08b - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 328893.156
Northing: 807397.243
Elevation : 411.732m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 15:28pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 08 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 08b - Proposed

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 328893.156
Northing: 807397.243
Elevation : 411.732m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 15:28pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 08 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 09 - Existing

Viewpoint 09 - Proposed - Year 02

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 330081.513
Northing: 806497.075
Elevation : 412.099m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 14:00pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 09 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 09 - Existing

Viewpoint 09 - Proposed - Year 05

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 330081.513
Northing: 806497.075
Elevation : 412.099m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 14:00pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 09 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 09a - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 330081.513
Northing: 806497.075
Elevation : 412.099m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 14:00pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 09 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 09a - Proposed - Year 02

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 330081.513
Northing: 806497.075
Elevation : 412.099m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 14:00pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 09 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 09a - Proposed - Year 05

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 330081.513
Northing: 806497.075
Elevation : 412.099m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 14:00pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 09 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 09b - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 330081.513
Northing: 806497.075
Elevation : 412.099m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 14:00pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 09 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 09b - Proposed - Year 02

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 330081.513
Northing: 806497.075
Elevation : 412.099m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 14:00pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 09 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 09b - Proposed - Year 05

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 330081.513
Northing: 806497.075
Elevation : 412.099m
Height of Camera : 1.4m
Orientation of View : NE
Date of Photography : 08 Feb 2023
Time of Photography : 14:00pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 09 - McAughtries Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 12 - Existing

Viewpoint 12 - Proposed - Year 02

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 331419.215
Northing: 805168.442
Elevation : 374.023m
Height of Camera : 1.4m
Orientation of View : N
Date of Photography : 08 Feb 2023
Time of Photography : 14:45pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 12 - Falston Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 12 - Existing

Viewpoint 12 - Proposed - Year 05

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 331419.215
Northing: 805168.442
Elevation : 374.023m
Height of Camera : 1.4m
Orientation of View : N
Date of Photography : 08 Feb 2023
Time of Photography : 14:45pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 12 - Falston Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 12 - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 331419.215
Northing: 805168.442
Elevation : 374.023m
Height of Camera : 1.4m
Orientation of View : N
Date of Photography : 08 Feb 2023
Time of Photography : 14:45pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 12 - Falston Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 12 - Proposed - Year 02

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 331419.215
Northing: 805168.442
Elevation : 374.023m
Height of Camera : 1.4m
Orientation of View : N
Date of Photography : 08 Feb 2023
Time of Photography : 14:45pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 12 - Falston Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 12 - Proposed - Year 05

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 331419.215
Northing: 805168.442
Elevation : 374.023m
Height of Camera : 1.4m
Orientation of View : N
Date of Photography : 08 Feb 2023
Time of Photography : 14:45pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 12 - Falston Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 16 - Existing

Viewpoint 16 - Proposed

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 336283.141
Northing: 806562.82
Elevation : 386.23m
Height of Camera : 1.4m
Orientation of View : NW
Date of Photography : 08 Feb 2023
Time of Photography : 11:27am

Far North Solar Farm Ltd - Ohau C

Viewpoint 16 - Haldon Arm Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 16 - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 336283.141
Northing: 806562.82
Elevation : 386.23m
Height of Camera : 1.4m
Orientation of View : NW
Date of Photography : 08 Feb 2023
Time of Photography : 11:27am

Far North Solar Farm Ltd - Ohau C

Viewpoint 16 - Haldon Arm Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 16 - Proposed

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 336283.141
Northing: 806562.82
Elevation : 386.23m
Height of Camera : 1.4m
Orientation of View : NW
Date of Photography : 08 Feb 2023
Time of Photography : 11:27am

Far North Solar Farm Ltd - Ohau C

Viewpoint 16 - Haldon Arm Road

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 22 - Existing

Viewpoint 22 - Proposed - Year 02

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 332530.098
Northing: 803795.977
Elevation : 360.736m
Height of Camera : 1.4m
Orientation of View : NW
Date of Photography : 10 Feb 2023
Time of Photography : 13:37pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 22 - Lake Benmore

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 22 - Existing

Viewpoint 22 - Proposed - Year 05

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 332530.098
Northing: 803795.977
Elevation : 360.736m
Height of Camera : 1.4m
Orientation of View : NW
Date of Photography : 10 Feb 2023
Time of Photography : 13:37pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 22 - Lake Benmore

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 22 - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 332530.098
Northing: 803795.977
Elevation : 360.736m
Height of Camera : 1.4m
Orientation of View : NW
Date of Photography : 10 Feb 2023
Time of Photography : 13:37pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 22 - Lake Benmore

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 22 - Proposed - Year 02

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 332530.098
Northing: 803795.977
Elevation : 360.736m
Height of Camera : 1.4m
Orientation of View : NW
Date of Photography : 10 Feb 2023
Time of Photography : 13:37pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 22 - Lake Benmore

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
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Version info: 0002
Date Printed: 17-05-2023

Viewpoint 22 - Proposed - Year 05

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 332530.098
Northing: 803795.977
Elevation : 360.736m
Height of Camera : 1.4m
Orientation of View : NW
Date of Photography : 10 Feb 2023
Time of Photography : 13:37pm

Far North Solar Farm Ltd - Ohau C

Viewpoint 22 - Lake Benmore

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 23 - Existing

Viewpoint 23 - Proposed

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 310818.826
Northing: 816197.524
Elevation : 1101.437m
Height of Camera : 1.4m
Orientation of View : SE
Date of Photography : 10 Feb 2023
Time of Photography : 9:23am

Far North Solar Farm Ltd - Ohau C

Viewpoint 23 - Greta Track

NOTES: All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were surveyed by Virtual View.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 17-05-2023

Viewpoint 23 - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 310818.826
Northing: 816197.524
Elevation : 1101.437m
Height of Camera : 1.4m
Orientation of View : SE
Date of Photography : 10 Feb 2023
Time of Photography : 9:23am

Far North Solar Farm Ltd - Ohau C

Viewpoint 23 - Greta Track

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Appendix D: Ecological Impact Assessment

ASSESSMENT OF ECOLOGICAL EFFECTS FOR THE PROPOSED ŌHAU C SOLAR FARM BETWEEN THE LOWER REACHES OF THE TEKAPO AND TWIZEL RIVERS, MACKENZIE DISTRICT

providing outstanding ecological services to sustain and improve our environments

Wildlands

R6621c

ASSESSMENT OF ECOLOGICAL EFFECTS FOR THE PROPOSED ŌHAU C SOLAR FARM BETWEEN THE LOWER REACHES OF THE TEKAPO AND TWIZEL RIVERS, MACKENZIE DISTRICT

A nearby induced wetland, off-site.

Contract Report No. 6621c

May 2023

Project Team:
Morgan Tracy – Report author
Rose Stuart – Report author
Justyna Giejsztowt – Report author
Roland Payne - Report author (botany)
Della Bennet – Report author (ornithology)
Fraser Gurney – Report author (ornithology)
Cameron Thorp – Report author (herpetology)
Vikki Smith – Report author (entomology)
William Shaw – Peer review

Prepared for:
Far North Solar Farms Ltd
C/- Williamson Water and Land Advisory
Auckland

CHRISTCHURCH OFFICE: 7A VULCAN PLACE, MIDDLETON, CHRISTCHURCH 8024;
P.O. BOX 9276, TOWER JUNCTION, CHRISTCHURCH 8149; Ph 03-338-4005

HEAD OFFICE: 99 SALA STREET, P.O. BOX 7137, TE NGAE, ROTORUA
Ph 07-343-9017; Fax 07-343-9018, email ecology@wildlands.co.nz, www.wildlands.co.nz

CONTENTS

Reviewed and approved for release by:

W.B. Shaw
Director/Lead Principal Ecologist
Wildland Consultants Ltd

1. INTRODUCTION

Williamson Water and Land Advisory (WWLA), on behalf of Far North Solar Farms Ltd (FNSF), are proposing to establish a new solar farm on a site near Lake Ōhau (hereafter referred to as Ōhau C) in the Mackenzie District, in South Canterbury. WWLA require an assessment of ecological effects for the proposed solar farm and advice on mitigation and ecological enhancement. WWLA also require a long-term management plan for the site.

Ōhau C is located between the Tekapo and Twizel Rivers. It is a flat site, with farmland to the north and rivers on the eastern and western boundaries. The Twizel River flows along the western side of the site and the Tekapo River flows along the eastern side. The site is approximately 10 kilometres to the southeast of Twizel township, and is currently used for farming and livestock grazing.

This report provides the findings of an ecological assessment for the proposed project. Mitigation measures, including ecological enhancement, are also provided.

2. PROPOSED WORKS

FNSF intend to install 736,866 solar panels across the site, with a four metre gap between each panel. Installation will require trenching (approximately half a metre in width) for electrical cables, which will run under the roads within the site. The panels will be installed using mounting trackers with driven piles for legs, which will minimise requirements for earthworks. The panels will be on an angle, with the highest end being 2.1 metres off the ground, and the lower end one metre off the ground. The panels will rotate approximately 45° degrees.

Forty-one six metre long inverters will be installed across the site, as well as 25 4.5 × 3.5 metre water tanks. One large control room will be built on site (dimensions to be determined).

Access roads will need to be developed for machinery for access to and around the site. Once installation is complete, solar panels will cover approximately 60% of the site.

FNSF have a strong interest in improving the local environment in addition to solar farm development. The site will have rabbit and hare-proof fencing surrounding the property. They intend to include indigenous plantings, weed control, and control of mammalian browsers in their long-term management of the site. Weed control methods around the solar panels are still being developed.

3. METHODS

3.1 Desktop assessments

Ecological Context and Databases

Desktop assessments were undertaken to determine the ecological values of the site. This included assessment of recent and historical aerial imagery and reviewing database records including Land Environments New Zealand (LENZ)[1], Land Cover Database (LCDB, v5.0)[2], the New Zealand Plant Conservation Network (NZPCN)[3], and iNaturalist (accessed December 2022)[4].

Original Vegetation

Potential natural vegetation, as mapped by Manaaki Whenua Landcare Research, has also been reviewed for the site. This describes the type of indigenous vegetation that would be expected to be present in the absence of human modifications and provides an indicator of what the pre-human ecological state may have been.

Avifauna

The eBird database[5] (maintained by Cornell University) was searched for bird records within a five-kilometre radius of the proposed site (January 2021 to January 2023) and in the surrounding area.

Lizards

The Department of Conservation Bioweb Herpetofauna database[6] (accessed May 2022) was checked for lizard records within a 20 kilometre radius of the site.

Terrestrial Invertebrates

The Global Biodiversity Information Facility[7] was searched for invertebrate records within five kilometres of the site, to see if any notable invertebrates (short-range endemics, protected species, species believed to be declining, or species listed as Threatened or At Risk) had been recorded nearby. Satellite photography was then examined to assess the likelihood of any notable invertebrate habitats being present on-site.

[1] https://www.landcareresearch.co.nz/tools-and-resources/mapping/lenz/
[2] https://ourenvironment.scinfo.org.nz/
[3] https://www.nzpcn.org.nz/
[4] https://www.inaturalist.org/
[5] https://ebird.org/atlasnz/home
[6] https://www.doc.govt.nz/our-work/reptiles-and-frogs-distribution/atlas/
[7] GBIF.org

3.2 Field assessments

3.2.1 Vegetation

Terrestrial vegetation was surveyed on 12 December 2022. Vegetation and associated habitat types were mapped and described following the structural classes of Atkinson (1985). Field mapping was digitised onto aerial imagery using ArcGIS 10.8. All vascular plant species observed are listed in Appendix 1.

3.2.2 Avifauna

An avifauna survey was undertaken on 14 December 2022. Three discrete continuous transects were walked to ensure all habitat types were visited and to maximise area coverage because of the site's large size. All bird species seen and heard were recorded, and any additional species detected while travelling between the transects were noted as incidental counts. The locations of Threatened and At Risk species were recorded with GPS waypoints.

3.2.3 Lizards

The site was visited on 13 December 2022 to determine habitats and potential species present. The walk-through lizard habitat assessment included assessing the quality of the habitat for lizards, visually surveying for active lizards, and handsearching of ground cover potential lizard habitat (e.g. rocks, pieces of wood). Weather conditions during the site visit were hot and sunny with intermittent cloud cover.

Targeted intensive surveys for lizards, using live-trapping methods, were not undertaken.

3.2.4 Invertebrates

A walk-through survey of invertebrates and their habitats was undertaken on 2 February 2023, with the primary aim of searching for notable invertebrates identified in the desktop assessment and their habitat on-site. Hand-searching involved looking on the ground and in vegetation and debris, and using a sweep-net to catch flying and jumping insects.

4. ECOLOGICAL CONTEXT

4.1 General overview

As noted in Section 1 above, the site is located between the lowest reaches of the Tekapo and Twizel Rivers. The Tekapo River discharges into the head of Lake Benmore, a human-made hydro lake, immediately adjacent to (to the east) of where the Ōhau River also discharges into the lake. The Twizel River flows into the Ōhau River about one kilometre upstream from the lake.

The site is low-lying largely flat land, *c.*400 metres above sea level, comprising the low interfluve between the Tekapo and Twizel Rivers. As such, the site is underlain by

alluvial gravels. The lower reaches of the Tekapo and Twizel Rivers are both braided systems, with a line of low eroded cliffs on the edges of the river channels.

Almost the entire site is grazed farmland and part of it is cultivated and cropped seasonally. A centre-pivot irrigator (diameter 1.5 kilometres) is present in the northwestern part of the site.

4.2 Pukaki Ecological District

The site is located in the Pukaki Ecological District and the following description is adapted from McEwen (1987).

Pukaki Ecological District is characterised by dry outwash plains between Lakes Tekapo and Benmore, mostly below 600 metres above sea level. The geology is fluvioglacial outwash deposits, with isolated greywacke and argillite hills. The climate is semi-arid to sub-humid with cold winters, warm summers and 600-1,600 mm of rainfall annually. Soils are moderately fertile but prone to drought in summer, they are easily erodible in steep areas with bare screes being common.

This Ecological District was historically typified by extensive red tussockland (*Chionochloa rubra*), replaced at altitude by snow tussock (*Chionochloa rigida*). Tussocklands had some kettlehole tarns and associated wetlands; some areas of hard tussock (*Festuca novae-zelandiae*) and scattered blue tussock (*Poa colensoi*). Some prostrate mat plants, e.g. *Coprosma petriei*, *Raoulia subsericea* as well as some scrub, including tūmatakuru/matagouri (*Discaria toumatou*) with mingimingi (*Coprosma propinqua*) were scattered throughout.

Pasture now occupies much of this Ecological District, with some tussocklands and areas of scrub (tūmatakuru, *Coprosma* spp., kōwhai (*Sophora* spp. and *Corokia*) remaining. Grazing by sheep and rabbits has significantly affected grasslands.

Braided riverbeds provide important habitat to a number of bird species, there are also several notable rare insects in the area.

4.3 Nearby protected areas

Lake Ruataniwha Conservation Area is adjacent to the proposed Ōhau C site, and it is made up of several separated sections. One of these sections primarily lies along the Twizel River, on the western side of the proposed solar farm property. The Ben Ōhau Conservation Area and adjacent Pukaki Flats Conservation Area is located seven kilometres north of the Ōhau C site. There are hard tussock (*Festuca novae-zelandiae*) grasslands to the east of Twizel. There is also the Glenbrook Conservation Area approximately eight kilometres to the southwest of Ōhau C.

4.4 Nearby sites of natural significance

The entirety of the Ōhau River has been identified as a Site of Natural Significance in the Mackenzie District Plan. It is recognised primarily for its avifauna habitat values, as well as areas of wetland. It extends along the Ōhau river from Lake Benmore into,

and including, areas of Lake Ruataniwha. This area overlaps with the north-eastern boundary of the proposed Ōhau C solar farm site.

4.5 Threatened Environment Classification

The Ōhau C site is classified entirely as a 'critically underprotected' land environment, with more than 30% indigenous vegetation left and less than 10% indigenous vegetation protected (Cieraad *et al.* 2015).

4.6 Land Cover Database (LCDB)

Two land cover types are mapped in the LCDB, with most of the site mapped as depleted grassland. An area of high producing exotic grassland is mapped where the centre pivot irrigator is located in the northwestern part of the property.

4.7 Potential natural vegetation

The site is identified as an area that would have historically been scrub, shrubland and tussock-grassland below the treeline.

4.8 Important Bird Area

The site is immediately adjacent to an Important Bird Area (IBA)[1] which includes the Ōhau, Pukaki, Twizel, and Tekapo Rivers. The site is in the wedge that forms the Ōhau-Tekapo Delta, where the Ōhau and Tekapo Rivers enter Lake Benmore. The full suite of endemic braided river birds is found in braided river habitat at the Delta, including kakī/black stilt (*Himantopus novaezelandiae*, Threatened-Nationally Critical).

This area is part of the Department of Conservation's Project River Recovery programme.

4.9 Braided rivers

Braided rivers and their associated gravel beds have been identified as a historically rare ecosystem type and are naturally uncommon on a national basis (Williams *et al.* 2007). Braided river ecosystems are therefore classified as Threatened-Endangered (Holdaway *et al.* 2012). Sixty-four percent of Aotearoa New Zealand's braided rivers occur in Canterbury. The braided rivers of the Mackenzie Basin drain into the Waitaki River and braided rivers and wetlands of the upper Waitaki Basin are under active restoration as part of "Project River Recovery" The programme is run by the Department of Conservation and funded by Meridian Energy and Genesis Energy under a compensatory agreement that recognises the impact of hydroelectric power development on these rivers and wetlands (DOC 2020).

[1] Forest & Bird 2016*:* New Zealand Seabirds - Sites on Land, Rivers, estuaries, coastal lagoons & harbours*. The Royal Forest & Bird Protection Society of New Zealand*, Wellington. 177 p.

4.10 Notable existing environmental modifications

The site has been named due to its proximity to the Ōhau C hydro power station on the Ōhau canal network, which is part of the larger Waitaki hydro scheme. This scheme comprises of five hydro-generation stations in the Upper Waitaki and three in the Lower Waitaki as well as a series of dams and canals to optimise generation potential. The Ōhau canal network runs from Lake Ōhau down through Lake Ruataniwha and into Lake Benmore. It is also fed by the Pukaki Canal, which brings water from Lakes Tekapo and Pukaki. Development of this hydro scheme has caused notable modifications to the surrounding environment through the construction of dams, formation of lakes (e.g. Lake Benmore), and diversion of water, and has drastically altered the hydrological regimes of the rivers in the Mackenzie basin.

4.11 Statutory context

4.11.1 Ecological significance

Areas of ecological significance in Canterbury are areas or habitats that meet one or more of the criteria listed in Appendix 3 of the Canterbury Regional Policy Statement (CRPS; see Appendix 2). This criteria set is provided for the evaluation of the significance of indigenous vegetation and habitat of indigenous fauna against 10 criteria within four categories:

- Representativeness
- Rarity or distinctive features
- Diversity and pattern
- Ecological context

The Mackenzie District Plan (MDP) defers to the CRPS for assessments of ecological significance. Each vegetation and habitat type at the site was assessed against these criteria.

4.11.2 Mackenzie District Plan

Relevant rules and definitions provided in the operative Mackenzie District Plan which relate to indigenous vegetation and vegetation clearance are summarised in Appendix 3. Vegetation and habitat types present at the site were assessed against the definition of indigenous vegetation and the definition of improved pasture, to assess whether they are subject to vegetation clearance rules. The Mackenzie District Plan also stipulates limits on activities adjacent to wetlands. The site was also assessed in relation to these rules.

Various Mackenzie District Plan provisions apply to the site:

- This site is zoned as Rural Zone.
- Mackenzie Basin Subzone applies across the entire site. This identifies the site as an Outstanding Natural Landscape.
- Sites of Natural Significance have been identified in proximity to the site, around the margins of Lake Benmore, and including the braided beds of Tekapo and Ōhau Rivers.

- The entire site is located within an area identified as being of High Visual Vulnerability[1].
- A hydro-electricity inundation hazard area has been identified along the river braid plains on both the eastern and western sides of the site, merging in the south where the rivers flow into Lake Benmore.

4.11.3 Wildlife Act 1953

All indigenous lizards and birds, and some indigenous invertebrates, are protected under the Wildlife Act (1953). It is an offence to disturb or destroy protected wildlife without a Wildlife Act Authorisation (WAA; also known as a wildlife permit) from the Department of Conservation. A permit must be obtained from the Department of Conservation before any protected wildlife (and/or their habitats) can be disturbed, handled, translocated or killed. Also, if an activity is likely to disturb or kill protected avifauna or their eggs, then a Wildlife Act Authority (permit) is needed from the Department of Conservation.

4.11.4 Natural wetlands

Natural wetlands were assessed using definitions in the Resource Management Act (RMA; 1991) and the National Policy Statement for Freshwater Management (NPS-FM; 2020). The RMA defines wetlands as "permanently or intermittently wet areas, shallow water, and land/water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions". The NPS-FM excludes the following situations from the RMA definition:

- A wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or
- A geothermal wetland; or
- Any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain derived water pooling.

Rule 8 of the Mackenzie District Councils Vegetation Clearance Rules specifies that clearance may not occur within 100 metres of an ecologically significant wetland or with 50 metres of all other wetlands. Vegetation and habitats on the site and within 100 metres of its boundaries were evaluated for wetland status.

[1] Landscape features and views sensitive to change and how their visual quality can be compromised by the individual or cumulative effects of land use and development activities which are not in harmony with the natural appearance of the landscape.

4.12 Vegetation and habitats

Vegetation cover at the Ōhau C site is predominantly grazed exotic grassland and cropland, with some small remnants of indigenous dryland and shrubland communities around the margins. There are no wetlands on the site, but there are a number of wetlands within 100 metres of the site boundary (Figure 1). Including the off-site wetlands, six vegetation and habitat types were identified:

1. Sweet briar-matagouri shrubland.
2. Cocksfoot grassland.
3. Brassica cropland.
4. Brome-hawkweed-sheep's sorrel grassland/herbfield.
5. Stonefield drylands.
6. Wetlands (offsite only)

1. Sweet briar-matagouri shrubland

This type is confined to two small patches in shallow gullies on the eastern edge of the site. Vegetation in these areas is dominated by exotic sweet briar (*Rosa rubiginosa*) with indigenous tūmatakuru/matagouri (At Risk – Declining), porcupine shrub (*Melicytus alpinus*) and mingimingi (Plate 1). Scattered exotic pines (mostly *Pinus contorta*) are emergent in places above the shrubs. There are also open areas, rocky ground, and exotic weeds, including mouse-ear hawkweed (*Pilosella officinarum*) and haresfoot trefoil (*Trifolium arvense*). Indigenous hard tussock and creeping pōhuehue (*Muehlenbeckia axillaris*) are also locally common.

Plate 1: Sweet briar-matagouri shrubland.

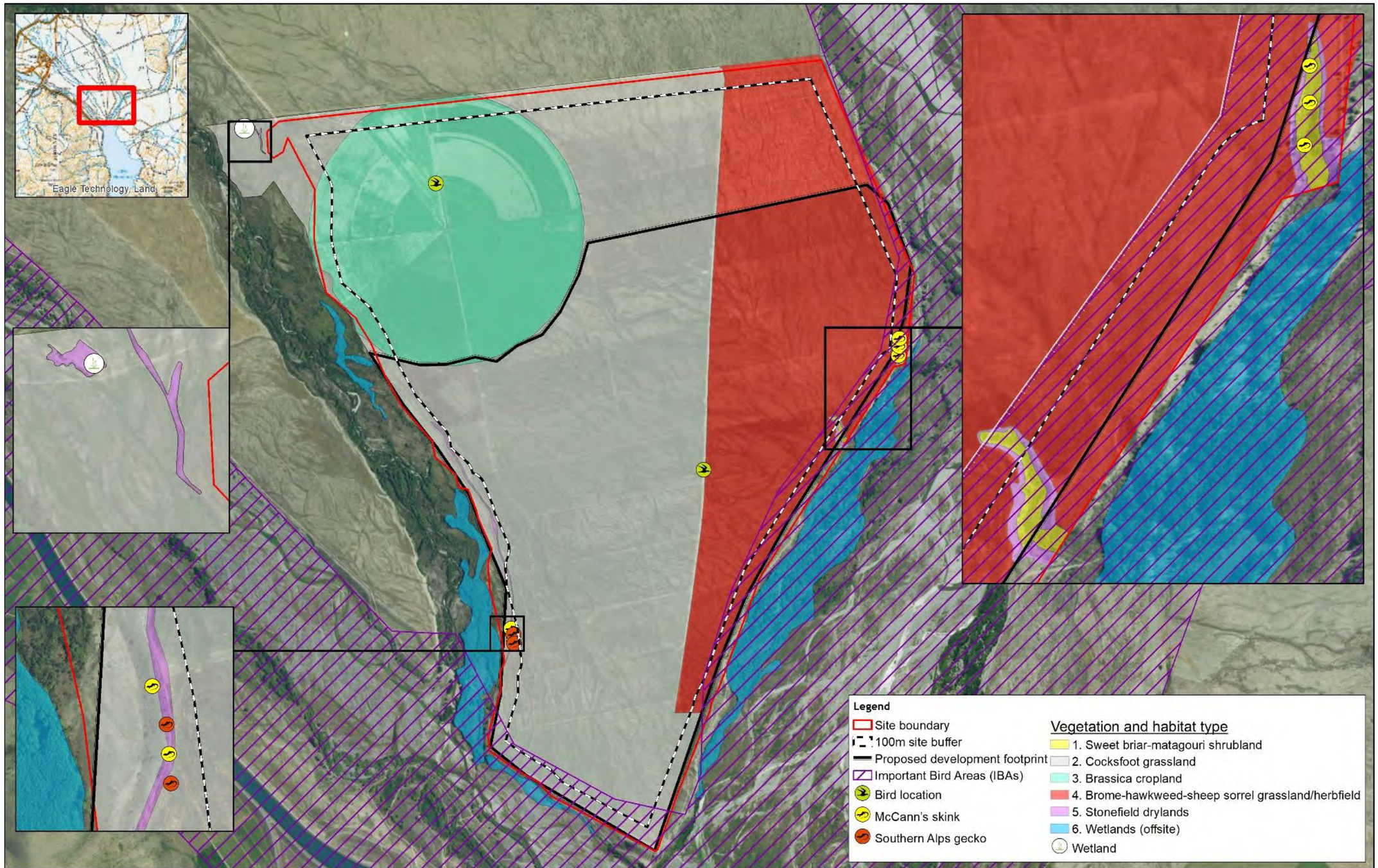

Figure 1. Vegetation and habitats at Ōhau C

2. Cocksfoot grassland

Cocksfoot (*Dactylis glomerata*) grassland is the most extensive vegetation type on the site and appears to have been sown mostly for hay and baleage production (Plate 2). The type is dominated by exotic species. It varies in height and composition across the site, in some paddocks the grass is over one metre tall where it is dominated by cocksfoot. In other areas it is shorter and comprises a mixture of exotics such as clovers (mostly *Trifolium repens and T. pratense*), lucerne (*Medicago sativa*) and other grasses including ryegrass (*Lolium perenne*) sweet vernal (*Anthoxanthum odoratum*) and red fescue (*Festuca rubra*). Around the margins, haresfoot trefoil and sheep's sorrel (*Rumex acetosella*) are also abundant and there are occasional patches where sweet briar is common.

Plate 2: Cocksfoot-dominant grassland, which covers much of the site.

3. Brassica cropland

In the northwest corner of the site there is a circular area of cropland under a centre-pivot irrigator which, at the time of the survey, was planted with a brassica crop. Little else appeared to be growing in this area. Stones and bare ground were abundant between crop plants (Plate 3).

4. Brome-hawkweed-sheep's sorrel grassland/herbfield

On the eastern side of the site there are numerous paddocks with exotics such as mouse-ear hawkweed, sheep's sorrel, and brome grasses (*Bromus tectorum* and *B. hordeaceus*) that are dominant (Plate 4). These areas appear to have been cultivated in the past but have not been resown recently. Cocksfoot, ryegrass, sweet vernal, clovers, and lucerne are all common exotics, along with herbaceous weeds such as haresfoot trefoil, viper's bugloss (*Echium vulgare*), and chicory (*Cichorium intybus*).

Plate 3: Irrigated brassica cropland, in the northern part of the site.

Plate 4: Brome-hawkweed-sheep's sorrel grassland/herbfield, which covers an extensive part of the site.

5. Stonefield drylands

Areas of stonefield and indigenous dryland vegetation are confined to the tops of old river terraces on the margins of the site. These areas are generally dominated by exotic weeds and grasses with mouse-ear hawkweed and haresfoot trefoil both abundant. However, local pockets of indigenous dryland vegetation persist on stony ground (Plate 5). Indigenous species observed in these areas included

creeping pōhuehue, maikaika/onion orchid (*Microtis unifolia*), blue wheatgrass (*Anthosachne solandri*) scabweed (*Raoulia hookeri*), and NZ harebell (*Wahlenbergia albomarginata*). Two At Risk - Declining species, mat daisy (*Raoulia australis*) and stout dwarf broom (*Carmichaelia monroi*), and Maniototo Cress (*Lepidium solandri* Threatened – Nationally Critical), were recorded just outside the site boundary.

Plate 5: Indigenous dryland vegetation with mat daisies (left) and scabweed (right) growing in stonefield dryland habitat on the margins on the site.

6. Wetlands

No wetlands are present on the subject site.

There is one small induced wetland within 100 metres outside of the northwest border of this site. It is located at the bottom of a small depression that appears to have been created by historic gravel extraction. Water pools in one corner of the gravel pit and exotic facultative wetland plants including crack willow (*Salix ×fragilis*), jointed rush (*Juncus articulatus*) and soft rush (*Juncus conglomeratus*) are growing here (Plate 4). Several other tree species are also present, including necklace poplar (*Populus deltoides*) and lodgepole pine. However, the surrounding area, including most of the old gravel pit, is dry and rocky, and supports multiple indigenous dryland species.

Other wetland habitats exist outside of the site along the floodplains of the both Tekapo and Twizel Rivers (Plate 6). Distance from the site varies but in both river beds there are wetlands within 100 metre of the site boundary. The largest and most extensive wetlands are in the Takapō/Tekapo River to the east of the site. However, both rivers have a similar network of riverine wetland habitats with shallow water, fens, swamps, and seepages. Considerable catchment modification has taken place in both of these rivers, which may have induced some of these wetlands through reduced water flow. Some wetlands have also been induced by vehicle tracks criss-crossing water channels.

Wetlands in both rivers are dominated by an exotic canopy of crack willow and alder (*Alnus glutinosa*) trees, but indigenous sedges and rushes are common beneath the canopy and around the margins of open water. Indigenous species observed in these areas include rautahi (*Carex maorica*), raupō (*Typha orientalis*), sedge (*Carex diandra*), spike sedge (*Eleocharis acuta*), and pūkio (*Carex secta*). Although no Threatened or At Risk species were observed,

extensive surveys of these wetlands were not undertaken as they were outside of the development site.

Another induced wetland was also recorded in an old gravel pit just to the northwest of the site (Figure 1). In this area, water pooling has allowed several crack willow and poplar (*Populus nigra*) trees to establish above weedy jointed rush and soft rush.

Plate 6: Wetland habitats within 100 metres of the site boundary. Large swamp wetland on margins of the Takapō River to the east of the site (left) and a small seepage wetland in the Twizel River, to west of the site (right).

5. FLORA

5.1 Overview

Fifteen indigenous and 42 exotic vascular plant species were recorded during the survey of the Ōhau C site (Appendix 1).

5.2 Threatened, at risk, and locally uncommon species

Only one species with a national threat ranking (de Lange *et al.* 2018) was recorded on the site: tūmatakuru/matagouri, classified as At Risk-Declining.

The national threat ranking is largely based on its restricted status in the North Island and matagouri is common in the South Island and the Mackenzie Basin. It was only recorded in shallow gullies on the eastern side of the site.

Four species with national threat rankings (de Lange *et al.* 2018) were recorded within 100 metres of the site boundary:

- Maniototo peppercress: Threatened – Nationally Critical.
- Stout dwarf broom: At Risk – Declining.
- Desert broom (*Carmichaelia petriei*): At Risk – Declining.
- Common mat daisy: At Risk – Declining.

Due to the proximity of Threatened and At Risk species to the property boundary, it is possible that individuals of these species would also be detected within the property in more detailed surveys.

Plate 7: Stout dwarf broom (At Risk – Declining) (left) and Maniototo peppercress (Threatened – Nationally Critical) (right).

5.3 Pest plants

Five plant species recorded at the site are listed as either 'pest' or 'Organisms of Interest' (OOI) in Environment Canterbury Regional Pest Management Plan (CRPMP; 2018-2038; Table 1).

Table 1: Pest plants and Organisms of Interest (PEST, OOL), listed in CRPMP, recorded at the Ōhau A site.

Scientific Name	Common Name(s)	Growth Form	Pest Status
Cytisus scoparius	Broom	Shrub	PEST
Echium vulgare	Vipers' bugloss	Herb	OOI
Hypericum perforatum	St John's wort	Herb	OOI
Pinus contorta *Pseudotsuga menziesii*	Wilding conifers	Tree	PEST

6. AVIFAUNA

The desktop assessment found records of 47 species (and two hybrid taxa) between January 2021 and January 2023 within five kilometres of the Ōhau C site. Of the 49 taxa, 33 are classified as indigenous and 16 as exotic. Records of seven Threatened species were found in the desktop assessment, including Nationally Critical kakī/black stilt (*Himantopus novaezelandiae*) and kotuku/white heron (*Ardea alba modesta*), Nationally Endangered tarapirohe/black-fronted tern, Nationally Vulnerable pūteketeke/Australasian crested grebe, taranui/Caspian tern (*Hydroprogne caspia*) and pārera/grey duck, and Nationally Increasing ngutu pare/wrybill (*Anarhynchus frontalis*).

Eight At Risk species were recorded, including: Declining pohowera/banded dotterel, tarāpuka/black-billed gull, kotoreke/marsh crake, pīhoihoi/New Zealand pipit and tōrea/South Island pied oystercatcher (*Haematopus finschi*), Relict māpunga/black shag and kawaupaka/little shag, and Naturally Uncommon Australian coot (*Fulica atra australis*).

Thirty bird species were recorded during the field survey (Table 2). Of these, 15 are indigenous and 15 exotic. One Threatened species (tarapirohe/black-fronted tern, Nationally Endangered) and four At Risk species (Declining pohowera/banded dotterel and tarāpuka/black-billed gull, and Relict māpunga/black shag and kawaupaka/little shag) were detected. Exotic passerines were the most common birds at the site, with skylarks (*Alauda arvensis*) being especially abundant. All species recorded during the field survey were also recorded in the desktop assessment.

Tarapirohe/black-fronted tern and pohowera/banded dotterel were observed during the field survey. Both species use the site for foraging and breed in or directly adjacent to the site. The site provides potential foraging and breeding habitat for kakī/black stilt and several other Threatened or At Risk species.

The stonefield dryland areas provide suitable habitat for pohowera/banded dotterel and South Island pied oystercatcher (*Haematopus finschi*, At Risk - Declining) to forage and breed, and may also be utilised by pihoihoi/New Zealand pipit. Banded dotterel were observed feeding in the cocksfoot grassland, brome-hawkweed-sheep sorrel grassland/herbfield, and brassica cropland, and they could use these habitats for breeding.

Wetlands adjacent to the site provide habitat suitable for matuku-hūrepo/Australasian bittern (Threatened-Nationally Critical) and kotoreke/marsh crake (At Risk-Declining). The *Carex* sp. and *Juncus* sp. provide suitable foraging areas and may provide breeding habitats. Neither of these species were detected during the site visit as these are highly cryptic species.

7. LIZARDS

Species recorded within a 20 kilometre radius of the Ōhau C site are listed in Table 3. Closest records and the likelihood of each species being found on-site are set out in Table 3.

Two lizard species were found during the field visit. McCann's skink (*Oligosoma maccanni;* Not Threatened) and Southern Alps gecko (*Woodworthia* "Southern Alps"; At Risk – Declining) were observed in stonefield dryland habitat (Figure 1). Two individuals of each species were found in rock piles at the base of a west-facing terrace slope in the southwestern part of the site (Plate 6). Three McCann's skinks were also found among rock piles in a gully in the northeastern part of the site.

Indigenous lizards are most often found where there is sufficient complex ground cover, such as dense vegetation (including rank exotic grass) and rock piles, which provides refuges from predators and inclement weather. High-quality habitat for most species of lizards inhabiting the Mackenzie District includes undeveloped outwash plains, dry river cobbles and talus slopes, especially where interspersed with indigenous shrubland, along with contiguous tracts of indigenous shrubland.

Table 2: Bird species records found in the desktop assessment and during the field survey at the Ōhau C site. Common names, scientific names, and threat classification are from Robertson *et al.* 2021.

Common Name(s)	Scientific Name	Threat Classification 2021	Likelihood of Presence at Site
Indigenous Species			
Australasian bittern/matuku-hūrepo	*Botaurus poiciloptilus*	Threatened-Nationally Critical	Possible
Black stilt/kakī	*Himantopus novaezelandiae*	Threatened-Nationally Critical	Highly likely
White heron/kōtuku	*Ardea alba modesta*	Threatened-Nationally Critical	Possible
Black-fronted tern/tarapirohe	*Chlidonias albostriatus*	Threatened-Nationally Endangered	Seen during visit
Australasian crested grebe/pūteketeke	*Podiceps cristatus australis*	Threatened-Nationally Vulnerable	Unlikely
Caspian tern/taranui	*Hydroprogne caspia*	Threatened-Nationally Vulnerable	Highly likely
Grey Duck/pārera	*Anas superciliosa*	Threatened-Nationally Vulnerable	Likely
Wrybill/ngutu pare	*Anarhynchus frontalis*	Threatened-Nationally Increasing	Likely
Banded dotterel/pohowera	*Charadrius bicinctus bicinctus*	At Risk-Declining	Seen during visit
Black-billed gull/tarāpuka	*Chroicocephalus bulleri*	At Risk-Declining	Seen during visit
Marsh crake/kotoreke	*Zapornia pusilla affinis*	At Risk-Declining	Likely
New Zealand pipit/pīhoihoi	*Anthus novaeseelandiae novaeseelandiae*	At Risk-Declining	Likely
South Island pied oystercatcher/tōrea	*Haematopus finschi*	At Risk-Declining	Likely
Black shag/māpunga	*Phalacrocorax carbo novaehollandiae*	At Risk-Relict	Seen during visit
Little shag/kawaupaka	*Microcarbo melanoleucos brevirostris*	At Risk-Relict	Seen during visit
Australian coot	*Fulica atra australis*	At Risk-Naturally Uncommon	Unlikely
Australasian shoveler/kuruwhengi	*Spatula rhynchotis*	Not Threatened	Highly likely
Black swan/kakīānau	*Cygnus atratus*	Not Threatened	Seen during visit
Grey duck – mallard hybrid	*Anas superciliosa × platyrhynchos*	Not Threatened	Seen during visit
Grey teal/tētē-moroiti	*Anas gracilis*	Not Threatened	Highly likely
Grey warbler/riroriro	*Gerygone igata*	Not Threatened	Seen during visit
Marsh crake/kotoreke	*Zapornia pusilla affinis*	At Risk-Declining	Possible
New Zealand scaup/pāpango	*Aythya novaeseelandiae*	Not Threatened	Highly unlikely
Paradise shelduck/pūtangitangi	*Tadorna variegate*	Not Threatened	Seen during visit
Pied stilt/poaka	*Himantopus himantopus leucocephalus*	Not Threatened	Seen during visit
Pied stilt x black stilt hybrid	*Himantopus himanoptus x novaezelandiae*	Not Threatened	Likely
Pūkeko	*Porphyrio melanotus melanotus*	Not Threatened	Unlikely
Shining cuckoo/pīpīwharauroa	*Chrysococcyx lucidus lucidus*	Not Threatened	Seen during visit
Silvereye/tauhou	*Zosterops lateralis lateralis*	Not Threatened	Seen during visit
South Island fantail/pīwakawaka	*Rhipidura fuliginosa fuliginosa*	Not Threatened	Seen during visit
Southern black-backed gull/karoro	*Larus dominicanus dominicanus*	Not Threatened	Seen during visit
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened	Highly likely
Swamp harrier/kāhu	*Circus approximans*	Not Threatened	Seen during visit
Welcome swallow/warou	*Hirundo neoxena neoxena*	Not Threatened	Seen during visit

Common Name(s)	Scientific Name	Threat Classification 2021	Likelihood of Presence at Site
White-faced heron/matuku moana	*Egretta novaehollandiae*	Not Threatened	Highly likely
Exotic Species			
Australian magpie	*Gymnorhina tibicen*	Introduced and Naturalised	Seen during visit
California quail	*Callipepla californica*	Introduced and Naturalised	Seen during visit
Canada goose	*Branta Canadensis*	Introduced and Naturalised	Seen during visit
Chaffinch	*Fringilla coelebs*	Introduced and Naturalised	Seen during visit
Common redpoll	*Acanthis flammea*	Introduced and Naturalised	Seen during visit
Dunnock	*Prunella modularis*	Introduced and Naturalised	Seen during visit
Eurasian blackbird	*Turdus merula*	Introduced and Naturalised	Seen during visit
Goldfinch	*Carduelis carduelis*	Introduced and Naturalised	Seen during visit
Greenfinch	*Chloris chloris*	Introduced and Naturalised	Seen during visit
House sparrow	*Passer domesticus*	Introduced and Naturalised	Seen during visit
Mallard	*Anas platyrhynchos*	Introduced and Naturalised	Likely
Passerine sp.	*Passeriformes* sp.	Introduced and Naturalised	Seen during visit
Rock pigeon	*Columba livia*	Introduced and Naturalised	Seen during visit
Skylark	*Alauda arvensis*	Introduced and Naturalised	Seen during visit
Song thrush	*Turdus philomelos*	Introduced and Naturalised	Seen during visit
Starling	*Sturnus vulgaris*	Introduced and Naturalised	Seen during visit
Yellowhammer	*Emberiza citronella*	Introduced and Naturalised	Seen during visit