rma ecology

Bendigo-Ophir Gold Project

Wetland Values Assessment

Report prepared for

Matakanui Gold Ltd

Prepared by

RMA Ecology Ltd

Report number and date

2352

October 2025

BETTER ECOLOGICAL OUTCOMES

PREPARED FOR:

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Project No. 2352

Version date: 17 October 2025

Version status: Issued

Citation:

RMA Ecology Ltd. September 2025. Bendigo-Ophir Gold Project: Wetland Values Assessment. Report prepared for Matakanui Gold Ltd. 73 pages & appendices.

Contents

List of abbreviations

Abbreviation	Term	Description
BOGP	Bendigo-Ophir Gold Project	Is the topic of this resource consent application and covers approx. 610 ha.
CODC	Central Otago District Council	
CODP	Central Otago District Plan	
DDF	Direct Disturbance Footprint	Approximately 610 ha of land within the ESA covering BOGP gold mining and ancillary activity areas that cause direct habitat loss through vegetation clearance and/or earthworks. Includes the Thomson Gorge Road realignment footprint, and buffers varying from 0–50 m in width for different components.
DDZ	Potential Dewatering Drawdown Zone	Approximately 142 ha zone with potential to dewater, because of indirect influence from the DDF.
ED	Ecological District	A local part of New Zealand where the topographical, geological, climatic, soil, and biological features, including the broad cultural pattern, produce a characteristic landscape and range of biological communities
ESA	Ecological Study Area	Approximately 5,000 ha of land composed of a mix of grazing lands, leasehold Crown land, and Crown land. For the purpose of this report, it is further divided into DDF, DDZ, and SLSW areas.
ELF	Engineered Landform	Land that has been modified by anthropogenic means.
EPA	Environmental Protection Authority	The New Zealand government agency responsible for regulating activities within the country that affect the environment
MEP	Minerals Exploration Permit	MEP60311 is named Bendigo Ophir to indicate the exploration permit extends from the historic town of Bendigo to Ophir, with an area of 251 km^2 (25,162 ha).
MGL	Matakanui Gold Limited	New Zealand company wholly owned subsidiary of Santana Minerals Ltd.
MPP	Minerals Prospecting Permit	
MRE	Mineral Resource Estimation	Evaluation estimating the grade and tonnage of an ore in a deposit.
NES Freshwater	Resource Management (National Environmental Standards for Freshwater) Regulations 2020	
NPS-IB	National Policy Statement for Indigenous Biodiversity 2023	
NZTCS	New Zealand Threat Classification System	System used within New Zealand to assess the conservation status of species
ORC	Otago Regional Council	
RMA	Resource Management Act	Resource Management Act 1991
RAS	Rise and Shine	Area of land with gold resource containing a MRE (2024) of 2,217,000oz of gold at a grade of 2.3g/t
SRX	Srex	Area of land with gold resource containing a MRE (2021) of 174,000oz of gold at a grade of 1.1g/t
SRE	Srex East	Area of land with gold resource containing a MRE (2021) of 11,000oz of gold at a grade of 1.3g/t
ELF	Engineered Landform	
SL	Surrounding Landscape	Area within the ESA that is separate from the DDF and DDZ
SLSW	Surrounding Landscape Surveyed for Wetlands	Area within the ESA that is separate from the DDF and DDZ and was surveyed for wetlands. It provides wider and assessed ecological context. The SLSW is a subset of the SL.
TSF	Tailings Storage Facility	Engineered structures designed and constructed to hold mineral waste (tailings) generated after the gold has been recovered at the processing plant

Abbreviation	Term	Description
WSA	Wetland Survey Area	The areas within which wetland presence was assessed on the ground within the ESA. Outside of the DDF and DDZ, representative sub-catchments only were surveyed in detail for wetlands, not the entire ESA.

Executive summary

Overview

This report describes the wetland values within the Direct Disturbance Footprint (DDF) and the potential Dewatering Drawdown Zone (DDZ) of the Bendigo Ophir Gold Project (BOGP). It also compares these wetland values to those of the surrounding landscape (referred to as the surrounding landscape surveyed for wetlands, or SLSW).

A total of 290 natural inland wetlands (as defined by the NPS-FM) totalling 11.3 ha were identified in the WSA, including 3.12 ha of wetlands (94 individual wetlands) in the DDF, and 2.37 ha of wetlands (21 individual wetlands) in the DDZ. Wetland values are high for swamps and fens in the SLSW, with seepages of moderate value. In the DDF and DDZ, swamps are high value, while fens and seepages have moderate values.

All wetland types (seepages, fens and swamps/marshes), in DDF, DDZ, and the SLSW, satisfy the significance criterion of the operative RPS and proposed RPS.

Methods

The New Zealand wetland delineation protocol was applied to map all wetlands (as defined within the NPS-FM) within the DDF, DDZ, and SLSW, incorporating the rapid test, vegetation tool, soils tool, and hydrology tool. A total of 123 wetland vegetation plots were completed in the DDF, DDZ, and SLSW, and a total of 270 person-hours were spent mapping wetlands. Indicative condition assessments were completed for all wetlands with vegetation plots, rating the degree of impact for nine indicator components from the Wetland Condition Handbook. The sum of all component scores provided an index of overall condition (spanning hydrology integrity, physicochemical parameters, ecosystem intactness, browsing/predation and harvesting regimes, and dominance of native plants). A Cumulative Link Model (CLM) with logit link function was applied to model the cumulative probabilities of achieving each condition level. The area, rather than the number of wetlands, was analysed to compare the DDF, DDZ, and SL, as well as the three wetland types.

Results

All 290 wetlands meet the classification as natural inland wetlands in the NPS-FM.

Within the DDF, 3.12 ha of wetland is present, composed primarily of swamp/marsh (2.51 ha) in valley floors and gullies, but with significant coverage of fen (0.49 ha), largely in gullies, and pockets of seepages on hillsides (0.13 ha). Most wetlands are relatively small in area (ca. 90% are less than 0.1 ha in area; ranging from 5 m^2 to >1 ha), except for a string of larger swamps/marshes along the valley floor of Rise and Shine Creek.

Within the DDZ, 2.37 ha of wetland is present, composed primarily of swamp/marsh (1.94 ha), and smaller scatterings of fen (0.37 ha) and seepages (0.06 ha).

Wetlands within the DDF, DDZ, and SLSW are almost exclusively dominated by herbaceous vegetation, and woody vegetation is rare. Exotic grasses and herbs dominate in most wetlands, but some wetlands are

dominated by native sedges. A total of ten Nationally or Regionally Threatened, At Risk and Data Deficient wetland species were detected in the WSA; these included:

• *Acaena inermis*	At Risk - Regionally declining	DDF only
• *Carex kaloides*	Threatened - Regionally Endangered	DDF and SLSW
• *Carex buchananii*	Threatened - Regionally Vulnerable	DDF and SLSW
• *Carex talboti*	Threatened - Regionally Vulnerable	DDF and SLSW
• *Carex diandra*	At Risk - Regionally Naturally Uncommon	DDF and SLSW
• *Deschampsia chapmanii*	Regionally Data deficient	DDF and SLSW
• *Juncus distegus*	At Risk - Regionally declining	DDF and SLSW
• *Olearia bullata*	At Risk - Regionally Naturally Uncommon	DDF and SLSW
• *Olearia lineata*	At Risk - Regionally declining	DDF and SLSW
• *Rumex flexuosus*	At Risk - Regionally Naturally Uncommon	DDF and SLSW

Nine Regionally Threatened or At Risk/Data Deficient species are found in both the DDF and SLSW, and one Regionally At-Risk species was found only in the DDF.

Within wetland plots, 94 plant species were identified, including 32 native species. A chart of the cumulative species detection over the 123 plots levels off, providing confidence that survey effort was sufficient to detect most wetland plant species onsite. Wetlands assessed in the DDF were in significantly poorer condition, had a greater introduced species cover (lower score), and experienced higher levels of animal disturbance compared to wetlands assessed in the SLSW.

Wetlands in the WSA under 800 m had lower overall condition, and more animal damage and introduced species than wetlands above 800 m. Seepages were more degraded than other wetland types, with lower overall condition and higher levels of animal disturbance through grazing and pugging. The vegetation communities and condition of wetlands in the WSA mirror the generally degraded state of lowland and montane wetlands in the wider Central Otago Ecological Region, due in large part to many decades of fire and grazing.

Fauna assessments relevant to wetlands (detailed in other reports) detected no fish life within the DDF, very limited fish life within the SL, and no wetland specialist avifauna in the ESA. Habitat for wetland birds and fish is limited and of poor quality, being constrained spatially and temporally.

To assist in the preparation of the Assessment of Effects, the anticipated impacts on wetlands from the proposed BOGP are outlined. Potential effects include loss of wetland area and reduction in wetland condition due to earthworks and vegetation clearance, surface water diversion and groundwater diversion (de-watering halos around mine pits estimated by the DDZ (BOGP Wetland Drawdown Assessment)), and indirect water quality effects of discharges to streams and wetlands.

1.0 Introduction

1.1 Project background

Matakanui Gold Limited ("MGL") is applying for resource consents to construct and operate a new gold mine, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project is named the Bendigo-Ophir Gold Project ("BOGP") and is located approximately 20 km north of Cromwell.

The BOGP is located within the footprint of Minerals Exploration Permit 60311, which overlays several pastoral stations that have grazed sheep and cattle in the area for over 100 years. MEP60311 is held by MGL under the Crown Minerals Act 1991. MGL has land access agreements with Bendigo and Ardgour Stations. The BOGP is located adjacent to land administered by the Department of Conservation ("DOC"), including the Bendigo Historic Reserve, the Bendigo Conservation Area, and the Ardgour Conservation Area. The BOGP planned operations do not directly impact these areas.

The BOGP's exploration has discovered numerous soil geochemical anomalies and extensive drill evaluation has defined four gold deposits worthy of economic extraction. The most significant is the Rise and Shine ("RAS") discovery which is, according to MGL, the most significant gold discovery in New Zealand in the past four decades. The other discoveries at Come in Time ("CIT"), Srex ("SRX") and Srex East ("SRE") are smaller in size and tenor.

The defined orebodies are planned to be mined by open pit methods. Underground mining is planned for the deeper parts of the RAS orebody in the later years of development.

Most of the mining activities, ancillary facilities and associated infrastructure will be in Shepherds Creek Valley. Access, and service and administration offices are planned to be located on the adjoining Ardgour Terrace.

Figure 1 provides an overview of the footprint associated with the establishment, operation and rehabilitation within the BOGP. We understand this footprint includes a range of buffers from 0–50 m, with widths varying for different components of the design. We have assumed that vegetation clearance and/or earthworks will occur in the entirety of this area. We understand that the area is designed to account for potential minor changes in the DDF over future revisions due to engineering and design alterations that may occur during detailed engineering design. A further 13.09 ha (approximately) of disturbance will be needed to establish the Thomson Gorge Road alternative alignment (Ardgour Rise). A further 2.75 ha (approximately) of disturbance will be needed to construct predator proof fences. The maximum potential disturbance, herein referred to as the Direct Disturbance Footprint (DDF) (**Figure 2**), including contingency, Ardgour Rise, and the predator proof fences is approximately 610 ha.

Aspects of the project that are not included in the DDF are the pipeline, borefield, and walking track to the CIT battery (**Figure 1**) as we understand (from the applicant) that these will be undertaken either as permitted activities (pipeline and borefield) or will have nil impact (walking route).

Approximately 52 ha of the DDF is in the agricultural area on Ardgour Terrace. This area will be used for offices, security, medical, laboratory, laydown, storage, contractor areas, topsoil storage, emulsion manufacture and magazine facilities plus quarries and roading.

Ecological work will include rehabilitation on directly disturbed areas, ecological uplift activities and pest exclusion area(s) adjacent to the footprint on nearby areas such as Ardgour and Bendigo Stations. A full description of the various activities comprising the establishment, operation and rehabilitation within the BOGP is provided in the Assessment of Environmental Effects prepared by Mitchell Daysh Limited.

However, by way of summary, the BOGP includes the following components:

- The establishment of the RAS Open Pit and SRX Open Pit, which are planned to form partial pit lakes at closure;
- The establishment of RAS Underground which utilises backfill with cement paste;
- The establishment of the CIT Open Pit, which is the smallest of all the footprints and is planned to be progressively backfilled with waste rock from the RAS Open Pit and profiled to integrate with the surrounding terrain. Rehabilitation will enable nearby native herb fields to be re-established at the completion of mining activities;
- The establishment of the small SRE Open Pit, which will be backfilled with waste rock before being covered with overburden to form the engineered landform for the adjoining SRX Open Pit ("SRX ELF");
- A conventional hard rock gold processing plant (1.2 million tonnes per annum (Mtpa) expandable to 1.8 Mtpa) applying modern Carbon-in-Leach ("CIL") technology constructed in the lower reach of Shepherds Valley. The plant will operate in a closed water circuit with the TSF. Residual chemicals in the tailings slurry will be detoxified and / or precipitated with specialist plant;
- The operation of the process plant will be supported by ancillary facilities such as maintenance workshops, raw material and process chemical storage, fuel depot, laboratory and warehousing. Mine offices, carparking and security services will also be established;
- The construction of the plant in the lower reaches of the Shepherds valley will include the realignment of Shepherds Creek;
- The establishment of water storage dams and tankage for use in the process plant, dust suppression and drinking water supply;
- The establishment of a Tailings Storage Facility ("TSF") in the upper reach of Shepherds Valley (including clean water diversion drains), which will utilise waste rock from mining activities within the project site;
- The establishment of permanent engineered landforms in the Shepherds Valley ("Shepherds ELF") and an unnamed creek west of RAS pit ("WELF");
- The establishment of temporary topsoil, vegetation and brown rock stockpiles around the project site;
- The extraction of groundwater from the Bendigo Aquifer for use in mining-related activities as well as supplying BOGP drinking water and replacing small irrigation water takes from Shepherds Creek. Bore water will be pumped to the processing plant via a pipeline over approximately 6.5 km;
- The establishment of supporting infrastructure / activities for the project, such as the upgrade of Ardgour Road and parts of Thomson Gorge Road to provide improved access to the BOGP, internal mine access and haul roads, water pipelines and underground utilities, and electricity supply to the

project site from Lindis Crossing via a new 66 kV overhead powerline that will follow the existing road reserve corridor;

- A realignment of part of Thomson Gorge Road, via Ardgour Station (Ardgour Rise) is planned to maintain public access through to the Manuherikia Valley;
- Main explosives magazines and emulsion mixing facilities (located outside the project site on Ardgour Terrace);
- The establishment of non-operational infrastructure associated with the BOGP on the Ardgour Terrace, including security, first aid and administrative offices, geology facilities, high voltage substation and temporary construction workers accommodation;
- The establishment of clean water diversion channels to intercept and divert stream and overland flows from the mine pits, TSF and ELF (**Figures 3 and 4**);
- The establishment of pest exclusion area(s) for ecological enhancement activities; and
- The establishment of the Ardgour Restoration Area.

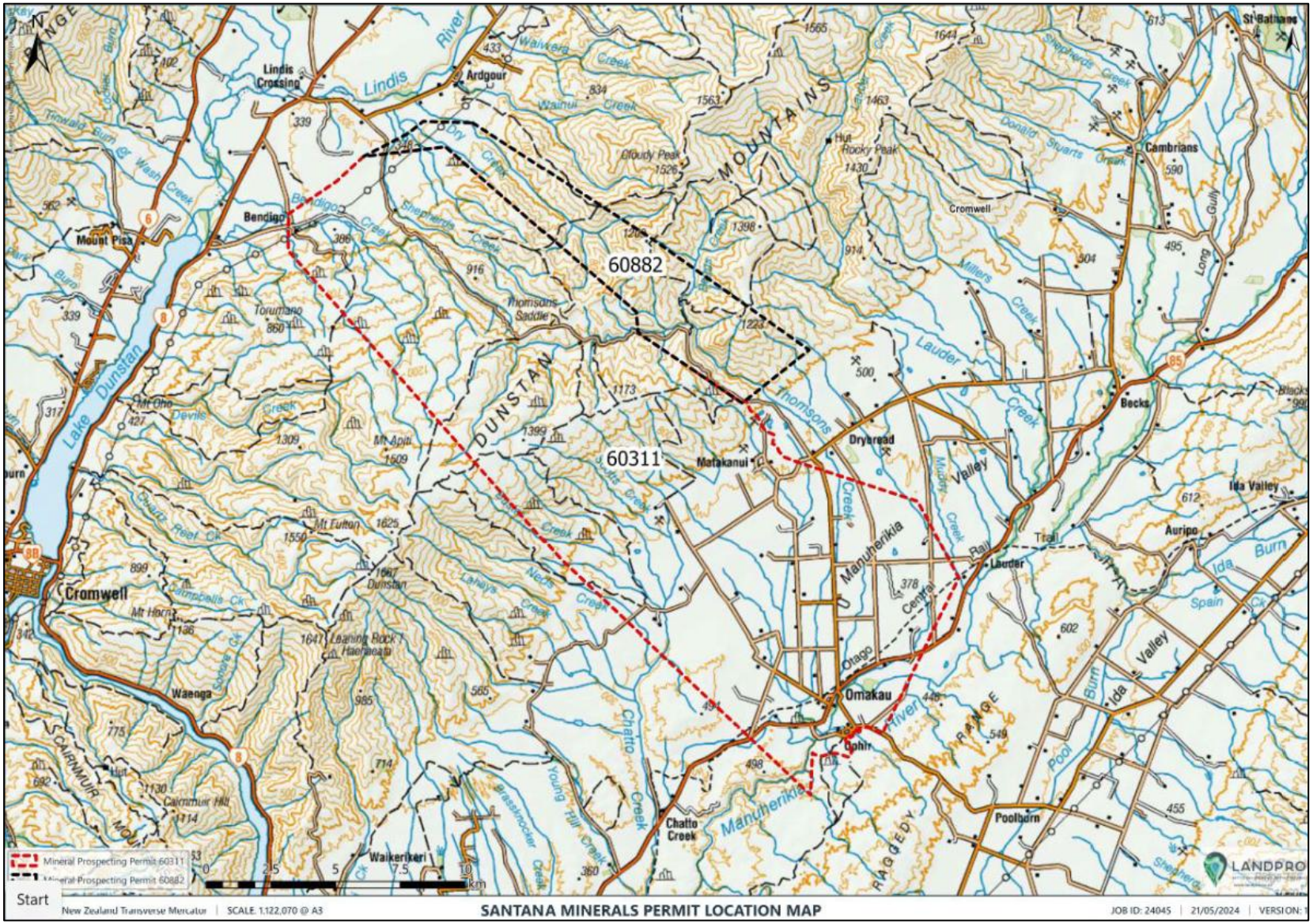


Figure 1. Map showing the mining permit area (red dotted and black dotted polygons). The Bendigo-Ophir Gold Project is located in the northern and central parts of the mining permit areas. Source: MGL.

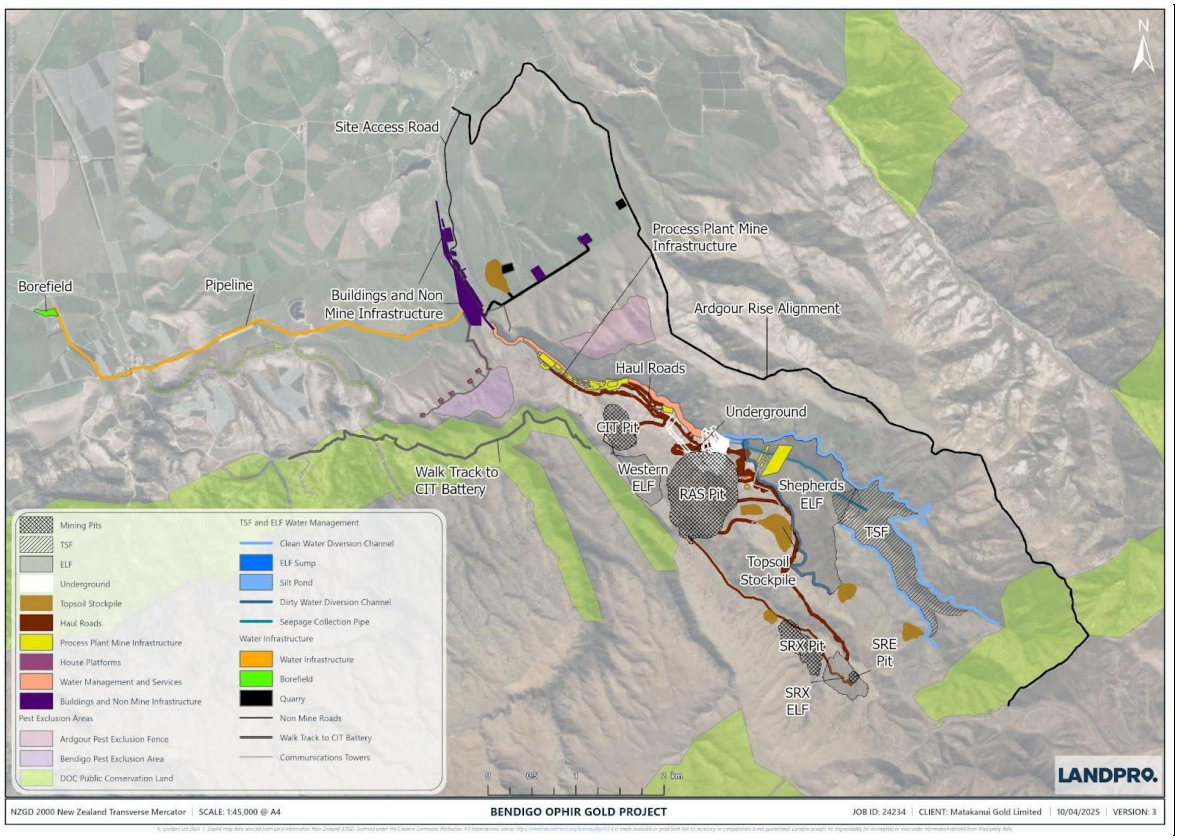


Figure 2. Overview site layout of the Bendigo-Ophir Gold Project, showing primary components of the DDF (excluding the Thompson Rd realignment footprint).

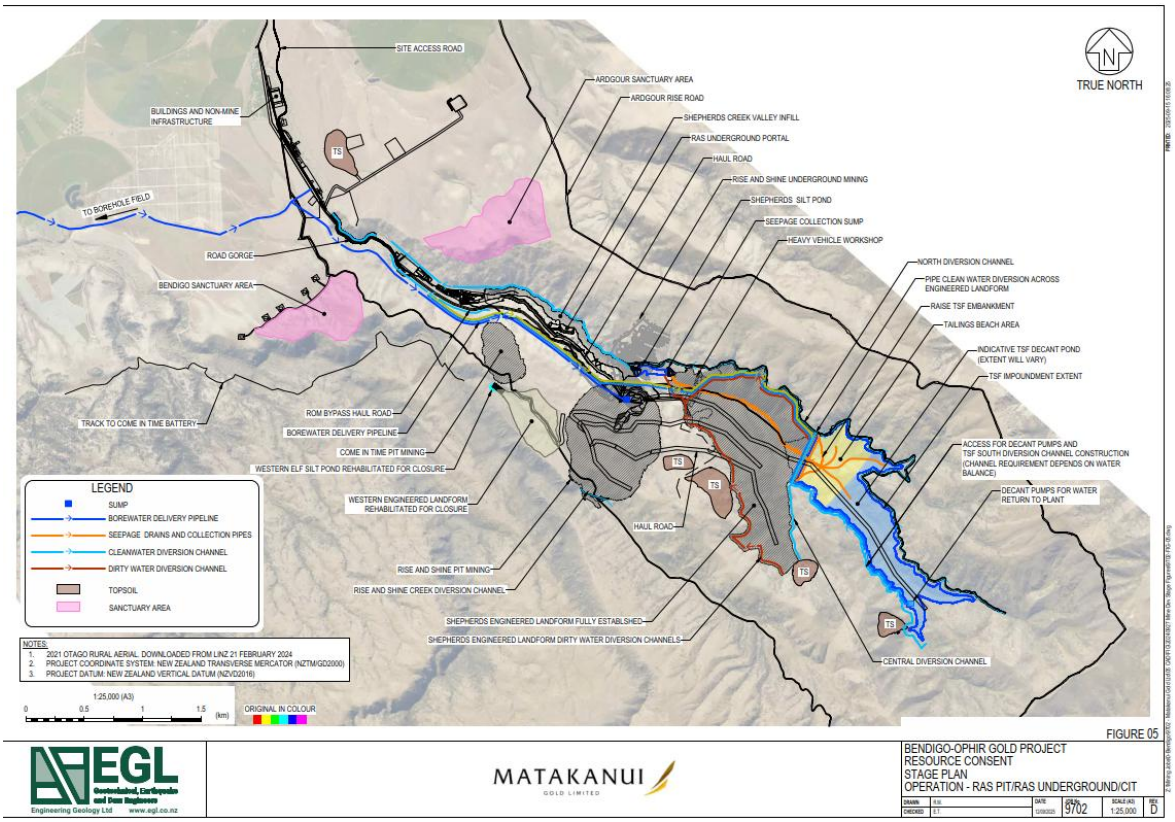


Figure 3. Stage plan for Rise and Shine and Come in Time mine pits, showing proposed water diversion channels around Rise and Shine pit, the TSF and ELF.

1.2 Purpose and scope

RMA Ecology Limited has been engaged by MGL to undertake ecological investigations and to prepare ecological values assessments for vegetation, wetlands, birds and herpetofauna[1]. Habitat NZ Limited has been engaged by MGL to undertake ecological investigations and to prepare ecological values assessments for invertebrates and bats. These ecological values assessments will form the basis of an ecological effects assessment that will be prepared by Alliance Ecology Limited, which will support approvals (including resource consent applications) under the Fast-Track Approvals legislation[2].

Broadly, the scope of this report is to describe the wetland values of the Direct Disturbance Footprint (DDF), potential Dewatering Drawdown Zone (DDZ) and the Surrounding Landscape (SL), which together make up the wider c. 5,000 ha Ecological Study Area (ESA) (**Figure 5**).

Specifically, this report contains:

- A description of the methods employed to investigate the wetland extent and wetland types within the ESA;
- A description of the ecological context of the ESA and wider Dunstan Mountains;
- The delineation, classification and description of wetlands within the ESA, including wetland class, elevation and location (DDF, DDZ, or SL);
- The description of wetland vegetation communities;
- A wetland plant species inventory with particular focus on species classified as Regionally or Nationally At Risk or Threatened, or that are otherwise rare or hold other values;
- Assessment of wetland condition; and
- Assessment of wetland value and significance.

The scope of this report is limited to assessing wetland ecological values. It does not include a comprehensive assessment of effects of the Project on these values. It does, however, provide a summary of potential effects to consider in a full effects assessment, which is being prepared by Alliance Ecology Ltd.

[1] This report was prepared in accordance with an approved variation (dated 16 May 2024) of our original approved offer of service (dated 24 October 2023).

[2] The Fast-Track Approvals Act was in force from 23 December 2024.

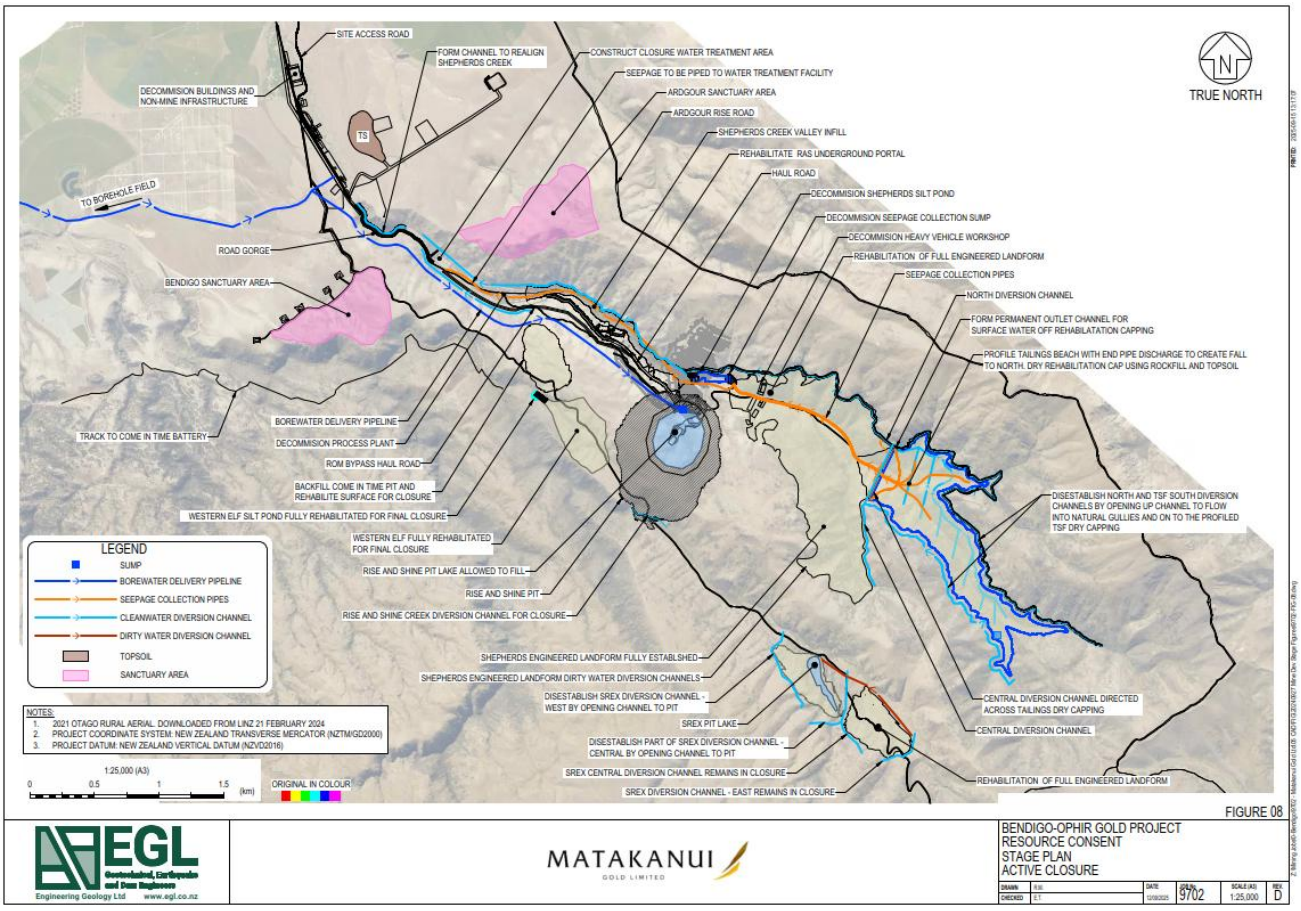


Figure 4. Stage plan for Rise and Shine and SRX/Shreks pits, showing proposed water diversion channels around SRX pit, the TSF and ELF.

1.3 Ecological study area

The ESA covers approximately 5,000 ha (**Figure 5**). The ESA includes both agricultural and conservation land. It includes a mix of private, leasehold Crown land, and Crown land administered by the Department of Conservation (DOC) (**Figure 6**). The present vegetation communities are a result of disturbances both contemporary and historical, and both natural and human-induced. The terrain has a range in elevation from c. 300 m to c. 1,300 m above sea level. The lower elevation vegetation communities, as well as those communities nearer to the Lindis/Clutha Valley, are comparably more disturbed than the higher elevation communities, near Thomson Saddle, along the south-eastern edge of the ESA.

The BOGP investigated mining operations and activities within the ESA and developed the Direct Disturbance Footprint (DDF). The DDF currently encompasses ca. 610 ha within the BOGP Study Area, within which gold mining and ancillary activities are proposed (**Figure 5**). An assessment of the potential dewatering drawdown zone (DDZ) also was developed, encompassing approximately 1.4 ha adjacent to certain activities in the DDF. This report provides quantitative and qualitative comparisons of wetland values directly affected by the Project DDF. We understand this footprint includes a range of buffers from 0–50 m, with widths varying for different components of the design. We have assumed that vegetation clearance and/or earthworks will occur in the entirety of this area. We understand that the area is designed to account for potential minor changes in the DDF over future revisions due to engineering and design alterations that may occur during detailed engineering design.

The buffers included in the DDF are not designed to cover indirect effects on wetlands. We have included and mapped one indirect component: the potential Dewatering Drawdown Zone (DDZ; see BOGP Wetland Drawdown Assessment). Regarding the DDZ, BOGP has committed to augment any drawdown effects to the surface-water fed swamp/marsh wetlands along the RAS valley floor; other wetlands within the DDZ, such as hillside seepages or gully fens, are excluded from this augmentation plan and are assumed to be impacted. We have not mapped other indirect effects, such as water quality impacts or surface water diversion.

The Surrounding Landscape (SL) includes all areas within the ESA that separate from the DDF and the DDZ. The Surrounding Landscape Surveyed for Wetlands (SLSW) is a subset of the SL that was surveyed for wetlands on the ground. The Wetland Survey Area (WSA) includes the DDF, the DDZ, and the SLSW.

Note that the DDF and SL definitions in this report are not the same as those in the Terrestrial Invertebrate Survey Report[3]. This (wetland) report does not include an additional buffer within the DDF, and this report does not have any satellite sites as part of the SL, whereas satellite sites are included in the SL within the Terrestrial Invertebrate report.

[3] Habitat NZ Ltd. (2024). Bendigo-Ophir Gold Project: Terrestrial Invertebrate Survey. Habitat NZ Ltd., Auckland. 54 p.

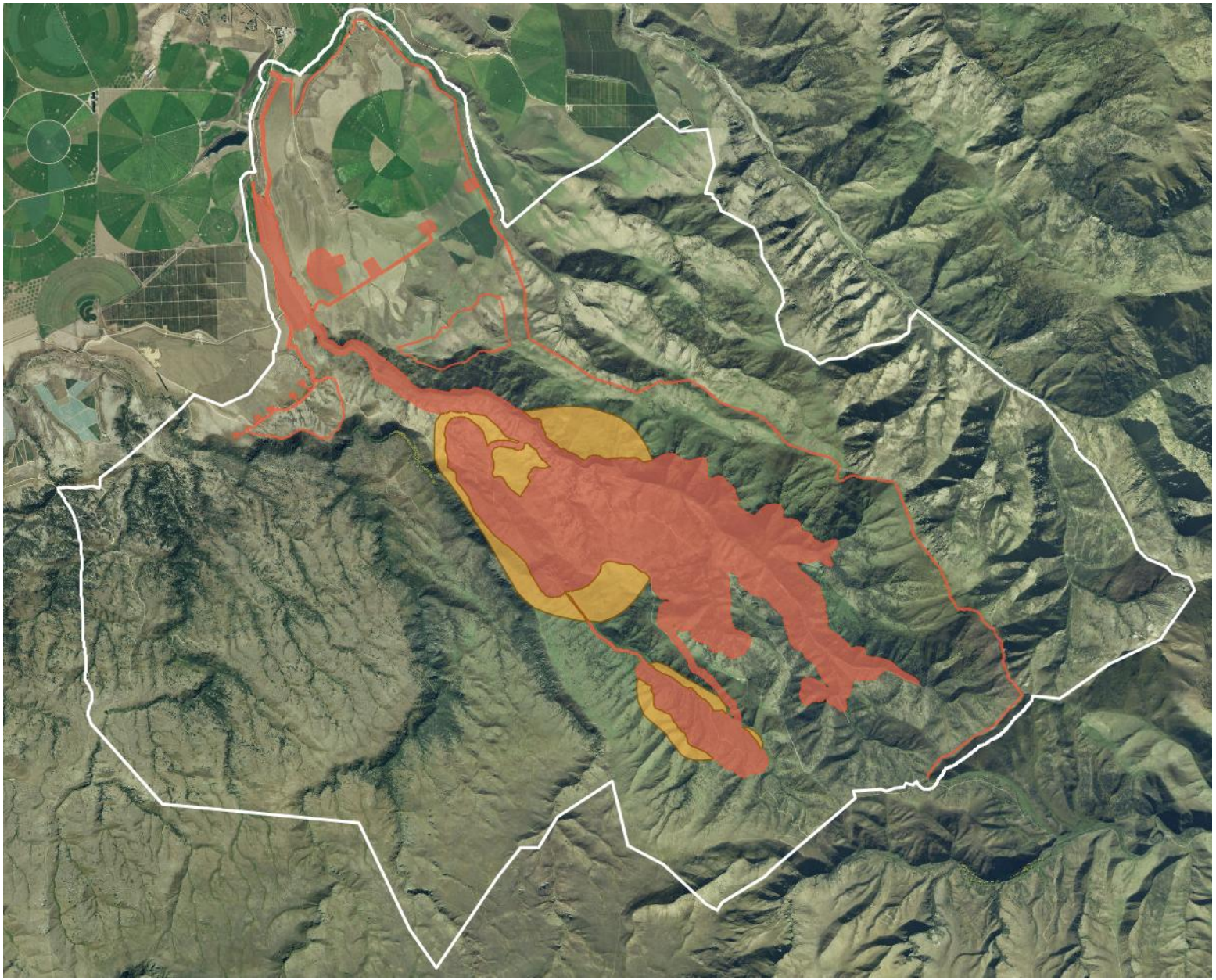


Figure 5. The Ecological Study Area (ESA - white boundary), Direct Disturbance Footprint (DDF in red), Potential Dewatering Drawdown Zone (DDZ in orange)

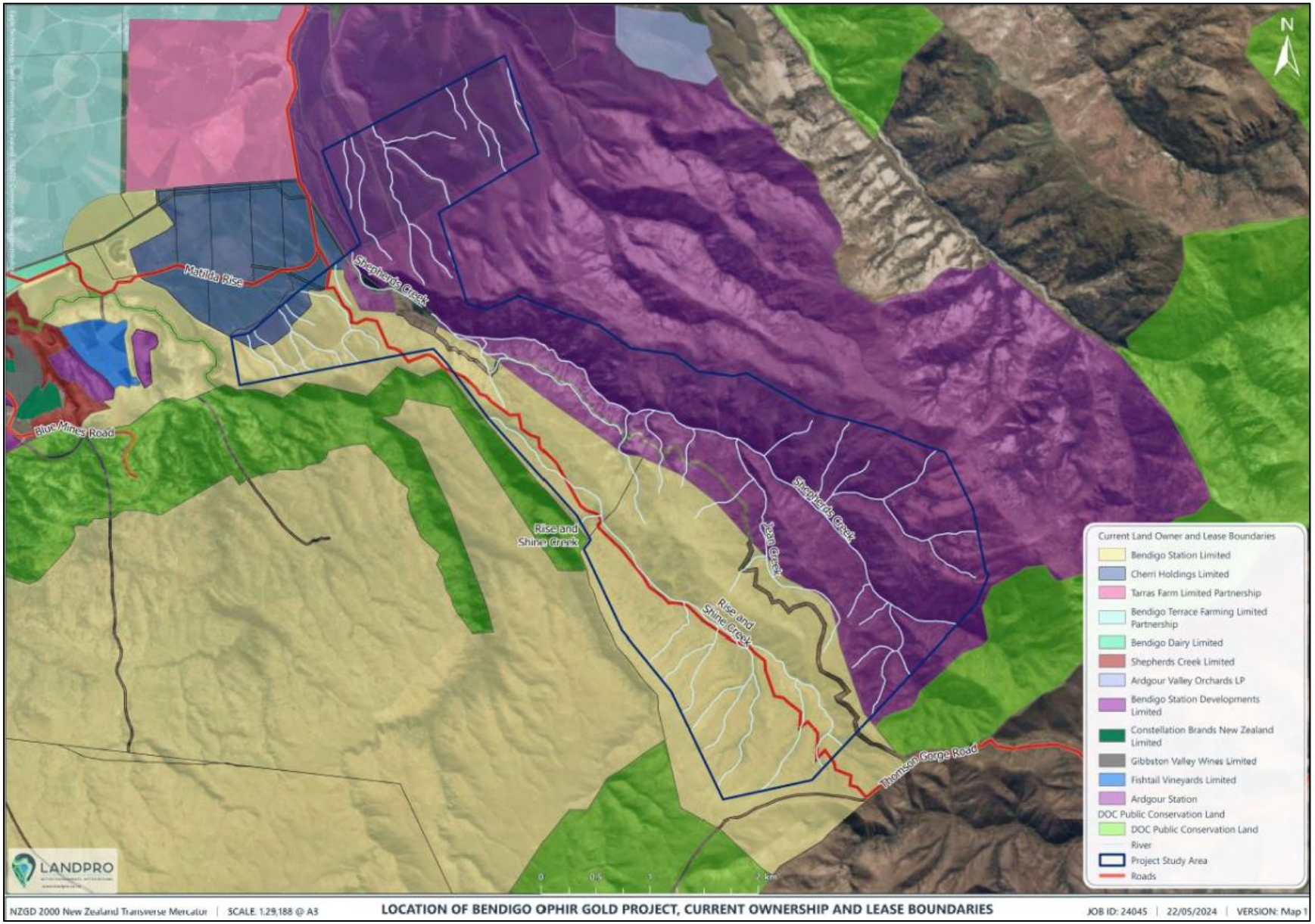


Figure 6. Land ownership within the Ecological Study Area and the surrounding area. Source: MGL.

1.4 Wetland survey area

Most of the ESA was surveyed for wetlands. The entire DDF and DDZ were surveyed for wetlands, and a subset of the SL (SLSW) was also surveyed (**Figure 7**). The SLSW areas were selected randomly from a set of similar-size sub-catchments on Ardgour and Bendigo Stations adjoining the DDF, to comment on how representative the DDF catchments were in terms of supporting wetland compared to other nearby areas. The SLSW also focused on potential sites that could be used as ecological compensation enhancement areas for an effects assessment (undertaken by Alliance Ecology Ltd).

The SLSW includes most of Ardgour Station and a portion of Bendigo Station. Areas of Crown Land at the head of Dry Creek, Shepherds Creek and Bendigo Creek were excluded from the survey, because these were far from any potentially feasible part of the Project footprint.

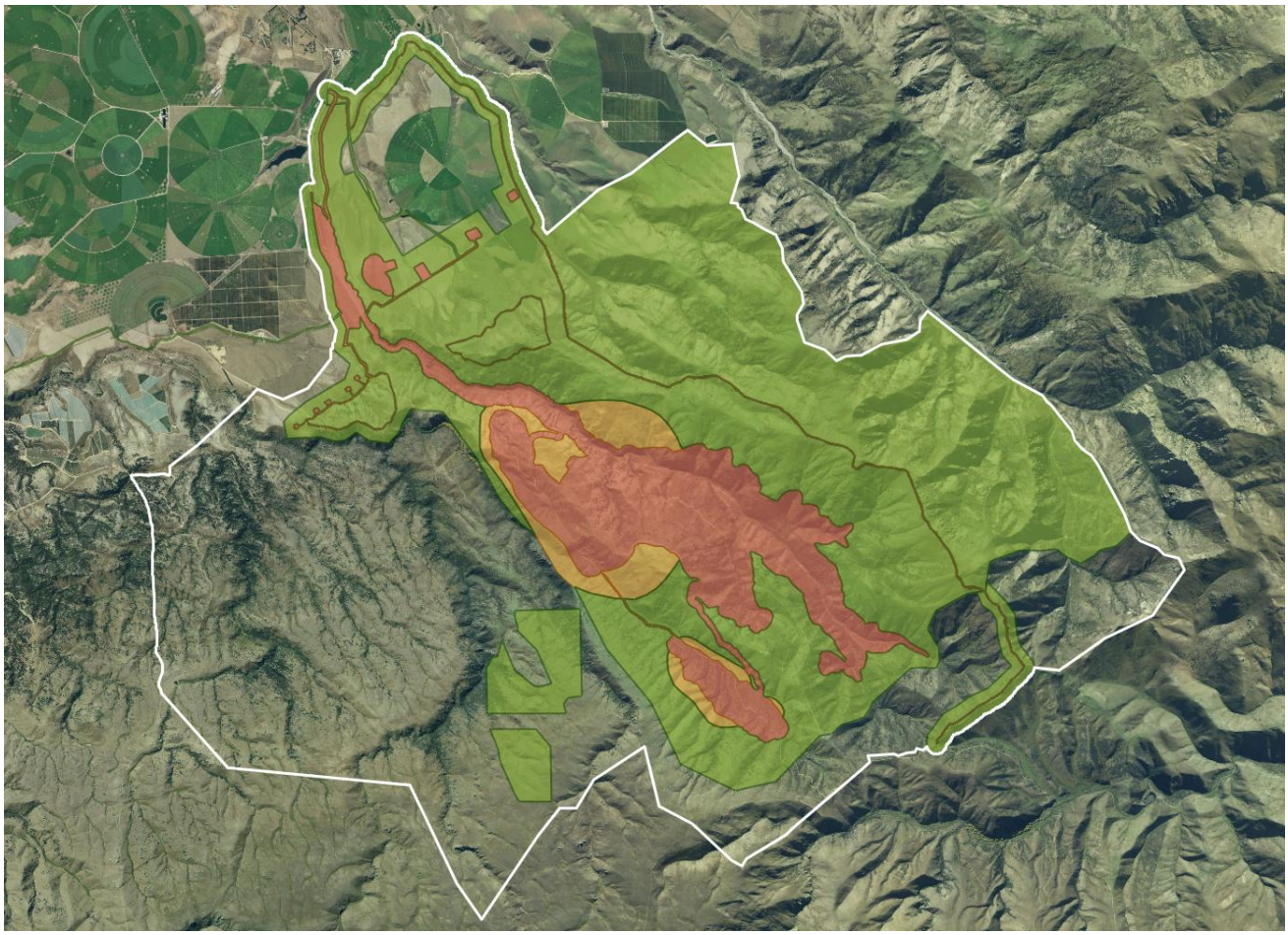


Figure 7. Areas surveyed for wetlands (WSA), including the DDF (in red), the DDZ (in orange), and the SLSW (in green). The ESA is outlined in white.

2.0 Methods

The methods employed to investigate wetlands within the ESA include four components:

- Desktop assessment;
- Wetland survey;
- Data analysis; and
- Assessment of value and significance.

2.1 Desktop assessment

A desktop assessment was undertaken of the ecological context and wetland values of the ESA and of the surrounding Dunstan Ecological District and Central Otago Ecological Region.

Information sources included:

- Historic and present-day aerial images from sources such as Retrolens;
- Publicly available GIS layers including:
    - Land Cover Database (LCDB), Land Environments New Zealand (LENZ), and Threatened Environment Classification (TEC) from Manaaki Whenua Landcare Research; and
    - Otago Wetland Mapping and Otago Ecosystems and Habitat Mapping from the Otago Regional Council website;
- New Zealand Plant Conservation Network plant lists, including lists for:
    - Bendigo Goldfields Reserve (BNDI);
    - Bendigo kanuka first loop of track (BENK); and
    - Bendigo kanuka second loop of track (BEN2);
- iNaturalist records;
- Journal articles and other publications, including consent applications;
- Naturally Uncommon Ecosystems list from Manaaki Whenua Landcare Research; and
- Previous ecological reports that have been prepared for MGL.

Aerial imagery and topography from Google Maps, Bing Maps, Council maps and LINZ were also used to desktop map, aiding identification of areas which could potentially contain wetland.

Imagery from a range of seasons and sources was used, as several species die off and change colour in winter (e.g. swarding Carex and raupo), and wetlands can be very visible as green patches during the summer dry. This information was used to help guide ground surveys.

The conservation status of vascular plant species was checked against the regional[4] and national[5] conservation status lists for vascular plants. Note, the Otago regional threat status classification for vascular plants (2024 draft) was updated in early 2025, after field work was completed. This report has been updated to reflect the threat classification of species in the current (2025) publication[6].

2.2 Wetland survey

The Resource Management Act 1991 (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 site was assessed for 'natural inland wetlands' based on the definition within the National Policy Statement for Freshwater Management 2020 (NPS-FM). Under the NPS Freshwater Management 2020 revision published in 2023: Sect 3.21, a "natural inland wetland' means a wetland (as defined in the [Resource Management] Act) that is not:

in the coastal marine area; or

a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or

a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or

a geothermal wetland; or

a wetland that:

(i) is within an area of pasture used for grazing; and

(ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless

(iii) *the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply*"

The updated NPS-FM technical support documents regarding wetland classification and delineation require that a step-wise assessment be undertaken. That assessment includes application of the exclusion criteria based on pasture grassland, assessment of threatened species habitat, and then application of three separate vegetation tests (Rapid Test, Dominance Test, and Prevalence Index). Wetland soils and hydrology information are then applied if the results of the vegetation community and exotic pasture grass exclusion are inconclusive.

The methodology applied for the identification of wetlands at this site was as follows:

[4] Jarvie, S., Barkla, J., Rance, B., Rogers, G., Ewans, R., Thorsen, M. (2025). Conservation status of indigenous vascular plants in Otago. Otago Regional Council, Otago Threat Classification Series, 2025/1.

[5] de Lange, Peter J., Jeremy R. Rolfe, John W. Barkla, Shannel P. Courtney, Paul D. Champion, Leon R. Perrie, Sarah M. Beadel, Kerry A. Ford, Ilse Breitwieser, Ines Schönberger, Rowan Hindmarsh-Walls, Peter B. Heenan and Kate Ladley (2017). Conservation status of New Zealand indigenous vascular plants. New Zealand Threat Classification Series 22. 82p.

[6] Jarvie, S., Barkla, J., Rance, B., Rogers, G., Ewans, R., Thorsen, M. (2025). Conservation status of indigenous vascular plants in Otago. Otago Regional Council, Otago Threat Classification Series, 2025/1.

- Visual assessment as to whether the potential wetland area could support a threatened species;
- Visual assessment as to whether the potential wetland and surrounding area is clearly dominated by pasture grass species (the Rapid Pasture Test);
- Visual assessment of areas where the vegetation composition includes species that are scored as wetland obligate, facultative wetland, or facultative (e.g., rushes, wet pasture or 'wetland-type' vegetation) as assessed by Clarkson *et al.*[7] *(*following the Pasture Exclusion Test, and Wetland Delineation Protocols as laid out in the Pasture Exclusion Assessment Methodology[8]);

Where these compositions exist, an assessment of vegetation, soils, and hydrology is required according to the Pasture Exclusion Assessment Methodology and the New Zealand Wetland Delineation Protocol[9] :

- Vegetation is assessed through plant identification and percentage cover (as per the method described by Clarkson[10]) of 2 x 2 m herbaceous vegetation plots, 5 m radius shrub plots and 10 m radius tree plots within a potential wetland area, and estimating the percent cover of all species present (based on above-ground live biomass). Plot shape can be altered where necessary to maintain the same plot area and remain within one vegetation community;

- Soils are assessed by applying the criteria outlined in the Hydric Soils Identification Guide[11] – which involves excavation of a soil core to 50 cm depth, photography, and examination for gleyed, mottled, peaty, or other hydric soil characteristics; and

- Hydrology is assessed by assessing the primary and secondary indicators outlined in the Ministry for the Environment (MfE) hydrology tool[12];

These steps are summarised in the flow diagrams in the MfE Pasture Exclusion Assessment Methodology (**Figure 8a**), which build on the MfE Wetland Delineation Protocols (**Figure 8b**)[13].

Wetland delineation data forms from the Pasture Exclusion Methodology were used in the field, incorporating the dominance test, prevalence index, hydrology assessment, soil assessment, and pasture exclusion test (**Appendix B**).

The placement of wetland plots (vegetation, soil and hydrology) was targeted, as per the Vegetation Tool for Wetland Delineation. Plots were located along transects spanning gradients in vegetation communities, from wetland core to dryland. Interpolation then enabled identification of the wetland boundary, i.e. the boundary sits between a plot identified as a wetland and a plot identified as not a wetland. In this way, plots allow for calibration of professional judgement, so the boundaries of wetlands can be mapped through identification of similar hydric vegetation communities, the balance of wetland vs dryland ('upland') plant species, and hydrological and soil indicators. Where dominant species are all facultative or obligate wetland plants, the 'rapid test' was used to determine wetland status.

[7] Clarkson B. R., Fitzgerald N. B., Champion P. D., Forester L., Rance B. D. (2021). New Zealand wetland plant indicator status ratings 2021: Data associated with Manaaki Whenua - Landcare Research contract report LC3975 for Hawke's Bay Regional Council.

[8] Ministry for the Environment. 2022. Pasture exclusion assessment methodology. Wellington: Ministry for the Environment.

[9] Ministry for the Environment. (2022). Wetland delineation protocols. Wellington: Ministry for the Environment.

[10] Clarkson, B. (2013). A vegetation tool for wetland delineation in New Zealand. Report prepared for Meridian Energy Limited by Landcare Research.

[11] Fraser S., Singleton P., Clarkson B. (2018). Hydric soils – field identification guide. Envirolink Tools Contract C09X1702. Manaaki Whenua – Landcare Research Contract Report LC3233 for Tasman District Council.

[12] Ministry for the Environment. (2021). Wetland delineation hydrology tool for Aotearoa New Zealand. Wellington: Ministry for the Environment.

[13] Ministry for the Environment. (2022). *Wetland delineation protocols*. Wellington: Ministry for the Environment. ISBN: 978-1-991077-05-9. Publication number: ME 1713.

To ensure all wetlands were mapped within the SLSW and DDF, desktop assessment of likely wetlands was used in combination with onsite scoping from high points using binoculars, to identify areas with potential wetlands, exclude those without, and target systematic ground searches of all valleys, gullies and hillslope depressions. To delineate wetlands on the ground, boundaries were walked and digitally mapped using the ArcGIS 'fieldmaps' application on GPS-enabled devices (field accuracy is ca. ±2–3 m in open terrain).

To identify wetland plants, we used the wetland indicator status group definitions (**Table 1)** and the indicator status assigned to each species in the New Zealand Wetland Plant List 2021[14].

A total of 123 wetland vegetation plots were completed in accordance with the wetland delineation protocols. These plots spanned wetlands in the DDF, DDZ, and SLSW (**Figure 9**).

Table 1. Wetland indicator status group definitions.

Code	Group	Definition
OBL	Obligate Wetland	Almost always is a hydrophyte, rarely in uplands (non-wetlands).
FACW	Facultative Wetland	Usually is a hydrophyte but occasionally found in uplands
FAC	Facultative	Commonly occurs as either a hydrophyte or non-hydrophyte
FACU	Facultative Upland	Occasionally is a hydrophyte but usually occurs in uplands.
UPL	Obligate Upland	Rarely is a hydrophyte, almost always in uplands.

After the revision of the proposed Thomson Gorge Road realignment, the upper and lower sections were extended to areas not within the original ESA, and the area was searched for wetland. Therefore, areas within this updated footprint and a 100 m buffer were assessed for wetlands (roughly 250 ha) based on aerial imagery, existing extensive site knowledge and photopoints, topography, and site photographs of vegetation provided by a local ecologist in May 2025.

A cautious approach was employed, and all four areas with the potential to be classified as wetland were mapped as wetland, primarily based on topography and absence of upland (dryland) or facultative upland plant species, and presence of facultative wetland species. These four wetlands were included in the overall sum of wetlands identified within the ESA.

[14] Clarkson BR, Fitzgerald NB, Champion PD, Forester L, Rance BD 2021. New Zealand wetland plant list 2021. Manaaki Whenua - Landcare Research contract report LC3975 for Hawke's Bay Regional Council.

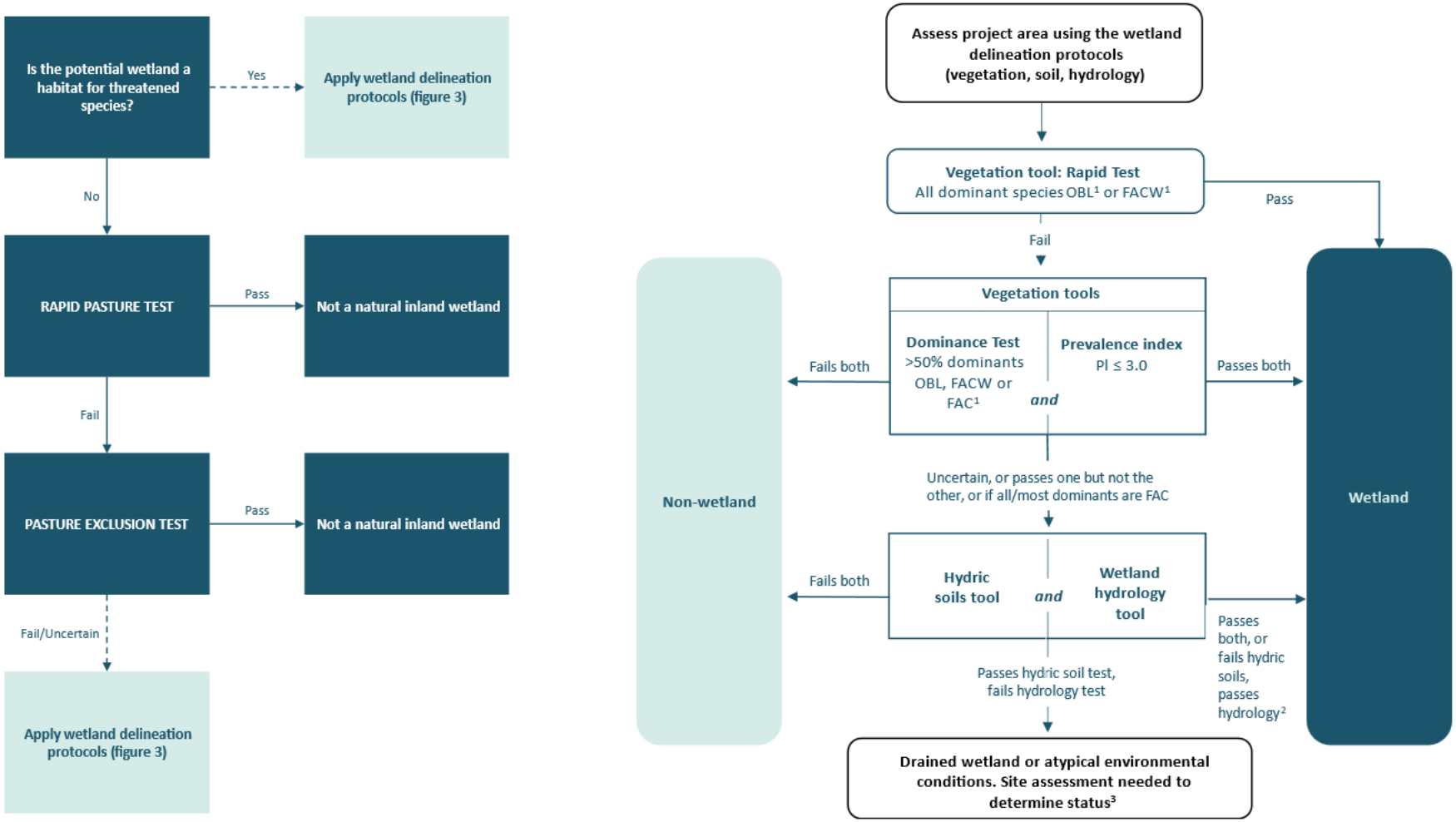


Figure 8. Left, **(a)** Wetland Rapid Test and Pasture Exclusion Methodology and right, **(b)** Wetland Delineation Methodology.

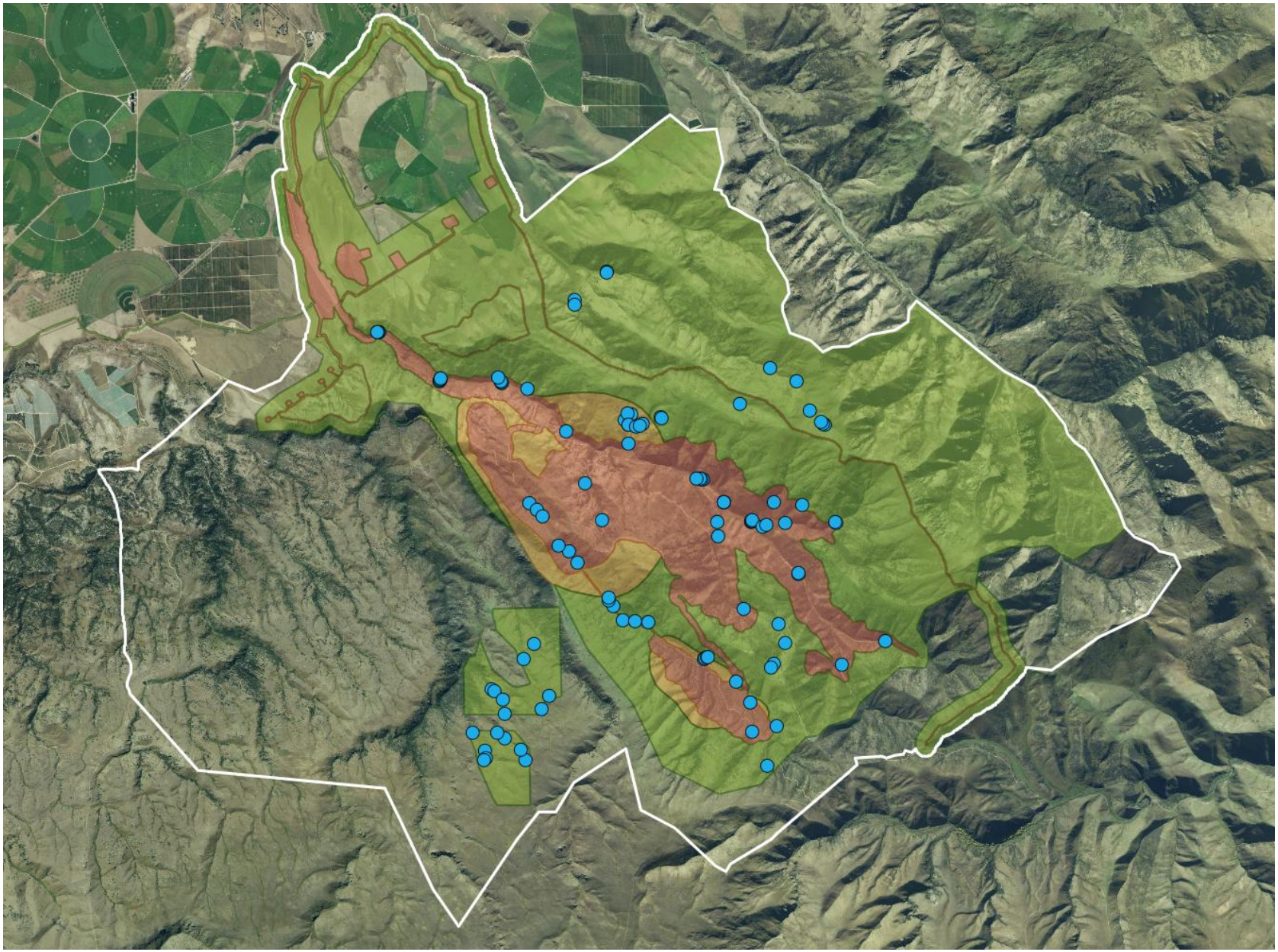


Figure 9. The location of wetland plots (blue circles) within the ESA (white border), DDF (in red), DDZ (in orange), SLSW (in green).

2.2.1 Wetland classification

The ESA contains a range of wetland vegetation types that are associated with hydrological and nutrient conditions, and botanical values. It was therefore useful for this assessment to classify these wetland types into broad groups.

Wetland types were classified by wetland class (as defined in Johnson and Gerbeaux[15]). Wetland classes occur as a sequence in the landscape, with differing water sources and nutrient levels. Bogs generally occur higher up in catchments and are fed by low-nutrient rainwater, seepages and fens are groundwater dominated and have a moderate or variable nutrient level, and marshes and swamps are high-nutrient, surface water dominated systems. In classifying wetlands onsite, we also characterised the primary landforms in which they occur.

Three groups of wetland types were identified:

- Seepages; where groundwater emerges from hillslopes, having a water table generally at or below ground level, and vegetation characteristic of a low to moderate nutrient status.
- Fens; present primarily in narrow gullies with vegetation characteristic of a moderate nutrient status and variable water table. The water sources for fens include overland and groundwater flow. Within gully systems in the ESA, water may flow overland in sections of the gully floor, and underground in others, forming groundwater-fed fens where flow re-emerges.
- Swamps and marshes; present primarily present in flat, wide valley floors, but also some gully landforms. Swamps are characterised by a high water table generally above the ground surface, and marshes have a water table which fluctuates markedly (usually seasonally) and can be above or below the ground surface. Both have vegetation communities and species indicative of a moderate to higher nutrient status. The water source is primarily overland flow.

No bogs were present on-site.

We consider this classification an appropriate approach to provide meaningful differentiation of values while maintaining the ability to map and collect data from each community type accurately and efficiently. The key variables for practically assessing wetland classification in the field include water table depth, vegetation type, landscape position, visible water sources, and soil characteristics observed in core samples or exposed areas.

Further description of wetland types was carried out by describing dominant vegetation communities, including dominant species and growth forms[16]. Existing classifications of vegetation communities (Singers and Rogers classification of terrestrial ecosystems[17] and the Land Cover Database) were a useful starting point. However, they were designed to classify vegetation across New Zealand, so they are too coarse (i.e., too few vegetation communities) and inaccurately describe the primary wetland vegetation communities

[15] Johnson, P., & Gerbeaux, P. (2004). Wetland Types in New Zealand. Department of Conservation, Wellington. ISBN: 0-478-22604-7.

[16] Atkinson, I.A.E. (1985). Derivation of vegetation mapping units for an ecological survey of Tongariro National Park, North Island, New Zealand. New Zealand Journal of Botany, 23(3), 361–378. DOI: 10.1080/0028825X.1985.10425343.

[17] Singers, N.J.D.; Rogers, G.M. 2014: A classification of New Zealand's terrestrial ecosystems. Science for Conservation 325. Department of Conservation, Wellington. 87 p.

present within the Project area. They also classify original indigenous ecosystems, which is less applicable within the ESA due to the low percentage cover of indigenous species remaining in many wetlands.

2.2.2 Species inventory

An inventory of wetland plant species was compiled, including species identified in vegetation plots, as well as incidental species detected while mapping wetlands, and those found during 9 hours of targeted searches for rare plants within wetlands in the ESA.

Fish and avifauna surveys do not form part of this assessment and are covered in separate reports [18, 19].

2.2.3 Wetland condition assessment

The condition, or present state, of wetlands influences wetland value. To classify wetland condition, relevant indicator components from the Handbook for Wetland Condition Monitoring [20] were assessed (**Table 2**). Other components, requiring long-term data to determine a change over time, were not assessed (and could not be in the time available to undertaken this assessment), nor were those requiring soil/water sampling and detailed laboratory analyses, as bio-physical variables included for the site sampling adequately addressed the implications of these by directly measuring wetland condition and surrounding land use.

Table 2. Selected wetland condition indicator components assessed.

Indicator	Indicator component	Description	Justification
Hydrological integrity	H1: Impact of manmade structures that alter the hydrological regime	Number/size/depth/effectiveness/ coverage of man-made structures (drains, stopbanks, tide gates, etc.) within the wetland and in the catchment. Extent of wetland affected by structures or water abstraction.	Water is arguably the paramount wetland determinant. Structures and abstraction alter (mostly decrease) water inflows/outflows.
	H3: Dryland plant invasion	Presence of dryland species/vegetation	Dryland species, e.g., broom, gorse, kanuka indicate a drop in water table
Physicochemical parameters	P1: Fire damage	Recent fires are evident from the loss of late successional vegetation, sparse vegetation cover, charred trunks of woody species, and visible ash deposits. Fires >2 years ago discernible from ash/charcoal layers in soil cores, absence of fire-sensitive species from vegetation (e.g.,	Fire destroys vegetation/ fauna. Recovery is usually relatively quick. Temporarily increases nutrients (pre-fire levels return after c.2 years)

[18] Waterways Consulting (2025) Bendigo Ophir Gold Mine: Aquatic assessment of effects. Report No. 38-2024A, prepared for Santana Minerals Limited. 90 p.

[19] RMA Ecology (2025) Bendigo-Ophir Gold Project: Avifauna values assessment. Report prepared for Matakanui Gold Ltd.

[20] Clarkson, B.R., Sorrell, B.K., Reeves, P.N., Champion, P.D., Partridge, T.R. and Clarkson, B.D., 2003. Handbook for monitoring wetland condition. *Coordinated monitoring of New Zealand wetlands. A Ministry for the Environment SMF funded project. Ministry for the Environment, Wellington*.

		Carex secta in swamps, *Empodisma*, *Sporadanthus* in bogs)	
	P2: Degree of sedimentation/erosion	Recent earthworks, heavy pugging, bank erosion or freshly dug drains in the catchment. Abrupt change in soil colour. Plants are partially buried by sediment. Suspended sediments.	Increased levels reduce water quality by, e.g., reducing light penetration
Ecosystem intactness	E2: Connectivity barriers	The presence of natural fish passage barriers, stop banks, and weirs isolating the system from riverine connections to other wetlands. Ring drains and box culverts around margins isolate wetlands from catchment groundwater. Loss of riparian vegetation and buffer vegetation connecting wetlands to native forests, lakes and rivers.	Lack of upstream or downstream connections prevents migration, especially of fauna, but also seed dispersal, and destroys the natural nutrient supply.
Browsing, predation and harvesting regimes	B1: Domestic/feral animal damage	Browse damage to foliage, branchlets; soft, herbaceous, palatable plant species absent or greatly reduced in number and stature. Animal tracks are visible in wetland. Damage to bark, e.g., biting and scratching. Disturbance to substrate, e.g., deer wallows, pig rooting, pugging of soil. (Use plot data and recce). Adequacy and extent of fencing.	Damages soil structure and chemistry, destabilises soil, increases turbidity, damages native vegetation and encourages weed invasion and movement of mammalian predators. Loss of habitat.
	B2: Introduced predator impacts on wildlife	Direct evidence from datasets (e.g., predator trapping and monitoring, 5-minute bird counts). Indirect evidence from predator tracks, scat counts. Presence of sensitive species such as fernbird, bittern, and banded rail would indicate low predator impacts.	Reduces wildlife species diversity and abundance, and recreational values.
	B3: Harvesting of biota	Recent vegetation harvesting readily observed; longer-term effects may be evident in the absence of key species from communities where they typically occur.	Reduces species diversity and abundance. Harvesting of dominant plants destroys habitat value, and can also lead to erosion and nutrient exports.
Dominance of native plants	D1 & D2: Introduced plant canopy and understory cover	Cover of introduced plants in vegetation plots. The extent of introduced plant invasion is determined from aerial photos or high vantage points.	Introduced plants can change wetland structure and function; may have poorer habitat value for native fauna, increase in sedimentation, drying and create monocultures (e.g., willows, tall fescue).

A simplified ‘none/very low/low/moderate/high’ scale was used to rate the degree of impact for each of these indicator components. A rating of 'none/very low' was assigned when impacts were completely absent or affect <1% of the wetland area. A ‘Low’ rating was assigned when impacts were of a low intensity, or affected 0–33% of the wetland area. A ‘medium’ rating was assigned when impacts were of a medium intensity, or affected 34–66% of the wetland area. A ‘High rating was assigned where impacts were of a high intensity, or affected 67–100% of the wetland area. Scores were assigned (5 for none, 4 for very low, 3 for low, 2 for medium, 1 for high) for each indicator component. These were totalled to provide an overall condition score for each wetland or cluster of wetland polygons with the same condition and wetland class.

Wetland vegetation plot data was used to provide an indicative assessment of indicator components D1 + D2; percent introduced plant cover, and H3; percent dryland plant invasion. All wetlands with sufficient data were assessed, i.e., those with vegetation plots. Wetland plots were in a stratified manner to (a) delineate wetlands and (b) record typical species present in each vegetation community. For this reason, and the presence of only one vegetation plot in many wetlands, condition scores for D1 + D2 and H3 should be considered indicative only.

An amendment to the protocol was made after it became apparent during data analysis that the separation of the ‘dominance of native plants’ indicator into understorey and canopy components (D1 + D2) was not well suited to pasture and open wetlands such as those at Bendigo Station within the study area. As per the wetland condition guidelines, any species partly or fully exposed to the sky is listed as a canopy species. In open grassland, herb field, sedgeland and rush land with few if any overlapping vegetation tiers, all but two species are classified as canopy. These two species were native and had only 1–2% coverage. This means very minor changes in coverage of these understorey species, or creation of new understorey species through shading by other plants, could result in very significant changes in introduced plant understorey cover and overall wetland condition score. Therefore, to avoid perverse results, indicators D1 (introduced plant species cover in understorey) and D2 (introduced plant species cover in canopy) were combined into an overall introduced plant cover (canopy and understorey), scored out of 10.

The overall total possible score from summing individual scores in **Table 2** ranges from 0–36.

2.3 Data analysis

2.3.1 Graduated colour maps

Graduated colour maps illustrating the percentage of native plant cover over the WSA were prepared using wetland plot data. Wetland condition and component indices also were prepared.

2.3.2 Wetland condition analyses

A Cumulative Link Model (CLM) was utilized to analyse wetland condition assessments, which were measured as ordinal conditions with a natural ranking. CLMs are particularly well-suited for this type of data as they effectively account for the ordered structure, allowing for robust analysis of relationships among ordinal variables.

The logit link function was applied to model the cumulative probabilities of achieving each condition level or lower. This approach ensured interpretable coefficient estimates expressed in log-odds terms, which were subsequently converted into odds ratios to evaluate the impact of wetland class and location on the assessments.

The model offers insights into how specific factors, such as location (DDF, DDZ, or SLSW) and wetland class (seepage, fen, or swamp/marsh), influence the likelihood of different scores for wetland condition components, including metrics like animal disturbance (rated 1–5) or the presence of introduced species (rated 2–10).

The area, rather than the number of wetlands, was analysed, as wetlands are highly variable in size, and incorporating area provides a more relevant and appropriate measure of the present state of wetlands.

2.4 Assessment of value and significance

Wetland value was assessed for each wetland category (class), in the DDF, the DDZ, and in the SLSW.

In addition, significance was assessed against the significance criteria in the Otago operative Regional Policy Statement (2019), the proposed Regional Policy Statement (2021), the Otago Regional Water Plan policy (2022), as well as the National Policy Statement for Indigenous Biodiversity (NPS-IB). Scales of assessment are specified in these documents, but are generally at the Ecological District scale, with some criteria such as rarity assessed at the national scale. As data on the Ecological District is limited, the Ecological Region scale was occasionally used (Central Otago Ecological Region).

3.0 Results

3.1 Ecological context

3.1.1 Dunstan Ecological District

The ESA lies within the Dunstan Range, encompassed by the Dunstan Ecological District (ED) in Central Otago. The Dunstan Range is a characteristically flat-topped Otago mountain range, which lies in the rain-shadow of the Southern Alps (McGlone, 1995). The mountains rise above 1,600 m a.s.l., with the glacially formed Clutha Valley and Ida Valley on either side at altitudes of 200–400 m a.s.l.

The Dunstan ED presents a unique ecological context shaped by its arid climate, moderate to high altitude, and geological history. Its location—on the leeward side of the Alps, far from the coast—results in a continental climate featuring some of New Zealand's harshest weather. While precipitation is generally low and varies annually, winter tends to bring the highest precipitation, sometimes as snow. Lowland areas experience strong winter frosts and hot summers, while higher elevations endure snowy winters and brief summers (McGlone, 1995).

Land use in the Dunstan ED is primarily extensive pastoral grazing of beef cattle and merino sheep, with more intensive irrigated agricultural and horticultural land use on the terraces and valley floor around Bendigo and the Lindis River.

Bendigo, situated on the northwest side of the Dunstan Range, was once a bustling gold mining settlement, which has left a lasting impact on its natural environment. Historical mining within the ESA centred around the Rise and Shine Creek, where extensive sluicing resulted in significant sediment deposition on the valley floor, potentially inducing or enlarging wetlands there by blocking stream channels.

3.1.2 Vegetation

The region is characterized by a mosaic of diverse habitats, including alpine and subalpine vegetation, shrubland, and riverine ecosystems. The dominant vegetation in higher elevations is alpine herbfield, characterized by low-growing, cushion-forming plants adapted to harsh conditions. These plants often have specialized adaptations to conserve water and withstand strong winds and frost. As elevation decreases, alpine herbfield transitions into subalpine shrubland, dominated by species such as mountain totara (very rare) (*Podocarpus nivalis*) and mountain beech (*Nothofagus solandri* var*. cliffortioides*) (none is known within the ESA). The lower slopes and valleys of the Dunstan Range support a variety of shrubland communities, including kanuka (*Kunzea serotina*)–matagouri (*Discaria toumatou*)–scented tree daisy (*Olearia odorata*) scrub.

Areas of Significant Natural Value identified in the Regional Plan include Bendigo Wetland and Bendigo Reserve (**Figure 10**). The Public Conservation Estate at the head of Rise and Shine, Shepherds and Dry Creek Valleys is identified as an area of Significant Natural Value, and partially overlaps with the ESA.

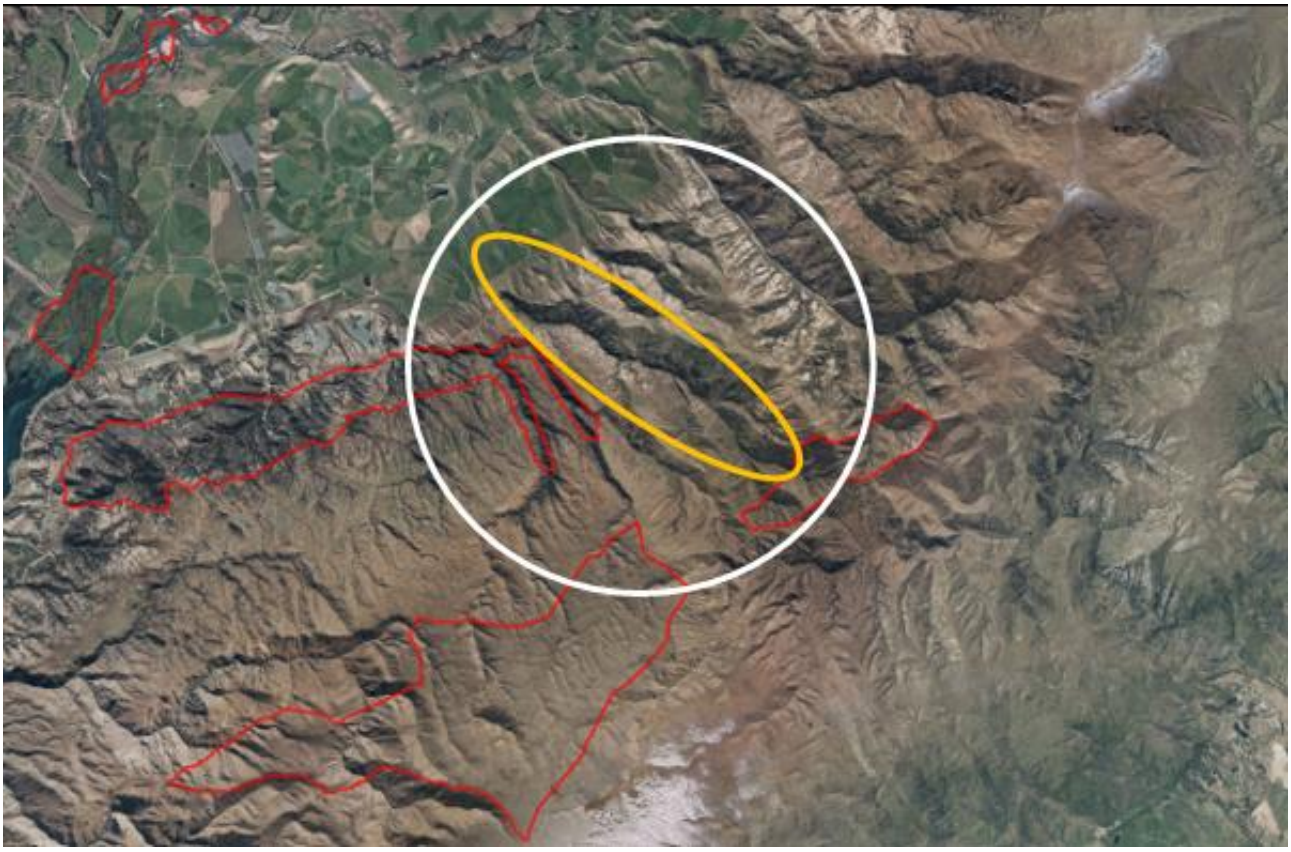


Figure 10. Areas of Significant Natural Value (red outlined polygons) (Central Otago District Council). The general location of the ESA is shown by the white circle and the general location of the DDF is indicated by the orange ellipse.

The Land Cover Database of New Zealand (LCDB version 5.0) indicates the ESA is dominated by low-producing grassland, with areas of depleted grassland, and mixed exotic shrubland, as well as areas of matagouri or grey scrub primarily within gullies. Higher elevations are dominated by areas of gravel or rock and tall tussock grassland.

Under the Threatened Environment Classification (TEC), the full range of Threatened Environment Classifications exist across the ESA, from acutely threatened (<10% indigenous cover remaining), primarily in the lowlands, to severely reduced (10% indigenous cover remaining), critically under protected (>30% remaining and <10% protected), and under protected (>30% remaining and 10–20% protected)'. Most of the site and the wetlands within it occur in the latter two classifications (**Figure 11**).

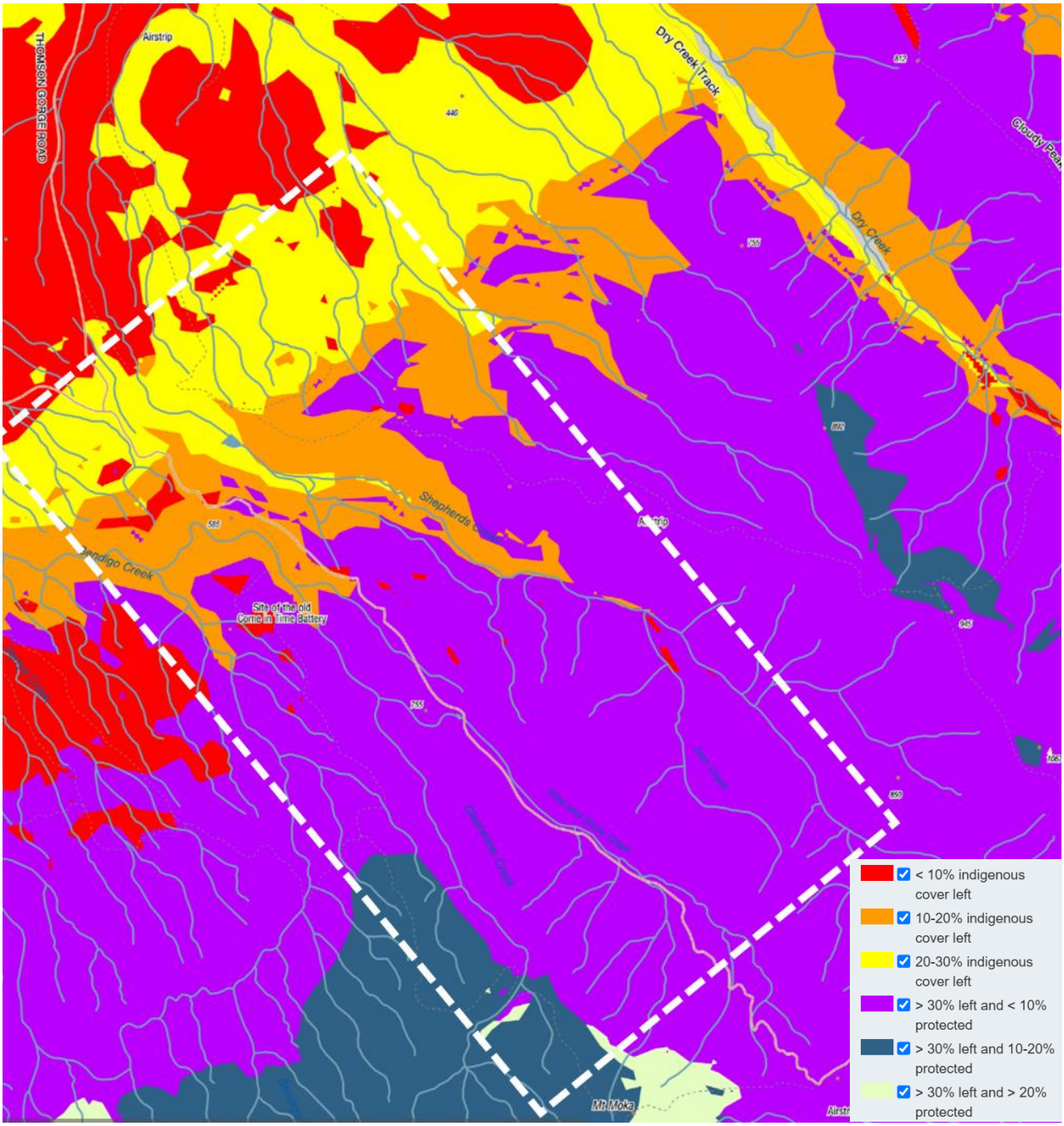


Figure 11. Threatened Environment Classification of the ESA (generally within the white box) and environs.

Present-day vegetation in wetlands in the Dunstan ED is primarily herbaceous. The nature of pre-human vegetation in the Dunstan ED and Central Otago is not well known for wetlands. Studies of subfossil plant remains focus on dryland communities. Existing herbaceous obligate and facultative wetland species such as *Carex secta, Carex coriacia, Carex kaloides*, *Carex geminata*, and *Eleocharis acuta* may have historically dominated wetlands with high water tables. *Carex secta* and wetland shrubs such as *Olearia bullata* are known to be susceptible to fire and may have been more prevalent historically. Harakeke (*Phormium* sp.) and raupo (*Typha orientalis*) also may have been present.

3.1.3 Streams

Streams are relevant to the connectivity of wetlands, particularly riparian swamps and marshes. There are two primary stream catchments in the DDF and adjacent DDZ: Shepherds Creek, and Rise and Shine Creek. The latter is a tributary of Bendigo Creek. Both have a perennial main stem within the ESA, but have an ephemeral reach downstream of irrigation water abstraction sites, where they flow across an alluvial terrace to the Lindis River and Clutha River. These ephemeral reaches constitute seasonal fish passage barriers.

Within the ESA, primary catchments include Bendigo Creek and its tributaries (Clearwater Creek, Aurora Creek, Perry's Creek), Shepherds Creek, Broad Gully Creek and tributaries of Dry Creek (**Figure 12**). Headwaters and tributaries of all streams are mostly intermittent or ephemeral, drying in summer for a period that varies from year to year[21].

No fish life has been detected within the DDF, and very limited fish life within the ESA. Fish life in the ESA includes exotic brown trout in the lower reaches of Bendigo Creek, and native kōaro in eDNA sampling upstream of the trout in Bendigo Creek[22]. This depauperate fish community and its distribution is likely linked to the absence of overland flow connecting to the Clutha River, and seasonal drying of the mid and upper reaches of many streams.

Water takes for irrigation are consented for Bendigo Creek, Shepherds Creek and Broad Gully Creek[23]. They are downstream of all wetlands mapped in the ESA. Water takes for mining exploration exist in Rise and Shine Creek and Shepherds Creek, upstream of some of the valley floor wetlands.

[21] Water Ways Consulting (2024) Bendigo-Ophir Gold Mine: Aquatic Assessment of Effects. Report prepared for Santana Minerals Ltd. Report No. 38-2024A. 90 p.

[22] Water Ways Consulting (2024) Bendigo-Ophir Gold Mine: Aquatic Assessment of Effects. Report prepared for Santana Minerals Ltd. Report No. 38-2024A. 90 p.

[23] https://maps.orc.govt.nz/OtagoViewer232/?map=fc3fd2187c4d4918bacf7ded142b2dad

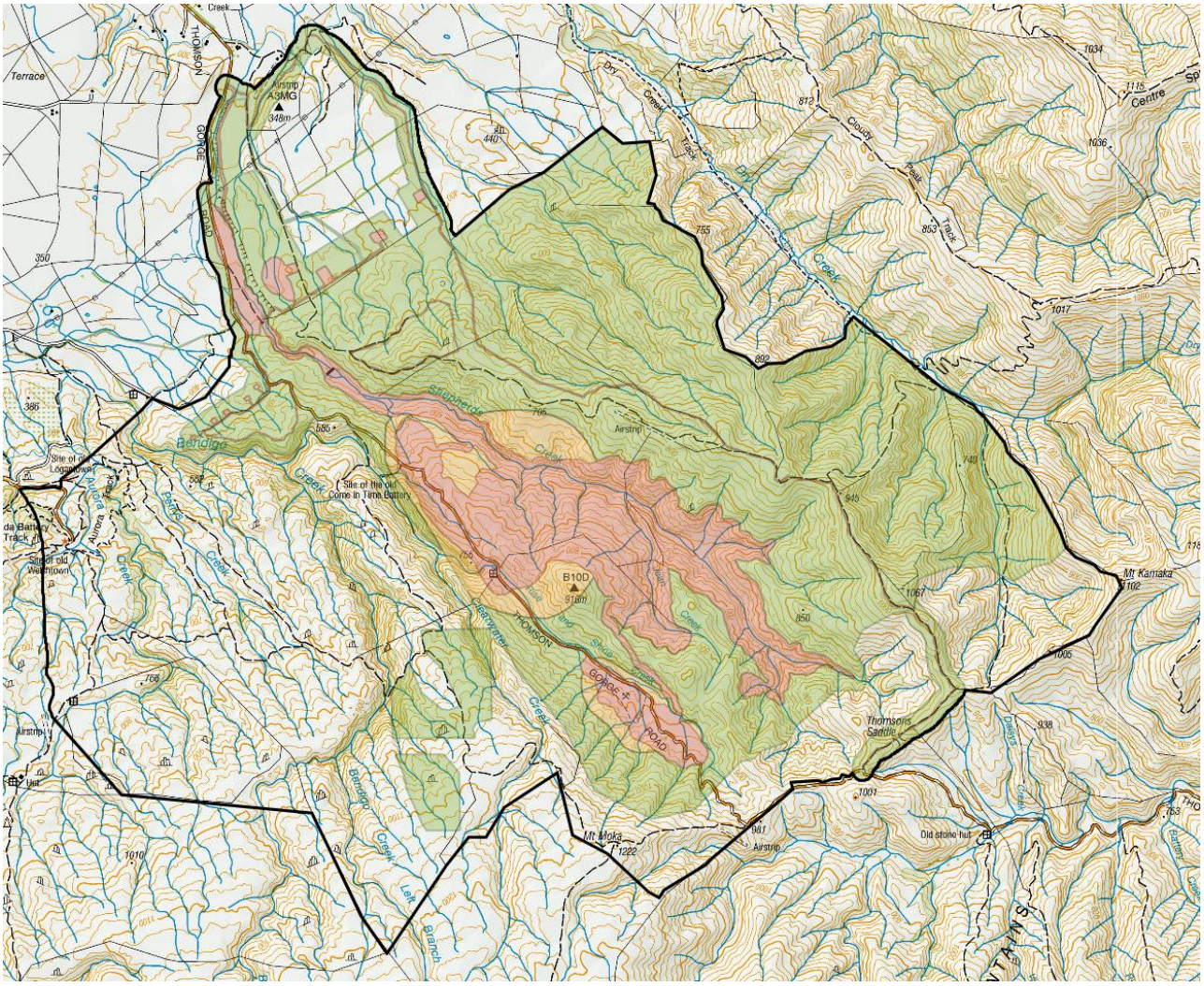


Figure 12. Streams (blue lines) within the ESA (black outline), DDF (red), DDZ (orange), and SLSW (green).

3.1.4 Wetlands

Wetlands are a threatened ecosystem in New Zealand. Approximately 10% of New Zealand's original freshwater wetlands remain today. This significant loss is due to historical drainage and land conversion for agriculture and urban development. The remaining wetlands are often fragmented and face ongoing threats, but they still play a crucial role in biodiversity and ecosystem health. Despite covering less than 1% of New Zealand's land area, wetlands are home to a disproportionate number of the country's threatened species, including 12% of all threatened invertebrates, 16% of threatened bird species, and 23% of threatened vascular plants.

No comprehensive wetland mapping for the Dunstan ED or wider Otago region is available to the public, as evidenced by a search of ORC online maps and a request for information to ORC. The Freshwater Environments of New Zealand (FENZ) wetland mapping layer has no wetlands mapped within the ESA, and only a handful of wetlands in the Dunstan Range, but extensive wetland areas mapped on the Pisa (**Figure 13**), Rock and Pillar and Lammerlaw Ranges.

It is apparent from onsite and desktop assessment that FENZ mapping is based on a model that maps only larger wetland areas, and fails to capture the myriad small to medium hillside seepages and gully fens in the

ESA. It is also clear that fens, seepages, and, to a lesser extent swamps, are not uncommon on the flat-topped mountain ranges of the Central Otago Ecological Region.

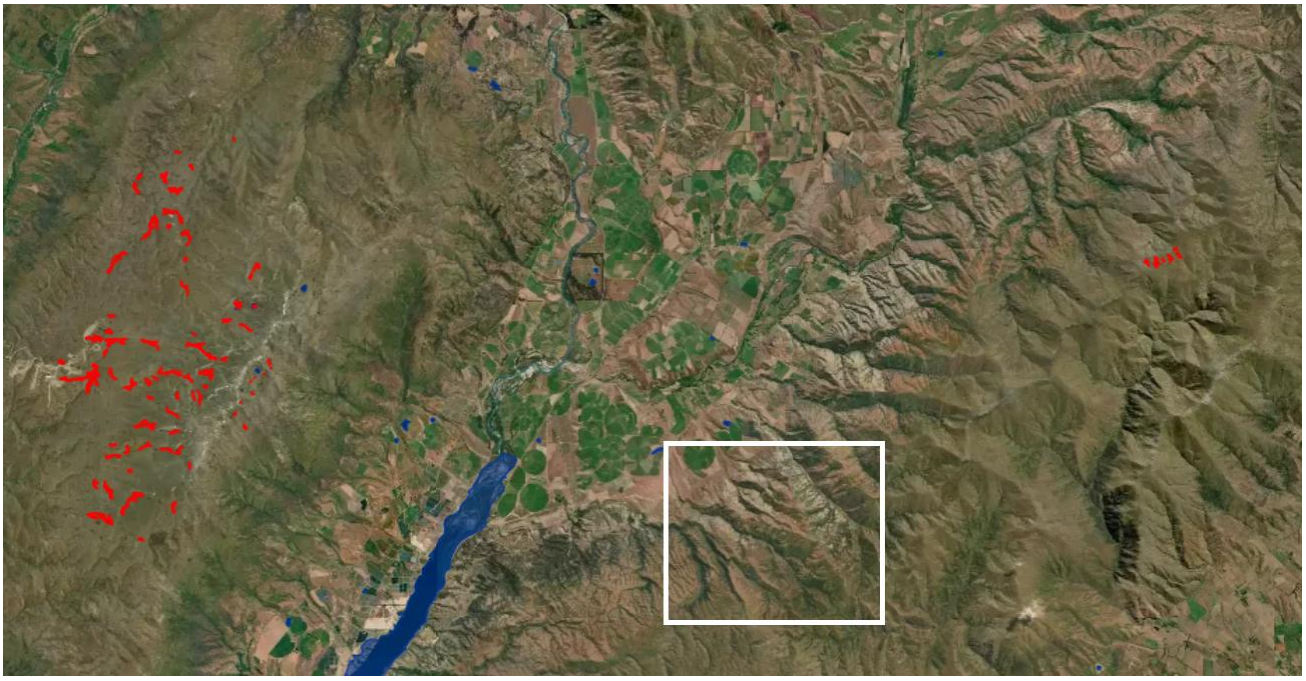


Figure 13. FENZ mapping of wetlands (red polygons) and lakes (blue polygons). The ESA is within the white box.

A desktop assessment of the Dunstan ED indicates seepages and fens are relatively common, but variable by catchment (**Figure 13**). Being a mountainous ED with a multitude of smaller streams, swamps are less common in the Dunstan ED. However, the larger valleys of the Cluden Stream and Dunstan Creek appear to contain large valley floor wetlands, most likely to be swamps or marshes (**Figures 14 and 15**), as does Rise and Shine Creek. Smaller catchments such as Thomsons, Beggs, Browns, Devils and Waiwera also have valley-floor wetland areas, which are likely to be swamps or marshes. Other valleys, such as Dry Creek, have permeable gravels and little or no valley-floor wetland.

The present state or condition of wetlands in the Dunstan ED is not well known, but wetlands in the wider Central Otago Ecological Region are generally in poor to moderate condition in lowlands and montane areas, due to many decades of fire, grazing and topdressing, and are primarily exotic grass and herb dominated, with some areas dominated by native *Carex* spp. (Barrie Wills *pers. comm*.). Subalpine and alpine wetlands above 1,200 m in Dunstan and Central Otago are in moderate to good condition, with native *Oreobolis* cushionfields being a prominent feature.

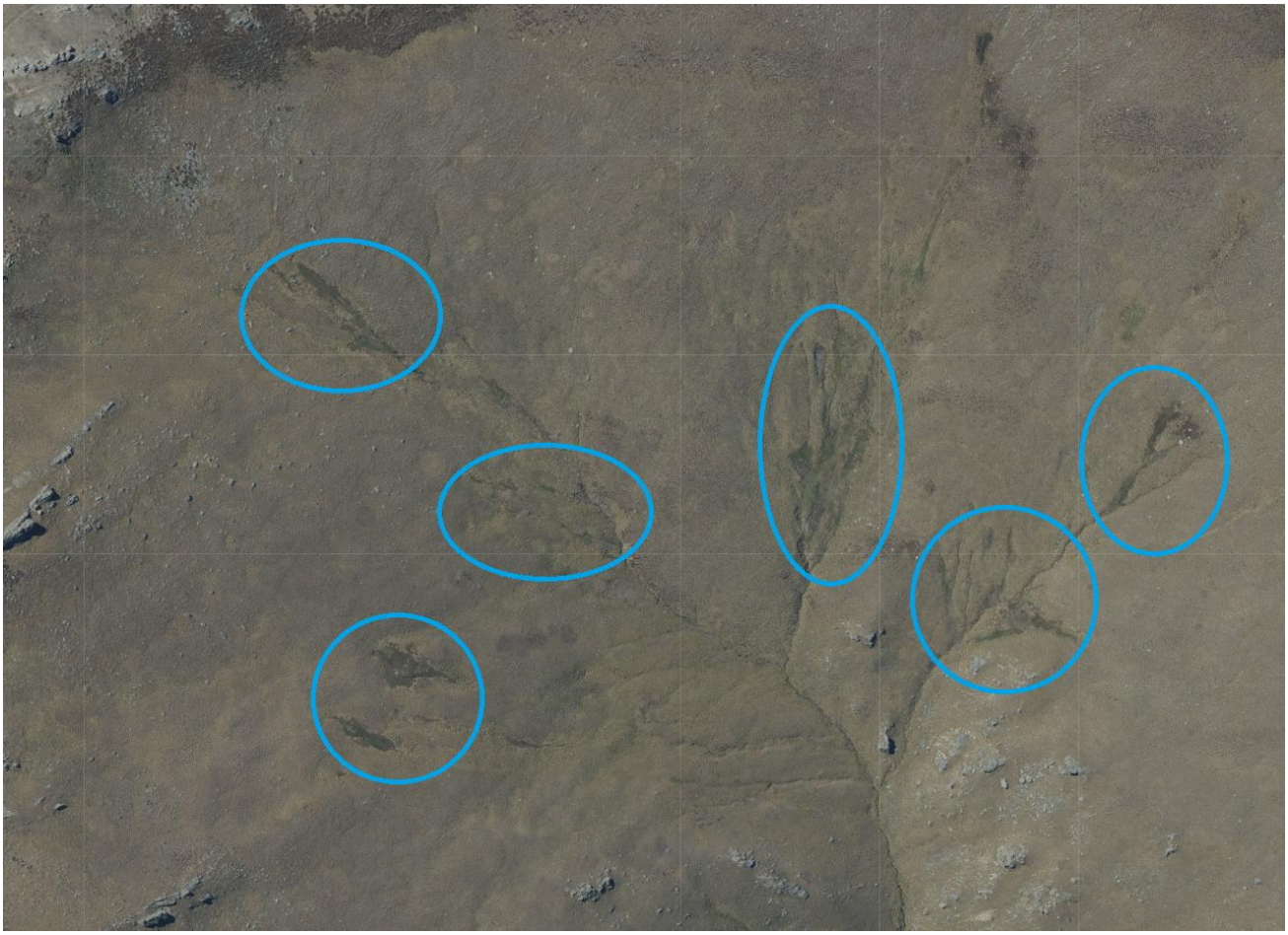


Figure 14. An example catchment within the Dunstan ED, which shows seepage and/or fen wetlands in the headwaters of Lauder Creek, none of which are mapped by the current FENZ wetland mapping. This demonstrates that seepage and/or fen wetlands may be far more common than known from the FENZ model alone.

Figure 15. Probable swamps/marshes in the valley floor of the upper Cluden Stream (left), and Dunstan Creek (right), in Dunstan ED.

No Regionally Significant Wetlands listed in the Regional Plan are present in the ESA, nor in the wider Dunstan Range. However, nearby Bendigo Wetland is a 154 ha Regionally Significant wetland located at the

head of Lake Dunstan, and is also an area of Significant Natural Value (**Figure 10)**. It is located 6 km west of the easternmost extent of the ESA (and 1.85 km east of the easternmost extent of the road realignment). The Clutha River flows into the lake, creating a high diversity of habitats for indigenous wetland flora and fauna. Native fish life there includes longfin eels and bullies. It provides regionally important feeding and breeding sites for waterfowl such as New Zealand scaup (*Aythya novaeseelandiae*), paradise shelduck (*Tadorna variegata*), black swan (*Cygnus atratus*), exotic waterfowl, as well as pied stilt (*Himantopus himantopus*) and other waders[24]. There are relatively large numbers of great crested grebe (*Podiceps cristatus australis*, classified as Threatened - Nationally Vulnerable) present on the lake, but are particularly present in the wetland[25].

3.2 Wetland distribution

A total of 290 wetlands were mapped in the wetland survey area (WSA) within the ESA (including within the area adjoining the proposed Thomson Road realignment), totalling 113,044 m^2 (11.30 ha) in area (**Table 3 and Figure 16**). Wetlands are distributed across the entire area surveyed, including all three relevant zones (DDF, DDZ, and SLSW).

Within the DDF, 94 wetlands are present, totalling 31,254 m^2 (3.12 ha) in area, composed primarily of swamp/marsh (25,097 m^2 or 2.51 ha) in valley floors and gullies, but with significant coverage of fen (4,886 m^2 or 0.48 ha), largely in gullies, and also hillside seepages (1,271 m^2 or 0.13 ha).

Within the DDZ, 21 wetlands are present, totalling 23,736 m^2 (2.37 ha) in area. Similar to the DDF distribution, most wetlands are swamp/marsh (19,416 m^2 or 1.94 ha) in valley floors and gullies. There are also fens (3,713 m^2 or 0.37 ha) and seepages (607 m^2 or 0.06 ha).

Wetland coverage as a percent of the total land area is greater within the DDF and the DDZ than the SLSW (**Table 3**), largely due to (a) the lack of wetlands in Dry Creek catchment, and (b) the fact that the DDF covers the lower parts of Shepherds valley, and parts of Rise and Shine valley (as does the DDZ), where swamps are more prevalent. Swamps cover 0.41% of the DDF and 0.32% of the DDZ, compared to 0.11% of the SLSW. Seepages cover a relatively small area overall. In the DDF seepages cover 0.02% of the total land area, and in the DDZ seepages cover 0.01% – likely because the DDF and DDZ do not encompass high altitude hillsides where seepages are more common.

Wetlands onsite are relatively small, apart from several larger swamp/marsh complexes in the valley floor of Rise and Shine Creek, the largest of which is 2.59 ha in area. Swamps/marshes are also present in valley floors and gullies in the catchments of Shepherds Creek, its tributary Jean Creek, and Broad Creek to the north.

Table 3. Area of wetland and coverage of the total assessed land area (%), by wetland class and altitude, comparing the WSA and its components: the DDF (total area 610.6 ha), DDZ (total area 141.9 ha), and SLSW (total area 2,428 ha).

[24] Fish and Game New Zealand (2010) Comments on the Consultative Draft Proposed Plan Change 2 (Regionally Significant Wetlands) to the Regional Plan: Water for Otago. Fish and Game New Zealand, Otago Region, Dunedin.

[25] Ornithological Society of New Zealand, Otago Branch (2009) George Chance Memorial Census of Great Crested Grebes in Central Otago, February 2009.

	Mapped wetland area (m^2)				Wetland coverage (% of total assessed land area)			
	WSA (DDF+DDZ+SLSW)	**DDF**	**DDZ**	**SLSW**	**WSA (DDF+DDZ+SLSW)**	**DDF**	**DDZ**	**SLSW**
All Wetlands	113,044	31,254	23,736	58,053	0.36	0.51	0.39	0.24
Seepage	7,539	1,271	607	5,660	0.02	0.02	0.01	0.02
Fen	35,345	4,886	3,713	26,746	0.11	0.08	0.06	0.11
Swamp/Marsh	70,160	25,097	19,416	25,647	0.22	0.41	0.32	0.11
Over 800m asl	26,609	1,625	1,568	23,415	0.08	0.03	0.03	0.10
Under 800m asl	86,435	29,629	22,168	34,638	0.27	0.49	0.36	0.14

Fens and marshes are present in gullies throughout, and are small to moderately sized (range 5 to 1,000 m^2; with 61% less than 100 m^2). Seepages are generally small (90% less than 100 m^2), and are particularly prevalent on the south-facing slopes of Shepherds Creek catchment, and at the head of Rise and Shine catchment.

Wetland coverage is related to altitude. In the WSA wetland coverage was greater below 800 m (0.27%) than above 800 m (0.08%) (**Table 3**).

Two wetlands within the DDF and one wetland within the SLSW had sufficient pasture species coverage to meet the Ministry for the Environment pasture exclusion test: W075 (with an area of 96 m^2) and W076 (with an area of 23 m^2) were in the DDF, and W027 (with an area of 44 m^2) was in the SLSW. We have included these wetlands within the total wetland area, as this exclusion applies specifically to pastoral farming[26], while the intended land use is mining. Note, the total area of these wetlands is minimal in relation to the overall wetland area within the DDF (0.4%).

All 290 wetlands meet the classification as natural inland wetlands. Several constructed wetlands (ponds) which do not meet the classification as natural inland wetlands have been excluded from this total, and from the total wetland area communicated in this report.

Wetlands which are induced or potentially induced by historic gold mining, do not meet the classification as constructed wetlands. They meet the classification as natural inland wetlands and are included in the total wetland area communicated in this report. There is no definitive evidence as to whether any wetlands were or were not induced by gold mining, as aerial imagery does not extend this far back in time.

[26] Clarkson, B., Denyer, K., & Bartlam, S. (2022). *Pasture exclusion assessment methodology*. Wellington: Ministry for the Environment. ISBN: 978-1-991077-08-0. Publication number: ME 1716.

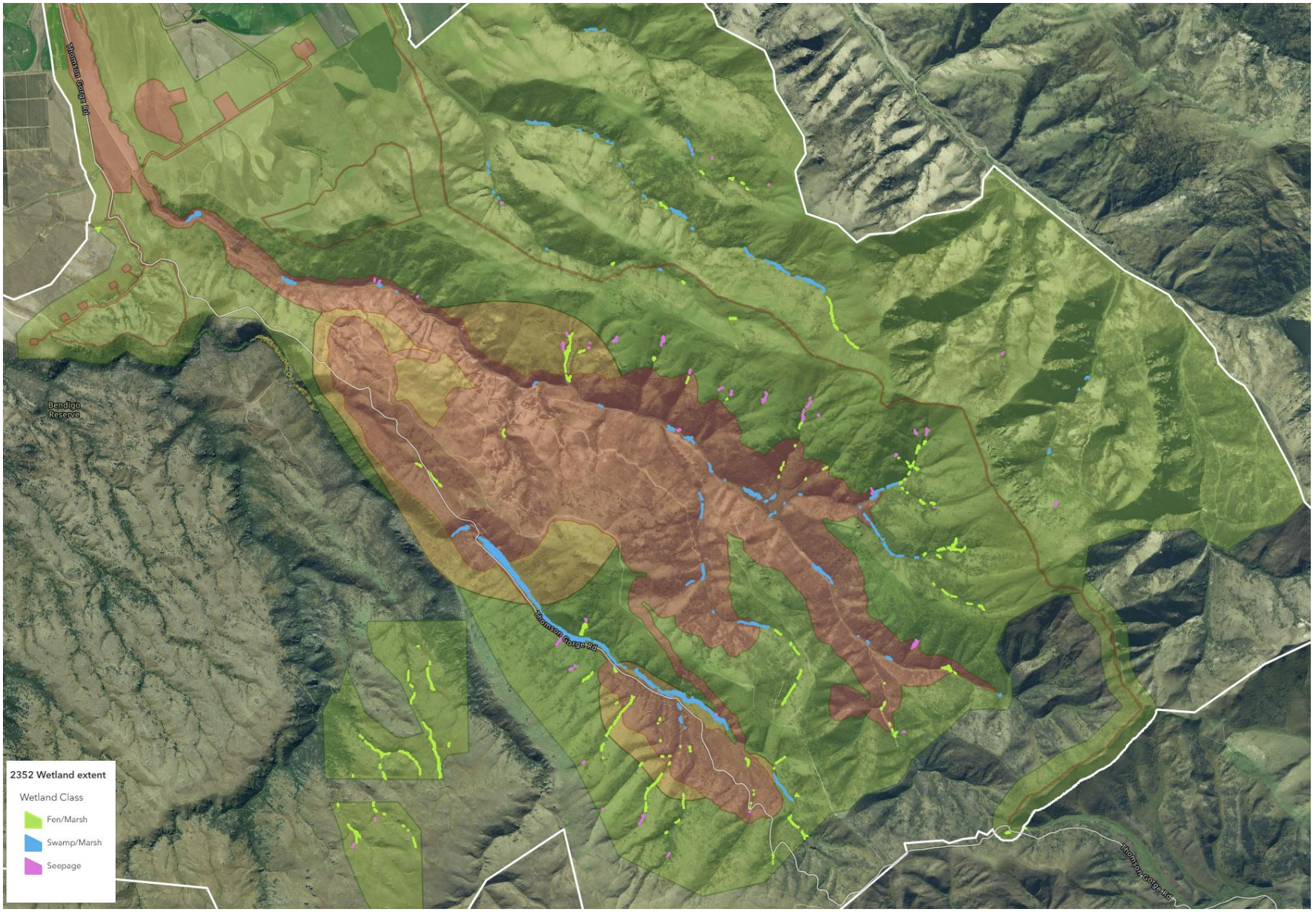


Figure 16. Distribution of wetlands within the SLSW (green polygon) within the ESA (white polygon). Wetlands are displayed by wetland class.

3.3 Vegetation communities

Wetlands within the ESA are almost exclusively dominated by herbaceous vegetation. Vegetation community structure is predominantly grassland, sedgeland and herbfield, with these community structures present across wetland classes.

The dominant species in wetland plots, and wetlands overall, include the exotic grass creeping bent (*Agrostis stolonifera*), exotic jointed rush (*Juncus articulatus)* and native sedge rautahi *(Carex coriacea).* Combined, these three species comprise over 50% of the vegetation cover within wetland plots in the ESA (**Appendix C**). Bare ground and water comprised around 5% cover in vegetation plots. These results illustrate a high degree of disturbance, with bareground attributable to cattle pugging, and the dominant species all being pioneer plant species which tolerate grazing, and which colonise rapidly after disturbance.

Woody vegetation is rare within the wetlands onsite. Matagouri and mingimingi (*Coprosma propinqua*) commonly border and partially overhang the margins of wetlands, along with occasional *Olearia lineata* in some gully wetlands. One facultative wetland shrub, *Olearia bullata*, is present in gully wetlands on rare occasions. The only woody species with over 1% cover in wetland plots is matagouri (*Discaria toumatou*).

The wetland vegetation communities present in the project area are inadequately described by the Singers and Rogers vegetation classification system. That system predicts original indigenous ecosystem units. However, few original wetland ecosystems remain onsite, due to the dominance of exotic species within many of the wetlands. The combination of indigenous species remaining also does not match the Singers and Rogers ecosystem units. There is one exception, as described in section 4.2.4.

The primary wetland classes and their associated vegetation communities in the ESA are described below.

Representative photos of each wetland and hydric soil cores are provided in **Appendix E**.

3.4 Wetland Classification

3.4.1 Hillside seepages

Seepages are areas on slopes which carry a moderate to steady flow of groundwater, often also surface water[27]. Seepages are located primarily where groundwater diffuses to the surface, especially at a change of slope, or where an impermeable basement raises the water table. The water flow is less than that which would be considered a stream or spring.

Seepages include flushes, which are fed by seasonal or rainfall-induced pulses of water. They intergrade with fens, but differ partly based on their size and slope: seepages occupy sites of active water movement having enhanced aeration and nutrient supply. Soils are generally mineral, but can be peaty, and nutrient levels range from low to high.

Seepages in the ESA are small and relatively sparse, but larger and more common on the south-facing slopes above Shepherds Stream, where they commonly grade into gully fens and marshes.

[27] Johnson, P.J; Gerbeaux, P. 2004. Wetland types in New Zealand. Department of Conservation, Wellington. 184 pp.

The dominant vegetation communities present in seepages in the ESA are dominated by exotic species:

- Grassland/sedgeland with *Juncus articulatus, Juncus effuses, Agrostis stolonifera. Trifolium repens, Lolium perenne, Holcus lanatus* and silver tussock *(Poa cita)* may occur on hummocks and margins. Often heavily influenced by pugging and grazing (**Plate 1**).
- Mossfield/grassland, with *Agrostis stolonifera* and *Trifolium repens.*
- Herbfield/rushland with *Nasturtium officinale* and *Juncus articulatus.* This vegetation type occurs where water tables and flow rates are higher.

Plate 1. Seepage wetland W092, in the SL on the south facing slope above Shepherds Creek, with grassland/sedgeland community dominated by *Juncus effusus* and *Agrostis stolonifera*.

3.4.2 Gully Fens

Fens are low to moderate fertility wetlands that are fed primarily by groundwater or surface water. They usually have organic soils and are located on low-gradient land. They are often intermediate in a sequence from seepages to marshes and swamps downstream.

Within the ESA, fens occur mostly within gully landforms. They are primarily palustrine, but some grade into riverine hydrosystems, being riparian and likely influenced by occasional flood events from the adjacent stream.

The dominant vegetation communities present in fens in the ESA are:

- Exotic grassland, dominated by creeping bent (*Agrostis stolonifera*), with blue sweetgrass (*Glyceria declinata*) in wetter areas. Additional species include Yorkshire fog (*Holcus lanatus*) and white clover (*Trifolium repens*) (**Plate 2**).
- Exotic rushland, dominated by *Juncus articulatus* and *Juncus effusus* var. *compactus.* Additional species include creeping bent (margins of wetland in **Plate 2**).
- Native sedgeland, dominated by the cutty grasses *Carex coriacea*, *Carex kaloides* and *Carex sinclairii,* interspersed with exotic grasses and herbs at lower coverage.

These vegetation communities intergrade significantly, and large areas of gully wetland consist of a combination of these communities and species. They also integrate with dryland exotic pasture species.

Plate 2: Wetland W217, a typical gully fen located on Bendigo Station within the SL. It is in relatively good condition, with low levels of pugging and only moderate grazing.

3.4.3 Valley floor swamps and marshes

Swamps receive a relatively rich supply of nutrients and often also sediment via surface runoff and groundwater from adjacent land, and are in valley floors and the lower end of some larger gullies. They usually have a combination of mineral and peat substrates and a high water table that sits above or

periodically above the ground surface. They intergrade with marshes, which usually have a lower water table that fluctuates markedly.

Swamps and marshes onsite are often riparian palustrine systems, with riverine components where they are heavily influenced by stream flood events least annually. These are typically the wetland communities with the greatest dominance of native species.

The dominant swamp and marsh vegetation communities are:

- Native sedgeland, dominated by the native cutty grasses *Carex coriacea, C. sinclairii* and *C. geminata*, as well as the exotics creeping bent grass *(Agrostis stolonifera),* and white clover *(Trifolium repens)* (**Plate 3**). This community is approximated by Singers and Rogers original ecosystem unit WL22 reasonably well:

  > "*WL22: Carex, Schoenus pauciflorus sedgeland with mosaics of a wide variety of species of Carex, including C. secta, C. virgata, C. diandra, C. coriacea, C. sinclairii and C. gauchichaudiana, and Schoenus pauciflorus, with locally small pools and lakes often with a fringe of raupō. Present in palustrine/riverine/lacustrine wetlands, which are widespread in the eastern South Island, occurring within inter-montane basins and valley floors of the Southern Alps/Kā Tiritiri o te Moana, and a dominant type at higher altitudes in inland Canterbury."*

  However, *Schoenus pauciflorus* is rare to occasional (on the DAFOR scale), and it does not represent a dominant species within any wetland vegetation plot.

- Exotic grassland, dominated by creeping bent (*Agrostis stolonifera*), blue sweetgrass (*Glyceria declinata*), and Yorkshire fog (*Holcus lanatus*). Additional species commonly include *Carex coriacea, Carex geminata* and *Juncus effusus* (**Plate 4**).

- Exotic herbfield, dominated by watercress *(Nasturtium officinale),* and duckweed *(Lemna disperma*), as well as creeping bent, creeping buttercup (*Ranunculus repens)* and white clover *(Trifolium repens*), often on hummocks created by cattle pugging.

Other swamp and marsh vegetation communities include:

- Mixed native/exotic tussockland dominated by scattered *Carex secta,* with other obligate wetland species watercress (*Nasturtium officinale)*, and duckweed *(Lemna disperma)*, as well as *Juncus articulata,* and *Agrostis stolonifera* (**Plate 5** background). This community occurs primarily in riparian swamps where water tables are consistently above the ground surface.

- Mixed low exotic grassland and native herbfield. Species include *Agrostis stolonifera, Ranunculus reflexus, Ranunculus glabrifolius, Montia fontana* subsp*. fontana,* and *Hydrocotyle novae-zeelandiae* (**Plate 5** foreground). Grazing may play a role in maintaining the short stature of exotic grasses in these areas, preventing them from outcompeting the low native herbs. These are not considered to be true freshwater turf wetlands, which are an ephemeral wetland type dominated by native herbfield and formed along the margins of lakes and river channels by water tables that fluctuate markedly, usually seasonally.

Plate 3. Wetland W003, a typical valley floor wetland in Rise and Shine Valley, with large areas of swamp dominated by native *Carex Coriacea* and *Carex geminata* sedgeland, with marshland on the margins, with exotic-dominated grassland and herbfield communities.

Plate 4. A typical example of a valley floor marsh within Ardgour station. This wetland is surface water fed, and is dominated by facultative wetland sedges and grasses, indicative of a seasonally fluctuating water table. It has been highly impacted by pugging and is heavily grazed.

Plate 5. Wetland W263 within Ardgour station in a central valley system, with mixed low exotic grassland and native herbfield in the foreground, and mixed tussockland dominated by *Carex secta* in the background behind the fence. A 2 x 2 m vegetation plot can be seen in the foreground.

Historic gold mining by sluicing has resulted in considerable sediment deposition in the Rise and Shine valley floor, and may have been responsible for inducing part or much of this valley floor wetland area. No historic aerial imagery is available to prove or disprove this. Under the NPS-Freshwater, induced wetlands constitute natural inland wetlands, so historic provenance is not relevant to wetland status.

3.4.4 Survey effort adequacy

We are confident that all wetlands within the SLSW were mapped. Over 270 person hours were dedicated to onsite wetland delineation within the ESA, providing a high degree of confidence in our wetland mapping.

Our site photo points indicate our on-the-ground coverage of the site (**Figure 17**), noting this is not a track log or comprehensive record of areas surveyed - any gaps were also assessed using desktop and onsite methods.

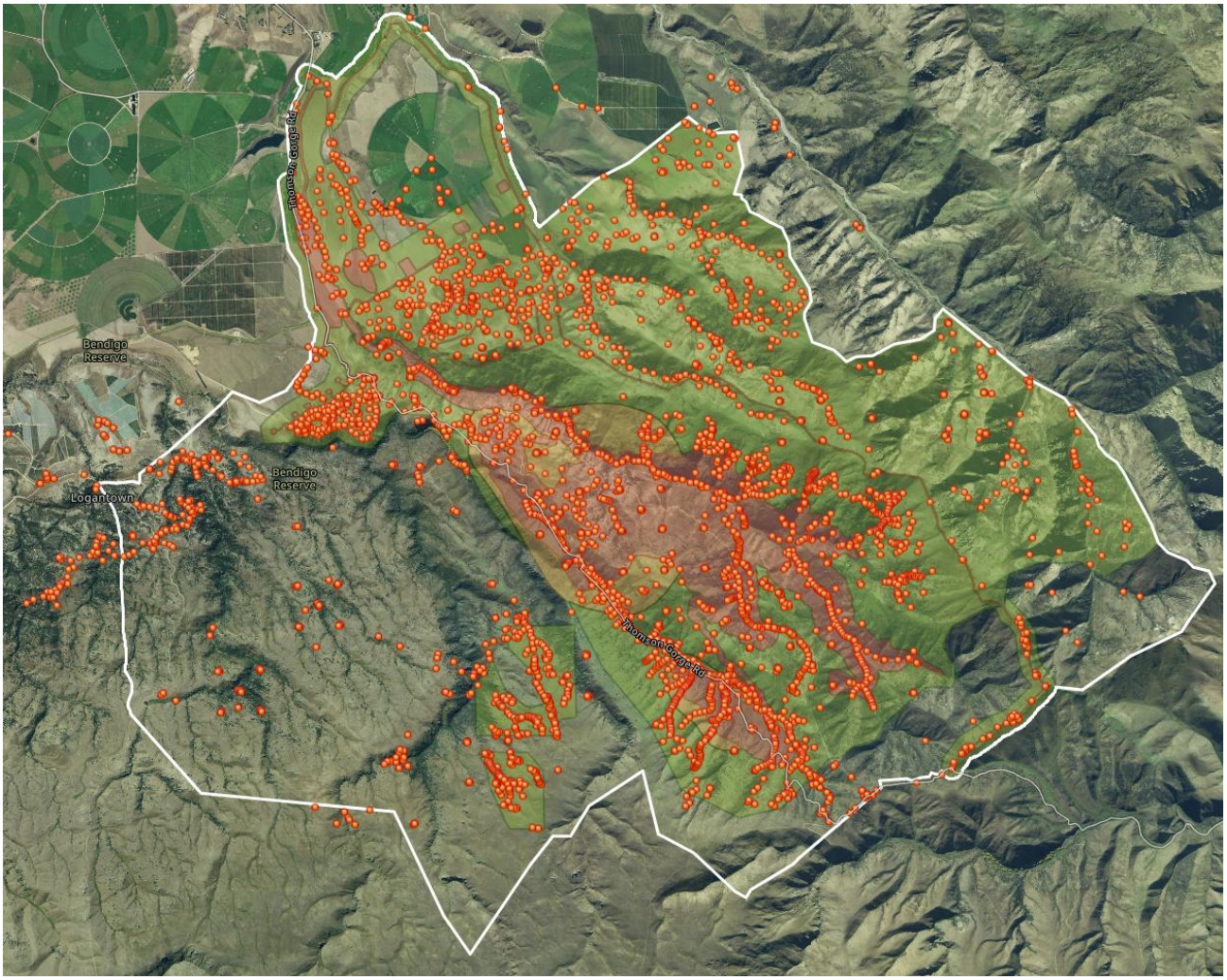


Figure 17. Photo points (orange circles) within the DDF (red polygon) and SLSW (green polygon), providing an indication of coverage onsite by ecologists during site investigations. Note, many routes involved no photo points, so these points can be considered a sub-sample of the areas visited.

A cumulative species detection curve was used to assess survey effort adequacy for detecting wetland species. Over half of these species (52) were detected by the twentieth wetland plot (**Figure 18**). Within these first 20 plots, an average of 2.6 new species were detected per wetland plot. The number of cumulative new species detected begins to level off by plot 42.

Within the last 20 wetland plots there were 7 new species detected, representing an average of 0.35 new species detected per wetland plot. The slight increase in new species detected from plot 84 corresponds to spring field surveys, when several new species emerged or flowered. Overall, the levelling off of the cumulative species detection chart provides confidence that survey effort was sufficient to detect most wetland plant species onsite. Note, the primary aim of wetland plots was to map wetlands, rather than inventory species.

Wetland species inventory and survey for threatened wetland plants was also carried out at the same time as wetland mapping, and during general botanical and rare species survey (as detailed in the vegetation report). Any additional wetland species data was incorporated into the wetland species list.

Figure 16. Cumulative new species detections across 108 wetland plots within the Bendigo-Ophir ESA (note, only a selection of wetland plot numbers are shown on the x-axis label).

3.4.5 Species inventory

Across 123 wetland vegetation plots, 94 plant species were identified, including 32 native species. A full inventory of wetland plant species in vegetation plots can be found in **Appendix C**.

Eight of the native plants found in wetland plots in the ESA are obligate wetland plants, as per the wetland indicator ratings list[28]. These are:

- *Carex secta*
- *Lemna disperma*
- *Carex sinclairii*
- *Eleocharis acuta*
- *Ranunculus glabrifolius*
- *Montia fontana* subsp. *Fontana*
- *Isolepis cernua*
- *Ranunculus macropus*

These plants are unique to wetlands and are not found in other vegetation types in the ESA.

Five native facultative wetland plants were recorded. They are present primarily in wetlands, but are also present in marginally wet sites within the ESA which are not classified as wetland. These are:

- *Carex coriacea*
- *Carex* sp.

[28] Clarkson BR, Fitzgerald NB, Champion PD, Forester L, Rance BD 2021. New Zealand wetland plant list 2021. Manaaki Whenua - Landcare Research contract report LC3975 for Hawke's Bay Regional Council.

- *Carex kaloides*
- *Carex geminata*
- *Juncus distegus*

Other plants found in wetlands were Facultative (FAC) or, in low numbers, Facultative Upland (FACU) and Upland (UPL) plants. These plants are not unique to wetlands and occur in other (dry land) vegetation communities within the ESA. Several species found in wetlands have no wetland indicator status assigned.

3.4.6 Threatened species

Of these species identified in the WSA, nine Regionally Threatened or At Risk/ Data Deficient species are found in both the DDF and SLSW, and one Regionally At-Risk species was found in just the DDF.

The identified species include three sedges, one rush, one bidibid, and two tree daisies (**Table 4**). It also includes two Regionally At Risk and one Regionally Data Deficient hydrophytic (FACW or OBL) species recorded in the ESA. The location and abundance of the latter three species were not recorded as they were not listed as threatened at the time of survey, but they are likely to occur in wetlands.

Four Threatened or At Risk plants were found in swamps and marshes, six in fens, and two in seepages (**Table 4**).

Lack of detection of a species in a wetland class or area does not confirm absence, particularly for small herbaceous species.

Further detail on each of these Threatened or At Risk wetland plants is provided in **Appendix D.**

Table 4. Nationally and Regionally Threatened and At-Risk species found in wetlands in the ESA, and observed distribution by wetland class, in the DDF and SLSW, using the DAFOR index for relative abundance, **D**: Dominant, **A**: Abundant, **F**: Frequent. **O**: Occasional, **R**: Rare. **P** indicates species that are present in the ESA, but their location and abundance was not noted, as they were listed as Not Threatened at the time of survey (Regional Threat Classifications have subsequently been revised). They are likely to occur in wetlands across the DDF and SLSW, as they are hydrophyte plant species (FACW or OBL).

						Direct Disturbance Footprint (DDF)				Surrounding Landscape Surveyed for Wetlands (SLSW)			
Species	**Common name**	**National conservation status (2024)**	**Regional conservation status (2025)**	**Wetland indicator rating**	**Structural class**	**All Wetlands**	**Swamp/ Marsh**	**Fen**	**Seepage**	**All Wetlands**	**Swamp/ Marsh**	**Fen**	**Seepage**
Acaena inermis	Spineless Acaena	Not Threatened	At Risk - Regionally declining		Herbs - Dicotyledons other than Composites	R							
Carex kaloides	Sedge	At Risk – Declining	Threatened - Regionally Endangered		Sedges	O	R	O		F	R	F	O
Carex buchananii	Buchanan's Sedge	At Risk – Declining	Threatened - Regionally Vulnerable	FAC	Sedges	R	R	R		R	O	R	
Carex talboti	Sedge	At Risk – Declining	Threatened - Regionally Vulnerable	FACW	Sedges	R	R	R		R			R
Carex diandra	Sedge	Not Threatened	At Risk - Regionally Naturally Uncommon	OBL	Sedges	P				P			
Deschampsia chapmanii	Hair-grass	Not Threatened	Regionally Data deficient	FACW	Grasses	P				P			
Juncus distegus	Rush	Not Threatened	At Risk - Regionally declining	FACW	Rushes & Allied Plants	O		O		O		O	
Olearia bullata	Tree daisy	Not Threatened	At Risk - Regionally Naturally Uncommon	FACW	Trees & Shrubs - Dicotyledons	R		R		R		R	

Olearia lineata	Tree daisy	At Risk – Declining	At Risk - Regionally declining	FACU	Trees & Shrubs - Dicotyledons	R		R	R	R
Rumex flexuosus	New Zealand dock	Not Threatened	At Risk - Regionally Naturally Uncommon		FACW		P*		P	

*Present at Lower Shepherd Creek artificial pond

3.4.7 Native vegetation cover

On a catchment scale or at a wetland types scale, no clear pattern in percent native plant cover in wetland plots is apparent (**Figure 19**). Several plots in valley floor swamps and marshes have moderate to high percent native vegetation cover (26-100%), primarily due to the dominance of native sedges, while those with low percent natives (0-25%) are dominated by exotic grasses and herbs. Native species with an average cover of 1% or more in plots are primarily sedges, including *Carex coriacea, Carex secta, Carex* sp. (no seed head present to enable identification), *Carex sinclairii, Carex kaloides, Carex geminata,* as well as the floating obligate wetland herb *Lemna disperma* (**Appendix C**).

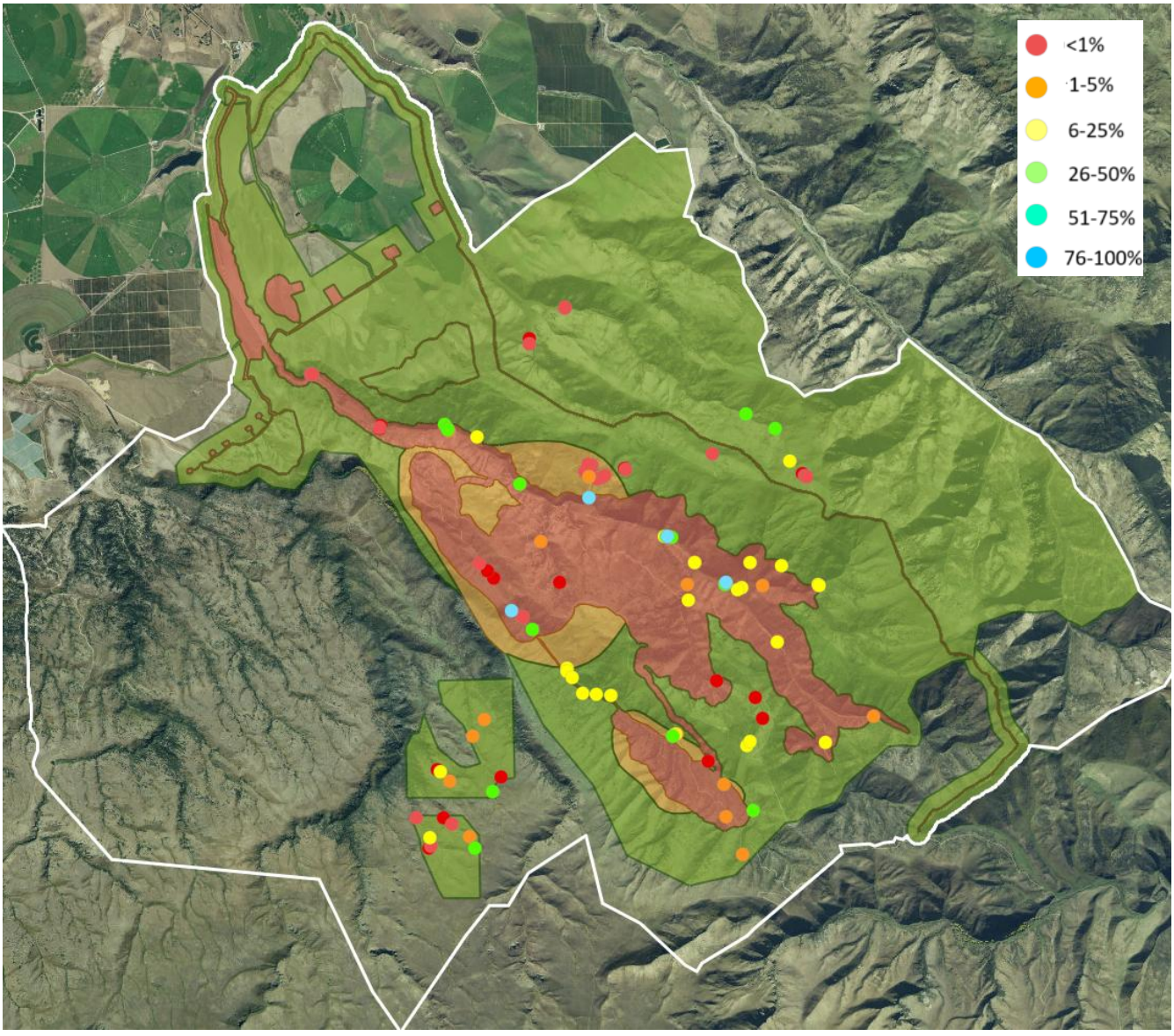


Figure 19. Graduated colour map of percent native plant cover in wetland plots within the ESA. The DDF extent is indicated by red polygons. Note, not all wetlands have vegetation plots.

3.5 Fauna

No specialist wetland avifauna were detected in the ESA [29]. A handful of exotic and 'Not Threatened' native waterfowl utilised artificial ponds in the ESA on a transient basis, including two small shallow ponds in the DDF. Species include putangitamgi/paradise shelduck, tētē moroiti/grey teal and rakiraki/mallard. These avifauna values are low. As they are constructed and maintained for irrigation and or stock water, these waterbodies do not meet the definition of a natural inland wetland under the NES-Freshwater.

Habitat for wetland birds is limited and of poor quality, being constrained spatially and temporally. At-Risk and Threatened wetland birds such as matuku-hūrepo/Australasian bittern, mātātā/ South Island fernbird, pūweto/spotless crake and kotoreke/ marsh crake require moderate to large areas of dense vegetative cover, ideally over shallow water to provide sufficient food and protection from predators. Preferred habitat consists of *Carex secta* or raupo over shallow water or on the edge of shallow open water. Within the ESA, no shallow open water with suitable fringing vegetation exists.

Swamps and fens with *Carex secta* are either sparsely covered and heavily grazed or very small. The large swamps within the Rise and Shine valley floor provide potential habitat in the form of swarding sedges up to 60 cm high, with very shallow water in places. However, these sedges die back in winter and are still low and sparse in spring when breeding occurs, resulting in low habitat quality. Other Threatened species, such as kakī/ black stilt, tarapirohe/ black-fronted tern and kotukū/ white heron, are occasional vagrants on riverbeds and seasonally dry irrigation ponds in the main Clutha Valley floor, but within the ESA, habitat is unsuitable, and the probability of these species using the ESA on occasion is very low, to point of these species most probably not using this site.

No wetland-specific invertebrates are known in the ESA, and no mention of wetlands is made in the site invertebrate survey [30].

3.6 Wetland Condition

Overall wetland condition scores ranged from a minimum of 22 to a maximum of 31. Swamps and marshes in Rise and Shine, Bendigo and Broad Gully catchments scored intermediate and moderately high in this range, while those in Shepherds Creek catchment tended to score comparatively low (**Figure 21**).

Although average condition scores across the three assessment zones were relatively similar (**Table 5**), the distribution of condition proportions were not (Figure 22). A greater proportion of wetlands in the DDF had lower to moderate condition scores, whereas wetlands in the DDZ and the SLSW tended to have moderate to higher condition (**Figure 22**).

The CLM model indicated that wetlands assessed in the DDF were in significantly poorer condition, had a greater introduced species cover (lower score), and experienced higher levels of animal disturbance compared to wetlands assessed in the DDZ and the SLSW (**Table 6**).

[29] RMA Ecology (2025) Bendigo-Ophir Gold Project: Avifauna values assessment. A report prepared for Matakanui Gold Limited.

[30] Habitat NZ Ltd. (2024). Bendigo-Ophir Gold Project: Terrestrial Invertebrate Survey. Habitat NZ Ltd., Auckland. 54 Pages.

Distinct differences were observed among wetland classes (regardless of location—since the model did not account for interaction effects between location and wetland class). Both fens and swamps/marshes had better overall condition and lower levels of animal disturbance than seepages. However, fens contained a higher proportion of introduced plant species than seeps, while swamps/marshes had fewer introduced plant species than seepages (**Table 3**).

Wetlands under 800 m had lower overall condition, and more animal damage and introduced species (**Table 3**), but in the DDF, this trend did not apply. This was likely due to the limited number of wetlands, because there were 14 wetlands above 800 m in the DDF, and 5 of those were assessed (**Table 5**). In contrast, there were 80 wetlands below 800 m in the DDF, and 56 of those were assessed.

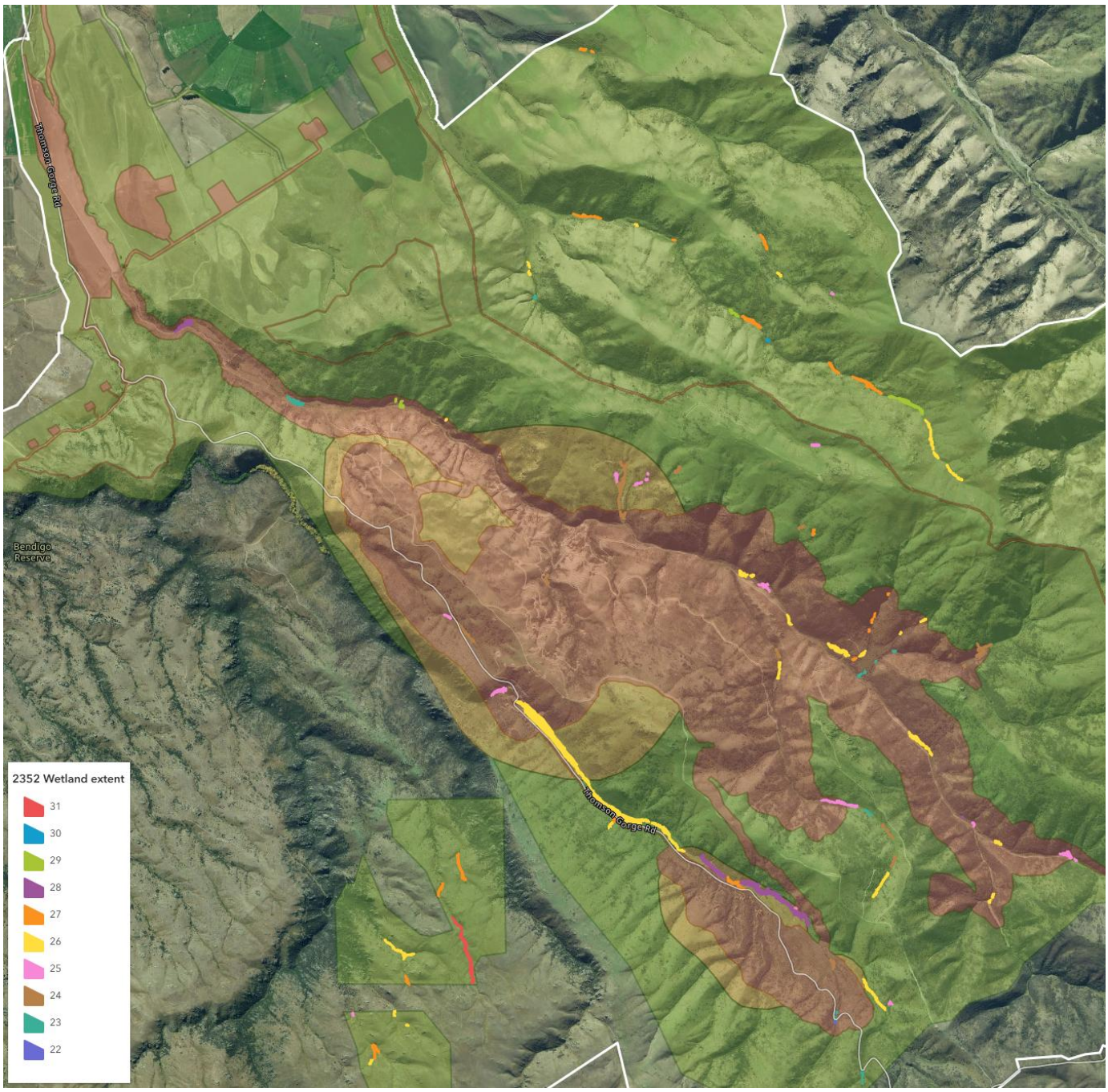


Figure 21. Graduated colour map of overall wetland condition score. Higher numbers relate to better ecological condition. Note, only a subset of wetlands (those with vegetation plots) was assessed for condition.

Table 5. Average wetland condition score, introduced species score (average of D1 + D2) and animal disturbance score (B1) for wetlands in the WSA, by location (DDF vs SLSW), wetland class, and altitude, and type. Averages account for wetland area. The number of assessed wetlands for each subset is also listed.

		Condition Scores												Sample sizes (# of assessed wetlands)			
		Average wetland condition score				Introduced species (D1 + D2)				Animal disturbance (B1)							
		WSA	DDF	DDZ	SLSW	WSA	DDF	DDZ	SLSW	WSA	DDF	DDZ	SLSW	WSA	DDF	DDZ	SLSW
All wetlands		26.4	25.6	26.7	26.8	3.6	3.6	3.7	3.6	2.3	2.0	2.4	2.5	122	61	14	61
Class	Seep	25.3	25.9	24.8	25.4	2.9	3.9	2.0	3.0	1.9	2.3	1.9	1.8	20	9	5	8
	Fen	26.4	24.8	24.1	27.3	2.9	2.6	2.0	3.2	2.5	2.4	1.1	2.8	57	23	3	32
	Swamp/Marsh	26.4	25.8	27.1	26.6	3.8	3.7	4.0	3.8	2.3	1.9	2.6	2.3	45	29	6	21
Altitude	Above 800m	27.2	23.7	26.0	27.4	3.3	2.0	4.0	3.4	2.7	2.0	2.0	2.8	31	5	1	26
	Below 800m	26.3	25.7	26.7	26.5	3.7	3.6	3.7	3.7	2.2	2.0	2.4	2.3	91	56	13	35
Type	Gully	26.1	24.9	24.2	27.0	2.9	2.6	2.1	3.3	2.3	2.1	1.2	2.6	77	38	5	39
	Hillside	25.2	26.2	24.8	25.0	2.7	4.1	2.0	2.6	1.8	2.3	1.9	1.5	16	7	4	6
	Valley Floor	26.6	25.9	27.1	26.8	4.0	4.0	4.0	3.9	2.3	1.9	2.6	2.4	29	16	5	16

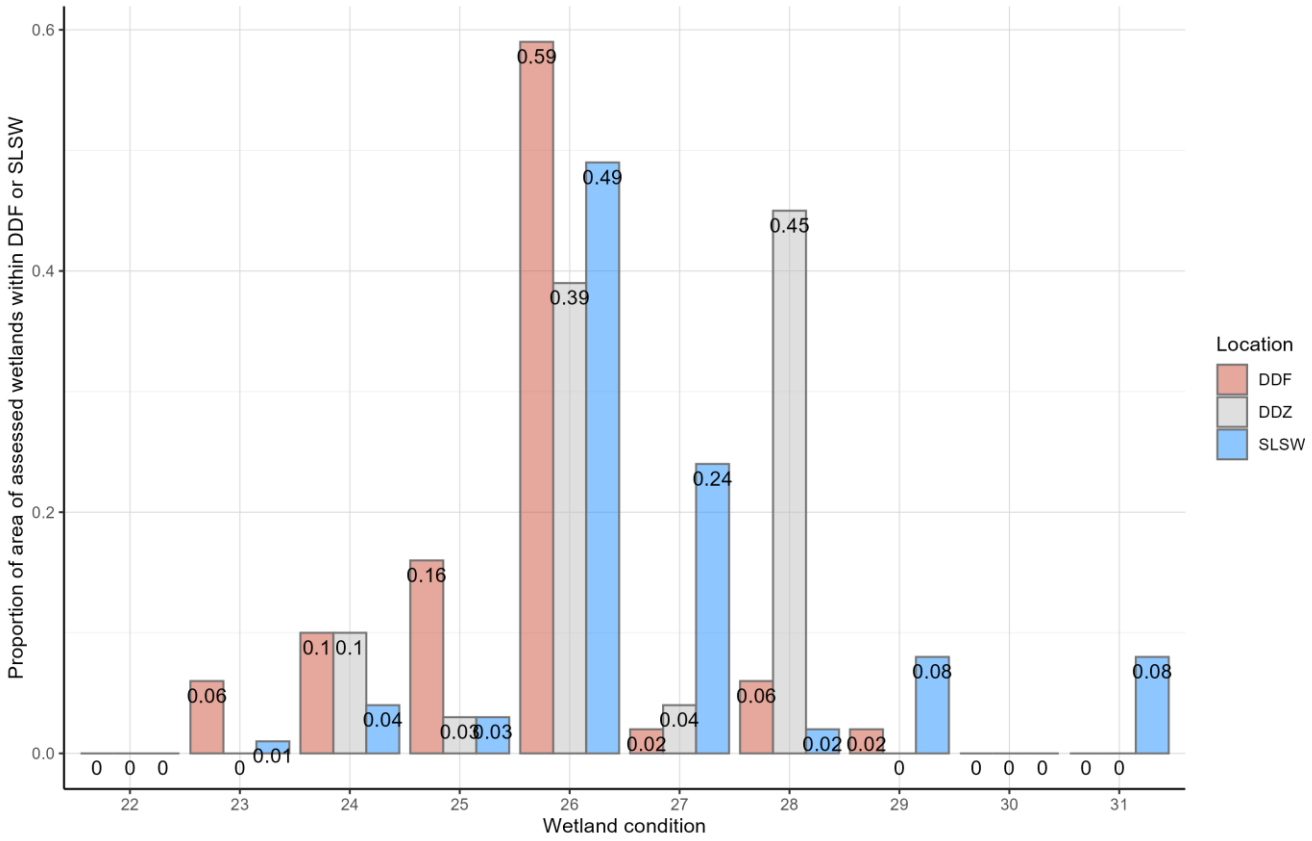


Figure 22. Distribution of wetland condition scores inside and outside the footprint (DDF + DDZ vs. SLSW), taking account of wetland area. Higher numbers relate to better condition.

Table 6. Effects of wetland **location** and **class** predictors on wetland condition scores, introduced species scores (average of D1 + D2), and animal disturbance scores (B1) in assessed wetlands using the CLM model. Positive and negative trends (+ and −) and significance (*** indicates significance at p <0.001) of effects, relative to the reference categories are shown.

Assessment	**Location**				**Class**			
	DDF*	DDZ	SLSW	p-value	Seep*	Fen	Swamp/Marsh	p-value
Wetland condition	*ref.*	+	+	***	*ref.*	+	+	***
Introduced species	*ref.*	+	+	***	*ref.*	−	+	***
Animal disturbance	*ref.*	+	+	***	*ref.*	+	+	***

*DDF and Seep were the reference categories for the **location** and **class** variables in the CLM models.

3.6.1 H1: Impact of anthropogenic structures that alter hydrological regime

Most wetlands are unimpacted by anthropogenic structures and scored none/very low (5/4) for this component, while a number (primarily swamps/marshes) scored low (3) due to the presence of roads and associated water diversion. Nine wetlands in lower Rise and Shine and Shepherds valley were impacted by drainage ditches or by water abstraction for mining purposes, scoring moderate (2). Wetland W002 in the DDF scored high, due to the presence of an artificial dam, as well as water abstraction for mining exploration immediately upstream.

3.6.2 P1: Fire damage

Both Ardgour and Bendigo Stations have a history of fire by Māori and European settlers, which has heavily influenced vegetation communities. However, fire as a management tool ceased in the late 1900s, and since then, no wetlands show evidence of recent fires in vegetation charring or soil cores, so all wetlands were scored 4 (very low impact).

3.6.3 P2: Degree of sedimentation/erosion

Sedimentation/erosion scores for assessed wetlands ranged from moderate (2) to none/very low (5/4). Recent earthworks near wetlands were rare, bank erosion was uncommon, and stream water was generally of low turbidity. Primary impacts were from heavy pugging and occasional bank erosion.

3.6.4 E2: Connectivity barriers

All wetlands scored moderate for connectivity barriers, as the connected streams very rarely flow through to the Clutha River, representing a fish passage barrier. However, most wetlands are well connected to streams or catchment groundwater due to the lack of artificial structures in the streams and the lack of ring drains around wetlands. Original buffer vegetation bordering wetlands has been lost through historic fires but has been replaced by a patchwork of matagouri scrub which provides some buffering.

3.6.5 B1: Domestic/feral animal damage

The impact of animal damage on wetlands in the WSA ranged from low (3) to high (1). Damage was almost solely attributable to domestic stock (cattle and sheep), rather than feral animals. No sites scored none/very low due to the presence of grazing impacts throughout.

Animal damage was primarily scored as moderate in the DDF and low or moderate in the DDZ and SLSW (**Figures 23** and **24**).

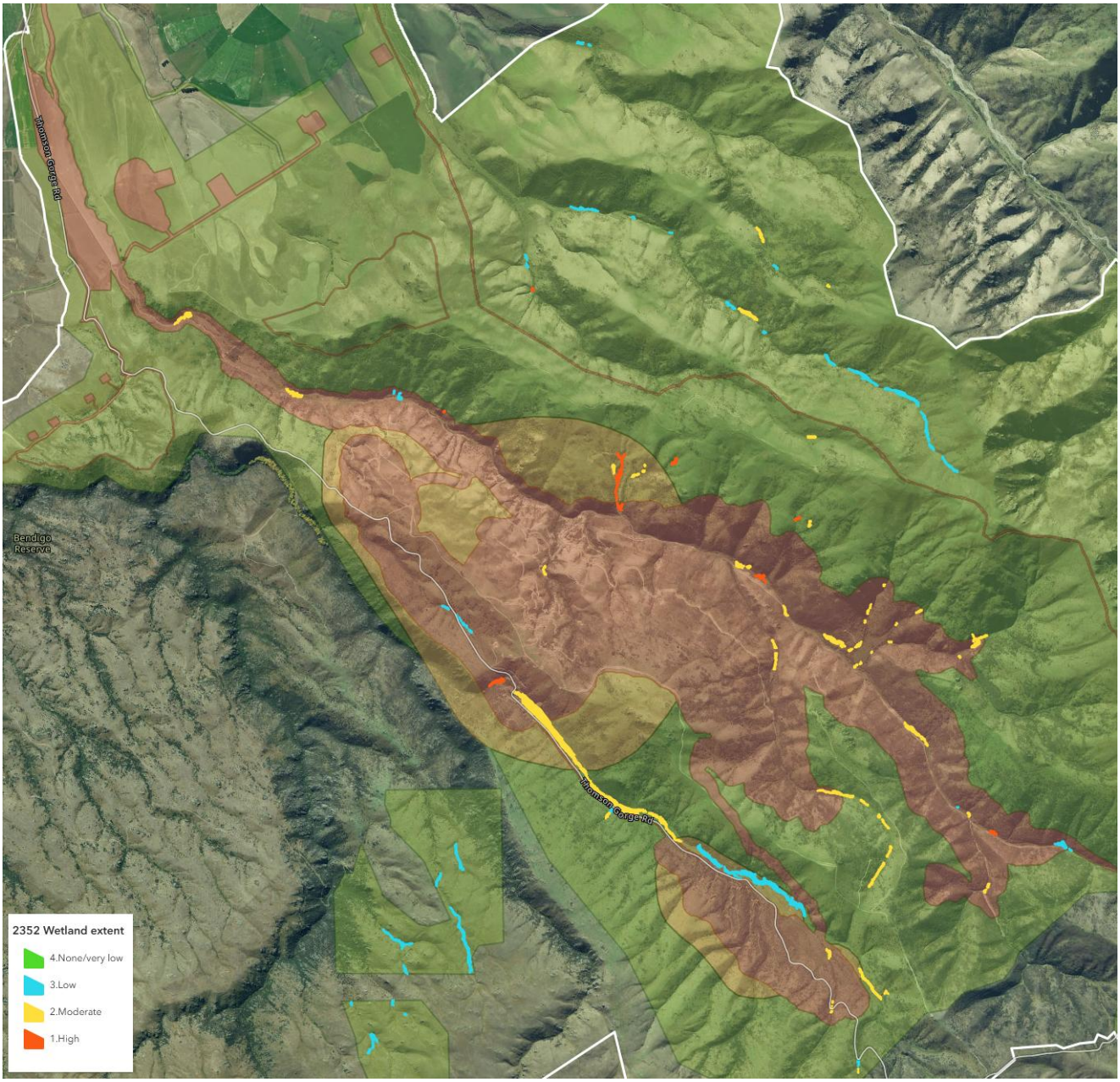


Figure 23. Graduated colour map of B1: domestic/feral animal damage scores. Note, polygons do not reflect actual wetland size; outline widths have been increased to improve visibility. The map excludes wetlands which were not assessed for domestic/feral animal damage, due to the lack of a wetland plot.

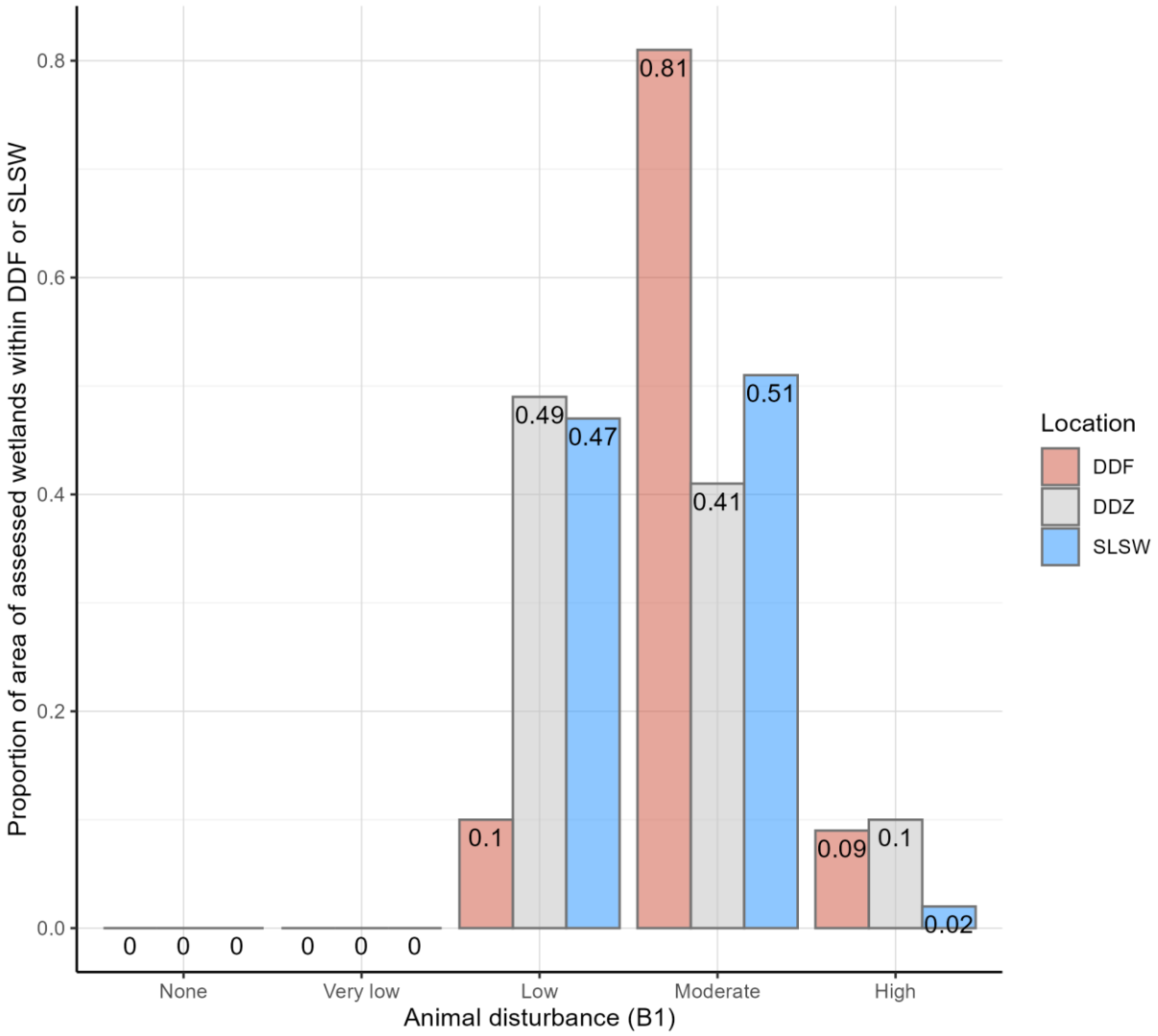


Figure 24. Animal damage condition scores (component B1) of wetlands in and outside the impact footprint (DDF + DDZ vs SLSW), taking account of wetland area.

Many wetlands within the ESA are heavily degraded by cattle pugging (**Plate 6**). Cattle were often seen within wetlands during spring when soil conditions were very wet. This high level of disturbance favours rapid colonisers[31], such as exotic pioneer species, with creeping bent grass (*Agrostis stolonifera)*, the rushes *Juncus articulatus* and *Juncus effusus,* watercress (*Nasturtium officinale)* and white clover (*Trifolium repens*) dominant in many wetlands in the ESA.

Grazing intensity by cattle and sheep ranged from low to intensive, sometimes forming occasional lawn-like grass turfs in valley floors where grazing is regular and intensive. Stock impacts are less significant at higher altitudes. It should be noted that present levels of stock damage at the time of survey may not mirror past stock damage, as stocking levels and species in each fenced block can change from month to month. Heavy pugging does tend to persist as hummocks.

[31] Reeves, P. N., & Champion, P. D. (2004). *Effects of livestock grazing on wetlands: Literature review*. NIWA Client Report HAM2004-059. Prepared for Environment Waikato. Hamilton, New Zealand.

Plate 6. Seepage wetland W177, in the SL on the south-facing slope above Shepherds Creek, showing heavy pugging and intensive grazing, scoring high for animal damage. This is typical of seepages onsite.

3.6.6 B2: Introduced predator impacts on wildlife

All wetlands scored high (1) for introduced predator impacts, due to the presence of a suite of mammalian predators in moderate to high numbers, a lack of predator control, and a lack of sensitive wetland bird species such as bittern, crake and fernbird in 5-minute bird counts and targeted wetland bird surveys[32].

3.6.7 B3: Harvesting of biota

All wetlands scored high for this component, due to the lack of harvesting of wetland biota, such as hunting or moss gathering.

[32] RMA Ecology (2025) Bendigo-Ophir Gold Project: Avifauna values assessment. Report prepared for Matakanui Gold Ltd.

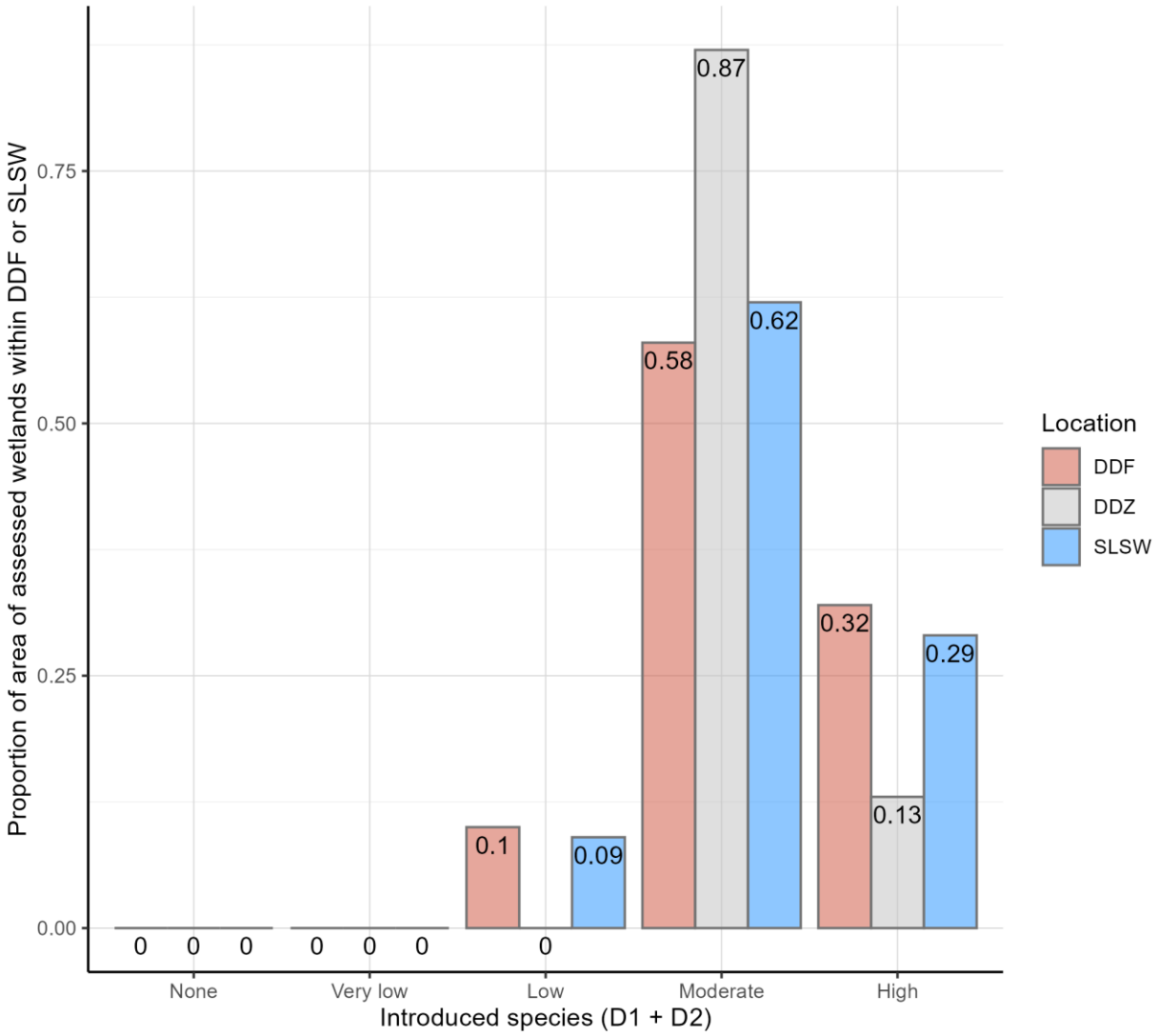


Figure 25. Introduced species condition scores for wetlands in and outside of the impact footprint (DDF vs SLSW), taking account of wetland area.

3.6.8 D1 & D2: Introduced plant canopy and understory cover

Introduced species scores ranged from a minimum of 2 to a maximum of 6 out of 10. Most introduced species are grasses, herbs and rushes. The DDF and SLSW had comparable introduced species condition scores. The DDZ stands out with most of the wetlands having moderate scores, whereas the DDF and SLSW have some scoring low and high as well. (**Figure 25**).

Highly invasive tree species likely to alter vegetation community structure were largely absent. Two exceptions are crack willow (*Salix fragilis*), and poplar (*Populus* sp.), which are present in mid Rise and Shine Valley near the pond. These species pose a significant ecological risk and appear to be slowly spreading. Crack willow is also present at low densities in Boundary Stream and Dry Creek catchments. Grazing may be limiting the spread of these weeds.

Exotic species dominance in wetlands did not correlate well with the level of soil disturbance by stock. This runs counter to expectations, and any pattern could be confounded by the fact that stock damage is likely to

vary month to month and may not reflect long-term historic stock impacts. Exotic species tend to be better adapted to high levels of disturbance and often outcompete native species under high levels.

3.7 Wetland significance assessment

The ESA does not contain areas of significant indigenous vegetation or significant habitats of indigenous fauna, as scheduled and mapped by the District Plan.

However, when assessed under the significance criteria in the operative Otago RPS (2019) and the proposed RPS (2021), all six wetland groups (seepages, fens and swamps/marshes in the DDF, DDZ, and SLSW) are classified as significant (**Table 7**). Only one criterion needs to be met to achieve significance.

Operative RPS significance criteria satisfied include:

- 1. The wetland groups are representative or typical of wetlands in the surrounding landscape (in the ESA as per this report) and the wider Central Otago Ecological Region, meeting criterion 1. Most are moderately to highly impacted by historic fires, and domestic stock grazing and pugging, and are dominated by exotic species, or seral native species such as *Carex* spp. However, this is typical of the degraded condition of lowland wetlands in the Surrounding Landscape (in the ESA), and in the wider Central Otago Ecological Region (Barrie Wills *pers. comm*.).
- 2a. Each group contains at least one indigenous species that is Nationally At Risk, satisfying criterion 2a. Although data for the ecological district is limited, all contain additional species which are Threatened or At Risk, in the region, Otago.
- 2b. Nationally, wetlands have less than 20% of their former extent remaining (estimations vary between 9.4 and 10.1% remaining [33] [34]), and thus all wetlands in the ESA satisfy the rarity criterion 2b for significance in the operative and proposed Regional Policy Statements.
- 3. Diverse natural gradients exist between wetland classes, including springs, seepages, fens, marshes and swamps, with riparian and riverine wetlands having direct connections to streams, satisfying criterion 3. Each catchment supports a high diversity of indigenous freshwater and terrestrial ecosystems that, although significantly altered, are well connected and support a diversity of freshwater and terrestrial indigenous flora and invertebrate fauna.
- 4. The distinctiveness criterion is not deemed to be triggered for wetlands at this site.
- 5a. The ecological context criterion 5a is met, as these wetlands provide important connectivity value allowing wind dispersal of indigenous vegetation between the northern and southern parts of the Dunstan ED, and waterborne dispersal along streams in the various catchments, particularly for riparian fens and marshes. They also provide buffering from land use impacts, protecting water quality, invertebrates and flora in streams in the ESA (criterion 5b).

In addition, all seepages are significant, as:

[33] https://www.doc.govt.nz/contentassets/13f28b4f23de4a2f9659390da194f902/protecting-our-places-brochure.pdf

[34] https://www.stats.govt.nz/indicators/wetland-extent/#:~:text=Analysis%20of%20change%20between%202001,original%20extent%20(1%2C501%2C000%20ha)

- 2c. Nationally, seepages are an endangered Naturally uncommon ecosystem, meeting rarity criteria 2c for significance in the operative and proposed Regional Policy Statements[35].

The significance criteria in the proposed Otago RPS (2021) reflects and expands on the criteria in the operative RPS, with the following edits. The proposed RPS groups has four criteria:

(a) representativeness:

(b) diversity and pattern:

(c) rarity and distinctiveness:

(d) ecological context.

In addition, the criteria descriptions are expanded. The primary differences are the addition of:

1. Ecological context criterion; the area must have at least moderate size and compact shape, in the context of the relevant ecological district.

2. Rarity criterion; If an area would quality as an SNA solely on the grounds that it provides habitat for a single indigenous fauna species that is At Risk (declining), and that the species is widespread in at least

three other regions, the area does not quality as an SNA unless:

(a) the species is rare within the region or ecological district where the area is located; or

(b) the protection of the species at that location is important for the persistence of the species as a whole.

(3) If an area would qualify as an SNA solely on the grounds that it contains one or more indigenous flora species that are Threatened or At Risk (declining), and those species are widespread in at least three other regions, the area does not qualify as an SNA unless:

(a) the species is rare within the region or ecological district where the area is located; or

(b) the protection of the species at that location is important for the persistence of the species as a whole.

Fens and Swamps/marshes in the DDF, DDZ, and SLSW meet criterion 3a, being at least moderate in area relative to others identified in the ED in desktop mapping. Seepages, however, appear to be small relative to others in the ED.

No wetland group classifies as significant solely on the grounds of Threatened or At Risk species presence, so update 2 (above) does not alter significance of any wetland groups.

Otago Regional Water Plan policy 10.4.1A includes a criterion (amongst others) that assigns significance to wetlands that are Higher than 800 metres above sea level. Within the DDF, there are 14 wetlands above 800 m asl. covering 0.16 ha. Similarly, in the DDZ there are 7 wetlands above 800 m asl. also covering 0.16 ha.

[35] Wiser SK, Buxton RP, Clarkson BR, Hoare RJB, Holdaway RJ, Richardson SJ, Smale MC, West C, Williams PA 2013. New Zealand's naturally uncommon ecosystems. In Dymond JR ed. Ecosystem services in New Zealand – conditions and trends. Manaaki Whenua Press, Lincoln, New Zealand. Pp. 49–61.

Table 7. Assessment of significance of wetlands at the site as assessed under various planning instruments. Only some criteria listed in the RPS documents have been assessed, as only one criterion need to be met for a site to be classified as 'significant'. For the Operative Otago RPS column below, the criterion assessed is rarity. For the Proposed Otago RPS, the criteria of rarity, representativeness and distinctiveness are assessed.

Class and location	Criterion	Significance Assessment Otago Operative RPS (2019) SNA criteria	Criteria Met (Y/N)	Significance Assessment Otago Proposed RPS (2021) SNA criteria	Criteria Met (Y/N)
DDF & DDZ Seepages	Rarity	**Criteria 2b** – Rarity. On a national scale, wetlands are a rare ecosystem and have been reduced to less than 20% of their former extent[36]. **Criteria 2c** – Rarity. Seepages are an originally rare (naturally uncommon) ecosystem on a national scale, and contain indigenous vegetation.	Yes Yes	**Criteria 1** – Representativeness. Seepages in the ESA are highly impacted by animal damage. This is typical of the degraded condition of lowland seepages in the Surrounding Landscape and in the wider Central Otago Ecological Region. **Criteria 2c** – Rarity. Seepages are an originally rare (naturally uncommon) ecosystem on a national scale, and contain indigenous vegetation.	Yes Yes
DDF & DDZ Fens	Rarity	**Criteria 2b** – Rarity. On a national scale, wetlands are a rare ecosystem and have been reduced to less than 20% of their former extent.	Yes	**Rarity and Distinctiveness:** Presence of at least five flora species which are Threatened or At Risk regionally, and/or nationally	Yes
DDF & DDZ Swamps/ Marshes	Rarity	**Criteria 2b** – Rarity. On a national scale, swamps have been reduced to less than 20% of their historic extent. They are the most impacted wetland class, as they have been reduced to an estimated 6% of their former extent[37].	Yes	**A1: Representativeness** – Contains large areas of indigenous dominated *Carex* sedgeland vegetation typical of the indigenous biodiversity of the Dunstan ED and Central Otago ER, where land use is similarly dominated by extensive pastoral grazing. The entire ED has been heavily influenced by historic fires, thus seral *Carex* wetland communities are characteristic. **Rarity and Distinctiveness:** Presence of at least three flora species which are Threatened or At Risk regionally, and/or nationally	Yes
SLSW Seepages	Rarity	**Criteria 2b** – Rarity. On a national scale, wetlands are a rare ecosystem and have been reduced to less than 20% of their former extent.	Yes	**Criteria 2c** – Rarity. Seepages are an originally rare (naturally uncommon) ecosystem on a national scale, and contain indigenous vegetation.	Yes

[36] https://www.stats.govt.nz/indicators/wetland-extent/#:~:text=Analysis%20of%20change%20between%202001,original%20extent%20(1%2C501%2C000%20ha).

[37] Ausseil, Anne-Gaelle & Gerbeaux, Philippe & Chadderton, William & Stephens, T. & Brown, D. & Leathwick, J.L.. (2008). Wetland ecosystems of national importance for biodiversity:Criteria, methods and candidate list of nationally important wetlands.

Class and location	Criterion	Significance Assessment Otago Operative RPS (2019) SNA criteria	Criteria Met (Y/N)	Significance Assessment Otago Proposed RPS (2021) SNA criteria	Criteria Met (Y/N)
		Criteria 2c – Rarity. Seepages are an originally rare (naturally uncommon) ecosystem on a national scale, and contain indigenous vegetation.		**Rarity and Distinctiveness**: Presence of at least three flora species which are Threatened or At Risk regionally, and/or nationally	
SLSW Fens	Rarity	**Criteria 2b** – Rarity. On a national scale, wetlands are a rare ecosystem and have been reduced to less than 20% of their former extent.	Yes	**Rarity and Distinctiveness:** Presence of at least two flora species which are Threatened or At Risk regionally, and/or nationally	Yes
SLSW Swamps/ Marshes	Rarity		Yes	**A1: Representativeness** – Contains large areas of indigenous dominated *Carex* sedgeland vegetation typical of the indigenous biodiversity of the Dunstan ED. Although a seral community, the entire ED has been heavily influenced by historic fires, making seral Carex wetland communities characteristic. **Rarity and Distinctiveness**: Presence of at least five flora species which are Threatened or At Risk regionally, and/or nationally	Yes

3.8 Wetland value assessment

The matters for assessment of value are broadly consistent with most significance criteria used by Councils, but extend to cover matters not normally considered when just assessing RMA section 6(c) matters. Ecological condition or quality are important since they contribute to how a feature might be affected by a proposed activity.

Swamps in the DDZ and SLSW were assessed to have Very High value, with all five other wetland areas or communities having moderate or High value (**Table 8**).

An ecological value assessment of individual Threatened and At Risk flora species found in wetlands in the DDF is presented in **Table 9.** National and Regional threat status were used to determine value.

Table 8. Ecological value assessment for the three classes in the three assessed locations in the BOGP ESA (determined by wetland class and by proposed impact).

Location and class	Matter				
	Representativeness	**Rarity and Distinctiveness**	**Diversity and Pattern**	**Ecological Context**	**Value Assessment**
DDF	Moderate	High	Low-Moderate	Moderate	**Moderate**
Seepages	Condition and 'naturalness' are low to moderate, with high stock impacts and high coverage of exotic species greater than typical for lowland wetlands in the Dunstan ED and Central Otago ER.	Indigenous vegetation in wetlands is National Priority 2 for protection[38]. Only 10% of the original extent remains on a national level. Seepages are an endangered naturally uncommon ecosystem on a national scale[39]. Naturally uncommon / originally rare ecosystems are National Priority 3 for protection[40]. No Threatened or At Risk species confirmed, although present in seepages in the Surrounding Landscape.	Low-moderate species and community diversity, with three dominant community types, primarily exotic. Grades into dryland and fen communities, but moderately-highly impacted by stock.	Primarily small and compact, or moderate size and not compact. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function. Does not provide suitable habitat for mobile avifauna.	
DDF	Low	High	Moderate	Moderate	**Moderate**
Fens	Low to moderate condition and 'naturalness'. Degraded condition is typical of lowland/montane wetlands in the Dunstan ED and Central Otago ER.	Indigenous vegetation in wetlands is National priority 2 for protection. Only 10% of the original extent remains on a national level. Three Regionally Threatened and two At Risk species were detected.	Moderate species and community diversity, primarily exotic. Grades into dryland, seepage and swamp/marsh communities, but moderately-highly impacted by stock.	Primarily moderate in size and not compact (elongated). Unlikely to provide suitable habitat to mobile avifauna	

[38] https://www.doc.govt.nz/contentassets/13f28b4f23de4a2f9659390da194f902/protecting-our-places-brochure.pdf

[39] Wiser SK, Buxton RP, Clarkson BR, Hoare RJB, Holdaway RJ, Richardson SJ, Smale MC, West C, Williams PA 2013. New Zealand's naturally uncommon ecosystems. In Dymond JR ed. Ecosystem services in New Zealand – conditions and trends. Manaaki Whenua Press, Lincoln, New Zealand. Pp. 49–61.

[40] https://www.doc.govt.nz/contentassets/13f28b4f23de4a2f9659390da194f902/protecting-our-places-brochure.pdf

Location and class	Matter				
	Representativeness	**Rarity and Distinctiveness**	**Diversity and Pattern**	**Ecological Context**	**Value Assessment**
DDF	Moderate	High	Moderate	High	**High**
Swamps/Marshes	Condition and 'naturalness' is moderate relative to other wetlands in the Dunstan ED and Central Otago ER, with native *Carex* sedgelands common, and stock impacts mostly moderate.	Indigenous vegetation in wetlands is National priority 2 for protection. Only 10% of the original extent remains on a national level. Swamps/marshes are uncommon in the ED and threatened nationally (only 6% of their original extent remains). Three Regionally Threatened species were detected.	Moderate species and community diversity. Gradients into marsh, dryland and fen communities, but moderately impacted by stock.	Moderate to large in area relative to other likely swamps/marshes in the valley floors in the ED. Potential to provide seasonal habitat to mobile avifauna and wetland invertebrates, but none detected (the latter was not specifically surveyed in wetlands).	
DDZ	Moderate	High	Low-Moderate	Moderate	**Moderate**
Seepages	Low to moderate condition and 'naturalness'. Degraded condition is typical of lowland/montane wetlands in the Dunstan ED and Central Otago ER.	Indigenous vegetation in wetlands is National priority 2 for protection. Only 10% of the original extent remains on a national level. Seepages are an endangered naturally uncommon ecosystem on a national scale. Naturally uncommon / originally rare ecosystems are National Priority 3 for protection.	Low-moderate species and community diversity, with three dominant community types, primarily exotic. Grades into dryland and fen communities, but moderately-highly impacted by stock.	Primarily small and compact, or moderate size and not compact. Does not provide suitable habitat to mobile avifauna.	

Location and class	Matter				
	Representativeness	**Rarity and Distinctiveness**	**Diversity and Pattern**	**Ecological Context**	**Value Assessment**
DDZ **Fens**	Low Low to moderate condition and 'naturalness'. Degraded condition is typical of lowland/montane wetlands in the Dunstan ED and Central Otago ER.	High Indigenous vegetation in wetlands is National priority 2 for protection. Only 10% of the original extent remains on a national level. Three Regionally Threatened and two At Risk species were detected.	Moderate Moderate species and community diversity, primarily exotic. Grades into dryland, seepage and swamp/marsh communities, but moderately-highly impacted by stock.	Moderate Primarily moderate in size and not compact (elongated). Unlikely to provide suitable habitat to mobile avifauna	**Moderate**
DDZ **Swamps/Marshes**	High Condition is moderate to high relative to the Dunstan ED and Central Otago ER, with native Carex sedgelands common, and stock impacts low to moderate.	High Wetlands are National priority 2 for protection. Swamps/marshes are uncommon in the ED and threatened nationally (only 6% of their original extent remains).	Moderate Moderate species and community diversity. Gradients into marsh, dryland and fen communities, but moderately impacted by stock.	High Buffering/connection Potential to provide seasonal habitat to mobile avifauna, and potentially wetland invertebrates, although none were detected (the latter was not specifically surveyed in wetlands).	**Very High**

Location and class	Matter				
	Representativeness	**Rarity and Distinctiveness**	**Diversity and Pattern**	**Ecological Context**	**Value Assessment**
SLSW	Moderate	High	Moderate	Moderate	**Moderate**
Seepages	Low to moderate condition and 'naturalness'. Degraded condition is typical of lowland/montane wetlands in the Dunstan ED and Central Otago ER.	Indigenous vegetation in wetlands is National priority 2 for protection. Only 10% of the original extent remains on a national level. Seepages are an endangered naturally uncommon ecosystem on a national scale. Naturally uncommon / originally rare ecosystems are National Priority 3 for protection. Two Regionally Threatened species were detected.	Moderate species and community diversity, with three dominant community types, primarily exotic. Grades into fen, marsh, and dryland communities, but moderately-highly impacted by stock.	Primarily small and compact, or moderate size and not compact. Does not provide suitable habitat to mobile avifauna.	
SLSW	High	High	Moderate	High	**High**
Fens	Moderately high condition and 'naturalness'. Degraded condition is typical of lowland/montane wetlands in the Dunstan ED and Central Otago ER.	Indigenous vegetation in wetlands is National priority 2 for protection. Only 10% of the original extent remains on a national level. Two Regionally Threatened and three At Risk species were detected.	Moderate species and community diversity, including three main communities, both native and exotic dominated. Natural gradients into marsh, swamp, seepage and dryland communities, but moderately impacted by stock.	Primarily moderate size and not compact (elongated). Unlikely to provide suitable habitat to mobile avifauna, but potentially to invertebrates, although none were detected.	

Location and class	Matter				
	Representativeness	**Rarity and Distinctiveness**	**Diversity and Pattern**	**Ecological Context**	**Value Assessment**
SLSW	High	High	Moderate	High	**Very High**
Swamps/Marshes	Condition is moderate to high relative to the Dunstan ED and Central Otago ER, with native Carex sedgelands common, and stock impacts low to moderate.	Wetlands are National priority 2 for protection. Swamps/marshes are uncommon in the ED and threatened nationally (only 6% of their original extent remains). Two Regionally Threatened and one At Risk species were detected.	Moderate species and community diversity, with five communities identified, including native-dominated. Natural gradients between swamp, marsh, dryland and fen communities, but moderately impacted by stock.	Buffering/connection Potential to provide seasonal habitat to mobile avifauna, and potentially wetland invertebrates, although none were detected (the latter was not specifically surveyed in wetlands).	

Table 9. Threat status and corresponding ecological value of Threatened and At Risk wetland plant species found in the ESA.

Species	Common name	National conservation status (2024)	Regional conservation status (2025)	Ecological Value
Acaena inermis	*Spineless Acaena*	Not Threatened	At Risk - Regionally declining	High value
Carex kaloides		At Risk – Declining	Threatened - Regionally Endangered	Very High value
Carex buchananii	*Buchanan's Sedge*	At Risk – Declining	Threatened - Regionally Vulnerable	Very High value
Carex diandra		Not threatened	At Risk – Regionally Naturally Uncommon	Moderate value
Carex talboti		At Risk – Declining	Threatened - Regionally Vulnerable	Very High value
Deschampsia chapmanii		Not Threatened	Regionally Data Deficient	Moderate value
Juncus distegus		Not Threatened	At Risk - Regionally declining	High value
Olearia bullata		Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate value
Olearia lineata		At Risk – Declining	At Risk - Regionally declining	High value
Rumex flexuosus	New Zealand dock	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate value

4.0 Potential effects on wetlands

This section includes an indicative list of potential adverse effects that may result from the project on wetlands during construction and ongoing operation. An effects assessment is included in the report prepared by Alliance Ecology Ltd.

Mining activities have the potential to result in a range of adverse effects on wetland ecological values during construction and ongoing operation.

Potential adverse effects on wetland values relating to mining construction for this project include:

- Wetland habitat loss totalling 3.12 ha, through vegetation clearance and earthworks within the DDF, including excavation, as well as infilling through deposition of overburden, waste-rock, and tailings. Of this area, 0.13 ha is seepage, 0.48 ha is fen, and 2.51 ha is swamp and marsh.
- Creation of habitat edge effects and alteration of the composition and health of adjacent vegetation (i.e., habitat degradation), which may affect wetland habitat suitability for flora and fauna.
- Loss of or harm to fauna species associated with vegetation clearance or earthworks activities, such construction noise, dust and lighting.
- Secondary (indirect) habitat loss through changes to local hydrology, resulting in the dewatering of nearby wetlands fed by surface water (swamps, marshes, and fens) or ground water (seepages and fens).
- Habitat fragmentation and loss of ecological connectivity. Fish passage is already limited below the site, and fish life is restricted to the lower reaches. There is connectivity between riparian wetlands within the same catchment, which could be impacted.
- The spread of exotic or invasive species can be facilitated or worsened through disturbance or the introduction of seed propagules via machinery. Planting unsuitable invasive species, such as willow (*Salix* spp.) and poplar (*Populus* spp.), for slope and waterway stabilization poses a significant long-term risk to wetlands.

Water quality in wetlands may be affected by sedimentation or contamination from leachates. Potential discharges from the mine, ELF, roading, and plant area could reach wetlands via direct flow, surface water pathways, streams, or groundwater. Sediment discharges can alter wetland conditions by causing sedimentation, encouraging dryland plant invasion, increasing introduced species, and, in extreme cases, reducing wetland extent through infilling. Potential long-term ongoing adverse ecological effects during mining operations may include:

- Ongoing disturbance effects on wetland birds, particularly on habitat margins/edges, through noise, vibration (including blasting), dust and lighting.
- Decreased resilience of remaining nearby wetlands where introduced weeds and animal pests have become established, due to mining disturbance.

- Impacts on wetlands from any alteration in the grazing regime. The effect of grazing alteration to wetlands are complex and will depend on stock type and stocking rate, season, frequency and length of grazing, and palatability and growth rate of species present onsite[41].

Uncertainty exists around the indirect effects of groundwater drawdown and surface water diversion, particularly in Rise and Shine Valley, where the greatest potential effects and highest value wetlands occur.

These matters will be addressed in the ecological effects assessment report prepared by Alliance Ecology Ltd.

[41] Reeves, P.N., & Champion, P.D. (2004). *Effects of livestock grazing on wetlands: a literature review*. NIWA Client Report HAM2004-059. National Institute of Water and Atmospheric Research Ltd., Hamilton, New Zealand.

Appendix A: Wetland delineation plot data form

NEW ZEALAND WETLAND DELINEATION DATA FORM: PASTURE TEST

SECTION A – SITE INFORMATION

Site:_____ Region:_____ Sampling point/ID:_____

Owner/address:_____ Date:_____ Land use:_____

Landform:_____ Local relief:_____ Land cover:_____

Is the land drained? YES___NO___UNKNOWN___ Investigator(s):_____ Slope*:_____

GPS (NZTM):_____ Altitude m:_____ Photo Nos:_____

Are climatic/hydrologic conditions on the site typical for this time of year? YES___NO___ (if NO explain in Remarks)

Are Vegetation___Soil___or Hydrology___ significantly disturbed? Are 'Normal Circumstances' present? YES___NO___

Are Vegetation___Soil___or Hydrology___ naturally problematic? Explain answers in Remarks if needed

SUMMARY OF FINDINGS—Attach site map showing sampling point locations, transects, important features etc.

Pasture exclusion? YES ☐ NO ☐

Hydrophytic vegetation present? YES ☐ NO ☐

Hydric soils present? YES ☐ NO ☐

Wetland hydrology present? YES ☐ NO ☐

Is the sampled area within a wetland? YES ☐ NO ☐

SECTION B – VEGETATION

Use scientific names of plants.	Absolute % cover	Dominant Species?	Indicator Status	Pasture % cover
Tree Stratum (Plot size:_____)				
1.				
2.				
3.				
4.				
Total tree cover (TT) =		50%_____	20%_____	
Sapling/Shrub Stratum (Plot size:_____)				
1.				
2.				
3.				
4.				
5.				
Total sapling/shrub cover (TS) =		50%_____	20%_____	
Herb Stratum (Plot size:_____)				
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
Total herb cover (TH) =		50%_____	20%_____	
			Total (P) =	
Total Vegetation Cover (TVC): TT+TS+TH =		50%_____		

Pasture Exclusion Test:

Pasture cover/Total vegetation cover (P/TVC) x100 = _____%

☐ Rapid Pasture Test

☐ Pasture Exclusion Test is >50%

Dominance Test:

No. Dominant Spp. OBL/FACW/FAC (A) _____

Tot. Dominant Spp. across strata (B) _____

% OBL/FACW/FAC (A/B) _____

Prevalence Index:

Total % cover of:		Multiply by:	
OBL	_____	x 1 =	_____
FACW	_____	x 2 =	_____
FAC	_____	x 3 =	_____
FACU	_____	x 4 =	_____
UPL	_____	x 5 =	_____
Total	_____(A)		_____(B)

Prevalence Index (B/A) = _____

Hydrophytic vegetation indicators:

☐ Rapid Test

☐ Dominance Test is >50%

☐ Prevalence Index is ≤3.0[1]

☐ Morphological adaptations[1] (supporting data in Remarks)

☐ Problematic hydrophytic vegetation[1]

Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Hydrophytic vegetation present?

YES ☐ NO ☐ UNCERTAIN ☐

Remarks:

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (cm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐ Gley profile OR
- ☐ Mottled profile

Horizon:
- ☐ Reductimorphic
- ☐ Redox mottled
- ☐ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location: Depression Flat Valley Gully Slope

Water table: Depth (cm) ____

High GW Perched Seepage Tidal Lithic

Pans: Depth (cm) _____

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Restricting layers: Depth (cm) _____

Slow perm argillic

☐ Pugged

Hydric soils present? YES ☐ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

Soil °C_____

- ☐ Surface water (1A)
- ☐ Groundwater <30 cm (1B)
- ☐ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☐ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☐ Saturation in aerial imagery (3F)
- ☐ Geomorphic position (4B)
- ☐ Shallow aquitard (4C)
- ☐ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D); refer to Section B: Vegetation

1. No. OBL & FACW dominant species _____(A)
2. No. FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

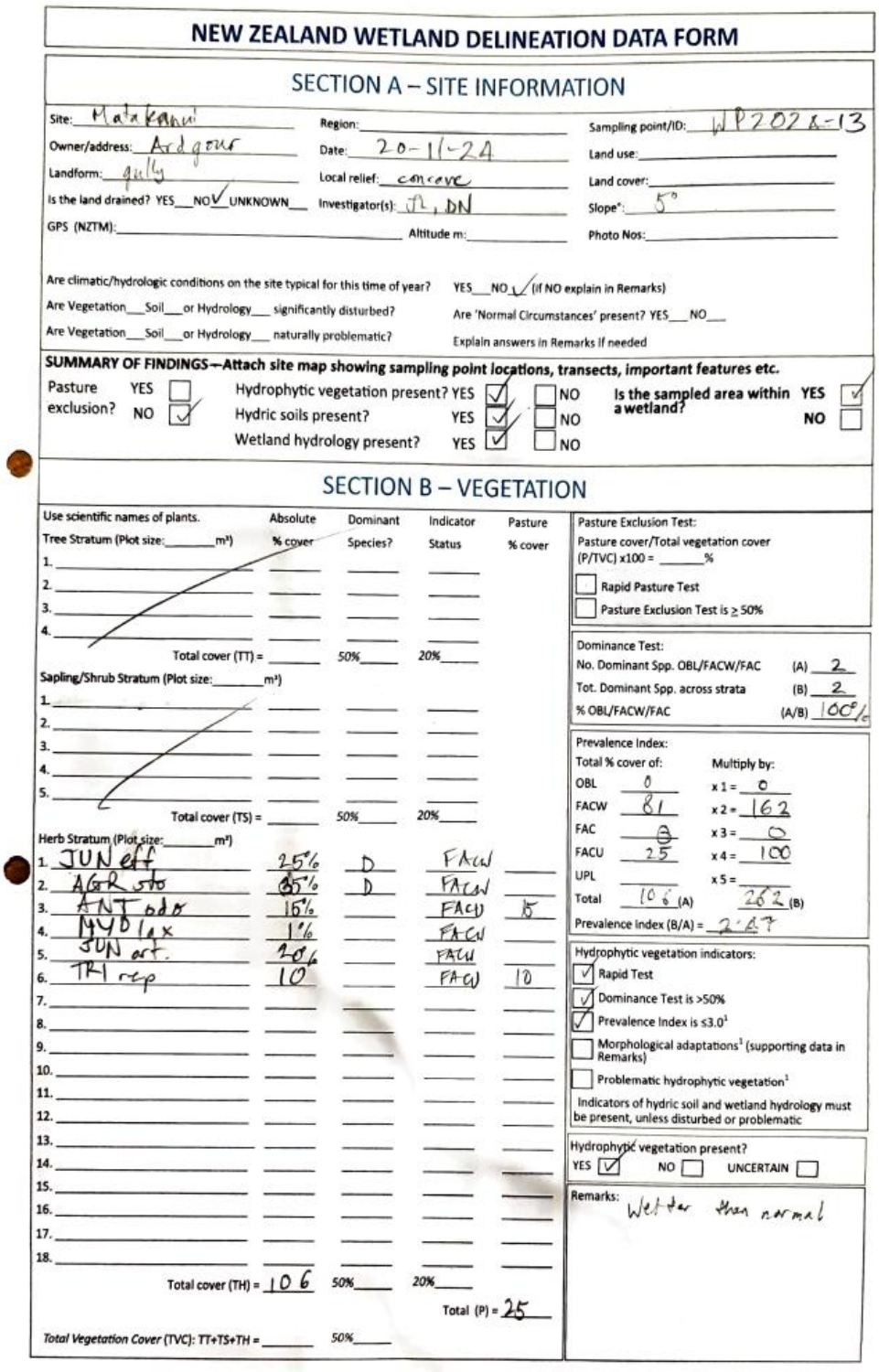
Wetland hydrology present? YES ☐ NO ☐

Sketch of site/vegetation types/sampling points:

Remarks:

Appendix B: Example of wetland delineation plot results

Indicative example of a completed wetland data sheet. Full wetland vegetation plot results are available on request.



NEW ZEALAND WETLAND DELINEATION DATA FORM

SECTION A – SITE INFORMATION

Site: Matakanui | Region: | Sampling point/ID: WP2026-13
Owner/address: Ardgour | Date: 20-11-24 | Land use:
Landform: gully | Local relief: concave | Land cover:
Is the land drained? YES__ NO✓ UNKNOWN__ | Investigator(s): JL, DN | Slope°: 5°
GPS (NZTM): | Altitude m: | Photo Nos:

Are climatic/hydrologic conditions on the site typical for this time of year? YES__ NO✓ (if NO explain in Remarks)
Are Vegetation__ Soil__ or Hydrology__ significantly disturbed? Are 'Normal Circumstances' present? YES__ NO__
Are Vegetation__ Soil__ or Hydrology__ naturally problematic? Explain answers in Remarks if needed

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features etc.

Pasture exclusion? YES ☐ NO ☑
Hydrophytic vegetation present? YES ☑ NO ☐
Hydric soils present? YES ☑ NO ☐
Wetland hydrology present? YES ☑ NO ☐
Is the sampled area within a wetland? YES ☑ NO ☐

SECTION B – VEGETATION

Use scientific names of plants.	Absolute % cover	Dominant Species?	Indicator Status	Pasture % cover
Tree Stratum (Plot size:____m²)				
1.				
2.				
3.				
4.				
Total cover (TT) = ____ 50%____ 20%____				
Sapling/Shrub Stratum (Plot size:____m²)				
1.				
2.				
3.				
4.				
5.				
Total cover (TS) = ____ 50%____ 20%____				
Herb Stratum (Plot size:____m²)				
1. JUN eff	25%	D	FACW	
2. AGR sto	35%	D	FACW	
3. ANT odo	15%		FACU	15
4. HYD lax	1%		FACW	
5. JUN art.	2%		FACU	
6. TRI rep	10		FACU	10
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
Total cover (TH) = 106 50%____ 20%____				
Total (P) = 25				
Total Vegetation Cover (TVC): TT+TS+TH = ____ 50%____				

Pasture Exclusion Test:
Pasture cover/Total vegetation cover (P/TVC) x100 = ____%
☐ Rapid Pasture Test
☐ Pasture Exclusion Test is ≥ 50%

Dominance Test:
No. Dominant Spp. OBL/FACW/FAC (A) 2
Tot. Dominant Spp. across strata (B) 2
% OBL/FACW/FAC (A/B) 100%

Prevalence Index:

Total % cover of:		Multiply by:	
OBL	0	x 1 =	0
FACW	81	x 2 =	162
FAC	0	x 3 =	0
FACU	25	x 4 =	100
UPL		x 5 =	
Total	106 (A)		262 (B)

Prevalence Index (B/A) = 2.47

Hydrophytic vegetation indicators:
☑ Rapid Test
☑ Dominance Test is >50%
☑ Prevalence Index is ≤3.0[1]
☐ Morphological adaptations[1] (supporting data in Remarks)
☐ Problematic hydrophytic vegetation[1]
Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Hydrophytic vegetation present?
YES ☑ NO ☐ UNCERTAIN ☐

Remarks: Wetter than normal

SECTION C – SOIL AND HYDROLOGY

Profile description: (Describe to the depth needed to confirm indicator presence/absence, 30 cm default)

Depth (cm)	Matrix colour (moist)	Mottles colour (moist)	Mottles %[1]	Mottles Size[2]	Mottle location[3]	Material[4]	Remarks
0-22	10YR 3/1	10YR 7/8	5%	10mm	–	mineral	
22-38	10YR 6/1	10YR 5/6	20%	"	–	"	

[1]Use % area charts; [2]Use size classes; [3]Ped face, pore, within ped along roots, within matrix; [4]Organic (peaty), humic, mineral soil

Hydric soil indicators:

Soil drainage (circle) W MW I P VP

Organic layers:
- ☐ Organic soil material
- ☐ Litter
- ☐ Fibric
- ☐ Mesic
- ☐ Humic
- ☐ Peaty topsoil
- ☐ Peaty subsoil

Concretions:
- ☐ Iron concretions
- ☐ Manganese concretions
- ☐ Nodular

Consistence:
- ☐ Plastic
- ☐ Sticky
- ☐ Fluid

Colours: profile form either:
- ☐
- ☑ Mottled

Horizon:
- ☑ Reductimorphic
- ☑ Redox mottled
- ☑ Redox segregations
- ☐ Perch-gley features

Cause of wetness (circle appropriate):

Location: Depression Flat Valley (Gully) Slope

Water table: Depth (cm) 0 cm

High GW Perched Seepage Tidal Lithic

Pans: Depth (cm) 38 rock

Pan Humus Fe-pan Densi- Duri- Fragi Ortstein

Layers: Depth (cm) _____

Slow perm argillic

☑ Pugged

Hydric soils present? YES ☑ NO ☐ UNCERTAIN ☐ NZSC subgroup _____

Primary hydrology indicators: minimum of 1 required; check all boxes that apply

Soil °C_____

- ☑ Surface water (1A)
- ☑ Groundwater <30 cm (1B)
- ☑ Soil saturation <30 cm (1C)
- ☐ Water marks (2A)
- ☐ Sediment deposits (2B)
- ☐ Drift deposits (2C)
- ☐ Algal mat/crust (2D)
- ☐ Iron deposits (2E)
- ☐ Surface soil cracks (2F)
- ☐ Inundation on aerial imagery (2G)
- ☐ Sparsely vegetated concave surface (2H)
- ☐ Salt crust (2I)
- ☐ Aquatic invertebrates (2J)
- ☑ Hydrogen sulphide odour (3A)
- ☐ Oxidised rhizosphere on roots (3B)
- ☐ Reduced iron (3C)
- ☐ Reduced iron in tilled soil (3D)
- ☐ High water table stunted/stressed plants (4A)

Secondary hydrology indicators: minimum of 2 required; check all boxes that apply

- ☐ Water-stained leaves (2K)
- ☐ Drainage patterns (2L)
- ☐ Dry-season water table (3E)
- ☑ Saturation in aerial imagery (3F)
- ☑ Geomorphic position (4B)
- ☑ Shallow aquitard (4C)
- ☑ FAC-neutral test (4D)
- ☐ Frost-heave hummocks (4E)

FAC-neutral test (4D); refer to Section B: Vegetation

1. No. OBL & FACW dominant species _____(A)
2. No. FACU & UPL dominant species _____(B)
3. Total _____(A+B)
4. FAC-neutral (>50%) _____(A/A+B)*100

Wetland hydrology present? YES ☑ NO ☐

Sketch of site/vegetation types/sampling points:

Remarks:

Appendix C: Plant species list from wetland plots

Species detected in 123 plots in wetlands in the ESA, in order of abundance (average percent cover per plot). Wetland indicator ratings; 1 – OBL, 2 – FACW, 3 – FAC, 4 – FACU, 5 – UPL. Non vascular species and bare ground and water are highlighted.

Common name	Species and indicator rating	Wetland indicator score	Indigenous	Threatened / At-Risk	Average percent cover
Creeping bent	*Agrostis stolonifera* FACW	2			24.08%
Jointed rush	*Juncus articulatus* FACW	2			15.53%
Rautahi	*Carex coriacea* FACW	2	1		11.82%
Bare ground/ water					5.22%
Soft rush	*Juncus effusus* var. *compactus* OBL	1			5.00%
Yorkshire fog	*Holcus lanatus* FAC	3			4.97%
White clover	*Trifolium repens* FACU	4			4.86%
Watercress	*Nasturtium officinale* OBL	1			3.21%
Pūrei	*Carex secta* OBL	1	1		2.44%
Duckweed	*Lemna disperma* OBL	1	1		2.40%
Sweet vernal	*Anthoxanthum odoratum* FACU	4			2.12%
Yellow sedge	*Carex demissa* FACW	2			2.07%
Floating sweetgrass	*Glyceria fluitans* OBL	1			2.00%
Liverwort/ moss					1.87%
Water forget-me-not	*Myosotis laxa* OBL	1			1.76%
Sedge sp.	*Carex* sp. FACW	2	1		1.33%
Matagouri	*Discaria toumatou* UPL	5	1		1.29%
Sedge	*Carex kaloides* FACW	2	1	At Risk - Declining	1.08%
Cutty grass	*Carex geminata* FACW	2	1		1.05%
Sinclair's sedge	*Carex sinclairii* OBL	1	1		1.00%
Perennial ryegrass	*Lolium perenne* FACU	4			0.90%
Crested dogstail	*Cynosurus cristatus* UPL	5			0.81%
Cocksfoot	*Dactylis glomerata* FACU	4			0.73%
Timothy	*Phleum pratense* FACU	4			0.68%
Buchanan's sedge	*Carex buchananii* FAC	3	1	At Risk - Declining	0.68%
Soft rush	*Juncus effusus* var. *effusus* FACW	2			0.53%
Sharp spike sedge	*Eleocharis acuta* OBL	1	1		0.50%
Toad rush	*Juncus bufonius* FACW	2			0.46%
Red clover	*Trifolium pratense* FACU	4			0.39%
Long-hair plume grass	*Pentapogon crinitus* UPL DIC cri	5	1		0.37%
Californian thistle	*Cirsium arvense* FACU	4			0.34%
Mingimingi	*Coprosma propinqua* FAC	3	1		0.28%
	Hydrocotyle novae-zeelandiae FAC	3	1		0.25%

Waoriki	*Ranunculus glabrifolius* OBL	1	1		0.21%
Talbot's sedge	*Carex talbotii* FACW	4	1	At Risk - Declining	0.20%
Mountain oat grass	*Pentapogon avenoides* UPL	5	1		0.20%
Broad-leaved dock	*Rumex obtusifolius* FAC	3			0.20%
Matagouri	*Discaria toumatou* UPL	5	1		0.18%
Scotch thistle	*Cirsium vulgare* FACU	4			0.18%
Matagouri	*Discaria toumatou* UPL	5	1		0.17%
Stitchwort	*Stellaria graminea* FAC	3			0.15%
Hairy buttercup	*Ranunculus reflexus* FACU	4	1		0.14%
Mouse-ear chickweed	*Cerastium fontanum* FACU	4			0.12%
Silver tussock	*Poa cita* FACU	4	1		0.12%
	Juncus distegus FACW	2	1	At Risk - Naturally uncommon	0.11%
Pōhuehue	*Muehlenbeckia complexa* FACU	4	1		0.10%
Sweet briar	*Rosa rubiginosa* UPL	5			0.10%
Annual poa	*Poa annua* FACU	4			0.10%
Tall willowherb	*Epilobium ciliatum* FAC	3			0.09%
Blinks	*Montia fontana* subsp. *fontana* OBL	1	1		0.09%
Suckling clover	*Trifolium dubium* UPL	5			0.08%
Cheatgrass	*Bromus tectorum* FACU	4			0.08%
Scented tree daisy	*Olearia odorata* FACU	4	1		0.07%
Hemlock	*Conium maculatum* FAC	3			0.07%
Black medick	*Medicago lupulina* FACU*	4			0.07%
Yarrow	*Achillea millefolium* FACU	4			0.05%
Browntop	*Agrostis capillaris* FACU	4			0.05%
Hawksbeard	*Crepis capillaris* FACU	4			0.05%
Monkey musk	*Erythranthe guttata* OBL	1			0.05%
Slender clubrush	*Isolepis cernua* OBL	1	1		0.05%
Kentucky bluegrass	*Poa pratensis* FACU	4			0.04%
Sheeps sorrel	*Rumex acetosella* FACU	4			0.04%
Pimpernel	*Lysimachia arvensis* FACU	4			0.04%
Self-heal	*Prunella vulgaris* FACU	4	1		0.04%
Foxglove	*Digitalis purpurea* UPL	5			0.03%
Clammy goosefoot	*Dysphania pumilio* FACU	4			0.03%
	Euchiton sp. FAC	3	1		0.03%
Blue tussock	*Poa colensoi* FACU	4	1		0.03%
Kirk's poa	*Poa kirkii* FACU	4	1		0.03%
Lotus	*Lotus pedunculatus* FAC	3			0.02%
	Koeleria spicata FACU	4			0.02%
Purging flax	*Linum catharticum* FAC	3			0.02%
Field forget-me-not	*Myosotis arvensis* FACU	4			0.02%
Beard grass	*Polypogon monspeliensis* FAC	3			0.02%
Grassland buttercup	*Ranunculus foliosus* FAC	3	1		0.02%
Swamp buttercup	*Ranunculus macropus* OBL	1	1	Data deficient	0.02%

Tall oat-grass	*Arrhenatherum elatius* FACU	4		0.01%
Soft brome	*Bromus hordeaceus* UPL	5		0.01%
Subterraneum clover	*Trifolium subterraneum* UPL	5		0.01%
Bastard grass	*Carex penalpina* FAC	3	1	0.01%
Musk	*Erythranthe moschata* OBL	1		0.01%
Bur medick	*Medicago nigra* FACU	4		0.01%
Hawkweed	*Pilosella officinarum* FACU	4		0.01%
Broad-leaved plantain	*Plantago major* FACU	4		0.01%
	Ranunculus sp. FAC	3		0.01%
Pearlwort	*Sagina procumbens* FACU	4		0.01%
Bog stitchwort	*Stellaria alsine* FACW	2		0.01%
Kohukohu	*Stellaria media* FACU	4		0.01%
Dandelion	*Taraxacum officinale* FACU	4		0.01%
Mountain violet	*Viola cunninghamii* FAC	3	1	0.01%

Appendix D: Threatened or At Risk plants within site wetlands

Acaena inermis	**Blue mountain bidibid/spineless bidibid**
National conservation status:	Not Threatened
Ecological value:	Moderate
Regional conservation status:	At Risk – Regionally Declining
Description:	A small endemic herb. Low-growing, mat-forming plant. It has soft, pinnate leaves that are typically bright green and finely divided. It is described as having no spines.
Habitat:	Coastal areas and open woodlands. It often grows in well-drained, fertile soils and can be seen in a variety of habitats ranging from grasslands to forest edges.
National distribution:	Found in both the North Island and South Island of New Zealand, but it is more commonly seen in the North Island.
Regional population trend:	Decline: 10–30%. >10,000 ha.
ESA distribution and population:	Rarely on wetland margins and in upland (dry land) areas

Carex kaloides	**Sedge**
National conservation status:	At Risk – Declining
Ecological value:	High
Regional conservation status:	Threatened – Regionally Endangered
Description:	Endemic. Rhizomatous; orange yellow, reddish yellow to orange, tufted swarding sedge. Individual tufts often rather large and tussock-like.
Habitat:	Montane to subalpine along river flats, in seepages, around the margins of lakes, ponds and tarns. Sometimes found in cushion bogs and amongst red tussock-dominated wetlands. Easily overlooked because its orange yellow leaves blend in with the surrounding taller vegetation.
National distribution:	Endemic. South Island in the east from Marlborough to Central Otago.
Regional population trend:	Decline: 10-30%. Regional Area <10 ha.
ESA distribution and population:	Present in wetland plots in DDF and SL at 7-50% cover. Frequent in some SL fens.
Threats:	A biologically sparse, naturally uncommon species which at times can be locally abundant. Can tolerate cattle browsing. However, it is vulnerable to competition from faster growing, taller exotic plant species [42]

[42] https://www.nzpcn.org.nz/flora/species/carex-kaloides/

Carex buchananii	**Buchanan's Sedge**
National conservation status:	At Risk – Declining
Ecological value:	High
Regional conservation status:	Threatened - Regionally vulnerable
Description:	A very distinct sedge easily recognised by the mostly reddish-brown culms and leaves, rarely yellow-green, arising from an ascending rhizome c. 3 mm diameter. Rather tall, stiffly erect tufted habit. Endemic.
Habitat:	Coastal to montane (up to 1000 m a.s.l.). On beaches, lagoon, lake, wetland and stream margins, or in damp ground within open forest or short tussock grassland. Facultative.
National/ regional distribution and trend:	North Island (uncommon, known only from scattered sites south of the Manawatu. South Island (more widespread and at times locally common, though often sporadically distributed, and apparently absent from Westland and Fiordland. Scarce in Southland). Present throughout the upper Clutha[43]. Regional trend stable: ±10%. Regional area ≤ 100 ha.
DDF distribution and population:	Estimated to be rare (1-10% coverage) within wetlands in the DDF, primarily in valley floor swamps and gully fens. Present in wetland plots 40 & 137 at 1-2% coverage.
Surrounding Landscape distribution and population:	Estimated to be Occasional (11-25% coverage) within wetlands in the SL, primarily in gully fens, but also valley floor swamps. Locally Abundant (51-75% cover) in one fen in the SL - detected in plot 54 in W232 in the SL at 65% coverage.
Threats:	Drainage and modification of wetland habitats. In lowland sites, invasive plant species can outcompete *Carex buchananii*.

Carex talbotii	**Talbot's sedge**
National conservation status:	At Risk – Declining
Ecological value:	High
Regional conservation status:	Threatened – Regionally Vulnerable
Description:	Endemic. Shortly rhizomatous, tufted dark purple red, wine-red, or orange red, tufted, small sedge.
Habitat:	A montane to subalpine (rarely lowland in the southern part of its range) wetland species inhabiting lake, tarn, pond, and stream side margins. It has also been collected from turfs bordering ephemeral wetlands.
National distribution:	In the North Island restricted to the Central Ranges and Mt Ruapehu where it is known from one alpine flush (Ruapehu) and one site in the Moawhango. In the South Island mainly easterly from Lake Tennyson south. Apparently not known from Marlborough or Westland.

[43] https://inaturalist.nz/observations?place_id=6803&subview=map&taxon_id=400398

Regional population trend:	Decline: 10-30%. <100 ha.
ESA distribution and population:	Rare in a scattering of seepages, fens and swamps in the DDF and SL.
Threats:	A biologically sparse species which is not so much threatened as nationally uncommon. However, some populations are now at risk through competition from taller and faster growing wetland weed species [44]

Carex diandra	**Sedge**
National conservation status:	Not Threatened
Ecological value:	Moderate
Regional conservation status:	At Risk – Regionally Naturally Uncommon
Description:	Endemic. Loosely tufted, non-tussock-forming, pale or bright green (rarely glaucous green), sedge.
Habitat:	Coastal to subalpine in open, moderately fertile to mid oligotrophic wetlands developed on river flats, within forest or in short or tall-tussock grasslands.
National distribution:	Indigenous. New Zealand: North and South Islands. Uncommon in the North Island and mainly found south of the Central Volcanic Plateau. More widespread in the South Island. Also present throughout the North Hemisphere and most of the Southern Hemisphere.
Regional population trend:	Stable: ± 10%.
ESA distribution and population:	Present in wetlands across the ESA. Location and abundance was not noted, as they were listed as Not Threatened at the time of survey.

Deschampsia chapmanii	**Tussock grass**
National conservation status:	Not Threatened
Ecological value:	Moderate
Regional conservation status:	Regionally Data Deficient
Description:	Endemic. Forms dense clumps and has fine, wiry leaves with tall flowering stems that produce delicate, airy flower heads.
Habitat:	Usually is a hydrophyte but occasionally found in uplands (non-wetlands) (FACW).
National distribution:	North Island, South Island, Stewart Island
Regional population trend:	N/A
ESA distribution and population:	Present in wetlands across the ESA. Location and abundance was not noted, as they were listed as Not Threatened at the time of survey.

[44] https://www.nzpcn.org.nz/flora/species/carex-talbotii/

Juncus distegus	Rush
National conservation status:	Not Threatened
Ecological value:	Moderate
Regional conservation status:	At Risk – Regionally Declining
Description:	Endemic rush. Small, dark green to red-green, wiry, tightly packed clumps. Flowering stems. Leaves absent. Brown, red/pink flowers.
Habitat:	Widespread but generally local in its occurrences. Coastal to upper montane (1200 m a.s.l.). Often fringing swamps, and in cloud forest common along board walks. Also present in drier hill country, and in tussock grassland. Tending to favour poorly drained clay soils.
National distribution:	North Island, South Island, Chatham Islands.
Regional population trend:	Decline: 10-30%. Estimated 5000– 20000 mature individuals in Otago.
ESA distribution and population:	Only observed in Jean Creek

Olearia bullata	**Tree daisy**
National conservation status:	Not Threatened
Ecological value:	Moderate
Regional conservation status:	At Risk – Regionally Naturally Uncommon
Description:	Endemic. Bushy greyish shrub with wide-angled interlacing reddish twigs bearing wrinkled narrow rolled leaves that are white underneath
Habitat:	Commonly in wet areas. Usually is a hydrophyte but occasionally found in non-wetlands (FACW).
National distribution:	South Island east of the main divide.
Regional population trend:	Stable: ± 10%. <100,000 individuals [45]
ESA distribution and population:	One individual observed in a fen / riparian margin near the border of the DDF

[45] Jarvie, S., Barkla, J., Rance, B., Rogers, G., Ewans, R., & Thorsen, M. (2024). *Regional Conservation Status of Indigenous Vascular Plants in Otago*. Otago Threat Classification Series 3. Otago Regional Council, Dunedin, New Zealand. ISBN: 978-1-7385867-2-1.

Olearia lineata	**Tree daisy**
National conservation status:	At Risk – Declining
Ecological value:	High
Regional conservation status:	At Risk – Regionally Declining
Description:	Endemic. Bushy small tree bearing masses of erect square in cross-section twigs that have clusters of small very thin leaves that are white underneath
Habitat:	Lowland to montane (10–300 m a.s.l.) grey scrub, tussock grassland and forest margins. Often on river terraces in or near seepages and ephemeral wetlands, on occasion even growing in shallow water. Also found on the margins of steep river gorges, and in and amongst rock outcrops, boulder field and at the toe of alluvial fans.
National distribution:	South Island, easterly from north Canterbury south to Southland and Stewart Island/Rakiura. Damper sites in the southern ⅔ of the South Island.
Regional population trend:	Decline: 10-30%. 5,000-20,000 mature individuals.
ESA distribution and population:	Occasional patches or individuals in gullies and observed rarely on wetland margins in the SL.
Threats:	Widespread and at times locally abundant (especially in some parts of Central Otago) *Olearia lineata* is otherwise often known from only widely scattered sites with few individuals. Although widespread, the majority of the known populations are not officially protected and recruitment is often lacking. *Olearia lineata,* together with the majority of eastern South Island endemic *Olearia* Sect. Divaricaster Heads, is the subject of a major Department of Conservation initiated Recovery Plan. As part of that work this species has been subject to intensive survey.

Rumex flexuosus	**New Zealand dock**
National conservation status:	Not Threatened
Ecological value:	Moderate
Regional conservation status:	At Risk – Regionally Naturally Uncommon
Description:	Endemic. Slender, perennial herb. It has narrow, wavy-edged leaves and reddish stems, often growing in damp or boggy habitats such as wetlands and stream edges.
Habitat:	Usually is a hydrophyte but occasionally found in uplands (FACW).
National distribution:	North Island, South Island, Stewart Island.
Regional population trend:	Stable: ± 10%.
ESA distribution and population:	Present at Lower Shepherd Creek artificial pond.

Appendix E: Representative wetland type photographs

Fen/Marsh:

Appendix E1. A fen/marsh in upper Shepherds Creek on the valley floor.

Appendix E1b. A fen/marsh in upper Shepherds Creek on the valley floor.

Appendix E1c. A fen/marsh in lower Shepherds Creek within a gully.

Appendix E1d-e. Example soils cores from fen/marsh wetlands from WP64 (left) and WP62 (right).

Swamp/marsh:

Appendix E2a. A swamp/marsh in upper Shepherds Creek on the valley floor.

Appendix E2b. A swamp/marsh in Rise and Shine on the valley floor.

Appendix E2c. A swamp/marsh in Rise and Shine on the valley floor.

Appendix E2d-e. Example soil cores from swamp/marsh wetlands from WP131 (left) and WP22 (right).

Seepage:

Appendix E3a. A seepage in lower Shepherds Creek on a hillside.

Appendix E3b. A seepage in upper Shepherds Creek on a hillside.

Appendix E3c. A seepage in Rise and Shine on a hillside.

Appendix E3d-e. Example soil cores from seepage wetlands from WP65 (left) and WP63 (right).

Appendix F: Wetland areas at higher resolution

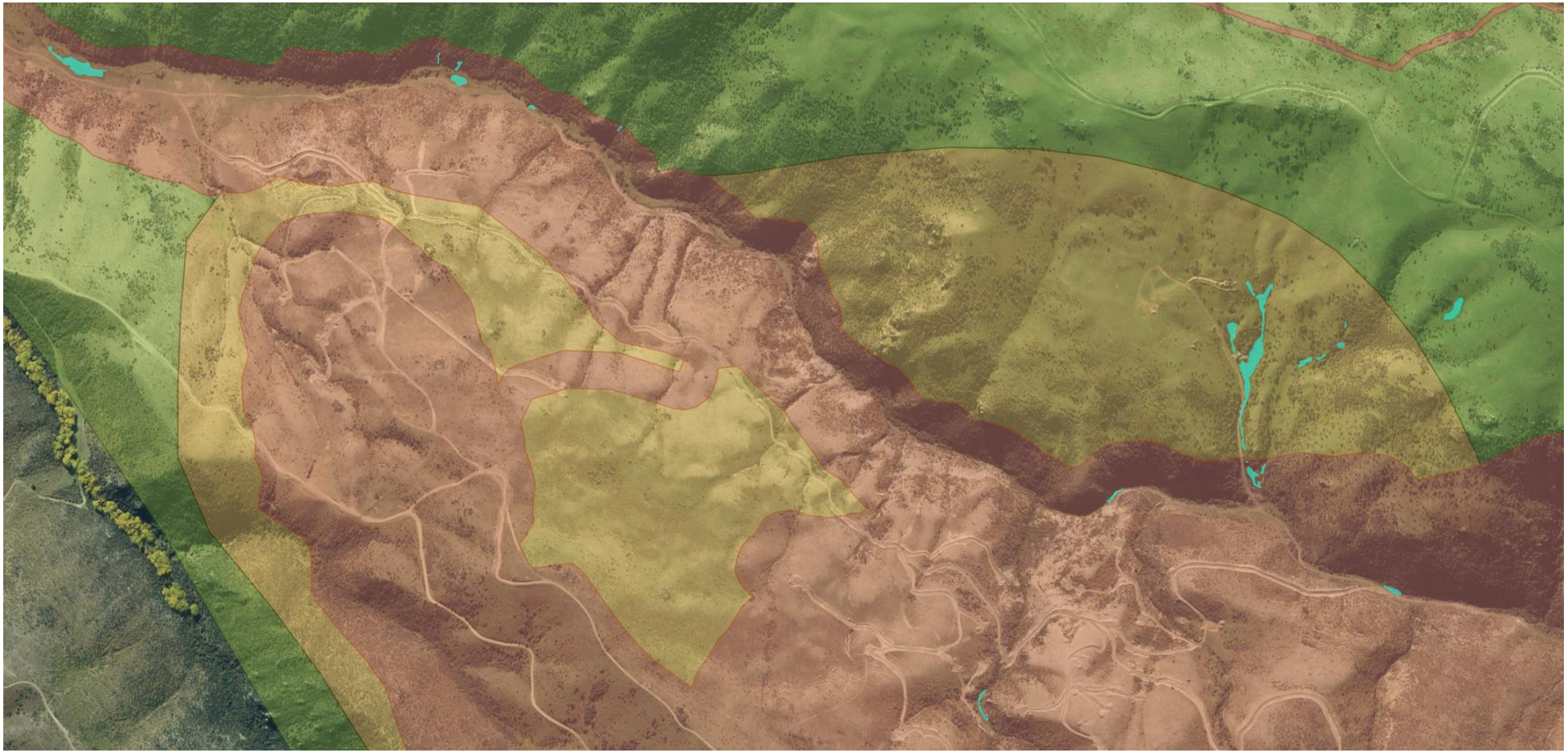


Figure F1. Near beginning of Shepherds Creek valley with wetlands highlighted in blue. DDF (red), DDZ (orange), SLSW (green).

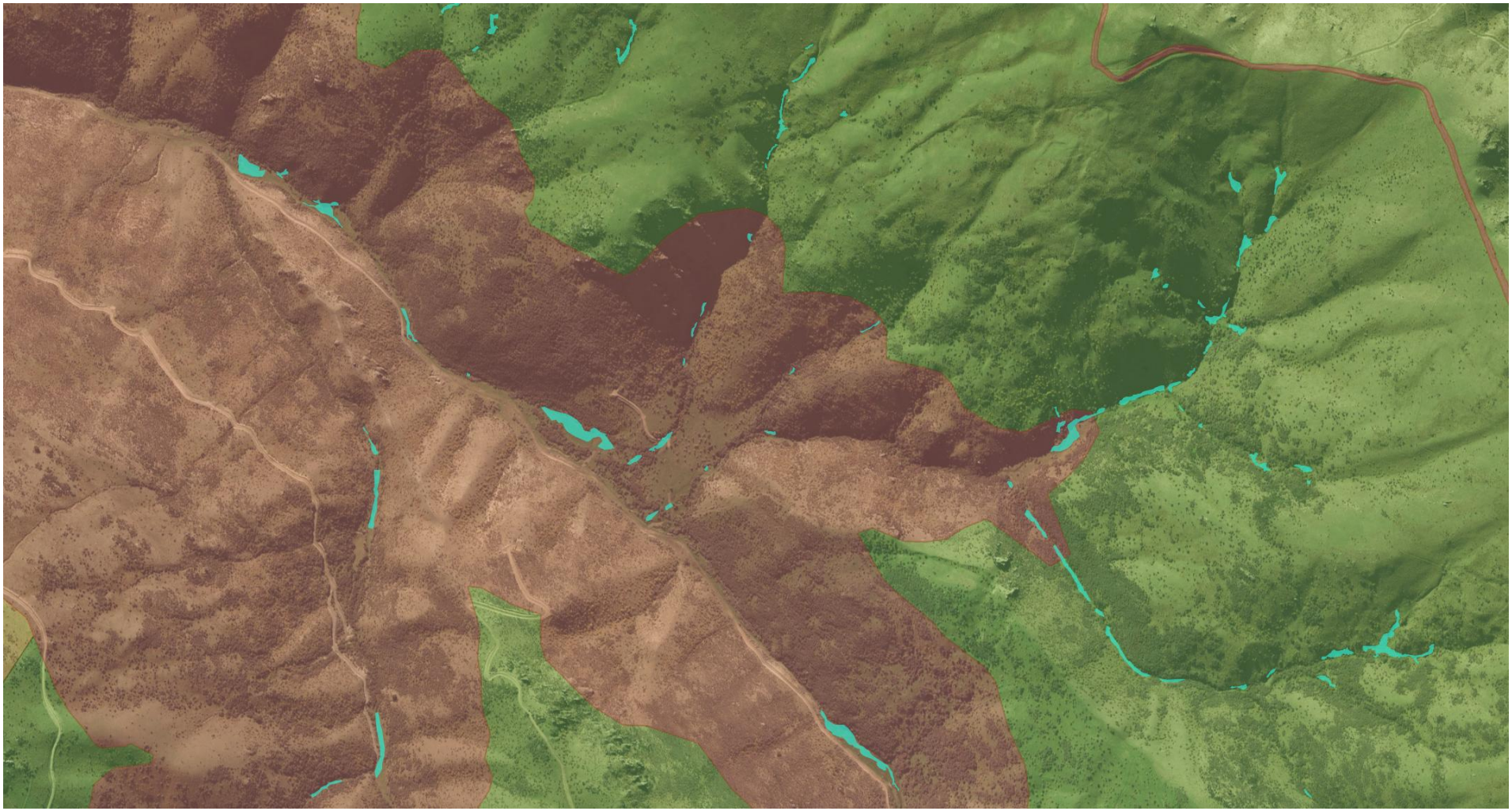


Figure F2. Mid- to upper- Shepherds Creek with wetlands highlighted in blue. DDF (red), DDZ (orange), SLSW (green).

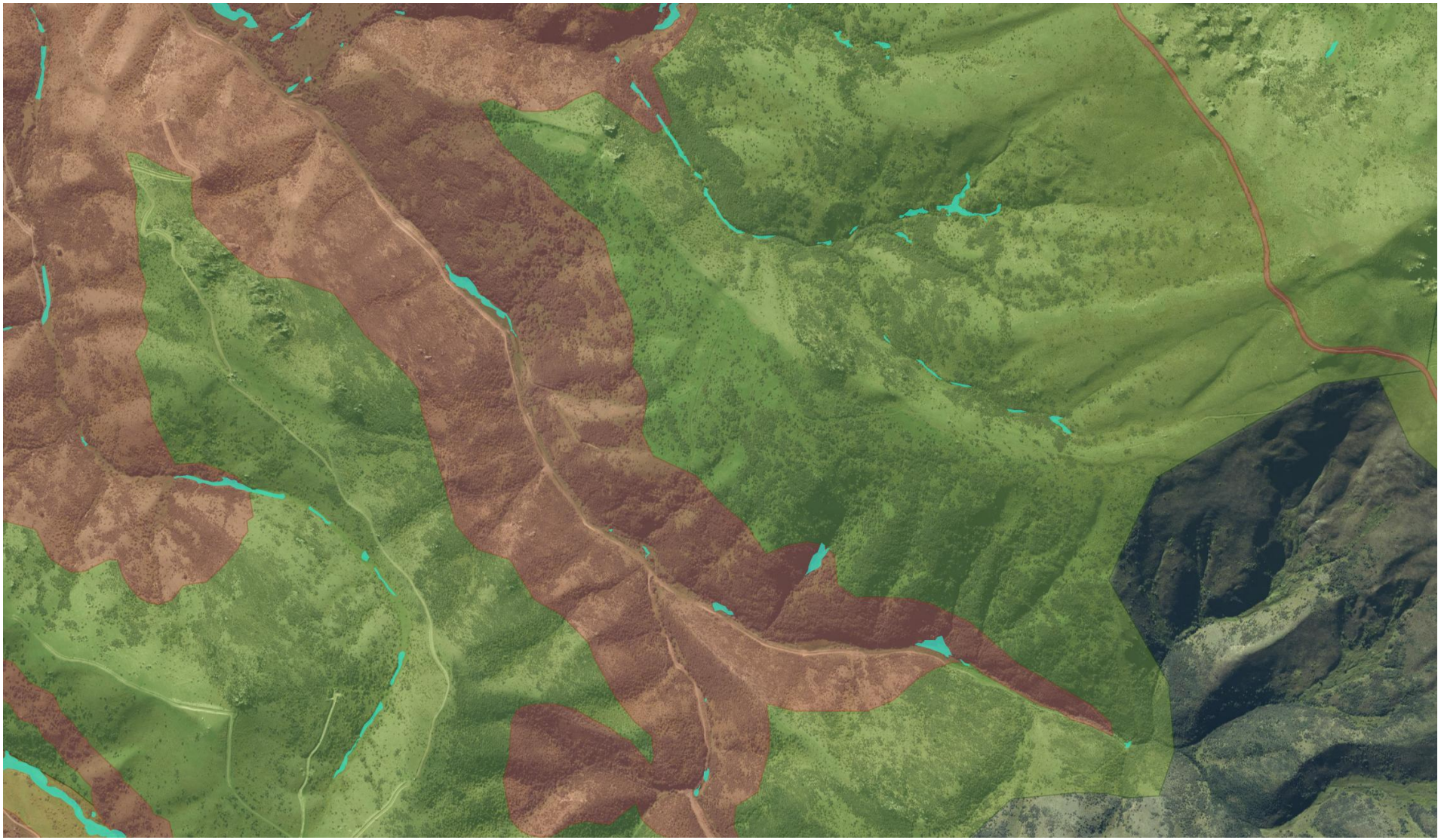


Figure F3. Upper Shepherds Creek and Jean Creek with wetlands highlighted in blue. DDF (red), DDZ (orange), SLSW (green).

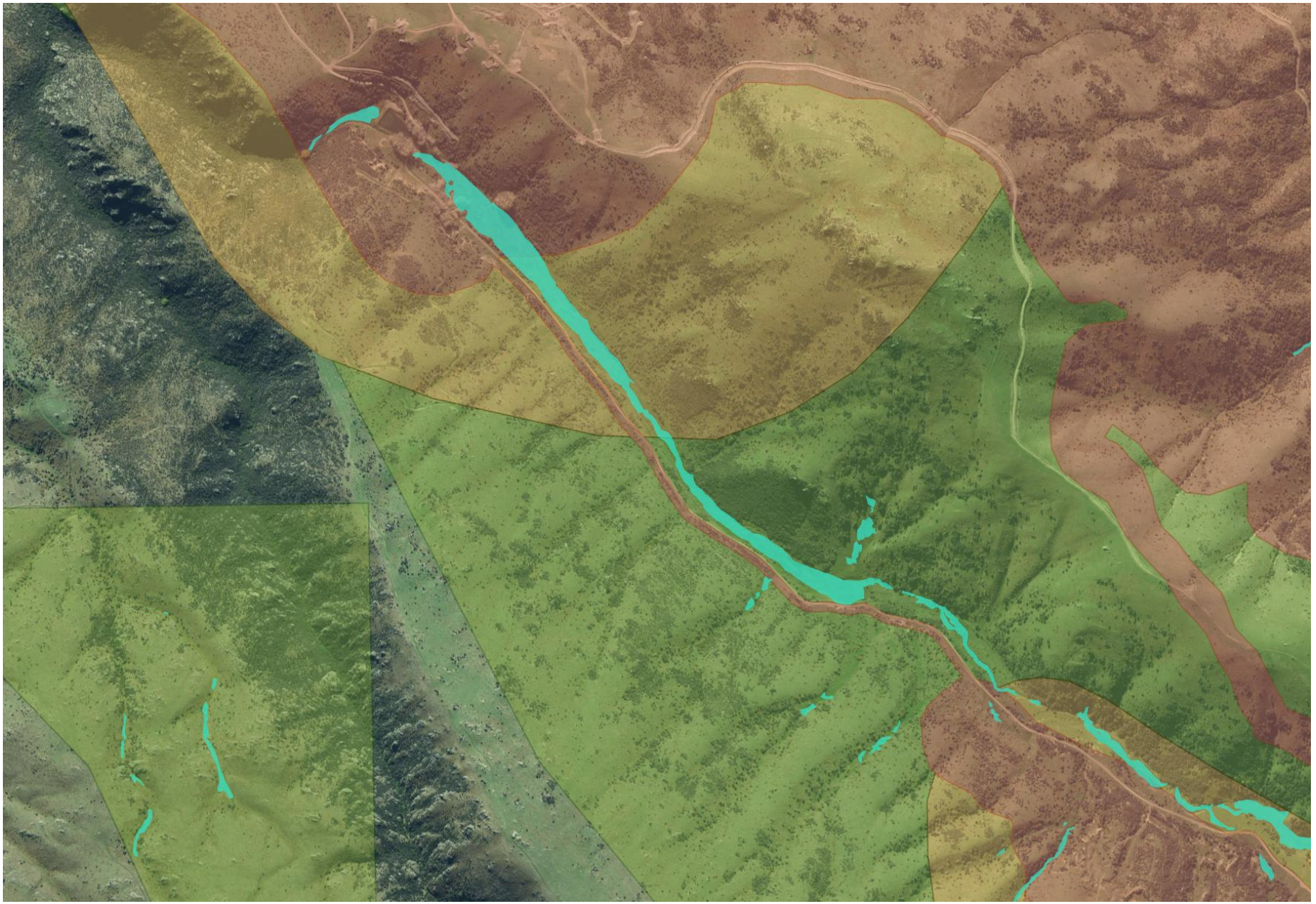


Figure F4. Rise and Shine Creek with wetlands highlighted in blue. DDF (red), DDZ (orange), SLSW (green).

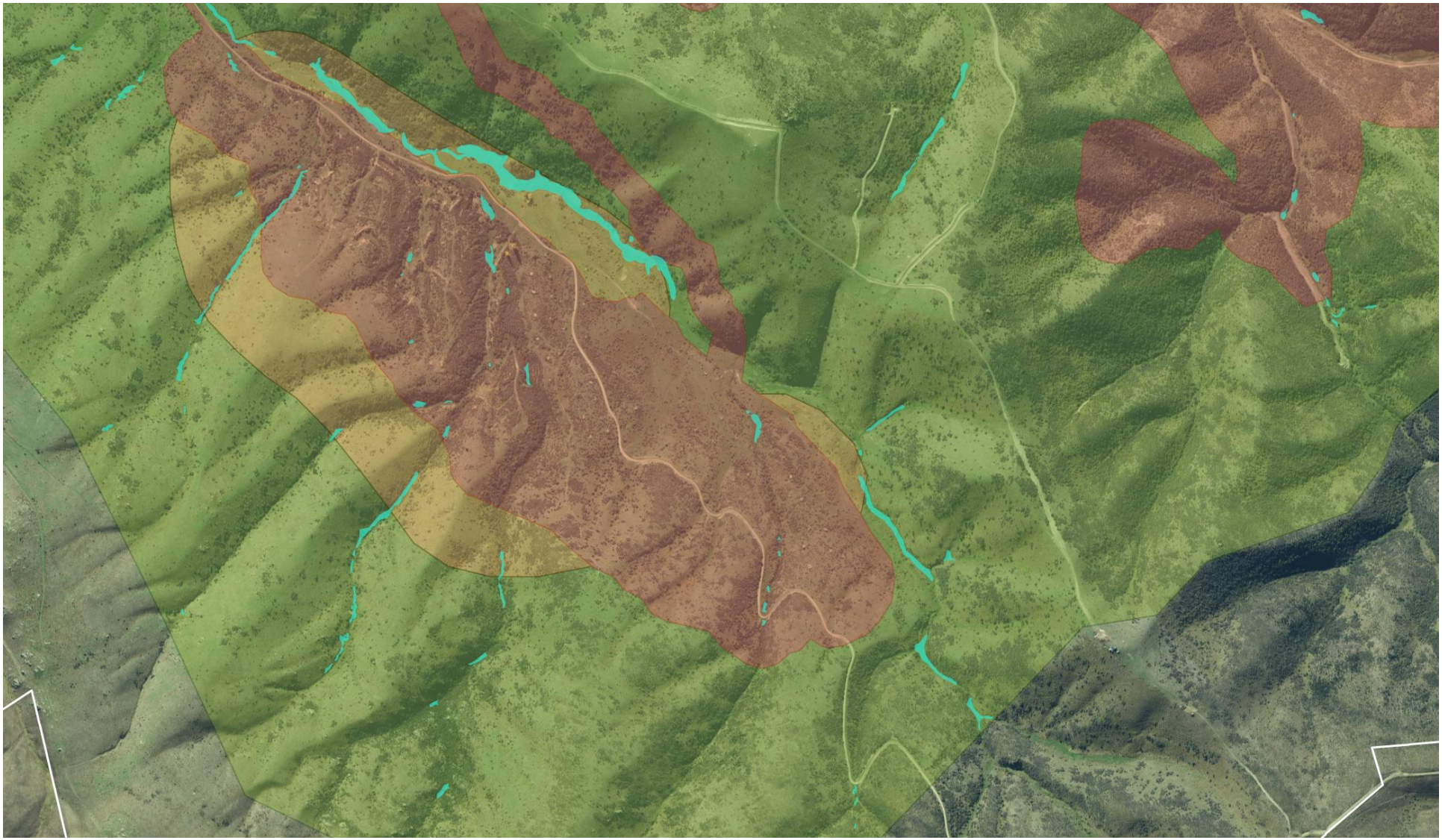


Figure F5. Rise and Shine Creek with wetlands highlighted in blue. DDF (red), DDZ (orange), SLSW (green).

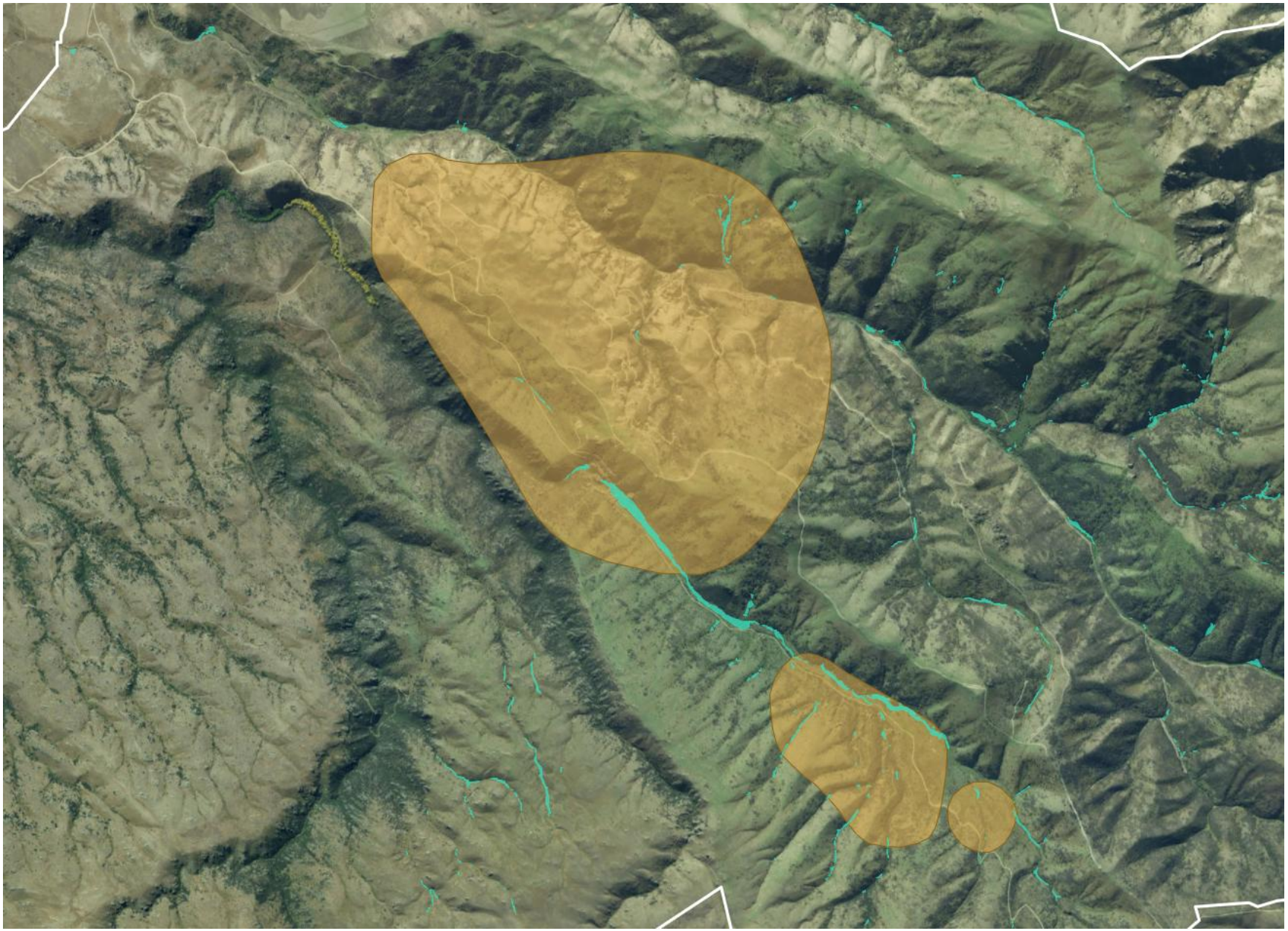


Figure F6. Unclipped Potential Dewatering Drawdown Zone (DDZ; orange) and wetlands (blue).

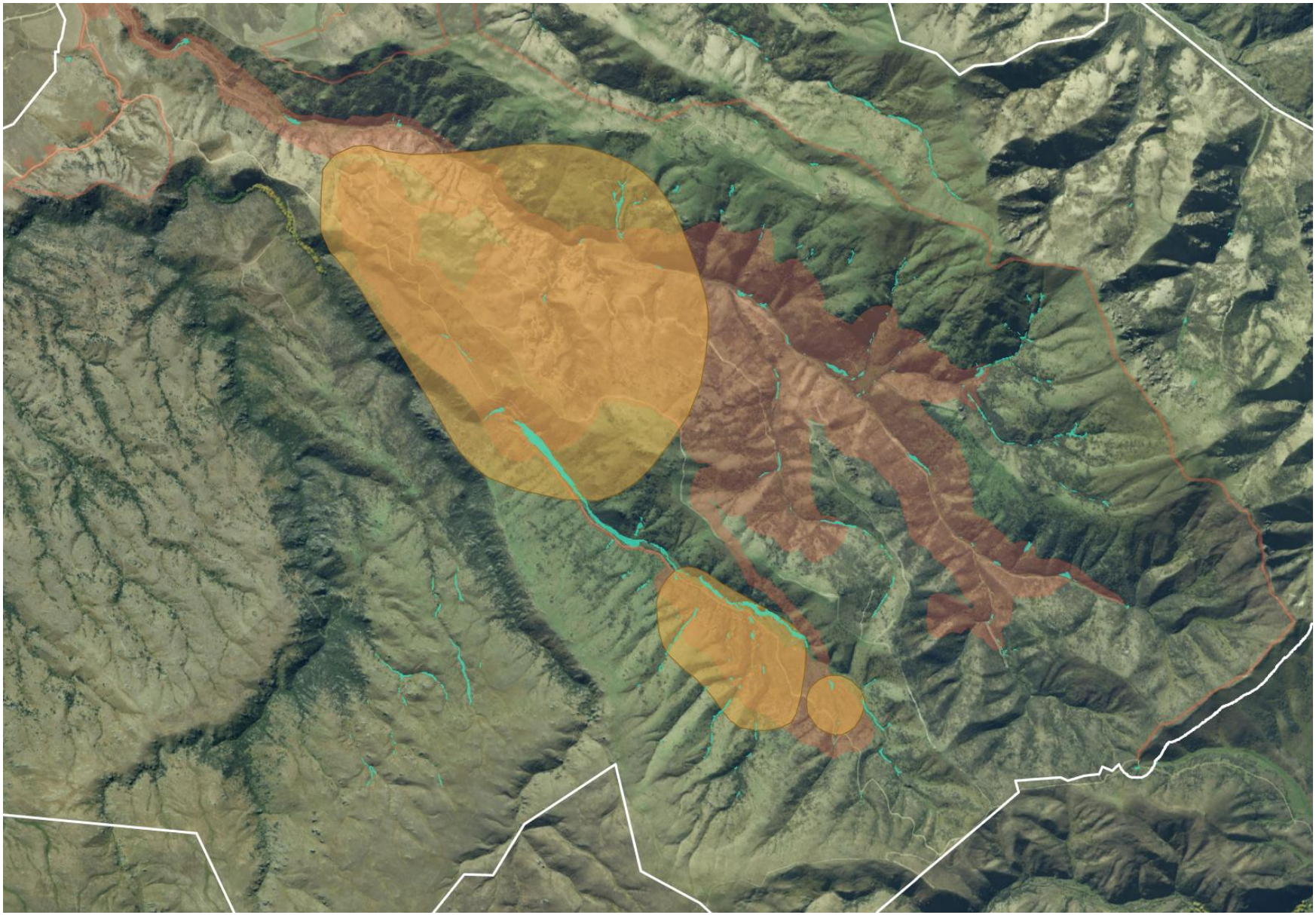


Figure F7. Unclipped Potential Dewatering Drawdown Zone (DDZ; orange), Direct Disturbance Footprint (DDF; red), and wetlands (blue).

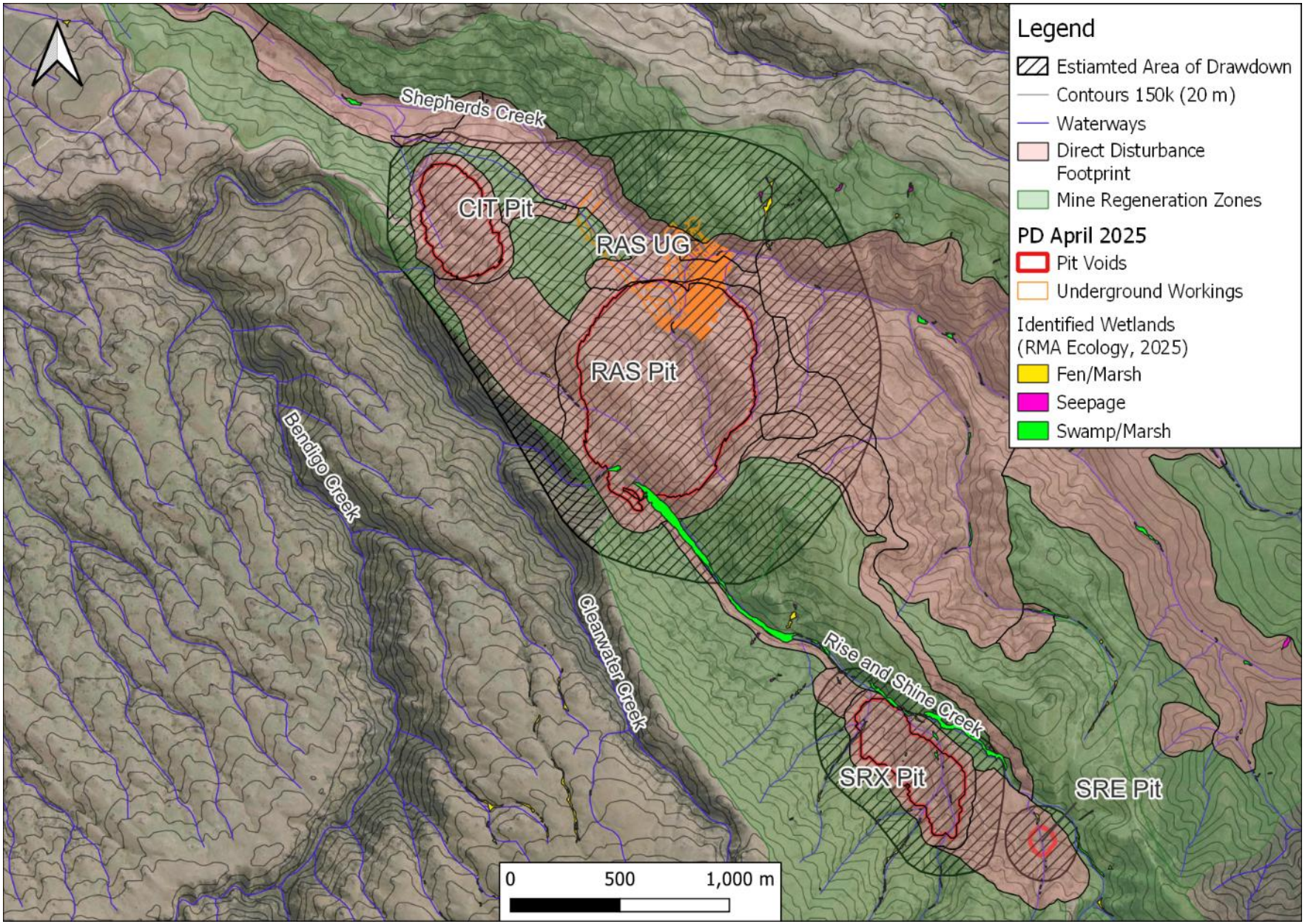


Figure F8. Estimated area of drawdown from 'BOGP Wetland Drawdown Assessment: Figure 5'.