Boffa Miskell

Shotover WWTP

Ecological Impact Assessment
Prepared for Queenstown Lakes District Council

28 May 2026

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Executive Summary

This Ecological Impact Assessment evaluates the potential effects of discharging treated wastewater from the Shotover Wastewater Treatment Plant to the Kawarau River via a new pipeline and outfall structure (or alternative pipeline configuration). The proposal includes installation of approximately 1.3 km of pipeline, construction works affecting up to a total of 16,000 m², including activities in a riverbed, and a 35-year discharge consent. Advanced wastewater treatment (including filtration, UV disinfection, and chemical dosing) is proposed to improve wastewater quality prior to discharge.

The terrestrial environment within the project footprint is highly modified and dominated by exotic vegetation (e.g. crack willow, buddleia, lupin), resulting in negligible to low ecological value. The Shotover River and delta provide habitat for braided river birds, including one Threatened species (black-fronted tern) and several At Risk species, however, this is outside the project footprint.

The Kawarau River is assessed as having high ecological value, with good water quality, nationally significant river characteristics, and habitat for indigenous fish such as longfin eel and kōaro (both At Risk – Declining). Freshwater communities are typical of a large, high-energy river system, with macroinvertebrates dominated by tolerant taxa and relatively low diversity; overall ecological condition is influenced by natural factors and historic land use.

The actual and potential construction effects include:

- Terrestrial vegetation clearance and terrestrial habitat disturbance within a modified footprint (very low ecological impact).
- Temporary disturbance to riverine birds, including potential impacts on birds nesting in the nearby braided river environment.
- Very low freshwater effects including sediment release, bed disturbance, and risk of fish disturbance, injury or mortality.
- Risk of terrestrial and aquatic weed spread, which could have higher consequences if transferred to more intact environments.

The actual and potential operational effects include:

- Localised changes in water quality (nutrients, metals, suspended solids) in the immediate vicinity of the discharge (within the near-field mixing area).
- After reasonable mixing (c.800 m downstream, indicated by monitoring point RS10 at c.950 m downstream), water quality is predicted to meet national and regional guidelines (other than dissolved reactive phosphorus) and return close to background conditions. Therefore, no secondary effects on the freshwater ecosystem are anticipated (e.g. excessive periphyton growth, changes in macroinvertebrate or fish communities).

- Minimal effects on flow regime and physical habitat due to the small area affected within the riverbed.

No cumulative effects on ecological values in the Kawarau River or further downstream at Lake Dunstan are expected. This is due to improvements in discharge quality and outfall design, the continued reduction of effects from the Dose and Drain field, and the cessation of the short-term Shotover River discharge once the proposed Kawarau River discharge becomes operational.

While many of the effects summarised above are localised, have a low likelihood of occurring and / or mostly result in a very low to low overall level of effect, a range of mitigation and management measures are proposed to avoid and further minimise adverse effects, including:

- Erosion and sediment controls during construction and revegetation of earthwork areas.
- Biosecurity protocols (e.g. Check, Clean, Dry) to prevent weed and pest spread.
- Pre-construction bird surveys and seasonal restrictions to avoid impacts on breeding riverine birds.
- Fish management during instream works.
- Ongoing ecological and water quality monitoring at multiple river sites and further investigation if monitoring detects a change that may be as a result of the discharge.

Most of the actual and potential ecological effects (with the exception of three) will be at a ‘very low’ level, without effects management measures in place. However, once the effects management measures are in place, all actual and potential ecological effects will be ‘very low’. A summary of the ecological values, potential and actual effects and overall level of effect with and without management measures are provided in the following table.

Summary of Ecological Effects Assessment

Ecological Component	Component / Effect	Ecological value	Overall level of effect	
			Pre-mitigation	Post-mitigation
Terrestrial Vegetation and Habitats	Vegetation clearance (construction)	Negligible - Low	Very Low	Very Low
	Habitat fragmentation (construction)	Negligible - Low	Very Low	Very Low
	Weed introduction and / or spread (construction)	Negligible - Low	Very Low	Very Low
	Spread of weeds to other sites (construction)	Negligible – Very High	Low – Very High	Very Low
Avifauna	Habitat loss and modification (construction)	Low – Very High	Very Low	Very Low
	Disturbance and displacement (construction)	Low – Very High	Very Low to Low	Very Low
	Impacts on nesting birds (terrestrial habitats) (construction)	Low	Very Low	Very Low
	Impacts on nesting birds (Shotover River and delta) (construction)	Low – Very High	Low - High	Very Low
	Changes in water quality	Low – Very High	No Effect	No Effect
Kawarau River	Bed and bank disturbance (construction)	High	Very Low	Very Low
	Fish injury / mortality (construction)	High	Very Low – Low	Very Low
	Sediment release (construction)	High	Very Low	Very Low
	Spread of aquatic weeds (construction)	Negligible – Very High	Low – Very High	Very Low
	Physical habitat modification	High	Very Low	Very Low
	Changes in water quality – Physical chemistry	High	Very Low*	Very Low
	Changes in water quality – Nutrients	High	Very Low*	Very Low
	Changes in water quality – Metals and other contaminants	High	Very Low*	Very Low
	Changes in water quality – Suspended solids	High	Very Low*	Very Low
	Changes in water quantity	High	Very Low	Very Low
	Ongoing structure maintenance	High	Very Low	Very Low

* The pre-mitigation level of effect for changes in water quality effects for the Kawarau River represent the mitigated discharge scenario following treatment and minimisation actions already undertaken.

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1.0 Introduction

Boffa Miskell Limited has been engaged by Queenstown Lakes District Council (QLDC) to prepare an EcIA to support the resource consent applications for the construction of the proposed wastewater discharge pipeline and / or outfall, and the proposed discharge of treated wastewater from the SWWTP to the Kawarau River.

1.1 Purpose and scope

The purpose of this report is to determine the ecological values of the Kawarau River and Shotover Delta site, and the types and levels of ecological effects associated with the proposed works, including construction of the wastewater discharge pipeline and potential outfall, and the long-term operation of the outfall and discharge.

The scope of this report includes the following:

- Desktop review of publicly accessible ecological information for the Kawarau River, Shotover Delta, and the wider surrounding area
- Site investigation of the project footprint and receiving environment of the proposed discharge, including undertaking assessments of freshwater and terrestrial environments
- Assessment of the ecological features and values in the project footprint and receiving environment
- An assessment of ecological effects prepared following the framework within the EcIA New Zealand (EIANZ) Guidelines (Roper-Lindsay et al., 2018).
- Mitigation and monitoring recommendations.

1.2 Limitations and assumptions

This report relies on discharge volumes, water quality predictions, hydrodynamic modelling, and civil design information provided by GHD (e.g. GHD, 2026). The content of this report is based on the accuracy and completeness of these inputs, and no independent verification of the underlying modelling or design assumptions has been undertaken.

1.3 Project Overview

The consent application is for the discharge of treated wastewater from the Shotover Wastewater Treatment Plant (SWWTP) to the Kawarau River via a pipeline and outfall. Wastewater treatment will include preliminary treatment via inlet screens and grit removal, secondary treatment via bioreactor tanks and secondary clarifiers, tertiary filtration and UV disinfection, and supplementary chemical dosing.

The treated wastewater will be discharged to the Kawarau River via an outfall located on the true left bank of the Kawarau River immediately upstream of the confluence with the Shotover (Kimiākau) River. Consent for the discharge of treated wastewater is sought for a duration of 35 years.

Associated consents relating to works in the riverbed to construct the outfall are also being sought and are assessed in this report.

2.0 Site Description

2.1 Site Location

The SWWTP is located on the Shotover River delta, between the true left bank of the Kawarau River and the true right bank of the Shotover River, approximately 40 m below Frankton Terrace. The discharge pipe will run from the south side of the SWWTP on the right bank of the Shotover River delta to the outfall on the Kawarau River immediately upstream of its confluence with the Shotover River (Figure 1).

2.2 Existing land use and site history

The right bank of the Shotover River delta is a mix of exposed gravels, mostly exotic vegetation and existing infrastructure, including the SWWTP, quarry storage areas and associated roads, and recreational tracks. While a large proportion of the Shotover River delta remains undeveloped, the delta and Shotover River are modified. Modifications include willow planting and weed invasion, off road vehicle use, gravel extraction and quarrying activities, the SWWTP and construction of the river training line / stop bank and other channel alignment works to prevent flooding.

The wider catchment has been substantially modified by historic gold mining, flood protection works, and land use, including urban development, transport infrastructure, agriculture, and recreation.

The Kawarau River is used for jet-boating and other recreational activities and non-commercial small-scale gravel extraction.

2.3 Background on SWWTP

The SWWTP was constructed in 1974, to treat wastewater for the wider Queenstown area with a basic inlet works channel and three oxidation ponds. Several upgrades have been undertaken over time to improve plant infrastructure, treatment and to cater for population growth in the Wakatipu Basin. The most recent upgrades were:

- Stage 1 upgrade of the SWWTP treatment train (commissioned in 2017), including addition of a grit removal, septage receiving facility, a Modified Ludzack-Ettinger (MLE) biological reactor with secondary clarification, and UV disinfection.
- Stage 2 upgrades undertaken in 2019 to construct a “disposal to land” scheme via rapid infiltration into the Shotover Delta gravels. This was known as the Dose and Drain (DaD).
- Stage 3 upgrades were completed in late 2025 to accommodate growth in the Queenstown area. These upgrades included an added secondary MLE and clarifier and increased the treatment capacity significantly to a 2048 population forecast and decommissioned the oxidation ponds.

Treated wastewater was discharged directly to the Shotover River via open channels up until 2019 when the DaD was commissioned. Disposal of treated wastewater to the DaD system involved flooding the gravels in the disposal field and allowing the treated wastewater to drain into the underlying gravels and into the shallow groundwater system. The DaD field experienced numerous issues after commissioning, with overflows and large areas of ponding.

The presence of ponded water created an unacceptable bird strike risk to aircraft due to the presence of waterfowl directly below the flight path for Queenstown Airport. Due to the risk, QLDC decided to redirect the treated wastewater down one of the historic channels to the Shotover River under emergency works provisions. This discharge commenced in March 2025.

Further plant upgrades have been proposed to improve the discharge quality, including supplementary chemical dosing to remove phosphorus, tertiary filtration to remove solids, and enhanced UV disinfection (if required).

Refer to the Assessment of Environmental Effects (AEE) (Landpro Limited, 2026) and Surface Water and Groundwater Assessment (GHD, 2026) for more detail on the history and planned upgrades of the SWWTP.

2.4 Monitoring locations

Five sites within the Kawarau River are monitored for ecological and water-quality parameters in accordance with the Shotover WWTP Receiving Environment Monitoring Plan (REMP) (GHD, 13 June 2025). Four of these sites (RS10, RS11, RS12 and RS14) are specified in the REMP for ecological monitoring, while RS13 is included as an additional ecology site to align with the established water-quality monitoring network (GHD, 2026). All sites are located on the true left bank of the Kawarau River (Figure 1).

RS10 is positioned in the Kawarau River downstream of the Shotover River confluence and represents the downstream receiving environment relative to the proposed discharge structure (i.e. the extent of the reasonable mixing zone). RS11 is located at the proposed discharge structure location. The remaining three sites (RS12, RS13, RS14) are situated upstream of the proposed discharge structure and characterise upstream conditions.

Sites RS11, RS12, and RS13 have been subject to historical water quality effects associated with elevated nutrient concentrations from the DaD groundwater and surface overflow (GHD, 2026), which may have contributed to ecological effects over this period. However, ecological monitoring was not undertaken at the time (i.e. before 2026) at these locations, so the extent of any ecological response cannot be confirmed. RS10 may similarly reflect historical and ongoing effects from the short-term discharge to the Shotover River (GHD, 2026).

RS14 represents upstream conditions in the Kawarau River unaffected by SWWTP discharges. Inclusion of all five sites in this assessment supports evaluation of any residual DaD-related effects, enables comparison between upstream and downstream conditions, and provides a more complete understanding of the existing environment and cumulative effects.

A limitation of all monitoring sites is that they are located on the true left bank of the Kawarau River and do not capture conditions within the main body of the river, which is too deep and fast-flowing to safely sample.

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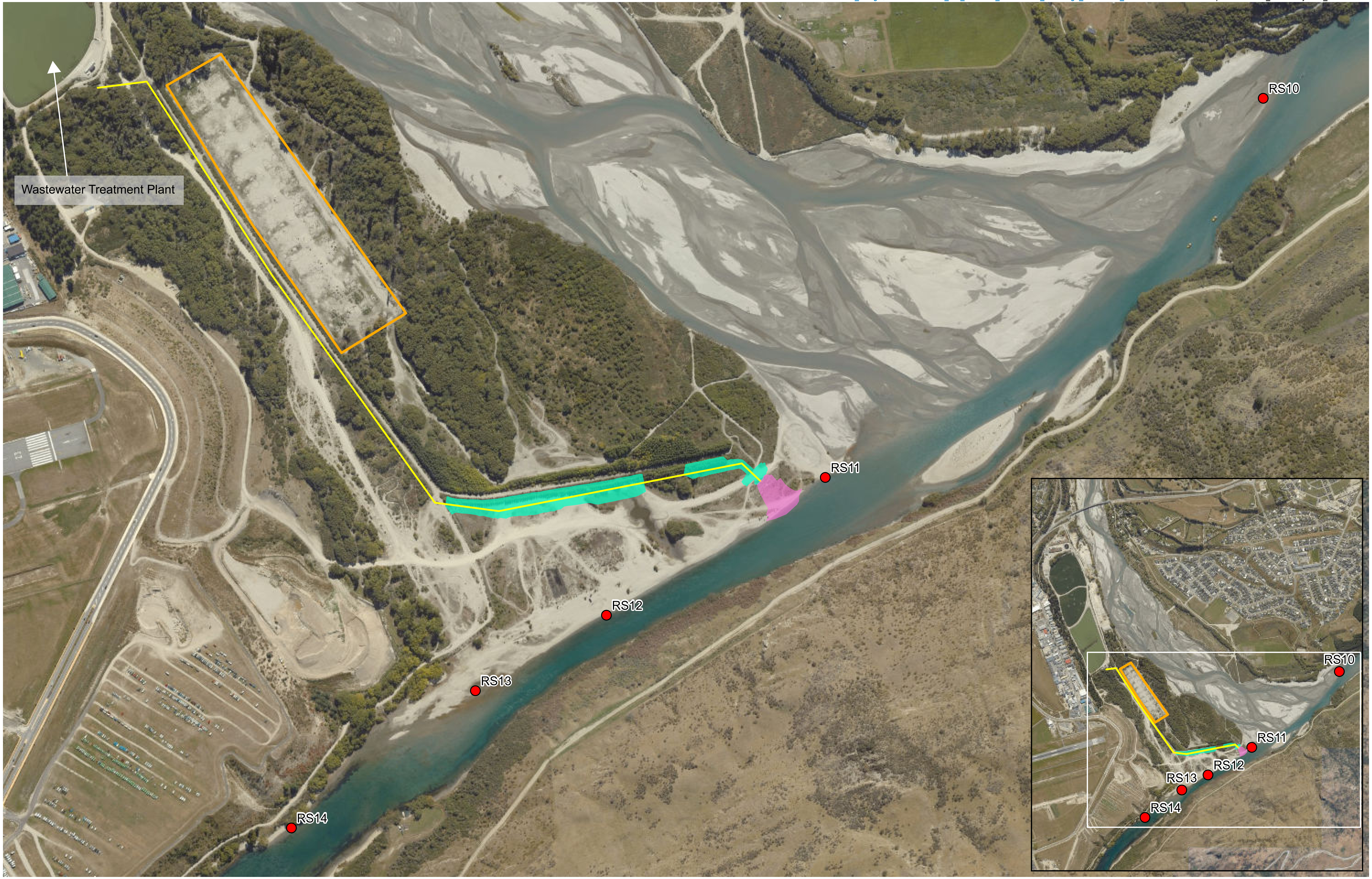

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Data Sources: Boffa Mikell, GHD, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Freshwater monitoring site
- Proposed sewer alignment
- Fill area
- Indicative rock outfall
- Historical DaD field

SHOTOVER WWTP LONG TERM DISCHARGE

Freshwater monitoring sites

Date: 28 May 2026 | Revision: 0

Plan prepared for GHD by Boffa Miskell Limited

Project Manager: Tanya.Cook@boffamiskell.co.nz | Drawn: LJa | Checked: TCo

Fig 1

3.0 Statutory context

The statutory policy and planning provisions relevant to this EcIA are outlined below. Refer to the Assessment of Environmental Effects (AEE) (Landpro Limited, 2026) for a detailed statutory assessment.

3.1 National Policy Statement for Freshwater Management 2020 (NPS FM)

The National Policy Statement for Freshwater Management 2020 (NPS-FM; amended December 2025) sets the objectives and policies for managing freshwater under the Resource Management Act 1991 (RMA). It requires councils to manage freshwater in line with Te Mana o te Wai and the National Objectives Framework to maintain or improve freshwater health.

The NPS-FM establishes national attribute states for key water-quality parameters (e.g., nutrients, clarity, *E. coli*), expressed as Bands A-D, with the national bottom line the upper limit of Attribute Band D. These bands provide a consistent basis for assessing current water quality, determining whether national bottom lines are met, and evaluating the potential effects of discharges on ecosystem and human-health values.

In this assessment, NPS-FM attribute bands are used as the primary national benchmark for interpreting predicted water-quality outcomes in the Kawarau River.

3.2 National Policy Statement for Indigenous Biodiversity 2023 (NPS-IB)

The National Policy Statement for Indigenous Biodiversity 2023 (NPS-IB) came into force on 4 August 2023 and sets out the objectives and policies for indigenous biodiversity management under the RMA. The overall objective of the NPS-IB is to maintain indigenous biodiversity across New Zealand so that there is 'at least no overall loss in indigenous biodiversity after the commencement date'. This assessment primarily relies on Appendix 1 of the NPS-IB to provide guidance on criteria for identifying significant natural areas (i.e. areas of ecological significance).

3.3 Otago Regional Council Regional Plan: Water for Otago

Schedule 15 of the Otago Regional Council (ORC) Regional Plan: Water for Otago (Otago Regional Council, 2021b; updated 2025) sets out regional limits and target values for rivers and lakes, including the Kawarau River (Receiving Water Group 2). These limits cover parameters including nitrate-nitrite nitrogen, dissolved reactive phosphorus (DRP), ammoniacal-N, and turbidity, and are designed to protect ecological health, contact recreation, and human-health values.

Schedule 15 of the Water for Otago plan limits are used in this assessment alongside NPS-FM attribute bands to contextualise both existing and predicted water quality and to evaluate compliance with regional objectives.

3.4 Otago Regional Council Regional Policy Statement

The appeals on the Proposed Otago Regional Policy Statement 2021 (Otago Regional Council, 2021a) have now been resolved and therefore is now considered operative; hereafter referred to as the ORPS. It provides the region's higher-level direction, with objectives and policies focused on integrated management, including the protection of freshwater, biodiversity, and groundwater values. This assessment primarily utilises Appendix 1 and 2 of the ORPS for assisting in the determination of ecological significance of features.

3.5 Water Conservation (Kawarau) Order 1997

The Water Conservation (Kawarau) Order 1997 provides the highest level of statutory protection for the Kawarau River system, including the Shotover River. The Order requires, in respect of the Kawarau[1] and Shotover[2] Rivers, that specified outstanding amenity and intrinsic values and characteristics are protected, and it constrains regional planning and resource consenting decisions accordingly.

For the relevant reach of the Kawarau River, the Order prohibits damming, requires that water quality is managed to a Class CR (Contact Recreation) standard as defined in Schedule 3 of the RMA 1991, and identifies the following outstanding characteristics as requiring protection pursuant to Schedule 2 of the Order:

- wild and scenic characteristics;
- natural characteristics, in particular the return flow in the upper section when the Shotover River is in high flood;
- scientific values, in particular the return flow in the upper section when the Shotover River is in high flood;
- recreational purposes, in particular rafting, jetboating, and kayaking.

Schedule 3 of the RMA clarifies that the water quality classes apply after reasonable mixing and provides the following explanation for *"Class CR Water (being water managed for contact recreation purposes)"*

1. The visual clarity of the water shall not be so low as to be unsuitable for bathing.
2. The water shall not be rendered unsuitable for bathing by the presence of contaminants.
3. There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

While the NPS-FM sets the national direction for freshwater management, it does not override the Water Conservation Order. However, the Regional Plan: Water for Otago incorporates both instruments, translating their requirements into practical numerical limits (e.g. Schedule 15) that are applied in consent assessments and water quality monitoring.

The application's assessment against the requirements of the Water Conservation Order are dealt with in detail in the Periphyton Risk Assessment (Boffa Miskell 2026), GHD's water quality report (GHD, 2026) and the AEE (Landpro Limited, 2026).

[1] Kawarau River mainstem from Scrubby Stream to Lake Wakatipu control gates (S133:940715 to S132:615707)

[2] Shotover River mainstem (at or about S132:645720 to S114:542262)

3.6 Queenstown Lakes District Plans

The SWWTP is subject to Designation #46 (QLDC Sewage Treatment Works) in both the Operative and Proposed Queenstown Lakes District Plans. The AEE (Landpro Limited, 2026) outlines the conditions of the designation.

Assessment against the policies and rules of the District Plan is outside the scope of this report and will be addressed in a separate application.

4.0 Proposed activity

The consent application is for the discharge of treated wastewater from the Shotover Wastewater Treatment Plant (SWWTP) to the Kawarau River via a pipeline and/or rock outfall.

The proposed construction and operation activities assessed in this report are summarised below. Refer to the AEE (Landpro Limited, 2026) and Surface Water and Groundwater Assessment (GHD, 2026) for more detail.

4.1 Construction activities

Construction activities include installation of an outfall on the true left bank of the Kawarau River immediately upstream of the Shotover River confluence, along with c.1.3 km of pipeline to convey treated wastewater from the SWWTP to the proposed outfall (Figure 1). Engineering design for the works outlined below is required to be completed by 31 December 2027 and construction completed by 31 December 2030.[3]

Construction of the pipeline will include:

- Installation and maintenance of erosion and sediment control (E&SC) measures in accordance with the measures set out in an E&SC Plan, which will be in line with GD05 (Landpro Limited 2026).
- Stripping of vegetation and stockpiling of topsoil along the pipeline pathway including disturbance of up to an 8 m wide construction corridor (4 m either side of the proposed pipeline), resulting in a total disturbance area of approximately 13,000 m^2, including vegetation clearance[4].
- Excavation of the trench, including stockpiling of cut material. Excavation will commence during low-flow river conditions to minimise the requirement for dewatering. If groundwater is encountered, dewatering will be in line with GD05, via a submersible pump to either a dewatering bag, or turkey nest or decanting earth bund.
- Installation of bedding material and pipe, backfilling of the trench, and reinstatement of the topsoil.

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[3] Environment Court Decision No. [2025] NZEnvC 178: Determination of application for waiver and application for enforcement orders. Annexure A, Order 1.19.

[4] Total land disturbance to install pipeline, including on QLDC land (10,243 m^2) and Crown land (2,262 m^2).

- Remediation of the trench and earth-worked areas following pipeline installation, including spreading of topsoil and seed/hydroseed to stabilise surface.

Preliminary design proposes a rock outfall structure for the outlet (Figure 2), however, this may change during detailed design. An alternative outfall configuration may be developed as described in the Assessment of Environmental Effects (Landpro Limited, 2026). This would potentially involve the replacement of the rock outfall with a pipe outfall into or onto the wetted bed of the Kawarau River. The detailed design, including whether any portion would be buried or incorporate diffuser infrastructure, has not yet been confirmed. Subsequently, this assessment has focussed on the current rock-outfall design; if the outfall design were to change, it is not expected to increase the extent of the project footprint or result in additional adverse ecological effects.

Installation of the currently proposed rock outfall structure is likely to include:

- Isolation of the outlet structure footprint and installation of E&SC measures in accordance with the E&SC Plan.
- Stripping of vegetation and excavation of the riverbed gravels, resulting in a total disturbance area of approximately 2,700 m^2.
- Based on the indicative concept design the outlet is proposed to be approximately 4 m wide x 0.4 m high, will protrude c. 10 m out into the wetted river channel and include placement of rocks tapering into the riverbank on either side of the outfall (Figure 2). This indicative design is subject to change during detailed design.
- Placement of boulder cover, followed by topsoil to allow establishment of grass and shrub cover to stabilise the surface.
- Placement of additional rock along the sides of the outlet structure, with trees and shrubs planted to visually integrate the structure, stabilise the margins, and discourage public access (Figure 2).

Figure 2: Proposed indicative design of outlet structure (to be confirmed in detailed design).

4.2 Operational activities

The operational activities are the discharge of treated wastewater from the SWWTP to the Kawarau River via the pipeline and outlet structure. Wastewater treatment will include preliminary treatment via inlet screens and grit removal, secondary treatment via bioreactor tanks and secondary clarifiers, tertiary filtration, UV disinfection and supplementary chemical dosing. Consent for the discharge of treated wastewater is being sought for a duration of 35 years.

4.2.1 Wastewater discharge volume and timing

A maximum daily discharge volume of 60,000 m^3 / day and a maximum instantaneous discharge rate of 694 L / s are being sought for the long-term consent. These limits are based on wastewater flow estimates presented in the GHD Water Quality Assessment Report (GHD, 2026) and AEE (Landpro Limited, 2026) and reflect the projected wastewater demand associated with Queenstown's forecast 2060 population. The long-term discharge volume from the SWWTP is predicted to reach an average daily flow of 25,904 m^3 / day by 2060, compared with 15,934 m^3 / day that occurred in 2024.

The discharge will be continuous, with flows varying according to diurnal and seasonal wastewater patterns.

4.2.2 Dispersion modelling

Dispersion modelling undertaken by GHD (2026) provides the hydrodynamic basis for the dilution patterns and water quality predictions described in Sections 4.2.3 and 4.2.4. These outputs have been relied on for this EcIA; full modelling methods, assumptions, and results are provided in GHD (2026).

GHD's (2026) modelling used the 2060 peak dry-weather discharge rate under mean annual low-flow conditions in the Kawarau and Shotover Rivers to provide a conservative representation of potential effects. Although higher treated wastewater discharge rates may occur during wet-weather periods due to stormwater inflow to the network, these events coincide with higher river flows. This is particularly evident in the Shotover River, which responds rapidly to rainfall and can reach flows many times greater than baseflow. Any increase in discharge volume during wet weather is therefore expected to be more than offset by increased river dilution capacity.

The modelling applied static flow inputs and simplified channel geometry, meaning it also likely underestimates the natural turbulence and variability that promote mixing. Both OpenFOAM and CORMIX were used, with consistent overall plume behaviour. OpenFOAM was adopted as the primary basis for the dilution assessment because it provides a more conservative representation of the receiving hydraulic environment.

4.2.3 Mixing areas

Dispersion modelling by GHD (2026) indicates that treated wastewater discharged to the Kawarau River remains near the true-left riverbank (Figure 3). This pattern is consistent with Shotover River inflows, with aerial imagery during high-flow periods also showing entrainment along the true-left bank of the Kawarau River.

The predictive modelling undertaken by GHD to determine the effects of the proposed discharge on water quality, which have been relied on for this assessment, have been undertaken for three mixing areas:

1. Near-field mixing area: Treated wastewater achieves an immediate 3-fold dilution on entering the Kawarau River. Flow around the outfall structure draws the plume along the true-left margin, with continued entrainment achieving a 5-fold dilution (c. 20% residual treated wastewater) by the downstream end of the structure (c. 40 m).
2. Reasonable mixing zone: The residual plume mixes with Shotover River inflows, resulting in a 50-fold reduction at RS10 (c. 2% residual treated wastewater)

downstream of the Shotover River confluence. In this zone, the plume influences roughly one-third of the River channel width, adjacent to the true-left bank. The reasonable mixing zone extends approximately 800 m downstream from the discharge structure to the downstream extent of the Shotover River confluence. RS10 is the monitoring location for the reasonable mixing zone, which is located approximately 950 m downstream of the point of discharge. This site has been selected on the basis that reasonable mixing is expected to occur along the length of the Shotover River confluence, which will change depending on the braid arrangement in the Shotover, which varies over time.

3. Far-field completely mixed: Aerial imagery from high-sediment Shotover events indicates that full mixing of the two rivers typically occurs further downstream where channel bends generate substantial turbulence. The point where the discharge is expected to be fully mixed is approximately 4 km downstream of the discharge structure, which is upstream of the Otago Regional Council's water quality monitoring station at Chard Road. Additional inflows from the Arrow and Nevis Rivers further promote dilution and dispersion of the discharge.

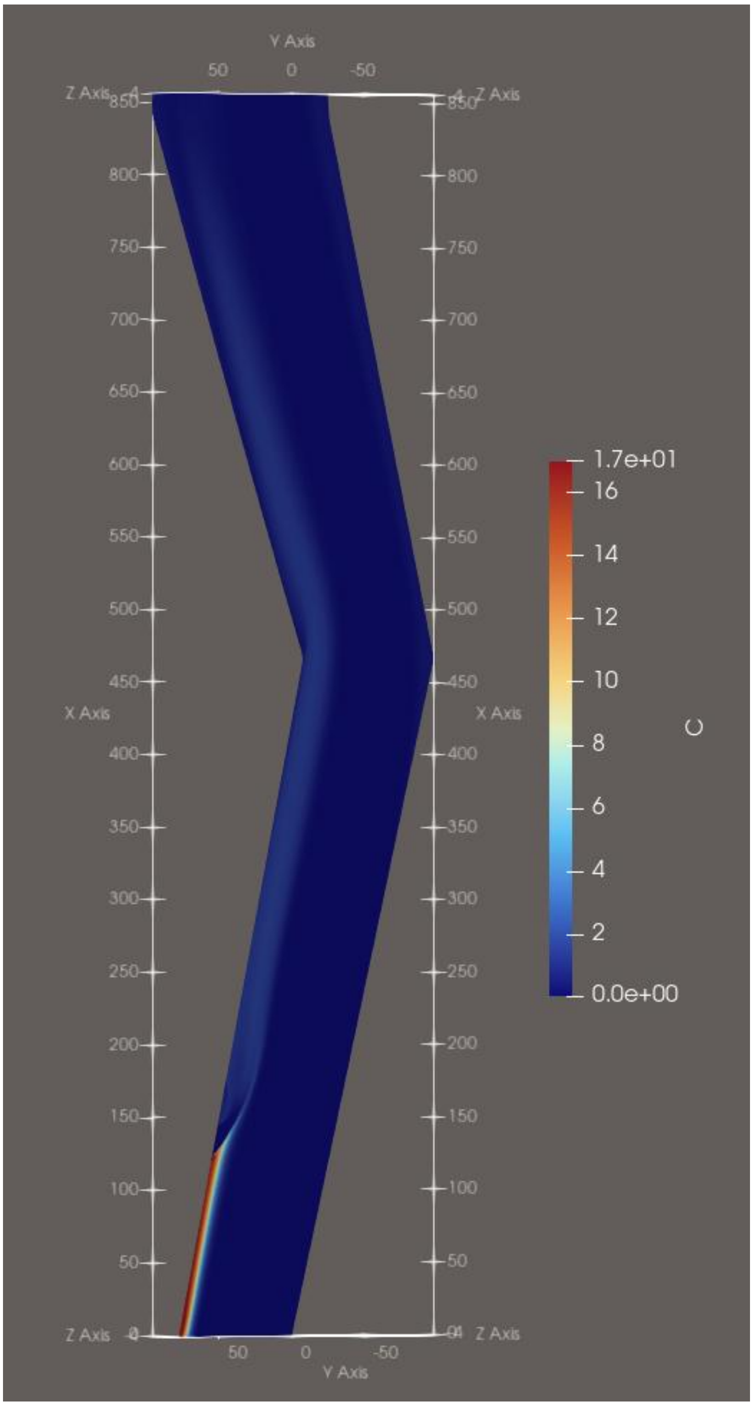

Figure 3. Predicted surface-water dispersion of treated wastewater in the Kawarau River. The X-axis represents the longitudinal distance downstream from the outfall (0 metres at the discharge point), and the Y-axis represents the cross-sectional width of the river. The plume remains entrained along the true left margin and occupies only a small proportion of the channel width. The increase in dilution at approximately 125 metres on the X-axis corresponds to the beginning of the Shotover River confluence, and RS10 (the point of reasonable mixing) is located at approximately 850 metres on the X-axis. Source: Appendix E, GHD (2026).

4.2.4 Predicted water quality

Predicted water-quality outcomes for each mixing area are summarised below. Full details are provided in GHD (2026).

4.2.4.1 Physical chemistry

Total suspended solids (TSS) represent fine particulate material in the water column and are a common indicator of physical effects from wastewater, which can contain residual solids from wastewater. The TSS concentration in the treated wastewater will be substantially lower than historical wastewater discharges due to the cessation of oxidation pond use and the introduction of tertiary filtration. Upstream, TSS concentrations at RS14 had a median of 3 g / m^3 between March 2025 and March 2026. Predicted concentrations within the near-field mixing area increase slightly to 3.4 g / m^3 under low-flow conditions and return to approximately 3 g / m^3 at RS10, effectively matching background levels.

Biological oxygen demand (BOD) reflects the oxygen required to break down organic matter and is used to assess the potential for wastewater to reduce dissolved oxygen. Upstream BOD at RS14 had a median of 0.5 g / m^3. Predicted concentrations increase to 1.4 g / m^3 within the near-field mixing area and reduce to approximately 0.59 g / m^3 after reasonable mixing at RS10, remaining low and similar to background conditions.

Changes in temperature, pH and dissolved oxygen at RS10 as a result of the proposed discharge are predicted to be negligible (GHD, 2026).

4.2.4.2 Nutrients

Wastewater typically contains elevated nitrogen and phosphorus species, which are the key nutrients associated with enrichment risk in freshwater systems. For this reason, ammoniacal nitrogen (AN), nitrate-nitrogen (nitrate-N), and dissolved reactive phosphorus (DRP) are the primary parameters used to assess nutrient effects against the National Policy Statement for Freshwater Management (NPS-FM) Attribute Bands and Schedule 15 criteria of the Otago Regional Plan.

Within the near-field mixing area (c. 20% residual wastewater): Predicted AN concentrations under low flow conditions are expected to fall within Attribute Band C of the NPS-FM, exceed the national bottom line, and exceed Schedule 15 criteria. Nitrate-N is within Attribute Band B and exceeds Schedule 15 criterion. DRP concentrations are expected to be below the NPS-FM national bottom line (Attribute Band D) and exceed Schedule 15 criteria.

After reasonable mixing (c. 2% residual wastewater) at RS10: AN is expected to meet Attribute Band A and the Schedule 15 value; nitrate-N is expected to be within Attribute Band A but exceed the Schedule 15 value; and DRP remains in Attribute Band D and exceeds the Schedule 15 value.

Far-field (fully mixed): All nutrient parameters (AN, DRP, nitrate-N; and total nitrogen and total phosphorus for lake criteria) are within Attribute Band A.

4.2.4.3 Metals and metalloids

Zinc, aluminium, and copper are the key trace metals associated with wastewater, arising from trade waste, stormwater inflows, and aluminium-based coagulants. These were assessed against the Australian and New Zealand Water Quality Guidelines (ANZG, 2018) including the Default Guideline Values (DGVs) for 99% and 95% freshwater species protection. Protection levels represent the proportion of species expected to be protected at a given concentration, and exceedance signals an increased probability of effects rather than a certainty of impact. For example, if a metal concentration is within the DGV for 99% species protection, the guidelines indicate that approximately 99% of species are expected to be protected, with only the most sensitive ~1% potentially affected. The results of the modelling by GHD (2026) show:

- Within the near-field mixing area: Aluminium exceeds the 80% species-protection DGV, zinc and copper exceed the 95% species-protection DGV.
- After reasonable mixing (at RS10): Aluminium, copper, and zinc concentrations are predicted to be slightly elevated relative to background levels; however, all concentrations are predicted to comply with the ANZG (2018) 99% species protection DGV criteria.
- Far-field (complete mixing): Concentrations of all three metal contaminants are predicted to be similar to background levels.

4.2.4.4 Per- and polyfluoroalkyl substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are persistent, human-made, mobile compounds that can be transported in freshwater systems and accumulate in aquatic biota. Of the many PFAS compounds, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) have been identified as key indicators of risk to ecology and health, with criteria specific to these compounds available.

Predicted concentrations of PFOS and PFOA in the treated wastewater are well within the DGVs for 99% species protection (ANZG, 2018; HEPA, 2025). Given the low concentrations in the discharge, river water immediately downstream of the outfall is also expected to meet recreational use criteria for PFOS and PFOA.

4.2.4.5 Microplastics

Microplastics were included for completeness, noting that environmental risk remains uncertain due to limited standardised methods and understanding of accumulation and toxicity. Analytical methods could only quantify particles >20 µm, so smaller fractions are unknown.

The proposed SWWTP upgrades include tertiary filtration which is expected to remove particles >10 µm, substantially reducing microplastic loads. As a result, microplastic concentrations in treated wastewater are expected to be effectively removed under the upgraded treatment process.

4.2.5 Maintenance of outfall

Regular monitoring and maintenance of the proposed system will be required. Key maintenance activities for the outfall structure (subject to its detailed design) will likely include potential rehabilitation of riprap or protective rocks following flood events, vegetation maintenance, and removing any debris accumulated at the outfall termini. It is not expected that excavation of riverbed gravels will be required as part of ongoing maintenance of the outfall.

5.0 Assessment methodology

5.1 Desktop review

5.1.1 Vegetation and Habitats

Existing information on terrestrial ecology values (indigenous vegetation, habitats of terrestrial fauna and terrestrial species) likely to occupy habitats within and adjacent to the proposed pipeline alignment were gathered. Key information sources reviewed for this assessment included:

- Recent and historic Google Earth imagery[5] and publicly available 0.1 m Urban Queenstown imagery (LINZ)[6];
- Geographic Information System (GIS) databases including:
    - Threatened Environment Classification (Manaaki Whenua / Landcare Research)[7];
    - Ecological Region and Ecological District GIS layers (McEwen, 1987); and
- Department of Conservation (DOC) herpetofauna database[8];
- i-Naturalist[9];
- Otago Regional Council's Regionally Significant Wetlands Maps[10]; and
- Queenstown Lakes Operative and Proposed District Plans.

5.1.2 Avifauna

A desktop review was undertaken to identify existing information on birds. Key sources reviewed for this assessment included:

- eBird[11] and the 10x10 km grid (DP18) in the online New Zealand Bird Atlas map that encompasses the Site[12].
- i-Naturalist.
- Technical reports and survey data, including:

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[5] Most recent imagery acquired 9 June 2024.

[6] Acquired 2021.

[7] Protected Areas Network » Maps » Our Environment

[8] Data from 2024 including the Queenstown area.

[9] Accessed 30 April 2026.

[10] https://www.orc.govt.nz/environment/water-care/wetlands-and-estuaries/regionally-significant-wetlands/queenstown-lakes-district/

[11] Explore - eBird (accessed 30 April 2026).

[12] Atlas Effort Map – New Zealand Bird Atlas (ebird.org). Accessed 30 April 2026.

- Draft Lower Shotover River bird survey data (2021 – 2025) (Dawn Palmer, Trustee Tucker Beach Wildlife Trust, *pers. comm.* 2026)
- The Kimiākau / Lower Shotover River Braided River Bird Survey Report (Palmer, 2022a).
- Shotover Wastewater Treatment Facility Bird Monitoring Reports (Palmer, 2021, 2022b, 2023, 2024).

5.1.3 Freshwater

A desktop review was undertaken to identify existing freshwater ecological features and to supplement the field surveys. Key sources reviewed for this assessment included:

- Regional Plan: Water for Otago (Otago Regional Council, 2021b; updated 2025)
- Queenstown Lakes Operative District Plan (Queenstown Lakes District Council, 2021)
- The NIWA-administered New Zealand Freshwater Fish Database (NZFFD), which holds records of freshwater fish distributions and occurrences based on previous surveys. Records within the Kawarau and Shotover Rivers were accessed, with a wider scan of Lake Wakitipu and its tributaries.
- The NIWA-administered Fish Passage Assessment Tool webpage, which holds records of in-stream structures and relevant fish passage assessments.
- The Wilderlab-administered Discover DNA explore webpage. This database holds records of eDNA samples based on previous freshwater surveys.
- Technical reports and water quality/ecological monitoring data, including:
    - Shotover WWTP | Surface Water and Groundwater Assessment (GHD, 2026).
    - The Land, Air, and Water Aotearoa (LAWA) website. Data pertains to the Kawarau River at Chard Road, accessed on 4 May 2026.[13]
    - Schedule 15 State of Environment Water Quality Report (Otago Regional Council, 2026).
    - Kawarau River bathymetry survey (Earth Sciences New Zealand, 2026).
    - Compliance of the Kawarau and Shotover Rivers with NPS-FM memorandum (Augspurger, 2026).

5.2 Field surveys

Ecological field surveys were completed between 10-12 March 2026. Kawarau River flows were stable over the month preceding the survey[13] and remained low during the survey period (approximately 105–110 m³ / s), which is slightly higher than typical summer low-flow conditions for that time of year (Earth Sciences New Zealand, 2026).

[13] Kawarau at Chard Road, Environmental Data Portal, Otago Regional Council.

5.2.1 Terrestrial

A walk-through survey of the vegetation and habitats within and adjacent to the proposed pipeline footprint that could potentially be affected by pipeline construction was undertaken by Scott Hooson (Terrestrial Ecologist) on 12 March 2026. During the vegetation surveys:

- The vegetation types within and adjacent to the proposed pipeline footprint were classified using the classification system and naming conventions developed by Atkinson (1985).
- Plant species, and their cover (using the DAFOR scale) were recorded in each of the vegetation communities.
- General notes were made on the condition of the vegetation communities and habitats present including the level of modification, and the presence of pest plants and animals.
- The ESRI ArcGIS Field Maps app was also used to mark geolocated locations of interest, and photographs were taken.

Because the vegetation types and habitats along the proposed pipeline alignment were exotic and highly modified, quantitative plot-based surveys were not measured.

5.2.2 Avifauna

A roaming inventory was compiled of all terrestrial bird species seen and heard by Scott Hooson during the site investigation. Given the generally low-quality terrestrial bird habitat types impacted by the proposal and the likely effect of the project on terrestrial birds, more detailed bird surveys were not considered necessary.

A walk-through survey of the Lower Shotover River from the State Highway 6 Road Bridge to the confluence of the Shotover and Kawarau Rivers (including the Shotover River delta), and the Kawarau River from the Shotover confluence approximately 1 km up the Kawarau River was undertaken by Scott Hooson and Tim Currie on 12 March 2026. Because the site investigation was completed outside the river bird breeding season and the time of year when internal migrants are present in braided riverbed habitats (generally July / August – January / March) the purpose of this survey was to gain familiarity with these river habitats and record the bird species using these habitats post-breeding season. There is recent existing draft data available from bird surveys of the Lower Shotover River (Dawn Palmer, Trustee Tucker Beach Wildlife Trust, unpubl. data May 2026)[14]. The most recent survey was completed in December 2025. The data recorded during this survey was only intended to complement the existing data.

Similarly, because there is reliable existing data on the bird assemblages that use the Shotover Oxidation Ponds available (Palmer, 2021, 2022b, 2023, 2024), and potential effects on birds using these ponds is limited to short-term construction disturbance and displacement effects, specific surveys of these ponds were not deemed necessary.

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[14] Data from surveys in December of 2021, 2024 and 2025. The 2025 survey data is preliminary, subject to change and is the result of a Citizen Science survey undertaken by volunteers of local conservation groups with the aim of developing a long-term data set.

5.2.3 Freshwater

The five sampling locations included in this assessment are described in Section 2.4 and shown in Figure 1. The surveys described below were undertaken by Tanya Cook and Tim Currie (Freshwater Ecologists).

5.2.3.1 Habitat

Riparian and in-stream habitat at each site was evaluated following the Rapid Habitat Assessment (RHA) tool (Clapcott, 2015). The RHA involves ranking ten parameters on a scale of 1–10: deposited sediment, macroinvertebrate habitat diversity, macroinvertebrate habitat abundance, fish cover diversity, fish cover abundance, hydraulic heterogeneity, bank erosion, bank vegetation, riparian width, and riparian shade. Scores for these parameters are summed to give a total RHA score between 10 and 100, with higher scores indicating better habitat availability.[15]

Deposited fine sediment was assessed concurrently with periphyton using Sediment Assessment Method 2 (SAM2) from Clapcott et al. (2011). The same five transects and four replicate points used for periphyton (described in Section 5.2.3.2) were assessed for percentage cover of fine sediment (<2 mm), ensuring spatial consistency across the indicators.

At each transect, the substrate composition was also recorded.

5.2.3.2 Periphyton

Periphyton cover was assessed using the periphyton cover estimation method described in Section 4 of the National Environmental Monitoring Standard (NEMS) for Periphyton (Ministry for the Environment, 2022b). At each site, a 40 m reach was established, with five transects spaced at 10 m intervals.

Along each transect, four evenly spaced replicate observations were made using an underwater viewer (bathyscope), working from the bank to a maximum depth of approximately 60 cm, or to the opposite bank where depths remained less than 60 cm.

At each observation point, the percentage cover of key periphyton groups were estimated following the cover classes and definitions in Table 1 in the NEMS for Periphyton. All observations were recorded directly onto the NEMS Periphyton field sheet (Annex B; Ministry for the Environment, 2022b).

The guidelines presented in Matheson et al. (2012) were used to interpret periphyton cover. These guidelines apply a weighted composite cover (PeriWCC), calculated as %filamentous cover + (%mat cover ÷ 2)[16], with an aesthetic nuisance threshold of ≥30%. Provisional general thresholds of <20%, 20-39%, 40-55%, and >55% PeriWCC are recommended as indicators of ‘excellent’, ‘good’, ‘fair’, and ‘poor’ ecological condition, respectively, at sites where other stressors are minimal.

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[15] The RHA protocol used in New Zealand is based on the United States Environmental Protection Agency (USEPA) habitat assessment methodology (Barbour et al., 1999), in which component scores are divided into quartiles labelled Optimal, Sub-optimal, Marginal, and Poor habitat condition.

[16] Sludge is not included in this calculation, as it is a separate periphyton category, and didymo is also excluded from the PeriWCC calculation because it does not respond to some environmental variables in the same manner as other common New Zealand periphyton species (Matheson et al., 2012).

5.2.3.3 Macroinvertebrates

Macroinvertebrates were sampled using the semi-quantitative kick-net method described in the NEMS for Macroinvertebrates (Ministry for the Environment, 2022a). A standard 0.5 mm mesh, D-shaped kick net was used. Three replicate samples were collected at each of the five sites in proportion to habitat availability, primarily from a run habitat, with a total sampled area of approximately 0.9-1.0 m² per replicate. Samples were preserved in ethanol and processed using the 200+ fixed count with rare-taxa scan method outlined in the NEMS for Macroinvertebrates (Annex E; Ministry for the Environment, 2022a).[17]

The following macroinvertebrate metrics were calculated for each sample:

- Taxonomic richness – total number of macroinvertebrate taxa.
- EPT taxonomic richness – number of Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) taxa, which are typically sensitive to pollution and habitat degradation.
- EPT taxonomic richness (excluding Hydroptilidae) – EPT richness excluding hydroptilid caddisflies, which are more tolerant of degraded conditions. This provides a more conservative indicator of "clean-water" EPT taxa.
- %EPT abundance – proportion of all individuals belonging to Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) taxa relative to the whole macroinvertebrate community. Higher values generally indicate better water and habitat quality.
- %EPT abundance (excluding Hydroptilidae) – as above, but excluding hydroptilid caddisflies to remove the influence of more tolerant EPT taxa.
- Macroinvertebrate Community Index (MCI-hb) – presence-based index using taxon-specific tolerance scores for hard-bottom streams (Annex D, Annex H; Ministry for the Environment, 2022a). Table 1 provides a summary of how MCI scores were used to evaluate stream health.
- Quantitative Macroinvertebrate Community Index (QMCI-hb) – abundance-weighted variant of the MCI, providing information on the dominance of sensitive versus tolerant taxa in hard-bottom streams. Table 1 provides a summary of how QMCI scores were used to evaluate stream health.
- Average Score Per Metric (ASPM) – composite index combining %EPT, EPT richness, and MCI (Ministry for the Environment, 2022a). ASPM attribute bands are defined in the National Policy Statement for Freshwater Management 2020 (NPS-FM; Ministry for the Environment, 2020) and provide an integrated measure of macroinvertebrate community health.

[17] The field collection method used in this study represents a minor modification to the Protocol C1 described in Stark et al. (2001). The NEMS-m laboratory processing method is the same as Protocol P2 of Stark et al. (2001), except updated tolerance scores for some taxa.

Table 1. Interpretation of MCI and QMCI scores for hard and soft-bottomed streams (Stark & Maxted, 2007).

Stream health	Water quality descriptions	MCI	QMCI
Excellent	Clean water	>119	>5.99
Good	Doubtful quality or possible mild enrichment	100-119	5.00-5.90
Fair	Probable moderate enrichment	80-99	4.00-4.99
Poor	Probable severe enrichment	<80	<4.00

Note, the NPS-FM also provides more conservative attribute band classifications for MCI and QMCI; these have been considered within this report but have not been used for classification in this instance in order to maintain consistency with the original index interpretation.

5.3 Limitations of methodology

5.3.1 Terrestrial

The terrestrial ecology survey of the pipeline alignment was completed on 12 March 2026 using the indicative pipeline alignment that was available at that time. The northern half of the alignment parallel to Shotover Road reflected in the application and consents being sought differs from the earlier indicative alignment. This change means that part of the northern section of the pipeline construction footprint was not walked or surveyed in detail. However, the vegetation communities along this section were observed and photographed and the modified vegetation and habitats along this section of the pipeline parallel to Shotover Road mean that it is very unlikely that there are ecological values present that would alter the conclusions of this assessment.

As described in Section 5.2.2, because the site investigation was completed outside the river bird breeding season, and the time of year when internal migrants are present in braided riverbed habitats (generally July / August – January / March), the braided river bird survey completed on 12 March cannot be relied upon to describe the avifauna assemblages of the Lower Shotover River and delta. For the purposes of assessing the potential effects of the project, reliable draft data from bird surveys of the Lower Shotover River (Dawn Palmer, Trustee Tucker Beach Wildlife Trust, *pers. comm.* May 2026) was used. This data is sufficient for the purposes of completing this assessment, noting that the potential effects of the project on braided river birds using the Shotover River and delta are limited to disturbance and displacement, and potentially impacts on nesting birds, in the vicinity of the proposed outfall structure location.

5.3.2 Freshwater

Only one freshwater field survey was undertaken, limiting the ability to capture temporal or seasonal variation in periphyton and habitat conditions; findings therefore represent conditions at the time of survey only.

Survey sites were restricted to the true left bank due to the depth of the Kawarau River, which may not fully represent conditions across the channel where hydraulic and substrate characteristics differ on the true right bank. However, ecological effects on the true right are expected to be negligible (not discernible from existing conditions) given the location of the discharge and the predicted plume remaining on the true left. The field survey also did not include a dedicated fish survey or trout-spawning habitat survey.

Lastly, estimates of the areas affected by the proposed works rely on approximations based on the current level of design detail. A conservative approach has been used when defining these areas for assessment. The specific areas of effect, such as the construction footprint and zone of influence, will be confirmed and refined through detailed design, and are expected to fall within the conservative areas assessed here.

5.4 Assessment of ecological values and effects

To determine the level of ecological effects associated with the Project, we have followed the EIANZ EcIA guidelines (Roper-Lindsay et al. 2018). In summary, the EcIA method requires assessments of:

- The values of communities, habitats / ecosystems and species (Appendix 1, Table 16 - Table 19);
- The magnitude of impact (Appendix 1, Table 20); and
- The level of ecological effect based on a decision matrix of ecological effect and magnitude of impact (Appendix 1, Table 21).

The EIANZ EcIA guidelines (Roper-Lindsay et al. 2018) note that the level of effect can then be used as a guide to the extent and nature of the ecological management response required (including the need for biodiversity offsetting). For example:

- '**Very High**' represents a level of effect that is unlikely to be acceptable on ecological grounds alone (even with compensation proposals). Activities having very high adverse effects should be avoided.
- '**High' and 'Moderate**' represent a level of effect that requires careful assessment and analysis of the individual case. Such an effect could be managed through avoidance, design, or extensive offset or compensation actions.
- '**Low'** and '**Very Low**' should not normally be of concern, although normal design, construction and operational care should be exercised to minimise adverse effects. If effects are assessed taking impact management measures developed during project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure low or very low-level effects.
- '**Very Low**' level effects can generally be classed as 'not more than minor' effects.

Further details are provided in Appendix 1.

5.5 Ecological significance assessment

5.5.1 Significance assessment - terrestrial vegetation and habitats

Section 6(c) of the RMA requires identification of sites of significant vegetation and significant habitats of indigenous fauna. Ecological significance of terrestrial vegetation and habitats was assessed using:

- The criteria for determining the significance of areas of indigenous vegetation and habitats of indigenous fauna listed in Policy 33.2.1.8 of the QLPDP;
- Appendix 2 of the ORPS; and
- The "*Criteria for identifying areas that qualify as significant natural areas (SNAs)*" in Appendix 1 of the National Policy Statement for Indigenous Biodiversity (NPS-IB; MfE 2023).

5.5.2 Significance assessment – freshwater

As required by Section 6(c) of the RMA 1991, this assessment considers the ecological significance of freshwater ecological features and habitats potentially affected by the proposed activities. Although Appendix 2 (APP2) of the ORPS is intended for the regional council when identifying Significant Natural Areas, the APP2 criteria were applied here as a guide to assess the significance of the Kawarau River.

The assessment considered the four APP2 criteria: representativeness, diversity and pattern, rarity and distinctiveness, and ecological context. The detailed principles and attributes that sit beneath each criterion are not repeated here. Appendix 1 (APP1) freshwater ecology values were also used to inform the assessment for the Kawarau River.

6.0 Ecological features and values

6.1 Ecological context

The Site straddles the southern boundary of the Shotover Ecological District (ED) and the northern boundary of the Remarkables ED within the Lakes Ecological Region (McEwen, 1987).

The proposed Kawarau wastewater discharge site lies across the Remarkables Ecological District (ED) and the Shotover ED in the Lakes Ecological Region.

The Remarkables ED comprises the steep, glaciated Remarkables and Hector Mountains and the southern portion of Lake Wakatipu. The geology of the ED is characterised by Paleozoic Haast schist and outwash gravels, with occasional alluvial sediment in the glacial outwash valleys. The climate, which is influenced by the rainshadow of the Main Divide, is typically cool and dry with rainfall ranging from 750 mm to 1,500 mm / year (McEwen, 1987).

The vegetation of the ED consists of a few small patches of montane mountain beech forest in narrow valleys, often with red beech and Hall's totara. Mānuka scrub and kowhai and kohuhu (*Pittosporum colensoi)* scrub (near Lake Wakatipu), inaka scrub, and bracken and tussock associations with narrow-leaved snow tussock, blue tussock, blue fescue in subalpine and alpine zones (McEwen, 1987).

The Shotover ED comprises steep schist mountain and hill country associated with the Shotover catchment, with alluvial and outwash deposits along valley floors and river terraces. The district lies within an inland montane environment east of the Main Divide and the climate, which is influenced by the rainshadow effect, is typically hot in summer, cold in winter and dry with rainfall ranging from 650 mm to 1,600 mm / year. North-west winds prevail (McEwen, 1987).

The original vegetation of the ED was likely to have been dominated by red beech forest at lower and mid elevations, with frequent silver beech. Shrubland communities were common on drier and more disturbed sites, grading to snow tussock, short tussock, herbfield and fellfield at higher altitudes. Typical flora included mānuka and kohuhu in the shrublands and narrow-leaved snow tussock, inaka, and hebe in the tussocklands (McEwen, 1987). Riparian and alluvial surfaces would also have supported localised scrub, wetland and braided river communities.

The Shotover ED is extensively grazed, though red beech forest remains near Lake Wakatipu and in Twelve Mile Creek Scenic Reserve. Mountain beech forest is more common in gullies up to the treeline. Indigenous scrub is present above the treeline and up to schist screefields (McEwen, 1987).

The site is mapped as BR1 hard tussock, scabweed, gravelfield / stonefield in potential natural ecosystem mapping for Otago (Singers & Rogers, 2014)[18]. It does not have a Threatened Environment Classification (TEC)[19] because it is within the Shotover River floodplain and the TEC system does not display or incorporate non-terrestrial ecosystems (rivers, lakes, marine ecosystems).

The Site does not contain any covenants or significant natural areas and is not part of the Protected Areas Network (Cieraad et al., 2015).

6.1.1 Shotover River Delta

The Shotover River originates in the Southern Alps and is characterised by an active braided channel system transporting large volumes of sediment derived from schist geology, culminating at the delta where the Shotover River joins the Kawarau River.

The lower Shotover River in the vicinity of the delta is characterised by braided river channels, with frequent flood flows resulting in a mobile gravel riverbed and changeable channels. The lower Shotover River with currently active flows and channels (true left bank of the delta) is approximately 650 m in width. A further ~ 700 m of the delta on the true right bank is covered with established vegetation and infrastructure.

Braided riverbeds are classified as 'naturally uncommon ecosystems'[20] (Williams et al., 2007), and have been classified as 'endangered' (Holdaway et al., 2012). They provide habitat for a range of Threatened, At Risk and endemic species in Aotearoa New Zealand (Williams et al. 2007) and support flora and fauna that are adapted to unpredictable and unstable environments (Hughey 1985).

As described in section 2.2 above, the Lower Shotover River and delta has been modified over time but retains ecological values associated with braided river habitats. However, the proposed activities associated with this application are confined to the true right side of the Lower Shotover River Floodplain. This part of the floodplain has been highly modified and stabilised by earthworks, installation of the river training wall, roads and tracks, and the establishment of

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[18] https://maps.orc.govt.nz/portal/home/webmap/viewer.html?layers=62df5a8a5b1f4576a049af2dca35cd08

[19] The Threatened Environment Classification is a combination of three national databases: Land Environments of New Zealand, Land Cover Database (Version 2) and the Protected Areas Network. The Threatened Environment Classification shows how much indigenous vegetation remains within land environments, how much is legally protected, and how the past vegetation loss and legal protection are distributed across New Zealand's landscape.

[20] Also referred to as 'originally rare' ecosystems.

willows and other exotic weeds and no longer supports the ecological values typical of braided rivers.

6.1.2 Kawarau River

The Kawarau River is a large, lake-fed system that forms the principal tributary of the Clutha River (Mata-au), joining it approximately 55 km downstream of Lake Wakatipu. Over the first c. 4 km below the lake outlet, the river is a 7th order stream with a low gradient, before transitioning into steeper, higher-energy gorge sections downstream. Its flows are governed primarily by the lake's seasonal storage and release regime rather than short-duration runoff events, resulting in relatively stable and predictable seasonal flow patterns compared with the Shotover River (GHD, 2026)

Lake Wakatipu is classified as microtrophic[21], with high water clarity and low nutrient concentrations that strongly influence the low-nutrient baseline of the upper Kawarau River. At the Shotover River confluence, immediately downstream of the proposed discharge structure, the Shotover forms an active gravel delta that delivers coarse sediment and fine suspended material during flow events. These inputs can locally modify channel form, flow patterns, and water clarity in the Kawarau downstream of the confluence (GHD, 2026).

The Kawarau River between Lake Wakatipu and Lake Dunstan is recognised as an outstanding waterbody under Schedule 1A of the Regional Plan: Water for Otago and in the ORPS. It is valued for its wild and scenic character, natural features, scientific values, and recreational importance. Ecologically, the river is valued for its diverse range of habitat types associated with its size, habitat heterogeneity, and extensive rock and gravel substrates. These habitats are recognised in Schedule 1A for supporting resident biota including trout, salmon, eels, and At Risk or rare indigenous fish species, and for providing significant habitat for kōaro. Although Schedule 1A identifies the river as weed-free upstream of Lake Dunstan (i.e. no aquatic pest plants), our surveys detected sparse *Lagarosiphon major* at RS13 and RS14 and didymo at RS11.

Mana whenua values are recognised in Schedule 1D, which identifies the cultural significance of the river's mauri and its importance for Kāi Tahu beliefs, values, and uses.

The ecological importance of the Kawarau River is further reinforced by the Water Conservation (Kawarau) Order 1997 (amended 2013). See Section **Error! Reference source not found.** for further detail.

6.2 Terrestrial

The following subsections describe the terrestrial vegetation and fauna within and adjacent to the proposed pipeline and outfall structure. This assessment has focussed on the proposed rock-outfall design; if the outfall design were to change to the alternative design, it is not

[21] https://www.lawa.org.nz/explore-data/otago-region/lakes/lake-whakatipu

expected to increase the extent of the project footprint or result in additional adverse ecological effects.

6.2.1 Vegetation and habitats

There are eight main (broad) vegetation types within the proposed pipeline alignment:

- Buddleia scrub
- Buddleia shrubland
- Crack willow forest
- Crack willow treeland
- Gravelfield (gravel roads / tracks and open areas of river gravels)
- Hemlock-Russell lupin herbfield
- Stonecrop herbfield
- Tree lupin shrubland

These vegetation types are described below. The vegetation cover is shown in the photograph in Figure 4 and the location and extent of each of the vegetation types within the construction footprint is shown on Figure 5 and Figure 6. A list of the plant species recorded in these vegetation types during the site visit is provided in Table 22 (Appendix 2), and photographs of the vegetation types are provided in Appendix 3.

With the exception of some areas of gravelfield which support a low diversity of degraded, sparse indigenous turf species, these vegetation types are entirely, or almost entirely, dominated by weedy plant species.

Figure 4. Photograph of the Site from the Remarkables Trig on 13 May 2026 showing existing vegetation cover along the proposed pipeline alignment (source: Dawn Palmer).

6.2.1.1 Crack willow forest and treeland

The main vegetation types along the pipeline alignment are crack willow forest and treeland.

There is mature crack willow forest at the northern end of the proposed pipeline alignment. The canopy of this forest is entirely dominated by large exotic crack willow trees with an average canopy height of c. 20 m. The sub-canopy and understorey plant species are exotic and include frequent crack willow and occasional elderberry trees with frequent Buddleia on the margins. The groundcover is sparse, with a sandy / silty substrate and a low diversity of weedy exotic herbs including frequent hemlock as well as infrequent plants of species such as nettle, aluminium plant, and male fern. This vegetation type was very modified, had abundant rabbit sign, informal bike tracks and there was frequent domestic rubbish.

Between the corner of the proposed pipeline alignment and the outfall structure there is younger planted crack willow on the side of the river training line / stop bank. The understorey here is also sparse and is characterised by exotic herbs including frequent hemlock, Californian thistle, bittersweet, water forget-me-not and St John's wort.

Areas of crack willow treeland were also present, including as small patches surrounded by open gravelfield. Where younger lower stature trees were present these often occurred with buddleia shrubs (i.e. crack willow / buddleia treeland) or with exotic herbs including hemlock and Russell lupin.

With the exception of a few *Coprosma* sp. seedlings that have self-established under the mature crack willow forest, these vegetation types are entirely exotic and of negligible ecological value.

6.2.1.2 Buddleia scrub and shrubland

The exotic shrub buddleia is widespread in the area and occurs as both taller denser scrub (where the canopy cover is greater than 80%) and as shrubland where canopy cover is discontinuous and between 20% - 80% and where shrubs are the dominant structural class.

Buddleia scrub was up to 4 m in height, although canopy height varied depending on age. The understorey was very sparse and included exotic plant species such as hemlock, occasional stone crop and infrequent tree lupin.

More open areas of buddleia shrubland typically grew over areas of gravels and silts with abundant stone crop. Buddleia shrubs were typically 2-4 m in height although seedlings were also very numerous. Other plant species were infrequent and included tree lupin, infrequent sweet briar and the exotic herbs woolly mullein, pimpernel, browntop, Scotch thistle and vipers's bugloss. A very small number (1-2 plants) of indigenous tree tutu were also recorded in this vegetation type. In places, buddleia shrubland grades into lupin shrubland.

These vegetation types are almost entirely exotic and of negligible ecological value.

File Ref: \\bmlaklfs1\NAT_design$\2025\BM250359_TBI_Shotover_Wastewater_Discharge_Short-term_Consent\GIS\ BM250359.aprx BM250359_Terrestrial_Habitat_North_A3L8:46 am

Boffa Miskell

www.boffamiskell.co.nz

0 40 m

1:1,750 @ A3

Data Sources: Boffa Miskell, GHD, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

Proposed sewer alignment

Extent of vegetation clearance

Vegetation Type

Buddleia scrub

Buddleia shrubland

Crack willow forest

Gravelfield

Stonecrop herbfield

SHOTOVER WWTP LONG TERM DISCHARGE

Terrestrial Vegetation

Date: 28 May 2026 | Revision: 0

Plan prepared for GHD by Boffa Miskell Limited

Project Manager: Tanya.Cook@boffamiskell.co.nz | Drawn: LJa | Checked: SHo

Fig 5

File Ref: \\bmlaklfs1\NAT_design$\2025\BM250359_TBI_Shotover_Wastewater_Discharge_Short-term_Consent\GIS\ BM250359.aprx BM250359_Terrestrial_Habitat_South_A3L8:46 am

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Fig 6

0 — 40 m

1:1,750 @ A3

LEGEND

- Proposed sewer alignment
- Fill area
- Indicative rock outfall
- Extent of vegetation clearance

Vegetation Type

- Buddleia scrub
- Buddleia shrubland
- Crack willow forest
- Crack willow treeland
- Gravelfield
- Hemlock-Russell lupin herbfield
- Stonecrop herbfield
- Tree lupin shrubland

Data Sources: Boffa Miskell, GHD, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

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6.2.1.3 Tree lupin shrubland

Tree lupin was more frequent nearer the Kawarau River but was present as shrubland within the proposed pipeline footprint. These areas were characterised by abundant tree lupin, shrubs of buddleia, and a range of exotic herbs including often abundant stonecrop, as well as infrequent pimpernel, centuary, ragwort, and the grasses Yorkshire fog, sweet vernal, and Chewings fescue.

This vegetation type is entirely exotic and of negligible ecological value.

6.2.1.4 Gravelfield (gravel roads / tracks and river gravels)

There are several formed gravel roads and tracks on the true right side of the Shotover River below the oxidation ponds that are used by trucks, offroad vehicles and cars to access the Kawarau River and Shotover Delta. Vehicle use has also created and / or maintained extensive areas of unvegetated gravelfield, particularly nearer the Kawarau River. The gravel roads and unvegetated areas of gravels are of negligible ecological value.

Depressions within the open gravelfield between the corner of the proposed pipeline alignment and the outfall structure are inundated occasionally by groundwater during flood events and support a sparse cover of indigenous dominated turf species that appear to be maintained by vehicles which prevents the other establishment of taller stature exotic species. Typically, this vegetation type was dominated by Sinclair’s stonecrop, but in some locations mudwort, *Centipedia* sp. and the exotic starwort were also present.

Areas of gravelfield that support turf species are dominated by indigenous turf species, but are degraded and modified by vehicles and are not representative. No Threatened or At Risk plant species are present[22] and river margins are not distinctive vegetation types, and in this location they are degraded by high levels of human disturbance. Although frequently disturbed, it likely provides habitat for At Risk bird species such as banded dotterel and New Zealand pipit. Conservatively, this landcover type scores moderate for rarity. Plant species diversity is very low and reflects human modification, rather than natural ecological patterns. This vegetation type is very small and modified so also scores very low for ecological context. Overall, it is of low ecological value.

6.2.1.5 Hemlock-Russell lupin herbfield

Nearer to the proposed outfall structure the terrestrial vegetation is herbfield dominated by hemlock and Russell lupin with a range of other exotic herbs and grasses including Californian thistle, water forget-me-not, pimpernel, mouse-ear chickweed, Yorkshire fog and Chewings fescue.

This vegetation type is entirely exotic and of negligible ecological value.

6.2.1.6 Stonecrop herbfield

On droughty gravel and silt substrates stonecrop was abundant and the dominant cover in areas where buddleia or tree lupin were less frequent. Other exotic herbs and grasses were infrequent due to heavy rabbit browse and included browntop, woolly mullein, pimpernel, Scotch thistle and vipers’s bugloss.

This vegetation type is entirely exotic and of negligible ecological value.

[22] Although *Lepinella serrulata* has been recorded nearby (i-Naturalist).

6.2.2 Avifauna

Habitats for birds within and adjacent to the proposed pipeline alignment and outfall structure are terrestrial habitats (crack willow forest and treeland, scrub and shrubland and gravelfield) as well as braided river (the Shotover River and delta) and river (Kawarau River) habitats in the vicinity of the outfall structure, and the oxidation ponds.

Based on the desktop review, site visit observations and the habitats present on Site, there are 28 key indigenous bird species of interest relevant to this assessment (Table 2). This list has been derived by excluding exotic species, species that do not have primary habitat within the Site or immediate surrounds, vagrant species, and species that are likely to visit the Site only rarely (i.e. the key species include all indigenous species (irrespective of conservation status) that are likely to use, or potentially use, the terrestrial habitats described above and the braided river and river habitats within and adjacent to the Site more than infrequently for foraging, roosting and / or nesting activities). A full list of the bird species recorded within the NZ Bird Atlas grid square (DP18) which encompasses the Site that are likely to utilise habitats within or adjacent to the Site, as well as in existing data and reports, are provided in Table 23, Appendix 4.

The key indigenous bird species include one Threatened species (black-fronted tern), seven At Risk species (banded dotterel, black-billed gull, New Zealand pipit, South Island pied oystercatcher, Australian coot, black shag and little shag) and 19 Not Threatened species (Table 2).

There is good information available on the bird assemblages using the SWTDA between May 2017 and June 2021 collected during regular (monthly or more frequently) monitoring by Dawn Palmer (Palmer, 2021). Terrestrial habitats for birds (crack willow forest and treeland, scrub and shrubland and gravelfield) support a range of indigenous bird species that regularly use the exotic, modified habitats within and adjacent to the pipeline construction footprint. They include Not Threatened species such as bellbird, grey warbler, kingfisher, shining cuckoo, silvereye, South Island fantail, tui, and swamp harrier (Palmer, 2021). South Island tomtit, (also Not Threatened) which typically utilise forested habitats, have also been recorded infrequently. New Zealand pipit (At Risk – Declining) have been recorded within the Sewage Treatment Works Designation Area (SWTDA) and small numbers of this species are expected to use the open areas of gravelfield and riverbed adjacent to the proposed construction footprint for foraging from time to time. Eastern falcon and long-tailed cuckoo (both classified as Threatened – Nationally Vulnerable) have been recorded during monthly five minute bird counts within the STWDA (Palmer, 2021). However, the habitats present adjacent to the proposed construction footprint do not provide core habitat for either species and they are likely infrequent visitors to the Site.

There is also reliable existing draft data available from bird surveys of the Lower Shotover River (Dawn Palmer, Trustee Tucker Beach Wildlife Trust, *pers. comm.* May 2026). Bird species recorded using the Lower Shotover River between the State Highway 6 Bridge and the confluence with the Kawarau River are black-fronted tern (Threatened – Nationally Vulnerable), banded dotterel, black-billed gull, SIPO (all At Risk – Declining), southern black-backed gull, pied stilt, and spur-winged plover (Not Threatened). Other riverine and water bird species that are expected to utilise the Lower Shotover River and the Kawarau River include black shag, little shag (At Risk – Relict) as well as waterfowl species including Australasian shoveler, grey teal, New Zealand scaup, paradise shelduck, welcome swallow and white-faced heron.

Table 2. Bird species recorded within the NZ Bird Atlas (grid square DP18), in existing data and reports, and recorded during the site visit that are likely to utilise habitats within or adjacent to the proposed pipeline and outfall construction footprint. Sorted by indigenous / introduced and by conservation status (Robertson et al., 2021).

Common Name	**Scientific Name**	**Conservation Status**	**eBird Square** DP18	**Existing data / reports**	**Site visit observation**
Black-fronted tern	*Chlidonias albostriatus*	Threatened – Nat. Endangered	x	x	
Banded dotterel	*Anarhynchus bicinctus*	At Risk - Declining	x	x	x
Black-billed gull	*Chroicocephalus bulleri*	At Risk - Declining	x	x	x
New Zealand pipit	*Anthus novaeseelandiae*	At Risk - Declining	x	x	
South Island pied oystercatcher	*Haematopus finschi*	At Risk - Declining	x	x	x
Australian coot	*Fulica atra*	At Risk - Naturally Uncommon	x	x	
Black shag	*Phalacrocorax carbo*	At Risk - Relict	x	x	x
Little shag	*Phalacrocorax melanoleucos*	At Risk - Relict	x	x	x
Australasian shoveler	*Spatula rhynchotis*	Not Threatened	x	x	
Bellbird	*Anthornis m. melanura*	Not Threatened	x	x	
Black swan	*Cygnus atratus*	Not Threatened	x	x	
Grey teal	*Anas gracilis*	Not Threatened	x	x	x
Grey warbler	*Gerygone igata*	Not Threatened	x	x	
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened	x	x	
New Zealand scaup	*Aythya novaeseelandiae*	Not Threatened	x	x	
Paradise shelduck	*Tadorna variegata*	Not Threatened	x	x	x
Pied stilt	*Himantopus leucocephalus*	Not Threatened	x	x	
Pukeko	*Porphyrio melanotus*	Not Threatened	x	x	
Shining cuckoo	*Chrysococcyx lucidus*	Not Threatened	x	x	
Silvereye	*Zosterops lateralis*	Not Threatened	x	x	x
South Island fantail	*Rhipidura f. fuliginosa*	Not Threatened	x	x	
South Island tomtit	*Petroica m. macrocephala*	Not Threatened	x	x	
Southern black-backed gull	*Larus dominicanus*	Not Threatened	x	x	x
Spur-winged plover	*Vanellus miles*	Not Threatened	x	x	x
Swamp harrier	*Circus approximans*	Not Threatened	x	x	
Tui	*Prosthemadera n. novaeseelandiae*	Not Threatened	x	x	
Welcome swallow	*Hirundo neoxena*	Not Threatened	x	x	x
White-faced heron	*Egretta novaehollandiae*	Not Threatened	x	x	

6.2.3 Herpetofauna

The vegetation and habitats within the proposed pipeline footprint have been subject to frequent modification including historic flooding / inundation, earthworks (including to install the river training line / stop bank in 2011) and vehicle damage, are shaded (e.g. crack willow forest and treeland), or are open habitats that are typically heavily browsed by rabbits and provide very limited refugia for lizards (e.g. stonecrop herbfield and gravelfield). The habitats within the construction footprint are considered unlikely to provide suitable habitat for indigenous lizards and they are not considered further in this assessment.

6.2.4 Bats

The nearest confirmed record of bats to the Site is c.18 km[23]. Based on this, and the habitat types present, it is considered very unlikely that bats are present. Bats are not considered further in this assessment.

6.3 Freshwater

6.3.1 Water quality

Water quality measurements have been undertaken by GHD since March 2025. These have been summarised in the sections below.

6.3.1.1 Physical chemistry

Field measurements of pH, dissolved oxygen (DO), temperature, and turbidity were collected across the Kawarau River monitoring sites by GHD. Overall:

- pH was consistently above neutral and showed little variation among sites, with a median of 7.77 (range 7.2-8.3).
- Dissolved oxygen was similar across sites, with the highest median at RS10 (11.2 mg / L) and the lowest at RS13 (10.20 mg / L). The overall median DO was 10.70 mg / L (range 5.18-14.60). All sites were within Attribute Band A of the NPS-FM (Table 3).
- Temperature was lowest at RS10 below the Shotover River confluence (median 10.50 C) and highest at RS14 (median 14.20 C). Across all sites, the median temperature was 12.95 C (range 3.90 - 21.90 C).
- Turbidity measurements were not consistently paired across sites and were limited in frequency at some locations. The highest recorded turbidity was 57.2 NTU at RS10, reflecting the naturally high sediment load contributed by the Shotover River (Figure 7), compared with the next highest recording of 3.34 NTU at RS11.

Seasonal shifts in physical chemistry parameters such as pH and temperature were evident. At RS10, winter conditions (June – August 2025) were characterised by a median pH of 8.00 and

[23] https://www.thebatcolab.co.nz/doc-bat-observations-map

temperature of 5.7 °C, while summer conditions (December 2025 - February 2026) showed a slightly lower median pH of 7.85 and higher median temperature of 15.8 °C (GHD, 2026).

Figure 7: Kawarau River, and Shotover Delta, looking north from the Remarkables showing high suspended solids load in the Shotover compared to the Kawarau. Photo taken on 11 November 2025 with peak flows of 195 cumecs recorded in the Shotover at Bowens Peak. Photo source: Dawn Palmer.

6.3.1.2 Nutrients

Water quality in the Kawarau River has been characterised using long-term monitoring at the Chard Road monitoring station (LAWA) and surface-water quality monitoring undertaken by GHD since March 2025 (GHD, 2026). Full analytical results and interpretation are provided within the Surface Water and Groundwater Assessment (GHD, 2026); only a brief ecological summary is presented here and comparisons with the NPS-FM Attribute Bands.

The water quality at the Kawarau River at Chard Road site reflects the combined influence of Lake Wakatipu and the Shotover River. The long-term data shows high water quality, with AN, nitrate nitrogen, and DRP consistently meeting NPS-FM Attribute Band A. Water clarity is classified as Attribute Band C, reflecting naturally elevated suspended sediment loads from glacial meltwater and sediment inputs from the Shotover River.

GHD's (2026) monitoring indicates slightly elevated nutrient concentrations at mid-reach sites (RS11-RS13), likely reflecting historical groundwater seepage through Shotover Delta gravels from the DaD field. At both RS14 (upstream in the Kawarau) and RS10 (downstream of the Shotover confluence), 95th percentile ammoniacal-N and nitrate-N concentrations meet Attribute Band A criteria. DRP at RS14 meets Attribute Band A, while RS10 falls within Attribute Band B, although the difference between sites was not statistically significant. DRP concentrations may be slightly higher at RS10 through the cumulative influence of the DaD field and Shotover River influence, including the current short-term wastewater discharge into the Shotover River. All nutrient parameters still meet Schedule 15 criteria of the Regional Plan: Water, indicating excellent water quality (Otago Regional Council, 2026).

Table 3. Summary of water-quality attribute states for the Kawarau River (combined findings from LAWA at Chard Road and GHD 2026 monitoring at RS10 and RS14).

Water quality parameter	NPS-FM Attribute Band	Source
Ammoniacal Nitrogen	A	LAWA and GHD (2026)
Nitrate Nitrogen	A	LAWA and GHD (2026)
Dissolved Reactive Phosphorus	A*	LAWA and GHD (2026)
Suspended Fine Sediment (Clarity)	C	LAWA
Dissolved oxygen	A	GHD (2026)

*Attribute Band A for RS14, Attribute Band B for RS10 (GHD, 2026). Although samples weren't statistically different.

6.3.1.3 Metals

The three metals reported in GHD (2026) are aluminium, copper, and zinc. Sites RS10 (downstream of the Shotover River confluence) and RS11 (upstream of the Shotover River confluence, but potentially influenced by DaD groundwater and/or surface overflows), were the primary monitoring sites reported for metals in GHD (2026), with data collected on 22 April 2026. The following is summarised from GHD (2026):

- Dissolved aluminium concentrations in April 2026 at RS10 (0.023 mg/L) and RS11 (0.007 mg/L) were below the 99% species protection DGV (0.027 mg/L)[24]. The elevated aluminium concentrations at RS10 compared to RS11 is associated with inputs from the Shotover River, which naturally contains elevated aluminium concentrations due to the geology and mineralogy of its catchment. GHD (2026) noted that dissolved aluminium concentrations were substantially lower than total aluminium concentrations, indicating that a large proportion of aluminium was bound to sediment and that aluminium solubility was reduced under the pH conditions present in the river waters.

- Dissolved copper concentrations in April 2026 at RS10 (0.0005 mg/L) and RS11 (0.0007 mg/L) were both below the 99% species protection DGV (0.001 mg/L).

- Dissolved zinc concentrations in April 2026 at RS10 (0.0061 mg/L) exceeded the 99% species protection DGV (0.0024 mg/L) but remained below the 95% species protection DGV (0.008 mg/L). Zinc concentrations at RS11 (<0.0005 mg/L) were well below the 99% species protection DGV. Zinc was also measured at RS14 on 3 April 2025 at 0.002 mg/L.

Overall, dissolved metal concentrations in the Kawarau River are generally low, with only zinc at RS10 in April 2026 exceeding a 99% species protection DGV (ANZG, 2018). This indicates that some metals may naturally exceed ANZG (2018) DGVs under background conditions downstream of the Shotover River confluence, with these temporary exceedances considered to primarily reflect natural catchment-derived inputs from the Shotover River.

6.3.1.4 Other

Other contaminants, including PFAS and microplastics, are not part of the GHD water-quality monitoring programme for the Kawarau River and have therefore not been assessed.

[24] DGV for aluminium for pH >6.5 (ANZG, 2018).

6.3.2 Habitat quality and availability

Riparian and in-stream habitat conditions, based on the RHA scores, across the five Kawarau River sites ranged from 44 (marginal) to 59 (sub-optimal) (Appendix 5.

Table 4Table 4). All sites shared characteristics of a mobile, gravel-bed river, with substrates dominated by small cobble, gravel and sand (Table 5). Minor variation occurred where periphyton, willow root mats or macrophytes were present, contributing to differences in invertebrate and fish habitat diversity among sites. Invertebrate habitat abundance was notably reduced at RS11 and RS13 due to the presence of didymo or sludge mats and areas of deposited sediment. Fish cover was limited across all sites (≤30%), reflecting the scarcity of large wood, overhanging vegetation and stable cover elements.

Hydraulic conditions across all sites were dominated by run habitat, characterised by a deep, fast-flowing thalweg and slower-flowing margins, with backwater areas forming along the true-left bank. This pattern is consistent with the bathymetry report (Earth Sciences New Zealand, 2026), with the exception of CX5 (corresponding to RS10), which exhibits a more uniform channel depth and velocity profile.

Riparian vegetation on the true left bank consisted largely of bare gravels with scattered willows on a low gradient slope, while the true right bank was steeper and comprised exotic shrubs (primarily gorse and matagouri) and rank grasses. Both margins provided minimal shading and contributed little additional in-stream structure.

All sites were assessed within the sub-optimal habitat category except RS11 (the proposed discharge structure location), which was classified as marginal. This lower score was driven primarily by reduced fish cover diversity and high deposited sediment cover (Table 4), with habitat features at RS11 limited to cobbles, occasional small pieces of woody debris and isolated boulders likely present in the deeper channel.

A photo of each site is provided in Appendix 5.

Table 4. Summary of the Rapid Habitat Assessment (Clapcott, 2015) scores for five Kawarau River sites surveyed on 10–11 March 2026. RS14 is located upstream of any potential DaD influence; RS11–RS13 are located down-gradient of the DaD/disposal field; and RS10 is located downstream of the Shotover River confluence. "Upstream" and "downstream" are referenced relative to the proposed discharge location.

Habitat parameter	RS14 - Upstream	RS13 – Upstream	RS12 – Upstream	RS11 - Proposed discharge location	RS10 - Downstream
Deposited sediment	5	5	7	1.5	1
Invertebrate habitat diversity	8	7	6	6	10
Invertebrate habitat abundance	10	5	9	5	7
Fish cover diversity	6	4	3	2	10
Fish cover abundance	5	3	5	4	4
Hydraulic heterogeneity	8	3	3	4	1
Bank erosion	8	10	10	9.5	9.5
Bank vegetation	4	3	3	3	2.5
Riparian width	10	10	10	9.5	10

Riparian shade	1.5	1	1	1	1
Total RHA score	65.5	51	57	45.5	55
Score interpretation	Sub-optimal	Sub-optimal	Sub-optimal	Marginal	Sub-optimal

Table 5. Average substrate composition (%) from five replicate transects to a maximum depth of 60 cm along the true left bank at five Kawarau River sites. RS14 is located upstream of any potential DaD influence; RS11–RS13 are located down-gradient of the DaD/disposal field; and RS10 is located downstream of the Shotover River confluence. "Upstream" and "downstream" are referenced relative to the proposed discharge location.

Substrate type	RS14 – Upstream	RS13 – Upstream	RS12 – Upstream	RS11 – Proposed discharge location	RS10 – Downstream
Large cobble (64–256 mm)	0	8	9	17	2
Small cobble (16–64 mm)	31	22	46	80	37
Gravel (2–16 mm)	23	32	31	3	38
Sand (0.06–2 mm)	46	38	15	0	24
Silt (<0.062 mm)	0	0	0	0	0

Table 6. Average water velocity and deposited sediment cover (mean and range) at Kawarau River sites RS10–RS14 along the true left bank, surveyed on 10–11 March 2026. RS14 is located upstream of any potential DaD influence; RS11–RS13 are located down-gradient of the DaD/disposal field; and RS10 is located downstream of the Shotover River confluence. "Upstream" and "downstream" are referenced relative to the proposed discharge location.

Site	Average water velocity (m/s)	Average deposited sediment (%) with range
RS14 – Upstream	0.4	28 (0 - 99)
RS13 – Upstream	0.2	28 (0 - 90)
RS12 – Upstream	0.1	14 (0 - 90)
RS11 – Proposed discharge location	0.4	73 (1 - 95)
RS10 – Downstream	0.5	86 (9 - 100)*

* RS10 recorded high deposited-sediment values because several replicates consisted entirely of sand along the true left margin.

6.3.3 Periphyton and macrophytes

Periphyton cover was generally low across the Kawarau River, consistent with an oligotrophic, mobile gravel-bed system. Refer to the Periphyton Risk Assessment for more detail on factors influencing periphyton growth (Boffa Miskell, 2026). RS10, RS12, and RS14 were characterised by very low periphyton cover, with all three sites recording more than 75% average cover of no algae.

In contrast, RS11 supported moderate didymo cover (average c. 35%), and RS13 exhibited extensive sludge mats (average c. 65%) (Figure 8). These patterns may reflect localised stability and slower velocities along the true-left margin, where substrate composition and reduced disturbance can allow periphyton mats to establish. For example, RS11 (the proposed discharge location) had the highest proportion of small cobbles (average 80%) and no sand, providing greater surface area for periphyton colonisation relative to other sites (Table 5). At RS13, the extensive sludge mats may also be influenced by slower local velocities (e.g. Table 6; Earth Sciences New Zealand, 2026). These sites RS11-RS13 may have additionally been affected by nutrient enrichment associated with the DAD overflow and groundwater infiltration.

All sites recorded PeriWCC values below 2%, reflecting the absence of filamentous algae and periphyton mats included in the calculation, placing all sites well within the ‘excellent’ ecological condition class (<20%) (Matheson et al., 2012).

Macrophytes occurred only in small, isolated patches within and between sites and did not materially influence habitat condition. Two species were recorded, *Myriophyllum triphyllum* at most sites and sparse *Lagarosiphon major* at RS13 and RS14, although neither were observed within the transects used for periphyton assessment.

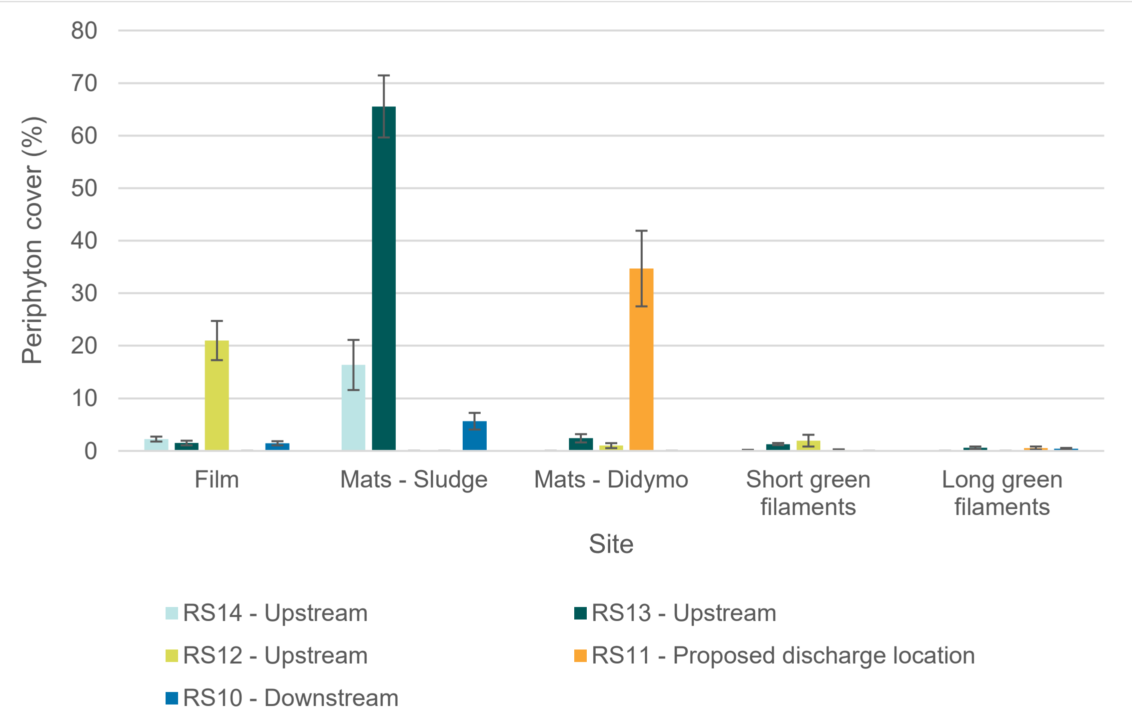

Figure 8. Average periphyton percentage cover (± standard error) at five Kawarau River sites, including upstream sites RS12–RS14, the proposed discharge structure location at RS11, and the downstream site RS10, surveyed on 10–11 March 2026. RS11–RS13 are located down-gradient of the DaD/disposal field, where historical overflows and groundwater infiltration may have influenced local conditions.

6.3.4 Macroinvertebrates

A total of 31 macroinvertebrate taxa were recorded across the Kawarau River sites, including 12 EPT taxa (two mayfly, two stonefly, and eight caddisfly taxa). EPT richness (excluding Hydroptilidae) and total taxa richness were lowest at RS12, while RS10 and RS14 supported the highest richness (Table 7).

Community composition varied among sites but was consistently dominated by pollution-tolerant taxa. Cladocera were the most abundant group, contributing more than 50% of total relative abundance at all sites and reaching approximately 80% at RS14 (Figure 8), likely reflecting drift from Lake Wakatipu. Other abundant taxa included oligochaete worms, *Potamopyrgus* snails, and dipterans such as *Chironomus* and Orthocladiinae. The only hydroptilid caddisfly recorded was *Oxyethira*.

Macroinvertebrate index scores reflected these patterns (Table 7). RS10 had the highest MCI and QMCI scores, both within the 'fair' quality class (Stark & Maxted, 2007), supported by the presence of *Zelandobius* stoneflies, an *Austroclima* mayfly, and higher relative abundances of *Deleatidium* mayflies. These scores place RS10 within Attribute Band C of the NPS-FM.[25]

All other sites were within the 'poor' MCI class, except RS13, which was marginally within 'fair'. All sites were below the NPS-FM national bottom line for MCI (90; Attribute Band D).[26]

For QMCI, RS11 and RS12 were below both the 'poor' threshold and the national bottom line of 4.5, driven by high proportions of tolerant taxa such as oligochaetes and *Chironomus*. RS13 and RS14 improved to the 'fair' QMCI class due to increased proportions of higher-scoring taxa. At RS13, this was primarily driven by elevated abundances of *Deleatidium*, which contributed to the higher %EPT. The higher *Deleatidium* abundance relative to other taxa at RS13 may reflect local habitat conditions that favour algal grazers, such as the greater extent of sludge, which can support biofilm and diatom development. At RS14, improvements were associated with higher proportions of *Cladocera* (hard bottom tolerance score of 5), which score higher than the dipteran taxa in higher relative abundances at RS11 and RS12 (Orthocladiinae = 2; *Chironomus* = 1). RS13 remained below the national bottom line despite being in the fair class, while RS14 was within Attribute Band C.

ASPM scores were below the NPS-FM national bottom line of 0.3 at all sites, although RS10 was close at 0.29. This reflects the low percentage of EPT abundance across the sites, with all sites recording less than 25% EPT (excluding Hydroptilidae).

Overall, macroinvertebrate communities in the Kawarau River were characterised by low EPT abundance, dominance of tolerant taxa, and index scores that were below or only marginally above national bottom lines. These results are consistent with wider patterns reported for the river; at Chard Road, the 5-year median MCI (82.1) and QMCI (2.1) recorded between 2017 and 2021 was also below the NPS-FM national bottom lines.

The eDNA record (536116) on Wilderlab did not identify any additional macroinvertebrate species such as freshwater mussel (kākahi) or freshwater crayfish (kōura).

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[25] Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment.

[26] Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment.

Table 7. Macroinvertebrate indices for the five Kawarau River sites, collected in March 2026. MCI and QMCI are colour-coded following Stark and Maxted (2007): red = 'poor' (MCI <80; QMCI <4) and orange = fair (MCI 80–99; QMCI 4–4.99). ASPM is colour-coded using NPS-FM thresholds, with Attribute Band D (<0.3) shown in red. RS11–RS13 are located down-gradient of the DaD / disposal field, where historical overflows and groundwater infiltration may have influenced local conditions.

Parameters	RS14 – Upstream	RS13 – Upstream	RS12 – Upstream	RS11 – Proposed discharge location	RS10 – Downstream
Taxa richness (total)	21	17	12	17	20
EPT taxa richness (total)	9	5	2	7	7
EPT taxonomic richness (excl. hydroptilids) (total)	8	4	2	6	6
% EPT abundance (average)	3.1	15.4	0.8	7.8	21.9
% EPT abundance (excl. hydroptilids) (average)	2.7	13.2	0.8	6.9	20.9
MCI-hb (average)	77	82	71	72	98
QMCI-hb (average)	4.68	4.35	3.31	3.78	4.98
APSM-hb (average)	0.19	0.23	0.14	0.18	0.29

* EPT = Ephemeroptera, Plecoptera, Trichoptera. MCI = Macroinvertebrate Community Index. QMCI = Quantitative MCI. ASPM = Average Score Per Metric. NEMS-m hb = hard-bottom tolerance values (Ministry for the Environment, 2022a).

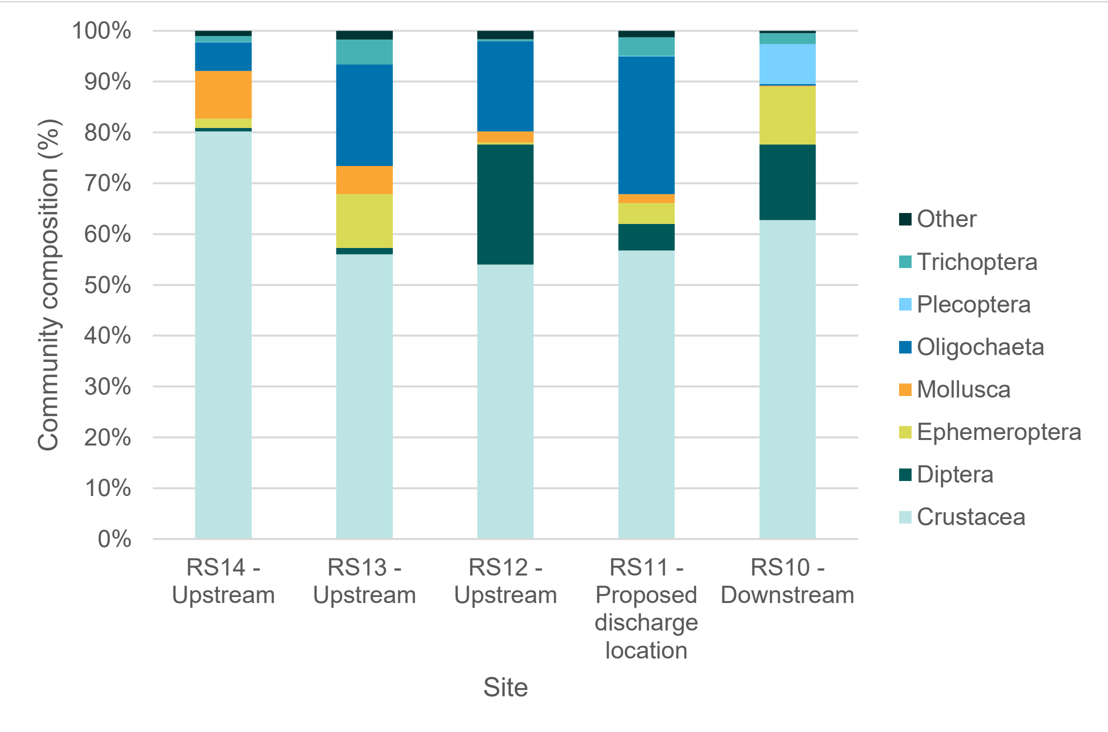

Figure 9. Relative abundances of macroinvertebrate taxonomic groups collected from the five Kawarau River sites, including upstream sites RS12–RS14, the proposed discharge structure location at RS11, and the downstream site RS10, surveyed on 10–11 March 2026. RS11–RS13 are located down-gradient of the DaD / disposal field, where historical overflows and groundwater infiltration may have influenced local conditions. "Other" includes Coelenterata, Coleoptera, Collembola, Nematoda, Nemertea, and Platyhelminthes.

6.3.5 Fish

The fish community of the Kawarau River, and the Shotover River which provides an indication of species that may also occur either permanently or transiently in the Kawarau, was informed by publicly accessible Wilderlab eDNA records (e.g. record 536116 collected at the proposed discharge structure location) and the NZFFD.

Within the Kawarau River, the following species have been recorded by both eDNA and the NZFFD:

- Longfin eel (*Anguilla dieffenbachii*; At Risk – Declining)
- Common bully (*Gobiomorphus cotidianus*; Not Threatened)
- Rainbow trout (*Oncorhynchus mykiss*; Introduced and Naturalised)
- Brown trout (*Salmo trutta*; Introduced and Naturalised).

Common bullies were also visually observed during fieldwork at several Kawarau River sites, with higher numbers seen at RS13. These observations support the eDNA and NZFFD records and indicate that common bullies are likely resident within the reach.

The Kawarau River is recognised in Schedule 1A of the Otago Regional Plan: Water as important habitat for kōaro (*Galaxias brevipinnis*; At Risk – Declining). Although habitat at the proposed discharge location is not preferred kōaro habitat (e.g. Petrove & McEwan, 2024), kōaro may still move through the reach. They are capable of forming land-locked lake populations and are recorded in tributaries to Lake Wakatipu and the Kawarau River, indicating suitable habitat connectivity and their likely presence within the Kawarau River system.

No additional species were recorded for the Shotover River, while additional NZFFD records for the Kawarau River tributaries include an unidentified Galaxiid species and perch (*Perca fluviatilis*; Introduced and Naturalised). Given the hydrological connection to Lake Wakatipu and Lake Dunstan, chinook salmon (*Oncorhynchus tshawytscha*; Introduced and Naturalised) may also infrequently occur within the system.

Two major hydroelectric dams on the Clutha River (Clyde and Roxburgh) restrict upstream migration to the Kawarau River, particularly of longfin eel elvers, and impede downstream migration of adults. Trap and transfer programmes operate at Roxburgh Dam to assist migration past the dam.

No publicly accessible information identifies any native fish or trout spawning habitat within the main stem of the Kawarau River. However, a local angler described two known trout spawning locations on the Kawarau near the proposed discharge location. One location is near RS13, upstream of the proposed discharge location. The other location is directly upstream of a gravel island near the true-right side of the River, opposite the confluence with the Shotover River.

6.3.6 Freshwater ecological value

The ecological value assessment has been applied at the reach scale of the Kawarau River between the upstream RS14 monitoring location and downstream of far-field complete mixing at the Otago Regional Councils Chard Road water quality monitoring location. While this scale is appropriate, we note that ecological data were primarily collected in the Kawarau River at, and adjacent to, the Shotover River confluence, where effects are expected to be more likely.

The Kawarau River scores High for representativeness, rarity and distinctiveness and ecological context, and Moderate for diversity and pattern and ecological integrity (Table 8). The overall ecological value of the Kawarau River is High.

Table 8. Summary of ecological value assessment for the Kawarau River using EIANZ guidelines (Roper-Lindsay et al., 2018).

Matter	Assessment	Value
Representative ness	Water quality is consistently high, with ammoniacal-N, nitrate-N and DRP meeting NPS-FM Attribute Band A (excluding some sites potentially influenced by DaD overflow or groundwater infiltration), and clarity reflecting natural suspended-sediment inputs from the Shotover River system. Habitat characteristics are representative of a large, mobile, gravel-bed river downstream of Lake Wakatipu. Ongoing modification occurs through jet-boating, bank disturbance, and historical land-use effects. Indigenous species are present, although riparian margins are largely exotic or comprise bare gravels/bedrock typical of high-energy rivers. The presence of didymo and lagarosiphon at some sites indicates a degree of anthropogenic impact.	High
Rarity and distinctiveness	The macroinvertebrate community reflects natural limitations typical of oligotrophic, high-energy systems (low nutrients, mobile substrates, high suspended sediment). Two indigenous fish species (longfin eel and common bully) were recorded, with kōaro likely to rely on the system; both longfin eel and kōaro are classified as At Risk – Declining. Periphyton condition was excellent across all sites. Large rivers of this type are relatively uncommon nationally, and the presence of longfin eel at this altitude and within a large, lake-fed system contributes to distinctiveness.	High
Diversity and pattern	Macroinvertebrate diversity is low to moderate, with communities dominated by lake-influenced Cladocera and tolerant taxa. Fish diversity is relatively low, which is typical of high-altitude and inland river systems of this type. Habitat pattern is characterised by consistent run habitat with good physical heterogeneity, providing a range of microhabitats.	Moderate
Ecological context	The river flows from Lake Wakatipu and contributes substantially to the Clutha (Mata-Au) system. Upstream migration into the Kawarau is constrained by the Clyde and Roxburgh dams, naturally limiting some longfin eel recruitment. The reach forms the main stem to a wide network of tributaries supporting kōaro and other indigenous species and provides important hydrological buffering and connectivity between inland catchments and the Clutha/Mata-Au.	High
Ecological integrity	Nativeness – Moderate: The fish community includes indigenous longfin eel, kōaro and common bully (all expected in this region), alongside introduced trout. Riparian vegetation is largely exotic, although extensive bare gravels / bedrock are natural for a high-energy river of this type. Pristineness – Moderate: Water quality remains excellent, aside from potential historical groundwater effects near the DaD overflow, but riparian margins are dominated by exotic vegetation. Diversity – Moderate: Fish diversity is low and macroinvertebrate diversity is moderate, noting the dominance of tolerant taxa; however, physical and habitat diversity is moderate to high. Resilience – High: Mobile substrates, high flows and volumes, and excellent water quality support strong natural resilience.	Moderate
OVERALL ECOLOGICAL VALUE		**High**

6.4 Summary of ecological values

Table 9 summarises our assessment of ecological values following the EIANZ guidelines (Roper-Lindsay et al. 2018; see Appendix 1).

Table 9. Summary of ecological values assigned to vegetation, habitats and indigenous fauna within and adjacent to the Site.

Ecosystem Component	Representativeness	Rarity / Distinctiveness	Diversity and Pattern	Ecological Context	Overall Ecological Value
Vegetation and Terrestrial Habitats					
Crack willow forest and treeland	Very Low	Very Low	Very Low	Very Low	Negligible
Buddleia scrub and shrubland	Very Low	Very Low	Very Low	Very Low	Negligible
Tree lupin shrubland	Very Low	Very Low	Very Low	Very Low	Negligible
Gravelfield (gravel roads/tracks and river beds)	Very Low	Moderate	Very Low	Very Low	Low
Hemlock-Russell lupin herbfield	Very Low	Very Low	Very Low	Very Low	Negligible
Stonecrop herbfield	Very Low	Very Low	Very Low	Very Low	Negligible
Avifauna					
Black-fronted tern	Threatened – Nationally Vulnerable				Very High
Banded dotterel, black-billed gull, New Zealand pipit, South Island pied oystercatcher	At Risk – Declining				High
Black shag, little shag,	At Risk - Relict				Moderate
Australian coot	At Risk – Naturally Uncommon				Moderate
All other key indigenous bird species	Not Threatened				Low
Freshwater					
Kawarau River	High	High	Moderate	High	High

6.5 Ecological significance

6.5.1 Identified Significant Sites

Neither the Queenstown Lakes Operative or Proposed District Plans identify any sites that are ecologically significant under S6(c) of the Resource Management Act (RMA) (i.e. Sites of Natural Significance) within or near the Site. However, neither plan includes a complete list of all the sites in the District that are ecologically significant under S6(c) of the RMA.

6.5.2 Significance assessment - terrestrial vegetation and habitats

As described in Section 5.5, three separate statutory significance assessment criteria are currently relevant to this Site:

- The criteria for determining the significance of areas of indigenous vegetation and habitats of indigenous fauna listed in Policy 33.2.1.8 of the QLPDP;
- Appendix 2 of the ORPS 2021[27].
- The "*Criteria for identifying areas that qualify as significant natural areas (SNAs)*" in Appendix 1 of the National Policy Statement for Indigenous Biodiversity (NPS-IB; MfE 2023).

Table 10 evaluates the terrestrial ecology values of the Site against these criteria. The ecological significance of the terrestrial ecology values of the Lower Shotover River and delta have not been evaluated because they are outside the project footprint, and other than potential disturbance effects to birds in the vicinity of the proposed outfall structure, will not be impacted by the proposal.

In summary, the vegetation and habitats within the construction footprint are not ecologically significant under the criteria for determining ecological significance in the QLPDP, ORPS and Appendix 1 of the NPS-IB.

[27] The ecological significance criteria in the ORPS are the same criteria as the NPS-IB ecological significance criteria.

Table 10: Evaluation of the Site against the NPS-IB criteria for determining significant indigenous vegetation and significant habitat of indigenous biodiversity.

QLPDP Criteria	ORPS / NPS-IB Criteria	Assessment	QLPDP criteria met?	ORPS / NPS-IB criteria met?
a. Representativeness	**A. Representativeness**			
Whether the area is an example of an indigenous vegetation type or habitat that is representative of that which formerly covered the Ecological District, including degraded examples if they are some of the last examples remaining	*(a) Indigenous vegetation that has ecological integrity that is typical of the character of the ecological district:* *(b) Habitat that supports a typical suite of indigenous fauna that is characteristic of the habitat type in the ecological district and retains at least a moderate range of species expected for that habitat type in the ecological district.*	The vegetation and habitats along the pipeline alignment are entirely, or almost entirely, dominated by exotic weedy plant species that are not representative of, or typical of, the vegetation which formerly covered the ED. These vegetation and habitat types do not have ecological integrity that is typical of the character of the ecological district. Depressions in areas of gravelfield support a low diversity of indigenous turf species. They are degraded and modified by vehicles and are not significant under this criterion. The vegetation and habitats within the Site support a suite of indigenous bird species typical of exotic dominated, degraded habitats but are not considered significant under this criterion.	No	No
c. Diversity and Pattern	**B. Diversity and Pattern**			
Whether the area supports a highly diverse assemblage of indigenous vegetation and habitat types, and whether these have a high indigenous biodiversity value including: *i. indigenous taxa;* *ii. ecological changes over gradients;*	*(a) at least a moderate diversity of indigenous species, vegetation, habitats of indigenous fauna or communities in the context of the ecological district:* *(b) presence of indigenous ecotones, complete or partial gradients or sequences.*	The vegetation and habitats along the pipeline alignment are almost entirely exotic vegetation with very few indigenous species. Exceptions were self-seeding *Coprosma* seedlings within crack willow forest and a small number of tree tutu plants and low diversity of indigenous turf species in areas of degraded open gravelfield nearer the Kawarau River. All vegetation types have either no, or a very low diversity of, indigenous species. No indigenous ecotones, gradients, or sequences are present; vegetation types are almost entirely exotic.	No	No

QLPDP Criteria	ORPS / NPS-IB Criteria	Assessment	QLPDP criteria met?	ORPS / NPS-IB criteria met?
		The vegetation and habitats along the pipeline alignment support a typical diversity of indigenous bird species for degraded exotic dominated habitats but are not considered significant under this criterion.		
b. Rarity	**C. Rarity/Distinctiveness**			
Whether the area supports; *i. indigenous vegetation and habitats within originally rare ecosystems;* *ii. indigenous species that are threatened, at risk, uncommon, nationally or within the ecological district;* *iii. indigenous vegetation or habitats of indigenous fauna that has been reduced to less than 20% of its former extent, regionally or within a relevant Land Environment or Ecological District;*	*An area that qualifies as an SNA under this criterion has at least one of the following attributes:* *(a) provides habitat for an indigenous species that is listed as Threatened or At Risk (declining) in the New Zealand Threat Classification System lists:* *(b) an indigenous vegetation type or an indigenous species that is uncommon within the region or ecological district:* *(c) an indigenous species or plant community at or near its natural distributional limit:*	The Site does not support vegetation of habitats within originally rare / naturally uncommon indigenous ecosystems (Williams et al., 2007) and are classified as 'endangered' (Holdaway et al., 2012). Although part of the Shotover River floodplain, the Site has been highly modified and stabilised by earthworks, installation of the river training wall, roads and tracks, and the establishment of willows and other exotic weeds. It no longer supports the ecological values typical of braided rivers. No Threatened, At Risk or uncommon plant species were recorded within the construction footprint. Eastern falcon, long-tailed cuckoo (both Threatened – Nationally Vulnerable) and New Zealand pipit (At Risk – Declining) have been recorded using terrestrial vegetation and habitats in the vicinity of the pipeline alignment (Palmer, 2021). However, these vegetation types and habitats do not	No	No
d. Distinctiveness				

QLPDP Criteria	ORPS / NPS-IB Criteria	Assessment	QLPDP criteria met?	ORPS / NPS-IB criteria met?
Whether the area supports or provides habitats for indigenous species: *i. at their distributional limit within Otago or nationally;* *ii. are endemic to the Otago region;* *iii. are distinctive, of restricted occurrence or have developed as a result of unique environmental factors;*	*(d) indigenous vegetation that has been reduced to less than 20 per cent of its pre-human extent in the ecological district, region, or land environment:* *(e) indigenous vegetation or habitat of indigenous fauna occurring on naturally uncommon ecosystems:* *(f) the type locality of an indigenous species:* *(g) the presence of a distinctive assemblage or community of indigenous species:* (h) *the presence of a special ecological or scientific feature.*	provide core habitat for these species and they are likely infrequent visitors to the Site. The Site does not support indigenous vegetation or habitats of indigenous fauna that have been reduced to less than 20% of their former extent or indigenous vegetation types or indigenous species that are uncommon within the region or ecological district. No habitats or species were recorded that are endemic to the Otago Region or at their distributional limit. The Site and surrounding area are not known to be the type locality of any indigenous species present at the Site. The Site does not have any distinctive assemblages or communities of indigenous species. The Site is not considered to contain any special ecological or scientific features.		
e. Ecological Context	**D. Ecological Context**			
The relationship of the area with its surroundings, including whether the area proposed to be cleared: *i. has important connectivity value allowing dispersal of indigenous fauna between different areas; has an important buffering function to protect values of an adjacent area or feature;* *ii. is important for indigenous fauna during some part of their life cycle.*	*An area that qualifies as an SNA under this criterion has at least one of the following attributes:* *(a) at least moderate size and a compact shape, in the context of the relevant ecological district:* *(b) well-buffered relative to remaining habitats in the relevant ecological district:* *(c) provides an important full or partial buffer to, or link between, one or more important habitats of*	The Site does not have important connectivity value in terms of allowing dispersal of indigenous fauna between different areas. While the exotic crack willow forest and treeland between the oxidation ponds and the Kawarau River plays a role in buffering the lower Shotover River from human activities, the vegetation within the construction footprint is not ecologically significant for this reason. The Site itself is not well buffered and has a long history of modification. It is fragmented by the river training line / stop bank and cycle track, Shotover Delta Road, numerous informal off-road vehicle tracks.	No	No

QLPDP Criteria	ORPS / NPS-IB Criteria	Assessment	QLPDP criteria met?	ORPS / NPS-IB criteria met?
	indigenous fauna or significant natural areas: (d) *important for the natural functioning of an ecosystem relative to remaining habitats in the ecological district.*	The vegetation and habitats along the pipeline alignment are not known to be important for indigenous fauna during part of their life cycle.		

6.5.3 Significance assessment - freshwater

The Kawarau River was assessed against the APP2 criteria in the ORPS for identifying Significant Natural Areas, using the Remarkables Ecological District as the assessment context. The river meets multiple APP2 attributes and is therefore considered ecologically significant (Table 11).

As discussed in Section 6.1.2, this outcome is consistent with Schedule 1A of the ORC Regional Plan and the Water Conservation (Kawarau) Order 1997, which recognises the Kawarau River as an outstanding waterbody (Regional Plan, Schedule 1A) and having outstanding amenity and intrinsic values, and characteristics (Water Conservation Order, Schedule 2). Sports fish (salmon and trout) are also identified as ecosystem values under Schedule 1A.

Table 11. Ecological significance assessment for the Kawarau River against APP2 criterion in the ORPS.

APP2 Criterion	APP2 Attribute	Reasoning for Meeting Criterion/Attribute
Representativeness	A7(b) – habitat that supports a typical suite of indigenous fauna that is characteristic of the habitat type in the ecological district and retains at least a moderate range of species expected for that habitat type in the ecological district.	Supports kōaro, longfin eel, common bully.
Rarity and distinctiveness	C6(a) – provides habitat for an indigenous species that is listed as Threatened or At Risk (declining) in the New Zealand Threat Classification System lists	Supports kōaro and longfin eel, which are both At Risk – Declining.
Ecological context	D3(c) – provides an important full or partial buffer to, or link between, one or more important habitats of indigenous fauna or significant natural areas.	Acts as the only ecological and hydrological corridor between Lake Wakatipu and the Clutha, linking multiple tributaries supporting indigenous fish.
	D3(d) – important for the natural functioning of an ecosystem relative to remaining habitats in the ecological district; and	Drives connectivity between habitat and contributes to ecological processes across the wider ecological district.

7.0 Unmitigated ecological effects assessment

This section assesses the potential direct and indirect ecological effects arising from the construction and operation of the proposed treated-wastewater discharge to the Kawarau River, including effects associated with the proposed pipeline and outfall structure installation and cumulative effects. The level of effect described is without effects management, other than standard construction controls (e.g. erosion and sediment control for earthworks).

This assessment relies on the dispersion modelling and construction design information provided by GHD (2026). The potential ecological effects (following the designed avoidance measures) and the activities that give rise to them are outlined below.

Potential effects of the proposed works on terrestrial vegetation are assessed at the scale of the Site. Potential effects of the proposal on avifauna are assessed at the scale of the ED. This scale / area has been selected to take into account the large home ranges of the key avifauna species considered for this assessment, particularly when foraging.

Potential effects of the proposed construction works and operational structure and discharge on the Kawarau River are assessed at the catchment scale, as the main value of the potentially impacted reach is in the ecosystem services provided to the catchment, both downstream and upstream.

The actual and potential adverse effects on terrestrial ecological values as a result of the construction of the proposed pipeline and outlet structure include:

- Vegetation clearance;
- Habitat fragmentation;
- Weed introduction and / or spread; and
- Effects on avifauna including:
    - Habitat loss / modification;
    - Disturbance and temporary displacement during construction;
    - Impacts on nesting birds; and
    - Altered feeding due to changes in food resources.

The actual and potential adverse effects on freshwater ecological values as a result of the construction of the outlet structure include:

- Bed and bank disturbance
- Potential for injury and / or mortality of native fish
- Sediment discharges
- Spread of aquatic weeds.

The actual and potential adverse effects on freshwater ecological values as a result of the operational discharge include:

- Physical habitat modification
- Changes in water quality
- Changes in water quantity
- Ongoing structure maintenance.

7.1 Terrestrial Vegetation and Habitats

There are three potential effects on vegetation and habitats that are considered relevant in relation to the construction of the discharge structure and proposed discharge:

- Vegetation clearance;
- Habitat fragmentation; and
- Weed introduction and / or spread.

Each of these potential effects, without mitigation, are assessed below.

7.1.1 Vegetation clearance

Section 6.2.1 describes the vegetation types within the construction footprint that will be removed during construction (excavation of the trench for the pipeline and earthworks to construct the outfall structure). The extent of vegetation types within the pipeline footprint that will be removed or disturbed by pipeline construction has been calculated based on an 8 m wide construction corridor along the pipeline alignment, plus the footprint of the area of 'design fill' and the footprint of the proposed rock outfall structure. If the outfall design were to change to the alternative design, it is not expected to increase the extent of the project footprint. Table 12 provides a summary of the vegetation types that will be removed, their ecological value, and the area (in m^2) that will be removed. The location and extent of these vegetation types within the construction footprint is shown on Figure 5 and Figure 6.

Table 12. Broad vegetation type, ecological value, and extent of vegetation communities within the pipeline footprint that will be removed.

Vegetation Community Categories	Ecological Value	Vegetation clearance (m^2)
Gravelfield (including depressions with sparse turf species)	Negligible and Low	5,843
Crack willow forest	Negligible	5,582
Hemlock-Russell lupin herbfield	Negligible	2,113
Buddleia shrubland	Negligible	1,591
Crack willow treeland	Negligible	1,422
Buddleia scrub	Negligible	952
Tree lupin shrubland	Negligible	865
Total		**19,017**

Depressions in areas of open gravelfield on the southern side of the river training line / stop bank between the corner of the proposed pipeline alignment and the outfall structure support sparse indigenous dominated turf species (as described in Section 6.2.1.4) that appear to be maintained by vehicle tracking. Some areas of this gravelfield that support sparse turf species will be removed during excavation of the trench for the pipeline or covered with design fill. The extent of this vegetation type that will be removed is small and this vegetation type, which is modified by vehicle use, is of low ecological value. The level of unmitigated effect is Very Low.

All the other vegetation and habitats within the proposed pipeline and outfall structure construction footprints are exotic, have a long history of modification, and are of negligible ecological value. The clearance of vegetation of negligible ecological value is not of ecological concern (a negligible magnitude of effect) and the level of unmitigated effect is Very Low.

No effects management is required to manage the clearance of vegetation.

7.1.2 Habitat fragmentation

Construction of the pipeline will have the effect of fragmenting some vegetation types and habitats. In general, where the vegetation is low stature (e.g. stone crop herbfield) the magnitude of these effects will be lower. In contrast, for taller stature vegetation types such as crack willow forest and treelands impacted by the proposed pipeline, fragmentation will increase light levels and alter habitat suitability for some of those species not adapted to living in edge habitat. Vegetation clearance along the pipeline may also adversely impact fauna, including indigenous birds, by creating barriers to movement. However, clearance of an 8 m wide corridor is not expected to be a barrier to the bird species using these habitats and the STWDA has a long history of modification. It is already fragmented by the construction of the river training line / stop bank in 2011 and cycle track (both of which the proposed pipeline is immediately adjacent to). Similarly, in the wider area, vegetation and habitats are further fragmented by Shotover Delta Road, numerous informal off-road vehicle tracks and recreational motor bike / and or mountain biking tracks (Figure 4). In this context, the magnitude of the effect of fragmentation on vegetation and habitats of negligible ecological value is low, which represents a Very Low level of unmitigated effect.

No effects management is required to manage habitat fragmentation.

7.1.3 Weed introduction and / or spread

With projects that involve earthworks, there is the potential for weed species to be introduced or established as a result of the works. Weed introduction and establishment can occur via the use of gravel or other material from external sources, the introduction of seeds or plant material on construction machinery, the spread of weeds from affected areas of the alignment to unaffected areas on construction machinery, and the establishment of weeds, and particularly weeds with wind-blown seeds, on bare substrates following construction works or following remediation work.

Weed introduction into this Site and weed spread within the Site is of less concern at this location because the terrestrial vegetation and habitats along the proposed construction footprint are of negligible and low ecological value. Further, vegetation and habitats adjacent to the construction footprint already support many environmental weeds including crack willow, grey willow, sycamore, elderberry, buddleia, sweet briar, tree lupin, old man's beard, Russell lupin, male fern, aluminium plant (and others) and heavy machinery and trucks have been entering and working in this area for many years. Although the introduction of new weed species should be avoided, the spread of existing weeds within the construction footprint is not of concern. In this context, the magnitude of effect of weed introduction and / or spread is negligible and the level of unmitigated effect is Very Low.

Because of the number and species of weeds present within the construction footprint, there is a high risk that construction works, and particularly activities involving machinery, equipment or materials that come into contact with soil, could spread these weed species to other locations and habitats, including for example more intact braided rivers or lake margins.

The potential receiving environments for any transfer are not known, and therefore no ecological value has been assigned. However, if the weed species present were introduced to a previously un-infested relatively intact ecosystem / habitat, they could significantly alter habitat structure, reduce native biodiversity and degrade ecological function. On this basis, the ecological consequence of spread is considered, without mitigation, high (regardless of the underlying value of the recipient system).

Given the short duration of works and the ability to manage the pathway, the likelihood of spread is low. However, because the ecological impact of weed establishment in relatively intact ecosystems / habitats is potentially very high, the unmitigated magnitude of effect is, in the worst case, potentially very high. This results in a level of unmitigated ecological effect ranging from Low to Very High (depending on the ecological value of the system).

Recommendations to manage weed spread to other locations outside of the Site are set out in Section 8.1.2.

The introduction and spread of aquatic pests, including weeds, is assessed separately in Section 7.3.4 of this report.

7.2 Avifauna

There are four potential effects on birds that are considered relevant in relation to the construction of the discharge structure and proposed discharge:

- Habitat loss / modification;
- Disturbance and temporary displacement during construction;
- Impacts on nesting birds; and
- Changes in water quality.

Each of these are assessed below.

7.2.1 Habitat Loss and Modification

The terrestrial habitats (i.e., excluding the Shotover and Kawarau Rivers) along the proposed pipeline alignment (exotic forest, treeland, scrub and shrubland) provide habitat for a range of indigenous and exotic bird species. Key indigenous terrestrial birds that regularly use these habitats include Not Threatened species such as grey warbler, South Island fantail, silvereye, bellbird, tui, shining cuckoo, kingfisher and swamp harrier (Palmer, 2021). Given the quality and quantity of terrestrial habitats that will be removed, the magnitude of the effect of the loss of the habitats within the 8 m wide pipeline construction footprint on these species is considered to be negligible. These species are common and widespread and are considered to be of low ecological value. A low magnitude of effect on bird species of low ecological values equates to a Very Low level of unmitigated effect.

New Zealand pipit (At Risk – Declining) have also been recorded using habitats within the STWDA (Palmer, 2021). This species is widespread in New Zealand, highly mobile and utilises a wide range of open habitats including grassland, tussockland and riverbeds. The open areas of gravelfield and riverbed adjacent to the proposed construction footprint are likely be utilised by small numbers of pipits for foraging, but the loss of these habitats relative to the available habitat in the surrounding area is expected to have a negligible magnitude of effect on this species. This equates to a Very Low level of unmitigated effect.

The Lower Shotover River and Shotover Delta provide good quality habitat for a number of indigenous braided river bird species. Draft unpublished data from annual surveys of the Lower Shotover River in December 2021, 2024, and 2025 (Dawn Palmer *pers. comm.* 2026) have recorded the presence of black-fronted tern (Threatened – Nationally Vulnerable), banded dotterel, black-billed gull, SIPO (all At Risk – Declining), southern black-backed gull, pied stilt, and spur-winged plover (Not Threatened). The proposal will not directly affect braided river habitats in the Lower Shotover River or Shotover Delta so no effects on these species are anticipated (and no mitigation needs to be proposed).

Construction of the proposed outfall structure will result in the loss and modification of a small area (approximately 2,660 m^2) of the Kawarau River bank and its margins. In conjunction with similar habitats up and downstream, this area of the Kawarau River provides potential foraging and roosting habitat for river bird species, including the species recorded in the Lower Shotover River and Shotover Delta (listed above) as well as shag species e.g. little shag and black shag (both At Risk - Relict) and waterfowl e.g. paradise duck, mallard, grey teal, Australasian shoveler (all Not Threatened). The small size of the habitat that will be removed and / or modified in the context of similar riverbed habitat in the wider area means that the level of unmitigated effect of habitat loss or modification at this location on these species is expected to be Very Low.

7.2.1 Disturbance and displacement (construction)

This section assesses the effect of the general disturbance and displacement effects during construction (no ongoing disturbance effects are anticipated during the operation of the wastewater discharge infrastructure). Disturbance and displacement effects are assessed separately below for bird species using the terrestrial vegetation and habitats along the proposed pipeline alignment, oxidation ponds, and braided river / river habitats. Effects on nesting birds, including disturbance, are assessed in the following section.

Construction activities may adversely affect terrestrial birds that utilise the vegetation and habitats within and adjacent to the proposed pipeline through noise, vibration and machinery and vehicle movements altering bird behaviour and potentially resulting in displacement. This effect will be temporary (construction duration is estimated to be c. 6 months) and although it is yet to be confirmed, pipeline construction will most likely be completed in sections (Ian Ho *pers. comm.* 2026) meaning construction activity (and disturbance) is expected to be confined to localised sections at any one time. Further, there are areas of similar habitat in the wider landscape for any terrestrial bird species to move away from construction activities if displaced by pipeline construction-related disturbance. The magnitude of effect for these species is therefore assessed as negligible (very slight change from the existing baseline condition) and the level of unmitigated ecological effect is Very Low.

The Shotover Wastewater Treatment Plant's oxidation ponds have historically supported open water habitat that supported large numbers of waterfowl (particularly Australasian shoveler, paradise shelduck, scaup, mallard and grey teal) as well as several other bird species (black-billed gulls, spur-winged plover, pied stilts etc.). These ponds have now been decommissioned, and repurposing of Pond 3 is now underway to establish a treated wastewater calamity pond if the level of treatment provided by the SWWTP is poor and not meeting consent limits. As a result, these oxidation ponds no longer provide habitat for waterfowl and other water and wetland birds and disturbance effects on birds do not need to be considered.

Construction activities at the proposed outfall structure have the potential to disturb and displace braided river and river bird species using these habitats for foraging, roosting and breeding. The Lower Shotover River and Shotover Delta provide foraging and roosting habitat for a number of indigenous braided river bird species including black-fronted tern (Threatened – Nationally Vulnerable), banded dotterel, black-billed gull, SIPO (all At Risk – Declining), southern black-backed gull, pied stilt, and spur-winged plover (Not Threatened) (Dawn Palmer unpubl. draft data). As for terrestrial bird species, construction works in the vicinity of the Shotover and Kawarau Rivers will be temporary (estimated construction duration for the outfall structure is two months) and habitats within the SWTDA in the vicinity of the Shotover and

Kawarau Rivers, and the proposed outfall structure already experience relatively high levels of human disturbance (gravel extraction, trucks, vehicles, cyclists, people and dogs). Further, for birds that are not nesting, there are extensive areas of braided river and riverine habitats in the wider area for these bird species to move away from construction activities to forage or roost if displaced by construction-related disturbance. The magnitude of effect for these species is therefore assessed as being negligible. The unmitigated level of ecological effect on these species, which are of low to very high ecological value, is Very Low to Low. The potential unmitigated effects of construction activities on nesting braided river birds are assessed in the following section.

7.2.2 Impacts on nesting birds

Potentially, there is a risk to nesting birds if pipeline construction works occur during the breeding season (September to February). This could arise either through vegetation clearance and earthworks damaging nests or via disruption of nesting behaviours due to noise and other disturbance.

The terrestrial vegetation and habitats within and adjacent to the construction footprint (exotic forest, treeland, scrub, shrubland and herbfields) provide limited breeding habitat for most indigenous bird species. The species most likely to nest in terrestrial vegetation and habitats within and adjacent to the proposed construction footprint (e.g. grey warbler, South Island fantail, silvereye) are Not Threatened species of low ecological value. Because construction works would only be likely to impact a small number of nests of these species (if any) the magnitude of effect is, at worst, considered to be Low. This equates to a Very Low level of unmitigated effect.

As described in Section 7.2.1, the Lower Shotover River and Shotover Delta provide potential nesting habitat for a number of indigenous braided river bird species including black-fronted tern (Threatened – Nationally Vulnerable), banded dotterel, black-billed gull, SIPO (all At Risk – Declining), southern black-backed gull, pied stilt, and spur-winged plover (Not Threatened) (Dawn Palmer *pers. comm.* 2026). There is, therefore, the potential for damage or disturbance to nests of these species if construction works are undertaken during the breeding season (1 September – 1 February) within or adjacent to suitable nesting habitats (these species typically prefer to nest in open areas of gravels, bare ground or sparse, low stature vegetation with good visibility so they can see predators approaching).

The northern section of the proposed alignment is unlikely to provide nesting habitat for these species because of the predominance of taller stature vegetation. The southern section of the proposed pipeline (from the corner of the river training wall / stop bank) to the outfall structure is also unlikely to provide good nesting habitat for these species due to the presence of areas of taller stature vegetation and high levels of human activity (as described in Section 7.2.1), although it is possible banded dotterels could nest in this area.

The Shotover Delta, north-east of the proposed outfall structure provides suitable breeding habitat for braided river birds. If works are undertaken in the vicinity of the outfall structure during the bird breeding season, there is the potential for damage or disturbance to nests of Threatened and At Risk braided river bird species, including colonies of black-fronted terns or black-billed gulls if they chose to nest in that area[28]. As described in Section 7.2.1 above, braided river habitats in the vicinity of the proposed outfall structure experience relatively high levels of human disturbance (gravel extraction, trucks, vehicles, cyclists, people and dogs). The likelihood of braided river birds nesting near the proposed outfall and being impacted by

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[28] Nesting locations of these species can change from year to year depending on a number of factors.

construction works is low. However, in the unlikely event this did occur, it could lead to a moderate magnitude of unmitigated effect on the local populations of these bird species which are of high and very high ecological value. Overall, this equates to an unmitigated High level of ecological effect.

Most indigenous bird species (and gamebird species, but excluding some species, for example spur-winged plover and southern black-backed gull) are either absolutely or partially protected under the Wildlife Act (1953) and it is unlawful to disturb the nesting of these species. Any works involving disturbance of protected indigenous bird species will likely require a permit from DOC.

Recommendations to avoid adverse effects on nesting braided river bird species during the construction phase of the project (which mean a Wildlife Act Authority will not be required) are provided in Section 8.0.

7.2.3 Changes in water quality

Changes in water quality downstream of the proposed discharge structure has the potential to impact food sources (macro-invertebrates and fish) and foraging behaviours of bird species that forage in the Kawarau River (primarily gulls, terns and shags). However, based on the assessment of changes in water quality in Section 7.4.2 of this report, no effect on these species is expected (and no mitigation is proposed).

7.3 Freshwater – Short-Term (Construction)

As described in Section 4.1, the proposed activities include the construction of the proposed outfall structure on the true left bank of the Kawarau River immediately upstream of the Shotover River confluence, along with c. 1.3 km of pipeline to convey treated wastewater from the SWWTP to the outfall structure.

As alluded to in Section 4.1, and discussed in the Assessment of Environmental Effects (Landpro Limited, 2026), an alternative outfall configuration may be developed, such as a discharge pipe rather than a rock outfall that extends into or onto the wetted bed of the Kawarau River. However, this assessment is based on the current information available as of May 2026 and focuses on the indicative rock outfall design. Any proposed alternative options to the indicative outfall design are not expected to increase the project footprint or alter the magnitude or scale of the potential adverse effects assessed below.

The proposed outfall structure will require the potential excavation and/or disturbance of up to 400-500 m^2 of in-stream substrate and may require the construction of a dry working area by the potential use of a temporary cofferdam or floating silt curtain. These specific construction details will be confirmed during the detailed design phase, but have been assessed below as the likely methodology. There will likely also be ongoing maintenance required, especially after flood events, which is discussed further in Section 7.4.4.

The temporary construction-related disturbance of the Kawarau River bed and banks is addressed in Section 7.3.2, the potential for localised injury or mortality of fish in Section 7.3.3, construction-related sediment discharges in Section 7.3.4, and the risk of spreading aquatic weeds from the Kawarau River to other waterbodies during or following construction is discussed in Section 7.3.4.

Standard industry practices and/or recommendations that further minimise the levels of these effects (if appropriate) are recommended in Section 8.0.

7.3.1 Bed and bank disturbance

Any in-stream works associated with the construction of the proposed outfall structure, including excavation of bed material and the establishment of a temporary dry-working area (if required), will be localised and have a short duration (e.g. up to two weeks). The footprint represents a very small proportion of the available channel habitat, and the river channel will remain connected and passable to fish throughout the duration of works. Works are also anticipated to occur during a low-flow period.

Furthermore, the proposed works occur within a reach already characterised by high natural and anthropogenic disturbance. The true left bank of the Kawarau River within the works area is already subject to regular disturbance from vehicle access (including heavy diesel vehicles for small-scale gravel and water extraction), jet-boat wash, and periodic high-flow events. The adjacent riverbed is similarly dynamic, with frequent substrate mobilisation and naturally high deposited-sediment cover. These conditions contribute to the benthic macroinvertebrate community on the left bank being dominated by tolerant taxa adapted to frequent physical disturbance.

While the long-term changes to the River bed associated with the outfall structure is covered in Section 7.4.1, the temporary construction-related disturbance is assessed as having a Negligible magnitude of effect due to the localised, temporary nature of the works and the frequently disturbed existing environment, resulting in a Very Low overall level of unmitigated effect in the context of the wider river system (and no mitigation is proposed).

7.3.2 Potential injury or mortality of native fish

Although the final construction methodology is not yet confirmed, works within or immediately adjacent to the active channel may disturb fish and could cause displacement, stranding, injury, or mortality.

Fish diversity at the proposed outfall location (RS11) is expected to be low, dominated by common bully, with potential for juvenile longfin eel and juvenile brown trout. The small in-stream works footprint, short duration of in-stream works (i.e. up to two weeks), and limited availability of suitable spawning habitat for both native and exotic (trout) species further reduce the likelihood of adverse effects on eggs or juvenile life stages. However, at the localised reach scale, there remains a potential for direct injury or mortality of individual fish during excavation or dewatering activities, particularly for common bullies.

At the catchment scale, this magnitude of effect is assessed as negligible, resulting in a Very Low level of unmitigated effect.

7.3.3 Sediment release

Construction activities, including installation of the discharge outfall and associated earthworks, may generate short-term increases in suspended sediment. The Kawarau River downstream of the Shotover River confluence already experiences frequent elevated suspended-sediment loads, particularly during Shotover River flood events. The Kawarau River at Chard Road monitoring station is already within Attribute Band C for visual clarity under the NPS-FM.

Any sediment pulses that do occur (e.g. if rainfall coincides with construction) are expected to be small-scale, short-lived, and potentially occur during periods when suspended sediment is naturally elevated from wider catchment inputs.

Overall, the unmitigated magnitude of effect for sediment release during construction is assessed as negligible due to the temporary and localised nature and background conditions. This results in a Very Low overall level of unmitigated effect.

7.3.4 Spread of aquatic weeds

The Kawarau River contains didymo and lagarosiphon, both recognised as invasive freshwater pests and regulated as unwanted organisms under the Biosecurity Act 1993. Construction works within the Kawarau River (described in Section 4.1), particularly activities involving machinery, equipment or materials that come into contact with the water or riverbed, create a short-term risk of transferring these species to other freshwater systems.

The potential receiving environments for any transfer are not known, and therefore no ecological value has been assigned. However, if didymo or lagarosiphon were introduced to a previously uninfested waterbody, they could significantly alter habitat structure, reduce native biodiversity and degrade ecological function and value. On this basis, the ecological consequence of spread is considered high regardless of the underlying value of the recipient system.

While the construction works are of short duration the likelihood of spread is low, the ecological impact of any establishment is very high, the unmitigated magnitude of effect is assessed as very high. This results in an overall level of unmitigated ecological effect ranging from Low to Very High under the EIANZ guidelines (depending on the ecological value of the system).

7.4 Freshwater – Long-Term (Operation)

As described in Section 4.2, the operational activities include the discharge of treated wastewater to the Kawarau River directly upstream of the confluence with the Shotover River. Consent is being sought for a duration of 35 years.

Permanent modification of river habitat as a result of the proposed outfall structure is covered in Section 7.5.1, the expected changes to water quality as a result of the discharge are covered in Section 7.5.2, changes in water quantity are covered in Section 7.5.3 and potential ongoing maintenance of the structure is covered in Section 7.5.4.

7.4.1 Physical habitat modification

As discussed in Section 4.1, the proposed discharge structure will result in the permanent replacement of approximately 400-500 m^2 of existing cobble-gravel bed habitat, with large boulders. The outfall structure will be placed over the existing substrate likely using a long reach excavator, with localised excavation and re-grading of bed material expected to accommodate the structure. The current small-cobble dominant substrate at RS11 provides limited fish habitat value, with substrate mobility and deposited sediment reducing suitability for both sensitive macroinvertebrate taxa and fish species. These conditions also mean the reach is unlikely to function as a spawning area for either native species (e.g. common bully) or introduced trout. This is supported by local angler knowledge, which did not identify the proposed outfall structures footprint (i.e. RS11) as a trout-spawning area.

The structure will not alter longitudinal fish connectivity as it only extends approximately 10 metres into the main river channel, which is about 12% of the cross-sectional wetted width (Earth Sciences New Zealand, 2026). The available flow area of the river channel is estimated to be reduced by 3.5% under low flow conditions and 7% during flood flows (GHD, 2026). Minor changes to local hydraulic conditions (e.g. small areas of turbulence or eddies around the structure) may slightly alter habitat suitability for resident fish such as common bullies. However, this isn't necessarily considered an adverse ecological effect, as the modified hydraulic conditions may also provide suitable habitat for other fish species and life stages. In addition, extensive comparable habitat remains available throughout the wider Kawarau River reach, including areas immediately upstream where habitat quality is anticipated to improve over time as residual effects associated with historical DaD overflow and infiltration continue to diminish.

The replacement of this small area of low-value fish habitat is, therefore, expected to have a negligible effect on fish populations at both the reach and catchment scale, with common bullies and any other resident fish able to utilise adjacent habitat. The change in substrate may cause a localised shift in macroinvertebrate composition near RS11, although the existing community is already dominated by tolerant taxa and any change would be ecologically insignificant at the reach or catchment scale. While the currently proposed outfall structure may incidentally create additional interstitial spaces for longfin eels or macroinvertebrates, this is not considered beneficial given its function as a wastewater discharge point.

Overall, the magnitude of effect is assessed as negligible, resulting in a Very Low overall level of unmitigated effect (and no mitigation is proposed).

7.4.2 Changes in water quality

Refer to Section 4.2.4 for a summary of water quality predictions and to GHD (2026) for the full analysis. These predictions are based on the 2060 peak dry weather flow under mean annual low flow conditions in the Kawarau and Shotover Rivers. Thus, the predictions are likely to provide an upper bound for the expected effects on river water quality, and, therefore, ecology.

The assessment of ecological effects in this section incorporates the mitigation inherent in the design and operation of the upgraded wastewater treatment system. The effects management hierarchy has already been applied to the discharge through contaminant minimisation and treatment-process improvements. As a result, the predicted water-quality concentrations represent a mitigated discharge, not an unmitigated scenario. This section (7.4.2) therefore evaluates the ecological effects of the mitigated discharge scenario.

The following characteristics and existing conditions of the Kawarau River system reduce the likely magnitude of ecological effects from changes in water quality:

- Low background nutrient concentrations: Background nutrient concentrations are generally low in the Kawarau River. Legacy inputs from the DaD groundwater and surface overflow currently remain locally influential, although the effect of these aren't expected to persist once the proposed new discharge becomes operational.
- Geology-driven metal influence: Downstream of the Shotover River confluence, naturally elevated metal concentrations such as dissolved zinc and total aluminium occur due to the Shotover's high sediment load, mineralogy, and geology (GHD, 2026). These geology-influenced metals can elevate background concentrations and may contribute to fauna below the Shotover River confluence, such as macroinvertebrate communities, being adapted to elevated concentrations of these metals.
- Cool, alpine-fed water temperatures: Particularly in winter, cool water temperatures naturally limit biological growth rates and reduce the likelihood of nuisance periphyton proliferation.

- High hydraulic disturbance: Frequent flood flows and localised bank / bed disturbance, including from jet-boat wash, increase bed scour and reduce substrate stability. Although flood flows in the Kawarau River are moderated by Lake Wakatipu, the Shotover River responds rapidly to rainfall events and enters the Kawarau immediately downstream (i.e. c. 125 m) of the proposed outfall, contributing to this disturbance regime downstream of the proposed outfall structure.
- Stable baseflows governed by Lake Wakatipu: The lake-regulated hydrology in the Kawarau River maintains strong dilution capacity and reduces the likelihood of prolonged low-flow periods that would otherwise favour nutrient or contaminant enrichment.
- High natural sediment load below the Shotover River confluence: Suspended sediment, primarily from the Shotover River, is likely to contribute to periphyton scour and reduces light penetration. While riparian shading is limited along the Kawarau River reach, the combination of sediment load and hydraulic disturbance constrains sustained periphyton accrual.

In addition, the Draft Otago Land and Water Regional Plan (Otago Regional Council, 2024) proposed interim targets for the Kawarau River at Chard Road to maintain all nutrient attributes in Band A and suspended sediment in Band D by 2034 and 2045 (noting that this draft plan has not yet been notified and may be subject to further change with current Resource Management reforms). These draft targets reinforce the need to ensure the discharge does not materially degrade existing water quality or hinder progress toward these NPS-FM outcomes.

Another consideration is that the baseline ecological condition of the Kawarau River has been influenced by a range of historical and ongoing stressors, including DaD overflow and groundwater inputs and the current treated wastewater discharge into the Shotover River. As a result, present conditions across the Kawarau River monitoring sites reflect an already modified state, noting that wider catchment activities (e.g. land use change) have also contributed to the long-term alteration of the system. This complicates the effects assessment because the proposed discharge will occur within an already modified system, making it more difficult to distinguish the ecological response to the new discharge from pre-existing influences.

Furthermore, the influence of the current short-term treated wastewater discharge to the Shotover River is expected to diminish over time downstream of the point of discharge within the Shotover River, once the proposed Kawarau River discharge becomes operational. Therefore, historical effects from the DaD and the current effects of the short-term Shotover discharge are not expected to persist once the proposed Kawarau River discharge is operational, minimising the cumulative effects attributable to the new discharge.

7.4.2.1 Physical chemistry changes

As summarised in Section 4.2.4.1, modelled concentrations of physical water chemistry parameters such as BOD within the near-field mixing area are similar compared to background / upstream Kawarau River levels. For example, the predicted near-field concentration of 1.5 g/m^3 at the end of the near-field mixing area is an increase of 0.9 g/m^3 BOD compared to upstream conditions, which represents a minor change and is still below guideline limits used in other regions of New Zealand of 2 mg/m^3 (e.g. Ausseil, 2013). After the reasonable mixing zone, modelled BOD concentrations are almost identical to background / upstream Kawarau River levels (predicted median 0.59 mg/m^3 after reasonable mixing compared to 0.5 mg/m^3 measured at upstream site RS14). This suggests that the discharge of treated wastewater will not materially change oxygen-demanding organic matter in the river, and any potential magnitude of effect is further reduced by the high background dissolved-oxygen concentrations (Attribute Band A) within the Kawarau River.

There will be minimal change in dissolved oxygen, pH and temperature levels in the Kawarau River as a result of the proposed discharge, which are expected to remain within the natural variation of background conditions (GHD, 2026).

Overall, the magnitude of physical chemistry effects after reasonable mixing is assessed as negligible, resulting in a Very Low mitigated level of ecological effect.

7.4.2.2 Nutrient enrichment

As described in Section 4.2.4.2, the discharge of treated wastewater has the potential to increase concentrations of nutrients, particularly AN, nitrate-N, and DRP in the near-field and reasonable mixing zones of Kawarau River. Elevated nutrient levels can promote periphyton or macrophyte growth in freshwater systems, especially where high light availability, stable substrate, and stable hydrology coincide (Biggs, 2000). Increased periphyton or macrophyte biomass can alter food-web dynamics, influence dissolved oxygen conditions, and affect feeding efficiency and habitat use for macroinvertebrates, fish, and riverine birds. At high concentrations, some nutrients (primarily AN) can be toxic to aquatic life.

In the Kawarau River, background nutrient concentrations upstream of the DaD influence are low, which is consistent with the limited periphyton currently observed. Historical nutrient inputs from the DaD groundwater and surface overflow may have contributed to slightly higher periphyton levels at some upstream sites (RS11 to RS13). These patterns cannot be attributed to the DaD alone because local habitat conditions, such as slower velocities and more stable substrate, also favour periphyton accrual. Periphyton levels recorded in March 2026 remained within the “excellent” category of Matheson et al. (2012), and macroinvertebrate communities did not show patterns that could be clearly linked to nutrient enrichment. These potential DaD related effects immediately upstream of the proposed outfall structure are expected to reduce over time as water quality improves and also demonstrates that the system did not significantly alter with this nutrient enrichment. In addition to DaD influences, stormwater inputs to the Kawarau River just upstream of RS13 also contribute to background nutrient and contaminant variability. With the proposed discharge to the Kawarau River, the short-term discharge to the Shotover River will also cease.

Further consideration of the potential effects of the proposed discharge on periphyton in the Kawarau River associated with nutrient enrichment is provided in the Shotover WWTP Periphyton Risk Assessment (Boffa Miskell, 2026), and its conclusions are consistent with the summary presented below.

Near-field mixing area

Within the near-field mixing area (0 to 40 metres downstream of the proposed outfall; described in Section 4.2.3), predicted nutrient concentrations fall within NPS-FM Attribute Band D for DRP, Attribute Band C for AN, and Attribute Band B for Nitrate-N. A localised increase in periphyton risk is therefore possible in this area yet reduced in magnitude by the inherent characteristics of the Kawarau River system such as high hydraulic disturbance and high dilution capacity described at the start of Section 7.4.2.2. The likelihood of macrophyte proliferation is also low given these same inherent characteristics and the very limited presence of macrophytes currently in the system, including in areas where nutrient enrichment has previously occurred due to the DaD overflow. However, with the predicted decline in water quality for the three modelled nutrients (AN, nitrate-N, DRP) at RS11, some level of very localised ecological effect (i.e. some increase in periphyton and macrophyte biomass) is expected (which is why the reasonable mixing zone is used for the primary assessment, consistent with the RMA's focus on effects after reasonable mixing).[29]

It is anticipated that this input of treated wastewater could result in a discernible ecological effect on periphyton and macrophyte growth, however, the design of the discharge structure, and the inherent characteristics of the Kawarau River, mean that this effect is anticipated to be highly localised. Longitudinally along the downstream gradient of Kawarau River, it is expected to occur only within the short reach along the true left bank of the Kawarau River between the discharge point and the beginning of the Shotover River confluence – approximately 125 metres; substantial dilution by the Shotover River begins to occur at this point as shown in Figure 3. Therefore, while the near-field mixing area is 0-40 metres, the longitudinal length of localised ecological effects from nutrient enrichment can be likely considered to occur for approximately 125 metres (and well within the reasonable mixing zone, which ends approximately 800 metres downstream of the point of discharge). Laterally, the plume is predicted to be entrained and confined to the true left bank of the Kawarau River and occupying an estimated maximum 1/3 of the wetted channel width.

Potential changes to macroinvertebrate communities (both abundance and composition) are unlikely to be significant because the existing community in the immediate vicinity of the treated wastewater outlet is already dominated by tolerant taxa that are resilient to moderate nutrient enrichment. Consequently, any indirect effects on higher trophic levels such as fish and birds that rely on macroinvertebrates as a food source are not anticipated. While ammoniacal N is modelled within NPS-FM Attribute Band C, indicating concentrations that may regularly affect the most sensitive 20% of species, it is important to note that the community, such as macroinvertebrates, contain very few sensitive taxa. As a result, the magnitude of any ecotoxicity related effect within the near-field mixing area is expected to be limited.

Coupled with the improved treatment quality of the SWWTP (e.g. chemical dosing for phosphorus removal) outlined in GHD (2026), the potential ecological effect will be limited in spatial extent, and the magnitude of effect and level of ecological effect will be limited to the near-field mixing area and within the reasonable mixing zone. Furthermore, the existing ecological value of RS11 may also be considered partially lower than the High value assigned to the wider Kawarau River, reflecting both its historical DaD influenced water quality conditions and its inherently pollution tolerant macroinvertebrate community.

Reasonable mixing zone

The effect of nutrient enrichment from the discharge has been assessed at the downstream end of the reasonable mixing zone after the Shotover River confluence, approximately 800 metres from the outfall. This approach is consistent with sections 70 and 107 of the RMA 1991, which require that certain adverse effects of a discharge should not cause certain adverse effects after 'reasonable mixing'.

At the point of reasonable mixing, modelled nutrient concentrations from the discharge are predicted to reduce to approximately 2% of the original discharge concentration, and only residual DRP remains elevated and within Attribute Band D. All other modelled nutrients are predicted to return to Attribute Band A and are within Schedule 15 thresholds of the Otago Regional Plan at RS10. The river's natural characteristics are likely to limit periphyton accrual despite elevated DRP, due to higher sediment loads, frequent disturbance from the Shotover River flows, and limited stable substrate. There is also little evidence of direct ecotoxicity from DRP, with its ecological relevance primarily linked to stimulating periphyton and macrophyte growth rather than causing acute toxicity to aquatic fauna (Ministry for the Environment, 2018).

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[29] Sections 69(3), 70(1), 107(1) and Schedule 3 of the RMA.

Macrophyte proliferation is not expected due to the inherent characteristics of the Kawarau River described earlier.

Many of the potential secondary effects of periphyton or macrophyte accrual, if they were to occur from elevated nutrients such as DRP, are also limited by the existing environment. For example:

- Low dissolved oxygen effects are unlikely because the Kawarau River maintains high background dissolved oxygen levels within Attribute Band A of the NPS-FM.
- Potential effects on fish feeding, habitat use or spawning are limited, as the reasonable mixing zone is expected to support mainly common bullies and occasional trout and is not known to provide high-value or sensitive spawning habitat on this true left bank where the Shotover River confluence is.
- While a discharge can sometimes alter local food-web dynamics by increasing organic material or productivity, the dominance of tolerant, low-value taxa (including macroinvertebrates) at this site means any increase in potential prey availability is unlikely to be ecologically meaningful or to attract species, such as trout to the area.

Far-field completely mixed

Downstream of RS10, once complete mixing of the discharge is achieved, predicted dilution reduces nutrient concentrations to levels that are unlikely to produce detectable ecological effects. Lagarosiphon is not expected to increase in response to the treated wastewater discharge, including no anticipated effect further downstream at Lake Dunstan.

Level of ecological effect after 'reasonable mixing'

Overall, the magnitude of ecological effect from elevated nutrients after 'reasonable mixing' is assessed as negligible (i.e. a very slight change from the existing baseline condition), resulting in a Very Low mitigated overall level of effect on the high ecologically valued Kawarau River.

As required under the Water Conservation (Kawarau) Order 1997, water quality in this reach must be managed to Class CR (contact recreation) standards beyond the reasonable mixing zone. Both the Periphyton Risk Assessment (Boffa Miskell, 2026) and the assessment above conclude that these standards will be maintained, with a negligible likelihood of undesirable biological growths beyond the reasonable mixing zone. Furthermore, the outstanding characteristics of the Kawarau River, such as its natural characteristics and scientific values, will not be affected by the proposed discharge, (i.e. will remain protected), as required under the Water Conservation Order.

Cumulative effects

The assessment has taken into account the effects of future population growth on the proposed discharge volumes. GHD (2006) conclude that there will be no cumulative effects on water quality in the Kawarau River as a result of the discharge, due to the recent and ongoing improvements in the discharge quality, continued reduction in the effects from the DaD, and cessation of the short term discharge to the Shotover River once the proposed discharge to the Kawarau commences. They also conclude that the proposed discharge will not result in a meaningful effect on the water quality of Lake Dunstan. Therefore, no cumulative effects on freshwater ecological values in the Kawarau River and Lake Dunstan are expected as a result of the proposed discharge.

7.4.2.3 Increase in metals / other wastewater contaminants

Metals such as aluminium, copper, and zinc can be elevated in wastewater discharges and can cause potential ecological effects through both water-column toxicity and particulate pathways, including adsorption to fine sediments or incorporation into periphyton where they may be ingested by grazing macroinvertebrates. The ANZG (2018) species-protection framework provides a useful basis for interpreting these eco-toxicity risks, primarily the potential for sub-lethal effects on the most sensitive aquatic species. As described in Section 4.2.4.3, protection levels represent the proportion of species expected to be protected at a given concentration, and exceedance signals an increased probability of effects rather than a certainty of impact.

As outlined in Section 4.2.4.3, aluminium is predicted to exceed the 80% species-protection DGV and zinc and copper exceed the 95% species-protection DGV within the near-field mixing area. After reasonable mixing, aluminium, copper, and zinc concentrations remain within the 99% species-protection level, indicating a very low likelihood of adverse effects.

Three factors contribute to reducing the magnitude of effect both within the near-field and reasonable mixing zones:

- Naturally elevated dissolved zinc and total aluminium concentrations occur downstream of the Shotover River confluence due to its natural mineralogy and high sediment load (GHD, 2026). As a result, any apparent exceedance of metals such as aluminium and zinc concentrations downstream of the beginning of the Shotover River confluence are unlikely to be much greater than what this section of the Kawarau River experiences naturally; therefore, ecotoxicity in this area is unlikely as fauna are already accustomed to high temporary and/or background concentrations of geology-influenced metal concentrations.
- The expected fauna in the near-field and reasonable mixing zones have low diversity and are dominated by tolerant macroinvertebrate taxa, so the severity and extent of any sub-lethal effects are uncertain and likely limited due to a lack of sensitive taxa.
- Deposition-related risks such as adsorption of metals to fine sediments, and accumulation of these metals in fine sediment/substrates, is low due to the high velocities, coarse substrate, and frequent disturbance that prevent fine-sediment accumulation and reduce long-term metal binding to the riverbed. This is evidenced by GHD's (2026) groundwater quality monitoring which showed low levels of metal adsorption to the substrates in the delta. Therefore, there is very low risk of cumulative effects associated with metal contaminants in the proposed discharge.

Predicted concentrations of PFAS and microplastics in the wastewater are negligible and the ecotoxicity effects of these in the Kawarau River is therefore also considered negligible (GHD, 2026).

Overall, we assess the magnitude of effect for increases in metal and other contaminants as negligible after reasonable mixing, reflecting the influence of Shotover River mineralogy and geology on background concentrations, the modelled concentrations after mixing, and the inherent characteristics of the Kawarau River that limit the likelihood of discernible ecological effects. This equates to a Very Low mitigated level of effect.

7.4.2.4 Increase in suspended solids

Treated wastewater can introduce suspended solids into receiving waters, which in turn can reduce light penetration, increase turbidity, smother benthic habitat, and impair feeding efficiency for aquatic fauna. However, as noted in Section 4.2.4.1, the Kawarau River (primarily below the Shotover River confluence) is already exposed to naturally high suspended-sediment loads, driven by glacially influenced catchments and the highly mobile gravel-bed system. Ecological communities in this reach are therefore likely adapted to frequent disturbance, variable clarity, and episodic sediment pulses.

The total suspended solids (TSS) concentration in the treated wastewater will be substantially lower than historical wastewater discharges due to the cessation of oxidation pond use and the introduction of tertiary filtration. As a result, the discharge is not expected to measurably increase suspended-solid levels in the Kawarau River (GHD, 2026). For example, the TSS is expected to match background levels at RS10 (see Section 4.2.4.1). Because the discharge will not measurably increase suspended solids above natural background levels, the magnitude of effect is assessed as negligible, equating to a Very Low mitigated level of ecological effect.

7.4.3 Changes in water quantity

The treated wastewater discharge (based on the 2060 peak rate of 0.34 m^3 / s wastewater discharge and Kawarau River flow of 83 m^3 / s) would comprise less than <0.5% of the Kawarau River flow (based on the assumptions outlined in GHD 2026). This additional flow is not expected to alter bed substrate downstream, fish habitat or behaviour, and the area where the discharge will be hydraulically discernible does not contain rare or distinctive habitat types relative to the wider river. The effect is most relevant during summer low-flow periods; however, the Kawarau River exhibits comparatively low flow seasonality due to the moderating influence of Lake Wakatipu. It is noted that the discharge represents an anthropogenic addition of flow rather than a natural hydrological input.

Overall, the changes in water quantity are expected to have a negligible magnitude of effect (i.e. a very slight and barely distinguishable change from the existing baseline hydrology) and Very Low unmitigated level of effect (and no mitigation is proposed).

7.4.4 Ongoing structure maintenance

Periodic maintenance of the proposed outfall structure may be required following large flood events to ensure it remains stable and functioning as intended. The specific maintenance methods are yet to be confirmed, but such works may involve the removal of debris, mobilisation of accumulated sediments, and repositioning or replacement of instream substrate (e.g. boulders). These activities have the potential to generate short-term sediment pulses, temporarily disturb / displace, injure or kill aquatic fauna within the immediate work area, or contribute to exotic / nuisance species being spread such as lagarosiphon or didymo.

Sediment that may be mobilised is already part of the river system and any resuspension plume of sediment is expected to be brief, localised, highly diluted, and occur within a reach naturally exposed to frequent sediment movement and high hydraulic disturbance from the discharge. These conditions also limit the likelihood of fine sediment accumulating for long periods or becoming anoxic around the structure. As described in Section 7.4.2.3 and GHD (2026), metals in this system show low adsorption to sediments, and the high-energy environment promotes rapid dispersion, further reducing the risk of ecotoxicity from resuspended material.

Fish residency around the structure is expected to be low, further reducing the likelihood of direct effects on fish.

While machinery can act as a vector for nuisance species, these aquatic species are already present within the Kawarau River and can establish without being spread by machinery. The unmitigated ecological risk relates primarily to the possibility of transferring these species to other waterbodies and Section 7.3.4 addresses this risk.

Given these factors above such as the small spatial footprint, short duration, existing disturbance regime, and limited risk of metal accumulation and resuspension, the unmitigated magnitude of effect is assessed as negligible, equating to a Very Low unmitigated level of effect.

The activities involved in this maintenance are yet to be detailed, therefore the provision of a relevant management plan is recommended in Section 8.1.6.

7.5 Summary of the level of potential unmitigated ecological effects

Table 13 summarises the potential level of unmitigated ecological effects on the ecological components impacted, or potentially impacted, by the proposed SWWTP upgrades (**without** implementation of effects management measures). For clarity, the assessments of changes in water quality (physical chemistry, nutrients, metals and other contaminants, and suspended solids) for the Kawarau River reflect the mitigated discharge scenario, as these water-quality parameters have already been subject to minimisation through treatment improvements and optimisation of discharge concentrations. All other ecological components are assessed on an unmitigated basis.

As terrestrial vegetation and habitats are of negligible – low ecological value, effects on terrestrial ecological values are temporary and confined to a small area (e.g. construction estimated to take c. 6 months and likely to be completed in small sections) and no ongoing effects on terrestrial values are anticipated during the operation of the wastewater discharge infrastructure, no cumulative adverse effects on terrestrial values are expected.

As covered in Section 7.4.2, there is unlikely to be cumulative effects on water quality (including nutrients and metals) in the Kawarau River or Lake Dunstan as a result of the proposed discharge, therefore, there is highly unlikely to be cumulative effects on freshwater ecological values.

Table 13. Summary of the assessment of unmitigated effects (i.e. without implementation of the further recommendations in Section 8.0). Note that changes in water quality effects for the Kawarau River represent the mitigated discharge scenario following treatment and minimisation.

Ecological Component	Component / Effect	Ecological Value	Magnitude of Effect	Overall Level of Unmitigated Effect
Terrestrial Vegetation and Habitats	Vegetation clearance (construction)	Negligible - Low	Negligible	Very Low
	Habitat fragmentation (construction)	Negligible - Low	Low	Very Low
	Weed introduction and / or spread (construction)	Negligible - Low	Negligible	Very Low
	Spread of weeds to other sites (construction)	Negligible – Very High	Very High (if it were to occur)	Low – Very High

Avifauna	Habitat loss and modification (construction)	Low – Very High	Negligible - Low	Very Low
	Disturbance and displacement (construction)	Low – Very High	Negligible - Low	Very Low to Low
	Impacts on nesting birds (terrestrial habitats) (construction)	Low	Low	Very Low
	Impacts on nesting birds (Shotover River and delta) (construction)	Low – Very High	Moderate	Low - High
	Changes in water quality	Low – Very High	No effect	No Effect
Kawarau River	Bed and bank disturbance (construction)	High	Negligible	Very Low
	Fish injury / mortality (construction)	High	Negligible – Low	Very Low – Low
	Sediment release (construction)	High	Negligible	Very Low
	Spread of aquatic weeds (construction)	Negligible – Very High	Very High (if it were to occur)	Low – Very High
	Physical habitat modification	High	Negligible	Very Low
	Changes in water quality – Physical chemistry	High	Negligible	Very Low
	Changes in water quality – Nutrients	High	Negligible	Very Low
	Changes in water quality – Metals and other contaminants	High	Negligible	Very Low
	Changes in water quality – Suspended solids	High	Negligible	Very Low
	Changes in water quantity	High	Negligible	Very Low
	Ongoing structure maintenance	High	Negligible	Very Low

8.0 Mitigation and monitoring recommendations

When considering the overall level of ecological effect and the extent to which management or mitigation measures may be required, the EIANZ (2018) guidelines suggest that "*Low and Very Low categories should not normally be of concern, although normal design, construction and operational care should be exercised to minimise adverse effects*". However, given the context for the Kawarau River, we have had regard to the direction provided by the NPS-FM, Otago Regional Plan, and ORPS, including the following NPS-FM policies which have been considered in our recommendations:

- Policy 7: The loss of river extent and values is avoided to the extent practicable.
- Policy 8: The significant values of outstanding water bodies are protected.
- Policy 9: The habitats of indigenous freshwater species are protected.
- Policy 10: The habitat of trout and salmon is protected, insofar as this is consistent with Policy 9.
- Policy 12: The national target (as set out in Appendix 3) for water quality improvement is achieved.
- Policy 13: The condition of water bodies and freshwater ecosystems is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends.

8.1 Mitigation Management Measures

8.1.1 Effects on nesting birds

Although the likelihood of braided river birds nesting near the proposed outfall structure and being impacted by construction works is considered to be low, if construction works commence during the bird breeding season (1 September to 1 February), a pre-construction survey should be undertaken by a suitably qualified ornithologist/ecologist to determine if there are any active nests (nests with eggs or chicks), or chicks of indigenous braided river bird species..

- The survey should cover the southern section of the proposed pipeline alignment (from the corner of the existing river training wall / stopbank) to the outfall structure, and include the open gravelfield habitat of the Shotover Delta within a 150 m radius of the outfall structure.
- The survey should be undertaken no earlier than eight working days prior to any works commencing.
- If nests or chicks of indigenous birds that are protected under the Wildlife Act are found, measures to avoid, minimise or mitigate potential adverse impacts should be included in a pre-works survey report.

- At a minimum, mitigation measures should include maintaining an appropriate exclusion zone between breeding or nesting sites and sources of continuous disturbance (but reduced minimum exclusion distances for intermittent, short-duration disturbance caused by work activities may be adopted where provided for by the bird survey report recommendations);
- Any person carrying out works must be informed of any bird breeding or nesting sites.

\- *Advice note: Most indigenous bird species (and gamebird species) are either absolutely or partially protected under the Wildlife Act (1953) and it is unlawful to disturb the nesting of these species. Compliance with the Wildlife Act 1953 and any authorities required under it are separate requirement to this resource consent application. However, any works involving disturbance or relocation of protected indigenous bird species will likely require a permit from the Department of Conservation.*

8.1.2 Spread of terrestrial and aquatic weed species

To avoid the spread of the terrestrial weed species from the Site to other locations, including potentially relatively intact ecosystems / habitats, all machinery must be cleaned before leaving the site. This includes removing all visible soil and plant material.

To avoid the spread of didymo and lagarosiphon, all machinery, equipment, and materials that contact river water or substrates must be cleaned, drained, and dried before leaving the site and entering a new waterway, in accordance with Check, Clean, Dry biosecurity protocols. This includes removing all visible plant material and sediment, followed by treatment using an approved disinfectant or drying for at least 48 hours. A site-specific biosecurity procedure should be implemented to ensure compliance by all contractors and to prevent the transfer of aquatic weeds to other waterbodies.

8.1.3 Sediment, erosion, and contaminant controls

Construction works will follow recognised erosion and sediment control guidelines (Leersnyder et al., 2016) and be planned to occur during a fine-weather window, which will minimise sediment mobilisation and downstream transport into the Kawarau River.

In the event of an unforeseen contaminant or sediment discharge during construction or operation, an adaptive management response should be enacted by a suitably experienced freshwater ecologist to assess potential ecological effects. Where adverse effects are identified, the ecologist should recommend appropriate remedial or mitigation measures.

8.1.4 Aquatic fauna disturbance

A Freshwater Fauna Management Plan (FFMP) should be prepared and implemented by a suitably qualified and experienced freshwater ecologist. The FFMP will include measures required to be undertaken prior to any disturbance of the Kawarau River where works occur within wetted habitat. The need for fish management will depend on the final construction design and methodology for the outfall structure, particularly where any temporary isolation (de-watering) of the riverbed is required (if any).

8.1.5 Fish interactions with the structure

A fish exclusion barrier should be incorporated into the design of the outfall pipe to prevent fish from entering the wastewater discharge pipeline. While the interstitial spaces within the outfall may theoretically provide habitat for species such as longfin eel, this is unlikely given their sensitivity to poor water quality.

8.1.6 Ongoing structure maintenance

A maintenance management plan should be prepared to guide any future works on the outfall structure following flood events. The plan should specify methods for debris removal, sediment handling, and repositioning of instream substrate, and avoid unnecessary disturbance to aquatic habitat. The plan should also require that all machinery and equipment used in or near the river is cleaned and free of aquatic pests prior to entering and leaving the site (as outlined in Section 8.1.3), to avoid the risk of transferring nuisance species to other waterbodies.

8.2 Monitoring Requirements

8.2.1 Existing and ongoing ecological monitoring (pre-installation)

Ecological monitoring at the five existing Kawarau River sites should continue until the installation and operation of the new outfall structure, consistent with the REMP (GHD, 13 June 2025). This will include water quality monitoring and ecological monitoring (deposited sediment, periphyton, macroinvertebrates) and will:

- Provide a robust baseline against which post-discharge effects of the proposed design can be assessed.
- Identify how the system is responding to the cessation of the DaD overflow / groundwater influence.

8.2.2 Monitoring of the new discharge (post-installation)

8.2.2.1 Monitoring locations

Once the new discharge is operational, ecological and water quality monitoring should occur at the following four locations. Monitoring at the first three sites below will continue from the existing REMP monitoring programme, while monitoring at the last site further downstream in the Kawarau River will commence prior to new proposed discharge to establish an appropriate pre-discharge baseline:

- One upstream Kawarau River site (e.g. RS14) to represent baseline conditions unaffected by the discharge. A second upstream site (e.g. RS12) may be retained if the REMP monitoring indicates spatial variability that requires two reference points, but one upstream site is likely sufficient for long-term monitoring. Currently being monitored under REMP requirements.

- One upstream Shotover River site (e.g. RS04B in the REMP) to represent background conditions in the Shotover River, which strongly influences the downstream Kawarau River sites. Currently being monitored under REMP requirements.
- One downstream Kawarau River site after the reasonable mixing zone (e.g. RS10) to assess after reasonable mixing effects. Currently being monitored under REMP requirements.
- One downstream Kawarau River site within far-field complete mixing , possibly approximately 4 km downstream of the discharge on the true right bank.). We recommend this site be incorporated into the existing monitoring programme two years prior to operation of the new structure to establish a pre-discharge baseline ecological condition. Not currently being monitored under REMP requirements.

The monitoring programme should allow refinement of monitoring locations or parameters if results indicate that certain sites are redundant or that additional sites are required. For example, if long-term results show no change in water quality or ecological condition at the furthest downstream site, the need for ongoing monitoring at that location could be re-evaluated.

8.2.2.2 Recommended monitoring parameters

It is recommended that periphyton, deposited sediment, and macroinvertebrates be monitored throughout the life of the consent (see Table 14 for timing, frequency, assessment methods, and metrics). This should be formalised in an Environmental Monitoring and Management Plan (EMMP), which should include an adaptive management framework to ensure any mitigation, management, remediation, etc. measures are undertaken in the event any adverse effect(s) are discovered during monitoring. The EMMP should detail trigger criteria for the ecological components that would be used to enact further investigation.

The following parameters have not been included in the recommended monitoring programme, with justifications provided below:

- Habitat condition (RHA): Physical habitat scores are unlikely to materially change in response to the discharge.
- Periphyton chlorophyll-a: Chlorophyll-a analysis is not included because laboratory processing timeframes limit its usefulness for timely adaptive management, and the periphyton community in this reach in March 2026 was low in cover, with the majority of the species being early-successional, fast-turnover taxa. As a result, chlorophyll-a provides limited additional value over visual cover assessments, which are more responsive to the types of changes expected.
- Fish: Fish monitoring is not included because this reach is difficult to sample consistently due to depth and hydraulic conditions/constraints, fish use of the area is likely transient and diversity is low, detection is likely to be low and therefore, if changes were observed, the cause of these would be difficult to determine.

Table 14. Proposed Kawarau River ecological monitoring components, timings, and frequency following the installation of the proposed discharge and outfall structure.

Component	Description	Timing & frequency	Assessment methods (reference)	Assessed metrics
Periphyton growth	Quantify periphyton visual cover.	Twice a year in low flow conditions in summer and autumn/early winter. For both, monitoring is only required if a period of greater than four weeks of stable low flow conditions occurs.	Periphyton visual cover measurements method (section 4) in the National Environmental Monitoring Standards (NEMS) for Periphyton (Ministry for the Environment, 2022b).	Percentage cover of visible stream bed covered by: • Bacterial and/or fungal growths (sewage fungus) • Filamentous algae more than 2 cm long • Diatoms or cyanobacteria mats more than 0.3 cm thick
Deposited sediment	Quantify deposited sediment visual cover.		At the same time and instream points as the periphyton monitoring, using Sediment Assessment Method 2 (instream visual assessment) in Clapcott et al. (2011).	Percentage cover of visible stream bed covered by deposited sediment.
Macroinvertebrates	Assess macroinvertebrate community composition and health.		Sampling should follow the 'Protocols for Sampling Macroinvertebrates in Wadable Streams' (Stark et al., 2001), specifically: • Protocol C3 (hard-bottomed quantitative) • Protocol P3 (full count with subsampling option) • Protocol QC3 (quality control for full count with subsampling option) Sampling at each site should involve: • Five replicate 0.1 m^2 Surber samples at random within the run habitat on the true left bank.	Taxa richness MCI QMCI %EPT taxa %EPT individuals APSM

8.3 Offset

After following the avoid, minimise, remedy, and mitigate actions recommended above there are not expected to be any residual adverse effects that need to be offset. The above recommended monitoring will confirm if this remains true through the operational phase, and whether the proposed design, discharge modelling, and inherent river system characteristics are accurate and successful in mitigating any ecological effects.

8.4 Summary of the level of potential mitigated ecological effects

Table 15 summarises the potential level of mitigated ecological effects on the ecological components impacted, or potentially impacted, by the proposed SWWTP upgrades (**with** implementation of effects management measures).

Table 15. Summary of the assessment of mitigated effects (i.e. with implementation of the recommendations in Section 8.0).

Ecological Component	Component / Effect	Ecological value	Overall level of effect	
			Pre-mitigation	Post-mitigation
Terrestrial Vegetation and Habitats	Vegetation clearance (construction)	Negligible - Low	Very Low	Very Low
	Habitat fragmentation (construction)	Negligible - Low	Very Low	Very Low
	Weed introduction and / or spread (construction)	Negligible - Low	Very Low	Very Low
	Spread of weeds to other sites (construction)	Negligible – Very High	Low – Very High	Very Low
Avifauna	Habitat loss and modification (construction)	Low – Very High	Very Low	Very Low
	Disturbance and displacement (construction)	Low – Very High	Very Low to Low	Very Low
	Impacts on nesting birds (terrestrial habitats) (construction)	Low	Very Low	Very Low
	Impacts on nesting birds (Shotover River and delta) (construction)	Low – Very High	Low - High	Very Low
	Changes in water quality	Low – Very High	No Effect	No Effect
Kawarau River	Bed and bank disturbance (construction)	High	Very Low	Very Low
	Fish injury / mortality (construction)	High	Very Low – Low	Very Low
	Sediment release (construction)	High	Very Low	Very Low

	Spread of aquatic weeds (construction)	Negligible – Very High	Low – Very High	Very Low
	Physical habitat modification	High	Very Low	Very Low
	Changes in water quality – Physical chemistry	High	Very Low*	Very Low
	Changes in water quality – Nutrients	High	Very Low*	Very Low
	Changes in water quality – Metals and other contaminants	High	Very Low*	Very Low
	Changes in water quality – Suspended solids	High	Very Low*	Very Low
	Changes in water quantity	High	Very Low	Very Low
	Ongoing structure maintenance	High	Very Low	Very Low

* The pre-mitigation level of effect for changes in water quality effects for the Kawarau River represent the mitigated discharge scenario following treatment and minimisation actions already undertaken.

9.0 References

ANZG. (2018). Australian & New Zealand guidelines for fresh & marine water quality. www.waterquality.gov.au/anz-guidelines

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.

Augspurger, J. (2026). Compliance of Kawarau and Shotover with Appendix 2A of the NPSFM 2020 (amended 2025) [Memorandum]. Otago Regional Council. https://www.qldc.govt.nz/media/slhdwhcn/3c-attc-compliance-of-the-kawarau-and-shotover-river-with-nps-fm.pdf

Ausseil, O. (2013). Recommended water quality limits for rivers and streams managed for Aquatic Ecosystem Health in the Wellington Region. Prepared by Aquanet Consulting Ltd for Greater Wellington Regional Council.

Barbour, M. T., Gerritsen, J., Snyder, B. D., & Stribling, J. B. (1999). Rapid bioassessment protocols for use in streams and wadeable rivers: Periphyton, benthic macroinvertebrates, and fish (EPA 841-B-99-002). U.S. Environmental Protection Agency; Office of Water.

Biggs, B. J. F. (2000). New Zealand periphyton guideline: Detecting, monitoring and managing enrichment of streams. Prepared by NIWA for the Ministry for the Environment.

Cieraad, E., Walker, S., Price, R., & Barringer, J. (2015). An updated assessment of indigenous cover remaining and legal protection in New Zealand's land environments. New Zealand Journal of Ecology, 39(2), 309–315.

Clapcott, J. (2015). National rapid habitat assessment protocol development for streams and rivers (Cawthron Report No. 2649). Prepared by Cawthron Institute for Northland Regional Council.

Clapcott, J., Young, R. G., Harding, J. S., Matthaei, C., Quinn, J. M., & Death, R. (2011). Sediment assessment methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute.

Earth Sciences New Zealand. (2026). Kawarau River bathymetry survey. Prepared by Earth Sciences New Zealand for GHD.

EIANZ. (2018). Ecological impact assessment (EcIA): EIANZ guidelines for use in New Zealand: Terrestrial and freshwater ecosystems. 2nd EDITION. Environment Institute of Australia and New Zealand.

GHD. (2026). Shotover WWTP: Surface water and groundwater assessment (draft). Prepared by GHD for Queenstown Lakes District Council.

HEPA. (2025). PFAS national environmental management plan Version 3.0. Heads of EPA Australia and New Zealand. https://www.dcceew.gov.au/sites/default/files/documents/pfas-nemp-3.pdf

Holdaway, R. J., Wiser, S. K., & Williams, P. A. (2012). Status assessment of New Zealand's naturally uncommon ecosystems. Conservation Biology, 26(4), 619–629.

Landpro Limited. (2026). Resource Consent Application to Otago Regional Council for Discharge of Treated Effluent & Associated Activities – Shotover Wastewater Treatment Plant. Prepared by Landpro Limited for Queenstown Lakes District Council.

Leersnyder, H., Bunting, K., Parsonson, M., & Stewart, C. (2016). Erosion and sediment control guide for land disturbing activities in the Auckland Region: Incorporating Amendment 1 (Auckland Council Guideline Document GD2016/005). Auckland Council. https://www.aucklandcouncil.govt.nz/UnitaryPlanDocuments/mir-erosion-sediment-control-guide-auckland-region.pdf

Matheson, F., Quinn, J. M., & Hickey, C. W. (2012). Review of the New Zealand instream plant and nutrient guidelines and development of an extended decision making framework: Phases 1 and 2 final report (NIWA Client Report Nos. HAM2012-081). Prepared by NIWA for the Ministry for Science & Innovation Envirolink Fund.

McEwen, W. M. (Ed.). (1987). Ecological regions and districts of New Zealand (3rd rev. ed. in four 1:500 000 maps). Department of Conservation.

Ministry for the Environment. (2018). A guide to attributes in Appendix 2 of the National Policy Statement for Freshwater Management (as amended 2017). Minister for the Environment. https://environment.govt.nz/assets/Publications/Files/a-draft-guide-to-attributes.pdf

Ministry for the Environment. (2020). National policy statement freshwater management 2020. Ministry for the Environment.

Ministry for the Environment. (2022a). National Environmental Monitoring Standards macroinvertebrates: Collection and processing of macroinvertebrate samples from rivers and streams. Version 1.0.0. Ministry for the Environment. https://www.nems.org.nz/documents/macroinvertebrates/

Ministry for the Environment. (2022b). National Environmental Monitoring Standards peripyton: Sampling and measuring periphyton in wadeable rivers and streams. Version 1.0.1. Ministry for the Environment. https://www.nems.org.nz/documents/periphyton/

Otago Regional Council. (2021a). Partially Operative Otago Regional Policy Statement 2019 (Declared Partially Operative 15 March 2021). Otago Regional Council.

Otago Regional Council. (2021b). Regional Plan: Water for Otago. Otago Regional Council.

Otago Regional Council. (2024). Proposed Land and Water Regional Plan (Draft Otago Land and Water Regional Plan. Final Draft for Council Meeting).

Otago Regional Council. (2026). Otago rivers & lakes water quality. Schedule 15 report 2025 (Water Quality SoE). Otago Regional Council. https://www.orc.govt.nz/media/k4qlsuku/otago-state-of-the-environment-soe-rivers-lakes-water-quality-schedule-15-report-2025.pdf

Palmer, D. (2021). Bird monitoring: Shotover Wastewater Treatment Designation Area, May 2017 – June 2021. Prepared by Natural Solutions for Nature Ltd for Queenstown Lakes District Council.

Palmer, D. (2022a). Kimiākau / Lower Shotover River braided river bird survey report.

Palmer, D. (2022b). Quarterly assessment of bird hazards – Shotover Wastewater Treatment Facility. Memo prepared by Natural Solutions for Nature Ltd for Queenstown Lakes District Council, dated 4 July 2022.

Palmer, D. (2023). Assessment of bird hazards – Shotover Wastewater Treatment Facility. Memo prepared by Natural Solutions for Nature Ltd for Queenstown Lakes District Council, dated 30 June 2023.

Palmer, D. (2024). Assessment of bird hazards – Shotover Wastewater Treatment Facility. Memo prepared by Natural Solutions for Nature Ltd for Queenstown Lakes District Council, dated 24 June 2024.

Petrove, N., & McEwan, A. (2024). Habitat requirements of native freshwater fish in Aotearoa New Zealand. Department of Conservation.

Queenstown Lakes District Council. (2021). Queenstown Lakes Operative District Plan. Queenstown Lakes District Council. https://www.qldc.govt.nz/your-council/district-plan/operative-district-plan#odp-volumes

Robertson, H. A., Baird, K. A., Elliott, G. P., Hitchmough, R. A., McArthur, N., Makan, T. D., Miskelly, C. M., Sagar, P. M., Scofield, R. P., Taylor, G. A., & Michel, P. (2021). Conservation status of birds in Aotearoa New Zealand, 2021 (New Zealand Threat Classification Series No. 36). Department of Conservation.

Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). Ecological impact assessment (EcIA). EIANZ guidelines for use in New Zealand: Terrestrial and freshwater ecosystems (2nd ed.). Environment Institute of Australia and New Zealand.

Singers, N. J. D., & Rogers, G. M. (2014). A classification of New Zealand's terrestrial ecosystems (Science for Conservation No. 325). Department of Conservation.

Stark, J. D., Boothroyd, I. K. G., Harding, J. S., Maxted, J. R., & Scarsbrook, M. R. (2001). Protocols for sampling macroinvertebrates in wadeable streams (p. 65). Prepared for the Ministry for the Environment.

Stark, J. D., & Maxted, J. R. (2007). A user guide for the Macroinvertebrate Community Index (Cawthron Report No. 1166). Prepared by Cawthron Institute for the Ministry for the Environment.

Williams, P. A., Wiser, S. K., Clarkson, B. R., & Stanley, M. C. (2007). New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. New Zealand Journal of Ecology, 31(2), 119–128.

Appendix 1: Ecological effects assessment methodology

As described in Section 5.4, this EcIA has followed the EIANZ EcIA guidelines to determine ecological value, magnitude of impact, and level of impact, based on the following tables. For terrestrial habitats and wetlands, the guidelines use four criteria to determine ecological value; representativeness, rarity, diversity, and context. These are considered and subjectively scored "high", "moderate", "low", or "very low" based on the assessor's experience and knowledge of the Site. Freshwater ecological value is assigned using the same four criteria, as well as an additional freshwater system integrity criterion (which considers "nativeness", "pristineness", "diversity", and "resilience"). The scores are then combined to provide a single Site score which ranges from "Very High" to "Negligible" ecological value in line with the reasoning provided in Table 19.

Table 16. *Attributes to be considered when assigning ecological value or importance to a Site or area of vegetation / habitat / community for terrestrial ecosystems (from Roper-Lindsay et al. 2018).*

Matters	Attributes to be Considered
Representativeness	Criteria for representative vegetation and aquatic habitats: – Typical structure and composition – Indigenous species dominate – Expected species and tiers are present – Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: – Species assemblages that are typical of the habitat – Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	Criteria for rare/distinctive vegetation and habitats: – Naturally uncommon, or induced scarcity – Amount of habitat or vegetation remaining – Distinctive ecological features – National priority for protection Criteria for rare/distinctive species or species assemblages: – Habitat supporting nationally Threatened or At Risk species, or locally uncommon species – Regional or national distribution limits of species or communities – Unusual species or assemblages – Endemism
Diversity and pattern	– Level of natural diversity, abundance and distribution – Biodiversity reflecting underlying diversity – Biogeographical considerations – pattern, complexity – Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	– Site history, and local environmental conditions which have influenced the development of habitats and communities – The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA) – Size, shape and buffering

Matters	Attributes to be Considered
	– Condition and sensitivity to change – Contribution of the Site to ecological networks, linkages, pathways and the protection and exchange of genetic material – Species role in ecosystem functioning – high level, key species identification, habitat as proxy

Table 17. *Criteria to consider for ecological value of freshwater habitats and species (modified from EIANZ (2018))*

Matter	Assessment considerations Freshwater
Representativeness	- Extent to which site/catchment is typical or characteristic - Stream order - Permanent, intermittent or ephemeral waterway - Catchment size - Standing water characteristics
Rarity/distinctiveness	- Supporting nationally or locally Threatened, At Risk or uncommon species - National distribution limits - Endemism - Distinctive ecological features - Type of lake/pond/wetland/spring.
Diversity and pattern	- Level of natural diversity - Diversity metrics - Complexity of community - Biogeographical considerations - pattern, complexity, size, shape.
Ecological context	- Stream order - Instream habitat - Riparian habitat - Local environmental conditions and influences, site history and development - Intactness, health and resilience of populations and communities - Contribution to ecological networks, linkages, pathways - Role in ecosystem functioning – high level, proxies.
Ecological Integrity[30]	Nativeness – the degree to which an ecosystem's structural composition is dominated by the indigenous biota characteristics of the particular region Pristineness – relates to a wide array of structural, functional, and physico-chemical elements (including connectivity), but is not necessarily dependent on indigenous biota constituting structural and functional elements Diversity – richness (the number of taxa) and evenness (the distribution of individuals amongst taxa); link to a possible reference condition; the use abundance weighting; and geographical scale Resilience (or adaptability) – quantifying the probability of maintaining an ecosystem's structural and functional characteristics under varying degrees of human pressure or stressors such as climate change.

[30] In addition to the measures prescribed in Table 17, an additional matter is considered when assigning ecological value to freshwater environments as described in (Roper-Lindsay et al., 2018). Ecological Integrity is considered as a way of integrating structural and functional components of freshwater systems into the ecological values matrix.

Table 18. *Criteria for assigning ecological value to species (Roper-Lindsay et al., 2018).*

Ecological Value	Species Classification
Negligible	Exotic species, including pests, species having recreational value.
Low	Nationally and locally common indigenous species.
Moderate	Species listed as any other category of *At Risk* (Recovering, Relict, Naturally Uncommon) found in the 'zone of influence' (ZOI) either permanently or seasonally; or Locally (ED) uncommon or distinctive species.
High	Species listed as *At Risk – Declining* found in the ZOI either permanently or seasonally.
Very High	*Nationally Threatened* (Nationally Critical, Nationally Endangered, Nationally Vulnerable) species found in the ZOI either permanently or seasonally.

Table 19. *Assigning overall value to areas (refer to Table 16 for the matters to be considered for terrestrial communities) (Roper-Lindsay et al., 2018).*

Value	Description
Negligible	Area rates Very Low for three matters and Moderate, Low or Very Low for remainder.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for two or more assessment matters Low or Very Low for the remainder Likely to be important at the level of the Ecological District.
High	Area rates High for two of the assessment matters, Moderate and Low for the remainder, or Area rates High for one of the assessment maters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Very High	Area rates High for three or all of the four assessment matters. Likely to be nationally important and recognised as such.

Table 20. *Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018).*

Magnitude	Description
Very High	Total loss of, or very major alteration, to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the Site altogether; AND/OR Loss of a very high proportion of the known population or range of the element / feature.
High	Major loss or major alteration to key elements/ features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element / feature.
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element / feature.

Magnitude	Description
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR Having a minor effect on the known population or range of the element / feature.
Negligible	Very slight change from existing baseline condition. Change barely distinguishable, approximating to the "no change" situation; AND/OR Having a negligible effect on the known population or range of the element / feature.

Table 21. *Criteria for describing the level of effect (Roper-Lindsay et al., 2018).*

		ECOLOGICAL VALUE				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
MAGNITUDE	**Very High**	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net Gain	Net Gain	Net Gain	Net Gain	Net Gain

Appendix 2: Plant species list

Table 22. Indigenous and exotic plant species recorded within the Site. Sorted by common name. Exotic plant species are denoted with an asterisk (*).

Common name	Species name	Growth Form	Conservation Status[31]
Agapanthus	*Agapanthus praecox**	Grass	
Aluminium plant	*Lamium galeobdolon**	Dicot Herb	
Bittersweet	*Solanum dulcamara**	Low Shrub	
Black nightshade	*Solanum nigrum**	Low Shrub	
Broad-leaved dock	*Rumex obtusifolius**	Dicot Herb	
Browntop	*Agrostis capillaris**	Grass	
Buddleia	*Buddleja davidii**	Shrub	
Californian thistle	*Cirsium arvense**	Dicot Herb	
Centuary	*Centaurium erythraea**	Dicot Herb	
Chewings fescue	*Festuca rubra**	Grass	
Crack willow	*Salix x fragilis**	Tree	
Douglas fir	*Pseudotsuga menziesii**	Tree	
Elderberry	*Sambucus nigra**	Shrub	
Glossy plantain	*Plantago triandra*	Dicot Herb	Not Threatened
Grey willow	*Salix cinerea**	Tree	
Hawksbeard	*Crepis capillaris**	Dicot Herb	
Hemlock	*Conium maculatum**	Dicot Herb	
Jointed rush	*Juncus articulatus**	Grass	
Lombardy poplar	*Populus nigra**	Tree	
Male fern	*Dryopteris filix-mas**	Fern	
Mint	*Mentha spicata**	Dicot Herb	
Moth mullein	*Verbascum virgatum**	Dicot Herb	
Mouse-ear chickweed	*Cerastium fontanum**	Dicot Herb	
Mudwort	*Limosella lineata*	Dicot Herb	Not Threatened
Necklace poplar	*Populus deltoides**	Tree	
Nettle	*Urtica urens**	Dicot Herb	
Old mans beard	*Clematis vitalba**	Climber/Vine	
Pimpernel	*Lysimachia arvensis**	Dicot Herb	
Purging flax	*Linum catharticum**	Dicot Herb	
Ragwort	*Jacobaea vulgaris**	Dicot Herb	

[31] de Lange et al. (2024)

Russell lupin	*Lupinus polyphyllus**	Dicot Herb	
Scotch thistle	*Cirsium vulgare**	Dicot Herb	
Silver tussock	*Poa cita*	Grass	Not Threatened
Sinclair's stonecrop	*Crassula sinclairii*	Dicot Herb	Not Threatened
St John's wort	*Hypericum perforatum**	Low Shrub	
Stitchwort	*Stellaria graminea**	Dicot Herb	
Stone crop	*Sedum acre**	Dicot Herb	
Sweet briar	*Rosa rubiginosa**	Shrub	
Sweet clover	*Melilotus albus**	Dicot Herb	
Sweet vernal	*Anthoxanthum odoratum**	Grass	
Sycamore	*Acer pseudoplatanus**	Tree	
Tall fescue	*Lolium arundinaceum**	Grass	
Toad rush	*Juncus bufonius**	Grass	
Tree lupin	*Lupinus arboreus**	Shrub	
Tree tutu	*Coriaria arborea*	Tree	Not Threatened
Viper's bugloss	*Echium vulgare**	Dicot Herb	
Water forget-me-not	*Myosotis laxa**	Dicot Herb	
Water starwort	*Callitriche stagnalis**	Dicot Herb	
Woolly mullein	*Verbascum thapsus**	Dicot Herb	
Yorkshire fog	*Holcus lanatus**	Grass	

Appendix 3: Photographs of vegetation types

Photo 1. Crack willow forest

Photo 2. Crack willow treeland

Photo 3. Buddleia scrub

Photo 4. Gravelfield (gravel roads / tracls and open areas of river gravels)

Photo 5. Hemlock-Russell lupin herbfield

Photo 6. Tree lupin shrubland

Photo 7. Buddleia shrubland

Photo 8. Stonecrop herbfield

Appendix 4: Bird species list

Table 23. Bird species recorded within the NZ Bird Atlas (grid square DP18) which encompasses the Site that are likely to utilise habitats within or adjacent to the Site, existing data and reports and during the site visit. Sorted by indigenous / introduced and by conservation status (Robertson et al., 2021).

Common Name	**Scientific Name**	**Conservation Status**	**eBird Square** DP18	**Existing data / reports**	**Site visit observation**
Black-fronted tern	*Chlidonias albostriatus*	Threatened – Nat. Endangered	x	x	
Caspian tern	*Hydroprogne caspia*	Threatened – Nat.Vulnerable		x	
Eastern falcon	*Falco novaeseelandiae*	Threatened – Nat.Vulnerable	x	x	
Long-tailed cuckoo	*Eudynamys taitensis*	Threatened – Nat. Vulnerable		x	
Banded dotterel	*Anarhynchus bicinctus*	At Risk - Declining	x	x	x
Black-billed gull	*Chroicocephalus bulleri*	At Risk - Declining	x	x	x
New Zealand pipit	*Anthus novaeseelandiae*	At Risk - Declining	x	x	
South Island pied oystercatcher	*Haematopus finschi*	At Risk - Declining	x	x	x
Pied shag	*Phalacrocorax varius*	At Risk - Recovering		x	
Black shag	*Phalacrocorax carbo*	At Risk - Relict	x	x	x
Little shag	*Phalacrocorax melanoleucos*	At Risk - Relict	x	x	x
Australian coot	*Fulica atra*	At Risk - Naturally Uncommon	x	x	
Little black shag	*Phalacrocorax sulcirostris*	At Risk - Naturally Uncommon	x	x	
Australasian shoveler	*Spatula rhynchotis*	Not Threatened	x	x	
Bellbird	*Anthornis m. melanura*	Not Threatened	x	x	
Black swan	*Cygnus atratus*	Not Threatened	x	x	
Grey teal	*Anas gracilis*	Not Threatened	x	x	x
Grey warbler	*Gerygone igata*	Not Threatened	x	x	
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened	x	x	
Mallard x grey duck	*Anas superciliosa*	Not Threatened	x	x	
New Zealand scaup	*Aythya novaeseelandiae*	Not Threatened	x	x	
Paradise shelduck	*Tadorna variegata*	Not Threatened	x	x	x
Pied stilt	*Himantopus leucocephalus*	Not Threatened	x	x	
Pukeko	*Porphyrio melanotus*	Not Threatened	x	x	
Shining cuckoo	*Chrysococcyx lucidus*	Not Threatened	x	x	
Silvereye	*Zosterops lateralis*	Not Threatened	x	x	x
South Island fantail	*Rhipidura f. fuliginosa*	Not Threatened	x	x	

South Island tomtit	*Petroica m. macrocephala*	Not Threatened	x	x	
Southern black-backed gull	*Larus dominicanus*	Not Threatened	x	x	x
Spur-winged plover	*Vanellus miles*	Not Threatened	x	x	x
Swamp harrier	*Circus approximans*	Not Threatened	x	x	
Tui	*Prosthemadera n. novaeseelandiae*	Not Threatened	x	x	
Welcome swallow	*Hirundo neoxena*	Not Threatened	x	x	x
White-faced heron	*Egretta novaehollandiae*	Not Threatened	x	x	
California quail	*Callipepla californica*	Introduced and Naturalised	x	x	
Canada goose	*Branta canadensis*	Introduced and Naturalised		x	
Chaffinch	*Fringilla coelebs*	Introduced and Naturalised	x	x	x
Common redpoll	*Acanthis flammea*	Introduced and Naturalised	x	x	
Common starling	*Sturnus vulgaris*	Introduced and Naturalised	x	x	
Dunnock	*Prunella modularis*	Introduced and Naturalised	x	x	x
Eurasian blackbird	*Turdus merula*	Introduced and Naturalised	x	x	x
Goldfinch	*Carduelis carduelis*	Introduced and Naturalised	x	x	x
Greenfinch	*Chloris chloris*	Introduced and Naturalised	x	x	x
House sparrow	*Passer domesticus*	Introduced and Naturalised	x	x	
Little owl	*Athene noctua*	Introduced and Naturalised	x		
Magpie	*Gymnorhina tibicen*	Introduced and Naturalised	x	x	
Mallard	*Anas platyrhynchos*	Introduced and Naturalised	x	x	x
Rock pigeon	*Columba livia*	Introduced and Naturalised	x	x	
Skylark	*Alauda arvensis*	Introduced and Naturalised	x	x	
Song thrush	*Turdus philomelos*	Introduced and Naturalised	x	x	
Yellowhammer	*Emberiza citrinella*	Introduced and Naturalised	x	x	

Appendix 5: Photos of Kawarau River freshwater monitoring sites (10-11 March 2026)

Photo 9. RS14, facing upstream.

Photo 10. RS13, facing upstream.

Photo 11. RS12, facing upstream.

Photo 12. RS11, facing upstream.

Photo 13. RS11, facing downstream.

Photo 14. RS10, facing upstream.

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