Earth Sciences New Zealand

Buller Plateaux Continuation Project

Assessment of environmental effects: Aquatic Ecology

Prepared for Bathurst Resources Limited

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Executive summary

Purpose and Description of the Project

Bathurst Resources Limited (including its subsidiary companies BT Mining Ltd, Bathurst Coal Ltd, and Buller Coal Ltd; BRL) has proposed the Buller Plateaux Continuation Project (BPCP or the Project) with the intention of securing the long-term production of high-quality coking coal on the West Coast by reconsenting existing Stockton Mine operations and developing new open-cast mining areas on the Denniston Plateau. The Project would open access to additional coal deposits to enable the extraction of approximately 20 million tonnes of coking coal over a 25-year period.

Project Scope

The BPCP covers five sub-areas on the Buller Plateaux: the existing Stockton Mine site, proposed new mines at Mount Frederick South (MFS) and Escarpment Extended (ESE), a connecting haul road (Upper Waimangaroa Haul Road, UWHR) linking Denniston to Stockton, and the already consented Cypress Mine area. The Project will utilise established infrastructure at Stockton (e.g., coal handling and processing facilities, water treatment systems) while constructing new roads, conveyor/haul routes, offices, water treatment plants, stockpiles and other support facilities as needed. A key integration element is the UWHR, which will allow coal from the new mining areas to be transported to Cypress and on to Stockton to link into the existing infrastructure and logistics chain. The BPCP will incorporate environmental management plans along with staged rehabilitation of mined areas and water management measures across the construction, operational, and closure phases.

Methods used for the aquatic ecology assessment of the Project

This assessment was focused on examining potential effects of the Project on aquatic values within three catchments on the Denniston Plateau: Whareatea, Waimangaroa and Cascade.[1] The key aquatic values considered were water quality, habitat, plants (periphyton and bryophytes), macroinvertebrates, kōura (freshwater crayfish) and freshwater fish. The assessment integrates information on these values from recent field surveys (2019–2025) conducted at more than 50 stream sites along with data from environmental monitoring and earlier studies, to provide a robust and current ecological baseline.

Data analyses included calculation of biotic indices and comparisons with guidelines, which were used to interpret the ecological data. The resulting interpretations were used to inform an ecological value framework for streams, which was adapted from published Ecological Impact Assessment (EcIA) Guidelines. We assigned an ecological value rating (from Negligible to Very High) to each stream site after considering its water quality, habitat integrity, and the abundance, diversity and rarity of the aquatic biota found. This systematic approach to describing the existing environment provides a clear basis for assessing potential Project effects and prioritising impact avoidance, mitigation, management, and offset/compensation planning.

The existing environment

Whareatea River catchment: Streams in the Whareatea catchment are typically small, steep waterways that are naturally acidic with slightly elevated dissolved metals (e.g., aluminium,

[1] Aquatic ecology values and assessment for Stockton Plateau are described in a separate report (Instream 2026).

iron, manganese). Upper headwater tributaries (e.g., Trent Stream) have low pH (~4.0–5.0) and conductivity, and flow through intact native vegetation. These naturally acidic headwaters, while low in nutrients, offer high-quality habitat with the aquatic biota adapted to the natural water chemistry. Periphyton growth is minimal due to low pH and shading, but [redacted] are common on submerged rocks. [redacted].

Historical coal mining on the Denniston Plateau has left a legacy of acid and metalliferous drainage (or acid mine drainage, AMD) in parts of this catchment. Rapid Stream (a tributary) receives drainage from the old Sullivan Mine adit, which has extremely low pH (~3.3), high dissolved metals that can be toxic to many macroinvertebrates and fish (e.g., aluminium), and precipitated iron hydroxides on the streambed. In and below these AMD-affected reaches, water quality and habitat are severely degraded – few algae or mosses can survive, and macroinvertebrate life is reduced to only the most tolerant taxa [redacted]

Ecological values in the Whareatea catchment were assessed as being High or Very High in the upper catchment and ranging from Negligible to Very High farther downstream. Sites on Rapid Stream impacted by AMD were assessed as Negligible to Low.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Assessment of effects

This assessment evaluated the potential effects of the BPCP on water quality, aquatic habitat, and freshwater ecological communities across the [redacted] during the construction, operational, and closure phases of the Project. Effects were assessed both before and after the application of proposed avoidance, mitigation, remediation, and management measures, with residual effects determining the overall significance.

During construction, potential effects are primarily associated with vegetation clearance, earthworks, road construction, stream diversions, and in-stream works. These activities may temporarily increase sediment loads, alter water quality, disturb stream channels, and affect movement of aquatic fauna [redacted]. With the implementation of erosion and sediment controls, water quality management, and culvert designs that provide for aquatic passage, most construction-phase effects are assessed as minor or less than minor. However, due to the extent of the UWHR construction activities and the high-rainfall environment of the Denniston Plateau, there remains a residual risk of more than minor effects from sediment and mine-affected water discharges (AMD) during construction, particularly during intense rainfall events, which will be actively monitored and adaptively managed.

Mining operations will result in the unavoidable removal of approximately 17.1 km of headwater streams in the Whareatea and Waimangaroa catchments. Residual effects associated with stream habitat loss and related hydrological alteration are assessed as more than minor to significant, reflecting the extent and duration of habitat removal. Residual effects associated with AMD and mine-affected water discharges may range from minor to more than minor, including during high rainfall and bypass events. However, these effects are expected to be reduced through active water capture, treatment systems, monitoring, and adaptive management. Other potential operational effects, including sediment and coal fine inputs, altered flow regimes, riparian vegetation loss, and disturbance from noise and human activity, are expected to be reduced to minor or less than minor with comprehensive mitigation, monitoring and adaptive management in place.

A positive effect of the Project is the remediation of historic mining impacts, particularly within the Cascade Creek catchment. Interception, treatment, and removal of historic AMD sources are expected to result in improvements in water quality, habitat condition and aquatic communities, representing a net environmental benefit in this catchment relative to the existing environment.

The closure phase focuses on decommissioning, rehabilitation, and long-term management of residual risks, particularly AMD and sediment. Progressive rehabilitation will result in the reinstatement of approximately 20.8 km of stream length, slightly exceeding the total length removed during mining. Reinstated streams and other closure waterbodies will be required to meet defined closure criteria for physical and chemical stability and ecological function, supported by monitoring and adaptive management until closure objectives are achieved.

Recommendations

A comprehensive set of mitigation, rehabilitation, compensation and monitoring measures to manage potential effects on aquatic ecology and deliver acceptable ecological outcomes is proposed for the BPCP. Key measures include progressive stream reinstatement (approximately 20.8 km), creation and rehabilitation of tarns and closure waterbodies, targeted remediation of historic AMD sources in the Cascade Creek catchment, and a fish passage barrier remediation programme that will provide broader catchment- and regional-scale ecological benefits.

1 Introduction

1.1 Purpose of the Project

Bathurst Resources Ltd (including its subsidiary companies BT Mining Ltd, Bathurst Coal Ltd, and Buller Coal Ltd; BRL) is seeking approvals through the Fast-track Approvals Act 2024 for the Buller Plateaux Continuation Project (BPCP, or the Project). The Project covers areas on the Stockton Plateau and the Denniston Plateau, which are collectively referred to as the Buller Plateaux.

The Project will enable approximately 20 million tonnes of coking coal to be mined, utilising existing infrastructure and facilities over 25 years to support and extend the current Stockton mine operations. A requirement for the Project to proceed is to reconsent the existing infrastructure and mining operations associated with the Stockton Mine and obtain consents to provide access to additional coal mining areas across the Buller Plateaux to enable mining in new areas, as the coal resource in the current Stockton operations are close to depletion, and further coal resources for blending are required. All elements of the Project are essential for the Project to be economically viable and to meet the coal blend requirements.

1.2 Background

1.2.1 Mining history and environmental legacy

The Buller Plateaux, located within the Buller District and West Coast Regional Council boundaries, has a long and complex history of coal mining, both underground and open cast (Harding and Boothroyd 2004). Mining began in the late 19th century, with significant development on the Denniston Plateau and, later, on the Stockton Plateau. These areas are underlain by the Brunner Coal Measures, which have been extensively mined since the early 1900s (Nathan 2015).

Large-scale open cast mining commenced on the Stockton Plateau in 1944, reaching peak production in 2008. This activity has significantly impacted the Ngākawau River catchment. While mining continues at Stockton, legacy issues persist. Several abandoned sites, including Mt William and the historic Stockton Plateau workings, continue to leach acid and metalliferous drainage (or acid mine drainage, AMD) into tributaries such as St Patrick Stream, Mangatini Stream, and Mine Creek. The discharges, occurring outside the current Stockton Coal Mine Licence (CML) area, are the responsibility of the Crown, and any AMD within the CML generated from pre 2017 mining disturbance is also the responsibility of the Crown as set out in the Deed of Commitment between the Crown, West Coast Regional Council, Buller District Council and BT Mining Ltd.

The Denniston Plateau, home to the existing Escarpment Mine, has a legacy of underground mining dating back to the early 1880s. Although the existing Escarpment Mine has been in care and maintenance (i.e., a temporary non-operational phase where mining ceases but environmental and safety management continue until operations resume or closure proceeds) since 2016, AMD from extensive historic workings continues to affect water quality. Numerous discharge points remain across the Denniston Plateau, some within the footprint of the existing Escarpment Mine. Several historic underground mining adits (tunnels) drain into the waterways of the Deep Stream catchment in the upper Waimangaroa River catchment. Other historic sites, such as the Sullivan Mine (closed 1996) and the former Cascade Mine (closed 2015), also contribute to ongoing environmental challenges. The Sullivan Mine, in particular, discharges highly acidic, metal-rich waters into Rapid Stream through an adit (Hogsden et al. 2020).

This extensive mining history has led to degraded water quality, loss of habitat and reduced ecological diversity in affected waterbodies. In response, current management strategies focus on active and passive treatment of mine water discharges. These include limestone dosing, water treatment systems, settling ponds, mussel shell reactors (which increase pH and remove heavy metals from AMD) and ecological rehabilitation efforts such as stream diversions and revegetation (Hogsden et al. 2016). Treatment efforts initiated at Stockton Mine in the early 2000s have significantly improved water quality in Mangatini Stream and the lower Ngākawau River, supporting the recovery of native fish populations such as kōaro (Gray et al. 2016, PDP 2024, Instream 2026). Treatment of AMD in the St Patrick Stream catchment began around 2005 and continues today. Considerable work has also been undertaken at Stockton Mine recreating or rehabilitating tarns (small alpine and sub-alpine ponds) since the early 2000s. A recent assessment indicated many recreated (i.e., constructed) tarns provide new and important habitats for macroinvertebrates (that prefer slow or standing waters) similar to nearby natural tarns on the Stockton Plateau (Watson et al. 2024a).

1.3 Purpose and scope of this report

The purpose of this report is to:

- Describe the current state of aquatic ecosystems in and downstream of the Project area on the Denniston Plateau within the Whareatea, Waimangaroa and Cascade catchments.
- Within these three catchments: (1) assess the potential effects of proposed mining activities on key ecological values, including plant communities (bryophytes, periphyton), macroinvertebrates, kōura (freshwater crayfish) and fish, and (2) describe how the effects are proposed to be managed.
- Provide recommendations for monitoring, mitigation, rehabilitation and compensation measures to minimise adverse effects, address residual effects and support ecological recovery.

The following is out of scope of this report:

- Water quality and aquatic ecology of streams and rivers in the Stockton Mine area (Ngākawau River catchment, Stockton Plateau), which is described in Instream (2026).
- Assessing the effects of the Project on wetlands, riparian vegetation or estuaries. The actual and potential effects of the Project on these ecological values have been assessed for wetlands and riparian vegetation by Ecological Solutions (2026).
- Assessing the effects of the Project related to the currently consented Cypress Mine, as only authorities under the Wildlife Act and a limited variation to existing consents are being sought under the Application, and these do not involve aquatic species[2].

[2] Aquatic ecology monitoring at Cypress Mine is reported annually to the West Coast Regional Council (WCRC) as per consent conditions to ensure no adverse effects on aquatic communities.

This report will be used in an Assessment of Environmental Effects (AEE) for the Project.

This report is structured in the following way:

- Description of the Project (Section 2)
- Methods (Section 3)
- Existing environment (Section 4)
- Assessment of effects of the Project (Section 5)
- Recommendations for mitigation, rehabilitation, compensation and monitoring (Section 6).

2 Description of the Project

2.1 Location and Project sub-areas

The Project covers areas across the Stockton Plateau and Denniston Plateau, collectively referred to as the Buller Plateaux. The Buller Plateaux are located approximately 15 km northeast of Westport, in the West Coast Region. The Project area comprises five Project sub-areas:

- Stockton;
- Mount Frederick South (MFS);
- Escarpment Extended (ESE);
- Upper Waimangaroa Haul Road (UWHR); and
- Cypress.

A plan showing the location of the Project and the five Project sub-areas is provided in Figure 2-1. Full details of the Project sub-areas are provided in the AEE Application. The UWHR will be a transport corridor that connects the Stockton and Denniston Plateaux and is located in the upper Waimangaroa catchment. The UWHR will connect the ESE and MFS sub-areas with Stockton. As noted above, Cypress Mine is authorised under existing consents except for the proposed sitewide Wildlife Authority Act application, which will be submitted as part of the FTAA application, and some consequential amendments required to integrate the Cypress consents with the Project.

The Project area covers four main catchments which are associated with the Project sub-areas as shown in Table 2-1 and Figure 2-2. The description of the existing environment (Section 4) and the assessment of effects (Section 5) of the Project in this report relates to the following three catchments: Waimangaroa River, Whareatea River, and Cascade Creek. The Ngākawau River catchment is covered in Instream (2026).

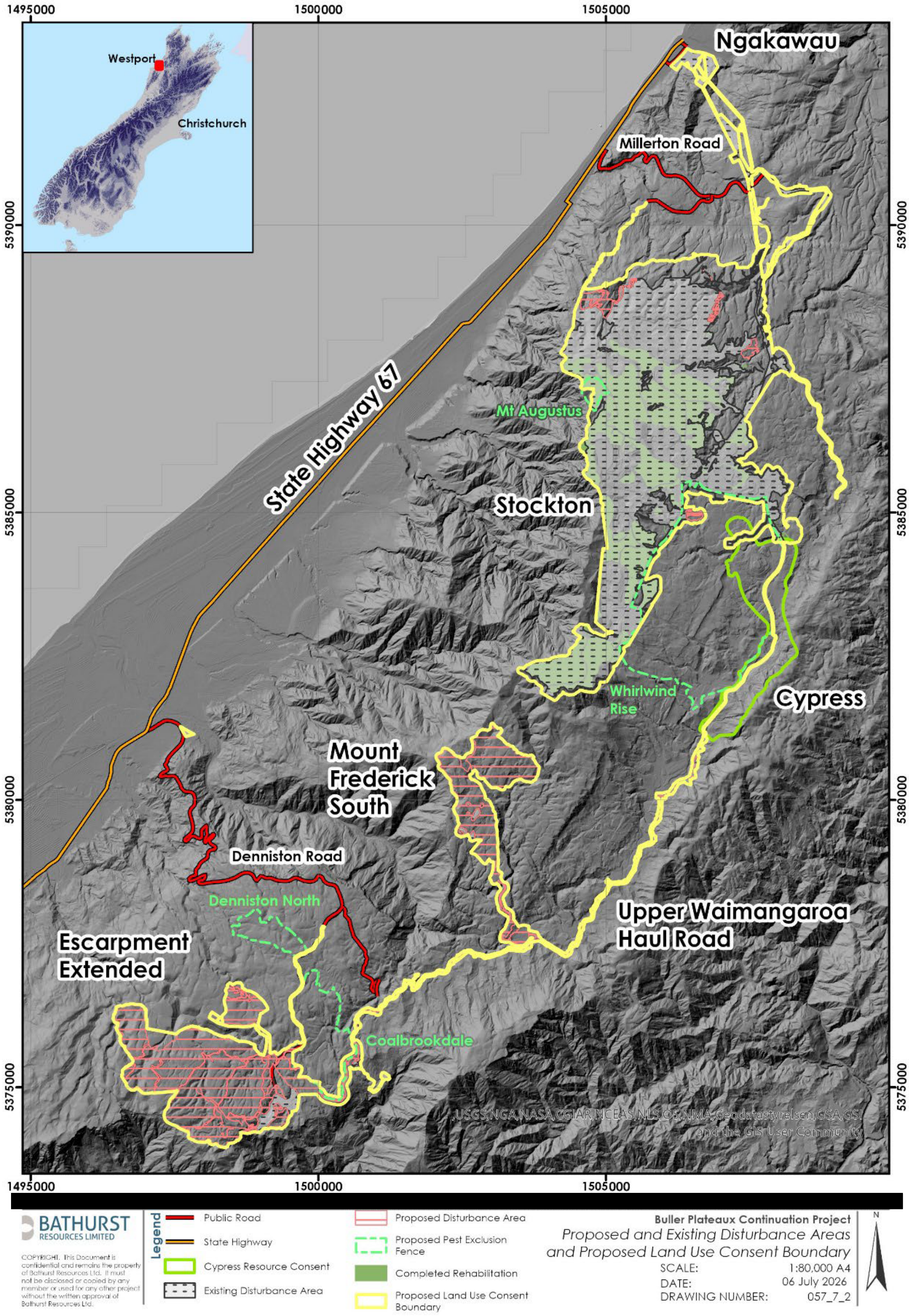

Figure 2-1: Map of the five Project sub-areas on the Buller Plateaux. Proposed and existing disturbance areas and the proposed land use consent boundary for the Project are shown. The Cypress sub-area (outlined in by the solid green line) is also shown.

Table 2-1: Four main river catchments across the Buller Plateaux and associated Project sub-areas.

Catchment	Project sub-area(s)
Ngākawau River	Stockton, Cypress
Waimangaroa River	Escarpment Extended, Mount Frederick South, UWHR, Cypress, Stockton
Whareatea River	Escarpment Extended
Cascade Creek	Escarpment Extended

[redacted]

2.2 Project overview

The Project will involve continuation of mining operations at Stockton Mine and the establishment and development of new mining areas in the ESE and MFS sub-areas. The Project will include construction of new roads, borrow pits and infrastructure (e.g., offices, water treatment plants, stockpiles) and the continued use of existing infrastructure at Stockton Mine (e.g., Ngākawau Coal Handling Facility) for mining activities and operations. The UWHR will connect the Denniston Plateau to the Stockton Mine which will enable use of existing infrastructure at Stockton and allow for coal transport across the new mine areas prior to rail-loadout at Ngākawau. The Project also includes progressive rehabilitation of operational areas and implementation of environmental management and rehabilitation plans.

Full details of the Project, including a comprehensive description of the construction, operation, closure and post-closures phases for all Project sub-areas are provided in the AEE.

2.2.1 Mining phases and implications for freshwater ecosystems and aquatic ecology

Mining and mining-related activities can cause physical and chemical changes to nearby waterways and downstream waterways through the different phases of mining activities, from construction through operation to closure and post-closure. These physical and chemical changes can affect waterways and biodiversity (e.g., Hogsden and Harding 2012, Barbarossa et al. 2026).

General effects on freshwater ecosystems during the life of a mining project can include:

- loss of headwater streams and habitat;
- potential for sediment generated or coal fines to discharge into waterways; and
- potential for AMD generated to discharge to waterways; and
- flow alteration/diversions/altered hydrology.

The potential effects of the Project (with the exception of Stockton) on the existing environment are assessed and a comprehensive set of proposed management measures to address the potential effects (through avoidance, minimisation, mitigation or compensation) are discussed in further detail in Section 5.

3 Methods

3.1 Aquatic ecology values assessment

This assessment focuses on effects on aquatic ecology values, specifically habitat and aquatic communities (plants, macroinvertebrates and kōura, fish) in the Whareatea River, Waimangaroa River, and Cascade Creek catchments. Information on water quality was included to characterise aquatic habitats at the time aquatic ecology values were assessed.

3.2 Aquatic ecology values and variables

The current state of water quality, habitat and aquatic ecology in streams and rivers is described for the three catchments within the relevant Project sub-areas for plants, macroinvertebrates, and fish.

Water quality is described using the following variables: pH, electrical conductivity (conductivity), dissolved metal concentrations, water temperature, turbidity, total suspended solids (TSS) and dissolved oxygen (DO). Habitat is described using variables such as instream substrate composition, riparian vegetation cover, and flow.

3.2.1 Plants (periphyton and bryophytes)

Periphyton comprises algae, bacteria, and fungi that grow on streambeds. It plays a vital role as a primary producer and food source for macroinvertebrates. Healthy levels of periphyton refer to thin films, which support high-quality macroinvertebrates such as mayflies, with the occasional development of thicker mixed periphyton communities (e.g., mats and filamentous algae). Excessive periphyton growth can smother substrate and reduce in-stream habitat available for high-quality macroinvertebrates. A range of factors including water quality, light availability, flow, temperature, substrate and grazing by macroinvertebrates influence periphyton communities.

Periphyton communities are described based on biomass (as chlorophyll *a*) and cover estimates in up to eight different categories (e.g., film, long green filament; NEMS 2022).

Bryophytes (mosses, liverworts and hornworts) are slow-growing primary producers that provide habitat and food for macroinvertebrates. Bryophytes can establish dense communities, particularly under low light conditions or on stable substrates, and presence often indicates permanent or near-permanent flow.

Bryophyte communities are described based on cover estimates, taxa richness[3] and the presence of species with conservation status or of special interest.

3.2.2 Macroinvertebrates and kōura

Macroinvertebrates have intrinsic ecological value, including high endemism among New Zealand freshwater insects, contribute to energy transfer within stream food webs, and are widely used as indicators of stream health due to their known sensitivity or tolerance to environmental conditions. The structure of macroinvertebrate communities is influenced by a range of physical and chemical factors, including flow, substrate, habitat availability, and water quality. As most

[3] Taxa/species richness is the number of taxa/species present and is a commonly used measure of biodiversity within a given location.

macroinvertebrates spend most of their life cycles in freshwater, they can provide a long-term picture of stream health.

Macroinvertebrate communities are described using composition of specific taxa, dominant taxa, taxa richness, the presence of species with conservation status (or of special interest) and the following macroinvertebrate community metrics:

- Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa richness[4]
- % EPT abundance
- Macroinvertebrate Community Index (MCI; and its quantitative variant, QMCI)
- Acid Mine Drainage Index (AMDI).

The MCI and QMCI assess stream health based on macroinvertebrate tolerance to organic pollution (Stark 1985; Stark and Maxted 2007), whereas the AMDI is an AMD specific index (Gray and Harding 2012). Interpretation tables of metric scores are provided in Appendix A.

Kōura (freshwater crayfish) are culturally significant and ecologically important nocturnal omnivores. They inhabit areas with stones and woody debris, which provide essential cover, and feed on plant material and macroinvertebrates.

Kōura are described based on presence, abundance and body size. Body sizes (measured as orbit – carapace length) provide an indication of the size and age structure of the population.

3.2.3 Fish

Freshwater fish are valued for biodiversity, cultural and recreational reasons. Diverse fish communities use a range of good quality habitats in streams and rivers. Several native migratory species require access to the sea to complete their lifecycle. Fish distribution is influenced by altitude and distance from the sea, instream habitat quality, elevation, physical barriers (e.g., waterfalls, boulders), water quality and food availability.

Fish communities are described based on species richness, abundance, and body size, and the presence of species with conservation status.

3.3 Sources of data and information

The descriptions and assessments of water quality, habitat, plant, macroinvertebrate and fish communities are based primarily on data collected in baseline surveys in Project sub-areas completed between 2019 and 2025 (Sinton et al. 2019, Hogsden et al. 2020, Watson et al. 2024 a,b,c, Rose and Watson 2025) and resource consent compliance monitoring programmes at Cypress Mine (BRL 2000, 2021, 2022, 2023, 2024). Fish records for all waterways were obtained from the New Zealand Freshwater Fish Database (NZFFD) in March 2025.

This assessment also draws on information and analyses from earlier investigations and surveys (from 2000 to 2018) across the Buller Plateaux to provide information over time and in areas where more recent data is not available. These reports include bryophytes (e.g., Suren and

[4] EPT taxa, i.e., mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera), are regarded as being more sensitive to changes in water quality and habitat than other aquatic macroinvertebrates and are generally considered more pollution-sensitive taxa.

Glenny 2003, Glenny 2009), macroinvertebrates (e.g., Boubée 2003, Harding 2008, Gray 2014, Jellyman 2015) and fish (e.g., Boubée 2003, Harding et al. 2006).

Survey and laboratory processing methods are detailed in technical reports and follow established and standard methods for freshwater ecological monitoring. Most recent surveys were carried out during baseflow conditions in spring, summer or early autumn. It is important to note that species-level identifications for bryophytes and macroinvertebrates taxa can be very difficult for some taxa found in these waterways. Furthermore, taxa richness results for bryophytes and macroinvertebrates may not be directly comparable between years due to different levels of expertise in identification. Interannual variability for macroinvertebrates can also reflect natural spatial and temporal variability and differences in sampling protocols.

The conservation status of species used in this report is based on the most recent New Zealand threat classification lists:

- Plants: Mosses (Michel et al. 2025), Hornworts and liverworts (de Lange et al. 2020)
- Invertebrates: Grainger et al. (2018)
- Freshwater fish: Dunn et al. (2025).

For data mentioned from earlier surveys (pre-2016), both historical and current conservation status are reported.

Note that data are not available for all variables used to describe water quality, habitat or aquatic communities at each site.

3.3.1 Additional survey and analysis to support assessment for bryophytes

Technical assessments of mine water management for the Project indicate that mine discharge from passive treatment systems (e.g., mussel shell reactors, MSRs) will have pH > 7, with other treatment available to manage pH as required. As many streams on the Buller Plateaux are naturally acidic (pH 4–6), treated discharge may elevate stream pH above natural levels, potentially affecting bryophytes.

To better understand the distribution of bryophytes across a pH range and assess the potential impact on bryophytes, a survey was conducted in November 2024 across nine streams spanning a pH gradient from 4.6 to 7.4 (Rose and Hogsden 2025). The key findings from the survey were:

- Of the 40 bryophyte taxa recorded, 10 were exclusive to naturally acidic streams, suggesting a preference for low pH conditions. Loss of these taxa from naturally acidic stream reaches downstream of treated discharge inputs may indicate sensitivity to elevated pH from treated discharge.
- Four taxa were found across both acidic and circumneutral streams, indicating broader pH tolerance and potential resilience to pH changes. The remaining 26 taxa were only found in circumneutral streams (pH 6.4 to 7.4).
- Assessments of species distributions were limited by the number of taxa recorded at only one or two sites.

- Bryophyte cover and biomass varied across the pH gradient. Cover was lowest (≤10%) at two sites with pH ≥ 6.8, despite suitable habitat conditions. However, biomass at these sites was comparable or higher than at others, possibly reflecting differences in species structure or growth forms. Both sites also had high species richness.
- Bryophyte richness increased with pH, with the highest richness (15 taxa) observed at pH 7.4.

Due to the limited distribution of many species in the 2024 survey, additional data from previous studies were incorporated to broaden understanding of bryophyte distribution across the pH gradient. The conclusions from this broader assessment (Hogsden and Hickey 2025) were:

- Bryophyte communities on the Buller Plateaux are diverse, with 126 taxa recorded across 50 stream sites spanning a pH range of 3.0–7.8. [redacted].
- Several taxa are pH generalists, with 30 bryophyte taxa occurring in both acidic (pH ≤4.5) and circumneutral (pH ≥6.5) streams. Of these taxa, 17 were recorded in streams up to or above pH 7. This suggests several taxa are likely tolerant of pH changes expected from treated mine discharge (up to pH 7) downstream of active and passive treatment systems for the Project.
- Other bryophytes, particularly acid-specialists (taxa only found in naturally acidic streams), may be vulnerable to changes in pH associated with mine water treatment. Substrate stability and shading are key habitat factors influencing bryophytes and should be considered alongside pH effects.

These results, considered alongside existing information, suggest that bryophyte cover is negatively associated with stream pH. This pattern is consistent with findings from the upper Waimangaroa River catchment, where Suren and Glenny (2003) reported that pH alone explained 37% of the variation in bryophyte cover. In that study, bryophyte cover was twice as high in low-pH streams with stable substrates (e.g., bedrock) on the western side of the valley compared to circumneutral streams with less stable substrates on the eastern side. Among all water quality variables assessed, only pH showed a significant relationship with bryophyte cover. [redacted]

By integrating findings from both the 2024 survey and historical datasets a more comprehensive understanding of bryophyte species' pH preferences and tolerances has been developed. This broader perspective strengthens the ecological baseline for assessing potential impacts of mine closure and treatment activities on bryophyte communities in naturally acidic streams.

3.4 Assessment approach

3.4.1 Assessing ecological value and effects

This assessment of ecological effects follows the Ecological Impact Assessment (EcIA) Guidelines developed by the Environmental Institute of Australia and New Zealand (EIANZ; Roper-Lindsay et al. 2018). This method involves assessing:

- the ecological value of communities, habitats, ecosystems, and species;
- the magnitude of potential impacts; and
- the overall level of ecological effect by combining ecological value and impact magnitude.

We have adapted the EIANZ framework and taken an approach analogous to that accepted for the recently approved Waihi North Project (Boffa Miskell Ltd 2025). This approach assigns ecological variables within a stream/site a value of: Negligible, Low, Moderate, High, or Very High ecological value. The classification is tailored to Buller Plateaux streams (including downstream lowland rivers) and considers five key ecological variables: (1) water quality and habitat, (2) plants (periphyton/bryophytes), (3) macroinvertebrates, (4) kōura and (5) fish. Each value level is defined by objective criteria from literature and site data – including taxa richness, biological indices (EPT richness, QMCI, AMDI), conservation status of species (New Zealand Threat Classification rankings), and water quality thresholds for stressors (e.g., pH, dissolved metals). Table 3-1 summarises the criteria used for each characteristic (ecological variable).

Higher value categories reflect near-pristine conditions, diverse communities and presence of sensitive biota (often including Threatened or At-Risk species), and little human impact. Lower categories reflect increasing degradation, such as AMD impacts (pH <3, high dissolved metals), heavy sediment/turbidity loads, dominance of tolerant taxa, and loss of sensitive species.

Table 3-1: Ecological value stream framework including description of stream condition and characteristics for water quality & habitat, plants, macroinvertebrates, kōura, and fish variables.

Value	Description (Stream condition)	Characteristics – Indicators for each ecological variable
Very High	Reference-quality stream in an almost natural state, with *negligible human-induced degradation*. Supports full expected range of indigenous biota. Often corresponds to protected or inaccessible sites (e.g., intact native forest headwaters).	**Water quality & habitat**: near-pristine physicochemical conditions (naturally low nutrients, clear water, pH and temperature in natural range); no significant contaminants or sediment inputs from human activities. Instream habitat structure natural and diverse (heterogeneous substrate, stable banks with intact riparian vegetation). **Plants**: periphyton and bryophytes indicative of unimpacted streams (clean-water algae/diatoms, high biomass only in forms typical of natural state). No nuisance algal blooms. Diverse bryophyte community including sensitive taxa. Bryophytes can be abundant. **Macroinvertebrates**: Species-rich community with many sensitive taxa. High diversity and abundance; community not dominated by any one group. QMCI ≥6 (indicating excellent quality). EPT taxa richness high, often ≥10–20+ species. No sign of AMD impact (AMDI >40;

Value	Description (Stream condition)	Characteristics – Indicators for each ecological variable
		classifying as *unimpacted*). **Kōura**: present and often abundant. Kōura thrive in absence of fish predation and in high-quality water; often found in high densities in pristine Buller Plateaux streams. **Fish**: high native fish diversity (>5 species) and abundance where access is not barred naturally. Typically includes multiple Threatened or At-Risk species, conferring conservation value – e.g., longfin eel, bluegill bully, shortjaw kōkopu if present. Sensitive migratory species (e.g., kōaro) common in uplands.
High	High ecological value but slightly modified from pristine condition. *Slight to moderate degradation* – usually some human influence (e.g., partial riparian clearance, minor pollution or habitat alteration) but ecosystem still robust.	**Water quality & habitat**: generally good, with only minor departures from natural state. Water chemistry still suitable for sensitive biota (e.g. ≥90% dissolved oxygen (DO) saturation, near-natural pH) and low contaminant levels. Possibly small areas of habitat modification (e.g. short reaches of channelisation, some riparian weeds or local bank erosion). Clean, clear water predominates, though slight increases in nutrients or fine sediment may occur occasionally. **Plants**: Streambed mostly natural biofilms; periphyton growth low to moderate. Occasional blooms of filamentous algae or diatom mats could occur if nutrients slightly elevated, but overall plant community indicates good quality. Mosses and liverworts common in shaded reaches, including some sensitive taxa. **Macroinvertebrates**: diverse community with many sensitive taxa present. QMCI often in "Good" range (~5-6). Some early signs of stress may appear (e.g. slight drop in EPT richness (≥8–~15) or a few tolerant taxa like chironomids present), but ecosystem processes intact. Little to no AMD effect (AMDI >40; would be classified as *unimpacted*). **Kōura**: present and often common where habitat allows. Minor disturbance has not eliminated kōura – they remain common in pools and under cobbles and boulders. **Fish**: native fish community intact and often diverse or at least one Threatened species present (e.g., shortjaw kokopū). Overall fish diversity high for the stream type (e.g., 4–5 native species in lower reaches).
Moderate	Moderate ecological value, with a mix of intact and degraded elements. *Moderate to high degradation* – human impacts are present, but the stream still retains some ecological functioning. Often corresponds to semi-modified landscapes (e.g. streams draining pasture with some buffering).	**Water quality & habitat**: intermediate condition. Water quality is often suboptimal for the most sensitive life (e.g., slightly elevated metal or nutrient concentrations, occasional low dissolved oxygen or pH changes). For example, streams may receive runoff from historic mining or agriculture causing moderate metal or turbidity levels that exceed pristine norms or some metal precipitates present. Habitat structure is partly altered – e.g. simplified channels, reduced in-stream large woody debris, patchy riparian cover (perhaps grasses with some shrubs/trees). Some fine sediment deposition and bank erosion evident. Still,

Value	Description (Stream condition)	Characteristics – Indicators for each ecological variable
		habitat supports a range of biota in places (refugia exist). **Plants**: periphyton can be abundant at times. Thick algal mats or filamentous green algae may develop during stable low flows, indicating nutrient enrichment. Bryophytes (including sensitive taxa) decline where substrate is silted and riparian canopy open. **Macroinvertebrates**: community includes mix of sensitive and tolerant taxa. Overall diversity is lower, and pollution-tolerant groups (snails, chironomids, worms) are more common. QMCI typically in mid-range (~4–5) and indicative of fair quality. EPT taxa are reduced (richness often >4–8) as mayflies/stoneflies drop out in degraded micro-habitats. If AMD present, AMDI (20–40) may indicate impacted (moderate impairment). **Kōura**: may still be present but in lower densities. Habitat disturbance (sedimentation, loss of cover, or low pH) may have reduced kōura numbers. Kōura persist in tributary refuges or where predatory fish are absent. **Fish**: moderate native fish diversity (e.g., 2–3 species) or at least one At-Risk species present (e.g., kōaro, torrentfish). In lower stream sections, presence of only common, tolerant native fish (e.g., common bully) indicates moderate value.
Low	Low ecological value with pervasive degradation. *Very high degradation* from stressors like pollution, mining, or channelization – most sensitive species are lost and ecosystem processes are impaired. Such streams provide limited ecological services beyond hardy life forms.	**Water quality & habitat**: poor. Water quality frequently fails to meet ecological guidelines – e.g. chronically elevated turbidity and sediment deposition or acidic/polluted flows from AMD or nutrient enrichment causing frequent nuisance algae. Metal hydroxide flocs or precipitates may coat the streambed below mine drainage sites (orange/white flocs or precipitates of iron/aluminium, respectively), smothering benthic habitat. Habitat structure is heavily modified or uniform (e.g., channelised drain, highly sedimented or AMD-impacted stream). Little riparian shading (often open, weed-dominated banks), leading to warmer temperatures and more algal growth. **Plants**: periphyton frequently overgrows – thick mats or nuisance blooms can be common in absence of control by macroinvertebrate grazers. Filamentous algae and cyanobacteria may dominate. Overall primary production can be excessive (a sign of poor health). **Macroinvertebrates**: impoverished community. Low diversity and abundance of sensitive taxa. Community usually dominated by a few very tolerant invertebrates (e.g., chironomids, worms, snails). Almost no mayflies, stoneflies, or caddisflies present (EPT% near zero). QMCI typically <4, indicative of poor or severally polluted conditions. EPT richness low (≤3 or 4). AMDI often classifies the site as *impacted* (20–30) or *severely impacted* (<20) by mining, if applicable (acid-tolerant taxa including certain midge larvae might remain). **Kōura**: usually

Value	Description (Stream condition)	Characteristics – Indicators for each ecological variable
		absent or rare. Poor habitat and water quality (especially very low pH or elevated heavy metals) can extirpate kōura populations. Any remaining individuals are in refuge areas and not sustaining a healthy population. **Fish**: low native fish diversity (e.g., 1 species) with only the hardiest native fish (e.g. shortfin eel, common bully) surviving and often in low numbers. In many such streams, no fish at all may be present – either due to toxic water (e.g., below coal mine seeps with pH ~3) or physical barriers combined with poor habitat. If fish are absent solely from natural barriers/causes (e.g., waterfall), that does not by itself mean "Low" value – here we refer to absence due to degradation. The overall ecological function as a native fish habitat is severely compromised.
Negligible	Negligible ecological value. Little ecological value, with most aquatic life eliminated or highly suppressed. Often an extreme case of contamination or habitat destruction (e.g., untreated AMD, or a stream converted to a straight farm drain with regular de-watering).	**Water quality & habitat**: critical condition. Water chemistry toxic or near-toxic for most fauna (pH <3.5 with high dissolved aluminium and iron from AMD; or chronic anoxia, or toxic levels of contaminants). Physical habitat offers almost no structure or refuge (e.g., concrete or highly sedimented bottom, no flow variability). **Plants**: little to no aquatic plant life besides perhaps some tolerant algae and bryophytes. Streambed often coated in bacterial slimes, iron oxidizing mats, or nothing at all. No periphyton of ecological value; primary production is minimal (or conversely, in human-made ponds, algal scums can dominate but support almost nothing else). **Macroinvertebrates**: extremely depauperate. Only a few tolerant organisms (if any) remain (e.g., chironomids) or no visible benthic macroinvertebrates at all. In surveys, one might find only 1–2 taxa in very low numbers (e.g., "3 individual chironomids" in a sample). QMCI scores in these conditions are typically meaningless. Typically, no EPT taxa except acid- or metal-tolerant EPT taxa. AMDI (<20) classifies such sites as *severely impacted* (worst category) if AMD is the cause of degradation. **Kōura**: absent. No habitat or water quality suitable for kōura. **Fish**: absent. Essentially no fish can survive these conditions.

Using this methodology, each stream or stream reach is evaluated against the above criteria for all five variables. For example, an undisturbed native forest stream on the Buller Plateaux with naturally low nutrient levels, pH ~4.5–6 (normal for West Coast rain-fed streams), abundant bryophytes, QMCI >6 and diverse mayflies, and supporting high densities of kōura would be rated 'Very High'. In contrast, a stream draining a mine area with pH ~3 and high dissolved metals (exceeding aquatic life thresholds), orange precipitates coating the streambed, only a handful of acid-tolerant macroinvertebrates (i.e., AMDI indicating severely impacted), no kōura or fish would be 'Negligible' in ecological value. Intermediate cases are classified Low–Moderate depending on the severity of AMD contamination, habitat loss and biotic impairment. For example, a pasture stream with moderate sediment deposition and a few sensitive species present might be classed as Moderate, whereas a heavily channelised agricultural drain with low QMCI and only eels would be Low.

Natural factors are important considerations in this assessment. Many Buller Plateaux headwaters lack fish naturally due to physical barriers (e.g., waterfalls); hence fish absence on its own is not necessarily degradation. We therefore look holistically at all variables. Each ecological variable is scored based on compiled field data (water chemistry, habitat surveys, periphyton cover, macroinvertebrate indices, kōura counts, fish surveys; Section 3.3) and then an integrated value is assigned (noting that the value is not necessarily a strict "average" because professional judgment is used to weigh, for instance, the presence of a Threatened species more heavily).

Using this framework ensures the classification is objective and transparent. For instance, macroinvertebrate indices like QMCI guide the assessment of water quality and organic enrichment, while the AMDI is specific for streams influenced by AMD to detect biotic impairment. The conservation status of species is factored in by assigning higher value if species classified as Threatened or At Risk are present – aligning with national significance criteria. Likewise, water quality is evaluated against known ecological tolerance limits (e.g., turbidity <5 NTU is ideal, >25 NTU begins to impair native fish feeding; pH below ~3 will eliminate most aquatic life (Quinn et al. 1992, Reid and Quinn 2011, Hogsden and Harding 2012, Cavanagh et al. 2014).

For the purposes of this assessment, we note that it is difficult to distinguish between High and Very High for water quality and habitat so these are often listed as High/Very High. In addition, the presence of a single juvenile kōaro at a site was not considered regionally important to automatically denote a 'High' rating for fish if present.

The scores from each characteristic (or ecological variable as presented in Table 3-1) were then used to assign an overall value for each site (Table 3-2) that has been used in this assessment.

Each value level is linked to management implications in the assessment of effects – e.g., streams rated High/Very High merit strong avoidance of impacts, whereas Low value streams might be candidates for rehabilitation to improve their condition. The assessment of effects is outlined in Section 5.

Table 3-2: EIANZ criteria for ascribing ecological value to sites or areas (adapted from Roper-Lindsay et al. 2018). This approach (five assessment matters) is used to define our overall value because sites tend to have kōura or fish, but not both, as top predators.

Value	Description
Very High	Area rates High or Very High for three or more of the five assessment matters.
High	Area rates High or Very High for two of the assessment matters, Moderate and Low for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates High or Very High for one matter, Moderate and Low for the remainder, or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder. Likely to be important at the level of the Ecological District.
Low	Area rates Low or Negligible for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Negligible for three matters and Moderate, Low or Negligible for remainder.

3.4.2 Additional sources of information

Detailed technical assessments of water quality (MWM 2026 a,b; Hickey 2026a,b,c,d), hydrology (MWM 2026c), sediments (MWM 2026d), ecotoxicology (Hickey 2026a), AMD and water quality modelling (MWM 2026e,f,g,h,i) and other aspects of aquatic values (i.e., aesthetics, cultural, recreational) have been addressed by others for the Project AEE. Water quality modelling predictions, proposed water quality guidelines, results and recommendations from these assessments were considered in this report to assess the potential effects of the Project on aquatic ecology within the Whareatea, Waimangaroa and Cascade catchments.

4 Existing environment

This section describes the existing environment and assesses the significance of species, habitats, ecosystems, and ecological values by catchment. Existing water quality, habitats and ecological communities is described with a focus on the last five years (2019–2025) for the current state supported with information back to 2000.

4.1 Overview of the Buller Plateaux environment and waterways

The Buller Plateaux, located in the Ngākawau Ecological District, is characterised by high annual rainfall (4,000–6,000 mm), poorly drained, infertile soils, and unique biota. Upland vegetation is primarily low-growing scrub, with areas of tussock, forest and wetland vegetation. The lower slopes of the plateaux are covered with temperate forest. Many streams in the area are naturally acidic (pH 4–6), with flow regimes largely driven by rainfall. This natural acidity results from a combination of geology, mineralogy, and vegetation (Winterbourn and Collier 1987; Hogsden et al. 2020). A recent review of water quality and aquatic ecology in waterways across the Buller Plateaux (Hogsden et al. 2020) reported the following key findings.

Waterways across the Buller Plateaux exhibit a wide pH range (2.5–7.9), with highly acidic conditions (pH <3) in some catchments due to AMD from historic and active mining (see Section 1.2.1). These streams often have elevated conductivity and dissolved metals (e.g., aluminium, Al; iron, Fe; nickel, Ni; zinc, Zn), with median Al concentrations exceeding water quality guidelines[5] in mining-affected waterways across the Buller Plateaux. Naturally acidic streams also show elevated levels of dissolved metals (typically slightly elevated) and organic carbon (>10 mg/L), with some streams reaching pH 3–4 due to organic acid flushes following rainfall events. Given the high annual rainfall and frequent rain days, regardless of the season, dilution and flushes of contaminants are important processes influencing water quality across the Buller Plateaux[6].

Stream flows on the Buller Plateaux are highly variable, with frequent flood events and a flashy hydrology due to low soil infiltration and impervious bedrock. Some headwater streams are ephemeral or intermittent, particularly in dry periods. Water clarity in streams and rivers across the Buller Plateaux is generally high, with median turbidity and TSS values below guidelines[5] in most catchments. High turbidity peaks typically follow flood events. Heavy rainfall can rapidly alter water chemistry, diluting AMD inputs and affecting stream conditions.

Diverse bryophyte and macroinvertebrate communities are found in many waterways across the Buller Plateaux. Bryophytes are slow-growing and can establish dense communities, particularly under low light conditions or on stable substrates. Naturally acidic and circumneutral streams support more abundant and diverse communities than highly acidic (pH <3) waterways, with several taxa widespread in streams across a wide pH range. K[redacted]

Fish are typically absent from upper catchment streams on the Buller Plateaux, likely due to elevation and physical barriers that prevent migration to suitable habitats in upper reaches

[5] ANZECC 2000; CCME 2003; noting the derivation and application of these guidelines is more limited to circumneutral streams.
[6] Variability in background water quality conditions during rainfall events is described in more detail in Hickey (2026a).

4.2 Whareatea River catchment

The Whareatea River flows down from the Denniston Plateau and into the Tasman Sea. The aquatic values of Whareatea River catchment are represented by data collected between 2019 and 2025 from 23 stream survey sites, including 14 located within or adjacent to the existing Escarpment Mine footprint (Table 4-1, Figure 4-2). Seven sites are in the Rapid Stream sub-catchment. Rapid Stream flows into the Whareatea River close to the Tasman Sea. Water quality in Rapid Stream is impacted by historic AMD from Sullivans Mine/Old Sullivan North workings. These seven sites were surveyed in 2019 and/ or 2020 and include sites upstream and downstream of the Sullivans Mine adit (Table 4-1, Figure 4-2).

The Whareatea catchment has been divided into upper, mid- and lower[7] sections for the purposes of this report. Upper refers to streams located upstream of the confluence of the Whareatea River with Conglomerate Stream and lower refers to the lowland reaches from ~700 m upstream of SH67 to the sea; the mid-section is between the upper and lower.

[redacted]

4.2.1 Water quality and habitat

Upper catchment

Streams in the upper Whareatea River catchment are naturally acidic, exhibiting low pH (generally in the 4.0–5.0 range) and low conductivity (often <30 µS/cm). The water chemistry of these streams reflects the Buller Plateaux's geologic setting – many headwater streams drain coal measure strata and organic-rich soils that leach acids but little ionic material resulting soft, poorly-buffered waters. For example, Trent Stream has pH ~4.5 and conductivity ranging from 20 to 30 µS/cm. Trent Stream and other headwater tributaries (e.g., S Creek, V40 Stream) also have slightly elevated metals (e.g., dissolved Al, 0.5–1 mg/L) which are derived from natural sources (Watson et al. 2024c). These headwater streams have clear water (low turbidity) with high dissolved organic carbon (DOC) from soils and leached tannins, often giving stream waters a tea-coloured appearance.

The physical habitat conditions of streams in the Whareatea catchment are generally diverse and high-quality, especially in the upper reaches. The headwater streams flow through steep, incised valleys covered in native forest. Channels are typically small (1.5–4 m wide) and shallow (0.05–0.2 m deep on average during baseflows), with gradients that produce step-pool and cascade morphologies (Alexander et al. 2024). Flow can be intermittent or ephemeral in some headwater tributaries and may only have surface flow following rainfall events or during wet periods, so may not provide permanent habitat for some macroinvertebrates that depend on flowing water.

Mid catchment

In parts of the mid-catchment, there have been historical coal mines/workings and downstream of these the water quality is severely degraded by AMD. The most significant example in the Whareatea catchment is Rapid Stream, which receives discharge from the historic Sullivan Mine adit. Immediately below the adit, the water in Rapid Stream is highly acidic (pH ~3.3) and carries an extremely high dissolved ionic load (conductivity ranging from 500 to 700 µS/cm; Hogsden et al. 2020). These values contrast markedly with the unimpacted waters upstream of the adit, with a pH between 4–5 (varies with flow) and a conductivity of ~25 µS/cm. At the Sullivan Mine adit, dissolved Al is ~5.5 mg/L, Ni ~0.04 mg/L and Zn ~0.21 mg/L, all of which exceed the 95% species protection trigger values from ANZECC (2000) guidelines. The stream bed is coated in orange iron hydroxides through this reach.

Riparian cover in the mid-catchment is intact and dense with streams bordered by wet temperate rainforest, including podocarp-hardwood trees, tree ferns, and a dense understory of native vegetation. Both the mainstem and tributaries feature waterfalls and chutes due to the steep topography, which acts to create deep pool habitats and boulder cascades, particularly in the mainstem.

Lower catchment

As mining-impacted waters flow downstream in Rapid Stream into the lower catchment, they mix with naturally acidic and circumneutral water from tributaries. Dilution by tributaries and natural buffering processes (e.g., reaction of AMD with higher pH waters) causes pH to increase and metal concentrations to decrease with distance from AMD sources. In Rapid Stream at

State Highway 67 (SH67), pH increases to ~5.2 and conductivity drops to <100 µS/cm, prior to entering the Whareatea River.

Where the Whareatea River flows under SH67, the water is near-neutral (pH ~ 6.4 to 7.1) and conductivity is low. The lower Whareatea catchment is defined by broadening of the stream channel as the gradient lessens. The morphology transitions to riffle-run sequences with occasional pools and the substrates are dominated by gravels and cobbles, although still interspersed with large rocks.

Representative stream habitats from survey sites in the upper, mid and lower Whareatea catchment are shown in Figure 4-3.

4.2.2 Plants

Periphyton

Periphyton cover was very low (<4%) at two sites on headwater tributaries (V40 and V70 Streams) and absent from other 12 sites located upstream of the Whareatea River upper site (Figure 4-4). Periphyton cover comprised thin films and short green filaments, where present. Consistent with low cover, periphyton biomass was also very low (chlorophyll *a* range: 0.1–1.3 mg/m^2).

High cover (up to 80%) of periphyton was reported in Rapid Stream sites downstream of the adit and primarily comprised thin films, medium mats and filaments (Figure 4-4). Proliferations of acid-tolerant filamentous green algae are known from directly downstream of the Sullivans Mine adit (Figure 4-5). Periphyton also dominated the stream bed in the lower Whareatea River, with high cover (80%) comprised primarily of thin film, mats and filamentous algae; biomass was low (chlorophyll *a* 4.4 mg/m^2).

Figure 4-5: Proliferation of filamentous green algae *Klebsormdium acidophilum* below the adit at Sullivans Mine in 2009. (Photo: K. Hogsden).

Bryophytes

Bryophyte surveys in the catchment were undertaken by Glenny (2009) who describes a site in the Whareatea River (located downstream of the confluence with V40 Stream) as having "excellent liverwort habitat of the type found in the Mangatini Stream gorge" [in the Ngākawau River catchment on the Buller Plateaux]. Jellyman and Stark (2013) considered that the species-rich bryophyte communities on the Buller Plateaux were indicative of streams with stable substrates and permanent (or near permanent) flow. Bryophytes thrive in low light conditions, such as the steep-sided gullies of Conglomerate Stream as well as small streams with high vegetation cover (e.g., Trent Stream).

The more spatially extensive surveys undertaken for the BPCP found that bryophytes are present and common in many streams, with cover ranging from 5 to 80% across sites (Figure 4-4). Bryophytes were dominant (>50% cover) at four sites (Trent A, S2, Upper and Lower Conglomerate) all of which had riparian vegetation that provided low light conditions (Figure 4-4). In the Rapid Stream sites, cover ranged from 5% to 40% and was lowest in the site below the adit at Sullivans Mine. The cover range is consistent with previous monitoring and assessments undertaken for the streams in the existing Escarpment Mine area (Jellyman and Stark 2013).

[redacted]

- [redacted]
- [redacted]

All other bryophyte species identified with a conservation status (19) were listed as "Not Threatened". The remaining five bryophytes were not listed.

[redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]

4.2.3 Macroinvertebrates and kōura

Macroinvertebrates

[redacted]

Taxa richness ranged from 9 to 43, with the lowest richness in Rapid Creek downstream of the adit at Sullivans Mine and the highest in Sandstone Stream (a lower catchment tributary of Rapid Creek) (Table 4-2). EPT richness ranged from 2 to 14 and %EPT taxa ranged from 9 to 95% across all sites. [redacted] However, high abundances of low-scoring chironomids resulted in many sites classified as fair to poor based on QMCI (Table 4-2).

The AMDI identified two sites as severely impacted – Rapid Stream downstream adit and Rapid Stream upstream Sandstone Stream – both of which receive historic AMD inputs from the adit. Two sites in S Creek were identified as 'impacted' by the AMDI in the 2024 survey. However, these two sites were likely misclassified due to low overall macroinvertebrate richness and

[redacted]

because of poor/limited substrate and low to non-existent flows at the time of sampling and are considered unimpacted by AMD based on water quality (Watson et al. 2024c).

[redacted]

[redacted]

[redacted]

All other macroinvertebrates identified to species level at surveyed sites are listed as "Not Threatened" or are not listed in the current conservation status report (Grainger et al. 2018). [redacted]ght.

Kōura

[redacted]

[redacted].

4.2.4 Fish

No fish were found at sites on the mid or upper catchment sites during surveys in 2020 and 2024. Fish are typically known to be absent from streams on the Denniston Plateau, which is likely due to elevation and physical barriers preventing migration to suitable habitats in the mid to upper catchment (Hogsden et al. 2020). [redacted]

[redacted]

[redacted]

[redacted]	[redacted]	[redacted]
[redacted]		
	[redacted]	
	[redacted]	
	[redacted]	

[redacted]

[redacted] [redacted]

[redacted]

4.3.1 Water quality and habitat

Upper catchment

Water quality in the upper catchment headwater tributaries of the Waimangaroa River and Deep Stream is characterised by acidic to circumneutral conditions, with stream pH ranging from 4.0 to 7.7. Higher pH values (>6.5) are typically found in eastern tributaries of the Waimangaroa draining granite and paragneiss geology, while western tributaries on quartz sandstone bedrock exhibit more acidic conditions (Suren and Glenny 2003). Natural acidity arises from the underlying geology and vegetation. Conductivity is consistently low (16–98 µS/cm) and dissolved aluminium concentrations exceed trigger levels for the 95% protection of species[11] in most tributary sites, which is typical on the Buller Plateaux (Hogsden et al. 2020). Other dissolved metals, such as Fe, Ni and Zn are below trigger levels. High dissolved oxygen levels (>96% or >7 mg/L) indicate conditions are suitable to support aquatic life, and turbidity is generally low to moderate (most sites <2 NTU, up to 5 NTU) at baseflows.

The tributary streams are typically small and narrow (0.7–3.0 m wide), with diverse substrates ranging from sand and coarse gravels (e.g., Mt Fred A and Mt Fred B) to large cobbles and boulders (e.g., Byrne Creek) to bedrock (e.g., Billo Stream). Riparian vegetation cover is high and comprises primarily native bush, including podocarp forest, manuka and ferns, which contributes to well-shaded habitats (Figure 4-8). One site in the Deep Stream catchment (Mt Fred A) is located on an area of exposed sandstone pavement (Figure 4-9). Sandstone pavement is considered a “Nationally Uncommon” and “Endangered” ecosystem (Holdaway et al. 2012). This site has an open canopy and is surrounded by manuka scrub. Stream habitat was diverse and included riffles, runs and pools across the sites. Old mine shafts are present in the headwaters of Mt Fred B.

Water quality in the mainstem of the upper Waimangaroa River is acidic (pH 4.5–5.5) with relatively low conductivity (<100 µS/cm) and elevated aluminium. The upper Waimangaroa drains naturally acidic tributaries (as described above) and mine-affected tributaries (e.g., Herbert and Whirlwind Streams) which contain AMD from Stockton and historic sources. Conductivity and dissolved metals can be elevated in mainstem sites downstream of mine-affected tributaries. No mine-affected water enters the Waimangaroa catchment from Cypress Mine[12]. The mainstem of the river is wider than the tributaries and has an open canopy (i.e., receives more light), with riparian vegetation common. Substrate ranges from cobbles to large boulders.

Lower catchment

In the lower reaches of the Waimangaroa River (at SH67) the water is slightly acidic (6.2) with very low conductivity (6 µS/cm). Dissolved Al exceeds the trigger level for the 95% protection of species but other metals are below trigger thresholds. Turbidity can be moderately high (7 NTU) and even higher during high flow events.

Representative habitats in the upper catchment tributaries, in the Deep Stream sub-catchment and in the mainstem of the Waimangaroa River are shown in Figure 4-8, Figure 4-9, and Figure 4-10, respectively.

[11] CCME (2003) and ANZECC (2000) guidelines
[12] Mine impacted water from Cypress Mine is directed into St Patricks Stream in the Ngākawau catchment.

[redacted]

4.3.2 Plants

Periphyton

Periphyton cover was low to moderately high (<10 to 43%) across tributary sites and absent from some small, shaded sites in the Deep Stream sub-catchment (Figure 4-11). Periphyton cover was typically higher in upper Waimangaroa mainstem sites (40 to 51%) which likely reflects greater light availability at the wider river site. Cover is also likely more variable at the mainstem sites, which receive higher flows that would remove periphyton. Periphyton cover can also be high (75%) in the lowland reaches of the mainstem which also likely reflects greater light availability at the wider river site (Figure 4-11). The periphyton comprised primarily thin films and medium mats, with low cover of filaments occasionally present. Periphyton biomass was generally low (< 5 mg/m^2) across all tributary and upper and lower mainstem sites.

Bryophytes

Bryophyte cover of the streambed ranged from 6 to 80% across 15 tributary sites (with data; Figure 4-11). Bryophytes were dominant (>60% cover) at two sites (Billo Stream and Billo Tributary), with riparian vegetation that provides shade under which bryophytes can thrive. Lower bryophyte cover (<30%) was observed at nearby tributary sites in the Deep Stream catchment (Mt Fred A, B, C and D), which are also smaller streams but have poor substrates (i.e., loose gravels) and light conditions (i.e., open canopy) that are less suitable for bryophytes (Figure 4-11). Bryophyte cover in some (shaded) upper catchment tributaries (Top Creek, Gomorrah Stream, Hut Stream) and in the Waimangaroa River mainstem sites was moderate (20–50%). Bryophyte cover was low (6–10%) in three upper catchment tributaries (Cedar Creek, Ernest Stream and Byrne Stream). Low and patchy bryophytes cover at Cedar Creek recorded in 2025 is consistent with an earlier survey at this site in 2003 (<4% cover, Suren and Glenny 2003). Low bryophyte cover in these streams may partially be due to circumneutral stream pH as other habitat conditions are suitable (Rose and Hogsden 2025), noting that pH in Gomorrah Creek and Top Creek is also circumneutral.

A total of 86 bryophytes were recorded across 10 tributary and 5 upper mainstem sites from 2019 to 2025, including 70 liverworts, 15 mosses and one hornwort. Common taxa across the sites included the liverworts *Chiloscyphus austrigenus* ssp *okaritanus*, *Cryptochila grandiflora, Pachyglossa tenacifolia*, *Isotachis montana*, *Riccardia crassa* and the mosses *Blinida lewinskyae* and *B. robustus*. Bryophyte richness ranged from 4 to 26 across the sites, with the lowest and highest richness both recorded in Waimanagaroa River mainstem sites (WRBBC and

4.3.4 Fish

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4.3.5 Summary

Water quality and habitat: The Waimangaroa River headwaters are characteristically acidic to circumneutral, low-conductivity streams draining the Denniston Plateau. Stream pH in upper tributaries ranges from about 4.0 up to 7.7, reflecting differences in underlying geology: western tributaries on quartz sandstone are more acidic (pH <5), while eastern tributaries on granite/paragneiss reach near-neutral pH (>6.5). Conductivity is consistently low, and dissolved Al is naturally elevated above guideline levels in most upland sites (a common feature of Buller Plateaux streams), whereas other dissolved metals (e.g., Fe, Ni, Zn) generally remain below toxicity guideline triggers. Headwater streams are small (0.5–3 m wide), flowing through steep

[17] Middle reaches are downstream of Burnetts Stream (Harding et al. 2006). Burnetts Stream is a tributary that flows into the Waimangaroa River just downstream of the Waimangaroa d/s Deep Stream survey site.

native forest gullies and scrub. Substrates are diverse, from sand and gravel beds to cobble/boulder runs and occasional bedrock sections. Dense riparian vegetation (podocarp forest, manuka, ferns) provides substantial shading and woody debris inputs, with generally high-quality habitat with riffle–run–pool sequences at most sites. One site in the Deep Stream sub-catchment (Mt Fred A) is located on an area of exposed sandstone pavement with an open canopy and manuka scrub vegetation. Old mine workings exist in parts of the sub-catchment (e.g., historic adits near Mt Fred and Burnett Stream, see Figure 4-9), but no active mining discharges enter these streams. Water quality in the mainstem of the upper Waimangaroa drains naturally acidic, circumneutral and mine-affected tributaries (from Stockton) resulting in elevated conductivity and metals at times. In the lower Waimangaroa River, pH increases, although remains still slightly acidic (pH ~6.2), and conductivity of the water can be very low (~6 μS/cm). The mainstem of the river is wider and receives more light with riparian vegetation common. Overall, water quality and habitat in the catchment ranges from near-pristine naturally acidic headwaters with diverse substrates and shaded channels to some waterways moderately impacted by historic AMD.

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[redacted]

4.4.1 Water quality and habitat

Across the ten sites, stream water pH ranged from acidic to circumneutral (pH 4.1 to 7.5), reflecting a gradient of increasing pH along the mainstem of Cascade Creek—from the most upstream site (Upper Cascade Creek) to the most downstream site (Cascade Creek d/s Rochfort Creek). This gradient is influenced by circumneutral tributary inflows from V8, V37, and Rochfort creeks (pH >6.5). Similarly, conductivity (92–279 µS/cm) and concentrations of dissolved metals of concern (Al, Fe, Cu, Zn) declined downstream in Cascade Creek. For example, Al concentrations dropped from 6.5 mg/L at the uppermost site (Upper Cascade Creek) to 0.05 mg/L downstream (Cascade Creek d/s Rochfort Creek). V37 Creek exhibits water quality similar to treated mine water (i.e., characterised by circumneutral pH and elevated calcium levels) despite receiving untreated discharge from the historic Escarpment Mine adit. This may be due to natural runoff or the presence of acid-neutralising materials in the streambed.

Dissolved Al concentrations exceeded the trigger levels for the protection of freshwater species in four mainstream sites[18], from upstream of the mine site (Upper Cascade Creek) to 2 km downstream of the confluence with V37 Creek. Trigger values for Cu, Ni and Zn were also exceeded at some of the mainstem sites (Hogsden et al. 2025). However, no metal exceedances were recorded just upstream of Rochfort Creek or in any of the tributaries. Dissolved oxygen levels were consistently high (>9 mg/L), indicating stream conditions supportive of aquatic life.

Habitat composition varied across sites but was predominantly riffles and runs (Figure 4-14). Substrate was mainly cobbles and gravels, with sand cover low at all sites. Metal flocs and precipitates were observed at four mainstem sites: iron floc and sludge at the two most upstream sites (Upper Cascade Creek and downstream of V8 Creek), and aluminium floc and precipitates at two sites downstream of the V37 Creek confluence (Figure 4-15). The presence of metal flocs and precipitates reflect changes in stream water pH, as the solubility of metal hydroxides is exceeded at different pH levels.

[18] Species protection levels were set based on narrative descriptors for ANZG (2018) with the two uppermost sites (Upper Cascade Creek and Cascade Creek d/s V8 Creek) identified as highly disturbed; 80%, Upper Cascade Creek; 90%, Cascade Creek d/s V8 Creek); 95% Cascade Creek d/s V37 Creek and Cascade Creek 2km d/s V37 Creek. Guideline values (GVs) for Al based on Hickey (2012) and others (Cu, Fe, Ni, Mn, Zn) based on Hickey (2026a), which were derived following ANZG (2018) and ANZECC (2000) to include site-specific toxicity modifying factors (pH, DOC, hardness).

[redacted]

[redacted]

4.4.2 Plants

Periphyton

Periphyton were typically absent, but where present (e.g., Cascade Creek u/s V37 Creek, V37 Creek, Cascade Creek d/s Rochfort Creek), cover was low to moderate (≤15%) and comprised of films. Biomass (as chlorophyll *a*) is also low, ranging from 0.7 to 3.6 mg/m^2.

Bryophytes

Bryophytes were the dominant plant present at three sites (Upper Cascade Creek, Cascade Creek d/s V8 Creek, and Rochfort Creek) and were absent from two sites (Cascade Creek u/s V37, V37 Creek). These differences likely reflect site-specific differences in canopy cover (i.e., light availability) and substrate suitability. Antecedent flow conditions (i.e., floods) may also reduce bryophyte cover.

Identification of bryophytes from samples collected at two sites in 2024 indicate that one moss species was present at Cascade Creek (*Polytrichadelphus magellanicus*). This species is not of conservation concern.

[redacted]

[redacted].

[redacted]

AMDI scores shown in Table 4-10 identified four sites in the Cascade Creek catchment as severely impacted (Upper Cascade Creek, V8 Creek, upstream and 2 km downstream of V37 Creek), and two as impacted (Cascade Creek downstream of V8 and V37 Creeks). V37 Creek was near the impacted/unimpacted threshold in 2024 but classified as unimpacted in 2025, with water chemistry suggesting no mine drainage influence. Three other sites were unimpacted: two mainstem sites over 2 km downstream of V37 Creek and Rochfort Creek (tributary).

[redacted]

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[redacted]

[redacted]nditions due to receiving AMD-affected water from historic underground mine discharges.

4.4.5 Summary

Water quality and habitat: The headwaters of Cascade Creek are heavily affected by historic AMD, resulting in very low pH (~4.1) and elevated dissolved metals (especially Al and Fe). In the affected headwater reaches, stream habitat is degraded by the metal deposits – cobbles, gravels and woody debris are smothered in iron/aluminium hydroxides, reducing substrate for aquatic life. Water quality improves progressively downstream as small, circumneutral tributaries dilute the mainstem, raising the pH to ~7.5 by the lower reaches. Below Rochfort Creek (a circumneutral, unimpacted tributary), Al and other dissolved metals are largely within acceptable levels and no longer forming precipitates. In these lower reaches, Cascade Creek flows through intact forest with riffle–run habitats over clean gravel and cobble beds.

Plants: Aquatic plant life in Cascade Creek is sparse, likely reflecting acidic headwaters and frequent high flows. Periphyton cover was low at most sites with virtually no visible periphyton in the upper acidic reaches in 2025. As water quality improves downstream, periphyton cover

[19] There is an NZFFD record from 1989 that captured: longfin eel, redfin bully, bluegill bully, common bully and torrentfish.

increases somewhat, but remains patchy. Bryophytes were the dominant cover at some sites. From the limited surveys to date, no rare or threatened bryophyte species have been recorded in this catchment.

[redacted]

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[redacted]	[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

5 Assessment of effects of the BPCP

This assessment of effects of the BPCP on aquatic habitat, water quality and ecology (specifically bryophytes, periphyton, macroinvertebrates, kōura and fish) are provided for catchments described in Section 4. For the purposes of this assessment, the Project footprint includes the total disturbance area associated with each sub-area under consideration. This includes elements such as infrastructure areas, water management structures, roads, pit shells and ex-pits[20] as described fully in the Application.

The assessment examines the effects of the Project for the MFS, ESE and UWHR sub-areas for the following phases: (1) construction, (2) operation and (3) closure. It is structured to provide a staged evaluation of potential impacts on aquatic habitats and ecology. An initial overview of the potential environmental effects of the Project relevant to these values is presented in Table 5-1, which is organised by phase and illustrates how effects may vary over time. The general effects identified Table 5-1 are then considered in greater detail in Sections 5.1 and 5.2, which describe the potential effects, proposed management measures, and the resulting residual effects for the construction and operational phases. The closure phase assessment focuses on management measures required to meet closure conditions and criteria (Section 5.3).

The assessment of effects is presented for before and after management measures have been applied. Effect magnitude was classified as either: Negligible (Very low), Less than minor (Low), Minor (Moderate), More than minor (High), or Significant (Very High). Effect magnitude is assessed by catchment and is further differentiated by mainstem rivers and tributaries. This distinction is made because the larger flows in mainstem rivers often reduce effect magnitude, whereas similar effects can have greater impacts in smaller waterways. For some effects, specific waterways are identified where relevant.

Residual effects are determined by evaluating the significance of potential effects after the proposed avoidance, mitigation, remediation measures have been applied. This process involves first identifying the nature, scale, duration, frequency, and reversibility of the unmitigated effects, and then reassessing these characteristics once the effects management measures are in place. Effects that cannot be fully avoided or mitigated are classified as residual effects. Their significance is assessed with reference to relevant ecological values, sensitivity of the receiving environment, and professional judgement, while taking account of uncertainty and the expected effectiveness of proposed management measures.

The ecological values assessed for waterways in the Whareatea River (Section 4.2.5), Waimangaroa River (Section 4.3.5) and Cascade Creek (Section 4.4.5) catchments informed this assessment. Naturally acidic streams on the Buller Plateaux are considered to have ecological and natural character values as a unique environment. That noted, streams outside of the current Project area are expected to have similar natural water quality and clarity, as well as similar taxa and intrinsic ecological values in terms of aquatic communities (i.e., bryophytes, macroinvertebrates, kōura and fish (where present)). It is uncommon in the South Island for headwater streams this close to the coast to be fishless (a feature driven by topography), therefore, there are limited examples of streams where kōura are the top trophic level.

[20] Pit shells show the planned limits of open-cast mining, while ex-pits are parts of those pits where mining has finished and is no longer active.

Residual effects ranked as More than minor or Significant (as shown in Table 5-2 and Table 5-3) have been considered for offsetting and/ or compensation. The assessment of residual effects is based on the expected performance and effectiveness of management actions (including sediment control, water treatment and rehabilitation) as set out for the Project in expert reports. As some of the actions proposed are at larger scale than previously undertaken in the Buller Plateaux environment, a degree of uncertainty remains despite expectations for scalability; accordingly, this assessment takes a precautionary approach to ensure a conservative analysis.

Climate change mitigation relevant to this assessment

Over the approximate life of the Project, the West Coast region is projected to have a 0.7–1.0°C rise in air temperature and experience more frequent intense rain events (with increased flood risks but little change to drought exposure). In our assessment of effects, we have assumed that mining and water management infrastructure are designed for the effects of climate change. The general assumptions are as follows:

- The **road construction** will have ensured that the upstream side of culverts and bridge structures on haul roads are appropriately sized and fortified to accommodate more frequent high-runoff events, preventing upstream ponding or 'washouts' in extreme storms.
- Water management infrastructure for **sediment and erosion** will have been designed and specified to handle extreme rainfall events to ensure clean runoff can be diverted around the ESE and MFS mine sites and that disturbed runoff is channelled into robust sediment control systems that are appropriately sized for these rainfall volumes. Given the Denniston Plateau is already a high-rainfall environment, heavy downpours would likely overwhelm standard infrastructure and erosion controls prior to explicit climate-change allowances. We have considered that the Project includes measures such as minimising exposed soil, armouring drains, staged earthworks, and enlarged settling ponds to handle future flood flows as outlined (BRL 2026c). Water management infrastructure has been designed with climate change considered and will be reviewed on a 5-yearly basis to allow adaptive updates to design and to incorporate evolving industry best practices for design criteria in response to the predicted changing climate (BRL 2026j).
- The **containment and treatment of AMD** (i.e., prevention of AMD entering waterways) is a key water management principle for the BPCP and central to the mine design. We have been advised that potentially acid-forming (PAF) material encapsulation in engineered landforms (ELFs) will minimise mine waste exposure and that the active water treatment plants plus the passive systems will be appropriately sized to cope with extreme rainfall events (MWM 2026h,i).
- When the Project is **reconstructing/reinstating streams** in the catchment, realigned stream channels will have variable widths and vegetated floodplains incorporated into their design to safely convey and dissipate larger flood flows without extensive bank erosion occurring. Reinstated streams will also incorporate armoured beds and roughened substrates to ensure they withstand more variable flow regimes and climate impacts over time. **Riparian vegetation** would be rapidly re-established (using native vegetation direct transfer (VDT, see Section 5.1.2) where possible and

plantings) along all newly reconstructed channels not only to stabilise banks against intense rainfall events but also to provide shade.

Table 5-1: The potential general effects on aquatic ecology during the construction, operational, and closure phases for the BPCP. These effects are explored in more detail in the following subsections of Section 5. The potential effects are described without management or control measures in place.

Effect category	Construction phase	Operational phase	Closure/Post closure
Habitat alteration & loss	Initial land and vegetation clearing to establish operations and infrastructure (e.g., roads, culverts); clearing activities modify stream channels and instream habitat and could restrict upstream and downstream movement of aquatic fauna.	Ongoing disturbance to habitat as mining progresses; stream diversions and open pits alter stream/river morphology and riparian zones, permanently removing or fragmenting aquatic habitats in places.	Permanent loss of some stream sections; incomplete habitat restoration leaves altered channels. Following rehabilitation, natural stream structure, habitat and connectivity may only partially recover.
Sediment & turbidity	Land clearance and earthworks expose soil resulting in potential for high sediment runoff into waterways. Increased turbidity and sediment deposition degrade water clarity and smother stream beds/habitat.	Soil and vegetation stripping exposes soil. Erosion from waste dumps/pits and haul roads can continue to mobilise sediment into streams (especially during high rainfall) with the potential for fine sediment to accumulate downstream in tributaries and mainstem over time.	If land is poorly rehabilitated, ongoing erosion of waste rock dumps and unrestored surfaces generates sediment for years. Post-closure storms can flush remaining sediment into streams, keeping water clarity low and stream beds clogged with fines.
Chemical contamination (AMD)	Initial exposure of rock and soil can leach metals (e.g., Al, Fe, Zn) and alter pH. AMD risk begins if sulphide-bearing rock is disturbed (e.g., haul road construction), though extensive AMD generation is usually limited until large-scale excavation. Without AMD control measures declines in aquatic communities may occur due to AMD effects of acidity, metal toxicity and habitat degradation.	Active mining produces AMD as rain and air (oxygen) interact with exposed sulfidic rock (overburden). Acidic, metal-rich drainage can seep or discharge into streams. This lowers pH and the metal concentrations often exceed water quality guidelines, harming aquatic life. Treated discharges (often neutralised to pH >7) can alter the chemistry of naturally acidic streams, potentially impacting species adapted to naturally low pH conditions. Without management hydrocarbons (fuels, oils) or nitrates (from explosives) may also contaminate runoff in this phase.	AMD can be a persistent legacy of mining. After closure, rainfall continues to leach acidity and metals from ELFs and exposed pit walls. Without ongoing treatment, toxic seepages can continue for decades, keeping water pH low and metal concentrations high in downstream waters.

Effect category	Construction phase	Operational phase	Closure/Post closure
Flow regime changes	Stream diversions or dewatering during site works can reduce flows in natural channels. Water may be pumped or dammed to keep the site dry, causing some streams to dry up or leading to altered flow variability. Loss of riparian cover and instream structure further alters flow patterns (e.g., faster runoff, less groundwater recharge) and instream habitat availability.	Water abstraction (e.g. for dust suppression) and diversion of streams around pits can lower stream levels. Direct stream diversions or removal will reduce instream habitat and increase the frequency of low-flow (or no flow) conditions in affected reaches. These flow alterations can lead to less dilution of pollutants, elevated water temperatures, changes in sediment transport (e.g., streams carry less gravel and deposit more fines) and markedly alter the aquatic communities that can be present at a site/in a waterway. Altered hydrology may also increase flow in some stream channels (e.g., diverted discharge points), affecting habitat.	Upon closure, flow may partially recover if streams are restored to a similar channel slope/morphology, but often hydrology is permanently altered and affects habitat availability. For example, changes to the underlying bedrock may alter soil permeability and runoff patterns. Flashy runoff from unvegetated post-mine landscapes can cause more erratic flows and bank erosion during storms. Where streams have been rerouted or confined in channels, natural flow patterns (seasonal highs and lows) may not fully re-establish. Baseflows may increase due to ELF seepage and reduced water abstraction activities during closure.

5.1 Construction effects

The construction phase of the Project comprises activities required to establish the site for operational use, including site preparation, earthworks, and the construction of mine infrastructure such as access roads and workshops/facilities. These activities have the potential to adversely affect freshwater ecosystems, particularly through physical modification of streams, rivers, and ponds/tarns, and disturbance of headwater catchments. Construction activities can increase sediment loads in receiving waterways and may alter water quality (e.g., pH), as well as introduce contaminants such as heavy metals (e.g., Al, Cd, Cu, Fe, Ni, and Zn), particularly prior to the full implementation of erosion, sediment, and water quality controls.

Infrastructure development during the construction phase, including haul roads such as the proposed UWHR, may intersect multiple waterways, particularly in headwater areas. The construction of haul roads typically requires the installation of culverts or similar structures, which can modify channel form and flow, and may create barriers to the movement of aquatic organisms, including macroinvertebrates, kōura, and fish (where present). Potential effects in headwater catchments can also propagate downstream, influencing hydrology, water quality, and aquatic ecological values.

5.1.1 Specific construction effects on streams

During mine construction, vegetation clearance, soil stripping, earthworks, and infrastructure development activities have direct physical impacts on waterways. These potential effects of the Project are summarised below:

- [redacted]
- **Road construction**: The road design for the UWHR has continuous cut and fill sections along the 12 km length between the southern limit of the Cypress South pit and the ESE Stockpile and Load Out Area in the Coal Haulage Infrastructure Area. This section has various geology along its length including colluvium/landslide material in the north, a mixture of Brunner Coal Measures (BCM) and Kaiata Mudstones (KMS) through the middle and transitioning into BCM for the southern section. The first 3.2 km of road at the northern end will use inert granite fill (borrow pit-sourced) for road construction but the remaining 8.8 km of road will use BCM cut from road alignment and placed close to its as source as bulk fill for the road. Some of the BCM and KMS materials are assumed to have PAF components. AMD generated from these materials[21] could result in significant water quality issues in downstream receiving waters, if not appropriately managed (MWM 2026b). AMD negatively affects stream communities via direct physiology effects of low pH and high metals and smothering of habitat with precipitates.

[21] The process by which AMD is generated occurs when sulfur-rich minerals like pyrite (iron sulfide) are exposed to oxygen and water, producing sulfuric acid that leaches toxic metals—including iron, aluminium, nickel and zinc—into surrounding waterways.

- **Sediment release:** Construction activities have the potential to greatly elevate sedimentation in waterways if not carefully controlled. With the construction of the UWHR, there will be vegetation clearance and surface cutting (i.e., road building) in the construction/disturbance footprint area resulting in significant quantities of loose earth being exposed. Road fill material (without surface stabilisation) has the potential to continue eroding until soil armouring (by larger particles) occurs. In combination with the high annual rainfall across the Buller Plateaux, this means that the building of the UWHR has been identified as having a high potential for sediment release to receiving waterways (MWM 2026b). Without proper management, high rainfall on exposed loose earth can quickly turn streams turbid as these waterways gain and transport high suspended sediment loads. This drop in water clarity, reduces light penetration needed for plant growth and affects visual feeding by aquatic fauna (although the headwaters are fishless these water clarity impacts can be transported downstream to lower catchment reaches where fish are present). Excess sediment in streams fills pools, creates unnaturally silty streambeds and reduces habitat complexity as fine sediment covers coarse streambed substrates. Fine sediment also clogs the gills of macroinvertebrates (and fish) and can abrade or smother periphyton on which macroinvertebrates feed. As flow/velocities decrease this material can come out of suspension and deposit on the stream bed, reducing interstitial spaces where macroinvertebrates live and lay eggs. Overall, without control measures in place, excessive sediment generated in the construction phase that enters a stream can immediately degrade aquatic habitat quality and initiate a decline in sensitive species.

- **Changes to water quality:** Early in construction, the chemical water quality effects are typically less pronounced than during mining operations. If any excavation activities in the construction phases reaches PAF rocks or coal seams, runoff water that is not captured and treated can become more acidic and carry dissolved metals. (e.g., Al, Fe, Ni, Zn) into streams, potentially exceeding natural background levels. Some of the BCM materials used for backfill of the UWHR are assumed to have PAF components, which may generate AMD (as noted above), whereas the road base (surface) will be non-acid forming (NAF)/granite. Additionally, construction involves use of concrete (which is alkaline when wet), fuels, and other chemicals. Accidental spills of diesel, oil, or concrete/cement washings can cause localised contamination (e.g., oil films on water or caustic pH spikes) and pose a risk to waterways in the Project sub-areas (Taylor & Tonkin 2026). While typically infrequent, such incidents can be toxic for aquatic organisms particularly in small streams.

- **Stream diversion and in-stream works:** To enable dry working areas, or altering areas for Project infrastructure, temporary diversions will occur in the construction phase for some streams. For example, small streams might be channelled through pipes or diversion channels. This alters flow regimes and some sections downstream of the construction may experience reduced flow or even dry out if water is bypassed. Conversely, if an area is being dewatered (e.g., by pumping), the collected water might be released at a different volume elsewhere, causing unnatural high flows at times. Flow disruptions can strand aquatic life or force it to drift/relocate farther downstream. Aquatic organisms adapted to certain flow conditions ([redacted]) may be lost if those conditions disappear because of a diversion.

  Road construction in the rugged terrain of the Denniston Plateau will require installation of new culverts (60) to enable the construction of the UWHR and other access roads (noting some existing culverts will be replaced as part of road construction). Culverts typically concentrate stream flow into a smaller cross-section than the natural stream so during floods, water can back up at the culvert inlet, creating an upstream ponding effect, and then exit the pipe outlet at high velocity. On the Denniston Plateau where high-intensity rain is common, it will be critical that culverts are properly sized to ensure they do not cause upstream flooding or result in high pressure scouring of the streambed below the culvert outlet.

- [redacted]

  The construction of a road across a stream creates a physical blockage across the stream corridor, with aquatic insects also impacted. Many aquatic insects have a winged adult life stage and migrate along the river corridor and a road can split what was once a continuous aquatic habitat into two isolated segment(s). Large culvert pipes can also be a high mortality zone for winged insects as spiders cue into this new migration corridor with extensive webs. Given the low traffic volume, and limited night-time work, the UWHR is expected to be a negligible barrier for adult insects.

- **Noise, vibration, and light disturbances:** Heavy construction noise (machinery and truck traffic) and blasting vibration are not typically major direct stressors to aquatic ecology although they can affect the behaviour of some aquatic fauna. If explosives are used near water, ground and water vibrations can damage stream banks and disturb substrates potentially dislodging benthic organisms or increasing sediment mobilisation.

  Artificial lighting at night disrupts the natural light-dark patterns of ecosystems and documented effects of artificial light on freshwater ecosystems include impacts on plant growth and composition as well as diverse changes to movement and behaviour patterns of fish and macroinvertebrates (e.g., Greenwood 2024). Light is an attractant for adult aquatic (and terrestrial) winged insects and may also disrupt nocturnal behaviours of aquatic organisms, such as migration and feeding patterns, if the lighting is located close to a waterway.

In summary, the construction phase has the potential to be characterised by immediate physical impacts: sedimentation and habitat alteration that occur on a short timescale. Streams adjacent to construction activities in the ESE, MFS, and UWHR sub-areas may experience declines in water clarity and habitat complexity from sediment inputs or water quality due to exposure of PAF materials/AMD generation. Whilst thorough environmental management during construction is required (e.g., sediment control), even with precautions, short-term and temporary degradation of water quality and in-stream habitat can occur during this establishment phase. The priority is to limit the extent of these effects during the construction phase because some of the infrastructure being installed (i.e., proper drainage and water treatment systems) is to ensure that when mining operations are underway, the appropriate treatment systems have been setup to reduce the potential effects that arise during the active mining/ operations phase.

5.1.2 Construction effects management

During construction activities, management measures will be in place to minimise effects on aquatic habitats in the ESE, MFS, and UWHR sub-areas.

- **Aquatic habitat alteration:** The Project requires landform change and some stream alteration during the construction phase. Reducing the numbers and lengths of streams impacted as well as the duration of impacts are priorities, with avoidance measures taken wherever possible during mine design and development. The landscape clearance will involve VDT, a process used — where practicable — to translocate vegetation and habitats as intact sods[22]. It is not clear at this stage the extent to which VDT will be used along stream banks, but it would be highly beneficial for later stream rehabilitation and reinstated streams if mature riparian vegetation could be used for reconstructed streams (BRL 2026b).

- **Road construction** and **sediment release:** To manage road construction and sediment release effects an erosion and sediment control plan will be implemented to prevent and minimise sediment discharges to streams (BRL 2026c). This will involve clean runoff diverted around work areas, exposed soils kept to a minimum, and use of sediment retention devices to capture surface runoff (e.g., ponds, silt fences). A range of practical steps can reduce sediment release into streams. These steps include timing particular works in drier seasons to reduce runoff/erosion, stabilising exposed soils quickly (e.g., hydroseeding road cuts) and constructing frequent cross-drains that disperse water onto vegetated ground. A combination of channel designs, silt fences, sediment ponds, stabilisation and revegetation techniques and staged earthworks as well as inspection and maintenance regimes will be implemented to mitigate sediment risks for the Project (as detailed in BRL 2026c). The sediment mitigation strategy has considered the high intensity rainfall events that occur in this area, noting that heavy rainfall can overwhelm such measures, at times, resulting in the potential for episodic high sediment loads in waterways. The UWHR will be constructed at multiple points simultaneously, therefore there will be multiple potential discharge points to receiving waterways, for which effects which will be monitored during construction with adaptive management applied.

- **Changes to water quality:** Best-practice protocols to prevent water quality contamination (for example, refuelling and chemical use kept well away from waterways, and on-site spill containment measures) will be followed (Tonkin & Taylor 2026). The mine plan assumes all PAF rock will be handled and treated to protect aquatic life (guidelines set out in Hickey 2026a) so PAF materials (e.g., in pits and waste rock areas; in fill under roads) will be carefully managed (e.g., encapsulated with alkaline material in ELFs, covered in geosynthetic clay liners (GCLs) on bulk fill under roads; MWM 2026e, BRL 2026d) to minimize AMD formation and seepage. Any acidity generated during construction of the infrastructure pads at ESE (near the existing mine site) and MFS at the bottom of the MFS haul road (adjacent to the Waimangaroa River), will be managed with portable treatment

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[redacted]

systems and localised AMD sludge management (MWM 2026e, BRL2026d). Monitoring will be undertaken to identify any water quality issues arising from AMD, which will be adaptively managed.

- [redacted]
- [redacted]
- **Noise, vibration and light disturbance**: To the extent practicable, the use of heavy machinery and any blasting activity during the construction phase should be minimised near streams not being altered or removed. Light disturbance should be actively managed to minimise adverse effects, using recognised standards and plan provisions that address the impacts of artificial lighting on wildlife and natural character (BRL 2026f). The proposed Buller District Plan—including the Te Tai o Poutini Plan—provides region specific policies and rules to reduce artificial light impacts on the West Coast. In general, the impacts of light at night can be reduced by having lights on only when necessary, at the lowest safe illumination and at a maximal distance from waterways. Where possible lights should be directed away from waterways or screened to not directly illuminate the water surface. Short wavelength light (e.g., ultraviolet or blue light) penetrates water further than longer wavelengths (e.g., orange or red) and has been linked with many ecological effects. Using

lights with limited blue light (warmer colours and lower Kelvin temperature colour ratings) are recommended and required under the proposed District Plan.

Together, these management measures will help to mitigate the potential construction phase effects on streams – including sedimentation, habitat alteration, water quality and habitat connectivity disruption – as far as is practicable. Project-specific water quality guidelines have been set for the protection of macroinvertebrates and fish communities and provide a range of levels of protection (Hickey 2026a).

5.1.3 Assessment of construction effects

Following recommended effects management measures, effects associated with aquatic habitat alteration, road construction, stream diversion and in-stream works, potential passage barriers for aquatic fauna, and noise, light and vibration disturbance during construction are expected to be minor or less than minor (Table 5-2). Residual effects associated with construction activities that may generate and discharge sediment and AMD contaminants to waterways are assessed as more than minor (Table 5-2), however these effects may be reduced to minor if successfully managed. The risk of sediment release remains high during the construction phase, even with controls in place, due to extent (length) and duration of works and likelihood of heavy rainfall events. Sediment discharges and water quality changes will therefore be actively monitored and adaptively managed during the construction phase to meet performance objectives and water quality guidelines.

[redacted].

5.2 Operational effects

The operational phase of the Project involves the extraction of coking coal and associated mining activities undertaken over the life of the mine. These activities include vegetation clearance and soil stripping, blasting, the use of temporary pit and overburden disposal areas, construction and filling of ELFs, mine water management and treatment (including discharge and by-pass events), and progressive rehabilitation.

During operations, mining activities will modify landforms and can disrupt or divert the natural flow paths of streams and rivers, alter channel morphology, and remove riparian vegetation (see Table 5-1). If not appropriately managed, these changes can increase soil and bank erosion, leading to elevated sediment and contaminant inputs to receiving waters. In addition, leachate from mine areas, including ELFs and coal stockpiles, has the potential to alter water chemistry and adversely affect aquatic life.

The combination of these effects can result in changes to stream and riverbed structure, reduced habitat availability, degraded water quality, and a decline in the diversity and abundance of aquatic fauna. The operational phase is expected to continue for the duration of mining activities (indicatively up to 16 years across the ESE, MFS, and UWHR sub-areas) and therefore requires ongoing and effective management and controls to manage adverse and cumulative effects on aquatic ecosystems that could otherwise be severe.

5.2.1 Specific operational effects on streams

During the operations phase, impacts on fresh water can become more widespread. Key potential impact pathways during this phase include:

- **Stream habitat removal**: The footprint of the proposed Project (Figure 2-2) contains several existing headwater streams as outlined in Section 4. Operational activities will unavoidably remove ~17.1 km of headwater streams over time within the Waimangaroa and Whareatea catchments; this comprises 3.6 km of stream in the MFS sub-area and 13.5 km in the ESE sub-area. Mining activities will remove their channel structure entirely. This will eliminate the aquatic habitat in those headwater streams and cut off the flow that would feed downstream environments. The loss of headwater streams is significant because these streams typically contribute clean, cool water as well as organic matter and aquatic insects downstream. [redacted]

[redacted]

- [redacted]
- [redacted]

- **Sediment inputs and erosion**: During operations mines continuously generate sediment through everyday activities, unlike the short-term, temporary disturbance events linked with construction. Large-scale vegetation and soil removal, open pits and waste rock piles mean large areas of bare earth and spoil remain exposed, noting that not all areas are exposed at the same time[24]. Heavy rainfall, which frequently occurs on the Buller Plateaux, has the potential to produce ongoing runoff laden with suspended solids from these exposed areas if not managed. Moreover, infrastructure such as haul roads also have the potential to contribute significant amounts of sediment-laden runoff (as well as coal fines, see below) during rain events unless robust erosion control measure are in place. In smaller headwater streams, sediment may take years to naturally flush out which can fundamentally shift the physical and biological characteristics of stream ecosystems. Clean gravels turn to silt beds favouring worms and snails over the sensitive EPT taxa that are abundant in unimpacted streams across the Buller Plateaux. Increased sediment loads stress sensitive macroinvertebrates often resulting in downstream drift in response to elevated suspended sediments (Ryan 1991). Excessive suspended sediment loads can also result in the physical scouring of substrates, removing periphyton and/or bryophytes and lowering in-stream productivity. Moreover, sediment can carry adsorbed pollutants (e.g., toxic metals, hydrocarbons), effectively moving contaminants into the stream and further downstream in the catchment on sediment particles. Active pits and waste rock areas often cannot be fully covered until mining operations are finished so some sediment release is inevitable throughout this phase and requires active on-going management.

- **AMD and water contamination**: During the operational phase, AMD has the potential to have the greatest impact on intact waterways. As mining progresses, more sulfur-bearing rock will be excavated from the BCM and stored in waste piles, and larger pit highwalls will be exposed, thereby expanding the potential surface area for AMD generation.

  The Project will produce AMD-affected water, which if not treated appropriately, is capable of significantly lowering the pH of receiving streams and significantly elevating dissolved metal concentrations, including potential constituents of concern – Al, Fe and lesser amounts of cadmium (Cd), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and zinc (Zn) (MWM 2026e). This AMD would be in addition to historic sources in the Project area. If these acidic, metal-rich waters are not effectively treated and enter downstream environments, the chemistry of

[23] The ecological values of these streams are summarised in Table 4-4 and Table 4-8.

[24] The total disturbance area for ESE and MFS sub-areas combined is 630ha, with the largest net exposed footprint between disturbance and rehabilitation approximately 120ha.

downstream will water change. If AMD mixes with less acidic tributaries, the rise in pH will cause many metals to precipitate out as solid hydroxides, forming visible flocs or precipitates on streambeds. For example, iron precipitates as rusty-orange coatings at pH >~3.5 and aluminium can form whitish deposits at pH 4.0–5.5 (Harding and Boothroyd 2004, Balintova and Petrilakova 2011; see site photos from Cascade Creek, Figure 4-14, Figure 4-15), noting that other precipitations and speciation changes occur at higher pH and with other factors (e.g., dissolved organic carbon, Botté et al. 2022; Hickey 2026a, Appendix D). AMD negatively effects stream communities because low pH and high metal concentrations have direct physiological effects on taxa, precipitates smother habitat and primary production is impacted altering food availability for macroinvertebrates and the interactions that occur within stream communities (Hogsden and Harding 2012).

During operations, mine impacted water (MIW) will be collected and treated. During periods of high flow, in the case of MFS, MIW may also be released via two flow triggered pathways: (i) sump bypasses to receiving streams, and (ii) direct discharges to the Waimangaroa River. These pathways operate only during elevated receiving water flows, are short lived (typically 1–2 days), and are infrequent (generally ≤5% of the time for bypasses and ≤10% for direct discharges) (MWM 2026h,i).

Water quality modelling for ESE and MFS indicates that, at downstream compliance locations, pH and metals (Al, Fe, Mn, Cu, Zn, Cd, Co, Ni) remain within proposed acute and chronic guideline values over the relevant exposure periods during bypass and direct discharge events, including under wet year and variable rainfall scenarios (MWM 2026h; MWM 2026i; Hickey 2026a). Brief increases in TSS and turbidity may also occur during these events; however, these peaks are short in duration and applicable guidelines are met at compliance locations (MWM 2026h; MWM 2026i). Such short duration sediment pulses are characteristic of high flow events and are not expected to result in persistent habitat degradation.

Bypass and direct discharge events occur during high rainfall and elevated flow conditions, characteristic of the flashy hydrology of the Buller Plateaux, which will provide dilution for MIW in receiving waters. While contaminant loads may temporarily increase during these events, instream concentrations will remain low due to dilution and the brief nature of exposure. Potential effects on aquatic communities are expected to be transient and localised, with a low risk of chronic or population level effects. Repeat wet years may increase the frequency of bypass and direct discharge events but are not predicted to alter this overall risk profile (MWM 2026h,i).

A range of risk assessment and contingency measures has been developed to minimise the likelihood of untreated MIW release due to water treatment plant (WTP) operational failure, noting that the probability of such failure is considered low (BRL 2026d). Notwithstanding these controls, there remains a residual potential for adverse effects on sensitive aquatic species if untreated discharges were to occur, as described above.

As noted in Section 4, changes in water chemistry caused by uncontrolled historic AMD sources already significantly affects aquatic communities in Rapid Stream

(Sections 4.2.2-4.2.5) and in Cascade Creek (Sections 4.4.3-4.4.5). Depending on the pH and metal concentrations, diversity in these streams is either highly reduced (represented by a few acid- and metal-tolerant taxa) or entire communities are absent. The wider Buller Plateaux contains several streams that have experienced long-term ecological degradation because AMD was not managed when historical mining activities were undertaken (i.e., Stockton, Instream 2026; Section 1.2.1). The consequences of inadequate AMD management are clearly observable in impacted streams and demonstrate the potential for habitat degradation without proper management and mitigation during the Project.

- **Elevated pH during passive treatment:** During the operations phase, mine impacted water will begin to be passively treated by MSRs at some locations (from 2029 in MFS sub-area and from 2030 in ESE sub-area; MWM 2026j, k). Water discharged from the MSRs may at times be ≥ pH 7 (MWM 2026 h,i), which is greater than the pH in receiving waters that are generally slightly acidic (typically pH 4.5–5.5) either naturally or due to upstream historic AMD inputs. There will be a mixing zone downstream of the MSR discharge points where pH will be elevated. In this zone, acid-specialist taxa (i.e., only found in acidic waters) may be affected by changes in pH associated with mine water treatment. Many macroinvertebrate taxa have wide pH tolerances and are likely to be unaffected by this change in water quality (up to pH 8; Harding et al. 2000) but some bryophytes may be affected (see Section 3.3.1). As the MSRs will be continuously discharging, this will be an on-going effect noting that the extent of downstream area with raised pH will be dependent on flow. Additional water treatments are available to manage discharge from MSRs (e.g., acid-trimming) if pH considered not suitable for receiving waters.

- **Release and deposition of coal fines:** Coal fines are produced through blasting, crushing, screening, and handling of coal-bearing material during operations. These very small particles can become airborne or be transported by runoff. When coal fines enter streams, they can elevate turbidity and reduce light penetration, smother benthic habitats, and impair spawning gravels by filling interstitial spaces. This leads to declines in sensitive macroinvertebrate taxa, reduced primary productivity, altered channel morphology, and stress on kōura or fish through gill irritation or clogging. During a 100-year flood event, inundation of the southern portion of the MFS coal stockpile pad may occur, creating a risk of coal fines and sediment mobilisation into floodwaters draining back to the Waimangaroa River system including Cedar Creek (MWM 2026c). Floodwaters are predicted to extend into the southern portion of the stockpile footprint, with modelled flood depths ranging from approximately 0.2 m to 1.2 m. Inundation is primarily associated with relict flood channels rather than widespread floodplain flooding (MWM 2026c). Such entrainment has the potential to cause short term increases in turbidity and sediment deposition, which could adversely affect water clarity, periphyton, and benthic habitat quality. While these effects would be associated with an infrequent extreme event, they may be locally significant during peak flows, highlighting the importance of flood protection measures to minimise contaminant mobilisation and ecological effects.

- **Hydrological alterations:** Active mining can dramatically change how water moves through the landscape because landform modifications can affect surface water channels and subsurface flows. We note that on the Denniston Plateau both soil depth and groundwater zones are relatively shallow in a number of areas compared to nearby catchments.

During the operational phase, the Project is predicted to cause both reductions and increases in stream flows depending on the location and water management activities. Median flows are expected to decrease by approximately 12–40% in some streams, while increasing downstream of treated mine water discharges. For example, median flows are predicted to increase by approximately 85% in V8 Creek (MM1 monitoring site) and >250% in the Whareatea River (KEL monitoring site) downstream of active treatment discharges (MWM 2026c). Despite the large proportional changes, the resulting median flows[25] remain within the range typical of small West Coast headwater streams and are expected to have neutral to positive ecological effects, primarily through increased wetted habitat and improved habitat connectivity. Low flows at MM1 and KEL are also predicted to increase substantially during operations (~760% and 1290%, respectively). In contrast, increases in low flows in the Waimangaroa River (at Smokestack monitoring site) downstream of the WTP will be comparatively more moderate (~90%) (MWM 2026c), reflecting the influence of treated discharges.

Operational water management will involve abstraction, diversion, storage, and discharge of water for dust suppression, mine dewatering, WTP operations, sump and drainage pumping, and treatment processes. Partial dewatering of streams can occur when surface water is diverted to maintain dry pit conditions or, in accordance with the Project's water management principles, when clean water is diverted around disturbed areas. Diversion drains, such as the Trent Stream CWD will typically direct water back into the same catchment but, at times, water may be directed elsewhere (i.e., Cascade catchment or ex-pit seal for treatment when it is being used to convey mine-affected water). Releases of stored water may generate short-term, unnatural flow peaks, which can increase macroinvertebrate drift and scour periphyton or bryophytes if not appropriately managed.

Prolonged or increased low flow conditions can lead to warming of stream water as well as greater daily temperature variation in streams (i.e., shallower water heats and cools faster). This temperature variability in streams would likely be exacerbated during operations either through flow diversions or riparian vegetation removal (see below). Warmer water carries less dissolved oxygen so low flows in unshaded streams can push conditions in waterways above thresholds that sensitive species can tolerate. Additionally, sediment deposition patterns change – slower flows deposit more fine sediment. If a stream is diverted around a pit, the diversion may be into an artificial channel (or pipe) with different flow characteristics (perhaps straighter, steeper, or smoother than the original stream), affecting habitat availability. Many aquatic biota have adapted to specific flow and hydraulic conditions (e.g., velocity, depth, substrate type); for example, some mayfly species need fast riffles to meet oxygen demand so might disappear if a stream is diverted into a drain where such conditions are absent.

[25] 0.3 m^3/s in V8 Creek (at MM1); 0.1 m^3/s in Whareatea River (at KEL)

The low flow effects discussed above are relevant for streams with continuous flow but some smaller headwater streams on the Denniston Plateau naturally have intermittent flows. Streams can be temporally intermittent (with drying typically occurring in mid to late summer/early autumn), spatially intermittent (with particular sections having characteristics that make them more prone to drying) or both. Many of the streams that will be subject to flow change under mining operations have low median flows (<0.1 m^3/s) so are likely to experience increased flow intermittency. Bryophytes require permanent flow and are typically sparse or absent in sites that experience intermittent flows resulting in reduced habitat availability or quality (e.g., Jellyman and Stark 2013). With increased intermittency we expect there would be a loss of bryophyte cover (and possibly some species) and a reduction in macroinvertebrate abundance as this habitat complexity is reduced in the stream. Macroinvertebrates exhibit a range of responses to flow intermittency: sensitive mayflies, stoneflies, and caddisflies (EPT taxa) often decline or disappear when streams dry, while tolerant groups (midges, snails, worms) survive and dominate until flow resumes. Recovery is typically rapid once water returns in systems, as insects hatch from drought-resistant eggs or recolonise from nearby perennial refuges.

Whilst some of the stream diversions associated with the Project may be less than a few hundred metres in length, the cumulative hydrological impact of all diversions will be a substantial reduction in the overall aquatic habitat quantity and quality available across the headwaters of the Whareatea and Waimangaroa during operations (~16 years). Several of these streams will be lost to mining with channels removed (see above) until rehabilitation/reinstatement is completed.

Surface water discharges from disturbed areas within the ESE and MFS sub-areas will be directed to off-site natural stream channels at proposed locations during operations (MWM 2026c). At discharge locations where post-development catchment areas exceed natural (pre-development) extents, unmanaged discharges could generate flows that are disproportionate to the capacity of receiving channels (MWM 2026c), particularly in small headwater streams and during high rainfall events. Such locations are therefore more sensitive to hydrological alteration. If discharge rates are not appropriately managed, increased peak flows and higher disturbance frequency may cause localised streambed and bank erosion, reduced substrate stability, and simplified benthic habitats in reaches downstream of discharge locations. Periphyton, bryophytes, and macroinvertebrates in affected channels may experience increased scour/removal or displacement during high-flow events, reduced persistence and recovery, and a shift towards disturbance-tolerant communities over time.

- [redacted]

- **Removal of riparian vegetation:** Vegetation (and topsoil) stripping will begin at ESE and MFS during construction, but most will occur during the operations phase of the Project. Vegetation removal will be staged as mining progresses through pit areas, with progressive rehabilitation planned as final landforms become available. Natural riparian vegetation (trees/shrubs along streams) provides shade, bank stability, as well as inputs of terrestrial insects and organic debris that provide food and habitat structure for stream biota. Riparian zones also act as a runoff filter reducing the amount of nutrients and sediment entering waterways. Without the canopy cover regulating sunlight and air temperature, streams have much greater water temperature variability. Streams with a more variable thermal regimes can impair aquatic communities with thermal stress and loss of sensitive taxa. Increased periphyton growth will likely occur in warmer waters with increased light availability, noting that periphyton cover is typically low in the forested headwater streams in the Whareatea and Waimangaroa catchments. In addition, removal of riparian vegetation makes stream banks weaker and more erosion prone, increasing the likelihood of sediment inputs to a stream.

- **Nutrient enrichment:** Mining is generally not a major source of nutrients into stream environments when compared to land-use activities such as agriculture, but certain mining activities can increase nutrients entering streams during the operational phase. Runoff from nitrogen-based explosives, nutrients from treated sewage disposal areas and nutrients from fertiliser applied as part of rehabilitation and revegetation are three key potentially significant sources of dissolved nutrients (nitrogen) in Buller Plateaux receiving waters during operations (Hickey 2026a,b). The predicted nitrate concentrations from mining explosives, sewage, and fertiliser sources are all well below NPS-FM toxicity standards and ANZG guideline values, indicating negligible risk of direct toxicity to aquatic species (Hickey 2026b). However, concentrations from ELF seepage and sump discharges (up to ~0.89 mg/L NO_3-N; Hickey (2026b) exceed the threshold (~0.44 mg/L) where periphyton growth may be stimulated under suitable conditions (Biggs 2000).

  Elevated nitrate can cause increased algal growth (or blooms) and it is likely a limiting nutrient for many streams on the Denniston Plateau which typically have very low nutrient concentrations. Because these streams are generally so nutrient-poor, even slight increases may stimulate periphyton growth, especially when combined with lower flows and increased sunlight after forest canopy removal. However, the overall risk of blooms/eutrophication is considered low because these streams would still likely be phosphorus limited. Typically, we would expect nutrient effects to be localised and decrease with distance from active mining areas.

- **Effects on aquatic values in lower catchment receiving waters:** T[redacted]

  Of the upper catchment effects described above, the three effects with the potential to have a detectable effect on lower catchment receiving waters and aquatic communities are: sediments, AMD/water contamination and hydrological alteration.

[26] We consider the lower catchment to be the section of the river where there is a marked change in gradient/slope. For the Whareatea River this occurs ~700 m upstream of SH67 whereas in the Waimangaroa River we have defined the lower catchment to downstream of the confluence with Conns Creek.

Without appropriate effects management, mining activities such as vegetation clearance and overburden removal can significantly increase sediment runoff into waterways. How long that may take to reach the lower catchment depends on several factors. The potential sediment effects include those already stated above but in the lower catchment the effects of high suspended sediments would also include potential clogging of fish gills, impaired respiration and reduced water clarity impacting the feeding ability of visual feeding fish (e.g., brown trout, īnanga; Cavanagh et al. 2014). Banded kōkopu, for example, exhibit a strong behavioural avoidance of elevated suspended sediment and juvenile banded kōkopu are highly sensitive to turbidity >25 NTU (Boubée et al. 1997).

The lower catchments of the Waimangaroa and Whareatea Rivers have diverse fish communities and the contaminants associated with AMD are toxic to fish as they cause physiological stress, impair reproduction and can result in mortality. Fish are typically very limited or absent in streams affected by AMD (Harding et al. 2006, Hogsden and Harding 2012). Any untreated AMD reaching the lowland reaches of either river would be diluted but could potentially have lethal or sub-lethal effects (e.g., influencing migration by creating chemical barriers) for fish.

The proposed mine design will result in hydrological alterations that change baseflows (e.g., increase in Whareatea River at KEL; MWM 2026c), potentially disrupt seasonal flow patterns, and alter the frequency and magnitude of peak flows. For fish in the lower catchments, these changes can affect migration cues, reduce habitat availability during critical life stages, and increase vulnerability to predation and competition. Additionally, altered flow regimes (i.e., lower flows) can exacerbate the impacts of sediments and water quality degradation, compounding stress on fish populations. Mahinga kai species such as īnanga (whitebait) are particularly sensitive to altered flows; for example, īnanga lay eggs in streamside vegetation during spring tides and changes in flow regimes can disturb these cues or desiccate eggs laid in the wrong place.

- **Noise and human activity:** Active mining involves blasting, drilling, and heavy vehicle traffic. While these mostly affect terrestrial environments, they can also cause vibrations in water bodies. If explosives are used near water, sufficiently large ground and water vibrations can disturb substrates potentially dislodging benthic organisms or increasing sediment mobilisation. Most studies that have reported direct harm from blasting have been recorded for fish (e.g., shock waves that can damage fish swim bladders and rupture internal organs) so damage to kōura would be a possibility.

  Large dust clouds generated by heavy mining vehicles on unsealed roads can deposit fine sediment onto nearby streams/wetlands or riparian habitat. The settling dust increases sedimentation and turbidity in these waterways, which clogs the gravel and streambed spaces that aquatic insect larvae depend on for habitat. Dust can also settle on riparian plants and water surfaces, potentially interfering with adult insects' feeding and egg-laying behaviours.

  During the operational phase human activity and associated biosecurity risks will need to be managed. The neighbouring Buller River catchment has experienced extensive blooms of *Didymosphenia geminata* (didymo) for nearly 20 years, but it has not been detected in the headwater streams of the Denniston Plateau. Didymo cells are known to be viable in water with low pH for short durations (pH 4 for 10 days; Kilroy et al. 2006). Thus, it should not be assumed that the water chemistry of these streams offers protection from didymo given it can survive in low pH water and blooms in waters with very low phosphorus concentrations (Kilroy and Bothwell 2012), such as those found on the Denniston Plateau. BRL will have staff and contractors working in the Project footprint as well as within the wider Buller catchment so given didymo cells can remain viable for days, the effect of didymo incursion requires managing. Didymo has the potential to alter periphyton communities to such an extent that the habitat structure of the stream bed is altered as are the aquatic communities that can be supported (Jellyman and Harding 2016).

- **Water quality improvements:** A positive effect of the Project is the planned remediation of historic mining contamination on the Buller Plateaux. The Project explicitly commits resources to manage and clean up historic AMD sources (termed "historic environmental liabilities") on behalf of the Crown, meaning old underground mine tunnels and waste dumps that have been leaching acid- and metal-laden water for decades will now be addressed. The Project proposes to excavate or cap these old workings via new open-cut mining to permanently remove major sources of AMD that have long degraded the water quality and stream communities in some streams. It is anticipated that as underground mines are excavated and rehabilitated, the acidity and metal loads to affected streams will drop markedly resulting in measurable "betterment" of downstream water quality proportional to the area of the old mine workings they eliminate. Over the life of the Project (≈25 years) and beyond, this cleanup, if successful, would translate into progressive improvements in aquatic ecosystem conditions.

  A specific example is the proposed improvement of water quality in the Cascade Creek catchment through the interception and active treatment of AMD from historic mines. At present, Cascade Creek suffers from very poor water quality (Section 4.4.1) due to AMD from several historic underground coal mine discharges. The Project proposes to do this by: intercepting some historic underground flow paths through the ex-pit seal for treatment by the WTP; mining out a proportion of historic underground workings within the ESE footprint (thereby effectively removing these as an AMD source); and improving water quality in Cascade Creek by discharging treated water via V8 Creek. With a reduction in chronic AMD inputs[27], we would expect recovery of the stream community over time to track any water quality improvements in the headwater reaches of Cascade Creek.

5.2.2 Operational effects management

The operational phase of the Project is when potential effects are likely to be most significant and therefore require the most management. A comprehensive mine water treatment system has been designed for the Project to manage and mitigate these effects and meet the established water quality guidelines for protection of aquatic life (Hickey 2026a). The Project will have a comprehensive water quality and ecology monitoring programmes to monitor and

[27] Noting there will still be some historic inputs to Cascade Creek upstream of V8 Creek.

mitigate any effects, paired with appropriate data reporting aligned with required consent conditions. Below are management approaches for operational effects.

- **Stream habitat removal**: Some streams and stream sections will be removed by the Project, and this constitutes an effect that cannot be avoided. Regardless of whether the effect is for the entire stream or a stream section, management measures will be implemented to reduce further downstream impacts, while stream reinstatement and rehabilitation will provide opportunities to manage the loss of habitat extent. Stream reinstatement will be a staged process as mining is completed in some areas while continuing in other areas. Streams will be progressively reinstated during rehabilitation as post-operational landforms are shaped. This will initially include establishment of stream channels and channel structure with habitat added to the extent possible at the time. The ecological value of various waterways has been assessed in Section 4 from which an assessment can be made regarding the streams that should be prioritised for management (i.e., streams with existing *High* or *Very High* values).

  In the MFS sub-area, 3.6 km of stream (with *Moderate* and *High* ecological values) will be lost during the Project but 8.1 km will be re-instated representing a gain of 3.8 km. In the ESE sub-area, 13.5 km of stream (with *High* and *Very High* ecological value) will be lost and 12.7 km will be re-instated, so there is a net loss of 0.7 km. The duration that a stream is lost (months to years) is considered for offsetting/compensation.

  Firstly, treated waters will be pumped back into the affected sub-catchments to partially replace the natural flows that would have come from the removed streams (BRL 2026d). By keeping neutralised treated mine water running down those stream channels, the Project ensures downstream ecosystems continue to receive flow (albeit artificially), helping to maintain aquatic connectivity and reduce the drying-out of habitats that could otherwise occur. [redacted].

- **Sediment inputs and erosion control:** Soil disturbances will be tightly managed to avoid heavy sediment runoff into streams. Clean water diversions will channel rainwater around the disturbed areas of the mine site to keep it from eroding exposed soils. Erosion controls (contouring to slow runoff, roughening slopes, rapid re-vegetation) and sediment capture structures are incorporated into the current design

[28] As per current mine plans for the Project.

(BRL 2026c). The largest potential effects of sediment come from disturbed areas which will be directed into sediment retention systems — in-pit sump ponds and settling ponds— so that turbid water is detained and particulates settle out before release. Haul roads and stockpiles that could produce turbid plumes if they enter streams (exacerbated during high rainfall events) will be lined with silt fences and cut-off drains to manage sediment effects. Progressive land rehabilitation (as much as possible) is planned to reduce the exposed area contributing sediment during operations. Even so, extreme weather events (storm floods) during this phase can cause large pulses of sediment despite controls. Real-time water quality monitoring and adaptive management approaches will be applied (including to cease works) if turbidity exceeds established thresholds (Hickey 2026a,c).

- **AMD and water contamination:** During operations mine impacted water will be treated through a series of in-pit sumps, surge/settling/oxidation ponds, WTPs, and MSRs (as they come online) as outlined in the water treatment report (MWM 2026g and reports therein) and process flow diagrams for ESE (MWM 2026j) and MFS (MWM 2026k). Water will be treated so that discharge is similar to the downstream receiving environment and meets established water quality guidelines for the Project (Hickey 2026a). Comprehensive water management and active treatment measures will be employed during the operational phase to mitigate AMD and protect downstream ecology. Processes and techniques include alkaline dosing (to neutralize acidity) and constructed treatment systems such as retention ponds and sediment settling basins. The WTPs raise pH and precipitate metals out of mine water before discharge, thereby significantly improving water quality. During high rainfall events, however, the capacity of treatment systems can be challenged, which may result in bypass or direct discharges (as above). Water quality guidelines are also expected to be met for bypass and direct discharges, with potential effects of these events limited in frequency and duration. A protocol will be developed to manage bypass water prior to release (MWM 2026g). Operational responses such as sump storage management and WTP capacity optimisation have been suggested to maintain water quality compliance during repeat wet years when the frequency of bypass and discharge events may increase MWM 2026h,i). As operations progress, mine waste will be encapsulated in ELFs designed to minimise water and oxygen ingress and reduce leachate.

  Compliance and performance monitoring stations will be established on all streams receiving mine water (e.g., below treatment plant outlets, bypass channels) to track pH, metals, and turbidity in real time or via frequent sampling during operations. If any parameter starts to approach consented compliance limits, adjustments will be made to treatment dosing to prevent an exceedance. In practice, mine operators also perform acid trimming of treated water – meaning the pH is adjusted (by adding a bit of acid back, if necessary) so that the discharge pH closely matches the natural stream pH just downstream. This avoids a scenario where over-treatment makes the water too alkaline for a naturally acidic stream, which could itself stress the native biota. Despite these controls, treated mine water is typically not pristine; it may still contain slightly elevated residual metals (e.g., Zn, Mn that are hard to completely remove) and sometimes higher nutrient levels (e.g., from explosives residue), although the effects of such residue have been assessed as having a negligible risk of direct toxicity to aquatic species (Hickey 2026a; see Section 5.2.1). Continuous monitoring and adaptive management are required during operations to identify and manage potential issues.

- **Elevated pH during passive treatment:** Monitoring and adaptive management (i.e., adjusting the pH of discharged water, acid trimming of MSR discharge) will be implemented to manage the potential effects of elevated pH during passive treatment in the operations phase. Monitoring and further studies will be undertaken to better understand how established bryophyte communities will respond to these changes in water quality following passive treatment. This will include monitoring at selected sites, assessments downstream of existing MSRs on Stockton Mine, and experimental trials to assess the tolerance of bryophyte communities exposed to sustained pH conditions of 6.5–7.5 during operations (Section 6.3.4). A provisional compliance range (pH 4.5–7.0) will be applied initially during operations, assessed as a 95th percentile of routine or continuous monitoring data. All data should continue to be reviewed to inform and guide adaptive management as required.

- **Release and deposition of coal fines:** Management measures are focused on preventing fines from leaving disturbed areas and capturing them before they reach waterways, including dust suppression, erosion and sediment controls, and settling ponds to allow fine particles to settle out before discharge (BRL 2026c). Stabilising exposed surfaces with geotextiles and/ or vegetation will limit coal fine release, while careful planning of coal stockpile locations and containment bunds will reduce the risk of runoff. To reduce ecological risks associated with flood inundation of the MFS coal stockpile pad during extreme events (100-year flood event), operational management will focus on preventing floodwater interaction with coal storage areas by maintaining sufficient pad elevation or bunding (≥1.2 m above existing ground levels, MWM 2026j). Appropriately aligned culvert and embankment design will further limit backwatering and uncontrolled flood pathways, collectively reducing the potential for mobilisation, downstream transport, and deposition of coal fines and minimising short-term effects on water quality and aquatic habitat. Performance water quality monitoring for turbidity (Hickey 2026a) will support early detection of issues and allow for operational adjustments.

- **Hydrological alterations:** The Project requires stream diversions for water management during operation, which will alter natural hydrology, habitat quality and aquatic communities in diverted streams. Where practicable, diversions will be managed to maintain hydrological continuity, sustain minimum flows and avoid exacerbating low-flow or high-sediment events. Water treatment systems and monitoring will ensure that water quality remains within acceptable levels to protect sensitive biota. Surface water discharges from operational areas will be subject to site-specific discharge management measures at locations where post-development catchment areas exceed pre-development extents (MWM 2026c).These measures include slow-release sumps or storage ponds to attenuate peak flows, bypass flow off-takes to redistribute runoff to suitably sized catchments, and control of discharge rates to better align with the capacity and natural variability of receiving channels (MWM 2026c). Where appropriate and practicable, flows may also be managed between multiple locations to further reduce pressure on individual receiving environments. Together, these controls are intended to minimise the risk of disproportionate flows to small headwater streams and associated adverse effects on stream habitat and aquatic communities.

- **Kōura passage barriers:** To ensure continued kōura passage through culverts, it is recommended that culverts are inspected after major floods (and no less than annually) to remediate any scour, passage or maintenance issues.

- **Riparian vegetation removal:** The operational phase often sees streams flowing through bare or sparsely vegetated landscapes. Progressive rehabilitation of mined areas, including VDT will occur during the operational phase of the Project, noting that it takes years for replanted vegetation to become effective shade-providers for streams. Therefore, streams will likely experience greater temperature extremes and more periphyton growth until shade has been restored. This will also be the case for reinstated streams (see Section 6.1.1).

- **Nutrient enrichment:** Performance monitoring of nitrogenous compounds is proposed for the ELFs (MWM 2026f). Adaptive management approaches for relevant activities (e.g., blasting, fertiliser application) will be implemented when operational triggers for receiving water thresholds are exceeded. Monitoring alongside adaptive nutrient management is recommended to confirm and manage potential risk of eutrophication.

- **Effects on aquatic values in lower catchment receiving waters:** The pH tolerance of many fish species in West Coast streams has been documented (Greig et al. 2010). While some species occur in naturally low pH streams, they are rarely found below pH 4. [redacted]. Greig et al. (2010) recommend guideline thresholds for fish of pH <4.5 and Al concentrations <1 mg/L. The proposed water quality guidelines for the Project are set for the protection of fish and macroinvertebrate communities (Hickey 2026a) and align with recommendations in Greig et al. (2010). Aquatic ecology monitoring will include fish at lower catchment sites (BRL 2026e).

- **Noise and human activity:** Maintain conservative setback distances (e.g., 30 m to over 100 m) from streams to be retained during blasting, where practicable, to minimise the risk of substrate disturbance, bed mobilisation and impacts on macroinvertebrates. Limit non-essential human activity and foot traffic instream and along stream margins to minimise disturbance, trampling and erosion. Light disturbance effects can be managed as per recommendations during construction phase. Regularly inspect instream and near-stream equipment (e.g., drills, pumps, hoses, sampling devices) for early detection of didymo. Aquatic ecology monitoring will include periphyton cover that will detect presence of didymo in waterways in addition to annual eDNA testing proposed for biosecurity management (BRL 2026g). If detected, implement Check-Clean-Dry Protocols, provide signage and training for staff on biosecurity risk management and reporting.

- **Water quality improvements:** The improvement of water quality in streams affected by historic AMD inputs (and expected subsequent improvements in ecological condition) is a positive effect of the Project. By extending modern environmental management to the Denniston Plateau's historic coalfields, the BPCP intends to leave some local streams in a better state than at present.

5.2.3 Assessment of operational effects

During the operations phase, most potential adverse effects on aquatic environments are assessed as minor or less than minor following implementation of the recommended effects management measures, including controls for sediment inputs and erosion, coal fines, hydrological alteration, kōura passage, riparian vegetation loss, nutrient enrichment, and noise and human activity (Table 5-3).

Residual effects associated with stream habitat removal and hydrological alterations, particularly within tributaries of the Whareatea and Waimangaroa catchments, are assessed as more than minor to significant. This reflects the extent and permanence of stream loss during mining operations. Residual effects associated with AMD and mine-affected water discharges may range from minor to more than minor, particularly during high rainfall conditions (including bypass events); however, these effects are expected to be reduced through active water capture, treatment, monitoring, and adaptive management. Overall, operational effects will be actively monitored and managed to meet water quality guidelines and performance objectives, with some localised positive effects, including anticipated improvements in water quality and ecological condition in Cascade Creek where historic mine drainage will be intercepted and treated (Table 5-3).

Monitoring, further studies, and adaptive management will be used to address uncertainties about how bryophyte communities respond to changes in water quality during passive treatment. Water quality and bryophyte monitoring and a provisional pH compliance range will guide operational controls, such as pH trimming. Bryophyte cover will be surveyed quarterly at selected reference and compliance sites, with declines triggering further investigation into species composition and mitigation needs. Additional studies, including assessments downstream of existing MSRs and experiments testing bryophyte tolerance to sustained pH 6.5–7.5, will address knowledge gaps and inform ongoing management of passive treatment effects (see Section 6.3.4).

Compensation, offsetting and other positive effects proposed to address more than minor to significant residual effects are described in Section 6.2.

5.3 Closure

The closure phase occurs following the cessation of mining operations and focuses on decommissioning, rehabilitation and long-term management of residual effects. During closure, mine-impacted water continues to be treated actively and then passively by MSRs for long-term management of AMD (BRL 2026d). Key closure activities include removal of mining infrastructure, water management, reshaping and stabilisation of final landforms, capping and rehabilitation of ELFs, progressive rehabilitation including revegetation using native species and VDT, restoration of natural drainage patterns and habitat creation / rehabilitation in reinstated streams and other closure waterbodies (BRL 2026b). Access roads will be narrowed or closed and rehabilitated.

The closure strategy and proposed closure outcomes are outlined in BRL (2026k). Closure planning and implementation will be guided by a staged, progressive rehabilitation framework, with management, monitoring and maintenance continuing until closure objectives, criteria and conditions are achieved and relinquishment can occur.

Reinstated streams, wetlands, tarns, and other closure waterbodies will remain in the post-mining landscape. These waterbodies will also be managed and monitored against defined closure criteria to demonstrate that they are physically and chemically stable, do not pose a risk to downstream water quality, and can support aquatic ecosystems or ecosystem services consistent with the agreed post-mining land use.

5.3.1 Specific closure effects and management for streams

Activities during closure that may affect aquatic ecology are primarily associated with water management (AMD), landform establishment (sediment) and transition from operational to post-mining hydrological regimes. Water management and progressive rehabilitation of stream habitats and other closure waterbodies will continue for waterbodies that will remain post-closure.

- **AMD:** AMD represents a key long-term consideration for freshwaters during the closure and post-closure phases of the Project. Potential sources of AMD, including exposed sulfidic rocks, ELFs, encapsulates sulfidic materials, and pit walls will remain in the post-mining landscape on site. If AMD sources are not effectively managed, adverse effects on aquatic ecology could occur. These potential effects include low pH, elevated dissolved metals, metal precipitates coating streambed, and streams comprised of tolerant taxa (as described above for operations phase).

  Closure management measures for AMD are designed to minimise the risk of long-term adverse effects on downstream environments and to ensure closure criteria can be met. The measures are adaptive and performance-based, recognising that AMD risks progressively reduce as landforms stabilise and reactive materials are isolated. The key measures include:

  1. *Source control through ELFs* – including encapsulation of PAF materials within NAF rock and cover systems designed to limit oxygen and water ingress (BRL 2026i). By enclosing PAF materials or sealing them under clay, geosynthetic liners or a thick NAF cap, the generation of new acidity is greatly reduced. ELF encapsulation should

ensure that remaining leachate can be treated passively through MSRs once the site is closed and rehabilitated.

2. *Continuation of AMD treatment* – long-term water treatment for AMD will be in place until AMD loads decrease to levels that are considered environmentally acceptable. During closure at MFS and ESE, active treatment is expected to be required for a period following mining with a staged transition to passive treatment with MSRs as contaminant loads decline and water quality criteria can be met (BRL 2026d). The MSRs will be sized to handle closure and post-closure contaminant loads and the high rainfall in the region (MWM 2026g).

Water quality monitoring will continue to track and demonstrate trends towards achieving closure criteria, with a focus on parameters relevant to AMD, including pH and dissolved metals. Adaptive management responses may include refinement of treatment systems or continuation of active treatment, as required. The success of this approach will be measured by water quality and ecological monitoring until agreed closure conditions are met.

- **Sediment:** Sediment mobilisation and persistence of sediment-bound contaminants are important closure considerations for freshwaters environments, particularly during high flow events. Potential effects include smothering benthic habitats, reduced water clarity, and episodic remobilisation of metal-bound sediments during high flow events. The Denniston Plateau is characterised by steep terrain and high-intensity rainfall events, meaning that disturbed or partially stabilised landforms can remain a source of sediments to streams, if not appropriately managed.

  At closure, sediment generation is expected to reduce progressively as final landforms are completed, surfaces are capped and revegetated, and drainage networks are integrated into the post-mining landscape. Some short-term sediment mobilisation may occur during the early stages of closure while vegetation establishes.

  During closure, sediment management measures will continue and focus on completion and stabilisation of final landforms, capping and revegetation of ELFs, and retention of selected water management features (e.g., settling ponds associated with MSRs to manage residual fine sediment and metal precipitates prior to discharge). Sediment management will continue until vegetation is fully re-established on stabilised landforms. Together these measures should minimise erosion and risk of sediment and sediment-bound contaminant remobilisation into streams.

  Water quality monitoring will continue to confirm water quality criteria (established for the protection of aquatic ecology, Hickey 2026a) are being met. Investigations and adaptive management will be undertaken if criteria are not met. Responses may include targeted stabilisation works, additional planting or maintenance of drainage features until acceptable performance is demonstrated (BRL 2026b). Achievement of sediment-related closure criteria will be verified with evidence of stable landforms, established vegetation cover and suitable in-stream conditions for aquatic ecology.

- **Altered stream morphology and hydrology:** Mining activities associated with the Project will have altered elements of natural drainage patterns and flow regimes within the ESE and MFS sub-areas through stream diversions, landform re-profiling, pit excavation, and water management infrastructure. These activities may have altered stream habitat for periphyton, bryophytes and macroinvertebrates in different ways (as discussed above for operations). Closure measures are designed to reinstate and manage flow pathways and integrate surface water drainage with rehabilitated landforms, ensure runoff patterns are compatible with downstream receiving environments and natural catchments (BRL 2026b,k).

  During closure, any remaining stream diversions or modifications will be restored to as natural a state as practicable, noting that some alterations are effectively permanent. Any remaining artificial channels should be re-engineered to be more sinuous with natural profiles (riffles, pools, meanders) rather than straight channels. Reconstructing stream channels should be done following natural channel design principles (e.g., vegetated floodplain alongside the main channel, placement of heterogenous substrate sizes (gravel, cobble, boulders) to create habitat and support aquatic life) and drop structures or weirs are either removed or replaced with structures that allow unobstructed passage for aquatic biota. Managed surface water discharge locations used during operations should be returned to natural catchments at closure (MWM 2026c).

  Flow regimes and channel forms will be restored as far as practicable to provide suitable habitat and support aquatic life. There will be increased baseflows from ELF seepage and reduced water abstraction during closure. Modelled hydrology shows increases in low flows at several downstream compliance sites, moderate to high median flow increases, and minimal changes in high flows across most sites (MWM 2026c). Increased baseflows and flow stability will expand available wetted habitat for aquatic biota and improve connectivity for movement or migration in some areas (e.g., shallow riffles or previously intermittent reaches may be passable more often) but may also reduce habitat suitability and spawning habitat (in downstream reaches) for some taxa.

  Permanent hydrological changes will also remain where a pit or other mine infrastructure (e.g., sump, polishing pond) are left to form a lake or closure waterbody. Closures waterbodies are covered below in Section 5.3.3.

5.3.2 Stream habitat rehabilitation and reinstatement

Mining activities associated with the Project will result in modification of some stream habitat, and in some cases permanent loss (see Section 5.2.1). Closure planning includes provision for rehabilitation and reinstatement of stream habitats[29] to support the aquatic communities and restore ecological functions where practicable (BRL 2026b, k). Closure criteria relevant to stream habitat focus on demonstrating that reinstated streams are physically stable, hydraulically functional, and provide suitable water quality and habitat to support aquatic flora and fauna.

[29] It is accepted that highly specialised habitats will be hard to rebuild; for example, a steep, boulder-filled stream supporting certain bryophytes or macroinvertebrates might be challenging to fully recreate in a new channel.

During closure, progressive rehabilitation will continue to reconstruct and restore stream habitats as mining infrastructure is removed and final landforms are shaped. This will include:

- Reinstatement of stream channels to integrate with rehabilitated catchments;
- Incorporation of habitat features to provide habitat complexity and hydraulic diversity (e.g., riffle-run-pool sequences, variable substrate sizes, woody material); and
- Restoration of riparian zones with riparian planting and VDT to stabilise banks, provide shade and contribute organic matter inputs to streams

The detailed design objectives, habitat features and implementation approach for these measures are described in Section 6.1.1.

Actions to support species recolonisation are recommended, as reinstated streams usually support less diverse communities due to simpler habitat structure or limited/slow recolonisation, particularly in mine-impacted landscapes (e.g., Kitto et al. 2015). More dispersal-limited organisms, such as bryophytes, present an additional challenge for ecological recovery. Species re-colonisation can be proactively managed, where practicable. Th[redacted]t is expected that these actions would accelerate the recovery of functioning aquatic ecosystems despite some unavoidable loss of pre-mining biodiversity.

Monitoring of reinstated stream habitats will be undertaken to demonstrate progress towards closure criteria, including assessment of channel stability, habitat condition, and ecological indicators.

5.3.3 Closure waterbodies

Mine closure will result in the permanent retention of several waterbodies within the post-mining landscape, including closure waterbodies associated with mine voids or water management infrastructure.

The detailed objectives, long-term water quality projections, habitat creation measures, management approach and monitoring proposed for closure waterbodies are provided in Sections 1.1.1 and 6.1.3.

6 Recommendations

6.1 Mitigation and rehabilitation measures

To address adverse effects of the Project, a suite of mitigation and rehabilitation measures are proposed to restore, rehabilitate and enhance aquatic ecosystems. These include stream recreation, tarn creation and rehabilitation, and the development of closure waterbodies, which have been designed to provide ecological values, ecosystem services and long-term resilience. The location of the proposed reinstated streams, tarns (and wetlands) and other closure water bodies in the ESE sub-area is shown in Figure 6-1 and in the MFS sub-area in Figure 6-2. The proposed measures are detailed further below, including context and justification.

[redacted]

6.1.1 Stream reinstatement and rehabilitation

The BPCP will result in the loss of existing natural stream extent (17.1 km of stream length) and the loss of the associated stream values (e.g., high quality habitat for bryophytes, diverse high quality macroinvertebrate communities including kōura) in the ESE and MFS sub-areas. Stream reinstatement following headwater stream removal is a critical component of mine site rehabilitation, aimed at restoring ecological function, hydrological connectivity and habitat within the catchment. Headwater streams play an essential role in nutrient cycling, sediment transport, and providing habitat for aquatic and riparian species.

Following the completion of mining operations and progressive rehabilitation of the mined landforms, there will be a reinstatement of approximately 20.8 km of stream length on the

Denniston Plateau (Figure 6-1, Figure 6-2). Stream reinstatement will be a staged process as mining is completed in some areas while continuing in other areas. Streams will be progressively reinstated during rehabilitation as post-operational landforms are shaped. This will initially include establishment of stream channels and channel structure with habitat added to the extent possible at the time. Hydrological reconnection and further habitat actions will occur at an appropriate time as rehabilitation progresses. A large proportion of the post-mining stream catchment will be located entirely within rehabilitated ELFs. Streams should, where practicable, be reinstated and rehabilitated with the intention of meeting the following seven high-level objectives:

1. *Restore hydrological connectivity*: Re-establish natural flow pathways to maintain upstream–downstream linkages and support catchment-scale water movement.
2. *Recreate natural channel morphology*: Design and construct stream channels that mimic pre-disturbance dimensions, sinuosity, gradient, and substrate composition (to the extent practicable) to promote stability and ecological function.
3. *Re-establish riparian and aquatic habitat*: Provide suitable conditions for colonisation by native flora and fauna through riparian planting and addition of instream habitat features (e.g., woody debris, riffle-pool sequences).
4. *Improve water quality and sediment dynamics*: Implement measures to reduce erosion (e.g., riparian planting, use of suitably sized substrate in stream channels), manage sediment transport, and maintain nutrient cycling processes typical of headwater systems.
5. *Enhance biodiversity and ecosystem services:* Support recovery of bryophytes, macroinvertebrate communities, and riparian wildlife, contributing to overall ecological catchment health.
6. *Ensure long-term stability and resilience:* Incorporate design elements that withstand variable flow regimes and climate impacts, reducing maintenance requirements.
7. *Meet regulatory and cultural obligations*: Align stream reinstatement with environmental legislation, resource consent conditions, and cultural values, including recognition of mana whenua perspectives on freshwater ecosystems.

More specifically, the Rehabilitation Management Plan (BRL 2026b) outlines the following design characteristics for stream reinstatement:

- Construct the base flow channel to have flow constrictions of a range in size to slow and create pools during base flows.
- Base flow channel to have variable widths, depending on the size of the catchment and resulting flow which the channel is designed to hold.
- Construct riffle, run and pool habitat sequences within the base flow channel, by using large boulders which pools will form behind.

- Create floodplains with variable widths alongside the base flow channel to attenuate higher flows and minimise bank erosion and channel scour.
- The base flow channel will have a natural streambed substrate with similar characteristics to natural streams. Bedrock generally cannot be recreated, however large boulders embedded in fine substrate such as sand can create a similar effect. These boulders may be used to create chute-pool habitats where appropriate.
- Large woody debris and large boulders installed at a frequency of at least one piece every 50m to increase the amount of stable habitat and cover for macroinvertebrates and fish.
- Outer riparian margins along the diversion channel will be restored using vegetation direct transfer (VDT) where available. Where VDT is not available, stream edges will be planted with appropriate species. Riparian vegetation will comprise wet-adapted plants on low gradient floodplains and trees/shrubs on bank slopes and provide bank stability, shade and organic matter inputs (e.g., wood debris, leaf litter).

The objectives and characteristics listed above provide guidance for stream reinstatement, but all elements may not be able to be provided for in all streams due to site-specific constraints. Accordingly, closure criteria for reinstated streams are focused on establishing suitable habitats for flora and fauna, thereby achieving functional stream habitat conditions and ecological outcomes. These criteria provide the basis for evaluating rehabilitation performance and determining closure success. Closure criteria should include:

- *Stream extent*: Reinstated streams achieve no net loss of stream extent, with total stream length equal to or greater than 100% of the pre-disturbance length.
- *Channel form and hydraulic diversity*: Baseflow channels display variable widths, depths, and flow constrictions that create hydraulic diversity consistent with local reference streams (and practicable given post-mining landforms).
- *Substrate composition*: Streambeds comprise a heterogeneous mix of cobbles and embedded boulders comparable to reference conditions within the catchment.
- *Habitat units:* Stable and well-defined riffle, run, and pool sequences are present and appropriately distributed along the reinstated channel.
- *Wetted width and flow resilience*: Wetted channel width is appropriate for catchment size and flow regime, providing sufficient low-flow habitat while maintaining stability during higher flows.
- *Structural habitat features:* Large woody debris and boulders are present at frequencies sufficient to provide habitat complexity, cover, and refuge for aquatic biota.
- *Riparian condition*: Riparian vegetation achieves target cover and structure to provide shading, organic matter inputs, bank stability, and long-term channel resilience.
- *Aquatic habitat suitability*: Habitat conditions support the establishment and persistence of periphyton, bryophyte, and macroinvertebrate communities.

- *Key species presence:* Key taxa, including bryophytes, macroinvertebrates and kōura, are present where consistent with catchment-specific reference conditions.
- *Biological function*: Evidence of aquatic biota use and ecological functioning is demonstrated and broadly comparable to nearby reference streams.

A recent fluvial geomorphic assessment of streams on the Denniston Plateau provides a physical framework for guiding stream reinstatement design (Alexander et al. 2024). The report indicates that local headwater streams are steep, confined systems shaped by bedrock geology, direct hillslope connectivity, episodic sediment inputs, and structural elements such as large boulders, woody debris and riparian shading. Streams had low sinuosity, variable channel dimensions, plane-bed, cascade and step-pool morphologies, and streambeds dominated by bedrock and boulders with patchy finer sediments. Habitat complexity is generated primarily by structural features, such as boulder steps, plunge pools and debris accumulations. Geomorphic characteristics and processes documented by Alexander et al. (2024) should be used to inform channel gradients, substrate composition, structural habitat features and riparian conditions during stream reinstatement design and planning, with the aim of establishing stable and resilient habitat suitable for bryophytes and macroinvertebrates.

To ensure that stream reinstatement reflects best practice and is robust across ecological, geotechnical and engineering considerations, it is recommended that reinstated stream designs are developed by a multidisciplinary team of Suitably Qualified and Experienced Practitioners (SQEPs). Collaborative design by SQEPs will ensure that reinstated streams are consistent with the geomorphic guidance, rehabilitation objectives and closure criteria, while maintaining the geochemical and structural integrity of post-mining landforms.

There is considerable uncertainty around the timescale for ecological recovery of these reinstated streams due to extended time required for physical and geomorphic adjustments/ stabilisation which influence habitat complexity and connectivity as well as the establishment of riparian vegetation which underpins shading, bank stability, and organic matter inputs (i.e., 10 to 20 years or more). Hydrology, water chemistry and proximity to colonist source populations add further complexity and variability to ecological recovery trajectories. In mining-impacted watersheds, the timeline for ecological recovery for some biological indicators could be expected in 10-15+ years after remediation begins (e.g., macroinvertebrates; Clements et al. 2026).

It is recommended that monitoring is undertaken to determine whether there is successful recovery of these reinstated streams (e.g., whether there is a sufficient supply of colonists in this mine-impacted landscape on the Buller Plateaux, Kitto et al. (2015)). Monitoring should include the same parameters and methods described for annual compliance surveys (Section 6.3.1), specifically: water quality, instream habitat, bryophytes, periphyton, macroinvertebrates, and kōura. This monitoring programme should be further developed and certified following stream reinstatement. This monitoring will provide information on whether additional interventions are required (e.g., sourcing further habitat structure, seeding with macroinvertebrates from elsewhere in the catchment, etc.). For example, macroinvertebrates (taxa richness and abundance) could be used as indicators of whether additional interventions are required.

6.1.2 Tarn creation and rehabilitation

Tarn creation and rehabilitation is proposed to mitigate for adverse effects to wetlands[30] and other aquatic ecosystems because of Project activities. Natural and constructed tarns are present on the Stockton Plateau (Figure 6-3). Additional areas in the ESE and MFS mining areas have been identified as potential suitable locations for construction of future tarns as mining activities finish, and progressive rehabilitation begins across the operational areas (see Figure 6-1, Figure 6-2; BRL 2026k).

Since the early 2000s, considerable work has been undertaken at Stockton Mine to rehabilitate or recreate tarns. A recent survey and assessment of tarn rehabilitation success in 19 tarns on Stockton indicated that while physical habitat and macroinvertebrate communities varied among tarns, many constructed tarns provide new and important habitats for native species similar to nearby natural tarns (Watson et al. 2024a; see Appendix B).

[redacted]

Recommendations to improve existing and future constructed tarns for aquatic ecology as part of the Project include:

- Substrate enhancement – Tarn beds should include a layer of fine sediment over rock or gravel, which supports emergent vegetation, provides refuge for macroinvertebrates, and helps maintain water permanence and quality. Tarn floors made solely of sand, gravel, or coal tend to lack macrophyte cover and have poorer ecological outcomes, including reduced invertebrate diversity and water retention.

- Structural habitat complexity – The addition of large woody debris, root-wads, and undercut banks can create essential shelter for aquatic species such as kōura and damselflies. These features mimic natural habitats and offer protection from predators, especially for juvenile kōura, which prefer shallow areas with fine substrates and cover, whereas adults favour cobble substrates and woody debris.

[30] Adverse effects of the Project on wetlands are covered in Ecological Solutions (2026).

- Vegetation and edge planting – Edge plantings and macrophyte beds should be established to provide habitat and reduce erosion. Rapid revegetation of areas surrounding tarns is recommended to stabilise soils and promote ecological recovery. Emergent vegetation and soft, moist substrates are particularly important for macroinvertebrates that rely on these conditions for reproduction and development (e.g., damselflies).

- Tarn design and hydrology – Constructed tarns should feature gently sloping banks and semi-natural hydrologic regimes to support diverse plant and macroinvertebrate communities. These features help replicate the conditions found in natural tarns and improve the likelihood of successful colonisation by aquatic species.

- Rehabilitation and colonisation support – The use of direct transfer methods (i.e., where vegetation and sediment from donor sites are relocated to new tarns) can facilitate the establishment of dispersal-limited species. This approach introduces organic-rich substrates and live organisms, including zooplankton resting eggs and terrestrial invertebrates, enhancing biodiversity and ecological resilience in newly created habitats.

6.1.3 Closure waterbodies

Some water management infrastructure (i.e., mine voids, sumps) will remain at closure of the BPCP. This infrastructure will be rehabilitated as closure waterbodies are repurposed with the intention of providing ecosystem services (BRL 2026d). Ecosystem services may include water management and storage, aquatic habitat and biodiversity, or renewable energy generation. Details of this infrastructure is provided in Table 6-1. The location of the closure waterbodies in the ESE sub-area is shown in Figure 6-1 and in the MFS sub-area in Figure 6-2.

Water quality in the closure waterbodies has not been modelled but is expected to be affected by AMD as they are located within the BCM. Effects of AMD can be managed by directly discharging MSR effluent into the closure waterbodies to increase pH as done at the existing Escarpment Mine, for example where the pH of Pit 3 Pit lake increased from ~3.7 to ~7.5 in less than 2 years (MWM 2026a).

Additional water quality parameters (e.g., metals, TSS) will need to be considered in design stages to confirm water quality is acceptable for intended purposes in the long-term (e.g., water storage for potential energy generation, supporting aquatic life). Furthermore, habitat creation and habitat features will be needed to increase biodiversity (see below) if water quality is suitable to support aquatic life. Further detailed studies will be required to determine water quality and key habitat features and extent for each closure waterbody, where practicable within the disturbance footprint.

[redacted]

	[redacted]
[redacted]	
[redacted]	

[redacted]

Littoral habitat creation

Provision of habitat for local flora and fauna is a potential ecosystem service that closure waterbodies may be designed to deliver after mine closure. The following recommendations outline features that should be considered for the creation of littoral habitat in closure waterbodies. The littoral zone should have a shallow gradient/gentle shoreline slope and riparian planting, with habitat features added, such as woody debris and rocky substrates for colonisation and oviposition. The following features are suggested to support ecological function, biodiversity, and long-term stability where habitat creation, to support local aquatic and semi-aquatic flora and fauna, is the proposed ecosystem service for a closure waterbody:

- Variable depth and bathymetry – Shallow littoral zones for macrophytes and macroinvertebrates and deeper areas for kōūra refuge.
- Gentle shoreline slopes – Gradual slopes (e.g., ≤1:5) in the littoral areas will allow colonisation by emergent plants and safe access for wildlife. Avoid steep banks in the littoral area that will limit habitat diversity.
- Substrate diversity – Use a mix of fine sediments, gravels, and embedded boulders to mimic natural lakebeds and habitats.
- Aquatic vegetation zones – Plant native emergent, submerged, and floating species to provide cover, oxygenation, and food resources. Ensure selected species are suited to local conditions.
- Woody debris and structural complexity – Install large woody debris for macroinvertebrate and kōura cover/habitat. Position woody debris along shallow margins for amphibians and birds.
- Riparian buffer – Establish native riparian vegetation for shade, bank stability, and organic matter input, including appropriate plants, shrubs and trees for terrestrial–aquatic connectivity.

6.2 Offsetting, compensation and other positive effects

BRL is committed to offsetting, compensating and providing other positive effects to address residual effects of the Project on fresh waters, including the loss of extent and quality of stream habitats. In the context of large-scale open-cast mining, such as that proposed for the Buller Plateaux, the permanent removal of stream habitats and associated ecosystems makes like-for-like replacement—central to the “no net loss” principle of biodiversity offsetting—impractical. The Project will result in the irreversible loss or significant alteration of several headwater streams (e.g., Conglomerate, Trent, V40, Billo Stream tributary, etc.), in the ESE and MFS sub-areas. Recognising that full ecological equivalence cannot be achieved where entire streams are removed, BRL will undertake a suite of compensation measures. These initiatives, developed in accordance with consent conditions, aim to provide alternative forms of remediation or ecological benefit to counterbalance the residual adverse effects of mining on freshwater environments.

The compensation strategy for the Project encompasses a range of actions designed to achieve, as far as possible, no net loss of aquatic ecosystem function at a broader landscape scale. This includes the restoration of degraded streams beyond the immediate Project disturbance footprint and enhancement of aquatic habitats in the wider West Coast region.

6.2.1 Improving the ecological condition of Cascade Creek

Issue: Ecological condition in upper Cascade Creek is currently poor with the upper reaches characterised by highly acidic conditions (pH as low as 4.1) and elevated concentrations of dissolved metals (e.g., Al, Fe) resulting from AMD associated with historic mining (Section 4.4.1, Hogsden et al. 2025). Several historic underground mine discharges contribute to persistently degraded water quality. Poor water quality and poor instream habitat (where metal flocs and precipitates coat the streambed) has resulted in a depauperate macroinvertebrate community dominated by acid- and metal-tolerant taxa and, as such, very limited prey availability for fish in the upper reaches.

Approach: As BPCP mining operations progress in the ESE area, infrastructure and long-term PAF dumps/engineered landforms will be established within the Cascade catchment. Mine-affected water captured for treatment of pH, TSS, and metals removal will exit via Lake Brazil to the Cascade catchment (or to the Whareatea River). The Project will actively intercept and treat historic AMD sources within the ESE footprint (via intercepting historic underground flow paths via the ex-pit seal and treating water at the WTP and mining out a proportion of historic underground workings[31]), thereby effectively removing these sources of AMD. The treated water will primarily be discharged to Cascade Creek via its tributary, V8 Creek.

Outcome: The removal and interception of historic AMD sources, together with the addition of treated mine water to Cascade (Creek via its tributary, V8 Creek) is expected to substantially improve water quality and ecological outcomes in the upper catchment downstream of the V8 Creek confluence (and possibly further upstream where the ex-pit seal drains enter into the Cascade). The anticipated water quality improvements include increased pH and reduced concentrations of dissolved metals, as well as a reduction in metal flocs and precipitates on the streambed, resulting in improved instream habitat quality.

[31] Estimated 76 ha of historic underground workings will be removed during operations.

Improved water quality and substrate condition are expected facilitate the recolonisation of additional macroinvertebrate species from surrounding streams, increasing the abundance and taxonomic richness and improving prey availability for fish. Overtime, the combination of improved water quality, instream habitat and food resources should enable the return of native fish such as kōaro ("At Risk–Declining") and shortjaw kōkopu ("Threatened – Nationally Vulnerable"), which have already been observed further downstream where water quality is comparatively better (Hogsden et al. 2025). While the extent to which treated mine water will accelerate the removal or burial of existing metal flocs and precipitates on instream substrates remains uncertain (Hogsden and Harding 2012), overall ecological recovery is anticipated to occur progressively, with timelines varying among taxa depending on life-history traits and dispersal capacity (i.e. months to years). Collectively, the interception and treatment of historic AMD sources, removal of selected underground workings, and controlled discharge of treated water are expected to increase biodiversity, restore ecological functions, and support long-term recovery of aquatic communities in the upper Cascade Creek catchment, particularly downstream of the V8 Creek confluence.

6.2.2 Fish barrier remediation

Issue: Streams and rivers in the West Coast region have fish passage issues arising from instream structures such as culverts and flood control works. This is a common issue around New Zealand because culverts are often installed where streams/rivers intersect the roading network. These culverts can have high water velocities but are often also physical barriers which prevent many fish species from swimming upstream (particularly juvenile life stages). In West Coast waterways, these challenges are further compounded by the region's steep terrain, flashy hydrology, and frequent flood events, making it difficult to design and maintain structures that allow continuous connectivity for fish (and kōura) populations.

Approach: A strategic fish passage barrier remediation programme will be designed to enhance native fish populations across the West Coast region. This will involve a programme that adopts a three-stage approach: (1) immediate remediation of three known high-priority fish passage barriers, (2) a comprehensive regional assessment and prioritisation of instream structures, and (3) implementation of future remediation projects based on ecological value and feasibility, while also incorporating cultural, economic, social, and other relevant considerations to ensure a holistic and inclusive approach.

Outcome: This fish passage barrier remediation programme will deliver measurable ecological benefits for three known high-priority fish passage barriers, restoring aquatic connectivity and expanding habitat availability for fish populations.

A more comprehensive proposed plan for the fish barrier remediation is provided in Appendix C.

6.3 Monitoring

A robust, adaptive monitoring programme is proposed to assess ecological conditions against this assessment and inform management to achieve the proposed conditions of consent. Opportunities to incorporate Mātauranga Māori into monitoring (and management protocols) will be explored, with such approaches to be developed collaboratively over time with iwi (BRL 2026e). The aquatic ecology monitoring programme should be guided by clear objectives in conditions and use event-driven triggers so that any emerging issues prompt timely investigation and action. Key recommendations are summarised in Table 6-2.

6.3.1 Baseline, compliance and trend monitoring

The monitoring programme should have clear objectives. Baseline conditions will be established with three surveys at each proposed monitoring site completed by March 2027. Comprehensive annual surveys should be undertaken at compliance and reference sites to document the state of waterways through the term of the consents (35 years). Reference sites (unaffected locations) represent natural background conditions, while compliance sites (downstream of mining/activities) indicate any Project-related changes. Measured parameters would include water quality, instream habitat, bryophytes, periphyton, macroinvertebrate, and kōura as described in the AEMP (BRL 2026e). Monitoring frequency should be reviewed following transition from the operational (mining) to closure phases to determine if any changes are appropriate.

6.3.2 Event-based monitoring

In addition to the monitoring outlined above, the Project will implement an event-based monitoring to respond to inform responses to changes in water quality and ecological conditions associated with Project activities. Potential events have been identified through the Project Risk Assessment (BRL 2026g) and will guide when additional monitoring, investigation, or management response may be required. Any additional monitoring or investigations required will be advised by a suitably qualified freshwater ecologist ensuring responses are appropriate to local receiving environments and aligned with ecological protection and compliance objectives. This approach supports adaptive management throughout the Project.

6.3.3 Eutrophication risk management

Mining-modified landforms will use a range of sumps and water interception tools to reduce nutrient runoff. Expected increased nitrate (NO_3-N) concentrations from mining explosives, sewage, and fertiliser sources are predicted to be well below NPS-FM toxicity standards and ANZG guideline values (Hickey 2026a). Concentrations from ELF seepage and sump discharges (up to ~0.89 mg/L NO_3-N; Hickey (2026b) exceed the threshold where periphyton growth may be stimulated under suitable conditions (~0.44 mg/L; Biggs 2000). This presents a eutrophication risk that requires monitoring. However, it is noted that the strong phosphorus limitation, high flow variability, and shading typical of West Coast rivers mean the overall eutrophication risk remains low, except during prolonged summer low flows when cumulative nutrient inputs could allow localized growth. Furthermore, nitrate that passes through the passive treatment systems (MSRs) will be converted to nitrogen gas further reducing this risk. Monitoring of NO_3-N, ammoniacal-N, dissolved reactive phosphorus (DRP), and periphyton cover, alongside adaptive nitrogen management, is recommended to confirm and manage this risk.

6.3.4 Bryophyte community monitoring during passive treatment

Water management for the BPCP will alter water quality in some streams and there is a knowledge gap regarding how established bryophyte communities will respond to changes in a range of parameters during passive treatment (i.e., downstream of MSRs) (e.g., pH, alkalinity, turbidity; see Hogsden and Hickey 2025). For example, it is uncertain how long existing bryophyte mats can persist if stream water pH increases beyond their normal range. To address this, the monitoring programme will initially recommend bryophyte cover surveys at three-month intervals at *selected* reference and compliance sites at the start of passive treatment. Site selection should be based on whether passively treated water is entering upstream. Any notable declines in bryophyte cover would trigger additional investigation into changes in species composition to determine what mitigation or management actions may be needed (e.g., adjusting the pH of discharged water or transplanting bryophytes).

A recent assessment of bryophytes downstream of the MSR at the existing Escarpment Mine recorded eight taxa at three sites (pH > 7.5; Gorinski 2025). The bryophyte community – moss-dominated and low in diversity – reflected the modified habitat characterised by open, poorly shaded aquatic areas with coarse substrates and low exotic vegetation. These conditions contrast with those experienced by the liverwort-rich communities typical of natural streams on the Buller Plateaux (see Section 3.3.1). Targeted experiments to assess the tolerance of bryophyte communities in natural streams exposed to sustained pH conditions of 6.5–7.5 and additional assessments of bryophytes downstream of other existing MSRs on the Buller Plateaux (e.g., Whirlwind Stream, part of Stockton Mine treatment system) are recommended before the Project MSRs come online (from 2029 in MFS sub-area and from 2030 in ESE sub-area; MWM 2026j,k) with the results being used to inform the need for pH trimming of MSR discharges.

6.3.5 Kōura population protection and monitoring

Two key measures are recommended to protect kōura populations during the Project: (1) engineering design for kōura passage through culverts and (2) translocation of kōura out of streams that will be removed by mining (Section 5.2.1). To monitor the success of (1), selected sites would be monitored over time to ensure the culverts were functioning as intended and permitting kōura passage. [redacted] and inform future activities in other waterbodies that are created or remediated over the life of the consent. By maintaining habitat connectivity and relocating some individuals (where habitat was lost to mining), the Project can help ensure that kōura populations persist on the Buller Plateaux (see Section 6.1.1).

6.3.6 Focused recovery monitoring at compensation sites

Where proposed Project activities (e.g., addition of treated water, mining out and sealing off historic AMD sources, Section 6.2.1) are intended to improve water quality in Cascade Creek as part of the Project's offsetting, compensation and positive effects, higher frequency monitoring is recommended to track the ecological recovery process. Such data will serve two purposes: (1) to verify that conditions continue to improve (e.g., increasing pH, decreasing metal concentrations, reduction in metal precipitates, return of sensitive macroinvertebrates) and no relapses occur, and (2) to provide a model for what successful rehabilitation looks like in mine-impacted streams in the region. For example, if impacted reaches of Cascade Creek show ecological recovery, the patterns observed (in terms of species return rates, habitat changes, etc.) can inform expectations and planning for other streams. Any lessons learned from their monitoring – such as which macroinvertebrate or fish species are the last to reappear or what environmental thresholds must be met for recovery to accelerate – will feed back into the adaptive management strategy for the BPCP. Three years of biannual surveys are proposed initially followed by a review of monitoring data and frequency to track longer-term recovery trends.

7 Glossary of abbreviations and terms

AEE	Assessment of Environmental Effects
AEMP	Aquatic Ecology Management Plan
Al	Aluminium
AMD	Acid and metalliferous drainage
AMDI	Acid Mine Drainage Index
BACI	Before-After-Control-Impact
BART	Barrier Assessment and Reporting Tool
BCM	Brunner Coal Measures
BRL	Bathurst Resources Limited
BPCP	Buller Plateaux Continuation Project
CWD	Clean Water Diversion
CML	Coal Mine License Area
DCI	Dendritic Connectivity Index
DO	Dissolved oxygen
DOC	Department of Conservation
d/s	downstream
Cd	Cadmium
Co	Cobalt
Conductivity	Electrical conductivity (measured as μS/cm); index of ionic content. A measure of how well water conducts electricity.
Cr	Chromium
Cu	Copper
DVG	Default value guideline
Catchment	An area of land bounded by natural features such as hills from which surface waters flow into streams, rivers and wetlands
Construction runoff	Any runoff, sediment laden or otherwise, that flows as a result from construction-related activities. Typically results from rainfall events.
EcIANZ	Ecological Impact Assessment New Zealand
Ecological District (ED)	A specific geographic area with a characteristic landscape and range of biological communities
eDNA	Environmental DNA
EcIA	Ecological Impact Assessment
EIANZ	Environmental Institute of Australia and New Zealand

EPT taxa	Macroinvertebrate metric comprised of Ephemeroptera (mayflies), Plectoptera (stoneflies) and Trichoptera (caddisflies) taxa
ELF	Engineered Landform
ESE	Escarpment Extended (Project sub-area)
Fe	Iron
FPAP	Fish Passage Action Plans
FPAT	Fish Passage Assessment Tool
GCLs	Geosynthetic clay liners
KMS	Kaiata Mudstones
Kōura	Freshwater crayfish
Macroinvertebrate	Macroinvertebrates are small organisms without backbones (e.g., insects, snails and worms) that are visible to the naked eye, of a size that will not pass through a 0.5 mm sieve.
MCA	Multi-Criteria Analysis
MFS	Mount Frederick South (Project sub-area)
MIW	Mine Impacted Water
Mn	Manganese
MSR	Mussel shell reactor
MWM	Mine Waste Management Ltd
NAF	Non-Acid Forming: Rock that does not contain elements that may oxidise to form water soluble compounds capable of forming acid
NES	National Environmental Standard
NESF	National Environmental Standard for Freshwater
Ni	Nickel
NPS-FM	National Policy Statement for Freshwater Management
NTU	Nephelometric Turbidity Unit
NZFFD	New Zealand Freshwater Fish Database
MCI	Macroinvertebrate Community Index
QMCI	Quantitative Macroinvertebrate Community Index
PAF	Potentially-Acid Forming: Rock that contains elements which may oxidise to form water soluble compounds capable of forming an acid
RPS	Regional Policy Statement (WCRC)
SQEPs	Suitably Qualified and Experienced Practitioners
u/s	upstream

UWHR	Upper Waimangaroa Haul Road (Project sub-area)
TSS	Total suspended solids
VDT	Vegetation Direct Transfer
WCRC	West Coast Regional Council
WTP	Water Treatment Plant
Zn	Zinc

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Appendix A Metric interpretation tables

Table A-1: Interpretation of MCI and QMCI scores (Stark and Maxted 2007).

Quality class	Interpretation	MCI	QMCI/SQMCI
Excellent	Clean water	>119	>5.99
Good	Doubtful quality or possible mild pollution	100–119	5.00–5.99
Fair	Probable moderate pollution	80–99	4.00–4.99
Poor	Probable severe pollution	<80	<4.00

Table A-2: Interpretation of AMDI scores (Gray and Harding 2012).

Likely water quality	AMDI range
Severely impacted	<20
Impacted	20–40
Unimpacted	>40

Appendix B Tarns on the Stockton Plateau

Natural and constructed tarns (alpine and sub-alpine ponds) are present on the Stockton Plateau. Tarns are considered naturally uncommon ecosystems in New Zealand. As a group, tarns are listed as “Not Threatened” (Department of Conservation 2020), noting that due to their small size and limited geographic range tarns can be threatened by human activity.

Since the early 2000s, considerable work has been undertaken at Stockton Mine to rehabilitate or recreate tarns. In 2024, the water quality, physical habitat, macroinvertebrate communities and ecological value was assessed in 19 natural and constructed (man-made) tarns within and adjacent to rehabilitated areas across the Stockton Mine (Watson et al. 2024a). The rehabilitation success of the constructed tarns was also evaluated and suggestions to improve aquatic health in tarns were made (See Section 6.1.2). The survey included six natural and 13 constructed tarns, with one natural tarn (TN3) too dry to sample for water quality and macroinvertebrates (Figure B-1). Representative tarn site photos are shown in Figure B-2.

[redacted]

[redacted]

Water quality and physical habitat (including plants)

Across the 19 tarns, pH ranged from highly acidic (pH 3.3, TM6) to near circumneutral (pH 6.4, TM14), with most tarns having slightly acidic waters (pH 5.0–5.5). Conductivity varied across all tarns (8.9–381 µS/cm) and was low (<70 µS/cm) in most tarns except TM6. Very high rainfall may have been a driver of lower conductivity observed among tarns across the Stockton Mine, but significantly higher conductivity observed in constructed compared to natural tarns likely reflects that constructed tarns were built on rehabilitated mine land. Most tarns had slightly elevated dissolved metal concentrations, with concentrations of five contaminants of concern (i.e., Al, Fe, Mn, Ni, and Zn; Hickey et al. 2012) notably higher at TM6. In all tarns, the concentration of Al was above the trigger values established for the 95% protection of freshwater species (CCME 2003). The trigger values for Ni and Zn were only exceeded at TM6.

The tarns varied in surface area (range: 18–1491 m^2), water depth (range: 3 to >120 cm), physical habitat structure and aquatic vegetation. Most tarns had a sediment floor and did not show evidence of erosion or scouring around the tarn margins. One tarn had granite substrate (with thin sediment on top), and another had a coal floor. Water permanence varied across all tarns (50 to 100%). A range of algae, moss, aquatic grasses and vegetation were present in the tarns, noting seven tarns (five constructed, two natural) did not have any macrophytes (emergent or submerged aquatic plants).

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Appendix C Fish barrier remediation

Summary

This section outlines a strategic fish passage barrier remediation programme designed to deliver measurable ecological benefits, restore aquatic connectivity, expand habitat availability, and enhance native fish populations across the West Coast region as compensation for the Project.

The programme adopts a three-stage approach: (1) immediate remediation of three known high-priority fish passage barriers, (2) a comprehensive regional assessment and prioritisation of instream structures, and (3) implementation of future remediation projects based on ecological value and feasibility, while also incorporating cultural, economic, social, and other relevant considerations to ensure a holistic and inclusive approach.

This initiative aligns with Bathurst's environmental responsibility goals and is supported by regional stakeholders including the West Coast Regional Council (WCRC) and the Department of Conservation (DOC). It represents a proactive compensation option that enables remediation outcomes currently constrained by limited funding, contributing meaningfully to long-term biodiversity enhancement across the region.

Overall, by funding immediate and future remediation efforts, this package provides a scalable and enduring framework for improving freshwater ecosystem health and resilience on the West Coast.

Background and Regional Context

Instream structures such as culverts, weirs, and dams are a significant contributor to the decline of New Zealand's native freshwater fish populations. These barriers disrupt critical migratory pathways, preventing fish from accessing habitats essential for growth, reproduction, and survival. As a result, restoring river connectivity has become a national priority for freshwater biodiversity conservation.

The West Coast region is characterised by steep, high-gradient streams within short catchments, most of which are less than 50 km long. These dynamic systems are shaped by intense and frequent rainfall, which rapidly translates into high-energy stream flows. Such conditions pose unique challenges for fish passage remediation, as temporary solutions (e.g., plastic ramps) are often ineffective. Durable, engineered interventions are required to withstand frequent flood events and ensure long-term functionality.

A nationwide inventory by Franklin et al. (2023) identified over 131,000 instream structures, with nearly half located within 50 km of the coastline. The West Coast alone contains approximately 40,600 km of river length, yet only 21% of its network remains freely accessible from the coastline. An estimated 44% of the region's rivers are upstream of known fish passage barriers, and a further 35% are upstream of unassessed structures – highlighting the scale of the connectivity issue.

Under the National Environmental Standards for Freshwater (NES-F 2020) and the National Policy Statement for Freshwater Management (NPS-FM 2020), regional councils are required to develop Fish Passage Action Plans (FPAPs) to document and prioritise remediation of instream structures. However, progress on the West Coast is often constrained by limited funding and capacity.

The Department of Conservation (DOC) has identified a list of high-priority culverts requiring remediation, underscoring the urgency of the issue. This proposed compensation package aligns with DOC's high-priority list. Furthermore, the West Coast Regional Council (WCRC) has expressed support for this compensation package proposal, recognising its potential to significantly enhance freshwater biodiversity. Barrier removal and remediation will directly increase habitat availability and improve fish passage across the region's river network. But practical implementation to achieve this common goal has been impacted by funding constraints.

Stage 1: Remediation of Three Known Barriers

Objective – To restore fish passage at three high-priority barriers identified through systematic assessment, enabling immediate ecological gains and setting a precedent for future remediation efforts.

Background and Justification – The three barriers selected for remediation were identified using the Fish Passage Assessment Tool (FPAT). The FPAT comprises a mobile app for collecting data on instream structures and a database tool that uses the collected information to calculate the risk that a structure will restrict fish passage (see Franklin et al. 2023). The Ministry for the Environment has endorsed use of the FPAT to meet NPS-FM (2020) requirements for documenting existing instream structures. The FPAT database has been linked to the Barrier Assessment and Reporting Tool (BART), which applies a dendritic connectivity index (DCI) to quantify catchment and sub-catchment connectivity (Cote et al. 2009). BART prioritises structures based on the potential improvement in river connectivity that would result from remediation, enabling targeted investment in addressing barriers that deliver the greatest ecological benefit.

Four high-priority fish passage barriers were identified based on their high FPAT scores, the ecological significance of upstream habitats, and their proximity to the Buller Plateaux, where the BPCP is located (Figures C-1 & C-2). Although only three barriers are planned for remediation in Stage 1 of the compensation package, a fourth was included as a contingency.

This approach provides flexibility to accommodate unforeseen logistical challenges – such as delays in securing resource consent or landowner permission – that may impact the remediation timeline for any of the initial three barriers. If such issues arise, the fourth barrier will be remediated instead, ensuring that three barriers are still addressed within Stage 1.

Proposed activities include:

1. Project management
2. Site-specific engineering assessments to determine the appropriate remediation design (e.g., rock ramps, vertical baffles).
3. Stakeholder engagement, including landowners, council and iwi, to determine if any consents are required, and to ensure culturally and ecologically appropriate solutions are installed.
4. Implementation of on-site remediation works, managed by a suitably qualified person (e.g. Earth Sciences New Zealand) with contractors experienced (or to be trained) in fish passage restoration.

Proposed Timeline

- Month 0: all necessarily approvals in place prior to commencement of work.
- Month 1–2: Pre-remediation baseline data collection including fish surveys and measurement of passage efficiency (to serve as a control).
- Month 3–4: Design sketches completed, contractors secured, and remedial works undertaken.
- Month 4–5: Immediate post-remediation structural checks.
- Month 12-13: 12 months post-remediation fish surveys and passage efficiency monitoring to determine the early ecological response and effectiveness of the solution.
- Month 24: 2 years post-remediation fish surveys to determine the longer-term outcomes and effectiveness of the solution.

Expected Outcomes and Deliverables

Table C-1 summarises the expected ecological benefits from remediating four high-priority fish passage barriers identified for Stage 1 of the compensation package. Only three of these four will be remediated, with the fourth structure listed as a contingency option. Remediation of the top three barriers alone will restore access to approximately 11.8 km of upstream habitat currently inaccessible to native fish species such as īnanga, kōaro, and longfin eel.

These benefits are quantified using the Dendritic Connectivity Index (DCI) within BART. The DCI measures how well different parts of a stream network are connected for fish movement. Higher DCI values indicate improved ecological connectivity and greater access to critical habitats.

Table C-1: Expected increases in connectivity (%DCI) and accessible stream length (km) following remediation of each of the four high priority barriers.

Site	FPAT ID	Increase in connectivity (%DCI)	Increase in linear stream length (km)
Break Creek	142731	20	4.8
Whareatea River	152537	9	4
Little Wanganui River	149110	6	3
Little Wanganui River	148677	3	1.5

The effectiveness of the remediation will be measured using Before-After-Control-Impact (BACI) monitoring. This will provide robust evidence of changes in fish movement and habitat use resulting from barrier removal or modification.

Indicative Timing

Stage 1 would begin in Year 1 of the Project.

- **Rock ramp** remediation. Used to remediate perching and drops from an instream structure (e.g., culvert or weir).
- **Vertical baffles**. Used to remediate high water velocities within culvert barrels.

Stage 2: Investigation and Prioritisation of Existing Instream Structures

Objective - To identify, document, and prioritise 965 unassessed fish passage barriers across the West Coast region using a standardised methodology (FPAT and BART), ensuring future remediation efforts are strategic, cost-effective, ecologically beneficial, and aligned with regional conservation and cultural values. This work will complement DOC's high-priority list of culverts requiring remediation for fish passage.

Background and Justification - While many instream structures have been assessed, a significant number remain undocumented – particularly on private land or in remote catchments. Without a complete regional inventory, remediation efforts risk being ad hoc or misaligned with ecological priorities. This stage will establish a robust, repeatable framework for identifying and prioritising barriers, incorporating scientific data and local knowledge.

Proposed Activities:

1. **Field-based FPAT assessments.** Undertake comprehensive field assessments to document all instream structures across the West Coast region and evaluate their risk to fish passage. This workstream will include capacity-building through the upskilling of local council staff, tangata whenua, and summer students in fish passage assessment methodologies.
2. **Identification of high-priority barriers.** Apply a multi-criteria analysis (MCA) to identify and prioritise barriers to fish migration. This process will involve:
    - Utilising BART to assess potential ecological gains in catchment connectivity using the DCI.
    - Engaging with stakeholders, including landowners, councils, and iwi, to incorporate cultural, social, and economic values alongside ecological considerations.
3. **Development of remediation solutions.** Undertake targeted field surveys to ground-truth the high-priority barriers identified through the MCA. These surveys will inform the selection of appropriate, evidence-based remediation solutions tailored to each barrier. Field surveys will determine the suitability of the site for remediation contingent upon physical access for machinery and necessary approvals (e.g., landowner).

Expected Outcomes and Deliverables

- A comprehensive, region-wide inventory of fish passage barriers.
- A prioritised list of remediation projects based on ecological, social and cultural values.
- Strengthened partnerships with iwi, local government, and community groups.

- Enhanced regional capacity for ongoing fish passage work.

Indicative Timing

To be developed based on scope, number of structures ground-truthed, and level of stakeholder involvement. Stage 2 would begin in Year 2 of the Project (pending approval) and is expected to take approximately two years. Ideally, the FPAT and BART assessments would be carried in the spring/summer of year one and development of remediation solutions and concept designs would occur in year two.

Stage 3: Implementation of Future Barrier Remediation Projects

Objective - To implement fish passage remediation projects based on the prioritisation framework developed in Stage 2, targeting high-priority barriers and integrating efforts with broader catchment restoration initiatives.

Background and Justification - Stage 3 builds on the outputs of Stage 2, enabling targeted remediation of barriers that offer the greatest ecological, social and cultural gains. This phase will also support long-term regional capacity building, ensuring fish passage restoration becomes embedded in local conservation planning and infrastructure management.

Proposed Activities

- **Remediation Implementation.** Undertake remediation works following the established process from Stage 1, including engineering design, stakeholder engagement, construction, and post-implementation monitoring for a total of up to 6 to 10 projects completed depending on the remediation option required for a particular site Where feasible, remediation efforts will be aligned with complementary freshwater restoration initiatives led by other entities (e.g., WCRC, DOC, community groups, iwi). These may include activities such as riparian planting and sediment control, with the aim of maximising ecological outcomes and enhancing overall catchment health.

- **Effectiveness Monitoring.** Apply a BACI monitoring and passage efficiency monitoring framework at selected sites to evaluate the ecological effectiveness of installed fish passage solutions. Engagement with iwi, landowners, and other stakeholders will be incorporated to validate findings, integrate mātauranga Māori, and inform adaptive management of future remediation efforts.

- **Data Updates and Reprioritisation.** Update FPAT records post-remediation and re-run BART to reassess and reprioritise remaining barriers. This will ensure that future efforts are aligned with the evolving connectivity network and regional biodiversity priorities.

- **Capacity Building.** Provide ongoing training and technical support for local contractors, council staff, and iwi representatives to build regional expertise in fish passage remediation and ensure long-term programme sustainability.

Expected Outcomes and Deliverables

- Remediation of additional high-priority barriers across the region.

- Measurable improvements in fish passage and habitat connectivity for native fish species across multiple catchments.
- Contribution to regional biodiversity goals and freshwater ecosystem resilience.
- Sustained partnerships and capacity for long-term fish passage work.
- Increased resilience of freshwater ecosystems.

Indicative Timing

To be determined based on barrier type, location, and remediation method; e.g., rock ramps, baffles, or full structure replacement. Stage 3 would begin by Year 4 of the Project (pending approval) and is expected to run for approximately 6–7 years.