PROPOSED WAITAHA HYDRO SCHEME

ASSESSMENT OF ENVIRONMENTAL EFFECTS

WHIO BLUE DUCK (*HYMENOLAIMUS MALACORHYNCHOS)*

July 2025

Report prepared for Westpower Ltd

Report prepared by: Fred Overmars (Sustainability Solutions Ltd)

Report peer reviewed by Dr John McLennan (Environmental Services Ltd)

Statement confirming compliance with the Environment Court's Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023

As an expert witness or peer reviewer, I have read, and I am familiar with the Environment Court's Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023.

I have prepared my, or provided input into, an assessment of effects for the Waitaha Hydro Scheme in compliance with the Code of Conduct and will continue to comply with it in this Fast-track Approvals Act process. In particular:

- my overriding duty is to assist the decision-maker impartially on matters within my expertise;
- unless I state otherwise, my assessment is within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express; and
- I have not, and will not behave as, an advocate for the Applicants.

Additional matters clarifying obligations set out in cl 9 of the Code of Conduct are addressed in Appendix I.

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Cover Photo: whio pair (centre) on large rock slab (disturbed from a roosting site), on north bank of Waitaha River near proposed Scheme intake and construction zone at Morgan Gorge entrance (IMG_3560, 2024-09-28).

1. INTRODUCTION

1.1 Westpower Ltd (**Westpower**) proposes a run-of-the-river hydro-electric power scheme (the **Scheme**) on the Waitaha River, approximately 60 km south of Hokitika on the West Coast of the South Island | Te Tai Poutini, Aotearoa New Zealand ('Aotearoa') (**Figure 1**).

1.2 The proposed Scheme is a run-of-the-river design with no instream storage. The Headworks situated at the top of Morgan Gorge include a low weir (<4 m high, up to 7 m in the sluice/diversion channel) and an intake structure that will divert water into a pressurised tunnel and desander. The 1.5 km long pressurised tunnel will convey the diverted water down to a Power Station below Morgan Gorge. After passing through the turbines, the diverted water will be returned via a tailrace discharging to the Waitaha River mainstem near the confluence with Alpha Creek. The Scheme will divert up to a maximum flow of 23 m^3/s (cumecs), while maintaining a minimum residual river flow of 3.5 m^3/s immediately downstream of the intake; there will be no abstraction when the river flow is below 3.5 m^3/s. The design includes a 10 m^3/s bypass valve to maintain water flow following Power Station outages. Emergency sirens will be installed at the Intake and Power Station to warn people of a sudden change in water flow in the event of emergency Power Station outages and of the opening of the 10 cumec bypass valve. The abstraction reach comprises approximately 2.5 km of the Waitaha River, including Morgan Gorge. Construction access to the Headworks above Morgan Gorge would initially be via helicopter and/or on foot and then via the parallel access tunnel once it is completed. There would be an access road plus 66 kV transmission line corridor (average 15 m in width) from Anderson Road to the Power Station. A new 66 kV line will be built along Waitaha Road (except the beginning) to the Power Station, and the existing transmission line at the beginning of Waitaha Road and along State Highway 6, Beach Road and Bold Head Road will be upgraded (hosting both 66 kV and 11 kV circuits). There will be road access from the access tunnel portal at the Headworks to the Waitaha River, and a temporary construction access between the access tunnel portal and nearby Construction Staging Area 1.

1.3 This report covers the full range of Scheme structures and activities other than the proposed Construction Staging Area 3 and Spoil Disposal Areas on the privately owned farm (these are highly likely to be beyond the range of whio activity and habitat). Further detail on the project design and project background information as it relates to whio is set out in **APPENDIX A**.

1.4 In preparing this report, the description of the proposed Scheme and Project Site as set out in the **Project Description** (and the **Project Overview Report**) has been considered.

1.5 A kōwhiowhio blue duck (*Hymenolaimus malacorhynchos*) (hereafter 'whio') population is present on waterways within and adjoining the Scheme area. Potential effects on whio arise from many aspects of the Scheme.

1.6 Westpower has commissioned Sustainability Solutions to assess the potential effects of the Scheme on kōwhiowhio blue duck (**Whio Report**).

1.7 This report:

- describes the investigations undertaken
- considers and assesses the existing environment relating to whio including, values and significance of the Project Site and potential effects of the Scheme on whio and whio habitat
- considers and assesses how (if necessary) these effects are proposed to be avoided, mitigated or remedied, and where necessary if more than minor adverse effects remain, how these should be managed through additional measures.

1.8 This report draws upon other Scheme studies of aspects of whio and whio habitat: the **eDNA Report** (prepared by S. McMurtrie and C. Grima; McMurtrie & Grima 2024); **Freshwater Ecology Report** (prepared by S. McMurtrie and C. Grima; McMurtrie & Grima 2025); **Hydrology Report** (prepared by M. Doyle, Consulting Hydrologist; Doyle 2025); **Noise Report** (prepared by A. Staples; Staples 2025); and **Sediment Report** (prepared by M. Hicks; Hicks 2025).

1.9 **Appendix B - Scope and Approach of Whio Report** has further detail on the scope and approach of this report.

1.10 Te Rūnanga o Makaawhio and Te Rūnanga o Ngāti Waewae (Poutini Ngāi Tahu) are acknowledged as holding tino rangatiratanga and as kaitiaki of whio in their takiwā (tribal district). Poutini Ngāi Tahu have a partnership agreement with Westpower in relation to the Project, as discussed by Mr. Armstrong in his report.

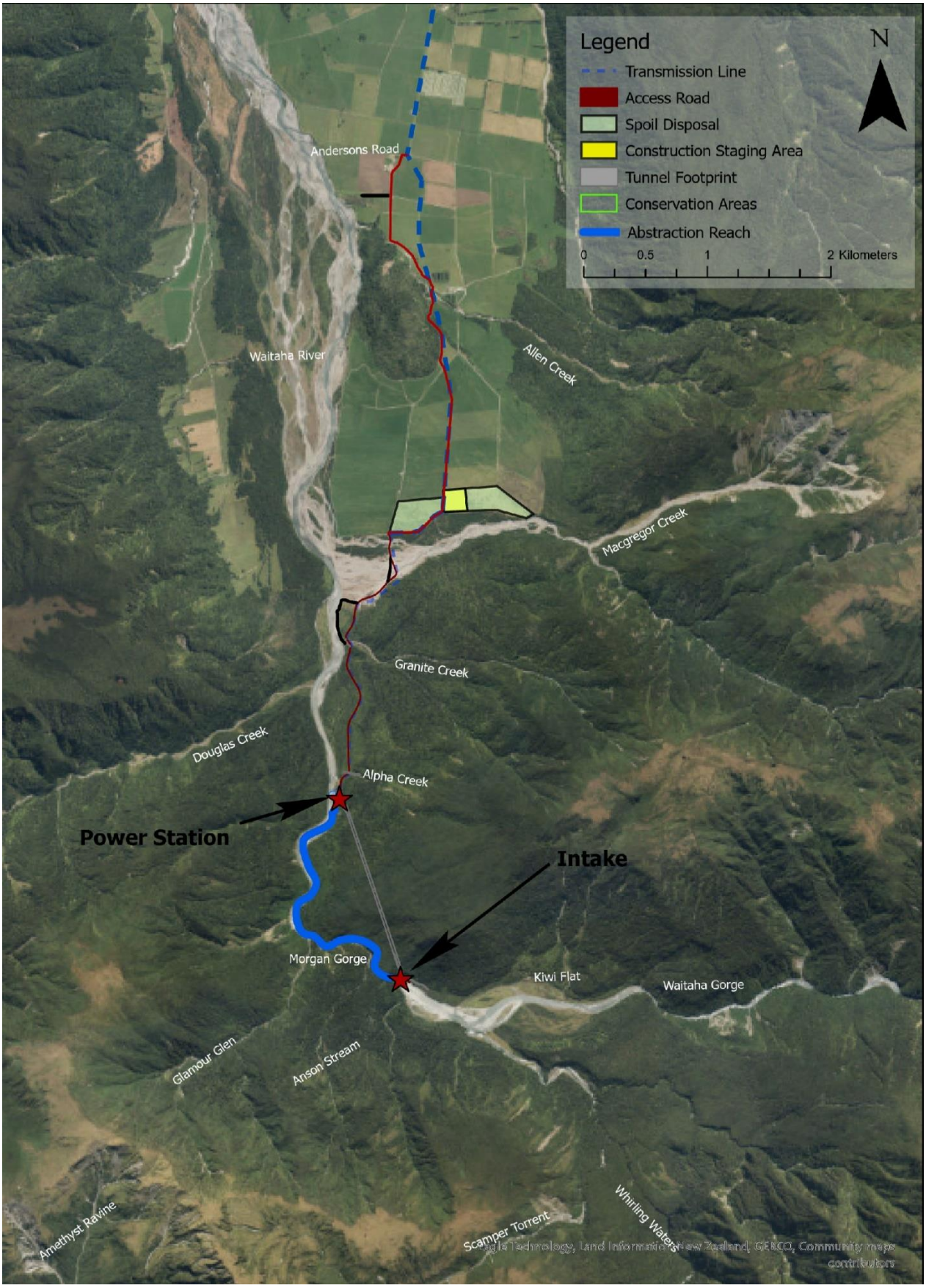

Figure 1: Waitaha Hydro Scheme overview and site locations (in relation to whio). (Source: Westpower)

2. EXISTING ENVIRONMENT

2.1 INVESTIGATIONS [1]

2.1 Baseline investigations were undertaken in 2006–2012 to assess:

- the whio population in the Scheme area, the balance of the Waitaha River catchment, and in the nearby Amethyst Ravine tributary of the Wanganui River
- breeding, longevity and territorial use in the Scheme area and vicinity
- whio aquatic habitat use preferences in the Scheme area and vicinity
- the introduced predator community in and adjoining the Scheme area and vicinity.

2.2 A whio survey was undertaken in spring 2024 to assess the current whio population status of the section of river and the tributaries that would be directly affected by or would closely adjoin the proposed Scheme. If the current population was found to be similar to that at the time of the previous surveys, it was considered reasonable to place some reliance on earlier findings, particularly population dynamics (breeding, mortality, immigration).

2.2 WHIO AND WHIO HABITAT[2]

2.3 Whio have cultural, spiritual, historic and traditional significance to Māori (Glaser et al. 2010) and are listed as a taonga species under the Ngāi Tahu Claims Settlement Act 1998.

WHIO POPULATION, DISTRIBUTION AND CONSERVATION STATUS

2.4 The total whio population is estimated at about 3000 (Department of Conservation 2024a). The DOC five yearly census in 2021 counted 863 pairs, 491 pairs in the North Island, and 372 pairs in the South Island. The number of whio pairs in monitored areas declined from 694 in 2022 to 587 in 2023, in part due to the impact of severe weather events like ex-Cyclone Gabrielle (Department of Conservation 2023).

2.5 Once abundant and widespread in Aotearoa, whio distribution and numbers have been diminished by habitat loss and predation, and they are now limited to rivers in forested catchments in Te Urewera, East Cape and central North Island, and along the West Coast of the South Island from Nelson to Fiordland. The species has been reintroduced to Taranaki Maunga. A slow contraction and fragmentation of whio range continues, especially in remote South Island areas (Innes et al. 2010; Williams 2025).

2.6 Whio is classified as a nationally vulnerable species (qualifiers: Conservation Dependent, Climate Impact, Partial Decline, Sparse), with a low to high ongoing or forecast population decline of 10–50% (Robertson et al. 2021). The species' long-term survival is dependent

[1] Further details of the investigations undertaken on whio and whio habitat in relation to the proposed Scheme are shown at **Appendix C - Investigations**.

[2] Further details of the existing environment in relation to whio and whio habitat are shown at **Appendix D - Detail of the Existing Environment**.

on in situ management in suitable large-scale mainland river systems, in particular, protection from the key threat of stoat (*Mustela erminea*) predation (Glaser et al. 2010).

2.7 The first priority of the current whio/blue duck recovery plan (Glaser et al. 2010) is to secure populations to a minimum of 400 pairs at eight 'Security Sites' spread through Aotearoa, each with a minimum of 50 pairs. Its second priority is to recover or re-establish populations throughout their former range, including having at least 100 pairs distributed between strategically located 'Recovery Sites'. A recent study found that more than 50 breeding pairs should be protected within a security site because of the low effective population size; and the higher genetic diversity and identification of at least two genetic clusters in the South Island warrants the establishment of additional security sites, particularly in Central South Island and Fiordland (Grosser et al. 2017). In 2024, there were 44 pairs in the Central Southern Alps security site, the security site nearest to the Scheme area.

WHIO GENETICS, ECOLOGY AND BEHAVIOUR

2.8 Whio is an endemic Aotearoa species and genus (Checklist Committee 2022). North Island and South Island whio represent two genetically distinct lineages (Grosser et al. 2017). The overall genetic diversity in whio is low and effective population size is small, putting the species at risk of further loss of genetic diversity due to genetic drift and inbreeding (ibid.).

2.9 Whio are specialist feeders and occupy a riverine habitat in which food is available in adequate quantity year-round and other essential resources (shelter, nesting sites, brood-rearing habitat) are present. They feed in shallow or deep water in rapids and pools, taking food from turbulent riffles, eddies downstream from rocks, and from rocky beds or shores (Marchant & Higgins 1990). They are primarily visual feeders of the water column (Martin et al. 2007). Food consists mostly of caddisfly larvae and other aquatic invertebrates, and sometimes algae and berries (Williams 2025).

2.10 The river sections in which whio now occur have comparatively higher gradients, shallow river margins, stable stream banks, stable coarse river substrates (with high proportions of boulders), pool and riffle sequences, abundant invertebrate prey, and forested catchments and riparian margins (Collier et al. 1993; Williams 2025). The water is fast-moving, cold, clear and highly oxygenated, and there is typically low transport of fine or suspended sediments. Birds can occur in forest streams as small as 0.3 m wide (Marchant & Higgins 1990; pers. obs.). In Te Urewera, most observations on side streams occurred late in the breeding season or during the moult period (Glaser & Allerby 2010).

2.11 Whio are generally encountered year-round as territorial pairs dispersed serially along a river, with single males attempting to claim space between pairs (Williams 2025). Once established, the territory is generally held for life.

2.12 Peak nesting time in the South Island is September to November (Studholme 2000). Renesting is uncommon and rarely occurs later than November. Nests are usually close to river edges in concealed sites, often in highly inaccessible locations. The incubation period extends for 33–35 days (Williams 2025), (Williams 2025). Whio are not necessarily faithful to the same nest sites in successive years (Williams 1991).

2.13 Moulting occurs over about 6 weeks, often in small side streams. In field studies in the Waitaha and Amethyst, birds showing signs of moulting were found in December and January. No moulting sites were found. Moulting can extend later if birds re-nest (Marchant & Higgins 1990).

2.14 Whio ducklings are relatively mature and mobile from birth (Marchant & Higgins 1990). They typically leave the nest within 48 hours of hatching. They can swim against strong currents and jump on rocks and ledges. Mortality of pre-fledged ducklings from flooding can be high. The mature ducklings gradually disperse from the territory when their parents start their post-breeding moult and are forcibly challenged and evicted by the adults after moulting. Age of first breeding is one or two years (Williams 2025).

2.15 Juveniles attempt to establish territories near their natal territory; settlement in rivers beyond their natal catchment is rare. This causes high levels of genetic relatedness within sections of rivers and strong genetic patterning between rivers (Williams 2025).

WAITAHA RIVER CHARACTERISTICS

2.16 The Waitaha River and its tributaries present a highly dynamic habitat for whio. The river is glacier-fed and drains a steep mountain catchment on the western slopes of the Southern Alps Kā Tiritiri o te Moana. The sometimes intense rainfall, seasonal temperature variation, and the effect of melting snow and ice together considerably influence the nature of river flow conditions (**Hydrology Report**). Increasing rainfall caused by climate change will exacerbate glacial melt.

2.17 In spring and early summer, the river flows high, and is discoloured with snowmelt. Flows recede over autumn and into winter, when flows drop to low levels and the river runs clear during dry periods.

2.18 The annual median flow at the Morgan Gorge entrance is 19.7 m^3/s and the annual mean flow is 34.6 m^3/s; the difference indicates the strong contribution of floods. The mean annual flood flow is 812 m^3/s, and the mean 20 year flood is 1177 m^3/s. The mean period between floods is 8.6 days, and the length of a flood is typically around two days.

2.19 The one day mean annual low flow (MALF1) is 7.09 m^3/s, and the seven day mean annual low flow (MALF7) is 7.57 m^3/s.

WHIO HABITAT IN SCHEME AREA

Kiwi Flat to Morgan Gorge

2.20 Kiwi Flat is a low gradient and wider section of the Waitaha River between the Waitaha and Morgan Gorges. Substrates are silt, sand, gravel, cobble and boulder, and the principal channel morphologies are run, riffle, plane bed and 'rock garden'. It has areas of defined channels that shift in location over time. During large flood events, flows through Morgan Gorge are constricted by its narrow dimensions and water levels rise and back up on Kiwi Flat towards and above the Whirling Water confluence (**Sediment Report**). This process results in a substantial drop-out of gravel, silt and sand in the reduced water velocities of

the backwater. Between major floods, the deposited bed material is reworked down the Waitaha channel to Morgan Gorge.

2.21 Kiwi Flat provides high quality whio feeding habitat because of the large extent, relative stability and invertebrate productivity of its relatively shallow and slower flowing waters amongst sand, gravel and cobble substrates. The lower reach of Whirling Water (a major tributary entering at Kiwi Flat) has similar characteristics but without glacial sediments, adding variety of habitat in a range of flow conditions. These factors, with the low altitude, may possibly be resulting in lower daily energy expenditure requirements (Godfrey et al. 2003).

2.22 Below the Whirling Water confluence, the Waitaha River is a single channel that steepens as it runs into Morgan Gorge. This provides less favoured whio habitat.

2.23 Caesar Creek, Labyrinth Creek and at least one of several other unnamed tributaries are also used for feeding, and may be used for moulting.

Abstraction Reach (Morgan Gorge to Tailrace)

2.24 In the Morgan Gorge section of the proposed abstraction reach (1.0 km, *c.*55 m fall), the Waitaha River has cut a slot gorge into basement rock. Channel morphology is mainly whitewater rapid, and the substrate is mainly bedrock and large boulders. Morgan Gorge is not known to be directly used by whio.

2.25 The abstraction reach below Morgan Gorge (1.5 km, *c.*50 m fall) primarily has a confined channel. The channel gradually widens (up to 30–50 m) and the bed flattens towards the proposed tailrace site. Substrate consists of bedrock, large boulders and shifting gravels, and more mobile fine sediments in higher velocity waters. Channel morphology changes from predominantly bouldery step pool and cascade to planebed. Water depths and velocities are much greater than those found to be preferred by whio, making for less favoured (though still used) whio habitat.

2.26 Anson Stream and other small tributaries enter the Morgan Gorge section via waterfalls or cascades. Anson Stream is used as feeding habitat, and lower Anson Stream may be used for nesting habitat. Glamour Glen and several other tributaries enter below Morgan Gorge. Glamour Glen is known to be used as feeding habitat.

Tailrace to Douglas Creek and Macgregor Creek and to Andersons Road

2.27 The river gradient reduces further in the reach from the proposed tailrace to the Douglas Creek and Macgregor Creek confluences (*c.*1.8 km length, 20 m fall). Although water depths and velocities are greater than those found to be preferred by whio, this reach is nevertheless regularly used.

2.28 Douglas Creek, running along the Alpine Fault, is a smaller tributary, with a substantial bedload. Macgregor Creek, a largely underground tributary with a large alluvial fan formed from a major landslide in 1903 (‘Robinson Slip’), discharges into the Waitaha River 800 m downstream of the Douglas Creek confluence. Whio are regularly present in Douglas Creek, and there has been a recent report of a single whio in lower Macgregor Creek.

2.29 Between the Macgregor Creek confluence and Andersons Road (c.4 km, 20 m fall), the Waitaha River opens up and becomes braided with expanses of gravels. There is less forest riparian habitat. Such habitat is not usually considered to be whio habitat, but a whio pair were recently recorded near Andersons Road.

WHIO POPULATION IN SCHEME AREA

2.30 Between 2006–2012, the whio population at Kiwi Flat was surveyed on seven occasions and the population in the abstraction reach down to the Douglas Creek confluence on five occasions. These sections were again surveyed in 2024.

2.31 Together, the results of the 2006–2012 surveys (including reported birds; 8-12 birds, 3–4 pairs) and the 2024 survey (12 birds, 4 pairs) suggest there has not been a substantial change of population state since 2012 at Kiwi Flat and down to the Douglas Creek confluence). Whether there was some constancy or variation in the intervening period cannot be determined.

2.32 The spatial distribution of the three pairs found at Kiwi Flat in 2024 is similar to the territorial pattern found during the 2007–2011 field studies. This adds to the evidence that there has not been a substantial change of population state at Kiwi Flat compared with that in 2006–2012.

2.33 There are recent reports of a whio pair seen on a farm pond and water race on Waitaha Farm in June–July of the past two years; a pair seen on the Waitaha River near Andersons Road in December 2024; and a single whio seen on Macgregor Creek in September 2024. Given their proximity in space and time, the two pair records are likely to be the same birds. Whether these reported birds are the same as birds found upstream during the 2024 survey, or are additional birds, is uncertain. There is no comparable data for these river sections (and the farm) during the earlier surveys.

2.34 Depending on whether or not the whio reported in 2023–2024 on the farm pond and near Andersons Road, and at Macgregor Creek, are different from other whio found upstream, there are 12-15 (4-5 pairs) currently known in the Scheme area. Pair density on the Waitaha River mainstem at Kiwi Flat was 0.83 per km (3 pairs in 3.6 km); and 0.17 or 0.33 per km (1 or 2 pairs in 6.0 km) between the Morgan Gorge mouth and Andersons Road. Tributary habitat may be contributing to these densities. On a mainstem basis, the Kiwi Flat density ranks third amongst 11 other known pair densities across Aotearoa (Godfrey et al. 2003).

2.35 Data from studies elsewhere indicate the whio population in the Scheme area is likely to be connected to other populations in the central Southern Alps, like a metapopulation, particularly through juvenile dispersal (Shaw 2012). The nature and scale of movement between the population in the Scheme area and those in adjoining catchments is, however, largely unknown.

2.36 Demographic analysis of the Kiwi Flat population in 2007–2011 showed there was insufficient local productivity to compensate for the high adult mortality, and to ensure long-term population stability (Overmars 2014). Yet the Kiwi Flat breeding population was

reasonably stable over the six year study period (7–11 total adults). The analysis indicated that the population is receiving immigrants from elsewhere, probably juveniles, and it could not persist in the absence of this immigration. This was supported by evidence of two and possibly four immigrant birds during the 2007–2011 study period. The then high density population at Amethyst Ravine was suggested as a likely source of immigration into the Kiwi Flat. Its current contributions to the Waitaha population are now questionable given the 2024 survey finding that the Amethyst Ravine population has halved since 2008.

2.37 In the 2024 survey, whilst one pair and two single males were found in the Morgan Gorge to Douglas Creek confluence reach, no whio scent nor sign was observed on the true right (eastern) bank. Faecal sign was abundant on the true left bank. This indicates the true right bank, where the proposed Power Station would be located, was not at that time subject to active whio habitat use (although use at other times is not precluded).

2.38 Although Morgan Gorge itself could not be surveyed and is unlikely to be used directly by whio as habitat, there was evidence in the earlier field studies of it being used as a flyway. There was evidence in December 2007 of a nesting attempt in Anson Creek just above its fall into Morgan Gorge (based on the presence of bird sign within the previous 24 hours in scrub alongside the stream).

WHIO POPULATION IN AMETHYST RAVINE

2.39 The whio population in a 5 km elevated valley reach of the Amethyst Ravine was surveyed on three occasions in 2007 and 2008, and again in 2024. Between 14–18 adults (including 5–8 pairs) were found on the three earlier occasions, a high density population (1–1.6 pairs/km). Eight adults and three pairs (0.6 pairs/km) were found in 2024. The current population is approximately half of what it was 16 years ago.

WHIO POPULATION ELSEWHERE IN WAITAHA CATCHMENT AND IN ADJOINING CATCHMENTS

2.40 The April 2007 survey also covered the Waitaha River above Kiwi Flat (including Reid Creek, Stag Creek and County Creek), and Scamper Torrent. It found a total of 17 birds including six pairs. The total Waitaha catchment population at that time thus was 27–28 adults (including nine pairs).

2.41 Between the Waitaha catchment and the Central Southern Alps security site, iNaturalist (since 2015) and eBird show scattered whio records in headwater catchments of the Hokitika River (excluding the Styx River), and in the Mikonui catchment. On the western side of the Main Divide southwards to the Haast River valley, there are concentrations of records in the Whataroa-Perth catchments (reflecting Predator Free South Westland activity) and in the Copland/Karangarua Valley, and single records at several other sites.

WHIO FOODS AND AQUATIC HABITAT USE PREFERENCES

2.42 Notwithstanding they are primary whio feeding habitat, the mainstem of the Waitaha River and most tributaries have low benthic invertebrate densities, species diversity, and species evenness, relative to stable tributaries (**Freshwater Ecology Report**). Abundant

and common taxa in whio faecal samples collected from the Waitaha River and Amethyst Ravine in April 2007 included Ephemeroptera (mayflies), Hydrobiosidae (caddisflies), Blephariceridae (net-winged midges), Maoridiamesinae (non-biting midges), Orthocladiinae (non-biting midges) and Elmidae (riffle beetles) (Overmars & McLennan 2010). Abundant seeds were also present, and in samples collected from the lower reaches of Whirling Water in June 2011.

2.43 Water depth and velocity data for assessing whio aquatic habitat feeding preferences at the Waitaha River were collected between September 2006 and January 2008 at a total of 60 sites where whio were observed feeding. Waitaha-specific habitat suitability criteria for whio were developed by Cawthron Institute (Allen & Hay 2013).

2.44 Whio used depths ranging from 0 to 1.1 m, with the optimum being relatively shallow water (0.21 m). This optimum is substantially shallower than the average depth under low flow conditions (~0.47 m at MALF1).

2.45 Velocity use ranged from 0 to 1.3 m/s. Velocity use curves were derived from data from all 60 sites, giving an optimum value of 0.23 m/s. These velocities are slower than the average velocity under low flow conditions (~0.43 m/s at MALF1 at Kiwi Flat), indicating whio prefer low velocity locations.

2.46 Overall, the study found that whio feeding habitat is predicted to increase because of the proposed flow reduction in dry and typical months, with no change in wet months (e.g. with a 19 m3/s abstraction, 90–175% habitat retention).

INTRODUCED SPECIES AND THEIR IMPACTS

2.47 Didymo (*Didymosphenia geminata*) is a freshwater alga that has recently arrived in Aotearoa (Kilroy & Unwin 2011). Thick growths of didymo form large mats on the bottom of streams and rivers that can adversely affect aquatic life. Didymo is a potential threat to whio as it can reduce their food source (Glaser et al. 2010). The recent eDNA sampling of the Waitaha catchment (**eDNA Report**) detected didymo at three tributary sites at Kiwi Flat and one mainstem site near Douglas Creek. The generally low didymo DNA signatures at these sites indicate didymo is not presently a dominant feature of the environment. The Waitaha River is likely to be less conducive to didymo blooms than many other rivers given its frequent floods and high suspended sediment loads that would keep biomass to a minimum.

2.48 Trout (and other diadromous fish species—including longfin eels (*Anguilla dieffenbachii*)—but except kōaro (*Galaxias brevipinnis*)), are not present above Morgan Gorge due to multiple natural barriers (**Freshwater Ecology Report**). There is evidence for competitive resource partitioning between whio and brown trout (*Salmo trutta*) over aquatic macroinvertebrate food supplies. While there is not a strong difference in invertebrate diversity and density above and below the gorge, a relationship between trout absence above Morgan Gorge and the relatively high whio numbers there remains possible, mediated by the lack of forced whio nocturnal feeding caused elsewhere by a corresponding invertebrate behavioural shift induced by trout.

2.49 A baseline assessment of small mammals found the Scheme area supports all of Aotearoa's most significant introduced predators: ship rats (*Rattus rattus*), mice (*Mus musculus*), possums (*Trichosurus vulpecula*) and stoats (Overmars & McLennan 2010). At the time of the surveys (January and May 2007), these predators were all at levels of abundance that exceeded recognised damage thresholds for reptiles, large invertebrates and various forest birds. The abundance of predators and the occurrence of predator irruptions in the Scheme area are a function primarily of periodic increased food supplies from rimu (*Dacrydium cupressinum*) masting. The predator abundance in summer-autumn 2007 likely was in response to rimu masting in autumn 2006. Stoat irruptions following rimu masting resulted in high rowi (*Apteryx rowi*) mortality at the nearby Ōkārito kiwi sanctuary (Robertson & de Monchy 2016).

2.50 The key current threat to whio is stoat predation (Whitehead et al. 2008, 2010; Glaser et al. 2010; Innes et al. 2010). Nesting whio females and their eggs are especially vulnerable over the long incubation period to stoats and possums, while rats and weka (*Gallirallus australis*) have been implicated in nest and egg destructions. Being flightless, moulting whio of both sexes are also vulnerable to attacks from predators.

2.51 Aerial 1080 pest control operations by OSPRI and its predecessors for the purpose of controlling and eradicating bovine tuberculosis (*Mycobacterium bovis)* have occurred in the foothills of the Waitaha Valley and adjoining areas for the past 30–40 years, including the Scheme area (Livingstone et al. 2015; [redacted], OSPRI, pers. comm. 2024-11-04). Given the benefits of this pest control for native avifauna (Innes et al. 2010; OSPRI 2016; Van Vianen et al. 2018), it is possible that the absence of decline of whio (and other avifauna) in the Scheme area since 2006 is related to the OSPRI 1080 operations. As OSPRI pursues its TB eradication intent, its aerial 1080 usage is expected to fall away to zero by 2030 (OSPRI 2021). An aerial operation in the upper Waitaha planned for January 2026 (OSPRI 2024) would extend down the valley only to the Waitaha Gorge, thus excluding the Scheme area. The withdrawal of OSPRI 1080 operations will likely place whio in the Scheme area and adjoining areas at increasing risk from predators.

MAJOR PERTURBATIONS: CLIMATE CHANGE, ALPINE FAULT AND SEDIMENT, AVIAN INFLUENZA

Climate Change

2.52 Recently updated climate projections, applied to the Kiwi Flat area, relative to a 1995–2014 baseline (20 years ago) and particularly relevant to whio include (using three Shared Socioeconomic Pathways, SSP1-2.6, SSP2-4.5 and SSP3-7.0; Ministry for the Environment 2024a) provide that average temperatures, summer temperatures, annual rainfall, number of very rainy days, and heavy rainfall (at the 99th percentile) will all increase significantly out to 2050 and 2090.

2.53 Whio meet two of five qualifiers for threatened and at risk species to be classified as 'Climate Impact' species: riverbed specialists that will be subject to greater fluctuations of river flow, and forest birds that will be subject to greater predation by rodents and mustelids as a result of an increased frequency and magnitude of beech masting events

(Robertson et al. 2021). The exclusion of podocarp forest (as occurs in the Scheme area) from the qualifier may reflect the greater declines between 1969–1979 (Bull et al. 1985) and 1999–2004 (Robertson et al. 2007) in whio distribution in beech forest than in podocarp forest.

2.54 A climate change vulnerability assessment (Brumby et al. 2025) assessed 1145 Aotearoa species against 16 traits within three dimensions of climate change vulnerability – sensitivity, low adaptive capacity and exposure. It identified whio as at 'latent risk' under three climate change scenarios and timeframes and 'highly vulnerable' under a high emissions scenario at late century. Latent risk describes taxa that are sensitive and have a lower adaptive capacity but are not yet exposed to climate change. Monitoring environmental variables and reassessment if predictions worsen is the recommended strategy for latent risk taxa.

2.55 A review of the impacts of climate change on Aotearoa environments (Keegan et al. 2022) identifies freshwater environments as particularly vulnerable to human-induced climate change, because availability and temperature of water are very sensitive to climatic conditions, and habitats are highly fragmented. Increased rainfall and greater flood frequency and intensity can disturb freshwater ecosystems, increase soil erosion, sedimentation and turbidity, strip benthic habitat and communities, and prevent fish (and potentially whio) from visually locating prey. Substantial knowledge gaps remain, particularly when impacts are indirect and have complicated mechanisms.

Alpine Fault and Sediment

2.56 There is a 75% (29–99%) probability of rupture on the central section (Lake Kaniere to Lake Ellery) of the Alpine Fault in the next 50 years, and an 82% (64–95%) probability that the next event will be a multi-section rupture with Mw ≥ 8 (Howarth et al. 2021). The Scheme area is in this risk zone.

2.57 Coseismic landsliding in mountainous regions will generate dramatically increased inputs of sediment to river, to which rivers will respond accordingly (Blagen et al. 2022). In general, rivers are expected to steepen to increase their sediment transport capability, causing bed elevations to increase progressively downstream.

2.58 As described at **paragraph 2.10**, the river sections in which whio now occur have comparatively higher gradients, shallow river margins, stable stream banks, stable coarse river substrates (with high proportions of boulders), pool and riffle sequences, abundant invertebrate prey, and forested catchments and riparian margins. The water is fast-moving, cold, clear and highly oxygenated, and there is usually low transport of fine or suspended sediments. In the Scheme area, these characteristics are at risk of being repeatedly impacted by increased landsliding induced by the predicted increase of significant heavy rainfall events. These characteristics are also at high risk of being lost for decades or longer when the Alpine Fault next ruptures sometime in coming years.

Avian Influenza

2.59 Avian influenza (bird flu) is a highly contagious viral disease in domestic and wild birds caused by avian influenza viruses, originating in poultry systems (Scientific Task Force on Avian Influenza and Wild Birds 2023). The principal current strain of concern is the H5N1 strain. This is now widely established in the Northern Hemisphere and into the Southern Hemisphere but it remains absent from Aotearoa, Australia and the Pacific Islands.

2.60 H5N1 is currently causing unparalleled mortality of wild birds and mammals worldwide (Scientific Task Force on Avian Influenza and Wild Birds 2023). H5N1 is expected to be brought to Aotearoa by migratory wild birds. For this reason, it is not likely that it could be kept out of Aotearoa over the long-term or be eradicated once it establishes in wild bird populations (Ministry for Primary Industries 2025).

2.61 Avian influenza presents a potential risk to whio. The risk is likely to be the greater for whio in relying on high adult survival for population resilience in the face of predation pressure, and the lesser for whio being territorial and well-spaced, reducing virus spread risk.

2.62 DOC is currently developing national response plans including for whio (Department of Conservation 2025). The situation could rapidly evolve.

2.3 VALUES AND SIGNIFICANCE ASSESSMENT [3]

2.63 Criteria/guidelines/matters to be considered (hereafter 'criteria') in assessing the significance and natural heritage values of the Scheme area for whio and whio habitat are expressed in:

- West Coast Regional Policy Statement 2020 (West Coast Regional Council 2020; 'RPS'): Policy 7.1 (a) and Appendix 1
- Proposed Te Tai o Poutini Plan – West Coast District Plan (Te Tai o Poutini Plan Committee 2022, 'pTTPP'): Policy ECO - P1, part 2 i – which applies the same criteria as the RPS
- Westland District Plan 2002 (Westland District Council 2002; 'WDP'): Policy 4.9 D
- West Coast Conservation Management Strategy 2010–2020 (Department of Conservation 2010; 'CMS'): Policy 1, Section 3.3.2.3 (Prioritising natural heritage work).

2.64 Current practice in assessing ecological value in Aotearoa is to recognise four over-arching criteria: representativeness, diversity and pattern, rarity and distinctiveness, and ecological context (Roper-Lindsay et al. 2018; Ministry for the Environment 2024b). This framework is adopted in the RPS and the pTTPP. Other criteria cited in the WDP and the West Coast CMS (i.e. viability, intactness, size, threat and migratory species) are here treated as attributes of these over-arching criteria. CMS 'natural landscape character' is

[3] Further detail on assessing significance in relation to whio and whio habitat for the purposes of the above planning documents is provided in **Appendix E - Significance of the Values Relating to Whio**.

not assessed as it requires landscape expertise, and WDP protected status is provided by the Scheme area primarily being on public conservation land.

2.65 **Table 1** below provides a summary of the significance of the values assessed in accordance with these criteria.

2.66 The whio population and habitat in the Scheme area meet the formulations of all four over-arching criteria for assessing ecological value. As such, the combined value across the four criteria is assessed as very high.

Table 1: Summary assessment of values relating to whio and whio habitat assessed in accordance with relevant planning provisions.

Criteria	**Current significance of whio values in the Waitaha Valley**
Representativeness – including Viability, Intactness and Size (RPS, WDP and CMS)	**High significance value:** The whio population and habitat in the Scheme area meet the formulations of representativeness, viability, intactness and a relatively large example of its type in the Wilberg Ecological District of the following criteria: RPS/pTTPP 1(a), 1(b); CMS 3.3.2.3 Policy 1 representativeness, viability, intactness; WDP Policy 4.9 D (i), (ii)).
Rarity/Distinctiveness – including Threat, Migratory Species (RPS, WDP and CMS)	**High significance value:** The whio population and habitat in the Scheme area meet the formulations of rarity/distinctiveness, taonga, threat, scientific or other cultural value of the following criteria: RPS/pTTPP 2(b), 2(d); CMS 3.3.2.3 Policy 1 threatened and/or taonga species and their habitat; WDP 4.9 D (iii), (vi), viii).
Diversity and Pattern (RPS and CMS)	**High significance value:** The whio habitats in the Scheme area meet RPS/pTTPP 3(a) and CMS 3.3.2.3 Policy 1 Diversity.
Ecological Context, including Connectivity (RPS)	**High significance value:** The whio population and habitat in the Scheme area meet RPS/pTTPP 4(a), 4(b) and WDP (v).

3. ENVIRONMENTAL EFFECTS ASSESSMENT

3.1 This assessment of effects has been prepared utilising field studies and literature on whio and whio habitat, and has been guided by the EIANZ guidelines for Ecological Impact Assessment in New Zealand (terrestrial and freshwater ecosystems) (Roper-Lindsay et al. 2018).

3.2 The direct and indirect environmental effects on whio and whio habitat associated with each phase of the Scheme (construction and operational), the suggested approaches to manage these effects, and effects after management measures have been applied are summarised at **Table 2**. Further detail on these matters is provided in **Appendix F - Potential Effects of the Scheme**.

SCHEME DESIGN

3.3 The Scheme design process has actively sought to avoid, remedy and otherwise to minimise effects on whio (and other environmental values).

3.4 An options selection process in October 2012 considered two options:

- Option A: intake weir at the mouth of Waitaha Gorge, settling basin and head pond on Kiwi Flat, tunnel to penstock and Power Station below Morgan Gorge
- Option B: intake weir at the Morgan Gorge entrance, underground settling basin, tunnel to penstock and Power Station below Morgan Gorge (chosen configuration).

3.5 Key elements of the design to avoid and minimise adverse effects on whio and whio habitat are:

- choice of a 'run-of-river' scheme as opposed to a dam (at a site elsewhere), avoiding the formation of a lake that could impact natural habitat
- choice of Option B avoids most impacts on Kiwi Flat watercourses and whio habitats
- low weir design minimises area of backwater effect
- choice of penstock and Power Station location reduces the abstraction reach compared with alternatives further downstream, and avoids impact on the stable tributary downstream
- choice of access to the Morgan Gorge intake via the tunnel avoids a vehicular access route into Kiwi Flat, minimising vegetation removal and sedimentation.

EFFECTS ASSESSED IN OTHER REPORTS

3.6 Whio are in the upper trophic level in Aotearoa riverine ecosystems and are reliant on maintenance of riverine ecosystem health. The following less than minor effects findings (post-mitigation in some instances) and other relevant mitigation practices identified by other Scheme reports on components of whio habitat are accepted and supported.

3.7 **Sediment Report (operational period effects):** transient sediment deposition in the abstraction reach; transient sand deposition downstream of the Power Station; effect of maintenance operations and emergency shutdowns on water clarity; aggradation along

Kiwi Flat; bank erosion opposite the Power Station; and gravel extraction from the active Waitaha and Macgregor Creek braid plains.

3.8 **Freshwater Ecology Report (construction and operational period effects)**: sediment release; release of cementitious contaminants; release of other construction-derived contaminants; spread of freshwater pest species (didymo); mortality of biota at the site of in-channel works; gravel extraction from the bed of the Waitaha River and Macgregor Creek (in relation to aquatic ecology); altered sediment dynamics within the abstraction reach and downstream of the tail race; backwater effects; bank erosion opposite the Power Station; residual flow (effects on periphyton, benthic aquatic macroinvertebrate community, fish community); exclusion of brown trout from above the weir at Morgan Gorge, while providing for kōaro access; rapid flow changes as part of planned maintenance or emergency shutdowns (effects on macroinvertebrates); surface water runoff; Intake in-channel maintenance works; loss of shading of waterways from removal of riparian vegetation; and artificial lighting around built infrastructure.

3.9 **Noise Report (construction and operational period effects)**: The findings and recommendations of the **Noise Report** relating to the 'Fly Neighbourly' programme and general noise management provisions in the draft construction noise management plan are accepted and supported.

Table 2: Environmental effects on whio associated with each phase of the Scheme (construction and operational), the suggested approaches to manage these effects, and effects after management measures have been applied.

River section / location	Works, structures, activities, timing	Degree of environmental effects (positive and adverse) (unmitigated)	Recommended effects management	Level of residual effects post effects management
PRE-CONSTRUCTION, CONSTRUCTION AND OPERATIONAL PHASES				
All	Helicopter flights, except when hovering, when landing or taking off at Scheme sites (excluding Construction Area 3), and except when during transmission line installation	Individual noise exposure events for whio from such flights will be less than 30 seconds, repeated on the return flight. Whio on flight paths to and from Scheme sites likely have a behavioural adaptation capability to single or occasional such levels of noise, given high ambient noise levels (except any whio in Macgregor Creek near Construction Area 3) Overall level of effect: **less than minor** (infrequent flights); **minor or potentially minor** (frequent flights during breeding and moulting periods)	On helicopter flight paths following the Waitaha River, to the extent practicable prioritising safety, follow a flight path on the true right side of the river. Avoid helicopter flying during the breeding season (September-December), if practicable To address the residual potential level of effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	**Less than minor**
PRE-CONSTRUCTION PHASE				
Morgan Gorge Headworks, Power Station, sites between Headworks and Power Station	Two geotechnical drill sites at Headworks, two at Station, two on hill country between Headworks and Power Station (including helicopter transport)	High helicopter noise potentially impacting whio that could be present at and near the Headworks site over three days (with potential temporary hearing threshold shift), and more continuous noise over three weeks possibly causing masking effects and behavioural and/or physiological responses. Lower levels of helicopter and drilling noise could impact whio at some distance from two drilling sites between Headworks and Power Station sites. Possible impact at Power Station sites if whio present nearby.	Before undertaking helicopter access at the Headworks and Power Station sites, if practicable (i.e. after the first incoming flight), inspect the surrounding site and gently guide any whio present to move to be more than 50 m away (excluding below Morgan Gorge entrance because of physical impracticality); if this is not practicable, where safety considerations allow, use a slow approach from perpendicular to the river, to enable any whio present to move from the site Avoid risk of additional effect by ensuring helicopter flight paths do not come closer than	**Less than minor**

		Unconfirmed breeding in Anson Stream and confirmed breeding activity at Headworks site. Impacts greater if occur in breeding season **Overall level of effect: more than minor** at Headworks site and two sites between it and Power Station; **potentially minor** at Power Station; **potentially significant** if undertaken during the breeding season	necessary towards river habitats, particularly Anson Stream if in the breeding season. To address the residual potential level of effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	
Morgan Gorge Headworks, Power Station	Geophysical surveying (including helicopter transport to/from sites)	Helicopter access on two occasions at each site Risk of whio temporary hearing damage from helicopter use at the Headworks site Risk of impact to breeding and nesting loss if undertaken during breeding season **Overall level of effect: more than minor, potentially significant if undertaken during breeding season**	Avoid undertaking geophysical surveying during the breeding season (September-December), if practicable Before undertaking helicopter access, if practicable (i.e. after the first incoming flight), inspect the surrounding site and gently guide any whio present to move to be more than 50 m away (excluding below Morgan Gorge entrance because of physical impracticality); if this is not practicable, where safety considerations allow, use a slow approach from perpendicular to the river, to enable any whio present to move from the site, and land at and take off from the riverbed more than 200 m upstream of the Morgan Gorge entrance. If practicable, combine the helicopter access for the drilling and geophysical surveying work To address the residual potential level of effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and a from year 11 similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	**Less than minor**

CONSTRUCTION PHASE				
Morgan Gorge Headworks	Construction of permanent Headworks structures (weir, sluice gate channel, intake channel and intake, access portal), accessway down to river Temporary Headworks structures (coffer dam/river diversion, Construction Staging Area 1, vehicular accessway to Staging Area (up to 24 months)	Blasting and helicopter use are two highest impact construction activities; plus lower-level noise and disturbance from use of machinery and human presence Weir and intake site has been a focal point for a whio pair throughout field studies Sound levels above 125 dBA (at which physical hearing damage occurs to birds for multiple blasts) are likely to be below this level beyond *c.*10 m from the blast site Whio appear to be tolerant of and may habituate to a low–moderate level of construction disturbance and noise; but absence of obvious behavioural response does not necessarily indicate absence of impact on a particular individual or species Cumulative impact of blasting, helicopter use, drilling, and other noise and disturbance is highly likely loss of breeding and recruitment by resident pair for 1–2 years (depending on seasonal timing of works) Kiwi Flat whio population may lose one of its three pairs to another area, with flow-on impacts on adjoining territory holders, and it may not be able to recover naturally **Overall level of effect: significant**	Before undertaking blasting, inspect the surrounding site and gently guide any whio present to move to at least 400 m away (excluding below Morgan Gorge entrance because of physical impracticality) Before undertaking helicopter access: if practicable, inspect the surrounding site and gently guide any whio present to move to be more than 50 m away (excluding below Morgan Gorge entrance because of physical impracticality); if this is not practicable, where safety considerations allow, use a slow approach from perpendicular to the river, to enable any whio present to move from the site Avoid helicopter flying up-valley of Construction Staging Area 1 Locate the helicopter landing site in Construction Staging Area 1 at its maximum down-valley practicable extent Time construction of weir and intake structure to avoid impacting whio breeding seasons, as far as practicable To address the residual less than minor level of effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	On balance and over time, after proposed mitigation including contributing to a regional ecosystem programme **residual effects would conservatively be less than minor, but there remains a possibility they may be positive**
Morgan Gorge Headworks	Construction of two accessways and Construction Staging Area 1	Accessways are on steep slopes, and Construction Staging Area 1 lies above an on eroding river margin; risk of downslope debris movement covering whio roost sites among large rocks below; rocks currently used for	Take every practicable step to retain present whio habitat features in this riparian zone, including a five metre setback from the steep bank at the Staging Area	**Less than minor**

	Weir backwater effects and sediment aggradation	roosting (true right bank) could be lost in use for rock armouring Backwater effects: temporary loss of whio feeding; possible permanent loss of roosting site(s) **Overall level of effect: minor**	To address the residual less than minor effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	
Power Station, tunnels	Pre-construction drilling Temporary construction Staging Area 2 (6 months); tunnel blasting and rock removal (approximately 21 months); construction and installation of Power Station switchyard/substation, tailrace and embankment (approximately 10 months, not continuous)	Blasting and helicopter use (up to 24 months) are two highest impact construction activities; plus lower-level noise and disturbance from use of machinery and human presence Whio pair found in 2024 on Waitaha mainstem 800 m upstream of the Power Station site, and two single birds elsewhere between Morgan Gorge mouth and Douglas Creek confluence. No evidence of whio habitat use on true right bank Power Station site (at nesting time). Suitable nesting habitat however present at Power Station site and on opposite bank. Disturbance to moulting at 'Stable Tributary' possible **Overall level of effect: potentially more than minor**	Before undertaking blasting that will have significant surface impact, inspect the surrounding site and gently guide any whio present to move to be more than 400 m away To address the residual potentially more than minor effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	**Less than minor**
Waitaha Farm to Power Station	Access road and heavy vehicle road, including 'drift deck'/ culverted ford construction at Macgregor Creek and box culvert and bunds construction at Alpha Creek, and bridge construction over Granite Creek (approximately 8 months)	Very likely abandonment of whio pair winter use of farm pond caused by heavy vehicle use and other traffic during construction phase (estimated 37 months), substituted by energetically less favourable habitat; disturbance of single bird using feeding habitat on Macgregor Creek, though likely comparable habitat available Low possibility of disturbance over construction phase to whio moulting at 'Stable Tributary' at time of heightened vulnerability Low possibility of disturbance to whio habitat use within 250 m of Granite Creek bridge during piling **Overall level of effect: minor**	Construct crossings at Alpha Creek and Macgregor Creek at times and/or places of no flow, as far as practicable Before undertaking piling at Granite Creek bridge, inspect the surrounding site and gently guide any whio present to move more than 50 m away To address the residual less than minor effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	**Less than minor**

Waitaha Farm to Power Station	66 kV power transmission line (approximately 4 months initially, with a short period towards the end)	Transmission line mostly located >50 m from whio river habitats. Conductors strung using a helicopter. Varying levels of helicopter noise disturbance effects along the length of the transmission line. Costs of disturbance may not be significant for the single birds found/reported in 2024 at Macgregor Creek and at Douglas Creek confluence, but more significant for whio pair on Waitaha Farm if needing to seek alternative winter foraging. **Overall level of effect: minor**	To address the residual less than minor effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	**Less than minor**
Site-wide	Scheme personnel interactions with whio	Specific elements of Scheme personnel interactions with whio have the potential to indirectly change whio behaviour, reducing their biological fitness as wild species. Leaving food also encourages predators (e.g. rats) **Overall level of effect: minor**	Do not disturb whio other than as provided for herein Do not feed whio Ensure all food and rubbish is collected and removed from Scheme sites	**Less than minor**
OPERATIONAL PHASE Note: for environmental baseline purposes, and given the proposed predator control management during the construction phase and continuing into the operational phase, it is assumed here that a whio population not dissimilar to the present will remain or, more likely, at some time be restored in the Scheme area in the operational phase				
Morgan Gorge Headworks	Weir: access for whio ducklings and kōaro (while avoiding trout access by creating a barrier to other fish species)	Trout are potential competitors with whio for invertebrates, currently absent above Morgan Gorge; residual flow could facilitate trout access into upper Waitaha catchment Present water velocities at Morgan Gorge are too great for whio ducklings to swim upstream to Kiwi Flat from nest sites in the gorge. Residual flow may result in lowered water velocities they could navigate to gain access for brood raising at Kiwi Flat **Overall level of effect: more than minor (potential trout access); minor positive (whio duckling access)**	Provide for whio duckling and kōaro access up the weir if a dual design is practicable (the **Freshwater Ecology Report** discussed the proposed design includes a barrier for other fish species including trout) Include input from a suitably qualified and experienced whio specialist in the detailed design phase of a whio duckling and kōaro passage structure at the weir	**Minor positive**
Morgan Gorge Headworks	Intake: whio duckling entrainment	Potential risk of whio duckling entrainment from them being unable to overcome approach velocity; risk avoided or minimised by intake being always below water surface level **Overall level of effect: less than minor**	Nil	**Less than minor**
Morgan Gorge Headworks	Artificial structures (weir, intake etc.) in natural environment	Site has been a focal point for a whio pair throughout field studies. Presence of whio at other intake structures (e.g. Whakapapa intake structure of Tongariro power	Nil	**Less than minor**

		scheme) indicates whio adaptability to such artificial structures **Overall level of effect: less than minor**		
Morgan Gorge Headworks	Channel maintenance (12–20 tonne digger to remove gravels/boulders; working in riverbed and water column; annually in summer low flow conditions plus if/when needed) Rebuilding accessway onto riverbed after major floods Associated helicopter use plus use for monitoring Siren use to alert people of change in Waitaha River flow of up to 13 m^3/s (*c.*30 seconds, *c.*4 times per year)	Site has been focal point for whio pair throughout whio field studies Siren sound level (*c.*120 dB), frequency (*c.*6 times per year) and duration (*c.*30 minutes) combined are well above the level for an avian hearing temporary threshold shift and approach levels that cause avian auditory damage Disturbances cumulatively will render site less attractive to whio, causing them to move elsewhere for at least the duration of the disturbance In worst-case scenario, whio hearing damage could occur, whio breeding activities would be directly impacted if activities occur between September–December, and whio could be displaced more permanently causing the local population to decline Activation of sediment at low flow in channel maintenance works is likely but effects within range of natural variability **Overall level of effect: significant**	Undertake intake channel maintenance, accessway rebuilding and helicopter use for maintenance purposes outside the breeding season (September–December), as far as practicable Before works, inspect the surrounding site and gently guide any whio present to move to be more than 50 m away (excluding below Morgan Gorge entrance and helicopter use because of physical impracticality) Locate the siren so that sound levels at the river are not more than 74-80 dB. To address the residual less than minor level of effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	**Less than minor**
Abstraction reach	Water abstraction and residual flow – diverts up to a maximum of 23 m^3/s – retains a residual flow of 3.5 m^3/s – 4 'no-take' days per annum for kayak passage (river flow 15 – 25 m^3/s) – no take during floods (>250 m^3/s)	Habitat modelling predictions indicate whio feeding habitat increases with flow reduction below about 12 m^3/s; at the proposed residual flow (3.5 m^3/s), increases are of the order of 125% on the one day mean annual low flow A sudden increase of flow (up to 13 m^3/s) on the residual 3.5 m^3/s in the abstraction reach caused by a rapid closing of the intake at Morgan Gorge (*c.*30 minutes, *c.*6 times per year) could cause mortality of whio ducklings (if present on or near the water) and loss of local seasonal recruitment. Impacts not expected on nesting sites. **Overall level of effect: minor**	Risk of whio duckling mortality and loss of seasonal recruitment low, not easily mitigated To address the residual less than minor effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	**Minor positive in respect of abstraction flow** **Less than minor in respect of sudden increase of flow**

Power Station	Siren use to alert people of change in Waitaha River flow of up to 13 m^3/s (*c.*30 seconds, *c.*4 times per year)	Siren sound level (*c.*120 dB) and duration combined are well above the level for an avian hearing temporary threshold shift and approach levels that cause avian auditory damage **Overall level of effect: minor**	Locate the siren that sound levels at the river are not more than 93 dB (less than the temporary threshold shift level), and preferably not more than 74-80 dB To address the residual potential level of effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.	**Less than minor**
Waitaha Farm to Power Station	Access road: use and maintenance	Other than Macgregor Creek, the road has limited frontage to river and stream whio habitats. Very limited ongoing vehicular use (1–2 weekly site visits) Last 2.2 km of access road to Power Station is within DOC land which has a general statutory right of public access; this could increase accessibility for bringing in dogs and thereby attacks on whio **Overall level of effect: minor**	Request DOC show the Waitaha access route on their walking and tracks website as a not permitted area for dog access, and install a no dogs sign at the beginning of public access onto the access route.	**Less than minor**
Waitaha Farm to Power Station	66 kV transmission lines	Minimum of three whio found or reported on waterways and farm pond in vicinity of transmission line Whio electrocution from electrical arcing if sitting on powerlines very unlikely Risk of whio collision with powerlines and consequent mortality low **Overall level of effect: less than minor**	Advise the public to report any dead whio that could be associated with a powerline event, through signage.	**Less than minor**
Site-wide	Artificial (non-UV) lighting, only at Power Station and Headworks; hour or so, up to 2-3 occasions annually Remote controlled infrared cameras at Power Station	Artificial lighting is a significant environmental pollutant with potentially wide impacts on many organisms. No studies of effects of artificial light on whio known No artificial lighting along the road corridor Potential mortality from whio striking glass if attracted to internal light at the Power Station avoided by no windows Infrared cameras do not affect wildlife; external lighting use very limited; best practice artificial lighting design principles adopted **Overall level of effect: less than minor**	Nil	**Less than minor**

4. RECOMMENDED ADVERSE EFFECTS MANAGEMENT AND MONITORING

4.1 In addition to the effects management recommendations summarised in **Table 2** and detailed in **Appendix F**, it is recommended that residual adverse effects be mitigated by a whio population maintenance initiative, that monitoring and reporting are undertaken, and that a whio management plan be prepared (to be included in the Avifauna Management Plan).

ADDRESSING RESIDUAL ADVERSE EFFECTS

4.2 It is acknowledged that it will be challenging to distinguish effects from predation or other perturbations from effects of the Scheme (for example, an unrelated increase in predators). At this time, it is considered that a standard trapping based predator control programme in and adjoining the Scheme area would be of limited use because of the likely scale of stoat immigration from adjoining forests and the decreasing effectiveness of trapping over time as stoat trap shyness develops (King 2023). However, future trapping technology is developing rapidly, for example, an automatic multi-species trap system with inbuilt artificial intelligence enabled species targeting, identification and monitoring. It may become feasible in the future to apply such a system to provide meaningful benefits to whio in the area, but that is difficult to predict. Any programme would be undertaken on public conservation land only.

4.3 At this time, an addition to an existing predator control programme elsewhere in the region is more likely to produce a benefit for whio. It might also produce benefits for other avifauna and long-tailed bats.

4.4 A predator control programme in the region that benefits whio should be undertaken over the construction phase (3–4 years); and continue for at least a total of ten-years (including construction), with the contribution of funds over the life of the consent to an ecosystem programme in the region. Reconsideration of the best use of the funds should occur at the end of year 10 of the contribution. This should consider any information on the benefits to the regional whio population of the previous use of the funds, and with input from DOC, what is the best ongoing use of funds, including at an ecosystem level in either the Waitaha Valley or elsewhere in the region, over the term of the consent.

4.5 These parameters would provide for proactive regional population support through the construction phase in the face of conservative *post mitigation* residual less than minor adverse effects throughout the Scheme area (including loss of breeding and recruitment for several seasons and possible local population loss); ongoing proactive support for the regional population through the operational phase (given the effects of ongoing disturbance at the weir and intake site); and reconsideration of the best use of the remaining annual contribution to benefit the regional ecosystem, after the first ten year period.

4.6 Should future technology support it, a future population maintenance initiative in the Scheme area could help to protect the genetic diversity of whio in the Central Southern Alps, where the protection of specific genetic diversity is warranted (Grosser et al, 2017). If population levels in time rise above current levels, spillover (especially of juveniles) into adjoining catchments may enhance populations there. A population maintenance initiative or contribution to regional predator control may also help to mitigate the effects of major perturbations that are likely over the consent period (35 years) — avian influenza, increasing climate change, and Alpine Fault rupture.

4.7 The proposed conditions of the consents specify an annual contribution for at least ten years, to an ecosystem programme that will benefit whio in the region (for example, predator control such as Zero Invasive Predators programme) and a similar contribution from year 11 extending to the life of the consent to an ecosystem programme in the region or locally in the Waitaha Valley. The contribution should commence alongside construction.

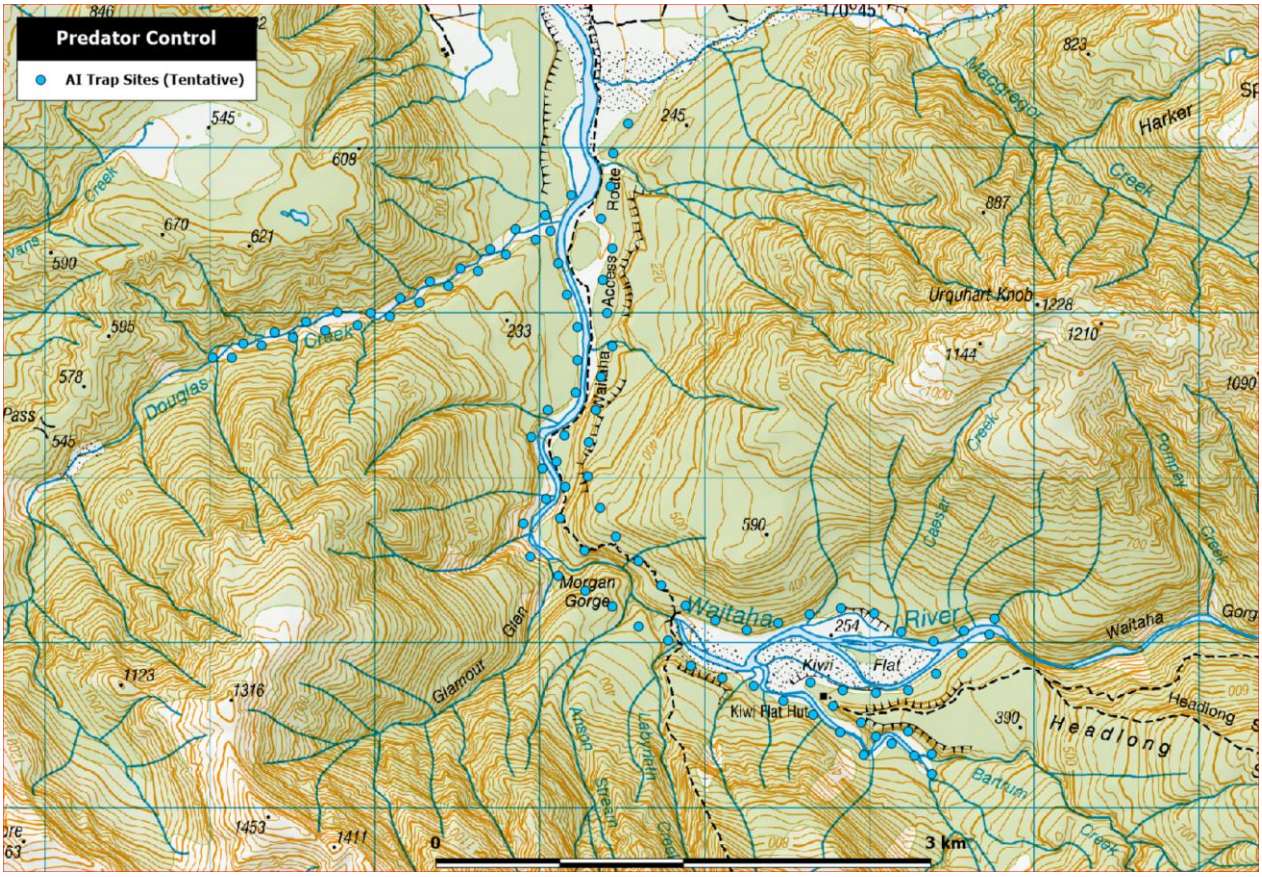

Figure 2: Potential trap locations.

WHIO MANAGEMENT PLAN

4.8 It is recommended that a whio management plan for the Scheme be prepared, incorporating the effects management recommendations summarised in **Table 2** and detailed in **Appendix E**, and proposed conditions include an annual contribution for at least ten years, to an ecosystem programme that will benefit whio in the region (for example, predator control such as the Zero Invasive Predators programme) and a similar

contribution from year 11 extending to the life of the consent to an ecosystem programme in the region or locally in the Waitaha Valley. The contribution should commence alongside construction.

5. KEY FINDINGS AND CONCLUSION

5.1 Whio is an iconic, upper trophic-level bird species now occurring only on clear, fast-flowing Aotearoa rivers and streams in highly natural condition. Whio is a taonga species under the Ngāi Tahu Claims Settlement Act 1998. Whio is an absolutely protected species under the Wildlife Act 1953.

5.2 Whio is classified as a nationally vulnerable species (qualifiers: Conservation Dependent, Climate Impact, Partial Decline, Sparse), with a low to high ongoing or forecast population decline of 10–50%. A slow contraction and fragmentation of whio range continues, especially in remote South Island areas.

5.3 The overall genetic diversity in whio is low and effective population size is small, putting the species at risk of further loss of genetic diversity due to genetic drift and inbreeding. The whio population in the Scheme area lies within the geographic scope of an additional long-term protection management site ('security site') in the Central South Island recommended by a recent genetic study.

5.4 A comprehensive whio field survey programme was undertaken over multiple years (2006–2012) in the broad Scheme area. A further survey was undertaken in spring 2024 to assess the current population status.

5.5 Together, the results of the 2006–2012 surveys and the 2024 survey suggest there has not been a substantial change of population state since 2012 at Kiwi Flat and down to the Douglas Creek confluence. Whether there was some constancy or variation in the intervening period cannot be determined.

5.6 However, the population in the Scheme area is now at heightened risk than perceived previously on account of the loss of potential immigration from Amethyst Ravine; the pending withdrawal of OSPRI 1080 operations; increasing climate change; the likelihood of avian influenza reaching Aotearoa in the short term; and the 75% probability of an Alpine Fault rupture in the next 50 years. The future of a whio population in the Scheme area is closely tied to the future of the adjoining population.

5.7 The whio population and whio habitat in the Scheme area are rated as being significant against the four ecological criteria of the RPS (and correspondingly, of the pTTPP – West Coast District Plan) for identifying significant terrestrial and freshwater indigenous biological diversity: representativeness, rarity/distinctiveness, diversity and pattern, and ecological context. The whio population and habitat are also rated as being significant against the West Coast CMS ecological criteria: representativeness, viability, diversity, presence of threatened and/or taonga species and their habitat, and intactness. They are further rated as being significant against the following criteria for significance of natural habitats and ecosystems in the WDP intactness, representativeness, distinctiveness, threat, connectivity, and scientific or other cultural value.

5.8 The proposed construction layout and spoil disposal areas on Waitaha Farm and the 66 kV transmission line north of Allen Creek are beyond the range of whio and whio habitat in the Scheme area.

5.9 The potential effects on whio and whio habitat of the remainder of the Scheme as otherwise described in the **Project Description** have been systematically assessed and mitigation proposed. Some aspects are subject to uncertainty.

5.10 Recommended effects management proposed by the **Sediment Report**, **Freshwater Ecology Report** and **Noise Report**, as relevant to whio habitat, are accepted and supported.

5.11 Blasting, helicopter use, pile driving, and siren use are the four Scheme activities that will have the highest potential disturbance impact on whio. There will also be lower-level noise and disturbance from use of other machinery. Other impacts may arise from response to new objects in the environment (neophobia). Human presence itself can evoke biological reactions in wildlife.

5.12 Although whio appear to be tolerant of and habituate to a low–moderate level of construction disturbance and noise, research has strongly established that an absence of an obvious behavioural response does not necessarily indicate absence of impact on a particular individual or species. Physiological changes can occur even when there are no outward changes in behaviour, with impacts on the ability to survive and reproduce. The below conclusions summarise the more than minor effects of the Scheme and how they will be managed.

5.13 **In the construction phase**, the conservative assessment is that the cumulative effect of drilling, blasting, helicopter use, and other noise and disturbance at the Morgan Gorge weir and intake site will principally impact the breeding whio pair in whose territory the activities will occur. Construction activities are highly likely to cause the partial or complete displacement of the whio pair from their territory, and loss of breeding and recruitment, over the pre-construction and construction time (up to 26 months). In a worst case scenario, it may cause the loss of one of three pairs in the Kiwi Flat population, from which it may not be able to recover naturally. This effect is assessed as **significant** despite the four site-specific mitigation steps proposed, including inspecting blasting sites beforehand and gently guiding any whio present to at least 400 m away (to avoid physical hearing loss of whio). A residual **less than minor** effect would remain.

5.14 The cumulative impact of drilling, blasting, helicopter use, and other noise and disturbance at the Power Station site during the construction phase is not easy to gauge. It likely will include disturbance to use of the Waitaha River as a flyway, possibly disturbance to breeding and habitat use in the locality, and conceivably disturbance to moulting at the 'Stable Tributary' (24–36 months). This effect is assessed as **more than minor**. Proposed site-specific mitigation is inspecting blasting sites beforehand and gently guiding any whio present to move to at least 400 m away (to avoid physical hearing loss of whio). However, a residual **potentially less than minor** effect would remain.

5.15 In summary, after proposed site-specific mitigation, significant or minor levels of effect remain for the following **construction phase** activities:

i. cumulative effect of drilling, blasting, helicopter use, and other noise and disturbance at the Morgan Gorge weir and intake site (potentially local pair loss - significant)

ii. construction of two accessways and Construction Staging Area, weir backwater effects and sediment aggradation (possible permanent loss of roosting site(s) – minor)

iii. cumulative impact of drilling, blasting, helicopter use, and other noise and disturbance at the Power Station Site (potential whio habitat use displacement - more than minor)

iv. access and heavy vehicle roads (pond pair and single birds disturbance - minor)

v. transmission line helicopter disturbance (pond pair and single birds disturbance - minor).

5.16 Given the resilience of the whio population in the Scheme area to date and level of effect post mitigation, it is assumed here that a whio population not dissimilar to the present will remain or, more likely, at some time be restored in the Scheme area in the operational phase.

5.17 A range of maintenance and related activities are proposed for the Headworks: channel maintenance; accessway rebuilding after major floods; associated helicopter use plus use for monitoring; and siren use to alert people of change in Waitaha River flow of up to 13 m^3/s. Siren sound level (*c.*120 dB), frequency (*c.4* times per year) and duration (*c.*30 seconds) combined are well above the level for an avian hearing temporary threshold shift and approach levels that cause avian auditory damage. Disturbances cumulatively will render the site less attractive to whio, causing them to move elsewhere for at least the duration of the disturbance. In worst-case scenario, whio hearing damage could occur, whio breeding activities would be directly impacted if activities occur between September–December, and whio could be displaced more permanently causing the local population to decline. Overall, these effects are assessed as **significant**.

5.18 Proposed site-specific mitigation includes undertaking maintenance activities outside the breeding season, where practicable (September–December), and locating the siren so that sound levels at the river are not more than 74-80 dB. A residual **less than minor** effect would remain.

5.19 At the Power Station (as at Morgan Gorge), the siren sound level (*c.*120 dB), frequency (*c.4* times per year) and duration (*c.*30 seconds) combined are well above the level for an avian hearing temporary threshold shift and approach levels that cause avian auditory damage. Proposed mitigation is to locate the siren so that sound levels at the river are not more than 93 dB (less than the temporary threshold shift level), and preferably not more than 74-80 dB.

5.20 After proposed site-specific mitigation, significant or minor adverse levels of effect remain for the following **operational phase** activities:

i. Morgan Gorge weir and intake site: loss of roosting sites with backwater effect (minor); channel maintenance, other maintenance and monitoring (with helicopter use), siren use (cumulatively, habitat use displacement, risk of recruitment loss - potentially significant)

ii. power station; siren use.

5.21 There are three possible broad options to mitigate the residual significant and minor adverse effects in the construction and operational phases of the Scheme:

i. institute a predator control programme in and adjoining the Scheme area using the standard DOC trapping method—which in practice also mostly relies on the additional use of periodic aerial 1080 applications to remove trap-shy female stoats from the population (which Westpower does not want to use)

ii. contribute towards extending the nearby Predator Free South Westland programme (Zero Invasive Predators) —in practice this would be in the Wanganui River catchment, with the disadvantage of not being in the Scheme area

iii. contribute towards a predator control programme elsewhere in the region that benefits the whio population for at least ten years but ideally the life of the consent, such as the nearby Predator Free South Westland programme (Nichols et al. 2024).

5.22 It is recommended that Westpower contributes to an ecosystem programme to benefit the regional whio population for at least ten years, but ideally the life of the consent (commencing on construction) to mitigate the residual **less than minor** effects of the Scheme on whio populations and habitats. The intention of an ecosystem programme is to support maintenance of the whio population in the region, accepting limitations if external influences (such as severe weather or avian flu) cause a material reduction in population. A wider ambit than solely a predator control programme is suggested to provide flexibility should the whio population in the Scheme area or region reduce and be impacted by external factors. If other options of contributing to maintaining the whio population in the region are preferred, 'Operation Nestegg' is a valuable option where chicks raised in captivity are released into an existing whio population to support it. A contribution to benefit the regional whio population is appropriate for at least a ten-year period but ideally the life of the consent (commencing with construction). After a ten-year period, there could be reassessment of whether the previous use of the contribution remains the best use of funds to benefit the regional ecosystem.

5.23 It is recommended that a whio management plan for the Scheme be prepared, incorporating the effects management recommendations summarised in **Table 2** and detailed in **Appendix E**, support the maintenance of the regional whio population. This would be included in the Avifauna Management Plan (AMP).

5.24 This report has sought to catalyse outcomes for an ongoing whio population and whio habitats compatible with co-existence of a hydroelectricity scheme seeking to use the same habitat. Overall it is concluded that whio and the Scheme can co-exist, subject to at least a ten year contribution (including construction) to an ecosystem programme, for example predator control, to benefit whio in the region. It is appropriate that there is also a contribution to an ecosystem programme that would extend for the life of the consent in the region or locally in the Waitaha Valley.

Appendix A - Further detail on Project Design and Project Background Information as it relates to Whio[4]

SCHEME LOCATION

The Scheme is proposed to be located predominantly on the true right side of the Waitaha River from State Highway 6 (SH6) to lower Kiwi Flat. For convenience, the Scheme's footprint is divided into four areas (**Figure 3**):

1. Headworks and temporary Construction Staging Area 1) (Footprint area 1)
2. Access route and transmission line corridor from Macgregor Creek to, and including, the Power Station site and Construction Staging Area 2 (Footprint area 2)
3. Access route and transmission line corridor from Macgregor Creek to the lower Waitaha Valley, spoil disposal area and Construction Staging Area 3 (Footprint area 3)
4. Remainder of the transmission line route to connect to SH6 and along SH6 to the connection with Westpower network near the Waitaha Bridge (Footprint area 4).

PROJECT SCOPE IN RELATION TO WHIO AND WHIO HABITAT

This assessment of potential effects on whio and whio habitat is based on design parameters for the Scheme as set out in the **Project Description.** Full details of the Scheme are provided in the **Project Description** and **Project Overview Report**.

Whio and whio habitat are present in the Scheme area primarily in Area 1 and Area 2.

Scheme component sites in Area 3 (access road for light and heavy vehicles, spoil disposal areas, transmission line, construction staging area) and Area 4 (light and heavy vehicle access road, disposal areas, transmission line) are largely distant from riverine and riparian environments that could constitute primary whio habitat. However, isolated occurrences of whio activity and whio habitat are present in Area 3 and Area 4 near the light vehicle and heavy vehicle access roads and the transmission line. The potential effects of these Scheme components on whio and whio habitat in Area 3 and Area 4 are therefore evaluated.

Also evaluated are three proposed water level recorders to be located outside Areas 1–4 (at Waitaha Gorge, near the Moonbeam Creek confluence, and at Scamper Torrent).

[4] This section is based on information supplied by Westpower.

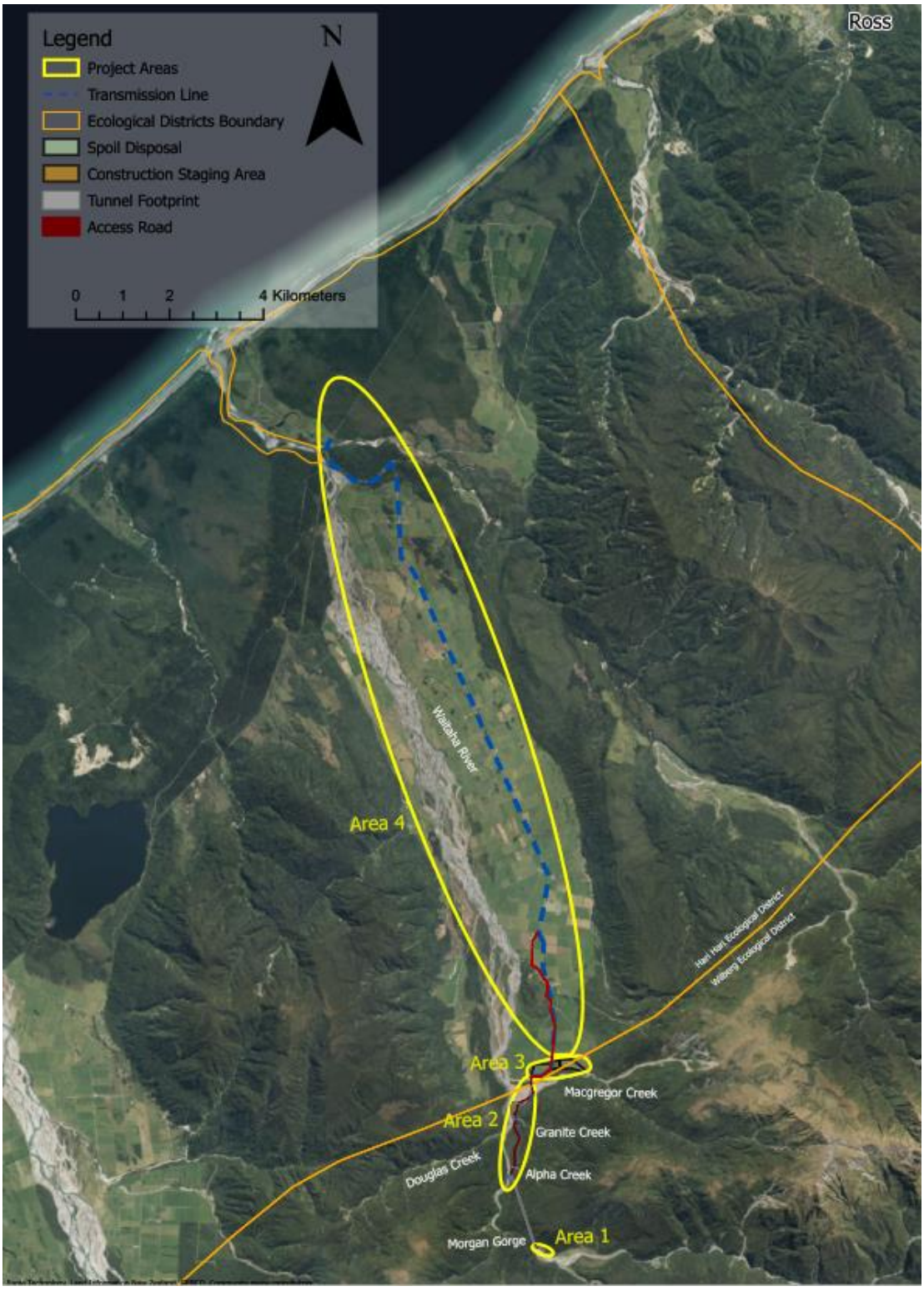

Figure 3: Waitaha Hydro Scheme overview and footprint areas. (Source: Westpower)
Area 1: Headworks and temporary Construction Staging Area 1
Area 2: Power Station site and Construction Staging Area 2, light + heavy vehicle access route and transmission line corridor to farm boundary on true right of Macgregor Creek
Area 3: Spoil disposal area and Construction Staging Area 3
Area 4: Access route and transmission line across the farm, gravel screening area, and transmission line along Waitaha Road, SH6, Beach Road and Bold Head Road to connection with Westpower network at the Waitaha Substation.

PRE-CONSTRUCTION AND CONSTRUCTION

Construction of the Scheme can be considered in four stages and one pre-construction stage (**Table 3**).

Table 3: Approximate construction timeline

Stage	Description	Estimated period from start
	Investigative geotechnical drilling for tunnel construction	Pre-construction
1.	Access road and transmission line from Waitaha Rd to the Power Station site. Construction Staging Areas 2 and 3. Bridge across Granite Creek.	1-10 months
2.	Tunnels and subsurface structures. Early works at the Intake. Construction Staging Area 1 and the access track from the access portal to Construction Staging Area 1. Short access track from access portal at the Intake to the river.	7-27 months
3.	Remaining water tunnel and desander excavations completed. Construction of the Intake channel and weir. Construction of power station, switchyard and tailrace. Construction of the remaining section of the transmission line from Waitaha Substation near SH6 to Macgregor Creek. Rebuild of Waitaha Substation.	28-33 months
4.	Equipment installation and commissioning at Power Station, switchyard and intake.	32-37 months

Construction Areas

Spoil Disposal Areas and Construction Staging Area 3: spoil from the tunnel will be utilised within the development earthwork areas where possible, or temporarily stockpiled before being transferred off public conservation land to be stored at the spoil disposal area which will be rehabilitated and used for development of pasture for farming purposes. Construction Staging Area 3 is temporary and will be rehabilitated to pasture, in accordance with the requirements of and as part of, the farming operation.

Access road and transmission line corridor: will be on average 17.5 m during construction and then 15 m with rehabilitation.

Waterway crossings: There will be waterway training and flood protection at Alpha Creek near the Power Station. In addition, there will be a 'drift deck'/culverted ford across Macgregor Creek, a bridge across Granite Creek and culverts and fords for other smaller waterways.

Power Station site: vegetation clearance for construction purposes will be kept to a minimum (no more than 100 m^3) and Construction Staging Area 2 will be rehabilitated including with planting of appropriate indigenous vegetation.

Headworks: vegetation clearance for construction purposes will be kept to a minimum and Construction Staging Area 1 will be approximately 0.7 ha. The land will be rehabilitated to indigenous vegetation cover following construction.

Noise and Vibration

Noise generation will arise from:

- helicopter movements, including for: transport of a drilling rig to and from sites; transport of personnel, equipment and materials between staging areas, and to the intake site and Construction Staging Area 1; and for installation of transmission line conductors
- tunnel blasting and excavation in the early stages (which will be a 24 hour operation)
- blasting at the Intake works and possibly piling at the Granite Creek bridge
- other construction activities at the construction areas, such as use of heavy vehicles and machinery.

Traffic

On the Waitaha Road and Anderson Road, there will be approximately 32 light vehicle movements one way (64 both ways) per day during the busiest period (when the tunnelling, Power Station, Headworks and transmission line works are overlapping).

After the initial few months, there will be a steady movement of trucks bringing in gravel and cement for concrete (for tunnel lining, Headworks, Power Station) for approximately two years, with an average number of trucks being four per day one way (eight both ways), with a 5 month period where there will be up to 6 trucks per day one way (12 both ways). There will also be sporadic oversize vehicle (over 40 tonnes) movements, to bring in parts for the temporary and permanent bridges for Granite Creek, tunnel excavation machines and turbine and switchyard equipment (generator, transformer).

On the access road between Construction Staging Area 3 (on private land) and Construction Staging Area 2 (Power Station site), light vehicles will move particularly during shift changes during tunnelling. Trucks will use this part of the access road mainly to transport spoil from tunnel and Power Station excavations to the spoil disposal areas on private land. On average there will be 38 truck movements per day (19 each way; assuming a 20-tonne truck) over the period of two and half years (encompassing the road and tunnel construction, and excavation at the Power Station site). Oversize vehicle movements here will occur sporadically.

The large majority of vehicle movements will occur during daytime hours. A small number of vehicle movements will occur at night during the tunnelling stage of construction as this is a 24-hour activity. Night-time vehicle movements will be limited where practicable.

Gravel Extraction

Gravel extraction for the access road will be sourced in part by horizontal scraping of dry gravel above water level and away from the edge of wet areas on beach areas on bed of the Waitaha River adjacent to McLeans farm (approximately 23 000 m3). Because of the dynamic nature of the river, specific sites will need to be defined prior to the of gravel extraction. Gravels will be screened at a site near the airstrip on Waitaha Farm and/or at Construction Staging Area 3

OPERATIONAL PERIOD

There will be a localised loss (approximately 6.8 ha) of indigenous forest/vegetation cover mostly on conservation land during construction of the Scheme. This will reduce, through rehabilitation and regeneration, to approximately 4.5 ha during the operational phase. Most of this clearance is made up of the access road and transmission line route (from Macgregor Creek to the Power Station site) and the Power Station site. A smaller area of clearance will be at the Headworks above Morgan Gorge (1 ha temporary, 0.1 ha permanent). All areas not required for the ongoing maintenance or operation of the Scheme will be rehabilitated.

Construction of the tunnels (water and access) and Headworks will take approximately two years to complete. While the Scheme's underground component will not affect whio habitat, there are potential effects of noise and vibration.
The access road and transmission line footprint will be an average 17.5 m in width during construction and 15 m width once operational. Where the road and transmission line are separate (between Macgregor Creek and Granite Creek, and on the farm), each component will be up to 10 m wide. Access road and transmission line lengths are approximately:

- Anderson Road to farm boundary at Macgregor Creek: 3.6 km (open farmland)
- Farm boundary at Macgregor Creek to Power Station: approximately 2.2 km (mainly forested DOC land)
- Headworks to proposed Construction Staging Area 1: approximately 140 m (mainly shrubland on DOC land).

The Scheme's footprint south of the farm boundary at Macgregor Creek is approximately 7.4 ha during construction and approximately 5 ha during operation (permanent). More than two thirds of the operational footprint (approximately 4 ha) consists of the road between the Power Station and the farm boundary at Macgregor Creek.

An additional approximately 21 ha (approximately 16 km) footprint includes the access road across the farm, and the transmission line from Construction Staging Area 3 to SH6, along SH6, Beach Road and Bold Head Road to Waitaha Substation (Area 4). The line is located within existing road reserve and across farmland, which is devoid of important vegetation/habitat for fauna.

Significant noise levels will arise from time to time from the use of the emergency warning sirens during flow bypass occasions at the Power Station, heavy machinery during maintenance works at the Intake site, and helicopters for access for maintenance and monitoring purposes at the Intake site (including the three water recorders).

The proposed abstraction levels are shown at **Table 4**. This provides for a minimum low flow level in the abstraction reach of 3.5 m^3/s; at all times; four 'no-take' days per annum for kayak usage; and for no abstraction when flows are above 250 m^3/s.

Table 4: Proposed abstraction levels

Scenario description	River flow	Down-stream release	Intake flow (diverted)	Range of headwater level
Normal operation scenario *Operation up to average flow*	< 35 m^3/s	3.5 – 32 m^3/s	0 – 23 m^3/s	EL 238.00 m
Kayak usage scenario *Flow range for kayakers*	15 – 25 m^3/s	15– 25 m^3/s	n/a	EL 238.40 m - EL 238.60 m
High flow scenario *Average to cutoff flow*	35 – 250 m^3/s	12 – 227 m^3/s	23 m^3/s	EL 238.00 m - EL 238.70 m
Extreme flood event scenario *No operation*	> 250 m^3/s	> 250 m^3/s	0 m^3/s	> EL 238.70 m

Appendix B - Scope and Approach of Whio Report

Whio is an iconic, upper trophic-level, nationally vulnerable and taonga bird species now occurring only on clear, fast-flowing Aotearoa rivers and streams in highly natural condition. Whio is an absolutely protected species under the Wildlife Act 1953.

This report assesses the effects of the Scheme on whio and whio habitat. It seeks to catalyse outcomes for an ongoing whio population and whio habitats compatible with co-existence of the Scheme seeking to use the same habitat. It seeks to enhance the mana of whio.

The report:

i. presents existing knowledge of whio, whio population, and whio habitats as necessary to evaluate the potential effects (adverse and positive) of the Scheme; whio habitat includes hydrology, sediment processes, freshwater biota, and predator communities and management

ii. draws on a comprehensive study programme undertaken over multiple years (2006–2012) encompassing repeated surveys of whio populations in the general Scheme area including in the nesting period; a detailed population study by marking individual whio using bands and radio-transmitters to assess breeding, territorial use and longevity; an assessment of whio aquatic habitat use preferences to help predict the effects of water abstraction on the whio population; and a predator survey (collated in an earlier assessment of environmental effects on whio; Overmars 2014)

iii. draws on a further whio survey undertaken in spring 2024, which established that the current whio population status of the Scheme area is broadly similar to that at the time of the previous surveys, making it reasonable to rely on the principal earlier findings

iv. draws on the literature on whio and whio environmental factors, including citizen science data from iNaturalist and eBird

v. assesses the potential effects of the Scheme in relation to whio and whio habitat during its construction and operational phases, broadly following EIANZ guidelines for ecological impact assessment (Roper-Lindsay et al. 2018), and recognising that the Wildlife (Authorisations) Amendment Act 2025 intends the protection of populations and individual wildlife

vi. assesses how these effects are proposed to be avoided, mitigated or remedied, and where significant adverse effects remain, how these should be addressed through additional effects management measures.

The report's geographic focus is the Waitaha River and its tributaries from Kiwi Flat to the Macgregor Creek confluence, and including whio reported in 2024 on Waitaha Farm and on Waitaha River further downstream. A precautionary approach is adopted when dealing with uncertainty.

The knowledge, rights and interests of Te Rūnanga o Makaawhio and Te Rūnanga o Ngāti Waewae (Poutini Ngāi Tahu) are acknowledged, towards fulfilling the EIANZ guidance on practicing ethically with respect to the rights and interests of indigenous peoples (Environment Institute of Australia and New Zealand 2022).

Appendix C - Investigations

PREVIOUS INVESTIGATIONS

C1. A baseline study of whio and whio habitat was undertaken over an 18 month period in 2006–2008, covering Scheme design options at the time that included two water intakes at Kiwi Flat and three power station sites below Morgan Gorge. The baseline study contributed to an options selection process in 2012 that led to the current Scheme configuration.

C2. The baseline study comprised:

- repeated surveys to determine the whio population and distribution in the Scheme area, including three surveys in the nesting period (October 2006, October and December 2007)
- detailed population study at Kiwi Flat by marking individual whio using bands and radio-transmitters, to assess breeding, territorial use and longevity (April 2007–January 2008)
- a one-off 'single-pass' whio survey of the mid and upper Waitaha catchment, and several surveys of the nearby Amethyst Ravine catchment (on account of a reported high density whio population there)
- assessment of whio aquatic habitat use preferences and development of an aquatic habitat use model to predict the effects of water abstraction on the whio population (2007–2008)
- a survey of the introduced predator community (January and May 2007).

C3. The baseline study was focussed on Kiwi Flat. The greater water flow and velocity of the river below Morgan Gorge precluded bird capture and detailed study there. Morgan Gorge was not surveyed because of its inaccessibility and safety risks, and low likelihood of direct whio habitat use.

C4. Four short surveys were subsequently undertaken: one to assess whio population changes and the state of bands and transmitters on study birds (December 2009); two in conjunction with removing the bands and transmitters (August 2010 and June 2011), and the fourth (December 2012) to address an information gap identified in whio use of the abstraction reach of the now preferred Scheme option downstream of Kiwi Flat.

C5. Whio survey methods and other activities broadly followed the Department of Conservation (**'DOC'**) whio field manual and the standard DOC Whio Survey Technique, including using a conservation dog, searching for faecal and feather sign, and following standards for monitoring at security and recovery sites (Blue Duck (Whio) Recovery Group 2022; Studholme 2000). Distinguishing non-marked birds relied on the territoriality of adult whio (i.e. birds seen more than *c.*1 km apart are probably different; King et al. 2000). Single birds that did not vocalise calls were assumed to be males[5], and if a male bird was observed to come together with a female bird, they were assumed to be a pair.

[5] This is consistent with observations of male-biased sex ratios of marked birds at Kiwi Flat between 2007–2011, and elsewhere (e.g. Glaser et al. 2010), as a result of high predation pressure on females especially when nesting.

C6. Whio records from the Scheme area were sought from other sources, including DOC databases (Bioweb, Whio Manager), other Scheme consultants, and DOC hut books.

C7. Outputs of these studies include a baseline report on whio population, habitat use and predators in the Scheme area and its environs (Overmars & McLennan 2010) and field data inputted into the whio component of the instream habitat flow assessment (Allen & Hay 2013).

C8. An assessment of the environmental effects of an earlier iteration of the Scheme on whio/blue duck was compiled in 2014 (Overmars 2014). This incorporated survey findings and data analysis up to 2012. It drew on extensive previous scientific work on whio and whio habitat (including studies undertaken for the Tongariro hydro-electricity power scheme resource consents renewal processes); the whio recovery plan (Glaser et al. 2010); and other surveys and assessments undertaken for the Waitaha Hydro Scheme (especially aquatic communities, hydrology, sediment and noise).

2024 INVESTIGATION

C9. A five day whio survey was undertaken from 27 September to 1 October 2024 (**2024 Survey**). This comprised two passes of the Waitaha River and the lower ends of its tributaries at Kiwi Flat, of the mainstem and the lower ends of its tributaries below Morgan Gorge down to Douglas Creek (excluding Morgan Gorge), and up Douglas Creek. These are the sections of river and the tributaries that would be directly affected by or closely adjoin the current proposed Scheme structures in its construction and operating phases. Three surveyors operated as two teams, each with a conservation dog.

C10. This was a pre-breeding survey that sought to identify the current location and number of territorial pairs and so provide an estimate of the distribution and abundance of the breeding population. If the current population was found to be similar to that at the time of the previous surveys, it was considered reasonable to place some reliance on earlier findings, particularly population dynamics (breeding, mortality, immigration).

C11. Additionally, a one pass survey was undertaken in the Amethyst Ravine in 2024 to assess the current status of the presumed source of immigration supporting the Kiwi Flat population in earlier years, given the 2014 report finding of insufficient local productivity at Kiwi Flat to compensate for high adult mortality.

C12. Resurveying the Waitaha catchment above Kiwi Flat was not considered necessary as an ongoing presence of whio there was supported by records from the DOC Whio Manager database (nine records since 2015), the results of an immediately prior eDNA survey at 20 sites spread through the Waitaha catchment above the Douglas Creek confluence (**eDNA Report**; two records), and an internet search (four records).

C13. The eDNA data found only one site indicating whio presence at and below Kiwi Flat (i.e. in the Scheme area). This site was on the Waitaha mainstem a little above its confluence with Douglas Creek. This locality was therefore closely searched in the 2024 survey.

C14. The 2024 investigation included accessing citizen science data from iNaturalist and eBird, and internet records. Comparable data was not available at the time of the 2006–2012

investigation. These data had the effect of extending investigation coverage from the Douglas Creek confluence to where Andersons Road meets the Waitaha River.

C15. Survey coverage in this location in 2024 also extended 800 m downstream from comparable surveys in the earlier investigations, from the Douglas Creek confluence to the Macgregor Creek confluence, on the true right bank of the Waitaha River only. Neither whio nor whio sign was found in this section. For practical purposes, comparisons between survey coverages in the earlier and later investigations are referred to as ‘down to the Douglas Creek confluence’.

Appendix D - Detail of the Existing Environment

ECOLOGICAL DISTRICT AND LAND ADMINISTRATION

D1. The Scheme is located at the foot of the mountainous central Southern Alps, near the Alpine Fault. It is principally in the Wilberg Ecological District (ED), but in the Harihari ED where northwest of the Alpine Fault – approximately at the Waitaha River-Douglas Creek confluence (McEwen 1987). Its principal components are located on public conservation land held under the Conservation Act 1987 and managed by DOC for conservation purposes (Conservation Area – Waitaha Forest and marginal strips); the balance is Crown Land riverbed, road reserve, and privately owned land.

WHIO POPULATION, DISTRIBUTION AND CONSERVATION STATUS

D2. The total whio population is estimated at about 3000 (Department of Conservation 2024a). The DOC five yearly census in 2021 counted 863 pairs, 491 pairs in the North Island, and 372 in the South Island. The number of whio pairs in monitored areas declined from 694 in 2022 to 587 in 2023, in part due to the impact of severe weather events like ex-Cyclone Gabrielle (Department of Conservation 2023).

D3. Once abundant and widespread in Aotearoa, whio distribution and numbers have been diminished by habitat loss and predation, and they are now limited to rivers in forested catchments in Te Urewera, East Cape and central North Island, and along the West Coast of the South Island from Nelson to Fiordland. The species has been reintroduced to Taranaki Maunga. A slow contraction and fragmentation of whio range continues, especially in remote South Island areas (Innes et al. 2010; Walker et al. 2018; Williams 2025).

D4. Whio is classified as a nationally vulnerable species (qualifiers: Conservation Dependent, Climate Impact, Partial Decline, Sparse), with a low to high ongoing or forecast population decline of 10–50% (Robertson et al. 2021). The species' long-term survival is dependent on in situ management in suitable large-scale mainland river systems, in particular, protection from the key current threat of stoat predation (Glaser et al. 2010).

D5. The first priority of the current whio/blue duck recovery plan (Glaser et al. 2010) is to secure populations to a minimum of 400 pairs at eight 'Security Sites' spread through Aotearoa, each with a minimum of 50 pairs. Its second priority is to recover or re-establish populations throughout the former range, including having at least 100 pairs distributed between strategically located 'Recovery Sites'. A recent study found that more than 50 breeding pairs should be protected within a security site because of the low effective population size; and the higher genetic diversity and identification of at least two genetic clusters in the South Island warrants the establishment of additional security sites, particularly in Central South Island and Fiordland (Grosser et al. 2017). In 2024, there were 44 pairs in the Central Southern Alps security site (Department of Conservation & Genesis Energy 2024), the security site nearest to the Scheme area.

D6. The Makarora | Makarore area has recently been proposed as a new whio recovery site, to retain its distinct whio genetic variation, a new haplotype (Hufton & Robertson 2023).

WHIO GENETICS, ECOLOGY AND BEHAVIOUR

D7. Whio is an endemic Aotearoa species and genus (Checklist Committee 2022). It is one of only four mountain torrent waterfowl species worldwide (Kear 2005). Whio do not exhibit a close genetic affinity to any other duck genus or tribe around the world (Robertson & Goldstien 2012).

D8. North Island and South Island whio represent two genetically distinct lineages (Grosser et al. 2017). Genetic diversity within each island follows a pattern of isolation by distance with relatively high levels of gene flow among populations, likely driven by male–juvenile dispersal. The overall genetic diversity in whio is low and effective population size (number of individuals that actively contribute to the next generation) is small, putting the species at risk of further loss of genetic diversity due to genetic drift as well as inbreeding (ibid.).

D9. Whio are specialist feeders and occupy a riverine habitat[6] in which food is available in adequate quantity year-round and other essential resources (shelter, nesting sites, brood-rearing habitat) are present. They feed in shallow or deep water in rapids and pools, taking food from turbulent riffles, eddies downstream from rocks, and from rocky beds or shores (Marchant & Higgins 1990). They are primarily visual feeders of the water column (Martin et al. 2007). Food consists mostly of caddisfly larvae and other aquatic invertebrates such as mayfly, stonefly and chironomid larvae, and sometimes algae and berries (Williams 2025). Whio diet varies between rivers and amongst birds (Collier 1991). There is no evidence of selective feeding (Veltman et al. 1995; Williams 2025).

D10. The river sections in which whio now occur have comparatively higher gradients, shallow river margins, stable stream banks, stable coarse river substrates (with high proportions of boulders), pool and riffle sequences, abundant invertebrate prey, and forested catchments and riparian margins (Collier et al. 1993; Williams 2025). The water is fast-moving, cold, clear and highly oxygenated, and there is typically low transport of fine or suspended sediments. Birds can occur in forest streams as small as 0.3 m wide (Marchant & Higgins 1990; pers. obs.). In Te Urewera, most observations on side streams occurred late in the breeding season or during the moult period (Glaser & Allerby 2010).

D11. Whio are generally encountered year-round as territorial pairs dispersed serially along a river, with single males attempting to claim space between pairs (Williams 2025). Territoriality results in low densities (an average of 1 pair per km of river). [7] Once established, the territory is generally held for life. Mate changes (whether of male or female) because of death or displacement rarely induce a change in territory location and pattern of use.

D12. Peak nesting time in the South Island is September to November (Studholme 2000). Renesting is uncommon and rarely occurs later than November. Nests are usually close to river edges (<30 m) in sites concealed by vegetation, rocks or overhangs, in holes in the riverbank, in

[6] Fossil remains were common in Takaka Hill deposits at considerable distances from surface water, suggesting whio were more terrestrial before mammalian predators arrived (Worthy & Holdaway 1994).
[7] Charlie Douglas wrote (at a time when stoats likely were not yet present in South Westland) of thirteen pairs of blue ducks, with numerous offspring, in about four miles of a creek (2 pairs per km; Pascoe 1957).

clefts in rocks, or on ledges in caves; nests are often in highly inaccessible locations (Kear 1972; Marchant & Higgins 1990; Young 2006). Whio are not necessarily faithful to the same nest sites in successive years (Williams 1991). While the female is incubating, the male waits on the riverside close to the nest. The average clutch is 5 or 6 eggs, and the incubation period extends for 33–35 days (Williams 2025). Both parents guard the ducklings during the 70–80 days until fledging and the brood is raised entirely within the territory. Average productivity is 1.3 fledglings per pair per year.

D13. Moulting occurs over about 6 weeks, often in small side streams. In field studies in the Waitaha and Amethyst, birds showing signs of moulting were found in December and January. No moulting sites were found. Moulting can extend later if birds re-nest (Marchant & Higgins 1990).

D14. Whio ducklings are relatively mature and mobile from birth (precocial; Marchant & Higgins 1990). They typically leave the nest within 48 hours of hatching (nidifugous). They can swim against strong currents and jump on rocks and ledges. Mortality of pre-fledged ducklings from flooding can be high. The mature ducklings gradually disperse from the territory when their parents start their post-breeding moult and are forcibly challenged and evicted by the adults after moulting. Age of first breeding is one or two years (Williams 2025).

D15. Juveniles attempt to establish territories near their natal territory; settlement in rivers beyond their natal catchment is rare. This causes high levels of genetic relatedness within sections of rivers and strong genetic patterning between rivers (Williams 2025).

WAITAHA RIVER CHARACTERISTICS

D16. The Waitaha River and its tributaries present a highly dynamic habitat for whio. The river is glacier-fed and drains a steep mountain catchment on the western slopes of the Southern Alps Kā Tiritiri o te Moana. The sometimes intense rain, seasonal temperature variation, and the effect of melting snow and ice together considerably influence on the nature of river flow conditions (**Hydrology Report**). Water quality is high. Increasing rainfall caused by climate change will exacerbate glacial melt.

D17. In spring and early summer, the river flows high, and is discoloured with snowmelt (**Hydrology Report**). Flows recede over autumn and into winter, when flows drop to low levels and the river runs clear during dry periods. The monthly median flow at the top of Morgan Gorge peaks in December (31.8 m^3/s), recedes in March to 20.8 m^3/s, and is lowest in July (10.3 m^3/s).

D18. The annual median flow at the Morgan Gorge entrance is 19.7 m^3/s and the annual mean flow is 34.6 m^3/s; the difference indicates the strong contribution of floods. The mean annual flood flow is 812 m^3/s, and the mean 20 year flood is 1177 m^3/s. The mean period between floods is 8.6 days, and the length of a flood (from onset to loss of flood discoloration) is typically around two days.

D19. The one day mean annual low flow (MALF1) is 7.09 m^3/s, and the seven day mean annual low flow (MALF7) is 7.57 m^3/s.

D20. The FRE3 value (the average number of floods per year exceeding three times the median flow – a measure of bed disturbance) is high (26.2; **Hydrology Report**).

WHIO HABITAT IN SCHEME AREA

Kiwi Flat to Morgan Gorge

D21. Kiwi Flat is a low gradient and wider section of the Waitaha River between the Waitaha and Morgan Gorges (length 2.2 km; **Photo 1**). Substrates are silt, sand, gravel, cobble and boulder, and the principal channel morphologies are run, riffle, plane bed and 'rock garden'[8]. It has areas of defined channels that shift in location over time. There are abandoned channels on the north and south banks, left after the river has cut down into new courses across the Flat over recent decades, and now covered with seral scrub vegetation.

D22. During large flood events, flows through Morgan Gorge are constricted by its narrow dimensions and water levels rise and back up on Kiwi Flat towards and above the Whirling Water confluence (**Sediment Report**; **Photo 3**). This process results in a substantial drop-out of gravel, silt and sand in the reduced water velocities of the backwater. Between major floods, the deposited bed material is reworked down the Waitaha channel to Morgan Gorge.

D23. Kiwi Flat provides high quality whio feeding habitat because of the large extent, relative stability and invertebrate productivity of its relatively shallow and slower flowing waters amongst sand, gravel and cobble substrates. The lower reach of Whirling Water (1.4 km; a major tributary entering at Kiwi Flat) has similar characteristics but without glacial sediments, adding variety of habitat in a range of flow conditions. These factors, with the low altitude, may possibly be resulting in lower daily energy expenditure requirements (Godfrey et al. 2003).

D24. Below the Whirling Water confluence, the river is a single channel that steepens as it runs into Morgan Gorge (**Photo 2**). This provides less favoured whio habitat.

D25. Caesar Creek, Labyrinth Creek and at least one of several other unnamed tributaries are also used for feeding, and may be used for moulting.

Abstraction Reach (Morgan Gorge to Tailrace)

D26. In the Morgan Gorge section of the proposed abstraction reach (1.0 km), the Waitaha River has cut a slot gorge into basement rock, *c.*20–40 m deep and *c.*10–30 m wide. The river initially falls gently between narrow rock walls (**Photo 4**), but becomes wider and falls more steeply thereafter (**Photo 5**). The river falls *c.*55 m through the gorge (from 235 m to 180 m asl). Channel morphology (Montgomery & Buffington 1997) is mainly whitewater rapid, and the substrate is mainly bedrock and large boulders (McMurtrie & Suren 2014). Morgan Gorge is not known to be directly used by whio.

[8] 'Rock garden' is an informal term referring to a distinctive river channel morphology: a bar partly or completely across the river in which water meanders or trickles through a bed of emergent cobbles or small boulders. When present, rock gardens are a highly preferred blue duck feeding habitat (Overmars 2014). A large rock garden towards the upper end of Kiwi Flat and another at the Whirling Water confluence were destroyed, possibly as a result of the 27–28 December 2010 atmospheric river event (West Coast Regional Council 2011; Prince et al. 2021).

D27. The abstraction reach below Morgan Gorge (1.5 km) primarily has a confined channel (**Photos 6 & 7**). The river falls *c.*50 m (from 180 m to 130 m asl, mean 1.8^{o} gradient). The channel gradually widens (up to 30–50 m) and the bed flattens somewhat towards the proposed tailrace site. Substrate consists of bedrock, large boulders and shifting gravels, and more mobile fine sediments in higher velocity waters; substrate size decreases downstream. Channel morphology changes from predominantly bouldery step pool and cascade to planebed. Mean and maximum depths measured at baseflow conditions at 17 transects in this section (and to the Douglas Creek confluence) were 79.3 cm and >250 cm respectively; measured mean and maximum water velocities were 0.77 m/s and >2.4 m/s (September 2006, unpublished data). These depths and velocities are much greater than those found to be preferred by whio (**paragraphs D55 & D56),** making for less favoured (though still used) whio habitat.

D28. Anson Stream and other small tributaries enter the Morgan Gorge section via waterfalls or cascades. Anson Stream is used as feeding habitat, and lower Anson Stream may be used for nesting habitat. Glamour Glen and several other tributaries enter below Morgan Gorge. Glamour Glen is known to be used as feeding habitat.

Tailrace to Douglas Creek and Macgregor Creek and to Andersons Road

D29. The river gradient reduces further in the reach from the proposed tailrace to the Douglas Creek and Macgregor Creek confluences (*c.*1.8 km length, 20 m fall). Mean and maximum depths measured at baseflow conditions at nine transects in this section were 69.0 cm and >130 cm respectively; mean and maximum water velocities were 0.56 m/s and 1.49 m/s (September 2006, unpublished data). Although these depths and velocities are greater than those found to be preferred by whio, this reach is nevertheless regularly used. The variety of habitat in a range of flow conditions at the Douglas Creek confluence may contribute.

D30. Douglas Creek, running along the Alpine Fault, is a smaller tributary, with a substantial bedload. Macgregor Creek, a largely underground tributary with a large alluvial fan formed from a major landslide in 1903 ('Robinson Slip'), discharges into the Waitaha River 800 m downstream of the Douglas Creek confluence. Whio were regularly found in Douglas Creek, and there has been a recent report of a single whio in lower Macgregor Creek.

D31. Between the Macgregor Creek confluence and Andersons Road (*c.*4 km, 20 m fall), the Waitaha River opens up and becomes braided with expanses of gravels. There is less riparian habitat. Such habitat is not usually considered to be whio habitat, but a whio pair were recently recorded near Andersons Road.

WHIO POPULATION IN SCHEME AREA

D32. Between 2006–2012, the whio population at Kiwi Flat was surveyed on seven occasions and the population in the abstraction reach down to the Douglas Creek confluence on five occasions. These sections were again surveyed in 2024. Survey results are summarised at **Table 5**.

Table 5: Adult and fully grown juvenile whio population observed during surveys at Kiwi Flat and in the abstraction reach down to the Douglas Creek confluence in 2006-2012 and in 2024.
Includes accessible reaches of tributaries discharging to the Waitaha River. The abstraction reach-Douglas Creek surveys variously extended up the lower reach of Douglas Creek. Search effort (days) refers to the number of days of searching for capture/marking/release of birds or other purposes (i.e. greater intensity). Search effort (passes) refers to standard walkthrough surveys (with or without a conservation dog). FAE = faecal deposit.
The pair(s) reported on Waitaha Farm in winter 2024 and on the Waitaha River at Andersons Road in December 2024, and the single whio reported on Macgregor Creek are not shown here, nor reported pairs in the Morgan Gorge to Douglas Creek section in 2006–2012) (see text).
Data sources: 2006–2012, Overmars (2014); 2024, current survey.

Observation Period	Search Effort	Adults Total	Adults Female	Pairs	Juve-niles	Search Effort	Adults Total	Adults Female	Pairs	Juve-niles
River Reach	*Kiwi Flat*					*Abstraction Reach-Douglas Creek*				
March 2006						1 pass				1
July 2006	5 days	8	≥2	≥2	2	1 pass	1			1
April 2007	5.5 days	10–11	3	3	1	1 pass	FAE			
September 2007 – January 2008	12 days	≥9	4	3		Nil				
December 2009	2 passes	8	3	3		1 pass				
August 2010	2 passes	10	4	3		Nil				
June 2011	2 passes	8	4	2	1	Nil				
December 2012	2 passes	7	3	3		3 passes	FAE			
September-October 2024	2 passes	8	3	3		2 passes	4	1	1	

D33. On all seven survey occasions up to 2012, a population of 8–12 adults (including fully grown juveniles and counting faecal sign as one bird) was found between Kiwi Flat and the Douglas Creek confluence. At Kiwi Flat, there were three pairs on five occasions, and a minimum of two pairs on two occasions. Between Morgan Gorge and the Douglas Creek confluence, a single bird or faecal sign only was found, on some occasions. There were several reports from other sources of a pair between Morgan Gorge and the Douglas Creek confluence (making for up to 4 pairs).

D34. In the 2024 survey, a total of 12 adults (4 pairs) were found between Kiwi Flat and the Douglas Creek confluence. There were three pairs and two single whio at Kiwi Flat (**Figure 4**), and one pair and two single birds between Morgan Gorge and the Douglas Creek confluence (one of the single birds being first found on Glamour Glen and the other being first found on Douglas Creek) (**Figure 5**).

D35. Together, the results of the 2006–2012 surveys (including reported birds) and the 2024 survey suggest there has not been a substantial change of population state since 2012 at Kiwi Flat and down to the Douglas Creek confluence (almost consistently 3-4 pairs, 2-6 singles). Whether there was some constancy or variation in the intervening period cannot be determined.

D36. To test their territorial boundary, the pair found on one occasion in Whirling Water in 2024 were gently guided downstream to a point where they would go no further, and they then walked back upstream ('WTH PR3', **Figure 6**). This boundary location is similar to that found in 2007–2011 when birds were marked with bands and radio-transmitters. Overall, the spatial distribution of the three pairs found at Kiwi Flat in 2024 is similar to the territorial pattern found during the previous field studies, other than for downstream movement of the pair in the reach below the Waitaha Gorge. This adds to the evidence that there has not been a substantial change of population state at Kiwi Flat compared with that in 2006–2012.

Figure 4: Locations of pairs and two single whio (confirmed or presumed males) found during 2024 survey at Kiwi Flat.
WTH = Waitaha; PR = pair; M1 = Male 1, etc. Proposed Scheme infrastructure outlines at Morgan Gorge entrance shown in black at top left. (Aerial photography: LINZ)

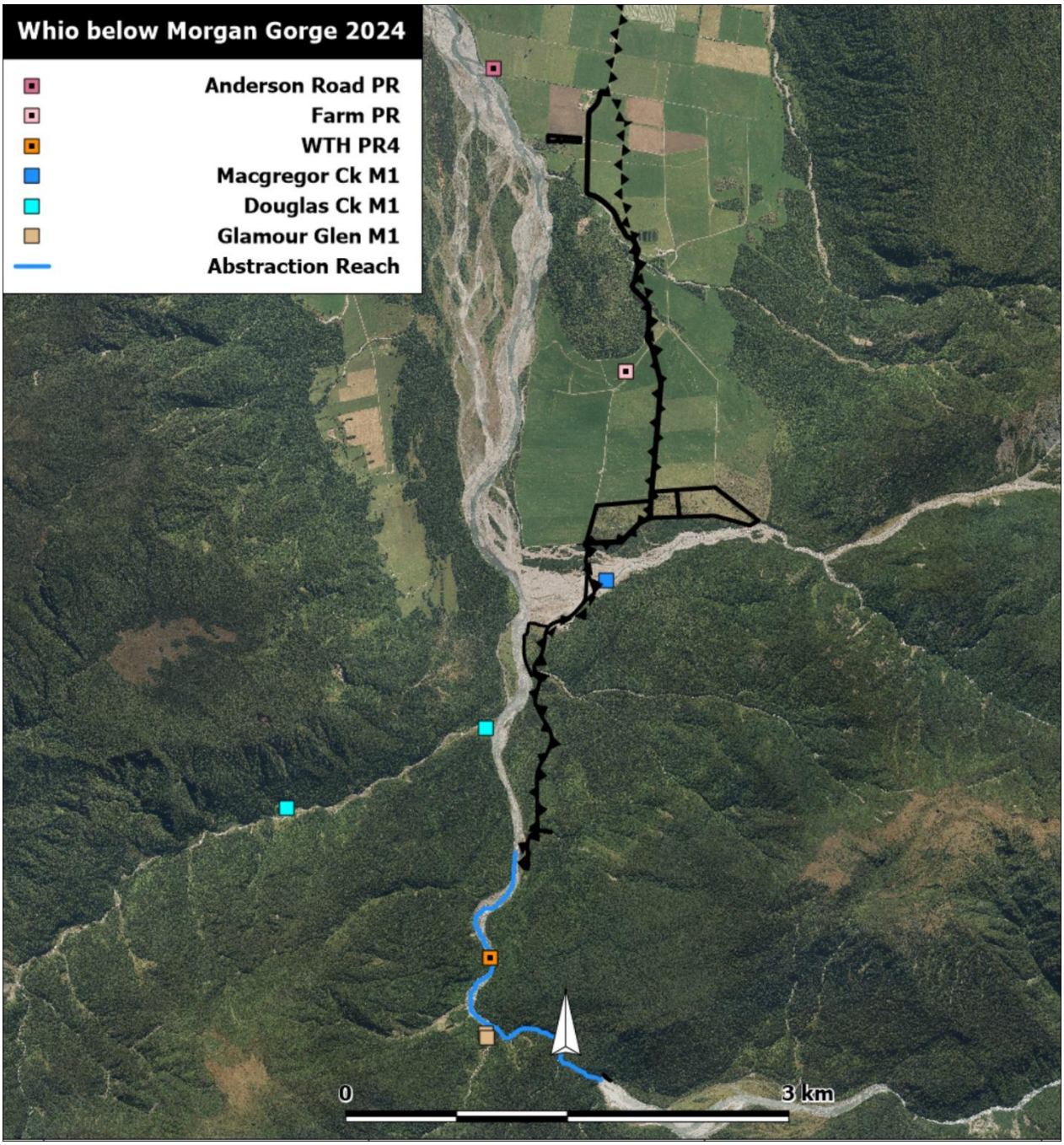

Figure 5: Locations of pairs and single whio (all confirmed or presumed males) found or reported during 2024 survey below Morgan Gorge.
Includes pair reported on Waitaha Farm and near Andersons Road. WTH = Waitaha; PR = pair; M1 = Male 1. Proposed Scheme infrastructure outlines (power station, access road, transmission line, spoil disposal and staging area, gravel screening) shown in black. (Aerial photography: LINZ)

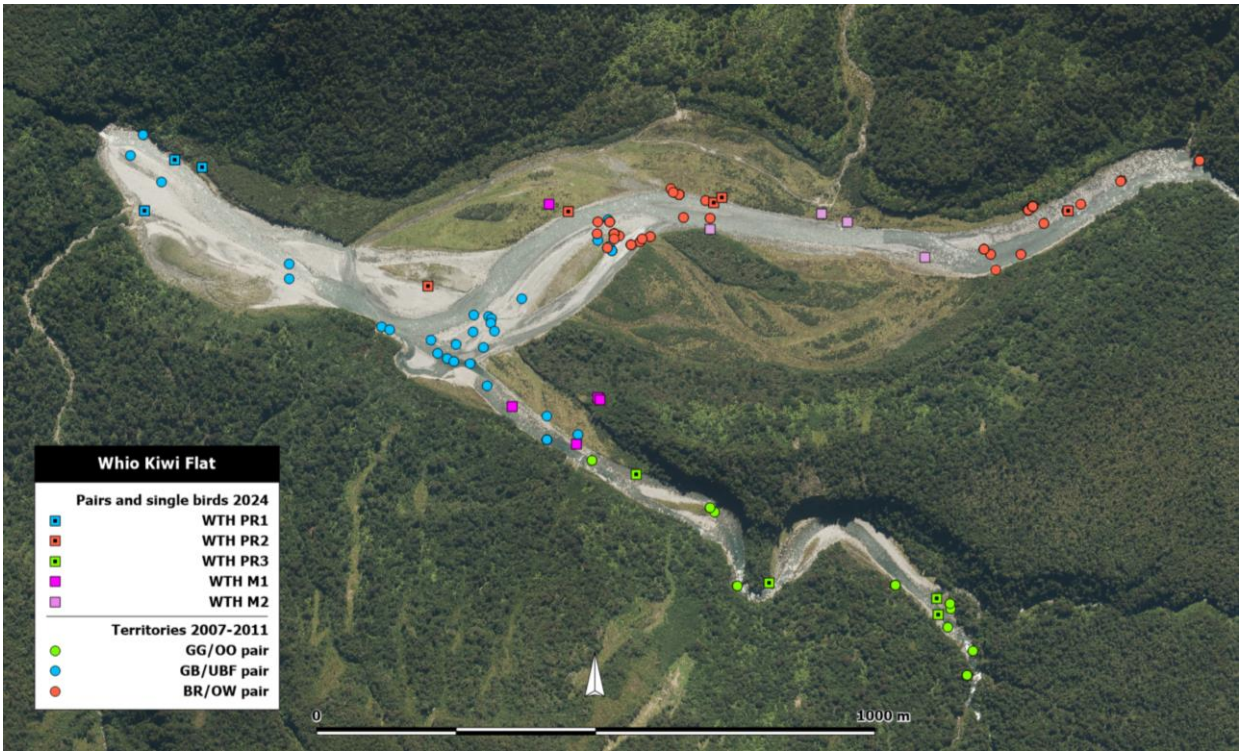

Figure 6: Spatial distribution of pairs and two single whio at Kiwi Flat in 2024 in relation to the three pairs present in 2007–2011.
WTH = Waitaha; PR = pair; M1 = Male 1, etc. GG/OO = green/orange pair; GB/UBF = green-blue/unbanded female pair; BR/OW = blue-red/orange-white pair. Proposed Scheme infrastructure outlines at Morgan Gorge shown at top left.

D37. There are recent reports[9] of a whio pair seen on a farm pond and water race on Waitaha Farm in June–July of the past two years; a pair seen on the Waitaha River near Andersons Road in December 2024; and a single whio seen on Macgregor Creek in September 2024 (**Figure 5**). Given their proximity in space and time, the two pair records are likely to be the same birds. Whether these reported birds are the same as birds found upstream during the 2024 survey, or

[9] [redacted] pers. comm. 2024-09-27, 2024-11-14; iNaturalist, 2024-12-29, https://www.inaturalist.org/observations/260311456.
Whio living on farm ponds is unusual (Williams 2005) but the record is accepted as credible, more so as the accompanying single whio record at Macgregor Creek was supported by a video recording. Notwithstanding that the braided character of the Waitaha River near Andersons Road would be a highly unusual whio habitat (O'Donnell & Moore 1983), the iNaturalist record is supported by a photo that matches the habitat indicated by aerial photographs (deep water at the foot of a rock groyne) and also is considered credible. These birds do not appear to be in the early stages of moulting.

are additional birds, is uncertain.[10] There is no comparable data for these river sections and the farm during the earlier surveys.

D38. Depending on whether or not the whio reported in 2023–2024 on the farm pond and near Andersons Road, and at Macgregor Creek, are different from other whio found upstream, there are 12-15 (4-5 pairs) currently known in the Scheme area. Pair density on the Waitaha River mainstem at Kiwi Flat was 0.83 per km (3 pairs in 3.6 km); and 0.17 or 0.33 per km (1 or 2 pairs in 6.0 km) between the Morgan Gorge mouth and Andersons Road. Tributary habitat may be contributing to these densities. On a mainstem basis, the Kiwi Flat density ranks third amongst 11 other known pair densities across Aotearoa (Godfrey et al. 2003).

D39. Data from studies elsewhere indicate the whio population in the Scheme area is likely to be connected to other populations in the central Southern Alps, like a metapopulation, particularly through juvenile dispersal (Shaw 2012). This is supported by the findings during the 2006–2012 studies of two immigrants into the Kiwi Flat population and one juvenile dispersing from Kiwi Flat to the Kakapotahi catchment. The nature and scale of movement between the population in the Scheme area and that in adjoining catchments is, however, largely unknown.

D40. Demographic analysis of the Kiwi Flat population in 2007–2011 showed there was insufficient local productivity to compensate for the high adult mortality, and to ensure long-term population stability (Overmars 2014). Yet the Kiwi Flat breeding population was reasonably stable over the six year study period (7–11 total adults). The analysis indicated that the population is receiving immigrants from elsewhere, probably juveniles, and it could not persist in the absence of this immigration. This was supported by evidence of two and possibly four immigrant birds at Kiwi Flat during the 2006–2011 study period. The then high density population at Amethyst Ravine was suggested as a likely source of immigration into the Kiwi Flat. Its current contributions to the Waitaha population are now questionable given the 2024 survey finding that the Amethyst Ravine population has halved since 2008.

D41. There has been increasing recognition of the impacts of radio-transmitters on wildlife e.g. increased thermoregulatory costs caused by feather disruption by the harness (Williams 2003; Blue Duck (Whio) Recovery Group 2022) – although neither of these studies cite mortality as a consequence. Radio-transmitters were placed on whio in the Waitaha for a number of years, following Recovery Group best practice. There were minor problems only with some bands and transmitters (Overmars & McLennan 2010). The bird with the longest period of bands and transmitter (five years) showed no abrasion on its legs or under the transmitter when these were recovered. It is therefore considered unlikely that the bands and transmitters contributed significantly to the high mortality at Kiwi Flat in 2007–2011.

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[10] These two reported pairs (assumed to be male and female) are located 4.0 and 6.0 km respectively downstream in a straight line from the nearest pair found by the 2024 survey, well beyond usual territory lengths (400–2400 m, median 1000 m; Godfrey e al. 2003). The winter only occurrence of the pair on the farm pond suggests seasonal movement. However, the late December occurrence of the pair near Andersons Road is less readily explicable. Given the highly territorial behaviour of whio (Marchant & Higgins 1990), the possibility that these two records are a pair using local habitat is not out of the question, unusual habitat notwithstanding. In the Mokihinui catchment, a citizen observation of a pair 2.5.km from the nearest other pair was considered to be additional (Shaw 2012).

D42. In the 2024 survey, whilst one pair and two single males were found in the Morgan Gorge to Douglas Creek confluence reach, no whio scent nor sign was observed on the true right (eastern) bank. Faecal sign was abundant on the true left bank. This indicates the true right bank, where the proposed Power Station would be located, was not at that time subject to active whio habitat use (although use at other times is not precluded).

Table 6: Recorded observations of whio entering and exiting Morgan Gorge at Kiwi Flat or otherwise using it as a flyway (2006–2007).
MG = Morgan Gorge; GB/– = green-blue banded male; UBF = unbanded female mate. Source: Overmars (2014).

Date	Observation Details
2006-09-14	Several birds seen flying out of Morgan Gorge; one joined another at MG entrance, and they then flew up towards Whirling Water
2007-09-24	GB/– and UBF flew down Waitaha River and into MG
2007-10-25	GB/– and UBF flew into MG
2007-10-26	UBF flew out of MG (flying about one third of the height of the swingbridge), joined GB/– at gorge entrance, they both flew to lower rock garden at Whirling Water confluence, she fed voraciously; both flew into MG 62 minutes later; he exited MG three further minutes later
2007-10-27	Bird sign within previous 24 hours in scrub alongside Anson Stream, nesting not confirmed (likely to be bird/s from Kiwi Flat)

D43. Although Morgan Gorge itself could not be surveyed and is unlikely to be used directly by whio as habitat, there was evidence in the earlier studies of it being used as a flyway (**Table 6**). There was evidence in December 2007 of a nesting attempt in Anson Creek just above its fall into Morgan Gorge (based on the presence of bird sign within the previous 24 hours in scrub alongside the stream).

D44. Historical records (DOC Bioweb) indicate there has been a decline in the reach below Morgan Gorge since the 1980s. Whio were reported in 1986 to 'nest every year' at the Douglas Creek confluence, two pairs were reported below Morgan Gorge in 2000, and pairs were reported in May 2007 and June 2008 around the Douglas Creek confluence. The Douglas Creek confluence seems to provide better habitat, possibly from the varied feeding opportunities of two rivers and perhaps higher invertebrate densities in Douglas Creek.

D45. Though breeding activity was expected during the 2024 survey, and this is a time when females are mostly seen feeding intensively, only semi-intensive feeding by one female whio was observed. Cold temperatures and high river flows in the weeks preceding the survey may have delayed the onset of breeding.

D46. Compared with 2006–2012, there were noticeably increased sediment volumes in the beds and on the banks of Whirling Water and the Waitaha mainstem at Kiwi Flat at the time of the 2024 survey. There was also substantial local hillslope landsliding (as evident in Google

Earth imagery); this is likely related to a recent significant weather event (possibly March 2019 atmospheric river, 1086 mm in 48 hours at Cropp River; Prince et al. 2021).

WHIO POPULATION AND HABITAT IN AMETHYST RAVINE

D47. The whio population in a 5 km elevated valley reach of the Amethyst Ravine was surveyed on three occasions in 2007 and 2008, and again in 2024 (**Table 7**). Between 14–18 adults (including 5–8 pairs) were found on the three earlier occasions, a high density population (1–1.6 pairs/km). Eight adults and three pairs (0.6 pairs/km) were found in 2024. The current population is approximately half of what it was 16 years ago.

Table 7: Adult and juvenile whio population observed during walkthrough surveys at Amethyst Ravine in 2007–2008 and in 2024.
Data sources: 2007–8, Overmars (2014); 2024, current survey.

Observation Period	Adults Total	Adults Female	Pairs	Juveniles
2007-04-22	18	8–9	8	1
2007-12-22	14	7–8	5	
2008-01-16	16	8	6	
2024-09-30	8	3	3	

D48. Increased sedimentation was also evident in the Amethyst Ravine riverbed in 2024, compared with the earlier surveys. The contrasting whio population outcomes at Kiwi Flat (no significant change) and in Amethyst Ravine (halving) suggests these sediment regime changes have not been a significant factor in whio habitat suitability.

WHIO POPULATIONS ELSEWHERE IN WAITAHA CATCHMENT AND IN ADJOINING CATCHMENTS

D49. The April 2007 survey also covered the Waitaha River above Kiwi Flat, including Reid and Stag Creeks and County Creek, and Scamper Torrent. It found a total of 17 birds, including six pairs. The total Waitaha catchment population at that time thus was 27–28 adults (including nine pairs).

D50. Six whio pairs were recorded in 2019 in the Perth-Barlow block (Whataroa River catchment) of the Predator Free South Westland area (Nichols et al. 2024). Whio have been observed in the Perth River since 2019, with groups of ducklings seen most years. Twelve individuals were reintroduced to the upper Perth and Whataroa catchments in 2024.

D51. Between the Waitaha catchment and the Central Southern Alps security site, iNaturalist (since 2015) and eBird show scattered whio records in headwater catchments of the Hokitika River (excluding the Styx River), and in the Mikonui catchment. On the western side of the Main Divide southwards to the Haast River valley, there are concentrations of records in the Whataroa-Perth catchments (reflecting Predator Free South Westland activity) and in the Copland/Karangarua Valley, and single records at several other sites.

WHIO FOODS AND AQUATIC HABITAT USE PREFERENCES

D52. Notwithstanding they are the primary whio feeding habitat, the mainstem of the Waitaha River and most tributaries have low benthic invertebrate densities, species diversity, and species evenness, relative to stable tributaries (**Freshwater Ecology Report**). The mayfly *Deleatidium* and orthoclad midges dominate the community of these sites. The limited invertebrate community is attributed to the naturally unstable nature of these sites, with a high disturbance regime, low nutrients and presence of glacial flour limiting basal food supply. The invertebrate community is therefore naturally limited to those taxa that can rapidly colonise or persist in disturbed environments, such as some chironomids and mayflies, with their non-synchronous life cycle and use of side braids, river margins and tributaries allowing for continual recolonisation of disturbed environments.

D53. Abundant and common taxa in whio faecal samples collected from the Waitaha River and Amethyst Ravine in April 2007 included Ephemeroptera (mayflies), Hydrobiosidae (caddisflies), Blephariceridae (net-winged midges), Maoridiamesinae (non-biting midges), Orthocladiinae (non-biting midges) and Elmidae (riffle beetles) (Overmars & McLennan 2010). Abundant seeds were also present, and in samples collected from the lower reaches of Whirling Water in June 2011.

D54. Water depth and velocity data for assessing whio aquatic habitat feeding preferences at the Waitaha River were collected between September 2006 and January 2008 at a total of 60 sites where whio were observed feeding. Waitaha-specific habitat suitability criteria for whio were developed by Cawthron Institute (Allen & Hay 2013).

D55. Whio used depths ranging from 0 to 1.1 m, with the optimum being relatively shallow water (0.21 m). This optimum is substantially shallower than the average depth under low flow conditions (~0.47 m at MALF1).

D56. Velocity use ranged from 0 to 1.3 m/s. Velocity use curves were derived from data from all 60 sites, giving an optimum value of 0.23 m/s. These velocities are slower than the average velocity under low flow conditions (~0.43 m/s at MALF1 in Kiwi Flat), indicating whio prefer low velocity locations.

D57. Overall, whio feeding habitat is predicted to increase because of the proposed flow reduction in dry and typical months, with no change in wet months (90–175% habitat retention).

INTRODUCED SPECIES AND THEIR IMPACTS

D58. Didymo (*Didymosphenia geminata*) is a freshwater alga that has recently arrived in Aotearoa (Kilroy & Unwin 2011). Thick growths of didymo form large mats on the bottom of streams and rivers that can adversely affect freshwater fish, plant and aquatic invertebrate species. Didymo is a potential threat to whio as it can reduce their food source (Glaser et al. 2010). Whilst its presence was not confirmed by sampling in 2007–2008, the recent eDNA sampling of the Waitaha catchment (**eDNA Report**) detected didymo DNA at three tributary sites at Kiwi Flat and one site on the mainstem near Douglas Creek. The generally low didymo DNA signatures at these sites indicate didymo is not presently a dominant feature of the

environment; didymo growths were not obvious at any of the sampling sites. The Waitaha River is likely to be less conducive to didymo blooms than many other rivers given its frequent floods and high suspended sediment loads that would keep biomass to a minimum.

D59. Trout (and other diadromous fish species—including longfin eels (*Anguilla dieffenbachii*)— but except kōaro (*Galaxias brevipinnis*)), are not present above Morgan Gorge due to multiple natural barriers (**Freshwater Ecology Report**). There is evidence for competitive resource partitioning between whio and trout over aquatic macroinvertebrate food supplies in North Island rivers; trout may impact whio (which are visual feeders; Martin et al. 2007) through causing a shift to nocturnal whio feeding by a corresponding invertebrate behavioural shift in aquatic invertebrate activity from diurnal to nocturnal (Townsend & Simon 2006); and Singers & Conley (2013) found an inverse relationship between trout and whio presences and absences in the Waimarino River (but do not directly attribute this to differences in invertebrate abundance in the presence or absence of trout). While there is not a strong difference in invertebrate diversity and density above and below the gorge (McMurtrie & Suren 2014), a relationship between trout absence above Morgan Gorge and the relatively high whio numbers there remains possible, mediated by the invertebrate behavioural shift induced by trout (M. Williams, in Young 2006).

D60. A small mammals baseline assessment found the Scheme area supports all of Aotearoa's most significant introduced predators: ship rats, mice, possums and stoats (Overmars & McLennan 2010). Cats (*Felix catus*) and Norway rats (*Rattus norvegicus*) probably reside on the dairy farms down the valley and rabbits are present on the adjoining riverbed; these species may straggle into the Morgan Gorge area sometimes. European hedgehogs (*Erinaceus europaeus)*, weasels (*Mustela nivalis*) and ferrets (*M. furo*) are probably absent altogether.

D61. At the time of the surveys (January and May 2007), ship rats, mice, possums and stoats were all at levels of abundance that exceeded recognised damage thresholds for reptiles, large invertebrates and various forest birds. The abundance of predators and the occurrence of predator irruptions in the Scheme area are a function primarily of periodic increased food supplies from rimu (*Dacrydium cupressinum*) masting. The predator abundance in summer-autumn 2007 likely was in response to rimu masting in autumn 2006. Stoat irruptions following rimu masting resulted in high rowi mortality at the nearby Ōkārito kiwi sanctuary (Robertson & de Monchy 2016).

D62. The key current threat to whio is stoat predation (Whitehead et al. 2008, 2010; Glaser et al. 2010; Innes et al. 2010). Nesting whio females and their eggs are especially vulnerable over the long incubation period to stoats and possums, while rats and weka have been implicated in nest and egg destructions. Being flightless, moulting birds of both sexes are also vulnerable to attacks from predators.

D63. Aerial 1080 pest control operations by OSPRI and its predecessors for the purpose of controlling and eradicating bovine tuberculosis have occurred in the foothills of the Waitaha Valley and adjoining areas for the past 30–40 years, including the Scheme area (Livingstone et al. 2015; [redacted], OSPRI Christchurch, pers. comm 2024-11-04). Given the benefits of this pest control for native avifauna (Innes et al. 2010; OSPRI 2016; Van Vianen et al. 2018), it is possible that the absence of decline of whio (and other avifauna) in the Scheme area since at

least 2006 is related to the OSPRI 1080 operations. As OSPRI pursues its TB eradication intent, its aerial 1080 usage is expected to fall away to zero by 2030 (OSPRI 2021). An aerial operation in the upper Waitaha planned for January 2026 (OSPRI 2024) would extend down the valley only to the Waitaha Gorge, thus excluding the Scheme area. The withdrawal of OSPRI 1080 operations likely will place whio in the Scheme area and adjoining areas at increasing risk from predators.

D64. Wild goats (*Capra hircus*) and their sign were observed in greater abundance in the Scheme area and Amethyst Ravine during the 2024 survey. A literature search found no reference to a detrimental effect of goat browsing on whio, although this remains possible.

MAJOR PERTURBATIONS: CLIMATE CHANGE, ALPINE FAULT AND SEDIMENT, AVIAN INFLUENZA

Climate Change

D65. Recently updated climate projections, applied to the Kiwi Flat area, relative to a 1995–2014 baseline (20 years ago) and particularly relevant to whio include (using three Shared Socioeconomic Pathways, SSP1-2.6, SSP2-4.5 and SSP3-7.0; Ministry for the Environment 2024a):

- the average temperature is likely to be 0.8–1.4°C warmer by 2050, and 0.8–3.0°C warmer by 2090
- the average temperature in summer is likely to increase by 0.9–1.5°C by 2050, and by 0.7–3.3°C by 2090
- annual rainfall is likely to increase between 4.0% and 3.6% by 2050, and increase by between 4.8% and 9.9% by 2090, with greatest seasonal change projected in winter
- the number of very rainy days (>25 mm) is projected to increase between 1.8 and 1.6 more per year by 2050, and between 2.3 and 4.3 more per year by 2090
- extreme rainfall (99th percentile) is projected to increase by between 5.5% and 5.5% by 2050, and between 5.6% and 13.8% by 2090. [11]

D66. Overall, the climate in the Waitaha Valley will be more unpredictable and hold greater extremes (**Hydrology Report**). The Waitaha River can expect average flow to increase, and larger and more frequent floods particularly in spring and winter. Late summer flows may reach slightly lower levels than previously, on account of snow being melted earlier in that period. Slightly warmer winter temperatures imply that less winter snow accumulation is likely and winter runoff may increase during low flow periods, as well as floods.

D67. Whio meet two of five qualifiers for threatened and at risk species to be classified as ‘Climate Impact’ species: riverbed specialists that will be subject to greater fluctuations of river flow, and forest birds that will be subject to greater predation by rodents and mustelids as a

[11] Most extreme rainfall events in Westland are associated with ‘atmospheric rivers’ (Prince et al. 2021). Central Westland receives 72%–78% of total precipitation and 92%–94% of extreme precipitation within 12 hours of an atmospheric river, with the largest atmospheric rivers exceeding 1000 mm of storm total precipitation over 3 days.

result of an increased frequency and magnitude of beech masting events (Robertson et al. 2021). The exclusion of podocarp forest (as occurs in the Scheme area) from the qualifier may reflect the greater declines between 1969–1979 (Bull et al. 1985) and 1999–2004 (Robertson et al. 2007) in whio distribution in beech forest than in podocarp forest. Ship rats (and possums) are more abundant in warmer forest sites (Walker et al. 2019) and their densities in the Scheme area may be expected to increase with rising temperatures.

D68. A climate change vulnerability assessment (Brumby et al. 2025) assessed 1145 Aotearoa species against 16 traits within three dimensions of climate change vulnerability: sensitivity, low adaptive capacity and exposure. It identified whio as at 'latent risk' under three climate change scenarios and timeframes (RCP4.5 at mid-century and late century, and RCP8.5 at mid-century), and 'highly vulnerable' under RCP8.5 at late century. Latent risk describes taxa that are sensitive and have a lower adaptive capacity but are not yet exposed to climate change. Monitoring environmental variables and reassessment if predictions worsen is the recommended strategy for these taxa.

D69. A review of the impacts of climate change on Aotearoa environments (Keegan et al. 2022) identifies freshwater environments as particularly vulnerable to human-induced climate change, because availability and temperature of water are very sensitive to climatic conditions, and habitats are highly fragmented. Physical changes are predicted to be widespread with water availability fluctuating due to increased extreme flood and drought frequency and temperature and sea-level rise. Extreme flooding may alter river morphology which may change habitat quality and availability. Streams with high sediment loads are especially vulnerable to warming water impacts. Increased rainfall and greater flood frequency and intensity can disturb freshwater ecosystems, increase soil erosion, sedimentation and turbidity, strip benthic habitat and communities, and prevent fish (and potentially whio) from visually locating prey. Increasing rainfall will exacerbate glacial melt. Substantial knowledge gaps remain, particularly when impacts are indirect and have complicated mechanisms.

Alpine Fault and Sediment

D70. There is a 75% (29–99% (95% CI)) probability of rupture on the central section (Lake Kaniere to Lake Ellery) of the Alpine Fault in the next 50 years, and an 82% (64–95% (95% CI)) probability that the next event will be a multi-section rupture with Mw ≥ 8 (Howarth et al. 2021). The Scheme area is in this risk zone.

D71. Coseismic landsliding in mountainous regions will generate substantial inputs of sediment to river systems (Blagen et al. 2022). The quantity of sediment introduced can correspond to between 10- and 100-years' worth of aseismically-generated sediment, and thus constitutes a dramatic increase in sediment input, to which rivers will respond accordingly. In general, rivers are expected to steepen in order to increase their sediment transport capability, causing bed elevations to increase progressively downstream.

D72. As described at **paragraph 2.10**, the river sections in which whio now occur have comparatively higher gradients, shallow river margins, stable stream banks, stable coarse river substrates (with high proportions of boulders), pool and riffle sequences, abundant invertebrate prey, and forested catchments and riparian margins (Collier et al. 1993; Williams 2025). The water is fast-moving, cold, clear and highly oxygenated, and there is typically low transport of

fine or suspended sediments. In the Scheme area, these characteristics are at risk of being repeatedly impacted by increased landsliding induced by the predicted increase of significant heavy rainfall events. These characteristics are also at high risk of being lost for decades when the Alpine Fault next ruptures sometime in coming years.

Avian Influenza

D73. Avian influenza (bird flu) is a highly contagious viral disease domestic and wild birds caused by avian influenza viruses, originating in poultry systems (Scientific Task Force on Avian Influenza and Wild Birds 2023), There are two main types: high pathogenicity avian influenza (**HPAI**), and low pathogenicity avian influenza (**LPAI**). The principal current concern is the H5N1 strain of HPAI. This is now widely established in the Northern Hemisphere and into the Southern Hemisphere, including the Antarctic Peninsula. It remains absent from Aotearoa, Australia and the Pacific Islands. H5N1 can spread to mammals including humans (Gartrell et al. 2024).

D74. H5N1 is currently causing unparalleled mortality of wild birds and mammals worldwide (Scientific Task Force on Avian Influenza and Wild Birds 2023). For species dependent on high adult survival and with low productivity, and species additionally under pressures from a range of other anthropogenic threats, the disease represents a significant risk to population status. The extent to which surviving exposure will confer immunity from future infection is not clear although some species-dependent immunity is expected.

D75. H5N1 is expected to be brought to Aotearoa by migratory wild birds. For this reason, it is not likely that it could be kept out of Aotearoa over the long-term or be eradicated once it establishes in wild bird populations (Ministry for Primary Industries 2025).

D76. Two government agencies describe the species at risk in Aotearoa somewhat differently:

- '[H5N1] can cause high numbers of deaths in poultry (chickens and turkeys), waterfowl (ducks, geese and swans), shorebirds (godwits, stilts and plovers) and seabirds (gulls and terns)' (Ministry for Primary Industries 2025).
- 'We don't know exactly what impact HPAI would have on native species; based on overseas evidence, it's more likely to affect colony nesting birds, seals and predator/scavenger species. Species, such as red and black-billed gulls, gannets, terns, seals and other seabirds are likely to be impacted due to the close contact transmission of the virus through secretions and faeces, as well as predator/scavenger species such as raptors' (Department of Conservation 2024b).

D77. Assuming 'waterfowl' generalises to all duck species, avian influenza presents a potential risk to whio. The risk is likely to be the greater for whio relying on high adult survival for population resilience in the face of predation pressure, and the lesser for whio being territorial and well-spaced, reducing virus spread risk.

D78. DOC is currently developing national response plans. For non-highly threatened bird species, 'the focus will be on minimising spread on public conservation land through strong biosecurity practices and supporting the health and resilience of threatened bird populations through conservation work such as breeding and predator control programmes' (Department of

Conservation 2025). It is anticipated that this approach will be applied to whio. The situation could rapidly evolve.

PHOTOS

Photo 1: Mid and lower Kiwi Flat, viewed from above the Morgan Gorge entrance. Waitaha River mainstem (left, slightly discoloured by glacial silt), Whirling Water (centre, clear water) and Caesar Creek mouth (lower left). Rapid, riffle, run and pool channel morphologies are evident. There have been significant changes to channel locations since this photo was taken. Photo: DSCN2812, 2005-09-18.

Photo 2: Water rapid at Morgan Gorge entrance (site of proposed weir and intake). Whio use of this habitat observed during previous investigations and in 2024 included standing and roosting sites, and flying into and out of the gorge. Photo: P1020305, 2009-12-16.

Photo 3: Waitaha River at Morgan Gorge entrance, in flood and backing up towards the Whirling Water confluence because of flow constriction. Estimated flow 400–500 m^3/s; date 2013-12-24 (Martin Doyle, pers. comm. 2014-04-22). Photo courtesy of Martin Doyle.

Photo 4: Morgan Gorge (abstraction reach). View upstream from Anson Stream confluence. The river here has a more gentle gradient than in the lower gorge (**Photo 5**). Photo DSCN2933, 2005-09-19.

Photo 5: Lower end of Morgan Gorge (abstraction reach). Near the hot springs, showing confined bouldery nature with rapids and cascades. Photo DSCN2940, 2005-09-21.

Photo 6: Waitaha River, 300 m below Morgan Gorge exit (abstraction reach). High gradient, with step pools and cascades predominant (governed by large boulders); shifting gravels and fine sediments deposited in lower velocity waters. Photo: DSCN3889, 2006-06-24.

Photo 7: Waitaha River below Morgan Gorge, *c.*400 m above proposed Power Station site (still in abstraction reach). Plane-bed channel morphology, characterised by a near flat cross-section and the presence of large clasts (boulders) within the flow. Photo: DSCN3891, 2006-06-24.

Appendix E - Significance of the Values Relating to Whio

E1. Criteria/guidelines/matters to be considered (hereafter 'criteria') in assessing the significance and natural heritage values of the Scheme area for whio and whio habitat are expressed in:

- West Coast Regional Policy Statement 2020 (West Coast Regional Council 2020; 'RPS'): Policy 7.1 (a) and **Appendix 1**
- Proposed Te Tai o Poutini Plan – West Coast District Plan (Te Tai o Poutini Plan Committee 2022, 'pTTPP'): Policy ECO - P1, part 2 i – which applies the same criteria as the RPS
- Westland District Plan 2002 (Westland District Council 2002; 'WDP'): Policy 4.9 D
- West Coast Conservation Management Strategy 2010–2020 (Department of Conservation 2010; 'CMS'): Policy 1, Section 3.3.2.3 (Prioritising natural heritage work).

E2. The RPS and WDP criteria are for the purposes of Section 6(c) of the Resource Management Act 1991, which requires the recognition and provision, as a matter of national importance, of 'the protection of areas of … significant habitats of indigenous fauna'. The CMS criteria are for the purposes of integrated conservation management of natural and historic resources under the Conservation Act 1987.

E3. Current practice in assessing ecological value in Aotearoa is to recognise four over-arching criteria: representativeness, diversity and pattern, rarity and distinctiveness, and ecological context (Roper-Lindsay et al. 2018; Ministry for the Environment 2024b). This framework is adopted in the West Coast RPS and the pTTPP. Other criteria cited in the WDP and the West Coast CMS (i.e. viability, intactness, size, threat and migratory species) are here treated as attributes of these over-arching criteria. CMS 'natural landscape character' is not assessed here as it requires landscape value expertise, and WDP protected status is provided for by the Scheme area primarily being on public conservation land. A finding of not significant does not imply a lack of biodiversity value (Walker et al. 2008).

E4. Whilst the Scheme area northwest of the Alpine Fault is in the Harihari ED (approximately below the Waitaha River-Douglas Creek confluence), for practical purposes the Wilberg ED is used as the primary frame of reference for the representativeness criterion. Its ecosystems are predominately unmodified except for the impacts of introduced mammalian herbivores and predators and the loss of extinct bird species (McEwen 1987). The balance of the Scheme area in the Harihari ED either has a similar character or is highly anthropogenically modified. Highly anthropogenically modified areas are outside the scope of this assessment.

E5. Significant Natural Areas are yet to be formalised in Westland District under the proposed Te Tai o Poutini Plan (Te Tai o Poutini Plan Committee 2022). Assessment of significance would be undertaken at the time of any resource consent application. The Plan was publicly notified in July 2022.

E6. The whio population and habitat in the Scheme area meet the formulations of all four over-arching criteria for assessing ecological value. As such, the combined value across the four criteria is assessed as very high.

E7. **Table** 1 of Section 2 of this report presents a summary of the following assessment.

RPS/pTTPP 1. Representativeness

a) Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the indigenous biological diversity of the relevant ecological district.

b) Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district

CMS 3.3.2.3 Representativeness, Diversity, Viability, Intactness

WDP 4.9 D (i, ii) Intactness, Representativeness

E8. The Wanganui River and (arguably) the Whataroa River are the other major river systems in the Wilberg Ecological District. Casual records and the presence of similar habitats and ecological processes suggest similar whio population levels. The area is relatively unmodified by human activity. The whio population and its habitat in the Scheme area are assessed as representative and a relatively large example of its type in the Wilberg Ecological District and one of the best examples of an association of species which is typical of its ecological district (RPS/pTTPP 1(a), 1(b); CMS 3.3.2.3 Policy 1 representativeness, viability, intactness; WDP 4.9 D (i), (ii)).

RPS/pTTPP 2. Rarity/Distinctiveness

b) Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.

d) Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combinations of factors.

CMS 3.3.2.3 Policy 1 Threatened species and/or taonga and their habitats

WDP 4.9 D (iii) Distinctiveness, (vi) Threat (viii) Scientific or other Cultural Value.

E9. Whio is classified as a nationally vulnerable species (qualifiers: Conservation Dependent, Climate Impact, Partial Decline, Sparse). Whio have cultural, spiritual, historic and traditional significance to Māori (Glaser et al. 2010) and are listed as a taonga species under the Ngāi Tahu Claims Settlement Act 1998. The number of whio pairs (4–5) in the Scheme area is *c.*0.5% of the national total of 863 at the 2021 national census (Department of Conservation 2024a). The whio population in the Waitaha Valley lies within the geographic scope of a proposed additional whio security site in the Central South Island, on account of the species' genetic diversity.

E10. Whio is listed in the National Policy Statement for Indigenous Biodiversity 2023 as a specified highly mobile fauna species (Ministry for the Environment 2024b). Policy 15 specifies that: Areas outside [Significant Natural Areas] that support specified highly mobile fauna are identified and managed to maintain their populations across their natural range, and information and awareness of highly mobile fauna is improved. However, renewable electricity

is specifically excluded from the coverage of the National Policy Statement for Indigenous Biodiversity.

E11. The Scheme area meets RPS/pTTPP 2(b), 2(d); CMS 3.3.2.3 Policy 1 threatened and/or taonga species and their habitat; WDP 4.9 D (iii), (vi), (viii)).

RPS/pTTPP 3. Diversity and Pattern

> *a) Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse biological and physical features or ecological gradients.*

CMS 3.3.2.3 Policy 1 Diversity

E12. The Scheme area contains a diversity of riverine systems (first to fifth order streams) at the lower end of a steep mountain catchment in the dynamically uplifting, high rainfall Southern Alps landscape. Spatially, it changes from a slightly braided nature at Kiwi Flat to cascading flows in Morgan Gorge and then a confined single channel dominated by extremes of substrate size (boulders, gravel, silt) until downstream of the Douglas Creek confluence, and then again becoming braided. Frequent flooding results in shifting channels. Glacial flour in the mainstem during late summer and autumn from glacier melting contrasts with remarkably clear water in Whirling Water. The range of tributaries offer temporal and flow habitat diversity that supports the whio population. Although whio nesting and moulting sites are largely unknown, indications point to diversity (e.g. Scamper Torrent). Whio metapopulation dynamics likely entail wider habitat diversity. The whio habitats in the Scheme area meet RPS/PTTPP 3(a) and CMS 3.3.2.3 Policy 1 Diversity.

RPS/pTTPP 4. Ecological Context

> *a) Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.*
>
> *b) Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.*

WDP 4.9 D (v) Connectivity

E13. The Scheme area is part of a network of highly natural waterways in the central Southern Alps in which whio populations are likely to be connected, like a metapopulation, particularly through juvenile dispersal (Shaw 2012). Previous demographic analysis showed that the Kiwi Flat population was receiving immigrants from elsewhere, probably juveniles, and it could not persist in the absence of this immigration, while there has also been dispersal from the Scheme area into another catchment. The Scheme area population contributes to the ecological and reproductive processes in this metapopulation, including connectivity of the population on the western slopes of the Southern Alps. The whio population and habitat in the Scheme area meet RPS/pTTPP 4(a), 4(b) and WDP (v).

Appendix F - Potential Effects of the Scheme

SCHEME DESIGN

F1. The Scheme design process has actively sought to avoid, remedy and otherwise to minimise effects on whio (and other environmental values).

F2. An options selection process in October 2012 considered two options:

- Option A: intake weir at the mouth of Waitaha Gorge, settling basin and head pond on Kiwi Flat, tunnel to penstock and Power Station below Morgan Gorge
- Option B: intake weir at the Morgan Gorge entrance, underground settling basin, tunnel to penstock and Power Station below Morgan Gorge (chosen configuration).

F3. Key elements of the design to avoid and minimise adverse effects on whio and whio habitat are:

- choice of a 'run-of-river' scheme as opposed to a dam (at a site elsewhere), avoiding the formation of a lake that could impact natural habitat
- choice of Option B avoids most impacts on Kiwi Flat watercourses and whio habitats
- low weir design minimises area of backwater effect
- choice of penstock and Power Station location reduces the abstraction reach compared with alternatives further downstream, and avoids impact on the stable tributary downstream
- choice of access to the Morgan Gorge intake via the tunnel avoids a vehicular access route into Kiwi Flat, minimising vegetation removal and sedimentation.

EFFECTS ASSESSED IN OTHER REPORTS

F4. Whio are in the upper trophic level in Aotearoa riverine ecosystems and are reliant on maintenance of riverine ecosystem health. The following less than minor effects findings (post-mitigation in some instances) and other relevant mitigation practices identified by other Scheme reports on components of whio habitat are accepted and supported. Aspects of the Scheme specific to these potential effects are not further addressed.

F5. **Sediment Report (construction and operational period effects):** gravel extraction from the active Waitaha and Macgregor Creek braid plains; transient fine sediment deposition in the abstraction reach; transient sand deposition downstream of the Power Station; effect of Intake maintenance operations, desander flushing, emergency power station shutdowns, and possible flushing flow releases into the abstraction reach on water clarity; backwater effects (aggradation at Kiwi Flat upstream of the intake weir); and bank erosion opposite the Power Station (during large floods or via the aerial plume of water from the emergency bypass valve).

F6. **Freshwater Ecology Report (construction and operational period effects)**: sediment release; release of cementitious contaminants; release of other construction-derived contaminants; spread of freshwater pest species (didymo); mortality of biota at the site of in-channel works; gravel extraction from the bed of the Waitaha River and Macgregor Creek (in

relation to aquatic ecology); altered sediment dynamics within the abstraction reach and downstream of the tail race; backwater effects; bank erosion opposite the Power Station; residual flow (effects on periphyton, benthic aquatic macroinvertebrate community, fish community); exclusion of brown trout from above the weir at Morgan Gorge, while providing for kōaro access; rapid flow changes as part of planned maintenance or emergency shutdowns (effects on macroinvertebrates); surface water runoff; Intake in-channel maintenance works; loss of shading of waterways from removal of riparian vegetation; and artificial lighting around built infrastructure.

F7. **Noise report (construction and operational period effects)**: adoption of the Vertical Aviation International's 'Fly Neighborly' programme to mitigate helicopter noise effects as far as practicable, and other general noise management provisions in the draft construction noise management plan.

NOISE AND OTHER DISTURBANCE – BRIEF SYNOPSIS

F8. The effects of noise and disturbance on wildlife is a developing field of scientific investigation. There is limited information on their impacts on whio (e.g. recreational disturbance; Eastwood 2002) but not on the scale of a significant hydro scheme. The following is intended to provide a framework for this assessment. Given the substantial uncertainty in this field, a precautionary approach is taken, which may prove or otherwise to have been wise.

F9. Noise and disturbance from blasting, helicopter use, pile driving, and siren use are the four Scheme activities that will have the highest potential impact on whio. There will also be lower-level noise and disturbance from use of other machinery. Other impacts may arise from response to new objects in the environment (neophobia) (Miller et al. 2025), habitat specialists (such as whio) typically being more responsive than habitat generalists. Human presence itself can evoke biological reactions in wildlife (Goumas et al. 2020).

F10. Noise from Scheme activities will occur in three classes: impulse noise (of short duration e.g. blasting); continuous (chronic) noise (e.g. operating machinery); and intermediate or hybrid noise (trains of impulses e.g. helicopter rotor noise) (van Niekerk 2021). The severity of an impact from a noise stimulus will depend on the temporal, intensity, and frequency features of the stimulus (Francis & Barber 2013).

F11. Several sound features are relevant to assessing effects on birds (Francis & Barber 2013). The "A" filter is based on equal loudness contours for human hearing; this filter provides a conservative estimate of bird hearing and is the best readily-available weighting for bird studies. Time-averaged values (e.g. equivalent continuous sound level (Leq)) can be extremely informative to describe chronic or frequent sounds; the time period needs to be specified. For disturbance sounds, exposure metrics that capture each sound event's maximum power (Lmax) and the rate at which power rises from the lowest detectable level to its maximum (i.e. onset) are important.

F12. Blasting energy is transmitted through the air as an impulse noise (airblast) and also through the ground as blast vibration. A literature search found only one reference on the wildlife effects of blast vibration (effect on ground-nesting birds; van Niekerk 2021). It is assumed here that blast vibration attenuation with distance and potential effects on whio are of

broadly similar magnitude to the airblast, and that both blast vibration and airblast attenuate with distance within the tunnels.

F13. Sound pressure level decreases about 6 dB for a point source with every doubling of distance, by the inverse square law (Dooling & Popper 2016).

F14. Greatest helicopter noise effects at ground level occur during descent, take-off and low altitude flight. Noise levels associated with low-level over flights or hovering of helicopters are typically 101–110 dB (assumed to be LAFmax; for a range of helicopter sizes; at a standardised distance of 50 feet (15.24 m); U.S. Fish and Wildlife Service 2006). These levels can be expected directly beneath helicopter use (i.e. landing, take-off and low-level hovering). Sound levels during flight between landing or hovering sites will be less, attenuating with distance according to the inverse square law.

F15. It is proposed to use Hughes 500 helicopters to transport personnel, equipment and materials from the Power Station Site or Construction Staging Area 3 near Macgregor Creek to the Headworks site (**Noise Report**). Whether these would be used for other activities involving helicopters is not identified. Expected noise levels of the Hughes 500 helicopter close to take-off and landing sites in the Scheme area are in the range of 95-100 dB LAFmax (**Noise Report).** The upper end of this range (100 dB LAFmax) is used in this assessment in estimating helicopter noise levels in situations not covered in the **Noise Report**. [12]

F16. Noise emission levels of medium- and large-sized construction equipment are typically in the 81-90 dB range (U.S. Fish and Wildlife Service 2006). This includes dump trucks, drill rigs, large pumps and generators, large chainsaws, and other moderate to large diesel engines such as excavators.

F17. Sounds have different biological effects on wildlife (Francis & Barber 2013; Dooling & Popper 2016). Exposure to extremely high sound levels can cause permanent or temporary hearing loss. At lower levels, impulse noise stimuli will likely trigger startle or hide responses to perceived threat, whereas frequent or chronic noises interfere with (or mask) cue detection (e.g. compromising predator/prey detection or mating signals, altering temporal or movement patterns, decreases in foraging or provisioning efficiency coupled with increased vigilance and anti-predator behaviour). Unwanted sound in turn translates into increasing physiological stress and biological fitness costs (survival and reproductive success), even when there are no outward changes in behaviour (e.g. Harbrow at al. 2011; Lasky & Bombaci 2023). The effect of fitness costs of disturbance may depend upon the availability of, and energy expended in moving to, alternative habitat (Gill et al. 2001). Such costs may not be insignificant for whio, a territorial species. Many potential costs associated with noise exposure have not been rigorously studied.

F18. Avian hearing encompasses a narrower range of frequencies than human hearing and avian hearing within that range is less sensitive than human hearing (Beason 2004). Birds are considered more resistant to temporary and permanent auditory damage and hearing loss from noise exposure than are humans and other animals, through their capability to regenerate the sensory hair cells of the inner ear, a capability not found in mammals (Dooling & Popper 2016).

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[12] Using the WKCGroup sound attenuation calculator.

The typical human is able to hear a bird vocalizing in a noisy environment at twice the distance of a typical bird, which suggests that relying on human hearing as the primary criterion seriously underestimates the effects of noise on bird communication. Birds, like humans and other animals, employ a range of short-term behavioural adaptations for communicating in noise resulting in a doubling to quadrupling of the efficiency of hearing in noise.

F19. Continuous noise levels above 110 dBA (sound level descriptor assumed to be LAFmax) lasting over 12–24 hours, or a single impulsive noise over 140 dBA (125 dBA for multiple blasts), can cause damage and loss of inner ear sensory hair cells resulting in a large initial threshold shift, followed by a small (~10–15 dBA) lingering threshold shift even after all hair cells have been regenerated (Dooling & Popper 2016). Temporary threshold shifts occur above about 93 dBA, and masking effects at levels above ambient noise levels. Behavioural and/or physiological responses may occur even below ambient noise levels. Short period alarms are non-continuous and unlikely to cause masking effects.

F20. Sound levels above 125 dBA (the level at which physical hearing damage occurs to birds for multiple blasts) from blasting are likely to be below this level beyond *c.*10 m from the blast site (Staples 2014). These sound levels will reduce to about 93 dBA, the threshold for temporary hearing effects, at about 500 m from the blast site. A 400 m exclusion zone for whio at the weir and intake site at the time of blasting is therefore necessary to avoid temporary physical hearing loss to whio. Blasting noise levels fall to river ambient levels at 2 km distance, the length of Kiwi Flat.

F21. Sound levels associated with low-level helicopter use (take-off, landing, hovering; 100 dB LAFmax; **paragraph F15**) will reduce to about 93 dBA, the threshold for temporary hearing effects, at about 33 m from the helicopter. A 50 m exclusion zone for whio at the time of all low-level helicopter flight is therefore recommended to avoid temporary physical hearing loss to whio.

F22. Whio appear to be tolerant of and may habituate to a low–moderate level of construction disturbance and noise, and have a capability to remove themselves when their tolerance level is exceeded. For example, a pair of whio was regularly seen (every 2–3 weeks) on the Amethyst Ravine during construction of the Amethyst hydro weir and intake structure, within sight of these works and structures ([redacted] pers. comm. 2013-10-03; [redacted], pers. comm. 2014-05-20). However, 'in our experience with stakeholders, habituation is an oft-cited reason for persistence and an absence of noise impacts, yet research on other stressors indicates that acclimation to a stressor might not release an organism from costs to fitness' (Francis & Barber 2013).

F23. A spectral analysis of two whio call recordings found that the majority of sound energy from the male calls is at 2500 – 6300 Hz, whilst the female call spans a wider, lower frequency range: 200 – 2,000 Hz (Adrian Staples, pers. comm. 2025-05-17).

F24. High levels of ambient noise near the Waitaha River (65–75 dB LAeq, can be more; **Noise Report**) will help to mask noise impacts on whio from Scheme activities. Ambient noise levels can be as low as 35 dB LAeq in locations far away from the river without direct line of sight and under fine, calm conditions.

HELICOPTER FLYING OTHER THAN AT HOVERING AND LANDING SITES (PRE-CONSTRUCTION, CONSTRUCTION AND OPERATIONAL PHASES)

F25. Helicopter flights in the pre-construction, construction and operational phases of the Scheme for the most part are expected to involve a flight path up the Waitaha River, and to begin either at the Construction Staging Area 3 near Macgregor Creek or from points further north (e.g. Hokitika) (**Noise Report**). These effects are assessed here, to avoid duplication in describing them for the range of Scheme activities and locations. Assessment of helicopter noise effects elsewhere are confined to those associated with take-off, landing, hovering, or other activities such as transmission line installation that necessitate flying at low altitudes.

F26. Flight height if coming up from the north of the Waitaha Valley is expected to be 500 feet (152 m) or above. Flights originating from Construction Staging Area 3 would reach this altitude within 500–600 m horizontal distance, upstream of the proposed crossing of Macgregor Creek. A 500 feet height would then be maintained until within 500–600 m of the Scheme destination.

F27. Expected noise levels at river or ground level from a helicopter at 500 feet are 75–80+ dB LAFmax (**Noise Report**), somewhat above ambient levels (65–75+ dB LAeq) while significantly above ambient levels in areas away from the river (as low as 35 dB LAeq). Expected noise levels at the take-off or landing point at Construction Staging Area 3 will be 90–95 dB LAFmax.

F28. Current whio presence underneath such flight paths include a pair and two single males in the Waitaha River reach from Glamour Glen to Macgregor Creek, and a single male reported from Macgregor Creek. The possible pair downstream of Macgregor Creek (**paragraph D37**) may be resident in these sections at times. Birds and sign were not found on the true right of the Waitaha River. However, at the stable tributary there is a possible moulting site.

F29. Individual noise exposure events for whio from such flights will be less than 30 seconds, repeated on the return flight. While whio respond strongly to low-altitude helicopter flight (Blue Duck (Whio) Recovery Group 2022), they likely have a behavioural adaptation capability to single or occasional such levels of noise, given the high ambient noise levels. However, any whio in Macgregor Creek near the helicopter take-off site may move elsewhere, likely to a less favourable habitat, together having some small consequence on their energy budget.

F30. The level of effect will increase with two factors: frequency, and if the flights occur during the breeding season (and possibly if they are during the moulting season).

F31. The following mitigation would reduce the effect of these parts of helicopter flight paths: to the extent practicable, follow a flight path on the true right side of the Waitaha River.

F32. The highest level of helicopter flights for transport purposes will occur when setting up the Construction Staging Area 1, potentially up to 20–30 movements (40–60 flights, <20–30 minutes noise exposure). Overall, and subject to the above mitigation, it is considered that infrequent helicopter flights on this flight path will have a **less than minor** adverse effect. The greatest frequency may have a **minor** or **potentially minor** adverse effect if it occurs during the breeding season or in the unlikely event that birds are moulting in the stable tributary.

PRE-CONSTRUCTION PHASE

Geotechnical Drilling

F33. Pre-construction geotechnical drillholes (vertical and horizontal boreholes) at seven sites would be undertaken. Three are located at the Morgan Gorge Headworks site (between intake and access portals, above the desander, and above the headgate shaft), two near the Power Station site, and two on the alignment of the tunnels between the Headworks and the Power Station sites. Each will have a 10 x 10 m drill site. Drilling equipment will be helicoptered to the sites (approximately one day of flying for set up and dismantling at each drilling location). At the Headworks and the Power Station sites, there will be a helipad and a campsite at each of what will later become Construction Staging Areas 1 and 2, and a water take. Each drill site will take approximately 10 days (total 70 days).

F34. At the Headworks site, the three drilling sites are located at about 10 m, 90 m and 200 m from the weir and intake. At these distances, expected noise levels from a helicopter bringing in and taking away the drilling rig are approximately 77–100 dB LAFmax; these would occur over three days only. Expected noise levels from the drilling rig at the weir and intake site (where whio may be) are approximately 59–94 dB LAFmax; these would be continuous noise during daytime for up to four weeks.

F35. These helicopter noise levels at their upper end are above the level for an avian hearing temporary threshold shift. The noise levels for the drilling rig at this site approach the temporary threshold shift level. Noise levels for the two more distant drill sites (58–75 dB LAFmax) are below or approaching ambient noise levels; whio behavioural and/or physiological responses are possible.

F36. The two drilling sites between the Headworks and the Power Station sites are located a minimum of *c.*300 m and *c.*450 m from the nearest recorded corresponding whio locations during all field surveys (Anson Stream and Waitaha River below Morgan Gorge respectively). The Anson Stream site is an unconfirmed breeding record. At these distances, expected noise levels from a helicopter bringing in and taking away the drilling rig are approximately 70–75 dB LAFmax; these would occur over two days only. Expected noise levels from the drilling rig are approximately 52–64 dB LAFmax; these would be continuous noise during daytime for up to four weeks.

F37. These helicopter noise levels, and drilling rig noise levels to a lesser extent, may cause masking effects and behavioural and/or physiological responses to whio if at sites away from the high ambient noise levels of the mainstem, such as Anson Stream. Whio have some behavioural capability to adapt to these circumstances, but less so when breeding. A possible nesting site was found in Anson Stream in 2007.

F38. At the Power Station site, the two drill holes sites will be located on the Power Station site itself (about 50 m from the river), and on the high terrace behind the site. No whio were found during the 2024 survey at the Power Station site, and no evidence was found during all investigations of breeding in the vicinity. However, whio presence at the time of the drilling remains a possibility.

F39. Human activity at the camps at the Headworks and Power Station sites through day and night has the potential to cause disturbance to whio.

F40. Overall, there would be high helicopter noise potentially impacting whio that could be present at and near the Headworks site over three days (with potential temporary hearing threshold shift), and more continuous noise over three weeks. Lower levels of noise could impact whio at some distance from the two drilling sites between the Headworks and the Power Station sites. There could be impact at the Power Station sites if whio are present nearby. The seven drill sites amount to seven days of helicopter impact. This level of effect of is assessed as **more than minor** at the Headworks site and the two sites between it and the Power Station. It is assessed as **potentially minor** at the Power Station. It is **potentially significant** if the drilling is undertaken during the breeding season.

F41. Risk of additional impact can be avoided by ensuring helicopter flight paths do not come closer than necessary towards river habitats, particularly Anson Stream if in the breeding season.

F42. The following mitigation is recommended, which would reduce the overall effect to **less than minor**:

i. *Avoid undertaking drilling during the breeding season (September-December), if practicable*

ii. *Before undertaking helicopter access at the Headworks and Power Station sites, if practicable, inspect the surrounding site and gently guide any whio present to move to be more than 50 m away (excluding below Morgan Gorge entrance because of physical impracticality); if this is not practicable, use a slow approach from perpendicular to the river, to enable any whio present to move from the site*

iii. *Avoid risk of additional effect by ensuring helicopter flight paths do not come closer than necessary towards river habitats, particularly Anson Stream if in the breeding season.*

iv. *To address the residual level of effect, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.*

Geophysical Surveying

F43. Geophysical surveying will involve the use of ground penetrating radar (GPR), supplemented where needed by a seismic survey (shear wave or P-wave). This will occur on each bank of the Waitaha River for about 100 m upstream from the entrance to Morgan Gorge; and GPR activity is expected to take 2–3 days, with a small team. Access will be by helicopter.

F44. Expected noise levels from a helicopter bringing in and taking out personnel and equipment for the GPR surveying will also be in the order of 100 dB LAFmax (on two occasions over 2-3 days).

F45. The ground-penetrating radar device itself is relatively quiet during operation, emitting electromagnetic waves rather than audible sound. The technology for creating vibrations for the seismic survey also cause relatively low noise levels: a 12 lb sledgehammer hitting a metal plate, or a “buffalo” gun firing blanks in a small 30 cm hole in the ground.

F46. There is a risk of temporary whio hearing loss from the helicopter access for the geophysical surveying at the Headworks site. Human activity immediately above the weir and intake at the Headworks the GPR work likely will cause direct disturbance. Human activity associated with the camp sites at the Headworks and Power Station sites has the potential to cause disturbance to whio.

F47. Overall, the level of effect of noise and disturbance associated with the geophysical surveying, including helicopter flight, during the pre-construction period is assessed as **minor**, and **potentially significant** if undertaken during the breeding season.

F48. Cumulatively, the geotechnical drilling and GPR work at the Headworks site may cause partial or complete displacement of the whio pair from the site for the duration (5–6 weeks for the drilling, 2-3 days for the GPR work). Loss of breeding could occur if the drilling and GPR work occur in the breeding season (although renesting may occur if the disturbance is early in the season).

F49. The following mitigation is recommended, which would reduce the overall effect to **less than minor**:

i. *Avoid undertaking drilling and geophysical surveying during the breeding season (September-December), if practicable*

ii. *Before bringing in and taking out the drill rig at the tunnel portals site, and*

iii. *If practicable, combine the helicopter access for the drilling and geophysical surveying work*

iv. *To address the residual level of effect contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.*

CONSTRUCTION PHASE

Morgan Gorge Headworks: Weir and Intake

F50. Pre-construction and construction activities associated with the following Scheme components at and near the Headworks that have the potential to impact whio and whio habitat are:

- Pre-construction geotechnical drilling (vertical and horizontal boreholes): three sites (between intake and access portals, above the desander, and above the headgate shaft); each will have 10 x 10 m drill sites; there will be a helipad and a campsite at what will later become Construction Staging Area 1, and a water take. Drilling equipment will be helicoptered to the sites (approximately one day of flying for set up and dismantling at each drilling location). Estimated 4 weeks duration maximum.
- Pre-construction geophysical surveying: a ground penetrating radar (GPR) survey, supplemented where needed by a seismic survey (shear wave or P-wave), extending about 100 m upstream on each bank of the Waitaha River from above the entrance to Morgan Gorge. The GPR activity will occur on the bed of the Waitaha River between the

Morgan Gorge entrance and about 100 m up-valley. It is expected to take 2–3 days, with a small team. Access will be by helicopter.

- Permanent or semi-permanent structures: weir (*c.*30 m long, 1 m crest width, <4 m high, up to 7 m in sluice/diversion channel); sluice channel, sluice gate and environmental flow gate; intake channel (in rock) and a gravel bed channel; access portal and headwall; and access road from the access portal to the riverbed (average width for construction 12 m, *c.*60 m long); toe of access road likely to require rock armouring to avoid damage from flood events)
- Temporary structures: coffer dam/river diversion and dewatering; Construction Staging Area 1 ; and vehicular accessway (average width for construction 9 m, *c.*140 m long) to Construction Staging Area 1. The staging area and its accessway will be rehabilitated at the end of construction
- These construction activities are expected to be spread over a period of approximately 24 months, with varied levels of intensity.

F51. The weir and intake site has been a focal point for a whio pair throughout whio field studies, for activities such as feeding on the river margins, standing and preening, the male being on guard for the female nesting nearby, and use of large rocks on the true right bank for roosting (Overmars 2014; 2024 survey). The site is in the whio flight path between a likely nesting site (although unconfirmed) downstream of the gorge entrance and feeding habitat upstream at Kiwi Flat.

Blasting and Helicopter Use

F52. Blasting will be used to cut the intake channel into rock by approximately three metres. The upstream corner of the gorge will be trimmed with a 6 m high cut to provide a suitable alignment. There will be a number of small blasts to excavate and profile the diversion channel. Before breaking out the tunnels at the Headworks, there will be work done from the outside first, for about 10 m into the hillside. A small borehole will be slowly increased to the desired width using small charges (much less impactful than the charges that will be used underground). Blasting of channels is of short duration, over a couple of weeks. Its timing is dependent on low flow, and so will need to be done in low flow season (likely winter), and may not be consecutive.

F53. As noted at paragraph F20, a 400 m exclusion zone at the weir and intake site at the time of blasting is necessary to avoid temporary physical hearing loss to whio.

F54. In total, blasting may occur over some weeks, spread over several time periods. Startle effects are the likely avian response, given the impulse nature of the sound. The resident whio pair in the lower portion of Kiwi Flat may be temporarily displaced, resulting in territorial competition with adjoining pair(s).

F55. Helicopters will be used in the construction of the headworks to transport personnel, equipment and materials from the Power Station site or Construction Staging Area 3 weir and intake and to Construction Staging Area 1 area over a period of up to 24 months. On most days when conditions are suitable for flying there could typically be eight movements (i.e. two return trips at the start and end of the day). During certain activities such as concrete pouring, there

may be higher helicopter activity for a number of days, although these will not all be consecutive days. Helicopter movements would occur only during daytime hours, and not during dawn or dusk for safety reasons.

F56. Thus, noise emissions levels up to 125 dBA from blasting, up to 101–110 dBA from helicopter use, and 81–90 dB from other machinery will occur at times through the construction period (up to 24 months).

F57. The cumulative effect of blasting, helicopter use, and other noise and disturbance, during the construction phase at the Morgan Gorge weir and intake site will principally impact the breeding whio pair in whose territory the activities will occur. Construction activities are highly likely to cause the partial or complete displacement of the whio pair from their territory, and loss of breeding and recruitment, over the construction time (approximately 26 months).

F58. Adjoining whio could be affected if the resident pair at the gorge entrance site compete for territory with the adjoining pair or pairs away from the construction area. During the breeding season, this may affect breeding through disruption of pair bonds, with potential flow-on effects as breeding productivity is related to pair bond longevity. One pair may shift to less favourable habitat.

F59. Whio use of Morgan Gorge as a flight path between Kiwi Flat, downstream of Morgan Gorge, and the tributaries, may be adversely affected. This may affect the social interaction of whio otherwise separated by the gorge, and also affect the availability of habitats (e.g. seasonally) downstream of Morgan Gorge.

F60. Given the evidence that the Kiwi Flat whio population has previously been unable to sustain itself without immigration (**paragraph D40**) and the halving of the previously high density Amethyst Ravine population that may have been sustaining the Kiwi Flat population (**paragraph D47**), and other environmental factors being equal, the Kiwi Flat population may lose one of its three pairs due to habitat loss from construction activities. Further, it may not be able to recover naturally from the pre-construction and construction phase impacts of the Scheme. There may be additional effects from territorial competition with adjoining whio pair(s). This effect is assessed as **significant.**

F61. The following mitigation is recommended, which would reduce the overall effect to **minor**:

i. *Before undertaking blasting, inspect the surrounding site and gently guide any whio present to move to be more than 400 m away (excluding below Morgan Gorge entrance because of physical impracticality).*

ii. *Before undertaking helicopter access: if practicable, inspect the surrounding site and gently guide any whio present to move to be more than 50 m away (excluding below Morgan Gorge entrance because of physical impracticality); if this is not practicable, use a slow approach from perpendicular to the river, to enable any whio present to move from the site*

iii. *Avoid helicopter flying up-valley of the construction staging area.*

iv. Locate the helicopter landing site at Construction Staging Area 1 at its maximum down-valley practicable extent.

v. Time the construction of the weir and intake structure to avoid impacting whio breeding seasons, as far as practicable.

vi. To address the residual significant level of effect, during construction contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.

Emergency siren

F62. Warning sirens are proposed to be installed at the intake and at the Power Station to alert people of bypass valve use, resulting in a change in Waitaha River flow in Morgan Gorge (increase of up to 13 m^3/s) and below the power station (decrease of up to 13 m^3/s). This would be triggered by weather events causing a fault on the transmission network or of an internal plant/machinery malfunction. The sirens intended to be used are highly directional E-Class 400 sirens which will point upstream at the Power Station and downstream at the Intake. The proposed siren sound level (*c.*130 dB), frequency (*c.4* times per year) and duration (*c.*30 seconds at the Headworks and Power Station and in the gorge) combined are well above the level for an avian hearing temporary threshold shift (temporary hearing loss which recovers over a period of minutes to days from the end of noise exposure, 93 dBA; Dooling & Popper 2016) and exceed levels that cause avian auditory damage (125 dB). Intensities of 93 dB, 80 dB and 74 dB would be expected at distances from source of *c.*21 m, 100 m and 200 m respectively. Thus the effects of siren noise would be below the temporary threshold shift level at *c.*21 m from the siren. Critically, noise modelling carried out by Marshall Day shows that the sound level at the river will not exceed 93 dB and cause temporary hearing loss to whio.

F63. Construction of the bridge across Granite Creek will include piles on at least one side of the riverbed. Noise levels of smaller vibratory and impact pile drivers are typically 91-100 dB (U.S. Fish and Wildlife Service 2006). The **Noise Report** proposes a 250 m buffer distance for piling (as proposed at Granite Creek) to ensure livestock are not exposed to noise levels above the criteria suggested for human exposure, which are equivalent to levels considered extremely unlikely to cause startle or similar effects in birds.

Morgan Gorge Headworks: Two Accessways and Construction Staging Area 1; Weir Backwater Effects and Sediment Aggradation

F64. Construction activities associated with the following Scheme components at this site that have the potential to impact whio and whio habitat are:

- accessway to river (12 m width, 60 m length, rock armouring of toe)
- accessway to Construction Staging Area 1 (temporary, 9 m width, 140 m length, common rock armouring of toe as river accessway)
- Construction Staging Area 1
- weir construction, leading to backwater infilling and sediment aggradation.

F65. The two accessways would be located on moderately steep slopes and appear to be partly on rockfall deposits (Yetton 2013) and river gravel sediments. Staging Area 1 is located on river sediments and overlooks a steep bank that drops to the river.

F66. Scattered large rocks lie at the base of these sites. Two of these rocks, side-by-side, were found to be whio roost sites during the 2024 survey (**cover photo**). Other large rocks nearby may be similarly used.

F67. Accessway construction could impact the stability of the steep bank above the river margin and cause material to cover the rocks below. The steep bank below Construction Staging Area 1 is currently actively eroding. Rocks currently used for roosting could be lost in use for rock armouring. This could all adversely affect local whio roosting opportunities).

F68. The weir would have a backwater effect extending about 200–300 m upstream until it intersected an approximately 3 m high, steep, boulder-bed riffle. The short pond created by the weir would quickly fill with cobbly-gravel material quickly, over the first small high-flow event or flood recession (**Sediment Report**).

F69 The findings and recommendations of the **Freshwater Ecology Report** and the **Sediment Report** in relation to backwater effects and sediment aggradation upstream of the weir and intake, as relevant to whio habitat, are accepted and supported.

F70. As the backwater fills and the riverbed equilibrates to the new bed level, there will be some temporary loss of whio feeding habitat and possibly temporary territory displacement and competition with neighbouring whio. The present roosting site on the true right bank would be covered by gravel, possibly resulting in the loss of this opportunity locally.

F71. Overall, after site-specific mitigation, a risk remains that construction of the two accessways and Staging Area 1, and sediment aggradation upstream following construction of the weir, may result in the permanent loss of roosting sites in this locality. This effect is assessed as **minor.**

F72. The following mitigation is recommended, which would reduce the overall effect to **less than minor**:

i. *Take every practicable step to retain the present whio habitat features in this riparian zone, including a five metre setback from the steep bank at the Construction Staging Area.*

ii. *Design roosting sites into the accessway rock armouring, if practicable.*

iii. *To address the residual less than minor effect, contribute to an ecosystem programme to benefit whio in the region for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.*

Power Station, Tunnels, Tailrace and Embankment

F73. Construction activities associated with the following Scheme components at this site that have the potential to impact whio and whio habitat are:

- Pre-construction geotechnical drilling (vertical and horizontal boreholes, camp sites etc., approximately 90 days)
- Temporary Construction Staging Area 2 (2 months)
- An access tunnel and a pressurised water tunnel (1.5 km long; 10 m horizontally and 6 m vertically distant at the Headworks; distance between portals at the Power Station end approximately 32 m) will be driven from the Power Station end using drill and blast techniques (21 months). Blasting initially will be confined to daylight hours; thereafter, it becomes a 24-hour operation
- Permanent structures (including equipment installation): power station, 66 kV switchyard and substation (fenced), tailrace and embankment, penstock (10 months)
- Helicopter flying.

F74. Blasting noise effects on the surface will occur during tunnel excavation in its early stages. Other noise and disturbance effects will arise from pre-construction drilling, construction of the Power Station, switchyard and tailrace and installation of equipment of equipment including the penstock, loading and movement of heavy vehicles to remove rock not used locally to the spoil disposal area, and extensive helicopter use.

F75. The 2024 survey found a whio pair on the Waitaha mainstem 800 m upstream of the Power Station site, and two single birds elsewhere between the Morgan Gorge exit and the Douglas Creek confluence. The survey conclusively found no evidence of whio habitat use on the true right bank of the river (at nesting time), where the Power Station would be located, although use at other times is not precluded. Suitable nesting habitat is present however, and the 'Stable Tributary' could be used as a moulting site.

F76. The cumulative effect on whio of blasting, helicopter use, drilling, and other noise and disturbance during the construction phase at the Power Station Site and environs is not easy to gauge because of uncertainties in local habitat use. Physical damage to whio hearing is not expected. Disturbance to breeding around the Power Station Site is very unlikely, although disturbance to breeding on the opposite bank is possible. Disturbance to use of the Waitaha River as a flyway is likely. Disturbance to moulting at the 'Stable Tributary' is possible. Overall, this effect is assessed as **more than minor**.

F77. The following mitigation is recommended, which would reduce the overall effect to **minor**:

iv. *Before undertaking blasting that will have significant surface impact, inspect the surrounding site and gently guide any whio present to move to be at least 400 m away.*

v. *To address the residual potentially more than minor effect, contribute to contribute to an ecosystem programme to benefit whio in the region for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.*

Waitaha Farm to Power Station (Access Road and Heavy Vehicle Road)

F78. Construction activities associated with the formation and use of the light vehicle access road and the heavy vehicle road have the potential to impact whio and whio habitat.

F79. Access vehicle road is proposed on Waitaha Farm (4approximately 3.6 km). It will then continue across Macgregor Creek and through indigenous forest to the power station (approximately 2.2 km). There will be box culvert with river training and flood protection bunds across and along Alpha Creek and a drift deck/culverted ford across Macgregor Creek. There will be a temporary and then a permanent bridge at Granite Creek, the latter requiring piles on at least one side of the riverbank. There will be a temporary track on the true right side of the Waitaha River to walk a digger from Macgregor Creek to Granite Creek for the temporary bridge construction. Approximately 38 small watercourses will be crossed utilising concrete fords or culverts. The road will be aligned to avoid works within the margins of, or discharge of sediment to, the 'Stable Tributary', with a minimum separation distance of 20 m. The width of the combined road and lines corridor during construction will be on average 17.5 m (which will reduce to 15 m after construction). A short section near Granite Creek is likely to be 25 m wide due to change in ground levels. Where not adjoining, the road corridor and the lines corridor will each be 10 m.

F80. The access road across private land, from Anderson Road to Construction Staging Area 3 will be used during the construction phase, and then infrequently during operational phase. During the busiest construction period, there will be approximately 64 light and 8-12 heavy vehicle movements (both ways) per day. The majority of vehicle movements will occur during daytime hours. A small number of light vehicle movements will occur at night during the tunnelling stage of construction as this is a 24 hour activity.

F81. On the access road between Construction Staging Area 3 (on private land) and Construction Staging Area 2 (Power Station site) light vehicles will move particularly during shift changes during tunnelling. Trucks will use this part of the access road mainly to transport spoil from tunnel and Power Station excavations to the spoil disposal areas on private land. On average there will be 38 truck movements per day (19 each way; assuming a 20-tonne truck) over the period of two and half years (encompassing the road and tunnel construction, and excavation at the Power Station site). Oversize vehicle movements here will occur sporadically.

F82. The farm pond where the whio pair was reported over the past two winters is located about 10 m from the access road on the farm. The occurrence of the whio pair on the pond was not known at the time of planning the 2024 survey and the site was not inspected. The pond is presumed to be attractive as a winter food source. Flow in the water race may be intermittent and therefore less used by whio.

F83. The single whio reported from Macgregor Creek in spring 2024 was located very approximately 150 m from the common access and heavy vehicle road alignment here. The site is presumed to be part of the bird's feeding range.

F84. The traffic across the farm during the busiest construction phase (64 light and 8-12 heavy vehicle movements for approximately five months) will almost certainly disturb the pair

wintering at the farm pond and the single bird on Macgregor Creek to the point of seeking alternative habitat elsewhere.

F85. There are alternative habitat sites on the mainstem and tributaries nearby for the whio pair and the single bird. However, being forced to seek food elsewhere is likely to cause an increased energy demand (cost of disturbance). This may not be significant for the single bird but likely will be more significant for the whio pair in needing to seek alternative winter foraging. This effect is assessed as **less than minor**. It is not easily mitigated.

F86. Although no sign of whio use was found at the 'Stable Tributary' in the spring 2024 whio survey, the possibility of use by whio when moulting and being highly vulnerable to disturbance (December-January) cannot be discounted. Notwithstanding adoption in the Scheme design of the **Freshwater Ecology Report** recommendation to locate the access road further than 20 m from the 'Stable Tributary', the site would be unavailable for (possible) whio use during the construction period.

F87. Macgregor Creek has variable flow channels and Alpha Creek has intermittent or ephemeral flow. The two creeks have mobile beds. Significant effects on whio habitat from of the crossings across these two creeks are very unlikely, especially if the fords are dry at the time of construction.

F88. The use of piling in the construction of the Granite Creek potentially entails a significant level of noise disturbance (91-100 dB). The **Noise Report** proposes a 250 m buffer distance for piling to ensure livestock are not exposed to noise levels above the criteria suggested for human exposure, a level also considered extremely unlikely to cause startle or similar effects in birds. The 2024 survey found no evidence of whio habitat use at Granite Creek, likely because of its steep, unstable, bouldery nature. The nearest whio on the Waitaha mainstem was at the Douglas Creek confluence, 400 m upstream. However, habitat use at Granite Creek and nearby on the mainstem is conceivable. Given whio habitat use is only at the possible level, and the limited exposure time, it is judged there is at most a potentially minor adverse effect from the Granite Creek bridge construction on whio and whio habitat.

F89. The anticipated level of heavy vehicle usage of the access road south of Macgregor Creek is unlikely to cause noise disturbance to whio on the Waitaha River mainstem, given the forest buffer (mostly more than 50 m) between the road and the riverbed.

F90. Studies are equivocal over the risks of altering predator dynamics by constructing a road access through a natural environment (Martin 2012), such as the proposed access roads for the Scheme. The roads themselves are considered not likely to significantly alter the natural dynamics of predator communities in the Scheme area.

F91. Artificial light at night disrupts the physiology and behaviour of many organisms. Given the forest buffer between the road and the river from Macgregor Creek to the Power Station Site, the effect on whio of artificial lighting associated with the small number of nocturnal light vehicle movements during the tunnelling stage is anticipated to be less than minor.

F92. The following mitigation is recommended, which would reduce the overall effect to **less than minor**:

vi. *Construct fords at Alpha Creek and Macgregor Creek at times and/or places of no flow, as far as practicable.*

vii. *Before undertaking piling at Granite Creek bridge, inspect the surrounding site and gently guide any whio present to move to be more than 50 m away.*

viii. *To address the residual less than minor effect, contribute to an ecosystem programme to benefit whio in the region for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.*

Waitaha Farm to Power Station: 66 kV Power Transmission Line

F93. Power poles will be installed using a tracked excavator and the conductors will be strung using a helicopter. Poles will not be installed in the bed of any creek. A pi-pole will be used on the raised area on the true left of Macgregor Creek, to avoid putting poles in the creek bed.

F94. The proposed 66 kV power transmission line will mostly be located >50 m from whio river habitats other than at three locations: where it crosses Macgregor Creek, near the confluence of Granite Creek with the Waitaha River, and at the Power Station. Effects of ground construction activities on whio are likely to be confined to noise effects from machinery only at these three sites, plus visual disturbance at Macgregor Creek. Varying levels of helicopter noise disturbance effects will occur along the length of the transmission line.

F95. Within the transmission line vicinity, the 2024 survey (including reported birds on Waitaha Farm) found a pair of whio on the Waitaha Farm pond (winter only), a single bird on Macgregor Creek, and a single bird around the Douglas Creek confluence. Possibly the two single bird reports are the same bird at different locations. These birds, if present at construction time, are likely to be displaced from these sites. As noted at **paragraph D43**, costs of disturbance may not be significant for the single bird at Macgregor Creek (and the single bird at the Douglas Creek confluence), but likely will be more significant for the whio pair if needing to seek alternative winter foraging. This effect is assessed as **minor**. It is not easily mitigated.

F96. The following mitigation is recommended, which would reduce the overall effect to **less than minor**:

ix. *To address the residual less than minor effect contribute to contribute to an ecosystem programme to benefit whio in the region for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.*

S*ite-wide: Scheme personnel interactions with whio*

F97. Further to the broad range of disturbance effects of the Scheme, several specific elements of Scheme personnel interactions with whio remain to be addressed**:** deliberate interaction other than provided herein, feeding, and leaving food and rubbish onsite. These activities have the potential to indirectly change whio behaviour, reducing their biological fitness as wild animals. Leaving food also encourages predators (e.g. rats). Such interactions would have a **minor** effect on whio.

F98. The last 2.2 km of the access road to the Power Station from the farm boundary at Macgregor Creek is mostly within DOC land. This has a statutory right of public access. By providing physically easier access into the Waitaha Valley, this part of the access road could increase its accessibility for bringing in dogs. However, it is assumed here that conditions in the granting of any approval for the Scheme would provide for keeping members of the public off this section of the access road because of health and safety risks for the duration of the construction phase.

F99. The Scheme provides that no dogs may be brought into the area by personnel associated with the construction and operation/maintenance of the Scheme. The following mitigation is recommended, which would reduce these human-whio interaction effects to **less than minor**:

x. Do not disturb whio other than as provided for herein

xi. Do not feed whio

xii. Ensure all food and rubbish is collected and removed from Scheme sites.

OPERATIONAL EFFECTS

F100. For environmental baseline purposes, and given the proposed predator control management during the construction phase and continuing into the operational phase, it is assumed here that a whio population not dissimilar to the present will remain or, more likely, at some time be restored in the Scheme area in the operational phase.

Morgan Gorge Headworks: Weir – Access for Whio Ducklings and Kōaro, Avoiding Trout Access

F101. Trout are currently absent from above Morgan Gorge. They are potential competitors with whio for macroinvertebrates as food. The design addresses the risk that the residual flow will facilitate trout access into the upper Waitaha catchment by creating a barrier for all fish species except kōaro, and if possible in one design, whio ducklings.

F102. As detailed in the **Freshwater Ecology Report**, retention of access for kōaro above Morgan Gorge is imperative in the life cycle of this diadromous species, while excluding trout access.

F103. There is evidence from field studies in 2006–2008 of a whio behavioural breeding adaptation at Kiwi Flat for gorge nesting sites (including Morgan Gorge), whilst obtaining their energetic and nutrient requirements at rock gardens that had high macro-invertebrate densities. This points to some capability to bring ducklings from distant nesting sites onto Kiwi Flat for brood raising (over land or by swimming). The location of nest sites in gorges or on steep torrents around Kiwi Flat may reduce their accessibility to predators.

F104. While the water velocity in Morgan Gorge at its natural flow is considered too great for ducklings to swim upstream to Kiwi Flat, this may not be the case for the proposed residual flow (3.5 m^3/s).

F105. Whio ducklings are as adept as any waterfowl at walking, running and swimming and are superior to most dabbling ducks at jumping and climbing (Pengelly & Kear 1972).

F106. Duckling access up the weir could be provided in the form of a ramp, with or without water flow at base flow levels, and with inset cobbles to provide resting places. The ramp would need to reach down to the water level. A wetted surface on the true left of the weir is provided for kōaro passage and whio access in the **Project Description**, and is pictured below.

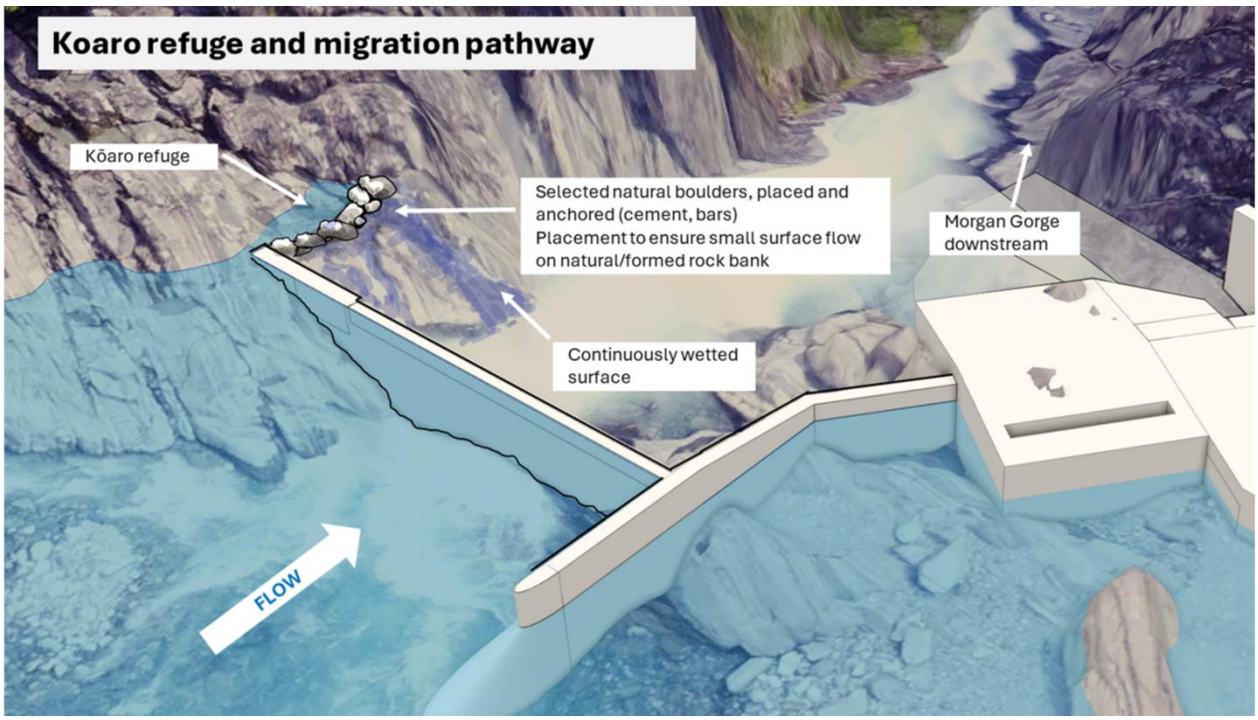


Figure 7: Proposed kōaro and duckling passage.

F107. Provision of duckling access could have a minor positive effect against the current environment baseline, where any ducklings from nest sites on the banks of Morgan Gorge would require overland access with greater predator risk. Duckling access could also enable any ducklings that go over the weir to return upstream.

F108. The following mitigation is recommended, which would result in a **minor positive effect**:

xiii. Provide for whio duckling and kōaro access up the weir (while excluding trout access).

xiv. Include input from a suitably qualified and experienced whio specialist in the detailed design phase of a whio duckling and kōaro passage structure at the weir.

Morgan Gorge Entrance: Intake – Whio Duckling Entrainment

F109. There is a risk with the intake structure of entrainment (entrapment) and incidental mortality from swimming ducklings being unable to overcome their approach velocity.

F110. Duckling entrainment risk is minimised by the intake design that provides for the intake portal being always below water surface level.

F111. The risk of duckling entrainment into the intake is assessed as **less than minor**.

Morgan Gorge Entrance: Artificial Structures (Weir and Intake) in Natural Environment

F112. The Headworks has been a focal point for a whio pair throughout the whio field studiesError! Reference source not found.. There is a possibility that the artificial structures at t he Headworks could deter whio utilising the site via a neophobic response.

F113. The presence of whio physically utilising other intake structures (e.g. Whakapapa intake of the Tongariro power scheme, including road access; pers. obs. 2009-10-25) shows whio can be expected to show adaptability to artificial structures such as the weir and intake. The effects of the presence of the Waitaha Scheme weir and intake structures are therefore considered to be **less than minor**.

Morgan Gorge Headworks: Maintenance and Related Activities

F114. Maintenance and related activities at the Headworks have the potential to impact whio and whio habitat.

F115. Channel maintenance work in the river would involve an excavator (~12–20 tonne, stored in the access tunnel), accessing the river via the tunnel accessway. The excavator would clear gravels/boulders to ensure that the river flows toward the intake and sluice gate. The full intake channel profile would not be recreated, but rather the channel 'trained', and larger boulders/debris moved so that water can flow in the desired direction and sluicing flows can do the bulk of the work of moving gravels.

F116. The excavator would be operating in the riverbed, on both banks. The sluice gate would be open to draw river levels down as necessary to minimise the depth of water to be forded. The excavator would likely be excavating material from within the water column. Materials would be moved to the riverbed on the true left side (opposite to the intake). It may remain there or be re-entrained by large flows and passed over the weir.

F117. Planned channel maintenance would be undertaken during summer (January - March) low flow conditions, likely for up to a working day. Pre-emptive maintenance work may also be undertaken prior to the whio breeding season (September-December) if necessary.

F118. The gravel accessway track to the riverbed (to be used by the excavator) will need to rebuilt after major flood events.

F119. There will be occasional periods of helicopter use for maintenance and monitoring purposes, bringing noise disturbance on the inward and outbound flight and locally intensive noise disturbance at landing and take-off (up to 101–110 dB).

F120. The proposed highly directional siren sound level (*c.*130 dB) at the Power Station, frequency (*c.4* times per year) and duration (*c.*30 seconds and intake and Power Station) combined are well above the level for an avian hearing temporary threshold shift (93 dB) and exceed levels that cause avian auditory damage (125 dB). Against ambient noise levels near the river (65-75 dB; **Noise Report**), a whio short-term behavioural response would likely occur at some point not much above 74 dB. At higher levels and repeated four times per year, the response would likely shift to a long-term habitat use displacement. Effects at ground level would be lessened if the siren was placed at height and/or topographically sheltered from the river.

F121. Such maintenance and related activities will disturb the whio pair (and potentially juveniles) such as have been present at the site throughout whio field studies (**paragraph D22**).

F122. These disturbances cumulatively will render this site less attractive to whio, causing them to move elsewhere for at least the duration of the disturbance. In a worst-case scenario, whio hearing damage could occur, whio breeding activities would be directly impacted if maintenance activities occur between September–December, and whio could be displaced more permanently causing local population decline. Overall, these effects are assessed as **significant**.

F123. Downstream habitat effects will be very minor. Activation of sediment at low flow and re-entrainment of excavated channel material during subsequent flood flows will be within the natural variability of the sediment system locally.

F124. The following mitigation is recommended, which would reduce the overall effect to **less than minor**:

xv. Undertake intake channel maintenance, accessway rebuilding and helicopter use for maintenance purposes outside the breeding season (September–December), as far as practicable.

xvi. Before works, inspect the surrounding site and gently guide any whio present to move to be more than 50 m away (excluding below Morgan Gorge entrance and helicopter use because of physical impracticality).

xvii. Locate the siren so that sound levels at the river are not more than 74-80 dB.

xviii. To address the residual less than minor level of effect contribute to an ecosystem programme to benefit whio in the region for at least a ten year period, and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.

Abstraction Reach: Residual Flow

F125. The following operational phase Scheme components in the abstraction reach have the potential to impact whio and whio habitat:

- Water abstraction: up to a maximum of 23 m^3/s at the Scheme intake; a residual flow of 3.5 m^3/s in the abstraction reach; no take when flows are less than 3.5 m^3/s; four 'no-take' days per annum for kayak passage (river flow 15–25 m^3/s); and no take during floods (>250 m^3/s). Water returned to the river via the tailrace will restore the natural flow.
- Bypass valve operation at the Power Station, resulting in changes in Waitaha River flow below Morgan Gorge (increase of up to 13 m^3/s) and below the Power Station (decrease of up to 13 m^3/s). This will likely occur for *c.*30 seconds, *c.4* times per year, as a result of weather events causing a fault on the transmission network, or an internal plant/machinery malfunction.

F126. Residual flows of 3.5 m^3/s in the abstraction reach will occur, on average, for 66% of the time, or 241 days per annum (**Hydrology Report**).

F127. The residual flow in the abstraction reach would be supplemented downstream of the Scheme intake by inflows from Anson Creek (300 m) and Glamour Glen (1000 m). These two streams would boost the residual flow below the intake at least 0.7 m^3/s for 50% of the time, increasing the residual flow below Glamour Glen to at least 4.2 m^3/s for that time (**Hydrology Report**).

F128. The vast majority of residual flow periods at the intake only last several days before being broken by a fresh (**Hydrology Report**). On average, there are 14 times a year when the residual flow state lasts up to a day, four occurrences when it lasts up to three days, and one occurrence when it lasts up to 10 days. These values will vary from year to year depending on the timing and amount of rain, the size of the snowpack and the temperature which melts it. Had the Scheme been operating over the past 51 years, the greatest period of unbroken residual flow would have lasted for 79 days during 1996. In comparison, in 1994 the longest period would have been 17 days.

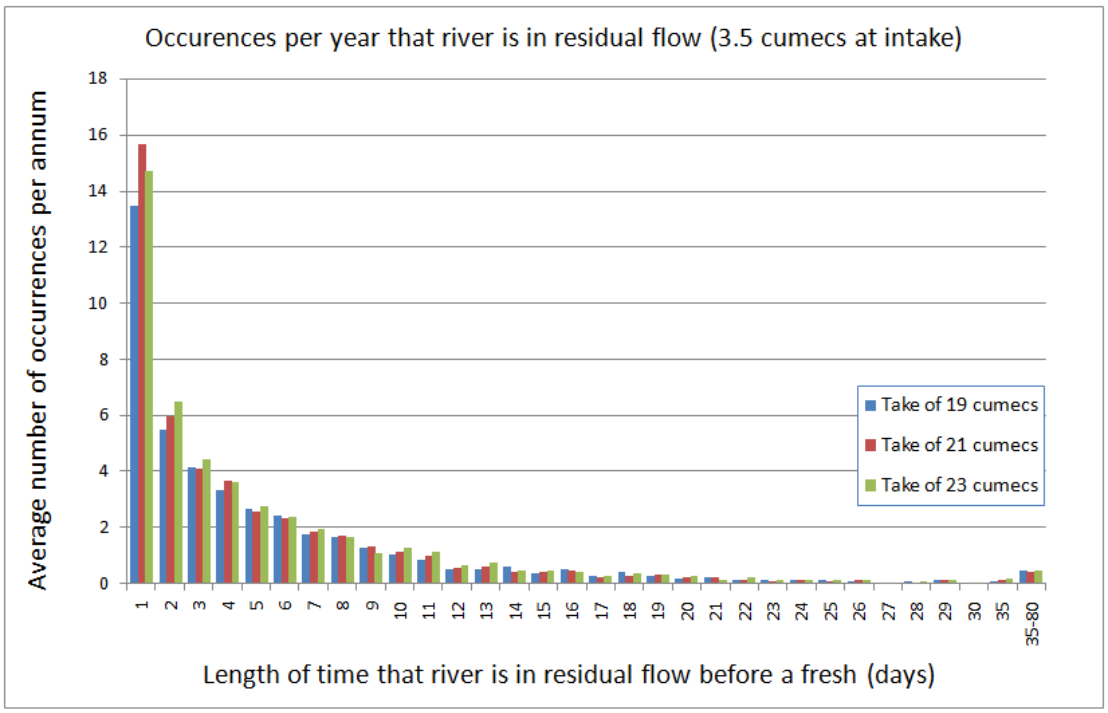


Figure 8: Length of time that river is in residual flow before a fresh.

F129. Because the river flow is very seasonal, the relative effect of the proposed abstraction is much reduced over late spring and summer, but conversely, in winter it is increased.

F130. The 2024 whio survey found one whio pair in the abstraction reach, and a single whio (first found in Glamour Glen).

F131. Craig & Hay (2013) developed habitat-flow predictions for whio in the Scheme abstraction reach (excluding Morgan Gorge). Their habitat modelling predictions indicate that whio feeding habitat increases with flow reduction below *c.*12 m^3/s (**Figure 9**). At the proposed residual flow of 3.5 m^3/s, increases are of the order of 125% on the one day mean annual low flow (MALF1).

F132. A sudden increase of flow (up to 13 m^3/s) on the residual 3.5 m^3/s in the abstraction reach caused by a rapid closing of the intake at Morgan Gorge (ramping effect) is likely to occur as a flood wave as it passes through the confines of Morgan Gorge. It would be reduced in height in the wider river between the gorge exit and the tailrace. Adult whio and whio ducklings are unlikely to be present on the water within Morgan Gorge at any time. Adults may be present between the below the gorge exit and the Power Station at any time, and whio ducklings in the breeding season. The flood wave is likely to be within the natural adaptability of adult whio on the water, but possibly not ducklings (if present on or near the water). Juvenile mortality could lead to the loss of local seasonal population recruitment. The flood wave is not expected to impact nesting sites as it will be below within the range of natural flow variability. Release of up to 10 m^3/s through the valve at the tailbay is not expected to impact whio (essentially being a reduction in flow).

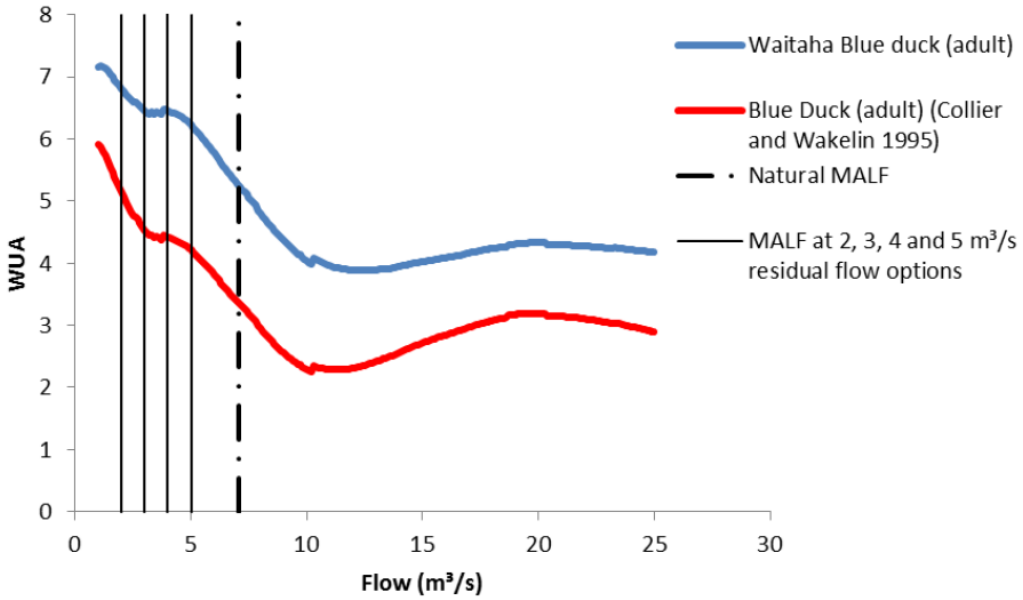


Figure 9: Average habitat availability (WUA) versus flow for adult whio predicted by habitat modelling for the Scheme abstraction reach, alongside predictions for whio on the Tongariro River.
WUA = weighted usable area; MALF = mean annual low flow. Source: Allen & Hay (2013).

F133. The effect of the proposed water abstraction itself on whio is assessed as **minor positive**. There is a risk that a flood wave in the abstraction reach in spring could cause incidental whio duckling mortality. This effect is assessed as **minor**. It is not easily mitigated.

F134. The following mitigation is recommended, which would reduce the overall effect to **minor**:

xix. To address the residual minor effect during the Scheme's operation, contribute to an ecosystem programme to benefit whio in the region, for at least a ten year period, and ideally the life of the consents.

Power Station

F135. Siren use to warn that a plume of water is being released at the tailrace is the only likely operational activity at the Power Station Site with potentially significant effects on whio. An adverse effect on any adult whio in the locality from the high pressure release of water in a bypass valve event seems unlikely, as is the possibility of whio ducklings being present.

F136. The proposed highly directional siren sound level (*c.*130 dB), frequency (*c.4* times per year) and duration (*c.*30 seconds) combined are well above the level for an avian hearing temporary threshold shift (93 dB) and approach levels that cause avian auditory damage (125 dB). Against ambient noise levels near the river (65-75 dB; **Noise Report**), a whio short-term behavioural response would likely occur at some point not much above 74 dB. At higher levels and repeated four times per year, the response would likely shift to a long-term habitat use displacement. Effects at ground level could be lessened if the siren was placed at height and/or topographically sheltered from the river. The current low level of (but nevertheless potential) whio habitat use at the Power Station compared to the intake site reduces the level of effect of the siren to minor.

F137. The following mitigation is recommended, which would reduce the siren effects to **less than minor**:

xx. Locate the siren so as that sound levels at the river are not more than 93 dB (less than the temporary threshold shift level), and preferably not more than 74-80 dB.

xxi. To address the residual potentially minor level of effect contribute to an ecosystem programme to benefit whio in the region for at least a ten year period and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.

Access Road (Waitaha Farm to Power Station)

F138. Operational phase activity associated with the access road will largely comprise diurnal site visits by light utility vehicles or small trucks to check on structures and for regular Scheme maintenance, plus maintenance of the road itself. Other than at Macgregor Creek, the access road has limited frontage to river and stream whio habitats. Effects of ongoing use and maintenance of the road access during the operational phase on whio and whio habitat are expected to be **less than minor**.

F139. As noted at **paragraph D47**, the last 2.2 km of the access road to the Power Station is mostly within DOC land, which has a general statutory right of public access. By providing physically easier access into the Waitaha Valley, this part of the access road could increase accessibility for bringing in dogs. Untrained dogs can easily kill or injure whio.

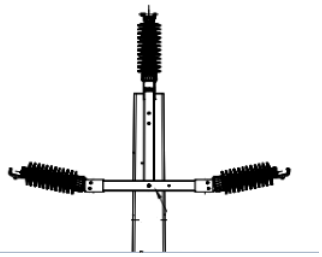
F140. The following mitigation is recommended, which would reduce these access road effects to **less than minor**:

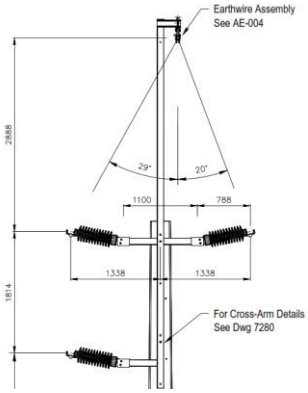
xxii. Request DOC show the Waitaha access route on their walking and tracks website as a not permitted area for dog access, and install a no dogs sign at the beginning of public access onto the access route (acknowledging Westpower cannot control the outcome).

Waitaha Farm to Power Station: 66 kV Power Transmission Line [13]

F141. Principal design parameters of the transmission line relevant to possible impacts on whio are:

- The transmission line between the Power Station and Waitaha Farm at Macgregor Creek will be mostly located within a joint road-transmission line corridor (17.5 m width, reduced to 15m through rehabilitation). The transmission line on Waitaha Farm is on a separate alignment from the access road.
- Pole spacing will generally be 150–180 m. Height of the poles generally is *c.*14 m (above ground); poles at either side of Macgregor Creek will be a maximum of 21 m (above the bed of the channel).
- For all but the 1 km length closest to the Power Station, there will be three conductors spaced triangularly, as shown in the diagram below at left.
- For all the 1 km length closest to the Power Station, there will be an additional 10 mm earth wire suspended on a steel post *c.*3 m above the pole, for a 1 km length from the Power Station, in a configuration shown in the diagram below at centre.
- The pi-pole on the true left bank of Macgregor Creek (and possibly elsewhere) will likely have metal crossarms, three conductors spaced horizontally along an 8 m span, and wooden poles, as shown in the diagram below at right (though with a wooden crossarm).
- The distance between conductors in the configurations shown at left and centre will be between 2.06 m and 2.67 m, with the shortest distance (1.82 m vertical) on the 1 km length closest to the power station.





[13] The transmission line north of about Allen Creek is beyond the known range of whio and whio habitat and is not considered here.

F142. During the 2024 survey, a minimum of three (possibly four) whio were found or reported present on waterways and the farm pond in the vicinity of the transmission line. They may be expected to move between these locations, and possibly share airspace with the transmission line.

F143. The two principal potential risks of the transmission lines for whio (and other bird species) are electrocution and collision.

F144. Electrocution arises from birds creating an electrical arc from contact across conductors. (from birds creating an electrical arc from contact across conductors). The risk of this occurring for whio from sitting on powerlines is considered remote. Whio in the Waitaha Valley have not generally been seen flying at the anticipated 6.5 m sag height (above ground) of the proposed powerlines (though flight in open habitats has not been observed); no reference has been found in the literature to whio roosting on powerlines; and the spacings of the conductors are much greater than whio body dimensions (530 mm body length and 410-500 mm wingspan (Williams 2005, 2025).

F145. No study or reports of whio vulnerability to powerline collision are known and assessment of vulnerability must consider the range of possible factors at play (Bevanger 1994).

F146. Whio eyes are frontally placed resulting in a relatively wide binocular field, but an extensive blind area behind the head (Martin et al. 2007). The enhanced binocularity of whio with the visual projection of the bill falling within the binocular field, coupled with their narrow tapering bill, functions to provide the visual control of bill position necessary for the capture of prey within the water column. These visual characteristics contrast to other bird species known to be vulnerable to powerline collisions (Martin & Shaw 2010), indicating that whio are less vulnerable.

F147. Other factors that may reduce whio powerline collision risk include whio having a lower wing loading (ratio of body mass to wing size); they do not fly in flocks or perch at heights; whio usually fly lower than the anticipated sag levels associated with the 14 m and 21 m heights of the powerlines (though flight in open habitats has not been observed); and any whio flying near the forest vegetation south of Granite Creek to the power station would be forced to fly over the top of the 1.3 km of the transmission line because of its relatively lower height.

F148. Other risk factors that may contribute to powerline collision potential include poor flight during nocturnal and crepuscular flight (although this seemingly is less frequent than diurnal flight); the double level of conductors of the principal proposed conductor configuration; and the triple level of conductors in the 1 km stretch nearest the power station (including the 10 mm earth wire).

F149. The effect level arising from risk of whio electrocution or collision with the 66 kV powerline is assessed as **less than minor**.

Site-wide: Lighting

F150. The Scheme proposes artificial (non-UV) lighting only at the Power Station and at the intake; there would be no artificial lighting along the road corridor. These will only be switched on during unplanned shutdown requiring night-time staff callout and repairs. Total use could be

an hour or so, on up to two or three occasions annually. The lighting will be designed to maximise the downward light output ratio and avoid any upward light/light scatter. Remote controlled infrared cameras will be used to see what is happening at the Power Station and at the intake after dark without need of additional lighting. The power station will not have windows, so avoiding spillage of internal light and potential incidental mortality from birds striking windows after being attracted to light.

F151. Artificial light at night disrupts the physiology and behaviour of many organisms, and alters species abundance and distribution, species interactions and ecosystem functioning. These effects span terrestrial, freshwater, and marine ecosystems (Cieraad & Farnworth 2023). No studies of the effects of artificial lighting on whio are known (ibid.).

F152. Whio generally are crepuscular (i.e. most active at dawn and dusk) and mostly shelter by day out of sight (Marchant & Higgins 1990; Blue Duck (Whio) Recovery Group 2022). However, at Kiwi Flat they were usually visible through daytime, roosting or feeding. Whio nocturnal activities were not studied, but they were noticeably less conspicuous diurnally during periods of full moon, suggesting they are nocturnal feeders when there is sufficient light available.

F153. The Headworks is a focal site for a whio pair (**paragraph D14**) and this locality is also used as a flight path into and exiting Morgan Gorge. No sign of whio on land was found during the 2024 survey at the Power Station site and more generally on the true right bank of the Waitaha River upstream from Macgregor Creek. A presumed pair were observed flying and settling on the river about 800 m upstream of the Power Station.

F154. The proposed lighting regime is consistent with current best practice artificial lighting design principles (Department of Climate Change, Energy, the Environment and Water 2023).

F155. Given the very limited use of external lighting, and the implementation of best practice artificial lighting design principles, it is expected that effects of the proposed lighting regime whio will be **less than minor**.

Additional effects management measures

F156. Residual effects after site-specific mitigation remain for the following Scheme components:

- Construction phase: Morgan Gorge Headworks, accessways, Construction Staging Area 1; Power Station and tunnels; access road and heavy vehicle road
- Operational phase: Morgan Gorge headworks weir and intake (backwater effects and sediment aggradation,

F157. To reduce these residual effects to **less than minor,** it is recommended to:

contribute to an ecosystem programme to benefit whio in the region for at least a ten year period and from year 11 a similar contribution for the life of the consents to an ecosystem programme in the region or locally in the Waitaha Valley.

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Appendix H - Acknowledgements

I express my gratitude to the many people who have contributed to this report.

[redacted] and their conservation dogs Tui and Bella did the hard yards of the spring 2024 survey. Advice from [redacted] is acknowledged.

[redacted] (DOC Hokitika) provided information and facilitated the granting of the DOC permit. Te Rūnanga o Makaawhio and Te Rūnanga o Ngāti Waewae supported granting of the permit.

[redacted] (Anderson Helicopters) safely transported us to and from our field work sites in the Waitaha Valley and in Amethyst Ravine.

[redacted] (Waitaha Farms) provided his whio records on the farm and in Macgregor Creek.

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[redacted] (OSPRI, Christchurch) provided information on OSPRI possum control operations in the Waitaha Valley and nearby.

DOC hut users provided whio records through the Kiwi Flat hut book.

Dr John McLennan (Environmental Services, Havelock North) advised, and peer reviewed a draft and final of this report.

Field work in 2024 was undertaken under a DOC Authority for research on public conservation land (Authorisation Number: 117686-RES).

I acknowledge the work of the Whio Recovery Group, and the use of Toitū Te Whenua Land Information New Zealand NZ basemap aerial imagery.

Appendix I - Code of Conduct Matters

QUALIFICATIONS AND EXPERIENCE

1. I have a B.Sc. in mathematics (University of Canterbury, 1977), a Diploma in Natural Resources (University of Canterbury/Lincoln College, 1978) and a Master of Applied Science in ecology (University of Canterbury/Lincoln College, 1980, 1st class honours).
2. I have 45 years of experience in conservation evaluation, ecological surveys, and assessments of environmental effects in relation to vegetation, flora and fauna in a range of natural terrestrial and freshwater ecosystems in Aotearoa New Zealand.
3. I am the managing director and consultant ecologist at my own company, Sustainability Solutions Ltd (since 2004). My principal work experience includes 27 years as an independent consulting ecologist (1998–present), conservancy ecologist for the Department of Conservation (DOC) West Coast Tai Poutini conservancy (1987–1997), and researcher at the Biological Resources Centre, DSIR, Wellington (1983–1986).
4. My consultancy experience includes undertaking or contributing towards ecological and wildlife surveys and assessments of ecological significance and/or environmental effects in a range of natural terrestrial and freshwater ecosystems (forests, shrublands, wetlands, subalpine, rivers and streams); preparing rehabilitation plans; obtaining resource consents for activities in natural environments; and being an ecologist peer reviewer or assessor on 19 Forest Stewardship Council (FSC) sustainable forest management certification assessments of exotic and indigenous forestry operations throughout Aotearoa New Zealand.
5. I am an author or co-author of >140 contract reports, publications, peer reviews, resource consent applications, and evidence for resource consent or Environment Court hearings.
6. Projects directly relevant to the Waitaha Hydro Scheme (in addition to those cited in this report) include:
    - coordination and lead report author, pre-feasibility environmental risk assessment, proposed Waitaha hydro scheme, 2005
    - coordination and report author, blue duck/whio population surveys, Mokihinui River, 2007 and 2008
    - participant and co-author, baseline fauna survey of proposed Waitaha hydro scheme area, 2007.

CODE OF CONDUCT – ADDITIONAL MATTERS

I note that the Environment Court Practice Note Code of Conduct for Expert Witnesses includes that the expert covers the below clause 9 aspects or clarifications to their evidence (bolded).

To the extent those matters are not clear to the Panel, a few particular points of clarification I wish to make are:

iii. describe the ambit of their evidence, listing the issues addressed by them and stating either that the evidence is within their area of expertise or that they are relying on the evidence of another witness; and

- *Should there be any uncertainty about my evidence or that of another, please seek clarification.*

v. state the reasons for the opinions they express, including why other alternative interpretations of data are not supported;

- *This report does not explicitly consider alternative interpretations of data. However, it carefully considers the evidence of [redacted] on behalf of the Director General of Conservation in relation to whio towards the Environment Court hearing on the proposed Mokihinui hydro project ([redacted]). [redacted] was a member of the national Whio Recovery Group between 1997 and 2007 and the leader of the group between November 1998 and September 2003, and was a regional strategic advisor for whio conservation at the time of his evidence. [redacted] evidence systematically examines whio population parameters on a riverine system not greatly dissimilar to the that of the present application.*

viii. describe any examination, test or other investigation on which they have relied and identify who carried those out with details of that person's qualifications, experience and expertise;

- *As noted in Appendix G Acknowledgements, [redacted] and [redacted] and their conservation dogs Tui and Bella contributed their specialist skills during the spring 2024 whio survey. Advice from [redacted] (DOC) is acknowledged. Other conservation dog handler and dog teams contributed to whio surveys and other field work in 2006–2012.*
- *[redacted] and [redacted] relevant qualifications and experience are:*

  [redacted] MSc Ecology; DOC South Westland (Haast 2002–2007); DOC Greymouth 2010–2018; Paparoa Wildlife Trust (2010–present, Project Manager 2021–present); DOC Certified Conservation Dog Handler Threatened Species (whio) 2014–present

  [redacted] MSc; DOC Certified Conservation Dog Handler Threatened Species; 26 years working experience with conservation dog primarily on kiwi and whio.