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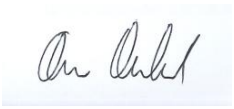
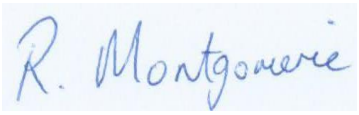
# Levin Landfill
# Ecological Assessment

Submitted to:
Horowhenua District Council

water fauna flora land

## Quality Assurance

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Appendix A – Raw Macroinvertebrate Data

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# 1.0 Introduction

## 1.1 Background

Horowhenua District Council (HDC) is seeking to mitigate the effects of leachate emanating from the now closed Levin Landfill Figure 1. The plume contains high concentrations of ammoniacal-nitrogen among other contaminants, which is migrating in shallow groundwater towards the nearby Hokio Stream. HDC have investigated a Best Practicable Option (BPO) for remediating the effects of the leachate on the receiving environment by intercepting and treating the bulk of the plume. To achieve this, an intercept channel is proposed to be dug into the confined shallow aquifer, ahead of the direction of the plume. Intercepted leachate would then be processed through the HDC wastewater treatment plant. It is expected that the intercept channel would result in localised lowering of groundwater level at a location that would result in drying and partial loss of a wetland on the landfill site over the lifetime of the intercept drain operation.

HDC engaged Ecological Solutions Ltd to assess the ecological values and identify wetlands in the areas which may be affected by the proposed remediation. In addition, though not directly affected by the intercept drain, an ecological assessment was conducted on Hokio Stream to assess potential current effects on the receiving environment.

## 1.2 Site History

The Levin Landfill received general waste from Levin and surrounds, which were disposed of in two unlined landfill areas until 2004, after which a modern lined facility was used until site closure in 2021. A leachate plume emanating from the old Landfill areas 1 and 2 (Figure 2) has been detected in monitoring boreholes within the site and to the north of the site. Emissions of particular concern are ammoniacal-nitrogen ($NH_4$-N), boron and chloride. The plumes of each contaminant are migrating north towards Hokio Stream at different velocity due to variation in mobility (Earthtech 2023, 2024). Boron is emanating primarily from Old Landfill Area 2 whereas ammoniacal-nitrogen is emanating primarily from Old Landfill area 1 at a slower rate of migration (Figure 2). The Earthtech (2023) hydrological assessment report found increased concentrations of ammoniacal-N in Hokio Stream, which are thought to represent the lower concentration outer edge of the plume.

## 1.3 Proposed Groundwater Intercept Drain

Assessment of groundwater leachate plume (Earthtech 2023) predicted that it is unlikely ammoniacal-N will exceed the ANZECC (95%ile) DGV of 2.1 mg/L at the monitoring locations on Hokio Stream; however, it will progressively exceed the Landfill consent average trigger value of 0.4 mg/L over time. In order to achieve the required remediation, the Best Practicable Option is a subsoil groundwater intercept drain (Intercept Drain) located parallel with the Northern Drain (Figure 3). The Intercept Drain will receive groundwater containing peak concentrations of ammoniacal nitrogen, which will be pumped out for treatment, either on site or discharged to municipal wastewater, if required.

The proposed Intercept Drain consists of a 200 m long subsoil drain with a fabric-wrapped drainage metal intake. The drain is to be constructed in two stages, with Stage 1 consisting of the 100 m long central section. Pumping from a central pumping chamber would drawdown groundwater by approximately 1.5 m at the drain, with an influence extending 50 m from the drain location, creating a groundwater capture zone of 0.5 ha (Figure 3).

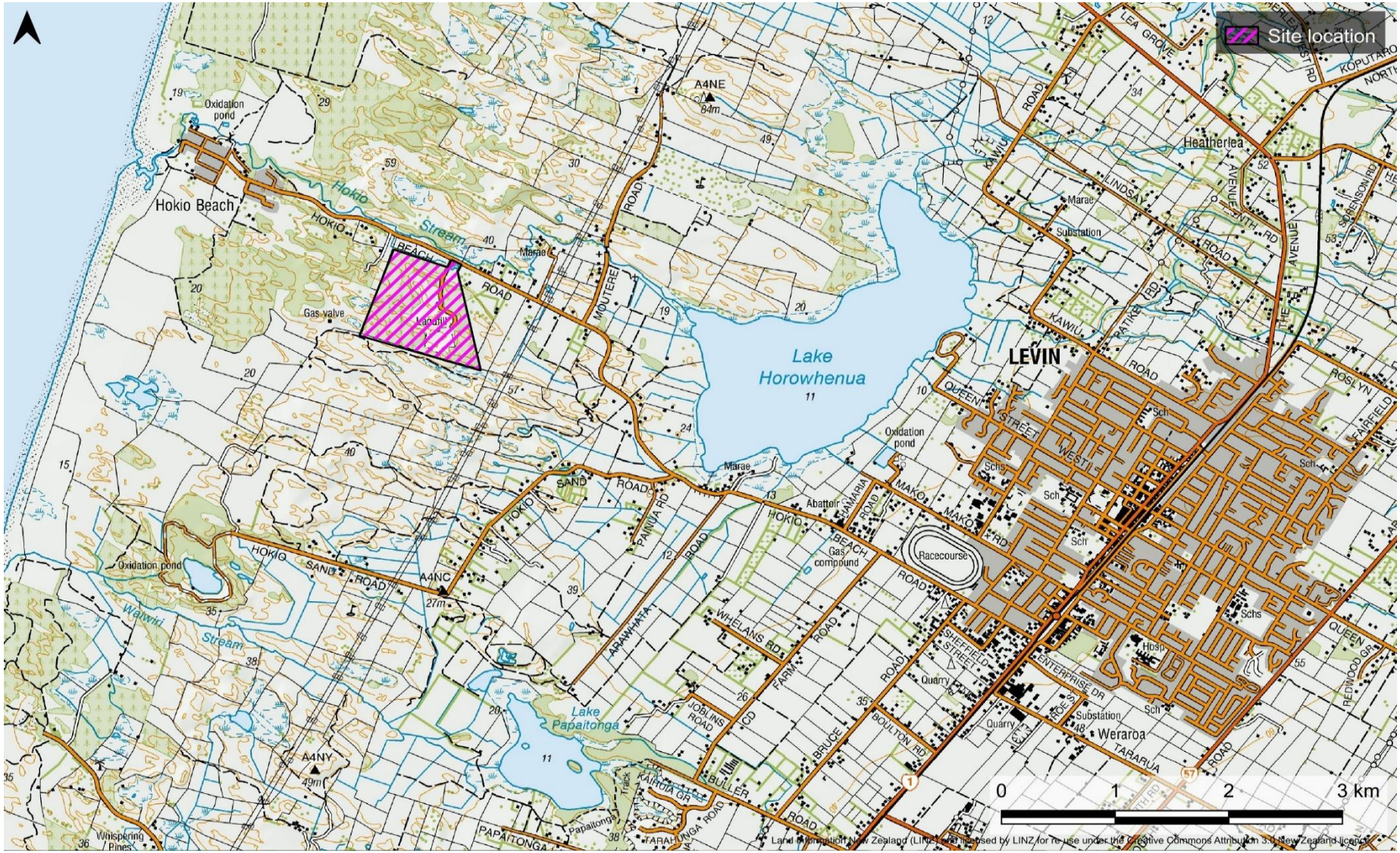



**Figure 1: Location of Levin Landfill.**




**Figure 2: Location of closed landfill areas and Northern Drain within the Levin Landfill site.**

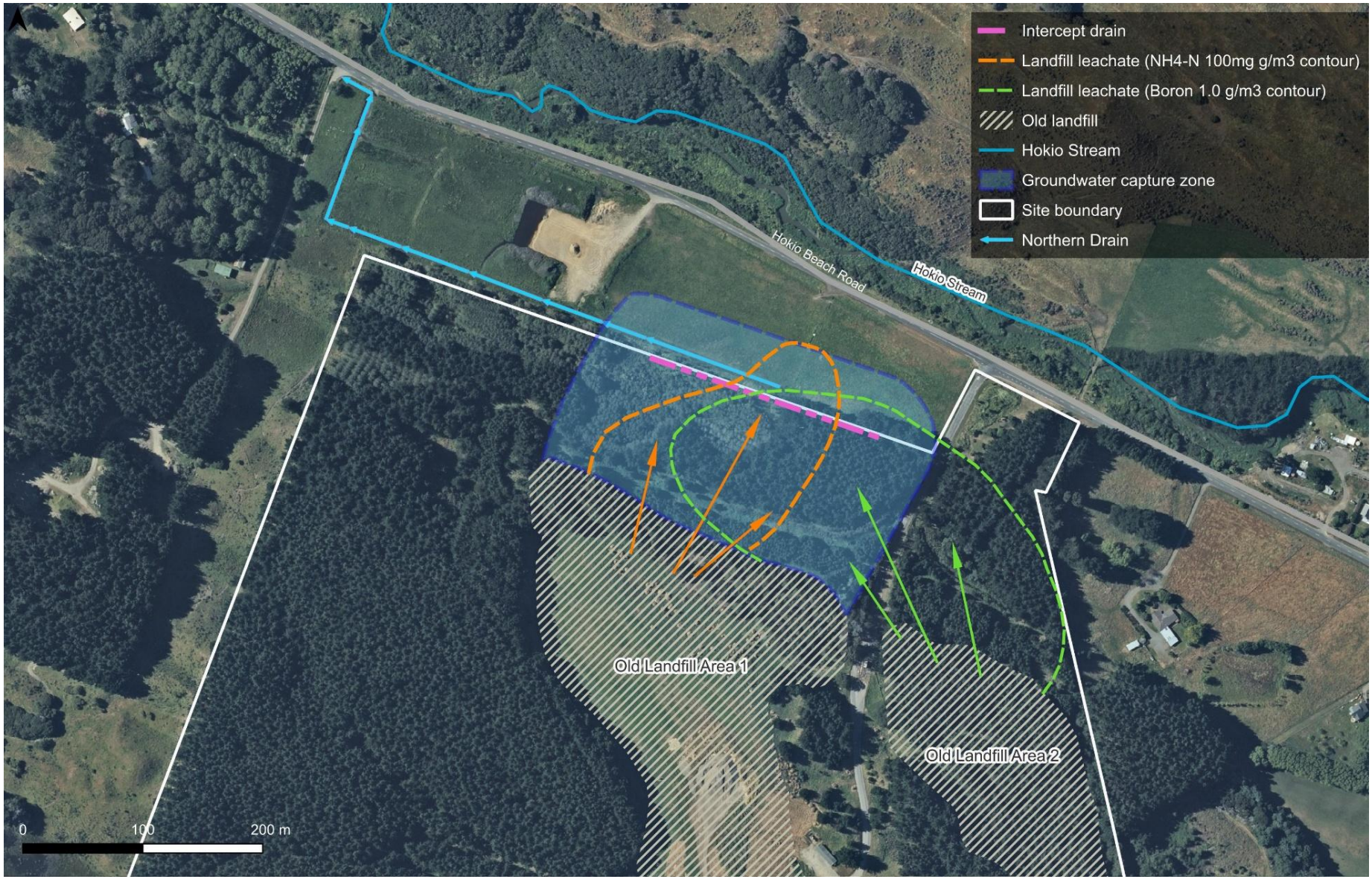



**Figure 3: Indicative location and direction of migrating leachate plumes and proposed intercept drain.**

# 2.0 Ecological Setting

The site is located in the Foxton Ecological District, a long belt of mostly consolidated sand dune country on the western coast of the lower North Island (McEwen 1987). The dune country was formed by aeolian deposition driven by prevailing northwest winds with dunes migrating longitudinally. The district extends from the western base of the Tararua Ranges at Paekakariki in the south to the mouth of the Rangitikei River in the north. The topography of the district is undulating and contains abundant small dune lakes and wetlands, numerous estuaries and coastal lagoons. Rainfall is evenly distributed between 800 mm to 1000 mm rainfall p/a.

As the dunes are naturally dynamic, foredune and backdune vegetation of different ages would have led to plant communities which vary in composition based on age and dune position. Foredune vegetation was sparse and comprising binding colonisers (e.g., pingao (*Ficinia spiralis*) and spinifex (*Spinifex sericeus*)). Older consolidated backdunes featured mixed podocarp/broadleaf forest types such as Kahikatea-matai/tawa-māhoe and Kahikatea-pukatea-tawa (Leathwick et al 2004). Burning by Māori instigated a dune building phase, resulting in extensive young to moderate aged dune communities featuring shrubland of mānuka with bracken on moderate aged dunes and pingao and *Coprosma acerosa* on young dunes (Singers 1997). Another dune building phase was initiated following European arrival, which was then intentionally stabilised through planting of exotic species such as marram grass (*Calamagrostis arenaria*) tree lupin (*Lupinus arboreus*) and later plantation pine forestry and pasture grasses for agriculture. Dune forming processes often create depressions which can lead to ponding in small lakes and wetlands known as duneslacks, these can contain specialist rushland vegetation (Esler 1969) with species such as *Carex pumila,* oioi (*Apodasmia similis),* toetoe (*Austroderia toetoe),* tī kōuka *(Cordyline australis)* and knobby club rush (*Ficinia nodosa)*.

## 2.1 Site Description

The Levin Landfill is located approximately 5 km to the west of the Levin Township, near the Hokio Stream, halfway between its outflow from Lake Horowhenua 2 km upstream and the rural community of Hokio Beach (Figure 1). The Hokio Stream flows in a westward direction on the opposite side of Hokio Beach Rd. The majority of the site except for the surface of former landfills, contains plantation pine forestry with small areas of exotic hardwood on wetter areas, particularly on terraces near Hokio Stream. The site is surrounded by farmland, featuring some exotic forestry and rural residences on consolidated sand dunes, with underlying gravels. Depth to groundwater is shallow across the site with an unconfined aquifer above a semi-permeable aquitard (Earthtech 2024). To the north of the landfill property is modified flat paddocks featuring drainage watercourses, the largest of which runs along the boundary between the properties. This drain (Northern Drain) runs parallel along the edge of swampy land at the toe of the sand dunes to the north of unlined landfill area 1 (Figure 2).

## 2.2 Hokio Stream

The Hokio Stream is a c. 8 km long waterway originating at the outlet of Lake Horowhenua, approximately 1.5 km direct to the east. The streambed substrate is sand over the majority of its length, although there is a section of cobble bottomed riffles a short distance downstream from the lake outlet. Hokio Stream is part of Lake Horowhenua Outstanding Natural Feature (Horowhenua District Plan 2015).

Lake Horowhenua is the largest of the Foxton Ecological District dune lakes. It is fed by small streams and artificial drainage channels within agricultural land and most of the Levin

Township. The lake is hypereutrophic (Plouviez et al. 2024) and has been affected by land use and historic discharges of wastewater and effluent. A weir at the outlet can impact fish passage at low water levels.

## 2.3 Landcover database

Landcover within the catchment primarily comprises a mix of urban settlement (Levin Township), rural production land for livestock and exotic pine plantation Figure 4. Indigenous vegetation is sparsely distributed, often comprising of small bush remnants.

## 2.4 Threatened Land Environment Classification (TEC)

The Threatened Environment Classification (TEC) combines data from three national databases: Land Environments of New Zealand (LENZ), the Land Cover Database (LCDB), and the national protected areas network (Cieraad et al. 2015, Walker et al. 2015). TEC is designed as a regional-national scale tool for assessing the threat status of land environments based on the loss of original natural vegetation cover and the extent to which the remaining indigenous vegetation is protected.

Environment C is characterised by warm temperatures, high solar radiation, moderate vapour pressure deficits and moderate annual water deficits typify the climate. While loess is the most widespread soil parent material, alluvium and old dune sands are also common. Slopes are very gentle, and soils are generally imperfectly drained.

The site and surrounds lie within land environment C3 which includes the dry, low-lying plains of the Manawatu. At levels III and IV the site is divided into two categories primarily based on soil drainage with the undulating dunes in C3.1b and the flatter stream terraces in C3.2c (LENZ). The division of the site into two land environment categories emphasises the contrast between the well-drained dune country which occupies most of the site, and the imperfectly drained soils of the stream terrace. Both C3.1b abd 3.2c are in Threatened Environment Classification 1 with less than 10% indigenous cover remaining.

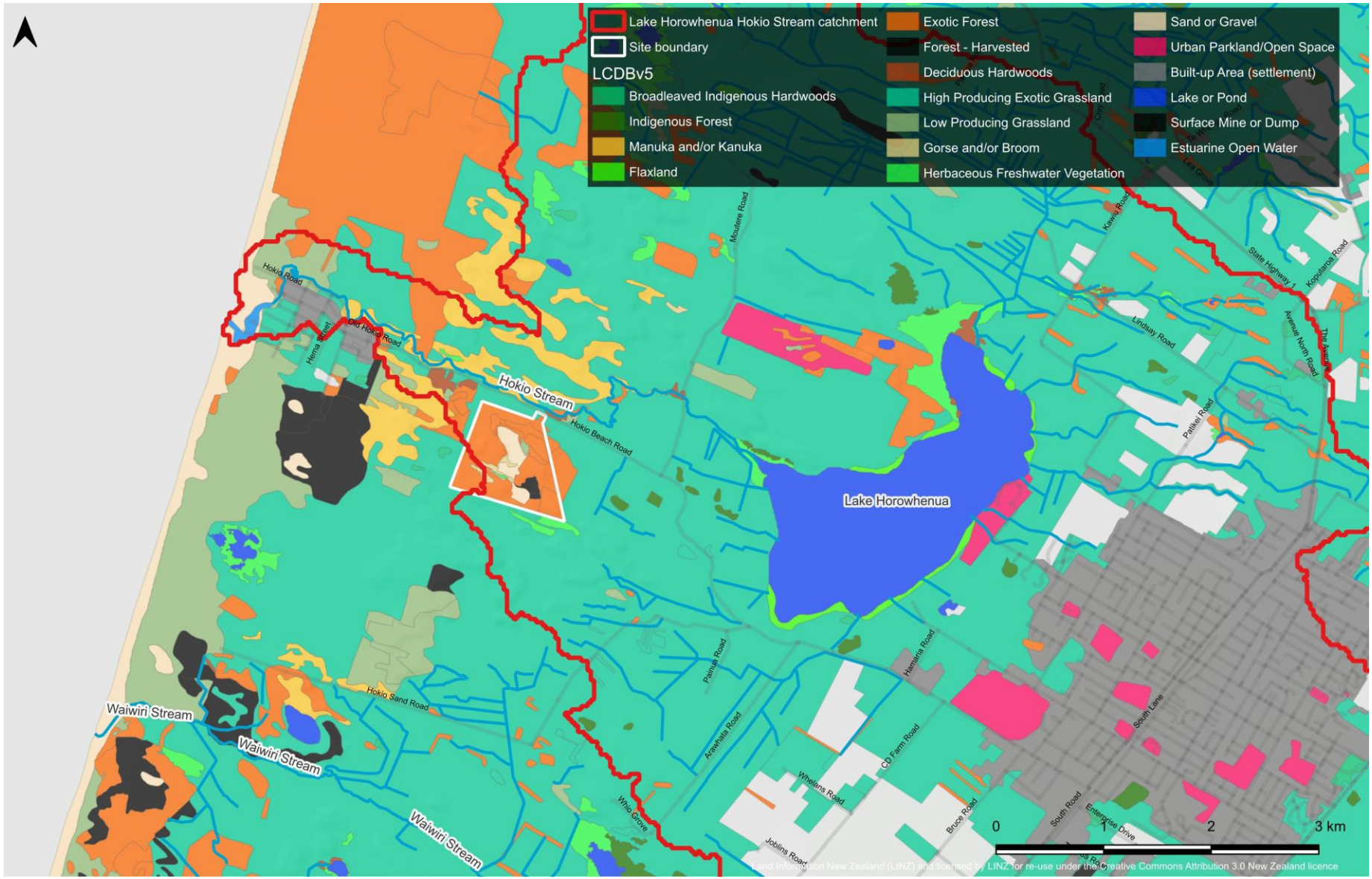



**Figure 4: Landcover at Levin Landfill and Surrounds LCDBv5.**

# 3.0 Methodology

## 3.1 Terrestrial Ecology

### 3.1.1 Vegetation

An initial desktop assessment was carried out using aerial imagery (Google Earth, Retrolens, topographic maps and GIS datasets) and ecological documentation (e.g., Leathwick et al. 2004; Maseyk 2007; Singers and Rogers 2014) to assist in determining historic landcover and vegetation types, current landcover and vegetation types, and hydrological patterns that might correspond with potential wetlands. A survey was carried out at the site on 11 September 2024. Plant species encountered were recorded and terrestrial habitats described and photographed.

### 3.1.2 Avifauna

Existing avifauna records within 10 km of the site were obtained from the New Zealand eBird database. These records were then used to prioritise which species would likely be present at the site given the habitat(s) available there. All birds seen or heard during the site visit were recorded and potential avian habitats were identified during the walk-through survey undertaken on 11 September 2024.

### 3.1.3 Herpetofauna

Existing lizard records within 5km of the site were obtained from the Department of Conservation's (DOC) database. These records were then used to prioritise which species would likely be present at the site given the habitat(s) available there. Potential lizard habitat within the site was identified by a walk-through survey undertaken on 11 September 2024.

### 3.1.4 Bats

Bat survey records within 25 km of the site were obtained from the Department of Conservation (DOC) database to assess the likelihood of bats using the site. Bats were not considered likely to present at the site.

## 3.2 Wetlands

An initial desktop review was carried out using aerial photography (Google Earth and Retrolens) to assist in determining potential locations of wetlands within which to carry out plot-based wetland surveys to confirm wetland presence. Additional information from S-Maps (Manaaki Whenua - Landcare Research Limited) was used to assist in determining soil properties within the site.

A ground survey at the site was undertaken on 11 September 2024 to assess the potential wetland habitats identified. Habitats were assessed in accordance with the Ministry for the Environment Wetland Delineation Protocols (MfE 2020) including the Vegetation Tool (Clarkson 2014), Hydric Soil Tool (Fraser et al. 2018) and Hydrology Tool (MfE 2021).

*Vegetation*

The vegetation survey involved undertaking 2 x 2 m vegetation plots within representative vegetation at potential wetlands across the site. This data was then used to apply the rapid, dominance and prevalence tests to confirm wetland status (Clarkson 2014).

*Hydric Soils*

Vegetation plots were accompanied by soil cores (50 cm depth) collected using a hand auger to assist in determining the presence (or not) of hydric soils. Soil colours were characterised using Munsell Colour charts to identify and describe chroma hues. In accordance with Fraser et al. (2018), hydric soils were those with pale, low chroma colours (value 4 or more and chroma 2 or less, or chroma 3 with value 6 or more) occupying 50% or more of the exposed matrix within the top 30 cm profile.

*Hydrology*

The hydrology tool (MfE 2021) was applied to determine wetland conditions. Data was gathered from site observations and soil core inspections as well as aerial photography to determine the presence of hydrology indicators. One primary hydrology indicator or two secondary indicators are required to confirm wetland hydrology[1].

## 3.3 Streams

### 3.3.1 Stream classification

The One Plan does not provide watercourse classification categories. General stream habitat characteristics (e.g., width, water depth, substrate type and size, freshwater habitat type, and the amount of riparian shading) were recorded and described in order to assist with the assessment of ecological values.

### 3.3.2 Sampling Sites

Sampling site details are presented in Table 1 with site locations shown in Figure 5. Site D1 is downstream or potentially within the edge of leachate plume and site D2 is downstream while Sites U1 and U2 are upstream of Levin Landfill. Downstream Sites were chosen in order to best detect potential effects of leachate, with upstream sites used as controls. The upstream sites were approximately 2km upstream due to limited access through private land. The downstream and upstream sites differed in character, with the channel straighter with steeper banks at the upstream sites.

### 3.3.3 Water Physicochemistry

Water physicochemical parameters including temperature, dissolved oxygen, conductivity, and pH were measured at each site using a calibrated hand held YSI meter. The time at which measurements were made was noted.

### 3.3.4 Habitat Characteristics

The following in-stream and riparian habitat characteristics were assessed and a photographic record made at each site:

- Channel width (m).
- Water depth (m).
- Streambed substrate (percent boulder, cobble, gravel, sand/silt).
- Streambed compaction and embeddedness.
- Organic matter content (percent logs, branches, leaves and detritus).

[1] Refer to the Wetland Hydrology Tool (MfE 2021) for the full list of indicators

- Channel shade (%).
- Streambank erosion (%).

### 3.3.5 Macrophytes and Periphyton

Macrophytes and any periphyton or bryophytes were visually assessed at each site and a photographic record made where cover was present and visible.

### 3.3.6 Benthic Macroinvertebrates

Five replicate benthic invertebrate Surber samples (0.1 $m^2$ area, mesh size 500 µm) were collected from each site in accordance with the National Environmental Monitoring Standards for Macroinvertebrates (NEMS 2020). Samples were collected from the same reach where habitat and aquatic flora data were collected. The following invertebrate metrics and indices were calculated:

- *Community composition* – relative abundance of the main taxonomic groups making up the macroinvertebrate communities recorded from each site. Can be used to provide a general indication of stream health based on the relative proportions of water and habitat sensitive and tolerant taxonomic groups.
- *Taxa number* – a measure of the overall health of the benthic macroinvertebrate community and habitat and water quality. In general, high taxa number can be an indication of a healthy waterway. The number of taxa present at a site can be highly variable and can fluctuate depending on many factors including habitat, water quality and sampling effort.
- *Macroinvertebrate Community Index (MCI)* – is a presence/absence-based index for measuring stream health in soft-bottomed streams. Individual taxa scores range from 1 (pollution tolerant) to 10 (highly pollution sensitive). MCI-sb scores range from <80 (poor) to >120 (excellent) and interpreted using the guidelines in Table 1 (Stark and Maxted 2007). The National Policy Statement for Freshwater Management 2020 (MfE 2020) (NPS-FM) presents MCI thresholds that categorise stream health into four attribute bands (A, B, C and D) Table 2 (MfE 2020).
- *Quantitative Macroinvertebrate Community Index (QMCI)* – the QMCI is a quantitative variant of the MCI and used to measure stream health for soft-bottomed streams. QMCI scores range from <4.00 (poor) to >6.00 (excellent) and is interpreted following the guidelines in Table 1 (Stark and Maxted 2007). The NPS-FM (MfE 2020) also presents QMCI thresholds that categorise stream health into four attribute bands (A, B, C and D) Table 2 (MfE 2020).
- *EPT taxa number* – a measure of the overall health of the community and of habitat and water quality. A community that has a higher number of water and habitat sensitive taxa from the groups Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) (EPT) indicates a healthier waterway.




**Figure 5: Stream sampling locations.**

**Table 1: MCI-sb and QMCI-sb quality classes (Maxted and Stark 2007).**

| Stream health | Descriptions | MCI-sb | QMCI-sb |
|---|---|---|---|
| Excellent | Clean water | >120 | >6.00 |
| Good | Doubtful quality/possible mild pollution | 100–119 | 5.00–5.99 |
| Fair | Probable moderate pollution | 80–99 | 4.00–4.99 |
| Poor | Probable severe enrichment | <80 | <4.00 |

**Table 2: MCI and QMCI Attribute Bands and descriptions (NPS-FM; MfE 2020).**

| Attribute | Description | MCI | QMCI |
|---|---|---|---|
| A | Macroinvertebrate community indicative of pristine conditions with almost no organic pollution or nutrient enrichment. | ≥130 | ≥6.50 |
| B | Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution / nutrient enrichment. | ≥110 - <130 | ≥5.5 - <6.5 |
| C | Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mixture of taxa sensitive and insensitive to organic pollution / nutrient enrichment. | ≥90 - <110 | ≥4.5 - <5.5 |
| **National bottom line** | | **90** | **4.5** |
| D | Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to organic pollution / nutrient enrichment. | <90 | <4.50 |

### 3.3.7 Fish Fauna

A search of New Zealand Freshwater Fish Database (NZFFD) and Wilderlab's database of publicly available environmental DNA (eDNA) data was carried out to determine fish records within the Site and wider catchment. The NZFFD search included records since 1985, while Wilderlab's database included records since 2021.

A total of 8 baited fine mesh fyke nets were set, half of these were evenly spaced along approximately 80 m reaches of stream both upstream and downstream of the landfill. The fyke nets were set in the afternoon and retrieved in the morning to reduce the potential of low dissolved oxygen stress on captured fish. Nets were placed over night during a period of 'good' fishing phase based on Maramataka calendar. Each eel was measured and assessed for the following parameters: length (mm), weight (g), external examination and assessment of eyes, fins, opercula and gills and for any lesions or parasites.

Environmental DNA (eDNA) was used to identifying the presence of species that may not have been captured during fyke net surveys. A single eDNA sample was collected at each site and sent to Wilderlab for analysis.

## 3.4 Assessment of Ecological Values Approach

Ecological values were assigned following the approach outlined in the Environment

Institute of Australia and New Zealand's (EIANZ) Ecological Impact Assessment guidelines (EcIAG) (Roper-Lindsay et al. 2018). The EcIAG outline a standardised approach for defining ecological values. The approach involves assessing four matters including representativeness, rarity/distinctiveness, diversity/pattern and ecological context with consideration of the attributes outlined in Table 7 of the EcIAG. The overall ecological values within the site and vicinity were assigned based on the four matters outlined above and using the scoring system outlined in Table 6 of the EcIAG.

## 3.5 Significance Assessment

Vegetation at the Site was assessed in relation to its potential to provide habitat for threatened fauna species and its potential to meet the vegetation of significance criteria outlined in Schedule 6 of the One Plan (Horizons Regional Council 2014).

## 3.6 Assessment of Effects Methodology

The magnitude of effect on each ecological value was considered in relation to the scale of the effect, extent of habitat loss or modification in relation to remaining habitat, duration of the effect, extent of the effect on species at the population level, impact on the sustainability of the ecosystem and intensity of the unmitigated effect. The magnitude of effect associated with each activity was evaluated based on the criteria outlined in Table 8 of the EcIAG reproduced as Table 3 below and assigning the overall level of effect using the matrix in Table 4. The magnitude of effects ranges between negligible and very high.

**Table 3: Criteria for describing magnitude of effect.**

| Magnitude | Description |
|---|---|
| Very high | Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature. |
| High | Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature. |
| Moderate | Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature. |
| Low | Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns; AND/OR having a minor effect on the known population or range of the element/feature. |
| Negligible | Very slight change from baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR having negligible effect on the known population or range of the element/feature. |

**Table 4: Criteria for describing level of effects.**

| Effect level | Ecological value | | | | |
|---|---|---|---|---|---|
| | ***Very high*** | ***High*** | ***Moderate*** | ***Low*** | ***Negligible*** |
| ***Very high*** | Very high | Very high | High | Moderate | Low |
| ***High*** | Very high | Very high | Moderate | Low | Very low |
| ***Moderate*** | High | High | Moderate | Low | Very low |
| ***Low*** | Moderate | Low | Low | Very low | Very low |
| ***Negligible*** | Low | Very low | Very low | Very low | Very low |
| ***Positive*** | Net gain | Net gain | Net gain | Net gain | Net gain |

# 4.0 Terrestrial Flora and Fauna

## 4.1 Vegetation

Vegetation cover on the site, excluding wetlands, was primarily highly modified and dominated by exotic species. Over most of the site is plantation forestry of *Pinus radiata* with small areas of exotic hardwoods on stream flats. The remainder of the site was open areas dominated by predominantly exotic grasses and herbaceous weeds.

Prior to human arrival, the site and surrounds would have consisted of coastal forest and duneland habitats. Retrolens imagery indicates that prior to land conversion for agricultural use (1950) much of the site comprised of manuka (*Leptospermum scoparium* agg.) flax (*Phormium tenax*) cabbage tree (*Cordyline australis*) scrub on the Hokio Stream flats, with undulating dune terrain containing agricultural grassland.

A number of small dune slacks occur amongst the undulating dunes to the south and west of the landfill. These are beneath a tall plantation canopy of plantation pine forestry and are in generally poor condition, though they contain some wetland vegetation such as *Carex secta.* These are upgradient and unaffected by the leachate plume or proposed intercept drain.

## 4.2 Avifauna

### 4.2.1 Desktop

The eBird database recorded a total of 109 avian species within 10 km of the site between 2008–2024. Of these, 78 native species were recorded with 23 species assigned a current threat classification (Threatened or At Risk; Robertson et al. 2021).

Waterfowl and shorebirds/seabirds represented the majority of the species contained in the records, which is expected given proximity of the site to the coast and Lake Horowhenua, however most of these are not associated with habitats on site. There are records of 'At Risk – Declining' spotless crake (*Porzana tabuensis tabuensis*) and banded rail (*Gallirallus philippensis*) 'Nationally Critical' Australasian bittern (*Botaurus poiciloptilus)* within 10 km, however these are associated with less modified duneslack wetlands and lakes nearby. It is considered unlikely that the site could support these or other Threatened or At Risk species.

**Table 5: eBird records within 10km of the site with a conservation status (At Risk or Threatened).**

| Common Name | Scientific Name | Conservation Status (Robertson et al. 2021) |
|---|---|---|
| Australasian bittern | *Botaurus poiciloptilus* | Threatened – Nationally Critical |
| Bar-tailed godwit | *Limosa lapponica* | At Risk – Declining |
| Black-billed gull | *Chroicocephalus bulleri* | At Risk – Declining |
| Black-fronted dotterel | *Elseyornis melanops* | At Risk – Naturally Uncommon |
| Black-fronted Tern | *Chlidonias albostriatus* | Threatened – Nationally Endangered |
| Buff-banded Rail | *Gallirallus philippensis* | At Risk – Declining |
| Buller's Shearwater | *Ardenna bulleri* | At Risk – Declining |
| Caspian tern | *Hydroprogne caspia* | Threatened – Naturally Vulnerable |
| Grey duck | *Anas superciliosa* | Threatened – Nationally Vulnerable |
| Fluttering shearwater | *Puffinus gavia* | At Risk – Relict |
| Black-billed gull | *Chroicocephalus bulleri* | At Risk – Declining |
| Yellow-crowned parakeet / Kākāriki | *Cyanoramphus auriceps* | At Risk – Declining |
| South Island pied oystercatcher | *Haematopus finschi* | At Risk – Declining |
| Spotless crake | *Porzana tabuensis tabuensis* | At Risk – Declining |
| Southern black-backed gull | *Larus dominicanus* | Threatened – Nationally Critical |
| Little black shag | *Phalacrocorax sulcirostris* | At Risk – Naturally Uncommon |
| Little shag | *Microcarbo melanoleucos brevirostris* | At Risk – Relict |
| Pied shag | *Phalacrocorax v. varius* | At Risk – Recovering |
| Red knot | *Calidris canutus* | At Risk – Declining |
| Eurasian coot | *Fulica atra* | At Risk – Naturally Uncommon |
| Royal spoonbill | *Platalea regia* | At Risk – Naturally Uncommon |
| Variable Oystercatcher | *Haematopus unicolor* | At Risk – Recovering |
| White-fronted tern | *Sterna striata* | At Risk – Declining |

# Wetlands

## 4.3 Natural Inland Wetlands

In respect to wetlands within the impact footprint, one wetland (Wetland 1) (1.93 ha) was identified (Figure 6). Wetland 1 consisted of predominantly sedgeland (Figure 7) comprising rautahi (*Carex secta*), cutty grass (*Carex geminata*) and tall fescue (*Lolium arundinaceum*) beneath standing dead black poplar (*Populus nigra*). Occasional shrubland (Figure 8) consisting of mānuka (*Leptospermum scoparium* agg.), mingimingi (*Coprosma propinqua*), scrambling pōhuehue (*Muehlenbeckia complexa*) and scattered tī kōuka (*Cordyline australis*) occurred in localised areas interspersed with tall fescue (*Lolium arundinaceum*) and Yorkshire fog (*Holcus lanatus*) grassland. Upland margins (Figure 9) consisted of radiata pine plantation (*Pinus radiata*) on southern margins with a scattered understorey of exotic and native shrubs such as poroporo (*Solanum laciniatum*). The margin to the north consisted of paddocks which to the east were grazed pasture, transitioning into hydrophytic vegetation towards the outflow of the Northern Drain into Hokio Stream toward the west.

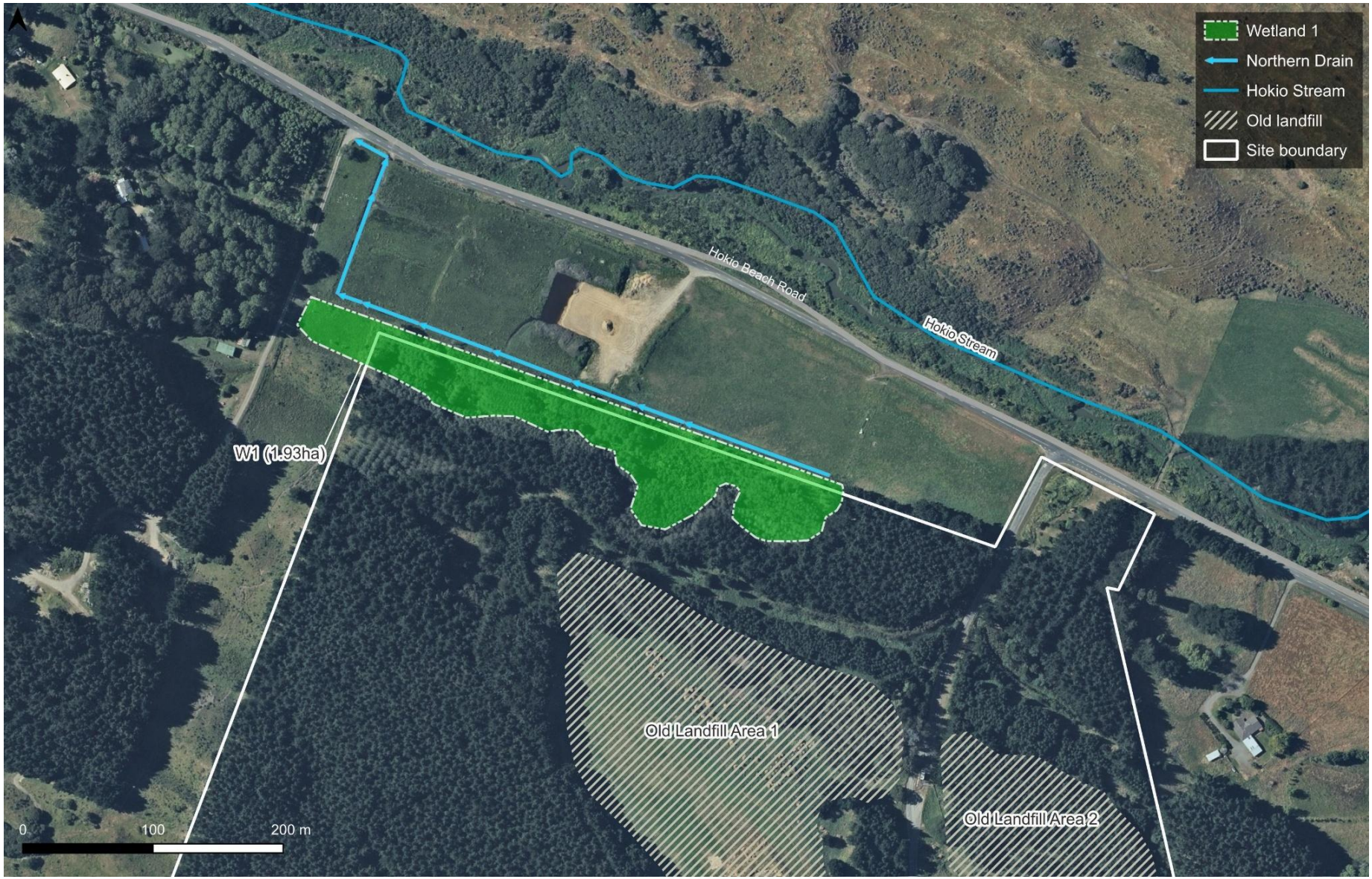



**Figure 6: Location of Wetland.**



**Figure 7: Wetland 1 sedgeland with prominent rautahi in the foreground beneath standing dead poplar.**



**Figure 8: Shrubland within Wetland 1 with scrambling pōhuehue on mānuka and mingimingi.**



**Figure 9: Radiata pine on upland margins of Wetland 1 with scattered exotic and native shrubs in the understorey (poroporo in foreground).**

### One Plan

Wetland 1 was classified as swamp wetland type based on property characteristics outlined in Johnson and Gerbaux (2004).

> *Swamp wetland*
>
> *Swamps receive a relatively rich supply of nutrients, and often sediment, via surface runoff and groundwater from adjacent land. Swamps usually have a combination of mineral and peat substrates. Leads of standing water or surface channels are often present, with gentle permanent or periodic internal flow, and the water table is usually permanently above some of the ground surface, or periodically above much of it. Swamps usually occur in basins, and on valley floors, deltas, and plains. Vegetation cover is often sedge, rush, reed, flax, tall herb, or scrub types, often intermingled, and also forest.*

Horizons regional council One Plan identifies Swamp habitats as:

> *Swamp and marsh wetlands support indigenous sedges, rushes, reeds, flaxland, tall herbs, herbfield, shrubs, scrub and forest.*

Swamp habitats comprised predominantly of indigenous vegetation are considered 'Threatened' habitats.

# 5.0 Hokio Stream

The Hokio Stream is a slow flowing small to moderate sized lowland, soft bottomed stream fed by the outflow of Lake Horowhenua. The stream is enriched by current and historic nutrient sources into Lake Horowhenua including wastewater from Levin, dairy farming and horticulture in the surrounding catchment. Though the surrounding landscape is generally highly modified, the riparian buffer contains indigenous vegetation along the majority of its length. This includes marginal aquatic, riverine wetland and riparian forest vegetation. The stream retains functional connectivity with its floodplain over much of its length, with large areas of riparian swamp flooded during high flows. While degraded by nutrient enrichment and land use change in the catchment, the stream is productive for tolerant taxa and supports a tuna (eel) fishery.

The Hokio Stream is not on site or directly affected by the proposed intercept drain, however it potentially receives landfill leachate. Ecological surveys in Hokio Stream were conducted at locations both upstream and downstream of the Levin Landfill and the leachate plume.

## 5.1 Stream Physiochemistry

Water quality readings at the time of the 10–11 September 2024 survey are presented in Table 6. All parameters varied between upstream and downstream sites with both downstream and upstream sites similar to each other. Temperature, dissolved oxygen, pH were all lower at downstream sites while electrical conductivity was higher (Table 6). A potential explanation for this variance is the nature of the Hokio Stream at the downstream sites where there is an influence riverine swamp which was partially submerged at the time of the survey due to high flows. Water physiochemistry could be modified by residence in the surrounding swamp due to high biological oxygen demand and shading by vegetation. The upstream sites in comparison are both near the outflow of Lake Horowhenua and would have similar water physiochemistry to the lake, where primary production and resulting dissolved oxygen is expected to be high during sunlight hours.

**Table 6: Water physiochemistry results during the 2024 survey.**

| Site | Location | Time (NZST) | Temp (°C) | Dissolved oxygen | | pH | Electrical Conductivity (µS/cm) |
|---|---|---|---|---|---|---|---|
| | | | | ($g/m^3$) | (%) | | |
| U1 | Upstream | 12.40 p.m. | 14.4 | 12.02 | 117.8 | 8.84 | 177.2 |
| U2 | Upstream | 2.10 p.m. | 14.9 | 12.40 | 122.7 | 8.93 | 179.4 |
| D1 | Downstream | 1.40 p.m. | 13.2 | 7.89 | 75.3 | 7.39 | 213 |
| D2 | Downstream | 10.25 a.m. | 13.0 | 6.64 | 63.1 | 7.27 | 214 |

## 5.2 Aquatic and Riparian Habitat

The riparian margins of the Hokio Stream contained a prominent component of indigenous vegetation throughout much of its length. The upstream reach assessed nearest the outflow from Lake Horowhenua was the most heavily modified due to historic channelisation, vegetation clearance and exotic woody tree species and herbaceous weeds. Upstream sections featured a straightened channel which, although wider than downstream, is a confined channel between steep banks. In places there was dense shade

from exotic trees, with a substrate of bedrock just below sampling site U2. Downstream of this section to the coast the stream contained well vegetated riparian margin, which included riverine wetland of flax and sedgeland. This riparian margin provides valuable indigenous terrestrial habitat.

## 5.3 Stream Physiochemistry

Water quality readings at the time of the 10–11 September 2024 survey are presented in Table 6. All parameters varied between upstream and downstream sites with both downstream and upstream sites similar to each other. Temperature, dissolved oxygen, pH were all lower at downstream sites while electrical conductivity was higher (Table 6). A potential explanation for this variance is the nature of the Hokio Stream at the downstream sites where there is an influence riverine swamp which was partially submerged at the time of the survey due to high flows. Water physiochemistry could be modified by residence in the surrounding swamp due to high biological oxygen demand and shading by vegetation. The upstream sites in comparison are both near the outflow of Lake Horowhenua and would have similar water physiochemistry to the lake, where primary production and resulting dissolved oxygen is expected to be high during sunlight hours.

**Table 7: Water physiochemistry results during the 2024 survey.**

| Site | Location | Time (NZST) | Temp (°C) | Dissolved oxygen | | pH | Electrical Conductivity (µS/cm) |
|---|---|---|---|---|---|---|---|
| | | | | ($g/m^3$) | (%) | | |
| U1 | Upstream | 12.40 p.m. | 14.4 | 12.02 | 117.8 | 8.84 | 177 |
| U2 | Upstream | 2.10 p.m. | 14.9 | 12.40 | 122.7 | 8.93 | 179 |
| D1 | Downstream | 1.40 p.m. | 13.2 | 7.89 | 75.3 | 7.39 | 213 |
| D2 | Downstream | 10.25 a.m. | 13.0 | 6.64 | 63.1 | 7.27 | 214 |

### 5.3.1 Upstream Site 1

Upstream site 1 Figure 10 is approximately 500 m below the weir at the outflow of Lake Horowhenua. The channel at site 1 was 8 m wide, had low channel sinuosity, had uniform water depths (>1 m) and a soft-bottomed silt/sand dominated streambed with no woody debris recorded. Water velocity was moderate-low (~0.4 m/s) at site 1 with aquatic habitat dominated by runs (100%). Streambanks were low gradient, stable and displayed no evidence of erosion and most likely reflect stable flow from Lake Horowhenua. The riparian margin had been fenced with a buffer of approximately 20 m planted in native vegetation on both sides.



**Figure 10: Upstream site 1.**

### 5.3.2 Upstream Site 2

Upstream Site 2 (Figure 11) is 220 m downstream of Upstream Site 1 and immediately upstream of Moutere Road Bridge. The stream atSite 2 was narrower and confined within steep sided streambanks (i.e., ~4 m high) that showed no evidence of erosion. Flow velocity was moderate (~0.5 m/s), with habitat was dominated by runs (100%) and water depth over 1m. The streambed was dominated by loosely packed sand/silt with occasional macrophyte beds and woody debris. Riparian vegetation is dominated by weedy, short exotic vegetation such as hops (*Humulus lupulus)* which continued right to the stream margin (water's edge) but provided minimal shade.



**Figure 11: Upstream Site 2.**

### 5.3.3 Downstream site 1

Downstream Site 1 Figure 12 is adjacent to the Levin Landfill site, near the sampling site at which the edge of the leachate plume was detected. Stream characteristics at this site were typical of the middle reaches of the Hokio Stream, as it meanders amongst riverine wetlands. The channel was 5 m wide and over 1 m deep between low gradient banks. The streambed was sand/silt with frequent macrophyte beds. Flow velocity was moderate (~0.5 m/s) and uniform. Vegetation was dominated by native vegetation with extensive flaxland and sedgeland which provided minimal shade. At the time of the survey much of the floodplain including flaxland/sedgeland approximately 50 m side was partially submerged.



**Figure 12: Downstream Site 1.**

### 5.3.4 Downstream Site 2

At Downstream Site 2 the channel, depth and flow velocities were more variable, featuring side branching through riparian vegetation with pool habitat between runs and occasional riffles  Figure 13.  Channel width was approximately 5 m and 1 m – >2 m depth.  The substrate was sand where flow velocity was greatest and sand/silt in pools.  Riparian habitat Figure 13 was similar at site 2 except for the presence of willows (*Salix x fragilis*) which created a partially closed canopy cover and large woody habitat within the stream channel and riparian zone.



**Figure 13:  Downstream site 2.**

## 5.4 Macrophytes and Periphyton

NIWA (2024) found the stream to be dominated by macrophytes, particularly marginal floating macrophytes such as exotic grasses and herbs encroaching into the stream.  These included sweetgrasses (*Glyceria maxima, G. declinata*), water celery (*Helosciadium nodiflorum*), watercress (*Nasturtium officianale*) and waterpepper (*Persicaria hydropiper*). Submerged aquatic macrophytes included exotics such as water purslane (*Ludwigia palustris),* starwort (*Callitriche stagnalis)* and charophytes (*Nitella spp.*).

## 5.5 Macroinvertebrates

### 5.5.1 Community Composition

Macroinvertebrates in Hokio Stream at all sites sampled were dominated by water and habitat tolerant taxonomic groups including Crustacea (71–87%) and Mollusca (5–26%) Figure 14. Particularly abundant at all sites were *Paracalliope* amphipods, which is typical for slow flowing lowland streams. Cladocera and copepods were also abundant, particularly at site U1. Mollusca were the next most common group with the snail *Potamopyrgus* recorded in all samples and in high numbers. The exotic *Physa* snail was present at all sites but was more abundant at upstream sites. Acarina (water mites) were the next most common group (1–3%). Other groups making up a small proportion of the communities were Diptera (true-flies) and Odonata (*Xanthocnemis*, *Austrolestes*). Of note is the high abundance of *Potamopyrgus*, which though generally tolerant, is sensitive to ammonia (Hickey and Vickers 1994).

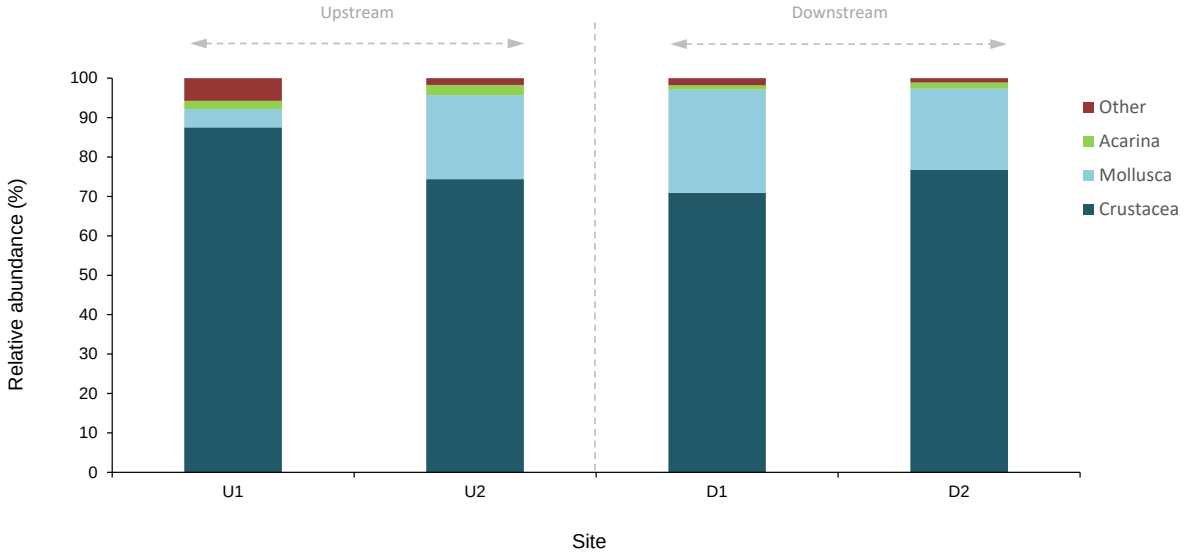



**Figure 14: Macroinvertebrate community composition.**

### 5.5.2 Taxa Number and Abundance

The mean number of taxa recorded at sites was moderate to low and ranged between 12.3 (± 1.0) and 20.0 (±1.6) at sites D1 and U1, respectively (Figure 15). The uppermost site U1 nearest the lake had higher taxa richness than the other upstream site U2 and the two downstream sites (range: 12.3–14.5 taxa). Abundance was high across all sites ranging from 1216.5 at site D1 to 2017.5 at site U2 with all sites except D1 within the margin of error Figure 16. Lower numbers of crustacea contributes the majority of the overall lower abundance at site D1 compared with the other sites.

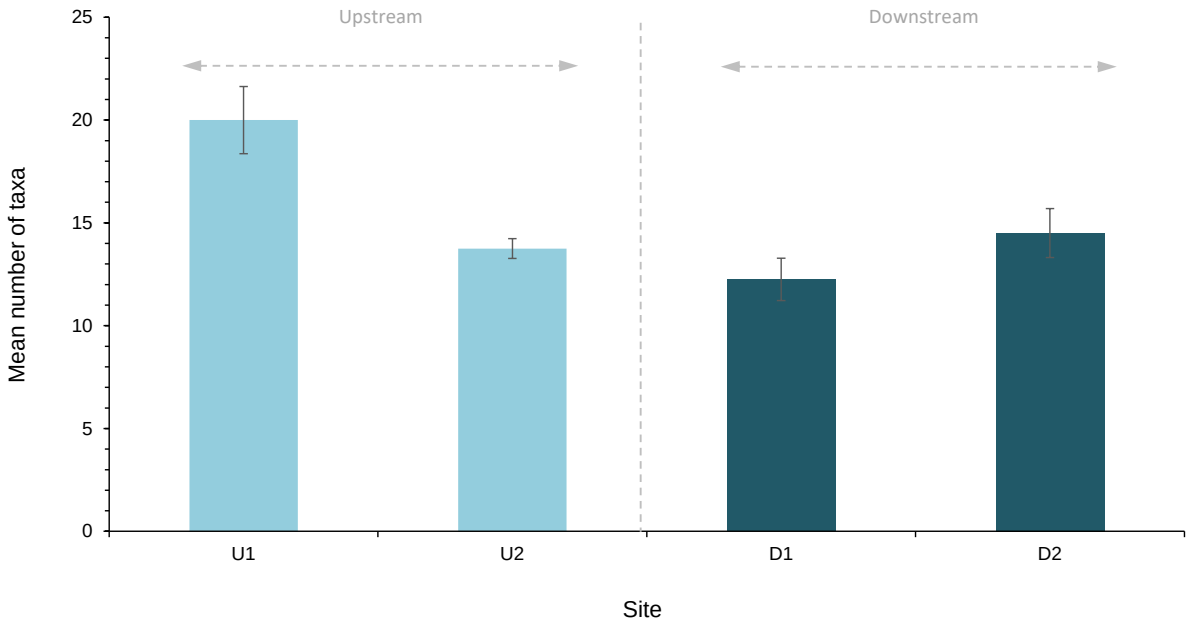



**Figure 15: Mean number of taxa (± 1 S.E.).**

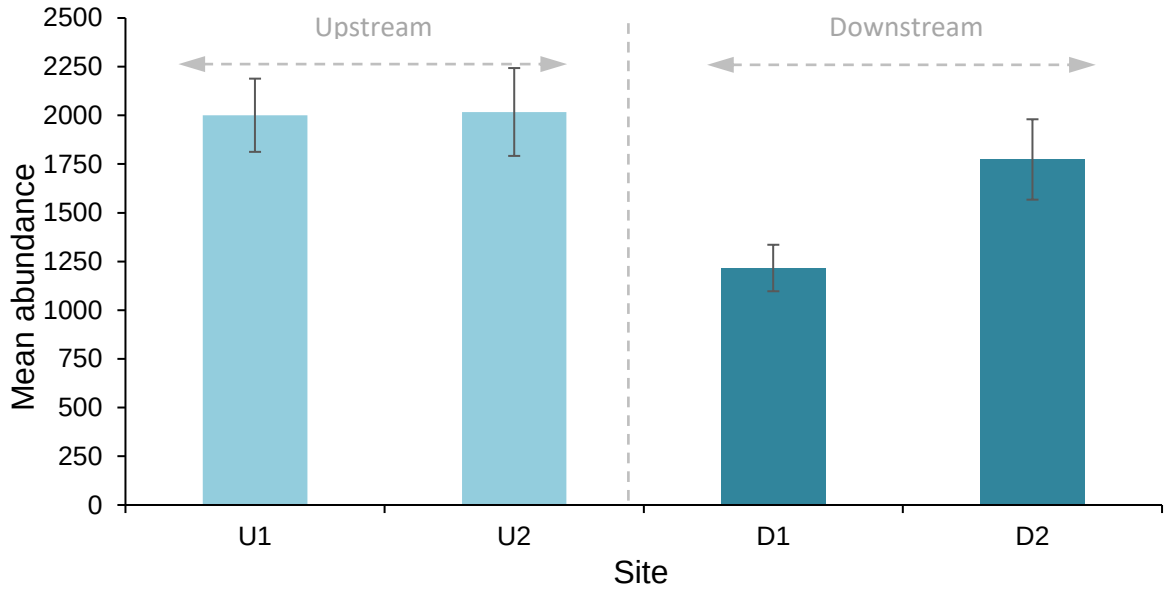



**Figure 16: Mean Macroinvertebrate abundance (± 1 S.E.).**

### 5.5.3 EPT and Percent EPT

There were no water and habitat sensitive mayfly (Ephemeroptera), caddisfly (Trichoptera) and stonefly (Plecoptera) (EPT) taxa recorded from any of the sites.

### 5.5.4 MCI and QMCI

Macroinvertebrate Community Index soft bottom (MCI-sb) scores ranged from 60.4 at D1 and 62.3 at U2 Figure 17. These scores are within the 'poor' quality class. Quantitative Macroinvertebrate Community Index (QMCI) scores ranged from 3.9 at site U1 and 4.5 at site U2.

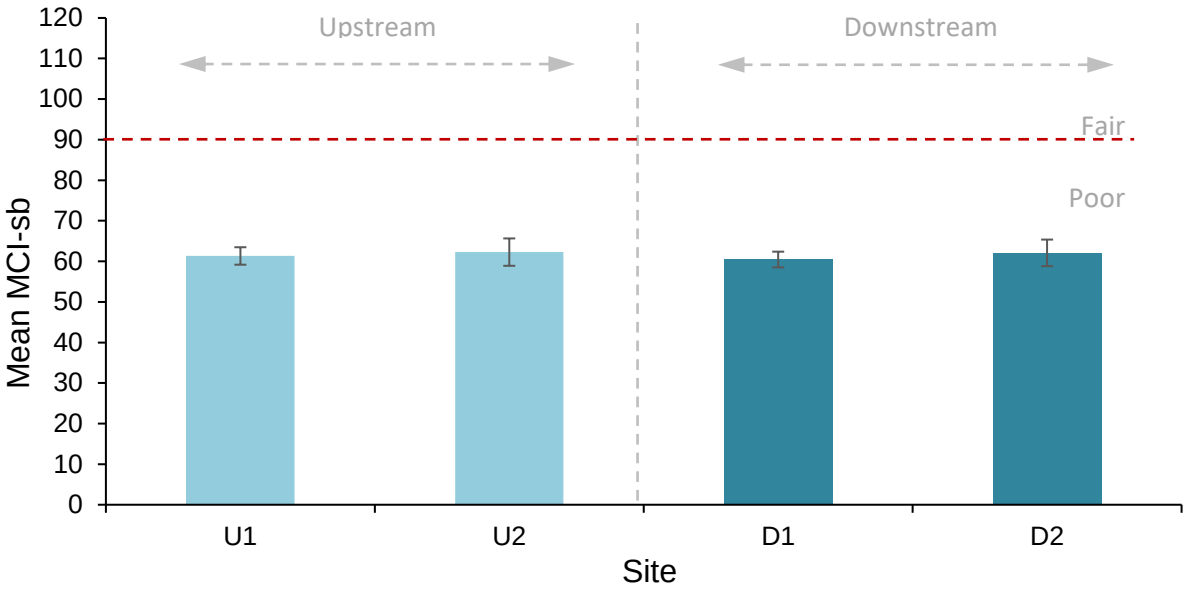



**Figure 17: Mean Macroinvertebrate Community Index soft-bottomed (MCI-sb) (± 1 S.E.).**

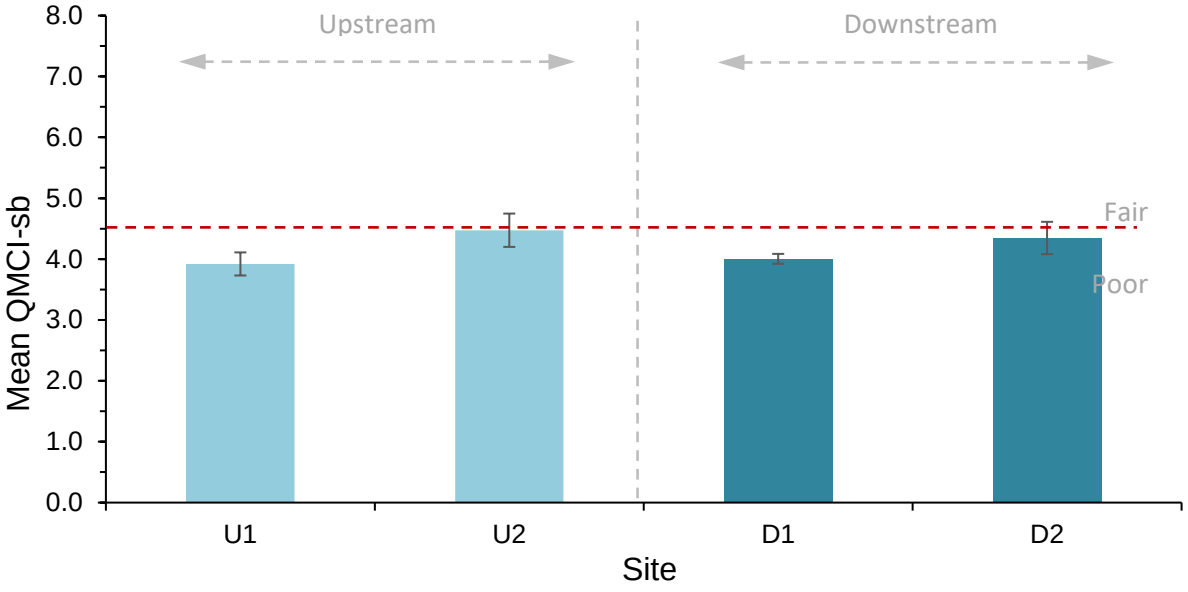



**Figure 18: Mean Quantitative Community Index soft-bottomed (MCI-sb) (± 1 S.E.).**

## 5.6 Fish Fauna

### 5.6.1 New Zealand Freshwater Fish Database

There are no database records on site or in the Hokio Stream in the reach adjacent to the site, however there are records from approximately 2 km downstream near the mouth and approximately 2 km upstream near the outlet from Lake Horowhenua. The record from near the river mouth is from a Massey University electric fishing survey in 2000 which found longfin eel (*Anguilla dieffenbachii*, At Risk – Declining Dunn et al., 2018), shortfin eel (*Anguilla australis*), common bully (*Gobiomorphus cotidianus*) and inanga (*Galaxias maculatus*, At Risk – Declining Dunn et al., 2018). Surveys from 2008-2013 in Hokio Stream just downstream from the lake outlet found shortfin and longfin eel, common bully (*Gobiomorphus cotidianus*), torrentfish (*Cheimarrichthys fosteri*, At Risk – Declining - Dunn

et al., 2018), perch (*Perca fluviatilis*) and goldfish (*Carassius auratus*). Records from Lake Horowhenua are dominated by introduced pest fish such as redfin perch, goldfish and koi carp (*Cyprinus carpio*). Native fish are also present in the lake, including smelt (*Retropinna retropinna*), common bully, yellow eye mullet (*Aldrichetta forsteri*), grey mullet (*Mugil cephalus*) and inanga.

Database records from lake tributaries contain a more diverse and sensitive assemblage of native fish species. These include banded kokopu (*Galaxias fasciatus*), giant kokopu (*Galaxias argenteus*, At Risk – Declining - Dunn et al., 2018), shortjaw kokopu (*Galaxias postvectis*, Threatened – Nationally Vulnerable Dunn et al., 2018), brown mudfish (*Neochanna apoda*, At Risk – Declining - Dunn et al., 2018), common bully, giant bully (*Gobiomorphus gobioides*, At Risk – Naturally Uncommon - Dunn et al., 2018), redfin bully (*Gobiomorphus huttoni*), koura (*Paranephrops planifrons*), longfin and shortfin eel.

### 5.6.2 Freshwater Fish Survey

A total of four native fish species were recorded during the trapping survey, these were; shortfin eel, longfin eel, inanga and common bully. There were no introduced fish species recorded). There were four shrimp (*Paratya curvirostris*) recorded at the downstream sites. Selected fish captured during the survey are shown in Figure 19.

The most abundant fish species recorded across the four sites were longfin eel (8 individuals) and shortfin eel (4 individuals) ( Table 8). Longfin eel were most abundant at the downstream site (7 individuals) than at the upstream site (1 individual).

**Table 8: Fish captured in Hokio Stream during the 2024 survey.**

| Common name | Scientific name | Count | Average Weight (g) | Average Length (cm) |
|---|---|---|---|---|
| Upstream | | | | |
| Longfin eel | *Anguilla dieffenbachii* | 1 | 370 | 49 |
| Shortfin eel | *Anguilla australis* | 2 | 220 | 46 |
| Common bully | *Gobiomorphus cotidianus* | 1 | | |
| Downstream | | | | |
| Longfin Eel | *Anguilla dieffenbachii* | *7* | 497 | 52 |
| Shortfin Eel | *Anguilla australis* | *2* | 240 | 45 |
| Elver | *Anguilla Spp.* | 2 | | |
| Inanga | *Galaxius maculatus* | 1 | | |
| Shrimp | *Paratya curvirostris* | 4 | | |

### 5.6.3 Fish Health

An external examination of the eyes, fins, opercula and gills was carried out on all eels captured during the survey. All fish had clear eyes and no evidence of fin erosion or shortening of the opercules was observed. The gills were difficult to examine closely due to the opercules however, no abnormalities were observed.

No external lesions or parasites were observed on any of the longfin or shortfin eels captured during the survey.



**Figure 19: Selected fish recorded in freshwater fish survey (longfin eel, shortfin eel, common bully and inanga, top to bottom).**

### 5.6.4 Environmental DNA

Environmental DNA (eDNA) sampling at two sites (U1 and D2) above and downstream of the Levin Landfill (refer to Figure 5 for site locations) provides an indication of species present in the waterway as shown in Table 9. Results of eDNA sampling indicated the presence of native species including longfin eel, shortfin eel and common bully present both up and downstream whereas banded kokopu were only detected at the downstream site and mullet were only detected at the upstream site. Our eDNA survey also indicated introduced fish species European perch (*Perca fluviatalis*) at both sites and goldfish (*Carassius auratus*) at the downstream site only.

**Table 9: Fish species detected in eDNA in Hokio Stream during the 2024 survey.**

| Common Name | Scientific Name | Upstream | Downstream |
|---|---|---|---|
| European perch | Perca fluviatilis | ✓ | ✓ |
| Common bully | Gobiomorphus cotidianus | ✓ | ✓ |
| Shortfin eel | Anguilla australis | ✓ | ✓ |
| Longfin eel | Anguilla dieffenbachii | ✓ | ✓ |
| Goldfish | Carassius auratus | ✗ | ✓ |
| Banded kokopu | Galaxias fasciatus | ✗ | ✓ |
| Mullets | Mugil | ✓ | ✗ |

## 5.7 Northern Drain

The Northern Drain was a straight man-made channel excavated to improve drainage of the paddocks to the north for agricultural use. The upper reach of the drain, adjacent to the site was choked with reed sweet grass (*Glyceria maxima*) and had no open water. The channel increases in width in the lower reaches, featuring some open water near its discharge into Hokio Stream. The drain is fed by groundwater and likely has high levels of leachate, reducing its suitability for some fish species.

# 6.0 Terrestrial and Wetland Ecological Values

## 6.1 Wetlands

Wetland 1 represented the highest value ecological feature on site due to the rarity (<10% remaining) and ecosystem functions of wetlands. It is also the only area on site containing prominent indigenous vegetation. When compared to wetland habitats within the vicinity of the site and the ED however, Wetland 1 is relatively small, with larger areas of riverine wetland present on the margins of Hokio Stream, Lake Horowhenua and in dune slack wetlands in the wider area. Wetland 1 is also modified, both by exotic vegetation (the standing dead canopy of poplars) and receives leachate via groundwater. The larger wetland habitats nearby provide open water habitat for threatened and at-risk aquatic avian species which Wetland 1 does not.

The current condition of Wetland 1 reflects former pressures exerted from exotic forestry, adjacent livestock farming and landfill activities. A history of contamination from nutrient loading and landfill leachate has limited habitat viability for native fish fauna and indigenous plant communities. The current sedgeland habitat, although predominantly native, lacks an established canopy cover of indigenous tree species expected for the ecosystem type. The

dieback of exotic trees within the habitat suggests contaminants are restricting the establishment of tree cover.

Added pressures such as hydrological variation from adjacent farm drains and exotic tree plantations as well as the introduction and spread of exotic plants and animals, further limits the ecological integrity of the habitat. Wetland 1 was therefore assessed as having 'Moderate' ecological value.

# 7.0 Freshwater Values

## 7.1 Hokio Stream

The Hokio Stream is an important waterway as it is the best and largest example of a dune slack outflow stream in the region (James and Joy 2009) and is the connection between Lake Horowhenua and the sea enabling the migration of diadromous species to and from the lake. The water quality is degraded by nutrient enrichment into Lake Horowhenua, though the aquatic and riparian habitat is largely intact. The stream supports both shortfin and long fin eel and a small number of other native fish species, with invertebrate communities featuring only tolerant taxa.

Our surveys found no evidence of current ecological effects of the leachate plume, with the high abundance of ammoniacal-nitrogen sensitive *Potamopyrgus* snails indicating leachate is not likely to be currently altering the Hokio Streams capacity to support aquatic fauna. The Hokio Stream is assessed as having 'High' ecological value.

## 7.2 Northern Drain

Northern Drain is a constructed waterway which drains wetland 1 and paddocks to the north of the site. In its upper reaches it is unlikely to support fish as it is lacks open water, being choked by exotic *Glyceria maxima*. Due to lack of fish habitat and dominance of exotic plant species the section of Northern Drain on site has been assigned a 'Low' overall ecological value.

**Table 10: Summary of ecological values following the EcIAG (Roper-Lindsay et al., 2018).**

| Feature | Representativeness | Rarity/distinctiveness | Diversity and pattern | Ecological context | Overall | Comment |
|---|---|---|---|---|---|---|
| ***Carex* dominated sedgeland swamp (Wetland 1)** | **Moderate.** | **High.** | **Moderate.** | **Low,** | **Moderate** | Contains components of characteristic vegetation (*Carex* sedgeland and indigenous shrubland) and habitat type is severely reduced (<10% indigenous cover remaining). Value reduced by the modifications of exotic vegetation (standing dead canopy of poplar and pine plantation and wattle at margins) and receives leachate. |
| **Plantation Pine** | **Very Low.** | **Very Low.** | **Low.** | **Low.** | **Low.** | Not representative of former vegetation, exotic, modified and disturbed seral vegetation with an exotic component. Provides limited habitat for native fauna at current stage |
| **Northern Drain** | **Low**. | **Low**. | **Low.** | **Low.** | **Low** | The Northern Drain is typical of an artificially constructed waterway for land conversion purposes and is not representative of historic waterways though it may have a role in providing connectivity through the Site and between watercourses. |
| **Hokio Stream** | **Moderate.** | **High** | **Low** | **High.** | **High** | Largest and best example of dune lake outflow in District, acts as a migration corridor for diadromous species moving between the sea and lake and provides habitat for At Risk fauna. Water quality is degraded reducing value for fish and benthic invertebrate communities. |
| **Indigenous fauna habitat** | | | | | | |
| **Avifauna** | **Low.** | **Low.** . | **Low.** | **Low.** | **Low** | The site provides habitat for common exotic and natives birds which is commonly available in the surrounding landscape. |

# 8.0 Assessment of Effects

## 8.1 Introduction

Ecological effects attributable to the construction of the groundwater intercept drain and associated infrastructure are vegetation clearance and disturbance due to earthworks, with operational effects primarily resulting from localised lowering of groundwater. These effects may be short term, medium term or long term (permanent) and have the potential to be cumulative in the way that they affect the existing environment.

Activities associated with the construction of the intercept drain to treat the leachate plume from the closed landfill will result in the following actual or potential effects:

- Partial drainage of existing wetland habitat (0.96 ha approximately).
- Disturbance / vegetation removal totalling 0.73 ha composed of
    - 0.36 ha of Wetland 1 and
    - 0.37 ha of pine plantation and exotic vegetation.
- Loss of Northern Drain (artificial) habitat (150 m)
- Creation of Wetland habitat (~1 ha)

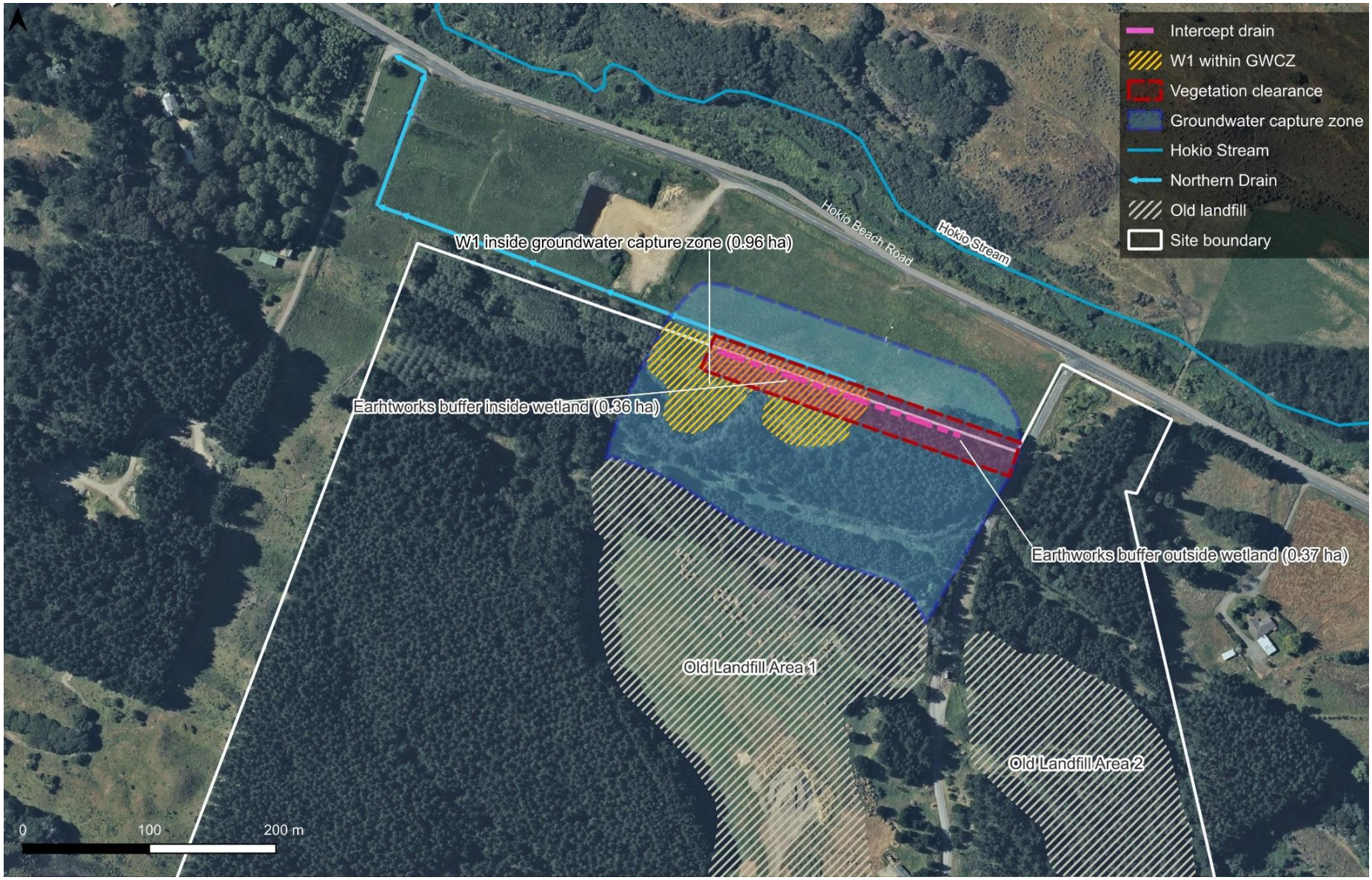



**Figure 20: Location of wetland loss resulting from groundwater capture.**

## 8.2 Effects on Wetlands

The proposed treatment operation could result in the partial drainage of Wetland 1 due to groundwater drawdown (0.96 ha approximately affected). The area within this groundwater capture zone is likely to be further affected by earthworks and vegetation clearance associated with construction of the Intercept Drain. The partial loss of Wetland 1 will result in a loss of highly modified swamp historically subject to drainage, land use pressures and contamination via groundwater leachate from the landfill. The margins of the Hokio Stream are predominantly riverine swamp habitat and Wetland 1 contributes a small isolated area of wetland within the catchment. Existing wetlands in the wider area are larger, more intact and more likely to support more diverse vegetation and native fauna communities.

The effects management hierarchy requires that effects on sensitive habitat and/or fauna be avoided if possible. Unavoidable removal of wetlands must be minimised or remediated in the first instance or offset or compensated for if that cannot be achieved. As wetland loss is in this case unavoidable, creation of ~1 ha of wetland habitat and additional buffer planting provides mitigation for part of the loss of this wetland.

## 8.3 Disturbance and Removal of Vegetation

During construction of the intercept drain an area of approximately 0.73 ha of vegetation can be expected to be removed or disturbed based on a buffer of 20 m to the south of the intercept drain and to the edge of the Northern Drain. This includes approximately 0.36ha of indigenous dominated *Carex* sedgeland wetland and 0.37 ha of exotic dominated pine plantation forestry. Disturbance and vegetation clearance associated with construction of the Intercept Drain in the pine plantation will have a 'Negligible' level of effect.

## 8.4 Effects on Northern Drain

Operation of the groundwater intercept drain is expected to result in drying of a 150 m section of the Northern Drain. This section lacks open water that could provide habitat for fish but water quality is affected by leachate that may limit some species.

## 8.5 Hokio Stream

Without mitigation, effects of leachate from Levin Landfill on Hokio Stream are likely to be High as the concentrations of ammoniacal-nitrogen are likely to exceed the tolerance of many macroinvertebrates and fish fauna. With mitigation of the intercept drain, the effects on Hokio Stream are expected to be 'Low'.

**Table 11: Magnitude and level of effects for the proposed activity before and after mitigation.**

| Activity | Effect | Ecological value | Magnitude of effect | Level of effect (no mitigation) | Proposed mitigation measures | Level of effect (with mitigation) |
|---|---|---|---|---|---|---|
| Lowering of groundwater level as a result of intercept drain extraction. | Loss of 0.96 ha of riverine swamp | Moderate | High | High | Creation of new wetland habitat and necessary enhancement of existing wetland habitat nearby. | Net gain |
| | Loss of 150m of Northern Drain | Low | Moderate | Low | None. | Low |
| Earthworks associated with Intercept drain construction | Disturbance to vegetation and habitat within wetland 1 | Moderate | Moderate | Moderate | Creation of new wetland habitat and necessary enhancement of existing wetland habitat nearby. | Net gain |
| | Disturbance to vegetation and habitat within plantation pine | Low | Moderate | Low | None. | Low |
| Vegetation removal surrounding construction footprint. | Loss of botanical values / habitat | Low | Low | Very Low | None | Negligible |
| Vegetation removal surrounding construction footprint. | Direct mortality to indigenous fauna | Low | Low | Very Low | Remove vegetation outside of the bird breeding season. | Negligible |
| | Direct mortality to indigenous fauna | Low | Low | Very Low | Remove vegetation outside of the bird breeding season. | Negligible |
| Leachate plume (no mitigation) | Hokio stream receives leachate | | high | | Intercept and treat leachate | Low |

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# APPENDIX A

## Raw Macroinvertebrate Data

| | MCI | MCI-sb | U1 A | U1 B | U1 C | U1 D | U2 A | U2 B | U2 C | U2 D | D1 A | D1 B | D1 C | D1 D | D2 A | D2 B | D2 C | D2 D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction sorted | | | 100 | | | | | | | | | | | | | | | |
| Ephemeroptera | | | | | | | | | | | | | | | | | | |
| *Acanthophlebia* | 7 | 9.6 | | | | | | | | | | | | | | | | |
| *Ameletopsis* | 10 | 10.0 | | | | | | | | | | | | | | | | |
| *Arachnocolus* | 8 | 8.1 | | | | | | | | | | | | | | | | |
| *Atalophlebioides* | 9 | 4.4 | | | | | | | | | | | | | | | | |
| *Austroclima* | 9 | 6.5 | | | | | | | | | | | | | | | | |
| *Austronella* | 7 | 4.7 | | | | | | | | | | | | | | | | |
| *Coloburiscus* | 9 | 8.1 | | | | | | | | | | | | | | | | |
| *Deleatidium* | 8 | 5.6 | | | | | | | | | | | | | | | | |
| *Ichthybotus* | 8 | 9.2 | | | | | | | | | | | | | | | | |
| *Isothraulus* | 8 | 7.1 | | | | | | | | | | | | | | | | |
| *Mauiulus* | 5 | 4.1 | | | | | | | | | | | | | | | | |
| *Neozephlebia* | 7 | 7.6 | | | | | | | | | | | | | | | | |
| *Nesameletus* | 9 | 8.6 | | | | | | | | | | | | | | | | |
| *Oniscigaster* | 10 | 5.1 | | | | | | | | | | | | | | | | |
| *Rallidens* | 9 | 3.9 | | | | | | | | | | | | | | | | |
| *Siphlaenigma* | 9 | | | | | | | | | | | | | | | | | |
| *Tepakia* | 8 | 7.6 | | | | | | | | | | | | | | | | |
| *Zephlebia* | 7 | 8.8 | | | | | | | | | | | | | | | | |
| Plecoptera | | | | | | | | | | | | | | | | | | |
| *Acroperla* | 5 | 5.1 | | | | | | | | | | | | | | | | |
| *Austroperla* | 9 | 8.4 | | | | | | | | | | | | | | | | |
| *Cristaperla* | 8 | | | | | | | | | | | | | | | | | |
| *Megaleptoperla* | 9 | 7.3 | | | | | | | | | | | | | | | | |
| *Nesoperla* | 5 | 5.7 | | | | | | | | | | | | | | | | |
| Notonemouridae indet | 8 | 8.0 | | | | | | | | | | | | | | | | |
| *Spaniocerca* | 8 | 8.8 | | | | | | | | | | | | | | | | |
| *Spaniocercoides* | 8 | | | | | | | | | | | | | | | | | |
| *Stenoperla* | 10 | 9.1 | | | | | | | | | | | | | | | | |
| *Taraperla* | 7 | 8.3 | | | | | | | | | | | | | | | | |
| *Zelandobius* | 5 | 7.4 | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Zelandoperla* | 10 | 8.9 | | | | | | | | | | |
| Trichoptera | | | | | | | | | | | | |
| *Alloecentrella* | 9 | | | | | | | | | | | |
| *Aoteapsyche* | 4 | 6.0 | | | | | | | | | | |
| *Beraeoptera* | 8 | 7.0 | | | | | | | | | | |
| *Confluens* | 5 | 7.2 | | | | | | | | | | |
| *Costachorema* | 7 | 7.2 | | | | | | | | | | |
| *Cryptobiosella* | 9 | | | | | | | | | | | |
| *Diplectrona* | 9 | | | | | | | | | | | |
| *Ecnomina* | 8 | 9.6 | | | | | | | | | | |
| *Edpercivalia* | 9 | 6.3 | | | | | | | | | | |
| *Helicopsyche* | 10 | 8.6 | | | | | | | | | | |
| *Hudsonema* | 6 | 6.5 | | | | | | | | | | |
| *Hydrobiosella* | 9 | 7.6 | | | | | | | | | | |
| *Hydrobiosis* | 5 | 6.7 | | | | | | | | | | |
| *Hydrochorema* | 9 | | | | | | | | | | | |
| *Kokiria* | 9 | | | | | | | | | | | |
| *Neurochorema* | 6 | 6.0 | | | | | | | | | | |
| *Oecetis* | 6 | 6.8 | | | | | | | | | | |
| *Oeconesidae* | 9 | 6.4 | | | | | | | | | | |
| *Olinga* | 9 | 7.9 | | | | | | | | | | |
| *Orthopsyche* | 9 | 7.5 | | | | | | | | | | |
| *Oxyethira* | 2 | 1.2 | | | | | | | | | | |
| *Paroxyethira* | 2 | 3.7 | 16 | 10 | 44 | 24 | 1 | | 2 | 2 | | 4 |
| *Philorheithrus* | 8 | 5.3 | | | | | | | | | | |
| *Plectrocnemia* | 8 | 6.6 | | | | | | | | | | |
| *Polyplectropus* | 8 | 8.1 | | | | | | | | | | |
| *Psilochorema* | 8 | 7.8 | | | | | | | | | | |
| *Pycnocentrella* | 9 | | | | | | | | | | | |
| *Pycnocentria* | 7 | 6.8 | | | | | | | | | | |
| *Pycnocentrodes* | 5 | 3.8 | | | | | | | | | | |
| *Tiphobiosis* | 6 | 9.3 | | | | | | | | | | |
| *Triplectides* | 5 | 5.7 | | | | | | | | | | |
| *Triplectidina* | 5 | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Zelandoptila* | 8 | 7.0 | | | | | | | | | | | | | | | | |
| *Zelolessica* | 10 | 6.5 | | | | | | | | | | | | | | | | |
| Odonata | | | | | | | | | | | | | | | | | | |
| Anisoptera | 5 | 6.0 | | | | | | | | | | | | | | | | |
| *Austrolestes* | 6 | 0.7 | | | 2 | | | | | | 1 | | | | | | | |
| *Ischnura* | 6 | 3.1 | | | | | | | | | | | | | | | | |
| *Xanthocnemis* | 5 | 1.2 | 11 | 12 | 15 | 9 | 11 | 12 | 2 | 2 | 11 | 10 | 12 | 11 | 16 | 5 | 9 | 1 |
| *Aeshna* | 5 | 1.4 | | | | | | | | | | | | | | | | |
| *Antipodochlora* | 6 | 6.3 | | | | | | | | | | | | | | | | |
| *Hemicordulia* | 5 | 0.4 | 1 | | | | | | | | | | | | | | | |
| *Hemianax* | | 1.1 | | | | | | | | | | | | | | | | |
| *Procordulia* | 6 | 3.8 | | | | | | | | | | | | | | | | |
| *Uropetala* | 5 | 0.4 | | | | | | | | | | | | | | | | |
| Hemiptera | | | | | | | | | | | | | | | | | | |
| *Anisops* | 5 | 2.2 | | | | | | | | | | | | | | | | |
| *Diaprepocoris* | 5 | 4.7 | 1 | 1 | | | | | | | | | | | | | | |
| *Microvelia* | 5 | 4.6 | 1 | 4 | 2 | 4 | 1 | | | | | | 2 | 1 | | | | |
| Saldidae | 5 | 3.9 | | | | | | | | | | | | | | | | |
| *Sigara* | 5 | 2.4 | | 1 | 2 | 3 | 1 | 1 | 1 | | | | | | | | 1 | |
| Megaloptera | | | | | | | | | | | | | | | | | | |
| *Archichauliodes* | 7 | 7.3 | | | | | | | | | | | | | | | | |
| Mecoptera | | | | | | | | | | | | | | | | | | |
| *Nannochorista* | 7 | | | | | | | | | | | | | | | | | |
| Neuroptera | | | | | | | | | | | | | | | | | | |
| *Kempynus* | 5 | | | | | | | | | | | | | | | | | |
| Coleoptera | | | | | | | | | | | | | | | | | | |
| *Antiporus* | 5 | 3.5 | | | | | | | | | | | | | | | | |
| *Berosus* | 5 | 8.0 | | | | | | | | | | | | | | | | |
| *Copelatus* | 5 | 3.7 | | | | | | | | | | | | | | | | |
| Dytiscidae | 5 | 0.4 | 1 | | 3 | | | | | | | | | | | | | |
| Elmidae | 6 | 7.2 | | | | | | | | | | | | | | | | |
| Enochrus | 5 | 2.6 | | | | | | | 2 | | | | | | | | | |
| Hydraenidae | 8 | 6.7 | | | | | | | | | | | | | | | | |
| Hydrophilidae | 5 | 8.0 | | | | | | 1 | | | | | | | 1 | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Liodessus* | 5 | 4.9 | 1 | 4 | | | | | | | | | | | | |
| *Onychohydrus* | 5 | 8.0 | | | | | | | | | | | | | | |
| Ptilodactylidae | 8 | 7.1 | | | | | | | | | | | | | | |
| *Rhantus* | 5 | 1.0 | | | | | | | | | | | 1 | | | |
| Scirtidae | 8 | 6.4 | | | | | | | | | | | | | | |
| Staphylinidae | 5 | 6.2 | | 1 | | | | | | 1 | | | | | 1 | 2 |
| Diptera | | | | | | | | | | | | | | | | |
| Anthomyiidae | 3 | 6.0 | | | | | | | | | | | | | | |
| *Aphrophila* | 5 | 5.6 | | | | | | | | | | | | | | |
| *Austrosimulium* | 3 | 3.9 | | | | | | | | | | | | | | |
| Blephariceridae | 7 | | | | | | | | | | | | | | | |
| Ceratopogonidae | 3 | 6.2 | | | | | | | | | | | | | | |
| Chironomidae | 2 | 3.8 | | | | | | | | | | | | | | |
| *Chironomus* | 1 | 3.4 | 2 | | 1 | | | | | | | | 1 | | 1 | |
| *Corynoneura* | 2 | 1.7 | 2 | | 13 | 2 | | | | | | | | | | |
| Culicidae | 3 | 1.2 | | | | | | | | | | | | | | |
| Dolichopididae | 3 | 8.6 | | | | | | | | | | | | | | |
| Empididae | 3 | 5.4 | | | 1 | | | | | | 1 | | | | | |
| Ephydridae | 4 | 1.4 | | | | | | | | | | | 1 | 1 | | |
| *Eriopterini* | 9 | 7.5 | | | | | | | | | | | | | | |
| *Harrisius* | 6 | 4.7 | | | | | | | | | | | | | | |
| Hexatomini | 5 | 6.7 | | | | | | | | | | | | | | |
| Limnophora | 3 | 4.5 | | | | | | | | | | | | | | |
| *Limonia* | 6 | 6.3 | | | | | | | | | | | | | | |
| *Lobodiamesa* | 5 | 7.7 | | | | | | | | | | | | | | |
| *Maoridiamesa* | 3 | 4.9 | | | | | | | | | | | | | | |
| *Mischoderus* | 4 | 5.9 | | | | | | | | | | | | | | |
| *Molophilus* | 5 | 6.3 | | | | | | | | | | | | | | |
| Muscidae | 3 | 1.6 | | | | | | | | | | | | | | |
| *Nothodixa* | 4 | 9.3 | | | | | | | | | | | | | | |
| Orthocladiinae | 2 | 3.2 | 4 | 3 | 18 | 16 | 1 | | | 1 | | 1 | | 1 | | 2 |
| *Paradixa* | 4 | 8.5 | | | | | | | | | | | | | | |
| *Paralimnophila* | 6 | 7.4 | | | | | | | | | | | 1 | | | |
| *Paucispinigera* | 6 | 7.7 | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pelecorhynchidae | 9 | | | | | | | | | | | | | | | | | | |
| Podonominae | 8 | 6.4 | | | | | | | | | | | | | | | | | |
| *Polypedilum* | 3 | 8.0 | | | | | | | | | | | | | | | | | |
| Psychodidae | 1 | 6.1 | | | | | 1 | 1 | | | | | | 1 | 1 | | | | |
| Sciomyzidae | 3 | 3.0 | | | | | | | | | | | | | | | | | |
| Stratiomyidae | 5 | 4.2 | | | | | | | | | | | | | | | | | |
| Syrphidae | 1 | 1.6 | | | | | | | | | | | | | | | | | |
| Tabanidae | 3 | 6.8 | | | | | | | | | | | | | | | | | |
| Tanypodinae | 5 | 6.5 | 1 | | | | | | | | | | | | | | | | |
| Tanytarsini | 3 | 4.5 | | | | | | | | | | | | | | | | | |
| Thaumaleidae | 9 | 8.8 | | | | | | | | | | | | | | | | | |
| Tipulidae | 5 | 3.4 | | | | | | | | | | | | | | | | | |
| *Zelandotipula* | 6 | 3.6 | 2 | | | | | | | | | | | | | | | | |
| Lepidoptera | | | | | | | | | | | | | | | | | | | |
| *Hygraula* | 4 | 1.3 | 1 | | | | | | | | | | | | | | | | |
| Collembola | | | | | | | | | | | | | | | | | | | |
| Collembola | 6 | 5.3 | 8 | 9 | 6 | 10 | 2 | 3 | 4 | | 2 | 2 | 3 | 1 | 7 | 2 | 1 | 2 | |
| Crustacea | | | | | | | | | | | | | | | | | | | |
| Amphipoda | 5 | 5.5 | | | | | | | | | | | | | | | | | |
| Cladocera | 5 | 0.7 | 117 | 395 | 266 | 340 | 12 | 6 | 21 | 27 | 79 | 84 | 189 | 81 | 193 | 107 | 120 | 143 | |
| Copepoda | 5 | 2.4 | 86 | 48 | 332 | 956 | 127 | 195 | 29 | 65 | 66 | 32 | 51 | 33 | 3 | 12 | 17 | 10 | |
| *Cruregens* | 5 | 4.9 | | | | | | | | | | | | | | | | | |
| *Halicarcinus* | | 5.1 | | | | | | | | | | | | | | | | | |
| *Helice* | | 6.6 | | | | | | | | | | | | | | | | | |
| Isopoda | 5 | 4.5 | | | | | | 2 | | 1 | 1 | | | | | | | | |
| Mysidae | | 6.4 | | | | | | | | | | | | | | | | | |
| Ostracoda | 3 | 1.9 | 1 | 11 | 32 | 11 | | | 1 | | 1 | | | | 6 | 14 | 7 | | |
| *Paracalliope* | 5 | 5.5 | 1272 | 1052 | 1034 | 1101 | 2072 | 680 | 1620 | 1264 | 804 | 583 | 840 | 612 | 1209 | 908 | 1424 | 1136 | |
| *Paraleptamphopus* | 5 | 5.5 | | | | | | | | | | | | | | | | | |
| *Paranephrops* | 5 | 8.4 | | | | | | | | | | | | | | | | | |
| *Paranthura* | 5 | 4.5 | | | | | | | | | | | | | | | | | |
| *Paratya* | 5 | 3.6 | | | | | | | | | | | | | | | | | |
| *Phreatogammarus* | 5 | 5.5 | | | | | | | | | | | | | | | | | |
| Talitridae | 5 | 5.5 | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tanaidacea | 4 | 6.8 | | | | | | | | | | | | | | | | |
| Tardigrada | | | | | | | | | | | | | | | | | | |
| Tardigrada | | 4.5 | | | | | | | | | | | | | | | | |
| Acarina | | | | | | | | | | | | | | | | | | |
| Acarina | 5 | 5.2 | 28 | 44 | 54 | 35 | 53 | 77 | 25 | 37 | 11 | 13 | 22 | 9 | 20 | 28 | 36 | 24 |
| Arachnida | | | | | | | | | | | | | | | | | | |
| *Dolomedes* | 5 | 6.2 | 1 | | | 1 | | | | 1 | | | | | | | | 1 |
| Mollusca | | | | | | | | | | | | | | | | | | |
| *Ferrissia* | 3 | 2.4 | | | | | | | | | | | | | | | | |
| *Glyptophysa* | 5 | 0.3 | | | | | | | | | | | | | | | | |
| *Gyraulus* | 3 | 1.7 | | | | | | | | | | | | | | | | 2 |
| *Hyridella* | 3 | 6.7 | | | | | | | | | | | | | | | | |
| *Latia* | 3 | 6.1 | | | | | | | | | | | | | | | | |
| Lymnaeidae | 3 | 1.2 | | | | | | | | | | | | | | | | |
| *Melanopsis* | 3 | 1.9 | | | | | | | | | | | | | | | | |
| *Physella (Physa)* | 3 | 0.1 | 64 | 81 | 79 | 33 | 19 | 41 | 11 | 22 | 1 | 12 | 5 | 6 | 4 | 3 | 1 | 4 |
| *Potamopyrgus* | 4 | 2.1 | 15 | 52 | 22 | 2 | 158 | 513 | 608 | 257 | 285 | 227 | 389 | 341 | 884 | 483 | 132 | 82 |
| Sphaeriidae | 3 | 2.9 | | 1 | | | | | | | | | | | | | | |
| Other | | | | | | | | | | | | | | | | | | |
| Oligochaeta | 1 | 3.8 | 5 | 3 | 2 | 4 | 1 | 20 | 4 | 3 | | 1 | 1 | | 7 | 6 | 2 | 4 |
| Hirudinea | 3 | 1.2 | | | | | | | | | | | | | | | | |
| Polychaeta | 3 | 6.7 | | | | | | | | | | | | | | | | |
| Platyhelminthes | 3 | 0.9 | | | | | | | | | | | | | | | | |
| Rhabdocoela | 3 | 0.9 | | | | | | | | | | | | | | | | |
| Nematoda | 3 | 3.1 | | 1 | | | | | | | | | | | 1 | | | 1 |
| Nemertea | 3 | 1.8 | | | | | | | | | | | | | | | | |
| Nematomorpha | 3 | 4.3 | | | | | | | | | | | | | | | | |
| Coelenterata | | | | | | | | | | | | | | | | | | |
| *Hydra* | 3 | 1.6 | 126 | 19 | 5 | | 3 | 19 | 16 | 10 | 2 | 4 | 4 | 11 | 1 | 2 | | |
| Bryozoa | | 4.0 | | | | | | | | | | | | | | | | |

# APPENDIX B

## Raw eDNA Data

| Scientific Name | Rank | CommonName | Group | 550372 | 544862 |
|---|---|---|---|---|---|
| Daphnia galeata | species | Water flea | Crustaceans | 21255 | 9334 |
| Perca fluviatilis | species | European perch | Fish | 10057 | 2331 |
| Potamothrix bavaricus | species | Aquatic oligochaete worm | Worms | 8 | 3666 |
| Gobiomorphus cotidianus | species | Common bully; tīpokopoko; toitoi | Fish | 1484 | 1392 |
| Anguilla australis | species | Shortfin eel; tuna; hao; aopori; hikumutu | Fish | 1054 | 1666 |
| Cyclotella cryptica | species | Brackish-water diatom | Diatoms | 14 | 2185 |
| Acanthocyclops americanus | species | Copepod | Crustaceans | 1831 | 119 |
| Anguilla dieffenbachii | species | Longfin eel; tuna; kūwharuwharu; reherehe; kirirua | Fish | 93 | 1256 |
| Dama dama | species | Fallow deer | Mammals | 0 | 1094 |
| Chaetogaster diastrophus | species | Oligochaete worm | Worms | 0 | 870 |
| Bothrioneurum vejdovskyanum | species | Worm | Worms | 0 | 749 |
| Henlea perpusilla | species | Worm | Worms | 0 | 645 |
| Carassius auratus | species | Goldfish; morihana | Fish | 0 | 634 |
| Echyridella menziesii | species | Freshwater mussel; kākahi; kāeo; torewai | Molluscs | 607 | 0 |
| Eukerria saltensis | species | Worm | Worms | 0 | 216 |
| Aulodrilus pluriseta | species | Aquatic oligochaete worm | Worms | 0 | 209 |
| Lumbriculus variegatus | species | Blackworm | Worms | 0 | 206 |
| Bos taurus | species | Cattle; kau | Mammals | 91 | 80 |
| Branchiura sowerbyi | species | Oligochaete worm | Worms | 5 | 147 |
| Cochliopodium kieliense | species | Amoeba | Amoebae | 0 | 114 |
| Hydra vulgaris | species | Hydra | Cnidarians | 25 | 81 |
| Paraphysomonas sp. | species | Golden-brown alga | Heterokont algae | 72 | 0 |
| Lumbricus rubellus | species | Red earthworm | Worms | 0 | 66 |
| Synchaeta pectinata | species | | Rotifers | 61 | 0 |
| uncultured Pythium | species | | Oomycetes | 14 | 43 |
| Acanthocyclops robustus | species | Copepod | Crustaceans | 44 | 8 |
| Galaxias fasciatus | species | Banded kokopu; kokōpu | Fish | 0 | 43 |
| Chamaedrilus aff. glandulosus B SM-2014 | species | Worm | Worms | 0 | 43 |
| Trichosurus vulpecula | species | Common brushtail possum; paihamu; paihama | Mammals | 0 | 38 |
| Rhopalosiphum padi | species | Bird cherry-oat aphid | Insects | 0 | 36 |
| Chaetogaster diaphanus | species | Oligochaete worm | Worms | 0 | 36 |
| Nais christinae | species | Sludgeworm | Worms | 0 | 33 |
| Cygnus atratus | species | Black swan; wāna; wani | Birds | 0 | 27 |
| Limnodrilus hoffmeisteri | species | Redworm | Worms | 0 | 20 |
| Chaetogaster sp. 10 JM-2023 | species | Worm | Worms | 0 | 20 |
| Apoikiospumella mondseeiensis | species | Golden alga | Heterokont algae | 16 | 0 |
| Potamopyrgus antipodarum | species | Mud Snail | Molluscs | 0 | 15 |

| | | | | | |
|---|---|---|---|---|---|
| Physella acuta | species | Left handed sinistral snail | Molluscs | 0 | 10 |
| Daphnia pulex or pulicaria | species | Water flea | Crustaceans | 0 | 9 |
| Tubifex tubifex | species | Sludge worm | Worms | 0 | 7 |
| Cervus elaphus | species | Red Deer; tia | Mammals | 0 | 7 |
| Ilyodrilus templetoni | species | Aquatic worm | Worms | 0 | 6 |
| Cyclostephanos | genus | Diatom | Diatoms | 3752 | 248 |
| Daphnia | genus | Water flea | Crustaceans | 2843 | 543 |
| Ilyodrilus | genus | Worm | Worms | 9 | 414 |
| Bothrioneurum | genus | Worm | Worms | 0 | 376 |
| Gobiomorphus | genus | Bullies | Fish | 154 | 144 |
| Anguilla | genus | Eels | Fish | 0 | 132 |
| Potamopyrgus | genus | Mud snails | Molluscs | 10 | 87 |
| Gobiomorphus cotidianus/basalis/dinae | genus | Common/Cran/Dinahs bully; titikura | Fish | 0 | 93 |
| Stephanodiscus | genus | Diatom | Diatoms | 84 | 8 |
| Cochliopodium | genus | Amoeba | Amoebae | 0 | 73 |
| Paracalliope | genus | Amphipod crustacean | Crustaceans | 0 | 41 |
| Nitzschia | genus | Pennate diatom | Diatoms | 0 | 36 |
| Chamaedrilus | genus | Worm | Worms | 0 | 24 |
| Chironomus | genus | Midges | Insects | 0 | 21 |
| Mugil | genus | Mullets | Fish | 20 | 0 |
| Girardia | genus | | Flatworms | 0 | 16 |
| Philodina | genus | Rotifer | Rotifers | 0 | 7 |
| Nais | genus | Sludgeworm | Worms | 0 | 7 |
| Sitobion | genus | | Insects | 6 | 0 |
| Plumatella | genus | Plumatella | Bryozoans | 0 | 5 |
| Limnophyes | genus | Non-biting midge | Insects | 0 | 5 |
| Anserinae | subfamily | Swans and geese | Birds | 451 | 586 |
| Tubificinae | subfamily | | Worms | 0 | 101 |
| Aphidinae | subfamily | | Insects | 0 | 35 |
| Cyclopidae | family | | Crustaceans | 14 | 0 |
| Chaetonotidae | family | | Other | 0 | 5 |
| root | no rank | Unidentified | Other | 7624 | 8963 |
| Metazoa | kingdom | Metazoans | Other | 7271 | 1256 |
| Rotifera | phylum | Rotifers | Other | 2161 | 114 |
| Actinopteri | class | | Other | 0 | 1520 |
| Chordata | phylum | Chordates | Other | 1105 | 191 |
| Gobiiformes | order | Gobies and sleepers | Fish | 190 | 199 |
| Crustacea | subphylum | Crustaceans | Other | 0 | 111 |
| Ploima | order | | Rotifers | 24 | 0 |
| Arcellinida | order | | Amoebae | 0 | 15 |
| Discosea | phylum | | Amoebae | 0 | 12 |
| unclassified Saccamoeba | no rank | | Amoebae | 0 | 12 |
| Sarcoptiformes | order | | Mites and ticks | 0 | 8 |