Ecology of the proposed development at: 25 Ashley Gorge Road

Prepared for:

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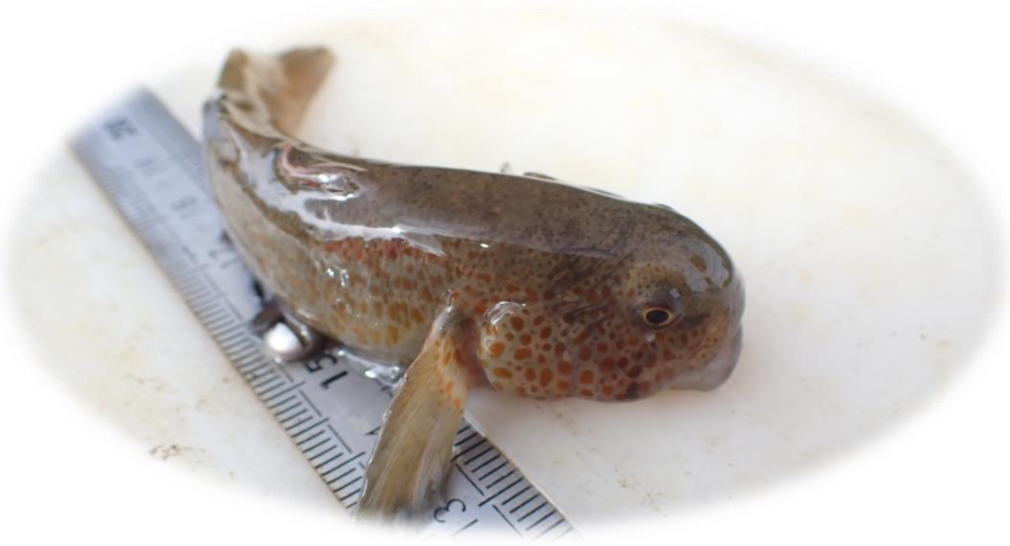

The native upland bully from Unnamed Stream, 25 Ashley Gorge Road

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Contents

1 Executive Summary

A block of rural land (c. 49 ha) is proposed for re-zoning from GRUZ to LLRZ Land Use change under the proposed Waimakariri District Plan.

Aquatic Ecology Limited was commissioned to undertake an ecological survey of the land block and identify ecological values in the two waterways flowing through the area, and terrestrial ecological values in respect to lizards and birdlife.

Of the two waterways (Unnamed Stream flowing past the old homestead), and Frahams Creek, it was Frahams Creek which provided better physical habitat quality. The relative difference in habitat quality was reflected in higher ecological stream health scores in Frahams Creek, but only reached a 'fair' standard based on national standards. The fish fauna was composed of two native species, the shortfin eel, and upland bully, both unthreatened species. Riparian plantings will benefit instream habitats values in a number of ways, not limited to bank stability, and shading, but with widths equal or greater than 10 m, increasing biodiversity around and within waterways. Due to the proposed large proportion of pervious soils and the use of detention basins to attenuate storm volume, detrimental effects of storm flows is not considered to be detrimental to aquatic ecology.

A total of 21 bird species were identified across the proposed development area, but of which only nine were native. The conservation status of all native birds was "not threatened". Bird abundance was heavily dominated by exotic birds. With the development of the proposed stormwater retention basins, and riparian planting around waterbodies and waterways, it is probable that the diversity and abundance of native birds will increase.

The proposed development area contained a population of native lizards (skinks), which triggers some requirements under the Wildlife Act, but which are not considered onerous. Some of the lizards will be required to be translocated a short distance to intended stormwater management areas. At those locations, it is recommended that some lizard habitats be constructed under the supervision of a herpetologist.

2 Proposal

It is proposed that a block of rural land (c. 49 ha), north of the township of Oxford, at 25 Ashley Gorge Road, be subject to rezoning (of the proposed Waimakariri District Plan) from GRUZ to LLRZ.

A residential density based on a minimum lot size of 3010m^2 and an average lot size of 5062m$^{2.}$ is proposed. The proposed Outline Development Plan (ODP) (November 2023), is provided in App. I.

3 Objectives

The following objectives will be satisfied by this report:

- Assess whether there are any significant aquatic or terrestrial ecosystems in the Proposed Development Area (PDA).
- Assess any adverse impacts on these ecosystems by the subdivision and development of PDA.
- Report on opportunities for restoration of these ecosystems, or mitigation of adverse impacts.

4 Waterways and physical habitat

Two waterways are present within the proposed development area (App. II, Figs. i-iii), hereby known as "Unnamed Stream" and "Frahams Creek" (Fig. 1). Both waterways had continuous flowing surface water during a field survey on 26/09/2023 and flow through culverts under the Ashley Gorge Road, on the east boundary of the proposed development area. The waterways then combine approximately 450 m downstream, ultimately becoming part of the headwater network of the Cust River.

4.1.1 Unnamed Stream physical habitat

Upstream of the northern boundary of the PDA, the Unnamed Stream was not fenced, and its banks appeared stock-eroded. The reach within the PDA, between the PDA boundary, to the homestead, was unfenced and subject to drain clearance at the time (App. II, Fig. iv), presumably for waterway clearance purposes. Signs of bed and riparian excavation were present, and most of the vegetation on the true left bank had been removed. Mature exotic vegetation was present in the true right bank riparian zone. No riparian fencing was observed on either bank. Substrate in this reach fluctuated between firm and soft clay, with no macrophytic growth. Waterway hydraulics consisted of a combination of run and pool habitats. The stock fence may have been temporarily removed for excavator access, but the farm was largely destocked at the time of site visit.

The reach downstream of the homestead was fenced on both banks at the time of survey, with a riparian buffer width of approximately 1-2 m on each bank (App. II, Fig. v). Riparian vegetation consisted of exotic species such as tall fescue, creeping buttercup and gorse. Both banks were actively eroded. Hydraulic habitat in this reach was composed of runs, riffles and pools. Substrate was dominated by soft sediment, with patchy areas of embedded gravel. Macrophytic growth was noted in this reach, with recorded species being floating sweetgrass (*Glyceria fluitans*), starwort (*Callitriche stagnalis*) and watercress (*Nasturtium officinale*).

4.1.2 Frahams Creek physical habitat

The upper reaches of the Frahams Creek (Sites 3 & 4 *in* Fig. 1) were highly incised, with a firm clay bed throughout (App. II, Figs. vi, vii). No macrophytes or stony substrate were present in this section of waterway. Aquatic habitats were dominated by cascade, riffle, run and pool forms. Riparian zones in this section were vegetated with mature exotic tree, shrub and herb species. Fences were present on both sides of the waterway, preventing stock access to surface water.

The lower reach of this waterway (Site 5 *in* Fig. 1) had significant lengths of shallow riffle habitat with cobble substrate (App. II, Fig. viii). Only the true left (north) bank of this section was fenced to prevent stock access. Riparian vegetation in the lower reach of the Frahams Creek consisted of exotic herbs and pasture grass, with sparse stands of exotic trees.

5 Field Methods

A drone reconnaissance survey of the land within the PDA was conducted on 15/08/2023. The purpose of this survey was to assess the area for potential wetland areas or surface water bodies. Following this, a field survey of the freshwater habitats and their ecology was conducted on 26/09/2023, and a bird survey on the 29/9/2023. As the weather warmed into late spring and summer, a lizard habitat assessment was conducted on 20/11/23, with a lizard distribution survey on the 21/01/24. The sections below describe the methods used during these surveys.

5.1.1 Assessment of habitat quality

On the 26/9/2023, the quality of aquatic habitat facilitated by the waterways within the proposed development area was assessed at four locations, Sites 1, 2, 3 and 5 (Fig. 1). Habitat assessments were conducted using Rapid Habitat Assessment (RHA) protocols (Clapcott 2015). An RHA grades ten faunal habitat requirements and produces a score out of 100 for each assessed site.

5.1.2 Macroinvertebrate sampling

On the 26/9/2023, samples of the macroinvertebrate community were collected from each of the two waterways, from both soft-bottomed and hard-bottomed locations.

The Unnamed Stream sample (Site 2, Fig. 1) was collected using the sampling protocol for soft-bottom streams (C2 *in* Stark *et al.* 2001). This involved jabbing a standard 0.3 m wide, 500-micron kicknet along the overhanging vegetation on the bank margin, and macrophytes, for 1 m, then sweeping the kicknet through the disturbed section twice. This process was repeated 10 times to create a one-pottle composite sample (total sample area = 0.3 m x 1 m x 10 m = 3 m^2).

The Frahams Creek sample (Site 5, Fig. 1) was collected using the sampling protocol for hard-bottom streams (C1 *in* Stark *et al.* 2001). Using the same kicknet, seven subsamples were taken by disturbing the surface layer of the substrate with the sampler's foot, for a distance of 30 cm ahead of the kicknet. This resulted in a total area of 0.63 m^2 (sample area = 0.09 m^2 × 7).

Following collection, both samples were field-preserved using denatured ethanol (90%), and transported to the AEL Christchurch laboratory for analysis. Macroinvertebrate analysis was conducted using the 'first 100' method, in which the first 100 individuals are identified and counted, followed by a scan of the remaining sample for any rare taxa. Invertebrates were identified using the standard identification keys (Chapman *et al.* 2011; Winterbourn 1973; Winterbourn *et al.* 2006).

5.1.3 Fish Sampling

Also, on the 26/9/2023, to assess the fish communities, electric fishing was conducted, under AEL's electric fishing permits (MPI Permit 749, DOC 70754-FAU and under authority from NCFGC). Electric fishing serves to briefly (approx. 3 seconds) render fish unconscious to facilitate their capture in nets for identification.

Two reaches of the Unnamed Stream and three reaches of the Frahams Creek were fished during the field survey. A Kainga EFM300 electric fishing machine was used for this survey, at an operating voltage of 200 V. D.C. This voltage provided a sufficient electrical field size to prevent fish escapement. The total sample time (i.e., the total time that the machine was actively electrifying the water) for these combined reaches was 20 minutes (Table 1). All captured fish were anaesthetised, identified, measured, and upon recovery from anaesthesia, released back into their resident habitats.

Overall conditions were adequate for electric fishing, with moderate surface water visibility but ideal electrical conductivity.

5.1.4 Lizard Surveys

On 20/11/2023, an initial desktop survey of habitat within the project area was undertaken by herpetologist Chris McClure to ascertain whether potential lizard habitat was present. This assessment was conducted using high resolution aerial imagery to determine the quality of habitat within the proposed project footprint. A review of the Department of Conservations BioWeb herpetofauna database (also referred to as the atlas of the amphibians and reptiles of New Zealand) was also completed. This atlas provides information on any locally occurring species descriptions, habitat information, images, and distribution maps.

In addition, on the 26/11/2023, a site visit was undertaken, manual and visual surveys (systematic search) were undertaken (DOC WAA Permit – 93529-FAU) while weather conditions were optimal (i.e., clear skies, light westerly winds, and air temperature c. 18°C). The survey consisted of visually identifying any potential habitat along fence lines, streams and around buildings. All areas identified as suitable habitat were visually searched for basking animals and manual searches were undertaken through any observed refugia (loose debris, wood, bricks, concrete, roofing iron).

Due to the finding that some lizard habitat was present, a field survey for lizard distribution was conducted on the 21/01/2024 using several conventional herpetological methods. The methods of the field survey are outlined in the stand-alone report provided in App. B.

5.1.5 Bird survey

On the 29/9/2023, conditions were suitable for the bird survey, with fine weather, with only light winds and no rain.

Along the two waterways, the nesting environment (i.e., trees and ground) was surveyed for the presence of nests, eggs, and nesting birds (App. II, Fig. i). Every prospective nest site was examined.

The remaining areas of the property were surveyed using the Line Transect sampling technique (Gregory *et al.* 2004). This technique involves the observer travelling along a predetermined line (App. III, Fig. i) and recording the number of birds, nests of other objects of relevance (droppings, footprints or burrows). Counting all birds and relevant objects along the line gives a good indication of population abundance. There were 31 transects (~8.5km) surveyed on the 29/09/23, undertaken by two observers. All birds and survey times were recorded for each transect.

6 Results

6.1 Physical habitat quality for aquatic fauna

Based on the Rapid Habitat Assessment results, the available aquatic habitat in both the Unnamed Stream and Frahams Creek is of low quality. Sites 1 and 2, on the Unnamed Stream, received scores of 20.5/100 and 27.5/100 respectively. The upstream habitat, in the vicinity of Site 1, was highly disturbed, with visible signs of bed and riparian excavation.

Sites 3 and 5, on the Frahams Creek, received scores of 28.5/100 and 41/100 respectively. While still low, the comparatively higher score at Site 5 is consistent with observed riffle habitat and cobble substrate in this reach.

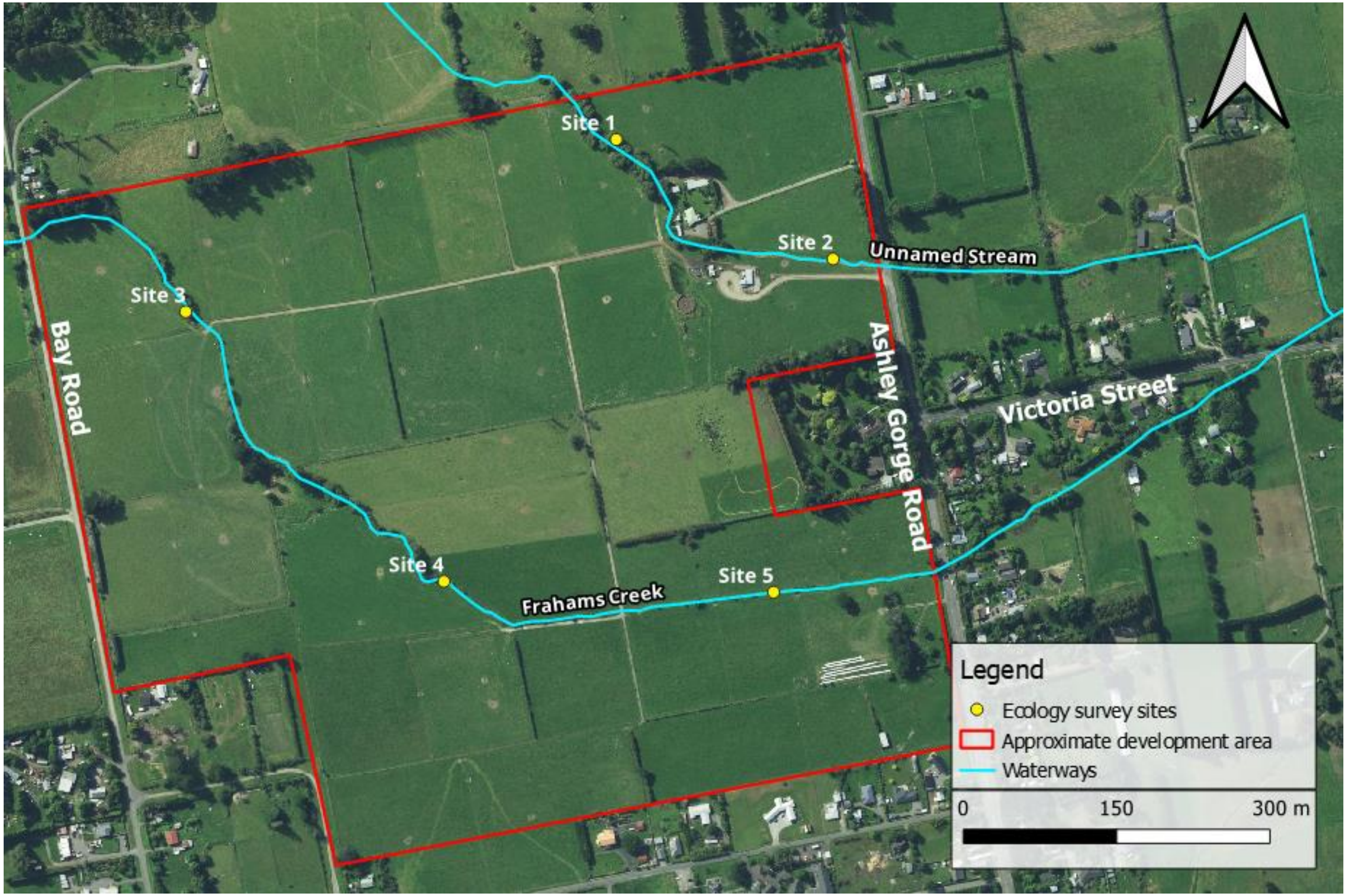

Figure 1. Map showing proposed development area at 25 Ashley Gorge Road. The fish population was sampled at all ecological survey sites, and the macroinvertebrate population was sampled at Sites 2 and 5.

6.2 Macroinvertebrate community

The macroinvertebrate community index (MCI) estimates health by using the macroinvertebrate community. The invertebrate sample collected from the Unnamed Stream (soft-bottomed) scored an MCI value of 66.7 which is indicative of “poor” water and habitat quality (App. IV, Table i). The dominant macroinvertebrate species was the aquatic snail *Potamopyrgus antipodarum*. This species has an MCI of 2.1 in soft substrate, indicating it has a high tolerance for contaminated aquatic habitats. The invertebrate sample collected from Frahams Creek (Hard-bottomed) scored an MCI value of 83.3, which is indicative of “fair” stream health (App. IV, Table ii). The dominant macroinvertebrate taxon was *Deleatidium,* high abundances usually suggest good habitat and water quality conditions.

6.3 Fish community

Following extensive fishing effort, just two fish species were identified in the proposed development area at 25 Ashley Gorge Road (Table 1). These were, in order of abundance, the upland bully (*Gobiomorphus breviceps*) and shortfin eel (*Anguilla australis*) (App. II, Fig. ix). Of these, only upland bully was caught in the Unnamed Stream. However, both the upland bully and shortfin eel were identified in Frahams Creek. Upland bullies were highly abundant in the lower Frahams Creek (Site 5, Fig. 1), with a catch rate of 5.17 fish per minute fishing time. One juvenile bully, caught at Site 5, was unable to be accurately identified due to its small size (23mm). This individual was likely an upland bully based on their small size, and their abundance at Site 5.

Table 1. Results of a fish survey across two waterways at 25 Ashley Gorge Road.

Waterway	Site	Electric fishing time (minutes)	Shortfin eel	Upland bully	Unidentified bully	Total
Unnamed Stream	1	4				0
	2	5		11		11
Frahams Creek	3	5	1			1
	4	4		4		4
	5	6		31	1	32
Total		**20**	**1**	**46**	**1**	**48**

6.4 Lizard Survey

The initial desktop survey identified that the vegetation present consists of pasture/rank grass, numerous weed species, and shelterbelt vegetation comprising of gorse (*Ulex*), broom (*Cytisus scoparius)*, hawthorn (*Crataegus sp.)*, poplar (*Poplar sp.*), pine (*Pinus sp.*), and other exotic tree species. Rank grass and other various weedy species coupled with dense shelterbelts and scattered refugia are known to provide suitable habitat for at least two species of locally occurring skink (Canterbury grass skink; *Oligosoma* aff. *polychroma*, Clade 4 and McCann’s skink; *Oligosoma maccanni*)

The review of the Department of Conservations herpetofauna database was also identified that three species of indigenous lizard (Table 2) have previously been found within a 10-km radius of the project area. The database did not have any records of lizards being present within the project footprint.

Table 2. Indigenous lizard species recorded in the DOC Herpetofauna database within a 10km radius of 25 Ashley Gorge Road, Oxford. Threat classification rankings from (Hitchmough *et al.* 2021).

Species	Common Name	Threat Classification Status
***Oligosoma* aff. *polychroma*, Clade 4**	Canterbury grass skink	At Risk – Declining
Naultinus gemmeus	Jewelled gecko	At Risk – Declining
***Woodworthia* “Southern Alps”**	Southern Alps gecko	At Risk - Declining

No lizards or their sign (faeces, sloughed skin etc…) were observed during the initial survey. However, several locations within the property were identified as areas of potential lizard habitat which required further assessment to confidently determine the presence/absence of indigenous lizards. These areas were located primarily along two waterways ("Unnamed Stream" and "Frahams Creek"), but also along several of the property's internal fences and some disused structures where unmaintained vegetation persisted.

Given the presence of lizard habitat, the field survey (21/1/2024) was conducted to determine lizard distribution, as reported in App. V. The January survey confirmed the presence of native skinks in the proposed development area, particularly around the disused dairy shed and outbuildings. The population could be between 150-200 individuals, and was considered to probably be the Canterbury grass skink and/or the McCanns Skink. The species have respective conservation status of 'at risk-declining' and 'not threatened' (Hitchmough *et al.* 2021).

6.5 Bird survey

During an extensive survey effort (App. III, Fig. i), 372 birds were observed, and 21 bird species were identified, of which nine of the identified species were native (Table 3). Of the observed birds, only 5.6% were endemic (i.e. native birds only found in New Zealand). All of the native birds, including the 4 endemic species, had a conservation status of "not threatened" (Robertson *et al.* 2016). The most abundant species was the European Goldfinch, making up 47% of the recorded birds. One Song Thrush nest was found on the ground underneath some poplar trees and no eggs were present.

There were two greylag goose nests observed, both of which had eggs and birds actively sitting on them. None of the 21 species have a significant conservation status. The Muscovy ducks and greylag geese were pets of the current tenant of the house.

7 Discussion

7.1 Existing aquatic ecosystem values

7.1.1 Aquatic macroinvertebrate community

The waterway termed Unnamed Stream was soft-bottomed (i.e. with a substrate covered in soft sediment) had an MCI score indicative of "poor" stream health (Stark & Maxted 2007). This result is consistent with the poor habitat quality assessed in this waterway (Clapcott RHA). This waterway had a clay bottom and small patches of macrophytes and overhanging bank vegetation that the invertebrates could utilise. *Potamopyrgus antipodarum* was the most abundant species and are tolerant of low water quality and habitat. The highest scoring taxa was *Paradixa* sp., with an MCI score of 8.5. Frahams Creek was hard-bottomed, and received an MCI score which is indicative of "fair" stream health. This result is consistent with the habitat availability observed in this waterway. This waterway had a stony bottom and was partially shaded by the true left bank. The highest scoring taxa were *Deleatidium* sp. And *Psilochorema sp.* None of the taxa present in either waterway have a significant conservation status (Grainger *et al.* 2018).

Table 3. Results of bird survey in proposed development area. The nine native bird species a highlighted in pink.

Scientific name	Common name	Origin	Approximate frequency	Abundance (rare, common, abundant, very abundant)	Habitat notes
Passer domesticus	**House Sparrow**	Exotic	59	Abundant	Exotic trees and in flight
Gymnorhina tibicen	**Australian Magpie**	Exotic	1	Rare	Pasture
Carduelis carduelis	**European Goldfinch**	Exotic	175	Very Abundant	Pasture
Porphyrio melanotus	**Pukeko**	Native	23	Common	In trees and pasture
Turdus merula	**Common Blackbird**	Exotic	29	Common	In trees and pasture
Fringilla coelebs	**Common Chaffinch**	Exotic	3	Rare	In trees and pasture
Tadorna variegata	**Paradise Shelduck**	Endemic	15	Common	Pasture
Turdus philomelos	**Song Thrush**	Exotic	6	Rare	In flight, pasture and trees
Anas platyrhynchos	**Mallard**	Exotic	14	Common	Pasture
Gerygone igata	**Grey Warbler**	Endemic	2	Rare	Trees
Rhipidura fuliginosa	**Fantail**	Endemic	1	Rare	In flight
Cairina moschata	**Muscovy Duck**	Exotic	11	Common	Adjacent to waterway
Sturnus vulgaris	**Common Starling**	Exotic	2	Rare	Trees
Hirundo neoxena	**Welcome Swallow**	Native	7	Rare	In flight
Columba livia	**Common Pigeon**	Exotic	2	Rare	Shed
Vanellus miles	**Spur-winged Plover**	Native	2	Rare	In flight
Anthornis melanura	**Bellbird**	Endemic	3	Rare	Trees
Anser anser	**Greylag Goose**	Exotic	5	Rare	On nest and pasture
Circus approximans	**Swamp Harrier**	Native	1	Rare	In flight
Chloris chloris	**European Greenfinch**	Exotic	5	Rare	Pasture
Zosterops lateralis	**Silvereye (waxeye)**	Native	5	Rare	Trees

7.1.2 Fish community

The abundance of upland bullies and low population density of migratory fish species (i.e. eels) in the surveyed waterways implies the presence of a fish passage barrier downstream of the proposed development area which prevents access to the sea.

This barrier is almost certainly attributable to the distance from the sea, and possible loss of surface water in some reaches. In particular, near Fernside.

We consider that improvement of aquatic habitat quality in the proposed development area is unlikely to increase fish species biodiversity. Excluding shortfin eels, no migratory fish have been recorded in the Cust River upstream of Egans Road (NZFFD). Migratory fish species downstream of Egans Road are the longfin eel, common bully, and brown trout (*Salmo trutta*).

Catch records of migratory native fish end approximately 31 km downstream of the proposed development area, and it is possible that a fish passage barrier, such as a perched culvert or drying reach, within this reach is likely to be preventing the upstream passage of trout and migratory galaxiids. Juvenile eels, including shortfin eels, are capable of negotiating perched culverts by climbing through the spray zone around the culvert edges. They are also capable of passing through some drying reaches. The drying reach, which varies in length from year-to-year, is located on the main Cust River south of Fernside, near Swannanoa Road This reach appears to be prone to drying in the summer (Google Earth imagery, Canterbury Maps), and is a short distance upstream of the upstream limit of migratory fish distribution.

Therefore, fish species within the proposed development area will only consist of (climbing) shortfin eels and nonmigratory upland bullies for the foreseeable future, despite any improvements to available habitat. However, despite this biodiversity restriction due to factors beyond the PDA boundary, we recommend that habitat improvements in the waterways be directed toward the habitat preferences of these two fish.

Habitat requirements for these species differ significantly. Shortfin eels show preferences toward low-flow habitats, with fine sediment substrate (Jowett & Richardson 1995). They are highly tolerant toward low quality habitats, and often found in waterways with low dissolved oxygen and high contaminant concentrations. Shortfin eels therefore require deep pool areas with trapped sediment. Upland bullies prefer higher water velocities than shortfin eels, especially riffle habitat with high levels of dissolved oxygen. They reproduce in cobble substrates, and therefore require clean cobble substrate in both riffle and run habitat.

7.2 Terrestrial values

7.2.1 Lizard habitat management and translocation

The identification of native lizards on the site triggers requirements under the Wildlife Act, as outlined in the full report (App. V). All of New Zealand's native lizards are 'absolutely protected' under the Wildlife Act 1953, section 63 (1) (c), and lizard habitats are protected by the Resource Management Act (1991).

From a management perspective, and where possible, lizard habitat should be retained and protected, but if that is not possible, lizards should be translocated to suitable habitats. Lizard salvage and relocation work typically requires (1) Wildlife Act authorisation (WAA) permit from the Department of Conservation (DOC), and a corresponding site-specific lizard management plan (LMP). Given the recent lengthy timeframes for permit processing by DOC, we recommend that this process be initiated as soon as possible.

7.2.2 Bird life

While a large variety of birds were identified from the survey area, most species were introduced (12 species out of 21) birds, and introduced birds were much more abundant than native birds. However, it is expected that increasing riparian plantings may enhance habitat for birds, including native species. There are options for managing vegetation around waterbodies and waterways which could enhance habitat for native species, and reduce the heavy dominance of exotic species over native birds. The are briefly discussed below.

7.3 Consideration of the Draft Outline Development Plan (App. I)

The latest ODP (Outline Development Plan, dated November 2023) is provided in App. I. This ODP indicates 3 stormwater management areas two adjacent to Frahams Creek. This ODP indicates that a proposed reserve (to the north-east) is placed just to the east of the old outbuildings where most of the lizards were located. It may be possible to construct lizard refugia in this reserve, and translocate lizards into them, prior to the destruction of the old utility buildings and former lizard habitat. Equally, the lizard population to the west could be translocated to 'rough-grass' refugia in the stormwater habitat proposed for that location. Lizards were also located in drains to the north and south, and these lizards could be accommodated in the nearest constructed habitat.

The scope of the ODP does not include detailed physical habitat restoration in the two waterways. However, both fish species tend to be habitat generalists, and may be found in a range of habitat types throughout Canterbury. There may be scope to increase water depth in some locations to provide habitat for larger eels. To reiterate a point made earlier, waterway restoration is unlikely to increase fish species biodiversity at this location, but it may be possible to re-establish historic isolated populations of non-migratory rare fish of special interest like the Canterbury mudfish, also within the stormwater management areas.

The habitat quality and ecology was markedly better in Frahams Creek compared to the Unnamed Stream to the north. However, ecological health was rather indifferent, and both waterways would ecologically benefit from vegetated riparian strips with a minimum width of 10 m. Vegetated riparian widths of that dimension are required to provide ecological benefit, as opposed to narrower strips which can only provide some shading, nutrient and contaminant uptake, and banks strengthening.

7.4 Proposed impacts and mitigation techniques

7.4.1 Aquatic ecology

Provided the waterways are retained and development setbacks are respected, the development is likely do have less than minor detrimental impact on aquatic ecology values in the development area.

Treated stormwater will be directed into one of the two surveyed waterways, following retention in one of three purpose-built stormwater treatment basins (App. I). The introduction of open water bodies will facilitate an increased abundance of Paradise shelduck and, if there is some water depth, the native scaup (*Aythya novaeseelandiae*) which are becoming more common in urbanised areas. Scaup appear to acclimatise well to the presence of humans (Robertson 1984). Dominance by introduced mallard ducks in the retention basins may be discouraged by avoiding the creation of mown grassed loafing area directly beside the water margins, and having a marginal water depth of more than dabbling depth. Discouraging people from feeding mallard ducks will also help in preventing waterbird dominance by the introduced mallard duck over native ducks (e.g. Grey duck, *Anas superciliosa superciliosa*). Instead, design should focus on forming a riparian planting of native rushes, which is preferred by native waterbirds, for nesting and rearing. This applies to scaup, and the native grey duck.

The discharge of stormwater into a waterway can impact on the turbidity and water velocity of the receiving waterbodies during rainfall events, depending on the design of retention basins. However, evidence of recent high flows in both waterways, such as woody debris and dried sediment on riparian plants, was observed during the ecological survey. This indicates the waterways are already susceptible to increases in turbidity and elevated flows during rainfall events. Due to storm volume attenuation of the proposed retention basins, and the small proportion of impervious catchment area, we consider that, with good design, there is every possibility that the stormwater discharge into the waterways is unlikely to cause a detrimental change to the existing hydrology.

In addition, habitat quality in both waterways is likely to improve because of the attendant riparian naturalisation proposed for the development. It is recommended that the hydraulics for both waterways be retained, and the riparian zones re-graded and planted with native riparian species such that their canopies closely overhang the water. Suitable plants species would include native tussocks (esp. *Carex* sp). and native grasses (*Juncus* spp.) near (within 20 cm of) the wetted margin during baseflow conditions, as indicated in the ECan planting guidelines (Environment Canterbury 2011). The canopy overhang provides refuge for invertebrates and fish, but the stream life also benefits from terrestrial invertebrate falling off bankside vegetation and trees. Overhanging fish cover is important for protection from terrestrial predators such as birds.

Shade is important in moderating water temperature and reducing macrophyte growth in the waterway by reducing photosynthetic biomass production (Quinn *et al.* 1997). The riparian zone should extend for a minimum of 10 m from the wetted margin at base flow, to provide a buffer strip for the filtering of stormwater runoff before it enters the waterway. The buffer strip should be planted with a moderate-high density of native flora. Any pedestrian pathways in the buffer strip should be pervious, with compacted gravel/grit or grass surfaces. Non-porous surfaces such as concrete or asphalt result in more stormwater runoff, potentially overloading the filtration efficiency of the buffer strip during rainfall events.

7.4.2 Terrestrial ecology

Terrestrial ecology in the proposed development area was initially limited to plants and birds during the Spring. This was later followed by an assessment of lizard habitat in summer (January 2024).

While a full vegetation survey was not executed, no native or threatened plants were recorded in the surveyed area during ecological surveys. Impacts of the proposal on flora are therefore restricted to the removal of mature exotic trees and shrubs, such as willow and poplar, and the loss of pasture grass. The removal of mature exotic trees and open pasture will decrease open grassland bird habitat in the proposed development area. However, this will be mitigated through the addition of native vegetation, especially along the riparian corridors of the Unnamed Stream and Frahams Creek. The fruits of native flora species such as karamu (*Coprosma robusta)*, pohuehue (*Muehlenbeckia australis)*, and five finger (*Pseudopanax arboreus)* are consumed by the native bellbird and waxeye, along with exotic birds such as the blackbird and song thrush (Williams & Karl 1996). NZ bellbirds also forage on harakeke (*Phormium tenax*) and kowhai (*Sophora* sp.) (Lukies 2020). The addition of these plants, when mature, will improve habitat and diet for native bird species in the vicinity when compared to existing vegetation.

Indigenous lizard species are known to often occupy habitats of otherwise low ecological value (i.e., exotic weedy, vegetation margins), this, combined with their shy and cryptic nature results in these species being easily overlooked. Herpetological surveys carried out at this property have identified several areas within the project footprint where indigenous lizards are present, if construction occurs in these areas, lizards will likely be displaced and possibly injured/killed. It is therefore recommended that where appropriate lizard habitat should be retained, protected, and enhanced to provide additional resources and refuge to support the locally occurring population.

Being strongly heliothermic (i.e. warmed by the sun) lizards require warm dry areas with lots of places to bask, as well as habitat complexity which provides safe refuge from predation. The construction, protection, and enhancement of lizard habitat will help to provide additional resources and refuge to support the locally occurring population.

The following are some key principles to consider when enhancing/creating habitat for Canterbury grass and McCann's skink species.

- Habitat foundation: Should be made up of grassland species (i.e., silver tussock; *Poa cita)*, which will provide a large unshaded area of habitat.
- Increase habitat complexity: Incorporate scattered ground cover plants such as native vines and prostrate shrubs (i.e., Prostrate kowhai; *Sophora prostrata*) to create a more complex variable habitat and provide refuge and food sources.
- Include clusters of native plants: The addition of native shrubs such as *Coprosma* sp, porcupine shrub, and other site-appropriate plants (e.g., matagouri, kanuka, manuka, flax/harakeke) will improve the ecosystem. It will also provide complexity, diversity, and additional food resources by producing fruits and attracting a variety of invertebrates. It is important to plant shrubs in clusters to limit shading.
- Provide 'non-plant' habitat complexity: In order for lizards to regulate their body temperature and stimulate their metabolism, they require safe warm dry areas to bask. This can be achieved by incorporating materials such as stone piles (e.g., greywacke/aggregate washed round river stones), large wood logs, layered slabs of rock or wood, aggregations of boulders etc. All of which are suitable materials for skinks, and provide both safe areas in which lizards can find refuge, and warm areas for sun basking.

7.4.3 Ecological corridors as mitigation

Wide buffer strips, mentioned in aquatic ecology mitigation techniques above, are important as ecological corridors for dispersal of adult macroinvertebrate stages and native birds (Christchurch City Council 2003). Unfortunately, no recreational or wildlife reserves are present along the riparian corridors upstream or downstream of the proposed development area. However, based on satellite imagery a significant percentage of the downstream catchment has wide riparian buffers, fenced to exclude stock, with mature vegetation on both banks. The continuation of these buffer strips, with the addition of dense and diverse native vegetation, will facilitate the effective dispersal of macroinvertebrates and native birds within the area.

Macroinvertebrates identified in the proposed development area that could utilise native vegetation in the riparian zone for dispersal are winged-adult stages of mayfly, caddisflies and true flies. The adults will emerge from the stream and use the riparian vegetation as a place for resting, feeding and hiding before finding a mate or dispersing. Some insect adults will lay eggs on overhanging riparian vegetation, so that young larvae can drop into the stream for the aquatic life stages.

Native bird species such as the bellbird, silvereye, fantail and grey warbler, all identified in the proposed development area, will also utilise native riparian vegetation for habitat, feeding and dispersal. While fragmented forest habitat facilitates a lower bird species biodiversity than large continuous forest habitat (Sam *et al.* 2014), a continuous planted riparian margin will provide both habitat and dispersal route for the species listed above between the plains to the east and foothills to the west.

The planting plans should be devised in conjunction with ecologists to enhance aquatic values in waterways, reserves, and green areas.

8 Recommendations

AEL recommends the following factors be considered in the design process for the proposed residential development, that;

- Naturalisation of waterways in the development area, including:
    - Re-grading of banks to a geotextile-stabilised slope, to ensure bank stability.
    - Native planting in riparian zones, including *Carex* sp. and *Juncus* sp. near the wetted margin at baseflow and larger shrub and tree species up the bank.
    - The retention of current hydraulic habitats, including riffle, run and pool areas.

- Minimum buffer strip widths of 10 m on each side of both waterways, measured from the wetted margin during baseflow conditions.
    - Buffer strips should be densely planted with native flora. This helps to support bird and insect biodiversity.
    - Any pedestrian pathways in buffer strip should be pervious (i.e., gravel or grass surface).

- The planted riparian zones along each waterway should be as continuous as possible to maximise bird and invertebrate dispersal. Riparian planting plans should be devised in partnership with aquatic ecologists and landscape architects.

- If lizard translocation is deemed necessary by a herpetologist, lizard habitat enhancement areas should be created using the key principles outlined in section 17.4.2 of this report.

- When further detail is available on the ODP, there is further opportunity to consider ways of enhancing the ecology.

9 Acknowledgements

We thank Ben O'Grady for land access for survey on several occasions.

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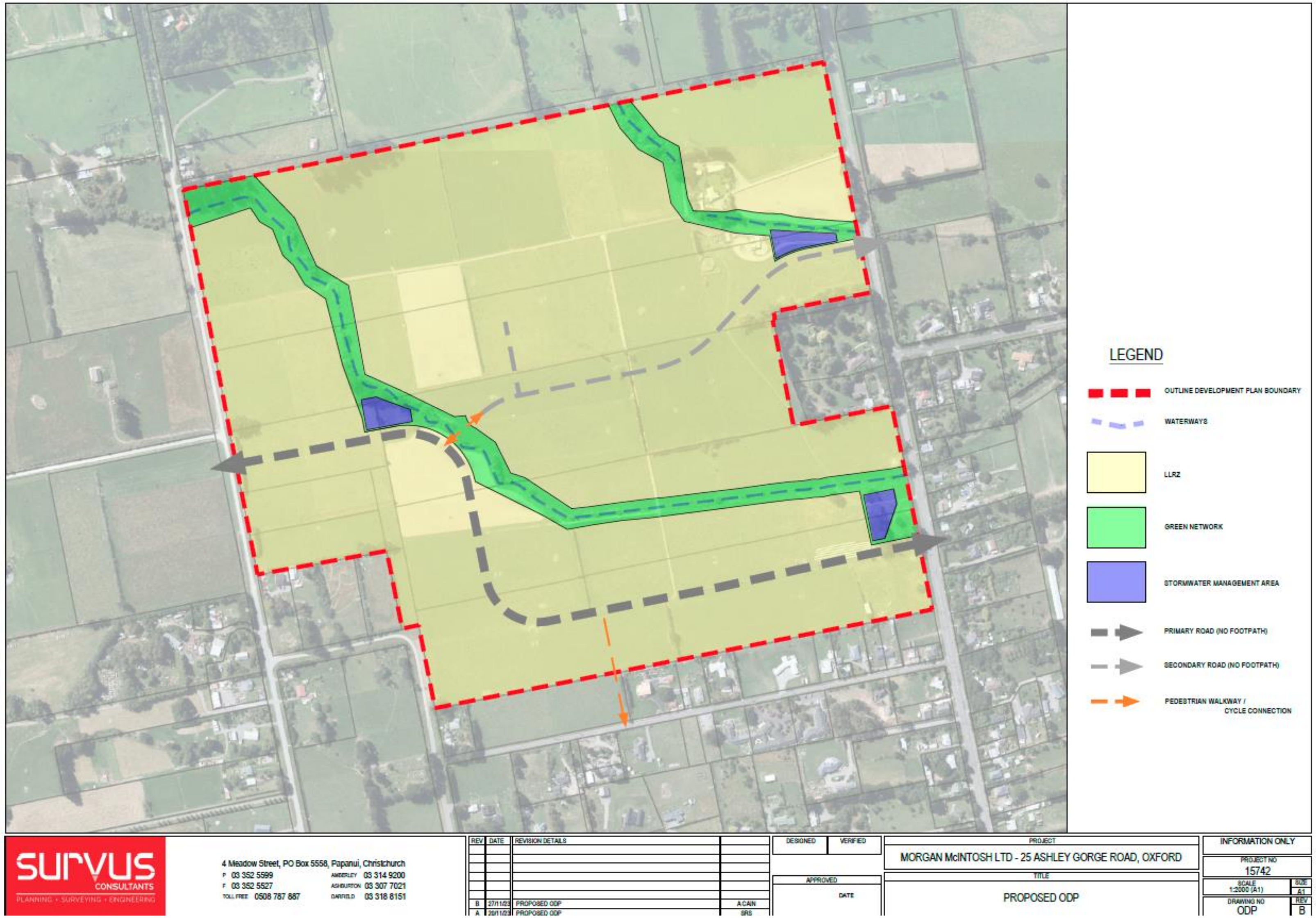
11 Appendix I. Draft Outline Development Plan (Nov 2023)



12 Appendix II. Site Photos mentioned in the text

Figure i. Looking south-west across the proposed development area from drone, 15/08/2023.Unnamed Stream in foreground, and Frahams Creek in background (arrowed).

Figure ii. Looking north-east across the proposed development area from drone, 15/08/2023. Frahams Creek in foreground.

Figure iii. Looking downstream along Frahams Creek, 15/08/2023.

12 Appendix II (cotd.). Site photos mentioned in the text

Figure iv. Looking upstream at Site 1 (Unnamed Stream), highly disturbed at the time of ecological survey. Photo taken 26/09/2023.

Figure v. Looking upstream at Site 2, Unnamed Stream. Macrophytic vegetation in margins, no riparian planting. Photo taken 26/09/2023.

Figure vi. Looking downstream at Site 3 Frahams Creek. Deeply incised, firm clay substrate. Photo taken 26/09/2023.

Figure vii. Looking upstream at Site 4, Frahams Creek. Clay substrate, riffle and pool habitats. Photo taken 26/09/2023.

Figure viii. Looking downstream at Site 5 (Frahams Ck). Long riffle habitat with cobble substrate. Photo taken 26/09/2023.

Figure ix. Shortfin eel caught at Site 3, Frahams Creek, 26/09/2023.

13 Appendix III. Bird Survey Extent

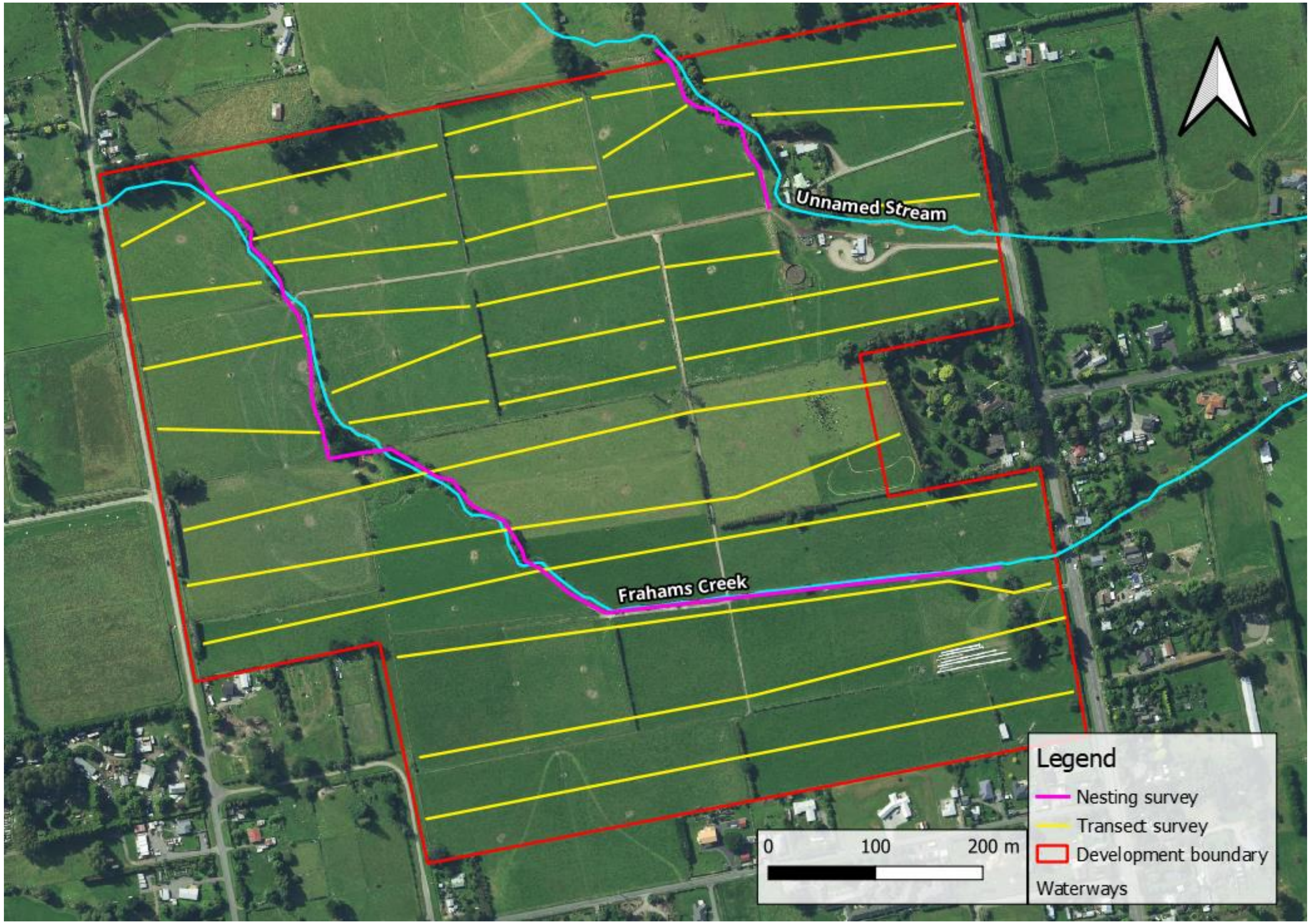


Figure i. Map of bird survey extents, including both transect and nesting surveys.

14 Appendix IV. Macroinvertebrate taxa lists

Table i. Invertebrate Results from Unnamed Stream (Site 2) using soft--bottom sampling protocols

		No.	MCI-sb	QMCI-sb
CRUSTACEA				
Copepoda		3	2.4	7.2
Ostracoda		6	2.4	14.4
INSECTA				
Odonata	*Xanthocnemis*	1	1.2	1.2
	Austrolestes	1	0.7	0.7
Diptera				
Chironomidae				
Orthocladiinae		6	3.2	19.2
Tanypodinae		1	6.5	6.5
Chironominae	*Tanytarsus*	1	3	3
Culicidae		1	1.2	1.2
Dixidae	*Paradixa*	1	8.5	8.5
Simuliidae	*Austrosimulium*	15	3.9	58.5
Sciomyzidae		1	3	3
Trichoptera				
Leptoceridae	*Hudsonema amabile*	2	6.5	13
	Triplectides	5	5.7	28.5
Hydroptilidae	*Oxyethira*	14	1.2	16.8
Hemiptera				
Corixidae	*Sigara*	1	2.4	2.4
Veliidae	*Microvelia macgregori*	3	4.6	13.8
ARACHNID	*Acari*	1	5.2	5.2
MOLLUSCA				
Gastropoda				
Hydrobiidae	*Potamopyrgus antipodarum*	38	2.1	79.8
Physidae	*Physa acuta*	6	0.1	0.6
Bivalvia				
Sphaeridae	*Sphaerium novaezelandiae*	1	2.9	2.9
No. Scoring taxa		20		
TOTAL No. of animals		108		
Total indice score		66.7		
%EPT		19.4		
MCI		66.7		
QMCI		2.7		

14 Appendix IV (cotd.). Macroinvertebrate taxa lists

		No.	MCI-hb	QMCI-hb
NEMATODA		3	3	
ANNELIDA				
Oligochaeta		19	1	19
CRUSTACEA				
Ostracoda		2	3	6
INSECTA				
Diptera				
Orthocladiinae		2	2	4
Tanypodinae		1	5	5
Simuliidae	*Austrosimulium*	27	3	81
Ephemeroptera				
Leptophlebiidae	*Deleatidium*	44	8	352
Trichoptera				
Leptoceridae	*Hudsonema amabile*	1	6	6
Hydrobiosidae	*Hydrobiosis parumbripennis*			0
	Hydrobiosis clavigera	2	5	10
	Psilochorema	2	8	16
Hydroptilidae	*Oxyethira*	1	2	2
MOLLUSCA				
Gastropoda				
Hydrobiidae	*Potamopyrgus antipodarum*	10	4	40
No. Scoring taxa		12		
TOTAL No. of animals		111		
Total indice score		50		
%EPT		45.0		
MCI		83.3		
QMCI		4.9		

Table ii. Invertebrate Results from Frahams Creek (Site 5) using hard-bottomed sampling protocols

15 Appendix V. Lizard Report by Chris McClure (herpetologist)

21st January 2024
Aquatic Ecology Limited

Dear Mark,

LIZARD SURVEY OF 25 Ashley Gorge Road, Oxford, Canterbury.

This letter summarises the results of a lizard survey conducted at 25 Ashley Gorge Road, it concludes that a site-specific lizard management plan and associated Wildlife Act Authority permit will be required for this application.

Several methods have been used to assess the habitat within the proposed project footprint (Figure 1) in terms of its values for native herpetofauna. These have included an initial desktop survey, an onsite visual assessment (site walkover), and a follow up lizard survey.

Figure 1. *Map identifying the boundary lines for 25 Ashley Gorge Road, where a lizard assessment and survey has taken place.*

15 Appendix V (cotd.). Lizard Report by Chris McClure (herpetologist)

Lizard survey

On the 6th of January 2024, a lizard survey was undertaken by Herpetologist Christine McClure. The purpose of this survey was to determine the presence of indigenous lizards within areas of potential lizard habitat identified at this site. Specific methodologies are described below.

Tracking Tunnels

Tracking tunnels (Black trakka standard tunnels 500mm (L) x 100mm (H) x 100mm (W), fitted with pre-inked cards; Gotcha Traps Ltd) were deployed in areas identified as potential lizard habitat within 25 Ashley Gorge Road (Figure 2). All tunnels were baited with raspberry jam and a 1cm^3 piece of tinned pear, tunnels remained on site for a total of eight days.

Figure 2. Map showing the location where 30 tracking tunnels (red markers) and 20 artificial cover objects (blue markers) were installed at 25 Ashley Gorge Road. Yellow stars, identify the position where evidence of skinks where located.

Tracking tunnels are more commonly used for indexing rodent and mustelid abundance at sites (Gillies & Williams 2013)[1], however recent studies have shown that tracking tunnels are approximately twice as likely to detect skinks compared to the traditionally used pitfall trap (Lettink *et al.* 2022)[2]. As this is a passive sampling technique, this monitoring method only allows for the confirmation of the presence, but not absence, of herpetofauna as it relies on the target species to willing encounter and enter the tunnel.

[1] Gillies C, Williams D. 2013. DOC tracking tunnel guide v2.5.2: Using tracking tunnels to monitor rodents and mustelids. Hamilton. Department of Conservation. 14p
[2] Lettink M, Young J, Monks J. 2022. Comparison of footprint tracking and pitfall trapping for detecting skinks. New Zealand Journal of Ecology 46(2): 3478

15 Appendix V (cotd.). Lizard Report by Chris McClure (herpetologist)

Artificial Cover Objects (ACO)

Artificial cover objects (ACO's; Onduline™, a bitumen roofing product, cut to c. 40 x 40 cm) were deliberately placed throughout the project area in locations which had been identified as suitable lizard habitat (Figure 2).

ACO's are one of several tools used to monitoring herpetofauna, the main advantages of artificial retreats compared with other sampling methods (e.g., pitfall trapping, systematic searches) are that they are easy to use, relatively inexpensive, insensitive to observer bias, and cause little or no habitat disturbance. They also provide offer shelter, protection from predators and/or thermoregulatory advantages (Lettink 2007)[3].

Results and Recommendations

This survey has confirmed that least one species of native New Zealand lizard resides within the project footprint at 25 Ashley Gorge Road project area. Lizards were identified through the presence of skink footprints and faeces on tracking tunnel cards and ACO's.

After reviewing local historical lizard records in the Department of Conservations BioWeb Herpetofauna Database (within a 5km radius of the property), it has been assumed that the species present will most likely be, Canterbury grass skink (*Oligosoma aff. polychroma,* Clade 4) and/or McCann's Skink (*Oligosoma maccanni*). These species have a conservation status of 'At Risk – Declining' and 'Not Threatened' respectively under the New Zealand Threat Classification System (Hitchmough *et al.* 2021)[4]. Both the Canterbury grass and McCann's skink occupy a wide range of habitats including but not limited to littoral zones, wetlands, dry grassland, shrubland, subalpine tussock land. Both these species are highly variable in colour and patterning, and it can be difficult to distinguish between the two species without capturing the animal.

Due to the overcast conditions experienced during this survey (cloud cover 6; average daily temp 21°C and light winds), no lizards were observed using the ACO's (lizards use the thermal properties of the black bitumen on warmer days). Lizard scat (faeces) was noted as present on top of three ACOs (AO4, 14, and 16) and it is highly likely that lizards were using others positioned around the property.

Skink footprints were observed on ten of the thirty tracking tunnel cards deployed (Figure 3), with the highest density being recorded within and around the disused dairy shed and outbuildings. As lizards were detected at this site through the presence of footprints on tracking cards (see appendix 1 for full results), it is not possible to accurately determine the population size from this lizard survey; this would require a regime of trapping (each trap installed at 2m spacing) in order to estimate the population densities of native skinks present within dense exotic grassland and shrub areas (Lettink et al. 2011) coupled with a mark-recapture analysis. Therefore, it has been estimated that the total lizard population size present within 25 Ashley Gorge Road could be between 150 - 200 individuals.

[3] Lettink, M. 2007: Adding to nature: can artificial retreats be used to monitor and restore lizard populations? Unpublished PhD thesis, University of Otago, Dunedin. 190 p

[4] Hitchmough R.A., Barr B., Knox C., Lettink M., Monks J.M., Patterson G.B., Reardon J.T., van Winkel D., Rolfe J., and Michel P. 2021: Conservation status of New Zealand reptiles, 2021. New Zealand Threat Classification Series 35. Department of Conservation, Wellington. 15 pp

15 Appendix V (cotd.). Lizard Report by Chris McClure (herpetologist)

The positive identification of an indigenous lizard species at this site triggers requirements outlined in the Wildlife Act. All New Zealand indigenous lizards are 'absolutely protected' under the Wildlife Act 1953, s63 (1) (c)), and lizard habitats are protected by the Resource Management Act (1991).

Ideally lizard habitat should be, where possible, retained and protected to maintain the resident population of native lizards. Where this is not possible, animals will need to be caught and relocated by a suitably qualified herpetologist, to an alternative approved location. Lizard salvage and relocation work typically requires the following: (1) Wildlife Act authorisation (WAA) permit from the Department of Conservation (DOC)[5]; and a (2) corresponding site-specific lizard management plan (LMP).

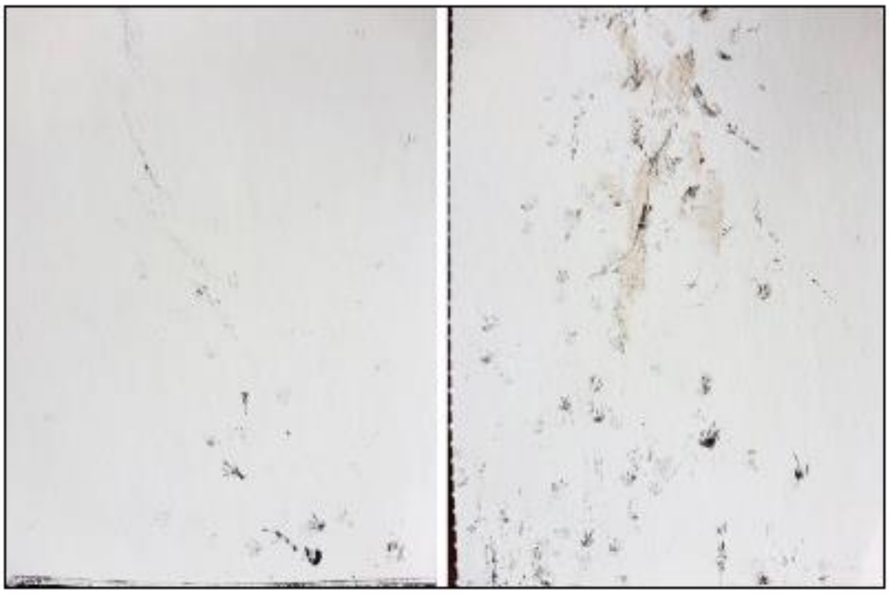


Figure 3. Tracking tunnel card AT23 and AT20 showing the presence of skink footprint and tail drag.

A LMP is a document written to identify actions required to ensure that lizards and their habitats are protected when disturbance or modification to land (vegetation clearance, earthworks, construction) is proposed. The aim of this document to demonstrate to DOC that when implemented the agreed actions will help to ensure a 'no net loss' of lizard values. A no-net loss outcome is consistent with Environment Canterbury Policy 9.3.1.3, and consistent with DOC advice relating to habitats of lizard species absolutely protected under the Wildlife Act (1953).

Yours sincerely

Christine McClure
Ecologist/Herpetologist

[5] Department of Conservation 2019: Key principles for lizard salvage and transfer in New Zealand. Lizard Technical Advisory Group. Department of Conservation, Wellington.

15 Appendix V (cotd.). Lizard Report by Chris McClure (herpetologist)

Appendix 1: Tracking tunnel and ACO results. Overcast conditions on the 14th of January 2024 did not provide optimal conditions for ACO's used at this site.

#	Trap Type	GPS	Installed	Removed	Notes (species prints on cards)
1	Tracking Tunnel	AT1	06/01/2024	14/01/2024	Invertebrates
2	Tracking Tunnel	AT2	06/01/2024	14/01/2024	Invertebrates
3	Tracking Tunnel	AT3	06/01/2024	14/01/2024	Invertebrates
4	Tracking Tunnel	AT4	06/01/2024	14/01/2024	Invertebrates, Skink
5	Tracking Tunnel	AT5	06/01/2024	14/01/2024	Invertebrates
6	ACO	AO1	06/01/2024	14/01/2024	Nothing
7	ACO	AO2	06/01/2024	14/01/2024	Nothing
8	ACO	AO3	06/01/2024	14/01/2024	Nothing
9	ACO	AO4	06/01/2024	14/01/2024	Skink faeces
10	ACO	AO5	06/01/2024	14/01/2024	Nothing
11	Tracking Tunnel	AT6	06/01/2024	14/01/2024	Rat, Invertebrates, Skink
12	Tracking Tunnel	AT7	06/01/2024	14/01/2024	Invertebrates
13	Tracking Tunnel	AT8	06/01/2024	14/01/2024	Invertebrates
14	Tracking Tunnel	AT9	06/01/2024	14/01/2024	Invertebrates
15	Tracking Tunnel	AT10	06/01/2024	14/01/2024	Invertebrates
16	Tracking Tunnel	AT11	06/01/2024	14/01/2024	Invertebrates, Skink
17	Tracking Tunnel	AT12	06/01/2024	14/01/2024	Rat, Skink
18	Tracking Tunnel	AT13	06/01/2024	14/01/2024	Invertebrates, Skink
19	Tracking Tunnel	AT14	06/01/2024	14/01/2024	Invertebrates
20	Tracking Tunnel	AT15	06/01/2024	14/01/2024	Blank
21	Tracking Tunnel	AT16	06/01/2024	14/01/2024	Mouse, Invertebrates
22	ACO	AO6	06/01/2024	14/01/2024	Nothing
23	ACO	AO7	06/01/2024	14/01/2024	Nothing
24	ACO	AO8	06/01/2024	14/01/2024	Nothing
25	ACO	AO9	06/01/2024	14/01/2024	Nothing
26	ACO	AO10	06/01/2024	14/01/2024	Nothing
27	ACO	AO11	06/01/2024	14/01/2024	Nothing
28	ACO	AO12	06/01/2024	14/01/2024	Nothing
29	ACO	AO13	06/01/2024	14/01/2024	Nothing
30	ACO	AO14	06/01/2024	14/01/2024	Skink faeces
31	ACO	AO15	06/01/2024	14/01/2024	Nothing
32	ACO	AO16	06/01/2024	14/01/2024	Skink faeces
33	ACO	AO17	06/01/2024	14/01/2024	Nothing
34	ACO	AO18	06/01/2024	14/01/2024	Nothing
35	ACO	AO19	06/01/2024	14/01/2024	Nothing
36	ACO	AO20	06/01/2024	14/01/2024	Nothing
37	Tracking Tunnel	AT17	06/01/2024	14/01/2024	Rat, Invertebrates
38	Tracking Tunnel	AT18	06/01/2024	14/01/2024	Mouse, Invertebrates
39	Tracking Tunnel	AT19	06/01/2024	14/01/2024	Blank
40	Tracking Tunnel	AT20	06/01/2024	14/01/2024	Skink
41	Tracking Tunnel	AT21	06/01/2024	14/01/2024	Invertebrates, Mouse
42	Tracking Tunnel	AT22	06/01/2024	14/01/2024	Blank
43	Tracking Tunnel	AT23	06/01/2024	14/01/2024	Skink
44	Tracking Tunnel	AT24	06/01/2024	14/01/2024	Blank
45	Tracking Tunnel	AT25	06/01/2024	14/01/2024	Mouse, Skink, Invertebrates
46	Tracking Tunnel	AT26	06/01/2024	14/01/2024	Invertebrates, Mouse, Skink
47	Tracking Tunnel	AT27	06/01/2024	14/01/2024	Invertebrates
48	Tracking Tunnel	AT28	06/01/2024	14/01/2024	Mouse
49	Tracking Tunnel	AT29	06/01/2024	14/01/2024	Invertebrates
50	Tracking Tunnel	AT30	06/01/2024	14/01/2024	Mouse, Skink