Before an Independent Hearings Panel
Appointed by Waimakariri District Council

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under: the Resource Management Act 1991

in the matter of: Submissions and further submissions on the Proposed Waimakariri District Plan

and: Hearing Stream 12: Rezoning requests (larger scale)

and: **Carter Group Property Limited**
(Submitter 237)

and: **Rolleston Industrial Developments Limited**
(Submitter 160)

Statement of evidence of Laura Drummond (Ecology) on behalf of Carter Group Limited and Rolleston Industrial Developments Limited

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Dated: 5 March 2024

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STATEMENT OF EVIDENCE OF LAURA DRUMMOND (ECOLOGY) ON BEHALF OF CARTER GROUP LIMITED AND ROLLESTON INDUSTRIAL DEVELOPMENTS LIMITED

INTRODUCTION

1 My full name is Laura Rose Drummond.

2 I am a Principal Scientist at Instream Consulting Limited (Instream). I have a Bachelor's degree in Science (2006) and a Master's degree in Ecology (2012) from the University of Canterbury. I am a member of the New Zealand Freshwater Sciences Society.

3 I have 16 years of experience in freshwater ecology consulting and research. I have been employed by Instream since 2023, where I specialise in surface water quality and freshwater ecology projects. Previously I held the position of Technical Director – Ecology at Pattle Delamore Partners (PDP). Internationally I have held positions as a Freshwater Ecologist, Fisheries Specialist and Environmental and Regulatory Specialist in Canada. Prior to this I was employed by the National Institute of Water and Atmospheric Research (NIWA) as a Freshwater Ecology Technician in Christchurch.

4 I am familiar with the submitters' request to rezone land bound by Mill Road, Whites Road, Bradleys Road (the Site).

5 I was involved in private plan change 31 (*PC31*) to rezone this land under the operative District Plan.

6 I have reviewed the Ecological Assessment undertaken by Aquatic Ecology Limited (*AEL*[1]) that was submitted as part of PC31 application and attached to this evidence.

7 I have attended two site visits where I have seen the current condition of the waterways and springs within the Site.

CODE OF CONDUCT

8 Although this is not an Environment Court hearing, I note that in preparing my evidence I have reviewed the Code of Conduct for Expert Witnesses contained in Part 9 of the Environment Court Practice Note 2023. I have complied with it in preparing my evidence. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where relying on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

[1] Taylor, M. & Payne, R. (2021). Land use change, 535 Mill Road, Ōhoka; Aquatic Ecology Report. Prepared for Rolleston Industrial Developments Ltd. AEL report No. 192. November 2021.

SCOPE OF EVIDENCE

9 My evidence will address:

9.1 the results of the ecological survey of the proposed zone change area (**Appendix 1**) undertaken by AEL.

9.2 the potential mitigation that can be provided to minimise impacts of the proposed land use change to aquatic features on Site;

9.3 potential enhancement and net ecological benefits at the Site and downgradient of the Site compared to current land use; and

9.4 potential buffer distances for springs and waterways.

10 In preparing my evidence, I have reviewed:

10.1 the Site Outline Development Plan (*ODP*).

10.2 the aquatic ecology report of the site undertaken by AEL (**Appendix 1**).

10.3 **Mr Eoghan O'Neil's** Stormwater and Wastewater evidence.

10.4 **Mr Bas Veendrick's** hydrological evidence.

SUMMARY OF EVIDENCE

11 An aquatic ecology survey of the Site was undertaken by AEL in 2021. The survey mapped the waterways and waterbodies on site, summarised ecological values, and recorded four fish species: the native longfin eel, shortfin eel, upland bully, and the introduced brown trout. No rare fish were recorded, and the report provides confidence that Canterbury mudfish do not occupy the Site waterways. Of the three native fish species recorded, the longfin eel has a national conservation status of 'declining' but remains well-distributed in Canterbury. The shortfin eel and upland bully have a conservation status of 'not threatened' (Dunn et al., 2017[2]). As part of the aquatic ecology survey and associated report, buffer distances were recommended for all waterways and waterbodies.

12 The rezoning request has the potential to improve the ecological condition of spring-fed waterways and spring heads within the Site. The Site is currently a dairy farm, and historical land use has resulted in highly modified site conditions for drainage purposes, with little shading or bank protection present and little habitat of

[2] Dunn, N. R.; Allibone, R. M.; Closs, G. P.; Crow, S.; David, B. O.; Goodman, J. M.; Griffiths, M.; Jack, D.; Ling, N.; Waters, J. M.; Rolfe, J. R. 2017. Conservation Status of New Zealand freshwater fishes, 2017. Department of Conservation, Wellington. No. 15 p

flow heterogeneity. With careful landscape design, there is potential for the Site to contain highly naturalised and enhanced watercourse corridors. In particular, there is an opportunity to link Ōhoka Stream to the Ōhoka Bush, downstream of Whites Road, to increase the length of the Ōhoka Stream ecological corridor and improve not only instream conditions, but overall biodiversity values in the area.

13 The provided minimum setback distances from waterways on the Site (springheads and watercourses) and an Ecological Management Plan will provide controls on potential ecological impacts to the Site. The removal of dairy farming activities from the Site will also result in a reduction in agricultural contaminants in the waterways on site and downgradient (nitrogen, phosphorus, sediment and *Escherichia coli (E. coli)*), as is consistent with the outcomes anticipated under the Canterbury Land and Water Regional Plan (LWRP) (which now includes Plan Change 7).

14 Careful design and mitigation strategies will be required to provide ecological betterment to both the onsite waterways and those downstream. The ODP for the rezoning request incorporates these measures and accordingly I support the rezoning request insofar as freshwater bodies and ecosystem values are concerned.

EXISTING CONDITIONS

15 I have been engaged by the submitters to comment on the current aquatic ecology values of the Site, as well as potential mitigation and enhancement options to minimise impacts of the proposed land use change to aquatic features within the Site. The current aquatic ecological values of the Site are taken from the field assessment by AEL in 2021 as provided in **Appendix 1**, as well as site visits I have undertaken. A summary of the aquatic values at the Site, as presented in Figure 1 of **Appendix 1**, is provided below:

15.1 At the northern end of the Site, a major tributary of the Ōhoka Stream flows through the Site. This waterway had the highest flow volume during the AEL field survey and my site visit. The ecology report documents gravel substrate with suitable trout spawning conditions and trout redds observed (**Appendix 1: Figure a, b**). It is noted this is the only stream sampled that recorded trout or trout redds.

15.2 Approximately 170 m to the south, an isolated groundwater-fed channel flows towards Whites Road (named groundwater seep). This channel is fed by a groundwater seep, with the downgradient channel having a fine sediment base and high levels of macrophytes in summer (**Appendix 1: Figures c, d**).

15.3 To the west, a spring-fed channelised waterway, named the Northern Spring Channel crosses through the Site. This

channel is fed by a mapped spring (Canterbury Maps[3]) within the Site near Bradleys Road (Northern Spring). Substrate was identified as a mixture of fine sediment and embedded gravel, with dense macrophytes present (**Appendix 1: Figures. e, f**).

15.4 Near the centre of the Site, a large, ponded area fed by a mapped spring (Southern Spring) is located near the existing homestead. The upstream most pond is manmade, with the downstream pond in a more natural condition, with mature vegetation and mapped spring presence (Canterbury Maps[4]). A channelised waterway flows towards Whites Road from the ponded area (**Appendix 1: Figures g, h**). The downstream channel has a fine sediment substrate and a high level of introduced macrophytes, especially watercress.

15.5 The waterway labelled Ponded Drain was considered ephemeral during the AEL site surveys. This channel was considered to drain runoff during rainfall, with ponded water but no base flow in winter conditions (**Appendix 1: Figures i, j**).

15.6 South of the ponded drain, a branch of the Ōhoka River, referred to as the South Ōhoka Branch, flows through the Site (**Appendix 1: Fig. k, i**). The upper section west of the farm buildings was noted by AEL to not have permanent flow, with no aquatic macrophytes observed between Bradleys Road and the farm buildings, or fish identified during the fishing survey. The lower reaches recorded gravel substrate and the response of longfin ells, shortfin eels and upland bullies.

15.7 Further south another drain crosses the Site, referred to as Ponded Drain 2 (**Appendix 1: Figures m, n**). This drain was similar to Ponded Drain 1, with very low standing water levels (3 cm) in winter conditions.

15.8 Along the south-western Site boundary is a shallow drainage channel, referred to as South Boundary Drain (**Appendix 1: Figures o, p**). Both of these channels lacked surface water in the winter of 2021, apart from two shallow ponded areas.

16 While a formal wetland assessment and delineation has not been undertaken at this stage, hydrology and botany indicators were used to assess three damp areas in the south of the Site during the aquatic ecology surveys. I personally assessed a further area (in response to PC31 submitter concerns) at the northeast of the Site, that was not included in the AEL report (see **Appendix 2** for photos). These areas were classed as non-wetlands by AEL

[3] https://mapviewer.canterburymaps.govt.nz/

[4] https://mapviewer.canterburymaps.govt.nz/

(**Appendix 1**) and my Site assessment confirmed the areas to the north as surface water depressions or overland flow paths.

17 The AEL report (**Appendix 1**) considers natural wetlands under the MfE guidelines are present around the Southern Spring Pond and the Northern Springhead. It is noted that field surveys during the subdivision consent stage will be required to confirm the presence and extent of natural inland wetlands on site. Any natural wetlands delineated on site will then require an assessment as per the National Policy Statement for Freshwater Management (NSPFM 2020[5]).

ASSESSMENT

18 The Site is currently a dairy farm, and historical land use has resulted in highly modified site conditions typically associated with dairy farms. Streams and spring heads have been fenced to exclude stock (approximately 1 m setbacks), with water flow from spring heads channelized to drain the land and little to no remaining native riparian vegetation.

19 While the Site's waterways have been modified from their natural state, the field surveys undertaken by AEL recorded four fish species: the native upland bully, shortfin and longfin eel, as well as the introduced brown trout. The longfin eel has the conservation status of "At Risk - Declining", while the remaining native species have a status of "not threatened", and the brown trout is introduced (Dunn et al. 2017). Suitable habitat and evidence of trout spawning (trout redds) were observed in the Ōhoka Stream tributary during the field survey (**Appendix 1**).

20 In addition to a recommendation on suitable buffer distances, which are discussed in Paragraph 23, the AEL ecological assessment made four key recommendations on habitat requirements to preserve ecological heath at the Site:

20.1 Maintaining bank stability.

20.2 Maintenance of spring base flows, and springhead depth (esp. at the Southern Spring Channel).

20.3 Maintenance of suitable hydraulics, and un-silted trout spawning gravels in the Ōhoka Stream Tributary and the South Ōhoka Branch.

20.4 Maintenance of fish passage for trout for the Ōhoka Stream tributary and the South Ōhoka Branch.

[5] https://environment.govt.nz/acts-and-regulations/national-policy-statements/national-policy-statement-freshwater-management/

21 When comparing past and current agricultural land use at the Site, a residential development has the potential to result in a net ecological benefit to aquatic ecological values and the above requirements are able to not only be achieved, but the ecological values of the waterways could be enhanced. Currently, the stream channels have been highly modified for drainage purposes, with no shading or bank protection present and little habitat or flow heterogeneity. With careful landscape design, there is potential for the Site to contain highly naturalised and enhanced watercourse corridors. In particular, there is an opportunity to link Ōhoka Stream to the Ōhoka Bush, downstream of Whites Road. This would provide an increase in the length of the Ōhoka Stream ecological corridor and improve not only instream conditions, but overall biodiversity values in the area.

22 The removal of dairy farming activities from this Site will result in a reduction in agricultural contaminants in the waterways (nitrogen, phosphorus, sediment and *Escherichia coli (E. coli)*), as is consistent with the outcomes anticipated under PC7 of the LWRP. The closest downstream Environment Canterbury monitoring site - Ōhoka River at Island Road[6] has high nutrient levels, in particular nitrate-nitrogen, which can be toxic at high levels, and dissolved inorganic nitrogen (DIN), which is the bioavailable form of nitrogen for plant growth. Five-year median nitrate-nitrogen concentration is 4.02 mg/L, which is above the LWRP PC7 target[7] of 3.8 mg/L and the National Policy Statement - Freshwater Management (NPS-FM 2020) national bottom line of 2.6 mg/L. The faecal bacteria *E. coli* is also elevated above guideline levels, with the 5-year median count at 893.5 cfu/100 ml, compared to the PC7 freshwater outcome value[8] of 130 cfu/100 ml and NPS-FM national bottom line of 260 cfu/100ml.

23 The potential to improve the ecological value of the waterways on site is reliant on maintaining hydrological connections. Mitigation of groundwater flow paths and minimum buffer distances from springs therefore need to be established, in order to reduce uncertainty in effects. As outlined in the evidence of **Mr Veendrick**, the highest risk of reduced spring flow and spring water levels is from shallow groundwater being intercepted by the construction of service trenches and hardfill areas (such as roads), which could reduce groundwater flow to the springs. Controls should be put in place to avoid short circuiting groundwater and to avoid a reduction in spring ecological value. Methods to achieve this are provided in the evidence of **Mr McLeod** and **Mr Veendrick**. With the construction methods available and the updated monitoring specified in the ODP text for both groundwater and surface water, I consider appropriate

[6] https://www.lawa.org.nz/explore-data/canterbury-region/river-quality/waimakariri-river-catchment/ohoka-river-at-island-road/

[7] Table 8-5: Water Quality Limits and Targets for Waimakariri Rivers.

[8] Table 8a Freshwater Outcomes for Waimakariri Sub-region Rivers.

controls can be implemented to maintain the hydrology of the springs on site, with monitoring required to confirm this.

24 Proposed minimum buffer distances for each waterway are provided below and in the ODP text. The proposed minimum buffer distances to waterbodies are considered suitable to protect, and in fact lead to enhancement of, the ecological values of the waterbodies on site.

25 To increase biodiversity values, and provide potential for increased filtration of contaminants to downgradient waterbodies (Kaiapoi Stream, Waimakariri River) in addition to the removal of agricultural activities, the ODP provides the following:

25.1 Large buffer distances (reserve space) to the northern and central spring heads (30 m), Ōhoka Stream tributary and southern spring head (20 m), Ōhoka Branch South, northern and southern spring channels (15 m), Southern spring channel (10 m) and South Boundary Drain (5 m).

25.2 Naturalisation of Ōhoka Stream, South Ōhoka Branch and the main spring complex, to improve instream values.

25.3 Vegetated swales to be used where possible along roadsides instead of kerb and channel, to minimise the level of contaminants entering the stormwater treatment systems and ultimately the waterways. Vegetated swales are effective at removing metals and some sediment.

25.4 Stormwater treatment systems will be designed to meet the Christchurch City Council Waterways Wetlands and Drainage Guide (WWDG) and located an appropriate distance from streams and spring heads. Stormwater treatment areas will be located outside of the 100-year flood zone and stormwater detention areas will be located outside of the 50-year flood zone, as discussed in the evidence of **Mr O'Neill**. The stormwater management system will be designed so that treatment areas fed by swales will be located furthest away from the stream to reduce the risk of contaminants entering waterways. This is particularly important for any stormwater that may enter the Ōhoka Stream tributary, which currently provides trout spawning habitat with well oxygenated, clean gravels.

26 At the subdivision consent stage, the enhancement in the form of naturalization of the springheads, spring-fed stream channels and the pond by the homestead, including native planting along the waterways and springs, would be relevant matters for consideration. These matters have been included in the ODP text.

27 To provide assurance that the current ecological values of aquatic features on the Site will be enhanced, an Ecological Management Plan is included as a requirement within the ODP text This plan

would require assessment by Council and would need to include plans for spring head restoration, waterway riparian management, aquatic buffer distances and adjacent land use. Ongoing maintenance and monitoring plans for riparian and stream management would also be required. The EMP would include, but not be limited to, the following:

27.1 Groundwater, spring water level and spring flow monitoring investigations across the site to inform construction methodologies;

27.2 Riparian planting plans with a focus on promotion of naturalised ecological conditions, including species composition, maintenance schedules, and pest and predator controls;

27.3 Landscape design drawings of stream setbacks are to include input and approval from a qualified freshwater ecologist, with a minimum of the first 7 m of the spring and stream setbacks will be reserved for riparian vegetation only, with no impervious structures and pathways as far as practicable away from the waterway; and

27.4 Stream ecology monitoring (i.e., fish, invertebrates, instream plants and deposited sediment surveys).

CONCLUSION

28 The aquatic ecology assessment (**Appendix 1**) recorded four fish species, with three native fish (upland bully, longfin and shortfin eel) and the introduced brown trout. Brown trout were only recorded in one waterway, Ōhoka Stream tributary, where evidence of trout spawning (redds) was also observed. All waterways had stock exclusion in place, however setbacks were limited, and riparian planting was mostly absent.

29 It is my opinion that the provided minimum setback distances from waterways on the Site (springheads and watercourses), the requirement to provide mitigation of groundwater flow paths to maintain hydrological connections to springs, and the requirement for an Ecological Management Plan will provide controls on potential ecological impacts to the Site.

30 The rezoning request has the potential to improve the current ecological values of aquatic features within the Site (which are degraded by current land use) and increase the naturalized corridor of Ōhoka Stream from the Ōhoka Bush reach downstream. The rezoning request also has the opportunity to provide a reduction in agricultural contaminants entering the waterways on site, which will assist in reducing levels of nitrogen and *E. coli* in downstream waterways required under PC7.

31 Careful design and mitigation strategies will be required to maintain hydrological connections and provide ecological betterment to both the onsite waterways and those downstream. The ODP and ODP text incorporate these measures and accordingly I support the rezoning request insofar as freshwater bodies and ecosystem values are concerned.

Dated: 5 March 2024

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Laura Drummond

APPENDIX 1 : AEL REPORT

Land Use Change, 535 Mill Road, Ohoka; Aquatic Ecology Report

Prepared for:
Rolleston Industrial Developments Ltd

AEL Report No. 192

Mark Taylor
Riley Payne

Final

November 2021

A juvenile brown trout from the Ohoka Tributary

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Contents

1 Executive Summary

A rural land parcel (approximately 156 ha) is proposed for a District Plan change to mixed-density residential and commercial. Aquatic Ecology Limited was commissioned to evaluate the aquatic ecology of the waterways and water bodies in the land parcel and recommend realignments and waterway setbacks on the basis of maintaining, and possibly enhancing ecological values.

Four fish species were identified, the native longfin eel, shortfin eel, upland bully, and the introduced brown trout. Of these, the longfin eel has a conservation status of declining. The other species do not have a conservation status. Notably, we did not identify the Canterbury mudfish, and we are confident that this endangered species does not reside in the land parcel, partly due to the widespread distribution of other predatory and competitive fish species.

Waterways were in good order due to extensive fencing, and we expect stream health measures to be in the order of 'fair' to 'good' based on national protocols.

We would recommend a minimum of 10 m buffer strip setbacks (from the water's edge) on principal waterways (Ohoka Stream tributary, South Ohoka Branch, Northern and Southern spring fed channels, and the groundwater seep). A 5 m service strip on the Un-named Stream, with a re-alignment of the ephemeral Ponded Drain into neighbouring perennial waterways. A minimum development offset of 20 m, but more if possible, should be applied from the point of wetland delineation (Ministry for the Environment 2020b) for the smaller of the two springheads (feeding Northern Spring Channel), but the larger spring feeding the Southern Spring Channel, requires a minimum of a 30 m setback.

The Northern Spring Channel could be diverted into, and benefit, the flow in the Southern Spring Channel. And the combined Southern and Northern Spring Channel would benefit from being combined and naturalised into a more meandering form. Likewise, the Ponded Drain could also be diverted into the lower reach of the Southern Spring Channel. Diversions and decommissioning of waterways is subject to the recent NES-F 2020 regulations.

We recommend the decommissioning of Ponded Drain (2), as it lacks aquatic values. We also identified 3 waterbodies with puddled water which we regard as not being wetlands and can be decommissioned.

2 Introduction and objectives

2.1 Proposal

A plan change is proposed for the property in the vicinity of 535 Mill Road, comprised of a large land parcel of 152.56 ha and other small parcels comprising of approximately 3.5 ha of rural zoned land. The proposed change will be from rural to the majority being residential 3 and residential 4a zones as defined in the Waimakariri District Plan. An outline development plan (ODP) was provided (Figure 1) which was overlaid with waterways mentioned later in the text. The ODP places stormwater treatment facilities across the development which will all flow toward the southeast of the plan change area, with green setback areas around waterbody areas of known environmental importance (App. I, Fig, a).

AEL was commissioned to assess the Plan Change area for ecological values in respect to waterways and waterbodies. This information will facilitate the finalisation of the Outline Development Plan in respect to the placement of setbacks and the ecological importance of aquatic habitats within the proposed plan change area (PPCA).

2.2 Methods

2.2.1 Background information

Some background information was available from previous studies, including previous trout spawning studies by AEL for the Waimakariri District Council (WDC), and AEL's district-wide studies underpinning

the WDC global consent for minor works on waterways. These studies did not include the proposed plan change area, but for context, provided ecological data in the general area, but also immediately downstream and to the north of the PPCA.

A low-scale fieldwork programme was followed as tabulated in Table 1.

Table 1. Field programme for the ecology assessment.

Date	Fieldwork
14/7/21	Initial reconnaissance
20/7/21	Trout spawning survey
21/7/21	Fish survey over PPCA-electric fishing
26-27/7/21	Fish survey over PPCA-netting and trapping

2.2.2 Electric fishing

Fishing locations and photos were recorded in the field using a high accuracy GPS receiver (Garmin GPSMap 64s). To assess the fish community, electric fishing was conducted, under AEL's electric fishing permits (MPI Permit 749, DOC 70754-FAU and under authority from NCFGC). The fished reaches encompassed all hydrological habitats in the surveyed waterways, most of which were considered riffles. The total sample time (i.e. the total time that the machine was actively electrifying the water) for these reaches was 57 minutes. Captured fish were then anaesthetised, identified, measured, and upon recovery from anaesthesia, released back into their resident habitats.

All electric fishing locations (Fig. 1) were fished on 21/07/2021 using a conventional Kainga EFM300 electric fishing machine at an operating voltage of 200 V. D.C. This voltage provided a sufficient electrical field size to prevent escapement. Electric fishing serves to briefly (approx. 3 seconds) render fish unconscious to facilitate their capture in nets for identification. The machine incorporates a timer, allowing the effective fishing time to be recorded. Overall conditions for fish capture using electric fishing were adequate, with good water conductivity and excellent water clarity.

2.2.3 Netting and Trapping

Due to the depth and macrophyte growth of a number of waterways on the property, electric fishing was supplemented with set-netting and trapping. This is because netting and trapping fishing techniques are more effective where deep and slow-flowing water is present. Nets and traps were set in the Southern Spring Channel, Groundwater Seep, and Ponded Drain, and deployed overnight on the 26th of July 2021 (Table 2, Figure 1). Nets used were mini and medium-sized baited fyke nets, with a 12 mm mesh. Traps used were Gee Minnow™ (GM) lines. Each line consisted of five baited Gee Minnow™ traps.

Table 2. Net and Trap setting on 26th July 2021.

Waterway (as in Fig. 1)	GM lines	Fyke nets (and size)
Groundwater Seep	2	2 mini
Southern Spring Channel	3	3 mediums, 1 mini
Ponded Drain	1	0

All captured fish were anesthetised, identified, measured, and after recovery, released back into their resident habitat.

2.3 Analytical methods and approach

During fieldwork, the provided ODP was accessed *via* a GPS-enabled ruggedised iPad, facilitating the corelation of core habitats to features in the field. Mapping was undertaken with Google Earth Pro and QGIS (v. 3.16.4). Isolated waterbodies were identified from Google Earth imagery of the PPCA with their hydrological sources evaluated using the sliding temporal scale with that software (2005-Dec 2020).

2.4 Description of waterways, fish fauna

Notably, all waterways and springheads we observed were effectively fenced from stock, either with a single electric hotwire, or multiple strands of barbed wire. We observed no apparent examples of stock intrusion into riparian zones. Fished habitats had a substrate composed of gravel with some silt, except for the Ohoka Stream tributary which had a gravel bed (Table 3).

Table 3. Substrate and depths of electric-fished sites in the PPCA.

Electric-fish location	Lower South Ohoka Branch	Lower South Ohoka Branch #2	Lower South Ohoka Branch #3	Upper South Ohoka Branch	Ohoka Tributary	Northern spring Channel
Substrate	gravel bed, ~30% embedded	90% fine + coarse sediment, 10% gravel (embedded)	gravel, 10% embedded	Soft sediment, wetland/macrophyte growth in waterway	Loose gravel bed, riffle, high flow	Soft sediment, macrophytic growth present (e.g. milfoil)
Reach length (m)	25	23	30	25	35	40
Maximum depth (cm)	25	27	17	24	37	26
Average depth (cm)	17	25	14	18	29	20

Based on our fieldwork, the physical habitats of surveyed waterways are described here, in north to south order, along with the fish catch results (Table 3). Photographs of the waterways are provided in App. II (Figs. a-e).

2.5 Fish results synopsis

Following significant fishing effort using electric fishing, netting and trapping techniques, a total of four species were identified on the 535 Mill Road property (Table 4). These were, in order of catch abundance, the upland bully (*Gobiomorphus breviceps*), shortfin eel (*Anguilla australis*), longfin eel (*Anguilla deiffenbachii*) and brown trout (*Salmo trutta*).

The brown trout was only identified in the Ohoka tributary. Suitable habitat for this species was identified in the lower reaches of the South Ohoka Branch, however after a significant electric fishing effort no brown trout were identified in this reach. Upland bullies in all fished locations appeared gravid, and therefore will be breeding within the property boundaries.

Table 4. Fish catch within the 535 Mill Road PPCA.

Site	Ohoka Stream Tributary	South Ohoka Branch	Northern spring	Southern spring incl. channel	Groundwater seep	Ponded drain
Method	**Electric fishing**	**Electric fishing**	**Electric fishing**	**Netting + Trapping**	**Netting + Trapping**	**Netting + Trapping**
Fishing Pressure	**14 minutes**	**33 minutes**	**10 minutes**	**4 GM lines, 4 Fyke nets**	**2 GM lines, 2 Fyke nets**	**1 GM line**
Upland bully	20	23	6	7	10	0
Shortfin eel	1	22	2	7	0	0
Longfin eel	0	1	0	1	0	0
Brown trout (juvenile)	1	0	0	0	0	0
Unidentified bully	2	3	0	0	0	0
Total row	**24**	**49**	**8**	**15**	**10**	**0**

2.5.1 Ohoka Stream tributary

To the north, and the waterway with the most apparent flow volume, was a tributary of the Ohoka Stream (Fig. 1). This waterway had a significant baseflow during our winter survey, and possessed a gravel substrate. It was considered perennial and flow-stable, based on the growth of luxuriant marginal aquatic flora and fauna (App. II, Figs. a, b). For the electric-fished reach near the proposed stormwater treatment reserve, the average surface water depth of this channel (along its thalweg or mid-line), at time of survey, was c. 29 cm.

A fresh (i.e., recent) trout redd was identified in the middle of PPCA (Fig. 1), but older redds were found north and south of this location (Fig. 1). So trout spawning habitat suitability may be widespread. Two native fish species were identified, neither of which have conservation status: the upland bully, and the shortfin eel. A number of juvenile bullies could not be identified to species level, but these are likely to be upland bully as well.

The ODP indicates this waterway is expected to have a minimum 10m esplanade setback each side which is likely to protect instream values, including those of trout spawning and maintenance of native fish populations. To maintain trout spawning habitat, the waterway would require low TSS and flow stability during the winter months. Upland bully requires clean gravel for spawning, and associated with high bully abundance. The tributary provides rearing for small brown trout, and both habitat and flow stability is important for this species. The channel should remain free of instream structures to facilitate the movement of large spawning trout between the PPCA and the lower reaches downstream of Whites Road. Any stormwater treatment outlets in this channel should be situated away from suitable trout spawning locations. These can be mapped when a more detailed plan is required.

2.5.2 Groundwater Seep

A short (c. 170 m) distance to the south, an isolated groundwater-fed channel flows towards Whites Road, appeared during the site investigation to be fed by a groundwater seep (Fig. 1), especially so when the water table is high during winter months, and reaches of the Groundwater Seep contain an abundance of macrophytes particularly watercress (App. II, Fig. c, d). During winter there was a perceptible flow, over a fine-substrate base. During summer, we consider that the channel would lose a significant proportion of base flow. However, based on the aquatic fauna present, some water is always present in the channel.

Only upland bullies were identified from the Groundwater Seep, despite significant fishing effort.

2.5.3 Northern Spring Channel

The northern spring channel is a linear waterway traversing the PPCA, and originating from a spring near Bradleys Road (Fig. 1). Substrate in this channel consists of a mixture of fine sediment and embedded gravel. Flow is slow but perceptible, at least during the winter months. The average surface water depth of this channel, taken across the electric fishing reach (Fig. 1), was c. 20 cm. Plant zonation suggests that the flow is perennial.

A reach in the northern third of the channel was electric fished (App. II, Figs. e, f) with the shortfin eel and upland bullies identified. The flow may be too low, and the substrate too fine, to provide trout spawning habitat.

2.5.4 Southern Spring Channel

The Southern Spring Channel originates in two large deep ponds near the main homestead, one of which (more northern) appears recently man-made. The ponds are identified as a spring on Canterbury Maps. The southern pond has a small discharge channel which flows south towards Whites Road(App. II, Figs. g, h). The ponds are surrounded by mature oak trees, and contain large amounts of woody debris and leaf litter from the surrounding deciduous trees. The channel contains a fine sediment substrate and a significant abundance of introduced macrophytes, especially watercress. Both springs and their respective channels are considered perennial.

The headwater ponds and channel were subject to significant fishing pressure during this survey. Three fish species were identified: the upland bully, shortfin eel, and the longfin eel. The longfin eel is the only species in the PPCA with a conservation status of "declining" (Dunn *et al.* 2017). It has a higher dependence of bank cover and water depth than the non-endangered shortfin eel. The specimen in the spring head was large (c. 1100 T.L.), reflecting the depth and size of its resident habitat.

Large eels need to be able to access the sea so they can migrate to their tropical spawning grounds, therefore the ecological linkage between the springhead to Whites Road (i.e., Southern Spring Channel, Fig. 1) is important in this role.

2.5.5 Ponded Drain

Ponded Drain (Fig. 1) is considered ephemeral, as indicated by tall fescue and the facultative aquatic buttercup growing on the channel base. This channel is likely used to drain runoff during rainfall, and their base flow appears to be zero. A fishing attempt in the limited amount of ponded drain water did not identify any aquatic species (App. II, Figs. i, j).

2.5.6 South Ohoka Branch

During our winter baseflow visit, this waterway conveyed a clear-water flow, over a gravel base. Similar to all other waterways in the PPCA, the fenced banks and bed were stable. The upper section west of the farm buildings is ephemeral, and while it was watered during our visit (App. II, Fig. k, mean depth c. 18 cm), it was observed to dry during a recent visit (pers. obs. Peter McAuley, Inovo). No obligate aquatic macrophytes were observed between Bradleys Road and the farm buildings, nor were any fish identified during the fishing survey.

However, the downstream section, east of the farm buildings, was considered to contain perennial flow. The average mid-channel water depth in this reach was c. 19 cm. The substrate in the downstream section consisted of loose gravel, with short sections of fine sediment. Three fish species were identified in moderate numbers, the upland bully, shortfin eel, and the longfin eel, the latter possessing conservation status. A number of small bullies could not be identified to species level, but were, very likely, juvenile upland bullies. No brown trout were identified during the fish and brown trout survey, but trout redds were identified during the spawning survey, but only east of the farm dwellings. We also note that the waterway is not fenced immediately downstream of the PPCA (south-east of Whites Road), and is currently quite degraded by stock access. This results in bank erosion, channel widening and sediment increases. Based on Google Earth Street View imagery, this appears to be an ongoing issue. Therefore, we consider that the PPCA reach of this stream would represent an important refuge of high-quality habitat for rearing and spawning for trout and native fish.

Accordingly, we would recommend the protection and naturalisation of this channel, but preserving the hydraulics and gravel substrate which are particularly important for trout spawning. In particular, the preservation of the existing wetted channel width at winter baseflow.

2.5.7 Ponded Drain 2 (dry)

This fenced waterway was chocked with buttercup and pasture grass and was too shallow to fish (c. 2 cm, App. II, Figs. m, n). The channel appeared to be ephemeral, and shallowed down-gradient and southwards. It appeared to have no ecological value, and any water in the channel is likely to originate from rainfall or irrigation runoff.

2.5.8 Unnamed Stream (dry)

This waterway ran along the south boundary of the PPCA and lacked surface water for most of its course, with surface water limited to puddles (App. II, Figs. o, p). There was no vegetation at all in the channel, and we consider it likely the channel is dry for most of the year.

2.5.9 Isolated waterbodies

A number of waterbodies were located, and were assessed in respect to their status as a natural wetland as per the MFE National Policy Statement (Ministry for the Environment 2020a), the Land and Water Regional Plan (LWRP) and the RMA.

In this regard, in Ministry for the Environment (2020a), a natural wetland means a wetland (as defined in the Act) that is not:

(a) a wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or
(b) a geothermal wetland; or
(c) any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain-derived water pooling

In the Land and Water Regional Plan (LWRP):...."

Wetland includes:
1. wetlands which are part of river, stream and lake beds;
2. natural ponds, swamps, marshes, fens, bogs, seeps, brackish areas, mountain wetlands, and other naturally wet areas that support an indigenous ecosystem of plants and animals specifically adapted to living in wet conditions, and provide a habitat for wildlife;
3. coastal wetlands above mean high water springs;

but excludes:
(a) wet pasture or where water temporarily ponds after rainfall
(b) artificial wetlands used for wastewater or stormwater treatment except where they are listed in Sections 6 to 15 of this Plan;
(c) artificial farm dams, drainage canals and detention dams; and
(d) reservoirs for firefighting, domestic or community water supply.

Under the RMA 1991 the definition of a wetland is simple:

"wetland includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions"

Waterbody 1

This shallow disconnected puddle was situated in the middle of a paddock, and appeared to be a puddle which lacked wetland vegetation, and was not fished (App. II, Fig. q). It possessed no wetland vegetation and was surrounded by pasture grass. It was not regarded as a natural wetland under the NPS 2020 definition, nor a wetland under the LWRP and RMA definitions.

Waterbody 2

This is the remnant of an old fluvial channel, now appearing as a depression vegetated in dryland plants (App. II, Fig. r). There was no surface water, aquatic plants, nor signs of aquatic habitat. However, the fluvial channel depression was quite apparent in 2012 satellite imagery. It is possible the channel has been partially filled in the meantime. It was not regarded as a natural wetland under the NPS 2020 definition, nor a wetland under the LWRP and RMA definitions.

Waterbody 3

This site may also have been a segment of a historic fluvial channel, but appears to be waste ground used for land fill, surrounded by grazed, heavily pugged pasture. It was not regarded as a natural wetland under the NPS 2020 definition, nor a wetland under the LWRP and RMA definitions.

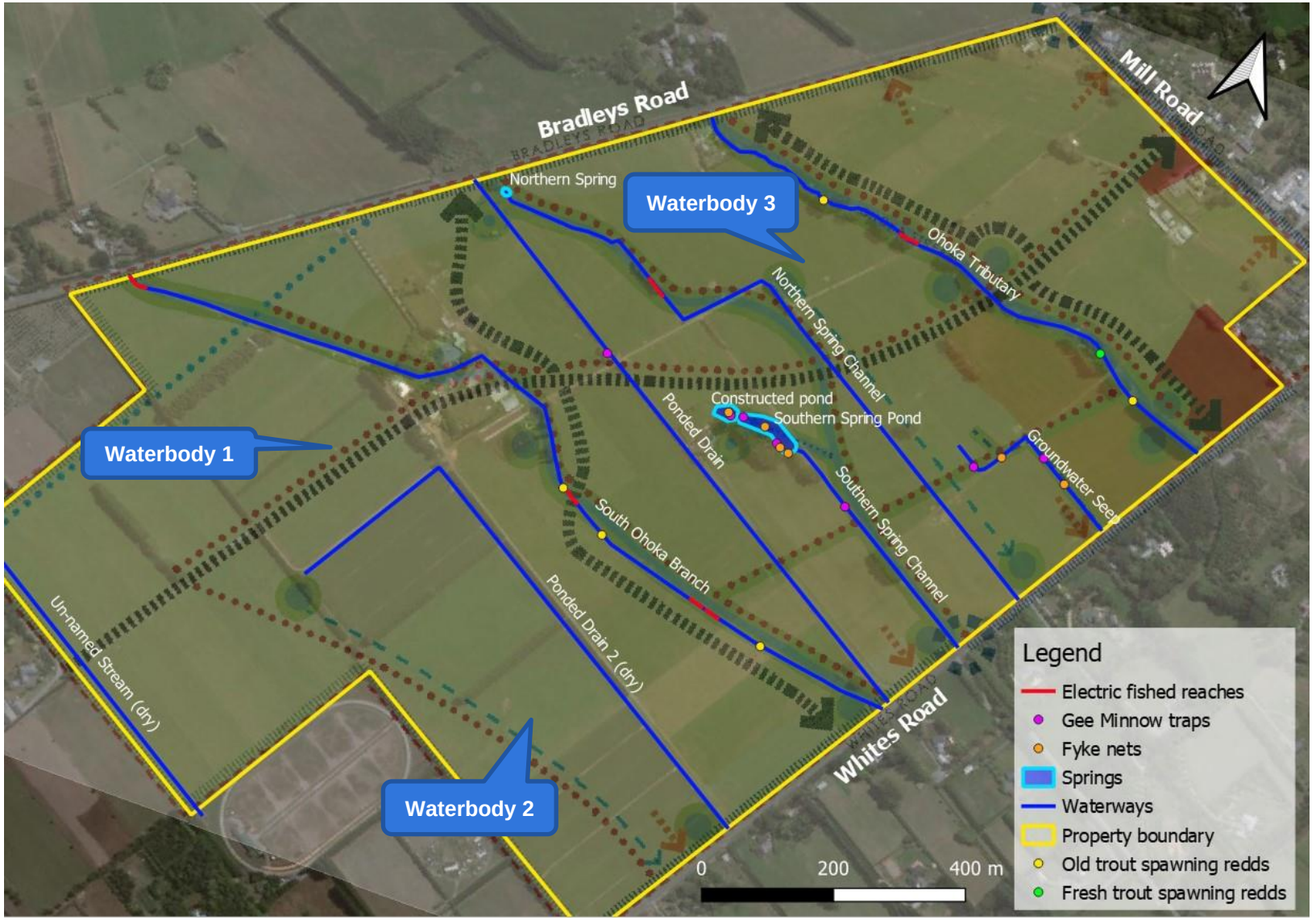

Figure 1. The outline development plan overlaid with waterways mentioned in the text.

3 Discussion

3.1 Ecology synopsis

No New Zealand Freshwater Fish Database (NZFFD) records have been recorded from the PPCA, although records exist in the surrounding area. Surveys completed by the Canterbury Regional Council (now Environment Canterbury) in 2001 record upland bullies (*Gobiomorphus breviceps*), common bullies (*Gobiomorphus cotidianus*) and shortfin eels (*Anguilla australis*) at Whites Road in the adjacent Ohoka Stream tributary, and the so-called "existing stream" at Whites Road (NZFFD cards 19680-19682, 19689-19690). A 2011 Department of Conservation (DOC) survey of the Ohoka Stream tributary downstream of Whites Road confirmed the presence of these three species. However, this survey also identified longfin eels (*Anguilla dieffenbachii*) and brown trout (*Salmo trutta*) in the waterway (NZFFD card 32080). The identified fish fauna in the Plan Change Area, in order of probable natural abundance, is the four species: upland bully, shortfin eel, longfin eel, and brown trout. It is probably that unidentified bullies are likely to be just upland bullies which are too difficult to identify in the field to species level. It is possible that some of these fish were common bullies. Of these, only the longfin eel has a significant conservation status of "declining", the remaining native species have a status of "not threatened", and the brown trout is introduced (Dunn *et al.* 2017).

In the PPCA, all of the waterways and waterbodies with ecological value were effectively fenced from stock, consequently bank structure, marginal plant growth, and substrate were stable. In particular, the fencing along the Ohoka Stream tributary, and the South Ohoka Branch maintains the coarse substrate and hydraulic characteristics essential for trout spawning.

A significant trout spawning survey was undertaken on the Ohoka Stream by AEL in 2018, as part of the Global Consent for the Waimakariri District Council & Environment Canterbury (Webb *et al.* 2018). Low numbers of trout redds (c. 5-25 redds/km) were identified from the Ohoka Stream tributary, downstream of Whites Road. The 2018 survey did not extend onto the PPCA.

The fish fauna within the PPCA was characteristic of steady flows, stable bank and habitat structure, with some gravel substrate. Of the four fish species identified, only the longfin eel had conservation status of nationally declining (Dunn *et al.* 2017). The remaining three species are listed as unthreatened (upland bully, shortfin eel), or introduced (brown trout)(Dunn *et al.* 2017).

The two eel species (i.e., shortfin eel, longfin eel) require sea access to complete their life cycles, being adept climbers as migratory juveniles, they can negotiate some instream structures like culverts and weirs. Adult spawning brown trout require access through Whites Road culverts along the courses of the Ohoka Stream tributary, and the South Ohoka Branch. Upland bullies spawn and rear locally, and benefit from gravel and cobbles for spawning and refuge (Jowett & Boustead 2001). The longfin eel grows to a large size, and is one of the largest freshwater eels species in the world. In the PPCA, a specimen of 1100 mm in length was obtained from the springhead at the Southern Spring Channel, and large individuals require significant water depth and stable bank structure.

The PPCA falls within the natural ecological range of the critically endangered Canterbury mudfish (*Galaxias burrowsius*). Accordingly, we were careful to ensure that the area was well-surveyed for isolated waterbodies where this species can survive, and that fishing methods were appropriate to catch these rare fish if they were present. However, given the results of this study, we are confident that the Canterbury mudfish does not survive in this PPCA. This is partly due to their absence in the fish catch, but also due to inability to survive predation and competition from the introduced brown trout and native eels, which are clearly widespread in the PPCA.

We did not survey freshwater invertebrates at the Plan Change level, as these assays can be undertaken at the consenting and AEE stage. Given the stable nature of the banks and flow, and the presence of some gravel reaches, we are confident that the invertebrate fauna would reflect at least fair stream health, and we consider it likely that koura (*Paranephrops zealandica*) are present in some locations.

3.2 Habitat requirements to preserve ecological values

Below are specific and general requirements to preserve fish values in the PPCA.

- Maintaining bank stability.
- Maintenance of spring base flows, and springhead depth (esp. at the Southern Spring Channel).
- Maintenance of suitable hydraulics, and unsilted trout spawning gravels in the Ohoka Stream Tributary and the South Ohoka Branch.
- Maintenance of fish passage for trout for the Ohoka Stream tributary and the South Ohoka Branch.

3.3 Notes on waterway alignment in respect to the November ODP

Following our ecological findings, some waterways are planned to be realigned to facilitate the development of an Outline Development Plan. All realignment proposals will be subject to accordance with the NES-F (National Environmental Standards) 2020 after the Plan Change stage. Waterways are presented in north-to-south order.

- There is no proposed change, in terms of alignment, in the Ohoka Tributary to the north of the PPCA, which will be left in its natural state.

- The Groundwater Seep may have a seasonal groundwater feed, and would benefit from being meandered and naturalised in some way.

- It is considered beneficial to combine the Northern Spring Channel baseflow into the Southern Spring Channel, possibly downstream of the spring-fed ponds. Both channels are perennial and are likely to be meandered and naturalised. The old linear channel of the Northern Spring Channel will then be decommissioned.

- The course of Ponded Drain, which appears ephemeral, could be diverted into the perennial Southern Spring Channel. The preference would be to maintain the perennial course of the lower Southern Spring Channel. The old linear course of the Ponded Drain will then be decommissioned.

- The course of the South Ohoka Branch will be retained in its present form.

- The course of Ponded Drain 2, which appears highly ephemeral, could be realigned into the South Ohoka Branch, but as its dry and lacks aquatic values, it can be decommissioned

- The channel on the southern boundary of the PPCA (referred to as Un-named Stream) was largely dry, and could remain in this location and provide utilitarian function as a swale. A 5 m buffer could be used as a service lane.

- Waterbodies 1, 2, and 3 (see Fig. 1), upon inspection, were not considered to be wetlands under the Act, LWRP, or the NPS-FM. Since they lacked any ecological merit, they may be decommissioned.

3.4 Recommendations on development setbacks and buffer strips

- A minimum 10 m ecologically functional buffer strip on each side of the principal waterways as measured from the water's edge (i.e. Ohoka Stream tributary, Groundwater Seep, Northern Spring and Southern Spring Channels, and South Ohoka Branch.) A width of 10 m or more is required to provide nutrient uptake, erosion control, shading to control nuisance aquatic weed

growth (if canopy height exceeds wetted width). At a minimum width of 10 m, there will be some ecological function for stream invertebrates .

- The setback on the southern Boundary (un-named stream in Fig. 1), can be reduced to a service strip of 5 m.
- A minimum of a 20 m buffer setback for the northern spring
- A minimum of a 30 m setback for the large Southern spring as indicated in the November ODP.

4 Conclusions

Our recommendations on setbacks and buffer strips, released earlier to the Applicant, have been incorporated into the November 2021 ODP (Appendix I, Figure a).

If the habitat requirements in section 3.2, the realignment notes in section 3.3 (including being subject to accordance with the NES 2020) and the recommendations on setbacks and buffer strips in section 3.4 are implemented, then the change of land use from rural to residential and commercial will maintain and/or improve the current ecological status of the land within the plan change area.

5 Acknowledgements

We thank Peter Sheriff for his assistance with land access, orientation to waterways, and discussions about the waterways in the PPCA. We are grateful to Janine McIvor and Malcolm Main for fieldwork assistance. Laura Drummond and Bas Veendrick, of Pattle Delamore Partners, made comments on an earlier draft.

6 References

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Jowett, I. G.; Boustead, N. C. 2001: Effects of substrate and sedimentation on the abundance of upland bullies (*Gobiomorphus breviceps*). *New Zealand Journal of Marine and Freshwater Research 35*: 605-613.

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7 Appendix I. Land use change plan (November 2021)

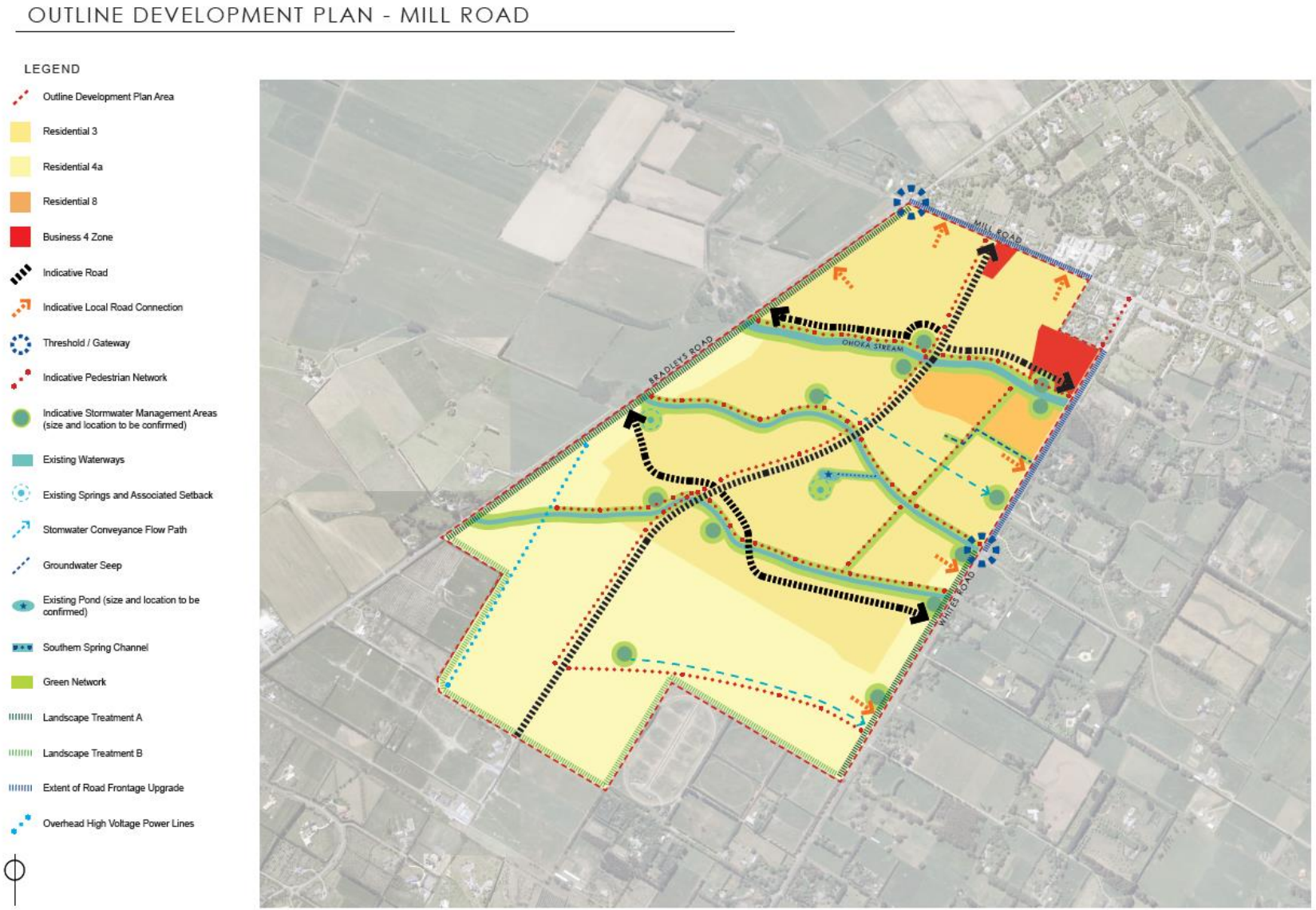

Figure a. Draft outline development plan for the land use change proposed at 535 Mill Road.

8 Appendix II. Photographs obtained during the field surveys

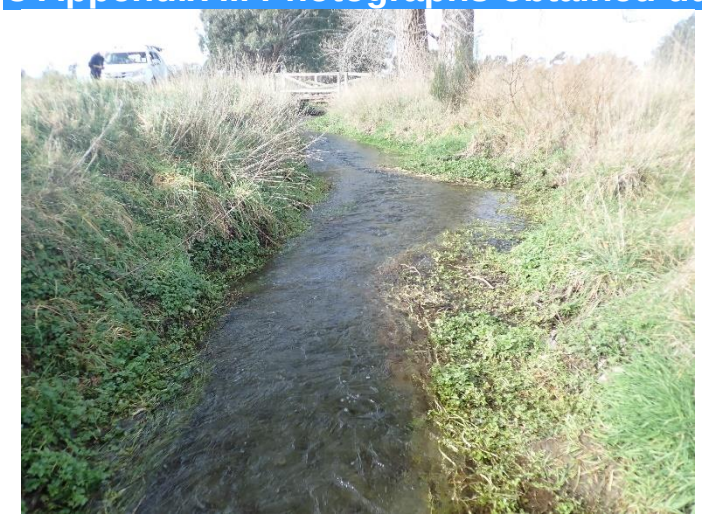

Figure a. Ohoka Stream tributary. Shortfin eels, upland bullies and brown trout were identified in this waterway. A fresh trout spawning redd was also located.

Figure b. Ohoka Stream tributary. Note the hotwire effectively protecting the fragile banks and marginal vegetation.

Figure c. Upstream section of the groundwater seep. Upland bullies were located in this section, caught in Gee Minnow traps (pictured).

Figure d. Downstream section of groundwater seep. Upland bullies were caught in this reach. Waterway fenced from stock by hotwire.

Figure e. The spring at the head of the Northern Spring Channel. It is protected by a hot-wire around its periphery.

Figure f. Northern spring channel. Upland bullies and shortfin eels were identified in this waterway.

Figure g. The south pond at the head of the Southern Spring Channel. Species located in these ponds were the longfin eel, shortfin eel and upland bully.

Figure h. Southern spring channel. The only species recorded in this channel was the upland bully. Turbidity in this photograph was from the setting of the GM traps line.

Figure i. GM traps set in the ponded drain. No flow is visible in this drain, and no fish species were recorded.

Figure j. Ponded drain, downstream of the GM set. Note the absence of aquatic flora.

Figure k. Upstream section of existing stream. No fish were identified at this location.

Figure l. Downstream section of existing stream. Longfin eels, shortfin eels, and upland bullies were present in this reach.

Figure m. Ponded drain 2. This waterway contained minimal (c. 3 cm) surface water, insufficient to fish.

Figure n. showing the small amount of water and terrestrial plants in ponded drain 2.

Figure o. Showing a ponded section of the Un-named south boundary waterway.

Figure p. Un-named south boundary waterway, looking upstream. At the time of survey, this was a dry channel with two shallow ponded sections located. No aquatic flora was identified, and therefore the shallow ponds were deemed low value.

Figure q. Waterbody 1. This pond filled a small depression in the middle of a paddock. No aquatic value and stock-accessible.

Figure r. Waterbody 2. The remains of an old fluvial channel present before 2012.

APPENDIX 2

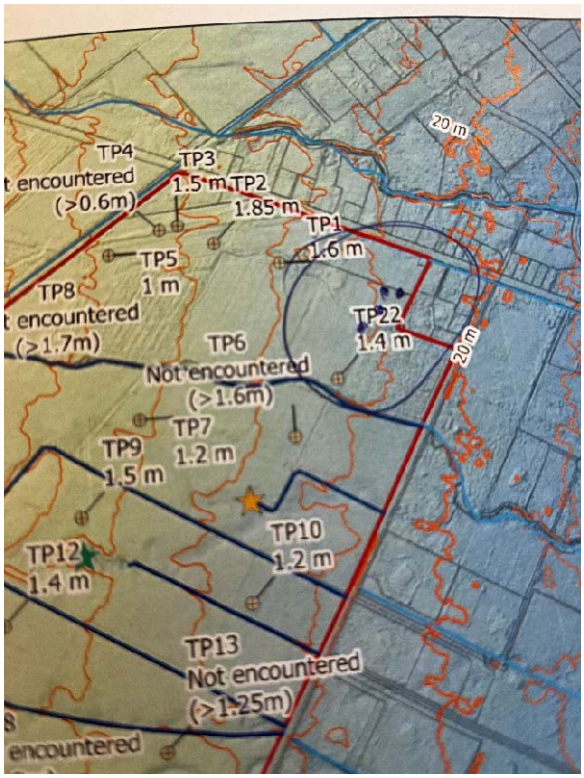

Figure 1: Submitter mark-up showing areas of potential spring presence (dots in circled area).

Figure 2: Surface water ponding in a depression area.

Figure 3: Surface water ponding in a depression area.

Figure 4: Surface water ponding associated with farm track.

Figure 5: Surface water ponding within the farm track.