Before the Independent Hearings Panel
at Waimakariri District Council

under: the Resource Management Act 1991

in the matter of: Proposed private plan change RCP31 to the Operative Waimakariri District Plan

and: **Rolleston Industrial Developments Limited**
Applicant

Evidence of Mark Taylor

Dated: 7 July 2023

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EVIDENCE OF MARK TAYLOR

1 My full name is Mark Taylor. I worked as a Senior Technical Officer for Fisheries Research Division (MAF), and National Institute of Water and Atmospheric Research (*NIWA*), before establishing Aquatic Ecology Limited (*AEL*) in 2001.

2 I have been a member of the New Zealand Freshwater Sciences Society for many years, and have served on the Living Laboratory Trust for the Styx River for many years.

3 Working under AEL we have had extensive greenfield survey work, mostly in Canterbury, and in the Waimakariri District, for industrial, retail and residential developments. However, we also have significant experience with ecological surveys for local government, including the Christchurch City Council, Waimakariri District Council (*WDC*), Fish and Game Council, and Environment Canterbury.

4 In particular reference to this study area, AEL has conducted trout redd surveys on the Ōhoka catchment for WDC in 2018, and fish resource and wetland surveys for this proposed plan change in 2021. We are contracted, quite soon, to undertake further trout resource surveys in the Ōhoka Stream receiving waters for WDC in July 2023, and were involved in ecological studies underpinning the WDC's global consent for minor river works.

5 In the recent past, AEL has been involved in green field ecological resource surveys for the development of Bellgrove north of Rangiora, and other small developments. We have also been involved in the translocation and care of fish during civil works involving road culverting on several occasions, including Ōhoka Stream.

CODE OF CONDUCT

6 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.

SCOPE OF EVIDENCE

7 In my evidence, I present the results of our ecological survey of the proposed Plan Change Area PC31 (**App. I, Fig. i**), and the ecological

impacts of a Plan Change of this area (c. 156 Ha), from rural to a zoning of Residential 2, Residential 4a, and Business 4 zones.

8 Documentation that I have considered in this evidence includes:

8.1 My AEL Report (No. 192) which I prepared in November 2021 for this plan change;

8.2 The latest Outline Development Plan (*ODP*) made available on 5th July 2023;

8.3 A minor amount of additional fieldwork to assess stream health on the 30th June 2023;

8.4 The S42A report;

8.5 Ms Laura Drummond's evidence; and

8.6 Selected Submissions.

SUMMARY

9 The fish community in the Plan Change Area were composed of four fish species, the native fish were composed of the longfin eel, shortfin eel, and upland bully. The brown trout was only identified from Ōhoka Stream, where the adult spawn in the winter months. We did not identify any rare fish, and are confident that the Canterbury mudfish does not occupy the proposed Plan Change Area.

10 Waterways and wetlands in the Plan Change Area were fenced from stock, and stream health metrics, based on indicator aquatic invertebrates, indicated "fair" stream health. Notable clean-water taxa, including native mayflies and caddisflies are present in low numbers, suggesting a degree of ecological connection to habitats downstream, particularly the long-established reserve of Ōhoka Bush.

11 It is considered that, with ecologically suitable riparian buffer strips and the existence of clear ecological pathways from downstream habitats, the ecology in the Plan Change Area can be significantly enhanced from its currently "fair" level. However, this will also require a high standard of stormwater treatment to protect the instream ecology within the Plan Change Area, but also the receiving environment, including Ōhoka Bush. Proposed stormwater treatment is covered in **Ms Drummond's** evidence.

12 Given the utility of Ōhoka Bush as a source of native insects, and an existing "fair" level of stream health within the Plan Change Area, a

high level of ecological protection holds promise to produce aquatic habitats of a significant standard in the Plan Change Area.

PHYSICAL HABITATS

13 The majority of the Plan Change Area is currently in use as a dairy farm. The farm does have a recent Farm Management Plan prepared by Fonterra, dated December 2020. The inspection showed a high degree of compliance with Fonterra's farm environment guidelines, with stock excluded from all waterbodies and waterways. The exclusion of waterways from stock was confirmed by our winter 2021 visit.

Fluvial Channels

14 Following an initial reconnaissance survey on 14th July 2021, a number of habitats were identified (**App. I ,Fig. i**), and recorded in my original report dated November 2021. Flowing waterways with permanent flow were, to the north, a major **tributary of the Ōhoka Stream**. This waterway had the most flow volume, and is a significant tributary of the Ōhoka Stream, or it could be regarded as the mainstem. 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**).

15 A short (c. 170 m) distance to the south, an isolated groundwater-fed channel flows towards Whites Road (named **groundwater seep**), and appeared during the site investigation to be fed by a groundwater seep, 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**). 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, some water is always present in the channel.

16 A short distance to the south, a spring fed channelised waterway traversed the Plan Change Area, which we named the **Northern Spring Channel.** 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 was c. 20 cm (**App. II, Figs. d, e**). Plant zonation suggests that the flow is perennial. This channel is fed by a spring, named Northern Spring, which has its origin within the Plan Change Area near Bradleys Road (see App. I) and is identified on Canterbury Maps.

17 Further south again, a channelised waterway rising from a spring (called Southern Spring pond) located roughly in the middle of the Plan Change Area, which we call the **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. A spring is identified on Canterbury Maps in this location. The southern pond has a small discharge channel which flows south towards Whites Road (**App. II, Figs. f, g**). 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.

18 Continuing south, **Ponded Drain** was considered ephemeral, as indicated by only facultive wetland plants (tall fescue and the buttercup) growing on the channel base. This channel is likely used to drain runoff during rainfall, and the base flow appears to be zero (**App. II, Fig. h**).

19 Further south, a branch of the Ōhoka River, termed the **South Ōhoka Branch** traverses the site. During our winter baseflow visit, this waterway conveyed a flow of clear water, over a gravel base (**App. II, Fig. i**). Similar to all other waterways in the proposed Plan Change Area, the fenced banks and bed were stable. The upper section west of the farm buildings is ephemeral, and while it had shallow water (c. 18 cm) during our visit (**App. II, Fig. j**, mean depth c. 18 cm), it was observed dry on a later date. No obligate aquatic macrophytes were observed between Bradleys Road and the farm buildings, nor were any fish identified during the fishing survey.

20 Continuing south, two ephemeral channelised habitats were at the southern end of the Plan Change Area, referred to as **Ponded Drain 2**, and **South Boundary Drain**, both of which lacked surface water in the winter of 2021.

Isolated Waterbodies

21 Based on their hydrology and botany, three damp areas in the south of the Plan Change Area were regarded as non-wetlands under the recent MFE guidelines (Ministry for the Environment 2020). These lacked water and water-loving plants (i.e. hydrophytes).

22 Natural wetlands under the recent MFE guidelines are represented by the **Southern Spring pond**, drained by the Southern Spring Channel and the springhead comprising the **Northern Spring.** Several isolated wet areas were assessed and categorised as "non wetlands" under the MFE guidelines.

AQUATIC ECOLOGY, DISPERAL AND COLONISATION

23 In shallow habitats, fishing was conducted using a standard electric fishing machine (Kainga EFM 300), whereas nets and traps were used in deeper waters (depths > 0.5 m). followed by a trout spawning survey on the 20th July 2021, to identify trout spawning reaches, then an ecological survey on 20-21st July 2021 (electric fishing), followed by a netting and trapping on 26-27th July 2021.

24 A total of four fish species were identified from the area. In order of capture abundance, these were upland bully, shortfin eel, longfin eel, and brown trout.

25 The Ōhoka Stream is an active trout spawning area, as demonstrated by our trout spawning survey in July 2021, and also serves as a rearing area for juvenile trout. It also forms a habitat for the native upland bully and the two native eel species.

26 The Central springs (northern and southern) and their channels includes both species of native eel and upland bullies, and eels and native bullies were found in most habitats in the Plan Change Area. No fish were identified in an isolated pond in the swale marked as Ponded Drain 2.

27 There are many examples of naturalised waterways in Canterbury, but restoration of native biodiversity and ecology has varied. One of the biggest problems to restoration is considered to be colonisation and dispersal issues, in that biota from reaches upstream or downstream cannot reach the restored reaches *via* the water path, initially to colonise naturalised habitats, but also to complete migratory lifecycles.

28 I consider that this ecological potential could be realised in the waterways in the Proposed Plan Change Area, provided upstream dispersal continues to occur from Ōhoka Bush, and upstream through the Ōhoka Stream bridge at Whites Road (**App. I, Fig. k**).

29 The native upland bully spawns and rears locally, and prefers gravel substrates. It is likely that upland bully recruitment from Ōhoka Bush habitat already benefits the Plan Change Area, by accessing the waterways through the Whites Road bridge. Habitat improvement within the plan change area will benefit this fish, but it is probable that birdlife in the Ōhoka Bush, will access proposed riparian flyway corridors through the Plan Change Area.

30 After 17 years of native bush establishment, stream health in Ōhoka Bush is high. A recent (27th June 2023) macroinvertebrate sample indicated particularly high stream health ecological metrics (MCI-hb 106, QMCI=6.2, %EPT = 81), which relates to "good" stream health in respect to the MCI, and "excellent" in respect to the QMCI metric

(Stark & Maxted 2007) (**App. II. Fig. l**). This resounding ecological result also attests to high water quality entering the Ōhoka Bush reserve from the Plan Change Area. During the 2018 trout redd survey the clear water and heterogenous flow structures were noted through Ōhoka Bush (Webb *et al.* 2018).

31 We also took the opportunity to assess the stream health at sites in the Plan Change Area. Within the Plan Change Area, Ōhoka Stream had stream health metrics a little lower (MCI=97.3 "fair", with a qMCI=5.88 "good") than the Ōhoka Bush reach, 560 m downstream.

32 For the South Ōhoka Branch, which does not have a surface flow connection to Ōhoka Bush, stream health metrics were lower, but not bad (MCI=82 "low fair", qMCI=3.9 "high poor"). Some "high-health" macroinvertebrates were present in low numbers (%EPT 6% abundance), compared to over 85% abundance EPT/clean water for the Ōhoka Stream and Ōhoka Bush sites.

33 Colonisation from sources upstream of Bradleys Road appear more limited, as they lack the degree of catchment naturalisation observed in Ōhoka Bush. It is worthy to note that several of the waterways rise within the Plan Change Area, so lack upstream colonisation sources. However, this makes colonisation from downstream sources even more important, if ecological restoration is to be realised. However, it would be possible, and I would recommend, translocating numbers of the native macroinvertebrates from Ōhoka Bush into the Northern Spring Channel, and South Ōhoka Branch to reduce their reliance on upstream migration path, and facilitate the colonisation process.

34 Once through the bridge, ecological dispersal to the groundwater seep, Northern Spring Channel, and Southern Spring Channel, and Ponded Drain, are also currently possible along the roadside drain along Whites Road. It is important that the Whites Road waterway is preserved, with minimum recourse to culverting (except for road crossings). Culverts will comply in respect to the NES in respect to fish passage (New Zealand Government 2020), but culverts inhibit macroinvertebrate passage (Blakely *et al.* 2006), and bridges are preferred.

35 Ideally, all channel crossings are achieved by bridging and not culverts. Culverts have the potential to stop the movement of aquatic macroinvertebrates, even if they are compliant in respect to fish passage. This is something that can be worked through at subdivision consenting stage.

ŌHOKA DESIGN REPORT (6 JULY 2023)

36 The plan indicates illustrative examples of native riparian strips and walkways to be used along the main waterways and waterbodies, with designs yet to be audited for ecological function. Bridge designs will provide open lit cross-sections above the water to allow the easy movement of fish and invertebrates along the channel.

OUTLINE DEVELOPMENT PLAN (5 JULY 2023 C. 4:47 PM)

37 Overall, it is proposed to naturalise almost all waterways which possess aquatic values, which in-turn increases and enhances the biodiversity.

38 The latest outline development plan differs from earlier versions by lacking a central Collector Road through the South End of the Plan Change Area, by incorporating a local road connection instead. The plan now removes the Residential 8 area, and other than two small Business 4 Zones and a school overlay/Residential 2, the remainder of the Plan Change Area is a mix of Residential 2 and Residential 4a housing. A large area of open ground will be used as a Polo Ground, but could be used for Residential 2 housing.

39 Proposed development setbacks have increased particularly for the Ōhoka Stream, but also for the South Ōhoka Branch, along with setbacks around the northern and southern spring channels, and the groundwater seep origin. These are tabulated in **App. III, Table 1**. Additional green areas have been provided around the origin of the groundwater seep. Pedestrian paths now feature around the central spring area, and the entire length of the Southern Spring Channel. An indicative pedestrian path link is proposed between the groundwater seep and the Ōhoka Stream.

40 These changes are manifested as improving amenity value for water features, but significant gains are also in setbacks around the Ōhoka Stream and its stormwater management areas (*SMAs*).

41 The importance of the dispersal path from existing naturalised areas are important for aquatic biota, and are summarised above. But ecologically functional riparian strips are proposed for the wetlands and waterbodies, and exceed the minimum required under the District Plan.

42 Some beneficial effects of vegetated riparian strips, like shading and reducing maximum water temperatures, but also nitrate uptake and sediment filtration can be achieved with vegetated buffer strips of just several metres in width. However, the uptake of phosphorous, and biological processes (mating, feeding, dispersal of adults) requires more vegetation width and a higher level of ecological suitability.

43 While specific widths demonstrating ecological function vary between studies, vegetated widths in excess of 10 m are most beneficial (Parkyn & Davies-Colley 2003). With flat topography and a considered planting plan with at least a partial focus on ecological function, I consider that setbacks in the order of 15 m will be sufficient to support ecological function. For swales which lack aquatic ecology values, a narrower strip may be used for the function of aesthetics, but also nutrient uptake and filtration of particulates within any overland flow.

PLAN CHANGE

44 Land use change from rural to low density urban, per se, is not necessarily an adverse impact to ecological values provided the following risks are managed:

44.1 Flow moderation and attenuation is preserved.

44.2 Stormwater is treated to a high level.

44.3 Riparian strips are of standard that they provide ecological function and maintain water quality and water shading.

45 Any conversion from rural land use involves the near elimination of stock nutrient inputs, to a level where plants and riparian strips can assimilate the often-reduced nutrient loading, minimising the chance of nutrient leaching to groundwater and surface waters. Retaining a high overall proportion of pervious catchment, but also including stormwater management areas, allows stormwater flows to be both attenuated and the discharge to be of higher water quality.

46 This point is made in the Summary of the evidence of **Mr Mthamo** (Reeftide Environmental), who concluded that the plan change would halt current nutrient discharges into surface water and groundwater. This is ecologically advantageous for the plan change rezoning.

47 Downstream of Whites Road, recolonisation routes, for birds, fish and invertebrates are possible along the Ōhoka Stream corridor with a significant length of the channel subject to riparian restoration east (i.e., "Ōhoka Bush"). This is because most of the Ōhoka Stream reach between Jacksons Road and Whites Road has been converted to lifestyle blocks and in those reaches, and in my opinion, the stream appeared to be in better order than through rural land use (**App. II, Fig. l**).

48 In a large comprehensive study, land use effects on water quality and aquatic habitat differences were identified between pasture, and those areas converted to pine and bushed catchments following 15 years of establishment (Quinn *et al.* 1997). The pastoralised land

was stocked in sheep, and cattle, but with some riparian kanuka and manuka. The greatest differences were between a change in land use between pasture and native forest. Pastoralised streams were warmer, less shaded, but with more photosynthetic activity. This led to more algae and suspended sediment. While aquatic invertebrates had higher biomass in pastoral streams, the community composition was different in streams with native forest compared to pasture, with clean-water (EPT) taxa two to three times higher in forest streams than pasture. In this study, Ōhoka Stream, in the bushed reach, had 9 clean-water taxa, with 7 clean-water taxa further upstream through the dairying reach, but the South tributary dairying reach had 5 clean-water taxa, but many represented by a single specimen.

49 In 2007, conversion of bare pastoral land into Ōhoka Bush, albeit with a Eucalypt plantation on the south bank, into a native bush reserve, is a demonstration of the restoration of instream values following native plantings of kahikatea, kowhai, and riparian tussock sedge. While it is unlikely that a pre-restoration ecological survey was conducted, I consider it highly unlikely that the stream health indices would have been as high as we recorded recently. Many of the beneficial ecological effects are mediated in the riparian zone. For this Plan Change area, the waterways appear to have been well-fenced for some time, albeit with a minimum setback of a metre or so, and the water quality and ecological restoration within the Ōhoka Bush reserve would have benefited from that fencing upstream.

REMARKS ON THE S42A REPORT

50 Sec. 6.9.1: I concur with the writer that the ecology in the Proposed Plan Area will improve, of this I will have little doubt. Moreover, I think the improvement could be significant provided that colonisation and dispersal paths are maintained to Ōhoka Bush, and as far as possible to upstream habitats. The other proviso is that the upwardly revised setback widths, which are considered ecologically adequate if planted suitably with native vegetation, especially close to the water's edge.

51 Sec. 6.10.4: In respect to a comment by FG Edge, I wish to point out that almost all waterway setbacks exceed the minimum 10 m setback by a significant margin, dependant on their ecological importance. In respect to setbacks recommended by DoC (Sec. 6.10.5 and 6.10.6), the original setback has been increased (doubled to 20 m) in the main waterway, Ōhoka Stream, and by 50% in the South Ōhoka Branch (to 15 m). I consider that the groundwater seep channel would be adequately protected by a 10 m setback, but which includes a riparian (vegetated) strip. A 10 m strip would provide adequate shading, nutrient uptake, physical filtering of overland flow, for a narrow waterway with a low flow

volume. Furthermore, the groundwater seep origin is now protected by a 20 m setback, which allows this origin to be protected and assist with potential groundwater inflows from nearby SMAs.

52 Tuna/Longfin eel (*Anguilla dieffenbachii*) has a conservation status of (nationally) declining (Dunn *et al.* 2017). However, maintaining bank stability through the use of ecologically significant setbacks from the banks, and maintenance of spring base flows (and depth) will enhance habitat for longfin eel. Longfin eel, particularly the larger specimens, require water depth, and stable bank structure for refuge. We did not record koura during the survey, but it is possible some are present, and this crustacean would also benefit from increased bank stability which is conferred by improved bank vegetation.

53 Our recent data indicates 'excellent' ecological stream health downstream of the proposed Plan Change Area in the vicinity of Whites Road. This is a testament of the upstream water quality within the proposed Plan Change Area, along with the physical habitat quality present in Ōhoka Bush. Maintenance of the Ōhoka Bush ecological health would be a logical monitoring objective for the Plan Change.

REMARKS TO ENVIRONMENT CANTERBURY SUBMISSION (S31)

54 Para 39: My evidence explores the concept of proposed habitat linkages between enhanced habitats within the Plan Change Area and naturalised habitats further downstream, specifically Ōhoka Bush. This is important for optimising biodiversity in the naturalised waterways within the proposed Plan Change Area. With consideration of colonisation and dispersal routes, dispersal could be broadened further to include neighbouring waterways, but will require waterway design considerations and dispersal routes under and along roads. Ecological linkages upstream (west) of the Plan Change Area are less pronounced, as there are less waterway corridors but may be possible along the Ōhoka Stream upstream of Bradleys Road. Flyways for birds may establish between tree copses outside the Plan Change Area, and the proposed riparian tree habitats. Bush birds require significant riparian widths, and these are provided in the proposed land use change.

55 Therefore, in response to para 39, I would claim there is a good probability that the ecology in the proposed Plan Change Area will be contiguous with, and a probable enhancement of, the ecology in the adjoining areas, including Ōhoka Bush, but with the proviso that dispersal routes are considered. From what I have read, Ōhoka Bush was a community-driven and constructed initiative, using plants and trees typical of the area, including kahikatea, totara, and

other trees. It is clear the aquatic ecology has benefitted from this initiative.

56 Paras 39-40: Freshwater values in the proposed Plan Change Area are not especially high, but they are likely to be significantly enhanced with naturalisation of the Plan Change. I cannot respond to the remark about 'several adverse effects' because I do not understand what the writer means. The identified fish species in the proposed Plan Change Area are well distributed in the Ōhoka Stream catchment, and elsewhere in New Zealand. However, I consider that urban impacts on the ecology will be successfully mitigated through the use of swales, effective stormwater treatment systems, and riparian plantings sympathetic to local ecology via proposed waterway setbacks. The water table will be preserved by ground soakage through swales and a high proportion of catchment areas composed of pervious soils. I note that a high level of stormwater treatment will be required to protect high ecological value downstream.

57 Para 39: The writer claims the proposed Plan Change Area is part of a historic wetland area, but I do not see this depiction in the historic maps. The earliest depiction on the historical map is between 1940 to 1944, in Canterbury Maps, which shows the area is extensively farmed within, and both upstream and downstream of the Plan Change Area (**App. IV, Fig. i**). On the website MapsPast.org.nz, the Plan Change Area possessed cadastral boundaries on the 1899 NZMS 13 map. However, several flax mills were present further downstream in the vicinity of Christmas Road, where the two main branches of the Ōhoka combine.

58 AEE level investigations are not required at a Plan Change level, but there are many examples of the restoration of ecological values with the conversion of rural land to a level of urban development, provided riparian strips are of ecological significance and stormwater treatment is effective. It is safe to assume that stormwater consents would likely require a level on ecological monitoring in the receiving environment, including the values within Ōhoka Bush.

REMARKS ON MS DRUMMONDS REPORT

59 I agree with the remarks made by **Ms Drummond**, and I am reassured that the stormwater management will be of a high standard, as indicated in **Mr O'Neill's** evidence.

REMARKS ON OTHER SUBMITTERS

60 In respect to a comment by Lance Peters (#238), that he opposes the Plan Change due to damage to local fishery and potential for environmental disaster. The mechanism for this is assumed to be by means of nutrients and contaminants. However, the combination of

stormwater management (see Mr **O'Neill's** evidence), nutrient input reduction (through loss of stock), and nutrient uptake enhancement (through significant riparian strips), is likely to improve water quality and fish habitat both within, and downstream, of the proposed Plan Change Area.

61 For submitters that note native birdlife will be adversely impacted: Once riparian habitats are developed near waterways and the wetland, there is enhanced opportunity for bush birds and water birds (especially kingfisher) to occupy roosting and nesting habitats near water, and due to the generally low density and siting of main roads some distance from waterways (especially the Southern Spring Channel), then I consider that bird life and habitat is likely to be significantly enhanced.

CONCLUSION

62 An assessment of the aquatic ecology in the Plan Change Area showed a number of fairly common native fish well distributed in the Kaiapoi River catchment. The Plan Change Area also includes Ōhoka Stream which supports some brown trout spawning, and the juvenile trout rear there.

63 Ōhoka Bush supports native aquatic insects, and there is evidence that there is upstream recruitment from this source into the Plan Change Area. This recruitment is also likely to extend to freshwater fish and possibly birdlife.

64 Objective assessments of ecological health indicates that the stream health in the Plan Change Area is "fair", but given the ecological links to Ōhoka Bush, and the provision of ecologically significant riparian strips and a high standard of stormwater treatment, I consider that there is a high probability that the Plan Change Area could become an outstanding ecological area.

Dated: 7 July 2023

Mark Taylor

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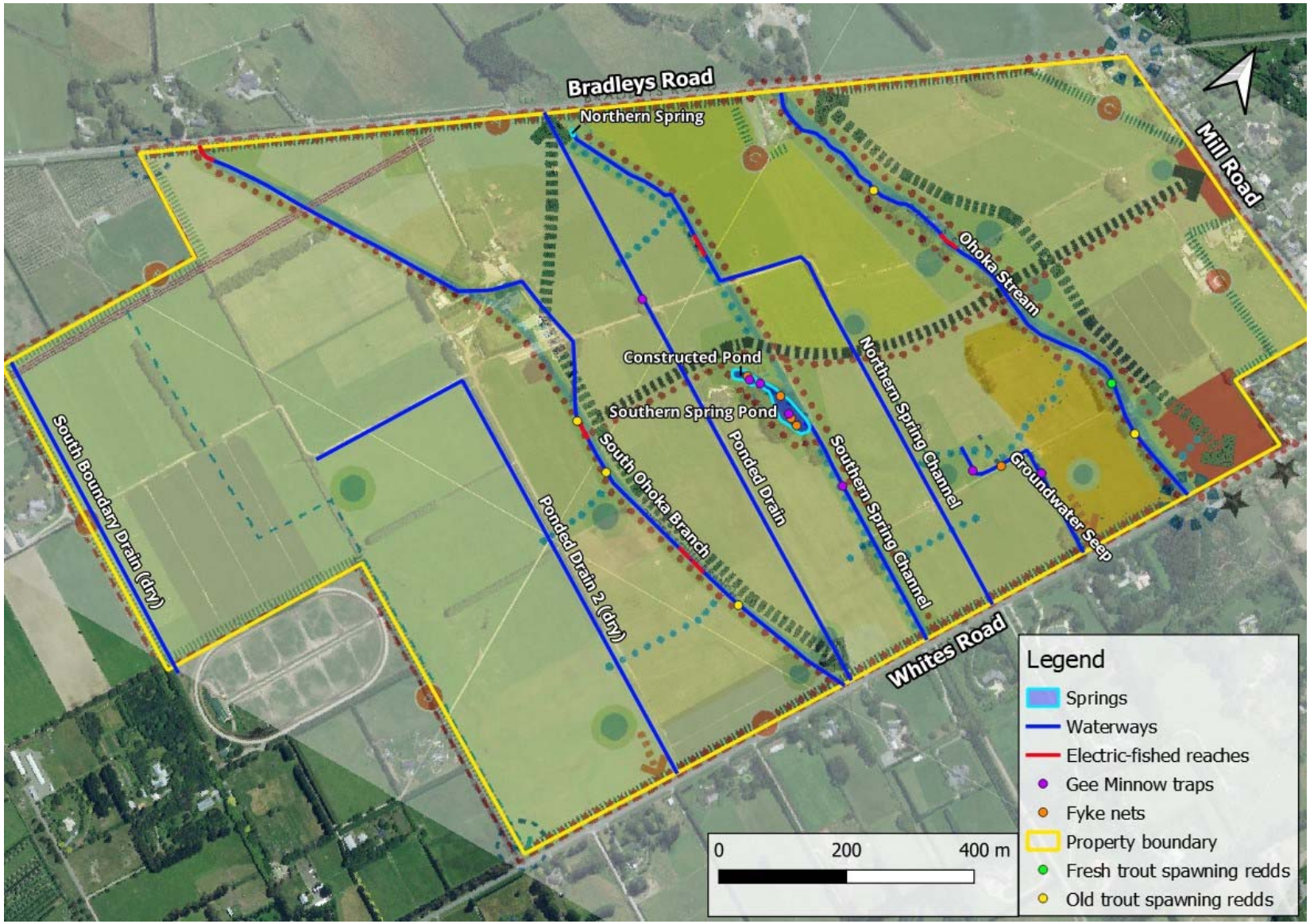
APPENDIX I. The outline development plan overlaid with waterways mentioned in the text (5th July c. 4:47 pm).



APPENDIX II. HABITAT PHOTOGRAPHS

Figure a. Ōhoka Stream (tributary) looking upstream, 14/07/2021

Figure b. Ōhoka Stream (tributary) looking downstream, 21/07/2021.

Figure c. Groundwater seep, looking downstream, 21/07/2021.

Figure d. Northern Spring Channel, looking upstream, 21/07/2021

Figure e. Northern Spring Channel, looking downstream, 21/07/2021

Figure f. Southern Pond, looking South, 14/07/2021.

Figure g. Southern Spring Channel, looking downstream, 14/07/2021.

Figure h. Ponded Drain, looking downstream, 14/07/2021.

Figure i. South Ōhoka Branch, downstream section, 21/07/2021.

Figure j. South Ōhoka Branch, upstream section, 21/07/2021.

Figure k. This small bridge over the Ōhoka Stream (on Whites Road) plays a major part in determining ecological potential in the Proposed Development Area.

Figure l. Ōhoka Stream downstream of Whites Road. Stream health metrics were high in this reach.

APPENDIX III. Waterway and Wetlands treatment table.

Waterway	Proposed vegetated setback (m)	Proposed treatment	Ecology Notes
Ōhoka Stream	20m, increased from an original 10m	No re-alignment	Perennial. Value for trout spawning and native fish
Groundwater seep	10 m	Course to naturalised if possible	Perennial probably. Upland bullies, suggesting some long-term permanence,
Groundwater seep (origin)	20 m (new)		
Northern Spring Channel	15 m, increased from an original 10 m	Course to be naturalised and re-directed south into the Southern Spring Channel. If required, the old linear path to be used as a stormwater conveyance flow path	Perennial
Northern Spring head	20 m		
Southern Spring Channel	15 m, increased from an original 10 m	Course to be naturalised to maximise the ecological corridor to Central Spring.	Strong perennial flow. Important ecological linkage to Central Spring
Central Spring head	30 m	Naturalised revegetation around margins, with some amenity features	Large central spring complex, justifying a setback more than the minimum.

Waterway	Proposed vegetated setback (m)	Proposed treatment	Ecology Notes
Ponded Drain	N/A	Ephemeral course to be naturalised and could be re-directed into the South Ōhoka Branch	ephemeral
South Ōhoka Branch	15 m, increased from an original 10 m	Naturalised and the course retained.	No fish or obligate aquatic macrophytes observed. But may have value for trout spawning if flow permanence and catchment area is increased through diversion of Ponded Drain catchment
Ponded Drain 2	N/A	Stormwater will be redirected into an old fluvial channel nearby.	Ephemeral, no aquatic or wetland value.
South Boundary Drain (‘Un-named Stream’)	5m	Course to be naturalised, but left in linear form.	Ephemeral, no aquatic or wetland value. Buffer strip width set to filter stormwater and some nutrient uptake.

APPENDIX IV. HISTORICAL IMAGERY OF THE PLAN CHANGE AREA – 1940-1944 (CANTERBURY MAPS IMAGERY).