BEFORE THE HEARINGS PANEL
FOR PROPOSED PRIVATE PLAN CHANGE 31 TO THE WAIMAKARIRI DISTRICT PLAN

UNDER the Resource Management Act 1991 (RMA)

AND

IN THE MATTER of an Application by Rolleston Industrial Developments Limited for a private plan change to the Waimakariri District Plan pursuant to Part 2 of the Schedule 1 of the Resource Management Act 1991

STATEMENT OF EVIDENCE OF GREG BURRELL ON BEHALF OF THE CANTERBURY REGIONAL COUNCIL

13 JULY 2023

Canterbury Regional Council's Solicitor
PO Box 4341 CHRISTCHURCH 8140
DX WX11179
Tel +64 3 379 7622
Fax +64 379 2467

Solicitor: I F Edwards
(imogen.edwards@wynnwilliams.co.nz)

WYNN WILLIAMS

SUMMARY STATEMENT

1 My evidence focuses on freshwater ecology. It summarises ecological values in the Plan Change 31 (**PC31**) area, discusses potential ecological effects associated with PC31, reviews the applicant's ecological assessment, and discusses relevant statutory instruments related to protection and enhancement of freshwater ecology values.

2 Historic maps indicate most of the PC31 area was once part of a very large wetland that was subsequently drained for farming. A range of wetlands (including springs and seeps) and flowing waterbodies of varying sizes occur within the PC31 area. All are affected to varying degrees by channelisation, lack of riparian trees and shrubs, and narrow fence setbacks. However, they all have considerable restoration potential, as they represent the vestiges of a once extensive wetland.

3 The presence of longfin eel in waterbodies within the PC31 area is noteworthy, due to their At Risk conservation status. Also noteworthy is the presence of trout spawning habitat and pollution-sensitive mayflies and caddisflies in Ōhoka Stream.

4 I consider the key potential negative effect associated withPC31 is the impact of urbanisation on hydrology of waterbodies, including threatened wetland ecosystems. The applicant has proposed buffers, or setbacks, of 10–20 m for perennial waterbodies. However, no evidence has been presented that indicates these buffers will protect waterbodies from hydrology impacts, particularly reduced baseflow.

5 I generally concur with the applicant's ecology evidence, with two exceptions. First, their assessments do not consider hydrological impacts of development on reduced flows and levels in waterbodies. Second, I consider it likely that the ecological value of proposed setbacks will be reduced by urban design requirements, including the addition of paths and limited tree planting due to urban safety considerations.

6 My conclusion is that PC31 has the potential for positive ecological effects on waterbodies and riparian zones, which is consistent with various planning instruments. However, I am uncertain whether these positive effects will outweigh potential negative effects of urban development on hydrology and the integrity and functioning of riparian buffer zones.

INTRODUCTION

7 My full name is Gregory Peter Burrell.

8 I have been engaged by Canterbury Regional Council (**Regional Council**) to provide evidence on freshwater ecology matters in relation to Private Plan Change Application 31 (**PC31**) to the Waimakariri District Plan.

9 I hold a Bachelor of Science, Post Graduate Diploma in Science, and a Doctor of Philosophy (PhD) in Science, all majoring in Zoology (in particular Ecology) and all obtained from Canterbury University. I am a member of the New Zealand Freshwater Sciences Society, the North American-based Society for Freshwater Science, and I co-facilitate the Christchurch Ecology Group. I have published scientific papers and a book chapter on ecology in relation to groundwater-surface water interactions.

10 I am a Director and Principal Scientist at Instream Consulting Limited. I have worked in the role for the past nine years. My work is centred on freshwater ecology and water quality, including assessing ecological values, assessments of environmental effects, restoration, and catchment planning. I have over 20 years' experience working as an ecologist.

11 Of relevance to PC31, I was a member of a Technical Advisory Group to the Regional Council as part of the Waimakariri Zone limit-setting process for the Canterbury Land and Water Regional Plan. As a member of that group, we addressed a range of resource management issues relevant to this hearing, including landuse impacts on groundwater levels, flows, wetlands, and water quality. At a more local level, I have previously undertaken ecological sampling in Ōhoka Stream downstream of the PC31 area, plus I conducted a roadside site visit to the PC31 area on 5 July 2023. I have not visited waterways within the PC31 area, but I have worked in similar ecological settings, with similar issues, elsewhere in the region.

12 Whilst I acknowledge that this is not an Environment Court hearing, I confirm that I have read and am familiar with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023. I have complied with the Code of Conduct in preparing this evidence and I agree to comply with it while giving any oral evidence during this hearing. Except where I state that I am relying on the

evidence of another person, my evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

SCOPE OF EVIDENCE

13 I have prepared this evidence on behalf of the Regional Council.

14 My evidence is in relation to freshwater ecology. My evidence addresses:

a. Ecological values.

b. Key potential ecological effects of PC31.

c. The applicant's ecology assessment.

d. Relevant legislation, strategies, and plans.

15 In preparing my evidence I have reviewed the following documents:

a. Private Plan Change Request (Novogroup 2022), including in particular:

i. Appendix D – Ecology Assessment (AEL 2021);

ii. Appendix G – Infrastructure Assessment (Inovo and PDP);

b. Section 42A Report, including:

i. Appendix 2 – Summary of Submissions;

ii. Appendix 5 – Natural Hazards (flooding);

c. Submissions from: the Regional Council (#507) and the Department of Conservation (DOC, #171).

d. A draft of the Statement of Evidence by Mr Wilkins on behalf of the Regional Council regarding groundwater matters.

e. The following Statements of Evidence on behalf of the applicant:

i. Mr Taylor (Ecology) dated 7 July 2023;

ii. Ms Drummond (Ecology) dated 7 July 2023;

iii. Mr O'Neil (Stormwater and Wastewater) dated 6 July;

iv. Mr Compton-Moen (Landscape) dated 7 July; and

v. Mr Milne (Landscape) dated 7 July.

ECOLOGICAL VALUES

Introduction

16 The following description of ecological values is largely based on Mr Taylor's evidence, coupled with my own review of existing data sources for the general area. These data sources include: Regional Council monitoring data, the New Zealand Freshwater Fish Database (**NZFFD**), and the Canterbury Maps Viewer website. As noted above, I have not visited waterways within the PC31 area, but I have viewed their upstream and downstream extents from the road, as well as previously sampling Ōhoka Stream further downstream. In addition, I have confirmed from staff from the Regional Council and Waimakariri District Council (**WDC**) that they have not undertaken any ecology sampling within the PC31 area.

17 The PC31 area is bounded by Bradleys Road, Mill Road, and Whites Road, and private properties to the southwest. Waterbodies potentially affected by the development include tributaries of Ōhoka Stream, springs, and wetlands. **Attachment 1** to my evidence is a copy of a site map from Mr Taylor's evidence, and I refer to its general layout and use the same waterway naming conventions in my evidence.

18 Throughout my evidence, when referring to certain waterbodies as wetlands, I use the New Zealand wetland classification system (Johnson and Gerbeaux 2004). Under this classification system, springs and seeps are recognised as wetlands, alongside swamps, bogs, and other wetland types. This classification is consistent with the RMA definition of a wetland as *'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.'*

Historic and Current Waterbodies

19 Digitised land survey maps from the 1800s, accessed through the Canterbury Maps Viewer website, show raupō (*Typha orientalis*) swamp (i.e., wetland) covering most of the PC31 area, interspersed with areas of mixed harakeke (*Phormium tenax*) and grasses (see **Attachment 2**).[1] Extensive drainage occurred throughout the area over 100 years ago, so

[1] The historic land survey maps are referred to as 'Black Maps' in the Canterbury Maps Viewer.

the area could be farmed. Aerial imagery from the Canterbury Maps Viewer website shows numerous waterways following a natural, winding course in imagery taken between 1940 and 1944 (see **Attachment 3**). Since the 1940s, most waterbodies have been realigned and straightened to some extent (see **Attachment 4**).

20 Currently, all waterbodies within the PC31 area are affected to varying degrees by channelisation, lack of riparian trees and shrubs, and insufficient buffering from adjacent landuse. These realigned, straightened, and unvegetated waterbodies have a very artificial appearance, but they are essentially the residue of a once extensive wetland. Although they are currently highly modified, they also have considerable restoration potential. That is because there is a range of aquatic habitats that would benefit from habitat enhancement. This includes streams with stony bed sediments and moderate to swift velocities, through to springs and seepages that are vestigial wetland habitats.

21 Based on the habitat descriptions in Mr Taylor's evidence (paragraphs 14–22), the 'Northern Spring', 'Southern Spring Pond', and 'Groundwater Seep' are wetlands. That is because, as noted in paragraph 18 above, springs and seeps are wetlands.

Terrestrial Ecology

22 No terrestrial ecology assessment has been completed for the PC31 area. However, based on aerial imagery and Mr Taylor's ecology evidence, it is reasonable to assume that there is minimal residual indigenous plant cover in the PC31 area. From the roadside, I could see sparse patches of native sedges (*Carex* spp.), rushes (*Juncus* spp.), and harakeke bordering waterbodies.

Water Quality

23 Water quality data for Ōhoka Stream downstream of the PC31 area is summarised in Ms Drummond's evidence (paragraph 15). In her summary, Ms Drummond notes very high concentrations of nitrate-nitrogen and elevated counts of the faecal indicator bacterium *Escherichia coli* in Ōhoka Stream. I agree with Ms Drummond that the data reflect existing agricultural landuse in the catchment. In the rural environment, high *E. coli* counts are typically associated with stock

access and poorly managed runoff, which can be managed by stock exclusion and improved land management practices. However, high nitrate concentrations in spring-fed streams are largely caused by leaching of nitrogen from cattle urine patches into groundwater. Reducing stocking rates is the most effective method of achieving large (50% or more) reductions in nitrate loss to groundwater from cattle.

Aquatic Invertebrates

24 Aquatic invertebrates can be good indicators of stream health, because they are relatively long-lived, do not move around much (compared to fish), and are sensitive to water quality, flow, and habitat conditions. Recent sampling results presented in Mr Taylor's evidence (paragraphs 30–32) show an invertebrate community within the PC31 area indicative of 'poor' to 'good' quality.[2] A sample taken downstream in Ōhoka Bush indicated 'good to 'excellent' quality.

25 Data presented by Mr Taylor are comparable to Regional Council monitoring data for the area. For example, a mean Quantitative Macroinvertebrate Community Index (**QMCI**) score of 4.9, indicative of 'fair' quality (Stark and Maxted 2007), was recorded over 2018–22 at the Regional Council's long term monitoring site on Ōhoka Stream at Bradleys Road (100 m northeast of Mill Road). One-off invertebrate samples taken by the Regional Council include a sample from 'South Ōhoka Branch' at Whites Road in 2006, where a QMCI score of 4.6 was recorded (indicative of 'fair' quality), and a sample from 'Ōhoka Stream' at Whites Road in 2006, where a QMCI score of 3.6 was recorded (indicative of 'poor' quality).

26 Overall, the invertebrate community in the Ōhoka Stream catchment is dominated by pollution-tolerant snails and crustaceans, with varying proportions of pollution-sensitive mayflies and caddisflies. The presence of sensitive mayflies and caddisflies is noteworthy, as it indicates there are stable source populations nearby that could re-colonise locations that are impacted by degraded water quality and habitat.

---

[2] Based on the interpretation of Macroinvertebrate Community Index (MCI) and Quantitative MCI scores recommended by Stark and Maxted (2007).

Fish

27 The fish community within the PC31 area is described in Mr Taylor's evidence (paragraphs 24–26). Fish present include native upland bullies (*Gobiomorphus breviceps*), shortfin eel (*Anguilla australis*), and longfin eel (*A. dieffenbachii*), and introduced brown trout (*Salmo trutta*). These are all widespread species in Canterbury lowland waterbodies, although longfin eel is notable because it has an At Risk conservation status (Dunn et al. 2018). The presence of trout spawning habitat within Ōhoka Stream is also notable because trout require swift flows and silt-free gravels to spawn within, and they are sensitive to excessive sedimentation.

28 I have reviewed fish records from the NZFFD and consider the species list provided by Mr Taylor is representative of the fish community typically found in the area. I found no additional fish species for the Ōhoka Stream catchment in the NZFFD. In addition, the NZFFD includes no catchment records for kēkēwai (freshwater crayfish; *Paranephrops zealandicus*) or kākahi (freshwater mussel; *Echyridella menziesii*), which are At Risk invertebrate species (Grainger et al. 2018).

POTENTIAL ECOLOGICAL EFFECTS OF THE PLAN CHANGE

29 I consider that the key adverse ecological effect associated with PC31 is the impact of urbanisation on hydrology of waterbodies, including threatened wetland ecosystems. That is because, as stated by Sorrell and Gerbeaux (2004), *'Hydrology is the single most important factor controlling the establishment and maintenance of wetlands, constraining which organisms grow where, and how productive they are.'* This means that impacts of the development on wetland hydrology could greatly hinder the restoration potential of wetlands and other waterbodies within the development area.

30 The key issue is the disruption and short-circuiting of groundwater flowpaths caused by hard fill, drains, and service trenches. This disruption and short-circuiting results in groundwater flows being channelised away from headwater springs, wetlands, and stream tributaries into constructed stormwater facilities or larger waterbodies further downstream. While the net supply of water to downstream waterways such as Ōhoka Stream may remain the same before and after development, the flow source to headwater springs and wetlands is

reduced. Intersection of groundwater flowpaths by the Northwood subdivision was likely a major factor contributing to the springfed headwaters of Kā Pūtahi Creek (formerly Kaputone Creek) drying up.

31 General guidance on wetland buffer zone size can be drawn from the Resource Management (National Environment Standards for Freshwater) Regulations 2020 (**NES-F**). The NES-F includes numerous rules regarding management of activities in relation to 'natural inland wetlands'. The definition of a natural inland wetland captures wetlands with vegetation cover comprising more than 50% exotic pasture species. I set out the definition in full, below:[3]

> **natural inland wetland** means a wetland (as defined in the Act) that is not:
>
> (a) in the coastal marine area; or
>
> (b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or
>
> (c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or
>
> (d) a geothermal wetland; or
>
> (e) a wetland that:
>
> > (i) is within an area of pasture used for grazing; and
> >
> > (ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the *National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology* (see clause 1.8)); unless
> >
> > (iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply

32 Regardless of the native plant-based definition, the NES-F includes varying buffer sizes to protect wetlands from human activities. In general, the NES-F requires that activities that involve earthworks or vegetation clearance are restricted within 10 m of a wetland, while activities potentially affecting wetland hydrology (take, use, dam, or divert) are restricted within 100 m of a wetland. This suggests that activities potentially affecting wetland hydrology, such as filling, draining, and trenching, should be restricted within 100 m of wetlands. I note that

---

3 See clause 3.21 of the National Policy Statement for Freshwater Management 2020.

a 100 m buffer was applied to springs as part of Plan Change 69 (Lincoln) in the Selwyn District.

33 The applicant has proposed buffer widths of 10–20 m for perennial waterbodies, with no accompanying rationale as to why a particular setback width has been chosen for a given waterbody. It is difficult to recommend a defensible buffer width for springs, wetlands, and other waterbodies, without some form of hydrological assessment. This is important, because without such information it is difficult to conclude that the proposed buffer widths offer sufficient protection from potential hydrological effects of development. Hydrological impacts of urban development are discussed further in the evidence of Mr Wilkins for the Regional Council.

34 While there is limited information supporting buffer zones of a particular width for protecting against hydrological impacts, there is abundant literature in relation to buffer zones for protecting waterbodies from adjacent land use. This includes a review of riparian setback distances (i.e., buffer zones) in New Zealand conducted by Fenemor and Samarasinghe (2020). The authors recommended a minimum waterway setback of 10 m for contaminant reduction to water bodies. They suggested a wider setback, of 15 m, for protection of freshwater ecosystem health, terrestrial and aquatic habitat diversity, and a minimum 20 m setback for recreational, cultural, aesthetic and landscape values. To adequately protect ecosystem health and diversity, the buffer needs to be dominated by native vegetation, with generous separation from any paths or roads that would reduce the value of the riparian corridor.

35 In summary, notwithstanding potential hydrological effects, the proposed buffers of 15–20 m width will help protect and enhance aquatic health and biodiversity in perennial waterbodies within and downstream of the PC31 area. The narrower buffer width of 10 m proposed for the ‘Groundwater Seep’ offers less than the minimum recommended protection of 15 m.

36 Without relevant hydrological evidence, I cannot assess whether the proposed buffer widths will be sufficient to protect against adverse hydrological impacts of PC31. In my opinion, it is appropriate to consider hydrological effects at the time of land rezoning as part of a plan change. That is because urban development could have a profound impact on

the hydrology of surface waterbodies. Other potential effects associated with PC31 include construction-related effects, impacts on fish passage, and impacts of stormwater discharges on receiving water quality. Overall, I consider these potential effects could be adequately addressed, with appropriate engineering design and construction methodologies.

THE APPLICANT'S ECOLOGY ASSESSMENT AND EVIDENCE

37 Overall, I consider that the ecology report, and evidence of Mr Taylor and Ms Drummond adequately describe aquatic ecology values in relation to the PC31 area. I also agree with their conclusions that PC31 has the *potential* (my emphasis) to dramatically improve the protection and state of waterbodies and their associated riparian zones within the PC31 area. However, as already discussed, I am concerned about potential hydrological impacts of the development on wetlands and smaller tributaries, and neither expert has addressed this issue.

38 I would also express more caution about the *likely* benefits of the proposed buffer zones than either ecology expert has expressed. That is because it is my experience that urban waterway setbacks are often filled with landscaping enhancements that do not enhance ecological values, such as paths, which detract from the ecological value of the buffer. In addition, landscape designs in urban areas must consider Crime Prevention Through Environmental Design. Such 'CPTED' features result in fewer trees being planted along paths bordering waterbodies. Thus, while the addition of generous setbacks along each waterbody has considerable potential to enhance waterbodies, the ecological value of the setback may be reduced by placement of paths and other impervious surfaces too close to the waterbody, along with limited tree planting for safety reasons.

39 The PC31 Outline Development Plan shows paths bordering each waterbody, within the nominated waterway setback. Appendix 1, page 6 of Mr Compton-Moen's evidence includes a landscape layout of the Ōhoka Stream setback, which shows the shared path well back from the waterway, which is good from an ecological perspective. However, it is unclear how representative the layout is of other waterbody setbacks within PC31. It is also unclear whether taller trees will be planted, to

better shade the waterway, rather than the lower shrubs or small trees indicated in the layout.

40 It would be helpful if the Outline Development Plan provided some more direction as to the placement of objects and plants within the waterbody setbacks. This might include requiring that paths and other impervious surfaces are mostly located a minimum distance from waterbodies (e.g., 10 m), and stating that a priority of the setback planting is providing sufficient tree shade to the waterbody to help prevent nuisance growths of aquatic algae and plants.

RELEVANT LEGISLATION, STRATEGIES, AND PLANS

41 In this section of my evidence, I comment on the relevant policy framework insofar as I consider it is relevant to ecological matters within my area of expertise.

42 Freshwaters in New Zealand are afforded protection via various pieces of legislation, plans, and policies. At the highest level, the Resource Management Act (**RMA**), Section 6 (Matters of National Importance), clause (a) requires *'the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development.'* Section 6(c) also requires *'the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.'* Section 2 of the RMA defines wetlands as, *'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.'*

43 Sitting below the RMA, the NES-F and the National Policy Statement for Freshwater Management 2020 (**NPS-FM**) each provide more direction as to how freshwater ecosystems should be protected. Amongst other things, the NES-F and NPS-FM seek to avoid further reductions to the extent and ecosystem health of rivers and wetlands. A complementary desired outcome of the New Zealand Biodiversity Strategy 2020 is restoration of wetland and other freshwater ecosystems to a "healthy functioning" state.

44 The Canterbury Regional Policy Statement 2013 (**CPRS**) recognises the loss of riparian and wetland habitats as a significant freshwater management issue. Policy 9.3.2 of the CPRS states that priorities for

protection within the region include areas of significant indigenous vegetation and habitats of Threatened and At Risk indigenous species. Policy 9.3.1 states that significance, with respect to ecosystems and indigenous biodiversity, shall be determined by assessing representativeness, rarity or distinctive features, diversity and pattern, and ecological context. These matters are further expanded in Appendix 3 of the CPRS. Policy 9.3.4 includes the requirement to promote ecological enhancement and restoration and Policy 9.3.5 relates specifically to wetland protection and enhancement. Policy 9.3.5 states that *'…ecologically significant wetlands do not include areas that are predominantly pasture and dominated by exotic plant species and where they are not significant habits of indigenous fauna.'*

45 I consider that the springs identified by the applicant within the PC31 area meet the criteria for ecological significance laid out in Appendix 3 of the CPRS. This is primarily because they meet the criteria of rarity/distinctiveness (less than 20% of the former extent of wetlands remains within the region). The identified springs also meet the criteria for 'natural inland wetlands' in the NPS-FM.

46 To be clear, most of the land within the PC31 area is covered in pasture and is neither a wetland nor ecologically significant; I am not saying that the entire PC31 area should be considered a Significant Natural Area. However, the identified springs clearly are wetlands and are significant. I cannot comment on whether there are other significant wetlands within the PC31 area because I have not entered the site and the applicant has not provided that level of detail.

47 Within the Canterbury Land and Water Regional Plan (**LWRP**), there are numerous objectives, policies, and rules relating to freshwater protection. If the PC31 area is rezoned and the land is subsequently developed, Policy 4.83, which encourages the restoration and enhancement of wetlands, and Policy 4.84, which encourages the development of wetlands and riparian plantings to reduce the impacts of development and enhance indigenous biodiversity, will be particularly relevant to any future regional resource consent application.

48 I also note that the Decisions version of Plan Change 7 to the LWRP includes new policies relevant to the PC31 area. I acknowledge that the Regional Council has not yet made Plan Change 7 operative. However, Plan Change 7 includes Policy 8.4.32: *'Enable activities that maintain,*

restore or enhance mahinga kai, safe fish passage, indigenous vegetation, habitats of indigenous fauna and significant habitats of trout and salmon' and Policy 8.4.33: *'Enable catchment restoration activities that focus on the protection of springs, the protection, establishment or enhancement of planted riparian margins, the creation, restoration or enhancement of wetlands, indigenous biodiversity in riparian margins, weed and pest control activities…'.*

49 Within the Waimakariri District Plan, Policy 4.1.1.3 states that *'land use activities should avoid, remedy, or mitigate adverse effects on environments susceptible to degradation such as river and stream margins, aquatic habitats, wetlands...'*. This is largely enforced via land use zoning, and via esplanade strip rules. Under Rule 33.1.4, the minimum width of an esplanade strip or reserve is 20 m. However, Rule 33.1.5 stipulates a minimum width of 5 m for Ōhoka Stream. I do not know why such a narrow esplanade reserve is provided for Ōhoka Stream in the District Plan.

CONCLUSION

50 PC31 has the *potential* to result in positive ecological effects on waterbodies and riparian zones, as a result of the buffer zones proposed by the applicant. However, I am unable to conclude whether these positive effects will outweigh potential negative effects of urban development on hydrology and the integrity and functioning of riparian buffer zones, in part due to the lack of information regarding the effects of PC31 on hydrology.

……

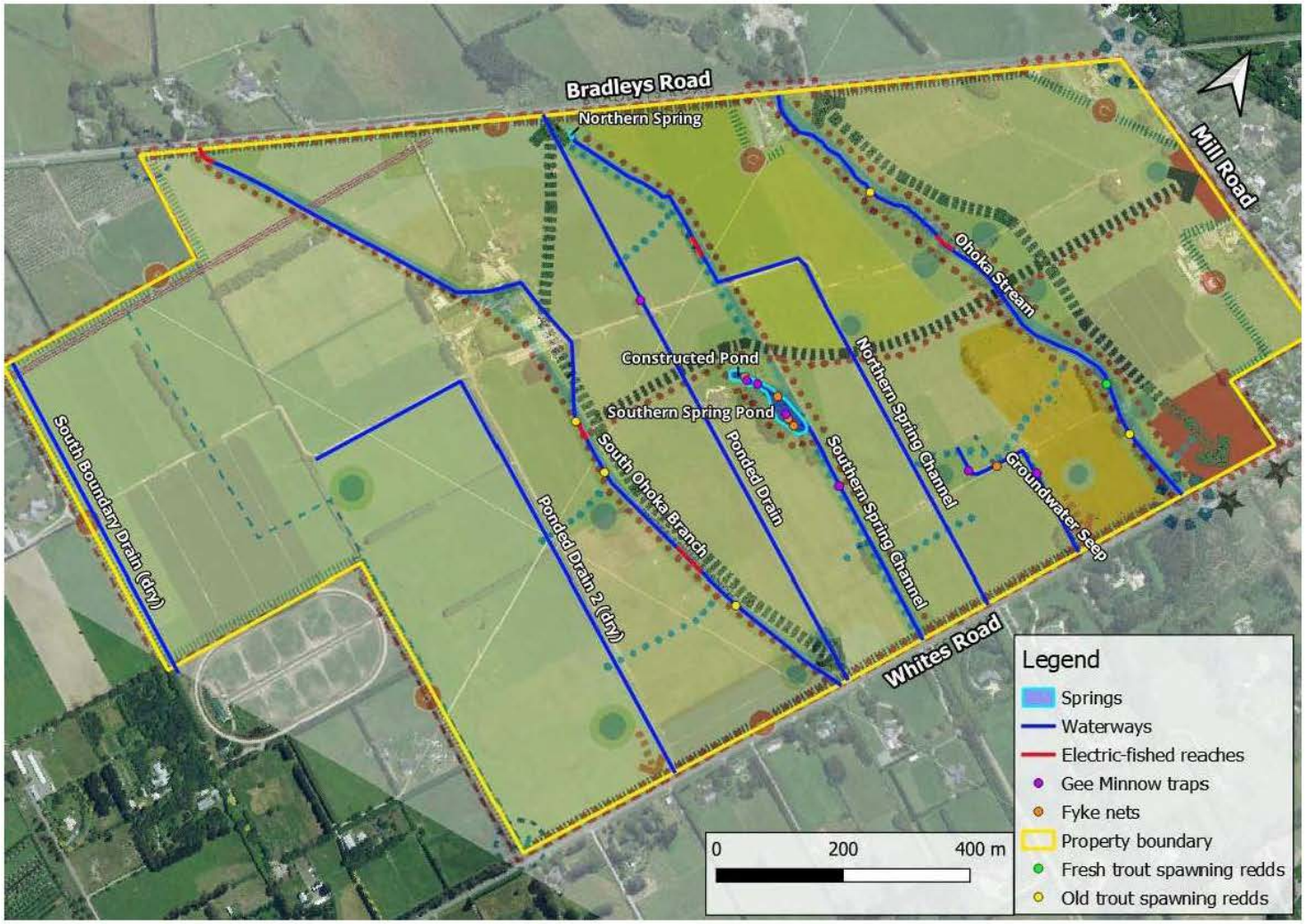
Dr Greg Burrell

13 July 2023

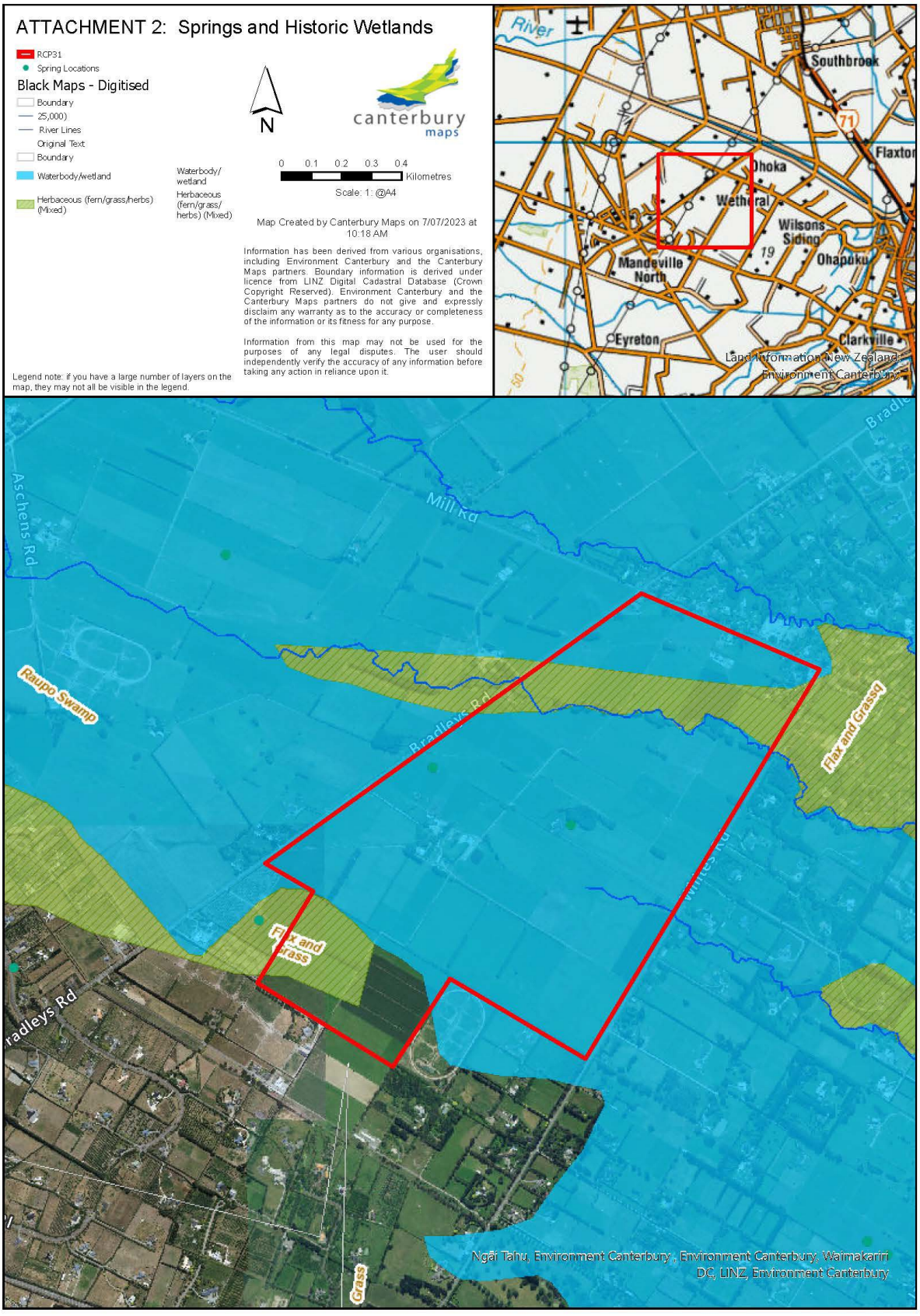
ATTACHMENT 1 – SITE MAP FROM TAYLOR EVIDENCE

ATTACHMENT 1: Site Map from Page 14 of Mr Taylor's Evidence, dated 7 July 2023.

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

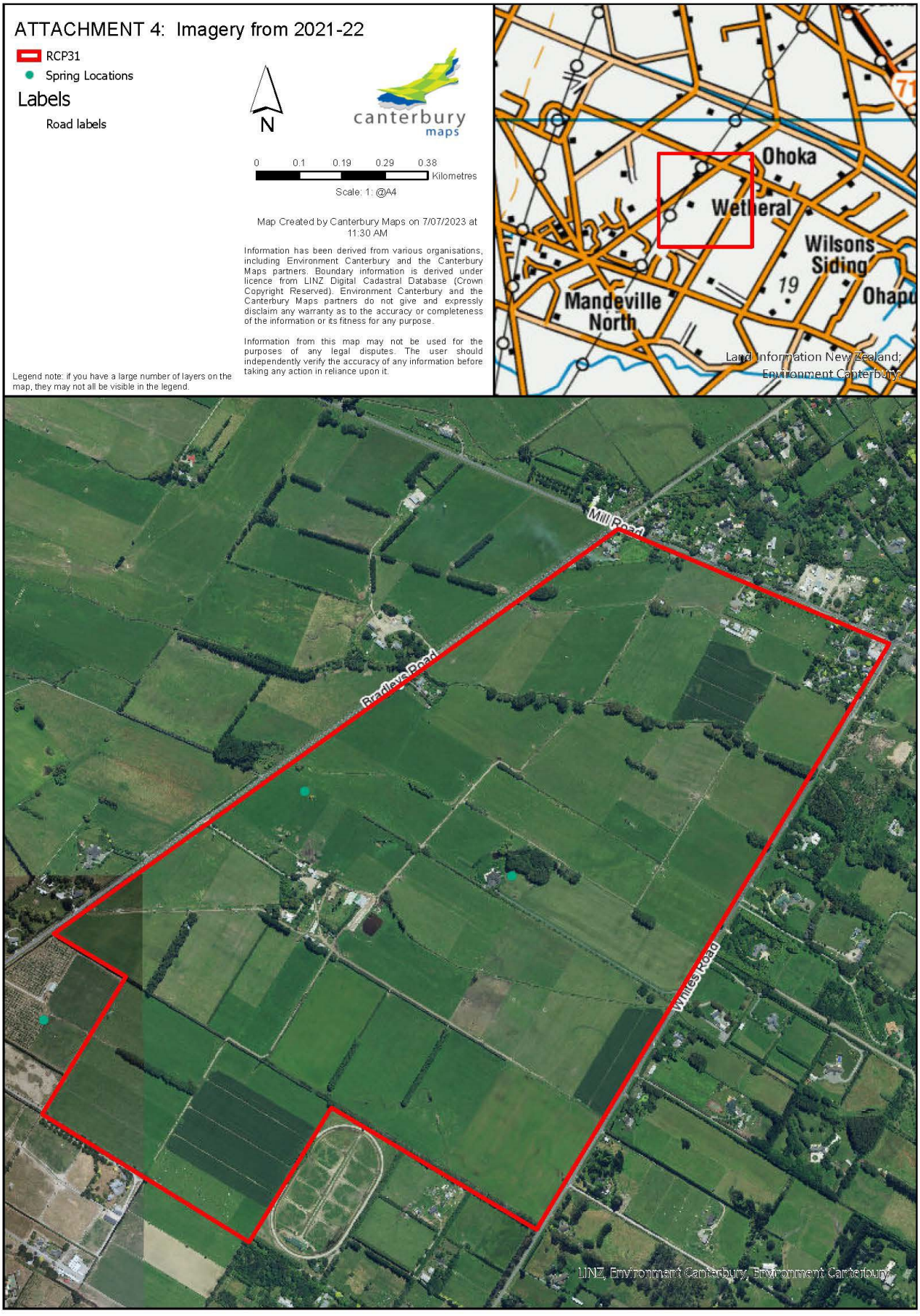


ATTACHMENT 2 – SPRING AND HISTORIC WETLANDS



ATTACHMENT 3 – CANTERBURY MAPS 1940S IMAGERY

ATTACHMENT 4 – CANTERBURY MAPS IMAGERY FROM 2021-2022



REFERENCES

Dunn NR, Allibone RM, Closs GP, Crow SK, David BO, Goodman JM, Griffiths M, Jack DC, Ling N, Waters JM, Rolfe JR. 2018. Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24.

Fenemor A, Samarasinghe O. 2020. Riparian setback distances from water bodies for high-risk land uses and activities. Report prepared by Manaaki Whenua Landcare Research for Tasman District Council, September 2020.

Grainger N, Harding J, Drinnan T, Collier K, Smith B, Death R, Makan T, Rolfe J. 2018. Conservation status of New Zealand freshwater invertebrates, 2018. Department of Conservation New Zealand Threat Classification Series 28.

Johnson P, Gerbeaux P. 2004. Wetland types in New Zealand. Wellington, New Zealand: Department of Conservation.

Stark JD, Maxted JR. 2007. A user guide for the Macroinvertebrate Community Index. Report prepared for the Ministry of the Environment Cawthron Report No 1166.