BEFORE THE WAIMAKARIRI DISTRICT PLAN REVIEW HEARINGS PANEL

IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	the hearing of submissions and further submissions on the Proposed Waimakariri District Plan
AND	hearing of submissions and further submissions on Variations 1 and 2 to the Proposed Waimakariri District Plan
	Hearing Stream 12E: Rezoning Requests

FIRST STATEMENT OF EVIDENCE OF MARK TAYLOR (ECOLOGY) FOR RICHARD AND GEOFF SPARK (PDP SUBMITTER 183 / VARIATION 1 SUBMITTER 61)

Dated 4 March 2024

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Summary Statement

1 A large proportion of a working dairy farm (Spark Farm) has been proposed to be developed into residential lots of various densities. The northern area (so-called Block A, north of Boys Road) and the area of south of Boys Road (Block B) are subject to re-zoning submissions on the proposed Waimakariri District Plan (PWDP) and Variation 1 to that plan.

2 Within the proposed development area, several small-scale ecological surveys were conducted. Both Blocks A & B were assessed for natural wetlands, with one natural wetland, of modest value, located in Block A. Many of the drains and channelised waterways in both Blocks A & B were evaluated for fish communities, and the Boys Road Drains were also assessed for macroinvertebrates. Within the drain network across the Spark Farm Development Area, and the Boys Road Drain, two fish species were identified, both native and unthreatened, these were the shortfin eel and upland bully. A site on the North Brook, first fished in 2005, was re-surveyed. This had 2 fish species, the common bully, shortfin eel, but also koura (freshwater crayfish) were present. These were present in 2005, but absent in 2023 was brown trout, the longfin eel, upland bully and lamprey. The lamprey, a species of some ecological interest, were found in the Middle Brook, but I consider they still exist in the North Brook.

3 This work complements an earlier ecological investigation that I was involved in on the Three Brooks (McMurtrie *et al.* 2005). This study included the North Brook and Middle Brook which border the development area, but also the South Brook. That study evaluated the links between land use types (i.e. rural, peri-urban, urban) and the associated aquatic ecology invertebrate and fish communities. It is therefore relevant to this land use change, and I cite this work frequently.

4 The 2005 study found that aquatic macroinvertebrate diversity was higher in rural reaches than urban reaches. Invertebrate communities in rural reaches had a higher proportion of high-health mayflies and caddisflies, whereas those in urban settings had more snails, microscopic crustaceans (i.e. copepods) and segmented worms.

5 The 2005 study also demonstrated that here was no statistical difference in fish species diversity or numbers across land use types, at least in the context of those present in the Three Brooks. Changes in macroinvertebrate diversity and community, potentially altered by land use, doesn't affect fish diet, as fish feed opportunistically and just eat available invertebrates. However, of importance to fish, and koura (freshwater crayfish), is habitat quality, and bank and bed stability. Flow regime is also important as flooding

can damage downstream habitats in various ways (e.g. damage to banks and bed, but flushing flows must be adequate to flush sediment).

6 One of the 2005 North Brook ecology sites was within Block A, and this was re-evaluated. The North Brook has more diverse ecological communities than its side drains. In Block A, high-health indicator invertebrate species were present, like *Pycnocentria, Helicopsyche sp., Deleatidium sp.*, and *Hudsonema sp.* Koura (*Paranephrops zealandicus*) were also found in the North Brook. The same three species, common bully, upland bully, and shortfin eels were present, but lamprey (*Geotria australis*) was not recorded recently, but were so in 2005. I consider that lamprey are still likely to be present in the North Brook because the habitat has not changed materially, and they are rare and often hard to detect.

7 The development area borders the Middle Brook on its west side, and we recorded upland bully and shortfin eel, but lamprey and koura were also identified there. Like the North Brook, no trout were recorded during this survey, but present in 2005.

8 WDC (Waimakariri District Council) has commissioned AEL over a number of years to evaluate trout spawning activity in the Three Brooks (including the North Brook and Middle Brook), and the utilisation of the North Brook for trout spawning was also undertaken during the winter. Compared to previous years, trout redd (i.e. egg nests) were well down in the North Brook, compared to our previous 3 surveys. However, trout redd numbers were much lower in the North Brook compared to the previous 3 surveys. The lack of juvenile brown trout recoded in the North Brook and Middle Brook during this recent survey, may attest to reduced spawning habitat, This is reported separately in our report to WDC (Taylor & Payne 2023). The reasons for the decline are unstudied and unknown, but it may explain why we didn't identify juvenile trout in the North Brook and Middle Brook. However, a decline in trout in the Middle and North Brooks will benefit koura populations, and small native fish.

9 I recommend unfragmented riparian buffer strips of 15 m for the North Brook, which has significant ecological values and potential ecological corridor potential to adjacent habitats. The Middle Brook flows through Block B only for a short distance, but an ecologically effective 10 m vegetated strip has the future potential of providing flyways and ecological passage between the open space south of Marsh Road through to existing buffers around the waterway at 2 & 10 Dunlop Road.

10 There are two channelised waterways flowing eastwards each side of Boys Road and discharge into the North Brook. The waterway on the North Side provides perennial habitat for 2 native fish species, and aquatic invertebrates upon which they forage. It is

recommended that this waterway be naturalised. The south waterway only provides ephemeral aquatic habitat.

11 To conclude, the 2005 study (McMurtrie et al. 2005) provides some recommendations on how ecological effects of land use change in the Three Brook area can be minimised. These are based around maintaining or creating riparian buffers, maintaining contiguity of habitat, sediment control, high-performance stormwater treatment, maintenance of original hydrology by attenuation stormflows, and physical habitat enhancements. Of these, stormwater treatment performance will have a major influence on macroinvertebrate community and diversity, but habitat structure and stability is more important for fish and koura.

INTRODUCTION

Qualifications and Experience

12 My full name is Mark James Taylor. I am an ecological consultant for Aquatic Ecology Limited, a company which I formed in 2001.

13 I hold a Bachelor of Science in Zoology.

14 I have over 30 years' experience in New Zealand freshwater ecology. I commenced studies on native fish distribution in South Westland in 1984 while employed by the Fisheries Research Division of the Ministry of Agriculture and Fisheries and, after 1992, with the National Institute of Water and Atmospheric Research (NIWA) as a senior technical officer. In 2001, I left NIWA to form my consultancy group Aquatic Ecology Limited (AEL), and I have been director ever since. I have authored and co-authored a number of scientific papers on fish ecology, but I have prepared a large number of environmental reports on a wide number of topics pertaining to aquatic ecology. Especially so in minimising and mitigating the impacts of urban development.

15 I am a member of the Limnological Society of New Zealand.

16 I have undertaken aquatic ecology assessments in the past in the vicinity of Rangiora township. For the Waimakariri District Council, trout redd surveys in 2005, 2006 2018, stream easements in 2007, compiling GIS data on ecological habitats for the WDC global consent for minor works on streams (2012 & field studies 2016). Mapping inanga (whitebait) spawning grounds in selected Waimakariri District lowland streams in 2021. Further afield for WDC, ecological work for the Kaiapoi township floodwater pumps in

2021. Last year WDC work was limited to a small fish ecology survey in Kowhai Ave, a tributary of the North Brook in Rangiora.

17 Working for WDC, in collaboration with another consultant, AEL was involved in an ecological survey of the 'Three Brooks' which constitutes the headwater tributaries of the Cam River in 2005. While dated, this is the most relevant study in respect to the Spark Dairy Farm's proposed development area, as it included survey on the North Brook and Middle Brook in the near vicinity. It includes a useful discussion on the impacts on the resident aquatic ecology as land is converted from rural to residential use.

18 Working for private clients, AEL continues to be involved in ecological assessments for other Private Plan changes in the Waimakariri District. These include assessments for the Carter Group at Ohoka, and also those for the development of Belgrove at the headwaters of the Cam River. However, AEL has also provided many ecological assessments for private clients in the Waimakariri District. Locally, these include assessments for the Carter Group at Ohoka, and also for the development of Bellgrove at the headwaters of the Cam River. There are no perceived conflicts of interest between my involvement in these Plan Changes.

Code of Conduct

19 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

20 I have been asked by the Applicant, to provide evidence regarding:

(a) The existing ecological values of the Site, taking into account any anticipated changes from rezoning the site from its current Rural Lifestyle Zone (**RLZ**), consistent with its current land use of Dairying.

(b) The ecological effects associated with the type of development likely to result from the proposed rezoning of the Site to General Residential Zone, Medium Density Residential (**GRZ, MDR**); and possibly some Business rezoning (**BIZ**).

(c) Whether the identified effects are appropriate, taking into account:

(i) The significance of the values identified;

(ii) The relevant standards applying within the GRZ, MDR and BIZ zone, and any district-wide provisions in the Waimakariri District Plan; and

(iii) Whether there are additional standards or measures that should be applied to avoid or mitigate the identified effects.

21 In preparing my evidence I have reviewed the following documents and evidence:

(a) Draft Outline Development Plans and scope of the proposal, indicating the options for rezoning from rural lifestyle zone to residential. This includes version 29 which is described in detail in the evidence of Nicole Lauenstein.

(b) AEL's earlier reports on the ecology of the waterways at this location.

(c) The results of a recent (13th January 2023) ecological survey.

(d) Expert reports and evidence prepared for the rezoning hearings, but especially that of Nicole Lauenstein.

SITE DESCRIPTION

22 A general description of the District is provided in the PWDP, which is bounded by the mainstem of the Waimakariri River to the South, and the Hurunui District to the North.

23 A map of the Proposed Plan Change Areas (PPCA) is provided in App. I Fig. i, along with some ecology sampling sites which I mention below in my evidence. In its entirety, the PPCA constitutes a significant proportion of the Spark Dairy Farm, with the Plan Change Area estimated at 26.6 Ha North of Boys Road, with a further 29.5 Ha, south of Boys Road. All of the land is pastoralised and flat.

24 The PPCA lies immediately south-east of the township of Rangiora, and is largely bounded by two natural tributaries feeding the Cam River which rise from Rangiora. These are the North Brook and Middle Brook. Three small aligned tributary drains traverse the Spark Dairy Farm, and flow eastwards into the North Brook. South of the PPCA and Spark Farm, the North Brook and Middle Brook join and form the Cam River. The Cam River flows into the lower Waimakariri River in the township of Kaiapoi.

THE CURRENT PROPOSAL

25 The current proposed development area is currently zoned as RU (Rural Zone, proposed District ePlan) and Rural Lifestyle in the Proposed Plan. I understand the proposal currently provided is summarised as follows:

a) *rezoning all that land (appx 30ha) to the west of the proposed Eastern Bypass from Rural Lifestyle Zone to General Residential and Medium Density – in the vicinity of Boys Road (South Belt) and Marsh Road Rangiora, outlined in red on Figure 1 below (portion south of South Belt/Boys Road); or in the alternative rezone the land to GRZ (General Residential Zone), MDR (Medium Density Residential), BIZ (General business), Format Retail/Mixed Use or a mix of GRZ, MDR, BIZ and/or Format Retail/Mixed Use zones.*

b) *rezoning all land north of Boys Road (South Belt) and within the Southeast Rangiora Development Area outlined in red on Figure 1 below (portion north of South Belt/Boys Road) GRZ (under the PWDP this land is zoned RLZ (Rural Lifestyle Zone), and is subject to a proposed Council certification process for delivery of land for housing).*

26 The draft proposed Outline Development Plan (ODP, Ver. 29) is presented in App. I, Figs. ii-v. The Applicant's Urban Designer, Nicole Lauenstein, will talk to her Plan in detail, but the main ecological features include ecologically significant riparian strips composed of a largely continuous sward of native plants. For Block A, a notable ecological advantage is the potential extension of the ecological corridor along the North Brook to the North Brook wetlands to the north, as seen in App. I, Fig. iii. In addition, the Middle Brook ecology will benefit from an ecologically significant riparian strip which will link mature copses of trees south of Marsh Road, to their counterparts and riparian strips on the properties of 2 & 10 Dunlops Road.

BACKGROUND ECOLOGICAL WORK - 2005 Land Use study

27 AEL was involved, and co-wrote, a study of the aquatic ecology of the "Three Brooks" (McMurtrie *et al.* 2005). The "Three Brooks" is the Cam River sub-catchment which is encompassed by the South Brook, Middle Brook and North Brook.

28 The purpose of that study, for the Waimakariri District Council, was for the planning of future growth, and to fill gaps in ecological knowledge of the Three Brook sub-catchment. A secondary objective was to analyse the associations of land use with the aquatic ecology, a topic is particularly relevant to this hearing and my evidence, as co-author of that study. For the ecological update in the Plan Change Area, a North Brook

site, labelled as “2005 Site 1” in App. I, Fig. I, was re-surveyed. Also of relevance, but not resurveyed, were two other 2005 survey sites further upstream of the PPCA on the North Brook, and a site on the Middle Brook downstream of the PPCA Marsh Road. In 2005, the survey sites were not chosen randomly, but were selected to provide ecological information on relatively superior habitats for each of the waterways and land use types.

29 The 2005 study noted that the 8 rural sites around Rangiora had higher macroinvertebrate diversity and a higher proportion of pollution-sensitive species than 8 sites in the Rangiora urban area. Rural sites had a higher proportion of mayflies and caddisflies, but urban sites had more snails, segmented worms, and micro-crustaceans (esp. Copepods). Rural sites had significantly higher ecological ‘stream health’ values than urban ones.

30 Koura were also more common in rural sites than urban ones, and recorded along the North Brook, and within the PPCA, specifically 2005 Site 1. They are highly likely to be distributed elsewhere in the North Brook, and since the conservation status of this large invertebrate is nationally ‘declining’ (Grainger et al. 2018), naturalisation and riparian development of the North Brook should consider the requirements of this large invertebrate. Koura are sensitive to predation from fish, but particularly so by brown trout (Shave et al. 1994). Within their populations, koura are quite territorial. In this way, the inclusion of cover elements utilisable by koura will benefit the population in the North Brook.

31 The 2005 Site (Site 1, App. I, Fig. i) was habitat for 6 identified fish species: brown trout fry and adults, longfin eel, shortfin eel, upland bully, common bully and juvenile lamprey. Of these, brown trout are the only introduced fish, the rest are native species. The ecology-based stream health score, based on the presence of invertebrate fauna sensitive to organic pollution, was 101, is considered “good” by national standards (Stark & Maxted 2007). Koura were also identified from this site in 2005, but also further upstream in the North Brook.

32 The lamprey is another North Brook fish species with conservation status. A number of juveniles (n=11) were recorded in 2005, which suggests that a spawning ground may exist in the vicinity. There is sparse knowledge of the breeding biology and habitat requirements of lamprey, but recent research shows that in a natural setting, they have spawned behind boulders which potential fish predators cannot access (Baker et al. 2017). However, I consider it’s possible that they spawn in other microhabitats with poor predator access. Potential egg predators include eels and possibly trout.

33 There was no significant difference is total fish numbers between the rural and urban land use sites, with differences attributed to local habitat features rather the land use differences. Habitat features important to fish include the availability of refuge from high flows and predators, but physical access to some habitats for migratory fish is likely to be a problem, especially as several fish species are sea migrants.

34 In summary, rural sites had higher macroinvertebrate diversity, but this did not translate into higher fish numbers for rural land use, as pointed out in para 21. The fish carrying capacity of a habitat is also a function of local macroinvertebrate abundance, and a suite of other ecological and physical habitat factors, including predation pressure, competition, fish refuge or cover, and habitat suitability. Fish are not picky eaters, and will feed comfortably on a low-diversity diet of invertebrates, provided they are abundant. The point was made in the 2005 study; that land use has a more direct effect on aquatic macroinvertebrates, as studies have shown they are much more sensitive to water quality, expressed in para 19, but fish are (generally) less sensitive to water quality than aquatic invertebrates, but relatively more sensitive to habitat, flow regime, and access issues. In respect to land use, koura appear to be a little more similar to fish than other invertebrates. Koura are long-lived and territorial, and flow regime and physical habitat stability important to them.

35 In conclusion, and relevant to the re-zoning of this land area, the 2005 land use assessment study (McMurtrie et al. 2005) provided recommendations on how ecological effects of land use change in the Three Brook area can be minimised. These are listed below:

- These are based around maintaining or creating riparian buffers
- maintaining contiguity of habitat for dispersal, sediment control during construction and development
- the implementation of a high-performance stormwater treatment, preferably those involving a treatment train that is effective at the removal of dissolved contaminants and fine sediment.
- maintenance of pre-development hydrology providing the full attenuation of stormflows
- habitat enhancement for instream biota and riparian birdlife

36 Of these, stormwater treatment performance will have a major influence of macroinvertebrate community and diversity, whereas habitat enhancements and bank and bed stability are relatively more important for fish and koura.

2023 STUDY

North Brook Fauna and Issues

37 Prior to the recent field survey, aerial imagery on Google Earth, Canterbury Maps, and ECan's Springs GIS layers were inspected for vegetation changes which could indicate wetlands. During the field visit, the paddocks were surveyed for wet areas by 4WD, with the vehicle survey trail indicated in App. II, Fig. i. One natural inland wetland, as defined by the recent MFE guidelines (Ministry for the Environment 2021a; Ministry for the Environment 2021b), was identified at 281 Boys Road. Historical and recent aerial photographs of this wetland is depicted in App. II, Figs. ii, iii. The wetland is fed by a trickle of groundwater rising from the west.

38 The locations of 2023 fishing sampling sites are depicted in App. I, Fig. i These consist of three shallow electric fishing sites, one in the Middle Brook (EF1) and two on Boys Road Drain (EF 2, 3). In addition, five drain-like habitats, which traversed the PPCA area, were fished with baited traps Gee Minnow traps (labelled as GM 1-5 in App. Fig. i) on tributaries of the North Brook.

39 On the North Brook, the 2005 ecological site mentioned above, was re-surveyed in respect to physical habitat quality, macroinvertebrate fauna, and fish fauna. This site was electric-fished using the same fishing machine and settings and methods as in 2005, and an invertebrate collection was obtained using conventional invertebrate collection protocols (Stark *et al.* 2001).

40 The re-surveyed 2005 North Brook site, now has a macroinvertebrate fauna composed of 15 taxa, with a stream health index (MCI-hb) of 92, which relates to score of health score of "fair", which, while down slightly from the 2005 MCI score of 101, could be seen as a good result for a fenced rural stream with stable banks. In 2023, the stream appeared to be carrying more silt and aquatic macrophytes on this visit in January compared to October 2005, but that may be a seasonal effect representing a difference in flushing flows.

41 The lack of juvenile lamprey at the North Brook site was disappointing, given they were present in number in 2005. However, 3 juveniles (i.e. ammocoetes) of this primitive 'fish' were recorded in the Middle Brook at Site EF1 (App. I, Fig. i), so lamprey spawning

is highly likely to be still occurring in the Middle Brook, but probably the North Brook, as the juveniles are often difficult to detect.

42 Other fish caught at the North Brook site were 3 common bully (only 1 in 2005), and 8 shortfin eel (13 in 2005). No upland bully were caught in the recent survey (but 7 in 2005), or longfin eel. It is almost certain that longfin eel is present in the waterway, and only one was caught in 2005, so they may be scarce in this waterway. Longfin eel require some water depth and bank structure. The reason for the upland bully absence, which is a very common native fish, is unknown. It is found in both urban and rural settings, but it likely to still be present. We found them in the North Brook tributaries, as detailed below.

43 In 2023, at the 2005 Site 1, 9 juvenile koura were identified, suggesting some local breeding, compared to only 3 medium-sized specimens in 2005. However, no trout were recorded during our recent visit, compared to 6 trout (1 fry, and 5 adults) in 2005. I consider that the lack of trout at this location may be responsible for the increase in koura numbers, as trout are effective predators on trout. Based on AEL's trout redd surveys (Taylor 2005; Taylor *et al.* 2012; Taylor & Payne 2023) there has been a distinct decline in trout redd numbers from 2005 to 2023, which is demonstrated in an overlay of the 2005 and 2012 trout redd results (App. II, Fig. iv). A decline in trout redd numbers of this magnitude is likely to be mediated in lower numbers of resident juvenile trout (AEL GPS data and Taylor *et al.* 2012).

44 Trout redds (i.e. egg nests within the stream gravel) are particularly sensitive to blocking with sediment, and there may be a problem with sediment generally in North Brook trout spawning reaches, at least downstream of the PPCA. Sediment of trout spawning gravels in the lower North Brook, downstream of Marsh Road, was commented on by me at the time in Taylor et al. (2012), and significantly increased bed sedimentation at Marsh Road, was recorded over a 5 year period by Environment Canterbury (Table 3-22 in Greer & Meredith 2016). The AEL 2023 trout spawning report also mentions an increase in bank erosion in the North Brook, so determining areas of bank erosion and instability should be a remediation priority for the North Brook. Our winter survey of North Brook, from its confluence with the Cam River to Spark Lane, revealed two localised problem areas involving sedimentation and bank collapse. These specific reaches are easily repaired, and with the expected increased stream bank stability as the riparian strip matures, bank slumps and slips should decrease.

45 More recently, using Environment Canterbury stream-walk data, the North Brook bed adjacent to the PPCA was assessed as having generally less than 20% sediment cover

(Hudson 2017), thus consistent with the LWRP environmental outcome, whereas the lower North Brook (i.e. downstream of Marsh Road) had higher sediment levels which were consistent with findings of the ECan monitoring site at Marsh Road. Thus, while trout redd gravels can be affected by even low levels of interstitial silt amongst gravels, I consider it likely that trout spawning habitat loss may be worse in the lower reaches of the North Brook, which is affecting recruitment of juvenile trout elsewhere. Overall, while fish biodiversity was less than in 2005, the numbers of koura were encouraging. The decline in trout numbers then, in respect to native fish diversity, may be considered as beneficial, given trout are effective predators on koura.

46 Three constructed waterways traversed the PPCA, one in Block A, and two in Block B. Based on 5 fished location, these contained few fish, and contained only the upland bully and shortfin eel. Both species capable of tolerating a degree of habitat isolation, with shortfin eel capable of evading drying reaches, and tolerating poor water quality conditions.

47 All of this considered, as bed sediment has a major detrimental effect on trout spawning habitat, but also detrimental to stream health generally, I would endorse the ECan proposal to install a sediment trap into the North Brook at the upstream margin of the PPCA (Spark Lane) with a second one at Marsh Road (see Fig. 5 *in* Hudson 2017). In respect to sediment trapping, a fortuitous location of a proposed SMA on the Middle Brook which would also serve to trap sediment upstream of a productive trout spawning ground (App. I, Fig. v).

MIDDLE BROOK

48 One site on the Middle Brook was fished (Site EF1 in App. I, Fig. i). Juvenile lamprey were recorded there. Lamprey were also recorded there in 2005, so it is highly likely lamprey spawning still occurs there. Like the North Brook, upland bully and shortfin eel were also present.

OTHER WATERWAYS

49 Two channelised waterways flow eastwards along each side of Boys Road, and discharge into the North Brook and both were ecologically surveyed. The waterway on the north side of the road had higher ecological stream health metrics compared to its counterpart on the south side of Boys Drain, and the Northern waterway had a macroinvertebrate fauna suggestive of permanent flow. In the waterway on the south side of Boys Road, the macroinvertebrate fauna was dominated by microcrustaceans capable of encysting, therefore suggestive of a drying reach. I recommend that the waterway along the north side of Boys Road be naturalised.

50 The fish fauna on the north side was composed of shortfin eel and the upland bully, with a total of 7 fish caught in 3 minutes. In contrast, after 12 minutes fishing, only one shortfin eel was caught from the waterway on the south side. Given that shortfin eel can opportunistically forage in temporary habitats, the fish catch also suggests that the waterway on the south side is temporary.

STORMWATER DISCHARGES

Change in environmental values with plan change

51 Evidence from studies in Christchurch indicate that poor stormwater quality may be having a slow and insidious effect on New Zealand's endemic macroinvertebrate fauna, the so-called "urban syndrome" effect. This is discussed in McMurtrie *et al.* (2005) in respect to the ecology in the Three Brooks. Alongside with habitat fragmentation which can potentially occur from urbanisation, and a peakier storm hydrograph, fish and koura are also adversely affected.

52 The differing mechanisms in which urbanisation effects macroinvertebrates and fish is mentioned in the Three Brooks study (McMurtrie *et al.* 2005)… *"The statistical analysis of the results from the land use study pointed out the macroinvertebrate fauna show signs of being sensitive to land use change, more so than the fish fauna, the latter being more sensitive to habitat conditions. It would appear that many macroinvertebrates are more sensitive to urban stormwater contaminants than fish."*

53 This point is borne out in laboratory trials which have demonstrated that both acute and chronic ecotoxicity trials on New Zealand invertebrates indicate that many aquatic invertebrates are many times more sensitive to urban contaminates than fish (Hickey 2000; Hickey & Vickers 1992). In streams with small baseflows and sensitive biota, like the North Brook, stormwater attenuation and treatment must be at a high level, as recommended in the 2005 study's recommendations on preventing a decline in ecological standards (McMurtrie *et al.* 2005).

54 While yet to be finalised, it is proposed that the Spark Farm stormwater treatment train will be of a high standard (Northbrook Infrastructure Assessment Report). Block A (north of Boys Road) already has stormwater consent (WDC184601). Block B (south of Boys Road) has no current stormwater discharge consent. Site stormwater management is anticipated to encompass a network of pipes, swales, basins and treatment devices and be compliant with the CCC and WDC design standards on treatment efficiency, attenuation, and construction.

55 Erosion and Sediment Control is also mentioned in the civil infrastructure report cited above (page 6). While details are not provided, it is expected that all methods will be compliant with Environment Canterbury published guide (Environment Canterbury 2007) and the more recent online ToolBox (Canterbury 2012). Erosion and Sediment Control will be monitored by the construction contractor, their monitoring engineer, and ECan and WDC representatives.

PROPOSED MITIGATION AGAINST EFFECTS OF LAND USE CHANGE

56 The 2005 report provides strategic direction on how adverse impacts on land use change can me mitigated (McMurtrie *et al.* 2005). These are listed in para 11 of the summary. Moreover, due to the recent naturalisation of many channelised waterways in mid-Canterbury, there is good local experience at stream habitat creation and remediation or the aquatic fauna found in the PPDA.

DEVELOPMENT SETBACKS

57 An ecological feature and strength of this development is the extent and quality of the proposed planted setback from the North Brook and a natural wetland, albeit in a degraded state. The setback on the Spark Farm side of the North Brook (the true right or South-West bank) will be composed of a 15 m planted ecological riparian buffer from the water's edge, bordered by a cycle/walkway of 5 m width. A natural vegetation visual screen is proposed between the pathway and neighbouring residences. Runoff from the cycle/walkway will flow away from the riparian buffer zone. The riparian buffer on the true left or north-east bank will of equal or greater native-planted width.

58 Native-planted setbacks of this width, and especially on level ground, are of a size that ecological benefits can be realised. Narrower planted widths provide shading, bank support, sediment control and nutrient uptake (Parkyn & Davies-Colley 2003). But widths greater than 10 m also provide dispersal paths for insects and birds. Buffer widths between 10-20 m are recommended to support sustainable native forest vegetation and protect most aquatic functions (Parkyn *et al.* 2000).

59 This North Brook riparian setback extends into the established setbacks at Spark Lane and Cotter Lane, and with this width could certainly act as an ecological corridor for birds, insects and other wildlife. With some additional planting to the north, this could link the green areas as far away as Cotter Lane.

60 The Middle Brook will also have a generous esplanade similar to the North Brook, with potential for an ecologically significant riparian strip with suitable planting.

COMMENT ON OUTLINE DESIGN PLAN AND EVIDENCE OF OTHERS

61 I have read the evidence and design narrative of Nicole Lauenstein. Nicole and I have collaborated together to ensure that ecological objectives are integrated into the development plan.

62 This is because instream ecological values, especially so in the North Brook, are high, and land use investigations have demonstrated that land use change from rural to urban in the Three Brooks area is associated with decrease in ecological values in these waterways. This work, in 2005, summarised key strategic drivers to maintain ecological values in the waterways, and these are included as key elements in the ODP. These include matters relating to ecological dispersal, physical habitat stability, stormwater quality, and maintenance, as much as possible, of a rural storm hydrograph in the North Brook.

63 AEL has prepared a memo to Mr. Lester on riparian plants which may be beneficial to the instream ecology, and facilitate ecological dispersal along the North and Middle Brooks to adjoining habitats.

64 Ms Lauenstein's planning evidence generally describes the location key stormwater management areas; which will include processes of stormwater retention and treatment. This fulfils an important planning function ensuring sufficient space is always available for effective stormwater management, by determining the locations of stormwater management areas (SMAs). This will be integrated into the site's hydrology, including key water channels and main flow paths. In conjunction with ecological function, value and landscaping objectives, development setbacks have also been set.

65 Using this collaborative approach between stormwater engineering, hydrology, ecology, and landscape, the adverse impacts of land use changes will be sharply mitigated, reduced to zero, or provide a net ecological enhancement. McMurtrie *et al.* (2005), summarised the ecological impacts of urbanisation as altered flow regimes from a pre-urban state, inputs of pollutants (sediment, heavy metals, and hydrocarbons) and habitat modification. I am confident the collaborative approach used here will be effective to mitigate the ecological impacts of land use change in the Three Brooks catchment. This will require further design when roading and lot layouts are formalised.

NPS FOR FRESHWATER MANAGEMENT (NPS-FM 2020)

66 The National Policy Statement for Freshwater Management (NPS-FM 2020) requires Regional Councils to apply a hierarchy of obligations for the protection of freshwater habitats, and the application of an effects management hierarchy to proposed impacts on those habitats.

67 Our report considers the matter against the 15 Policies outlined in the NPS for Freshwater Management (NPS-FM 2020), and as based on the information available to me, the proposal is consistent with the Policies of the NPS-FM 2020.

NES FOR FRESHWATER (NES-F 2020)

68 The National Environmental Standards for Freshwater (NES-F 2020) is concerned with infrastructure impacts on freshwater habitats. In this context, compliance with Regulation 63 (for culverts) would be required, but potentially for weirs, aprons and ramps (Regs. 64, and 68).

69 At the re-zoning stage, there is no current information in the Civil Infrastructure report regarding bridging (Rezoning Request, Fraser Thomas 2024). Bridging details will be provided at the subdivision consent stage, however I understand they will be fully compliant with the NES and various construction guidelines (Christchurch City Council 2003).

70 From an ecological perspective, it is important that ecological pathways are as contiguous as possible, but especially that the ecological pathway extends under the Rangiora Eastern Link Road (REL) bridge. This is a requirement for the flighted lifestages of aquatic invertebrates, but also fish. Some waterbirds also closely follow waterway corridors, and there should be sufficient height above the water surface to accommodate low-flying waterbirds.

71 Culverts should be avoided as much as possible. Even when designed passable by fish, they are considered impassable for winged aquatic invertebrates (e.g. mayflies and caddisflies) which inhabit the North Brook and Middle Brook.

72 As reported before, there is a natural inland wetland south of Boys Road, which is discernible in historic (1960-1964) imagery in Canterbury Maps (App. II, Figs. ii, iii). This is described in the background report to my evidence. While currently invaded by exotic weed species, especially willow weed, some native wetland rushes were present, including *J. pallidus*, and the sedge Carex *virgata*. With setback and protection, there is scope for this habitat to be naturalised and restored. This area has

been integrated into the ODP and will align with the development setback around the reserve area in App. I, Fig. iv.

73 In the context of this development area, the area is traversed, flowing west to east, with a number of farm drains indicated in App. I, Fig. ii. These are quite linear and appear constructed. As such, while they provide some ecological value, they may not be considered rivers under the RMA definition. If and where I possible, these waterways should be naturalised and planted.

NPS FOR INDIGENOUS BIODIVERSITY (NPS-IB 2023)

74 Blocks A, B, and C were surveyed for indigenous (native) plants on the 18/1/24, and it was apparent that all of the proposed Blocks had little indigenous flora, with only 15 indigenous vascular plants identified (Payne *et.* al 2024). All terrestrial native plant species in the survey area were present in low densities, but not sufficient to provide habitat for native fauna.

75 A bird observation survey identified 5 indigenous bird species within the proposed Blocks. All species were common throughout the Low Plains ecological district.

76 Based on ECan black maps (Canterbury Maps), the proposed development area was historically dominated by wetland habitat. Indigenous flora and fauna in the survey area were not representative of historic wetland habitat, or the existing indigenous habitat of the Low Plains ecological district.

77 Diversity and abundance of indigenous flora and fauna was low in the survey area, in comparison to the greater Low Plains ecological district.

78 All indigenous flora and fauna identified in the survey area were highly common throughout the Low Plains ecological area. No rare or distinctive indigenous habitats were identified in the survey area.

79 Indigenous flora was not dominant in any locations, and was only present in small, localised areas. Due to the small size, these areas did not provide ecological linkages between other native habitats outside of the proposed development.

80 Indigenous flora and fauna within the survey area therefore did **not** meet any of the four criteria used to distinguish a Significant Natural Area. It was concluded that no Significant Natural Areas were present within the proposed development boundary.

81 Rule 3.16 of the NPS-IB therefore applies to the proposed development area. The small remnants of indigenous vegetation must be managed using the effects management

hierarchy. If these remnants require removal, native planting elsewhere is recommended to offset the impacts.

CONCLUSION

82 A large proportion of a working dairy farm (Spark Farm) has been proposed to be developed into residential lots of various densities. The northern area (so-called Block A, north of Boys Road) and the area of south of Boys Road (Block B) are subject to re-zoning submissions on the PWDP and Variation 1 to that plan.

83 Within the proposed development area, several small-scale ecological surveys were conducted between January 2023 and January 2024 to determine the aquatic ecology and identify remnants of native vegetation. Firstly, this information is useful from a planning context in respect to habitat protection and management. Secondly, especially based on the flora, whether habitats can be assessed as natural inland wetlands under the National Policy Statement 2020 for Freshwater Management, or Significant Natural Areas based on criteria for NPS-Indigenous Biodiversity 2023. In this context, one natural inland wetland, albeit degraded, was identified south of Boys Road.

84 The North Brook has the highest ecological value, both for native fish, but also for trout spawning, and koura habitat. Lamprey (kana kana) have been recorded from the North Brook in the past, and these are still probably present.

85 Juvenile lamprey were recorded from the Middle Brook, as they have been in the past, and it is clear that lamprey are probably spawning in both the North Brook and Middle Brook. The Middle Brook also contains some trout spawning habitat. However, this development proposal has little ecological implications for the Middle Brook, which will continue to flow through a section of land not subject to development. However, it is proposed that both waterways be subject to habitat enhancement through riparian planting.

86 While design detail has not been undertaken, the development has significant ecological potential by linking the proposed enhanced ecological corridor of the North Brook to an existing planted wetland area of significant size (i.e. Northbrook wetlands on Cotter Lane). Likewise, on the Middle Brook, there is significant potential to enhance the habitat quality in this waterway, and promote ecological links along this waterway between Marshes Road and Dunlops Road. Both waterways have setbacks of a setback which will facilitate ecological dispersal and linkage to adjoining habitats.

Finally, with a already planned setback, there is also potential for the restoration of a degraded wetland near Boys Road to a more natural indigenous state.

Mark James Taylor

4 March 2024

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Appendix I. Recent fishing locations in the PPCA, and the earlier (2005) survey site.

Figure i. A general map of the Proposed Plan Change Area, illustrating fishing locations, by method, and the ECan database location.

Figure ii. Overall Development Plan, Blocks A, B & C (Version 29).

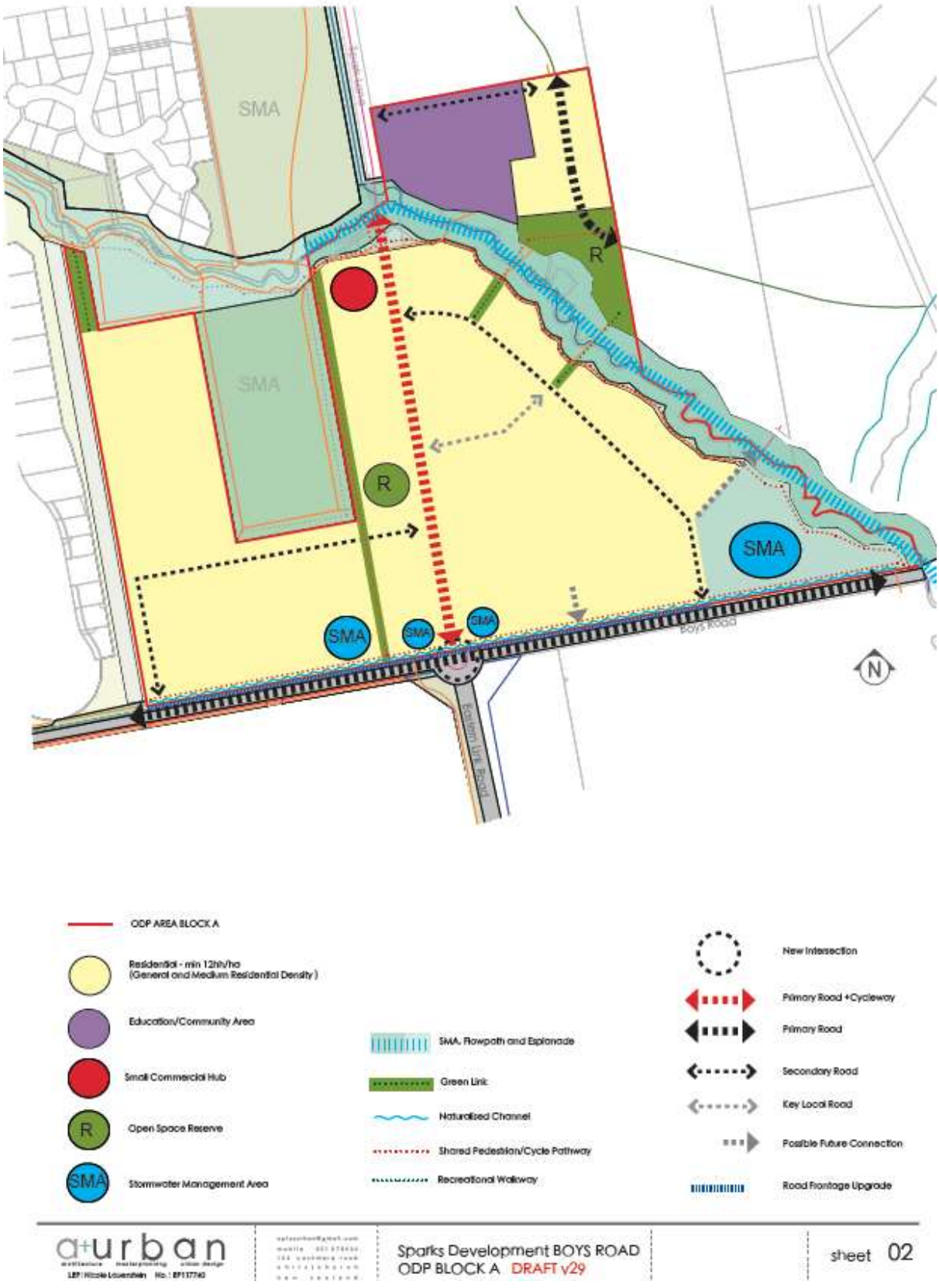

Figure iii. Sparks Development Plan, Block A only (version 29).

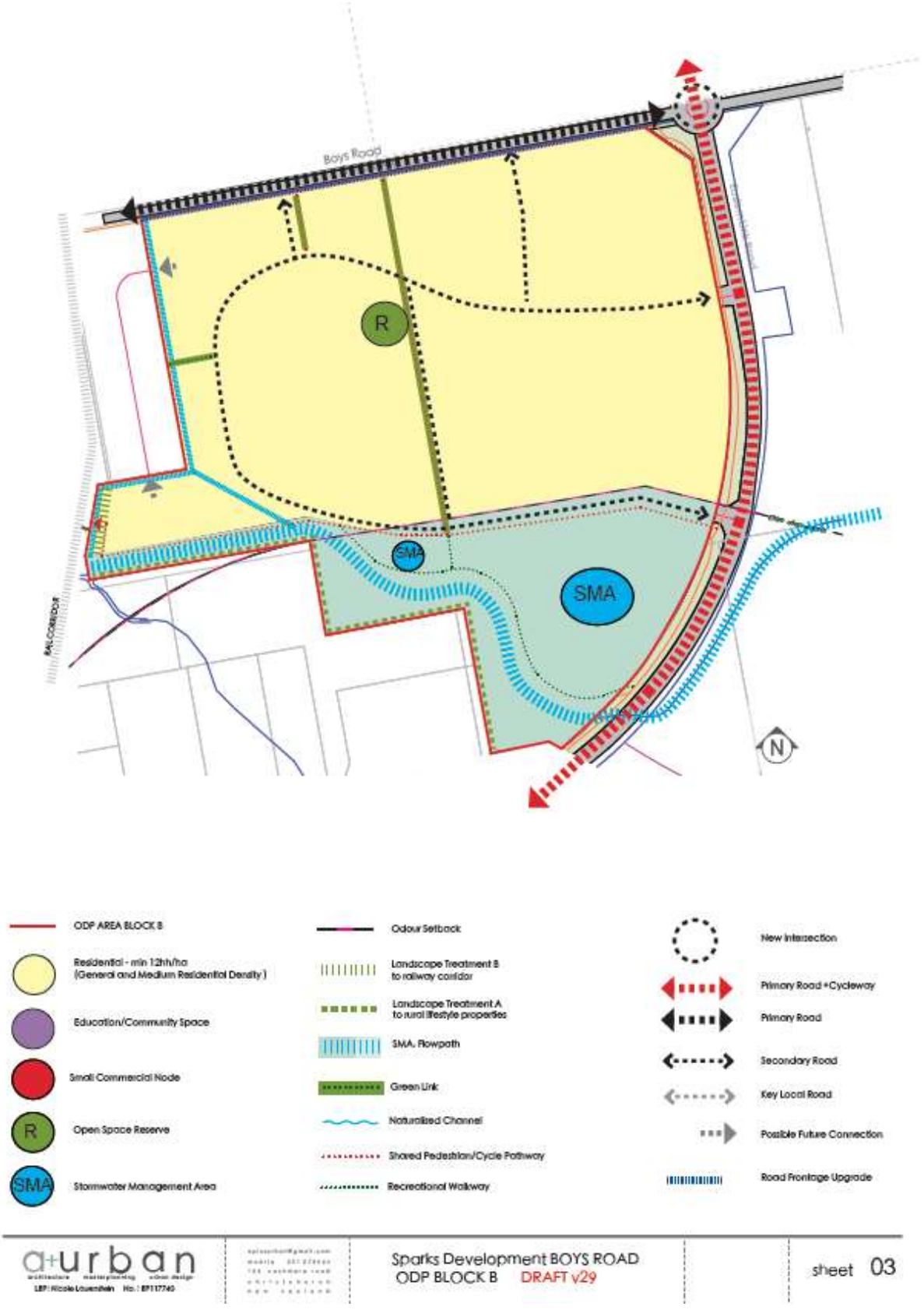

Figure iv. Sparks Development Plan, Block B only (version 29).

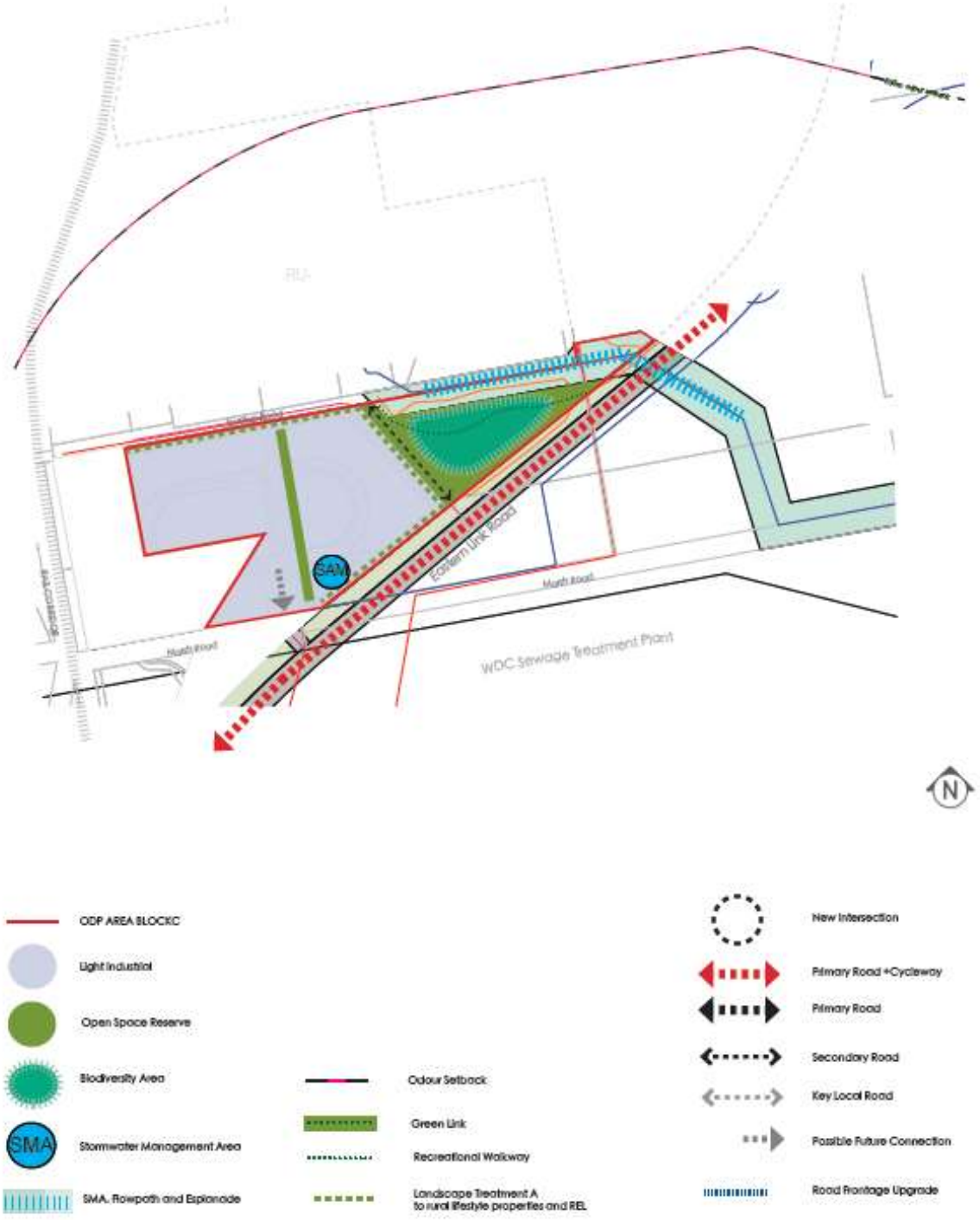

Figure v. Sparks Development Plan, Block C only (version 29). This SMA development may function as a fortuitously well-placed sediment trap for the Middle Brook.

APPENDIX II. Figure i. The survey course (yellow track) to identify isolated wetlands in the PPCA.

Figure ii. Wetland aerial (Canterbury Maps (1960-1964), on the property of 281 Boys Road.

Figure iii. Wetland aerial (Canterbury Maps "recent imagery") on the property of 281 Boys Road.

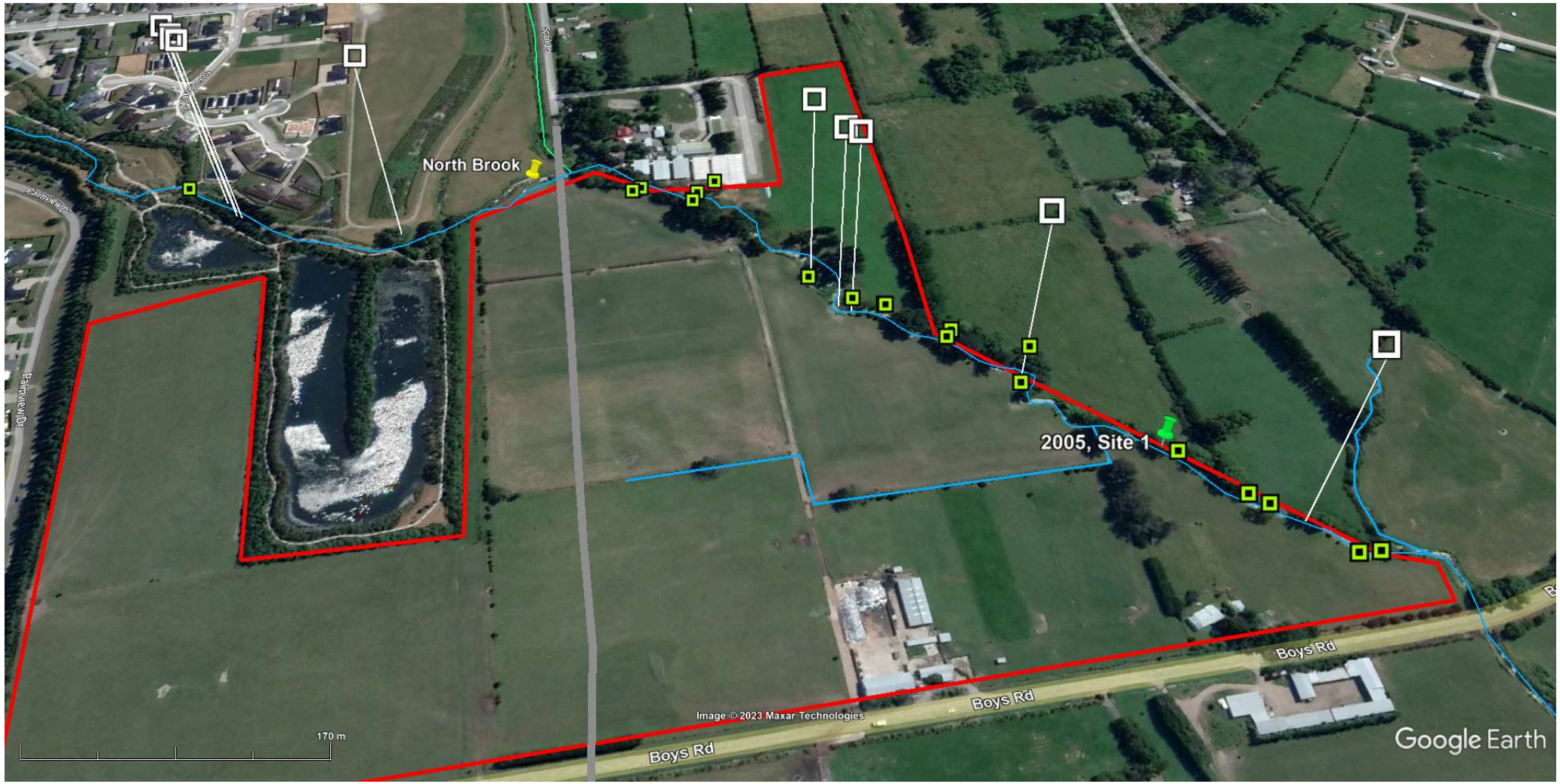

Figure iv. Green icons = 2005 trout redd distribution, elevated white icons = 2012 redd distribution.