BEFORE THE HEARINGS PANEL APPOINTED BY CANTERBURY REGIONAL COUNCIL

UNDER the Resource Management Act 1991 (RMA)

AND

IN THE MATTER of an application by Canterbury Regional Council

for resouce consent to discharge agrichemicals to rivers and their connected waterbodies, air and the coastal marine area, and the clearance of vegetation, for the purposes of weed management to provide flood, erosion, drainage and river enhancement works.

STATEMENT OF EVIDENCE OF JEAN-MARIE LOUISE JACK ON BEHALF OF CANTERBURY REGIONAL COUNCIL (APPLICANT)

11 March 2023

Introduction

1. My full name is Jean-Marie Louise Jack I am employed by the Canterbury Regional Council as an ecologist (Team Leader, Land Ecology).

2. I am a member of the Environment Institute of Australia and New Zealand, a professional body for environmental practitioners.

Background

3. This statement of evidence relates to the Canterbury Regional Council's (CRC) (the applicant) resource consent applications CRC222040, CRC222041, and CRC222043 to discharge agrichemicals to water and to land in circumstances where they may enter water, and associated vegetation clearance.

4. This evidence will provide the decision-maker with information and advice related to the actual and potential effects of the proposed activities on terrestrial ecology including wetland habitats.

Qualifications

5. My principal qualifications include PhD (Ecology), Post-graduate Certificate in Environmental Management and Post-graduate Diploma of Viticulture & Oenology from Lincoln University, and a Bachelor of Commerce & Administration from Victoria University. My PhD concerned the provision of ecosystem services by indigenous plants within agricultural landscapes.

6. My current role at CRC is Team Leader of Land Ecology within the Science Group. I have been working at the Council since 2011.

7. Post tertiary study, my work experience has largely been at CRC providing advice relating to biodiversity. My initial role as a Biodiversity Officer focussed on providing advice on ecological restoration to external customers including weed control, facilitating biodiversity funding, and leading programmes including regional initiatives on fish passage and wilding conifer control. From 2017 I have worked in the Science Group as a Senior Scientist and now Team Leader. These roles involve providing advice to CRC staff and external customers regarding ecological monitoring, ecological significance assessment, ecological impact assessment and effects management.

8. In my current role I regularly review ecological impact assessments (EcIA) for Consents Planners and have facilitated guidelines for EcIA regarding Canterbury herpetofauna (lizards).

9. I have experience with several areas of ecology; most of my expertise relates to Canterbury habitats including braided rivers, wetlands, drylands, and lizard & mudfish habitats. I have led multiple river bird and lizard surveys across many of Canterbury's braided river environments.

10. I have visited many of the river environments to which these proceedings relate and am familiar with some areas of the drainage network. My evidence relies on my knowledge of these environments, a desktop review for information and the applicant's reports.

Code of Conduct

11. While not required for a Council hearing for a resource consent application, I confirm that I have read the code of conduct for expert witnesses as set out in the Environment Court's Practice Note 2023. I have complied with the practice note when preparing my written statement of evidence and will do so for any oral evidence I provide.

12. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Scope of evidence

13. I was asked to provide evidence on behalf of the applicant on:

- A description of terrestrial ecology and wetland habitats associated with the project area and connected to rivers, including drains (all waterways); and
- Impacts of herbicide spray discharge on terrestrial ecology and wetlands including vegetation clearance in and within 10m of wetlands; and
- Means to manage potential effects on terrestrial ecology and wetlands.

14. Wildlands Consultants Ltd (2024) provided CRC with a collation of desktop surveys of indigenous terrestrial vegetation, invertebrate, lizard, bat and avifauna values associated with the project area and describes potential effects of spraying on these values. I generally agree with these descriptions and potential effects and focus my evidence on further describing the ecological values and means to manage potentially adverse effects on terrestrial ecology, particularly relating to riverbirds and lizards.

15. In this evidence I:

a) Provide a broad description of the project environments and describe the terrestrial and wetland ecological values typically present within the proposed project environments and their ecological significance; and
b) Provide a brief assessment of the potential impacts of the proposed herbicide spray discharge on these ecological values; and
c) Comment on the proposed impact management approaches to manage potential adverse effects of herbicide spray discharge on terrestrial ecology and wetlands.

16. In preparing my evidence, I have reviewed sections of the following documents and evidence:

a) CRC222040, CRC222041, CRC220043 - Application CP LU DW DA - Global Application for Canterbury Region - Assessment of Environmental Effects
b) 'Internal Spray Handbook Example April 2023' prepared by CRC
c) Technical ecological advice for Environment Canterbury agrichemical spray consent application. Contract Report No. 6914a Wildlands. January 2024.

Summary of evidence

17. In summary my evidence shows:

a) Key ecological features identified within the project area and receiving environment include braided river ecosystems, wetlands, associated indigenous vegetation and habitats of fauna.

b) Braided river habitats within the proposed area are ecologically significant under the Canterbury Regional Policy Statement (CRPS) assessment criteria. These areas are a naturally uncommon ecosystem type and provide habitat to threatened fauna including many freshwater dependent species of plants, birds and, in the case of the Rangitata, Orari and Opihi, the native long-tailed bat.

c) Riparian areas of rivers and drains may hold significant ecological value, particularly those less modified and adjoining wetland habitats. In places drains may offer habitat to native species which have otherwise been displaced from historic habitats and provide important habitat to swamp specialist birds.

d) Weed encroachment on river environments presents a serious threat to indigenous ecosystems. The use of herbicides to control weeds within river environments offers an efficient means to address this threat. The potential positive outcomes of herbicide use to reduce weed cover are however accompanied by potential adverse effects.

e) Further information on the receiving environments would be required to determine the ecological significance of specific operational sites and consequently the potential level of any site-specific adverse effects.

f) The potential level of adverse effects of the proposed activities on terrestrial ecology may be very high without impact management including avoidance of areas containing high ecological value.

g) Impact management relies on pre-spray processes involving both remote (desktop) assessments and ground-based surveys for locating areas of ecological value to enable avoidance or otherwise appropriately managing adverse effects.

Assessment of Receiving Environment

Description of terrestrial ecology and wetland habitats of the project area

18. The project area includes all waterways within Canterbury Regional Council (CRC) jurisdiction and includes river fairways, berms, river access tracks, and drain

channels & banks associated with drainage networks. The areas primarily targeted (but not exclusively) for herbicide spraying are those within river and drainage rating districts (Figure 1).

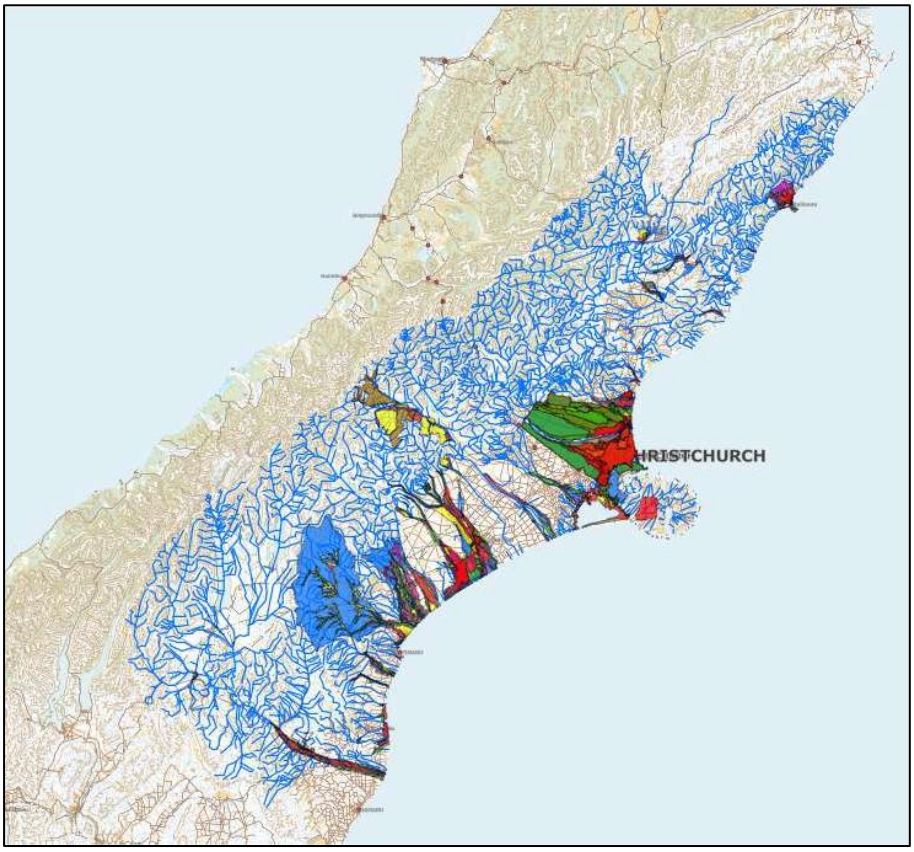

Figure 1: Map of the project area supplied by applicant[1]. Agrichemical discharge may occur near or in any of these waterways (blue lines) throughout Canterbury. The coloured areas identify established river and drainage rating districts.

19. Given the region-wide context, terrestrial habitats associated with these waterways will represent a diversity of ecosystems which occur from inland valleys, through hill-country to the eastern plains.

20. Project areas include dynamic braided river environments, associated wetlands, and a diversity of riparian habitats alongside relatively stable stream and drainage channels. For each of these three broad environments I provide a general description of their ecological values.

Braided river environments

21. Braided river environments are dynamic, presenting a ‘stable-yet-disturbed’ system of interacting species and habitats (Harris et al., 2024). These environments include

[1] CRC File: C21C/234037-6.

extensive vegetated and unvegetated riverbed, and contiguous plant communities within river margins (berms). Often spanning ecological districts (McEwen, 1987) braided rivers provide habitat to a diverse assemblage of species, including many which are Threatened (Townsend et al., 2008), and are considered uncommon ecosystems classified as Threatened-Endangered (Holdaway, 2012; Williams et al., 2007).

22. As naturally uncommon ecosystems (Williams et al., 2007), all braided river environments within the project area including the bed and margins are considered ecologically significant under the Canterbury Regional Policy Statement (CRPS) criterion 8 (Environment Canterbury, 2013; Wildlands, 2013). Given that most of these rivers hold distinctive assemblages of species, support Nationally Threatened, At-Risk or Uncommon species, present diverse habitat types or provide important ecological linkages or buffering, the various areas targeted for spraying will also meet multiple other significance criteria of the CRPS.

23. Throughout braided river systems the relative extent of the plant communities and faunal habitat is driven by river flows and associated disturbance regimes. Other factors include weeds, water abstraction and sedimentation (Harris et al., 2024).

24. Reflecting the general trend of habitat loss and a lack of legal protection from mountains to sea, the upper reaches of braided rivers typically hold plant communities with higher proportions of indigenous species, while indigenous species occurrence and extent reduces within lowland reaches (Harding, 2009; McEwen, 1987; Walker et al., 2015).

Braided river plant communities

25. Dominant vegetation types occurring within the more recently active braidplain of upper reaches include extensive indigenous herbfield and low producing exotic grassland. These vegetation types typically continue across older river terraces which also hold indigenous mossfield, tussockland and shrubland.

26. Vegetation of lowland reaches are heavily modified from original (pre-human) cover which in the floodplains of the Low Plains[2] likely included a mosaic of short native tussock and grassland, grey scrub, kowhai-mixed hardwood forest and associated wetlands (McEwen, 1987; Harding, 2009) . Today the dominant vegetation types of recently active braidplains often include exotic herbfield and grassland, while vegetation types within river berms include planted (flood protection) or naturalised exotic forest and treeland, vineland, gorse/broom scrub/shrubland and exotic grassland. Islands of these higher stature vegetation types may also occur within the fairway. River margins in lowland areas are often stabilised by engineered stopbanks forming raised berms.

[2] The Low Plains includes the lower reaches of waterways (<300m a.s.l) from the Waipara River south to the Opihi River.

27. Dominant plant species occurring within these lowland areas and within the active riverbed today frequently include the exotic species: yellow lupin (*Lupinus arboreus*), brassica (*Brassica* spp.), Californian poppy (*Eschscholzia californica*), monkey musk (*Erythranthe guttata*), gorse (*Ulex europaeus*) and broom (*Cytosis scoparium*). Rare or occasional native plants include mat daisies (*Raoulia australis* (At Risk: Declining), *R. hookeri and R. tenuicaulis*), creeping pōhuehue (*Muehlenbeckia axillaris*), leafless pōhuehue (*Muelenbeckia ephedroides;* Threatened – Nationally Vulnerable), and willowherb (*Epilobium melanocaulon*). The pioneering species, particularly *R. tenuicaulis* and *Epilobium* species, may establish shortly following disturbance on new gravel bed deposition (i.e., following a flood) and grow at round 15-20cm per year (Wardle, 1972).

28. Dominant plant species of lowland berms include exotic forests of crack willow (*Salix fragilis*), poplar species (*Populus* spp.) and sycamore (*Acer pseudoplatanus*). Frequently the native vine pohuehue (*Muehlenbeckia australis*) or the exotic vines old man's beard (*Clematis vitalba*) and ivy (*Hedera canariensis*) occur within canopies. Sub-canopies often include exotic broom (*Cytosis scoparium)*, gorse (*Ulex europaeus*), plum (*Prunus* sp.) and black berry (*Rubus fruticosus*). Native trees, including kanuka (*Kunzea* spp.), kowhai (*Sophora microphylla),* lowland ribbonwood *(Plagianthus regius),* kohuhu (*Pittosporum tenuifolium*), and cabbage tree (*Cordyline australis*), are rare in occurrence, as are other native species such as coprosma (*Coprosma* spp.), small-leaved pohuehue (*Muehlenbeckia complexa),* prickly shield fern (*Polystichum vestitum*) and hound's tongue (*Zealandia pustulata*).

29. Where forest is not present, exotic scrub and shrubland is the next most common vegetation of the margins. Scotch broom, gorse and yellow lupin are often the dominant species. Scattered emergent trees including crack willow, poplar, pine and sycamore can also occur, commonly accompanied by vines of pōhuehue and old man's beard.

30. Exotic grassland occurs at the edge or within spaces unoccupied by the vegetation structures reported above.

31. All vegetation types of braided river environments described above may provide habitat to indigenous fauna (Wildlands, 2015).

32. The occurrences of native plants within river berms are considered ecologically significant where they are uncommon in the Ecological District. With <1 - 5% of any plant community remaining in the Low or High Plains ED, which covers most of the project area, any indigenous vegetation within this area would be ecologically significant (Wildlands, 2013; Harding, 2009).

Braided river habitats – Fauna

33. Records of indigenous fauna found within the project area have been collated by Wildlands (2024) and include invertebrates, bees, bats, lizards and avifauna. I

provide below further information on the use of the braided rivers by lizards and avifauna.

Braided river habitats – Lizards

34. Discrete areas within riparian areas provide suitable habitat to lizards. Lizards may inhabit both indigenous and exotic vegetation and their potential to occupy modified habitats is high (Wildlands, 2015). Lizards have been recorded to occur within the landcover types occurring within river environments including exotic forest (margins & old pine), low & high producing grasslands, gorse and broom, and gravel and rock (Ibid.) Wildlands (2024) determined at least 13 species are likely to inhabit riparian areas of the project area.

35. Of these, the most likely to be found in areas targeted by spray operations are the grass skinks of the *Oligosoma* genus,including *O. aff. polychroma* Clade 4 & 5 (At Risk, Declining) and McCann's skink (*O. maccanni*; Not threatened). Less frequently, gecko species including Southern Alps (*Woodworthia* "Southern Alps"; At Risk - Declining), Waitaha gecko (*Woodworthia* cf. *brunnea;* At Risk - Declining), and Jewelled gecko (*Naultinus gemmeus;* At Risk - Declining). The Canterbury spotted skink (*Oligosoma lineoocellatum;* Nationally Critical) may also occur.

36. A history of disturbance, likely predation pressures and the extensive shading by the riparian forest structure (which reduces basking opportunities, critical for the biology of these lizards) lessens the quality of lizard habitat provided by riparian areas of lowland river reaches. While lizards are likely to be in low numbers and the habitat degraded, the river berms within lowland areas provide some of the last remaining habitat to At-Risk~~t~~ and Threatened lizard species, connecting populations which have otherwise become highly isolated across their natural ranges. As such I consider such habitats as ecologically significant.

37. My experience surveying for lizards across river berms or more stable riverbed areas indicates these animals may disperse into riparian areas and more stable areas of riverbed that experience only infrequent inundation by high / flood events (2+ years). It is presumed lizards will be lost from areas when these events re-occur (Jack, 2022). This ephemeral quality of habitats is characteristic of a braided river ecosystem which is defined by systematic disturbances. These disturbance events maintain the diversity of habitats, including the low stature vegetation favourable to lizards, and support the diverse assemblage of species known from braided river ecosystems.

Braided river habitats – avifauna (birds)

38. Braided rivers provide important habitat for indigenous river birds, many of which are Threatened or At-Risk of extinction (Robertson et al., 2021). The use of these environments by avifauna is well known with habitats described and mapped by O'Donnell (2000). Observations of river birds are regularly recorded by ground surveys across many of the region's rivers. These surveys are conducted from

September to early December. This timing captures the height of nesting for most riverbed-nesting bird species (O'Donnell, 2000).

39. While some rivers support higher numbers or a greater diversity of avifauna, all rivers are part of a river bird habitat network, each contributing to the network's resilience. For example, during the nesting season the large alpine-fed rivers often experience high flows which can flood river bird nests. Concurrently, hill-fed rivers and their nesting occupants may be unaffected by the same precipitation event and provide nesting habitat to those displaced.

Associated wetland habitats

40. Small riverine wetlands are common within braided river environments including within berms. While often dominated by an exotic willow canopy (and therefore difficult to distinguish aerially from adjoining riparian willow forest) native wetland plants such as flax (*Phormium tenax*), restiad spp. (rushes), *Carex* spp. and other sedges are often present in these habitats.

41. Many wetlands within or adjoining the project area have either been indicatively mapped from aerial imagery, or ground survey. However, many will be unmapped, and, as with other braided river habitats, their occurrence and extent will change over time with disturbances associated with braided river dynamics.

42. Like indigenous vegetation, any wetland within lowland environments will be considered ecologically significant due to the reduced extent of these habitats (Wildlands, 2013).

Associated riparian habitats alongside stable stream and drainage channels

43. Riparian margins of streams may hold ecological value both in the species assemblage that inhabit them, or their ability to buffer aquatic ecological values within the water ways from surrounding land use (nutrient and sediment issues).

44. In lowland areas the small stable waterways that contribute to the managed drainage network may represent remnant habitats of historically extensive wetlands or provide habitat to fauna.

Stream and drain networks - Plant communities

45. Where riparian areas are not heavily, or routinely disturbed, indigenous vegetation may occur. I would expect such discrete areas of drains and waterways to present similar, albeit less frequent, values to those I am familiar with from surveys undertaken for stock water races.

46. Recent surveys of some water race sections in the Waimakariri and Selwyn District District found At-Risk-Declining plant species including *Carex buchananii*, *Isolepis*

basilaris, Mentha cunninghamii, Ranunculus foliosus, Rytidosperma exiguum, and *R. merum* (Meurk, In Prep).

47. More frequently observed, yet uncommon plants of riparian margins within the Low Plains context, include *Centella uniflora, Schoenus pauciflorus, Carex petriei, C breviculmis, Blechnum penna-marina, B. discolor, B. chambersii, Gonocarpus aggregatus, Lobelia angulata, Rorippa palustris, Nertera/Leptostigma, Haloragis erecta, Histiopteris incisa, Eleocharis gracilis, Glossostigma elatinoides, Plantago triandra, Polystichum spp.* These occurrences have been recorded within the online public platform called iNaturalist.

48. Riparian areas containing naturally occurring Uncommon, At-Risk-Declining or Threatened species would be considered ecologically significant. As will all naturally occurring indigenous riparian vegetation within land environments where <10% of such vegetation remains; this includes all the Canterbury Plains (Walker et al., 2015).

Stream and drain networks - avifauna

49. Many indigenous birds including riparian species, open water divers, waders and waterfowl will utilise the riparian habitats of the stream and drainage networks. Of note however are the secretive swamp specialists, Australasian Bittern (*Botaurus poiciloptilus*), marsh crake (*Zapornia pusilla*) and spotless crake (*Zapornia tabuensis*). These species are known to utilise the dense wetland vegetation occurring within or adjoining drains including the Halswell Canal and Styx Drain.

Stream and drain networks - lizards

50. Riparian areas of streams and drains may provide habitat to indigenous lizards, principally grass skinks.

Assessment of Effects on the Environment

Impacts of herbicide spray discharge on terrestrial ecology and wetlands

51. Herbicide spraying is used to control exotic vegetation within river environments. Within river environments these weeds often displace indigenous vegetation and habitats and disrupt dynamic braided river systems which support the establishment and maintenance of those values (O'Donnell et al., 2016, Harris et al., 2024).

52. Exotic weed encroachment on river environments presents a serious threat to indigenous ecosystems, displacing specialist river species. For instance, river-nesting birds rely on clear gravels, and or low stature vegetation for breeding and foraging. As taller stature weeds establish on higher more stable areas this forces birds to nest on lower more flood-prone areas where nests might be lost (O'Donnell

et al., 2016). Such displacement would also apply to riverbed specialist plant and invertebrate species, while lizard habitat may also be reduced in quality and extent.

53. The potential positive outcomes of herbicide use to reduce weed cover are however accompanied by potential adverse effects. I do not have expertise in the mechanisms by which herbicides might directly affect species, however those potential adverse effects outlined by the advice of Wildlands (2024) aligns with my own understanding and observations with regards to effects on vegetation.

54. Potential adverse effects of the proposed spraying on terrestrial ecology and wetlands relate to the removal of indigenous vegetation and associated habitats for indigenous species, and direct effects on fauna through disturbance or non-target herbicide application. Such non-target application may occur through direct application, spills, or spray drift.

Potential effects on indigenous vegetation and wetlands

55. All plant communities of the three broad environments described above will be sensitive to the proposed herbicides.

56. Vegetation of wetland habitats, including those found beneath an exotic canopy, will be sensitive to herbicides.

57. In lower reaches (i.e., Low Plains) where seed sources for native vegetation is highly limited, adverse effects may be compounded by the loss of relatively small areas of uncommon native vegetation. The occurrence of native vegetation within dynamic river environments relies on seed sources remaining within and surrounding that dynamic environment (Brummer et al., 2016).

58. The level of effect of the removal of indigenous vegetation and habitats could vary from very low to very high depending on the value (i.e., importance) and magnitude of impact (i.e., extent of vegetation lost). Given the high values present within the proposed spray areas, impact management to avoid and or mitigate such effects is appropriate, particularly within wetlands and lowland reaches.

Potential effects on fauna – disturbance and habitat loss

59. The potential effects of aerial vs ground operations will differ with regards to their associated spray operations. Ground operations may cause damage to vegetation with vehicle access, trampling, clearance of access tracks or disturbance to fauna. Aerial operations will avoid these associated potential effects, or in the case of disturbance be of only short duration.

60. With regards to disturbance of braided river riverbed-nesting birds, aerial operations to monitor colonial nesting birds in Canterbury with drones was found to have little impact on the birds (Bell & Harborne, 2019) while overseas research looking at drone-induced disturbance recommends drones are not flown lower than 30m above

birds (Wilson et al., 2022). While there is a lack of data on the disturbance caused by helicopters on New Zealand's river bird species, my own observations of helicopters being used to monitor river-nesting birds indicate colonial species such as black-fronted terns become disturbed where machines become stationary about 50m above nests. Following brief duration disturbances, birds quickly return to nests.

61. Given that spraying targets areas with extensive weed cover which riverbed-nesting birds generally do not nest within, I would consider the potential disturbance effect of an aerial spray operation on these species to be very low, while that of a ground operation if occurring within suitable habitat (i.e., relatively clear gravels etc.) to be low yet warranting some effects management during the nesting season.

62. Lizard habitat would primarily be impacted by the associated disturbance from ground-based spraying operations such as the clearance of access tracks or spraying of discrete areas of vegetation (which may be exotic). Like the potential effects on indigenous vegetation, the level of effect on lizards may also be compounded where habitat is uncommon and or ephemeral. The persistence of grass skinks for instance within the braided river ecosystem relies on remnant populations being maintained to act as sources from which to disperse from following natural disturbances. Riparian habitat of drains or waterways within the Low Plains may also be important where otherwise habitat is scarce.

63. Australasian Bittern (*Botaurus poiciloptilus*), marsh crake (*Zapornia pusilla*) and spotless crake (*Zapornia tabuensis*) known to be present within wetlands adjoining some of the drainage networks including the Halswell Canal and Styx Drain may be disturbed by spraying activities. Given their threatened and at-risk status, disturbance of these species during the nesting season (August – February) would constitute a high level of effect.

64. Because the spatial extent of most indigenous vegetation and habitats within the project are not known, and that the extent of these values may change over the duration of the proposed consent, a process which allows for current extents, or at least a representative number of sites, to be mapped is critical to mitigate or avoid potentially adverse effects on these ecological values.

Management of Effects

65. The Application includes measures to avoid, remedy or mitigate effects on terrestrial ecology (Para 437, p.89). Measures include prior to spraying identifying areas of 'significant natural value' or known areas of indigenous vegetation and habitats and to then adapt spray operations to avoid discharges to these areas, which might entail adapting the extent of spray operations, or switching from an aerial operation to a ground-based approach to allow more targeted spray application.

66. CRC holds an inventory of some ecological values within river environments however records are not comprehensive. And the location and extent of values will change over time. Further ground survey and protocols to update inventory records on the location of indigenous vegetation and habitat values would be required to inform spray operations to avoid significant effects.

Managing effects on indigenous vegetation, wetlands and habitats

67. To manage potential adverse effects on indigenous vegetation, wetlands, and habitats the extent of these values requires mapping and a process adopted by which planned spray operations would be adjusted to avoid these values, mitigate significant effects, or allow an impact management plan to appropriately address any loss of ecological values in terms of type and extent.

68. Existing mapping of terrestrial ecology values available to CRC staff include an inventory of freshwater wetlands, river bird habitat and past occurrences, some lizard habitat occurrence records, Department of Conservation (DOC) bat habitat and roosting sites and Significant Natural Areas mapped by some District Councils. Various other mapping layers provide information on biodiversity values, including the location of biodiversity restoration projects. External mapping platforms such as iNaturalist also provide a publicly accessible inventory of species observations.

69. The National Policy Statement for Freshwater Management 2020 (NPS-FM) requires the mapping of the critical freshwater habitat of threatened freshwater dependent species to give effect to the National Objectives Framework. In response to this a map viewer collecting known locations of the region's 78 known threatened freshwater dependent species is also in preparation (Gray & Butt, In Prep) and could inform spray operations.

70. A recent pilot study by CRC Land Ecologists to monitor the terrestrial braided river environments mapped habitats within selected reaches of the Rakitata and Hakatere / Ashburton rivers (Wildland Consultants, 2022; 2023). This work mapped vegetation and recorded species diversity and cover. Such work, if resourced, could also inform spray operations.

71. Spatial information may be queried to inform spray operations. For instance, currently mapped wetland habitats can be queried to show where they intercept with drainage networks and then further information and advice sought regarding the potential for an operation to impact those habitats.

72. Currently however occurrence record inventories are limited, and river environments are dynamic. This means that the occurrence and extent of discrete ecological features such as indigenous vegetation or the use of areas by indigenous fauna including nesting river birds and lizards is not comprehensive and will change over time.

73. Indigenous vegetation may colonise areas of riverbed, wetland, or riparian areas within 1-3 years. Given this, spatial mapping of habitats would be required prior to operations where spraying occurs less frequently than annually to identify early colonising native vegetation. This would be particularly relevant to riverbeds in which colonising species such as *Raoulia* species occur. Extensive areas of these mat forming species could develop within 3-5 years (Brummer et al., 2016) and spraying such areas should be avoided.

74. Mapping at least a representative number of indigenous vegetation sites to protect seed sources could mitigate loss of some indigenous vegetation. This would augment the general guideline for spray operators to avoid spraying native vegetation as outlined within the Contractor Spray Handbook.

Managing potential effects on fauna – disturbance and habitat loss

Riverbed-nesting birds

75. I consider the proposed spraying activity to have a very low (aerial spraying) or low (ground-based spraying) level of potential (disturbance) effects on riverbed-nesting birds. This is because areas targeted for spraying are generally not used by these birds to nest due to the weed cover, while disturbance from aerial spraying would be of short duration.

76. Recommended condition 47 in the s42A report recommends pre-spray river bird surveys should be undertaken to avoid adversely impacting birds between 1 August and 1 March. My standard advice to CRC staff with regards to authorising ground-based activities which might disturb nesting river birds is to conduct such surveys for works occurring between 1 September and 1 February and to use our standard conditions which allow for accurate and consistent reporting of observed river bird values (Jack, 2021). These standard conditions cover the primary breeding period of riverbed-nesting birds (O'Donnell, 2000) and were developed through a review of managing adverse impacts of gravel extraction activities (another form of potential disturbance) on Canterbury's riverbed-nesting birds (McArthur et al., 2018).

77. These standard conditions also include provisions for pre-works survey exemptions where riverbeds are unsuitable for nesting, or the habitat has experienced disturbances which would preclude recent nesting. For instance, river reaches with significant weed cover, rivers that have no surface water for prolonged periods, particularly narrow rivers, or those that have experienced a bank-to bank flood in recent times. Provided evidence, CRC Land Ecology staff make a case-by-case determination on whether exemptions to bird survey conditions are valid.

78. Pre-spray ground-based river bird surveys are somewhat unfeasible for extensive aerial spray operations which might cover 20km reaches. Some

precautionary mitigation of the potential effects from aerial spraying is possible for colonial nesting birds. If aerial spraying is to occur between 1 September and 1 February, information on known sites of nesting colonies for the operational area could be sought from relevant parties who monitor river birds (CRC, DOC & river care groups) and the information used to inform flight paths to avoid spraying these colonies - which will be visible to pilots and spray operators. And pre-flight checks of spray areas for colonies could also be carried out as a standard practice.

79. Where ground-based spraying is to occur across suitable river bird habitat between 1 September and 1 February then a pre-spray bird survey using the standard conditions, and some training of field staff supervisors, is appropriate.

80. Undertaking spraying outside this timeframe, as I understand is currently the general practice, would provide a precautionary approach.

Other avifauna

81. Disturbance of swamp specialist birds including Australasian Bittern and crake species particularly during the nesting season (August – February) is important. Pre-work surveys of suitable habitat would mitigate risks of disturbance and allow avoidance of nests. These species are known to utilise wetlands adjoining the Halswell Canal and the Styx Drain. Bittern within the greater Christchurch area are regularly monitored during the nesting season by CRC staff and DOC. These monitoring programmes could also inform any spray works.

Lizards

82. Ground-based spraying which requires maintenance or establishment of access tracks and involves ground disturbance poses the greatest risk to lizard habitat values. Where ground-based spraying will remove suitable lizard habitat then a pre-spray lizard survey is appropriate. Some training of field staff supervisors would also assist with avoidance of habitat disturbance.

83. Surveys to determine the presence of lizards within an area should generally only be undertaken between October and April. These months are suitable for lizard surveys in Canterbury, though some work can be undertaken in September & May (warm and fine days only). Optimal conditions vary with the methods used (e.g. for checks using ‘Onduline’ detection tools, the optimal temperature range is c.12-18 degrees; if temperatures are too hot or too cold lizards are unlikely to use the Onduline retreats and be detected). Similar temps are good for visual searching but if live trapping (pitfall or funnel) is undertaken much warmer temperatures are recommended. May is not suitable (too cold) for live trapping and only offers very marginal short windows for visual searching; as winter approaches lizards only bask for short periods of time in the warmer parts of the day, and are therefore harder to detect (M Lettink, *pers comm.* 2019).

84. CRC Land Ecology staff could make a case-by-case determination on whether pre-spray ground operations warrant a lizard survey.

85. Confirming and maintaining at least a representative and spatially distributed number of lizard habitat sites within the receiving environments, including waterway and drain margins, could mitigate the effects of some lizard habitat loss from spray operations.

    Other management – plantings

86. As noted by the s42A report, progressive planting to shade smaller waterways and prevent weed growth may be used to reduce the use of herbicide (Page 7, paragraph 35.c.). While I generally agree this approach is effective, such planting requires consideration of any mudfish habitat which may be adversely affected if such planting reduces instream macrophyte growth which mudfish require.

Conclusions and Recommendations

87. My evidence identifies significant ecological values within the project area environments. At a broad scale these include the braided river ecosystems, and at a finer scale include discrete sites of indigenous vegetation, wetlands and habitats.

88. These ecological values are seriously threatened by weed encroachment, and the use of herbicides provide an efficient means to address this threat. Indigenous vegetation and habitats are however sensitive to herbicides, and maintaining inventories of these values is necessary to ensure the potential adverse effects of herbicides is managed.

89. While CRC holds inventories of these values, further information on their current occurrence, particularly for indigenous vegetation and lizard habitat, would be required to determine their presence within any spray area. This information can then inform spray operations so that potential effects can be managed appropriately.

90. Confirming and maintaining at least a representative and spatially distributed number of indigenous vegetation and fauna sites within the receiving environments, including waterway and drain margins, could further mitigate the effects of some habitat loss from spray operations.

91. In addition to spatial inventories, where necessary ground-based pre-works surveys for avifauna and lizards as well as seeking current occurrence information from relevant agencies, would mitigate potential effects of spray operations on these species.

92. If these impact management actions are implemented as described then significant adverse effects on indigenous vegetation and habitats could be avoided, mitigated or remedied.

93. Having in place information systems which inventory ecological values and the ability to receive advice and use that information to adjust spray operations to avoid indigenous vegetation and habitats is important.

References

Bell, M. & Harborne, P. 2019. The use of an Unmanned Aerial Vehicle to census large breeding colonies of black-billed gull (*Larus bulleri*) and white-fronted tern (*Sterna striata*) at the Ashburton River/Hakatere River mouth. Notornis, 2019, Vol. 66: 95-97.

Brummer, T., Byrom, A., Sullivan, J. & Hulme, P. 2016. Alien and native plant richness and abundance respond to different environmental drivers across multiple gravel floodplain ecosystems. Diversity and Distributions, Pp 1–13.

Environment Canterbury. 2013. Canterbury Regional Policy Statement 2013. Environment Canterbury Regional Council, Christchurch. 233 pp.

Gray, D. & Butt, J. In Prep. NPS-FM threatened species habitat mapping. Environment Canterbury Science Summary Report No. R24/##

Harding, M. 2009. Canterbury land protection strategy. Nature Heritage Fund. Wellington.

Harris, H., Tonkin, J. & McIntosh, A. 2024. Multiscale ecological resilience in braided rivers. In: Thoms, M., Fuller, I. (Eds.) Resilience and Riverine Landscapes. Elsevier, pp. 157 - 175.

Jack, J. 2021. Braided river bird surveys of nine hill-fed Canterbury rivers, spring 2019; Consideration of bird survey requirements for gravel extraction. Environment Canterbury Technical Report. Report No. R23/25. ISBN 978-1-99-002772-7.

Jack, J. 2022. Lizard habitat use and herpetofauna values within Environment Canterbury Land; Lizard Surveys 2018 – 2020. Environment Canterbury Report No. R20/51.

McEwen, W. 1987. Ecological regions and districts of New Zealand. Biological Resources Centre (N.Z.), New Zealand. Dept. of Conservation ISBN 0-478-01000-1.

Meurk, C. In Prep. Report prepared for the Canterbury Regional Council Land Ecology P20.

O'Donnell, C. 2000. Environment Canterbury Unpublished Report U00/37 - The significance of river and open water habitats for indigenous birds in Canterbury, New Zealand (June 2000). Report by Dr Colin F. J. O'Donnell, Science & Research Unit, Department of Conservation

Robertson, H.A., Baird, K.A., Elliott, G.P., Hitchmough, R.A., McArthur, N.J., Makan, T.D., Miskelly, C.M., O'Donnell, C.F.J., Sagar, P.M., Scofield, R.P., Taylor, G.A., Michel, P. 2021. Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation, Wellington. 43 p.

Townsend, A. J., de Lange, P., Duffy, C., Miskelly, C., Molloy, J. & Norton, D. 2008. New Zealand threat classification system manual. Department of Conservation, Wellington.

Wardle, P. 1972. Plant succession on Greywacke gravel and scree in the Subalpine Belt in Canterbury, New Zealand. New Zealand Journal of Botany. 10:3, 387-398.

Walker, S., Cieraad, E. and Barringer, J. 2015. The Threatened Environment Classification for New Zealand 2012: a guide for users. Landcare Research Report LC2184.

Wildland Consultants Ltd. (Wildlands). 2013. Guidelines for the application of ecological significance criteria for indigenous vegetation and habitats of indigenous fauna and wetlands in Canterbury. Contract Report No. 2289c prepared for Environment Canterbury.

Wildland Consultants Ltd. (Wildlands). 2015. Fauna habitat values of sites dominated by exotic vegetation in Canterbury. A report prepared for Environment Canterbury.

Wildland Consultants Ltd. 2022. Vegetation monitoring methodology on the Hakatere / Ashburton River braidplain, Canterbury. Contract Report No. 6205. Council File: C23C/122398.

Wildland Consultants Ltd. 2023. Ecological monitoring of the Rakitata / Rangitata River braidplain, Canterbury. Contract Report No. 6576. Council File: C23C/122131.

Wildland Consultants Ltd. (Wildlands). 2024. Technical ecological advice for Environment Canterbury agrichemical spray consent application. Contract Report No. 6914a Wildlands. January 2024.

Williams, P.A., Wiser, S., Clarkson, B., and Stanley, M. 2007. New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. New Zealand Journal of Ecology 31(2): 199-128.

Wilson, J., Amano, T. & Fuller, R. 2022. Drone-induced flight initiation distances for shorebirds in mixed-species flocks. Journal of Applied Ecology. 2023;00:1–12.