

Disclaimer: This document refers to Proposed Plan Change 5 to the Land and Water Regional Plan (Nutrient Management). All aspects of this Plan Change are currently under appeal. The final form of Plan Change 5 will not be known until all appeals are resolved.

Memo

Date	27 November 2017
To	Waimakariri Water Zone Committee
CC	Waimakariri Technical Team
From	Jarred Arthur and Alastair Picken

Instream Ecosystems Management Options

Executive Summary

The purpose of this memo is to:

- Identify management options that the Zone Committee can make draft recommendations on **now** with current information
- Identify management options that the Zone Committee **would like to recommend** but requires specific further information on the economic, cultural and social benefits and costs before doing so
- Identify management options that the Zone Committee **does not** want to recommend so they can be struck out
- Identify any additional management options that the Committee wants to recommend.

The memo is not all encompassing in that it is not explicit about protecting cultural areas, though many of the management options will support cultural values. Advice on protecting cultural areas will follow next year as well as options for managing nitrates and water quantity.

What's the problem?

Several waterways in your zone do not exhibit healthy ecosystems due to a range of environmental pressures resulting from land use, reduced flows and discharges. The current pathways assessment indicates that further interventions are needed to address current and legacy issues to meet your community outcomes for water.

These interventions or management options are presented in this paper through a series of questions. The options are primarily non-regulatory, that is, they are not required by any plan rules. Current Land and Water Regional Plan policies and rules are intended to support healthy stream ecosystems, so the solution is not so much about needing more regulation, but more about funding practical on the ground actions and monitoring to demonstrate progress towards achieving your outcomes. That said, there are a few management options for enhancing plan rules which may further help address the big issues.

How to use this memo

This is a long memo. However, the focus of your reading should be on the questions in the main body of the report and using the supporting information in the appendices to aid your discussions.

In the main body of the memo we explain the purpose of the workshop. We then recap on the tools to guide your decision making which are your community outcomes and agreed principles for the instream ecosystems key decision area. A very brief overview of how current plans and on the ground actions support health stream ecosystems is followed by a summary of the seven key issues for the zone.

The main focus of the report is a series of zone wide and geographically focussed questions and associated commentary to support your discussions and elicit draft recommendations from you.

There are five appendices containing useful information, maps and figures to dip into to support your discussions.

Appendix 1 summarises how Land and Water Regional Plan (LWRP) provisions currently supports instream ecosystem health.

Appendix 2 provides flowcharts summarising the current rules for excluding stock from rivers, lakes and wetlands.

Appendix 3 elaborates on the seven key issues in the main body of the report with a more detailed summary.

Appendix 4 provides a traffic light summary that recaps on how far the current regulatory tools and on the ground actions (current pathways scenario) gets you towards your community outcomes against a range of indicators.

Appendix 5 is a compendium of useful maps referenced throughout the report to support your deliberations.

Purpose – why are we having this workshop?

The purpose of this workshop is to explore options for managing waterways to improve instream ecosystem health. Specifically, what management options can be applied predominantly at the stream corridor level (within the stream channel and riparian margins) to improve water quality, aquatic habitats, amenity values, recreational opportunities and mahinga kai values. The aim of the workshop is for you, the Waimakariri Water Zone Committee (WWZC), to have a constructive discussion around the implications of these management options on your community outcomes. Wider management options for improving ecosystem health that exist beyond the stream corridor (e.g. improving surface water allocation regimes and nutrient management) are acknowledged. You will have the opportunity to discuss these other management options in detail next year. Please note that management options for improving stream health are likely to have additional benefits on cultural, amenity and recreational values within the Waimakariri zone. **We firmly believe that these management options you will be discussing are likely to have the most immediate impact on improving waterways overall in your zone.**

The structure of the workshop is designed for you to construct draft recommendations for your Waimakariri Zone Implementation Plan Addendum (ZIPA). To achieve this, the format of the workshop will centre around specific questions listed within this document. These questions are intended to facilitate discussions within your group. The goal by the end of the workshop is that the WWZC will guide staff on draft recommendations for inclusion in the ZIP Addendum; and, for the more complex or controversial topics, narrow down the list of options so that we can come back to you with further information to assist in your decision-making process next year including an initial assessment of the economic implications.

The following memo provides a summary of how Waimakariri zone waterways are currently managed, the key issues in the zone, and questions that the Zone Committee should consider in order to improve stream ecosystem health.

What tools guide good decision-making?

You have a number of tools to help in your decision-making process. The foundation is your community outcomes, which were established by you with consultation with the community, and it should represent core community values and interests. The community outcomes are as follows:

- Lowland stream water quality and water quantity supports mahinga kai gathering and a diversity of aquatic life.
- The Ashley/Rakahuri River is safe for contact recreation, has improved river habitat, improved fish passage, improved customary use, and flows that support natural coastal processes.
- The Waimakariri River as a receiving environment is a healthy habitat for freshwater and coastal species, and is protected and managed as an outstanding natural landscape and recreation resource
- The zone has safe and reliable drinking water, preferably from secure sources, and the Tuahiwi community has a high quality water supply.
- The biodiversity of coastal lagoons and foothills wetlands are protected with improved biodiversity on the plains.
- Highly reliable irrigation water, to a target of 95%, is available in the Zone.
- Optimal water and nutrient management is common practice.
- There is improved contribution to the regional economy from the Zone.

We discussed six key principles in a previous workshop, which are intended to help you with your decision-making process. Management options should also be considered based on their ability to deliver on these principles. The six principles are:

1. Manage contaminants at source.
2. The Zone Committee supports the implementation of regulatory tools.
3. Audited Farm Environmental Plans for consented activities and Management Plans for permitted activities, under the Canterbury Land and Water Regional Plan, will be the cornerstone of managing contaminant losses from farmland.
4. Stock exclusion from waterways will be a crucial first step towards improving stream ecosystems, including small land holdings.
5. The quality of stormwater and other point and diffuse source discharges from other industries must be improved over time to achieve mahinga kai and other ecosystem outcomes.
6. The Zone Committee will give particular priority to on-the-ground environmental projects that deliver measurable and enduring instream benefits, improve the quality of the environment at key recreational sites and for mahinga kai purposes, and at sites of high ecological significance.

Finally, the Zone Committee also needs to be mindful that the ZIP Addendum is not itself a regulatory document. However, the ZIP Addendum may contain recommendations that will later be given effect to through a change to a part of the Land & Water Regional Plan.

Plan changes must meet a range of requirements under the RMA (including national policy statements, national environmental standards, etc). Staff will continue to provide advice to the Zone Committee on how any statutory recommendations it might wish to make can be shaped to fit within the “box of possibilities” framed by the RMA requirements.

Staff will also provide guidance to the Zone Committee about keeping the planning framework within this zone as simple as possible, so that the community can understand what is required of them, and Council can implement and enforce the plan effectively. This advice will include making use of existing regulations where they are already in place and playing their part in achieving outcomes.

How is the zone managed now?

Regulatory governance

A summary of the policies and rules in the Canterbury Land and Water Regional Plan (LWRP) and Waimakariri River Regional Plan (WRRP) that contribute to protecting water quality and stream ecosystems (Table 1) is provided below. The main activities controlled or supported by these plans are listed below and what they do is further explained in Appendix 1. Flowcharts summarising the region-wide stock exclusion rules are provided in Appendix 2.

Table 1: Planning provisions that protect instream ecosystems in the Waimakariri water zone.

Plan Topic	Summary
Nutrient management (Plan Change 5 decisions)	Aims to minimise nitrogen, phosphorus, sediment and faecal contamination of waterbodies by requiring all farming activities on more than 10 ha to implement either an audited Farm Environment Plan (consented activities) or Management Plan (permitted activities)
Stock exclusion	Aims to protect water quality and natural habitats of aquatic life in rivers, lakes and wetlands from the adverse effects of stock access
Wetlands and riparian margins	Controls a range of activities with potential to cause damage to wetlands and riparian margins
Fine sediment removal and habitat restoration	Both plans support restoration activities such as protection of springheads, restore or enhance riparian margins, wetlands and remove nuisance plant growth and fine sediment from waterways.
Activities in and around the beds of lakes rivers	Both plans control the potential effects of earthworks, structures, vegetation clearance and planting in the beds or riparian margins of waterbodies on water quality, biodiversity, spawning habitats and fish passage.

Plan Topic	Summary
Stormwater ¹	Controls the management of stormwater discharges into and from reticulated systems including the quality. Also controls discharges directly to rivers, lakes, wetlands and to land where it may affect those waterbodies.

Figure 1 below shows where the LWRP and WRRP currently apply within the Waimakariri zone.

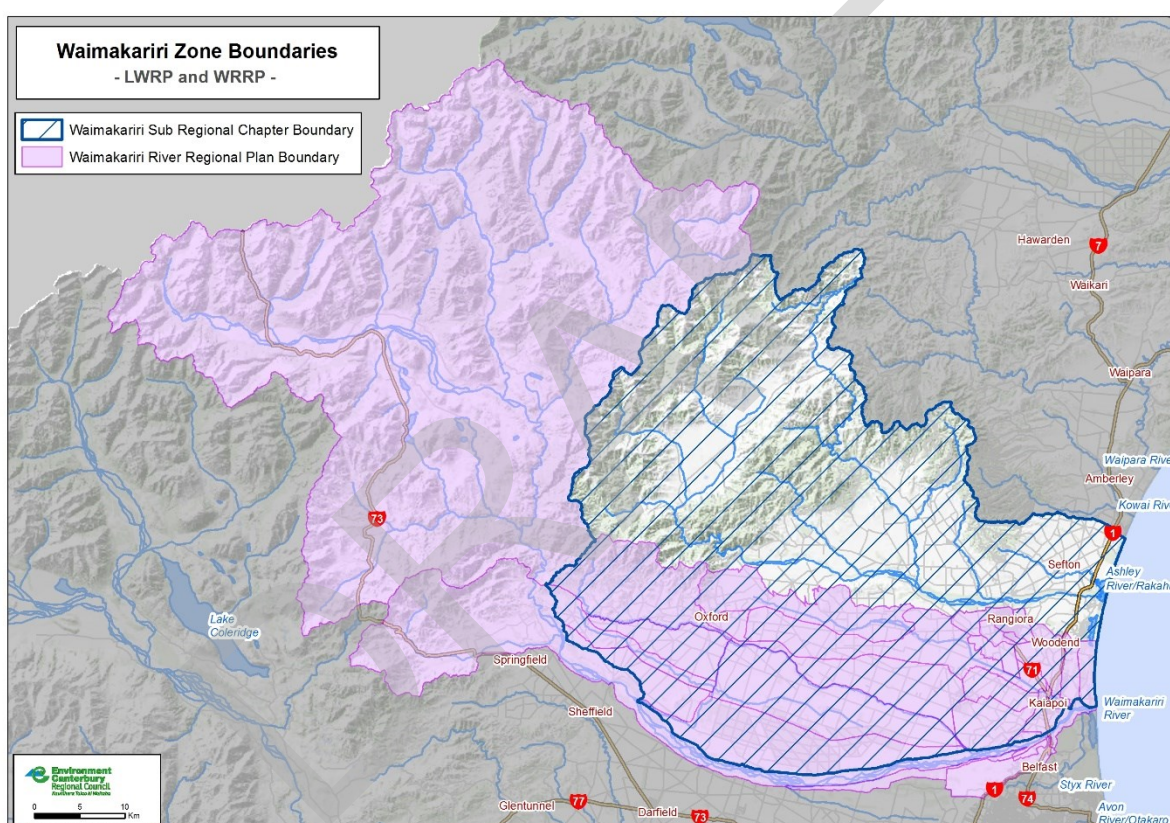


Figure 1: Areas covered by the Section 8 of the Land and Water Regional Plan and the Waimakariri River Regional Plan

On the ground actions

Restorative projects provide tangible benefits to Waimakariri zone waterways without the need for additional regulation. These include education, fencing, planting, bank re-battering and

¹ See workshop paper “Stormwater Management within the Waimakariri zone” and meeting agenda item “Rangiora Stormwater Network Discharge Consent Application” dated 13 November 2017 for more information.

water sharing enabled through the planning framework. These are often managed and run by community or research groups with funding from a variety of sources. Examples of Waimakariri zone waterway groups include:

- Ashley Rakahuri River Care Group
- Cam River Enhancement Subcommittee
- Kaiapoi River Rehabilitation Joint Working Party
- Silverstream Advisory Group
- Blue Planet (Rangiora High School's environmental group)
- Cust Main Drain Water Users Group
- Taranaki Creek Water Users Group

Priority on the ground actions for the zone will be delivered under the “Our Big Rocks” programme. Our Big Rocks joins together science, planning & strategy process with priority on-ground actions to achieve real outcomes for the zone. There are 10 Big Rocks, 3 of which are zone wide programmes and 7 that are location based projects. These are shown in Figure 2 below.

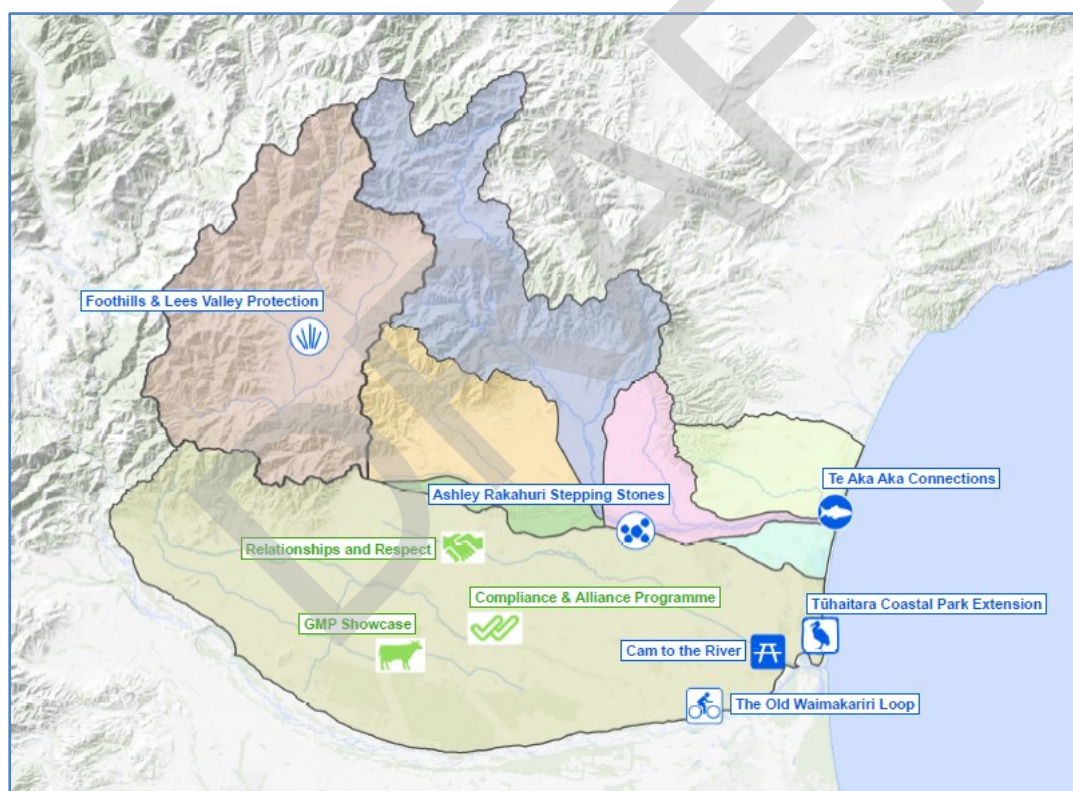


Figure 2: Waimakariri - Location of priority on the ground actions – Our Big Rocks

The “First 500” spring protection project is directly relevant to improving stream ecosystems. The initiative entails a pro-active approach to the protection and enhancement of major spring heads and the first 500m reach with riparian setbacks and planting. Up to \$10,000 of funding is available for each project based on a set of criteria. The intended outcome is to work with landowners to kick-start the process of better management of springs and the waterways they feed in priority catchments. Silverstream is one of the priority catchments.



Figure 3: Example of springhead protection and planting for a first 500 project

What are the big issues for the zone?

Piecing together current state and investigation data, expert panel opinion, and community feedback has highlighted seven key issues that primarily affect instream ecosystem health and function (Table 2 overleaf). Appendix 3 summarises the results of the current state and trends report (Greer and Meredith 2016), and details of other sources of information that have determined what the key issues are in the zone. Appendix 4 summarises the key measures of ecosystem health and how they are likely to respond in the future under current management regimes and climate change (i.e. a Current Pathways scenario).

Table 2: Key issues for instream ecosystem health in Waimakariri zone waterways.

Issue	Narrative
Excessive fine sediment deposition in spring-fed streams	Benthic sediment has a range of negative ecological effects on instream fauna, and has been shown to be the most important predictor of invertebrate community composition in some Canterbury streams. Given the detrimental effects of deposited fine sediment on invertebrates and fish, it is likely that the high degree of sedimentation in spring-fed streams in the Waimakariri zone is a major factor contributing to the poor state of ecosystem health. Managing sediment sources will in most cases also reduce phosphorus and faecal contaminant inputs. This will have indirect benefits for reducing aquatic plant growth and health risks to recreational users.
Limited data and monitoring	Good monitoring data is sparse throughout the Waimakariri zone. While some issues such as sediment deposition are clear, the lack of long-term monitoring data prevents certainty about the state and trend of water quality and ecology for many waterways, and the drivers behind these. Improved water quality and ecosystem health monitoring will improve our understanding of how to effectively and efficiently manage waterways in the zone. This includes investigating the extent of native, sport and pest fish populations in the zone, and the health of population important for mahinga kai.
Inadequate habitat protection	Instream habitat is in a degraded state throughout many spring-fed streams in the zone. Aside from the prevalence of fine sediment entering streams, many spring-fed waterways are extensively modified with steep banks, straightened channels, and a lack of bankside shading. Stream modification, in addition to high nutrient levels, encourages nuisance aquatic plant growths, which is evident throughout the zone's spring-fed streams. Nuisance aquatic plant growths further degrade stream habitat and therefore aquatic community health, and requires continual clearing and maintenance in drains. Waimakariri zone stream sites containing species of high ecological, cultural and recreational importance are absent in current plan schedules that protect habitat (e.g. salmon spawning). There are also no added habitat protection provisions for some highly engendered species (e.g. mudfish) and areas of high value habitat such as springheads would benefit from more-targeted restorative efforts such as the actions proposed through First 500 project which targets protection of the first 500 m downstream of springheads in the region
Barriers to fish passage	Fish recruitment depends on barrier-free migration paths along the length of stream catchments. Culverts, weirs, tide and flood gates, and other artificial barriers to fish passage are present in many stream locations throughout the zone. The state and condition of fish screens on water takes is poorly understood and requires further investigation to replace these with industry-agreed designs.
Poor recreational water quality	<i>E. coli</i> levels commonly exceed those deemed acceptable for protecting the health of swimmers and other primary contact recreation users. This is particularly the case in the Waimakariri zone's lowland waterways. Additionally, potentially toxic cyanobacteria growths can be a health risk over the summer in the Ashley River catchment. The LWRP provides additional provisions for the protection of recreational sites, however as it stands only the Ashley River at the Ashley Gorge bathing site is currently recognised under Schedule 6 when more of the zone's waterways are likely to have significant sites for primary contact recreation.
²High nitrate levels in northern Waimakariri spring-fed tributaries	High nitrate concentrations in the upper Kaiapoi River catchment (particularly Silverstream) are currently breaching national bottom lines for nitrate toxicity under the NPSFM 2017. Reducing stream nitrogen levels will predominantly be achieved by improving nutrient management and land-use practices at the catchment scale, rather than the small benefits that gained at the stream corridor level through mitigations such as planting margins and wetland installations. However, planting stream margins and protecting wetlands will have a host of other ecosystem benefits including those related to habitat quality.
³Low flows	Adequate flow provisions are required to improve stream water quality and provide for instream habitat and fish passage. Current minimum flows in many zone waterways are below the flows recommended by studies, and some catchments are currently overallocated for water use. Increasing dry periods are expected with changing climatic conditions. This will result in lower summer flows and increasing flow-related pressures on water quality and instream communities. A parallel workstream is reviewing the current flow and allocation limits and the management of groundwater takes that deplete stream flows.

What are the options for improving instream ecosystem health?

You have several options that will help improve instream ecosystem health in your zone. It is important that all options are considered in a broad context, both in terms of their impact on other community outcomes (e.g. regional economy) and how they will compliment management decisions made across other key decision areas (e.g. improving surface water flows, reducing nitrates, and protecting and enhancing cultural areas). The following questions are intended to help you construct draft recommendations for your Waimakariri ZIPA. The questions are spatially based on their applicability to specific geographic areas within the Waimakariri zone. We intend to work through these questions in today's workshop.

All Waterways

Support for Good Management Practice (GMP)

1. *Is current support for the implementation of Good Management Practice sufficient?*

- Added resourcing, education and industry support will help ensure that land users can comply with the conditions of their Farm Environment Plans. This will contribute to reduce nutrient, sediment and faecal inputs to waterways. Support for conceptual Waimakariri 'Big Rocks' projects will help achieve these. Specifically:
 - Relationships and Respect
 - GMP Showcase
 - Compliance and Alliance Programme 2017-18

Ecosystem health monitoring

2. *Is current state of the environment monitoring sufficient to adequately assess the state of streams and rivers in the zone, and to test the effectiveness of plan implementation moving forward? If not, which rivers would you prioritise for monitoring?*

- Improved resourcing to increase the spatial extent of monitoring in the zone will help to assess poorly understood catchments, as well as indicate how management processes are performing. However, there are cost implications that will need taking into account.
- Zone Committee support for fish monitoring programmes will provide a better understanding of fish species distributions in the zone, including native fish diversity and extent of mahinga kai species.

Fish passage

3. *Does the Zone Committee agree that allowing unimpeded fish passage in waterways is a key step in achieving community outcomes related to improving biodiversity and mahinga kai? Which rivers you would you prioritise for barrier removal?*

- Fish barrier locations are reasonably well understood. Investigating effective fish barrier mitigations will improve fish recruitment and spatial diversity.
- Consideration will need to be given to protection of native fish populations that currently protected from predation by natural and man-made barriers.

- Investigating inadequate fish screen designs with industry approved designs will reduce fish mortality rates at water takes.
- **Appendix 5 Map 1** shows the location of known fish barriers.

Freshwater bathing sites

4. *Does the zone committee want to add any freshwater bathing sites to Schedule 6 of the LWRP and Environment Canterbury's recreational monitoring programme, if so what sites?*
 - The NPSFM 2017 requires regional councils to identify primary contact sites (any size river or lake that is considered important for recreation) and monitor and report on these sites. Schedule 6 of the LWRP identifies areas on rivers or lake commonly used for freshwater bathing. The only freshwater bathing area in schedule 6 of the LWRP is the Ashley Gorge picnic ground.
 - The significance of including areas for freshwater bathing in Schedule 6 it is that farmed cattle, deer and pigs are prohibited from being in a river or lake bed for 1000 m upstream of the site under the stock exclusion rules.
 - **Appendix 5 Map 2** shows the sites Environment Canterbury currently monitors for contact recreation

Canterbury mudfish habitat sites

5. *Subject to scientific evidence, does the Zone Committee support the addition of significant Canterbury mudfish sites to a Schedule of the LWRP including:*
 - *Tutaipatu Lagoon*
 - *Taranaki Creek*
 - *Peacock Springs*
 - *Eyre River tributary*
 - *Coopers Creek tributary*
 - *Mounsey's stream tributary*
 - The Department of Conservation has requested the addition of known threatened Canterbury mudfish sites to Schedule 17³. The submission on Plan Change 4 listed sites in the Ashley River/Rakahuri and Waimakariri catchments.
 - Identifying Canterbury mudfish sites in a schedule would provide extra protection through controls on activities in and around rivers with the potential to damage sites. The types of activities requiring additional controls will need further investigation.
 - **Appendix 5 Map 3** shows the location of DoC's mudfish habitat sites.

³ Submission by the Director General of Conservation on Plan Change 4 (Omnibus)

Stream re-alignment

6. *Does the Zone Committee consider stream realignment to be an issue in the zone e.g. for the purpose of new land development?*

- The modification of natural stream channels can be hugely disruptive and destructive to instream ecosystem health and function.
- If the Zone Committee considers this to be an ongoing issue, staff can provide advice on existing controls to facilitate a discussion on a way forward next year.

Spring-fed Plains Streams

Strengthening stock exclusion rules

7. *Do the Zone Committee think that the LWRP stock exclusion provisions need to be extended in some form?*

8. *If so, do the Zone Committee consider that stock should also be excluded from springheads and artificial watercourses⁴ e.g. farm drains but excluding others such as irrigation canals, water supply races and canals for the supply of electricity generation?*

9. *Do the Zone Committee agree that the PC5 audited FEP and Management Plan requirements that “vegetated riparian margins of **sufficient width** are maintained to minimise nutrient, sediment and microbial pathogen losses to waterbodies” satisfactorily manage the risks? (emphasis added)*

- Spring-fed streams have poorer macroinvertebrate communities and water quality due in part to sedimentation and faecal contamination from stock access. Open, unfenced drains can also provide a direct pathway for contaminants to enter streams.
- An Expert Panel on stream ecology and water quality⁵ has recommended that stock should also be excluded from drains given the connections between artificial and natural watercourses. Other zone committees have made similar recommendations to extend the rules to drains⁶. The LWRP region-wide stock exclusion rules cover natural

⁴ **Artificial watercourse:** the RMA does not define this term. However, the LWRP defines an artificial watercourse as “a watercourse that is created by human action. It includes an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage channel. It does not include artificial swales, kerb and channelling or other watercourses designed to convey stormwater.

⁵ The Expert Panel includes Environment Canterbury, Ngāi Tahu, Fish and Game, Dairy NZ, Landcare Research, NIWA and consultants.

⁶ **Drain:** is not defined in the RMA but a definition is provided in the LWRP which makes drains a sub-type of an artificial watercourse. It means “includes any artificial watercourse that has been constructed for the purpose of land drainage of surface or subsurface water and can be a farm drainage channel, an open race or subsurface pipe, tile or mole drain”.

watercourses which includes rivers⁷, lakes and wetlands. This includes modified watercourses but does not artificial watercourses such as farm drains.

- The Expert Panel has also suggested excluding all stock from some waterbodies. The main impact of doing this would be to extend the rules to sheep. The benefits of doing this are not particularly clear whereas the costs could be significant.
- The Expert Panel has also suggested mandatory setbacks. This might increase setbacks already in place on some farms and reduce them on others. There are water quality and ecological benefits from wide riparian margins, but there are also significant costs from fencing, loss of productive land, and weed control etc. The current approach is for FEPs and Management Plans to require riparian margins of “sufficient width”. This provides good direction and flexibility for farm by farm considerations recognising that there is no magic number for all situations.
- **Appendix 5 Map 4** illustrates the surface water bodies where stock (farmed deer, cattle and pigs) are currently excluded under the rules and the additional areas if drains and springheads were to be included.

Sediment

10. Given that sediment is probably the most important driver of poor ecosystem health in spring-fed streams, will improved sediment monitoring help understand the problem and therefore address it?

- Understanding sediment extent and character in spring-fed plain waterways, including longitudinal sampling within individual catchments, will help pin point sediment sources and gauge the effectiveness of management approaches. Identifying key sediment sources will help target on the ground projects to reduce the sediment source.
- **Appendix 5 Map 5** describes an example of the sediment issue from the Cam and Silverstream rivers.

Springheads

11. Springheads are a highly valued ecosystem that require protection. What sort of actions would the Zone Committee like to see around springheads, and how would they support them?

- Springheads are point sources for groundwater contaminants entering streams. Targeting wetland plantings and stock exclusion at and below springheads will have important ecosystem functions such as assimilating nutrients and protecting physical springhead habitat. This type of work is being proposed through Environment Canterbury’s First 500 project.

⁷ **River:** The RMA and LWRP defines a river as a continually or intermittently flowing body of fresh water and includes a stream and modified watercourse, but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal).

- Protecting springheads is also consistent with the notion of a top-down management approach. That is, target mitigations at the head of a catchment first before moving downstream to have the maximum effectiveness.
- **Appendix 5 Map 6** shows the location of springheads in the zone.

Bank erosion

12. Does the Zone Committee consider that the ZIPA should promote on-the-ground actions to stabilise steep and unstable banks on many spring-fed streams in the zone?

- Resourcing, implementing and supporting projects that prioritise stabilising stream banks through re-battering and riparian planting will reduce the influx and generation of fine sediments from banks collapse. Planting riparian buffers also has the advantage of protecting streams from adjacent land use erosion and sediment generation.
- **Appendix 5 Map 7** shows an example of where bank slumping is an issue in the Cam and Silverstream catchments.

Drain management

13. Does the Zone Committee wish to receive advice on drain cleaning practices?

- Drain cleaning is necessary to ensure drains perform their drainage function, but cleaning practices to manage excessive aquatic plant growth and sediment can be controversial and impact on ecology.
- Nutrient management and stream shading through riparian planting will inhibit instream plant growths. The Zone Committee may wish to promote and resource projects that promote planting, and support good drain clearing practices where plantings do not exist.

Coastal Waterbodies

Reducing contaminant sources

14. Does the Zone Committee agree that improving ecosystem health in coastal waterbodies such as the Ashley / Rakahuri – Saltwater Creek Estuary will be achieved primarily by reducing contaminant sources feeding them from wider stream catchments?

- Management options prioritised at controlling contaminants in wider catchments will have downstream benefits for receiving coastal environments.

Priority on the ground projects

15. In addition to supporting the “Waimakariri Big Rocks” projects in the coastal area, are there other priority areas and on the ground projects that will provide enduring benefits for instream ecosystem and cultural values, and provide recreational opportunities?

- The Waimakariri 'Big Rocks' projects provide scope for improving a number of instream waterway values while also providing increased recreational opportunities and aesthetic improvements. Specifically in the coastal area:
 - Tuhaitara Coastal Park
 - Te Aka Aka Connections
- Education, resourcing and supporting waterway restoration groups and private stream rehabilitation efforts to plant stream banks and riparian setbacks will improve instream habitat, increase shading, and help buffer and stabilise stream banks. Encouraging industry groups to incentivise such projects will increase the coverage of such projects.
- The Zone Committee may wish to focus firstly on rehabilitating waterways with particularly high ecological, cultural or recreational values, or that have already established well-developed rehabilitation project plans. Examples of priority catchments may include:
 - Taranaki Creek;
 - Cam River; or,
 - Silverstream.

Coastal habitat monitoring

16. Is the monitoring of coastal lagoon and hāpua-type environments in the Waimakariri Zone sufficient to understand and effectively manage water quality, habitat quality and ecosystem health?

- Improved resourcing to extend monitoring in coastal environments will help to assess the poorly understood condition of lagoon and hāpua type ecosystems, as well as indicate how management processes are performing. Of particular importance is examining the state of sedimentation in coastal waterbodies. Coastal waterbodies serve as gateways and nursery grounds for migratory species that also reside at times in upper catchment reaches.

Climate change

17. Does the Zone Committee believe that future-proofing inanga spawning areas by protecting potential habitat under climate change scenarios is currently important?

- Sea level rise will result in higher spring tides and a greater level of saltwater intrusion into lowland waterways. This has the implication that inanga spawning grounds will likely shift further inland in the future. The Zone Committee may think its valuable to future-proof potential inland spawning environments through on the ground projects that focus of rehabilitating and protecting vegetation at stream margins.
- **Appendix 5 Map 8** shows the location of inanga spawning habitat identified on planning maps and protected under the LWRP.

Ashley River / Rakahuri and Saltwater Creek Catchments

Salmon spawning sites

18. Subject to scientific evidence, does the Zone Committee support the addition of significant salmon spawning sites to Schedule 17 such as:

- *Ashley River (above the gorge)*
 - *Duck Creek*
 - *Townshend Stream*
 - *Broom Stream*
 - *Okuku River*
-
- There are no salmon spawning sites listed in Schedule 17 of the LWRP for the rivers within the Waimakariri sub-region. North Canterbury Fish and Game have provisionally identified spawning sites within headwaters and tributaries of the Ashley River/Rakahuri that could be added to this Schedule.
 - The significance of including salmon spawning sites in Schedule 17 is that farmed cattle, deer and pigs are excluded from these sites under the stock exclusion rules. There are also restrictions or controls on other activities such as gravel extraction, fine sediment removal, and earthworks and vegetation clearance in and around rivers.
 - **Appendix 5 Map 9** shows the location of salmon spawning sites identified by North Canterbury Fish and Game.

Weed and pest control

19. Does the Zone Committee wish to actively support weed control and predator control in the Ashley River/Rakahuri to protect braided river bird habitat?

- Riverbed weed growth continually constrains the Ashley River / Rakahuri inhibiting its ability to braid, which is an important natural feature that protects nesting birds and aquatic biodiversity. Support for ongoing riverbed weed control will prevent this from occurring.
- Support for ongoing trapping and poisoning of mammalian predators will likely reduce predation rates on river bird eggs, juveniles and adults.

Priority on the ground projects

20. In addition to supporting "Waimakariri Big Rocks" projects in the Ashley/Rakahuri and Saltwater Creek catchments, are there other priority areas and on the ground projects that will provide enduring benefits for instream ecosystem and cultural values, and provide recreational opportunities?

- The Waimakariri 'Big Rocks' projects provide scope for improving a number of instream waterway values while also providing increased recreational opportunities and aesthetic improvements. Specifically in this catchment:
 - Ashley Rakahuri – Stepping Stones
 - Lees Valley and Foothills

- Education, resourcing and supporting waterway restoration groups and private stream rehabilitation efforts to plant stream banks and riparian setbacks will improve instream habitat, increase shading, and help buffer and stabilise stream banks. Encouraging industry groups to incentivise such projects will increase the coverage of such projects.
- The Zone Committee may wish to focus firstly on rehabilitating waterways with particularly high ecological, cultural or recreational values, or that have already established well-developed rehabilitation project plans. Examples of priority catchments may include:
 - Taranaki Creek

Erosion and critical source areas

21. Does the Zone Committee want to look more closely at the potential erosion and sediment risks from plantation forestry activities in the hill-fed catchments of the Ashley River/Rakahuri?

- Plantation forests can adversely affect the environment if not well managed. The greatest risk occurs during harvesting and earthworks.
- This issue was highlighted during the public meetings on current state and current pathways with reference to Bullock Creek. The Zone Committee should confirm if this is an issue worth looking at or not given the NES for Plantation Forestry will come into force May 2018 and the Committee will be busy next year and need to focus on the critical few issues

Northern Waimakariri Tributaries

Stormwater

22. Does the Zone Committee agree that the stormwater provisions in the LWRP and work being done by Waimakariri District Council (WDC) for its stormwater discharge consent applications will improve urban water quality over time?

- WDC is developing stormwater network consent applications and Stormwater Management Plans for Oxford, Rangiora, Kaiapoi, Woodend and Pegasus to comply with the requirements in the LWRP
- Numeric limits for discharges from reticulated stormwater systems will be an important component of the consent decision making process.
- As discussed at the zone committee meeting on 13 November WDC is consulting on a new stormwater bylaw to help regulate discharges into their network.

Pest fish species

23. Is investigating the extent of pest fish species in waterways, such as those in the vicinity of the Kaiapoi Lakes, a priority given their poorly understood distribution, but likely limitations to breed under current climatic conditions? What about with the

potential for increasingly viable breeding populations under warming climate conditions?

- Knowledge about pest fish populations in waterways is mainly related to anecdotal evidence. Support for targeted investigations, or for routine fish monitoring, will help understand the pest fish situation in the zone and whether any further interventions are required.

Priority on the ground projects

24. In addition to supporting “Waimakariri Big Rocks” projects in the northern Waimakariri tributaries, are there other priority areas and on the ground projects that will provide enduring benefits for instream ecosystem and cultural values, and create recreational opportunities?

- The Waimakariri ‘Big Rocks’ projects provide scope for improving a number of instream waterway values while also providing increased recreational opportunities and aesthetic improvements. Specifically in this area:
 - Old Waimakariri Wetlands and Loop Track
 - Cam to the River
- Education, resourcing and supporting waterway restoration groups and private stream rehabilitation efforts to plant stream banks and riparian setbacks will improve instream habitat, increase shading, and help buffer and stabilise stream banks. Encouraging industry groups to incentivise such projects will increase the coverage of such projects.
- The Zone Committee may wish to focus firstly on rehabilitating waterways with particularly high ecological, cultural or recreational values, or that have already established well-developed rehabilitation project plans. Examples of priority catchments may include:
 - Cam River – Cam River Enhancement Subcommittee
- University of Canterbury CAREX group
 - Silverstream – Silverstream Advisory Group
 - Kaiapoi River – Kaiapoi River Rehabilitation Working Party

Appendix 1

How the LWRP supports instream ecosystem health

The table below provides a summary of the main LWRP topic areas where policies and rules contribute to the protection or enhancement of water quality and stream ecosystems. It is not intended to be exhaustive.

Plan Topic	What does it do?
Freshwater Outcomes for Canterbury Rivers Policies: Table 1a See Figure A1.1 below	<p>The LWRP sets out region-wide freshwater outcomes (numeric and descriptive) for Canterbury Rivers and Lakes. There are no lakes in the Waimakariri sub-region. Where freshwater outcomes have been collaboratively determined at a catchment-scale these are included in the relevant sub-region section.</p> <p>Note: <i>in developing freshwater outcomes for the rivers in our sub-region (Section 8) we will need to comply with the NPSFM 2014 (and 2017 amendments) including a requirement to maintain or improve water quality within a Freshwater Management Unit (FMU) and improve water quality to at least meets national bottom lines for compulsory “attributes” for ecological health and human health for recreation.</i></p>
Nutrient Management Policies: 4.34 – 4.41D Rules: 5.14A – 5.64 PC5 under appeal	<p>PC5 aims to minimise nitrogen, phosphorus, sediment and faecal contamination of waterbodies. Policies and rules on the management of nutrients will require all farming activities on more than 10 ha to implement either an Audited Farm Environment Plan or Management Plan.</p> <p>Permitted farming activities will be required to prepare a Management Plan and implement a list of good practices including the identification of critical source areas for phosphorus loss, including for any part of the property within the High Runoff Risk Phosphorus Zone (HRRPZ).</p> <p>Higher risk farming activities with irrigation over 50 ha and/or the intensive winter grazing of cattle will require a resource consent that directs them to prepare and implement a Farm Environment Plan that is audited to ensure farming in accordance with good management practice (GMP) including the</p>

Plan Topic	What does it do?
	management of critical source areas for phosphorus loss including for any part of the property within the HRRPZ. These properties are also required to prepare an OVERSEER (or approved equivalent) modelled nutrient budget that is registered with the Farm Portal.
Stock Exclusion Policies: 4.31 - 4.32 Rules: 5.68A – 5.71, Schedule 7 and 7A (PC5 decisions), Schedules 1, 6 and 17 Planning maps	<p>Protects water quality and natural habitats in waterways from the adverse effects of stock access.</p> <p>Farmed deer, cattle and pigs are prohibited from inanga spawning habitats, salmon spawning sites, community drinking water protection zones, spring-fed plains rivers and waterways within 1000 m upstream of a freshwater bathing site.</p> <p>It is a non-complying activity (consent) for intensively farmed stock⁸ to access by to any river over 1m wide or 10cm deep</p> <p>Other stock (not intensively farmed e.g. sheep) are permitted to access rivers and wetlands without consent only if it does not result in pugging or de-vegetation that exposes bare earth, a change in colour of clarity of water, or cattle standing in any lake within a Lake Zone, a lake classified as a High Naturalness Waterbody, or any lake located outside the Hill and High Country Area, otherwise consent is needed.</p> <p>There is an exception to these conditions for stock crossing points. Farm Environment Plans (consented activities) and Management Plans (permitted activities) require compliance with the stock exclusion rules.⁹</p>

⁸ Intensively farmed stock means: cattle or deer grazed on irrigated land or contained for break-feeding of winter crops; dairy cattle of any class, including cows, whether dry or milking, and whether on irrigated land or not; or farmed pigs.

⁹ Note: there are also various industry guidance documents on stock exclusion and/or riparian management including: Industry-agreed Good Management Practices relating to water quality; WIL's Guide to Preparing a Farm Environment Plan; and the Sustainable Dairying: Water Accord.

Plan Topic	What does it do?
	<p>Plan Change 4 also introduced new rules to define the extent of the ‘bed’ of a braided river when applying the stock exclusion rules which is helpful for the Ashley/Rakahuri and Waimakariri rivers.</p>
<p>Wetland and Riparian Margins</p> <p>Policies: 4.40, 4.81 – 4.85</p> <p>Rules: 5.65, 5.167-5.169 Schedule 7 and Schedule 7A</p>	<p>Riparian margin is defined for the purpose of rules on “earthworks and vegetation clearance in riparian areas”. It means land within 10 m of the bed of any lake, river or wetland boundary within Hill and High Country land or land shown as High Soil Erosion Risk on the planning maps and 5 m in all other land.</p> <p>Wetlands and riparian planting are integral parts of land drainage and storm water systems in rural and urban areas, to reduce the effects on water quality and to enhance indigenous biodiversity and amenity values.</p> <p>Fertiliser is not to be put onto riparian planting from which stock is excluded or where there is no riparian planting, within 10 m of the bed of a permanently flowing river, lake, artificial watercourse or wetland boundary.</p> <p>Audited Farm Environment Plans are a means of delivering good riparian management. Wetlands, riparian areas and margins of waterbodies are to be managed to avoid damage to the bed and margins to avoid direct input of nutrients, sediment, and microbial pathogens.</p> <p>Management Plans for Farming require vegetated buffer strips of at least 5 m width between areas of winter grazing of cattle and any river, lake, drain or wetland</p> <p>Both FEPs and Management Plans require vegetated riparian margins of <u>sufficient width</u> are maintained to minimise, nutrient, sediment and microbial pathogen losses to waterbodies.</p>
<p>Fine Sediment Removal and Habitat Restoration</p>	<p>Catchment restoration activities that protect springheads, restore or enhance riparian margins, wetlands and remove nuisance plant growth and fine sediment from waterways are supported.</p>

Plan Topic	What does it do?
<p>Policies: 4.92A</p> <p>Rules: 5.146A – 5.146B</p>	<p>Whilst many small-scale restoration activities are permitted, consent and a Management Plan is required to remove fine sediment from a river for habitat restoration due to the potential for downstream effects. A management plan describes (amongst other things) the location, timing and method of sediment removal; the location of sensitive species within the work area and 250m downstream; assessment of potential downstream effects and how they will be avoided or mitigated</p>
<p>Activities in Beds of Lakes and Rivers</p> <p>Policies: 4.85A – 4.92</p> <p>Rules: 5.163 – 5.169, Schedule 17</p> <p>Planning maps – inanga spawning habitat</p>	<p>Controls potential effects of earthworks, installation and maintenance of structures, vegetation clearance and planting in the beds or riparian margins of waterbodies on (amongst other things) water quality, biodiversity, inanga and salmon spawning and fish passage.</p>
<p>Stormwater</p> <p>Policies: 4.15 – 4.17, Table 1 – Freshwater Outcomes for Canterbury Rivers and Lakes</p> <p>Rules: 5.93A – 5.97</p> <p>Schedule 5 - Mixing Zones and Receiving Water Standards</p> <p>Schedule 8 - Region-wide Water Quality Limits</p>	<p>Manages the discharge of stormwater into and from reticulated stormwater systems or directly to the environment.</p> <p>From 2025 operators of reticulated stormwater systems (generally Territorial Authorities) are required to manage the quality and quantity of stormwater both <u>entering</u> the stormwater network and <u>exiting</u> the system. Reticulated network operators are to apply for resource consents for discharges from their networks in urban areas by 30 June 2018.</p> <p>The application is to include a Stormwater Management Plans which are living documents used to show how discharges into and from the system will be managed and treated to (among other things)</p>

Plan Topic	What does it do?
	<p>progressively improve the quality of the discharge over time to meet the water quality outcomes for the waterbody set out in Table 1, Schedules 5 and 8 and the relevant sub-region section by 2025.</p> <p>Where there is no “available reticulated stormwater system” (defined in the plan) rules control stormwater discharges directly to the rivers, lakes, wetlands, artificial watercourse, or to land (where it may affect these waterbodies), including the discharge quality.</p>
<p>Areas on Rivers or Lakes commonly used for Freshwater Bathing</p> <p>Schedule 6</p>	<p>The NPSFM 2017 also requires regional councils to identify primary contact sites (any size river or lake that is considered important for recreation) and monitor and report on these sites. Schedule 6 of the LWRP identifies areas on rivers or lake commonly used for freshwater bathing. The only freshwater bathing area in schedule 6 of the LWRP is the Ashley Gorge picnic ground.</p> <p>The significance of including areas for freshwater bathing in Schedule 6 it is that farmed cattle, deer and pigs are prohibited from being in a river or lake for 1000 m upstream of the site under the region-wide stock exclusion rules (see above).</p>
<p>Salmon Spawning Sites</p> <p>Schedule 17</p>	<p>There are no salmon spawning sites listed in Schedule 17 of the LWRP for the rivers within the Waimakariri sub-region.</p> <p>The significance of including sites in Schedule 17 it is that farmed cattle, deer and pigs are prohibited from being in a river or lake for 1000 m upstream of the site under the region-wide stock exclusion rules.</p>
<p>Inanga Spawning Habitat</p> <p>Planning maps</p>	<p>Plan Change 4 provided greater protection for areas where inanga may spawn. Inanga spawning areas and habitat areas are identified on planning maps.</p> <p>The protection of habitat is achieved through rules controlling a range of activities. Some works are permitted in inanga spawning areas if they happen outside the inanga spawning period of 1 March to 1 June. This exclusion period is longer for activities that would have a longer lasting impact on habitat such</p>

Plan Topic	What does it do?
	as vegetation clearance, cultivation and earthworks. Farmed pigs, cattle and deer must be excluded from inanga spawning habitat all year round.
Spring-fed plains rivers Planning maps	<p>As noted above, farmed pigs, cattle and deer must be excluded from the bed of “spring-fed plains rivers”. These rivers are shown on LWRP planning maps for the Ashley/Rakahuri catchment but do not include rivers in the area covered by the WRRP.</p> <p>Note: Work to map “spring-fed plains rivers” in the WRRP area is being undertaken and changes to the planning maps will be notified as part of the plan change for the Waimakariri sub-region. See indicative map of river classes in the Figure A1.2 below.</p>

Note: the last Government signalled that a top priority is gazetting national regulations for excluding stock from waterways and issued a draft proposal as part of the Government’s freshwater reforms in the document “Clean Water”¹⁰. We do not know if or when regulations will come forward or their final form. When they do we will need to review the LWRP stock exclusion provisions and the regulations may require us to withdraw or amend rules that are inconsistent or less stringent than them.

¹⁰ <http://www.mfe.govt.nz/publications/fresh-water/clean-water-90-of-rivers-and-lakes-swimmable-2040>.

Table 1a Freshwater Outcomes for Canterbury Rivers

Management unit	Sub-unit	Ecological health indicators			Macrophyte indicators		Periphyton indicators			Siltation indicator	Microbiological indicator				
		QMCI* [min score]	Dissolved oxygen [min saturation] (%)	Temperature [max] (°C)	Emergent macrophytes [max cover of bed] (%)	Total macrophytes [max cover of bed] (%)	Chlorophyll a [max biomass] (mg/m ²)	Filamentous algae >20 mm [max cover of bed] (%)	Cyanobacteria a mat cover (%)	Fine sediment <2 mm diameter [max cover of bed] (%)	Suitability for contact recreation [SFRG*]				
Natural state	Rivers are maintained in a natural state														
Alpine - upland		6	90	20			50	10	20	10	Good				
Alpine - lower							120	20	30		Good to Fair				
Hill-fed - upland							50	10	20	15	Good				
Hill-fed - lower							200	30	50		Good to Fair				
	Urban	3.5			No value set		200	30	50	20	No value set				
Lake-fed		6			20	30	200	30	50	10	Good				
Banks Peninsula		5					120	20	30	20	No value set				
Spring-fed -upland		6					20	30	50	10	20	10	Good		
Spring-fed - lower basins		5					30	30	200	30	50		Fair		
Spring-fed -plains		5					70		30	50	200	30	50	20	No value set
	Urban	3.5							30	60	200	30	50	30	No value set

*Key:

QMCI = quantitative macroinvertebrate community index

SFRG = Suitability for Recreation Grade from Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas, Ministry for the Environment, June 200

Figure A1.1: LWRP table 1a detailing region-wide numerical outcomes for Canterbury Rivers.

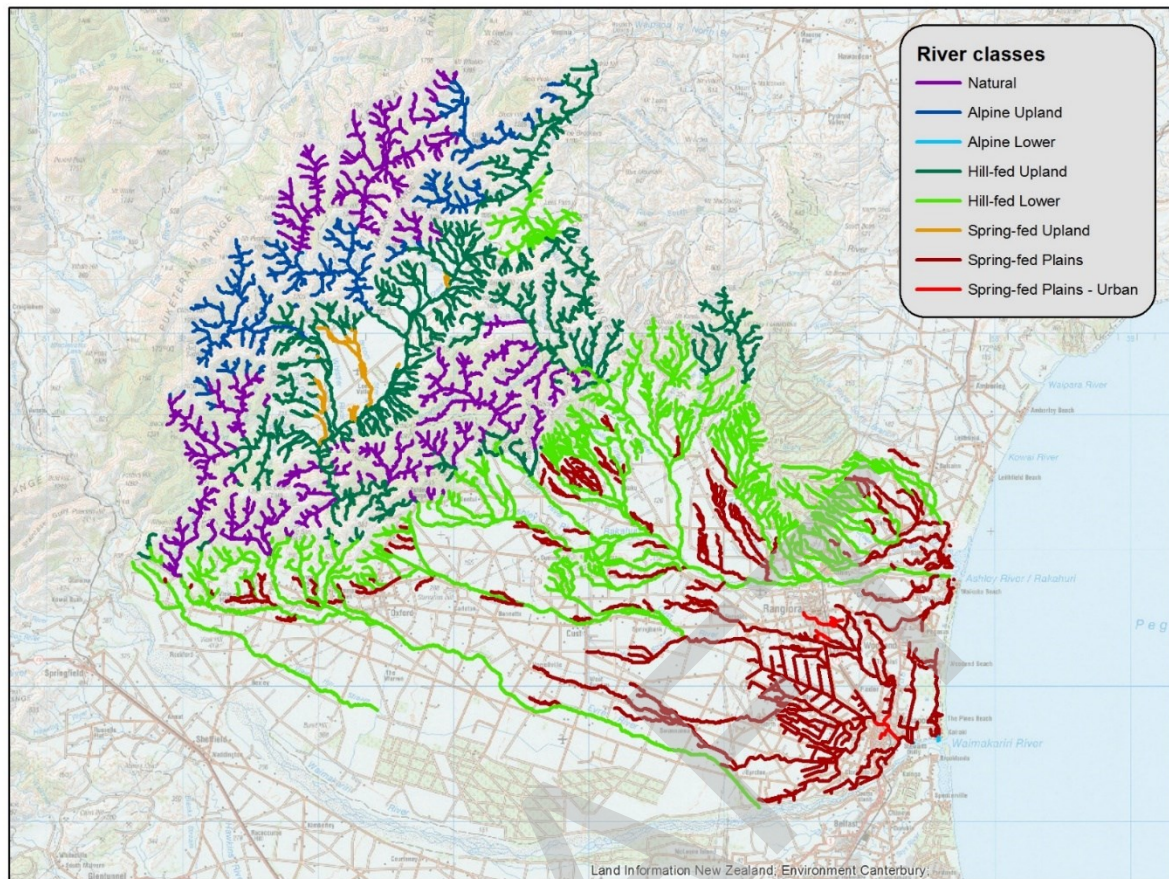


Figure A1.2: Map of waterway classifications in the Waimakariri zone.

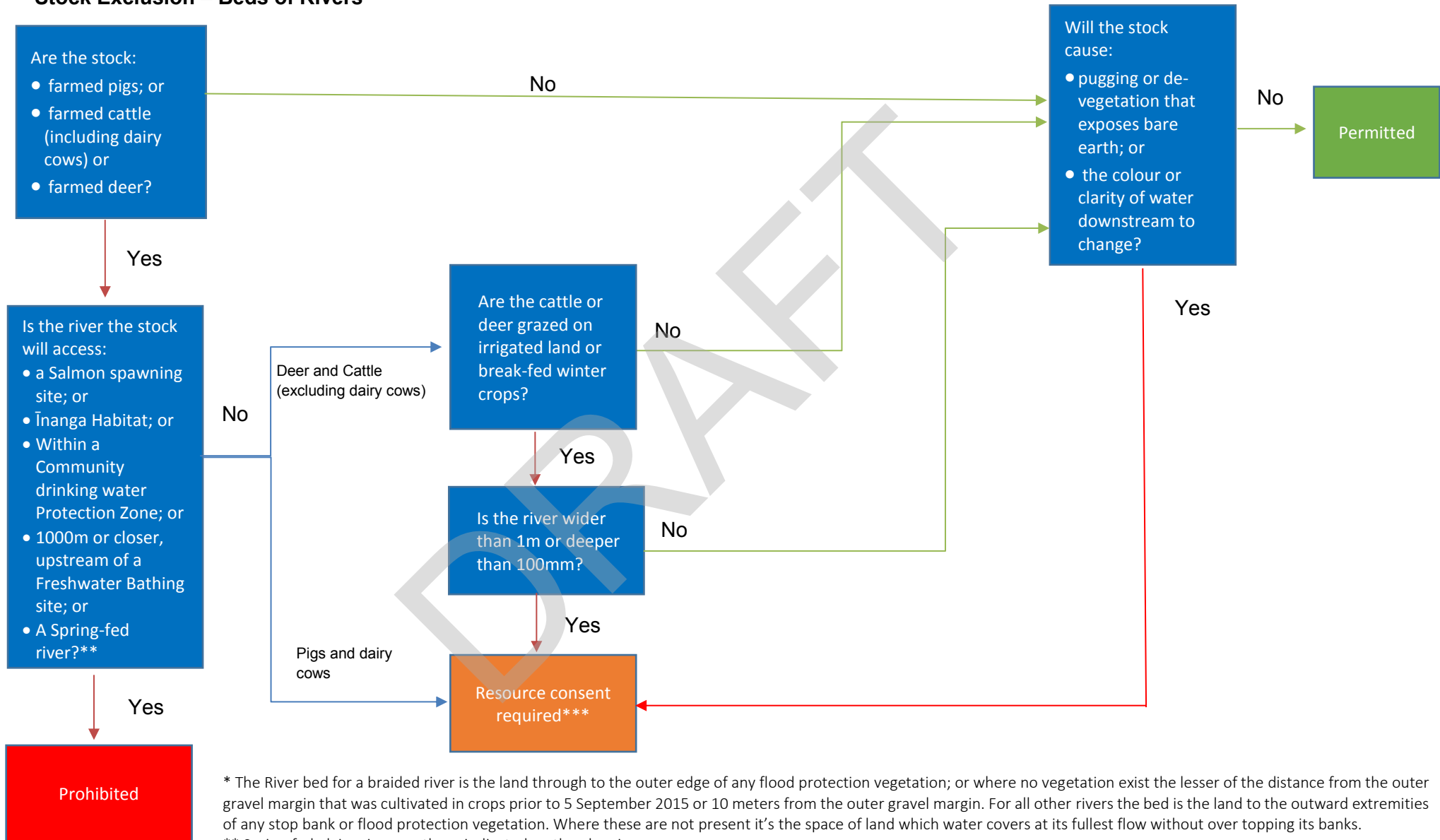
Appendix 2

Flowcharts summarising the Stock Exclusion Rules

The flowcharts on the following pages summarise the stock exclusion rules in the Land and Water Regional Plan. They are not an alternative to reading the rules themselves but are provided to the Zone Committee to aid interpretation.

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Stock Exclusion – Beds of Rivers*

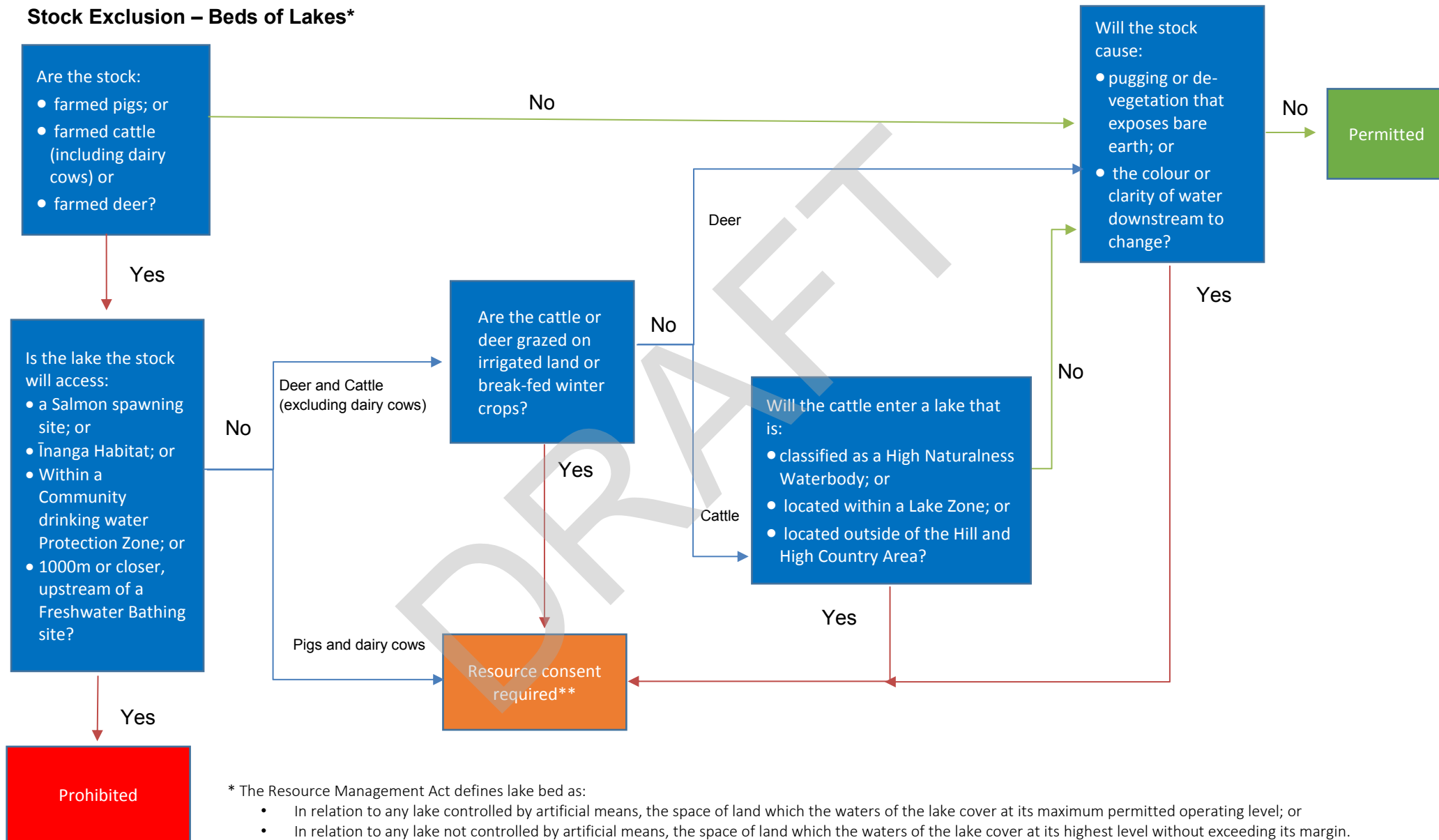


* The River bed for a braided river is the land through to the outer edge of any flood protection vegetation; or where no vegetation exist the lesser of the distance from the outer gravel margin that was cultivated in crops prior to 5 September 2015 or 10 meters from the outer gravel margin. For all other rivers the bed is the land to the outward extremities of any stop bank or flood protection vegetation. Where these are not present it's the space of land which water covers at its fullest flow without over topping its banks.

** Spring-fed plains river are those indicated on the planning maps

***Non complying activity if dairy cattle or pigs or other cattle or deer being grazed on irrigated land or being break-fed on winter feed crops and bed more than 1 metre wide or 10 cm deep. Discretionary for all others.

Stock Exclusion – Beds of Lakes*



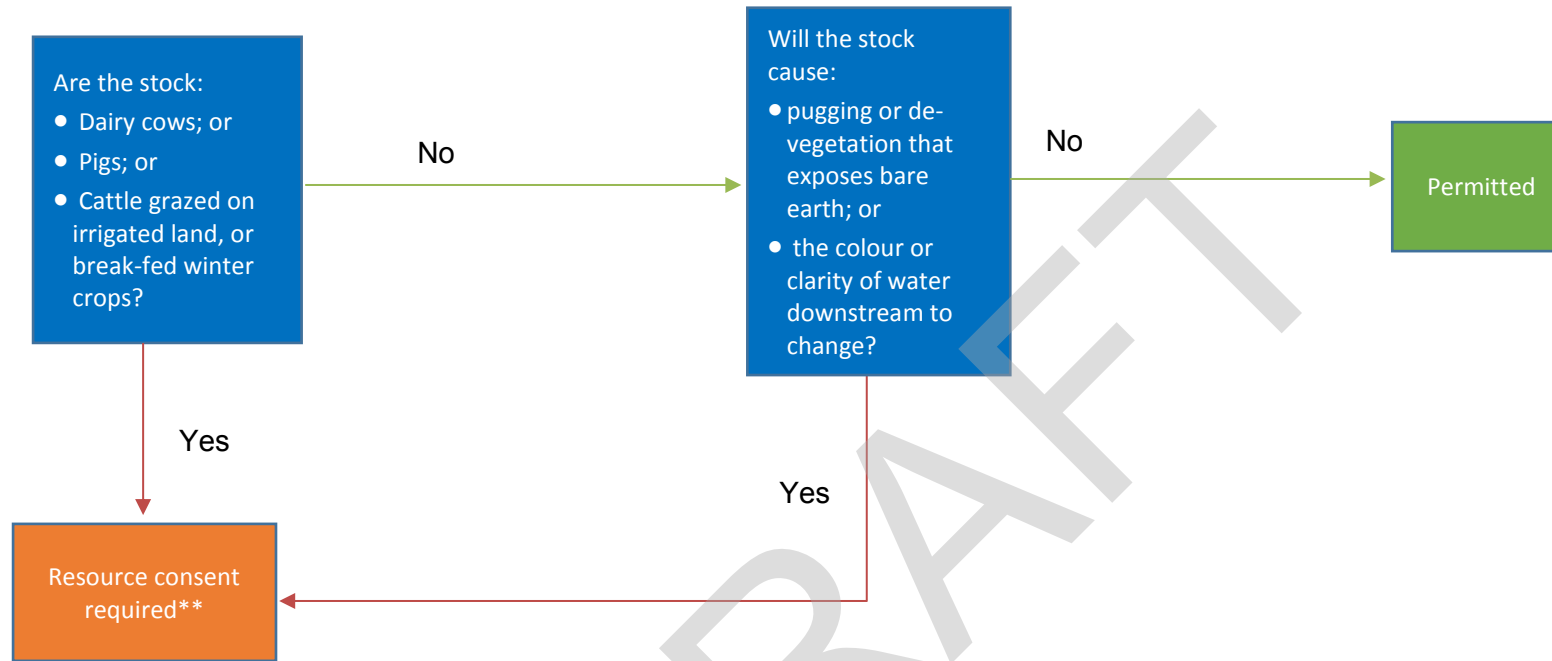
* The Resource Management Act defines lake bed as:

- In relation to any lake controlled by artificial means, the space of land which the waters of the lake cover at its maximum permitted operating level; or
- In relation to any lake not controlled by artificial means, the space of land which the waters of the lake cover at its highest level without exceeding its margin.

The extent of lakebeds is therefore determined by their lake margins and the type of vegetation (wetland) present.

** Non complying activity if dairy cattle or pigs or other cattle or deer being grazed on irrigated land or being break-fed on winter feed crops more than 1metre wide or 10cm deep. Discretionary for all others

Stock Exclusion – Beds of Wetlands*



* Wetland location information is available via Environment Canterbury's GIS layers, however this is not comprehensive. You will also need to refer to the LWRP definition of wetland and wetland boundary. Wetland is defined as "coastal wetlands, wetlands which are part of a river, stream or lake; and natural ponds, swamps, marshes, fens, bogs, seeps, brackish areas, mountain wetlands, and other naturally wet areas that support an indigenous ecosystem of plants and animals specifically adapted to living in wet conditions, and provide a habitat for wildlife. It excludes:

- wet pasture or where water temporarily ponds after rainfall;
- artificial wetlands used for wastewater or storm water treatment;
- artificial farm dams, drainage canals and detention dams; and
- reservoirs for firefighting, domestic or community water supply."

Wetland boundary is the point in the transition from wetland to dryland where wetland plant species occur at more than four times their un-grazed height apart. Wetland edge has a similar meaning.

**Non complying activity if dairy cattle or pigs or other cattle or deer being grazed on irrigated land or being break-fed on winter feed crops. Discretionary for other stock

Appendix 3

Key issues – what and where are the problems?

The Waimakariri zone water quality and ecology: state and trend report (Greer and Meredith 2016) highlights that many waterways in the Waimakariri zone exhibit degraded habitat conditions and poor water quality. This is particularly the case for lowland spring-fed streams, reflecting their sensitivity to the intensive land use pressures in both the Ashley River / Rakahuri and Waimakariri catchments. The following section summarises the key issues in the zone as detailed by state of the environment monitoring, investigative surveys, and anecdotal evidence.

Current state and trends

Ashley River / Rakahuri and Saltwater Creek catchments

The limited monitoring data that exists suggests that invertebrate communities are in a degraded state in half of the monitored hill-fed rivers in the Ashley River catchment. Dissolved inorganic nitrogen concentrations are sufficient to cause nuisance periphyton growths, however periphyton is generally low. Many hill-fed rivers contain excessive amounts of deposited fine sediment and degraded ecosystem health in some of these tributaries is likely to be, at least in part, the result of this as well as the effect of recent years of drought. Bullock Creek (as sampled at Birch Hill Road) appears to be the most degraded of monitored hill-fed streams in terms of invertebrate health, habitat quality and water quality. The site suffers from high nitrates, high fine sediment cover, low dissolved oxygen, and high periphyton cover.

Faecal contamination is generally low in the Ashley, Glentui and Grey Rivers, and *E. coli* levels rarely exceed guidelines for recreational health (MfE and MoH 2003). In contrast, potentially toxic cyanobacteria blooms occur seasonally in the Ashley River. There are regularly excessive growths of *Phormidium* at the State Highway 1 and the Rangiora-Loburn Road recreational monitoring sites during the summer months, which may pose a threat to recreational user's health.

Spring-fed rivers in the Ashley River catchment are characterised by invertebrate communities of poor health. Several factors could be contributing to this, although high deposited fine sediment cover is undoubtedly a key driver of poor ecosystem health in spring-fed streams. Macrophyte cover is also high at many monitored spring-fed sites, and LWRP total macrophyte and/or emergent macrophyte (Appendix1 Figure A1.1) are regularly not being met at sites in Saltwater Creek, Taranaki Creek and Waikuku Stream. Water quality data suggests that poor stream shading, and elevated dissolved organic nitrogen and dissolved reactive phosphorus concentrations, caused by intensive land-use pressures, is driving high aquatic plant growth. Nitrate-nitrite nitrogen and ammoniacal nitrogen concentrations at some Ashley spring-fed sites exceed thresholds for the protection of 99% of species (NPSFM 2017), but nitrate and ammonia toxicity are unlikely to be significant drivers of degraded invertebrate community health.

In terms of recreational value, spring-fed rivers in the Ashley River catchment are unsuitable for primary contact recreation due to significant faecal contamination. However, toxic cyanobacteria does not appear to pose a health risk in these streams.

Comprehensive long-term data does not exist for the waterways in the Lees Valley. However, quarterly sampling conducted between 2014 and 2016 indicates that current levels of land intensification are not causing excessive nutrient enrichment, and nitrogen concentrations are low. The reaches of the Ashley River that run through Lees Valley and the Ashley Gorge remain high quality riverine habitats, and are likely to be very sensitive to any increases in dissolved nutrient concentrations. Protection of spring-fed stream systems and wetland areas in the Lees Valley is important. Not only to ensure the habitat provided by these systems remains, but also to prevent them from becoming sources of contaminants, such as sediment, phosphorus and *E. coli*, that could affect the significant ecological and recreational values of waterways in the lower Ashley River / Rakahuri.

Northern Waimakariri tributaries

Data records for the northern Waimakariri tributaries are limited, and monitoring in the upper hill-fed reaches is particularly poor. This gives little certainty as to the state of these streams. Monthly investigative monitoring of water and habitat quality was undertaken in the upper Cust and Eyre River catchments between October 2009 and September 2010. The results of this monitoring showed that water quality and habitat quality was generally poor. Dissolved nutrient (dissolved inorganic nitrogen and dissolved reactive phosphorus) levels were high at many sites, although filamentous algal cover is generally low across upper Cust and Eyre catchment streams. Sediment cover is high in some tributaries exceeding the LWRP outcome for hill-fed lower streams (Appendix 1 Figure A1.1) at many sites, while invertebrate communities are severely degraded in many places. Not surprisingly the sites with the best water quality and least fine sediment cover also had the healthiest invertebrate communities.

All the streams sampled in the study met the LWRP outcome for filamentous algal cover (Appendix 1 Figure A1.1). This is of particular interest given that dissolved nutrients (dissolved inorganic nitrogen and dissolved reactive phosphorus) are often sufficient to increase the risk of nuisance periphyton at most study sites. Nitrate levels are within NPSFM 2017 national bottom lines for protecting biodiversity, however there is some risk of nitrate toxicity effects at sites such as the Cust River at SH72 and Ellis Drain at Stubbs Road. The investigation indicates that the *E. coli* threshold for primary recreation (550 MPN/100 mL; MfE & MoH 2003) is commonly exceeded in upper Cust and Eyre catchment sites. Coopers Creek, the Eyre River at SH72, Gammons Creek and Trout Stream contain low *E. coli* levels.

Spring-fed tributaries of the lower Waimakariri River contain a more generous data record than their hill-fed counterparts. The Kaiapoi River catchment is regularly monitored and benthic fine sediment cover generally exceeds LWRP outcomes (Appendix 1 Figure A1.1) and guideline values for the protection of biodiversity. Similarly, the composition of invertebrate communities in Kaiapoi River catchment indicate that water and habitat quality is poor. The only spring-fed site to regularly meet the LWRP QMCI outcome (Appendix 1 Figure A1.1) is the Silverstream at Heywards Road. Deposited fine sediment is undoubtedly a key driver for poor invertebrate community health throughout all spring-fed tributaries in the Waimakariri zone.

High nitrate concentrations are currently breaching NPSFM 2017 national bottom lines for nitrate toxicity in the upper Silverstream. The Cust Main Drain and Ohoka River also contain nitrate levels approaching toxicity thresholds set to protect biodiversity. There is the trend of increasing dissolved inorganic nitrogen and nitrite-nitrate nitrogen concentrations in the Kaiapoi River at Island Road. Invertebrate communities are still healthy in the Silverstream when compared to other lowland streams in the Waimakariri zone. This is not to say that if nitrate concentrations were lower, biodiversity would not improve, rather there are likely to be multiple stressors driving degraded ecosystem health in the Kaiapoi River catchment. Factors such as fine sediment and macrophyte growth are also important drivers of degraded ecosystem health.

High concentrations of dissolved inorganic nitrogen and dissolved reactive phosphorus combined with suitable growing conditions has led to high macrophyte cover throughout spring-fed streams in the Kaiapoi River catchment. LWRP total macrophyte and/or emergent macrophyte outcomes (Appendix 1 Figure A1.1) are exceeded at sites in the Silverstream, Ohoka River and North Brook. High macrophyte cover may be having some negative ecological effects in certain reaches of these rivers, including contributing to the degraded state of resident invertebrate communities. However, these effects are once again likely to be minimal compared to those caused by benthic fine sediment cover.

Spring-fed waterways in the Kaiapoi River catchment are unsuitable for contact recreation due to significant faecal contamination. Toxic cyanobacteria does not appear to pose a significant health risk in this and other spring-fed systems.

Understanding the key drivers of water quality in the lower Kaiapoi River is made difficult by a long water residence time and complex hydrological interactions with the Waimakariri River. Consequently, a better understanding of the hydrology, water quality and ecology of the river is needed if the overall health of the river is to be improved. Neither the Courtenay nor Kaikanui Stream are currently monitored for water quality or ecological health. However, past investigations show that issues in Courtenay Stream are likely to be very similar to those of other spring fed streams in the zone. These issues include high nutrient concentrations, excessive sediment accumulation, and extensive macrophyte growths. The Kaikanui Stream is now primarily fed by surface water runoff from the area to the south of Kaiapoi and is generally sluggish or stagnant with long pooled sections. At its lower end, where it connects to Courtenay Stream, Kaikanui Stream has been configured as a stormwater treatment facility to settle out suspended sediments and treat or accumulate common stormwater contaminants. Therefore, the issues with Kaikanui Stream are mostly related to stormwater.

Coastal areas

Little monitoring data for coastal environments exist in the Waimakariri zone. However, mapping surveys indicate that fine sediment deposition is excessive in many areas of the Ashley River / Rakahuri – Saltwater Creek Estuary. Coastal waterbodies are receiving environments for contaminants entering wider catchment streams and rivers. For this reason, it is reasonable to assume that water and habitat quality is reflective of the poor ecosystem state in many Waimakariri zone streams. Faecal coliform levels are elevated in some estuary

environments, and the Estuary Trophic Index indicates nutrient enrichment in the Ashley River / Rakahuri – Saltwater Creek Estuary.

Other information sources

Past surveys have identified numerous structures within Waimakariri zone streams that act as barriers to fish migration (Appendix 5 Map 1). These include perched culverts, weirs and other artificial structures. These barriers prevent migratory fish species from completing their life-cycles and limit native and sports fish distribution within streams and rivers. Anecdotal evidence also suggests that tide and flood gates in the lower reaches of lowland streams are significant barriers to fish passage. Little is known about the adequacy of fish screens on intakes within the zone, and this requires further investigation to help reduce fish mortality

Springhead locations have been surveyed in many areas within the zone and are now documented in GIS databases. Springheads are sensitive environments that provide source groundwater to the very head of spring-fed plain streams. They can fluctuate with the rising and falling of the groundwater table, so springs can pop up adjacent to streams and be seemingly disconnected from any defined surface water channel. However, they are often connected by subsurface or less conspicuous overland flow paths and are therefore still vessels for contaminant transport. Springheads can sometimes be useful as bottlenecks for filtering and assimilating contaminants using wetlands or other protective measures.

Streamwalk surveys are one off intensive physical and biological surveys of entire stream catchments. In the last two years, streamwalks have been conducted on the Silverstream and Cam River catchments including the three Brooks. Each survey confirmed current state and trend report findings that excessive fine sediment deposition is longitudinally extensive along extended catchment reaches. This is probably characteristic of most spring-fed plain streams in the Waimakariri zone where sediment is perhaps the most important driver of poor ecosystem health. Streamwalks also found that excessive aquatic plant growth is widespread which has implications for impeding stream flows and reducing habitat quality (**see Appendix 5 Map 10**).

In many spring-fed plain streams, channels are straightened with step stream banks. Stream bank and channel modifications of this nature promotes bank instability and increases the chances of bank collapse and erosion. These critical source areas contribute largely quantities of sediment to stable spring-fed systems that do not have the flow capacity to flush them away. Streamwalks also identified other critical source areas including rill and gully erosion, and areas of bed scouring. Erosion and sediment issues in Ashley River / Rakahuri hill-fed catchment streams have also been identified by community members. While it is not empirically confirmed, members of the community believe that forestry practise in the upper catchments are significant contributors to the problem.

The LWRP contains several schedules that provide added protection to sites of high ecological and recreational importance. Schedule 6 protects popular bathing beach sites, while Schedule 17 protects inanga and salmon spawning sites.

Only the Ashley River at Ashley Gorge is included as a bathing site in Schedule 6, although the Ashley River at Rangiora Loburn-Bridge and Kaiapoi River at Kaiapoi boat ramp sites are currently monitored as part of Environment Canterbury's seasonal recreational water health monitoring programme

The Waimakariri zone does not have any salmon spawning sites recognised in Schedule 17 of the LWRP. However, North Canterbury Fish and Game spawning surveys have identified several important salmon spawning sites in the upper Ashley River catchment.

While there are no specific schedules in the LWRP that recognise the rare and vulnerable Canterbury mudfish, the Department of Conservation has recognised several important mudfish populations in the Waimakariri and Ashley/Rakahuri catchments.

The availability of good fish monitoring data is absent for the Waimakariri Zone, with any fish records that do exist often being either sparsely distributed or old. Native fish distribution is poorly understood and it is therefore difficult to inform management decisions around their protection. Recreational coarse fish populations (e.g. Perch, Carp and Rudd) are known to exist in the Kaiapoi Lakes area. However, no data is available to show the structure of their populations (e.g. size class information and whether they are breeding) or whether they have expanded into other zone waterways. Cooler water temperatures mean it is less likely that conditions are suited for populations to breed proficiently (Adrian Meredith per comms.), but with the advent of warming climatic conditions, it would be negligent to assume that this will not change in the future.

Climate change also presents further risks for the effective protection of native species. Habitat shifts for tidal and other coastal species, and increasingly favourable conditions for invasive species, are two such examples. Inanga spawn within the spring high tide mark and these inanga spawning habitats will likely shift with sea-level rise and increased saltwater intrusion in tidal stream reaches. Coastal habitat, such as that in the Ashley River / Rakahuri – Saltwater Creek Estuary, will be lost to coastal retreat with increasing sea-level rise.

Climate change will likely result in extended dry periods with increasing droughts and lower river flows over summer. This will increase flow pressures on habitat availability and fish recruitment as drying will prevent fish passage. Ecological stream flow reports highlight the pressures that summer low flows are already placing on available fish habitat in the Waimakariri zone.

Appendix 4

How far will current management tools get us?

Current Pathways

The Current Pathways assessment (memo dated 31 Oct 2017) used an expert panel approach to assess how likely key measures in water and habitat quality, and their effect on measures of ecosystem health, will respond to changing climatic conditions and current management practises. This included the effect of implementing Good Management Practise (GMP) using audited Farm Environment Plans and other recently implemented tools under PC5. Current Pathway assessment results are useful as they are the key measures required to gauge “what management tools, additional to those already implemented, are needed to improve stream ecosystem health in the zone?”

Table A4.1 (overleaf) presents a qualitative summary of the current state of water and habitat quality in the Waimakariri Zone, and the predicted change expected in these measures as a result of current management tools and climate change.

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Table A4.1: Charts of key water quality and ecosystem health measures and how they relate to achieving relevant Waimakairi zone community objectives. Each measure is colour coded qualitatively according to their current state and expected state in the future under the Current Pathways scenario.

Community outcomes and narrative	Sub-outcome	Technical indicators	Current State	Current Pathways
The water quality and quantity of spring-fed streams maintains or improves mahinga kai gathering and diverse aquatic life Narrative: The habitat, flow and water quality in the spring fed streams supports abundant and diverse aquatic life (including native flora and fauna). Spring fed streams contain safe and plentiful kai for gathering. The flow and visual appearance of the spring fed streams meet aesthetic values and promotes customary use. Plant and animal pest species are managed or eliminated.	Water quality and instream habitat	Nitrogen for plant growth		
		Sediment, phosphorus and <i>E. coli</i>		
	Water quantity	Overall flows plus low flows and minimum flows		
	Mahinga kai and diverse aquatic life	Macroinvertebrate Community Index (MCI)		
		Diversity and abundances of fish species (including taonga species)		
		Ammonia Toxicity (NPS)		
		Nitrate Toxicity (NPS)		
	Aesthetic values	Clarity		
		Macrophyte		
	Customary use and recreation	Cyanobacteria		
		<i>E. coli</i> .		
		Cultural assessment		

Community outcomes and narrative	Sub-outcome	Technical indicators	Current State	Current Pathways
<p>The Ashley/Rakahuri River is safe for contact recreation, has improved river habitat, fish passage, and customary use; and has flows that support natural coastal processes</p> <p>Narrative: The river meets National standards for swimmable contact recreation. The habitat and fish passage along the river are improved to encourage more customary use and mahinga kai gathering. Braided river bird populations are protected and numbers improved. The river mouth and estuary are healthy and functioning.</p>	Contact recreation	Cyanobacteria		
		<i>E coli.</i> in Ashley River (NPS)		
	River habitat	Periphyton (nuisance algae)		
		Sediment		
		Phosphorus for plant growth		
		Nitrogen for plant growth		
	Fish passage	Fish passage		
	Customary use and mahinga kai	Cultural assessment		
		Macroinvertebrate Community Index (MCI) (NPS)		
		Diversity and abundances of fish species (including taonga species)		
		Nitrate Toxicity (NPS)		
		Ammonia Toxicity (NPS)		
	Flows	Continuous flow over length of river (connectedness)		
		Overall flows plus low flows and minimum flows		
	Braided birds	Flow - braid morphology		
		Pest weeds		
		Food supply		
	River mouth and estuary	Faecal coliforms		
		Macroalgae distribution and abundance		
		Aquatic vegetation		
		Sedimentation		
		Metals in shellfish		
		Estuary Trophic Index		

Community outcomes and narrative	Sub-outcome	Technical indicators	Current State	Current Pathways
The Waimakariri River as a receiving environment is a healthy habitat for freshwater and coastal species, and is protected and managed as an outstanding natural landscape and recreation resource Narrative: Flow and water quality are maintained to support and enhance aquatic life. The river mouth is healthy and functioning. The natural braided characteristics of this alpine river are recognised for aesthetic and amenity values. Recreational opportunities, along and on the river, are sustained.	Habitat for freshwater and coastal species	Macroinvertebrates		
		Diversity and abundance of fish species		
		Nitrate Toxicity (NPS)		
		Ammonia Toxicity (NPS)		
		Macroinvertebrate Community Index (MCI)		
		Periphyton/Phytoplankton (nuisance algae)		
	Recreation resource	Cyanobacteria		
		Changes in recreational opportunities		
		<i>E coli.</i>		
	Flows and river mouth	Flow		
	Water quality	Phosphorus for plant growth		
		Nitrogen for plant growth		
Indigenous biodiversity in the zone is protected and improved Narrative: Protect and improve the indigenous biodiversity, habitat or ecosystems. Plant and animal pest species are managed or eliminated.	indigenous biodiversity, habitat or ecosystems	Extent of indigenous vegetation		
		Biodiversity values		
		Freshwater wetland extent		

Appendix 5

Map Compendium

Provided as a standalone document

DRAFT