Canterbury Water Management Strategy
Waimakariri Zone Committee

Agenda

Monday 31 January 2022

3:30pm

Council Chamber
215High Street
Rangiora

Members:
Michael Blackwell
Martha Jolly
Erin Harvie
Carolyne Latham
Judith Roper-Lindsay
Wendy Main
Arapata Reuben (Te Ngai Tūāhuriri Rūnanga)
John Cooke (Te Ngai Tūāhuriri Rūnanga)
Sandra Stewart (WDC Councillor)
Megan Hands (ECan Councillor)

Chairperson and Members

CWMS WAIMAKARIRI ZONE COMMITTEE

AGENDA FOR THE MEETING OF THE CANTERBURY WATER MANAGEMENT STRATEGY WAIMAKARIRI ZONE COMMITTEE TO BE HELD IN THE COUNCIL CHAMBER, 215 HIGH STREET, RANGIORA ON MONDAY 31 JANUARY 2022 COMMENCING AT 3:30PM.

Recommendations in reports are not to be construed as Council policy until adopted by the Council

BUSINESS

PAGES

KARAKIA

1. BUSINESS

1.1 **Apologies**

1.2 **Welcome and Introductions**

1.3 **Register of Interests**

Advice of any changes or updates. *5-6*

2. OPPORTUNITY FOR THE PUBLIC TO SPEAK

3. REPORTS

3.1 **Zone Committee Action Plan Initiatives – Recommendations – M Griffin (CWMS Facilitator)**

RECOMMENDATION *7*

THAT the CWMS Waimakariri Zone Committee:

(a) **Receives** information on the following initiatives to be considered for support using the Waimakariri Zone Committee Action Plan Budget as follows:

- Taranaki Stream Inanga Spawning improvement: $ 8,600
- Sefton Saltwater Creek Catchment Group Monitoring Programme (Year 1 of 3): $ 3,835
- Northbrook Stream corridor (Year 1 of 2) $10,000
- Waimakariri Biodiversity Trust Establishment Programme: $ 5,000
- Total: $27,435

(b) Confirms for initiatives i – iii, that the Waimakariri Water Zone Committee:

i. **Supports** the recommendation for this initiative to receive the proposed funding from the 2021/22 Waimakariri Water Zone Committee Action Plan Budget; or

ii. **Requests further information** on the initiative before deciding to recommend funding support using the 2021/22 Waimakariri Zone Committee Action Plan Budget; or

iii. **Does not support** the recommendation for this initiative to receive funding using the 2021/22 Waimakariri Zone Committee Action Plan Budget.

3.2 **ESR Nitrate Sensor Field Study in Waimakariri – Update - M Griffin (CWMS Facilitator) and A Arps (Northern Zone Manager, Ecan)**

RECOMMENDATION *8-31*

THAT the CWMS Waimakariri Zone Committee:

(a) **Receives** these updates for its information, and with reference to the committees working groups, action plan, and engagement priorities in 2022.

4. COMMITTEE UPDATES – M GRIFFIN (CWMS FACILITATOR, ECAN)

4.1 **Proposed Plan Change 7.**

4.2 **Essential Freshwater Package – ECan updates.**

4.3 **Zone Committee Working Groups.**

4.4 **ECan Biodiversity Snapshot 2020/21.**

4.5 **WDC Land and Water Committee.**

4.6 **Waimakariri Zone Communications Report (November 2021 – January 2022).**

4.7 **Waimakariri Water Zone Committee Schedule and Priorities for 2022.**

4.8 **Action points from the previous Zone Committee meeting – November 2021.**

RECOMMENDATION *32-62*

THAT the CWMS Waimakariri Zone Committee:

(a) **Receives** these updates for its information, and with reference to the Committees working groups, action plan, and engagement priorities in 2022.

5. REPORT FOR INFORMATION

5.1 **Stormwater Management from Sutton Tools Ltd – Sophie Allen (WDC, Water Environment Advisor)**

RECOMMENDATION *63-67*

THAT the CWMS Waimakariri Zone Committee:

(a) **Receives** the report for information from the EDC Utilities and Roading Committee.

6. CONFIRMATION OF MINUTES

6.1 **Minutes of the Canterbury Water Management Strategy Waimakariri Zone Committee meeting – 1 November 2021**

RECOMMENDATION *68-75*

THAT the CWMS Waimakariri Zone Committee:

(b) **Confirms** the Minutes of the Canterbury Water Management Strategy Waimakariri Zone Committee meeting, held on 1 November 2021, as a true and accurate record.

KARAKIA

NEXT MEETING

The next meeting of the CWMS Waimakariri Water Zone Committee is scheduled for the 4 April 2022 at 3:30pm.

WAIMAKARIRI WATER ZONE COMMITTEE

Register of Interests – at 1 November 2021

Name	Committee Member Interests
Michael Blackwell	- Director/ Shareholder – Blackwells Limited, Kaiapoi - 4Ha property, Tuahiwi
John Cooke	- Director/Shareholder – Executive Limousines 2015 Limited - Director/Shareholder – Express Hire Limited - Director/Shareholder – Secure Property Management Limited - Director/Shareholder – Testpro Limited - Director/Shareholder – Acropolis Wedding and Event Hire Limited - Director/Shareholder – Pines Beach Store Limited - Director/Shareholder – Coastal Dream 2005 Limited – 4Ha property, Kaiapoi - Interim Trustee – Section 6 Survey Office Plan 465273 Ahu Whenua Trust
Megan Hands	- Director/Shareholder – Landsavvy Limited - Member – NZ Institute of Primary Industry Management - Member – NZ Young Farmers - Member – Institute of Directors NZ - ECan Councillor
Erin Harvie	- Shareholder – Bowden Consultancy Limited, trading as Bowden Environmental - Trustee – Waimakariri Landcare Trust - Co-ordinator - Waimakariri Landcare Trust - Member – NZ Hydrological Society - Member – NZ Institute of Primary Industry Management - Involvement with Cust River Water User Group
Martha Jolly	- Veterinary surgeon (Companion animal) - Student of Masters in Water Resource Management (2nd year) - Volunteer assistant the Styx Living Laboratory Trust - Volunteer educator Vets for Compassion - Volunteer clinician SPCA NZ - Member – Forest and Bird NZ
Carolyne Latham	- Farmer – Sheep, beef - Director – Latham Ag Ltd Consulting - Shareholder – Silver Fern Farms, Farmlands - Registered Member – New Zealand Institute of Primary Industry Management
Wendy Main	- Dairy Farmer – Trinity Holdings (2001) Ltd - Registered Nurse - Member Federated Farmers - Consent to Farm and related consents for water and effluent with ECan - Shareholder – Silver Fern Farms, Farmlands, LIC

Arapata Reuben	- Trustee – Tuhono Trust - Trustee – Mana Waitaha Charitable Trust - Member – National Kiwi Recovery Group - Rūnanga Rep – Christchurch/West Melton Water Zone Committee - Rūnanga Rep – Ashburton Water Zone Committee
Judith Roper-Lindsay	- Director/ecologist – JR-L Consulting Ltd. - Landowner/small-scale sheep farmer, Ashley downs - Fellow – Environment Institute of Australia and New Zealand (EIANZ) - Chair – Waimakariri Biodiversity Trust
Sandra Stewart	- Self-employed journalist - Landowner, 4Ha Springbank – sheep & dogs - WDC Councillor

AGENDA ITEM NO: 3.1	**SUBJECT:** Zone Committee Action Plan Initiatives – Recommendations
REPORT TO: Waimakariri Water Zone Committee	**DATE OF MEETING:** 31 January 2022
REPORT BY: Murray Griffin, CWMS Facilitator – Waimakariri	

1. PURPOSE

The purpose of the agenda item is for the Waimakariri Water Zone Committee to consider several initiatives and make recommendations to Environment Canterbury whether to support these initiatives using the Zone Committee's Action Plan Budget for the 2021-22 financial year.

2. RECOMMENDATION

That the Waimakariri Water Zone Committee:

1) **Receives** information on the following initiatives to be considered for support using the Waimakariri Zone Committee Action Plan Budget as follows:

a)	Taranaki Stream Inanga Spawning improvement	$ 8,600
b)	Sefton Saltwater Creek Catchment Group Monitoring Programme (Year 1 of 3)	$ 3,835
c)	Northbrook Stream corridor (Year 1 of 2)	$10,000
d)	Waimakariri Biodiversity Trust Establishment Programme	$ 5,000
	Total:	$27,435

2) **Confirms for initiatives 1a – d, that the Waimakariri Water Zone Committee:**

a) **Supports** the recommendation for this initiative to receive the proposed funding from the 2021/22 Waimakariri Water Zone Committee Action Plan Budget; or

b) **Requests further information** on the initiative before deciding to recommend funding support using the 2021/22 Waimakariri Zone Committee Action Plan Budget; or

c) **Does not support** the recommendation for this initiative to receive funding using the 2021/22 Waimakariri Zone Committee Action Plan Budget.

3. BACKGROUND

As part of their Long-Term Plan 2021-2031, Environment Canterbury established the Zone Committee Action Plan Budget (formerly referred to as the Community Engagement Fund) and committed $50,000 per zone for the 2021-22 financial year.

The confirmed purpose of the budget is to support Zone Committees to focus on implementing their action plan and leverage other funding opportunities to achieve their Canterbury Water Management Strategy (CWMS) priorities.

Action Plan Budget Initiatives – Assessment

The Waimakariri Water Zone Committee has considered the above initiatives as options to support in this initial year of their 2021 – 2024 Action Plan. In doing so, the committee has contributed to developing an assessment approach and template for the above and future Action Plan initiatives.

Assessment details for each initiative will be provided to the Zone Committee prior to the meeting to support its decision making.

AGENDA ITEM NO: 3.2	SUBJECT: ESR nitrate sensor field study in Waimakariri – update
REPORT TO: Waimakariri Water Zone Committee	MEETING DATE: 31 January 2022
REPORT BY: Murray Griffin, CWMS Facilitator – Waimakariri, ECan	

PURPOSE
To provide the Water Zone Committee with an update on a field study conducted by ESR in Waimakariri District and Silverstream Reserve using an optical nitrate sensor.

RECOMMENDATION

That the Zone Committee:

> **Receives** these updates for its information, and with reference to the committee's working groups, action plan, and engagement priorities in 2022.

BACKGROUND
The Institute of Environmental Science & Research (ESR) is a Crown Research Institute, wholly owned by the NZ Government. One of the Institute's undertakings is scientific research aimed at improving the safety of freshwater and groundwater resources.

Examining the fate and transport of nitrate in NZ groundwater systems has been a key topic of ESR's groundwater research over the last decade. ESR have found that NZ's alluvial gravel aquifers have negligible ability to naturally attenuate nitrate and, in many locations, groundwater systems have reached the limit of mitigating nitrate pollution through natural dilution. To remedy this and to provide potential means for farming within water quality limits, ESR is researching and developing options to address nitrate pollution, including ways to enhance denitrification of groundwater, as presented to the committee back in May 2019.

ESR's work in the Waimakariri District has been focused on the Kaiapoi catchment, particularly around Silverstream. A summary and location of current projects is provided below:

- Establishment of two real-time monitoring stations at Tram RD and Wai-Eyre where we collect high frequency WL and chemistry data to better understand GW/SW interaction.
- Groundwater Mitigation project – involving the installation of a Woodchip Permeable Reactive Barrier (PRB), which is a trench filled with a wood/gravel mixture, designed to remove nitrate contamination from shallow GW.
- Eyreton septic tank study – investigating wastewater contaminant transport under "real-life" use conditions.
- Groundwater ecology – sampling for invertebrates and assessing their vulnerability to GW contamination.

Update on recent field study using an Optical Nitrate Sensor
This current update is focused on novel applications of a UV Optical Nitrate Sensor in a surface and groundwater quality field study.

The main objectives of this study, and the accompanying paper are thus:
i) to demonstrate, and provide technical details of how ESR have deployed UV optical nitrate sensors in water quality investigation and monitoring;
ii) to explain some of the limitations we have identified with the two approaches we took;
iii) to provide recommendations for future improvements.

- For a more detailed overview on this field study please refer to **agenda item 4-1**.

WHO

This update will be provided by:

- Lee Burbery – former Senior scientist within ESR's groundwater team

Novel Applications of a UV Optical Nitrate Sensor in a Surface-/Ground-Water Quality Field Study

Lee Burbery[1], Phil Abraham[1], David Wood[1], Steve de Lima[2]

[1]Institute of Environmental Science and Research Ltd. (ESR), Christchurch, New Zealand.

[2]National Institute of Water and Atmospherical Science (NIWA), Christchurch, New Zealand.

Abstract

Field deployable UV optical nitrate sensors are a tool enabling automated, high frequency, reliable in situ nitrate analyses. Application of such sensor technology is demonstrated for two aspects of an investigative study of nitrate pollution in surface- and ground-water of a lowland catchment. In the first case, a rapid, in-stream nitrate survey was made by fixing a UV optical nitrate sensor operating in continuous measurement mode to a sport kayak that was paddled along the full 10 km length of the stream in just over 3 hours. The continuous nitrate dataset revealed pollution and dilution hot-spots, knowledge of which is useful for future resource management decision making. Furthermore, based on relative differences in nitrate and nitrite measured with the optical sensor between a summer and winter survey, it is hypothesised that denitrification is active in the stream during the summer period when temperatures are higher and biomass is more abundant. In the second example, the UV optical nitrate sensor was configured with appropriate technology to establish an autonomous and fully automated nitrate monitoring station that takes daily measurements of groundwater from four different depths in a gravel aquifer as well as in the nearby surface water, for the purpose of studying nitrate dynamics. The UV optical nitrate sensor has proven reliable and demonstrated low maintenance demands with only a small analytical error identified once due to biofilm interference effects and spectral drift that was easily corrected for. The high temporal frequency groundwater nitrate dataset obtained with the UV optical sensor has revealed some interesting dynamics in nitrate-depth relationship within the unconfined aquifer. It is proposed advanced study to characterise the dynamics would benefit from higher resolution sampling across the variably saturated zone at/near the water table, the financial and practical constraints of doing so are perceivably low, given the capability and low operating cost of the UV optical nitrate sensor.

1. Introduction

Nitrate is considered the most common groundwater contaminant in the world (UN, 2011) and one of eight water quality variables the United Nations specify for measuring ambient water quality under Sustainable Development Goal 6.3 (UN, 2018). Results from New Zealand's State of the Environment (SoE) national monitoring program that are compiled from an annual survey involving discrete manual sampling, suggest that nitrate concentrations in many surface- and ground-waters across the country continue to display an increasing trend, as a consequence of intensified land-use practices (Howard-Williams 2010, Joy, 2015; MfE, 2017). Recent government reforms to freshwater resource management in New Zealand are hoping to correct this trend, however for remedial action to be effective requires an improved understanding of the distribution and timing of nitrate impacts in the hydrological environment.

Field deployable UV spectrophotometric nitrate sensors suitable for environmental studies have evolved from technological advances in photodiode array spectrometers and continuous wave light sources (Sakamoto et al., 2017). They represent a tool enabling automated, high frequency, reliable in situ nitrate analyses that simply was not achievable in the past, either due to the cost of resources required to collect, process and analyse water samples using wet chemistry analytical techniques, or, as with the case of nitrate ion selective electrodes (that

are capable of in situ measurement) - high maintenance demands. Originally a highly specialised and costly apparatus developed for study of nutrient dynamics in the marine environment (Finch et al., 1998; Johnson and Coletti, 2002), within the last five years UV optical nitrate sensors have become widely commercially available and proven useful also in the study of limnological (Birgand et al., 2016), riverine (Cameron et al., 2014; Bieroza and Heathwaite, 2017; Burkitt, 2017; Snyder et al., 2017; Wollheim et al., 2017) and groundwater (Pu et al., 2011; Opsahl et al., 2107; MacDonald et al., 2017; Saraceno et al., 2018) environments. The purpose of this paper is to demonstrate two examples where UV optical nitrate sensors have been applied in a relatively novel way to collect high volume and high frequency nitrate datasets for investigative purposes. The work described represents a small and specific technical component of a bigger study aimed at characterising groundwater nitrate transport pathways in a relatively small lowland catchment, where surface flows are sourced entirely by groundwater discharge (Stenger et al, 2016).

In the first instance, we report on how a UV optical nitrate sensor was applied to survey water quality along a continuous reach of the main surface water body, providing an efficient way of mapping spatial variations of nitrate concentrations in the groundwater-fed stream and identifying pollution hot-spots. Secondly, we provide details of an autonomous groundwater nitrate monitoring station we have established along the bank of the stream, and from which high frequency groundwater nitrate measurements are being made from a cluster of wells. To the best of our knowledge, it represents the first example of UV optical nitrate sensors being employed in New Zealand to examine groundwater quality. Our field application shares similarities with that of Saraceno et al. (2018), in so much that it aims to conduct continuous real-time groundwater quality monitoring from different depths within the local groundwater system. Unlike that Californian case study however, where the focus was on recording nitrate from two deep production wells and in a shallower monitoring well, and where most of the hardware was run from a mains electricity supply, the nitrate monitoring station we describe is fully autonomous, sampling groundwater from four wells in addition to a measurement of nitrate within the nearby stream. It serves to illustrate how automated, continuous groundwater nitrate measurement requiring low maintenance can be achieved in remote locations, using appropriate technologies.

The main objectives of this paper are thus:

i) to demonstrate, and provide technical details of how we have deployed UV optical nitrate sensors in water quality investigation and monitoring;
ii) to explain some of the limitations we have identified with the two approaches we took;
iii) to provide recommendations for future improvements.

Notwithstanding that our time-series nitrate data collection is for investigative monitoring purposes, to illustrate the advantage of continuous data collection made possible with an optical nitrate sensor, we analyse a component of the data as if it were being collected for strategic groundwater nitrate monitoring (Fretwell et al., 2006). Accordingly, we apply some decision criteria and as an extra objective, examine loss of detail (i.e. error) in the nitrate time-series dataset, assuming sampling were less frequent, consistent with more common practice.

2. Materials and Methods

2.1. UV optical nitrate sensor

The work we describe in this paper centres around application of a TriOS OPUS UV optical nitrate sensor (TriOS, Germany) the technical specifications of which can be found on the company website (www.trios.de). The OPUS analyses UV spectra within the 210 – 350 nm

wavelength. Our sensor was set-up with a 10 mm pathlength, since we found this provided the best absorbance spectra for the natural water in Silverstream catchment, which is has low turbidity (<37 NTU), low Dissolved Organic Carbon (DOC) (<0.6 mg/L and low carbonate content (alkalinity <100 mg/L $CaCO_3$). We operated the OPUS sensor using its default factory-calibrated settings that measure nitrate, nitrite, total suspended solids equivalent (TSSeq) and dissolved organic carbon concentration equivalent (DOCeq). TriOS report the instrument detection limits for the respective analytes as being: 0.03, 0.05, 4 and 0.5 mg/L. Our quality assurance procedure for the instrument primarily focussed on accuracy of nitrate measurement and followed published guidelines (Pellerin et al., 2013). In addition to precision checks against nitrate standards made before field deployment, measurement accuracy was periodically cross-checked against independent nitrate and nitrite analyses made by FIA-ECD, in the laboratory. Given that they are both proxy measurements, quality control checks were not made on TSSeq or DOCeq.

2.2. Environmental setting

The techniques we describe are generic and might be applied in any hydrological setting. Nonetheless, for some background context we provide a brief overview of the catchment and explanation of the investigative problem our nitrate measurements were applied to.

2.2.1.1.1. Surface water

Silverstream is a lowland stream, 10 km in length and located near the coastal margin of the Canterbury Plains, South Island, New Zealand. It is the largest tributary of the Kaiapoi River (Figure 1). The Canterbury Plains represents the largest aquifer system in New Zealand, composed from (circa. 300 - 500 m) thick deposits of Quaternary alluvial gravel outwash (Wilson, 1985; Baal, 1996). Along the coastal margin, such as in this case, the gravel is interbedded with low-permeability silt, clay and peat sediments that mark marginal marine transgressive sediments, deposited during eustatic sea-level changes. These act as confining layers to the gravel aquifer (Brown and Weeber, 1992). Flow in Silverstream is sourced from groundwater discharge that upwells in the area as an effect of the coastal boundary. Various spring point discharges are mapped, as are modified surface drain features, yet it is presumed diffuse groundwater discharge occurs also through the streambed (Dodson, 2012; 2013). There are unconfirmed reports from locals of sand boils having occasionally been witnessed in the streambed after routine maintenance works to clear excessive weed growth. The stream channel is variable, but typically 2.5 m wide and between 0.1 and 0.5 m deep.

Environment Canterbury (ECan) - the local government body that is responsible for environmental management of the region - continuously monitor the flow of Silverstream at one location (Harpers Road), approximately 3 km from the headwater (Figure 1). Monthly in-stream nitrate concentrations are measured there also. The 5-year median flow statistic at the recorder site is 0.175 m^3/s. The median nitrate concentration for the same period is 7.3 mg NO_3-N/L (range 5.9-10.5 mg NO_3-N/L; average 7.7±1.3 mg/L). Such concentrations are above the national bottom line water quality standard for lowland streams aimed at protecting ecological health (MfE, 2018).

In 2013, Dodson (2013) reviewed all available historic water quality data for Silverstream and its spring-fed tributaries, from which he developed a conceptual model of the catchment. The nitrate dataset used in that work was limited to surface water quality observations made at just 10 discrete points along Silverstream, results from which had been collated from at least three separate fieldwork campaigns conducted for different objectives, at different times and spanning six years. Interpretation of the observations was thus subject to errors associated

with integrating across a discontinuous dataset. A continuous nitrate survey along the stream length was identified as more reliable approach for tracing nitrate patterns down the catchment and pin-pointing pollution hot-spots. It was this task we put a UV optical nitrate sensor to.

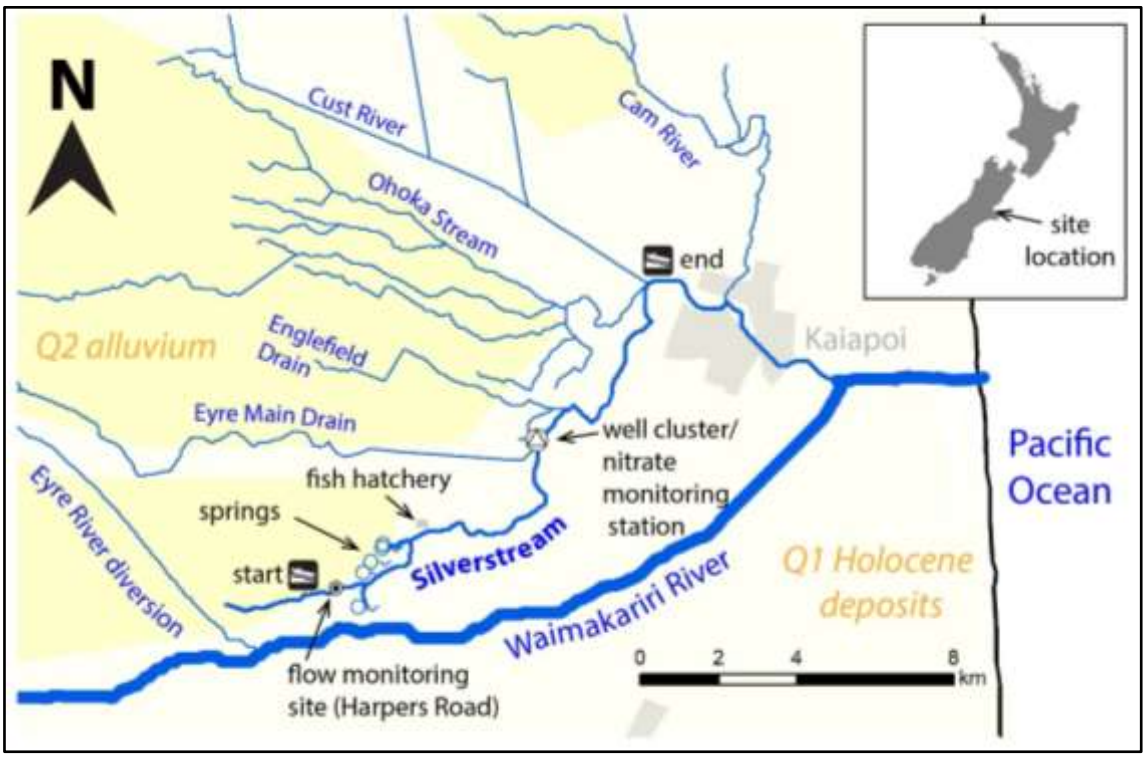

Figure 1. Silverstream site location plan. The start and end of the surveyed reach are marked, as is the location of the automated nitrate monitoring station.

2.2.1.2. Groundwater

Knowledge of the spatial distribution of nitrate impacts in the gravel aquifer system that discharges to Silverstream has largely been accrued from occasional surveys of private water supply wells that are widely spaced apart and generally target a common depth, 10's of metres below the water table, where yields are good and risk of nitrate contamination is lower than at shallower depths (Dodson, 2012). To gain a better understanding of the depth variation of nitrate in the gravel aquifer system and enable study of the groundwater-surface water continuum, in 2017 we installed a cluster of tiered monitoring wells in the catchment, alongside Silverstream (at the location marked on Figure 1). The cluster comprises five monitoring wells constructed with 50 mm uPVC well casing. Three wells target groundwater in the unconfined surficial gravel aquifer, composed from river outwash sediments deposited since the last glacial maximum, 15 ka b.p. (Brown and Weeber, 1992). These deposits were confirmed to 30 m, where silt, clay and peat belonging to the Bromley Formation (Brown and Weeber, 1992) was identified. A monitoring well was installed at 33 m depth, within a sand bed marking the base of the Bromley Formation. Below the Bromley Formation is a confined gravel aquifer, known as the Linwood Gravels. A fifth monitoring well was completed within this formation. At the time the wells were installed in June 2016, the water table was encountered 2.160 m below ground surface and the piezometric heads measured for groundwater in the Bromley Formation and Linwood Gravels were 1.660 m and 1.800 m, above ground surface, respectively. The positive vertical hydraulic gradient detected at the well cluster is consistent with the preconception that groundwater up-welling occurs in the locality. The well construction details are provided in Table 1. Whilst four of the wells were completed identically with 0.5 m screen lengths, the shallowest well which monitors at/near the water table condition was

completed with a 1 m screen section, to accommodate for water table fluctuations (of which we had no prior knowledge of). Land-use immediately about the well cluster is unirrigated dryland pasture, used primarily for grazing sheep and horses.

Table 1: Monitoring well specifications. Static water levels and water chemistry are those measured at time of well installation, June 2016. Chemistry results are from accredited IANZ laboratory, determined using standard APHA methods.

Well #	screened depth (bgl)	static water level (m bgl)	Static water level (m asl)	standing volume of water in well (L)	comment	Nitrate (mg/L)	Nitrite (mg/L)	DOC (mg/L)
BW24/0342	38.8-39.3	-1.800	10.874	80.6	Linwood Gravel aquifer	2.9	0.002	<0.5
BW24/0343	19.6-20.1	2.090	6.823	35.2	Riccarton Gravel aquifer	3.8	0.007	<0.5
BW24/0344	2.0-3.0	2.160	6.717	1.6	Water table; Springston Formation	5.4	0.041	0.7
BW24/0345	7.9-8.4	2.050	6.749	12.4	Inferred interface b/w Sringston Formation/Riccarton Gravel aquifer	4.4	<0.002	<0.5
BW24/0346	29.8-30.3	-1.660	10.101	62.6	Bromley Formation, aquitard	0.36	0.027	1.9

Bgl = below ground level (negative value indicates above ground level).
M asl = metres above mean sea level, surveyed to Lyttelton Datum 1937.

2.3. In-stream nitrate survey

2.3.1.1. Materials

For the stream survey, the TriOS OPUS sensor was operated through a proprietary TriBOX3 control unit, powered from a 12V battery. To protect the sensor, it was shielded in a perforated holster improvised from 50 mm uPVC well casing. The holster was rigged to the side of a kayak in a way that allowed for it and the sensor to be lowered to a depth 0.4 m below the kayak. Attached also to the holster were temperature, dissolved oxygen, ORP, pH and electrical conductivity sensors from a YSI Pro series meter (Xylem Group, USA). Care was taken to ensure that the sampling window of the OPUS sensor was oriented 90° to the direction of travel. A GPSMap 64S global position positioning system (Garmin, USA) was stored in the kayak and used to track the geographic location during the survey (see Figure 2).

Figure 2. Instrument set-up on white-water kayak used for stream surveys.

2.3.1.2. Method

In-stream nitrate surveys were conducted in December (summer) 2016 and June (winter) 2017. The survey in June was timed to occur after routine stream maintenance works, which had dredged the stream of nuisance weed growth. In that survey, ECan did some complementary concurrent flow-gauging at 11 locations along the surveyed reach, following standard methods. Water quality sensors were calibrated at the start of each survey and instrument clocks were synchronised with the GPS unit. All the sensing equipment was programmed to take automated measurements every two minutes.

Both surveys started approximately 3 km, downstream from the headwater, where it was possible to launch and paddle the kayak (Figure 1). In the summer, weed and overgrowth obstructed progress in places, such that portage of the kayak was required, resulting in

discontinuities in the water quality dataset over two sections, 15 m and 50 m in length, respectively. In the winter, it was easier to navigate the stream due to the clearance of vegetation. Consequently, despite the same length of stream being surveyed, it was completed in a shorter time of 3.3 hours, versus the 4 hours it took in the summer. General field conditions at the times of the two surveys are summarised in Table 2.

Table 2: Field conditions at the time of the two in-stream nitrate surveys.

	survey #1	**survey #2**
Date	15/12/2016	29/6/2017
Season	summer	winter
Antecedent 7-day rainfall (mm)[#]	39	14
Average air temperature (°C)[#]	15.6	6.4
Average water temperature @ Harpers Road[$] (°C)	14.9	11.1
Mean daily flow @ Harpers Road[*] (L/s)	101	167
Daily average nitrate concentration @ Harpers Road[$] (mg NO_3-N/L)	6.3	6.3
Daily range nitrate concentration @ Harpers Road[$] (mg NO_3-N/L)	3.5-6.2	4.5-6.6
Surveyed reach length (km)	10.4	10.7
Survey time (minutes)	248	200

#http://cliflo.com
*Data supplied by Environment Canterbury.
$Recorded from UV optical nitrate sensor; data supplied from Lincoln Agritech Ltd

2.4. Groundwater nitrate monitoring station

2.4.1.1. Technical specifications

The nitrate groundwater monitoring station was sited at the multi-level well cluster and built around the same TriOS OPUS sensor as used in the stream survey. The OPUS sensor together with a Unidata 6536 electrical conductivity sensor (Unidata, Australia) were housed in a plastic flow cell built from uPVC plumbing components. Automated monitoring was limited to groundwater from the four wells screening the gravel aquifer units, since the well screening sand of the Bromley Formation aquitard was anoxic, low yielding and devoid of any nitrate (Table 1). A surface water sample from Silverstream itself was included in the automated monitoring, the schematics of which are shown in Figure 3.

A programmable, remote terminal unit (RTU) comprising a Neon 2013E 3G metering module (Unidata, Australia) unit was used to systematically control water sampling from individual sampling points to the flow cell where water chemistry measurements were made. Dedicated 12 Volt submersible pumps (Whale brand, Northern Ireland) were deployed down the wells and in the stream. The pumps provided flow rates of between 4 and 6 L/min, which generated less than 40 mm drawdown in the wells. In the deeper wells, booster pump models were used and a hose was extended to the well screen height. Preliminary testing showed this ensured samples were representative of water composition in the aquifer and not biased by effects of any stagnant water in the well-casing. The artesian pressure condition on the deep well required an electrical solenoid valve to be used to prevent siphoning effects after sampling. All the other sampling lines were fitted with mechanical one-way valves to prevent back-flow mixing of water and ensure only the well being pumped was sampled. To protect against frost and reduce solar warming effects, hoses were buried in the ground. Where this was not possible, they were lagged with pipe insulation. A vented PT12 pressure transducer (Seametrics, USA) was positioned down the 20 m deep well, from which real-time groundwater level data were monitored. Groundwater pressures were also monitored in the other wells, albeit using stand alone, non-vented LevelTROLL 300 data loggers (In Situ, USA). Atmospheric pressure was measured at the site using a BaroTROLL 500 (In Situ, USA) and used to make barometric compensations on the non-vented logger data.

The solenoid valve, Whale pumps, OPUS nitrate sensor, electrical conductivity sensor and PT12 pressure transducer were all controlled and operated through the Neon RTU. The unit was powered using a 12V 5Ah battery that was charged from a 50 Watt solar panel. Because of limitations in solar power, especially in the austral winter, sampling frequency was limited to daily measurement that commenced at 13:00 hours NZST. The measurement cycle started with a record of the static water level, followed by systematic water sampling and measurement from the wells following the order listed in Table 1. The operation involved sequential pumping of the wells for a period of 10 minutes each. This effectively meant somewhere between 40 and 60 litres (equivalent to 1.4 - 26 well-casing volumes of water (see Table 1)) was purged from any single well, and as our preliminary trials demonstrated, ensured that the water being sampled was representative of water from the formation. Water chemistry measurements were made over the last minute of the pump cycle. Following sampling of the four wells, a water sample and automated measurement was made from Silverstream. The complete sampling routine lasted 50 minutes, after which the Neon RTU radio-telemetered all data to the Neon network - a web-based platform from which results could be accessed.

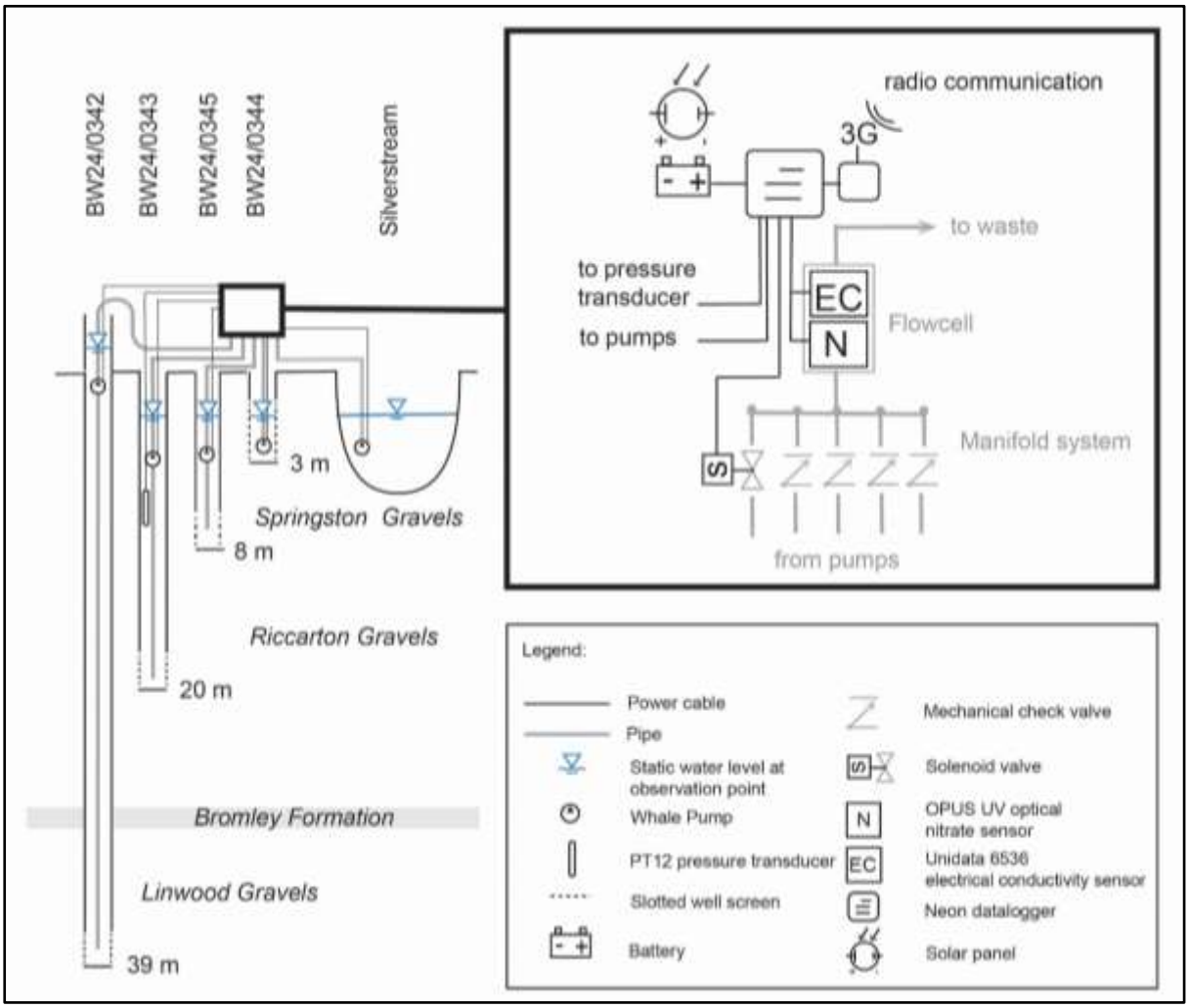

Figure 3. Schematic of the autonomous nitrate monitoring station at the tiered well cluster in Silverstream catchment. Note: images are not to scale. See Figure 1 for site location map.

Initially, maintenance of the system was conducted on an ad hoc basis due to resourcing constraints. 8 months was the longest time interval between maintenance checks. After 18 months (i.e. from September 2019), routine quarterly maintenance checks of the field system

were made. The small volume of the flow cell in which the Opus nitrate sensor was housed prevented operation of an ancillary wiper as is often used as an automatic cleaning measure on optical nitrate sensors. Alternative cleansing methods such as pneumatic, disinfectant rinse or sonication were also ruled out as either too complicated or impractical. Instead, we opted to do a manual clean of the UV optical nitrate sensor lens, using a cotton tip on each maintenance visit. On such visits, a spot check of groundwater levels was made with a manual 101 P7 water level meter (Solinst, Canada) and discrete water samples were taken from the wells by manually activating the pumps wired to the Neon 3006M system. Water samples were submitted for lab analyses using a combination of methods. On all occasions, a lab-based TriOS OPUS UV optical nitrate sensor with 10 mm pathlength was used to cross reference the field results. Occasionally, split water samples were subject to nitrate and nitrite analyses following standard method 4500 NO_3^- I, and DOC was measured according to standard method APHA 5310 C (APHA, 2012).

2.4.1.2. Error analysis of time-series data

In addition to long-term trend analysis, exceedance of the Maximum Acceptable Value (MAV) in the Drinking Water Standards New Zealand (DWSNZ) (MoH, 2018) or 50% MAV are the most common decision criteria/regulatory thresholds applied to groundwater nitrate in New Zealand. In this study, we were limited to only two years-worth of nitrate data, which restricted our ability to conduct any reliable statistical trend analyses or apply signal processing techniques in any meaningful way. Accordingly, to assess what extra potential detail the high frequency monitoring dataset from the well cluster provides, we performed an error analysis of the daily groundwater nitrate data measured for shallow groundwater (i.e. from well BW24/0344).

The New Zealand National Groundwater Monitoring Program (NGMP) operates a quarterly sampling routine (Rosen, 1999; Moreau-Fournier and Daughney, 2012), the reasoning being to capture seasonal changes in water quality variables. It is rare that groundwater quality in New Zealand is ever sampled more frequently than monthly (pers. comm Shaun Thomsen manager groundwater monitoring, ECan). As an assessment of the worth of the high frequency (daily) dataset, we evaluated the Root Mean Squared Error (RMSE) between observed daily nitrate values y_i and estimated values $\hat{y}_i$ that were linear interpolations of a lower frequency observational dataset:

$$RMSE = \sqrt{\frac{\sum_{i=0}^{n}(\hat{y}_i - y_i)^2}{n}}, \qquad (1)$$

where n is the number of observations (i.e., 730 for two full years of data; 1 April 2018 – 30 March 2020). The sampling frequencies we could assume were limited by the length of the available dataset and were: 3-times/week; weekly; monthly; quarterly; biannually, and annually, coinciding with weekdays in all cases.

3. Results and Discussion

3.1.1.1. Stream survey

Figure 4 maps the nitrate results of the in-stream survey made by kayak. The continuous water chemistry data for all four water chemistry parameters measured by the TriOS OPUS UV optical nitrate sensor are plot in Figure 5. The survey did not reveal any discrete point discharges occurring through the bed of Silverstream, which is not necessarily surprising considering the diffuse nature of both nitrate pollution and streambed conductance. The high-spatial sampling resolution with the optical nitrate sensor did however detect several step-

changes, marking both pollution hot-spots and diluting factors along the study reach that were related to visual surface water features. Three obvious decreases in the nitrate profile were detected at 0.5 km, 5.8 km and 6.8 km. These corresponded to dilution effects from a spring that is sourced from water lost from the Waimakariri River and inputs from Eyre Main Drain and Englefield Drain, respectively (e.g. Figure 1). The Waimakariri River is a braided alpine river that drains from the Southern Alps and is naturally low in nitrate (typically <0.1 mg NO_3-N/L; Dodson, 2013). It is of little surprise spring waters in the Silverstream catchment have a Waimakariri River water provenance, given the course of Silverstream itself follows a paleochannel of the Waimakariri River that was abandoned following a major flood event in 1867. Direct re-connection between the two water courses has since been prevented by engineered flood prevention measures. The extent of the relict fan deposits from the Holocene period can be seen in Figure 1. In contrast, Eyre Main Drain and Englefield Drain are artificial land drains cut to dewater what was originally flax swamp land, for productive farming. Being heavier soils than the thin, free-draining loam and gravel outwash around Silverstream headwater, it is conceivable they have a higher capacity to attenuate nitrate, which could explain the lower nitrate concentrations discharged via these drains. Step-increases in nitrate detected at 0.9 and 1.7 km mark the effect of small tributaries on the true-left of Silverstream that drain groundwater discharging from the Eyre River fan (Figures 4, 5). The nitrogen contribution from the first of these was particularly pronounced in the winter survey (Figure 5).

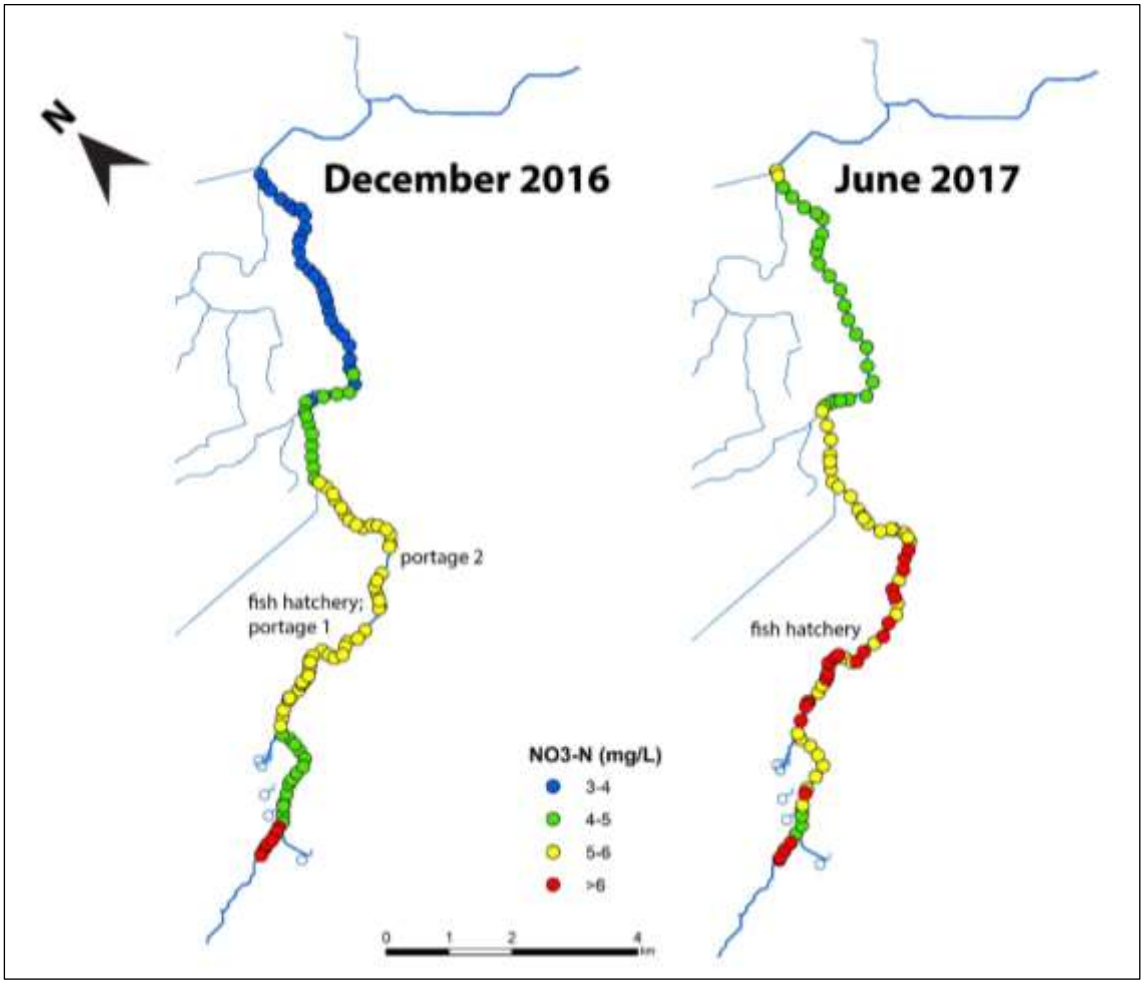

Figure 4. Map of nitrate concentrations surveyed within Silverstream. [Left:] summer 2016; [Right:] winter 2017. See Figure 1 for names of tributaries.

A fish hatchery site on the banks of Silverstream diverts much of the stream flow from the main channel, for the raising of salmon (Figure 1). Along the 300 m stream reach past the hatchery (between 2.35 and 2.64 km) both DOCeq and TSSeq data demonstrated significant variability in the summer survey, although nitrate and nitrate did not (Figure 5). These results are an effect of the low flow condition of Silverstream along this reach, as a consequence of the water diversion. For DOCeq and TSSeq, it is not possible to separate measurement noise factors (e.g. agitation of the streambed sediments by the kayak) from any signal of the true natural state. A small spike in DOCeq and TSSeq is evident in the dataset at the point of discharge from the hatchery where water re-enters the main channel over a weir. Nitrite concentrations were notably elevated (1.31 mg NO_2-N/L) at this point in December where coincidentally a drop in 0.3 pH units was also detected with the YSI ProPlus meter (data not shown).

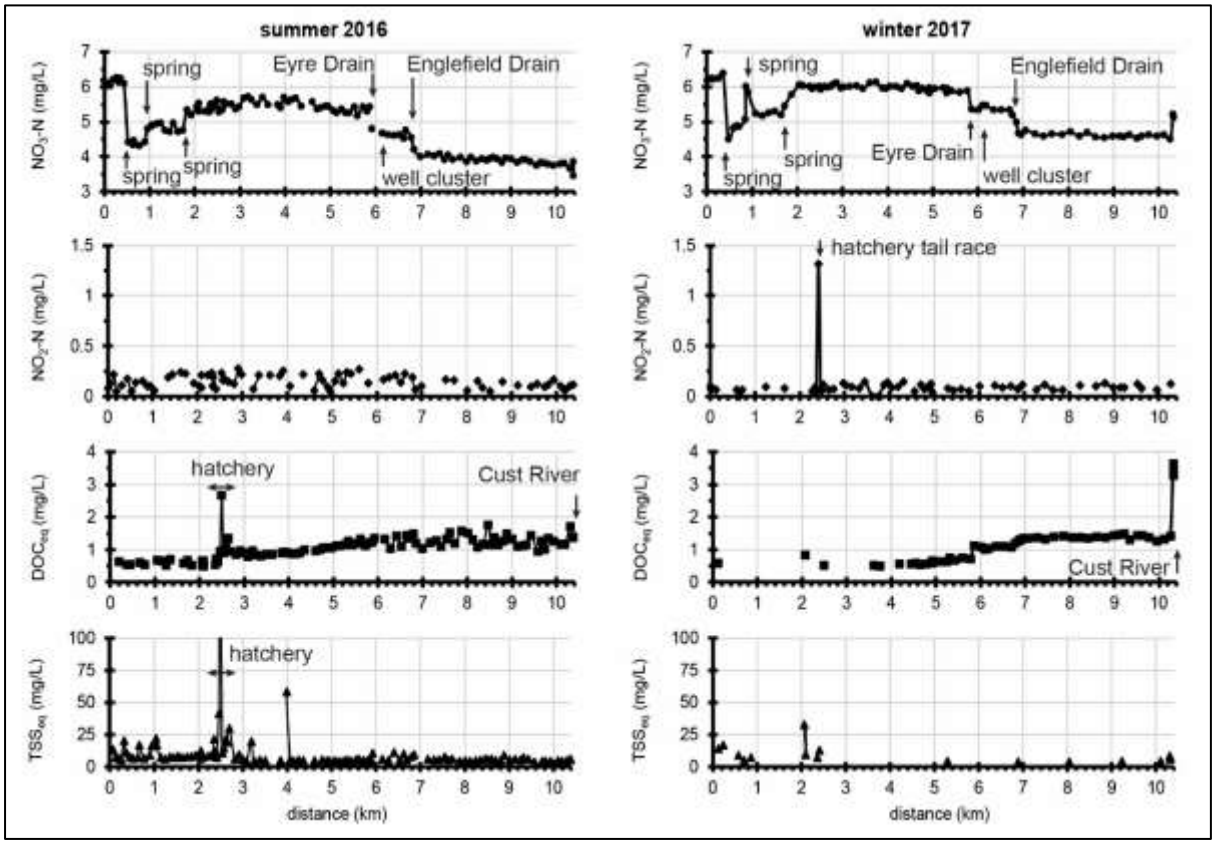

Figure 5. Continuous nitrate, nitrite, dissolved organic carbon equivalent and total suspended solids concentrations measured along Silverstream. [Left:] summer survey (December 2016); [right:] winter (June 2017) results. Note: 50 m and 15 m portages were made at 1.63 km and 2.35 km distance in the summer survey, albeit too short to demonstrate any loss of detail in plots. Missing data indicate concentrations below instrument detection limit.

Ranging between 6.09 - 6.25, and 6.17 - 6.39 mg NO_3-N/L, the respective nitrate concentrations in Silverstream headwaters was not significantly different between the summer and winter surveys. However, along the main undisturbed reach, between 2.0 and 5.9 km, the nitrate concentration was notably lower in the summer than it was in the winter survey, when the stream had been dredged and cleared of weed. Streamflow in the winter was also 60% more and the water temperature 3°C cooler. Coincidentally, the nitrite concentration was elevated in the summer (median 0.15 mg NO_2-N/L), versus in the winter (median 0.07 mg

NO_2-N/L). Whilst no verification of the accuracy of nitrite measurement was made at the time of the stream surveys, confidence in the accuracy of the TriOS OPUS UV optical nitrate sensor was garnered from the long-term operation of the sensor at the groundwater monitoring station, which included analysis of water sampled from Silverstream (results for which are presented below). Consequently, we have no reason to doubt the disparity in the nitrite data between the two in-stream surveys, and assume nitrite was elevated in the summer. Accordingly, we propose the lower nitrate/higher nitrite state observed in the summer is symbolic of in-stream nitrogen cycling and could well be an indication of incomplete denitrification reactions (e.g. Burbery, 2018) that conceivably occur in the benthic zone of the stream (e.g. Peterson et al., 2001; Findlay et al., 2011). The shallower stream depth, warmer temperature, slower-moving water conditions and sediment entrapment promoted by macrophytes experienced in the summer survey are physiological factors known to increase denitrification potential in small streams like Silverstream (Riis et al., 2019; Preiner et al., 2020).

3.2. Groundwater nitrate monitoring station

3.2.1.1. Accuracy of nitrate measurement

Assuming FIA-ECD to be a more accurate ('true') analysis of nitrate, we found the UV optical nitrate sensor to demonstrate an average error of 0.1 mg/L or 2% in NO_3-N, for the conditions at Silverstream (Figure 6a). This falls well within the manufacturers claim of ± (5 % + 0.1 mg/L) (www.trios.de). Bias was towards underestimation of nitrate and errors were heteroscedastic – increasing with increasing nitrate concentration (Figure 6b).

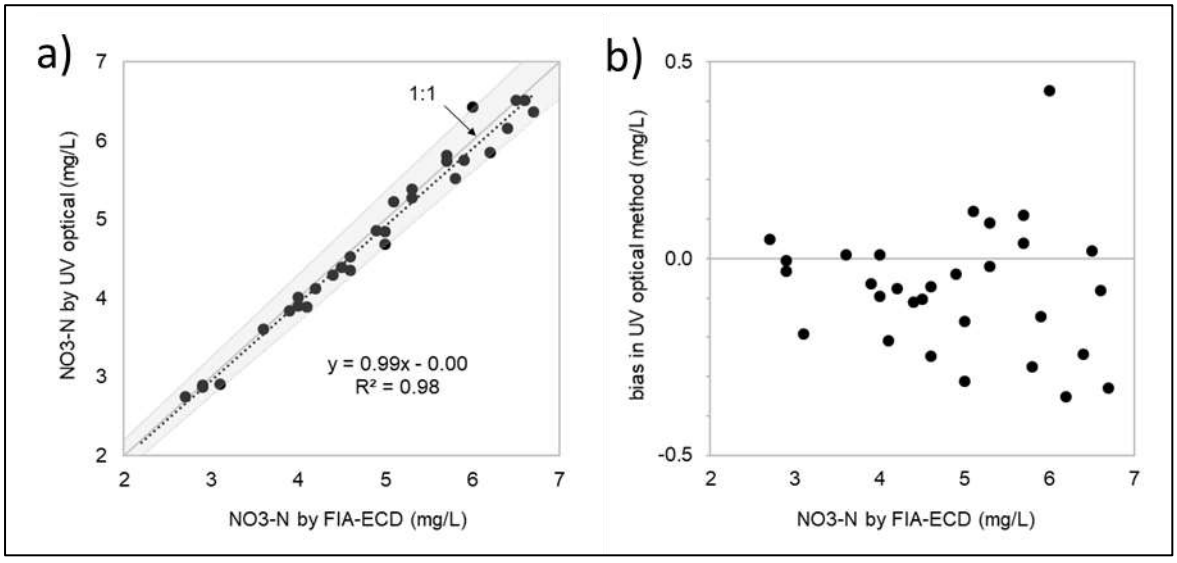

Figure 6. Nitrate measurement error. [Fig. 6a:] Correlation of automated field measurement of nitrate using UV optical nitrate sensor with lab-based measurements made by standard flow injection analysis-electron capture detection method. Grey shading marks expected error bands, as reported by sensor manufacturer. Dotted black line is a linear regression fit to the data. Corresponding equation is shown on chart. [Fig. 6b:] distribution of measurement errors.

As the A360 data from the nitrate monitoring station reveals (Figure 7a), manual cleaning of the OPUS sensor window at maintenance intervals was not always effective. Only in August 2018, November 2019 and May 2020 did it appear wiping the lens with a cotton swab work

effectively to restore the optical efficiency of the spectrophotometer. Irrespective of this practical misgiving, interference of organic carbon on nitrate measurement accuracy resulted just once and corresponded to when A360 drifted above 0.52 absorbance units, due to what we assume was biofilm growth over the lens window. The spectral drift error itself was nonetheless small – just 0.2 mg NO_3-N/L in magnitude. This result is consistent with the findings of Opsahl et al. (2017) and Macdonald et al. (2017) who reported the UV optical nitrate sensors they deployed to measure groundwater nitrate did not suffer any drift effects. In those case examples, 8 weeks was the longest interval between maintenance checks that included lens cleaning. The drift error encountered in our study over the period September – November 2019 was corrected for. An example of the linear correction applied to the nitrate dataset is shown in Figure 7b.

It is worth noting that as an improvement to our operation of the TriOS OPUS sensor, we have since modified our maintenance schedule to ensure a site maintenance visit is made before A360 reaches 0.5. Furthermore, whilst we so far have yet to collect any hard evidence to suggest it necessarily improves the lens cleaning, as a precautionary step, we now soak the cotton bud in contact lens solution as part of the lens cleansing routine. The rationale for this is that we presume it aids with protein (i.e. biofilm) removal.

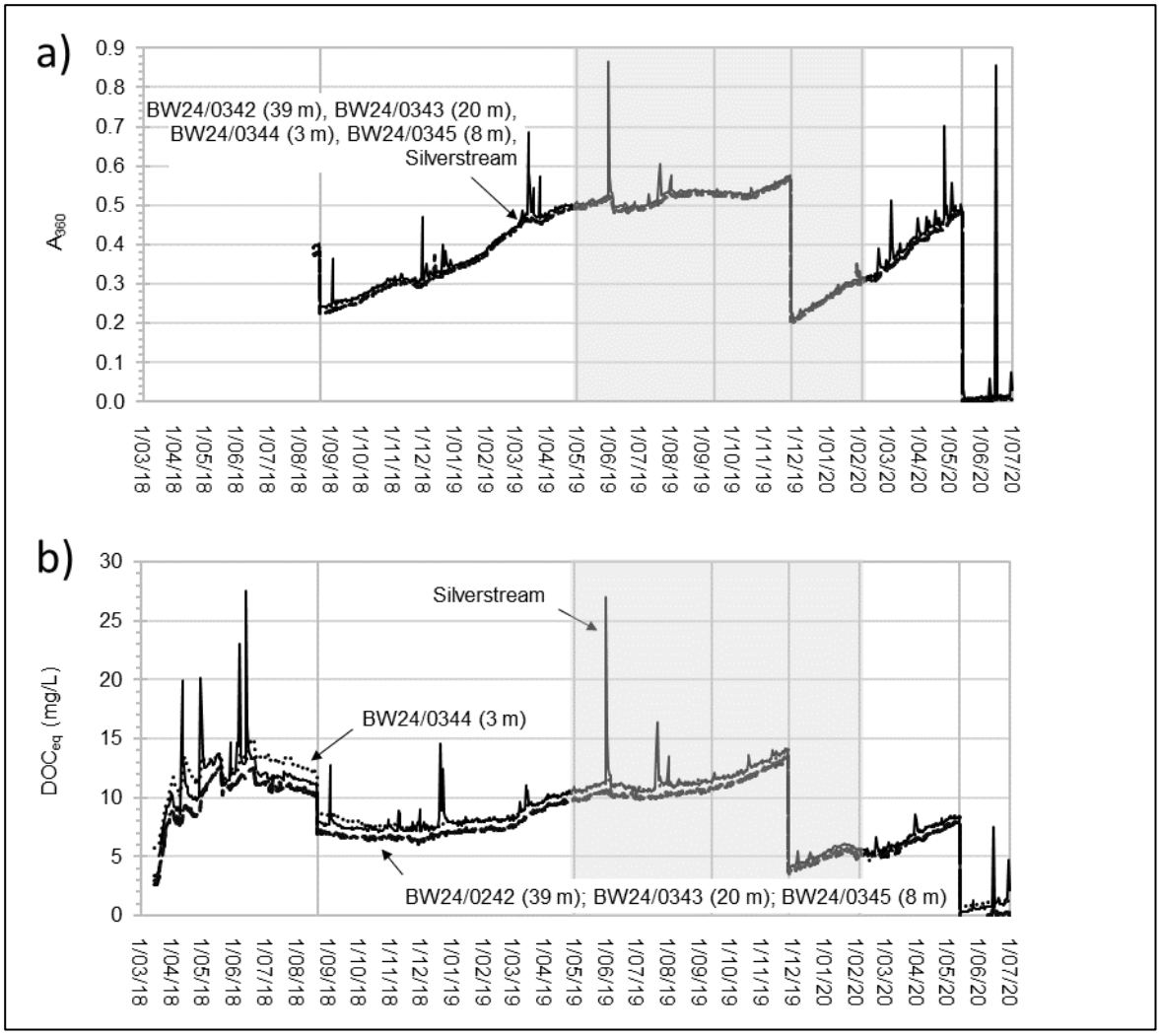

Figure 7. Daily time-series results of A360 measurements (Fig. 7a) and dissolved organic carbon equivalent (Fig. 7b), made from TriOS Opus sensor. Grey vertical grid lines denote field maintenance check and optical sensor lens cleaning events. Grey shaded region marks

frame of Figure 8, encompassing the time when a correction was applied to sensor nitrate results.

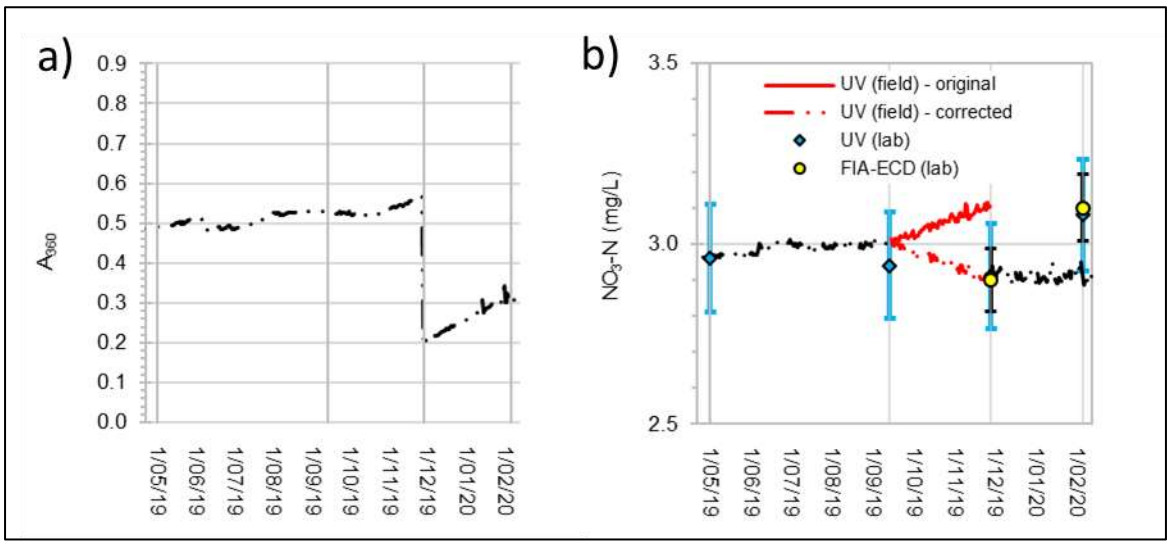

Figure 8. Detail of drift in UV sensor measurement caused by biofouling of optical lens that occurred November 2019, demonstrated for data from well BW24/0342. [Fig. 8a:] A360 time-series data that provided an indicator of biofouling that was effectively cleaned on 29 November 2019. [Fig. 8b:] Nitrate results for the same period showing raw 'original' concentration recorded by the optical nitrate sensor and post-processed result, 'corrected' assuming linear drift. Results from lab-based nitrate concentration measurements made on grab samples taken as QA/QC checks are also shown with accompanying 95% confidence band.

3.2.1.2. Dynamics of groundwater nitrate

Figure 9a plots the corrected daily nitrate dataset for the cluster of four wells and nearby Silverstream. The flashy nature of nitrate impacts in Silverstream versus a more buffered response in the groundwater system is clearly apparent. The abrupt drops in nitrate coincide with storm flows in Silverstream that acted to dilute nitrate impacts. Such storm event dynamics are commonly encountered in headwater catchments (e.g. Wollheim et al., 2017) and have been witnessed in other lowland streams on the Canterbury Plains (e.g. Graham, 2019). Whilst we are confident the acute low nitrate measurements made for the water from Silverstream on storm events were real, we cannot rule out that some of the low readings might be inaccurate and biased by turbidity of the stream water sample that occasionally spiked above the calibration regime of the sensor with its 10 mm optical pathlength. The low nitrate readings for Silverstream on 1/6/2019 and 14/6/2020 are two obvious occasions when such interference effects likely impacted nitrate measurement, since the A360 readings on these occasions show significant light absorbance at 360 nm, in excess of 0.8 absorbance units (e.g. Figure 7a).

Unlike surface water, groundwater samples are not prone to acute turbidity effects. Groundwater nitrate concentrations in the confined Linwood Gravel aquifer have remained almost constant over the two years of monitoring, whereas concentrations in the unconfined aquifer have demonstrated more variance. Interestingly, at the start of monitoring, nitrate concentrations were inversely correlated with depth, which is consistent with notion that nitrate impacts are sourced from the land, thus greatest impacts are encountered at the phreatic

surface. In April 2018 however, nitrate concentrations flipped, such that nitrate impacts near the water table were less than those measured at 8 m depth, or 20 m depth, even. The high frequency monitoring has revealed four such nitrate-depth inversions have occurred over the two-year monitoring period, the shortest event lasting approximately 2 weeks. In both years, the seasonal maxima for groundwater nitrate coincided with springtime (August – November) when the water table was relatively low. Conversely, seasonally low nitrate concentrations appear to occur when groundwater levels are at their seasonal maxima (Figure 9b). Mathematical analysis of the groundwater nitrate signals is a future work objective that is beyond the scope of this paper. The plan being that the high frequency continuous dataset from the monitoring station will aid development of a predictive groundwater quality model.

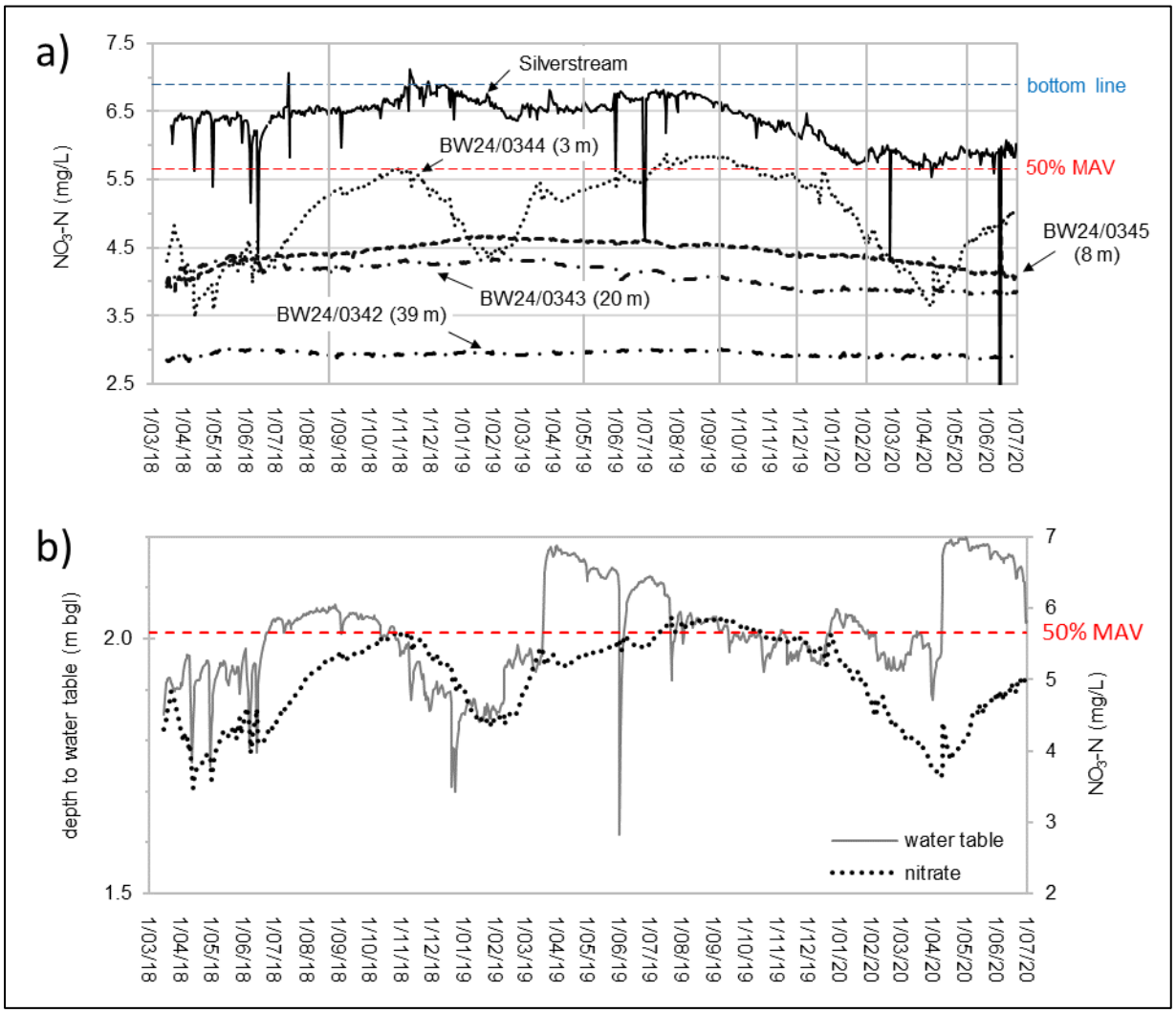

Figure 9: [Fig. 9a:] Daily nitrate time-series data from UV optical sensor for all monitored wells in the tiered well cluster and Silverstream. [Fig. 9b:] Nitrate concentration measured from well BW24/0344 that screens the water table, plot with concurrent depth to water table. '50% MAV' = Half Maximum Acceptable Value for nitrate in the New Zealand Drinking Water Standards. 'Bottom line' is the regulatory nitrate threshold for lowland streams in New Zealand.

The ability to make continuous measurement has revealed that nitrate concentrations near the water table and in surface water exhibited high variability in the first half of year 2018. This marked a relatively (but not extremely) wet period during which the water table fluctuated greatly (see Figure 9b). Despite the water table attaining higher and lower stages since, such

high frequency variability has not been repeated. The variance in those data are symbolic of the complex dynamic behaviour of nitrogen leaching that is rate limited by the mass stored in the soil/vadose zone, and which is supplied to the saturated zone with infiltration, whilst coincidentally being flushed out of the vadose zone by a rising water table. It is probable that the nitrate measurements made in well BW24/0344, which screens across the water table and samples a variably saturated thickness of water (that has so far varied between 0.81 and 1.0 m) are influenced by this fact and not representative of a strict point measurement (e.g. Rozemeijer and van der Velde, 2014). Future inverse modelling efforts of the groundwater nitrate at the well cluster need to be considerate of this limitation.

Regarding this design limitation, the data so far collected indicate more detailed measurement of nitrate at the water table would benefit our scientific goal. Modifications we foresee to the existing practical set-up that could enable this are extension of the manifold arrangement; connection to some low-flow sampling method (e.g. a peristaltic pump) that might facilitate sampling water from various levels across the variably saturated portion of the phreatic aquifer via bundles of sampling tubes, and some minor reprogramming of the Neon RTU. Collection of a sample directly at the water table could be informative and conceivably can be achieved by implementing well BW24/0344 with a floating port coupled to a low flow sampling pump. Such technical modifications to the sampling strategy are to be explored. A distinct advantage of the UV optical nitrate sensor is that the financial cost of making more nitrate measurements at the monitoring site is effectively very small. We also recognise that lysimeter apparatus to measure and constrain nitrogen leaching rates from the soil zone would be a useful addition to the nitrate monitoring station for the purpose of constraining future mathematical models of the system dynamics. The UV optical nitrate sensor however is likely to be more vulnerable to interference effects from DOC when used in analysis of soil drainage water, and likely to demand calibration (Uusheimo et al., 2017; Yeshno et al., 2019).

3.2.1.3. Error analysis of time-series dataset

On Figure 9a is marked the national ‘bottom line’ or regulatory water quality limit for nitrate in lowland streams in New Zealand used for surface water management and protection of ecology in Silverstream. The daily nitrate record at the field site suggest it was exceeded on three days of the 2-year monitoring period. The ‘50% MAV’ applies to groundwater nitrate concentrations. Exceedance of this decision criterion was encountered only at the shallowest monitoring well (BW24/0344), over winter and spring (July – October) 2019.

Figure 10 shows the estimated nitrate times-series relating to different sampling frequencies, compared to the original (actual) observed daily data for the case of shallow groundwater monitored from well BW24/0344. The plots illustrate the progressive loss in detail resulting from longer intervals between sampling events, as is further demonstrated in the RMSE results presented in Figure 11. There is an obvious inflexion in the curve plot in Figure 11, coinciding with weekly observation frequency. A smaller apparent inflexion occurs about the quarterly observation data point (that is very evident if only one years-worth of data are analysed; data not shown).

The latter tends to indicate that quarterly measurement is appropriate for capturing a distinct level of detail in the nitrate data that we can be attributed to seasonal variance. This is consistent with the result of Moreau-Fournier and Daughney (2012) who conducted a comprehensive analysis of nitrate data in the NGMP and found that sampling nitrate less frequently than quarterly would be detrimental to the objectives of the NGMP. Fluctuations in shallow groundwater nitrate concentrations that are not related to seasonal effects appear to

occur at frequencies that demand at worst, weekly monitoring to detect, as indicted by the first inflexion point in Figure 11.

In terms of exceedance of common regulatory decision criterion for groundwater, groundwater nitrate concentrations at the monitoring site have never exceeded the DWSNZ MAV but did exceed 50% MAV (i.e. >5.65 mg/L NO_3-N) concentration on 105 days over the two years monitoring period, occurring within the winter months of 2019. It is interesting to note that quarterly monitoring would have detected such an exceedance, yet annual sampling such as applied to New Zealand's SoE reporting and is conducted anytime between September and December, potentially would have missed it.

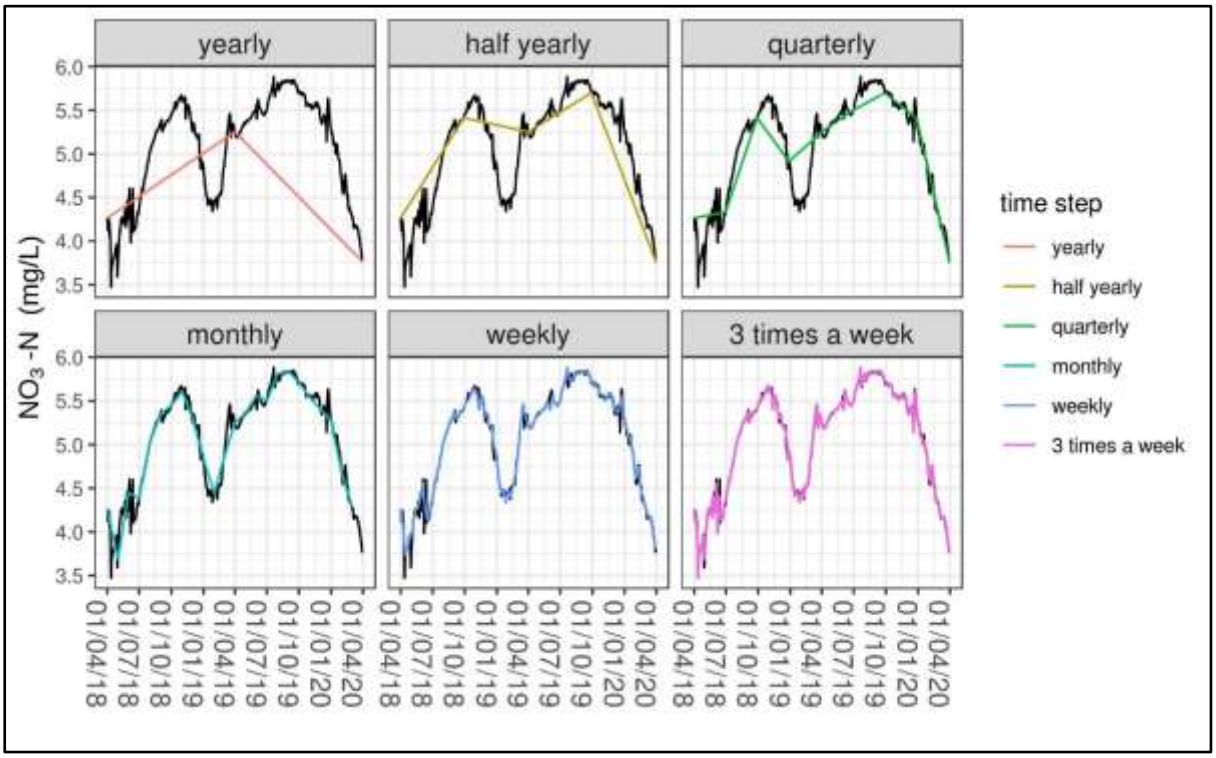

Figure 10: Nitrate concentrations for shallow groundwater in well BW24/0344, showing reduced signals and values that might have been estimated (interpolated) if different sampling frequencies had been applied.

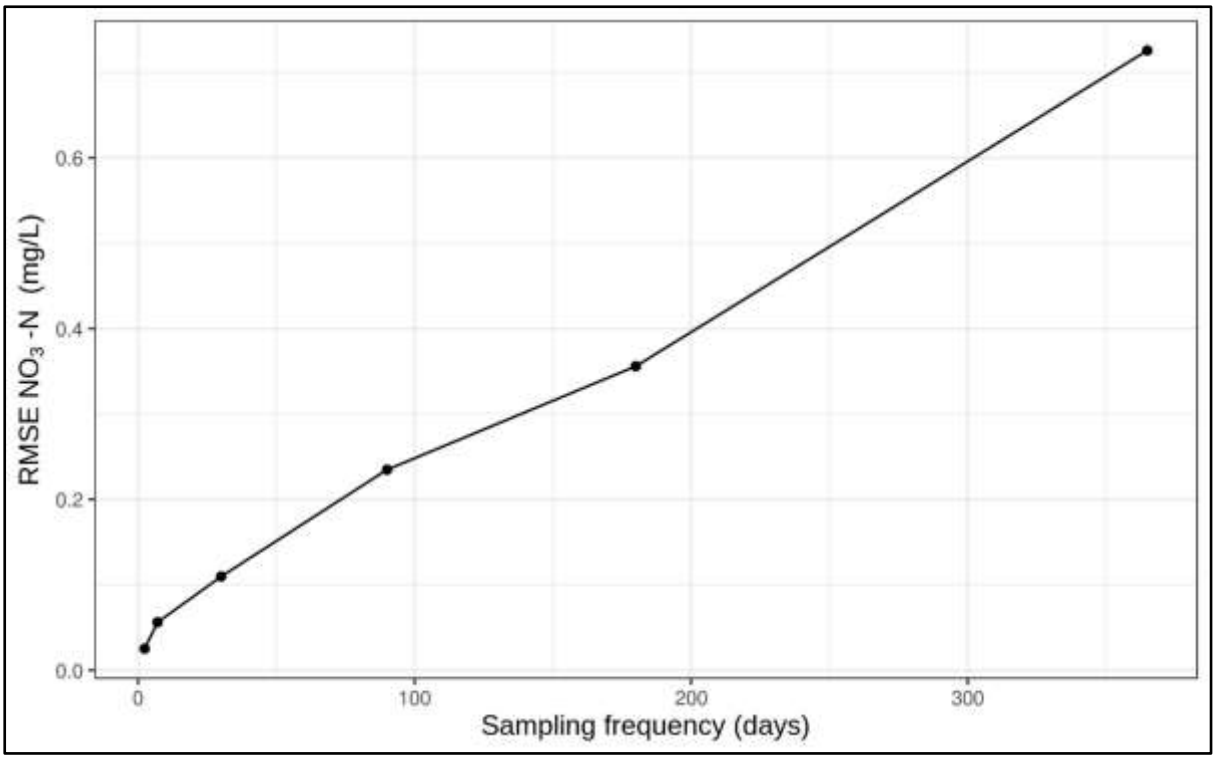

Figure 11: RMSE as a function of sampling frequency, for the modelled groundwater nitrate concentrations plot in Figure 10.

4. Summary and Conclusion

UV optical nitrate sensors present a useful analytical tool for automated, high frequency, reliable in situ nitrate analyses. We configured such a sensor with appropriate technology and applied them in two relatively novel ways to collect data on the spatial and temporal dynamics of nitrate pollution in the Silverstream catchment. Firstly, repeat transient nitrate surveys of the low order, groundwater-fed stream were made by attaching the nitrate sensor to a kayak and operating it in continuous measurement mode, as the kayak was paddled down the stream. From that exploratory study, we conclude:

- The portability of the TriOS OPUS UV optical nitrate sensor allows for rapid in-stream surveys to be conducted. A continuous dataset covering an approximately 10 km reach was collected using this method in just over 3 hours. The speed of the survey was limited by the navigability of the stream, which was hindered in summer by excessive weed growth.
- The in-stream nitrate survey did not detect any discrete nitrate inputs through the stream bed, such as from elusive sand boils. It was however successful at detecting both pollution and dilution effects of small tributaries and land drains discharging to the stream. Consequently, two spring-fed tributaries of Silverstream have been identified as nitrate hot-spots and thus represent locations where end-of-pipe nitrate mitigation measures might be best targeted.
- The general profile of nitrate along the surveyed reach did not vary much between the summer and winter. However, marginally lower nitrate in conjunction with elevated nitrite concentrations were sensed within the stream in the summer survey when it was choked with plant biomass and conditions hypothetically were more likely to support denitrification in the benthic zone.

In a second practical example, the UV optical nitrate sensor formed the central instrument of an autonomous, relatively low-tech automated nitrate monitoring station that has been set-up to make daily nitrate measurements of groundwater from a cluster of multi-level wells in addition to the nearby stream. The sensor has functioned adequately on its default factory calibration settings and the station has been operating – fault-free - for two years. Learnings so far from the practical body of the work are:

- Despite the ad hoc QA/QC applied to operation of the field station initially and poor lens cleaning routine, the TriOS OPUS UV optical nitrate sensor has so far proven a rugged and reliable instrument.
- Periodic, routine maintenance on a quarterly basis has proven to be largely sufficient with the sensor suffering very small spectral drift error from biofilm build-up only on one occasion and when A360 measurement tracked above 0.52 absorbance units. The drift error (of less than 0.2 mg/L NO_3-N) was easily corrected.
- Whilst yet to be verified as an improvement, the manual lens cleaning protocol for the optical sensor has been revised to include use of optical lens solution to enhance proteinaceous biofilm removal.
- Daily nitrate measurement made possible with the automated sensor has revealed some curious inversions of the nitrate concentration – depth profile in the gravel aquifer of the Silverstream catchment that warrant further investigation.
- In this regard, there is scope for higher spatial resolution groundwater nitrate sampling across the variably saturated zone, including measurement of nitrate in soil leachate at the study site. An advantage of the UV optical nitrate sensor is that the cost of making such additional measurements is relatively small.
- Because DOC levels tend to be higher in soil drainage water than groundwater there is a risk the nitrate sensor might suffer interference effects when applied to monitor soil leachate, which if proven true will demand more calibration.

Acknowledgements

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5. References

APHA (2012) Standard Methods for the Examination of Water and Waste Water. 22nd Edition, American Public Health Association, American Water Works Association, Water Environment Federation.

Baal, A. (1996). Valley fills and coastal cliffs buried beneath an alluvial plain: Evidence from variation of permeabilities in gravel aquifers, Canterbury Plains, New Zealand. *J. Hydrol. (NZ)* 35 (1): 1-27.

Brown, L.J. and Weeber, J.H. (1992). Geology of the Christchurch urban area. Scale 1:25,000. Institute of Geological & Nuclear Sciences, Lower Hutt, New Zealand.

Bieroza, M.Z. and Heathwaite, A.L. (2016). Unravelling organic matter and nutrient biogeochemistry in groundwater-fed rivers under baseflow conditions: uncertainty in in situ high-frequency analysis, *Sci. Tot. Environ.* 572: 1520-1533. https://doi.org/10.1016/j.scitotenv.2016.02.046

Birgand, F., Aveni-Deforge,K., Smith, B., Maxwell, B., Horstman, M., Gerling, A.B., Carey, C.C. (2016). First report of a novel multiplexer pumping system coupled to a water quality probe to collect high temporal frequency in situ water chemistry measurements at multiple sites. *Limnol. Oceanogr.: Methods* 14: 767–783.

Brown, L.J.; Weeber, J.H. (1992). Geology of the Christchurch urban area. Scale 1:25,000. Institute of Geological & Nuclear Sciences, Lower Hutt, New Zealand.

Burbery, L.F. (2018). Nitrate reactivity in Groundwater: A Brief Review of the Science, Practical Methods of Assessment and Collation of Results from New Zealand Field Investigations. *J. Hydrol. (NZ)* 57 (2): 51-79.

Burkitt, L.L, Jordan, P., Singh, R., and Elwan, A. (2017). High resolution monitoring of river nitrate in agricultural catchments – a case on the Manawatu River, New Zealand. An Envirolink report (MAUX1604 / 1720-HZLC135) prepared for Horizons Regional Council, 19 p.

Cameron, K., Di, H.J., Roberts, A., Beale, N., Weir, J., Borrie, N. (2014). Monitoring effects of Southland demonstration farm on stream water nitrate.. *In: Nutrient management for the farm, catchment and community.* (Eds L.D. Currie and C L. Christensen). http://flrc.massey.ac.nz/publications.html. Occasional Report No. 27. Fertilizer and Lime Research Centre, Massey University, Palmerston North, New Zealand, 6 p.

Dodson, M., Aitchison-Earl, P., Scott, L. (2012). Ashley-Waimakariri groundwater resources investigation. Environment Canterbury Report No. R12/69, 100 p.

Dodson, M. (2013). Recharge Sources to Springs Along the Northern Lower Waimakariri River. Environment Canterbury Report No. R13/50, 27 p.

Fretwell, B.A., Short, R.I., Sutton, J.S. (2006). Guidance on the design and installation of groundwater quality monitoring points. Environment Agency Science Report SC020093, 87 p.

Finch, M.S., Hydes, D.J., Clayson, C.H. , Weigl, B., Dakin, J., Gwillam, P. (1998) A low power ultra violet spectrophotometer for measurement of nitrate in seawater: introduction, calibration and initial sea trials. *Analytica Chimica Acta* 377:167–177.

Findlay, S. E. G., Mulholland, P. J., Hamilton, S. K., Tank, J. L., Bernot, M. J., Burgin, A. J., Crenshaw, C. L., Dodds, W. K., Grimm, N., McDowell, W. H., Potter, J. D., & Sobota, D. J. (2011). Cross-stream comparison of substrate-specific denitrification potential. *Biogeochemistry*, *104* (1-3): 381-392. https://doi.org/10.1007/s10533-010-9512-8.

Graham, H. (2019). A water quality study of Barkers Creek, South Canterbury. MSc thesis, University of Canterbury, New Zealand. 185 p.

Howard-Williams, C., Davies-Colley, R., Rutherford, K., Wilcock, R. (2010). Diffuse pollution and freshwater degradation: New Zealand Perspectives. Proceedings of the 14th International Conference of the IWA Diffuse Pollution Specialist Group, DIPCON 2010

Joy, M. K. (2015). Polluted inheritance New Zealand's freshwater crisis. Wellington: Bridget Williams Books Limited. doi:10.7810/9780908321612.

Johnson, K.S., and L.J. Coletti. (2002). In situ ultraviolet spectrophotometry for high resolution and long-term monitoring of nitrate, bromide and bisulfide in the ocean. *Deep Sea Research Part I* 49 (1): 291-1,305, https://doi.org/10.1016/ S0967-0637(02)00020-1.

MacDonald, G., Levison, J., Parker, B. (2017). On methods for in-well nitrate monitoring using optical sensors, *Ground Water Monit. R.* 37, (4): 60–70.

Ministry for the Environment and Statistics New Zealand (2017). New Zealand's Environmental Reporting Series: Our fresh water 2017. Retrieved from www.mfe.govt.nz and www.stats.govt.nz.

Ministry for the Environment (2018). A Guide to Attributes in Appendix 2 of the National Policy Statement for Freshwater Management (as amended 2017). Wellington: Ministry for the Environment.

Ministry of Health (2018). Drinking-water Standards for New Zealand 2005 (revised 2018). Wellington: Ministry of Health.

Moreau-Fournier M. and Daughney C.J. (2012). Dynamic groundwater monitoring networks: a manageable method for reviewing sampling frequency, *J. Environ. Monit.*, 14(12): 3129-3136; doi: 10.1039/C2EM30624G.

Opsahl, S.P., Musgrove, M., Slattery, R.N. (2017). New insights into nitrate dynamics in a karst groundwater system gained from in situ high-frequency optical sensor measurements. *J. Hydrol.* 546: 179– 188. https://doi.org/10.1016/j.jhydrol.2016.12.038.

Pellerin, B.A., Bergamaschi, B.A., Downing, B.D., Saraceno, J.F., Garrett, J.A., Olsen, L.D. (2013). Optical techniques for the determination of nitrate in environmental waters: Guidelines for instrument selection, operation, deployment, maintenance, quality assurance, and data reporting: U.S. Geological Survey Techniques and Methods 1–D5, 37 p.

Peterson, B.J., Wollheim, W.M., Mulholland, P.J., Webster, J.R., Meyer, J.L., Tank, J.L., Martí, E., Bowden, W.B., Valett, H.M., Hershey, A.E., McDowell, W.H., Dodds, W.K., Hamilton, S.K., Gregory, S., Morrall, D.D. (2001). Control of Nitrogen Export from Watersheds by Headwater Streams. *Science 292 (5514):* 86-90. DOI: 10.1126/science.1056874

Preiner, S., Dai, Y., Pucher, M., Reitsema, R.E., Schoelynck, J., Meire, P., Hein, T. (2020). Effects of macrophytes on ecosystem metabolism and net nutrient uptake in a groundwater fed lowland river. *Sci. Tot. Environ.* 721, 137620. https://doi.org/10.1016/j.scitotenv.2020.137620.

Pu, J., Yuan, D., He, Q., Wang, Z., Hu, Z., Gou, P. (2011). High resolution monitoring of nitrate variations in a typical subterranean karst stream, Chongqing, China, *Environ. Earth Sci*., 64: 1985–1993, doi:10.1007/s12665-011-1019-7, 2011.

Riis, T., Tank, J.L., Reisinger, A.J., Aubenau, A., Roche, K.R., Levi, P.S., Baattrup-Pedersen, A., Alnoee, A.B.,Bolster, D. (2019). Riverine macrophytes control seasonal nutrient uptake via both physical and biological pathways. *Freshwater Biol.* 65 (2): 1-15. https://doi.org/10.1111/fwb.13412

Rosen, M. (1999). The importance of long-term, seasonal monitoring of groundwater wells in the New Zealand National Groundwater Monitoring Programme (NGMP). *J. Hydrol. (NZ)*, 38 (1): 145-169.

Rozemeijer, J. and van der Velde, Y. (2014). Temporal variability in groundwater and surface water quality in humid agricultural catchments; driving processes and consequences for regional water quality monitoring. *Fundam. Appl. Limnol.* 184 (3): 195–209.

Sakamoto, C.M., Johnson, K.S., Coletti, L.J., Maurer, T.L., Massion, G., Pennington, J.T., Plant, J.N. , Jannasch, H.W., Chavez, F.P. (2017). Hourly in situ nitrate on a coastal mooring: A 15-year record and insights into new production. *Oceanography* 30 (4):114–127, https://doi.org/10.5670/oceanog.2017.428.

Saraceno, J., Kulongoski, J.T., Mathany, T.M. (2018). A novel high-frequency groundwater quality monitoring system. *Environ. Monit. Assess.* 190 (8): 477. doi:10.1007/s10661-018-6853-6.

Snyder, L., Potter, J. D., McDowell, W. H. (2018). An evaluation of nitrate, fDOM, and turbidity sensors in New Hampshire Streams. *Water Resour. Res.*, 54, 2466–2479. https://doi.org/10.1002/ 2017WR020678.

Stenger, R., Wilson, S., Barkle, G.F., Close, M.E., Woodward, S.J., Burbery, L.F., Pang, L., Rekker, J., Wöhling, T., Clague, J.C., McDowell, R, Thomas, S., Clothier, B., Lilburne, L., Miller, B. (2016). Transfer Pathways Programme (TPP) – New research to determine pathway-specific contaminant transfers from the land to water bodies. *In: Integrated nutrient and water management for sustainable farming.* (Eds L.D. Currie and R. Singh). http://flrc.massey.ac.nz/publications.html. Occasional Report No. 29. Fertilizer and Lime Research Centre, Massey University, Palmerston North, New Zealand. 6 p.

United Nations (2011). UN-Water Policy Brief: Water Quality. 7 May 2011. http://www.unwater.org/publications/un-water-policy-brief-water-quality/

United Nations (2018). Sustainable Development Goal 6 Synthesis Report 2018 on Water and Sanitation. https://sustainabledevelopment.un.org/content/documents/19901SDG6_SR2018_web_3.pdf

Uusheimo, S., Tulonen, T., Arvola, L.. Arola, H., Linjama, J., Huttula, T. (2017). Organic carbon causes interference with nitrate and nitrite measurements by UV/Vis spectrometers: the importance of local calibration. *Environ. Monit. Assess.* 189, 357. https://doi.org/10.1007/s10661-017-6056-6.

Wilson, D. (1985). Erosional and Depositional Trends in Rivers of the Canterbury Plains, New Zealand. *J. Hydrol. (NZ)* 24 (1): 32-44.

Wollheim, W. M., Mulukutla, G. K., Cook, C., Carey, R. O. (2017). Aquatic Nitrate Retention at River Network Scales Across Flow Conditions Determined Using Nested In Situ Sensors. *Water Resour. Res.* 53 (11): 9740-9756. https://doi.org/10.1002/2017WR020644.

Yeshno, E., Arnon, S., Dahan, O. (2019). Real-time monitoring of nitrate in soils as a key for optimization of agricultural productivity and prevention of groundwater pollution. *Hydrol. Earth Syst. Sci.,* 23: 3997–4010. https://doi.org/10.5194/hess-23-3997-2019.

AGENDA ITEM NO: 4	SUBJECT: Committee Updates
REPORT TO: Waimakariri Water Zone Committee	MEETING DATE: 31 January 2022
REPORT BY: Murray Griffin, CWMS Facilitator – Waimakariri, ECan	

PURPOSE

The purpose of the agenda item is to provide the committee with an overview of updates to be tabled.

RECOMMENDATION

That the Zone Committee:

> **Receives** these updates for its information, and with reference to the committee's working groups, action plan, and engagement priorities in 2022.

COMMITTEE UPDATES

The following updates will be addressed with the committee:

1. Proposed Plan Change 7 – Canterbury Land & Water Regional Plan

The Council has made its decisions on Plan Change 7 (PC7) to the Canterbury Land & Water Regional Plan and Plan Change 2 (PC2) to the Waimakariri River Regional Plan. The Council's decisions adopt the independent hearing commissioners' recommendations on PC7 and PC2 in their entirety. The decisions were publicly notified on 20 November 2021 and the appeal period has now closed. There are five appeals on PC7, made by the following submitters:

- Synlait Milk Limited
- Rangitata South Irrigation Limited
- Mulligan, Kerse and Kingston
- Rayonier New Zealand Limited and Port Blakely Limited
- Te Rūnanga o Ngāi Tahu and Te Rūnanga o Arowhenua

Council staff are working through the content of the appeals on PC7 at the present time. At the moment if people want to see any appeal documents they must request them from the High Court.

For more information, go to:

Plan Change 7 and Plan Change 2 - What you need to know | Environment Canterbury (ecan.govt.nz)

2. Essential Freshwater Package – ECan Updates

The following link takes you to the homepage for Environment Canterbury updates on the Government's Essential Freshwater Package. This provides a summary and advice on the Government's Essential Freshwater package and Te Mana o te Wai, plus frequently asked questions, which are regularly reviewed and updated. A series of documents for consent applicants and their advisers is also being produced.

Link to the ECan updates on the Essential Freshwater Package:

Essential Freshwater package | Environment Canterbury (ecan.govt.nz)

3. Zone Committee Working Groups

Landcare Working Group

Erin Harvie provided the following update:

- Waimakariri Landcare Trust has recently appointed a coordinator, Erin Harvie, to assist with representing and advocating on behalf of members both at the district and regional level; to promote environmental stewardship of the members to the wider public; and provide some administrative support.
- The Trust recently organised a meeting between various interested parties within the Waimakariri to discuss monitoring. This was to facilitate an initial discussion between groups and identify if there was any appetite for a strategic and collaborative approach to monitoring within the Waimakariri. All parties appeared to be receptive to such an approach but agreed that the next step, meeting with the district and regional council technical experts for advice on designing a monitoring programme, would occur after the decision on Plan Change 7.
- The Next Generation Farming Project work continues. There is some exciting work being undertaken alongside Our Land and Water science challenge looking at alternative land uses within different farm system types. The first two out of four properties, an arable farm and a sheep and beef farm are nearing completion for the first stage with a baseline analysis of the whole farm system. The next stage is to present the findings and discuss alternative options for which three or four will be investigated and modelled in more detail.
- The first round of integrated farm plans have been undertaken for three high performing farms within the district. A workshop was undertaken in November to discuss and refine the process undertaken and outline the benefits identified by the farm owners and operators. The second round of Integrated Farm Plans has commenced using a more refined process and it is intended to hold an event in the future. Any events will be advertised on both the Waimakariri Landcare Trust website and via Facebook Page.
- The Trust's website is also now up and running: https://waimaklandcaretrust.co.nz/

Biodiversity Working Group

Judith Roper-Lindsay has provided the following update:

- The BWG has not met since August last year. However, a number of actions have progressed:
- The Biodiversity Trust is working towards registration, and has several projects under discussion for activation in 2022
- Judith Roper-Lindsay and Martha Jolly attended the "Environmental Networking Forum" organised by WDC in November
- Concerns about the Ashley/Rakahuri River values and management remain; members continue to monitor media coverage of incidents and consent applications; Judith liaising with ARRP on invertebrate monitoring there
- Some preliminary research into naming of "Drains" has been carried out

Coastal Catchments Working Group

Carolyne Latham had provided the following update on the Sefton Saltwater Creek Catchment Group:

- The next Sefton Saltwater Creek Catchment Group field trip is on Wednesday 23rd February 2022 1-3pm at the Broad Rd retention area near Boyne Creek bridge. The focus is on soils and attendees are required to bring a spade square soil/pasture sample in a bucket. The group will do some easy activities to learn about soil characteristics, observe the variety of soils present in the catchment, and learn about some ways to look after soil health. There will also be an update on the monitoring programme proposal, and a chance to check out the Fox's and Boyne's Creeks confluence.

Monitoring Working Group

Erin Harvie provided the following update:

- The Trust recently organised a meeting between various interested parties within the Waimakariri to discuss monitoring. This was to facilitate an initial discussion between groups and identify if there was any appetite for a strategic and collaborative approach to monitoring within the Waimakariri. All parties appeared to be receptive to such an approach but agreed that the next step, meeting with the district and regional council technical experts for advice on designing a monitoring programme, would occur after the decision on Plan Change 7

4. ECan Biodiversity Snapshot 2020/21

The ECan Biodiversity Snapshot 2020/21 has been published and highlights the work undertaken and achievements in the 2020/21 financial year for the biodiversity work programme, delivery of biodiversity projects, project effectiveness study and case studies highlighting some of the on-the-ground mahi. Please find this story attached as **agenda item 5.1.**

5. WDC Land & Water Committee

The previous WDC Land & Water Committee meeting will be held on **Tuesday 16 November 2021** and the agenda for this meeting is provided as **agenda item 5.2**

6. Waimakariri Zone Communications Report (Nov 2021 – Jan 2022) by Kim Whitwell

Please find the most recent communications report from Kim Whitwell (Northern Principal Communications and Engagement Advisor, ECan) attached as **agenda item 5.3.**

7. Waimakariri Water Zone Committee Schedule and Priorities for 2022

Below is the Zone Committee's proposed meeting and workshop/field visit scheduled for 2022:

- **31 January 2022 – Meeting**
- 14 February 2020 – Northern 'Mega-Zone' workshop and field visit (Kaikōura)
- 7 March – Workshop/field visit
- **4 April 2022 – Meeting**
- 2 May – Workshop/field visit
- 6 June – Workshop/field visit
- **4 July 2022 – Meeting**
- 1 August – Workshop/field visit
- **5 September 2022 – Meeting**
- 3 October – Workshop/field visit
- 7 November – Workshop/field visit
- **5 December 2022 – Meeting**

8. Action points from the previous zone committee meeting – Nov 2021

Action points from the previous meetings:

- M Blackwell (Dec 2020) & E Harvie (May 2021) requested that the CWMS Waimakariri Zone Committee be provided with updated water quality and ecological data for the Waimakariri district on a quarterly basis.
- Clr S Stewart requested if a report on the Infiltration Trench Trial project in South Eyre could be submitted to the Committee.

Action points from the 1 November meeting:

- Judith Roper Lindsay requested an investigation into the die-off of trees in the Lineside Drain, Courtenay Stream, Kaiapoi River area as reported at the meeting.
- Clr S Stewart requested information on the definition of private drinking water supply well by Environment Canterbury.
- Clr S Stewart requested information on the realignment of the North Brook tributary and water quality sampling at Tūtaepatu Lagoon.

Fin.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Image: Kororā (Little blue penguin)

Biodiversity snapshot

2020/21

Essential to thriving nature is thriving biodiversity. Having environments that are rich in biodiversity means that nature can better provide the benefits we rely on. However, our indigenous biodiversity continues to be affected by humans and continues to decline across Canterbury and Aotearoa New Zealand.

The common threats to biodiversity in Canterbury remain introduced pests and continuing land use change and intensification. While some of the most important ecosystems and habitat are found in public conservation land, much of Canterbury's remaining indigenous biodiversity is on privately owned land. In response, Environment Canterbury has a regionally coordinated biodiversity programme which seeks to ensure that the decline is halted and indigenous species, habitats and ecosystems are supported to thrive. Partnerships and collaboration between landowners, communities and public agencies are critical to its success.

Our priority is to focus first on protecting and maintaining what remains, and our guiding principles – how we work – follow four tenets: action for priority ecosystems; smart information and management; working with others; and leading by example/our land, our people. These principles are all considered in how we initiate, develop, implement, and monitor biodiversity projects in Canterbury.

Working with the community

This year, the Community Partnerships programme continued working hand in hand with our community to build on the capacity and capability development of community organisations that has occurred over the past few years. Our community organisations continue to deliver projects that improve their local environment through education, collaboration and on-the-ground action.

Key achievements

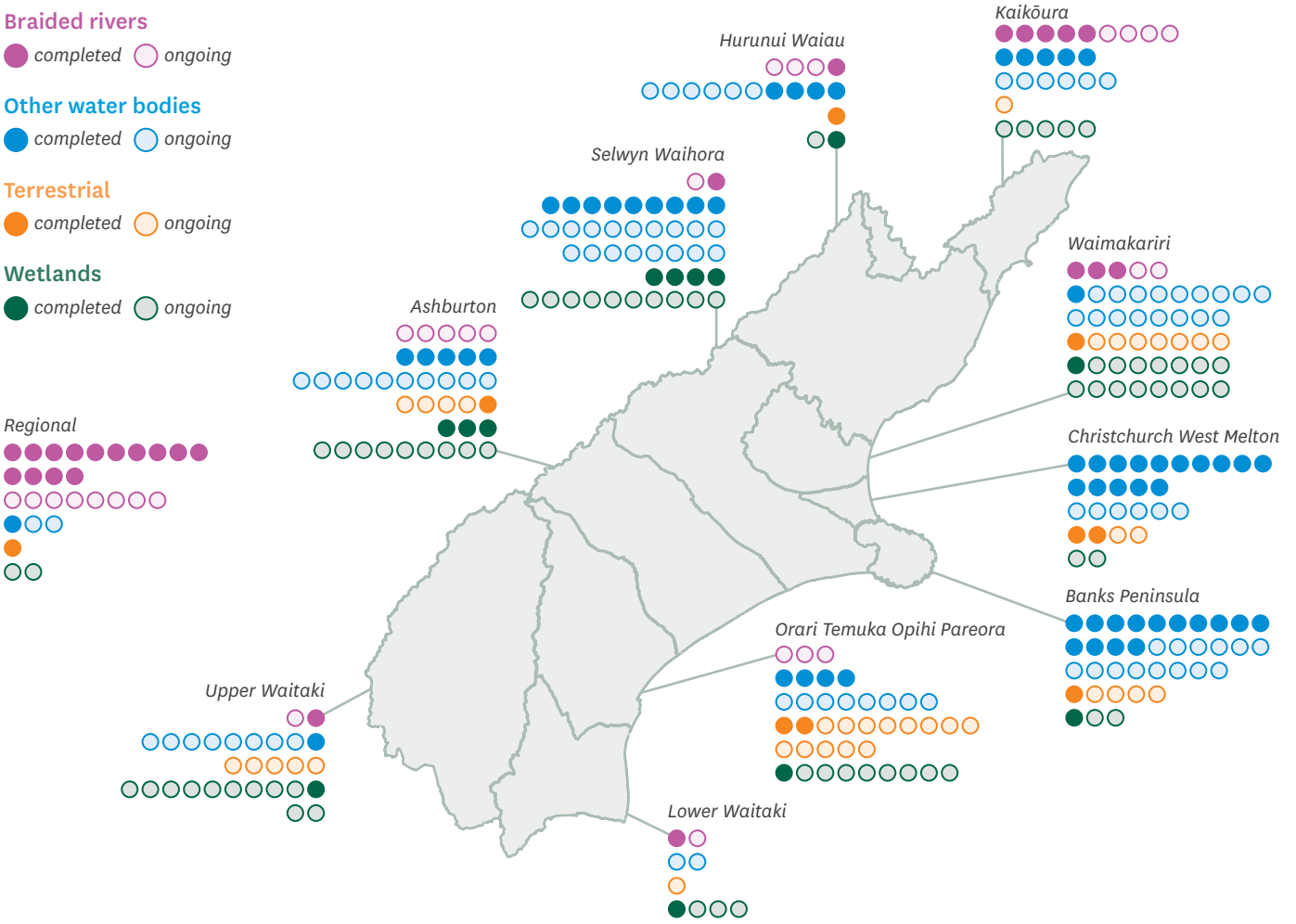
- The Networking for the Environment programme delivered huis that focused on intergenerational leadership, how to access and apply for funding, why councils' long-term plans matter, and telling your environmental story. The programme includes key central and local government partners and community organisations.
- Five community predator trapping projects were funded to protect high value biodiversity areas. The projects sought to protect long-tail bats in Geraldine, forest birds in the Mt Oxford Foothills, shorebirds in Kaikoura, wetland birds in Kaiapoi, and several species in the Rakaia River Gorge.
- Provided financial support for a Kororā (little blue penguin) population survey on Banks Peninsula, carried out using citizen science and new app technology.

Image: Predator traps for protection of long-tail bats in Geraldine. Credit: Tony Doy.

Key project data 2020/21

Over the 2020/21 financial year the Regional Biodiversity team and Zone Delivery biodiversity officers delivered projects that had specific biodiversity outcomes.

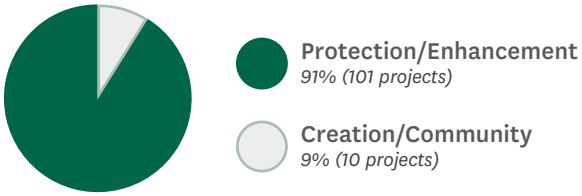
The development and delivery of these projects closely aligned with Environment Canterbury's 2020 — 2023 Strategic Direction, specifically; decisive action for healthy freshwater, land and coastal ecosystems; helping communities be well prepared for changes in the natural environment; accelerate regeneration of the natural environment; building community engagement and action; and lead climate change resilience.



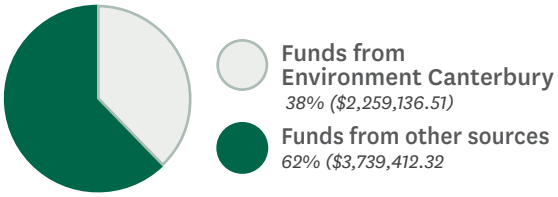
Total completed projects (111)

Total ongoing projects (231)

Nature of projects 2020/21



Funding source of projects 2020/21



Planting area ***36 ha***

Number of plants ***75,319***

Length of protective fencing ***38,737 m***

Area fenced ***162 ha***

Weed control ***110,593 ha***

Fish habitat improved ***6,203 m²***

Natural fish passages enabled ***2***

Pest control area ***179,275 ha***

Biodiversity project effectiveness

A significant component of the biodiversity programme is the delivery of on-the-ground projects in partnership with willing landowners, agencies, NGO's and others on private and public land. While Environment Canterbury provides regular reporting of the project outputs and expenditure, reporting on the effectiveness of projects and the outcomes achieved has been limited. To address this gap, the biodiversity project effectiveness workstream provides an opportunity to monitor and reassess previously completed biodiversity projects.

Each year completed biodiversity projects were randomly selected from three to four years prior, which allowed us to address the time lag factor between actions taken and the benefits being realised.

What we did

Each project site was measured by experienced biodiversity staff for intermediate-term effectiveness by assessing standardised outcomes for different project actions (e.g., fencing, weed control, planting, animal pest control, mahinga kai) and for the likelihood of long-term effectiveness by assessment of a variety of factors (such as physical, ecological context and connectivity, and site management).

What we found

Over a period of three years the results indicated that the effectiveness of biodiversity projects in the medium-term were generally high and mostly on-track to meeting the project outcomes, and that the longer-term effectiveness of the projects possessed a moderate to high likelihood of achieving a successful outcome. What was apparent is that the risk of not achieving the project outcomes is very closely linked to the lack of active management at the project location by the landowner or grant recipient. This information helps Environment Canterbury to ensure that there is ongoing maintenance of the project written into the contractual agreement between council and the landowner/grant recipient.

Results

Year	Projects assessed	Site has legal protection	Site is actively managed	Average intermediate score (out of 5)*	Average long-term score (out of 3)**
2018/2019	12	7	4	4.0	2.6
2019/2020	13	3	12	4.1	2.4
2020/2021	15	9	11	3.7	2.4

** a score of 5 means that the outcome is met, there is a tangible positive outcome and there are no risks to achieving the outcome*

*** a score of 3 means that there is a high likelihood of long-term effectiveness and no tangible negative impacts*

Project effectiveness case study – Deep Stream

This project was an extensive protection and restoration project of a large wetland and several spring-fed branches of Deep Stream, mid-Canterbury in the Orari Temuka Opihi Pareora Water Management Zone. The project area included public conservation land and private ownership. The project works involved willow removal and control along 18km of stream; willow control in 35ha wetland; fencing across 14.8km to exclude stock access and native riparian planting to support native regeneration. Works commenced in 2011/12 and finished in 2014/15. Environment Canterbury contributed $80,000 to the $285,000 project.

The project effectiveness assessment was carried out in July 2019 and scored highly for both intermediate-term effectiveness and likelihood of long-term effectiveness, and specifically meet the project outcomes developed by the landowner, Fish & Game, and Environment Canterbury. The assessment noted that the site undergoes regular maintenance of willow regrowth and new invasions, and identified several further recommendations regarding the ongoing challenges that the landowner faces, specifically regarding other invasive weeds such as grey willow.

Image credit: Hamish Stevens and Frances Schmechel

Case studies

The below highlights just some of the amazing on-the-ground work that has occurred in our priority areas to improve habitat for our native species.

Braided rivers

Ashburton River/Hakatere

The Ashburton River/Hakatere is a nationally important habitat for braided river birds and this year the focus was on implementing the river management strategy, including signage and improving the facilities and management at the river mouth. The community assists with predator trapping and are regularly updated on monitoring results and actions.

Predator control is also ongoing at two other locations on the river near the SH1 bridge and above the gorge. The work here is showing promising results as monitoring surveys indicate that the nationally vulnerable banded dotterel population has increased in the upper river.

The work across the Ashburton River/ Hakatere is guided by a management strategy, along with engagement with the community, and is carried out in collaboration with agencies and community groups.

Image: Ashburton River/Hakatere
Credit: Andrew Crossland

Upper Rangitata – Tōrea/South Island pied oystercatcher project

A pilot study launched by Manaaki Whenua/Landcare Research, and partially funded by Environment Canterbury, in the upper Rangitata to test tracking methods and determine the survival and migration patterns of Tōrea/South Island pied oystercatchers revealed new information on the fate of their nests and chicks, and where they migrate to post-breeding.

Image: Tōrea/South Island Pied Oystercatcher

Tracking has indicated some of their key flyways and the extent of a North and South Island habitat network that supports their wintering. This new knowledge is already linking the kaitiaki of South Island braided rivers, coastal harbours, and the flyways between them.

GPS tags have also provided valuable insights into migration timing, duration, stop overs and flyways, which has linked breeding and wintering sites. In the long-term, they will also provide data on survival, particularly fledglings.

Wetlands

Immediate Steps wetland projects

During the 2020/21 year, there were 12 wetland projects completed through Environment Canterbury's Immediate Steps Biodiversity programme. In total, the on-the-ground actions for these projects resulted in planting over 17,000 native species across more than 15 hectares, and over 955 hectares of weed control.

Pigeon Bay Raupō wetland

Two of our farming leaders, Hugh and Jane Eaton of Pigeon Bay, completed a 1.0 ha fence around their 0.3 ha wetland and adjacent secondary forest, in addition to native restoration planting at the edge of the wetland. Since stepping forward as one of the wetlands demonstration site owners, the project has grown from physical protection and enhancement to encompass formal legal protection via a Banks Peninsula Conservation Trust covenant to protect the wetland in perpetuity.

Managing Wetlands as Farm Assets project

The programme continued into its second year with support from Environment Canterbury, NZ Landcare Trust and other primary industry stakeholders. The programme confirmed the 14 sites with wetlands on actively managed farms and continued to work with those landowners to develop appropriate actions to protect and restore the wetlands. Led by the landowners, five field demonstration days were held. On-the-ground actions have been implemented at three of the sites, and design is progressing on a constructed wetland, chosen as a site to further demonstrate their function on working farms.

Terrestrial

Partnering with Christchurch City Council for Banks Peninsula weed control

Environment Canterbury provided ongoing funding towards the Christchurch City Council programme to contain and control the spread of spur valerian across the rock outcrops and coastal cliffs of Banks Peninsula. Through the programme, major populations of spur valerian have been identified and surveyed, control measures are occurring, and monitoring has shown a reduction in the numbers. The next steps for the programme is to continue the control of the identified spur valerian populations, and to continue educating landowners.

Kakahu Bush predator control update

Image: Long-tailed bat
Credit: Kirsty Myron, iNaturalist

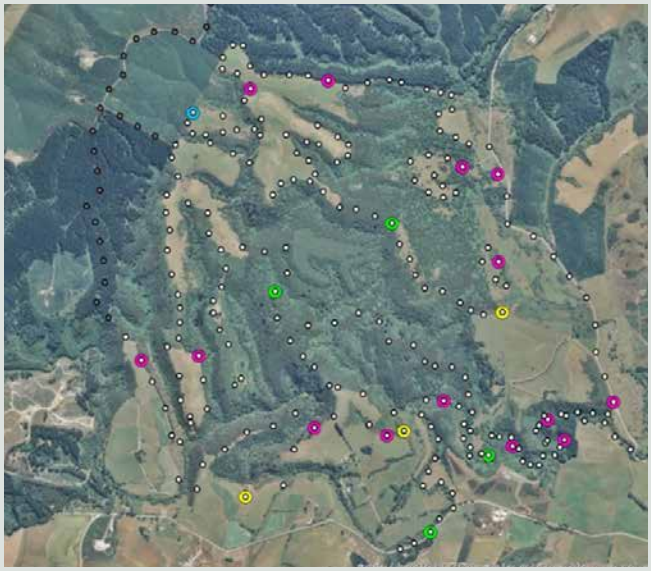
Predator control has been carried out at Kakahu bush for the last 16 years with the main purpose being to protect a colony of Long-tailed bats (Chalinolobus tuberculatus).

In 2020, predator trapping continued on a monthly basis with the addition of an annual poisoning programme, the first of which was completed in August 2020 and again in June 2021.

Possum abundance monitoring was completed in November 2020 which showed a decrease in numbers from 2019. This monitoring will be completed again in 2021 to gauge if numbers are continuing to decrease.

Image: Sentinel Traps used in Kakahu

While the Department of Conservation (DOC) continue to monitor bats in the wider area (the results are not yet available) a 2020 report received from DOC has shown that a by-product of the predator trapping has meant indigenous bird numbers from twenty species have nearly doubled over a period of twenty years.



Legend

- *Trap waypoints (221)*
- *Rat (4)*
- *Rabbit (1)*
- *Possum (14)*
- *Hedghog (3)*
- *Port Blakely Traps (24)*

Fish habitat

Finding barriers to fish passage

Between November 2020 and January 2021, our summer students assessed nearly all Environment Canterbury owned in-stream structures for barriers to fish passage, where fish habitat is available upstream. This initial assessment has informed the development of future fish passage work programmes and will assist in meeting the requirements of central government's Essential Freshwater package, specifically to ensure structures do not impede the movement of native fish in our waterways.

Image: Kōwaro/Canterbury mudfish (threatened, nationally critical)

Many of Canterbury's indigenous fish species are classified as threatened or at risk of extinction and need to be able to access feeding and spawning sites to maintain viable populations.

Biodiversity on our land

Environment Canterbury continues to lead by example and increase biodiversity protection on our land. Examples of operational project work on Environment Canterbury-owned land:

Environmental weed control and predator trapping in native forest, Kaikoura River Protection Reserves.

Weed control was undertaken at the Kowhai Bush, Luke Creek and Waimangarara River reserves, where the focus was to control pest species that were changing the structure of the forest. Predator trapping continues to be undertaken at Kowhai Bush with the aim to protect populations of riflemen and South Island robin. However, recent monitoring indicated that while nesting was successful for riflemen, their overall numbers within Kowhai Bush are in decline.

A South Island robin tagged June 2021. Credit: Jean Jack.

Fencing to protect sensitive native dryland shrubs and trees from stock and wild animal browse, West Melton Reserves.

Rabbit-proof fences were installed on both sides of the Waimakariri River to protect various dryland remnant populations of threatened, locally uncommon or iconic species.

Native lizard habitat enhancement, West Melton Reserves.

Enhancement included the construction of predator proof fences, the installation of habitat in the form of rock piles, and predator control.

Environmental weed control in dryland and wetland habitats, Kaitorete Spit

Control of established and novel weeds in wetland and dryland lakeshore habitats, including common gorse, broom and not so common sweet briar, iceplant, and African boxthorn. This work is to protect the now retired lakeshore habitats from establishing weeds.

Retirement of grazing licenses

Several reserve grazing land licenses were retired in the Ashburton area as a first stage towards permanent forest establishment

Control of shrub and tree weeds in native dry shrubland, Stour River reserve, South Ashburton River.

Grazing was removed from the 17ha site to protect the remaining native shrubland, tussockland and groundcovers, and associated native fauna. Weed control of various species, including gorse and Douglas fir, has been periodically undertaken to maintain these values.

The Whakaora Te Waihora programme, Te Waihora/Lake Ellesmere

This programme continues to deliver projects that contribute to improving the biodiversity values in and around Te Waihora/Lake Ellesmere. These include the Whakaora Te Waikēkēwai project that is co-managed with Te Taumutu Rūnanga and has secured $4.16 million to restore a whole waterway; a trial re-establishment of macrophytes/water plants in Te Waihora that previously provided important habitats for aquatic species; co-funding the Weed Strikeforce; the Whakaora Te Ahuriri project that has created a constructed wetland over four hectares and has already increased aquatic and terrestrial biodiversity; and the Whakakōhanga Kōrero forum that is bringing together key stakeholders in order to be more strategic and effective in restoring Te Waihora.

Image: Ahuriri Lagoon

Weed control in the Ahuriri reserves, Halswell River.

There has been around five years of sustained grey willow control within the main raupō stands and willow forest in this series of extensive wetland on the left of the Halswell River.

E21/8757

WAIMAKARIRI
DISTRICT COUNCIL

Land and Water Committee

Agenda

Tuesday 16 November 2021

1.00pm

Council Chamber
215 High Street
Rangiora

Members:
Cr Sandra Stewart (Chairperson)
Cr Neville Atkinson
Cr Kirstyn Barnett
Cr Al Blackie
Cr Niki Mealings
Cr Paul Williams

The Chairperson and Members
LAND AND WATER COMMITTEE

AGENDA OF THE LAND AND WATER COMMITTEE TO BE HELD IN THE COUNCIL CHAMBER, 215 HIGH STREET, RANGIORA ON TUESDAY 16 NOVEMBER 2021 AT 1PM.

Recommendations in reports are not to be construed as Council policy until adopted by the Council

BUSINESS

Page No

1 APOLOGIES

2 CONFLICTS OF INTEREST

Conflicts of interest (if any) to be reported for minuting.

3 CONFIRMATION OF MINUTES

3.1 Minutes of a meeting of the Land and Water Committee held on Tuesday 20 July 2021

5-10

RECOMMENDATION

THAT the Land and Water Committee:

(a) **Confirms**, as a true and correct record, the circulated Minutes of the meeting of the Land and Water Committee held on 20 July 2021.

4 MATTERS ARISING

5 DEPUTATION/PRESENTATIONS

Nil.

6 REPORTS

6.1 Cam River Enhancement Fund Review Decision – Sophie Allen (Water Environment Advisor)

11-19

RECOMMENDATION

THAT the Land and Water Committee:

(a) **Receives** memo No. 211014166428.

(b) **Approves** the strategic direction laid out in Option 2 'in-stream physical works, catchment works and engagement' (the preferred option) for the allocation of the remaining $179,758 of the Cam River Enhancement Fund on in-stream and catchment works.

(c) **Notes** that Council staff will seek the agreement of North Canterbury Fish and Game, and consult with the Department of Conservation for the allocation of funding to Option 2, as required by the Environment Court decision.

(d) **Circulates** this report to the Waimakariri Water Zone Committee, the Rangiora-Ashley and Kaiapoi-Tuahiwi Community Boards, the Rūnanga-WDC Liaison meeting, and the Central Rural Drainage Advisory Group.

7 PORTFOLIO UPDATES

7.1 Biodiversity – Councillor Sandra Stewart

7.2 Land based Indigenous Reserves (Including River Margins) – Councillor Al Blackie

8 QUESTIONS

9 URGENT GENERAL BUSINESS

10 MATTERS TO BE CONSIDERED WITH THE PUBLIC EXCLUDED

Section 48, Local Government Official Information and Meetings Act 1987

RECOMMENDATION

THAT the public be excluded from the following parts of the proceedings of this meeting.

The general subject of the matter to be considered while the public is excluded, the reason for passing this resolution in relation to the matter and the specific grounds under section 48(1) of the Local Government Official Information and Meetings Act 1987 for the passing of this resolution, are as follows:

Item Nº	Minutes/Report of:	General subject of each matter to be considered	Reason for passing this resolution in relation to each matter	Ground(s) under section 48(1) for the passing of this resolution
10.1	Sophie Allen (Water Environment Advisor)	North Brook Trail – project endorsement and project support	Good reason to withhold exists under Section 7	Section 48(1)(a)

This resolution is made in reliance on section 48(1)(a) of the Local Government Official Information and Meetings Act 1987, and the particular interest or interests protected by section 6 or section 7 of that Act which would be prejudiced by the holding of the whole or relevant part of the proceedings of the meeting in public are as follows:

Item Nº	Reason for protection of interests	Ref NZS 9202:2003 Appendix A
10.1	Protection of privacy of natural persons To carry out commercial activities without prejudice	A2(a) A2(b)ii

CLOSED MEETING

See In Committee Agenda (blue papers)

OPEN MEETING

NEXT MEETING

The next meeting of the Land and Water Committee is scheduled for 1pm, Tuesday 15 February 2021 in the Council Chambers, 215 High Street, Rangiora.

Briefing

CWMS Goals and Progress Report – M Griffin and M Renganthan (ECAN)

WAIMAKARIRI DISTRICT COUNCIL

MINUTES OF THE MEETING OF THE LAND AND WATER COMMITTEE HELD IN THE FUNCTION ROOM AT THE RANGIORA TOWN HALL, 303 HIGH STREET, RANGIORA ON TUESDAY 20 JULY 2021 COMMENCING AT 1PM.

PRESENT

Councillors S Stewart (Chairperson), N Atkinson, K Barnett, A Blackie, N Mealings, P Williams, P Redmond and Mayor D Gordon.

IN ATTENDANCE

C Brown (Manager Community and Recreation), G Cleary (Manager Utilities and Roading), K Simpson (Three Waters Manager), S Allen (Water Environment Officer), D Lewis (Land Drainage Engineer) and T Künkel (Governance Team Leader).

Five members of the public attended the meeting.

1 APOLOGIES

There were no apologies recorded.

2 CONFLICTS OF INTEREST

There were no conflicts of interest declared.

3 CONFIRMATION OF MINUTES

3.1 Minutes of a meeting of the Land and Water Committee held on Tuesday 20 July 2021

Moved: Councillor Stewart Seconded: Councillor Mealings

THAT the Land and Water Committee:

(a) **Confirms**, as a true and correct record, the circulated Minutes of the meeting of the Land and Water Committee held on 20 July 2021.

CARRIED

4 MATTERS ARISING

Nil.

At this time, supplementary Item 6.1 was taken. The Minutes have been recorded in the order of the Agenda.

5 DEPUTATION/PRESENTATIONS

5.1 Northbrook Connectivity Trail – E Harvie (Waimakariri Landcare Trust), G Spark and R Stalker)

E Harvie from the Waimakariri Landcare Trust noted that the Trust was a farmer-led organisation developed to support sustainable agriculture by working in partnership with the industry, local authorities, and Iwi to address environmental concerns. The Trust had received funding under the Sustainable Food and Fiber Futures Fund from the Ministry for Primary Industries for a three year project seeking to identify, test

and share on-farm practices to address environmental concerns. Four pod groups had formed under the project and each pod group had a specific area of interest. The "improved community wellbeing group" sought to focus on community wellbeing, increased engagement between rural and urban communities and iwi engagement. The concept of a connectivity trail along the Northbrook stream was developed from within this pod group.

G Spark explained that it was envisaged that the proposed Northbrook Connectivity Trail would be a walkway/cycleway constructed on the Spark family's land along the Northbrook stream between the Northbrook wetlands and Marsh Road. As the trail would be situated beside a working farm, the trail would be an opportunity to build connections between the rural and urban communities by showing sustainable farming practices. It was suggested that informative boards be erected along the trail highlighting the cultural and historic significance of the Northbrook area as well as farming in the Waimakariri area. G Spark noted that there was a possibility to extend the trail along the western bank of the Cam River in future. However, for the proposed Northbrook Connectivity Trail to be a community asset, the project would need to be supported by the Council and the community in general.

Councillor Blackie questioned as to why the engagement with Ngai Tuahuriri had not progressed. E Harvie acknowledged that the Ngai Tuahuriri input was critical. However, the Rūnanga had indicated that due to time constants they were not currently able to deal with this matter.

Mayor Gordon commended the Spark family for being willing to open their land for a community trail. The Council was keen to work with the Waimakariri Landcare Trust and the Spark family on this project, and he believed that the project needed to be progressed.

Councillor Atkinson enquired if thought had been given to the ongoing maintenance cost of the trail once it had been established. G Spark commented that, at present, the project was only at a visionary stage. As the Spark family would be providing access to the land there would have to be extensive discussion with the Council on the development and the maintenance of the trail.

In response to questions from Councillor Barnett, G Spark confirmed that the information contained on the proposed information boards would be discussed with all parties involved prior to installation. The core principle would however be to make the information boards as educational and interesting as possible.

Councillor Stewart thanked the Spark family for opening their land for a community trail. She highlighted the Council's Arohatia te Awa initiative which was developing a track along the Waimakariri District's waterways and the proposed Northbrook Connectivity Trail could link up with the Arohatia te Awa which was currently being developed from Kaiapoi to Revells Road. The Council had made $1 million provision to advance the Arohatia te Awa project. Councillor Stewart suggested that staff should work with the Spark family on the development of the trail and submit a more detail proposal to the Committee for possible endorsement in a few months. She further suggested that the proposed Northbrook Connectivity Trail be presented to the Arohatia te Awa Working Group for input. The Rūnanga was represented on the Arohatia te Awa Working Group, which may assist with Ngai Tuahuriri, input into the proposed trail.

6 REPORTS

6.1 Zone Implementation Programme Addendum Capital Works Programme 2021/21 – S Allen (Water Environment Advisor)

S Allen summarised the proposed Capital Works Programme for the 2021-22 financial year as developed from the Zone Implementation Programme Addendum (ZIPA). She highlighted the following:

- Budgetary provision had not been made in the 2021-22 financial year for fish passage improvements and the drainage maintenance and management projects as the Council would be undertaking the Forestdale Wetland fencing.

- Continuation of the South Brook beside the Townsend Fields Stormwater Management Area planting and also the continuation of the terrestrial plantings on the Kaiapoi River. There may be an opportunity to allocate funding to a watercress Mahinga kai project in the Cam River, however, the Rūnanga still needed to indorse the project.

- Re-grading of 105 meters of the right bank of Taranaki Stream directly above the tide gate was proposed, followed by planting with suitable native vegetation for inanga spawning. The Council had applied for co-funding for this project from the Environment Canterbury Regional Fish Habitat Fund, and a response was anticipated by mid-August 2021. If the funding was not received the project would have to be carried over to the next financial year or scaled down.

Councillor Williams enquired that if the deer fencing at the Forestdale Wetland was not delayed, would it have been destroyed during the May 2021 flood event. C Brown explained that the purpose of the fencing was to keep deer out of the larger wetland area, so the Council could therefore position the fencing so that it was not vulnerable to flooding.

Councillor Stewart questioned if the footbridge was the only requirement to enable the development of a loop path at Townsend Fields. S Allen advised that currently there was no walking track, however, people would be able to walk in the area as the Council had made provision for a rough track to be development in the future. It was suggested that a smaller wooden footbridge could be installed to create a loop track.

Councillor Mealings thanked the Spark family for their 'community mind-set' and also the Land Care Trust for the work that they had been doing. She believed that it was important that communities should be shown how sustainable farming was being done.

Moved: Councillor P Williams Seconded: Councillor A Blackie

THAT the Land and Water Committee:

(a) **Receives** report No. 210401054395.

(b) **Supports** the proposed 2021-22 Waimakariri District Council capital expenditure work programme, based on Zone Implementation Programme Addendum (ZIPA) recommendations.

(c) **Circulates** this report to Council, Community Boards, WDC-Rūnanga liaison meeting and the Waimakariri Water Zone Committee for their information.

CARRIED

6.2 **Wetland Area in the Lineside Road – Bramleys Road area – update on wetland definition and land owner concerns – S Allen (Water Environment Advisor)**

S Allen noted that there had been some confusion regarding the National Environmental Standards – Freshwater (2020) definition of wetlands in general. Staff had therefore used the wetland area at Lineside Road as a case study for the implementation of the National Environmental Standards. This area had triggered ongoing concerns from landowners regarding drainage maintenance. Environment Canterbury (ECan) had been received pollution complaints from community members about sediment and other water quality contaminants viewed downstream. The Council had carried out drainage works within the area on a reactive basis over the years and staff intend to carry out works in summer 2021-22 within the area defined ecologically as a wetland for improvement of drainage for landowners.

Councillor Atkinson sought clarity on what maintenance the landowners were referring to that the Council had not done. K Simpson acknowledged that drainage maintenance in this area was problematic as it was a natural low-lying basin. The Council depend on the various Drainage Advisory Groups to advise the Council of what maintenance was needed in a specific area. The Council had consistency carried out drainage works in this area over the last 10-years. However, most of the work done by the Council related to sediment removal, as the area was prone to sediment build-up due to its low-lying nature. Due to the wet nature of the area the landowners were expecting the Council to do maintenance on a more regular basis.

Councillor Blackie questioned what work the staff was proposing to do in this area in 2021-22. K Simpson advised that the majority of the work would again be sediment removal. There was also some drainage maintenance work that needed to be done, however, the area was to wet for the machinery to enter at this time.

Councillor Mealings enquired what defined a wetland in terms of the National Policy Statement of Freshwater Management (NES-F). S Allen explained that the NES-F rules apply to 'natural wetlands' and did not include any area of improved pasture that was dominated by exotic pasture species and was being used for grazing. Councillor Mealings further enquired if this area was listed in the Council's District Plan as a wetland. S Allen confirmed that the area was not considered a nature wetland and as such had not been included in the District Plan.

Moved: Councillor S Stewart Seconded: Councillor A Blackie

THAT the Land and Water Committee:

(d) **Receives** Report No. 210630106619.

(e) **Notes** that Ministry for the Environment had released draft guidance on the definition of natural inland wetlands, however that this planning definition had not yet been applied to the Lineside-Bramleys Road basin area as to whether it was a natural inland wetland under the National Environmental Standards for Freshwater (2020).

(f) **Notes** the intention of WDC staff to carry out works to improve drainage in the Lineside Road Bramleys Road basin area this summer 2021-2022.

(g) **Notes** that Environment Canterbury interprets the physical works proposed by WDC to be permitted under section (46) National Environmental Standards – Freshwater (2020) even if the area was to be defined as a natural inland wetland.

(h) **Notes** that the Environment Canterbury wetlands GIS layer had been temporarily removed from Canterbury Maps, therefore WDC would continue to use a downloaded version of this map for determination of potential inland natural wetlands where the National Environmental Standards – Freshwater (2020) rules may apply.

(i) **Circulates** this report to the Central Rural Drainage Advisory Group, Community Boards and the Waimakariri Water Zone Committee.

CARRIED

Councillor Stewart advised that at the last few Central Rural Drainage Advisory Group meetings landowners in this area had complained rigorously about the lack of drainage maintenance. The landowners seemed to have difficulty in understanding the nature of the land itself. She believed that if the Council wished to improve the ecological value of the Cam and Kaiapoi Rivers the drainage problems in this area would need to be resolved. As this seemed that this area was the main source of the sediment deposits in the Cam and Kaiapoi Rivers.

7 PORTFOLIO UPDATES

7.1 Biodiversity – Councillor S Stewart

- Waimakariri Biodiversity Trust had appointed eight Trustees and had its first meeting to finalise the Trust's regulatory documents. It was anticipated that the Trust would request the Council for seed funding to get up and running.
- She encouraged members to attend the first Arohatia Te Awa public planting from 10am to 12:30pm on 14 August 2021 at the Cam River down Revells Road.
- The Biodiversity Champions had been required to complete questionnaire on the greenspace work that the Council was doing which had biodiversity components. It seemed that ECan wished to establish a regional baseline for biodiversity enhancement.

7.2 Land based Indigenous Reserves (Including River Margins) – Councillor A Blackie

No discussion emanated from this point.

8 QUESTIONS

Nil.

9 URGENT GENERAL BUSINESS

Nil.

NEXT MEETING

The next meeting of the Land and Water Committee was scheduled for 1pm, Tuesday 21 September 2021 in the Function Room, Rangiora Town Hall.

THERE BEING NO FURTHER BUSINESS THE MEETING CLOSED AT 1.43PM.

_____

Chairperson

_____

Date

BRIEFING

Review of Cam River Enhancement Fund projects – S Allen (Water Environment Advisor)

WAIMAKARIRI DISTRICT COUNCIL

REPORT FOR DECISION

FILE NO and TRIM NO:	DRA-19 / 211014166428
REPORT TO:	LAND AND WATER COMMITTEE
DATE OF MEETING:	16 November 2021
AUTHOR(S):	Sophie Allen – Water Environment Advisor
SUBJECT:	Cam River Enhancement Fund Review Decision
ENDORSED BY: (for Reports to Council, Committees or Boards)	Department Manager / Chief Executive

1. SUMMARY

1.1 This report reviews strategic options and provides a recommendation for decision regarding the future of the Cam River Enhancement Fund.

1.2 There is a remaining $179,758 allocated to the Cam River Enhancement Fund (as of the end of September 2021).

1.3 The recommended option is for an integrated catchment approach i.e. a waterway 'in-stream' component and a rural catchment component to prevent sources of contaminants.

1.4 An in-stream physical works work programme, (i.e. solely focussing on the waterway component) was approved by the Cam River Enhancement Fund subcommittee in August 2017.

1.5 A strategic review of the approved work programme was undertaken July-October 2021 by WDC staff due to issues raised with design effectiveness, cost of construction, consent condition compliance, and landowner feedback.

1.6 There were three broad options considered by the strategic-level review, with the advantages and disadvantages of each option presented to the Land and Water Committee in July 2021.

1.6.1 Option 1: Continue with a 'in-stream' physical works programme (including monitoring of sediment trap effectiveness by a Masters student), but to scale back the number of projects due to increased construction costs, consent compliance challenges, and effectiveness of design issues.

1.6.2 Option 2: Carry out a mix of limited 'in-stream' physical works (to the value of approximately $90,000), and carry-out, or incentivise with community members, catchment works (to the value of approximately $90,000), to improve land use in the catchment, focussed on working with rural landowners. This option also contains potential roading improvements to improve sediment run-off from gravel roads.

1.6.3 Option 3: Run a targeted education and engagement programme (to the value of $180,000) to improve land use in the catchment, focussed on rural and urban landowners. Incentives could be provide by the Fund, such as helping with the cost of fencing off critical source areas (CSAs) for sediment and contaminants, or for encouragement of the establishment of catchment management groups.

1.7. Following discussions with selected WDC staff, Environment Canterbury staff, the Rūnanga liaison meeting environmental kaitiaki, and the Waimakariri Water Zone Committee, the recommended option by WDC 3 Waters staff is for Option 2 to be pursued.

2. RECOMMENDATION

THAT the Land and Water Committee:

(a) **Receives** memo No. 211014166428.

(b) **Approves** the strategic direction laid out by Option 2 'in-stream physical works, catchment works and engagement' (the preferred option) for the allocation of the remaining $179,758 of the Cam River Enhancement Fund on in-stream and catchment works.

(c) **Notes** that Council staff will seek the agreement of North Canterbury Fish and Game, and consult with the Department of Conservation for the allocation of funding to Option 2, as required by the Environment Court decision.

(d) **Circulates** this report to the Waimakariri Water Zone Committee, the Rangiora-Ashley and Kaiapoi-Tuahiwi Community Boards, the Rūnanga-WDC Liaison meeting, and the Central Rural Drainage Advisory Group.

3. BACKGROUND

3.1. The Cam River Enhancement Fund was established by an Environment Court ruling in July 2001. This ruling required the consent holder (WDC) to provide an amount of $25,000 per year over a five year period.

3.2. The purpose of the fund, as noted in the Environment Court decision, was to be used "for habitat restoration in the Cam River system … as agreed between North Canterbury Fish and Game Council and the consent holder in consultation with the Department of Conservation."

3.3. It was on this basis that a Cam River and Tributaries Enhancement Committee was informally set up with Council staff. Given their interest in the Cam River, representatives of Te Ngāi Tūāhuriri Rūnanga, the Cam River Working Party, and Environment Canterbury were also invited to attend.

3.4. Initially landowner applications were accepted for the fund, with some budget allocated to planting and fencing projects. A strategic catchment approach, however, was decided to be undertaken by the Committee. The Committee commissioned a scoping strategy of the Cam River and its tributaries from Dr Henry Hudson. A final version of this report was delivered in 2017 (TRIM 170410035142[v2]).

3.5. Based on the Scoping Strategy by Dr Henry Hudson, funding was allocated to 'in-stream' projects, and detailed engineering design of elements was completed over the period 2018-20. The Scoping Strategy also refers to the importance of engaging with community to manage land use effects, however no budget was allocated to any land use engagement or improvements.

3.6. In the 2018-20 period, three sediment traps were installed along the Tuahiwi Stream, and bank stabilisation was carried out at three sites along the North Brook and Middle Brook. Riparian and wetland plant species were planted alongside springs on a Fernside farm in spring 2020.

3.7. Update reports on the Cam River Enhancement Fund were presented to the Land and Water Committee on 11 June 2020 (TRIM 200526062002[v2]) and 16 February 2021

(TRIM 210203017399). A workshop on the strategic options for the future of the fund was held with the Land and Water Committee 20 July 2021. A discussion was held with the Waimakariri Water Zone Committee on 4 October 2021.

4. ISSUES AND OPTIONS

Strategic Review

4.1. In April 2021 a briefing from WDC staff to the Land and Water Committee raised issues regarding cost and design effectiveness, consent conditions compliance and landowner feedback (TRIM 210422065548). WDC staff paused the autumn 2021 physical works that were planned, awaiting a strategic review of whether to continue with the programme as approved.

Purpose and Scoping Strategy

4.2. The strategic review has looked at the original purpose of the Environment Court decision 'for habitat restoration in the Cam River system' and any constraints around the allocation of the Cam River Enhancement Fund. Although a physical works 'in-stream' programme was approved by the Cam River Enhancement Fund Subcommittee, WDC staff deem there is the potential to also achieve the purpose through physical works in the catchment and management measures such as engagement with landowners, and potentially providing incentives or directly funding works. This view is compatible with the Scoping Strategy for the Cam River (2017) by Dr Henry Hudson. In the executive summary of the Scoping Strategy for the Cam River (2017), Dr Henry Hudson states 'In terms of bang for the buck, the greatest benefit for the vision is to control sediment and contaminants getting into and moving down waterways and removing excessive fine sediment that is already in the waterways.' This is a whole of catchment approach, which is accepted as best practice for waterway restoration.

4.3. The Scoping Strategy also notes that many of the techniques recommended in the strategy were experimental, so that 'costs and effectiveness need to be rigorously quantified'. WDC staff have identified that this is the case, with questions around methodology required to meet consent compliance as one example of this uncertainty.

4.4. Rural land management is usually defined as primarily the role of the landowner and the regulator, Environment Canterbury, under Section 30 of the Resource Management Act (1991). Stock exclusion is often a requirement under the Canterbury Land and Water Regional Plan, and Critical Source Areas (CSAs) are usually identified in Farm Environment Plans for farms requiring land use consents. Despite these identified requirements of the landowner and potential role confusion between WDC and Environment Canterbury, the recommendation for the preferred Option 2 acknowledges catchment works, before entering a waterway, is likely to give the best feasibility, cost effectiveness and environmental benefits.

Options analysis

4.5. Three options were proposed in the strategic review. Table 1 provides an overview of the three options, and Table 2 compares the options. Table 2 includes a review of potential integration opportunities with other programmes by WDC and other agencies.

4.6. The evaluation criteria used by WDC staff to evaluate the three options were primarily feasibility, cost effectiveness, and environmental benefit, with alignment with other WDC projects also a consideration (see Table 2).

4.7. Option 1: **Instream physical works programme**. This option is a reduced works programme of that which was approved in August 2017 due to funding constraints. It focusses primarily on fine sediment reduction. It is suggested, if to pursue this option, to reduce the intended size of sediment traps, to allow for easier compliance with consent conditions, and also to aid with ease of maintenance to empty sediment traps. This will require finding new locations for sediment traps. WDC staff support lengthening sediment trap design to allow for settlement of finer sediments. WDC staff also support removal of

the creation of ‘drainage wetlands’ from the physical works programme due to low design effectiveness where they are inserted at the base of open drains, where there is already long grass filtration. Drainage wetlands are more suitable for the base of tile drains, and where the river will not backflow during flood events. This option retains the $25,000 budget allocation for a study of sediment traps success by a Waterways Centre Masters student.

4.8. Option 2: ‘**Instream physical works programme and rural catchment component**’. This option is a much reduced in-stream physical works programme projects compared to Option 1; limited to projects with a methodology for consent compliance, a suitable design and a willing landowner. This option does not retain the $25k budget allocation for a study of sediment traps success by a Waterways Centre Masters student, and the number of new sediment traps installed will be reduced to only three if within a waterway. Additional sediment traps could be funded if they are located in ephemeral drains off-river, due to reduced size and consent requirements. This option addresses both in-stream legacy contaminants and source control via catchment physical works and engagement. To avoid over-commitment, the catchment engagement programme is proposed to focus on rural land use management only. A high-level analysis showed that an urban stormwater engagement programme would not achieve the purpose of the fund for ‘habitat restoration of the Cam River’ to the same degree as a rural land use focus. Option 2 would require re-surveying of target reaches (i.e. a ‘Stream Walk’) for Critical Source Areas (CSAs, see Figure 1), and to identify examples of natural sediment traps where sediment could be removed. Environment Canterbury ‘Stream Walk’ data from 2016 would inform the re-survey, but would need updating. Gravel road improvements, potentially with an examination of drainages cut-outs and an argillite gravel trial, for Marsh Road and Waikoruru Road to reduce dust and sediment run-off, are being scoped with support from the WDC Roading Team due to issues noted during a September 2021 storm event (Figure 2).

Figure 1: Example of a Critical Source Area (CSA) on the North Brook where fencing is recommended to be moved back to provide stock exclusion.

Figure 2: Fine sediment run-off from gravel into drain (river-sourced gravel) – Marsh Road September 2021

4.9. Option 3: **Targeted engagement and incentives programme**. This option is for a targeted engagement and incentives programme to improve land use management, focussing on decreasing contaminants, particularly sediment, *E. coli* and nitrate, as well as the urban contaminants of zinc and copper. There is an opportunity to collaborate with others such as Te Ngāi Tūāhuriri Rūnanga and Environment Canterbury (i.e. the Land Management Advisor and Poū Matai Kō roles). Funding could also be used for a WDC Project Delivery Unit staff of consultant to assist in the delivery of the engagement programme.

Table 1: A description of Options 1, 2, and 3

	Option 1 – In stream physical works **NOT RECOMMENDED**	**Option 2 – Scaled back in-stream physical works, and increased catchment works and engagement** **PREFERRED OPTION**	**Option 3 –Catchment engagement and incentives programme** **NOT RECOMMENDED**
Project scope	An estimated 6 x small or medium sediment traps created. and 2 x bank stabilisation works. Maintenance of sediment traps until 2023. Masters student for monitoring sediment trap effectiveness	An estimated 3 x small sediment traps (or more if off-river in drains). 1 x large bank stabilisation project (project BS1). Maintenance (emptying) of sediment traps and until 2023. No Masters monitoring project. Removal of sediment from naturally existing sediment traps. Identification and fencing of Critical Source Areas (CSAs) and small bank stabilisation works – either by WDC or landowner via funding incentives Gravel road management and monitoring – management of drainage cut-outs and potential argillite trial to reduce dust and sediment run-off	Engagement programme resourcing 0.5FTE for 1.5-2 years and funding for allocation of incentives to both rural and urban landowners.
Proposed staff resourcing	Water Environment Advisor as the programme manager	Water Environment Advisor as the programme manager	Water Environment Advisor as the programme manager, Potentially Project Delivery Unit (PDU) role as engagement manager
Contractors	Sicon as the drainage contract holder, or possibility of an open tender	Sicon as the drainage contract holder, or possibility of an open tender.	Possibility of a fixed-term employee role for the engagement programme.
Length of programme	2021-2023 (physical works over two years). Maintenance costs to transfer to rural drainage budgets/ ZIPA budget	2021-2023 physical works completed January 2022 – 30 June 2023 rural catchment engagement programme	January 2022 start – 30 June 2023 for engagement programme
Potential collaboration partners		Environment Canterbury (Land Management Advisor and Poū Matai Kō roles). Te Ngāi Tūāhuriri Rūnanga	Environment Canterbury (Land Management Advisor and Poū Matai Kō roles). Te Ngāi Tūāhuriri Rūnanga

Table 2: A evaluative comparison of Options 1, 2, and 3

	Option 1 – Physical works	**Option 2 - Limited physical works and catchment engagement**	**Option 3 -Extended engagement programme**
Focus of works	Legacy sediment	Legacy sediment and source control of contaminants (sediment, nitrate, *E. coli*)	Source control of contaminants (sediment, nitrate, zinc, copper, *E. coli*)
Feasibility	Some difficulties with methodologies for consent compliance, existing designs and obtaining landowner permission	In stream works can focus on projects with suitable methodologies for consent compliance, suitable designs and landowner permission. Critical Source Areas (CSAs) requiring fencing have been identified to still be present on farms in the Cam River catchment.	Limited urban contaminant sources have been identified that are suitable for a catchment engagement programme
Cost Effectiveness	Value is reduced by consent compliance erosion and sediment control costs	Most cost effective in-stream projects could be carried out, with least cost effective in stream projects removed	Could hire a temporary staff member for an employee role. Potential to leverage other initiatives and funding sources, but also a risk of no impact (i.e. no community 'buy-in')
Environmental Benefit	Environmental benefit is reduced due to limited projects able to be funded.	Environmental benefit improved from Option 1 due to improved cost effectiveness, permitting more works to occur, including catchment physical works. More surety of success than Option 3, where community buy-in might not be achieved.	Less able to be assessed than for Options 1 and 2, as depends on the level of community 'buy-in'.
Measurement of effectiveness	Masters monitoring, maintenance records (e.g. weight of sediment removed from traps)	Maintenance records (e.g. weight of sediment removed from traps)	To be determined – may be indirect measurements with less accuracy
Benefits of alignment with other projects	Supports Arohatia te Awa	Supports Arohatia te Awa and the North Brook Trail	Supports Arohatia te Awa, North Brook Trail and urban stormwater management (Stormwater Network Discharge Consents)
Other comments	Success of works depends on confirming an appropriate methodology and re-designing some projects	Could be stretching resourcing thin to deliver both physical work and a land use catchment engagement programme	An employee role would be more cost effective than contracting staff from the Project Delivery Unit

Agreement of Fish and Game, and consultation with DOC

4.10. If Option 2 were approved by the Land and Water Committee at the 16 November 2021 meeting, WDC staff would approach North Canterbury Fish and Game for their agreement, and the Department of Conservation (Rangiora Office) would be consulted, before changes to the programme could be finalised, as per the Environment Court decision.

Implications for Community Wellbeing

There are implications on community wellbeing, discussed by the issues and options that are the subject matter of this report.

4.11. The Management Team has reviewed this report and support the recommendations.

5. COMMUNITY VIEWS

5.1. Mana whenua

Te Ngāi Tūāhuriri hapū are likely to be affected by, or have an interest in the subject matter of this report. The preference of the Ngāi Tūāhuriri Rūnanga Kaitaki Representatives for Options 1, 2 or 3 was discussed at the Runanga-WDC meeting on 1 July 2021 at a strategic level for preference, without details provided of each option. The kaitaiki indicated an interest in an option which allows for a more collaborative approach between agencies.

5.2. Groups and Organisations

There are groups and organisations likely to be affected by, or to have an interest in the subject matter of this report, such as rural landowners within the Cam River Catchment. The Waimakariri Water Zone Committee reviewed options at a workshop on 4 October 2021.

5.3. Wider Community

The wider community is not likely to be affected by, or to have an interest in the subject matter of this report.

6. OTHER IMPLICATIONS AND RISK MANAGEMENT

6.1. Financial Implications

There are no new budgets proposed by this report, only the reallocation of an existing budget, to enhance cost-effectiveness and environmental benefit.

6.2. Sustainability and Climate Change Impacts

The recommendations in this report do have sustainability and/or climate change impacts, regarding the restoration of the Cam River for mahinga kai, biodiversity habitat improvements and community connection to the waterway into the future.

6.3 Risk Management

There are minor risks arising from the adoption/implementation of the recommendations in this report. The preferred option (Option 2) is able to be directly measured for effectiveness for physical works, but not so easily for indirect actions undertaken by catchment landowners that are incentivised to undertake actions, for which it could be harder to monitor effects.

6.3. Health and Safety

There are no health and safety risks arising from the adoption/implementation of the recommendations in this report. This report is for setting strategic direction only.

7. CONTEXT

7.1. Consistency with Policy

This matter is not a matter of significance in terms of the Council's Significance and Engagement Policy.

7.2. Authorising Legislation

7.2.1. Resource Management Act (1991) – Consents for physical works under the Canterbury Land and Water Regional Plan.

7.3. Consistency with Community Outcomes

The Council's community outcomes are relevant to the actions arising from recommendations in this report, in particular that there is 'A healthy and sustainable environment for all.'

7.4. Authorising Delegations

7.4.1. The Land and Water Committee holds the delegation for allocation of the Cam River Enhancement Fund.

November 2021 – January 2022 communications report for Waimakariri Water Zone Committee

- **Prepared by:** Kim Whitwell, Principal Communications and Engagement Advisor (Northern), Environment Canterbury
- **Prepared for:** Waimakariri Water Zone Committee meeting, Monday 31 January 2022

This report provides and overview of communication and engagement activity completed by Environment Canterbury communications and engagement staff (and contracted communications professionals). Normal channels used include:

- Environment Canterbury website and Facebook
- Waimakariri District Council channels
- Local Water Zone email newsletter (through Environment Canterbury)
- North Canterbury News

Date	Content	Overview
November	Foxs Creek planting day	• Community focus • Environment Canterbury biodiversity funding • Ashley River Rakahuri catchment
	Irrigating top tips for the summer season (North Canterbury feature)	• Zone delivery led • Tips for irrigating over summer (part one of two) Irrigation on the road, restrictions & tips for lifestyle block owners
	Community Conversation (post-event story and meeting notes)	• Zone delivery / operations led • North Canterbury feature • Topics discussed, meeting notes and presentation slides
	Southern black-backed gull control at Waimakariri River	• Operations led • Educational piece about why we control them • Recurring comms
December	Waimakariri Shed Talk (post-event story)	• Zone delivery led • Focus on cultural and biodiversity values in the zone
	LAWA: Can I swim here? campaign (best spots to swim in North Canterbury)	• Operations led • North Canterbury focused
	Fonterra Sustainable Catchments projects	• Zone delivery led • Ashley River Rakahuri catchment • Biodiversity & farmer action focused

	View Hill School biodiversity project – Canterbury mudfish	• Operations led • Community, youth, biodiversity, and education focus
January	Kaiapoi eel relocation	• Zone delivery led • Biodiversity & mahinga kai focus
	Protecting our precious braided river birds (long-form feature)	• Operations led • Community involvement • Short form provided to local newspapers

Planned communication activity January 2021 onwards

Focus on catchment approach, groups, and projects

- Community conversation advertising & content
- Chair column & email newsletter
- Content & advice for lifestyle block owners

Popular content and things to note:

- Environment Canterbury Communications and Engagement Advisor Emily O'Connell is now supporting North Canterbury communication and engagement activity for Environment Canterbury. This includes the Waimakariri zone.
- Popular on social media: content about Waimakariri / the region's braided river birds has been relatively popular across channels over the last few months. Focus on promoting public knowledge and understanding about these birds, and their threats, has been a focus for communication activity.
- Any ideas on stories feel free to contact Kim, Marco or Murray.

Media content to note:

- Stuff feature on the Braided River Revival work: https://www.rnz.co.nz/news/national/459009/new-conservation-plan-for-canterbury-s-braided-rivers
- Stuff feature on the suspected dog attack at the black-billed gull colony at Woodstock: https://www.stuff.co.nz/environment/127069075/suspected-dog-attack-causes-500-critically-endangered-gulls-to-abandon-nests
- Stuff feature on Ashley River Rakahuri gravel extraction (consent applications): https://www.stuff.co.nz/environment/127357334/quarry-company-wants-to-extract-thousands-of-tonnes-of-gravel-from-canterbury-riverbed

WAIMAKARIRI DISTRICT COUNCIL

REPORT FOR INFORMATION

FILE NO and TRIM NO:	DRA-06-07-01 / 210721119499
REPORT TO:	UTILITIES AND ROADING COMMITTEE
DATE OF MEETING:	16 November 2021
AUTHOR(S):	Sophie Allen – Water Environment Advisor
SUBJECT:	Stormwater management from Sutton Tools Ltd

ENDORSED BY: (for Reports to Council, Committees or Boards)	Department Manager	Chief Executive

1. SUMMARY

1.1 This report provides an update on the management of stormwater from the Sutton Tools Ltd site, an engineering workshop located on Dale Street, Kaiapoi.

1.2 A pollution incidence response of oil slicks in the Cam River was received by Environment Canterbury in March 2021. This oil was linked to a spill from the Sutton Tools site of cutting oil used for machining of tools. This spill entered the Council's stormwater network and discharged into the Cam River to the north of the Kaiapoi Mill site.

1.3 Previous oil slick reports in the Cam River have been received by Environment Canterbury pollution response hotline, however have not been previously been substantiated to be linked to Sutton Tools. This case was substantiated, with a warning letter sent to Sutton Tools by Environment Canterbury. Due to cooperation from Sutton Tools to implement immediate improvements, no enforcement action was undertaken.

1.4 Environment Canterbury and Waimakariri District Council (WDC) have confirmed that Sutton Tools is required to obtain a discharge consent from Environment Canterbury. WDC will be shown the consent application before lodging, as the Council will be an affected party as owner of the reticulated network. Stormwater discharge from Sutton Tools will come under the Kaiapoi Stormwater Network Discharge Consent after 1 January 2025 as a high-risk site.

1.5 Sutton Tools have improved spill response measures and employed temporary stormwater mitigation procedures as learnings from the spill event in March 2021.

1.6 Sutton Tools are developing a stormwater management plan and have engaged an engineering consultant, E2 Environmental Ltd, to assist with this process. This management plan is expected to form the basis of the consent application to Environment Canterbury. It is understood that Sutton Tools is considering installation of an on-site oil separator and a sediment capture device, and to provide a sampling point for monitoring of discharge on-site.

1.7 WDC staff are planning the replacement of two chambers and associated infrastructure downstream of the Sutton Tools site, due to health and safety concerns and also to improve the ability to sample the discharge from the Sutton Tools site. This will restrict the public from accessing the manhole.

Attachments:

i. Email from Sutton Tools (Richard Frew) dated 4/6/21 (TRIM 210604090394)

2. RECOMMENDATION

THAT the Committee:

(a) **Receives** Report No. 210721119499.

(b) **Notes** the issue of an oil slick pollution event on the Cam River in March 2021, which was traced to Sutton Tools on Dale Street, Kaiapoi.

(c) **Notes** that temporary stormwater improvements have been carried out by Sutton Tools to clean up the spill and also to prevent further spills, such as installation of bunding and cleaning of discharge pipes.

(d) **Notes** that Sutton Tools are developing a stormwater management plan with upgrades to their system, and will seek a stormwater discharge consent from Environment Canterbury, as deemed to be a high-risk site, which Waimakariri District Council, as owner of the reticulated network, will not allow to discharge as a permitted activity.

(e) **Notes** that the site will come under the proposed Waimakariri District Council Kaiapoi Stormwater Network Discharge Consent after 1 January 2025.

(f) **Notes** that WDC staff, among others, are supporting Sutton Tools with advice regarding stormwater management, to prevent further spills.

(g) **Circulates** this report to the Land and Water Committee, Waimakariri Water Zone Committee, Coastal Rural Drainage Advisory Group, Kaiapoi-Tuahiwi Community Board, and the Rūnanga - Council monthly liaison meeting.

3. BACKGROUND

3.1. An oil slick in the Cam River was reported by a member of the public to Environment Canterbury Pollution Incidence Response in March 2021 (Figure 1). This oil was linked to a spill from the Sutton Tools site of cutting oil used for machining of tools.

Figure 1: A photo of the oil slick visible on the Cam River, March 2021

3.2. Sutton Tools underwent a site inspection on 31 March 2021, carried out by Environment Canterbury staff, with WDC 3 Waters staff present. Environment Canterbury recommended installation of temporary measures, such as bunding for spill protection, as well as implementing a stormwater management plan that would meet any discharge consent requirements.

3.3. The stormwater pipe from Sutton Tools crosses the Kaiapoi Domain to Ranfurly Street, then discharges to the Cam River from an outlet on the Kaiapoi Mill property (see Figure 2).

Figure 2: Stormwater discharge pipe from Sutton Tools through the Kaiapoi domain (in green).

4. ISSUES AND OPTIONS

Temporary measures for spill response

4.1. The immediate measures undertaken by Sutton Tools to clean up the spill were to jet out the lateral to the WDC chamber in the Kaiapoi Domain to remove any oil remaining and to add an adsorptive filter sock to the chamber in the Kaiapoi Domain. The temporary measures of Sutton Tools to reduce the risk of further spills were to install bunding around an on-site sump and to improve their forklift ramp to prevent oil spills from containers being transported around the site.

4.2. WDC staff have deemed that additional flushing downstream of the WDC chamber in the Kaiapoi Domain was not required as high rainfall events after the event would have already flushed the system or the oil would have volatised into the air. The downstream system has been inspected at the manhole access points and there are no remaining signs of oil in the WDC stormwater system.

Long-term management

4.3. Sutton Tools is working on a stormwater management plan with the technical support of engineering consultant E2 Environmental Ltd. The details of what is proposed for treatment has not yet been confirmed by Sutton Tools. WDC will be shown the consent application before lodging, as the Council will be an affected party as owner of the reticulated network. WDC will be able to provide comment on the proposed solution at this stage.

4.4. The two chambers and associated infrastructure in the Kaiapoi Domain are proposed to be upgraded by WDC staff to a standard chamber design, a larger diameter pipe, a sampling point sump, and a new manhole cover. The works will improve health and safety by restricting access to who can open the chambers and also to improve the ability to sample the discharge from the Sutton Tools site for WDC staff.

4.5. WDC will continue in a supporting role to work with Sutton Tools, with Environment Canterbury as the regulatory and consenting authority until 1 January 2025. By this date, there will potentially be the establishment of a water services entity under the Three Waters Reform, who will take on responsibility for the stormwater network and any stormwater network discharge consent.

Clarification of high or medium risk stormwater discharge

4.6. Assessment against the Schedule 3 (Hazardous Industry Activities) of the Canterbury Land and Water Regional Plan had previously defined Sutton Tools as an engineering workshop with metal fabrication. This HAIL activity is defined as medium risk by the Stormwater Drainage and Watercourse Protection Bylaw (2018), which would qualify to be covered by the proposed Kaiapoi Stormwater Network Discharge Consent CRC204215.

4.7. Following further research into the oil products stored at Sutton Tools, Environment Canterbury has confirmed that Sutton Tools meets the Schedule 3 category A as well (chemical manufacture, application and bulk storage) due to the storage of a large volume of a cutting oil, a petroleum-based product. This is classified as a high risk under the Stormwater Drainage and Watercourse Protection Bylaw (2018).

4.8. Under Rule 5.93A of the Canterbury Land and Water Regional Plan, a discharge into a reticulation network is a permitted activity if the owner of the network provides permission. Waimakariri District Council, as the owner of the network, is not considering granting approval to Sutton Tools due to the high risk definition of the site. Therefore the discharge is a discretionary activity under Rule 5.97 of the Canterbury Land and Water Regional Plan. A separate discharge consent is required to be obtained from Environment Canterbury.

4.9. Stormwater discharge from Sutton Tools will come under the Kaiapoi Stormwater Network Discharge Consent after 1 January 2025. Sutton Tools will be required to receive an approval from WDC, or potentially a water services entity, for a Pollution Prevention Plan.

Kaiapoi Stormwater Network Discharge Consent Monitoring

4.10. In addition to monitoring by Sutton Tools of their own discharge, it is proposed under the Kaiapoi Stormwater Network Discharge Consent from 2021-22 onwards that WDC will monitor the discharge pipe below Sutton Tools quarterly for any noticeable scums, or signs of oil discharge. The receiving environment, the Cam River, will also be monitored downstream quarterly for stream health and impact of stormwater on the waterway. Further stormwater issues should be detected either by Sutton Tools or WDC monitoring.

Implications for Community Wellbeing

There are implications on community wellbeing by the issues and options that are the subject matter of this report. Stormwater management can improve water quality for community who access the Cam River for a variety of reasons.

4.11. The Management Team has reviewed this report and support the recommendations.

5. COMMUNITY VIEWS

5.1. **Mana whenua**

Te Ngāi Tūāhuriri hapū are likely to be affected by, or have an interest in the subject matter of this report. A copy of this report will be presented to the monthly Council – Rūnanga meeting.

5.2. **Groups and Organisations**

There are groups and organisations likely to be affected by, or to have an interest in the subject matter of this report, such as the Coastal Rural Drainage Advisory Group.

5.3. **Wider Community**

The wider community is not likely to be affected by, or to have an interest in the subject matter of this report.

6. OTHER IMPLICATIONS AND RISK MANAGEMENT

6.1. **Financial Implications**

There are no financial implications of the decisions sought by this report.

6.2. **Sustainability and Climate Change Impacts**

The recommendations in this report do not have sustainability and/or climate change impacts. This report is for information only.

6.3 **Risk Management**

There are no risks arising from the adoption/implementation of the recommendations in this report. This report is for information only.

Health and Safety

There are no health and safety risks arising from the adoption/implementation of the recommendations in this report.

7. CONTEXT

7.1. **Consistency with Policy**

This matter is not a matter of significance in terms of the Council's Significance and Engagement Policy.

7.2. **Authorising Legislation** Resource Management Act (1991) – Sutton Tools will apply for a discharge consent under the Canterbury Land and Water Regional Plan.

7.3. **Consistency with Community Outcomes**

The Council's community outcomes are relevant to the actions arising from recommendations in this report.

7.4. **Authorising Delegations**

No delegations apply. This report is for information only.

MINUTES OF THE MEETING OF THE CANTERBURY WATER MANAGEMENT STRATEGY WAIMAKARIRI ZONE COMMITTEE HELD IN THE COUNCIL CHAMBER AT THE RANGIORA SERVICE CENTRE, 215 HIGH STREET, RANGIORA, ON MONDAY 1 NOVEMBER 2021 AT 3.30PM.

PRESENT

Michael Blackwell (Chairperson) Erin Harvie, Carolyne Latham, Wendy Main, Judith Roper-Lindsay, John Cooke (Te Ngāi Tūāhuriri Rūnanga representative), Arapata Reuben (Te Ngāi Tūāhuriri Rūnanga representative), and Councillor Sandra Stewart (WDC Councillor).

IN ATTENDANCE

Councillor P Redmond (WDC Councillor), Councillor G Edge (ECan Councillor), M Bate (Kaiapoi Resident), R Johnston (Oxford Farmer), J Ensor (Mandeville Resident), D Hill (North Canterbury News) and J Benn (Department of Conservation).

S Allen (WDC Water Environment Advisor), D Lewis (WDC Land Drainage Engineer), A Arps (ECan Zone Manager), K Whitwell (ECan Principal Communications and Engagement Advisor), M Griffin (ECan CWMS Facilitation Team Leader) and T Kunkel (WDC Governance Team Leader).

KARAKIA

M Griffin provided the karakia to open the meeting.

1 BUSINESS

1.1 Apologies

Moved: E Harvie Seconded: A Reuben

Apologies were received and sustained from Martha Jolly and Councillor Megan Hands (ECan Councillor) for absence.

CARRIED

1.2 Welcome and Introductions

The Chairperson welcomed all the members present and requested members and attendees to introduce themselves to the members of the public in attendance.

1.3 Register of Interests

E Harvie advised that she had been appointed as the Lead Co-ordinator for the Waimakariri Landcare Trust and she was now also a full member of the New Zealand Institute of Primary Industry Management. She therefore requested that the Register of Interests be updated accordingly.

2. OPPORTUNITY FOR THE PUBLIC TO SPEAK

2.1 M Bate – Kaiapoi Resident

M Bate showed various photos of dead trees and new growth in the Lineside Road Drain, Courtney Steam, and Kaiapoi River (near the Askeaton Boat ramp) area. He noted that if the trees had died due to saltwater intrusion, there would not be any regeneration or new trees growing in these areas. Also, some of the dead trees were not close enough to the waterways to be effected by saltwater intrusion. He therefore believed that the trees had been poisoned by the spraying of chemicals.

J Roper-Lindsay questioned when the older trees had died, she asked if it was possible that the 2011 earthquake could have caused a surge in saltwater intrusion thus killing the trees. She noted that the killing of the trees by spraying chemicals would mean that the spraying had to have occurred on a regular basis over a long period of time, and it was unclear who would have done this. She therefore suggested that the possibility should be investigated that the trees died due to the occurrence of a natural event.

M Bate noted that the saltwater intrusion was still occurring annually, if the trees had therefore died due to saltwater intrusion, there would be no new trees growing in these areas. He therefore maintained that the trees had been poisoned over an extended period of time by the consistent spraying of chemicals along the waterways.

M Bate also tabled a notice that appeared in the local newspaper that listed the various rivers in the Canterbury Region that were scheduled to be spayed in 2022. The notice also listed the chemicals to be used such as glyphosate, triclopyr, metsulfuron, etc. He noted that the food chain was continuously being poisoned and the biodiversity along the waterways was declining each year.

M Bate expressed his dismay with the spraying for weed control done by ECan between the Ashley Gorge and the Okuku River confluence. Although the undergrowth in this part of the river was not indigenous, it at least provided some biodiversity and assisted with the controlling of flooding.

In conclusion, he noted that the birds were being blamed for the deterioration of the Lineside Road Drain. However, the fact that the drain had been sprayed with chemical for the last 20-years was not being taken into consideration.

A Reuben advised that Ngāi Tūāhuriri also objected to the use of the Sodium fluoroacetate, and other chemicals, due to their effect on the natural environment. The effect of the chemicals could be observed in sharp rise in illnesses that modern communities were struggling with. He further noted that the Christchurch West Melton Water Zone Committee was able to persuade the Christchurch City Council not to use chemicals around public open spaces.

J Roper-Lindsay enquired if the Waimakariri District Council also had a Global Spraying Plan. S Allen confirmed that the Council had a holistic weed control plan. However, she advised that the notices that appeared in local newspaper usually listed all the areas that may need weed control in the next year. She clarified this was a generic notice, and did not mean that all the areas listed would actually be sprayed.

2.2 **R Johnston – Oxford Farmer**

R Johnston enquired if there had been any process made with the exploratory drilling to establish the relationship between the Christchurch Aquifer System and groundwater sources north of the Waimakariri River. He noted with concern that the winter feed crop restrictions contained in Plan Change 7 to the Canterbury Land and Water Regional Plan were based on the relationship to the Christchurch aquifers. However, R Johnston's inquiry on this matter suggests it would now seem that the connection was not based on proven fact, but rather on opinion. He therefore believed that the public was led astray on this matter, as the possibility of contamination of the Christchurch Aquifer System by the Waimakariri District's groundwater was very small.

R Johnston also raised a point regarding the zoning colour coding used for parts of the Waimakariri District in the Plan Change 7 maps, as it was no true indication of the ground coverage in the district. He further also believed that the Ashley/Rakahuri River should not have been sprayed for weed control, as a more forceful approach was needed to ensure effective results.

In conclusion, R Johnston again invited the CWMS Waimakariri Zone Committee members to visit his property to look at the damage that the Ashley/Rakahuri River had done to the river frontage of his property. He noted that the river protection work done at his property frontage had survived the recent flood event in May 2021. However, it directed the water downstream and caused destruction further down the river.

2.3 **J Ensor – Mandeville Residents**

J Ensor believed that the Council had successfully managed the nitrates in the Waimakariri District's water supply and the maintenance of its water infrastructure, thereby ensuring the high quality of its drinking water. He expressed a concern that ECan and the Council would not have control of the district's water supplies under the proposed Three Waters Reform. He therefore questioned if the CWMS Waimakariri Zone Committee would play a role in the monitoring of water standards after the proposed reform.

M Blackwell advised that the Three Waters Reform was outside the CWMS Waimakariri Zone Committee's brief. Councillor S Stewart confirmed the matter was being dealt with by the Council.

3. REPORTS

3.1 **ZIPA Implementation – First Quarterly Update 2021/22 – S Allen (WDC, Water Environment Advisor) and M Griffin (CWMS Facilitator, Ecan)**

M Griffin and S Allen took the report as read.

A Reuben sought clarity on the matrix used by Council staff to classify priority indigenous habitats for protection and enhancement. S Allen noted that the Council was using a matrix adapted from ECan's criteria for Significant Natural Areas (SNA) for the District Plan review.

A Reuben noted that Ngāi Tūāhuriri's views may differ on what should be considered a priority. J Roper-Lindsay explained that cultural, historical and educational values were excluded from the ECan criteria to ensure a matrix based solely based on ecological and biodiversity values.

In response to questions, S Allen advised that, based on past experience, the sampling being undertaken to test the nitrate limits in private wells would only be completed by end of November 2021. It was envisaged that a report on the results of the study would be available in February 2022. She noted that the Council had been advised that all results of private well testing must be submitted to the Ministry of Health and eventually to Taumata Arowai. It was hoped that more information on the state of private well supplies would become available as more data was collated by the Ministry of Health.

Councillor S Stewart requested additional information on the work being done by ECan in defining the boundaries of Private Supply Well Areas. S Allen undertook to ensure that the information was provided as part of the next quarterly update.

Councillor S Stewart also asked for additional information on the realignment of tributary of North Brook and the sampling at Tūtaepatu Lagoon. M Griffin undertook to ensure that the CWMS Waimakariri Zone Committee was updated on these matters.

J Roper- Lindsay noted that she was also interested in the results of the sampling at Tūtaepatu Lagoon. She suggested that the General Manager of the Tūhaitara Coastal Park, Greg Byrnes, be invited to update the CWMS Waimakariri Zone Committee on the general health of the park.

Moved: J Roper- Lindsay Seconded: A Reuben

THAT the CWMS Waimakariri Zone Committee:

(a) **Receives** the information and priority setting contained in this report.

CARRIED

3.2 **Braided River Revival Programme – Update – M Griffin (CWMS Facilitator, ECan) and A Arps (Northern Zone Manager, ECan)**

A Arps provided the CWMS Waimakariri Zone Committee with an update on the Braided River Revival Programme (Whakahaumanu Ngā Awa ā Pākihi). He highlighted the following:

- A brief outline of the Braided River Revival Programme, including ECan's role in managing braided rivers in the region.
- Explained that the Programme would not be regulatory driven, but would endeavour to create a holistic approach to braided river management.
- Clarified how the Ashely/Rakahuri River would be effected by programme, by focusing on current and planned projects.
- Community resilience issues, such as later erosion, gravel lock up, and habitat loss.
- Provided an overview of Ashley/Rakahuri River Vegetation Clearance Project.

M Blackwell stated that it was heartening to note that that an effort was being made to create more biodiversity along the braided rivers.

J Roper- Lindsay noted that the Biodiversity Working Group was very interested in the work being done to ensure biodiversity along the Ashley/Rakahuri River. She questioned if biodiversity assessments were done as part of the proposed Braided River Revival Programme. She was concerned that large areas of vegetation, including willows, were being removed without biodiversity assessments. She further noted that for the preservation of the food chain, it was also important to protect the instream biodiversity and not only focus on the banks of the river. A Arps explained that islands of vegetation had been left in the areas which had been cleared to maintain the biodiversity values in these areas. He noted that Courtney Bamber had been appointed by ECan as a Braided River Advisor, she and a team of specialists would be conducting various assessments of the braided rivers in Canterbury, including cultural and biodiversity assessments.

J Roper- Lindsay and A Reuben noted their worry that ECan's Braided River Revival Programme Plan did not make provision for consultation with the community and the CWMS Waimakariri Zone Committee. A Arps confirmed that the community and the Committee would be consulted on the programme.

In response to questions, C Latham advised that the CWMS Waimakariri Zone Committee did not have sufficient information to make a decision on the future flow of the Ashley/Rakahuri River. She believed that the community needed to be consulted on what vegetation would be considered acceptable to grow in the river. The Committee also needed more clarity on how the braided rivers would be managed once the work had been done.

J Roper-Lindsay raised a concern that the main objectives of the Braided River Revival Programme had never been discussed with the CWMS Waimakariri Zone Committee. There seem to be different anticipated outcomes from the programme, which was causing confusion. She suggested that there should be a discussion with all parties involved in the programme to ensure consensus on the future of the Ashley/Rakahuri River.

A Reuben agreed with J Roper-Lindsay, and stated that he was struggling to ascertain the benefits of the Braided River Revival Programme, as it did not seem to be a holistic consultative programme, but rather just many smaller projects along the Ashley/Rakahuri River. He questioned how ECan would be measuring the success of the programme.

A Arps advised that a large amount of the planned consultation for the Braided River Revival Programme had been delayed due to the May 2021 floods and the COVID-19 restrictions. He explained that the overall aim of the programme would be to return the Ashley/Rakahuri River to its natural character.

C Latham and J Roper-Lindsay stated that the CWMS Waimakariri Zone Committee needed more information on what would be considered the natural character of the Ashley/Rakahuri River and what projects needed to be implemented to return the river to this state.

M Blackwell noted that it may have been more productive if the CWMS Waimakariri Zone Committee and other stakeholders were consulted earlier on the Braided River Revival Programme.

Councillor G Edge advised that ECan had established a new Catchment Subcommittee, which would be looking at the future management of all the Canterbury Rivers in line with the National Policy Statement of Freshwater. He assured the CWMS Waimakariri Zone Committee that ECan would work with the Committee and other stakeholders to achieve the best possible outcome for the Ashley/Rakahuri River.

Moved: J Roper- Lindsay Seconded: W Main

THAT the CWMS Waimakariri Zone Committee:

(a) **Receive** the information taken into consideration the Committee's Action Plan Priorities and Engagement for 2021-2024.

CARRIED

4. COMMITTEE UPDATES – M GRIFFIN (ECAN)

4.1 Proposed Plan Change 7 – Canterbury Land and Water Regional Plan

In response to a question from E Harvie, M Griffin advised that the additional time granted by the Minister for the Environment had allowed the OVERSEER review report to be included in the documentation to be considered by the ECan Council on 17 November 2021. M Griffin confirmed that the ECan Council meeting to be held on 17 November 2021 would be open to the public.

Councillor G Edge explained that the ECan Council would be briefed on the recommendations of the independent hearing commissioners and the OVERSEER report on 10 November 2021, where after the information would be made available to the public on 11 November 2021.

4.2 Essential Freshwater Package – ECan Update on Freshwater Farm Plans

No discussion emanated from this point.

4.3 CWMS Progress Report 2021

No discussion emanated from this point.

4.4 **Zone Committee Working Groups**

- Landcare Working Group

  E Harvie noted that all the interested parties that attended the meeting on water quality monitoring in the Waimakariri District were very receptive to having a holistic approach to water quality monitoring.

- Biodiversity Working Group

  No discussion emanated from this point.

- Coastal Catchments Working Group

  No discussion emanated from this point.

- Monitoring Working Group

  No discussion emanated from this point.

4.5 **Zone Committee Action Plan 2021-2024**

No discussion emanated from this point.

4.6 **WDC Land and Water Committee**

Councillor S Stewart noted that the Land and Water Committee meeting would be held on 16 November 2021, were ECan would be updating the Committee on the work being done by the CWMS Waimakariri Zone Committee.

4.7 **Waimakariri Zone Communications Report (July – October 2021)**

No discussion emanated from this point.

4.8 **Lineside Road Drain**

M Blackwell advised that the problems being experienced at the Lineside Road Drain had also been raised at the Central Rural Drainage Advisory Group meetings. The responsibility for dealing with the Lineside Road basin drainage issues seemed to circulate between ECan and the Council, with the landowners getting frustrated in the middle. However, there seemed to be consensus that it is both a drainage problem and a water quality concern. He therefore urged ECan and the Council to work together in resolving this matter. If the problem could not be resolved, then ECan and the Council should at least take some action to mitigate the landowners' problems.

Councillor S Stewart endorsed the abovementioned comments made by M Blackwell. She was a member of the Central Rural Drainage Advisory Group and there was consensus within the Group that this was a drainage issue, caused by the Council's lack of maintenance of the Lineside Road Drain. She noted that resolving the problem was being delayed by the lack of clarity on the definition of a natural wetland in the National Policy Statement for Freshwater Management 2020. She noted that until the problems with the drain were solved, sediment would continue to flow and build-up in the Kaiapoi and Cam Rivers.

4.9 **Action Points from previous Zone Committee Meetings – August 2021**.

J Roper-Lindsay requested that the quarterly updates on water quality and ecological data for the Waimakariri District be included as a standard item in the CWMS Waimakariri Zone Committee's calendar.

Moved: J Cooke Seconded: E Harvie

THAT the CWMS Waimakariri Zone Committee:

(a) **Receives** these updates for its information, and with reference to the Committee's 2021 Work Programme and Community Engagement priorities.

CARRIED

5. CONFIRMATION OF MINUTES

5.1 Minutes of the Canterbury Water Management Strategy Waimakariri Zone Committee meeting – 2 August 2021

Moved: J Roper-Lindsay Seconded: A Reuben

THAT the CWMS Waimakariri Zone Committee:

(a) **Confirms** the amended Minutes of the Canterbury Water Management Strategy Waimakariri Zone Committee meeting, held on 2 August 2021, as a true and accurate record.

CARRIED

5.2 Matters Arising

None.

9 GENERAL BUSINESS

9.1 Submission on the Minister of Environment's discussion document on wetlands

J Roper-Lindsay tabled ECan's submission on the Minister of Environment's discussion document on wetlands, as she believed that members would benefit from studying the submission. The submission included the apprehensions surrounding the definition of a natural wetland. She commented that there seemed to be pressure on the Minister of Environment to ease the protection on natural wetlands, to allow, farming, quarrying, mining etc.

A Reuben confirmed that Ngāi Tūāhuriri had also made a submission on the Minister of Environment's discussion document on wetlands.

9.2 Relationship between the Christchurch Aquifer System and groundwater sources north of the Waimakariri River

C Latham expressed her concern about several inaccuracies in the statements made by R Johnston. The CWMS Waimakariri Zone Committee was extensively briefed on this matter and the relationship between the Christchurch Aquifer System and groundwater sources north of the Waimakariri River with the best science information available at the time. The committee consequently had to accept this relationship in its ZIPA recommendation for PC& and the drilling of monitoring wells was undertaken to help monitor this relationship with the Christchurch aquifers over time.

9.2 Work being done by the CWMS Waimakariri Zone Committee

The Chairperson thanked Michael Bate for his continued efforts to preserve the waterways in the Waimakariri District. He also expressed his gratitude to the Committee members for their support during the year.

The CWMS Waimakariri Zone Committee expressed their thanks for the governance work being done by Council staff, and presented T Kunkel with a gift voucher in appreciation.

KARAKIA

A Reuben provided the karakia to close the meeting.

NEXT MEETING

The next meeting of the CWMS Waimakariri Water Zone Committee was scheduled for the 31 January 2022 at 3:30pm.

THERE BEING NO FURTHER BUSINESS, THE MEETING CLOSED AT 5.45 PM.

CONFIRMED

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Chairperson Date