Ōtūkaikino

Stormwater Management Plan

July 2024

Christchurch City Council

Ōtūkaikino

Stormwater Management Plan

Three Waters Unit
Christchurch City Council

This version submitted February 2025

Version History

Version number	Version purpose	Date	TRIM reference
1	Original Ōtūkaikino SMP adopted by Council June 2023 and delivered to Environment Canterbury.	June 2023	20/1027631
2	Ōtūkaikino SMP revised after the original SMP was not accepted by Environment Canterbury. The revision purpose is to further reduce zinc contaminant loads from developed sub-catchments. Changes to Section 10.	July 2024	23/2002346
3	Ōtūkaikino SMP revised after review comments received from Environment Canterbury. Corrections to Table 2.	December 2024	24/2193821
4	Final Ōtūkaikino SMP submitted to Environment Canterbury.	February 2025	25/377483

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List of Abbreviations

Abbreviation	Definition
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average recurrence interval, the long-term average interval between floods
ASPM	Macrophyte Average Score Per Metric
BMP	Best Management Practice
CCC	Christchurch City Council
CHI	Cultural Health Index
CLM	Contaminant Load Model
DIN	Dissolved Inorganic Nitrogen
DRP	Dissolved Reactive Phosphorus
ECan	Environment Canterbury
E. coli	*Escherichia coli*
GWL	Groundwater Level
HAIL	Hazardous Activities and Industries List
IGSC	Interim Global Stormwater Consent
IPCC	Intergovernmental Panel on Climate Change
ISQG	Interim Sediment Quality Guidelines
LDRP	Land Drainage Recovery Programme
LLUR	Listed Land Use Register
LTP	Long Term Plan
LWRP	Land and Water Regional Plan
MCI	Macroinvertebrate Community Index
NPS-FM	National Policy Statement on Freshwater Management
ppb	parts per billion
PAH	Polycyclic Aromatic Hydrocarbon

QMCI	Quantitative Macroinvertebrate Community Index
RMA	Resource Management Act
UDS	Greater Christchurch Urban Development Strategy

Contributors

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1. Executive Summary

A Stormwater Management Plan for the Ōtūkaikino River is a requirement of the Comprehensive Stormwater Network Discharge Consent (CRC231955). Its purpose is to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity and to improve the quality of rivers and streams. The stormwater management plan sets out methods the Council will implement to meet the targets in the consent.

Water quality and ecological health are typically higher than in other city waterways, although waterway values have declined as a result of changes in the catchment. Urbanisation has affected Wilsons Stream, a constructed drain, and pastoral and other rural activities have had lesser effects on Ōtūkaikino Creek and its tributaries. Most of the catchment is predicted to remain rural, with the exception of the expanding Belfast urban boundary.

Stormwater from new developments will pass through detention basins to mitigate new contaminant generation. Pre-existing development will also be treated. Recognising the relatively high values of the waterways, the Stormwater Management Plan proposes that all urban stormwater be treated through basins and wetlands before it is discharged. Considered design of these facilities is required to ensure they do not increase the incidence of bird strike to aircraft associated with Christchurch International Airport.

Treatment through basins and wetlands obtains good removal of particles (sediment) but less complete removal of dissolved metals such as copper and zinc. These metals, which mainly come from unpainted roofs, vehicle tyres and vehicle brakes would be better controlled at source, but it will be some time until the Council can effect such controls.

Development will divert some rainfall away from ground infiltration into stormwater runoff as impervious surfaces are created. However, the effect on groundwater quantity and spring flows is expected to be slight. This is because of the influence of large inflows into groundwater from the Waimakariri River.

Developed areas are adequately protected from flooding. Urban areas are elevated above the creek and its rural floodplain and are protected from flooding in the Waimakariri River either by their elevation or by stopbanks. Some localised ponding could occur within the various sub-catchments in extreme rain events. Buildings in rural zones are elevated above a potential breakout through the Waimakariri River primary stopbanks.

Part One
Plan Initiation

2. Background to the Stormwater Management Plan

2.1. Purpose and scope

The purpose of a Stormwater Management Plan (SMP) is defined in condition 6 of the Comprehensive Stormwater Network Discharge Consent (CSNDC), CRC231955, and includes contributing to meeting contaminant load reduction standards, setting (and meeting) additional contaminant load reduction targets and demonstrating the means by which stormwater discharges will be progressively improved toward meeting receiving environment objectives and targets.

The aim of the CSNDC is to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity. The CSNDC promotes progressive water quality improvement toward targets in the Land and Water Regional Plan through the use of best practicable options for stormwater quality improvement and peak flow mitigation.

Stormwater management plans set out the means by which the Council will comply with the conditions in the CSNDC. However, due to governance processes, the SMP cannot address all environmental improvement targets signalled in the consent. The SMP is given effect through the Council's Long Term Plan (LTP), which is a statutory process. The relative timing of LTP processes and the SMP do not permit this SMP to commit to unfunded, new initiatives to achieve aspirational targets.

The Council proposes to respond to the CSNDC by adding a second stream of improvement planning.

COMPLIANCE STREAM

Comprehensive Stormwater Network Discharge Consent (standards and targets)

⇩

Stormwater Management Plan

⇩

A plan to meet standards and targets set by consent conditions to limit stormwater contaminant discharges.

IMPROVEMENT STREAM

Integrated Water Strategy 2019 (aspirations, improvements)

⇩

Surface Water Implementation Plan
(anticipated commencement 2022)

⇩

A strategy identifying best practicable options to deliver at-source contaminant control and desired improvements in ecology and stream health over the long term.

Both plans inform and are funded through the **Long Term Plan**

The SMP process includes:

1 Identify the existing state of the environment in the catchment.

2 Identify the contributions by existing and future activities to stormwater quality and quantity.

3 Estimate trends from urban growth, technology, lifestyle, climate, etc on water quality and quantity.

4 Develop measures (including planning, education, enforcement, source control, etc as funded in the LTP) to control or mitigate effects.

5 Estimate the effectiveness of chosen mitigation measures through contaminant load and flood modelling.

The Surface Water Implementation Plan process includes:

- Prepare a plan that will permit the Council to meet or exceed consent condition targets.
- Engage with Council teams and external stakeholders responsible for contaminant generating activities; obtain agreement about control measures.

2.2. Stormwater Management Plan Catchments

This SMP is one of seven plans being prepared over the period 2020 to 2024 for the Ōpāwaho-Heathcote, Huritini-Halswell, Ihutai-Estuary and Coastal and Ōtūkaikino catchments and Settlements of Te Pātaka-o-Rākaihautū-Banks Peninsula, and Ōtākaro-Avon and Pūharakekenui-Styx catchments, (Figure 1).

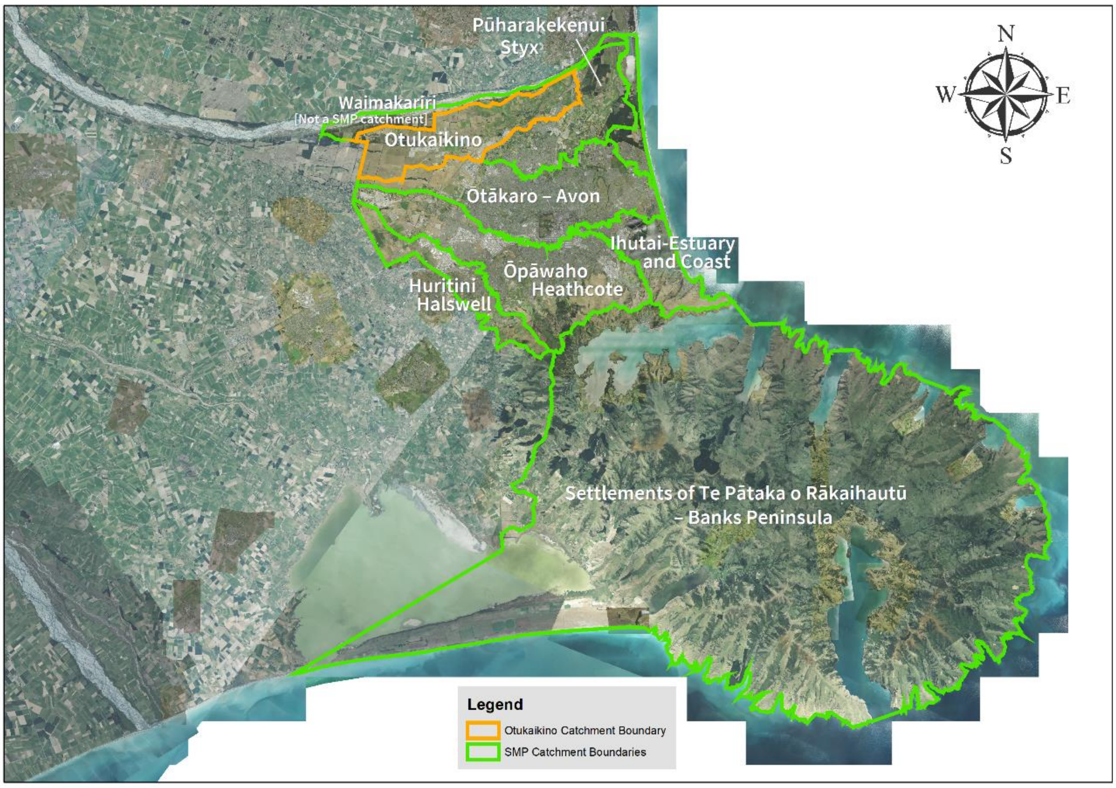


Figure 1: Area covered by the Comprehensive Stormwater Network Discharge Consent

2.3. Regional Planning Requirements

2.3.1. Canterbury Regional Policy Statement

The Canterbury Regional Policy Statement (CRPS) sets out how natural and physical resources are to be sustainably managed in an integrated way. The needs of current and future generations can be provided for by maintaining or improving environmental values. The CRPS requires that objectives, policies and methods are to be set in regional plans, including the setting of minimum water quality standards.

2.3.2. Land and Water Regional Plan

The Land and Water Regional Plan 2015 encourages the development of stormwater management plans under Rule 5.93. The intention of the rule is that SMPs will be developed to show how a local authority will meet the relevant policy on water quality.

2.3.3. Greater Christchurch Urban Development Strategy

The Greater Christchurch Urban Development Strategy (UDS) Partnership has been working collaboratively for over a decade to tackle urban issues and manage the growth of the city and its surrounding towns.

The strategy was prepared under the Local Government Act 2002 and it is to be implemented through various planning tools, including:

- Amendments to the Canterbury Regional Policy Statement (CRPS);
- Changes to regional and district plans to reflect the CRPS changes;
- Stormwater planning to give effect to the LWRP; and
- Outline Development Plans for new development areas ('Greenfield areas') and existing re-development areas ('Brownfield areas').

Therefore, the preparation of this SMP plays a role in implementing the UDS.

2.4. Non-Statutory Documents

- Integrated Water Strategy 2019
- Surface Water Implementation Plan 2022 (to be developed)
- Mahaanui Iwi Management Plan 2013
- Ngāi Tahu Freshwater Policy Statement (Te Rūnanga O Ngāi Tahu 1999)
- Infrastructure Design Standard (Christchurch City Council 2010)
- Waterways, Wetlands and Drainage Guide (Christchurch City Council 2003)
- Erosion and Sediment Control Toolbox for Canterbury (Environment Canterbury)
- Healthy Waterbodies Action Plan (Christchurch City Council 2023)

2.5. The Council's Strategic Objective for Water

The Christchurch City Council has adopted community outcomes to promote community wellbeing.

The Water Outcome Healthy Environment includes:

Healthy water bodies: "Surface water quality is essential for supporting ecosystems, recreation, cultural values and the health of residents."

2.6. The District Plan

The Christchurch District Plan promotes responsible stormwater disposal through Policy 8.2.3.4 – Stormwater Disposal, which states:

a. District-wide:
   i. Avoid any increase in sediment and contaminants entering water bodies resulting from stormwater disposal.
   ii. Ensure that stormwater is disposed of in a manner which maintains or enhances the quality of surface water and groundwater.
   iii. Ensure that any necessary stormwater control and disposal systems and the upgrading of existing infrastructure are sufficient for the amount and rate of anticipated runoff.
   iv. Ensure that stormwater is disposed of in a manner which is consistent with maintaining public health.

b. Outside the central city:
   i. Encourage stormwater treatment and disposal through low-impact or water-sensitive designs that imitate natural processes to manage and mitigate the adverse effects of stormwater discharges.
   ii. Ensure stormwater is disposed of in stormwater management areas so as to avoid inundation within the subdivision or on adjoining land.
   iii. Where feasible, utilise stormwater management areas for multiple uses and ensure they have a high quality interface with residential activities or commercial activities.
   iv. Incorporate and plant indigenous vegetation that is appropriate to the specific site.
   v. Ensure that realignment of any watercourse occurs in a manner that improves stormwater drainage and enhances ecological, mahinga kai and landscape values.
   vi. Ensure that stormwater management measures do not increase the potential for bird-strike to aircraft in proximity to the airport.
   vii. Encourage on-site rain-water collection for non-potable use.
   viii. Ensure there is sufficient capacity to meet the required level of service in the infrastructure design standard or if sufficient capacity is not available, ensure that the effects of development are mitigated on-site.

The District Plan includes specific policies relating to bird strike on aircraft. These include Policy 6.7.2.1.3 which states, "Avoid or mitigate the potential effects of activities that could interfere with the safe navigation and control of aircraft, including activities that could interfere with visibility or increase the possibility of birdstrike."

District Plan Policies 8.9.2.2 and 8.9.2.3 make earthworks subject to a consent. Conditions of consent for earthworks over a threshold include the requirement for an Erosion and Sediment Control Plan (ESCP). An ESCP is submitted and approved with a consent application and its implementation is verified by building consent officers.

2.7. Bylaws

The Stormwater and Land Drainage Bylaw (2022) will restrict discharges of any material, hazardous substance, chemical, sewage, trade waste or other substance that causes or is likely to cause a nuisance, into the stormwater network.

The Traffic & Parking Bylaw 2017 allows the Council to require an offender to remove material spilled onto roads.

2.8. Building Act

The Council can use powers under the Building Act to require ESCPs to be submitted when an associated land use consent is not required.

2.9. Integrated Water Strategy

Objectives 3 and 4 of the Christchurch City Council's draft Integrated Water Strategy are summarised as *"enhancement of ecological, cultural and natural values and water quality improvement."*

The preferred strategy option for achieving the objectives is to *"continue … the implementation of the current approach to stormwater management (embodied by the development of the Stormwater Management Plans) …"*

2.10. Mahaanui Iwi Management Plan

The Mahaanui Iwi Management Plan "… is an expression of kaitiakitanga and rangatiratanga…(It) provides a values-based, … policy framework for the protection and enhancement of Ngāi Tahu values, and for achieving outcomes that provide for the relationship of Ngāi Tahu with natural resources across Ngā Pākihi Whakatekateka o Waitaha and Te Pātaka o Rākaihautū (the Canterbury Plains and Banks Peninsula)". The Ōtūkaikino Stormwater Management Plan acknowledges the Iwi Management Plan policies and can contribute to policies which fall within the scope of a stormwater management plan (SMP). There is more detail in Section 10.9.

2.11. Infrastructure Design Standard

The Infrastructure Design Standard 2016 (IDS) is the Council's development code and is a revision of the Christchurch Metropolitan Code of Urban Subdivision 1987. The IDS promotes environmental protection via a values-based design philosophy and consideration of bio-diversity and ecological function (IDS, section 5.2.3 Four Purposes).

2.12. Goals and Objectives for Surface Water Management

The Ōtūkaikino Stormwater Management Plan and the Surface Water Implementation Plan will together be consistent with the *Integrated Water Strategy 2019* which identifies overall goals and objectives for surface water management. Jointly these plans will support so far as is practicable the *Mahaanui Iwi Management Plan* (Jolly et al, 2013) objectives for the Ōtūkaikino Stormwater Management Plan.

The Council's high-level goals in the Integrated Water Strategy are:
Goal 1: The multiple uses of water are valued by all for the benefit of all;
Goal 2: Water quality and ecosystems are protected and enhanced;
Goal 3: The effects of flooding, climate change and sea level rise are understood, and the community is assisted to adapt to them; and
Goal 4: Water is managed in a sustainable and integrated way in line with the principles of kaitiakatanga.
Te Rūnanga o Ngāi Tahu Freshwater Policy (Ngāi Tahu, 1999) lists several water quality and water quantity policies that apply throughout the Ngāi Tahu Takiwā. The *Iwi Management Plan* (Jolly et al, 2013) has objectives for the Waimakariri Catchment that are directly relevant to the Ōtūkaikino SMP. These are objectives numbered:

(2) The discharge of contaminants to the Waimakariri and its tributaries is eliminated.

(3) Water quality and flows in the Waimakariri and its tributaries are improved to enable whānau and the wider community to have places they can go to swim and fish.

(4) The mauri and mahinga kai values of the Waimakariri and its tributaries and associated springs, wetlands and lagoons are protected and restored; mō tātou, ā, mō kā uri ā muri ake nei.

The CSNDC sets freshwater outcomes based on Land and Water Regional Plan targets. The CSNDC Environmental Monitoring Programme (EMP) will assess the ecological and cultural health of waterways and coastal areas, and progress made under the SMP. The EMP assesses a range of parameters, and progress can be measured against LWRP guidelines for macroinvertebrate indices, macrophytes, periphyton, siltation and a range of water quality parameters.

The SMP programme will contribute toward delivery on these objectives through improving water quality in the rivers and streams. Other plans and programmes must play a part in restoring riparian margins and protecting and restoring springs and mahinga kai site in order to deliver on tangata whenua and LWRP objectives.

Stormwater quantity effects considered in this SMP include mitigation of additional runoff generated by urban intensification and the reduction in network level-of-service in the east of the catchment as sea levels rise over the SMP planning period.

Other sources and reports that have informed the SMP include:

- State of the Takiwā;
- Surface water and sediment quality monitoring;
- Listed Land Use Register (contaminated sites database, ECan);
- Groundwater and springs study;
- Ecological survey;
- Flood management planning for the Waimakariri River (Environment Canterbury);
- Contaminant load model.

The duration of this stormwater management plan is 10 years. Water quality has been its primary focus. To maintain the existing good water quality in receiving waters, it will be necessary to mitigate any adverse effects from new urban growth and to improve stormwater quality from existing developed areas.

3. Principal Issues

Waterways in this catchment are spring fed and predominantly rural. Ōtūkaikino Creek and tributaries have the best overall water quality within the Christchurch urban area and are described as being in good to excellent ecological health (Boffa Miskell, 2017). Ecological health is thought to have been compromised by historical land drainage and vegetation clearance (Jensen, 2002) and water quality is impacted somewhat by stock access to streams and drains. An ecological survey of the Ōtūkaikino Creek in 2017 (Boffa Miskell, 2017) was unable to find stonefly larva, previously detected in 2012, indicating a decline in stream health over that period.

The challenge for the Christchurch City Council, Environment Canterbury and landowners is to retain the natural and ecological values that exist by ensuring that agricultural and urban disturbances are reduced below an acceptable threshold.

Part Two
The Catchment

4. Catchment Description

4.1. Geography

The Ōtūkaikino catchment is 6,200 hectares in area, much of it comprising old river bed of the Waimakariri River South Branch. The South Branch, seen in Figure 8, was closed off in the 1930s.

Four periods of fan-building and down-cutting by the Waimakariri River, believed to be associated with glacial events and post-glacial changes in sea level and sedimentation rates, have been recognised from soil and geological evidence. Four age groups of soils occupy the surfaces of the fans both north and south of the current river. These soil groups are named Lismore (oldest), Templeton, Waimakariri and Selwyn (youngest). The catchment is now separated from the river and protected from flooding by a stopbank.

River deposition and erosion processes have left gently undulating surfaces with generally east trending channel remnants. On the dry plains the surface is covered by wind-blown loess and near the river the surface is comprised of very recent river sands and silts. Abandoned river braids east of McLeans Island carry water seeping from the Waimakariri River and emerging as springs.

4.2. Soils

4.2.1. Soils of the Plains

"Soils of this area are recent alluvial Selwyn soils. They sit on the reworked gravel of a glacial outwash fan that was probably laid down over 20,000 years ago. Adjacent Templeton soils to the south were laid down 6,000 to 3,000 years ago but the Selwyn group of soils has formed on sediments probably laid down within the last 300 years, during floods, including floods that were still going on at European settlement, before stopbanks were built about 1870."

In past times great quantities of dust from the riverbeds were lifted by strong north-west winds and deposited over the plains. This dust was sandy near the rivers, but the sediments became finer as distance from the rivers increased. Waimakariri series soils in the upper catchment received a heavy dressing of sandy material.

"Terraces bear soils that are mostly shallow or stony; (with) some strips of soils with stones at the surface, and others where stones are buried. In a few places one to two metres of fine sediment overlies stones." [Internet source; unnamed author]

4.3. Drainage Network

4.3.1. Streams and drainage channels

The main water features in this catchment are spring-fed streams flowing in old channels of the Waimakariri River South Branch. These streams mostly flow through lower-lying pastoral land north of Johns Road. Further east Wilsons Drain is the outfall for much of Belfast and discharges into Ōtūkaikino Creek via Ōtūkaikino Wetland.

The dry plains west of the airport are traversed by remnant river channels that are mostly dry. Ground permeability is so high that there are not considered to be drainage paths per se west of the airport, and precipitation infiltrates into the ground.

North and east of the airport a pattern of streams and drains pick up springs arising from the Waimakariri River, flowing eastward into the Ōtūkaikino Creek which joins the Waimakariri River close to the State Highway 1 Waimakariri Bridge.

4.3.2. Stormwater system

The public stormwater network starts in roadside channels which receive discharges from private property and the carriageway. The primary function of side channels is to maintain dry traffic lanes. Side channels lead to street sumps (catchpits) which discharge into a pipe network. The pipe network's level of service is that road drainage will avoid traffic hazards in a five-year average recurrence interval rainfall. Occasional road and property flooding occurs due to sump blockage or system capacity, which is normally responded to by reactive maintenance. The pipe network discharges into drains and waterways.

Industrial sites in the west of the catchment, including the airport, generally dispose of their own stormwater into ground soakage. On most industrial sites rainfall appears to infiltrate into the ground without a formal collection system. East of Gardiners Road, approximately, the soils are less permeable and groundwater becomes shallower so that disposal of treated stormwater into surface water is more common. In this area most urban stormwater is treated in basins or wetlands and discharged into tributaries of Ōtūkaikino Creek.

Figure 2: Drainage and stormwater system (eastern catchment)

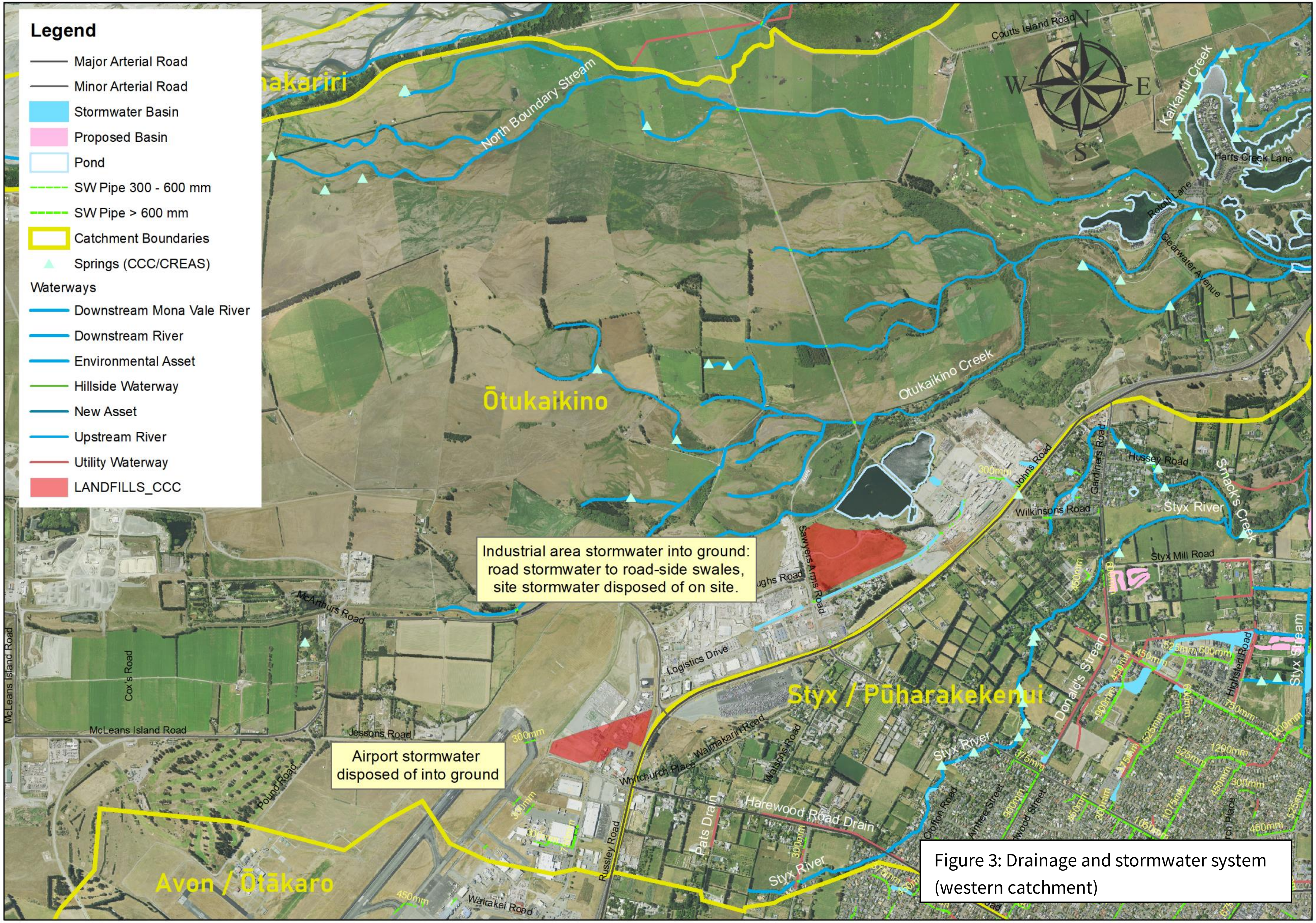


Figure 3: Drainage and stormwater system (western catchment)

4.4. Groundwater - Physical

4.4.1. Depth to groundwater

Water level records held by Environment Canterbury (ECan, 2017) indicate that groundwater is within five metres of the surface near the Waimakariri River, but deeper in the south-western part of the catchment. This reflects local topographic variations and also the downward movement of seepage from the Waimakariri River as it moves south and east.

4.4.2. Groundwater flow patterns

Piezometric contours for the catchment (Figure 4) indicate that groundwater moves in a predominantly east-south-easterly direction, becoming more easterly as groundwater approaches the coast. This suggests that losses from the Waimakariri River recharge shallow groundwater to the west, from where the water flows easterly towards Christchurch, before discharging at the coast.

Groundwater also discharges to springs in the eastern part of the catchment (Figure 2 and Figure 3) at locations where the depth to groundwater is very shallow. Springs feed small tributaries of the Ōtūkaikino Creek. The flow from these creeks is likely to vary seasonally with changes in groundwater levels.

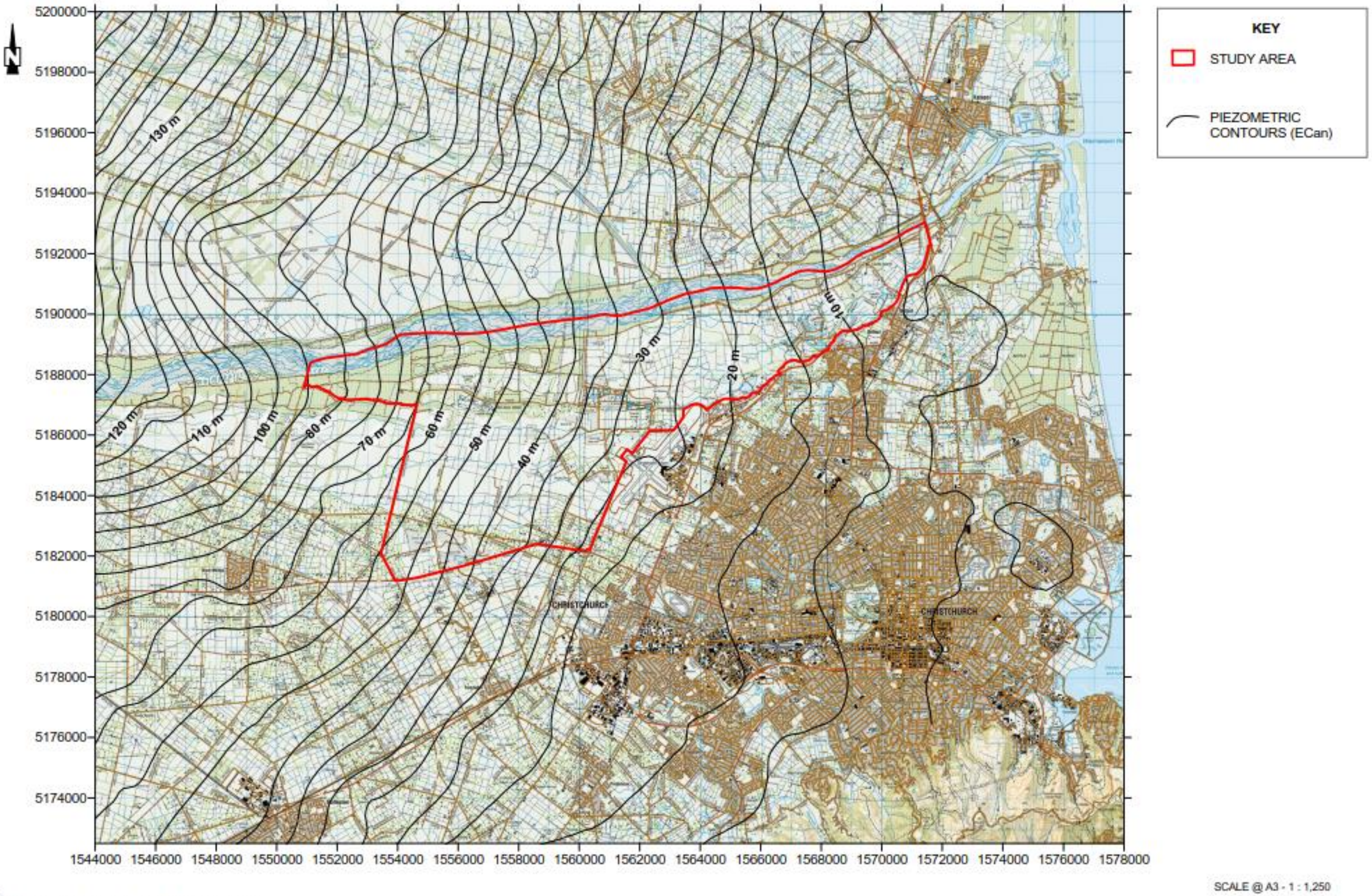
Groundwater gradients are low, consistent with the geology. The flow gradient is approximately 0.006 across the majority of the catchment but flattens to 0.002 in the east and may vary seasonally. Records do not indicate the presence of significant thicknesses of low permeability strata. This suggests that the shallow groundwater and the deeper gravel aquifers may be relatively well linked, although the majority of the flow is likely to be more horizontal than vertical.

The available monitoring data indicate that saline intrusion does not extend into the catchment's shallow groundwater systems.

4.4.3. Seasonal groundwater levels

Groundwater levels vary both seasonally and over long periods due to changes in recharge into and discharge from the aquifer. Four bores in shallow gravels have been monitored for between 18 and 64 years.

Three of the four bores are located in the southern part of the catchment and indicate that the water table fluctuates by 0.5m to 6.5m seasonally (depending on location), with peak water levels generally occurring at the end of winter. Bore M35/8370 is located closer to the river in the centre of the catchment and seasonal fluctuations within this bore are generally of the order of 0.5m.



SOURCE:
1. CONTOURS DERIVED FROM ENVIRONMENT CANTERBURY (ECAN) MAPS
2. CADASTRAL AND TOPOGRAPHICAL INFORMATION DERIVED FROM LINZ DATA AND ECAN MAPS.

Figure 4: Groundwater contours

5. Tangata Whenua Cultural Values

5.1. Wai Maori

Ko te wai te oranga o ngā mea kātoa

Water is the life giver of all things

Water is a significant cultural resource that connects Ngāi Tahu to the landscape and the culture and traditions of the tūpuna. All water originated from the separation of Rangi and Papatūānuku and their continuing tears for one another. Rain is Rangi's tears for his beloved Papatūānuku and mist is regarded as Papatūānuku's tears for Rangi.

For tāngata whenua, the current state of cultural health of the waterways and groundwater is evidence that water management and governance in the takiwā has failed to protect freshwater resources. Surface and groundwater resources are over-allocated in many catchments and water quality is degraded by urban and rural land uses. This has significant effects on the relationship of Ngāi Tahu to water, particularly with regard to mauri, mahinga kai, cultural wellbeing and indigenous biodiversity.

A significant kaupapa that emerges from (the Mahaanui Iwi Management Plan) is the need to rethink the way water is valued and used, including the kind of land use that water is supporting, and the use of water as a receiving environment for contaminants such as sediment and nutrients. Fundamental to tāngata whenua perspectives on freshwater is that water is a taonga, and water management and land use should reflect this importance. Because of the fundamental importance of water to all life and human activity, Ngāi Tahu maintain that the integrity of all waterways must be jealously protected. This does not preclude the responsible use of water but merely states the parameters which Ngāi Tahu believe any such use should remain within. The utilisation of any resource for the benefit of the wider community is encouraged, providing that it is done with the long-term welfare of both the community and the resource in mind."

(Mahaanui Iwi Management Plan, Part 5.3 Wai Māori)

5.2. Ngāi Tahu Site Specific Cultural Values

The Ōtūkaikino Creek follows the original river bed of the Waimakariri South Branch, which was the main stem of the Waimakariri River until a series of stop banks and groynes were created during flood protection works at McLeans Island. This severed the connectivity, and the South Branch of the Waimakariri River became the lowland spring-fed waterway it is today.

Prior to these flood protection works the South Branch of the Waimakariri River was highly significant to mana whenua, as it was associated with many mahinga kai sites, urupā, kāinga and kāinga nohoanga (Tau, Goodall, Palmer, & Tau, 1990). The name Ōtūkaikino also refers to a protected wetland reserve to the east of the waterway, which has been designated by mana whenua as a traditional wai whakaheke tūpāpaku (water burial site).

The current Ōtūkaikino waterway covers 16km in length, with the headwater springs located in the Issacs Conservation and Wildlife Trust site and on rural land in McLeans Island. While some riparian planting of natives has occurred in these upper reaches, much of the riparian margins are dominated by willow and few of the springs have been planted. In the mid-reaches, between the Scout Camp and Clearwater Resort significant riparian restoration works have been undertaken with many of these plantings well established. This section is dominated by willows, but it also includes some pockets of regenerating wetland habitat. Willow clearance and control works are currently being undertaken by Environment Canterbury along this section. The Groynes reserve area consists of multiple ponds, restoration plantings and is a popular recreation area. Plantings along the stream in this area are dominated by willows and other exotic species. The downstream reach of the Ōtūkaikino Creek consists of The Groynes reserve to the Waimakariri River. This section of the waterway has had extensive ecological restoration plantings and willow removal works are ongoing. Due to the May 2021 floods, extensive sedimentation has occurred in the lower reaches of the stream where it meets the Waimakariri River. The Ōtūkaikino wetland is located between State Highway 74 and Main North Road and is a remnant of the original wetlands that would have covered the Ōtūkaikino Catchment. It is managed as a Living Memorial in conjunction with mana whenua, the Department of Conservation and funeral directors Lamb and Hayward.

5.3. Te Ngāi Tūāhuriri Rūnanga Position Statement / Cultural Impact Assessment

The Rūnanga supplies a Position Statement in lieu of consultation. It is the Rūnanga's preference to avoid endorsing or criticising the SMP. They have provided the following statement and recommendations:

"Te Ngāi Tūāhuriri Rūnanga do not oppose the Ōtūkaikino Stormwater Management Plan, but have the following issues/concerns in conjunction with concerns raised in the 2022 State of Takiwā report:

Ngā Wai/Wai Māori - Freshwater

CCC has identified a high level of zinc at on site (near the Omaka Scout Camp), and levels of dissolved copper above consent target levels. The 2022 State of Takiwā report by MKT identified concerning levels of phosphorous, *E. coli* and nitrate-nitrogen within the sites surveyed in this catchment.

Fine sediment is a significant issue within the catchment, with several sites exhibiting sediment accumulation. This has been exacerbated through the lack of riparian planting at most sites and willow removal works downstream of the Groynes occurring at the time of the 2022 State of Takiwā monitoring.

Current stormwater treatment methodologies are reliant on predominantly passive methods (e.g., rain gardens, stormwater basins). Rūnanga are concerned with the efficacy of these treatment methods.

Any discharge of untreated wastewater into the Ōtūkaikino catchment (including from the overflow site, Tyrone Street Pumping Station, and from private wastewater systems) is intolerable under the principles of kaitiakitanga and tikanga and has a directly adverse impact on wai māori.

Rūnanga are concerned that areas set aside for mitigation will not be sufficient for significant water quality improvement. Mana whenua want CCC to give serious consideration to the addition of other methods to compliment treatment (see Recommendation 13 below).

It has been identified that stock access to the waterway may be a factor impacting water quality throughout the catchment, contributing to sedimentation and contamination. This is of particular concern around spring sites.

Taonga Species and Mahinga Kai

Rūnanga are concerned that the water quality objectives stated in the CSNDC are not stringent enough to reduce containment levels within the Ōtūkaikino catchment.

The lack of riparian plantings and as well as native and instream habitats throughout the catchment limits the ability for taonga species to recover within the catchment, and the ability for mana whenua to undertake mahinga kai practices, where appropriate.

The Ōtūkaikino Stormwater Management Plan has identified that in-stream habitat conditions have grown worse over the time that CCC have been monitoring. In-stream habitats are key to the ongoing health and recovery of taonga species."

Table 1: Response to Cultural Impact Assessment

No.	Recommendation *	Action Taken
1	Engage with mana whenua prior to any proposed changes, enhancements, translocations and/or diversions rather than consult retrospectively.	Yes, the Council expects to engage with mana whenua in this way.
2	Ensure mana whenua can implement their own management strategies (which include practices such as rāhui, or other customary tools), in keeping with treaty principles.	Where mana whenua management strategies can be effected through stormwater management plans the Council will engage with mana whenua in good faith and will implement what is achievable.
3	A catchment-based planting plan must be developed that ensures riparian margins are protected and provide sufficient habitat for taonga species. This should include removal of exotic pest species (e.g. blackberry, clematis, willows) to prevent indigenous planting being choked. These works must have stringent erosion and sediment controls in place during works to protect the awa.	Council Units will be made aware of this recommendation directly and will action through two plans: the Surface Water Implementation Plan and the Healthy Water Bodies Plan, Strategic plan for surface water.
4	Nitrate, phosphate, and *E. coli* levels within the catchment must be monitored regularly and the sources of this contamination be identified as soon as possible.	Nitrates, phosphates and E. coli are monitored through monthly samples. Where there is an exceedance, this is investigated and reported on through the annual report.

No.	Recommendation *	Action Taken
5	Pending results of *E. coli* investigation, appropriate measures must be implemented to reduce levels of contamination within the catchment. Further information on the source of the *E. coli* contamination and measures to reduce contamination must be discussed with Rūnanga through appropriate channels.	Acknowledge
6	Sediment sources must be investigated throughout the catchment, and specific plans for planting be developed and enacted to mitigate erosion impacts in these areas. As mentioned above, any plantation works must have stringent erosion and sediment controls to protect the awa.	Acknowledge
7	Council should investigate options to improve instream habitats. Measures to improve in-stream habitat must be discussed with Rūnanga through appropriate channels.	Yes, Council are investigating instream habitat improvements.
8	Mahinga kai sites should be developed throughout the catchment in conjunction with mana whenua, where culturally appropriate.	Acknowledge
9	Ensure the protection and enhancement of known spring sites.	Policy 9.5.2.2.3 – Ngā wai in the Christchurch District Plan protects the natural character of springs. Section 8.7.4.6 (CDP) allows conditions to control the extent to which springs are protected. CCC projects will always protect springs near water bodies.
10	Where stormwater treatment facilities cannot be installed, ensure that stormwater is diverted into the wastewater system, especially in industrial areas.	This should be effective in principle. The Council is investigating feasibility; however, it seems unlikely to become widely used.
11	Acknowledge that the mixing of human effluent (wastewater) and stormwater leading to discharge into the Ōtūkaikino is intolerable. Appropriate oversight of the installation and maintenance of private wastewater systems, and regular maintenance of the Tyrone Street Pumping Station must be undertaken to prevent overflow events.	Acknowledge

No.	Recommendation *	Action Taken
12	Support regular State of the Takiwā reporting in the catchment.	A State of the Takiwā framework is being developed in consultation with Mahaanui Kurataiao and an MKT employee is being funded to do this (and other duties).
13	Investigate the potential of denitrifying bioreactors to support nitrate conversion, specifically in areas where nitrate levels exceeded ANZEEC guidelines, and shell bioreactors to assist with metal contamination reduction.	Acknowledge
14	Enact more stringent water quality guidelines in line with that of groundwater/drinking water, alongside monitoring of potential sources of contamination.	Acknowledge
15	Ensure stringent erosion and sediment controls across the catchment, with particular regard for development in locations of LLUR sites.	Acknowledge
16	Council must ensure that waterways are appropriately fenced and protected from stock where possible.	Acknowledge

*Source: Te Ngāi Tūāhuriri Rūnanga Position Statement: Ōtūkaikino

5.4. Cultural Monitoring

Cultural monitoring enables the Council and Ngāi Tāhu to compare future conditions against the State of the Takiwā Report, 2007. Cultural monitoring will be carried out as part of the Environmental Monitoring Programme. Sites will be sampled five-yearly in conjunction with the monitoring of surface water quality, instream sediment quality and aquatic ecology.

A cultural health assessment of this catchment was carried out for the 2022 mātauranga monitoring report. The assessment is based on surrounding land use, vegetation, riverbed condition, water clarity, habitat variety and changes to the river channel. Monitoring indicated that the catchment is in moderate cultural health, with those sites where extensive restoration works have been undertaken scoring the highest. The catchment has been highly modified from a braided river to a low plains spring-fed stream and adjacent agricultural land uses and roads were identified as the largest pressures on site health.

Two of the six sites (Ōtūkaikino Wetland and Ōtūkaikino at Isaacs Conservation Reserve) scored above 4 out of 5 (Good). The average of six scores was 3.3 (Moderate).

Fine sediment is a significant issue for the creek, with several sites exhibiting sediment accumulation. This has been exacerbated through the lack of riparian planting at most sites and recent willow removal works downstream of the Groynes. Furthermore, the May 2021 floods caused significant sediment deposition in the furthest downstream reaches of the Ōtūkaikino and therefore monitoring could not be conducted further downstream than Dickeys Road bridge.

Water quality testing and assessment identified a range of concerns throughout the assessment. Zinc was detected throughout the catchment, but in concentrations below the ANZG guidelines for 95% species protection. Copper concentrations were below the limits of detection. Phosphorus, *E. Coli* and nitrate-nitrogen were identified to be the contaminants of concern within this catchment and further studies should be conducted to identify the likely sources of these.

None of the sites surveyed are currently utilised for mahinga kai practices due to limited site access, lack of indigenous planting, sedimentation, and water contamination.

6. The Receiving Environment

6.1. Receiving Water Classification

Waterways in the Ōtūkaikino catchment are classified in the Waimakariri River Regional Plan (WRRP). That classification is described below.

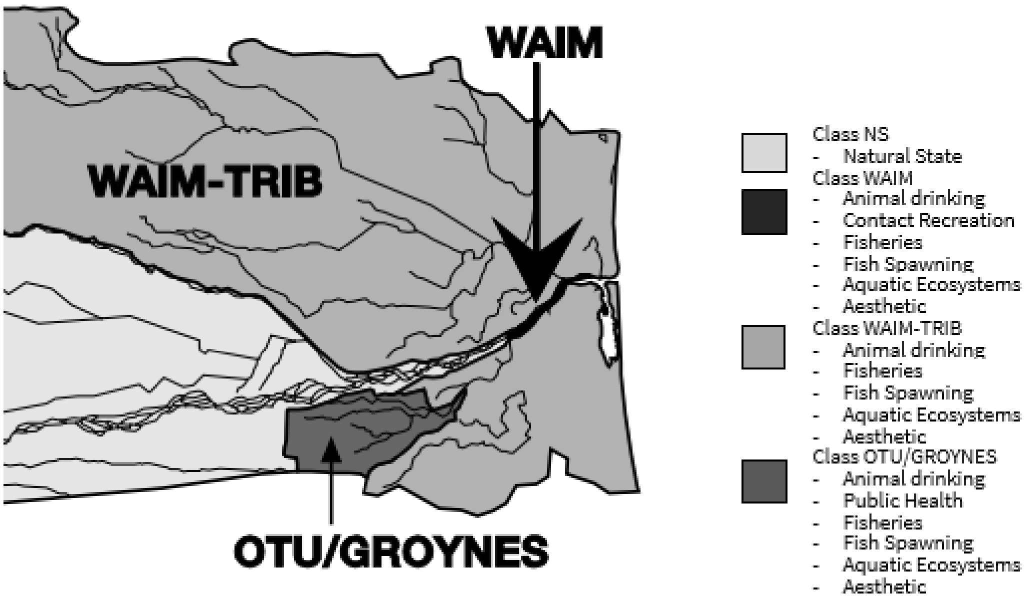


Figure 5: Ōtūkaikino water classification

Waters west of Clearwater (including most tributaries of the Ōtūkaikino Creek) are classified in the WRRP as 'OTU/GROYNES' and waters east (downstream, including Wilsons Drain) are classified 'WAIM-TRIB'. Standards for OTU/GROYNES water exceeds WAIM-TRIB in the requirement that "the natural quality of the water with respect to organisms of public health significance shall not be altered."

However, the Council must meet Receiving Environment Objectives and Attribute Target Levels (numerical targets) from the Consent CRC231955, Schedule 7. These are more restrictive than the WRRP classification. Receiving environment objectives that apply (Schedule 7 in the CSNDC) are reproduced in Appendix F and discussed in the section below.

6.2. Water Quality

The Council monitors water quality monthly at three sites: the Groynes Inlet (since 2008), Wilsons Drain (since 2013) and the Omaka Scout Camp (since 2014). Results from monthly copper and zinc monitoring are summarised in Table 2.

Water quality in the rural part of the catchment is very good, because the water arises directly from the Waimakariri River (via seepage and spring flow) with few inputs from urban sources. Water quality samples meet the Waimakariri River Regional Plan receiving water standards.

The water quality index scores in 2019 were 84.0 (Good) at The Groynes site and 89.2 (Good) at the Scout Camp site. A score of 90 is Very Good (and 100 is the maximum possible score). These scores are best equal in the city with the Styx River at Main North Road.

Despite the rural nature of the catchment the monthly water quality sampling shows occasional exceedances of the Schedule 7 Attribute Target Levels for metals. Reasons for the exceedances are not obvious but are being monitored via the monitoring programme and site visits.

Table 2: Dissolved copper and zinc exceedances in monthly water quality monitoring

Year	Ōtūkaikino Creek at the Groynes Inlet		Ōtūkaikino Creek at the Scout Camp		Wilsons Drain	
	Dissolved Copper exceeds 0.00152 mg/L	Dissolved Zinc exceeds 0.00868 mg/L	Dissolved Copper exceeds 0.00152 mg/L	Dissolved Zinc exceeds 0.00868 mg/L	Dissolved Copper exceeds 0.00152 mg/L	Dissolved Zinc exceeds 0.00868 mg/L
2008	0 (only 3 months sampled)	0	ns	ns	ns	ns
2009	0	0	ns	ns	ns	ns
2010	0	0	ns	ns	ns	ns
2011	0	0	ns	ns	ns	0
2012	1	1	ns	ns	ns	1
2013	0	1	ns	ns	0	1
2014	0	1	0	1 (only 3 months sampled)	0	1
2015	1	1	0	3	0	1
2016	0	1	0	1	0	1
2017	2	0	0	2	0	1
2018	0	0	0	0	0	2
2019	2	0	0	0	0	0
2020	0	0	2	0	0	0
2021	0	0	0	0	0	0
2022	0	0	0	0	1	2

ns = no sampling

6.3. Sediment Quality

Streambed sediments can demonstrate the effects of stormwater discharges if contaminants such as metals and persistent organics accumulate. Accumulated contaminants can adversely affect stream biota.

Bed sediments were sampled for grain size, metals, organic carbon, phosphorus and PAHs (Boffa Miskell, 2022). Wilsons Drain at Main North Road had the highest proportion (68.9%) of silt/clay (<0.063mm), out of all three sediment monitoring sites. Ōtūkaikino Creek at The Groynes inlet also had a relatively high proportion (44.7%) of silt/clay substrata.

Metal contaminants are usually found in higher concentrations in sediment samples with the higher silt and clay contents (i.e., substrata <0.063 mm in size), as the greater surface area of smaller particles increases the amount of metal adsorbed. With the exception of OTUKAI02 (Wilsons Drain), total recoverable copper, lead, and zinc for all sites were below the CSNDC guidelines and the ISQG-high and ISQG-low of the ANZECC (2000) sediment quality guidelines. The concentration of zinc in the streambed material at OTUKAI02 was above the CSNDC guideline, but below ISQG-low ANZECC (2000) sediment quality guideline. Where the sediment concentration is below the ISQG-low, it is considered that there is low risk of adverse effects to aquatic life. The concentrations of zinc at OTUKAI02 was markedly greater (approx. at least 9 times greater) than that recorded in 2019.

Total phosphorus (TP) and Total organic carbon (TOC) concentrations ranged from 290 to 1413 mg / kg TP, and 0.22 to 7.4 g / 100 g TOC. The highest concentration of both TP was recorded at OTUKAI02 (Wilsons Drain), indicating this site (and possibly others) may be impacted by fertilisers. Contaminants such as fertilisers, pesticides, and industrial chemicals can cause elevated TOC concentrations. TOC was highest at OTUKAI01 (The Groynes Inlet). Canopy cover and overhanging vegetation was also high at this site, which could have influenced the TOC concentration.

There are no listed ANZECC (2000) guidelines for TP or TOC. However, the levels measured in the three sites surveyed were similar to levels detected in other catchments within the Christchurch City limits (e.g., InStream Consulting Ltd, 2019, 2020).

Total PAHs of all sites, normalised to 1% TOC (as recommended in ANZECC 2000), were well below the ISQG-high and ISQG-low guidelines of the ANZECC (2000) sediment quality guidelines. The highest recorded PAH concentration was at OTUKAI02 (Wilsons Drain at Main North Road).

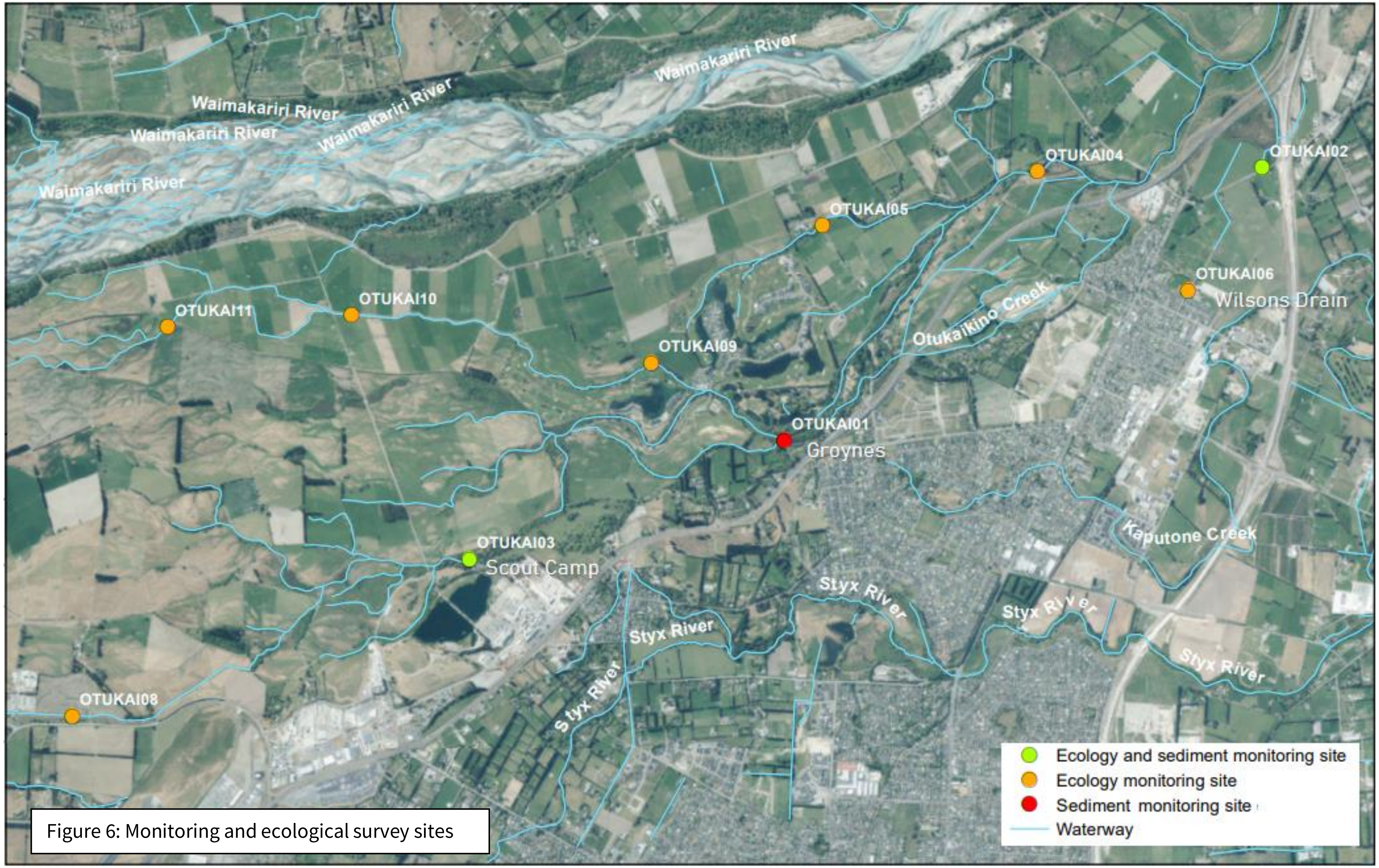


Figure 6: Monitoring and ecological survey sites

6.4. Aquatic Ecology

Aquatic ecology surveys are carried out at five-year intervals at the nine sites in the Ōtūkaikino Stream and tributaries. Riparian and in-stream habitat conditions, sediment contaminant concentrations, and the macroinvertebrate and fish communities were last surveyed in March 2022. Monitoring data from nine sites in the Ōtūkaikino River Catchment showed that riparian habitat conditions were similar to previous years at most sites. OTUKAI04 (Ōtūkaikino upstream of Dickeys Rd) and OTUKAI10 (Ōtūkaikino at Coutts Is. Rd) have improved riparian margins, where riparian planting of indigenous vegetation has taken place. The greatest regression in riparian conditions was observed at OTUKAI09 (Clearwater Resort) and OTUKAI11 (Ōtūkaikino Headwaters) where margins had become dominated by sprayed grass and grey willow, respectively. All other sites were typically buffered by mown or pasture grasses.

In-stream habitat conditions at all sites had generally worsened compared to previous years. Sites were typically wider, deeper, and slower than previous years, with a significantly higher cover of fine sediments. Changes to substrate index score, embeddedness, sediment depth, and sediment cover from previous years to this survey (2022) all indicate an increased presence of finer substrates, like sand and silt. Site OTUKAI08 was the exception, where the stream bed remained dominated by cobble and gravel substrates but still showed an increase in sediment cover and depth. Only one site, OTUKAI08 (Ōtūkaikino at McLeans Is.), met the CSNDC attribute target level for maximum fine sediment cover. Moreover, macrophyte cover has increased at most sites, where four sites exceeded the CSNDC attribute target level for maximum macrophyte cover. Excess macrophyte growth can reduce velocity, catch suspended sediments and reduce availability of coarser substates. The increased presence of fine sediment and macrophyte cover in the catchments means coarser substrates, like cobbles, are less available to aquatic biota (for grazing, egg laying, using as refugia).

Mats of the toxic cyanobacteria, *Phormidium*, were found at sites OTUKAI05 (Kaikanui Creek), OTUKAI08 (McLeans Is. Rd), OTUKAI09 (Clearwater Resort), and OTUKAI10 (Coutts Is. Rd) ranging from 1% to 18% cover. Toxic cyanobacteria were not noted in either the 2012, 2017 or 2021 surveys. The presence of toxic algae is of concern to the recreational value of the stream as it can pose a risk to human and animal health. Blooms can be associated with higher water temperatures and elevated nutrient levels.

The basic water quality parameters of conductivity, pH, and water temperature were within ranges expected in spring-fed urban environments during base-flow conditions. Measurements were similar to previous years and met the LWRP guideline value. Dissolved oxygen (DO) levels were low at 8 of the 11 sites, not meeting the LWRP guideline value of 70% or greater saturation on the day of the survey. However, the streams are groundwater-fed, and groundwater can have low DO. DO can vary diurnally and seasonally, and macrophyte and algal abundances at a site can greatly influence DO concentrations, thus the increased cover of macrophytes at sites could explain some the lower saturation. DO measured in monthly water quality monitoring mostly exceeds 80% saturation. The presence of taxa sensitive to oxygen levels, such as kēkēwai (freshwater crayfish) and trout may indicate that dissolved oxygen saturation in the catchments is generally acceptable.

Macroinvertebrates are an important and commonly used measure of stream or ecosystem health. Invertebrate community composition in 2022 was similar to previous years, being dominated by pollution-tolerant snails and the stony-cased caddisflies *Pycnocentria evecta, Pycnocentrodes aureulus.*

All five-yearly monitoring sites, except OTUKAI04, OTUKAI05, OTUKAI09, and OTUKAI10 were below the LWRP guideline of a minimum MCI of 90, or minimum QMCI of 5. The ASPM guideline values were exceeded at most five-yearly monitoring sites, except OTUKAI11, OTUKAI02, and OTUKAI06. Similarly, none of the annual monitoring sites met the NPS-FM national bottom line and consent target value, respectively, while the ASPM guideline was exceeded at all sites.

Indigenous fish species were present at all 11 sites within the Ōtūkaikino River and Cashmere Stream catchments. Most importantly, six sites, supported longfin eels, an "At Risk, Declining" species. The presence of elvers (juvenile eels, either longfin or shortfin) (Table 3) at most sites is encouraging and can be a good sign for population recruitment and persistence. Inanga, another "At Risk, Declining" species was also found in the Cashmere Stream Catchment (HEATH28). Inanga may have been present at other sites; however, inanga can be underestimated using electric fishing techniques (Joy et al. 2013). Of the sites that were comparable between years, there was no overall trend in community composition over time.

6.5. Comparison to consent attribute target levels

The CCC's CSNDC has attribute target levels for sediment concentrations of copper, lead, zinc, and total PAHs, fine sediment cover, total macrophyte cover, long filamentous algae cover, and QMCI scores.

Consent targets for sediment copper, lead, zinc, and total PAHs have been mostly compliant in the 2017 and 2022 monitoring years with only zinc exceeding the consent target at one site (OTUKAI03, Wilsons Drain at Main Road) in 2022. Fine sediment cover was within the guidelines at most sites in 2017, however in 2022 all but one site (OTUKAI08, McLeans Is.) exceeded the consent target of a maximum of 20% fine sediment cover.

Consent targets for long filamentous algae cover have been met at all sites sampled over the past 10 years. Compliance with QMCI scores has decreased over time, with 88.8% of sites complying with the QMCI target of 5 or greater in 2017, and only 36% of sites complied in 2022.

The basic water-quality parameters of pH, dissolved oxygen, conductivity and temperature were within ranges expected in spring-fed plains waterways during base-flow conditions. Shading was present at most sites, and there was a diversity of in-stream habitat, with little channel modification at most sites. Macrophytes were present at all sites, however total cover was low and filamentous algae were rare.

The full *Ōtūkaikino and Cashmere Monitoring 2022, Five-Yearly and Annual Aquatic Ecology Monitoring Report* can be found at https://ccc.govt.nz/assets/Documents/Environment/Water/Monitoring-Reports/2022-reports/Otukaikino_Ecology_monitoring_2022.pdf

Table 3: Total numbers of fish caught or seen at the nine sites surveyed in 2022.

Site ID	Site name	Fishing method	Common bully	Upland bully	Unidentified Bully spp.	Inanga	Longfin eel	Shortfin eel	Unidentified Eel species	Elver	Brown trout
OTUKAI02	Wilsons Drain, Main North Rd	Traps	0	0	2 (36-38)	0	4 (450-700)	0	0	0	0
OTUKAI03	Ōtūkaikino Ck, Scout Camp	EFM	0	25 (20-60)	16 (20-30)	0	0	7 (150-350)	0	5 (100-120)	1 (80)
OTUKAI04	Ōtūkaikino u/s Dickeys Rd	Traps	4 (53-100)	0	2 (34)	0	4 (560-1010)	0	0	0	0
OTUKAI05	Kaikanui Ck d/s Clearwater Resort	EFM	0	1 (56)	0	0	4 (300-1020)	11 (170-360)	5 (80-500)	7 (65-120)	0
OTUKAI06	Wilsons Drain, Tyrone St	EFM	0	0	9 (28-30)	0	0	7 (150-800)	1	1 (40)	0
OTUKAI08	Ōtūkaikino Ck, Mcleans Is	EFM	0	1 (68)	No information	0	0	28 (155-1000)	9	11 (110-150)	0
OTUKAI09	Ōtūkaikino Ck, Clearwater Res	EFM	4 (30-40)	11 (30-50)	1 (20)	0	6 (150-600)	6 (150-250)	0	2 (100-120)	0

Site ID	Site name	Fishing method	Common bully	Upland bully	Unidentified Bully spp.	Inanga	Longfin eel	Shortfin eel	Unidentified Eel species	Elver	Brown trout
OTUKAI10	Ōtūkaikino Ck, off Coutts Is Rd	EFM	0	19 (40-64)	3 (30)	0	0	3 (200-320)	1 (600)	1 (110)	2 (100-150)
OTUKAI11	Ōtūkaikino Ck headwaters	Traps	0	7 (64-114)	0	0	1 (1015)	0	0	0	0

Size ranges are shown in (). One value means minimum and maximum size were the same.

EFM = Electric fishing machine

Table 4: Conservation status of fish found in the survey (Dunn et al, 2017)

Common Name	Scientific Name	Conservation Status
Common bully	*Gobiomorphus cotidianus*	Not threatened
Upland Bully	*Gobiomorphus breviceps*	Not threatened
Inanga	*Galaxias maculatus*	At risk - declining
Longfin Eel	*Anguilla dieffenbachii*	At risk - declining
Shortfiln Eel	*Anguilla australis*	Not threatened
Brown trout	*Salmo trutta*	Introduced and naturalised

6.6. Groundwater Quality

Groundwater quality has been considered with reference to nitrate N, electrical conductivity, bacterial indicators and metals.

6.6.1. Nitrate

Nitrate is present at relatively low concentrations, mostly below 1 mg N/L. Concentrations are consistent with seepage of very good quality alpine river water into the groundwater system.

6.6.2. Electrical conductivity

Electrical conductivity (EC) values are generally low, indicating fresh water that is not significantly influenced by high ionic concentrations. All but two of the bores tested for EC are less than 50m deep so it is difficult to assess any relationship between EC and depth. Three bores have sufficient data to assess recent trends in EC and the results indicate that EC has remained relatively stable in the groundwater since regular monitoring began in 2013.

6.6.3. Bacterial indicators

The available information on bacterial indicators (faecal coliforms and *E. Coli*) indicates that detections have increased in number since 2015, consistent with the much greater number of samples collected since that time. Detections have been recorded in the eastern half of the study area, as well as in the south in the zone with slightly higher EC and nitrate concentrations. There are only two results for bores with depths greater than 50m so it is not possible to assess the trend of bacterial indicators with depth.

7. Land Use

7.1. Present Situation

Ōtūkaikino Catchment land zonings include rural (RuW), rural urban fringe (RuUF), quarrying (RuQ), airport (SPA), heavy industrial (IH), golf resort (SPG), and open space (OCM, OCN, OCP, OCWM) as shown in Figure 7.

A substantial part of the catchment is zoned for low-intensity, open-space land uses (OCP, OWM, Ru, RuUF, SPG). Commercial development is continuing in the industrial and airport zones.

7.2. Development and Trends

Christchurch City's population is expected to grow by around 23,000 people between 2015 and 2025 and by a further 40,300 people between 2025 and 2046 (Price, 2014). In the 2015 to 2025 period household growth is expected to be 18,000 households.

Belfast South, Aidanfield, Travis Wetland and Wigram are the localities with the highest levels of growth, reflected in developing greenfield areas. Belfast South includes a developing Residential New Neighbourhood (RNN) zone between Johns Road and The Groynes.

7.2.1. Residential Growth

The Applefields/Devondale site (93 Ha) north of Johns Road is zoned residential new neighbourhood (RNN) and is projected to gain 735 households by 2020 and 1,358 households by 2041. Stormwater mitigation measures for this development have been authorised by the Council under the Styx SMP Consent CNC131249. There are no other undeveloped residential areas in the catchment.

7.2.2. Industrial Growth

There are three developing industrial areas: an area north of Factory Road (approx. 74ha within catchment), an area east of Marshlands Rd/Main North Rd (approx. 25ha within catchment), and the Broughs Road/Logistics Drive area (approx. 92ha). The areas north of Belfast are recently zoned Industrial. The older heavy industrial zone north-west of Johns Road (Broughs/Logistics) has until recently had primary industrial uses such as container storage, saw milling, aggregate processing, concrete manufacture, and a significant proportion of vacant land. Development appears to be intensifying with more sites occupied and a tendency for increased site coverage.

Part of the Specific Purpose (Airport) (SPA) Zone contains the equivalent of heavy industrial activity. However approximately half of the SPA zone is expected to remain as grassy runout areas around runways.

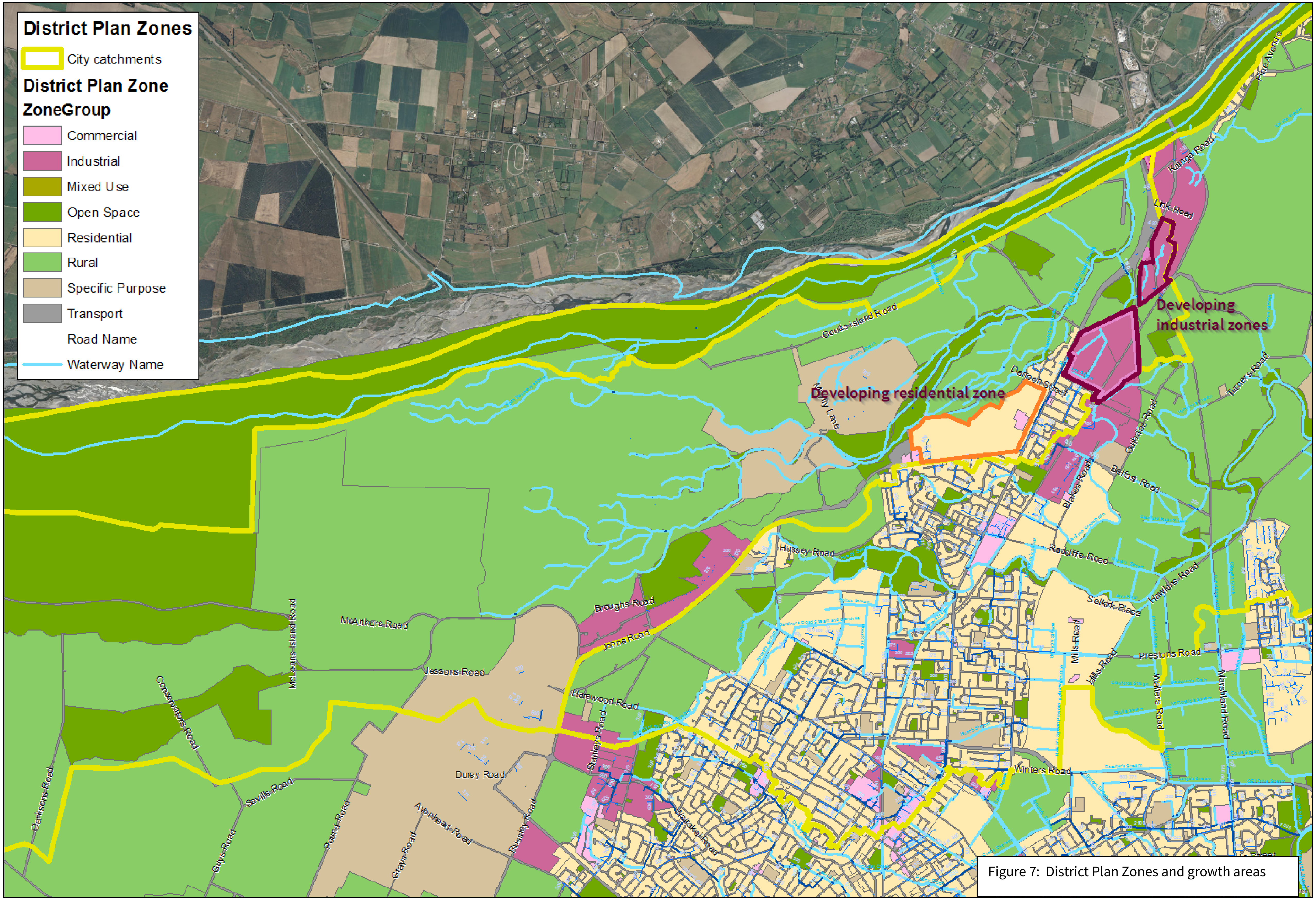


Figure 7: District Plan Zones and growth areas

7.3. Contaminated Sites and Stormwater

7.3.1. Background

Contaminants may be released from two types of sites:

- Sites with in-ground contaminants that may be entrained in stormwater, typically when soil is disturbed and
- Sites where on-site activities, usually industrial in nature, may release chemical or metal contaminants into stormwater (or into the ground).

The National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health Regulations (NES) help to identify potentially hazardous activities and industries which are listed in the Hazardous Activities and Industries List (HAIL), found at http://www.mfe.govt.nz/land/hazardous-activities-and-industries-list-hail#hail-web

Such sites are listed in a Listed Land Use Register when they become known to the Regional Council either through a consent application (to ECan or the CCC) or through investigations. Sampling, excavation, subdivision, removal of fuel storage tanks and changing land use on these sites may require a resource consent and remedial action.

7.3.2. Low Risk Sites

A Memorandum of Understanding (MoU) was agreed between the Council and ECan in July 2014 to allow stormwater discharges from low-risk residential rebuild sites listed on the LLUR and/or identified as having had HAIL activities to be processed by the Council rather than ECan. It is anticipated that as confidence grows over time in the operation of the MoU, the list of “low risk” situations that the Council can process will be extended. For example, sites on the LLUR, where only a portion of the site has had a hazardous activity and the construction will not disturb that part of the site, are considered low risk.

Parts of the Ōtūkaikino Catchment are listed on the LLUR because of old landfills, saw mills, timber treatment plants and orchards. Persistent chemicals may be associated with these sites, however they are generally at low risk of discharging contaminants into stormwater unless the sites are disturbed (e.g. during development). Many of these sites have been investigated as part of subdivision and site development and remediated as necessary.

7.3.3. Higher Risk Sites

“High risk” is generally a reference to sites with persistent or hazardous chemicals in the soil or in use on site. High-risk sites include contaminated sites and some industrial sites.

Many contaminants adhere to sediments and can be mobilised into surface or groundwater when soils are disturbed. These contaminants can be managed by using good sediment control during earthworks and taking care with where soil is disposed of. More specific measures, including on-site treatment, may be needed for more mobile contaminants that cannot be controlled by typical sediment control practices.

All land-use consent applications are checked against the LLUR. Where development is proposed on a site listed in the Listed Land Use Register the application is referred to the Council’s Environmental Health Team. Conditions are attached to the resource consent to deal with short term and long term exposure of contaminants, often requiring site remediation.

7.3.4. Industrial Sites

Industrial sites will be managed in accordance with CRC231955 Conditions 47 and 48 in a process that will occur in parallel to SMPs. The Council will:

- Gather information about and develop a desktop-based identification of industrial sites, ranking sites for risk relative to stormwater discharge;
- Audit at least 15 (principally high-risk) sites per year;
- Inform audited industries of the results of audits and work closely with these industries to achieve outcomes in line with the Stormwater Bylaw;
- Communicate with industries about stormwater discharge standards and the means of meeting these standards.

The Council will be empowered to do these actions by the Stormwater and Land Drainage Bylaw 2022.

7.3.5. Historical Landfills

There are two known closed landfills in the catchment; at Orchard Road and Greywacke Road; shown in Figure 3. The composition of material at these sites is unknown.

The main risk factor for landfills from stormwater is the inundation of previously dry landfill by groundwater mounding associated with infiltration and detention basins. This can cause leaching of contaminants from the landfill into groundwater. The landfill near Greywacke Road is located next to a pond so the waste material may already be inundated.

The nature (size, depth and likely materials) of the closed landfills means that the risks to groundwater quality associated with groundwater mounding are likely to be low. It is not anticipated that large-scale infiltration basins will be installed near the old landfills. Some private infiltration basins and swales have been installed nearby under resource consents issued by Environment Canterbury.

7.3.6. Facilities Built Near Contaminated Sites

There may be soil contamination from farming activities (e.g. agricultural chemicals) and lead paint or asbestos associated with old buildings.

Table 15, Appendix C contains comments about the proximity of proposed mitigation facilities to sites where land contamination might be present.

8. Contaminants in Stormwater

8.1. Introduction

Urban activities cause environmental effects either by shedding more or faster stormwater runoff or by discharging contaminants into stormwater that are harmful to the environment. Most urban surfaces have some form of coating (e.g. paint or galvanising) and a transient layer of wind-blown dust, combustion products, cleaning compounds, etc. Most of these substances are soluble or slightly soluble in rainwater and are transported in dissolved and particulate form into the stormwater network.

8.2. Contaminants and Contaminant Sources

The Christchurch City Council and Environment Canterbury monitor rivers, streams and stormwater for a range of water quality indicators. These include total suspended solids (TSS) (dust, sediment, grit, and particles of all types), heavy metals, a range of hydrocarbons, bacteria and dissolved oxygen among other indicators. From time to time the Council samples for newly discovered ("emerging") contaminants, and both councils are aware of the likelihood that there are other unknown, harmful substances in stormwater.

The Council's monitoring programme is largely based on the Land and Water Regional Plan's

- Schedule 5 Table S5A and Table S5B Indicators and Toxicants, and
- Schedule 8 Water Quality Limits

Contaminants of most concern in the Christchurch District are:

- Dust, sediment, grit and particles of all types capable of being transported in stormwater, referred to as total suspended solids (TSS). TSS include metal particles, aggregates of metallic compounds, and charged (e.g. clay) particles with attached metal ions.
- Dissolved and particulate zinc
- Dissolved and particulate copper
- Polycyclic aromatic hydrocarbons (PAHs)
- Pathogens
- Nutrients (mostly phosphorus)

Lesser contaminants, which generally do not exceed guidelines, are:

- Hydrocarbons (oil and grease)
- Cadmium and lead

8.2.1. Suspended Solids

Particle sources include streambank erosion, animal waste, construction activity, land cultivation, combustion, industrial products, tyre and brake wear and paint coating breakdown. Some particles are natural materials and some are artificial (e.g. paint chips). Soil particles contain metals and may carry adsorbed chemicals.

Suspended solids are damaging because they deposit on stream beds and fill the spaces between stones, greatly reducing the refuge options for instream life. Fine particles can release attached toxic compounds which harm the food chain.

The most important sources of particles in waterways in this catchment are likely to be:

- Ōtūkaikino Creek; stock access to and into waterways
- Wilsons Stream; road runoff - a combination of road surface wear and vehicle emissions.

8.2.2. Zinc

Zinc is used as a protective coating for steel on corrugated iron roofs, rooftop ventilators, chain link fencing, lighting poles and various barriers and fences. Although a zinc layer is long-lived it is slowly being dissolved by rainwater. Industrial and farm buildings often have unpainted galvanised roofs and can be large sources of zinc. Residential areas typically have painted or tile roofs, but many of these have older paint coatings in poor condition and can be a significant source of zinc.

Roofs create approximately 75% of urban zinc. Roads create approximately 25%, much of which is from tyres. Zinc makes up about 0.8% by weight of tyres in which zinc oxide is a vulcanising catalyst. Zinc released onto roads is very fine and dissolves and is transported readily in stormwater.

Other zinc sources include galvanised fencing and posts, fungicides, paint pigments and wood preservatives.

Many sources such as Timperley et al (2005) report that tyre-derived zinc is transported onto other surfaces, including roofs, by wind. Stormwater sampling in Christchurch supports this, showing zinc runoff from nominally zinc-free surfaces such as concrete tile roofs.

8.2.3. Copper

Dissolved copper has been found above consent target levels in monthly water sampling in the Ōtūkaikino Creek. The reason for the exceedance is not known and no potential sources have yet been identified, although the Council is investigating.

The predominant copper source in urban stormwater is thought to be vehicle brake pad wear. Copper could be expected to exceed guidelines in Wilsons Stream during some rainfalls.

8.2.4. Polynuclear aromatic hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are created when products like coal, oil, gas, and garbage are incompletely burned. PAHs are a concern because they do not break down very easily and can stay in the environment for long periods of time. PAHs may come from coal tar sealants and diesel or industrial combustion.

8.2.5. Pathogens

Monthly water quality monitoring measures the numbers of EColi as an indicator bacterium for the presence of faecal pathogens. Bacteria are most concerning if they are from human sources, representing a risk of communicable diseases. EColi counts are usually caused by waterfowl (ESR, 2015). Potential sources in this catchment could include farm animals and dogs.

Ōtūkaikino Creek

EColi counts mostly do not exceed safe levels for contact recreation (550 counts/100 ml). There were pathogen exceedances in monthly sampling in 2020 (one), 2018 (two), 2014 (one), 2013 (one), 2012 (one) and 2011 (two).

Wilsons Stream

There have been one or two pathogen exceedances per year in monthly sampling since 2017.

8.2.6. Nutrients

International research indicates that important nutrient sources include decaying leaves, sediment, fertiliser and bird and animal faeces. Nutrients can lead to excessive aquatic plant growth.

Ōtūkaikino Creek

Phosphorus in Ōtūkaikino Creek exceeds the LWRP guideline (0.016 mg/L) less than once per year in monthly sampling since 2009. It regularly exceeded for a period during 2008-9 which may indicate an anthropogenic source; possibly fertiliser or animal dung. Nitrogen very seldom exceeds the LWRP guideline (DIN < 1.5 mg/l).

Wilsons Stream

Phosphorus is generally near or above the LWRP guideline and nitrogen generally exceeds the LWRP guideline.

8.2.7. Contaminant sources

Table 5: Catchment-specific contaminant sources into Ōtūkaikino Creek

Contaminant	Source	Contribution	Possible Mitigation Methods
Sediment	Farm animals trample stream banks	Significant	Stock exclusion (fence waterways)
	Farm animals faeces dropped in-stream	Unknown	Stock exclusion (fence waterways)
	Construction sites	Unknown, possibly mitigated	Sediment & erosion controls
	Road works	Low	Sediment controls
	Atmospheric deposition	Low	Riparian tree cover
	Plants (leaves, etc)	Low (seasonal)	None
	Vehicle emissions	Low	Treat road runoff
	Visitor activity (stream access)	Medium	Signage
Zinc	Bare galvanised roofs	Relatively few galv. roofs discharging to waterways in this catchment. (High city-wide.)	Replace with: Non-metal roofs or Pre-coated Zn-Al Paint with: Low zinc paint
	Ageing painted roofs	High city-wide. Could be an issue as new pre-coated roofs age.	Replace with: Non-metal roofs or Pre-coated Zn-Al Paint with: Low zinc paint

Contaminant	Source	Contribution	Possible Mitigation Methods
	Bare Zn-Al[1] roofs	High city-wide. Moderate in this catchment where industrial roofs discharge into the ground.	Replace with: Non-metal roofs or Pre-coated Zn-Al Paint with: Low zinc paint
	Vehicle tyres	High city-wide. Most road runoff into ground in this catchment	Treat runoff from: Busiest roads Car parks Manoeuvering areas
	Industrial discharges (inferred from monitoring)	Medium	Controls on industrial sites
Copper	Brake pads	High city-wide. Most road runoff into ground in this catchment	Legislation bans copper in brake pads
	Roofs, cladding, spouting, downpipes	Low but increasing	Ban on copper cladding
Lead	Paint flakes/chips from old buildings	Unknown but more likely to contaminate soil than water	Site remediation during development
Waterfowl sourced bacteria	Ducks, geese	Major bacteria source	Not stormwater related. Not covered by this Plan
Industrial discharges	Deliberate spills or poorly controlled sites	Unknown	Regulation, monitoring and enforcement
Polynuclear aromatic hydrocarbons	(Old) coal tar street surfaces. Combustion	Unknown. Likely low	Encapsulation. Removal. Monitor
Nitrate and nitrite	Groundwater Fertiliser	Moderate Believed low	Beyond CCC control Education
Phosphate	Industrial sources Fertiliser Leaves	Moderate Believed to be a minor source unknown	Education, enforcement Education

[1] Zinc-aluminium coated steel. Has commonly replaced galvanised iron since 1994.

9. Flood Hazards

9.1. History

The threat to Christchurch City from the Waimakariri River was understood early in the period of European settlement. In 1860, Samuel Butler described early attempts to tame the river, noting that the river could easily move from its current position and flow through Christchurch. The period between the 1860s and the 1960s has been described by Logan as "The Hundred Years War" which was "to make the Waimakariri go, not where it wanted, but where the engineers dictated" (Logan, 1980). Work in the late 1800s was successful in keeping floods out of Christchurch, and the objective at the time was protection of land on the southern side of the River. It wasn't until the Waimakariri River Improvement Act of 1992 that official efforts became focused on protecting both sides of the River.

Significant advancements in the level of protection were achieved in the late 1920s with the Eyre River Diversion; early 1930s with stopbanks on the south branch from Halkett to Harewood and cutting-off the South Branch by the construction of Crossbank (across the South Branch to the east of McLeans Island). However, two large floods in the 1950s which resulted in river breakouts and flooding of adjoining land led to a major scheme review and a works programme commencing in the 1960s, at an estimated cost of £1.6million.

Figure 8 represents the river before the current flood control scheme with North and South Branches flanking Coutts Island. Figure 9 is an outline of the 1960 flood control scheme.

The 1960s scheme –completed in the early 1980s – resulted in a continuous line of primary stopbanks from the mouth of the Waimakariri River to the west of McLeans Island. Further upstream from this point, the river (is) naturally constrained by topography with assistance from the construction of some spur groynes (Sweeny 2016).

Works described above created a separate Waimakariri River South Branch. Its name was changed to Ōtūkaikino Creek in 1987 by the NZ Geographic Board.

9.2. Stopbanks - Environment Canterbury

"The existing Waimakariri River primary stopbanks have hydraulic capacity to contain up to a 500 year return period flood (4,730 cumecs) with freeboard, however there is a significant risk of stopbank breach during (various) flood events due to the very high energy of the floodwaters, significant bed material movement, and the risk of an altered river course and/or berm erosion.

A risk assessment determined that there is some risk of stopbank breach during a 100-year flood (4,000 cumecs), as occurred at Coutts Island in 1957 (3,900 cumec peak flow). This risk increases with the size of flood, and … on antecedent flood events, so a failure is almost certain somewhere (probably on the Christchurch rather than the Kaiapoi side) for a 500-year flood.

(A) secondary stopbanking system has been designed to capture … primary stopbank breach flows and return them to the river at two points; water flowing from breaches in the Halkett area would be directed back into the river at Miners Road, and water flowing from breaches in the McLeans or Coutts Island area would be returned at the Ōtūkaikino Creek outlet, just upstream of the Motorway Bridge.

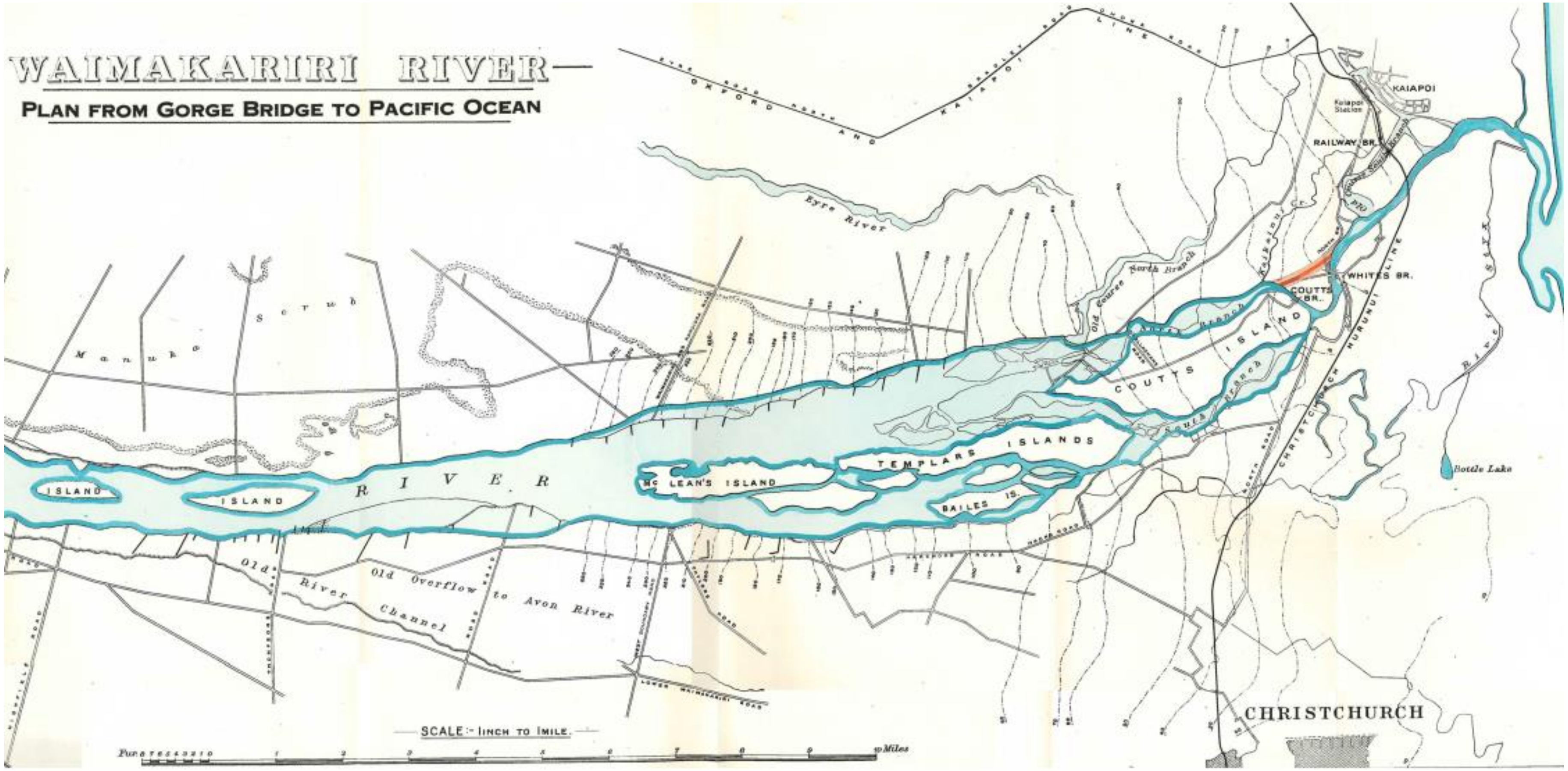


Figure 8: Waimakariri River (G Nelson 1928)

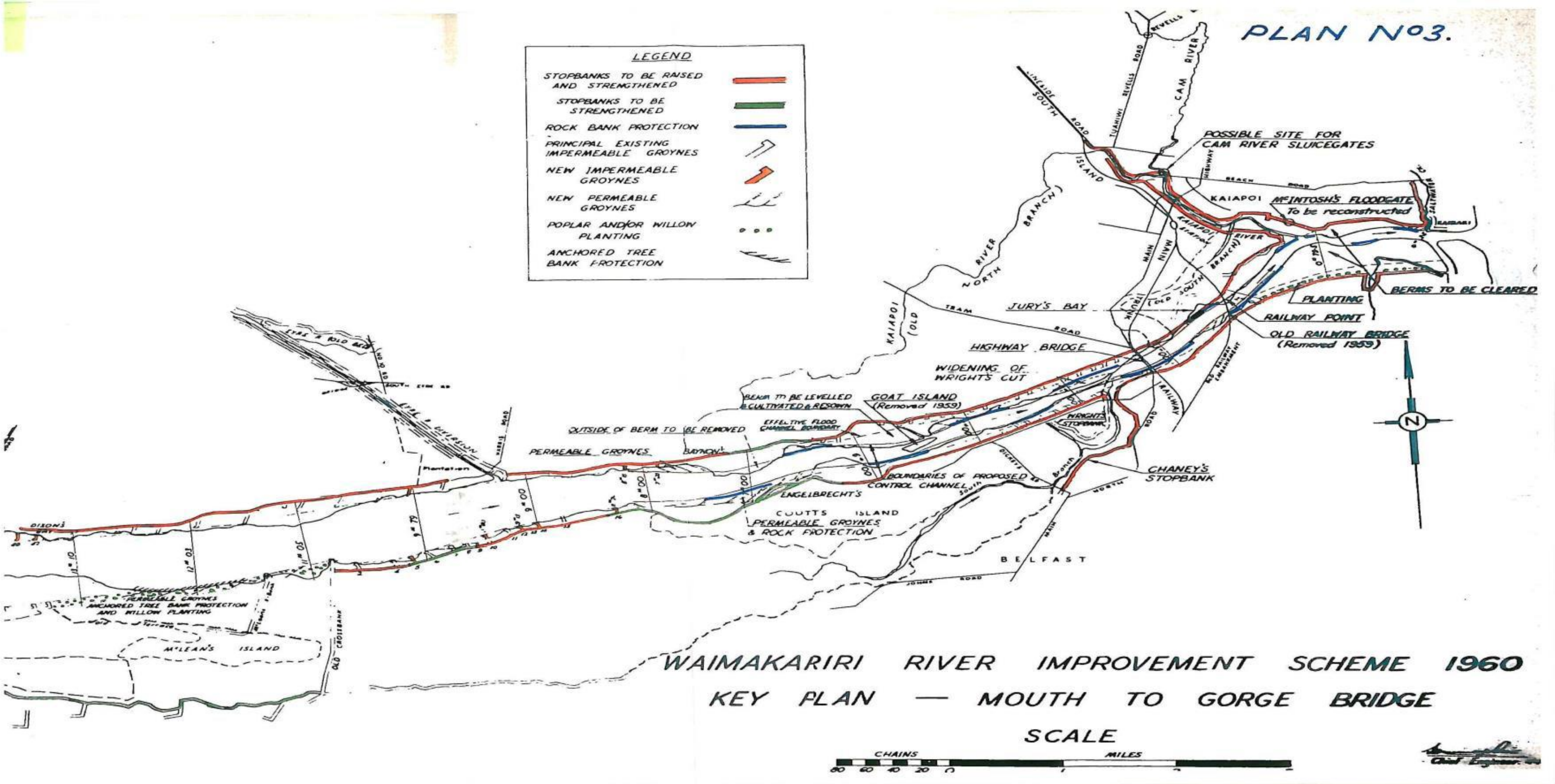


Figure 9: Waimakariri River Improvement Scheme 1960

The design breach flow for the Halkett breach is 1,000 cumecs, and for the McLeans/Coutts Island (the design) breach (flow) is 2,000 cumecs. These are the expected breach flows in the event of a very large 6,500 cumec flood (of estimated 10,000 year return period)." (Ian Heslop, ECan, 2015)

The secondary stopbanking system is indicated in Figure 10.

9.3. Flooding Risk to Urban Areas

Urban areas are elevated above the creek and its rural floodplain and are protected from flooding in the Waimakariri River either by elevation or by stopbanking. Some localised ponding could occur within the various sub-catchments in extreme rain events. Buildings in rural zones are on elevated land that will remain dry in the event of a potential breakout of the Waimakariri River through its primary stopbank.

Older Belfast residential areas sit on a low, flat ridge between the Ōtūkaikino and Kā Pūtahi Creeks. Small topographical variations concentrate runoff from extreme storms into hollows and slight valleys. On such occasions sufficient water could accumulate to flood houses whose floors are near the ground. Older houses founded on piles appear to be safely elevated but approximately 8 newer houses on low (concrete slab) foundations appear to be subject to inundation from information in interim 50 year flood level modelling.

Since 2014 all new house floors have been assigned floor levels safe from flooding, as determined from hydraulic modelling.

Industrial zones in the north-west are on elevated ground and tend to shed stormwater away from the Ōtūkaikino Creek, following the lie of the land. In heavy rainfall this could lead to limited, localised surface flooding.

9.4. Should the Christchurch City Council Manage Flooding in Ōtūkaikino Creek?

Ōtūkaikino Creek has a mostly rural catchment, north of the secondary stopbank. Runoff from urban areas join the creek from detention basins in the vicinity of The Groynes and in Wilsons Drain which discharges near Chaneys. High water levels in the Waimakariri River may effect the urban area by restricting the outflow of water from Wilsons Drain. This is expected to be a rare event.

Flows from existing and new development within the catchment are moderated by detention and will not affect water levels in Ōtūkaikino Creek sufficiently to influence other developed land. For these reasons the Council does not need to manage flooding in the Ōtūkaikino Creek.

Sections 9.6, 9.7 and 12 discuss provision to limit flooding within the catchment.

9.5. Flood Modelling

Flood levels estimated by hydraulic modelling are used in setting floor levels to limit risks to new development.

The Council developed a hydraulic model of the Pūharakekenui-Styx catchment in 2012 as part of planning for residential and industrial growth in the Belfast area. The model assesses the expected response of the city's stormwater network, streams, rivers and floodplains to prolonged rainfall, and was the best available representation of the Pūharakekenui-Styx catchment at the time. The model included part of the Ōtūkaikino catchment for technical reasons. However, Ōtūkaikino topography and stormwater network are not accurately represented in the undeveloped north of Belfast and are to be refined for expected model release in 2025.

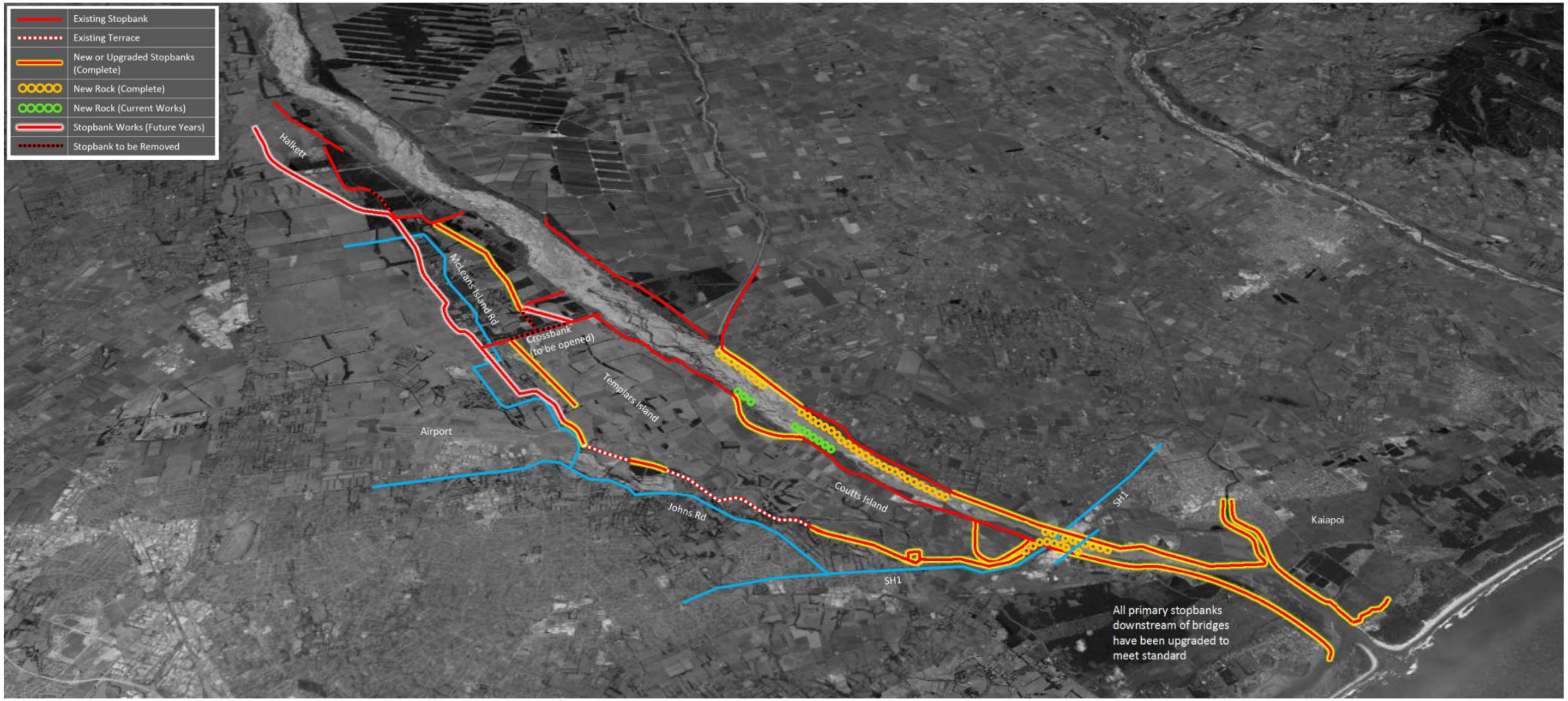


Figure 10: Waimakariri River Scheme, Primary and Secondary Stopbanks

The hydraulic model is being updated and includes the urban part of the Ōtūkaikino catchment. It uses the Danish Hydraulic Institute (DHI) suite of software, MOUSE, MIKE 21, MIKE 11 and MIKE Flood and MIKE URBAN to create a 1-D model of waterways and a 2-D model of floodplains. Land cover under existing development and maximum probable development will be modelled for both 50 year average recurrence interval (ARI) and 200 year ARI rain events.

Flood maps will be inserted into an updated Ōtūkaikino SMP and provided to Environment Canterbury when they are available.

9.6. Flooding Standards

The city's drainage systems are principally designed to serve the expectations of safe vehicle travel and flood-free housing. Stormwater networks of side channels, pipes and drains keep traffic lanes free of ponded water in frequent events. In more extreme rainfalls the lower lying parts of roads and private properties store water in excess of system capacity until it can be drained away. Houses are expected to be built sufficiently high to remain dry in all but the most extreme events.

The following are standards from the Infrastructure Design Standard and Waterways Wetlands and Drainage Guide which incorporate or provide the Council's drainage levels of service.

- Road drainage, pipes and minor drains are designed so that the 5 year annual recurrence interval rainfall does not cause a nuisance to traffic.
- Hillside drainage must ensure that a 20 year annual recurrence interval rainfall does not endanger property.
- Within Flood Ponding Management Areas minimum floor levels are set 400mm above the 200 year annual recurrence interval flood level. FMAs are those areas covered by the 200 year ARI flood level plus a 250mm freeboard allowance. (400 mm floor height above flood level includes the 250 mm freeboard plus an assumed 150 mm minimum foundation height above the natural ground.)
- There are proposed development restrictions for "High Flood Hazard Management Areas" (HFHMA) defined as areas where, in a 500 year annual recurrence interval flood the water would be more than 1m deep or the product of velocity times depth is greater than 1.
- Otherwise, a 50 year annual recurrence interval event is used for setting the minimum floor levels as required by the Building Act.

9.7. Floodplain Management Strategy

The flooding risk in internal waterways and drains is dealt with by:

- Planning: Flooding and flood levels in the urban area are estimated by hydraulic modelling. Results of modelling are used to set new floor levels and to inform stormwater network renewals.
- Avoidance: Built-up areas are located on high ground or are protected by stopbanks.
- Mitigation: Increased stormwater flows generated by development are detained in treatment basins and released at a controlled rate up to a 10 year annual recurrence interval storm. Spillage above a 10 year annual recurrence interval event cause increased flows.
- District Plan rules:

- New builds within Flood Hazard Management Areas are required to have a floor level above the 200 year average recurrence interval (ARI) flood level plus 400 mm. (A full definition including tidal influences found in the Christchurch District Plan section 5.4).

- Rules under the Building Act 1991:
    - Outside the Fixed Minimum Floor Level Overlay all new builds are required to have a floor level that is above the 50-year ARI flood level plus 400 mm.
    - New houses in Clearbrook will have floors higher than a 10,000 year ARI flood event resulting in a major stopbank breach.
- An appropriately designed and managed stormwater network:
    - Stormwater networks should have capacity to convey a 20% ARI rain event.

9.8. Monitoring Flood Levels

Flood levels estimated by modelling will be reported for key locations as required by the CSNDC's Schedule 10. By this means both Councils can check whether stormwater facilities are adequately limiting development effects. Two monitoring locations are suggested, for confirmation after the Pūharakekenui-Styx River – Ōtūkaikino 2025 Model is delivered.

Table 6: Suggested key monitoring locations for Schedule 10 Water Level Compliance

2025 Pūharakekenui-Styx River – Ōtūkaikino hydraulic model (in development).					
The development scenario is maximum probable development. Sea level: allowance for 0.5 m sea level rise.					
Receiving Environment	**Monitoring Location**	**Baseline Year**	**Annual Exceedance Probability**	**Maximum allowable increase**	**Modelled increase**
Wilsons Drain	Main North Road (upstream)	To be decided after 2025 model is run	10% and 2%	To be decided	To be decided
Wilsons Drain	Christchurch Northern Motorway (upstream)	To be decided after 2025 model is run	10% and 2%	To be decided	To be decided

9.9. Sea Level Rise

Rising sea levels are not expected to affect the Ōtūkaikino Catchment within the term of this plan. Developed parts of the catchment are sufficiently elevated to be free of the effects of up to two metres' sea level rise .

Part Three
Objectives and Principles

10. Developing a Water Quality Approach

10.1. Introduction

The Ōtūkaikino Creek has the highest water quality and ecological values of any Christchurch waterway. Due to its location and character, it is highly valued by Ngāi Tahu. Changes in the catchment, apparently more in the rural area, have led to a decline in ecological values. The Council is unable to significantly influence activities on rural land owned by others but would like to maintain values in this waterway through managing urban activities.

Mitigation options have been considered for urban-sourced contaminants that are considered harmful or exceed water quality targets. Commonly detected contaminants that can be mitigated through the SMP are:

- Sediment (as consent conditions require control by specified means)
- Copper and zinc
- Industrial discharges containing oils, cleaning compounds, nitrates/nitrites, chemicals, etc (section 11.5)

Metals typically exceed water quality targets for relatively short periods during and after rainfall. It is believed these exceedances affect ecosystem health but the relationship between concentrations, durations and effects needs more research.

10.2. Contaminant Model

A contaminant load model (CLM) for this catchment was developed by DHI Ltd and Dr Tom Cochrane (University of Canterbury). The model combines MEDUSA[2] Version 2.0 which models urban areas, and rural sediment loads developed from tables of published sediment yields for rural areas (NIWA[3]). MEDUSA is an event-based pollutant load process model used to predict amount of TSS, Cu and Zn contributed by individual impermeable surfaces during rain events. Parameters are the surface area, material type, average rainfall intensity, pH, rainfall duration, and length of antecedent dry period for individual surfaces (Charters et al. 2020). Rates of contaminant discharge are based on sampling of stormwater discharged from Christchurch roofs, roads and car parks. The Ōtūkaikino CLM estimates the annual load of the three contaminants for each of the 23 sub-catchments. Subcatchments are mapped in Figure 11 (which has finer detail of subcatchments with treatment) and Appendix B Figure 13 (overview).

[2] **M**odelled **E**stimates of **D**ischarges for **U**rban **S**tormwater **A**ssessments
[3] National Institute of Water and Atmosphere

10.3. Potential contaminant controls

Table 7 shows the range of contaminant controls that could be used to remove contaminants from stormwater (subject to constraints such as funding and landowner permission).

Table 7: Potential contaminant controls

Contaminant	Source	Potential Control	Comment	How the controls could be implemented
TSS, copper, zinc	New subdivisions (large sites)	Facilities in new developments to limit increases in flow rate and capture TSS	Good mitigation for TSS; partial mitigation for dissolved metals	As conditions on subdivision, resource or building consents
TSS, copper, zinc	New development (small sites)	On-site (private) devices	Good mitigation for TSS; partial mitigation for dissolved metals	Included in Table 11: Minimum Requirements for Developed Sites
TSS, copper, zinc	Existing development	New stormwater treatment facilities	Good mitigation for TSS; partial mitigation for dissolved metals	CCC funding treatment for existing areas
Copper, zinc	Existing and new development	Mussel shell filter	Good zinc removal. Potentially good copper removal. May capture residual TSS.	Filter installed within or attached to a wetland
TSS, copper, zinc	Existing development	Sump inserts (filter bags)	Uncertain effectiveness but about to be trialled in Christchurch (early 2023)	Filter bags deployed; target busy roads.
TSS (mostly sediment)	Construction & excavation sites	CCC implements and monitors on-site erosion and sediment control	Can be difficult to do and is sometimes poorly managed on site	Effected through conditions on individual resource or building consents.

Contaminant	Source	Potential Control	Comment	How the controls could be implemented
TSS (mostly sediment)	Road works	CCC requires, implements and monitors site erosion and sediment control	Many contractors do this already	Required by Road Opening (road works) Permits. Controls in Traffic & Parking Bylaw 2017.
TSS, copper, zinc	Vehicle traffic	Rain gardens, tree pits, and filters to treat runoff from busy roads. Road sweeping	Partial removal of zinc and copper.	Install treatment devices over time to treat stormwater from contaminated catchments.
Copper	Vehicle brake pads	Educate residents about the value of low/no copper brake pads. Advocate with Government for legislation change	Legislation in USA is changing the brake pad market. Some low-Cu pads available in NZ. Copper content of brake pads anticipated to reduce from 2025 following USA legislation.	Copper-free brake pads becoming available by market forces. CCC educates local auto industry and residents.
Copper	Architectural copper (roofs, spouting, downpipes)	Transparent sealer applied to copper surfaces	May not be fully effective e.g. inside downpipes. Sealer must be maintained in good condition or copper will continue to discharge.	This is a current control effected through building consents.
Copper	Architectural copper (roofs, spouting, downpipes)	Investigate the feasibility of a District Plan rule to discourage the use of copper claddings.		By seeking legal advice about the practicability of such a Rule. Under way.
Copper, zinc	Roads, roofs	Divert first flush to the wastewater network	Limited capacity available in WW network	This is one of a number of Schedule 4 (CSNDC Condition 40) investigations.
Zinc	Bare zinc-coated steel roofs (new)	All new roofs low zinc emitting or zinc free (non-steel) and kept well painted	Factory-painted zinc/aluminium coated steel is	

Contaminant	Source	Potential Control	Comment	How the controls could be implemented
			the most common new residential roofing.	
Zinc	Bare steel roofs (mostly industrial)	1. Educate and encourage use of pre-painted roofing 2. Potential District Plan rule to require roof runoff treatment on site. 3. Potential District Plan rule to discourage the use of bare zinc roofing.	Compact on-site devices available.	1. Educate and encourage use of pre-painted roofing 2. Investigate the feasibility of a District Plan rule to require roof runoff treatment on site. 3. Investigate the feasibility of a District Plan rule to discourage bare zinc roofing.
Zinc	Poorly maintained roofs	Education programme re roof maintenance. Possible incentives.	Old paint coatings expose zinc primer and zinc substrate. Can be half as bad as bare roof. Roof re-painting could cost 20-30% of the cost of re-roofing.	CCC to investigate the costs & benefits of painting v renewal v civic scale stormwater treatment. Under way.
Zinc	Vehicle tyre wear	Non-toxic alternative introduced by industry. Treat road runoff.	Treatment is partially effective. Overseas research may discover a less toxic alternative to zinc. No current alternative.	Install road runoff treatment devices. CCC will continue to engage with the government through MfE
Industrial waste and spills	Poorly controlled industrial sites	Surveillance, education, on-site improvements, enforcement	ECan & CCC Pollution Prevention Teams are working on this	CCC Industrial site audit teams visit, educate and enforce starting with high-risk sites.
Pathogens (bacteria, etc)	Water fowl, livestock, dogs, wastewater overflows.	Reduce waterfowl numbers, dog controls, WW overflow controls	Some dog and wastewater overflow controls in place.	Implement outside the SMP. CCC is not empowered by the consent to control waterfowl
Nutrients	Rural and urban sources	Investigate sources. Education and enforcement		Education and enforcement used to control private/industrial sources.

10.4. Factors affecting selection of actions for the SMP

Actions considered are those in Table 7.

Basins and wetlands remove TSS effectively, although they are less effective for dissolved metals from roofs and roads. As TSS and metals are discharged in some measure from every impervious urban surface, basins can be useful controls when they treat extensive areas. There is sufficient land available to construct basins and wetlands to treat existing and developing areas.

Contaminants could be eliminated at source by substitution of non-contaminating materials. This could involve for example:

- Substitution of building materials or methods, which would probably involve additional costs to individuals and businesses. (Building materials substitution would have to be voluntary as the Council does not have powers to prohibit the use of normal building materials).
- Substitution for zinc oxide in tyres, although no acceptable substitute has been found to date.

Contaminants could be reduced at or near source by, for example:

- Painting or repainting roofs,
- Treating roof runoff at the downpipe, e.g. in a modular canister-type filter.

However, the Council has been advised that its powers to require these forms of treatment are limited, and new legislation may be needed.

Street sweeping picks up litter, stones and sand but does not effectively remove fine particles containing most of the metal contaminants (Depree, 2011). A street sweeping trial has occurred under Condition 7, Schedule 4 c. and the results may influence future contaminant mitigation choices.

Sump inserts (filter bags) have been considered following trials in Hamilton, Hastings and Nelson. Sump inserts are known to effectively trap litter and stones but have variable effectiveness trapping fine contaminants.

Some contaminant discharges can be reduced voluntarily through education. The Council is developing an education programme through its Community Waterways Partnership. An education programme is expected to have effects in the long term, and to be more effective for some contaminants (e.g. domestic chemicals, dog poo) than others such as vehicle emissions.

Although mitigation at source should be more effective than treatment of stormwater there are significant barriers to implementing source controls. In the present day the government or local and regional authorities are likely to have to demonstrate that source controls effected by land-owners are both necessary and the best practicable option. This could be difficult given significant gaps in our knowledge about the effects of short-term contaminant discharges in stormwater.

More information, such as the long-term costs and benefits of maintaining roof coatings, substituting roof materials or installing stormwater filters, would be required before the Council could consult on and select best practicable options. Work being carried out under CRC231955 Conditions 59 and 60 should provide better information. It is expected that additional work will be initiated through the proposed Surface Water Implementation Plan referred to in section 2.1.

10.5. Planning for Treatment

Of the options considered above basin and wetland treatment is believed to be the most cost-effective way to mitigate stormwater quality and quantity by treating whole sub-catchments. Facilities must be built to manage stormwater quantity from developing areas and it is efficient for them to also perform a contaminant removal role. There will be significant residential or industrial development in six sub-catchments. A seventh residential sub-catchment (Rushmore) is already developed. Stormwater treatment for these seven areas will be carried out in first flush basin/wetland combinations in locations shown in Figure 11. There will be some pre-treatment of paved areas in industrial zones. The treatment is intended to limit the annual contaminant load after development to less than the pre-development load.

An industrial area near Roto Kohatu will discharge stormwater into the ground after on-site treatment under consents from Environment Canterbury. Christchurch International Airport and its commercial zone will discharge stormwater into the ground after treatment under consents from Environment Canterbury. Remaining sub-catchments are rural and will not be treated.

10.6. Contaminant Model Results

The CLM uses a theoretical treatment efficiency to estimate contaminant load removal by facilities as a percentage of event loads. Treatment efficiencies are tabled in Appendix D based on findings from international research. Reported treatment efficiencies indicate that facilities are typically effective in removing particles (TSS) but are likely to remove a low to moderate percentage of dissolved metals. Dissolved metals, which form a significant part of the contaminant load tend to be sourced from roofs and roads.

This Revised SMP reports on two sets of model scenarios:

A. A set of runs for the original, June 2023 SMP representing standard basin/wetland treatment, and
B. A further set of runs for this Revised July 2024 SMP representing enhanced stormwater treatment.

All 23 sub-catchments were modelled, with model results reported in Appendix E.

10.6.1. Original June 2023 SMP

In developing a treatment option for the Original June 2023 SMP contaminant loads were modelled for four scenarios:

1. Estimated contaminant load in the reference year, which is 2018, the year in which the consent was initially granted.
2. Estimated contaminant load in the seven urban sub-catchments that discharge to surface water after full development with no stormwater treatment.
3. Estimated contaminant load in the seven fully developed urban sub-catchments after treatment in planned basins and wetlands.
4. Estimated contaminant load in the seven fully developed urban sub-catchments after treatment in planned basins and wetlands with all new industrial roofs factory coated (painted). (In the earlier model runs it was assumed that 50% of industrial roofs are painted and 50% are bare zinc/aluminium, as observed in a survey in Hornby.)

In the seven sub-catchments to be treated (Applefields, Blue Skies, Chaneys East, Chaneys West, JRH, Rushmore and Wilsons Drain) modelling indicated that after full development and after water quality treatment through basins and wetlands, and with new industrial roofs factory coated:

- TSS was estimated to reduce from 7,400 (present day) to 2,300 kg/yr.
- Copper was estimated to reduce from 3.4 (present day) to 2.9 kg/yr.
- Zinc was not able to be fully mitigated and would increase from 79 (present day) to 121 kg/yr.

10.6.2. Comment on model results

Model output suggests that the TSS load per hectare is similar for fully developed catchments whether industrial or residential. Copper and zinc loads are elevated in all developed catchments per hectare and tend to be higher in industrial catchments. Good removal of TSS and copper is indicated for a standard first flush basin/wetland combination. However, the model indicates that basins and wetlands would not remove sufficient zinc to limit the post-development annual zinc load to below the present-day load. (Noting however that model outcomes for copper and zinc reflect rather conservative removal efficiencies. Wet weather monitoring of Knights, Prestons, Curletts and Wigram basins in 2020/21 indicate higher removal efficiencies may be possible.)

Scenario 4 above was the treatment option proposed in the Original Ōtūkaikino SMP delivered to Environment Canterbury in June 2023. The SMP indicated that zinc was not expected to be fully mitigated post-development because the dissolved zinc fraction is not sufficiently captured by basins/wetlands. Environment Canterbury staff indicated in discussions that this would be an unacceptable outcome. The Council was advised to find means of reducing the post-development zinc load below the pre-development load.

10.7. Proposed mussel shell filters

Research at Lincoln University (Odeh, Dosher & Cochrane, 2022) shows that crushed mussel shell can be a good medium for capturing total zinc. The research paper indicates that the treatment is effective at a laboratory scale although the Council is unaware of it being used at a large scale.
Following from the research a mussel shell filter is being trialled in Hoon Hay Valley Basin and another is to be trialled in Wigram Wetland. Subject to testing and design it is thought that a mussel shell filter could be installed as a bund of crushed mussel shell at the outlet end of a wetland, of a height and width that will allow sufficient contact time for zinc adsorption. A solids filter is likely to be needed upstream from the mussel shell to capture floating organic material.

Odeh et al achieved treatment efficiencies of between 60 and 95% for zinc, depending on the contact time (determined by flow rate through the apparatus). Laboratory contact times appear to be achievable at a wetland scale. Treatment efficiencies of 40 and 50% were modelled for the sake of conservatism.

10.7.1. Revised July 2024 SMP

Council staff agreed to improve water quality mitigation processes to deliver a more acceptable outcome. Additional mitigation scenarios which included filters of crushed mussel shell were modelled for a fully developed catchment. Full scale filters should perform the same function as laboratory scale filters given the same contact time. Mussel shell filters were modelled at the discharge end of each wetland and given a metal removal efficiency of 40 and 50% (in two separate runs). 40 and 50% is lower than the laboratory results. Subject to successful trials in the Wigram East Basin a mussel shell filter will be trialled in a wetland in the Ōtūkaikino Catchment. If the trial is successful all wetlands in this catchment could be fitted with mussel shell filters. If a mussel shell filter cannot be made to work the Council can install Filterra™ biofilters fed with partially treated stormwater pumped from the wetland. Two representative scenarios were run and are reported below:

5. Filters of crushed mussel shell are added into wetlands to provide additional dissolved metal adsorption. All new industrial roofs are factory coated.
6. Filters of crushed mussel shell are added into wetlands. All new industrial roofs are factory coated. Industrial roof and paved area runoff is treated through biofilters.

Model results from the six scenarios are summarised in Table 8.

Table 8: CLM results for combined seven sub-catchments with treatment basins; Applefields, Blue Skies, Chaneys East, Chaneys West, JRH, Rushmore and Wilsons Drain South.

	Scenario	**TSS** (kg/yr)	**Copper** (kg/yr)	**Zinc** (kg/yr)
1.	Base (2018) scenario	7,420	3.4	79
2.	Unmitigated full development	25,900	12.4	286
3.	Full development mitigated with basins and wetlands	2,293	3.3	167
4.	Full development mitigated with basins and wetlands. And all new industrial roofs painted. **This scenario was used to develop targets in the Original SMP**	2,277	2.9	121
5.	Full development mitigated with basins and wetlands. And all new industrial roofs painted. And mussel shell filter bund in wetlands (treatment efficiency range 40 to 50% conservatively assumed) **This scenario is used to develop targets in the Revised SMP**	1,139 – 1,366 (untested[4])	1.4 – 1.7 (untested)	60 - 72
6.	Full development mitigated with basins and wetlands. All new industrial roofs painted.	1,262 – 1,550	1.4 - 1.7	54 - 67

[4] Odeh et al tested zinc capture in a mussel shell filter. TSS and copper were not tested but the model assumes that treatment efficiencies are the same (40 and 50%) as for zinc. The assumption is not critical to the SMP.

Scenario	TSS (kg/yr)	Copper (kg/yr)	Zinc (kg/yr)
Mussel shell filter bund in wetlands (treatment efficiency range 40 to 50% conservatively assumed) Industrial roof and paved area runoff treated in biofilters.	(untested)	(untested)	

Post-treatment TSS is higher in scenario 6 because residential roofs were modelled differently. The difference is not significant for the SMP delivery.

10.8. Lessons from monitoring treatment basins

Wet weather monitoring of treatment facilities has produced encouraging results from its first year. Facilities being monitored are first-flush basins followed by a wetland, which are the default large treatment system. Treatment efficiencies obtained from 2020/21 wet weather monitoring of Curletts, Wigram, Prestons and Knights Stream facilities (PDP, 2021 and NIWA, 2022), indicate the potential for a high percentage of TSS and metals removal. Monitoring will be ongoing. A comment on previous monitoring is made in a memorandum titled *Inferences from Performance of Treatment Basins 1993-2020*

The Council is not confident to adopt these limited data for modelling. Conservative treatment efficiencies taken from the Christchurch Contaminant Load Model (Golder, 2018) have been used in the Ōtūkaikino contaminant load model. These treatment efficiencies were sourced from WWDG guidelines, Auckland Regional Council guidelines, and international research.

10.9. Role of Monitoring and Tangata Whenua Values in Setting Targets

10.9.1. Environmental Drivers

Waterways in the rural part of the catchment are in good condition. Monitoring indicates that Wilsons Drain, out of Belfast, is more likely to exceed contaminant targets than Ōtūkaikino Creek, probably due to contaminant discharges associated with urban development. This information influenced the decision to treat existing development in the older part of Belfast.

10.9.2. Mahaanui Iwi Management Plan Objectives

This plan recognises and is intended to help support the policies and objectives for water and the environment in the Ōtūkaikino Catchment, from the Mahaanui Iwi Management Plan 2013 as detailed in

Table 9.

Table 9: Response to the Mahaanui Iwi Management Plan

Iwi Management Plan	Ōtūkaikino SMP response
Policy WAI1.1 To require the elimination of all industrial, stormwater and agricultural discharges into the Waimakariri as a matter of priority. The river must be able to be used for mahinga kai and recreation without concerns for human health.	The SMP can contribute toward Policy WAI1.1 by treating almost all stormwater to reduce the amount of non-point source pollution.
Policy WAI2.1 To consistently and effectively advocate for a change in perception and treatment of lowland waterways in the catchment: from public utility and unlimited resource to wāhi taonga.	The SMP can be consistent with this policy.
Policy WAI2.2 To require that the value of lowland waterways in the Waimakariri catchment as mahinga kai is protected and restored, including but not limited to: (a) Management focused on mauri and mahinga kai; (b) Management according to Ki Uta Ki Tai, and therefore the maintenance of fish passage from source to sea; (c) Elimination of point and non point source pollution; (d) Protection of whitebait spawning areas (kōhanga), via rāhui; and (e) Provisions for the connections between waterways, wetlands and waipuna.	The SMP can contribute toward Policy WAI2.2(c) by treating most stormwater to reduce the amount of non-point source pollution. (Road runoff from Clearwater is attenuated through the ponds but is not otherwise treated at this time.) SMP activities do not affect (a), (b), (d) and (e).
Policy WAI2.6 To require that all wetlands and waipuna in the Waimakariri catchment are recognised and provided for as wāhi taonga, as per general policy on Wetland, waipuna and riparian margins.	Waipuna wihin #940 Main North Road are now in Council ownership and will be protected from development.
WAI3.3 To protect groundwater resources in the Waimakariri catchment from effects as a result of inappropriate or unsustainable land use and discharge to land activities.	The SMP proposes to monitor groundwater for effects from stormwater infiltration, and to improve pre-infiltration treatment if necessary.

10.10. Consultation

Development of the SMP was carried out in consultation with the parties nominated in Condition 4 (Papatipu Rūnanga, the Christchurch-West Melton Zone Committee, the Waimāero Fendalton-Waimairi-Harewood Community Board, the Department of Conservation and ECan's River Engineer).

The draft SMP was released for public consultation for 40 working days. A summary of responses from consultation is in Appendix H.

10.11. Changes in response to public submissions

Five public submissions, and one from the Waimāero Fendalton-Waimairi-Harewood Community Board, and one from the Department of Conservation were received.

The SMP was amended to improve the support for bird strike risk management as requested by Christchurch International Airport Ltd. The Department of Conservation raised issues that are relevant for the Council's environmental teams but are outside the scope of the SMP. The SMP responds to some objectives in Ngāi Tahu's Mahaanui Iwi Management Plan.

10.12. Technical Peer Reviews

The draft SMP was reviewed by a Technical Peer Review Panel as required by Condition 15. Panellists were selected for expertise in contaminated sites and land management, hydrogeology, contaminant load modelling and freshwater and coastal ecology.

The contaminated sites and land management reviewer recommended information be updated for clarification, which was done. A suggested method for assessing if a site is high or low risk and adding HAIL sites to possible contaminant sources was considered outside the scope of the SMP.

The hydrogeology reviewer made many suggestions for considering additional groundwater matters. The suggestions were not taken up because the SMP does not propose any infiltration of stormwater into groundwater and the SMP is not expected to adversely affect groundwater.

Contaminant load modelling for the SMP was supported by the reviewer.

The ecology reviewer suggested corrections in matters of detail such as monitoring site names, display of sites on maps, and inclusion of additional data. The reviewer's suggestions were adopted.

The reviews and the Council's detailed responses to the reviews are supplied to Environment Canterbury with the SMP.

10.13. Contaminant Mitigation Targets

An annual load reduction target was developed from the contaminant load model as required by Condition 6b. The targets are selected from Scenario 5 in Table 8 and apply to the seven sub-catchments that will be treated through basins and wetlands. The numerical value of the targets apply to sub-catchments once they are fully developed under Christchurch District Plan rules, although the year when full development will be reached is unknown.

Table 10: Contaminant mitigation targets

Contaminant	Target reductions in stormwater contaminant load Resulting from construction of new stormwater mitigation facilities and source control measures Compared to the consent application base year 2018		
	5 years from 2018 (year 2023)	10 years from 2018 (year 2028)	Full development
TSS	Little new development yet	Reduction proportional to % development	69% reduction below 2018 (7,400 to 2,300 kg/yr)[5]
Total Zinc	Little new development yet	Reduction proportional to % development	9% reduction below 2018 (79 to 72 kg/yr)
Total Copper	Little new development yet	Reduction proportional to % development	14% reduction below 2018 (3.4 to 2.9 kg/yr)[6]

10.14. Less significant contaminants

Contaminants of lesser significance are sometimes detected at low levels, but do not have a mitigation strategy because they either do not exceed guidelines or have a non-stormwater source. These include:

- *E. coli:* implies a risk of other pathogens harmful to humans. (There are no pathogen targets in the consent. Pathogen controls are likely to be considered in the Surface Water Improvement Plan).
- Polycyclic aromatic hydrocarbons (PAHs): no consent targets. Do not exceed LWRP guidelines.
- Nitrate and nitrite: no direct consent targets. Non-stormwater sources.
- Phosphorus: no direct consent target. Believed to be predominantly animal sources in this catchment.
- Ammonia: no consent target. Does not exceed LWRP guidelines.

[5] Omits unverified TSS reductions through mussel shell filters
[6] Omits unverified copper reductions through mussel shell filters

11. Mitigation Plan

11.1. Actions for the SMP

Stormwater from the seven sub-catchments that discharge to surface water will be treated in Council basins and wetlands. Both existing and new development will be treated with the intention to treat all developed areas discharging to surface water.

Developing industrial sites in the industrial area near the Roto Kohatu lakes will self-mitigate via on-site detention and infiltration basins. As industrial sites discharging into land these sites are excluded from the CSNDC by Condition 2c. and will be consented by Environment Canterbury.

Based on modelling, environmental drivers and tangata whenua values, and considering best practicable options, the first seven contaminant load reduction actions below will be implemented in this catchment.

1. It is expected that all residential roofs will be coated (i.e. painted) or non-steel.
2. Stormwater from the Applefields, Blue Skies, Chaneys East and West, JRH, Rushmore and Wilsons Drain South sub-catchments will be treated through first-flush basins and wetlands. Wetland performance will be enhanced with mussel shell filters.
3. Stormwater generated from hardstanding areas within each industrial allotment to be pre-treated using an approved gross pollutant trap (GPT), vegetated swale or other proprietary pre-treatment device.
4. All new industrial roofs are required to be coated (painted).
5. Erosion and sediment control on development and construction sites, (Section 12 Goal 1.3).
6. Auditing high-risk industrial sites and working with occupiers to remediate contaminated stormwater discharges, (Section 12 Goal 4.2 to 4.4).
7. Working with community groups and the public to educate the community about the effects of and mitigation of stormwater contaminants, (Section 12 Goal 5.1).

The remaining actions were considered for implementation in addition to treatment basins, and were modelled, but are not proposed in the SMP:

8. Treatment of roof runoff from new industrial roofs at the downpipe.
9. Treatment of runoff from all industrial impervious surfaces (e.g. through biofilters treating industrial zones).

Actions 1 to 7 are realistic in that they can be implemented by the Council using its powers under the Local Government Act. With actions 1 to 7 implemented it is estimated that copper will slightly reduce after full development (and the introduction of low-copper brake pads could reduce copper discharges still further). It is estimated that zinc will decrease by 9% after full development with the proposed mitigation.

Actions 8 and 9 would gain a greater reduction of zinc, but are considered impracticable to put into effect, as the Council does not have powers to require these measures to be implemented. Action 9 is possible but only achieves a small gain for significant increased cost.

11.2. New Development

The SMP anticipates that there will be new development in residential and commercial zones indicated in Figure 7: District Plan Zones and growth areas. Stormwater treatment facilities for new developments are typically funded by developers and additional facilities serving established areas will be funded by the Council. It is the intention that stormwater from 100% of new development and existing development be treated. Proposed and existing treatment facilities are mapped in Figure 11. Most facilities are detention basin/wetland combinations which treat stormwater and release a reduced flow rate into watercourses.

Section 11.1 requirements 3., 4. and 5. for new and re-development will be communicated to applicants during the stormwater approval process. For sites discharging to a Council SW treatment facility the Council will require either use of coated roof materials where there is a zinc component or on-site treatment of zinc materials.

Substantial developments, greater than 1,000 square metres disturbed area, will treat the first flush (first 25 mm) of rainfall unless by agreement with the Christchurch City Council.

To comply with section 8.4.7.3.c in the Christchurch District Plan, stormwater must:

i. be detained in storage so that post-development peak flows do not exceed pre-development peaks up to the 2% ARI critical duration event for the catchment.
ii. be treated by the best practicable option as measured against Receiving Environment Attribute Target Levels in CRC231955 Schedule 7.
iii. be discharged into the ground by infiltration after treatment where practicable.

Private facilities may discharge stormwater into the ground in infiltration basins that treat stormwater by filtration through a soil liner. All stormwater from infiltration basins up to a 50-year ARI event is to go into the ground. Stormwater infiltration basins must fully drain within 48 hours of the cessation of a 2% AEP rain event. Approval to discharge is required from either the Christchurch City Council or Environment Canterbury; see Section 11.6.

For any sites not discharging to a Council SW treatment facility the Schedule 6 requirements will apply.

Contaminants, particularly sediments, generated by development will be controlled by:

- actions and requirements of this SMP,
- rules in the district plan,
- the Stormwater Bylaw 2022, and
- the Erosion and Sediment Control Toolbox for Canterbury.

For economy of space the CCC will accept facilities designed to the Partial Detention Strategy which is:

- A first flush basin holding runoff from 25 mm of rainfall, discharging into
- A wetland attached to the first flush basin having provision for additional storage up to 500 mm deep during a 10 % to 2% AEP event.

A rationale for basin sizing is given in Table 12.

11.3. Minimum standards

Individual developments are required to treat stormwater to mitigate changes in quantity or quality arising from the development. The minimum standard for stormwater treatment is Table 10.

Table 11: Minimum requirements for new development sites

Source of Stormwater Discharge(s)	Stormwater Treatment Requirements
From/during land disturbance activities	An approved Erosion and Sediment Control Plan is required
From new / re-development **residential** roof and hardstand areas	No discharge onto or into land where the slope exceeds 5 degrees. Sumps collecting runoff from new hardstand areas shall be fitted with submerged or trapped outlets wherever practicable. First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m^2 and buildings with uncoated galvanised metal roofs or guttering/spouting (1). Sites increasing impervious by 150 m^2 or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide. An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat (2). On-site rain water storage is required for new and redevelopment sites on the hills. Stormwater may not be discharged from a new copper roof or spouting or through a copper downpipe unless the copper surfaces are coated
From new / re-development **non-residential** roof and hardstand areas	No discharge onto or into land where the slope exceeds 5 degrees First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m^2, buildings with uncoated (3) galvanised roofs or guttering/spouting and high-use sites Sites increasing impervious by 150m^2 or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide. Hard-stand runoff shall be pre-treated with a gross pollutant trap or approved, similar pre-treatment device. An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required (4) Site management and spill procedures are required for sites that engage in hazardous activities (5) Stormwater may not be discharged from a new copper roof or spouting or through a copper downpipe unless the copper surfaces are coated
Any land use with Canterbury Land and Water Regional Plan Schedule 3 activities.	An application for approval under the Stormwater and Land Drainage Bylaw 2022 must be made to authorise connection and discharge into the Council network.

<u>Explanatory notes for Table 11:</u>

1. The first flush is the first 25 mm of rainfall
2. The Council has discretion to waive the requirement for first-flush treatment of hardstand areas on large residential sites with a low impervious percentage where the amount of pollution-generating hardstand being added is considered to have less than minor effect.
3. which is extracted from Christchurch City Council On-site Stormwater Mitigation Guide (CCC 2021). The guide includes information about on-site storage and treatment for small to medium sites.
4. "Uncoated" means without a painted or enamelled coating. Council has discretion to waive the requirement for first flush treatment of hardstand areas on large residential sites where the amount and type of pollution-generating hardstand being added is considered to have a less than minor effect.
5. Quantity assessment and mitigation - The effects of the discharge on the stormwater network capacity and/or the extent or duration of flooding on downstream properties are to be assessed. Where Council considers an increase (including cumulative increases) has a more than minor effect, on-site stormwater attenuation or stormwater network upgrade shall be provided. The details of storage volume and peak discharges or network capacity required to mitigate effects on flooding or network capacity constraints shall be determined by th e Christchurch City Council Planning Engineer.
6. Site management and spill procedures – Procedures are to be implemented to prevent the discharge of hazardous substances or spilled contaminants discharging into any land or surface waters via any conveyance path.

11.4. Operational controls on stormwater and sediment

The management of sites which may experience erosion and/or discharge sediment during development works is controlled by conditions of either resource consents or building consents, as applicable, for earthworks and building. The Stormwater and Land Drainage Bylaw 2022 specifies some standards for activities not controlled by consents. Standards for sediment discharges are set by the Sediment Discharge Management Plan 2021 (SDMP). The sediment discharge management process should work as follows:

1. Allowable TSS (total suspended solids) concentration trigger levels for discharges to the stormwater network are set by the SDMP.
2. An erosion and sediment control plan (ESCP) is prepared by a 'suitably qualified and experienced professional' as determined by a site risk assessment
3. The TSS concentration trigger levels for the site are included in authorisations or conditions where possible.
4. The ESC measures are implemented on site and monitored.

11.5. Industries and High Risk Site Discharges

The Council will manage industrial sites through its Stormwater and Land Drainage Bylaw 2022. The bylaw requires industrial contaminants to be controlled to meet best practice. The Christchurch City Council's expectation is that stormwater entering its network is managed according to best practice, especially where the discharge occurs directly into a waterway. On-site pre-treatment may be required unless contaminant levels are less than LWRP Schedule 5 standards.

Where industrial site occupiers do not meet the required standards for discharge into the network, the site will be removed from the CSNDC and will require a separate resource consent from ECan for its discharge. A condition is included in the CSNDC for this process and all industrial sites excluded from the resource consent will be listed on Schedule 1 attached to the consent.

In managing high-risk sites, the Council will:

- Audit at least 15 high-risk sites per year;
- Inform audited industries of the results of audits and work closely with these industries to achieve outcomes in line with the Stormwater Bylaw;
- Communicate with industries about stormwater discharge standards and the means of meeting these standards.

Change will be sought through a combination of education and enforcement.

- Education will be carried out through an industry liaison group.
- Enforcement will happen as pollution prevention officers identify and visit high-risk industrial sites and work with industries to improve site management.

Contamination risks are limited to a degree by acceptance of trade wastes into the wastewater system. This is authorised through Trade Waste Consents and the monitoring of consents permits a degree of oversight and site control.

Future needs include:

- More interaction with industries by the Council; communication, awareness and education

- Improved knowledge of the environmental effects of compounds discharged by industrial sites
- Ongoing site checks until the Council is confident that all risky sites are controlled adequately
- Upgrades on non-compliant sites

11.6. Expectations for Industrial Area Stormwater Discharges

The Christchurch City Council will authorise new discharges into land on industrial sites if:

1. The discharges are not from sites on Schedule 1; and
2. The discharges do not pose an unacceptably high risk to ground/surface water contamination.

Stormwater from the industrial zone west of The Groynes is discharged to ground on individual sites or groups of sites. These discharges have been consented by Environment Canterbury and will continue to be consented by ECan under the current stormwater consent CRC231955.

All discharges into its network must be authorised by the Christchurch City Council.

Because of the sensitivity of the receiving water, the Council will manage industrial stormwater as follows:

a. No industrial sites will discharge directly into surface water without treatment.
b. The Council will require the use of painted zinc/aluminium coated steel OR non-steel roofing for new industrial subdivisions and advocate the use of painted zinc/aluminium coated steel OR non-steel roofing by means of a direct request accompanying every LIM and PIM, supported by a technical statement detailing the environmental effects of zinc.
c. At least the 25mm first-flush will be treated; or the 25mm first flush from hard stand and landscape areas if roof water goes to ground separately.
d. Off-site treatment will occur in facilities vested in Council and serving as large an area as practicable.
e. On-site treatment will be in soil infiltration basins designed in accordance with the Waterways Wetlands and Drainage Guide, chapter 6.

Where industrial site owners (or occupiers) cannot meet the required standards for discharge into the network, the site will be removed from the CSNDC and will require a separate resource consent from ECan for its discharge. A condition is included in the CSNDC for this process and all industrial sites excluded from the resource consent will be listed on Schedule 1 attached to the consent.

11.7. New Treatment Facilities

The Council proposes facilities to treat stormwater from:

a. Four new sub-catchments Blue Skies, Applefields/Eminence, JRH and Chaneys West (see Figure 11) in new basins and wetlands,

b. The existing Belfast residential area and a new industrial area to the north in a new first-flush basin and wetland (provisionally named “Ōtūkaikino”) at #940 Main North Road.

c. The Rushmore Drive/Darroch Street residential area stormwater in a new first-flush basin and wetland situated on Darroch Reserve, to the west.

Wetland design will include enhanced metals removal by a mussel shell filter or the equivalent. Performance of mussel shell filters will be monitored across the City until they are satisfactorily validated.

Basins or wetlands or associated earthworks must not interfere with springs nor with the baseflow regime into the Ōtūkaikino Creek. It is of the highest importance that basins and wetlands are designed to minimise impacts of basin discharges on the Ōtūkaikino Wetland.

The risk of discharging stormwater onto or through contaminated land is low. Land in the Johns Road residential subdivisions and in North Belfast in the vicinity of proposed treatment basins does not appear to be contaminated. Table 15 in Appendix C comments on the status of land in the proximity of proposed basins, referencing the Listed Land Use Register. An old landfill north of Greywacke Road comprises the known contaminated land in the catchment. Industrial sites in the vicinity infiltrate stormwater into the ground under consents issued by Environment Canterbury.

11.7.1. Designing basins to minimise bird-strike on aircraft

Christchurch District Plan Policy 6.7.2.1.2 – Avoidance or mitigation of navigational or operational impediments – is a policy to avoid or mitigate the potential effects of activities that could interfere with the safe navigation and control of aircraft, including activities that could interfere with visibility or increase the possibility of bird-strike. Plan provisions include:

- 5 Natural Hazards - for activities and earthworks in the Waimakariri Flood Management Area (5.4.3.3 RD3, matter k.);
- 8 Subdivision - general matters of control in relation to new ponding areas (8.7.4.3(f)) and Policy 8.2.3.4(b., vi.) Stormwater Disposal;
- 8 Subdivision - Development Requirements for stormwater for South Masham and Yaldhurst ODP areas (Appendices 8.10.5.D(5)(b) and 8.10.28.D(a)(5)(d));
- 11 Utilities - matters of discretion for new ponding areas (11.10.6(j))

New stormwater facilities within the Christchurch International Airport Bird Strike Management Area, a defined zone extending 3 km from airport runway thresholds (mapped in District Plan Appendix 6.11.7.5) must meet activity standards in section 6.7.4.3 of the Christchurch District Plan (see Figure 12). Assessments should consider any actual or potential effects relating to bird strike where relevant to an application, regardless of whether or not the proposal is located within the Bird Strike Management Area (6.7.3(c.)). Depending on the facts of the particular application:

- Strategic objective 3.3.12 Infrastructure, policy 6.7.2.1.2 Avoidance or mitigation of navigational or operational impediments, and policy 8.2.3.4 Stormwater disposal, are relevant to activities that have the potential to increase the risk of bird strike whether they are within or outside of the CIABSMA;
- Chapters 5, 6, 8, 11, 13 & 17 contain matters of assessment or control to manage bird strike risk for particular activities;
- Bird strike risk may be a relevant consideration when the Council considers a discretionary or non-complying activity.

Basin planners and designers are also required to consider the potential for new water bodies within 13 kilometres of airport runway thresholds to increase the risk of bird strike. New water bodies can provide habitat that will attract waterfowl and high risk species and bring their flight lines into intersection with aircraft flight lines. The risk potential should be quantified and, where required, managed in a manner indicated via a Bird Strike Risk Assessment carried out by a person with suitable ornithological training. Guidance material is contained as Appendix G. Persons developing stormwater facilities within 13 km of airport runway thresholds (identified in figure 12) should consult with CIAL.

Table 12 Sizing rationale for proposed treatment facilities

Sub-catchment (see Figure 11)	**Contributing area**	**Land Use**	**Runoff vol. coeff. (1) & First flush volume**	**Indicative FF Basin Area**	**Indicative FF Basin Volume**	**Indicative Wetland Area**	**Potential extra wetland flooding vol. (2)**	**References / comments**
Facility planning transferred from Styx Stormwater Management Plan 2013								
Applefields FF basin & wetland	33.2 Ha	Developing residential	0.63 5,300 m^3	0.52 Ha	5,300 m^3	0.91 Ha	4,500 m^3	Basins built 2015
Chaneys East FF Basin & Wetland	10.5 Ha	Greenfields industrial	0.7 2,100 m^3	0.46 Ha	4,000 m^3	0.68 Ha	2,000 m^3	
Chaneys West FF Basin & Wetland	7.5 Ha	Greenfields industrial	0.81 1,500 m^3	0.9 Ha				Basins built 2021
Ōtūkaikino FF Basin & Wetland	68.2 Ha	Existing residential	0.41 7,000 m^3	3.42 Ha	34,000 m^3 Incl. flood attenuation	4.46 Ha	22,200 m^3	
	49.3 Ha	Greenfields industrial	0.81 10,000 m^3					
JRH FF Basin and Wetland	56 Ha	Greenfields residential	0.63 8,800 m^3	3 Ha	9,000 m^3	2.4 Ha	12,500 m^3	Trim 19/146287
New stormwater planning								
Rushmore FF Basin & Wetland (Darroch Reserve)	13 Ha	Existing residential	0.41 1,300 m^3	n/a	20,000 x 0.1-0.15 m = 2-3,000 m^3	~ 2 Ha	6,000 m^3	
Blue Skies Basin and Wetland	6 Ha	Greenfields residential	0.63 950 m^3	0.2 Ha	(950 m^3)	2.5 Ha	Unknown at this time	

Lakes – industrial Individual sites to ground assumed	51.3 Ha	Existing and developing industrial	Unknown - individual sites	Unknown - individual sites	Unknown - individual sites	n/a	n/a	Individual sites expected to self-mitigate

Notes:

(1) Runoff volume coefficient from WWDG Table 6-10

(2) Wetlands may be flooded up to an additional depth of 500 mm in events exceeding 10 year ARI. Over-flooding increases effective detention storage without significant compromise to wetland treatment effectiveness.

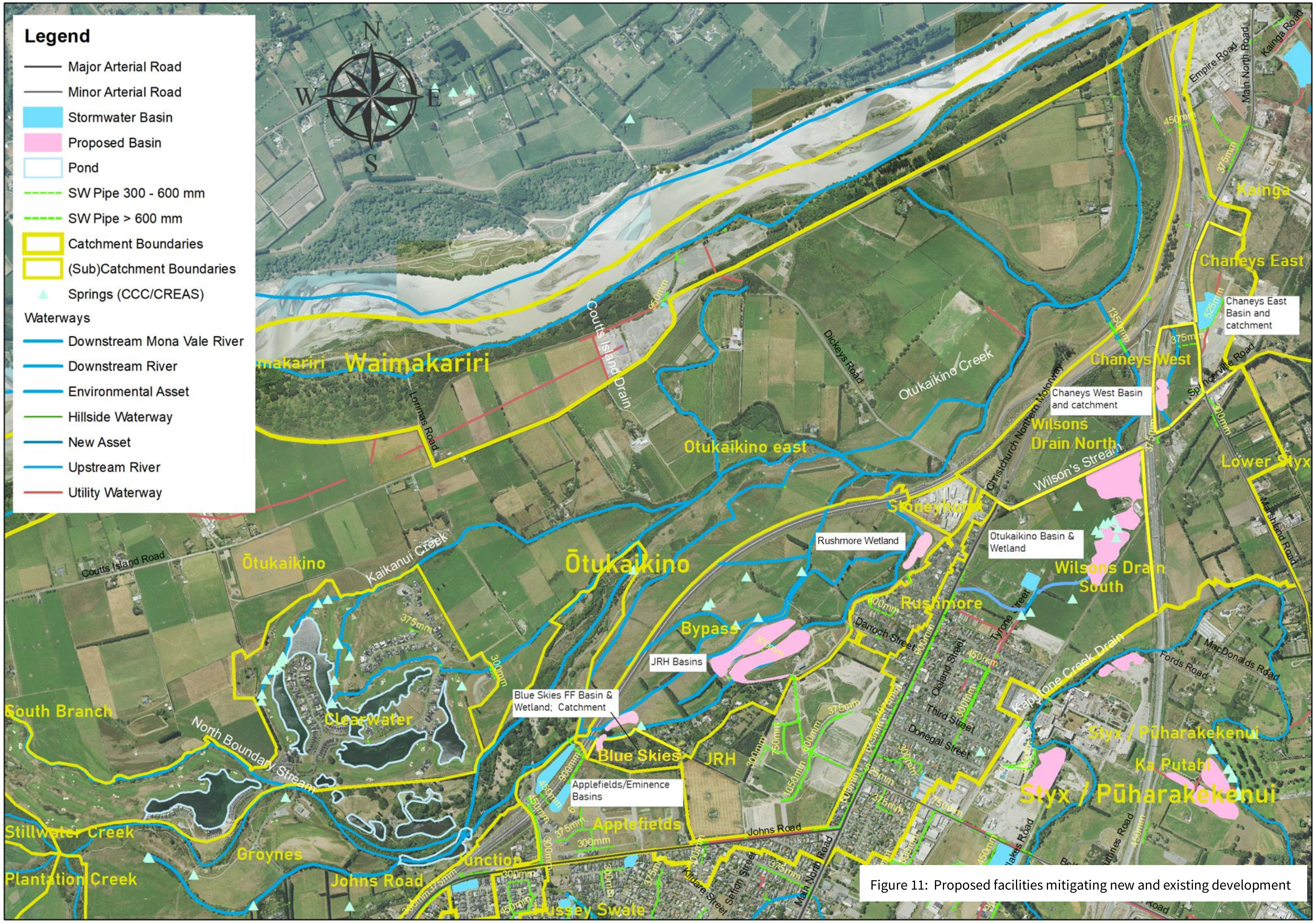


Figure 11: Proposed facilities mitigating new and existing development

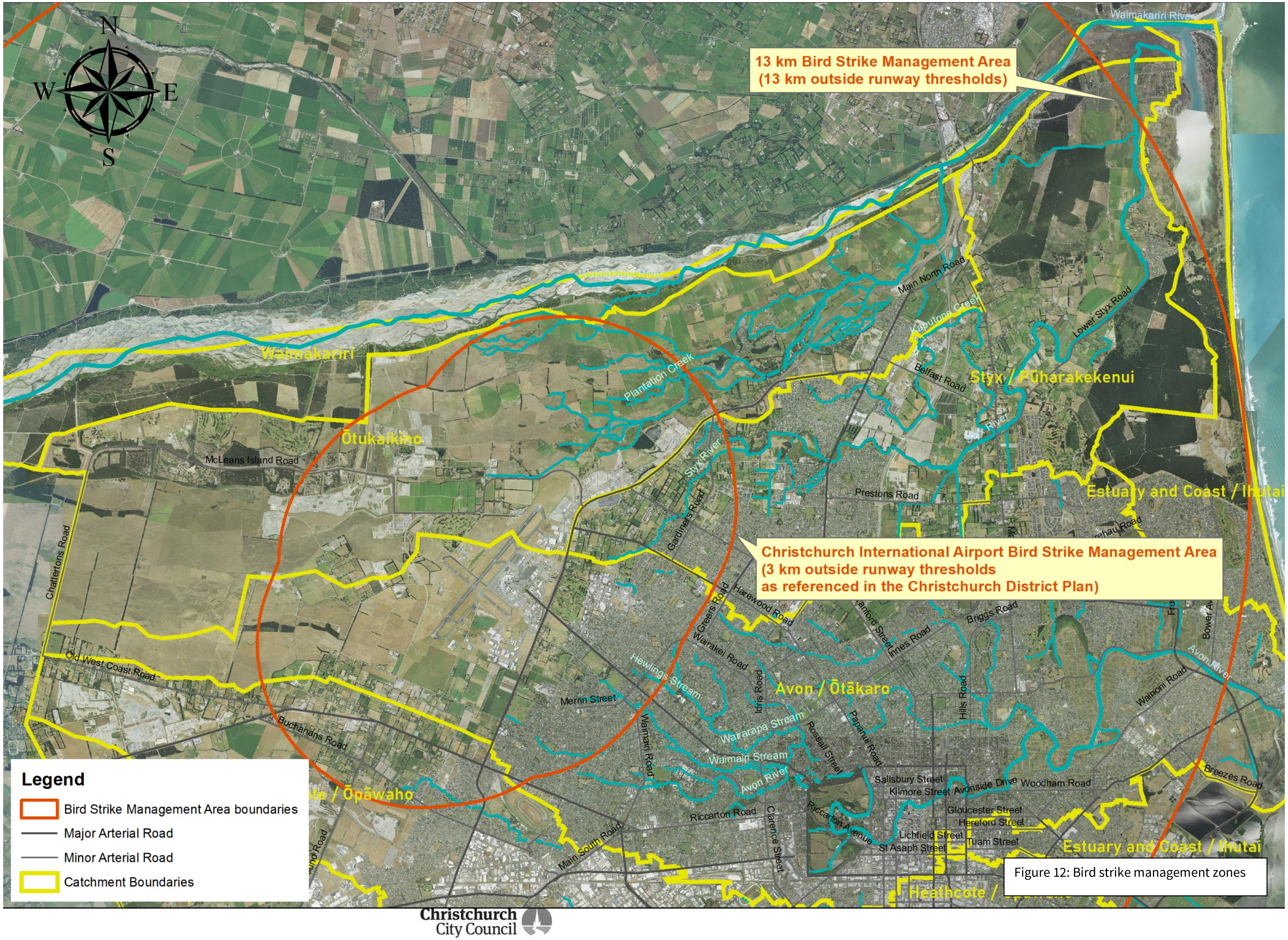


Figure 12: Bird strike management zones

11.7.2. Avoiding groundwater mounding beneath infiltration basins

Groundwater rises locally to some degree (mounding) when an infiltration basin is discharging. Adverse effects (either waterlogging of adjacent land or impeded drainage) can be avoided by carefully locating basins with reference to groundwater depth. Mounding is not relevant to proposed Council basins, which discharge to surface water. Groundwater depth is not expected to be limiting for most future private basins because they are small and will be situated on gravelly plains in the north-western half of the catchment; refer to Figure 3. Mounding is less likely where permeable gravels underlie a basin. Infiltration basin site selection and design is to conform to sections 6.5.3 and 6.5.4 in the WWDG.

Groundwater Quantity and Quality Assessment for the Heathcote Catchment (PDP, 2016) indicates, based on modelling, that "…the extent of mounding (beneath basins) is expected to be limited. Under a worst case scenario infiltration could cause groundwater levels to rise by up to 3m during a 50-year storm event." This advice is relevant to the Ōtūkaikino Catchment.

Where groundwater may rise either to ground level or the basin floor level the designer must make provision, as appropriate, to discharge at a slower rate, and/or store stormwater until infiltration is no longer impeded, or acquire or remediate adjacent land that may be subject to water logging.

11.7.3. Effects of stormwater on groundwater

New stormwater management systems created during urban development may be either detention or infiltration basins. The Council promotes the use of infiltration basins where possible but its new treatment facilities in the east of the catchment will be in areas of high groundwater and will have to discharge to surface water. Private stormwater treatment facilities in the Greywacke Road area discharge into the ground. If the basins are appropriately constructed, and located away from community drinking water supply protection zones and landfills the effects on groundwater are expected to be very limited.

Groundwater mounding could cause adverse groundwater quality effects in the vicinity of old landfills or other contaminated sites. This issue will continue to be considered on a site-by-site basis.

Stormwater treatment mechanisms are expected to have minor effects on groundwater quality overall. Shallow groundwater will be monitored monthly north of Wilkersons Road (which is down-gradient from industrial area discharges into ground) for a period, until the effects, if any, of private infiltration basins are understood. If groundwater sampling shows a trend of increasing contamination the Council can modify standard infiltration basin designs, requiring thicker soil filtration layers.

11.7.4. Changes to springs and baseflow

Because of the large amount of inflow from the Waimakariri River and the comparatively large amount of rainfall on the plains, the reduction in groundwater recharge due to urbanisation across those parts of the catchment where detention basins are suitable is not expected to be significant in the context of the overall water balance (PDP, 2016). Overall effects are expected to be small.

Pattle Delamore Partners investigated the expected effects of urban development on the water balance, base flow and springs (PDP, 2022). Two factors affect the amount of infiltration to groundwater:

1. a proportion of stormwater runoff will be detained in treatment basins and infiltrated into the ground

2. a significant proportion of total rainfall falls in small amounts that are held in the soil zone and transpire or evaporate without reaching groundwater.

Pattle Delamore Partners found that:

1. Anticipated development should result in a very minor decrease in groundwater recharge because infiltration into the ground from treatment basins is not practicable in the eastern part of the catchment.
2. The percentage baseflow decrease is estimated to be less than 1%.
3. Changes to spring flows are not anticipated to be noticeable.

11.7.5. Monitoring springs

The report by Pattle Delamore Partners Ltd on potential changes to springs and baseflow concluded that a slight reduction in infiltration to groundwater can be expected due to increased imperviousness resulting from development. The anticipated change would be less than 1% after full development, which may occur after the expiry of the consent. Potential changes during the term of the SMP are expected to be less than this. In terms of Schedule 2(l) there are not expected to be measurable effects from diversion of stormwater and monitoring is not proposed.

11.8. Cultural Impact Assessment – Position Statement

Mahaanui Kurataiao has delivered a Position Statement which is Te Ngāi Tūāhuriri Rūnanga's designated means of providing a cultural impact assessment. The Position Statement is summarised in section 5.3.

11.9. Environmental Monitoring

The Council carries out surface water quality monitoring monthly at 51 sites within the Christchurch district. Four sites are within this catchment. This monitoring is not time or rainfall related.

To better quantify contaminant concentrations and track the effects of contaminant mitigation strategies the Council could increase the amount of monitoring during wet weather. The characteristics of the Christchurch water network are different from other cities and local information is needed. Short term monitoring is needed to refine knowledge about zinc loads from different road types and the difference between first-flush and steady-state concentrations. Long term monitoring of treatment systems is needed to verify the performance of basins, swales, rain gardens and filters.

As mentioned in section 11.7.3 shallow groundwater will be monitored monthly north of Wilkersons Road (which is down-gradient from industrial area discharges into ground) for a period, until the effects, if any, of private infiltration basins are understood.

11.10. Pathogens

Pathogens can be minimised by excluding stock from waterways and, ideally, by introducing planted buffer strips. Some bacteria will continue to be introduced by waterfowl and runoff from pastoral land.

There is one wastewater overflow in the catchment, at the Tyrone Street Pumping Station, 76 Tyrone Street. Due to available capacity an overflow is very unlikely unless there is an equipment malfunction.

If there is a wastewater overflow it will be held in the proposed Ōtūkaikino treatment basin for as long as capacity is available or until the level of pathogens has been reduced to a safe level.

11.11. Nutrients

Nutrient inputs in this catchment are mostly of rural origin and do not fall within the scope of this plan.

The Council will cooperate with Environment Canterbury to develop and implement a catchment management plan for rural parts of the catchment.

12. Plan Objectives

These objectives address the issues arising from Sections 3 and 5 through 11.

Objective 1. Control sediment discharges

Our goals are

1.1 Ensure the quality of stormwater from all new development sites or re-development sites is treated to best practice (with section 11.3 being the minimum standard).

1.2 100% of stormwater treatment facilities contributing to Table 10 contaminant mitigation targets (consent condition 6b) are constructed and conform to WWDG standards.

1.3 Sediment from 95% of consented construction activities on the flat is treated to best practice by 2025.

1.4 Analyse options for carrying out street sweeping, sump cleaning, and diversion to wastewater trials in 2020/21 (Schedule 4b & d).

Action Plan for Urban Sediment				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Sediment (urban)				
1.1 New developments	Plan and oversee installation of detention basins, wetlands & swales	District Plan (Development contributions) and Long Term Plan	Normal planning processes.	Ongoing
1.2 New treatment facilities	Ensure new facilities are built to best practice	Designs should conform to the Infrastructure Design Standard	Normal Council planning, design and procurement process.	Ongoing
1.3 Construction & excavation sites	On-site sediment and erosion control effected through Erosion and Sediment Control Plans	Council enforcement powers under the Building Act 2004.	Train Building Inspectors. Implement an enforcement process. Contractor(s) on standby for cleanup when breaches occur.	ESC now part of resource consents for earthworks and building
1.4 Road runoff contains sediment	Investigate & develop methods to treat runoff from arterial roads,	Increase frequency of street sweeping, rain gardens	Street sweeping trials. Construct rain gardens where feasible.	Commenced 2021

Recommended for consideration through the Surface Water Implementation Plan

1.5 Road sediment is reduced by a best practicable option determined by the results of street sweeping, sump cleaning and alternative treatment trials (Schedule 4c, f, g & h.)

Objective 2. Control zinc contaminants

Our goals are

2.1 [repeats Goal 1.2] All the facilities required to meet the Table 10 targets are constructed.

2.2 Groundwater does not become contaminated with zinc above the Attribute Target Levels for Waterways in Schedule 7:

2.3 By 2025 the Council will have investigated zinc mitigation measures and carried out cost/benefit analyses toward identifying their effectiveness as best practicable options.

2.4 By 2025 the Council has consulted with key stakeholders and identified a long term zinc strategy consistent with current technologies.

2.5 The CCC collaborates with local and regional government in a joint submission to central government seeking national measures and industry standards to reduce the discharge of building and vehicle contaminants.

Action Plan for Zinc				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Zinc				
2.1 Same as 1.1				
2.2	Track zinc concentration in groundwater	Groundwater monitoring	Sample groundwater monthly down-gradient from industrial area	From 2023
2.3 & 2.4 Bare steel roofs emit zinc	Investigate/consult acceptable material for new roofs. (Choices non-metallic or pre-painted zinc/aluminium.)	District Plan rule (if possible) otherwise investigate Regional Rule or legislation	Investigate environmental harm and costs/benefits of alternative materials. Consult widely.	Under way
2.3 Ageing Colorsteel® likely to emit zinc	Research zinc emissions from ageing Colorsteel®	Sampling roof runoff	Sample runoff from ageing roofs, monitor trends, liaise with industry.	
2.4	Research and implement best	Catchment scale filtration	Research and trials	Under way 2022

Action Plan for Zinc				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Vehicle (tyre) zinc	practicable means of zinc removal from busy roads	systems. Wetlands & rain gardens if space is available		
2.5	National measures and industry standards to reduce the discharge of building and vehicle contaminants.	Represent Council position to Ministry for the Environment	Regular meetings with MfE staff	Ongoing

Recommended for consideration through the Surface Water Implementation Plan

2.3 The Council engages in research into and trials means of trapping roof-sourced zinc on site.

2.4 The Council adopts a zinc limitation strategy based on identified best practicable options.

Objective 3. Control copper contaminants

Our goals are

3.1 The Council consults with the government, through the Ministry for the Environment, about legislation to limit the copper content in vehicle brake pads.

3.2 The Council does not permit stormwater discharges into the network from unprotected copper cladding, spouting or downpipes.

3.3 The Council will investigate the feasibility of a district plan rule to discourage the use of copper claddings.

Action Plan for Copper				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Copper				
3.1 Vehicle brake pads	Request legislation requiring low/no copper in brake pads	Combined regional and local authority approach to government re legislation to apply nation-wide.	Liaison between local and regional councils. Representation to government via NZTA, MfE	Unknown
3.2 & 3.3 Architectural copper (roofs,	Prohibit the use of unprotected architectural copper.	NZ-wide legislation; possible District Plan rule; otherwise	Liaise with government thru MfE. Investigate and consult.	Unknown

Action Plan for Copper				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
spouting, downpipes)	Seek to limit or eliminated the use of architectural copper.	investigate Regional Rule		

Objective 4. Control industrial site contaminants

Our goals are

4.1 A database of industrial sites considered to be medium or high risk is compiled, based on the best available information, by 2025

4.2 High risk industrial sites are audited by the approved procedure under the CSNDC

Action Plan for Industrial Sites				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
4.1 Limited information about industrial sites.	Gather data to improve database of industrial site information.	Desktop analysis, questionnaires, Chamber of Commerce	Desktop analysis, mailouts, questionnaires, industry liaison	Started 2021
4.2 Industries unaware of effects of discharges to stormwater	Develop awareness among all industries of the harmful effects of contaminated discharges.	Educate via mail-outs. Educate during site audits.	Inspect sites in risk order. Communicate results and expectations	Started 2021
4.3 Some industries failing to control harmful substances	Ensure that harmful substances are contained, tracked, and disposed of safely	Audit sites and follow up with education and enforcement.	Protocols for site controls developed jointly by CCC, ECan and industry. Site audits.	Phase in over c 5 years
4.4 Non-compliant discharges	Trace and eliminate discharges	Audit sites and follow up with education and enforcement.	Communicate the issue to industry & visit industries. Generate improvement plan. Engage and obtain compliance.	Phase in over c 5 years

Objective 5. Engagement and education

Our goals are

5.1 By 2025 the Council will be working with community groups to engage with the public to educate participants about current stormwater practice and enable the public to take action to stop contaminants at source.

5.2 By 2025 the Council will be engaging regularly with the Ministry for the Environment to collaborate on contaminant reduction initiatives.

Action Plan for Engagement and Education				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
5.1 Valuing Water Resources	Education and engagement to empower community groups Each new generation values waterways	Joint partnership prog to effectively co-ordinate existing education and engagement of community groups	Partner delivery (Council, ECan, Ngāi Tahu, CWMS) with stream care and other community groups	Ongoing
5.1 Communication strategy	Develop a long term communication strategy	Strategy development	Understand community thinking about waterways. Agree message and means of communicating.	Ongoing
5.1 Promote community action	Encourage supportive community groups	More direct support for active groups. Provide information and involve in planning	Assist groups to develop goals and action plans. Share Council planning. Fund and track funding. Monitor results.	Ongoing
5.2 CCC and MfE engaged re heavy metals reduction.	CCC to seek regular contact with relevant MfE planning team(s).	The anticipated mechanism is regulation or national education campaign.	Council to contact MfE, starting at executive level, progressing to staff level contacts	Ongoing

Objective 6. Manage flooding

Our goals are

6.1 The quantity of stormwater from all new development sites or re-development sites will be attenuated to at least the minimum standard of section 11.2.

6.2 Protection for property will continue to be achieved through mitigation of water quantity effects during development and controls on new floor levels.

Action Plan for Flooding				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
6.1 Control extra stormwater from new development	Limit the increase in peak stormwater runoff.	Stormwater from new subdivisions is controlled through basins. Stormwater from larger individual sites attenuated on site.	Normal planning processes	Ongoing
6.2 Minimise flooding caused by city growth & change	Monitor changes to impervious areas and stormwater network capacity and compensate if necessary	Regular computer-based flood modelling.	Keep models up to date as the city changes. Compare models with flood events. Plan for flood mitigation as necessary.	Ongoing

Objective 7. Maintain stream base-flows and spring flows

Our goals are

7.1 Stormwater will be infiltrated into the ground where practicable, after treatment, in order to maintain as much as possible the pre-development water balance.

Note: Infiltration of stormwater into the ground, after acceptable treatment, is the Council's preferred means of stormwater discharge.

Action Plan for Flooding				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
7.1 Maintain base flows	Infiltrate stormwater into ground where practicable.	Stormwater networks in new development prioritise detention and infiltration.	Normal planning processes	Ongoing

Part Four
Stormwater Outcomes

13. Conclusion

The purpose of the Comprehensive Stormwater Network Discharge Consent is to drive planning and actions that will progressively improve the quality of stormwater discharges.

Actions the Council can take through the stormwater management plan must be accompanied by other actions if the Council's Community Outcome (Healthy Environment) and the Mahaanui Iwi Management Plan objectives are to be realised. Further actions, by the Council and others, include:

- Raise awareness and educate citizens on how to stop contaminants from entering stormwater at source.
- Eliminate or reduce contaminants at source (e.g. by substituting for contaminating building materials).
- Remove contaminants from stormwater before they enter natural water.
- Restore waterway corridors to a natural state.
- Restore and plant riparian margins.
- Improve instream habitat by sediment removal, riparian tree planting (for temperature control, bank stability and shelter).
- Improve biodiversity to improve food sources for instream life.
- Performance monitoring of treatment facilities.

Progressive improvement can occur through further activities in Table 13:

Table 13: Areas for improvement outside of the stormwater management plan

Activity	Motivation for the Activity
The Council regulating and acting under regulations to stop the discharge of contaminants.	As required by conditions of CRC231955 (CSNDC)
The Council investigating new means of controlling contaminants at source (e.g by materials substitution or innovative means of treatment).	As required by conditions of CRC231955 (CSNDC)
The Council and others implementing new or improved contaminant mitigation practices.	Through the proposed Surface Water Implementation Plan (referred to in section 2.1)
The Council and others making progressive environmental improvements such as restoring waterways and their corridors to a natural state.	Community Outcome (Healthy Environment)
Citizen-based awareness and advocacy for clean water and improved biodiversity.	Kaitiakatanga
Advocacy by Ngāi Tahu for the mana of water and waterways.	Kaitiakatanga. Kawanatanga. Mahaanui Iwi Management Plan

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Appendix A Schedule 2 responses

Table 14: Schedule 2 matters to be included in SMPs: CRC231955 Condition 7

	Matters for inclusion in SMPs	Addressed in which Section of the SMP
a.	Specific guidelines for implementation of stormwater management to achieve the purpose of SMPs;	The SMP is the guideline
b.	A definition of the extent of the stormwater infrastructure, that forms the stormwater network within the SMP area for the purposes of this consent;	4.3
c.	A contaminant load reduction target(s) for each catchment within that SMP area and a description of the process and considerations used in setting the contaminant load reduction target(s) required by Condition 6(b) using the best reasonably practicable model or method and input data;	10.2 to 10.11
d.	A description of statutory and non-statutory planning mechanisms being used by the Consent Holder to achieve compliance with the conditions of this consent including the requirement to improve discharge water quality. These mechanisms shall include: i. Relevant objectives, policies, standards and rules in the Christchurch District Plan; ii. Relevant bylaws; and iii. Relevant strategies, codes, standards and guidelines;	2.3 through 2.11
e.	Mitigation methods to achieve compliance with the conditions of this resource consent including the requirement to improve discharge water quality under Condition 23, and to meet the contaminant load reduction targets for each catchment as determined	11.

	through the SMPs and the standards for the whole of Christchurch set in Condition 19. These methods shall include: i. Stormwater mitigation facilities and devices; ii. Erosion and sediment control guidelines; iii. Education and awareness initiatives on source control systems and site management programmes; iv. Support for third party initiatives on source control reduction methods; v. Prioritising stormwater treatment in catchments: that discharge in proximity to areas of high ecological or cultural value, such as habitat for threatened species or Areas of Significant Natural Value under the Regional Coastal Environment Plan (Canterbury Regional Council, 2012); and areas with high contaminant loads;	
f.	Locations and identification of Christchurch City Council water quality and water quantity mitigation facilities and devices; including a description and justification for separation distances between mitigation facilities or devices and any contaminated land;	11.7 and Figure 11
g.	Identification of areas planned for future development and a description of the Consent Holder's consideration to retrofit water quality and quantity mitigation for existing catchments through these developments where reasonably practicable;	7.2 and Figure 7
h.	Identification of areas subject to known flood hazards;	9
i.	A description of how environmental monitoring and assessment of tangata whenua values have been used to develop water quality mitigation methods and practices;	10.9
j.	Results from and interpretation of water quantity and quality modelling, including identification of sub-catchments with high levels of contaminants;	10.6 and Appendix E

k.	Mapping of existing information from Canterbury Regional Council and the Consent Holder showing locations where discrete spring vents occur;	Figures 2 and 3
l.	Consideration of any effects of the diversion and discharge of stormwater on base-flow in waterways and springs and details of monitoring that will be undertaken of any waterways and springs that could be affected by stormwater management changes anticipated within the life of the SMP;	11.7.4
m.	A cultural impact assessment;	5.3
n.	A summary of outcomes resulting from any collaboration with Papatipu Rūnanga on SMP development;	MKT advised that the cultural impact assessment was sufficient.
o.	An assessment of the effectiveness of water quality or quantity mitigation methods established under previous SMPs and identification of any changes in methods or designs resulting from the assessment;	10.6
p.	Assessment and description of any additional or new modelling, monitoring and mitigation methods being implemented by the Consent Holder;	10.2
q.	A summary of feedback obtained in accordance with Condition 8 and if / how that feedback has been incorporated into the SMP;	Included in Public Submission summary.
r.	If the Consent Holder intends to use land not owned or managed by the Consent Holder for stormwater management, a description of the specific consultation undertaken with the affected land owner;	Not applicable; no non-Council land to be used for stormwater management.

s.	Identification of key monitoring locations in addition to those identified in Schedule 10 where modelled assessments of water levels and/or volumes shall be made. For all monitoring locations, water level reductions or tolerances for increases shall be set for the critical 2% and 10% AEP events in accordance with the objective and ATLs in Schedule 10 and shall be reported with the model update results required under Condition 55;	9.8
t.	Procedures, to be developed in consultation with Christchurch International Airport Limited, for the management of the risk of bird strike for any facility owned or managed by the Christchurch City Council within 3 kilometres of the airport;	11.7.1
u.	A description of any relevant options assessments undertaken to identify the drivers behind mitigation measures selected; and	10.4
v.	An assessment of the potential change to the overall water balance for the SMP area arising from the change in pervious area and the stormwater management systems proposed.	11.7.3

Appendix B Sub-catchment Map

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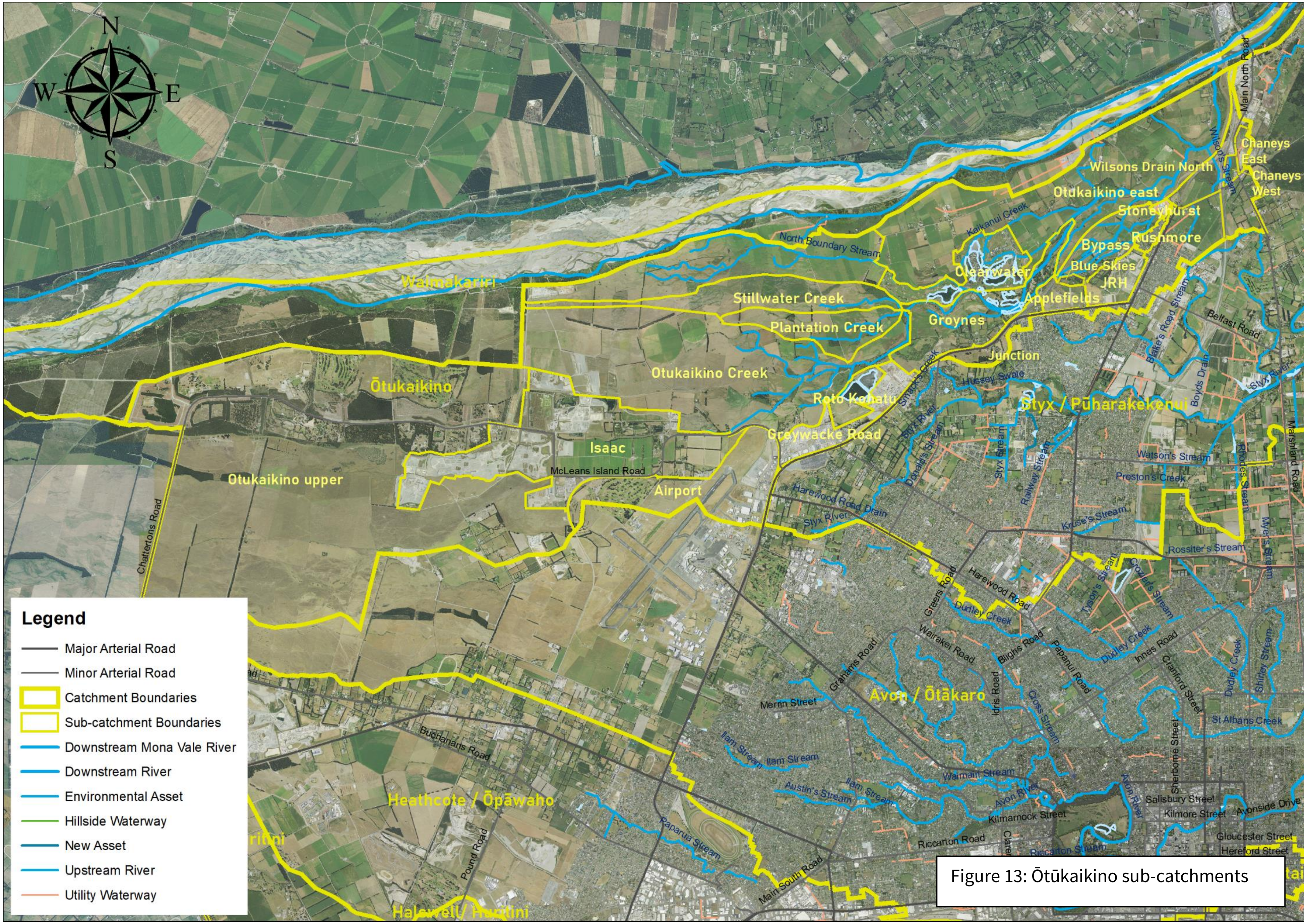

Figure 13: Ōtūkaikino sub-catchments

Appendix C Basins and land contamination

Table 15: Proximity of proposed treatment basins to contaminated land

Basin ID	Address	Investigation report	Report Date	Findings	Justification for siting basin
1103	925 Main North Rd RS 40311 Cant. Dist. , Pt Lots 1, 1, 1, 2, 3 DP 9738	Adjacent only INV255755 Leach field sampling INV267411 Sub-slab soil sampling	Mar 2020 Jun 2020	No entry in LLUR	No known contamination. Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
1102	987 Main North Rd RS 31379 Cant. Dist., Pt Lot 1 DP 9738, Stopped Rd SO 11681	No investigations in LLUR		No entry in LLUR	No known contamination. Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
1101	1000 Main North Rd Secs 1, 3 SO 540092	INV18970 Prelim. Site investigation for ground contamination, Belfast Greenfield Bus. Area	Apr 2013	INV18970 No entry in LLUR. Possible unlisted farming HAIL activities.	No known contamination. Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
1100	940 Main North Rd Lot 1 DP506549, Lot 5 DP 71209 96 Tyrone St	INV18970 Prelim. Site investigation for ground contamination,	Apr 2013	INV18970 No entry in LLUR. Possible unlisted farming HAIL activities.	No known contamination. Likely no significant contamination. Site will be investigated and

Basin ID	Address	Investigation report	Report Date	Findings	Justification for siting basin
	Lots 6, 7 DP 71209	Belfast Greenfield Bus. Area			remediated if necessary during basin construction.
1099	12 Fords Rd Sec 5 SO 540092	INV18970 Prelim. Site investigation for ground contamination, Belfast Greenfield Bus. Area	Apr 2013	INV18970 No entry in LLUR. Possible unlisted farming HAIL activities.	No known contamination. Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
1108	43 Darroch St RS 34409, Sec 13 SO 518339	INV225319 INV83015 Contaminated site mgmt. plan, Reconfiguration of Stoneyhurst Sawmill Site	Sept 2017 Apr 2014	No entry in LLUR	No known contamination.

Appendix D Treatment Efficiencies

Table 16: Treatment system efficiencies assumed in the contaminant load model

Table 6: Treatment systems and efficiencies assumed in the C-CLM.

Treatment system	TSS treatment efficiency (% removal)				Zinc treatment efficiency (% removal)				Copper treatment efficiency (% removal)			
	Roofs	Roads	Paved Surface	Grassland	Roofs	Roads	Paved Surface	Grassland	Roofs	Roads	Paved Surface	Grassland
Single treatment systems												
Basin & wetland	50.0	80.0	80.0	80.0	25.0	60.0	60.0	60.0	30.0	70.0	70.0	70.0
Rain garden	70.0	80.0	80.0	80.0	60.0	70.0	70.0	70.0	70.0	75.0	75.0	75.0
Stormfilter	50.0	75.0	75.0	75.0	15.0	40.0	40.0	40.0	20.0	65.0	65.0	65.0
Wet pond	10.0	75.0	75.0	75.0	5.0	30.0	30.0	30.0	5.0	40.0	40.0	40.0
Basin	10.0	60.0	60.0	60.0	5.0	20.0	20.0	20.0	5.0	30.0	30.0	30.0
First flush Basin	10.0	60.0	60.0	60.0	5.0	20.0	20.0	20.0	5.0	30.0	30.0	30.0
Wetland	50.0	80.0	80.0	80.0	25.0	60.0	60.0	60.0	30.0	70.0	70.0	70.0
Soil adsorption basin	89.0	89.0	89.0	89.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0
Swale	30.0	75.0	75.0	75.0	15.0	40.0	40.0	40.0	20.0	50.0	50.0	50.0
Combined treatment systems												
Basin and basin & wetland	55.0	92.0	92.0	92.0	28.8	68.0	68.0	68.0	33.5	79.0	79.0	79.0
Basin and First flush basin	19.0	84.0	84.0	84.0	9.8	36.0	36.0	36.0	9.8	51.0	51.0	51.0
Rain garden and basin and wetland	85.0	96.0	96.0	96.0	70.0	88.0	88.0	88.0	79.0	92.5	92.5	92.5
Swale and basin and wetland	65.0	95.0	95.0	95.0	36.3	76.0	76.0	76.0	44.0	85.0	85.0	85.0
Swale and first flush Basin	37.0	90.0	90.0	90.0	19.3	52.0	52.0	52.0	24.0	65.0	65.0	65.0

This table is Table 6 in the CSNDC Conditions, Schedule 5, *Assessment of Current and Future Contaminant load for Christchurch,* Golder Associates

Mussel shell filters: treatment efficiency assumed to be 40% in one run and 50% in a second run for all contaminants.

Appendix E Contaminant Load Model Results

Table 17: 2018 (reference) annual contaminant loads

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Sub-catchment	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**
Airport	7662.28	437.64	3021.78	1449.46	2753.4	71.39	55.65	10.24	5.44	0.065	2.32	0.29	1.33	0.66	0.031
Applefields	1125.63	0.46	658.48	0	466.7	3.35	0.05	3.29	0	0.011	0.3	0	0.29	0	0.005
Blue Skies	107.64	0.8	14.85	0	92	0.13	0.09	0.03	0	0.002	0.01	0	0.01	0	0.001
Bypass	2943.5	12.98	2115.35	9.17	806	15.93	1.56	14.32	0.03	0.019	0.98	0.03	0.93	0	0.009
Chaneys East	442.48	11.84	302.32	39.22	89.1	4.03	1.51	2.38	0.15	0.002	0.16	0.01	0.13	0.02	0.001
Chaneys West	210	8.86	170.88	29.36	0.9	1.61	1.13	0.37	0.11	0.000	0.09	0.01	0.08	0.01	0.000
Clearwater	4556.06	95.54	1259.04	37.48	3164	14.07	11.38	2.47	0.14	0.075	0.87	0.26	0.56	0.02	0.036
Greywacke Road	6431.87	606.91	2910.76	1998.91	915.3	98.78	77.14	14.12	7.5	0.022	2.62	0.41	1.28	0.92	0.010
Groynes	6773.98	38.84	1632.08	105.66	4997.4	8.6	4.88	3.21	0.4	0.118	0.87	0.04	0.72	0.05	0.056
Isaac	23314.8	177.94	7766.51	540.85	14829.5	48.98	22.49	24.11	2.03	0.350	3.99	0.15	3.42	0.25	0.167
Johns Road	1890.36	11.74	1358.46	19.65	500.5	11.4	1.44	9.88	0.07	0.012	0.63	0.02	0.6	0.01	0.006
JRH	365.37	5.1	37.04	4.82	318.4	0.71	0.62	0.07	0.02	0.008	0.03	0.01	0.02	0	0.004
Junction	1678.2	34.05	1332.84	40.11	271.2	11.55	4.13	7.27	0.15	0.006	0.68	0.07	0.59	0.02	0.003
Ōtūkaikino Creek	26218.69	22.21	3974.51	65.28	22183.4	13.75	2.8	10.18	0.24	0.524	2.04	0.02	1.74	0.03	0.249
Ōtūkaikino east	22407.61	135.23	4766.62	395.66	17110.1	37.51	17.05	18.54	1.48	0.442	2.6	0.13	2.1	0.18	0.190

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Ōtūkaikino upper	77478.77	188.17	12884	575.1	63831.5	53.59	23.8	26.13	2.16	1.510	6.82	0.16	5.68	0.26	0.715
Plantation Creek	3992.82	0	274.62	0	3718.2	0.63	0	0.54	0	0.088	0.16	0	0.12	0	0.042
Roto Kohatu	1452.43	2.35	753.51	7.77	688.8	1.82	0.3	1.48	0.03	0.016	0.35	0	0.33	0	0.008
Rushmore	544.71	70.44	346.26	15.01	113	9.33	8.36	0.91	0.06	0.003	0.36	0.2	0.15	0.01	0.001
South Branch	13981.34	10.14	2348.14	33.57	11589.5	6.29	1.29	4.6	0.13	0.274	1.19	0.01	1.04	0.02	0.130
Stillwater Creek	6230.6	0.29	224.67	0.94	6004.7	0.62	0.04	0.44	0	0.142	0.17	0	0.1	0	0.067
Stoneyhurst	346.34	58.24	0	192.9	95.2	8.13	7.41	0	0.72	0.002	0.13	0.04	0	0.09	0.001
Wilsons Drain North	5921.19	50.25	4855.31	155.43	860.2	7.96	6.36	0	0.58	0.020	2.26	0.04	2.14	0.07	0.010
Wilsons Drain South	4624.45	359.47	3242.78	249	773.2	59.56	43.12	15.48	0.93	0.018	2.46	0.91	1.43	0.11	0.009
Total (kg/yr)	**220,701**	**2,339**	**56,250**	**5,965**	**156,172**	**521.67**	**292.60**	**170.06**	**22.37**	**3.73**	**32.09**	**2.81**	**24.79**	**2.73**	**1.75**

Note: 'Carpark' refers to paved areas in industrial zones

Table 18: Estimated annual contaminant loads from fully developed sub-catchments before treatment

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Sub-catchment	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**
Airport	7662.28	437.64	3021.78	1449.46	2753.4	71.39	55.65	10.24	5.44	0.065	2.32	0.29	1.33	0.66	0.031
Applefields	3186.78	0.46	658.48	0	180	33.84	0.05	3.29	0	0.002	1.4	0	0.29	0	0.004
Blue Skies	622.89	0.8	14.85	0	33.9	6.65	0.09	0.03	0	0.000	0.27	0	0.01	0	0.001
Bypass	2943.5	12.98	2115.35	9.17	806	15.93	1.56	14.32	0.03	0.019	0.98	0.03	0.93	0	0.009
Chaneys East	1875.5	11.84	302.32	39.22	27.9	24.23	1.51	2.38	0.15	0.000	0.97	0.01	0.13	0.02	0.001
Chaneys West	1127.46	8.86	170.88	29.36	0.3	14.78	1.13	0.37	0.11	0.000	0.59	0.01	0.08	0.01	0.000
Clearwater	4556.06	95.54	1259.04	37.48	3164	14.07	11.38	2.47	0.14	0.075	0.87	0.26	0.56	0.02	0.036
Greywacke Road	6431.87	606.91	2910.76	1998.91	915.3	98.78	77.14	14.12	7.5	0.022	2.62	0.41	1.28	0.92	0.010
Groynes	6773.98	38.84	1632.08	105.66	4997.4	8.6	4.88	3.21	0.4	0.118	0.87	0.04	0.72	0.05	0.056
Isaac	23314.8	177.94	7766.51	540.85	14829.5	48.98	22.49	24.11	2.03	0.350	3.99	0.15	3.42	0.25	0.167
Johns Road	1890.36	11.74	1358.46	19.65	500.5	11.4	1.44	9.88	0.07	0.012	0.63	0.02	0.6	0.01	0.006
JRH	5017.44	5.1	37.04	4.82	116.5	54.84	0.62	0.07	0.02	0.001	2.27	0.01	0.02	0	0.003
Junction	1678.2	34.05	1332.84	40.11	271.2	11.55	4.13	7.27	0.15	0.006	0.68	0.07	0.59	0.02	0.003
Ōtūkaikino Creek	26218.69	22.21	3974.51	65.28	22183.4	13.75	2.8	10.18	0.24	0.524	2.04	0.02	1.74	0.03	0.249
Ōtūkaikino east	22407.61	135.23	4766.62	395.66	17110.1	37.51	17.05	18.54	1.48	0.442	2.6	0.13	2.1	0.18	0.190

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Ōtūkaikino upper	77478.77	188.17	12884	575.1	63831.5	53.59	23.8	26.13	2.16	1.510	6.82	0.16	5.68	0.26	0.715
Plantation Creek	3992.82	0	274.62	0	3718.2	0.63	0	0.54	0	0.088	0.16	0	0.12	0	0.042
Roto Kohatu	1452.43	2.35	753.51	7.77	688.8	1.82	0.3	1.48	0.03	0.016	0.35	0	0.33	0	0.008
Rushmore	544.71	70.44	346.26	15.01	113	9.33	8.36	0.91	0.06	0.003	0.36	0.2	0.15	0.01	0.001
South Branch	13981.34	10.14	2348.14	33.57	11589.5	6.29	1.29	4.6	0.13	0.274	1.19	0.01	1.04	0.02	0.130
Stillwater Creek	6230.6	0.29	224.67	0.94	6004.7	0.62	0.04	0.44	0	0.142	0.17	0	0.1	0	0.067
Stoneyhurst	346.34	58.24	0	192.9	95.2	8.13	7.41	0	0.72	0.002	0.13	0.04	0	0.09	0.001
Wilsons Drain North	5921.19	50.25	4855.31	155.43	860.2	7.96	6.36	0	0.58	0.020	2.26	0.04	2.14	0.07	0.010
Wilsons Drain South	13528.71	359.47	3242.78	249	444.8	142.66	43.12	15.48	0.93	0.005	6.5	0.91	1.43	0.11	0.011
Total (kg/yr)	**239,184**	**2,339**	**56,250**	**5,965**	**155,235**	**729.28**	**292.60**	**170.06**	**22.37**	**3.70**	**41.04**	**2.81**	**24.79**	**2.73**	**1.75**

Note: 'Carpark' refers to paved areas in industrial zones

Table 19: Estimated annual contaminant loads after full development and basin/wetland treatment.

Green sub-catchments are treated in basins + wetlands.

White sub-catchments are untreated: contaminant loads unchanged from Baseline

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Sub-catchment	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**
Airport	7662.3	437.6	3021.8	1449.5	2753.4	71.39	55.65	10.24	5.44	0.065	2.32	0.290	1.330	0.660	0.031
Applefields	274.6	23.9	234.9	1.4	14.4	21.03	18.50	2.48	0.02	0.001	0.34	0.060	0.271	0.002	0.001
Blue Skies	54.1	5.2	45.9	0.3	2.7	4.22	3.79	0.42	0.00	0.000	0.07	0.012	0.053	0.000	0.000
Bypass	2943.5	13.0	2115.4	9.2	806.0	15.93	1.56	14.32	0.03	0.019	0.98	0.030	0.930	0.000	0.009
Chaneys East	172.4	27.1	71.9	71.1	2.2	14.60	12.43	1.10	1.07	0.000	0.28	0.110	0.083	0.085	0.000
Chaneys West	103.8	16.6	43.9	43.4	0.0	8.90	7.59	0.67	0.65	0.000	0.17	0.069	0.051	0.052	0.000
Clearwater	4556.1	95.5	1259.0	37.5	3164.0	14.07	11.38	2.47	0.14	0.075	0.87	0.260	0.560	0.020	0.036
Greywacke Rd	6431.9	606.9	2910.8	1998.9	915.3	98.78	77.14	14.12	7.50	0.022	2.62	0.410	1.280	0.920	0.010
Groynes	6774.0	38.8	1632.1	105.7	4997.4	8.60	4.88	3.21	0.40	0.118	0.87	0.040	0.720	0.050	0.056
Isaac	23314.8	177.9	7766.5	540.9	14829.5	48.98	22.49	24.11	2.03	0.350	3.99	0.150	3.420	0.250	0.167
Johns Road	1890.4	11.7	1358.5	19.7	500.5	11.40	1.44	9.88	0.07	0.012	0.63	0.020	0.600	0.010	0.006
JRH	434.5	40.3	382.5	2.3	9.3	34.73	31.22	3.48	0.04	0.000	0.55	0.099	0.443	0.003	0.001
Junction	1678.2	34.1	1332.8	40.1	271.2	11.55	4.13	7.27	0.15	0.006	0.68	0.070	0.590	0.020	0.003
Ōtūkaikino Ck	26218.7	22.2	3974.5	65.3	22183.4	13.75	2.80	10.18	0.24	0.524	2.04	0.020	1.740	0.030	0.249

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Ōtūkaikino east	22407.6	135.2	4766.6	395.7	17110.1	37.51	17.05	18.54	1.48	0.442	2.60	0.130	2.100	0.180	0.190
Ōtūkaikino upper	77478.8	188.2	12884.0	575.1	63831.5	53.59	23.80	26.13	2.16	1.510	6.82	0.160	5.680	0.260	0.715
Plantation Creek	3992.8	0.0	274.6	0.0	3718.2	0.63	0.00	0.54	0.00	0.088	0.16	0.000	0.120	0.000	0.042
Roto Kohatu	1452.4	2.4	753.5	7.8	688.8	1.82	0.30	1.48	0.03	0.016	0.35	0.000	0.330	0.000	0.008
Rushmore	69.6	31.7	27.7	1.2	9.1	6.30	6.00	0.29	0.02	0.001	0.17	0.130	0.032	0.002	0.000
South Branch	13981.3	10.1	2348.1	33.6	11589.5	6.29	1.29	4.60	0.13	0.274	1.19	0.010	1.040	0.020	0.130
Stillwater Creek	6230.6	0.3	224.7	0.9	6004.7	0.62	0.04	0.44	0.00	0.142	0.17	0.000	0.100	0.000	0.067
Stoneyhurst	346.3	58.2	0.0	192.9	95.2	8.13	7.41	0.00	0.72	0.002	0.13	0.040	0.000	0.090	0.001
Wilsons Drain North	5921.2	50.3	4855.3	155.4	860.2	7.96	6.36	0.00	0.58	0.020	2.26	0.040	2.140	0.070	0.010
Wilsons Drain South	1184.8	124.7	702.0	322.5	35.6	76.90	56.70	15.30	4.84	0.002	1.72	0.515	0.812	0.388	0.002
Total (kg/yr)	**219667**	**2298**	**5623**	**6556**	**154600**	**650.20**	**399.67**	**183.48**	**30.45**	**3.69**	**34.62**	**2.88**	**26.52**	**3.45**	**1.74**

Note: 'Carpark' refers to paved areas in industrial zones

Table 20: Estimated annual contaminant loads after full development and basin/wetland treatment with mussel shell filters and 100% industrial roofs factory coated steel.

Green sub-catchments are treated.

White sub-catchments are untreated: contaminant loads unchanged from Baseline

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Sub-catchment	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**	**Total**	**Roofs**	**Roads**	**Carpark**	**Rural**
Airport	7662.3	437.6	3021.8	1449.5	2753.4	71.39	55.65	10.24	5.44	0.065	2.32	0.290	1.330	0.660	0.031
Applefields	164.7	14.3	140.9	0.83	8.64	12.5	11.0	1.49	0.013	0.0004	0.20	0.035	0.16	0.0013	0.0005
Blue Skies	32.2	2.9	27.5	0.17	1.63	2.48	2.23	0.25	0.0025	0.0001	0.039	0.007	0.032	0.0002	0.0001
Bypass	2943.5	13.0	2115.4	9.2	806.0	15.93	1.56	14.32	0.03	0.019	0.98	0.030	0.930	0.000	0.009
Chaneys East	102.0	14.9	43.1	42.7	1.34	4.35	3.05	0.64	0.0001	0.0001	0.14	0.036	0.05	0.051	0.0001
Chaneys West	61.44	9.09	26.3	26.0	0.014	2.65	1.86	0.40	0.39	0.000	0.082	0.02	0.03	0.03	0.000
Clearwater	4556.1	95.5	1259.0	37.5	3164.0	14.07	11.38	2.47	0.14	0.075	0.87	0.260	0.560	0.020	0.036
Greywacke Rd	6431.9	606.9	2910.8	1998.9	915.3	98.78	77.14	14.12	7.50	0.022	2.62	0.410	1.280	0.920	0.010
Groynes	6774.0	38.8	1632.1	105.7	4997.4	8.60	4.88	3.21	0.40	0.118	0.87	0.040	0.720	0.050	0.056
Isaac	23314.8	177.9	7766.5	540.9	14829.5	48.98	22.49	24.11	2.03	0.350	3.99	0.150	3.420	0.250	0.167
Johns Road	1890.4	11.7	1358.5	19.7	500.5	11.40	1.44	9.88	0.07	0.012	0.63	0.020	0.600	0.010	0.006
JRH	260.6	24.1	229.5	1.40	5.59	20.7	18.6	2.09	0.02	0.003	0.33	0.06	0.27	0.0017	0.0003
Junction	1678.2	34.1	1332.8	40.1	271.2	11.55	4.13	7.27	0.15	0.006	0.68	0.070	0.590	0.020	0.003
Ōtūkaikino Ck	26218.7	22.2	3974.5	65.3	22183.4	13.75	2.80	10.18	0.24	0.524	2.04	0.020	1.740	0.030	0.249

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Ōtūkaikino east	22407.6	135.2	4766.6	395.7	17110.1	37.51	17.05	18.54	1.48	0.442	2.60	0.130	2.100	0.180	0.190
Ōtūkaikino upper	77478.8	188.2	12884.0	575.1	63831.5	53.59	23.80	26.13	2.16	1.510	6.82	0.160	5.680	0.260	0.715
Plantation Creek	3992.8	0.0	274.6	0.0	3718.2	0.63	0.00	0.54	0.00	0.088	0.16	0.000	0.120	0.000	0.042
Roto Kohatu	1452.4	2.4	753.5	7.8	688.8	1.82	0.30	1.48	0.03	0.016	0.35	0.000	0.330	0.000	0.008
Rushmore	40.8	18.0	16.6	0.72	5.42	3.56	3.37	0.17	0.012	0.0005	0.10	0.08	0.019	0.0013	0.0002
South Branch	13981.3	10.1	2348.1	33.6	11589.5	6.29	1.29	4.60	0.13	0.274	1.19	0.010	1.040	0.020	0.130
Stillwater Creek	6230.6	0.3	224.7	0.9	6004.7	0.62	0.04	0.44	0.00	0.142	0.17	0.000	0.100	0.000	0.067
Stoneyhurst	346.3	58.2	0.0	192.9	95.2	8.13	7.41	0.00	0.72	0.002	0.13	0.040	0.000	0.090	0.001
Wilsons Drain North	5921.2	50.3	4855.3	155.4	860.2	7.96	6.36	0.00	0.58	0.020	2.26	0.040	2.140	0.070	0.010
Wilsons Drain South	704.6	68.5	421.2	193.5	21.4	26.1	14.04	9.2	2.90	0.001	0.88	0.16	0.49	0.23	0.0013
Total (kg/yr)	**214,647**	**2,034.2**	**52,383.3**	**5,893.5**	**154,362**	**483.34**	**291.87**	**161.77**	**24.4**	**3.690**	**30.4**	**2.068**	**23.73**	**2.89**	**1.73**

Note: 'Carpark' refers to paved areas in industrial zones

Green cell annual loads assume 40% contaminant capture by mussel shell filters. "Contaminant capture" means the capture of a proportion of contaminants that remain after basin/wetland treatment.

Appendix F Attribute Target Levels, Schedules 7 to 10

Waterways, Coastal and Groundwater Receiving Environment Attribute Target Levels in Schedules 7 to 10 from Condition 23, Consent CRC231955.

Schedule 7: Receiving Environment Objectives and Attribute Target Levels for Waterways

The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels.
TBC-A = To Be Confirmed once a full year of monitoring allows hardness modified values to be calculated, in accordance with Condition 52.
TBC-B = To Be Confirmed following engagement with Papatipu Rūnanga, through an update to the EMP, in accordance with Condition 54.

Objective	Attribute	Attribute Target Level	Basis for Target
Adverse effects on ecological values do not occur due to stormwater inputs	QMCI	Lower limit QMCI scores: • Spring-fed – plains – urban waterways: 3.5 • Spring-fed – plains waterways: 5 • Banks Peninsula waterways: 5	QMCI is an indicator of aquatic ecological health, with higher numbers indicative of better quality habitats, due to a higher abundance of more sensitive species. QMCI scores are taken from the guidelines in Table 1a of the LWRP (Canterbury Regional Council, 2018). This metric is designed for wade able sites and should therefore be used with caution for non-wade able sites. These targets can be achieved through reducing contaminant loads and waterway restoration.
Adverse effects on water clarity and aquatic biota do not occur due to sediment inputs	Fine sediment (<2 mm diameter) percent cover of stream bed TSS concentrations in surface water	Upper limit fine sediment percent cover of stream bed: • Spring-fed – plains – urban waterways: 30% • Spring-fed – plains waterways: 20% • Banks Peninsula waterways: 20%	Sediment (particularly from construction) can decrease the clarity of the water and can negatively affect the photosynthesis of plants and therefore primary productivity within streams, interfere with feeding through the smothering of food supply, and can clog suitable habitat for species. The sediment cover Target Levels are taken from the standards for the original Styx and South-West Stormwater Management Plan consents and are based on Table 1a of the LWRP (Canterbury Regional Council, 2018). These targets should be

		Upper limit concentration of TSS in surface water: 25 mg/L No statistically significant increase in TSS concentrations in surface water	used with caution at sites that likely naturally have soft-bottom channels. These targets can be achieved through reducing contaminant loads (particularly using erosion and sediment control) and instream sediment removal.
Adverse effects on aquatic biota do not occur due to copper, lead and zinc inputs in surface water	Zinc, copper and lead concentrations in surface water	Upper limit concentration of dissolved zinc: • Ōtākaro/ Avon River catchment: 0.0297 mg/L • Ōpāwaho/ Heathcote River catchment: 0.04526 mg/L • Cashmere Stream: 0.00724 mg/L • Huritīni / Halswell River catchment: 0.01919 mg/L • Pūharakekenui/ Styx River catchment: 0.01214 mg/L • Ōtūkaikino River catchment: 0.00868 mg/L • Linwood Canal: 0.146 mg/L • Banks Peninsula catchments: TBC-A	These metals can be toxic to aquatic organisms, negatively affecting such things as fecundity, maturation, respiration, physical structure and behaviour. The Council has developed these hardness modified trigger values in accordance with the methodology in the 'Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand' (ANZG, 2018) guidelines, and the species protection level relevant to each waterway in the LWRP (Canterbury Regional Council, 2017). This calculation document can be provided on request. These targets can be achieved primarily through reducing contaminant loads.

		Upper limit concentration of dissolved copper: • Ōtākaro/ Avon River catchment: 0.00356 mg/L • Ōpāwaho/ Heathcote River catchment: 0.00543 mg/L • Cashmere Stream: 0.00302 mg/L • Huritīni / Halswell River catchment: 0.00336 mg/L • Pūharakekenui/ Styx River catchment: 0.00212 mg/L • Ōtūkaikino River catchment: 0.00152 mg/L • Linwood Canal: 0.0175 mg/L • Banks Peninsula catchments: TBC-A	

Objective	Attribute	Attribute Target Level	Basis for Target
		Upper limit concentration of dissolved lead: • Ōtākaro/ Avon River catchment: 0.01554 mg/L • Ōpāwaho/ Heathcote River catchment: 0.02916 mg/L • Cashmere Stream: 0.00521 mg/L • Huritīni / Halswell River catchment: 0.01257 mg/L • Pūharakekenui/ Styx River catchment: 0.00634 mg/L • Ōtūkaikino River catchment: 0.00384 mg/L • Linwood Canal: 0.167 mg/L • Banks Peninsula catchments: TBC-A No statistically significant increase in copper, lead and zinc concentrations	

Excessive growth of macrophytes and filamentous algae does not occur due to nutrient inputs	Total macrophyte and filamentous algae (>20 mm length) cover of stream bed	Upper limit total macrophyte cover of the stream bed: w. Spring-fed – plains – urban waterways: 60% x. Spring-fed – plains waterways: 50% y. Banks Peninsula waterways: 30% Upper limit filamentous algae cover of the stream bed:	Macrophyte and algae cover are indicators of the quality of aquatic habitat. Targets are taken from Table 1a of the LWRP (Canterbury Regional Council, 2018). Improvement towards these targets can be achieved by reduction in nutrient concentrations and riparian planting to shade the waterways.

Objective	Attribute	Attribute Target Level	Basis for Target
		• Spring-fed – plains – urban waterways: 30% • Spring-fed – plains waterways: 30% • Banks Peninsula waterways: 20%	
Adverse effects on aquatic biota do not occur due to zinc, copper, lead and PAHs in instream sediment	Zinc, copper, lead and PAHs concentrations in instream sediment	Upper limit concentration of total recoverable metals for all classifications: • Copper = 65 mg/kg dry weight • Lead = 50 mg/kg dry weight • Zinc = 200 mg/kg dry weight • Total PAHs = 10 mg/kg dry weight No statistically significant increase in copper, lead, zinc and Total PAHs	Meta Metals can bind to sediment and remain in waterways, potentially negatively affecting biota. These trigger values are based on the ANZG guidelines (ANZG, 2018). These targets can be achieved through reducing contaminant loads and instream sediment removal.
Adverse effects on Mana Whenua values do not occur due to stormwater inputs	Waterway Cultural Health Index and State of Takiwā scores	Lower limit averaged Waterway Cultural Health Index and State of Takiwā scores for all classifications: • Spring-fed – plains – urban waterways: TBC-B • Spring-fed – plains waterways: TBC-B Banks Peninsula waterways: TBC-B	The Waterway Cultural Health Index assesses cultural values and indicators of environmental health, such as mahinga kai (food gathering). These indices are on a scale of 1 - 5, with higher scores indicative of greater cultural values. No guidelines are available currently for the different types of waterways, so these targets will be developed specifically for this consent, with higher targets for waterways with higher values. These targets

			can be achieved through reducing contaminant loads and habitat restoration.

Schedule 9: Receiving Environment Objectives and Attribute Target Levels for Groundwater and Springs

The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels

Objective	Attribute	Attribute Target Level	Basis for Target
Protect drinking water quality	Copper, lead, zinc and *Escherichia coli* concentrations in drinking water	Concentration to not exceed: • Dissolved Copper: 0.5 mg/L • Dissolved Lead: 0.0025 mg/L • Dissolved Zinc:0.375 mg/L No statistically significant increase in the concentration of *Escherichia coli* at drinking water supply wells	The most important use of Christchurch groundwater is the supply of the urban reticulated drinking water supply. Contaminants in stormwater that infiltrate into the ground could impact on the quality of water supply wells and/or springs. The compliance criteria for a potable and wholesome water supply are specified in the Drinking Water Standards for New Zealand 2005 (Revised 2008). Metals and *E.coli* were chosen for these targets, as these are contaminants present in stormwater. The target values for copper and lead are a quarter of the Maximum Acceptable Value (MAV) or Guideline Value (GV) taken from the Drinking Water Standards for New Zealand 2005 (revised 2008). This is to ensure investigations occur before the water quality limits in the LWRP are exceeded, which are that concentrations are not to exceed 50% of the MAV. An equivalent criterion has also been applied to the zinc target, which is not included in the LWRP water quality limits but has a guideline in the drinking water standards.
Avoid widespread adverse effects on shallow groundwater quality	Electrical conductivity in groundwater	• No statistically significant increase in electrical conductivity	Contaminants in stormwater that infiltrate into the ground could impact on groundwater quality. Long term groundwater quality at monitoring wells is undertaken by Canterbury Regional Council. Those monitoring points that occur within the urban area could be impacted by Council stormwater management activities. Electrical conductivity is to be used as an indicator for identifying any general changes in groundwater quality related to recharge.

Appendix G Guidelines for Bird Strike Management

In Stormwater Basin/Water Body Design

Purpose of Design Guidelines

Bird strike is defined in the Christchurch District Plan as when a bird or flock of birds collide with an aircraft and is a key threat to the safe operation of Christchurch International Airport. It is of particular concern throughout the Ōtūkaikino catchment, which lies immediately to the north of the main Christchurch Airport runway. Bird strike is a significant safety risk which requires diligent management and collaboration between Christchurch International Airport Ltd (CIAL/ the airport), local government and surrounding landowners.

Strategies for reducing the risk of strikes at the airport focus on managing wildlife populations on and surrounding the airport. There are provisions in the District Plan addressing issues arising out of incompatible land uses relating to the avoidance of bird strike risk introduced in Chapter 6, Section 6.7 Aircraft Protection, supported by Policy 6.7.2.1.2. Section 6.7.4.3 Activity status tables – Bird strike Management Areas outlines activities and specific standards aimed at managing the establishment of new land uses such as water bodies and stormwater basins that might provide new and additional habitat that is attractive to birds, such that it may increase the movement of birds across flight paths. Appendix 6.11.7.5 outlines controls related to water bodies and stormwater basins within the 3km radius, however considerations for bird strike must also be taken into account up to 13km from the airport runway thresholds, in collaboration with CIAL.

Parameters

Bird strike risk can be avoided or minimised appropriately using best practice guidance provided below, in the District Plan, in collaboration with CIAL[7]

Bird use of stormwater management basins are similar to those of natural water bodies. Parameters to minimise bird strike are similar for both basins and water bodies, and include minimising facility surface area as much as practicable, and design considerations such as:

- maximisation of drainage to avoid standing water,
- increased bank gradients to deter bird nesting,
- avoidance of permanent island features which can provide perching sites for birds,
- appropriate landscape design considering perimeter plant species selection and densities (diagrammed in Figure 1 below).

Ongoing bird strike risk management also extends beyond design and implementation to water body or basin operations, maintenance and/or monitoring.

[7] Rules in the District Plan specifically control the creation of new stormwater basins or water bodies within identified Birdstrike Management Areas (i.e., Rule 6.7.4.3.1 Activity P3). Other plan provisions also deal with bird strike and are generally referenced in Section 11.6.1 of this management plan.

The risk of bird strike will vary from site to site and may be influenced by factors such as proximity to the airport, the flight patterns of specific bird species, surrounding land uses and natural factors such as season, species ecology, and landscape features.

Some general guidelines for design of stormwater basins / water bodies to minimise the risk of bird strike are shown in Figure 14. Specific implementation of these guidelines will vary on a site-by-site basis and should be undertaken in consultation with CIAL and on receipt of ornithologist advice.

Additional guidelines are:

1. Minimising open water and vegetative cover that provides food, shelter or roosting for birds are the primary habitat features of focus for bird risk management near the airport.

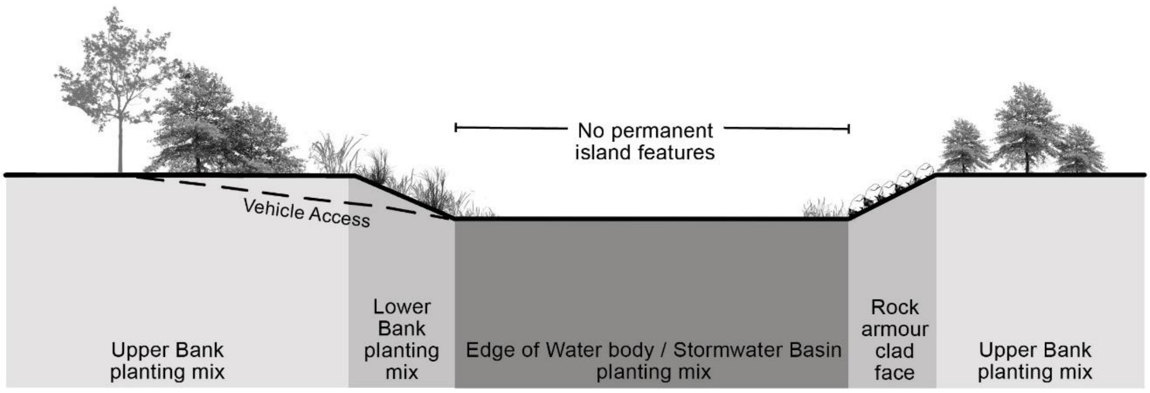

Figure 14: Typical basin section

2. Landscape planting plans must limit the attractiveness of basins to birds using suitable non-attracting plant species. Vegetation with berries, nuts, desirable forage, attractive flowers, edible tubers or roots, or large, abundant or high-nutrient seeds should be avoided as a potential wildlife attractant. In general, using low diversity planting strategies and avoiding high-nutrient organic soil amendment (which can attract invertebrates that attract certain birds) is important. Plant species should be limited to those listed in Table 21 (and Appendix 6.11.9 of the District Plan).

Table 21: Plant species for Water Bodies /Stormwater Basins in the Ōtūkaikino Catchment

Edge of Water body / Stormwater basin	
Botanical name	**Common name**
Schoenoplectus validus / tabernaemontani	lake club rush / kapungawha
Eleocharis acuta	spike sedge
Carex germinata	makura
Schoenus pauciflorus	bog rush
Polystichum vestitum	prickly shield fern
Juncus pallidus	tussock rush / wiwi
Cyperus ustulatus	umbrella sedge

Lower Bank	
Botanical name	**Common name**
Anemanthele lessoniana	wind grass
Astelia fragrans	bush lily / kakaha
Coprosma propinqua	mikimiki
Dianella nigra	ink berry / turutu
Plagianthus divaricatus	swamp ribbonwood
Upper Bank	
Botanical name	**Common name**
Aristotelia serrata	makomako / wineberry
Carpodetus serratus	marbleleaf / putaputaweta
Coprosma rotundifolia	roundleaved coprosma
Dodonea viscosa (frost tender)	akeake
Eleocarpus hookerianus	pokaka
Griselinia littoralis	kapuka / broadleaf
Hebe salicifolia	koromiko
Hoheria angustifolia	narrow leaved lacebark
Kunzea ericoides	kanuka
Leptospermum scoparium	manuka
Lophomyrtus obcordata	rohutu / NZ myrtle
Myrsine australis	mapou
Myrsine divaricata	weeping mapou
Pittosporum eugenioides	lemonwood
Pittosporum tenuifolium	matipo
Plagianthus regius	lowland ribbonwood
Podocarpus totara	totara
Prumnopitys taxifolia	matai
Pseudowintera colorata	peppertree
Sophora microphylla	kowhai

3. High risk bird species of particular concern to aircraft bird strike are summarised in Table 22. Flexibility or adaptability is needed as birds may modify their behaviour in response to installation of new stormwater facilities in ways that were not anticipated during design,

resulting in an aviation safety problem. Continued collaboration between stormwater facility designers and CIAL is recommended.

Table 22: Bird species causing particular risk of bird strike
Source: Dr. Leigh Bull, 2021.

Bird Species	Habitat Characteristics
Southern black-backed gull (*Larus dominicanus*)	Found in most habitats. Colonies can occur on islands, steep headlands, sand, or shingle spits or on islands in shingle riverbeds.
Canada goose (*Branta canadensis*)	Graze on pasture, young crops, and aquatic plants. Prefer pastoral land adjacent to a lake or large pond.
Feral pigeon/ Rock pigeon (*Columba livia*)	Variety of habitats. Roost and nest in buildings, under bridges/wharves, and on ledges of cliffs and caves. Occupy open habitats, usually near water (e.g. river-beds, sea and lake shores, agricultural pasture, and urban parklands).
Spur-winged plover (*Vanellus miles*)	Move in response to availability of wetlands. Use temporary and recently constructed artificial wetlands, and leave a drying wetland or diminished food supply.

Stormwater basin designers should make early contact with CIAL for referral to an ornithologist familiar with aviation operations.

Appendix H Feedback on the Ōtūkaikino SMP

1. Feedback from the parties listed in Condition 4:

The parties listed in Condition 4 are:

- Papatipu Rūnanga
- The relevant Zone Committee
- The relevant Community Boards
- The Department of Conservation
- The CRC Regional Engineer

The Papatipu Rūnanga for this catchment is Te Ngāi Tūāhuriri Rūnanga. Te Ngāi Tūāhuriri Rūnanga has declined to be consulted directly during preparation of SMPs. The Rūnanga has chosen to make a position statement about each SMP upon receiving the finalised SMP. It is believed that the Rūnanga supports the removal of stormwater and other contaminants from rivers in principle but considers any plan that does not fully support the Mahaanui Iwi Management Plan is insufficient. The rūnanga is unwilling to either criticise or endorse the SMP. Many objectives in the Iwi Management Plan are outside the scope of SMPs and are not addressed or not addressed in full.

The Christchurch-West Melton Zone Committee received a briefing about the SMP during its development and received a copy of the consultation version of the SMP. The Zone Committee was pleased that all urban surface runoff to surface water is to be treated. One Committee member solicited support for a potential project to build wetlands near Ōtūkaikino Creek for environmental enhancement; however, the SMP objectives do not include environmental enhancement of this type.

The Waimāero Fendalton-Waimairi-Harewood Community Board is the community board in this catchment. The board received a briefing about the SMP during development and responded to the consultation version of the SMP as follows:

Question from Community Board	Answer to Community Board
Wanted to know if residents are aware of environmental risks of using copper as a building material,	The Community Waterways Partnership Programme (CWPP) Team is preparing educational material about contaminants including a brochure about copper building materials.
Recommended that education include practical tips	The CWPP Team is including "What can I do" tips in educational material.
Wanted to know how residents can be informed about flood models and flood risks	CCC regards flood models as normal business (i.e. not needing explanation) and provides information on request.

The Department of Conservation approved the proposal to treat all urban runoff, promoted fish passage, asked for details of stream and drain maintenance and requested monitoring of treatment facilities' efficiency.

The Department questioned aspects of the SMP as follows:

Issues raised by DoC	Response
Noted a low percentage removal of metals by wetlands	(subsequently) mussel shell filters added into wetlands
Queried metals exceedances in water quality and sediment sampling,	Exceedances in upper catchment not able to be explained. CCC trying to investigate.
Queried effects arising from disposal of industrial stormwater into the ground	One-off groundwater monitoring under way in Logistics Drive area.
Queried discrepancies in descriptions of sites	Corrected in this version
Noted declines in riparian habitat and dissolved oxygen	Not a SMP issue. D.O. troughs in summer.

The Council contacted the CRC Regional Engineer to ask for feedback on specified flooding issues. The CCC put forward that this catchment is adequately protected from flooding by the Waimakariri stopbanks and thus no mitigation is proposed. ECan indicated that limited staff time was available to provide a response, and no feedback was received. It appeared that the CRC Regional Engineer agreed that flooding is not an issue requiring inclusion in this SMP. Subsequently an ECan reviewer suggested that detention basins be sized for partial detention. Internal flood mitigation is proposed but without explicit reference in the SMP. The SMP will be updated to state that stormwater runoff from all new developments will be detained.

2. Feedback from Public Consultation

A business enquired about investigations into reducing the effects of sediment discharges. CCC replied that investigations of street sweeping are under way.

Christchurch International Airport Ltd made a submission about means of reducing the risk of bird strike on aircraft. Each point in the submission was discussed with the submitter and most were incorporated into the SMP in Appendix G - Guidelines for bird strike management.

A private submitter asked for flood control to receive highest priority city-wide. The CCC replied that flood management is a high priority which receives oversight from the Department of Internal Affairs.

A private submitter proposed rain tanks for both new builds and existing houses. The CCC said there are rain tank rules for new builds, but these cannot be applied to existing houses.

A private submitter raised flood management issues caused by infill housing in Woolston. Staff helped the submitter but noted that the submission does not relate to Ōtūkaikino catchment.