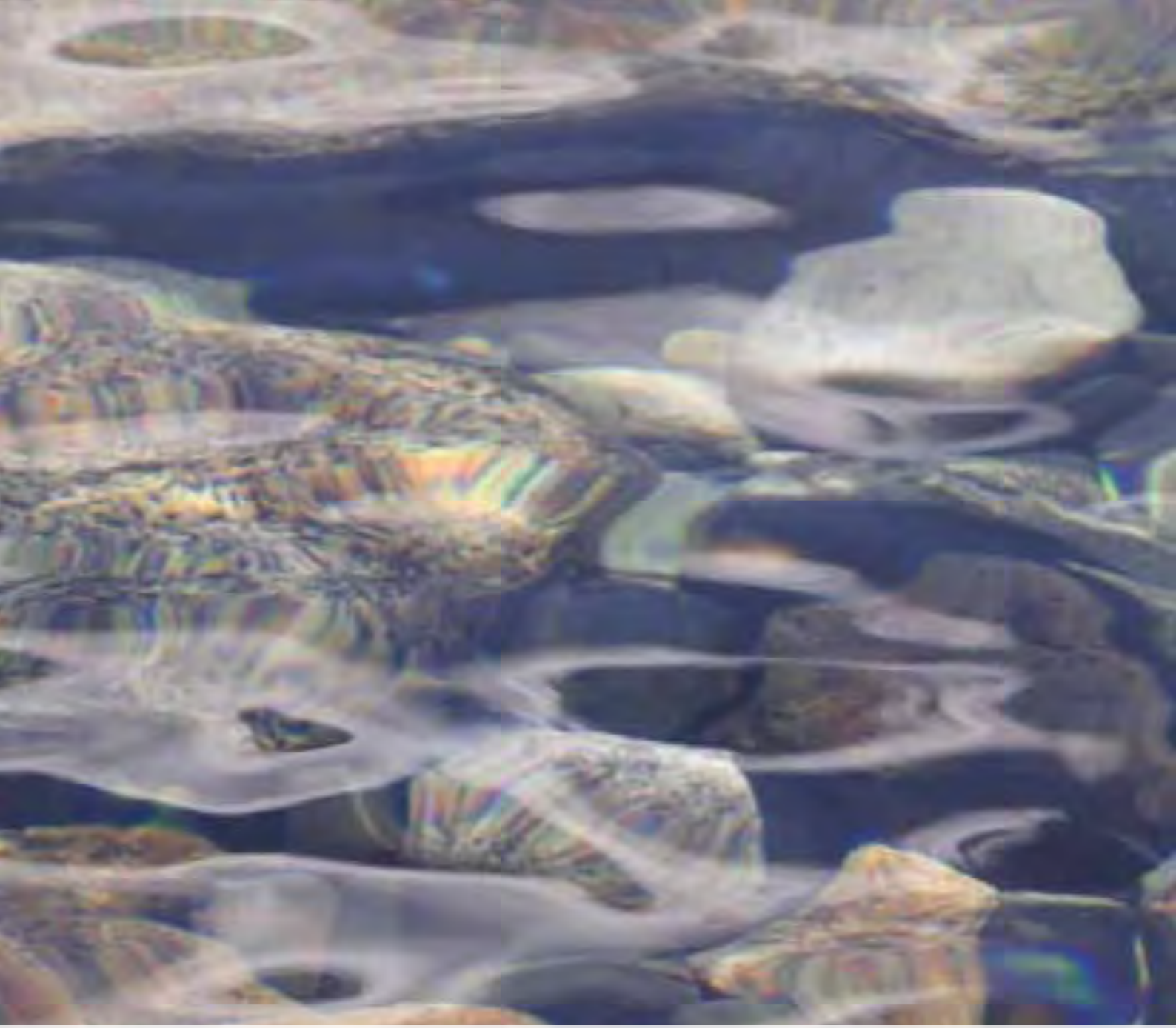


Christchurch City Council

# Surface Water Strategy 2009 – 2039

Ōtautahi/Christchurch and Te Pātaka o Rākaihautū/Banks Peninsula*

Christchurch City Council

* There is no binding commitment on the Christchurch City Council to proceed with any prospective project detailed in this document. Council spending priorities are reviewed frequently, including through the Long Term Council Community Plan process. All decisions as to whether or not a project will commence remain with the Council.

# Foreword

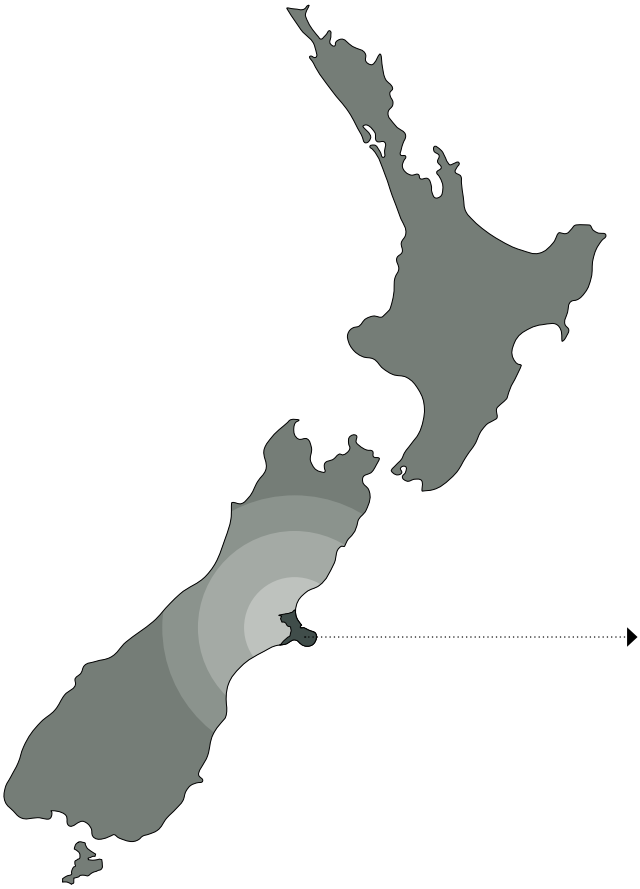
Our surface water – springs, streams, rivers and lakes – are a precious resource for current and future generations. These surface water resources are an important part of the unique culture and natural values of the district, shaping the landscape and our heritage. They are of fundamental importance to Ngāi Tahu, highly valued by residents for recreation, and crucial to the health of the environment in which we live. They are vital to the well-being of our communities, and are one of the City's defining features.

How the Council manages land-use and stormwater directly affects these important resources and the residents of Christchurch.

The Surface Water Strategy outlines our vision for surface water management. It will guide the Council's asset management and planning processes. It aims to ensure that our management of Christchurch and Banks Peninsula's springs, streams, rivers, lakes and stormwater, leaves the resources in a better state for future generations.

We are committed to providing Christchurch residents with surface water that is managed in a manner that supports the environmental, social, cultural and economic well-being of current and future generations.

Bob Parker
Mayor



CHRISTCHURCH CITY
The springs, streams, rivers and lakes of Christchurch are vital to the well-being of residents.

O te Wai
Nā te Pō, ko te Ao
Tana ko te Ao Mārama
Tana ko te Ao Tūroa
Tana do te Kore te Whiwhia
Tana ko te Kore te Rawea
Tana ko te Kore te Tāmaua
Tana ko to Kore Mātua
Tana ko Mākū
Te Punawai o Te Ao

From eternity came the universe
From the universe the bright clear light
From the bright light the enduring light
From the enduring light the void unattainable
From the void unattainable, the void intangible
From the void intangible the void unstable
From the void unstable the void endowed with paternity
From which came the moisture
The source of all the worlds water
Whakapapa o Te Wai

(Ngāi Tahu, 2009)

# Contents

# Executive Summary

The springs, streams, rivers and lakes of Christchurch are vital to the well-being of Christchurch residents and are one of the City's defining features. Christchurch City Council has a responsibility to ensure these surface water resources are managed in a manner that supports the environmental, social, cultural and economic well-being of current and future generations.

The Council's surface water management vision is that:

*The surface water resources of Christchurch and Banks Peninsula support the social, cultural, economic and environmental health of residents, and are managed wisely for future generations.*

Over the last 10 years (since the Natural Asset Management Strategy was adopted by the Council in 1999) the policy and planning framework for surface water management has changed considerably, particularly with the notification of the Proposed Natural Resources Regional Plan (PNRRP) and the adoption of the Greater Christchurch Urban Development Strategy (UDS). The PNRRP sets high water quality standards for the region. Improving water quality is a challenge, particularly in existing urban areas where stormwater, carrying contaminants and pollutants, is discharged into waterways with little treatment. Changing land-use practices are also increasing the impervious surfaces of the City. Increases in impervious surfaces are resulting in increased stormwater run-off. Upgrades to the stormwater network will be required if existing flood levels of service are to be maintained and water quality improved. Climate change will also impact surface water management, with sea level rise and changing weather patterns increasing the risk of flooding in some parts of the City.

The Council's goals are to:

1. Improve the water quality of our surface water resources;
2. Reduce the adverse effects of flooding;
3. Improve the ecosystem health of surface water resources;
4. Protect and restore Ngāi Tahu values associated with surface water resources;
5. Support a range of recreation activities on and around waterways;
6. Protect heritage values associated with surface water;
7. Protect and enhance the landscape values of surface water;
8. Support community involvement in surface water management;
9. Manage stormwater in an efficient manner that supports Goals 1 – 8.

The Strategy includes an implementation programme which focuses on areas where the Council can make the most difference and address the most pressing issues. To work towards the goals the Council is committed to:

- minimising sources of pollutants;
- managing stormwater in a manner that supports the Council's goals;
- developing Integrated Catchment Management Plans;
- reviewing development standards;
- implementing a community education programme; and
- undertaking further investigations.

The extent to which the implementation programme is funded will depend on decisions made in future Long Term Council Community Plan processes. Some timings and funding may change from what is outlined in the Strategy, but the Strategy will remain as a clear Council commitment to working towards the goals and objectives.

# Part One: Technical and background information

# 01

# Introduction

The springs, streams, rivers and lakes of Christchurch are vital to the well-being of our communities and are one of the City's defining features. The size and range of these surface water resources is exceptional and includes:

- lakes (Lake Ellesmere/Te Waihora and Lake Forsyth/Te Roto o Wairewa);
- rivers ( the Avon/Ōtakaro, Heathcote/Ōpawaho, Styx/ Puharakekenui and part of the Halswell/Huritini and Waimakariri);
- many tributaries and streams;
- springs;
- wetlands associated with the above; and
- stormwater.

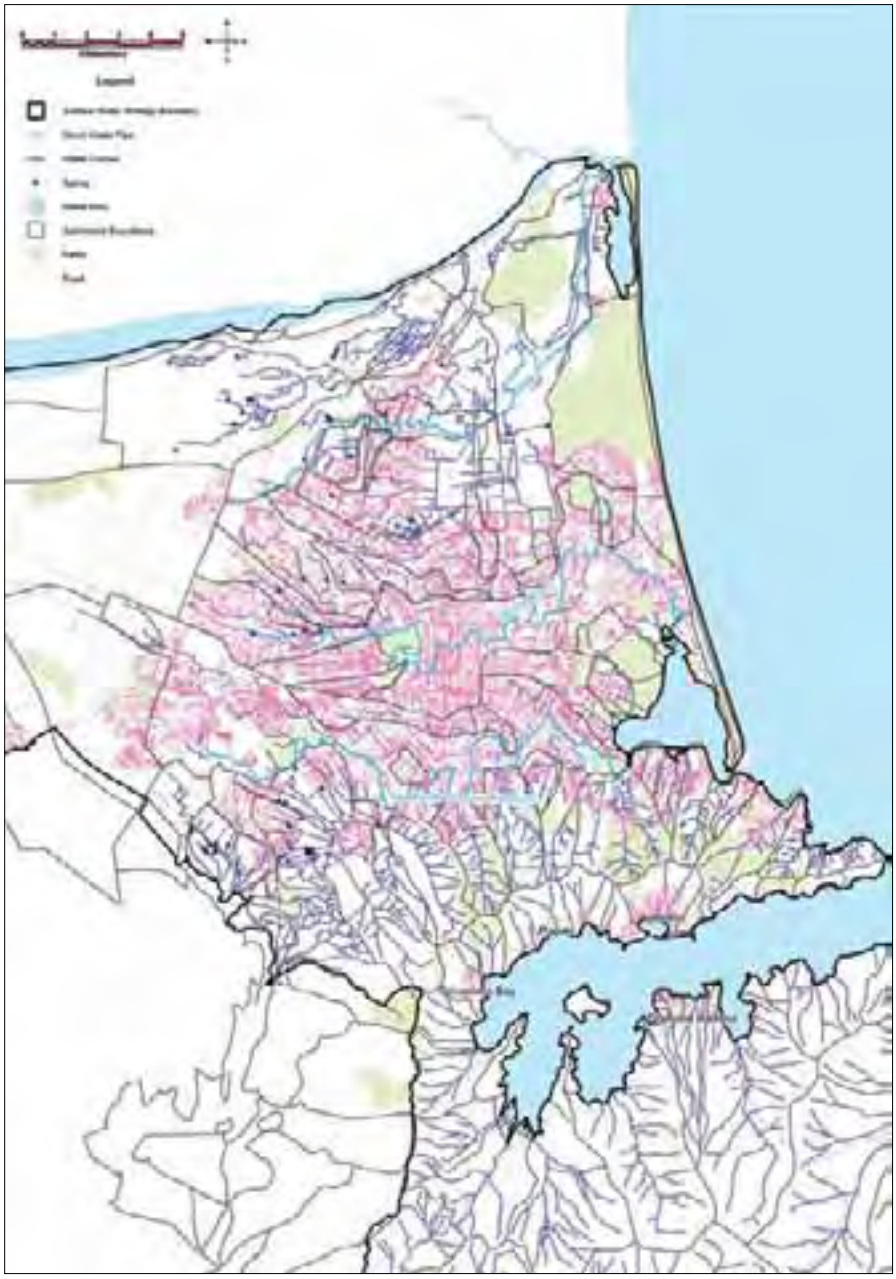


FIGURE 1.1. SURFACE WATER NETWORK OF CHRISTCHURCH

These surface water resources are an important part of the unique culture and natural values of the district, shaping the landscape and our heritage. They are of fundamental importance to Ngāi Tahu, highly valued by residents for recreation and crucial to the health of the environment in which we live. Surface water affects the state of the coastal and marine environment, including highly significant resources such as the Avon-Heathcote Estuary/Ihutai. On Banks Peninsula some communities - Akaroa, Duvauchelle, Pigeon Bay, Takamatua, Little River – derive their drinking water from surface water.

Christchurch City Council (the Council) has a responsibility to ensure surface water is managed in a manner that supports the environmental, social, cultural and economic well-being of current and future generations.

## 1.1 PURPOSE OF THE SURFACE WATER STRATEGY

The primary purpose of this Strategy is to direct the Council's decision-making relating to surface water. To do this the Strategy establishes:

(a) the Council's surface water management goals for the next 30 years and beyond, and
(b) what the Council will do to work towards achieving those goals.

Other organisations and the general public may find the Strategy helpful in providing an overview of local surface water management, including the impact of development and climate change, regulatory requirements and the Council's planned Surface Water Strategy implementation programme.

## 1.2 DEFINITION OF SURFACE WATER

For the purpose of this Strategy, surface water is defined as all freshwater ecosystems above ground, including stormwater[1], springs, rivers, streams, lakes and associated wetlands. It includes natural, artificial, and ephemeral waterways, and although intricately connected with, excludes groundwater[2] and the sea[3].

*[1] Stormwater pipes below ground are included, on the basis that they carry water both from and to another surface water resource (e.g. from rainfall to river).*
*[2] The Council's Water Supply Strategy and the Canterbury Water Management Strategy cover groundwater resources in the region.*
*[3] ECan's Regional Coastal Environment Plan includes coastal areas of Christchurch and Banks Peninsula.*

FIGURE 1.2. SURFACE WATER NETWORK OF BANKS PENINSULA

PHOTO: THE STYX RIVER / PUHARAKEKENUI

## 1.3 SCOPE OF THE STRATEGY

The Strategy includes water quality, tangata whenua, drainage, landscape, heritage and recreation aspects of the Council's surface water management. It excludes civil defence and emergency management relating to flood risk.

## 1.4 THE HEALTHY ENVIRONMENT STRATEGIES

The Surface Water Strategy is part of the Council's suite of Healthy Environment Strategies, which include the: Biodiversity, Water Supply, Public Open Space and Climate Smart strategies. The Healthy Environment Strategies establish the Council's policies for natural resource management in the City. The Surface Water Strategy is related to each of these strategies:

- Biodiversity Strategy - implementation of the Surface Water Strategy will support the goals and objectives of the Biodiversity Strategy by improving water quality and the ecosystem health of surface water resources.
- Water Supply Strategy - implementation of the Surface Water Strategy will help achieve the goals and objectives of the Water Supply Strategy through improving water quality of surface water resources used for drinking water. Both strategies also recommend that the use of rain-tanks is investigated.
- Public Open Space Strategy - the rivers, lakes, streams and multi-value stormwater mechanisms discussed in the Surface Water Strategy form part of the City's public open space network.
- Climate Smart Strategy - the Surface Water Strategy discusses the impact of climate change on surface water resources and identifies some further investigations that will inform the Climate Smart Strategy.

# 02

# Context

## 2.1 LANDSCAPE AND GEOLOGY

The action of surface water has shaped the landscape of Christchurch and Banks Peninsula. Banks Peninsula was formed by the eruption of large volcanoes during a period of volcanic activity that lasted from 11 to 5.8 million years ago. The resulting circular island was some 3,000 metres high. Over the intervening millions of years, rainfall, streams and rivers eroded the island into the series of spurs and gullies radiating from the crater rims that we see today. The eroded substrate from the volcanic slopes was (and continues to be) deposited on the valley floors. Figure 2.1 shows the geological formation of Canterbury and Banks Peninsula. On these low-lying lands the valley streams were, to varying degrees, impounded by beach deposits, so that small wetlands and estuaries formed.

Lakes Ellesmere/Te Waihora and Forsyth/ Te Roto o Wairewa were created by the gravels and shingle brought down from the mountains by the Rakaia River and other rivers, driven north by southerly storms and forming Kaitorete Spit. This boulder bank blocked off the Selwyn and Halswell/Huritini Rivers, forming the shallow lakes.

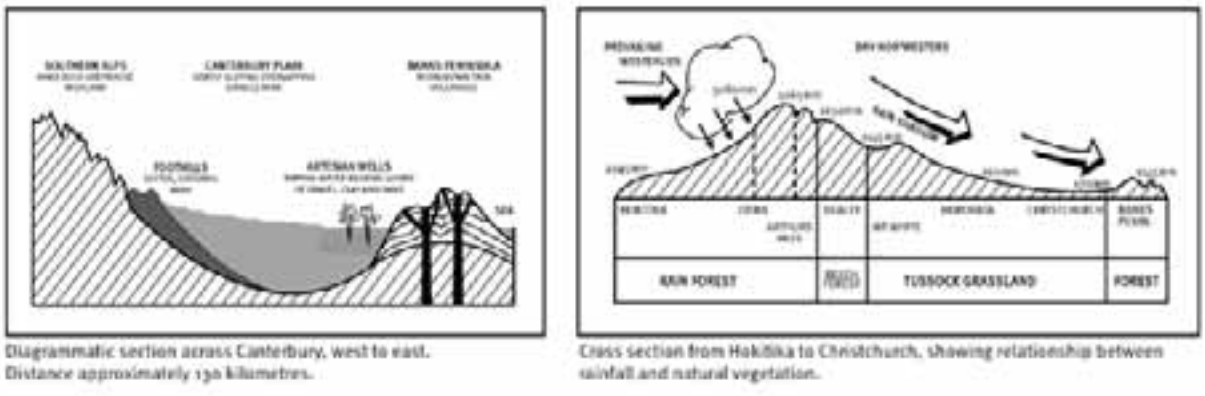
Glacial and fluvial outwash from the rising mountains linked Banks Peninsula to the mainland. Where the alluvial plains met the volcanic Peninsula and the beach dune systems of the coast, drainage was impeded, causing the heavy soils to become saturated. This resulted in the wetlands that originally characterised much of what is now the urban City.

## 2.2 HISTORY

The Waitaha were the first settlers of the Christchurch area, followed in the 1500s by Ngāti Mamoe, both from the North Island. In the mid 1700s Ngāi Tahu migrated south and over time assumed customary authority over the South Island. At this time Christchurch and Banks Peninsula was covered by indigenous forests, wetlands and grasslands. Water was central to the Ngāi Tahu way of life. Puna[4] were vital sources of fresh drinking water and were held with high regard as the source of waterways. They were prized for their spiritual significance and used for sacred and ceremonial purposes. Surface water provided a source of food, a means of transport and was used for sacred ceremonial purposes and recreation.

[4] *Translations of Māori terms are found in the glossary.*

FIGURE 2.1. THE GEOLOGY AND FORMATION OF CANTERBURY PLAINS AND BANKS PENINSULA




Diagrammatic section across Canterbury, west to east. Distance approximately 130 kilometres.

Cross section from Hokitika to Christchurch, showing relationship between rainfall and natural vegetation.

Source: Peninsula and Plain *The History and Geography of Banks Peninsula and the Canterbury Plains*

PHOTO: EPHEMERAL POND, LAKE ELLESMERE / TE WAIHORA

Consequently, settlements were often located close to major waterways. Water-based mahinga kai was particularly important because horticultural crops were not easily grown in the harsh South Island/Te Waipounamu climate.

In the 1840s the Canterbury Association decided upon the slightly elevated 400 hectares on the Avon River/Ōtakaro for a new city. Although this area was higher and therefore drier, most of the surrounding land was marsh and raupō swamp. The "Black Maps" of 1856 provide an idea of what the City surrounds were like when the first European immigrants arrived. To the east and north of the City there were large sand dunes and deep peat swamps. The swamps between the dunes were often at a lower elevation than the rivers and streams which criss-crossed the land. To the west there were areas of drier gravel and shingle. Banks Peninsula was covered with indigenous forest, with the exception of steep, exposed rocky ground and wetlands in the valley floors.

The large swampy areas made building houses and roads difficult, and water-borne diseases caused the highest number of deaths per thousand people of any New Zealand centre at the time. Draining the swamps seemed the only way to build the City and improve the health of its citizens.

In 1875 the Christchurch Drainage Board was empowered to maintain and modify natural watercourses and construct sewers and drains. Over the next 120 years the stormwater network was expanded, and natural watercourses modified.

In 1989, the Drainage Board's responsibilities passed to the newly amalgamated Council as the Board itself was disbanded. Over the following 10 years the Council's philosophy towards surface water changed from viewing waterways as drainage conduits to seeing them as an important part of the City's environment. This was reflected in the Waterways and Wetlands Natural Asset Management Strategy (1999) and the Waterways and Wetlands Drainage Guide (2002). These documents moved the Council towards more holistic surface water management, based on six 'values' – drainage, water quality, culture, heritage, landscape and recreation. In 2006 Christchurch City Council and Banks Peninsula District Council combined and Banks Peninsula became part of the Council's jurisdiction.

# 03

# Summary of the Current Situation

Today, Christchurch and Banks Peninsula is characterised by a network of surface water, ranging from large lakes to narrow tributaries with intermittent flows, and including:

- Lakes Ellesmere/Te Waihora and Forsyth/Te Roto o Wairewa, as well as a number of smaller lakes.
- Approximately 78kms of rivers (the Avon/Ōtakaro, Heathcote/Opāwaho, Styx/Puharakekenui and part of the Waimakariri and Halswell/Huritini Rivers and a number on Banks Peninsula).
- 2605kms of streams and tributaries (many of them ephemeral).
- 1300kms of stormwater pipes.

## 3.1 THE POLICY AND PLANNING FRAMEWORK

The Council's planning and management of surface water sits within a complex national and regional policy framework, set out in both statutory and non-statutory documents. These documents are listed in Appendix B. The Council's responsibilities with regard to surface water management are primarily described in the Resource Management Act ( RMA 1991) and the Local Government Act (LGA 2002). Figure 2.2 shows the relationship of the Surface Water Strategy to the RMA 1991 and the LGA 2002.

The LGA 2002 requires the Council to promote the social, economic, environmental and cultural well-being of current and future generations[5]. The LGA 2002 confers specific land drainage responsibilities on territorial authorities – to assess stormwater services and maintain the capacity of existing

[5] *Local Government Act (2002) Section 10 (a) and (b).*

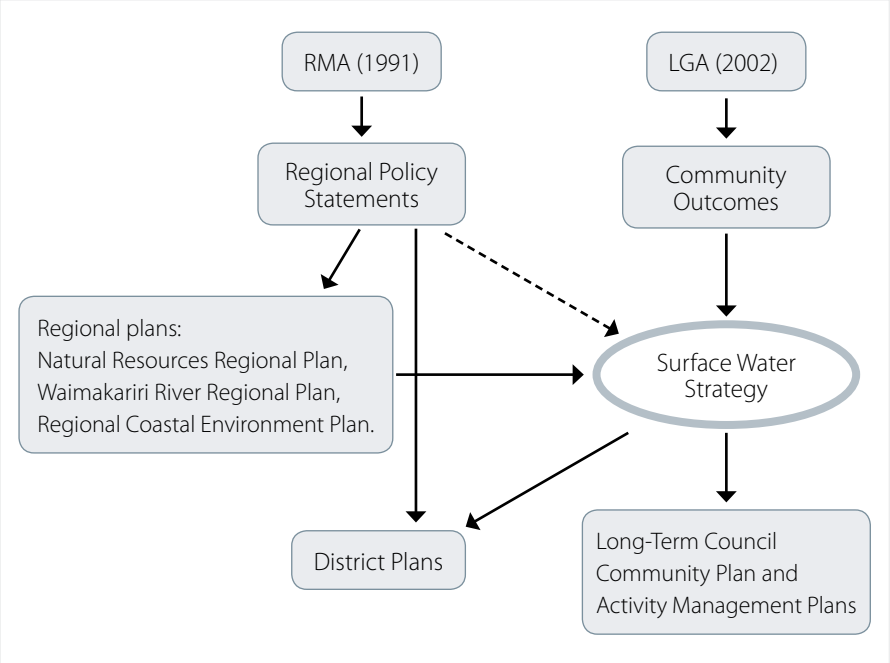



FIGURE 2.2. THE RELATIONSHIP OF THE SURFACE WATER STRATEGY TO THE RMA (1991) AND LGA (2002)

stormwater networks[6], and requires all local authorities to prepare Activity Management Plans and Long Term Council Community Plans (LTCCPs).

The RMA 1991 promotes the sustainable management of natural and physical resources[7]. Sections 30 and 31 of the RMA 1991 establish the resource management functions of local authorities. The control of water quality and quantity is largely a regional council (Environment Canterbury) function. The control of the effects of land-use activities is largely a territorial authority (Christchurch City Council) function.

Under the RMA (1991), Environment Canterbury is responsible for preparing the Regional Policy Statement (RPS) and the regional planning documents - Proposed Natural Resources Regional Plan (PNRRP) and the Waimakariri River Regional Plan (WRRP). The RPS and the PNRRP contain several chapters relevant to surface water management, while the WRRP provides for the management of the Waimakariri River catchment. The City Council is required to give effect to the RPS and must comply with the regional objectives, policies and rules established in the PNRRP. Land-use activities (directed by the Council in its District Plans and Environment Canterbury in its Regional Plans) and stormwater management directly effect the state of surface water.

Therefore, both the Council and Environment Canterbury have significant responsibilities for ensuring surface water resources are managed for the well-being of residents. A summary of the role of organisations involved in the planning and management of surface water in Christchurch is provided in Appendix C.

*[6] Local Government Act (2002) Section 125 and 130.*
*[7] Resource Management Act (1991) Section 6.*

## 3.2 TANGATA WHENUA VALUES

The surface water of Christchurch and Banks Peninsula is of primary importance to Ngāi Tahu, the tangata whenua of Christchurch. It is a taonga left by tūpuna to provide and sustain all life, and is literally referred to as the lifeblood of Papatūānuku. The present generation, as tangata tiaki, has a responsibility to ensure this taonga is available to future generations in as good, if not better, quality than that which they inherited.

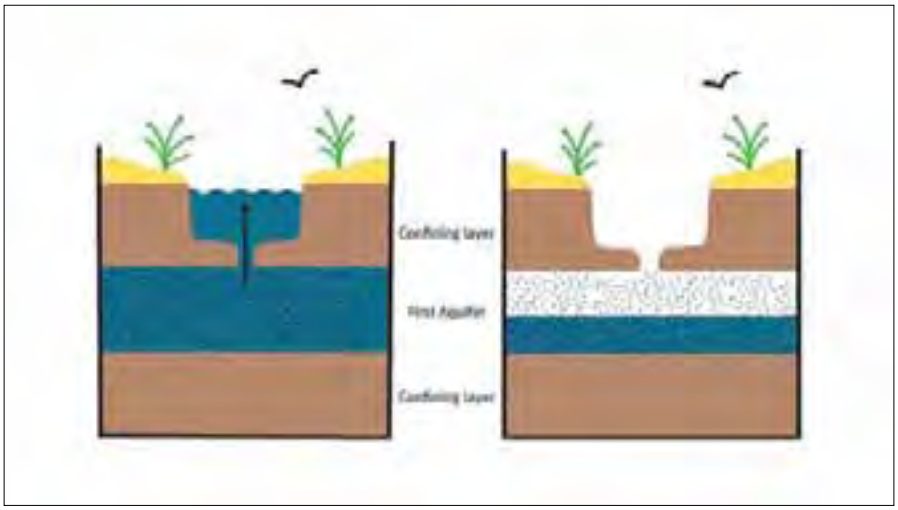
A shared whakapapa underpins the Ngāi Tahu relationship to water. Descended from Ranginui and Paptūānuku, Ngāi Tahu holds a genealogical relationship with the natural environment – the mountains, forests and waters, and life supported by them. All things are related and have their own mauri. This underpins the Ngāi Tahu philosophy of 'ki uta ki tai' – literally 'from the mountains to the sea' – where waterways are seen as part of one interconnected system. Kaitiakitanga or stewardship describes the responsibility that Ngāi Tahu has to protect the integrity of the natural environment, including water and valued waterways.

Water remains of prime importance to the iwi. Puna on the plains and Banks Peninsula hold special significance to Ngāi Tahu. The occurrence and wellbeing of puna is a matter of particular significance to Ngāi Tahu. Continued access to, and the health of, mahinga kai is also highly important and enables Ngāi Tahu to participate in the practices of its tūpuna. A Ngāi Tahu State of the Takiwa' cultural health assessment found the Avon/Ōtakaro and Heathcote/Ōpawaho rivers, and the estuary they flow into, to be in poor cultural health and of little present value for mahinga kai.

## 3.3 WATER QUANTITY

The majority of streams on the Peninsula are rain-fed. In contrast, all the major river catchments of the urban City rivers, (the Heathcote/Opāwaho, Avon/Ōtakaro, Styx/Puharakekenui and Halswell/Huritini), are spring-fed and hydraulically connected to groundwater. In some cases springs in the upper reaches of these catchments have stopped flowing where groundwater levels have fallen (through abstraction or lack of recharge) or when land around them has been disturbed by development and earthworks (see Figure 3.1).

FIGURE 3.1: SPRINGS: THE INTERACTION BETWEEN GROUND AND SURFACE WATER.



Surface water flows are altered by abstraction, either for business (such as irrigation) or household use. There is no significant direct abstraction from urban waterways, but water is abstracted for household use in some settlements on Banks Peninsula. Minimum flow levels have been established for the Avon/Ōtakaro and Heathcote/Ōpawaho rivers, Cashmere Stream and various Banks Peninsula streams in the PNRRP. These minimums are set at levels that can reasonably sustain environmental values. Below these levels the surface water environment is likely to be seriously compromised.

## 3.4 FLOOD RISK

Due to Christchurch's geology many parts of the City are prone to flooding, for example Henderson's Basin in south-west Christchurch. Here shallow groundwater aquifers meet relatively impermeable volcanic rock, and the confluence of streams and tributaries make the area susceptible to flooding. Prolonged flooding is less common on Banks Peninsula where the relatively short and steep catchments mean that water flows quickly out to sea. Nevertheless 'flash floods' can occur in extreme events and have been documented in the Akaroa Harbour basin. More often stormwater run-off on the Peninsula results in gully erosion and land slips.

Flood hazard is managed by reducing the risk of occurrence and improving readiness, response and recovery. The Council's responsibilities include reducing flood risk through civil defence and emergency management, land-use planning controls and stormwater management.

The primary purpose of stormwater management is to reduce the frequency of flooding to a defined level of service. The stormwater network in most of urban Christchurch is designed to contain a five year average return interval storm (a flood event that occurs on average once every five years). There is a higher (20 year average return interval) level of service for hill waterways, and new greenfield developments (50 year average return interval).

Land-use activities are controlled by the Council through the City and District Plans. A recent variation[8] to the City Plan sought to manage the potential effects of flooding by limiting development in ponding areas and increasing minimum floor levels for buildings in Flood Management Areas (identified in the City Plan).

## 3.5 WATER QUALITY

Good water quality is essential for supporting ecosystems, recreation, cultural values and the health of residents, particularly where water supplies are reliant in whole or in part on surface water resources. On Banks Peninsula - Akaroa, Duvauchelle, Pigeon Bay, Takamatua and Little River[9] derive their drinking water from surface water supplies. There is a high risk of microbiological contamination of Banks Peninsula streams due to stock access to or near streams. Incidents of stream and spring contamination are of specific concern where streams provide the main source of domestic water supply. Sediment from erosion of the loess soils is also a particular issue in Peninsula streams.

In urban Christchurch, the Knights and Nottingham Streams, upper Heathcote River/Opawaho, upper Avon River/Ōtakaro, Styx/Puharakekenui River and Otukaikino Creek have generally better water quality than other urban Christchurch waterways, but relatively high bacteria concentrations, most likely caused by stormwater discharges, wastewater overflows, domestic animals, wildlife or rural land-uses. Pesticide data indicates that herbicides are present in these waterways at low concentrations.

[8] *Variation 48 to the City Plan.*

[9] *The following streams supply water to these settlements: Aylmers Stream, Balguerie Stream, Grehan Stream, Pipers Stream, Dick Stream, Takamatua Stream, Police Creek.*

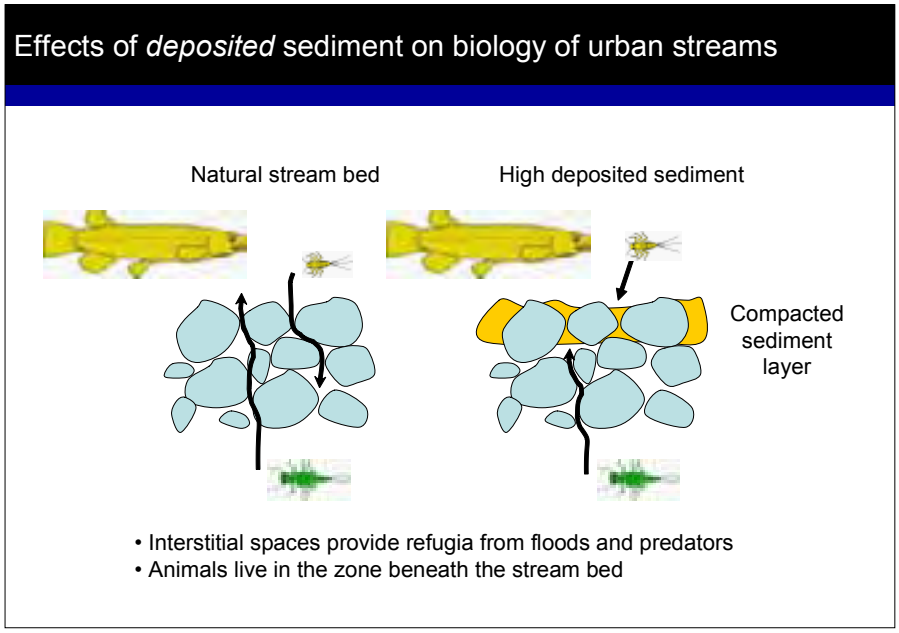



FIGURE 3.2: EFFECTS OF DEPOSITED SEDIMENT ON BIOLOGY OF URBAN STREAMS.

The Avon/Ōtakaro and Heathcote/Opāwaho rivers generally have the poorest water quality reflecting the urbanised nature of these catchments, particularly the Heathcote River/Opāwaho and the Addington Main Drain which flow through industrial areas. The majority of monitoring sites on these rivers have recorded sediment concentrations that exceed aesthetic guideline values[10], and a large number, particularly in the Heathcote River/Opāwaho, have exceeded guidelines for behavioural impairment in fish[11]. The deposition of fine sediment on the river and tributary beds has also affected the composition of species (see Figure 3.2), as species can be smothered by layers of silt or be indirectly affected by changes to habitat and/or food availability.

High levels of sediment in the Heathcote River/Opāwaho are, in the main, caused by stormwater from the steep and easily eroded loess soils of the Port Hills, as well as a lack of suitable vegetation to protect banks.

Nitrogen and phosphorus are the primary nutrients that influence plant and algal growth in waterways. Nitrate-nitrite concentrations have been decreasing in the Avon/Ōtakaro and Heathcote/Opāwaho rivers catchments, but remain high, and median concentrations are above the trigger value[12] for adverse ecosystem effects. In contrast a number of monitoring sites in the City have shown an increase in phosphorus over the last 15 years, which is cause for concern. Elevated phosphorus concentrations can be linked to a range of potential sources, including industrial activities and market gardening/agricultural activities. On Banks Peninsula elevated phosphorus concentrations can be a result of run-off from the naturally phosphate-rich volcanic catchments.

The main toxicants found in our urban waterways are ammonia-nitrogen and heavy metals. Heavy metals can be toxic to plants and animals at low concentrations. Some very high concentrations of metals have been recorded in tributaries that flow through industrial areas. Table 3.1 summarises the major pollutants of our waterways and their effects.

Appendix D gives an indication of the 2008 level of compliance of the Avon/Ōtakaro, Heathcote/Opāwaho, Halswell/Huritini, Otukaikino and the Styx/Puharakekenui Rivers with relevant guidelines.

Table 3.1 Summary of Pollutants

| **Pollutants** | **Effects** |
|---|---|
| **Sediments** – suspended solids, dissolved solids, turbidity, deposited sediments. | Stream turbidity<br>Habitat loss<br>Recreation/aesthetic loss<br>Transport contaminants (such as metals)<br>Filling of lakes, estuaries and harbours and lower river reaches<br>Fish and invertebrate loss |
| **Nutrients** – nitrate, nitrite, ammonia, organic nitrogen, phosphate, total phosphorus. | Algae blooms<br>Aquatic weed growth<br>Eutrophication<br>Ammonia and nitrate toxicity<br>Recreation/aesthetic loss |
| **Microbes and viruses** – total and faecal coliforms, faecal streptococci, viruses, *E coli*, Enterococci. | Ear/intestinal infections in humans<br>Shellfish bed closure<br>Recreation/aesthetic loss |
| **Organic Matter** - vegetation, sewage, other oxygen demanding materials. | Dissolved oxygen depletion<br>Odours<br>Fish kills<br>Nutrient loading<br>Recreation/ aesthetic loss<br>Microbes and viruses (see above) |
| **Toxicants** – heavy metals (cadmium, copper, lead, zinc), hydrocarbons, pesticides/herbicides, toxic algae. | Human and aquatic toxicity<br>Bioaccumulation in the food chain<br>Recreation/aesthetic loss |
| **Thermal pollution** | Dissolved oxygen depletion<br>Habitat changes |
| **Litter and debris** | Recreation/aesthetic loss<br>Wildlife hazard |

*[10] ECan Report No. U07/42 prepared by Pattle Delamore Partners Ltd – Avon/Otakaro and Heathcote/Opawaho rivers: analysis of water quality data from 1882-2006 .*
*[11] 25 mg/l. (Ryan 1991)*
*[12] ANZECC guidelines for fresh and marine water quality (ANZECC, 2000)*

PHOTO: CONFLUENCE OF THE OKANA AND OKUTI.

## 3.6 ECOSYSTEM HEALTH

The surface water resources of Christchurch are internationally important ecological assets, characterised by high numbers of wetland bird species. More than 100,000 wetland and coastal birds can settle in Christchurch at peak times, with many species occurring in nationally and internationally significant numbers. In fact, the area supports the largest populations found anywhere in New Zealand with no less than thirteen species: Australasian Crested Grebe, Spotted Shag, Black Swan, Canada Goose, Paradise Shelduck, New Zealand Shoveler, New Zealand Scaup, Grey Teal, Banded Dotterel, Sharp-tailed Sandpiper, Pectoral Sandpiper, Curlew Sandpiper and Red-necked Stint. Habitat restoration efforts have resulted in significant gains in native bird species, for instance indigenous waterfowl such as Paradise Duck and Scaup have returned to the City in large numbers since riparian plantings of native species have increased. Exotic species such as Mallard Ducks and Canada Geese are also present in large numbers.

Because of major differences in the types of habitats, fish species present in the lowland, urban rivers of the City are very different from those found in the streams of the Peninsula. Inanga are found in virtually all waterways, usually not far upstream from the sea. Other inanga species such as the Banded Kokopu and Koaro are found only in the bush-clad Peninsula streams. Longfin and Shortfin Tuna or eels are widespread. Adult Kanakana are occasionally reported in the Ōtakaro/Avon and Heathcote/Opāwaho rivers as they make their way upstream to spawn. Bullies, Paraki, Torrentfish, and introduced species such as Brown Trout, Goldfish, Perch and Rudd are present.

Invertebrates, although not as visible as birds and fish, are key to ecosystem health. There has been considerable variation in macroinvertebrate communities across the district and over time. In the last three years (2006 onwards) there has been an increase in the number of sites with very poor and very good macroinvertebrate health.

Invertebrate, fish and bird biodiversity is under constant pressure from:

- Pollution, as described in Table 3.1.
- Changing stormwater runoff patterns, which affects the ability of rivers to flush sediment and remove aquatic macrophytes.
- Excessive sediment inputs.
- Aggressive willow invasions, which change the shade regime and modify channel flows.
- Aggressive exotic aquatic macrophytes and weeds which block flow and displace natives.
- Drying of upper reaches and loss of springs.
- Riparian management, where bank maintenance affects river behaviour.

**Lake Ellesmere/Te Waihora**

Lake Ellesmere/Te Waihora is the largest lake in Canterbury and the largest coastal lagoon in New Zealand, covering some 20,000ha. It is a highly valued mahinga kai area for Ngāi Tahu. The lake is shallow and brackish, with a connection to the sea which is artificially opened from time to time to manage water levels. It is an internationally recognised important wildlife habitat and an important link in the chain of coastal lagoons and estuaries along the Canterbury coast. As many as 38,000 birds have been surveyed on the lake, which also supports a wide range of freshwater and salt-marsh plant species and is a habitat for 15 fish species and a number of insects, including some endangered and vulnerable species. However, the increase in irrigation on the plains, along with rainfall variability has led to changes in groundwater levels and spring flows. This has resulted in lower flows in most of the rivers and streams that run into Lake Ellesmere/Te Waihora.

**Lake Forsyth/Te Roto o Wairewa**
Lake Forsyth/Te Roto o Wairewa has particular water quality problems, including eutrophication and sedimentation. The most severe is the summer blooming of the *Nodularia* species of cyano-bacteria which produces toxic by-products deadly to mammals (but less toxic to fish or birds). Despite this the lake has proved remarkably resilient and is still a functioning ecosystem. The nationally endangered Southern Crested Grebe was locally extinct by 1860, however, in the mid 1980s a small number began to appear in autumn. This number has increased every year to the point where 200 – 300 birds, approximately 75% of the entire New Zealand population of the Crested Grebe, now winter on the Lake. For Ngāi Tahu, the return of the Crested Grebe is a sign of progress toward their goal of restoring this valued lake and mahinga kai. The Rūnanga's vision for the lake includes investigation into the establishment of a semi-permanent opening to the sea to reduce the current pattern of lake level peaks and troughs, and to improve water quality.

**Waimakariri Braided River**
This large braided river is one of the best examples of braided riverbed and associated wetland habitat in New Zealand. The river supports an impressive assemblage of wetland birds and a majority of the threatened species breeding within Christchurch, including Wrybill, Black-billed Gull, Black-fronted Tern and Australasian Bittern.

## 3.7 RECREATION

Surface water is of tremendous value for recreation, and the wide range of water resources within the district supports a variety of activities for residents and visitors. Recreation on and around surface waterways is a popular activity for Christchurch residents, particularly walking along river corridors where it is possible. Surface water provides opportunities for sailing, jet boating, kayaking, wind and kite surfing, rowing, canoeing, punting and fishing. The adjacent land provides amenities for activities such as walking, biking, wildlife viewing, picnicking and relaxation. Recreational use of surface water is directly affected by water quality. Poor water quality can effect the health of users and is a recurring issue in some areas of the City.

As the population of Christchurch grows, the recreation demand on surface water will increase. Overcrowding is already occurring in areas such as Kerrs Reach on the Avon River/Ōtakaro. In some areas access to surface water could be improved, although this has to be done sensitively as recreational use can conflict with other values such as the conservation of species.

## 3.8 LANDSCAPE AND AMENITY

Surface water is an important landscape feature of Christchurch and is part of the identity and character of the City. For example, the Avon River/Ōtakaro is perceived as an icon of Christchurch, with its image printed on numerous postcards and calendars. On a more modest scale rivers and streams are features of many neighbourhoods. Their natural form contrasts with the built environment, providing relief from the otherwise grid-like and impervious nature of the City. The City Plan reflects the importance of the City's rivers in the landscape, classing them as 'Outstanding Natural Features'.

# 04

# Current Challenges

## 4.1 KEY ISSUE: IMPROVING WATER QUALITY

The Proposed Natural Resources Regional Plan (NRRP) sets high water quality standards for 'receiving' waterways[13] in the region. As summarised in section 3.5 the water quality of most of Christchurch's urban rivers and tributaries remains relatively poor.

Poor water quality effects the health of waterways, reduces their recreation value, limits the public's enjoyment of the resources and effects Ngāi Tahu cultural values. Pollution events have killed fish and after storm events wastewater discharges can make waterways unsuitable for contact recreation and are culturally offensive to Ngāi Tahu. Both Environment Canterbury and the Council have focused considerable effort on reducing pollution events. However, though water quality has improved in some instances (for example, nitrate-nitrite concentrations in the Avon Ōtakaro and Heathcote/Opāwaho rivers have decreased), in others it is at best static and at worst declining (for example, phosphorus concentrations are increasing in the Avon Ōtakaro and Heathcote /Opāwaho rivers)[14].

**Challenge: What can the Council do to improve the water quality of surface water resources?**

*[13] Waterways (mainly natural), into which stormwater and other contaminants are discharged.*
*[14] Pattle Delamore Partners Ltd for Environment Canterbury, 2007.*

## 4.2 KEY DRIVER OF CHANGE: URBAN GROWTH AND INTENSIFICATION

The population of Christchurch is expected to increase by around 80,000 over the next 30 years[15]. The Greater Christchurch Urban Development Strategy (the UDS) establishes that this growth will be accommodated by greenfield development (at a decreasing rate) and by increasing the rate of urban intensification and renewal within the existing City boundaries.

Urban development profoundly alters surface water resources. When land is developed the vegetation that intercepts and slows rainfall run-off is removed. Grading flattens the terrain and fills in natural depressions that would normally provide temporary storage for rainfall and slow run-off. The topsoil and layers of humus are removed and the remaining subsoil is compacted. The addition of buildings, roads, car parks and other impervious surfaces increase stormwater run-off. Development and impervious surfaces also limit the amount of water that can infiltrate the soil and reach groundwater, reducing the amount of water that can recharge aquifers and feed springs. Finally, as stormwater runs over rooftops and lawns, car parks and industrial sites, it picks up a variety of contaminants and pollutants which are discharged into waterways and the coastal environment.

*[15] Christchurch City Council 2009 – 19 Long Term Council Community Plan population projections at 6 August 2008.*

**Urban intensification**

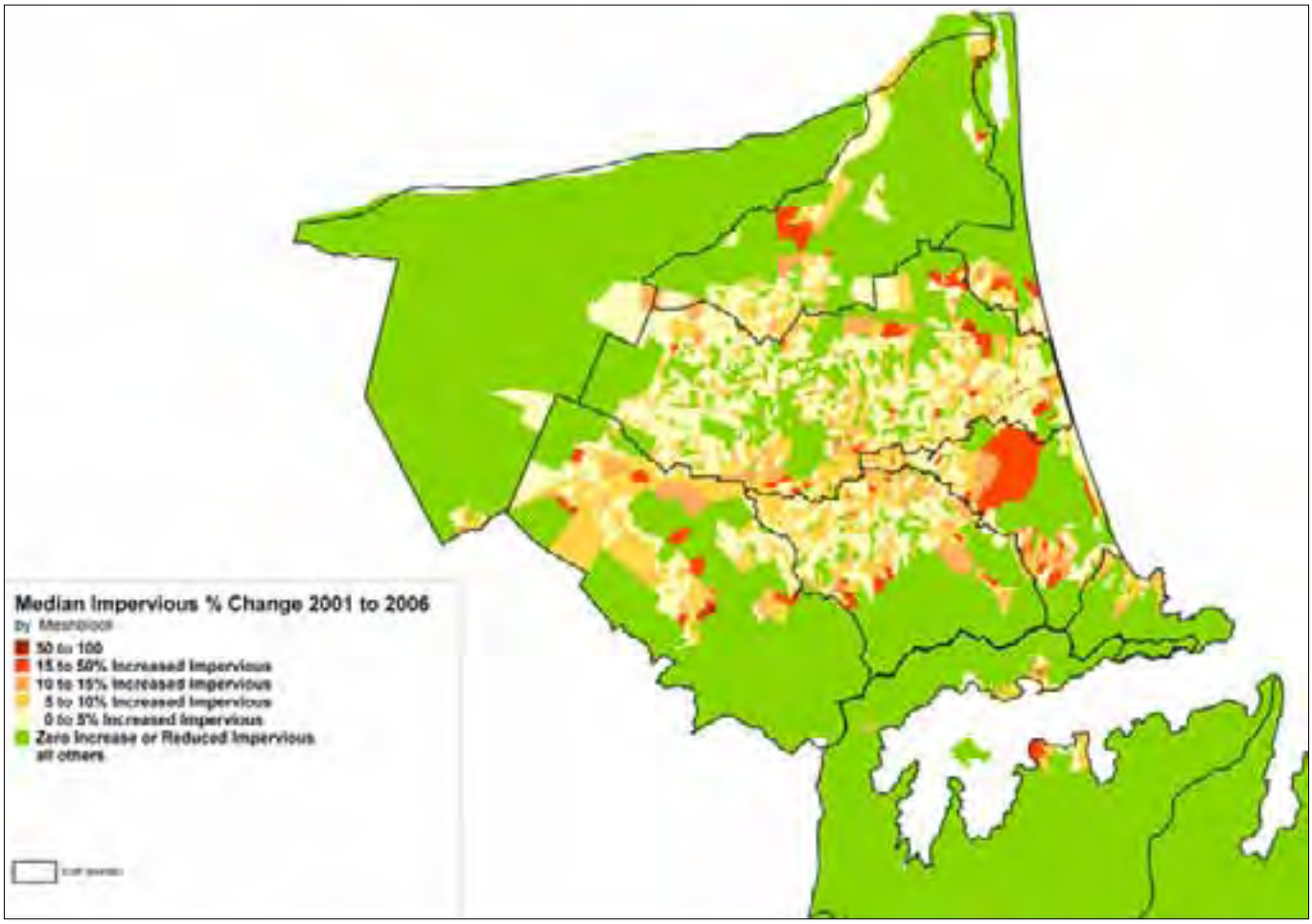
Some intensification of urban development is currently allowed for in the City Plan. A review of the capacity of existing stormwater infrastructure has shown between a quarter and half of sub-catchments covering these areas or "zones" in the City Plan [16] will require capacity improvement (see Figure 4.2).

The number of catchments requiring stormwater infrastructure upgrades will depend on how the areas develop[17]. The results of this review are summarised in Appendix H.

*[16] Sub-catchments and City Plan zones do not have the same boundaries. Some of the sub-catchments shown in Figure 6 contain only portions of L2, L3 and L4 zones, but the whole catchment is included for the purposes of identifying the capacity of that catchment.*

*[17] Whether the Council pursues a conservative, moderate or aggressive intensification development in these areas. This decision is part of the Greater Christchurch Urban Development Strategy work programme.*

FIGURE 4.1: MEDIAN IMPERVIOUS PERCENTAGE CHANGE 2001 TO 2006



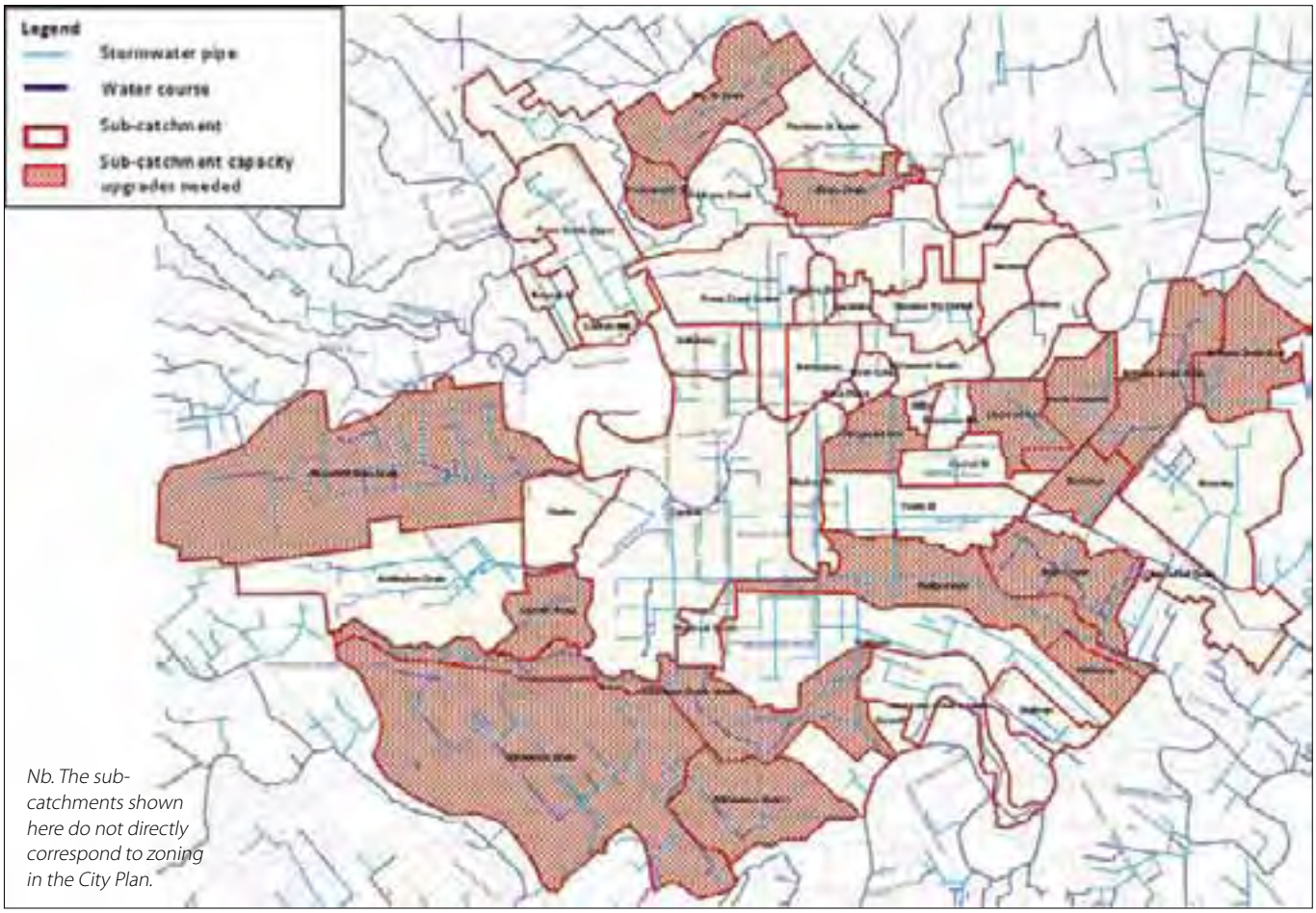
**Greenfield development**
To meet the objectives of the UDS, the housing density in greenfield developments will also increase. Figure 4.1 shows that the amount of impervious areas has significantly grown in greenfield sites in the last 17 years. The Waterways and Wetlands Drainage Guide (Christchurch City Council, 2003) contains guidance for developers on how stormwater should be managed and follows the principles similar to those of low impact urban design and development (LIUDD)[18]. The Guide encourages the use of stormwater mechanisms that support a number of values, such as constructed wetlands, which provide stormwater quality treatment, enhance local biodiversity and landscape values. However, these mechanisms require more land than mechanisms which support only one value (for example, proprietary water quality devices). This can result in a perceived conflict between increasing housing density and the use of stormwater management mechanisms that support a range of values.

**Ongoing property renovation**
The effect of ongoing property renovation such as additions and alterations, patios and paving, new driveways etc, could create additional demand for stormwater infrastructure capacity outside greenfield developments and urban intensification areas.

**Challenge: How should the Council manage stormwater run-off from urban development?**

*[18] LIUDD is a programme led by Landcare Research Manaaki Whenua and other institutions such as The University of Auckland. LIUDD is a design approach and a range of structural techniques to minimise off-site impacts of stormwater, while enhancing biodiversity and improving urban amenity and quality of the urban environment (The University of Auckland and Landcare Research, 2009).*

FIGURE 4.2 CENTRAL CITY CATCHMENTS REQUIRING CAPACITY UPGRADES




*Nb. The sub-catchments shown here do not directly correspond to zoning in the City Plan.*

## 4.3 KEY RISK: IMPACT OF CLIMATE CHANGE ON SURFACE WATER

The earth's climate has been changing since its atmosphere was first formed approximately 4.7 billion years ago. Natural climate variations will continue into the future, however there is wide ranging evidence that global temperature has increased at a much quicker rate over the last century due to increases in greenhouse gas emissions.

The Intergovernmental Panel on Climate Change's Fourth Assessment Report explains that evidence indicates many natural systems are being affected by regional climate changes and especially temperature change. Since 1950 there has been 0.3 – 0.7 °C warming across the Australia/New Zealand region as a whole[19]. There have been more heat waves, fewer frosts, more rain in south-west New Zealand, less rain in north-east New Zealand and a rise in sea level of about 0.07m. Even with current climate change mitigation policies, global greenhouse gas emissions will continue to grow over the next few decades.

*[19] NIWA National Climate Centre and the Royal Society of New Zealand, Impacts: New Zealand and the South Pacific (brochure), April 2007, National Institute of Water and Atmospheric Research.*

The Canterbury climate is expected to become warmer and drier. Temperature increases will most likely cause water temperatures to rise and 'normal' river levels to drop as evaporation rates increase and baseflow is impacted by increased abstraction. Should less rainfall occur on the plains, waterbodies and waterways that depend on rainfall may have less flow, flow for shorter durations or disappear completely. The combined effect of temperature increases and falling water levels is likely to negatively impact the ecological values of surface water. However, the impact of climate change will be different for waterways such as the Waimakariri River, which have headwaters in the mountains. For these rivers an increase in rainfall in the mountains would lead to an increase in the amount of water flowing down the rivers and may increase the risk of flooding.

Projections suggest it is likely that heavier rainstorms may occur more frequently, although the Christchurch rainfall record shows no trend to date[20].

*[20] Review of the frequency of high intensity rainfalls in Christchurch, NIWA report for Christchurch City Council, 2009.*

If this projection eventuates, it will have a significant impact on stormwater management in the City, particularly in areas already prone to flood events. Increased storm events on the steep catchments of Banks Peninsula may lead to a greater risk of tunnel gully erosion and slips. This will not only impact the environment, but also the drinking water of several settlements which abstract their water from Banks Peninsula rivers and streams.

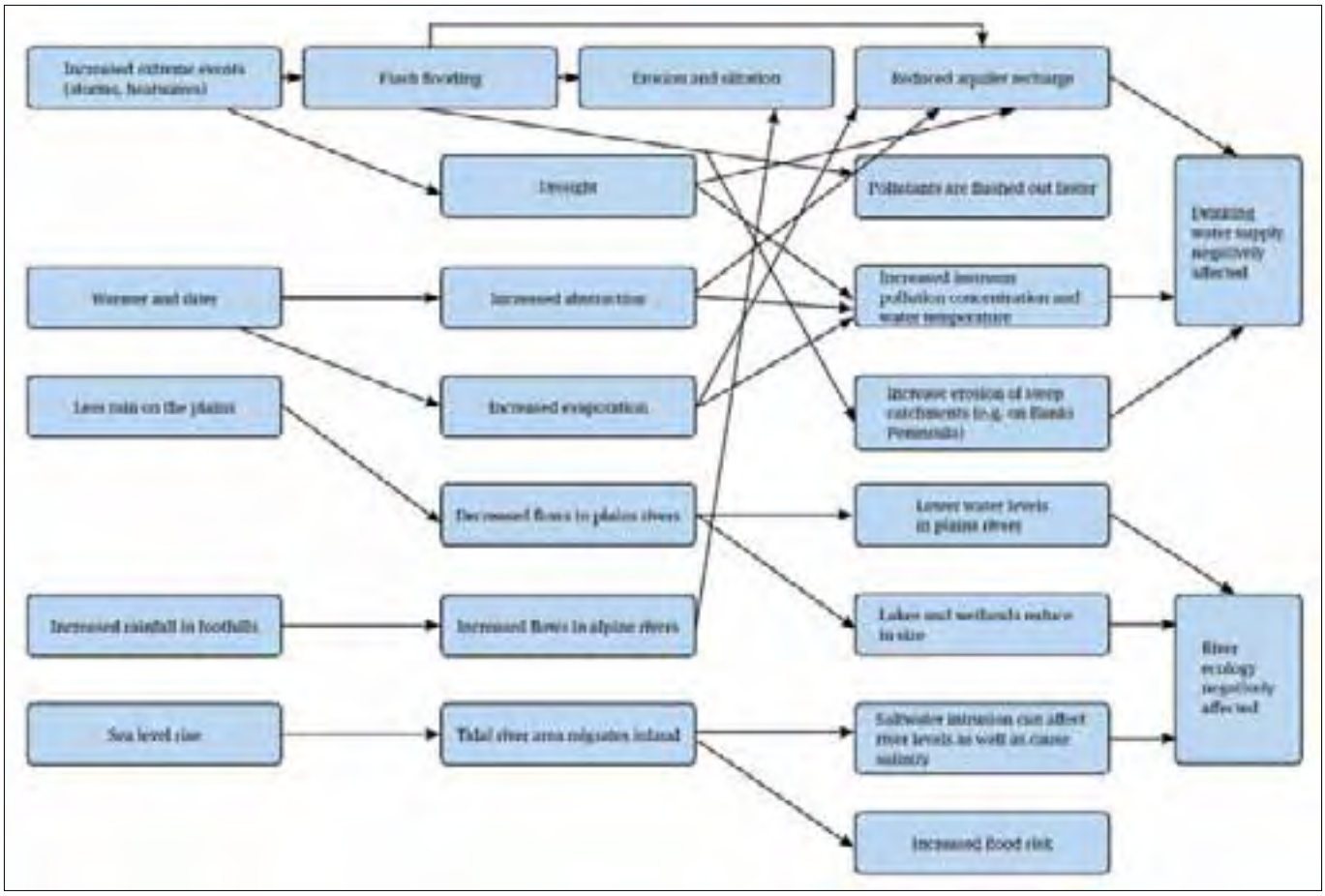
Climate change will not only impact the amount of surface water, but could result in warmer water temperatures, leading to an increase in the occurrence of algal blooms and mosquito breeding habitats in sluggish waterways (where water is not free flowing) or where natural predators are limited. Rising sea levels will cause salt-water intrusion further upstream, increasing salt-marsh mosquito habitat, which is a potential vector for Murray Valley encephalitis and Ross River Fever.

PHOTO: KAYAKING ON THE STYX RIVER / PUHARAKEKENUI.

The Ministry for the Environment *Coastal Hazards and Climate Change: a guidance manual for local government in New Zealand* (2008) recommends local authorities expect a 0.5m sea level rise and plan for a 0.8m by 2100. Sea level rise will increase the risk of flooding in parts of Christchurch, and salt water intrusion will impact the Avon/Ōtakaro and Heathcote/Opāwaho rivers freshwater ecosystems. The capacity of stormwater infrastructure will be reduced, and during flood events, stormwater in low lying suburbs may need to be pumped from areas below sea level into waterways with higher water levels. In time this will effect most stormwater systems east of Fitzgerald Avenue. Sea level rise combined with extreme storm events will increase the likelihood of these rivers overtopping their banks.

**Challenge: How should Council manage the effects of climate change on surface water?**

FIGURE 4.3: POTENTIAL CLIMATE CHANGE EFFECTS ON SURFACE WATER



# Part Two: **Our Vision, goals and objectives**

# 05

# Our vision, goals and objectives

## 5.1 OUR VISION

The surface water resources of Christchurch support the social, cultural, economic and environmental well-being of residents, and are managed wisely for future generations.

## 5.2 OUR GOALS

The Council is committed to:

1. Improving the water quality of our surface water resources.
2. Reducing the adverse effects of flooding.
3. Improving the ecosystem health of surface water resources.
4. Protecting and restoring Ngāi Tahu values associated with surface water resources.
5. Supporting a range of recreation activities on and around waterways.
6. Protecting heritage values associated with surface water.
7. Protecting and enhancing the landscape values of surface water.
8. Supporting community involvement in surface water management.
9. Manage stormwater in an efficient manner that supports Goals 1 – 8.

These goals, and the objectives outlined below, are based on the multi-value approach to surface water management established in the Natural Asset Management Strategy (1999) and Waterways, Wetlands and Drainage Guide (2003). These goals are interdependent – the Council cannot work towards Goal 3 (improve ecosystem health) without improving water quality (Goal 1), nor can the Council restore Ngāi Tahu values (Goal 4) without improving ecosystem health. Sometimes the goals will conflict, for example where reducing flood risks compromise ecosystem health. In each case a judgement must be made on what is the priority in that particular instance.

## 5.3 OUR OBJECTIVES

**Goal 1. Improve the water quality of our surface water resources**

Achieving a high standard of water quality in our surface water is essential to restoring the mauri (life force) of these resources and the achievement of Goals 3, 4 and 5. Good water quality is necessary for ecosystem health and many recreation activities. It adds to the amenity value of the waterbody, and is essential in the Banks Peninsula streams and rivers which supply drinking water to residents.

*Our objectives are to:*

1.1 Implement stormwater treatment so that receiving waters in urban areas at least meet USEPA[21] water quality standards for copper, zinc and lead.

1.2 Meet PNRRP water quality standards for dissolved oxygen, temperature, pH, conductivity, suspended solids, turbidity, nitrate-nitrite, ammonia, phosphorus and E.coli.

1.3 Remove pollutants, including sediment, at source where possible.

1.4 Ensure there are no ecological impacts in receiving waterways from construction activities.

1.5 Protect springs and their surrounding habitats from the adverse effects of land-use activities.

[21] *U.S. Environment Protection Agency.*

**Goal 2. Reduce the adverse effects of flooding**

The City is naturally flood prone, much of it is drained wetland and there are significant flood plains within its boundaries. Good drainage and management of river flows is necessary to reduce the risk of flooding, which could increase as climate change results in continuing sea level rise and changes in weather patterns. A flexible approach is needed to manage this increased risk, particularly where urban development is planned.

*Our objectives are to:*

2.1 Maintain the flood storage and flow capacity of ponding areas, wetlands and floodplains that remain largely undeveloped.

2.2 Limit further development in high flood risk areas.

2.3 Limit further development and mitigate the effects of flooding in moderate risk areas.

2.4 Manage the effects of development to avoid an increased flood risk on public and private land downstream.

**Goal 3. Improve the ecosystem health of surface water resources**

The springs, streams, rivers, lakes and associated wetlands of Christchurch are important ecological assets, pivotal to the existence and migration of plants, invertebrates, fish and birds. Healthy riparian vegetation contributes significantly to achieving water quality objectives (Goal 1) and restoring Ngāi Tahu values. Protecting existing indigenous biodiversity is paramount, as restoring lost biodiversity is extremely resource intensive and in some cases not possible.

*Our objectives are to:*

3.1 Protect existing surface water habitats and indigenous species.

3.2 Restore a range of indigenous riparian and aquatic habitats and species.

3.3 Ensure maintenance of waterways and their margins supports their ecosystem health.

3.4 Manage pest species in an effective and efficient manner.

**Goal 4. Protect and restore Ngāi Tahu values associated with surface water resources**

Water is of prime importance to Ngāi Tahu. The present generation as tangata tiaki has a responsibility to ensure this taonga is available to future generations in as good, if not better, state than when it was passed to them. This goal is dependent on Goal 1 (water quality) and Goal 3 (ecosystem health).

*Our objectives are to:*

4.1 Protect, maintain and restore the mauri (life force) of waterways.

4.2 Protect and restore mahinga kai species and habitats.

4.3 Maintain and restore access to traditional surface water resources and support their sustainable cultural harvest.

4.4 Involve Ngāi Tahu, as Kaitiaki, in surface water management activities.

**Goal 5. Support a range of recreation activities on and around waterways**

Ensuring opportunities for recreation are available to all residents is important to supporting the well-being of residents. The surface waterways of Christchurch are an important recreation asset, however recreation activities can conflict with other values and access may have to be managed in some areas.

*Our objectives are to:*

5.1 Integrate surface water into the public open space network.

5.2 Improve public access where possible.

5.3 Manage recreation activities to ensure they are not detrimental to significant ecological and Ngāi Tahu cultural values.

**Goal 6: Protect heritage values associated with surface water**

The surface water of Christchurch and Banks Peninsula reflects the history of the area. Many places and structures of heritage value can be found along waterways including places or items of social, cultural, spiritual, architectural, artistic, archaeological, technological and craftsmanship significance. Ensuring these are protected will contribute to maintaining the unique local identity of Christchurch.

*Our objectives are to:*

6.1 Protect heritage places, values and archaeological, wāhi tapu and wāhi taonga sites associated with surface water.

6.2 Manage Council-owned assets with heritage value in accordance with the ICOMOS[22] NZ charter.

[22] *International Council on Monuments and Sites*

PHOTO: LAKE ELLESMERE / TE WAIHORA

**Goal 7: Protect and enhance the landscape values of surface water**

Much of the landscape of Christchurch and Banks Peninsula has been shaped by the action of surface water, and the landscape of the waterways themselves reflects an intricate interplay of natural processes and man-made intervention. This landscape is an important feature of the 'Garden City'[23] image of Christchurch. The manner in which we manage surface water can enhance the landscape of the City. Protecting and enhancing this landscape is the Council's responsibility.

*Our objectives are to:*

7.1 Protect the outstanding natural landscapes and features of surface water.

7.2 Enhance the natural character and visual amenity of waterways.

7.3 Ensure surface water management enhances the 'Garden City' image of Christchurch.

*[23] For the purposes of this strategy Garden City is a broad concept that includes Christchurch's biological, horticultural, heritage places, landscape and amenity heritage and recognises the wide range of cultural influences that contribute to the existing and future identity of Christchurch*

**Goal 8: Support community involvement in surface water management**

Community groups and volunteers contribute significantly to protecting, enhancing and managing surface water in Christchurch and Banks Peninsula. This community involvement has many social benefits and reinforces connections between residents and the environment in which we live. Community action and participation also raises awareness of issues and how individuals can play their part.

*Our objectives are to:*

8.1 Support community groups, projects and individuals to further the Strategy's goals.

8.2 Increase awareness and understanding of surface water management.

8.3 Engage the community when planning and designing surface water management activities.

8.4 Learn from and build on community expertise and experience.

**Goal 9: Manage stormwater in an efficient manner that supports Goals 1 to 8.**

The Council's stormwater infrastructure should be delivered to support Goals 1 to 8 in the most effective and cost-efficient manner. This includes co-ordinating stormwater infrastructure provision and maintenance with other infrastructure works, such as roading renewals.

*Our objectives are to:*

9.1 Ensure the design, development, and maintenance of the Council's infrastructure supports Goals 1 to 8.

9.2 Co-ordinate the provision and maintenance of stormwater infrastructure with other Council infrastructure.

# Part Three: Implementation

# 06

# Overview of Implementation

Achieving the goals and objectives of the Strategy will take some time and will not be straightforward, but will need to be an ongoing process. The following sections (7 to 13) set out the Council's planned implementation programme to achieve the goals and objectives of the Strategy. This is not an exhaustive list of everything the Council could possibly do. The implementation programme focuses on areas where the Council can make the most difference and address the most pressing issues. It reflects a realistic expectation of what the Council can put into action. Table 6.1 summarises the implementation programmes that will help achieve the Strategy's goals. The extent to which the implementation programme is funded will depend on decisions made in the Long Term Council Community Plan (LTCCP) process.

The Council will focus on:

- **Managing stormwater in a manner that supports a range of values, such as through LIUDD principles (Section 7).**
  Stormwater run-off is the chief driver of water quality in urban catchments and stormwater management is crucial to reducing flood events. Section 7 contains stormwater policies which reflect how the Council expects to manage stormwater in different land-use areas.

- **Developing Integrated Catchment Management Plans (Section 8).**
  ICMPs will set water quality objectives for catchments and establish how stormwater will be managed to meet those requirements.

- **Reviewing development standards and the existing Council planning framework in respect of the issues, goals and objectives identified in this Strategy (Section 9).**
  The Council will review the City Plan, District Plan, and other Council planning documents, and consider changes to meet the goals and objectives identified.

- **Minimising sources of pollutants (Section 10).**
  Minimising the sources of pollutants will be crucial to improving the water quality of Christchurch's surface water resources. The Council will focus on improving its own practises, leading by example.

- **Implementing a co-ordinated community education and engagement programme (Section 11).**
  Community understanding of surface water management - the issues, costs, benefits, and what individuals can do - is essential to achieving the goals and objectives of the Strategy. The Council will work with Ecan to engage with, and raise awareness amongst, the community about surface water.

- **Undertaking a programme of investigations (Section 12).**
  The development of the Strategy has highlighted many unanswered questions. Initiating a research programme that systematically identifies and works with partners to answer key questions will ensure Council's decision-making is based on evidence.

| Table 6.1: Summary the Implementation Programmes for achieving the Strategy's Goals | |
|---|---|
| **SWS Goal** | **Implementation Programme** |
| 1. Improve the water quality of our surface water resources. | Minimise sources of pollution.<br>Implement stormwater policies.<br>Prepare and implement ICMPs.<br>Raise minimum development standards.<br>Community education.<br>Investigations. |
| 2. Reduce the adverse effects of flooding. | Implement stormwater policies.<br>Prepare and implement ICMPs.<br>Raise minimum development standards.<br>Community education.<br>Investigations. |
| 3. Improve the ecosystem health of surface water resources. | Minimise sources of pollution.<br>Implement stormwater policies.<br>Prepare and implement ICMPs.<br>Raise minimum development standards.<br>Community education.<br>Investigations. |
| 4. Protect and restore Ngāi Tahu values associated with surface water resources. | Minimise sources of pollution.<br>Implement stormwater policies.<br>Prepare and implement ICMPs.<br>Raise minimum development standards.<br>Community education. |
| 5. Support a range of recreation activities on and around waterways. | Minimise sources of pollution.<br>Prepare and implement ICMPs. |
| 6. Protect heritage values associated with surface water. | Community education. |
| 7. Protect and enhance the landscape values of surface water. | Implement stormwater policies.<br>Prepare and implement ICMPs.<br>Raise minimum development standards. |
| 8. Support community involvement in surface water management. | Community education. |
| 9. Manage stormwater in an efficient manner that supports goals 1 to 8. | Minimise sources of pollution.<br>Stormwater policies.<br>Prepare and implement ICMPs.<br>Raise minimum development standards. |

# 07

# Stormwater management policies

## 7.1 STORMWATER MANAGEMENT

Stormwater management is the cornerstone to achieving the goals and objectives of the Strategy, in particular Goal 1 (water quality), Goal 2 (flood risk), Goal 3 (ecosystem health) and Goal 4 (Ngāi Tahu values). See Figure 7.1 for an overview of stormwater management approaches.

**On-site and collective treatment**

Stormwater can be managed either on-site (i.e. stormwater from an individual property is treated on the property) or collectively (i.e. stormwater from multiple properties/subdivisions is treated together). Examples of on-site treatment include rain-tanks and rain-gardens. Collective stormwater treatment includes retention and detention ponds and swales.

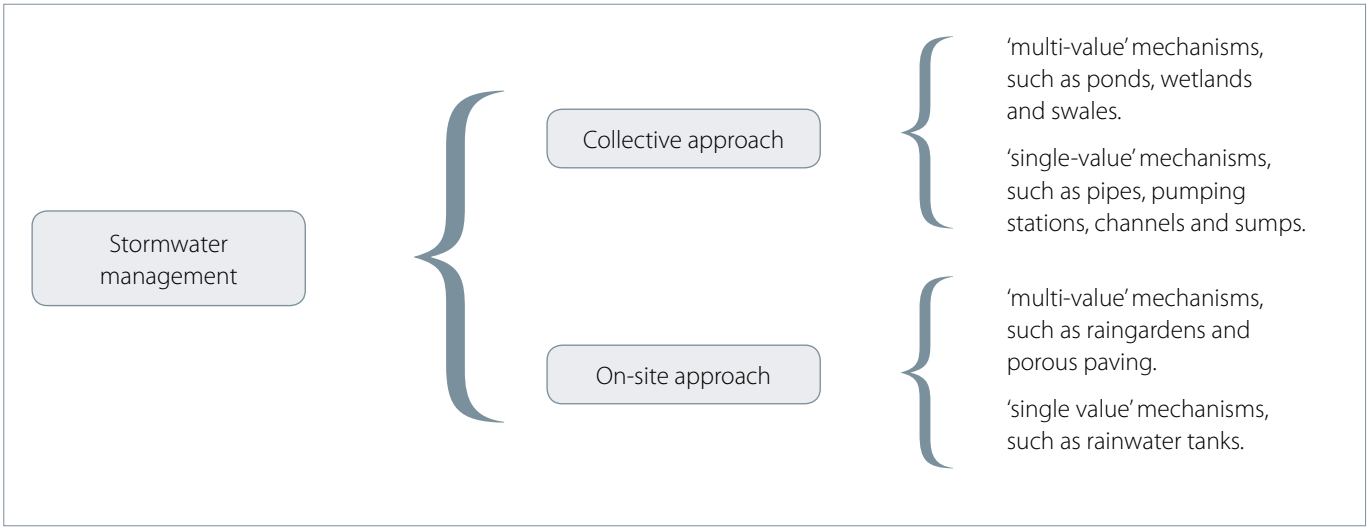
In general, stormwater in Christchurch has been managed collectively since 1875 (the formation of Christchurch Drainage Board)[24]. Developing the Surface Water Strategy has provided an opportunity for the Council to consider the role of on-site stormwater management in meeting the key challenges we face (water quality, urban growth and climate change) and achieving the goals and objectives of the Strategy. On-site stormwater management would be advantageous in that:

- Stormwater could be treated before it enters the collective system.
- It could reduce the need for Council owned collective treatment.
- It could be installed and maintained by the developer and subsequent property owners.

The Council will continue to pursue collective stormwater treatment as collective stormwater management is efficient, cost-effective and relatively easy to ensure maintenance. However, there are instances, such as in urban intensification areas and industrial and business areas, where the Council will pursue on-site stormwater treatment. Before pursuing on-site stormwater management the Council must establish processes for ensuring they are maintained and educate property owners/developers on installation, standards and maintenance. If these

*[24] The Board received its first engineering report in 1877. The scheme presented recommended that stormwater be carried by street channels and brick and pipe drains to the natural streams and rivers that criss-crossed Christchurch at the time.*

FIGURE 7.1. OVERVIEW OF STORMWATER MANAGEMENT APPROACHES



processes are not established, and to a high enough standards, water quality improvements may be compromised and the risk of nuisance flooding increased.

**Single-value and multi-value treatment**

Prior to the Natural Asset Management Strategy 1999 (NAMS) and Waterways and Wetlands Drainage Guide 2003 (WWDG), all stormwater was managed for one value only – drainage. The NAMS and the WWDG represented a crucial change in management philosophy. Stormwater, particularly in greenfield areas, is now managed to support a range of values, for example improving water quality and adding to the amenity of the area. Mechanisms that support a range of values are sometimes called 'water-sensitive' or 'low-impact'. Multi-value approaches, much like those advocated by LIUDD principles, aim to utilise natural processes such as vegetation and soil to provide stormwater management solutions that add value to urban environments through enhancing habitat, biodiversity, landscaping, amenity, recreational opportunities and cultural identity.

Single-value and multi-value approaches are not mutually exclusive and are often used together in 'treatment trains'.

## 7.2 DEVELOPMENT OF POLICIES

The policies outlined in sections 7.3 to 7.9 were developed by assessing a range of stormwater management mechanisms against their ability to:

- mitigate flood risk;
- improve water quality;
- improve biodiversity;
- enhance the landscape;
- support recreation;
- protect heritage;
- support Ngāi Tahu values.

These criteria reflect the Strategy's goals. Capital and operational costs of the different mechanisms were also compared. Finally, the feasibility of the mechanisms in different land-use areas were assessed,[25] and 'preferred' mechanisms were identified for different land-use areas. See Appendix E for a summary of the preferred mechanisms. In most cases multi-value stormwater management is preferred as this approach best supports the achievement of the Strategy's goals. See Figure 7.2 for examples of multi-valued approaches to stormwater management.

[25] *Christchurch City Council, 2009*


FIGURE 7.2: PHOTOGRAPHS OF MULTI-VALUE STORMWATER MANAGEMENT MECHANISMS.

These stormwater policies aim to clarify the Council's approach to stormwater management in different parts of Christchurch: urban intensification areas, greenfield developments, suburbs, industrial and business areas, Banks Peninsula townships and settlements, and rural areas.

## 7.3 RESIDENTIAL URBAN INTENSIFICATION AREAS

Urban intensification areas are existing urban areas that can be developed at a higher density (this excludes greenfield developments of high density housing). At present urban intensification areas are signalled by Living 2, Living 3 and Living 4 zoning in the City Plan.

As identified in the 'Current Challenges' (section 4), the stormwater infrastructure in some catchments does not have capacity for the expected increase in stormwater run-off resulting from urban intensification. To meet the demands of urban intensification the Council could:

- Allow stormwater to pond on streets and properties (effectively lower existing levels of service in these areas).
- Upgrade the existing single-value (piped) infrastructure.
- Upgrade the existing infrastructure to multi-value stormwater treatment.
- Require on-site stormwater detention for all new development so that there is no effect on Council infrastructure.

A preliminary assessment of these options is summarised in Appendix F. The cost of three options has been estimated (see Appendix H):

a. Using a network of swales (multi-value treatment).
b. Upgrading the existing infrastructure as a piped network (single-value treatment).
c. Requiring roof tanks (on-site detention).

Multi-value stormwater treatment would support the objectives of the Surface Water Strategy, Public Open Space Strategy, and Central City Revitalisation Strategy which states the Council's commitment to 'greening' the Central City. Multi-value treatment would also assist in improving water quality in the Avon/Ōtakaro and Heathcote/Opāwaho rivers, helping the Council to meet PNRRP requirements and Goal 1 of the Strategy. But unlike greenfield development areas, space for collective, multi-value stormwater treatment in intensification areas is limited and relatively expensive. Of the two multi-value treatments evaluated, developing treatment trains with detention basins is the most expensive as the Council would be required to purchase land.


FIGURE 7.4. PREFERRED STORMWATER MECHANISMS IN URBAN INTENSIFICATION AREAS

The costs of upgrading stormwater infrastructure (either piped or multi-value) could be recovered through Development Contributions (DCs), however this might result in DCs in these catchments being so large that they act as a disincentive to development – contrary to Council's urban intensification commitments in the UDS and Central City Revitalisation Strategy. To keep DCs at a level that encourages urban growth in intensification areas, upgrade costs would probably need to be subsidised by rates.

On-site stormwater treatment is the cheapest option for the Council, as the majority of costs would fall to developers and subsequent property owners. But there are drawbacks as discussed in section 7.1. The Council would have to prepare guidance on what on-site stormwater treatment was acceptable and establish a process for ensuring the ongoing maintenance of the systems/devices.

Further work is urgently needed to identify the best options for Council to pursue. In the meantime, it is the Council's policy in urban intensification areas (see Figure 7.4) to:

a. Maintain the existing stormwater infrastructure.
b. Implement multi-value stormwater management as opportunities arise.
c. Encourage on-site stormwater management where possible.
d. Promote the maximisation of pervious surfaces in developments and public spaces.

See Appendix E for examples of preferred mechanisms.

PHOTO: CHRISTCHURCH SCHOOL CHILDREN PLANTING INDIGENOUS SPECIES TO SUPPORT BIODIVERSITY

## 7.4 GREENFIELD DEVELOPMENT AREAS

Greenfield areas are non-urban land (usually rural) which will be developed for urban land-uses (residential, business or industrial). The greenfield development areas identified in the UDS include south-west Christchurch and Belfast. The framework for developing these areas is outlined in Area Plans[26] prepared for each. Area Plans are subsequently reflected in District Plan changes setting our more detailed provisions, including outline development plans for these areas.

[26] *Area Plans are non-statutory documents, establishing objectives and policies for land-use change in areas of urban growth.*

Space for multi-value stormwater treatment is not limited in greenfield areas, and as such, the Council has the opportunity to influence the design of subdivisions and ensure that they are planned in a manner that has 'low-impact' on waterways. Multi-value devices best support the goals and objectives of the Strategy it is the Council's policy in greenfield developments (see Figure 7.5) to:

a. Implement multi-value stormwater management.
b. Ensure the design of subdivisions minimises their impact on surface water.

See Appendix F for examples of preferred mechanisms.

## 7.5 EXISTING SUBURBS

Existing suburbs are those residential areas of Christchurch City (excluding hill suburbs and Banks Peninsula) that are not identified as urban intensification areas. They are characterised by low-density housing interspersed with local business centres, schools and open spaces.

Retrofitting stormwater treatment in these areas will be costly as space is limited and costs cannot be recovered through Development Contributions. It is therefore the Council's policy in existing suburbs (see Figure 7.6) to:

a. Maintain the existing stormwater infrastructure.
b. Implement multi-value stormwater management when upgrading roads.
c. Encourage on-site management of stormwater where appropriate.

See Appendix E for examples of preferred mechanisms.

## 7.6 INDUSTRIAL AND BUSINESS AREAS

Industrial areas refer to existing sites that accommodate processing, manufacturing, storage, construction, distribution, wholesale trade and utilities. Business areas refer to land used for retail, administration, offices, leisure and entertainment activities. Waterways that travel through industrial areas are some of the most polluted in Christchurch, however retrofitting stormwater treatment is resource intensive and, as with existing suburbs, cannot be recovered through Development Contributions.

It is the Council's policy in industrial and business areas (see Figure 7.7 to:

a. Maintain the existing stormwater infrastructure.
b. Promote removal of contaminants at source.
c. Encourage on-site management of stormwater where possible.
d. Implement single-value and multi-value stormwater management as opportunities arise.

See Appendix E for examples of preferred mechanisms.

FIGURE 7.5. PREFERRED MECHANISMS IN GREENFIELD DEVELOPMENTS

FIGURE 7.6. PREFERRED STORMWATER MECHANISMS IN EXISTING SUBURBS

## 7.7 BANKS PENINSULA TOWNSHIPS, SETTLEMENTS AND HILL SUBURBS.

Banks Peninsula townships and settlements include Lyttelton, Akaroa, Little River and Diamond Harbour.
The townships and settlements of the Peninsula are predominantly coastal and characterised by low to medium density housing surrounded by large areas of rural land and steep catchments. The hill suburbs of Christchurch include Redcliffs, Cashmere, Sumner and Westmorland.
The loess soils of Banks Peninsula and the Port Hills mean that sedimentation is a particular issue and the steep catchments limit the use of some multi-value mechanisms.

It is the Council's policy in Banks Peninsula townships and settlements (see Figure 7.8) to:

a. Maintain the existing stormwater infrastructure.
b. Improve stormwater quality through a range of stormwater mechanisms as opportunities arise.

See Appendix E for examples of preferred mechanisms.

## 7.8 RURAL AREAS

The majority of Banks Peninsula is rural and rural land surrounds the City on the plains. The dominant rural land-use is pastoral farming, but horticulture and forestry are also features of this business sector in Christchurch. Most of the streams and rivers of Banks Peninsula run through rural land, which is the main determinant of water quality in the waterways of the area. Stock with unlimited access to waterways can damage banks and pollute waterways. Septic tank discharges may also be causing high nutrient levels in some areas. These issues are particularly important where surface water is used as drinking water (for example in Akaroa and Little River).

It is the Council's policy in rural areas (see Figure 7.9) to:

a. Encourage the planting and fencing of riparian margins.
b. Encourage on-site management of stormwater where possible.

See Appendix E for examples of preferred mechanisms.

FIGURE 7.7. PREFERRED MECHANISMS IN INDUSTRIAL AND BUSINESS AREAS.

FIGURE 7.8. PREFERRED STORMWATER MANAGEMENT MECHANISMS IN BANKS PENINSULA TOWNSHIPS AND SETTLEMENTS.

## 7.9 LINK WITH PUBLIC OPEN SPACE

Collective, multi-value stormwater management mechanisms can provide important amenity and open space values. The Council's Public Open Space Strategy provides a framework for public open space provision in Christchurch and should also be referred to when planning or making decisions on surface water management.

The table 7.1 summarises the Council's proposed timeframe to implement stormwater policies proposed in the Strategy.

The Council will:

- Further investigate options for stormwater management in intensification areas.
- Implement recommendations from the intensification options investigation.
- Build and manage its stormwater network in line with the policies outlined.

FIGURE 7.9. PREFERRED STORMWATER MANAGEMENT MECHANISMS IN RURAL AREAS.


Table 7.1 Implementation Programme: Stormwater Management Policies

| **Short-term (0-3 yrs)** | | **Medium-term (3-10 yrs)** | | **Long-term (10 plus yrs)** | |
|---|---|---|---|---|---|
| **Task** | **Approx. Cost** | **Task** | **Approx. Cost** | **Task** | **Approx. Cost** |
| **7.a** Further investigate options for stormwater management in intensification areas. | Approx. $50,000 | **7.b** Implement recommendations from intensification options investigation. | Dependent on **7.a** | - | - |
| **7.c** Build and manage stormwater network in line with Policies. | Within existing budgets | **7.c** Build and manage stormwater network in line with Policies. | Within existing budgets | | |

# 08

# Integrated Catchment Management Plan programme

PHOTO: BLACK-BILLED GULLS (ENDANGERED SPECIES), BEXLEY WETLAND.

## 8.1 INTRODUCTION TO INTEGRATED CATCHMENT MANAGEMENT PLANS (ICMPS)

The Council is committed to developing ICMPs for all catchments within its jurisdiction. ICMPs establish how stormwater within a water catchment will be managed in response to current and planned land-use activities and changes. Integrated catchment management will be crucial to achieving the goals and objectives of the Surface Water Strategy and meeting the requirements of the PNRRP.

ICMPs will establish water quality and quantity objectives for a given catchment and will set out how stormwater will be managed to meet those objectives. Resource consents will be needed for those ICMPs that do not meet the permitted water quality standards for stormwater discharges set in the PNRRP. All urban catchments in Christchurch will require a discharge resource consent. Once an ICMP has been completed and any necessary resource consent is granted, the Council will have a responsibility to meet the objectives of the ICMP and conditions of consent.

## 8.2 ICMP BOUNDARIES

The ICMP boundaries are outlined in Figures 8.1 and 8.2. These boundaries are based on catchments that discharge into the same receiving environment (e.g. the estuary, the ocean, Lake Ellesmere/Te Waihora and Lake Forsyth/ Te Roto o Wairewa). Where an Area Plan is in place, or being developed, the boundary has been adjusted so that the whole urban growth area is covered by one ICMP. Table 8.1 shows the ICMPs that will be developed.

Table 8.1 List of ICMPs and their catchments.

| ICMP | Sub-catchments | Comments |
|---|---|---|
| **Styx/ Puharakekenui** | Upper Styx/Puharakekenui | The Styx/Puharakekenui ICMP includes part of the Otukaikino, so that the whole of the Belfast Area Plan area is covered by one ICMP. *ICMP development underway.* |
| | Lower Styx/Puharakekenui | |
| | Kaputone | |
| **Avon River** | Upper Avon River Tributaries | |
| | Mid Avon River | |
| | Lower Avon River | |
| | City | |
| | Horseshoe Lake | |
| **Lower Heathcote River** | Mid Heathcote River | The Upper Heathcote River is part of the South-West ICMP. |
| | Lower Heathcote River | |
| **South-West** | Upper Heathcote River | The upper Heathcote River and upper Halswell catchments correspond with the South-West Area Plan study area. *ICMP already completed.* |
| | Upper Halswell | |
| **Coastal** | Coastal | Includes coastal areas from South shore to Brooklands Lagoon. |
| **Estuary** | Estuary | |
| | Estuary Hills | |
| **Sumner/Redcliffs** | Ocean discharge | |
| **Outer Christchurch** | Northwest Plains | Part of the Otukaikino catchment will be covered by the Styx/Puharakekenui ICMP. |
| | Waimakariri-Otukaikino | |
| **Lyttelton Harbour** | All catchments draining into the Harbour | |
| **Akaroa Harbour** | All catchments draining into the Harbour | |
| **Lakes** | All catchments draining into Lake Ellesmere/Te Waihora and Lake Forsyth/Te Roto o Wairewa | NB. A sub-catchment within this ICMP crosses CCC and Selwyn boundary. |
| **Southern Bays** | All Banks Peninsula catchments from Lake Forsyth/Te Roto o Wairewa round to Akaroa Harbour | |
| **Northern & Eastern Bays** | All Banks Peninsula catchments from Akaroa Harbour round to Lyttelton Harbour | |

FIGURE 8.1 URBAN CHRISTCHURCH ICMP BOUNDARIES

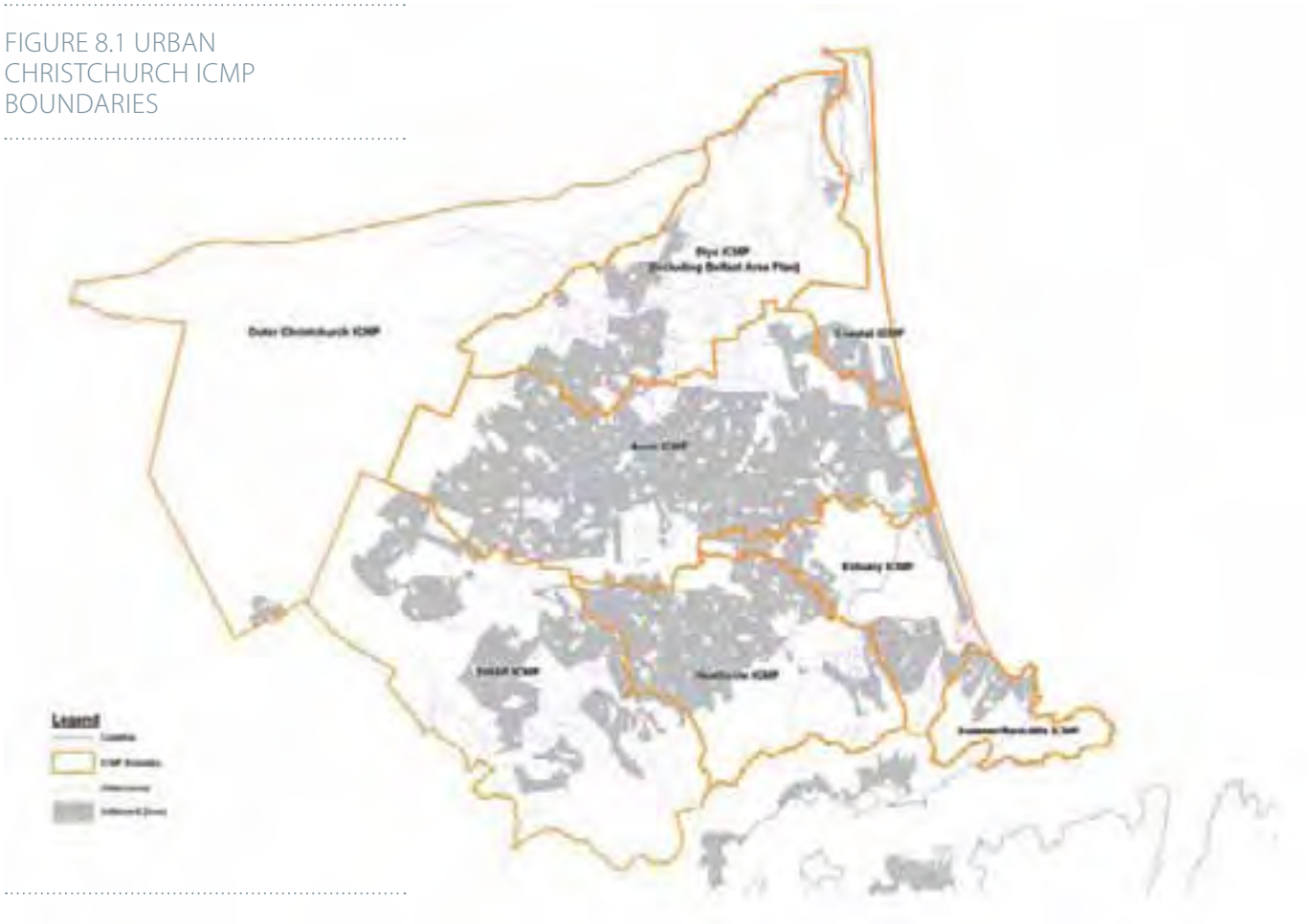



PHOTO: LAKE ELLESMERE / TE WAIHORA

## 8.3 PROGRAMME FOR DEVELOPMENT

Developing ICMPs is resource intensive and will therefore be staged over a number of years. To determine the priority and general order in which ICMPs should be developed, the ICMP areas were assessed against the criteria in Table 8.2.

The South-West ICMP has already been completed, and the Styx/Puharakekenui ICMP is underway. Based on an assessment of ICMP areas against the criteria outlined above, and following feedback during the public consultation process, the priority and general order in which the rest of the ICMPs will be developed is:

1. Lower Heathcote River ICMP;
2. Avon River ICMP;
3. Estuary ICMP;
4. Lyttelton ICMP and Akaroa ICMP;
5. Coastal ICMP;
6. Sumner/Redcliffs ICMP and Lakes ICMP;
7. Southern Bays ICMP and Northern, Eastern Bays ICMP;
8. Outer Christchurch ICMP.

## 8.4 FRAMEWORK FOR DEVELOPMENT

The Planning & Consents Protocol for Surface Water Management[27] sets out the various stages of planning and investigations that are required to develop an ICMP. Table 8.2 shows the implementation programme proposed for the development of the ICMPs. After gathering base information, water quality objectives for the ICMP area are established. The Surface Water Strategy goals and objectives are intended to provide an agreed foundation for the ICMP objectives. Subsequently the stormwater management system is designed to meet those ICMP and Surface Water Strategy objectives. The stormwater management policies will provide a framework for the development of stormwater management solutions in different types of land-use and development. Figure 8.3 shows the ICMP process and how the Surface Water Strategy links with the ICMP objectives and stormwater management system designs.

[27] *Christchurch City Council and Environment Canterbury, 2008.*

Table 8.2

| **Assessment Criteria** | | | **Sources** |
|---|---|---|---|
| **Regulatory** | PNRRP | Catchments where the ICMP is required by the PNRRP are prioritised. | PNRRP Rule WQL7 |
| **Threats/Issues** | Greenfield urban development | Catchments where greenfield development is planned are prioritised. | City Plan<br>UDS |
| | Urban intensification | Catchments where urban intensification is planned are prioritised. | City Plan<br>UDS |
| | Flood risk to property | Catchments with a high flood risk are prioritised. | City Plan |
| **Strengths** | Water quality | Catchments where water quality is generally relatively high are prioritised. | Analysis of Water Quality Data for Christchurch City Waterways (Main, 2007) |
| | Biodiversity value | Catchments of relatively high ecological value are prioritised. | City Plan<br>Biodiversity Strategy |
| | Importance to Ngāi Tahu | Catchments of high importance to Ngāi Tahu are prioritised. | Surface Water Strategy Background Report: Summary of Ngāi Tahu Values |

## 8.5 IMPLEMENTING THE ICMPS

Once an ICMP has been developed, the Council will seek a resource consent for stormwater discharges from Environment Canterbury. If a resource consent is granted, new stormwater management activities arising from land-use change or development can be approved by the Council at the same time as the subdivision application. If the Council does not grant approval (e.g. if the activity would cause the Council to breach its conditions under the ICMP resource consent, or if the activity does not align with the Surface Water Strategy objectives and stormwater policies) a separate resource consent from Environment Canterbury will be required.

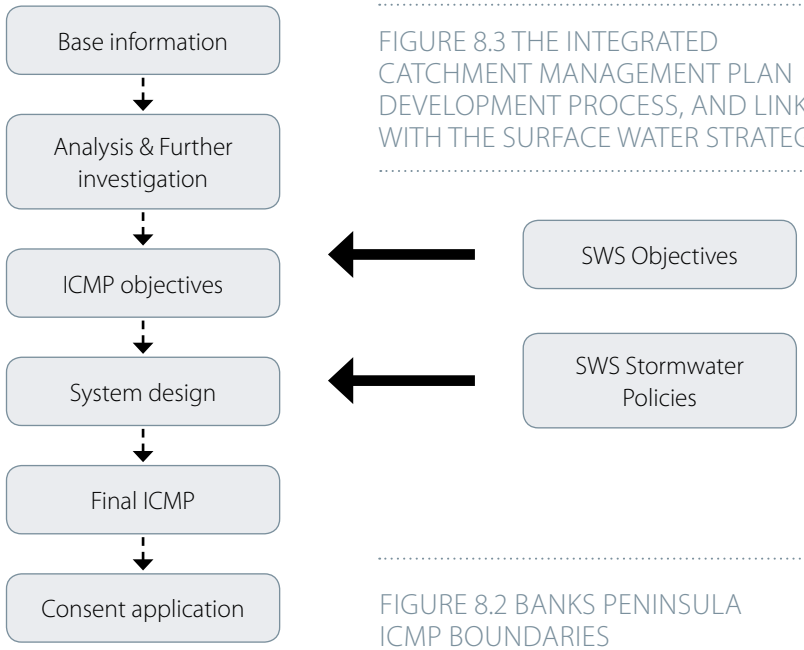



FIGURE 8.3 THE INTEGRATED CATCHMENT MANAGEMENT PLAN DEVELOPMENT PROCESS, AND LINKS WITH THE SURFACE WATER STRATEGY

FIGURE 8.2 BANKS PENINSULA ICMP BOUNDARIES

PHOTO: LOWER AVON RIVER / ŌTAKARO

While the ICMPs are being developed, the Council will seek an 'interim global consent' from Environment Canterbury. The global consent for the City will last seven years, and allow the Council to approve stormwater discharges for subdivisions up to 4ha on the flat, and 2ha on the hills (see Figure 8.4).

Implementation of the ICMPs will require land purchase for stormwater management systems and education programmes aimed at businesses and householders in the area. The cost will depend on the scale and level of management proposed in the ICMPs and will be decided through the LTCCP process.

The Council will:

- Develop ICMPs for all catchments in its jurisdiction. [28]
- Revise the Planning & Consents Protocol for Surface Water Management to reflect this ICMP Programme.

[28] *The approximate costs outlined here are for the development of the ICMPs. They do not include the cost of implementing the ICMPs, which will be determined by the ICMP.*

**Figure 8.4: The differences between subdivision and stormwater discharge consent processing under current, interim, and ICMP regimes.**

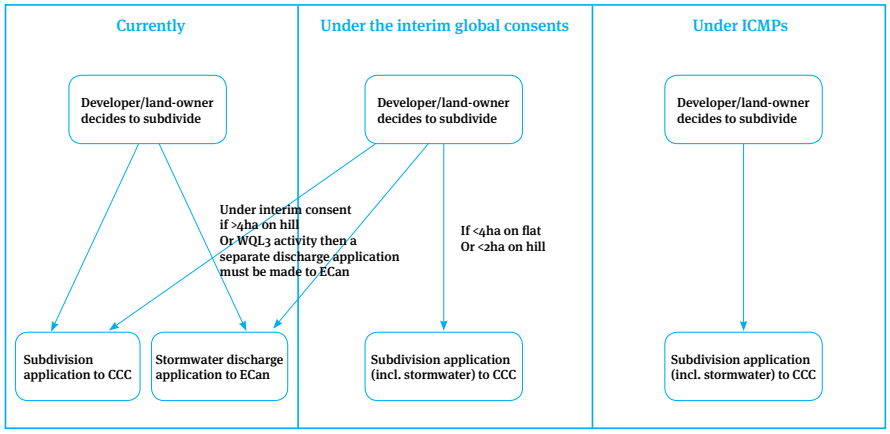



Table 8.2 Implementation Programme: ICMP Development

| **Short-term (0-3 yrs)** | | **Medium-term (4-10 yrs)** | | **Long-term (10 plus yrs)** | |
|---|---|---|---|---|---|
| **Task** | **Approx. Cost** | **Task** | **Approx. Cost** | **Task** | **Approx. Cost** |
| **8.n** Revise planning and consents protocol. | Within existing budgets. | **8.d** Avon River ICMP developed. | $500,000 (partly funded within existing budgets). | **8.i** Sumner/Redcliffs ICMP developed. | $250,000 |
| | | | | **8.j** Lakes ICMP developed. | $250,000 |
| | | | | **8.k** Southern Bays ICMP developed. | $250,000 |
| **8.a** South-west ICMP (completed). | Within existing budgets. | **8.e** Estuary ICMP developed. | $500,000 (partly funded within existing budgets). | **8.l** Northern & Eastern Bays ICMP. | $250,000 |
| **8.b** Styx/ Puharakekenui ICMP developed. | Within existing budgets. | **8.f** Lyttelton ICMP developed. | $500,000 (partly funded within existing budgets). | **8.m** Outer Christchurch ICMP developed. | $250,000 |
| **8.c** Lower Heathcote River ICMP developed. | Within existing budgets. | **8.g** Akaroa ICMP developed. | $500,000 (partly funded within existing budgets). | | |
| | | **8.h** Coastal ICMP developed. | $500,000 (partly funded within existing budgets). | | |

# 09

# Development Standards

## 9.1 DEVELOPMENT STANDARDS

In addition to the water quality standards set through the ICMPs, the Council sets standards effecting surface water management through the City and District Plans, and the Infrastructure Design Standards (IDS). The City and District Plans contain objectives, policies and rules that govern land-use change and development. The IDS sets the Council's standards for the building of public assets (such as stormwater infrastructure), including those created by subdivision/private development and subsequently managed by the Council.

## 9.2 THE CITY AND DISTRICT PLANS, INFRASTRUCTURE DESIGN STANDARDS, AND WATERWAYS, WETLANDS AND DRAINAGE GUIDE

A review of the City and District Plan provisions identified that both plans will need to be changed to achieve the goals, objectives and stormwater policies of the Surface Water Strategy. It is important to note that the District Plans only apply to surface water management in areas where land-use is changing. Therefore improving the City and District Plan provisions will have the most direct impact in greenfield and urban intensification areas.

Several parts of the IDS relate to surface water: Part 4 (geotechnical requirements), Part 5 (stormwater and land drainage), Part 8 (roading) and Part 10 (parks, streets and open spaces). The IDS refers to the Waterways, Wetlands and Drainage Guide (WWDG), which contains detailed technical guidance on stormwater management, particularly multi-value mechanisms. Over the long-term, the design and construction of subdivisions and urban development will have a large impact on how well the goals and objectives of the Surface Water Strategy are achieved and the liveability of a neighbourhood. As with the City and District Plans, the IDS has been reviewed and several areas of improvement have been identified. Table 9.1 provides a summary of the gap analysis undertaken between the Surface Water Strategy and the Council's development standards.

PHOTO: MACROPHYTE CONTROL, STYX RIVER / PUHARAKEKENUI

Table 9.1: Summary of Gap Analysis between Surface Water Strategy and the Council's development standards.
✓ = covered in document x = not covered in document

| SWS Goal | SWS Objectives | City Plan | Banks Peninsula District Plan | IDS | WWDG |
|---|---|---|---|---|---|
| 1. Water quality | 1.1. Implement stormwater treatment. | n/a | n/a | ✓ | ✓ |
| | 1.2. Meet NRRP standards. | n/a | n/a | x | x |
| | 1.3. Remove pollutants at source. | x | x | x | x |
| | 1.4. Ensure no ecological impacts from construction. | x | x | x | x |
| | 1.5. Protect springs. | x | x | x | ✓ |
| 2. Flood risk | 2.1. Maintain the flood storage capacity of ponding areas, wetlands and floodplains. | ✓/x (partially)2 | ✓/x (partially) | n/a | n/a |
| | 2.2. Limit further development in high flood risk areas. | ✓/x (partially) | ✓/x (partially) | n/a | n/a |
| | 2.3. Limit further development in moderate risk areas. | ✓/x (partially) | ✓/x (partially) | n/a | n/a |
| | 2.4. Manage effects of development to avoid increased flood risk downstream. | ✓/x (partially) | ✓/x (partially) | n/a | n/a |
| 3. Ecosystem health | 3.1. Protect existing indigenous habitats and species. | ✓ | ✓ | x | ✓ |
| | 3.2. Restore a range of indigenous habitats and species. | x | x | x | ✓/x (partially3) |
| | 3.3. Ensure maintenance of waterways supports ecosystem health. | n/a | n/a | n/a | ✓ |
| 4. Ngāi Tahu | 4.1. Protect and restore the mauri of waterways. | ✓ | ✓ | x | ✓ |
| | 4.2. Protect and restore mahinga kai. | ✓ | ✓ | x | ✓ |
| | 4.3. Support sustainable cultural harvest. | x | x | x | ✓ |
| | 4.4. Involve Ngai Tahu in surface water management. | n/a | n/a | n/a | n/a |
| 5. Recreation | 5.1. Integrate surface water into public open space. | x | x | x | ✓ |
| | 5.2. Improve public access where possible. | ✓ | ✓ | x | ✓ |
| | 5.3. Ensure recreation is not detrimental to significant ecological values. | x | x | X | x |
| 6. Heritage | 6.1. Protect heritage places and values. | ✓ | ✓ | x | ✓ |
| | 6.2. Manage Council assets in accordance with ICOMOS NZ charter. | n/a | n/a | x | X |
| 7. Landscape | 7.1. Protect outstanding natural landscapes and features. | ✓ | ✓ | x | ✓ |
| | 7.2. Protect natural character and visual amenity. | ✓ | ✓ | x | ✓ |
| | 7.3. Ensure surface water management enhances 'Garden City' image. | n/a | n/a | x | x |
| 8. Community | 8.1. Support community groups and projects. | n/a | n/a | n/a | n/a |
| | 8.2. Increase awareness of surface water management. | n/a | n/a | n/a | n/a |
| | 8.3. Engage community in management activities. | n/a | n/a | n/a | n/a |
| | 8.4. Learn from community expertise and experience. | n/a | n/a | n/a | n/a |

| | | | | | |
|---|---|---|---|---|---|
| 9. Stormwater management | 9.1. Ensure infrastructure supports Goals 1 to 8. | n/a | n/a | x | x |
| | 9.2. Co-ordinate provision and maintenance of stormwater with other infrastructure. | n/a | n/a | x | x |
| Land-use | Relevant Stormwater Management Policies | | | | |
| Urban intensification | To be determined by project 7.a which will investigate stormwater management options in intensification areas. | - | - | - | - |
| Greenfield | Multi-value stormwater treatment. | x | x | ✓ | ✓ |
| Existing suburbs | a. Maintain existing infrastructure. | n/a | n/a | n/a | n/a |
| | b. Upgrade to multi-value mechanisms. | x | x | ✓ | ✓ |
| Industrial and Business | a. Encourage on-site management of stormwater. | x | x | x | x |
| | b. Upgrade using a range of stormwater mechanisms. | x | x | x | x |
| Banks Peninsula townships and settlements | a. Maintain the existing infrastructure. | n/a | n/a | n/a | n/a |
| | b. Upgrade using a range of mechanisms. | x | x | x | x |
| Rural areas | a. Encourage planting and fencing of riparian margins. | x | x | x | ✓ |
| | b. Encourage on-site stormwater management where possible. | x | x | x | x |

Although many changes to the City and District Plans are needed to address all the gaps identified in the review (summarised in Table 9.1), the Council is going to focus on:

- Identifying high and moderate flood risk areas. Although Variation 48 restricts development and established minimum floor levels for buildings in Flood Management Areas, further work is required to better identify and map these areas. This will help the Council meet Goal 2 of this Strategy (reduce flood risk).
- Improving and clarifying stormwater management requirements in Greenfield developments. This will help Council implement the stormwater policies identified in Section 7 of this Strategy.
- Implementing stormwater management requirements in urban intensification areas as identified in the 'urban intensification options investigation' (Task 7.a in Section 7).

Table 9.2 (next page) summarises the proposed Implementation Programme work needed to raise the Council's development standards.

The Council will:

- Improve its knowledge of, and define, high and medium risk flood areas.
- Review City Plan land-use controls in high and medium flood risk areas.
- Review the City and District Plan provisions relevant to stormwater in Greenfield and urban intensification development.
- Prepare any plan changes identified by the Greenfield and urban intensification review.
- Review Waterways, Wetlands and Drainage Guide to include on-site stormwater management.

PHOTO: AUSTRALASIAN COOT

| Table 9.2. Implementation Programme: Raising Minimum Development Standards | | | | | |
|---|---|---|---|---|---|
| **Short-term (0-3 yrs)** | | **Medium-term (4-10 yrs)** | | **Long-term (10 plus yrs)** | |
| **Task** | **Approx. Cost** | **Task** | **Approx. Cost** | **Task** | **Approx. Cost** |
| **9.a** Define high and moderate risk flood areas.<br>**9.b** Review city Plan land-use controls in high and moderate flood risk areas.<br>**9.c** Review District Plans and IDS provisions for development in Greenfield and urban intensification areas.<br>**9.d** Prepare any plan changes identified by review. | Within existing budgets<br>Within existing budgets<br>Within existing budgets<br>Within existing budgets | **9.e** Review WW&DG to include on-site stormwater management. | $40,000 | - | - |

# 10

# Minimising The Sources of Pollution

## 10.1 SOURCES OF POLLUTION

Minimising the sources of pollution is not a straight forward or simple task. Identifying point and non-point sources of pollution is complex and will require close collaboration between local authorities and commitment from Central Government to reduce and/or remove sources. Tackling non-point-source pollution (for example, zinc from roofs, copper from brake-pad linings) is particularly challenging and requires a central government-led approach (for example by setting National Standards).

There are a variety of ways the Council could reduce pollutant sources, including:

- Spill prevention and clean-up.
- Improving maintenance activities, for example street sweeping and sump/silt trap cleaning.
- Reducing the use and creation of pollutants (e.g. sediment) in operations and maintenance activities.
- Reducing waste and improving disposal practices.
- Improving storage practises.
- Monitoring discharges, enforcing breaches (particularly industrial discharges) and elimination of illicit discharges.
- Fleet vehicle maintenance.
- Reducing overflows from the wastewater network.
- Ensuring Council owned land is managed to meet the Strategy's Goals.
- Public information and education.

The Council already works with Environment Canterbury to respond to pollution events reported via Environment Canterbury's Pollution Hotline. Environment Canterbury also promotes the Pollution Prevention Guide, designed to help businesses assess and reduce their risk of polluting waterways. However, there is always more that could be done to reduce the use of polluting materials and provide general public information and education on the sources of pollutants.

PHOTO: FRESHWATER WETLAND, BEXLEY RESERVE

## 10.2 COUNCIL TAKING THE LEAD

The Council will take the lead and reduce the use and sources of pollutants in its operations and activities (see Table 10.1). This commitment will need to be championed across the organisation and through the different units in the Council.

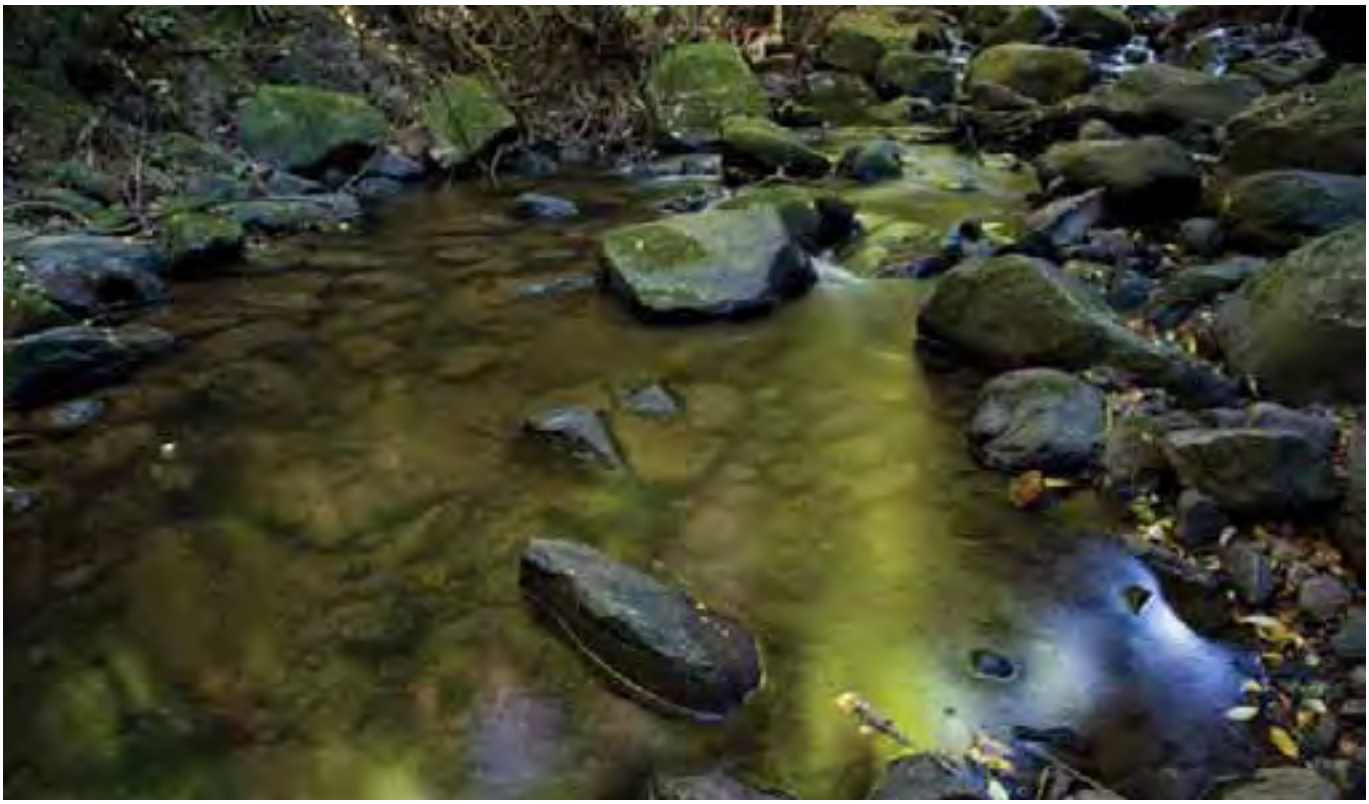
The Council will:

- Review Council operations and maintenance activities, and identify opportunities for improvement, to meet the Strategy's goals.
- Implement the findings of the pollutants review.
- Advocate to central government for the reduction of pollutants where opportunities arise.

PHOTO: OKUTI STREAM, BANKS PENINSULA

Table 10.1. Implementation Programme: Minimising Sources of Pollution

| **Short-term (0-3 yrs)** | | **Medium-term (4-10 yrs)** | | **Long-term (10 plus yrs)** | |
|---|---|---|---|---|---|
| **Task** | **Approx. Cost** | **Task** | **Approx. Cost** | **Task** | **Approx. Cost** |
| **10.a** Review Council operations and maintenance activities and identify opportunities for improvement.<br><br>**10.b** Implement findings of pollutant review.<br><br>**10.c** Advocate to central government where opportunities arise for the reduction of pollutants. | Within existing budgets<br><br>Within existing budgets<br><br>Within existing budgets | **10.c**. Advocate to central government for the reduction of pollutants, for example, through National Standards. | Within existing budgets | **10.c** Advocate to central government for the reduction of pollutants, for example, through National Standards. | Within existing budgets |



# 11

# Community Engagement

## 11.1 SUPPORTING THE COMMUNITY

Considerable work has been, and is being, undertaken by community organisations and individuals to improve the state of surface water in Christchurch. Community efforts include restoration, planting, monitoring, education, and reporting damage and pollution incidents. The Council will learn from, and build on, the community's expertise and experiences and it is important that the Council supports community efforts that align with the goals and objectives of the Strategy.

## 11.2 THE COMMUNITY EDUCATION STRATEGIC PLAN

Community education will be central to achieving the goals and objectives of the Strategy. A Community Education Strategic Plan[29] has been prepared to increase residents' awareness of Christchurch's surface water resources and understanding of why they are important and encourage community engagement through participation in surface water enhancement and protection.

The Community Education Strategic Plan will be implemented in collaboration with Environment Canterbury and other key stakeholders, to foster collaboration and avoid duplication of effort and resources. A 'Letter of Intent' signed by the Council and Environment Canterbury confirms both Councils' commitment to working together on community education related to surface water. Table 11 summarises the Implementation programme to deliver community education on surface water.

[29] *Community Education Strategic Plan for the Surface Water Strategy, CCC, 2009.*

## 11.3 KEY AUDIENCES

The key audiences identified are:

- Christchurch residents;
- School communities;
- Community groups involved in surface water protection and enhancement;
- Business sector, including industry and developer.

## 11.4 EDUCATION PLANS

The Community Education Strategic Plan provides direction on the following:

- Existing practices – what the Council is currently doing now around waterways and wetlands education.
- Current community knowledge of rivers and streams and what communities are willing to do to address issues and enhance waterways.

The following education plans will be created:

- Awareness education plan;
- Schools education plan;
- ICMP education plan.

An important aspect for each plan is to have clearly defined educational objectives and measurable outcomes, which will enable robust monitoring and evaluation. Additionally, follow-up research studies similar to the River Guardians baseline research[30] will monitor the levels of awareness and actions residents undertake to assist in the care of waterways and wetlands.

The education plans will include a variety of education tools, specific to the key audiences. These education tools could range from interpretation (for example of stormwater management facilities) to education material for schools.

[30] *Market Research Report for the River Guardian Project, Environment Canterbury, 2007.*

## 11.5 AWARENESS EDUCATION PLAN

Overview: Work with ECan to raise general awareness of the local waterways. This will form the foundation for subsequent plans.

The general awareness education plan will have a combination of themes on city waterways, wetlands and stormwater. It will include tactics covering specific issues, such as the different types of contaminants in stormwater, the effects of stormwater on rivers and streams, and how to prevent contaminants entering stormwater.

## 11.6 SCHOOLS EDUCATION PLAN

Overview: Work with ECan to develop a comprehensive schools education programme that incorporates stream care, waterway enhancement and stormwater management, is linked to the NZ Curriculum and builds on existing environmental education schemes.

Because this plan will be looking at a target audience of school communities, the tactics are likely to focus around general actions that can be taken in the waterways in the local areas specific to each school. It will involve:

a. Generic environmental education content about waterways, wetlands and stormwater systems in Christchurch.
b. Targeted actions, including monitoring and restoration activities, on a local waterway close to the school.

## 11.7 ICMP EDUCATION PLANS

*Overview: Increase understanding of the ICMPs. These education plans will target industry, developers, and residents in the ICMP area.*

This plan will focus more around the issues specific to the ICMP area, stormwater management in the area and what the ICMP means for residents, businesses and developers.

The education plans indicated will not operate in isolation. They will be managed in a manner which will complement one another, and each will be designed to provide opportunities for increasing community engagement.

The table below summarises the community education Implementation Programme.

The Council will:

- Work with ECan to develop an education plan for raising general awareness of surface water issues, and the management and actions that can be taken in the community.
- Develop education plans for ICMP areas.
- Develop an equitable funding process for community groups involved in surface water management.
- Work with ECan to develop an education plan for schools, building on existing programmes.

Table 11.1 Implementation Programme: Community Education

| **Short-term (0-3 yrs)** | | **Medium-term (4-10 yrs)** | | **Long-term (10 plus yrs)** | |
|---|---|---|---|---|---|
| **Task** | **Approx. Cost** | **Task** | **Approx. Cost** | **Task** | **Approx. Cost** |
| **11.a** Develop education plan for general awareness campaign. | Within existing budgets | **11.o** Develop an equitable funding process for community groups. | Within existing budgets | **11. j** Develop education plan for Sumner ICMP | Within existing budgets |
| **11.b** Develop education plan for South-west ICMP. | Additional funding required. | **11.p** Develop education plan for schools. | Additional funding required. | **11. k** Develop education plan for Lakes ICMP | Additional funding required. |
| **11.c** Develop education plan for Styx/Puharakekenui ICMP. | Additional funding required. | **11.e** Develop education plan for Avon ICMP | Additional funding required. | **11. l** Develop education plan for Southern Bays ICMP | Additional funding required. |
| **11.d** Develop education plan for Heathcote ICMP. | Additional funding required. | **11.f** Develop education plan for Estuary ICMP | Additional funding required. | **11.m** Develop education plan for Northern&Eastern Bays ICMP | Additional funding required. |
| | | **11.g** Develop education plan for Coastal ICMP | Additional funding required. | **11.n** Develop education plan for Outer Christchurch ICMP | |
| | | **11.h** Develop education plan for Akaroa ICMP. | Additional funding required. | | |
| | | **11.i** Develop education plan for Lyttelton ICMP | Additional funding required. | | |

FIGURE 11.1: EXAMPLE BILLBOARD FROM GENERAL AWARENESS CAMPAIGN.

# 12

# Investigations

The development of the Strategy has highlighted fresh questions and areas where information and knowledge could be improved. A research programme that identifies and prioritises research/information/modelling work will inform the Council's decision-making and support the review and continuing improvement of the Strategy.

The projects listed in Table 12.1 below were identified during the development of the Strategy. These are in addition to investigations required to develop ICMPs (which are included in the estimated cost of ICMP discussed in Section 8). The priority assigned to them reflects how well they support the Strategy's goals and their impact on the Council's decision-making. Table 12.2 summarises the Council's proposed timeframe to implement the further investigative work needed.

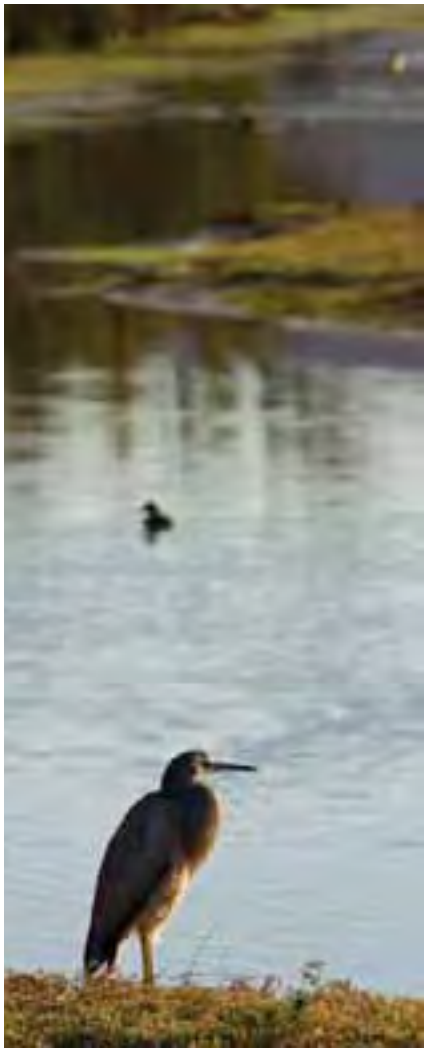


PHOTO: WHITE-FACED HERON

Table 12.1 Suggested investigations

| Project | Strategy goal alignment | Council Decision(s) it will inform | Links with other Council work | Priority |
|---|---|---|---|---|
| Identifying the source of E.coli in waterways. | Goal 1 ( water quality)<br>Goal 4 (Ngāi Tahu)<br>Goal 5 (recreation) | Where Council's resources are best spent to reduce E.coli. | ICMP programme<br>Wastewater upgrades | High |
| Investigate effect of climate change on intensity of rainfall in Christchurch. | Goal 2 (flood risk) | What Council needs to do to prepare for climate change. | Climate Smart Implementation Plan | High |
| Investigate the rates of stormwater runoff from urban catchments. | Goal 2 (flood risk) | Advance planning for where and when new stormwater infrastructure needed. | Strategic Intensification Review | Medium |
| Identify dysfunctional riparian and aquatic ecosystems. | Goal 3 (ecosystem health) | Where Council's resources are best spent to improve ecosystem health. | Biodiversity Strategy | Medium |

PHOTO: PIED STILTS AND SWANS, LAKE ELLESMERE / TE WAIHORA

The cost to the Council could be reduced by working with other stakeholders where appropriate. Environment Canterbury will be a key partner in this research. Co-ordination and collaboration will be necessary to ensure that efforts are not duplicated and that public funds are appropriately used towards the best possible outcome.

The Council will:

- Investigate the sources of *E.coli* in waterways.
- Investigate the effect of climate change on rainfall intensity.
- Investigate the rates of run-off.
- Identify dysfunctional riparian and aquatic ecosystems.

Table 12.2 Implementation Programme: Investigations

| **Short-term (0-3 yrs)** | | **Medium-term (4-10 yrs)** | | **Long-term (10 plus yrs)** | |
|---|---|---|---|---|---|
| **Task** | **Approx. Cost** | **Task** | **Approx. Cost** | **Task** | **Approx. Cost** |
| **12.a** Investigate the sources of E.coli in waterways. | Within existing budgets. | - | - | - | - |
| **12.c** Investigate the effect of climate change on rainfall intensity. | Within existing budgets. | | | | |
| **12.d** Investigate the rates of stormwater run-off. | Within existing budgets. | | | | |
| **12.e** Identify dysfunctional riparian and aquatic ecosystems. | Within existing budgets. | | | | |

# 13

# Implementation Plan

## 13.1 TIMEFRAMES AND RESPONSIBILITIES

The adoption of the Strategy is the first step towards improving the state of Christchurch's surface water resources. Its implementation now requires commitment from Elected Members, Council staff and the community. Table 13.1 summarises the actions identified in the previous sections 7 – 12. It gives an indication of the overall cost of implementing the Strategy and shows how this cost is spread over the next ten or more years.

PHOTO:
UPPER BROOKLANDS LAGOON

## 13.2 WORKING WITH OTHERS

The Council will work with Ngāi Tahu, as kaitiaki, in implementing the Surface Water Strategy. Working with Ngāi Tahu, ECan and other key stakeholders will be essential to the successful implementation of the Strategy. Te Rūnanga o Ngāi Tahu (TRONT), the relevant Papatipu Rūnanga and ECan should be involved in the implementation of tasks identified, particularly the development of ICMPs. Other stakeholders, such as those identified in Appendix A, should be kept informed of progress and consulted with on relevant projects as they are undertaken. Cooperation and collaboration between stakeholders will enable the Strategy to be implemented in the most efficient manner, avoiding duplication of effort and fostering innovative solutions to issues.

Table 13.1. Implementation Plan for the Surface Water Strategy

| | Task # | Task | Outputs | Implementation Programme | Strategy Goals | Lead Responsibility | Priority | Approximate Cost | Links with other work |
|---|---|---|---|---|---|---|---|---|---|
| **Short-term (0 – 3 years)** | | | | | | | | | |
| Specific projects | 7.a | Further investigate options for stormwater management in intensification areas. | Report recommending how Council should manage stormwater in these areas. | Stormwater policy | Goal 1 (water quality)<br>Goal 2 (flood risk) | Strategy & Planning | High | Within existing budgets. | UDS<br>ICMP Programme |
| | 8.n | Revise Planning and Consents Protocol. | Updated Protocol. | ICMP development | - | Strategy & Planning | Medium | Within existing budgets. | ICMP Programme |
| | 8.a | South-west ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | High | Within existing budgets. | SW Area Plan<br>UDS |
| | 8.b | Styx/Puharakekenui ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | High | Within existing budgets. | Belfast Area Plan<br>UDS |
| | 8.c | Lower Heathcote River ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | High | Within existing budgets. | UDS |
| | 9.a | Define high and moderate risk flood areas. | Report and maps identifying high and medium risk flood areas. | Reviewing development standards | Goal 2 | Strategy & Planning | High | Within existing budgets. | City Plan Programme<br>UDS |
| | 9.b | Review City Plan land-use controls in high and moderate flood risk areas. | Report to Council recommending changes to the City Plan to control land-use in high and medium flood risk areas. | Reviewing development standards | Goal 2 | Strategy & Planning | High | Within existing budgets. | City Plan Programme<br>UDS |
| | 9.c | Review City and District Plans and IDS provisions for development in Greenfield and urban intensification areas. | Report identifying opportunities for improving surface water management in Greenfield and urban intensification areas in the City Plan. | Reviewing development standards | Goal 2 | Strategy & Planning | High | Within existing budgets. | City Plan Programme<br>IDS Review |
| | 9.d | Prepare any plan changes identified by review. | Plan change notified. | Reviewing development standards | Goal 2 | Strategy & Planning | High | Within existing budgets. | City Plan Programme<br>IDS Review |
| | 10.a | Review pollutants used by Council and identify opportunities for improvement. | Report on pollutants Council uses and options for reducing. | Minimising sources of pollution | Goal 1 (water quality)<br>Goal 3 (ecosystem) | City Environment | Low | Within existing budgets. | - |

| Table 13.1. Implementation Plan for the Surface Water Strategy | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Task #** | **Task** | **Outputs** | **Implementation Programme** | **Strategy Goals** | **Lead Responsibility** | **Priority** | **Approximate Cost** | **Links with other work** |
| | 10.b | Implement findings of pollutant review. (10.a) | As identified by review. | Minimising sources of pollution | Goal 1 (water quality)<br>Goal 3 (ecosystem) | City Environment | Low | Within existing budgets. | - |
| | 12.a | Investigate the sources of *E.coli* in waterways. | Series of reports on the source of *E.coli.* | Investigations | Goal 1 (water quality)<br>Goal 3 (ecosystem health)<br>Goal 4 (Ngāi Tahu values)<br>Goal 5 (Recreation). | City Environment | High | Within existing budgets. | ICMPs |
| | 12.c | Investigate the effect of climate change on rainfall intensity. | Report on effect of climate change on rainfall intensity. | Investigations | Goal 2 (flood risk) | City Environment | High | Within existing budgets. | ICMPs<br>UDS<br>Climate Smart Strategy |
| | 12.d | Investigate the rates of stormwater runoff from urban catchments. | Report comparing stormwater run-off in different urban zones. | Advance planning for where and when new stormwater infrastructure needed | Goal 2 (flood risk) | City Environment | Medium | Within existing budgets. | UDS |
| | 12.e | Identify dysfunctional riparian and aquatic ecosystems. | Report identifying dysfunctional ecosystems in Christchurch. | Where Council's resources are best spent to improve ecosystem health. | Goal 3 (ecosystem health) | City Environment | Medium | Within existing funding | Biodiversity Strategy |
| | 11.a. | Develop education plans for key audiences. | Education plans complete. | Community Education | Goals 1 - 8 | City Environment | High | Within existing funding | - |
| Ongoing | 7.c | Build and manage stormwater network in line with Policies. | Stormwater designed to support strategy goals. | Stormwater policy | Goals 1 - 7 | Capital Programme | Medium | Within existing budgets. | - |
| | 10.c | Advocate to central government where opportunities arise for the reduction of pollutants. | | Minimising sources of pollution | Goal 1 (water quality)<br>Goal 3 (ecosystem) | City Environment | Low | Within existing budgets. | - |
| | | | | | Total additional expenditure required: | | | None, all within existing budgets | |

Table 13.1. Implementation Plan for the Surface Water Strategy

| | Task # | Task | Outputs | Implementation Programme | Strategy Goals | Lead Responsibility | Priority | Approximate Cost | Links with other work |
|---|---|---|---|---|---|---|---|---|---|
| **Medium-term (4 – 10 years)** | | | | | | | | | |
| Specific projects | 7.b | Implement recommendations from intensification options investigation (8.a). | Capacity of stormwater infrastructure meets demand from development. | Stormwater policy | Goal 1 (water quality)<br>Goal 2 (flood risk) | City Environment Capital Programme | High | Dependent on outcome of 8.a | UDS<br>ICMP Programme |
| | 8.d | Avon River ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | High | Total cost approx: $500,000<br>$280,000 within existing budgets<br>Additional $220,000 needed | UDS |
| | 8.e | Estuary ICMP developed. | ICMP completed (but not consented) | ICMP development | Goals 1 – 7. | City Environment | High | Total cost approx: $500,000<br>$280,000 within existing budgets<br>Additional $220,000 needed | - |
| | 8.f | Coastal ICMP developed. | ICMP completed (but not consented) | ICMP development | Goals 1 – 7. | City Environment | High | Total cost approx: $500,000<br>$280,000 within existing budgets<br>Additional $220,000 needed | - |
| | 8.g | Akaroa ICMP developed. | ICMP completed (but not consented) | ICMP development | Goals 1 – 7. | City Environment | High | Total cost approx: $500,000<br>$280,000 within existing budgets<br>Additional $220,000 needed | Akaroa Settlements Study |
| | 8.h | Lyttelton ICMP developed. | ICMP completed (but not consented) | ICMP development | Goals 1 – 7. | City Environment | High | Total cost approx: $500,000<br>$280,000 within existing budgets<br>Additional $220,000 needed | - |

| Table 13.1. Implementation Plan for the Surface Water Strategy | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Task #** | **Task** | **Outputs** | **Implementation Programme** | **Strategy Goals** | **Lead Responsibility** | **Priority** | **Approximate Cost** | **Links with other work** |
| | | Implement findings of report on pollutants Council uses (7.a). | Reduction in Council use of pollutants. | Minimising sources of pollution | Goal 1 (water quality) | City Environment | Low | Dependent on outcome of 7.a. | |
| | 12.b | Map springs on Banks Peninsula . | Banks Peninsula springs mapped and available in GIS. | Investigations | Goal 1 | City Environment | Low | $75,000 | - |
| Ongoing | 7.c | Build and manage stormwater in line with Policies. | Stormwater designed to support strategy goals. | Stormwater policy | Goals 1 - 7 | City Environment Capital Programme | Medium | Within existing budgets. | - |
| | 10.c | Advocate to central government where opportunities arise for the reduction of pollutants. | - | Minimising sources of pollution | Goal 1 (water quality) Goal 3 (ecosystem) | City Environment | Low | Within existing budgets. | - |
| | | | | | Total additional expenditure required: | | | $1,175,000 | |
| **Long-term (10 plus years)** | | | | | | | | | |
| Specific projects | 8.i | Sumner/Redcliffs ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | High | $250,000 | - |
| | 8.j | Lakes ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | High | $250,000 | - |
| | 8.k | Southern Bays ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | Medium | $250,000 | - |
| | 8.l | Northern & Eastern Bays ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | Medium | $250,000 | - |
| | 8.m | Outer Christchurch ICMP developed. | ICMP completed (but not consented). | ICMP development | Goals 1 – 7. | City Environment | Medium | $250,000 | - |
| Ongoing | 7.c | Build and manage stormwater in line with Policies. | Stormwater designed to support strategy goals. | Stormwater policy | Goals 1 - 7 | Capital Programme | Medium | Within existing budgets. | - |
| | 10.c | Advocate to central government where opportunities arise for the reduction of pollutants. | - | Minimising sources of pollution | Goal 1 (water quality) Goal 3 (ecosystem) | City Environment | Low | Within existing budgets. | - |
| | | | | | Total additional expenditure required: | | | $1,250,000 | |

## 13.3 FUNDING AND INTERACTION WITH THE LONG TERM COUNCIL COMMUNITY PLAN (LTCCP)

The full costs of implementing the Strategy are dependent on the implications and outcomes of the further investigations and ICMPs outlined in the Implementation programme. The extent to which the implementation programme is funded will depend on decisions made in the LTCCP process. The LGA 2002 requires the Council to prepare, consult and adopt an LTCCP which is reviewed every three years. In the intervening two years the Council can adopt changes to the LTCCP in Annual Plans. The LTCCP process determines the level of services and their cost that the Council will provide for the community. It is through this process that the implementation projects identified in this Strategy will be balanced against other Council projects and services. The next LTCCP review in 2012 will need to consider the medium and long-term projects identified. Some timings and funding may change, but the Strategy will remain as a clear Council commitment to achieving the goals and objectives stated. The figure below shows the links between the LGA 2002, Council Strategic Planning and the LTCCP.

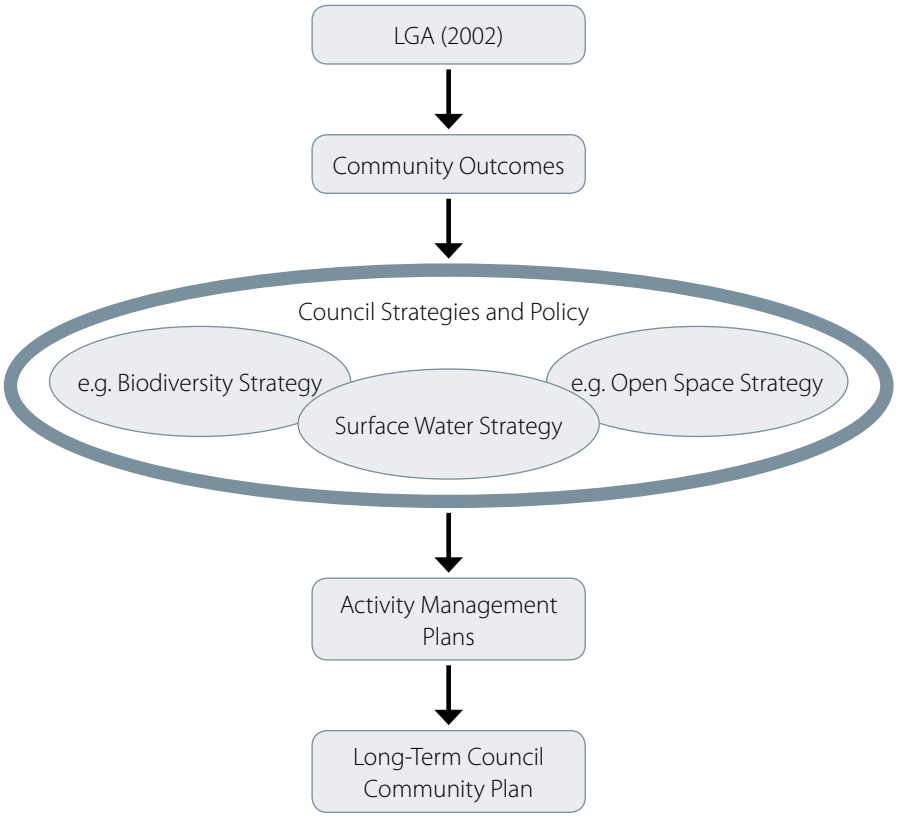



FIGURE 13.1 CONNECTIONS BETWEEN THE LGA 2002, COUNCIL STRATEGIC PLANNING, AND THE LTCCP

## 13.4 MONITORING

The effectiveness of the Strategy will be monitored through four key programmes:

a. **State of the Environment Monitoring Programme**
   This Council monitoring programme aims to detect changes in environmental quality, including surface water resources.

b. **Annual Report**
   The Council's Annual Report shows how the Council is delivering on the outcomes agreed in the LTCCP. It includes Council activities with regard to waterways and land drainage activities.

c. **State of the Takiwā**
   The State of the Takiwā is a culturally based monitoring and reporting system prepared and conducted by TRONT. It assesses the contemporary cultural health of natural resources, including surface water resources.

d. **Community Monitoring**
   The Council's Community Outcomes Report, Annual Resident's Survey and Environment Canterbury's Urban Waterways Community survey assess various aspects of community engagement and satisfaction with Council services.

## 13.5 REVIEW

The Strategy is intended to be a 'living document' that can be adjusted in the face of additional information. The implementation plan should be reviewed annually. This annual review should include a summary of what has been progressed in the previous year, and an assessment of whether changes to current methods are needed. The whole Strategy should be reviewed on a five-yearly basis. The full review should include analysis of monitoring trends and discussion of what has been achieved. The first full review is scheduled for 2014 and is expected to correspond with the five-yearly review of the Water Supply Strategy and completion of a proposed Wastewater Strategy, thus allowing for a 'three waters' approach.

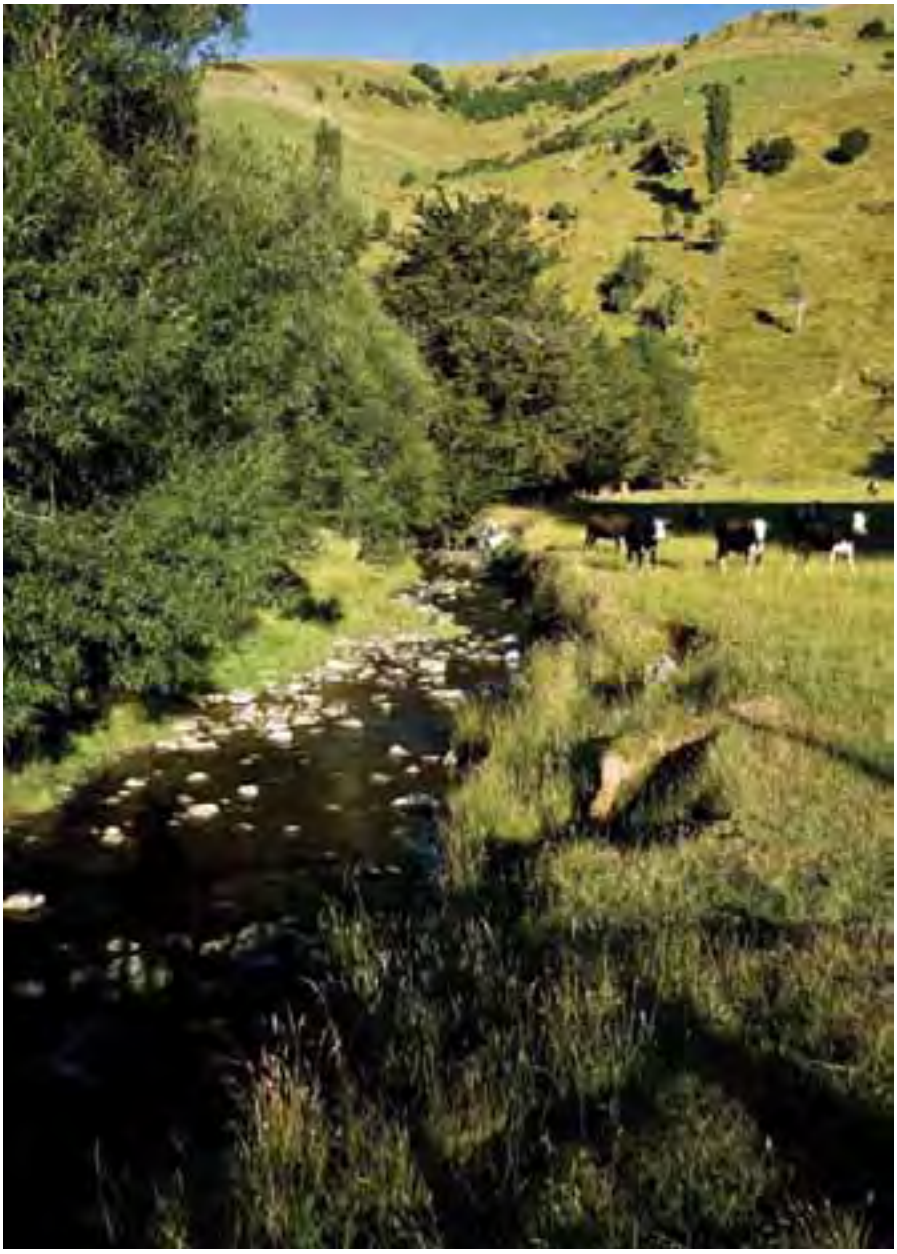


PHOTO: STREAM THROUGH RURAL FARMLAND ON BANKS PENINSULA

## GLOSSARY

**Collective stormwater management**
Collective stormwater management describes where stormwater from several properties or lots is treated together.

**Ephemeral streams/tributaries**
Ephemeral streams or tributaries are transitory, or short-lived, and usually only flow after periods of rainfall.

**Eutrophication** Eutrophication is an increase in chemical nutrients — compounds containing nitrogen or phosphorus — in an ecosystem. The term is often used to mean the resultant increase in the ecosystem's primary productivity (excessive plant growth and decay), and further effects including lack of oxygen and severe reductions in water quality, fish, and other animal populations.

**Impervious surfaces** Impervious surfaces are surfaces that do not allow water to soak through the material to the soil or substrate beneath.

**Inanga** Whitebait.

**Iwi** Tribe.

**Kaitiakitanga** Stewardship.

**Kanakana** Lamprey.

**Level of Service** The services the Council provides the community as set out in the Long-Term Council Community Plan.

**Living 2, 3, and 4 zones**
The City Plan divides residential areas into a series of 'living' zones. Each zone has different rules governing development in the zone. In general Living 2 is the least dense, and Living 4 the most dense residential development.

**Loess Soil** A light-coloured, fine-grained accumulation of clay and silt deposited by the wind.

**Macrophytes** A macrophyte is an aquatic plant that grows in or near water and is either emergent, submergent, or floating. Macrophytes provide cover for fish and substrate for aquatic invertebrates, produce oxygen, and act as food for some fish and wildlife.

**Mahinga kai** Areas from which food is harvested.

**Multi-value stormwater management/low impact urban design and development (LIUDD)**
Multi- value stormwater management describes stormwater mechanisms (see below) that have more than one outcome (e.g. they improve water quality as well as dealing with stormwater quantity).

**Mauri** Essential life force.

**On-site stormwater management**
On-site stormwater management describes a system where stormwater is treated/detained on the property on which it is generated.

**Paraki** Smelt.

**Papatūānuku** Earth mother.

**Point-source and non-point-sources of pollution**
Water pollution affecting a water body from diffuse sources, such as polluted runoff from agricultural areas draining into a river. A point source of pollution is a single, identifiable, localized source of water pollution, for example stormwater pipe discharging into a river.

**Puna** Springs.

**Raupō** Bulrush.

**Ranginui** Sky father.

**Sedimentation** Sedimentation is the tendency for particles in suspension to settle out of the water in which they are flowing and build up on the beds and margins of waterways.

**Stormwater retention and detention**
Holding back the flow of stormwater to reduce flooding.

**Stormwater management**
: General term describing the deliberate manipulation of stormwater to mitigate its effects which can include both detention and treatment.

**Stormwater mechanisms**
: Stormwater mechanisms include the wide variety of devices and methods that are used to mitigate the effects of stormwater run-off, mostly from urban development.

**Stormwater treatment**
: Improving the quality of stormwater.

**Surface Water**
: For the purposes of this Strategy surface water is defined as all freshwater above ground – stormwater, springs, rivers, streams, lakes and associated wetlands. It excludes groundwater and the sea.

**Tangata tiaki**
: Guardians.

**Tangata whenua**
: People of the land.

**Treatment trains**
: Stormwater is usually managed with a series of detention and treatment mechanisms. The stormwater flows down the 'treatment train' before being discharged into waterways.

**Tuna**
: Eels.

**Tūpuna**
: Ancestors.

**Whakapapa**
: Geneaology.

**Wāhi tapu**
: Sacred sites.

**Wāhi taonga**
: Treasured sites.

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## APPENDIX A
**EXTERNAL STAKEHOLDERS**

Avon-Heathcote Estuary Ihutai Trust
Banks Peninsula Conservation Trust
Canterbury District Health Board
Department of Conservation
Environment Canterbury
North Canterbury Federated Farmers
Ministry for the Environment
North Canterbury Fish & Game
Waihora Ellesmere Trust
Styx/Puharakekenui Living Laboratory Trust
Mahaanui Kurataiao Limited
Te Rūnanga o Ngāi Tahu
Travis Wetland Trust

## APPENDIX B

**THE CURRENT POLICY AND PLANNING FRAMEWORK**

| The policy & planning framework for surface water. | | |
|---|---|---|
| Statutory | | Non-Statutory |
| National | Biosecurity Act (1993)<br>Building Act (2004)<br>Civil Defence and Emergency Management Act (2002)<br>Conservation Act (1986)<br>Hazardous Substances and New Organisms Act (1996)<br>Health Act (1956)<br>Historic Places Trust Act (1954)<br>Local Government Act (2002)<br>New Zealand Walkways Act (1990)<br>Public Works Act (1981)<br>Queen Elizabeth II National Trust Act (1977)<br>Resource Management Act (1991)<br>Reserves Act (1977)<br>Soil Conservation and Rivers Control Act (1941)<br>Sport and Recreation New Zealand Act (2002)<br>Treaty of Waitangi | New Zealand Biodiversity Strategy<br>Sustainable Development Action Plan<br>Walking Access New Zealand<br>Climate Change Policy |
| Regional | Land and Vegetation Management Regional Plan: Part II (1997)<br>Proposed Natural Resources Regional Plan<br>Regional Policy Statement (1998, currently under review) | Erosion and Sediment Control Guidelines (2007)<br>Greater Christchurch Urban Development Strategy (2007)<br>Living Streams Programme<br>Pollution Prevention Guide<br>Regional Pest Management Strategy (2005)<br>Regional Biodiversity Strategy<br>Te Rūnanga o Ngāi Tahu Freshwater Policy (2001)<br>Te Whakatau Kaupapa (1990) |
| Local | Integrated Catchment Management Plan for South-west Christchurch (draft)<br>Christchurch City Plan (2005)<br>Proposed Banks Peninsula District Plan | Avon River River Floodplain Management Strategy (draft, 2000)<br>Heathcote River River Floodplain Management Strategy (1998)<br>Ihutai Management Plan (2004)<br>Infrastructure Design Standards (draft)<br>Te Taumutu Runanaga Natural Resources Management Plan (2003)<br>Vision 2000 – 2040 The Styx/Puharakekenui<br>Waterways and Wetlands Natural Asset Management Strategy (1999)<br>Waterways, Wetlands and Drainage Guide (2003)<br>Waterways and Land Drainage Asset Management Plan (2006)<br>Lake Ellesmere / Te Waihora Community Strategy |

## APPENDIX C

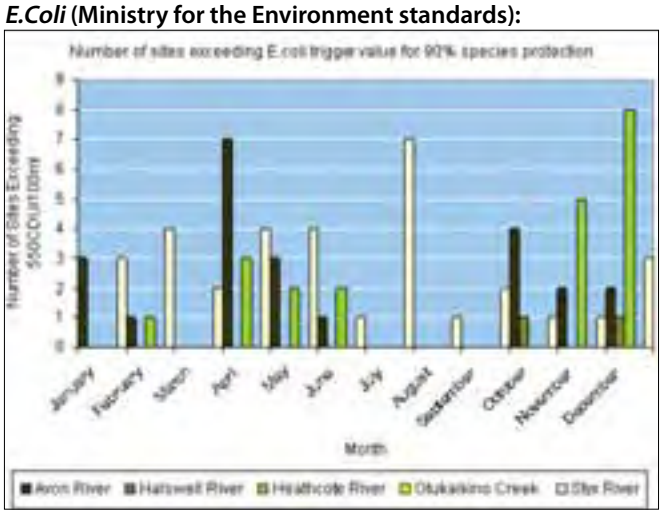
**THE ROLES OF ORGANISATIONS INVOLVED IN SURFACE WATER MANAGEMENT**

| Organisations involved with surface water in Christchurch | | |
|---|---|---|
| | Organisation | Role |
| National | Department of Conservation (DoC) | DoC is responsible for the conservation of New Zealand's natural and historic heritage, for the benefit of present and future New Zealanders. It manages marine and terrestrial reserves and advocates for the conservation of natural and cultural resources. |
| | Ministry for Environment (MfE) | MfE provides leadership on environmental sustainability across central and local government, and the community. The Ministry has specific RMA functions which include: the issue of national policy statements; environmental standards; and water conservation orders. |
| | Historic Places Trust (HPT) | The HPT is a charitable trust established by an Act of Parliament in 1954. The Trust's mission is to promote the identification, protection, preservation and conservation of the historical and cultural heritage of New Zealand. |
| | Sport and Recreation New Zealand (SPARC) | SPARC is the crown entity responsible for sport & recreation in New Zealand. SPARC leads research and development, and the implementation of policies that recognise the importance of sport and physical recreation in New Zealand. |
| | Transit New Zealand | Transit is the crown entity responsible for state highways. |
| | Ministry of Culture and Heritage | The Ministry for Culture and Heritage provides advice to the New Zealand government on culture and heritage matters. It assists government in its provision and management of cultural resources for the benefit of all New Zealanders, and undertakes a number of activities that support and promote the history and heritage of New Zealand. |
| Regional | Environment Canterbury (ECan) | The role of ECan is to promote the sustainable management of natural and physical resources, primarily under the RMA (1991), including the preparation of a Regional Policy Statement, National Resources Regional Plan, and a Regional Coastal Plan. These Statements and Plans directly impact surface water in Christchurch. |
| | Canterbury District Health Board (CDHB) | Responsible for providing Government funded health care services for Canterbury, including improving, promoting and protecting the health of communities. Surface water directly affects community health. |
| | Te Rūnanga o Ngāi Tahu (TRONT) | TRONT is the organisation, established by the Te Rūnanga o Ngāi Tahu Act (1996), that services the Ngāi Tahu iwi's statutory rights. It has an important role in surface water– as a landowner and through it's commitment to the sustainable use of natural resources, reflecting Ngāi Tahu values. |
| | Sport Canterbury | Sport Canterbury is responsible for sport development, physical activity programmes, education and events in Canterbury. Some of these are dependent on surface waterways. |
| Local | Christchurch City Council (The Council) | The Council has a central role in the planning, provision and maintenance of surface water in Christchurch. Through managing the City's stormwater network, and land-use planning that directly affect s surface water. |
| | Maahanui Kurataiao Limited (MKT) | MKT represents the six Ngāi Tahu Rūnanga within the Christchurch territory. A Memorandum of Understanding (MoU) formalises how the Rūnanga, represented by MKT, can participate in CCC decision-making processes, and the preparation of strategies such as the Surface Water Strategy. |
| | Community Organisations | Community groups / organisations, play an important part in the management of surface water throughout Christchurch, particularly on the Peninsula. Some examples are:<br>Te Waihora / Lake Ellesmere Trust;<br>Ihutai (Avon -Heathcote Estuary) Trust;<br>Styx/Puharakekenui Living Laboratory Trust;<br>Banks Peninsula Conservation Trust;<br>Lyttelton Harbour Issues Group;<br>Federated Farmers. |

## APPENDIX D

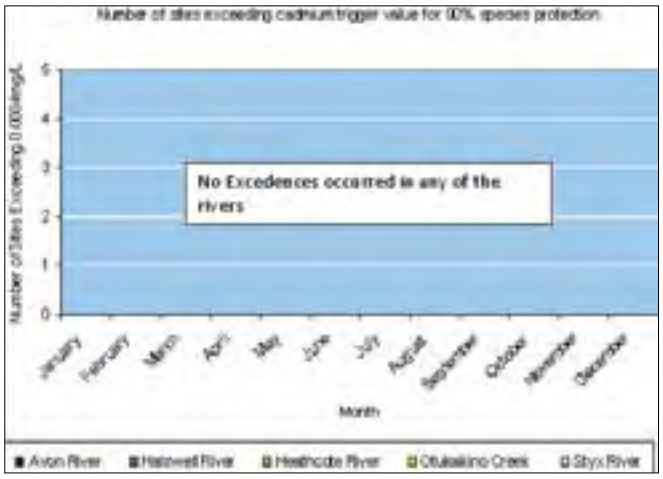
### 2008 WATER QUALITY DATA FOR THE MAIN CITY RIVERS

***E.Coli* (Ministry for the Environment standards):**

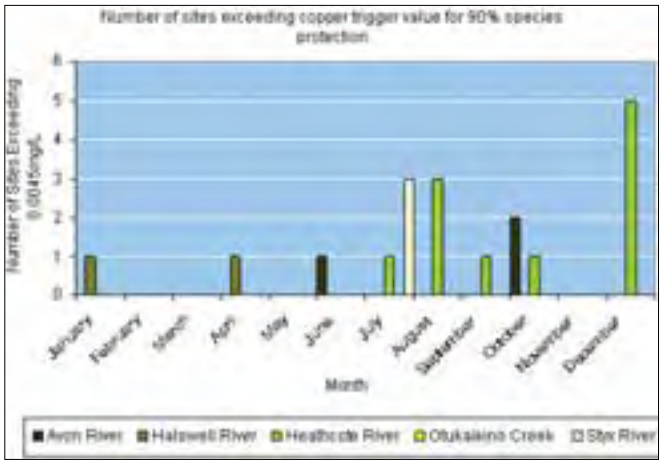



The following monitoring data are compared against ANZECC (2000) standards.

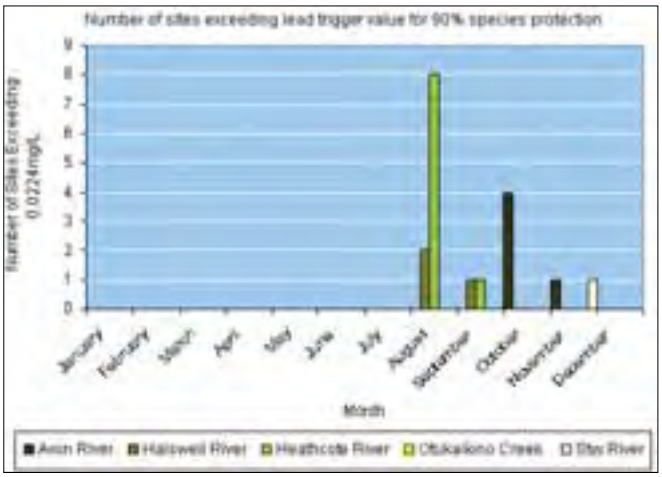
**Cadmium:**



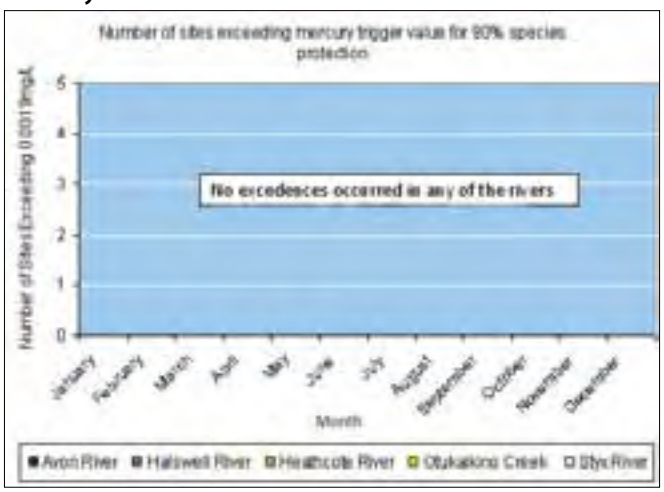

**Copper:**



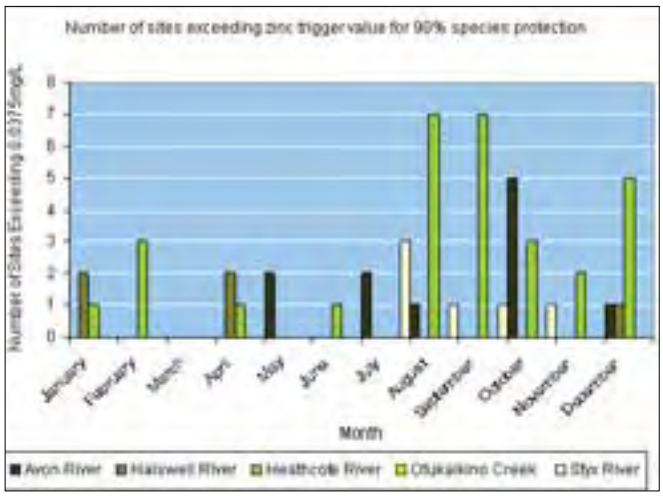

**Lead:**




**Mercury:**




**Zinc:**



## APPENDIX E: PREFERRED STORMWATER MECHANISMS

**Preferred mechanisms**

A list of preferred surface water management mechanisms has been provided in relation to each of the area types presented in the Strategy. Preferred mechanisms have been identified using a multicriteria analysis whereby each mechanism is given a score indicating the extent to which it supports a range of values (including flood hazard mitigation, water quality, biodiversity, landscape, recreation, heritage, Ngāi Tahu and capital and operation and expenditure). Scores have been weighted to reflect the perceived significance of each value and subjected to an internal review process. The outcome of the analysis and other available information has been used to determine a list of preferred surface water management mechanisms for each area type. Twenty-one commonly occurring surface water management mechanisms have been assessed, ranging from conventional approaches, such as pipes and stop banks, to water-sensitive and shared-responsibility measures, such as swales and rainwater tanks. Mechanisms are presented in this summary from most preferred to least preferred in descending order. Below, is an example of a multi-criteria analysis matrix used to assess surface water management mechanisms (for example dentention ponds) against a range of significant values.

**Example of a multi-criteria analysis matrix used to assess surface water management mechanisms**

| Well beings | Environmental | | | | Social and cultural | | | Economic | | **Total Score** |
|---|---|---|---|---|---|---|---|---|---|---|
| Surface water values | Flood hazard mitigation | Water quality | Biodiversity | Landscape | Recreation | Heritage | Ngāi Tahu | Cap Ex | Op Ex | |
| Raw score | 100 | 100 | 100 | 100 | 50 | 100 | 100 | 0 | 0 | |
| Weighting | 0.275 | 0.275 | 0.131 | 0.079 | 0.057 | 0.06 | 0.054 | 0.016 | 0.054 | |
| Final score | 27.5 | 27.5 | 13.1 | 7.9 | 2.85 | 6 | 5.4 | 0 | 0 | **90.25** |

**Urban intensification areas**

| **Preferred mechanisms** | **Rationale** |
|---|---|
| Riparian planting and buffer zones | Provides significant protection of water quality within the margins of existing waterways. Supports multiple values. |
| Rain gardens | Compact form of stormwater management. Supports multiple values. |
| Green roofs | Easier to achieve at the time of intensification and new development. Provides onsite stormwater management. |
| Porous paving | Useful approach for parking lots and driveways in built-up areas. |
| Concrete channels and sumps | Provides current surface water management service in built up areas. |
| Sand filters | Useful in confined spaces that cannot support vegetation. |
| Infiltration measures | Relatively compact stormwater management mechanism. |
| Bank protection | Provides protection from flood hazard within the margins of waterways. |
| Litter/debris traps | Provides efficient protection of water quality in built up areas. |
| Rainwater tanks | Provides onsite retention and reuse of stormwater. |
| Flood gates and flap valves | Provides in stream protection from flood hazards |
| Stormwater piping | Provides current surface water management service in built up areas. |
| Pumping stations | Provides compact protection from flood hazards. |
| Proprietary systems | May provide (depending on system) water quality treatment and quantity management, but does not support any other values. Some systems may be useful on small sites and space-limited areas where there is not enough land for other alternatives. |

**Greenfield development areas**

| Preferred mechanisms | Rationale |
|---|---|
| Riparian planting and buffer zones<br>Constructed wetlands<br>Open space provision | Sufficient land is usually available to provide for large-scale, water-sensitive approaches. Support for multiple values. |
| Detention areas | Sufficient land is usually available in new developments to provide water-sensitive approaches. Supports multiple values. |
| Rain gardens | Relatively low cost of installation. Easy to install at the time of building and development. Supports multiple values. |
| Swales and filter strips | Sufficient land is usually available in new developments to provide water-sensitive approaches. |
| Porous Paving | Appropriate for new driveways and quiet lanes that experience light traffic flows in Greenfield areas. |
| Green roofs | Significantly easier to install at the time of building and development, rather than as a retrofit. |
| Infiltration measures | May be appropriate for Greenfield areas where there are space constraints. It is a relatively compact mechanism that is easily applied at street and lot level. |
| Rainwater tanks | Relatively low cost and easy to install at the time of development. |
| Subsoil drainage | Useful means to remove water retained in new open space areas. |


**Existing suburbs**

| Preferred mechanisms | Rationale |
|---|---|
| Riparian planting and buffer zones | There are opportunities in existing suburbs to increase native plantings around waterways for the purposes of improving the quality of surface water runoff. Supports multiple values. |
| Rain gardens | Relatively low cost of installation. Compact and fits well with existing plantings and urban design. Supports multiple values. |
| Swales and filter strips | Appropriate for the retrofit of existing channels and pipes in rural areas. Supports multiple values. |
| Porous paving | Porous paving can be used to replace footpath paving and driveway materials as required, which will increase soakage to ground and reduce stormwater runoff. |
| Channels and sumps | Provides an existing and effective flood mitigation function in suburban areas. |
| Infiltration measures | Relatively compact mechanism that can easily be applied at street or lot level. |
| Bank protection | Provides erosion protection in areas where housing encroaches on the waterway margin. Can reflect a range of values if properly designed. |
| Litter/debris traps | Low cost means for maintaining water quality in existing suburbs and keeping children away from stormwater drains. |
| Rainwater tanks | Relatively low cost mechanism and easy to install in relation to existing housing. |
| Floodgates and flap valves<br>Land/house raising | Currently provides in-stream protection from flood hazards in a number of suburban areas. Viable means for reducing the risk of flood damage in areas where homes and other buildings are already established. |
| Stormwater piping | Provides an existing and effective flood mitigation function in existing suburbs. |
| Subsoil drains | Provides a solution for water ponding in existing open space areas that are surrounded by development. |
| Pumping stations<br>Stop banks | Provides an existing flood protection service to suburbs in the north of Christchurch. Likely to become increasingly important to offset the effects of sea level rise in low lying suburbs. |

**Industrial and business areas**

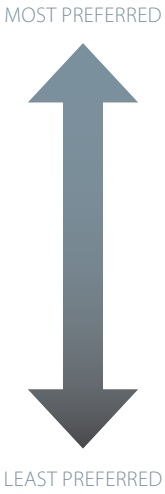
| Preferred mechanisms | Rationale |
|---|---|
| Riparian planting and buffer zones | Riparian planting and buffer zones can provide significant filtration of stormwater runoff and reduce pollution from industrial and business areas. Supports multiple values. |
| Rain gardens | Low cost and compact mechanism for the retention and reuse of stormwater in industrial and business areas. Supports multiple values. |
| Swales and filter strips | Appropriate for the retrofit of existing channels and pipes in industrial and business areas. |
| Green roofs | Due to the large impervious surface area in industrial and business areas, green roofs provide a means for the onsite retention and reuse of surface water. |
| Channels and sumps | Provides current surface water management service in industrial and business areas. |
| Sand filters | Useful in confined spaces that cannot normally support vegetation. |
| Infiltration measures | Useful approach for detaining stormwater and filtering pollution. This mechanism is also compact and can be installed at street or lot level. |
| Bank protection | Provides protection from flood hazards within the margins of waterways and is, therefore, a relatively compact means of surface water management. |
| Litter and debris traps | Provides efficient protection of water quality in industrial and business areas. |
| Oil and water separators | Appropriate surface water management mechanism in areas that have significant contaminant generation, such as industrial areas. |
| Rainwater tanks | Due to the large impervious surface area in industrial and business areas, rainwater tanks provide a means for the onsite retention of surface water. |
| Land raising/house raising | This may be an appropriate mechanism for land owners to take to protect existing property from flood damage in industrial and business areas. |
| Stormwater piping | Provides current surface water management service in industrial and business areas. |

**Small settlements**

| Preferred mechanisms | Rationale |
|---|---|
| Riparian planting and buffer zones | Riparian planting and buffer zones can provide significant filtration of stormwater runoff to waterways and slow the flow of water. Supports multiple values. |
| Porous paving | Porous paving can be used to replace footpath paving and driveway materials as required, which will increase soakage to ground and reduce stormwater runoff. |
| Channels and sumps | Provides an existing and effective flood mitigation function in residential areas. |
| Infiltration measures | Relatively compact mechanism for the detention and storage of surface water, which may be appropriate in low-lying settlements. |
| Bank protection | Provides erosion protection in areas where housing encroaches on the waterway margin. Can reflect a range of values if properly designed. |
| Litter and debris traps | Low-cost means for maintaining water quality in small settlements and keeping children away from stormwater drains. |
| Rainwater tanks | Relatively low-cost mechanism and easy to install in relation to existing housing. |
| Land raising/house raising | This may be a useful response to surface flooding or inundation associated sea level rise in low-lying, coastal areas. |
| Stormwater piping | Provides an existing and effective flood mitigation function in existing residential areas. |
| Subsoil drainage | Provides a solution for water ponding in low-lying, open space areas that are surrounded by development. |
| Pumping stations | This may be a useful response to surface flooding or inundation associated with sea level rise in low-lying, coastal areas. |


**Rural areas**

| Preferred mechanisms | Rationale |
|---|---|
| Riparian planting and buffer zones<br>Constructed wetlands | There is usually sufficient land available for a planted riparian margin, which is useful for keeping stock and effluent out of waterways. Rural areas also have sufficient land for the provision of constructed wetlands. |
| Detention areas | Sufficient land is usually available to provide water sensitive approaches, such as detention areas. |
| Swales and filter strips | Feasible approach to stormwater management in rural areas and an alternative to concrete channels, sumps and pipes. |
| Bank protection | Helps to protect waterway banks from erosion, which is a significant issue in rural areas. |
| Rainwater tanks | These have long been utilised to provide water for domestic needs in rural areas. |
| Stop banks | Provides current flood protection for rural land in the north of Christchurch. |



## APPENDIX F: INITIAL OPTIONS ASSESSMENT IN INTENSIFICATION AREAS

Options considered where future flows will exceed capacity are:

- Regulate to maintain high floor levels; allow stormwater to pond on streets and properties; no physical works;
- Upgrade the capacity of pipes and drains;
- Bypass under-capacity pipework by pumping;
- Detain stormwater on roads in swales or storage elements;
- Detain stormwater at source in private storage tanks ("rain tanks", etc);
- Detain stormwater in small, distributed ponding basins.

**Regulation Only**
Do not implement quantity mitigation measures. Rely on shallow and preferably widely distributed ponding (where this is possible) to store the proportion of storm events that cannot be accommodated by the stormwater network. Ensure houses are higher than anticipated flood levels.

Could be implemented where a catchment is particularly suitable. An ideal catchment would be flat, with streets lower than properties and houses built on high foundations.

| Positive | Negative | Points of Interest |
|---|---|---|
| Stormwater systems may cope better than expected, particularly with higher maintenance such as leaf clearing. | Would not meet the existing drainage level of service (LOS). LOS would need to be amended. | In many catchments the degree of ponding might not differ greatly from at present. |
| Low cost option. | | Could be implemented for some (suitable) catchments and not others. |

**Upgrade Pipe Capacity**
Install larger pipes and/or open drains as necessary.

| Positive | Negative | Points of Interest |
|---|---|---|
| Will maintain the existing drainage level of service. | Does not assist with stormwater quality improvement. | Could happen over many years as development occurs. |
| Upgrades should be able to be timed to match development contributions. | | Cost of growth would need to be predicted accurately for development contributions to be fully collected. |

**Detain stormwater on roads in swales or storage elements**
Replace kerb and channel with grassed swales that detain road and property stormwater runoff.

| Positive | Negative | Points of Interest |
|---|---|---|
| Should maintain the existing drainage level of service. | Makes access to properties more difficult. | Would introduce new and unfamiliar elements to streets. |
| Would assist with stormwater quality improvement. | Installation would need to coincide with road renewal (at the end of an 80 year road life cycle). | Other options such as rain tanks might be used while waiting for road renewal and swale installation. |
| | More grass for CCC to mow. | Would probably assist with stormwater quality improvement. |
| | CCC will need to oversee performance and maintenance . | Does not need to be in the same street as infill houses. |

**Private rain tanks**
Require new developments to install on-site storage in rain tanks.

| Positive | Negative | Points of Interest |
|---|---|---|
| Should maintain the existing drainage level of service. | People generally dislike the appearance of traditional rain tanks (however there are many design options available now). | Traditional tanks only catch roof runoff and not runoff from paved areas. Additional storage is probably needed if this option is to work well. |
| Timing of installation matches development. | Rain tanks take up space. | |
| | CCC will need to oversee performance and maintenance. | |
| | Does not assist with stormwater quality improvement. | |

**Detain stormwater in small, distributed ponding basins**
Establish ponding basins within neighbourhoods, on ex-residential properties. This option would be more expensive than others and is not listed .

| Positive | Negative | Points of Interest |
|---|---|---|
| Should maintain the existing drainage level of service. | Expensive | Stormwater would have to be pumped into or out of basins. |
| Potential additional green spaces in neighbourhoods. | | |
| Would assist with stormwater quality improvement. | | |

**Bypass Pumping**
In selected catchments, pump excess stormwater to bypass under-capacity pipework. Practical in only a few catchments e.g. Wilderness Drain where the upper catchment is near a large waterway.

| Positive | Negative | Points of Interest |
|---|---|---|
| Will maintain the existing drainage level of service. | Timing of construction may not suit collection of development contributions. | |
| Less expensive than upgrading stormwater mains. | | |

## APPENDIX G: ASSESSMENT OF THE PRIORITY OF ICMPS

**Assessment of ICMPs against Surface water values**

| | | Regulatory | Threats/Issues | | | Strengths | | |
|---|---|---|---|---|---|---|---|---|
| ICMP | **Total Score** | ICMP required by PNRRP<br>0 = none<br>3 = required | Greenfield development<br>0 = none<br>3 = planned | Urban intensification<br>0 = none<br>3 = planned | Flood risk<br>0 = very low<br>1 = low<br>2 = average<br>3 = high | Water quality<br>0 = very low<br>1 = low<br>2 = moderate<br>3 = high | Biodiversity value<br>0 = very low<br>1 = low<br>2 = moderate<br>3 = high | Importance to Ngāi Tahu<br>0 = very low<br>1 = low<br>2 = moderate<br>3 = high |
| Styx/Puharakekenui | **15** | 3 | 3 | 0 | 2 | 2 | 3 | 2 |
| Heathcote River | **15** | 3 | 0 | 3 | 3 | 1 | 2 | 3 |
| South-West | **14** | 3 | 3 | 0 | 2 | 2 | 2 | 2 |
| Avon River | **14** | 3 | 0 | 3 | 2 | 1 | 2 | 3 |
| Estuary | **12** | 3 | 0 | 0 | 2 | 1 | 3 | 3 |
| Coastal | **12** | 3 | 0 | 0 | 2 | 2 | 2 | 3 |
| Lyttelton Harbour | **11** | 3 | 0 | 0 | 1 | 2 | 2 | 3 |
| Akaroa Harbour | **11** | 3 | 0 | 0 | 1 | 2 | 2 | 3 |
| Sumner/Redcliffs | **9** | 3 | 0 | 0 | 1 | 2 | 2 | 1 |
| Lakes | **9** | 0 | 0 | 0 | 1 | 2 | 3 | 3 |
| Southern Bays | **8** | 0 | 0 | 0 | 1 | 2 | 3 | 2 |
| Northern & Eastern Bays | **8** | 0 | 0 | 0 | 1 | 2 | 3 | 2 |
| Outer Christchurch | **7** | 0 | 0 | 0 | 1 | 2 | 2 | 2 |

Although based on available literature, the scoring reflects the interpretation and opinion of Council staff and should not be taken as a classification of waterways or used outside the context of this report.

## APPENDIX H: EFFECTS OF URBAN INTENSIFICATION ON THE STORMWATER SYSTEM

| Catchment Name | Catch-ment Area (Ha) | Present Mains Capacity | Future Mains Capacity | Comment | Backlog Cost | UDS Infill Effects | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Piping upgrade Costs | Road Swale Costs | Rain Tanks Costs | Sea Level Rise Effect? |
| Addington Drain | 169.7 | Adequate | Adequate | | $2.2M | $0 | $0 | $0 | No |
| Avon River Loop | 11.6 | (no mains) | (no mains) | Only small pipes | $0.2M | $0 | $0 | $0 | Yes (small) |
| Barbadoes | 36.8 | (no mains) | (no mains) | Only small pipes | $0.5M | $0 | $0 | $0 | No |
| Bells Creek | 71.8 | Some up-grades needed | Some up-grades needed | Much of Bells Creek is open waterway | $1.6M | $0.3M | $0.9M | $1.3M | Yes |
| Bings Drain | 43.5 | Marginally adequate | Upgrade needed | Preferably naturalised waterway | $0.7M | $0.3M | $0.6M | $0.2M | No |
| Brittans Drain East | 67.7 | (no mains) | (no mains) | No L2/L3 component | $0.9M | $0 | $0 | $0 | Yes |
| Brittans Drain West | 77 | Theoretical under-capacity | Upgrade needed | Sections of open waterway | $3.3M | $0.1M | $0.1M | $0.1M | Yes |
| Bromley | 137 | - | - | Minor L2 area | $2M | $0 | $0 | $0 | Maybe |
| Buckleys (Buckleys Road) | 30.1 | Theoretical under-capacity | Upgrade needed | | $0.9M | $0.2M | $0.5M | $0.2M | Maybe |
| Carlton Mill | 11 | (no mains) | (no mains) | n/a (small catchment) | $0.1M | $0 | $0 | $0 | No |
| Cashel St | 37.6 | Adequate | Adequate | | $0.1M | $0 | $0 | $0 | No |
| Central | | - | - | Assume no change to imperviousness | $2.2M | $0 | $0 | $0 | No |
| City Outfall Drain | 84.7 | Adequate | Adequate | Flooding Ferry Rd area will worsen under L2/L3 | $1.2M | $0 | $0 | $0 | Yes |
| Domett | 10.5 | (no mains) | (no mains) | n/a (small catchment) | $0.1M | $0 | $0 | $0 | No |
| Fitzgerald Ave | 37.3 | Adequate | Upgrade needed | | $1.5M | $0.4M | $1.2M | $0.3M | No |
| Flockton St Basin | 65.8 | Adequate | Should be adequate | Small L2/L3 component | $0.6M | $0 | $0 | $0 | No |
| Frees Creek Lower | 88 | Adequate | Adequate | | $1.2M | $0 | $0 | $0 | No |
| Frees Creek Upper | 104.1 | Adequate | Adequate | | $1.4M | $0 | $0 | $0 | No |

| Catchment Name | Catch-ment Area (Ha) | Present Mains Capacity | Future Mains Capacity | Comment | Backlog Cost | UDS Infill Effects | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Piping upgrade Costs | Road Swale Costs | Rain Tanks Costs | Sea Level Rise Effect? |
| Geraldine | 12.4 | (no mains) | (no mains) | Expect pipes adequate | $0 | $0 | $0 | $0 | No |
| Gilby | 7.6 | (no mains) | (no mains) | n/a (small catchment) | $0.1M | $0 | $0 | $0 | No |
| Hagley | 46.4 | n/a - park | | | $0.1M | $0 | $0 | $0 | |
| Jacksons Creek Lower | 64 | Adequate | Adequate | Mostly open waterway – staying open | $0.9M | $0 | $0 | $0 | Yes |
| Jacksons Creek Upper | 136 | Road culverts under capacity | Upgrades needed | Flood flows divert out of catchment | $3.6M | $0.7M | $1.6M | $2.5M | No |
| Lincoln Road | 42.2 | Adequate | Upgrade needed | | $0.5M | $0.4M | $1.1M | $0.5M | No |
| Linwood Ave | 40.4 | Theoretical under-capacity | Upgrade needed | | $1.6M | $0.1M | $0.6M | $0.3M | Yes |
| Madras St | 42 | Adequate | Adequate | | $0.3M | $0 | $0 | $0 | No |
| Medway | 35 | (no mains) | (no mains) | No L2/L3 growth | $0.4M | $0 | $0 | $0 | Yes |
| Montreal South | 20.5 | Adequate | Adequate | Existing B3 area – little change expected | $0.3M | $0 | $0 | $0 | No |
| North Linwood | 46.6 | Adequate | Upgrade needed | | $0.3M | $0.2M | $0.3M | $0.2M | Yes |
| Northern Drain | 27.5 | Theoretical under-capacity | Upgrade needed | New pipe down Caledonian Rd to Bealey Ave needed | $0.6M | $0.1M | $0.2M | $0.5M | No |
| Nova Place | 4.8 | (no mains) | (no mains) | Should be okay | $0 | $0 | $0 | $0 | No |
| Phillipstown | 112 | Theoretical under-capacity | Upgrade needed | Ferry Rd brick barrel theoretically under-sized. Inter-connections may provide extra capacity | $2.2M | $0.8M | $1.3M | $0.9M | Yes |
| Retreat | 45 | - | - | No L2/L3 growth | $0.8M | $0 | $0 | $0 | Yes |
| Riccarton Main Drain | 325 | Small under-capacity west of Westfield | Upgrade west of Westfield | capacity OK to Westfield. New mains required west of Mall. | $5M | $1.5M | $4.5M | $4M | No |
| Richmond South | 34.5 | (no mains) | (no mains) | Branch piping upgrades | $0.6M | $0 | $0 | $0 | No |
| Rossall St | 18.9 | Adequate | Expect to be adequate | L2 zone covers a little under half the catchment. Shouldn›t cause a capacity problem | $0.3M | $0 | $0 | $0 | No |
| Salisbury | 33.3 | Marginal | Marginal | If growth is minimal existing system should cope. | $0.3M | $0 | $0 | $0 | No |
| Shirley | 30 | - | - | No L2/L3 growth | $0.3M | $0 | $0 | $0 | No |

| Catchment Name | Catch-ment Area (Ha) | Present Mains Capacity | Future Mains Capacity | Comment | Backlog Cost | UDS Infill Effects | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Piping upgrade Costs | Road Swale Costs | Rain Tanks Costs | Sea Level Rise Effect? |
| St Albans Stream | 208 | Adequate | Expect many road and private access culvert upgrades. | Stream capacity limited by private and road culverts. Flood bypass to Webb St assists retaining capacity. | $2.9M | $1.1M | $2.8M | $1.4M | No |
| Stanmore Rd (shifted) | 15.5 | Adequate | Probably adequate | n/a | $0.2M | $0 | $0 | $0 | Yes |
| Stevens Drain | 14.7 | Marginal | Upgrade needed | Need to duplicate Stevens Drain - probably on Madras St | $0.4M | $0.3M | $0.6M | $1.4M | No |
| Sullivan | 31.6 | (no mains) | (no mains) | n/a | $0.5M | $0 | $0 | $0 | No |
| Swanns Rd Outfall | 45.5 | Adequate | Adequate | Capacity OK at present. Can be upsized if necessary when brick barrel renewed. | $0.7M | $0 | $0 | $0 | Yes |
| Tay Street Drain | 88.8 | Under capacity | Upgrade needed | Major upgrade needed over most of the length | $3.4M | $0.1M | $0.3M | $0.2M | No |
| Tuam St | 82 | Adequate | Adequate | Adequate capacity | $0.2M | $0 | $0 | $0 | Yes |
| Waltham (Charles St Divn) | 162.4 | Adequate | Adequate | Large mains, relatively modern, designed for existing B zone | $2.3M | $0 | $0 | $0 | Yes |
| Westminster St | 24.6 | Adequate | Upgrade needed | Probably need to duplicate the 600mm main on St Albans St | $0.3M | $0.3M | $0.9M | $0.6M | No |
| Wildberry | 24.5 | Small theoretical under-capacity | Upgrade needed | 400m of D600 + 150m of D300 | $0.4M | $0.1M | $0.1M | $0.1M | No |
| Wilderness Drain | 371.1 | Small theoretical under-capacity | Upgrade needed | Main under-sized for L2. | $5.5M | $0.5M | $1.6M | $0.9M | No |
| Wilderness Drain No 2 | 87.9 | Theoretical under-capacity | Upgrade needed | Main under-sized for L2/L3. | $2.7M | $0.3M | $0.9M | $0.7M | No |
| **TOTALS** | **1700** | | | | **$58.6M** | **$6.8M** | **$20.1M** | **$16.3M** | |

## APPENDIX I: THE STRATEGY DEVELOPMENT PROCESS

The Strategy development began with an analysis of the present situation. A series of background reports (see Bibliography) identified current surface water issues and their drivers. These were reviewed by Councillors, Community Boards and external stakeholders[31]. Draft goals and objectives were then prepared, based on a holistic, values-based approach to surface water management. These goals and objectives were discussed with Community Boards, Ngāi Tahu, and the Greater Christchurch Urban Development Strategy (UDS) partners and committees, which includes Waimakariri District Council, Selwyn District Council, and the New Zealand Transport Agency). The implementation policies and programmes identified are the chief methods by which the Council will move towards achieving the Strategy's goals and objectives. Due to their importance in implementing the Strategy and the need for co-ordination with other organisations, the policies and programmes relating to stormwater management were reviewed by external stakeholders before being finalised. The Strategy was drafted and approved by Council for public consultation from Monday 15 July to Friday 14 August 2009. The figure below shows the process undertaken in the development of the Strategy.

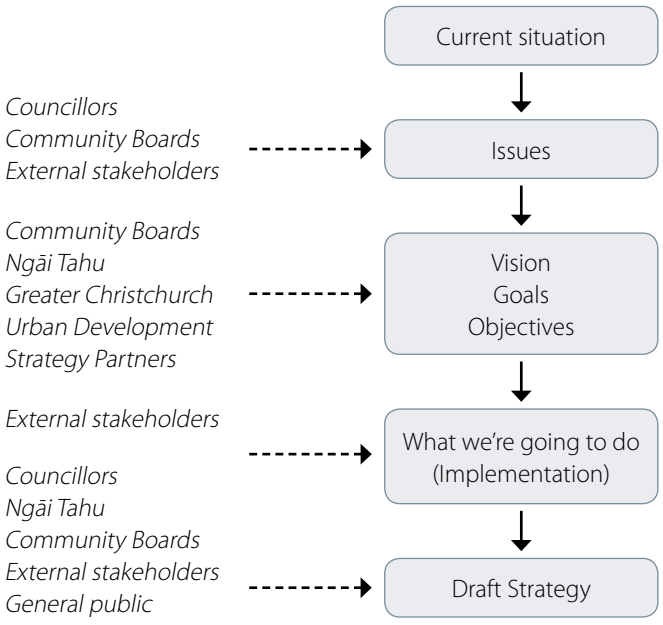



FIGURE I.1: DEVELOPMENT OF THE SURFACE WATER STRATEGY

[31] *See Appendix A for a list of the external stakeholders consulted.*

**How to get printed copies of the Strategy**
Printed copies of the Strategy or the Strategy on CD can be requested by calling (03) 941 8999
or emailing: surfacewater@ccc.govt.nz

**How to find the Strategy on the Internet**
The Strategy is also available in Adobe Acrobat PDF document format at the following internet address:
http://www.ccc.govt.nz/environment/healthyenvironmentstrategies/surfacewater

**Contact information**
If you have any technical questions or comments on the Strategy, please send an email to: surfacewater@ccc.govt.nz

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