A strategy for the protection and restoration of waterways and wetlands in Christchurch

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ABSTRACT
In its original natural state, Christchurch's surface water environment comprised three small coastal rivers, their estuaries, numerous spring fed streams and wetlands. This system sustained local Māori for 800 years or so.

The development of the City through European settlement has included the straightening and enlargement of rivers, construction of an extensive drainage system and the filling of low lying land.

Over the last 10 years, a new management philosophy has evolved as set out in the Council's Natural Asset Management Strategy for Waterways and Wetlands. It represents an investment of NZ$160 million over 40 years. It reflects six main values; landscape, recreation, culture, ecology, heritage and drainage.

This paper describes the Strategy and its programme of restoration and protection.

THE NATURAL SYSTEM

Christchurch was originally a mixture of dry land and wetland, with the driving agent the movement of surface water and groundwater across the alluvial plains from the mountains to the sea (Fig. 1). 'Black Maps' (maps approved by J. Thomas and Thomas Cass, Chief Surveyors 1856), provide a valuable record of the terrain that existed in Christchurch City before European settlement became fully established (Fig. 2).

Modern water and soil maps of the Christchurch area (Fig. 3) illustrate the diversity of surface water environments. These include gravel outwashes from the extensive Waimakariri River system, the volcanic Port Hills with a mantle of wind-blown loess soil, coastal silts and sands, and three smaller coastal rivers (the Styx, Avon, and Heathcote rivers) that, in their headwaters, have numerous springs. The northern part of those springs are fed by seepage from the Waimakariri River, and the more southern parts are fed from rainfall recharge to the west.

THE MODIFIED SYSTEM

Early settlers had to contend with extensive swampland areas in Christchurch (Fig. 4A–C). Past management practice, understandably, was to get rid of water, particularly as it was often contaminated with human waste and associated diseases. One of the first organisations established by the settlers was the Christchurch Drainage Board, whose single focus was to drain Christchurch. That was done efficiently and effectively for some 100 years, and the pattern of development reflects a utilitarian approach to surface water — an extensive network of pipes and drainage channels, and enlarging existing waterways to convey ever-increasing amounts of urban run-off (Fig. 5A–F). This long history of capital expenditure on utility structures resulted in loss of natural water environments.

COMMUNITY EXPECTATIONS

Although people are attracted to the Avon River flowing through the central city, the health of that river is very much dependant on the management

[1] Editor's note: now known as the Greenspace Unit. Robert Watts is now retired from the Christchurch City Council.

of tributary catchments feeding it. However, the culture for some 100 years was of getting water from one place to another as quickly as possible, and occupying minimal space.

In recent times, guiding legislation has reflected different attitudes in the community. The purpose of the Resource Management Act (1991) is 'to promote the sustainable management of natural and physical resources', and the Local Government Amendment Act (2003), provides for forward financial planning by Councils for the management of infrastructural assets. In addition, the intentions of the Resource Management Act have been translated into various policies and strategies by regional and district councils. Recent examples are provided by the Christchurch City Plan, produced by the Christchurch City Council (CCC 1999a), and the Natural Resources Regional Plan in preparation by Environment Canterbury.

Many of these governing policies and strategies are related to managing Christchurch's water resources, and together provide a more holistic approach. When these policies and strategies are translated, along with local knowledge and enthusiasm, it becomes possible to crystallize the surface water management demands of our community into a set of values. Using this values-based approach, six were identified:

1. Landscape
2. Recreation
3. Culture
4. Ecology
5. Heritage
6. Drainage.

Actively incorporating these values creates ideal opportunities for developing community assets through managing surface water under the guise of land drainage (Fig. 6A–F). The water and soil map (Fig. 3) demonstrates the wonderful diversity of surface water environments in the Christchurch area that we can capitalise on for greening our city.

ASSET MANAGEMENT

Returning to an asset management approach; we can project what future generations may need to spend on replacing the piping system in Christchurch (Fig. 7). At the peak of stormwater pipe installation (from the 1950s to the 1960s, and probably also into the 1970s), huge amounts of money was spent on flood relief projects. The fabric of that system has to be refurbished or replaced in the future, and future generations may be faced with spending about NZ$40 million per decade.

The replacement of large drainage pipes is often through private land, with high capital costs and declining asset values, and some time in the future they will need to be refurbished or replaced again at a similar cost (Fig. 8A,B). However, another approach is the development of more natural waterways, often through public land. Capital costs are lower, asset values appreciate over time and replacement may never be needed (Fig. 8C,D).

For the piping option, the drainage benefit has certainly been achieved, and there may be some space on the surface of the ground for landscaping and recreational use (Fig. 8B). However, when the alternative is compared, that of a naturalised waterway on public land with public access, we find that — certainly with the larger diameter pipes — the cost of the land, shaping the earth and planting it out is a lesser capital cost and an increasing asset value. People, plants and animals populate the area and future generations do not have to replace a piping infrastructure. They may have to refurbish the waterway over time, but the six values achieved (Fig. 8D) means that there is a high cost/benefit ratio compared with piping.

When managing surface water values, it is important to critically compare the actual land type with the desirable areas required for sustainable management.

A crude analysis of the land spaces within urban Christchurch (Table 1) revealed that road reserves comprise some 14% of our urban land area. Parks in Christchurch occupy some 15%, about the same area as road reserves. Parks are by-and-large fairly discrete areas, especially when compared to roadside reserves that resemble a patchwork quilt when mapped at the

Table 1 Proportions of some urban land types in Christchurch.

Land type	Percentage
Road Reserves	14%
Parks	15%
Waterways (in public land)	1%
Waterways (in private land)	1%

city scale for Christchurch. Waterways in public ownership are 1%, the same area occupied in private property. Hence, it is very important to establish good working relationships with property owners to maximise the values of those waterways.

For satisfying the six values (landscape, recreation, culture, ecology, heritage, and drainage) we need to increase the amount of space occupied by waterways and wetlands. The desirable minimum for waterways, wetlands and drainage needs is estimated at 5%. To avoid increasing the total amount controlled by the council, we have to work imaginatively on that existing 30% or so in road reserves and parks. This raises a set of challenges, including:

- How can roading design be improved to assist in achieving water quality and quantity requirements of receiving waters?
- How can reserves be created that are part of a continuous linkage for our natural water systems?

The overarching issue is effective management of flooding of course, and the flood plains of Christchurch are illustrated in Fig. 9. However, there are also large numbers of bird species in Christchurch, and we have a responsibility for them as well[2]. Christchurch also has ecological heritage sites and sites of significance to tangata whenua (Fig. 10). Furthermore, Christchurch is in the process of active urban growth (Fig. 11). This urban growth creates problems for those living on flood plain areas because those areas become increasingly more flooded unless space is created in the landscape to detain water in the urban growth area in as natural a way as possible.

NATURAL ASSET MANAGEMENT

The conventional utility asset management approach is to examine individual elements of the system and assess its age, condition, and capacity, to determine what maintenance is required for that asset in the future.

However, for a natural system this philosophy and its associated methodologies are largely unsuccessful. Instead, an area-based approach was adopted, where the city is divided up to highlight the remarkably different environments. This approach helped to identify issues specific to a locality, reflecting topography, the nature of the water system and community interests (Fig. 12). This allows, in turn, the development of visions and strategies, and a costed and prioritised set of protection and restoration projects. Examples of some visions and strategies for specific areas are illustrated in Appendix 1–2.

The south-west Christchurch urban growth area (the Halswell Wigram growth area) is currently a very high priority for the Christchurch City Council. The overall vision — ‘To claim, restore and emphasise waterways and wetlands in a way that accommodates and also mitigates the effects of existing and future urban development, while adding value to quality of life’ — was created from a set of strategies outlined in Appendix 1. These strategies are aimed at addressing the issues relating to that particular area (Appendix 1, in bold). We needed a visual context for all of the issues and strategies, and for the Halswell Wigram urban growth area we envisage a framework of open space that enables us to create multiple benefits.

The Port Hills are also within the south-west urban growth region, but are quite a different area with different issues. These issues include soil erosion and the effects of land use, the need to re-establish vegetation, to satisfy bird

[2] Editor’s note: as documented in these proceedings by Andrew Crossland’s paper.

life, and to satisfy human recreation needs (Appendix 2).

As the title of this paper indicates, the strategy can be reduced to two main activities; *protection* and *restoration*. Finding space in the landscape for this natural system to function with minimal interference is usually quite difficult. However, the Styx River reserve provides a positive example of what can be achieved. A property owner sought to have their rural land rezoned for urban use. The Christchurch City Council examined the esplanade reserve needs of the Styx River, and found that the statutory minimum of 20 m was insufficient because legislation indicated that there were other attributes to protect (e.g., natural river terrace, adequate buffer for nesting birds, landscape amenity and provision of a water quality management area). Through negotiation with the property owner, a 50 to 80 m esplanade reserve was acquired. In this case, the land was not zoned residential, so the Christchurch City Council bought the land at rural rates using reserve contribution from the subdivision, and this rural zoning has been retained.

Another method of protection within private property is through city plan rules. There are set-back distances for various kinds of waterway, for which retaining walls, earthworks, and other structures require close scrutiny and special consent (Fig. 13).

Christchurch City Council (CCC 2003) have recently published a guide — the *Waterways, Wetlands and Drainage Guide*. This guide is a design manual that shows how to enhance, design and create waterways and wetlands.

THE FUTURE

And what of the future? The *Waterways and wetlands natural asset management strategy* (CCC 1999b, 2000) identifies 350 projects aimed at achieving a state of existence for systems that do not require future generations to replace — in other words, *sustainable systems*. The two activities of protection and restoration incur quite large initial expenditures for the first few decades, but this diminishes over time as the system becomes more sustainable (Fig. 14). The average expenditure of a sustainable strategy is about the same as the average expenditure for what was previously spent on utility structures per annum.

Another major issue relating to managing water quality and quantity is the focus on individual projects, and getting mitigation measures in place for each particular discharge. Currently, there are 100 resource consents and more than 800 conditions to comply with — and that is only for recent projects. At that rate it would take several hundred years before the city actually achieves an ideal surface water system (Fig. 15).

A more strategic approach is contained within a draft planning and consents protocol between Environment Canterbury (a regional authority) and Christchurch City Council that provides for

Table 2 Cost Share Components.

Piped System	Developer(s) meet full cost as a required service.
Pretreatment Swale	Developer(s) meet full cost as a water quality mitigation measure.
Reserve	Developer(s) meet full cost, partly as stormwater mitigation, partly as reserve contribution.
Green Corridor	Land acquired in advance as a strategic purchase by the Council. Cost shared between Council (on behalf of greater community) and developers. Developers contribution coming partly from stormwater mitigation and partly reserve contribution.
Park	Acquired by Council initially as a strategic purchase, usually funded by 'Cash in Lieu' account.
Waterway	Designed and constructed by Council. Cost share between Council and developers as a stormwater mitigation measure.
Pond	Designed and constructed by Council. Cost share between Council and developers as a stormwater mitigation measure.

an area-based resource consent prepared from an integrated catchment management plan. This allows the 'hot-spots' to be identified and prioritised, rather than just focussing on new development.

Table 2 shows how costs might be apportioned between the community at large (through rates) and the developers. Under recent Environment Court decisions, the degree to which waterways and wetlands, that are constructed as stormwater mitigation measures, form part of reserve contributions is entirely a Council decision based on the open space objectives for the locality. Hence the proportions of cost shares will need to be guided by the circumstances applying to each individual scheme and would vary from location to location.

ACKNOWLEDGEMENTS

Development of the Natural Asset Management Strategy for Waterways and Wetlands was a team effort. I gratefully acknowledge everybody who contributed — more than 20 council staff, volunteers and consultants — all those who produced the strategy document in the short time frame of five months.

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Fig. 1 The extensive river system of the Waimakariri River, north of Christchurch, crosses the alluvial plains and conveys surface and ground water from the mountains to the sea.

Fig. 2 Example of a 'Black Map' illustrating south-west Christchurch in 1856.

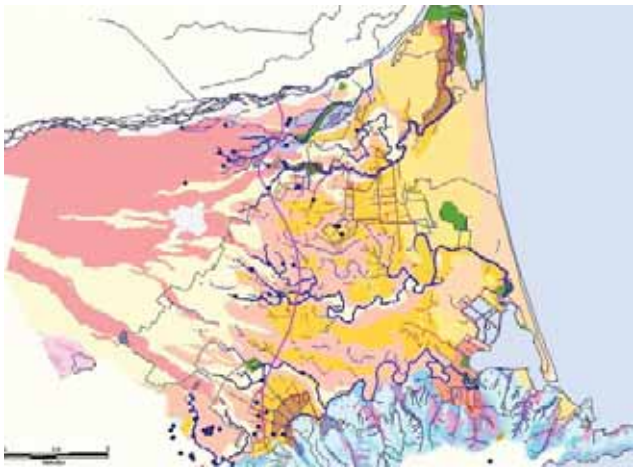


Fig. 3 Water and soil map illustrating the diversity of surface water environments in Christchurch and surrounding areas.

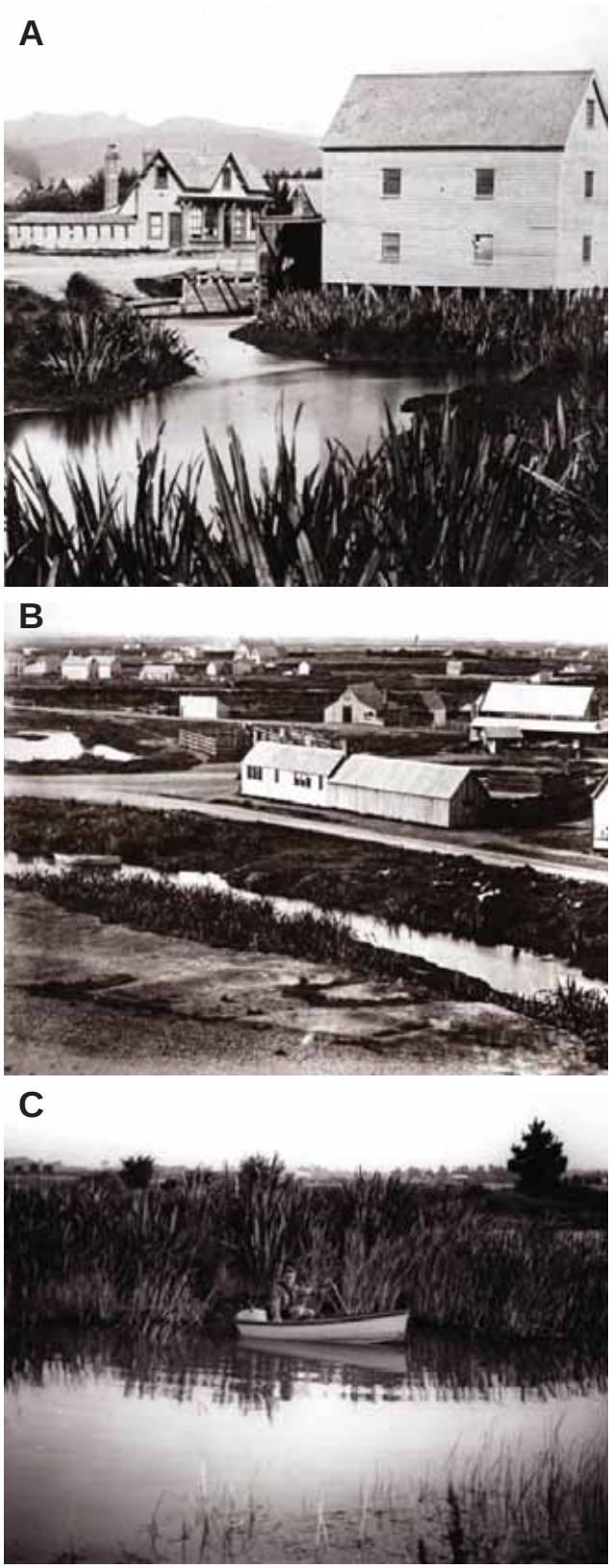


Fig. 4 A–C Early photographs of Christchurch — 'the city on a swamp'.

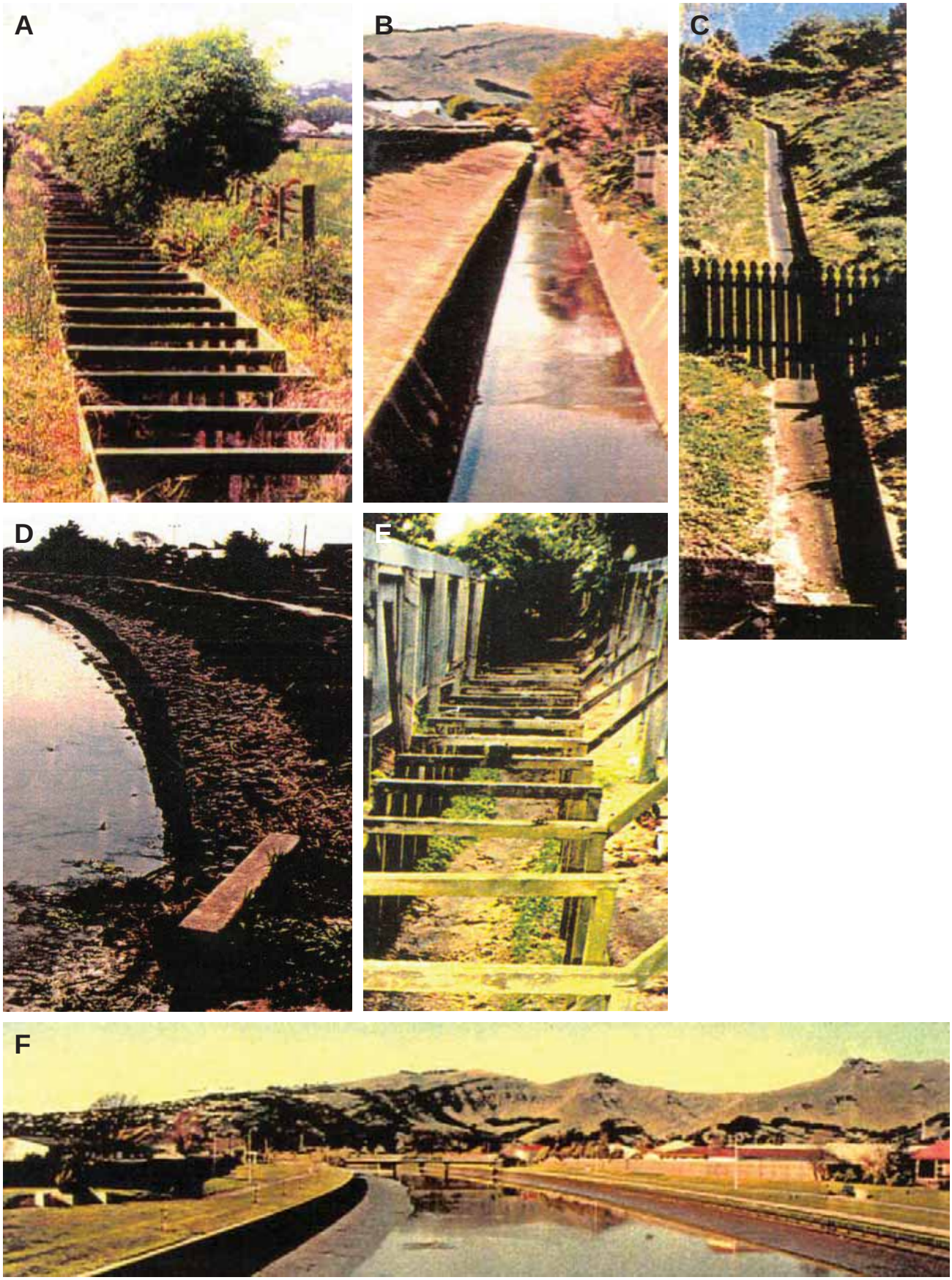


Fig. 5 A–F The legacy of previous water management practices include an extensive infrastructure of pipes, drainage channels, and enlarged and straightened existing waterways.

Fig. 6 A–F Notable examples of enhanced waterways in the Christchurch area. **A**, saltmarsh, Avon-Heathcote Estuary; **B**, Alderson Avenue, Hillsborough; **C**, Heathcote River, Thorrington School; **D**, Paeroa Reserve, Riccarton; **E**, saltmarsh wetland, Humphries Drive; **F**, Kaputone Creek, Belfast.

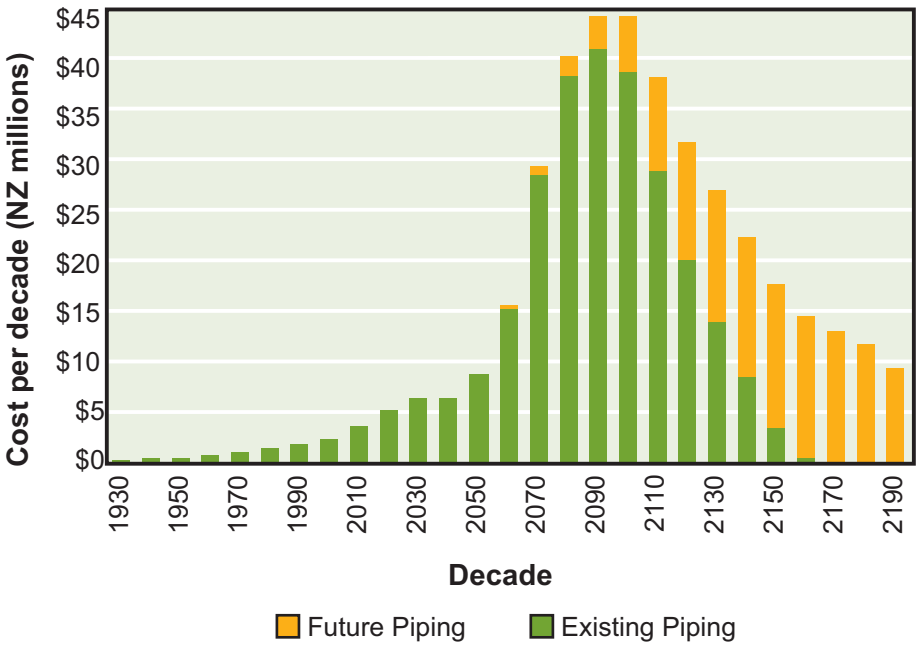


Fig. 7 Previous and projected costs of pipe renewals in Christchurch City.

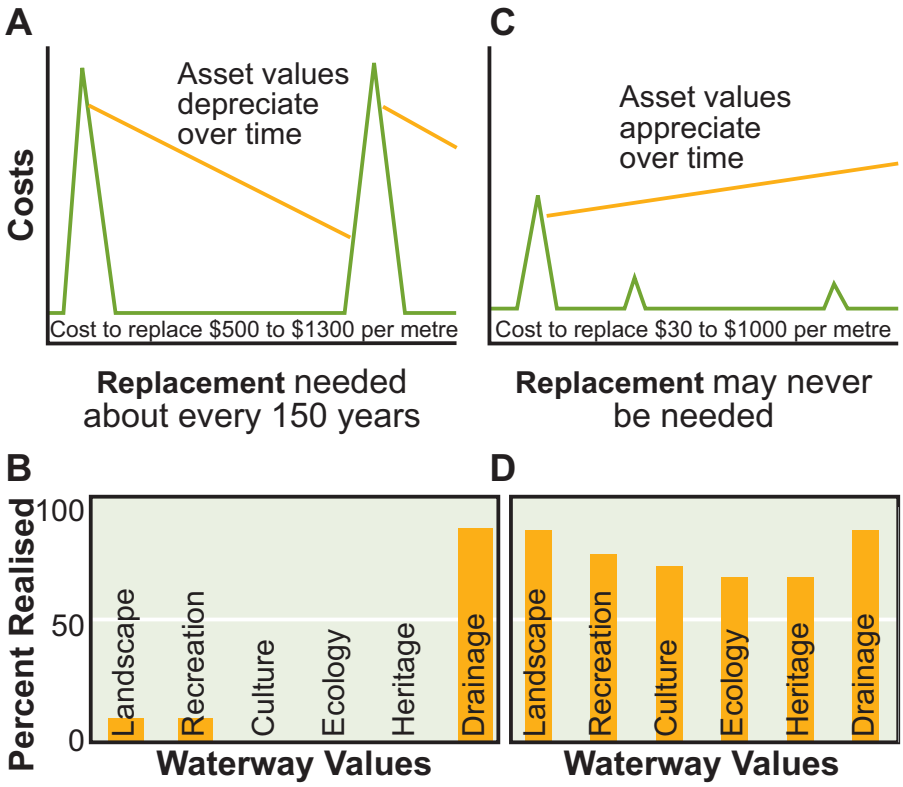


Fig. 8 Asset cost and value comparison — large pipes through private land vs. waterways in public land. **A**, costs of piping; **B**, realised values of piping; **C**, costs of 'natural treatment'; **D**, realised values of 'natural treatment'.

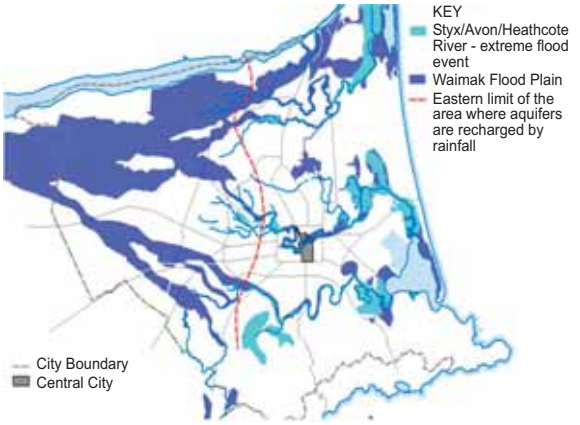


Fig. 9 Flood plains of Christchurch and surrounds.

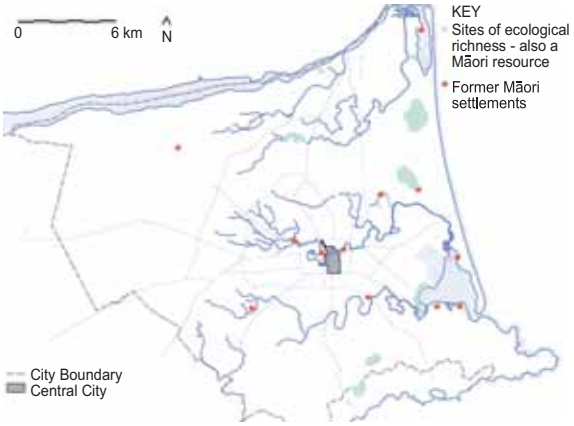


Fig. 10 Sites of ecological richness and former Māori settlements.

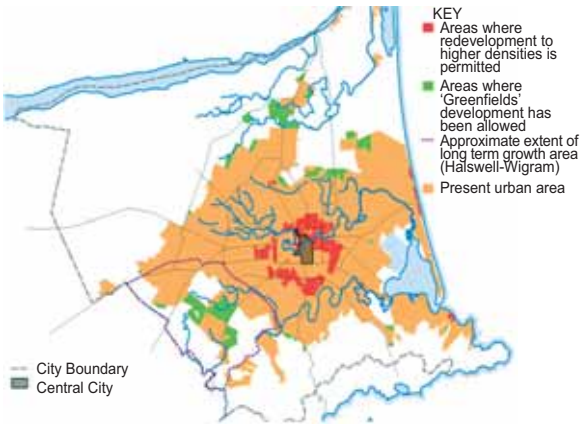


Fig. 11 Present urban area and projected growth in Christchurch.

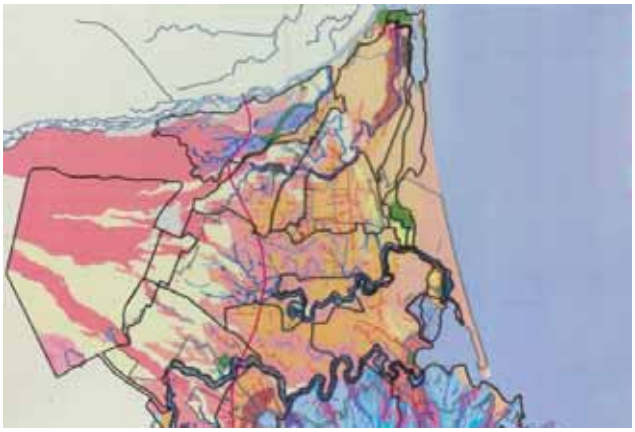


Fig. 12 Overview of project areas in Christchurch and surrounds.

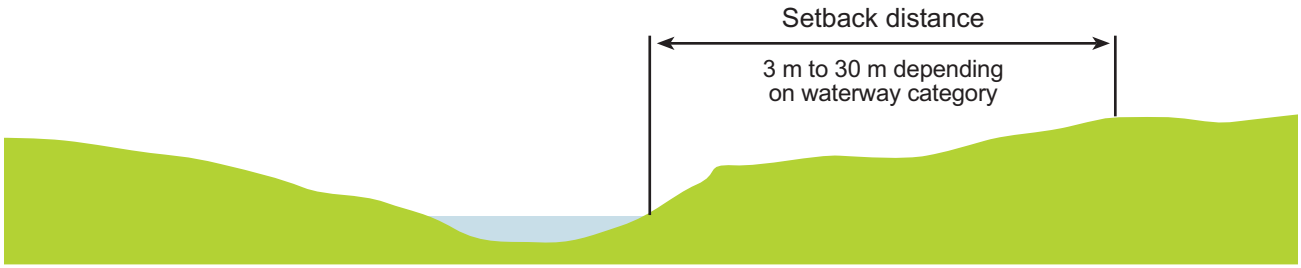


Fig. 13 Setback rules from City Plan.

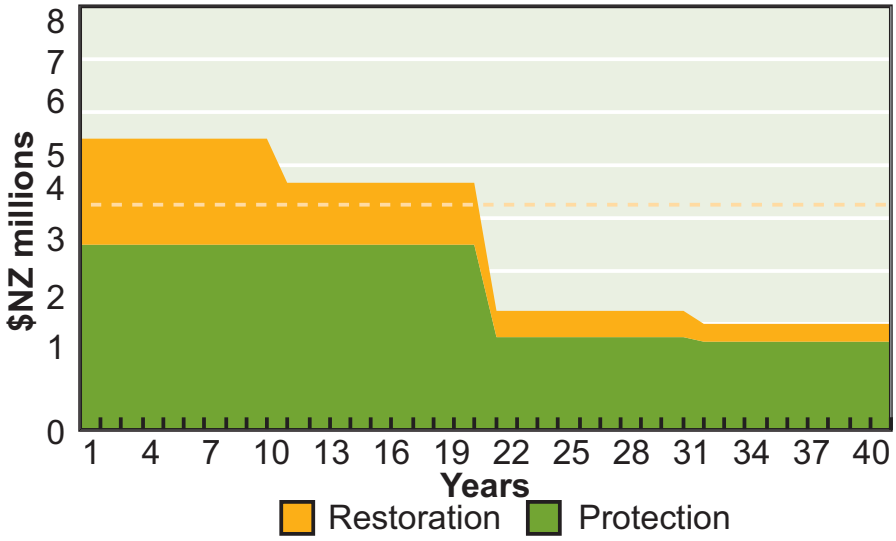


Fig. 14 Graph illustrating restoration and protection costs over time for a sustainable waterways system. Dashed line is the historical expenditure on land drainage.

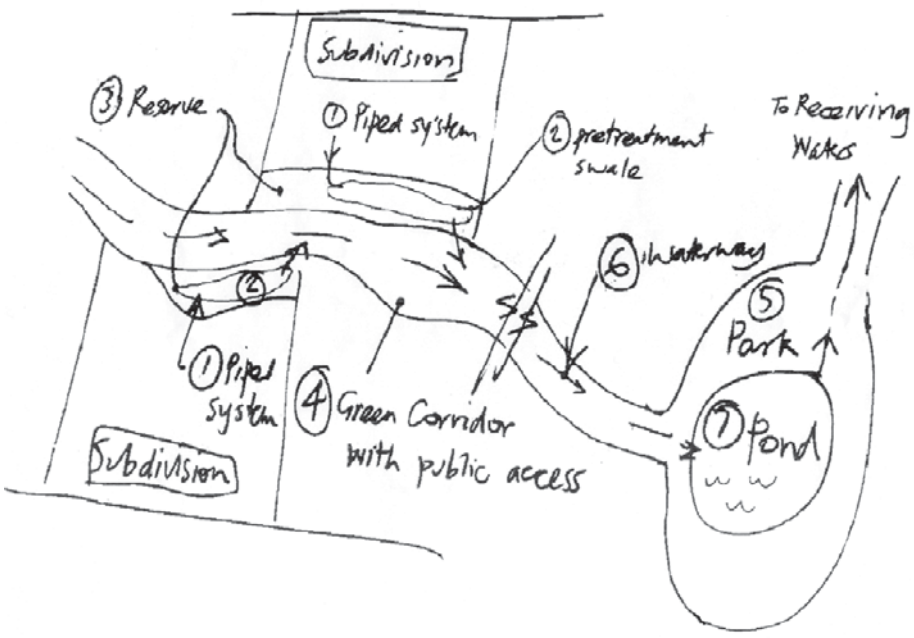


Fig. 15 Idealised surface water system.

APPENDIX 1
HALSWELL WIGRAM GROWTH AREA.

'Welling up of groundwater – Halswell and Heathcote River Headwaters'

VISION
To claim, restore and emphasise waterways and wetlands in a way that accommodates and also mitigates the effects of existing and future urban development, while adding value to quality of life.

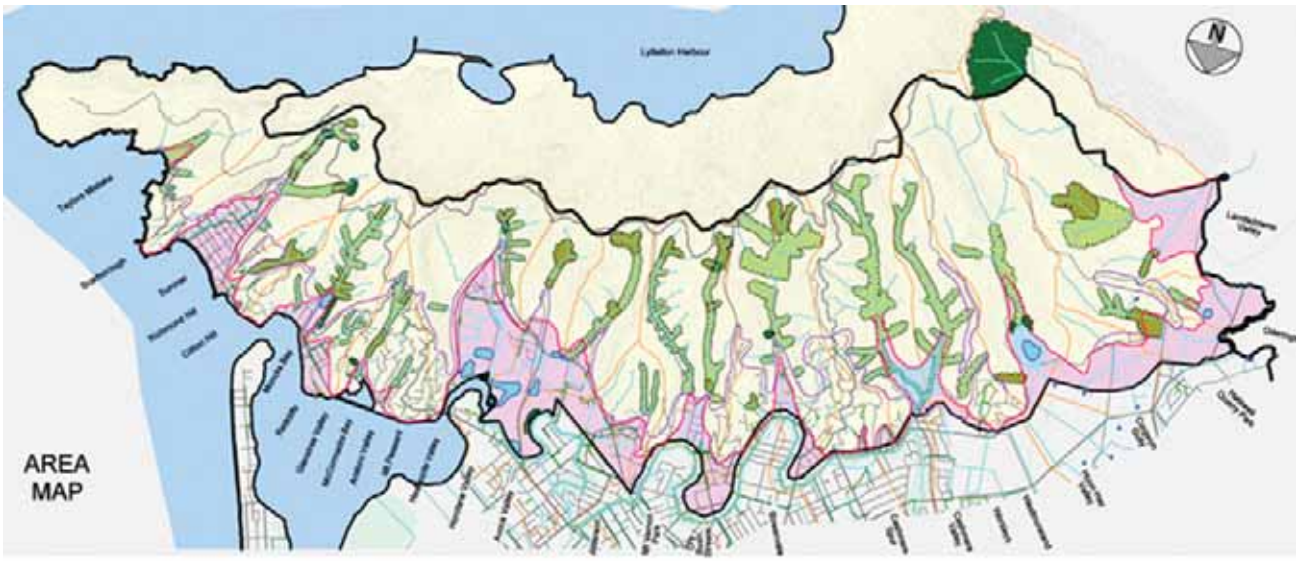
STRATEGIES
- **Develop partnerships with key stakeholders, including landowners, developers, tangata whenua and the community, to raise the profile, protect and restore waterways and wetlands**
- **Explore imaginative solutions for street design and streetscape that give effects to the Heathcote River Floodplain Management Strategy through stormwater detention, water quality treatment and soakage to ground**
- Where space and ground conditions allow, develop mechanisms within existing waterways to reduce peak flows and allow future downsizing of existing pipe systems through detention, retention and soakage
- Develop and encourage sustainable rural management practices for open space areas adjacent to riparian buffer strips
- Protect and highlight natural heritage features such as river terraces, channels, swales, and local soil types and also to capitalise on opportunities offered by disused gravel pits and high groundwater
- Emphasize the characters of the area through use of appropriate plant associations around waterways and wetlands, while maintaining views to the Port Hills and Alps
- **Establish ecological corridors along waterways and wetlands through appropriate planting and improve public access and recreational opportunities**
- Increase the diversity and abundance of terrestrial, wetland and migratory birds
- **Protect springs, wetlands and other sites of significance in the area to tangata whenua**
- **Acknowledge the strategy as a means of implementing Community Board objectives.**

Halswell/Wigram and Cashmere Stream Ponding Areas.

APPENDIX 2
PORT HILLS 'FORESTED VALLEYS'.

VISION
A breathing place of green gullies, clear water and open tussocklands.
A refuge for wildlife and an immediate space for people to enjoy.

STRATEGIES
- Ensure soil conservation valley and side-gully restoration planting, and sustainable tussock grassland and stock management
- Establish ecological and recreational linkages along waterways in residential areas where possible (daylighting)
- Define and implement practices to attain sustainable greenfields residential development
- Develop a sea level rise strategy.



Waterways and wetlands natural asset management strategy (CCC 1999b)
Port Hills — Project Area 1.