CHRISTCHURCH

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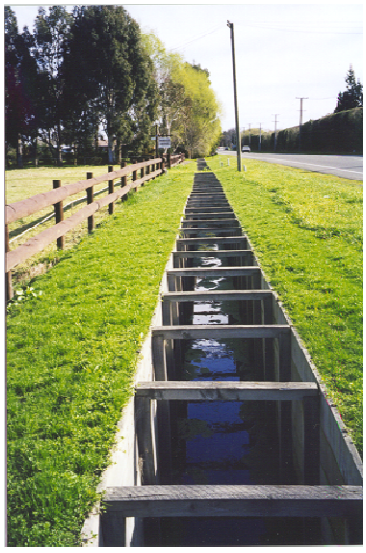
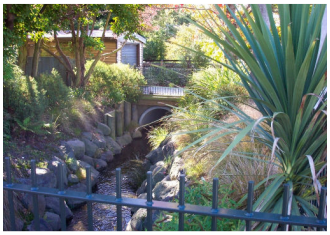
Water & Sanitary Services Assessments





Stormwater Drainage

February 2009

Water & Sanitary Services Assessment - Stormwater Drainage

Prepared for

Christchurch City Council

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R2	14/10/2004		Dean Kimpton Director, i-business consulting	
R3	March 2005	Options	Paul Dickson, Drainage Engineer	
R4	February 2009	Banks Peninsula assessment incorporated	Paul Dickson, Drainage Engineer	

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Summary

PURPOSE AND SCOPE

The Local Government Act 2002 requires all territorial authorities to carry out assessments of stormwater services. The objective of the assessment is to identify risks and show how these services will be managed by the Christchurch City Council to achieve community outcomes in a sustainable manner.

STORMWATER SERVICES IN CHRISTCHURCH CITY

The roles of Council with respect to stormwater drainage services in the city are to coordinate the setting of Community Outcomes and as a service provider. The key service functions of stormwater drainage infrastructure are the:

- Protection of property, public safety and access
- Protection of ecosystems
- Creation of productive land

ADEQUACY OF STORMWATER SERVICES

Christchurch city has invested heavily in flood relief works over the past 40 years in response to a series of destructive floods through the 1960's, 1970's and 1980's. A combination of historical investment in physical upgrading works and planning measures has effectively mitigated risks associated with the inundation of dwellings and buildings, and there are very few urban development constraints in the city that are not mitigated by planning rules, proper subdivision design and building design.

The investment in urban stormwater services on Banks Peninsula has been more modest, and service improvements are warranted in some Peninsula communities.

In rural areas stormwater is generally disposed of by ground soakage or to watercourses. There are unlikely to be any significant constraints on additional rural type development related to drainage. There are unlikely to be significant constraints on additional rural-type development related to the disposal of stormwater.

PUBLIC HEALTH RISKS

RISKS ASSOCIATED WITH STORMWATER SERVICES

Potential health impacts associated with the stormwater drainage network are:

- Illness caused by contact with micro-biological or chemical contaminants in natural water resources through the use of streams, rivers, estuaries and beaches for recreational purposes, or drinking potable water drawn from pollution water sources.

- Injury or death caused by falls from stormwater structures or drowning.
- Illness from mosquito bites.

The range of contaminants in stormwater and the current extent of environmental impacts on the City's watercourses are:

- **Microbiological** concentrations **(**including bacteria, viruses and protozoa) generally exceed contact recreation guidelines. The main source of contamination in dry weather is believed to be waterfowl. The impact of wet weather pollution is lessened by rain water dilution and the low level of recreational activity at these times.
- **Chemical** contaminates include organic compounds such as hydrocarbons, pesticides and organic wastes, and inorganic compounds such as metals and metaloids. The concentration of heavy metals in stormwater and river sediments exceeds the relevant water quality guidelines for the protection of aquatic organisms,
- **Nutrients**, including nitrogen and phosphorus, can cause algal blooms and prolific growth of aquatic plants when elevated levels. There is extensive growth of algae, especially in the Avon River, likely to be linked to nutrient enrichment in the streams.
- **Banks Peninsula waterways** generally have better water quality than lowland waterways north of the Port Hills, although Lyttelton and Governors Bay streams are more likely to be turbid and have faecal contamination.

Although microbiological concentrations, at times, exceed contact recreation guidelines, neither Council nor the Medical Officer of Health have any record of injury or illness that is attributable to deficiencies in the design, operation or maintenance of the stormwater network, and health risks are assessed as low.

RISKS ASSOCIATED WITH THE LACK OF A RETICULATED STORMWATER DRAINAGE SYSTEM

There are less likely to be stormwater systems in rural areas. Because of the much larger allotments in rural areas, and the higher proportion of permeable, vegetated areas, there are few problems when reticulated stormwater disposal is unavailable.

RISKS TO STORMWATER COMMUNITIES

Assessments of stormwater services were carried out at a "community" level to identify risks to particular communities.

Types of Communities	Community	Risk Assessment
Communities served by public drainage systems	Urban area to receiving waters-drained by street channels, street, sumps, pipes, open water courses and streams	Quality of water in urban rivers and streams continues to degrade due to urban discharges Increasing risk of land flooding due to inner urban intensification. Risk of flooding due climate change. Risk of insect borne diseases if an exotic vector establishes in Christchurch.
	Banks Peninsula Settlements	Risk of flooding and access difficulties from under-capacity stormwater infrastructure. Water quality from time to time not compliant with ECan rules.
	Rural areas serviced by Council maintained streams and drains	Low levels of risk
	Brooklands – discharge to a controlled groundwater storage zone.	Low levels of risk
Communities served by private drainage systems	Rural areas discharging storm-water run-off by either direct soakage to ground or to open drains funded privately	Low levels of risk
	Industrial areas discharging to ground via soakage basins	Risks of ground water contamination through leakage or spills onto ground or contaminants entering soak pits.

ENVIRONMENTAL RISKS

Water quality monitoring indicates that several of the environmental parameters monitored exceed minimum guideline levels. Ecosystems in the majority of streams are in degraded condition, however the impacts on waterway habitats appears to be accepted by the majority of the community and a rigorous debate on the community costs and benefits of markedly improving environmental outcomes is required. The Council's Surface Water Strategy, in preparation, will provide an opportunity for this discussion in its consultation phase.

Environment Canterbury has issued for comment a Proposed (draft) Natural Resources Plan which will, when adopted, set the rules and water quality standards with which Council must comply for all existing point source discharges. It is likely that the standards will require additional planning, investigations and investment in land and treatment facilities.

OPTIONS TO ADDRESS RISKS

1. Options to address water quality degradation.

    a. Prepare and implement integrated catchment management plans (ICMPs) as required by the Proposed NRRP. This option will require the Council to be aware of land use activities in the catchment and control harmful discharges.

    b. Prepare and implement ICMPs; investigate operational measures such as street sweeping and sump cleaning that will improve discharge quality, and implement selected measures.

    c. As above, but improve stormwater treatment by construction of in-line treatment devices.

    d. Undertake a study of storm water discharge quality in selected catchments and assess the impact of storm water quality on the receiving waterways

2. Options to address the risk of land flooding due to urban intensification:

    a. Continuous improvement of stormwater infrastructure as proposed in the stormwater drainage asset management plan.

    b. A step increase in stormwater capacity early in the development cycle.

3. Options to address the risk of insect borne diseases:

    a. minimise the potential habitat for insects by minimising the number of open water bodies in the city (i.e. eliminate ornamental and environmental water bodies)
    b. limit the number of likely habitats while monitoring for insect nuisances and maintaining an awareness of potential problems. The Council currently implements this option.
    c. control insect populations only if an exotic insect establishes in Canterbury.

4. Climate change and associated effects is a risk which should be dealt with via planning measures until the scale and timing of effects is better understood.

5. The risk of ground water contamination in industrial areas through private stormwater soakage is primarily controlled by Environment Canterbury which authorises these discharges via resource consents. Options available to the Christchurch City Council are:

a. advocate for appropriate levels of environmental protection.

b. construct additional stormwater infrastructure to provide services to at-risk areas.

COUNCIL'S ROLE

The proposed role of Council is to continue as:

- Facilitator of community consultation to establish community outcomes and service standards for stormwater services.
- Owner of infrastructure delivering public stormwater services to the community.
- Partner to Environment Canterbury and the Ministry of Health in the achievement of regulatory outcomes, and advocate for the community in the setting of environmental standards.
- Monitoring city growth, water quality and the health of habitats, and the development of policies, infrastructure management and development plans, District Plan measures and public education programmes to ensure environmental and public health standards are achieved.

1.0 Purpose and scope

The Local Government Act 2002 requires all territorial authorities to carry out assessments of Water and Sanitary Services (refer Appendix A for a summary of the relevant clauses and the assessment process). This requirement reflects concerns expressed by government agencies in recent years that in some parts of New Zealand little thought has been given to the ability to provide water and sanitary services of an acceptable standard sustainably into the future.

The objective of this assessment is to show, as a basis for consultation, the risks associated with stormwater drainage services and how these services in Christchurch will be managed by the Christchurch City Council (the Council) to achieve community outcomes in a sustainable manner. Council will present a summary of this assessment in its Annual Plan, providing its customers with an opportunity to comment on the findings and proposals.

The scope of this assessment includes both stormwater services provided by Council and those provided privately within the City boundaries. The Christchurch territorial authority (shown in Figure 1) area is bounded to the east by the Pacific ocean and the estuary of the Heathcote and Avon Rivers, and in the north by the Waimakariri River.

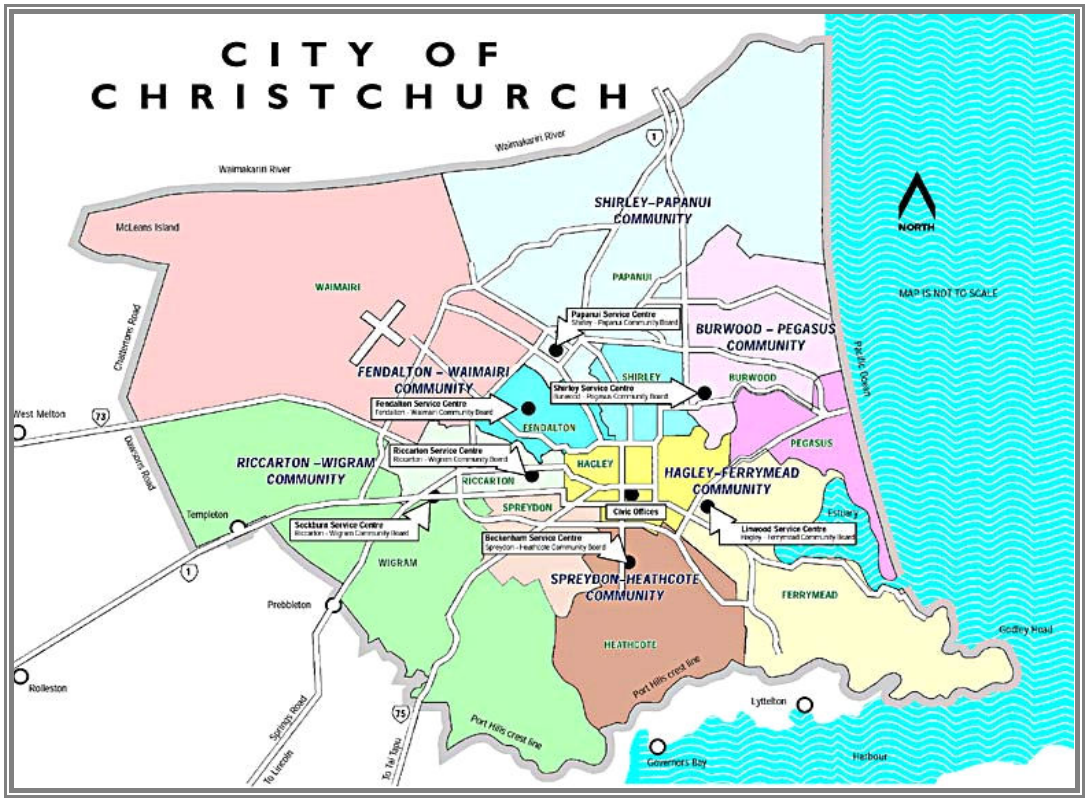


Figure 1 – Territorial Authority Area

Updated map of Christchurch City to come

2.0 Stormwater services in Christchurch City

2.1 Description of stormwater services

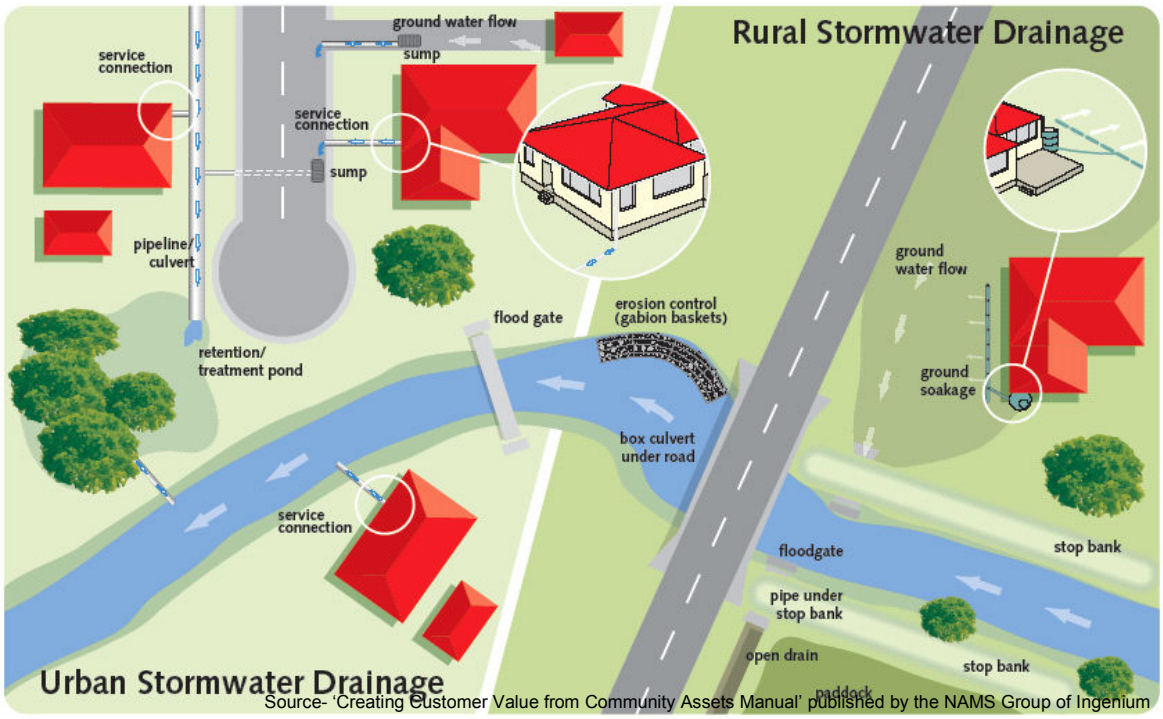
The key service functions, and type, of stormwater drainage infrastructure (shown in **Figure 2**), are the;

- **Protection of property, public safety and access** by the interception of surface and groundwater flows generated by rainfall run-off, conveyance a point of discharge and the containment of flood flows within natural and man-made water-courses;

  Council assets
  - ground soakage basins and chambers
  - surface channels and swales
  - sumps and inlets
  - pipes, culverts and open drains
  - stormwater detention and treatment ponds
  - stop-banks

  Privately owned assets
  - ground soakage chambers
  - retention tanks
  - service connections and open drains

- **Protection of ecosystems** by controlling the level of pollutants and sediment in stormwater;
  - grass swales,
  - soakage systems,
  - detention basins, and
  - constructed wetlands.
- **Creation of productive land** by managing the level of the natural water table.
  - open drains, and
  - sub-soil drains.



Source- 'Creating Customer Value from Community Assets Manual' published by the NAMS Group of Ingenium

Figure 2 – Stormwater & Land Drainage Services

The four major rivers within the City are the Avon River/ Otakaro, Heathcote River/Opāwaho, Styx/ Purakaunui and Halswell/ Huritini Rivers. Their situation within the urban area has the potential to affect the health, safety and wellbeing of residents. Rivers of equivalent size on Banks Peninsula (Kaituna, Okana) have much lesser health and safety implications because of their rural location.

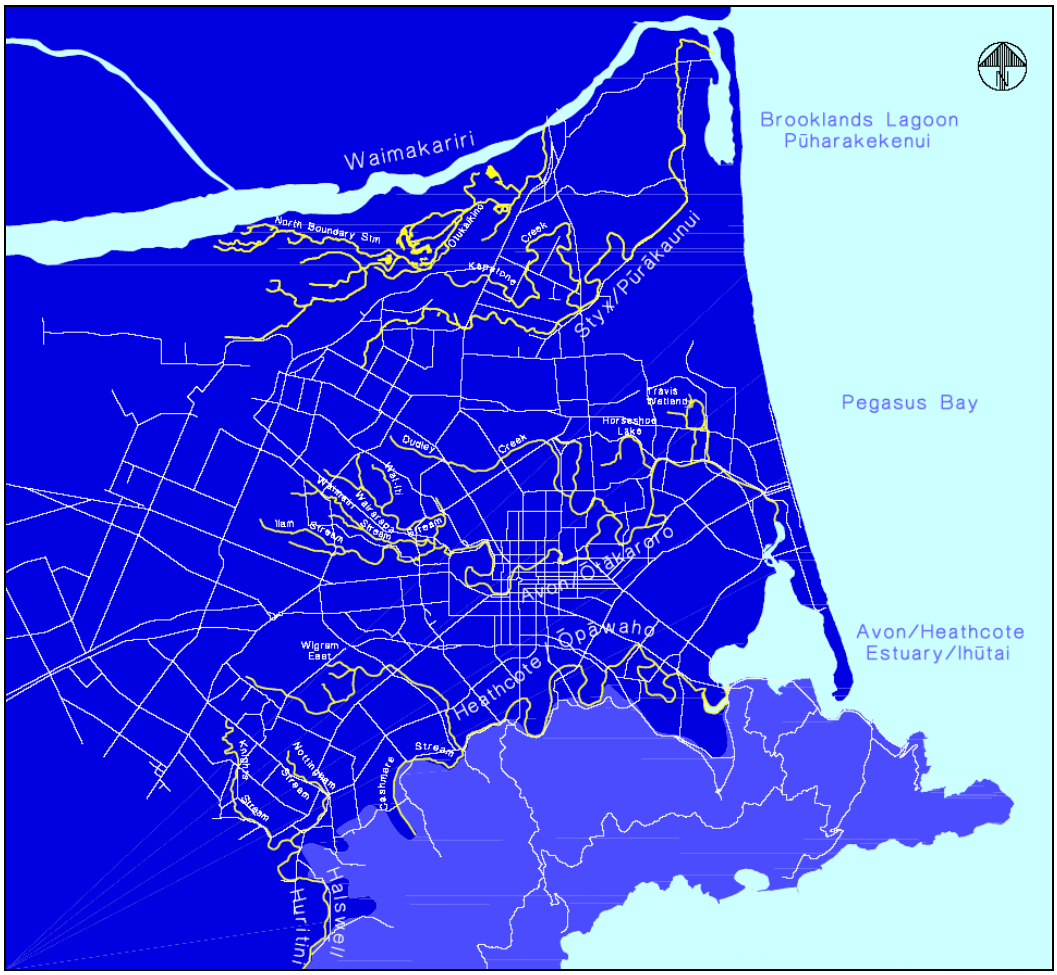


Figure 3 – Main Waterways in the Christchurch Area

Updated map of Christchurch and Banks Peninsula to come

The scope and value of the stormwater system is summarised. Plans covering major urban areas is included as Appendix B.

Utility waterways	Quantity	Book Value
- Piped reticulation:	785 km	$381M
- Stormwater pumping stations	28	$5.7M
- Stormwater detention basins	150	$3.6M
- Stopbanks	12 km	$1.6M
- Lined drains	69 km	$41M
- Unlined drains	55 km	$1.5M

Natural waterways

-	Rivers (urban)	160 km	$8.5M (enhancements)
-	Environmental asset waterways	156 km	$9.1M
-	Banks Peninsula Streams	not quantified	
-	Covenants and esplanade strips	5.4 km	$0.9M

2.2 The Roles of Council

The Local Government Act 2002 has changed the focus of territorial authorities from being primarily focused on Council services and activities to coordinating the achievement of total community outcomes, with Council being only one of a number of organisations that can contribute to the achievement of the outcomes. Stormwater service issues that may impact on the achievement of these community outcomes are identified and evaluated in the risk assessment (refer to Section 5). The community outcomes adopted by Council are included in Appendix C.

- The Council has several roles with respect to stormwater drainage services in its area. The first of these is to coordinate the setting of Community Outcomes to which stormwater and other activities in the city are expected to contribute, and to monitor progress towards the achievement of these outcomes. Community Outcomes, which are stated in Council's Long Term Council Community Plan (LTCCP), are set through a process of public consultation and describe the type of city desired by the community in the future. The Council is one of a number of organisations that will contribute to the achievement of community outcomes.

- The second role of Council with respect to stormwater in the City is as a service provider. The control and ownership of public stormwater systems in Christchurch is vested in the Council on behalf of the community. Council is responsible for all strategic and control types of activities associated with the stormwater system, including policy setting, setting of charges, setting service levels, ensuring the required outcomes are achieved as efficiently as possible and quality assurance. Council aims to provide the lowest cost services to the Community that is consistent with achieving the required service standards and long term sustainability.

Council has legislative obligations associated with stormwater services under the following statues:

- Health Act 1956 – under Section 23 Council has a general responsibility "to improve, promote and protect public health within its district". This involves identifying potential health risks and ensuring that these risks are managed to within acceptable levels. This responsibility extends to stormwater drainage (both systems provided by Council and privately).
- Building Act 1991 – under Section 24 every local authority is responsible for enforcing the provisions of the New Zealand Building Code, which requires that *"buildings and sitework shall be constructed in a way that protects people and other property from the adverse effects of surface water"*. This requirement is achieved by the provision of private stormwater systems to service developments. These private systems usually discharge into Council owned stormwater systems.
- Resource Management Act 1991 (and amendments) – requires territorial authorities to manage the effects of the use, development and protection of land activities. Council, through the provisions of its district plan, other statutory responsibilities or as managers of community infrastructure, manage land use activities in ways that minimise impact on water quality.

2.3 Key relationships

Waimakariri and Selwyn District Councils adjoin Christchurch City. A significant cross boundary issue relates to management decisions by CCC in the Halswell River catchment, where there are potential flood level, sedimentation and water quality impacts on the lower reaches of the Halswell River and environmentally sensitive Lake Ellesmere within the Selwyn District Council boundaries.

Environment Canterbury (the operating names of the Canterbury Regional Council) has an environmental regulatory and monitoring role under the Resource Management Act that includes the management of resource consents issued for the discharge of stormwater run-off water to watercourses and groundwater. Discharges of stormwater before 4 July 2004 are currently authorised by a rule (General Authorisation for Stormwater) in the Canterbury Transitional Regional Plan (CTRP). Before the end of 2009 Environment Canterbury is expected to grant an Interim Global Stormwater Resource Consent for the whole of Christchurch City.

The proposed Natural Resources Regional Plan (Chapter 4: Water Quality) sets out Environment Canterbury's approach to water quality management, stating water quality issues, establishing water quality outcomes for different types of surface and groundwater bodies, and setting out the policies and methods to achieve these outcomes.

The Ministry of Health has statutory responsibility for public health issues in New Zealand including health related aspects of stormwater drainage. The Act specifically requires consultation with the Medical Officer of Health over the content of Water Services Assessments.

The results of preliminary consultation undertaken during the preparation of this assessment with Environment Canterbury and the Ministry of Health is included as Appendix F.

3.0 Definition of Communities

The Local Government Act 2002 requires that assessments of water and sanitary services be carried out at a "community" level. In making this determination, it is necessary to strike a balance between defining communities at a very high level in which case the assessments are likely to overlook what may be significant issues and a very detailed level in which case the assessments may become too complex to be reasonably comprehensible or of practical use.

Council has adopted the approach of defining communities by separating those areas serviced by Council and privately owned assets, and then further separating those areas serviced by a system that is distinctly different from the norm. Using this definition the following communities have been identified:

1. **Public drainage systems**

    a) Urban area to natural water – via street channels, street, sumps, pipes and open drains.
    b) Banks Peninsula settlements discharging to natural water via some public infrastructure.
    c) Rural areas serviced by Council maintained streams and drains.
    d) Brooklands – discharge to a controlled groundwater storage zone.

2. **Private drainage systems**

    a) Rural areas discharging stormwater run-off by either direct soakage to ground or via privately maintained open drains to natural water, either funded by:
        - Individual property owners, or
        - Collectively with the involvement of Environment Canterbury.
    b) Industrial areas discharging to ground via soakage basins
        - Christchurch international airport
        - Johns Road industrial zone
        - Halswell industrial area (part)

The extent and location of these communities is shown in Figure 4.

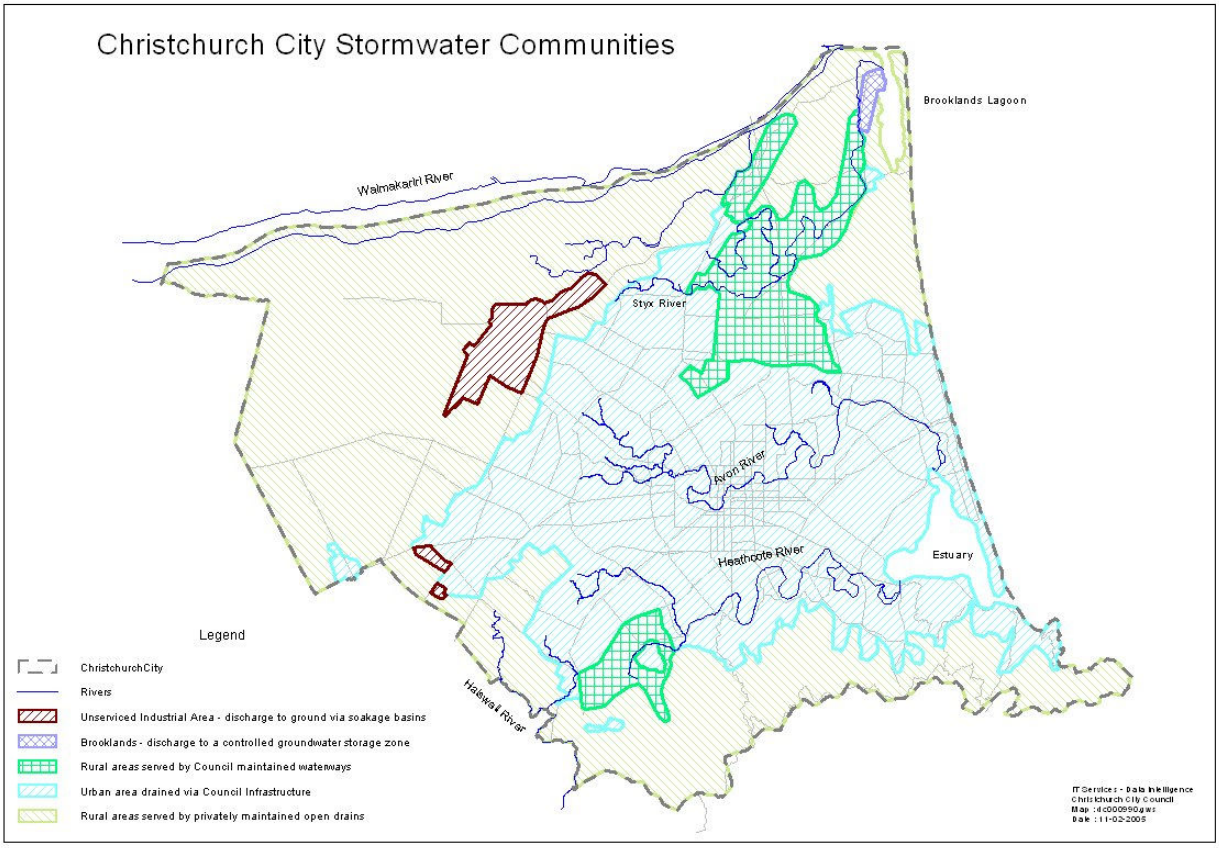


Figure 4 - Plan of Communities for the Assessment

4.0 Adequacy of stormwater services

4.1 Growth trends

Expansion and changes to the land drainage system are driven by two major influences:

- Population growth leading to city growth and associated land development.
- Demand for system enhancements to protect or restore natural values and provide improved recreational opportunities.

City growth generates requirements for the conversion of rural or semi rural land on the urban edge for residential and commercial use and in-fill subdivision to create additional residential sections. Both development types greatly increase the proportion of impervious area, and the resulting increase in the quantity and intensity of stormwater run-off requires new and upgraded stormwater mains and stormwater treatment and detention facilities. The infrastructure mix is dependant on the location of growth areas and external drivers such as flood management strategies and regional water quality and quantity plans.

The anticipated areas of significant residential growth (shown in Figure 5) are predominantly in the Styx and Halswell River catchments, both of which are controlled by Flood Management Plans.

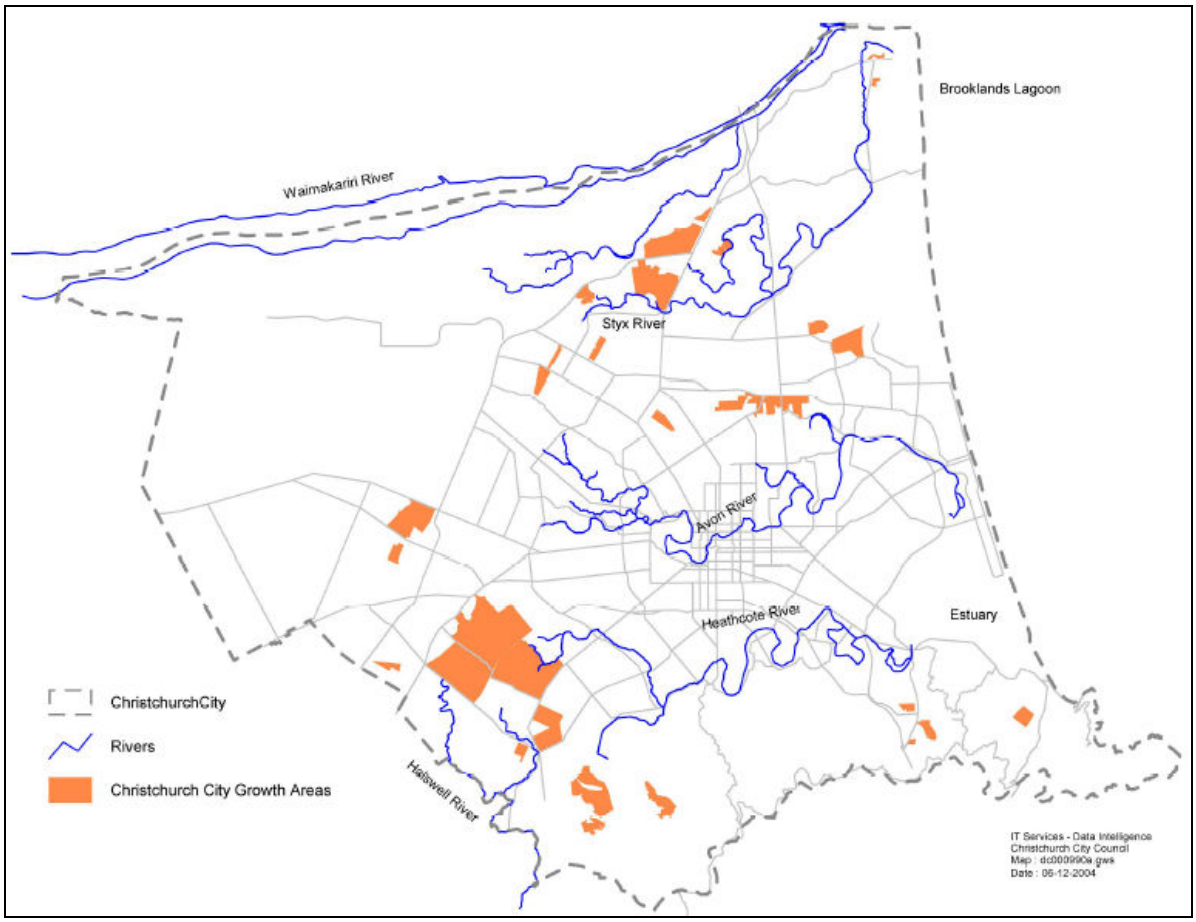


Figure 5 – Christchurch Growth Areas

Relatively strong population growth (8%) is forecasted in Christchurch over the next 20 years, although this is a reduction on the 10% experienced over the period 1991 to 2001. The trend of increasing population density in the urban area due to infill housing and apartments (20.3 to 20.9 residents/ hectare over the period 1996 to 2001) is expected to continue.

4.2 Development issues and constraints

A large area of urban Christchurch is located on floodplains and there are significant areas at risk from flooding, with the levels of damage increasing significantly as silt laden stormwater enters buildings.

The Christchurch Drainage Board Council installed many flood relief works over the past 40 years in response to a series of destructive floods through the 1960's, 1970's and 1980's, the largest and most important single work being the Woolston Cut which bypassed the 2.75 kilometre Woolston Loop to solve flooding in the Lower Heathcote River.

Flood awareness maps are maintained to record of all known flood prone areas, and extensive studies have been undertaken to support Floodplain Management Plans for the Styx River, Heathcote and Avon Rivers which identify the location and intensity of development and strategies for the management of stormwater capacity and environmental issues.

The stormwater ponding and flood management areas within the city are shown in Figure 6. These are generally located alongside the major river systems and along the coast.

The floodplain management approach focuses on reducing actual and potential flood damage through the adoption of a combination of;

- stormwater capacity upgrade projects,
- planning (implemented through the District Plan) measures, such as zoning, waterway setbacks, restrictions on excavation and filling, policies and minimum floor level restrictions,
- maintaining the storage capacity of floodplains, wetlands, and ponding areas,
- installation of both private and public stormwater retention facilities,
- specific criteria (Waterways, Wetlands and Drainage Guide) for design related to the frequency of inundation and the damage, and inconvenience impacts,
- requiring secondary flow-paths to convey floodwater safely when the capacity of the primary stormwater system is exceeded, and
- other measures.

The combination of historical investment in physical upgrading works and planning measures has effectively mitigated risks associated with the inundation of dwellings and buildings, and there are very few urban development constraints in the city that are not mitigated by planning rules, proper subdivision design and building design.

Ongoing drainage upgrading work is programmed in association with road upgrading works and where catchment modelling identifies potential flooding issues associated with sub-divisional development. Specific projects programmed to increase the capacity of the stormwater drainage network are;

- South West Christchurch stormwater management planning
- Belfast Area Plan stormwater component
- Horners Drain/Kruses Drain capacity improvement planning
- Cranford Basin stormwater management planning

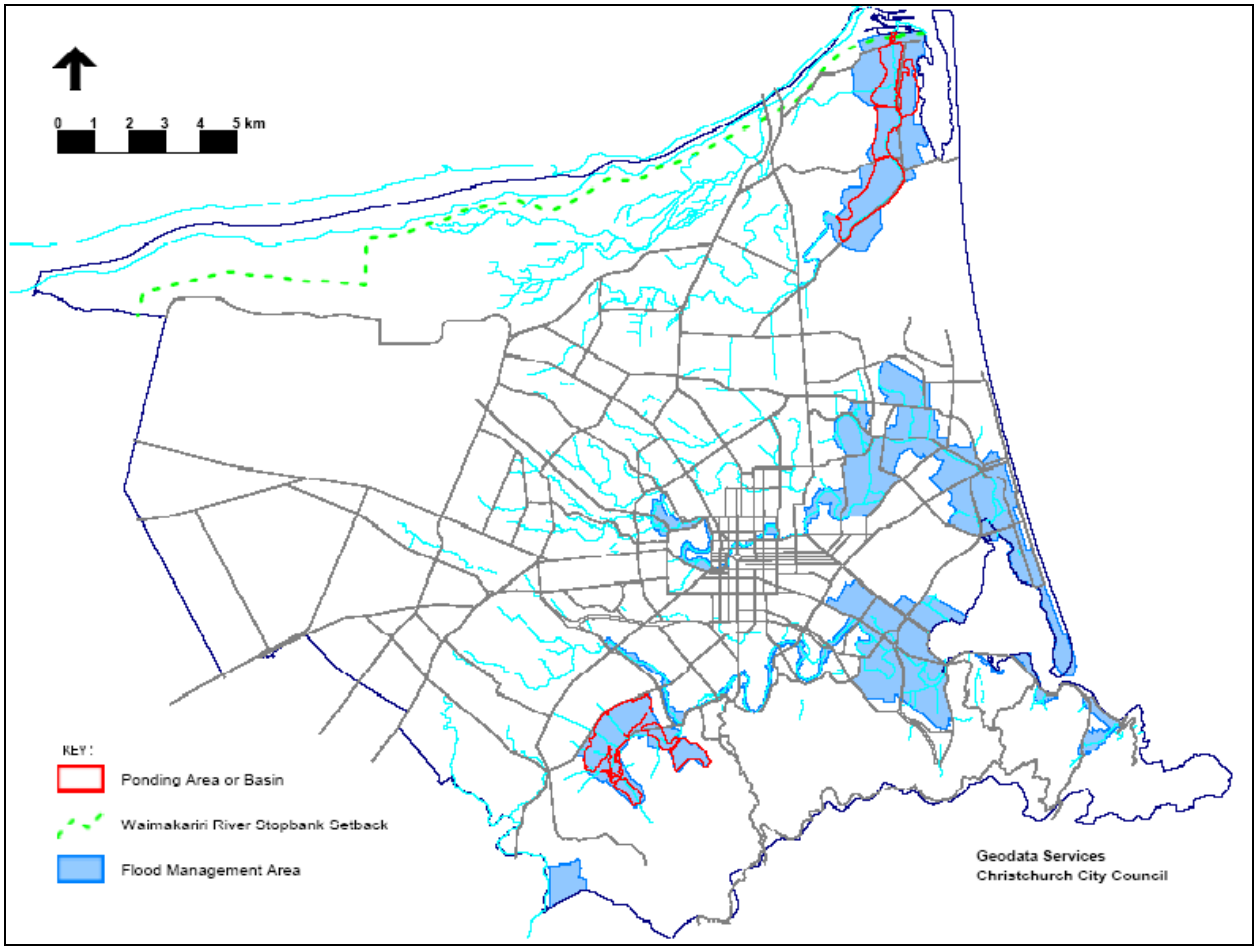


Figure 6 – Flood Management Plan

In rural areas there are unlikely to be significant constraints on additional rural-type development related to the disposal of stormwater.

4.3 Rural Areas and Banks Peninsula

The dispersed nature of rural development means that, in general, runoff from roads and buildings can be accommodated safely within the immediate area. Contaminants from the more heavily trafficked roads may be detectable in the environment, including in groundwater, but are not expected to affect community health.

Stormwater issues in both the urban and rural parts of Banks Peninsula are less critical than in the city, mostly due to relatively low levels of development. Known problems include:

- Less well developed stormwater infrastructure in small settlements has some capacity problems
- Pipe systems are in poorer condition than in the city
- Loess soils exposed to erosive processes and increased runoff by roading, drains, agricultural activities and reduced forest cover are prone to slips, erosion and sediment discharge.

The geology of the area is highly sensitive to change and, as development continues, stormwater issues will become more and more prominent. Sedimentation on streams and harbours is highly visible and is increasingly becoming a subject of local concern.

5.0 Public health risks and environmental impacts

5.1 Assessing risks

Risks associated with the stormwater drainage to each community have been assessed in terms of their potential to compromise the achievement of public health and environmental (to the extent that contamination of natural water resources impacts on public health) community outcomes for Christchurch City. The Community Outcome statements relating to stormwater and land drainage services, and the manner in which these services contribute to their achievement, are shown in the table below.

Christchurch City Community Outcomes			
A Sustainable, Natural Environment	**A Safe City**	**Healthy And Active People**	**Inclusive Communities**
Our City's natural resources, biodiversity, landscapes and ecosystem integrity are protected and enhanced.	Our City's urban form and infrastructure maximise safety and security for all people from crime, injury and hazards.	Our City provides the natural and built environments that enable people to enjoy long and healthy lives.	Our City encourages a diversity of lifestyles, and a sense of social connection, place and identity.
			
Waterways are planned and managed to take advantage of naturally occurring drainage corridors, & to provide natural habitat for plants and wildlife. Naturally occurring wetlands are protected.	The waterway system is designed to minimise the impact of 50 year floods. Waterways are designed to minimise risks from drowning.	Access to and along waterways is improved to encourage outdoor recreation such as walking & canoeing.	Residents are encouraged to become involved in caring for waterways and wetlands in their neighbourhoods.

The methodology used to quantify risk is consistent with AS/NZS 4360:1999 Risk Management. Risks are assessed in terms of the likelihood they will occur and the resulting consequences using the framework adopted in Council's asset management plan for risk assessment purposes.

The risk framework and detailed risk assessment are included as Appendices D and E respectively. Risk issues and mitigation proposals are stated in the Assessment of Communities in Section 6.

As the focus of this assessment is on public health, only risks associated with the flooding of habitable buildings are considered. Nuisance flooding is addressed through the Asset Management Planning process.

5.2 Risks associated with the lack of a reticulated stormwater drainage system

The effective disposal of stormwater is important for public safety, the protection of property and the environment and to minimise disruptions to the ability of the community to use public amenities such as transportation systems.

In the absence of a reticulated stormwater system individual properties must make individual arrangements for stormwater disposal. The onsite disposal of stormwater in urban areas is often impractical and is likely to lead to significant differences from property to property in the standard of stormwater disposal. In Christchurch approximately 30% of the city is located on poor draining soils which do not support the effective functioning of on site stormwater soakage systems. Inadequate stormwater disposal is likely to lead to overland flows onto adjacent properties.

Stormwater retention tanks can be used in conjunction with a reticulated stormwater system in urban areas, offering the benefit of reducing peak discharges to the stormwater system and reducing the use of the reticulated water supply for purposes such as garden watering.

Councils must provide systems for the disposal of stormwater from public land such as roads. In urban areas an integrated community wide approach to stormwater management is more effective than an individual piecemeal approach with the stormwater system provided to dispose of stormwater from public land also being designed to accommodate stormwater from private property.

Reticulated stormwater systems are not generally practical or cost effective in rural areas. Because of the much larger allotments in rural areas and the higher proportion of pervious (vegetated) areas, problems with individual stormwater disposal in rural areas are less than in urban areas.

5.3 Risks associated with stormwater services

Potential health impacts associated with the stormwater drainage network are:

- Illness caused by contact with micro-biological or chemical contaminants in natural water resources through the use of streams, rivers, estuaries and beaches for recreational purposes, or drinking potable water drawn from pollution water sources.
- Injury or death caused by falls from stormwater structures or drowning.
- Illness from mosquito bites.

Due to the nature of waterways, any catchment alterations in both the urban and rural situation will have an impact downstream unless suitable design and management measures are taken to mitigate those impacts. Potential environmental impacts of stormwater flows in both urban and rural locations relate to degraded water quality, sedimentation, channel erosion, loss of riparian vegetation, increased nutrient loading and habitat fragmentation. In addition stormwater infiltration to groundwater has implications for groundwater quality, particularly where it is affected by spills or illegal discharges.

Council undertakes an on-going water quality monitoring programme. The range of contaminants in stormwater and the current extent of environmental impacts on the City's watercourses are:

- **Microbiological** concentrations **(**including bacteria, viruses and protozoa) generally exceed contact recreation guidelines. In particular the Medical Officer of Health is concerned at the level of pollutants in the Avon, Estuary, the Groynes, where there is extensive recreational activity and, to a lesser extent, the Heathcote. The main source of contamination in dry weather is believed to be waterfowl. The impact of wet weather pollution, which comes from roof and sealed surfaces runoff, illegal connections and occasional sewer overflows, is lessened by rain water dilution and the low level of recreational activity at these times.
- **Chemical** contaminants include organic compounds such as hydrocarbons, pesticides and organic wastes, and inorganic compounds such as metals and metaloids.
  The concentration of heavy metals in stormwater and river sediments exceeds the relevant water quality guidelines for the protection of aquatic organisms, although there is variability from site to site and storm to storm. The risk of toxic effects from heavy metals in the estuary is low, and dredging in the lower reaches of rivers could prevent a build-up of contaminated sediment. The concentration of polynuclear aromatic hydrocarbons in the Avon/ Heathcote estuary does exceed the relevant low-level standard.
- **Nutrients**, including nitrogen and phosphorus, can cause algal blooms and prolific growth of aquatic plants when elevated levels. There is extensive growth of algae, especially in the Avon River, likely to be linked to nutrient enrichment in the streams. Regular toxic algal blooms in Wairewa/Lake Forsyth are caused by nutrients, warm water and lack of wind.
- **Physical contaminants** such as fine sediment can affect the colour and clarity of the water and the behaviour of aquatic ecosystems. The loess soils on the Port Hills are particularly susceptible to erosion as a result of earthworks or subdivision. The Avon and Heathcote Rivers were gravel bed water ways prior to European settlement. The effect of past and current land uses has resulted in fine sediment blanketing the gravel beds and the build up of mounds of fine sediment below the outlets of some stormwater pipes. As flushing flows occur relatively infrequently in lowland waterways these streams have limited if any ability to be self cleansing

Although microbiological concentrations, at times, exceed contact recreation guidelines, neither Council nor the Medical Officer of Health have any record of injury or illness that is attributable to deficiencies in the design, operation or maintenance of the stormwater network, and health risks are assessed as low.

There is no evidence of groundwater contamination attributable to stormwater quality, although there are significant risks associated with leakage or spills from chemical storage facilities at the airport and adjoining industrial area, where the aquifers are semi-confined. The risk of aquifer contamination from stormwater soakage facilities is low.

5.4 Risk mitigation controls

Water quality monitoring indicates that several of the environmental parameters monitored exceed minimum guideline levels. Ecosystems in the majority of streams are in degraded condition, with nutrient enrichment and sedimentation of riverbeds from urbanisation and general land use activities in the catchments.

Although Council would prefer the indicators to be lower, the impacts on waterway habitats appears to be accepted by the majority of the community and a rigorous debate on the community costs and benefits of markedly improving environmental outcomes is required.

The overriding objective of both Council and Environment Canterbury is to ensure there is no further decline in the quality of water in the City's streams, rivers, estuaries and aquifers. Council currently operates the stormwater drainage network under a general authorisation agreement with Environment Canterbury. Currently only sub-divisions of greater than 30 allotments require Resource Consents.

Variation 1 of the Proposed Natural Resources Regional Plan notified by Environment Canterbury on the 3 July 2004 contains rules controlling stormwater discharges and sets water quality standards for rivers and lakes. All new stormwater discharges after the 3 July 2004, and eventually all existing discharges will be required to meet the provisions of the Plan.

Council will continue to implement the following controls to manage health and safety risks in the City and ensure there is no further degradation of waterways;

- Work with Environment Canterbury and the Ministry of Health to monitor water quality in the City's streams, rivers and beaches and identify actions required to protect public health.
- Implementing stormwater collection and disposal in growth areas according to Integrated Catchment Management Plans approved by Environment Canterbury
- Planning measures are taken to ensure no habitable building is inundated, and where there are capacity constraints within the system Council has an objective to ensure there is no increase in peak discharges as a result of urbanisation.
- Investigate the effectiveness of urban design options offering environmental benefits, such as grass swales and detention ponds, and implement as justified.
- Maintain infrastructure serviceability by implementing a programme of inspections, vegetation trimming, rubbish removal, aquatic weed removal and dredging of sediments.
- Maintain and effective emergency response capability for system failures with health impacts.
- On-going policy development and consultation with developers and the general public.
- Community education, including school education programmes, publications and the maintenance of a website.
- Stream naturalisation programme in conjunction with urban development. Riparian revegetation, apart form improving visual aesthetics, has a significant role in maintaining or improving water quality and

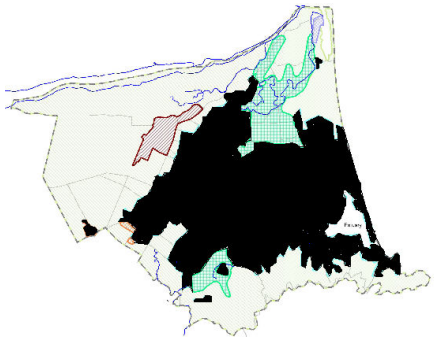
the habitat by stabilising banks against stream erosion, filtering and trapping the overland flow of contaminants from nearby land.

- Implement the specific health and safety related design criteria in Waterways, Wetlands and Drainage Guide, covering materials selection and features such as access points to water, public accessway, drainage structures, lighting and signage, and fencing.

6.0 Assessment of Public Systems

6.1 Urban area to public drainage system

Description



Council provides a stormwater system for the effective disposal of stormwater from the developed urban and contiguous rural areas (zoned for residential development) within the City. The urban community serviced by the public drainage system covers all built up areas in the city excluding the small industrial pockets at Christchurch airport, John's Road and Halswell where free draining soils allow the discharge of stormwater run-off to the ground via soakage facilities.

The public system comprises a network of pipes and open channels which convey stormwater to natural watercourses, and stormwater detention facilities within the network which reduce peak flows and treat stormwater. The reticulated urban area at Templeton discharges stormwater into soakage areas owned and maintained by CCC. A map of the network is included as Appendix F.

The system is generally designed to minimise the impact of floods up to a return period of 50 years (as stipulated in the Building Act), risks from drowning and environmental impacts. The capacity of the primary system of pipes and drains is designed to handle a 5 year event without overflowing. Flows in excess of this event are managed by secondary flow paths and storage areas designed to protect property and public health. A more conservative design approach is taken for stormwater drainage on hills and natural waterways to avoid nuisances in, respectively, floods of 20 year and 100 year return period.

Planning measures are taken to ensure no habitable building is inundated, and where there are capacity constraints within the system Council has an objective to ensure there is no increase in peak discharges as a result of urbanisation.

Roof and hardstand water from private property is discharged to a controlled Council connection or a specifically designed system. The installation of private stormwater retention tanks prior to discharge into the public stormwater system to reduce peak discharges to pre-development levels (negating the need to provide or upgrade piped systems) is an available option considered for new developments.

Current Demand

With minor exceptions the urban area is served by stormwater networks that provide an agreed level of protection against nuisance flooding (5 and 50 year return period respectively). There is demand from sectors of the community for the city to reduce the impacts of stormwater on the natural environment, and this demand is seen also in Environment Canterbury's proposed water quality plan.

Future Demand

Growth in the urban community will be a mix of infill housing, predominantly in the central city, and new development in a number of areas including Belfast, south west Christchurch, Burwood, Yaldhurst, Heathcote Valley and the Cashmere Valley. Current stormwater system upgrading programmes, which include a mix of increasing pipe capacity, detention basins and soakage basins, are designed to maintain or reduce current peak flow levels. It is considered that there are no constraints to development in the urban area serviced by public systems.

Risk Assessment

Community Outcome Linkage	Risk	Risk Rating
Sustainable City	Contamination of aquifers from soakage pits.	Low
	Disturbance of natural springs affects habitats in streams and rivers.	High
	Toxic sediment build-up in estuary & rivers.	Moderate
	The decline in the health of the aquatic ecosystems of the Avon and Heathcote Rivers.	High
Safe City Healthy & Active People	Water quality of urban streams does not comply the proposed standards of Chapter 4 of the Variation 1 of the Proposed Natural Resources Regional Plan due to the entry of sewage into the stormwater system (indirect impact addressed in the Council's wastewater service assessment).	Moderate
	An exotic mosquito establishes in Christchurch waterways and wetlands and becomes a vector for disease.	Moderate
	Contamination of rivers used for recreation - micro-biological and toxicants.	Low
	Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 3 years)	High
	Climate change– more intense rainfall & sea-level rise leads to flooding of buildings.	Low
	Failure of soakage facilities (Templeton) – flooding of buildings	Low
	Stormwater structures non-compliant with CCC design code.	Low
	Flooding of buildings due to network failures - poor condition or maintenance.	Low
	Growth- increased runoff from development exceeds system capacity (poor planning).	Low
	Standard of stormwater protection in developed areas eroded by increase in proportion of impervious areas (eg due to infill housing).	Low
	Growth- increased run-off to Halswell causes flooding in Selwyn District.	Low

Options

The assessment of risks associated with stormwater management in developed areas of Christchurch indicates that the system is being well managed, that processes are in place to address significant issues and that no major new initiatives are required.

Environment Canterbury are monitoring impacts of development on natural springs and are developing policies to mitigate these risks. Options required to address any gaps between existing environmental performance

and water quality standards adopted in the Environment Canterbury Natural Resources Plan will be considered when that Plan becomes effective.

Options to address water quality degradation.

1. Complete the pilot South-west Christchurch integrated catchment management plan (ICMP) and commence a Plan for the upper Styx Catchment. Coordinate between Council Units to locate, monitor and control harmful commercial/industrial discharges.

2. Develop and approve a programme for preparing and implementing ICMPs. (Includes the Option 1. measures). Investigate operational measures such as street sweeping and sump cleaning that will improve discharge quality, and implement selected measures. Develop codes of practice that will minimise the effects of new urban and greenfields developments on surface water quality (in preparation).

3. As above, and in addition introduce planning measures to protect groundwater from the effects of urban activities.

4. As above and in addition develop and fund a Council strategy implemented by cross-Unit team(s) to minimise the impacts of stormwater discharges on receiving waters and meet (when operative) NRRP standards.

Options to address the risk of land flooding due to urban intensification:

1. Continuous improvement of stormwater infrastructure as proposed in the stormwater drainage asset management plan.

2. A step increase in stormwater capacity at an earlier point in the urbanisation cycle.

The Council's current practice is continuous improvement.

Options for controlling the risk of an insect vector establishing are:

1. To minimise the potential habitat for insects by minimising the number of open water bodies in the city,

2. To limit the number of likely habitats while monitoring for insect nuisances and maintaining an awareness of potential problems,

3. Control insect populations only if an exotic insect establishes in Canterbury.

The Council currently implements option two.

Climate change and associated effects is a risk which should be dealt with via planning measures until the timing of effects is better understood.

Role of Council

The proposed role of Council is to continue to:

- Facilitate community consultation to establish community outcomes and service standards for stormwater services.
- Develop strategies, policies, infrastructure management and development plans, City Plan measures and public education programmes
- Ensure community outcomes and environmental and public health standards are achieved through delivery of public infrastructure by developers.
- Own and maintain infrastructure delivering public stormwater services to the community.
- Partner with Environment Canterbury and the Ministry of Health in the achievement of regulatory outcomes, and advocate for the community in the setting of environmental standards.
- Monitor city growth, water quality, the health of habitats, and community satisfaction.

6.2 Banks Peninsula Settlements

Description

Map of
Banks Peninsula
Settlements
to come

Settlements on Banks Peninsula generally have some form of publicly maintained stormwater network (in proportion to the size of the community), although only the larger settlements of Lyttelton, Governors Bay, Diamond Harbour and Akaroa have appreciable amounts of piping. Stormwater from properties may be discharged onto hillsides where this is convenient or, where they exist, to the kerb and channel or roadside drains. Built-up areas are not extensive and stormwater is quickly directed into hillside watercourses. Aside from Lyttelton, where pre-existing watercourses are enclosed in "brick barrels", formal stormwater infrastructure is minimal.

Growth

Growth of Banks Peninsula communities is slow because of isolation. Some growth is occurring around Lyttelton Harbour but growth further afield is sporadic as developments occur for holiday housing. Growth areas have not been predicted with any certainty.

Current and Future Demand

Current demands are for:

- Improved maintenance of public drains, particularly roadside drains and pipe inlets
- Assessing the condition of Council owned networks
- New stormwater infrastructure required for development

Risk Assessment

Community Outcome Linkage	Risk	Risk Rating
Sustainable City	Contamination of community watercourses with chemicals and nutrients.	Low
Safe City Healthy & Active People	Informal rural stormwater drains hamper emergency access during storms	Moderate
	Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 3 years).	Moderate
	Climate change– higher intensity rainfall results in flooding of buildings.	Low
	Flooding due to drainage failures - poor condition or maintenance.	Moderate
	Growth and rezoning- increased runoff from development exceeds system capacity (poor planning).	Moderate
		Low

Issues and options to be considered

The assessment of risks associated with stormwater management in the Banks Peninsula settlements indicate that moderate risks exist associated with the lesser degree of development of stormwater infrastructure on the Peninsula. Environment Canterbury's proposed Natural Resources Regional Plan will form a basis for mitigating environmental risks. Risks to health and safety may be over-stated in that the risks are experienced by relatively few people who are in some measure prepared for these risks.

Environment Canterbury rather than the CCC is responsible to monitor the impacts of rural run-off on water quality, and to develop strategies to mitigate these risks. Options required to address any gaps between existing environmental performance and water quality standards adopted in the Environment Canterbury Natural Resources Plan will be considered when that Plan becomes effective.

Policies and processes are in place to address growth issues, but could be of limited effect without vigilant supervision and the cooperation of developers.

There are risks associated with the impact of climate change but these are unquantified and may be no greater than the risks arising from growth.

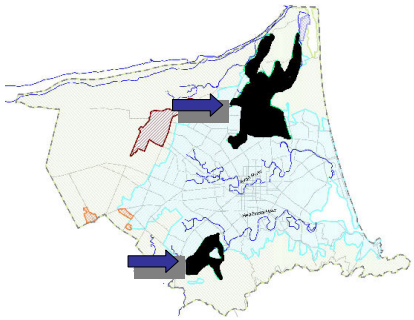
Role of Council

The proposed role of Council is to continue to:

- Facilitate community consultation to establish community outcomes and service standards for stormwater services.
- Develop strategies, policies, infrastructure management and development plans, City Plan measures and public education programmes.
- Ensure community outcomes and environmental and public health standards are achieved through delivery of public infrastructure by developers.
- Own and maintain infrastructure delivering public stormwater services to the community.
- Prioritise the assessment of asset condition in Banks Peninsula infrastructure
- Partner to Environment Canterbury and the Ministry of Health in the achievement of regulatory outcomes, and advocate for the community in the setting of environmental standards.
- Monitor city growth, water quality, the health of habitats, and community satisfaction.

6.3 Rural area to public drainage system

Description



Rural areas serviced by publicly maintained natural watercourses and man-made open drains are in Marshland, Belfast and Halswell where on-site disposal is not practical because the predominant soil type is impervious or there is a high water table. The open drains have a dual role in lower the water table to create productive land.

Growth

The significant development of rural land will occur in south west Christchurch, where the majority of existing rural land serviced by public drains is either committed, zoned or likely to be zoned for urban use. There is also the possibility of further tracts of rural land being rezoned for lifestyle blocks.

The anticipated minimal development of rural land with public stormwater services in Belfast is currently provided for. There appears to be a trend for less intensive horticultural development which may lessen environmental impacts relating to the degradation of streams by sediments, nutrients and chemicals. In addition the new Hazardous Substances and New Organisms Act will tighten control on the application of chemicals and reduce contamination risks.

Current and Future Demand

Current demand is satisfied by the infrastructure in place. Future demand in this community is expected to reduce as rural areas become developed as envisaged by the Council's area plans.

Risk Assessment

Community Outcome Linkage	Risk	Risk Rating
Sustainable City	Contamination of recreational watercourses with chemicals and nutrients.	Low
Safe City Healthy & Active People	Contamination of rivers - micro-biological and toxicants.	Low
	Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 3 years).	High
	Climate change– higher intensity rainfall results in flooding of buildings.	Moderate
	Flooding due to network failures - poor condition or maintenance.	Low
	Growth and rezoning- increased runoff from development exceeds system capacity (poor planning).	Low
	Growth- increased run-off to Halswell causes flooding in Selwyn District.	Low

Issues and options to be considered

The assessment of risks associated with stormwater management in the serviced rural indicate that policies, processes and programmes are in place to address growth issues, but that there are significant risks associated with the impact of climate change and, in the future, meeting stricter water quality standards.

Council will work with Environment Canterbury to monitor the impacts of rural run-off on water quality, and to develop strategies to mitigate these risks.

Options required to address any gaps between existing environmental performance and water quality standards adopted in the Environment Canterbury Natural Resources Plan will be considered when that Plan becomes effective.

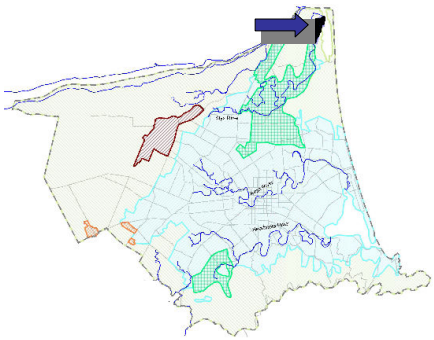
Role of Council

The proposed role of Council is to continue as:

- Facilitator of community consultation to establish community outcomes and service standards for stormwater services.
- Owner of infrastructure delivering public stormwater services to the community.
- Partner to Environment Canterbury and the Ministry of Health in the achievement of regulatory outcomes, and advocate for the community in the setting of environmental standards.
- Monitoring city growth, water quality and the health of habitats, and the development of policies, infrastructure management and development plans, District Plan measures and public education programmes to ensure environmental and public health standards are achieved.

6.4 Brooklands

Description



The Brooklands community is a small residential area situated adjacent to the Brooklands lagoon in the north-east comer of the city. Stormwater run-off is by controlled discharge to the groundwater storage zone via soakage trenches and perforated pipes constructed under grass roadside swales. This stormwater disposal system is also designed to lower the natural groundwater levels in the area.

Growth

The majority of land zoned for residential use is developed. Stormwater disposal from the limited additional development can be dissipated without overloading existing the system, and there are no development constraints.

Risk Assessment

Sustainable City	Contamination of aquifers from soakage pits	Low
	Contamination of Brookland Lagoon from urban stormwater run-off	Low
	Sediment build-up impacts on the Brookland Lagoon habitat.	Low
Safe City Healthy & Active People	Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 3 years)	Low
	Climate change– higher intensity rainfall and sea-level rise results in flooding of buildings	Low
	Growth- increased runoff exceeds system capacity (poor planning)	Low

Issues and options to be considered

As all identified risks associated with stormwater disposal from the Brooklands community are assessed as low no options have been considered

Role of Council

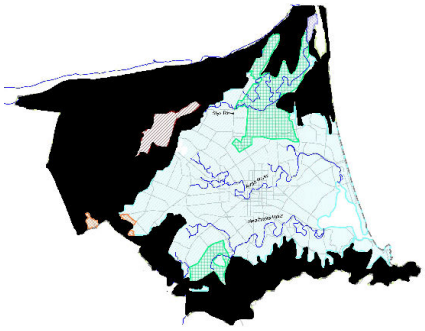
The proposed role of Council is to continue as:

- Facilitator of community consultation to establish community outcomes and service standards for stormwater services.
- Owner of infrastructure delivering public stormwater services to the community.
- Partner to Environment Canterbury and the Ministry of Health in the achievement of regulatory outcomes, and advocate for the community in the setting of environmental standards.
- Monitoring city growth, water quality and the health of habitats, and the development of policies, infrastructure management and development plans, District Plan measures and public education programmes to ensure environmental and public health standards are achieved.

7.0 Assessment of Private Systems

7.1 Rural areas discharging to soakage or private drains

Description



Unserviced rural areas are located between the developed urban area and the city boundary. The large area to the north and the Burwood forest reserve are predominately on free draining soils and gravels, and stormwater run-off is discharged by soakage to ground. Private drains maintained individually or collectively in schemes co-ordinated by Environment Canterbury are used in areas of poorer drainage, particularly in the south west and north eastern rural areas.

Stormwater run-off from the Port Hills rural areas drains to the Heathcote and Halswell Rivers.

Growth

Growth within the next 10 years is expected to be modest, and mostly of rural life-style block in nature. Accordingly it is anticipated that the rural nature of the area will not change significantly and that there will not be any significant changes in the quantity of stormwater run-off. Any development in these areas will be subject to Resource Consents which will set conditions for mitigating environmental impacts.

Risk Assessment

Community Outcome Linkage	Risk	Risk Rating
Sustainable City	Contamination of watercourses with chemicals and nutrients.	Low
	Contamination of groundwater in the recharge zone (downstream impact on the quality of bore water and streams)	Low
	Sediment build-up affects habitat in estuaries & rivers	Low
Safe City Healthy & Active People	Contamination of rivers - micro-biological and toxicants	Low
	Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 3 years)	High
	Climate change– higher intensity rainfall results in flooding of buildings	Low
	Growth- increased runoff from development exceeds system capacity (poor planning)	Low
	Growth- increased run-off to Halswell causes flooding in Selwyn District	Low

Issues and options to be considered

The assessment of risks associated with stormwater management in the serviced rural indicate that processes and programmes are in place to address growth issues, but that there are significant risks associated with contaminates in rural run-off that may particularly affect both unconfined aquifers in the groundwater recharge zone and streams in Halswell. There are also risks associated with the impact of climate change and, in the future, meeting stricter water quality standards.

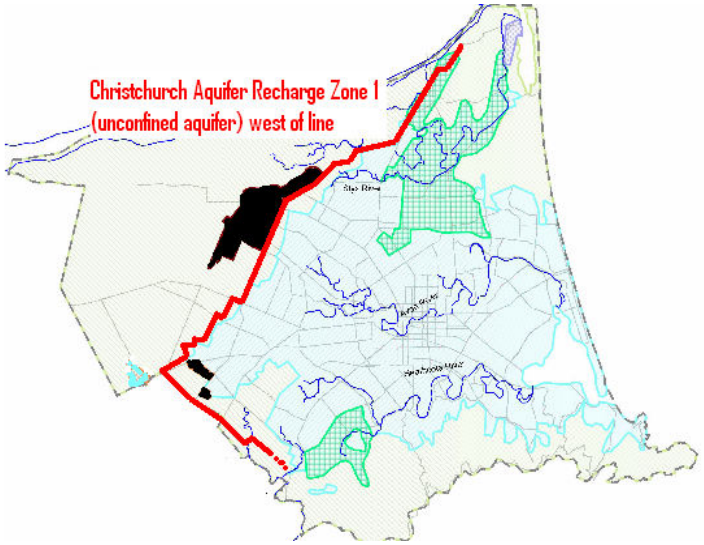
Options required to address any gaps between existing environmental performance and water quality standards adopted in the Environment Canterbury Natural Resources Plan will be considered when that Plan becomes effective.

Role of the Council

The Council's role with respect to the management of stormwater is specified in the General Authorisation issued by Environment Canterbury. Environmental issues are dealt with by way of conditions of Resource Consents, and for the rural un-serviced area the legal relationship is between Environment Canterbury and individual property owners.

It is recommended that Christchurch City Council has an advisory role with respect to stormwater disposal from the unserviced rural areas except where land is rezoned for urban use in areas of poor soakage, in which case the Council role will be as for the general urban area.

7.2 Industrial areas discharging to ground



Description

The Christchurch International Airport, adjoining John's Road industrial area and part of the Halswell industrial areas is located on free draining gravels covered by soils of variable permeability, and discharges stormwater directly to the groundwater storage zone via privately maintained soakage facilities.

Growth

Further development within this defined community will be serviced by private stormwater soakage facilities where it is demonstrated that there is adequate soil permeability. It is believed that soils are permeable and that there are no constraints to the planned developments related to contaminants and the ability to treat stormwater.

Risk Assessment

Community Outcome Linkage	Risk	Risk Rating
Sustainable City	Contamination of aquifers from soakage pits	Moderate
	Contamination of aquifers and watercourses from industrial spills and leakage	High
Safe City Healthy & Active People	The water quality outcomes established in the Proposed Natural Resources Regional Plan will not be achieved because of intensification of land uses development and the cumulative effect of discharges to land	Moderate to High
	Climate change– higher intensity rainfall results in flooding of buildings	Low
	Growth- increased runoff exceeds system capacity (poor planning)	Low

Issues and options to be considered:

No risks have been identified which are the direct responsibility of Council. Environment Canterbury are concerned at risks associated with leakage and spills from chemical and fuel storage and handling. The Christchurch City Council will support the Regional Council's role in ensuring any mitigation measures required are undertaken.

The risk of ground water contamination via private industrial soakage areas is controlled by Environment Canterbury through resource consents. Options available to the Christchurch City Council are to:

a. advocate for appropriate levels of environmental protection.

b. construct additional stormwater infrastructure to provide services to at-risk areas.

Role of the Council

It is recommended that CCC has a role as advocate for addressing Council's concerns relating to the protection of water resources.

References

References

CCC Community Plan 2004/ 2014

CCC Waterways and Land Drainage Asset Management Plan 2004

CCC Annual Survey of Residents – March 2004

Waterways, Wetlands and Drainage Guide – Part B: Design

Report - Analysis of Stormwater Quality Controls in Christchurch (Dr. A H Elliot, June 1997)

Report – Christchurch City Surface Water Quality Data 1995-97 and Water Quality Trends 1986- 1997

CCC District Plan Variation 48- “Management of the Flood Hazard in Christchurch”

Environment Canterbury ‘Proposed Natural Resources Regional Plan, Chapter 4: Water Quality’

Local Government Know-How - Guide to Assessing Water and Sanitary Services Under the Local Government Act 2002

AS/NZS 4360: 1999 Risk Management

Risk Management Guidelines- Companion to AS/NZS 4360:2004

Banks Peninsula Water and Sanitary Services Assessment 2005, MWH

An analysis of Water quality Data for Christchurch City waterways and the Standards in the Proposed Natural Resources Regional Plan, Malcolm Main, April 2008

Appendix A - Requirements for Water Services Assessments

Appendix A – Requirements for Water Services Assessments

The requirement for territorial local authorities to prepare water and sanitary service assessments, and the procedures for doing so, are set out in the following clauses of the Local Government Act 2002.

Section 125 of the Local Government Act 2002 requires that:

"125. (1) A territorial authority must, from time to time, in accordance with sections 126 and 127, assess the provision within its district of:

(a) water services; and

(b) other sanitary services."

and that:

"125 (3) An assessment may be included in the territorial authority's long-term council community plan, but, if it is not, the territorial authority must adopt the assessment using the special consultative procedure."

Note: "**Water Services"** is defined in the Act as meaning "water supply and wastewater services".

"Wastewater services" is defined in the Act as meaning **"….sewerage, treatment and disposal of sewage, and stormwater drainage"**

Section 126 of the Local Government Act 2002 requires that:

"(1) An assessment of water services must contain the following information:

a) A description of the means by which stormwater is disposed of within the district, including the extent to which drainage works are provided within the district by the territorial authority and by any other person; and"

b) An assessment of any risks to the community relating to the absence in any area of either a water supply or a reticulated wastewater service or both; and

c) A statement of current and estimated future demands for water services within its district and a statement of any issues relating to-

(ii) the health and environmental impacts of discharges of stormwater and sewage (whether treated or untreated) arising from current and future demands; and

d) A statement of the options available to meet the current and future demands identified under paragraph (d) and assessment of the suitability of each option for the district and for each community within it; and

e) A statement of the territorial authority's intended role in meeting the current and future demands identified under paragraph (d); and

f) the territorial authority's proposals for meeting the current and future demands identified under paragraph (d), including proposals for any new or replacement infrastructure.

Section 128 (1) of the Local Government Act 2002 requires that:

"In making an assessment under section 125, the territorial authority must:

(a) Consult the appropriate Medical Officer of Health; and

(b) Take into account the duties of the territorial authority under section 23 of the Health Act 1956.

Note: The duties of a territorial authority in respect of public health as defined in Section 23 of the Health Act 1956 are:

"….to improve, promote, and protect public health within its district, and for that purpose every local authority is hereby empowered and directed:

a) To appoint all such Environmental Health Officers and other officers and servants as in its opinion are necessary for the proper discharge of its duties under this Act:

b) To cause inspection of its district to be regularly made for the purpose of ascertaining if any nuisances, or any conditions likely to be injurious to health or offensive, exist in the district:

c) If satisfied that any nuisance, or any condition likely to be injurious to health or offensive, exists in the district, to cause all proper steps to be taken to secure the abatement of the nuisance or the removal of the condition:

d) Subject to the direction of the Director-General, to enforce within its district the provisions of all regulations under this Act for the time being in force in that district:

e) To make bylaws under and for the purposes of this Act or any other Act authorising the making of bylaws for the protection of public health:

f) To furnish from time to time to the Medical Officer of Health such reports as to diseases and sanitary conditions within its district as the Director-General or the Medical Officer of Health may require.

Section 128 (2) of the Local Government Act 2002 requires that

"In making an assessment of current and future demands for water services and options to meet those demands, a territorial authority must consider—

(a) The full range of options and their environmental and public health impacts, including (but not limited to)—

(i) On-site collection and disposal; and

(ii) Grey water and stormwater reuse or recycling; and

(iii) Demand-reduction strategies, including public education, information, promotion of appropriate technologies, pricing, and regulation; and

(iv) The full range of technologies available; and

(b) Any comments by the Medical Officer of Health."

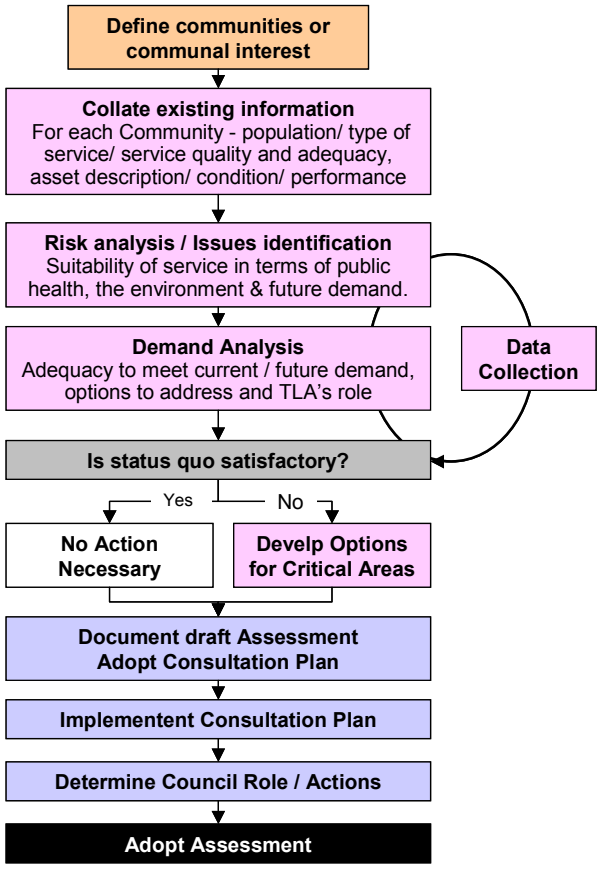
Assessment Process

The structure of this report follows the methodology shown in the figure opposite. The focus is on the analysis of information relating to environmental and public health impacts of the service, and the adequacy of plans to cater for any future growth in demand.

Where analysis shows that the existing provision of services is deficient or planned developments are insufficient to meet future demand, options are developed to address the deficiencies and presented for community consultation in this assessment.

A risk assessment of significant issues identified in consultation and data collation exercise has been undertaken to identify further data collection needs and whether options need to be developed to address service inadequacies.

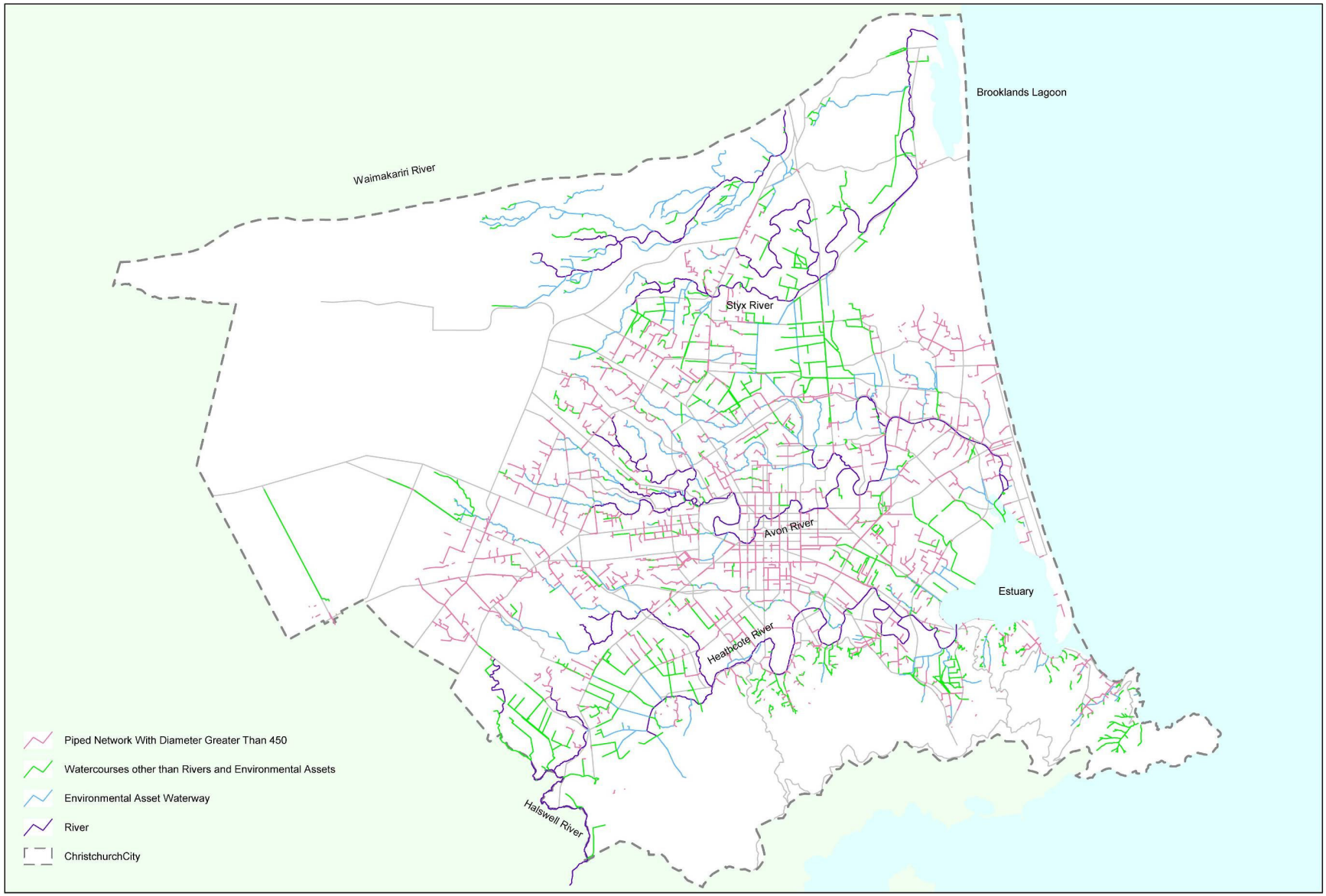
This assessment will be summarised in the Council's 2005 Long Term Council Community Plan (LTCCP) and be the subject of a public consultation process as specified in the Act. A final assessment will be adopted at the completion of the LTCCP consultation.



Service Assessment Process

Appendix B – Plan of Stormwater Drainage System

Appendix B – Plan of Stormwater System



IT Services - Data Intelligenance
Christchurch City Council

Christchurch Land Drainage System

Map : dc000991.gws
Date : 3-12-2004

Plans of Lyttelton and Akaroa stormwater reticulation to come

Appendix C – Community Outcomes

Appendix C - Community outcomes

The Local Government Act 2002 changes the focus of local authorities from being primarily focussed on Council services and activities to coordinating the achievement of total community outcomes, with Council only one of a number of organisations that may contribute to the achievement of the outcomes. It is important that stormwater services issues that may impact on the achievement of these community outcomes are considered in the Assessment, and a statement of possible issues is set out below as a basis for discussion.

Community Outcome	How Waterways and Wetlands Management Contributes	Issues Arising
Environmental		
A Sustainable City	Waterways are planned and managed to take advantage of naturally occurring drainage corridors, and to provide natural habitat for plants and wildlife. Naturally occurring wetlands are protected.	Adverse effects relating to the operation of stormwater systems are understood and managed (scouring, water quality, degradation). Identification of areas of the city where development or other permitted activity is restricted by the ability to manage stormwater to an acceptable standard.
A Safe City	The waterway system is designed to minimise the impact of 50 year floods. Waterways are designed to minimise risks from drowning.	Compliance with Resource Consent conditions for stormwater discharges Public safety risks associate with access to the stormwater system understood and managed. Ability of the stormwater system to meet future demand within natural and regulatory constraints Identification of areas subject to flooding.
Social		
Healthy and Active People	Access to and along waterways is improved to encourage outdoor recreation such as walking & canoeing.	Public safety risks associate with access to the stormwater system understood and managed.
Strong and Inclusive Communities	Residents are encouraged to become involved in caring for waterways and wetlands in their neighbourhoods.	No issues.

Current performance measures to assess the stormwater service's contribution to community outcomes include:

Aspect of Service	Issues Arising
Environmental	
Flooding is managed to prevent inundation into dwellings in accordance with design standards.	No dwellings constructed in accordance with design standards are inundated in residential areas
Stormwater retention and inline storage (such as ponding areas) for managing surface water are provided in new developments.	No increase in peak discharges as a result of urbanisation.
Managing waterways to meet drainage requirements while protecting and conserving environmental values.	Protect at least one kilometre of waterway margins per year by covenant, reserve contribution or road stopping. Residents believe waterways, drains and wetlands are well looked after (target 100%). Waterways cleared of vegetation at least 2 times per year to maintain efficient drainage (target 100%).
Social	
Provide opportunities to raise people's awareness, involve communities and guardianship of waterways.	Six educational bus trips organised per year, at least three community groups involved in environmental monitoring and guardianship and maintenance of the WaterLink website.

Appendix D – Risk Framework

Appendix D – Risk Framework

The risk framework below has been adopted for the identification, evaluation and management of risks at CCC and has been used, in a modified form, for the stormwater service assessment. The framework is consistent with AS/NZS 4360: 1999 Risk Management.

Context of Risk – Consequences of failure

The criteria in the "Risk Consequence Ratings Table" below are used to determine the impact of a failure event each of the critical business areas of CCC. Weightings have been applied to reflect the focus of the stormwater assessment on health/ safety, and environmental risks.

Impact	Impacts on Public Health and Safety	Environmental Damage	Environmental and Legal Compliance	Financial Impact: Direct Costs (Repair, Lost Revenue, 3rd party damage, legal costs)	Image, Reputation and Public Support	Service Delivery Impact on Customers and Community
Weighting	5	5	5	0	0	0
1 –Insignificant	No health or safety impact. Injury managed with 1st Aid	Small, reversible environmental harm permitted by terms of a resource consent.	No breaches.	< $10,000	No media attention or damage to reputation.	< 20 Customer-hours. Very localised-little disruptive effect.
2 –Minor	Minor health or safety impact on small number of people. Injury dealt with by Dr. No Hospitalisation	Localised non persisting contamination which dissipates/disperses. Death of flora/fauna where propagules are available locally for regeneration.	Minor breaches affecting very small part of the system or service.	$10,000 to $50,000	Minimal media attention, but minor damage to image to a small group of people. May be some local coverage-not front page.	20 – 500 Customer-hours. Inconvenience to small group of residents.
3 –Moderate	Serious health or safety impact on small number (injuries require hospitalisation) or minor impact on large number of people.	Serious damage or loss to a locally important habitat or ecosystem. Loss of a population of a locally uncommon species.	One-off major breach, affecting a small part of the network or service	$50,000 – 200,000	Negative local media coverage, community concerned about Council performance.	500 to 20,000 Customer-hours. Some disruption to a wider group.
4 –Major	Extensive injuries or significant health or safety impacts, single fatality.	Damage to or loss of a regionally or nationally important habitat. Local loss of a species. Habitat reduced below 20% of former (1840) extent. Establishment of significant new pest.	Several major breaches affecting a significant part of the network or service.	$200,000 – 1,000,000	Negative national media coverage, major decrease in community support. Loss of key staff.	20,000 to 500,000 Customer-hours. Significant effect on large group. Political involvement.
5 -Disaster	Widespread health or safety impacts, multiple fatalities.	Loss of a nationally significant habitat or ecosystem.	Widespread and major breaches of standards, failure to meet legislative requirements over most of system area / network.	>$1,000,000	Negative international media coverage, loss of community support. External enquiry. Appointment of Commissioner.	More than 500,000 Customer hours. Significant effect to community at large. Community alienation.

Likelihood of failure

The likelihood that a risk could occur. Considered the "Risk Probability Ratings Table".

A	Rare	Could occur only in exceptional circumstances (unlikely next 50 years)
B	Unlikely	Could occur at some time in the next 50 years
C	Possible	Could occur at some time in the next 10 years
D	Likely	Could occur once a year
E	Almost Certain	Is expected to occur several times a year
F	Certain	Occurs on a daily basis

Impact of failure

The results of the risk evaluation process provide a risk rating of 'low', 'moderate', 'high', or 'extreme', as a result of considering together the likelihood of failure and consequence of the risk occurring.

Likelihood	Consequences				
	1	2	3	4	5
A					
B					
C					
D					
E					
F					

Key – Risk Rating

Low
Moderate
High
Extreme

Appendix E – Risk Assessment

CHRISTCHURCH STORMWATER SERVICES										
Risk	**Current Controls**	**Current Risk Scores**				**Future Risk Scores**				**Comment**
		Impact		**Likelihood**	**Peak Risk**	**Impact**		**Likelihood**	**Peak Risk**	
		Health	**Environment**			**Health**	**Environment**			
URBAN AREA TO PUBLIC DRAINAGE SYSTEM										
Contamination of aquifers from soakage facilities	• Water quality monitoring	2	2	B	Low	2	2	B	Low	
Disturbance of natural springs affects habitats in streams and rivers.	• Resource consent process. • Monitoring of impacts by ECan	1	2	C	Moderate	1	3	D	High	
Toxic sediment build-up in estuary and rivers	• Sediment testing • Sediment control structures • Stream naturalisation programme	2	3	C	Moderate	2	3	C	Moderate	
The decline in health of the aquatic ecosystems of the Avon and Heathcote Rivers	• Water quality monitoring by CCC	3	3	D	High	3	3	D	High	
Water quality in urban streams does not comply with the proposed standards of Chapter 4 of the Variation 1 of the Proposed Natural Resources Regional Plan due to the entry of sewage into the stormwater system	• Inflow/ infiltration reduction programme	2	2	D	Moderate	2	2	D	Moderate	Indirect impact addressed in the Council's wastewater service assessment.
An exotic mosquito establishes in Christchurch waterways and wetlands and becomes a vector for disease	• Monitoring of insect numbers by Crown Public Health on behalf of CCC	3	1	C	Moderate	3	1	C	Moderate	
Contamination of rivers used for recreation - micro-biological and toxicants.	• Water quality monitoring • Emergency response plan	2	2	B	Low	2	2	B	Low	

CHRISTCHURCH STORMWATER SERVICES										
Risk	**Current Controls**	**Current Risk Scores**				**Future Risk Scores**				**Comment**
		Impact			**Peak Risk**	**Impact**			**Peak Risk**	
		Health	**Environment**	**Likelihood**		**Health**	**Environment**	**Likelihood**		
Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 5 years)	• Water quality monitoring programme • Stream naturalisation programme	2	2	B	Low	2	2	E	High	CCC will have an advocacy role in terms of promoting suitable water quality standards.
Climate change– more intense rainfall & sea-level rise leads to flooding of buildings.	• Reviewing international research • Monitoring rainfall patterns	1	1	B	Low	1	2	B	Low	
Failure of soakage facilities (Templeton) – flooding of buildings	• Emergency response plan	2	1	B	Low	2	1	B	Low	
Stormwater structures non-compliant with CCC design code.	• Approval of designs • Supervision of works	2	1	B	Low	2	1	B	Low	
Flooding of buildings due to network failures - poor condition or maintenance.	• Emergency response plan • Drainage inspection programme	2	1	B	Low	2	1	B	Low	Management responsibility is specified. Rapid response minimises impact.
Growth- increased runoff from development exceeds system capacity (poor planning).	• Network modelling • Regulatory control of development	2	1	B	Low	2	1	B	Low	
Standard of stormwater protection in developed areas eroded by increase in proportion of impervious areas (eg due to infill housing).	• Network modelling • Regulatory control of development	2	1	B	Low	1	1	D	Moderate	
Growth- increased run-off to Halswell causes flooding in Selwyn District	• Network modelling • Regulatory control of development	2	1	B	Low	2	1	B	2	

CHRISTCHURCH STORMWATER SERVICES										
Risk	**Current Controls**	**Current Risk Scores**				**Future Risk Scores**				**Comment**
		Impact			**Peak Risk**	**Impact**			**Peak Risk**	
		Health	**Environment**	**Likelihood**		**Health**	**Environment**	**Likelihood**		
BANKS PENINSULA SETTLEMENTS										
Informal rural stormwater drains hamper emergency access during storms	• Road drainage inspection programme	3	1	C	Moderate	3	1	C	Moderate	
Contamination of community watercourses with chemicals and nutrients	• Water quality monitoring • Emergency response plan • Public education	2	2	B	Low	2	2	B	Low	
Water quality resulting from development activity is non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 5 years).	• Sediment control plans required with development plans • Supervision of development	1	2 to 3	D	Moderate	2	2	D	Moderate	ECan may issue and monitor sediment discharge consents. CCC has control of the degree of supervision applied.
Climate change– higher intensity rainfall results in flooding of buildings.	• Reviewing international research • Monitoring rainfall patterns	1	1	B	Low	1	2	B	Low	
Flooding due to drainage failures - poor condition or maintenance.	• Emergency response plan • Asset Management programme	2	1	C	Moderate	2	1	C	Moderate	More likely in Akaroa, Lyttelton
Growth and rezoning- increased runoff from development exceeds system capacity (poor planning).	• Network studies • Regulatory control of development	2	1	B	Low	2	1	B	Low	

CHRISTCHURCH STORMWATER SERVICES										
Risk	**Current Controls**	**Current Risk Scores**				**Future Risk Scores**				**Comment**
		Impact		**Likelihood**	**Peak Risk**	**Impact**		**Likelihood**	**Peak Risk**	
		Health	**Environment**			**Health**	**Environment**			
RURAL AREA TO PUBLIC DRAINAGE SYSTEM										
Contamination of recreational watercourses with chemicals and nutrients	• Water quality monitoring • Emergency response plan • Public education	2	2	B	Low	2	2	B	Low	
Contamination of rivers - micro-biological and toxicants.	• Water quality monitoring • Emergency response plan	2	2	B	Low	2	2	B	Low	
Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 5 years).	• Water quality monitoring programme • Stream naturalisation programme	2	2	B	Low	2	2	E	High	CCC will have an advocacy role in terms of promoting suitable water quality
Climate change– higher intensity rainfall results in flooding of buildings.	• Reviewing international research • Monitoring rainfall patterns	1	1	B	Low	1	2	B	Low	
Flooding due to network failures - poor condition or maintenance.	• Emergency response plan • Drainage inspection programme	2	1	B	Low	2	1	B	Low	Management responsibility is specified. Rapid response minimises impact.
Growth and rezoning- increased runoff from development exceeds system capacity (poor planning).	• Network studies • Regulatory control of development	2	1	B	Low	2	1	B	Low	
Growth- increased run-off to Halswell causes flooding in Selwyn District.	• Network studies • Regulatory control of development	2	1	B	Low	2	1	B	2	

CHRISTCHURCH STORMWATER SERVICES										
Risk	**Current Controls**	**Current Risk Scores**				**Future Risk Scores**				**Comment**
		Impact			**Peak Risk**	**Impact**			**Peak Risk**	
		Health	**Environment**	**Likelihood**		**Health**	**Environment**	**Likelihood**		
BROOKLANDS										
Contamination of aquifers from soakage pits	• Water quality monitoring	1	2	B	Low	1	2	B	Low	
Contamination of Brookland Lagoon from urban stormwater run-off	• Water quality monitoring	1	2	B	Low	1	2	B	Low	
Sediment build-up impacts on the Brookland Lagoon habitat.	• Maintenance of soakage system	1	2	B	Low	1	2	B	Low	
Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 5 years)	• Water quality monitoring programme • Stream naturalisation programme	2	2	A	Low	2	2	B	Low	
Climate change– higher intensity rainfall and sea-level rise results in flooding of buildings	• Reviewing international research • Monitoring rainfall patterns	1	1	B	Low	1	2	B	Low	
Growth- increased runoff exceeds system capacity (poor planning)	• Regulatory control of development	2	1	B	Low	2	1	B	Low	
RURAL AREAS DISCHARGING TO SOAKAGE OR PRIVATE DRAINS										
Contamination of groundwater in the aquifer recharge zone	• Water quality monitoring	1	2	B	Low	1	2	B	Low	
Contamination of watercourses with chemicals and nutrients	• Water quality monitoring • Emergency response plan	1	2	B	Low	1	2	B	Low	
Sediment build-up affects habitat in estuaries and rivers	• Maintenance of soakage system	1	2	B	Low	1	2	B	Low	

CHRISTCHURCH STORMWATER SERVICES										
Risk	**Current Controls**	**Current Risk Scores**				**Future Risk Scores**				**Comment**
		Impact			**Peak Risk**	**Impact**			**Peak Risk**	
		Health	**Environment**	**Likelihood**		**Health**	**Environment**	**Likelihood**		
Contamination of rivers - micro-biological and toxicants.	• Water quality monitoring • Emergency response plan	2	2	B	Low	2	2	B	Low	
Water quality non-compliant with draft standards in the Environment Canterbury Water Quality Plan (likely to become effective within 5 years)	• Water quality monitoring programme	2	2	A	Low	2	2	E	High	
Climate change– higher intensity rainfall and sea-level rise results in flooding of buildings	• Reviewing international research • Monitoring rainfall patterns	1	1	B	Low	1	2	B	Low	
Growth- increased runoff from development exceeds system capacity (poor planning).	• Regulatory control of development	2	1	B	Low	2	1	B	Low	
Growth- increased run-off to Halswell causes flooding in Selwyn District.	• Network studies • Regulatory control of development	2	1	B	Low	2	1	B	2	
INDUSTRIAL AREAS DISCHARGING TO SOAKAGE										
Contamination of aquifers from soakage pits	• Regulatory requirements on design of soakage pits	1	2	B	Moderate	1	2	B	Moderate	
Contamination of aquifers and watercourses from industrial spills and leakage.	• Emergency response plan. • Regulatory requirements on design and maintenance of storage facilities.	2	4	C	High	2	4	C	High	
The water quality outcomes established in the Proposed Natural Resources Regional Plan will not be achieved because of intensification of land uses development and the cumulative effect of discharges to land	• Water quality monitoring programme	2	2 to 3	C	Moderate	2	2 to 3	C to D	Moderate to High	

CHRISTCHURCH STORMWATER SERVICES										
Risk	**Current Controls**	**Current Risk Scores**				**Future Risk Scores**				**Comment**
		Impact			**Peak Risk**	**Impact**			**Peak Risk**	
		Health	**Environment**	**Likelihood**		**Health**	**Environment**	**Likelihood**		
Climate change– higher intensity rainfall and sea-level rise results in flooding of buildings	• Reviewing international research • Monitoring rainfall patterns	1	1	B	Low	1	2	B	Low	
Growth- increased runoff exceeds system capacity (poor planning)	• Regulatory control of development	2	1	B	Low	2	1	B	Low	

Appendix F – Prior Consultation Undertaken

Appendix F – Prior Consultation Undertaken

1. Initial Consultation

The key purpose of the initial consultation was to ensure that third parties relevant to the assessments and their primary issues were identified at an early stage so that they could be taken into account in the definition of communities and in the preparation of the Assessments. The following third parties have been included in the initial consultation carried out as part of the assessment.

Party Consulted	Reasons for Consultation
Medical Officer of Health Canterbury District Health Board	Consultation with the Medical Officer of Health is required by Section 128 (1) (a) of the Local Government Act 2002. The Medical Officer of Health will have a good understanding of health related issues concerning water services in Christchurch and has been asked to provide input to this scoping report.
Environment Canterbury (Ecan)	Ecan has a role as an environmental regulator in terms of the Resource Management Act and as such has views on environmental issues related to water and sanitary services in Christchurch. They may also have information available on effects of discharges on the natural environment and were asked to provide input to this scoping report.

Medical Officer of Health - Canterbury District Health Board (CDHB)

Geoff O'Brien (Health Protection Officer) provided the following information and comments relevant to the stormwater drainage assessment.

Health Department submissions to the CCC LTCCP did not include any comment on stormwater drainage. They perceive the most significant issues as relating to the discharge of stormwater borne pollutants into the #1 aquifer from which drinking water is taken, and the impact of pollutants in receiving waters on recreational water quality in the Avon, the Estuary, the Groynes, and, to a lesser extent, the Heathcote.

They see Ecan as being responsible for addressing stormwater pollution and groundwater contamination problems by setting, monitoring and enforcing standards. The Ministry's role is as a facilitator in the setting of standards, and has no mandate to force compliance. CC has recently received a consent to discharge sewage to natural waters during storm event. The Ministry consider the consent process to be robust and fair.

Potential contamination of aquifers- the most significant risk is the potential contamination of the #1 aquifer (which may be unconfined) at the airport and adjoining industrial area. The airport takes water from this aquifer and supplies a number of businesses (including hotels).

River, streams and beaches water quality- The bathing and shellfish micro-biological standard is at times not met in the Avon, Estuary and Scarborough/ Sumner beaches. The impact of bird life is likely to be the main cause of the pollution, compounded by discharges from the sewage treatment plant in the Estuary and on the beaches. However, no instance of a notifiable disease that can be related directly to water quality has been recorded.

Public safety – no record of any safety incidents relating to the design or operation of the stormwater drainage system.
Bio-security- only problems relate to mosquito biting (ie no risk of exotic diseases) m mostly associated with wetlands. The are no issues relating to stormwater drainage.

Environment Canterbury

Ken Taylor (Environmental Quality Manager) provided the following information and comments relevant to the stormwater drainage assessment.

Issues

There are no stormwater quality and discharge issues that ECan considers need to be addressed by CCC outside of the Resource Consent process.

Sediment deposition in the rivers is the biggest issue, the major concern being the loss of habitat.

Contamination of ground water – there is no evidence of any groundwater contamination from stormwater discharges. However ECan has identified a significant risk associated with the accidental discharge of contaminates to unconfined aquifers at the airport and industrial areas in the west of the city area, where large volumes of hydrocarbons and chemicals are stored, and are working with those businesses to mitigate the risk.

Natural watercourse quality- an increasing issue is the leakage of nutrients into watercourses as farming activity becomes more intensive.

Resource consents- currently ECan becomes involved in the consent process where subdivisions with more than 35 properties are proposed. The main concern relates to the interference of natural

springs when development occurs and the resulting diminution of low flow levels (particularly in the Styx river).

River capacity- ECan advise that, although there are no flooding problems within the CCC boundaries with respect to water entering dwellings and buildings, flooding has been experienced in:

The lower reaches of the Styx River. Low level risk (5 to 10 year return period) which causes some damage to farmland, and for which resource management policies have been adopted by Ecan.

The Proposed Natural Resources Plan (Section 4 Water Quality) covers the background, issues and proposed water quality standards for stormwater discharges. If adopted in their current form it is anticipated there will be significant compliance issues when the standard becomes operative. CCC would be required to prepare Stormwater Management Plans and demonstrate compliance with the standard.

2. Outcomes from other Council consultation initiatives

Annual Survey of Residents

National Research Bureau **C** undertook a comprehensive survey of Christchurch residents, reporting the findings in March 2004. The survey on stormwater and land drainage was limited to a question relating to the 'value for money' of this service and whether the interviewee considered more or less should be spent on the service.

The general comments section of the survey attracted little evidence of any concern about stormwater drainage in the city, with problems identified relating to localised flooding with relatively minor impact due to obstructions in street channels (e.g. leaves and kerb-crossings) and blocked street sumps.