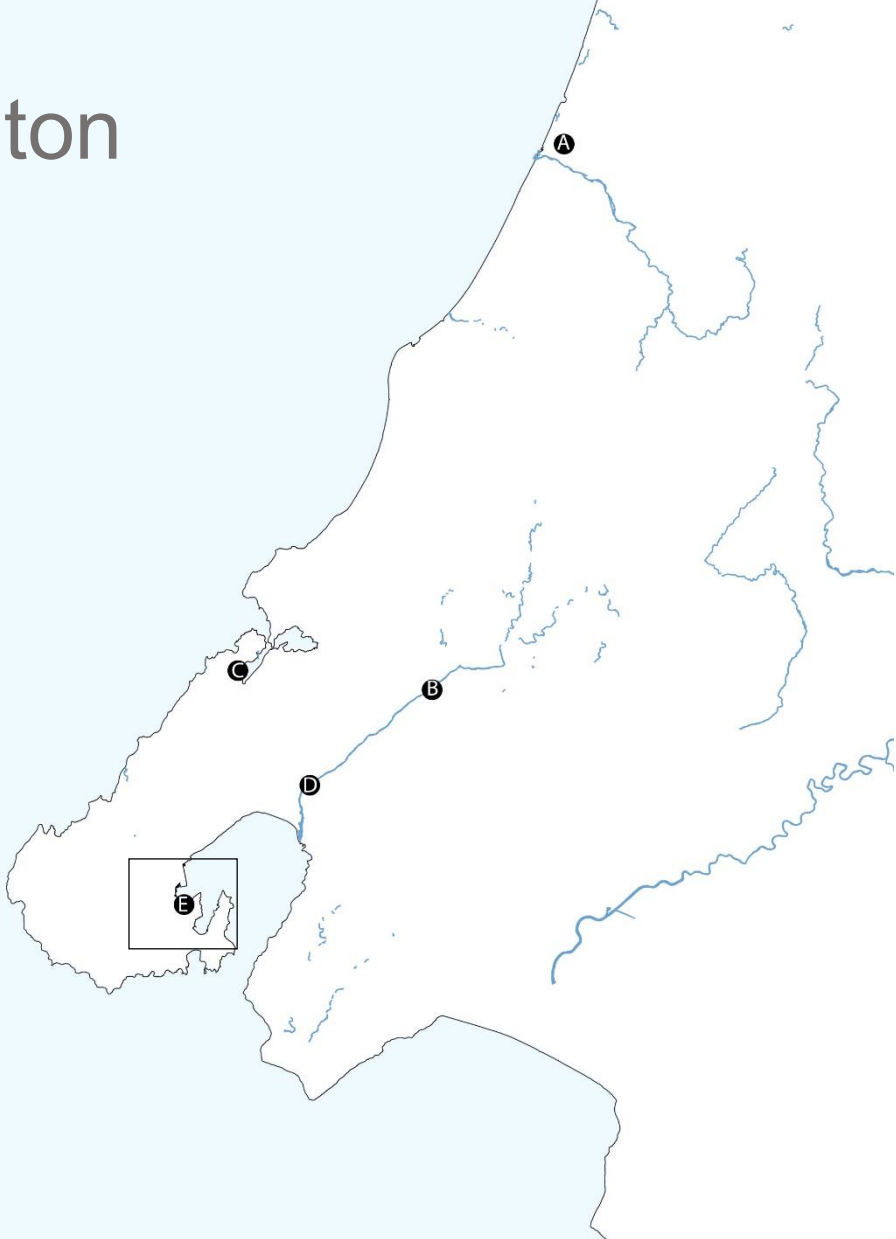


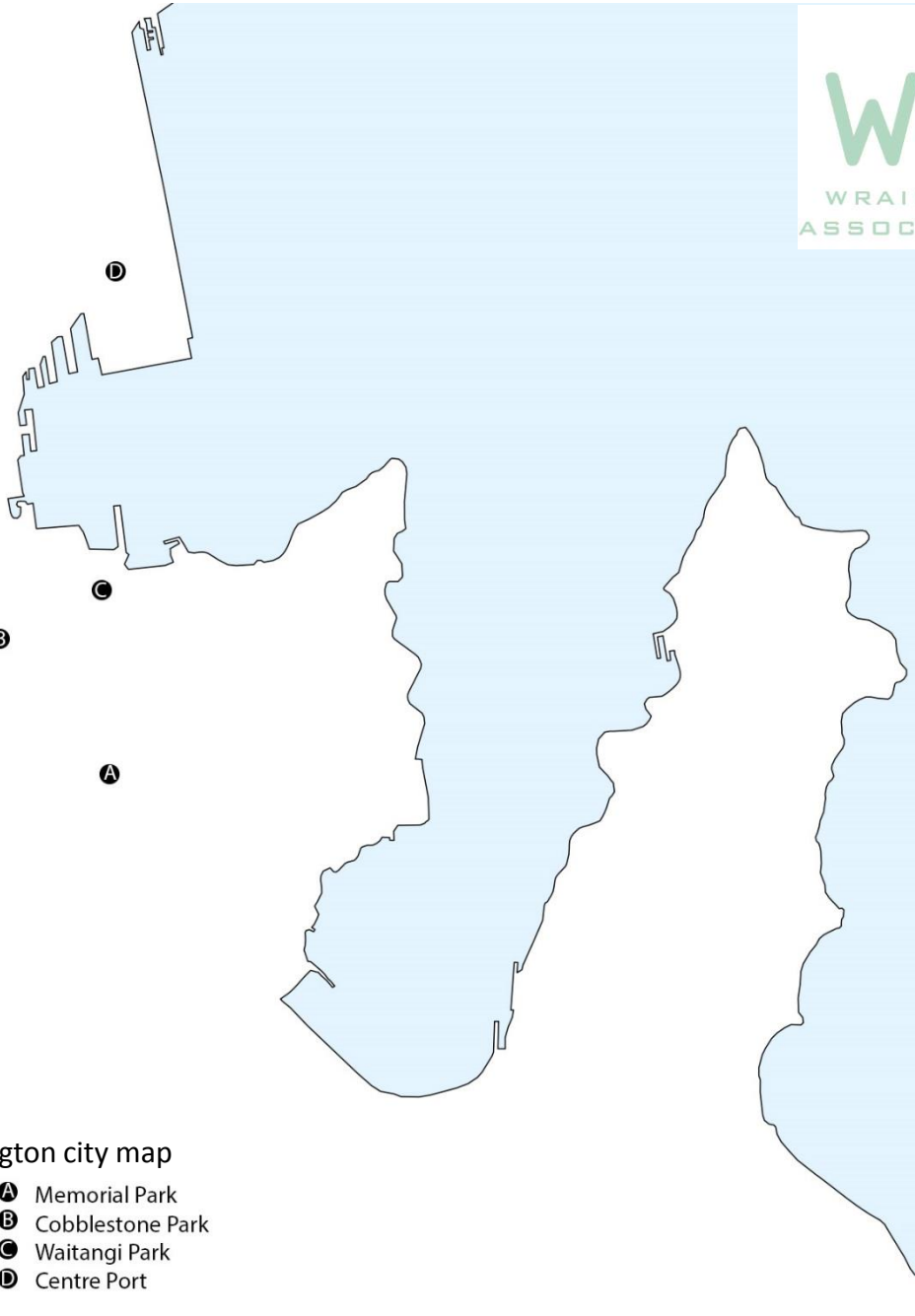
WSUD Forum 2014

Wellington



Contextual map

- N
- A Otaki
 - B Upper Hutt
 - C Porirua
 - D Lower Hutt
 - E Wellington



Wellington city map

- N
- A Memorial Park
 - B Cobblestone Park
 - C Waitangi Park
 - D Centre Port



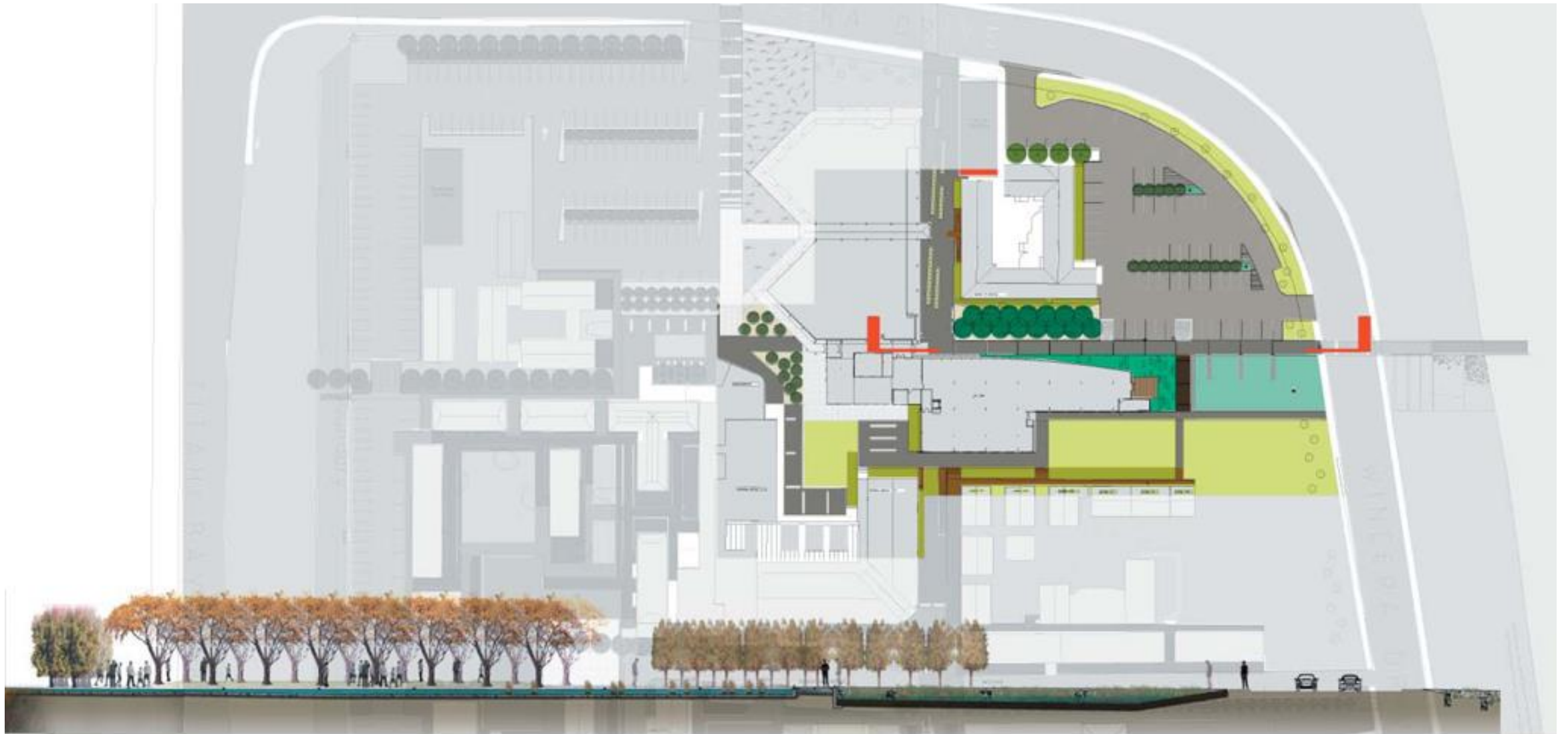
Nga Purapura



Nga Purapura



Nga Purapura



Whitirea Library



Whitirea Library



Whitirea Library

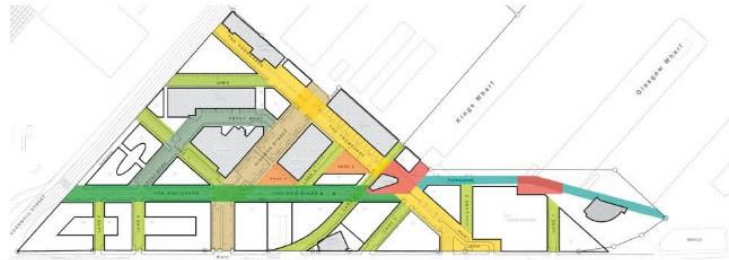


Dowse Museum

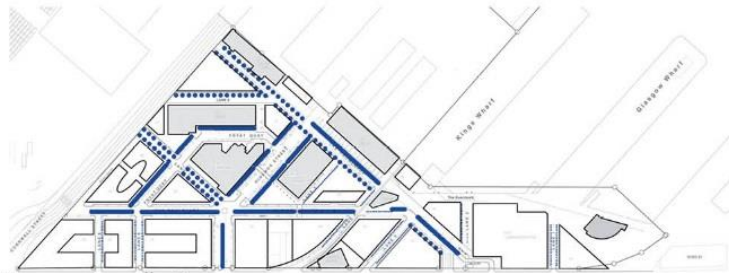


Dowse Museum

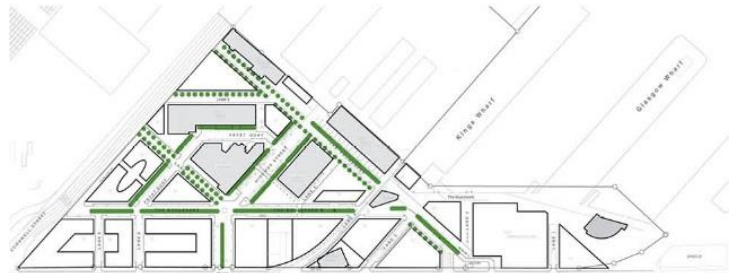
Harbour Quays WSUD strategy showing stormwater system integrated with urban design



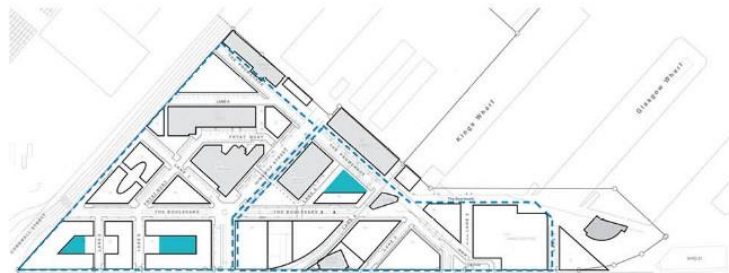
Street network, squares & parks



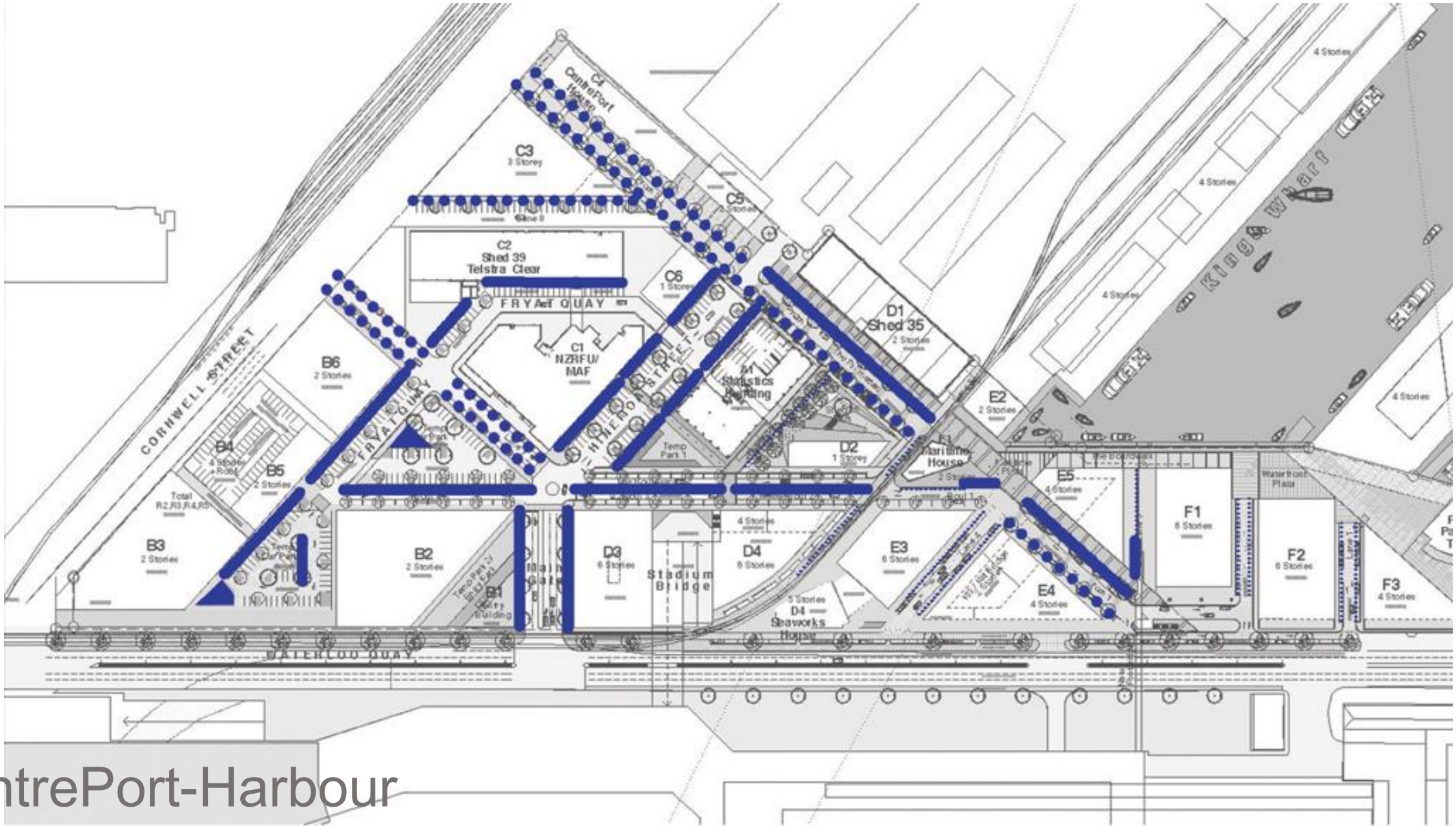
Stormwater collection



Stormwater infiltration



Stormwater storage and reuse



CentrePort-Harbour
Quays



CentrePort-Harbour
Quays

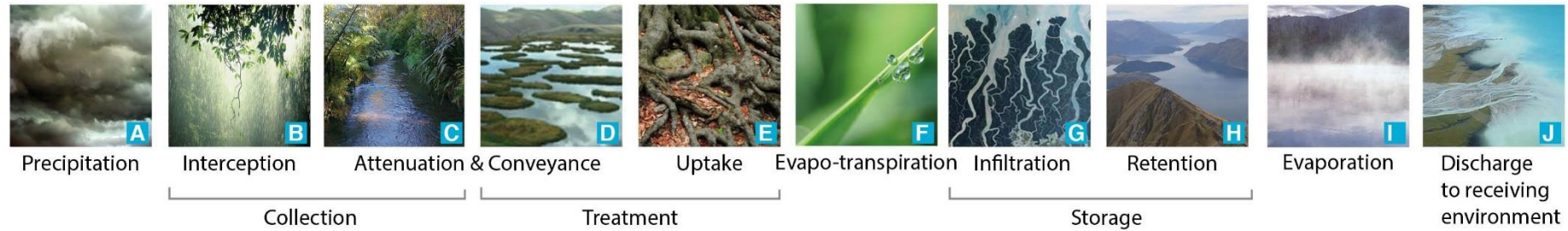


CentrePort-Harbour
Quays



CentrePort-Harbour
Quays

1.1 Natural systems



In a natural system, rainfall is intercepted, absorbed and filtered by plants and the soil. This infiltration keeps groundwater and soil moisture levels at reasonably stable levels. Soil and vegetation operates like a sponge - retaining and releasing water, collecting and attenuating flows. Types of vegetation and land use significantly affect the natural hydrological cycle.

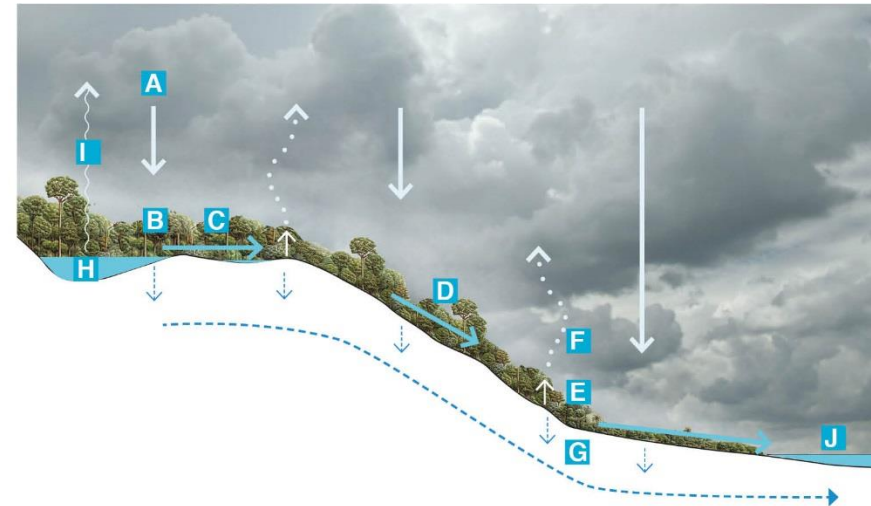
Stream margins, or riparian areas, are an important part of stream biodiversity; providing habitat and shelter for fish and increasing bird and insect life, improving water quality by filtering out some pollutants and preventing damage to stream banks.

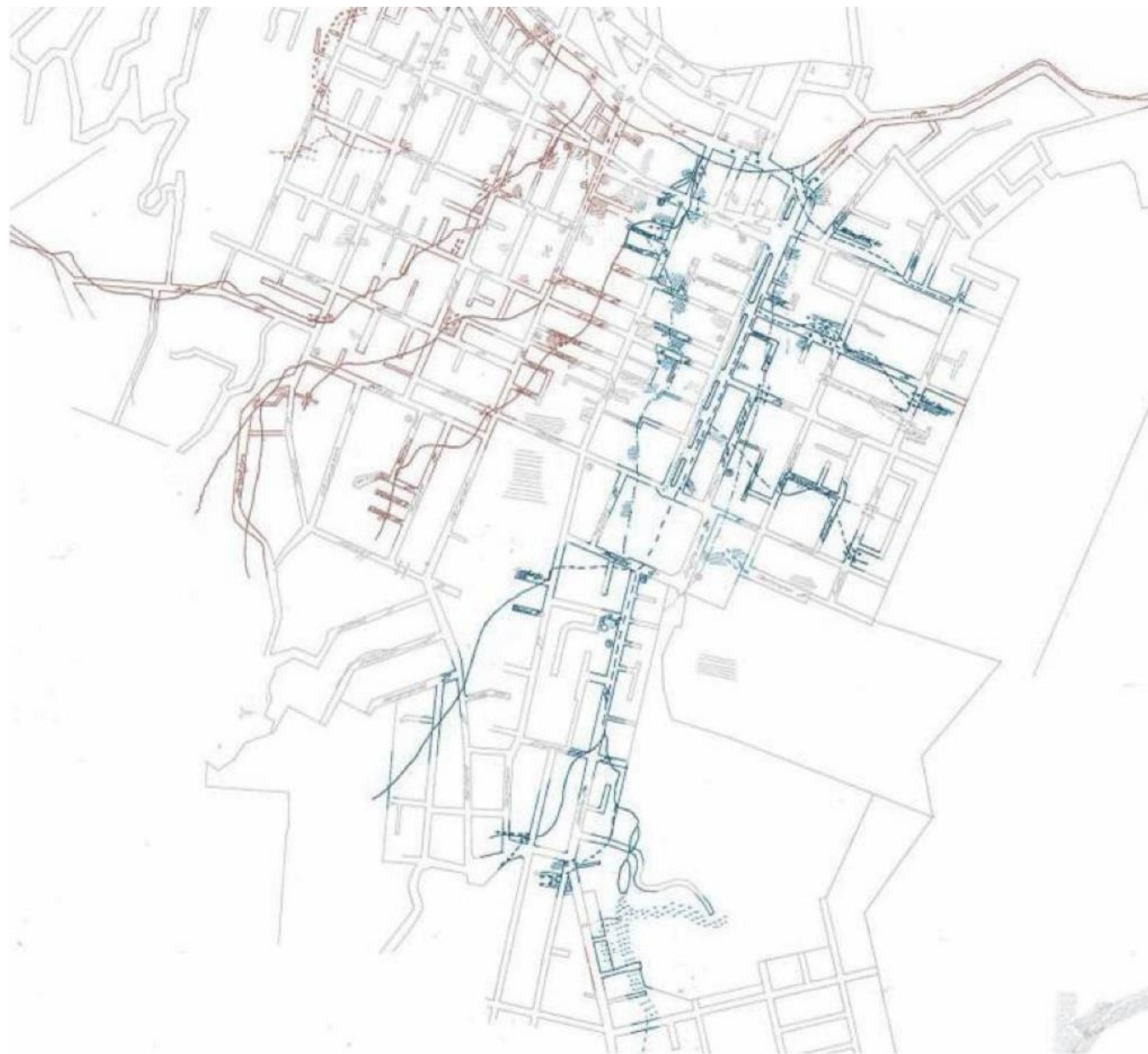
Attributes

- Flood attenuation
- High ecosystem services
- Natural beauty
- Nutrient distribution
- Infiltration charges ground water storage
- Shapes habitats for aquatic plants
- Clean available water

Issues (to human settlement)

- Flooding can occur in big events
- Land area intensive
- Integrating dynamic (natural) and rigid (man-made) structure
- Super saturation of soils can occur

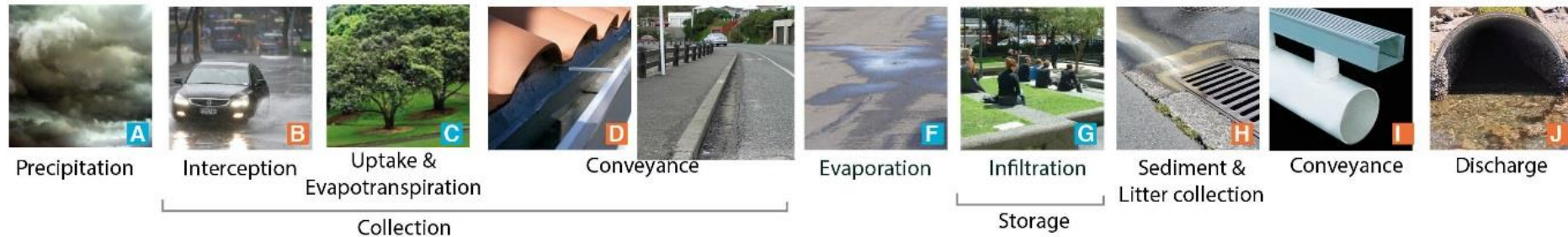




Subsoil Survey of Central Wellington City (1936)

Showing the Waitangi stream and tributaries and other streams passing through the city

1.2 Conventional systems



Conventional stormwater systems collect rainwater and discharge to streams and the sea. Apart from sumps, which collect some sediment and litter, there is usually no treatment of stormwater before it is discharged.

Typically, conventional stormwater systems are designed to manage quantity not quality - however rapid drainage of urban catchments can cause high peak flows. With fixed infrastructure capacity, this can cause flooding.

Sediments and pollutants from urban activity accumulate on roofs, roads and pavements.

Pollutants include:

- Heavy metals
- Organics and faecal matter
- Nutrients
- Litter.

When it rains, runoff can be contaminated with pollutants and be transported to streams or the sea.

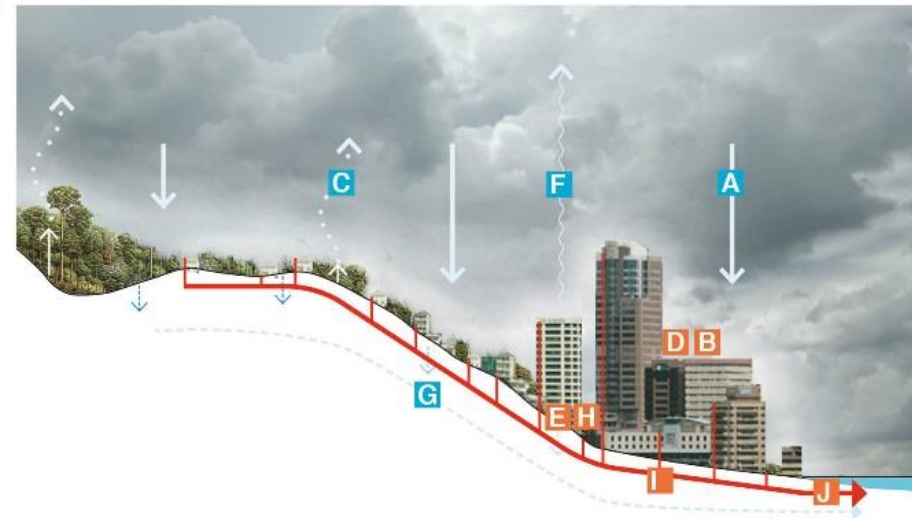
Hard surfaces reduce infiltration which reduces ground water and soil moisture content. This can cause soils to shrink, destabilising older built structures and infrastructure. Conversely, over saturation of subsoils can affect constructed pavements.

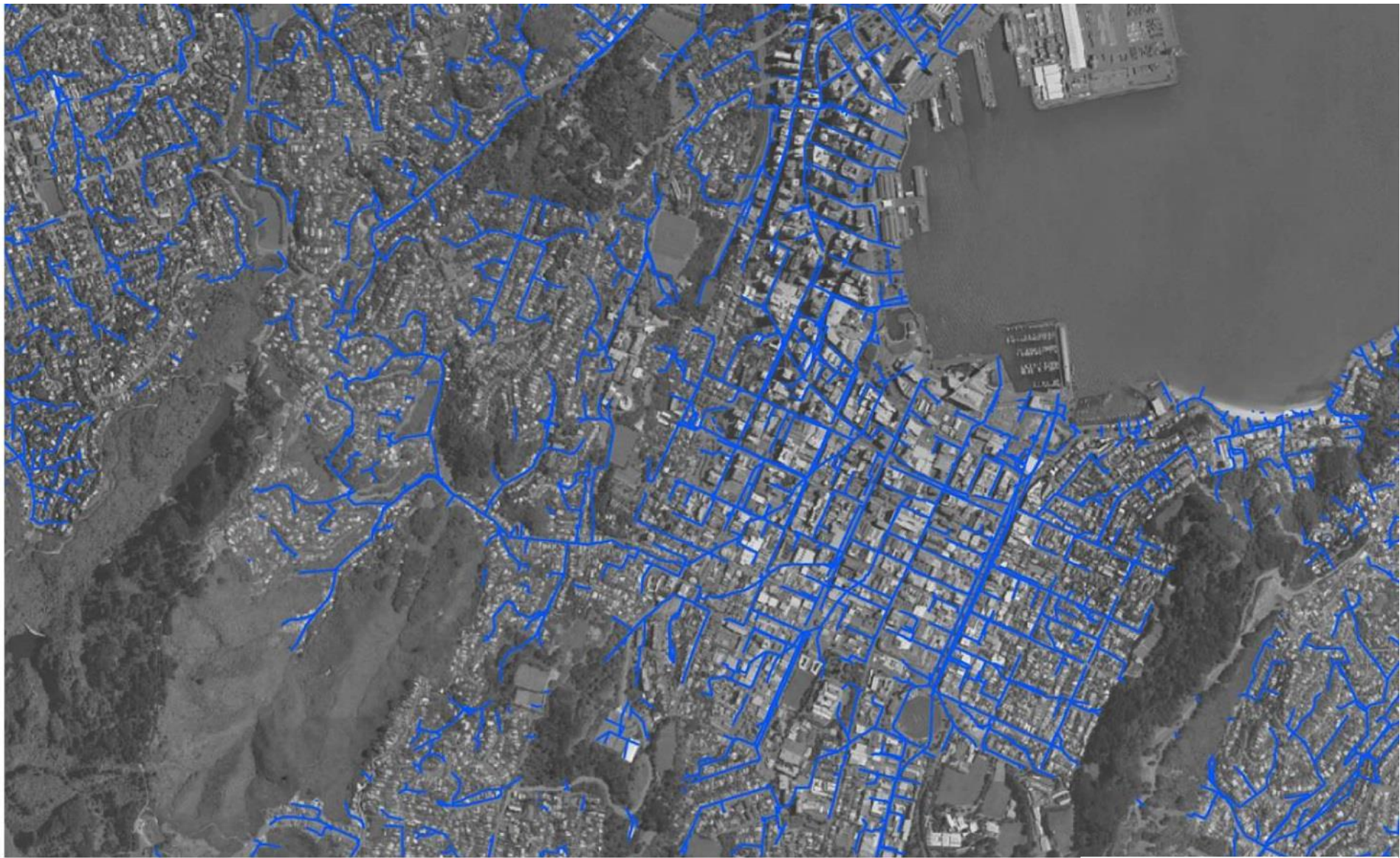
Attributes

- Minimal land requirement
- Flood mitigation
- Prevents over-saturation of soil

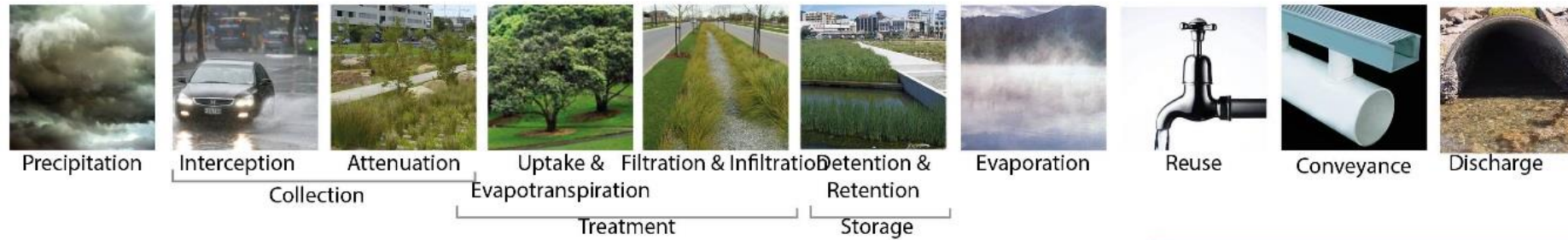
Issues

- Pollution of receiving ecosystems
- Health Impacts from polluted waterways
- Flooding
- Reduces ground water
- Risk of element failure





1.3 An integrated WSUD system



Natural and urban stormwater systems each have their own attributes and issues. WSUD combines the positive attributes of the natural water cycle and urban-engineered network to design systems that use vegetation, soils and natural processes to reduce the volume, rate and peak flows of stormwater runoff.

In Wellington a WSUD approach will help the piped networks cope with increasing frequency of heavy rain and reduce pollution of natural water bodies.

For Wellington City WSUD is series of holistic design and development practices that:

- Work with, not against, natural systems - supporting integrated management of natural and physical resources.
- Enhance ecosystem and human health.
- Maximise on-site management of effects in order to minimise off-site effects
- Foster the efficient use of resources - creating opportunities to reduce, reuse and recycle thereby

reducing energy demand and waste generation

- Recognise and provide for tangata whenua while fostering kaitiakitanga ('guardianship') through partnership
- Guide development so multiple social, cultural and environmental functions co-exist
- Promote economically efficient, practical solutions that consider total lifecycle cost and value to the community.

When urban design is considered alongside water values, stormwater is no longer seen as a waste product. Rather, it is considered a potential resource and an important part of the urban water system.

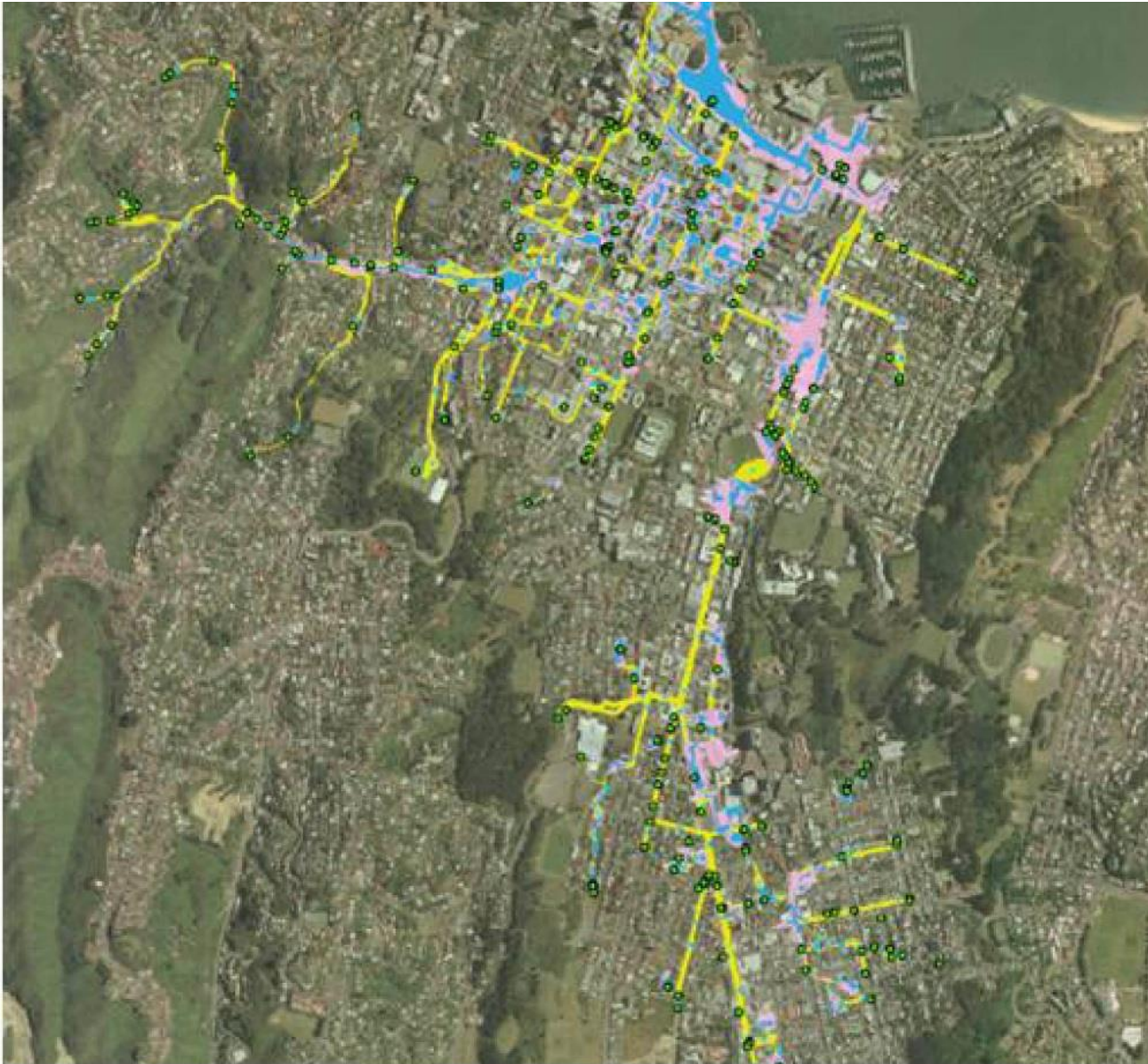
WSUD requires creative design: the result is that we limit flooding and pollution. The design measures shown in this document are examples of how this can be achieved. There are more.

Attributes

- At source stormwater management
- Combined multiple functions - integrated stormwater treatment with landscape elements
- Improves the visual and ecological amenity of sites and streets
- Provides passive irrigation to 'green' site and street elements
- Reduces potable water use
- Protects or enhances water quality in downstream environments
- Urban ecology/habitat

Issues

- Components, such as soils, can be sensitive to damage during construction
- Public perception of increased pest habitats
- Adjustment to standard maintenance requirements of drainage assets
- Risk of element failure



Current 50 year flood modellin
Mapping Flood Hazards -
Newtown and Te Aro (SKM)

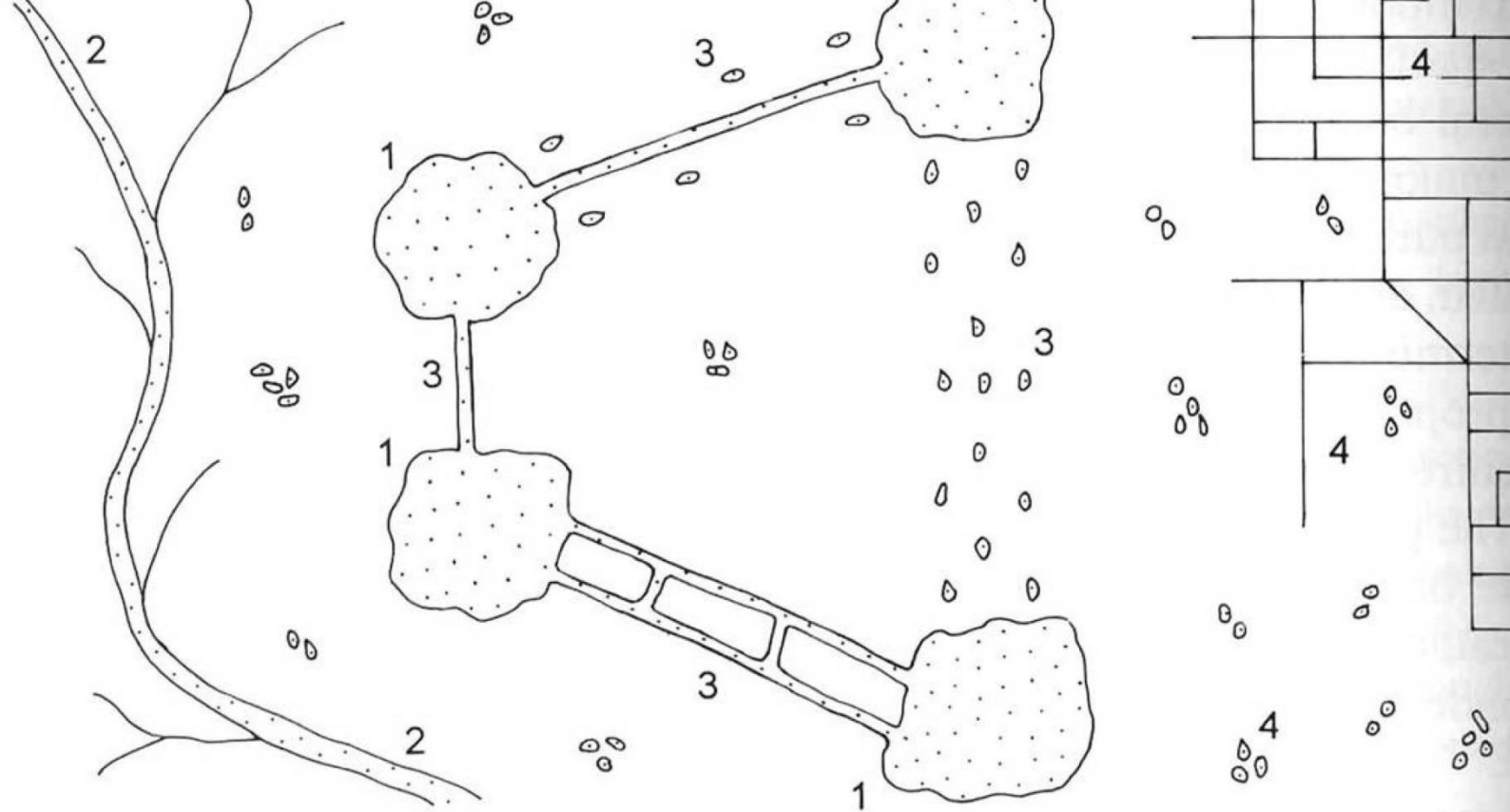


Fig. 13.4. Top-priority ecological 'indispensables' in planning a landscape.
1 = a few large patches of natural vegetation; 2 = major stream or river corridor; 3 = connectivity with corridors and stepping stones between large patches; 4 = heterogeneous bits of nature across the matrix.

source: Richard Foreman
Land Mosaics: The Ecology of Landscapes and Regions

natural + cultural + social

waitangi park



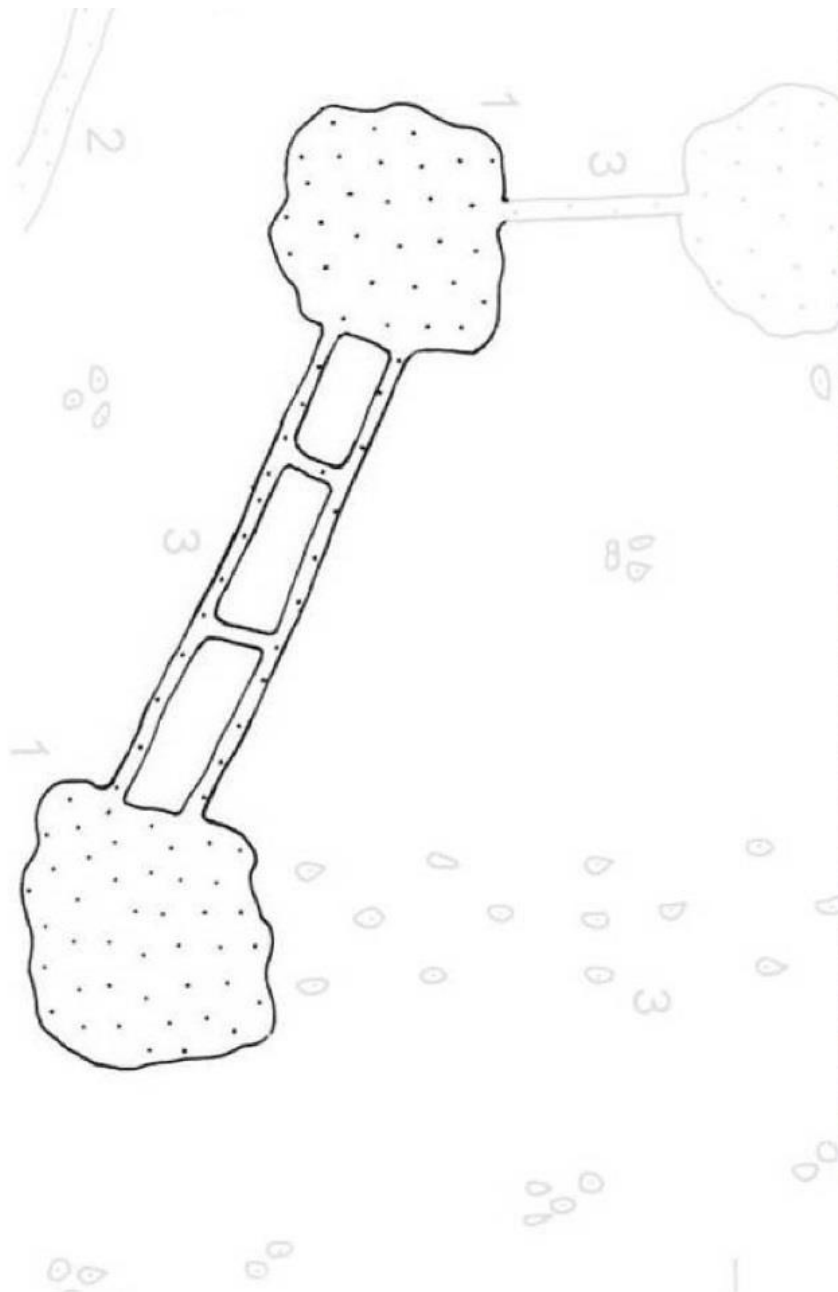
natural + cultural + social

waitangi park



natural + cultural + social

waitangi park

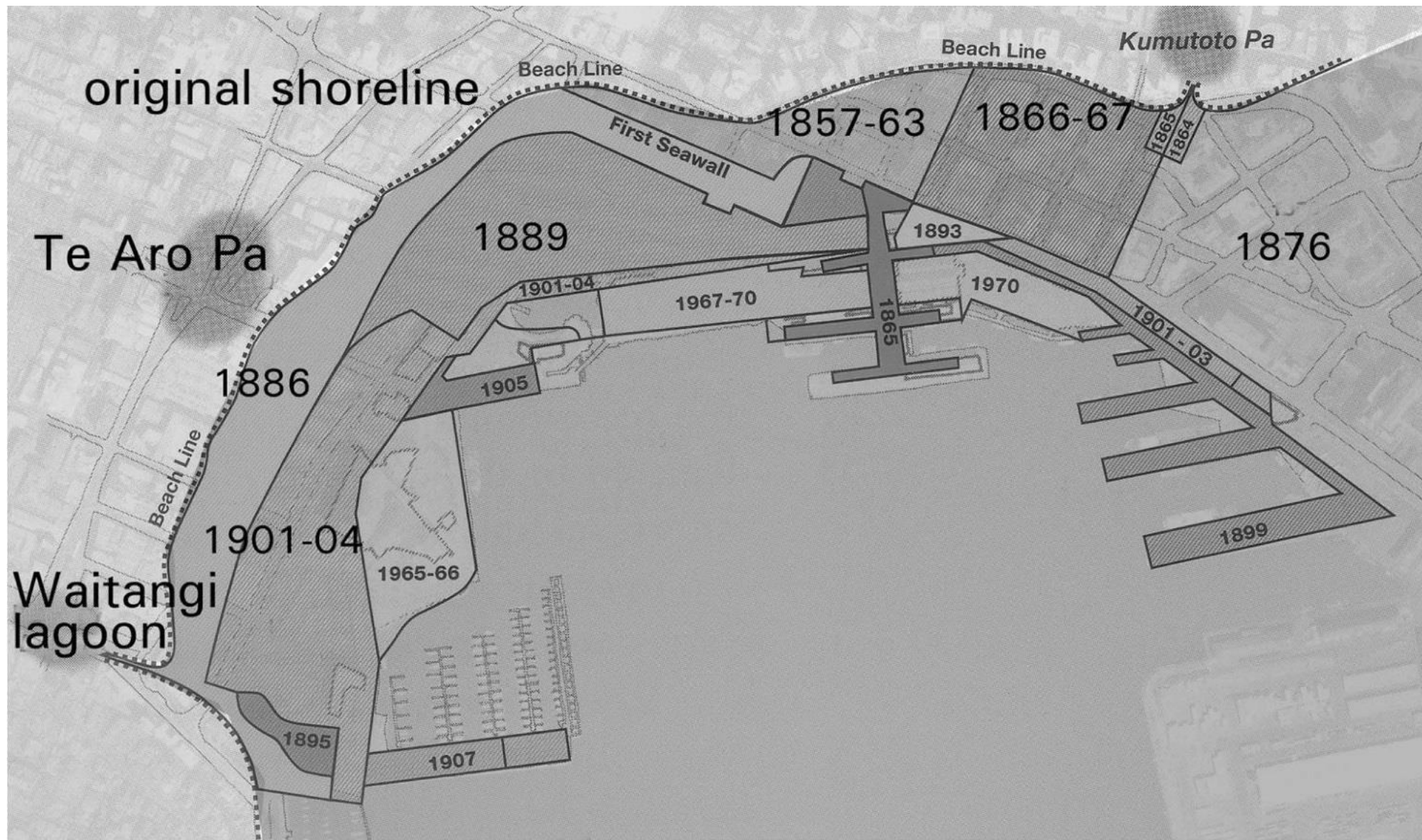


natural + cultural + social

waitangi park



Waitangi Park



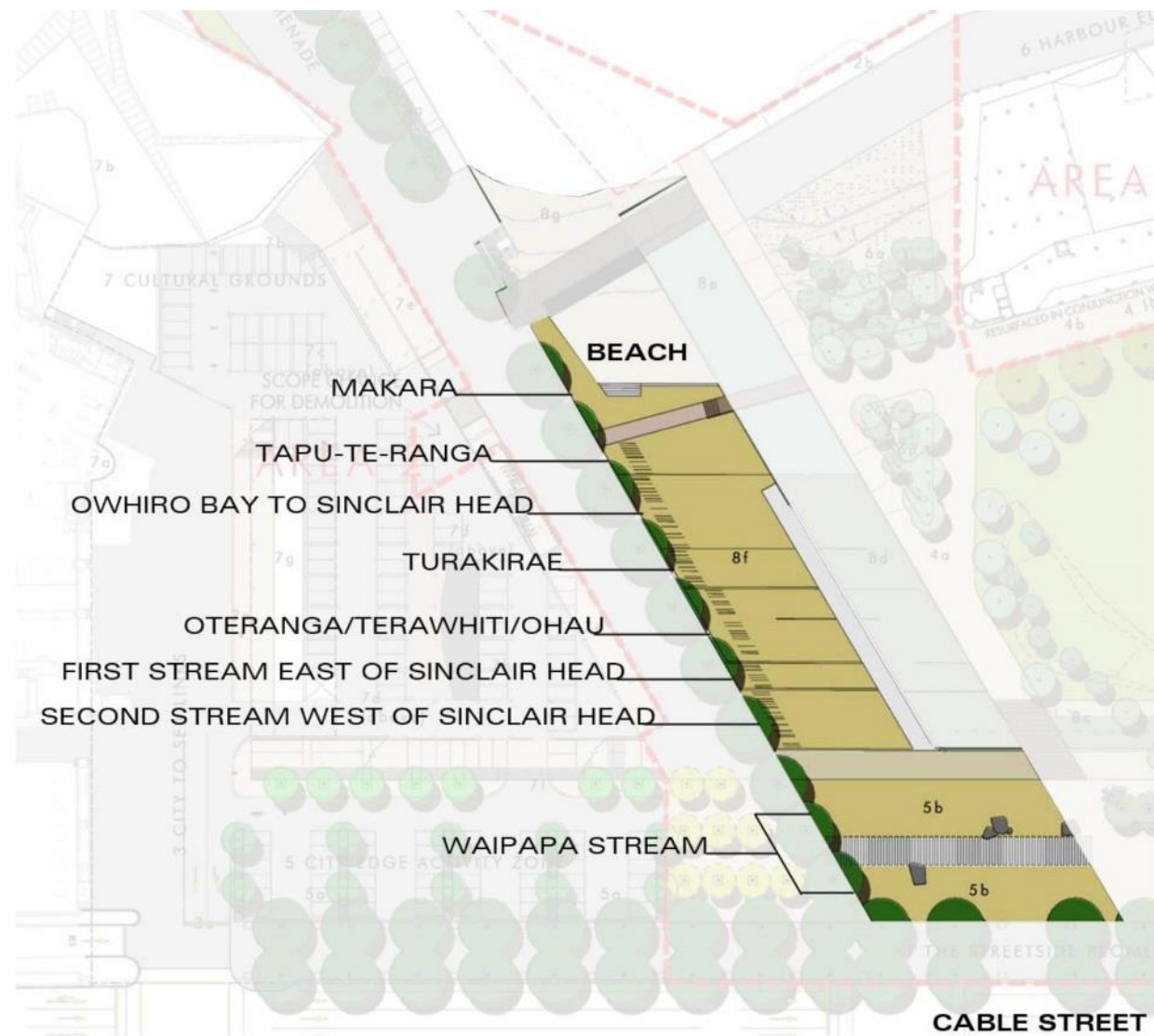
natural + cultural + social

waitangi park



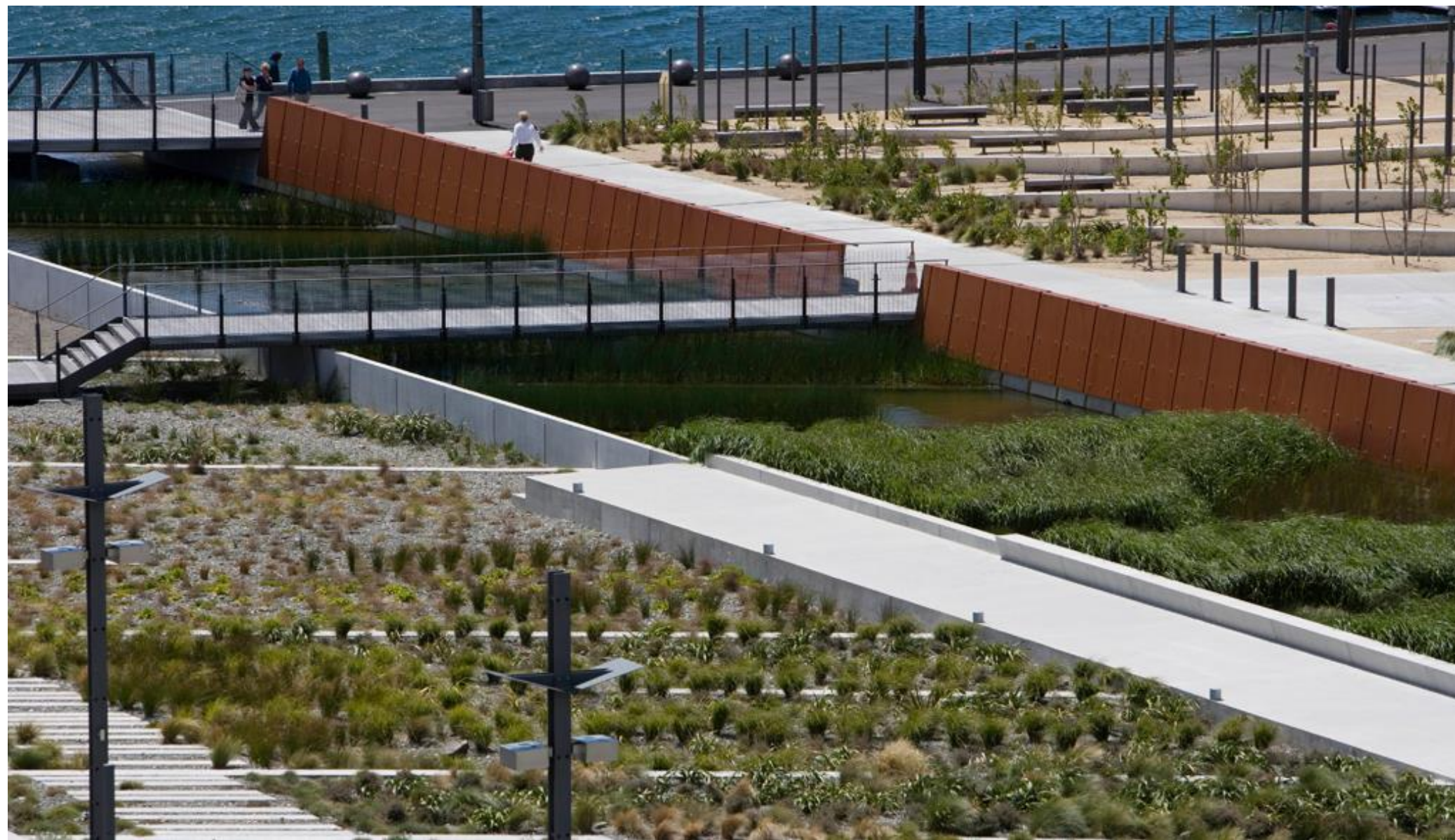
natural + cultural + social

waitangi park



natural + cultural + social
maximum interface

waitangi park
51





A choice of pathways
Connection to a network

natural + cultural + social

waitangi park





The activity zone

natural + cultural + social
maximum interface

waitangi park
41



natural + cultural + social
maximum interface

waitangi park



The field

natural + cultural + social
maximum interface

waitangi park



natural + cultural + social
maximum interface

waitangi park



Environmental infrastructure
The Waitangi Stream

natural + cultural + social

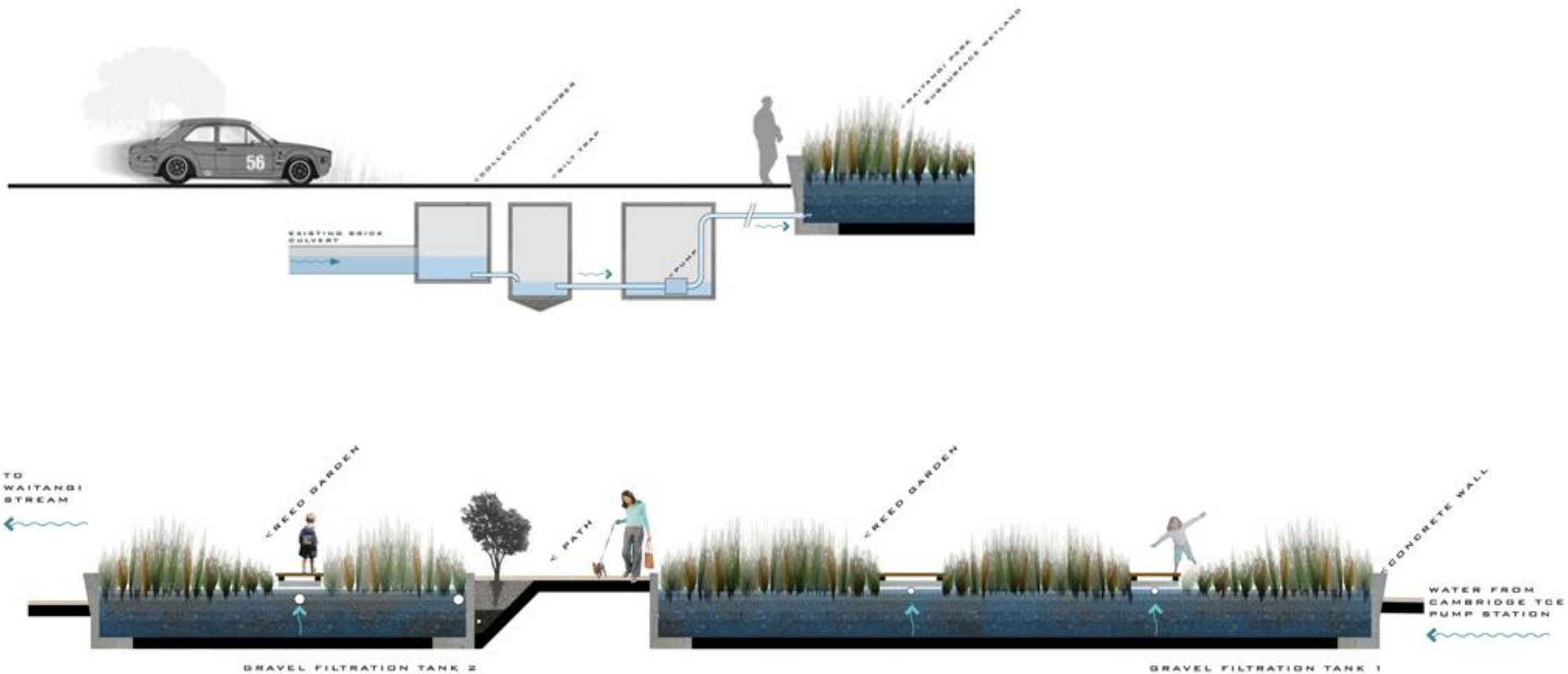
waitangi park



polishing wetland

natural + cultural + social
maximum interface

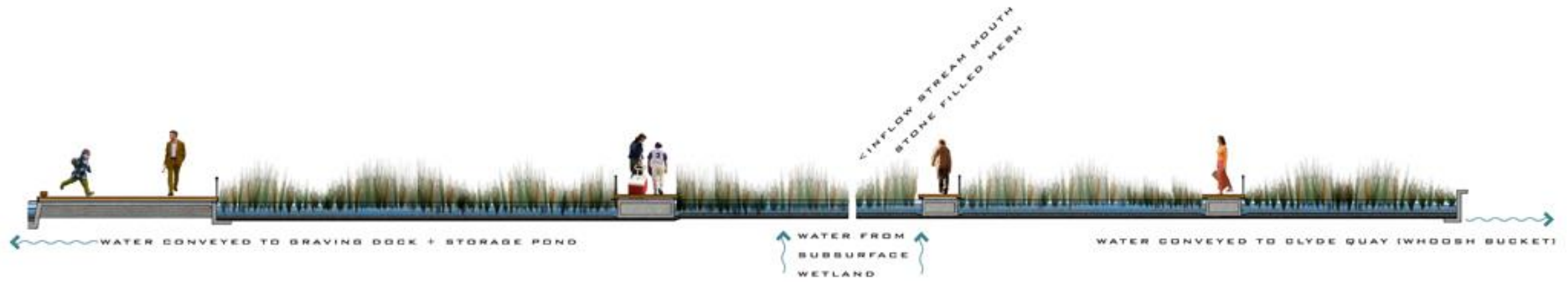
waitangi park



Waitangi Park

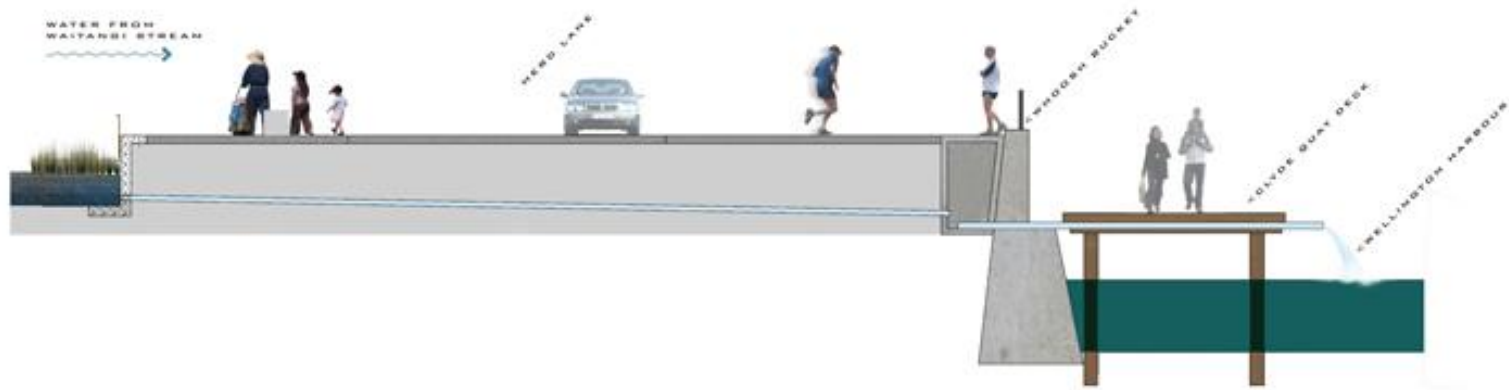


Waitangi Park





Waitangi Park



Waitangi Park

Waitangi Park





waitangi park



Memorial Park



Memorial Park



Memorial Park

3.1 Low density residential development

Characteristics

Low-density residential development is characterised by low-rise, single houses on individual lots, typically associated with private open space in the form of rear gardens and/or street setbacks. Land ownership is likely to be under the control of a single owner with site coverage not generally exceeding 35% of the lot area.

Issues

- Demand/need for landscape amenity
- Reliance on mains water
- Impervious pavements increase runoff.

Opportunities

- Integration of vegetated WSUD measures to provide landscape amenity
- Roof water collection and storage to supplement mains water supply
- Opt for permeable paving to reduce runoff.



Low density residential, Churton Park

Aim:

Collect, detain and reuse stormwater to reduce discharge into street stormwater network.

Potential WSUD measures:

- Rainwater tanks for reuse e.g. irrigation, vehicle washing and to smooth peak discharge flow
- Bio-retention system and rain gardens (lined when on contaminated sites) to improve stormwater quality
- Carbon and sand filters to treat runoff where space is limited
- Street trees to increase permeability and provide shade, wind shelter, amenity and habitat.



Rainwater tank



Permeable paving



Rain garden



Vegetative cover

3.2 Medium to high-density development

(residential, commercial, institutional)

Characteristics

Medium to high-density development typically has a site-coverage of more than 35%. Multiple units, uses and ownership may, but not always, occur on a single parcel of land. Private open space is limited and communal or public open space associated with the development is at a premium.

Issues

- High site coverage increases runoff
- Range of demands and uses of limited open space.

Opportunities

- Integrate WSUD measures into the architecture of structures to reduce runoff volume
- Integrate vegetated WSUD measures to provide landscape amenity in both private and public open space
- WSUD measures can enhance sustainable profiles of buildings and organisations.



Willis Street high density development

Aim:

Collect, detain and treat stormwater to improve quality and smooth discharge flows. Integrate WSUD measures to create multifunctional architecture and open space.

Potential WSUD measures:

- Green roofs to reduce runoff volume
- Green walls to slow runoff and smooth peak discharge
- Rainwater tanks for re-use and/or to smooth peak discharge
- Stormwater planters to reduce and smooth stormwater discharge
- Permeable paving in pedestrian areas to reduce runoff volumes
- Rain gardens and bio-retention to provide amenity, detention and stormwater treatment.



Green roof



Green wall



Rainwater tank



Raingarden

3.3 Industrial development

Characteristics

Industrial activities are typically associated with large areas of roof and impervious pavement. They are often associated with hazardous substances that have to be carefully managed to prevent contact with stormwater runoff. Generally, this type of open space is valued for its function over amenity.

Issues

- High site coverage increases runoff
- Inherent risk associated with onsite hazardous substances.

Opportunities

- WSUD measures can be used as tools within hazardous substances risk management strategies
- WSUD measures can treat runoff from impervious pavements
- WSUD vegetation measures can be used to mitigate site activity impacts on adjacent land uses.
- WSUD measures can enhance the image of companies/organisations.



Centreport

Aim:

Collect, detain and treat stormwater to improve stormwater quality and smooth discharge flow. Use WSUD measures to mitigate negative effects that may be associated with particular industrial activities.

Potential WSUD measures:

- Rainwater tanks for reuse e.g. irrigation, vehicle washing and to smooth peak discharge flow
- Bio-retention system and rain gardens (lined when on contaminated sites) to improve stormwater quality
- Carbon and sand filters to treat runoff where space is limited
- Street trees to increase permeability and provide shade, wind shelter, amenity and habitat.



Bio-retention system



Subsurface rain tank



Street trees



Filter media

3.4 Streets, private ways and car parks

Characteristics

Streets, private ways and car parks are the most accessible forms of open space in urban areas. They facilitate the movement of pedestrians, vehicles and services.

Typically associated with impermeable surfacing such as pavements and roads, runoff from streets, private ways and car parks receive and convey contaminants from vehicles, road materials, maintenance operations and spillages that may occur. Runoff is also heavily influenced by surrounding land use eg. unpainted galvanised roofs.

Issues

- Contamination accumulation on surfaces and conveyance by stormwater runoff
- Competing demand for space (at and below grade) for amenity, movement and provision of services.
- Management of infiltration to avoid supersaturated and associated risks.

Opportunities

- Streets, while not the sole source of contaminants, may be the best places to treat stormwater
- WSUD measures support compliance with the Council's Transport Strategy by minimising adverse environmental effects associated with transport activity
- WSUD measures can enhance environmental quality and enhance amenity in streets, private ways and car parks.



Jervois quay

Aim:

The integration of collection, detention, treatment and infiltration of stormwater within road reserves, privateways and car parks, prior to discharge into the conventional stormwater network or receiving environment.

Potential WSUD measures:

- Vegetated swales to intercept and slow runoff
- Raingardens and bio-retention systems in car parks or along verges to filter, treat and detain stormwater while improving amenity and habitat
- Perforated kerbs to allow runoff to enter detention/treatment measures
- Street trees to increase permeability, provide shade and shelter, improve amenity and habitat
- Permeable paving in pedestrian areas to reduce runoff volume
- In-ground tanks to store treated stormwater for reuse in irrigation and to smooth peak flows.



Vegetated swale



Subsurface detention



Rain-gardens



Permeable paving

3.5 Parks and gardens

Characteristics

Parks and gardens are areas of City Council-managed open space used for active and passive recreation.

Issues

- Recreational needs of the community may restrict where and to what extent WSUD measures occur.

Opportunities

- Integrate WSUD measures to support WCC Public Space Design Policy Objective 6: sustainability
- Parks and gardens may have space to detain and treat stormwater from the upper catchment to mitigate stormwater quality and quantity effects downstream
- Plan and manage parks and gardens to allow for WSUD measures while balancing the recreational requirements of the community.
- Provide 5m minimum riparian buffers
- To work with care groups to contribute to overall catchment goals



Waitangi Park

Aim:

Design parks and gardens to mitigate the adverse effects of upper-catchment stormwater while balancing the recreational needs of the community.

Potential WSUD measures:

- Vegetated swales to slow runoff and allow infiltration
- Raingardens and bio-retention systems to treat stormwater
- Vegetation cover to reduce runoff and enhance infiltration
- Retention ponds to store runoff and smooth peak flows
- Detention ponds to slow runoff and smooth peak flows
- Wetlands to slow and treat stormwater and provide amenity and habitat.



Waitangi Park: collection & filtration 'treatment train'



Constructed wetland



Vegetated swale



Bio-retention tree pit



Detention pond

3.6 Bush and reserves

Characteristics

Bush and reserves are areas of established or regenerating vegetation (native, exotic and mixed). Values include ecological processes, passive recreation, scenic amenity and natural heritage. Bush and reserves may be managed by the City Council, the Department of Conservation or private landowners.

Areas of bush and reserve often have a natural water cycle – for example, a stream - formed by topography, soils and vegetation cover. However bush and reserves often receive urban stormwater runoff.

Riparian or stream margin management is an important part of stream and catchment biodiversity. This improves water quality and habitat by giving shelter for fish, filtering out some pollutants, preventing damage to stream banks and increasing bird and insect life.

Issues

- Degradation of bush areas and reserves due to the discharge of contaminated urban stormwater
- Erosion and scouring of areas of bush and reserve due to the discharge of large volumes of water over short time periods.



Otarl-Wilton's Bush

Aim:

Protect bush and reserves from impacts associated with the quality and quantity of stormwater discharge.

Opportunities

- Establish or enhance riparian planting to increase the ability to remove contaminants and manage water temperature and flow
- Protect and enhance vegetation cover
- Implement WSUD measures to manage the quality and quantity of urban stormwater prior to discharge into areas of bush or reserve.
- Provide 5 m-minimum riparian buffers
- Work with care groups to contribute to overall catchment goals.

Potential WSUD measures:

- Vegetated swales to intercept and slow runoff upstream from bush or reserve
- Plant or enhance vegetation to mitigate quality and quantity effects of urban stormwater entering areas of bush or reserve
- Dissipation measures to mitigate erosion caused by point discharges
- Retention and detention ponds to attenuate, store runoff, smooth peak flows, provide habitat and fire-fighting supply.



Riparian planting



Buffer planting



Detention pond



Dissipation measure



