Ōtākaro Avon River Corridor Regeneration Plan

Draft Land Use Assessment Report Ecological Restoration

September 2017

REGENERATE CHRISTCHURCH
TE KŌWATAWATA

ŌTĀKARO AVON RIVER CORRIDOR REGENERATION PLAN

Draft Land Use Assessment Report

Ecological Restoration

Contents

1 Introduction

1.1 Purpose of this report

This report has been prepared alongside a number of Land Use Assessment Reports to inform the "Assessment of Land Use Options" and ultimately the preparation of the Ōtākaro Avon River Corridor Regeneration Plan (Plan).

The purpose of the Land Use Assessment Reports is to define the scope and establish the specific drivers, benefits and objectives for the land use/s that will best contribute to the overarching vision and objectives of the Ōtākaro Avon River Regeneration Plan

1.2 Context

This report investigates potential ecological restoration opportunities in the Ōtākaro Avon River Corridor Regeneration Area[1] (Area). Ecological restoration is defined as the practice of renewing and restoring changed, degraded, damaged or destroyed ecosystems and habitats by active human intervention and action.

This report sets out:

- A description of ecological restoration and its requirements.
- The key problems/opportunities, benefits and risks connected with ecological enhancements. This is supported by an investment logic map (ILM), shown in Appendix 1.
- The range of feasible ecological restoration approaches to be considered and indicative costs associated with each, if ecological restoration opportunities are included in the longlist of land use options for further consideration.

While not a complete indicative business case, this report includes some of the steps contained within the Treasury's guidelines for "Better Business Cases for Capital Proposals: Indicative Business Case"[2], including critical success factors, benefits, risks, constraints and dependencies. Applying this approach provides a structure to test, refine and further develop the theme of ecological restoration, which in turn will inform the shortlist of land use combinations.

1.3 Appended and related assessments

In support of this land use type, a land use assessment on the specific use for water quality improvement has also been prepared. This is an appendix (separate volume) to this report.

[1] As defined in the Outline for the Ōtākaro Avon River Corridor Regeneration Plan (Regenerate Christchurch, 2017).
[2] See: http://www.treasury.govt.nz/statesector/investmentmanagement/plan/bbc/guidance

2 Land use description

2.1 Overview

Developing the Plan presents an opportunity to explore and determine possible approaches for ecological restoration of the Area. Ecological restoration would contribute to creating a place for New Zealand's native flora and wildlife to regenerate and providing spaces and places for the local community.

The Area is subject to tidal inundation and flooding (Figure 1). Deciding where and what ecological restoration can occur will depend on, and will influence, the urban infrastructure requirements, including for flood management, stormwater storage and treatment, water quality improvement, and transport and service connections. Underpinning any restoration will be the establishment of natural and connected water systems. Where any constructed flood defences, including stopbanks, are finally located will have a major effect on the type of vegetation and habitats compatible with the different flooding scenarios.

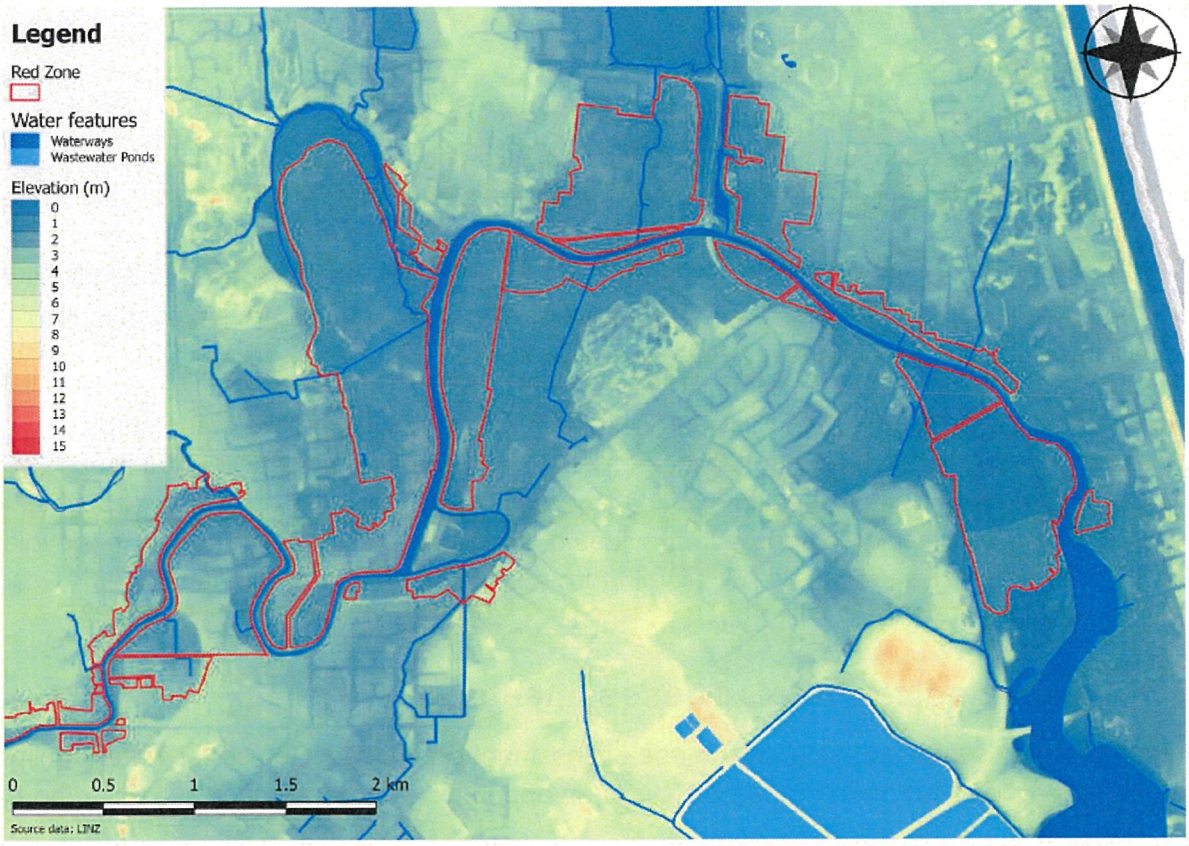


Figure 1: Ground surface elevations in the vicinity of the Ōtākaro Avon River Corridor relative to NZ Vertical Datum derived from 2015 LiDAR data.

Decisions on infrastructure priorities will enable better focus for establishing ecological restoration project constraints, viability and prioritisation. Ecological restoration could then be woven into and accommodate the infrastructure project planning, and vice versa.

Integrating ecological restoration with any provision of walking and cycling paths will require careful design, informed by specialists in ecological restoration, recreation provision and crime prevention through environmental design (CPTED).

This section sets the scene for the existing condition of the land within the Area.

2.2 The land

Land within the Area that is owned by the Crown is currently managed by Land Information New Zealand (LINZ). This land has been predominantly cleared of built form. Some private properties remain where the owners have not accepted the Crown offer. Some vegetation has been retained based on the Canterbury Earthquake Recovery Authority's (CERA's) Vegetation Retention Methodology.

Transitional uses of the land have been approved by LINZ. The Avon Ōtākaro Transitional Trail follows the river from Barbadoes Street to Pages Road. It takes advantage of Christchurch City Council's (Council's) repair of the stopbanks to improve the surface for walking and cycling.

2.3 Adaptation to change

The type and location of different habitats will change over time with climate change and sea level rise, and this needs to be allowed for in any restoration projects.

An adaptive management approach[3] to restoration would provide a practical means to help understand the complex relationships between the hydrology, ecological succession and effects of climate change and sea level rise (Orchard 2017a).

The spatial layout of compatible indigenous vegetation will vary from the historical pattern of vegetation (as in **Error! Reference source not found.**) because much of the Area has subsided as a result of the earthquakes.

[3] "Adaptive management" is an iterative method of decisionmaking in the face of uncertainty that reduces uncertainty by continuous monitoring. It is used especially in managing ecosystems.

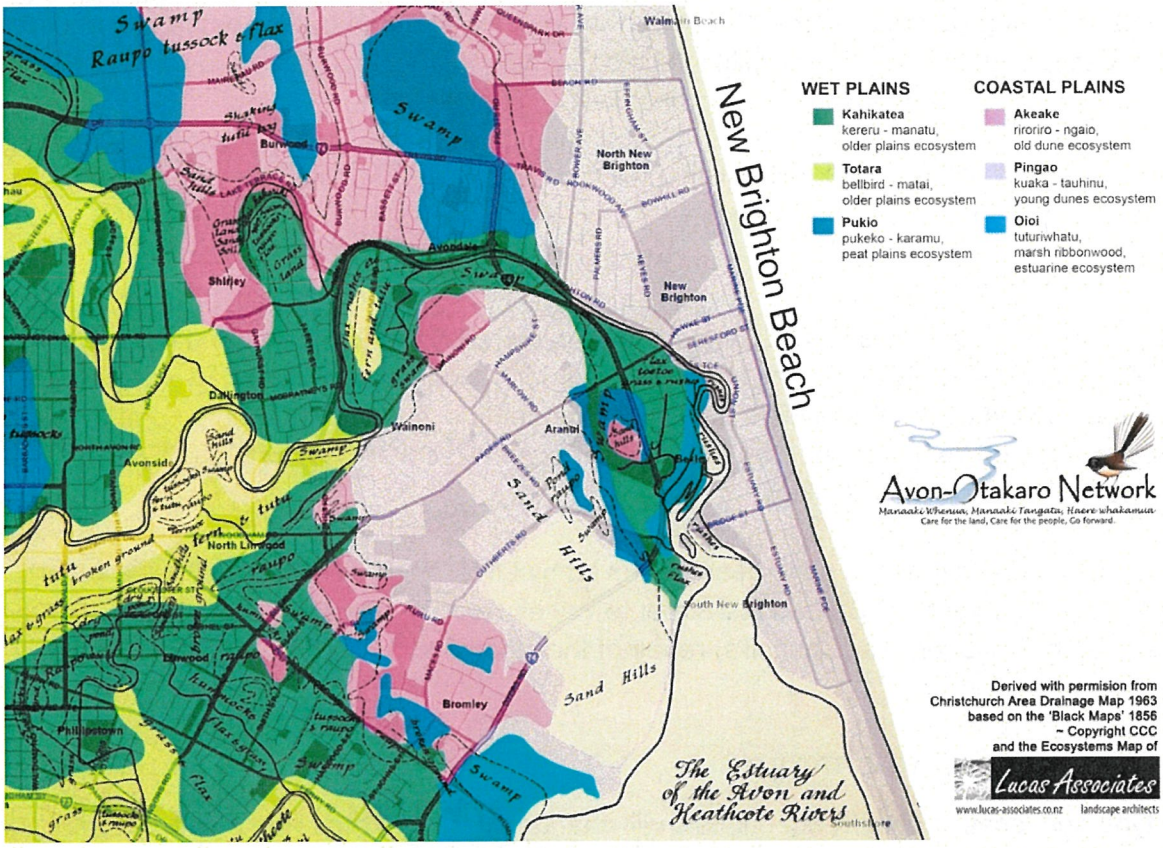


Figure 2: Ecosystems of the lower Avon-Ōtākaro catchment based on the 'Black Maps' and the Ecosystems 1995-7 report. Map of Lucas Associates http://www.avonotakaronetwork.co.nz/f/6531fd3dd92f0ea9.pdf

2.4 Land and community needs opportunities

The future of the Area, and the contribution of the Area to the regeneration of *greater Christchurch*[4], is an important issue for the people and communities of *greater Christchurch*.

In the Regenerate Christchurch Community Needs Assessment Survey (April 2017)[5], 75% of respondents indicated that it is very important to ensure that the "unique landscapes and indigenous wildlife and plants in the regenerated areas are protected and enhanced".

Facilitating regeneration of this area presents an opportunity to:

- enhance the connection between the central city and New Brighton, the Estuary and the open coast
- improve the health of the Ōtākaro Avon River
- avoid and/or mitigate natural hazards
- positively influence the future of east Christchurch and enhance community wellbeing[6]

[4] All terms in italics have the meaning given to those terms in the Greater Christchurch Regeneration Act 2016.
[5] Report prepared by Nielsen for Regenerate Christchurch: "Community Needs Assessment Survey for the Regeneration of the Ōtākaro/Avon River Corridor", April 2017.
[6] See the Outline for the Ōtākaro Avon River Corridor Regeneration Plan, April 2017.

2.5 Existing ecological condition

Indigenous and exotic vegetation and fauna has been kept to varying degrees in the Area, with variable biodiversity value. Vegetation Retention Methodology applied by CERA, and then LINZ, retained indigenous trees and shrubs and tall exotic trees throughout the residential red zone portion of the Area. This vegetation provides habitat for a range of indigenous and introduced wildlife.

Crown-owned residential red zone land within the Area is maintained by LINZ by mowing, weed control and taking care of retained vegetation. Most of the area is fenced to exclude vehicles and to reduce the incidences of rubbish dumping.

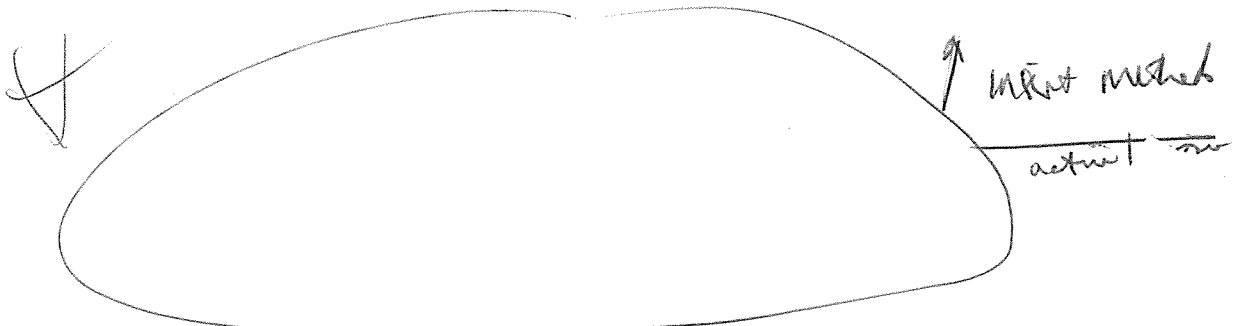
Much of the land subsided because of the earthquakes. This has led to wetter conditions that no longer suit the previous vegetation and associated fauna species. This is particularly apparent in the lower Ōtākaro/Avon River. As a direct consequence of these changes, tidal mudflat areas have expanded by several hectares while the riparian and saltmarsh zones have contracted because they are restricted by existing stopbanks. In many areas these upper zones will disappear altogether if existing stopbanks remain in place. For these vegetation types to migrate inland, replacement stopbanks would need to be constructed further back from the river's edge.

2.6 What is ecological restoration?

Ecological restoration is the practice of renewing and restoring degraded, damaged or destroyed ecosystems and habitats by active human intervention and action. It includes indigenous environments and species on land, in freshwater and in estuarine and marine environments.

When considering ecological restoration it should be noted that:

- An ecosystem is unlikely to be returned to its original state, but many of its functions, including those that provide ecological services, may be restored or re-established.
- The Ōtākaro Avon River is considerably different from a pre-European state due to dredging, pollution, bank modifications, planting and realignments. So constraints on reconstruction and modification that enhance or improve the ecology should not be as limiting as, for example, in a natural system.
- Homogeneous restoration planting may have an adverse effect on extant aquatic/margin invertebrate communities. Retaining habitat diversity is very important for conserving existing indigenous invertebrate diversity.



2.7 Precedents and examples

To provide context, here are some examples of New Zealand ecological projects.

Mahinga Kai Exemplar, Anzac Drive Reserve, Christchurch  http://www.avonotakaronetwork.co.nz/projects/mahinga-kai.html	• The Mahinga Kai Exemplar (MKE) project was created by the 2013 agreement between Te Rūnanga o Ngāi Tahu, the Centre for Freshwater Management and Avon Ōtākaro Network to work together to enhance mahinga kai values in the river catchment, starting with this exemplar. • MKE is a natural restoration project aimed at restoring as much indigenous habitat appropriate to the current environment as possible, with the objectives of enhancing water quality, biodiversity and mahinga kai values. • It also seeks to: - develop educational resources for all ages with regard to these values - exemplify collaborative approaches between iwi, community and agencies (Council, Department of Conservation (DOC), Environment Canterbury and University of Canterbury) in achieving these objectives.
Charlesworth Wetland, Christchurch  https://cccgovtnz.cwp.govt.nz/parks-and-gardens/explore-parks/plains-and-wetlands/charlesworth-wetland-reserve http://www.estuary.org.nz/projects/charlesworth.html	• This 20 ha of land bordered by Linwood Ave and Humphries Drive was drained and cleared for pasture from the 1920s. From 1991, Council cleared the paddocks and scraped tidal pools. The reserve opened in 2005. • Saltmarsh habitats have developed through facilitation of the tide into selected areas. Natural colonisation processes have occurred. • Since 2005 just over 100,000 trees, shrubs and saltmarsh plants have been planted, largely by volunteers coordinated by the Avon Heathcote Estuary Ihutai Trust and supervised by Council Park Rangers. • A volunteer maintenance team takes on tasks such as planting, pruning, invasive weed removal and watering.
Travis Wetland, Burwood, Christchurch	• Travis Wetland is a 116ha ecological restoration programme formerly drained and used as a dairy farm. It is the last large freshwater wetland in Christchurch – an important habitat for native wetland plants, birds, invertebrates and fish. It is a mahinga kai (food gathering) site.

 http://traviswetland.org.nz/	• The wetland has an on-site education centre with laboratory, meeting room and classroom facilities, and a visitor information centre. • Travis Wetland provides scientific benefit as a research site, for education and a recreation experience • Management of the use of Travis Wetlands is through the Reserves Act 1977 and Resource Management Act 1991, especially the Christchurch District Plan provisions. A community-based organisation, the Travis Wetland Trust, works in with Council in managing the wetlands.
Riccarton Bush/Pūtaringamotu, Christchurch  http://www.riccartonhouse.co.nz/riccarton-bush/	• Riccarton Bush is 7.7ha dominated by kahikatea trees. Managed by the Riccarton Bush Trust, the main objective is to restore the Bush to a state where natural processes can take over. • The boundaries of the Bush are secured by fencing, eliminating private gates and walking tracks and rubbish dumping. • Weeds and pests such as possum and domestic cats are controlled and a 1km predator-proof perimeter fence was erected in 2004, when a translocation programme began of fauna (including kiwi) and flora, previously endemic to the bush.
Orokonui Ecosanctuary, Waitati, Dunedin  https://orokonui.nz/	• This predator-free commercial operation is restoring the forest ecosystem by animal pest and weed removal, replanting with locally sourced native species and the return of lost birds, reptiles and bats. • A 9km, NZ$2.2m pest-proof encloses 307ha and keeps out introduced mammals such as possums, rats, mice, stoats, ferrets and cats. • It has an education centre, café and guided tours. Income from visitors contributes to the conservation work. • The ecosanctuary is a project of the Otago Natural History Trust, a registered charitable trust with 1400 members. The elected Board of Trustees oversees policy and planning. It operates in partnership with DOC, the University of Otago, the Otago Museum, NHNZ and Kati Huirapa Rūnaka ki Puketeraki (who have a seat as of right).

	Major sponsors include the Southern Trust, NZ Lottery Grants Board, Community Trust of Otago and Marie and Graeme Bennett.
Zealandia: The Karori Sanctuary Experience, Wellington  http://www.visitzealandia.com/annualreport	• A pest mammal exclusion fence (built in 1999) encircles 225ha of regenerating native forest. The exhibition and visitor and education centre opened in 2010. • From a low base, populations of some birds have mushroomed throughout Wellington from the sanctuary's halo/nursery effect. This halo effect multiplies the area that benefits from the fence by around 10 times. • Karori Sanctuary Trust (1995) is an independent charitable trust with support from, among others: Wellington City Council, government, Mitsubishi Motors New Zealand Ltd, DOC, Victoria University of Wellington, and Wellington Tenths Trust. • Zealandia creates economic activity each year for the city through jobs, local purchases and visitor attraction. It is an invaluable educational and community activity asset.

2.8 Assumptions and uncertainties

This report has been prepared with the following uncertainties and assumptions.

Uncertainty	Assumption
Land ownership	Future land ownership is currently unknown.
Implementation of Plan	It is assumed that implementation of the Plan is enabled, including funding, land ownership, governance, management and delivery responsibilities
Capital costs	Indicative forecasted capital costs have been developed based on limited and generic information. A range of potential costs has been provided. The cost will depend on the implementation options and plans pursued. These figures are for comparative purposes only and will require a concept design, implementation approach and more defined cost estimation to establish a more robust budget.
Operational costs	Operational costs for ecological restoration can be high. Maintaining restoration projects is essential to protect the capital investment, especially protection from pests. The specific maintenance regime and costs will depend on the ecosystem and the restoration approach taken.

3 Strategic assessment

3.1 Purpose

This section outlines the case for change, by addressing:

- Strategic context
- Problem definition
- Investment drivers, existing arrangements and business needs
- Potential investment scope
- Benefits, risks, constraints and dependencies

This section has been informed by the community ideas, suggestions and proposals received by Regenerate Christchurch (outlined in the "Assessment of Land Use Options") and feedback through stakeholder workshops.

3.2 Strategic context

The Greater Christchurch Regeneration Act 2016 establishes Regenerate Christchurch's purpose as to "support a vibrant, thriving Christchurch that has economic, social, and lifestyle opportunities for residents, businesses, visitors, investors and developers". The overarching vision and objectives for the Area are:

Our Shared Ōtākaro Avon River Corridor Vision:

'The river is part of us and we are part of the river.

It is a living part of our city.

A place of history and culture

where people gather, play, and celebrate together.

A place of learning and discovery

where traditional knowledge, science and technology meet.

A place for ideas and innovation

where we create new ways of living and connecting.

OUR VISION IS FOR THE RIVER TO CONNECT US TOGETHER –

with each other, with nature and with new possibilities.

Our Shared Ōtākaro Avon River Corridor Objectives:

For Christchurch

- Support safe, strong and healthy communities that are well-connected with each other and with the wider city.
- Provide opportunities for enhanced community participation, recreation and leisure.
- Create a restored native habitat with good quality water so there is an abundant source of mahinga kai, birdlife and native species.
- Create opportunities for sustainable economic activity and connections that enhance our wellbeing and prosperity now and into the future.

For New Zealand

- Develop the Ōtākaro Avon River Corridor Regeneration Area as a destination that attracts a wide range of domestic and international visitors.
- Establish a world-leading living laboratory, where we learn, experiment and research; testing and creating new ideas and ways of living.
- Demonstrate how to adapt to the challenges and opportunities presented by natural hazards, climate change and a river's floodplain.

The ultimate purpose of the Plan is to enable long-term uses of land in the Area that will contribute to, and support, the regeneration of east Christchurch and greater Christchurch. The vision and objectives have been developed in order to achieve this.

3.3 The case for change

The distinctive nature of the east has been based on the proximity to the rivers and the sea,

The opportunity to enhance the connections of communities with the Ōtākaro Avon River would bring benefits in sense of belonging and positive identity, health, wellbeing, social, economic and environmental benefits.

The earthquakes have changed the natural environment in the east of Christchurch,

The changes result from lateral spread, liquefaction, land settlement, with loss of both indigenous and exotic vegetation, and damaged facilities. Tidal dynamics have changed, coastal erosion has increased, and vegetation composition and wildlife habitat have been significantly altered. The land, vegetation and wildlife are still adapting to the new environmental conditions.

The open space of the Area provide a unique opportunity to establish a restored ecological habitat.

The community needs survey provides strong evidence of the communities desire for an improved and accessible natural environment.

The case for change has been mapped in an investment logic map, see Appendix 1. That process is described in the following sections.

3.4 Investment drivers (problems/opportunities)

The first step in establishing a case for change is to identify drivers for investment. These drivers encompass the problems that need to be addressed, their causes and the related opportunity if they are addressed. They inform the assessment of how ecological restoration could contribute to achieving the overarching objectives and Land Use Assessment Criteria[7] for the Area.

Please note that the Flood Mitigation and Water Quality Improvements Land Use Assessments address associated problems regarding integration with flood management measures and water quality.

The following table provides an overview of the investment drivers which will help guide any decisions around future use including ecological enhancements in the Area.

Land use driver	Causes of problem
1. There has been a loss of wetlands and lowland biodiversity in Canterbury, leading to reduced habitat, declining aquatic life and loss of native birdlife.	• Urbanisation • Conversion and drainage for horticultural or agricultural use • Ongoing expansion of residential housing • Pollution • Increase in pests and predators
2. Urban constraints limit the ability of ecosystems to adapt to changing hydrological conditions and climate change, leading to loss of bio-diversity.	• Changes in ground levels, water and salinity regimes • Earthquake land impacts • Changes in flood plains • Changes to the Estuary affecting the tidal regime
3. Reduced access to and connection with quality natural environments as a result of the earthquakes has a negative impact on people's identity and wellbeing.	• Natural environments were damaged and changed as a result of the earthquake • Pedestrian bridges and walking and cycling paths were damaged by the earthquakes,
4. Christchurch lacks amenity and visitor attractions, which results in short term stays and a failure to capitalise on potential tourist spend.	• Visitor attractions in Christchurch have been focussed on the central city. Since the earthquakes visitor numbers have decreased

[7] See: Assessment of Land Use Options For Public Feedback (Regenerate Christchurch, 2017)

3.5 Ecological restoration investment objectives

These objectives will ultimately be used to assess any ecological restoration opportunities presented if areas for ecological restoration activities are included in the longlist of land use options for further consideration.

The ecological restoration investment objectives are to:

- Support the restoration of connected and resilient aquatic and terrestrial biodiversity, including estuarine and brackish wetlands, and habitats to support viable wildlife populations in the city.
- Improve people's access to quality natural environments and provide places where people can connect with nature.
- Establish a living laboratory in the Area to monitor, raise awareness and educate about the effects and benefits of ecological restoration.
- Recognise, enhance and celebrate sites of cultural significance, and improve and extend opportunities for mahinga kai tikanga throughout the Area.
- Provide internationally recognised educational, recreational and ecotourism opportunities.

3.6 Benefits

To be able to measure the success of any transport opportunity, these benefits have been established:

- **Improved Ecosystem services** including but not limited to carbon sequestration, stormwater retention and filtering, improved air quality and enhanced biodiversity.
- **Improved cultural wellbeing**, including re-establishment of the Area as a source of mahinga kai
- **Savings in infrastructure**, maintenance and hazard management costs.
- **Improved physical, mental, emotional and spiritual wellbeing** as individuals, families and communities through opportunities to connect with nature and enabling active lifestyles
- **Enhances economic activity** due to greater visitation and attraction of migrants
- **Attracts** researchers, students and other authorities to Christchurch.

3.7 Contribution to Overarching Vision and Objectives

Ecological enhancements are considered to contribute to the overarching vision by

The following table sets out how ecological restoration could contribute to the Overarching Vision and Objectives:

Overarching objectives	Link to ecological restoration benefits
For Christchurch	
Support safe, strong and healthy communities that are well-connected with each other and with the wider city.	**Improved physical, mental, emotional and spiritual wellbeing** as individuals, families and communities through opportunities to connect with nature and enabling active lifestyles.
Provide opportunities for enhanced community participation, recreation and leisure.	**Improved physical, mental, emotional and spiritual wellbeing** as individuals, families and communities through opportunities to connect with nature and enabling active lifestyles.
Create a restored native habitat with good quality water so there is an abundant source of mahinga kai, birdlife and native species.	• **Improved Ecosystem services**[8] – including but not limited to carbon sequestration, stormwater retention and filtering, improved air quality and enhanced biodiversity. • **Improved cultural wellbeing**, including re-establishment of the Area as a source of mahinga kai.
Create opportunities for sustainable economic activity and connections that enhance our wellbeing and prosperity now and into the future.	**Savings in infrastructure**, maintenance and hazard management costs.
For New Zealand	
Develop the Ōtākaro Avon River Corridor Regeneration Area as a destination that attracts a wide range of domestic and international visitors.	**Enhances** economic activity due to greater visitation and attraction of migrants.
Establish a world-leading living laboratory, where we learn, experiment and research; testing and creating new ideas and ways of living.	**Attracts** researchers, students and other authorities to Christchurch.
Demonstrate how to adapt to the challenges and opportunities presented by natural hazards, climate change and a river's floodplain.	**Attracts** researchers, students and other authorities to Christchurch.

[8] The concept of 'ecosystem services' is detailed in Appendix 4.

3.8 Scope assessment

An initial scope has been developed to guide the potential options for ecological restoration. There are differing options for restoration depending on the restoration goals and on the existing and potential habitat.

Minimum interference	Allowing an ecosystem to recover on its own, or with a minimum of human interference.
Passive	Seed sources are present and pests are managed. May have a simple fence to keep out stock and restrict people.
Active restoration	Intensive intervention with a planting and maintenance programme may be necessary in areas with: • few seed sources • competing invasive exotic species with substantial existing seed banks from urbanisation • interim ground treatments (levelling, rolling, seeding with grass and mowing).
Active restoration, predator exclusion fence	Eco-sanctuary where pests are managed, an area is predator proof fenced, and species are introduced.

3.9 Risks

It is also important to identify and record any potential risks relating to ecological restoration opportunities, and their mitigations.

Risk	Mitigation process	Residual risk rating
Space is unsafe.	CPTED principles to be identified and adopted.	Moderate
Once delivered, the space/place is not financially sustainable and/or is not well maintained.	Do fiscal planning that focuses on the initial delivery of the facility and the ongoing costs of staffing, maintenance, and expansion.	High
The capital cost is greater than forecast.	The costs include in this assessment are indicative only. Progress more detailed studies prior to establishing budgets and establish a robust project management methodology.	High
Operating costs are greater than forecast.	The costs include in this assessment are indicative only.	High

	Progress more detailed studies prior to establishing budgets and establish a robust project management methodology.	

3.10 Constraints and interdependencies

The following interdependencies have been identified for ecological restoration opportunities.

Interdependency	Description
Infrastructure	The type and purpose of ecological restoration cannot be finalised until the hydrological regime is known. This depends on the location and design of any urban infrastructure for flood management stormwater treatment and transport connections. When these are known, ecological restoration can then be woven into and accommodate the infrastructure planning – and vice versa.
Current and planned Council provision	Christchurch City Council has a number of natural environment strategies.
Connection with existing ecological projects	Connectivity with any ecological restoration in the Area needs to be considered in relation to other ecological sites and habitats.
Transport linkages	Accessibility for all ages and stages and income levels is important. Developing ecological restoration areas needs to be considered in relation to the development of walking and cycling facilities.
Land use assessment reports	Land uses cannot be considered in isolation, and all land use assessments must be considered together.
Other regeneration and urban master plans	Any land use needs to consider other projects undertaken by Regenerate Christchurch, Development Christchurch Ltd and Christchurch City Council in nearby areas, including New Brighton and the central city.
The Plan	The Plan which sets out proposed land uses is being prepared under the Greater Christchurch Regeneration Act. The Minister makes the final decision on whether or not to approve the draft Plan. In making this decision, the Minister must have regard to/consider matters set out in section 38 of the Act. This includes considering the fiscal and financial implications of the draft Plan and whether the draft Plan is in the public interest.
The Crown's investment in land	The Crown has made a significant investment in this land and is the critical decision maker in determining the future use of the Ōtākaro Avon River Corridor. The overall return on investment (financial and non-financial) is a critical issue for the decision makers.

4 Ecological restoration options

4.1 Purpose

The purpose of this section is to:

- Establish the critical success factors for ecological restoration
- Understand the demand with respect to ecological restoration
- Develop a set of example options to inform the development of a longlist of land use options

4.2 Critical success factors

Critical success factors are attributes that are essential for ensuring any economic activity land use types align with the overall vision and objectives for the Area. They are crucial, not desirable. Further, it is important to differentiate between critical success factors and design principles.

The following factors are essential to successful implementation of ecological restoration opportunities if included in the longlist of land use options for further consideration.

Critical success factor	Description
Wellbeing	How well the option meets the objectives of : • creating a healthy environment that encourages social and community activities and engagement • promoting recreation and active lifestyles providing a safe environment
Environmental restoration	How well the option will deliver environment restoration which: • contributes to Mahinga Kai • improves natural habitat • treats stormwater
Resilience	How well the option: • is responsive to future changes especially sea level rise
Affordable and achievable	How well the option: • has benefits that outweigh the CAPEX and OPEX costs • contributes to an increase in employment • recognises the skills and drive available for successful delivery
Accessibility	How well the option: • uses universal design principles • has low/no cost activities • provides activities for different and diverse ethnicities, ages and abilities • provides access through all modes of transport

Connectivity	How well the option improves connection: • between the Area and the surrounding area • between the east and the rest of Greater Christchurch • involve local communities in kaitiakitanga/guardianship
Visitor attractiveness	How well the option encourages visits to the Area

4.3 Demand analysis

Protection and enhancement of ecosystems and habitats and connection to nature are recognised as important factors for wellbeing.

Since the Community Wellbeing Survey[9] began in September 2012, those surveyed have identified a number of issues continuing to have a moderate or major negative impact on their everyday lives. In the most recent survey in September 2016, the issues relevant to this assessment persisted, although to a lesser degree. These are:

Issues: percentage of those surveyed who identified the issues continuing to have a moderate or major negative impact on their everyday lives	Sept 2012	Sept 2013	Sept 2014	Sept 2015	Sept 2016
Being in a damaged environment and/or surrounded by construction work	30	20	19	20	10
Loss of other recreational, cultural and leisure time facilities	34	17	17	15	9
Loss of outdoor sports and active recreation facilities	20	10	11	10	8
Loss of usual access to the natural environment	24	10	10	7	5

In the Community Needs Assessment Survey in April 2017[10] prepared for Regenerate Christchurch, 75% of respondents indicated that it is very important to ensure the "unique landscapes and indigenous wildlife and plants in the regenerated areas are protected and enhanced".

4.4 Potential options

To inform the development of a longlist of land use options, a list of potential ecological restoration examples has been developed. These options, outlined below, are examples with the potential to meet the investment objectives and critical success factors outlined in this report. They are intended to provide context for the development of a longlist of land use options only, and should **not** be interpreted as ecological restoration opportunities that will be included in the Area.

[9] https://www.cph.co.nz/your-health/wellbeing-survey/
[10] Report prepared by Nielsen for Regenerate Christchurch: "Community Needs Assessment Survey for the Regeneration of the Ōtākaro Avon River Corridor", April 2017.

4.4.1 Retaining existing vegetation

Indigenous vegetation and large exotic trees have been retained under the vegetation retention policy. Many other plants and trees that were part of domestic gardens have also been retained. Existing mammals are mustelids, possum, rats and mice and feral cats. Other existing aquatic and terrestrial fauna are invertebrates, fish and birds.

The Avon Ōtākaro Forest Park group has negotiated with LINZ to fence and maintain areas of native vegetation that have value as a seed source.

4.4.2 Riparian environments

Riparian vegetation can influence the health of waterways and how they function, with many social and cultural benefits including aesthetics, recreation, and flood control.

However, the Ōtākaro Avon River is a highly modified ecosystem, and species have adapted to the existing environment. Any riparian restoration would need to be sympathetic to the existing environment and the species present. A homogeneous restoration planting may have an adverse effect on extant aquatic/margin invertebrate communities. Retaining habitat diversity is very important for conserving existing indigenous invertebrate diversity, for example even muddy river edges are important for some invertebrate communities[11]. So maintaining a varied riparian environment and avoiding a completely homogeneous environment will be important to protect existing communities.

Two key factors determine whether the buffer will become self-sustaining over the long term (more than 50 years): the plantings must out-compete the weeds and new seedlings must establish under the plantings through natural regeneration. To achieve both factors, plants must form a closed canopy that shades the ground. This reduces and prevents weed dominance and creates conditions that favour the establishment of new seedlings. Dense riparian plantings provide the best environment for reducing weedy ground cover. If this amount of space is not available, then planting dense shrubs on the edges to reduce light entering the buffer can help.

Increasing the riparian vegetation will come with significant maintenance costs due to weed invasion.

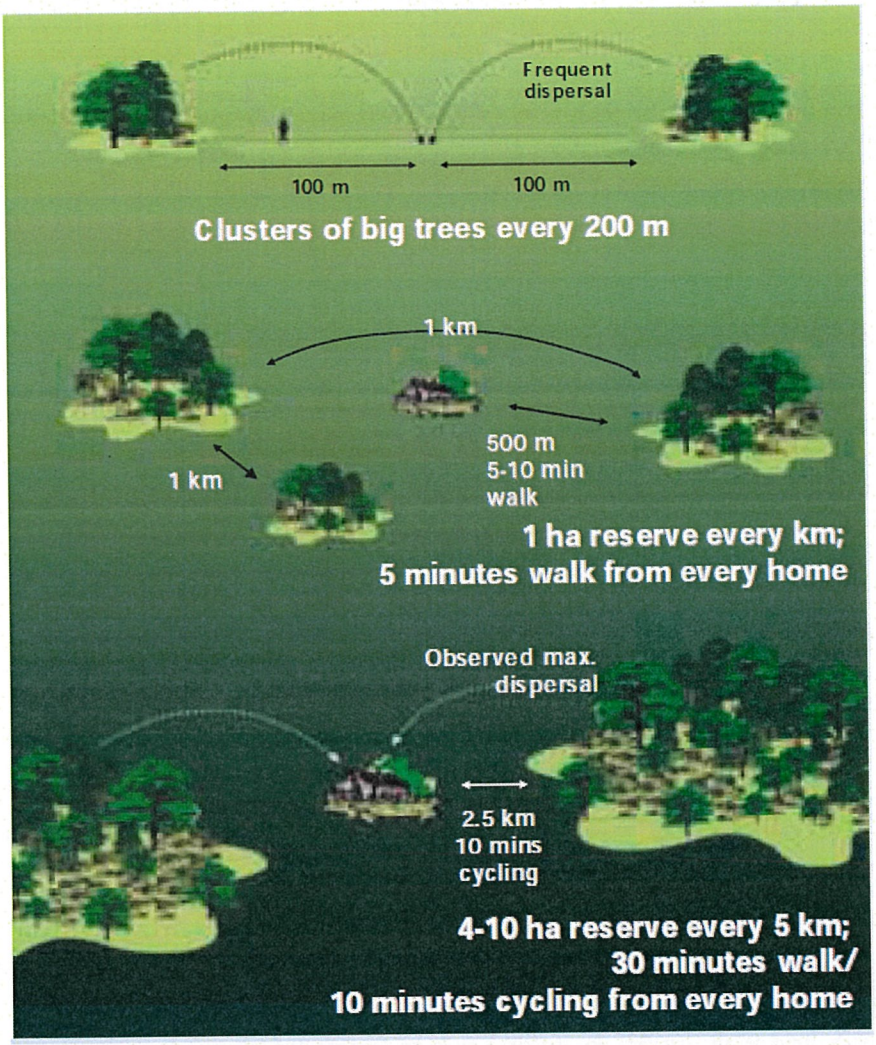
4.4.3 A minimal network of patches of "forest" restored ecologically

The understanding of forest dynamics across the landscape and how to integrate nature and production is based on observing and modelling dispersal, regeneration and forest succession processes (Meurk and Hall 2006). By linking this to theory of ideal reserve design (in terms of size, shape and spacing), planning for optimal forest patch configurations for urban landscapes can ensure their ecological and cultural sustainability. This means that indigenous nature is not only viable but always visible and accessible to the community – so everyone grows up experiencing, knowing and wanting to protect it (Meurk and Swaffield 2000). Natural heritage is also projected to visitors at high profile locations and becomes inextricably associated with sense of place.

[11] McFarlane report on Styx River Reserve (Christchurch City Council ref 14/195955)

Approximate minimum targets for forest patch size and density in urban environments are depicted below. This configuration is built around a pattern of nested forest patches of various sizes that are known to provide minimal security for a range of plants, including those that are frost- or wind-sensitive, and at least the more common iconic wildlife – fantails, bellbirds, tūī, kereru, tomtits, brown-creepers, lizards and invertebrates.

The long-term viability of vulnerable species will also depend on the availability of seed sources and deeper refuges for sensitive wildlife. Also integral is landscape connectivity and a suburban matrix that has food or safe resting places scattered through it. This may include both native and exotic plants, but a key component of a wildlife-friendly neighbourhood will be vigorous predator and weed control.



The above illustration shows how a patch pattern can be constructed for modified landscapes where available land is limited, by including a range of minimum forest patch sizes, to achieve spatial connectivity.

- > 5ha patches at about 5km spacing – for core sanctuaries in an urban context.
- > 1ha patches at about 1km spacing – to provide habitat for most plants, lizards, insectivorous birds and invertebrates and resource-rich "stepping stones" for larger frugivorous or honey-eating birds.

- 200m^2 groves at about 200m spacing – to provide groves of New Zealand trees, finer-grained stepping stones, and feeding stations.

4.4.4 Large estuarine wetland areas in the lower Ōtākaro Avon River

Many ecological values of the lower Ōtākaro Avon River have been significantly modified and degraded over the years, with additional change since the earthquakes, and there has been a significant loss of native vegetation in the area.

The naturally occurring vegetation in this area is significant and of high conservation value, particularly in the riparian and salt marsh areas. Salt marsh is a habitat and vegetation that occupies the upper part of the tidal range around the margins of estuaries. It comprises land plants that are tolerant of salt and tidal inundation, located between the mudflats of the lower part of the tidal range and the land above. Salt provides a major stress upon plant growth and survival, so the plants that occur there (called halophytes) have mechanisms to deal with excessive salinity. Salt marshes are dynamic, and shifting channels in the estuary have caused them to change historically. Where sediment has been deposited, salt marsh vegetation has colonised, where it has been removed the salt marsh has retreated. Salt marshes are important for vegetation, fauna and as spawning areas for fish. They also play a major role in protecting the adjacent land through shoreline stability by absorbing wave energy and reducing erosion.

The earthquakes mean that the zone suitable for salt marsh has moved with the land. In the lower Ōtākaro Avon River where the land has dropped, the estuary side of salt marsh is now too far down in the tidal range for salt marsh plants to survive. On the landward side, where there are not stopbanks or walls, areas previously beyond the tidal range are now inundated to varying degrees and have become suitable for salt marsh. The overall effect will be migration of the salt marsh inland. To retain the ecological and coastal defence values of the salt marsh, it is important to allow this migration to occur.

Council's top priority for wetland restoration is to provide space for tidal coastal wetlands. The lower to mid Ōtākaro Avon River, the lower Ōpāwaho/Heathcote River and Brooklands are the only places where tidal/coastal wetlands/shrublands in the city can be retained and established. These places provide us with the best and perhaps only opportunity to do this.

The Area has the space for ecological migration, and especially in the Bexley area which would allow for sea level rise and the need for coastal estuarine ecosystems to migrate with environmental change. This would help safeguard the future of the Estuary and the estuarine ecosystems by allowing them to move/expand with projected sea level rise. Estuarine wetland areas will take less intensive intervention as increased salinity and frequent tidal inundation will control many pest species, and estuarine vegetation will re-establish over time.

Bexley – estuarine wetland ~80ha
Allowing nature to do most of the work to re-establish the ecosystems and associated species in the Bexley area is likely to be the most authentic approach in terms of habitat replication, and the most economic. This could be achieved by removing the existing

stopbanks, removing the fill, structures and roads, and building new stopbanks on the edge of the Area adjacent to Bexley Road/Anzac Drive. This would enable various levels of inundation of the land adjacent to the shore by tidal water in some place on every tidal cycle, and in others only under extreme events, depending on the specific features of individual sites.

In most places the combination of increased soil salinity, periodic shallow tidal inundation and natural dispersal of saltmarsh plant seeds and living material, will result in saltmarsh regeneration immediately landward of where this vegetation occurred pre-quake.

- The area south of Pages Road would provide additional habitat for mudflat invertebrates, fish breeding areas among rushes, enhanced habitat for wetland birds and freshwater species such as in raupō beds around freshwater springs. This would ensure that the full sequence of estuarine habitats could become established – tidal mudflats to lower saltmarsh to upper marsh of rushes and shrubland; then salt meadow with its associated turf microhabitats and coastal shrubland and forest adjacent to the stopbanks.
- In the Bexley area north of Pages Road, if the existing river-side defences were removed, existing freshwater springs would create ponds and wetland areas with associated habitats, with a brackish influence from the Ōtākaro Avon River along the eastern side of the area. This would create a different habitat from the Bexley area south of Pages Road, with more freshwater present.

4.4.5 Large freshwater wetland areas and an extensive network of smaller wetlands

Enhancement or development of large wetland areas would build on existing complexes. Freshwater wetlands are of lower priority in the Area than estuarine wetlands as there are other places in the catchment where they can be sited. They will require greater intervention to control pest species, especially species from residential gardens. Establishment of wetland plants would need to be through active restoration and planting, at least in the early stages. Areas suitable for wetlands are as follows.

Horseshoe Lake – freshwater wetland ~50 ha
The area north of New Brighton Road surrounded by Horseshoe Lake is very low lying. Currently lake water is pumped into the Ōtākaro Avon River by pump station 205 at the south-east end of the lake. Options for reducing the pumping and allowing this area to flood would provide wetland conditions that could be enhanced by active restoration. This area would then provide some flood mitigation and wetland treatment of stormwater before discharge into the river.

Retain and maintain Cockayne Reserve – freshwater wetland ~5ha
Pre-quakes, Cockayne Reserve was a freshwater wetland with dominant species of Raupō and cabbage tree. It was infested by the wetland weed purple loosestrife (*Lythrum salicaria*). Brackish water is now entering Cockayne Reserve as the stopbanks have breached and a new transition zone of saltmarsh/brackish vegetation is developing.

Anzac Drive Reserve – freshwater wetland including Lake Kate Sheppard ~17ha
Other constructed wetlands for stormwater treatment.

4.4.6 An extensive network of 400ha ecological restoration

The patch approach in section 4.4.3 above could be extended to cover a much greater area.

4.4.7 50ha fenced predator-free area (sanctuary) for introducing target species

Fenced sanctuaries are one of a large range of conservation techniques. They can deliver conservation, community participation, educational, research and commercial benefits. A sanctuary could add to the network and variety of native biodiversity in the city.

However, sanctuary concepts work best where there is an integrated and supported plan to maintain biodiversity across the wider urban landscape. Otherwise the vulnerable species emigrating from the predator-protected area will be lost outside the fence. What is achieved within the sanctuary needs to be supported by works and initiatives outside. This will involve a significant increase in operational costs for predator control and habitat maintenance in the wider urban area.

Council staff consider that the investment should be made in establishing plantings and ecological management across the Area. The predator-proof fence would only then be contemplated once the plantings have become well established and will adequately support the threatened species being considered for translocation. Then the costs and benefits of having a fence can be better calculated and realised.

Constructing a predator-proof fence in a wetland area with multiple drains and streams is more difficult and more expensive than for an equivalent area of dry land. Specially designed wetland fencing and water crossings would be required to avoid incursions though these access points.

A fenced sanctuary is suitable for protecting well-defined areas. A fence reduces or eliminates the need for recurring trapping or poisoning operations and provides safe breeding conditions for rare species, some of which may then forage out into the city. A fenced area creates a tangible barrier that the public can identify with. It provides a limited number of controlled entry points, contributing to a better educational, recreational and visitor experience for people using the area. A sanctuary has an advocacy role as it can expand public support and interest for nature conservation, through education and public awareness programmes.

However, a fenced sanctuary is expensive to build and operate, especially in a wet area or area subject to flooding. It has high capital costs, high depreciation costs and expensive ongoing operational costs as it requires ongoing maintenance to ensure the fence is in good condition and to manage any pest incursions. Depending on the design and terrain a fence is not a perfect barrier, especially for mice. Vandalism is a risk.

Evaluation of a proposal that extended beyond the Area (eg to Travis Wetland) would need extensive assessment. It is not clear whether the functioning of a larger eco-sanctuary would depend on the installation of a wildlife bridge (at an estimated cost of at least $5m). In terms of connectivity for people, a bridge would add to the experience (and the cost). But the first rule of wildlife bridges or overpasses (or underpasses) is that they are just that; for wildlife only. They are never combined with pedestrian overpasses. The vast majority of species introduced to an eco-sanctuary will be birds. Overpasses have been demonstrated to work very well internationally where small, medium and large mammal populations are present and important.

The Visitor Attractions Land Use Assessment identifies the opportunity for an eco-sanctuary to form part of the destination provided by the Area.

4.5 Summary of options

A list of potential ecological restoration options has been developed for the Area as detailed below.

Option	Description	Capital cost	Operational cost per year
A	Retain existing vegetation in the Ōtākaro Avon River Corridor	N/A	$4m
B	Riparian environments – active restoration of 13km x 300m up to 325ha (50% coverage) CAPEX: $150,000/ha OPEX: $15,000/ha for first 5 years	$24.4m	$2.4m
C	A minimal network of patches of "forest" restored ecologically – 30ha CAPEX: $100,000/ha OPEX: $12,000/ha for first 5 years	$3m	$360,000
D	Large estuarine wetland areas in the lower Ōtākaro Avon River – 80ha (may overlap with Green Spine) CAPEX: $20,000/ha (does not include engineering work to breach stopbanks, etc.) OPEX: $5,000/ha for first 5 years	$1.6m	$960,000

Option	Description	Capital cost	Operational cost per year
E	Large freshwater wetland areas and an extensive network of smaller wetlands – 80ha CAPEX: $100,000/ha (does not include engineering work to create wetlands, etc) OPEX: $12,000/ha for first 5 years	$8m	$400,000
F	An extensive network of 400ha ecological restoration (may overlap with other approaches above) CAPEX: $100,000/ha OPEX: $12,000/ha for first 5 years, decreasing after that	$40m	$4.8m
G	50ha fenced predator-free area (sanctuary) for introducing target species	$7.7m	$1m

4.6 Land Use Attributes

Through workshops with ecologists, and some proponents of projects with an ecological focus, a set of land use attributes for ecological restoration has been developed. The land use attributes are the key outputs from this report that will inform the long list of land use options. These are:

1. Investigate and understand the current state of the environment, and monitor and record key changes and trends to inform planning, design and ongoing management.
2. Ensure the Area is connected to the wider landscape and ecosystems of Ōtautahi/Christchurch and Waitaha/Canterbury Plains.
3. Ensure the Ōtākaro Avon River is connected with its floodplain and hydrological system, and reduce the flood risk in the Area and surrounding vicinity.
4. Improve water quality within and outside the Area (acknowledging that some of this will be beyond the scope of the Regeneration Plan).
5. Work with nature and natural processes to restore and enhance indigenous ecosystems and habitats for fish, birds and invertebrates within and adjacent to the Area and wider landscape.
6. Celebrate the indigenous biodiversity and natural landscape features of the Area and optimise the quality of people's experience of nature while limiting negative impacts on flora and fauna.
7. Work with the community and encourage community-led initiatives and kaitiakitanga/stewardship of the environment.
8. Acknowledge and reflect the stories of the land and water and the communities past and present.

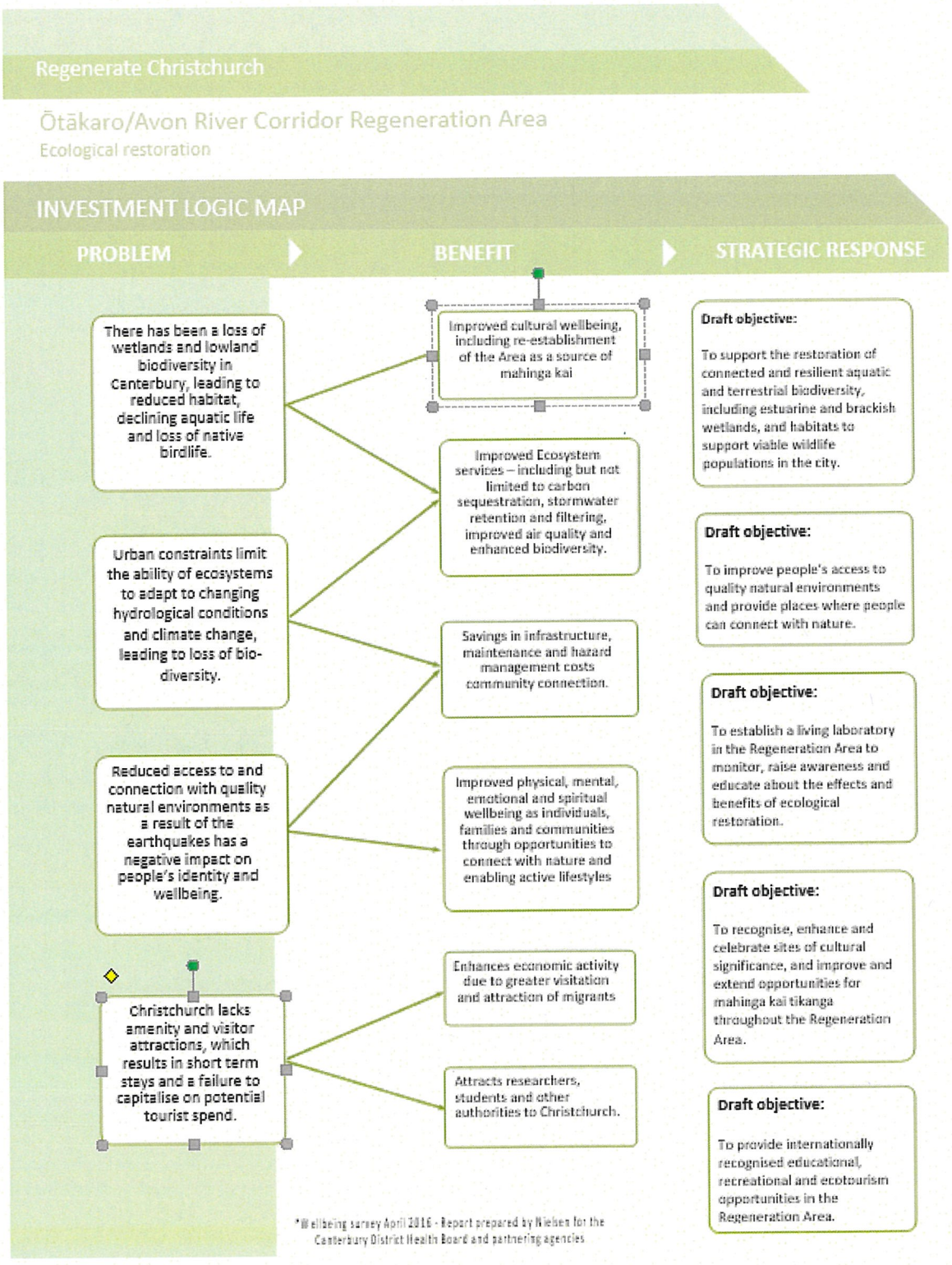
9. Use environmentally sensitive planning, design and development principles (such as Low Impact Urban Design and Development – LIUDD) throughout the Area.

5 Conclusion

As a result of the work completed in this report, which included stakeholder workshops and consideration of the ideas, suggestions and proposals received by Regenerate Christchurch from the community, **it is recommended that ecological restoration opportunities be included in the longlist of land use options for further consideration.**

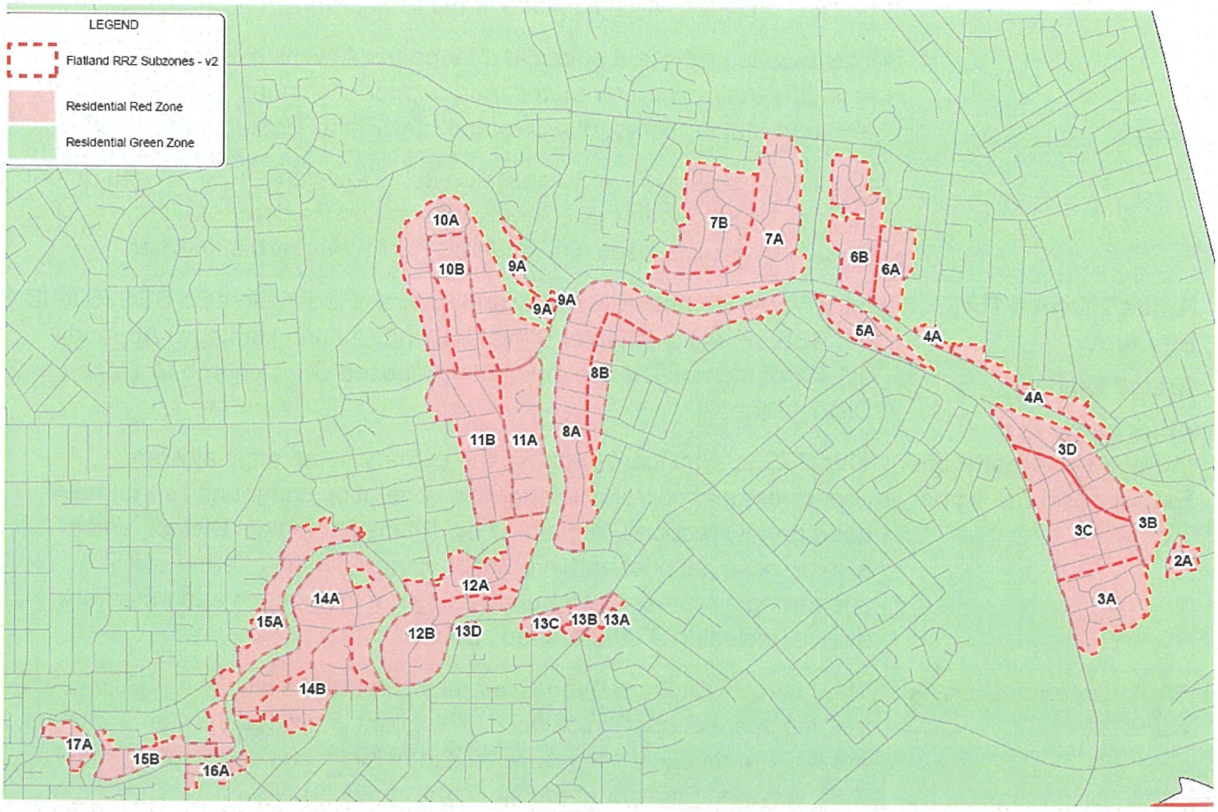
Appendix 1: Investment logic map

The investment logic map process is aimed at providing a framework for identifying the problems which need to be resolved, the potential benefits from addressing the problems and the development of investment objectives with respect to a potential project or land use.



Appendix 2: Summary of the current ecological condition and provisions

The residential red zone area has been divided into areas, shown below. In 2015, a cross agency Technical Advisory Group summarised the condition of these areas.



Area	Brief description	Area	Brief description
2	Owles Tce, Evans Ave	10	Burwood (Horseshoe Lake)
3	Bexley	11	Dallington (North of McBratneys Road)
4	New Brighton Road	12	Dallington (South of McBratneys Road)
5	Avondale (east of Anzac Drive) New Brighton (south bank)	13	Wainoni
6	New Brighton (west)	14	Avonside
7	Burwood	15	Richmond
8	Avondale	16	Linwood
9	Burwood (east of Horseshoe Lake)	17	Avon Loop

This summary is not complete. For example, an analysis of aquatic and river margin invertebrate diversity will be needed to establish a baseline, in addition to a fish and plant biodiversity review.

Area	Summary of current ecological condition
All areas adjacent to the Ōtākaro Avon River and Tributaries	Ōtākaro Avon River and Tributaries identified as Site of Ecological Significance (SES) (Site ID no. SES/LP/24) in Chapter 9 (Natural and Cultural Heritage) Appendix 9.1.4.1 of the notified version of the proposed Christchurch Replacement District Plan. This SES is significant because it "supports At-Risk fish species including their migration routes, and supports indigenous vegetation and avifauna that is representative of the Low Plains Ecological District". The Ōtākaro Avon River is classified as a Downstream River with a 30m setback as per Chapter 6 (General Rules and Procedures) of the notified version of the proposed Christchurch Replacement District Plan.
Areas 2 Owles Tce, Evans Ave **Area 3 Bexley** **Adjacent to the Ihutai/Avon Heathcote Estuary and Environs**	Ihutai/Avon Heathcote Estuary and Environs identified as a SES (Site ID no. SES/LP/14) in Chapter 9 (Natural and Cultural Heritage) Appendix 9.1.4.1 of the notified version of the proposed Christchurch Replacement District Plan. This SES is significant because the estuary "is an originally rare ecosystem that contains indigenous vegetation communities that have been greatly reduced within the Low Plains Ecological District, and is also of local, national and international importance in terms of it supporting a representative assemblage of indigenous and migratory birdlife, including 23 threatened species".
All Areas except areas 2 and 3	The adjacent Ōtākaro Avon River mainstem has a significant yellow flag iris (*Iris pseudacorus*) infestation. This plant is a weed that forms dense tuberous mats excluding native wetland plants, choking wetlands and waterways and may degrade whitebait spawning areas. The plant is designated an "unwanted organism" under the Biosecurity Act and is identified as a pest by ECan.
Adjacent to Areas 6, 7	Travis Wetland is a SES (Site ID no. SES/LP/2), because "it contains a large area of vegetation that is representative of the Low Plains Ecological District including threatened and locally rare plant species, and also provides habitat that supports representative assemblages of native wetland birds including several threatened, at risk and locally rare species". The wetland also has considerable educational value.
2 Owles Tce, Evans Ave	The southern boundary of Area 2A is at the boundary between the Ihutai/Avon Heathcote Estuary and Environs SES/LP/14, and the Ōtākaro Avon River and Tributaries SES/LP/24. This site includes Naughty Boys' Island, which is a wildlife haven for birds and is located adjacent to the south boundary of Area 2A.
3 Bexley	Comprises a large portion of the western side of the river meander. The site has been subject to a number of human activities including large scale residential subdivision.
5. Avondale (east of Anzac Drive) New Brighton (south bank) **6 New Brighton (west)**	An inanga spawning site is present in Kate Sheppard Stream (also referred to as Lake Kate Sheppard) immediately adjoining the western boundary of Area 6 (Council spawning site location "Reach ID6").

7 Burwood	Inanga spawning sites are present in Corser Stream within Area 7 (Council spawning site location "Reach ID 4") and the adjacent section of the Ōtākaro Avon River (Council spawning site location "Reach ID 5"). Corser Stream is one of the first examples of drain naturalisation and considered to be a flagship for enhancement. The natural landform in Area 7 has been modified by placement of approximately 1m of sand/gravel fill during subdivision construction.
8 Avondale	Area 8 adjoins the Porritt Park Loop at its southern end, a remnant ox-bow of the Ōtākaro Avon River. Inanga spawning sites are present in the adjoining section of the Ōtākaro Avon River (Council spawning site locations "Reach ID 3 and 5").
9 Burwood (east of Horseshoe Lake) **10 Burwood (Horseshoe Lake)**	Also adjoining Horseshoe Lake Reserve (Site ID no. SES/LP/8), significant because "it contains a relatively large area of vegetation that is representative of the Low Plains Ecological District, and provides habitat for an At Risk plant species, and representative assemblages of indigenous birds including three threatened species". An inanga spawning site is present in the adjoining section of the Ōtākaro Avon River (Council spawning site location "Reach ID3").
11 Dallington (North of McBratneys Road)	An inanga spawning site is present in the adjoining section of the Ōtākaro Avon River (Council spawning site location "Reach ID3").
13 Wainoni	Areas 13A, 13B and 13C are adjacent to the Porritt Park Loop of the Ōtākaro Avon River, which is classified in Chapter 6 (General Rules and Procedures) of the notified version of the proposed Replacement District Plan as an Environmental Asset Waterway with a 7m setback.
15 Richmond	The site includes Dudley Creek. The south western corner of Harvey Terrace and Templar Street has a Significant Tree (Black Locust) –Tree ID No. T139 in Chapter 9 of the notified version of the proposed Christchurch Replacement District Plan.

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Chris Cole
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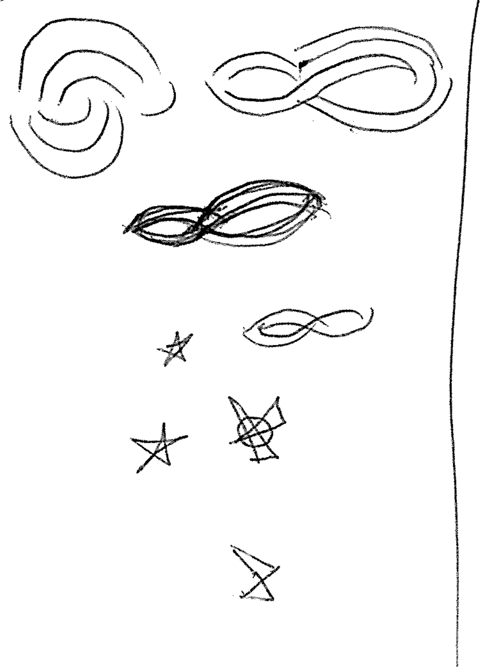

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