BEFORE THE CANTERBURY REGIONAL COUNCIL

UNDER THE	Resource Management Act 1991
AND	
IN THE MATTER	of Application CRC131249 by the Christchurch City Council for a discharge permit to discharge contaminants (being stormwater) onto and into land and into water in the Styx River area

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STATEMENT OF EVIDENCE OF ANTONY BRUCE SHADBOLT

INTRODUCTION

Qualifications and Role

1. My full name is Antony Bruce Shadbolt. I hold a National Diploma in Amenity Horticulture (NDH), a Bachelors Degree in Landscape Architecture (BLA), a Masters Degree in Forestry Science (M.For.Sci) and am currently completing a PhD in Forestry Science with a focus on wildlife management in modified habitats.

2. I am employed as a Landscape Architect with the Capital Investigations Unit of the Capital Programme Group, Christchurch City Council. In this role I provide professional planning and design advice to a broad range of internal and external clients on a range of landscape and ecological related issues. It is in this role that I give evidence to the Hearing Panel on this application, and as co-author of the Styx SMP.

3. I have over 14 years experience as a landscape architect with the Christchurch City Council, including more than ten years direct involvement with the planning and implementation of a City Council strategic planning document called the Styx Vision 2000 – 2040. During this time I was also seconded to the Asset and Network Planning (Greenspace) Team for a period of 12 months to fill the role of the Styx River Planner while the planner was on extended leave.

4. I am also currently employed by the faculty of Commerce, Lincoln University as a part time lecturer in the Agroforestry (FORS270) and Forest Management (FORS310), with a focus on the ecosystem services of trees and forests, biodiversity, and managing riparian areas. For the past five years I have also been employed by the School of Landscape Architecture (Lincoln University) as a contract lecturer in the third-year paper Landscape Ecology (LASC312), and more recently Planting Practices (LASC207) with a focus on ecological aspects of landscape design and planning, ecological restoration and wildlife management.

5. Through my Lincoln University role, I am also currently leading a 12-month research project investigating the value of various habitats along the Styx River and Kaputone Streams as important wildlife habitat for native waterfowl using motion sensing camera traps.

6. I have a non-employment related interest in the Styx River. I am, and have been an active member of the Board of Management of the Styx Living Laboratory Trust for more than six years, and have in the past also been on the Board of Management of the Guardians of the Styx. These are both voluntary roles.

7. I confirm that I have read and agreed to comply with the Code of Conduct for expert witnesses (Environment Court Consolidated Practice Note 2006 and its November 2011 amendment). This evidence is within my area of expertise, except where I state that I am relying on facts or information provided by another person. I have not knowingly omitted to consider facts or information that might alter or detract from the opinions I express.

Scope of Evidence

8. My evidence addresses the following matters:

   8.1. City Council Approach to Waterways Planning & Management

   8.2. The Role of Stormwater Facilities in City-wide Wildlife Management

   8.3. Response to Specific Submitters on Disturbance to Wildlife

   8.4 Mahaanui Kurataiao (MKT) Submission

   8.5 Conclusions.

9. In preparing my evidence, I have read the following documents:

   8.1 Styx SMP and Blueprint for Surface Water Management

   8.2 Mahaanui Iwi Management Plan

   8.3 Submissions Received on Public Notification of Consent Application

   8.4 Officers Report

   8.5 Relevant sections of the documents listed in **Attachment G**

City Council Approach to Waterways Planning & Management

10. The Styx Stormwater Management Plan (Styx SMP) is just one strategy developed by the Christchurch City Council (CCC) to maintain and wherever possible improve the quality of water entering natural waterways and wetlands, and manage for the full range of values attributed to waterways in the city. The catchment objectives for the Styx SMP (Section 2.3, Page 7) are to:
    - Maintain the good existing water quality of rivers and streams, and where appropriate, improve water quality in the face of urban growth expected over the next 35 years.
    - Accommodate expected urban growth over the next 35 years without a significant increase in the cost of flood damage to the community.

- Achieve the above two objectives using CCC's multi-value approach articulated in the "Surface Water Strategy 2009-2039".

11. To this end the CCC has adopted a 6-values approach to waterways management, where the six values are drainage, ecology, landscape, recreation, culture and heritage. This 6-values approach to waterways management was pioneered by the CCC Waterways and Wetlands team in the 1990's and has seen a significant paradigm shift in the way waterways are now seen and valued in 21st century Christchurch.

12. The Christchurch City Council has a long and proven philosophy of managing and restoring waterways throughout the city for multiple (six) values: drainage, ecology, landscape, recreation, culture and heritage. This six-values approach has seen many kilometres of waterway restored from their formerly degraded states to environmental assets that support a wide range of indigenous fauna and flora, and now make a significant contribution to the full range of values.

13. The Styx Vision 2000 – 2040 is a Council planning document, approved by Council in July 2001, that 1) describes the six-values in relation to the Styx River environment, 2) outlines the consultative process, and 3) discusses the future management of the river system in terms of achieving five significant broad and over-aching visions. These visions offer this generation the opportunity not only to protect and preserve the unique character and features of the Styx River system, but also to leave behind something of greater value for generations to come in much the same manner that foresight and visionary thinking provided our current generation with assets like Hagley Park.

14. The five visions of the Styx Vision 2000 – 2040 include:

- 1) To create a viable springfed river ecosystem
- 2) To create a source to sea experience
- 3) To develop a living laboratory
- 4) To establish The Styx as a place to be
- 5) To foster a range of partnerships

15. A Master Plan (Styx Master Plan) for public open space along the Styx River and its tributaries was being prepared by the Asset & Network Planning, Greenspace Unit of the CCC at the time of the 2011 Christchurch earthquake, however this planning process has been delayed while other planning processes take priority, and the Master Plan is currently in its draft form only. It is proposed that the Styx Master Plan process will be re-commence in 2014.

16. When finalised, the Styx Master Plan will not be a statutory plan as required by, or prepared under legislation such as the Reserves Act 1977, nor will it be a legal document that commits the Council or any other organisation to any proposed action. However it will provide opportunity to highlight the public open space, natural and tangata whenua values of the area. As such, the purpose of this Plan will be to:

- Guide, influence and advocate for the ongoing integrated management and development of public open space,
- Provide long-term objectives to promote the protection and enhancement of biodiversity and ecology,
- Promote public access and recreational opportunities,
- Promote educational and applied research that focuses on sustainable management, and
- Promote and protect historical and cultural features.

17. A critical factor in achieving the visions and goals of the Styx Vision 2000 – 2040, particularly Visions 1, 2 and 4, is the acquisition and protection of strategic parcels of land along the length of the Styx River and its tributaries. Acquiring significant parcels of land along both natural (and artificial, Refer **Attachment A**) waterways throughout the Styx River catchment also allows for the full range of values to be managed. As such, the existing parks and reserves along the Styx River and tributaries offer a broad range of experiences and opportunities for recreation, appreciation of natural character, rural amenity, education, cultural use (for example cultural harvesting), wildlife habitat and drainage function. Acquisition of land for the implementation of the Styx SMP will play an important role in complementing these reserves, and by doing so significantly increase the range of opportunities available to manage and protect these values.

18. The main stem of the Styx River, between Nunweek Park (Harewood) and the floodgates at Brooklands, covers a distance of approximately 22.8 kilometres. Of this length the Council has been successful in acquiring in public ownership approximately 6.1 km or reserve land along the true left bank (TLB), and approximately 7.9 km reserve land along the true right bank (TRB). In addition to this reserve almost one kilometre is protected as esplanade strip along both banks, and unformed legal road on both sides of the river extends from Marshland Road to the mouth of the Styx River providing a good degree of public access for both recreation and cultural purposes. This unformed legal road therefore complements the reserve network by extending these opportunities an additional ten kilometres along the TLB and 7.8 km along the TRB. As such, protection and public access have been achieved along 27% of the TLB (71% including esplanade strips and unformed legal road), and 35% of the TRB (69% including esplanade strips and unformed legal road).

19. In terms of achieving the 40-year vision of a Source to Sea Experience through the creation of an Urban National Reserve Network (Styx Vision 2000 – 2040), the Christchurch City Council is on target in terms of reserve acquisitions (average 31% of river length buffered by reserve within 33% of the Vision's 40-year timeframe), and in terms of public access is well advanced (70% of length available for public access within 33% of the Vision's timeframe).

20. Since the late 1970s on the Otukaikino River alone, the CCC (then Waimairi District Council) has established significant restoration plantings and stream buffers along almost 4.9 km of the true left bank, and 5.4 km along the true right bank between Roto Kohatu Reserve and Dickey Road. Within The Groynes Reserve alone, 1.4 km of waterway have been restored.

21. Furthermore North Boundary Stream, East Stream, Kaikanui Stream, artificial lakes and feeder waterways within Clearwater Golf Resort, all of which are tributaries of the Otukaikino River, have been naturalised and restored as part of the *'Caring for the Otukaikino'* (Boffa Miskell Ltd 2000) waterway management agreement. Also, City Council Ranger Services have successfully partnered with Fish and Game NZ and the local landowner/manager to carry out waterway restoration on private land with the help from ECan's Immediate Steps Biodiversity Fund. This work has involved fencing to exclude livestock from the Otukaikino and tributaries, weed control, restoration planting and establishment.

22. On South Boundary Stream, another tributary of the Otukaikino River, the CCC has entered into a conservation covenant agreement on private land where a significant area of willow woodland (approximately 1.9 ha) is in the process of being restored to native forest. Within the site are the headwater springs of South Boundary Stream; a tributary of the Otukaikino River and are therefore likely to be of special significance to Ngai Tahu values as well as recreation and ecological values in terms of protecting water quality. The CCC is responsible for ongoing development and maintenance of this site, with an annual capital budget of $20,000 over and above routine maintenance and establishment costs.

23. Similarly, on the Styx River significant waterway restoration and native wetland and forest plantings have taken place since the 1980s, but more significantly over the past five to ten years. On the true left bank of the Styx River, approximately 5.8 km of riparian and forest planting has been undertaken, with approximately the same length being planted on the true right bank between Nunweek Park (Harewood) and the floodgates near the mouth of the river. Significant lengths of Kaputone Stream and Smacks Stream have also been restored, including sections of tributary waterways such as Radcliffe Road Drain, Mundys Road Drain and Cavendish Road Drains which were previously timber lined Class-3 waterways. Such restoration work is expected to continue, and now that the Styx River reserve network is being managed as a Regional Park (a park classification that is managed by Council Ranger Services primarily for the preservation and appreciation of natural environments), the pace of restoration work is anticipated to increase.

24. The selection of photographs in **Attachment B** illustrate some of the CCC work relating to the restoration of timber boxed drains to natural waterways that support a broad range of values; most specifically culture and ecology. **Attachment A** illustrates an example of where property acquisition has been specifically undertaken in part to protect and restore Class-3 tributary waterways of the Styx River: (Humm's Drain and Brown's Drain).

The Role of Stormwater Facilities in Catchment-wide Wildlife Management

25. The series of earthquakes, and their impacts on Council reserve acquisition budgets has meant that the scope for acquisition of new reserves has been

greatly reduced. The Council now has a reduced annual budget of $500,000 for new waterways and wetlands related land acquisitions, however this budget is city-wide, including the whole of Banks Peninsula. Therefore allocation of this fund is heavily contested and prioritised.

26. Proposed subdivisions and other developments including Highfield and the International Golf Academy are anticipated to provide an important addition to the length of public reserve along the Styx River, and Council officers work closely with such developers to ensure that the visions and goals of the Styx Vision 2000 – 2040 are realised. However the Council is limited in terms of how wide esplanade reserves must be, and often these widths do not provide for adequate buffering of waterways from the impacts of development.

27. The Styx SMP offers significant potential for realising the goals and visions of the Styx Vision 2000 – 2040 through strategic property acquisition. This was indeed one of the key intentions of strategically locating stormwater facilities listed in the Styx SMP within close proximity of waterways, while still recognising the need to maintain adequate riparian setbacks and buffers to protect natural character, landform, drainage, ecological, cultural, recreation, landscape and in places historic values associated with the waterways.

28. As such, many of the facilities proposed in the Styx SMP will allow for significant extensions and enhancements of the Styx River Urban National Reserve network. Based on the Styx SMP sub-catchment maps, these include the Gardiners Facility (more than 240 m additional reserve length along the Styx); Railway Facility (more than 330 m); Radcliffe (more than 200 m) Mundys (more than 290 m); Highfield (more than 340 m); Totalling more then 1.4 km additional reserve length.

29. Similarly, on the Kaputone Stream stormwater facilities at Blakes provide additional reserve lengths of more than 310 m; Arterial (more than 675 m); Works-5 (more than 200 m); Works-1 (more than 180 m); Works-4 (more than 200 m); Totalling more than 1.5 km additional reserve length.

30. Within these reserve areas there is considerable potential to provide for the full range of waterways values: drainage, landscape, ecology, recreation, culture and heritage. Given the current Council budget constraints in terms of waterways and wetlands related reserve acquisitions, the acquisition of land identified in the Styx SMP is likely to be one of the main ways in which the Council is able to acquire and protect significant parcels of riparian reserve and associated habitat along the Styx River and its tributaries in the short to medium term future. In taking this approach, it is likely to also be a key practical means of achieving the goals and visions of the Styx Vision 2000 – 2040.

31. As well as waterway restoration, the Council is striving to establish a series of significant indigenous forest patches strategically dispersed across the Styx River catchment to provide core habitat for a range of forest dependent fauna and flora.

32. The distribution of forest patches across the Styx catchment has been modelled on the work of Meurk and Hall (2006) who recommend large forest patches (>6.25 ha) at five kilometres apart, with smaller (1.56 ha) forest patches at one-kilometre centres to promote viable populations of native bush birds across the urban environment.

33. I have also performed population viability analysis for two locally extinct native bush bird species (tui and South Island tomtit) using Vortex 5.1 population viability analysis software to inform the forest patch area requirements and forest patch spatial arrangement for these and similar species. The results of this modelling illustrate that large forest patches; larger than those recommended by Meurk and Hall (2006), are likely to be required to sustain robust and viable populations of native bush birds in the Styx catchment. As well as their obvious ecological value, these forest patches are also expected to have significant recreational, landscape, historic, cultural and drainage values.

34. Throughout the Styx catchment there are many examples of reserves alongside the Styx River, Kaputone Stream and Smacks Creek where waterway and forest restoration is well underway, representing Council's commitment to achieving the vision of a Viable Spring-fed River Ecosystem (Vision-1: Styx Vision 2000 – 2040).

35. For example at the confluence of the Styx River and Kaputone Stream, the Council has acquired two large parcels of land, totalling more than ten hectares on which all six values: drainage, landscape, ecology, recreation, culture and heritage are managed. Since 2010, the Council has planted more than 35,000 native trees, shrubs and groundcovers including 1772 kahikatea and 860 totara. In July and August this year, an additional 5900 plants including an additional 725 kahikatea and 560 totara will be planted at this site to increase the forested area to more than 5.5 ha. It is planned that forest within this single reserve area will ultimately cover an area in excess 8.3 ha, and that future adjacent reserve acquisitions could increase this area even further. Note that at 8.3 ha, this forest will be approximately one-hectare larger in area than Riccarton Bush (7.3 ha).

36. Styx Mill Conservation Reserve provides another example of a reserve managed for multiple values, and where significant forest planting has been carried out. Native forest planting commenced at this reserve in the late 1980's/early 1990's, and forest plantings now cover an estimated 8.7 ha, with more than 1.1 ha programmed for planting before the end of June 2013, totalling more than 9.8 ha. Within Styx Mill Conservation Reserve it is planned to ultimately establish approximately more than 32 hectares of native forest within the existing reserve area, providing a key component of the catchment-wide forest patch/bush bird distribution.

37. The acquisition of additional land identified in the Styx SMP adjacent to Styx Mill Conservation Reserve has the potential to secure the entirety of the Styx basin in public ownership, and is expected to increase the long term viability of the forest ecosystem, and particularly the planned reintroduction of locally extinct bush bird populations. This increase in population viability will be achieved by increasing the forested area, and thereby increasing the Reserve's carrying capacity and reducing probability of local extinctions. To this end, Styx Mill Conservation Reserve, along with the range of other planned forested reserves across the Styx River catchment each play a strategic role in achieving viable populations of bush birds and other keystone species, considered as taonga across Christchurch.

38. As identified in the Styx SMP it is anticipated that the establishment of well designed and integrated stormwater treatment facilities throughout the Styx catchment will play a significant role in creating new forest habitat, buffering core forest and riparian forest habitats, and also extending these habitats by way of the establishment of ecologically appropriate plant communities within and surrounding the facilities.

39. Where forested stormwater facilities are proposed, these forests are also anticipated to serve a drainage function in terms of their ability to process contaminants, intercept, take-up and transpire potentially large volumes of water, thus preventing their discharge into receiving waters. These forested facilities will extend and complement the riparian buffers proposed along the Styx catchment waterways. The concept of forested stormwater facilities is discussed in further detail below (Paragraph 55) in response to Ngai Tahu concerns relating to planting within facilities.

40. It is therefore my opinion that the implementation of the Styx SMP will have a significant positive influence on the landscape, wildlife, ecology, recreation and cultural values of the Styx catchment. It will do this by increasing the area of restored habitat, increasing the viability of city-wide wildlife populations, creating new recreational opportunities and highlighting cultural values and facilitating both access to and use of traditional resources.

Response to Specific Submitters on Disturbance to Wildlife

41. In response to the submission of Ms Lyn Maree Torrance of 66 Claridges Road (SUB029068), firstly on the matter of proximity of the Cavendish facility to her property, this facility will be located more than 400 m from her property and is therefore unlikely to have any direct visual or other adverse affect.

42. Ms Torrance has also requested to *"ensure that the local area's flora and fauna is not disturbed"*. Mr and Mrs Barrett of 86b Claridges Road (SUB029080) raise similar concerns, and highlight the presence of a range of wildlife species with particular reference to local pukeko populations, therefore I will address both submissions together here.

43. Pukekos are conspicuous and iconic birds throughout the Styx catchment whose habitat is likely to be displaced by urban development. Although indigenous to New Zealand, they are neither endemic nor of conservation concern. Their range extends from Stewart Island, throughout New Zealand northward along the east coast of Australia, throughout tropical East Asia where they are known as the *East Asian Purple Swamp Hen,* India, Africa and Southern Europe. They are very mobile birds and are easily able to move around the Christchurch landscape as habitats change, often flying at night *(Crossland pers. comm.)*. Their population is abundant throughout the Styx catchment, particularly along the rural margins of waterways and riparian willow woodlands as evidenced by systematic camera trapping study, which I led through my role with Lincoln University.

44. To date, having deployed motion triggered professional camera traps at 54 locations along the Styx and Kaputone Streams, this species has been recorded at 42 (78%) of these sites, representing the most prolifically sampled wildlife species in these habitats. Ongoing habitat restoration work throughout the Styx catchment and the wider Christchurch environment is likely to maintain, if not result in a net increase in this species' distribution and abundance, along with other species of greater conservation concern and value. Well designed stormwater treatment facilities in the Styx catchment are therefore anticipated to contribute positively to these important wildlife values, including significant 'green areas' where pukekos can be expected to remain an iconic local inhabitant.

45. Mr & Mrs Barrett also refer to a wide variety of wildlife including roosting birds, ducks, pukekos and hawks in the paddocks behind their property. If these paddocks are to be developed as residential subdivision it is almost certain that these wildlife species would be displaced, although at Northwood many pukekos habituated and persisted throughout many parts of the subdivision particularly near the interface with the Styx Mill Conservation Reserve. However it needs to be clear that this current consent application is for the treatment and discharge of stormwater to ground and to surface water in the Styx catchment, and not for subdivision. The construction of the stormwater treatment facilities identified in the Styx SMP is not likely to have any adverse affect on wildlife populations immediately adjacent to the Barrett and/or Torrance properties.

46. In terms of the willow and poplar trees identified by Mr and Mrs Barrett that they wish to have retained, this is a matter to be taken into account through future

subdivision plans. Facilities proposed in Styx SMP will have no affect on these features. However the Council recognises the range of values and roles that such large exotic trees can provide for wildlife species including roosting sites, food sources for insectivorous birds, nesting sites and decay cavities for cavity nesting species such as paradise shelduck, grey teal, grey duck and kingfisher. Wherever stormwater treatment facilities are likely to impact upon such trees or other important habitat features, these will be addressed and where possible incorporated into the detailed design of facilities during the design process. While the Styx SMP is not designed to address site specific issues at this level of detail, an over-arching theme of the SMP is the protection, restoration, expansion and creation of new wildlife habitat throughout the Styx catchment.

47. It is therefore my opinion that the implementation of the Styx SMP will have considerable advantages to both local and city-wide wildlife populations through the proactive management and long-term protection of key habitat features in the landscape, and the creation of new quality wildlife habitats that will be protected in perpetuity through public ownership. Furthermore, the facilities proposed in the Styx SMP allow considerable scope for significant planting of large growing trees and forests. These are landscape elements that would not easily be achieved without acquisition of the large areas of green-space proposed under the Styx SMP. In my opinion these significant plantings are likely to more than compensate for the potential loss of the currently rural trees and shelter belts that may occur during the separate process of residential subdivision in the area.

Mahaanui Kurataiao (MKT) Submission

48. Based on identified cultural values, the aspirations of Ngai Tahu (as set out in the submission of Mahaanui Kurataiao (SUB029100) on the Styx SMP and recently published Mahaanui Iwi Management Plan) are closely aligned with the visions and philosophies of the Christchurch City Council with regard to waterways and surface water management. Although not explicitly covered in the Styx SMP, it is my opinion that many of the values and concerns identified by Ngai Tahu are either covered in a range of other high level planning strategies (such as the Biodiversity Strategy, Surface Water Management Strategy, Waterways and Wetlands Natural Asset Management Strategy, Styx Vision 2000 – 2040) planning documents (e.g. the Christchurch City Plan, Belfast Area Plan, Draft Styx River

Corridor Master Plan, Brooklands Reserves Master Plan), design guides (Waterways, Wetlands and Drainage Guide, Draft Citywide Bank Stability and Treatment Options and Guidelines – Upstream Waterways), and a broad range of other Council and Council commissioned documents and reports (refer to bibliography – **Attachment G**). Within these documents, reports and strategies a broad range of cultural values are explicitly identified, thus giving Council a good degree of direction in terms of how such values should be recognised, protected, enhanced and well managed.

49. Wherever waterway restoration requires physical works (e.g. bank re-grading, structures or works on the waterway margins or the bed) other than riparian planting, this can often be undertaken under the City's Global consent for minor works on the margins and beds of waterways (CRC100750.1), and its related dam and divert water consent CRC100748.1) and discharge of water consent (CRC100749.1). All three ECan consents expire on the 5th January 2045, and allow Council to carry out minor works in the beds and margins of waterways. There are specific conditions relating to the use of these Consents, one of which requires Council to notify both MKT and the New Zealand Historic Places Trust prior to work commencing. This notification provides details on the location and description of works being carried out, methods of sediment control and timing of works. Furthermore, operational works involving (e.g.) the removal of willow trees and roots must also conform to these consent conditions, and the CCC Land Drainage Team has processes in place to ensure this occurs.

50. As well as the many waterway restoration projects that complement Ngai Tahu values and aspirations there are numerous other examples across the Styx River catchment where various cultural values have been considered and celebrated. These include the acquisition of key property for the protection of natural springs (Thompson's Farm, **Attachment C**) growing of traditional Maori medicinal plants (565R Marshland Road, **Attachment D**), traditional Maori cropping, and establishment of Pa Harakeke as a traditional weaving resource (Styx Living Laboratory Precinct, **Attachment E**) and the celebration of Maori culture in built structures such as bridges, boardwalks, integrated artwork and interpretation features **(Attachment F)**. In my opinion, this illustrates a commitment on behalf of the Council to incorporate and celebrate traditional values.

51. MKT have raised concern that the facilities included in the Styx SMP may be fixed in terms of their location within the catchment. However it is my understanding that there will be a good degree of flexibility to amend the location of these facilities in response to land constraints, proximity to significant features such as springs, and/or as new land acquisition opportunities arise.

52. Another concern of MKT is with regard to the adequate separation of stormwater treatment facilities from natural springs and natural wetlands. In terms of final design solutions, a six values approach to waterways and wetlands management will be taken. This approach recognises the importance of protecting natural features and their associated landforms, and as such adequate buffers will need to be established in order to maintain both natural character and function.

53. Protecting natural landform and associated terrestrial plant and animal communities is an essential component in achieving Vision-1 of the Styx Vision 2000 – 2040: "*a Viable Spring-fed River Ecosystem*". This vision recognises the important ecological role of natural landforms and adequate buffers in maintaining a representative sample of indigenous plants and animals, and their associations and interactions throughout the catchment. While aquatic and riparian habitats are well represented within the catchment, terrestrial ecosystems are not, and hence the importance of protecting these ecosystems through effective setbacks and buffers. The Council's desire to protect and restore these terrestrial ecosystems as part of the concept of a *Viable Spring-fed River Ecosystem* is reflected in the range of reserve acquisitions and development proposals, some of which are included in **Attachments A, C, D** and **E**.

54. In terms of effective buffer widths, these are likely to vary from site to site throughout the Styx catchment dependent on the respective values being managed. As a rule of thumb, a 50 m buffer is recognised as being an effective width that can mitigate many common 'edge effects' that may impact on natural environments such as waterways and wetlands. These effects include but are not limited to weed incursion, increased light, increased temperatures, lower soil moisture, increased wind-speed, increased noise and other disturbances, all of which have adverse impacts on ecological processes. Therefore the Council will need to pay serious attention to ensuring adequate and effective buffers are established that protect and wherever possible enhance all six values including cultural values.

55. MKT have also raised concern about the choice of planting in the proposed facilities; specifically the planting of forests. However stormwater detention and/or treatment facilities that are designed in the form of forested wetlands and/or basins can provide a number of benefits to water quality, water detention, biodiversity and landscape values, and also solve some common problems associated with more traditionally styled facilities.

56. Vegetation plays an important role in improving water quality, and ponds that incorporate permanent pools of water can use the biological action of plants (and other associated organisms) to trap and treat pollutants. Vegetation, forest floor organic matter and soil microorganisms can provide sufficient chemical or biochemical action to treat water during its impoundment, removing a variety of nutrients, pathogens and heavy metals. Furthermore, vegetation within detention ponds slows runoff flow, filters large particles, and provides large surface areas on which pollutant-removing micro-organisms thrive. Vegetation also decomposes into an organic soil layer which is active in neutralising heavy metals, and releases oxygen into the soil improving water quality. The shade provided by forest trees also serves to reduce water temperatures prior to being discharged into natural waterways.

57. In terms of water storage, although some pond capacity will be lost through vegetative volume/basal area of the trees themselves, a large volume of water can also be taken up by trees and stored within stems and tissues and used for direct metabolic purposes. As an example, mature apple trees (deciduous) were found to uptake up to 70 litres of water per day during summer, declining to around 20 litres per day towards autumn (Green *et al.* 2003). However evergreen tree species such as New Zealand natives could be assumed to have a far greater uptake capacity through the autumn and winter months than would deciduous apple trees.

58. Furthermore, establishing forested basins would serve to relieve waterfowl related problems by discouraging Canada geese, black swans, mallard and paradise ducks. These species tend to favour large areas of open water surrounded by turf where they are able to loaf on the water and graze on nearby amenity turf where they have clear sightlines of approaching predators. In these situations they typically: 1) cause significant damage to amenity turf as a result of their grazing and fouling activity, 2) negatively impact on water quality, 3) can be aggressive

towards people, and 4) in some locations can pose a significant risk of aircraft bird-strike. Forested basins are not suited to such species, however will encourage more desirable native bush birds such as bellbird, wood pigeon, tui, fantail, shining cuckoo, grey warbler and others.

59. Planting of native forest in retention pond areas should be modelled on the species composition and forest structure occurring in Riccarton Bush; a naturally occurring ponding area within Christchurch City. Kahikatea would be an ideal species to plant in forested retention ponds as it is tolerant of a range of site conditions, and can tolerate short term inundation. The Styx Master Plan is currently being prepared and includes proposals for significant areas of forest distributed throughout the catchment in order to achieve viable wildlife populations and a large range of other landscape, ecological, recreational, cultural, heritage and drainage values and benefits. As discussed earlier in my evidence, developing forested stormwater facilities is likely to play a significant part in achieving the Styx Vision.

60. I therefore believe that through close collaboration with Ngai Tahu, (facilitated through MKT) throughout the course of the implementation of the Styx SMP that Ngai Tahu concerns related to wildlife, planting and amenity issues can be addressed, satisfied and where appropriate, mitigated.

Conclusions

61. Based on the above evidence, I believe that the Styx SMP offers the greatest opportunity to maximise the protection of the Styx River and its tributaries through the acquisition and appropriate management of strategically located reserves throughout the catchment. Within these reserves the Council and community will be best-placed to protect, manage and enhance all six values of waterway management; those being drainage, landscape, ecology, recreation, culture and heritage.

62. Without the ability, through use of the Styx SMP, to secure significant parcels of public reserve land alongside waterways within the Styx catchment, a six values approach to waterways management would be difficult to achieve in the face of

post-earthquake funding constraints, and the Styx Vision 2000 – 2040 would be unlikely to be realised to its full potential.

63. By acquiring the necessary reserve areas and widths under the Styx SMP, the CCC has the ability to maintain and enhance natural character (natural character being perhaps the most valued factor in terms of the appreciation of landscape and recreation values), which plays a significant role in appreciating and connecting with cultural and ecological aspects of the wider landscape.

64. The Styx SMP therefore offers the best opportunity to undertake stormwater management with a multi-scaled, six values philosophy; an approach not achievable to the same degree with smaller decentralised facilities typical of low impact urban design principles which manage predominantly for drainage values only.

A Shadbolt

22nd April 2013

ATTACHMENT A: 76 Turners Road (Humm's & Brown's Drain)


Styx River
Source to Sea Walkway
Riparian Podocarp Forest
Riparian Podocarp Forest
Podocarp - Broadleaf Forest
Naturalised Drain
Open Grassed Area
Car Park
Right-of-way
Proposed House Site
Podocarp - Broadleaf Forest
Turners Road

ATTACHMENT B: Timber Boxed Drain Naturalisation Projects

Radcliffe Road Drain

Figure 1: Remnant of timber boxed section Radcliffe Road Drain (303 Radcliffe Road) to be retained for educational purposes, illustrate more recent changes in waterway management philosophies. Naturalised section of Radcliffe Road Drain and Radcliffe Road Drain Diversion are visible in background (27th March 2013).

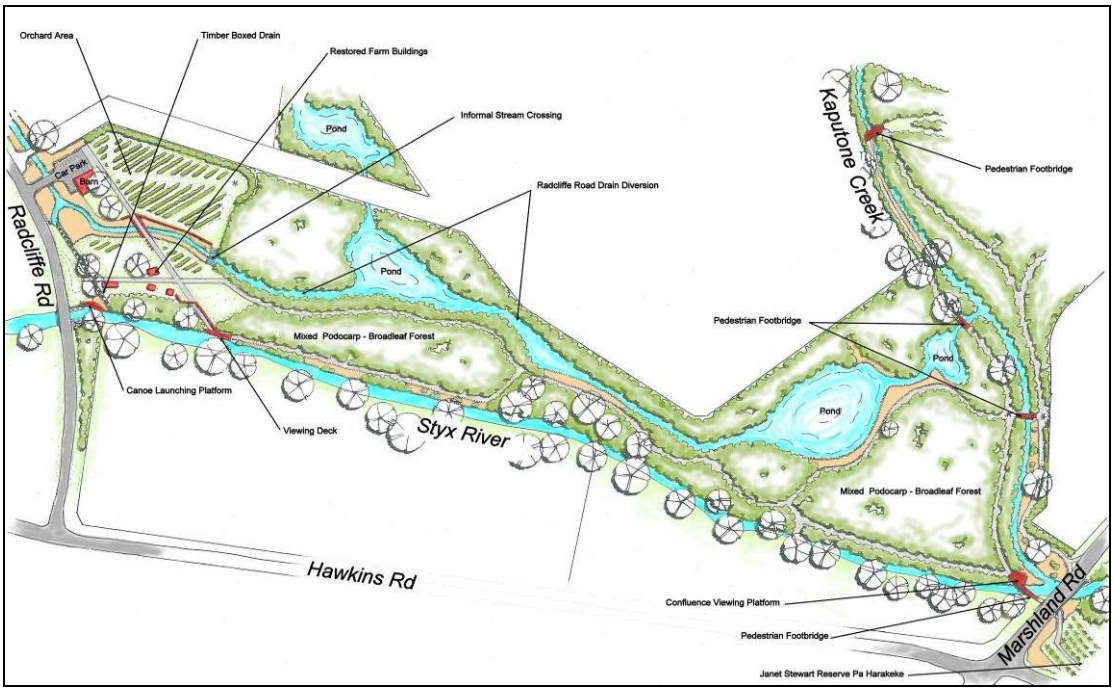


Figure 2: Landscape concept plan for 303 Radcliffe Road site showing significant waterway restoration of Radcliffe Road Drain, Kaputone Stream and Styx River and associated forest restoration.

Figure 3: Radcliffe Road Drain upstream of 283 Radcliffe Road bridge following removal of timber-boxing and re-grading (19th September 2003).

Figure 4: Naturalisation of Radcliffe Road Drain upstream of 283 Radcliffe Road bridge (27th March 2013)

Figure 5: Radcliffe Road Drain following removal of timber boxed drain upstream from, 301 Radcliffe Road bridge (September 2003).

Figure 6: Naturalisation of Radcliffe Road Drain upstream from, 301 Radcliffe Road bridge (27th March 2013).

Figure 7: Radcliffe Road Drain Diversion, 303 Radcliffe Road (4th June 2004)

Figure 8: Naturalisation of Radcliffe Road Drain Diversion, 303 Radcliffe Road March 2013.

Figure 9: Radcliffe Road Drain Diversion, 303 Radcliffe Road (4th June 2004)

Figure 10: Naturalisation of Radcliffe Road Drain Diversion, 303 Radcliffe Road March 2013.

Cavendish Road Drain

Figure 11: Remnant of timber boxed section of Cavendish Road Drain within Styx Mill Conservation Reserve to be retained for educational purposes, illustrate more recent changes in waterway management philosophies (27th March 2013).

Figure 12: Restored section of Cavendish Road Drain (27th March 2013).

Figure 13: Restored section of Cavendish Road Drain (27th March 2013).

Papanui Stream

Figure 14: Papanui Stream immediately down stream from Horners Branch Drain. Note that this waterway was originally a degraded timber boxed drain.

Horners Branch Drain

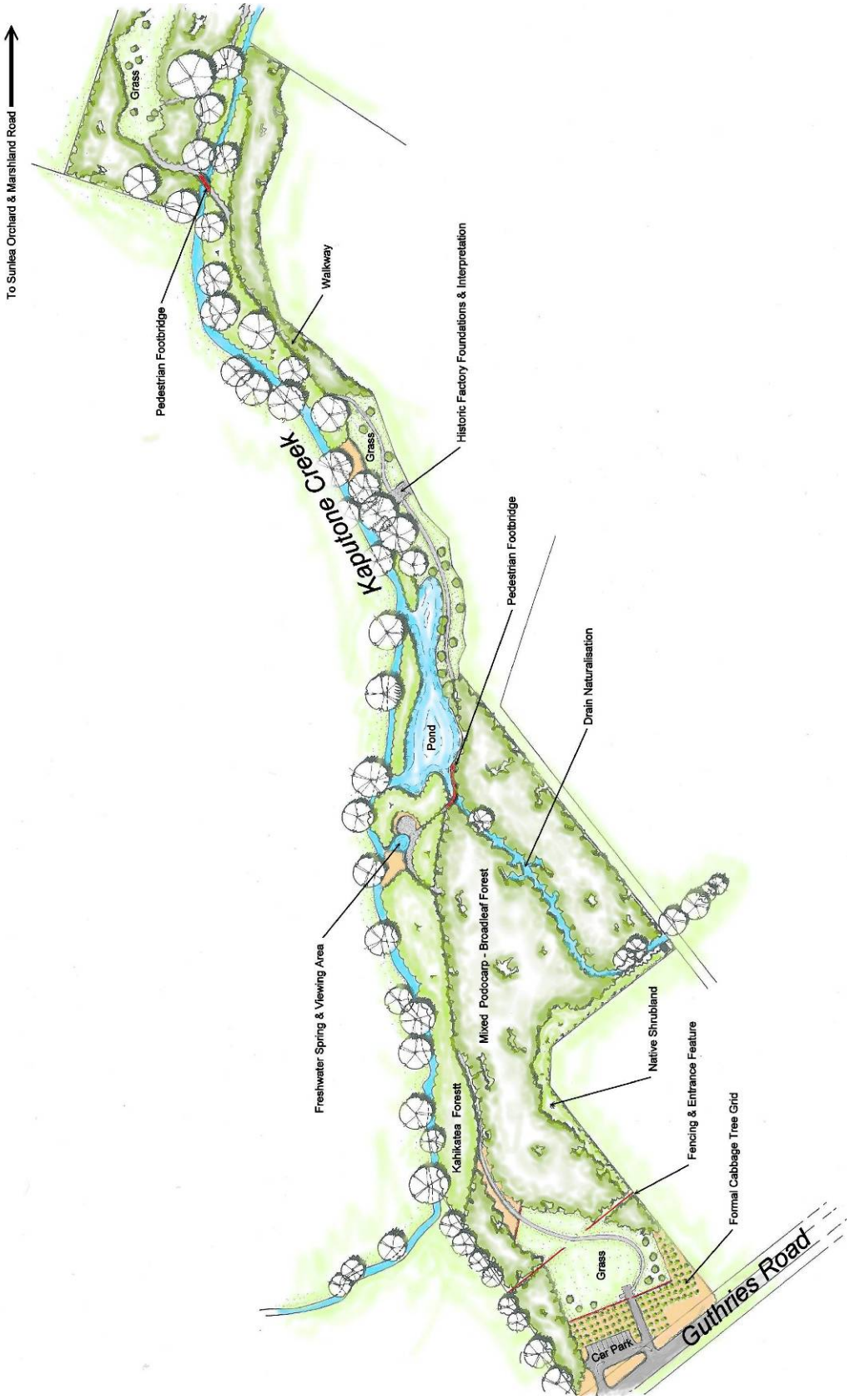
Figure 15: Horners Branch Drain, Procter Street Reserve, Papanui East Cluster. This tributary drain of Papanui Stream was previously piped infrastructure (Category 4) prior to day-lighting and waterway restoration work being completed as part of a City Streets roading project.

Murchison Park Drain

Figure 16: Murchison Park Drain hosts one of the first waterway restoration projects in Christchurch City. Plantings by Waimairi District Council in the 1980's are now semi-mature and provide a range of natural waterway values.

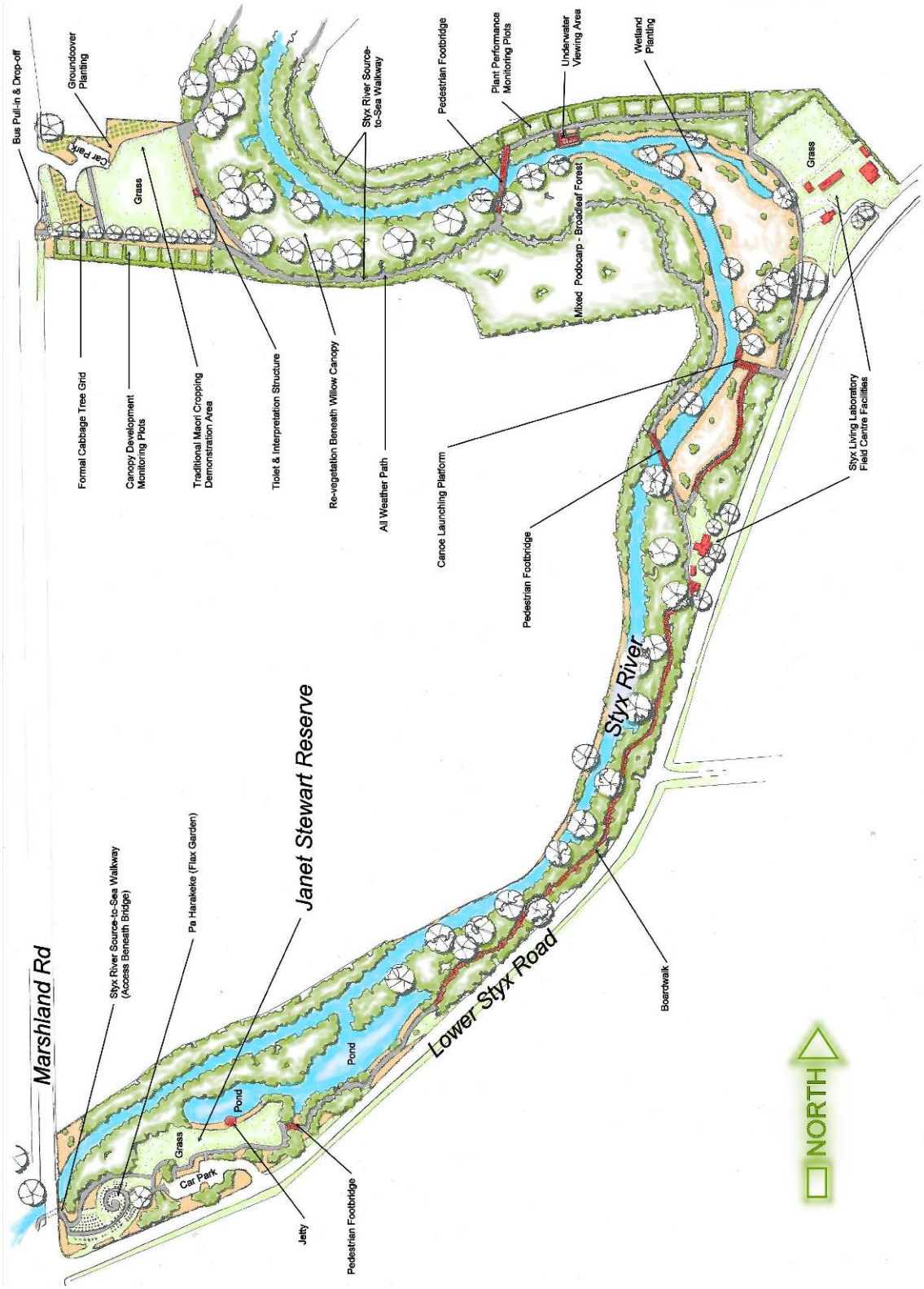
Figure 17: Murchison Park Drain hosts one of the first waterway restoration projects in Christchurch City. Plantings by Waimairi District Council in the 1980's are now semi-mature and provide a range of natural waterway values.

ATTACHMENT C: 62R Guthries Road (Thompson's Farm)



ATTACHMENT D: 565R Marshland Road (Maori Medicinal Plants Demonstration Area)

ATTACHMENT E: Styx Living Laboratory Precinct



ATTACHMENT F: Built Environment

ATTACHMENT G: Bibliography

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