
Christchurch City Council
ATTACHMENTS - UNDER SEPARATE COVER

Date: Wednesday 21 June 2023
Time: 9.00 am
Venue: Council Chambers, Civic Offices,
53 Hereford Street, Christchurch

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Submissions table – Draft Ōtūkaikino Stormwater Management Plan, June 2023

Organisations / Businesses

ID	Name - Organisation	Submitter feedback	Staff response to questions or concerns (if applicable)
50946	Jason Middlemiss - Waimāero Fendalton- Waimairi-Harewood Community Board	<p>The Board fully supports the Ōtūkaikino Stormwater Management Plan and thanks staff for all their hard work putting it together.</p> <p>If the Council holds hearings on this consultation, the Board would like to speak.</p> <p>The Board is interested in the discouragement of copper building cladding. Do residents currently know of the environmental risks when using copper as a building material? Perhaps on the council website there could be a list of building materials that highlight the positive and negative environmental impacts – this helps residents be fully informed through the building process and are encouraged to make more environmental friendly decisions.</p> <p>The Board recommends that education should include practical and tangible tips. For example, rather than saying “avoid washing your car on the road” provide a better alternative i.e. “instead, wash your car on the grass” – giving alternative solutions not only educates residents but empowers them to make better decisions.</p> <p>The Board would like more information around what the “flood models and knowledge on flood risks” will involve. For example, how will residents be kept in the loop with this information? Especially those residents impacted by flooding. Is there a specific strategy in place and goals and milestones to reach? Will the impacts on climate change be included in this? More detail would be helpful to understand the breadth on this.</p>	<p>The SMP Team thanks the board for its support.</p> <p>It is likely that a few well-informed residents and professionals know of the environmental risks when copper is used as a building material. The Asset Planning – Stormwater Team has an information brochure in preparation.</p> <p>The Board’s recommendation that education should include practical and tangible tips will be referred to the Community Waterways Partnership programme team.</p> <p>Staff generally view flood models as part of normal business in the same way that wastewater and water supply network models inform design and operation. However, if flood modelling is of special interest the Asset Planning – Stormwater Team could deliver a presentation on request.</p>
50822	John White – Isaac Group Ltd	CCC to give feedback on the goal 1 of "investigation to reduce the environmental effects of sediment discharges – by 2023".	There are investigations under way to better quantify the benefits of street sweeping and catchpit filters in Christchurch.
51132	Christine Hetherington – Boffa Miskell Limited, on behalf of Christchurch International Airport Limited (F Hayman)	<p>(See submission attachment 51132)</p> <p>See attached file</p>	<p>To be answered separately.</p> <p>Paul Dickson has met with the submitter. Each point in the submission has been discussed and Paul has indicated which requests will be incorporated into the SMP. The CIAL is invited to provide bird strike mitigation proposals for inclusion as an appendix to the SMP.</p>

Submissions table – Draft Ōtūkaikino Stormwater Management Plan, June 2023

Individuals

ID	Name - Organisation	Submitter feedback	Staff response to questions or concerns (if applicable)
51012	Stephen East	Goal six should be prioritized as the most pressing goal. It is absolutely vital that Christchurch's flood management is updated and improved. Half our city was underwater in 2022! With the impacts of climate change only becoming more and more serve our city will be impacted worse than it was after the earthquakes if flood mitigation isn't prioritized. It is the most vital issue for Christchurch.	Flood management is a high priority for the Council and is an activity that the Council deals with effectively. There is government oversight in that the Department of Internal Affairs benchmarks the Christchurch City Council's response against other Councils. In some usually isolated areas the stormwater network does not operate as it should. The Council works to remedy these situations.
51021	Richard Rowe	Required rainwater storage for all new builds . Subsidised rainwater storage for existing houses. Make all new street gardens rainwater retention gardens	The Council does some of these things. New development and redevelopment where there is greater than 70% site coverage must mitigate the effects of development (i.e. store excess water); and new houses on the hills must install rainwater tanks. The Local Government Act does not appear to permit a Council to require rainwater storage for existing houses but a subsidy would be possible. Modelling in overseas situations indicates fairly reliably that rainwater tanks alleviate flooding up to a 5 year average recurrence interval (ARI) but not beyond. As the Council's stormwater network is designed for and generally handles a 5 year ARI storm the inconvenience and cost the Council is not greatly motivated to promote rainwater tanks, given the degree of inconvenience and cost.
50852	Cheryl Horrell	<p>(See submission attachment 50852)</p> <p>Draft Ōtūkaikino Stormwater Management Plan

 Goal six - Manage flooding

 Our goals are

</p> <ul style="list-style-type: none"> To limit the quantity of stormwater from all new development sites to pre-development levels, and minimise stormwater increases from re- development sites through consent conditions.

 To protect houses from flooding during and after development by having controls on new floor levels.

 Continue to improve flood models and our knowledge of flood risks.

 <p>I note that Council proposes to protect future homes from stormwater flooding but nothing in Council's proposal will protect existing homes from increased stormwater run-off from multiple housing units being built on surrounding properties. Flooding Management Council proposes to protect future homes from stormwater flooding in Woolston but nothing in Council's proposal will protect existing homes from increased stormwater run-off from multiple housing units being built on surrounding properties. You intend "To limit the quantity of stormwater from all new development sites to pre-development levels, and minimise stormwater increases from re-development sites through consent conditions." This proposal will purportedly "Protect houses from flooding during and after development by having controls on new floor levels. [And] continue to improve flood models and [your] knowledge of flood risks." I do not see however how the proposal will prevent flooding from encroaching onto streets and footpaths and overflowing existing drainage systems which have repeatedly proven to be inadequate over the past 10 years. Several single home sites are under development in Woolston at present and all but one (52 McKenzie Ave) are being replaced by four or five</p>	<p>This submission raises the issue that limiting the quantity of stormwater from new development sites to pre development levels does not necessarily alleviate additional flooding caused by intensification. Stormwater planners do not believe this is a significant problem in the Styx catchment, because older residential areas are not zoned for intensification. However, its significance in other parts of the city, for example Woolston, is acknowledged.</p> <p>Development intensification in some residential zones is allowed through the District Plan. The Plan imposes some limitations on development, for example a proposed Tsunami Management Area that extends within and around the Woolston area and where intensification is to be avoided. (Refer to the black hatched area on the map attached below, which is extracted from Plan Change 14). However, there is a high evidential threshold if the effects of intensification are to be dealt with directly by restrictions in the District Plan. Further technical work including modelling is required to support any change limiting intensification due to stormwater effects. It can be that stormwater effects remain to be dealt with at a later time.</p> <p>Submissions received on Plan Change 14 (Housing and Business Choice) are now being reviewed including Ms Horrell's submission. Following further submissions, officers will prepare recommendations to an Independent Hearings Panel on the submissions, and submitters have the opportunity to be heard. A stormwater/flood model of the Heathcote catchment is due for completion c August 2023. The model will provide good, reliable desktop estimates of the effects of intensification. The writer (Paul Dickson) would be happy to discuss the model and other stormwater issues in our offices if the submitter would like to visit. In the medium term there is the intention to investigate for inclusion, for Council approval in the 2024 Long Term Plan, an allowance to mitigate capacity problems such as those raised in this submission. In the longer term it is hoped that the model will allow a better understanding of the consequences of development at the time of future district plan reviews.</p> <p>Ms Horrell is thanked for her submission, which raises an issue that stormwater planners have been aware of for some time.</p> <p>Tsunami threat is not able to be dealt with through a SMP submissions process. The Council has a coastal hazard adaptation planning programme which is looking into coastal and sea level-related hazards. Information</p>

Submissions table – Draft Ōtūkaikino Stormwater Management Plan, June 2023

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		<p>individual units. Your proposals to manage flooding by raising housing floor levels do not stand up to scrutiny; five new houses will undoubtedly contribute more stormwater pressure on existing systems than the original one home surrounded by permeable land.</p> <p>Development taking place in Woolston in late 2022 and early 2023 contain multiple units, up to five homes per section (six in one Smith Street development) on land originally consented for one residential dwelling. These multiple units are surrounded by impermeable surfaces which are likely to contribute to increased surface flooding which will not prevent new homes from being flooded, even on higher foundations. Existing Smith Street residents have already experienced severe flooding which may not have entered homes but damaged vehicles, garages and everything else outside the homes. Flooding is flooding, residents are trapped in their homes unable to go to work or attend medical or other appointments. Council has a responsibility to try to prevent flooding not raise the floor levels of new homes and abandon existing, long term residents to floodwaters.</p> <p>New regulations on three storied apartments with lots of shared permeable spaces to provide gardens and social areas have been corrupted in Woolston by fast, cheap building to make a quick buck from the lack of adequate protections. Someone will have to pay for this business as usual botch-up and if local residents have any say in the matter it will be the authorities, local and central government, who will have to fix the mess that is occurring on their watch. We know enough now to stop building in places and in a manner that will leave residents living in flood prone homes as the impacts of global warming increase. This year's flooding from Cyclone Gabrielle should be a warning to councils and central government not to ignore the needs of residents who find themselves stranded in flood prone areas.</p> <p>Low Lying Land Fear of being surrounded by cheap rental complexes is upsetting enough but the major threat to homes in Bluebell Lane is our vulnerability to flooding. Post earthquake LiDAR readings identified that our lane had sunk relative to surrounding properties. The Earthquake Commission [EQC] made lump sum offers to buy out our increased flooding risk. I attempted to negotiate on the issue on the grounds that the buyout was not sufficient to raise our homes above the new flood levels. EQC refused to bargain and when I raised the matter with the Minister for Earthquake Recovery she told me the issue had been settled. It was certainly not settled with me or my neighbours but EQC sent their offer to my bank which was still mentioned as an "interested party" in my property after I had paid my mortgage off years earlier. I instructed the bank to invest the money while I waited for a fair offer to raise my home above the newly designated flood levels. That money remains as a separate investment in my bank. Council has overlooked this planning opportunity to protect homes on sunken land which should be identified as a "Qualifying Matter" under the MDRS for Woolston.</p>	<p>about the programme and contact details can be found on the CCC website by typing "coastal hazard" in the search bar.</p>

Submissions table – Draft Ōtūkaikino Stormwater Management Plan, June 2023

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		<p>Tsunami Risk Bluebell Lane is also inside a “Tsunami Management Area” It is irresponsible to allow infill housing in that same zone thus allowing new homes to be built in the path of a tsunami. Perhaps councillors and staff should lose their indemnity so they can be held personally liable for the consequences of poor planning decisions. The potential danger to existing homeowners could be exacerbated if increased housing density is allowed in a tsunami management area. Bluebell Lane and other Woolston residents must depend on council to protect our homes and communities from floods and tsunami. We also need our local communities to remain functionally connected and not disrupted by mass rental housing. I submit that Council is ignoring the plight of existing home owners who had liquefaction flood onto their properties from surrounding land following the 2010 and 2011 earthquakes. Council has also failed to address the issue of land that sank during the earthquakes and left existing home owners vulnerable to flooding from surrounding properties. Indeed Council has concealed the increased flooding vulnerability behind higher foundation requirements for new or rebuilt homes leaving existing homes increasingly vulnerable to flooding on foundations lower than Council considers safe from flooding.</p> <p>Lack of Council Communication Although council maps show our area as requiring new higher foundation levels Council has not contacted home owners to advise them of how existing homes might be protected from flooding or tsunami. Council has an obligation to clearly identify any flooding vulnerability to existing homes; and to mitigate the possibility of surrounding new homes on higher foundations and less permeable surrounding land channelling floodwater into lower lying areas. Residents on flood vulnerable land must be able to rely on Council to protect them. It is arguable that owners of houses sitting below safe floor levels should retreat, surely we have learnt that much post Cyclone Gabrielle. Combine our lower flooring levels with our homes being in a tsunami management area and the fact that ground water in Woolston is just below the surface, I am stunned that Council has not seen the need to, if not retreat from this area, at least restrict more housing. It is possible we may not need to retreat if any further infill development was restricted in this high risk area. Ignoring this issue and proposing increased housing density with higher foundations is irresponsible in the circumstances. I appreciate the work performed by Council post earthquakes to provide holding ponds to alleviate flooding but as Council's own proposals indicate, new houses crammed together on impermeable land need to be built with higher foundations than we and other existing homes in this area have. It seems inevitable that we will be flooded when the waters rise. What existing residents need is much better drainage, less crammed in housing and more permeable surfaces if we are not to slip under future floodwaters. Existing home owners cannot do anything about their land having slumped but it would be a grave injustice if our homes were to be flooded because greater housing density contributed to water flooding into</p>	

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		lower lying houses. Council has this one chance and the responsibility to protect residents from future disasters by identifying Bluebell Lane and other land that has sunk as a “Qualifying Matter” due to it being a “...High Flood Hazard Management Area [and] Flood Ponding Management Area...”. In addition to addressing existing drainage problems, the high water table, and ensuring the retention of adequate surrounding permeable land, Council needs to restrict housing density in Woolston around homes already experiencing increased flooding vulnerability.	

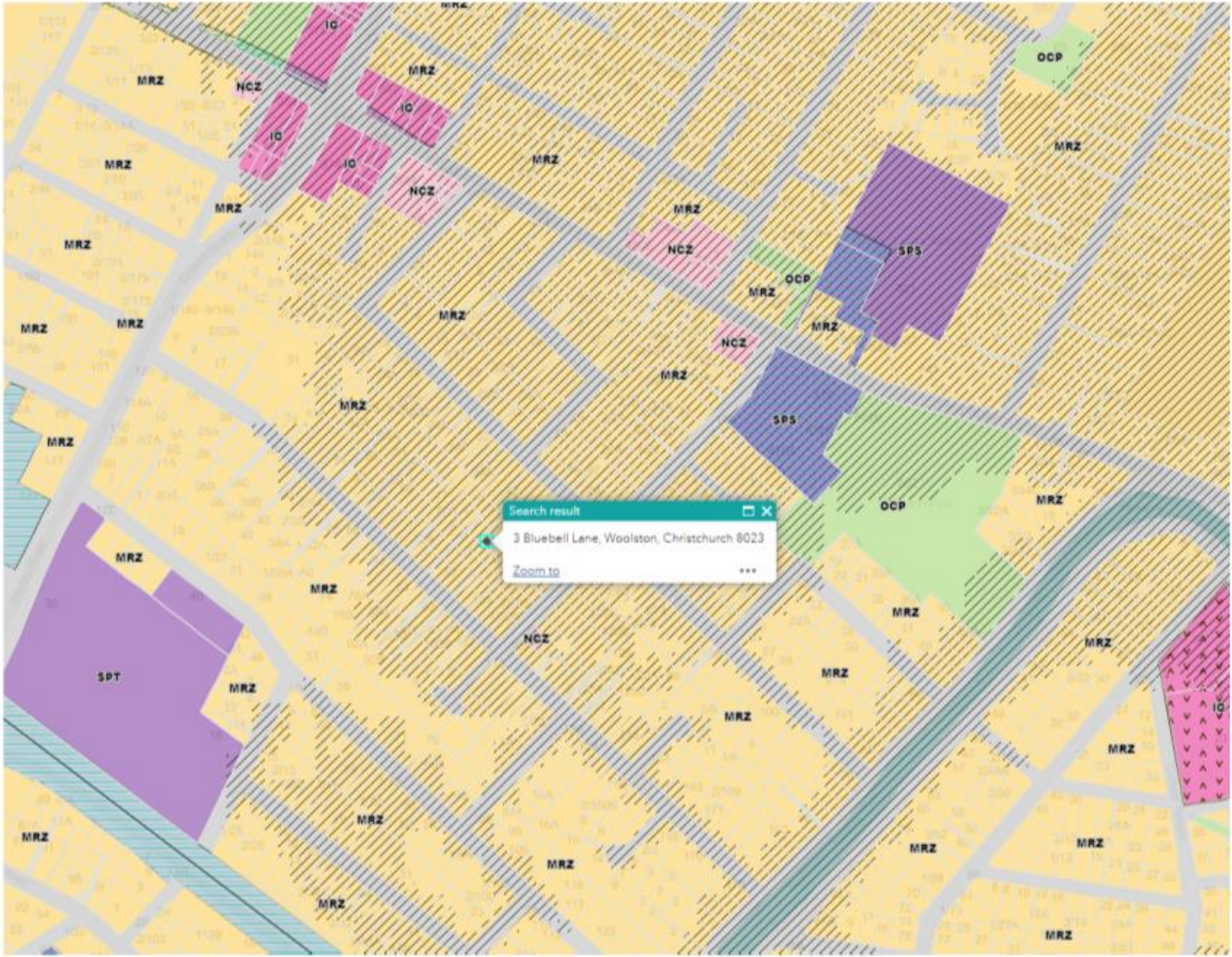


Figure 1: Proposed Tsunami Management Area (black hatching) within part of Woolston

Supporting Documents – Cheryl Horrell



1. 6 Manning Place.



2. 5 Manning Place.

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3. 38 Wildberry Street.



4. 54 & 56 Wildberry Street.



5. 79 Wildberry Street.

6. 100 Wildberry Street, No photo as yet.



7. 112 Wildberry Street.

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8. 456 Ferry Road, no photo.



9. 6, 8, & 10 Hopkins Street



10. 15 Hopkins Street.



11. 18 Hopkins Street.

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12. 22 Hopkins Street.



13. 24 Hopkins Street.

14. 5 Findlay Place, no photo. 15.

52 McKenzie Ave, no photo.



16. 84 Richardson Terrace.

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17. McKenzie Ave Footbridge. Home for a growing family of rats.

Attachment #51132

Written Submission on Draft Ōtūkaikino Stormwater Management Plan

To: Christchurch City Council

- 1. Name of submitter:** Christchurch International Airport Limited ("CIAL")
- 2.** This is a submission on the **Draft Ōtūkaikino Stormwater Management Plan (Draft OSMP) 2023.**
- 3. Submitter Details:**

Christchurch International Airport Limited

PO Box 14001,

Christchurch 8544

Attention: F Hayman, Environment and Planning Manager.

Phone: 027 201 2330.

Email: felicity.hayman@cial.co.nz

Signature:



Dated: 2 May 2023.

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process of investigating future land use options for this site. Rough calculations are that this area comprises approximately 7% of the area covered by the draft OSMP (estimated to be 6,200 ha). The location of this area is shown on the plan contained as **Attachment 1 to Appendix A**.

Bird Strike

Introduction

Bird strike is defined in the Christchurch District Plan as when a bird or flock of birds collide with an aircraft. This can cause damage to the aircraft, which compromises safety and, in many instances, forces an emergency landing. It is of particular concern in the Ōtūkaikino catchment, which lies immediately to the north of the main Christchurch Airport runway and is within the Bird Strike Radii.

Bird Strike Risk

Bird strike risk is increased by flocks of birds flying across flight paths between different parts of the city. Birds fly across the city every day between roosting areas, feeding areas, and areas of standing water. The more activities / sites near the Airport that attract birds, the more likely it is that birds will fly across flight paths between these activities / sites and increase the risk that bird strike will occur at or near the Airport. New activities which will attract birds may need to be managed to ensure that they will not increase bird strike risk at the Airport. There are three main elements to how an off-airport bird attracting land use contributes to strike risk:

- a) *Identification of air space aircraft share with bird (3, 8 and 13km radii)*
- b) *Identification of high – risk bird species (size and behaviour of species), and*
- c) *Identification of where there is potential for collision with aircraft.*

Given Ōtūkaikino's location directly within flight paths, and close distance to the Airport, planes and birds in this area will share airspace. Therefore, it is critical for the safety and function of CIAL's operations that bird strike risk within the Ōtūkaikino catchment is managed appropriately, and any risk is avoided and minimised as far as possible.

The CAA data (which includes a review and update to include CIAL's records) shows monthly strikes and near strikes at CIA from 2013 to June 2021. Statistics for the three years ending 31 December 2020 indicate that Christchurch has higher levels of bird strike than Auckland or Wellington airports¹.

Management of Bird Strike Risk

Bird strike is a significant safety risk which requires diligent management and CIAL collaboration with local government and surrounding landowners. CIAL has a responsibility (including legal duties as in CAA Rule 139.71) to provide a safe airport operating environment and therefore must actively work to minimise the threat and incidence of bird strike around Christchurch Airport as well as on the airfield and land controlled by CIAL. Bird strike that occurs, for example through the creation of water bodies, refuse dumps, landfills, sewage treatment and disposal and agricultural activities, will affect the ability of CIAL to provide this safe environment.

The Council is required under the CSNDC to manage bird strike risk. Condition 28 of CRC 231955 states:

'To ensure the risk of bird strike is minimised, the following design requirements shall apply to facilities within 3 kilometres of Christchurch International Airport:

¹ Evidence of F Blackmore, Hearings on Proposed Selwyn District Plan, September 2021.

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- a) *Stormwater infiltration basins shall fully drain within 48 hours of the cessation of a 2% AEP stormwater event;*
- b) *Sufficient rapid soakage overflow capacity shall be provided to minimise the ponding of stormwater outside of the infiltration area(s); and*
- c) *Landscape design shall limit attractiveness to birds through the use of suitable nonbird attracting species’.*

Condition 6 of this consent, which prescribes the purpose of Stormwater Management Plan (SMP’s), requires Council to *‘Implement the conditions of this consent as they apply to each catchment, including the best practicable option for weed management in the Puharakekenui/Styx River as determined under Schedule 4(x)’.*

CIAL consider that Condition 28 expressly requires CCC, through this SMP, to ensure that the risk of bird strike is minimised through appropriate acknowledgement and reflection of Condition 28.

In addition, Condition 7 of the consent requires that SMPs shall include, but not be limited to, the information set out in Schedule 2. Schedule 2(t) states *‘Procedures, to be developed in consultation with Christchurch International Airport Limited, for the management of the bird strike for any facility owned or managed by Christchurch City Council within 3 kilometres of the airport’.*

National Airports Safeguarding Framework

The Australian Government has developed a National Airports Safeguarding Framework (NASF)² which is considered to be the most comprehensive guide to incompatible land uses around airports. This categorises land use types into wildlife attraction risk categories (high, moderate, low and very low) and determines actions (incompatible, mitigate, monitor, no action) for existing and proposed developments within radial distances from the aerodrome (3, 8 and 13kms).

The 13-km circle was originally based on a statistic that 95% of bird strikes occur below 2,000 ft, and that an aircraft on a normal approach would descend into this zone at approximately 13-km from the runway. An assumption was made that birds would remain overhead the attraction (at up to 2,000 ft) and that overflying aircraft would be at risk. In essence, this only looks at the site risk which is only one of the three elements of an off-airport hazard. Like the site risk, the flight path risk will generally become greater the closer the bird attracting habitat is to the airport³. CIAL considers that the NASF guidelines provide appropriate guidance for the management of the risk of bird strike. **Attachment 1 to Appendix A** outlines these radii as they relate to the area covered by the draft OSMP (and is a slightly enlarged version of Figure 12 contained in the Draft OSMP).

To this extent the CCC District Plan includes specific planning provisions to assist with managing off airport bird strike risk. CIAL has also worked with CCC in the development of a CCC internal practice note which is intended to provide assistance to planning staff and application of the birdstrike provisions within the CDP. It outlines the need, and how to consider bird strike when processing applications within proximity of CIAL, for the types of land uses that have the potential to create or increase bird strike risk.

Conclusion

CIAL consider it an integral part of its function to be involved in matters relating to bird strike risk in a strategic manner, to minimise the development of land uses (such as stormwater retention basins)

² DIRD [Department of Infrastructure and Regional Development, Australian Government] (2012) NASF Guideline C. https://www.infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/nasf_principles_guidelines.aspx Accessed 19/7/21 (as referred to in the evidence of P Shaw, referenced above).

³ Source: Extracts of Evidence of P Shaw, Hearings on the Proposed Selwyn District Plan

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which can be an attractive habitat to birds. CIAL are happy to work with CCC and landowners/ developers in this area to manage any bird strike related risks appropriately.

CIAL's Detailed Submission

CIAL's detailed submission is contained as **Appendix A**.

Appendix A: CIAL's Detailed Submission

Text changes to the draft OSMP (Draft Ōtūkaikino Stormwater Management Plan) sought as part of this submission are shown as ~~strikeout~~ for text to be deleted and **bold underlined** for text to be added. CIAL also request that any other related and appropriate amendments are made to the Plan to give effect to this request.

Chapter / provision	CIAL's reasons for submission	Relief sought
Overall	CIAL is a nationally significant facility located within the area covered by the provisions of the draft OSMP. CIAL requests that further recognition of the airport and its environs, and matters relating to its ongoing operation (namely bird strike) are provided within the Plan, and that the Plan should be amended to clearly reflect this.	Amend the Plan as outlined below.
Executive Summary	<p>CIAL request that specific reference is made to bird strike in the Executive Summary to the document.</p> <p>CIAL also request that the description of the catchment be amended to better reflect existing and potential land uses within the catchment, noting that these are subject to change throughout the life of the plan.</p>	<p>Add new sentence at the end of the third paragraph of the Executive Summary as follows:</p> <p><i>'Stormwater from new developments will pass through detention basins to mitigate new contaminant generation. Pre-existing development will also be treated. Recognising the relatively high values of the waterways, the Stormwater Management Plan proposes that all urban stormwater be treated through basins and wetlands before it is discharged. <u>Considered design of these facilities within the vicinity of CIAL and/ or within the identified Bird Strike Radii is required to ensure that these do not increase the risk of bird strike for aircraft use associated with Christchurch International Airport</u>.'</i></p>

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Chapter / provision	CIAL's reasons for submission	Relief sought
		<p>Amend the last sentence of the second paragraph as follows:</p> <p><i><u>'Whilst the majority of the catchment is predominantly predicted to remain rural, land use within the Catchment may change over the ten year life of the Plan (including with the exception of the an expanded Belfast urban boundary'.</u></i></p>
2.2 Regional Planning Requirements		<p>Add a reference to the Comprehensive Stormwater Network Discharge Consent within Section 2.2.2 Land and Water Regional Plan before the existing paragraph, as follows:</p> <p><i><u>'The Land and Water Regional Plan 2015 contains objectives, policies and methods relating to stormwater management. The CSNDC gives effect to the outcomes sought in both the Land and Water Regional Plan and CPRS'.</u></i></p>
2.5 The District Plan	CIAL considers that specific reference should be made to policy provisions of the Plan relating to bird strike in the context of stormwater disposal.	<p>Add a paragraph immediately prior to the paragraph titled 'District Plan Policies 8.9.22 e.' as follows:</p> <p><i><u>'The Plan also includes specific policies relating to bird strike. These include Policy 6.7.2.1.3, which states: 'Avoid or mitigate the potential effects of activities that could interfere with the safe navigation and control of aircraft, including activities that could interfere with visibility or increase the possibility of birdstrike'.</u></i></p>

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Chapter / provision	CIAL's reasons for submission	Relief sought
3. Principal Issues	As above.	Add the following sentence add the end of the second paragraph: <i><u>'This needs to occur whilst ensuring that other significant land uses, such as Christchurch International Airport, are not adversely affected by the solutions adopted. Bird strike is a significant issue which should be considered in locating and designing proposed stormwater facilities within the Ōtūkaikino catchment'.</u></i>
7.2.2 Industrial Growth	The draft OSMP contains information which is not considered to be accurate relating to the Specific Purpose (Airport) Zone.	Delete the following sentence as shown below: 'Part of the Specific Purpose (Airport) (SPA) Zone contains the equivalent of heavy industrial activity. However approximately half of the SPA zone is expected to remain as grassy runout areas around runways'.
New section 7.2.3 Other Growth	CIAL requests that the Plan specifically recognise the role of the airport and the projected growth of such.	Add a new section 7.2.3 'Other Growth' as follows: <i><u>'CIAL owns and operates Christchurch International Airport (Christchurch Airport). Christchurch Airport is the largest airport in the South Island and the second largest airport in New Zealand. CIAL are also the owner of a significant land parcel (approximately 420ha) within the area covered by this Plan (the future use of which has not been established)'.</u></i>
11.1 New Development	CIAL supports the inclusion of reference to the design of basins to minimise bird strike risk on aircraft (Section 11.6.1), however	Add a sentence following 'The minimum standards for stormwater detention and

Chapter / provision	CIAL's reasons for submission	Relief sought
	considers that this needs to be placed in the context of earlier sections of the Plan.	treatment associated with new development follow in Table 10': <u>'Specific consideration should also be given to design requirements of such facilities to ensure that the risk of bird strike is minimised'.</u>
Section 11 – Mitigation Options 11.6.1	<p>CIAL supports the inclusion of this section, however considers that the manner in which the information has been presented is confusing for the plan user. Section 11.6.1 deals with 'Designing Basins for Minimise Bird Strike on Aircraft' in the section on 'Mitigation Options', however bird strike has not been identified as an issue in the prior sections of the Plan. CIAL has made comments on earlier sections of the draft OSMP relating to this matter.</p> <p>Given the significance of this issue, CIAL also considers it appropriate to make specific reference to the relevant condition of the global consent which relate to bird strike (particularly given this SMP has is required and has been prepared with reference to that consent).</p> <p>Further, CIAL considers it preferable for Figure 12 (Bird Strike Management Zones) to be enlarged as it relates to the area covered by the draft OSMP. It is also requested that Figures 10 and 11 are removed from this section to avoid confusion (from initial reading they are not referenced to, nor relate to, Section 11.6.1).</p> <p>CIAL request that guidance material on the location and design of stormwater facilities to reduce the potential for bird strike risks is included within the Plan. It would appreciate the opportunity to</p>	<p>Amend Section 11.6.1. as follows:</p> <ul style="list-style-type: none"> - Add the words '<u>In addition</u>' prior to the current first paragraph commencing 'Christchurch District Plan Policy 6.7.2.1.2 ..' - Add reference to condition 28 of the global consent at the end of the second paragraph as follows: "...must meet activity standards in Section 6.7.4.3 of the Christchurch District Plan (see Figure 12) and <u>Condition 28 of CRC214226. In summary:</u> <ul style="list-style-type: none"> • <u>Stormwater infiltration basins must fully drain within 48 hours of the cessation of a 2% AEP stormwater event.</u> • <u>Sufficient rapid soakage overflow capacity must be provided to minimise the ponding of stormwater outside of the infiltration area(s).</u>

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Chapter / provision	CIAL's reasons for submission	Relief sought
	develop this material, in conjunction with CCC, for inclusion within this Plan. This material could be complimentary, but not replicate, the internal CCC advice note on bird strike.	<ul style="list-style-type: none"> • <u>Landscape design must limit attractiveness to birds through the use of suitable non-bird attracting species'</u>. - Relocate Figures 10 and 11 to other appropriate sections of the Plan. - Enlarge Figure 12 as it specifically relates to the draft OSMF spatial area generally in accordance with the plan contained as Attachment 1. <p>[Note: specific plan to be developed in conjunction with CCC – but is intended to include the following information</p> <ul style="list-style-type: none"> • Bird Strike Radii and associated runway threshold points • Ōtūkaikino Catchment Management Plan boundaries]. - Amend the last sentence as follows and add an additional sentence: <p><u>'Guidance material will be made available if/ when developed is contained as Appendix G. It is recommended that persons developing stormwater facilities within 13km of the airport runway thresholds identified in</u></p>

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Chapter / provision	CIAL's reasons for submission	Relief sought
		<p><u>Figure X</u> [contained as Attachment 1 to this submission] <u>consult with CIAL</u>’.</p> <p>[Note: Appendix G to be developed in conjunction with CCC].</p>
New objective	CIAL consider that the plan objectives do not give sufficient consideration to the issue of bird strike, nor the circumstances in which this may occur.	<p>Add a new Objective 5 as follows:</p> <p><u>‘Our goals are</u></p> <ol style="list-style-type: none"> <u>1. To minimise the potential risk of bird strike to aircraft through consideration of the location and design of stormwater facilities.</u> <u>2. To collaborate with CIAL to ensure that (1) is achieved’.</u> <p>Add a new Action Plan for Bird Strike [included at the end of this submission – to be further developed in conjunction with CCC].</p> <p>Undertake consequential renumbering of objectives and any associated provisions.</p>
14 Conclusion	CIAL considers that recognition of bird strike should be made in the conclusion section of the document.	<p>Add an additional bullet point to the third paragraph as follows:</p> <ul style="list-style-type: none"> <u>• ‘Reduce the threat of birdstrike through consideration of appropriate stormwater facility location and design’.</u>
Appendices New Appendix G	CIAL request that guidance material on the location and design of stormwater facilities to reduce the potential for bird strike risks is	Add a new Appendix G titled <u>‘Guidance Material Relating to Bird Strike’.</u>

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Chapter / provision	CIAL's reasons for submission	Relief sought
	<p>included within the Plan. Such material would provide additional certainty for the developers of stormwater facilities within the catchment, and enable the OSMP to operate closer to a 'one-stop-shop' for the design of stormwater facilities.</p> <p>CIAL would appreciate the opportunity to develop this material, in conjunction with CCC, for inclusion within this Plan. This material could be complimentary, but not replicate, the internal CCC advice note on bird strike.</p>	<p>[Note: this guidance material is to be developed in conjunction with CCC]</p> <p>Make provision for amendment/ updating of this practice note as and when required (ie as a result of associated changes within the District Plan/ as a result of changes in national regulatory planning framework).</p>

Action Plan for Bird Strike				
Goal	Action	Mechanism	Action Components	Timing
5.1	Incorporate guidance notes on bird strike in SMP	<p>Development of guidance notes.</p> <p>Referral of matters relating to stormwater facility design within 13km radii of airport runway threshold to CIAL.</p>	<p>Develop guidance notes on bird strike in partnership with CIAL.</p> <p>Keep records of stormwater basins developed within catchment area.</p> <p>Provide records to CIAL at annual intervals.</p>	Immediate and ongoing
5.2	Ongoing liaison with CIAL	Bi annual meetings with CIAL and ECan to		As above.

BM220104-01aV4/CIAL Submission to CCC on Draft OSMP
Page 7

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		discuss bird strike.		
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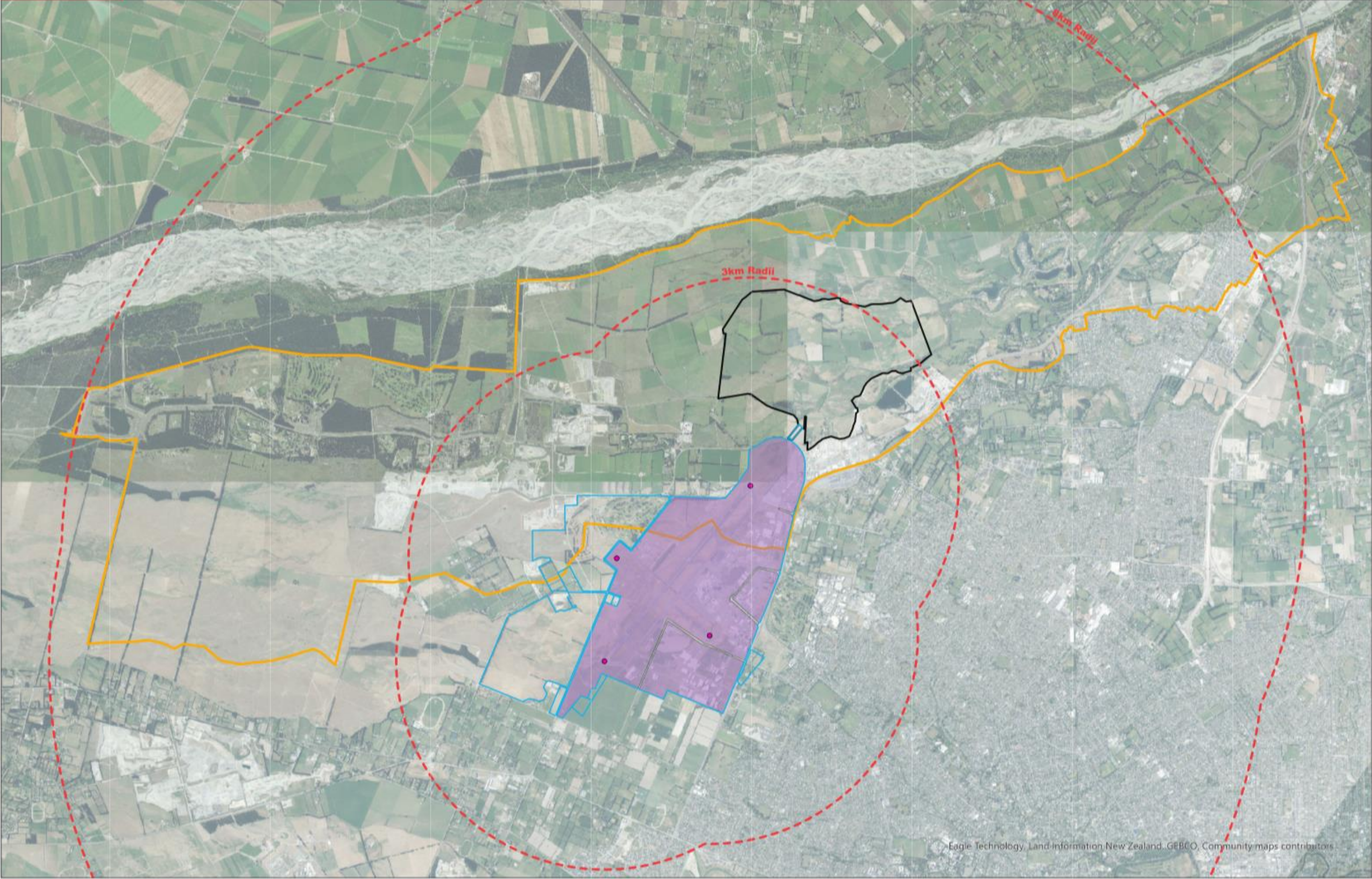
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Attachment A

Attachment A
Item 6

Attachment #51132

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





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Data Sources:
Christchurch City Council
Projection: NZGD 2000 New Zealand Transverse Mercator
0 1,500 m
1:50,000 @ A3

LEGEND
 Otukaikino Catchment
 CIAL Land Interests
 Special Purpose (Airport) Zone
 Airport Designation (CCC)
 Shipley's block boundary

Bird Strike Management Areas
(Radii off Airport Runway Threshold)
 3km
 8km
 13km (extends beyond boundaries shown on this plan)
 Runway Thresholds

Christchurch International Airport Context Map:
For Submission on CCC Draft Otukaikino Stormwater Management Plan

Date: 2 May 2023 | Revision: 0
Plan prepared for CIAL by Boffa Miskell Limited
Project Manager: mark.brown@boffamiskell.co.nz | Drawn: HHu | Checked: Nva

Attachment
1

Ōtūkaikino

Stormwater Management Plan



March 2023

Ōtūkaikino

Stormwater Management Plan

Three Waters Unit
Christchurch City Council

March 2023

TRIM 20/1027631

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Ōtūkaikino Wetland

List of Abbreviations

Abbreviation	Definition
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average recurrence interval, the long-term average interval between floods
ASPM	Macrophyte Average Score Per Metric
BMP	Best Management Practice
CCC	Christchurch City Council
CHI	Cultural Health Index
CLM	Contaminant Load Model
DIN	Dissolved Inorganic Nitrogen
DRP	Dissolved Reactive Phosphorus
ECan	Environment Canterbury
<i>E. coli</i>	<i>Escherichia coli</i>
GWL	Groundwater Level
HAIL	Hazardous Activities and Industries List
IGSC	Interim Global Stormwater Consent
IPCC	Intergovernmental Panel on Climate Change
ISQG	Interim Sediment Quality Guidelines
LDRP	Land Drainage Recovery Programme
LLUR	Listed Land Use Register
LTP	Long Term Plan
LWRP	Land and Water Regional Plan
MCI	Macroinvertebrate Community Index
NPS-FM	National Policy Statement on Freshwater Management
ppb	parts per billion
PAH	Polycyclic Aromatic Hydrocarbon
QMCI	Quantitative Macroinvertebrate Community Index
RMA	Resource Management Act
UDS	Greater Christchurch Urban Development Strategy



Contributors

<u>Contributor</u>	<u>Position</u>
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Belinda Margetts	Freshwater Ecologist, Christchurch City Council

1. Executive Summary

A Stormwater Management Plan for the Ōtūkaikino River is a requirement of the Comprehensive Stormwater Network Discharge Consent (CRC214226). Its purpose is to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity and to improve the quality of rivers and streams. The stormwater management plan sets out methods the Council will implement to meet the consent targets in the consent.

Water quality and ecological health are typically higher than in other city waterways, although waterway values have declined as a result of changes in the catchment. Urbanisation has affected Wilsons Stream, a constructed drain, and pastoral and other rural activities have had lesser effects on Ōtūkaikino Creek and its tributaries. The majority of the catchment is predicted to remain rural, with the exception of the expanding Belfast urban boundary.

Stormwater from new developments will pass through detention basins to mitigate new contaminant generation. Pre-existing development will also be treated. Recognising the relatively high values of the waterways, the Stormwater Management Plan proposes that all urban stormwater be treated through basins and wetlands before it is discharged. Considered design of these facilities is required to ensure they do not increase the incidence of bird strike to aircraft associated with Christchurch International Airport.

Treatment through basins and wetlands obtains good removal of particles (sediment) but less complete removal of dissolved metals such as copper and zinc. These metals, which mainly come from unpainted roofs, vehicle tyres and vehicle brakes would be better controlled at source, but it will be some time until the Council can effect such controls.

Despite some diversion of stormwater from ground infiltration, where land is undeveloped, into stormwater runoff when land is developed, the effect on groundwater quantity and spring flows is considered to be slight. This is because of the influence of large inflows into groundwater from the Waimakariri River.

Developed areas are adequately protected from flooding. Urban areas are elevated above the creek and its rural floodplain, and are protected from flooding in the Waimakariri River either by height or by stopbanks. Some localised ponding could occur within the various sub-catchments in extreme rain events. Buildings in rural zones are elevated above a potential breakout through the Waimakariri River primary stopbanks.

Part One Plan Initiation

2. Background to the Stormwater Management Plan

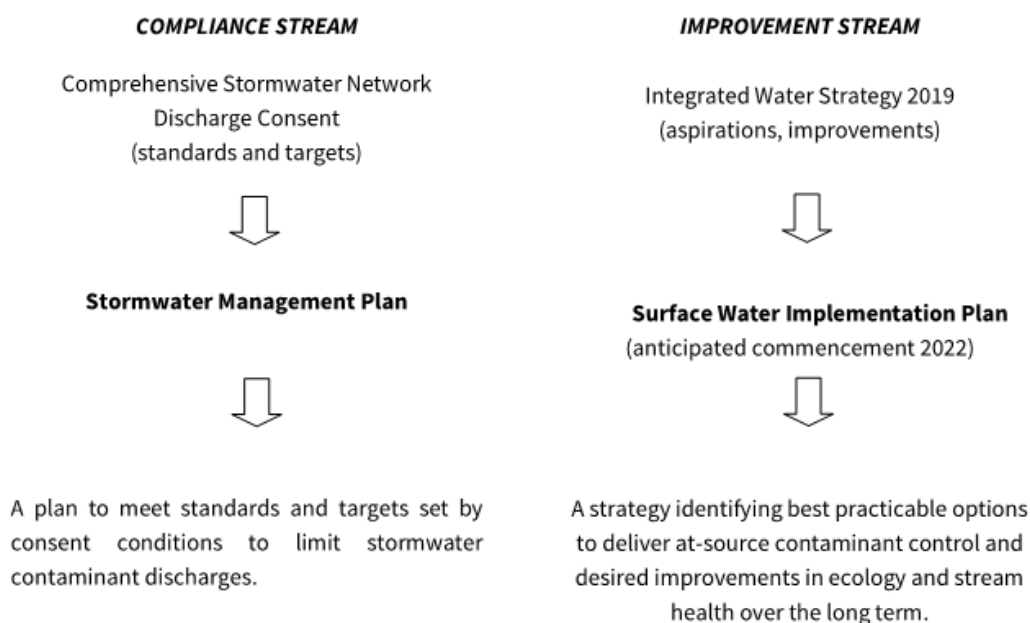
1.1 Purpose and scope

The purpose of a Stormwater Management Plan (SMP) is defined in condition 6 of the Comprehensive Stormwater Network Discharge Consent (CSNDC), CRC214226, and includes contributing to meeting contaminant load reduction standards, setting (and meeting) additional contaminant load reduction targets and demonstrating the means by which stormwater discharges will be progressively improved toward meeting receiving environment objectives and targets.

The aim of the CSNDC is to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity. The CSNDC promotes progressive water quality improvement toward targets in the Land and Water Regional Plan through the use of best practicable options for stormwater quality improvement and peak flow mitigation.

Stormwater management plans set out the means by which the Council will comply with the conditions in the CSNDC. However, due to governance processes, the SMP cannot address all environmental improvement targets signalled in the consent. The SMP is given effect through the Council's Long Term Plan (LTP), which is a statutory process. The relative timing of LTP processes and the SMP do not permit this SMP to commit to unfunded, new initiatives to achieve aspirational targets.

The Council proposes to respond to the CSNDC by adding a second stream of improvement planning.



Both plans inform and are funded through the **Long Term Plan**

The SMP process includes:

- 1 Identify the existing state of the environment in the catchment.
- 2 Identify the contributions by existing and future activities to stormwater quality and quantity.
- 3 Estimate trends from urban growth, technology, lifestyle, climate, etc on water quality and quantity.
- 4 Develop measures (including planning, education, enforcement, source control, etc as funded in the LTP) to control or mitigate effects.
- 5 Estimate the effectiveness of chosen mitigation measures through contaminant load and flood modelling.

The Surface Water Implementation Plan process includes:

- Prepare a plan that will permit the Council to meet or exceed consent condition targets.
- Engage with Council teams and external stakeholders responsible for contaminant generating activities; obtain agreement about control measures.

2.1. Stormwater Management Plan Catchments

This SMP is one of seven plans being prepared over the period 2020 to 2024 for the Ōpāwaho-Heathcote, Huritini-Halswell, Ihutai-Estuary and Coastal and Ōtūkaikino catchments and Settlements of Te Pātaka-o-Rākahautū-Banks Peninsula, and Ōtākaro-Avon and Pūharakekenui-Styx catchments, (Figure 1).

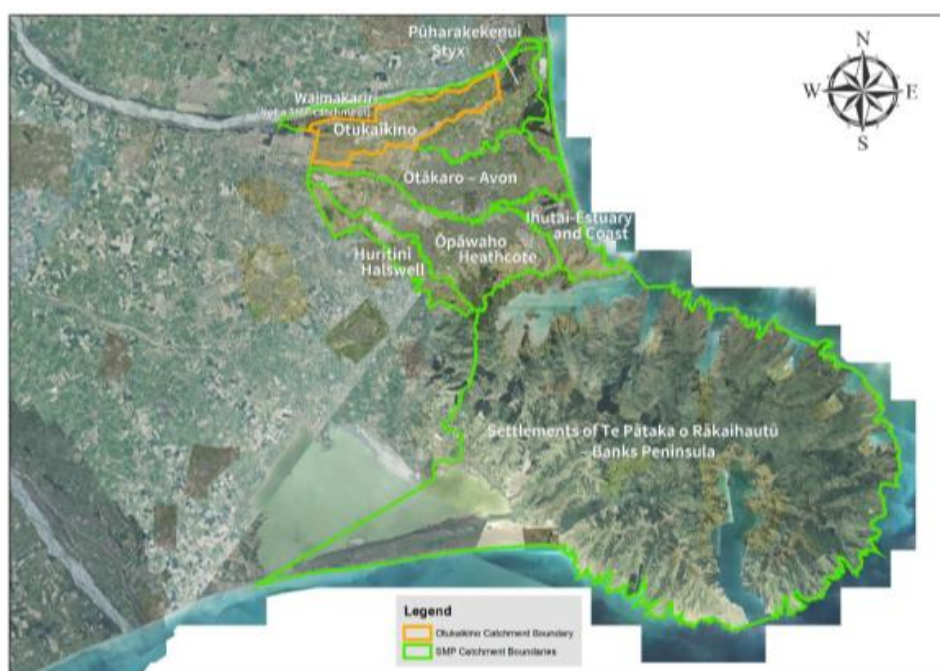


Figure 1: Area covered by the Comprehensive Stormwater Network Discharge Consent

2.2. Regional Planning Requirements

2.2.1. Canterbury Regional Policy Statement

The Canterbury Regional Policy Statement (CRPS) sets out how natural and physical resources are to be sustainably managed in an integrated way. The needs of current and future generations can be provided for by maintaining or improving environmental values. The CRPS requires that objectives, policies and methods are to be set in regional plans, including the setting of minimum water quality standards.

2.2.2. Land and Water Regional Plan

The Land and Water Regional Plan 2015 encourages the development of stormwater management plans under Rule 5.93. The intention of the rule is that SMPs will be developed to show how a local authority will meet the relevant policy on water quality.

2.2.3. Greater Christchurch Urban Development Strategy

The Greater Christchurch Urban Development Strategy (UDS) Partnership has been working collaboratively for over a decade to tackle urban issues and manage the growth of the city and its surrounding towns.

The strategy was prepared under the Local Government Act 2002 and it is to be implemented through various planning tools, including:

- Amendments to the Canterbury Regional Policy Statement (CRPS);
- Changes to regional and district plans to reflect the CRPS changes;
- Stormwater planning to give effect to the LWRP; and
- Outline Development Plans for new development areas ('Greenfield areas') and existing re-development areas ('Brownfield areas').

Therefore the preparation of this SMP plays a role in implementing the UDS.

2.3. Non-Statutory Documents

- Integrated Water Strategy 2019
- Surface Water Implementation Plan 2022 (to be developed)
- Mahaanui Iwi Management Plan 2013
- Ngai Tahu Freshwater Policy Statement (Te Rūnanga O Ngai Tahu 1999)
- Infrastructure Design Standard (Christchurch City Council 2010)
- Waterways, Wetlands and Drainage Guide (Christchurch City Council 2003)
- Erosion and Sediment Control Toolbox for Canterbury (Environment Canterbury)
- Estuary Management Plan 2020 – 2030 (Avon-Heathcote Estuary Ihutai Trust)

2.4. The Council's Strategic Objective for Water

The Christchurch City Council has adopted community outcomes to promote community wellbeing.

The Water Outcome Healthy Environment includes:

Healthy water bodies: “Surface water quality is essential for supporting ecosystems, recreation, cultural values and the health of residents.”

2.5. The District Plan

The Christchurch District Plan promotes responsible stormwater disposal through Policy 8.2.3.4 – Stormwater Disposal, which states:

- a. District-wide:
 - i. Avoid any increase in sediment and contaminants entering water bodies as a result of stormwater disposal.
 - ii. Ensure that stormwater is disposed of in a manner which maintains or enhances the quality of surface water and groundwater.
 - iii. Ensure that any necessary stormwater control and disposal systems and the upgrading of existing infrastructure are sufficient for the amount and rate of anticipated runoff.
 - iv. Ensure that stormwater is disposed of in a manner which is consistent with maintaining public health.
- b. Outside the central city:
 - i. Encourage stormwater treatment and disposal through low-impact or water-sensitive designs that imitate natural processes to manage and mitigate the adverse effects of stormwater discharges.
 - ii. Ensure stormwater is disposed of in stormwater management areas so as to avoid inundation within the subdivision or on adjoining land.
 - iii. Where feasible, utilise stormwater management areas for multiple uses and ensure they have a high quality interface with residential activities or commercial activities.
 - iv. Incorporate and plant indigenous vegetation that is appropriate to the specific site.
 - v. Ensure that realignment of any watercourse occurs in a manner that improves stormwater drainage and enhances ecological, mahinga kai and landscape values.
 - vi. Ensure that stormwater management measures do not increase the potential for bird-strike to aircraft in proximity to the airport.
 - vii. Encourage on-site rain-water collection for non-potable use.
 - viii. Ensure there is sufficient capacity to meet the required level of service in the infrastructure design standard or if sufficient capacity is not available, ensure that the effects of development are mitigated on-site.

The District Plan includes specific policies relating to bird strike on aircraft. These include Policy 6.7.2.1.3 which states, “Avoid or mitigate the potential effects of activities that could interfere with the safe navigation and control of aircraft, including activities that could interfere with visibility or increase the possibility of birdstrike.”

District Plan Policies 8.9.2.2 and 8.9.2.3 make earthworks subject to a consent. Conditions of consent for earthworks over a threshold include the requirement for an Erosion and Sediment Control Plan (ESCP). An ESCP is submitted and approved with a consent application and its implementation is verified by building consent officers.

2.6. Bylaws

The draft Stormwater and Land Drainage Bylaw (in preparation) will restrict discharges of any material, hazardous substance, chemical, sewage, trade waste or other substance that causes or is likely to cause a nuisance, into the stormwater network.

The Traffic & Parking Bylaw 2017 allows the Council to require an offender to remove material spilled onto roads.

2.7. Building Act

The Council can use powers under the Building Act to require ESCPs to be submitted when an associated land use consent is not required.

2.8. Integrated Water Strategy

Objectives 3 and 4 of the Christchurch City Council's draft Integrated Water Strategy are summarised as *"enhancement of ecological, cultural and natural values and water quality improvement."*

The preferred strategy option for achieving the objectives is to *"continue ... the implementation of the current approach to stormwater management (embodied by the development of the Stormwater Management Plans) ..."*

2.9. Mahaanui Iwi Management Plan

The Mahaanui Iwi Management Plan "... is an expression of kaitiakitanga and rangatiratanga...(It) provides a values-based, ... policy framework for the protection and enhancement of Ngāi Tahu values, and for achieving outcomes that provide for the relationship of Ngāi Tahu with natural resources across Ngā Pākihi Whakatekateka o Waitaha and Te Pātaka o Rākaihautū (the Canterbury Plains and Banks Peninsula)". The Ihutai-Estuary and Coastal SMP acknowledges the Iwi Management Plan policies, and can contribute to policies which fall within the scope of a stormwater management plan (SMP). There is more detail in Section 10.5.

2.10. Infrastructure Design Standard

The Infrastructure Design Standard 2016 (IDS) is the Council's development code and is a revision of the Christchurch Metropolitan Code of Urban Subdivision 1987. The IDS promotes environmental protection via a values-based design philosophy and consideration of bio-diversity and ecological function (IDS, section 5.2.3 Four Purposes)

2.11. Goals and Objectives for Surface Water Management

The Ōtūkaikino Stormwater Management Plan and the Surface Water Implementation Plan will together be consistent with the *Integrated Water Strategy 2019* which identifies overall goals and objectives for surface water management. Jointly these plans will support so far as is practicable the *Mahaanui Iwi Management Plan* objectives for the Ihutai/Avon-Heathcote Estuary catchment (Jolly et al, 2013).

The Council's high-level goals in the Integrated Water Strategy are:

Goal 1: The multiple uses of water are valued by all for the benefit of all;

Goal 2: Water quality and ecosystems are protected and enhanced;

Goal 3: The effects of flooding, climate change and sea level rise are understood, and the community is assisted to adapt to them; and

Goal 4: Water is managed in a sustainable and integrated way in line with the principles of kaitiakitanga. *Te Rūnanga o Ngāi Tahu Freshwater Policy* (Ngāi Tahu, 1999) lists several water quality and water quantity policies that apply throughout the Ngāi Tahu Takiwā. The *Iwi Management Plan* (Jolly et al, 2013) has objectives for the Waimakariri Catchment that are directly relevant to the Ōtūkaikino SMP. These are objectives numbered:

- (2) The discharge of contaminants to the Waimakariri and its tributaries is eliminated.
- (3) Water quality and flows in the Waimakariri and its tributaries are improved to enable whānau and the wider community to have places they can go to swim and fish.
- (4) The mauri and mahinga kai values of the Waimakariri and its tributaries and associated springs, wetlands and lagoons are protected and restored; *mō tātou, ā, mō kā uri ā muri ake nei*.

The CSNDC sets freshwater outcomes based on Land and Water Regional Plan targets. The CSNDC Environmental Monitoring Programme (EMP) will assess the ecological and cultural health of waterways and coastal areas, and progress made under the SMP. The EMP assesses a range of parameters, and progress can be measured against LWRP guidelines for macroinvertebrate indices, macrophytes, periphyton, siltation and a range of water quality parameters.

The SMP programme will contribute toward delivery on these objectives through improving water quality in the rivers and streams. Other plans and programmes must play a part in restoring riparian margins, and protecting and restoring springs and mahinga kai site in order to deliver on tangata whenua and LWRP objectives.

Stormwater quantity effects considered in this SMP include mitigation of additional runoff generated by urban intensification and the reduction in network level-of-service in the east of the catchment as sea levels rise over the SMP planning period.

Other sources and reports that have informed the SMP include:

- State of the Takiwā;
- Surface water and sediment quality monitoring;
- Listed Land Use Register (contaminated sites database, ECan);
- Groundwater and springs study;
- Ecological survey;
- Flood management planning for the Waimakariri River (Environment Canterbury);
- Contaminant load model.

The duration of this stormwater management plan is 10 years. Water quality has been its primary focus. To maintain the existing good water quality in receiving waters, it will be necessary to mitigate any adverse effects from new urban growth and to improve stormwater quality from existing developed areas.

3. Principal Issues

Waterways in this catchment are spring fed and predominantly rural. Ōtūkaikino Creek and tributaries have the best overall water quality within the Christchurch urban area and are described as being in good to excellent ecological health (Boffa Miskell, 2017). Ecological health is thought to have been compromised by historical land drainage and vegetation clearance (Jensen, 2002) and water quality is impacted somewhat by stock access to streams and drains. An ecological survey of the Ōtūkaikino Creek in 2017 (Boffa Miskell, 2017) was unable to find stonefly larva, previously detected in 2012, indicating a decline in stream health over that period.

The challenge for the Christchurch City Council, Environment Canterbury and land owners is to retain the natural and ecological values that exist by ensuring that agricultural and urban disturbances are reduced below an acceptable threshold.



Part Two
The Catchment

4. Catchment Description

4.1. Geography

The Ōtūkaikino catchment is 6,200 hectares in area, much of it comprising old river bed of the Waimakariri River South Branch. The South Branch, seen in Figure 8, was closed off in the 1930s.

Four periods of fan-building and down-cutting by the Waimakariri River, believed to be associated with glacial events and post-glacial changes in sea level and sedimentation rates, have been recognised from soil and geological evidence. Four age groups of soils occupy the surfaces of the fans both north and south of the current river. These soil groups are named Lismore (oldest), Templeton, Waimakariri and Selwyn (youngest). The catchment is now separated from the river and protected from flooding by a stopbank.

River deposition and erosion processes have left gently undulating surfaces with generally east trending channel remnants. On the dry plains the surface is covered by wind blown loess and near the river the surface is comprised of very recent river sands and silts. Abandoned river braids east of McLeans Island carry water seeping from the Waimakariri River and emerging as springs.

4.2. Soils

4.2.1. Soils of the Plains

“Soils of this area are recent alluvial Selwyn soils. They sit on the reworked gravel of a glacial outwash fan that was probably laid down over 20,000 years ago. Adjacent Templeton soils to the south were laid down 6,000 to 3,000 years ago but the Selwyn group of soils has formed on sediments probably laid down within the last 300 years, during floods, including floods that were still going on at European settlement, before stopbanks were built about 1870.”

In past times great quantities of dust from the riverbeds were lifted by strong north-west winds and deposited over the plains. This dust was sandy near the rivers, but the sediments became finer as distance from the rivers increased. Waimakariri series soils in the upper catchment received a heavy dressing of sandy material.

“Terraces bear soils that are mostly shallow or stony; (with) some strips of soils with stones at the surface, and others where stones are buried. In a few places one to two metres of fine sediment overlies stones.” [Internet source; author not identified]

4.3. Drainage Network

4.3.1. Streams and drainage channels

The main water features in this catchment are spring-fed streams flowing in old channels of the Waimakariri River South Branch. These streams mostly flow through lower-lying pastoral land north of Johns Road. Further east Wilsons Drain is the outfall for much of Belfast and discharges into Ōtūkaikino Creek via Ōtūkaikino Wetland.

The dry plains west of the airport are traversed by remnant river channels that are mostly dry. Ground permeability is so high that there are not considered to be drainage paths per se west of the airport, and precipitation infiltrates into the ground.

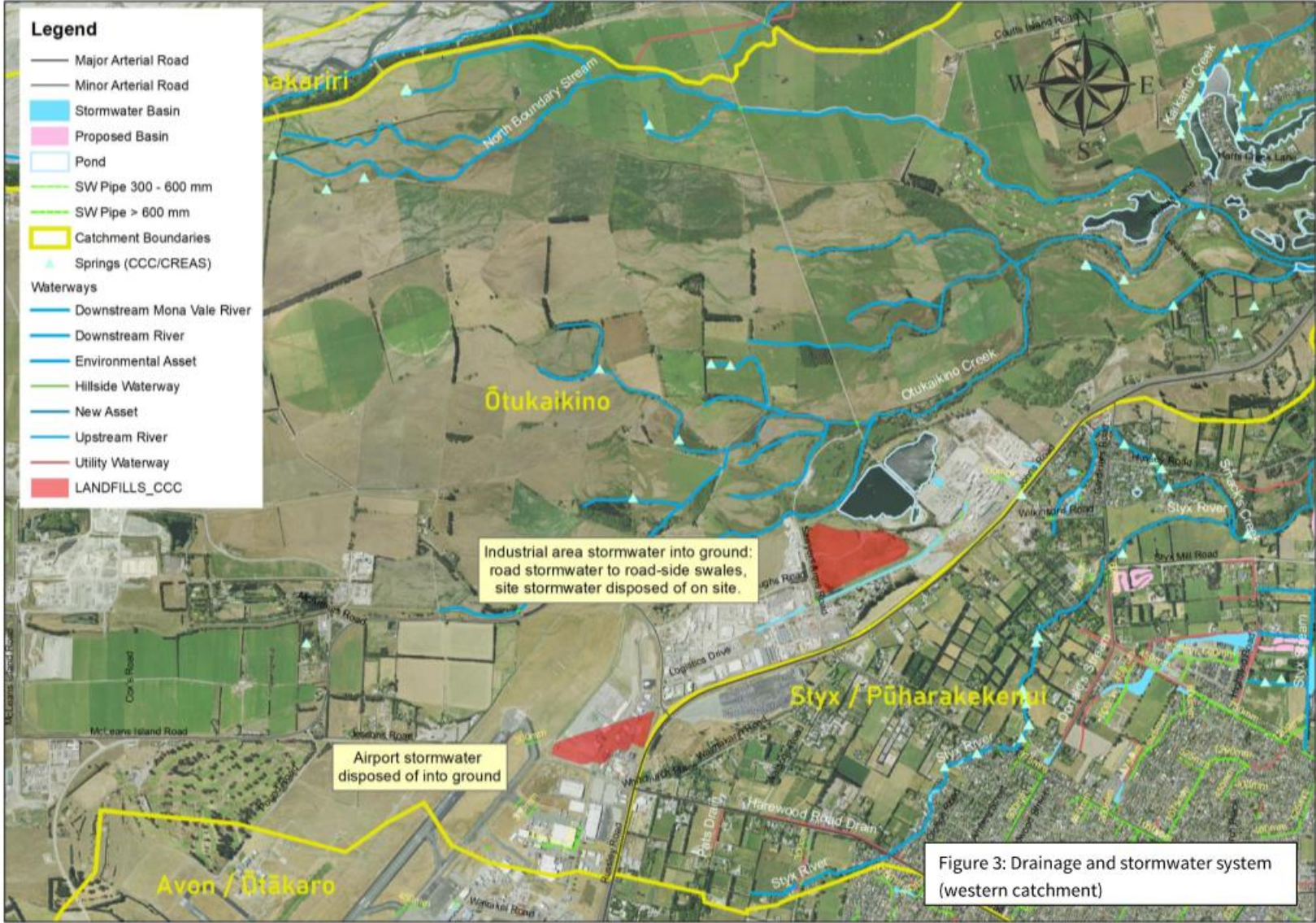
North and east of the airport a pattern of streams and drains pick up springs arising from the Waimakariri River, flowing eastward into the Ōtūkaikino Creek which joins the Waimakariri River close to the State Highway 1 Waimakariri Bridge.

4.3.2. Stormwater system

The public stormwater network starts in roadside channels which receive discharges from private property and the carriageway. The primary function of side channels is to maintain dry traffic lanes. Side channels lead to street sumps (catchpits) which discharge into a pipe network. The pipe network's level of service is that road drainage will avoid traffic hazards in a five-year average recurrence interval rainfall. Occasional road and property flooding occurs due to sump blockage or system capacity, which is normally responded to by reactive maintenance. The pipe network discharges into drains and waterways.

Industrial sites in the west of the catchment, including the airport, generally dispose of their own stormwater into ground soakage. On the majority of industrial sites rainfall appears to infiltrate into the ground without a formal collection system. East of Gardiners Road, approximately, the soils are less permeable and groundwater becomes shallower so that disposal of treated stormwater into surface water is more common. In this area most urban stormwater is treated in basins or wetlands and discharged into tributaries of Ōtūkaikino Creek.





4.4. Groundwater - Physical

4.4.1. Depth to groundwater

Water level records held by Environment Canterbury (ECan, 2017) indicate that groundwater is within five metres of the surface near the Waimakariri River, but deeper in the south-western part of the catchment. This reflects local topographic variations and also the downward movement of seepage from the Waimakariri River as it moves south and east.

4.4.2. Groundwater flow patterns

Piezometric contours for the catchment (Figure 4) indicate that groundwater moves in a predominantly east-south-easterly direction, becoming more easterly as groundwater approaches the coast. This suggests that losses from the Waimakariri River recharge shallow groundwater to the west, from where the water flows easterly towards Christchurch, before discharging at the coast.

Groundwater also discharges to springs in the eastern part of the catchment (Figure 2 and Figure 3) at locations where the depth to groundwater is very shallow. Springs feed small tributaries of the Ōtūkaikino Creek. The flow from these creeks is likely to vary seasonally with changes in groundwater levels.

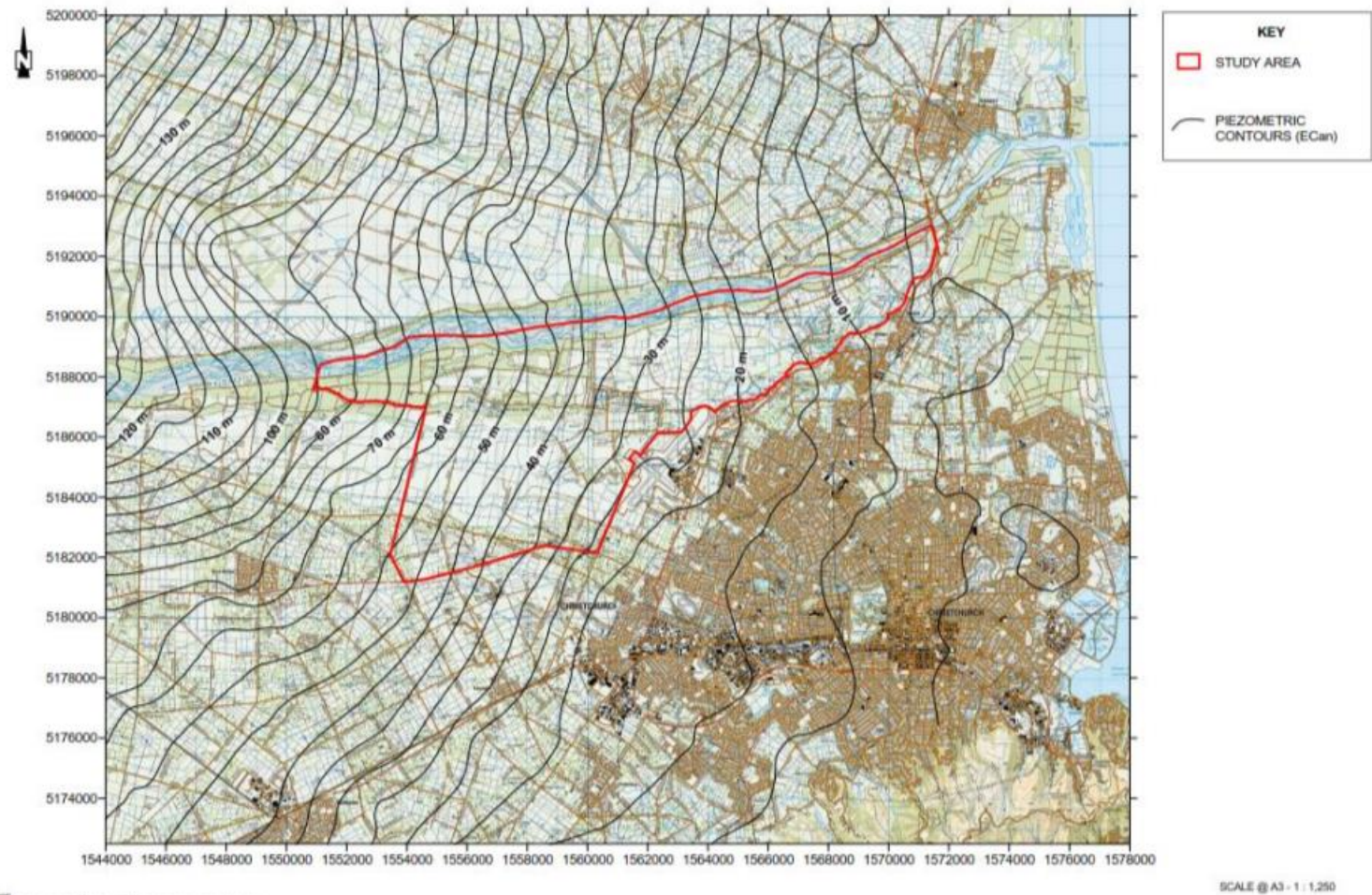
Groundwater gradients are low, consistent with the geology. The flow gradient is approximately 0.006 across the majority of the catchment but flattens to 0.002 in the east and may vary seasonally. Records do not indicate the presence of significant thicknesses of low permeability strata. This suggests that the shallow groundwater and the deeper gravel aquifers may be relatively well linked, although the majority of the flow is likely to be more horizontal than vertical.

The available monitoring data indicate that saline intrusion does not extend into the catchment's shallow groundwater systems.

4.4.3. Seasonal groundwater levels

Groundwater levels vary both seasonally and over long periods due to changes in recharge into and discharge from the aquifer. Four bores in shallow gravels have been monitored for between 18 and 64 years.

Three of the four bores are located in the southern part of the catchment and indicate that the water table fluctuates by 0.5m to 6.5m seasonally (depending on location), with peak water levels generally occurring at the end of winter. Bore M35/8370 is located closer to the river in the centre of the catchment and seasonal fluctuations within this bore are generally of the order of 0.5m.



SOURCE:
1. CONTOURS DERIVED FROM ENVIRONMENT CANTERBURY (ECAN) MAPS
2. CADASTRAL AND TOPOGRAPHICAL INFORMATION DERIVED FROM LINZ DATA AND
ECAN MAPS

Figure 4: Groundwater contours

5. Tangata Whenua Cultural Values

5.1. Wai Maori

Ko te wai te oranga o ngā mea katoa

Water is the life giver of all things

Water is a significant cultural resource that connects Ngāi Tahu to the landscape and the culture and traditions of the tūpuna. All water originated from the separation of Rangi and Papatūānuku and their continuing tears for one another. Rain is Rangi's tears for his beloved Papatūānuku and mist is regarded as Papatūānuku's tears for Rangi.

For tāngata whenua, the current state of cultural health of the waterways and groundwater is evidence that water management and governance in the takiwā has failed to protect freshwater resources. Surface and groundwater resources are over-allocated in many catchments and water quality is degraded as a result of urban and rural land use. This has significant effects on the relationship of Ngāi Tahu to water, particularly with regard to mauri, mahinga kai, cultural wellbeing and indigenous biodiversity.

A significant kaupapa that emerges from (the Mahaanui Iwi Management Plan) is the need to rethink the way water is valued and used, including the kind of land use that water is supporting, and the use of water as a receiving environment for contaminants such as sediment and nutrients. Fundamental to tāngata whenua perspectives on freshwater is that water is a taonga, and water management and land use should reflect this importance. Because of the fundamental importance of water to all life and human activity, Ngāi Tahu maintain that the integrity of all waterways must be jealously protected. This does not preclude the responsible use of water, but merely states the parameters which Ngāi Tahu believe any such use should remain within. The utilisation of any resource for the benefit of the wider community is encouraged, providing that it is done with the long-term welfare of both the community and the resource in mind."

(Mahaanui Iwi Management Plan, Part 5.3 Wai Māori)

5.2. Ngāi Tahu Site Specific Cultural Values

The Ōtūkaikino Creek follows the original river bed of the Waimakariri South Branch, which was the main stem of the Waimakariri River until a series of stop banks and groynes were created during flood protection works at McLeans Island. This severed the connectivity and the South Branch of the Waimakariri River became the lowland spring-fed waterway it is today.

Prior to these flood protection works the South Branch of the Waimakariri River was highly significant to mana whenua, as it was associated with many mahinga kai sites, urupā, kāinga and kāinga nohoanga (Tau, Goodall, Palmer, & Tau, 1990). The name Ōtūkaikino also refers to a protected wetland reserve to the east of the waterway, which has been designated by mana whenua as a traditional wai whakaheke tūpāpaku (water burial site).

The current Ōtūkaikino waterway covers 16km in length, with the headwater springs located in the Issacs Conservation and Wildlife Trust site and on rural land in McLeans Island. While some riparian planting of natives has occurred in these upper reaches, much of the riparian margins are dominated by willow and few of the springs have been planted. In the mid-reaches, between the Scout Camp and Clearwater Resort significant riparian restoration works have been undertaken with many of these plantings well established. This section is dominated by willows, but it also includes some pockets of regenerating wetland habitat. Willow clearance and control works are currently being undertaken by Environment Canterbury along this section. The Groynes reserve area consists of multiple ponds, restoration plantings and is a popular recreation area. Plantings along the stream in this area are dominated by willows and other exotic species. The downstream reach of the Ōtūkaikino Creek consists of The Groynes reserve to the Waimakariri River. This section of the waterway has had extensive ecological restoration plantings and willow removal works are ongoing. Due to the May 2021 floods, extensive sedimentation has occurred in the lower reaches of the stream where it meets the Waimakariri River. The Ōtūkaikino wetland is located between State Highway 74 and Main North Road and is a remnant of the original wetlands that would have covered the Ōtūkaikino Catchment. It is managed as a Living Memorial in conjunction with mana whenua, the Department of Conservation and funeral directors Lamb and Hayward.

5.3. Te Ngāi Tūāhuriri Rūnanga Position Statement / Cultural Impact Assessment

To come once the Rūnanga Position Statement is received

Table 1: Response to Cultural Impact Assessment

Recommendation	Action Taken	Reason

5.4. Cultural Monitoring

Cultural monitoring enables the Council and Ngāi Tahu to compare future conditions against the State of the Takiwā Report, 2007. Cultural monitoring will be carried out as part of the Environmental Monitoring Programme. Sites will be sampled five-yearly in conjunction with the monitoring of surface water quality, instream sediment quality and aquatic ecology.

A cultural health assessment of this catchment was carried out for the 2022 mātauranga monitoring report. The assessment is based on surrounding land use, vegetation, land use, riverbed condition,

water clarity, habitat variety and changes to the river channel. Monitoring indicated that the catchment is in moderate cultural health, with those sites where extensive restoration works have been undertaken scoring the highest. The catchment has been highly modified from a braided river to a low plains spring-fed stream and adjacent agricultural land uses and roads were identified as the largest pressures on site health.

Two of the six sites (Ōtūkaikino Wetland and Ōtūkaikino at Isaacs Conservation Reserve) scored above 4 out of 5 (Good). The average of six scores was 3.3 (Moderate).

Fine sediment is a significant issue for the creek, with several sites exhibiting sediment accumulation. This has been exacerbated through the lack of riparian planting at most sites and recent willow removal works downstream of the Groynes. Furthermore, the May 2021 floods caused significant sediment deposition in the furthest downstream reaches of the Ōtūkaikino and therefore monitoring could not be conducted further downstream than Dickeys Road bridge.

Water quality testing and assessment identified a range of concerns throughout the assessment. Zinc was detected throughout the catchment, but in concentrations below the ANZG guidelines for 95% species protection. Copper concentrations were below the limits of detection. Phosphorus, *E.Coli* and nitrate-nitrogen were identified to be the contaminants of concern within this catchment and further studies should be conducted to identify the likely sources of these.

None of the sites surveyed are currently utilised for mahinga kai practices due to limited site access, lack of indigenous planting, sedimentation, and water contamination.

6. The Receiving Environment

6.1. Receiving Water Classification

Waterways in the Ōtūkaikino catchment are classified in the Waimakariri River Regional Plan (WRRP). That classification is described below.

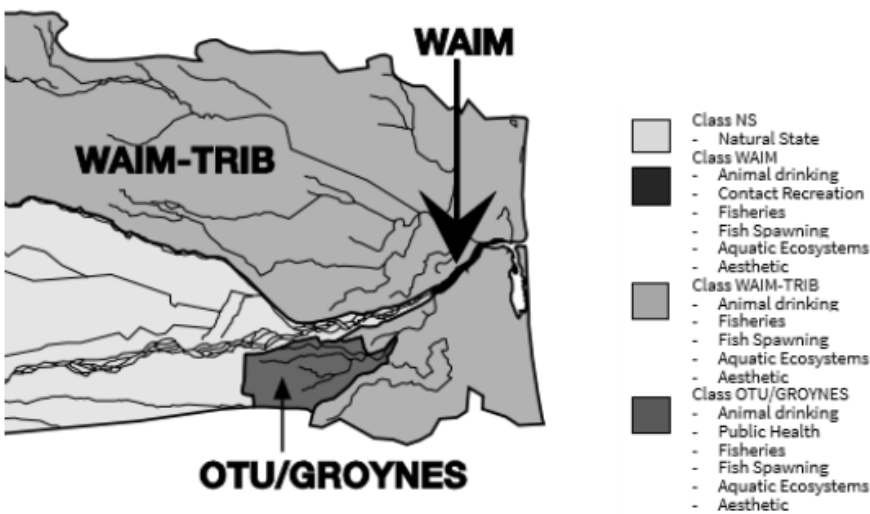


Figure 5: Ōtūkaikino water classification

Waters west of Clearwater (including most tributaries of the Ōtūkaikino Creek) are classified in the WRRP as ‘OTU/GROYNES’ and waters east (downstream, including Wilsons Drain) are classified ‘WAIM-TRIB’. Standards for OTU/GROYNES water exceeds WAIM-TRIB in the requirement that “the natural quality of the water with respect to organisms of public health significance shall not be altered.”

However the Council must meet Receiving Environment Objectives and Attribute Target Levels (numerical targets) from the Consent CRC214226, Schedule 7. These are more restrictive than the WRRP classification. Receiving environment objectives that apply (Schedule 7 in the CSNDC) are reproduced in Appendix F and discussed in the section below.

6.2. Water Quality

The Council monitors water quality monthly at three sites: the Groynes Inlet (since 2008), Wilsons Drain (since 2013) and the Omaka Scout Camp (since 2014). Results from monthly copper and zinc monitoring are summarised in Table 2.

Water quality in the rural part of the catchment is very good, because the water arises directly from the Waimakariri River (via seepage and spring flow) with few inputs from urban sources. Water quality samples meet the Waimakariri River Regional Plan receiving water standards.

The water quality index scores in 2019 were 84.0 (Good) at The Groynes site and 89.2 (Good) at the Scout Camp site. A score of 90 is Very Good (and 100 is the maximum possible score). These scores are best equal in the city with the Styx River at Main North Road.

Despite the rural nature of the catchment the monthly water quality sampling shows occasional exceedences of the Schedule 7 Attribute Target Levels for metals. Reasons for the exceedences are not obvious but are being monitored via the monitoring programme and site visits.

Table 2: Dissolved copper and zinc exceedences in monthly water quality monitoring

Year	Ōtūkaikino Creek at the Groynes Inlet		Ōtūkaikino Creek at the Scout Camp		Wilsons Drain	
	Dissolved Copper exceeds 0.00152 mg/L	Dissolved Zinc exceeds 0.00868 mg/L	Dissolved Copper exceeds 0.00152 mg/L	Dissolved Zinc exceeds 0.00868 mg/L	Dissolved Copper exceeds 0.00152 mg/L	Dissolved Zinc exceeds 0.00868 mg/L
2008	0 (only 3 months sampled)	0	ns	ns	ns	ns
2009	0	0	ns	ns	ns	ns
2010	0	0	ns	ns	ns	ns
2011	0	0	ns	ns	ns	ns
2012	1	1	ns	ns	ns	ns
2013	0	1	ns	ns	0	0 (only 3 months sampled)
2014	0	1	0	1 (only 3 months sampled)	0	1
2015	1	1	0	3	0	3
2016	0	1	0	1	0	0
2017	2	0	1	2	0	0
2018	0	0	0	0	0	0
2019	2	0	0	0	0	0
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0

ns = no sampling

6.3. Sediment Quality

Streambed sediments can demonstrate the effects of stormwater discharges if contaminants such as metals and persistent organics accumulate. Accumulated contaminants can adversely affect stream biota.

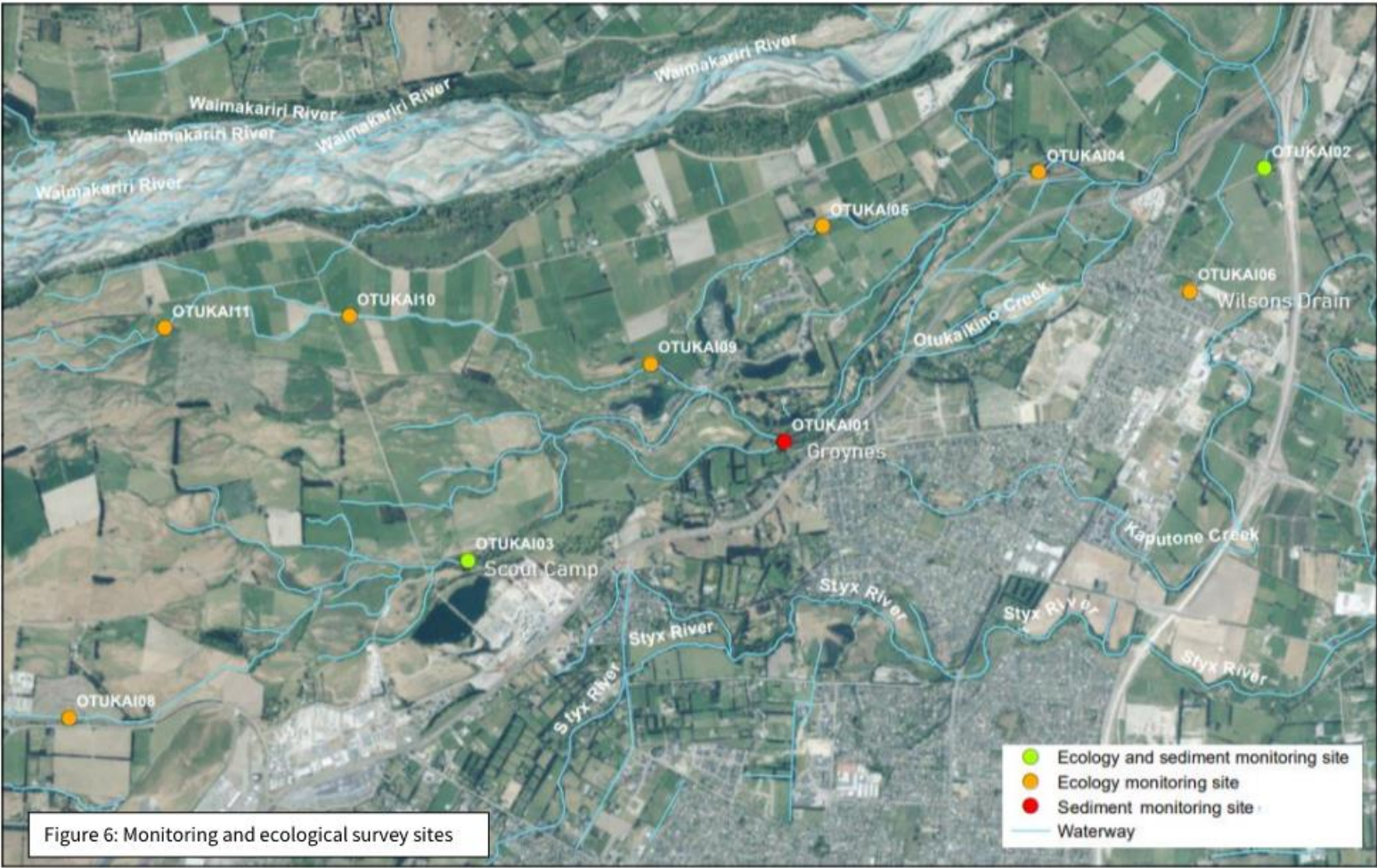
Bed sediments were sampled for grain size, metals, organic carbon, phosphorus and PAHs (Boffa Miskell, 2022). Wilsons Drain at Main North Road had the highest proportion (68.9%) of silt/clay (<0.063mm), out of all three sediment monitoring sites. Ōtūkaikino Creek at The Groynes inlet also had a relatively high proportion (44.7%) of silt/clay substrata.

Metal contaminants are usually found in higher concentrations in sediment samples with the higher silt and clay contents (i.e., substrata <0.063 mm in size), as the greater surface area of smaller particles increases the amount of metal adsorbed. With the exception of OTUKAI02 (Wilsons Drain), total recoverable copper, lead, and zinc for all sites were below the LWRP guidelines and the ISQG-high and ISQG-low of the ANZECC (2000) sediment quality guidelines. The concentration of zinc in the streambed material at OTUKAI02 was above the LWRP guideline, but below ISQG-low ANZECC (2000) sediment quality guideline. Where the sediment concentration is below the ISQG-low, it is considered that there is low risk of adverse effects to aquatic life. The concentrations of zinc at OTUKAI02 was markedly greater (approx. at least 9 times greater) than that recorded in 2019.

Total phosphorus (TP) and Total organic carbon (TOC) concentrations ranged from 290 to 1413 mg / kg TP, and 0.22 to 7.4 g / 100 g TOC. The highest concentration of both TP was recorded at OTUKAI02 (Wilsons Drain), indicating this site (and possibly others) may be impacted by fertilisers. Contaminants such as fertilisers, pesticides, and industrial chemicals can cause elevated TOC concentrations. TOC was highest at OTUKAI01 (The Groynes Inlet). Canopy cover and overhanging vegetation was also high at this site, which could have influenced the TOC concentration.

There are no listed ANZECC (2000) guidelines for TP or TOC. However, the levels measured in the three sites surveyed were similar to levels detected in other catchments within the Christchurch City limits (e.g., InStream Consulting Ltd, 2019, 2020).

Total PAHs of all sites, normalised to 1% TOC (as recommended in ANZECC 2000), were well below the ISQG-high and ISQG-low guidelines of the ANZECC (2000) sediment quality guidelines. The highest recorded PAH concentration was at OTUKAI02 (Wilsons Drain at Main North Road).



6.4. Aquatic Ecology

Aquatic ecology surveys are carried out at five year intervals at the nine sites in the Otukaikino Stream and tributaries (

). Riparian and in-stream habitat conditions, sediment contaminant concentrations, and the macroinvertebrate and fish communities were last surveyed in March 2022. Monitoring data from nine sites in the Ōtūkaikino River Catchment showed that riparian habitat conditions were similar to previous years at most sites. OTUKAI04 (Ōtūkaikino upstream of Dickey's Rd) and OTUKAI10 (Ōtūkaikino at Coutts Is. Rd) have improved riparian margins, where riparian planting of indigenous vegetation has taken place. The greatest regression in riparian conditions was observed at OTUKAI09 (Clearwater Resort) and OTUKAI11 (Ōtūkaikino Headwaters) where margins had become dominated by sprayed grass and grey willow, respectively. All other sites were typically buffered by mown or pasture grasses.

In-stream habitat conditions at all sites had generally worsened compared to previous years. Sites were typically wider, deeper, and slower than previous years, with a significantly higher cover of fine sediments. Changes to substrate index score, embeddedness, sediment depth, and sediment cover from previous years to this survey (2022) all indicate an increased presence of finer substrates, like sand and silt. Site OTUKAI08 was the exception, where the stream bed remained dominated by cobble and gravel substrates but still showed an increase in sediment cover and depth. Only one site, OTUKAI08 (Ōtūkaikino at McLeans Is.), met the CSNDC attribute target level for maximum fine sediment cover. Moreover, macrophyte cover has increased at most sites, where four sites exceeded the CSNDC attribute target level for maximum macrophyte cover. Excess macrophyte growth can reduce velocity, catch suspended sediments and reduce availability of coarser substrates. The increased presence of fine sediment and macrophyte cover in the catchments means coarser substrates, like cobbles, are less available to aquatic biota (for grazing, egg laying, using as refugia).

Mats of the toxic cyanobacteria, *Phormidium*, were found at sites OTUKAI05 (Kaikanui Creek), OTUKAI08 (McLeans Is. Rd), OTUKAI09 (Clearwater Resort), and OTUKAI10 (Coutts Is. Rd) ranging from 1% to 18% cover. Toxic cyanobacteria were not noted in either the 2012, 2017 or 2021 surveys. The presence of toxic algae is of concern to the recreational value of the stream as it can pose a risk to human and animal health. Blooms can be associated with higher water temperatures and elevated nutrient levels.

The basic water quality parameters of conductivity, pH, and water temperature were within ranges expected in spring-fed urban environments during base-flow conditions. Measurements were similar to previous years and met the LWRP guideline value. Dissolved oxygen (DO) levels were low at 8 of the 11 sites, not meeting the LWRP guideline value of 70% or greater saturation on the day of the survey. However, the streams are groundwater-fed, and groundwater can have low DO. DO can vary diurnally and seasonally, and macrophyte and algal abundances at a site can greatly influence DO concentrations, thus the increased cover of macrophytes at sites could explain some the lower saturation. DO measured in monthly water quality monitoring mostly exceeds 80% saturation. The presence of taxa sensitive to oxygen levels, such as kēkēwai (freshwater crayfish) and trout may indicate that dissolved oxygen saturation in the catchments is generally acceptable.

Macroinvertebrates are an important and commonly used measure of stream or ecosystem health. Invertebrate community composition in 2022 was similar to previous years, being dominated by pollution-tolerant snails and the stony-cased caddisflies *Pycnocentria evecta*, *Pycnocentroides aureulus*.

All five-yearly monitoring sites, except OTUKAI04, OTUKAI05, OTUKAI09, and OTUKAI10 were below the LWRP guideline of a minimum MCI of 90, or minimum QMCI of 5. The ASPM guideline values were exceeded at most five-yearly monitoring sites, except OTUKAI11, OTUKAI02, and OTUKAI06. Similarly, none of the annual monitoring sites met the NPS-FM national bottom line and consent target value, respectively, while the ASPM guideline was exceeded at all sites.

Indigenous fish species were present at all 11 sites within the Ōtūkaikino River and Cashmere Stream catchments. Most importantly, six sites, supported longfin eels, an “At Risk, Declining” species. The presence of elvers (juvenile eels, either longfin or shortfin) (Table 3) at most sites is encouraging and can be a good sign for population recruitment and persistence. Inanga, another “At Risk, Declining” species was also found in the Cashmere Stream Catchment (HEATH28). Inanga may have been present at other sites; however, inanga can be underestimated using electric fishing techniques (Joy et al. 2013). Of the sites that were comparable between years, there was no overall trend in community composition over time.

6.5. Comparison to consent attribute target levels

The CCC's CSNDC has attribute target levels for sediment concentrations of copper, lead, zinc, and total PAHs, fine sediment cover, total macrophyte cover, long filamentous algae cover, and QMCI scores.

Consent targets for sediment copper, lead, zinc, and total PAHs have been mostly compliant in the 2017 and 2022 monitoring years with only zinc exceeding the consent target at one site (OTUKAI03, Wilsons Drain at Main Road) in 2022. Fine sediment cover was within the guidelines at most sites in 2017, however in 2022 all but one site (OTUKAI08, McLeans Is.) exceeded the consent target of a maximum of 20% fine sediment cover.

Consent targets for long filamentous algae cover have been met at all sites sampled over the past 10 years. Compliance with QMCI scores has decreased over time, with 88.8% of sites complying with the QMCI target of 5 or greater in 2017, and only 36% of sites complied in 2022.

The basic water-quality parameters of pH, dissolved oxygen, conductivity and temperature were within ranges expected in spring-fed plains waterways during base-flow conditions. In-stream and riparian conditions, although variable among sites, were generally good with high substrate indices (indicating stream-bed substrates dominated by cobbles). Shading was present at most sites, and there was a diversity of in-stream habitat, with little channel modification at most sites. Macrophytes were present at all sites, however total cover was low and filamentous algae were rare.

The full *Ōtūkaikino and Cashmere Monitoring 2022, Five-Yearly and Annual Aquatic Ecology Monitoring Report* can be found at https://ccc.govt.nz/assets/Documents/Environment/Water/Monitoring-Reports/2022-reports/Otukaikino_Ecology_monitoring_2022.pdf

Table 3: Total numbers of fish caught or seen at the nine sites surveyed in 2022.

Site ID	Site name	Fishing method	Common bully	Upland bully	Unidentified Bully spp.	Inanga	Longfin eel	Shortfin eel	Unidentified Eel species	Elver	Brown trout
OTUKAI02	Wilsons Drain, Main North Rd	Traps	0	0	2 (36-38)	0	4 (450-700)	0	0	0	0
OTUKAI03	Ōtūkaikino Ck, Scout Camp	EFM	0	25 (20-60)	16 (20-30)	0	0	7 (150-350)	0	5 (100-120)	1 (80)
OTUKAI04	Ōtūkaikino u/s Dickey's Rd	Traps	4 (53-100)	0	2 (34)	0	4 (560-1010)	0	0	0	0
OTUKAI05	Kaikanui Ck d/s Clearwater Resort	EFM	0	1 (56)	0	0	4 (300-1020)	11 (170-360)	5 (80-500)	7 (65-120)	0
OTUKAI06	Wilsons Drain, Tyrone St	EFM	0	0	9 (28-30)	0	0	7 (150-800)	1	1 (40)	0
OTUKAI08	Ōtūkaikino Ck, Mcleans Is	EFM	0	1 (68)	No information	0	0	28 (155-1000)	9	11 (110-150)	0
OTUKAI09	Ōtūkaikino Ck, Clearwater Res	EFM	4 (30-40)	11 (30-50)	1 (20)	0	6 (150-600)	6 (150-250)	0	2 (100-120)	0



Site ID	Site name	Fishing method	Common bully	Upland bully	Unidentified Bully spp.	Inanga	Longfin eel	Shortfin eel	Unidentified Eel species	Elver	Brown trout
OTUKAI10	Ōtūkaikino Ck, off Coutts Is Rd	EFM	0	19 (40-64)	3 (30)	0	0	3 (200-320)	1 (600)	1 (110)	2 (100-150)
OTUKAI11	Ōtūkaikino Ck headwaters	Traps	0	7 (64-114)	0	0	1 (1015)	0	0	0	0

Size ranges are shown in (). One value means minimum and maximum size were the same.

EFM = Electric fishing machine

Table 4: Conservation status of fish found in the survey (Dunn et al, 2017)

Common Name	Scientific Name	Conservation Status
Common bully	<i>Gobiomorphus cotidianus</i>	Not threatened
Upland Bully	<i>Gobiomorphus breviceps</i>	Not threatened
Inanga	<i>Galaxias maculatus</i>	At risk - declining
Longfin Eel	<i>Anguilla dieffenbachii</i>	At risk - declining
Shortfin Eel	<i>Anguilla australis</i>	Not threatened
Brown trout	<i>Salmo trutta</i>	Introduced and naturalised

6.6. Groundwater Quality

Groundwater quality has been considered with reference to nitrate N, electrical conductivity, bacterial indicators and metals.

6.6.1. Nitrate

Nitrate is present at relatively low concentrations, mostly below 1 mg N/L. Concentrations are consistent with seepage of very good quality alpine river water into the groundwater system.

6.6.2. Electrical conductivity

Electrical conductivity (EC) values are generally low, indicating fresh water that is not significantly influenced by high ionic concentrations. All but two of the bores tested for EC are less than 50m deep so it is difficult to assess any relationship between EC and depth. Three bores have sufficient data to assess recent trends in EC and the results indicate that EC has remained relatively stable in the groundwater since regular monitoring began in 2013.

6.6.3. Bacterial indicators

The available information on bacterial indicators (faecal coliforms and *E. Coli*) indicates that detections have increased in number since 2015, consistent with the much greater number of samples collected since that time. Detections have been recorded in the eastern half of the study area, as well as in the south in the zone with slightly higher EC and nitrate concentrations. There are only two results for bores with depths greater than 50m so it is not possible to assess the trend of bacterial indicators with depth.

7. Land Use

7.1. Present Situation

Ōtūkaikino Catchment land zonings include rural (RuW), rural urban fringe (RuUF), quarrying (RuQ), airport (SPA), heavy industrial (IH), golf resort (SPG), and open space (OCM, OCN, OCP, OCWM) as shown in Figure 7.

A substantial part of the catchment is zoned for low-intensity, open-space land uses (OCP, OWM, Ru, RuUF, SPG). Commercial development is continuing in the industrial and airport zones.

7.2. Development and Trends

Christchurch City's population is expected to grow by around 23,000 people between 2015 and 2025 and by a further 40,300 people between 2025 and 2046 (Price, 2014). In the 2015 to 2025 period household growth is expected to be 18,000 households.

Belfast South, Aidanfield, Travis Wetland and Wigram are the localities with the highest levels of growth, reflecting developing greenfield areas. Belfast South includes a developing Residential New Neighbourhood (RNN) zone between Johns Road and The Groyne.

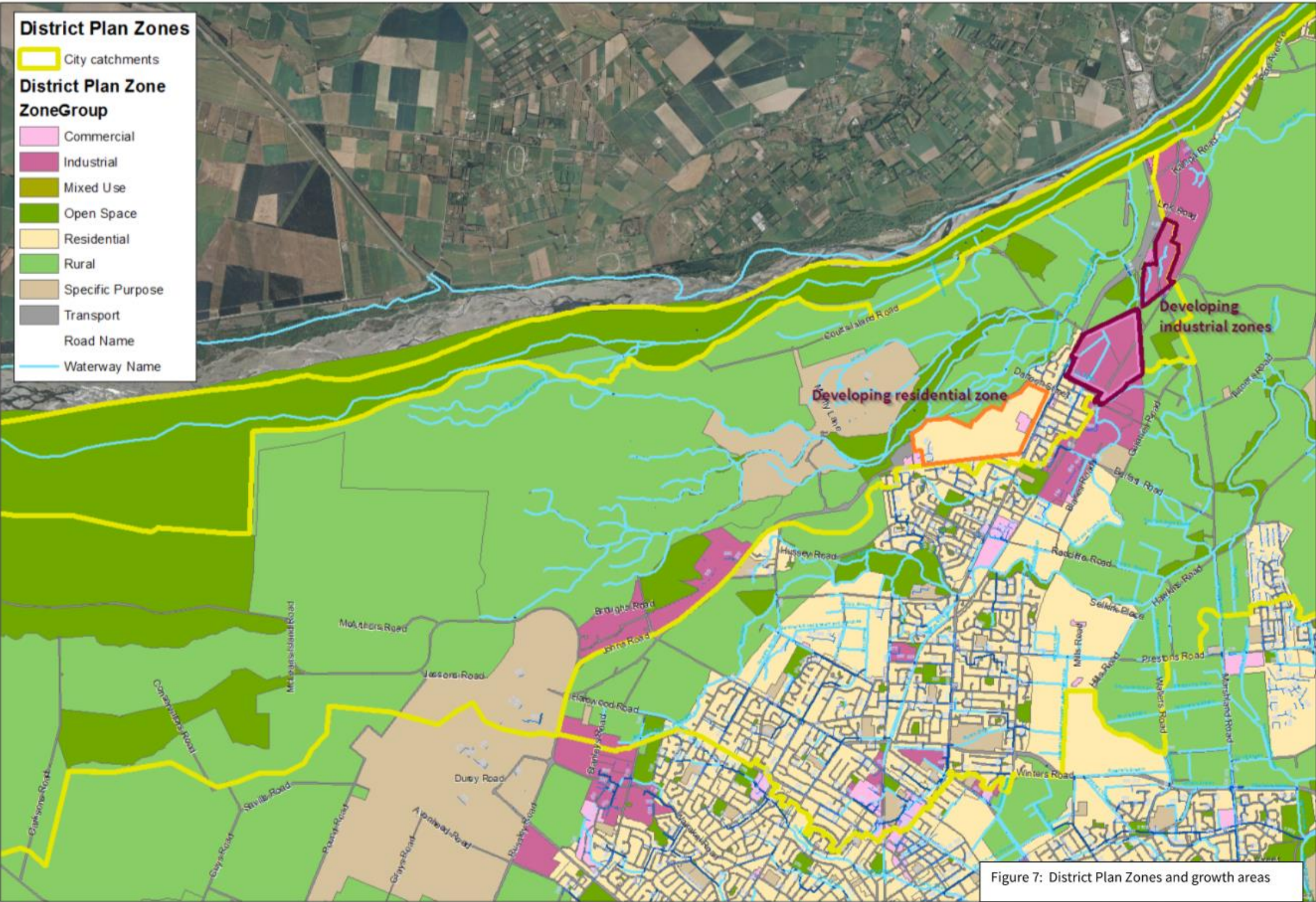
7.2.1. Residential Growth

The Applefields/Devondale site (93 Ha) north of Johns Road is zoned residential new neighbourhood (RNN) and is projected to gain 735 households by 2020 and 1,358 households by 2041 (TRIM 14/1085416). Stormwater mitigation measures for this development have been authorised by the Council under the Styx SMP Consent CNC131249. There are no other undeveloped residential areas in the catchment.

7.2.2. Industrial Growth

There are three developing industrial areas: an area north of Factory Road (approx. 74ha within catchment), an area east of Marshlands Rd/Main North Rd (approx. 25ha within catchment), and the Broughs Road/Logistics Drive area (approx. 92ha). The areas north of Belfast are recently zoned Industrial. The older heavy industrial zone north-west of Johns Road (Broughs/Logistics) has until recently had primary industrial uses such as container storage, saw milling, aggregate processing, concrete manufacture, and a significant proportion of vacant land. Development appears to be intensifying with more sites occupied and a tendency for increased site coverage.

Part of the Specific Purpose (Airport) (SPA) Zone contains the equivalent of heavy industrial activity. However approximately half of the SPA zone is expected to remain as grassy runout areas around runways.



7.3. Contaminated Sites and Stormwater

7.3.1. Background

Contaminants may be released from two types of sites:

- Sites with in-ground contaminants that may be entrained in stormwater, typically when soil is disturbed and
- Sites where on-site activities, usually industrial in nature, may release chemical or metal contaminants into stormwater (or into the ground).

The National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health Regulations (NES) help to identify potentially hazardous activities and industries which are listed in the Hazardous Activities and Industries List (HAIL), found at <http://www.mfe.govt.nz/land/hazardous-activities-and-industries-list-hail#hail-web>

Such sites are listed in a Listed Land Use Register when they become known to the Regional Council either through a consent application (to ECan or the CCC) or through investigations. Sampling, excavation, subdivision, removal of fuel storage tanks and changing land use on these sites may require a resource consent and remedial action.

7.3.2. Low Risk Sites

A Memorandum of Understanding (MoU) was agreed between the Council and ECan in July 2014 to allow stormwater discharges from low-risk residential rebuild sites listed on the LLUR and/or identified as having had HAIL activities to be processed by the Council rather than ECan. It is anticipated that as confidence grows over time in the operation of the MoU, the list of “low risk” situations that the Council can process will be extended. For example, sites on the LLUR, where only a portion of the site has had a hazardous activity and the construction will not disturb that part of the site, are considered low risk.

Parts of the Ōtūkaikino Catchment are listed on the LLUR because of old landfills, saw mills, timber treatment plants and orchards. Persistent chemicals may be associated with these sites, however they are generally at low risk of discharging contaminants into stormwater unless the sites are disturbed (e.g. during development). Many of these sites have been investigated as part of subdivision and site development and remediated as necessary.

7.3.3. Higher Risk Sites

“High risk” is generally a reference to sites with persistent or hazardous chemicals in the soil or in use on site. High-risk sites include contaminated sites and some industrial sites.

Many contaminants adhere to sediments and can be mobilised into surface or groundwater when soils are disturbed. These contaminants can be managed by using good sediment control during earthworks and taking care with where soil is disposed of. More specific measures, including on-site treatment, may be needed for more mobile contaminants that cannot be controlled by typical sediment control practices.

All land-use consent applications are checked against the LLUR. Where development is proposed on a site listed in the Listed Land Use Register the application is referred to the Council’s Environmental

Health Team. Conditions are attached to the resource consent to deal with short term and long term exposure of contaminants, often requiring site remediation.

7.3.4. Industrial Sites

Industrial sites will be managed in accordance with CRC214226 Conditions 47 and 48 in a process that will occur in parallel to SMPs. The Council will:

- Gather information about and develop a desktop-based identification of industrial sites, ranking sites for risk relative to stormwater discharge;
- Audit at least 15 (principally high-risk) sites per year;
- Inform audited industries of the results of audits and work closely with these industries to achieve outcomes in line with the Stormwater Bylaw;
- Communicate with industries about stormwater discharge standards and the means of meeting these standards.

The Council will be empowered to do these actions by the Stormwater and Land Drainage Bylaw 2022.

7.3.5. Historical Landfills

There are two known closed landfills in the catchment; at Orchard Road and Greywacke Road; shown in Figure 3. The composition of material at these sites is unknown.

The main risk factor for landfills from stormwater is the inundation of previously dry landfill by groundwater mounding associated with infiltration and detention basins. This can cause leaching of contaminants from the landfill into groundwater. The landfill near Greywacke Road is located next to a pond so the waste material may already be inundated.

The nature (size, depth and likely materials) of the closed landfills means that the risks to groundwater quality associated with groundwater mounding are likely to be low. It is not anticipated that large-scale infiltration basins will be installed near the old landfills. Some private infiltration basins and swales have been installed nearby under resource consents issued by Environment Canterbury.

7.3.6. Facilities Built Near Contaminated Sites

There may be soil contamination from farming activities (e.g. agricultural chemicals) and lead paint or asbestos associated with old buildings.

Table 14, Appendix C contains comments about the proximity of proposed mitigation facilities to sites where land contamination might be present.

8. Contaminants in Stormwater

8.1. Introduction

Urban activities cause environmental effects either by shedding more or faster stormwater runoff or by discharging contaminants into stormwater that are harmful to the environment. Most urban surfaces have some form of coating (e.g. paint or galvanising) and a transient layer of wind-blown dust, combustion products, cleaning compounds, etc. Most of these substances are soluble or slightly soluble in rainwater and are transported in dissolved and particulate form into the stormwater network.

8.2. Contaminants and Contaminant Sources

The Christchurch City Council and Environment Canterbury monitor rivers, streams and stormwater for a range of water quality indicators. These include total suspended solids (TSS) (dust, sediment, grit, and particles of all types), heavy metals, a range of hydrocarbons, bacteria and dissolved oxygen among other indicators. From time to time the Council samples for newly discovered (“emerging”) contaminants, and both councils are aware of the likelihood that there are other unknown, harmful substances in stormwater.

The Council’s monitoring programme is largely based on the Land and Water Regional Plan’s

- Schedule 5 Table S5A and Table S5B Indicators and Toxicants, and
- Schedule 8 Region-wide Water Quality Limits

Contaminants of most concern in the Christchurch District are:

- Dust, sediment, grit and particles of all types capable of being transported in stormwater, referred to as total suspended solids (TSS). TSS include metal particles, aggregates of metallic compounds, and charged (e.g. clay) particles with attached metal ions.
- Dissolved and particulate zinc
- Dissolved and particulate copper
- Polycyclic aromatic hydrocarbons (PAHs)
- Pathogens
- Nutrients (mostly phosphorus)

Lesser contaminants, which generally do not exceed guidelines, are:

- Hydrocarbons (oil and grease)
- Cadmium and lead

8.3. Suspended Solids

Particle sources include streambank erosion, animal waste, construction activity, land cultivation, combustion, industrial products, tyre and brake wear and paint coating breakdown. Some particles are natural materials and some are artificial (e.g. paint chips). Soil particles contain metals and may carry adsorbed chemicals.

Suspended solids are damaging because they deposit on stream beds and fill the spaces between stones, greatly reducing the refuge options for instream life. Fine particles can release attached toxic compounds which harm the food chain.

The most important sources of particles in waterways in this catchment are likely to be:

- Ōtūkaikino Creek; stock access to and into waterways
- Wilsons Stream; road runoff - a combination of road surface wear and vehicle emissions.

8.4. Zinc

Zinc is used as a protective coating for steel on corrugated iron roofs, rooftop ventilators, chain link fencing, lighting poles and various barriers and fences. Although a zinc layer is long-lived it is slowly being dissolved by rain water. Industrial and farm buildings often have unpainted galvanised roofs and can be large sources of zinc. Residential areas typically have painted or tile roofs, but many of these have older paint coatings in poor condition and can be a significant source of zinc.

Roofs create approximately 75% of urban zinc. Roads create approximately 25%, much of which is from tyres. Zinc makes up about 0.8% by weight of tyres in which zinc oxide is a vulcanising catalyst. Zinc released onto roads is very fine and dissolves and is transported readily in stormwater.

Other zinc sources include galvanised fencing and posts, fungicides, paint pigments and wood preservatives.

Many sources such as Timperley et al (2005) report that tyre-derived zinc is transported onto other surfaces, including roofs, by wind. Stormwater sampling in Christchurch supports this, showing zinc runoff from nominally zinc-free surfaces such as concrete tile roofs.

8.4.1. Copper

Dissolved copper has been found above consent target levels in monthly water sampling in the Ōtūkaikino Creek. The reason for the exceedance is not known and no potential sources have yet been identified, although the Council is investigating.

The predominant copper source in urban stormwater is thought to be vehicle brake pad wear. Copper could be expected to exceed guidelines in Wilsons Stream during some rainfalls.

8.4.2. Polynuclear aromatic hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are created when products like coal, oil, gas, and garbage are incompletely burned. PAHs are a concern because they do not break down very easily and can stay in the environment for long periods of time. PAHs may come from coal tar sealants and diesel or industrial combustion.

8.4.3. Pathogens

Monthly water quality monitoring measures the numbers of EColi as an indicator bacterium for the presence of faecal pathogens. Bacteria are most concerning if they are from human sources, representing a risk of communicable diseases. EColi counts are usually caused by waterfowl (ESR, 2015). Potential sources in this catchment could include farm animals and dogs.

Ōtūkaikino Creek

EColi counts mostly do not exceed safe levels for contact recreation (550 counts/100 ml). There were pathogen exceedances in monthly sampling in 2020 (one), 2018 (two), 2014 (one), 2013 (one), 2012 (one) and 2011 (two).

Wilsons Stream

There have been several pathogen exceedances annually in monthly sampling since 2017.

8.4.4. Nutrients

International research indicates that important nutrient sources include decaying leaves, sediment, fertiliser and bird and animal faeces. Nutrients can lead to excessive aquatic plant growth.

Ōtūkaikino Creek

Phosphorus in Ōtūkaikino Creek exceeds the LWRP guideline (0.016 mg/L) less than once per year in monthly sampling since 2009. It regularly exceeded for a period during 2008-9 which may indicate an anthropogenic source; possibly fertiliser or animal dung. Nitrogen very seldom exceeds the LWRP guideline (DIN < 1.5 mg/l).

Wilsons Stream

Phosphorus is generally near or above the LWRP guideline and nitrogen generally exceeds the LWRP guideline.

8.4.5. Contaminant sources

Table 5: Catchment-specific contaminant sources into Ōtūkaikino Creek

Contaminant	Source	Contribution	Possible Mitigation Methods
Sediment	Farm animals trample stream banks	Significant	Stock exclusion (fence waterways)
	Farm animals faeces dropped in-stream	Unknown	Stock exclusion (fence waterways)
	Construction sites	Unknown, possibly mitigated	Sediment & erosion controls
	Road works	Low	Sediment controls
	Atmospheric deposition	Low	Riparian tree cover
	Plants (leaves, etc)	Low (seasonal)	None
	Vehicle emissions	Low	Treat road runoff
	Visitor activity (stream access)	Medium	Signage
Zinc	Bare galvanised roofs	Relatively few galv. roofs discharging to waterways in this catchment. (High city-wide.)	Replace with: Non-metal roofs or Pre-coated Zn-Al Paint with: Low zinc paint
	Ageing painted roofs	High city-wide. Could be an issue as new pre-coated roofs age.	Replace with: Non-metal roofs or Pre-coated Zn-Al Paint with: Low zinc paint

Contaminant	Source	Contribution	Possible Mitigation Methods
	Bare Zn-Al ¹ roofs	High city-wide. Moderate in this catchment where industrial roofs discharge into the ground.	Replace with: Non-metal roofs or Pre-coated Zn-Al Paint with: Low zinc paint
	Vehicle tyres	High city-wide. Most road runoff into ground in this catchment	Treat runoff from: Busiest roads Car parks Manoeuvring areas
	Industrial discharges (inferred from monitoring)	Medium	Controls on industrial sites
Copper	Brake pads	High city-wide. Most road runoff into ground in this catchment	Legislation bans copper in brake pads
	Roofs, cladding, spouting, downpipes	Low but increasing	Ban on copper cladding
Lead	Paint flakes/chips from old buildings	Unknown but more likely to contaminate soil than water	Site remediation during development
Waterfowl sourced bacteria	Ducks, geese	Major bacteria source	Not stormwater related. Not covered by this Plan
Industrial discharges	Deliberate spills or poorly controlled sites	Unknown	Regulation, monitoring and enforcement
Polynuclear aromatic hydrocarbons	(Old) coal tar street surfaces. Combustion	Unknown. Likely low	Encapsulation. Removal. Monitor
Nitrate and nitrite	Groundwater Fertiliser	Moderate Believed low	Beyond CCC control Education
Phosphate	Industrial sources Fertiliser Leaves	Moderate Believed to be a minor source unknown	Education, enforcement Education

¹ Zinc-aluminium coated steel. Has commonly replaced galvanised iron since 1994.

9. Flood Hazards

9.1. History

The threat to Christchurch City from the Waimakariri River was understood early in the period of European settlement. In 1860, Samuel Butler described early attempts to tame the river, noting that the river could easily move from its current position and flow through Christchurch. The period between the 1860s and the 1960s has been described by Logan as “The Hundred Years War” which was “to make the Waimakariri go, not where it wanted, but where the engineers dictated” (Logan, 1980). Work in the late 1800s was successful in keeping floods out of Christchurch, and the objective at the time was protection of land on the southern side of the River. It wasn’t until the Waimakariri River Improvement Act of 1992 that official efforts became focused on protecting both sides of the River.

Significant advancements in the level of protection were achieved in the late 1920s with the Eyre River Diversion; early 1930s with stopbanks on the south branch from Halkett to Harewood, and cutting-off the South Branch by the construction of Crossbank (across the South Branch to the east of McLeans Island). However, two large floods in the 1950s which resulted in river breakouts and flooding of adjoining land led to a major scheme review and a works programme commencing in the 1960s, at an estimated cost of £1.6million.

Figure 8 represents the river before the current flood control scheme with North and South Branches flanking Coutts Island.

Figure 9 is an outline of the 1960 flood control scheme.

The 1960s scheme – eventually completed in the early 1980s – resulted in a continuous line of primary stopbanks from the mouth of the Waimakariri River to the west of McLeans Island. Further upstream from this point, the river (is) naturally constrained by topography with assistance from the construction of some spur groynes (Sweeny 2016).

Works described above created a separate Waimakariri River South Branch. Its name was changed to Ōtūkaikino Creek in 1987 by the NZ Geographic Board.

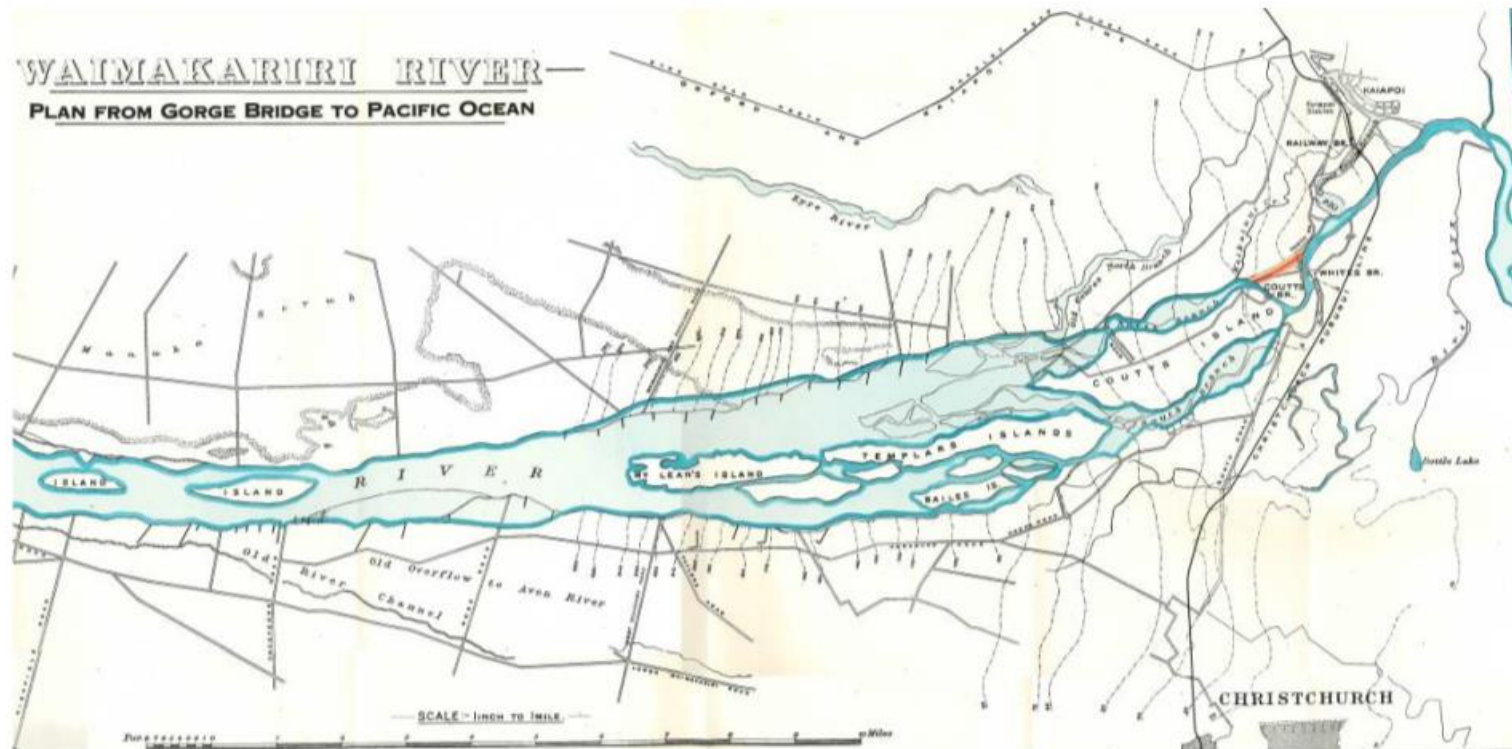


Figure 8: Waimakariri River (G Nelson 1928)

9.2. Stopbanks - Environment Canterbury

“The existing Waimakariri River primary stopbanks have hydraulic capacity to contain up to a 500 year return period flood (4,730 cumecs) with freeboard, however there is a significant risk of stopbank breach during (various) flood events due to the very high energy of the floodwaters, significant bed material movement, and the risk of an altered river course and/or berm erosion.

A risk assessment determined that there is some risk of stopbank breach during a 100-year flood (4,000 cumecs), as occurred at Coutts Island in 1957 (3,900 cumec peak flow). This risk increases with the size of flood, and ... on antecedent flood events, so a failure is almost certain somewhere (probably on the Christchurch rather than the Kaiapoi side) for a 500-year flood.

The secondary stopbanking system has been designed to capture the primary stopbank breach flows and return them to the river at two points; water flowing from breaches in the Halkett area would be directed back into the river at Miners Road, and water flowing from breaches in the McLeans or Coutts Island area would be returned at the Ōtūkaikino Creek outlet, just upstream of the Motorway Bridge. The design breach flow for the Halkett breach is 1,000 cumecs, and for the McLeans/Coutts Island (the design) breach (flow) is 2,000 cumecs. These are the expected breach flows in the event of a very large 6,500 cumec flood (of estimated 10,000 year return period).” (Ian Heslop, ECan, 2015)

The secondary stopbanking system is indicated in Figure 10.

9.3. Should the Christchurch City Council Manage Flooding in the Creek?

Residential and industrial land south and east of Ōtūkaikino Creek is on an elevated terrace. This land has adequate drainage to the creek and is above the level of flooding in the creek. A secondary stopbank constructed by Environment Canterbury (see Figure 10) exists to contain breakout flow from the Waimakariri River if the primary stopbanks are breached near McLeans or Coutts Islands.

Flows from existing and new development will not affect water levels in the creek sufficiently to influence other developed land. The Council does not need to manage flooding in the Ōtūkaikino Creek.

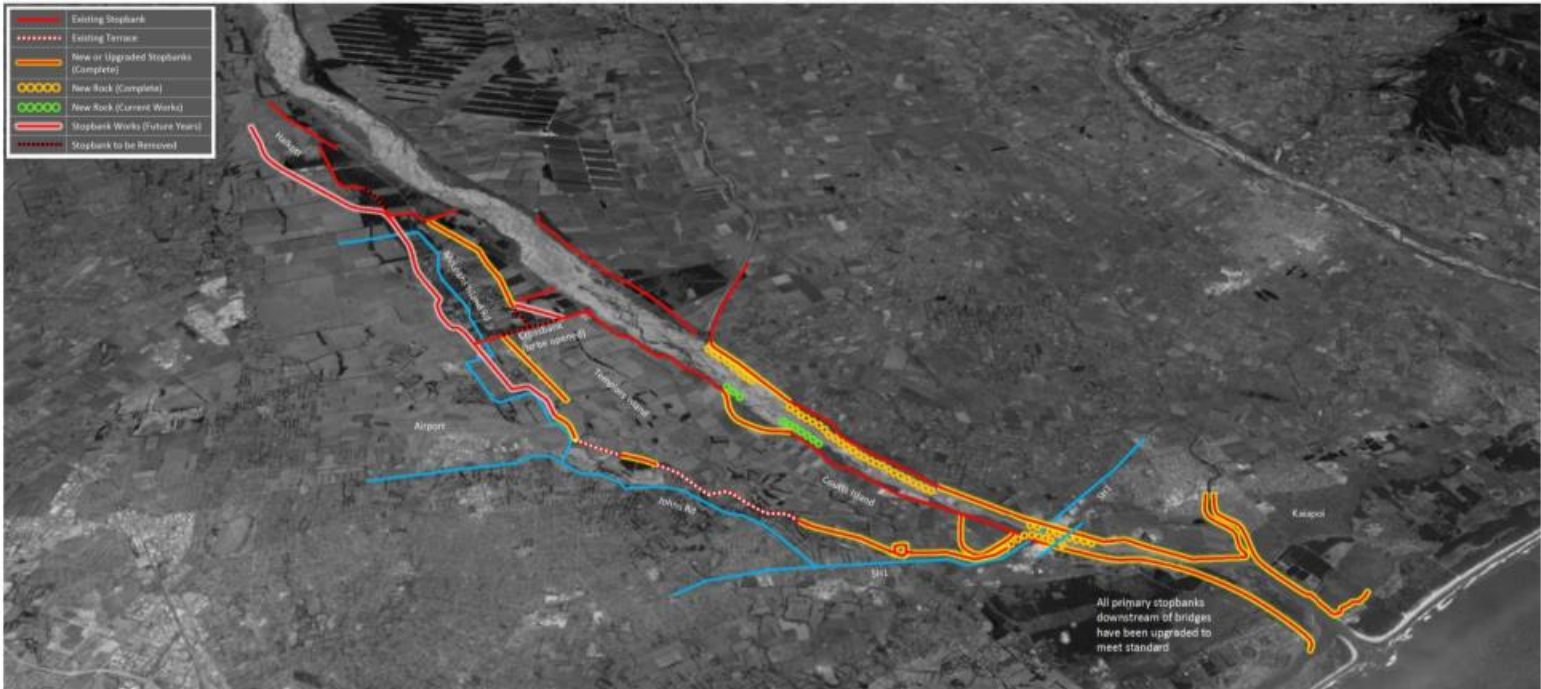


Figure 10: Waimakariri River Scheme, Primary and Secondary Stopbanks

Section Three Objectives and Principles

10. Developing a Water Quality Approach

10.1. Introduction

The Ōtūkaikino Creek has the highest water quality and ecological values of any Christchurch waterway. Due to its location and character it is highly valued by Ngāi Tahu. Changes in the catchment, apparently mostly in the rural area, have led to a decline in ecological values. The Council is unable to significantly influence activities on rural land owned by others but would like to maintain the values in this waterway through managing urban activities.

Mitigation options have been considered for contaminants that are considered harmful or exceed water quality targets. Commonly detected contaminants that can be mitigated through the SMP are:

- Sediment (as consent conditions require control by specified means)
- Copper and zinc
- Industrial discharges containing oils, cleaning compounds, nitrates/nitrites, chemicals, etc (section 11.4)

Metals typically exceed water quality targets for relatively short periods during and after rainfall. It is believed that they affect ecosystem health but the relationship between concentrations, durations and effects has yet to be quantified.

10.2. Contaminant model

A contaminant load model (CLM) for this catchment was developed by DHI and Dr Tom Cochrane (University of Canterbury). The model combines MEDUSA² Version 2.0 and a published rural sediment yields (NIWA³). MEDUSA is an event-based pollutant load process model used to predict amount of TSS, Cu and Zn contributed by an individual impermeable surface during a rain event. Predictions are based the surface area, material type, average rainfall intensity, pH, rainfall duration, and length of antecedent dry period (Charters et al. 2020).

The Ōtūkaikino CLM estimates the annual load of three contaminants, total suspended solids (TSS), copper and zinc for each of the 23 sub-catchments. Subcatchments are mapped in Appendix B Figure 13 (overview) and Figure 11 (which has finer detail of subcatchments with treatment). Rates of contaminant discharge are based on sampling of stormwater discharged from Christchurch roofs, roads and car parks. Contaminant loads were modelled for three scenarios:

- Estimated contaminant load in the reference year, which is 2018, the year in which the consent was initially granted.
- Estimated contaminant load in the seven urban sub-catchments that discharge to surface water after full development. Six sub-catchments are zoned for ongoing/future development, and one other is already fully developed.
- Estimated contaminant load in the seven fully developed sub-catchments after treatment in planned facilities.

Annual contaminant loads for the three scenarios are tabled in Appendix E.

² Modelled Estimates of Discharges for Urban Stormwater Assessments

³ National Institute of Water and Atmosphere

Modelled mitigation facilities are civic scale detention basins and wetlands first planned under the Styx SMP 2012 and updated in this SMP – see Figure 11. Planned facilities will mitigate future growth and also treat stormwater from untreated, existing development. Stormwater from some parts of the catchment (e.g. the airport and Greywacke Road industrial area) is treated in private devices and discharged into ground soakage.

The model estimates treatment efficiency (contaminant removal) as a percentage of estimated total annual contaminant load. Treatment efficiencies are tabled in Appendix D, based on findings from international research. Treatment efficiencies indicate that facilities are typically effective in removing particles (TSS) but are estimated to remove a low to moderate percentage of dissolved metals which form a significant part of the contaminant stream from roofs and roads.

The model was run for three further scenarios to test potential source controls:

1. All new industrial roofs are painted.
2. All roof runoff from new industrial roofs is treated at the downpipe.
3. All roof runoff from residential and industrial areas is treated at the downpipe,

10.3. Contaminant Model Results

All sub-catchments were modelled, with model results reported in Appendix E. This section discusses seven urban sub-catchments discharging to surface water, six sub-catchments in which there will be significant residential and/or industrial development, and one developed residential sub-catchment that will be treated in a proposed treatment facility. The remaining sub-catchments are rural or discharge into the ground after treatment.

For the seven mitigated sub-catchments (Applefields, Blue Skies, Chaney's East, Chaney's West, JRH, Rushmore and Wilson's Drain) in total, modelling indicates that after full development and with quality treatment through basins and wetlands:


1. TSS is estimated to reduce from 7,400 (present day) to 2,300 kg/yr.
2. Copper is estimated to reduce from 3.4 (present day) to 2.9 kg/yr.
3. Zinc is not able to be fully mitigated and will increase from 79 (present day) to 121 kg/yr.

Model outcomes for copper and zinc reflect rather conservative removal efficiencies used in the CLM. Wet weather monitoring of Knights, Prestons, Curletts and Wigram basins in 2020/21 indicate that higher removal efficiencies may be possible.

The model was run for three further scenarios representing possible additional mitigation:

4. All new industrial roofs are painted. (In the earlier model runs it was assumed that 50% of industrial roofs are painted and 50% are bare zinc/aluminium, as observed in Hornby.)
5. All roof runoff from new industrial roofs is treated at the downpipe.
6. All roof runoff from residential and industrial areas is treated at the downpipe.

Results from the six model runs are summarised in Table 6.



It is assumed that the amounts of contaminants discharged into surface water from other sub-catchments will not change. Those other sub-catchments are either mostly rural, or discharge their stormwater into the ground after treatment.

Table 6: CLM results for seven sub-catchments with treatment basins; Applefields, Blue Skies, Chaneys East, Chaneys West, JRH, Rushmore and Wilsons Drain South.

	TSS (kg/yr)	Copper (kg/yr)	Zinc (kg/yr)
Base (2018) scenario	7,420	3.4	79
Unmitigated full development	25,900	12.4	286
Full development mitigated with basins and wetlands	2,293	3.3	167
Full development mitigated with basins and wetlands. And all industrial roofs painted. And possible 20% reduction from low-copper brake pads ⁴ over time (for information only).	2,277	2.9	121
Full development mitigated with basins and wetlands. (50% of industrial roofs painted – status quo). And all industrial roof runoff treated at the downpipe ⁵ . And possible 20% reduction from low-copper brake pads over time (for information only).	2,157	2.7	104
Full development mitigated with basins and wetlands. (50% of industrial roofs painted – status quo). And all industrial and residential roof runoff treated at the downpipe. And possible 20% reduction from low-copper brake pads over time (for information only).	2,078	2.5	58

⁴ Low copper brake pads are assumed to become increasingly accepted over time.

⁵ "Treated at the downpipe" by passing roof runoff through a proprietary filter.

Sampling indicates that copper and zinc readily dissolve into stormwater from particles abraded from tyres and brake pads. Road particles are transported onto various surfaces by wind. Dissolved copper and zinc cannot be completely captured by roof treatment or basins and wetlands. Treatment on-site at the downpipe is beneficial.

10.4. Lessons from monitoring of treatment basins

Wet weather monitoring of treatment facilities has produced encouraging results from its first year. Facilities being monitored are first-flush basins followed by a wetland, which are the default large treatment system. Treatment efficiencies obtained from 2020/21 wet weather monitoring of Curletts, Wigram, Prestons and Knights Stream facilities (PDP, 2021 and NIWA, 2022), indicate the potential for a high percentage of TSS and metals removal. Monitoring will be ongoing. A comment on previous monitoring is made in a memorandum titled *Inferences from Performance of Treatment Basins 1993-2020* (TRIM 22/490757).

The Council is not confident to adopt these limited data for modelling. Conservative treatment efficiencies taken from the Christchurch Contaminant Load Model (Golder, 2018) have been used in the Ōtūkaikino contaminant load model. These treatment efficiencies were sourced from WWDG guidelines, Auckland Regional Council guidelines, and international research.

10.5. Role of Monitoring and Tangata Whenua Values in Setting Targets

10.5.1. Environmental Drivers

Waterways in the rural part of the catchment are in good condition. Monitoring indicates that Wilsons Drain, out of Belfast, is more likely to exceed contaminant targets than Ōtūkaikino Creek, probably due to contaminant discharges associated with urban development. This information influenced the decision to treat existing development in the older part of Belfast.

10.5.2. Maahanui Iwi Management Plan Objectives

This plan recognises and is intended to help support the policies and objectives for water and the environment in the Ihūtai Catchment, from the Maahanui Iwi Management Plan 2013 as detailed in Table 7.

Table 7: Response to the Maahanui Iwi Management Plan

Iwi Management Plan	Ōtūkaikino SMP response
Policy WAI1.1 To require the elimination of all industrial, stormwater and agricultural discharges into the Waimakariri as a matter of priority. The river must be able to be used for mahinga kai and recreation without concerns for human health.	The SMP can contribute toward Policy WAI1.1 by treating almost all stormwater to reduce the amount of non-point source pollution.
Policy WAI2.1 To consistently and effectively advocate for a change in perception and treatment of lowland waterways in the	The SMP can be consistent with this policy.

Iwi Management Plan	Ōtūkaikino SMP response
catchment: from public utility and unlimited resource to wāhi taonga.	
<p>Policy WAI2.2 To require that the value of lowland waterways in the Waimakariri catchment as mahinga kai is protected and restored, including but not limited to:</p> <ul style="list-style-type: none"> (a) Management focused on mauri and mahinga kai; (b) Management according to Ki Uta Ki Tai, and therefore the maintenance of fish passage from source to sea; (c) Elimination of point and non point source pollution; (d) Protection of whitebait spawning areas (kōhanga), via rāhui; and (e) Provisions for the connections between waterways, wetlands and waipuna. 	<p>The SMP can contribute toward Policy WAI2.2(c) by treating most stormwater to reduce the amount of non-point source pollution. (Road runoff from Clearwater is attenuated through the ponds but is not otherwise treated at this time.) SMP activities do not affect (a), (b), (d) and (e).</p>
<p>Policy WAI2.6 To require that all wetlands and waipuna in the Waimakariri catchment are recognised and provided for as wāhi taonga, as per general policy on Wetland, waipuna and riparian margins.</p>	<p>Waipuna within #940 Main North Road are now in Council ownership and will be protected from development.</p>
<p>WAI3.3 To protect groundwater resources in the Waimakariri catchment from effects as a result of inappropriate or unsustainable land use and discharge to land activities.</p>	<p>The SMP proposes to monitor groundwater for effects from stormwater infiltration, and to improve pre-infiltration treatment if necessary.</p>

10.5.3. Cultural Impact Assessment – Position Statement

Mahaanui Kurataio is preparing a Position Statement which is Te Ngāi Tūāhuriri Rūnanga's designated means of providing a cultural impact assessment. The Position Statement will be submitted to Environment Canterbury when it is received.

10.6. Potential controls

Table 8: Potential contaminant controls

Contaminant	Source	Potential Control Option	Comment	How the controls could be implemented
TSS, copper, zinc	New subdivisions (large sites)	Facilities in new developments to limit increases in flow rate and capture TSS	Good mitigation for TSS; partial mitigation for dissolved metals	As conditions on subdivision, resource or building consents
TSS, copper, zinc	New development (small sites)	On-site (private) devices	Good mitigation for TSS; partial mitigation for dissolved metals	Included in Table 10: Minimum Requirements for Developed Sites
TSS, copper, zinc	Existing development	New stormwater treatment facilities	Good mitigation for TSS; partial mitigation for dissolved metals	CCC funding treatment for existing areas
TSS, copper, zinc	Existing development	Sump inserts (filter bags)	Uncertain effectiveness but about to be trialled in Christchurch (early 2023)	Filter bags deployed; target busy roads.
TSS (mostly sediment)	Construction & excavation sites	CCC implements and monitors on-site erosion and sediment control	Can be difficult to do and is often poorly managed on site	Effectuated through conditions on individual resource or building consents.
TSS (mostly sediment)	Road works	CCC requires, implements and monitors site erosion and sediment control	Many contractors do this already	Required as a condition of Road Opening (road works) Permits. Controls in Traffic & Parking Bylaw 2017.
TSS, copper, zinc	Vehicle traffic	Rain gardens, tree pits, and filters to treat runoff from busy roads.	Partial removal of zinc and copper.	Install treatment devices over time to treat stormwater from contaminated catchments.

Contaminant	Source	Potential Control Option	Comment	How the controls could be implemented
Road sweeping				
Copper	Vehicle brake pads	Educate residents about the value of low/no copper brake pads. Advocate with Government for legislation change	Legislation in USA is changing the brake pad market. Some low-Cu pads available in NZ. Copper content of brake pads anticipated to reduce from 2025 following USA legislation.	Copper-free brake pads becoming available by market forces. CCC educates local auto industry and residents.
Copper	Architectural copper (roofs, spouting, downpipes)	Transparent sealer applied to copper surfaces	May not be fully effective e.g. inside downpipes. Sealer must be maintained in good condition or copper will continue to discharge.	This is a current control effected through building consents.
Copper	Architectural copper (roofs, spouting, downpipes)	Investigate the feasibility of a District Plan rule to discourage the use of copper claddings.		By seeking legal advice about the practicability of such a Rule. Under way.
Copper, zinc	Roads, roofs	Divert first flush to the wastewater network	Limited capacity available in WW network	This option is one of a number of Schedule 4 (CSNDC Condition 40) investigations.
Zinc	Bare zinc-coated steel roofs (new)	All new roofs low zinc emitting or zinc free (non-steel)	Colorsteel® and equivalents is the most common new residential roofing.	
Zinc	Bare steel roofs (mostly industrial)	1. Educate and encourage use of pre-painted roofing 2. Potential District Plan rule to require roof runoff treatment on site.	Compact on-site devices available.	1. Educate and encourage use of pre-painted roofing 2. Investigate the feasibility of a District Plan rule to require roof runoff treatment on site. 3. Investigate the feasibility of a District Plan rule to

Contaminant	Source	Potential Control Option	Comment	How the controls could be implemented
		3. Potential District Plan rule to discourage the use of bare zinc roofing.		discourage the use of bare zinc roofing.
Zinc	Poorly maintained roofs	Education programme re roof maintenance. Possible incentives.	Old paint coatings expose zinc primer and zinc substrate. Can be half as bad as bare roof. Roof re-painting could cost 20-30% of the cost of re-roofing.	CCC to investigate the costs & benefits of painting v renewal v civic scale stormwater treatment. Under way.
Zinc	Vehicle tyre wear	Non-toxic alternative introduced by industry. Treat road runoff.	Treatment is partially effective. Overseas research may discover a less toxic alternative to zinc. No current alternative.	Install road runoff treatment devices. CCC will continue to engage with the government through MfE
Industrial waste and spills	Poorly controlled industrial sites	Surveillance, education, on-site improvements, enforcement	ECan & CCC Pollution Prevention Teams are working on this	CCC Industrial site audit teams visit, educate and enforce starting with high risk sites.
Pathogens (bacteria, etc)	Water fowl, livestock, dogs, wastewater overflows..	Reduce water fowl numbers, dog controls, WW overflow controls	Some dog and wastewater overflow controls in place.	Would need to be implemented outside the SMP. CCC not empowered by the consent to control waterfowl
Phosphorus	Rural and urban sources	Investigate sources. Education and enforcement		Education and enforcement used to control private/industrial sources.
Nitrogen	Probable agricultural sources (via groundwater)	Investigate sources. Education and enforcement		Use education and enforcement to control private/industrial sources.

10.7. Factors affecting option selection

Options considered are listed in Table 8.

In this catchment there is sufficient land available to construct basins and wetlands to treat existing as well as new areas. Basins and wetlands remove TSS effectively, although they are less effective against dissolved metals from roofs and roads. As TSS and metals are discharged in some measure from every impervious urban surface, basins can be useful controls if they treat extensive areas.

Contaminants (including metal contaminants) could be eliminated at source by substitution of non-contaminating materials. This could involve for example:

- Substitution of building materials or methods, which would probably involve additional costs to individuals and businesses. (Building materials substitution would have to be voluntary as the Council does not have powers to prohibit the use of normal building materials.)
- Substitution for zinc oxide in tyres, although no acceptable substitute has been found to date.

Contaminants could be reduced at or near source by, for example:

- Painting or repainting roofs,
- Treating roof runoff at the downpipe, e.g. in a modular canister-type filter.

The Council has been advised that its powers to require these forms of treatment are limited, and new legislation may be needed.

Street sweeping picks up litter, stones and sand but does not effectively remove fine particles containing the majority of metal contaminants (Depree, 2011). A street sweeping trial has occurred under Condition 7, Schedule 4 c. and the results may influence future options selection.

Sump inserts (filter bags) may be trialled subject to the results of trials in Hamilton, Hastings and Nelson. Sump inserts are known to effectively trap litter and stones but have variable effectiveness trapping fine contaminants.

Some contaminant discharges can be reduced voluntarily through education. The Council is developing an education programme through its Community Waterways Partnership. An education programme is expected to have effects in the long term, and to be more effective for some contaminants (e.g. domestic chemicals, dog poo) than others such as vehicle emissions.

Although mitigation at source should be more effective than treatment of stormwater there are significant barriers to implementing source controls. In the present day the government or local and regional authorities are likely to have to demonstrate that source controls effected by land owners are both necessary and the best practicable option. This could be difficult given significant gaps in our knowledge about the effects of short term contaminant discharges in stormwater.

More information, such as the long term costs and benefits of maintaining roof coatings, substituting roof materials or installing stormwater filters, would be required before the Council could consult on and select best practicable options. Work being carried out under CRC214226 Conditions 59 and 60 should provide better information. It is expected that additional work will be initiated through the proposed Surface Water Implementation Plan referred to in section 2.1.

10.8. Options in the SMP

Stormwater from new development is typically managed in detention basins which limit discharge increases and serve as treatment facilities. Some facilities can treat stormwater from new and existing developments. The seven sub-catchments that discharge to surface water will be treated. Newly developing industrial sites in the industrial area near the Roto Kohatu lakes will self-mitigate via on-site detention and infiltration basins.

Based on modelling, environmental drivers and tangata whenua values, and considering best practicable options, the first seven contaminant load reduction options below will be implemented in this catchment.

1. (As is normal in present day) all residential roofs are expected to be coated (i.e. painted) or non-steel.
2. Stormwater from the Applefields, Blue Skies, Chaney's East and West, JRH, Rushmore and Wilsons Drain South sub-catchments will be treated through first-flush basins and wetlands.
3. Stormwater generated from hardstanding areas within each industrial allotment to be pre-treated using an approved gross pollutant trap (GPT), vegetated swale or other proprietary pre-treatment device.
4. All new industrial roofs are required to be coated (painted).
5. Erosion and sediment control on development and construction sites, (Section 12 Goal 1.3).
6. Auditing high-risk industrial sites and working with occupiers to remediate contaminated stormwater discharges, (Section 12 Goal 4.2 to 4.4).
7. Working with community groups and the public to educate the community about the effects of and mitigation of stormwater contaminants, (Section 12 Goal 5.1).

The remaining options have been considered for implementation through the SMP in addition to treatment basins, and modelled:

8. Treatment of roof runoff from new industrial roofs at the downpipe.
9. All industrial and residential roofs to install roof runoff treatment at the downpipe,

Options 1 to 7 are realistic in that they can be implemented by the Council using its powers under the Local Government Act. With options 1 to 7 implemented it is estimated that copper will not increase upon full development, and the introduction of low-copper brake pads could reduce copper discharges still further. It is estimated that zinc will increase by 53% upon full development even with the proposed mitigation.

Options 8 and 9 would gain a significant reduction of zinc, but are considered impracticable to put into effect, as the Council does not have powers to require these measures to be implemented.

10.9. Contaminant Mitigation Targets

An annual load reduction target was developed from the contaminant load model as required by Condition 6b. The target is based on results from the contaminant load model. The target is set for the seven sub-catchments that will be treated through basins and wetlands. The remaining sub-catchments are not expected to discharge additional contaminants from new development into surface water. The numerical target applies to sub-catchments fully developed under Christchurch District Plan rules. The year when full development will be reached is unknown; hence five-yearly CLM updates should relate to the percentage of full development that has occurred at that time.

Reductions result from treatment in new facilities and anticipated changes in contaminant sources.

Table 9: Contaminant mitigation targets

Contaminant	Target reductions in stormwater contaminant load		
	Resulting from construction of new stormwater mitigation facilities and source control measures		
	Compared to the consent application base year 2018		
	5 years from 2018 (year 2023)	10 years from 2018 (year 2028)	Full development
TSS	No significant development yet	Reduction proportional to % development	69% reduction
Total Zinc	No significant development yet	Increase not exceeding proportion developed	Not exceeding 53% increase on 2018
Total Copper	No significant development yet	Reduction proportional to % development	14% reduction

10.10. Less significant contaminants

Contaminants of lesser significance are sometimes detected at low levels, but do not have a mitigation strategy because they either do not exceed guidelines or have a non-stormwater source. These include:

- *E. coli*: implies a risk of other pathogens harmful to humans. (There are no pathogen targets in the consent. Pathogen controls are likely to be considered in the Surface Water Improvement Plan).
- Polycyclic aromatic hydrocarbons (PAHs): no consent targets. Do not exceed LWRP guidelines.
- Nitrate and nitrite: no direct consent targets. Non-stormwater sources.
- Phosphorus: no direct consent target. Believed to be predominantly animal sources in this catchment.
- Ammonia: no consent target. Does not exceed LWRP guidelines.

11. Mitigation Plan

11.1. New Development

The SMP assumes that the city will extend through new development in the residential and commercial zones indicated in Figure 7: District Plan Zones and growth areas.

Contaminants, particularly sediments, generated by development will be controlled by:

- rules in the district plan,
- the Stormwater Bylaw 2021,
- the Erosion and Sediment Control Toolbox for Canterbury
- actions and requirements of this SMP.

In order to comply with section 8.4.7.3.c in the Christchurch District Plan, stormwater must:

- be detained in storage so that post-development peak flows do not exceed pre-development peaks up to the 2% ARI critical duration event for the catchment.
- be treated by the best practicable option as measured against Receiving Environment Attribute Target Levels in CRC214226 Schedule 7.
- be discharged into the ground by infiltration where practicable.

The minimum standards for stormwater detention and treatment associated with new development follow in Table 10.

Stormwater treatment facilities can serve both new developments, normally funded by developers, and established areas funded by the Council. Both existing and proposed treatment facilities, existing and under construction, are mapped in Figure 11. Most facilities are detention basins, which treat stormwater and release a reduced flow rate into watercourses. Some smaller private facilities are infiltration basins that treat stormwater by filtration through a soil liner. All stormwater from infiltration basins up to (typically) a 50-year ARI event goes into the ground.

Stormwater infiltration basins must fully drain within 48 hours of the cessation of a 2% AEP rain event.

A rationale for basin sizing is in Table 11.

11.2. Mitigating individual site stormwater

Individual developments are required to treat stormwater to mitigate any change in quantity or quality arising from the development. The minimum standard for stormwater treatment is in Table 10 which is extracted from Christchurch City Council On-site Stormwater Mitigation Guide (CCC 2021). The guide includes information about on-site storage and treatment for small to medium sites.

Table 10: Minimum requirements for new development sites

Source of Stormwater Discharge(s)	Total area of disturbance does not exceed 1,000m ²	Total area of disturbance equals or is greater than 1,000 m ²
From/during land disturbance activities	An approved Erosion and Sediment Control Plan is required	An approved Erosion and Sediment Control Plan is required
From new / re-development residential roof and hardstand areas	<p>No discharge onto or into land where the slope exceeds 5 degrees.</p> <p>Sumps collecting runoff from new hardstand areas shall be fitted with submerged or trapped outlets wherever practicable.</p> <p>Sites increasing impervious by 150m² or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide.</p> <p>An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat (2).</p> <p>On-site rain water storage is required for new and redevelopment sites on the hills.</p>	<p>No discharge onto or into land where the slope exceeds 5 degrees.</p> <p>First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m² and buildings with copper or uncoated galvanised metal roofs or guttering/spouting (1).</p> <p>Sites increasing impervious by 150m² or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide.</p> <p>An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat (2).</p> <p>On-site rain water storage is required for new and redevelopment sites on the hills.</p>
From new / re-development non-residential roof and hardstand areas	<p>No discharge onto or into land where the slope exceeds 5 degrees</p> <p>First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m², buildings with copper or uncoated galvanised roofs or guttering/spouting and high-use sites</p>	<p>No discharge onto or into land where the slope exceeds 5 degrees</p> <p>First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m², buildings with copper or uncoated (3) galvanised roofs or guttering/spouting and high-use sites</p>

Source of Stormwater Discharge(s)	Total area of disturbance does not exceed 1,000m ²	Total area of disturbance equals or is greater than 1,000 m ²
	Sites increasing impervious by 150m ² or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide.	Sites increasing impervious by 150m ² or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide.
	An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required (4)	An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required (4)
	Site management and spill procedures required for sites that engage in hazardous activities (5)	Site management and spill procedures required for sites that engage in hazardous activities (5)
Any land use with Canterbury Land and Water Regional Plan Schedule 3 activities.	An application for approval under the Stormwater and Land Drainage Bylaw 2022 must be made to authorise connection and discharge into the Council network.	An application for approval under the Stormwater and Land Drainage Bylaw 2022 must be made to authorise connection and discharge into the Council network.

Explanatory notes for Table 10:

4. The first flush is the first 25 mm of runoff
5. The Council has discretion to waive the requirement for first-flush treatment of hardstand areas on large residential sites with a low impervious percentage where the amount of pollution-generating hardstand being added is considered to have less than minor effect.
6. “Uncoated” means without a painted or enamelled coating. Council has discretion to waive the requirement for first flush treatment of hardstand areas on large residential sites where the amount and type of pollution-generating hardstand being added is considered to have a less than minor effect.
7. Quantity assessment and mitigation - The effects of the discharge on the stormwater network capacity and/or the extent or duration of flooding on downstream properties are to be assessed. Where Council considers an increase (including cumulative increases) has a more than minor effect, on-site stormwater attenuation or stormwater network upgrade shall be provided. The details of storage volume and peak discharges or network capacity required to mitigate effects on flooding or network capacity constraints shall be determined by the Christchurch City Council planning engineer.
8. Site management and spill procedures – Procedures are to be implemented to prevent the discharge of hazardous substances or spilled contaminants discharging into any land or surface waters via any conveyance path.

11.3. Operational controls on stormwater and sediment

The management of sites which may experience erosion and/or discharge sediment during development works is controlled by conditions of either resource consents or building consents, as applicable, for earthworks and building. The Stormwater and Land Drainage Bylaw 2022 specifies some standards for activities not controlled by consents.

Standards for sediment discharges are set by the Sediment Discharge Management Plan 2021 (SDMP). The sediment discharge management process should work as follows:

1. Allowable TSS (total suspended solids) concentration trigger levels for discharges to the stormwater network are set by the SDMP.
2. An erosion and sediment control plan (ESCP) is prepared by a 'suitably qualified and experienced professional' as determined by a site risk assessment
3. The TSS concentration trigger levels for the site are included in authorisations or conditions where possible.
4. The ESC measures are implemented on site and monitored.

11.4. Industries and High Risk Site Discharges

The Council will manage industrial sites through its Stormwater and Land Drainage Bylaw 2022. The bylaw requires industrial contaminants to be controlled to meet best practice. The Christchurch City Council's expectation is that stormwater entering its network is managed according to best practice, especially where the discharge occurs directly into a waterway. On-site pre-treatment may be required unless contaminant levels are less than LWRP Schedule 5 standards.

Where industrial site occupiers do not meet the required standards for discharge into the network, the site will be removed from the CSNDC and will require a separate resource consent from ECan for its discharge. A condition is included in the CSNDC for this process and all industrial sites excluded from the resource consent will be listed on Schedule 1 attached to the consent.

In managing high-risk sites the Council will:

- Audit at least 15 high-risk sites per year;
- Inform audited industries of the results of audits and work closely with these industries to achieve outcomes in line with the Stormwater Bylaw;
- Communicate with industries about stormwater discharge standards and the means of meeting these standards.

Change will be sought through a combination of education and enforcement.

- Education will be carried out through an industry liaison group.
- Enforcement will happen as pollution prevention officers identify and visit high-risk industrial sites and work with industries to improve site management.

Contamination risks are limited to a degree by acceptance of trade wastes into the wastewater system. This is authorised through Trade Waste Consents and the monitoring of consents permits a degree of oversight and site control.

Future needs include:

- More interaction with industries by the Council; communication, awareness and education

- Improved knowledge of the environmental effects of compounds discharged by industrial sites
- Ongoing site checks until the Council is confident that all risky sites are controlled adequately
- Upgrades on non-compliant sites

11.5. Expectations for Industrial Area Stormwater Discharges

Stormwater from the industrial zone west of The Groynes is discharged to ground on individual sites or groups of sites. These discharges have been consented by Environment Canterbury (ECan) and will continue to be consented by ECan under the current stormwater consent CRC214226.

According to the CSNDC (CRC214226) Conditions the Council will authorise roof stormwater discharges into land under this consent and ECan will continue to authorise discharges into land.

All discharges into its network must be authorised by the Christchurch City Council.

Because of the sensitivity of the receiving water, the Council will manage industrial stormwater as follows:

- a. No industrial sites will discharge into surface water.
- b. The Council will advocate the use of painted zinc/aluminium coated steel OR non-steel roofing by means of a direct request accompanying every LIM and PIM, supported by a technical statement detailing the environmental effects of zinc.
- c. Roof runoff from painted zinc/aluminium roofs may be discharged into the ground without treatment.
- d. At least the 25mm first-flush will be treated; or the 25mm first flush from hard stand and landscape areas if roof water goes to ground separately.
- e. Off-site treatment will occur in facilities vested in Council and serving as large an area as practicable.
- f. On-site treatment will be in soil infiltration basins designed in accordance with the Waterways Wetlands and Drainage Guide, chapter 6.

Where industrial site owners (or occupiers) cannot meet the required standards for discharge into the network, the site will be removed from the CSNDC and will require a separate resource consent from ECan for its discharge. A condition is included in the CSNDC for this process and all industrial sites excluded from the resource consent will be listed on Schedule 1 attached to the consent.

11.6. New Treatment Facilities

Stormwater from new developments will be treated. The Ōtūkaikino Creek has good ecological status, so this SMP seeks that:

- a. Stormwater will be discharged into ground infiltration if practicable, after treatment to best practice;
- b. Otherwise urban stormwater will be treated to best practice before discharge to surface water.

In either case at least the 25mm first flush will be detained and treated. Before infiltration to ground, stormwater must be treated according to the recommendations of the Waterways Wetlands and Drainage Guide chapter 6.

The Council proposes to treat stormwater from two existing residential catchments:

- a. The existing Belfast residential area will be treated in a new first-flush basin and wetland (provisionally named “Ōtūkaikino” at #940 Main North Road.

- b. The Rushmore Drive/Darroch Street residential area stormwater will be treated in a new first-flush basin and wetland situated on Darroch Reserve, to the west.

The risk of discharging stormwater onto or through contaminated land is low. Land in the Johns Road residential subdivision and in North Belfast in the vicinity of proposed treatment basins does not appear to be contaminated. Table 14, Appendix C comments on the status of land in the proximity of proposed basins, referencing the Listed Land Use Register. An old landfill north of Greywacke Road comprises the known contaminated land in the catchment. Industrial sites in the vicinity infiltrate stormwater into the ground under consents issued by Environment Canterbury.

11.6.1. Designing basins to minimise bird-strike on aircraft

Christchurch District Plan Policy 6.7.2.1.2 – Avoidance or mitigation of navigational or operational impediments – is a policy to avoid or mitigate the potential effects of activities that could interfere with the safe navigation and control of aircraft, including activities that could interfere with visibility or increase the possibility of bird-strike. Plan provisions include:

- 5 Natural Hazards - for activities and earthworks in the Waimakariri Flood Management Area (5.4.3.3 RD3, matter k.);
- 8 Subdivision - general matters of control in relation to new ponding areas (8.7.4.3(f)) and Policy 8.2.3.4(b., vi.) Stormwater Disposal;
- 8 Subdivision - Development Requirements for stormwater for South Masham and Yaldhurst ODP areas (Appendices 8.10.5.D(5)(b) and 8.10.28.D(a)(5)(d));
- 11 Utilities - matters of discretion for new ponding areas (11.10.6(j))

New stormwater facilities within the Christchurch International Airport Bird Strike Management Area, a defined zone extending 3 km from airport runway thresholds (mapped in District Plan Appendix 6.11.7.5) must meet activity standards in section 6.7.4.3 of the Christchurch District Plan (see Figure 12).

Assessments should consider any actual or potential effects relating to bird strike where relevant to an application, regardless of whether or not the proposal is located within the Bird Strike Management Area (6.7.3(c.)). Depending on the facts of the particular application:

- Strategic objective 3.3.12 Infrastructure, policy 6.7.2.1.2 Avoidance or mitigation of navigational or operational impediments, and policy 8.2.3.4 Stormwater disposal, are relevant to activities that have the potential to increase the risk of bird strike whether they are within or outside of the CIABSMA;
- Chapters 5, 6, 8, 11, 13 & 17 contain matters of assessment or control to manage bird strike risk for particular activities;
- Bird strike risk may be a relevant consideration when the Council considers a discretionary or non-complying activity.

Basin planners and designers are also required to consider the potential for new water bodies within 13 kilometres of airport runway thresholds to increase the risk of bird strike. New water bodies can provide habitat that will attract waterfowl and high risk species and bring their flight lines into intersection with aircraft flight lines. The risk potential should be quantified and, where required, managed in a manner indicated via a Bird Strike Risk Assessment carried out by a person with suitable ornithological training. Guidance material is contained as Appendix G. Persons developing stormwater facilities within 13 km of airport runway thresholds (identified in figure 12) should consult with CIAL.

Table 11 Sizing rationale for proposed treatment facilities

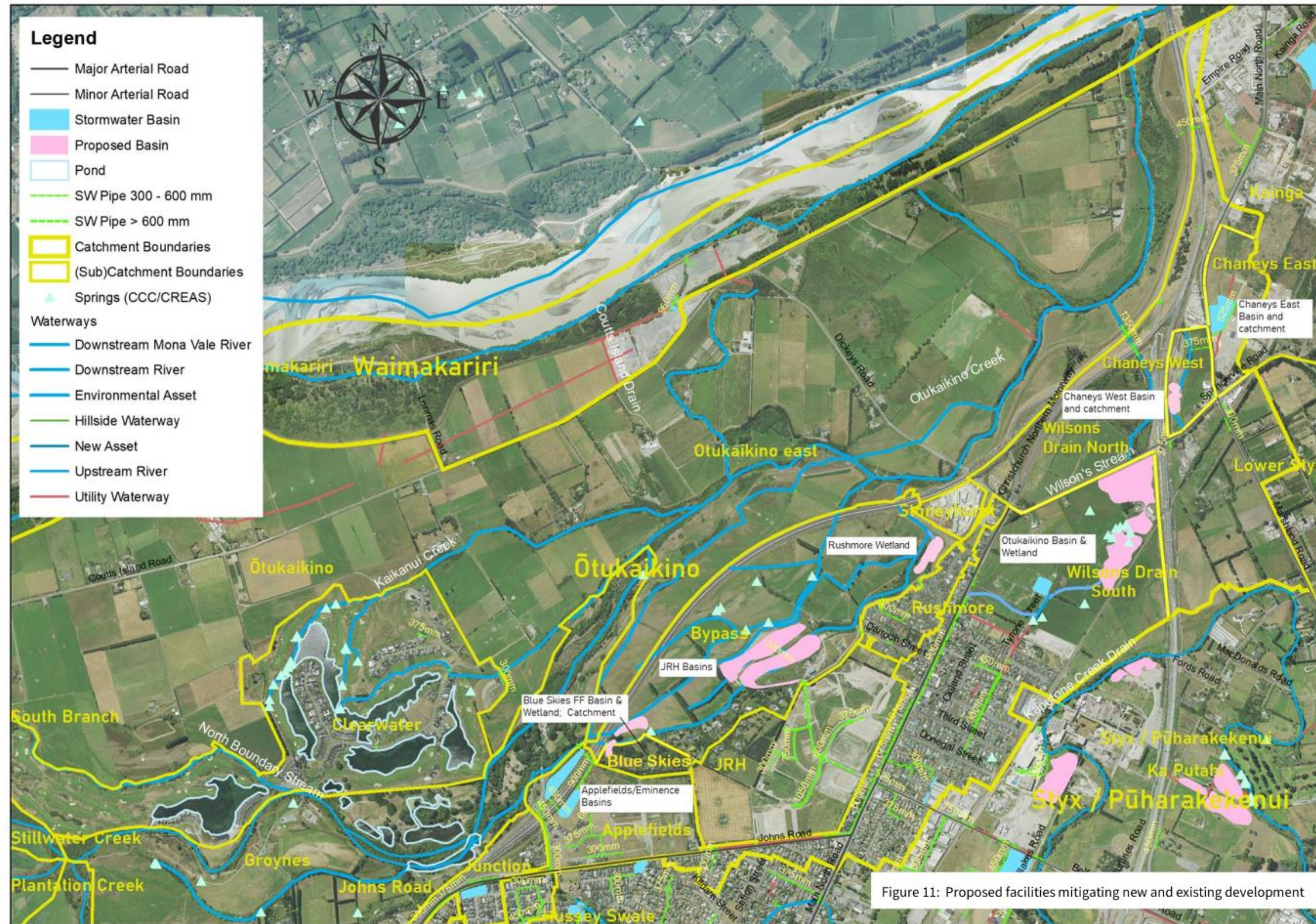
Sub-catchment (see Figure 11)	Contributing area	Land Use	Runoff vol. coeff. (1) & First flush volume	Indicative FF Basin Area	Indicative FF Basin Volume	Indicative Wetland Area	Potential extra wetland flooding vol. (2)	References / comments
Facility planning transferred from Styx Stormwater Management Plan 2013								
Applefields FF basin & wetland	33.2 Ha	Developing residential	0.63 5,300 m ³	0.52 Ha	5,300 m ³	0.91 Ha	4,500 m ³	Basins built 2015
Chaney's East FF Basin & Wetland	10.5 Ha	Greenfields industrial	0.7 2,100 m ³	0.46 Ha	4,000 m ³	0.68 Ha	2,000 m ³	
Chaney's West FF Basin & Wetland	7.5 Ha	Greenfields industrial	0.81 1,500 m ³	0.9 Ha				Basins built 2021
Ōtūkaikino FF Basin & Wetland	68.2 Ha	Existing residential	0.41 7,000 m ³	3.42 Ha	34,000 m ³ Incl. flood attenuation	4.46 Ha	22,200 m ³	
	49.3 Ha	Greenfields industrial	0.81 10,000 m ³					
JRH FF Basin and Wetland	56 Ha	Greenfields residential	0.63 8,800 m ³	3 Ha	9,000 m ³	2.4 Ha	12,500 m ³	Trim 19/146287
New stormwater planning								
Rushmore FF Basin & Wetland (Darroch Reserve)	13 Ha	Existing residential	0.41 1,300 m ³	n/a	20,000 x 0.1-0.15 m = 2-3,000 m ³	~ 2 Ha	6,000 m ³	
Blue Skies Basin and Wetland	6 Ha	Greenfields residential	0.63 950 m ³	0.2 Ha	(950 m ³)	2.5 Ha	Unknown at this time	

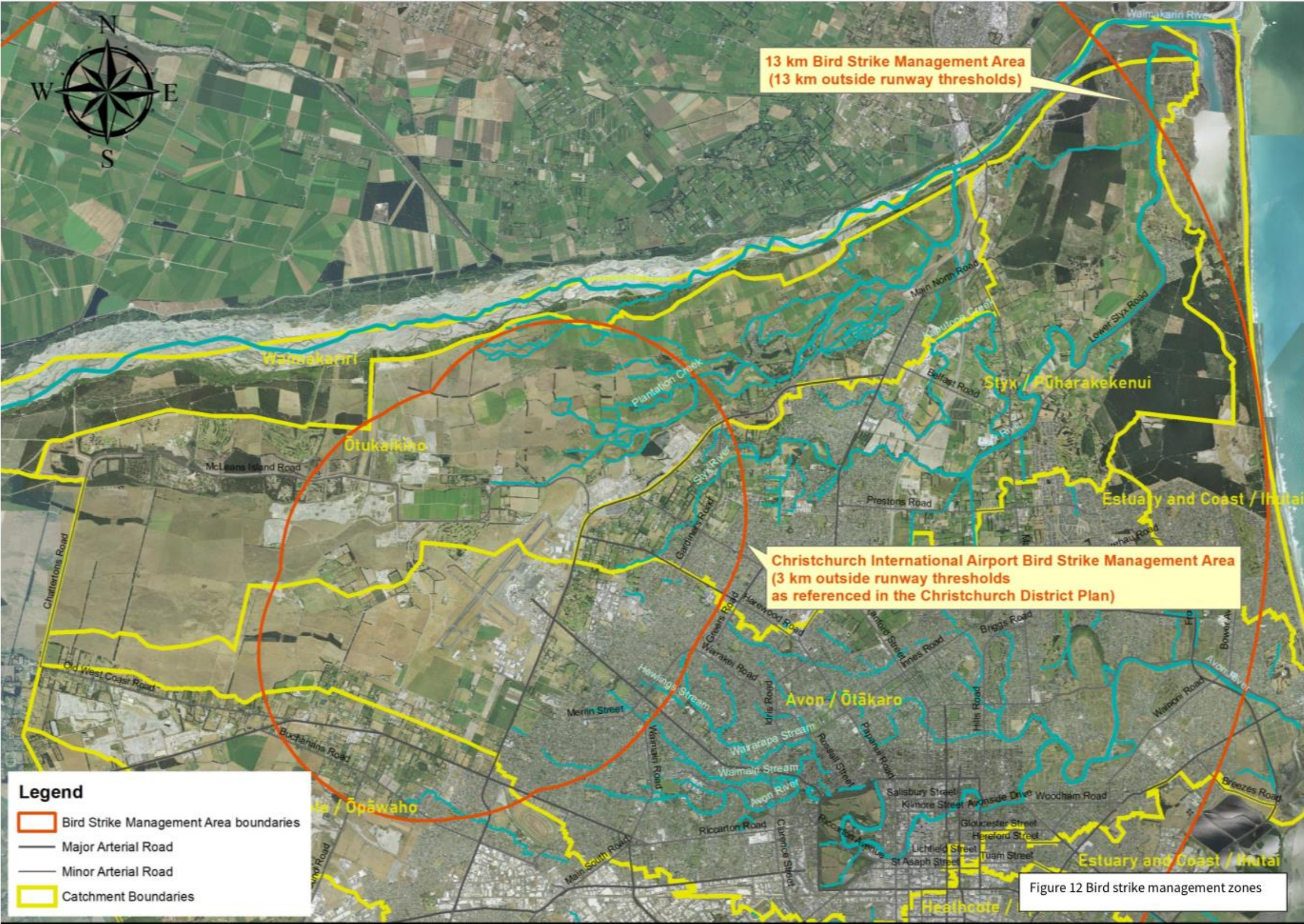


Lakes – industrial Individual sites to ground?	51.3 Ha	Existing and developing industrial	Unknown - individual sites	Unknown - individual sites	Unknown - individual sites	n/a	n/a	Individual sites expected to self- mitigate
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Notes:

- (1) Runoff volume coefficient from WWDG Table 6-10
- (2) Wetlands may be flooded up to an additional depth of 500 mm in events exceeding 10 year ARI. Over-flooding increases effective detention storage without significant compromise to wetland treatment effectiveness.





11.6.2. Avoiding groundwater mounding beneath infiltration basins

Groundwater rises locally to some degree (mounding) when an infiltration basin is discharging. Adverse effects (either waterlogging of adjacent land or impeded drainage) can be avoided by carefully locating basins with reference to groundwater depth. Mounding is not relevant to proposed Council basins, which discharge to surface water. Groundwater depth is not expected to be limiting for most future private basins because they are small and will be situated on gravelly plains in the north-western half of the catchment; refer to Figure 3. Mounding is less likely where permeable gravels underlie a basin. Infiltration basin site selection and design is to conform to sections 6.5.3 and 6.5.4 in the WWDG.

Groundwater Quantity and Quality Assessment for the Heathcote Catchment (PDP, 2016) indicates, based on modelling, that "...the extent of mounding (beneath basins) is expected to be limited. Under a worst case scenario infiltration could cause groundwater levels to rise by up to 3m during a 50-year storm event." This advice is relevant to the Ōtūkaikino Catchment.

Where groundwater may rise either to ground level or the basin floor level the designer must make provision, as appropriate, to discharge at a slower rate, and/or store stormwater until infiltration is no longer impeded, or acquire or remediate adjacent land that may be subject to water logging.

11.6.3. Effects of stormwater on groundwater

New stormwater management systems created during urban development may be either detention or infiltration basins. The Council promotes the use of infiltration basins where possible but its new treatment facilities in the east of the catchment will be in areas of high groundwater and will have to discharge to surface water. Private stormwater treatment facilities in the Greywacke Road area discharge into the ground. If the basins are appropriately constructed, and located away from community drinking water supply protection zones and landfills the effects on groundwater are expected to be very limited.

Groundwater mounding could cause adverse groundwater quality effects in the vicinity of old landfills or other contaminated sites. This issue will continue to be considered on a site-by-site basis.

Stormwater treatment mechanisms are expected to have minor effects on groundwater quality overall. Shallow groundwater will be monitored monthly north of Wilkersons Road (which is down-gradient from industrial area discharges into ground) for a period, until the effects, if any, of private infiltration basins are understood. If groundwater sampling shows a trend of increasing contamination the Council can modify standard infiltration basin designs, requiring thicker soil filtration layers.

11.6.4. Changes to springs and baseflow

Because of the large amount of inflow from the Waimakariri River and the comparatively large amount of rainfall on the plains, the reduction in groundwater recharge due to urbanisation across those parts of the catchment where detention basins are suitable is not expected to be significant in the context of the overall water balance (PDP, 2016). Overall effects are expected to be small.

Pattle Delamore Partners investigated the expected effects of urban development on the water balance, base flow and springs (PDP, 2022). Two factors affect the amount of infiltration to groundwater:

1. a proportion of stormwater runoff will be detained in treatment basins and infiltrated into the ground

2. a significant proportion of total rainfall falls in small amounts that are held in the soil zone and transpire or evaporate without reaching groundwater.

Pattle Delamore Partners found that:

1. Anticipated development should result in a very minor decrease in groundwater recharge because infiltration into the ground from treatment basins is not practicable in the eastern part of the catchment.
2. The percentage baseflow decrease is estimated to be less than 1%.
3. Changes to spring flows are not anticipated to be noticeable.

11.7. Changes in response to public submissions

This section will be completed after the public consultation period.

11.8. Environmental Monitoring

The Council carries out “state of the environment” monitoring monthly at 46 sites within the Christchurch district. Three sites are within this catchment. State of the environment monitoring is not time or rainfall related and does not often coincide with wet weather.

To better quantify contaminant concentrations and track the effects of contaminant mitigation strategies the Council could increase the amount of monitoring during wet weather. The characteristics of the Christchurch water network are different from other cities and local information is needed. Short term monitoring is needed to refine knowledge about zinc loads from different road types and the difference between first-flush and steady-state concentrations. Long term monitoring of treatment systems is needed to verify the performance of basins, swales, rain gardens and filters.

As mentioned in section 11.6.3 shallow groundwater will be monitored monthly north of Wilkersons Road (which is down-gradient from industrial area discharges into ground) for a period, until the effects, if any, of private infiltration basins are understood.

11.9. Pathogens

Pathogens can be minimised by excluding stock from waterways and, ideally, by introducing planted buffer strips. Some bacteria will continue to be introduced by waterfowl and runoff from pastoral land.

There is one wastewater overflow in the catchment, at the Tyrone Street Pumping Station, 76 Tyrone Street. Due to available capacity an overflow is very unlikely unless there is an equipment malfunction.

If there is a wastewater overflow it will be held in the proposed Ōtūkaikino treatment basin for as long as capacity is available or until the level of pathogens has been reduced to a safe level.

11.10. Nutrients

Nutrient inputs in this catchment are mostly of rural origin and do not fall within the scope of this plan.

The Council will cooperate with Environment Canterbury to develop and implement a catchment management plan for rural parts of the catchment.

12. Plan Objectives

These objectives address the issues arising from Sections 3 and 5 through 11.

Objective 1. Control sediment discharges

Our goals are

- 1.1 Ensure the quality of stormwater from all new development sites or re-development sites is treated to best practice (with section 11.2 being the minimum standard)
- 1.2 100% of stormwater treatment facilities contributing to Table 9 contaminant mitigation targets (consent condition 6b) are constructed and conform to WWDG standards.
- 1.3 Sediment from 95% of consented construction activities on the flat is treated to best practice by 2025
- 1.4 Analyse options for carrying out street sweeping, sump cleaning, and diversion to wastewater trials in 2020/21 (Schedule 4b & d)

Action Plan for Urban Sediment				
Goal	Action	Mechanism	Action Components	Timing
Sediment (urban)				
1.1 New developments	Plan and oversee installation of detention basins, wetlands & swales	District Plan (Development contributions) and Long Term Plan	Normal planning processes.	Ongoing
1.2 New treatment facilities	Ensure new facilities are built to best practice	Designs should conform to the Infrastructure Design Standard	Normal Council planning, design and procurement process.	Ongoing
1.3 Construction & excavation sites	On-site sediment and erosion control effected through Erosion and Sediment Control Plans	Council enforcement powers under the Building Act 2004.	Train Building Inspectors. Implement an enforcement process. Contractor(s) on standby for cleanup when breaches occur.	ESC now part of resource consents for earthworks and building
1.4 Road runoff contains sediment	Investigate & develop methods to treat runoff from arterial roads,	Increase frequency of street sweeping, rain gardens	Street sweeping trials. Construct rain gardens where feasible.	Commenced 2021

Recommended for consideration through the Surface Water Strategic Plan

- 1.5 Road sediment is reduced by a best practicable option determined by the results of street sweeping, sump cleaning and alternative treatment trials (Schedule 4c, f, g & h.)

Objective 2. Control zinc contaminants

Our goals are

- 2.1 [repeats Goal 1.2] All the facilities required to meet the Table 9 targets are constructed.
- 2.2 Groundwater does not become contaminated with zinc above the Attribute Target Levels for Waterways in Schedule 7:
- 2.3 By 2025 the Council will have investigated zinc mitigation measures and carried out cost/benefit analyses toward identifying their effectiveness as best practicable options.
- 2.4 By 2025 the Council has consulted with key stakeholders and identified a long term zinc strategy consistent with current technologies.
- 2.5 The CCC collaborates with local and regional government in a joint submission to central government seeking national measures and industry standards to reduce the discharge of building and vehicle contaminants.

Action Plan for Zinc				
Goal	Action	Mechanism	Action Components	Timing
Zinc				
2.1	Same as 1.1			
2.2	Track zinc concentration in groundwater	Groundwater monitoring	Sample groundwater monthly down-gradient from industrial area	From 2023
2.3 & 2.4 Bare steel roofs emit zinc	Investigate/consult acceptable material for new roofs. (Choices non-metallic or pre-painted zinc/aluminium.)	District Plan rule (if possible) otherwise investigate Regional Rule or legislation	Investigate environmental harm and costs/benefits of alternative materials. Consult widely.	Under way
2.3 Ageing Colorsteel® likely to emit zinc	Research zinc emissions from ageing Colorsteel®	Sampling roof runoff	Sample runoff from ageing roofs, monitor trends, liaise with industry.	
2.4	Research and implement best	Catchment scale filtration	Research and trials	Under way 2022

Action Plan for Zinc				
Goal	Action	Mechanism	Action Components	Timing
Vehicle (tyre) zinc	practicable means of zinc removal from busy roads	systems. Wetlands & rain gardens if space is available		
2.5	National measures and industry standards to reduce the discharge of building and vehicle contaminants.	Represent Council position to Ministry for the Environment	Regular meetings with MfE staff	ongoing

Recommended for consideration through the Surface Water Strategic Plan

- 2.3 The Council engages in research into and trials means of trapping roof-sourced zinc on site.
- 2.4 The Council adopts a zinc limitation strategy based on identified best practicable options.

Objective 3. Control copper contaminants

Our goals are

- 3.1 The Council consults with the government, through the Ministry for the Environment, about legislation to limit the copper content in vehicle brake pads.
- 3.2 The Council does not permit stormwater discharges into the network from unprotected copper cladding, spouting or downpipes.
- 3.3 The Council will investigate the feasibility of a district plan rule to discourage the use of copper claddings.

Action Plan for Copper				
Goal	Action	Mechanism	Action Components	Timing
Copper				
3.1 Vehicle brake pads	Request legislation requiring low/no copper in brake pads	Combined regional and local authority approach to government re legislation to apply nation-wide.	Liaison between local and regional councils. Representation to government via NZTA, MfE	Unknown
3.2 & 3.3 Architectural copper (roofs,	Prohibit the use of unprotected architectural copper.	NZ-wide legislation; possible District Plan rule; otherwise	Liaise with government thru MfE. Investigate and consult.	Unknown

Action Plan for Copper				
Goal	Action	Mechanism	Action Components	Timing
spouting, downpipes)	Seek to limit or eliminated the use of architectural copper.	investigate Regional Rule		

Objective 4. Control industrial site contaminants

Our goals are

- 4.1 A database of industrial sites considered to be medium or high risk is compiled, based on the best available information, by 2025
- 4.2 High risk industrial sites are audited by the approved procedure under the CSNDC

Action Plan for Industrial Sites				
Goal	Action	Mechanism	Action Components	Timing
4.1 Limited information about industrial sites.	Gather data to improve database of industrial site information.	Desktop analysis, questionnaires, Chamber of Commerce	Desktop analysis, mailouts, questionnaires, industry liaison	Started 2021
4.2 Industries unaware of effects of discharges to stormwater	Develop awareness among all industries of the harmful effects of contaminated discharges.	Educate via mail-outs. Educate during site audits.	Inspect sites in risk order. Communicate results and expectations	Started 2021
4.3 Some industries failing to control harmful substances	Ensure that harmful substances are contained, tracked, and disposed of safely	Audit sites and follow up with education and enforcement.	Protocols for site controls developed jointly by CCC, ECan and industry. Site audits.	Phase in over c 5 years
4.4 Non-compliant discharges	Trace and eliminate discharges	Audit sites and follow up with education and enforcement.	Communicate the issue to industry & visit industries. Generate improvement plan. Engage and obtain compliance.	Phase in over c 5 years

Objective 5. Engagement and education

Our goals are

- 5.1 By 2025 the Council will be working with community groups to engage with the public to educate participants about current stormwater practice and enable the public to take action to stop contaminants at source.
- 5.2 By 2025 the Council will be engaging regularly with the Ministry for the Environment to collaborate on contaminant reduction initiatives.

Action Plan for Engagement and Education				
Goal	Action	Mechanism	Action Components	Timing
5.1 Valuing Water Resources	Education and engagement to empower community groups Each new generation values waterways	Joint partnership prog to effectively co-ordinate existing education and engagement of community groups	Partner delivery (Council, ECan, Ngāi Tahu, CWMS) with stream care and other community groups	Ongoing
5.1 Communication strategy	Develop a long term communication strategy	Strategy development	Understand community thinking about waterways. Agree message and means of communicating.	Ongoing
5.1 Promote community action	Encourage supportive community groups	More direct support for active groups. Provide information and involve in planning	Assist groups to develop goals and action plans. Share Council planning. Fund and track funding. Monitor results.	Ongoing
5.2 CCC and MfE engaged re heavy metals reduction.	CCC to seek regular contact with relevant MfE planning team(s).	The anticipated mechanism is regulation or national education campaign.	Council to contact MfE, starting at executive level, progressing to staff level contacts	Ongoing

Objective 6. Manage flooding

Our goals are

- 6.1 The quantity of stormwater from all new development sites or re-development sites will be attenuated to at least the minimum standard of section 11.5
- 6.2 Protection for property will continue to be achieved through full mitigation of water quantity effects during development and controls on new floor levels.

Action Plan for Flooding				
Goal	Action	Mechanism	Action Components	Timing
6.1 Control extra stormwater from new development	Limit the increase in peak stormwater runoff.	Stormwater from new subdivisions is controlled through basins. Stormwater from larger individual sites attenuated on site.	Normal planning processes	Ongoing
6.2 Minimise flooding caused by city growth & change	Monitor changes to impervious areas and stormwater network capacity and compensate if necessary	Regular computer-based flood modelling.	Keep models up-to-date as the city changes. Compare models with flood events. Plan for flood mitigation as necessary.	Ongoing

Objective 7. Maintain stream base-flows and spring flows

Our goals are

- 7.1 Stormwater will be infiltrated into the ground where practicable, after treatment, in order to maintain as much as possible the pre-development water balance.

Note: Infiltration of stormwater into the ground, after acceptable treatment, is the Council's preferred means of stormwater discharge.

Action Plan for Flooding				
Goal	Action	Mechanism	Action Components	Timing
7.1 Maintain base flows	Infiltrate stormwater into ground where practicable.	Stormwater networks in newdevelopment prioritise detention and infiltration.	Normal planning processes	Ongoing

13. Waterway Capacity and Flooding

13.1. Flooding

Urban areas are elevated above the creek and its rural floodplain, and are protected from flooding in the Waimakariri River either by height or by stopbanking. Some localised ponding could occur within the various sub-catchments in extreme rain events. Buildings in rural zones are elevated above a potential breakout through the Waimakariri River primary stopbanks.

Older Belfast residential areas sit on a low, flat ridge between the Ōtūkaikino and Kā Putahi Creeks. Small topographical variations will concentrate runoff from extreme storms into hollows and slight valleys. On such occasions sufficient water could accumulate to flood houses whose floors are near the ground. Older houses founded on piles appear to be safely elevated but approximately 8 newer houses on low (concrete slab) foundations appear to be subject to inundation based on modelled 50 year flood levels.

Since 2014 all new house floors have been assigned floor levels safe from flooding, as determined from hydraulic modelling.

Industrial zones are on elevated ground and tend to shed stormwater away from the Ōtūkaikino Creek, with the lie of the land. In heavy rainfall this could lead to limited, localised surface flooding.

13.2. Flooding Standards

The city's drainage systems are principally designed to serve the expectations of safe vehicle travel and flood free housing. Stormwater networks of side channels, pipes and drains keep traffic lanes free of ponded water in frequent events. In more extreme rainfalls the lower lying parts of roads and private properties store water in excess of system capacity until it can be drained away. Houses are expected to be built sufficiently high to remain dry in all but the most extreme events.

The following are standards from the Infrastructure Design Standard and Waterways Wetlands and Drainage Guide which incorporate or provide the Council's drainage levels of service.

- Road drainage, pipes and minor drains are designed so that the 5 year annual recurrence interval rainfall does not cause a nuisance to traffic.
- Hillside drainage must ensure that a 20 year annual recurrence interval rainfall does not endanger property.
- Within Flood Ponding Management Areas minimum floor levels are set 400mm above the 200 year annual recurrence interval flood level. FMAs are those areas covered by the 200 year ARI flood level plus a 250mm freeboard allowance. (400 mm floor height above flood level includes the 250 mm freeboard plus an assumed 150 mm minimum foundation height above the natural ground.)
- There are proposed development restrictions for "High Flood Hazard Management Areas" (HFHMA) defined as areas where, in a 500 year annual recurrence interval flood the water would be more than 1m deep or the product of velocity times depth is greater than 1.
- Otherwise a 50 year annual recurrence interval event is used for set the minimum floor levels as required by the Building Act.

13.3. Floodplain Management Strategy

River flooding in the catchment is managed by Environment Canterbury; the Christchurch City Council will not model or control river or stream flooding.

The flooding risk in internal waterways and drains is dealt with by:

- Avoidance: built-up areas are located on high ground or on the outer side of stopbanks.
- District plan rules.
 - New builds within Flood Hazard Management Areas are required to have a floor level above the 200 year average recurrence interval (ARI) flood level plus 400 mm. (A full definition including tidal influences found in the Christchurch District Plan section 5.4).
- Rules under the Building Act 1991
 - Outside the Fixed Minimum Floor Level Overlay all new builds are required to have a floor level that is above the 50-year ARI flood level plus 400 mm.
 - New houses in Clearbrook will have floors higher than a 10,000 year ARI flood event resulting in a major stopbank breach.
- An appropriately designed and managed stormwater network
 - Stormwater networks should have capacity to convey a 20% annual exceedance probability rain event.
 - New houses will have floors higher than a 200-year ARI flood event.

13.4. Sea Level Rise

Rising sea levels are not expected to affect the Ōtūkaikino Catchment within the term of this plan. Developed parts of the catchment are sufficiently elevated to be free of the effects of sea level rise of up to two metres.

Section Four Stormwater Outcomes

Item 6

Attachment B

14. Conclusion

The purpose of the Comprehensive Stormwater Network Discharge Consent is to drive planning and actions that will progressively improve the quality of stormwater discharges.

Actions the Council can take through the stormwater management plan must be accompanied by other actions if the Council’s Community Outcome (Healthy Environment) and the Mahaanui Iwi Management Plan objectives are to be realised. Further actions, by the Council and others, include:

- Raise awareness and educate citizens on how to stop contaminants from entering stormwater at source.
- Eliminate or reduce contaminants at source (e.g. by substituting for contaminating building materials).
- Remove contaminants from stormwater before they enter natural water.
- Restore waterway corridors to a natural state.
- Restore and plant riparian margins.
- Improve instream habitat by sediment removal, riparian tree planting (for temperature control, bank stability and shelter).
- Improve biodiversity to improve food sources for instream life.
- Performance monitoring of treatment facilities.

Progressive improvement can occur through further activities in Table 12:

Table 12: Areas for improvement outside of the stormwater management plan

Activity	Motivation for the Activity
The Council regulating and acting under regulations to stop the discharge of contaminants.	As required by conditions of CRC214226 (CSNDC)
The Council investigating new means of controlling contaminants at source (e.g by materials substitution or innovative means of treatment).	As required by conditions of CRC214226 (CSNDC)
The Council and others implementing new or improved contaminant mitigation practices.	Through the proposed Surface Water Implementation Plan 2021 (referred to in section 2.1)
The Council and others making progressive environmental improvements such as restoring waterways and their corridors to a natural state.	Community Outcome (Healthy Environment)
Citizen-based awareness and advocacy for clean water and improved biodiversity.	Kaitiakitanga
Advocacy by Ngāi Tahu for the mana of water and waterways.	Kaitiakitanga. Kawanatanga. Mahaanui Iwi Management Plan

15. References

- Aquatic Ecology Ltd (2012) *Fish Values of the Ōtūkaikino River*, AEL Report No. 85
- Boffa Miskell Limited (2017) *Ōtūkaikino River Catchment Aquatic Ecology 2017*.
- Boffa Miskell Limited (2022) *Ōtūkaikino and Cashmere Monitoring 2022 | Five-Yearly and Annual Aquatic Ecology Monitoring*. Report prepared by Boffa Miskell Limited for the Christchurch City Council.
- Brewer, P. (1997) *Vehicles as a source of Heavy Metal Contamination in the Environment* M.Sc. Thesis, University of Reading, Berkshire, UK.
- CCC (2003) *Waterways, Wetlands and Drainage Guide*, Christchurch City Council (TRIM 10/124664).
- CCC (2009) *Surface Water Strategy 2009-2039*, Christchurch City Council (TRIM 13/990164).
- Charters F. (2016) *Stormwater Contaminant Load Monitoring and Modelling of the Addington Brook Catchment*
- Collins, J. A. (1984) *Roadside lead in New Zealand and its significance for human and animal health*. NZ J. Sci. 27: 93-97.
- Couch-Lewis, Y. (2008) *Ōpawāho (Ōpawāho - Heathcote River, Ihutai – Heathcote Avon Estuary, Stream Wharf Stream, Middle Ōpawāho, Upper Ōpawāho) Tangata Whenua Research*. AspxZ Ltd
- Cox, J. E. & Mead, C. B. (19xx) *Soil Evidence Relating To Post-Glacial Climate On The Canterbury Plains*, Soil Bureau, DSIR
- Depree, C. (2011) *Street sweeping: an effective non-structural Best Management Practice (BMP) for improving stormwater quality in Nelson?* National Institute of Water and Atmospheric Research Ltd (TRIM 11/277708).
- ECan 2013 *Christchurch groundwater quality monitoring*
- ECan, 2017. <https://apps.canterburymaps.govt.nz/AdvancedViewer/> Accessed May and June 2017
- ESR (2015) *Faecal Sources in the Avon River/Ōtakaro, Heathcote River/Ōpawāho and the Estuary of the Heathcote & Avon Rivers/Ihutai*
- EOS Ecology (2012) *Long-term Monitoring of Aquatic Invertebrates: Ōtūkaikino River Catchment 2012* (TRIM 13/220747).
- Gilpin, B and Moriarity, E. (2009) *Faecal Source tracking in the Avon River, Christchurch March – May 2009*, Environment Canterbury, Report R09/67 (TRIM 10/57569).
- Golder Associates, (2018) *Assessment of Current and Future Contaminant Loads in Christchurch*. (Schedule 5 to CSNDC Conditions in TRIM 20/168116)
- Hayward S., Meredith A. and Stevenson M. (2009) *Review of proposed NRRP water quality objectives and standards for rivers and lakes in the Canterbury region* ECan

Jensen, C. (2002) *Botanical Survey of Ōtūkaikino*

Jolly, D. and Nga Papatipu Rūnanga Working Group (2013) *Mahaanui Iwi Management Plan* Mahaanui Kurataiao Ltd (TRIM 14/433774).

Lang, M., S. Orchard, T. Falwasser, M. Rupene, C. Williams, N. Tirikatene-Nash, and R. Couch. (2012) *Cultural Health Assessment of the Avon-Heathcote Estuary and its Catchment*, Mahaanui Kurataiao Ltd (TRIM 12/850168).

Legret, M. and C. Pagotto (1999) *Evaluation of pollutant loadings in the runoff waters from a major rural highway*. The Science of the Total Environment, Vol. 235, pp. 143-150

Logan, R. (2008) *Waimakariri – An Illustrated History*; Phillips & King Publishers.

Margetts, B. (2013) *Christchurch Rivers Ecosystem Monitoring, Annual Results Summary* (2013) (TRIM 13/609513)

Margetts, B & Marshall, W (2016) *Summary of Heathcote River sampling against ANZECC (2000) and Environment Canterbury Land and Water Regional Plan guidelines*.

Margetts, B (2014a) *Interim Global Stormwater Consent, Surface Water Quality Monitoring Report for the Period May 2013 – April 2014*, Christchurch City Council, July 2014 (TRIM 14/810303).

Margetts, B (2014b) *Interim Global Stormwater Consent, Wet Weather Monitoring Report for the Period May 2013 – April 2014*, Christchurch City Council, July 2014 (TRIM 14/810311).

Margetts, B. and Marshall, W. (2015) *Surface Water Monitoring Report for Christchurch City Waterways: January – December 2015* (TRIM 16/852653)

Moore, J., J. Gadd, P. Pattinson, C. Hyde and P. Miselis (2012) *Field evaluation of media filtration stormwater treatment devices*. NZ Transport Agency research report 493.

Nelson, G. (1928) *Report on the Waimakariri River (New Zealand), being a general discussion of the problems presented by that river and the means of solving them*

Ngāi Tahu (1999) *Te Rūnanga o Ngāi Tahu Freshwater Policy*.

NIWA (2002) *New Zealand Stream Health Monitoring and Assessment Kit: Stream Monitoring Manual*, NIWA Technical Report 40.

NIWA (2022) *Targeted wet weather monitoring of Curlett and Haytons Streams 2021*.

Pattle Delamore Partners Ltd (2021) *Prestons and Knights Stream Stormwater Facility Monitoring 2020-2021 Annual Report*. (Draft)

Pattle Delamore Partners Ltd (2022) *Groundwater Quantity and Quality Assessment for the Ōtūkaikino Catchment*

Price, D. (2014) *Notes on Changes in Population and demographics in Christchurch City as at September 2014*.

Stark, J.D. and Maxted, J.R. (2007) *A User Guide for the Macroinvertebrate Community Index*, Cawthron Institute, Nelson. Report No. 1166.

Sweeny, A. (2016) *Waimakariri Flood Protection Project: Building Banks and Raising Interest*

Taylor, M. Blair, W. (2013) *Fish Values of the Ōtūkaikino River* (2012) Aquatic Ecology Ltd Report (TRIM 13/333297)

TDC Environmental (2015) *Zinc Sources in California Urban Runoff*

Timperley, M., G. Bailey, P. Pattinson and G. Kuschel (2003) *Zinc, Copper and Lead in Road Runoff*, 26th Australian Transport Research Forum, Wellington, New Zealand (TRIM 14/1282623).

TRCA (2011) *Low Impact Development Stormwater Management Planning and Design Guide*, Version 1.0, Toronto and Region Conservation Authority.

USEPA (2015) *Memorandum of Understanding on Copper Mitigation in Watersheds and Waterways*.

Retrieved from:

http://water.epa.gov/polwaste/npdes/stormwater/upload/copper_brakepads_mou.pdf. Accessed 6 March 2015.

Winston, R., Hunt, B., Kennedy, S. and Wright, J. (2011) *Evaluation of Permeable Friction Course (PFC), Roadside Filter Strips, Dry Swales, and Wetland Swales for Treatment of Highway Stormwater Runoff*, North Carolina Department of Transportation. Retrieved from:
<http://www.ncdot.gov/doh/preconstruct/tpb/research/download/2007-21finalreport.pdf>. Accessed 17 January 2013.

Appendix A Schedule 2 responses

Table 13: Schedule 2 matters to be included in SMPs: CRC231955 Condition 7

Matters for inclusion in SMPs	Addressed in which Section of the SMP
a. Specific guidelines for implementation of stormwater management to achieve the purpose of SMPs;	The SMP is the guideline
b. A definition of the extent of the stormwater infrastructure, that forms the stormwater network within the SMP area for the purposes of this consent;	4.3
c. A contaminant load reduction target(s) for each catchment within that SMP area and a description of the process and considerations used in setting the contaminant load reduction target(s) required by Condition 6(b) using the best reasonably practicable model or method and input data;	10.2 to 10.9
d. A description of statutory and non-statutory planning mechanisms being used by the Consent Holder to achieve compliance with the conditions of this consent including the requirement to improve discharge water quality. These mechanisms shall include: <ul style="list-style-type: none"> i. Relevant objectives, policies, standards and rules in the Christchurch District Plan; ii. Relevant bylaws; and iii. Relevant strategies, codes, standards and guidelines; 	2.3 through 2.11
e. Mitigation methods to achieve compliance with the conditions of this resource consent including the requirement to improve discharge water quality under Condition 23, and to meet the contaminant load reduction targets for each catchment as determined	11.

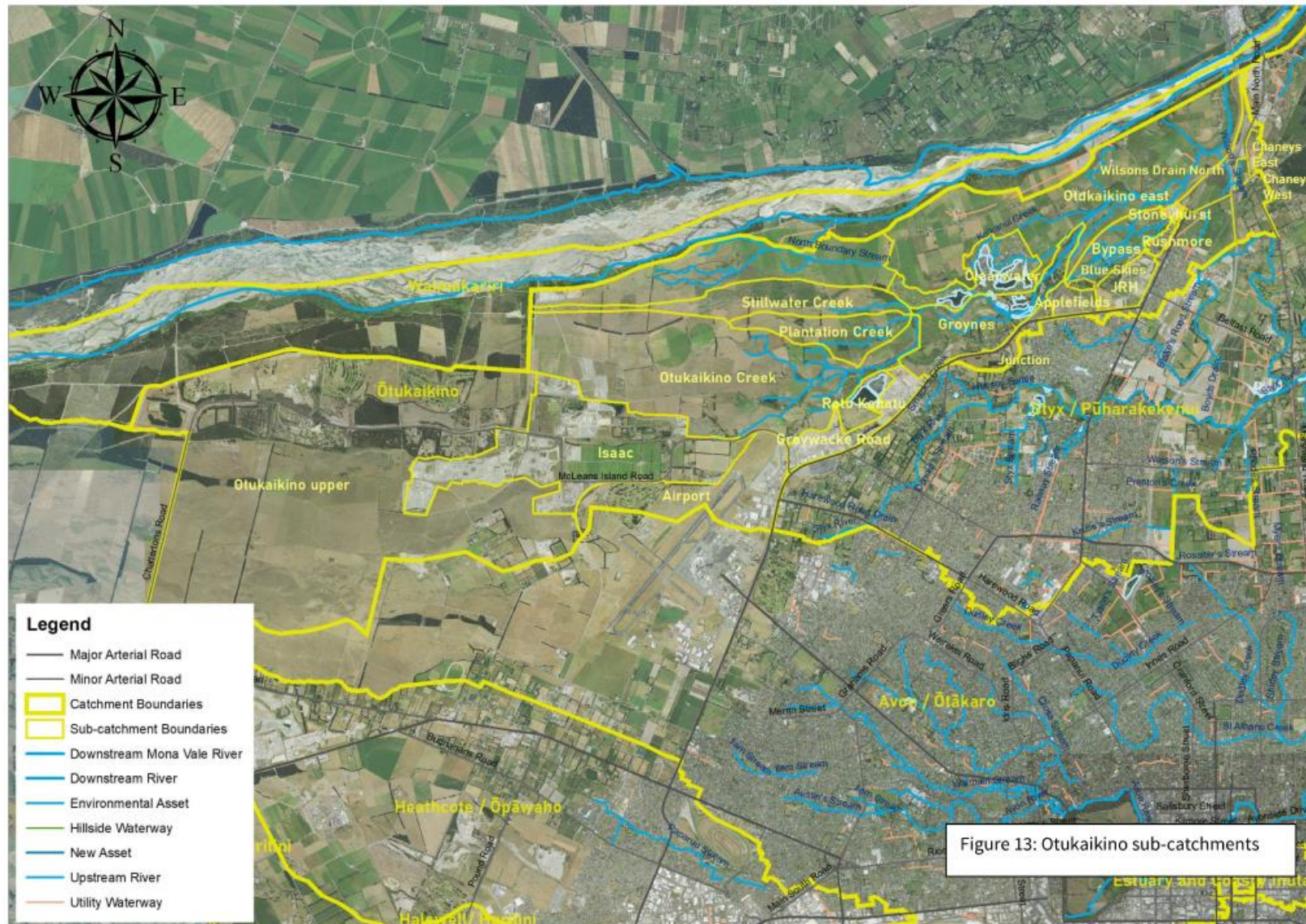
	<p>through the SMPs and the standards for the whole of Christchurch set in Condition 19. These methods shall include:</p> <ul style="list-style-type: none"> i. Stormwater mitigation facilities and devices; ii. Erosion and sediment control guidelines; iii. Education and awareness initiatives on source control systems and site management programmes; iv. Support for third party initiatives on source control reduction methods; v. Prioritising stormwater treatment in catchments: that discharge in proximity to areas of high ecological or cultural value, such as habitat for threatened species or Areas of Significant Natural Value under the Regional Coastal Environment Plan (Canterbury Regional Council, 2012); and areas with high contaminant loads; 	
f.	Locations and identification of Christchurch City Council water quality and water quantity mitigation facilities and devices; including a description and justification for separation distances between mitigation facilities or devices and any contaminated land;	11.6
g.	Identification of areas planned for future development and a description of the Consent Holder's consideration to retrofit water quality and quantity mitigation for existing catchments through these developments where reasonably practicable;	7.2 and Error! Reference source not found.
h.	Identification of areas subject to known flood hazards;	9 and 13
i.	A description of how environmental monitoring and assessment of tangata whenua values have been used to develop water quality mitigation methods and practices;	10.5
j.	Results from and interpretation of water quantity and quality modelling, including identification of sub-catchments with high levels of contaminants;	10.3 and Appendix E

k.	Mapping of existing information from Canterbury Regional Council and the Consent Holder showing locations where discrete spring vents occur;	Figures 2 and 3
l.	Consideration of any effects of the diversion and discharge of stormwater on base-flow in waterways and springs and details of monitoring that will be undertaken of any waterways and springs that could be affected by stormwater management changes anticipated within the life of the SMP;	11.6.4
m.	A cultural impact assessment;	10.5.3
n.	A summary of outcomes resulting from any collaboration with Papatipu Rūnanga on SMP development;	MKT advised that the cultural impact assessment was sufficient.
o.	An assessment of the effectiveness of water quality or quantity mitigation methods established under previous SMPs and identification of any changes in methods or designs resulting from the assessment;	10.4
p.	Assessment and description of any additional or new modelling, monitoring and mitigation methods being implemented by the Consent Holder;	10.2
q.	A summary of feedback obtained in accordance with Condition 8 and if / how that feedback has been incorporated into the SMP;	Awaiting feedback from public consultation
r.	If the Consent Holder intends to use land not owned or managed by the Consent Holder for stormwater management, a description of the specific consultation undertaken with the affected land owner;	Not applicable; no non-Council land to be used for stormwater management.

s.	Identification of key monitoring locations in addition to those identified in Schedule 10 where modelled assessments of water levels and/or volumes shall be made. For all monitoring locations, water level reductions or tolerances for increases shall be set for the critical 2% and 10% AEP events in accordance with the objective and ATLs in Schedule 10 and shall be reported with the model update results required under Condition 55;	No key locations. Flooding is not a factor for CCC control in this SMP
t.	Procedures, to be developed in consultation with Christchurch International Airport Limited, for the management of the risk of bird strike for any facility owned or managed by the Christchurch City Council within 3 kilometres of the airport;	11.6.1
u.	A description of any relevant options assessments undertaken to identify the drivers behind mitigation measures selected; and	10.7
v.	An assessment of the potential change to the overall water balance for the SMP area arising from the change in pervious area and the stormwater management systems proposed.	11.6.3

Appendix B Sub-catchment Map

Next page



Appendix C Basins and land contamination

Table 14: Proximity of proposed treatment basins to contaminated land

Basin ID	Address	Investigation report	Report Date	Findings	Justification for siting basin
1103	925 Main North Rd	Adjacent only	Mar 2020	No entry in LLUR	No known contamination.
	RS 40311 Cant. Dist., Pt Lots 1, 1, 1, 2, 3 DP 9738	INV255755 Leach field sampling INV267411 Sub-slab soil sampling	Jun 2020		Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
1102	987 Main North Rd RS 31379 Cant. Dist., Pt Lot 1 DP 9738, Stopped Rd SO 11681	No investigations in LLUR		No entry in LLUR	No known contamination. Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
1101	1000 Main North Rd Secs 1, 3 SO 540092	INV18970 Prelim. Site investigation for ground contamination, Belfast Greenfield Bus. Area	Apr 2013	INV18970 No entry in LLUR. Possible unlisted farming HAIL activities.	No known contamination. Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
1100	940 Main North Rd Lot 1 DP506549, Lot 5 DP 71209 96 Tyrone St	INV18970 Prelim. Site investigation for ground contamination,	Apr 2013	INV18970 No entry in LLUR. Possible unlisted farming HAIL activities.	No known contamination. Likely no significant contamination. Site will be investigated and

Basin ID	Address	Investigation report	Report Date	Findings	Justification for siting basin
	Lots 6, 7 DP 71209	Belfast Greenfield Bus. Area			remediated if necessary during basin construction.
1099	12 Fords Rd Sec 5 SO 540092	INV18970 Prelim. Site investigation for ground contamination, Belfast Greenfield Bus. Area	Apr 2013	INV18970 No entry in LLUR. Possible unlisted farming HAIL activities.	No known contamination. Likely no significant contamination. Site will be investigated and remediated if necessary during basin construction.
1109	12 Dickeys Road Sec 5 SO 517352, Lot 1 DP 83173, Sec 11 SO 517352, RES 2687, Sec 1 SO 515352, Lot 4 DP 473524	INV225319 Prelim. Site investigation JRHL – NW Belfast SW System	Sept 2017	No entry in LLUR	No known contamination.
1108	43 Darroch St RS 34409, Sec 13 SO 518339	INV225319 INV83015 Contaminated site mgmt. plan, Reconfiguration of Stoneyhurst Sawmill Site	Sept 2017 Apr 2014	No entry in LLUR	No known contamination.

Appendix D Treatment Efficiencies

Table 15: Treatment system efficiencies assumed in the contaminant load model

Table 6: Treatment systems and efficiencies assumed in the C-CLM.

Treatment system	TSS treatment efficiency (% removal)				Zinc treatment efficiency (% removal)				Copper treatment efficiency (% removal)			
	Roofs	Roads	Paved Surface	Grassland	Roofs	Roads	Paved Surface	Grassland	Roofs	Roads	Paved Surface	Grassland
Single treatment systems												
Basin & wetland	50.0	80.0	80.0	80.0	25.0	60.0	60.0	60.0	30.0	70.0	70.0	70.0
Rain garden	70.0	80.0	80.0	80.0	60.0	70.0	70.0	70.0	70.0	75.0	75.0	75.0
Stormfilter	50.0	75.0	75.0	75.0	15.0	40.0	40.0	40.0	20.0	65.0	65.0	65.0
Wet pond	10.0	75.0	75.0	75.0	5.0	30.0	30.0	30.0	5.0	40.0	40.0	40.0
Basin	10.0	60.0	60.0	60.0	5.0	20.0	20.0	20.0	5.0	30.0	30.0	30.0
First flush Basin	10.0	60.0	60.0	60.0	5.0	20.0	20.0	20.0	5.0	30.0	30.0	30.0
Wetland	50.0	80.0	80.0	80.0	25.0	60.0	60.0	60.0	30.0	70.0	70.0	70.0
Soil adsorption basin	89.0	89.0	89.0	89.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0
Swale	30.0	75.0	75.0	75.0	15.0	40.0	40.0	40.0	20.0	50.0	50.0	50.0
Combined treatment systems												
Basin and basin & wetland	55.0	92.0	92.0	92.0	28.8	68.0	68.0	68.0	33.5	79.0	79.0	79.0
Basin and First flush basin	19.0	84.0	84.0	84.0	9.8	36.0	36.0	36.0	9.8	51.0	51.0	51.0
Rain garden and basin and wetland	85.0	96.0	96.0	96.0	70.0	88.0	88.0	88.0	79.0	92.5	92.5	92.5
Swale and basin and wetland	65.0	95.0	95.0	95.0	36.3	76.0	76.0	76.0	44.0	85.0	85.0	85.0
Swale and first flush Basin	37.0	90.0	90.0	90.0	19.3	52.0	52.0	52.0	24.0	65.0	65.0	65.0

This table is Table 6 in the CSNDC Conditions, Schedule 5, *Assessment of Current and Future Contaminant load for Christchurch*, Golder Associates.

Appendix E Contaminant Load Model Results

Table 16: 2018 (reference) annual contaminant loads

Sub-catchment	Total	TSS Load (kg/yr)				Zinc Load (kg/yr)					Copper Load (kg/yr)				
		Roofs	Roads	Carpark	Rural	Total	Roofs	Roads	Carpark	Rural	Total	Roofs	Roads	Carpark	Rural
Airport	7662.28	437.64	3021.78	1449.46	2753.4	71.39	55.65	10.24	5.44	0.065	2.32	0.29	1.33	0.66	0.031
Applefields	1125.63	0.46	658.48	0	466.7	3.35	0.05	3.29	0	0.011	0.3	0	0.29	0	0.005
Blue Skies	107.64	0.8	14.85	0	92	0.13	0.09	0.03	0	0.002	0.01	0	0.01	0	0.001
Bypass	2943.5	12.98	2115.35	9.17	806	15.93	1.56	14.32	0.03	0.019	0.98	0.03	0.93	0	0.009
Chaney's East	442.48	11.84	302.32	39.22	89.1	4.03	1.51	2.38	0.15	0.002	0.16	0.01	0.13	0.02	0.001
Chaney's West	210	8.86	170.88	29.36	0.9	1.61	1.13	0.37	0.11	0.000	0.09	0.01	0.08	0.01	0.000
Clearwater	4556.06	95.54	1259.04	37.48	3164	14.07	11.38	2.47	0.14	0.075	0.87	0.26	0.56	0.02	0.036
Greywacke Road	6431.87	606.91	2910.76	1998.91	915.3	98.78	77.14	14.12	7.5	0.022	2.62	0.41	1.28	0.92	0.010
Groynes	6773.98	38.84	1632.08	105.66	4997.4	8.6	4.88	3.21	0.4	0.118	0.87	0.04	0.72	0.05	0.056
Isaac	23314.8	177.94	7766.51	540.85	14829.5	48.98	22.49	24.11	2.03	0.350	3.99	0.15	3.42	0.25	0.167
Johns Road	1890.36	11.74	1358.46	19.65	500.5	11.4	1.44	9.88	0.07	0.012	0.63	0.02	0.6	0.01	0.006
JRH	365.37	5.1	37.04	4.82	318.4	0.71	0.62	0.07	0.02	0.008	0.03	0.01	0.02	0	0.004
Junction	1678.2	34.05	1332.84	40.11	271.2	11.55	4.13	7.27	0.15	0.006	0.68	0.07	0.59	0.02	0.003
Ōtūkaikino Creek	26218.69	22.21	3974.51	65.28	22183.4	13.75	2.8	10.18	0.24	0.524	2.04	0.02	1.74	0.03	0.249
Ōtūkaikino east	22407.61	135.23	4766.62	395.66	17110.1	37.51	17.05	18.54	1.48	0.442	2.6	0.13	2.1	0.18	0.190
Ōtūkaikino upper	77478.77	188.17	12884	575.1	63831.5	53.59	23.8	26.13	2.16	1.510	6.82	0.16	5.68	0.26	0.715
Plantation Creek	3992.82	0	274.62	0	3718.2	0.63	0	0.54	0	0.088	0.16	0	0.12	0	0.042

		TSS Load (kg/yr)				Zinc Load (kg/yr)					Copper Load (kg/yr)				
Roto Kohatu	1452.43	2.35	753.51	7.77	688.8	1.82	0.3	1.48	0.03	0.016	0.35	0	0.33	0	0.008
Rushmore	544.71	70.44	346.26	15.01	113	9.33	8.36	0.91	0.06	0.003	0.36	0.2	0.15	0.01	0.001
South Branch	13981.34	10.14	2348.14	33.57	11589.5	6.29	1.29	4.6	0.13	0.274	1.19	0.01	1.04	0.02	0.130
Stillwater Creek	6230.6	0.29	224.67	0.94	6004.7	0.62	0.04	0.44	0	0.142	0.17	0	0.1	0	0.067
Stoneyhurst	346.34	58.24	0	192.9	95.2	8.13	7.41	0	0.72	0.002	0.13	0.04	0	0.09	0.001
Wilsons Drain North	5921.19	50.25	4855.31	155.43	860.2	7.96	6.36	0	0.58	0.020	2.26	0.04	2.14	0.07	0.010
Wilsons Drain South	4624.45	359.47	3242.78	249	773.2	59.56	43.12	15.48	0.93	0.018	2.46	0.91	1.43	0.11	0.009
Total (kg/yr)	220,701	2,339	56,250	5,965	156,172	521.67	292.60	170.06	22.37	3.73	32.09	2.81	24.79	2.73	1.75

Note: 'Carpark' refers to paved areas in industrial zones



Table 17: Estimated annual contaminant loads from fully developed sub-catchments before treatment

Sub-catchment	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
	Total	Roofs	Roads	Carpark	Rural	Total	Roofs	Roads	Carpark	Rural	Total	Roofs	Roads	Carpark	Rural
Airport	7662.28	437.64	3021.78	1449.46	2753.4	71.39	55.65	10.24	5.44	0.065	2.32	0.29	1.33	0.66	0.031
Applefields	3186.78	0.46	658.48	0	180	33.84	0.05	3.29	0	0.002	1.4	0	0.29	0	0.004
Blue Skies	622.89	0.8	14.85	0	33.9	6.65	0.09	0.03	0	0.000	0.27	0	0.01	0	0.001
Bypass	2943.5	12.98	2115.35	9.17	806	15.93	1.56	14.32	0.03	0.019	0.98	0.03	0.93	0	0.009
Chaney's East	1875.5	11.84	302.32	39.22	27.9	24.23	1.51	2.38	0.15	0.000	0.97	0.01	0.13	0.02	0.001
Chaney's West	1127.46	8.86	170.88	29.36	0.3	14.78	1.13	0.37	0.11	0.000	0.59	0.01	0.08	0.01	0.000
Clearwater	4556.06	95.54	1259.04	37.48	3164	14.07	11.38	2.47	0.14	0.075	0.87	0.26	0.56	0.02	0.036
Greywacke Road	6431.87	606.91	2910.76	1998.91	915.3	98.78	77.14	14.12	7.5	0.022	2.62	0.41	1.28	0.92	0.010
Groynes	6773.98	38.84	1632.08	105.66	4997.4	8.6	4.88	3.21	0.4	0.118	0.87	0.04	0.72	0.05	0.056
Isaac	23314.8	177.94	7766.51	540.85	14829.5	48.98	22.49	24.11	2.03	0.350	3.99	0.15	3.42	0.25	0.167
Johns Road	1890.36	11.74	1358.46	19.65	500.5	11.4	1.44	9.88	0.07	0.012	0.63	0.02	0.6	0.01	0.006
JRH	5017.44	5.1	37.04	4.82	116.5	54.84	0.62	0.07	0.02	0.001	2.27	0.01	0.02	0	0.003
Junction	1678.2	34.05	1332.84	40.11	271.2	11.55	4.13	7.27	0.15	0.006	0.68	0.07	0.59	0.02	0.003
Ōtūkaikino Creek	26218.69	22.21	3974.51	65.28	22183.4	13.75	2.8	10.18	0.24	0.524	2.04	0.02	1.74	0.03	0.249
Ōtūkaikino east	22407.61	135.23	4766.62	395.66	17110.1	37.51	17.05	18.54	1.48	0.442	2.6	0.13	2.1	0.18	0.190

	TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Ötūkaikino upper	77478.77	188.17	12884	575.1	63831.5	53.59	23.8	26.13	2.16	1.510	6.82	0.16	5.68	0.26	0.715
Plantation Creek	3992.82	0	274.62	0	3718.2	0.63	0	0.54	0	0.088	0.16	0	0.12	0	0.042
Roto Kohatu	1452.43	2.35	753.51	7.77	688.8	1.82	0.3	1.48	0.03	0.016	0.35	0	0.33	0	0.008
Rushmore	544.71	70.44	346.26	15.01	113	9.33	8.36	0.91	0.06	0.003	0.36	0.2	0.15	0.01	0.001
South Branch	13981.34	10.14	2348.14	33.57	11589.5	6.29	1.29	4.6	0.13	0.274	1.19	0.01	1.04	0.02	0.130
Stillwater Creek	6230.6	0.29	224.67	0.94	6004.7	0.62	0.04	0.44	0	0.142	0.17	0	0.1	0	0.067
Stoneyhurst	346.34	58.24	0	192.9	95.2	8.13	7.41	0	0.72	0.002	0.13	0.04	0	0.09	0.001
Wilsons Drain North	5921.19	50.25	4855.31	155.43	860.2	7.96	6.36	0	0.58	0.020	2.26	0.04	2.14	0.07	0.010
Wilsons Drain South	13528.71	359.47	3242.78	249	444.8	142.66	43.12	15.48	0.93	0.005	6.5	0.91	1.43	0.11	0.011
Total (kg/yr)	239,184	2,339	56,250	5,965	155,235	729.28	292.60	170.06	22.37	3.70	41.04	2.81	24.79	2.73	1.75

Note: 'Carpark' refers to paved areas in industrial zones

Table 18: Estimated annual contaminant loads after full development and basin/wetland treatment. Green sub-catchments are treated in basins + wetlands.

Sub-catchment	Total	TSS Load (kg/yr)				Total	Zinc Load (kg/yr)				Total	Copper Load (kg/yr)			
		Roofs	Roads	Carpark	Rural		Roofs	Roads	Carpark	Rural		Roofs	Roads	Carpark	Rural
Airport	7662.3	437.6	3021.8	1449.5	2753.4	71.39	55.65	10.24	5.44	0.065	2.32	0.290	1.330	0.660	0.031
Applefields	274.6	23.9	234.9	1.4	14.4	21.03	18.50	2.48	0.02	0.001	0.34	0.060	0.271	0.002	0.001
Blue Skies	54.1	5.2	45.9	0.3	2.7	4.22	3.79	0.42	0.00	0.000	0.07	0.012	0.053	0.000	0.000
Bypass	2943.5	13.0	2115.4	9.2	806.0	15.93	1.56	14.32	0.03	0.019	0.98	0.030	0.930	0.000	0.009
Chaneys East	172.4	27.1	71.9	71.1	2.2	14.60	12.43	1.10	1.07	0.000	0.28	0.110	0.083	0.085	0.000
Chaneys West	103.8	16.6	43.9	43.4	0.0	8.90	7.59	0.67	0.65	0.000	0.17	0.069	0.051	0.052	0.000
Clearwater	4556.1	95.5	1259.0	37.5	3164.0	14.07	11.38	2.47	0.14	0.075	0.87	0.260	0.560	0.020	0.036
Greywacke Rd	6431.9	606.9	2910.8	1998.9	915.3	98.78	77.14	14.12	7.50	0.022	2.62	0.410	1.280	0.920	0.010
Groynes	6774.0	38.8	1632.1	105.7	4997.4	8.60	4.88	3.21	0.40	0.118	0.87	0.040	0.720	0.050	0.056
Isaac	23314.8	177.9	7766.5	540.9	14829.5	48.98	22.49	24.11	2.03	0.350	3.99	0.150	3.420	0.250	0.167
Johns Road	1890.4	11.7	1358.5	19.7	500.5	11.40	1.44	9.88	0.07	0.012	0.63	0.020	0.600	0.010	0.006
JRH	434.5	40.3	382.5	2.3	9.3	34.73	31.22	3.48	0.04	0.000	0.55	0.099	0.443	0.003	0.001
Junction	1678.2	34.1	1332.8	40.1	271.2	11.55	4.13	7.27	0.15	0.006	0.68	0.070	0.590	0.020	0.003
Ōtūkaikino Ck	26218.7	22.2	3974.5	65.3	22183.4	13.75	2.80	10.18	0.24	0.524	2.04	0.020	1.740	0.030	0.249
Ōtūkaikino east	22407.6	135.2	4766.6	395.7	17110.1	37.51	17.05	18.54	1.48	0.442	2.60	0.130	2.100	0.180	0.190

		TSS Load (kg/yr)					Zinc Load (kg/yr)					Copper Load (kg/yr)				
Ōtūkaikino upper	77478.8	188.2	12884.0	575.1	63831.5	53.59	23.80	26.13	2.16	1.510	6.82	0.160	5.680	0.260	0.715	
Plantation Creek	3992.8	0.0	274.6	0.0	3718.2	0.63	0.00	0.54	0.00	0.088	0.16	0.000	0.120	0.000	0.042	
Roto Kohatu	1452.4	2.4	753.5	7.8	688.8	1.82	0.30	1.48	0.03	0.016	0.35	0.000	0.330	0.000	0.008	
Rushmore	69.6	31.7	27.7	1.2	9.1	6.30	6.00	0.29	0.02	0.001	0.17	0.130	0.032	0.002	0.000	
South Branch	13981.3	10.1	2348.1	33.6	11589.5	6.29	1.29	4.60	0.13	0.274	1.19	0.010	1.040	0.020	0.130	
Stillwater Creek	6230.6	0.3	224.7	0.9	6004.7	0.62	0.04	0.44	0.00	0.142	0.17	0.000	0.100	0.000	0.067	
Stoneyhurst	346.3	58.2	0.0	192.9	95.2	8.13	7.41	0.00	0.72	0.002	0.13	0.040	0.000	0.090	0.001	
Wilsons Drain North	5921.2	50.3	4855.3	155.4	860.2	7.96	6.36	0.00	0.58	0.020	2.26	0.040	2.140	0.070	0.010	
Wilsons Drain South	1184.8	124.7	702.0	322.5	35.6	76.90	56.70	15.30	4.84	0.002	1.72	0.515	0.812	0.388	0.002	
Total (kg/yr)	219667	2298	5623	6556	154600	650.20	399.67	183.48	30.45	3.69	34.62	2.88	26.52	3.45	1.74	

Note: 'Carpark' refers to paved areas in industrial zones

Appendix F Attribute Target Levels, Schedules 7 to 10

Waterways, Coastal and Groundwater Receiving Environment Attribute Target Levels in Schedules 7 to 10 from Condition 23, Consent CRC231955.

Schedule 7: Receiving Environment Objectives and Attribute Target Levels for Waterways

The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels.

TBC-A = To Be Confirmed once a full year of monitoring allows hardness modified values to be calculated, in accordance with Condition 52.

TBC-B = To Be Confirmed following engagement with Papatipu Rūnanga, through an update to the EMP, in accordance with Condition 54.

Objective	Attribute	Attribute Target Level	Basis for Target
Adverse effects on ecological values do not occur due to stormwater inputs	QMCI	Lower limit QMCI scores: <ul style="list-style-type: none"> Spring-fed – plains – urban waterways: 3.5 Spring-fed – plains waterways: 5 Banks Peninsula waterways: 5 	QMCI is an indicator of aquatic ecological health, with higher numbers indicative of better quality habitats, due to a higher abundance of more sensitive species. QMCI scores are taken from the guidelines in Table 1a of the LWRP (Canterbury Regional Council, 2018). This metric is designed for wade able sites and should therefore be used with caution for non-wade able sites. These targets can be achieved through reducing contaminant loads and waterway restoration.
Adverse effects on water clarity and aquatic biota do not occur due to sediment inputs	<p>Fine sediment (<2 mm diameter) percent cover of stream bed</p> <p>TSS concentrations in surface water</p>	<p>Upper limit fine sediment percent cover of stream bed:</p> <ul style="list-style-type: none"> Spring-fed – plains – urban waterways: 30% Spring-fed – plains waterways: 20% Banks Peninsula waterways: 20% 	Sediment (particularly from construction) can decrease the clarity of the water, and can negatively affect the photosynthesis of plants and therefore primary productivity within streams, interfere with feeding through the smothering of food supply, and can clog suitable habitat for species. The sediment cover Target Levels are taken from the standards for the original Styx and South-West Stormwater Management Plan consents, and are based on Table 1a of the LWRP (Canterbury Regional Council, 2018). These targets should be

		<p>Upper limit concentration of TSS in surface water: 25 mg/L</p> <p>No statistically significant increase in TSS concentrations in surface water</p>	<p>used with caution at sites that likely naturally have soft-bottom channels. These targets can be achieved through reducing contaminant loads (particularly using erosion and sediment control) and instream sediment removal.</p>
Adverse effects on aquatic biota do not occur due to copper, lead and zinc inputs in surface water	Zinc, copper and lead concentrations in surface water	<p>Upper limit concentration of dissolved zinc:</p> <ul style="list-style-type: none"> • Ōtākaro/ Avon River catchment: 0.0297 mg/L • Ōpāwaho/ Heathcote River catchment: 0.04526 mg/L • Cashmere Stream: 0.00724 mg/L • Huritini / Halswell River catchment: 0.01919 mg/L • Pūharakekenui/ Styx River catchment: 0.01214 mg/L • Ōtūkaikino River catchment: 0.00868 mg/L • Linwood Canal: 0.146 mg/L • Banks Peninsula catchments: TBC-A 	<p>These metals can be toxic to aquatic organisms, negatively affecting such things as fecundity, maturation, respiration, physical structure and behavior. The Council has developed these hardness modified trigger values in accordance with the methodology in the 'Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand' (ANZG, 2018) guidelines, and the species protection level relevant to each waterway in the LWRP (Canterbury Regional Council, 2017). This calculation document can be provided on request.</p> <p>These targets can be achieved primarily through reducing contaminant loads.</p>

		<p>Upper limit concentration of dissolved copper:</p> <ul style="list-style-type: none">• Ōtākaro/ Avon River catchment: 0.00356 mg/L• Ōpāwaho/ Heathcote River catchment: 0.00543 mg/L• Cashmere Stream: 0.00302 mg/L• Huritini / Halswell River catchment: 0.00336 mg/L• Pūharakekenui/ Styx River catchment: 0.00212 mg/L• Ōtūkaikino River catchment: 0.00152 mg/L• Linwood Canal: 0.0175 mg/L• Banks Peninsula catchments: TBC-A	
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Objective	Attribute	Attribute Target Level	Basis for Target
		<p>Upper limit concentration of dissolved lead:</p> <ul style="list-style-type: none"> • Ōtākaro/ Avon River catchment: 0.01554 mg/L • Ōpāwaho/ Heathcote River catchment: 0.02916 mg/L • Cashmere Stream: 0.00521 mg/L • Huritini / Halswell River catchment: 0.01257 mg/L • Pūharakekenui/ Styx River catchment: 0.00634 mg/L • Ōtūkaikino River catchment: 0.00384 mg/L • Linwood Canal: 0.167 mg/L • Banks Peninsula catchments: TBC-A <p>No statistically significant increase in copper, lead and zinc concentrations</p>	

Excessive growth of macrophytes and filamentous algae does not occur due to nutrient inputs	Total macrophyte and filamentous algae (>20 mm length) cover of stream bed	<p>Upper limit total macrophyte cover of the stream bed:</p> <ul style="list-style-type: none"> w. Spring-fed – plains – urban waterways: 60% x. Spring-fed – plains waterways: 50% y. Banks Peninsula waterways: 30% <p>Upper limit filamentous algae cover of the stream bed:</p>	Macrophyte and algae cover are indicators of the quality of aquatic habitat. Targets are taken from Table 1a of the LWRP (Canterbury Regional Council, 2018). Improvement towards these targets can be achieved by reduction in nutrient concentrations and riparian planting to shade the waterways.
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Objective	Attribute	Attribute Target Level	Basis for Target
		<ul style="list-style-type: none"> Spring-fed – plains – urban waterways: 30% Spring-fed – plains waterways: 30% Banks Peninsula waterways: 20% 	
Adverse effects on aquatic biota do not occur due to zinc, copper, lead and PAHs in instream sediment	Zinc, copper, lead and PAHs concentrations in instream sediment	<p>Upper limit concentration of total recoverable metals for all classifications:</p> <ul style="list-style-type: none"> Copper = 65 mg/kg dry weight Lead = 50 mg/kg dry weight Zinc = 200 mg/kg dry weight Total PAHs = 10 mg/kg dry weight <p>No statistically significant increase in copper, lead, zinc and Total PAHs</p>	Meta Metals can bind to sediment and remain in waterways, potentially negatively affecting biota. These trigger values are based on the ANZG guidelines (ANZG, 2018). These targets can be achieved through reducing contaminant loads and instream sediment removal.
Adverse effects on Mana Whenua values do not occur due to stormwater inputs	Waterway Cultural Health Index and State of Takiwā scores	<p>Lower limit averaged Waterway Cultural Health Index and State of Takiwā scores for all classifications:</p> <ul style="list-style-type: none"> Spring-fed – plains – urban waterways: TBC-B Spring-fed – plains waterways: TBC-B Banks Peninsula waterways: TBC-B 	The Waterway Cultural Health Index assesses cultural values and indicators of environmental health, such as mahinga kai (food gathering). These indices are on a scale of 1 - 5, with higher scores indicative of greater cultural values. No guidelines are available currently for the different types of waterways, so these targets will be developed specifically for this consent, with higher targets for waterways with higher values. These targets

			can be achieved through reducing contaminant loads and habitat restoration.
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Schedule 9: Receiving Environment Objectives and Attribute Target Levels for Groundwater and Springs

The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels

Objective	Attribute	Attribute Target Level	Basis for Target
Protect drinking water quality	Copper, lead, zinc and <i>Escherichia coli</i> concentrations in drinking water	<p>Concentration to not exceed:</p> <ul style="list-style-type: none"> Dissolved Copper: 0.5 mg/L Dissolved Lead: 0.0025 mg/L Dissolved Zinc: 0.375 mg/L <p>No statistically significant increase in the concentration of <i>Escherichia coli</i> at drinking water supply wells</p>	<p>The most important use of Christchurch groundwater is the supply of the urban reticulated drinking water supply. Contaminants in stormwater that infiltrate into the ground could impact on the quality of water supply wells and/or springs. The compliance criteria for a potable and wholesome water supply are specified in the Drinking Water Standards for New Zealand 2005 (Revised 2008). Metals and <i>E.coli</i> were chosen for these targets, as these are contaminants present in stormwater. The target values for copper and lead are a quarter of the Maximum Acceptable Value (MAV) or Guideline Value (GV) taken from the Drinking Water Standards for New Zealand 2005 (revised 2008). This is to ensure investigations occur before the water quality limits in the LWRP are exceeded, which are that concentrations are not to exceed 50% of the MAV. An equivalent criteria has also been applied to the zinc target, which is not included in the LWRP water quality limits, but has a guideline in the drinking water standards.</p>
Avoid widespread adverse effects on shallow groundwater quality	Electrical conductivity in groundwater	<ul style="list-style-type: none"> No statistically significant increase in electrical conductivity 	<p>Contaminants in stormwater that infiltrate into the ground could impact on groundwater quality. Long term groundwater quality at monitoring wells is undertaken by Canterbury Regional Council. Those monitoring points that occur within the urban area could be impacted by Council stormwater management activities. Electrical conductivity is to be used as an indicator for identifying any general changes in groundwater quality related to recharge.</p>

Appendix G Guidelines for Bird Strike Management

In Stormwater Basin/Water Body Design

Purpose of Design Guidelines

Bird strike is defined in the Christchurch District Plan as when a bird or flock of birds collide with an aircraft and is a key threat to the safe operation of Christchurch International Airport. It is of particular concern throughout the Ōtūkaikino catchment, which lies immediately to the north of the main Christchurch Airport runway. Bird strike is a significant safety risk which requires diligent management and collaboration between Christchurch International Airport Ltd (CIAL/ the airport), local government and surrounding landowners.

Strategies for reducing the risk of strikes at the airport focus on managing wildlife populations on and surrounding the airport. There are provisions in the District Plan addressing issues arising out of incompatible land uses relating to the avoidance of bird strike risk introduced in Chapter 6, Section 6.7 Aircraft Protection, supported by Policy 6.7.2.1.2. Section 6.7.4.3 Activity status tables – Bird strike Management Areas outlines activities and specific standards aimed at managing the establishment of new land uses such as water bodies and stormwater basins that might provide new and additional habitat that is attractive to birds, such that it may increase the movement of birds across flight paths. Appendix 6.11.7.5 outlines controls related to water bodies and stormwater basins within the 3km radius, however considerations for bird strike must also be taken into account up to 13km from the airport runway thresholds, in collaboration with CIAL.

Parameters

Bird strike risk can be avoided or minimised appropriately using best practice guidance provided below, in the District Plan, in collaboration with CIAL⁶

Bird use of stormwater management basins are similar to those of natural water bodies. Parameters to minimise bird strike are similar for both basins and water bodies, and include minimising facility surface area as much as practicable, and design considerations such as:

- maximisation of drainage to avoid standing water,
- increased bank gradients to deter bird nesting,
- avoidance of permanent island features which can provide perching sites for birds,
- appropriate landscape design considering perimeter plant species selection and densities (diagrammed in Figure 1 below).

Ongoing bird strike risk management also extends beyond design and implementation to water body or basin operations, maintenance and/or monitoring.

⁶ Rules in the District Plan specifically control the creation of new stormwater basins or water bodies within identified Birdstrike Management Areas (i.e., Rule 6.7.4.3.1 Activity P3). Other plan provisions also deal with bird strike, and are generally referenced in Section X of this management plan.

The risk of bird strike will vary from site to site and may be influenced by factors such as proximity to the airport, the flight patterns of specific bird species, surrounding land uses and natural factors such as season, species ecology, and landscape features.

Some general guidelines for design of stormwater basins / water bodies to minimise the risk of bird strike are shown in Figure 14. Specific implementation of these guidelines will vary on a site-by-site basis and should be undertaken in consultation with CIAL and on receipt of ornithologist advice.

Additional guidelines are:

1. Minimising open water and vegetative cover that provides food, shelter or roosting for birds are the primary habitat features of focus for bird risk management near the airport.

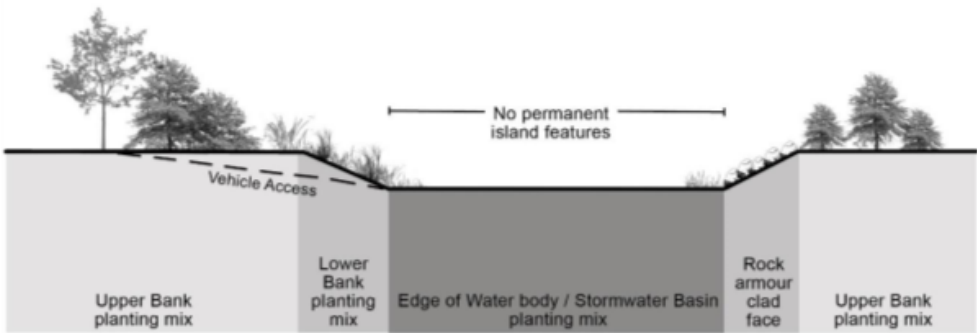


Figure 14: Typical basin section

2. Landscape planting plans must limit the attractiveness of basins to birds using suitable non-attracting plant species. Vegetation with berries, nuts, desirable forage, attractive flowers, edible tubers or roots, or large, abundant or high-nutrient seeds should be avoided as a potential wildlife attractant. In general, using low diversity planting strategies and avoiding high-nutrient organic soil amendment (which can attract invertebrates that attract certain birds) is important. Plant species should be limited to those listed in Table 19 (and Appendix 6.11.9 of the District Plan).

Table 19: Plant species for Water Bodies /Stormwater Basins in the Ōtūkaikino Catchment

Edge of Water body / Stormwater basin	
Botanical name	Common name
<i>Schoenoplectus validus / tabernaemontani</i>	lake club rush / kapungawha
<i>Eleocharis acuta</i>	spike sedge
<i>Carex germinata</i>	makura
<i>Schoenus pauciflorus</i>	bog rush
<i>Polystichum vestitum</i>	prickly shield fern
<i>Juncus pallidus</i>	tussock rush / wiwi
<i>Cyperus ustulatus</i>	umbrella sedge

Lower Bank	
Botanical name	Common name
<i>Anemanthele lessoniana</i>	wind grass
<i>Astelia fragrans</i>	bush lily / kakaha
<i>Coprosma propinqua</i>	mikimiki
<i>Dianella nigra</i>	ink berry / turutu
<i>Plagianthus divaricatus</i>	swamp ribbonwood
Upper Bank	
Botanical name	Common name
<i>Aristotelia serrata</i>	makomako / wineberry
<i>Carpodetus serratus</i>	marbleleaf / putaputaweta
<i>Coprosma rotundifolia</i>	roundleaved coprosma
<i>Dodonea viscosa</i> (frost tender)	akeake
<i>Eleocarpus hookerianus</i>	pokaka
<i>Griselinia littoralis</i>	kapuka / broadleaf
<i>Hebe salicifolia</i>	koromiko
<i>Hoheria angustifolia</i>	narrow leaved lacebark
<i>Kunzea ericoides</i>	kanuka
<i>Leptospermum scoparium</i>	manuka
<i>Lophomyrtus obcordata</i>	rohutu / NZ myrtle
<i>Myrsine australis</i>	mapou
<i>Myrsine divaricata</i>	weeping mapou
<i>Pittosporum eugenioides</i>	lemonwood
<i>Pittosporum tenuifolium</i>	matipo
<i>Plagianthus regius</i>	lowland ribbonwood
<i>Podocarpus totara</i>	totara
<i>Prumnopitys taxifolia</i>	matai
<i>Pseudowintera colorata</i>	peppertree
<i>Sophora microphylla</i>	kowhai

- High risk bird species of particular concern to aircraft bird strike are summarised in Table 20. Flexibility or adaptability is needed as birds may modify their behaviour in response to installation of new stormwater facilities in ways that were not anticipated during design,

resulting in an aviation safety problem. Continued collaboration between stormwater facility designers and CIAL is recommended.

Table 20: Bird species causing particular risk of bird strike
Source: Dr. Leigh Bull, 2021.

Bird Species	Habitat Characteristics
Southern black-backed gull (<i>Larus dominicanus</i>)	Found in most habitats. Colonies can occur on islands, steep headlands, sand, or shingle spits or on islands in shingle riverbeds.
Canada goose (<i>Branta canadensis</i>)	Graze on pasture, young crops, and aquatic plants. Prefer pastoral land adjacent to a lake or large pond.
Feral pigeon/ Rock pigeon (<i>Columba livia</i>)	Variety of habitats. Roost and nest in buildings, under bridges/wharves, and on ledges of cliffs and caves. Occupy open habitats, usually near water (e.g. riverbeds, sea and lake shores, agricultural pasture, and urban parklands).
Spur-winged plover (<i>Vanellus miles</i>)	Move in response to availability of wetlands. Use temporary and recently constructed artificial wetlands, and leave a drying wetland or diminished food supply.

Stormwater basin designers should make early contact with CIAL for referral to an ornithologist familiar with aviation operations.