Comprehensive Stormwater Network Discharge Consent Annual Report – June 2023

Prepared to meet the requirements of CRC231955

Christchurch City Council

Christchurch City Council

Internal Document Review and Approval

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Acronyms and Abbreviations

ATL	Attribute Target Level
CBA	Cost-Benefit Analysis
Council	Christchurch City Council
CSNDC	Comprehensive Stormwater Network Discharge Consent
ECan	Environment Canterbury Regional Council
EMP	Environmental Monitoring Programme
ESCP	Erosion Sediment Control Plan
ICCM	Instream Contaminant Concentration Model
IDS	Infrastructure Design Standards
IGSC	Interim Global Stormwater Consent
LWRP	Land and Water Regional Plan
MEDUSA	Modelled Estimates of Discharges for Urban Stormwater Assessments
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
PAH	Polycyclic aromatic hydrocarbons
QMCI	Quantitative Macroinvertebrate Index
SDMP	Sediment Discharge Management Plan
SMP	Stormwater Management Plan
TPRP	Technical Peer Review Panel
TSS	Total Suspended Solids
TWWM	Targeted Wet Weather Monitoring
WWDG	Waterways Wetlands Design Guide

1. Purpose of the Annual Report

In December 2019, Environment Canterbury Regional Council (ECan), granted the Comprehensive Stormwater Network Discharge Consent (CSNDC) CRC231955, to the Christchurch City Council (Council). As per Condition 61, the Council must produce an Annual Report on 30 June each year, reporting on the previous calendar year of consent activities undertaken. The Annual Report is provided to ECan, Banks Peninsula and Christchurch West-Melton Zone Committees, Papatipu Rūnanga (via Mahaanui Kurataiao Limited), and is published on the Council's website.

This third CSNDC Annual Report primarily covers the period 1 January to 31 December 2022.

2. Summary of Developments Authorised under this Consent

The Council has authorised stormwater discharges under consent CRC231955, since 20 December 2019, when the consent order was issued. This occurs when an applicant (e.g. developer or customer building a new residential dwelling) applies for a resource consent, building consent, or subdivision consent; and is required to ensure that the discharge of stormwater from the building or site is legally authorised. An applicant may then choose to request authorisation from the Council to discharge stormwater under consent CRC231955 or to obtain their own resource consent from ECan.

The authorisations given by the Council to applicants have been for sites including subdivisions, redevelopment of commercial and industrial sites, residential housing units, schools, and individual house lots. Appendix A provides the list of sites that were authorised in 2022 to discharge under the CSNDC, as required by Condition 61(h).

ECan are notified of sites authorised to discharge under the consent on a monthly basis. The Council requests advice from ECan on applications for discharge approval which might hold unacceptably high risk. In accordance with Condition 2(d), those sites which ECan advise should be considered to hold unacceptably high risk, are not provided with stormwater approval by Council. Rather their discharge is managed via resource consent with ECan.

3. Changes to Regulatory Framework Affecting Stormwater Management Plans (SMPs)

There have been no changes to regulatory frameworks which would warrant changes to SMPs.

4. Alignment with Christchurch-West Melton Sub-Regional Section of the Canterbury Land and Water Regional Plan (LWRP)

This resource consent was developed under the then operative version of the LWRP. While this plan will in future be reviewed with regard to Central Government's National Policy Statement for Freshwater Management 2022, this review has not yet addressed the Christchurch-West Melton sub-regional section of the LWRP, and thus no further reporting on this matter is required.

5. Complaints or Observations regarding Spring Flow

There have been no specific complaints received by the Council regarding spring flow and/or quality. However, it is common to receive complaints regarding low waterway flow in the Waimairi and Wai-iti Streams, mainly during summer months when groundwater level is expected to be lower.

6. Canterbury Regional Council – Consent Compliance Reviews for 2022

ECan undertook a compliance monitoring review of the CSNDC and sent through a report to the Council on 31 August 2022, sighting 10 non-compliances. While most of the non-compliance matters are administrative and have been subsequently addressed, the key matters identified to be addressed were:

- Re-submit the Huritīni/Halswell, and Ōpāwaho/Heathcote SMPs. This is still to be completed.
- Submit Schedule 4(r) Styx River Macrophyte report. This has been completed.
- Re-submit the Sediment Discharge Management Plan. This plan incorporated Stormwater and Land Drainage Bylaw 2022 changes and has now been submitted and certified by ECan.
- Complete Condition 54 - The Attribute Target Levels in Schedules 7 and 8 for the Waterway Cultural Health Index, Marine Cultural Health Index and State of Takiwa scores, as well as the associated mana whenua values monitoring sites and methodology in the EMP, shall be developed in collaboration with Papatipu Runanga. This has been completed and will be included in EMP Chapter 8.
- Submit Condition 59 – Responses to Monitoring (Surface Water) – Investigation Report 2020 and 2021. This report was submitted and accepted by ECan in December 2022.

7. Stormwater Management Plans

7.1. Background and Purpose

Stormwater Management Plans are required to be developed and updated for each river catchment, as per CSNDC conditions 4 and 5. Condition 6 and Schedule 2 provide the purpose and requirements of SMPs. These SMPs provide commentary on the future approach of the Council for these catchments in relation to flood protection, ecology and water quality, and hydrogeology (groundwater).

7.2. Progress to-date on SMP Programme

As per Condition 5, the SMPs for the Huritīni-Halswell and Ōpāwaho-Heathcote were completed and reviewed by the TPRP, as per Condition 14(b) and 15(b). They went out for public consultation in July and August 2021. Once submissions were considered and SMPs updated, they were sent to Council, adopted and then lodged with ECan in December 2021. ECan has provided technical feedback and Council staff are in the process of updating the SMPs for resubmission in 2023, for ECan signoff. Council staff still await definition of treatment facility catchments by a consultant; the definition has proved more difficult than expected.

The draft Ihutai-Estuary and Coastal SMP went out for public consultation and submissions in March and April 2022. The SMP was adopted by Council on 9 June 2022 and lodged with ECan on 30 June 2022, for review and signoff. ECan subsequently provided further technical comment; this was discussed and incorporated into the SMP, which was re-submitted in December 2022 for ECan's certification.

The draft Ōtūkaikino SMP went out for public consultation and submissions in March and May 2023. The SMP was adopted by Council on 21 June 2023 and lodged with ECan on 2 October 2023.

7.3. Implementation Plan

The implementation plan, as per Condition 11, was lodged with ECan in 2021. The next plan aligned with the new LTP 2024-34 will be submitted with the 2024 CSNDC Annual report.

The updated programme of stormwater capital works for the Council and anticipated private development, with budgets linked to the Council's LTP, for the period FY2023-31, is provided in Appendix B .

7.4. Summary of Contaminant Load Reduction Targets in SMPs

Condition 19 require Council to specify target contaminant load reductions to be achieved by proposed facilities and devices. Numerical targets are proposed based on a contaminant load model. The Auckland Regional Council's contaminant load model was adapted to Christchurch conditions by

Golder Ltd and run for the four major catchments. A separate model was created for the Ihutai-Estuary And Coastal Catchment.

Ihutai-Estuary And Coastal Catchment SMP

An annual load reduction target was developed from the contaminant load model as required by Condition 6b. The target is based on potential reduction through a treatment facility (Linwood Paddocks). The year when it is anticipated to be complete is 2027.

Results from the Ihutai-Estuary And Coastal catchment model can be found in Appendix C.

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

Table 1: Target reductions in stormwater contaminant load (tonnes/year) resulting from treatment in a new facility in contaminant sources compared to the consent application base year 2018, for the Ihutai-Estuary and Coastal Catchment SMP.

Contaminant	Target reductions in stormwater contaminant load Resulting from construction of a new stormwater mitigation facility Compared to the consent application base year 2018 On completion of the wetland as a percentage of the contaminant load entering the estuary (year c. 2027)
TSS	3.4%
Total Zinc	5%
Total Copper	5.3%

Target reductions are estimated by the Coastal catchment model for a proposed stormwater treatment wetland in Linwood Paddocks, adjacent to Dyers Road, treating 90% of the Bromley industrial area.

TSS are reduced less than metals because of the relatively large sediment contribution attributed to untreated hill catchments.

8. Environmental Monitoring Programme (EMP)

Adherent to Condition 49, an EMP was formulated and implemented, to determine whether receiving environment objectives and attribute target levels were being met. The monitoring carried out under this programme includes monitoring of soil quality at infiltration facilities; groundwater; surface water levels and flows, sea level, and rainfall levels; surface water quality; instream sediment quality; aquatic ecology; and mana whenua values. Please note that the mana whenua values monitoring programme (Condition 54), will start in July 2022, so the first reporting of this will be in the 2023 Annual Report, to be submitted in June 2024.

The current EMP version 9 was approved in 2022 (Appendix C) and the Council is working on EMP version 10.

8.1. Soil Quality Monitoring at Infiltration Facilities

Chapter 2 of the EMP requires the sampling of soil from six different infiltration facilities, on a five-yearly basis. Monitoring was undertaken in 2010, 2015, and 2020. Sampling will be undertaken again in 2025 and findings presented in the 2026 Annual Report.

8.2. Groundwater

This report doesn't include a trend analysis of change for electrical conductivity, copper, zinc and *E.coli*, due to inconsistent and insufficient data set from dedicated sampling points for the three years period to be able to conduct a trend analysis.

For the 2022 calendar year, the report serves as an interim report until the finalisation of the new version of the Environmental Monitoring Programme (Groundwater Section). Once the revision is complete, the council will develop a monitoring schedule that aligns with the newly revised EMP. In addition, the annual report also included the summary of the groundwater related investigation projects that provide support to the ongoing groundwater quality and quantity work.

8.3. Surface Water Levels and Flows, Sea-Level, and Rainfall Depth

Subchapter 4.3 requires the Council to report on the following regarding stormwater quantity models on a 5-yearly basis, starting in 2021:

- Any significant changes made to the input parameters of the models;
- Any significant changes to development patterns (greenfield or brownfield);
- Any significant updates to model hydraulics (bridges, culverts, etc.);
- Any significant calibration or validation exercises undertaken;

- A discussion of progress toward meeting the flood mitigation targets set in Schedule 10 of the consent;
- Any other relevant discussion involving changes to models or analysis of modelling results.

The following water quantity modelling project was completed in the past year:

- Ōtākaro/Avon River Catchment model update

The following water quantity modelling projects are currently underway:

- Ōpāwaho/Heathcote River Catchment model calibration and updates;
- Huritīni/Halswell River Catchment model build; and
- Pūharakekenui/Styx River Catchment model build; and
- Matuku Takotako/Sumner model build.

Following completion of these models, after submission of this CSNDC Annual Report, detailed reports will be provided to ECan. A detailed summary, and links to the Consultant reports are contained in Table 2 below.

Table 2: Current Baseline of Water Quantity Models by Catchment

Catchment/SMP Area	Model(s) Available	Status/Current Work Plan	Future Updated Programme
Ōtākaro/ Avon	Avon Citywide model ED2014 (GHD, 2018)	The Avon Citywide model calibrated to ED2020 is the most advanced whole catchment model. This DHI MIKE Flood model is described in the model status report (TRIM 20/1650017, July 2022). Section 10.2 "Recommendations for Model Improvement" detail issues that may be improved upon as part of a future model improvement programme, or capital works project.	Avon Citywide model ED2014 (GHD, 2018) has been updated by GHD to ED2020, and Future Development (FD) as part of Council's LDRP97 (Multi-hazard) project. Project was completed in July 2022. Notable improvements to the model include: Updated boundary conditions (Tide statistics, Rainfall statistics including Climate Change increases) Updated physical representations of basins, pipe and channel network, pump stations, and ground surface/ 2D mesh

Catchment/SMP Area	Model(s) Available	Status/Current Work Plan	Future Updated Programme
Ōpāwaho/ Heathcote	Heathcote Citywide model ED2014 (Aecom, 2019); Heathcote M7 (1D) model (updated by DHI, 2019)	The Heathcote Citywide model calibrated to ED2014 is the most advanced whole catchment model. This DHI MIKE Flood model is described in the model status report (TRIM 19/1263033, October 2019). Section 10.1 "Identified Issues of Low Importance and Future Improvements" detail issues that may be improved upon as part of a future model improvement programme, or capital works project.	Heathcote Citywide model ED2014 (Aecom, 2019) has been recalibrated (calibration 2017, completed February 2022) due to mass balance errors discovered after model build project completion. Subsequent model updates by DHI to ED2020 have been completed (April 2022). Updates to Future Development (FD) as part of Council's LDRP530 (Upper Heathcote Storage Optimisation) project will be completed in July 2023. Notable improvements to the model include: Updated boundary conditions (Tide statistics, Rainfall statistics including Climate Change increases) Updated physical representations of basins, pipe and channel network, pump stations, and ground surface/ 2D mesh

Catchment/SMP Area	Model(s) Available	Status/Current Work Plan	Future Updated Programme
Huritīni/ Halswell	Halswell River Hydraulic Model ED2011 (DHI, 2015)	The Halswell River Hydraulic Model has been adapted by CCC from ECan (ECan, 2013), verified to 1975 and 1977 flood events. Updated by DHI in 2015 the model is representative of approximately ED2011. This DHI MIKE Flood model is described in the model status report (TRIM 15/376874, March 2015). Section 9 "Recommendations for future work" detail issues that may be improved upon as part of a future model improvement programme, or capital works project.	A new Halswell Citywide model built in DHI MIKE Flood, calibrated to ED2014, and built to represent ED2020 is being peer reviewed (expected June 2022). ED2020 results and Future Development (FD) is currently being built by Beca. Upon completion this model will be the most advanced whole catchment model. This work has been delayed until September 2023. Notable improvements to the model include: Updated boundary conditions (Rainfall statistics including Climate Change increases) Updated physical representations of basins, pipe and channel network, and ground surface/ 2D mesh

Catchment/SMP Area	Model(s) Available	Status/Current Work Plan	Future Updated Programme
Pūharakekenui/ Styx	Styx river catchment model ED2011/ ED2014 (GHD, 2012/ 2017)	The Styx River catchment model originally built in 2010, was recalibrated and fully updated in 2012, and updated to the "Citywide" specification in the 1D domain in 2017. This DHI MIKE Flood model is the most advanced whole catchment model, and is described in the following model status reports (listed in reverse chronological order): TRIM 18/909126 (1D update, 2017); TRIM 17/1183411 (2D not updated); TRIM 12/256842 (full model update, 2012). TRIM 18/909126 generally states the 2D MIKE Flood model component remains to be completed as part of a future model improvement programme, or capital works project.	A new Styx Citywide model built in DHI MIKE Flood, calibrated to ED2017, and built to represent ED2022 and Future Development (FD) is currently being procured, with early works already started. A tender is to be let in June 2023, with work expected to be complete by November 2024. Upon completion this model will be the most advanced whole catchment model. Notable improvements to the model include: Updated boundary conditions (Tide statistics, Rainfall statistics including Climate Change increases) Updated physical representations of basins, pipe and channel network, and ground surface/ 2D mesh

Catchment/SMP Area	Model(s) Available	Status/Current Work Plan	Future Updated Programme
Matuku Takotako/ Sumner	Sumner Citywide model ED2014 (GHD, 2018)	The Sumner Citywide model calibrated to ED2014 is the most advanced whole catchment model. This DHI MIKE Flood model is described in the model status report (TRIM 18/634374, December 2017). Section 6.0 "Recommended Model Refinement" detail issues that may be improved upon as part of a future model improvement programme, or capital works project.	Sumner Citywide model ED2014 (GHD, 2018) has been recalibrated by GHD and CCC (calibration 2013, completed in December 2021). Updates to ED2020 including Future Development (FD) is scheduled for completion inDecember 2023. Notable improvements to the model include: Updated boundary conditions (Tide statistics, Rainfall statistics including Climate Change increases) Updated physical representations of pipe and channel network, and ground surface/ 2D mesh
Banks Peninsula	Grehan Stream ED2014 (GHD, 2015)	The Grehan Stream model is a single catchment model validated to ED2014. This DHI MIKE 11 model is described in the final report (TRIM 15/791494, June 2015).	Grehan Stream was a one-off model to inform SW flood mitigation capital works projects. There is not an ongoing programme of model updates for this model.

Catchment/SMP Area	Model(s) Available	Status/Current Work Plan	Future Updated Programme
Banks Peninsula	Other: ECan	ECan build and update models for some Banks Peninsula settlements including Little River.	

8.4. Waterway and Coastal Waters Monitoring

8.4.1. Surface Water Quality

Surface water quality monitoring was carried out for the 2023 monitoring year, in accordance with Chapter 5 of the EMP. A full report is attached in Appendix F .

In summary:

- The Council monitors the water quality of representative waterbodies within Christchurch and Banks Peninsula;
- Monthly water samples were collected from 51 sites in Banks Peninsula (Stream Reserve Drain, Balguerie Stream, and Aylmers Stream), Ōtākaro-Avon River, Ōpāwaho-Heathcote River, Huritini-Halswell River, Pūharakekenui-Styx River, Ōtūkaikino River, Linwood Canal, and coastal waters (Ihutai – Avon-Heathcote Estuary, Lyttelton Port, Cass Bay, and Akaroa Harbour). Eleven sites in the Pūharakekenui-Styx River catchment were monitored by the Styx Living Laboratory Trust. Two wet weather monitoring events were also conducted in the Ōtūkaikino River catchment and at the coastal water sites;
- Over 36,000 tests were conducted during 2020-2022 for the Council monthly monitoring, with over 24,000 of these allowing the assessment of each waterway site against relevant guideline levels;
- The priority parameters to address include bacteria (as indicated by *Escherichia coli*), sediment, dissolved copper, phosphorus, and dissolved zinc. The coastal sites generally had issues with dissolved copper and zinc contamination;
- Based on the Water Quality Index, the Ōpāwaho-Heathcote River and Pūharakekenui-Styx recorded ‘poor’ water quality, the Ōtākaro-Avon River, and the Huritini-Halswell River and the Banks Peninsula waterways recorded ‘fair’ water quality, and the Ōtūkaikino River recorded ‘good’ water quality. The Ōtūkaikino River recorded the best water quality out of all the catchments. The best site for water quality was Waimairi Stream, followed by Ōtūkaikino at Groynes, and Avon at Carlton Mill. The catchment with the worst water quality was the Ōpāwaho-Heathcote River. The worst site for water quality was Curlett at Motorway, followed by Curlett upstream of Heathcote River, and Cashmere at Worsleys Road;
- Water quality at the sites has mostly remained steady over time since monitoring began in the early (mostly in the mid-2000s);

- The waterways requiring particular water quality management are Curletts Road Stream, Cashmere Stream, Nottingham Stream, and Addington Brook; and
- A number of recommendations are provided in the report. In particular:
    - Curletts Stream, Addington Brook, and Nottingham Stream are prioritised for contaminant source control and treatment.
    - An investigation into increasing levels of *E. coli* in the Ōtūkaikino River is implemented.
    - Construction of the Council stormwater wetlands in Belfast (Ōtūkaikino River catchment) is prioritised.
    - Erosion and sediment control measures continue to be implemented as a priority, and further investigations in particular are carried out to determine how to mitigate discharges of loess sediment into the Ōpāwaho-Heathcote River (principally Cashmere Stream).
    - Investigations on sources of faecal and phosphorus contamination are carried out.
    - The Action Plan for the Council Community Outcome for Healthy Water Bodies is continued to be developed.

8.4.2. Instream Sediment Quality and Aquatic Ecology

For the 2022 monitoring year, the following instream sediment quality and aquatic ecology monitoring was carried out in accordance with Chapters 6 and 7 of the EMP:

- Five-yearly aquatic ecology (habitat, macroinvertebrates, and fish) and instream sediment monitoring in the Ōtūkaikino River (9 sites) (Appendix G);[1]
- Monthly fine sediment monitoring (17 sites) (Appendix H); and
- Annual aquatic ecology monitoring in Cashmere Stream (2 sites), Wilsons Stream (2 sites), and Balguerie Steam (1 site, desktop assessment of ECan data only) (Appendix G).

Of note from the monitoring:

[1] https://ccc.govt.nz/assets/Documents/Environment/Water/Monitoring-Reports/2022-reports/Otukaikino_Ecology_monitoring_2022.pdf

- Riparian habitat largely comprised of deciduous exotic trees (primarily willows) in the Ōtūkaikino River catchment. There were some sites where noticeable deterioration in riparian conditions had occurred since 2017. Willow removal had occurred at some sites and replaced with native planting, which will in time provide shading and fish cover;
- Instream habitat quality in the Ōtūkaikino River catchment is moderate and variable across sites. Larger substrates were dominant throughout the catchment with soft sediment depth being generally low across all sites. Instream habitat conditions had generally worsened at all sites compared to previous years with sites being typically wider, deeper and slower with higher cover of fine sediment;
- Riparian and instream habitat conditions in Cashmere Stream and Wilsons Stream catchment sites were largely unchanged over time. However, there was a decline in riparian habitat at one Cashmere Stream site due to a new terraced courtyard increasing impervious surfaces;
- Macrophyte cover at Ōtūkaikino River sites was high at some sites, and higher than recorded in previous years. There was no obvious changes in macrophyte cover at the annual sites;
- Filamentous algae were rare, or absent from most five-yearly and annual sites in 2022. The toxic cyanobacteria *Phormidium* was found at several sites in the Ōtūkaikino River catchment which had not been recorded in previous years;
- Concentrations of common stormwater contaminants in sediments were generally low at most sites in the Ōtūkaikino River catchment, apart from a marked increase in zinc at Omaka Scout Camp. This could be associated with greater fine sediment cover in 2022;
- The macroinvertebrate community was dominated by pollution-tolerant taxa at most five-yearly and annual sites. Of note was the presence of the mayfly *Coloburiscus humeralis* and caddisflies *Olinga feredayi* and *Helicopsyche albenscens* in the Ōtūkaikino River catchment. These species are considered 'sensitive' to poor water and habitat quality. However, *Coloburiscus humeralis* and *Olinga feredayi* were present at fewer sites and in lower abundances, than in 2017. The stonefly *Zelandobius* was not found in 2022 and hasn't been recorded in the Council's long-term monitoring of the Ōtūkaikino River catchment since 2012;

- Quantitative Macroinvertebrate Community Index (QMCI) scores declined over time at some at Ōtūkaikino River catchment sites. This was largely attributed to changes in instream physical habitat from increases in sediment depth and cover, resulting in a change in macroinvertebrate communities;
- Macroinvertebrate communities remained similar over time at the Cashmere Stream and Wilsons Stream annual sites;
- A single kēkēwai (freshwater crayfish) was caught in one of the Cashmere Stream sites. This species has an At-Risk Declining conservation status;
- The fish community in both the Ōtūkaikino River (including Wilsons Drain) and Cashmere Stream catchments were dominated by indigenous species that are commonly found in Christchurch's waterways. Upland bullies and shortfin eels were the most commonly encountered species, but longfin eels, inanga, common bully, and brown trout were also found; and
- Overall, some measures of ecosystem health (e.g., sediment depth, macrophyte cover, Macroinvertebrate Community Index, QMCI, and Average Score Per Metric) at sites in the Ōtūkaikino River and Cashmere Stream catchments are worse than previous years, indicating degradation. Macroinvertebrate indices at the Balguerie Stream site on Banks Peninsula showed increasing or stable trends, indicating no degradation in ecosystem health.

8.4.3. Fine Sediment

Fine sediment cover monitoring was carried out for the 2022 monitoring year, in accordance with Chapter 7 of the EMP. A full report is attached in Appendix H .

This was the second year that monthly deposited sediment data was available to be summarised for the full calendar year. There were no obvious trends in fine sediment between sites and catchments, with similar but variable results. Overall, fine sediment cover was high and exceeded consent target levels at 12 of the 17 monitoring sites. Curlett Road Stream Upstream of Opāwaho-Heathcote River confluence and Kā Pūtahi Creek at Blakes Road had the highest median cover across all 17 sites. Pūharakekenui-Styx River at Main North Road had the lowest median cover.

There is currently insufficient data to conduct trend analysis, as three years of data are required. Further monitoring will indicate whether there are any improving or declining trends in fine sediment cover over time.

The following recommendations were made:

- Continuation of long term monitoring to establish if sediment cover changes over time;
- Stormwater treatment facilities are prioritised in catchments that do not have stormwater treatment in place and are showing high sediment levels (e.g., Nottingham Stream and Ferniehurst Street in the Ōpāwaho-Heathcote River);
- Working with industry to prevent sediment runoff from individual sites from getting into the stormwater system and then into waterways;
- Continuing to implement tasks under the CSNDC to reduce sediment discharges, such as:
    - Implementing the Risk Matrix and Transition Plan for Excluded Sites (Condition 3);
    - Ensuring site-specific Erosion and Sediment Control Plans (Condition 41);
    - Instigating the Sediment Discharge Management Plan (Conditions 43-46);
    - Embedding a Building Consent approval and inspection process with respect to erosion and sediment control (Schedule 4i); and
    - Implementing the sustainable behaviour change programme (Schedule 4m).
- Implementation of tasks in the Healthy Waterbodies Action Plan such as:
    - Reducing sediment discharges, in conjunction with other stakeholders, such as Environment Canterbury (e.g., by instigating the CSNDC, Stormwater and Land Drainage Bylaw, Building Act, Community Waterways Partnership, and Surface Water Implementation Plan);
    - Carrying out education/behaviour change campaigns via the Community Water Partnership to reduce sediment inputs to waterways;
    - Removing excessive fine bed sediment where appropriate; and
    - Reviewing Council maintenance practices to ensure effects on water quality are mitigated as far as possible (e.g.,

preventing sediment discharge due to macrophyte removal).

8.4.4. Mana Whenua Values

The ATLs in Schedules 7 and 8 for the Waterway Cultural Health Index, Marine Cultural Health Index and State of Takiwa scores, as well as the associated mana whenua values monitoring sites and methodology in Chapter 8 of the EMP, have been developed in accordance with Condition 54. The ATLs for all sites were set at a score of 5. These will be incorporated into Chapter 8 of the EMP in the coming months.

The Ōtūkaikino River catchment mana whenua values monitoring was conducted in April 2022 and produced the first cultural health assessment of this catchment, thereby establishing a baseline from which future improvements in cultural health can be measured. Six sites were monitored. Overall, this monitoring indicated that the catchment is in moderate cultural health, with those sites at which extensive restoration works have been undertaken scoring the highest. Adjacent agricultural and transportation land uses were identified as the largest pressures on site health, and the catchment has been highly modified from a braided river to a low plains spring-fed stream. Phosphorous, *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 six sites met the Attribute Target Level of '5' under Schedule 7 of the CSNDC.

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

The Ōtūkaikino Monitoring Report can be viewed in Appendix I .

8.4.5. Holistic Assessment

A 2022 summary of surface water quality, instream sediment, aquatic ecology (including monthly fine sediment), and mana whenua values monitoring at sites where monitoring overlaps, is provided in Table 5.

There is some variation in monitoring aspects at the sites. For example, poor water quality did not always reflect poor instream sediment quality. Equally, better habitat quality (such as larger substrate and riparian shading) did not necessarily result in better ecological condition (e.g., QMCI). Although several threatened and locally uncommon species were found in 2022, habitat conditions and water quality conditions remain moderate.

Table 3: Summary of surface water quality, instream sediment quality, aquatic ecology, and mana whenua values at waterway sites where monitoring overlaps. ATL = Attribute Target Level; BOD_5 = Biochemical Oxygen Demand; DIN = Dissolved Inorganic Nitrogen; DRP = Dissolved Reactive Phosphorus; EPT = the total number of taxa within the "pollution sensitive" orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies); *E. coli* = *Escherichia coli*; QMCI = Quantitative Macroinvertebrate Index; TSS = Total Suspended Solids. There were no overlapping mana whenua sites for this monitoring year.

Site	Monthly surface water quality	Wet weather surface water quality	Instream sediment quality	Aquatic Ecology	Monthly fine sediment	Mana whenua values
Ōtūkaikino River Groynes Inlet	WQI: Good	Guideline exceedances in copper, zinc, TSS, *E.coli*	ATL met	N/A	ATL exceeded	N/A
Wilsons Drain at Main North Road	WQI: Poor Contaminants of concern: turbidity, dissolved zinc, DIN, *E.coli*	Guideline exceedances in zinc, TSS, turbidity, BOD_5, DIN, DRP, *E.coli*	ATL met	• Moderate shading, low algae and macrophyte cover, dominated by fine sediment • Exceeded in fine sediment cover • Did not meet QMCI guideline • Unidentified bully species, and 'At Risk - Declining' longfin eel present	ATL met	N/A

Site	Monthly surface water quality	Wet weather surface water quality	Instream sediment quality	Aquatic Ecology	Monthly fine sediment	Mana whenua values
Ōtūkaikino Creek Omaka Scout Camp	WQI: Good Contaminants of concern: dissolved copper, *E.coli*	Guideline exceedances in zinc, *E.coli*	Lead ATL exceeded	• Moderate shading, high algae and macrophyte cover, moderate-high cover of fine sediment • Exceeded fine sediment cover, total macrophyte cover • Did not meet QMCI guideline • Unidentified bully species, upland bully, elver and shortfin eel present	ATL met	N/A

8.4.6. Comparison to Attribute Target Levels

Table 4 and Table 5 provide a collation of whether all of the Receiving Environment Objectives and Attribute Target Levels for Waterways (Schedule 7) and Coastal Areas (Schedule 8), respectively, have been met for the 2022 monitoring year[2].

In summary:

- The following ATLs in Schedule 7 were met at most sites:
  - Algae cover;
  - Copper, zinc, lead, and PAHs in instream sediment; and
  - Dissolved lead and TSS in surface water.
- The following ATLs in Schedule 7 were not met at any sites:
  - Mana whenua values.
- The following ATLs in Schedule 8 were met at most sites:
  - TSS, and dissolved lead, copper and zinc in surface water.

[2] Balguerie Stream metrics could not be assessed against ATLs for macrophyte and filamentous algae cover. This is due to monitoring of this site being carried out by Environment Canterbury, who use different methods to the CSNDC EMP.

Table 4: Assessment against Comprehensive Stormwater Network Discharge Consent Schedule 7 (Waterways) Attribute Target Levels (ATLs) for 2022 monitoring year. PAHs = Polycyclic aromatic hydrocarbons; QMCI = Quantitative Macroinvertebrate Community Index; TSS = Total Suspended Solids.

Objective	Attribute	Attribute Target Level	Monitoring Report	Outcome
Adverse effects on ecological values do not occur due to stormwater inputs	QMCI	Lower limit QMCI scores: • Spring-fed – plains – urban waterways: 3.5 • Spring-fed – plains waterways: 5 • Banks Peninsula waterways: 5	Ōtūkaikino River five-yearly (wadeable sites) and annual aquatic ecology monitoring: Appendix F	• Five-yearly data: not met at 5 of the 9 sites • Annual monitoring: not met at 4 of 5 sites (Balguerie Stream met the ATL)
Adverse effects on water clarity and aquatic biota do not occur due to sediment inputs	Fine sediment (<2 mm diameter) percent cover of stream bed TSS concentrations in surface water	Upper limit fine sediment percent cover of stream bed: Spring-fed – plains – urban waterways: 30% Spring-fed – plains waterways: 20% Banks Peninsula waterways: 20% Upper limit concentration of TSS in surface water: 25 mg/L No statistically significant increase in TSS concentrations	Ōtūkaikino River five-yearly (wadeable sites) and annual aquatic ecology monitoring: Appendix F Monthly sediment cover: Appendix E Monthly surface water monitoring: Appendix D	Five-yearly fine sediment cover data: not met at 8 of the 9 sites Annual monitoring fine sediment cover data: not met at 4 of the 5 sites Monthly fine sediment cover: not met at 12 of the 17 sites Monthly TSS: 25 mg/L met at all 47 sites Monthly TSS: statistical increase in TSS recorded at Haytons Stream, Curlett at Motorway, Halswell River at Tai Tapu Road, and Wilsons Stream
Adverse effects on aquatic biota do not occur due to	Zinc, copper and lead concentrations in surface water	Upper limit concentration of dissolved zinc: Ōtākaro-Avon River	Monthly surface water monitoring: Appendix D	Zinc: not met at 26 of 47 sites Copper: not met at 30 of 47 sites

Objective	Attribute	Attribute Target Level	Monitoring Report	Outcome
copper, lead and zinc inputs in surface water		catchment: 0.02951 mg/L Ōpāwaho-Heathcote River catchment: 0.0396 mg/L Cashmere Stream: 0.00634 mg/L Huritini-Halswell River catchment: 0.01743 mg/L Pūharakekenui-Styx River catchment: 0.01172 mg/L Ōtukaikino River catchment: 0.00912 mg/L Stream Reserve Drain & Aylmers Stream (Banks Peninsula): ≤0.00293 mg/L Balguerie Stream (Banks Peninsula): ≤0.00254 mg/L Upper limit concentration of dissolved copper: Ōtākaro-Avon and Ōpāwaho-Heathcote River catchments: 0.0018 mg/L Huritini-Halswell, Pūharakekenui-Styx and Ōtūkaikino River catchments: 0.0014 mg/L Cashmere Stream and Banks Peninsula waterways: 0.001		Lead: met at all 47 monitoring sites Copper: statistical increase at 1 of 47 sites (Curlett at Motorway) Lead: no statistical increase at 47 sites Zinc: statistical increase at 3 of 47 sites (Addington Brook, Curlett at Motorway, and Nottingham at Candys Rd)

Objective	Attribute	Attribute Target Level	Monitoring Report	Outcome
		mg/L Upper limit concentration of dissolved lead: Ōtākaro-Avon River catchment: 0.01539 mg/L Ōpāwaho-Heathcote River catchment: 0.02388 mg/L Cashmere Stream: 0.00427 mg/L Huritini-Halswell River catchment: 0.01089 mg/L Pūharakekenui-Styx River catchment: 0.00601 mg/L Ōtūkaikino River catchment: 0.00414 mg/L Stream Reserve Drain & Aylmers Stream (Banks Peninsula): ≤0.00135 mg/L Balguerie Stream (Banks Peninsula): ≤0.00109mg/L No statistically significant increase in copper, lead and zinc concentrations		
Excessive growth of macrophytes and filamentous	Total macrophyte and filamentous algae cover (>20 mm	Upper limit total macrophyte cover of stream bed: Spring-fed – plains – urban	Ōtūkaikino River five-yearly (wadeable sites) and	Five-yearly macrophyte data: not met at 5 of the 9 sites Annual macrophyte data: not

Objective	Attribute	Attribute Target Level	Monitoring Report	Outcome
algae does not occur due to nutrient inputs	length) cover of stream bed	waterways: 60% Spring-fed – plains waterways: 50% Banks Peninsula waterways: 30% Upper limit filamentous algae cover of the stream bed: Spring-fed – plains – urban waterways: 60% Spring-fed – plains waterways: 50% Banks Peninsula waterways: 20%	annual aquatic ecology monitoring: Appendix F	met at 2 of 4 sites Five-yearly algae data: met at all of the 9 sites Annual algae data: met at all sites
Adverse effects on aquatic biota do now occur due to zinc, copper, lead and PAHs in instream sediment	Zinc, copper, lead and PAHs concentrations in instream sediment	Upper limit concentration of total recoverable metals for all classifications: Copper = 65 mg/kg dry weight Lead = 50 mg/kg dry weight Zinc = 200 mg/kg dry weight Total PAHs = 410 mg/kg dry weight No statistically significant increase in copper, lead, zinc and Total PAHs	Ōtūkaikino River five-yearly (wadeable sites) and annual aquatic ecology monitoring: Appendix F	Zinc: not met at 1 of the 3 sites Copper: met at all 3 sites Lead: met at all 3 sites Total PAHs: met at all 3 sites No increase in copper, lead, zinc and Total PAHs at all sites
Adverse effects on	Waterway Cultural	Lower limit averaged	Ōtūkaikino Mana	Not met at any of the 8 sites

Objective	Attribute	Attribute Target Level	Monitoring Report	Outcome
Mana Whenua values do not occur due to stormwater inputs	Health Index and State of Takiwā scores	Waterway Cultural Health Index and State of Takiwā scores for all waterway classifications: 5	Whenua values Monitoring Report (Appendix I)	

Table 5: Assessment against Comprehensive Stormwater Network Discharge Consent Schedule 8 (Coastal Waters) Attribute Target Levels (ATLs) for 2021 monitoring year. PAHs = Polycyclic aromatic hydrocarbons; TSS = Total Suspended Solids. Includes tidal waterway sites of Avon at Bridge Street, Heathcote at Ferrymead Bridge, Heathcote at Tunnel Road, and Linwood Canal, which are assessed against coastal ATL due to high salinity levels.

Objective	Attribute	Attribute Target Level	Monitoring Report	Outcome
Adverse effects on water clarity and aquatic biota do not occur due to sediment inputs	TSS concentrations in surface water	No statistically significant increase in TSS concentrations	Monthly surface water monitoring (Appendix F)	Met at all 8 sites
Adverse effects on aquatic biota do not occur due to copper, lead and zinc inputs in surface water	Copper, lead and zinc concentrations in surface water	Maximum dissolved metal concentrations for all classes (with the exception of the Operational Area of the Port of Lyttelton): Copper: 0.0013 mg/L Lead: 0.0044 mg/L Zinc: 0.008 mg/L No statistically significant increase in copper, lead and zinc concentrations.	Monthly surface water monitoring: Appendix D	Zinc: not met at 2 tidal waterway sites out of the total 8 sites Copper: not met at 2 tidal waterway sites out of all 8 sites Lead: met at all 8 sites No statistical increase at all tidal waterway and coastal sites

9. Condition 59 – Responses to Monitoring

Condition 59 requires the Council to report on any results which identify that TSS, copper, lead, and zinc Attribute Target Levels in surface water, as set out in Schedules 7 and 8, and *Escherichia coli*, copper, lead, and zinc in groundwater, as set out in Schedule 9, are not being met.

Where these levels are exceeded, the Council is required to engage with ECan and conduct investigations into these exceedances during the year following monitoring. The results of these investigations are to be reported in the following year's CSNDC annual report.

9.1. Schedules 7 (Waterways) and 8 (Coastal Waters)

The 2020 and 2021 surface water monitoring report identified that 32 (2020) and 31 (2021) of the 51 monitoring sites did not meet at least one of these ATLs. As this is a large number of sites, four sites were recommended as priorities for investigation, due to each site not just exceeding guideline levels for the given parameter, but also because of an increasing trend in concentrations. These four sites were Ōpāwaho-Heathcote River at Ferry Road Bridge, Curlett Stream at Motorway, Addington Brook, and Nottingham Stream at Candys Road.

In response to this, a Condition 59 Responses to Monitoring Report 2022 & 2023 was written in 2022 (Appendix J). This report provided an evaluation of whether these exceedances of ATLs are due to stormwater discharges authorised under this resource consent, as well as proposed remediation with associated timelines.

Copper, zinc, and TSS issues at the four priority sites are most likely due in part to stormwater discharges authorised under the CSNDC. However, there are also likely other illicit (e.g., dry-weather) discharges not authorised under the consent that may be impacting contaminant levels.

To address the impacts from stormwater, a number of remediation actions were proposed. This included gathering more data on where contaminants are coming from by continuing targeted wet weather monitoring within the Curlett Stream catchment. The first stage of monitoring of this stream has been completed and the associated report can be found in Appendix K . The Condition 59 report also recommended adding additional wet weather monitoring in the lower Ōpāwaho-Heathcote River and Nottingham Stream. Dry weather monitoring was also proposed within Curlett Stream and Addington Brook to identify non-stormwater illicit discharges.

Prior to developing these monitoring plans, it was identified that an assessment of high-risk sites was required to inform the best location for monitoring sites. This high-risk sites assessment is provided in Appendix L .

Council is now working towards developing the wet weather and dry monitoring plans for these sites, with completion expected over the next few weeks. These monitoring plans will then be provided to ECan for comment, with monitoring implemented as soon as practicable afterwards.

To treat stormwater contaminants before discharge to the waterways, it is proposed to construct Council stormwater treatment facilities within Addington Brook and Nottingham Stream. All these remediation options will be supplemented by existing work programmes under the CSNDC, such as Industrial Site Audits and other source control programmes, as well as Environment Canterbury programmes.

Council considers work under this condition to be a long-term project. Each annual report will consider whether sites are regularly being prioritised for investigation, and the project as a whole will be iterative and adaptive, building on lessons learned in previous years.

This year's surface water quality monitoring report identified thirty-six sites triggering further investigations under Condition 59, due to not meeting the ATLs for TSS, copper, or zinc (Appendix F). These sites were prioritised to three: Curletts at Motorway in the Ōpāwaho-Heathcote River catchment, Addington Brook in the Ōtākaro-Avon River catchment, and Nottingham at Candys Rd in the Huritini-Halswell River catchment. These are the same sites prioritised for investigation for the last two years and therefore Condition 59 investigations are already under way.

9.2. Schedule 9 (Groundwater)

The exceedances of *E.coli* at Sockburn Pump Station and Estuary Pump Station recorded in the 2022 calendar year were not from the source water. The investigation found that the exceedances were due to one off contamination in the suction tank prior to chlorination. Pump stations were isolated and were returned to service with subsequent clear results. A new sampling plan was upgraded and commenced since the incident. Copper, zinc and lead were not sampled from the wells considering that it was not required by the Drinking Water Standards NZ. Since the introduction of new Drinking Water Quality Assurance Rules in 2023, the Council is currently undertaking a sampling plan for chemicals in the source water as required. The results will be presented in the next year's report. Following the above clarifications, the Council confirms that no further Responses to Monitoring work are required under Condition 59 – Groundwater.

10. Stormwater Quality Investigation Programme (Schedule 3)

Conditions 37-39 require the Council to carry out a series of actions contained in Schedule 3, with the aim to improve the management of stormwater quality and assess and reduce stormwater effects on the receiving environment. Furthermore, Condition 38 provides the following list with regards to the purpose of this programme:

- Monitor the performance of selected stormwater treatment facilities and devices;
- Assess the potential for the application of new technologies and management strategies;
- Investigate using various models and techniques of water quality improvement strategies and options.

The following information details progress of each of the Schedule 3 actions undertaken in 2022.

10.1. Schedule 3(b) – Develop an Instream Contaminant Concentration Model (ICCM)

An ICCM bridges the gap between stormwater contaminant loads (based on land use) and water quality in surface water. This is an important part of determining the effects of stormwater on the receiving environment so that ecological outcomes are enhanced.

The Christchurch City Council ICCM is underway, with hydraulic modelling software developer, DHI and University of Canterbury collaborating to develop the model.

The model utilises the University of Canterbury (UC) GIS contaminant load model called MEDUSA. MEDUSA has been calibrated for a number of Christchurch catchments, including Okeover Stream, Addington Brook, and the Ōpāwaho/Heathcote River. DHI previously teamed with the University of Canterbury to produce an online version of MEDUSA ('MEDUSA Online') and this will be the platform used for the ICCM. The advantage of MEDUSA Online is that it will be useful for educational purposes (being available with a web interface) as well as easily testing a range of stormwater quality management scenarios.

An example of the frontend of the proposed ICCM web platform is shown below in Figure 1.

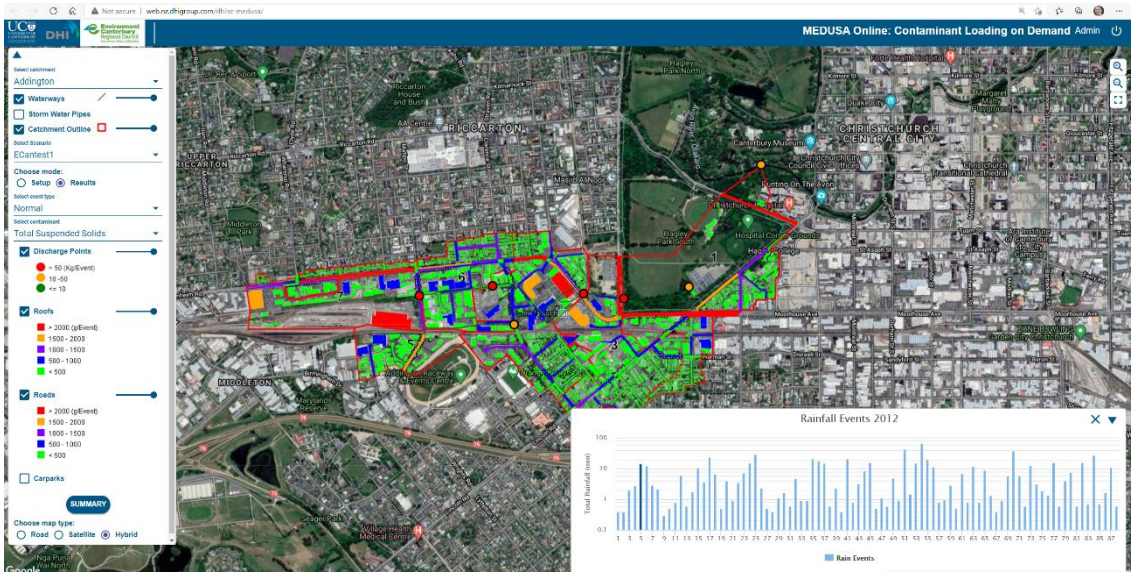

Figure 1: Proposed frontend of the ICCM web platform

The project will determine the annual loads of TSS and total and dissolved Cu and Zn generated in the following catchments:

- Pūharakekenui/Styx
- Ōtākaro/Avon
- Ōpāwaho/Heathcote
- Huritini/Halswell
- Ōtūkaikino
- Ihutai/Coastal and Estuary

The ICCM will have three scalable modules – Pollutant Generation, Pollutant Treatment, and Scenario Manager (Figure 2):

- Pollutant Generation module will generate total and dissolved zinc, copper, and TSS loads from individual surfaces for individual storm events; It will generate both first flush and second stage pollutant load for individual events and surfaces;
- Pollutant Treatment module will simulate inclusion of site-specific treatment options or catchment wide measures;
- Scenario Manager module will allow for the simulation of different scenarios, such as land use changes (green field to brown field or vice versa), changing surface types (permeable or impermeable), or adding/deleting treatment systems.

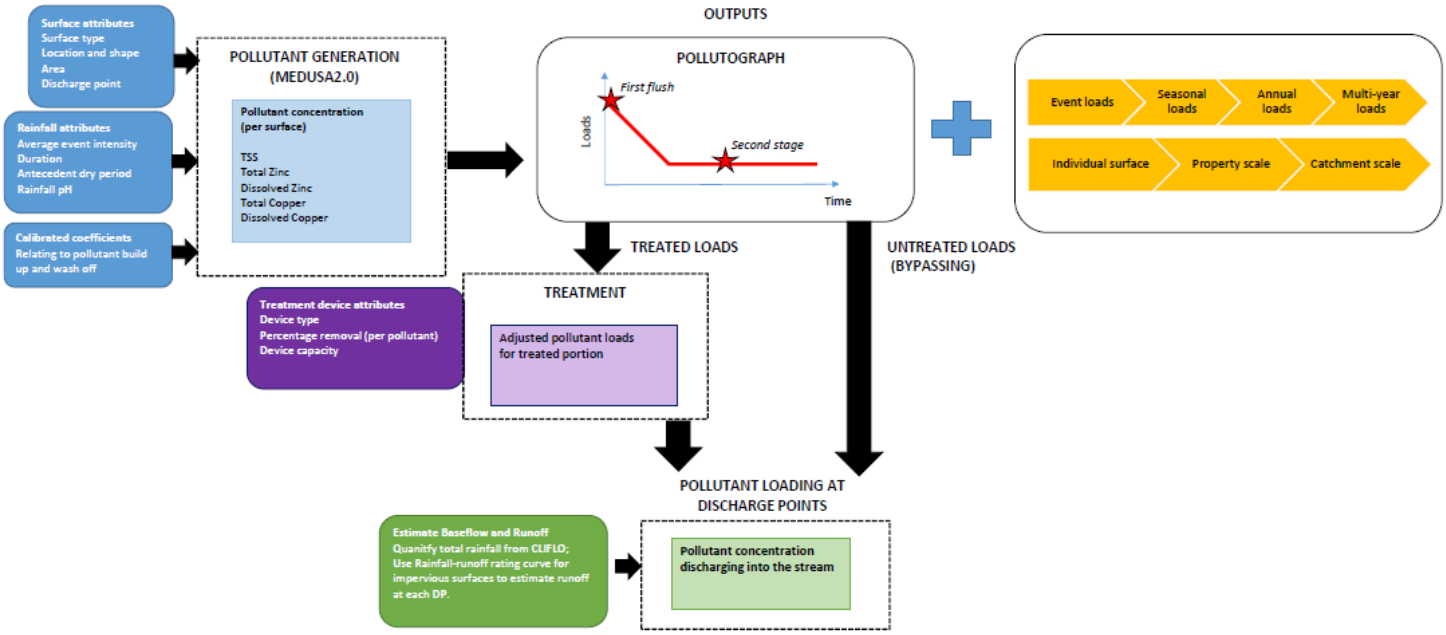

Figure 2: Proposed ICCM framework

Inclusion of sediment yield from pervious surfaces will be based on the mean annual yield from the NIWA national dataset developed for the Ministry of Environment (Hicks, M., Semademi-Davies, A., Haddadchi, A., Shankar, U., Plew, D. 2019. Updated sediment load estimator for New Zealand. NIWA Client Report No. 2018341CH, prepared for Ministry for the Environment)

Results from the platform include:

- Event mean, peak, or median loads for each surface.
- Loads can be processed to produce seasonal, annual, or multiyear loads at different scales (individual surfaces, property, or catchment wide).
- Option to query results aggregated at sub-catchment level to identify target sub-catchment of priority.
- Options to identify potential range of loads from minimum to median to peak or maximum levels, at selected locations across the year or for multiple storm events.

Reporting on reductions in stormwater contaminant load at the following time horizons (as per CSNDC Table 2) using CCC provided treatment scenarios:

- 2018
- 2023

- 2028
- 2043

Progress to date includes:

- Identifying roof types as per MEDUSA schema.
- Private property hardstand based on imperviousness.
- Identification of the catchments for all treatment devices.

10.2. Schedule 3(d) – Feasibility Study of Receiving Environment Response Research Programme

The Council is required to investigate a knowledge base to assist with ways to predict responses of the receiving environment to changes in network contaminant loads and resulting instream concentrations. Consideration is to be given on how and when the receiving environment might respond to changes in contaminant concentrations, how much work would be involved to predict results, what sort of models are possible, how monitoring to obtain real world results would be carried out, how long it would take the biological community to respond, and any gaps in knowledge.

NIWA have been engaged to lead the investigation project. A scope for this project was confirmed in 2022, following review from ECan and the TPRP. A workshop was held earlier in the year with NIWA, local ecologists, members of the TPRP, and ECan scientists. Council, ECan, and members of the TPRP are currently reviewing the draft report.

10.3. Schedule 3(f) – Alternative Modelling Impact Investigation

This task is being implemented via other scheduled items such as Schedule 3(a), Schedule 3(d and e), and Schedule 3(g and h).

10.4. Schedule 3(g) – Feasibility Study of Instream Remediation Programme

The Council is required to carry-out a feasibility investigation into the techniques for remediating adverse effects of stormwater sediment discharges on receiving environments. The work shall include consideration of sediment cover of the bed, and copper, lead, zinc and Polycyclic Aromatic Hydrocarbon contamination. This work is being carried out by NIWA with a workshop previously being held to obtain expert advice from local ecologists, members of the TPRP, and ECan scientists. A second workshop is scheduled for August, with a draft report due in September.

10.5. Schedule 3(i) – Device Effectiveness Monitoring and Modelling

10.5.1. Stormfilters at Richardson Terrace, Bells Creek

The investigation of this facility has yet to commence. The Council is still negotiating with contractors with the aim of having work start before the end of 2023.

10.6. Schedule 3(j) – Implementation of Device Effectiveness Monitoring and Modelling

Schedule 3(j) requires the Council to apply monitoring outputs from Schedule 3(i), along with other stormwater modelling and monitoring data being gathered, to inform the planning and design of stormwater systems and facilities, including in the development of Implementation Plans, and reviews of SMPs, Infrastructure Design Standards (IDS) and the Waterways Wetlands and Design Guide (WWDG). This task has no start or end dates assigned to it and has been considered an ongoing objective of implementation of findings. For the calendar year 2022, there were no findings significant enough to have warranted a review of either the IDS or WWDG.

10.7. Schedule 3(k) – Targeted Wet Weather Monitoring Programme

Targeted Wet Weather Monitoring (TWWM) is to be performed to improve knowledge of the state of the receiving environment, contaminant inputs and treatment efficiency, and to inform mitigation options. Hayton and Curlett Streams were identified as the first priority catchments to investigate, due to being identified as having the poorest water quality within Christchurch City in previous years.

A report of the first stage of monitoring of Hayton and Curlett Streams is provided in Appendix K . The specific long-term objectives of this project were to (1) map hotspots or localised discharges of contaminants along the length of the streams during base flows and storm flows, (2) investigate whether there are also hotspots of other currently unknown emerging or unusual contaminants, and (3) to establish what discharges from individual sites are contributing to the identified hotspots of contaminants.

This stage of the TWWM project incorporated sampling at 15 different locations throughout the Haytons and Curletts Stream catchments, and upstream and downstream within the Ōpāwaho/Heathcote River. Sampling was primarily conducted using autosamplers to collect water samples throughout the duration of a storm event, supplemented with Nalgene Stormwater Sampler bottles to collect “grab” samples during high flow events at additional sites. Sites were monitored collaboratively with Environment Canterbury, University of Canterbury and NIWA, with sampling by all agencies during the same rain events to allow comparisons across the catchments. Four events were

sampled between May and December 2021 at 7 to 9 sites simultaneously, with technical issues or flooding preventing sampling at the remaining sites.

Curlett Stream had the highest concentrations of metals (copper and zinc), TSS, BOD_5 and *E. coli*. However, some high concentrations were occasionally observed in upper Haytons Stream for TSS and dissolved copper. In addition, nutrient water quality data suggest that both Haytons and Curlett Streams received dissolved reactive phosphorus, ammoniacal nitrogen and nitrate input, sometimes simultaneously with *E. coli* and BOD_5. Some uncertainties persist regarding the locations presenting the highest concentrations for each event due to either the variability between samples and events or the possible overestimation of pollutants (especially particulate forms) in samples collected by Nalgene bottles at some sites.

The current land use of the Curlett Stream subcatchment comprises many potential pollutant sources (various industrial sites, scrap metal yards, railway, machinery manufacturing sites). It will be difficult to achieve the third objective of identifying individual sites contributing to hot spots, without putting in place a widespread monitoring programme to collect samples at the scale of individual potential contributing sites. However, this may not be technically nor economically feasible.

A number of recommendations were provided in the report for future monitoring, to address areas of uncertainty, and to gain a better understanding of the main contributing sources to Haytons and Curlett Streams. Most of these recommendations were in relation to sampling techniques and site locations. It was also recommended to sample up to eight additional storm events in the next stage of monitoring, to better account for the variability of pollutant export between events. A review of the results after four additional events should be carried out. In addition, in order to map hot spots during base flow conditions (one of the objectives of the project), some dry weather investigations should be carried out to identify 'illicit' non-stormwater discharges.

The next stage of targeted wet weather monitoring is currently being scoped. This considers the requirements of this year's Condition 59 assessment (responses to monitoring) and is outlined in Section 9.1.

11. Other Actions (Schedule 4)

Schedule 4 provides a list of actions to be carried out, both to ensure the implementation of the conditions of the resource consent, and further improvement of water quality/quantity monitoring and improvement. Timeframes for these actions are provided in these same schedule, and those completed and ongoing are summarised below.

11.1. Schedule 4(c) – Trials of Increased Street Sweeping and Sump Cleaning

This action requires the Council to carry out targeted trials for increased targeted/selective street-sweeping and sump-cleaning, should the cost-benefit analysis in Schedule 4(b) provide sufficient merit. Given that the cost-benefit analysis found sufficient merit in instigating a programme, the Council has established a draft scope and is currently working with the University of Canterbury to conduct a trial at five sites to develop a road runoff quality dataset on pre and post sweeping runoff quality.

For each site, seven trials were run, where rainfall was applied to the road surface and runoff collected from a 1 m^2 sampling plot set under the simulator. The trial conditions were: unswept conditions at 11 mm/hr (Trial 1), post-vacuum-swept conditions at 11, 22 and 33 mm/hr (Trials 2-4 respectively) and post-regenerative-swept conditions at 11, 22 and 33 mm/hr (Trials 5-7 respectively). All trials were run with ≥4 days antecedent dry period.

The preliminary results were presented at the Stormwater Conference in 2023 and the detailed report will be submitted to ECan by the end of 2023.

11.2. Schedule 4(f) - Application of Trial Results for Street-Sweeping, Sump-Cleaning, and Alternative Stormwater Treatment Methods to Planning/Design of Facilities, SMPs, IDS, and WWDG

Similar to Schedule 3(j), Schedule 4(f) requires the Council to apply the results of trials of street-sweeping, sump-cleaning, and alternative stormwater treatment (Schedule 4c), along with results from other stormwater modelling and monitoring data being gathered, to the planning and design of stormwater systems and facilities. including in the development and review of SMPs, IDS, and the WWDG. This work can commence once findings are available from Schedule 3(j) and schedule 4(c).

11.3. Schedules 4(g and h) – Increasing frequency of street sweeping and sump cleaning.

These actions are contingent on the findings from Schedule 4(c), which is to be completed in late 2023.

11.4. Schedule 4(i) – ESCP within Building Control and Resource Consent Processes

The Stormwater and Land Drainage Bylaw 2022 was adopted by the Council and came into force in July 2022. The Sediment Discharge Management Plan has been revised to incorporate the Bylaw. It was resubmitted to ECan for review and has been certified.

11.5. Schedule 4(j) – Developing a programme for operational inspection of private stormwater treatment devices.

The Council is required to develop a program for the operational inspection of a sample of private stormwater treatment and/or retention devices on non-industrial sites (such as commercial business complexes, rest homes, residential homes and multi-apartment buildings, education centres and so forth) for the purposes of ensuring proper function and maintenance. In 2021, of the 15 representative stormwater treatment devices across the different catchments inspected, 12 of them were in good condition and were fully functional. Three of the devices were non-compliant and currently are under investigation. Details of the inspection sites and the type of inspected devices can be found in the attached report (Appendix M).

The CSNDC requires work under this condition to be a long-term project. Each year representative devices from the various catchments will be inspected and maintained as per the manufacturer's guidelines. The internal database and workflow have been established to record the inspections and maintenance reports and to track down the devices for future follow-up. The recommendations have been made to integrate approved stormwater treatment devices in the Council's mainstream legal documents such as Land Information Memorandum (LIM) to keep track of its ownership and regular maintenance.

11.6. Schedule 4(m) – Community Water Engagement Programme

During 2022 a handful more agencies and schools have signed the charter. Despite Covid 19 issues restricting major events taking place, a number of small activities have been occurring between members of the partnership, here are some examples:

- Following on from their Stormwater Superhero Campaign Christchurch West Melton Zone Committee presented two local businesses with Stormwater Superhero awards in November to increase awareness of what industry is doing to improve awareness of stormwater and impact on our waterways Tunnel Wash and Christchurch Ready Mix Concrete.
- EnviroHub is managing the Stormwater Superhero Trailer and it has been out and about visiting over a dozen locations (including schools, farmers markets and commercial venues). It is popular with young people and has engaged over 1200 students and adults, focusing on issues around stormwater contamination in the last 6 months. It is possible to book the Stormwater Super Hero Trailer and a facilitator for events. In January/ February 2023the trailer will be attending various events such as Summer at the Styx, Estuary Fest and other summer time events. The evaluation of the trailer as a stormwater advocacy tool is

underway and a report will be made available at the next CSNDC Annual report.

- Schools who have been working with Te Tuna Tāone have been sharing messages about how we can create healthier rivers for Tuna on billboards, buses, postcards and school fences.
- The first of two partnership building workshops was held in December 2022 (facilitated by Rose Challies from Terra Nova), the second was held in February 2023 to clarify direction, action and alignment to maximise impact for the Community Waterways Partnership in the years ahead.
- The preliminary build of the Community Waterways Partnership online hub has begun and was launched in June 2023. Content was provided by partners to go on the site. The site is currently managed by the Quality and Compliance Team, at Christchurch City Council.
- The Avon Ōtākaro River Network and local schools, with the support from Council and ECan, are undertaking an in-river litter clean-up in the lower reaches of the Ōtākaro River.
- A workshop was held to choose potential issues for a behaviour change programme. Initial discussions focused on awareness raising around the damage caused by sediment entering our waterways via our stormwater drains - with the focus on building sites and public reporting via Snap Send Solve. Other foci included raising awareness and behaviour change about heavy metal contamination, reducing water entering rivers by installing rainwater tanks and picking up dog poop and putting it in the red bin. Discussion was informed by priorities and behaviour change likelihood research undertaken by the National Science Challenge.
- A workshop has been held with education providers that are signed up to the charter, to look at how they can align their work and support one another with sharing resources and actions undertaken with schools.

Examples of school riparian plantings supported by Council Parks Community Rangers and education programmes include:

- In the Ōtākaro Catchment: Villa Maria and Drinkable Rivers at Corfe Reserve, St Albans School Tikanga Rua Reo (St Albans Creek) with Te Tuna Tāone (and are involved in planning for future renewal work), Burnside High School, Wairararpa/Cobham Intermediate and Burnside Primary School Wairarapa Stream. Ilam School undertook a planting with Canterbury University on Ilam Stream funded by CHCHWM Zone Committee.
- In the Huritini Catchment Te Kura o te Tauawa Halswell School planting at Muir Park (Te Tauawa a Maka Nottingham Stream), and Seven Oaks

School and Mingimingi Hautoa at Springlands (Ōpouira Knight Stream Catchment) with Te Tuna Tāone and Council stormwater programme and Springlands volunteer group.

- In the Ōpāwaho Catchment Beckenham te Kura o Pūroto at Beckenham Ponds and Cashmere High School along Waimokihi Brook (Ōpāwaho Catchment), Our Lady of Assumption Waimokihi Stream at Centennial Park, Ōpāwa School and Ōpāwaho Heathcote River Network planting alongside Richardson Terrace.

11.7. Schedule 4(n, o, p, and q) – River Care Liaison Groups and Industrial Liaisons Group

The River Care Liaison Group meeting was held on the 2 August 2022 with seven representatives from five community groups. The agenda items were:

- Overview of technical and feasibility studies;
- Environmental monitoring;
- Stormwater management plan programme;
- Implementation programme.

The Council decided to forego the annual Industrial Liaison Group meeting because the key focus of the meetings was to discuss and finalise the industrial risk matrix, which has now been completed. So on this basis it was elected to send a letter outlining the past year's activities and issues relating to stormwater discharges from industrial sites within Christchurch City as required by the conditions of Christchurch City Council's Comprehensive Stormwater Network Discharge Consent (CSNDC). The letter covered the following matters:

- CSNDC Annual Report;
- Variation to CSNDC – CRC231955;
- Risk Matrix for Transitional Arrangements Finalised
- Industrial site audit process;
- New Stormwater Technologies
- Consent compliance;
- Monitoring.

There has been no follow up from industry members regarding the letter.

11.8. Schedule 4(r) – Pūharakekenui/Styx River Weed Management

This action was to investigate various options for river channel weed (macrophyte) management practices, to mitigate flood risk in the Pūharakekenui/Styx River. While investigations, bar the diquat study, were

completed by June 2021, unforeseen circumstances and illness meant that an interim report was submitted to ECan in July 2021.

The diquat trial was eventually conducted in March 2022, and the final report was submitted to ECan in May 2023 (Appendix N). Given the delayed delivery of this report it has been decided to include it with this Annual Report.

11.9. Schedule 4(s) – Identifying best practicable management options for mitigating flooding through river weed management as reported in Schedule 4(r)

This work has been awarded to a consultancy and a report is expected in 2023 in time for the findings to be incorporated into the Styx SMP that is to be lodged with ECan for certification in December 2023.

12. Other Investigations and Monitoring

12.1. Condition 32 Stormwater Infiltration Facilities Investigations

This investigation looked at a series of site-specific assessments of contamination risk and appropriate mitigation. This work was undertaken in two stages:

a) Desktop Assessments: identifying which basins were not compliant with the separation distances in Condition 32(a) and 32(b), and applying an initial risk screening based on land use.

b) Conceptual Site Model: the application of a conceptual site model to identify the scale of any risk of contamination of domestic and community supply wells within the distances in Condition 32(a) and 32(b).

The summary report of the above investigations, to satisfy Condition 32(d), was lodged with ECan in December 2021. Subsequent to lodgement, ECan and Council have had discussions regarding the report findings, which are still to be resolved. The final report will be available with the 2023 Annual Report.

12.2. Performance of Stormwater Infiltration Basins and their impact on Groundwater Levels and Quality

The CSNDC EMP 3.2.3 and 3.3.1 requires an investigation into the performance of stormwater basins and their impact on groundwater levels and quality. This study was carried out over a period of 12 months, monitoring the facilities detailed in Table 6 below.

Table 6: Infiltration Basin monitoring

Basin	Awatea Basin	Kākāpō Basin (Riccarton Racecourse)	Outlook Place Industrial Park
Area of Infiltration Basins (ha)	Six Infiltration basins ranging in size from 0.21/1.53ha	Two basins at approximately 0.05 and 0.08ha	Two basins at approximately 0.022 and 0.057ha

Basin	Awatea Basin	Kākāpō Basin (Riccarton Racecourse)	Outlook Place Industrial Park
Estimated Depth to Average Groundwater (m bgl)	7m	9m	3m
Suitable for Spring-fed Stream monitoring	Yes, Heathcote River headwaters 350m from closest infiltration basin	No nearby spring-fed streams	No, Styx River tributary headwaters 600m from closest infiltration basin, which is too far away to observe effects specifically related to this basin
Existing Monitoring Bores	Three new monitoring bores will need to be constructed	Two new monitoring bores will need to be constructed to monitor the water table. Existing bore M35/11995 can also be used for monitoring purposes	Two new monitoring bores will need to be constructed to monitor the water table
Suitable for Pre-Basin monitoring	No, basin has been operating for many years	Yes, basin has yet to be completed	No, basin has been operating for several years

The key tasks of this assessment were:

- Monitoring in at least one new basin, designed to characterise the change from the pre-basin to post-basin environment.
- Establishment of suitable monitoring wells at each site to provide an up-gradient – down-gradient comparison of groundwater quality, assessed against Schedule 9. This will involve drilling new monitoring bores that are screened across the water table at Awatea Basin (3 new bores), Kākāpō Basin (2 new bores), and Outlook Place Basin (2 new bores). An existing bore (M35/11995, 37.7m deep) near Kākāpō Basin could be used for monitoring subject to talks with the bore owner.
- Bores to be fitted with transducers to provide a continuous record of groundwater levels and electrical conductivity.
- Pressure transducers fitted within each basin to record when they fill with stormwater to indicate when the discharges occur and to provide a correlation with the groundwater level monitoring record.
- Carry out monthly water quality monitoring at these bores for *E. coli*, copper, lead, zinc, and electrical conductivity. The timing of the sampling within each month is adjusted to cover the main periods of stormwater discharge as indicated by the pressure transducer readings.

Conclusions

Groundwater Quality

Based on the analytical data and monitoring well logger data for the total investigation period of June 2021 to May 2022 in comparison to the attribute target levels, the operation of the three infiltration basins in this investigation does not appear to have an adverse effect on the quality of shallow groundwater beneath the basins.

There were no exceedances of the attribute target levels for metals (copper, lead and zinc) in groundwater during the 12 monthly sampling events.

Surface water samples collected from the basins (where water was present at the time of sampling) did not report concentrations of analytes above the attribute target levels. While the attribute target levels are not applicable to surface water within the basin, the data provides some assurance that stormwater discharging into the basins is currently not resulting in deterioration of groundwater quality.

No statistically significant trends were reported for EC in groundwater beneath the basins.

Analysis of groundwater quality in upgradient and downgradient wells at each basin was not completed as groundwater flow direction at each basin could not be adequately inferred. However, water quality and quantity (groundwater elevation) between wells within each basin was broadly consistent.

Groundwater Quantity

Overall, there appears to be a good correlation between rainfall events and increased groundwater elevation at all three basins. This is expected as the infiltration basins are designed to capture surface water from the broader area and allow for rapid infiltration to ground.

Rainfall data plotted with both groundwater elevation and standing water levels in the basins (Appendix B of the attached report) reported a good correlation with rainfall events as low as 2-4 mm correlating with standing water in the basins. The correlation indicates that the infiltration basins are operating as required with rainfall events resulting in water levels registered at the basin followed by rapid infiltration to groundwater which reports short term increases in groundwater elevation.

The logger at Awatea basin malfunctioned resulting in no data for a five-month period from 3 September 2021 to 28 February 2022. No data is available from 15 March due to a separate fault with the broader Awatea basin system.

Effects on Electrical Conductivity and Springs

There does not appear to be any adverse effects on the water quality or quantity of nearby springs from the operation of infiltration basins at the three basins.

There were no statistically significant increasing trends in EC in groundwater beneath the three basins.

For the full report see Appendix O .

13. Industrial Site Audit Programme

The industrial site audit programme assists site occupiers to identify on-site risks, infrastructure, and site management practices that could impact stormwater being discharged from their sites. The purpose of the programme is to resolve problems at the source and thereby improve stormwater quality to promote healthier waterways and instream biota.

In 2022, 15 industrial sites were audited with at least 10 of those sites agreed with ECan. Details of the audited sites can be found in Table 7.

Table 7: Industrial Site Audits undertaken in 2022.

Business Name	Site Address	Industry Category	Waterway Impacted	Audit Date
Alpha Equipment Rental & Sales	33-35 Edmonton Road, Hornby, Christchurch 8042	Motor Vehicle and Equipment Associated Facilities	Halswell Junction Outfall	10/03/2022
Container Transport & Storage	121 Branston Street, Hornby, Christchurch 8042	Motor Vehicle and Equipment Associated Facilities	Halswell Junction Outfall	21/03/2022
Aabaas Industries	20 Kotzikas Place, Wigram, Christchurch 8042	Primary and Fabricated Metal Product Manufacturers	Curlett Stream	5/04/2022
Reimagineers 3R Group Ltd	8 Calgary Place, Hornby, Christchurch	Scrap and Waste Recycling Facilities	Halswell Junction Outfall	5/04/2022
Higgins Contractors	63 Pilkington Way, Wigram, Christchurch 8042	Building, Construction, Landscaping, and Earthworks Related Activities	Hayton Stream	16/05/2022
Intergroup	11 Tanya Street, Bromley Christchurch 8062	Waste Transfer and Composting Facilities	Charlesworth Drain	25/05/2022
Dominion Trading Co Ltd	333 Blenheim Rd, Middleton	Battery and metal recycling	Curlett Stream	9/06/2022
Hynds Pipe Systems Ltd	22 Canada Crescent, Hornby, Christchurch 8042	Transportation, Industrial, and Commercial Equipment	Halswell Junction Outfall	7/07/2022

Business Name	Site Address	Industry Category	Waterway Impacted	Audit Date
		Manufacturers		
Truck Stops REAUDIT	38 Waterloo Road, Hornby, Christchurch 8042	Motor Vehicle and Equipment Associated Facilities	Hayton Stream	7/07/2022
Owens Warehousing	16 Baigent Way Middleton Christchurch	Transport & Warehousing	Curlett Stream	27/07/2022
Owens Transport	22 Baigent Way Middleton Christchurch	Transport & Warehousing	Curlett Stream	27/07/2022
Local Car Removal	43 Vickerys Rd, Wigram	Automobile Salvage Yards	Hayton Stream	1/09/2022
3Way Solutions	58 Pilkington Way, Wigram	Primary and Fabricated Metal Product Manufacturers	Hayton Stream	8/09/2022
Thermosash Commercial	12 Braeburn Drive	Transportation, Industrial, and Commercial Equipment Manufacturers	Hayton Stream	8/09/2022
Hexion (NZ) Ltd	135 Waterloo Rd Hornby, Christchurch 8441	Chemical manufacturing	Hayton Stream	15/11/2022

14. Updates to CSNDC Schedule 1

The list of sites excluded from the CSNDC Schedule 1 can be found in Appendix P .

15. Engagement with Papatipu Rūnanga

The Council is committed to working in partnership and collaboration with Papatipu Rūnanga of the Christchurch District. More specifically, these Rūnanga, in no particular order, include:

- Te Ngāi Tūāhuriri Rūnanga;
- Te Hapū o Ngāti Wheke (Rāpaki);
- Te Rūnanga o Koukourārata;
- Wairewa Rūnanga;

- Ōnuku Rūnanga; and
- Te Taumutu Rūnanga.

The Council has engaged with Papatipu Rūnanga in the development of SMPs and the respective implementation plan, through providing quarterly reports to and by holding annual meetings with Mahaanui Kurataiao Ltd (30 August 2022). MKT has assisted the Council with providing position statements for the Papatipu Rūnanga on the Ōpāwaho-Heathcote, Huritīni-Halswell, and Ihutai-Estuary Coastal SMPs.

MKT provided assistance with CSNDC Condition 54, in establishing Attribute Target Levels in Schedules 7 and 8 for the Waterway Cultural Health Index, Marine Cultural Health Index and State of Takiwa scores. They also undertook cultural reviews of various schedule 3 and 4 technical/ investigation scopes and reports.

16. Appendices

Appendix A : Developments Authorised Under CRC231955

Appendix B : Stormwater Implementation Plan FY 2023-31

Appendix C : Ihutai Estuary Contaminant Load Model Results

Appendix D Environmental Monitoring Programme (Version 9)

Appendix E : Groundwater Quality and Quantity Annual Report

Appendix F : Surface Water Quality Report

Appendix G : Aquatic Ecology Monitoring Report

Appendix H : Fine Sediment Cover Report

Appendix I : MKT - 2022 Ōtūkaikino catchment mana whenua monitoring report

Appendix J : Condition 59 Responses to Monitoring

Appendix K : CSNDC Surface Water Targeted Wet Weather Monitoring Report

Appendix L : CSNDC Condition 59 - high-risk sites analysis report

Appendix M : Inspection of Private Stormwater Treatment Devices Report

Appendix N : Weed Management and Flooding in the Pūharakekenui/ Styx River

Appendix O : CSNDC Groundwater Stormwater Basin Environmental Investigation

Appendix P : CSNDC Schedule 1