Christchurch City Waterway Fine Sediment Annual Report 2023

Prepared to meet the Requirements of CRC231955

Christchurch City Council

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Christchurch City Council

Report: Christchurch City Waterway Fine Sediment Annual Report 2023

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Executive Summary

The Christchurch City Council (Council) is required to monitor fine sediment cover of representative waterbodies within Christchurch and Banks Peninsula, as part of the Comprehensive Stormwater Network Discharge Consent (CSNDC; CRC231955). Fine sediment monitoring was undertaken monthly at 17 sites from waterways within the five main river catchments of Christchurch (Ōtākaro-Avon River, Opāwaho-Heathcote River, Huritini-Halswell River, Pūharakekenui-Styx River, and Ōtūkaikino River).

This was the third year that monthly deposited sediment data was available to summarise 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 11 of the 17 monitoring sites. Curlett Road Stream Upstream of Opāwaho-Heathcote River confluence had the highest median cover across all 17 sites. Pūharakekenui-Styx River at Main North Road had the lowest median cover.

This is the first year with sufficient data to conduct trend analysis. Four of the 17 sites showed decreasing trends over time which would indicate the fine sediment levels within these monitoring sites are improving over time. No increasing trends were recorded in the other 13 monitoring sites.

It is recommended that stormwater treatment facilities are prioritised in catchments that do not have stormwater treatment in place and are showing high sediment levels. This is particularly for Nottingham Stream and Ferniehurst Street in the Ōpāwaho-Heathcote River. Council should also continue working with industry to prevent sediment runoff from individual sites from getting into the stormwater system and then into waterways, as well as implementing specific tasks under the CSNDC to reduce sediment discharges.

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1. Introduction

The Christchurch City Council (Council) is required to monitor fine sediment cover of representative waterbodies within Christchurch and Banks Peninsula, as part of the Comprehensive Stormwater Network Discharge Consent (CSNDC; CRC231955). In accordance with the CSNDC Environmental Monitoring Programme (EMP), monitoring was undertaken monthly at waterway sites. This report summarises the results for the monthly monitoring for the 2023 calendar year.

2. Methods

2.1. Monitoring Sites

Fine sediment monitoring was undertaken at 17 sites from waterways within the five main river catchments of Christchurch (Ōtākaro-Avon River, Opāwaho-Heathcote River, Huritini-Halswell River, Pūharakekenui-Styx River and Ōtūkaikino River) (Table 1). Non-wadeable sites were not included due to the difficulties in sampling this environment and because these sites can naturally be soft-bottomed.

2.2. Sampling and Testing Methods

Council has monitored most sites monthly since mid-2020. Fine sediment cover (< 2 mm; i.e., silt/sand) of the streambed was estimated at each site. The sampling method used was adapted from (a) methods used by ECan (Rachel Webster, ECan, personal communication, August 2015) and (b) Sediment Assessment Method 2 from Clapcott *et al* (2011). These methods have been adapted to allow a relatively semi-quantitative assessment of each reach, without having to undertake lengthy, and therefore costly, investigations. These measurements were taken by Council laboratory staff.

The reach assessed was 30 metres in length where available, with the reach starting at the downstream coordinate for the site and continuing upstream from that point. The upstream and downstream extents of each reach were marked to ensure consistency between monitoring events. The entire reach was transversed and ten estimates were taken of fine sediment (< 2 mm) percent cover, with these estimates taken at roughly equidistant points. A bathyscope was used to assess the percent cover of fine sediments and the ten estimates encompassed all habitat types within the wetted margin of the reach (i.e., pools, runs, riffles, backwaters) and habitat types recorded.

Estimates consisted of only visible cover, not assumed cover (e.g., not assumed sediment under macrophytes). Sediment that settles thickly on macrophytes and other substrates was included in the estimate. Each estimate was rounded to the nearest 5%, with 1% recorded if a small amount of sediment is present, and 0% recorded if no sediment was present.

Where possible, observations were conducted by the same observer across each site and each month, to ensure consistency in the sometimes subjective percent cover assessments. If the visibility was not favourable at the time of the scheduled sampling, the site was not required to be revisited for that month.

Turbid water was an issue in 2023, no measurements were taken due to turbid water preventing vision of the streambed at the following sites: Ōpāwaho - Heathcote River at Ferniehurst Street in January, March, May, June, July, 2023; Dudley Creek in February 2023; Cureltts Road Stream upstream of Ōpāwaho – Heathcote River confluence in May 2023; Addington Brook in June 2023; Cashmere Stream in June, July 2023; and Ōpāwaho – Heathcote River at Rose Street in December 2023.

In January 2023 no measurements were taken at Knights Stream as macrophytes were covering the stream, which prevented access and in March 2023 no measurements were taken due to safety issues. At Ōtūkaikino Creek at Omaka Scout Camp no measurements were taken in February 2023 due to access being blocked to the stream. In March and April 2023, no measurements were taken at Ōtūkaikino Creek at Groynes Inlet due to tree felling blocking access to the stream. In August 2023, no measurements were taken at Curletts Road Stream due to debris blocking access to the water. In September 2023, no measurements were taken at Cashmere Stream, Curletts Road Stream, Ferniehurst Street, Rose Street, Warren Crescent, Knights Stream, Nottingham Stream, Ōtūkaikino Creek at Omaka Scout Camp, and Styx Mill Conservation Reserve due to low staffing levels for the laboratory team.

Table 1: Christchurch City Council waterway fine sediment monitoring sites and associated waterway classifications under the Comprehensive Stormwater Network Discharge Consent Environmental Monitoring Programme to allow comparison to Attribute Target Levels.

Catchment	Site ID	Site	Easting (NZTM)	Northing (NZTM)	Waterway Classification	% Cover Attribute Target Level	Monitoring instigated
Ōtākaro-Avon	AVON08	Riccarton Main Drain	1568683	5180019	Spring-fed – plains – urban	30	June 2020
	AVON09	Addington Brook	1569427	5179826	Spring-fed – plains – urban	30	June 2020
	AVON10	Dudley Creek	1572574	5182150	Spring-fed – plains – urban	30	June 2020
	AVON12	Avon River at Carlton Mill Corner	1569737	5181259	Spring-fed – plains – urban	30	June 2020
Ōpāwaho-Heathcote	HEATH06	Heathcote River at Rose Street	1568701	5175918	Spring-fed – plains – urban	30	June 2020
	HEATH07	Heathcote River at Ferniehurst Street	1569157	5175612	Spring-fed – plains – urban	30	June 2020
	HEATH10	Curlett Road Stream Upstream of Heathcote River Confluence	1566928	5177711	Spring-fed – plains – urban	30	June 2020
	HEATH27	Cashmere Stream, Behind 406 Cashmere Road (downstream of stormwater discharge)	1567453	5174866	Banks Peninsula	20	June 2020
	HEATH31	Heathcote River at Warren Crescent	1566034	5177359	Spring-fed – plains – urban	30	June 2020
Pūharakekenui-Styx	STYX03	Styx River at Main North Road	1569066	5187219	Spring-fed – plains	20	June 2020
	STYX04	Kā Pūtahi Creek at Blakes Road	1570401	5188030	Spring-fed – plains	20	June 2020
	STYX09	Kā Pūtahi Creek at Ouruhia Reserve	1571754	5190116	Spring-fed – plains	20	July 2021
	STYX12	Styx River at Styx Mill Conservation Reserve	1568252	5187755	Spring-fed – plains	20	July 2021
Huritini-Halswell	HALS03	Nottingham Stream at Candys Road	1564532	5173080	Spring-fed – plains	20	June 2020

Catchment	Site ID	Site	Easting (NZTM)	Northing (NZTM)	Waterway Classification	% Cover Attribute Target Level	Monitoring instigated
	HALS05	Knights Stream at Sabys Road	1563723	5172852	Spring-fed – plains	20	June 2020
Ōtūkaikino	OTUKAI01	Ōtūkaikino River at Groynes Inlet	1567878	5188869	Spring-fed – plains	20	July 2021
	OTUKAI03	Ōtūkaikino Creek at Omaka Scout Camp	1565664	5188038	Spring-fed – plains	20	June 2020

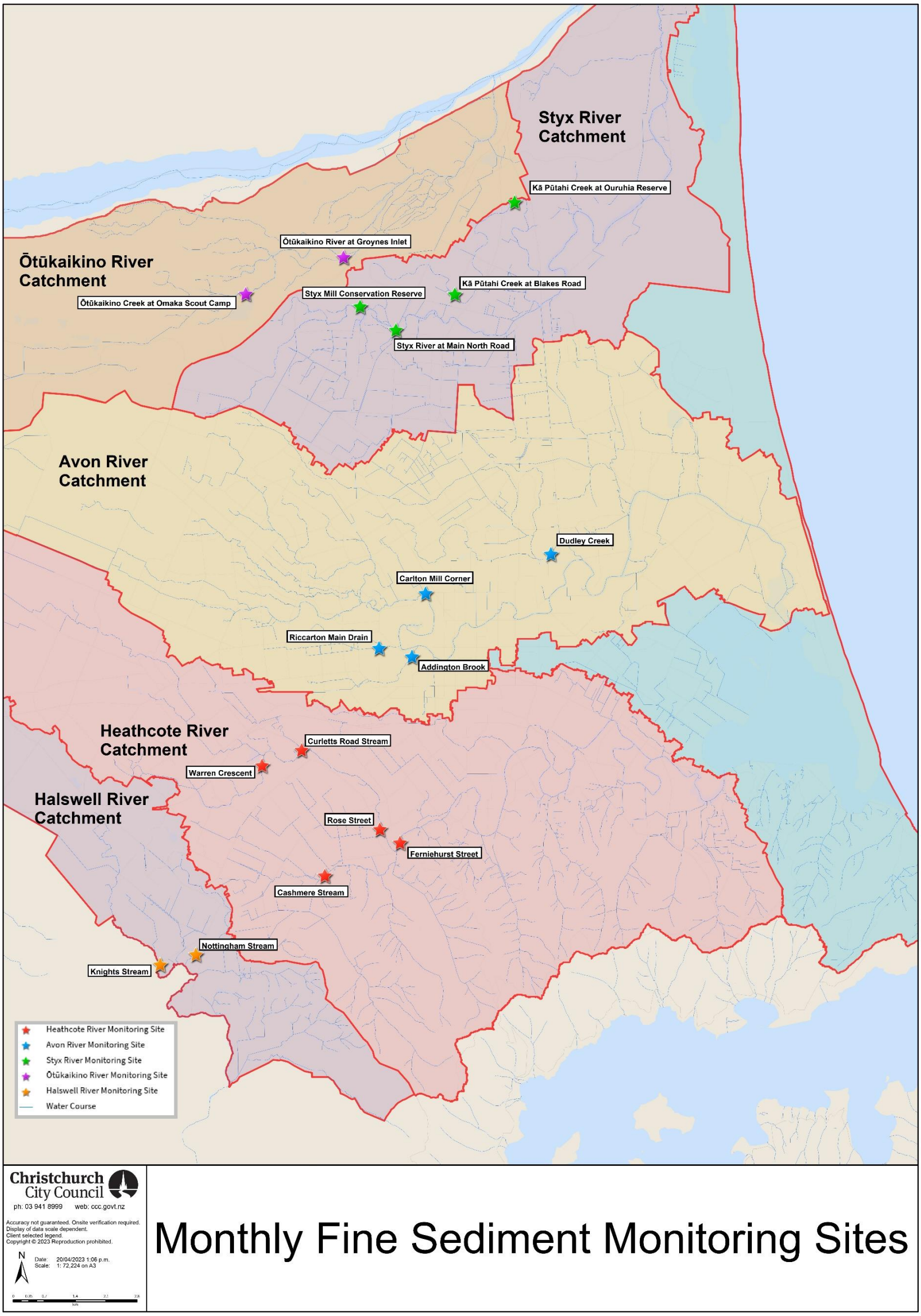


Figure 1: Christchurch City Council waterway fine sediment monitoring sites.

2.3. Data Analysis

2.3.1. Summary Statistics and Graphs

Monthly fine sediment monitoring data was summarised using box plots in the program RStudio (Version 2023.12.1+402 "Ocean Storm" Release). The dark lines in the boxes of the boxplots represent the medians, and the bottom and top lines of the boxes represent the 25th and 75th percentiles (the interquartile range), respectively. The T-bars that extend from the boxes approximate the location of 90% of the data (i.e., the 5th and 95th percentiles). These percentiles were calculated using HAZEN methodology (Ministry for the Environment, 2003).

2.3.2. Attribute Target Levels

The medians of the fine sediment boxplots were compared to the Attribute Target Levels (ATLs) in Schedule 7 of the consent (Table 1). These ATLs are based on the Canterbury Land and Water Regional Plan (LWRP) Table 1a (Freshwater Outcomes for Canterbury Rivers; Environment Canterbury, 2019). The LWRP waterway classification determines which ATL is appropriate. All of the sites within the Ōtākaro-Avon and Ōpāwaho Heathcote River catchments are classified as 'Spring-fed plains – urban', with an ATL of 30% fine sediment cover. The exception to this is Cashmere Stream which is classified as 'Banks Peninsula' and has an ATL of 20% fine sediment cover. All sites within the Pūharakekenui-Styx, Huritini-Halswell, and Ōtūkaikino River catchments are classified as 'Spring-fed – plains', with an ATL of 20% fine sediment cover.

2.3.3. Temporal Trends

Temporal trends analysis was carried out on the monthly data to determine whether fine sediment cover is declining, improving, or staying the same over time. All data collected since monitoring began in 2021 was used to conduct the temporal trend analysis.

Trend analysis was conducted using Time Trends Version 7.0, build 1 (NIWA, 2014). The Seasonal Kendall trend test was used to test the significance, magnitude, and direction of the trends, providing an average annual percentage change. A change was considered meaningful when there was a statistically significant ($p \leq 0.05$) positive or negative result greater than 1% (NiWA, 2020).

3. Results

3.1.1. Spatial differences

There were no obvious trends in fine sediment between sites and catchments (Figure 2). Curlett Road Stream Upstream of Ōpāwaho-Heathcote River confluence had the highest median cover of 100% across all 17 sites, with Curlett Road Stream recording less than 100% on only two occasions (Figure 2). The red lines are the consent Attribute Target Levels. High sediment cover was also recorded at Kā Pūtahi Creek at Blakes Road (median of 95%) and in the Ōpāwaho-Heathcote River at Nottingham Stream (median of 85%). Pūharakekenui-Styx River at Main North Road had the lowest median cover (median of 1%). Low sediment cover was also recorded at Ōtākaro-Avon River at Carlton Mill Corner (median of 5%) and at Pūharakekenui-Styx River Styx Mill Reserve (median of 10%). The most variable site overall was Knights Stream in the Huritini-Halswell catchment (median of 70%; range of 25% - 100%).

3.1.2. Comparison to Attribute Target Levels

ATLs for fine sediment cover were complied with at six of the 17 monitoring sites (Figure 2). These sites were Omaka Scout Camp in the Ōtūkaikino River (median of 17.5%), Main North Road (median of 1%) and Styx Mill Reserve in the Pūharakekenui-Styx River (median of 10%). Riccarton Main Drain (median of 25%) and Carlton Mill Corner (median of 5%) in the Ōtākaro-Avon River catchment, and Rose Street (median of 21.5%) in the Ōpāwaho-Heathcote River catchment.

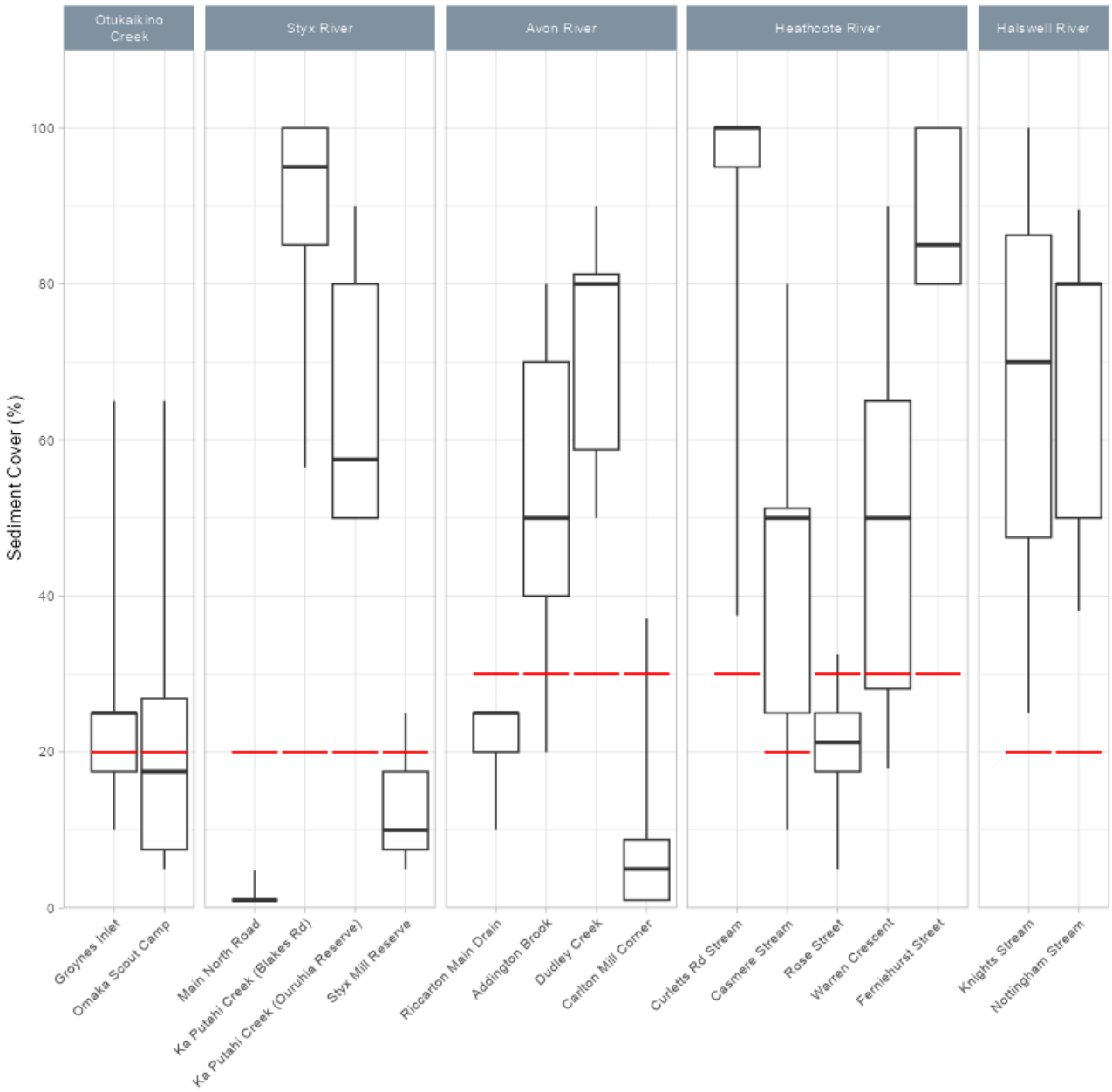


Figure 2: Monthly fine sediment percent cover at 17 sites in Christchurch City from January - December 2023. The red lines indicate the consent Attribute Target Levels.

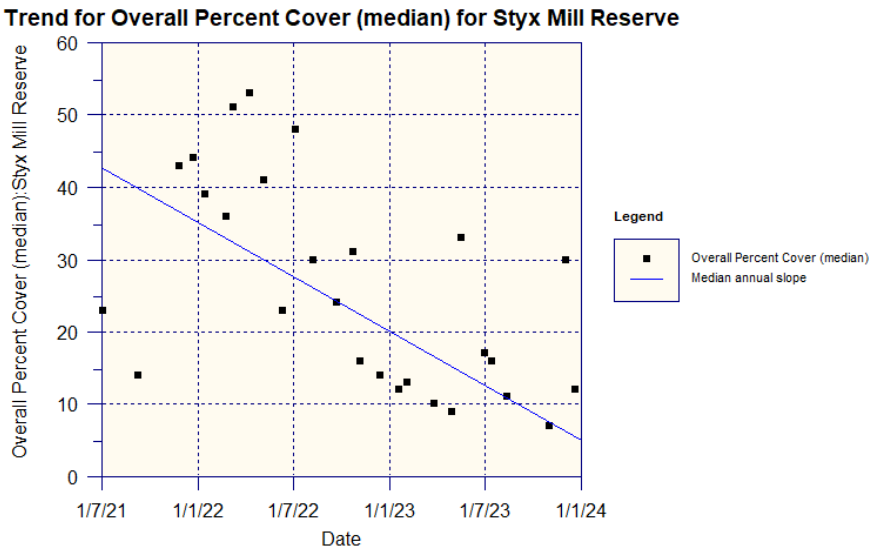
3.1.3. Temporal Trends

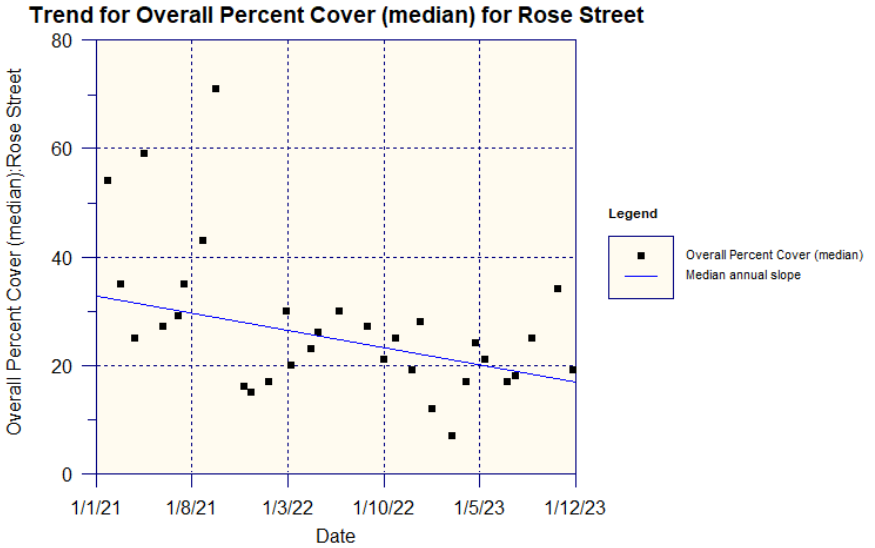
There were four out of the 17 monitoring sites that had meaningful decreasing trends over the last three years of data. The other 13 monitoring sites did not have any meaningful increasing trends over the last three years. Styx Mill Reserve in the Pūharakekenui-Styx River showed the largest decreasing average annual change of 68.41%. Rose Street and Ferniehurst Street in the Ōpāwaho-Heathcote River had decreasing trends with average annual changes of 20.07% and 5.64% respectively. Nottingham Stream at Candys Road in the Huritini-Halswell River had a decreasing trend with an average annual change of 10.95%.

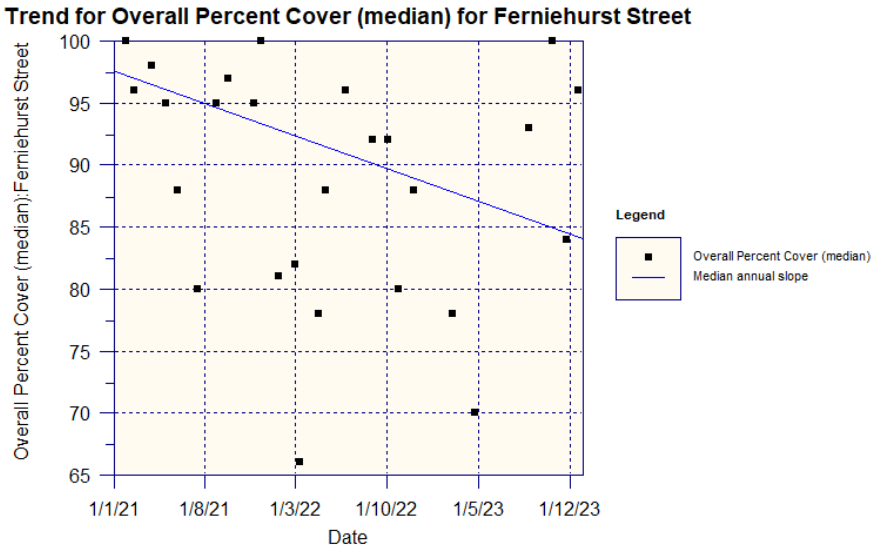
Table 2: Direction of significant temporal trends (2020 – 2023) for monthly fine sediment cover at Christchurch City Council fine sediment monitoring sites.

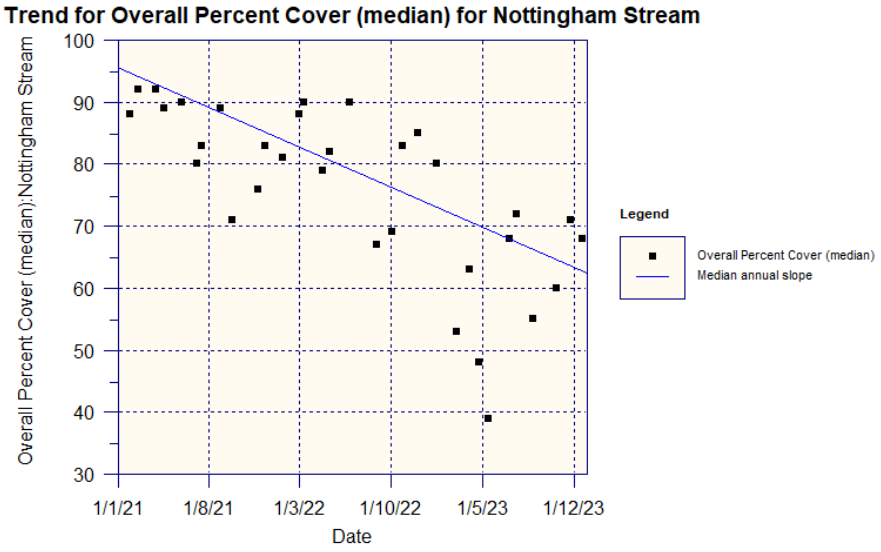
Site	Median Fine Sediment Cover Average Annual Change
Styx Mill Reserve	↓ 68.41%
Rose Street	↓ 20.07
Ferniehurst Street	↓ 5.64%
Nottingham Stream	↓ 13.69%

Figure 3: Graphs of significant temporal trends (2020 – 2023) for monthly fine sediment cover at Christchurch City Council fine sediment monitoring sites.









4. Discussion

Monitoring data from 2023 shows no obvious patterns in fine sediment between sites and catchments. Fine sediment cover was high and exceeded consent target levels at 11 of the 17 monitoring sites. This partly reflects the naturally high fine sediment cover present in some of the spring-fed streams sampled across Christchurch, but mostly reflects the negative impacts of rural and urban land use on sediment erosion and fine sediment deposition.

The three sites with the highest sediment cover were Curlett Road Stream Upstream of Ōpāwaho-Heathcote River confluence, Kā Pūtahi Creek at Blakes Road, and Ferniehurst Street in the Ōpāwaho-Heathcote River. All these sites are in highly urban or industrial areas likely subjected to sediment discharges.

Time trends have been conducted with data over three years starting in 2021. There were no meaningful increasing trends for any of the 17 monitored sites. There were however, four sites that had meaningful decreasing trends. These sites were Styx Mill Reserve in the Pūharakekenui-Styx River, Rose Street & Ferniehurst Street in the Ōpāwaho-Heathcote River, and Nottingham Stream at Candys Road in the Huritini-Halswell River (Table 2).

There are stormwater facilities upstream of the Curletts Road (Curletts wetland) and Blakes Road (Spring Grove Basin) sites to treat stormwater from these catchments. The high cover at these sites indicates legacy sediment is present, however both of these facilities are only recently completed and operational. There are no Council stormwater facilities in the immediate catchment of Nottingham Stream however a facility is planned for the future. Investigations for this are currently being scoped. The Ferniehurst Street sampling site is downstream of the confluence of the Ōpāwaho and Cashmere Stream, with Cashmere Stream receiving hill runoff that is often sediment-laden with rainfall. Several facilities have recently been completed in the Cashmere Stream catchment including Cashmere Valley Dam, Worsleys Basins and Te Kuru which may contribute to the slight decrease shown at the Ferniehurst St site.

Pūharakekenui-Styx River at Main North Road had the lowest median cover, followed by Ōtākaro-Avon River at Carlton Mill Corner and Pūharakekenui-Styx River at Styx Mill Reserve. Low levels at the Pūharakekenui-Styx River at Main North Road may be a reflection of the fast flow recorded at this site, which flushes sediment, as well as the immediate upstream catchment being predominantly the Styx Mill Conservation Reserve, which will be less affected by human activities. Gravels are present at Carlton Mill Corner with fast flowing riffle habitat, which flushes out fine sediments and prevents settling on the stream bed.

5. Recommendations

Based on the results of the monitoring above, the below is recommended:

- Continuation of long-term monitoring to establish if sediment cover changes over time. Particularly in relation to the Curlett Road Stream Upstream of Ōpāwaho-Heathcote River confluence and Kā Pūtahi Creek at Blakes Road sites;
- 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);
- 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);
  - Implementing 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 the tasks in the Healthy Water Bodies Action plan relating to reducing sediment discharge, such as:
  - Reducing sediment discharges, in conjunction with other stakeholders, such as Environment Canterbury (e.g., by implementing 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).

6. Acknowledgements

Thank you to Council laboratory staff, who collected the monthly monitoring samples.

7. References

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