Thomsons Creek Constructed Wetland

Summary of Environmental Monitoring 2020-2025

Revised 16 June 2025

Constructed wetland, Sluice Channel

By:

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freestone
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1. Introduction

Recent water quality reports have found that the Thomsons Creek at SH85 site was below the national bottom line for dissolved reactive phosphorus (DRP), the faecal indicator bacterium Escherichia coli (E. coli) and suspended fine sediments (based on criteria in the National Objectives Framework (NOF) within the National Policy Statement for Freshwater Management) (Hudson & Shelley 2019, Ozanne et al. 2023). The analysis by Ozanne et al. (2023) found that whilst ammoniacal nitrogen and DRP concentrations have improved over the period 2012-2022, nitrate-nitrite nitrogen (NNN) and total nitrogen (TN) concentrations have increased.

The poor water quality in parts of Thomsons Creek has long been recognised. It is in part due to irrigation practices and other farming practices in the catchment, especially the predominance of flood irrigation methods (ORC 2006). While many (but not all) systems have now been converted to efficient irrigation systems, sediment and phosphorus concentrations are still elevated.

Historical goldmining in the catchment is also likely to contribute to contemporary water quality by affecting drainage patterns and through “legacy” fine sediments discharged to tributaries by sluicing operations. Such changes are particularly apparent in the sub catchment of Thomsons Creek known as the Sluice Channel (also known as the Sludge Channel). In addition to the effects of human activities in the catchment, the geology of the catchment includes the Manuherekia Group, a sedimentary fill that formed at the prehistoric Lake Manuherekia. The finer grained sediments within this group (lacusturine clay, silt shale, quartz sand) can be very erodible, which is likely to be contributing to sediment loads in the catchment.

As part of the Manuherekia Exemplar Catchment project, a wetland and sediment traps were constructed in the lower reaches of the Sluice Channel to trap and retain sediment and reduce phosphorus loads from the Sluice Channel sub-catchment. Figure 1 presents a timeline of activities in the Thomsons Creek catchment. Construction of the wetland began in December 2022 with the inflows diverted around the wetland area in April 2023 allowing the main physical construction to be completed by the end of June 2023. Planting was completed in early summer 2023 and inflows were returned to the wetland in mid-February 2025. Figure 2 shows the lower Sluice channel before and after the construction works.

Water quality samples have been collected from the Thomsons Creek catchment by local members of the community group, and since July 2023, by senior pupils of Ōmakau school overseen firstly by Lucy Franke the enviro-schools co-ordinator and in the last 18 months with Becky Clements from the ORC with students from Ōmakau School (Figure 1). These water quality samples include a baseline period prior to construction works, samples collected while the works were being undertaken, and some samples subsequent to the works being completed. In addition, surveys of sediment cover and macroinvertebrate communities have been undertaken periodically. This report summarises the results of water quality sampling and ecological surveys undertaken in the Thomsons Creek catchment between August 2000 and May 2025.

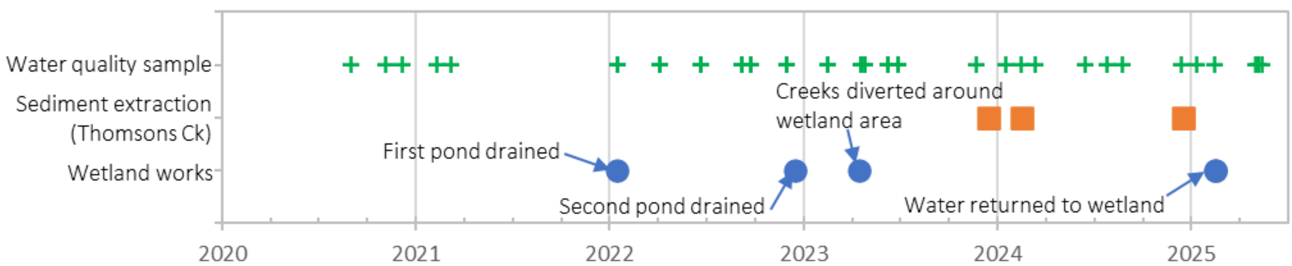

Figure 1 Timeline of works undertaken to construct a wetland in the lower Sluice Channel (blue circles) and gravel extraction from Thomsons Creek upstream and downstream of the Sluice Channel (orange squares). Green crosses indicate when water quality samples were collected.

Figure 2 Aerial photographs of the lower Sluice Channel prior to (left) and immediately after (right) the construction of the constructed wetland.

2. Methods

2.1. Monitoring sites

Monitoring has been undertaken at two sites in Thomsons Creek (Sites 1 & 2 in Figure 3) and four sites in the Sluice Channel catchment (Sites 3, 4, 5 & 6 in Figure 3) as well as at a and the exit to the wetland or ponds (Site 7 in Figure 3).

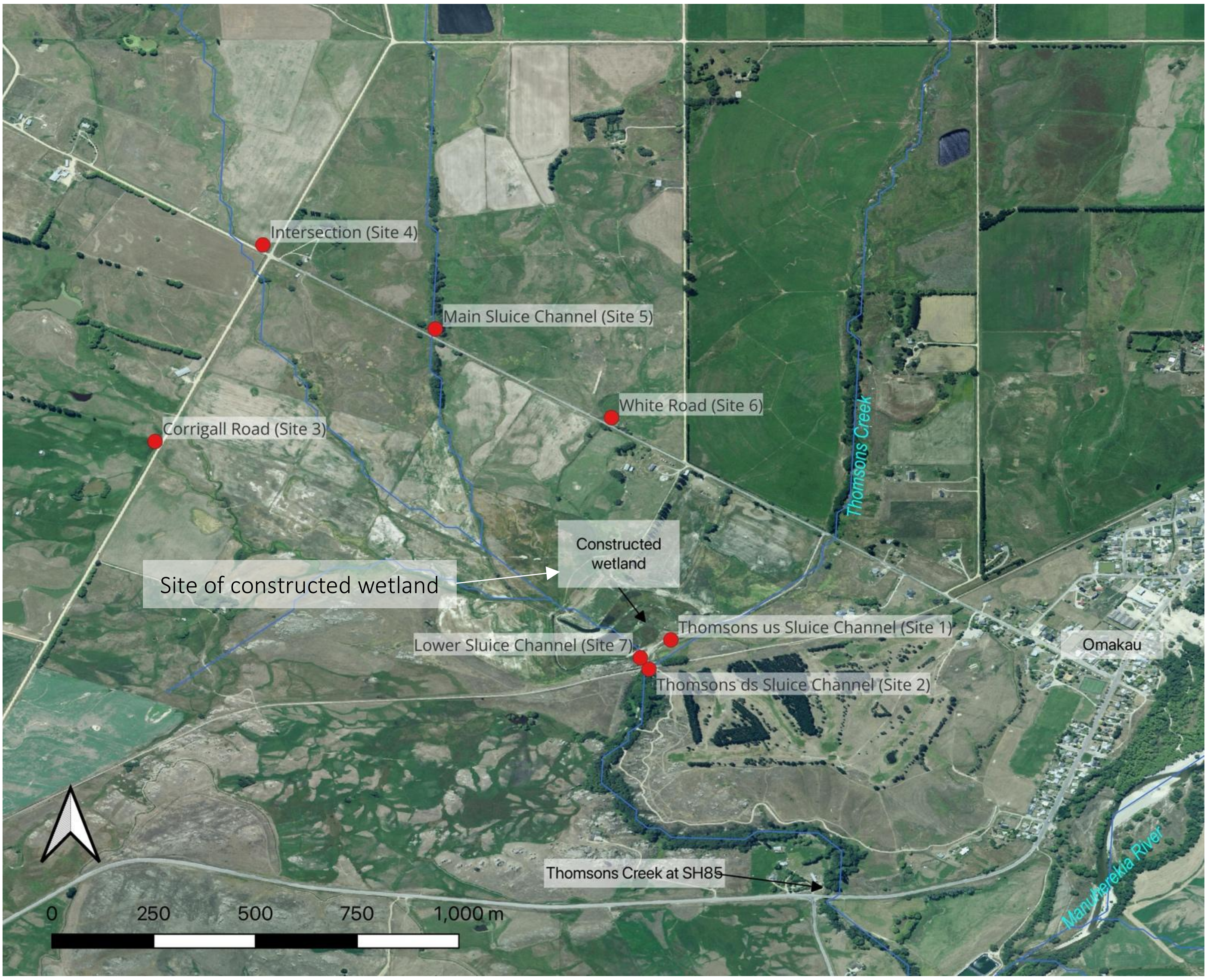

Figure 3 Monitoring sites in the Thomsons Creek and Sluice Channel catchment. Note: monitoring was undertaken at two sites in Thomsons Creek (Sites 1 & 2) and four sites in the Sluice Channel catchment (Sites 3, 4, 5 & 6) and one site at the outflow from the ponds/wetland where the Sluice Channel enters Thomsons Creek (Site 7).

2.2. Water quality

Water quality grab samples were collected from up to seven sites (site 3 was often not sampled due to a lack of surface flow) in the immediate vicinity of the constructed wetland on thirty occasions between August 2000 and May 2025. Samples on each occasion were analysed for turbidity, total suspended solids (TSS), total ammoniacal nitrogen, NNN, DRP and *E. coli*. The samples were collected by local members of the community group, and since July 2023, by Ōmakau school senior students overseen by Lucy Franke the enviro-schools co-ordinator and more recently Becky Clements from ORC.

2.3. Sediment

Sediment assessments were undertaken on four occasions (31 August 2020, 5 December 2022, 9 February 2024, 10 March 2025). Sediment cover and composition was assessed at two sites in the mainstem of Thomsons Creek (upstream and downstream of the Sluice Channel confluence) following the SAM-2 protocol (instream visual estimate of % sediment cover) of Clapcott *et al.* (2011). The depth of fine sediment was measured at one site (Site 5) in a tributary of the Sluice Channel following the SAM-6 protocol (sediment depth) of Clapcott *et al.* (2011).

2.4. Macroinvertebrates

Macroinvertebrate samples were collected from two sites in Thomsons Creek (upstream and downstream of Sluice Channel confluence) on four occasions (31 August 2020, 5 December 2022, 9 February 2024, 10 March 2025).

At each site, one kick-net sample was collected, following Protocol C2 of Stark *et al.* (2001). This protocol involves sampling a range of habitats available at a site, including riffles, mosses, wooden debris and leaf packs. Samples were preserved in 90% isopropyl alcohol in the field and returned to a laboratory for processing. Samples were processed following Protocol P1 (Stark *et al.* 2001; "semi-quantitative coded abundance"). The sieve contents were then placed onto a white tray, and the macroinvertebrates were identified under a dissecting microscope (10-40X), using the identification key of Winterbourn *et al.* (2006). Each macroinvertebrate taxon was coded into one of five abundance categories: Rare (R, 1-4), Common (C, 5-19), Abundant (A, 20-99), Very Abundant (VA, 100-499) or Very, Very Abundant (VVA, 500+). In the laboratory, the samples were passed through a 500 µm sieve to remove fine material. Macroinvertebrate samples were processed by Ryder Environmental Ltd. (31 August 2020, 5 December 2022, 9 February 2024) and Freestone Freshwater (10 March 2025).

The following indices were calculated for each sample:

- Taxon richness is the total number of taxa collected at a sampling site. In general terms, high taxa richness may be considered 'good'; however, mildly impacted or polluted rivers, with slight nutrient enrichment, can have higher species richness than unimpacted, pristine streams.

- EPT richness is the sum of the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) species collected. Many taxa within these groups are sensitive to some types of pollution or degraded habitat conditions, so if EPT species (%EPTtaxa) constitute a high percentage of the total number of macroinvertebrate taxa at a site, this can give an indication of degraded water quality and/or habitat conditions. In this report, purse-cased caddisflies (Hydroptilidae: *Oxyethira* and *Paroxyethira*) were excluded from the EPT count, due to their tolerance of enriched conditions.

- Macroinvertebrate Community Index (MCI; Stark 1985) is calculated based on the tolerance scores for each macroinvertebrate taxon present in a sample. Each macroinvertebrate taxon is assigned a score of between 1 and 10, with low scores representing taxa that are tolerant of poor water quality and/or habitat conditions, while sensitive taxa have high scores. The tolerance scores The MCI score is calculated by averaging the tolerance scores of all taxa collected and multiplying this value by 20 (a scaling factor). The tolerance scores used to calculate MCI and SQMCI scores are based on Greenwood et al. (2015).

- The Semi-Quantitative Macroinvertebrate Community Index (SQMCI; Stark 1998) is a variation of the MCI that weights the tolerance value for each taxon based on the relative abundance of that taxon (weightings based on coded-abundance data: R = 1, C = 4, A = 20, VA = 100, VVA = 500).

3. Results & Discussion

3.1. Water Quality

3.1.1. Inputs to the constructed wetland

Water quality at most tributaries of the Sluice Channel was poor with elevated concentrations of ammoniacal nitrogen and NNN at most sites (Table 1). Whilst the frequency and timing of sampling do not comply with the requirements to formally grade a site based on the NOF, the results of these analyses do provide some indication of the state of the water quality at these sites. Concentrations of ammoniacal nitrogen (compared to Table 5 of the NOF) were consistent with all of these sites sitting in B-band, with ammoniacal nitrogen levels occasionally impacting the 5% most sensitive species (Table 1). Similarly, nitrate concentrations (compared with Table 6 of the NOF) would place most sites in B-band for nitrate toxicity, although the Site 3 (Corrigall Road) was consistent with A-band and Site 6 at the Yards below the national bottom line in Band C, indicating that nitrate concentrations are approaching the level that is expected to result in mortality of sensitive species (Table 1).

DRP concentrations were elevated at all sites (Table 1) and represent levels that are well above reference (unimpacted) conditions (Table 20 of the NOF). High levels of DRP can contribute to high biomasses of periphyton or macrophytes, which can impact on macroinvertebrate and fish communities (Table 20 of the NOF)

Whilst the *E. coli* data available for these sites falls well short of the requirements to grade a site under the NOF (Table 20 of the NOF), concentrations of *E. coli* were very high at all sites at times (Table 1) and would place these sites in E-band, which is below the national bottom line and represent a high risk for primary (i.e. swimming) or secondary contact (e.g. fishing).

Turbidity and TSS were not compared to Table 8 of the NOF, due to the lack of turbidity-clarity or TSS-clarity relationships for Thomsons Creek, however, both turbidity and TSS readings were elevated at all sites (Table 1) indicating that they are unlikely to meet the national bottom line for suspended fine sediment.

Table 1 Summary of water quality variables measured at five sites in the Sluice Channel catchment between August 2020 and May 2025. NOF = National Objectives Framework (from Appendices 2A & B of the National Policy Statement for Freshwater Management 2020).

Site	Statistic	Ammoniacal nitrogen mg/L	NNN mg/L	DRP mg/L	E. coli cfu/100 mL	TSS mg/L	Turbidity NTU
Site 3 Corrigall Rd	Sample size	18	18	18	18	18	18
	Minimum	<0.010	<0.002	<0.004	8	<3	1
	Maximum	0.380	1.36	0.27	5500	310	210
	Mean	0.078	0.526	0.099	1241	33	20
	Median	0.023	0.316	0.076	380	10	6
	95th percentile	0.364	1.348	0.266	5020	216	138
Indicative NOF state		B	A	D	E		
Site 4 Intersection	Sample size	31	31	31	31	31	31
	Minimum	<0.010	<0.002	<0.004	<10	<3	1
	Maximum	0.380	3.1	0.32	4400	280	171
	Mean	0.048	0.582	0.089	759	23	14
	Median	0.022	0.126	0.061	110	7	7
	95th percentile	0.206	2.695	0.259	3785	71	48
Indicative NOF state		B	B	D	E		
Site 5 Main Sluice Channel	Sample size	31	31	31	31	31	31
	Minimum	<0.010	0.005	<0.005	<1000	<3	1
	Maximum	0.103	1.65	0.179	7500	60	49
	Mean	0.030	0.767	0.054	1185	12	9
	Median	0.021	0.8	0.035	300	7	6
	95th percentile	0.102	1.576	0.138	4965	39	37
Indicative NOF state		B	B	D	E		
Site 6 Yards	Sample size	32	32	32	32	32	32
	Minimum	<0.010	0.008	0.005	<10	<3	1
	Maximum	0.154	6.9	0.186	27000	78	30
	Mean	0.032	1.832	0.038	1122	17	7
	Median	0.026	1.51	0.018	125	6	3
	95th percentile	0.079	5.689	0.168	2790	77	29
Indicative NOF state		B	C	D	E		
Lower Sluice Channel	Sample size	33	33	33	33	33	33
	Minimum	<0.010	<0.002	0.005	<10	<3	1
	Maximum	0.230	2	0.21	30000	62	56
	Mean	0.039	0.63	0.069	1600	16	11
	Median	0.021	0.56	0.065	150	13	8
	95th percentile	0.128	1.892	0.187	4000	58	52
Indicative NOF state		B	B	D	E		

3.1.2. Thomsons Creek

Caveat to the water quality analyses presented in this section:

The constructed wetland was completed in February 2025 when the inflowing tributaries were diverted into the wetland and planting was completed in October 2023 and it will take several years before the *Carex* plants are fully grown. Therefore, it is likely to be several years before the wetland reaches fully efficacy.

In addition, given the limited period of water quality sampling since the wetland has been completed (March 2025 to May 2025) more sampling is required before definitive conclusions can be drawn regarding the performance/efficacy of the constructed wetland.

Nitrogen

Water samples were collected from two locations in Thomsons Creek (upstream and downstream of the Sluice Channel confluence) with any degradation in water quality attributes at these two sites providing an indication of the effect of outflows from the Sluice Channel on the water quality of Thomsons Creek downstream.

Prior to the works to construct the wetland, ammoniacal nitrogen concentrations at the two sites on Thomsons Creek were higher downstream of the Sluice Channel confluence, but concentrations during and after construction were not significantly different (Table 2, Figure 4a). In contrast, NNN concentrations were similar both prior to and during construction, but were higher at the downstream site following construction (Table 2, Figure 4b).

The observed ammoniacal nitrogen and NNN concentrations did not reach levels that are expected to be associated with toxic effects on aquatic life (as per Tables 5 & 6 of the NPSFM).

These results are consistent with conditions in the pond that was present in the lower reaches of the Sluice Channel having low oxygen conditions that favour reducing processes, while conditions when the inflows from the Sluice Channel catchment by-passed the wetland area, and following the construction of the wetland favouring oxidising processes (i.e. oxidisation of ammoniacal nitrogen to nitrate nitrogen).

Phosphorus

Concentrations of DRP in Thomsons Creek were higher at the site downstream of the Sluice channel confluence than at the upstream site over all three periods considered (Table 2, Figure 4c)

These results suggest that on the constructed wetland has not reduced phosphorus concentrations in the Sluice Channel. However, it is important to keep the caveat at the start of this section in mind and reserve judgement on the efficacy of the wetland at reducing DRP concentrations until the plantings are fully grown and a longer period of data is available.

Microbiological contamination

Concentrations of *E. coli* were elevated at both sites in Thomsons Creek on most sampling occasions and represent a high risk for primary (i.e. swimming) or secondary contact (e.g. fishing) (Table 2, Figure 4c). There was no evidence of a difference between the two sites in Thomsons Creek prior to the construction of the wetland, or following those works, although concentrations were higher at the downstream site than the upstream site during the period of construction (Table 2, Figure 4c).

These results suggest that *E. coli* die-off within the pond prior to construction and within the constructed wetland, while *E*. *coli* were exported to Thomsons Creek in the flows that were diverted around the construction area while works were being undertaken. It is expected that the increased travel time through the constructed wetland and increased exposure to UV light within the wetland will enhance die-off of *E. coli* resulting in reduced *E. coli* concentrations entering Thomsons Creek.

Suspended sediment

Turbidity and TSS are both measures of how much sediment and other matter there is in water and, which affects how clear the water is (or conversely, how dirty it is). Prior to and during the construction of the wetland, turbidity and TSS concentrations were high at both sites, but higher (i.e. worse) downstream of the Sluice Channel confluence (Table 2, Figure 4e & f). However, turbidity and TSS concentrations in Thomsons Creek downstream of the Sluice Channel confluence were similar to those upstream of the confluence after the construction works (post-works) (Table 2, Figure 4e & f).

These preliminary results are encouraging, suggesting that the constructed wetland is effective at reducing suspended sediment being exported from the Sluice Channel to Thomsons Creek.

Table 2 Comparison of water quality at sites in Thomsons Creek (upstream vs. downstream) for three periods – prior to wetland construction works (Pre), during the works (During) and following the completion of the works (Post). Analysis by paired t-test (with samples paired by sampling occasion). Data for *E. coli*, TSS and turbidity were $\log_{10}$ transformed prior to analysis.

Variable	Time	df	*t*-stat	P	
Ammoniacal N	Pre	10	3.16	0.010	Downstream > Upstream
	During	15	-0.78	0.45	
	Post	4	1.00	0.37	
NNN	Pre	10	0.05	0.96	
	During	15	1.25	0.23	
	Post	4	3.81	0.019	Downstream > Upstream
DRP	Pre	10	2.81	0.009	Downstream > Upstream
	During	15	4.54	<0.001	Downstream > Upstream
	Post	4	6.52	0.003	Downstream > Upstream
E. coli (log)	Pre	10	1.69	0.12	
	During	15	2.84	0.012	Downstream > Upstream
	Post	4	4.00	0.20	
TSS (log)	Pre	10	4.33	0.001	Downstream > Upstream
	During	15	3.45	0.004	Downstream > Upstream
	Post	4	-1.54	0.60	
Turbidity (log)	Pre	10	4.50	0.001	Downstream > Upstream
	During	15	5.94	<0.001	Downstream > Upstream
	Post	4	-1.54	0.20	

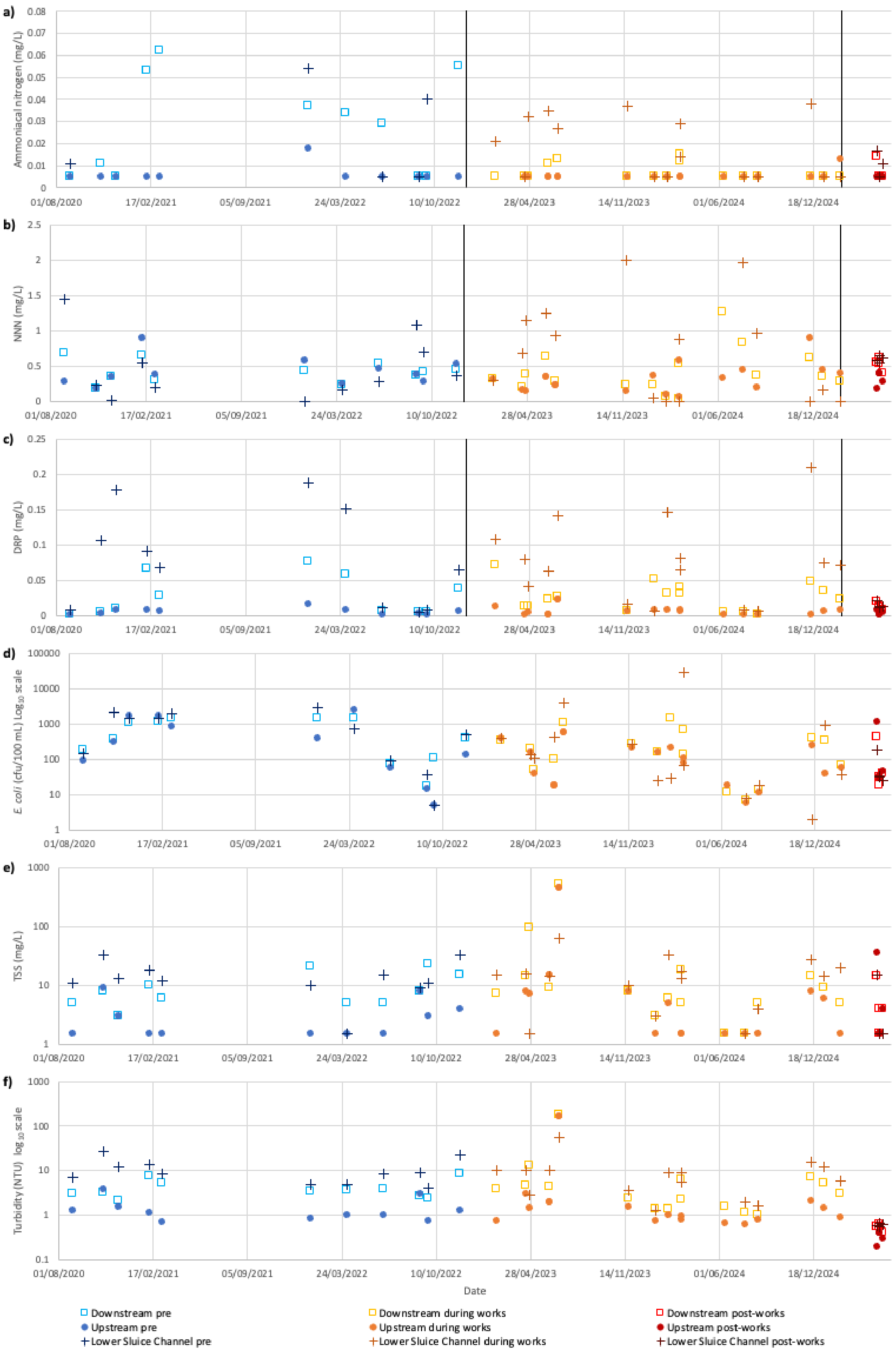

Figure 4 Comparison of (a) ammoniacal nitrogen, (b) NNN, (c) DRP, (d) *E. coli*, (e) TSS, and (f) turbidity at sites in Thomsons Creek upstream (solid circles) and downstream (open squares) of the Sluice Channel confluence and in the lower Sluice Channel (crosses) between August 2020 and May 2025. Vertical black lines indicate the construction period.

3.2. Sediment cover and depth

The substrate at both sites in Thomsons Creek has been dominated by a mix of coarse gravel and fine gravel on all survey occasions (Table 3). Fine sediment (<2 mm) cover was variable through time with higher coverage at the upstream site than at the downstream site on 31 August 2020, while cover by fine sediments at the two sites was similar on 5 December 2022, while on 9 February 2024 and 10 March 2025, fine sediment cover was higher at the downstream site (Table 3). Willows were removed from the banks of Thomsons Creek between the August 2020 and March 2025 surveys and sediment was extracted from the bed of Thomsons Creek in December 2023, February 2024 and December 2024 and these activities are expected to have affected the composition of the substrate at these sites.

Table 3 Sediment cover at two sites in Thomsons Creek estimated by visual assessment (SAM-2) on four occasions and pebble counts (SAM-3) on two occasions.

Date	#		Veg	Sand <2 mm	Fine Gravels 2-16 mm	Coarse Gravels 16-64 mm	Cobble 64-256 mm
SEDIMENT COVER (SAM-2)							
31 August 2020	1	Thomsons Creek upstream of the Sluice Channel	0	15	82	3	0
	2	Thomsons Creek downstream of the Sluice Channel	10	6	50	35	0
5 December 2022	1	Thomsons Creek upstream of the Sluice Channel	0	6	36	63	0
	2	Thomsons Creek downstream of the Sluice Channel	0	7	40	54	0
9 February 2024	1	Thomsons Creek upstream of the Sluice Channel	1	4	34	61	0
	2	Thomsons Creek downstream of the Sluice Channel	1	33	34	32	0
10 March 2025	1	Thomsons Creek upstream of the Sluice Channel	0	0	7	93	0
	2	Thomsons Creek downstream of the Sluice Channel	0	16	44	40	0
WOLMAN PEBBLE COUNT (SAM-3)							
31 August 2020	1	Thomsons Creek upstream of the Sluice Channel	6	34	40	20	0
	2	Thomsons Creek downstream of the Sluice Channel	14	18	35	34	0
10 March 2025	1	Thomsons Creek upstream of the Sluice Channel	0	3	21	74	2
	2	Thomsons Creek downstream of the Sluice Channel	3	11	36	49	1

The bed of Site 5 in the main Sluice Channel was dominated by fine sediments (cover 96-100% on all three occasions). For this reason, a sediment probe was used to estimate the depth of fine sediment on the bed at this site. Table 4 summarises the results of these surveys, with the average depth of fine sediments at this site ranging from 0.31 m to 0.43 m and depths in excess of 0.9 m (the length of the probe) being recorded. These results indicate the very large amount of fine sediment in the Sluice Channel catchment and the potential contribution of this sub-catchment to sediment loads in Thomsons Creek and the Manuherekia River.

Table 4 Sediment probe depth at Site 5 in the Sluice Channel estimated following the SAM-2 protocol

Date	Sediment depth (m)	
	Mean	Maximum
31-Aug-20	0.34	0.72
5-Dec-22	0.31	0.64
9-Feb-24	0.36	>0.90
10-Mar-25	0.43	>0.90

3.3. Macroinvertebrates

The macroinvertebrate community data for the two sites sampled on the three sampling occasions are presented in Appendix A. Macroinvertebrate metrics for samples collected on 31 August 2020, 5 December 2022 and 9 February 2024 are summarised in Table 5 while full macroinvertebrate community composition data is presented in Table 6.

On 10 March 2025, the macroinvertebrate community at both sites were numerically dominated by riffle beetle larvae (Elmidae), the common mayfly *Deleatidium*, and the mudsnail *Potamopyrgus antipodarum* (Table 6). The amphipod *Paracalliope* was also among the most abundant taxa at the downstream site (Table 6).

The MCI score at the upstream site was higher than the downstream site on all sampling occasions, with the score for the upstream site indicative of good water and/or habitat quality (based on the criteria of Stark &Maxted 2007), while the score for the downstream site was indicative of fair water and/or habitat quality on most sampling occasions, but the score for good water and/or habitat quality on the 10 March 2025 (Table 6.). SQMCI scores for the upstream site were higher than for the downstream site on 5 December 2022 and 10 March 2025 sampling occasions (Table 6). Meanwhile the difference in SQMCI score for the two sites on the 31 August 2020 and 9 February 2024 sampling occasions were small, indicating that the ecological state of both sites was similar on those occasions (Table 6).

The results of macroinvertebrate community sampling on most occasion are consistent with a degradation in water and/or habitat quality between the upstream and downstream site on Thomsons Creek.

Table 5 Macroinvertebrate community composition and coded-abundance at two sites in Thomsons Creek on four sampling occasions.

Metric	Thomsons Creek u/s Sluice Channel				Thomsons Creek d/s Sluice Channel			
	31/08/20	05/12/22	09/02/24	10/03/25	31/08/20	05/12/22	09/02/24	10/03/25
Number of taxa	20	16	22	17	23	25	22	20
Number of EPT taxa[1]	7	8	9	8	7	7	10	7
% EPT taxa[1]	35	50	41	47	30	28	45	35
MCI score	109	115	106	109	96	92	96	106
SQMCI score	6.54	6.18	5.69	6.30	6.38	5.49	5.78	5.55

1 = Excluding Hydroptilidae

Table 6 Macroinvertebrate community composition and coded-abundance at two sites in Thomsons Creek on 10 March 2025. The abundance codes used are as follows: R = 1-4 individuals, C=5-19 individuals, A=20-100 individuals, VA=100-500 individuals, VVA>500 individuals. Tolerance values are from Greenwood *et al.* (2015)

TAXON	Tolerance value*	Thomsons Creek u/s Sluice Channel 10/3/2025	Thomsons Creek d/s Sluice Channel 10/3/2025
COLEOPTERA (Beetles)			
Elmidae	6	VVA	VVA
CRUSTACEA (Shrimp, amphipods)			
Ostracoda	3	C	A
Paracalliope	5	A	VVA
DIPTERA (True flies)			
Eriopterini	9		R
Muscidae	4	R	R
EPHEMEROPTERA (Mayflies)			
Deleatidium species	7	VVA	VVA
MEGALOPTERA (Dobsonflies)			
Archichauliodes diversus	8	R	C
MOLLUSCA (Snails)			
Gyraulus	3		A
Physa / Physella species	2	R	A
Potamopyrgus antipodarum	5	VA	VVA
Sphaeriidae	2		C
NEMATODA (Round worms)	5	R	R
OLIGOCHAETA (Segmented worms)	5	C	A
PLATYHELMINTHES (Flatworms)	4		R
TRICHOPTERA (Caddis flies)			
Hudsonema amabile	4	C	A
Hydrobiosidae early instar	5	C	C
Hydrobiosis species	8	C	C
Hydropsyche - Aoteapsyche grp	8	C	A
Psilochorema species	7	A	A
Pycnocentria species	5	A	VA
Pycnocentrodes species	6	A	A
Number of taxa		**17**	**20**
Number of EPT taxa (excl. Hydroptilidae)		**8**	**7**
% EPT taxa (excl. Hydroptilidae)		**47**	**35**
MCI score		**109**	**106**
SQMCI score		**6.30**	**5.55**

4. Conclusions & Recommendations

The results of water quality, sediment and macroinvertebrate monitoring prior to construction of the wetland beginning were largely consistent with the Sluice Channel making a significant contribution to poor water and/or habitat quality in the lower reaches of Thomsons Creek. Water quality at most tributaries of the Sluice Channel was poor with elevated concentrations of ammoniacal nitrogen, NNN, DRP, *E. coli* and suspended sediment at most sites, with some sites exceeding national bottom lines for some attributes.

The constructed wetland was completed in February 2025 when the inflowing tributaries were diverted into the wetland and planting was completed in October 2023. It will take several years before plantings are fully grown. This, along with the limited period of water quality sampling since the wetland has been completed (March 2025 to May 2025), mean that more sampling is required before definitive conclusions can be drawn regarding the performance/efficacy of the constructed wetland.

Baseline water quality monitoring indicates that conditions in the pond that was present in the lower reaches of the Sluice Channel likely had low oxygen conditions that favoured reducing processes, while conditions when the inflows from the Sluice Channel catchment by-passed the wetland area, and following the construction of the wetland appear to favour oxidising processes (i.e. oxidisation of ammoniacal nitrogen to nitrate nitrogen). Comparison of DRP concentrations pre- and post- construction suggest that on the constructed wetland has not reduced phosphorus concentrations in the Sluice Channel. Given the limited data available and the fact that the wetland plantings are still establishing, it is too early to judge the efficacy of the wetland at reducing DRP concentrations.

Concentrations of *E. coli* in Thomsons Creek were similar upstream and downstream of the Sluice Channel input suggesting that conditions within the pond prior to construction favoured *E. coli* die-off and it appears that conditions within the constructed wetland do too. In comparison, *E. coli* concentrations were significantly higher downstream than upstream of the Sluice Channel inflow during the period when flows were diverted around the construction area while works were being undertaken,. It is expected that the increased travel time through the constructed wetland and increased exposure to UV light within the wetland will enhance die-off of *E. coli* resulting in reduced *E. coli* concentrations entering Thomsons Creek.

The preliminary results suggest that the constructed wetland is effective at reducing suspended sediment being exported from the Sluice Channel to Thomsons Creek.

Fine sediment (<2 mm) cover in Thomsons Creek was variable through time with higher coverage at the upstream site than at the downstream site on 31 August 2020, while cover by fine sediments at the two sites was similar on 5 December 2022, while on 9 February 2024 and 10 March 2025, fine sediment cover was higher at the downstream site

The results of macroinvertebrate community sampling on most occasion are consistent with a degradation in water and/or habitat quality between the upstream and downstream site on Thomsons Creek.

4.1. Recommendations

The constructed wetland was completed in February 2025 and at the time of writing, limited post-construction data is available (March 2025 to May 2025),. It is likely to take several years before plantings are fully grown and the wetland is fully established and its capacity to retain, assimilate and transform is realised. For these reasons, it is recommended that water quality and environmental sampling (sediment cover and macroinvertebrates) should continue. Continued sampling would support definitive conclusions can be drawn regarding the performance/efficacy of the constructed wetland.

The cost of such monitoring is relatively small, especially when considering the cost of the physical works to construct the wetland and establish the wetland vegetation. The wetland construction was part of the Manuherekia Exemplar Catchment Project, and such monitoring data would provide important information to assess the benefits of the investment in the construction of the wetland, communicate the lessons learned from the work done in this project and to inform decision making on similar projects in the future.

The Thomsons Creek at SH85 water quality monitoring site is downstream of the Sluice Channel and so any improvements in the quality of the water leaving the Sluice Channel sub-catchment should affect water quality at the SH85 site. This site is part of Otago Regional Council's State of the Environment (SoE) programme, and the poor water quality at this site has been recognised for many years (ORC 2006). Recent water quality reports have found that the Thomsons Creek at SH85 site was below the national bottom line for dissolved reactive phosphorus (DRP), the faecal indicator bacterium *E. coli* and suspended fine sediments (based on criteria in the National Objectives Framework (NOF) within the National Policy Statement for Freshwater Management) (Hudson & Shelley 2019, Ozanne et al. 2023). Continued monitoring of the Sluice Channel and Thomsons Creek upstream and immediately downstream of the Sluice Channel confluence will provide valuable information to aid in the interpretation of any changes in water quality observed Thomsons Creek at SH85 water quality monitoring site.

On-going monitoring should include:

- Water quality monitoring in Thomsons Creek upstream (Site 1) and downstream (Site 2) of the Sluice Channel and at the outflow from the constructed wetland (lower Sluice Channel). Water quality entering the constructed wetland would be required to assess the on-going efficacy of the wetland in remediating water quality in the Sluice Channel. This could be a continuation of the current sites in major inputs to the wetland (Sites 5 and 6) or where these major inflows enter the wetland. Ideally, water quality monitoring would be done monthly to match SoE monitoring at the SH85 site.
- Sediment monitoring in Thomsons Creek upstream and downstream of the Sluice Channel using visual estimates of fine sediment cover (SAM-2) and/or pebble counts (SAM-3). SAM-2 assessments could focus on fine sediment cover. Sediment monitoring could be done annually.
- Macroinvertebrate monitoring in Thomsons Creek upstream and downstream of the Sluice Channel would allow assessment of whether wetland has remediated the impact of outflows from the Sluice Channel on macroinvertebrate community composition in Thomsons Creek. Macroinvertebrate monitoring could be done annually.

5. References

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6. Appendix A Macroinvertebrate data

Table A1 Macroinvertebrate community composition and abundance at two sites in Thomsons Creek on three sampling occasions (31 August 2020, 5 December 2022 and 9 February 2024). The abundance codes used are as follows: R = 1-4 individuals, C=5-19 individuals, A=20-100 individuals, VA=100-500 individuals, VVA>500 individuals.

TAXON	Tolerance value*	Thomsons Creek u/s Sluice Channel 31/08/20	5/12/22	9/02/24	Thomsons Creek d/s Sluice Channel 31/08/20	5/12/22	9/02/24
COLEOPTERA (Beetles)							
Elmidae	6	A	VA	VVA	A	A	VA
CRUSTACEA (Shrimp, amphipods)							
Cladocera	1					C	
Ostracoda	3	R	C	A	A	VA	C
Paracalliope	5	C	VA	VVA	C	VVA	VVA
Paraleptamphopus	7					R	
DIPTERA (True flies)							
Austrosimulium species	6	A	A		R	C	
Ceratopogonidae	6					R	
Chironomus	1					R	
Ephydridae	4			R			
Eriopterini	9	R					
Maoridiamesa species	7				R		
Mischoderus							R
Muscidae	4			A			C
Orthocladiinae	4	C	C	VA	A	R	A
Stratiomyidae	2				R		
Tanypodinae	5			C		R	R
Tanytarsini	5			VA	R		A
EPHEMEROPTERA (Mayflies)							
Austroclima species	6			C			R
Deleatidium species	7	VVA	VVA	VVA	VVA	VVA	VVA
HEMIPTERA (Bugs)							
Sigara species	2					C	
MEGALOPTERA (Dobsonflies)							
Archichauliodes diversus	8	R	R	R		R	
MOLLUSCA (Snails)							
Gyraulus species	3					A	
Physa/Physella species	2	R		A	R	A	A
Potamopyrgus antipodarum	5	A	A	VA	A	VA	VA
Sphaeriidae	2	R			R	C	C
NEMATODA (Round worms)	5				R		
NEMERTEA (Proboscis worms)	2	R			R		
OLIGOCHAETA (Segmented worms)	5	VA	VA	C	VA	VA	A
PLATYHELMINTHES (Flatworms)	4	C			C	A	
PLECOPTERA (Stoneflies)							
Zelandobius species	7	C			R		

Table A1 Macroinvertebrate community composition and abundance at two sites in Thomsons Creek on three sampling occasions (31 August 2020, 5 December 2022 and 9 February 2024). The abundance codes used are as follows: R = 1-4 individuals, C=5-19 individuals, A=20-100 individuals, VA=100-500 individuals, VVA>500 individuals.

TAXON	Tolerance value*	Thomsons Creek u/s sludge channel 31/08/20	5/12/22	9/02/24	Thomsons Creek d/s sludge 31/08/20	5/12/22	9/02/24
TRICHOPTERA (Caddis flies)							
Beraeoptera	7			R			
Hudsonema amabile	4		C	A	C	A	C
Hydrobiosidae early instar	5		A				
Hydrobiosis species	8	A	A	A	A	A	A
Hydropsyche - Aoteapsyche grp	8	R	R	C			A
Oecetis	4						R
Oxyethira albiceps	3			C	R		
Polyplectropus	3					R	
Psilochorema species	7	C	C	A	C	C	A
Pycnocentria species	5	C	A	VA	C	A	VA
Pycnocentrodes species	6	C	VVA	VA	R	A	C
Number of taxa		**20**	**16**	**22**	**23**	**25**	**22**
Number of EPT taxa (excl. Hydroptilidae)		**7**	**8**	**9**	**7**	**7**	**10**
% EPT taxa (excl. Hydroptilidae)		**35**	**50**	**41**	**30**	**28**	**45**
MCI score		**109**	**115**	**106**	**96**	**92**	**96**
SQMCI score		**6.54**	**6.18**	**5.69**	**6.38**	**5.49**	**5.78**