



Otago
Regional
Council

Flow naturalisation of Mill Creek

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This document describes how naturalised flow statistics at the flow recorder on Mill Creek at Fish Trap were derived.

Daily flow time series data for Mill Creek

The daily flow time series data available for analysis are listed in **Table 1**. The locations of the sites are shown in **Figure 1**. The current consents used in this study (shown in **Figure 1**) are listed in **Table A1** in the **Appendix**.

Table 1: The daily flow time series data available for analysis above Mill Creek at Fish Trap.

Sites	Start	End	Length (year)
Mill Creek at Fish Trap	31/03/1983	24/04/2023	40.1
Mill Creek at Hunter Road	18/09/2018	14/10/2020	2.1

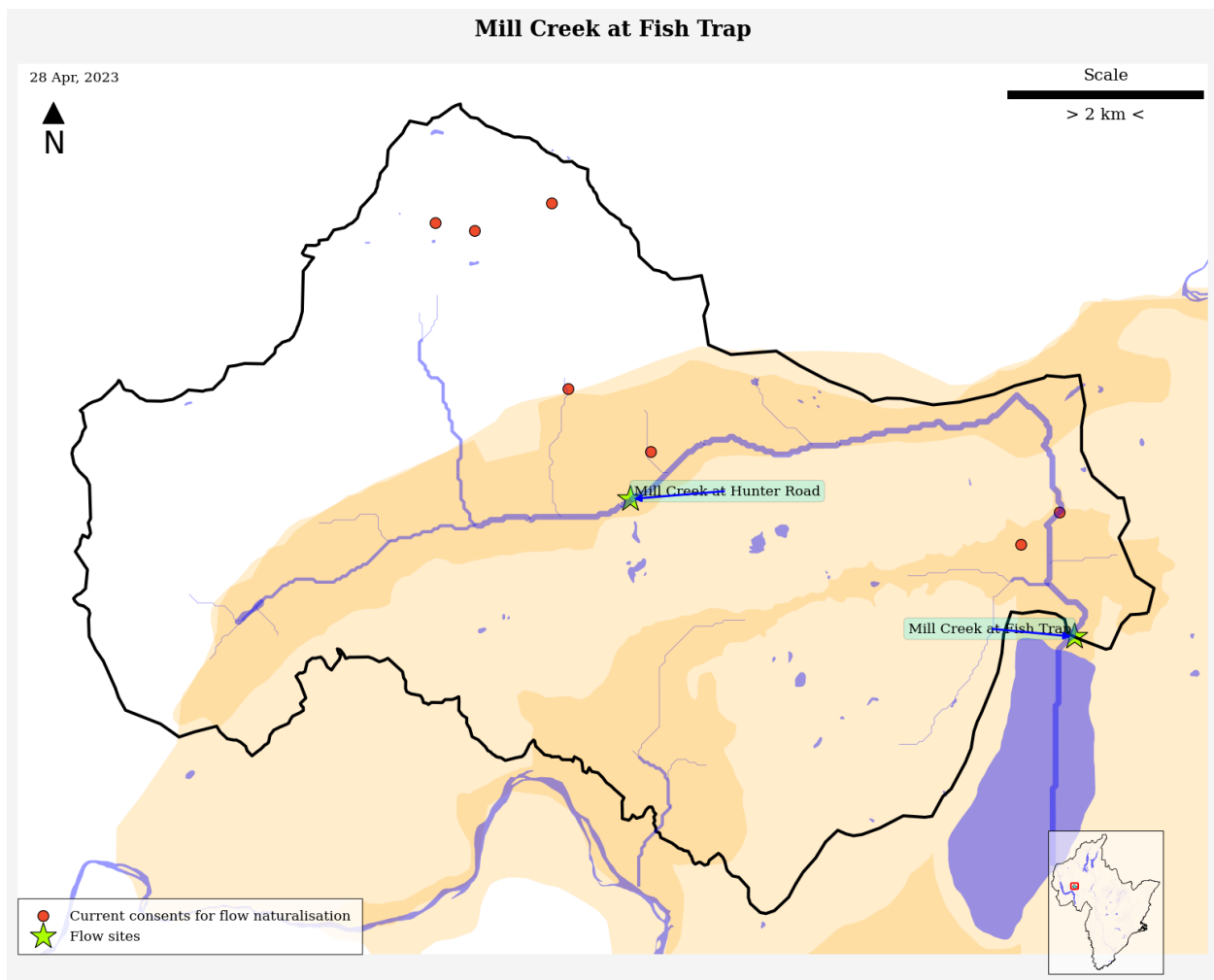


Figure 1: The location of flow recorders and current consents used in this study on Mill Creek in Central Otago.

The flow recorder at Mill Creek at Hunter Road is not considered in this study as it is not the location of interest.

Daily water use time series

Time series data of water use (WU) is used to naturalise the flow at Mill Creek at Fish Trap flow recorder. All consents above the flow recorder must first be identified.

Total water use above Mill Creek at Fish Trap flow recorder

Altogether 96 consents have been issued in history above the Mill Creek at Fish Trap flow recorder. However, 41¹ consents are used in the flow naturalisation process (See **Table A1** in the Appendix). As shown in the table, 7 are currently active. **Figure 2** shows the total water use (WU) regime above Mill Creek at Fish Trap.

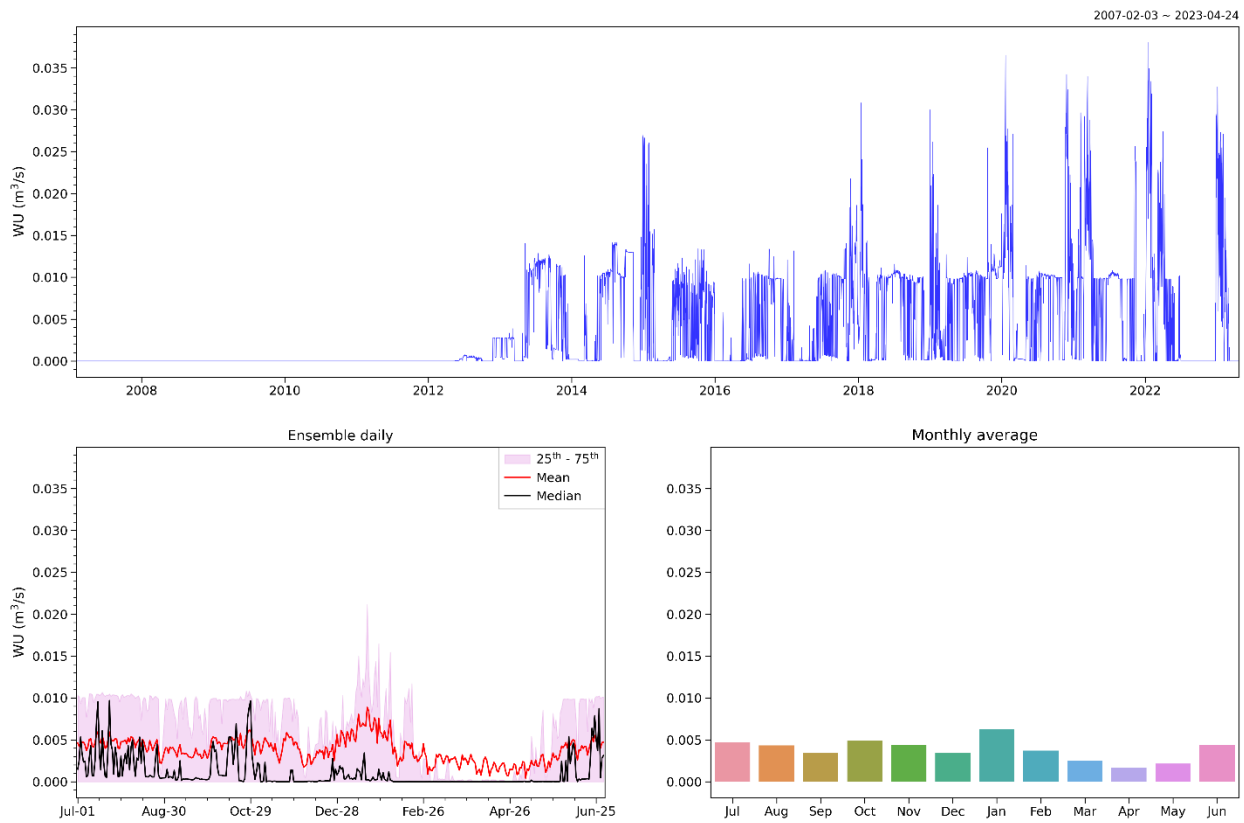


Figure 2: The total water use upstream of the recorder at Mill Creek at Fish trap.

¹ 41 consents used in this study are listed in **Table A1** in the **Appendix**. They are the consents left by filtering out:

- Groundwater takes with no effect on the nearby water body (refer to the attribute of *Stream depletion rate*)
- Non-consumptive takes
- Retakes

As shown in **Figure 2**, the patterns before and after the water year 2013/14 are different due to water meter abstraction data not being available prior to the 2013/14 season. In this study, only the water use data after 2013/14 is available to be used. The average total WU during the water year (July - June) is 6 L/s after 2013/14.

Flow naturalisation

This section describes how the naturalised flow statistics are estimated for the flow recorder at Mill Creek at Fish Trap.

Method

The naturalised flow time series can be estimated by adding the upstream total WU to the observed flow records.

Producing long-term flow statistics is the key goal for this study including the naturalised seven-day mean annual flow (7dMALF) and long-term median and mean flows for the flow recorder at Mill Creek at Fish Trap.

Naturalised flow Statistics

Basic flow statistics (Table 2).

Table 2: Naturalised flow statistics for the recorder at Mill Creek at Fish Trap (01/07/2013 ~ 24/04/2023).

Site	Mean (m³/s)	Median (m³/s)	FRE3² (year⁻¹)	7dMALF (m³/s) (Jul - Jun)
Mill Creek at Fish Trap (Naturalised)	0.431	0.394	1.7	0.247
Mill Creek at Fish Trap (observed)	0.425	0.388	1.7	0.243

² The frequency of events exceeding three times the median flow value. In this study, an independent event is defined by a minimal event interval of 7 days.

The naturalised mean annual 7-day moving average flows of 5- and 10-year return periods at Mill Creek at Fish Trap are estimated as $Q_{7,5} = 0.219$ and $Q_{7,10} = 0.185$ m³/s, respectively.

It must be noted that the $Q_{7,5}$ and $Q_{7,10}$ values were estimated using a relatively shorter naturalised time series and they may vary dramatically when more data is available in the future. Using different distributions could also vary the results.

Appendix

Table A1. The consents used for flow naturalisation at site Mill Creek at Fish Trap

Consent	Status	Water meter	Allocation type	Category	Consented rate	Stream depletion rate
WR1791Q	Cancelled			Surface Take	20.8	
2004.011.V1	Current	WM0742, WM1462		Surface Take	4.3	
2004.013	Current		Primary	Surface Take	1.5	
RM12.113.01	Current	WM0622	Primary	Surface Take	16.2	
RM14.124.01	Current	WM0536	Primary	Surface Take	50	
RM18.439.01	Current	WM1517	Primary	Groundwater Take	15	4.9
RM20.296.02	Current			Surface Take		
RM21.284.01	Current			Surface Take	13.7	
2000.383	Expired	WM0015	Primary	Surface Take	9.84	
2002.542.V1	Expired		Primary	Surface Take	28	
2038	Expired			Surface Take		
2167	Expired			Surface Take		
2271	Expired			Surface Take		
2380	Expired			Surface Take		
2392A	Expired			Surface Take		
2656A	Expired			Surface Take		
2884	Expired			Surface Take		
2992	Expired			Surface Take		
3058	Expired			Surface Take		
3252B	Expired			Surface Take		
3734	Expired			Surface Take		
3760	Expired			Surface Take		
3766	Expired			Surface Take		
3766C	Expired			Surface Take		
3800	Expired			Surface Take		
3802	Expired			Surface Take		
4041	Expired			Surface Take		
4086B	Expired			Surface Take		

Consent	Status	Water meter	Allocation type	Category	Consented rate	Stream depletion rate
4086D	Expired			Surface Take		
4225	Expired			Surface Take		
95A17	Expired			Surface Take	14	
97031	Expired			Surface Take	0.14	
99260	Expired			Surface Take	0.092	
99390	Expired			Surface Take	0.12	
RM21.260.02	Rejected			Surface Take		
RM21.362.02	Rejected			Surface Take		
93246	Surrendered			Surface Take		
95521	Surrendered			Surface Take		
96030	Surrendered	WM0536		Surface Take	27.8	
RM17.360.01	Surrendered	WM1517		Groundwater Take	15	4
2000.284	Withdrawn			Surface Take		