



Otago
Regional
Council

Flow Naturalisation of the Kakanui River

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This document describes how naturalised flows were derived for four sites in the Kakanui River catchment in North Otago.

Method

Daily flows and water take time series data were used to derive naturalised flows. The sum of water take data was added to corresponding existing flow records to get a naturalised flow at each flow site.

The following table (**Table 1**) shows the data availability of the existing flows recorded at the four locations:

Table 1: The daily flow time series available at four sites in the Kakanui catchment.

Target locations	Start	End	Length (year)	Data completion (%)
Kauru at Ewings	13/11/1991	24/04/2023	31.4	70.6
Kakanui at Clifton Falls Bridge	09/04/1981	24/04/2023	42.0	97.8
Kakanui at Mill Dam	18/12/1989	24/04/2023	33.4	98.6
Kakanui at McCones	17/01/2003	24/04/2023	20.3	99.8

Note: All the daily flow time series, water metering data, and consents/water meter information were downloaded on 24th April 2023.

Total water use estimations

The total upstream water use above each flow recorder listed in Table 1 is estimated. Estimations use the water metering data from all possible identified consents, including both historic and current ones.

Kauru at Ewings flow site

There are two current consents upstream of the Kauru at the Ewings site shown in **Figure 1**.

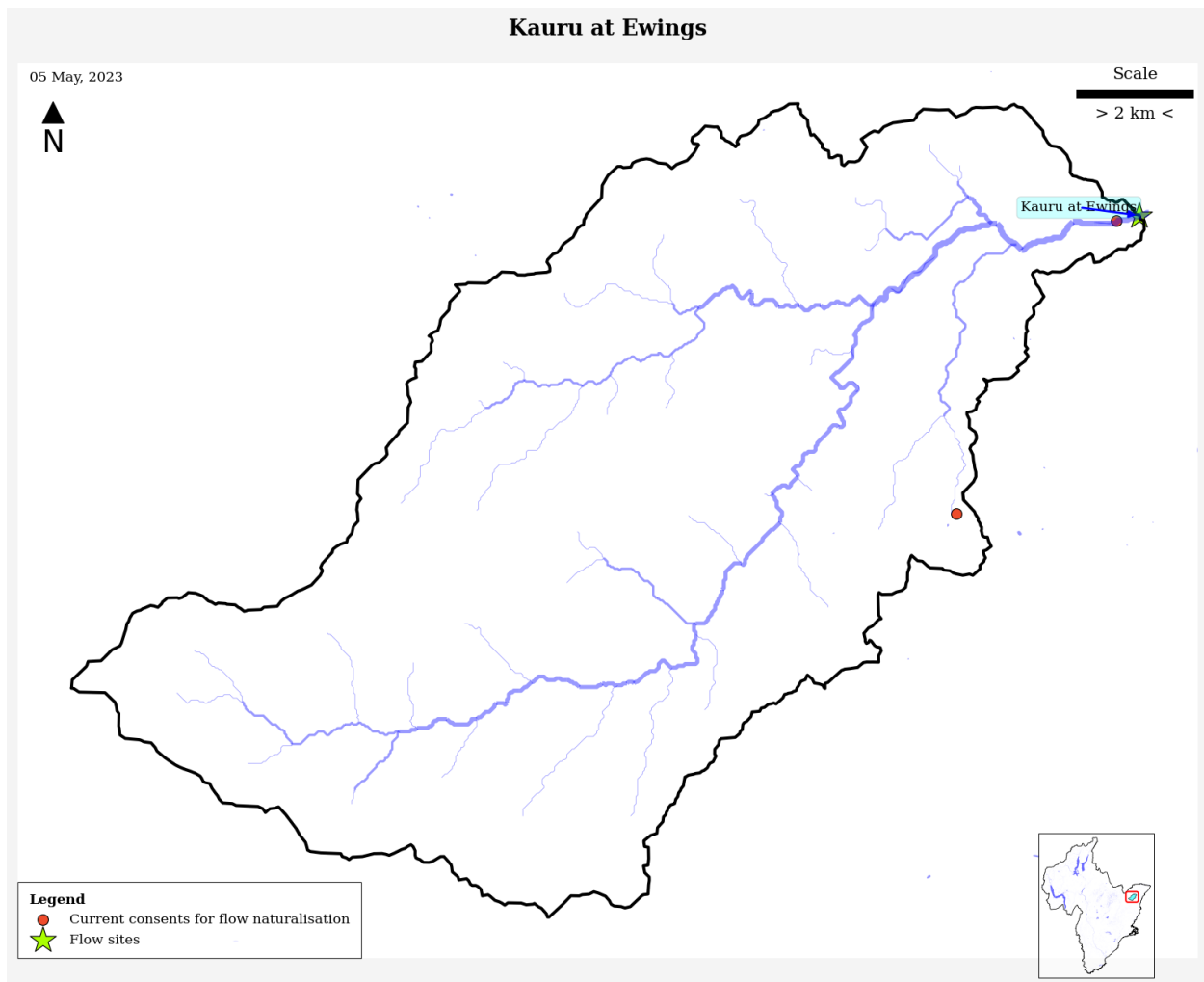


Figure 1: The current consents and flow site in the upstream catchment area above Kauru at Ewings.

The complete list of consents used to estimate the total water use above Kauru at Ewings can be found in **Table 1** from [this file](#).

Figure 2 shows the overall flow regime for the total water use above the Kauru at Ewings site. The estimated abstraction measurements began on 25th September 2016.

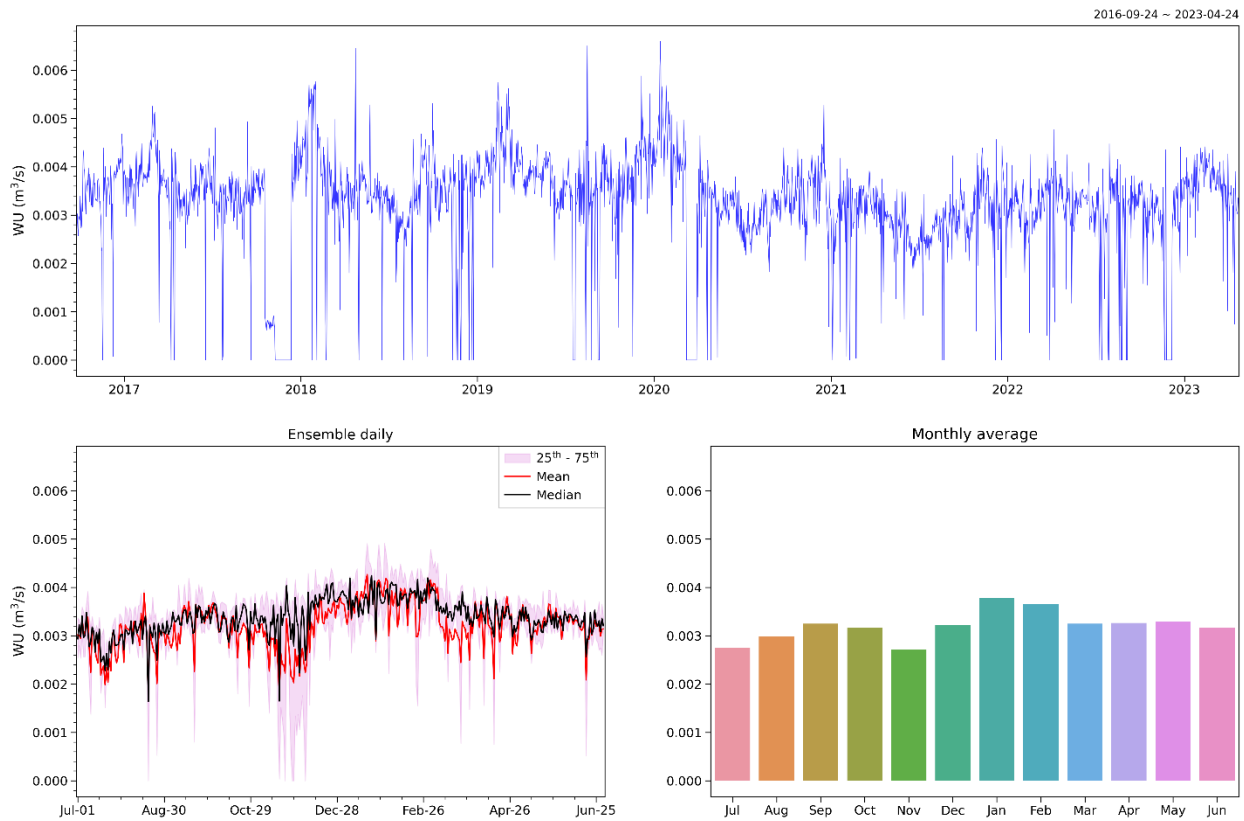


Figure 2: The total water use regime above the Ewings flow site.

Figure 2 shows that water take occurs throughout the year, with higher water use between January and March. The average water use across the whole data period is 3.2 L/s.

Clifton Falls Bridge flow site

The complete list of consents used to estimate the total water use above Clifton Falls Bridge can be found in **Table 1** from [this file](#).

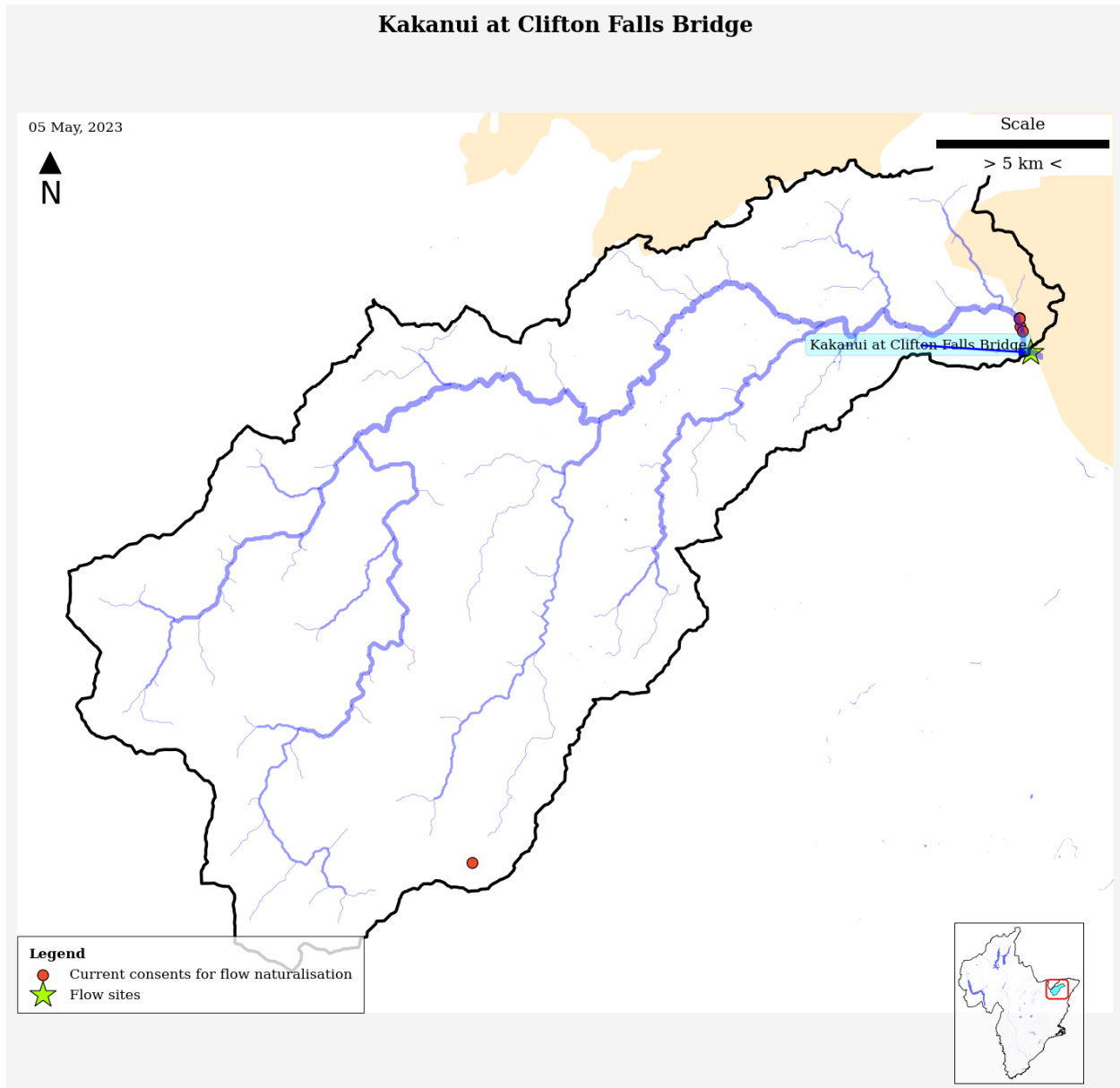


Figure 3: The current consents and flow sites in the upstream catchment area above the Clifton Falls Bridge flow recorder.

The total water use hydrograph and distribution for the area above Clifton Falls Bridge are shown in **Figure 4**. The estimated total abstraction measurement began on 26th November 2004. The water use

above Clifton Falls Bridge occurs between October and April; the total water use during these months is 26 L/s on average.

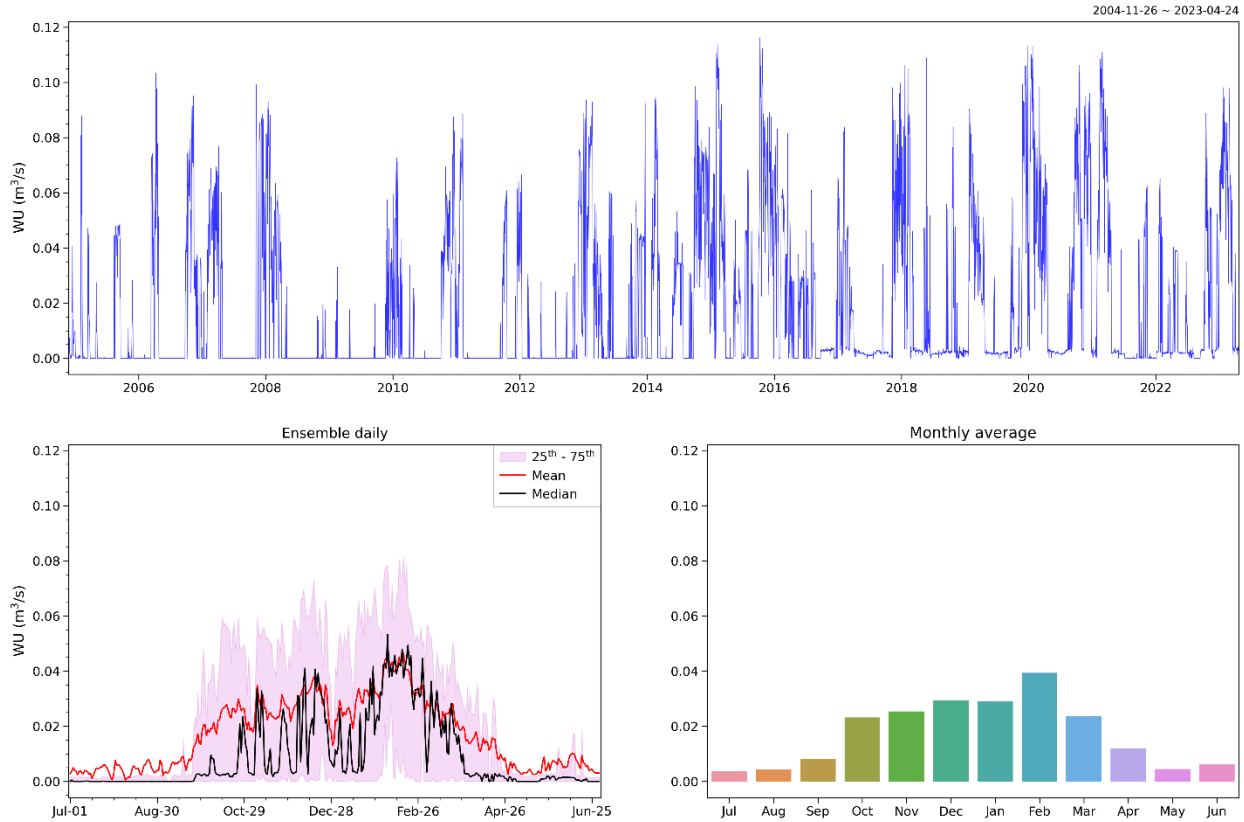


Figure 4: The total water use regime above the Clifton Falls Bridge flow site on the Kakanui River.

Mill Dam flow site

There are 34 current consents used for the estimation in the naturalised flow above the Mill Dam flow recorder. The location of these consents is shown in **Figure 5**.

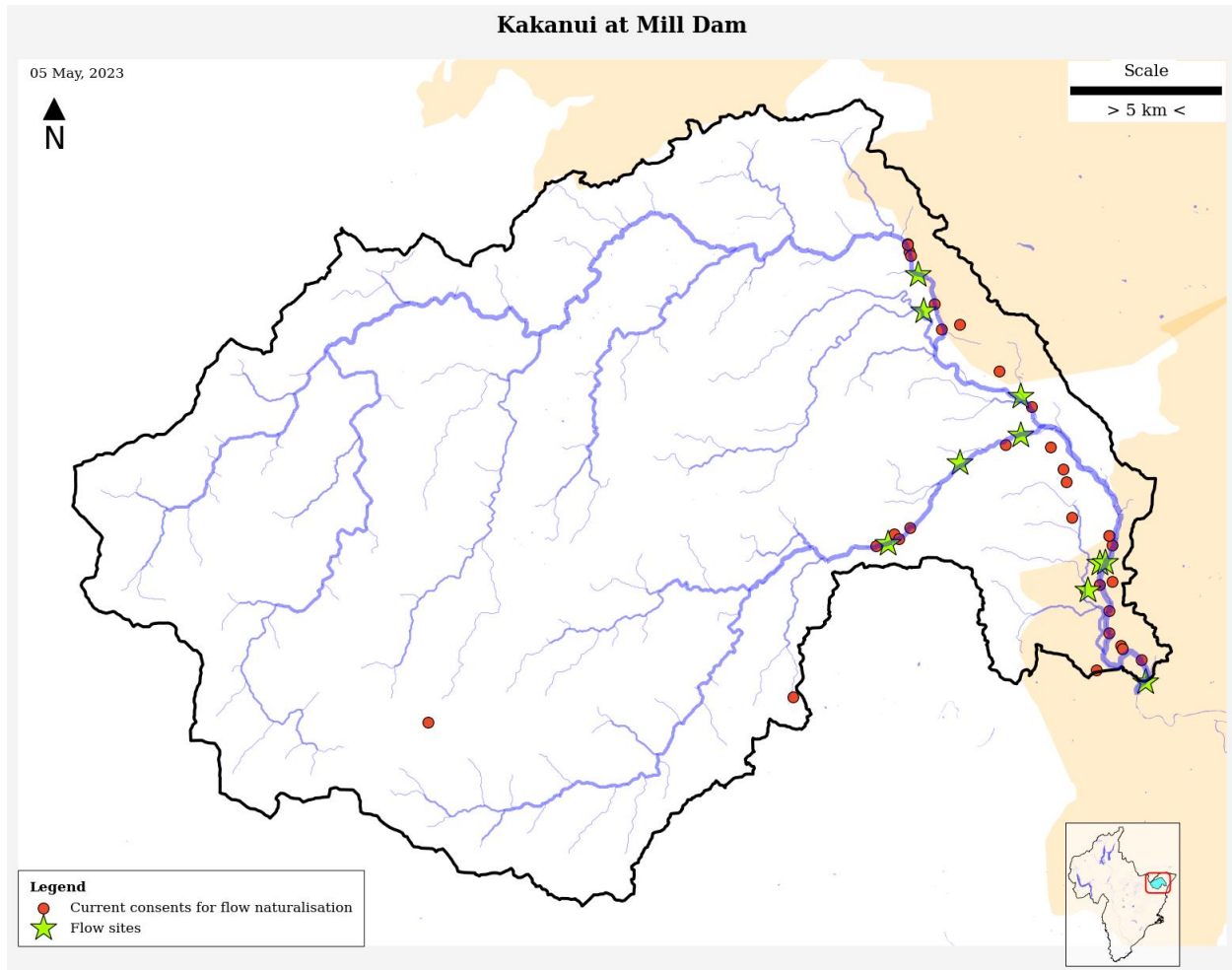


Figure 5: The current consents and flow sites in the upstream catchment area above the Mill Dam flow recorder

The complete list of consents used to estimate the total water use above the Mill Dam recorder can be found in **Table 1** from [this file](#).

As shown in **Figure 6**, the estimated total abstraction measurement began on 3rd November 2003. The water use above Mill Dam is mostly between September and April, and the average total water use across these periods is 125 L/s (**Figure 6**).

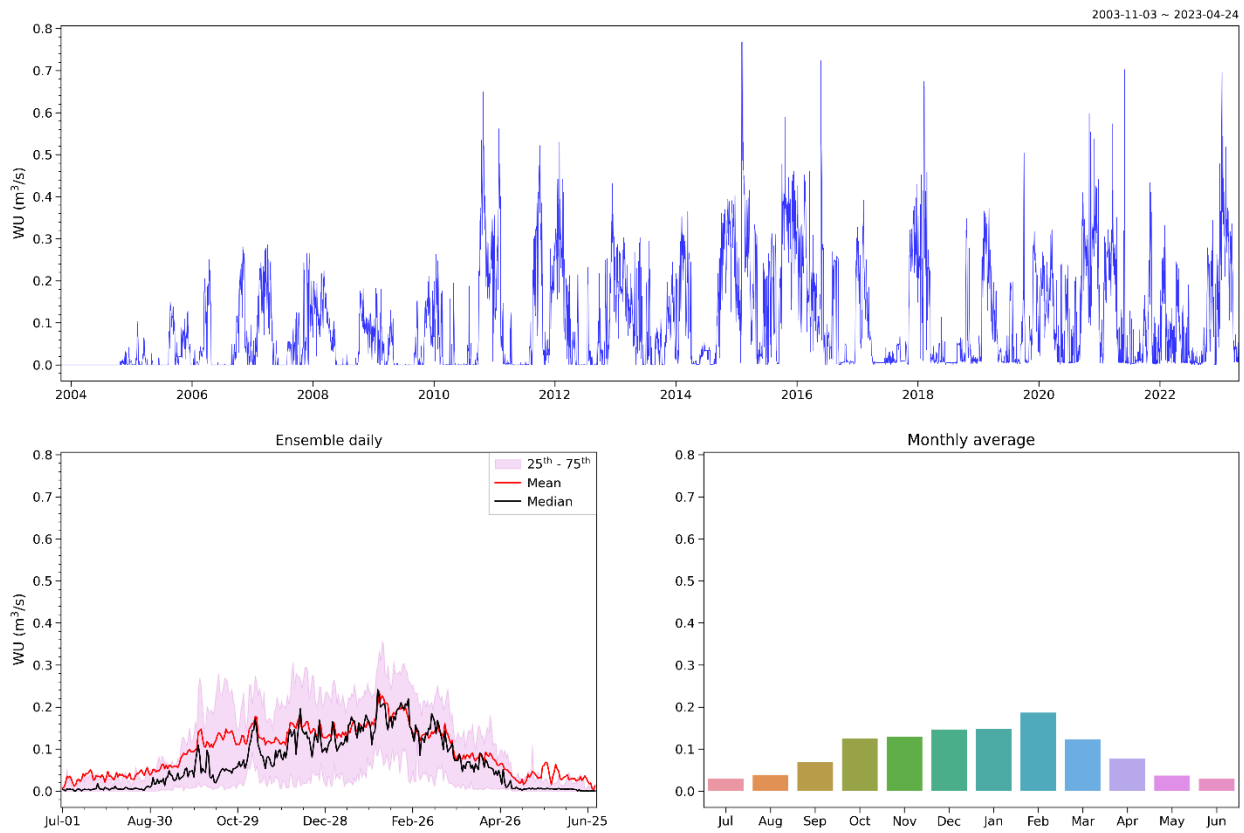


Figure 6: The total water use regime above the Mill Dam flow site on the Kakanui River.

McCones flow site

The complete list of consents used to estimate the total water use above the McCones recorder can be found in **Table 1** from [this file](#). These consents all have the water use data available and abstraction measurements began on 3rd November 2003.

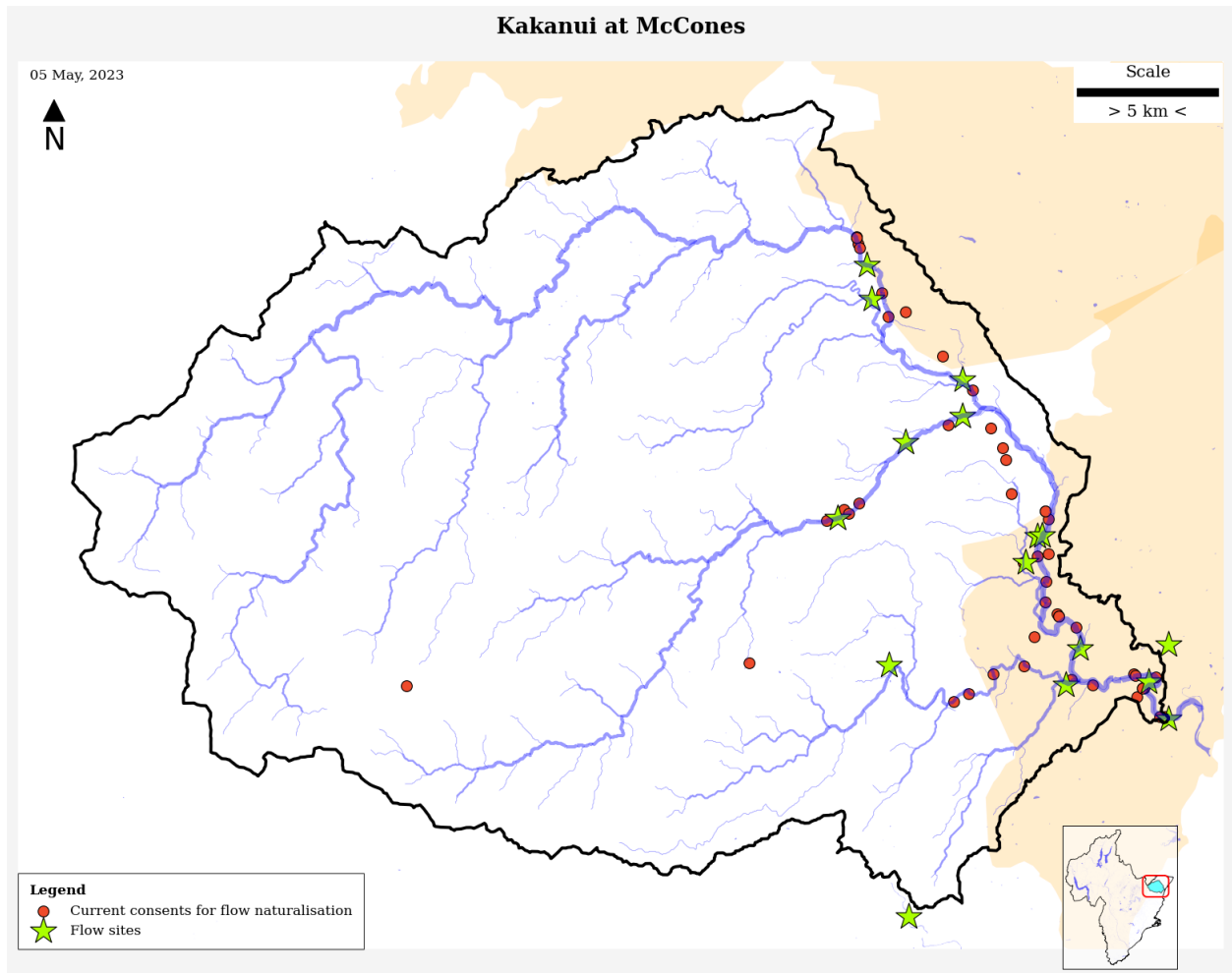


Figure 7: The current consents and flow sites in the upstream catchment area above the McCones flow recorder.

The total water use hydrograph and distribution above the McCones flow site are shown in **Figure 8**. The average total water use above the flow recorder at McCones during the irrigation season (September - April) is 160 L/s.

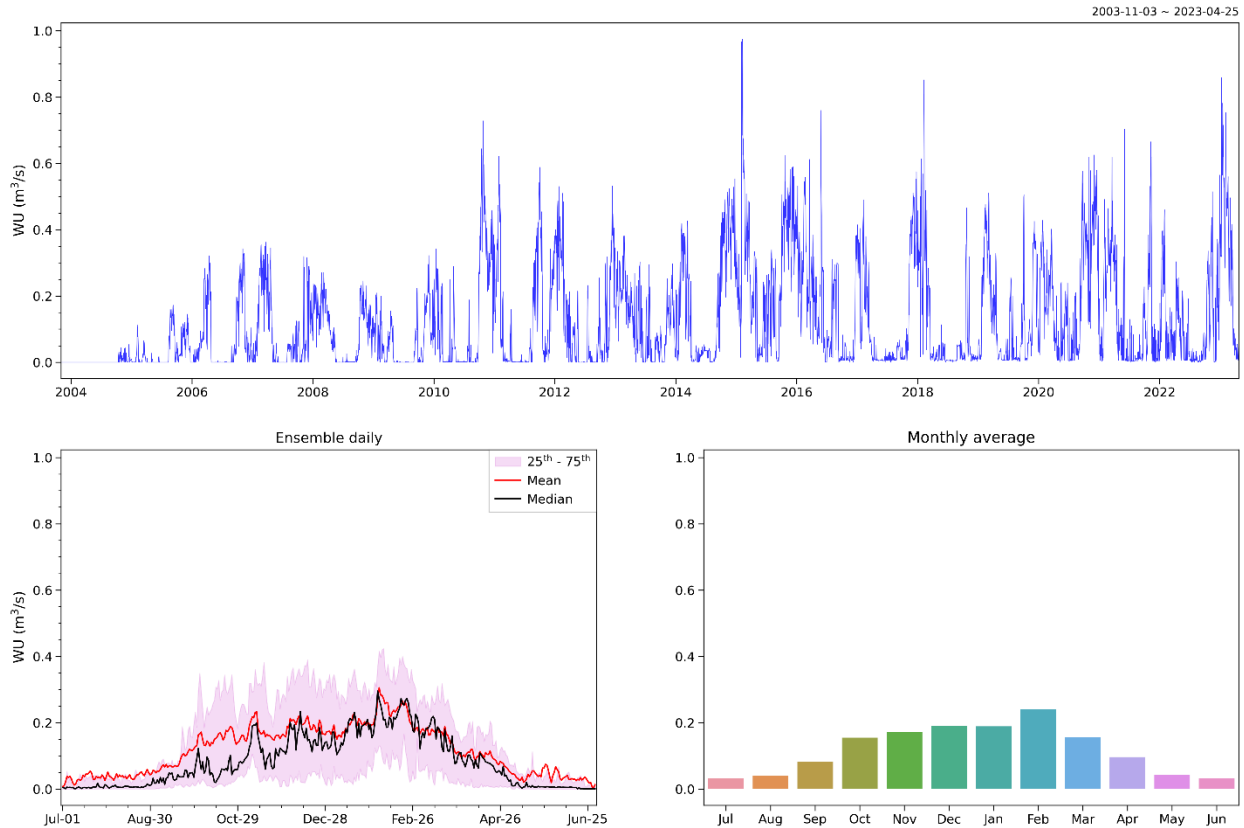


Figure 8: The total water use regime above the McCones flow site on the Kakanui River.

Flow naturalisation for the site locations

Method

The total water use data for the area above the flow recorders is needed for flow naturalisation for the Kakanui River. Total water use was estimated by assuming data gaps as zero takes (this might not be true, but there is no information on these data gaps).

Figure 9 below illustrates the total water use above the three flow recorders at Clifton Falls, Mill Dam, and McCones.

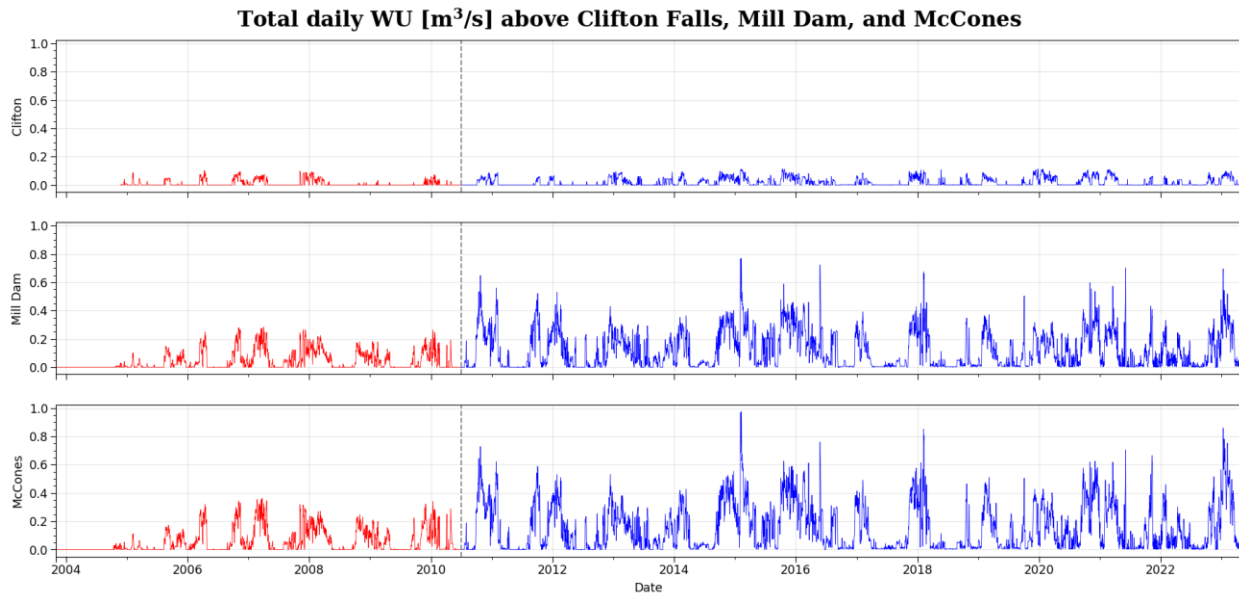


Figure 9: Total water uses above Clifton Falls, Mill Dam and McCones in the Kakanui River.

As shown in Figure 9, the total water use pattern is different before and after the water year 2010/11. In this specific case scenario, the periods of from 2010/11 onwards are applied to estimate the naturalised flows for the three recorders along the Kakanui River.

Therefore, to make a fair comparison of the naturalised seven-day mean annual low flow (7dMALF) values in the Kakanui River, the following conditions are needed:

- The total water use time series needs to be available over the *same periods* for all three flow recorders along the Kakanui River, if possible. In this case, as the water use patterns shown in Figure 9, the periods of the water year 2010/11 onwards are applied.
- Water years, i.e., *1 July - 30 June*, are used to calculate the naturalised 7dMLAFs for consistency.

Estimated flow Statistics

Table 2 summarises the calculated flow statistics.

Table 2: The naturalised 7dMALF summary for all recorders in the Kakanui catchment in North Otago (flow unit in m³/s, and FRE3 unit in year⁻¹).

Site	Start	End	Mean	Median	7dMALF	FRE3
Kauru at Ewings (observed)	24/09/2016	24/04/2023	1.421	0.572	0.119	7.6
Kauru at Ewings (naturalised)	24/09/2016	24/04/2023	1.425	0.575	0.122	7.6
Kakanui at Clifton Falls Bridge (observed)	7/07/2010	24/04/2023	3.507	1.698	0.523	8.1
Kakanui at Clifton Falls Bridge (naturalised)	7/07/2010	24/04/2023	3.528	1.714	0.551	8.0
Kakanui at Mill Dam (observed)	7/07/2010	24/04/2023	5.170	2.284	0.501	7.9
Kakanui at Mill Dam (naturalised)	7/07/2010	24/04/2023	5.293	2.394	0.685	7.7
Kakanui at McCones (observed)	7/07/2010	24/04/2023	5.497	2.512	0.462	7.3
Kakanui at McCones (naturalised)	7/07/2010	24/04/2023	5.650	2.645	0.712	7.0