Hydrology of Marlborough Summary, June 2024

Report prepared by Charlotte Tomlinson, 6th July 2024.

Data from the Marlborough District Council's Environmental Monitoring network was primarily used in preparing this report and supplemented with data from the Marlborough Research Centre, MetService, NIWA, and FENZ.

Executive Summary

June was a warm and wet end to a very dry 12 months. June 2024 is the 12th warmest June on record for the 93 years 1932 to 2024, with only 2 ground frosts recorded, compared to the long-term average of 11.4.

11 of the last 12 months have recorded below average rainfall in Blenheim. The 12 month rainfall total for Blenheim is 374 mm from June 2023 to July 2024 (the 2023-24 hydrological year). This is 58% of the long-term average annual rainfall, and the third lowest annual rainfall total at the site in 94 years.

Across Marlborough, rainfall for the hydrological year varied from 57% to 84% of long-term average annual rainfall. No rainfall monitoring site recorded average or above average rainfall for the year.

River flows have increased somewhat following on from June rainfall. Mean flow in the Wairau River at Tuamarina for the hydrological year was 54 m^3/s, compared to an average of 100 m^3/s over the full flow record. This shows the effect of the extended dry conditions over the past 12 months.

Soil moisture in Blenheim at the end of June was sitting slightly below field capacity at 36%. Soils around the region look to be generally near field capacity, which is similar to the historic average. Soils are slightly wetter than normal around the Flaxbourne/Ward area, while soils are still drier than normal in the south of the region, including the upper Awatere Valley and Molesworth.

The effect of the low rainfall and river flows over the past 12 months can be seen most clearly in the Wairau Aquifer. Over the past 12 months, groundwater levels have consistently been at or near the minimum observed levels since records began at the Conders well in 1973. These record low levels are caused by both the long-term declining trend in the aquifer level, coupled with the effect of drought. Consistent rain events over the remainder of winter and spring will be needed to replenish the aquifer before next summer, although this will not address the long-term declining trend.

The first half of July is expected to bring frosty mornings and sunny, cold days. Mid-month, a weather system is likely to move in from the Tasman Sea, with northern and western areas most at risk of heavy rain. Fronts should move through quickly for the rest of the month, meaning more rain is likely in the second half of July. Temperatures are likely to be near average or above average. There remains a 60-70% chance that La Niña will develop during spring.

Climate

June 2024 saw mild temperatures across the country, caused by a persistent area of low pressure which sat over the Tasman Sea from the 12th to 25th of June. The low produced numerous northerly fronts which moved across the country, leading to prolonged spells of wet weather.

The weather in Blenheim during June can be described as warm, cloudy, and wet. June 2024 is the 12th warmest June on record for the 93 years 1932 to 2024, with an average temperature of 9.5°C. This is 0.7°C above the long-term average temperature for June. The month of June has undergone a significant warming trend over recent decades, with 8 of the 10 warmest Junes on record occurring since 2002. Blenheim recorded just 2 ground frosts on the 4th and 5th of June, compared to the long-term average of 11.4.

Blenheim was cloudier than usual in June, with 113 sunshine hours (75% of the long-term average).

Rainfall

Blenheim has recorded just 58% of the long-term average rainfall over the past 12 months (July to June). 374 mm of rain was recorded at the Marlborough Research Centre in this period, compared to 644 mm on average. This is the third lowest annual rainfall total at the site in the 94 years from 1930 to 2024.

Wairau Valley at Southwold has recorded 674 mm for the 2034-34 hydrological year. This is 68% of the average annual rainfall, and the 6th driest year since the site was established in 1918.

Figure 1 shows total rainfall for the hydrological year for rainfall sites in Marlborough as a percentage of average annual rainfall. The lowest rainfall when compared to average was recorded in Blenheim at the MDC and Marlborough Research Centre sites, which recorded 57% and 58% of average annual rainfall respectively. Rain gauge sites with less than 10 years of data were excluded from the analysis.

The other rainfall sites around Marlborough recorded between 63% to 84% of average annual rainfall. There was no clear spatial pattern to rainfall when looking at the 12 month period as a whole. None of the rainfall monitoring sites in Marlborough recorded average or above average rainfall for the hydrological year.

There are climatic similarities between 2023-24 and 1997-98. 1997-98 was widely regarded as one of the strongest El Niño–Southern Oscillation events in recorded history, causing severe drought in eastern parts of New Zealand. Rainfall in Blenheim for the two El Niño events is almost identical, with 1997-98 rainfall totalling 375 mm.

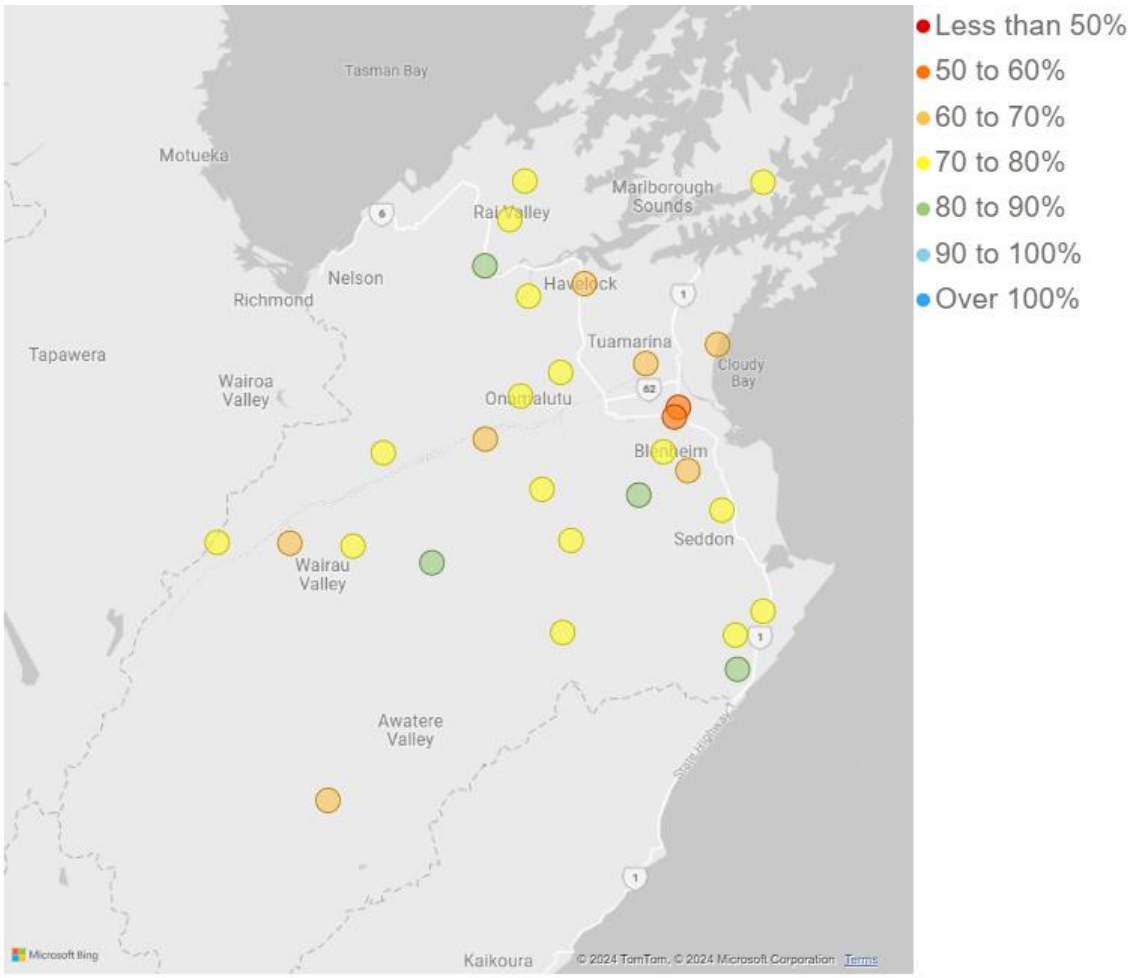

Figure 1. Total rainfall for the 2023/24 hydrological year (1 July 2023 to 30 June 2024) at monitoring sites around Marlborough, as a percentage of average rainfall.

Figure 2 shows monthly rainfall for the 2023-24 hydrological year at four key sites in Southern Marlborough, compared to monthly averages. Rainfall was near average or slightly above average for all four sites in June.

The Branch rainfall site recorded 123 mm of rainfall in June, bringing the annual total to 850 mm. This is the lowest rainfall recorded in a hydrological year since the site was established in 1978. The previous annual minimum of 893 mm was recorded in 1997-98, which as previously mentioned was one of the strongest El Niño events of the 20th century.

After record low rainfall in May, Awatere at Awapiri recorded 106 mm of rainfall in June (above average). This brings the annual total to 620 mm, which is 75% of average annual rainfall. This is the 7th driest year since the site was established in 1995.

The Flaxbourne recorded 95 mm of rainfall in June, bringing the annual total to 537 mm. This is 77% of the long-term average, and the 4th driest year in the 17 years the site has been operating.

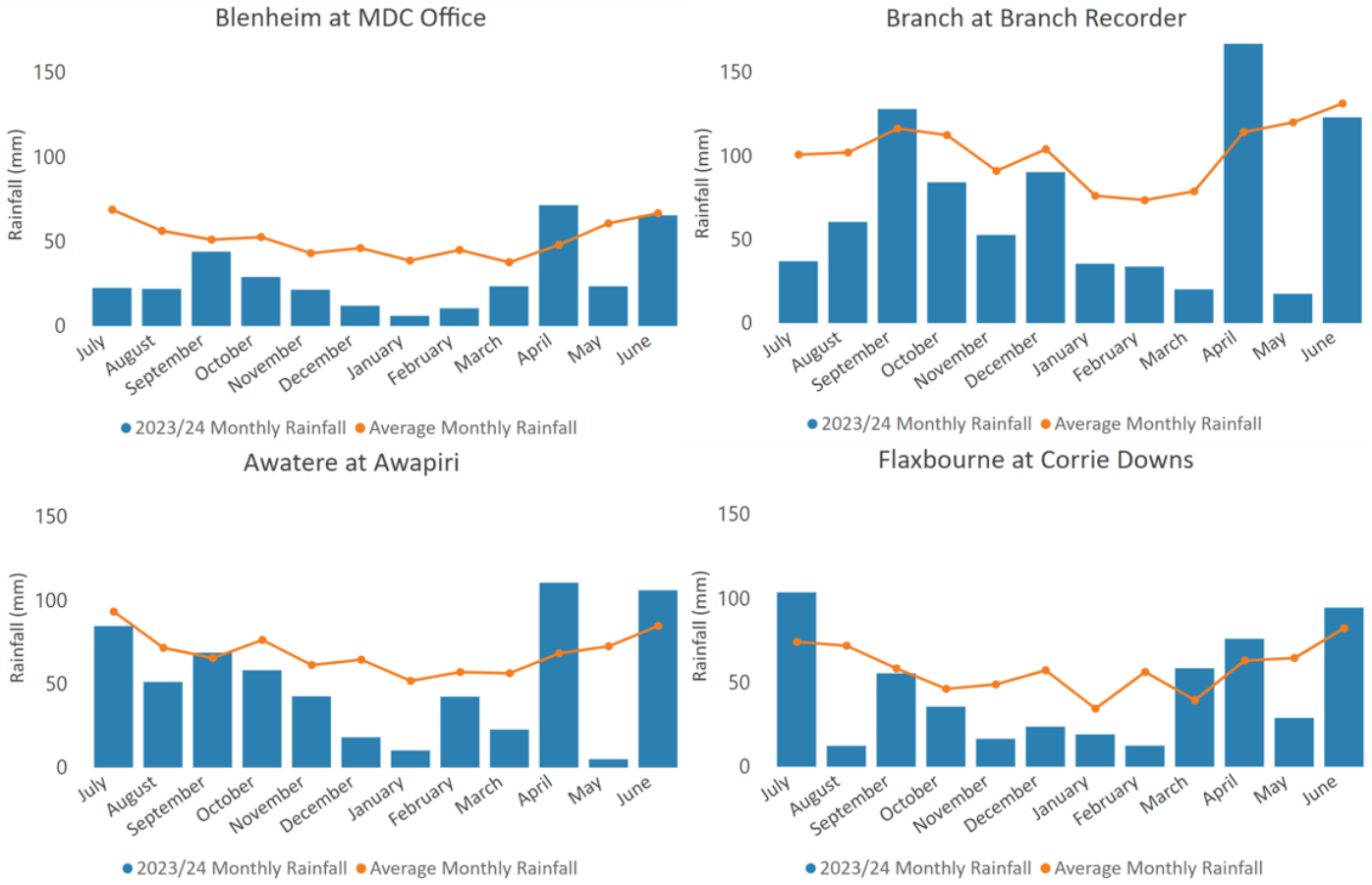

Figure 2. Monthly rainfall totals for the 2023-24 hydrological year from four key sites around Southern Marlborough, compared to average monthly rainfall totals.

Figure 3 shows monthly rainfall for the 2023-24 hydrological year at four key sites in Northern Marlborough, compared to monthly averages.

At Tunakino 329 mm of rain was recorded in June, bringing the annual total to 1,904 mm. This is 76% of the average annual rainfall and the 4th driest year since the site records begin in 1986. The Top Valley rainfall site was also established in 1986 and has also recorded the 4th driest year on record, with 1,163 mm in the 2023-24 hydrological year. Among the other low rainfall years at the site are previous El Niño years, including 1997-98 and 2014-15.

Picton rainfall for June was 144 mm, bringing the annual total to 868 mm. This is the lowest annual total since the site was established in 2018.

Kenepuru Head recorded 178 mm of rainfall in June (near average). This brings the annual total to 1,309 mm, which is 77% of average annual rainfall. This is the 5th driest year since the site was established in 2011.

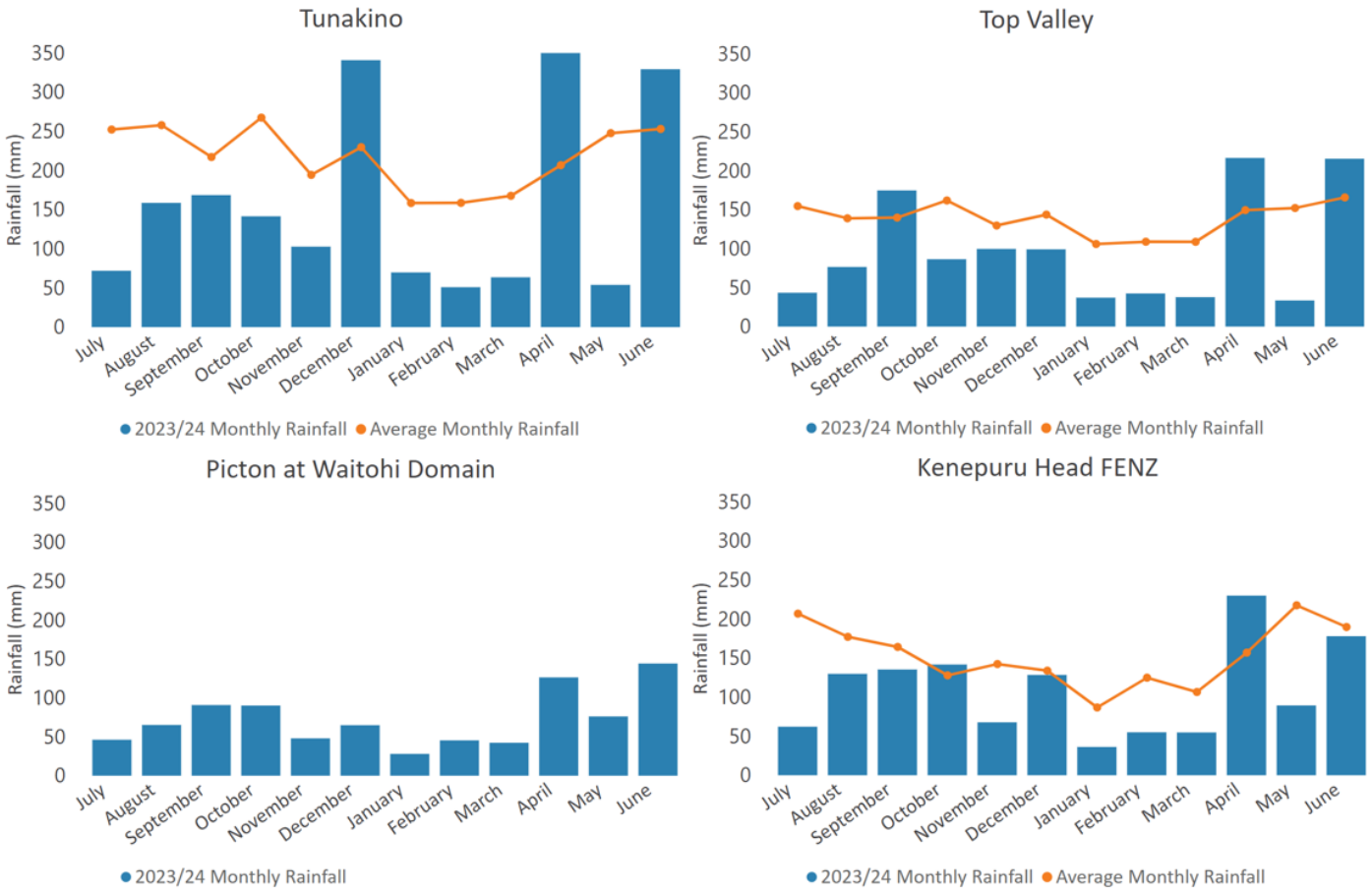

Figure 3. Monthly rainfall totals for the 2023-24 hydrological year from four key sites around Northern Marlborough, compared to average monthly rainfall totals. Note the adjusted scale when compared with the graphs in Figure 2 above.

A full list of monthly rainfall totals for the 2023/24 hydrological year at all rainfall monitoring sites can be found in the appendix.

River Flows

At Awatere at Awapiri average flow in June was 12 m^3/s, which is 70% of the June long-term average flow. Baseflow was in the lower quartile at the start of the month, before rising from mid-month to reach just below average baseflow by the end of June (see Figure 4 below).

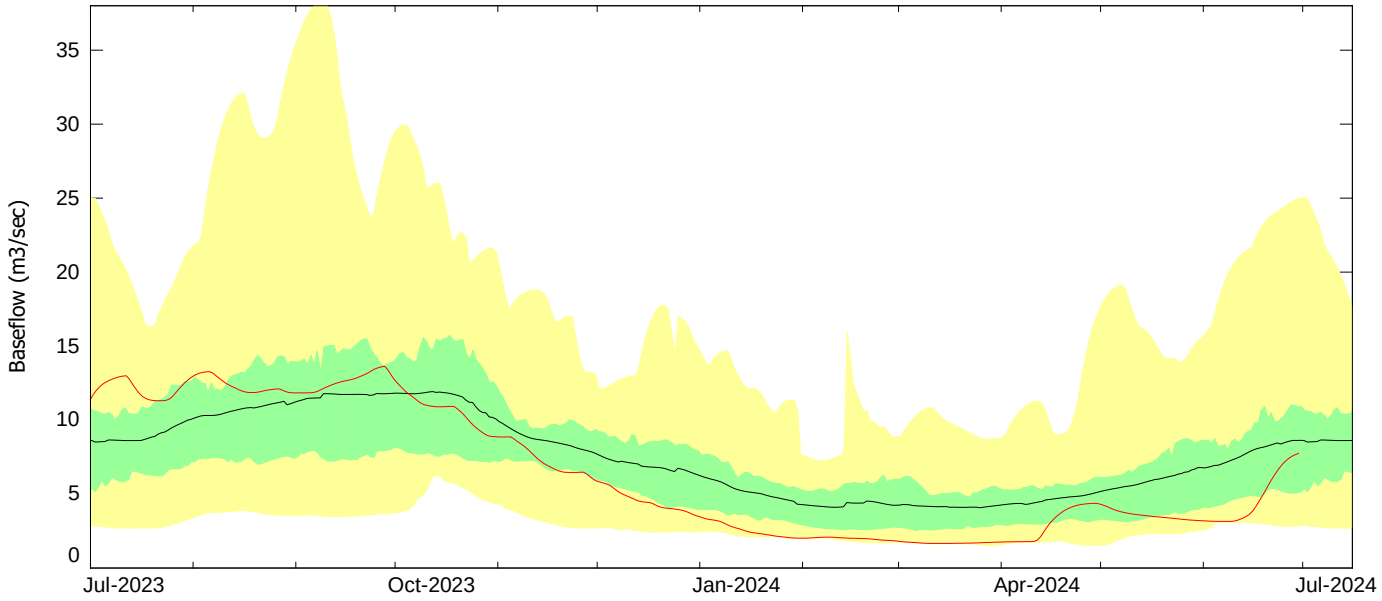

Figure 4. Awatere River at Awapiri baseflow, from 1 July 2023 to 1 July 2024. The black line is average baseflow and the red line is the 2023/24 baseflow. The green section is the middle 50% of data and the yellow sections show the upper and lower quartiles.

Average flow in June was 13 m^3/s at Waihopai at Craiglochart, which is 75% of the June long-term average flow. From the second week of June, there were four small flow peaks, the largest of which was approximately 85 m^3/s. As can be seen in Figure 5 below, from the second week of June baseflow rose steadily to reach slightly above average baseflow by the end of the month.

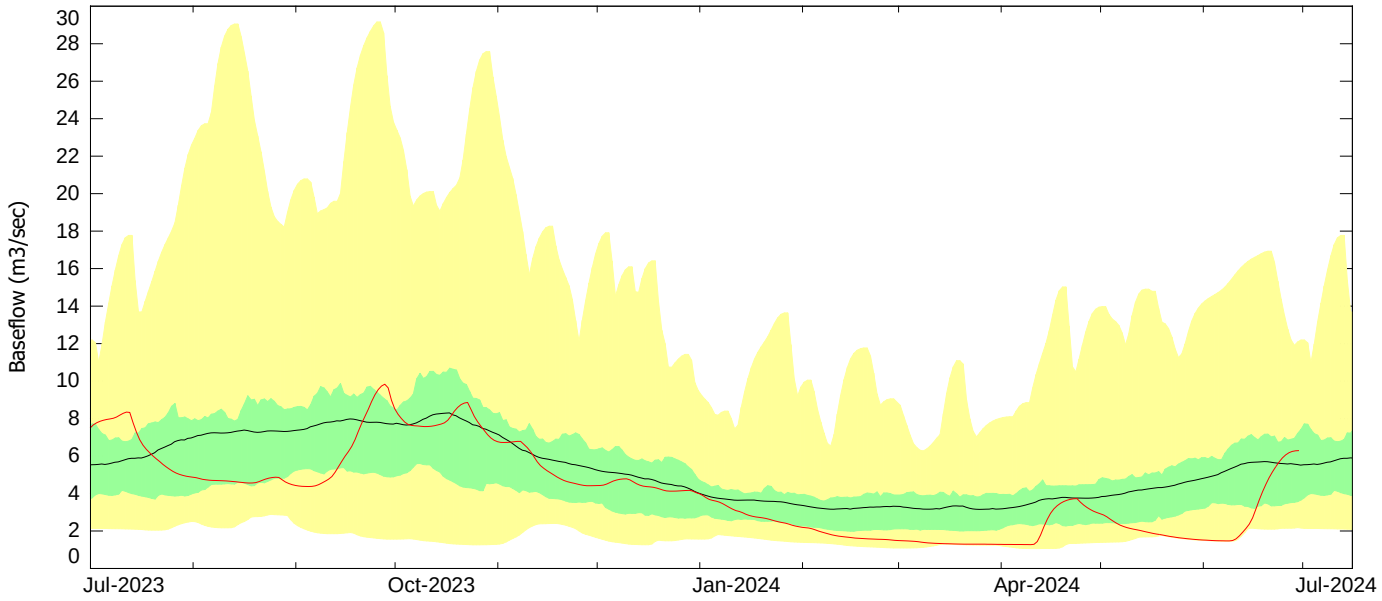

Figure 5. Waihopai River at Craiglochart baseflow, from 1 July 2023 to 1 July 2024. The black line is average baseflow and the red line is the 2023/24 baseflow. The green section is the middle 50% of data and the yellow sections show the upper and lower quartiles.

Wairau at Tuamarina flow averaged 96 m^3/s in March, which is just below the long-term average of 115 m^3/s. Similar to the Waihopai, there were four small flow peaks in the Wairau from the second week of June. The largest of these peaked at 380 m^3/s. Baseflow increased following these events, reaching just above average by the end of June (see Figure 6 below).

Over the full flow record (1960-2024), average flow in the Wairau River at Tuamarina is approximately 100 m^3/s. For the 2023-24 hydrological year, the average flow was 54 m^3/s, showing the large effect of the ongoing dry conditions experienced over the last 12 months. The largest flood in the 2023-24 hydrological year was 1,200 m^3/s, below the mean annual flood of 1,900 m^3/s.

The only year on record with a lower mean annual flow was 1997-98, with mean flow of 51 m^3/s. As previously discussed, this was a year with a strong El Niño event. There were no floods above 500 m^3/s during the 1997-98 hydrological year.

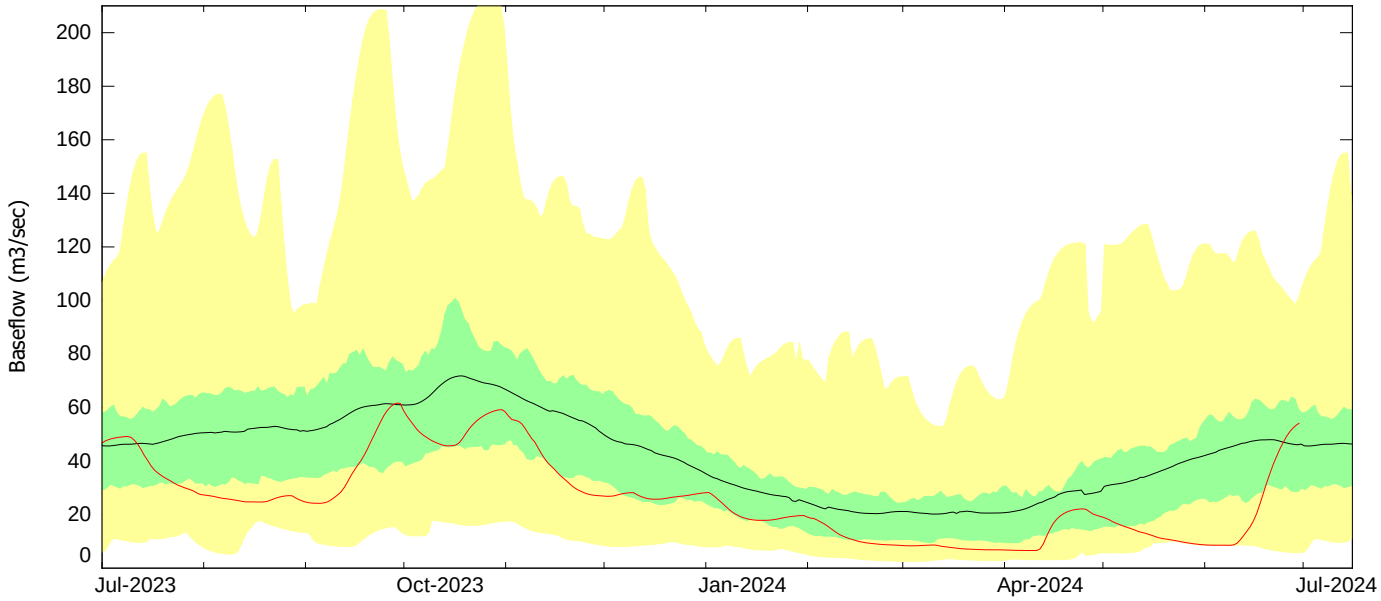

Figure 6. Wairau River at Tuamarina baseflow, from 1 July 2023 to 30 June 2024. The black line is average baseflow and the red line is the 2023/24 baseflow. The green section is the middle 50% of data and the yellow sections show the upper and lower quartiles.

Average flow in the Rai was 18 m^3/s in June, which is above the long-term average flow for June of 15 m^3/s. A 220 m^3/s flood occurred on the 10th of June, followed by smaller high flows later in the month.

Baseflow was in the lower quartile at the beginning of June, quickly rising in response to the flood in the second week of June. Baseflow was within the upper quartile by the end of June.

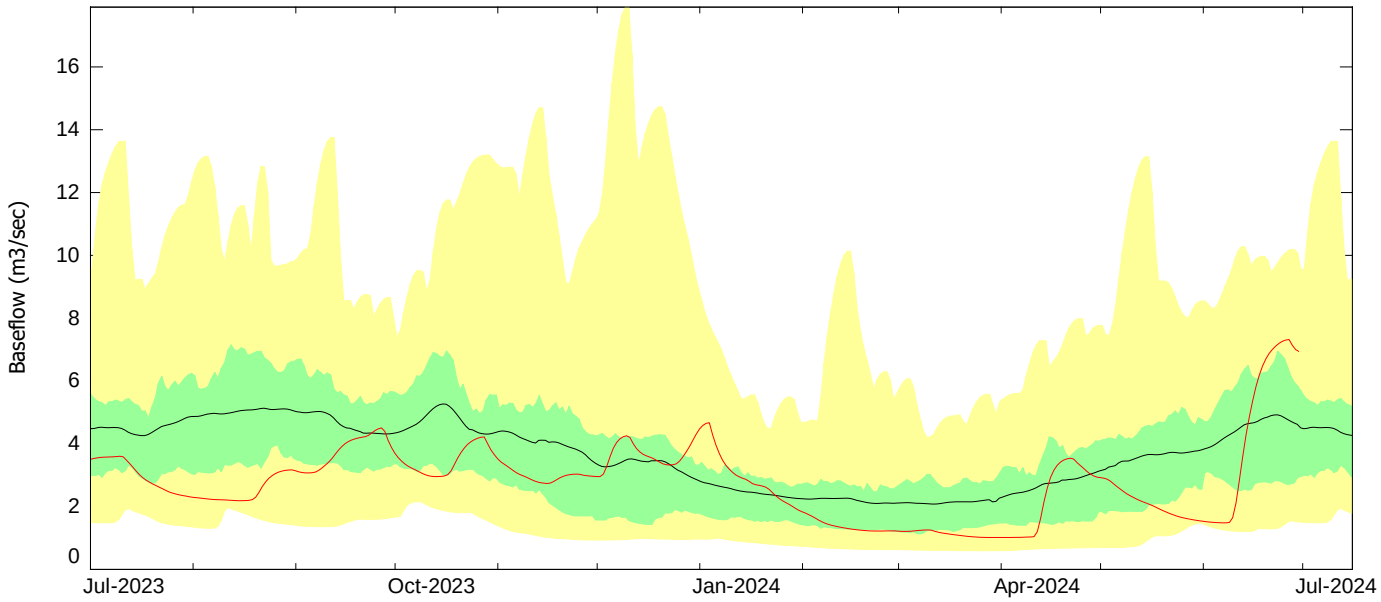

Figure 7. Rai River at Rai Falls baseflow, from 1 July 2023 to 30 June 2024. The black line is average baseflow and the red line is the 2023/24 baseflow. The green section is the middle 50% of data and the yellow sections show the upper and lower quartiles.

A full summary of river flows for June 2024 can be seen in the appendix, Table 2.

Soil Moisture

15 mm of rain fell on the 9th of June in Blenheim, raising soil moisture from 30% to 34%. Two additional rainfall events of 15 mm or greater occurred on the 14th and 23rd of the month, with soil moisture reaching field capacity after each of these events. As of the end of June, soil moisture was sitting at 36%, slightly below field capacity. Figure 8 below shows daily soil moisture data from July 2023 to June 2024.

Figure 8. Shallow soil moisture at the Marlborough Research Centre (Blenheim) from the 1st of July 2023 to the 30th of June 2024.

The soil moisture deficit map from NIWA (see Figure 9 below) shows that at the end of June soils in Marlborough were at or near field capacity, similar to the historic average.

The soil moisture anomaly map (Figure 10) shows how much wetter or drier soils are when compared to the historic average. Soils are wetter than normal around Flaxbourne/Ward (south-east of the region) and similar to average in the north of the region. Soils are still drier than normal in the south of the region, including the upper Awatere Valley and Molesworth.

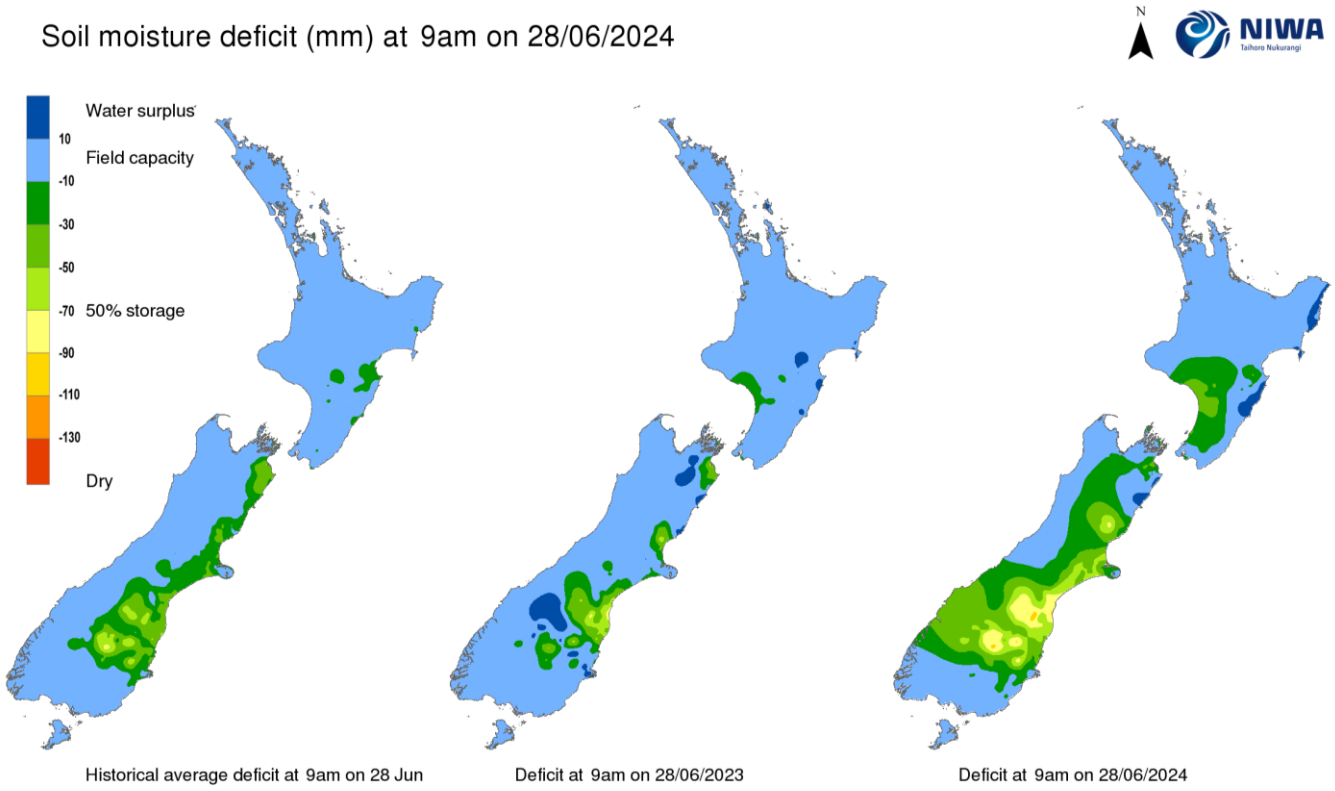

Figure 9. Soil moisture deficit maps of New Zealand, retrieved from NIWA on 28/06/2024.

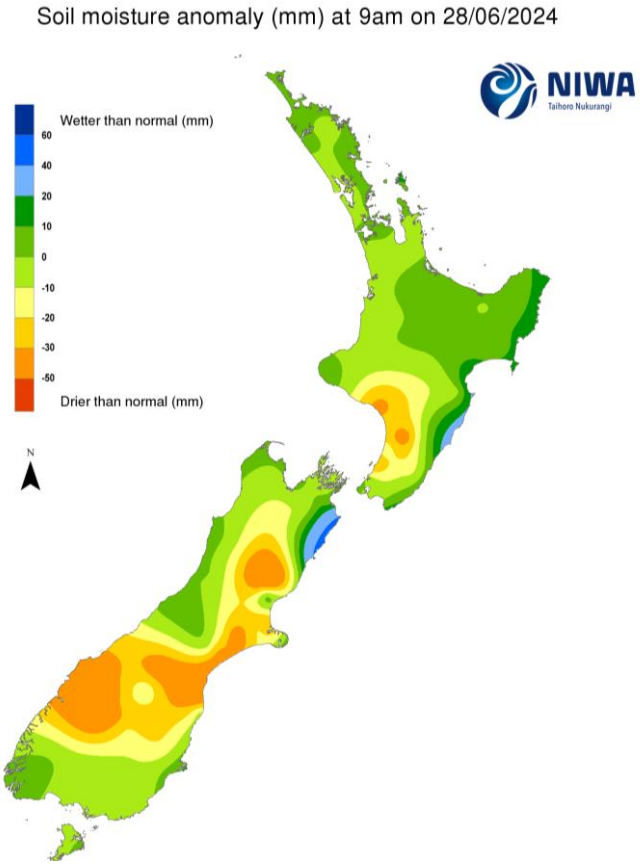

Figure 10. Soil moisture anomaly map of New Zealand, retrieved from NIWA 28/06/2024.

Groundwater

The effect of the low rainfall and subdued river flows over the past 12 months can be seen most clearly in Marlborough's largest aquifer. The water level in the Wairau Aquifer has been within the lower quartile for all 12 months from July 2023 to June 2024 (see Figure 11 below). Throughout the year, groundwater levels have consistently been at or near the minimum observed levels since records began at the Conders Well in 1973.

These record low levels are caused by the long-term declining trend in the aquifer level, coupled with the effect of the current drought. Consistent rain events over the remainder of winter and spring will be needed to replenish the aquifer before next summer, although this will not address the long-term declining trend.

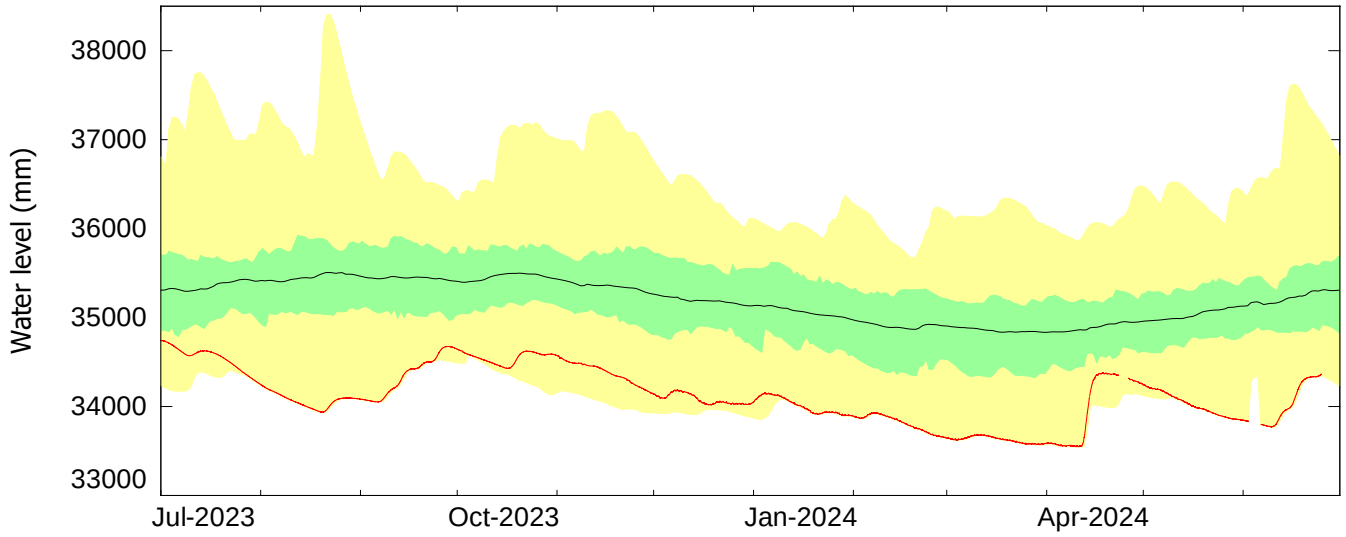

Figure 11. Wairau Aquifer at Conders well water level, from 1 July 2023 to 30 June 2024. The black line is average groundwater level, and the red line is the 2023/24 groundwater level. The green section is the middle 50% of data and the yellow sections show the upper and lower quartiles.

As the Riverlands Aquifer has a confined structure, much of the variation in water levels throughout the year is as a direct result of pumping. The increase in water level from April onwards (see Figure 12 below) corresponds with a decrease in pumping demand. Water levels are somewhat lower than average due to the ongoing dry conditions over the last 12 months.

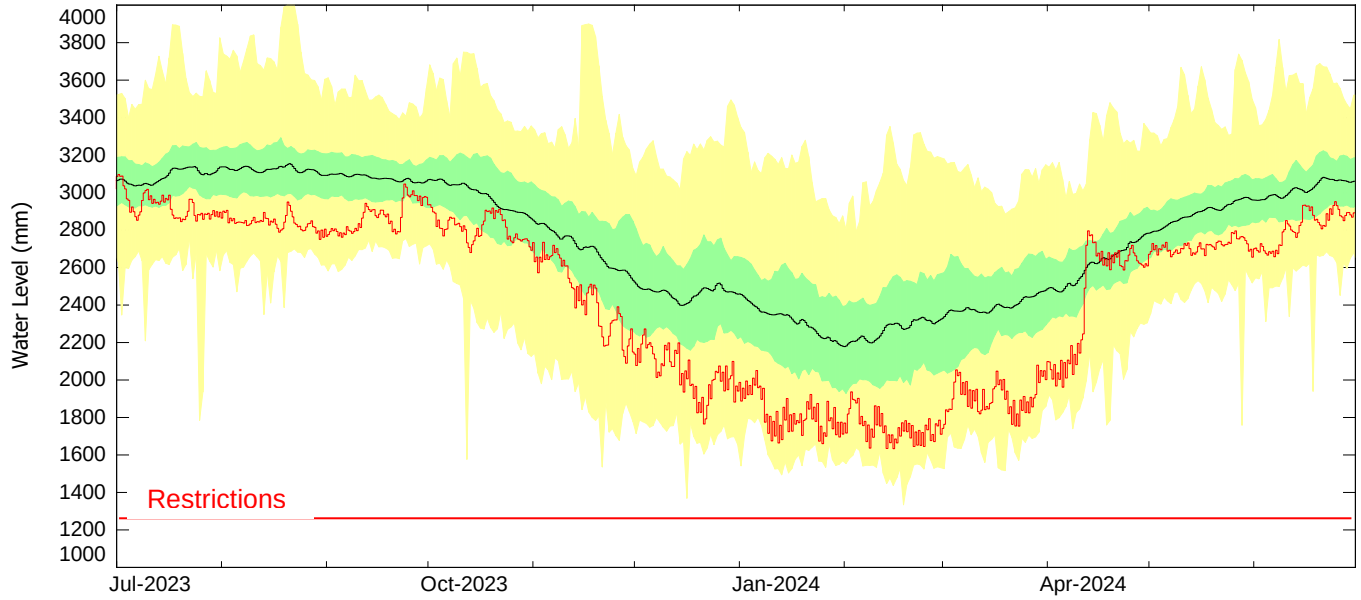

Figure 12. Riverlands Lagoon Well water level, from 1 July 2023 to 30 June 2024. The black line is average groundwater level, and the red line is the 2023/24 groundwater level. The green section is the middle 50% of data and the yellow sections show the upper and lower quartiles.

Climate Outlook July to September 2024

Cold southerly winds are likely in the first half of July, with plenty of frosty mornings and sunny, cold days. Towards the middle of the month, a weather system is likely to develop and move in from the Tasman Sea, with northern and western areas most at risk of heavy rain. Low pressure systems and fronts should move through quickly in the second half of the month, meaning more rain is likely in the second half of July. Temperatures in July are likely to be near average or above average.

There remains a 60-70% chance that La Niña will develop during spring.

The predictions for Marlborough/Tasman from July to September are:

- Temperature – above average (50% chance) or average (45% chance)
- Rainfall – near average (40% chance) or above average (35% chance)
- Soil Moisture – near or below average
- River Flows – near or below average

Appendix

Table 1. Monthly rainfall totals (mm) for the 2023-24 hydrological year at monitoring sites in Marlborough (listed alphabetically).

Site	July	August	September	October	November	December	January	February	March	April	May	June	**Total**
Awatere at Awapiri	85	51	69	58	43	18	10	42	23	111	5	106	**620**
Awatere Glenbrae NRFA	44	18	53	48	20	24	16	12	31	61	19	77	**424**
Beneagle at Farm Stream	49	31	59	44	31	42	12	23	34	78	25	85	**511**
Blenheim at MDC Office	23	22	44	29	22	12	6	11	24	72	24	66	**352**
Branch at Branch Recorder	37	61	128	84	53	90	36	34	20	167	18	123	**850**
Branch at Mt Morris	34	70	215	188	105	191	80	58	65	136	15	144	**1300**
Flaxbourne at Corrie Downs	104	12	56	36	17	24	19	13	59	76	29	95	**537**
Kaituna Rainfall at Higgins Bridge	41	76	116	121	45	104	39	42	33	200	30	138	**983**
Kenepuru Head NRFA	62	130	135	142	68	128	36	55	55	230	89	178	**1309**
Koromiko NRFA	46	79	117	103	53	76	47	32	38	150	79	191	**1010**
Lake Elterwater Climate	97	12	65	43	22	30	18	19	72	80	23	87	**566**
Lansdowne NRFA	46	64	80	45	42	18	14	22	28	99	23	92	**573**
Malings	56	101	227	239	59	129	81	98	79	99	35	134	**1334**
Mid Awatere Valley NRFA	39	38	50	37	28	21	5	26	21	83	5	84	**436**
Molesworth NRFA	41	38	72	62	35	15	18	42	14	49	19	63	**469**
Omaka at Ramshead Saddle	44	52	72	50	60	56	15	32	23	120	15	104	**642**
Onamalutu at Bartletts Creek Saddle	68	156	175	104	58	89	41	38	86	226	27	202	**1268**
Onamalutu at Hilltop Road NRFA	48	96	175	119	53	126	53	40	71	210	36	192	**1218**
Picton Climate at Waitohi Domain	46	65	91	90	48	65	28	45	42	126	76	144	**868**
Pudding Hill NRFA	54	39	77	81	47	16	27	48	33	19	29	60	**530**
Rai at Rai Falls	44	119	234	183	102	280	73	49	49	278	45	278	**1734**
Rai Valley NRFA	50	128	180	163	101	312	67	37	42	241	43	245	**1609**
Rarangi at Driving Range	31	52	63	71	24	18	26	18	26	140	34	108	**609**
Red Hills	36	49	161	113	79	90	62	54	62	183	26	171	**1084**
St Arnaud NRFA	57	70	120	125	97	146	79	65	60	78	23	109	**1030**
Taylor at Taylor Pass Landfill	40	27	47	39	25	21	14	23	31	73	26	63	**428**
Taylor at Tinpot	85	48	112	58	53	56	16	26	59	131	35	145	**822**

Site	July	August	September	October	November	December	January	February	March	April	May	June	**Total**
Te Rapa	174	19	84	55	53	52	44	65	62	82	47	93	**828**
Top Valley at Staircase Ridge	43	77	175	87	100	99	37	43	38	217	34	216	**1163**
Tor Darroch NRFA	47	61	114	100	89	71	52	38	30	148	26	116	**891**
Tunakino	72	159	169	142	103	341	70	51	64	351	54	329	**1904**
Upper Clarence NRFA	106	31	50	37	49	10	6	36	14	20	16	56	**432**
Waihopai at Craiglochart	26	55	60	38	56	13	13	16	36	106	13	75	**505**
Waihopai at Spray Confluence	38	65	101	58	75	39	34	26	24	121	19	107	**706**
Waikakaho	49	57	73	71	35	35	27	23	30	136	32	111	**678**
Wairau Valley at Southwold	51	75	80	48	42	27	17	20	43	136	19	116	**674**
Wakamarina at Twin Falls	44	104	176	198	95	211	82	65	47	254	46	188	**1508**
Ward NRFA	136	18	55	41	26	31	24	32	43	68	31	107	**613**
Wye at Charlies Rest	35	68	113	83	69	55	25	36	38	127	23	95	**765**

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Table 2. A summary of river flows in Marlborough for June 2024.

Site Name	June Mean Flow (m3/s)	June Long-Term Mean Flow (m3/s)	% of long-term mean	Flow Record Begins	Catchment Area (km2)
Rai River at Rai Falls	18.37	15.17	121	1979	211
Kaituna River at Higgins Bridge	4.06	6.38	64	1989	135
Branch River at Weir Intake	14.64	24.38	60	1958	551
Goulter River at Horseshoe Bend	10.19	11.38	90	2010	154
Waihopai River at Craiglochart	13.17	17.42	76	1960	745
Ohinemahuta River at Domain	1.86	1.75	106	2013	33
Are Are Creek at Kaituna Tuamarina Track	0.53	0.75	70	2007	32
Tuamarina River at Para Road	2.28	3.18	72	2024	100
Wairau River at Tuamarina	96.13	114.33	84	1960	3430
Omaka River at Gorge	1.34	1.63	82	1993	91
Taylor River at Borough Weir	1.06	0.93	114	1961	65
Flaxbourne River at Corrie Downs	1.37	0.89	155	2003	71
Awatere River at Awapiri	11.60	16.77	69	1977	983