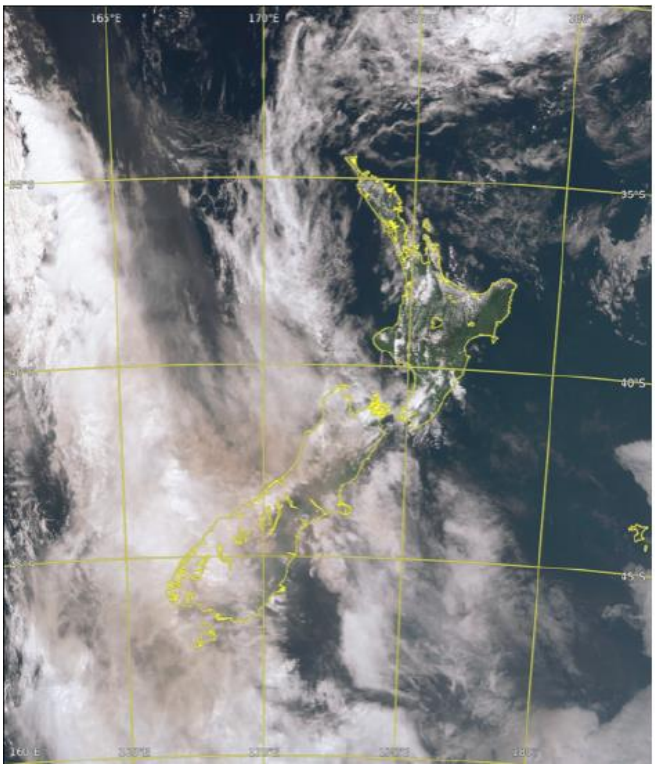
greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Climate and Water Resources Summary for the Wellington Region

Cold Season (May to October) 2019

Release date: 29 Nov 2019

Contents



Smoke from Australian bushfires at the end of the cold season started to flow towards New Zealand, caught by the upper level jet. This satellite photo, of 9 November at 3pm, shows a significant amount of smoke mixing with the cold front approaching New Zealand. Image courtesy of MetService.

In this report you will find:

More information

For more information on monitoring sites and up-to-date data please visit http://www.gw.govt.nz/environmental-science/. Several climate sites are operated by NIWA and/or MetService, and GWRC is grateful for permission to present the data in this report.

Disclaimer

Report release date: Nov 2019

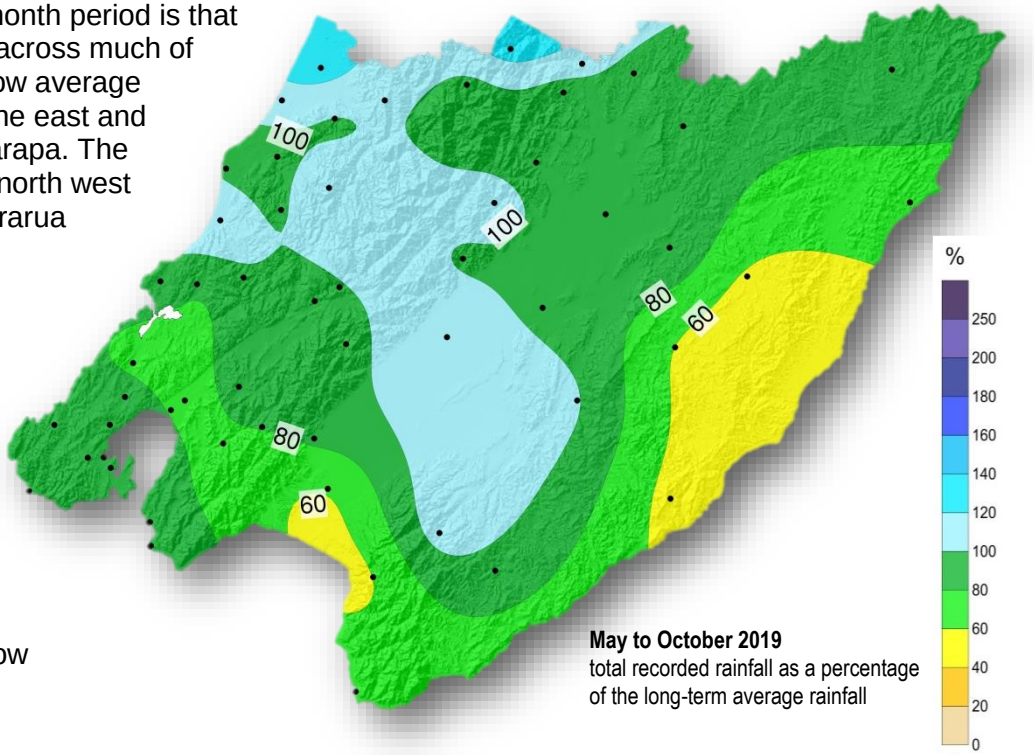
The cold season from May to October 2019 saw around 80-120% of average rainfall across much of the region over the entire six month period. However, a look into the rainfall patterns on a monthly basis (see next page) shows that the rainfall anomaly showed variation from month to month.

Rainfall (May to October)

The map to the right shows rainfall recorded during the entire May to October 2019 period as a percentage of the long term average.

The pattern for the six month period is that of near average rainfall across much of the region. Areas of below average rainfall occurred about the east and south coast of the Wairarapa. The wettest area was to the north west of the region and the Tararua Range.

Individual monthly totals show a varied picture (see the following page for monthly rainfall percentage maps). The monthly analysis highlights the variability in rainfall from month to month, with areas of above average rainfall and below average rainfall differing by month.



Analysis of the number of days that it rained can be interesting. If more than 1mm of rain is recorded in a day this is called a 'Rain Day' and if there is more than 25mm this is termed a 'Heavy Rain Day'.

The table below shows that most areas had close to the average number of Rain and Heavy Rain days. The Hutt Valley and Wellington lowland area and Eastern Wairarapa had 2 to 3 more Heavy Rain Days than normal.

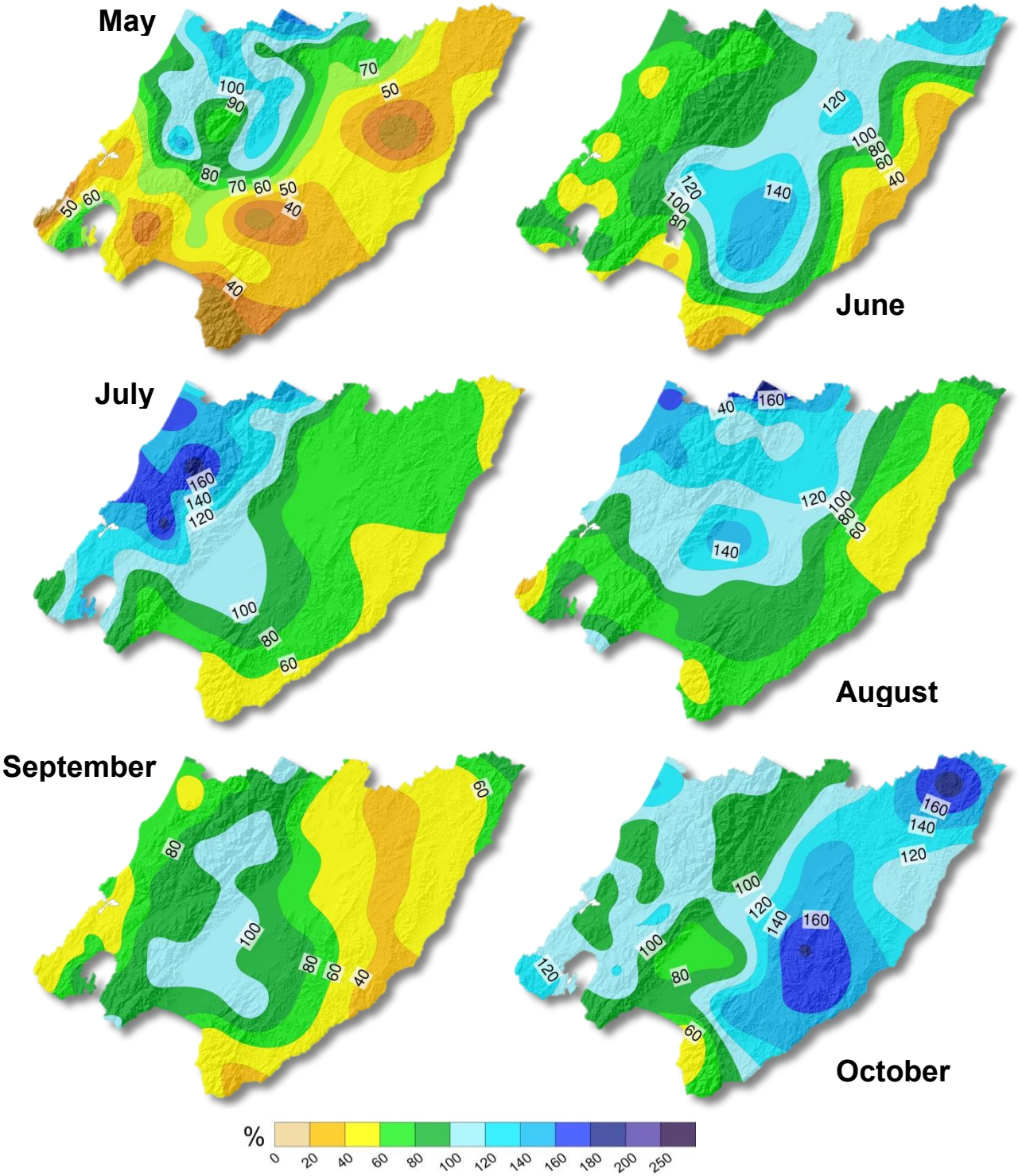
Number of Rain Days and Heavy Rain Days during May to October across the region (long-term average in brackets.)

	Kāpiti Coast		Porirua	Hutt Valley & Wellington		Ruamāhanga		Eastern Wairarapa
	Lowland	Hills	Lowland	Lowland	Hills	Lowland	Hills	
Rain Days (>1mm)	65 [70]	111 [104]	63 [66]	65 [69]	93 [95]	67 [66]	115 [114]	72 [76]
Heavy Rain Days(>25mm)	4 [4]	27 [24]	5 [5]	2 [5]	15 [13]	3 [3]	39 [34]	6 [7]

Rainfall by the month

The maps below show the percentage of average rainfall for each month of the cold season (May to October 2019). May rainfall was below average over the Wairarapa east coast and hills as well as southern coastal areas. June to August rainfall had largely average to above average rainfall across most areas with the exception of parts of the east coast which was below average.

September rainfall conditions were drier than average while October finally saw some decent rainfall amounts (up to 160% of average) occurring over the eastern hills and coast.

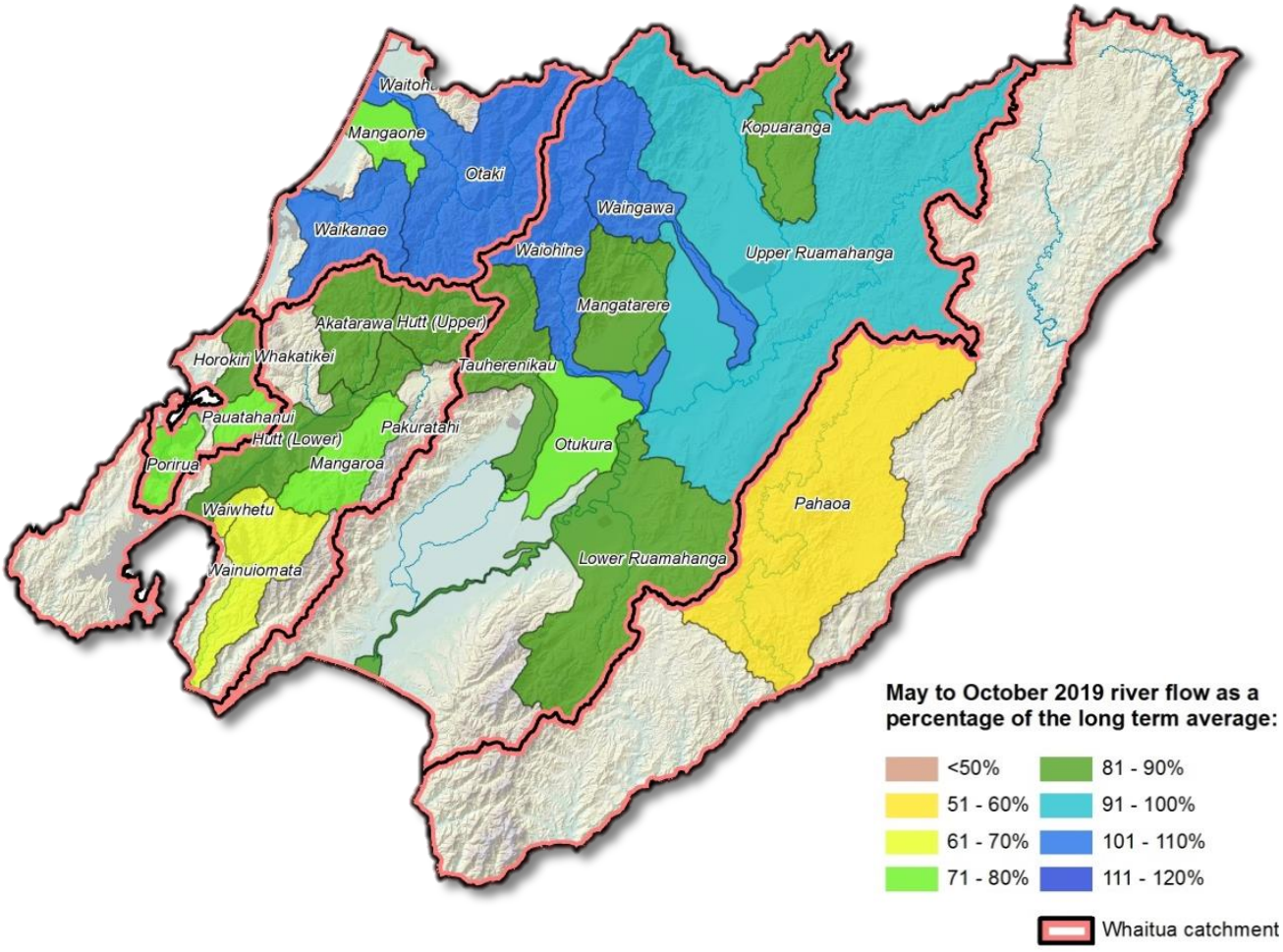


Monthly rainfall as a percentage of the long-term average

River flow

The map below shows the average river and stream flow conditions over the May to October 2019 period, for various monitored catchments, as a percentage of the long-term average flow for the same period.

The majority of the region's stream and rivers experienced below average to average flows during the six month period.



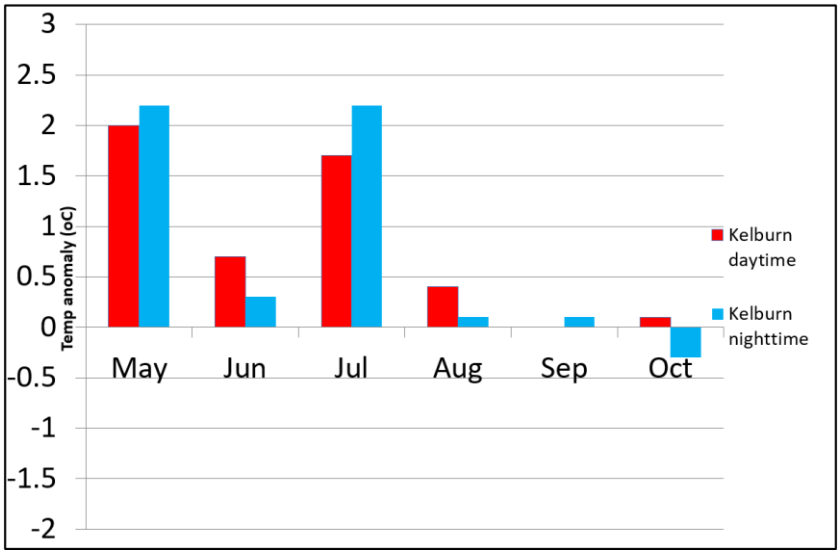
Rivers draining the northern Tararua Range (Waingawa, Waiohine and Otaki rivers) were the only catchments where recorded flow was above average – albeit just slightly higher at up to 110%.
The Pahaoa River on the east coast had the lowest flow anomaly at 51% of average for the May to October period. But the month to month figures shown wide variation:

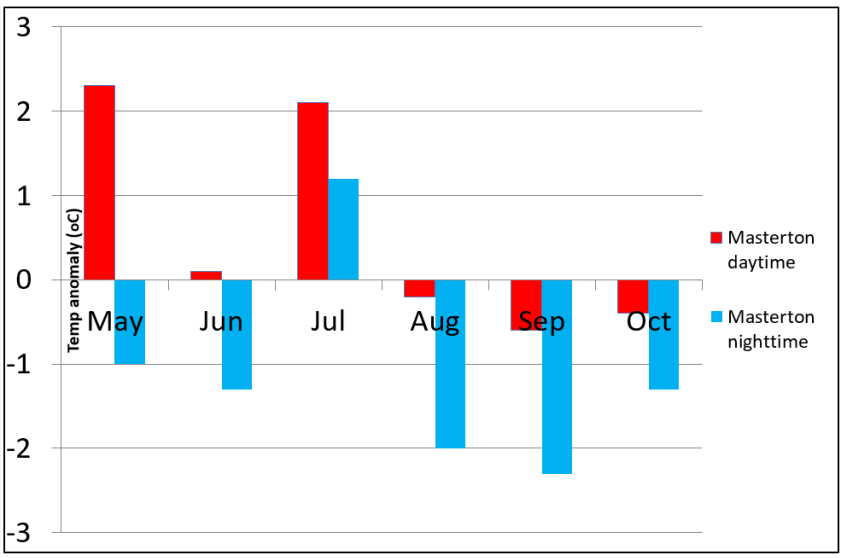
- May <20%
- June 100%
- July 30%
- August 52%
- September 40%
- October 100%

Air temperatures

Air temperature is measured at a number of meteorological monitoring sites across the region. It is useful to look at the anomalies (i.e., departures from normal) in average temperatures month by month, in order to understand the climate anomalies.

The graphs below show the monthly average daytime maximum and average nighttime minimum temperature anomalies (i.e., based on every day of the month) for Kelburn (upper panel) and Masterton (lower panel). We can see that the cold season was warmer than normal in the first half, and colder than normal in the second half of the season. For Masterton, the nighttime minimum temperatures were generally below average, possibly as a reflection of drier conditions and clear sky nights into spring, which favour heat loss into space.





Average daytime and nighttime temperature anomalies for Kelburn (top) and Masterton (bottom) for the cold season period. The first half of the period was warmer than average, and the second half was either about average (Wellington) or colder than average (Masterton).

SOURCE: Data from MetService meteorological stations.

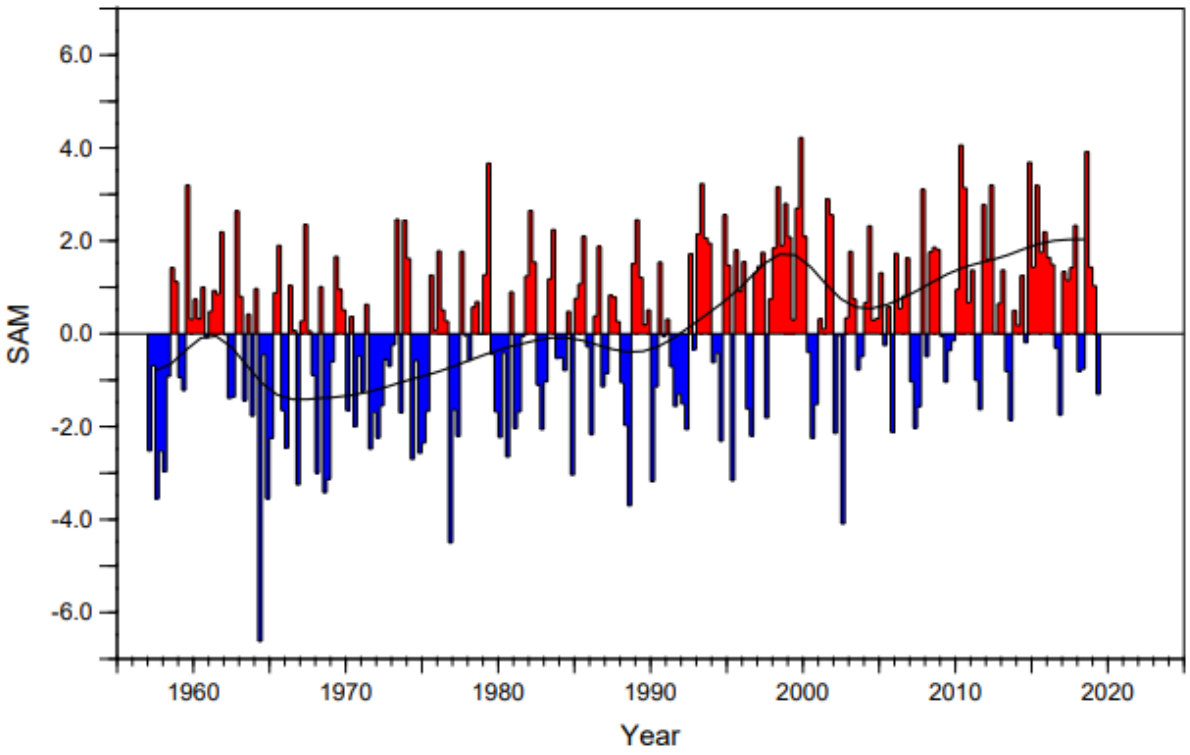
Global climate drivers

Climate variability and climate change

People often ask if the variable weather patterns in our region are a result of climate change. While natural climate variability has always been quite pronounced in our region, weather extremes are expected to get worse as a result of human-induced climate change and "global warming" caused by greenhouse gas emissions (http://www.royalsociety.org.nz/expert-advice/papers/yr2016/climate-change-implications-for-new-zealand/).

Some key observations about climate variability and change in our region during the period May to October 2019 are:

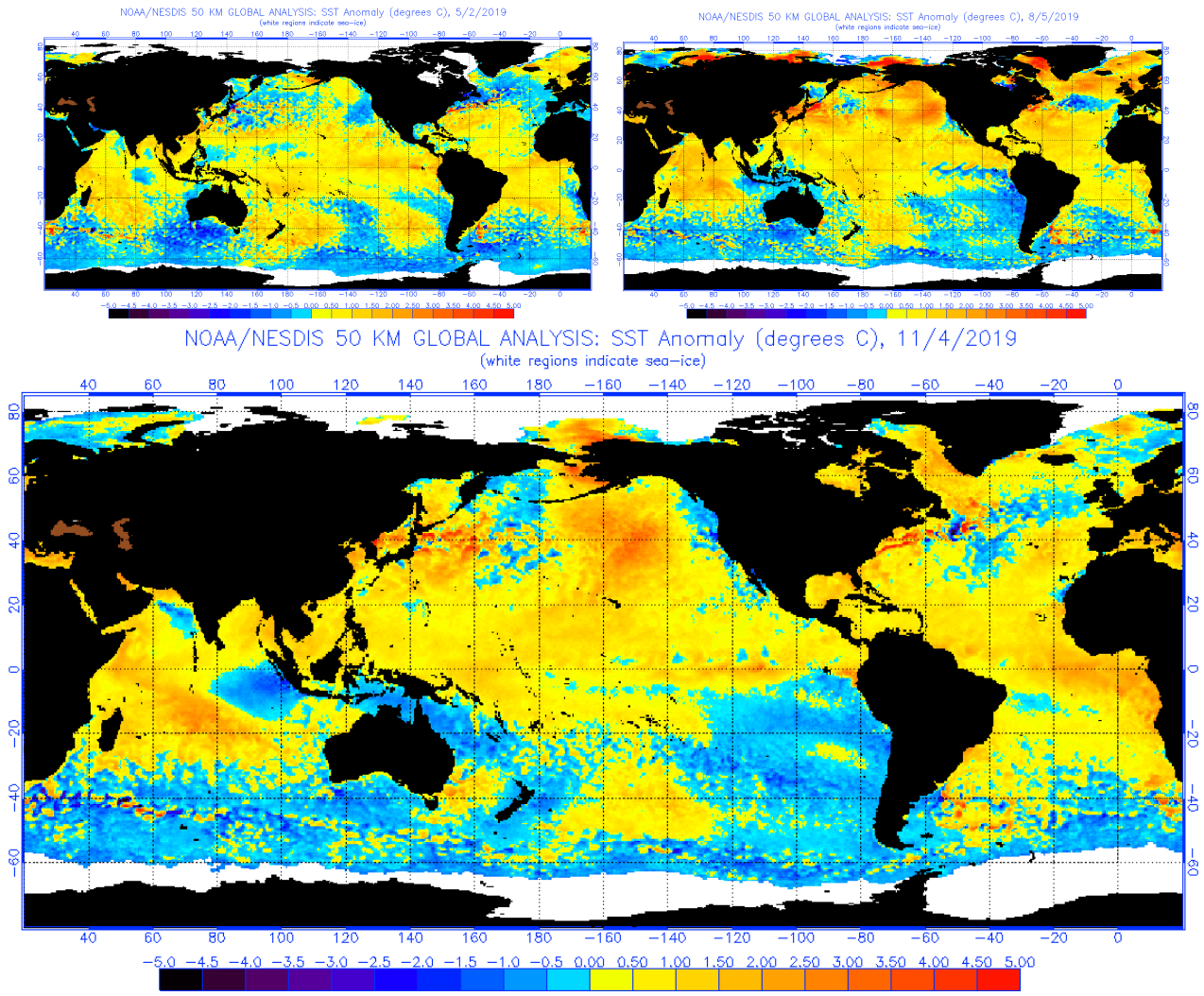
- The six-month period was warmer than normal in the first half and normal to colder than normal in the second half of the season;
- The sea surface temperatures (following page) have shifted from warmer than normal to below normal around New Zealand, following a similar shift in air temperature;
- The Southern Annular Mode (below), which has been predominantly positive as a whole, has shifted into negative during the last cold season (graph below). The SAM continues to be on the negative side, and is predicted to remain so into the first half of December.



The Southern annular mode (SAM) has been predominantly positive (red), but it shifted to negative during the last cold season (shown by the last blue bar). Source: http://www.nerc-bas.ac.uk/icd/gjma/sam.html

Global climate drivers and extreme weather events

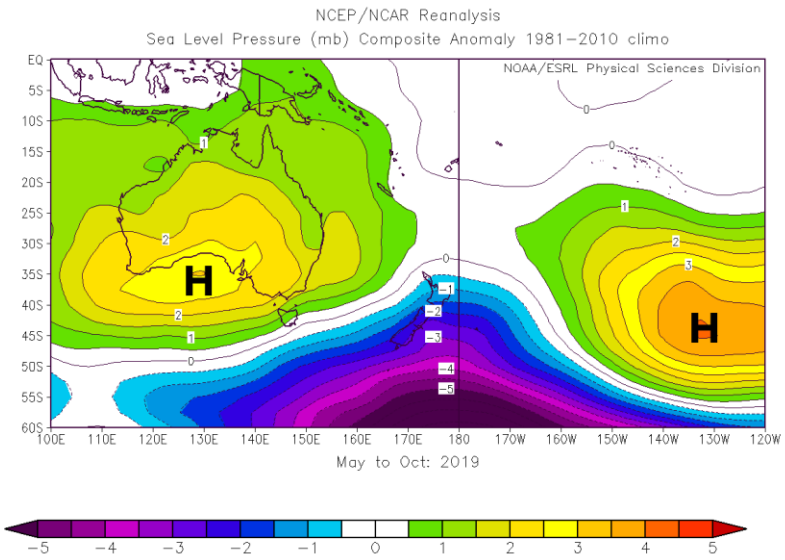
Climate drivers are global mechanisms that can influence the weather in our region. The El Niño/Southern Oscillation[1] (ENSO) phenomenon has been neutral, and is expected to remain so. The sea surface temperature around New Zealand has shifted from being warmer than normal at the beginning of the season to colder than normal, but is back to warmer than normal again as of November. The sea ice extent around Antarctica has been much lower than average, finishing the season at similar levels to what had been observed last year (seen in white, bottom panel).



Sea surface temperature anomalies on 2nd May 2019 (left), 5th Aug 2019 (right) and 4th Nov 2019 (bottom). We can see the equatorial Pacific in a neutral phase in regards to ENSO, and colder than normal waters affecting New Zealand towards the end of the period. Source: NOAA/USA.

The pressure anomalies over the six month period show two anticyclones (marked as H) and New Zealand dominated by low pressure in between. This pattern contributed to more frequent southerlies and colder than average temperatures during the second half of the season, in association with a predominantly negative SAM index.

[1] https://www.niwa.co.nz/education-+-and-training/schools/students/enln



Mean sea level pressure anomaly for May to Oct 2019.

High pressure anomalies dominated the oceanic areas east and west of New Zealand, with low pressure anomalies south of New Zealand. This pattern helped to create colder conditions during the second half of the cold season, as the low pressure area considerably intensified, compared to the first half of the season.

Source: NOAA (USA).

Another climate driver of interest has been the Indian Ocean Dipole, which has been very strongly positive. This can be seen in the SST map on the previous page, showing very warm waters in the western Indian Ocean and cooler than normal waters north and northwest of Australia. The positive Indian Ocean Dipole, together with the negative SAM, have acted in concert to help explain the development of a very windy spring season for Wellington, with an almost uninterrupted westerly flow.

Seasonal climate outlook update

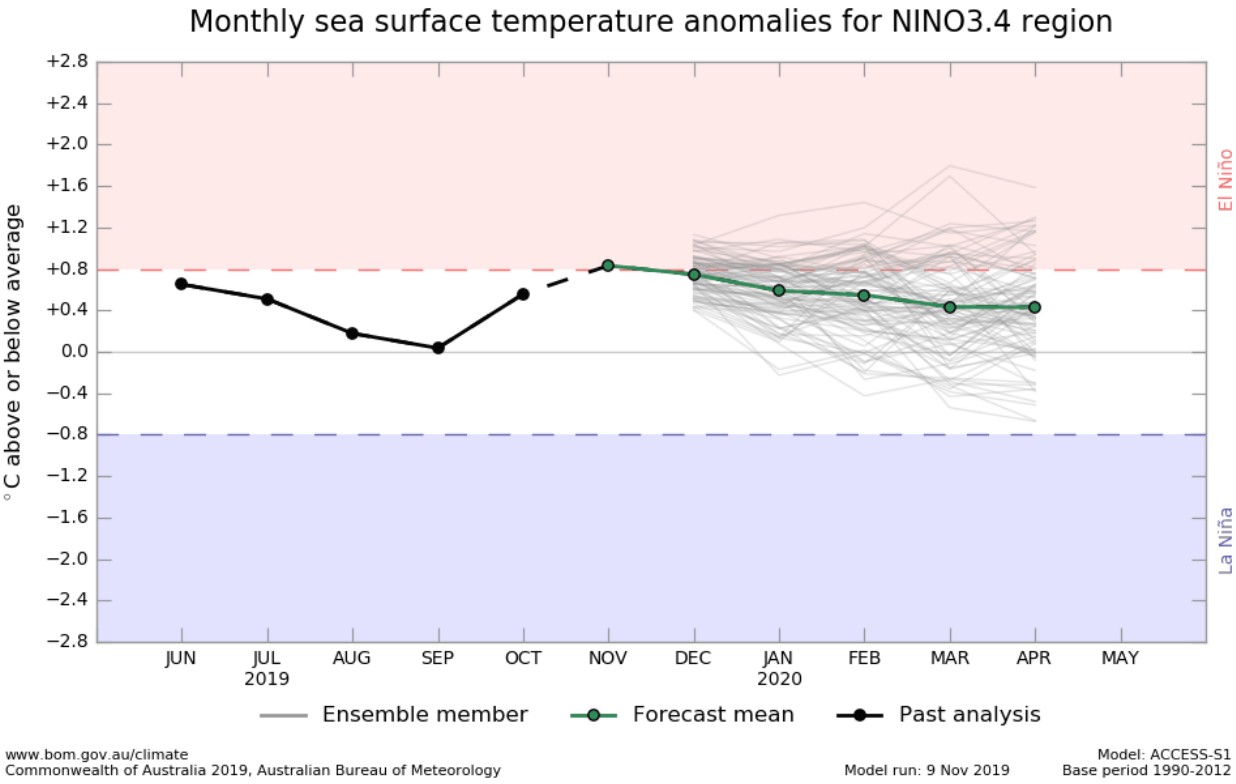
The ENSO phenomenon is expected to remain neutral for at least the next season, even though the water in the Equatorial Pacific has been warmer than average in a relatively wide band. The waters around New Zealand have reverted back to warmer than average, and are expected to remain warm during the coming season, based on the overall projections by the seasonal prediction models. The Indian Ocean Dipole (IOD) is also expected to remain positive for the initial part of summer, with a potential to enhance the westerly flow over New Zealand at least during December.

The following points summarise the expected pattern over the next three months:

- ENSO phenomenon likely remaining neutral during the next season;
- Vigorous westerlies to continue into December, giving way to northeasterly flows later in the season;
- Mixed rainfall anomalies, likely starting dry in the Wairarapa and shifting to a more easterly regime influence later in the season (low confidence for rainfall totals);
- Warmer than average Sea Surface Temperature likely around New Zealand;
- A warmer than average, but variable summer. Heat waves likely;

- High chance of heavy rainfall events and thunderstorms later in the season, significant easterly events possible.

The full climate outlook for summer will be released with our regular seasonal briefing before Christmas.



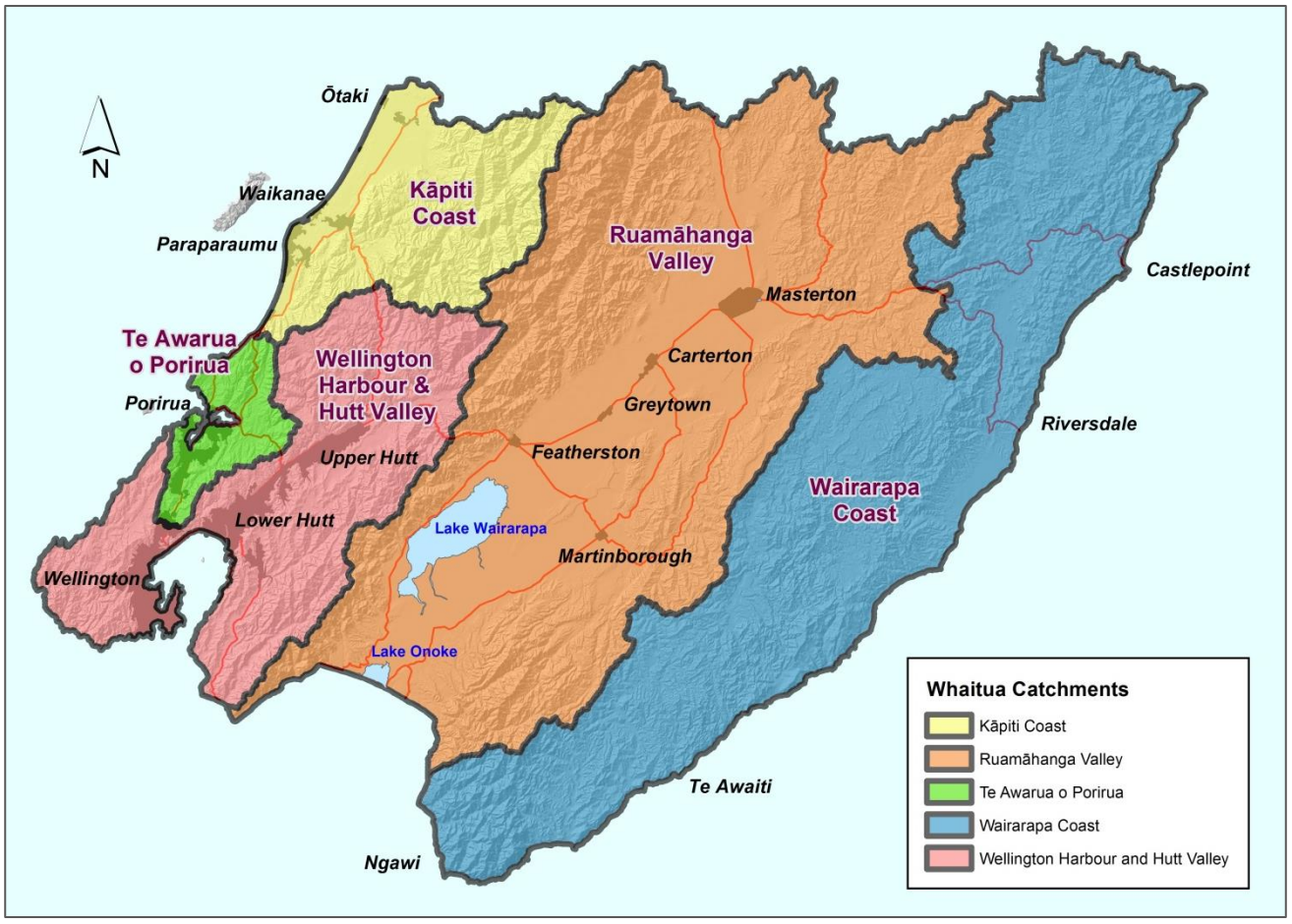
ENSO predictions as of 9 Nov 2019, showing that the ENSO phenomenon has been neutral, and is expected to remain so for the next few months. *Source: BOM (Australia)*

What happened in each whaitua catchment?

Climate and water resource summaries are provided in the following sections for each of the five Wellington region whaitua catchment areas (as shown below). The whaitua catchments provide an important sub-regional basis for environmental management in the Wellington region[2], and roughly coincide with the different climate and water resource zones.

Click the following links for November 2017 to April 2018 summaries for:

- Wellington Harbour and Hutt Valley
- Te Awarua-o-Porirua
- Kāpiti Coast
- Ruamāhanga Valley
- Wairarapa Coast

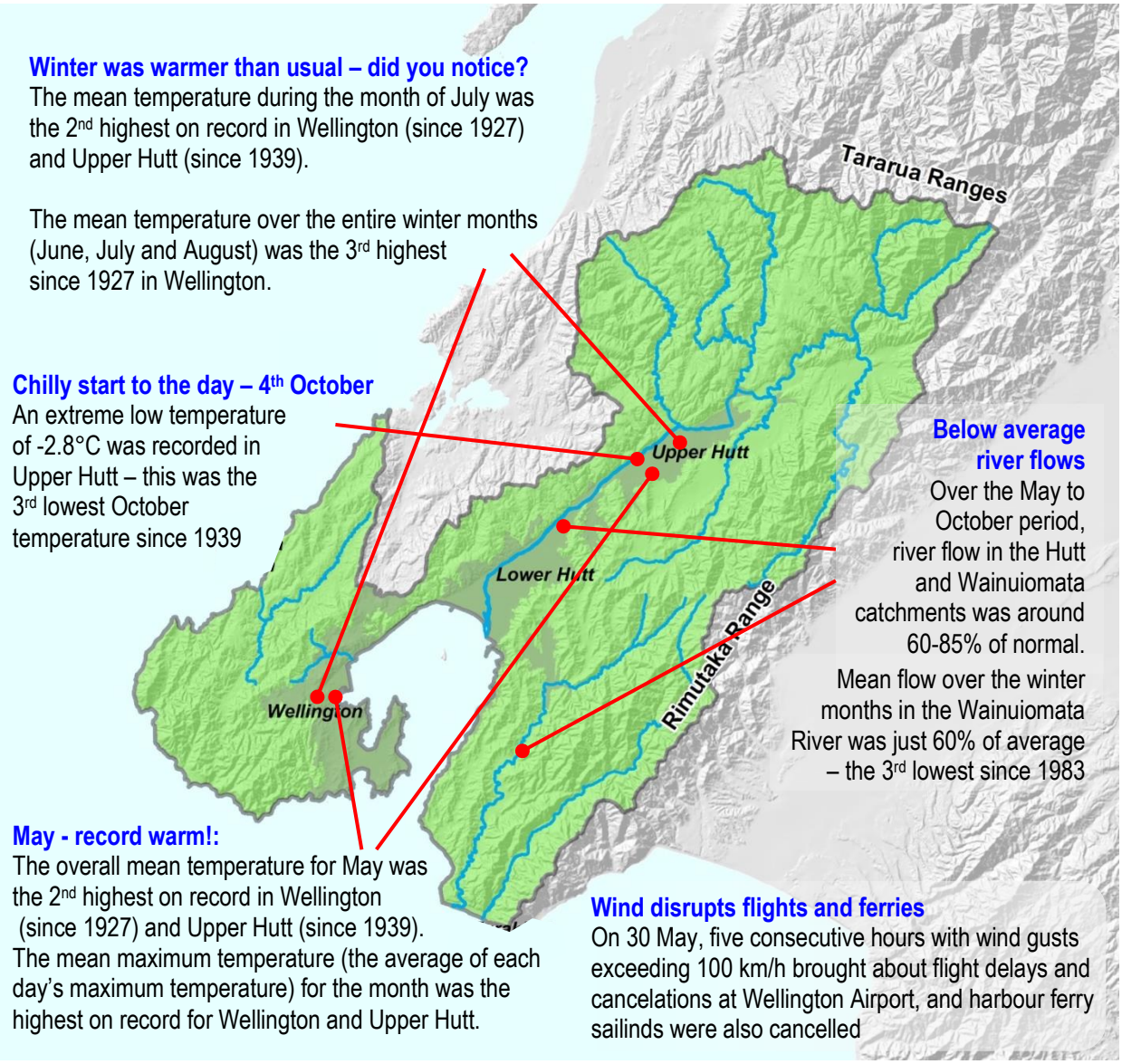


Map of the five whaitua catchment areas in the Wellington region. Each whaitua roughly coincides with a climatic zone, expressing the marked east-to-west contrast that we experience in our region.

[2] http://www.gw.govt.nz/whaitua-committees/

Wellington Harbour and Hutt Valley climate summary

- **Total rainfall was around average with the exception of Lower Hutt and Wainuiomata**
- **2019 winter mean temperatures were the 2nd highest on record**
- **Mean maximum temperature in May was the highest on record**

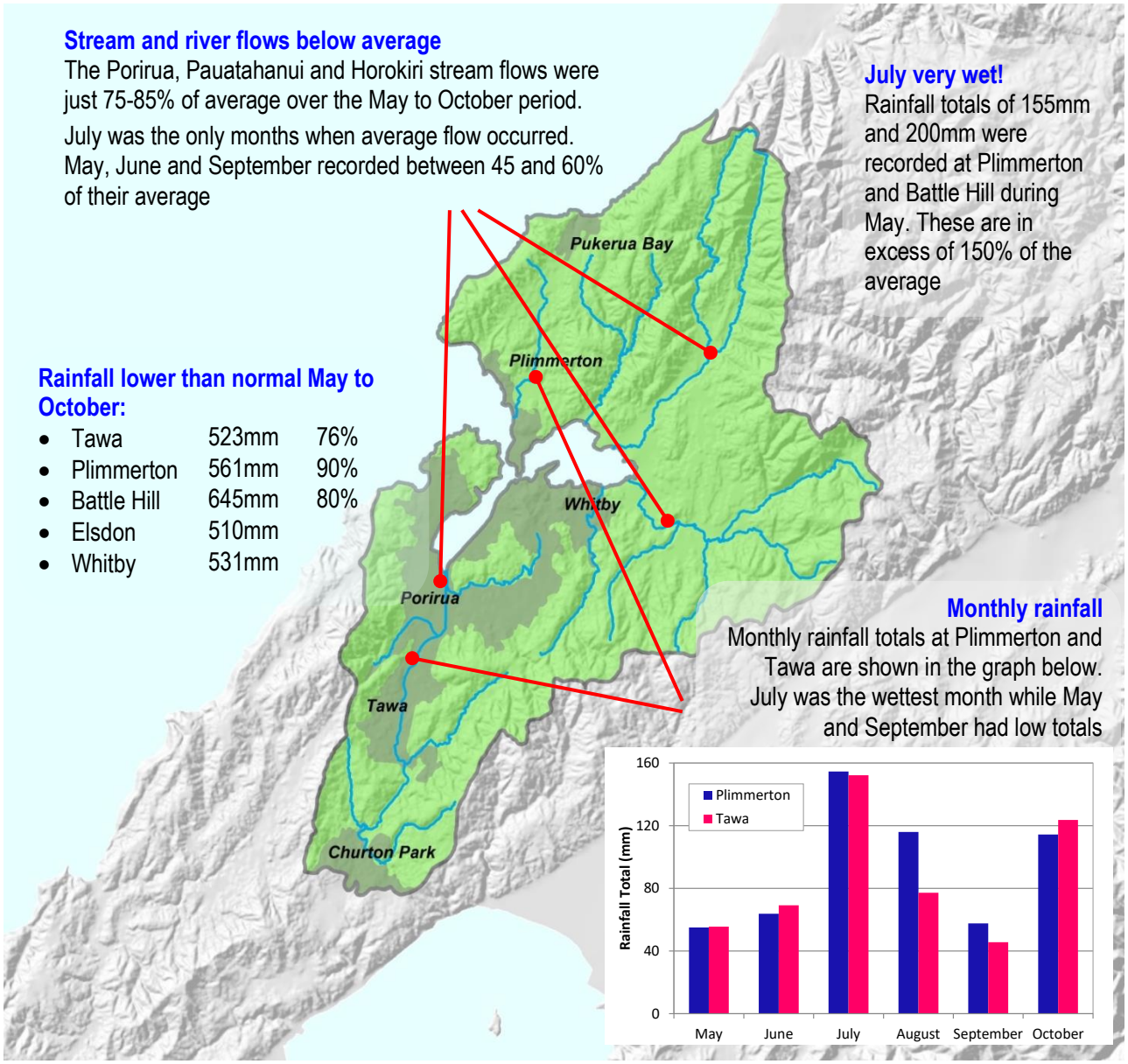


Want to look at the summary tables and graphs?

- Rainfall
- River flows

Te Awarua-o-Porirua climate summary

- **Total six month rainfall 75% to 90% of average**
- **Very wet July**
- **May to June period had only up to 60% of normal rainfall**

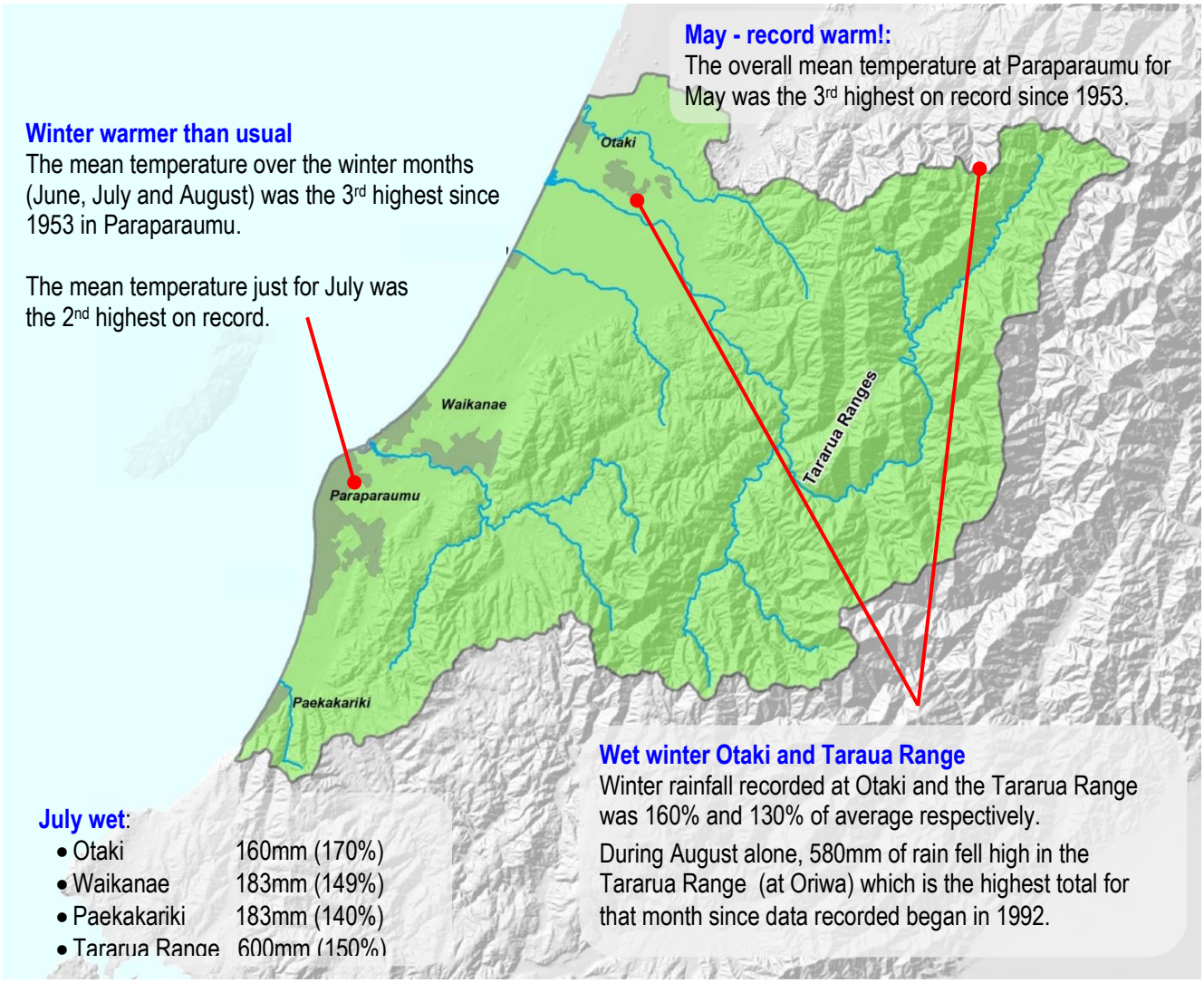


Want to look at the summary tables and graphs?

- Rainfall
- River flows

Kāpiti Coast climate summary

- **Six month rainfall was around average in Paekakariki and Waikanae but above average in Otaki. The Tararua Range experienced around average rainfall**
- **July was vey wet all over with 140-170% of normal rainfall recorded. Otaki and the Tararua Range had over 150% of average rainfall in August as well**
- **River flows tended average to above average over the 6 month period**

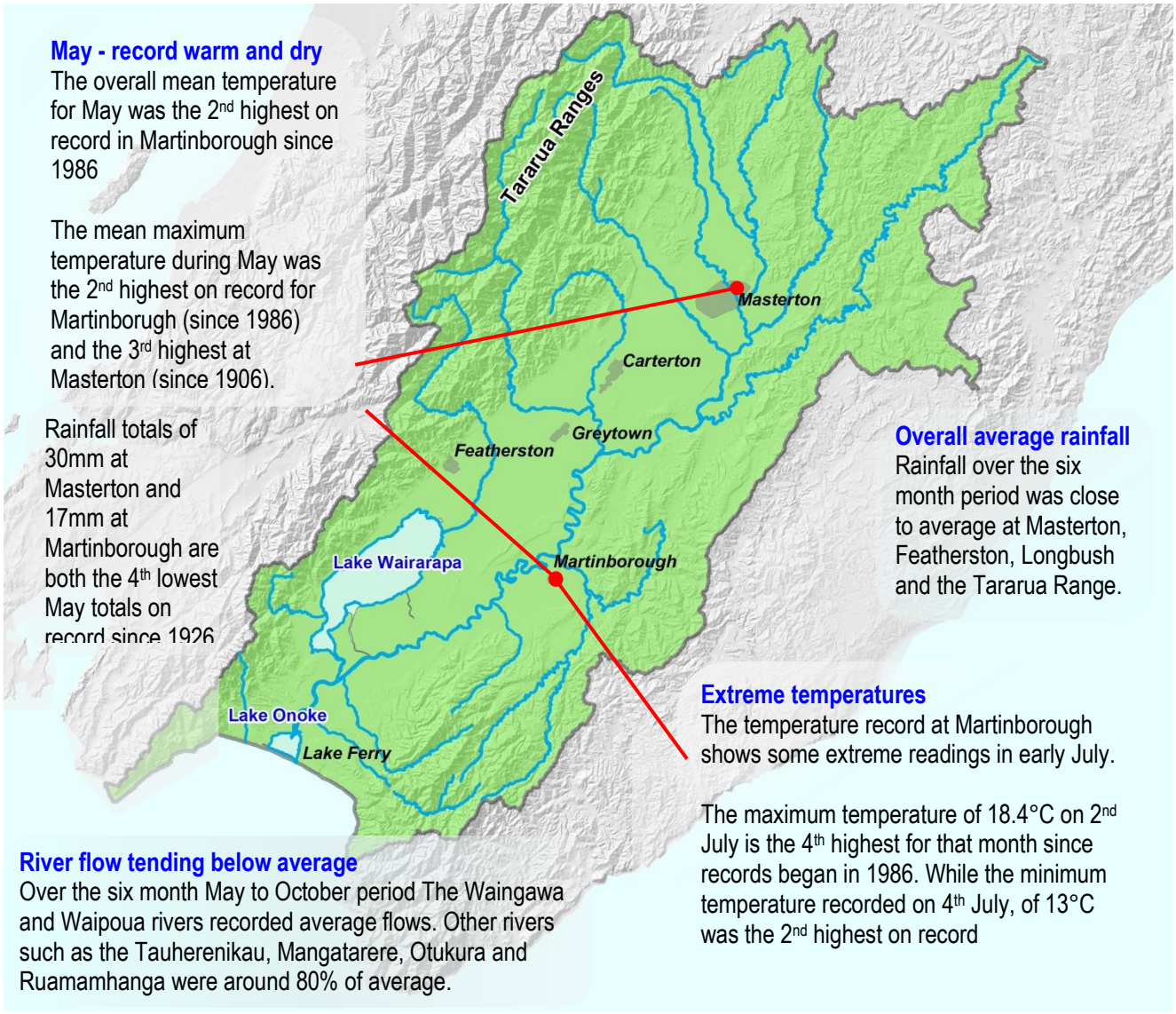


Want to look at the summary tables and graphs?

- Rainfall
- River flows

Ruamāhanga Valley climate summary

- **Six month rainfall around average**
- **Winter months warmer than normal**



May - record warm and dry
The overall mean temperature for May was the 2nd highest on record in Martinborough since 1986

The mean maximum temperature during May was the 2nd highest on record for Martinborough (since 1986) and the 3rd highest at Masterton (since 1906).

Rainfall totals of 30mm at Masterton and 17mm at Martinborough are both the 4th lowest May totals on record since 1926

Overall average rainfall
Rainfall over the six month period was close to average at Masterton, Featherston, Longbush and the Tararua Range.

Extreme temperatures
The temperature record at Martinborough shows some extreme readings in early July.

The maximum temperature of 18.4°C on 2nd July is the 4th highest for that month since records began in 1986. While the minimum temperature recorded on 4th July, of 13°C was the 2nd highest on record

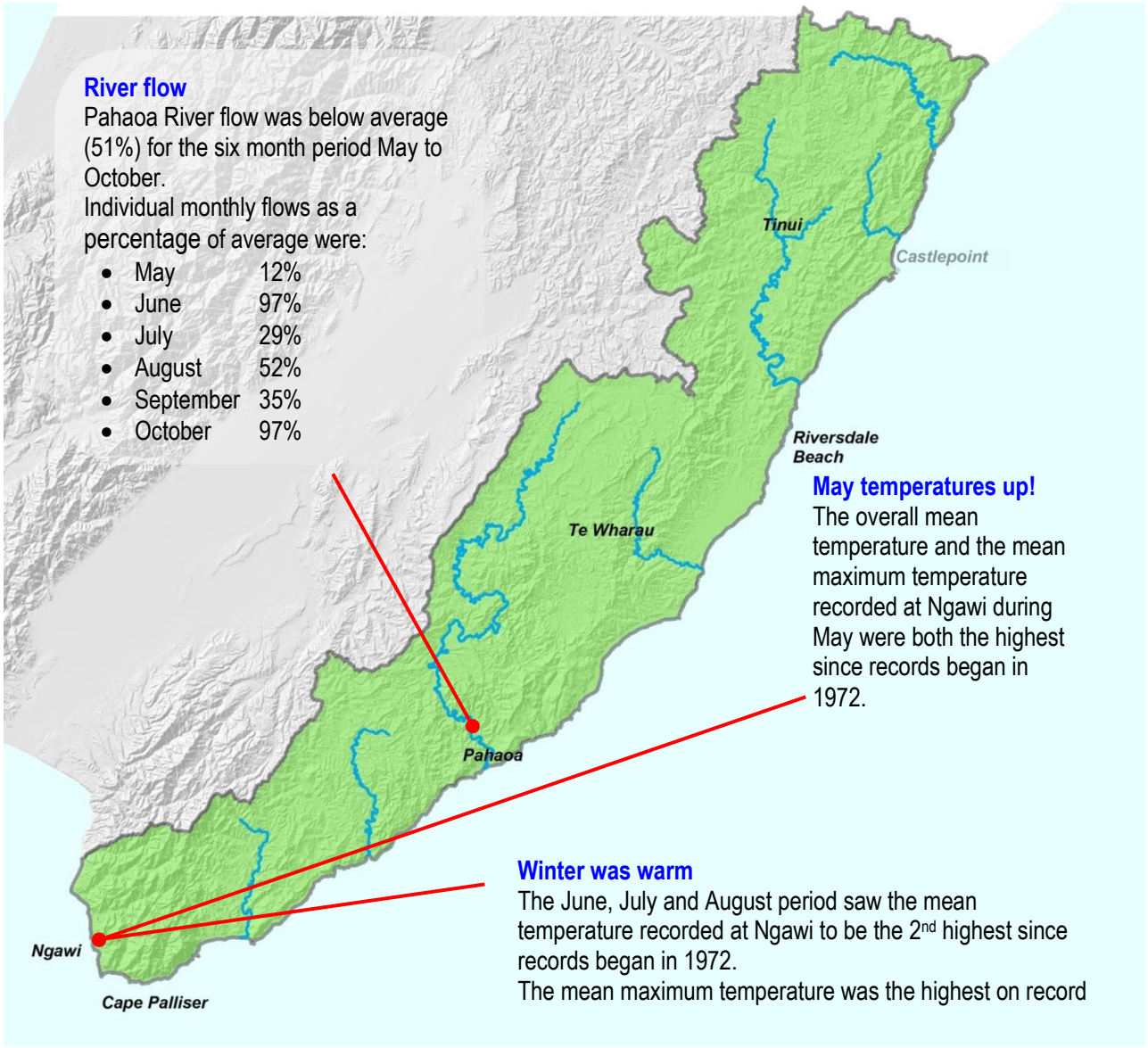
River flow tending below average
Over the six month May to October period The Waingawa and Waipoua rivers recorded average flows. Other rivers such as the Tauherenikau, Mangatarere, Otukura and Ruamamhanga were around 80% of average.

Want to look at the summary tables and graphs?

- Rainfall
- River flows

Wairarapa Coast climate summary

- **Very low river flows in May, July and September**
- **Warm May and winter months**
- **Wet October**



Want to look at the summary tables and graphs?

- Rainfall
- Soil moisture

Rainfall statistics

Rainfall was variable over individual six months in the May to October period, but ended up largely around average.

Whaitua	Location	May %	Jun %	Jul %	Aug %	Sep %	Oct %	May-Oct (mm)	May-Oct %
Wellington Harbour & Hutt Valley Click to see cumulative rainfall plots	Kaitoke	94	85	114	102	91	110	1309	98
	Lower Hutt	60	44	114	66	61	84	528	73
	Wainuiomata	36	77	80	63	95	123	904	76
	Karori	79	86	124	91	87	136	727	101
	Wellington	72	86	139	98	100	116	591	103
Te Awarua-o-Porirua Click to see cumulative rainfall plots	Battle Hill	45	60	155	85	56	97	645	82
	Whenua Tapu	56	60	153	114	64	107	561	92
	Tawa	50	59	128	72	56	100	523	76
Kāpiti Coast Click to see cumulative rainfall plots	Otaki	101	128	169	162	53	133	708	127
	Waikanae	94	53	149	110	65	93	661	94
	Paekakariki	60	69	142	104	59	171	722	100
	Tararua (Otaki headwaters)	103	83	152	158	81	103	2898	112
Ruamāhanga Click to see cumulative rainfall plots	Masterton	61	111	71	137	58	140	500	95
	Featherston	82	109	92	147	91	113	644	107
	Longbush	46	143	75	102	80	182	573	102
	Tararua (Waiohine headwaters)	90	74	110	112	86	102	2594	96
Wairarapa Coast Click to see cumulative rainfall plots	Tanawa Hut	41	150	69	58	53	188	706	90
	Ngaumu	22	94	35	55	38	115	366	59

Click the following links to return to climate summaries for:

- Wellington Harbour & Hutt Valley
- Te Awarua-o-Porirua
- Kāpiti Coast
- Ruamāhanga
- Wairarapa Coast

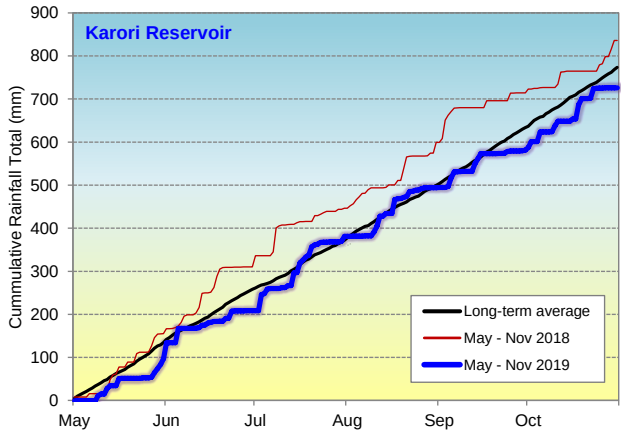
Cumulative rainfall plots

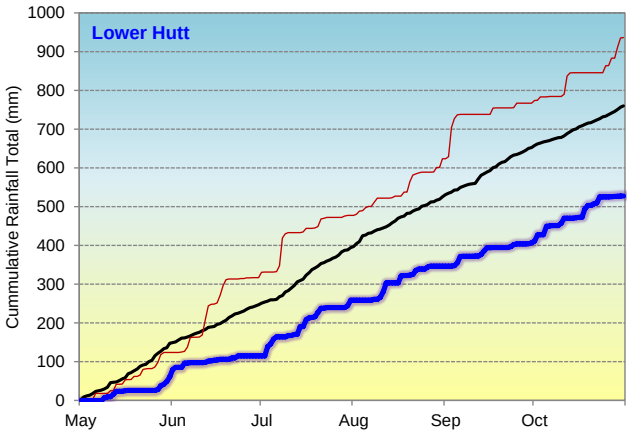
Cumulative rainfall totals for the May to October 2019 period are detailed for various rain gauges sites across the regional whaitua areas, as denoted by the blue trace on the following plots. The May to October 2018 period is denoted by the red trace and the black trace represents the long-term average rainfall accumulation.

Wellington and Hutt Valley

The plots highlight that the rainfall accumulation during the May to October period was about average in Wellington and below average in the Hutt Valley.

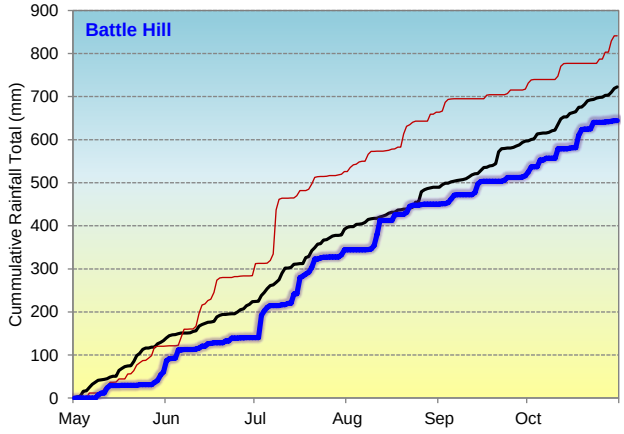
The total rainfall at Karori was similar to the previous year while Lower Hutt end lower.

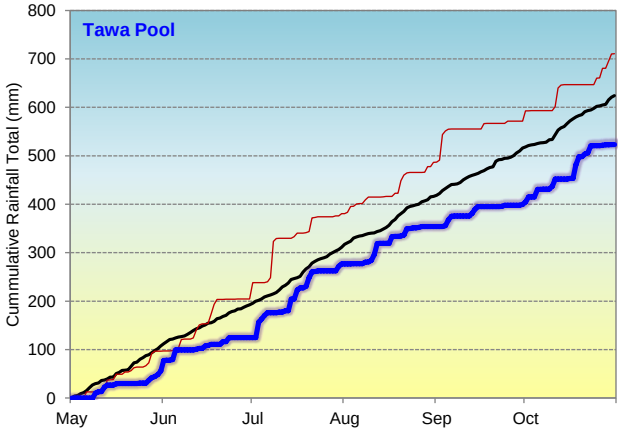




Porirua Harbour

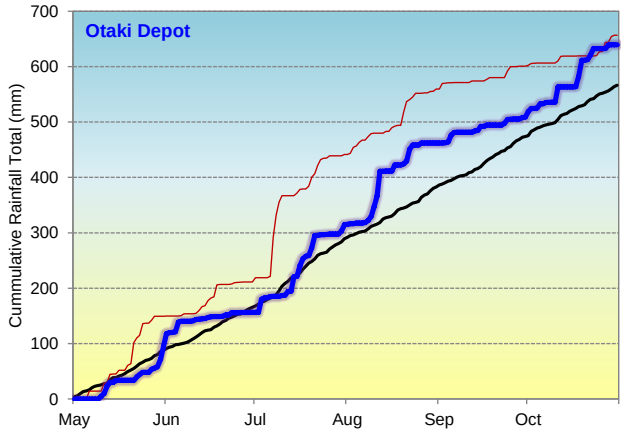
The plots show that the rainfall accumulation evolution over the May to October period at the two sites within the Te Awarua-o-Porirua whaitua area were quite similar, with around average rainfall untilJuly before higher than normal totals brought the entire period above average.

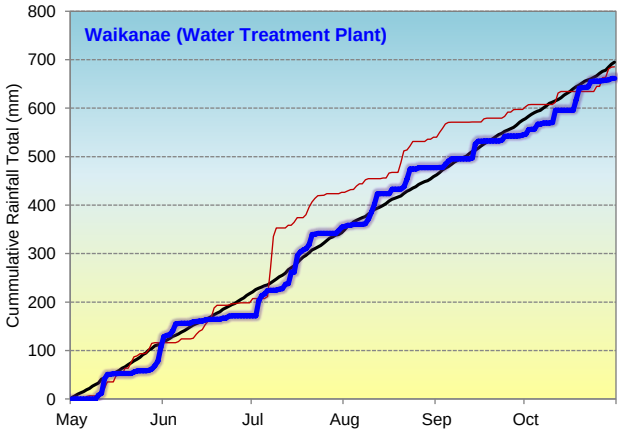




Kāpiti Coast

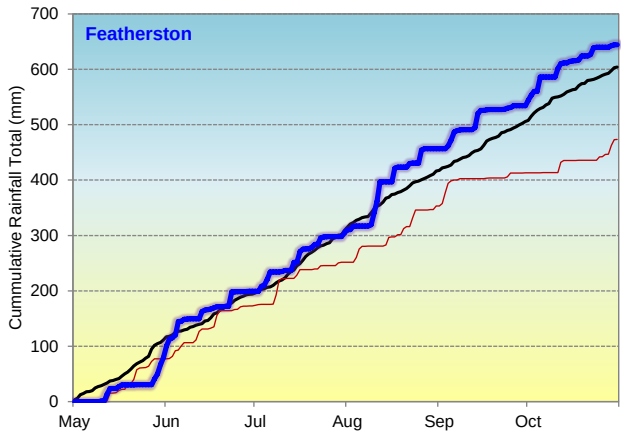
Rainfall recorded at Otaki was around 100mm higher than average for the May to October period, similarto the previous year.

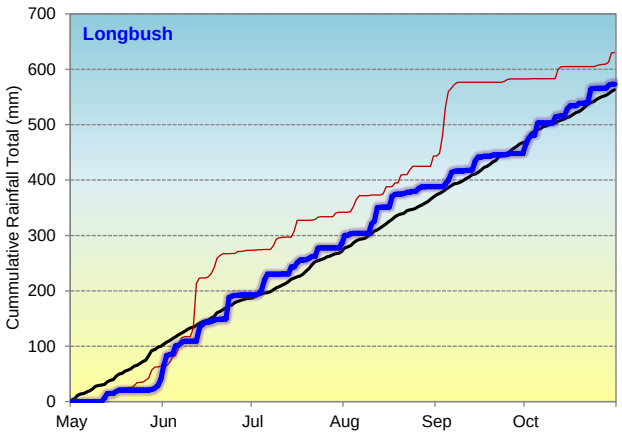




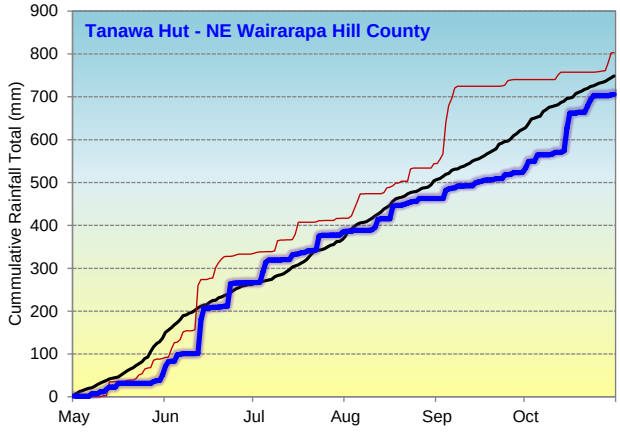
Ruamāhanga

Rainfall at Featherston ended up slightly above average for the May to October period. Longbush tracked close to average for much of the year after a dry start.





Wairarapa Coast



The Tanawa Hut rain gauge in the Wairarapa Coast area showed a similar rainfall accumulation trend to the Longbush gauge (above) up until around August before experiencing a period of less than normal rainfall.

River flows - averages

The average river flows over the entire May to October period were around normal (80 to 120%) for many monitored rivers and streams. Some notable exceptions were the Wainuiomata and Pahaoa rivers that were below 70%.

		Flow as a percentage of average						
Whaitua	**River**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**May-Oct**
Wellington Harbour & Hutt Valley	Hutt River - Kaitoke	72	85	98	94	78	94	88
	Hutt River - Taita Gorge	63	92	99	90	75	92	87
	Akatarawa River	68	77	108	97	67	85	85
	Mangaroa River	42	95	77	71	69	99	77
	Waiwhetu Stream	52	49	71	62	63	71	62
	Wainuiomata River	42	68	65	57	78	80	66
Te Awarua-o-Porirua	Porirua	62	59	97	75	60	83	74
	Pauatahanui	51	61	103	89	63	99	80
	Horokiri	44	55	141	92	62	91	85
Kāpiti Coast	Waitohu	196	183	171	168	127	122	156
	Otaki	88	102	130	129	82	99	105
	Mangaone	88	84	73	82	44	64	71
	Waikanae	76	71	153	144	82	100	107
Ruamāhanga	Kopuaranga	39	105	69	129	42	87	82
	Waingawa	76	95	107	125	90	103	101
	Waiohine	83	101	107	117	90	103	101
	Mangatarere	57	103	77	101	82	74	84
	Tauherenikau	74	94	85	98	83	94	88
	Otukura	46	80	51	97	85	79	75
	Ruamāhanga	56	90	74	104	71	92	82
Wairarapa Coast	Pahaoa	12	97	29	52	35	97	51

Click the following links to return to climate summaries for:

- Wellington Harbour & Hutt Valley
- Te Awarua-o-Porirua
- Kāpiti Coast
- Ruamāhanga
- Wairarapa Coast

River flows – lowest

Minimum river and stream flows recorded during the May to October 2019 period. All flows were at least 150% of the long-term average 7-day low flows for the May to October period.

Whaitua	River	Minimum Flow		
		Flow (m^3/s)	Date	Comment
Wellington Harbour & Hutt Valley	Hutt (Kaitoke)	2.068	22 May	
	Hutt (Taita Gorge)	8.331	3 May	*230% of average low flow*
	Akatarawa	1.861	22 May	
	Mangaroa	0.719	21 May	
	Wainuiomata	0.255	21 May	
Te Awarua-o-Porirua	Porirua	0.336	20 May	*220% of average low flow*
	Pauatahanui	0.224	21 May	*240% of average low flow*
	Horokiri	0.169	21 May	
Kāpiti Coast	Waitohu	1.243	17 September	
	Otaki	8.607	3 May	
	Mangaone	0.141	7 July	
	Waikanae	1.853	26 June	*180% of average low flow*
Ruamāhanga	Kopuaranga	0.456	6 May	*150% of average low flow*
	Waingawa	2.140	3 May	
	Waiohine	5.892	3 May	
	Mangatarere	0.451	22 May	*230% of average low flow*
	Tauherenikau	2.319	22 May	
	Otukura	0.148	21 May	*230% of average low flow*
	Ruamāhanga (Upper)	4.557	3 May	
	Ruamāhanga (Lower)	18.010	3 May	
Wairarapa Coast	Pahaoa	0.611	24 May	

** Analyses have been completed on provisional data which may be subject to change once it is processed and archived.*

Click the following links to return to climate summaries for:

- Wellington Harbour & Hutt Valley
- Te Awarua-o-Porirua
- Kāpiti Coast
- Ruamāhanga
- Wairarapa Coast

River flows – highest

Maximum river and stream flows recorded during the May to October 2019 period. The estimated return period is given for each event. There were no significant high flow events recorde during the period.

Whaitua	River	Maximum Flow		
		Flow (m^3/s)	Date	Return Period (years)
Wellington Harbour & Hutt Valley	Hutt (Kaitoke)	122	24 September	1
	Hutt(Taita Gorge)	378	16 July	1
	Akatarawa	115	12 August	1
	Mangaroa	36	16 July	1
	Waiwhetu	6	5 October	1
	Wainuiomata	6	1 June	1
Te Awarua-o-Porirua	Porirua	21	14 July	1
	Pauatahanui	15	16 July	1
	Horokiri	12	12 August	1
Kāpiti Coast	Otaki	483	5 October	1
	Mangaone	4	12 August	1
	Waikanae	85	12 August	1
Ruamāhanga	Kopuaranga	33	18 August	1
	Waingawa	141	26 August	1
	Waiohine	338	24 September	1
	Mangatarere	14	12 August	1
	Tauherenikau	151	30 May	1
	Otukura	6	13 August	1
	Ruamāhanga (Upper)	234	13 August	1
	Ruamāhanga (Lower)	506	13 August	1
Wairarapa Coast	Pahaoa	108	14 June	1

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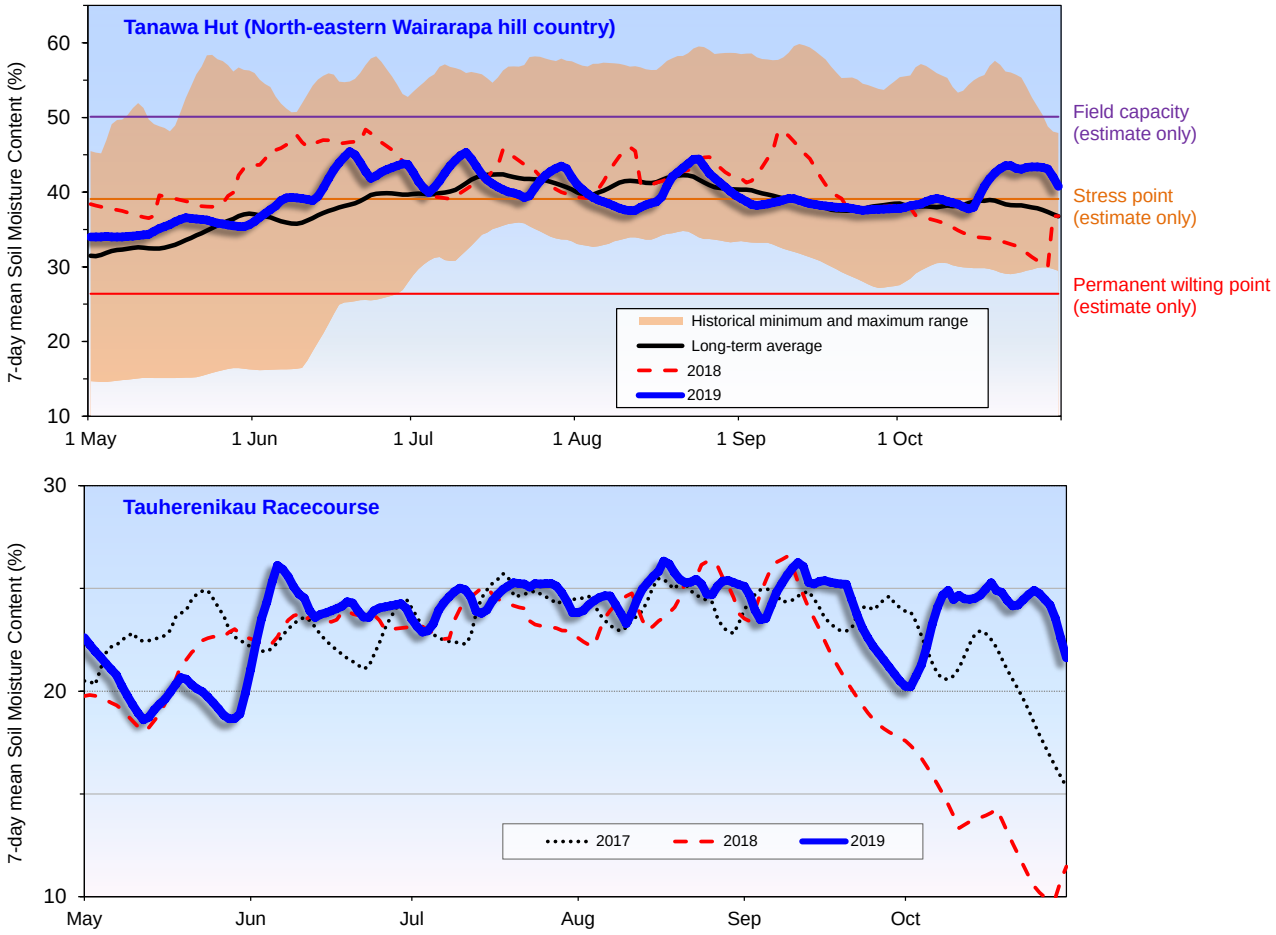
Soil moisture content

Wairarapa Coast

May to October 2019 soil moisture content at monitoring sites at Tanawa Hut in north-east Wairarapa (Wairarapa Coast whaitua) and Tauherenikau racecourse (Ruamāhanga whaitua) are plotted below.

Soil moisture at Tanawa Hutt has tracked closely to the long-term average for much of the period.



Drought monitoring

GWRC maintains a drought check webpage with regional anomaly maps and links to live data across the region:

http://www.gwrc.govt.nz/drought-check/

Climate Briefings

Additionally to the extended water resources reports, the Environmental Science department, GWRC, also produces seasonal updates specifically targeting the farming community. Those can be accessed from the main Climate and Water Resource webpage:

http://www.gw.govt.nz/seasonal-climate-and-water-resource-summaries-2/

Environmental data

GWRC maintains a comprehensive online environmental data server feeding real time, live data across the region for several climatic and hydrological variables

http://graphs.gw.govt.nz

Interactive Climate Change Mapping

The Environmental Science department at GWRC has produced one of the first comprehensive climate change mapping tools publicly available in New Zealand. The online mapping tool is fully interactive and easy to understand, allowing users to plot over twenty different variables, projected over every available IPCC scenario for both mid and late century

https://mapping1.gw.govt.nz/gw/ClimateChange/

Sea level Rise Mapper (New)

The Environmental Science department at GWRC is also making available a comprehensive sea level rise (SLR) mapper for the whole region. The tool allows users to have a view of sea level rise impacts, for values between zero and 5m SLR, including the effects of storm surge for selected heights. We encourage community and stakeholders to use this tool as a first screening of likely impacts that the region will be dealing with, as sea levels continue to rise.

https://mapping1.gw.govt.nz/GW/SLR/

The Greater Wellington Regional Council's purpose is to enrich life in the Wellington Region by building resilient, connected and prosperous communities, protecting and enhancing our natural assets, and inspiring pride in what makes us unique

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