greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Climate and Water Resources Summary for the Wellington Region

Cold Season (May to October) 2016

Release date: November 2016

Contents

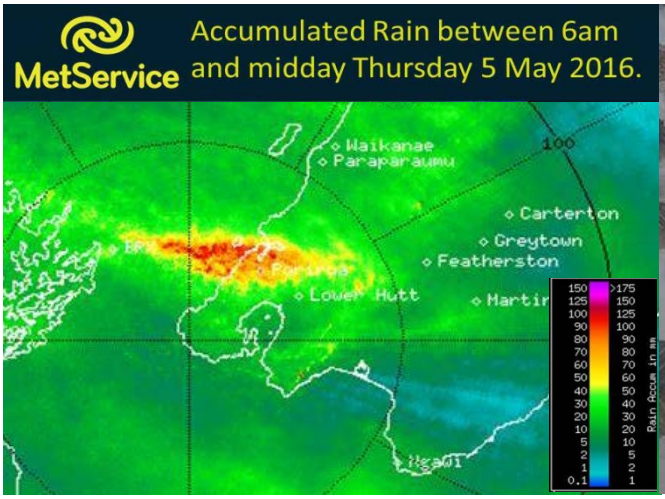


Image from MetService showing the very intense rainfall that fell over Porirua in a 6-hour period.
Image: MetService

Surface flooding on Warspite Ave in Cannons Creek/Waitangirua
Photo: Ayla Parker

Torrential rain wreaked havoc across Porirua on the morning of 5th May 2016. Areas of flooding occurred in Titahi Bay, Elsdon, the CBD, Waitangirua and Cannons Creek as the deluge occurred after a prolonged period of dry weather and stormwater drains struggled to cope with the very intense rainfall and other factors such as autumn leaves.

A number of roads were submerged and schools closed across the city. The Fire Service was kept busy attending over 50 callouts between 9am and midday.

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: November 2016

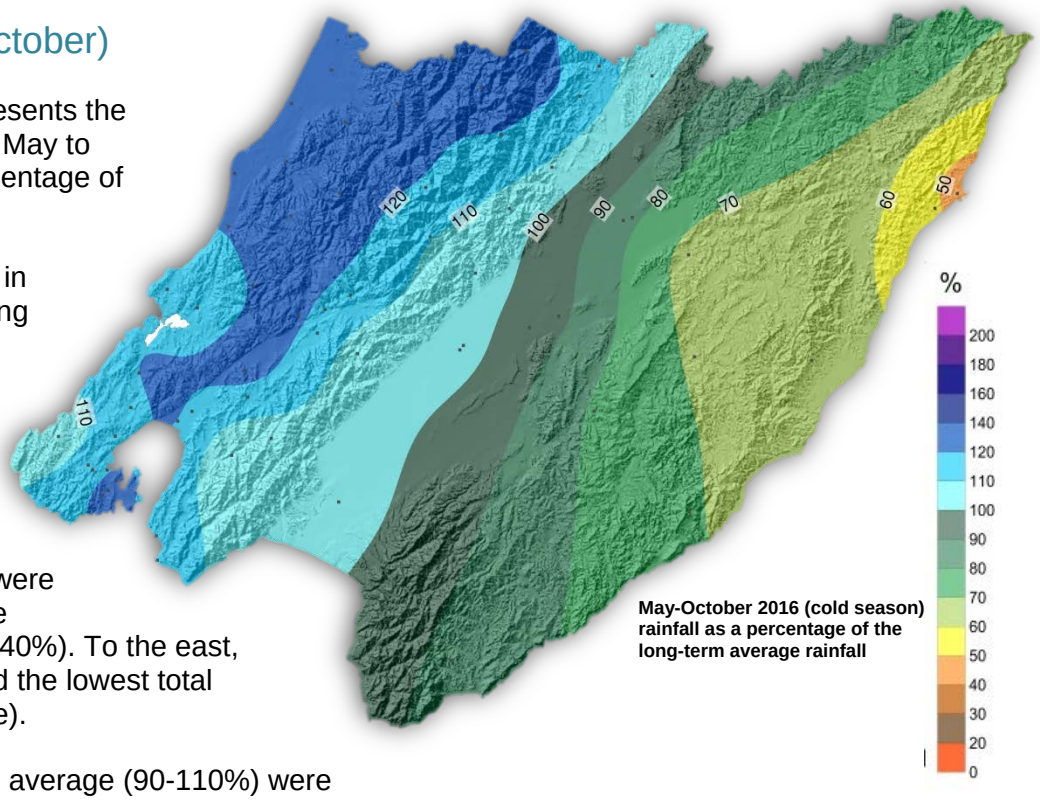
The cold season from May to October 2016 was drier than average in the east and wetter than average in the west. The northern part of the Wairarapa eastern hill area was the driest during this period.

Rainfall (May to October)

The map to the right presents the rainfall recorded during May to October 2016 as a percentage of the long term average.

There is a clear pattern in the rainfall anomaly going from above average rainfall in western areas to below average rainfall in the east.

Areas with the highest above average rainfall were the Kapiti Coast and the Tararua Range (up to 140%). To the east, Castlepoint experienced the lowest total (around 40% of average).



Recorded rainfall shows there was a west to east gradient of decreasing rainfall when compared to normal.

Rainfall totals about the average (90-110%) were experienced around the eastern foothills of the Tararua and Rimutaka ranges and into parts of the Ruamahanga valley.

The pattern is a result of the number of north-westerly weather systems that brought rain to the region – with much of it falling on the western side and lesser amounts making it over the ranges and into the Wairarapa.

Separate rainfall maps for each month are shown on the next page.

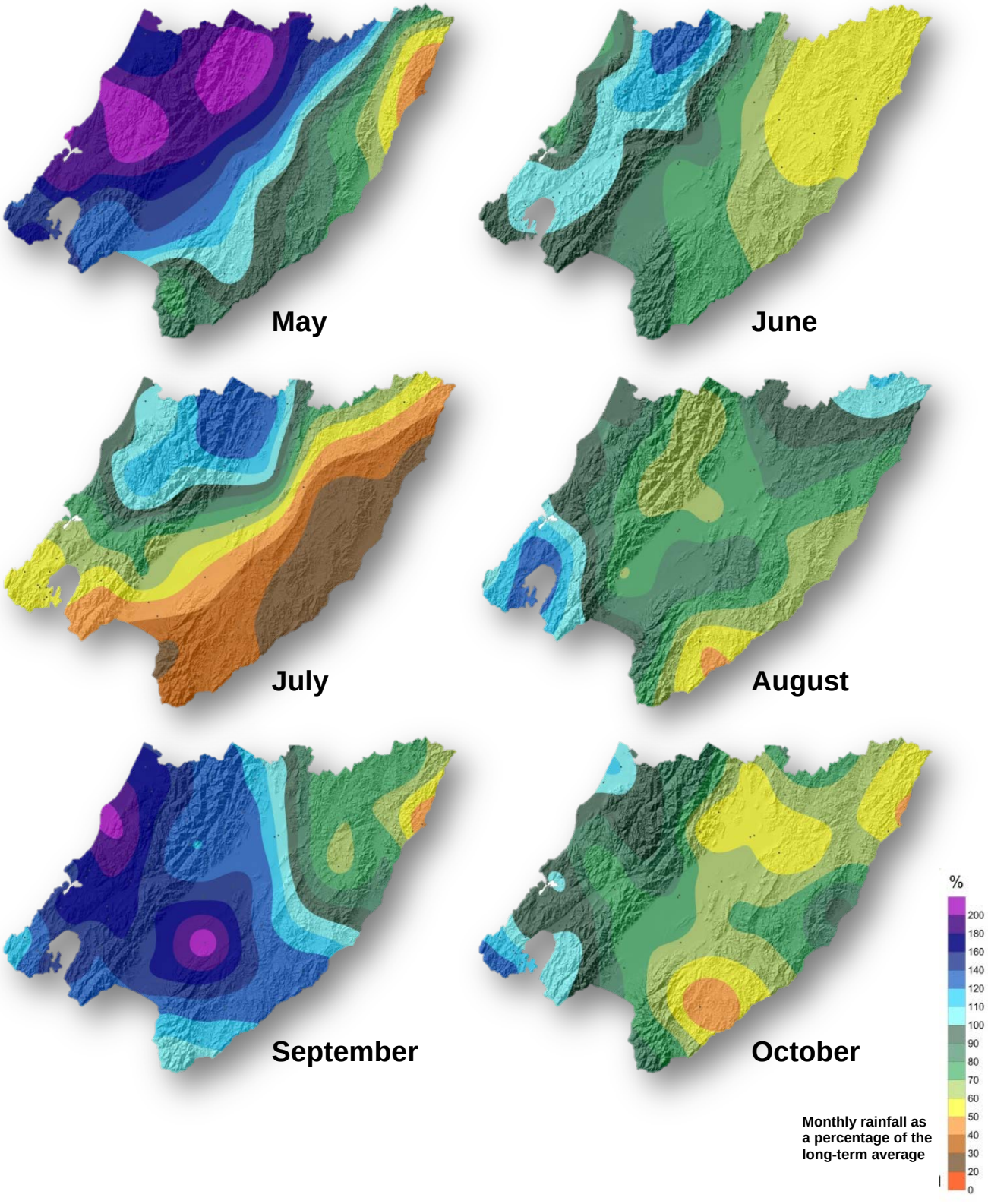
Another way to consider the weather is to look at the number of days that it rained. If more than 1mm of rain is recorded in a day this is called a 'Rain Day' and if there is more than 25mm this is termed a 'Heavy Rain Day'. The table below shows that most areas were near the average with the main exception being the Eastern Wairarapa where there were 15 fewer rain days (>1mm) compared to the long-term average.

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

	Kapiti Coast		Porirua	Hutt Valley & Wellington		Ruamahanga		Eastern Wairarapa
	Lowland	Hills	Lowland	Lowland	Hills	Lowland	Hills	
Rain Days (>1mm)	77 [71]	111 [103]	72 [66]	75 [69]	97 [95]	69 [67]	112 [114]	67 [82]
Heavy Rain Days(>25mm)	5 [4]	33 [24]	7 [5]	8 [6]	16 [13]	2 [3]	42 [34]	3 [4]

Rainfall by the month

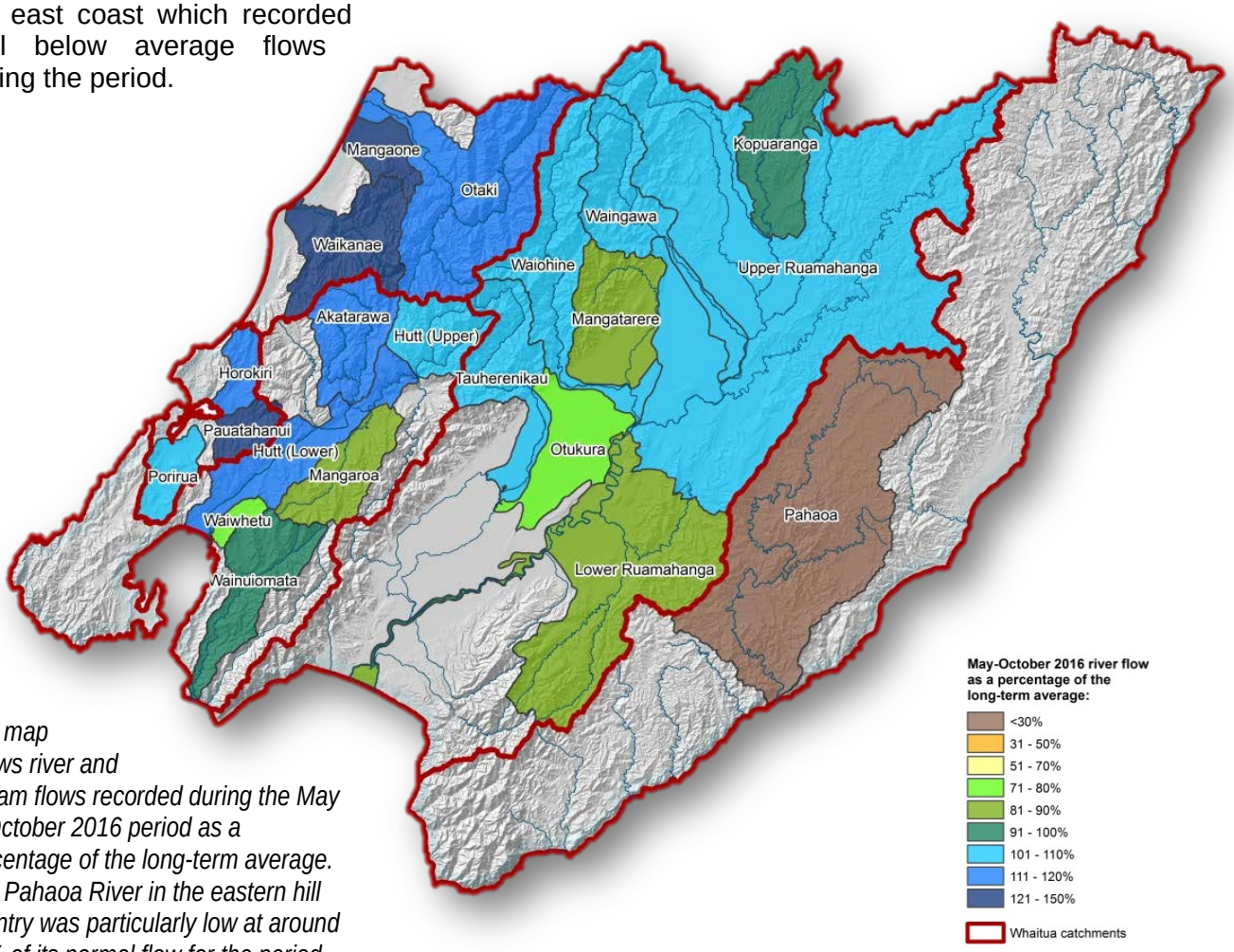
The maps below show the percentage of average rainfall for each month of the May to October 2016 cold season. Western and southern areas were relatively wet in May and September while July was characterised by very dry conditions through the Wairarapa and on the east coast.



River flows

The map below shows the mean recorded river and stream flows, between May and October, for various monitored catchments as a percentage of average flow.

The majority of monitored catchment areas across the region experienced above average flows in the May to October period. A notable exception was the Pahaoa River on the east coast which recorded well below average flows during the period.



The map shows river and stream flows recorded during the May to October 2016 period as a percentage of the long-term average. The Pahaoa River in the eastern hill country was particularly low at around 30% of its normal flow for the period.

Deluge – 5th May

A short but very intense period of rainfall occurred over Porirua city on 5th May. While rain fell over all of Wellington, Hutt Valley and Kapiti – the most intense band crossed over Porirua between Titahi Bay and the eastern suburbs of Cannons Creek and Waitangirua.

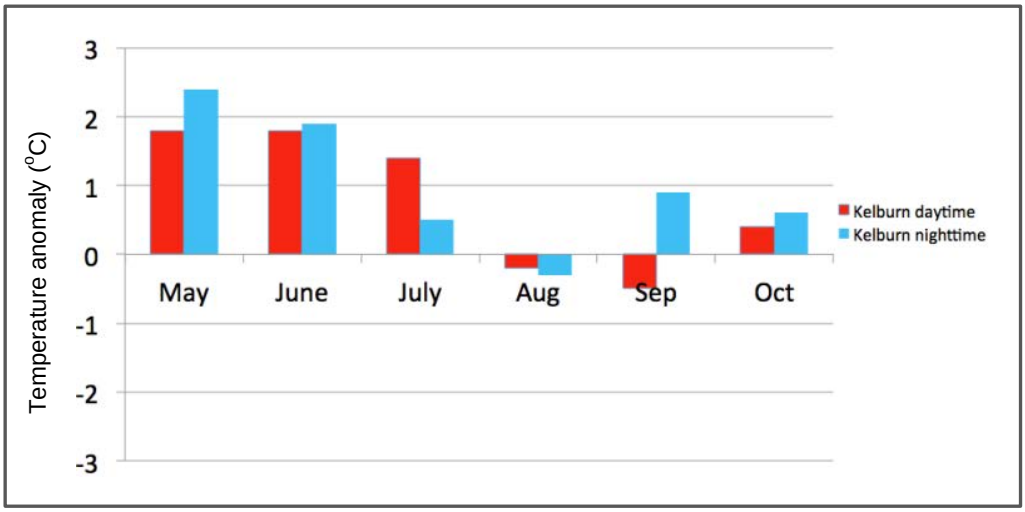
GWRC rainfall monitoring sites at Tawa, Whenua Tapu and Battle Hill noted moderate rainfall but the most intense rainfall occurred between these locations.

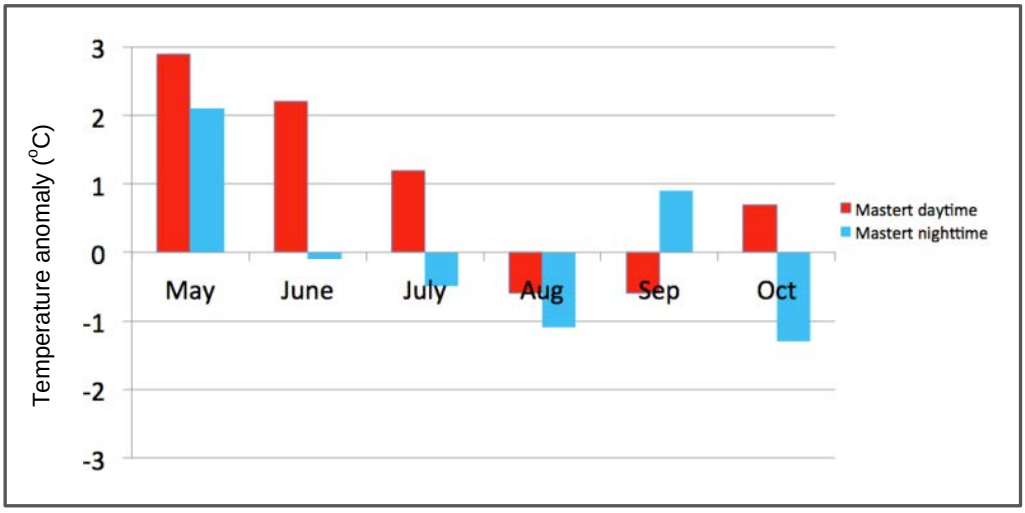
Wellington Water Ltd, as part of a catchment investigation, had access to temporary rain gauges installed in the Cannons Creek and Waitangirua areas – right in the centre of the storm. Very intense rainfall totals of 33mm over 30 minutes, 47mm over 1 hour, and 73mm over 2 hours were recorded.

Air temperatures

Air temperature is measured at a number of meteorological monitoring sites across the region. It is useful to look at patterns in seasonal anomalies (i.e., differences from normal) in average extremes of temperature (i.e. daytime maximum and night time minimum) across the region to help interpret how dominant and widespread the climate anomalies have been.

The graphs below show the evolution of the daytime maximum and night time minimum temperature anomalies for Kelburn (upper panel) and Masterton (lower panel). The graphs show that the first half of the period was much warmer than average, more so for daytime temperatures in the Wairarapa and for both daytime and night time temperatures in Wellington. The second half saw a combination of above average and below average temperatures, with some cold night time averages in the Wairarapa.





Average daytime and night time temperature anomalies for Kelburn (top) and Masterton (bottom) for the cold season period. Much warmer than average temperatures were seen during the first half of the period, and more normal temperatures during the second half.

SOURCE: Data from MetService meteorological stations.

Global climate drivers

Climate variability and climate change

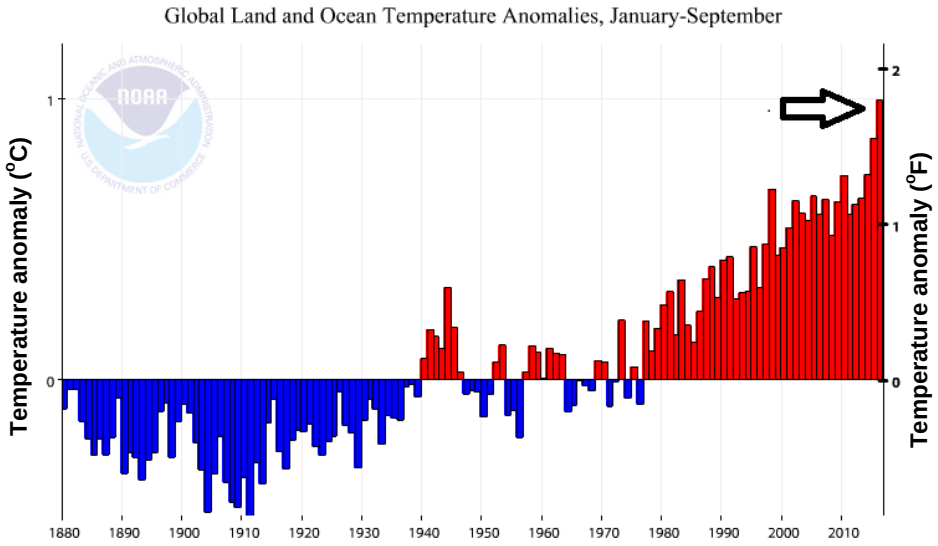
People often ask if the variable weather patterns in our region are a result of climate change. While natural climate variability has always been quite pronounced in our region, weather extremes are expected to get worse as a result of human-induced climate change and "global warming" caused by greenhouse 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 2016:

- The period started with record mild temperatures (late autumn and early winter) and progressed closer to normal conditions towards the end in the Wellington region.
- Globally, the year to date (as of 30th September) has been the hottest on record by a sizable margin (see below), with the last three years being the three hottest years ever measured.
- The oceanic water temperatures were very much above average around New Zealand in May. The warmer than average waters spread to the south and dissipated somewhat towards the end of the period, while in the Equatorial Pacific weak La Niña-like conditions developed (Sea surface temperature anomalies shown below)
- A large low pressure anomaly between Australia and New Zealand contributed to a slight increase in the north-westerly winds (see figure at bottom of next page), creating conditions for more frequent storms in the west and warmer than average temperatures overall
- The effects of climate change are already being felt in our region as they are superimposed onto natural climate fluctuations.

Global Land and Ocean temperature anomalies for the year to date finishing 30th September 2016.

Source: NOAA (USA).

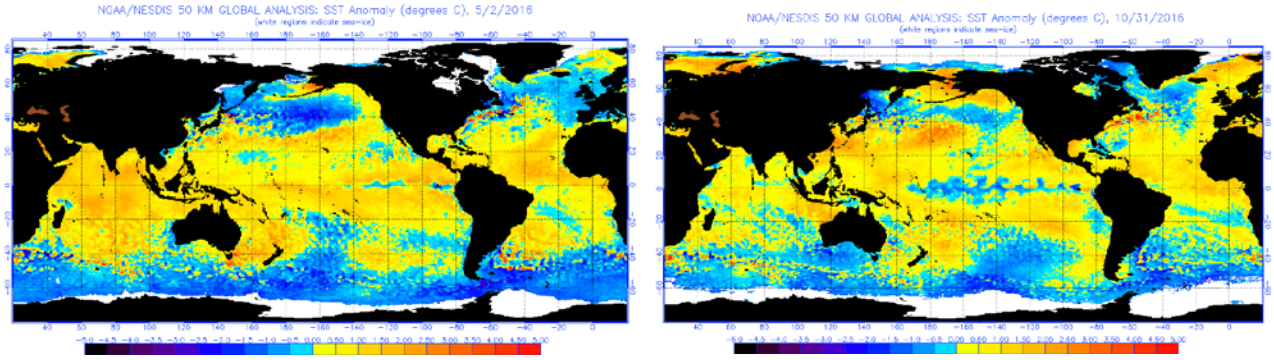


The arrow shows that 2016 is shaping up to be the hottest year on record, followed by 2015 and 2014. The temperature anomalies are calculated in respect to the 20th century average, showing a global anomaly of about 1°C.

Note degrees Celsius (°C) indicated on the left hand scale and degrees Fahrenheit (°F) on the right hand scale.

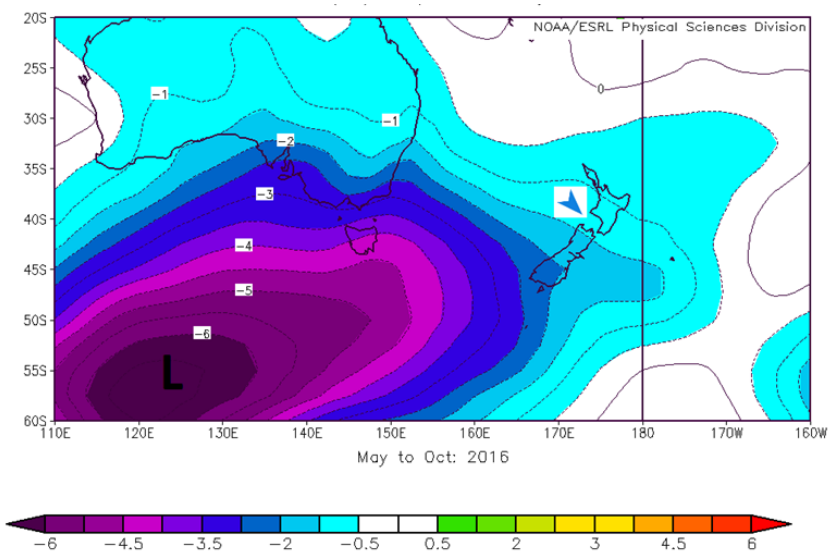
Global climate drivers and extreme weather events

Climate drivers are global mechanisms that can influence the weather in our region. The El Niño/Southern Oscillation[1] (ENSO) phenomenon was transitioning to neutral during the beginning of the cold season (left hand side panel below) and acquired a weak La Niña signature towards the end of the period, as seen by the colder than average water band in the Equatorial Pacific (right hand side panel below).



Sea surface temperature anomalies on 2nd May 2016 (left) and 31st Oct 2016 (right). A strong warming around New Zealand has expanded to the south and decreased in intensity, explaining the closer to average air temperature behaviour during Spring. In the Equatorial Pacific the evolution of a weak La Niña-like signature can also be observed on the right panel. The sea ice around Antarctica (white) expanded towards the end of the cold season, but is less pronounced than normal in the New Zealand sector. Source: NOAA/USA.

With the ENSO phenomenon being near neutral, the seal level pressure anomalies (shown below) and the regional sea surface temperatures around New Zealand were largely responsible for the warmer than average temperatures and the rainfall contrast of wet conditions in the west and dry conditions in the east. In the figure below, the vigorous low pressure anomaly to the south of Australia (indicated with an L) helped bring north-westerly storms (indicated by the arrow) and warmer air into New Zealand.



Mean sea level pressure anomaly between May and October 2016.

A strong low pressure anomaly between Australia and New Zealand (indicated by L) contributed to increased north-westerly winds (as shown by the arrow), with more storms in the west and warmer than average temperatures during most of the cold season.

Source: NOAA (USA).

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

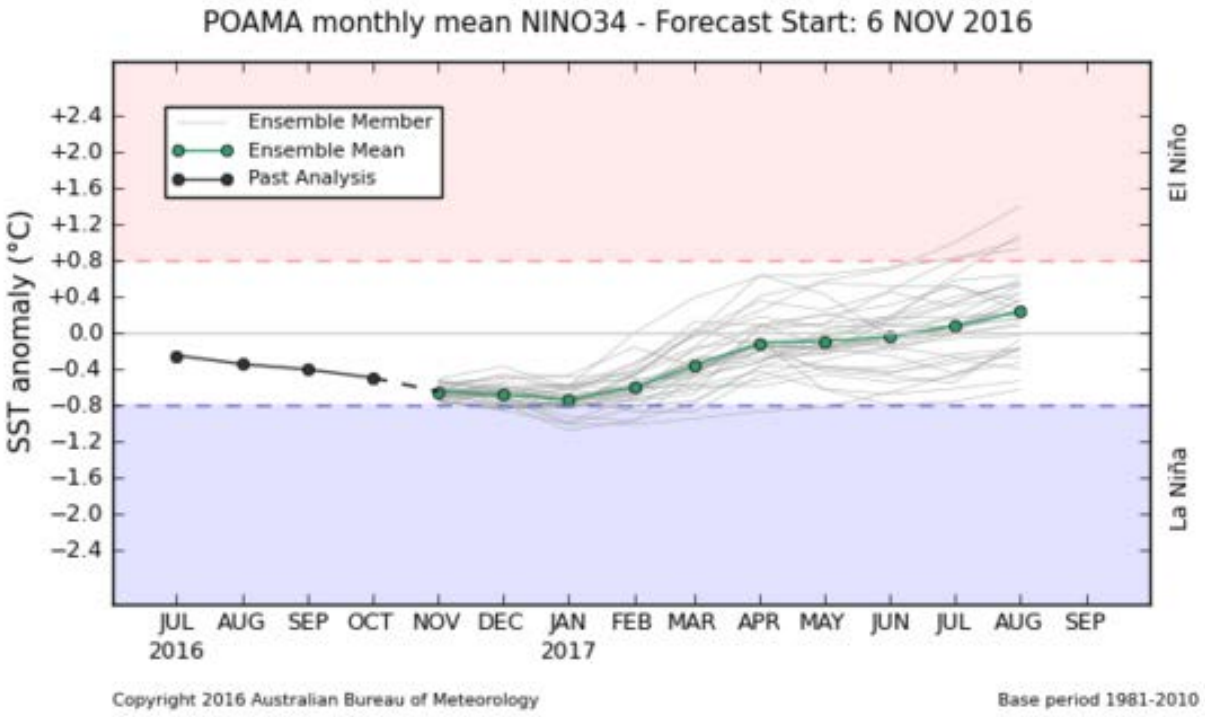
Seasonal climate outlook update

The ENSO is expected to remain borderline between neutral and La Niña for the remainder of 2016 and early 2017 (see below), with a possible short-lived La Niña developing.

However, even if La Niña does not eventuate we will likely experience some effects often associated with it such as prolonged dry periods, blocking systems and occasional easterly storms.

As of November the rainfall has been quite consistent, with a remarkable recovery of soil moisture levels for most of the Wairarapa. Given the forecast for between neutral and La Niña conditions, we anticipate normal rainfall into summer, although with an irregular distribution with fairly long dry and hot periods interrupted by heavy easterly rainfall events typically observed during La Niña summers.

A complete climate outlook will be released by mid-December 2016.



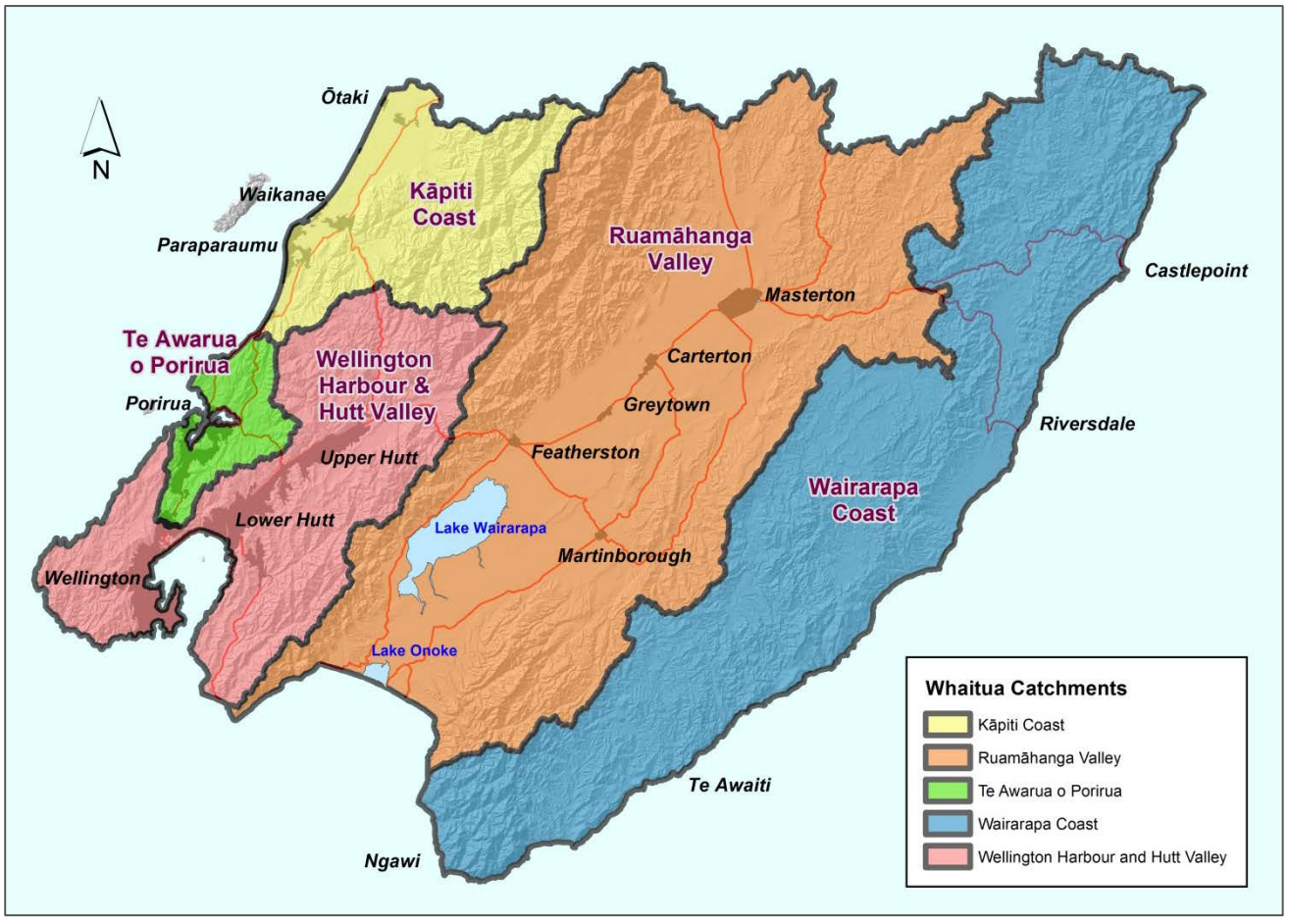
ENSO predictions as of 6 Nov 2016, showing borderline conditions between La Niña and neutral phase for the next few months and then returning to normal into 2017. *Source: BOM (Australia)*

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 May to October 2016 summaries for:

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

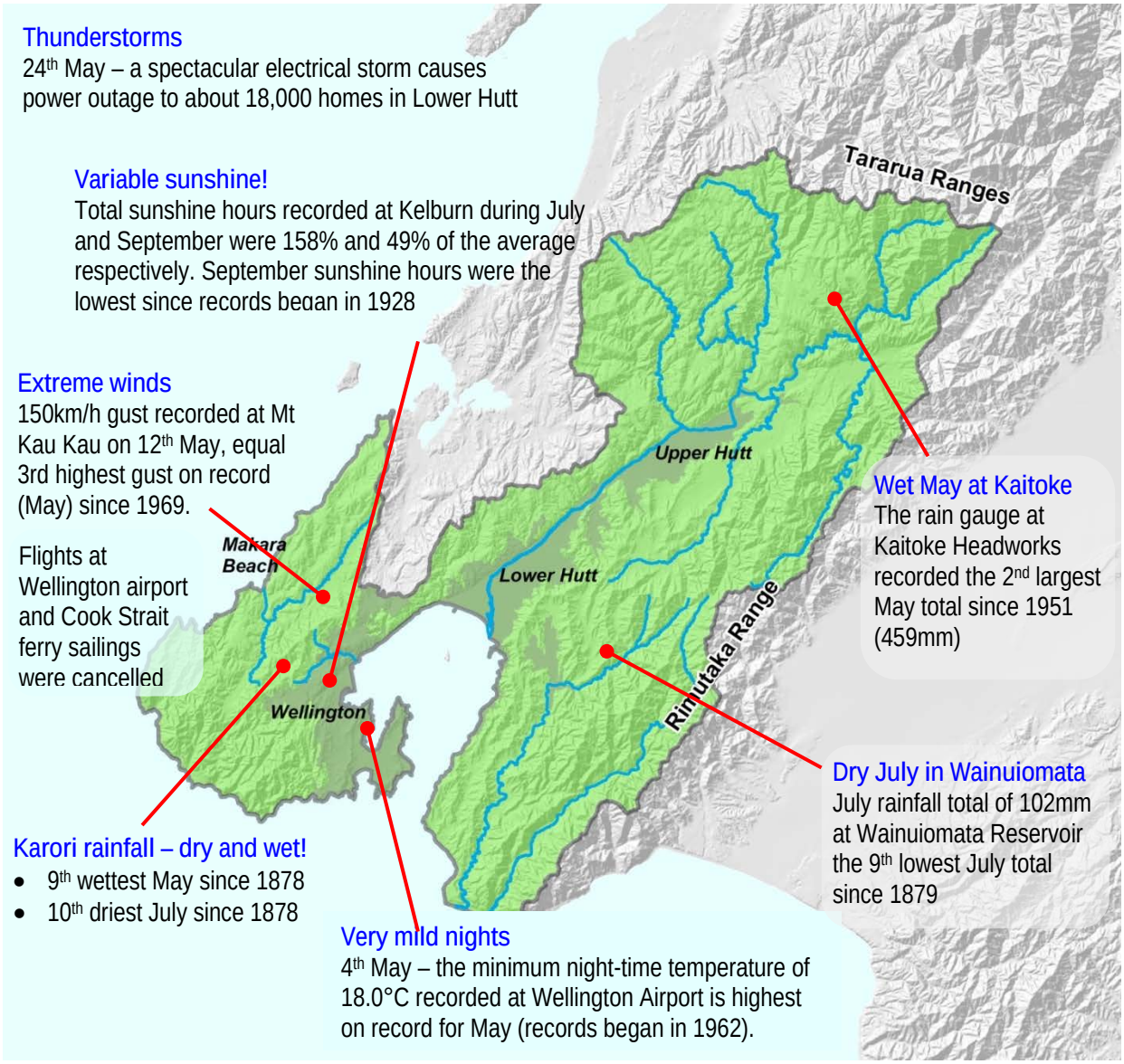


Map of the five whaitua catchment areas in the Wellington region. Each whaitua roughly coincides with a climatic zone, expressing the marked east-to-west contrast that we experience in our region.

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

Wellington Harbour and Hutt Valley climate summary

- **Warmer than average**
- Very high rain totals during May
- Relatively low rainfall during July
- Some notable winds gusts, and record high night time temperatures.



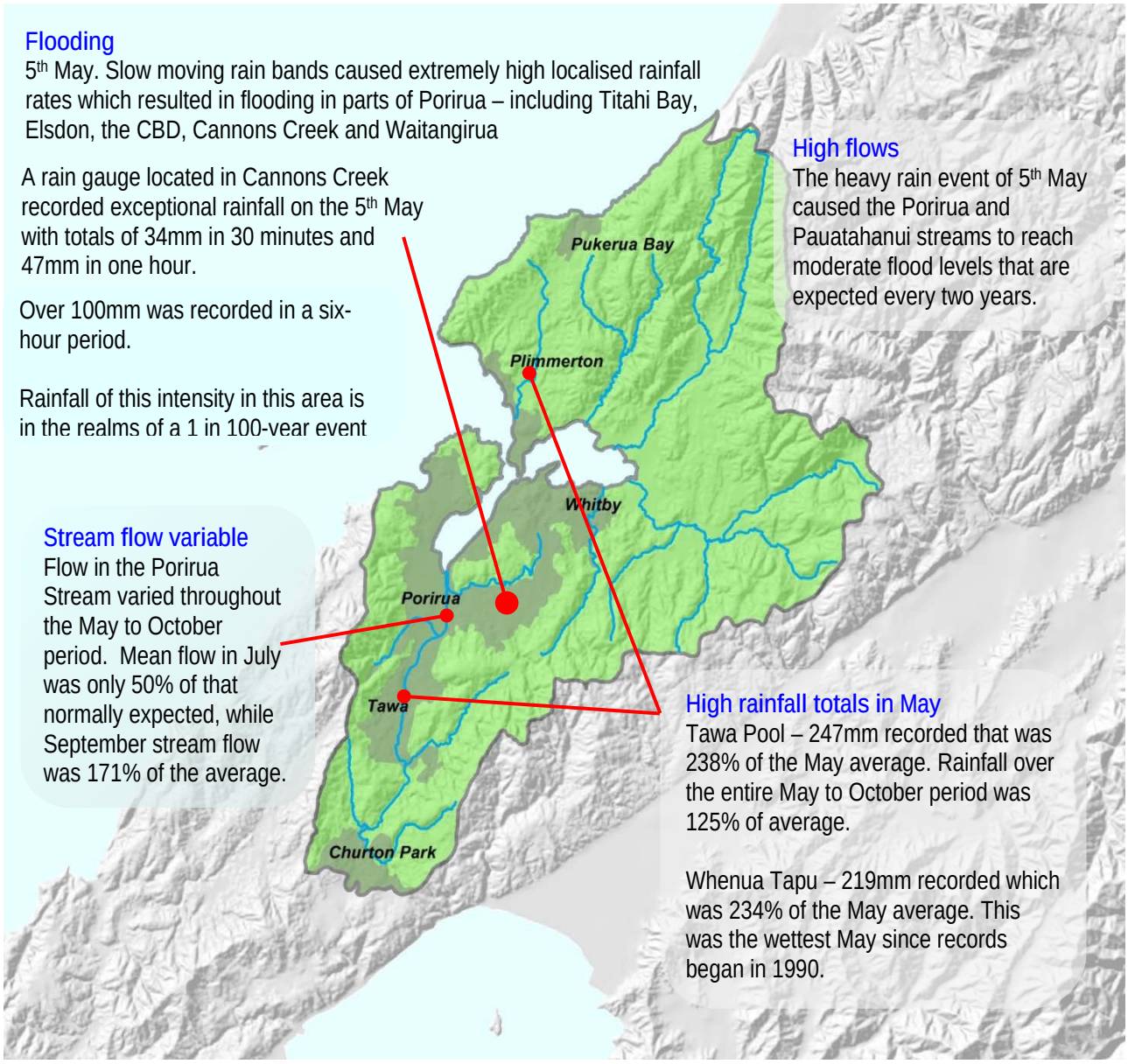
Want to look at the summary tables and graphs?

Rainfall

River flows

Te Awarua-o-Porirua climate summary

- **Warmer than average**
- **A number of heavy rainfall events with 5th May notable for very intense rainfall and associated flooding**



Want to look at the summary tables and graphs?

Rainfall

River flows

Kāpiti Coast climate summary

- **Warmer than average**
- **May and September very wet across the coastal plains areas**
- **Very high sunshine hours for winter months at Paraparaumu**

Two very wet months

May and September brought well above average rainfall totals to the Kapiti Coast.

- May: Otaki 192%
  Waikanae 191%
  McKay's Crossing 180%
- September: Otaki 192%
  Waikanae 191%
  McKay's Crossing 180%

Sunny winter

Throughout the winter months Paraparaumu received 123% of the normal sunshine hours. This is the 3rd highest winter total since records began in 1953.

Coastal erosion

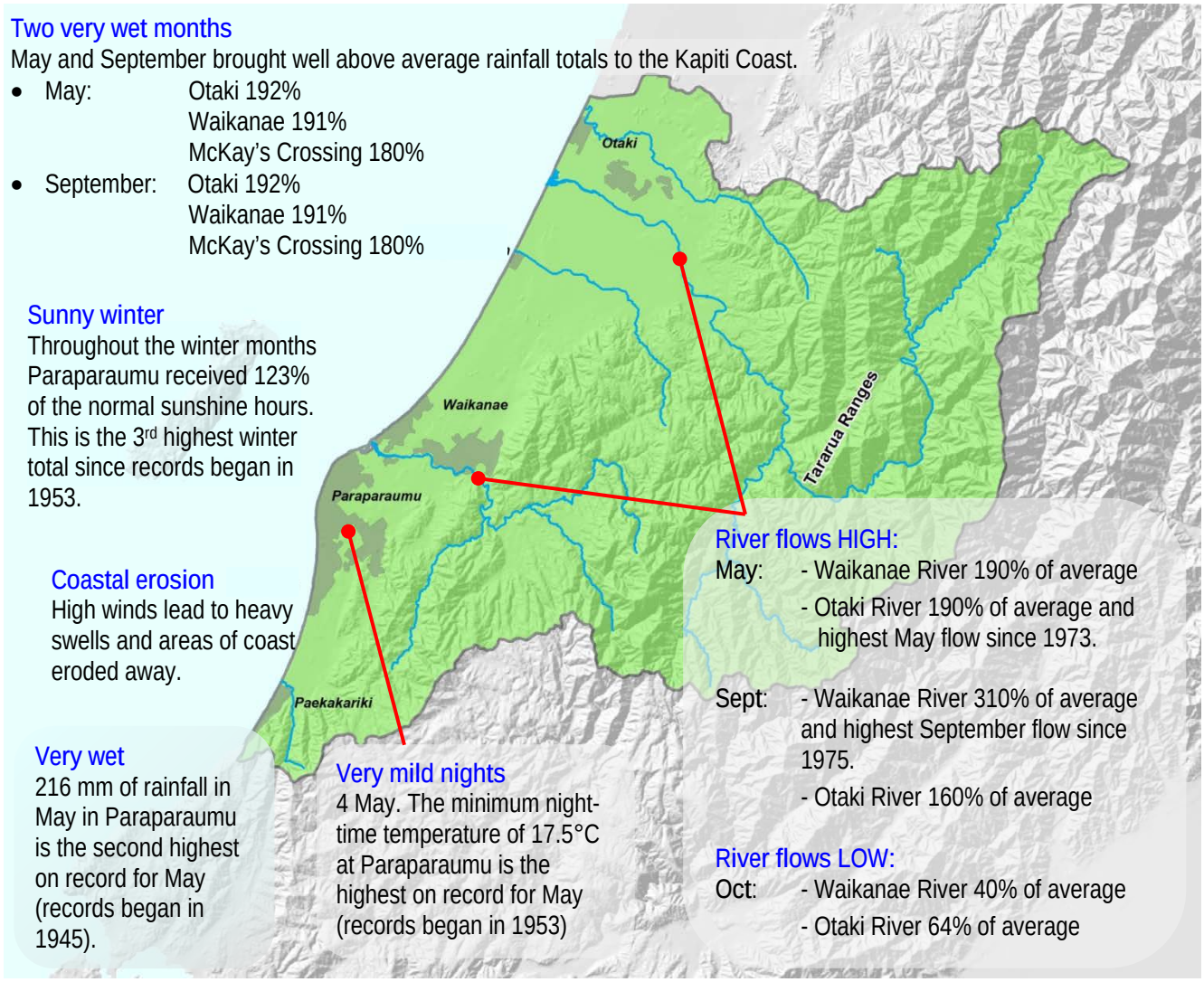
High winds lead to heavy swells and areas of coast eroded away.

Very wet

216 mm of rainfall in May in Paraparaumu is the second highest on record for May (records began in 1945).

Very mild nights

4 May. The minimum night-time temperature of 17.5°C at Paraparaumu is the highest on record for May (records began in 1953)



River flows HIGH:

May: - Waikanae River 190% of average
- Otaki River 190% of average and highest May flow since 1973.

Sept: - Waikanae River 310% of average and highest September flow since 1975.
- Otaki River 160% of average

River flows LOW:

Oct: - Waikanae River 40% of average
- Otaki River 64% of average

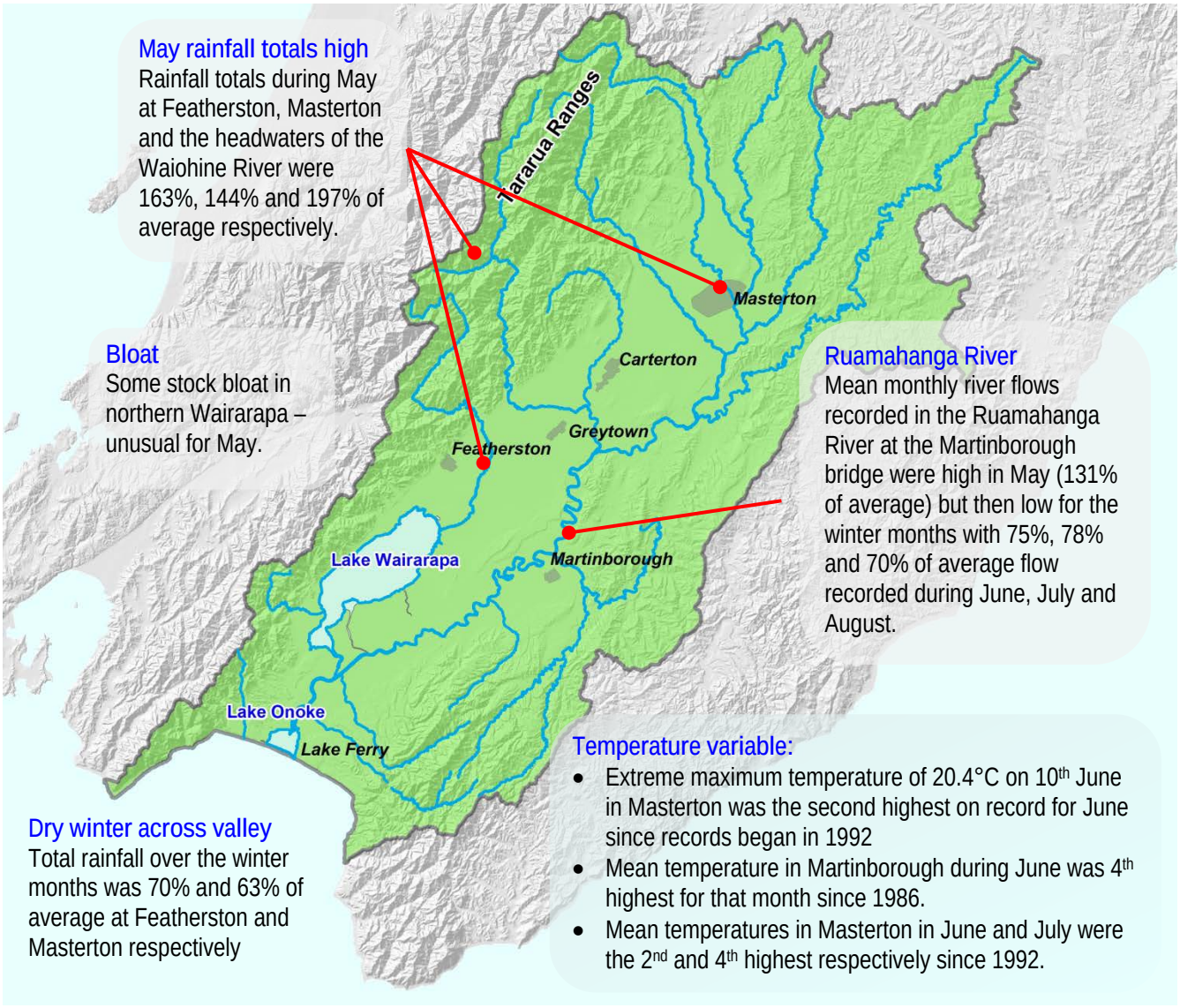
Want to look at the summary tables and graphs?

Rainfall

River flows

Ruamāhanga Valley climate summary

- **Warmest on record**
- Drier than average



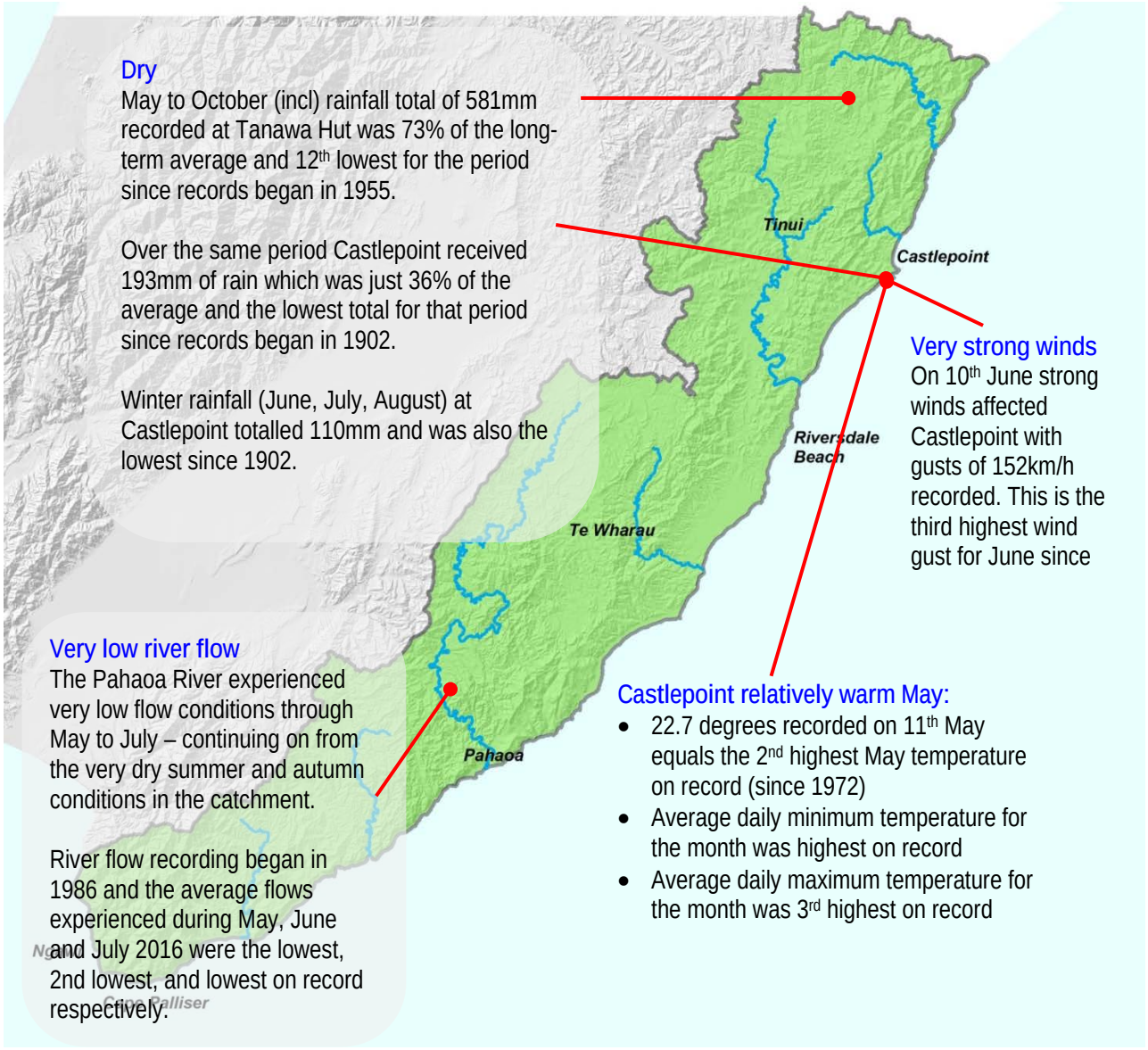
Want to look at the summary tables and graphs?

Rainfall

River flows

Wairarapa Coast climate summary

- **Warmer than average**
- **Much drier than average**
- Some notable wind gusts and overall hot days and warm nights
- Pahaoa River flows very low compared to average conditions



Want to look at the summary tables and graphs?

Rainfall

Soil moisture

Rainfall statistics

Rainfall tended to be around average to above average for the western side of the region and below average in the Wairarapa and east coast areas.

May was a very wet month at most sites except for those on the Wairarapa Coast.

Whaitua	Location	May %	Jun %	Jul %	Aug %	Sept %	Oct %	May-Oct (mm)	May-Oct (%)
Wellington Harbour & Hutt Valley Click to see cumulative rainfall plots	Kaitoke	216	85	111	69	139	95	1543	116
	Lower Hutt	200	103	62	125	154	81	850	116
	Wainuiomata	108	103	44	97	123	110	1124	95
	Karori	185	114	49	120	138	125	860	119
	Wellington	227	122	60	149	161	71	768	139
Te Awarua-o-Porirua Click to see cumulative rainfall plots	Battle Hill	153	62	58	91	170	102	806	103
	Whenua Tapu	234	79	88	102	143	96	722	120
	Tawa	238	119	61	129	182	84	841	125
Kāpiti Coast Click to see cumulative rainfall plots	Otaki	192	83	109	113	176	127	730	134
	Waikanae	191	99	86	89	180	84	848	120
	Paekakariki	180	69	58	82	178	84	743	101
	Tararua	213	117	113	72	131	94	3445	123
Ruamāhanga Click to see cumulative rainfall plots	Masterton	144	63	56	73	110	69	434	79
	Featherston	163	65	73	72	122	89	584	96
	Longbush	96	69	32	101	119	76	436	78
	Tararua	197	118	114	58	113	91	3043	112
Wairarapa Coast Click to see cumulative rainfall plots	Tanawa Hut	55	74	56	112	86	60	581	73
	Stoney Creek	111	77	39	44	123	29	569	66
	Ngaumu	73	49	16	73	57	52	352	51

Click the following links to return to climate summaries for:

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

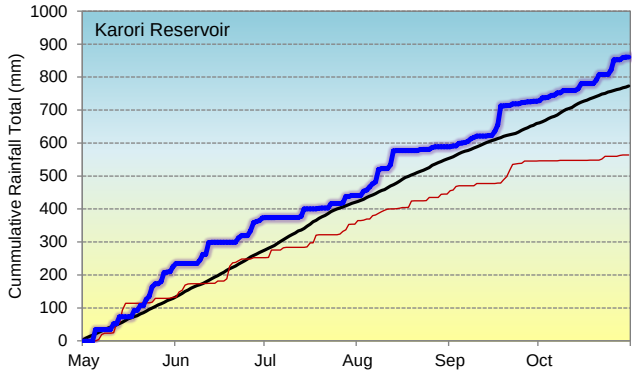
Cumulative rainfall plots

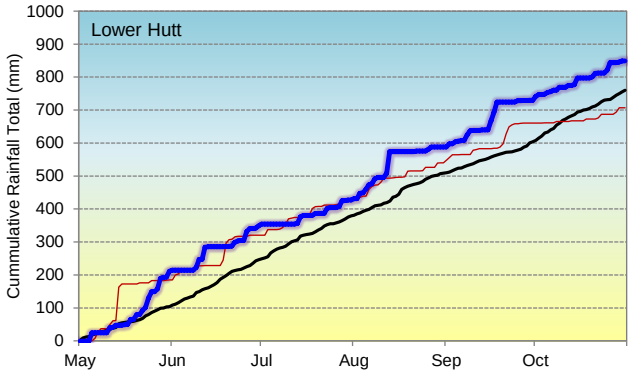
Wellington and Hutt Valley

Cumulative rainfall totals for the May to October period; 2016 (blue line), 2015 (red line) and long-term average (black line).

The plots highlight that the rainfall accumulation during 2016 has been above average at both the Karori and Lower Hutt rain gauge sites. The rainfall at Karori from May to October 2016 period was 90mm (11%) above the average and 300mm greater than the same period in 2015.

Rainfall in Lower Hutt during May to October 2015 was 140mm greater than the same period in 2015 and 90mm (12%) above the average.



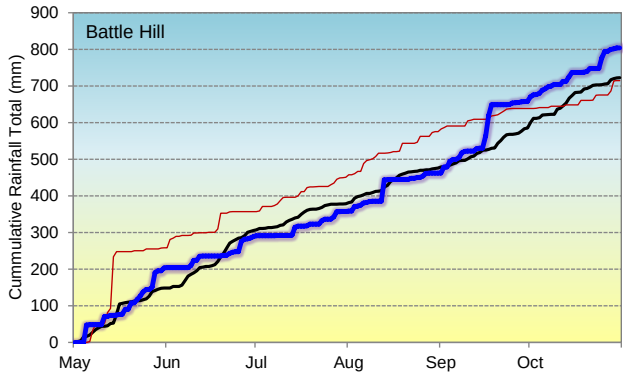


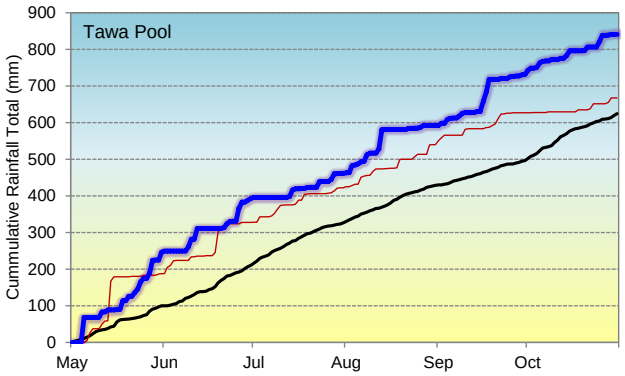
Porirua Harbour

Cumulative rainfall totals for the May to October period; 2016 (blue line), 2015 (red line) and long-term average (black line).

The plots highlight differing rainfall accumulation trends in the current 2016 year at the two sites within the Te Awarua-o-Porirua whaitua area. Rainfall at Battle Hill accumulated at near to the average rate until around mid-September and ended up 80mm greater than the average.

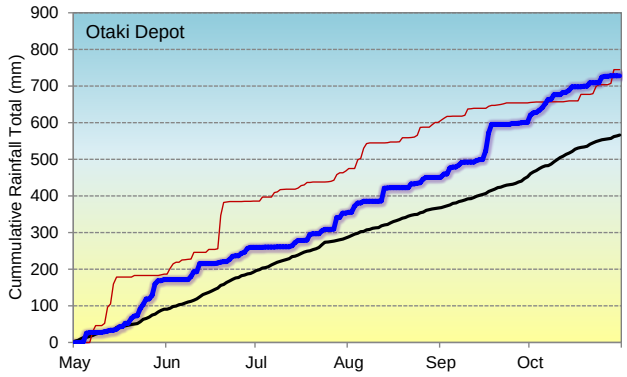
Rainfall at Tawa Pool however, accumulated at a rate well above average in May and June 2016 and ended the period with a total about 220mm greater than the average.

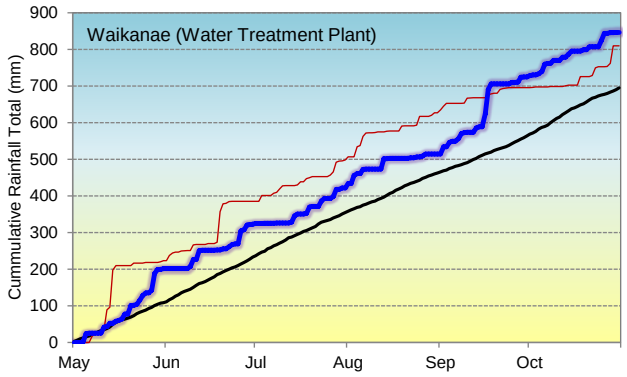




Kapiti Coast

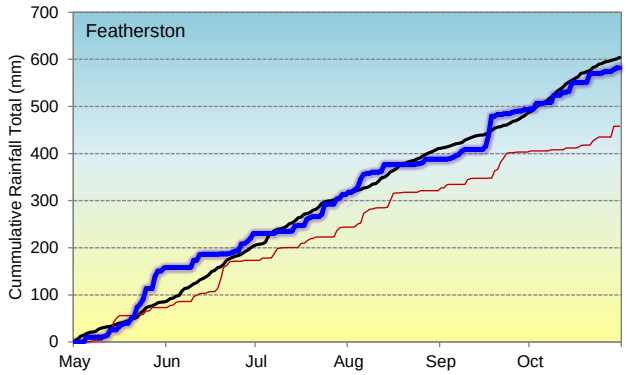
Cumulative rainfall totals for the May to October period; 2016 (blue line), 2015 (red line) and long-term average (black line). Rainfall recorded at Otaki and Waikanae shows two large jumps in 2016 rainfall accumulation in late May and mid-September. Both sites ended around 150mm (about 25%) greater than the average May to October accumulation.

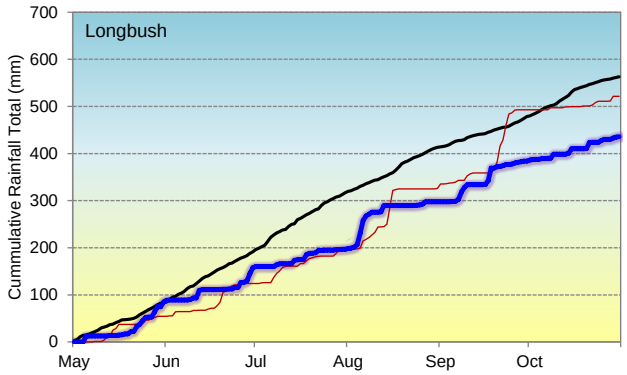




Ruamahanga

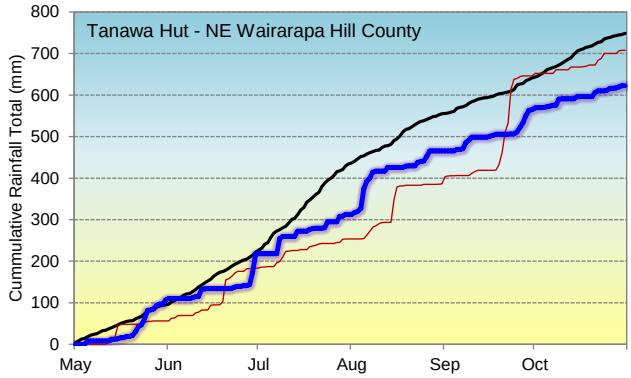
Cumulative rainfall totals for the May to October period; 2016 (blue line), 2015 (red line) and long-term average (black line). Rainfall in the lower Ruamahanga valley (Featherston) tracking pretty much around the average for the entire May to October period. Rainfall accumulation at Longbush trended lower than normal and ended 130mm (23%) lower than average.





Wairarapa Coast

Cumulative rainfall totals for the May to October period; 2016 (blue line), 2015 (red line) and long-term average (black line). The rainfall accumulation at Tanawa Hut from May to October has trended at a below average rate and ended 125mm (17%) below the average..



River flows - averages

Percentage of average river flow for each month and whole of the May to October 2016 period.

Flows across the region have been largely around average to above average over the cold season for catchments in the western part of the region and average to below average for eastern parts.

		Flow as a percentage of average						
Whaitua	River	May	Jun	Jul	Aug	Sep	Oct	May-Oct
Wellington Harbour & Hutt Valley	Hutt River - Kaitoke	167	113	99	84	142	69	109
	Hutt River - Taita Gorge	159	118	86	90	196	60	112
	Akatarawa River	164	120	91	92	213	48	114
	Mangaroa River	96	102	60	90	166	51	90
	Wainuiomata River	59	103	50	107	183	67	91
Te Awarua-o-Porirua	Porirua	122	104	50	129	171	90	107
	Pauatahanui	166	127	76	108	223	87	124
	Horokiri	126	93	66	101	264	90	117
Kāpiti Coast	Otaki	190	120	106	81	159	64	115
	Mangaone	149	115	99	107	267	71	127
	Waikanae	189	126	81	101	310	40	130
Ruamāhanga	Kopuaranga	128	56	108	108	114	47	92
	Waingawa	165	107	122	77	117	80	109
	Waiohine	169	106	106	75	125	75	107
	Mangatarere	173	66	96	80	118	43	90
	Ruamahanga	131	75	78	70	106	61	84
Wairarapa Coast	Pahaoa	3	8	6	41	43	50	23

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

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- Kāpiti Coast
- Ruamāhanga
- Wairarapa Coast

River flows - averages

Maximum river and stream flows recorded during the May to October 2016 period. The estimated return period is given for each event.

Whaitua	River	Maximum Flow		
		Flow (m^3/s)	**Date**	**Return Period (years)**
Wellington Harbour & Hutt Valley	Hutt (Kaitoke)	138	24 July	1
	Hutt(Taita Gorge)	457	17 September	1
	Akatarawa	148	17 September	1
	Mangaroa	34	18 September	1
	Wainuiomata	8.6	18 September	1
Te Awarua-o-Porirua	Porirua	35	13 August	2
	Pauatahanui	38	5 May	2
	Horokiri	17	17 September	1
Kāpiti Coast	Otaki	593	16 September	1
	Mangaone	9	17 September	1
	Waikanae	198	17 September	3.5
Ruamāhanga	Kopuaranga	24	6 August	1
	Waingawa	175	24 July	1
	Waiohine	476	16 September	1
	Mangatarere	21	17 September	1
	Tauherenikau	212	24 July	1
	Otukura	8	18 September	1
	Ruamahanga (Upper)	270	24 July	1
	Ruamahanga (Lower)	654	18 September	1
Wairarapa Coast	Pahaoa	49	6 August	1

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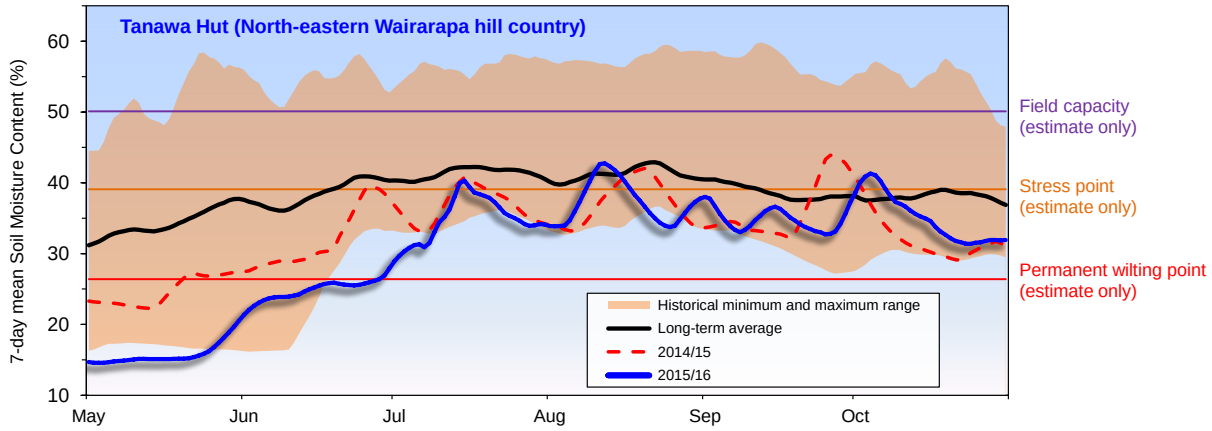
Soil moisture content

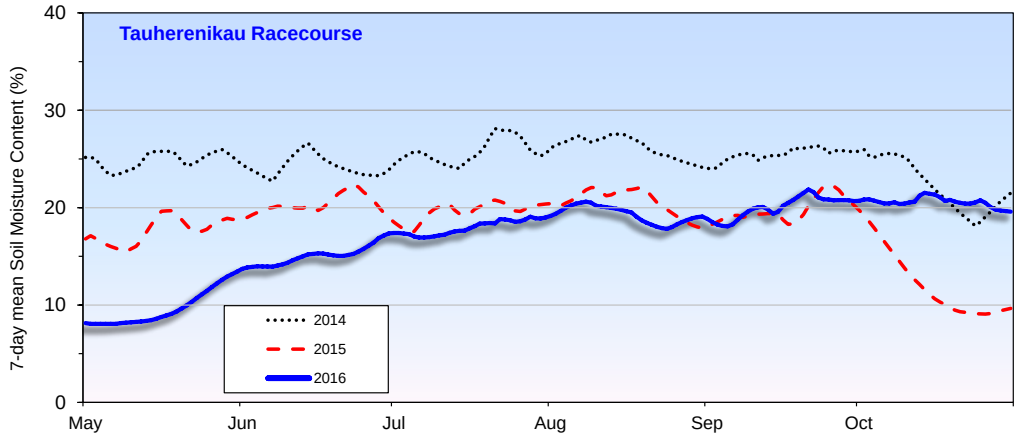
Wairarapa Coast

May to October 2016 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 was at low levels at Tanawa Hutt in May before recovering by about mid-July to sit around normal levels.

Levels at Tauherenikau started May very low and recovered slowly but steadily by the end of October to sit at levels similar to those experienced in 2014.





Drought monitoring

NIWA maintains a 'drought monitor' website that provides more information on soil moisture conditions (and other hydrological and climatic information relevant to drought assessment):

https://www.niwa.co.nz/climate/information-and-resources/drought

Climate Briefings

Additionally to the operational (seasonal) reports, the Environmental Science department, GWRC, produces monthly climate briefings specifically targeting the farming community in periods of significant climate anomalies such as an El Niño year. Those can be accessed at the bottom of the Climate and Water Resource webpage:

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

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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