



greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Hydrology State of the Environment monitoring programme

Annual data report 2012/13

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Contents

1.	Introduction	1
2.	Overview of the Hydrology SoE monitoring programme	2
2.1	Monitoring objectives	2
2.2	Monitoring network	2
2.2.1	Rainfall	2
2.2.2	River levels and flow	3
2.2.3	Lake levels	3
2.2.4	Wetland levels	4
2.2.5	Tide levels	4
2.2.6	Soil moisture	4
2.2.7	Groundwater levels	4
2.2.8	Changes to the network during 2012/13	5
3.	Rainfall	10
4.	River flows	18
5.	Groundwater levels	25
6.	Lake and wetland levels	27
7.	Soil moisture	29
	References	30

1. Introduction

Greater Wellington Regional Council (GWRC) operates a hydrometric network for measuring rainfall, river levels, lake levels, groundwater levels, tide levels and soil moisture.

This report contains the key results from the Hydrology State of Environment (SoE) monitoring programme for the period 1 July 2012 to 30 June 2013 inclusive. Summaries of the recorded data are compared to long term averages, and any significant hydrological events are also detailed.

The Hydrology SoE programme is solely concerned with collecting data on the 'quantity' of the region's water resources. GWRC operates other monitoring programmes which gather information on water quality and ecosystem health that are reported on separately.

2. Overview of the Hydrology SoE monitoring programme

Rainfall and river levels have been monitored for many years in the Wellington region. Some of the earliest records date back to 1878 for the Karori Reservoir and 1890 for the Wainuiomata Reservoir. Over the years the region's hydrometric network has evolved and grown and now comprises:

- 58 rainfall sites
- 62 river level/flow recording sites
- 6 lake level sites
- 5 wetland water level sites
- 2 tide level sites
- 4 soil moisture sites
- 67 groundwater level sites (plus a further 61 manually monitored sites).

All hydrological data is captured, processed and archived in accordance with national and international standards and quality assurance procedures. Telemetered rainfall, river, lake, groundwater and tide data is available at <http://graphs.gw.govt.nz/>.

2.1 Monitoring objectives

The information collected is used for:

- Council to make informed decisions on the state of the region's freshwater resources and manage its sustainable allocation and use
- Policy and Regional Plan development and review
- Providing information on the state of our water resources and the baseline quantity of water
- Detecting long and short term trends in climate and water resources
- Providing flood and drought warnings
- Resource consent monitoring.

2.2 Monitoring network

2.2.1 Rainfall

Figure 2.1 shows the distribution of the 58 rainfall sites. There is good coverage across the region with the exception of the Eastern Wairarapa hill country where the distribution of sites is relatively sparse.

All rainfall sites are automatic and typically record rainfall amounts at 5 minute intervals. The majority of sites are telemetered back to the GWRC database to allow for real time monitoring.

Two measuring devices are at each site; an automatic tipping-bucket rain gauge that records rainfall amounts in 5 minute intervals, and a check/storage gauge that collects and stores all rainfall between staff visits.

All rainfall and river sites have alarm levels that are automatically triggered if a high intensity of rainfall occurs or if river levels start to rise. Alarms are received by flood-warning staff and a flood event will be monitored at any time of the day with warnings to authorities and landowners issued if dangerous flood levels are predicted.

2.2.2 River levels and flow

River levels are recorded at 62 sites across the region. The distribution of these sites is shown in Figure 2.2 and is similar to the rainfall network.

Sites were originally installed for a number of reasons including flood warning, public water supply and water resource monitoring. As such the network tends to concentrate on the larger rivers and the upper parts of catchments. This has been changing over time as GWRC undertakes more monitoring in agricultural and urban areas and in the lower reaches of the catchments to manage abstractions, maintain minimum flows and ensure regional plan rules are being met.

All river sites are automatic and typically record river levels every 5 to 15 minutes. Data is stored on loggers at the site, as well as sent back to the GWRC database via telemetry to allow for real time monitoring.

GWRC staff also physically measure the amount of flow in rivers and streams by completing a 'flow gauging' using specialised equipment, and can measure from a trickle in a ditch to a major flood in the Ruamahanga River. The gauged flow and the water level at the time are used to build up a flow-rating relationship that is used to convert the continuously measured river water levels into flow values. The flow-rating relationships at each site change often due to events such as a flood which might alter the river bed level, therefore gaugings are undertaken regularly to ensure the correct flows are being calculated from the recorded water levels.

All rainfall and river sites have alarm levels that are automatically triggered if a high intensity of rainfall occurs or if river levels start to rise. Alarms are received by flood-warning staff and a flood event will be monitored at any time of the day with warnings to authorities and landowners issued if dangerous flood levels are predicted.

2.2.3 Lake levels

The location of the six lake sites are shown in Figure 2.3. Three are situated on Lake Wairarapa to monitor compliance with minimum water levels (as set out in the National Water Conservation Order for the lake) and to monitor lake levels for flood control.

The site at Lake Onoke is monitored for flood control purposes, particularly if the lake opening to the sea becomes blocked.

The other two sites have been operating since 2007 and monitor the levels of Lake Kohangapiripiri and Lake Kohangatera (collectively known as the Parangarahu Lakes). These lakes are part of East Harbour Regional Park and are of national significance.

2.2.4 Wetland levels

Wetland monitoring is a relatively recent development in GWRC's hydrological network. GWRC currently operate five continuous water level recorders on two wetland areas. Four of those are sited in the Te Hapua wetland complex near Te Horo on the Kapiti Coast. The remaining site is situated on the Taumata Lagoon near the confluence of the Waiohine and Ruamahanga rivers in the Wairarapa. The locations of these sites are shown in Figure 2.3.

2.2.5 Tide levels

Tide levels are monitored at two sites; Wellington Harbour at Queens Wharf and Porirua Harbour at the Mana Cruising Club. The locations of these sites are shown in Figure 2.3.

Two other sites (Hutt River at Estuary Bridge and Lake Onoke at Lake Ferry) can also be used to infer tide levels as they are situated at the mouths of the Hutt and Ruamahanga rivers respectively.

2.2.6 Soil moisture

Soil moisture is monitored at four sites in the region (although note that the Alloa site was closed during the 2012/13 year). The locations of these sites are shown in Figure 2.3.

Knowing the water content of soil is important for managing groundwater recharge, assessing agricultural irrigation needs and soil chemistry. It is also used for analysis of long-term climate trends, measuring how often plant growth is restricted by soil moisture and providing an indication for early intervention and drought management decisions.

2.2.7 Groundwater levels

The groundwater monitoring network covers the three principal groundwater areas in the region; Lower Hutt Valley, Kapiti Coast and Wairarapa Valley. The network utilises dedicated monitoring boreholes as well as privately owned boreholes, and the location of sites are shown in Figure 2.4.

Continuous data on groundwater levels are collected at 67 sites. These are automatic sites where the groundwater level is recorded every 5 to 15 minutes and stored in a data logger at the site. The majority of sites are also linked to GWRC's database via telemetry.

In addition to the automatic monitoring sites, GWRC also manually measures groundwater levels at a further 61 sites every four to six weeks. Data from these manual sites can be compared to data from automatic sites to provide a fuller picture of the state of the region's groundwater resource.

A number of these sites are also part of the groundwater quality network which is reported on separately (refer to the 2012/13 Annual Data Report for Groundwater Quality State of the Environment monitoring programme).

2.2.8 Changes to the network during 2012/13

A small number of changes were made to the hydrological network in the 2012/13 monitoring year. Four new telemetered sites were installed:

Rainfall	
1.	Makara Stream at Mill Creek Wind Farm
River	
2.	Carrington Water Race at below overflow
3.	Booths Creek at Andersons Line
Lake	
4.	Lake Wairarapa at Barrage Argonaut

Two automatic groundwater monitoring sites were decommissioned during the monitoring year:

1. Kahutara Groundwater Zone at Green
2. Te Ore Ore Groundwater Zone at Himona

In addition, three water level sites on floodway channels in the Lower Wairarapa Valley Diversion Scheme have been included in this report:

1. Lower Wairarapa Valley Diversion Scheme Floodway at Jenkins Dip
2. Lower Wairarapa Valley Diversion Scheme Floodway at Hikinui Sill
3. Lower Wairarapa Valley Diversion Scheme Floodway at Oporua

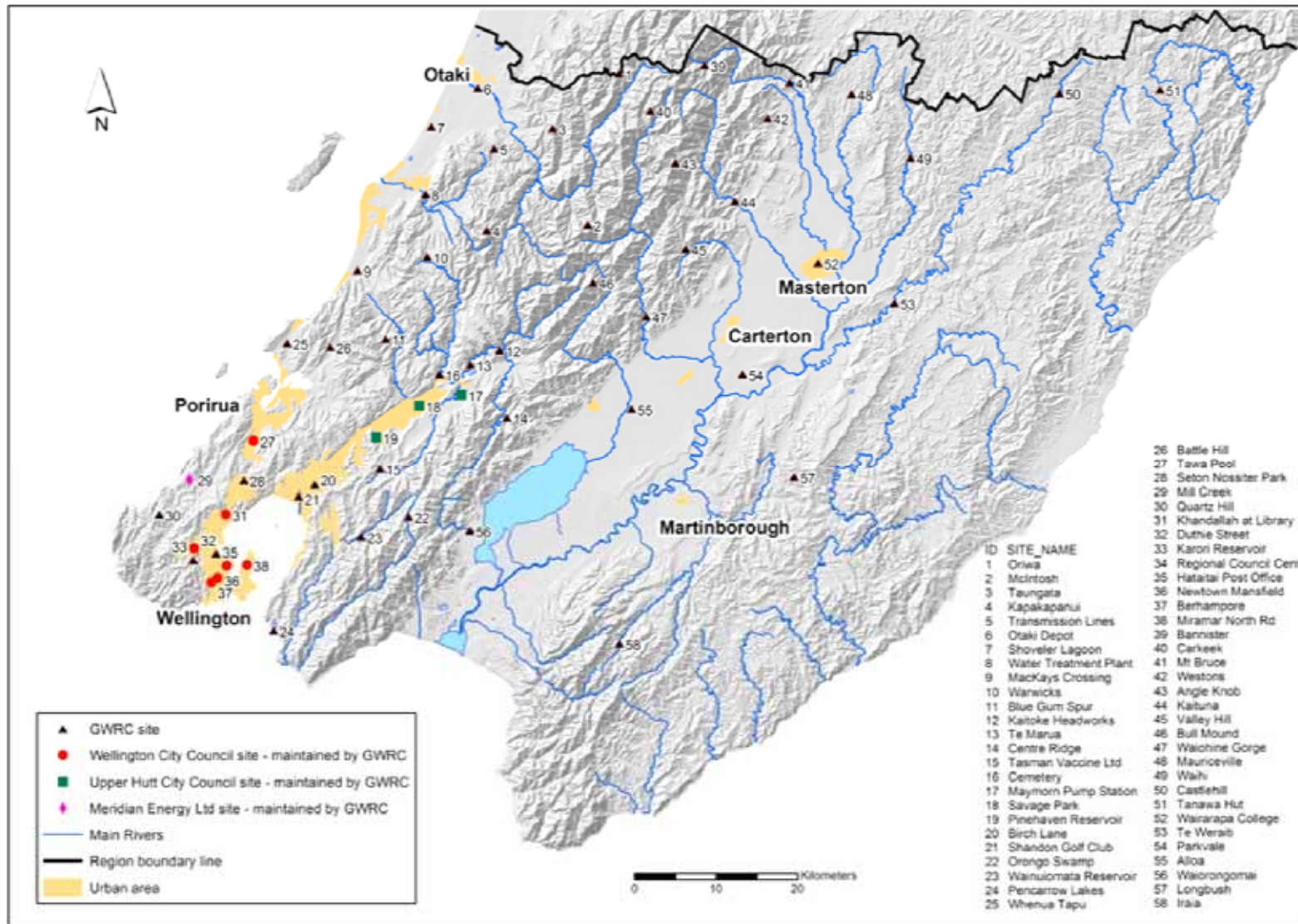


Figure 2.1: Automatic rainfall monitoring sites

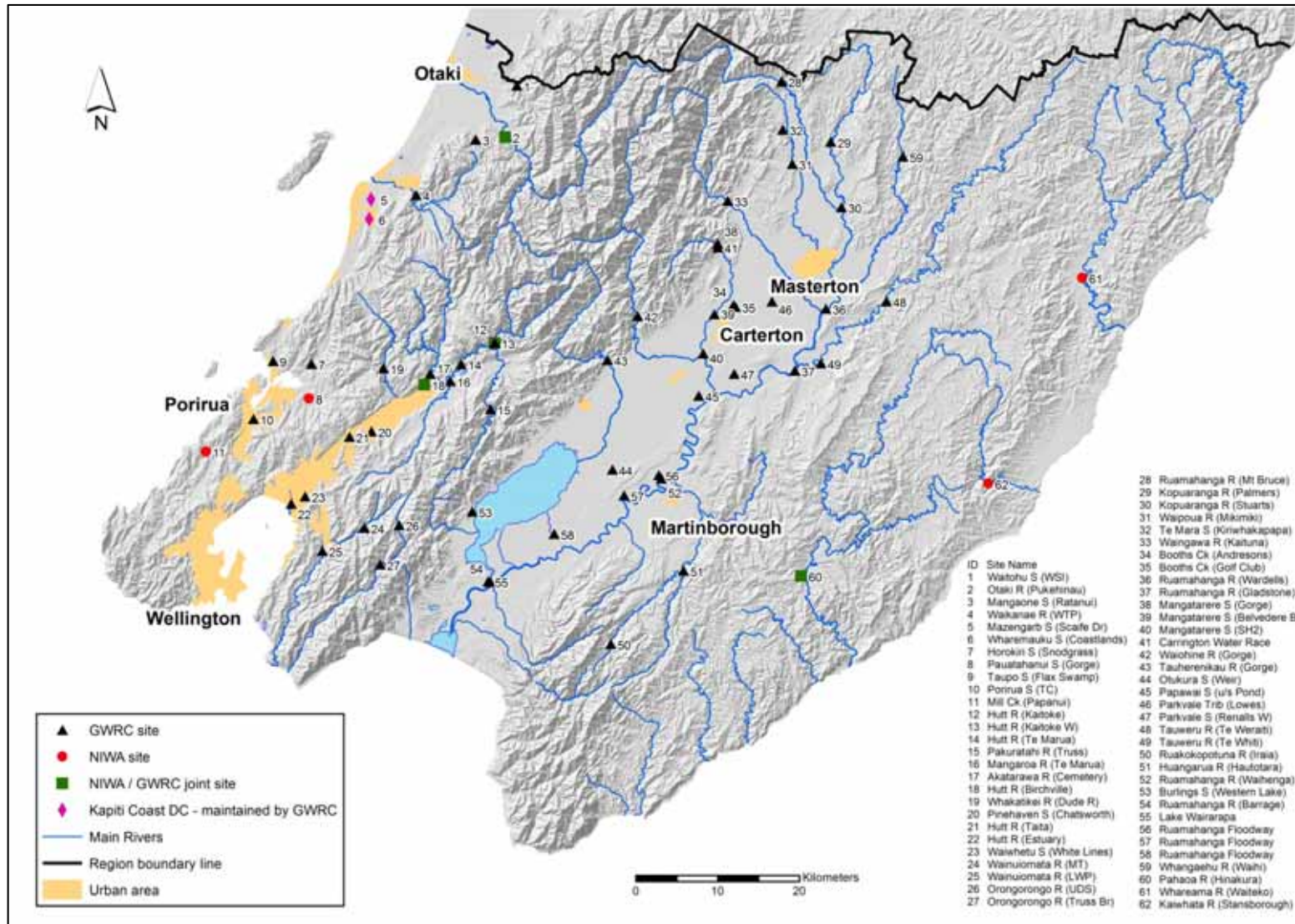


Figure 2.2: Automatic river level/flow monitoring sites

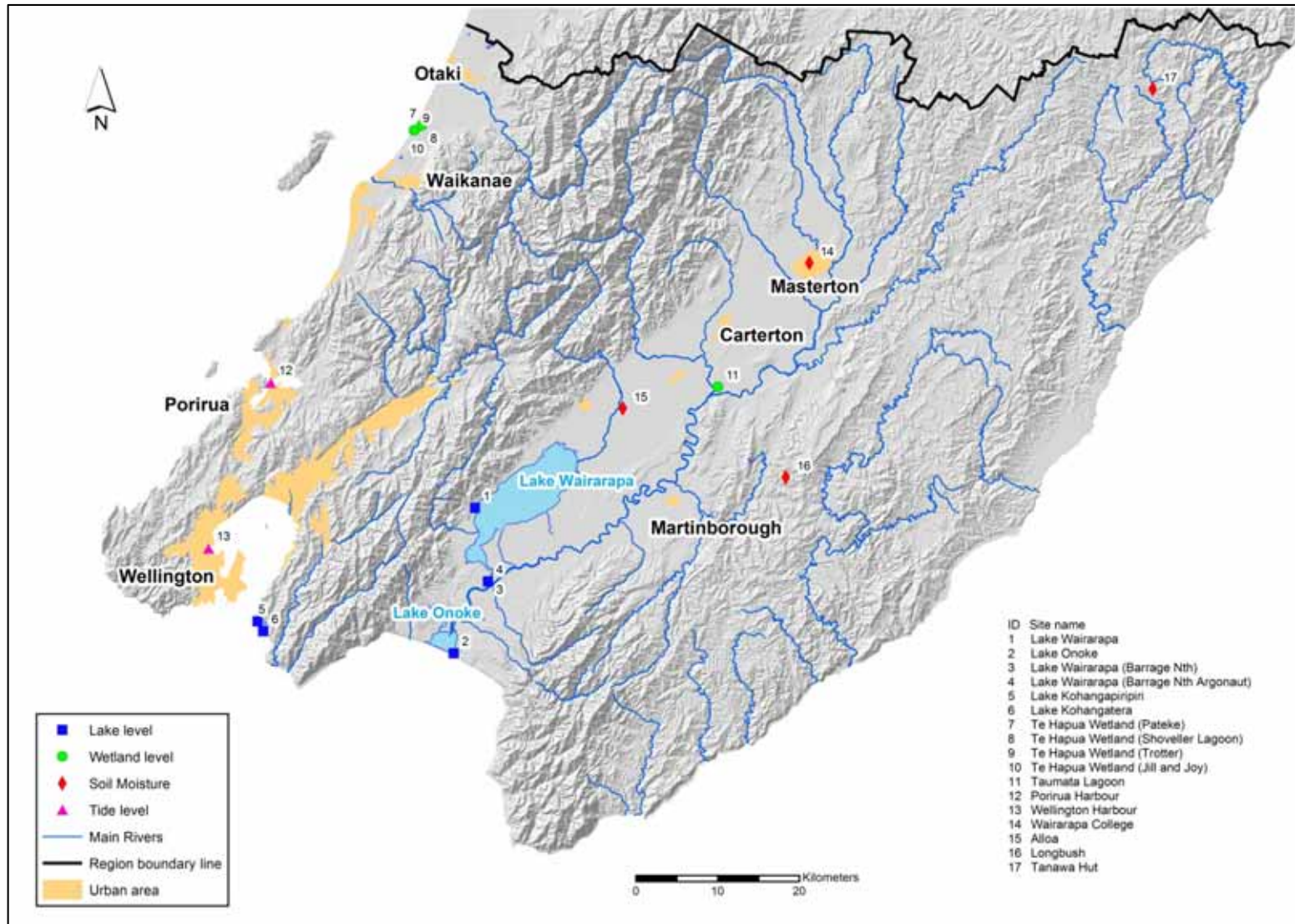


Figure 2.3: Automatic lake level, wetland level, tide level and soil moisture monitoring sites

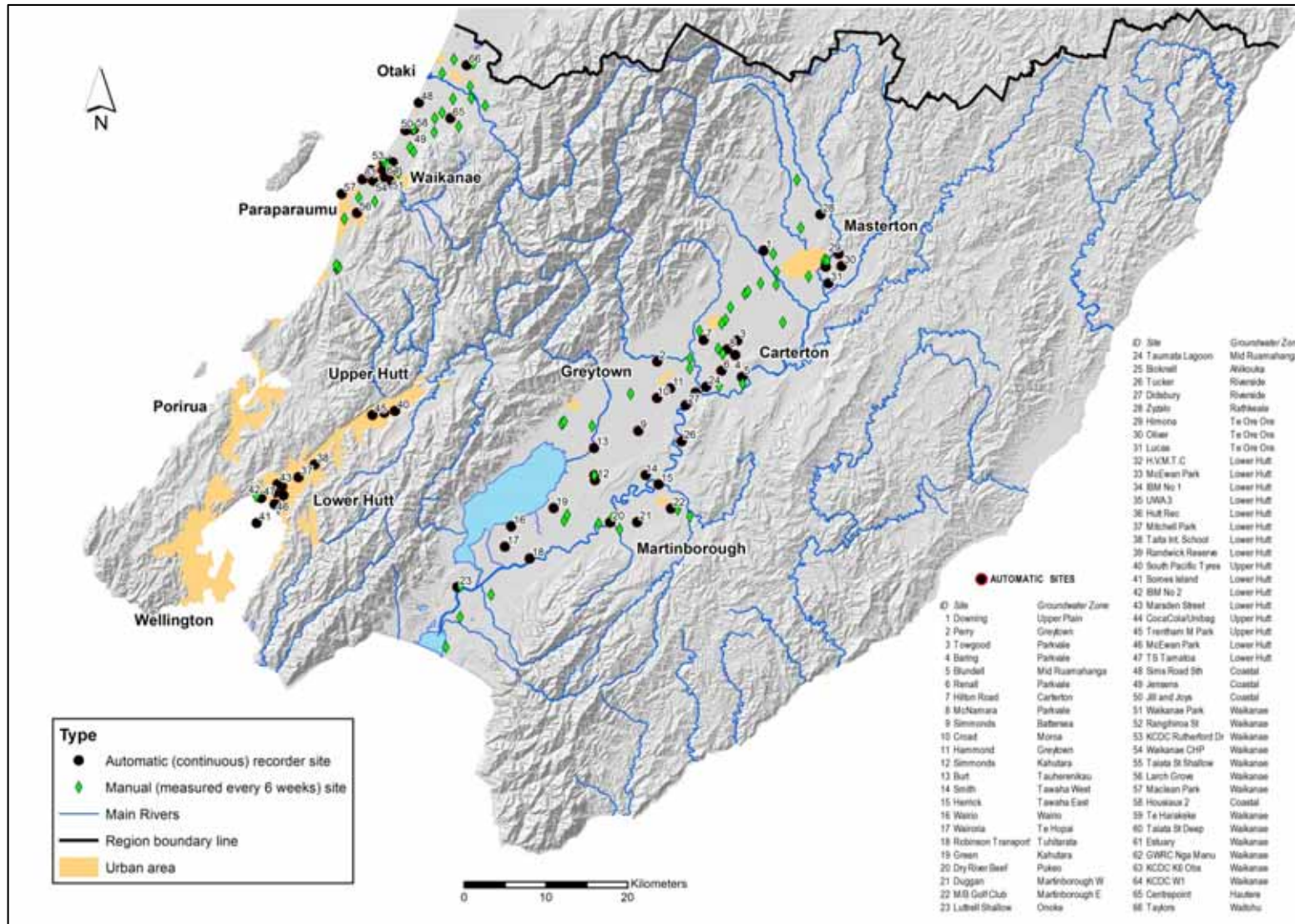


Figure 2.4: Groundwater level sites

3. Rainfall

Table 3.1 summarises the total annual rainfall for 2012/13. Sites with greater than 10 percent difference from their long term average are shaded orange (below average) and blue (above average).

Table 3.1: 2012/13 annual rainfall totals and as a percentage of long term average

Site	Catchment	2012/13 total (mm)	Average (mm)	% of long term average
Kapiti Coast				
Oriwa (Taranua)	Otaki	4246	4604	92
McIntosh (Taranua)	Otaki	4266	5065	84
Taungata (Taranua)	Otaki	2669	2927	91
Kapakapanui (Taranua)	Otaki	2278	2400	95
Transmission Lines	Mangaone	1584	1674	95
Otaki Depot	Otaki	970	1022	95
Shoveler Lagoon	Te Hapua Wetlands	938	NA ¹	
Water Treatment Plant	Waikanae	1011	1240	82
MacKays Crossing	Whareroa	1142	NA ¹	
Hutt Valley				
Warwicks	Akatarawa	2181	2256	97
Blue Gum Spur	Whakatikei	1901	1950	97
Kaitoke Headworks	Hutt	1968	2298	86
Te Marua	Hutt	1617	1819	89
Centre Ridge	Pakuratahi	1945	2049	95
Tasman Vaccine Ltd	Mangaroa	1669	1576	106
Cemetery	Akatarawa	1571	1703	92
Maymorn Pump Station	Mangaroa	1595	NA ¹	
Savage Park	Hutt	1480	NA ¹	
Birch Lane	Hutt	1147	1261	91
Shandon Golf Club	Hutt	1098	1009	109
Wainuiomata/Orongorongo				
Orongo Swamp	Orongorongo	2480	2455	101
Wainuiomata Reservoir	Wainuiomata	1707	1935	88
Pencarrow Lakes	Pencarrow Lakes	828	NA ¹	
Porirua				
Whenua Tapu	Taupo	1164	1066	109
Tawa Pool	Porirua	1101	1136	97
Seton Nossiter Park	Porirua	1190	1154	103

Table 3.1 continued

Site	Catchment	2012/13 total (mm)	Average (mm)	% of long term average
Wellington				
Mill Creek	Mill Creek	885	NA ¹	
Quartz Hill	Makara	1086	NA ¹	
Khandallah at Library	Wellington City	1228	1223	100
Duthie Street	Karori	1338	1344	100
Karori Reservoir	Kaiwharawhara	1290	1243	104
Regional Council	Wellington City	958	1005	95
Hataitai Post Office	Wellington City	978	1037	94
Newtown Mansfield	Wellington City	1049	1054	100
Berhampore	Wellington City	1073	1144	94
Miramar North Rd	Wellington City	992	957	104
Upper Ruamahanga and tributaries				
Bannister (Tararua)	Ruamahanga	7032	6136	115
Carkeek (Tararua)	Waiohine	3643	4531	80
Mt Bruce	Ruamahanga	1920	2442	79
Westons	Waipoua	2056	NA ¹	
Angle Knob (Tararua)	Waingawa	5753	6877	84
Kaituna	Waingawa	1596	1940	82
Valley Hill	Mangatarere	2468	2811	88
Bull Mound (Tararua)	Tauherenikau	3690	4508	82
Waiohine Gorge	Waiohine	1724	NA ¹	
Mauriceville	Kopuaranga	1299	NA ¹	
Waihi	Whangaehu	1024	1186	86
Castlehill	Tauweru	1038	1148	90
Mid-Lower Ruamahanga Valley				
Wairarapa College	Ruamahanga	866	NA ¹	
Te Weraiti	Tauweru	753	839	90
Parkvale	Parkvale	777	NA ¹	
Alloa	Tauherenikau	1010	1082	93
Matthews	Waiorongomai	1440	NA ¹	
Eastern Wairarapa Hills				
Tanawa Hut	Whareama	1084	1308	83
Longbush	Waikoukou	907	937	97

¹ Insufficient number of years of data recorded to calculate average rainfall

Monthly rainfall totals as compared to the long term monthly average are shown in Figure 3.1 for a selection of sites across the region.



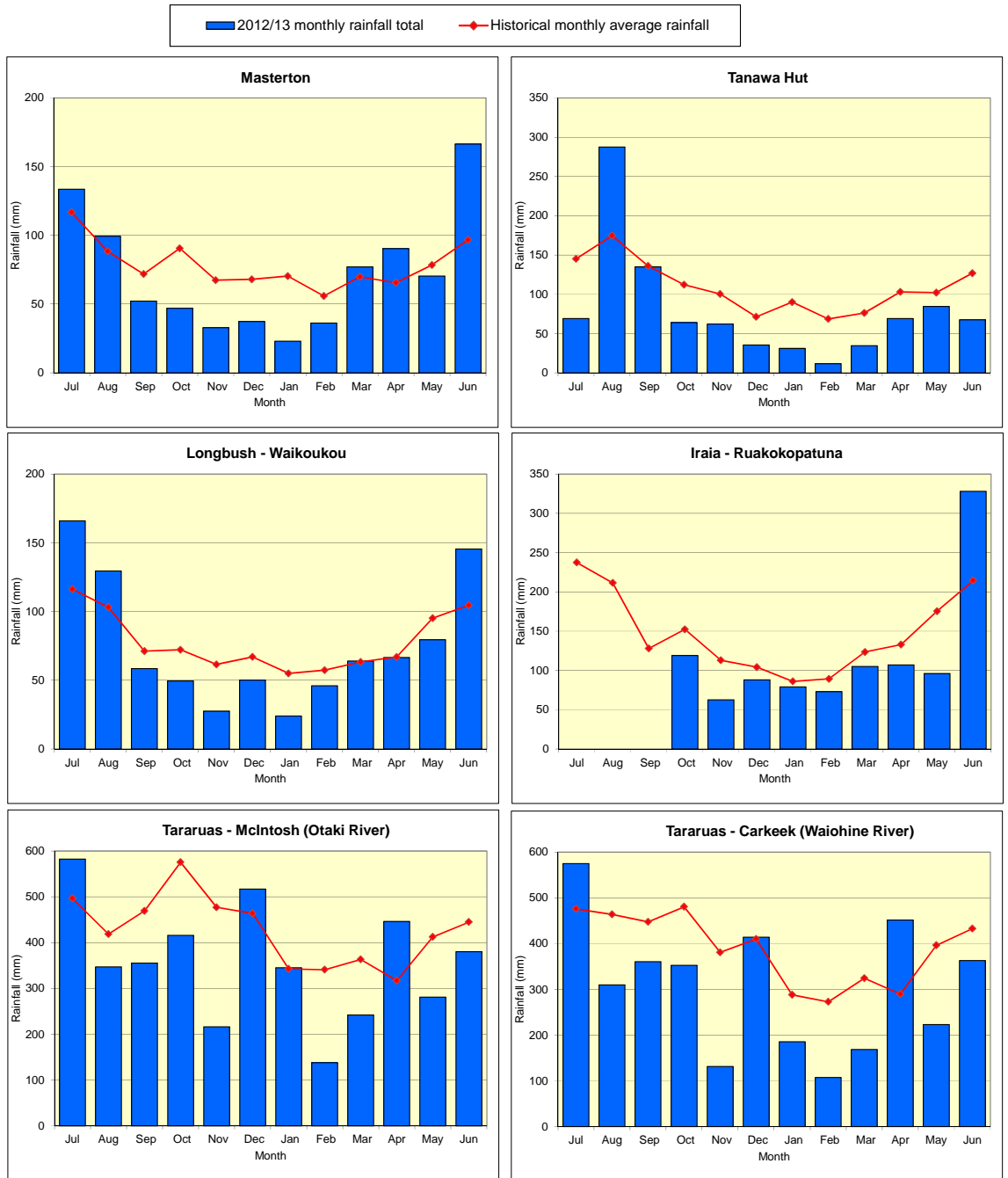


Figure 3.1: 2012/13 monthly rainfall totals and long-term averages

Table 3.2 summarises seasonal rainfall totals for selected sites across the region. Sites with greater than 10 percent difference from their long term average are shaded orange (below average) and blue (above average).

Table 3.2: 2012/13 seasonal rainfall totals

Rain gauge location		Rainfall as a percentage of the long term average			
		Winter 2012	Spring 2012	Summer 2012/13	Autumn 2013
Kapiti	Otaki	104%	69%	92%	115%
	Waikanae	89%	67%	139%	129%
Porirua	Whenua Tapu	103%	62%	125%	132%
Wellington	Karori	112%	53%	90%	101%
Wainuiomata	Reservoir	77%	57%	95%	93%
Hutt Valley	Lower Hutt	79%	52%	94%	112%
	Kaitoke	93%	71%	98%	78%
Wairarapa Valley	Featherston	111%	70%	101%	109%
	Masterton	97%	65%	55%	116%
Eastern Wairarapa Hills	Tanawa Hut	108%	57%	33%	67%
	Longbush	117%	77%	76%	90%
Tararua Ranges	McIntosh	95%	65%	90%	90%
	Carkeek	86%	65%	73%	82%

Maximum recorded rainfall totals over short durations (1, 6 and 12 hours) are detailed in Table 3.3. The return period was estimated by completing a frequency analysis. Values in blue shaded cells indicate a return period of 5 years or more.

Table 3.3: Maximum short duration rainfall totals during 2012/13

Site	1 hour		6 hours		12 hours	
	Rainfall Start date	Return period (years)	Rainfall Start date	Return period (years)	Rainfall Start date	Return period (years)
Water Treatment Plant (Waikanae)	28.0mm 25 Apr 2013	7.8	44.0mm 4 Feb 2013	< 2	61.0mm 4 Feb 2013	< 2
QE Park (Paekakariki) ¹	40.0mm 4 Feb 2013	42	68.0mm 4 Feb 2013	14	84.5mm 4 Feb 2013	9
Warwicks (Akatarawa)	27.0mm 4 Feb 2013	4	63.0mm 4 Feb 2013	< 2	88.0mm 4 Feb 2013	< 2
Te Marua (Upper Hutt)	54.5mm 4 Feb 2013	> 40	80.0mm 4 Feb 2013	5.5	95.0mm 4 Feb 2013	2.5
TVL (Mangaroa)	29.5mm 4 Feb 2013	6	60.0mm 4 Feb 2013	4	92.0mm 4 Feb 2013	6.5
Birch Lane (Lower Hutt)	28.0mm 4 Feb 2013	7	55.0mm 4 Feb 2013	2.5	67.0mm 4 Feb 2013	< 2
Wainuiomata Reservoir (Wainuiomata)	27.5mm 4 Feb 2013	10	74.5mm 20 Jun 2013	5	112.0mm 20 Jun 2013	4
Seton Nossiter Park (Porirua)	25.7mm 4 Feb 2013	11	36.4mm 17 Sep 2012	< 2	58.8mm 4 Feb 2013	2
Karori Reservoir (Wellington City)	28.4mm 6 May 2013	5.5	53.4mm 24 Jul 2012	4	73.8mm 22 Jun 2013	6.5
McIntosh (W Tararua Range)	20.0mm 3 Jan 2013	< 2	54.0mm 12 Apr 2013	< 2	93.0mm 12 Apr 2013	< 2
Angle Knob (E Tararua Range)	28.5mm 4 Feb 2013	< 2	100.0mm 15 Jul 2012	< 2	151.0mm 15 Jul 2012	< 2
Waiohine Gorge ² (Waiohine)	12.5mm 26 Dec 2012	< 2	31.0mm 4 Feb 2013	< 2	48.5mm 4 Feb 2013	< 2
Wairarapa College (Masterton) ¹	20.8mm 18 Mar 2013	6.5	44.2mm 18 Mar 2013	4.5	54.2mm 18 Mar 2013	3
Alloa (Featherston) ³	16.0mm 4 Feb 2013	3	49.0mm 18 Mar 2013	14	74.0mm 18 Mar 2013	15
Castlehill (Tauweru)	13.0mm 5 Jul 2012	< 2	31.5mm 5 Jul 2012	< 2	37.5mm 5 Jul 2012	< 2
Tanawa Hut (Whareama)	16.0mm 5 Jul 2012	< 2	34.0mm 5 Jul 2012	< 2	47.0mm 5 Jul 2012	< 2

¹ Return periods estimated using HIRDS v3.0 (NIWA 2002).

² Return periods estimated using 'Waiohine at Phelps' site that was closed in January 2010.

³ Alloa decommissioned Nov 2012. Values derived from extending record with Racecourse site data (scaled based on correlation).

Maximum recorded rainfall totals over longer periods (24, 48 and 72 hours) are detailed in Table 3.4. Values in blue shaded cells indicate a return period of 5 years or more.

Table 3.4: Maximum long duration rainfall totals during 2012/13

Site	24 hours		48 hours		72 hours	
	Rainfall <i>Start date</i>	Return period (years)	Rainfall <i>Start date</i>	Return period (years)	Rainfall <i>Start date</i>	Return period (years)
Water Treatment Plant (Waikanae)	70.5mm <i>4 Feb 2013</i>	< 2	76.0mm <i>17 Mar 2013</i>	< 2	76.0mm <i>16 Mar 2013</i>	< 2
QE Park (Paekakariki) ¹	94.5mm <i>4 Feb 2013</i>	3.5	112.5mm <i>20 Jun 2013</i>	4	135.5mm <i>20 Jun 2013</i>	7
Warwicks (Akatarawa)	106.5mm <i>4 Feb 2013</i>	< 2	116.5mm <i>12 Jan 2013</i>	< 2	144.0mm <i>12 Jan 2013</i>	< 2
Te Marua (Upper Hutt)	107.0mm <i>4 Feb 2013</i>	< 2	109.0mm <i>4 Feb 2013</i>	< 2	109.0mm <i>3 Feb 2013</i>	< 2
TVL (Mangaroa)	115.5mm <i>20 Jun 2013</i>	5	168.5mm <i>20 Jun 2013</i>	9	212.0mm <i>20 Jun 2013</i>	13
Birch Lane (Lower Hutt)	81.5mm <i>4 Feb 2013</i>	< 2	116.5mm <i>20 Jun 2013</i>	4	147.0mm <i>20 Jun 2013</i>	5
Wainuiomata Reservoir (Wainuiomata)	140.0mm <i>20 Jun 2013</i>	3.5	209.5mm <i>20 Jun 2013</i>	5.5	257.0mm <i>20 Jun 2013</i>	6.5
Seton Nossiter Park (Porirua)	72.2mm <i>4 Feb 2013</i>	2	73.5mm <i>4 Feb 2013</i>	< 2	83.8mm <i>19 Jun 2013</i>	< 2
Karori Reservoir (Wellington City)	103.6mm <i>21 Jun 2013</i>	20	134.2mm <i>20 Jun 2013</i>	17.5	164.2mm <i>19 Jun 2013</i>	30
McIntosh (W Tararua Range)	130.0mm <i>18 Mar 2013</i>	< 2	206.0mm <i>17 Mar 2013</i>	< 2	239.0mm <i>14 Jul 2012</i>	< 2
Angle Knob (E Tararua Range)	218.5mm <i>15 Jul 2012</i>	< 2	331.0mm <i>14 Jul 2012</i>	< 2	337.5mm <i>14 Jul 2012</i>	< 2
Waiohine Gorge ² (Waiohine)	71.5mm <i>4 Feb 2013</i>	< 2	85.5mm <i>7 Sep 2012</i>	< 2	114.5mm <i>6 Sep 2012</i>	< 2
Wairarapa College (Masterton) ¹	74.4mm <i>18 Mar 2013</i>	2.5	76.6mm <i>17 Mar 2013</i>	< 2	76.6mm <i>16 Mar 2013</i>	< 2
Alloa (Featherston) ³	99.2mm <i>18 Mar 2013</i>	13	106.0mm <i>18 Mar 2013</i>	8	106.4mm <i>17 Mar 2013</i>	7
Castlehill (Tauweru)	60.5mm <i>4 Jul 2012</i>	< 2	73.5mm <i>4 Jul 2012</i>	< 2	83.5mm <i>3 Jul 2012</i>	< 2
Tanawa Hut (Whareama)	79.0mm <i>4 Jul 2012</i>	< 2	100.0mm <i>4 Jul 2012</i>	< 2	123.0mm <i>3 Jul 2012</i>	< 2

¹ Return periods estimated using HIRDS v3.0 (NIWA 2002).

² Return periods estimated using 'Waiohine at Phelps' site that was closed in January 2010.

³ Alloa decommissioned Nov 2012. Values derived from extending record with Racecourse site data (scaled based on correlation).

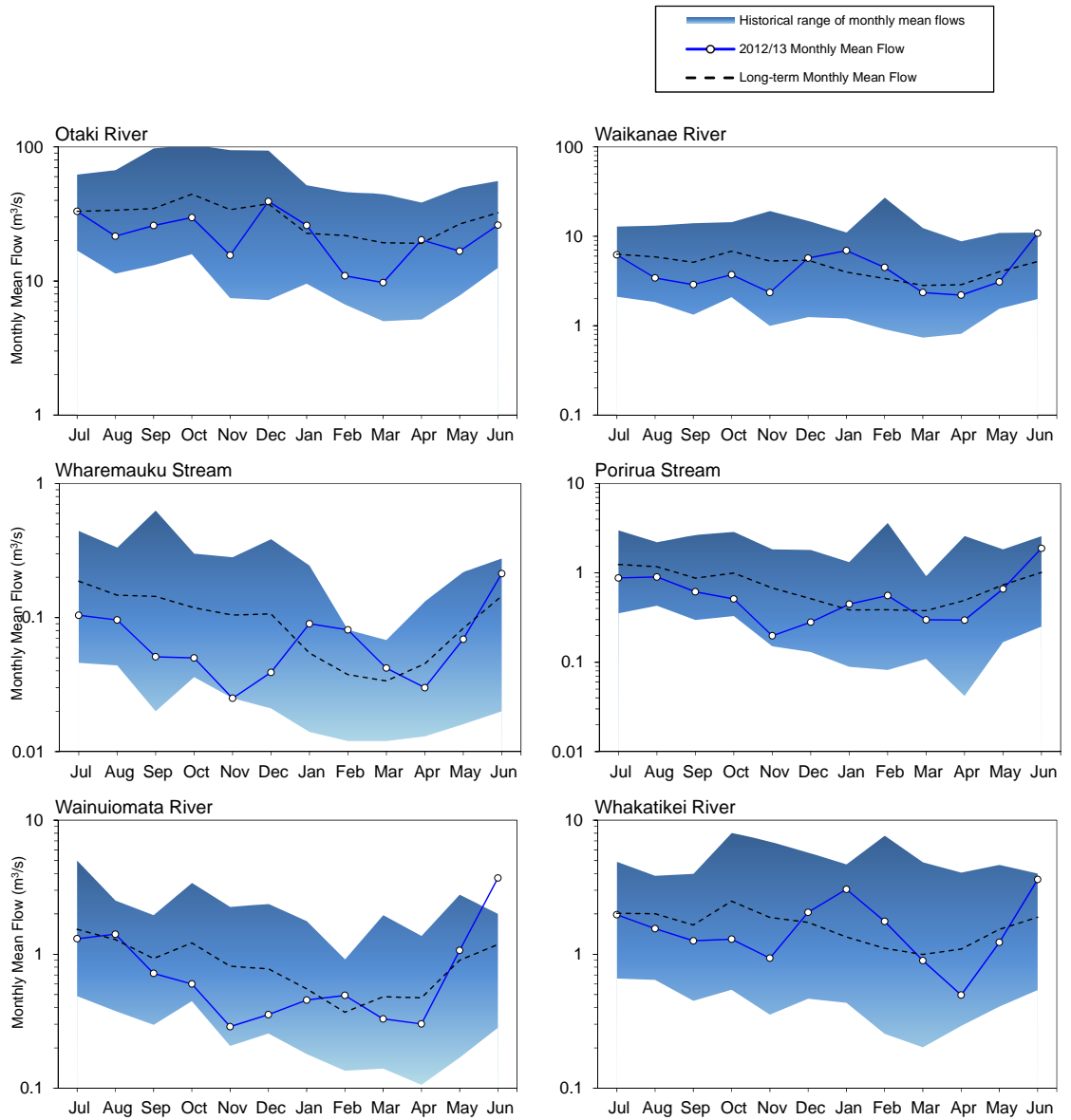
Table 3.5 details the lowest rainfall totals recorded over 14 and 28 day periods.

Table 3.5: Lowest rainfall totals during 2012/13

Site	14 days		28 days	
	Rainfall minima (mm)	Start date	Rainfall minima (mm)	Start date
Angle Knob (Tararua Range)	2.5	18 Feb 2013	16	13 Feb 2013
Waikanae Water Treatment Plant	0	5 Feb 2013	2	5 Feb 2013
Kaitoke Headworks (north Upper Hutt)	0	6 Feb 2013	0	6 Feb 2013
Shandon Golf Club (Petone)	0	5 Feb 2013	0	5 Feb 2013
Wainuiomata Reservoir	0	6 Feb 2013	0	6 Feb 2013
Karori Reservoir (Wellington)	0	17 Feb 2013	0	17 Feb 2013
Waiohine Gorge (Tararua foothills, Wairarapa)	0	6 Feb 2013	6.5	6 Feb 2013
Wairarapa College (Masterton)	0	19 Mar 2013	0.8	8 Feb 2013
Alloa (Featherston)	0	20 Mar 2013	2	6 Feb 2013
Tanawa Hut (northeast Wairarapa)	0	5 Feb 2013	1.5	5 Feb 2013

4. River flows

Mean monthly river flows for selected sites are detailed in Figure 4.1. The plots cover main rivers in the Kapiti Coast, Porirua, Hutt Valley, Wairarapa Valley and the Eastern Hills areas.



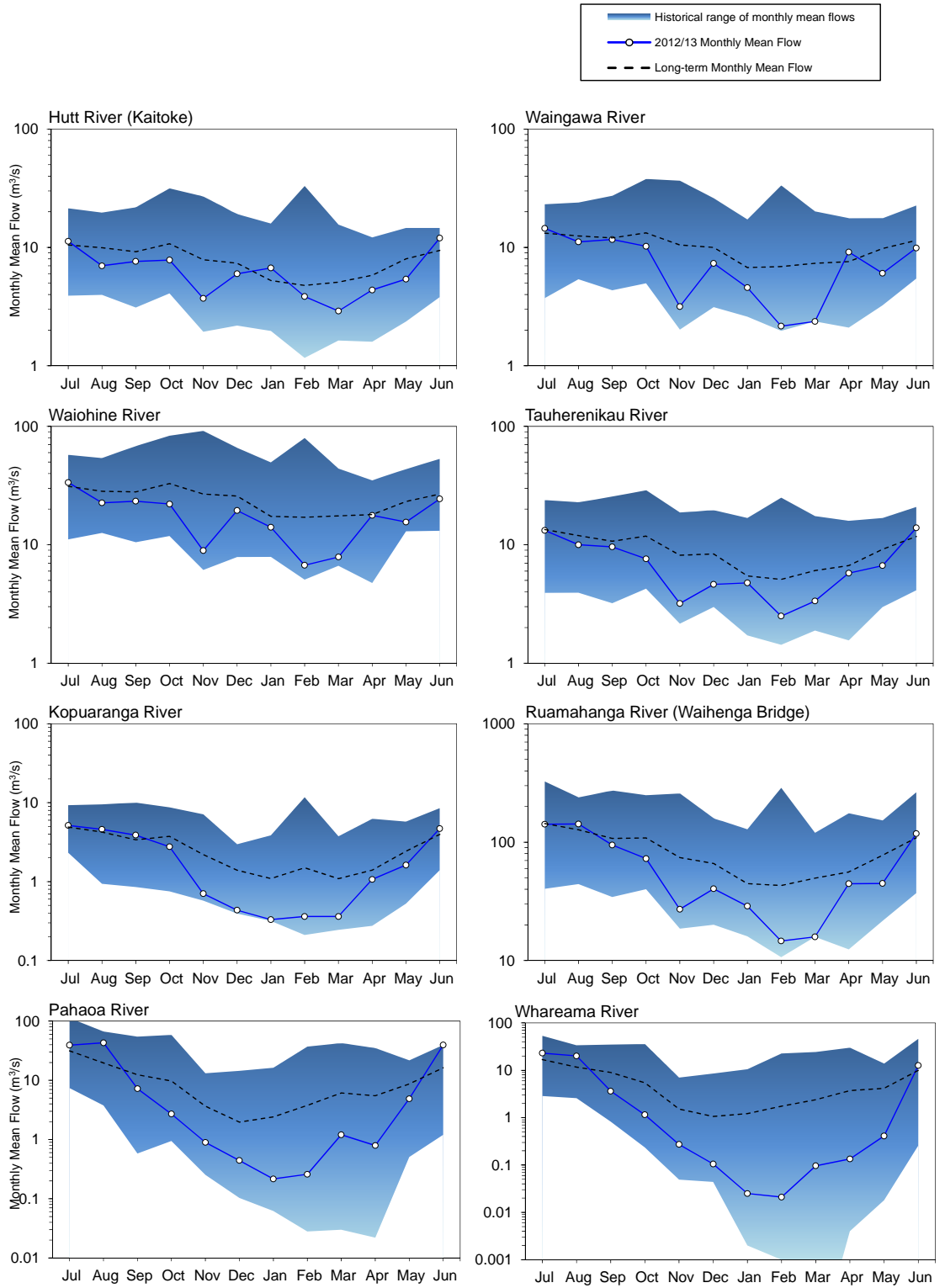


Figure 4.1: 2012/13 mean monthly river flows and long term averages

Maximum recorded river flows for a number of sites are detailed in Table 4.1¹. Cells shaded orange indicate that the 2012/13 maximum flow is the lowest recorded for that site.

Table 4.1: Maximum river and stream flows during 2012/13

Site	2012/13 maximum flow (m ³ /s)	Date occurred	Estimated return period (years)
Waitohu Stream at Water Supply Intake	17.2	16 Jul 2012	< 2
Otaki River at Pukehinau ²	506	15 Jul 2012	< 2
Mangaone Stream at Ratanui	6.5	4 Feb 2013	< 2
Waikanae River at Water Treatment Plant	161	4 Feb 2013	2.5
Hutt River at Te Marua	209	4 Feb 2013	< 2
Hutt River at Birchville ²	505	4 Feb 2013	< 2
Hutt River at Taita Gorge	585	5 Feb 2013	< 2
Pakuratahi River at Truss Bridge	61	4 Feb 2013	< 2
Mangaroa River at Te Marua	87	21 Jun 2013	< 2
Akatarawa River at Cemetery	323	4 Feb 2013	2.5
Whakatikei River at Dude Ranch	119	4 Feb 2013	6
Waiwhetu Stream at Whites Line East	13.6	21 Jun 2013	3
Wainuiomata River at Manuka Track	47	21 Jun 2013	6
Wainuiomata River at Leonard Wood Park	89	21 Jun 2013	4.5
Orongorongo River at Upper Dam Site	20	4 Feb 2013	< 2
Taupo Stream at Flax Swamp	6.5	18 Jun 2013	5.5
Horokiri Stream at Snodgrass	39	4 Feb 2013	4
Porirua Stream at Town Centre	44	4 Feb 2013	5
Ruamahanga River at Mt Bruce	164	15 Jul 2012	< 2
Ruamahanga River at Wardells Bridge	238	10 Sep 2012	< 2
Ruamahanga River at Gladstone Bridge	551	1 Aug 2012	< 2
Ruamahanga River at Waihenga Bridge	750	1 Aug 2012	< 2
Waipoua River at Mikimiki Bridge	52	9 Sep 2012	< 2
Waingawa River at Kaituna	122	7 Sep 2012	< 2
Mangatarere Stream at Gorge	30	9 Sep 2012	< 2
Waiohine River at Gorge	325	15 Jul 2012	< 2
Tauherenikau River at Gorge	96	25 Jul 2012	< 2
Kopuaranga River at Palmers	29	10 Sep 2012	< 2
Tauweru River at Te Weraiti	263	6 Jul 2012	4
Huangarua River at Hautotara	86	22 Jun 2013	< 2
Pahaoa River at Hinakura ²	359	1 Aug 2012	< 2

¹ River level stations that are not rated for high flows are omitted from the table.

² Data provided by NIWA but frequency analysis performed by GWRC.

Minimum recorded river flows (averaged over 7 and 28 day periods) are detailed in Table 4.2 for the western part of the region, and Table 4.3 for the eastern part of the region. Cells shaded orange indicate that the 2012/13 minimum flow is the lowest recorded for that site.

Table 4.2: Lowest 7-day and 28-day mean flows during 2012/13 in the western Wellington region

Site	7-day duration			28-day duration		
	2012/13 lowest mean flow (m ³ /s)	Start date	Estimated return period (years)	2012/13 lowest mean flow (m ³ /s)	Start date	Estimated return period (years)
Waitohu Stream at WSI	0.165	11 Mar 2013	< 2	0.188	18 Feb 2013	2.5
Otaki River at Pukehinau ¹	3.212	10 Mar 2013	59	4.323	18 Feb 2013	59
Mangaone Stream at Ratanui	0.085	10 Mar 2013	< 2	0.103	18 Feb 2013	< 2
Waikanae River at WTP	1.098	10 Mar 2013	< 2	1.405	18 Feb 2013	< 2
Hutt River at Birchville ^{1,2}	2.492	10 Mar 2013	2	3.067	18 Feb 2013	4
Hutt River at Taita Gorge ²	4.092	11 Mar 2013	< 2	5.120	18 Feb 2013	2
Pakuratahi River at Truss Bridge	0.199	11 Mar 2013	3	0.235	18 Feb 2013	5
Mangaroa River at Te Marua	0.412	11 Mar 2013	< 2	0.474	18 Feb 2013	2
Akatarawa River at Cemetery	0.969	11 Mar 2013	2.5	1.155	24 Mar 2013	3
Whakatikei River at Dude Ranch	0.338	5 Apr 2013	< 2	0.399	24 Mar 2013	< 2
Wainuiomata River at Manuka Track	0.176	10 Mar 2013	2	0.208	18 Feb 2013	2
Wainuiomata River at LWP ²	0.232	10 Mar 2013	2	0.323	17 Feb 2013	2.5
Orongorongo River at UDS	0.011	10 Mar 2013	> 55	0.018	18 Feb 2013	> 55
Taupo Stream at Flax Swamp	0.008	10 Mar 2013	< 2	0.010	18 Feb 2013	< 2
Horokiri Stream at Snodgrass	0.107	5 Apr 2013	< 2	0.144	24 Mar 2013	< 2
Porirua Stream at Town Centre	0.124	10 Mar 2013	3	0.140	17 Feb 2013	5

¹ Data provided by NIWA but frequency analysis performed by GWRC.

² Low flow likely to have been significantly affected by upstream abstraction.

Table 4.3: Lowest 7-day and 28-day mean flows¹ during 2012/13 in the Wairarapa

Site	7-day duration			28-day duration		
	2012/13 lowest mean flow (m ³ /s)	Start date	Estimated return period (years)	2012/13 lowest mean flow (m ³ /s)	Start date	Estimated return period (years)
Ruamahanga River at Mt Bruce	0.730	10 Mar 2013	70	0.866	18 Feb 2013	70
Ruamahanga River at Wardells ²	1.416	11 Mar 2013	42	1.721	18 Feb 2013	34
Ruamahanga River at Waihenga Br ²	4.430	11 Mar 2013	66	5.517	18 Feb 2013	66
Waipoua River at Mikimiki ⁴	0.123	11 Mar 2013	-	0.157	18 Feb 2013	-
Waingawa River at Kaituna	0.697	10 Mar 2013	> 70	0.792	18 Feb 2013	> 70
Mangatarere Stream at Gorge	0.077	11 Mar 2013	15	0.103	18 Feb 2013	20
Waiohine River at Gorge	2.060	10 Mar 2013	> 70	2.581	18 Feb 2013	> 70
Tauherenikau River at Gorge	0.792	11 Mar 2013	35	0.988	18 Feb 2013	40
Kopuaranga River at Palmers ²	0.253	23 Feb 2013	3	0.257	18 Feb 2013	6
Otukura Stream at Weir ²	0.026	11 Mar 2013	7	0.049	18 Feb 2013	3.5
Papawai Stream u/s Oxi Pond ²	0.139	21 Feb 2013	-	0.163	7 Jan 2013	-
Pahaoa River at Hinakura ³	0.030	10 Mar 2013	4.5	0.045	18 Feb 2013	5

¹ Only the river level sites that are rated for low flows are shown in the table.

² Low flow likely to have been significantly affected by upstream abstraction.

³ Data provided by NIWA.

⁴ Short record site.

GWRC has set levels on a number of rivers and streams across the region to signify when abstraction restrictions should begin (restriction thresholds) and when all abstractions shall stop (minimum flows). These are defined in the Regional Freshwater Plan (RFP).

Table 4.4 summarises the number of instances that the first restriction threshold was reached during 2012/13 for rivers and streams as specified in the RFP. Results from the previous three years are included for comparison.

Table 4.4: Number of days where mean daily flow was below the first restriction threshold as specified in the Regional Freshwater Plan

Area	River or stream	First restriction threshold (m ³ /s)	Number of days below threshold			
			2012/13	2011/12	2010/11	2009/10
Kapiti Coast	Waitohu Stream	0.180	13	43	17	0
	Otaki River	4.375	21	4	1	0
	Mangaone Stream	0.045	0	0	0	0
Wairarapa	Ruamahanga River	9.800	54	0	18	0
	Waiohine River	3.040	22	0	2	0
	Tauherenikau River	1.350	32	0	4	0
	Waingawa River	1.900	70	13	51	17
	Kopuaranga River	0.270	34	0	0	0
	Waipoua River	0.300	64	0	13	0
	Mangatarere Stream	0.330	103	22	96	46
Wellington/Hutt Valley	Hutt River	1.450	0	0	0	0
	Wainuiomata River	0.360	38	0	0	41

As part of its floodwarning service, GWRC sets high river level alarms on many of its monitoring sites to provide early warning of rising river levels and possible flooding. Table 4.5 lists sites where flood warning alarms were triggered during 2012/13.

Table 4.5: Flood warning alarms triggered during 2012/13

Event date	Sites where alarms were triggered
5-6 July 2012	Ruamahanga at Gladstone Ruamahanga at Waihenga Taueru at Te Weraiti
15 July 2012	Hutt at Kaitoke Otaki at Pukehinau Ruamahanga at Waihenga
25 July 2012	Ruamahanga at Waihenga
1 August 2012	Ruamahanga at Gladstone Ruamahanga at Waihenga Ruamahanga at Wardells Taueru at Te Weraiti
9-10 September 2012	Ruamahanga at Gladstone Ruamahanga at Waihenga Ruamahanga at Wardells
17 September 2012	Porirua at Town Centre
30 December 2012	Akatarawa at Cemetery Hutt at Kaitoke Waikanae at WTP
4-5 February 2013	Akatarawa at Cemetery Hutt at Birchville Hutt at Kaitoke Porirua at Town Centre Waikanae at WTP Waiwhetu at WLE
10 April 2013	Hutt at Te Marua
17 June 2013	Porirua at Town Centre
20-23 June 2013	Hutt at Birchville Mangaroa at Te Marua Porirua at Town Centre Waikanae at WTP Wainuiomata at LWP Wainuiomata at Manuka Track Waiwhetu at WLE

5. Groundwater levels

Figure 5.1 shows mean monthly groundwater levels for 2012/13 (black line) compared to historical mean monthly groundwater levels (dotted line) at selected sites in the Wairarapa Valley. The grey shaded areas represent the range of historic minimum and maximum mean monthly levels.

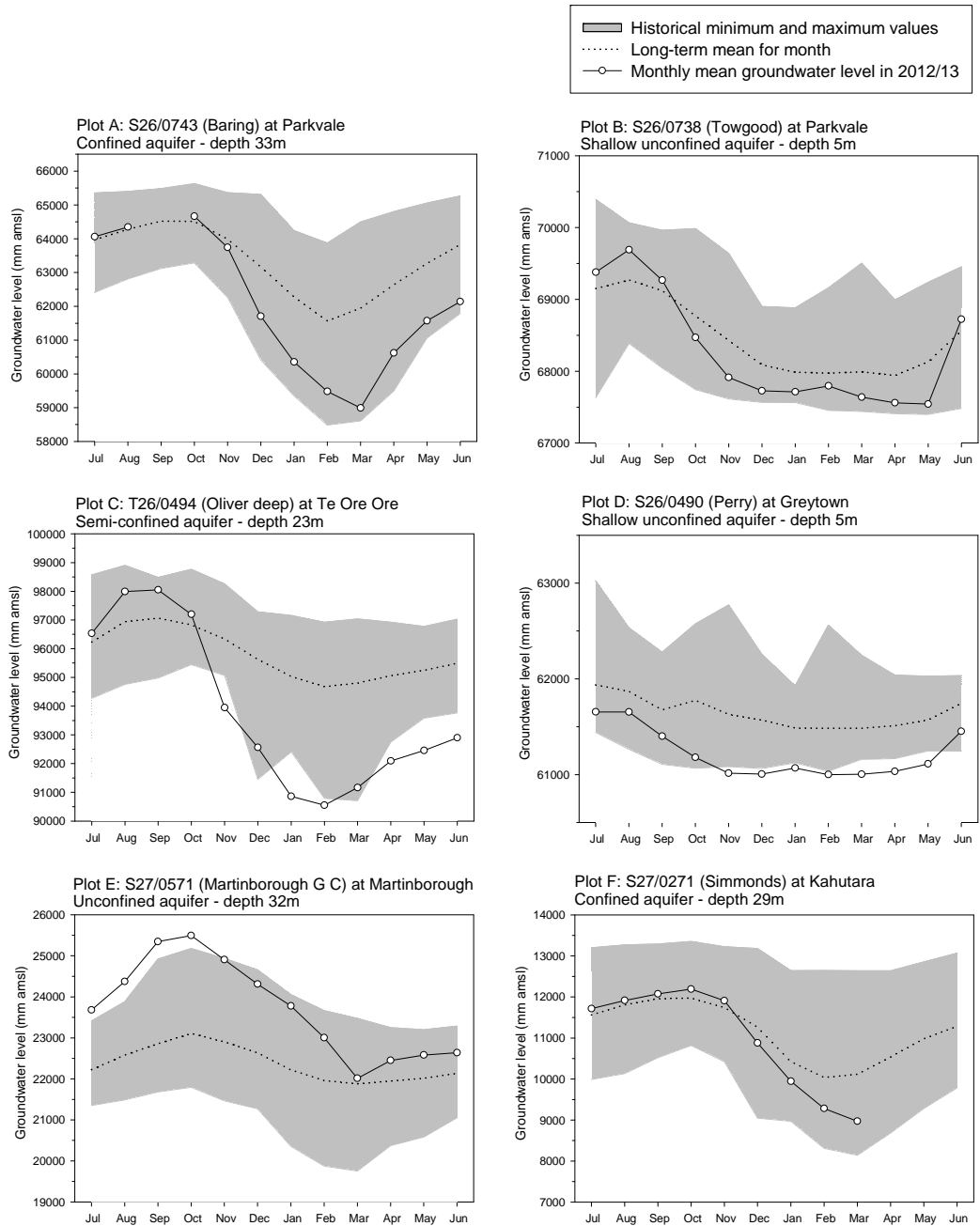


Figure 5.1: 2012/13 mean monthly groundwater levels in the Wairarapa

Figure 5.2 shows mean monthly groundwater levels for 2012/13 (black line) compared to historical mean monthly groundwater levels (dotted line) at selected sites in the Hutt Valley and on the Kapiti Coast. The grey shaded areas represent the range of historic minimum and maximum mean monthly levels.

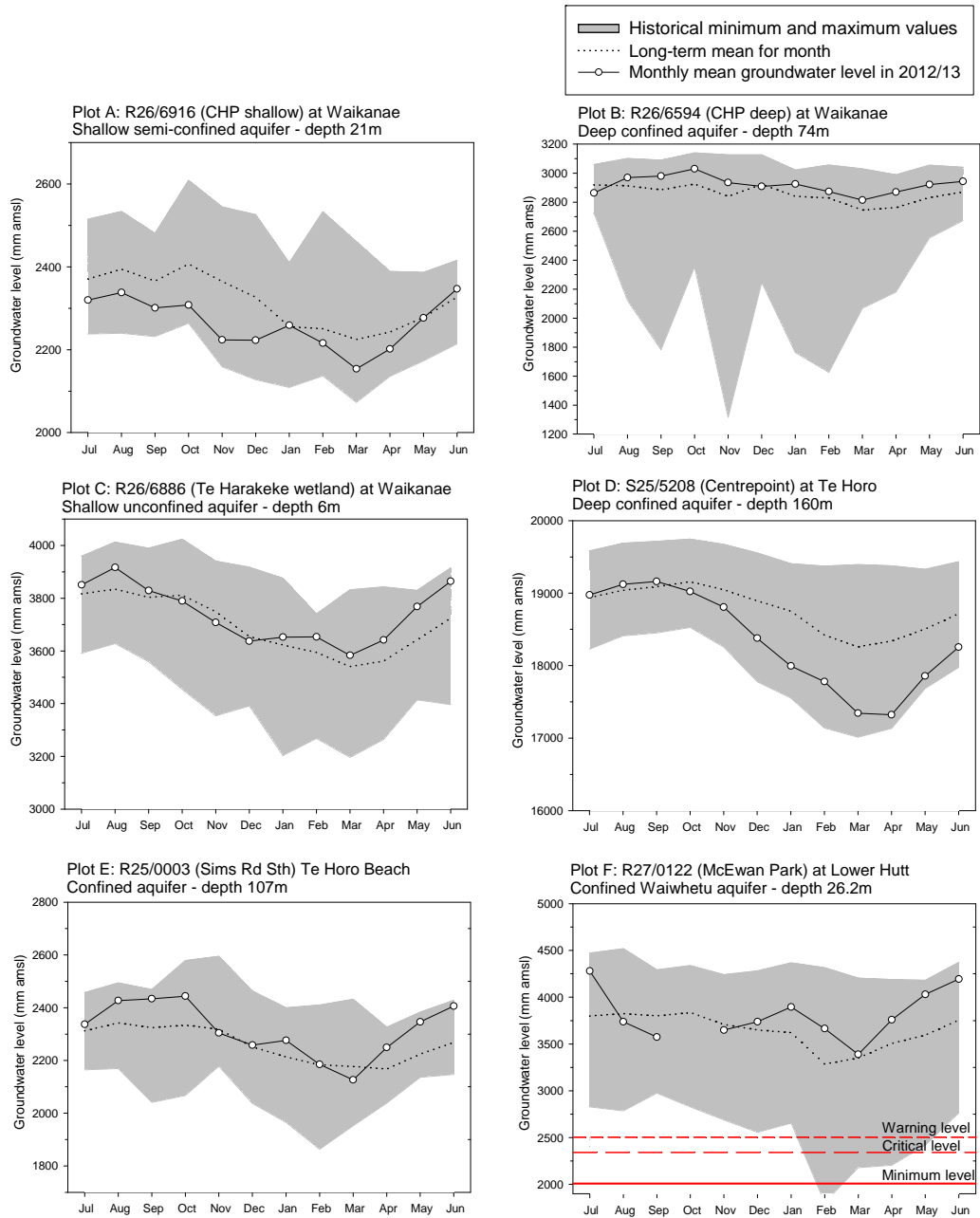


Figure 5.2: 2012/13 mean monthly groundwater levels in the Hutt Valley and on the Kapiti Coast

6. Lake and wetland levels

2012/13 mean monthly lake levels are shown in Figure 6.1. For comparison the long-term mean and historical range are also plotted. The minimum lake water level for Lake Wairarapa (as specified by the National Water Conservation Order) is shown by the red line.

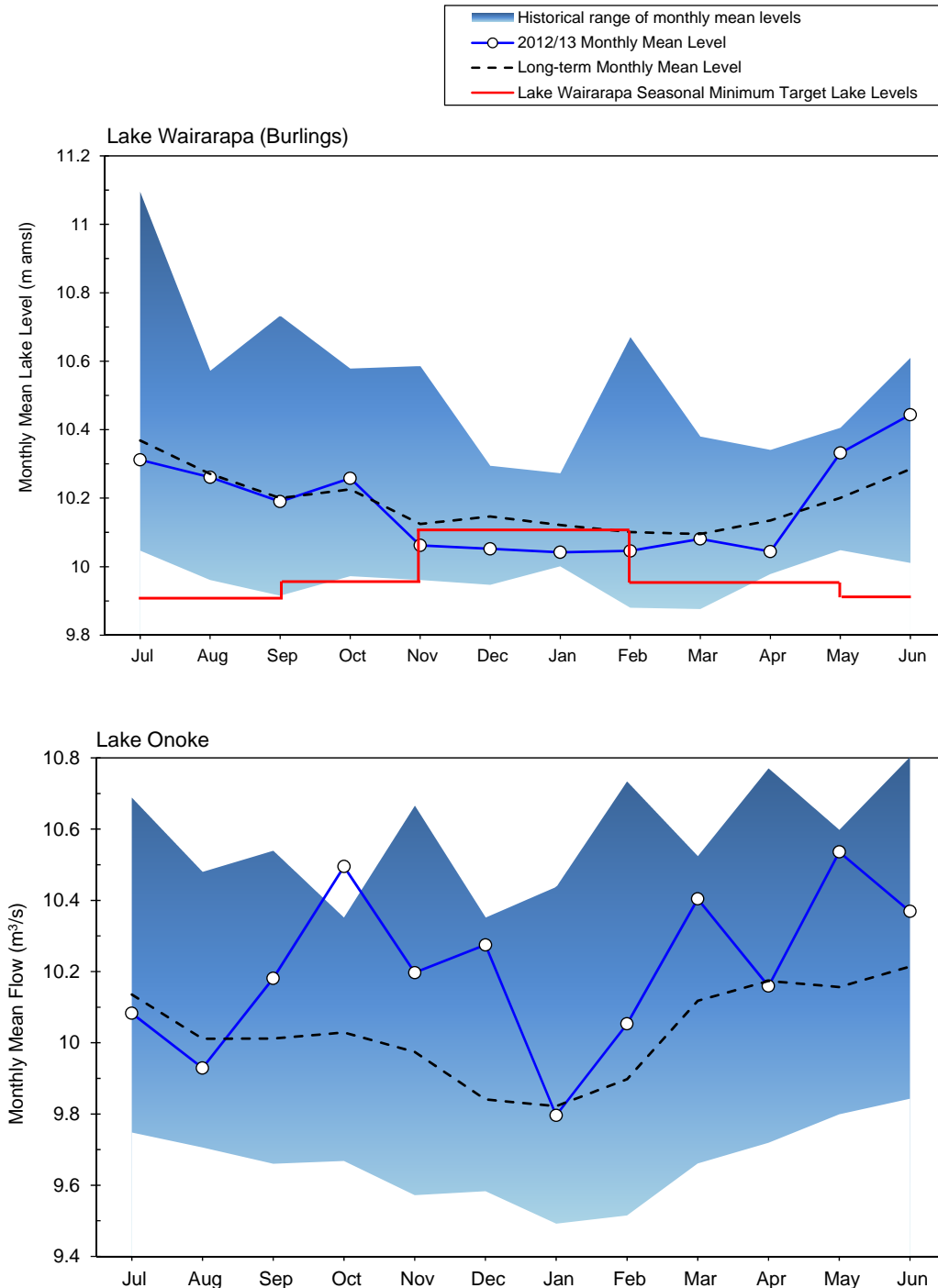


Figure 6.1: 2012/13 mean monthly lake levels

Water levels recorded in the Te Hapua wetland complex during 2012/13 are shown in Figure 6.2.

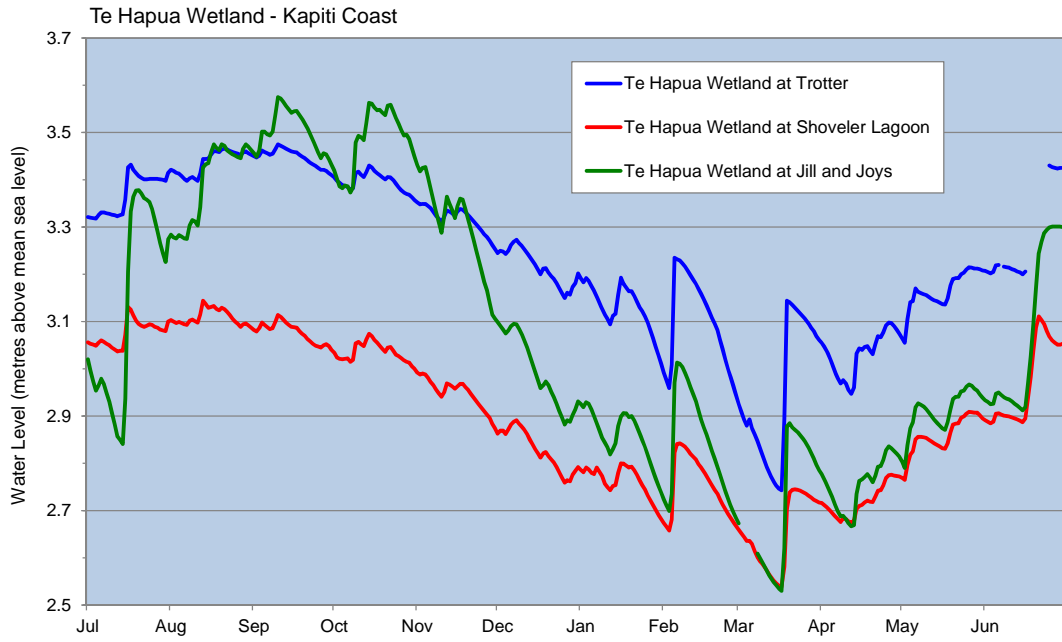


Figure 6.2: 2012/13 water levels in Te Hapua wetland complex

7. Soil moisture

2012/13 mean daily soil moisture content at the Tanawa Hut (near Tinui) and Tauherenikau sites are shown in Figure 7.1. The long-term mean and historical range of recorded values are also shown.

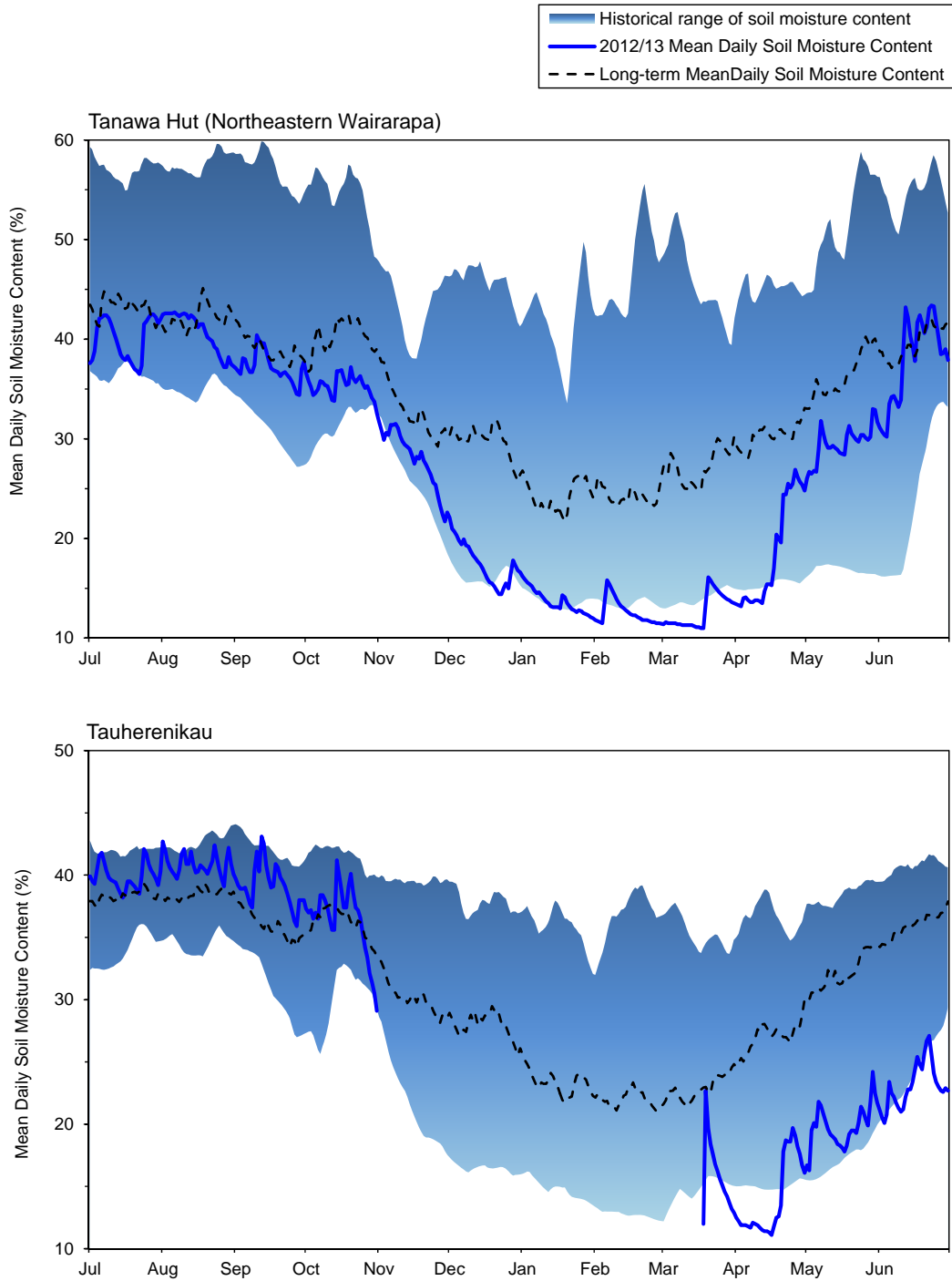


Figure 7.1: 2012/13 mean daily soil moisture content

References

NIWA. 2011. *HIRDS.V3: High Intensity Rainfall Design System*. Accessed from <http://hirds.niwa.co.nz/>