



greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Hydrology State of the Environment monitoring programme

Annual data report 2014/15

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Contents

1.	Introduction	1
2.	Overview of Hydrology SoE monitoring programme	2
2.1	Monitoring objectives	2
2.2	Monitoring network	3
2.2.1	Rainfall	3
2.2.2	River levels and flow	3
2.2.3	Lake levels	4
2.2.4	Wetland levels	4
2.2.5	Tide levels	4
2.2.6	Soil moisture	4
2.2.7	Groundwater levels	5
2.2.8	Whaitua areas	5
3.	Results	10
3.1	Rainfall	10
3.2	River flows	18
3.3	Groundwater levels	27
3.4	Lake and wetland levels	29
3.5	Soil moisture	31
	References	32

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 key results from the Hydrology State of Environment (SoE) monitoring programme for the period 1 July 2014 to 30 June 2015 inclusive. Summaries of the recorded data are compared to long term averages, and any significant hydrological events are 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. Refer to:

- Rivers State of the Environment Monitoring Programme: Annual Data Report 2014/15 (Keenan & Morar, 2015)
- Groundwater Quality State of the Environment Monitoring Programme: Annual Data Report 2014/15 (Tidswell, 2015)

2. Overview of Hydrology SoE monitoring programme

Rainfall and river levels have been monitored for many years in the Wellington Region. Some of the earliest rainfall records date back to 1878 at the Karori Reservoir site and 1890 at the Wainuiomata Reservoir site. 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
- 70 groundwater level sites (plus a further 71 manually monitored sites).

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

2.1 Monitoring objectives

The information collected is used for:

- 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
- Making informed decisions on the state of the Region's freshwater resources and manage its sustainable allocation and use
- Informing whaitua committees to enable the creation of a unique vision and to prioritise objectives for land and water management
- Policy and Regional Plan development and review
- 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 maintained by GWRC. There is good coverage across much of the Region with the exception of the Eastern Wairarapa hill country where the distribution of sites is sparse.

All rainfall sites are automatic and typically record rainfall amounts at five minute intervals into a data logger on site. The majority of sites are telemetered back to the GWRC database to allow real time monitoring.

There are two measuring devices at each site; an automatic tipping-bucket rain gauge that records rainfall amounts in 0.5mm or 0.2mm increments and a check/storage gauge that collects and stores all rainfall between site visits by the monitoring team when it is measured and emptied.

A number of rainfall sites have alarm levels that are automatically triggered if a high intensity rainfall above a certain threshold occurs. Alarms are received by flood-warning staff and a flood event will be monitored at any time of the day with warnings issued to relevant authorities and landowners if dangerous flood levels are predicted.

2.2.2 River levels and flow

River levels are recorded at 62 sites across the Wellington Region. The distribution of the sites is shown in Figure 2.2 and is similar to the rainfall network. During the 2014/15 year four of the sites were operated solely by NIWA and another four were jointly maintained by NIWA and GWRC.

River level 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 environmental flows and ensure regional plan rules are being met.

All river sites are automatic and typically record river levels every five to 15 minutes. Data are stored on loggers at the site, as well as being 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 of the flow gauging 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.

Most river sites have flood alarm levels that are automatically triggered if a river level rises above a certain threshold. Alarms are received by flood-warning staff and a flood event will be monitored at any time of the day with warnings to relevant 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 and to monitor lake levels for flood control. The prescribed minimum lake water levels are set out in the Lake Wairarapa Wetlands Management Guidelines (Lake Wairarapa Co-ordinating Committee 1991), the Regional Freshwater Plan (GWRC 1999), and the Proposed Natural Resources Plan for the Wellington Region (GWRC 2015).

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

The other two lake 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. 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 70 bores. These are automatic sites where the groundwater level is recorded every five 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. Some of the sites have separate recorders in two bores (for example, a deep bore and a shallow bore).

In addition to the automatic monitoring sites, GWRC also manually measures groundwater levels at a further 71 sites every four to seven 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 (Tidswell, 2015).

2.2.8 Whaitua areas

Managing the water resources of our Region in a way that meets current needs and those of future generation's means that we need to understand what is important to people in their local area.

GWRC has identified five areas that place different demands on land and water resources and is enlisting the support of community groups called whaitua committees to help understand local needs and make recommendations on how they are to be managed. The Māori word whaitua means a designated space or catchment.

Whaitua committees will be established for the Wairarapa East Coast, Ruamāhanga Valley, Wellington/Hutt Valley, Porirua Harbour and Kāpiti Coast over the next few years. They will combine the knowledge and experience of the community who live in the catchment: iwi, householders, farmers, scientists, recreationalists and environmentalists.

The Ruamāhanga Whaitua Committee and the Te Awarua-o-Porirua Whaitua Committee have been established to date.

The whaitua areas are referenced throughout this report and in particular the areas are shown on the maps of the monitoring network in Figures 2.1 to 2.4.

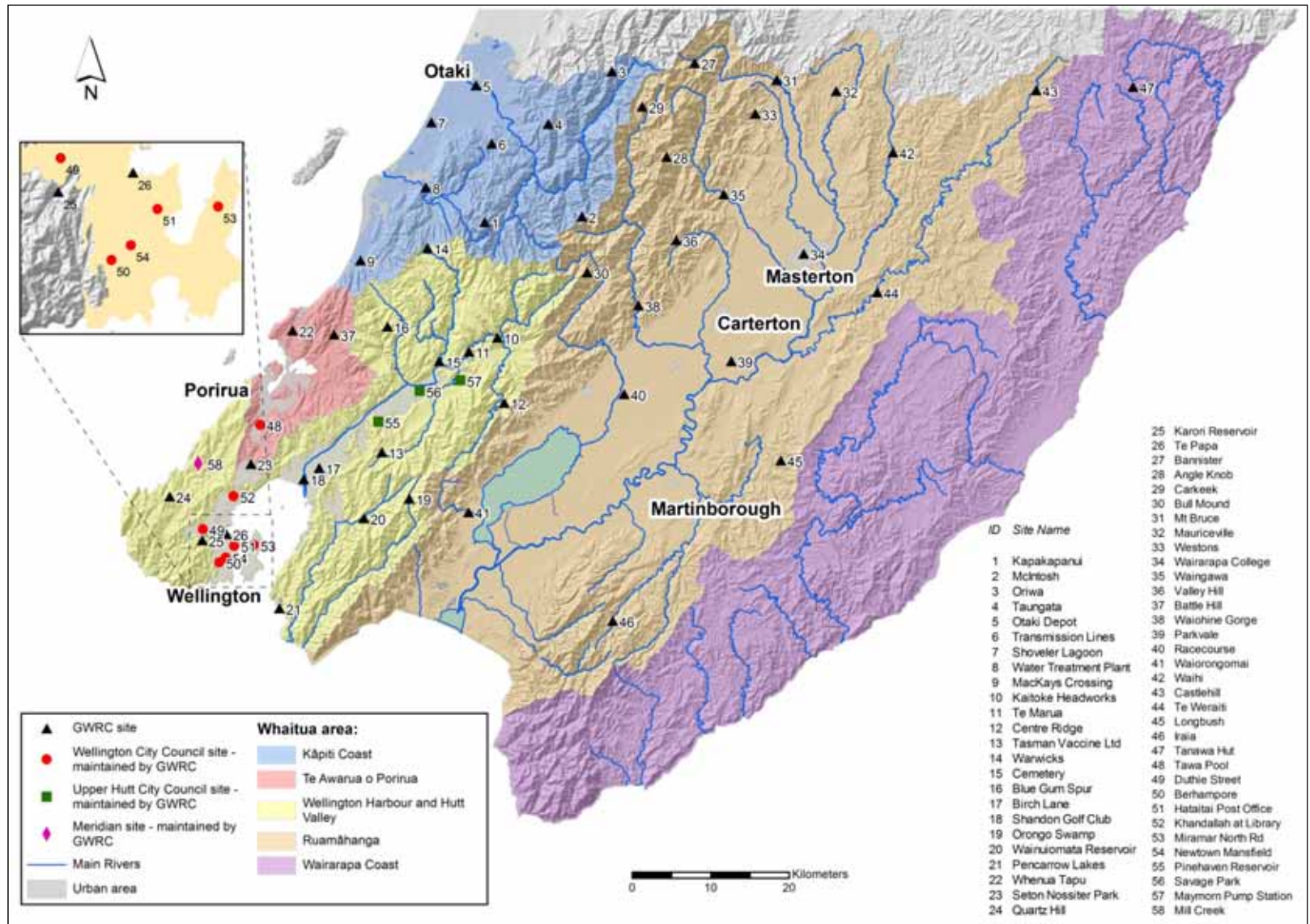


Figure 2.1: Automatic rainfall monitoring sites 2014/15

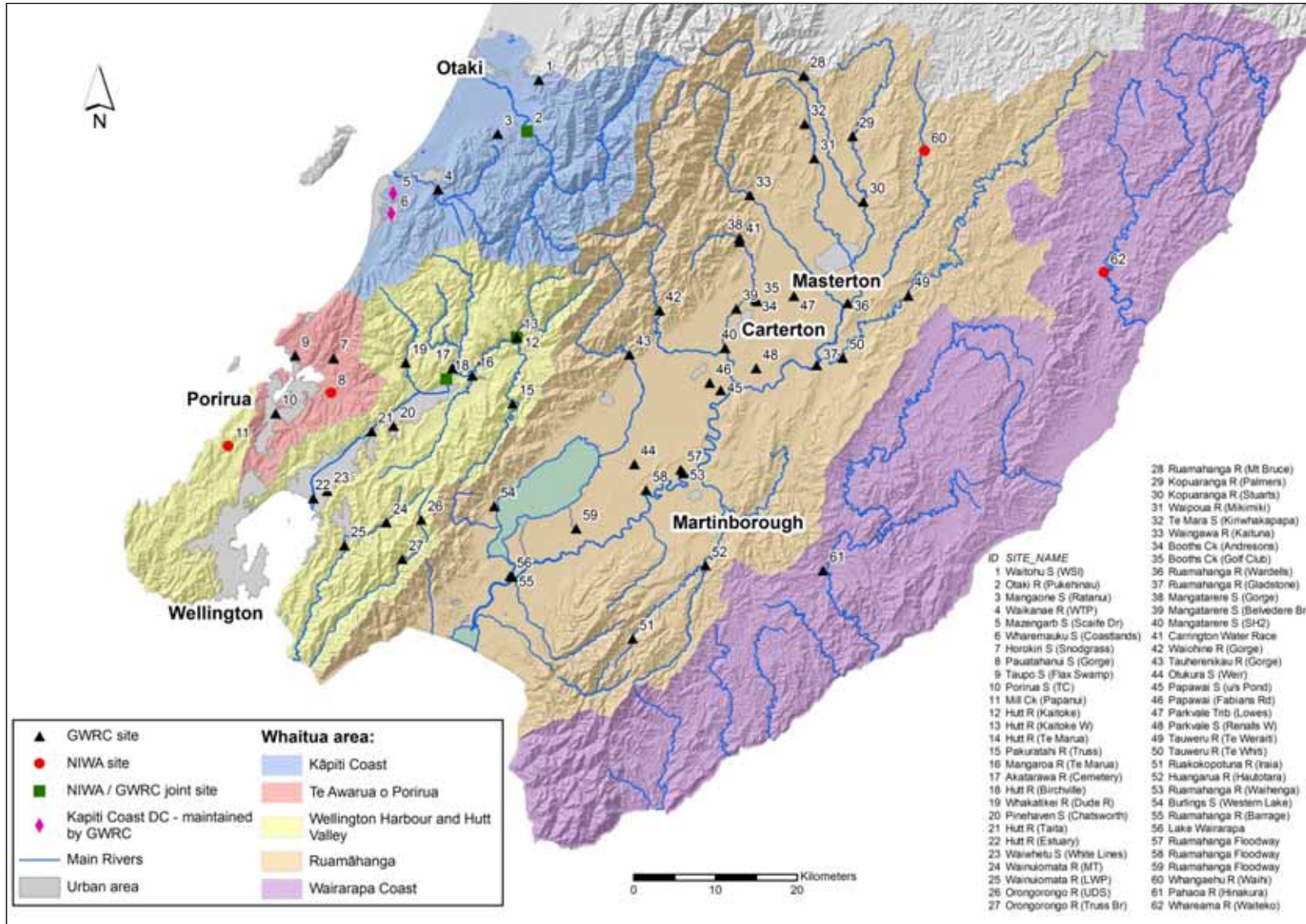


Figure 2.2: Automatic river level/flow monitoring sites 2014/15

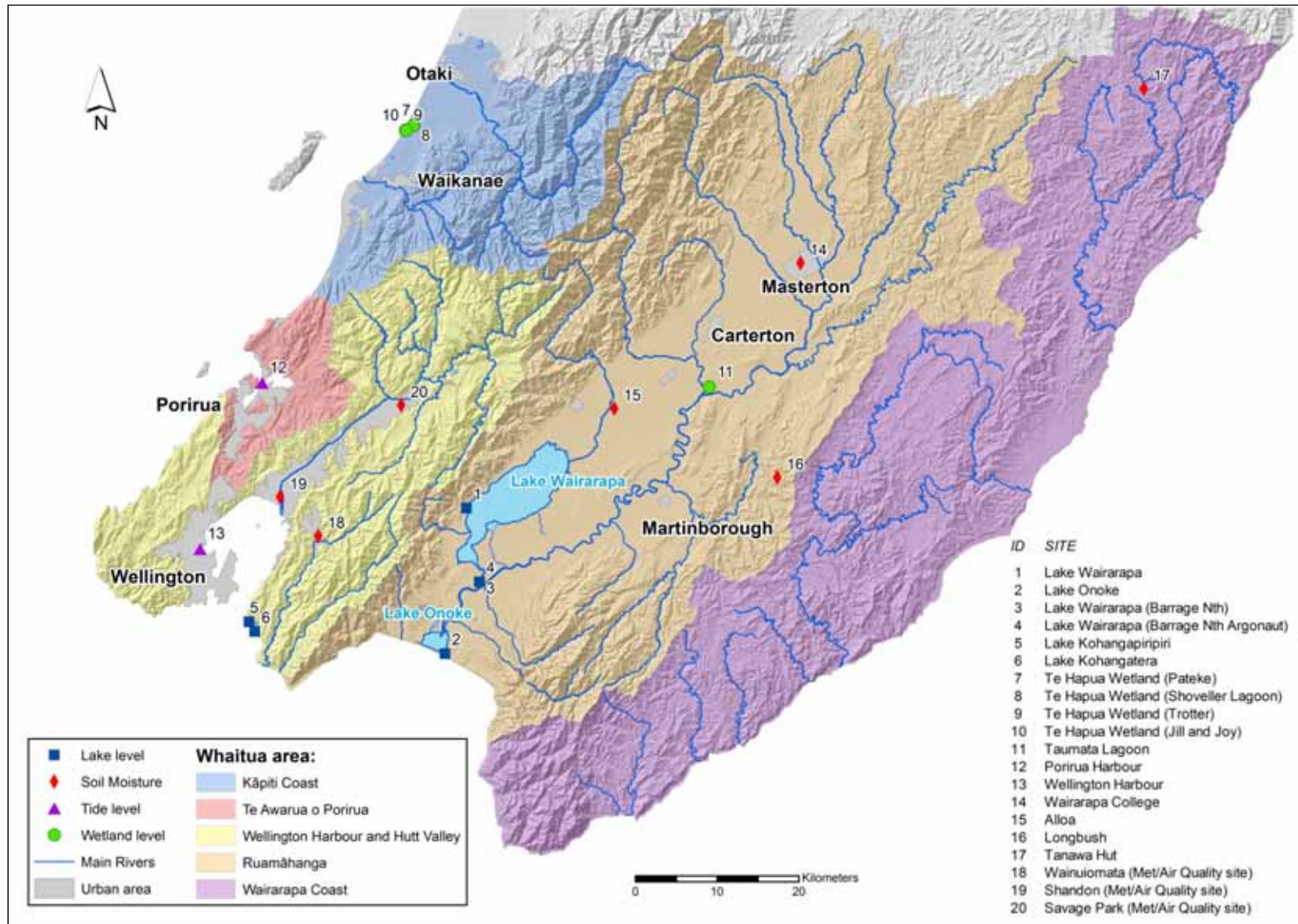


Figure 2.3: Automatic lake level, wetland level, tide level and soil moisture monitoring sites 2014/15

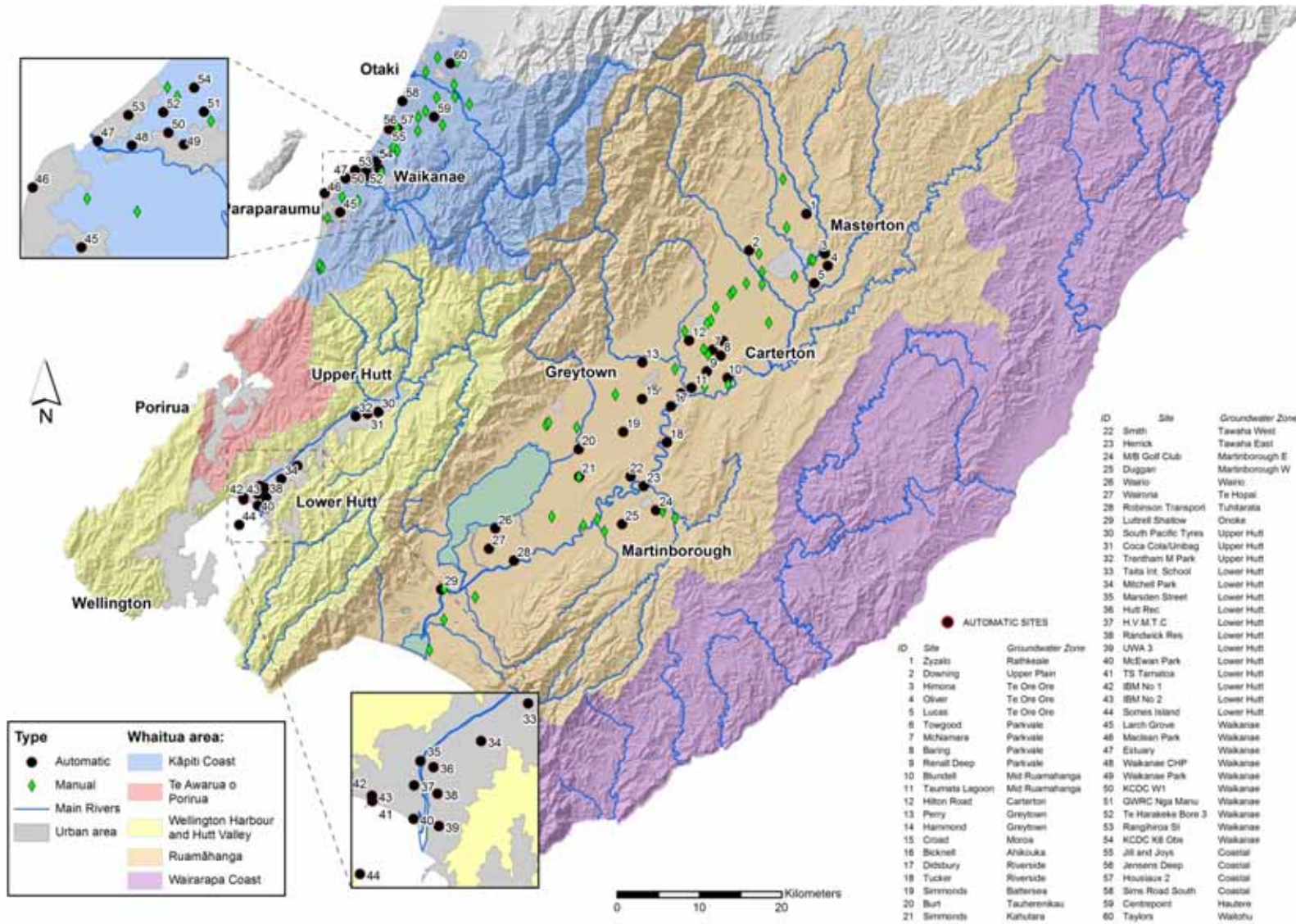


Figure 2.4: Groundwater level sites 2014/15

3. Results

3.1 Rainfall

Table 3.1 summarises the total annual rainfall for 2014/15 at a range of monitoring sites across the Region that are grouped by whaitua area. Sites with greater than 15 percent difference from their long term average are shaded orange (below average) and blue (above average).

Table 3.1: Annual rainfall totals (2014/15) and percentage of long term average

Rainfall Site	Catchment	2014/15 total (mm)	Average (mm) <i>(Data period)</i>	% of long term average
Kāpiti Coast whaitua				
Oriwa (Tararua)	Otaki	4991	4634 (1991-2014)	108
McIntosh (Tararua)	Otaki	5030	5121 (1991-2014)	98
Taungata (Tararua)	Otaki	3325	2907 (1991-2014)	114
Kapakapanui (Tararua)	Otaki	2701	2383 (1991-2014)	113
Transmission Lines	Mangaone	1909	1639 (1992-2014)	116
Otaki Depot	Otaki	1181	1017 (1984-2014)	116
Shoveler Lagoon	Te Hapua Wetlands	972	937 (2009-2014)	104
Water Treatment Plant	Waikanae	1326	1231 (1969-2014)	108
McKay's Crossing	Whareroa	1222	1202 (1972-2014)	102
Wellington Harbour and Hutt Valley whaitua				
Warwicks	Akatarawa	2394	2247 (1980-2014)	107
Blue Gum Spur	Whakatikei	2050	1891 (1981-2014)	108
Kaitoke Headworks	Hutt	1803	2283 (1950-2014)	79
Te Marua	Hutt	1639	1857 (1993-2014)	88
Centre Ridge	Pakuratahi	1807	2075 (1984-2014)	87
Tasman Vaccine Ltd	Mangaroa	1544	1564 (1968-2014)	99
Cemetery	Akatarawa	1541	1689 (1988-2014)	91
Pinehaven	Hutt	1260	1415 (1978-2014)	89
Birch Lane/Mabey Rd	Hutt	1039	1250 (1995-2014)	83
Shandon Golf Club	Hutt	991	1023 (2000-2014)	97
Quartz Hill	Makara	799	1158 (2007-2014)	69
Khandallah at Library	Wellington City	1287	1223 (1996-2014)	105
Karori Reservoir	Kaiwharawhara	1011	1334 (1951-2014)	76
Regional Council	Wellington City	847	972 (1996-2014)	87
Hataitai Post Office	Wellington City	749	1034 (1997-2014)	72
Newtown Mansfield	Wellington City	844	1085 (1996-2014)	78
Orongo Swamp	Orongorongo	2050	2459 (1980-2014)	83
Wainuiomata Reservoir	Wainuiomata	1557	1902 (1951-2014)	82
Pencarrow Lakes	Pencarrow Lakes	653	972 (2007-2014)	67

Table 3.1 (continued)

Rainfall Site	Catchment	2014/15 total (mm)	Average (mm) (Data period)	% of long term average
Te Awarua-o-Porirua whaitua				
Battle Hill	Horokiri	1364	1161 (2003-2014)	118
Whenua Tapu	Taupo	991	1059 (1990-2014)	94
Tawa Pool	Porirua	1123	1133 (1996-2014)	99
Seton Nossiter Park	Porirua	1140	1154 (1992-2014)	99
Ruamāhanga whaitua				
Bannister (Tararua)	Ruamahanga	4737	6152 (1974-2014)	77
Carkeek (Tararua)	Waiohine	4264	4547 (1976-2014)	94
Mt Bruce	Ruamahanga	2130	2442 (1997-2014)	87
Westons	Waipoua	2418	NA ¹	
Angle Knob (Tararua)	Waingawa	7121	6985 (1974-2014)	102
Kaituna	Waingawa	1714	1909 (1994-2014)	90
Valley Hill	Mangatarere	2469	2852 (1997-2014)	87
Bull Mound (Tararua)	Tauherenikau	4091	4523 (1976-2014)	90
Waiohine Gorge/Phelps	Waiohine	2080	2069 (1974-2014)	101
Mauriceville	Kopuaranga	1285	1498 (2008-2014)	86
Waihi	Whangaehu	914	1158 (2001-2014)	79
Castlehill	Tauweru	922	1164 (1991-2014)	79
Wairarapa College	Ruamahanga	837	900 (2002-2014)	93
Te Weraiti	Tauweru	648	839 (1997-2014)	77
Alloa/Racecourse	Tauherenikau	865	1073 (1999-2014)	81
Matthews	Wairongomai	1375	NA ¹	
Longbush	Waikoukou	727	934 (1955-2014)	79
Wairarapa Coast whaitua				
Tanawa Hut	Whareama	838	1308 (1955-2014)	64

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

Monthly rainfall totals at a number of rainfall monitoring sites across the Region are shown in Figure 3.1.

The 2014/15 totals are compared to the long term monthly average.

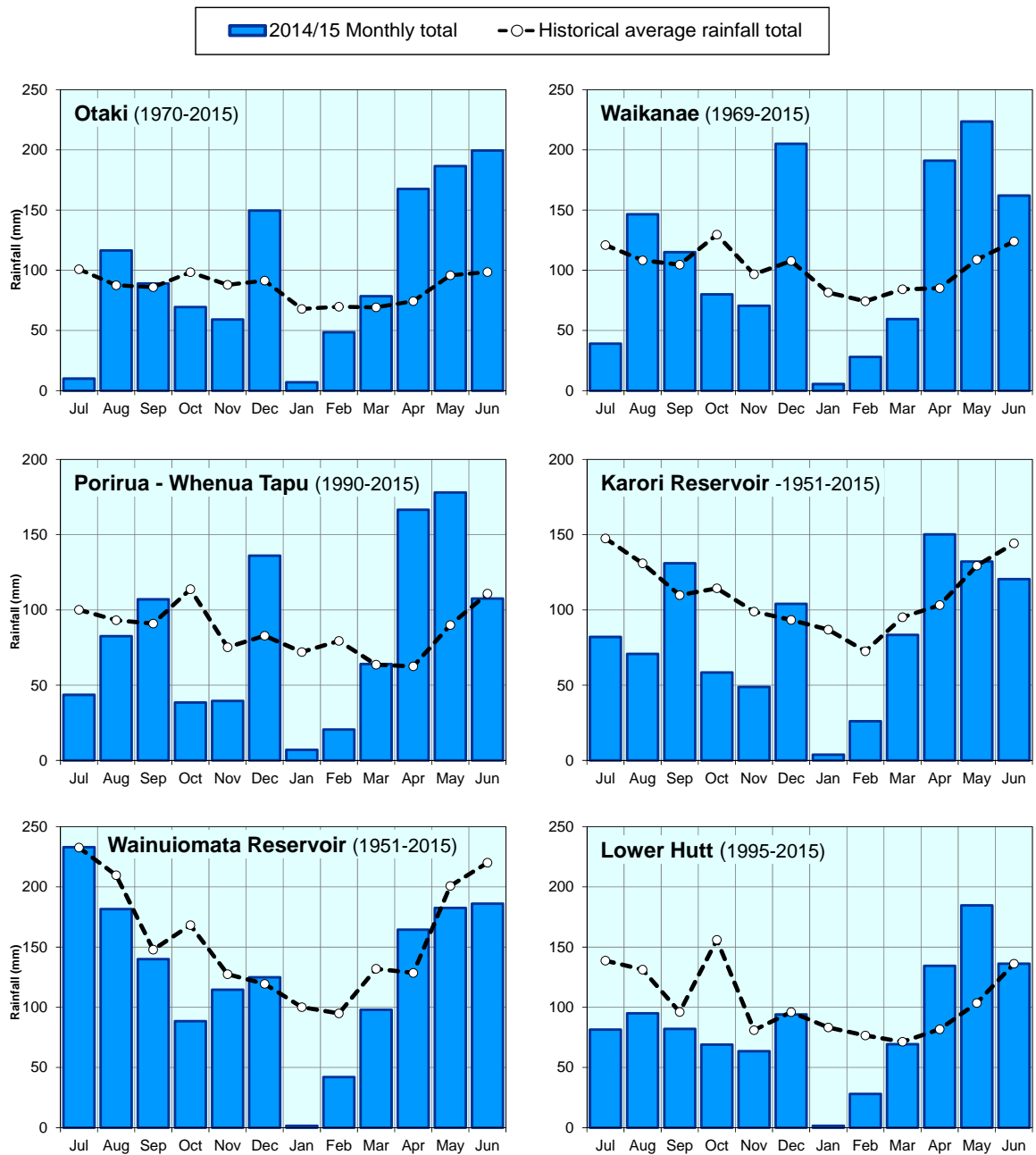


Figure 3.1: Monthly rainfall totals (2014/15) and long-term averages

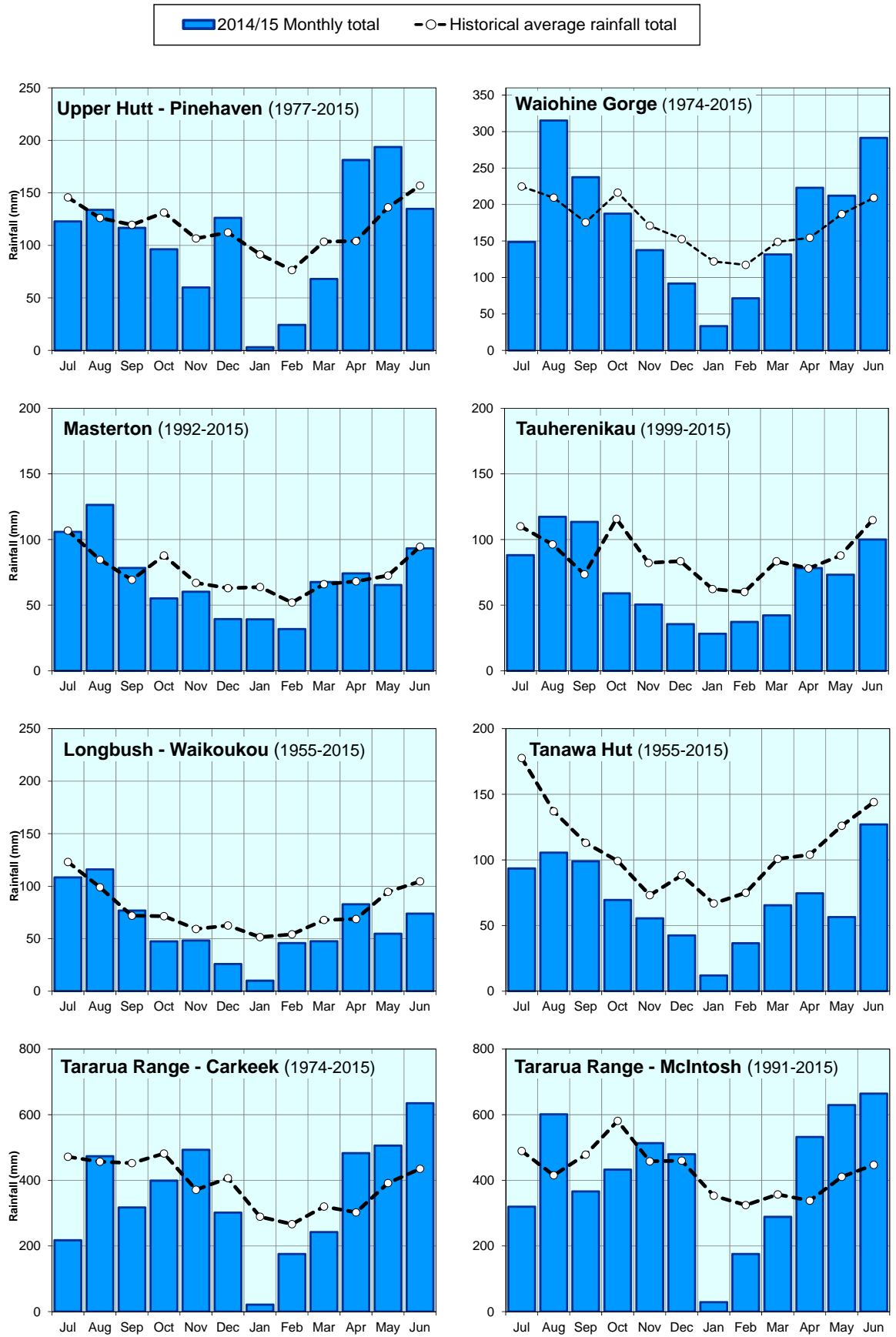


Figure 3.1 (continued)

Seasonal rainfall totals for locations across the Wellington Region are presented in Table 3.2.

Sites that have a greater than 20 percent difference from their long term seasonal average are shaded orange (below average) or blue (above average).

Table 3.2: Seasonal rainfall totals as percentage of long-term mean

Whaitua area	Rain gauge location	Rainfall as a percentage of the long term average			
		Winter 2014	Spring 2014	Summer 2014/15	Autumn 2015
Kāpiti Coast	Otaki	61%	76%	89%	199%
	Waikanae	73%	90%	98%	92%
	McKay's Crossing	70%	81%	85%	196%
	McIntosh (Tararua Range)	111%	86%	61%	131%
Te Awarua-o-Porirua	Whenua Tapu	68%	66%	69%	186%
	Paparangi	57%	76%	68%	161%
Wellington Harbour and Hutt Valley	Kaitoke	73%	83%	36%	106%
	Lower Hutt	61%	64%	47%	153%
	Wainuiomata	78%	76%	49%	93%
	Newtown	64%	62%	55%	135%
	Karori	60%	80%	54%	118%
	Makara	61%	71%	56%	99%
Ruamāhanga	Mt Bruce	86%	94%	36%	98%
	Waihi	79%	82%	48%	94%
	Castlehill	85%	85%	51%	80%
	Masterton	95%	89%	64%	100%
	Featherston	83%	86%	52%	81%
	Longbush	86%	85%	49%	81%
	Carkeek (Tararua Range)	93%	93%	51%	125%
Wairarapa Coast	Tanawa Hut	65%	79%	39%	58%

An analysis of the maximum recorded rainfall totals during the 2014/15 year for specific time periods of 1, 6 and 12 hour durations is detailed in Table 3.3.

Return periods have been estimated by frequency analysis. Values in blue shaded cells indicate a rainfall total with a 5-year return period or greater.

Table 3.3: Maximum short duration rainfall totals during 2014/15

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)
Otaki Depot (Otaki)	15.5 mm <i>12 May 2015</i>	1	63 mm <i>19 Jun 2015</i>	25	76 mm <i>19 Jun 2015</i>	19
McKay's Crossing (Paekakariki) ¹	22.5 mm <i>14 May 2015</i>	4	88 mm <i>14 May 2015</i>	50	112 mm <i>14 May 2015</i>	45
Warwicks (Akatarawa)	27.5 mm <i>14 May 2015</i>	5	79 mm <i>14 May 2015</i>	4	109 mm <i>14 May 2015</i>	3
Battle Hill (Horokiri)	30 mm <i>14 May 2015</i>	10	76 mm <i>14 May 2015</i>	30	112 mm <i>14 May 2015</i>	50
TVL (Mangaroa)	24.5 mm <i>12 May 2015</i>	3	42 mm <i>27 Oct 2014</i>	1	60 mm <i>14 May 2015</i>	2
Birch Lane (Lower Hutt)	42.4 mm <i>14 May 2015</i>	40	65 mm <i>14 May 2015</i>	4	87 mm <i>14 May 2015</i>	5
Wainuiomata Reservoir (Wainuiomata)	28.2 mm <i>14 May 2015</i>	10	47 mm <i>14 May 2015</i>	1	64 mm <i>14 May 2015</i>	1
Tawa Pool (Porirua)	39 mm <i>14 May 2015</i>	20	76 mm <i>14 May 2015</i>	15	95 mm <i>14 May 2015</i>	15
Karori Reservoir (Wellington City)	30.4 mm <i>28 Apr 2015</i>	7	34 mm <i>28 Apr 2015</i>	1	41 mm <i>28 Apr 2015</i>	1
McIntosh (W Tararua Range)	27.9 mm <i>19 Jun 2015</i>	2	117 mm <i>19 Jun 2015</i>	4	156 mm <i>20 Jun 2015</i>	3
Bannister Basin (E Tararua Range)	24.5 mm <i>26 Nov 2014</i>	1	101 mm <i>27 Oct 2014</i>	1	133 mm <i>27 Oct 2014</i>	1
Waiohine Gorge ² (Waiohine)	15.5 mm <i>2 Aug 2014</i>	1	69 mm <i>2 Aug 2014</i>	5	105 mm <i>2 Aug 2014</i>	5
Wairarapa College (Masterton) ¹	22.0 mm <i>21 Jan 2015</i>	8	35 mm <i>21 Jan 2015</i>	2	35 mm <i>21 Jan 2015</i>	1
Tauherenkau Racecourse (Featherston) ³	25.6 mm <i>21 Jan 2015</i>	30	28 mm <i>21 Jan 2015</i>	1	32 mm <i>2 Aug 2014</i>	1
Castlehill (Tauweru)	11.0 mm <i>20 Jun 2015</i>	1	37 mm <i>20 Jun 2015</i>	2	54 mm <i>20 Jun 2015</i>	2
Tanawa Hut (Whareama)	9.0 mm <i>29 Mar 2015</i>	1	29 mm <i>20 Jun 2015</i>	1	44 mm <i>20 Jun 2015</i>	1

¹ Return period estimated using HIRDS v3.0 (NIWA 2011).

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

³ Return period estimated combining Racecourse data with 'Alloa' site that was closed in November 2012

An analysis of the maximum recorded rainfall totals during the 2014/15 year for longer duration events of 24, 48 and 72 hour durations is detailed in Table 3.4.

Return periods have been estimated by frequency analysis. Values in blue shaded cells indicate a rainfall total with a 5-year return period or greater.

Table 3.4: Maximum long duration rainfall totals during 2014/15

Site	24 hour		48 hours		72 hours	
	Rainfall Start date	Return period (years)	Rainfall Start date	Return period (years)	Rainfall Start date	Return period (years)
Otaki Depot (Otaki)	93 mm 19 Jun 2015	20	128 mm 19 Jun 2015	35	130 mm 19 Jun 2015	30
McKay's Crossing (Paekakariki) ¹	145 mm 14 May 2015	40	165 mm 15 May 2015	35	179 mm 13 May 2015	35
Warwicks (Akatarawa)	147 mm 14 May 2015	3	178 mm 14 May 2015	3	229 mm 9 Apr 2015	5
Battle Hill (Horokiri)	144 mm 14 May 2015	40	160 mm 13 May 2015	30	184 mm 13 May 2015	30
TVL (Mangaroa)	88 mm 14 May 2015	2	108 mm 15 May 2015	2	128 mm 13 May 2015	2
Birch Lane (Lower Hutt)	105 mm 14 May 2015	4	112 mm 14 May 2015	4	124 mm 13 May 2015	3
Wainuiomata Reservoir (Wainuiomata)	80 mm 14 May 2015	1	94 mm 14 May 2015	1	99 mm 13 May 2015	1
Tawa Pool (Porirua)	115 mm 14 May 2015	20	120 mm 14 May 2015	15	128 mm 9 Apr 2015	13
Karori Reservoir (Wellington City)	52 mm 8 Apr 2015	1	65 mm 8 Apr 2015	1	84 mm 13 May 2015	1
McIntosh (W Tararua Range)	226 mm 19 Jun 2015	3	326 mm 19 Jun 2015	5	352 mm 19 Jun 2015	4
Bannister Basin (E Tararua Range)	183 mm 2 Aug 2014	1	259 mm 2 Aug 2014	1	280 mm 2 Aug 2014	1
Waiohine Gorge ² (Waiohine)	125 mm 3 Aug 2014	4	170 mm 2 Aug 2014	4	177 mm 2 Aug 2014	3
Wairarapa College (Masterton) ¹	39 mm 20 Jun 2015	1	50 mm 19 Jun 2015	1	54 mm 22 Jul 2014	1
Racecourse (Featherston) ³	42 mm 3 Aug 2014	1	56 mm 2 Aug 2014	1	57 mm 2 Aug 2014	1
Castlehill (Tauweru)	66 mm 20 Jun 2015	1	80 mm 20 Jun 2015	1	82 mm 20 Jun 2015	1
Tanawa Hut (Whareama)	54 mm 20 Jun 2015	1	63 mm 20 Jun 2015	1	65 mm 20 Jun 2015	1

¹ Return period estimated using HIRDS v3.0 (NIWA 2011).

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

³ Return period estimated combining Racecourse data with 'Alloa' site that was closed in November 2012

The lowest recorded rainfall totals over periods of 14 days, 28 days and 3 months are detailed in Table 3.5 for sites across the region.

Table 3.5: Lowest rainfall totals during 2014/15

Site	14 days		28 days		3 months	
	Rainfall (mm)	Start Date	Rainfall (mm)	Start Date	Rainfall (mm)	Start Date
Otaki Depot (Otaki)	0	30 Jun 2014, 22 Aug 2014, 17 Jan 2015	6	30-Jun 2014	130	21 Dec 2014
Water Treatment Plant (Waikanae)	0	22 Aug 2014, 17 Jan 2015	5	31 Dec 2014	90	25 Dec 2014
McKay's Crossing (Paekakariki)	0	23 Aug 2014, 17 Jan 2015, 9 Feb 2015	1	31 Dec 2014	79	20 Dec 2014
Battle Hill (Horokiri)	0	17 Jan 2015	6.5	31 Dec 2014	111	20 Dec 2014
Tawa Pool	0	17 Jan 2015	3	31 Dec 2014	114	20 Dec 2014
Karori Reservoir	0	17 Jan 2015	3.6	3 Jan 2015	113	3 Jan 2015
Newtown	0	17 Jan 2015	2.4	31 Dec 2014	95	21 Dec 2014
Birch Lane (Lower Hutt)	0	17 Jan 2015	1.5	31 Dec 2014	99	31 Dec 2014
Wainuiomata Reservoir	0	17 Jan 2015	1	3 Jan 2015	135	12 Dec 2014
Savage Park (Upper Hutt)	1	31 Dec 2014	4.6	3 Jan 2015	108	21 Dec 2014
Kaitoke Headworks	0	31 Dec 2014	3.5	31 Dec 2014	125	31 Dec 2014
McIntosh (Tararuas - Penn Creek)	6.5	16 Feb 2015	25	31 Dec 2014	468	22 Dec 2014
Bannister Basin (Tararuas - Ruamahanga River)	7	31 Dec 2014	53	31 Dec 2014	500	22 Dec 2014
Waiohine River Gorge	0	31 Dec 2014	18	21 Dec 2014	166	2 Dec 2014
Wairarapa College (Masterton)	0.8	24 Dec 2014	3	13 Dec 2014	86	13 Dec 2014
Tauherenikau Racecourse (Featherston)	0	8 Oct 2014	3.4	22 Dec 2014	86	6 Nov 2014
Tanawa Hut (E Wairarapa - Whareama)	0	21 Dec 2014	0.5	21 Dec 2014	69	13 Dec 2014
Longbush (E Wairarapa, Waikoukou)	0	20 Dec 2014	0.5	20 Dec 2014	60	14 Nov 2014

3.2 River flows

Mean monthly river flows for selected monitoring sites are detailed in Figure 3.2. The plots cover main rivers in the Kapiti Coast, Porirua, Hutt Valley, Wairarapa Valley and the Eastern Hills areas.

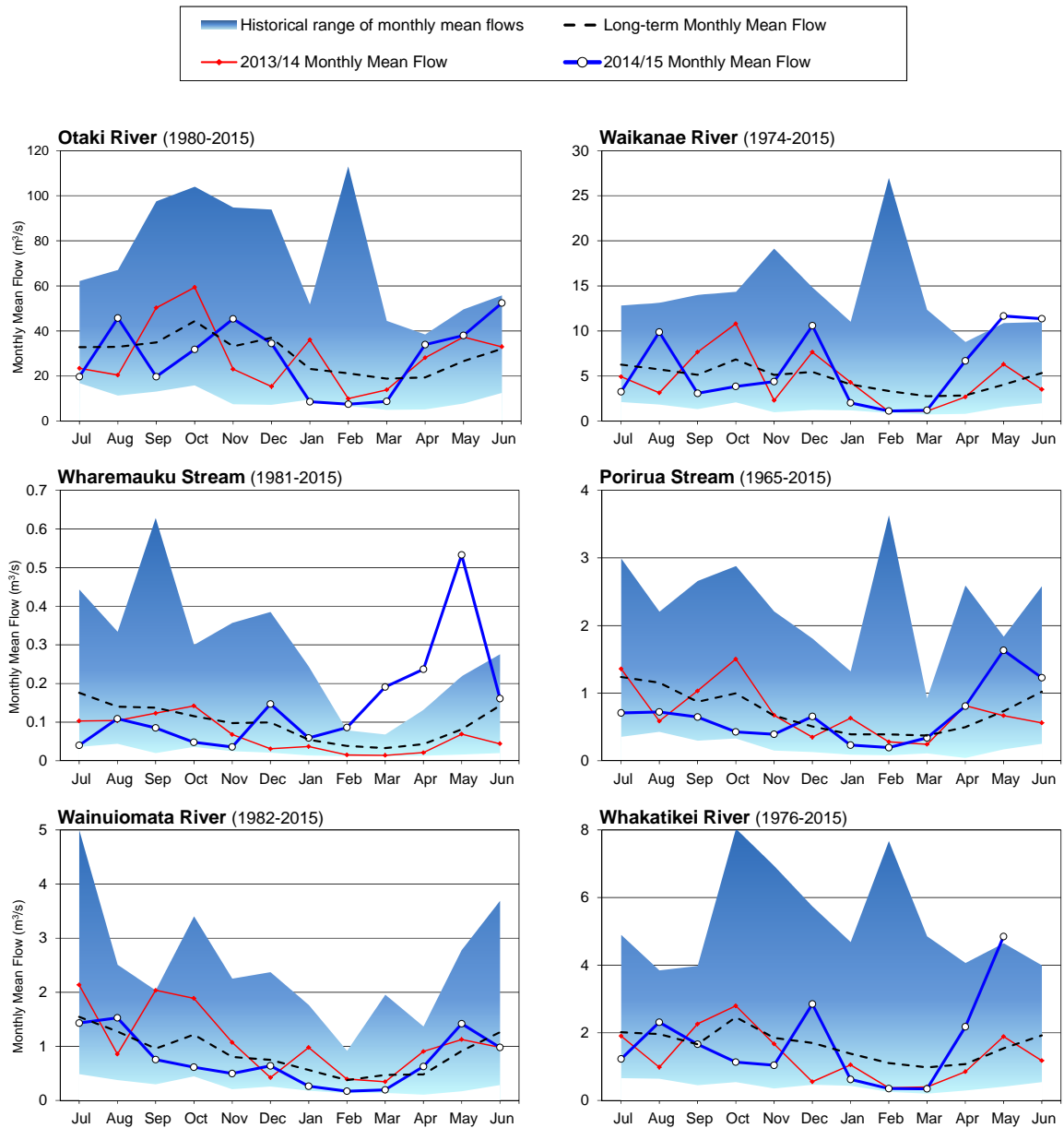


Figure 3.2: Mean monthly river flows (2014/15) and long term averages

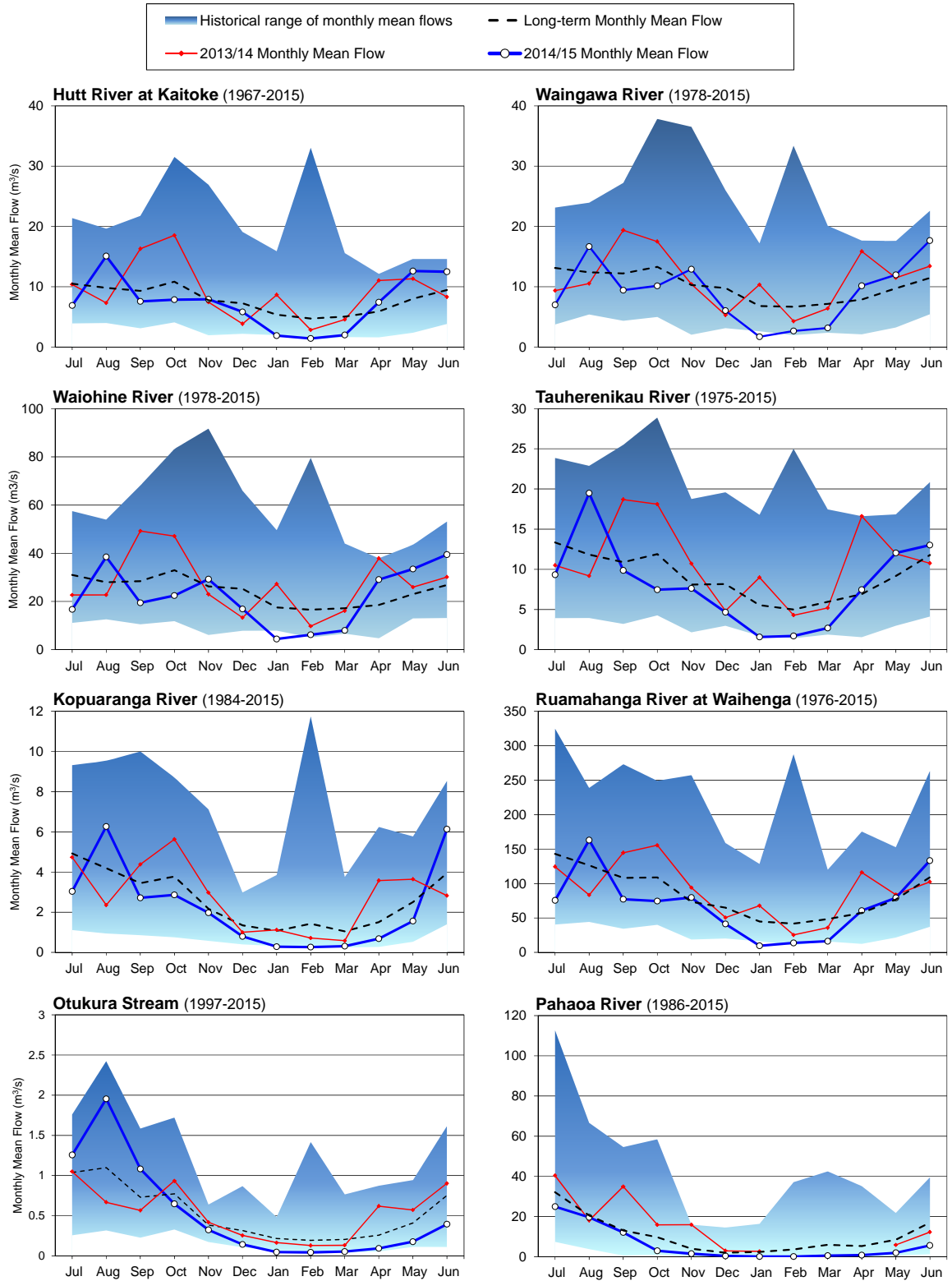


Figure 3.2 (continued)

Maximum recorded river flows for a number of sites are detailed in Table 3.6. The sites highlighted with blue shading indicate a flood flow in excess of a 5-year return period.

Table 3.6: Maximum river and stream flows during 2014/15

Site	2014/15 maximum flow (m ³ /s)	Date occurred	Estimated return period (years)
Waitohu Stream at Water Supply Intake	83	19 Jun 2015	14
Otaki River at Pukehinau ¹	1205	19 Jun 2015	8
Mangaone Stream at Ratanui	20	19 Jun 2015	5
Waikanae River at Water Treatment Plant	278	20 Jun 2015	14
Hutt River at Kaitoke ¹	274	2 Aug 2014	3
Hutt River at Birchville	606	2 Aug 2014	1.5
Hutt River at Taita Gorge	733	14 May 2015	2
Pakuratahi River at Truss Bridge	93	28 Apr 2015	2
Mangaroa River at Te Marua	63	14 May 2015	1
Akatarawa River at Cemetery	303	14 May 2015	2.5
Whakatikei River at Dude Ranch	131	14 May 2015	7
Waiwhetu Stream at Whites Line East	13	14 May 2015	2
Wainuiomata River at Manuka Track	30	14 May 2015	2
Wainuiomata River at Leonard Wood Park	38	14 May 2015	1
Orongorongo River at Upper Dam Site	19	14 May 2015	1
Taupo Stream at Flax Swamp	10	14 May 2015	28
Horokiri Stream at Snodgrass	60	14 May 2015	12
Porirua Stream at Town Centre	66	14 May 2015	20
Ruamahanga River at Mt Bruce	300	20 Jun 2015	2
Ruamahanga River at Wardells	599	20 Jun 2015	5
Ruamahanga River at Gladstone Bridge	1032	20 Jun 2015	4
Ruamahanga River at Waihenga Bridge	1063	20 Jun 2015	2
Waipoua River at Mikimiki Bridge	162	20 Jun 2015	2
Waingawa River at Kaituna	320	19 Jun 2015	3.5
Mangatarere River at Gorge	46	20 Jun 2015	1
Waiohine River at Gorge	933	19 Jun 2015	3
Tauherenikau at Gorge	362	2 Aug 2014	4
Kopuaranga at Palmers Bridge	59	21 Jun 2015	1
Taueru River at Te Weraiti	83	23 Jul 2014	1
Huangarua at Hautotara	87	23 Jul 2014	1
Pahaoa River at Hinakura ¹	227	23 Jul 2014	1

¹ Data provided by NIWA but frequency analysis performed by GWRC

Minimum recorded river flows (averaged over 7 and 28 day periods) during the 2014/15 year are detailed in Table 3.7 for the western part of the Region, and Table 3.8 for the eastern part of the Region. Significant low flow events (5-year return period or greater) are shaded orange.

Table 3.7: Lowest 7-day and 28-day mean flows during 2014/15 in the western Wellington Region

Site	Data begins	7-day duration			28-day duration		
		2014/15 lowest mean flow (m ³ /s)	Start date	Estimated return period (years)	2014/15 lowest mean flow (m ³ /s)	Start date	Estimated return period (years)
Waitohu Stream at WSI	1994	0.114	27 Feb 2015	6	0.143	6 Feb 2015	7
Otaki River at Pukehinau ²	1980	2.905	27 Feb 2015	30	4.178	6 Feb 2015	25
Mangaone Stream at Ratanui	1993	0.072	27 Feb 2015	2	0.085	6 Feb 2015	3
Waikanae River at WTP	1974	0.779	19 Mar 2015	6	1.036	10 Mar 2015	4
Hutt River at Kaitoke ²	1968	0.849	27 Feb 2015	40	1.081	6 Feb 2015	23
Hutt River at Birchville ^{1,2}	1970	2.735	27 Feb 2015	2	2.985	6 Feb 2015	4
Hutt River at Taita Gorge ¹	1979	3.044	27 Feb 2015	3	3.327	6 Feb 2015	10
Pakuratahi River at Truss Bridge	1978	0.147	27 Feb 2015	17	0.173	7 Feb 2015	22
Mangaroa River at Te Marua	1977	0.189	27 Feb 2015	9	0.236	6 Feb 2015	14
Akatarawa River at Cemetery	1979	0.804	27 Feb 2015	7	0.905	6 Feb 2015	10
Whakatikei River at Dude Ranch	1976	0.261	31 Mar 2015	4	0.304	10 Mar 2015	4
Wainuiomata River at Manuka Track	1982	0.129	27 Feb 2015	6	0.152	7 Feb 2015	6
Orongorongo River at UDS	1980	0.040	27 Feb 2015	1.5	0.056	7 Feb 2015	2
Taupo Stream at Flax Swamp	1979	0.007	16 Feb 2015	2	0.008	6 Feb 2015	3
Horokiri Stream at Snodgrass	2002	0.093	31 Mar 2015	2	0.104	6 Feb 2015	2
Porirua Stream at Town Centre	1965	0.129	27 Feb 2015	3	0.17	6 Feb 2015	3

¹ Low flow likely to have been significantly affected by upstream abstraction.

² Data provided by NIWA but frequency analysis performed by GWRC

Table 3.8: Lowest 7-day and 28-day mean flows during 2014/15 in the Wairarapa

Site	Data begins	7-day duration			28-day duration		
		2014/15 lowest mean flow (m ³ /s)	Start date	Estimated return period (years)	2014/15 lowest mean flow (m ³ /s)	Start date	Estimated return period (years)
Ruamahanga River at Mt Bruce	1975	0.826	27 Feb 2015	18	1.33	4 Jan 2015	9
Ruamahanga River at Wardells ^{1,4}	1977	1.993	28 Feb 2015	7	2.692	5 Jan 2015	7
Ruamahanga River at Waihenga Br ¹	1976	4.630	28 Feb 2015	40	7.450	8 Feb 2015	17
Waipoua River at Mikimiki ³	2007	0.109	28 Feb 2015	7	0.25	7 Feb 2015	4
Waingawa River at Kaituna	1977	0.974	27 Feb 2015	9	1.39	4 Jan 2015	10
Mangatarere Strm at Gorge	1999	0.095	27 Feb 2015	7	0.159	7 Feb 2015	5
Waiohine River at Gorge	1978	2.148	27 Feb 2015	60	3.488	4 Jan 2015	25
Tauherenikau River at Gorge	1975	0.842	27 Feb 2015	16	1.171	7 Feb 2015	14
Kopuaranga River at Palmers ¹	1984	0.218	28 Feb 2015	6	0.245	7 Feb 2015	7
Otukura Stream at Weir ¹	1997	0.022	1 Mar 2015	9	0.037	11 Feb 2015	12
Papawai Stream u/s Oxi Pond ¹	2006	0.116	1 Mar 2015	2	0.119	7 Feb 2015	3
Pahaoa River at Hinakura ²	1986	0.027	16 Jan 2015	4	0.053	17 Jan 2015	4

¹ Low flow likely to have been significantly affected by upstream abstraction.

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

³ Short data record at site.

⁴ Record disrupted by channel works – some analysis based on upstream recorder.

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

Table 3.9 summarises the number of instances that the first restriction threshold was reached during 2014/15 for rivers and streams as specified in the Regional Freshwater Plan. Results from the previous three years are included for comparison.

Table 3.9: 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			
			2011/12	2012/13	2013/14	2014/15
Kapiti Coast	Waitohu Stream	0.180	43	13	51	55
	Otaki River	4.375	4	21	3	34
	Mangaone Stream	0.045	0	0	0	0
	Waikanae River	0.900	0	0	35	24
Wairarapa	Ruamahanga River (Wardells)	2.700	6	50	0	32
	Ruamahanga River (Waihenga)	9.800	0	54	2	49
	Waiohine River	3.040	0	22	0	23
	Tauherenikau River	1.350	0	32	1	54
	Waingawa River	1.900	13	70	21	69
	Kopuaranga River	0.270	0	34	0	50
	Waipoua River	0.300	0	64	0	46
Mangatarere Stream (Gorge)	0.330	22	103	26	87	
Wellington/Hutt Valley	Hutt River (Birchville)	1.450	0	0	0	0
	Wainuiomata River (Leonard Wood Park)	0.360	0	38	13	70
	Orongorongo River	0.100	0	2	0	0

Area	River or stream	First restriction threshold (m ³ /s)	Number of days below threshold			
			2011/12	2012/13	2013/14	2014/15
Kapiti Coast	Waitohu Stream	0.180	43	13	51	55
	Otaki River	4.375	4	21	3	34
	Mangaone Stream	0.045	0	0	0	0
	Waikanae River	0.900	0	0	35	24
Wairarapa	Ruamahanga River (Wardells)	2.700	6	50	0	32
	Ruamahanga River (Waihenga)	9.800	0	54	2	49
	Waiohine River	3.040	0	22	0	23
	Tauherenikau River	1.350	0	32	1	54
	Waingawa River	1.900	13	70	21	69
	Kopuaranga River	0.270	0	34	0	50
	Waipoua River	0.300	0	64	0	46
	Mangatarere Stream (Gorge)	0.330	22	103	26	87
Wellington/Hutt Valley	Hutt River (Birchville)	1.450	0	0	0	0
	Wainuiomata River (Leonard Wood Park)	0.360	0	38	13	70
	Orongorongo River	0.100	0	2	0	0

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 3.10 lists the rivers and sites where flood warning alarms were triggered during 2014/15.

Table 3.10: Flood warning alarms triggered during 2014/15

Event Date	Sites where alarms were triggered
2-3 August 2014	<ul style="list-style-type: none"> • Waipoua at Mikimiki • Waiohine at Gorge • Ruamahanga at Mt Bruce • Ruamahanga at Wardells • Ruamahanga at Gladstone • Ruamahanga at Waihenga • Ruamahanga at Jenkins Dip • Waikanae at Water Treatment Plant • Hutt at Birchville
7-8 August 2014	<ul style="list-style-type: none"> • Waipoua at Mikimiki • Ruamahanga at Mt Bruce • Ruamahanga at Wardells • Ruamahanga at Gladstone • Ruamahanga at Waihenga • Otaki at Pukehinau
11-12 August 2014	<ul style="list-style-type: none"> • Ruamahanga at Mt Bruce • Ruamahanga at Gladstone
19 September 2014	<ul style="list-style-type: none"> • Horokiri at Snodgrass
6 October 2014	<ul style="list-style-type: none"> • Waipoua at Mikimiki
27 October 2014	<ul style="list-style-type: none"> • Waiohine at Gorge • Ruamahanga at Mt Bruce • Ruamahanga at Gladstone • Ruamahanga at Waihenga • Waitohu at Water Supply Intake • Otaki at Pukehinau • Waikanae at Water Treatment Plant • Akatarawa at Cemetery • Hutt at Birchville
22 November 2014	<ul style="list-style-type: none"> • Ruamahanga at Mt Bruce
26 November 2014	<ul style="list-style-type: none"> • Ruamahanga at Mt Bruce
10 December 2014	<ul style="list-style-type: none"> • Waitohu at Water Supply Intake • Mangaone at Ratanui • Waikanae at Water Treatment Plant • Horokiri at Snodgrass
7 April 2015	<ul style="list-style-type: none"> • Porirua at Town Centre
10 April 2015	<ul style="list-style-type: none"> • Mangaone at Ratanui • Waikanae at Water Treatment Plant

Table 3.10 (continued)

13 April 2015	<ul style="list-style-type: none"> • Waiohine at Gorge • Ruamahanga at Mt Bruce • Ruamahanga at Wardells • Ruamahanga at Gladstone • Ruamahanga at Waihenga
28 April 2015	<ul style="list-style-type: none"> • Ruamahanga at Mt Bruce • Ruamahanga at Gladstone • Ruamahanga at Waihenga • Waitohu at Water Supply Intake
7-8 May 2015	<ul style="list-style-type: none"> • Ruamahanga at Mt Bruce • Waitohu at Water Supply Intake
12 May 2015	<ul style="list-style-type: none"> • Waitohu at Water Supply Intake • Waikanae at Water Treatment Plant
14 May 2015	<ul style="list-style-type: none"> • Waikanae at Water Treatment Plant • Horokiri at Snodgrass • Porirua at Town Centre • Akatarawa at Cemetery • Hutt at Birchville • Waiwhetu at Whites Line East • Wainuiomata at Manuka Track
10 June 2015	<ul style="list-style-type: none"> • Waiohine at Gorge • Ruamahanga at Mt Bruce • Ruamahanga at Gladstone • Otaki at Pukehinau • Akatarawa at Cemetery
19-20 June 2015	<ul style="list-style-type: none"> • Waipoua at Mikimiki • Waingawa at Kaituna • Waiohine at Gorge • Ruamahanga at Mt Bruce • Ruamahanga at Wardells • Ruamahanga at Gladstone • Ruamahanga at Waihenga • Ruamahanga at Jenkins Dip • Waitohu at Water Supply Intake • Otaki at Pukehinau • Mangaone at Ratanui • Waikanae at Water Treatment Plant • Porirua at Town Centre • Akatarawa at Cemetery • Hutt at Birchville

3.3 Groundwater levels

Figure 3.3 shows mean monthly groundwater levels for 2014/15 (blue line) compared to historical mean monthly groundwater levels (dotted line) at selected monitoring bores in the Wairarapa Valley. The shaded areas represent the range of historic minimum and maximum mean monthly groundwater levels at each site.

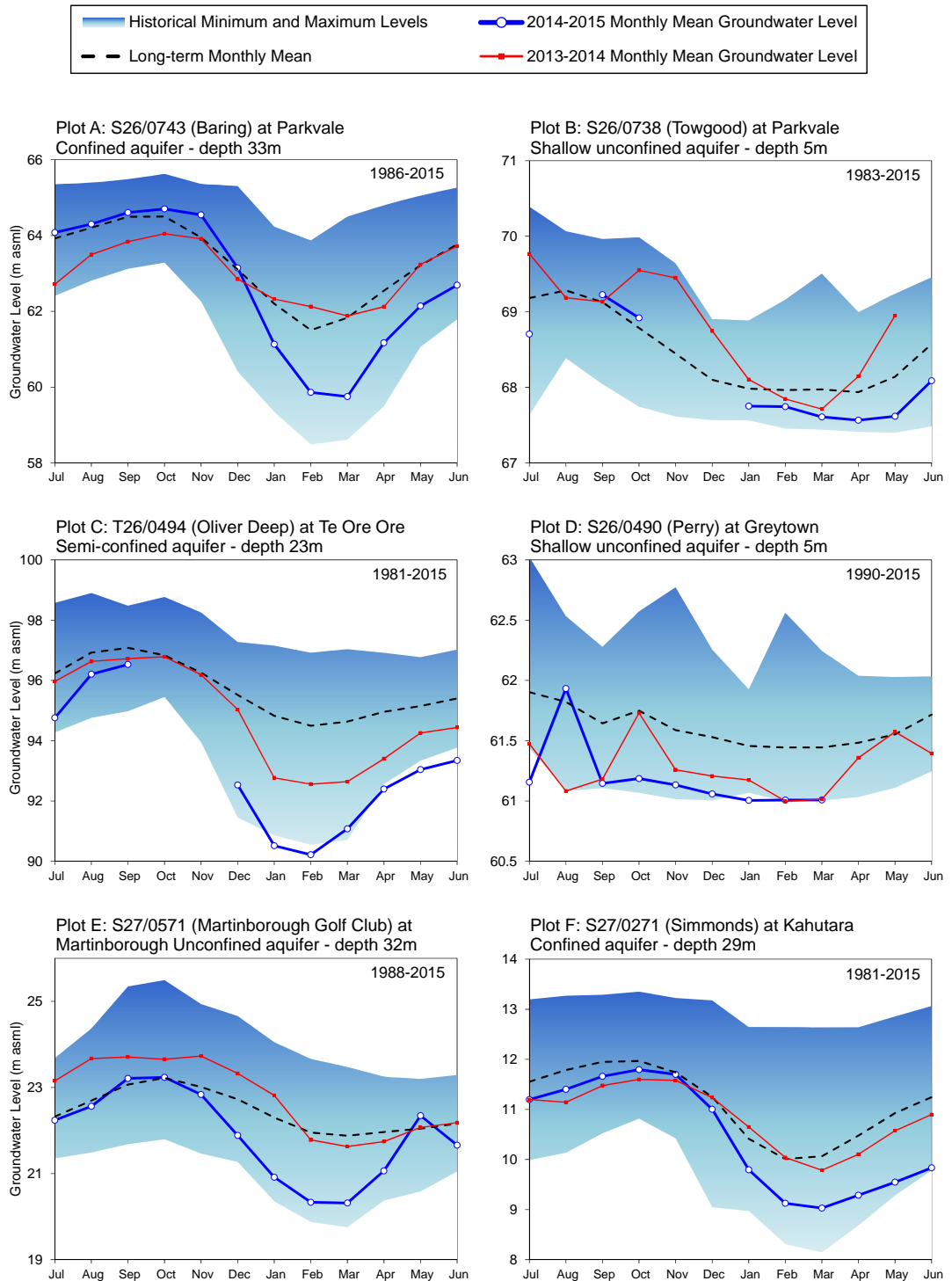


Figure 3.3: Mean monthly groundwater levels in the Wairarapa 2014/15

Figure 3.4 shows mean monthly groundwater levels for 2014/15 (blue line) compared to historical mean monthly groundwater levels (dotted line) at selected monitoring bores in the Hutt Valley and on the Kapiti Coast. The blue shaded areas represent the range of historic minimum and maximum mean monthly groundwater levels at each site.

The bottom right graph shows alarm levels defined on the Waiwhetu Artesian Aquifer to manage the risk of saltwater intrusion.

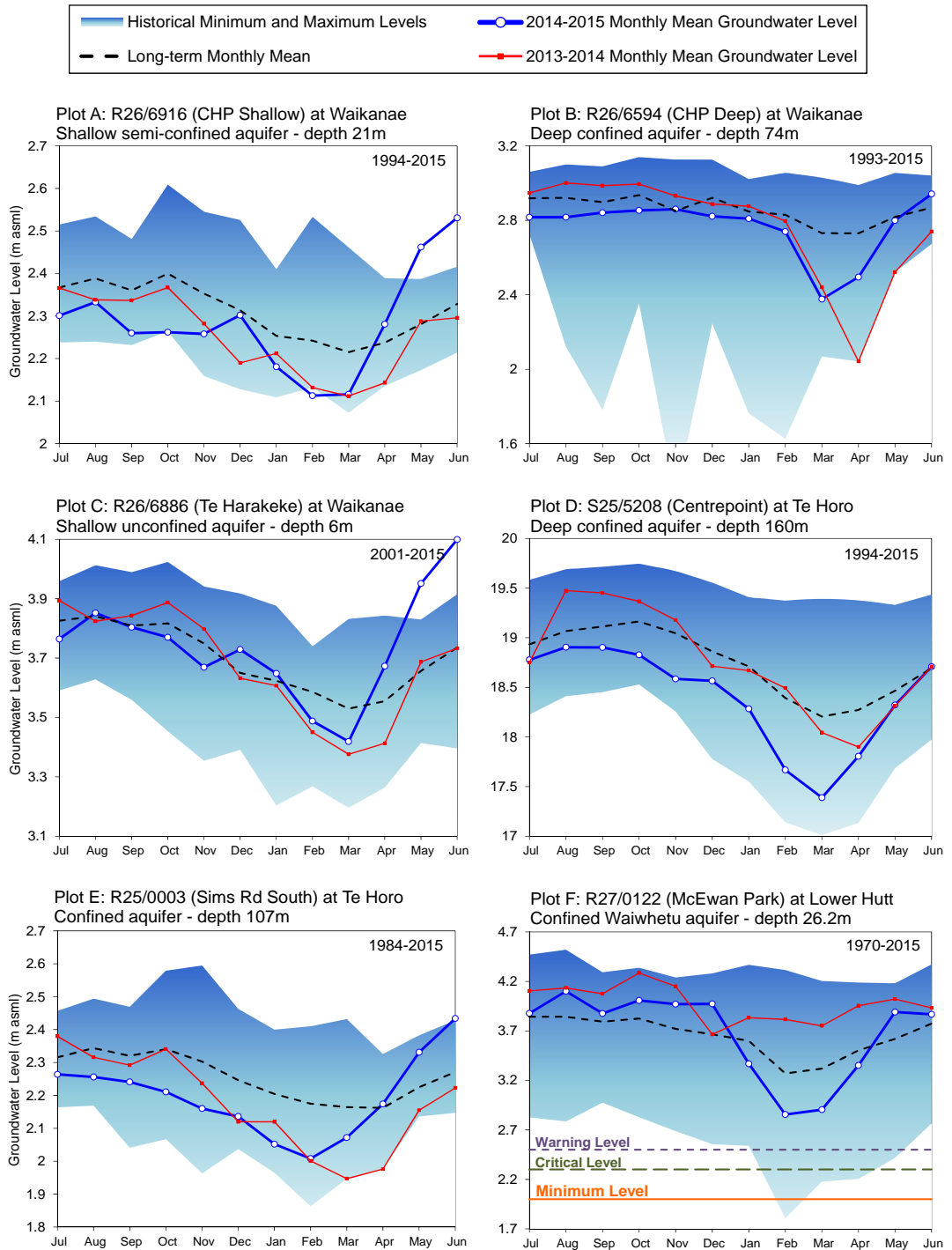


Figure 3.4: 2014/15 mean monthly groundwater levels in the Hutt Valley and on the Kapiti Coast 2014/15

3.4 Lake and wetland levels

Recorded lake levels at Lake Wairarapa and Lake Onoke are shown in Figure 3.5. The 2014/15 data are presented as a daily mean level (thin blue trace) and a monthly mean level (bold blue trace).

For comparison the long-term mean and historical range are also plotted. The minimum lake water level for Lake Wairarapa (as specified in the Regional Freshwater Plan) is shown by the red shaded area.

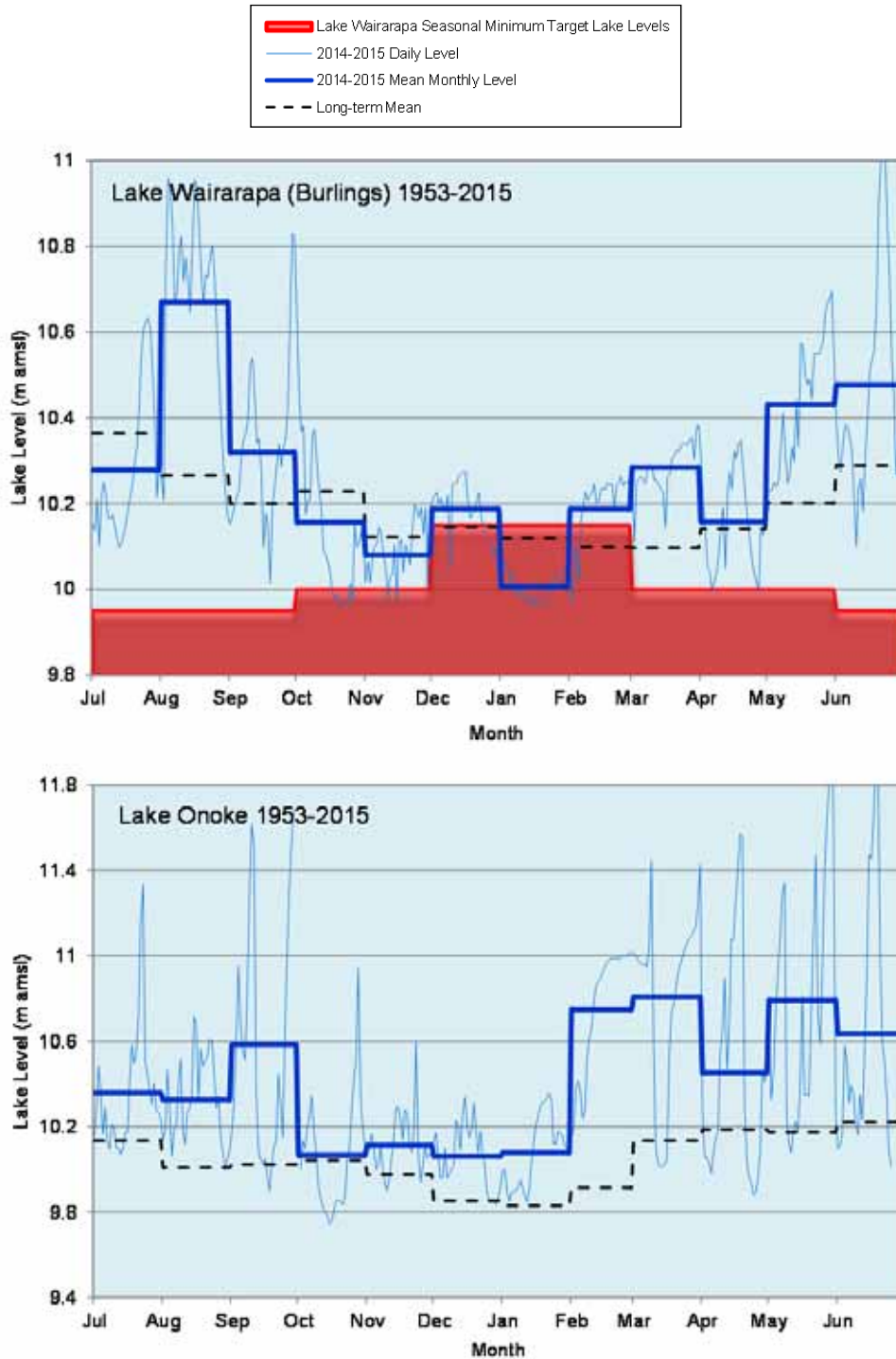


Figure 3.5: Mean monthly lake levels 2014/15

Water levels have been recorded at three monitoring sites within the Te Hapua wetland complex on the Kapiti Coast since 2008. Figure 3.6 shows the 2014/15 recorded daily mean water levels at each site in comparison to all previous years of record.

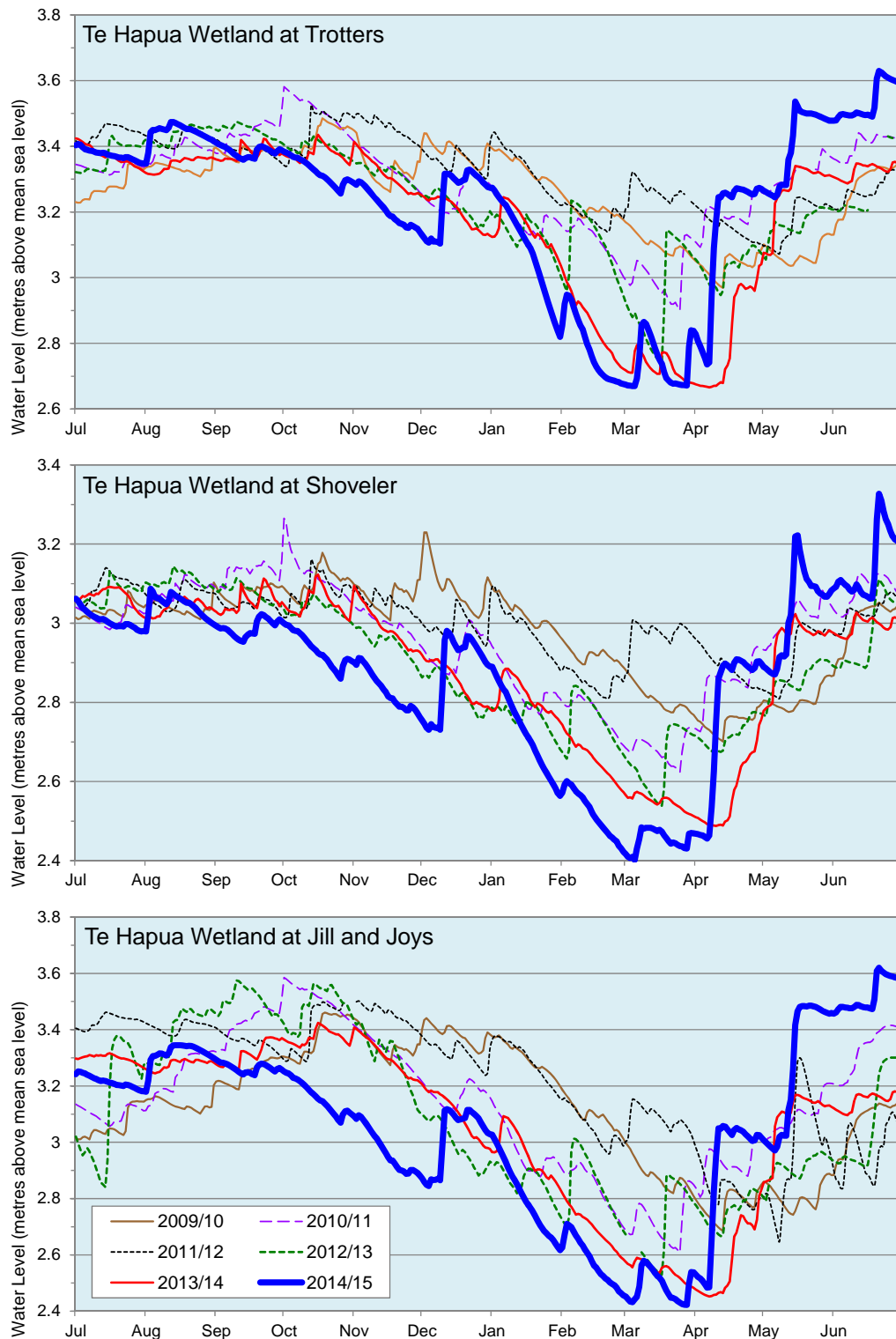


Figure 3.6: Daily mean water levels in Te Hapua wetland complex (Kapiti Coast)

3.5 Soil moisture

Monitoring results for soil moisture content are detailed in Figure 3.7 for the Tanawa Hut (near Tinui) and Longbush monitoring sites.

The long-term mean and historical range of recorded values are also shown.

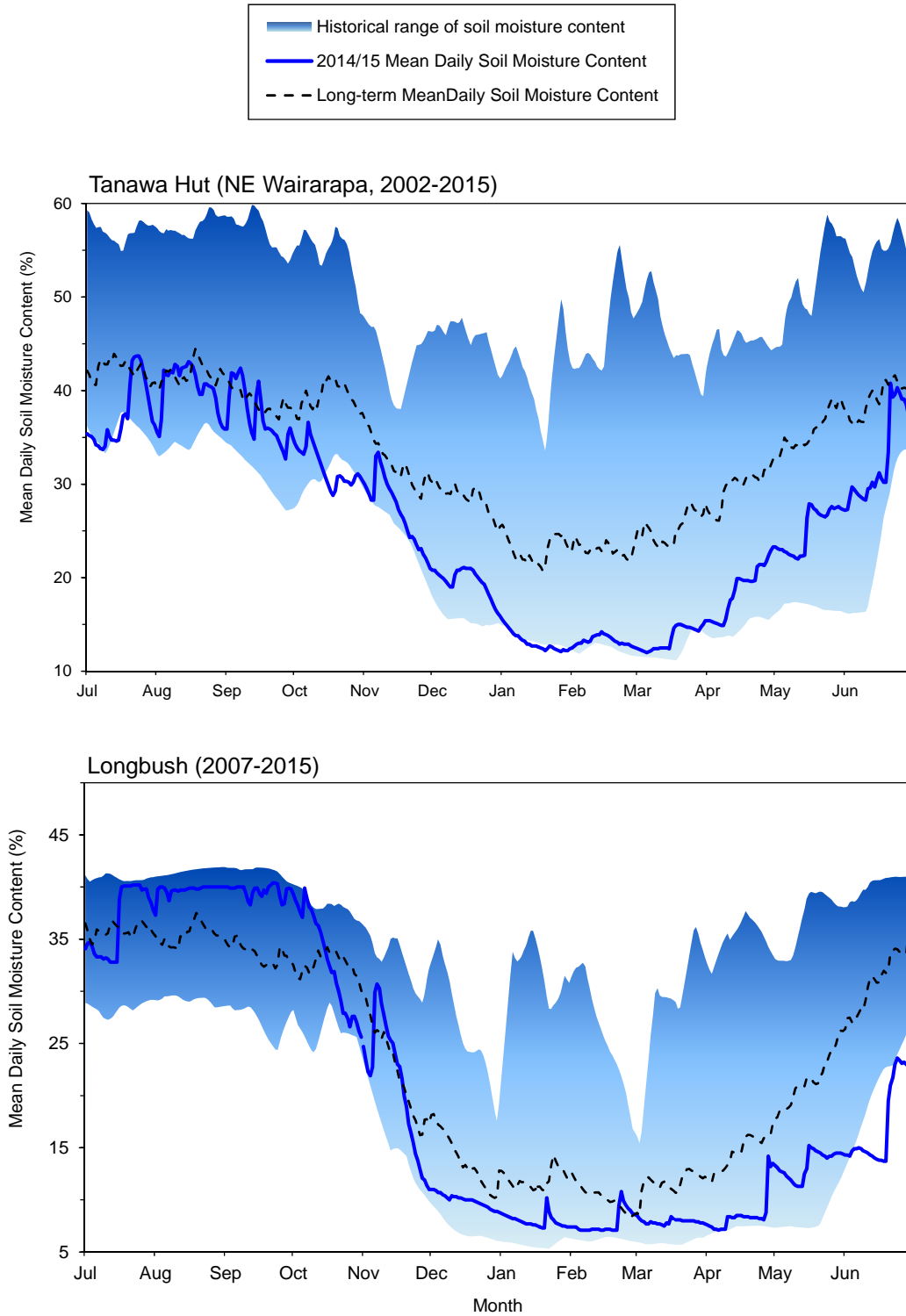


Figure 3.7: Mean daily soil moisture content 2014/15

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