

Appendix A Stakeholder Engagement


Table A.1 – Stakeholder engagement


Organisation	Point of Contact
Agri-specialists	Rod Hodgson
Dairy NZ	Chris Neil
Federated Farmers	Rodger Ludbrook
FNDC	Kathryn Ross
Fonterra	Carly Robinson
Hikurangi Plains Water	Evan Smeath
Horticulture NZ	Chris Keenan
Individual	Harry Burkhardt
Individual	Ben Dalton
Individual	Peter Cooper
Individual	Naida Glavish
Individual	Jim Peters
Individual	Haami Piripi
Individual	Allan Pivac
Individual	Rawson Wright
Individual	Mike Stevens
Irrigation NZ	Andrew Curtis
Kauri Coast Water	Allister McCahon
KDC	Anna Curnow
Kerikeri Irrigation Limited	Bill hunter
Landcorp	Gordon Williams
Maungatapere Irrigation Limited	John Wiessing
MSD	Eru Lyndon
Northash	Hamish Davidson
Northland Agriculture Forum	Julie Jonker
Northland Aquaculture working group	Andrew Forsythe
Northland Dairy Development Trust	Penny Smart
Northland Economic Action Group	Graham Dawson
Northland Horticulture Forum	Patrick Malley

Organisation	Point of Contact
Northland Inc	David Wilson
Northport	John Moore
Northpower	Russell Watson
Rabobank	Tafi Manjela
Rural Support Trust	Julie Jonker
Te Taitokerau Maori Agriculture Forum	Hemi Toia
Top Energy	Russell Shaw
Vegetables New Zealand	Andre Burns
WDC	Jude Thompson
Westpac	Rod Pakinson

Figure A.1 – Stakeholder engagement questionnaire

NORTHLAND STRATEGIC WATER INFRASTRUCTURE STUDY STAKEHOLDER QUESTIONNAIRE





Opus has been commissioned to undertake a region wide strategic water infrastructure study on behalf of Northland Regional Council, in conjunction with the Ministry of Primary Industries (MPI) Irrigation Acceleration Fund (IAF). The purpose of the study is to determine where improved water infrastructure (including water storage and distribution networks) could support tactical water use in agricultural production while achieving authentic community outcomes.

While the study has a primary focus on irrigable land, it will consider other potential areas of demand and benefits in those proximities. The combination of these uses of water will be used to identify spatial locations of one or more areas that have technical, environmental and financial merit for further investigation.

In undertaking this initial region wide assessment, we would like your help. Your opinion is a first step on a long consultation journey which will ultimately result in effective collaboration and engagement.

Respondent Details

Respondent: <input style="width: 95%; height: 25px;" type="text"/>	Email: <input style="width: 95%; height: 25px;" type="text"/>
	Phone: <input style="width: 95%; height: 25px;" type="text"/>

What is your organisation's, or sector you represent, particular use(s) of water, e.g. agriculture, drinking water, industry, etc.?

How important is a reliable water supply to your organisation's, or sector you represent, particular uses?

1 (low) 2 3 4 5 6 7 8 9 (high)

What level of reliability of supply is required by your organisation's, or sector you represent, particular uses, expressed in terms of the ability to access water over the peak water demand periods?

60% 65% 70% 75% 80% 85% 90% 95% 100%

To what extent do you believe demand for your organisation's, or sector you represent, particular uses of water is going to change over the next 20 years?

Reduce Stay the same Increase by 25% Increase by 50% Double or more

Would your organisation, or sector you represent, support investment to improve water infrastructure in Northland?

1 (low) 2 3 4 5 6 7 8 9 (high)

If yes (to the previous question), please describe the possible ways in which you perceive your organisation, or sector you represent, would likely support such investment.

To what extent do you think improving water infrastructure to increase the availability and reliability of the water resource will influence Northland in regards to:

Economic outcomes?	1 (low) <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>	7 <input type="radio"/>	8 <input type="radio"/>	9 (high) <input type="radio"/>
Social objectives?	1 (low) <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>	7 <input type="radio"/>	8 <input type="radio"/>	9 (high) <input type="radio"/>
Cultural interests?	1 (low) <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>	7 <input type="radio"/>	8 <input type="radio"/>	9 (high) <input type="radio"/>
Environment protection?	1 (low) <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>	7 <input type="radio"/>	8 <input type="radio"/>	9 (high) <input type="radio"/>

What specific benefits can you see for your organisation, or sector you represent, from improving water infrastructure in Northland?

What specific benefits can you see for the wider Northland community resulting from water infrastructure in Northland?

What challenges and/or road blocks do you perceive to improving water infrastructure in Northland?

Any other comments?

Please indicate your level of interest in this study and willingness to be engaged in the investigation process?

1 (low) 2 3 4 5 6 7 8 9 (high)

SUBMIT SURVEY

Or please return to Chris Frost at Opus International Consultants Limited
 e. Chris.Frost@opus.co.nz
 t. 02108156443

Appendix B Water Take Consents

This Appendix presents breakdown of consents, particularly irrigation consents by source, use type, and consented take rate and volumes.

Table B.1 – Current consent number by purpose and source

Purpose	Consent numbers (no.)						Total
	Bore	Dam	Diversion	Geothermal	Lake	Run-of-stream	
Drinking	74	8			3	51	136
Industrial	18	3			1	9	31
Irrigation	153	42			3	123	321
Other	15	8	15	1		8	47
Total	260	61	15	1	7	191	535

Table B.2 – Allocated water for current consents by purpose

Water demand category	Consent numbers	Daily volume (m ³ /d)	Take rate (l/s)
Drinking	136	154,672	1,790
Industrial	31	25,563	296
Irrigation	321	515,290	5,964
Other	47	19,028	220
Total	535	714,554	8,270

Table B.3 – Allocated irrigation water by source

Source	Rate (l/s)	Daily volume (m ³ /d)
Bore	314	27,134
Dam	2,814	243,161
Lake	6	479
River/stream/spring	2,830	244,517
Total	5,964	515,290

Table B.4 – Allocated irrigation water by type

Type of crop/irrigation	Rate (l/s)	Daily volume (m ³ /d)
Arable/Crop	65	5,583
Floriculture	10	840
Frost Protection	7	605
Horticulture	3,232	279,227
Nursery	5	437
Pasture	2,548	220,177
Recreational/Sports	82	7,067
Vegetables/Market Garden	16	1,356
Total	5,964	515,290

Appendix C Land Use Capability

Table C.1 – Description of Land Use Capability (LUC) classes

LUC Class	Description*
1	Land with virtually no limitations for arable use and suitable for cultivated crops, pasture or forestry
2	Land with slight limitations for arable use and suitable for cultivated crops, pasture or forestry
3	Land with moderate limitations for arable use, but suitable for cultivated crops, pasture or forestry
4	Land with moderate limitations for arable use, but suitable for occasional cropping, pasture or forestry
5	High producing land unsuitable for arable use, but only slight limitations for pastoral or forestry use
6	Non-arable land with moderate limitations for use under perennial vegetation such as pasture or forest
7	Non-arable land with severe limitations to use under perennial vegetation such as pasture or forest
8	Land with very severe to extreme limitations or hazards that make it unsuitable for cropping, pasture or forestry

* As given in Landcare (2008)

Table C.2 - Areas (ha) of Land Use Capability (LUC) classes in the Northland Region

LUC Class	Area (ha)	Percentage area
1	435	0.03%
2	36,126	2.9%
3	91,166	7.3%
4	301,772	24.2%
5	8,292	0.7%
6	614,430	49.2%
7	153,956	12.3%
8	30,183	2.4%
Other	11,616	0.9%
Total area (ha)	1,247,977	100%

Table C.3 - Areas (ha) of Land Use Capability (LUC) classes by command area.

No.	Command Area	Area (ha)								Total irrigable area
		LUC Class								
		1	2	3	4	5	6	7	8	
1	Aupouri Peninsula	-	-	3,245 (7.3%)	10,128 (22.9%)	-	8,764 (19.8%)	19,072 (43.1%)	3,085 (7%)	44,294
2	Awanui Plains	-	7,697 (33.5%)	7,713 (33.5%)	5,134 (22.3%)	716 (3.1%)	1,588 (6.9%)	142 (0.6%)	-	22,991
3	Kerikeri	-	1,222 (9.2%)	5,796 (43.9%)	4,744 (35.9%)	163 (1.2%)	1,289 (9.8%)	-	-	13,215
4	Waimate North	92 (0.4%)	1,709 (7.9%)	4,211 (19.4%)	9,138 (42.2%)	64 (0.3%)	6,443 (29.7%)	-	-	21,657
5	Kaikohe	-	2,123 (9.6%)	4,897 (22.1%)	8,760 (39.6%)	848 (3.8%)	5,483 (24.8%)	-	-	22,111
6	Waimamaku	-	464 (12.1%)	227 (5.9%)	2,392 (62.6%)	-	740 (19.3%)	-	1 (0.03%)	3,824
7	Hikurangi	-	66 (0.2%)	6,690 (21.9%)	19,786 (64.6%)	-	3,442 (11.2%)	630 (2.1%)	-	30,614
8	Glenbervie	-	-	1,824 (46.1%)	1,997 (50.4%)	-	137 (3.5%)	-	-	3,958
9	Mangakahia	-	-	385 (3.9%)	7,619 (76.6%)	-	1,933 (19.4%)	4 (0%)	-	9,941
10	Maungatapere	-	1,218 (9.8%)	1,726 (13.8%)	6,604 (52.9%)	320 (2.6%)	2,475 (19.8%)	136 (1.1%)	-	12,478
11	Maungakaramea	162	1,218	1,942	10,570	-	4,588	-	-	18,480

No.	Command Area	Area (ha)								Total irrigable area
		LUC Class								
		1	2	3	4	5	6	7	8	
		(0.9%)	(6.6%)	(10.5%)	(57.2%)		(24.8%)			
12	Ruakaka	-	100 (1.7%)	4,077 (69.6%)	1,211 (20.7%)	-	467 (8%)	4 (0.1%)	-	5,859
13	Waipu	-	1,828 (22%)	1,571 (18.9%)	3,906 (47%)	-	984 (11.8%)	18 (0.2%)	-	8,307
14	Kaihu	-	347 (7.6%)	696 (15.2%)	2,949 (64.4%)	-	588 (12.8%)	-	-	4,580
15	Hoanga	-	1,534 (49.7%)	688 (22.3%)	840 (27.2%)	-	24 (0.8%)	-	-	3,086
16	North Kaipara	-	5,139 (19.6%)	5,648 (21.5%)	12,911 (49.2%)	-	2,361 (9%)	158 (0.6%)	-	26,218
17	Ruawai	-	6,471 (49.5%)	2,729 (20.9%)	3,700 (28.3%)	44 (0.3%)	116 (0.9%)	-	-	13,059
18	Mangawhai	-	114 (1.4%)	1,896 (23.1%)	6,116 (74.4%)	-	68 (0.8%)	25 (0.3%)	7 (0.08%)	8,226

Note: The values in brackets show the LUC class as a percentage of total irrigable area of the command area

Appendix D Soils

Table D.1 - Soil PAW Classes

No.	Area	Area (ha)					Total irrigable area
		PAW Class (mm/m)					
		70	100	130	150	200	
1	Aupouri Peninsula	22,019	16,749	2,477	-	3,093	44,338
2	Awanui Plains	5,028	5,917	-	-	12,072	23,017
3	Kerikeri	-	1,279	-	-	11,947	13,226
4	Waimate North	1,946	3,363	4,216	-	12,151	21,675
5	Kaikohe	796	4,525	-	1,417	15,394	22,133
6	Waimamaku	-	1,499	-	-	2,329	3,829
7	Hikurangi	8,256	-	6,063	-	16,318	30,637
8	Glenbervie	-	413	773	-	2,775	3,960
9	Mangakahia	-	1,494	-	-	8,456	9,950
10	Maungatapere	-	-	3,132	-	9,356	12,488
11	Maungakaramea	1,127	2,353	-	1,063	13,951	18,494
12	Ruakaka	-	-	272	-	5,590	5,862
13	Waipu	-	-	-	-	8,312	8,312
14	Kaihu	777	1,477	-	-	2,332	4,585
15	Hoanga	224	2,115	-	-	750	3,089
16	North Kaipara	7,314	18,928	-	-	-	26,242
17	Ruawai	-	10,557	-	-	2,513	13,070
18	Mangawhai	868	2,301	-	-	5,061	8,230

Note: The areas given above for the total irrigable area. These values may not exactly match with the values listed in Column 4 in Table 3.3. This is because the spatial areas within different GIS layers (e.g. soils, LUC, LCDB) used for this study contain minor inconsistencies.

Appendix E Climate Stations

Table E.1 - Climate station used for different areas

Area	Climate station
Aupouri Peninsula	Houhora
Awanui Plains	Kaitaia
Kerikeri	Kerikeri
Waimate North	Kerikeri
Kaikohe	Kaikohe
Waimamaku	Hokianga
Hikurangi	Hikurangi
Glenbervie	Hikurangi
Mangakahia	Whangarei
Maungatapere	Whangarei
Maungakaramea	Whangarei
Ruakaka	Whangarei
Waipu	Whangarei
Kaihu	Dargaville
Hoanga	Dargaville
North Kaipara	Dargaville
Ruawai	Ruawai
Mangawhai	Leigh

Appendix F Irrigation Water Demand

Table F.1 – Northland census area unit locations



Table F.2 – 90th percentile annual irrigation demands by crop and soil type

Area	Total irrigable area (ha)					Net irrigable area (%)	Crop	% crop area (%)	90 th percentile annual demand (mm/yr)					90 th percentile annual area demand (Mm ³ /yr)
	PAW Class (mm/m)								PAW Class (mm/m)					
	70	100	130	150	200				70	100	130	150	200	
Aupouri Peninsula	22,019	16,749	2,477		3,093	60	Avocado	40	907	581	529	562	511	190.9
							Citrus	30	601	529	453	479	390	
							pasture	20	1,094	636	626	627	576	
							Potato	10	996	754	736	699	652	
Awantui Plains	5,028	5,917		-	12,072	75	Pasture	40	946	522	510	513	453	98.0
							Potato	30	877	676	651	603	549	
							Citrus	20	493	423	351	373	276	
							Lettuce	10	868	701	698	606	590	
Kerikeri	-	1,279		-	11,947	80	Kiwifruit	40	683	541	484	527	455	36.9
							Citrus	30	423	361	297	318	237	
							Pasture	20	869	460	443	442	385	
							Grapes	10	238	222	129	197	85	
Waimate North	1,946	3,363	4,216		12,151	80	Citrus	40	423	361	297	318	237	73.0
							Kiwifruit	30	683	541	484	527	455	
							Potato	20	806	620	593	555	506	
							Pasture	10	869	460	443	442	385	
Kaikohe	796	4,525		1,417	15,394	80	Avocado	35	655	375	320	350	295	60.4
							Citrus	25	372	312	236	266	186	
							Kiwifruit	20	645	481	437	469	407	
							Potato	10	747	551	544	500	437	
							Pasture	10	813	403	394	389	325	
Waimamaku		1,499	-	-	2,329	80	Pasture	100	1,004	524	512	514	462	14.9
Hikurangi	8,256		6,063		16,318	60	Pasture	100	818	437	428	425	364	91.7
Glenbervie		413	773	-	2,775	60	Avocado	60	673	400	358	382	324	7.1
							Citrus	40	403	345	276	300	214	

Area	Total irrigable area (ha)					Net irrigable area (%)	Crop	% crop area (%)	90 th percentile annual demand (mm/yr)					90 th percentile annual area demand (Mm ³ /yr)
	PAW Class (mm/m)								PAW Class (mm/m)					
	70	100	130	150	200				70	100	130	150	200	
Mangakahia		1,494		-	8,456	60	Pasture	100	795	397	386	383	318	19.7
Maungatapere			3,132	-	9,356	80	Avocado	60	675	363	320	348	287	31.9
							Kiwifruit	30	655	476	425	466	403	
							Citrus	10	375	308	234	300	178	
Maungakamea	1,127	2,353		1,063	13,951	75	Avocado	50	675	363	320	348	287	53.9
							Potato	30	735	535	530	491	435	
							Kiwifruit	20	655	476	425	466	403	
Ruakaka		-	272	-	5,590	80	Pasture	100	795	397	386	383	318	15.1
Waipu				-	8,312	80	Pasture	100	795	397	386	383	318	21.1
Kaihu	777	1,477		-	2,332	80	Pasture	100	969	508	503	505	456	20.5
Hoanga	224	2,115		-	750	80	Pasture	60	969	508	503	505	456	11.9
							Kumara	40	496	456	423	423	269	
North Kaipara	7,314	18,928		-		75	Pasture	30	969	508	503	505	456	118.0
							Potato	30	867	643	627	589	540	
							Kumara	30	496	456	423	423	269	
							Avocado	10	798	481	433	454	410	
Ruawai		10,557	-		2,513	80	Pasture	60	1,013	552	542	539	491	53.0
							Kumara	40	524	492	462	455	306	
Mangawhai	868	2,301	-	-	5,061	60	Avocado	50	837	511	457	488	439	17.4
							Grapes	30	295	282	180	249	133	
							Olives	20	367	333	263	290	148	

Note: The water demands shown above are for irrigating the total irrigable area within a command area, if water is not a constraint. Table 6.1 lists a summary of potential irrigable area based on available water resources to meet the required irrigation supply-demand reliability.

Appendix G Flow data availability and correlation

This Appendix lists a summary of available flow data and estimated flow statistics.

Table G.1 – Flow data availability by hydrometric station

Site number#1	Hydrometric station	Record start day	Record end day	Number of records (days)	Number of gaps (days)
1	Selwyn Swamp at Big Flat Rd (Aupouri)	-	-	0	-
2	Whangatane at Spillway	2/02/2007	10/09/2015	3,141	2
3	Awanui at Waikuruki	5/04/1990	5/02/1992	628	44
4	Te Puhi at Meffin Rd	14/08/2009	10/09/2015	2,216	3
5	Awanui (NIWA) at School Cut	14/07/2000	10/09/2015	5,431	106
6	Victoria at Double Crossing	5/04/1990	23/04/1992	728	22
7	Tarawhataroa at Puriri Place	2/02/2007	10/09/2015	3,139	4
8	Victoria at Thompson Br.	1/04/1990	23/04/1992	754	-
9	Victoria at Victoria Valley Road	18/08/2006	10/09/2015	3,299	12
10	Takahue at Diggers Valley Rd Br	28/06/1990	28/05/1994	795	636
11	Takahue at Grays	14/08/2009	10/09/2015	2,203	16
12	Rangitane at Tubbs	16/07/1977	30/10/2001	7,966	907
13	Rangitane at Stirling	11/07/2007	10/09/2015	2,967	17
14	Waipapa at Pungaere Rd	20/09/1975	26/06/1996	1,308	6,278
16	Waipapa at Landing	15/07/1977	3/03/1981	1,328	-
17	Kerikeri at Peacock Garden	21/11/2001	11/09/2015	4,242	801
20	Maungaparerua at Tyrees Ford	19/11/1999	11/09/2015	5,040	736
21	Puketotara at Backblocks	11/09/1975	31/01/1989	4,168	724
22	Waitangi at Wakelins	21/11/2001	11/09/2015	5,007	36
23	Waitangi at Waimate North Rd	2/10/2011	11/09/2015	1,429	12
24	Waitangi at SH10	21/05/2014	10/09/2015	440	38
26	Waiaruhe at Puketona	3/02/1984	12/05/2014	6,448	4,609
27	Waikaka at Totara Trees Weir	12/01/1989	30/10/1996	2,796	53
28	Te Tunaotemaku at Rock Weir	7/01/1989	25/11/1992	1,418	1
29	Punakitere at Taheke	3/10/1999	11/09/2015	5,767	56
31	Waiotu at SH1 Br	16/07/2006	11/09/2015	3,343	2
32	Whakapara at Cableway	28/02/2002	11/09/2015	4,930	14
33	Mangakahia at Gorge	19/11/1999	11/09/2015	5,551	225
35	Mangahahuru at County	29/07/2006	11/09/2015	3,330	2

Site number ^{#1}	Hydrometric station	Record start day	Record end day	Number of records (days)	Number of gaps (days)
	Weir				
36	Hikurangi at Moengawahine	8/09/2006	11/09/2015	3,281	10
37	Ngunguru at Kiripaka	20/10/2011	6/11/2014	1,114	-
38	Wairua at Purua	22/04/2009	11/09/2015	2,320	14
39	Opouteke at Suspension Br	3/10/1999	11/09/2015	5,767	56
40	Mangere at Knights Rd	12/11/2006	11/09/2015	3,221	5
41	Hatea at Whareora Rd	19/09/2007	11/09/2015	2,913	2
42	Waipao at Draffins Rd	15/11/2006	10/09/2015	3,212	10
43	Wairua at Wairua Br	8/09/1961	1/09/2014	19,148	204
44	Mangakahia at Titoki Br	3/10/1999	11/09/2015	5,759	64
45	Kaihu at Gorge	3/10/1999	11/09/2015	5,785	38
46	Otaika at Kay	29/01/2011	11/09/2015	1,665	22
47	Ruakaka at Flyger Rd	14/10/2006	11/09/2015	3,132	123
48	North at Applecross Rd	3/10/1999	11/09/2015	5,806	17
49	Millbrook at Millbridge Rd	19/11/1982	4/12/1984	684	63
50	Ahuroa at Braigh Flats	3/10/1999	11/09/2015	5,745	78
51	Waihoihoi at St Marys Rd	10/12/2007	10/09/2015	2,798	34
52	Waionehu at McLean Rd	14/10/2006	18/06/2015	3,149	21
53	Ahuroa at Durham Rd	1/05/1981	27/06/1997	5,568	334
54	Hakaru Trib. at Brown S.3	7/05/1988	24/04/1995	2,544	-
55	Hakaru Trib. at Pacific Orchard S.16	12/05/1988	22/04/1993	1,807	-
56	Hakaru at Topuni Creek Farm	2/10/2013	8/09/2015	497	210
	Awanui (NIWA) Back Up Water Level	12/02/2013	11/09/2015	940	2
	Kaihu at Rotu	1/06/1977	15/09/1980	1,164	39
	Kirikiri at Cheviot St Footbridge	3/07/2014	10/09/2015	420	15
	Waipapa at Forest Ranger	1/12/2001	11/09/2015	4,984	49
	Waipoua at SH12	1/06/2007	14/05/2013	2,145	30

^{#1} Locations of the hydrometric sites are shown in Figure 5.1

Table G.2 – Estimated flow statistics at approximate intake locations for reservoirs

Area - Storage		Approximate location	NZ Reach number ^{#1}	Flow (m ³ /s)	
				Mean	Median
Awanui Plains		Awanui River above school	1003890	5.45	3.97
Kerikeri	Puketotara	Puketotara at Backblocks	1006712	1.08	0.75
	Waipapa	Waipapa at Pungaere Rd	1005752	0.60	0.46
Waimate North	Upper	Waitangi at Waimate North Rd	1008074	1.66	0.99
	Lower	Confluence of Waitangi and Waiaruhe	1008048	6.59	3.27
Kaikohe		Punakitere above Taheke	1011883	4.77	2.69
Waimamaku		Waimamaku	1014196	3.61	1.92
Hikurangi	Upper	Confluence of Waiotu and Whakapara	1014436	10.7	6.9
	Lower	Wairua above Purua	1016617	21	12.5
Glenbervie		Hatea above Whareora Rd	1017464	1.3	0.75
Mangakahia	East	Hikurangi below Moengawahine confluence	1016863	5.9	2.8
	West	Confluence of Opouteke and Mangakahia	1016892	15.4	8.9
Maungatapere		Wairua at Wairua Br	1018572	19.6	11.9
Maungakamea		Maungakamea catchment	1020820	1.16	0.89
Ruakaka		Ruakaka at Flyger Rd	1021503	0.95	0.35
Waipu		Confluence of Ahuroa-Millbrook	1023446	1.51	0.87
Kaihu		Kaihu at Gorge	1019201	4.0	2.52
Hoanga		Hoanga East catchment above scheme	1020608	5.0	2.7
North Kaipara	Confluence of Wairua and Hikurangi		1019899	44.8	26.4
Ruawai					
Mangawhai		Hakaru above Topuni Cr Farm	1026117	1.2	0.55

Appendix H Storage

This Appendix presents the approximate locations of the intake or instream reservoirs considered along with storage volume hydrographs and consecutive irrigation deficit days.

Awanui Plains Area

Figure H.1 – Approximate location of intake for water harvesting or instream dam for the Awanui Plains Area



Figure H.2 – Storage hydrograph for the Awanui Plains Area

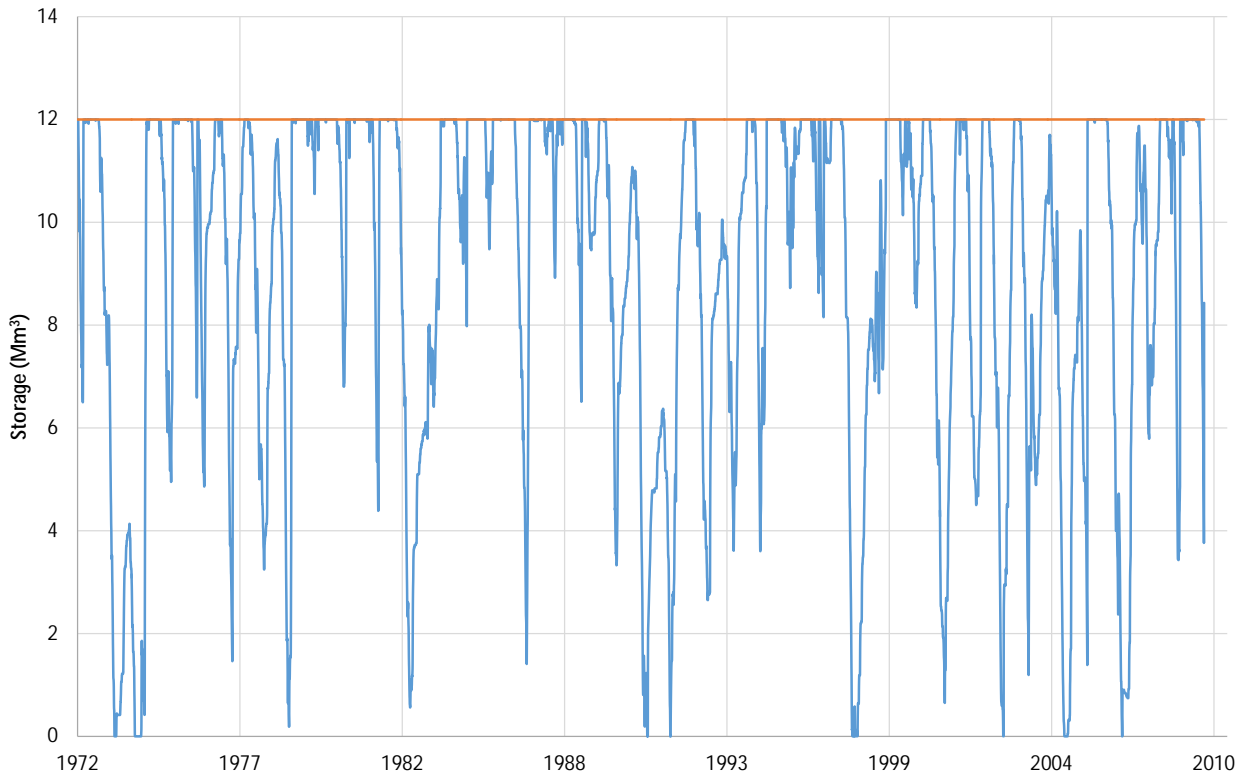
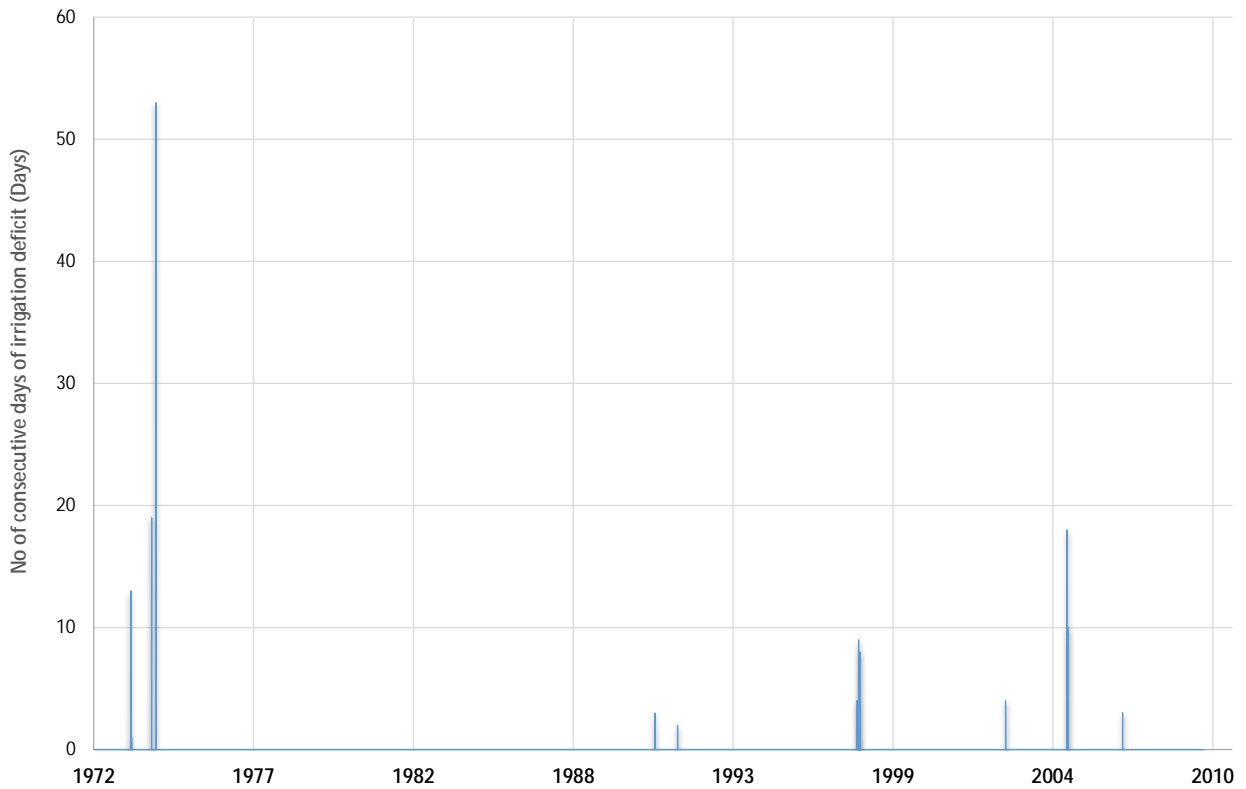


Figure H.3 – Irrigation supply deficit days for the Awanui Plains Area



Kerikeri Area

Figure H.4 – Approximate locations of intakes for water harvesting or instream dams for the Kerikeri Area



Figure H.5 – Puketotara storage hydrograph in the Kerikeri Area

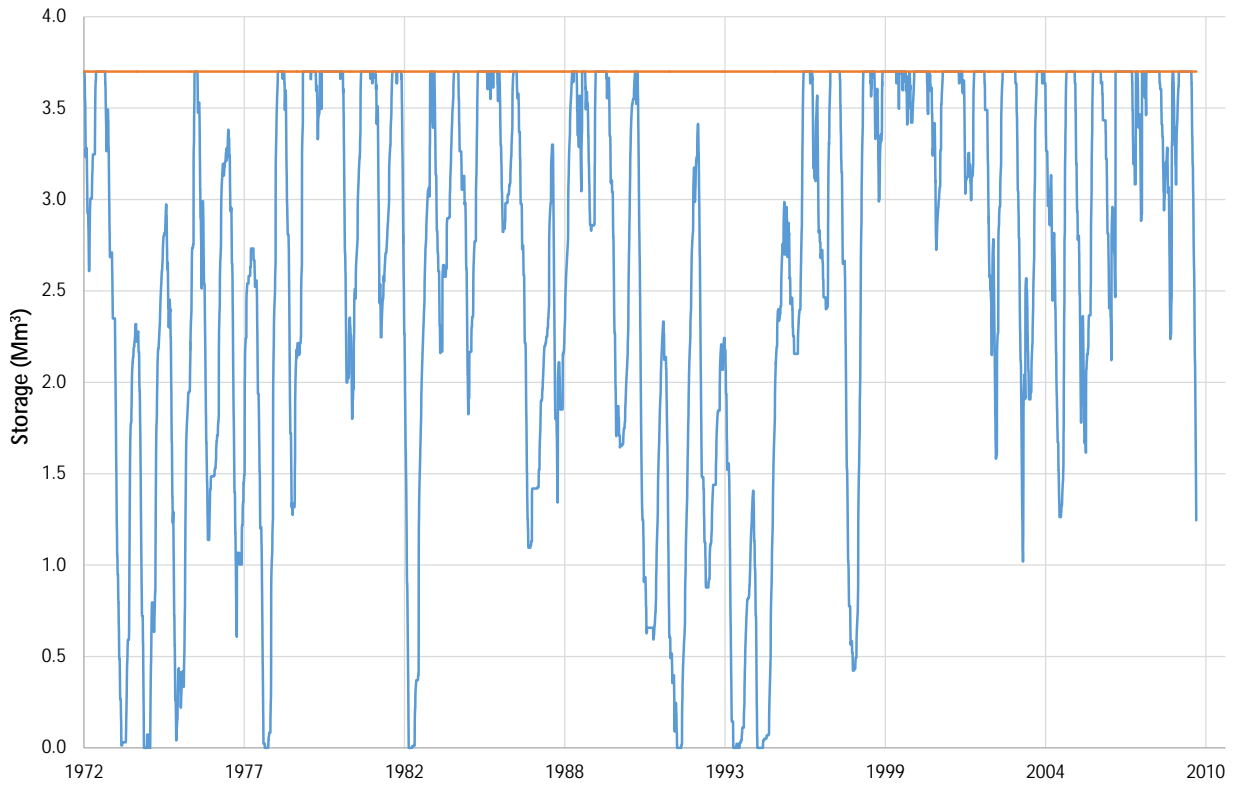


Figure H.6 – Waipapa storage hydrograph in the Kerikeri Area

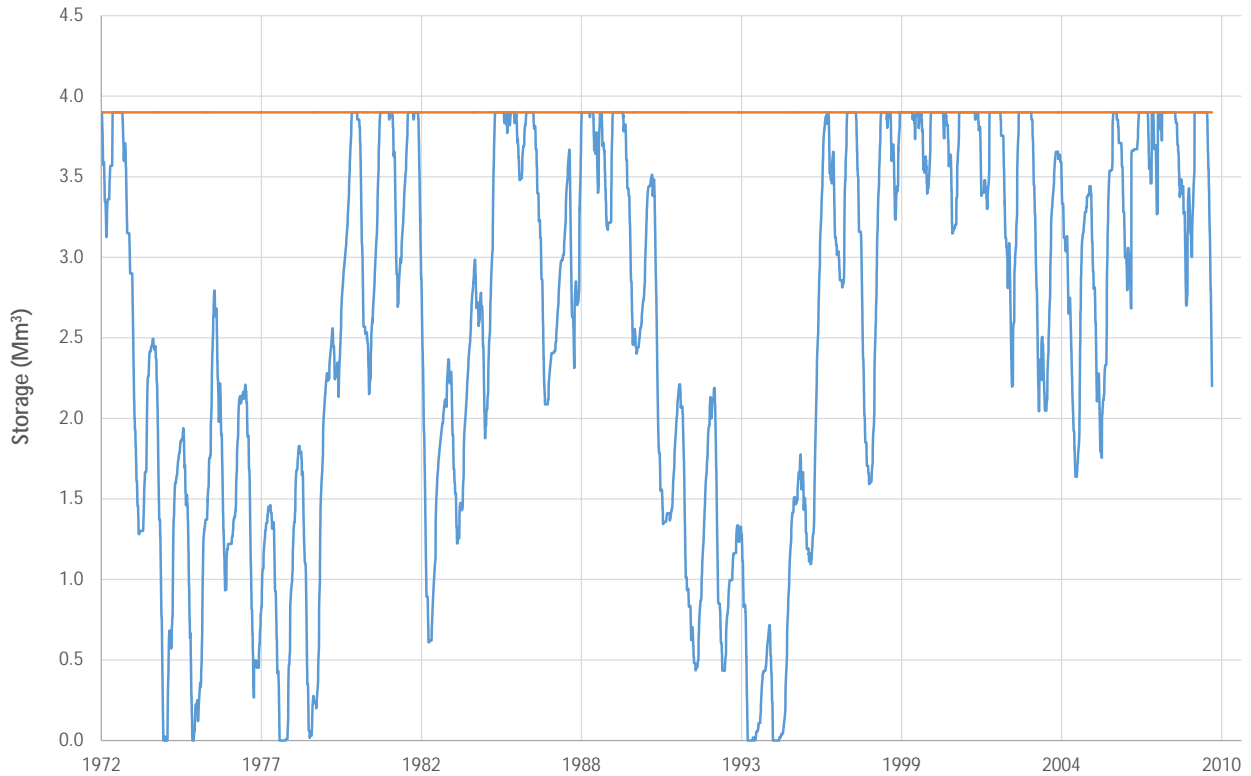


Figure H.7 – Irrigation supply deficit days for the area supplied by the Puketotara storage in the Kerikeri Area

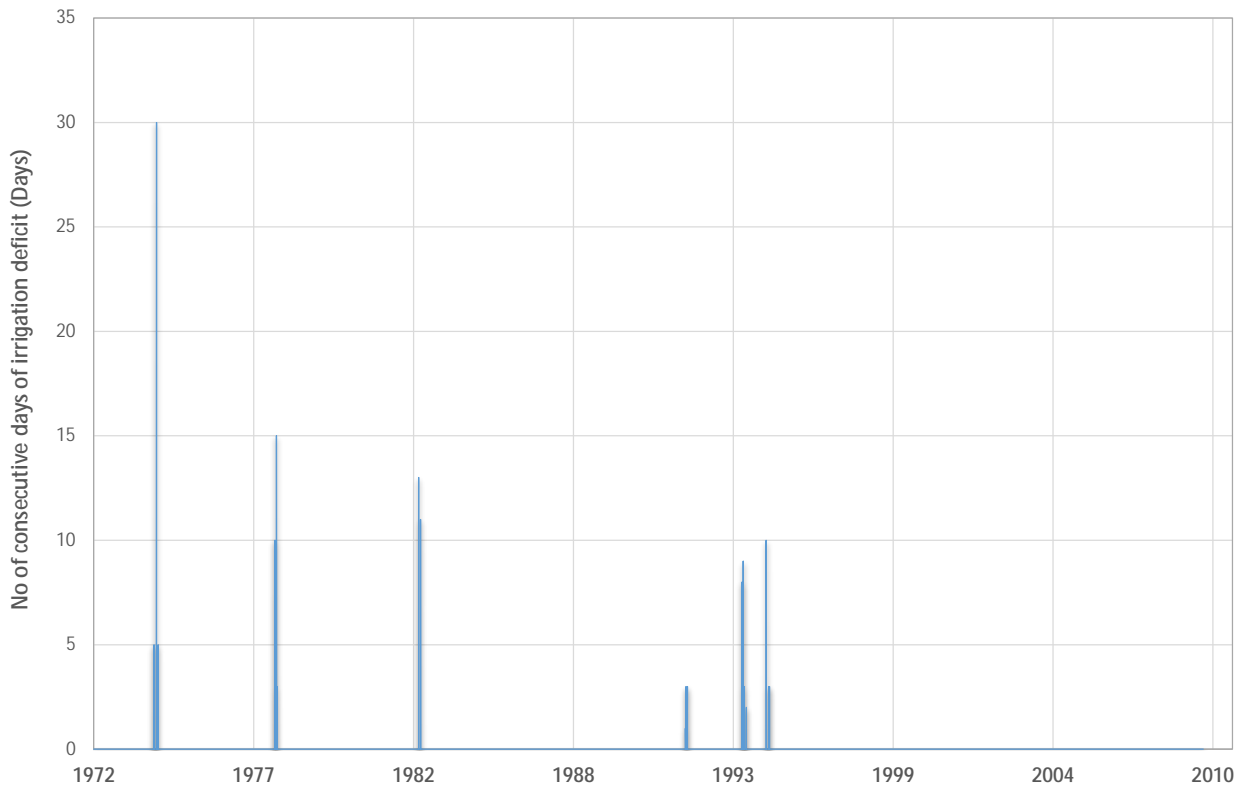
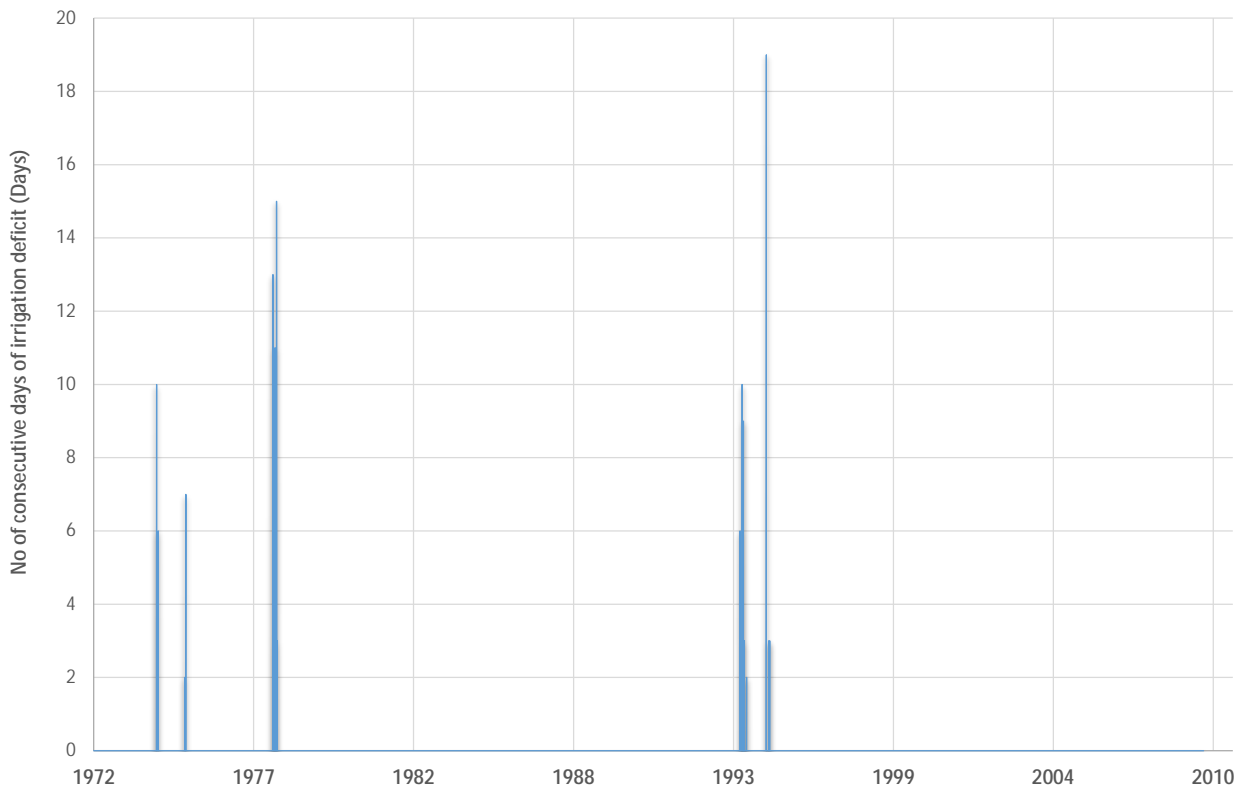


Figure H.8 – Irrigation supply deficit days for the area supplied by the Waipapa storage in the Kerikeri Area



Waimate North Area

Figure H.9 – Approximate locations of intakes for water harvesting or instream dams for the Waimate North Area



Figure H.10 – Upper storage hydrograph in the Waimate North Area

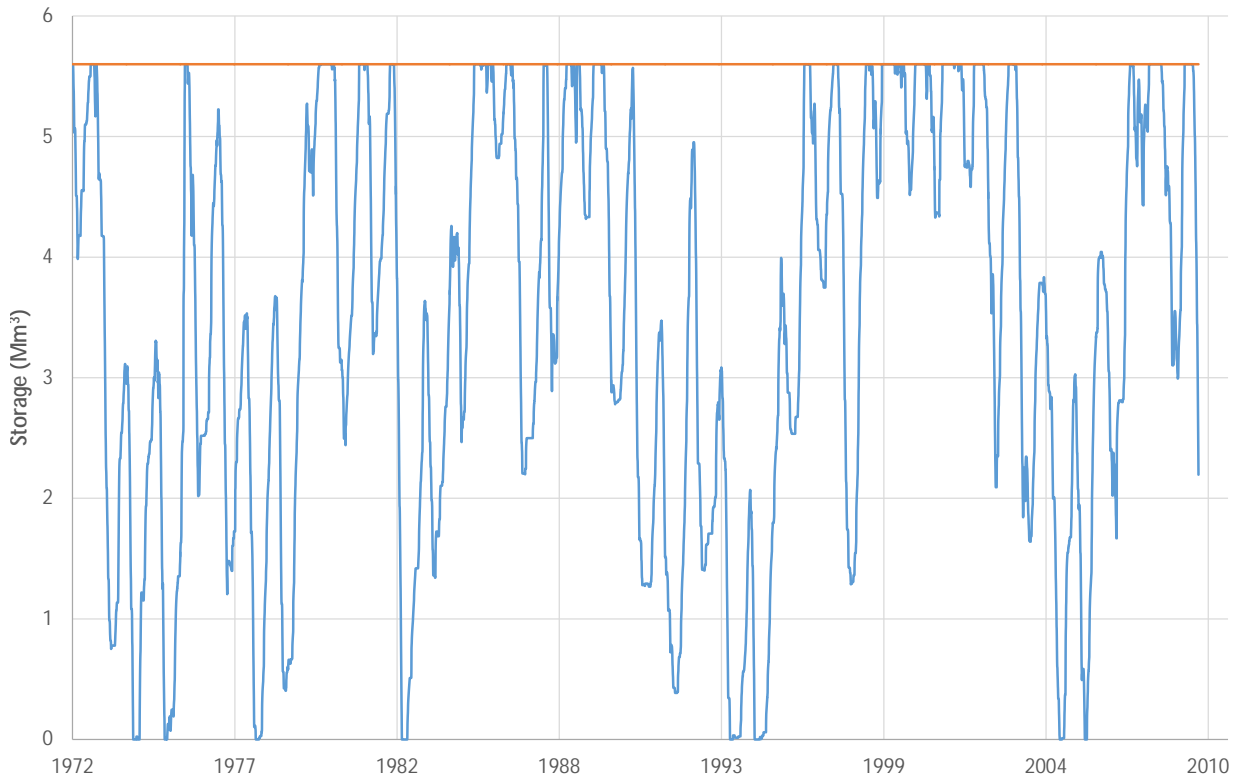


Figure H.11 – Lower storage hydrograph in the Waimate North Area

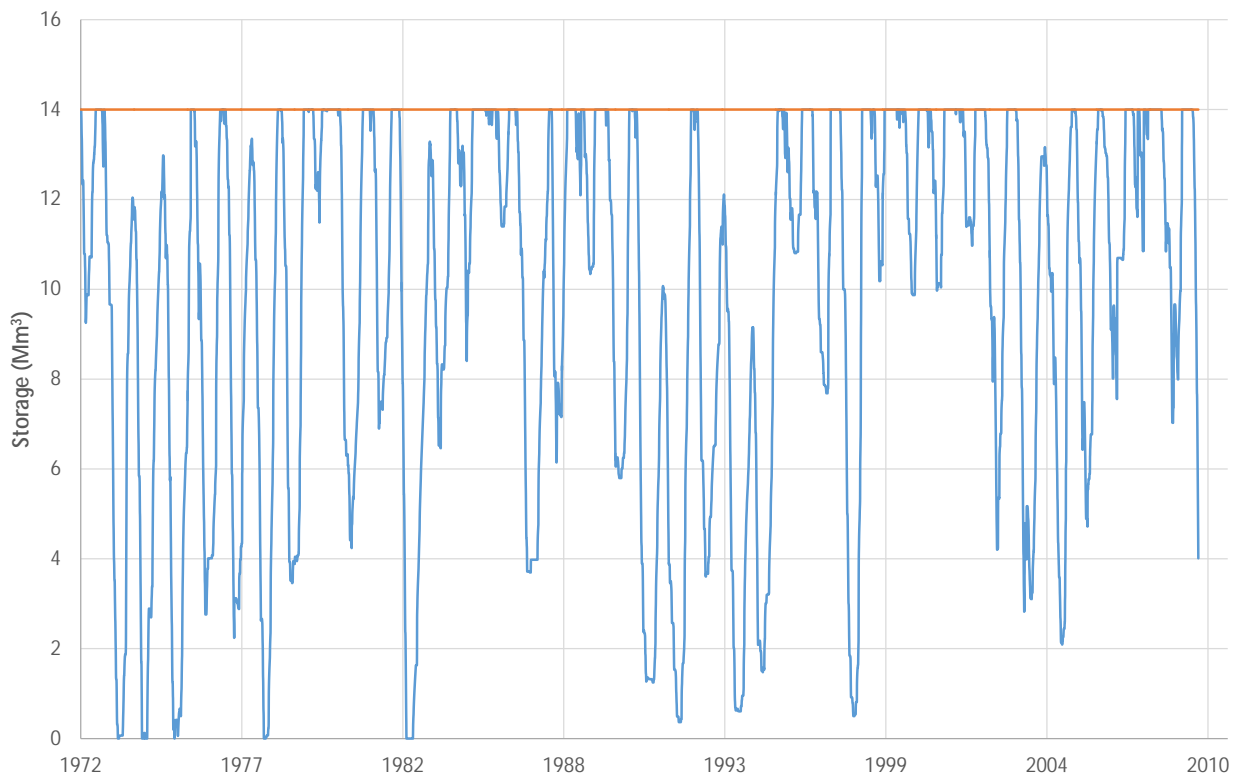


Figure H.12 – Irrigation supply deficit days for the area supplied by the upper storage in the Waimate North Area

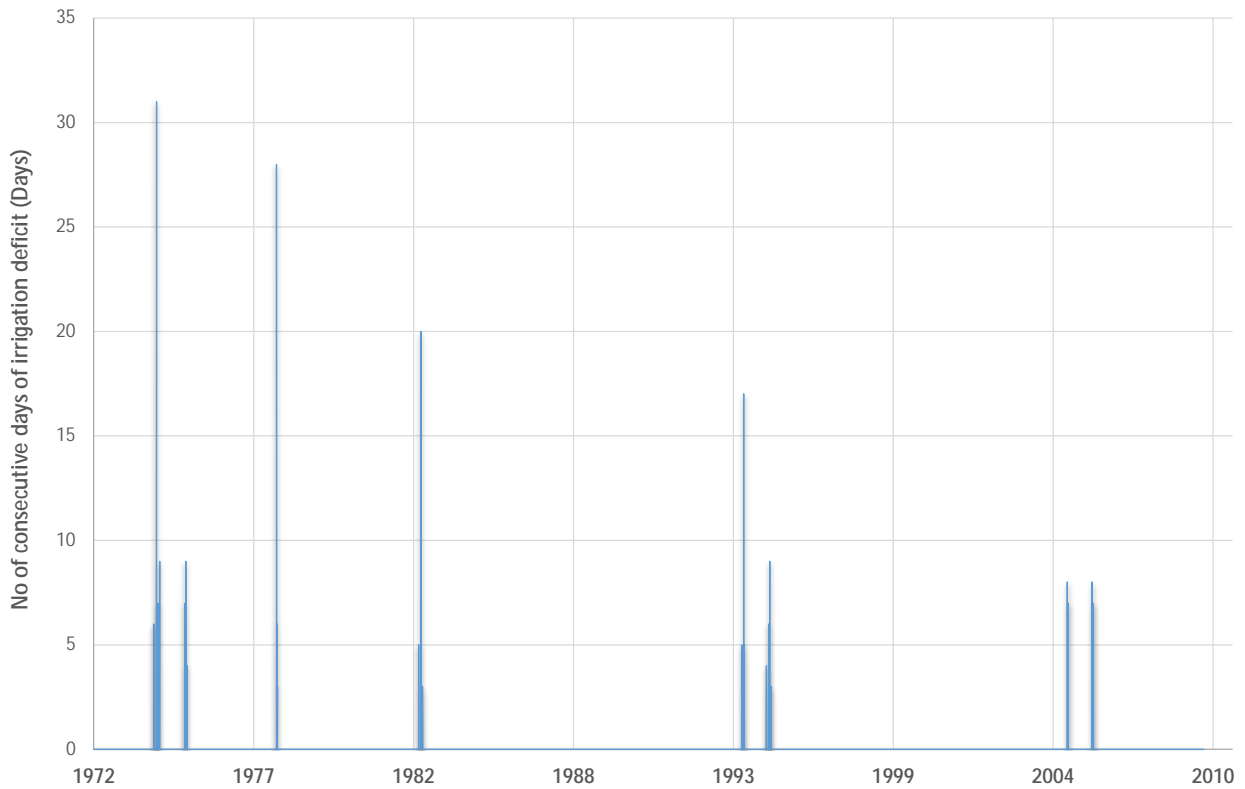
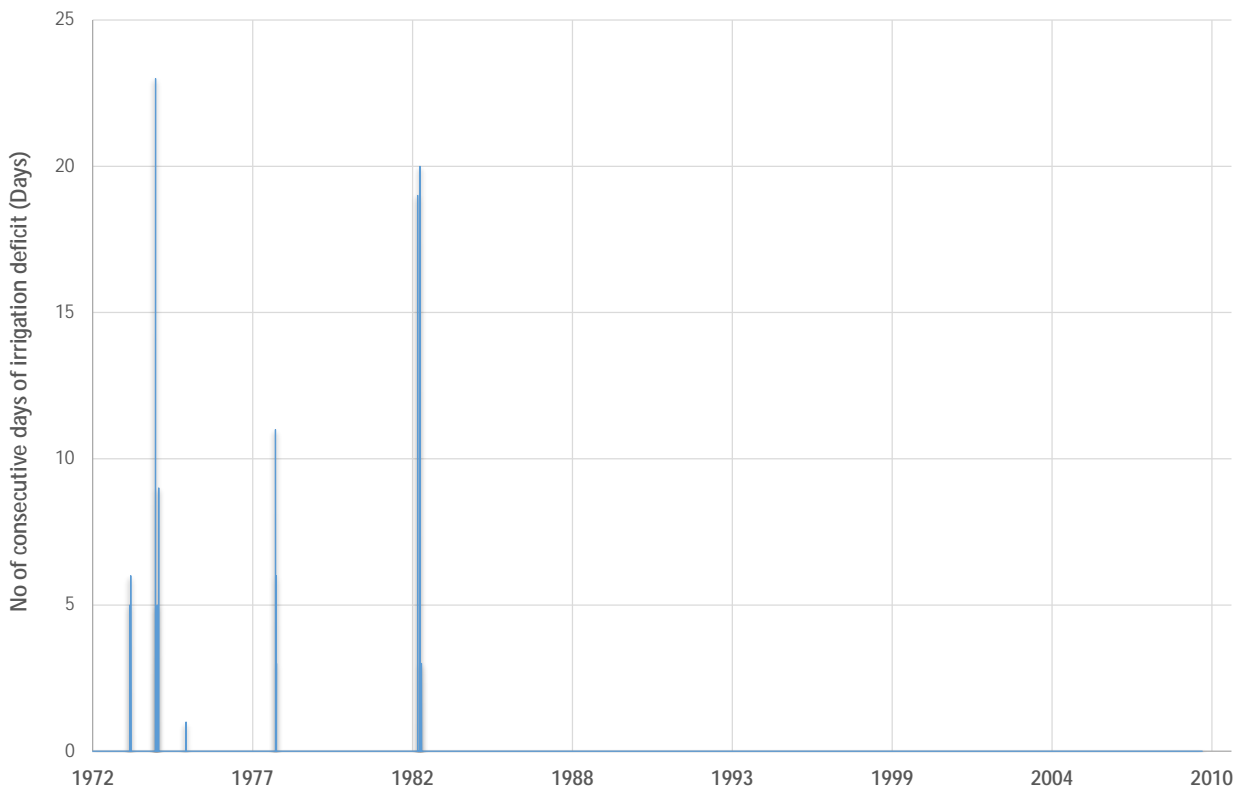


Figure H.13 – Irrigation supply deficit days for the area supplied by the lower storage in the Waimate North Area



Kaikohe Area

Figure H.14 – Approximate location of intake for water harvesting or instream dam for the Kaikohe Area



Figure H.15 – Storage hydrograph for the Kaikohe Area

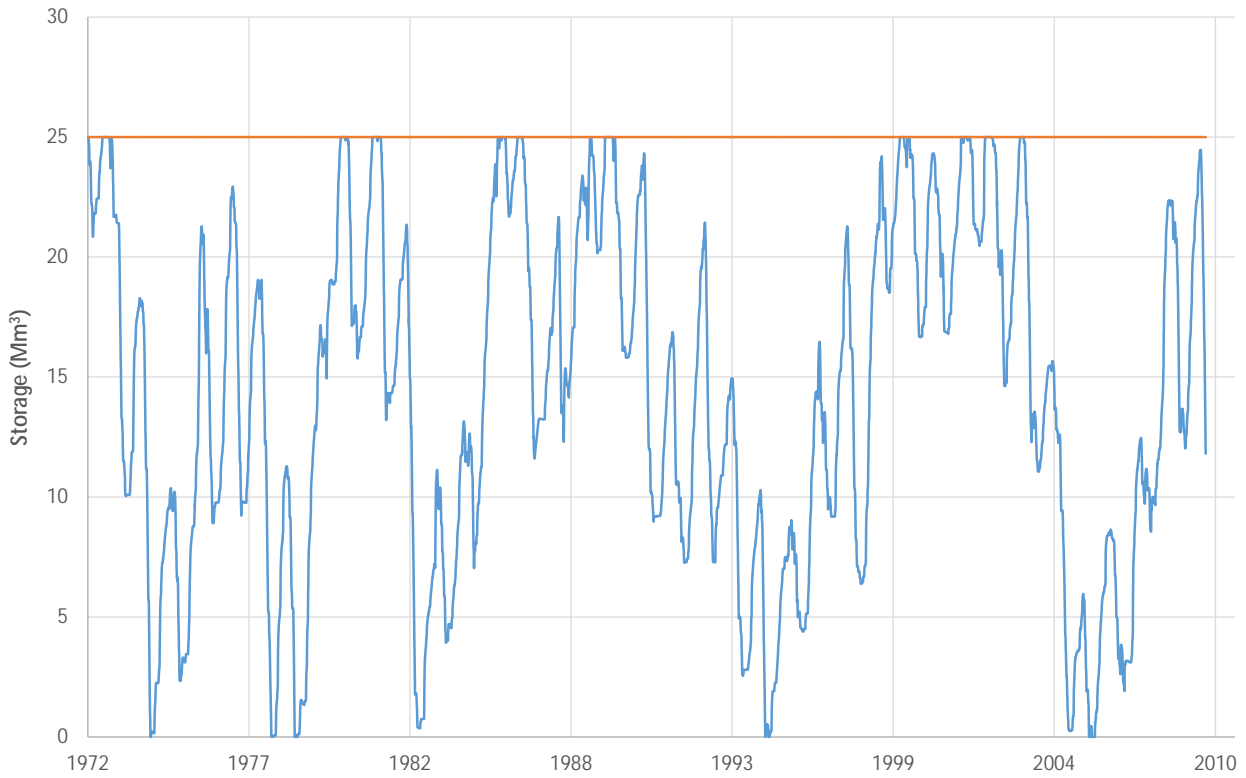
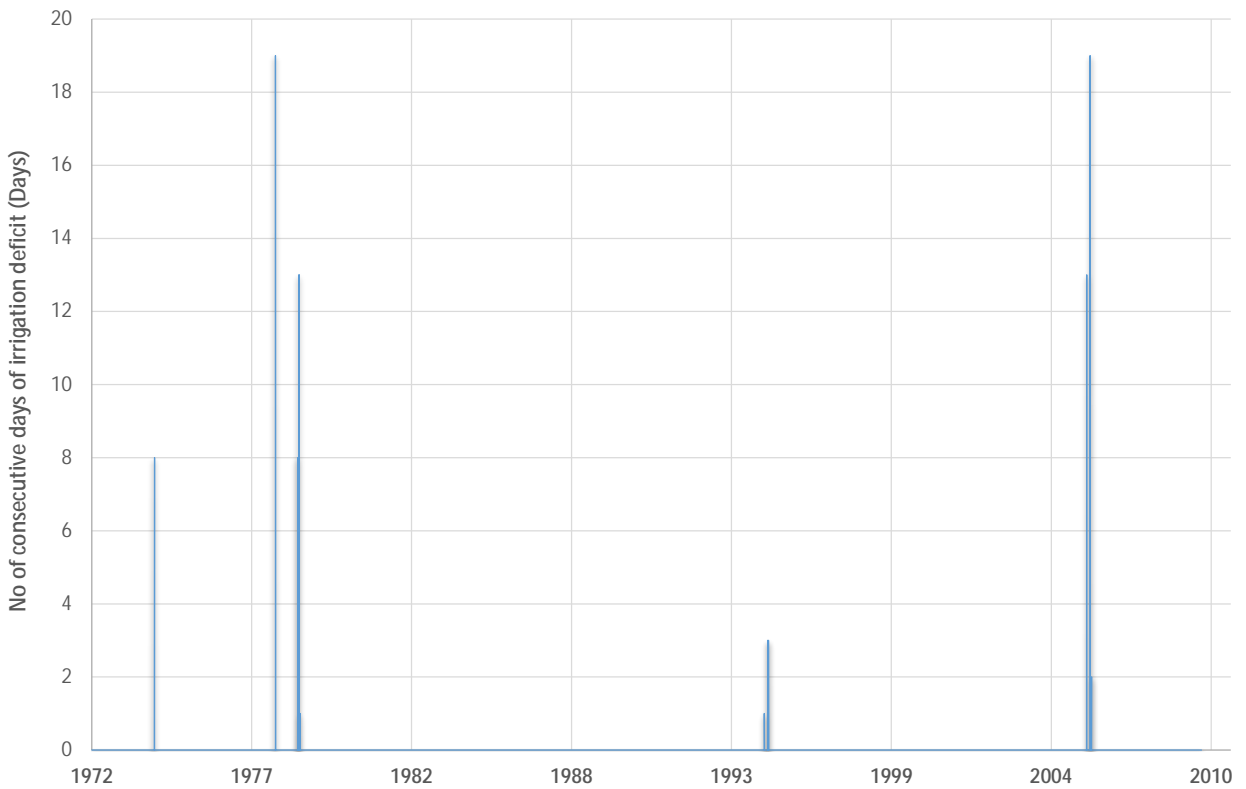


Figure H.16 – Irrigation supply deficit days for the Kaikohe Area



Waimamaku Area

Figure H.17 – Approximate location of intake for water harvesting or instream dam for the Waimamaku Area



Figure H.18 – Storage hydrograph for the Waimamaku Area

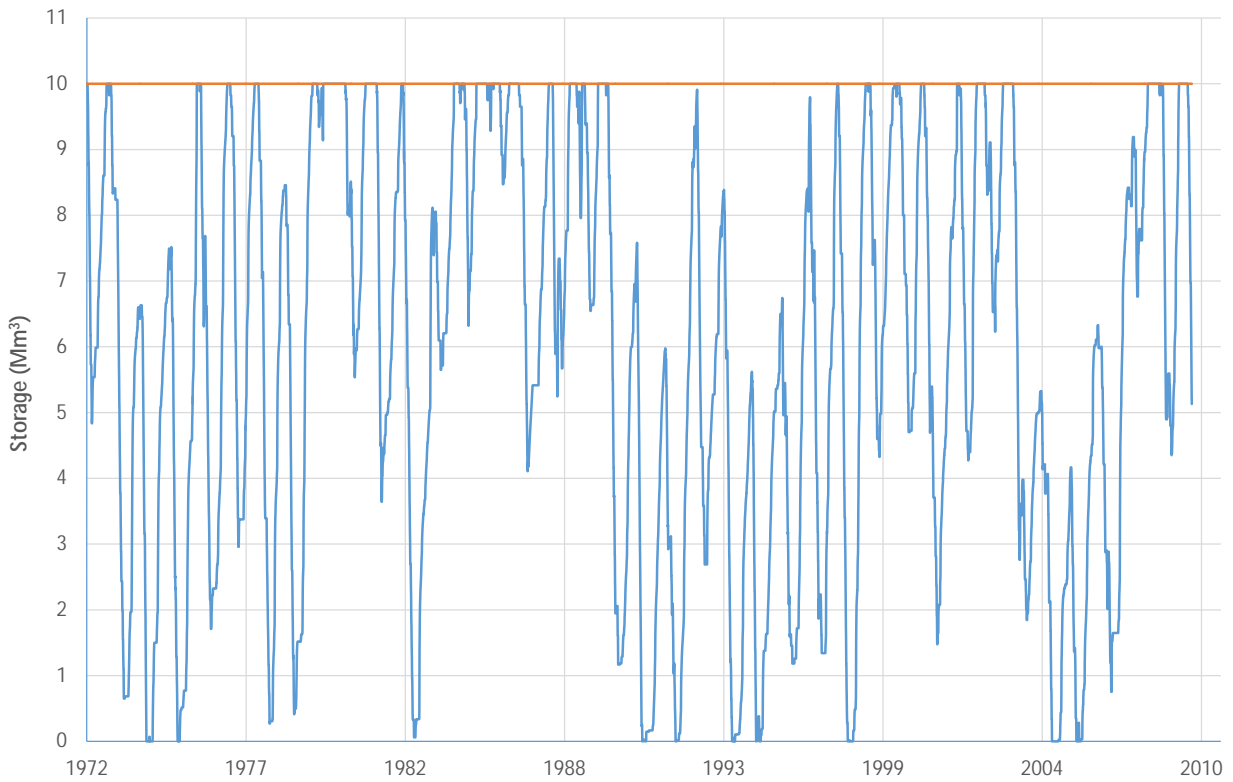
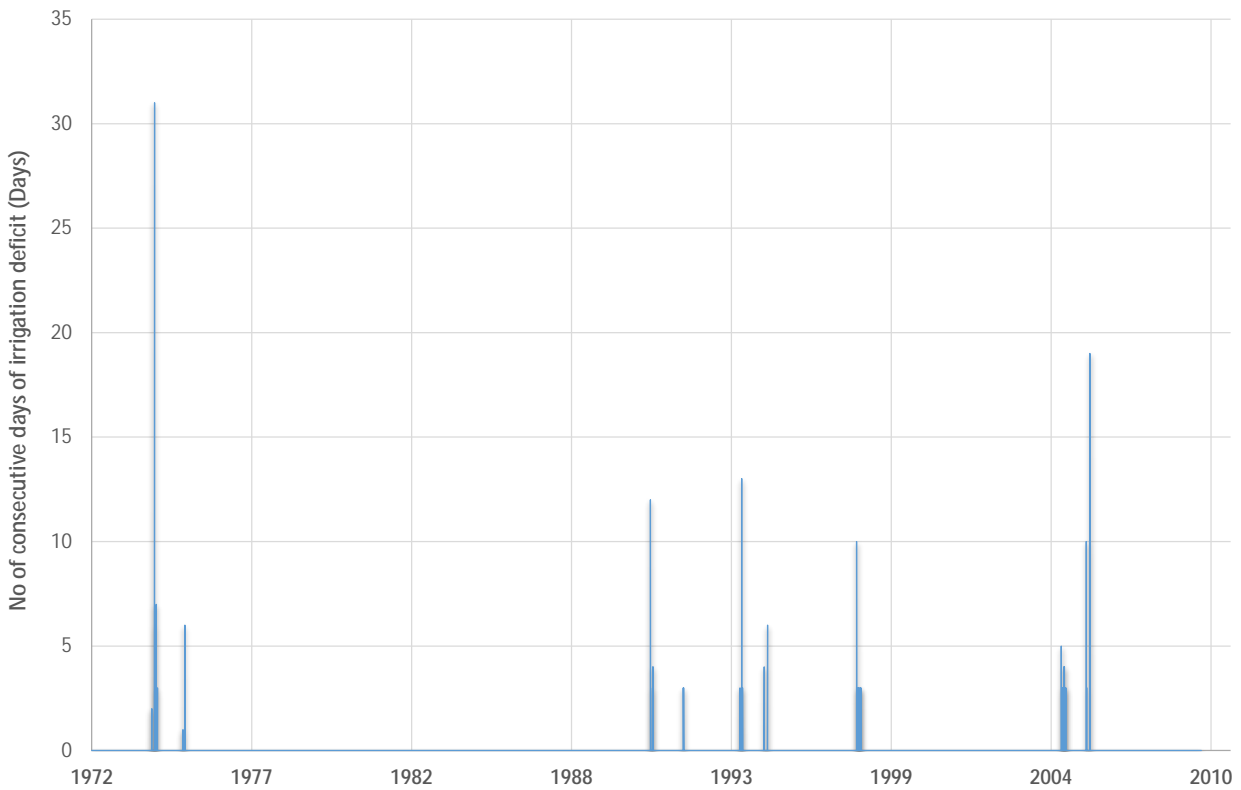


Figure H.19 – Irrigation supply deficit days for the Waimamaku Area



Hikurangi Area

Figure H.20 – Approximate locations of intakes for water harvesting or instream dams for the Hikurangi Area



Figure H.21 – Upper storage hydrograph in the Hikurangi Area

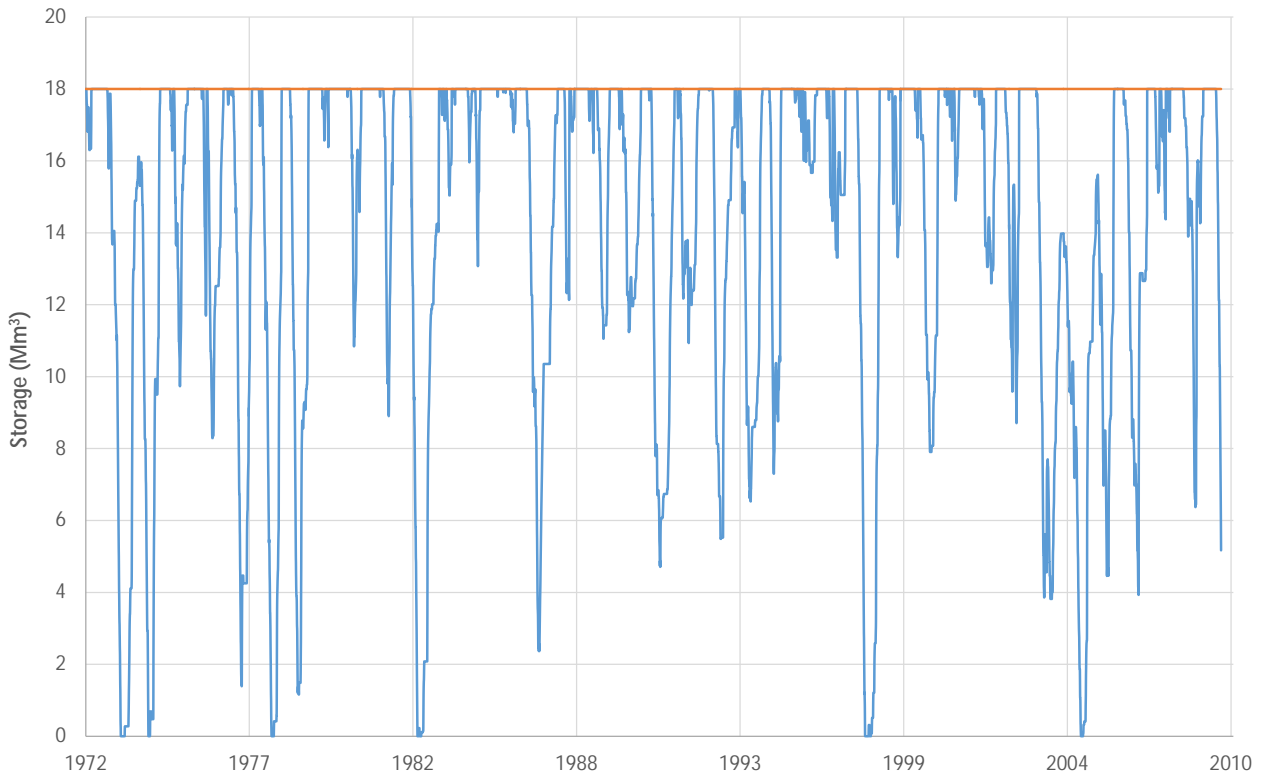


Figure H.22 – Lower storage hydrograph in the Hikurangi Area

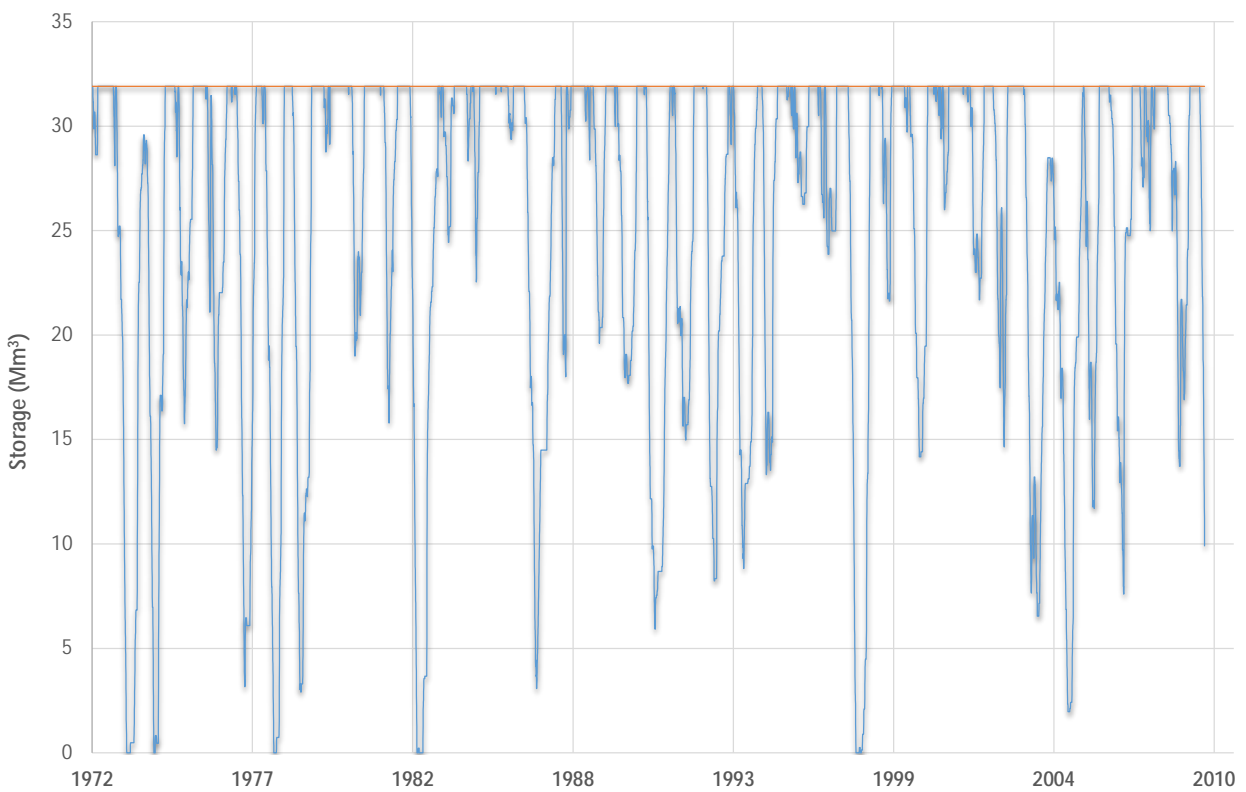


Figure H.23 – Irrigation supply deficit days for the area supplied by the upper storage in the Hukurangi Area

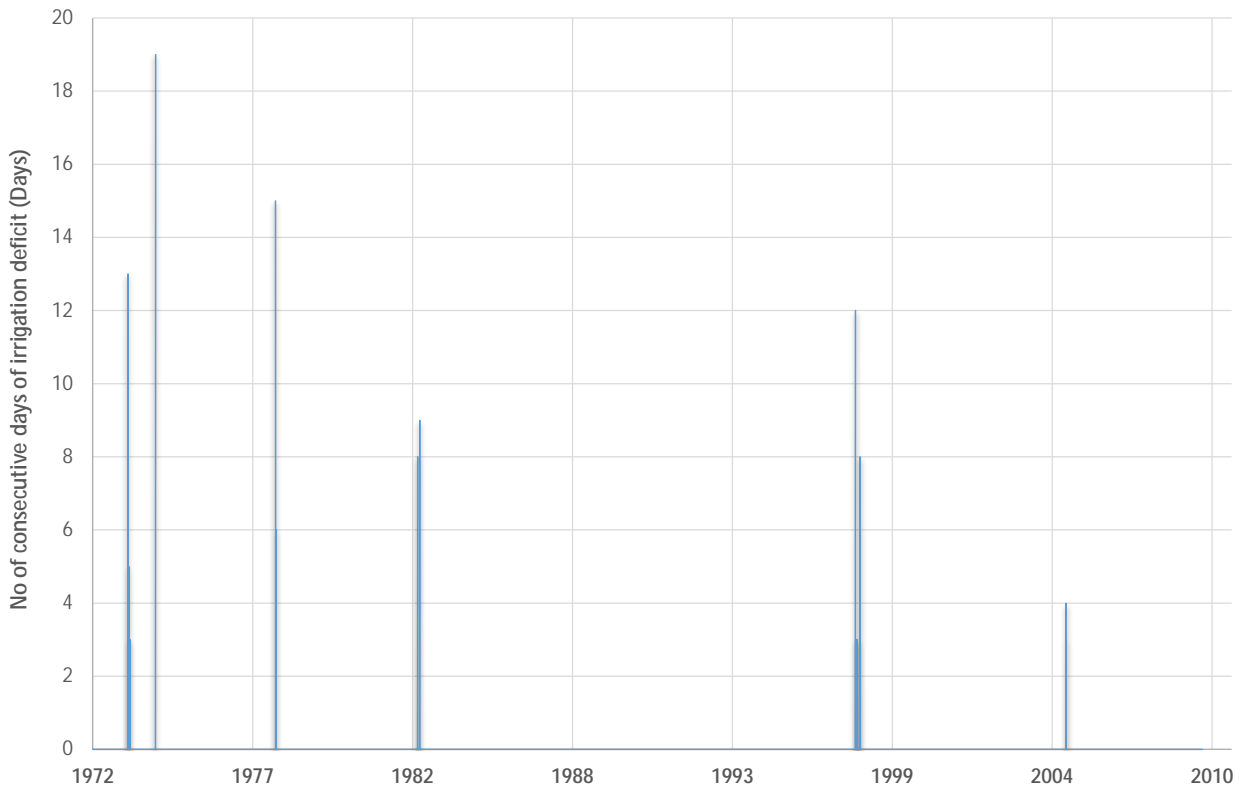


Figure H.24 – Irrigation supply deficit days for the area supplied by the lower storage in the Hukurangi Area

