6 Water Quantity and Flows

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6.1 Water Quantity and Flows: Main Points

Pressures

- Northland's water resources are under increasing pressure to meet demands from a variety of consumptive users – including the agriculture, horticulture, public and private water supply and industry sectors.
- Currently, there are 416 consents allocated up to 563,868m^3/day of water from streams, rivers and dams in Northland.
- The Wairua, Whangarei Harbour, Waitangi and Kerikeri catchments are the most heavily utilised for their water resources.

State

- Annual rainfall ranges from 900mm in low-lying coastal areas to over 2900mm in higher altitudes.
- Flows vary greatly between catchments, which can be largely attributed to rainfall patterns, catchment size and catchment geology. In Northland, catchment geology greatly influences low flows during drought conditions.
- Northland's climate is such that it will experience a regional drought, on average, once every three years at East Coast and inland locations, and once every four years at west coast and high altitude locations.

Responses

- The Revised Proposed Regional Water and Soil Plan contains rules that set standards for minimum water quality or minimum levels of water flows.
- The main policy on drought response is an emphasis on the data collection network, publicity and early warning of potential drought problems.
- Minimum flows have been determined to protect the many functions of water.
- The Northland Regional Council operates a hydrometric network consisting of 37 sites (24 river level, 4 tidal, 9 rainfall). The network is complemented by 55 daily rainfall reader sites, and 13 lake level monitoring sites.

6.2 Introduction to Surface Water Quantity in Northland

The Northland Regional Council has responsibilities under the Resource Management Act to control water use, and to monitor the level and flow of water bodies. Successful management of the water resources will stem directly from informed resource management decisions. This can only be achieved from accurate knowledge of the environment itself, including climate, water quantity, present water use and potential demand for water in Northland. The Council also controls the use of land for the purpose of maintaining sufficient water flows for human uses and aquatic life.

Natural water quantities are directly related to the soils we stand on and the rain that falls overhead. Some rain seeps into the ground and becomes part of the groundwater system, while the rest flows over the land to our streams and rivers that discharge into the coastal environment.

Waipoua River

6.3 Regional Policy Statement Objectives

The Regional Policy Statement contains a range of objectives relating to the quantity of Northland's surface water resources. These objectives seek to maintain flows, conserve water resources, and protect the natural environment from adverse effects.

The Regional Policy Statement objectives are:

- **The maintenance of the flows and levels in significant streams, rivers, lakes and wetlands to preserve their natural character and to protect high ecological, cultural or scenic values.**
- **The maintenance of water flows and levels in natural water bodies that are sufficient to preserve their life-supporting capacity, natural character, intrinsic values and associated or dependent values.**
- **The efficient use and conservation of water resources.**
- **To protect property and other values from adverse effects due to the diversion of water from its natural drainage pattern.**

6.4 Surface Water Quantity Issues

- The conflict between allocation of water for consumptive uses such as public and industrial water supplies and irrigation while still protecting natural, intrinsic and amenity values of the water body. There are numerous examples in Northland.

- The conflict between taking water and the spiritual and cultural values of water bodies to tangata whenua, the degradation of the mauri (life force), wairua (spirit) of the river, lake or wetland, and traditional food and weaving resources.

- The competition between various consumptive water uses where the demand for water exceeds quantities naturally available.

- The loss of natural wetlands, their habitat and intrinsic values due to land drainage

- The changes in water quantities due to major land use changes, such as deforestation, afforestation, urbanisation and major drainage works.

- The effects of dams, weirs, culverts and other structures in streams, particularly as barriers to the movement of stream life, flooding, erosion and flow reductions.

Typical Northland stream passing through farmland suffering from bank erosion

6.5 Pressures on Surface Water Quantity

6.5.1 Demand for Surface Water

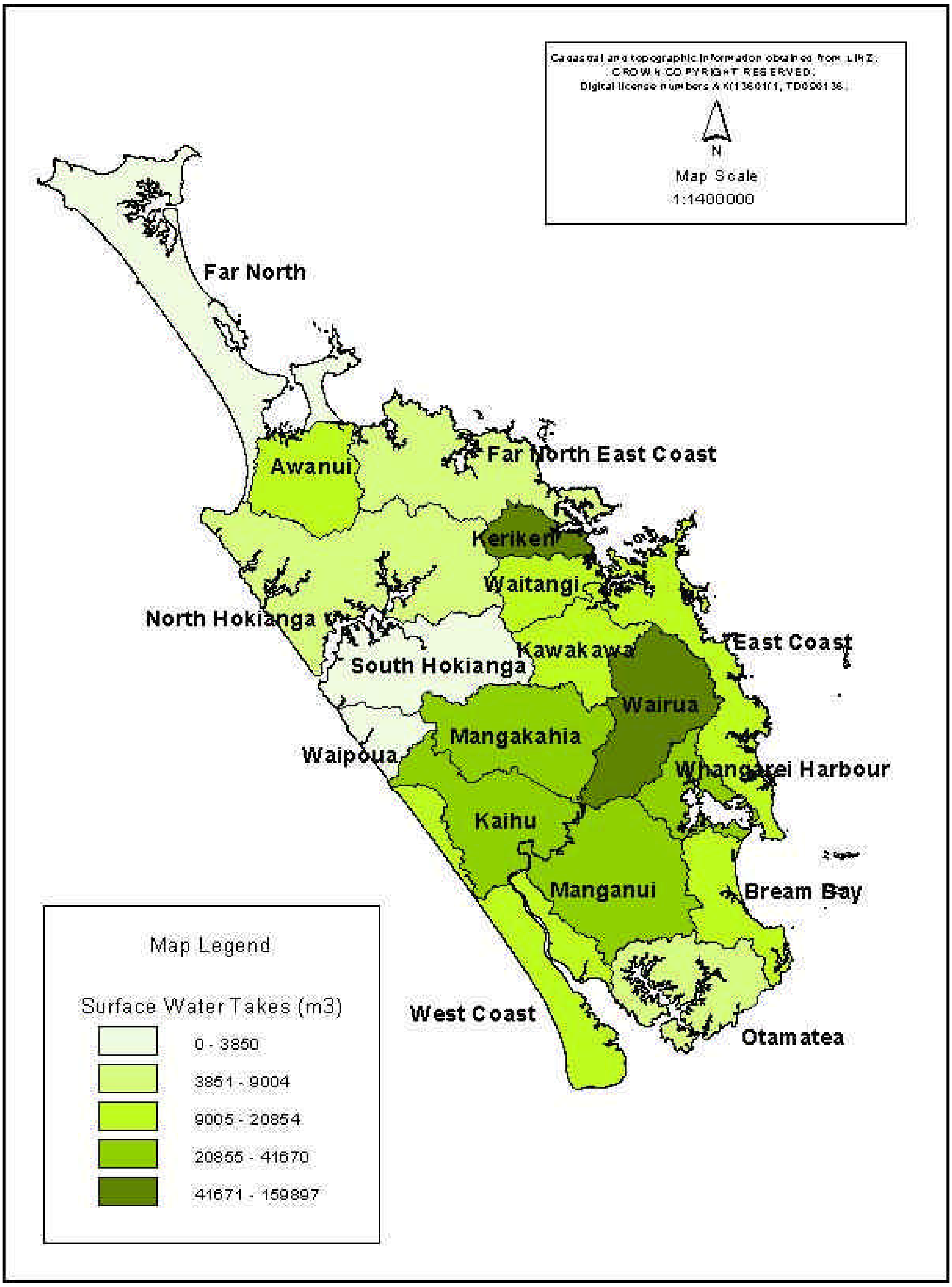
Northland's water resources are under increasing pressure to meet demands from a variety of consumptive users. These users include the agriculture, horticulture, water supply and industry sectors. Taking water for these sectors must be considered against the ability of the water to maintain its life-supporting capacity for aquatic life, aesthetic value and the spiritual and cultural value of water to tangata whenua. Lower water levels can result in increased water temperatures, depleted dissolved oxygen levels, increased algal growth and general degradation of water quality. Low water levels also reduce the ability of water bodies to assimilate waste.

Different uses and values are not always compatible, particularly during summer months when there is less water available. To ensure that conflict between the use of water resources and the potential for adverse effects from excessive uses are decreased, efficient use of water must be promoted. Water resources are managed through the resource consent process.

Surface water availability within the region is affected by consumptive water use, including surface water takes, dams and diversions, and culverts and fords. Pressures are also placed on lakes and wetlands, with land use change having an impact on most aspects of water quantity.

6.5.2 Surface Water Takes

Northland Regional Council requires resource consents for the majority of surface water takes. There are 416 consents allocating 563,868 m^3 per day of water from streams, rivers and dams in Northland. Map 8 shows surface water demand by water management area. Surface water takes are concentrated around population centres and areas where irrigation is required for horticulture and agriculture. There are 69 consents granted for the Wairua Catchment and it is recognised that water resources are fully allocated (refer **case study : Wairua River Catchment Management Study**). The Whangarei Harbour, Waitangi and Kerikeri catchments are also heavily utilised for their water resources.



Map 8: Surface water takes by water management area

Wairua has the largest number of consents granted but it is the Kerikeri catchment (refer **Case Study: Kerikeri Irrigation Company**) which uses the greatest amount of water (refer Figure 20). Figure 21 shows which sector uses the most water (all of the totals in figure 21 exclude the Wairua Power Station as it is only a diversion – allocated up 2,592,000 m^3 per day).

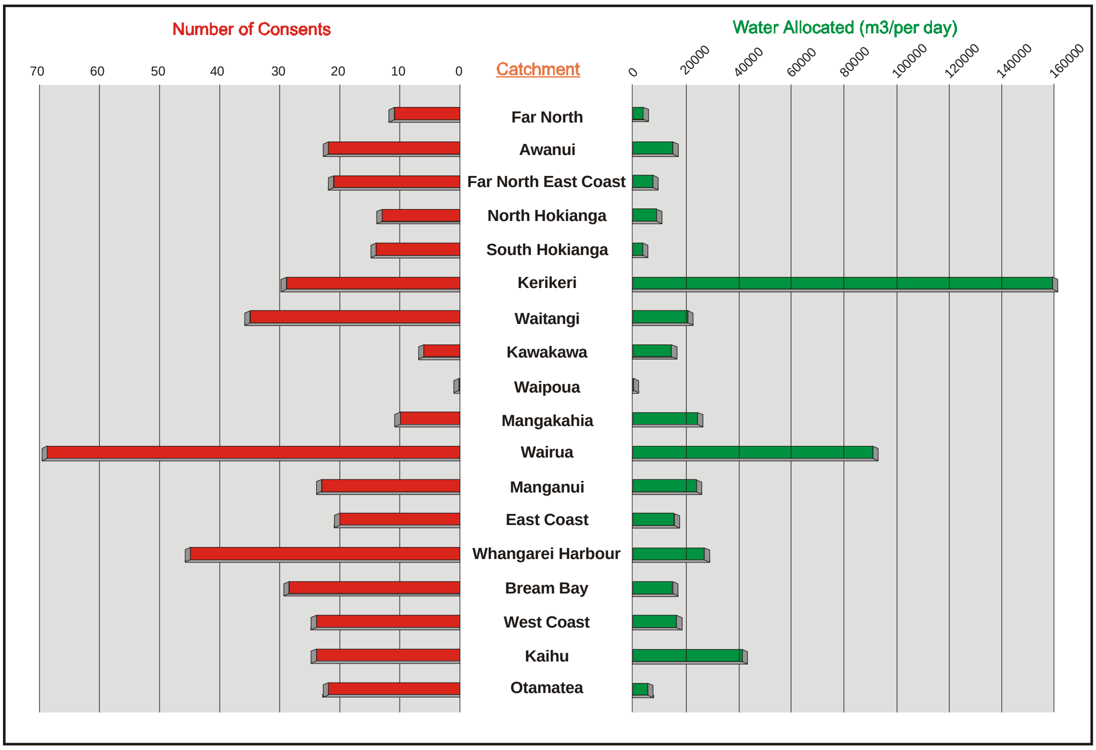


Figure 20: Number of consents against allocation of water per management area.

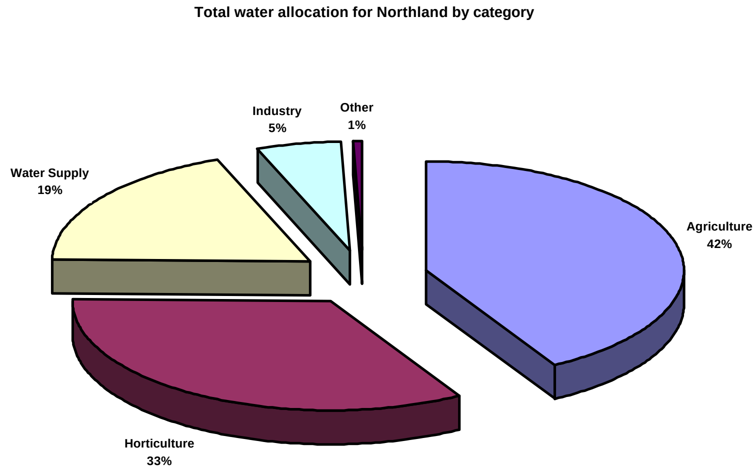


Figure 21: Pie chart showing water use by category.

Agriculture is the greatest user of water in Northland, consuming nearly half of the allocated surface water total. This water is mainly used for irrigation, and to a lesser extent for cowshed wash down and stock watering. Figure 21 does not take into account water taken as a permitted activity (32 m^3 per day), as no record or information is required by the Council to be kept. The largest surface water take in Northland is the Mangakahia Irrigation Committee, which has a consent to take a combined total volume of 19,400 cubic meters per day (refer **Case Study: Mangakahia Irrigation Scheme**)

Spray Irrigation

Horticulture accounts for 33% or 188,524 m^3 per day of the total volume of water allocated. Most of the horticulture activities take place on the fertile volcanic soils near Kerikeri, Piano Hill (north Whangarei), Maungatapere and Maungakaramea and on the sandy clay loam soils on the west coast near Dargaville.

Water supplies to towns and cities account for 19% of the total allocation of water for Northland. The District Councils are the main suppliers of water, taking from streams, rivers, springs and dams. As coastal development takes place, demand for water supply in these areas will increase and additional sources of water will have to be found (refer **Case Study: Opononi/Omapere water supply issue**). These areas are prone to lower rainfall and longer periods of dry weather.

Historically and currently some towns are facing problems finding additional water sources to supplement existing supplies, and provide for development (such as Kaitaia, Kaikohe, and Russell).

Water use for industrial needs is comparatively low compared to other sectors, comprising of only 5% of total water allocation. Some of the largest water users include dairy factories, meatworks and cement works. Notably, some of the major, and many minor industries in the region utilise urban public water supplies (for example in Whangarei and Kaitaia).

6.5.3 Dams and Diversions

Compared to other regions in New Zealand, Northland has only a small number of weirs and dams, of which 44 are consented activities. Resource consents are required when the dam is greater than 3 metres in depth, holds more than 20,000 m^3 or dams a watercourse that flows during all seasons.

Dams range in size and purpose. Dams smaller than 0.5m in depth are primarily used on farms for stock water, and rely solely on runoff for replenishment. Dams greater than 0.5m and less than 3m deep are generally used as small storage dams for recreational parks, wetlands, and agricultural needs. Larger dams are used for a range of activities including agriculture, horticulture and public water supply.

Irrigation Dam

Most of Northland's oldest dams were built for municipal water supply. The early 1980s saw the development of the Kerikeri Irrigation Scheme and the creation of two large irrigation dams, associated supply dams and weirs to provide water for horticultural purposes (refer **Case Study: Kerikeri Irrigation Co. Ltd)**. The occurrence of the 1986-1987 and 1990-1992 droughts prompted the then Northland Dairy Company to promote dam construction to dairy farmers. Irrigation of pasture during prolonged dry periods of weather would allow for greater pasture growth and lead to an increase in dairy production.

Large dams can affect fish passage, sediment transport, water quality and the natural flow regime. They can however, when managed efficiently, stabilise stream flows, reduce flooding, contribute to base flows, provide large open water bodies and, create to a small extent, a seasonal-wetland environment.

There are 144 consents for diversions in Northland, most of which are for flood schemes, with the exception of the Wairua Power Station which is used for the generation of electricity. Diversions can occur when the existing river channels are straightened, meanders removed, channels created to divert water from the natural watercourse or stop banks are built to contain floodwaters. Despite helping to reduce the impact of floodwaters on life and

Awanui River

property, diversions can lead to erosion of river beds and banks, inhibit fish passage, disrupt aquatic environments and affect water quality.

6.5.4 Culverts and Fords

There are 129 resource consents granted for the construction of culverts and fords, as permanent crossings across Northland's rivers and streams. Fords generally alter the bed of the stream whereas culverts can be used to divert water flow to allow additional structures to be built over top, as in the case of road construction. When culverts and fords are properly constructed and maintained they have little long term effect on rivers and streams. However, they do alter the stream bed and its natural flow and can reduce flood capacity and inhibit fish passage.

6.5.5 Land Use Changes

Land use changes have had a direct effect on river flow and water balance. Trends in land use over the last 30 years are listed in table 10. Future trends suggest that more uneconomic farmland will be planted in pines, there will be an increase in farms converting to dairy production and more lifestyle properties created.

Table 10: Land use changes and effects

Land use change	Effects
Reversion from pasture to scrub/weeds	Water yield expected to decrease slowly until similar to a natural scrub, then bush catchment.
Pasture and scrub/weeds to pines	Water yield expected to decrease, frequency of bank-full flows decrease, river regimes adjust to a lower supply of sediment from the land. Observed increases in streambank erosion as rivers adjust from a "pastureland stream" to a "bush stream". Expected to stabilise in a new regime after 20+ years.
Intensifying of land use on pastoral land	Land grazed more intensively, but can be improved by pasture management to offset any effects of heavier stocking (increased rate of sediment runoff following pugging, compaction and reduced infiltration). More surface and subsurface drainage, smoothing of paddocks during cultivation and fodder crop rotation to reduce water ponding, all of which result in more rapid runoff.

6.5.6 Lakes and Wetlands

Presently, there is little pressure on lakes to supply water as only a few Northland lakes have surface water takes. However, as most lakes are relatively small and shallow, they have a sensitive water balance and a limited capacity to assimilate any contaminants. They are prone to nutrient enrichment from stock and fertiliser, particularly where lakeside vegetation has been grazed or removed, and where there is direct stock access to the lake.

The drainage of wetlands has resulted in many wetland species now being rare or endangered. Drainage has other adverse effects, such as loss of buffer storage for flood waters, which leads to increased flood peaks and reduced summer flows, as well as loss in the capacity of wetlands to trap and reduce sediment, nutrients and other contaminants.

Wetland at Maungatapere

6.6 State of our Water Resources

6.6.1 Rainfall

Northland's rainfall distribution pattern results from its narrow shape and topography. The Northland peninsula is 260 kilometres long, extends in a northwesterly direction and at its narrowest point, in the Aupouri Peninsula, is only 10 km wide. The Tutamoe and the Waima ranges, on the west coast, are the highest ranges in Northland reaching an altitude of only 770 and 781 metres respectively.

Telemetered rainfall site

The topographical variation across Northland causes rainfall distribution patterns to vary considerably over relatively small areas. Annual rainfall ranges from 900mm in low-lying coastal areas to over 2900mm in higher altitudes. Generally the higher altitude areas of the west and east coast receive more rainfall while low-lying areas receive less **(**Refer Map 9: Mean Annual Rainfall for Northland).

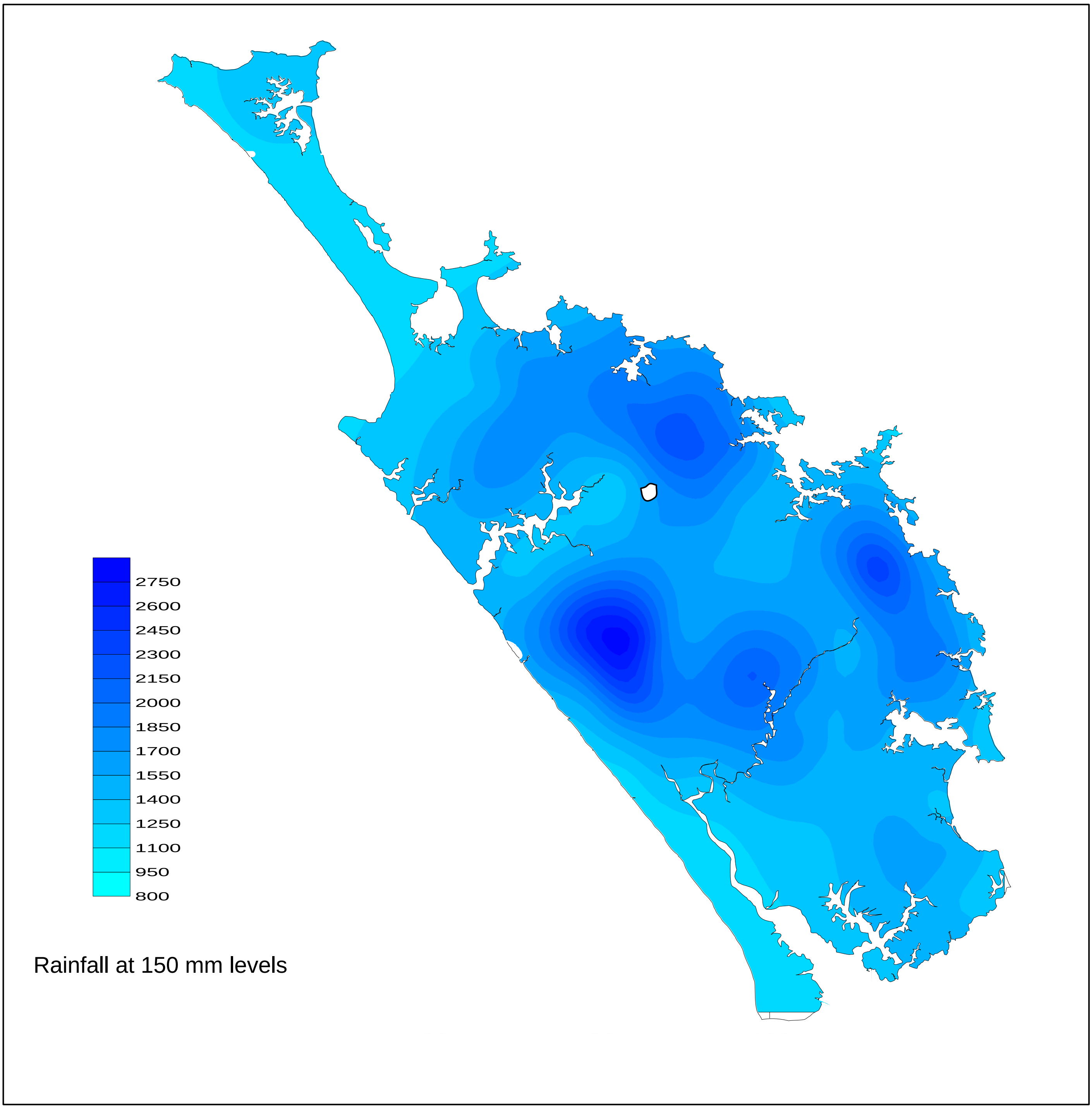
Due to the seasonal movement of high pressure belts, seasonal influences on rainfall are well defined. Rainfall is highest in winter and lowest in summer. However, Northland does experience high-intensity rainfall, associated with the passage of tropical or sub-tropical storms, which pass over Northland in summer from November through to March. Summer cyclones also occur infrequently during periods of La Nina weather phases. Modified tropical cyclonic depressions from the north may affect Northland on average once every five years. These events produce very high rainfall up to 100 to 150mm per hour and can cause widespread flooding, especially when they coincide with extreme high tides. Isolated thunderstorm cells dump vast amounts of rain over very small areas causing extreme flash flooding.

Daily rainfall reader site

Monitoring and obtaining information about Northland's rainfall resource is important so that short and longterm changes in rainfall, which have the potential to severely affect distribution and quantity of water resources in the region, can be detected.

The Northland Regional Council, NIWA and the MetService collect rainfall data at various locations in Northland (refer Map 9: Mean Annual Rainfall for Northland). Historical rainfall data with records greater than five years are available for over 260 Northland stations, of which 76 have records greater than 30 years **(refer appendix 1)**. The 108 years of records for a station still operating in Kaitaia, is the longest for the region.

Map 9: Mean Annual Rainfall for Northland



6.6.2 Droughts

Northland experiences two types of drought, regional and localised. Northland's climate is such that it will experience a regional drought, on average, once every three years at east coast and inland locations, and once every four years at west coast and high altitude locations (refer table 11). Droughts result in significantly greater evapo-transpiration rates, severe soil moisture deficits and lower than average river flows which ultimately affect water supply and in-stream ecosystems (**see Case Study: Drought 1986/1987**)

Northland's water resources are already limited, compared to other regions in New Zealand, due in part to the short lengths of many Northland rivers (excluding the Wairua Catchment). With the potential increase in demand for water combined with the possibility of global warming, drought problems in the future could become prevalent and the effects far reaching.

Table 11: Northland Regional Drought Years to 1993 (after Keyte, 1993)

Regional Drought Year	Return Period (yrs)	Regional Drought Year	Return Period (yrs)
1907-08	4	1946-47	4
1913-14	6	1949-50	20
1914-15	100	1953-54	3
1918-19	20	1961-62	5
1919-20	20	1963-64	8
1924-25	10	1967-68	5
1925-26	4	1969-70	3
1927-28	6	1972-73	8
1928-29	4	1973-74	9
1930-31	12	1977-78	8
1932-33	15	1982-83	40
1941-42	6	1986-87	20
1942-43	5	1990-91	7
1945-46	18	1991-92	7

6.6.3 River Flow

Northland has a dense network of rivers and streams, many of which are relatively short with small catchments. Catchments on the east coast tend to be smaller than those on the west coast. Most of the major rivers have their outlets into harbours with few discharging directly to the coast.

Many Northland rivers show 'drowned valley' characteristics with large harbours and estuaries at their mouths. The Kaipara Harbour represents the sunken lower reaches of Northland's largest river (the Northern Wairoa), draining a catchment area of some 3650 km^2, or 29% of the land area of Northland.

The Wairua River, a major tributary of the Northern Wairoa River

Flooding tends to occur during winter months when flow is higher but can occur in summer when remnant cyclones, usually down-graded to tropical depressions, make their way far enough south to the Northland Peninsula. However, there is generally a broad seasonal pattern of higher flows during the winter months, and lower flows during the summer months. Most rivers have 10-20% of the yearly flow in summer months, and flow is largely maintained by groundwater baseflow.

Differences in flows between catchments can be attributed to rainfall patterns, catchment size and catchment geology. In Northland catchment geology greatly influences low flows during drought conditions.

Fractured basalt rock readily absorbs rainfall and slowly releases it through springs. This slow release sustains the flow during dry periods at more than 3.5 $l/s/km^2$. Examples of rivers flowing through basaltic and greywacke geology are the Punakitere, Waipao, Waipapa and Ngunguru Rivers.

Catchments with less pervious geology absorb less rain and therefore have less water available in storage. Flows from these catchments tend to recede quickly during dry summers, with little sustaining baseflow. Many streams in the Aupouri Peninsula have little or no baseflow and in catchments where there is underlying mudstone-sandstone geology, less than 1 $l/s/km^2$ is released during drought months. Examples of rivers in Northland that flow through catchments of mudstone-sandstone geology are Selwyn Swamp and the Awanui Rivers.

Table 12 shows information such as minimum, maximum, median, mean and annual flood flows from various rivers in Northland. Six stations are operated by NIWA.

Table 12: Flow Statistics from Various Stations in Northland

Site Number	River	Area (km2)	Authority	Min Flow (l/s)	Median Flow (l/s)	Mean Flow (l/s)	Max Flow (m3/s)	Annual Flood (m3/s)	Years Record	Data Start
802	Selwyn Swamp	1.74	NRC	2	16	31	3	1.2	36	1965
1316	Awanui	222	NIWA	322	2772	6044	221	149	43	1958
1903	Oruru	79	NIWA	369	1342	2273	96	64	13	1988
3412	Rangitane	21.4	NRC	17	439	675	47	23	24	1977
3506	Maungaparerua	11.1	NIWA	11.3	200	452	89	44	34	1967
3722	Waitangi	302	NIWA	351	4105	8086	605	220	22	1979
3819	Waiharakeke	229	NRC	12	2036	5022	188	86	34	1967
4901	Ngunguru	12.5	NRC	45	204	392	114	61	32	1969
5527	Waiarohia	18.6	NRC	20	158	323	98	25	22	1979
5528	Raumanga	16.3	NRC	50	185	326	69	26	22	1979
5901	Ruakaka (WDC Take)	45.3	NRC	0	219	738	87	64	17	1984
6007	Waionehu	24.5	NRC	1	153	437	29	23	18	1982
6015	North	38.4	NRC	48	360	852	63	34	19	1982
6016	Waihiohoi	25.1	NRC	26	263	519	33	18	17	1984
6018	Ahuroa (Braigh Flats)	57	NRC	46	533	1169	170	66	18	1983
46611	Kaihu (Gorge)	116	NRC	526	2601	4159	395	150	31	1970
46618	Mangakahia (Twin Bridges)	246	NIWA	968	5007	6928	1038	484	41	1960
46625	Hikurangi	189	NRC	104	1850	5187	299	238	41	1960
46626	Mangakahia (Titoki)	798	NRC	1567	12959	25792	949	524	18	1983
46627	Waiotu	125	NRC	105	1564	4129	159	105	14	1987
46632	Whakapara	162	NRC	310	2300	5799	546	193	45	1956
46641	Waipao	36.7	NRC	59	457	653	21	13	22	1979
46644	Wairua (Purua Bridge)	544	NRC	750	7791	18510	313	205	41	1960
46646	Mangere	79	NRC	46	546	1495	91	55	18	1983
46647	Wairua (Wairua Bridge)	707	NRC	981	11278	21136	483	233	40	1961
46651	Manganui	411	NRC	77	2801	8753	320	168	41	1960
46674	Mangahahuru	20.5	NRC	49	310	478	19	13	33	1968
47595	Punakitere	284.4	NRC	369	2967	6698	158	153	7	1994
7804	Waipapa	122	NIWA	443	2136	4523	470	248	26	1975
1046651	Opouteke	105	NRC	332	2026	3776	507	212	17	1984

6.6.4 Tidal Monitoring

Northland's sea level monitoring stations play an important role in the investigation of such effects as storm surges, tsunami, seasonal and annual variations as well as sea level responses to climate patterns. Data from the coastal network also assists the Northland Regional Council to address the coastal hazard requirements of various statutes and plans.

The Regional Council operates four automatic water level recorders located in tidal environments. Two are located on the East Coast at Marsden Point and Opua and two on the West Coast at Pouto Point and Dargaville. Water levels are recorded at five-minute intervals at Marsden Point and Pouto Point and 15 minute intervals at Opua and Dargaville. All stations except Opua are radio telemetered.

Tidal monitoring station at Dargaville

Barometric pressure is measured at Pouto Point and Dargaville (additionally wind speed, direction and rainfall are measured at the Dargaville station). Two stations operated by the Northland Port Corporation supplement the NRC's tidal network. Both stations are within the Whangarei Harbour - one at Port Whangarei and one at Marsden Point. Data from these stations is used by the Royal New Zealand Navy Hydrographic Office for tide predictions.

6.6.5 Lakes and Wetlands

Northland has a large number of small and generally shallow lakes and associated wetlands, most of which have been formed between stabilised sand dunes along the west coast. The dune lakes are grouped on the Aupouri, Karikari and Pouto peninsulas. These lakes vary in size, with the majority being between five to 35 hectares in area and generally less than 15 metres deep. Lake Taharoa of the Kai Iwi Group is one of the largest and deepest dune lakes within New Zealand, covering an area of 237 hectares and up to 37 metres deep.

The dune lakes in the region usually have little or no continuous surface water inflows or outflows and are primarily fed by direct rainfall on to their surfaces or through the surrounding wetlands. As a result their levels fluctuate considerably with climatic patterns. The inland lakes, formed through the damming of valleys by lava flows, are generally fed through rainfall and surface water flow. Two such lakes are Lake Omapere and Lake Owahareiti near Kaikohe. These lakes have significant spiritual and cultural significance to tangata whenua.

Wetland near Whangarei

There are numerous wetlands in Northland, the most significant being the Hikurangi Swamp, the Motatau Wetlands and those linked with Lake Omapere and the mid catchments of larger rivers, such as Manganui/Tauraroa. However, up to 95% of Northland's natural wetlands have been lost due to drainage and conversion of land to agricultural uses. The remaining wetlands tend to be small and scattered, and continue to be vulnerable to changes in hydrologic regimes, and to the effects of stock grazing and further land development.

There has been little monitoring of the hydrology of remaining wetlands in the region.

6.6.7 Outstanding Value Rivers and Lakes

The Revised Proposed Water and Soil Plan lists some rivers or sections of rivers in Northland, and lakes which have outstanding features and values for which it is appropriate to either prohibit the taking of water, or to allow the take of only very minor quantities of water.

These rivers and lakes;

- May have catchments which are dominated by indigenous vegetation and which are largely unmodified natural ecosystems.
- Are recognised to be taonga requiring flow preservation in a natural or near natural state, or
- Are an essential part of an outstanding landscape.

The outstanding value rivers identified by the Council include:

- Waipoua River
- Whirinaki River
- Waipapa River

- Mangamuka River
- Punaruku River
- Lake Ora

Lake Ora

6.7 Response to Surface Water Quantity Issues

6.7.1 Northland Regional Council

Plans and Policies

The **Regional Policy Statement** sets out to provide an overview of the resource management issues of the region, and contains policies and methods to achieve integrated management of the region's natural and physical resources. In Northland there are many significant problems and potential conflicts between use, development and protection of the region's water resources.

The **Regional Water and Soil Plan** sets standards for allowing, restricting or prohibiting activities, and will contain detailed policies and rules that the Regional Council will use for deciding on applications for water-related consents. These will include setting minimum water quality standards or minimum levels of water flows.

Water Shortage Direction and Drought Response Guidelines

In response to a serious temporary water shortage in Northland the Council can issue a water shortage direction to allow continued water takes (pursuant to Section 329 of the RMA). Based on the current pattern of water use, the application of a water shortage direction to large areas of Northland at any one time is unlikely. It is most likely that the need would be confined to a few sub-catchments at any one time.

Compliance with resource consents, efficient use of water and voluntary reductions are important prerequisites to the implementation of a water shortage direction. Only when these are insufficient to prevent a severe shortage of water is a water shortage direction necessary. The maintenance of people's health is given the highest priority of water use.

The main policy on drought response is emphasis on the data collection network, publicity and early warning of potential drought problems. The include the notification of pending water shortages and dissemination of information; modification of water use; and compliance.

Minimum Flow Criteria

Research has emphasised the need to maintain minimum flows that protect the functioning and non-extractive uses of rivers. These functions include the life-supporting capacity and waste assimilation potential of the water bodies and also meeting the needs of recreational, amenity and cultural uses.

Generally, smaller rivers are more sensitive to the potentially adverse effects of flow reduction on their life-supporting capacity than the larger rivers.

The Mean Annual Low Flow (MALF) has been specified as the design minimum flow for flow-sensitive rivers. The MALF is obtained by averaging the lowest daily flow for each year of record. This average estimates a natural minimum, which generally occurs in summer.

Minimum flow requirements when MALF does not apply are rivers or parts of rivers that are less sensitive to reduction in flow arising from taking, damming and diverting surface water and therefore lower minimum flows are acceptable to avoid adverse effects on the aquatic ecosystem.

The continuous "7 day" one in five-year return period low flow is used as a design minimum for these types of rivers. The "7 day" value is used, as it is considered to be a more reliable and meaningful statistical measure of flow. Table 13 shows the MALF and '7 day' one in five-year return period in various Northland rivers with long term record.

Table 13: DMF (Design Minimum Flows) in various Northland rivers. The * indicates flows that have been naturalised for the Wairua Catchment Report (WCR) i.e. water use added to recorded flow values.

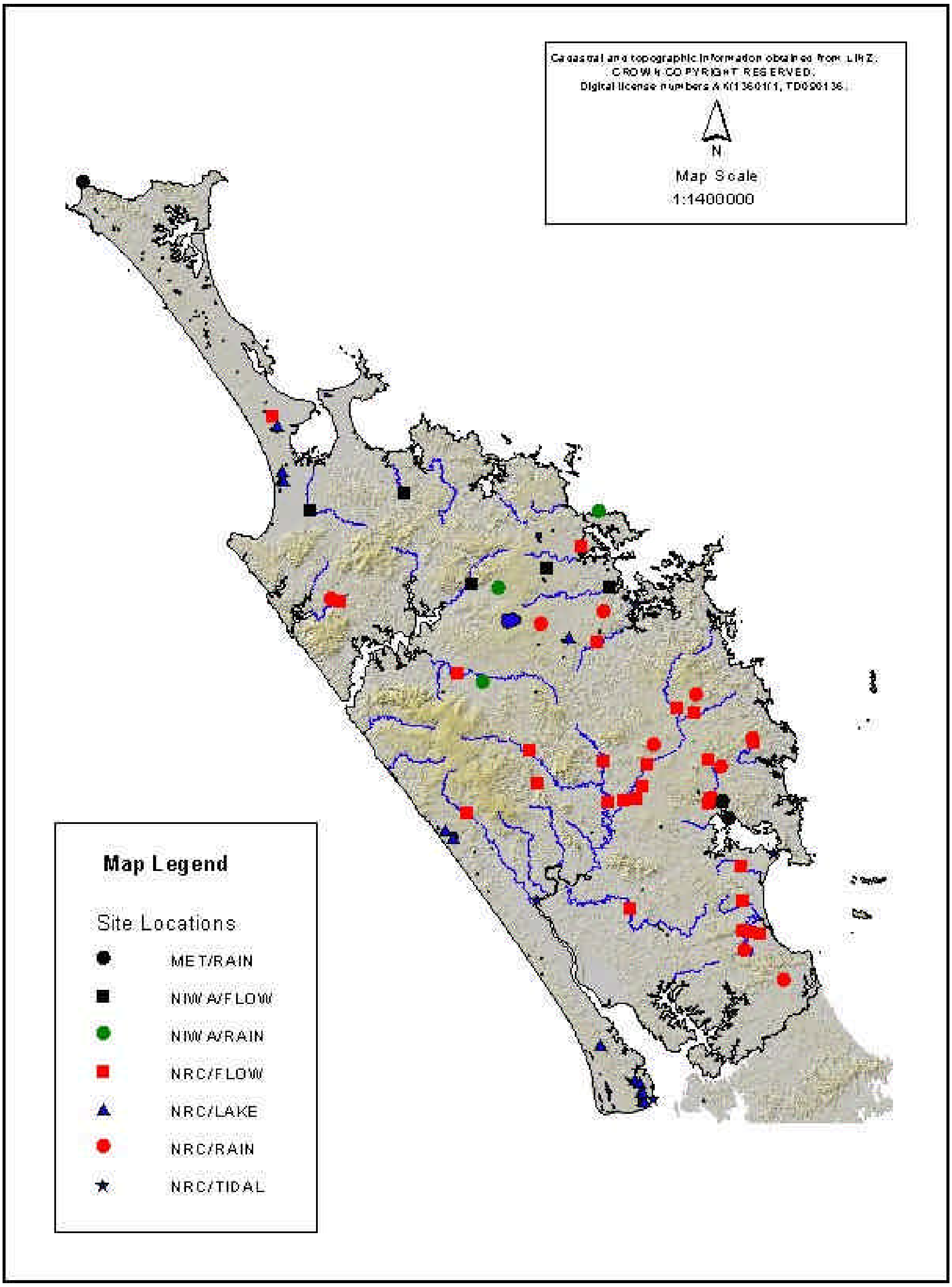
Site	River	Area (km2)	Auth	Data Start	Years Record	MALF (1 day average l/s)	1 in 5 yr DDF, (7 day min flow l/s)
802	Selwyn Swamp	1.74	NRC	1983	36	4	2.2
1316	Awanui (Kaitaia)	222	NIWA	1984	43	550	477
1903	Oruru	79	NIWA	1988	13	505	434
3412	Rangitane	21.4	NRC	1960	24	124	46
3506	Maungaparerua	11.1	NIWA	1979	34	31	23
3722	Waitangi	302	NIWA	1982	22	1052	630
3819	Waiharakeke	229	NRC	1960	34	118	45
4901	Ngunguru	12.5	NRC	1987	32	73	61
5527	Waiarohia	18.6	NRC	1984	22	54	35
5528	Raumanga	16.3	NRC	1983	22	73	63
6007	Waionehu	24.5	NRC	1969	18	21	13
6015	North	38.4	NRC	1983	19	89	65
6016	Waihiohoi	25.1	NRC	1979	17	79	54
6018	Ahuroa	57	NRC	1979	18	133	94
46611	Kaihu (Gorge)	116	NRC	1983	31	646	609
46618	Mangakahia (Twin Bridges)	246	NIWA	1960	41	1406	1164
46625	Hikurangi	189	NRC	1968	41	417	250
46626	Mangakahia (Titoki)	798	NRC	1979	18	2926	2400
*46627 (WCR)	Waiotu (SH1)	125	NRC	1997	42	226	184
*46632 (WCR)	Whakapara (Cableway)	162	NRC	1977	14	881	668
*46641 (WCR)	Waipao	36.7	NRC	1970	22	226	181
*46644 (WCR)	Wairua (Purua)	544	NRC	1994	41	1986	1535
*46646 (WCR)	Mangere (Knight Road)	79	NRC	1984	18	130	115
*46647 (WCR)	Wairua (Wairua Bridge)	707	NRC	1961	40	2410	1900
46651	Manganui	411	NRC	1978	41	340	141
*46674 (WCR)	Mangahahuru	20.5	NRC	1959	33	105	78
47595	Punakitere (Taheke)	284.4	NRC	1958	7	639	531
47804	Waipapa (Puketi Forest)	122	NIWA	1960	23	736	566
1046651	Opouteke	105	NRC	1967	17	607	493

The Hydrometric Network

The Northland Regional Council operates a hydrometric network consisting of 37 sites (24 river level sites, four tidal monitoring sites and nine rainfall sites) which collect continuous data at either five or 15-minute intervals (refer map 10). The hydrometric network also consists of 55 daily rainfall stations, operated by voluntary readers and 13 lake level sites recording monthly water levels. This network is also supplemented by three MetService rainfall sites and nine NIWA sites (three rainfall sites and six water level sites) collecting continuous 15-minute data.

Of the 37 continuous data recording sites, 18 are part of a telemetry system where data can be sent via radio to a base station at the Northland Regional Council offices in Whangarei. These telemetered sites provide a real-time picture of the state of the region's water resources while the tidal station at Marsden Point acts as part of the Pacific Rim tsunami-monitoring network.

During periods of extreme rainfall, the telemetered sites play an important role, ensuring that both the Civil Defence and the general public are kept informed, via media releases, of flooding in Northland. During periods of drought, water levels are also monitored and when a low threshold is reached a low flow-gauging programme is undertaken in the river catchments affected. These manual flow measurements enable the flow to be accurately determined and are used to monitor water usage. There are 11,679 flow gauging records for 1503 Northland sites held by the Northland Regional Council.



Map 10: The Hydrological Network

6.8 Case Study: Kerikeri Irrigation Company Limited.

Horticulture was first established within the Kerikeri area in the 1920s, with the planting of citrus orchards. Kerikeri has rich volcanic soils ideal for horticultural development. However, the natural ability of these soils to retain water is low, and during summer droughts supplementary irrigation is essential for consistently high quality fruit.

Since the streams in the area are small and their drought flows are very low, storage of winter runoff was deemed necessary. With this in mind, a community storage scheme based on 2 large storage dams with the capacity to supply water to 2800 hectares of property was created in the early 1980s. The irrigation company now supplies water to 2300 hectares of horticultural land, and 300 hectares of broad irrigation and public water supply. All dam structures and weirs are owned by a public company, but are run as a corporate company, where 350 shareholders use the water for irrigation of crops on their properties.

The northern irrigation dam, Lake Manuwai, supplies water to the northern part of the Kerikeri area and can hold up to 8,000,000 m^3 of water and has a catchment area (including the diversion) of 575 hectares. The southern irrigation dam, Lake Waingaro, can hold up to 4,800,000 m^3 and has a catchment (including the diversion) of 645 hectares. Associated with the dams are a number of weirs, small supply dams and diversions.

The storage of winter rainfall and subsequent release of water during summer months, when demand is high, reduces pressure on streams and ensures that minimum flows are released for ecological purposes. The dams also provide an area that can be enjoyed for aesthetic value. The dams have been planted with both exotic and native species, picnic areas established, walkways created and the northern dam is utilised for recreational water activities.

NRC water quality monitoring on the Kerikeri Irrigation Lakes

6.9 Case Study: Mangakahia Irrigation

In 1993, dairy farmers in the Mangakahia River Valley area formed a group called the Mangakahia Irrigation Committee for the purpose of taking water from the Mangakahia River for farm irrigation.

In 1996, after a series of hearings and appeals, resource consents were issued to 14 applicants to take more than 59,210 cubic metres per day from the Mangakahia River for a period of six years. Establishment of irrigation systems has occurred on a staggered basis and the maximum allocation has not yet been fully utilised. Only five of the 14 consent holders are exercising their resource consents to abstract water, a combined total maximum volume of 19,400 cubic metres per day.

All takes currently exercised are above NRC's water level recording station situated at Titoki, with a catchment area of 798 km^2. The mean annual flow at this station is 3300 litres per second and the one in five-year design drought flow is estimated as 2200 litres per second.

During the irrigation period, usually from November to March, the Mangakahia Irrigation Committee and NRC staff monitor flows at the Titoki Station daily. NRC operates a radio telemetry system providing real time data, while the Irrigation Committee derives daily flows from an interphone at the same station.

The irrigation period for the 1999-2000 year is shown in Figure 22. When flows in the Mangakahia River at Titoki Bridge reach 3000 litres per second, NRC staff warns the Mangakahia Irrigation Committee that river flows are low enough for the committee to consider implementing the 'rationing strategy'. The difference between 'rationing' and ceasing irrigation is only 150 litres per second, and normally about two days, unless it rains.

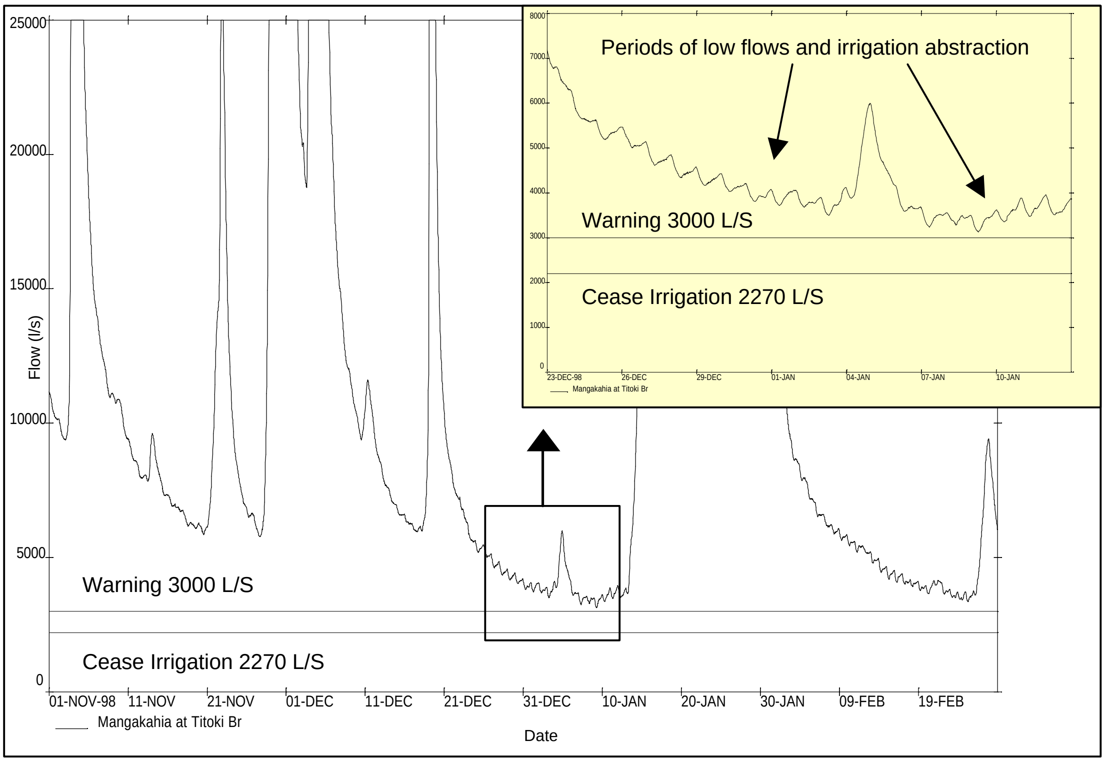


Figure 22: Hydrograph of Mangakahia River flows over summer irrigation months (1999-2000)

6.10 Case Study: Drought 1986-1987

The 1986-87 drought (estimated one in 20-year return period) was most severe on the east coast of Northland, from Whangarei to Russell, inland from Dargaville to the Wairua River catchment, and southward to Maungaturoto. This drought was associated with a very strong 'El Nino' event.

For the year 1986, Whangarei had approximately two-thirds of its average annual rainfall, whereas Kaikohe received only half (the driest year of 55 years of record). Dargaville had 90% of its average annual rainfall and Kaitaia slightly above average.

The table below gives estimates of the return period for the drought at various rainfall stations based on rainfall and the number of days of soil moisture deficit for the four-month period November 1986 – February 1987.

Station	Years of Record	Ranking	Return Period (Yrs)
Waiharara	31	2nd driest	20
Kaitaia	91	13th driest	7
Kawakawa	64	2nd driest	40
Parakao	36	driest	65
Ruatangata	24	driest	40
Glenbervie Forest	38	4th driest	10
Wairua Falls	71	3rd driest	25
Maungatapere	39	Driest	70
Mangapai	17	Driest	30
Waipu Cove	39	2nd driest	25
Topuni	33	4th driest	9

The drought led to the following effects:

- Very little recharge of ground water resulting in abnormally low spring flows and ground water levels. The groundwater levels at Whatitiri-Poroti were the lowest recorded. These low levels were enough to prevent the Whangarei District Council from using the Poroti springs bores for water supply. Flows in the Maunu and Kamo Springs water supplies were the lowest recorded.
- Two of the major water storage dams in Northland, the Whangarei City Whau Valley dam and the Kerikeri Irrigation southern reservoir were at very low levels as were lakes in the sand country of the far north.
- In some coastal areas, heavy summer use of limited groundwater resources combined with the lack of recharge led to seawater intrusion into aquifers, contaminating bores.
- Many farmers reported water supplies from shallow bores, springs and small streams had dried up.
- Costly transport of water to rural residents with water delivery firms working overtime to keep up demand.
- Water use restrictions imposed by the Whangarei District Council.
- Minimal grass cover, early drying off of dairy herds, low milk production, low calving rates and loss of income from selling stock.
- Reduced stream habitat caused by lowered water quality and quantity (low water levels in streams and rivers, high water temperatures and increased aquatic weed growth)

In response to the severity of the drought local authorities promoted:

- public awareness of the drought and associated water resource problems
- intensified monitoring of water resource availability

- where necessary, the use of temporary emergency measures, available under the water and soil legislation, to protect water resources and/or restrict use of water

6.11 Case Study: Opononi/Omapere Water Crisis

Opononi/Omapere is a coastal settlement and tourist area located on the sothwestern shores of the Hokianga Harbour. The population is approximately 600 residents which swells to roughly 1600 people during the busy Christmas period. The influx of tourists and holidaymakers coincides with the dryer summer months. As a result water resources are placed under intense pressure to meet increased demands.

The main water supply for the Opononi/Omapere community is from the Waiotemarama Stream. This stream, typical for this area, flows through a steep, small catchment. During summer months when demand for water is highest the stream typically experiences low flow conditions.

To ensure that the in-stream values are not compromised, the Far North District Council is required by consent conditions, as of 1998, to allow 10 litres per second to flow downstream of the point of take. Every summer, since the issue of the new consent conditions, the FNDC has had to put restrictions on water use within the Opononi/Omapere area to meet these continuation flow requirements.

Under current Northland Regional Council Policy the FNDC has until the year 2004 to find alternative sources of water. This should help ease pressures on the Waiotemarama Stream.

FAR NORTH DISTRICT COUNCIL

PUBLIC NOTICES

OPONONI/OMAPERE WATER SUPPLY

Owing to a lack of rainfall stream flows are reducing at the raw water intake in the Waiotemarama Gorge. This is starting to affect the water supply.

To preserve the availability of water for normal domestic purposes in the Opononi/Omapere supply area the use of garden sprinklers, irrigation systems and hoses is prohibited until further notice.

Consumers are asked to try and conserve water as much as possible, to avoid further restrictions.

Source: Northern News 19/12/00

Weir at Waiotemarama Stream