Glenbervie Area

Figure H.25 – Approximate location of intake for water harvesting or instream dam for the Glenbervie Area

Figure H.26 – Storage hydrograph for the Glenbervie Area

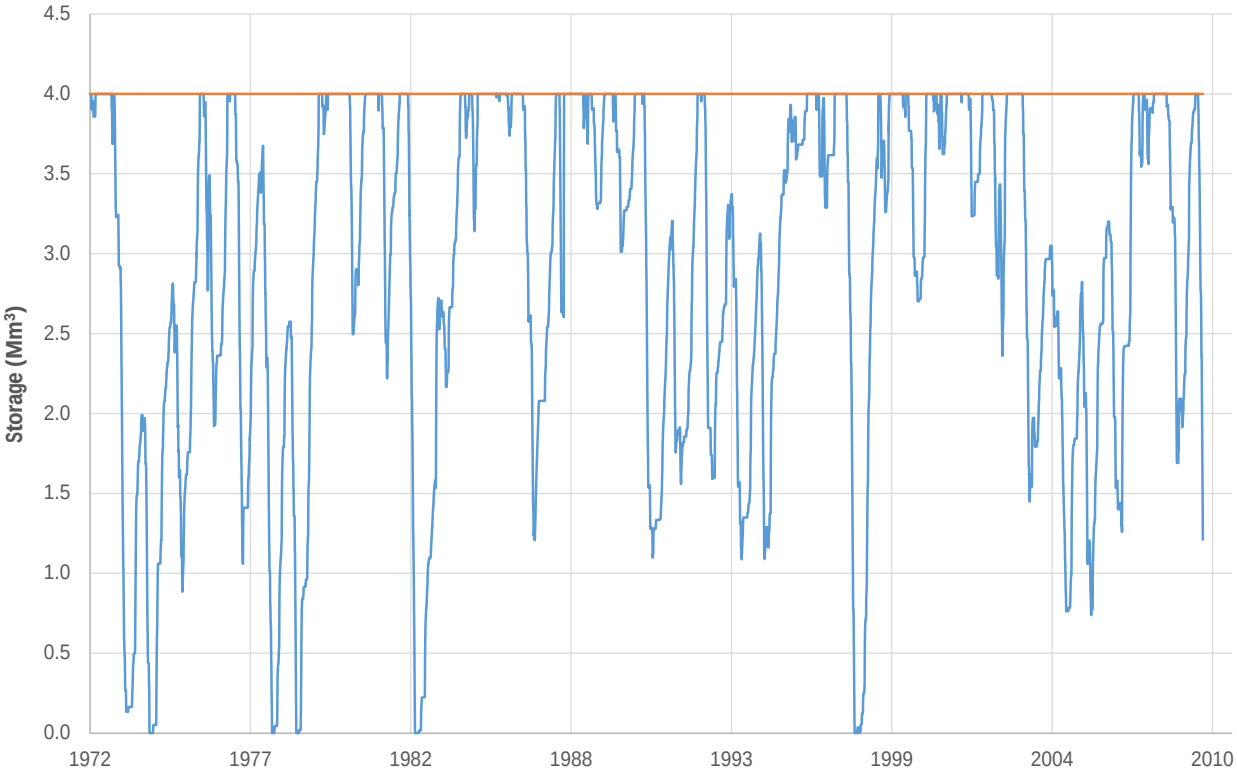
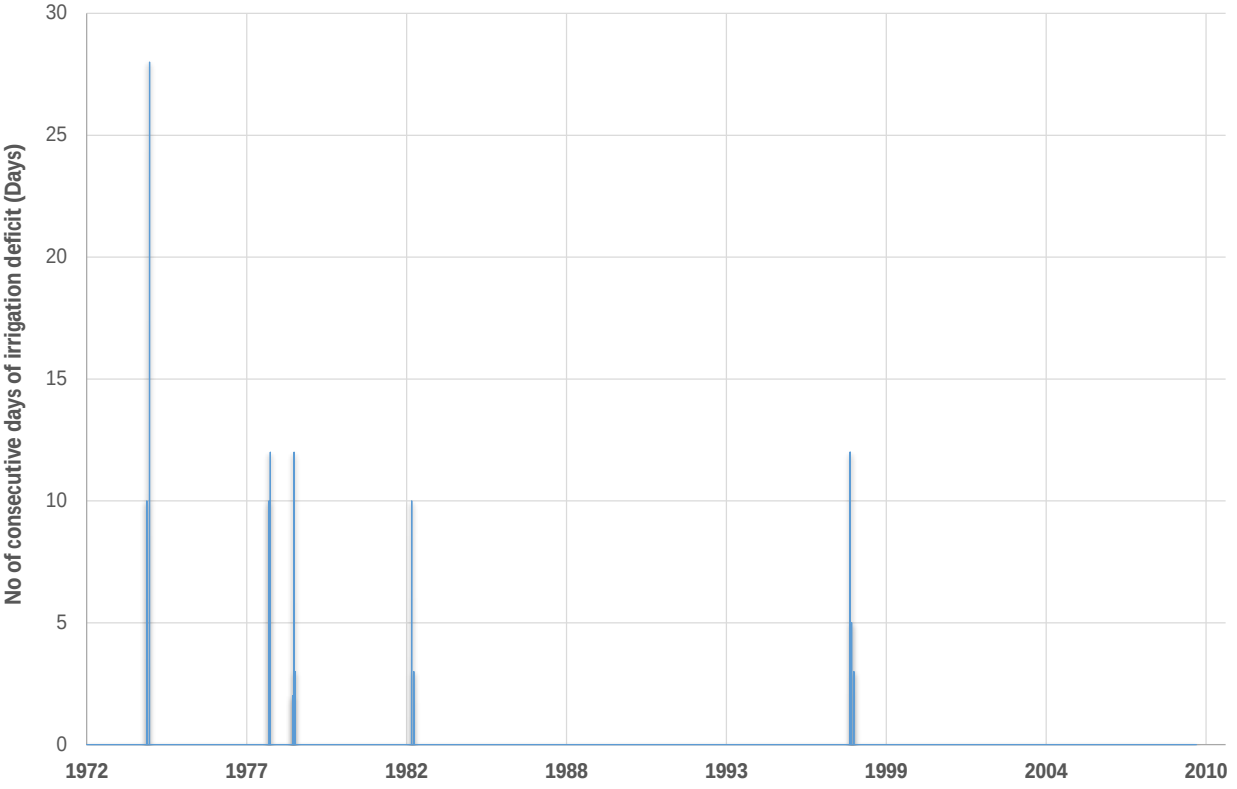


Figure H.27 – Irrigation supply deficit days for the Glenbervie Area



Mangakahia Area

Figure H.28 – Approximate locations of intakes for water harvesting or instream dams for the Mangakahia Area

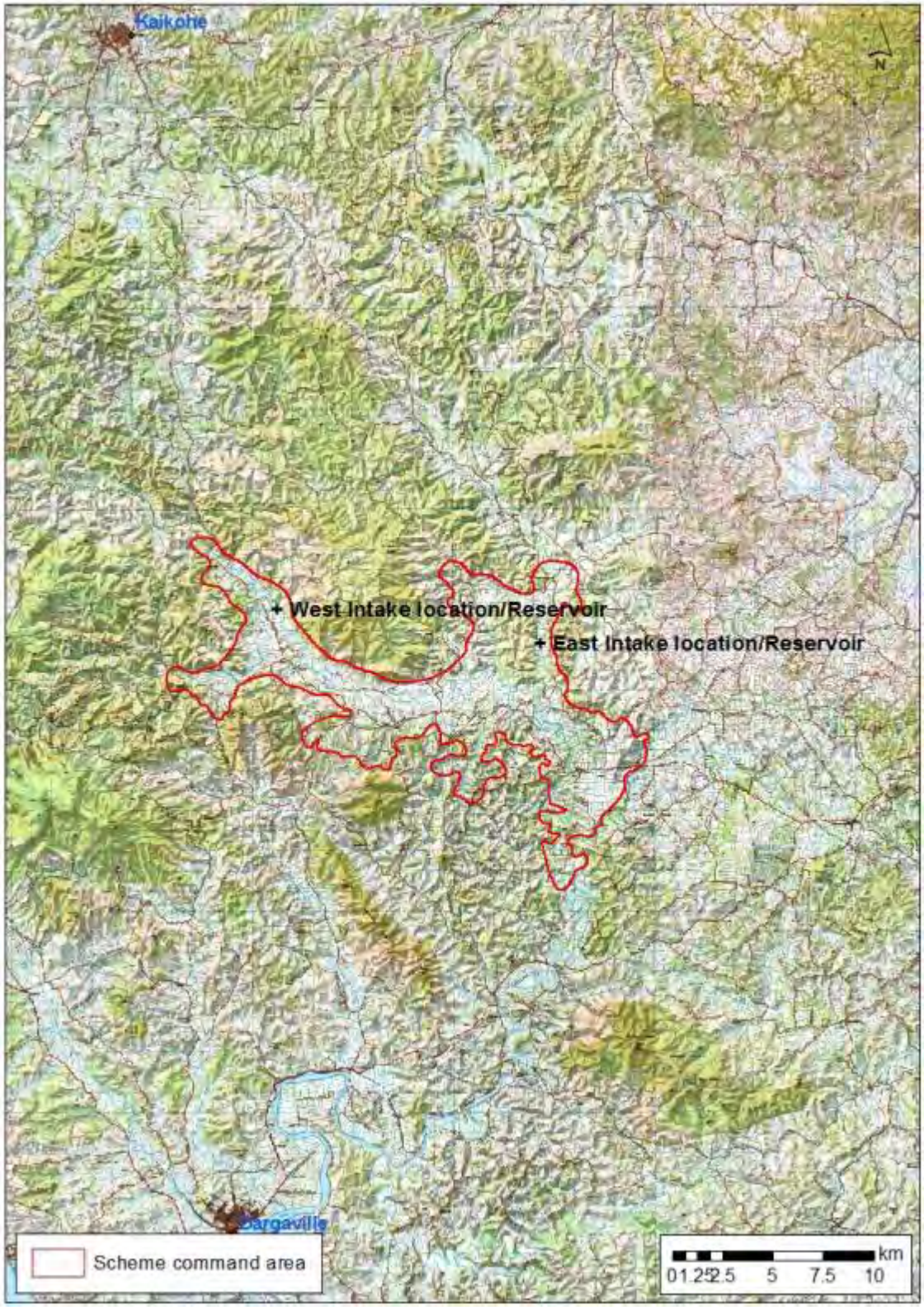


Figure H.29 – West storage hydrograph in the Mangakahia Area

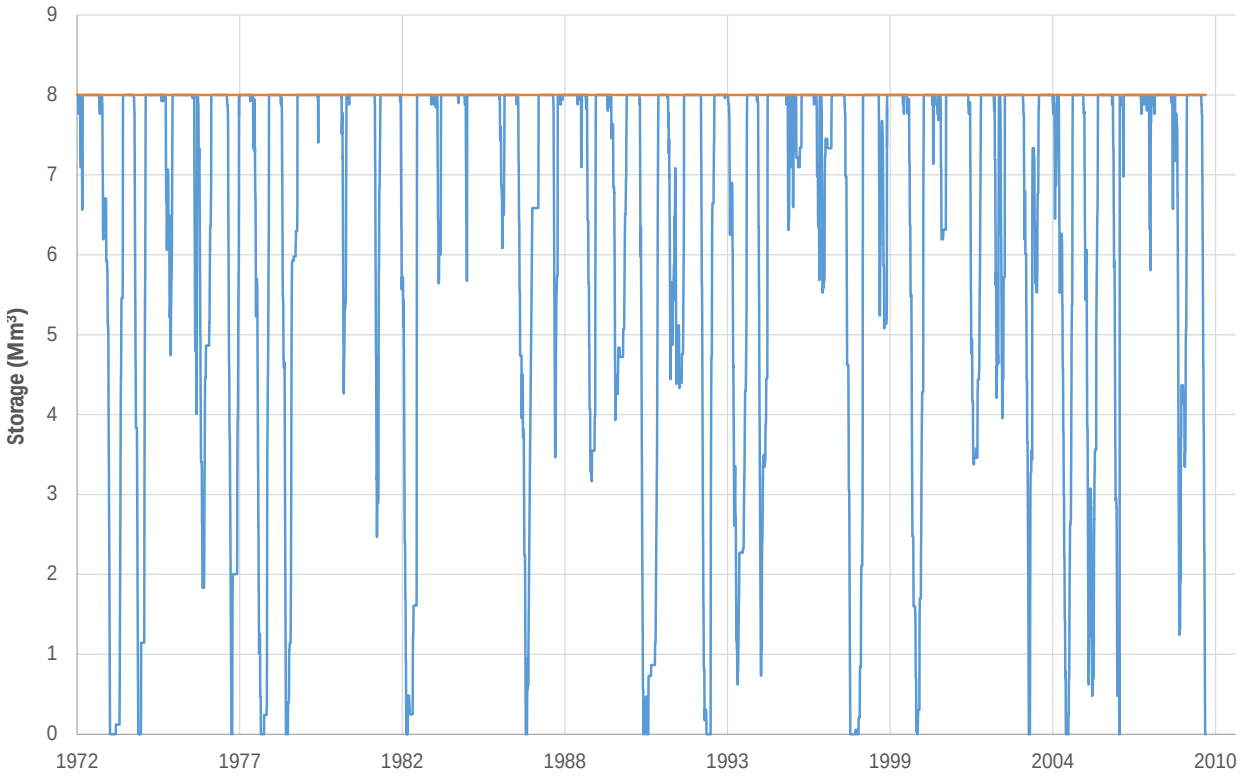


Figure H.30 – East storage hydrograph in the Mangakahia Area

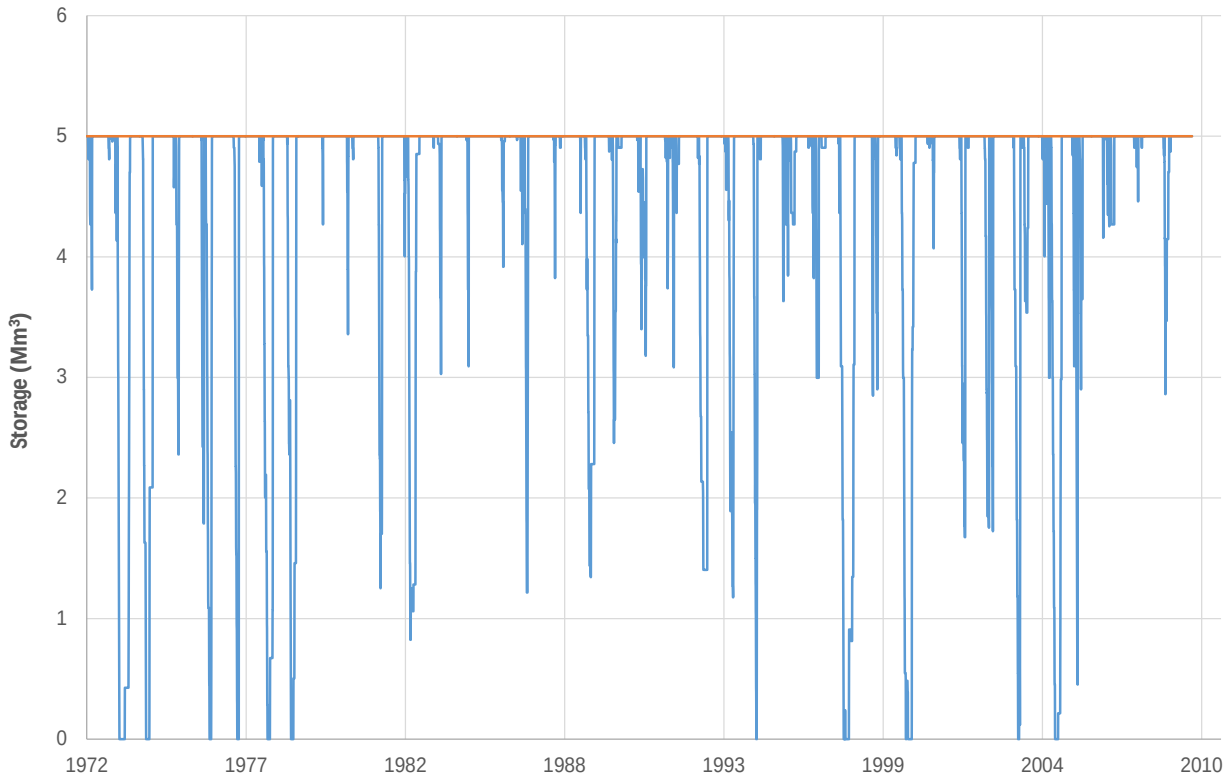


Figure H.31 – Irrigation supply deficit days for the area supplied by the West storage in the Mangakahia Area

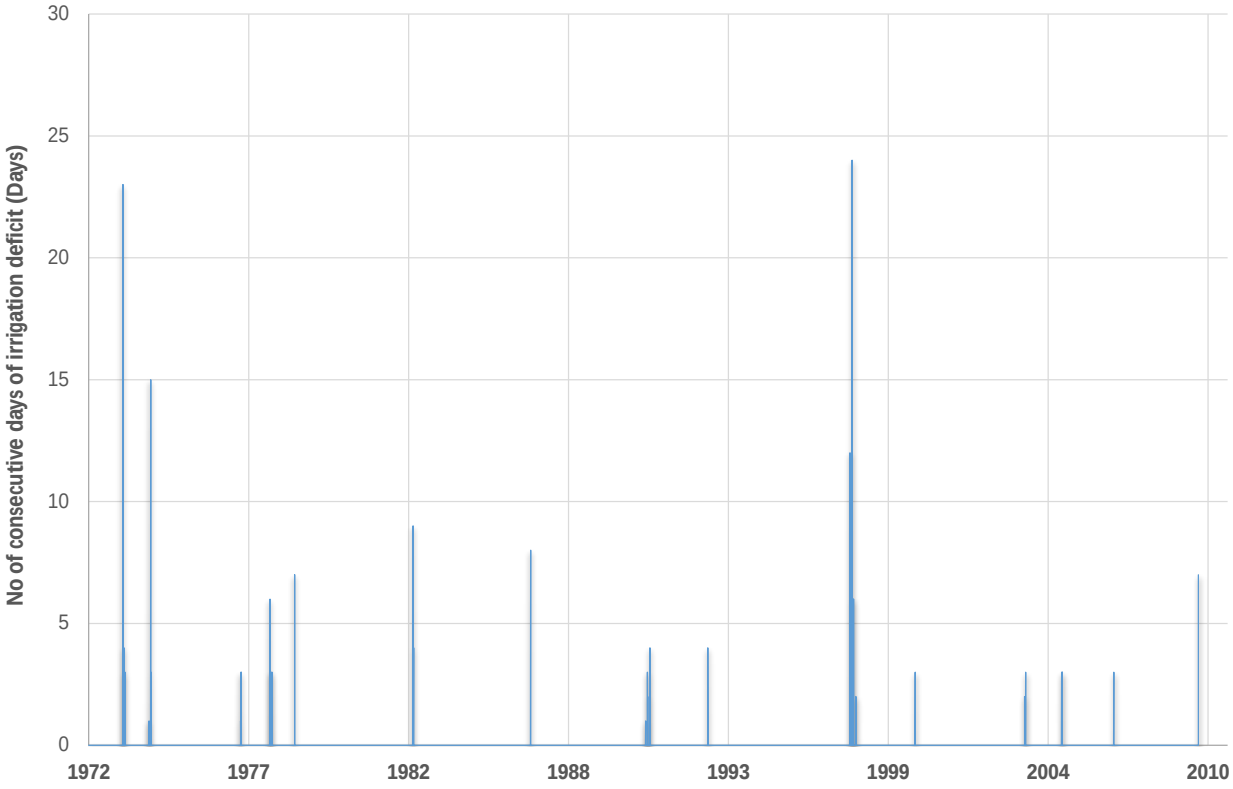
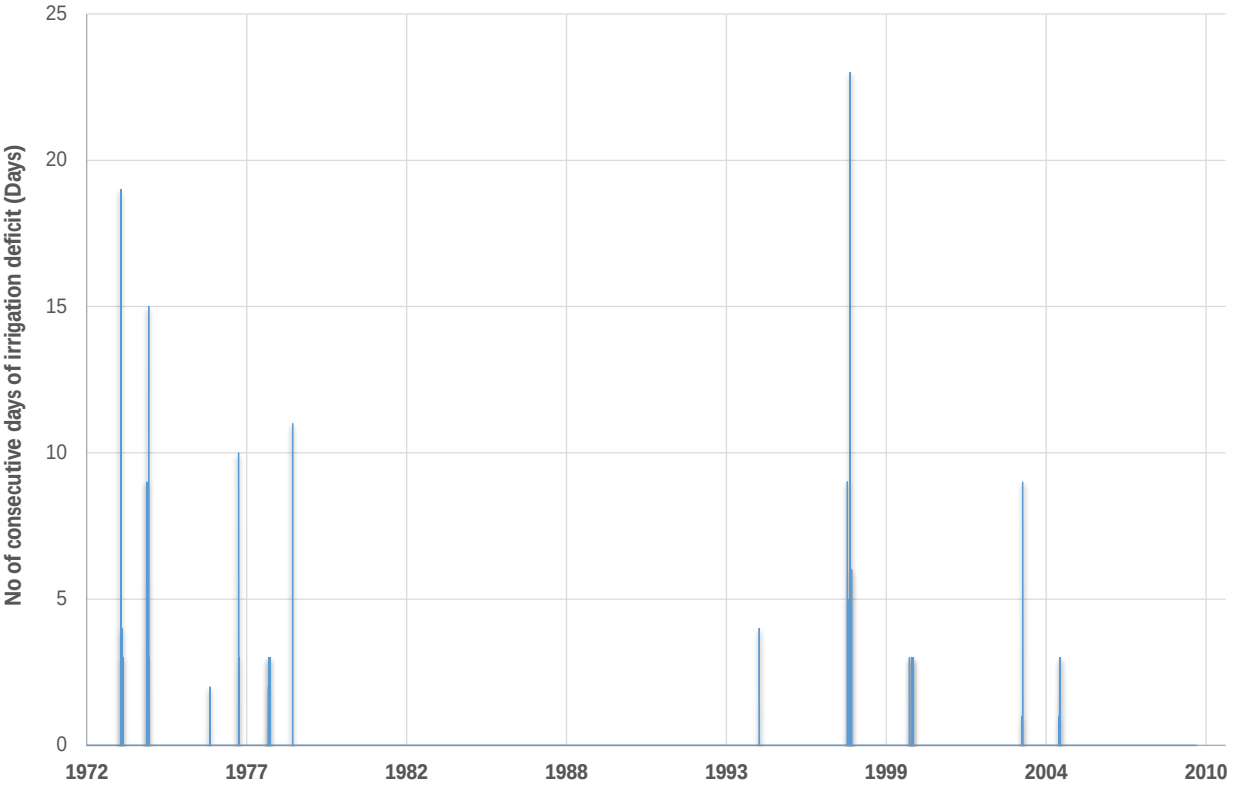


Figure H.32 – Irrigation supply deficit days for the area supplied by the East storage in the Mangakahia Area



Maungatapere Area

Figure H.33 – Approximate location of intake for water harvesting or instream dam for the Maungatapere Area

Figure H.34 – Storage hydrograph for the Maungatapere Area

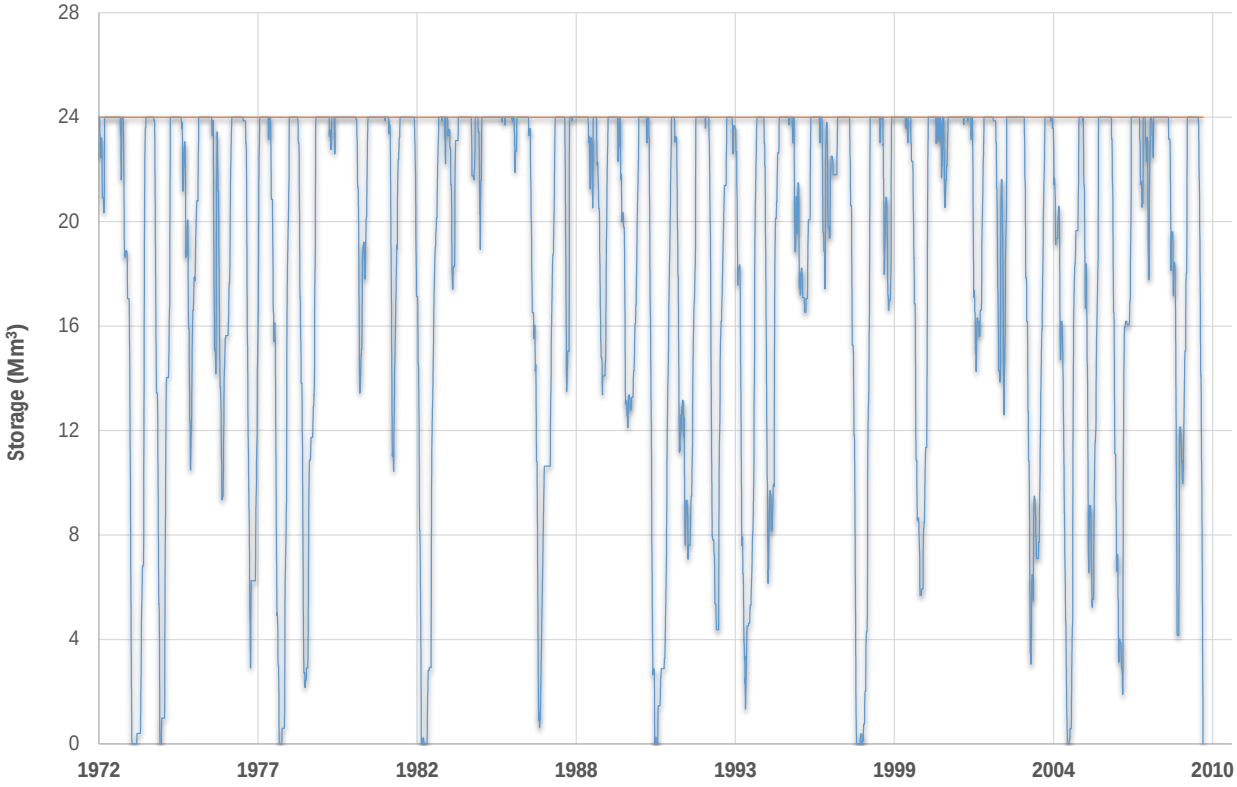
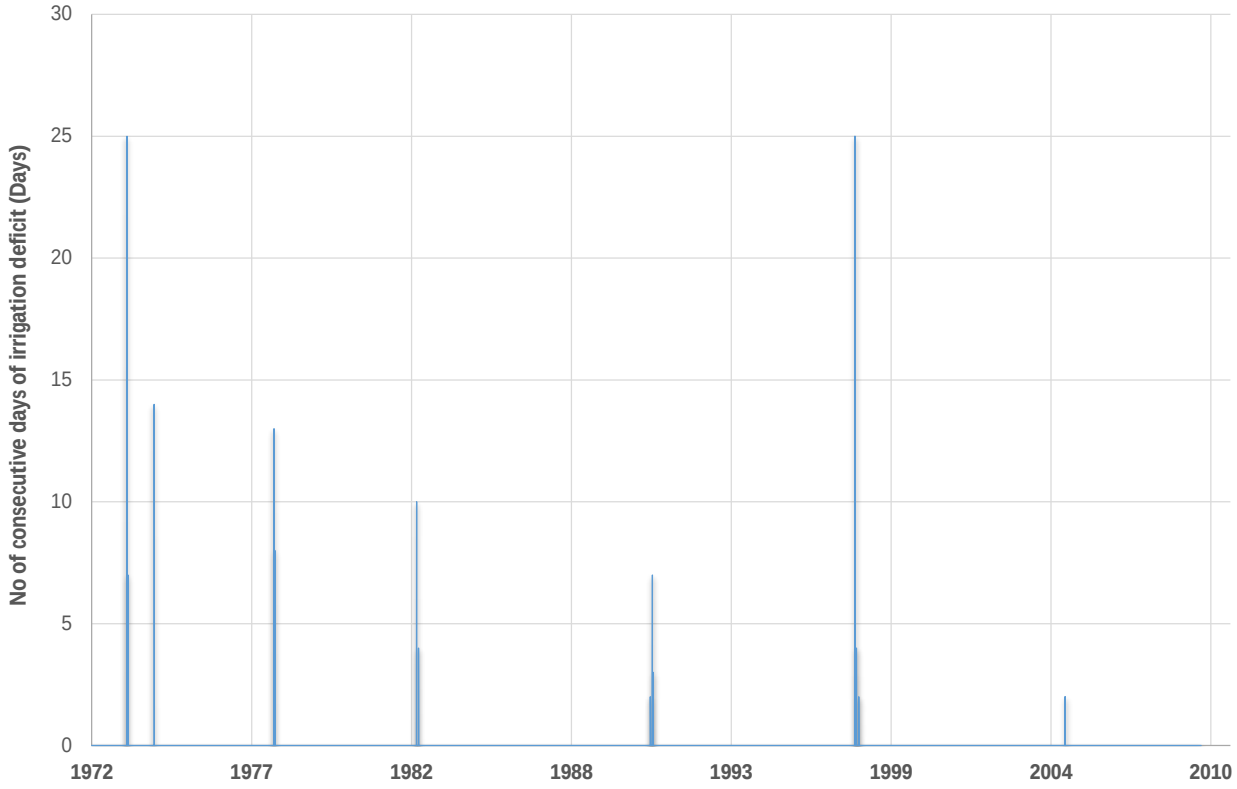


Figure H.35 – Irrigation supply deficit days for the Maungatapere Area



Maungakaramea Area

Figure H.36 – Approximate location of intake for water harvesting or instream dam for the Maungakaramea Area

Figure H.37 – Storage hydrograph for the Maungakaramea Area

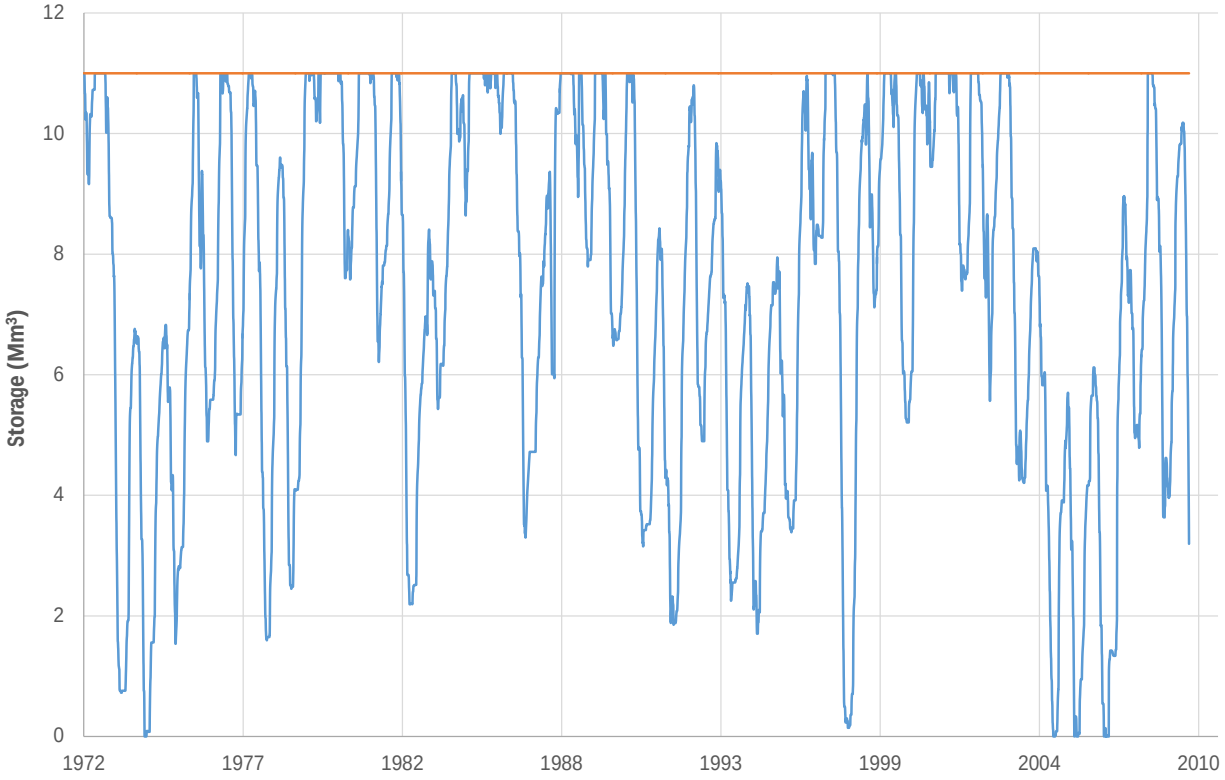
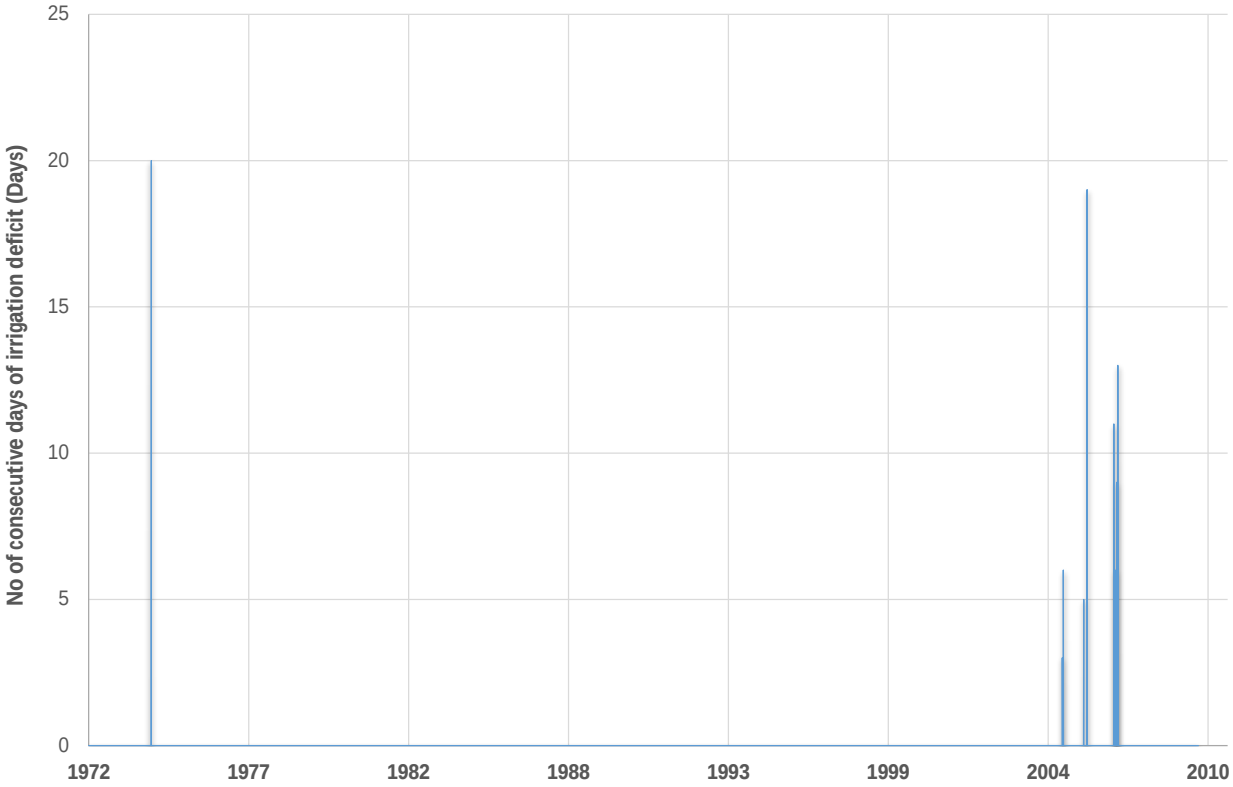


Figure H.38 – Irrigation supply deficit days for the Maungakaramea Area



Ruakaka Area

Figure H.39 – Approximate location of intake for water harvesting or instream dam for the Ruakaka Area

Figure H.40 – Storage hydrograph for the Ruakaka Area

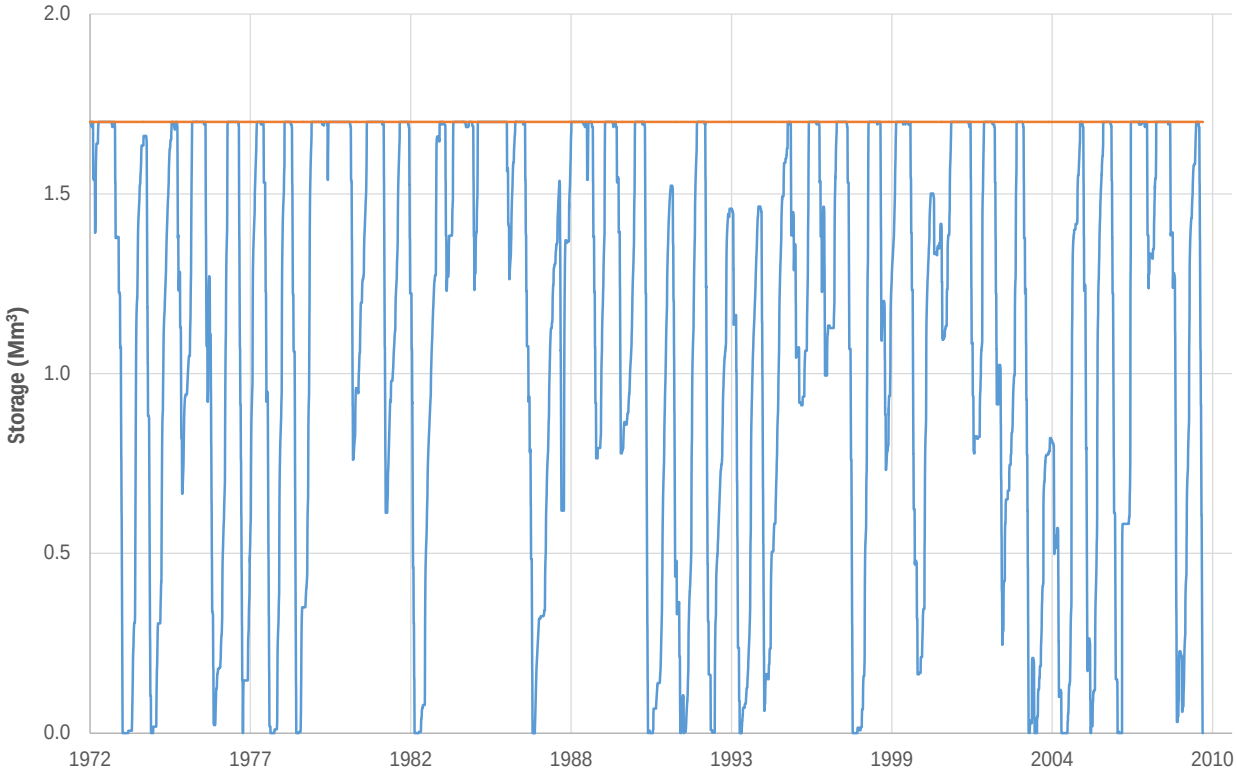
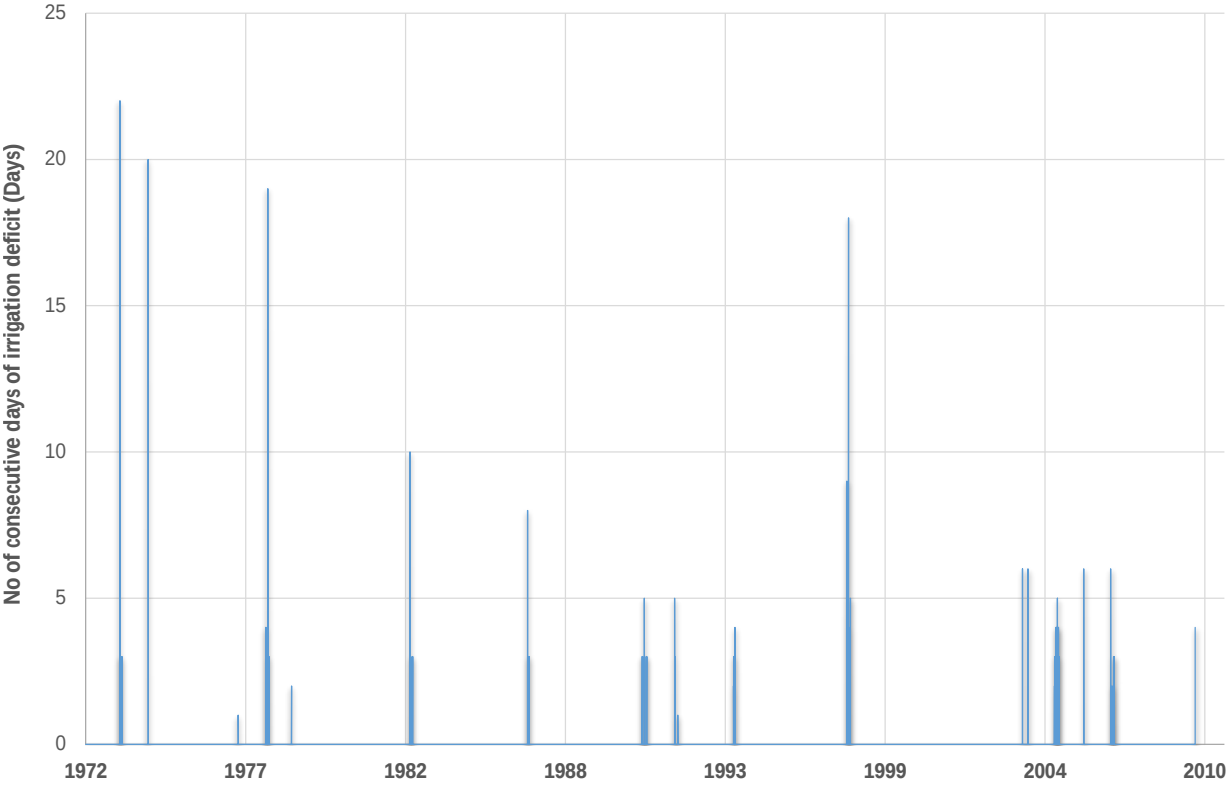


Figure H.41 – Irrigation supply deficit days for the Ruakaka Area



Waipu Area

Figure H.42 – Approximate location of intake for water harvesting or instream dam for the Waipu Area

Figure H.43 – Storage hydrograph for the Waipu Area

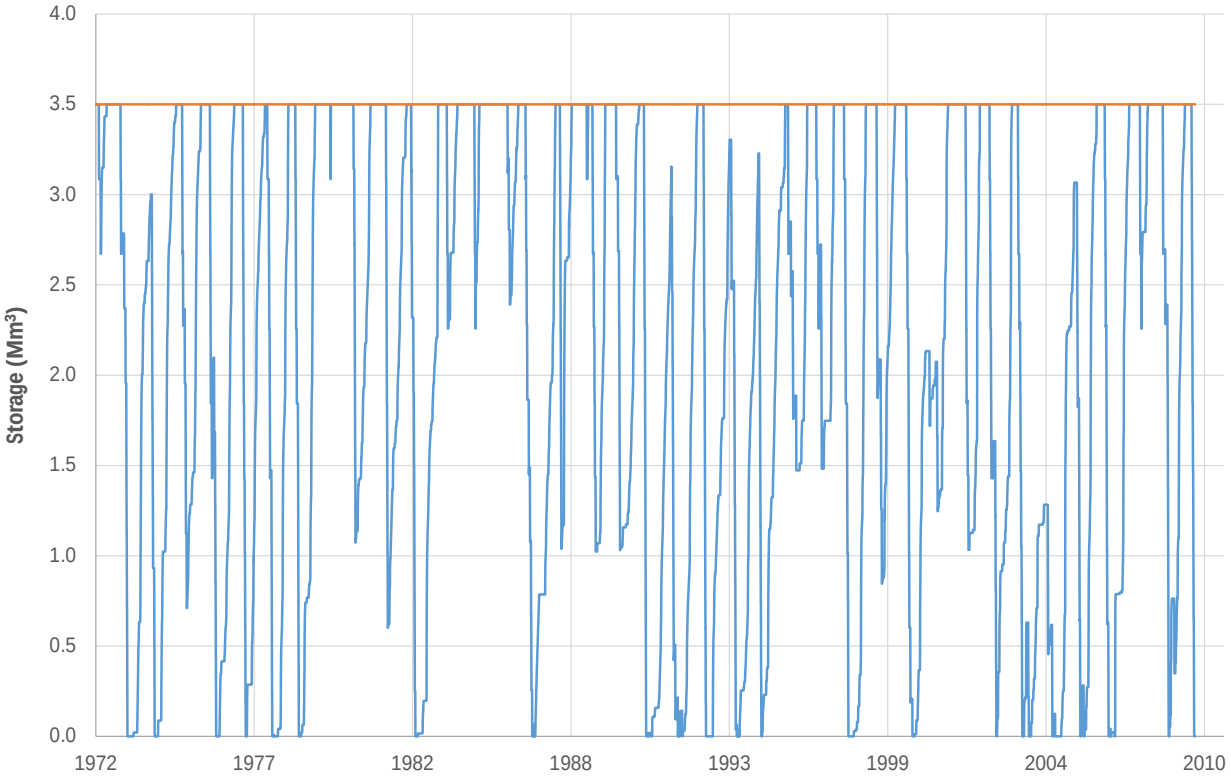
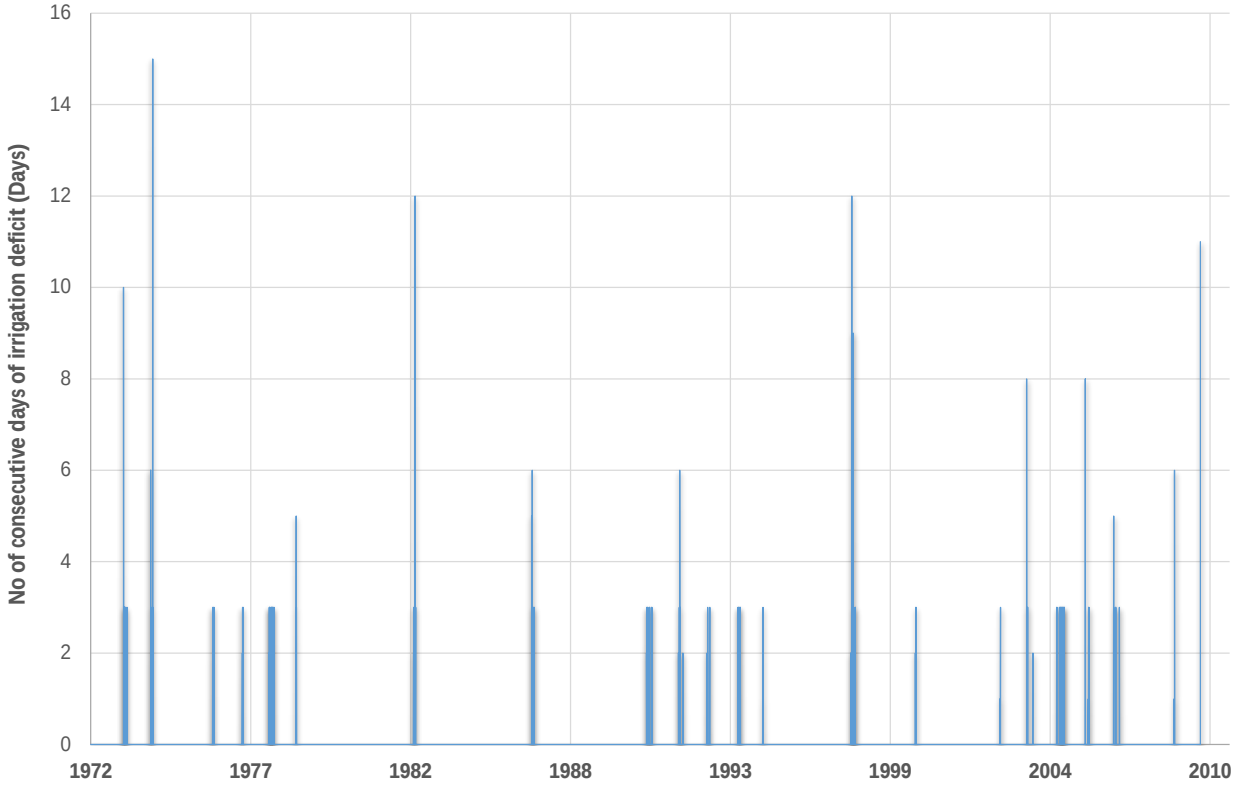


Figure H.44 – Irrigation supply deficit days for the Waipu Area



Kaihu Area

Figure H.45 – Approximate location of intake for water harvesting or instream dam for the Kaihu Area

Figure H.46 – Storage hydrograph for the Kaihu Area

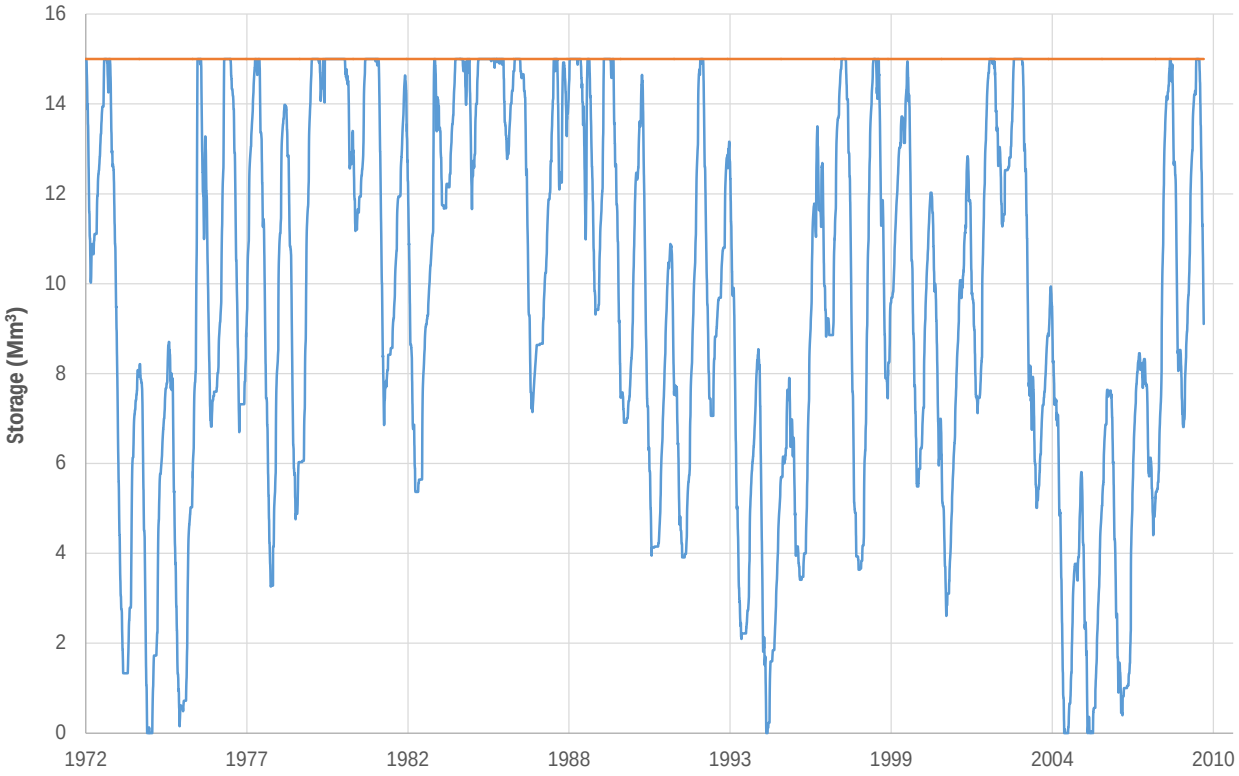
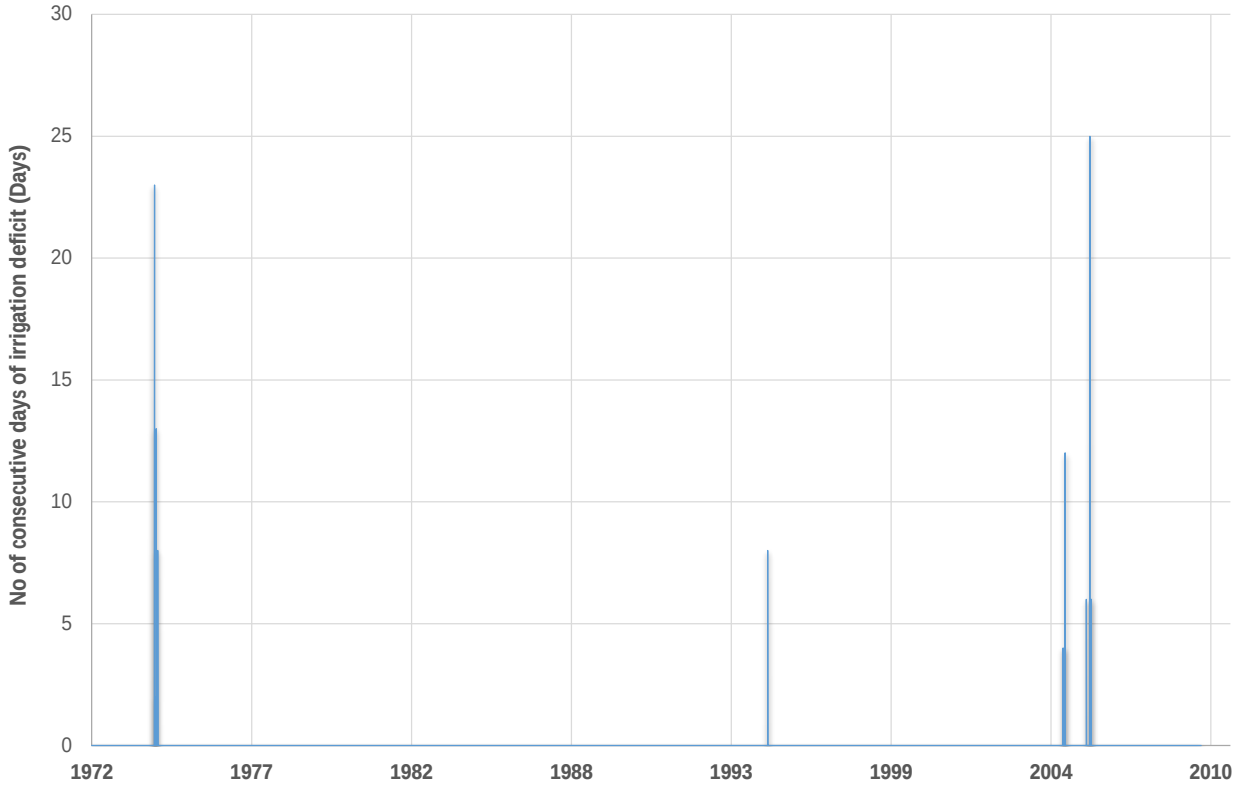


Figure H.47 – Irrigation supply deficit days for the Kaihu Area



Hoanga Area

Figure H.48 – Approximate location of intake for water harvesting or instream dam for the Hoanga Area

Figure H.49 – Storage hydrograph for the Hoanga Area

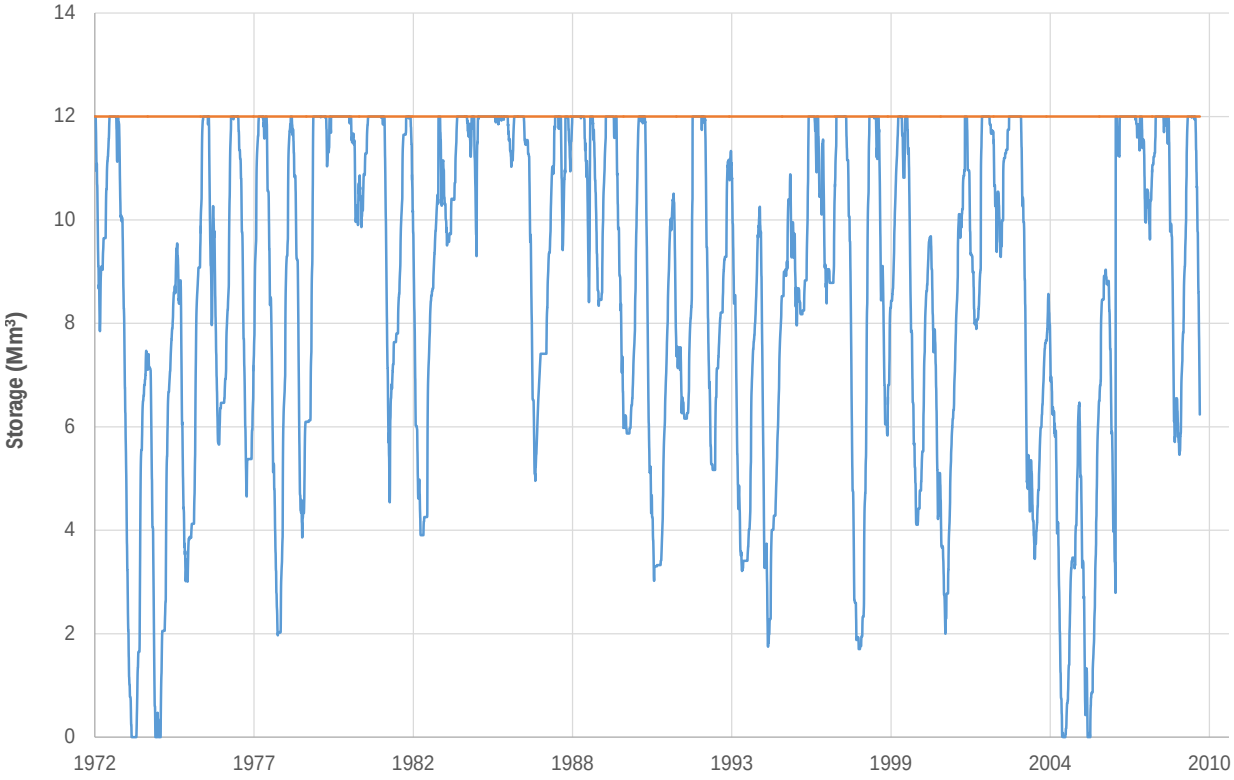
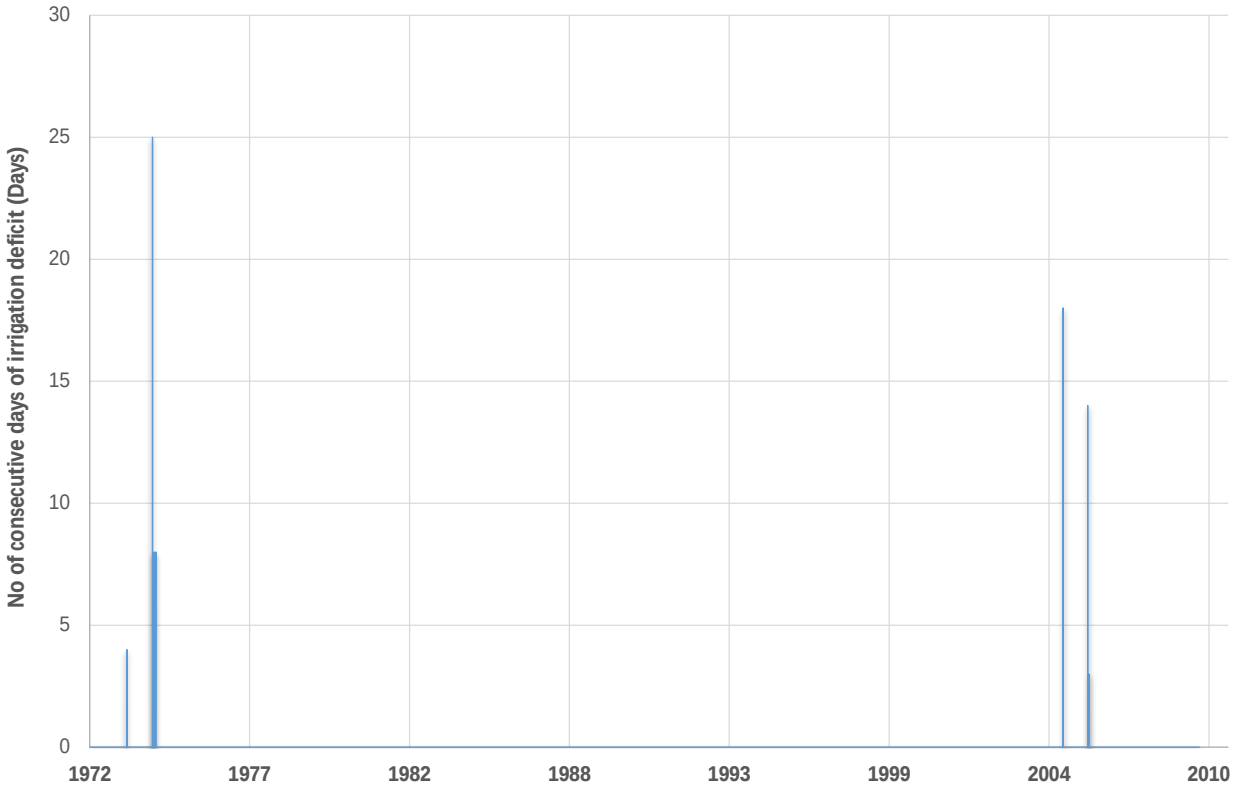


Figure H.50 – Irrigation supply deficit days for the Hoanga Area



North Kaipara and Ruawai Area

Figure H.51 – Approximate location of intake for water harvesting or instream dam for the North Kaipara and Ruawai Areas

Figure H.52 – Storage hydrograph for the North Kaipara and Ruawai Areas

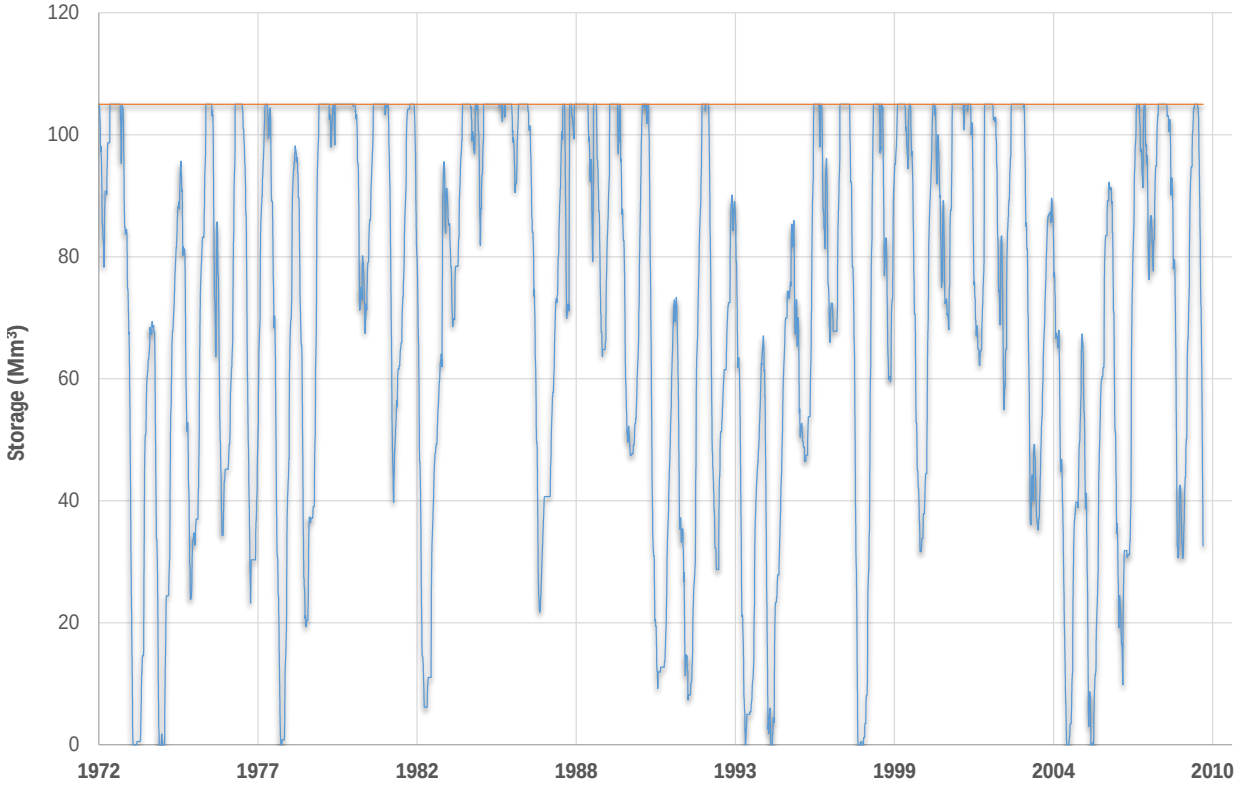
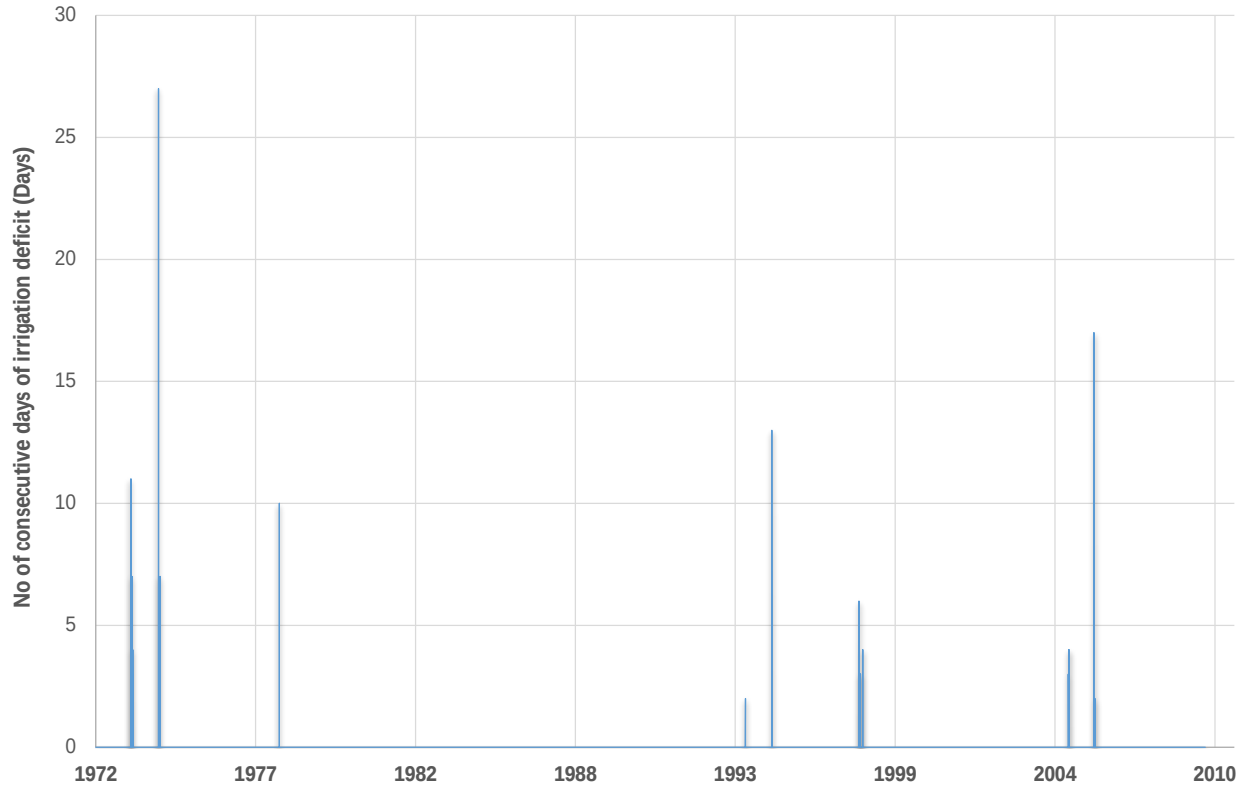


Figure H.53 – Irrigation supply deficit days for the North Kaipara and Ruawai Areas



Mangawhai Area

Figure H.54 – Approximate location of intake for water harvesting or instream dam for the Mangawhai Area

Figure H.55 – Storage hydrograph for the Mangawhai Area

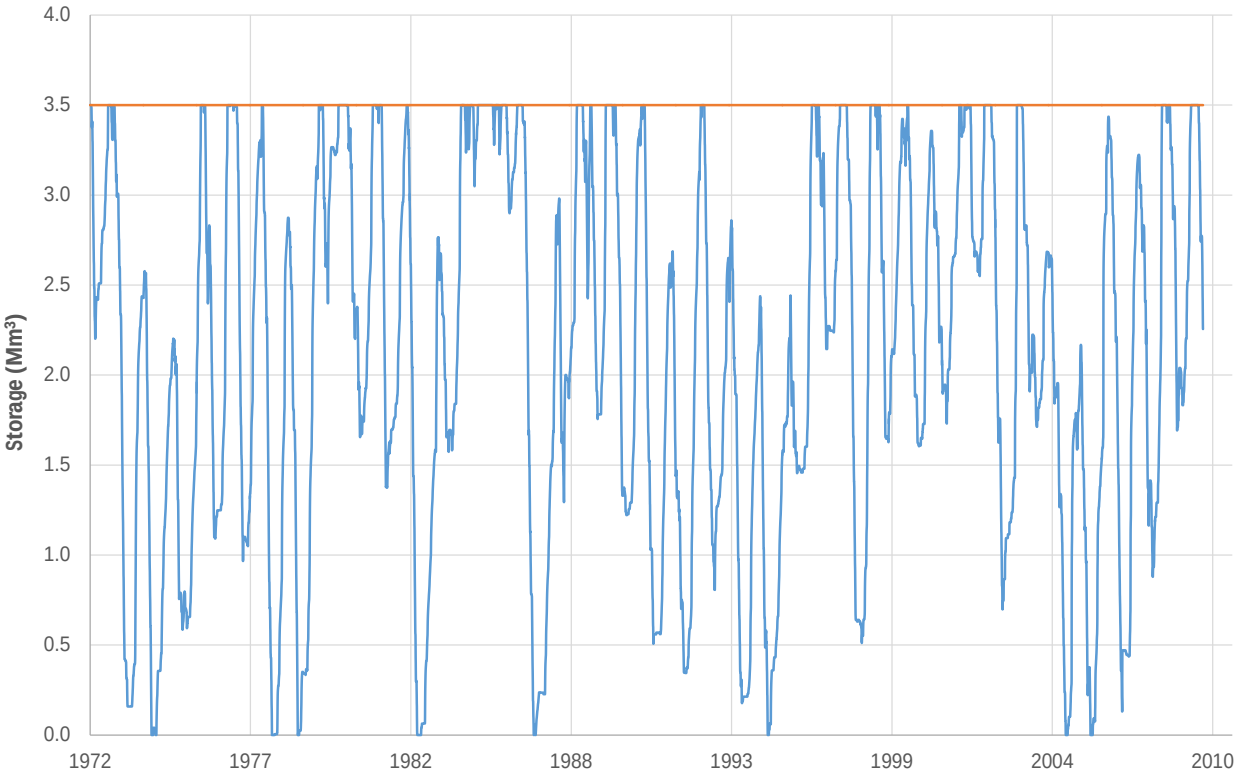
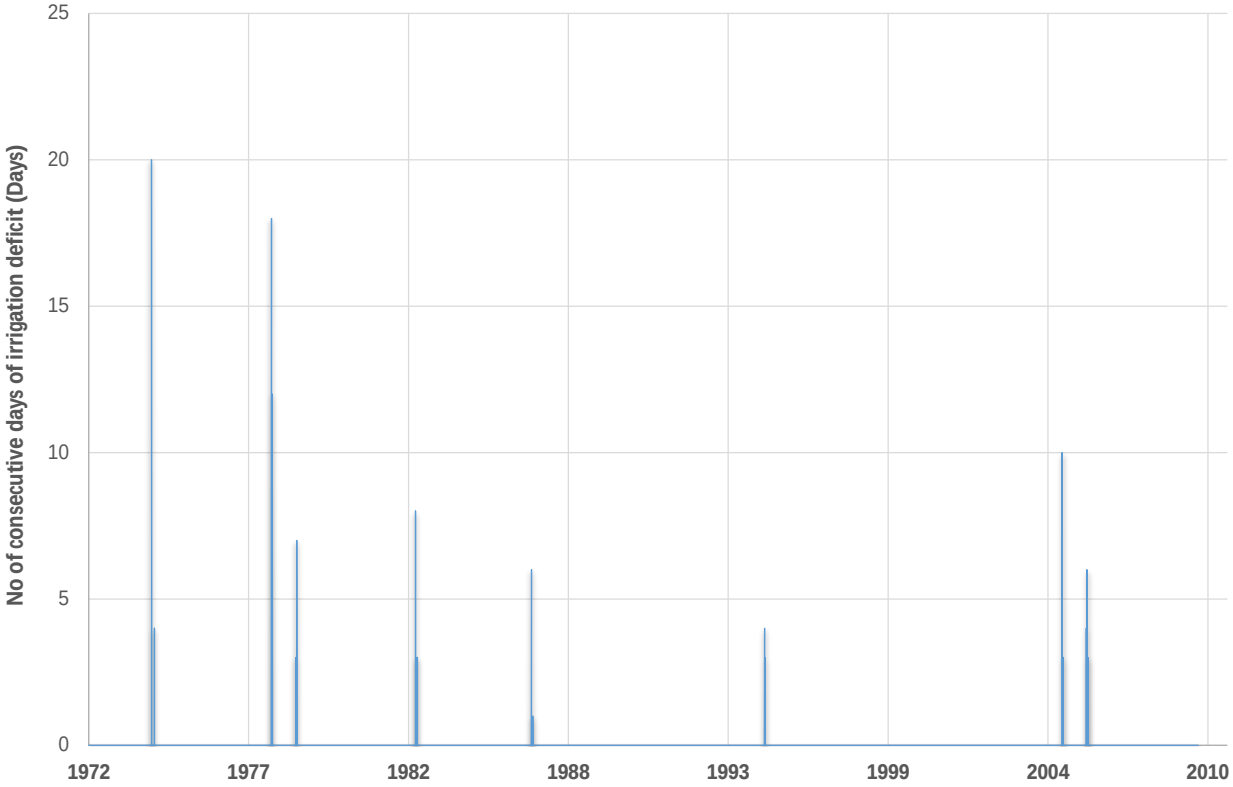


Figure H.56 – Irrigation supply deficit days for the Mangawhai Area



Appendix I Dairy performance and irrigated potential

Dairy performance and irrigated potential

Much of Northland's land has impeded drainage, so is not as well-suited to intensive irrigation as alluvial land in Canterbury. The function of irrigation in Northland on many of the soil types will therefore be to maintain production in dry seasons, including true drought mitigation, rather than to change to fully intensive irrigated dairy production. Some idea of the reality of the potential for increased production from irrigated dairy farming is gained by tracking dairying changes in Northland and relevant other regions over the past twenty years.

Dairy current production

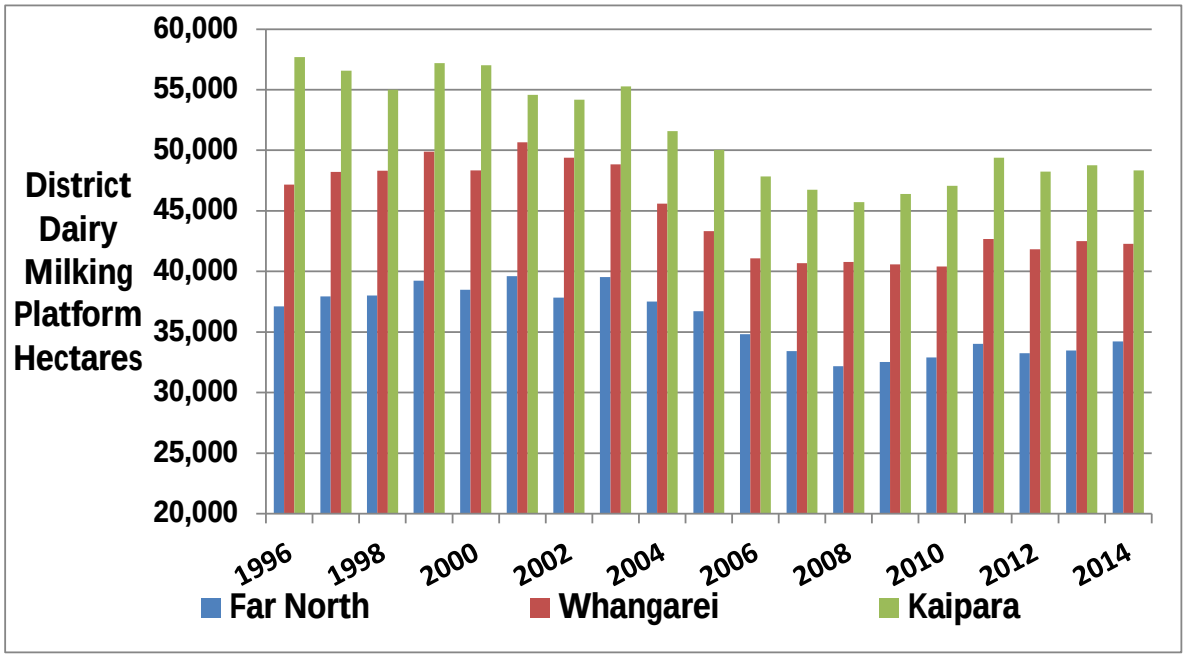
This section tracks changes in the districts of Northland from 1996 to 2014 in the areas of land used for dairy milking platforms, in the number of cows, and in the productivity per hectare of land used in the dairy milking platforms.

Dairy land use

Dairy statistics indicate that in the last twenty years the land in dairy milking platforms or 'Total effective hectares' in dairy as recorded by DairyNZ and LIC on farms in Northland peaked at 145,000 hectares in 1999 to 2001. It then steadily declined to around 119,000 hectares in 2008 and 2009, and has since firmed to about 125,000 hectares. This is a total area about 12% less than used in 1996.

The fluctuation in hectares in dairy production in each of the three Northland districts followed the same track over this period.

Figure I.1 - Dairying land area in Northland districts 1996-2014



Work by BERL at the national level including studies such as Analysis of the value of pasture to the New Zealand economy, editions in 2007 and 2011 for the Pasture Renewal Charitable Trust have indicated that this area usually constitutes a serious under-estimate of the area of land applied to dairy industry use. In effect this area is the milking platforms from functioning dairy farms. It

does not necessarily include areas in gullies, shelter belts, and run-offs and certainly does not include land used in dairy support growing out replacement dairy stock off the core dairy farm.

As an example as recorded in the Statistics New Zealand Census of Agricultural Production, at a national level the total dairy cattle numbers on dairy farms in 2012 were recorded as 75% of all dairy cattle. This share was down from 79% of all dairy cattle in 2007, just five years earlier. The cows and heifers not in-calf, and the cows that were NOT on dairy farms in 2007 were 47% of these classes of animals, and the share had increased to 54% of these animals by 2012. This gives the indication that a significant amount of land other than the dairy farm milking platform land is being used in the dairy industry.

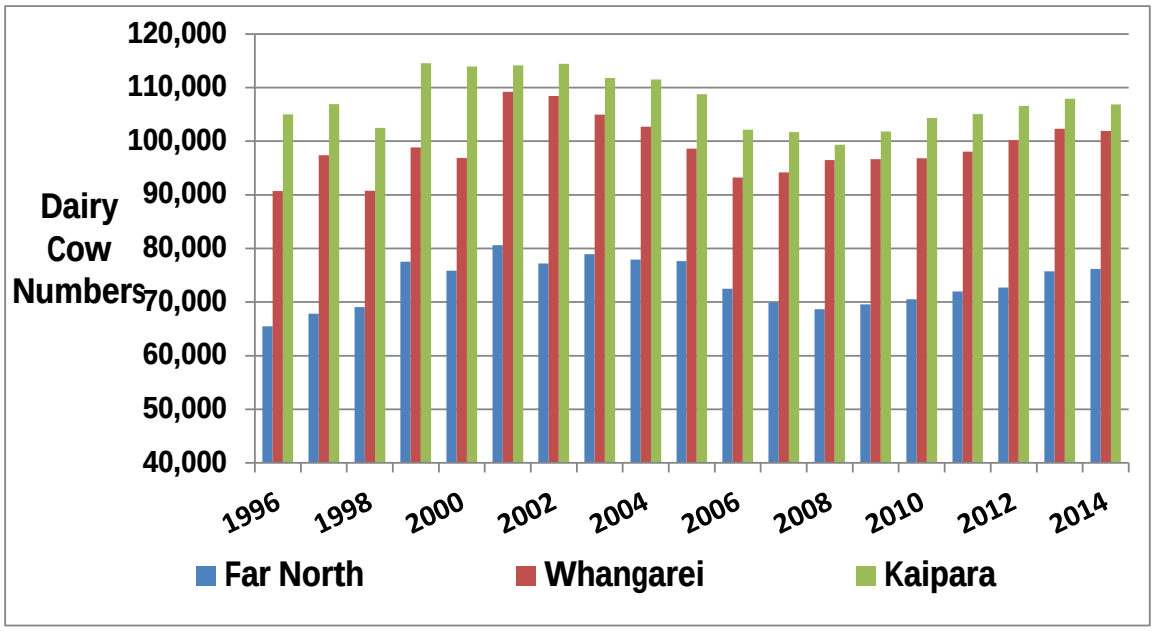
In fact at a national level, the stock units carried off the dairy farms in 2007 was an additional 22% of the number of stock units on the dairy farms, and in 2012 had increased to 26% additional to the stock units on the dairy farms.

The implications are that in Northland the current land used by the dairy industry is likely to be of the order of 155,000 to 160,000 hectares. Some of the 30,000 hectares currently used for dairy support could well be suitable for dairying, with irrigation, and land used for other livestock rearing could be used in dairy support. **The implication is that there could well be land potentially capable of increased irrigated dairy production.**

Dairy cow numbers

The number of cows in Northland has not increased as strongly as nationally. There were 261,000 in 1996, these increased to 300,000 in 2001 – 2002, and then declined to 265,000 in 2007, and have firmed to 285,000 by 2014. Over the whole period, cow numbers in Northland increased by 9%. Over the same period New Zealand dairy cow numbers increased from 2.9 million to 4.9 million, and increase by 68%. The fluctuation in cow numbers in each of the three Northland districts followed the same track over this period.

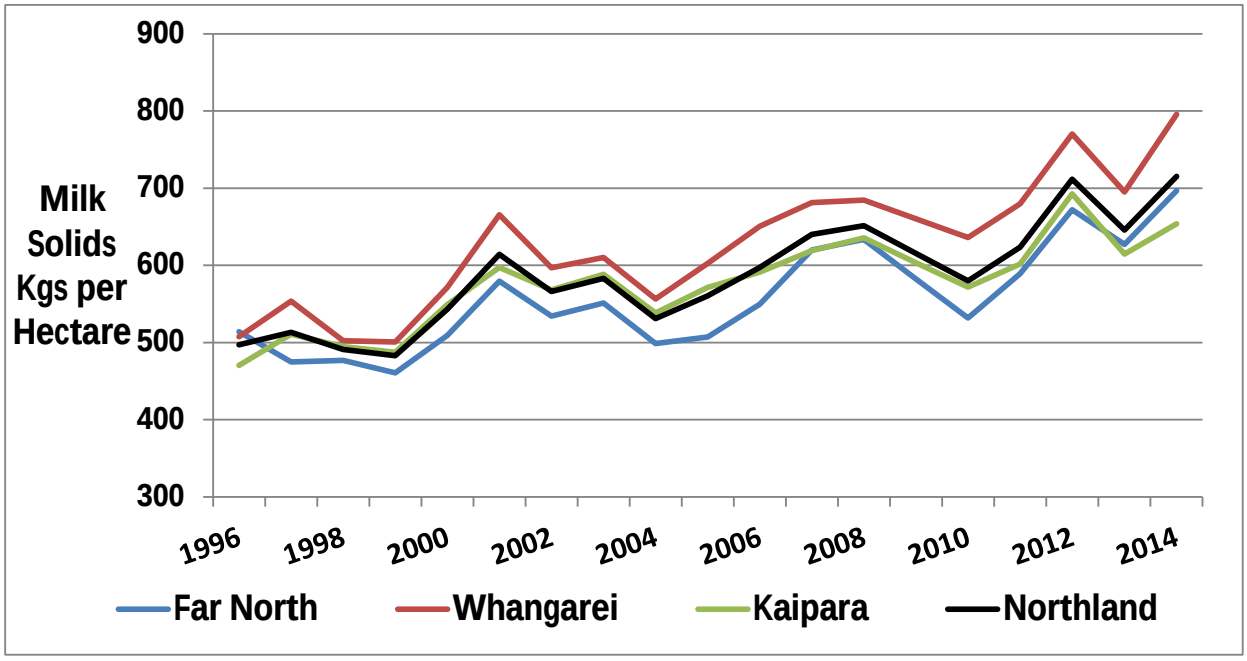
Figure I.2 - Dairy cow numbers in Northland districts 1996-2014



Dairy land productivity

The production of milk solids (MS) over this period increased in Northland by 27%. Given that the total milking platform declined by 12%, this indicates an increase in production of MS per hectare. Once again, the fluctuation in production of MS per hectare in each of the three Northland districts followed the same track over this period.

Figure I.3 - Dairy Milk Solids per hectare in Northland districts 1996-2014



The other key aspect which this track of production per hectare shows is that the production from season to season has wide fluctuations, with differences between peak and trough of 120 kg MS per hectare to 150 kg MS per hectare.

Irrigation to mitigate drought in dairying

There are two main potential impacts of irrigation on dairy productivity:

- first the reduced fluctuation as discussed above, and
- second, the straight increase in production per hectare.

That first potential impact of irrigation would substantially reduce fluctuations in productivity as between seasons. By tracking the upper modal production per hectare over the period 1996 to 2014 and assuming that in the lower production years that level could be achieved, these estimates indicate that if fluctuations in production per hectare could have been largely eliminated over that period in Northland, total production would have increased by 10%.

The first indication is that irrigation could mitigate dry seasons and increase production by 10%.

Irrigation for a step-change in dairy productivity

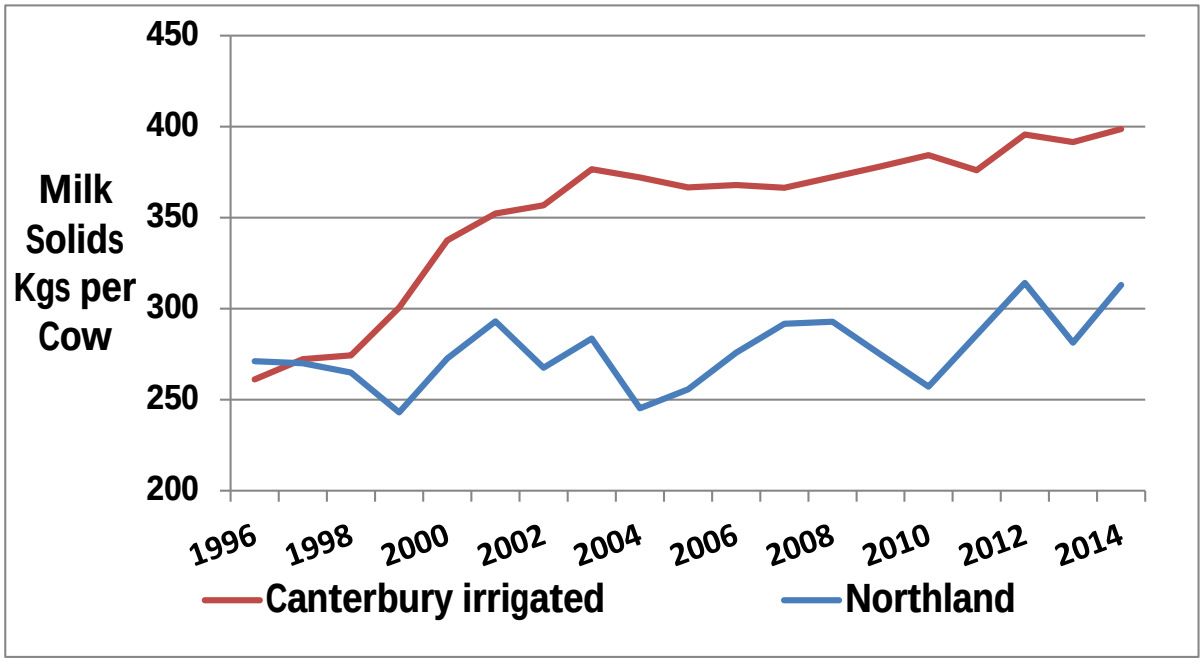
Where land type is suitable for intensive irrigation the greatest potential production increase further exceeds the 10% noted above where irrigation is just used to mitigate dry

seasons. Intensive irrigation undertaken on free-draining alluvial soil stimulates both increased production per cow and increased stocking rate per hectare. The resultant cumulative effects causes production per hectare to increase strongly.

This change can be illustrated by tracking productivity in two Canterbury districts, Selwyn and Ashburton, over the period 1996 to 2003 when they were adopting intensive irrigation, and continuing on to the present. There is also likely some parallel investment occurring in these regions in both animal genetics and grass species to help achieve this productivity lift.

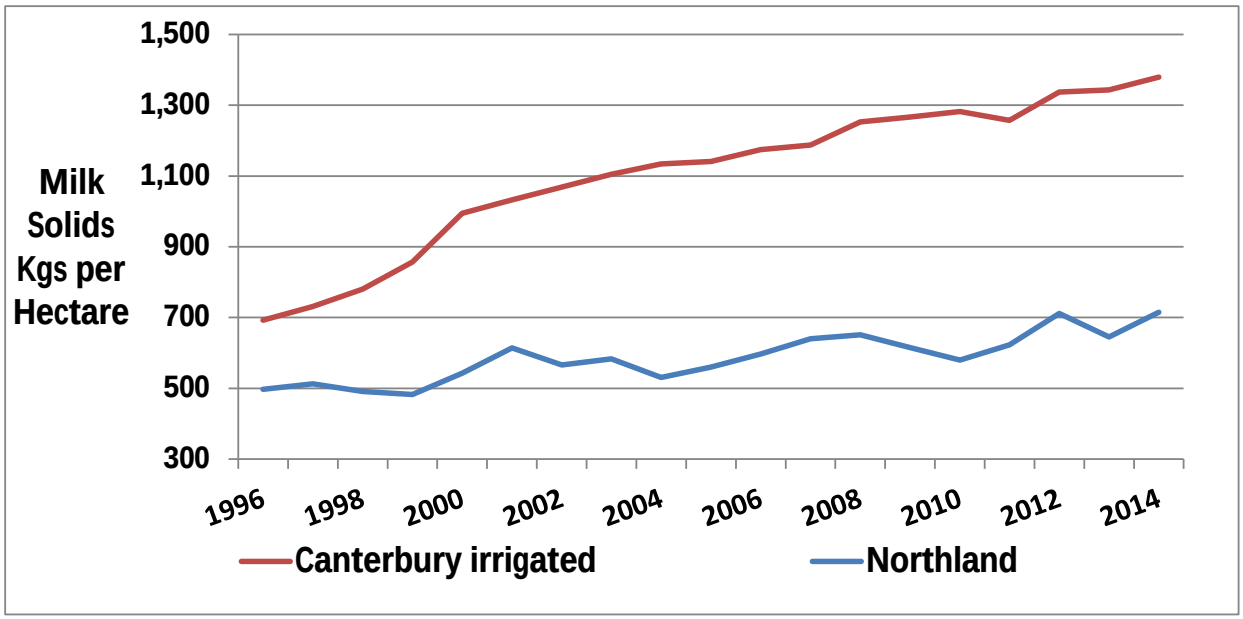
The two Canterbury districts had similar productivity of MS per cow to Northland at the beginning of the period. This rapidly increased to being about 35% greater than Northland. Thereafter it remained relatively steadily at approximately 35%.

Figure I.4 - Milk Solids per cow in Northland and Canterbury 1996-2014



Taken together with the stocking rate increases the total production of MS per hectare in the two Canterbury districts nearly doubled from 700 kg MS per hectare initially to about 1,400 kg MS per hectare in 2014.

Figure I.4 - Milk Solids per hectare in Northland and Canterbury 1996-2014



The indication from this high-level comparison is that in areas of Northland with relatively free-draining soils and access to substantial volumes of water for intensive irrigation, the production of MS per hectare could be increased by about 50%. This assumes that productivity of dairying on free-draining soil is equal to the Northland average.

However as we have stated above, much of Northland's land has impeded drainage, so is not as well-suited to intensive irrigation as alluvial land in Canterbury. Also both of these figures are regional averages, not specific to soil type.

Appendix J Cluster area locations

Figure J.1 - Cluster Area 1 - Far North with LUC class areas

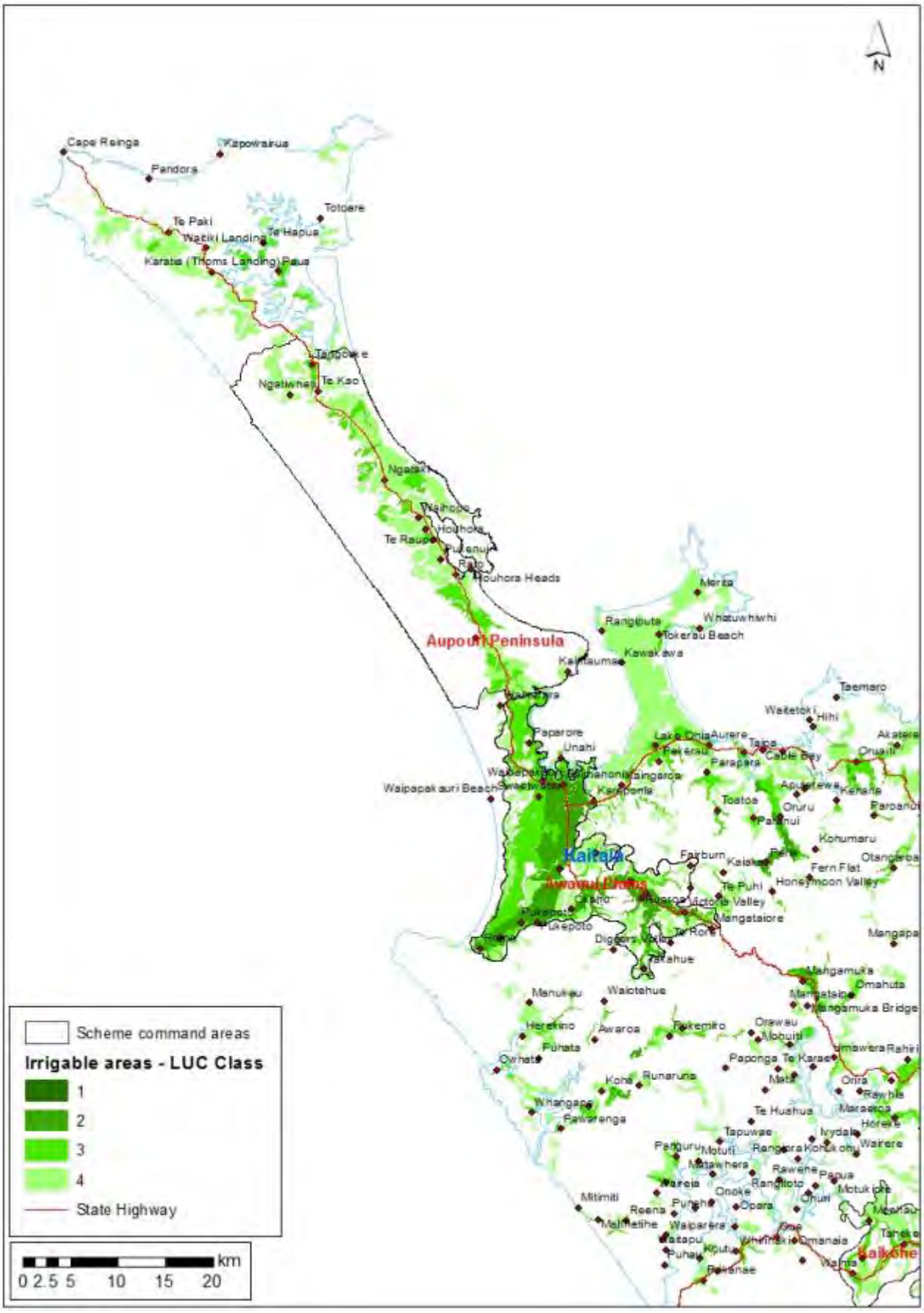


Figure J.2 Cluster Area 1 - Mid-North with LUC class areas

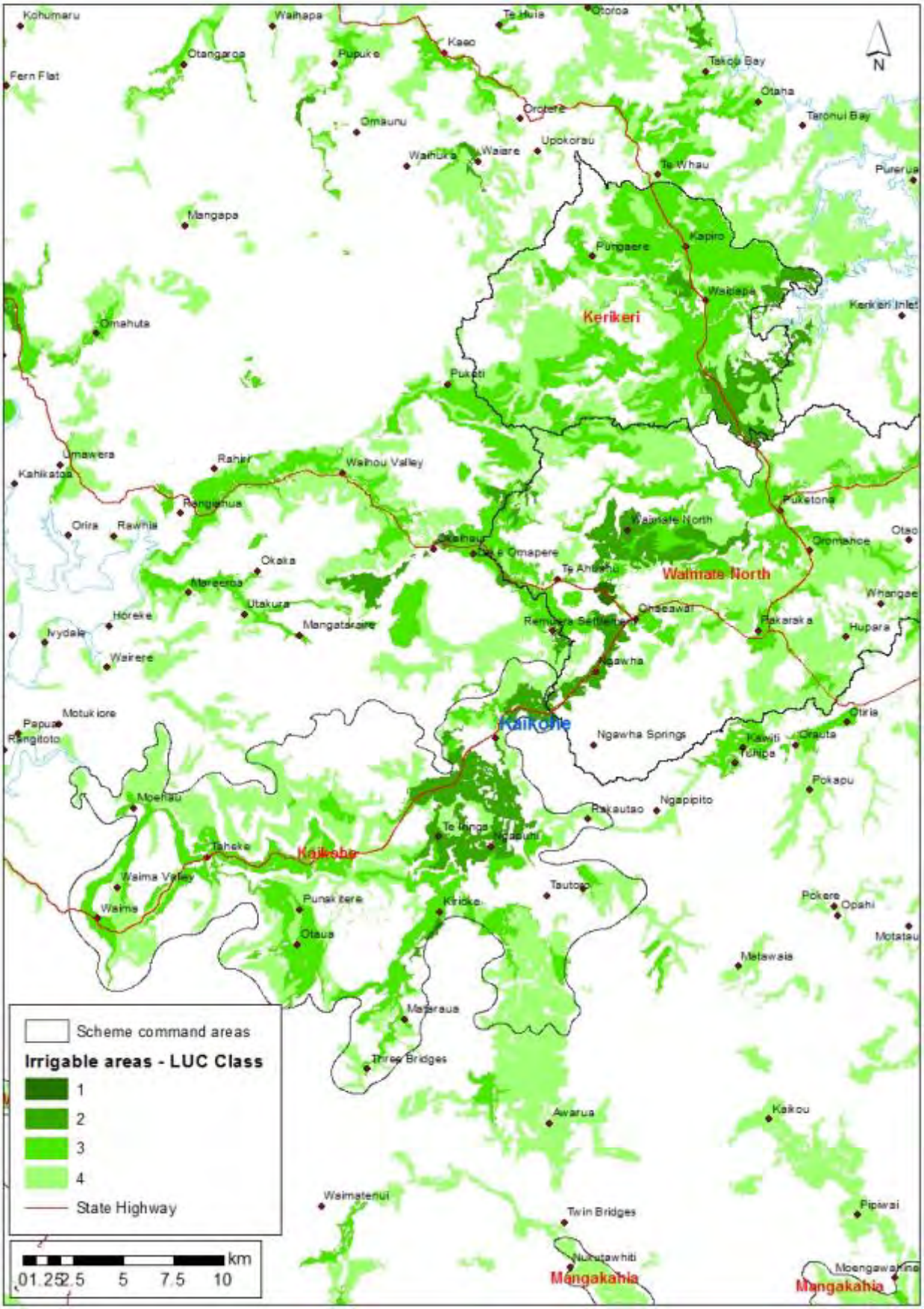


Figure J.3 - Cluster Area 3 - Whangarei and surrounds with LUC class areas

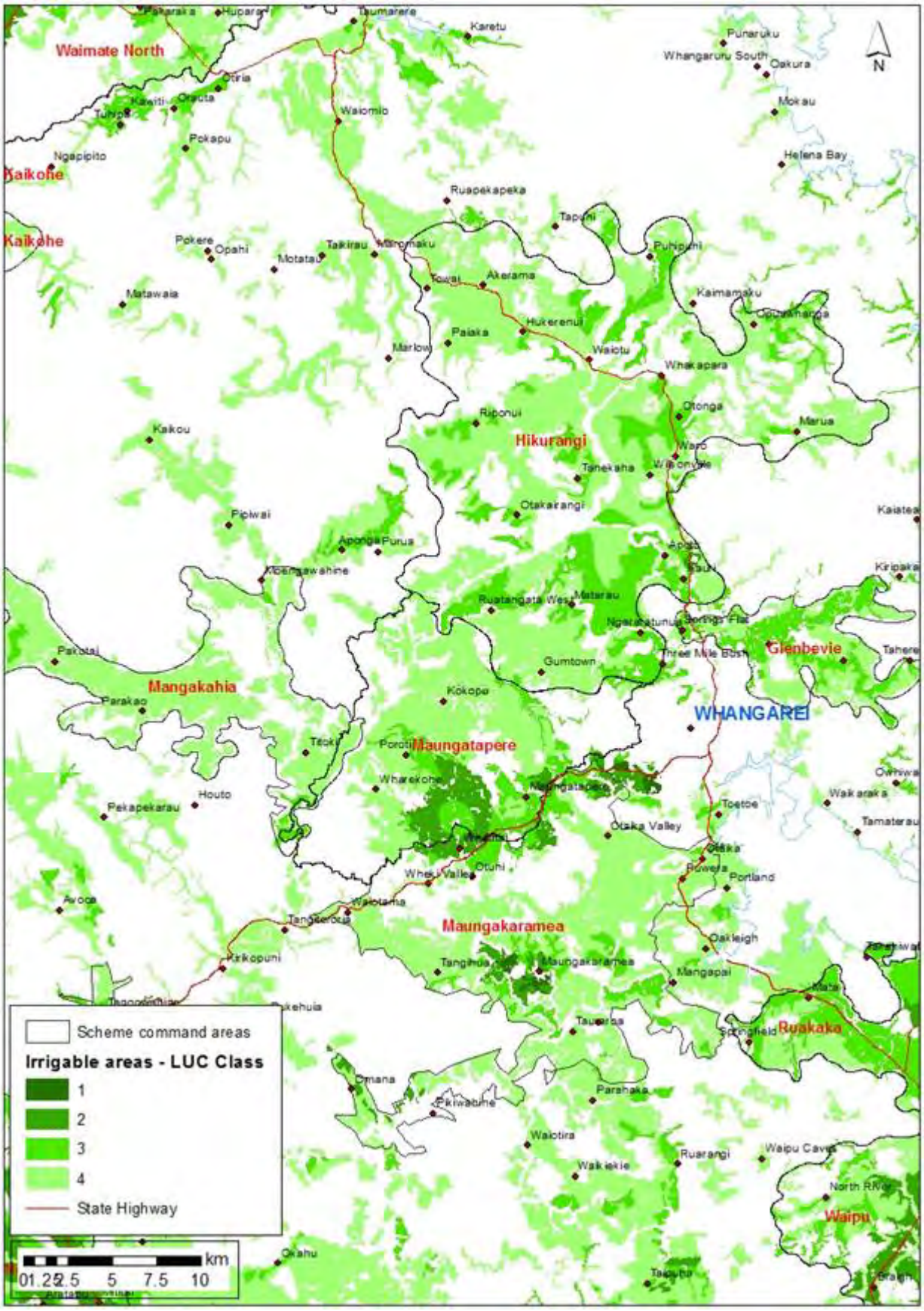
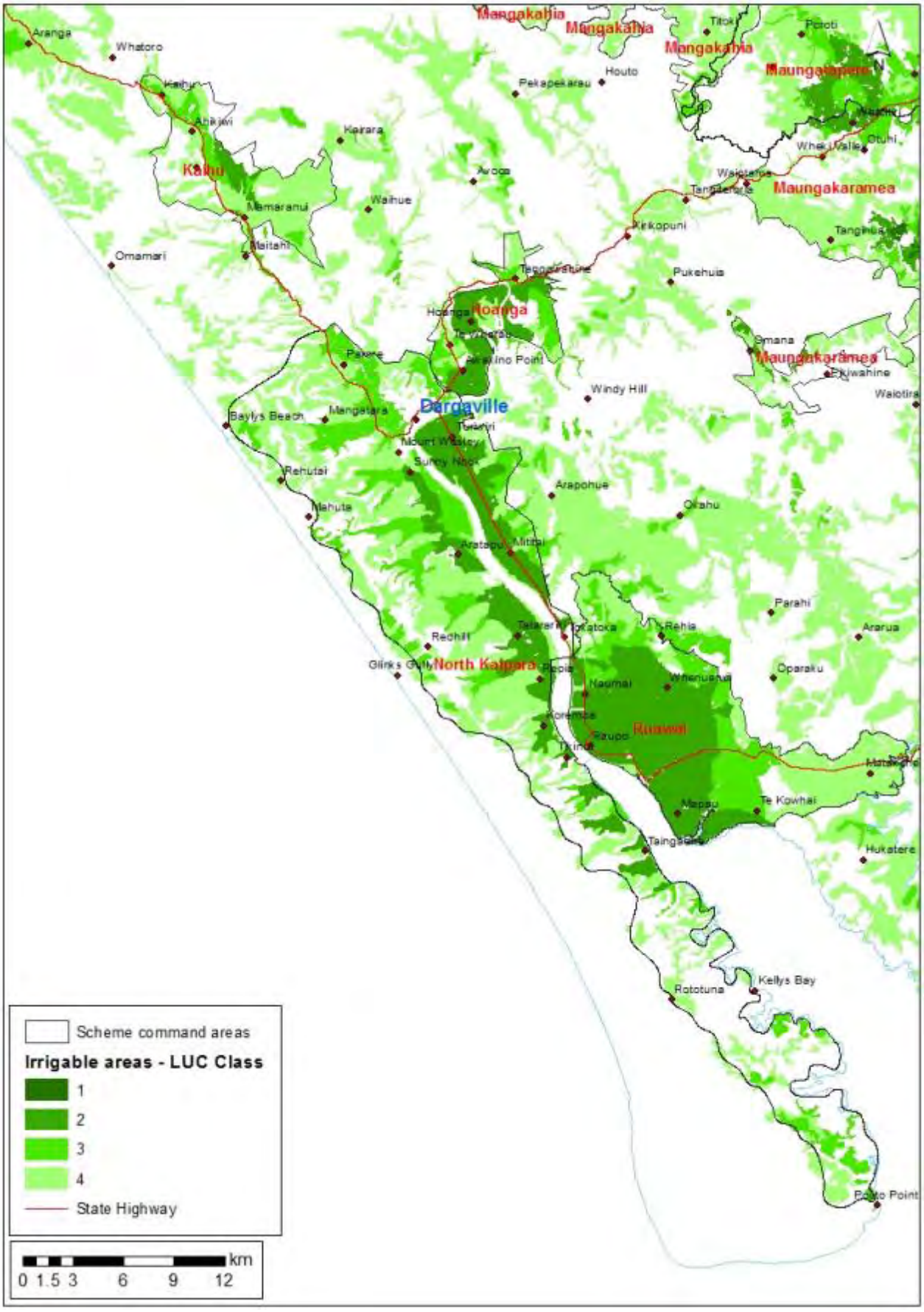


Figure J.4 - Cluster Area 3- Kaipara with LUC class areas



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