

## GROUNDWATER MONITORING

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Groundwater resources in Northland vary in both quantity and quality, depending on the geology of the aquifer system. The main aquifer systems exist in the basalts such as Kaikohe and Whangarei, and in the Aupouri sands. There are also many other smaller sand and gravel coastal aquifers, and generally less productive greywacke aquifers throughout the region. Rainfall is the main recharge source for Northland's aquifers.

Monitoring of groundwater resources in the Northland Region can be divided into three main areas; State of the Environment monitoring to meet the **performance targets** (refer page 18) for groundwater monitoring, compliance monitoring, which is the monitoring of drilling activities and groundwater takes and specific groundwater investigations.

The primary objective of State of the Environment monitoring is to identify environmental issues and trends in groundwater and promote informed environmental decision-making. Several different networks are in place to collect this information including a regional groundwater level monitoring network and two groundwater quality monitoring programmes, one the national programme and the other a regional network.

**Groundwater level monitoring** (refer page 3) was carried out in the past year at 75 sites throughout northland to provide information to monitor the effects of climate, land use change and groundwater abstractions. Low groundwater levels were recorded at many sites from Kaikohe to Mangawhai as a result of low rainfall recharge in 2004-05, however these groundwater levels have recovered to near average during 2005-06.

**Groundwater quality monitoring** (refer page 6) was carried out at seven sites as part of the National Groundwater Monitoring Programme (NGWMP) and 29 as part of the regional Groundwater Quality Monitoring programme (GWQMP).



Artesian bore overflow.

**Specific groundwater investigations** (refer page 9) were undertaken in the Ruawai, Taipa, Russell, Awanui and Mangonui areas. Areas of saline (saltwater) contamination have been discovered at Ruawai, elevated nitrate levels still occur in a number of bores in Taipa, and monitoring at Russell has indicated bacterial contamination and the increased risk of saline (saltwater) contamination. Up-to-date groundwater level and saltwater contamination information is available for the Russell area. A bore close to the foreshore at Mangonui is also being monitored for saltwater contamination. The Awanui area is currently being studied to assess the effects of free-flowing artesian bores on the surrounding groundwater resource. Age testing of groundwater in five bores was also carried out in 2005-06.

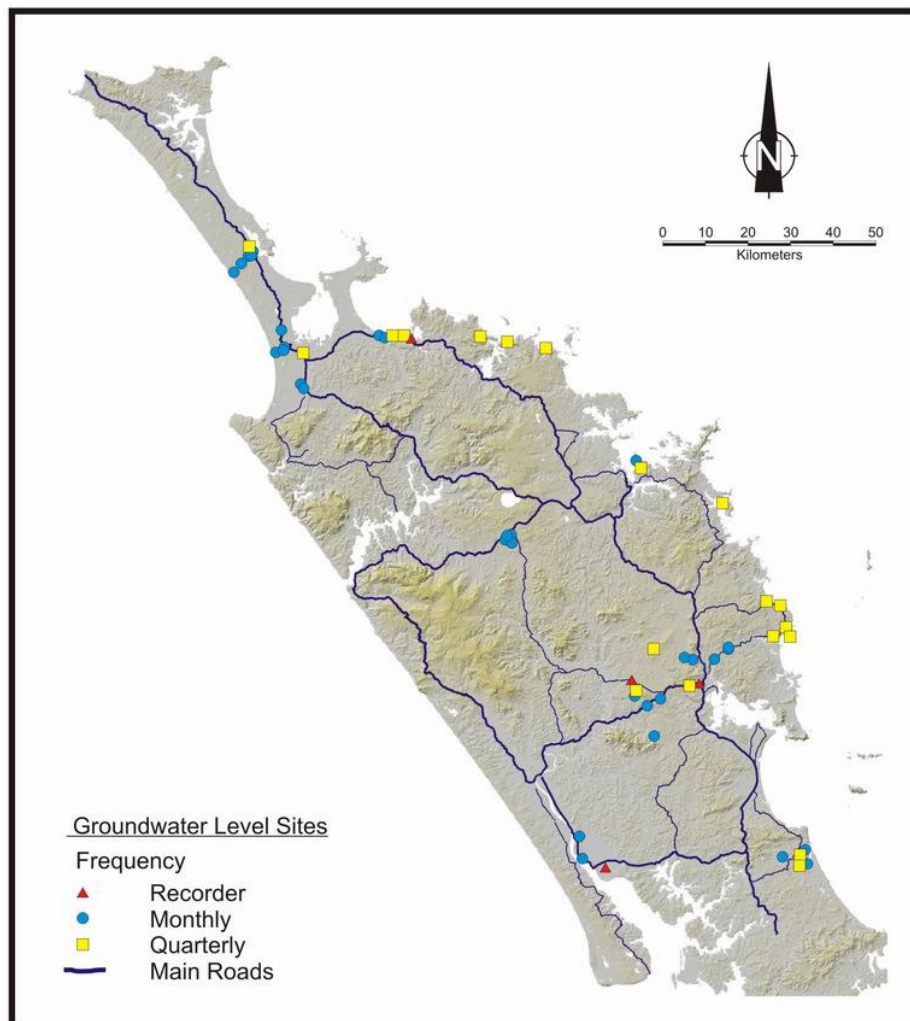
**Hydro-geological investigations** (refer page 12) were carried out in three 'at risk' aquifers; Kaikohe, Three Mile Bush and Maungakaramaea to review sustainable yields of these aquifers. The Kaikohe investigation indicates additional work is required to better

understand recharge to the Kaikohe aquifer. This work will be undertaken in the 2006-07 year. Future groundwater investigations will include reviews of sustainable yields in three coastal aquifers, yet to be selected.

**Compliance monitoring** (refer page 15) includes the monitoring of bore construction for bores that require a bore permit and monitoring of groundwater take resource consents. During 2005-06 there were only minor non compliances with bore construction permits and no formal enforcement action was taken against groundwater take consent holders. The Regional Council established a pumping test programme in 2005-06, with the objective to determine the characteristics of groundwater in different aquifers in Northland.

## Groundwater Level Monitoring

Groundwater level monitoring provides information on the effects of climate, land use change and groundwater abstractions. Groundwater level monitoring is carried out as part of the region wide hydrometric network. Regional groundwater level monitoring began on a monthly basis during the late 1980s with some records extending back to 1975. Groundwater levels are recorded continuously at nine sites, monthly at 45 sites, and quarterly at 21 sites. These sites have been chosen to provide adequate regional coverage as well as targeting specific environmental concerns. The locations of the current groundwater level monitoring sites are shown on the map below.



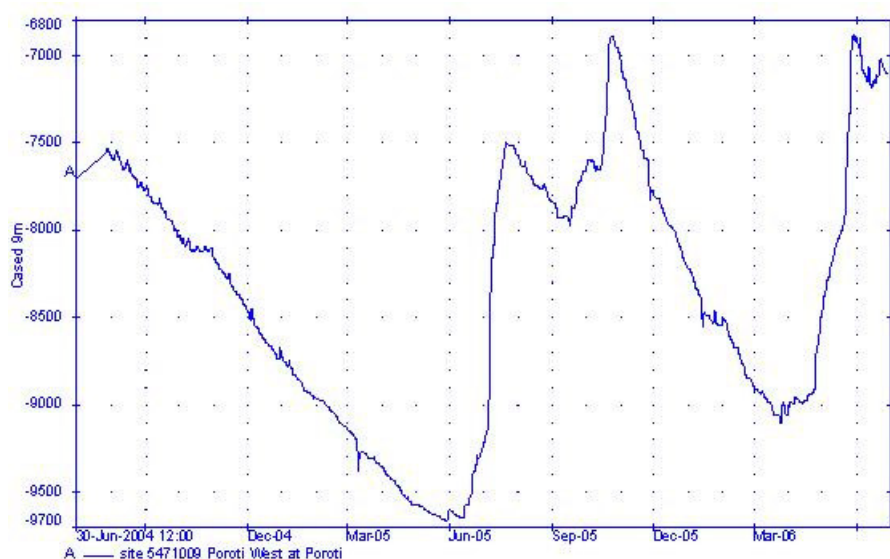
## Results of Groundwater Level Monitoring

Groundwater levels in June 2005 were at or near the lowest recorded levels for the past 16 years in the Kaikohe, Whangarei and Mangawhai areas as a result of low rainfall recharge in 2003 and 2004, particularly during the winter months. Groundwater level monitoring in these areas indicates that water levels have recovered during 2005-06.

Groundwater level results for the 2005-06 financial year are presented below for several aquifers monitored throughout Northland. In most cases historical water levels are provided for comparisons.

### Whangarei Basalt Aquifer

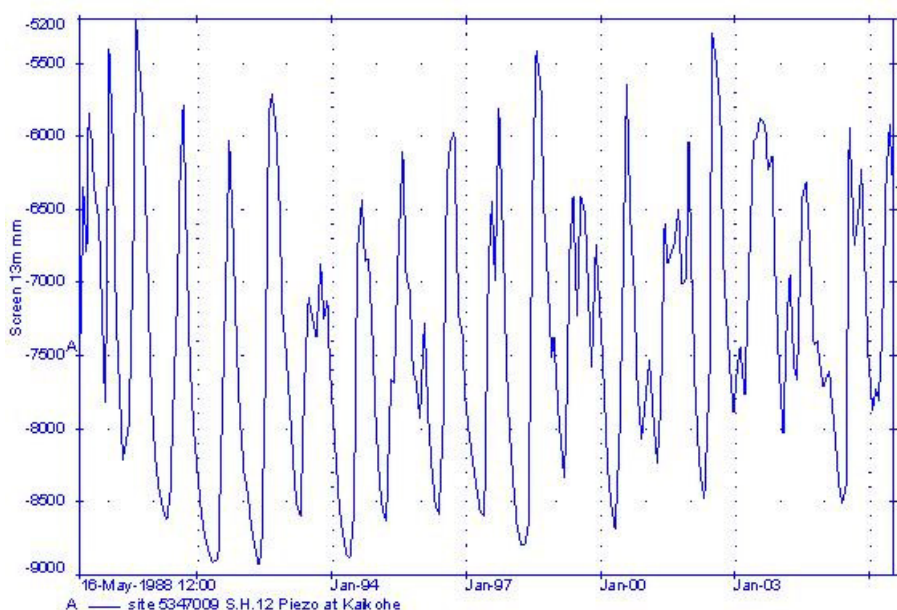
As expected, groundwater level is generally highest from July to September and then drops during the summer months as shown in the graph below for Poroti West monitoring bore in the Whangarei basalt aquifer. Note: the vertical axis of the graph is depth below ground level in millimetres.



The low rainfall in 2004-05 resulted in a recharge peak approximately 1 metre less than the average recharge peak for July to September. At Poroti west the low rainfall recharge resulted in the lowest groundwater level since the record began in 1980 being recorded in June 2005. However, increased rainfall over 2005-06 has resulted in the groundwater level recovering to just below monthly averages.

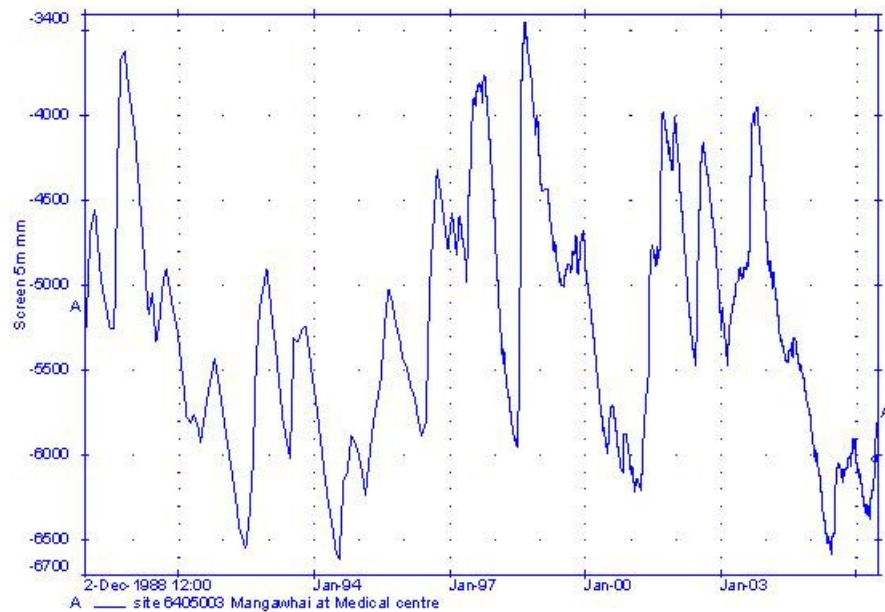
### Kaikohe Basalt Aquifer

The groundwater level in the State Highway 12 monitoring bore shows strong seasonal variation as a result of the direct influence of rainfall. In July 2005 groundwater levels in the Kaikohe area were near or at the lowest on record. Groundwater levels in the Kaikohe area have recovered to near monthly averages during 2005-06. Note: the vertical axis of the graph is depth below ground level in millimetres.



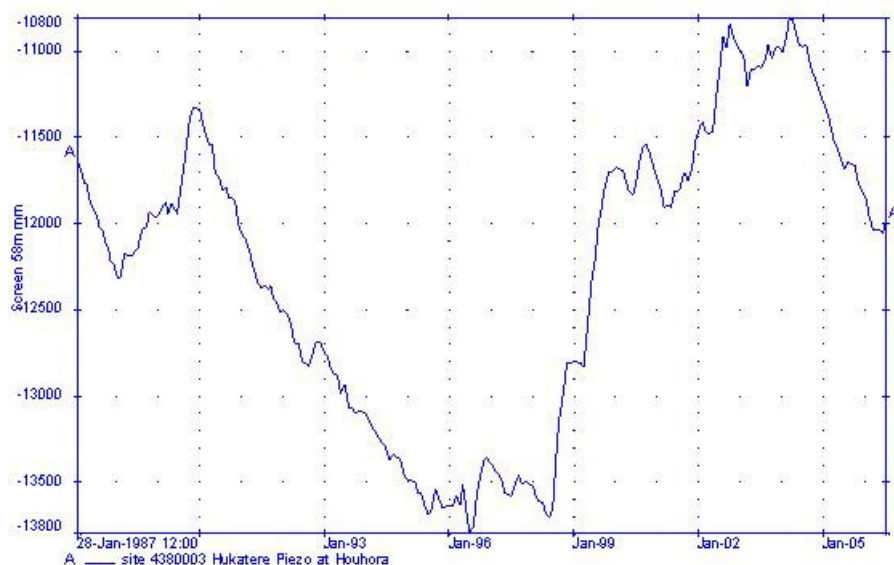
### Mangawhai Sand Aquifer

Rainfall for the 2005-06 monitoring period in the Tara/Mangawhai area has been above average for the months of April and May. Groundwater levels in the Mangawhai area generally increase to a recharge peak around October as a result of the delay between rainfall events and the actual recharge of the groundwater resource. Note: the vertical axis of the graph is depth below ground level in millimetres.



### Aupouri Sand Aquifer

The Aupouri aquifer has a large storage capacity. The large volume of water in storage within the deep sand and shell bed aquifer buffers the effects of rainfall recharge. The decline in the water level in the Hukatere Forest monitoring bore from 1987 to 1996 (shown in the graph below) is likely to be a result of less than average rainfall in the late 1980's to early 1990's, and the effects of plantation forestry reducing recharge to the system. Felling of the forestry and increased rainfall is likely to have resulted in the increase in groundwater levels recorded from 1998 to 2004. Over 2005-06 groundwater levels have been on the decline again. Note: the vertical axis of the graph is depth below ground level in millimetres.

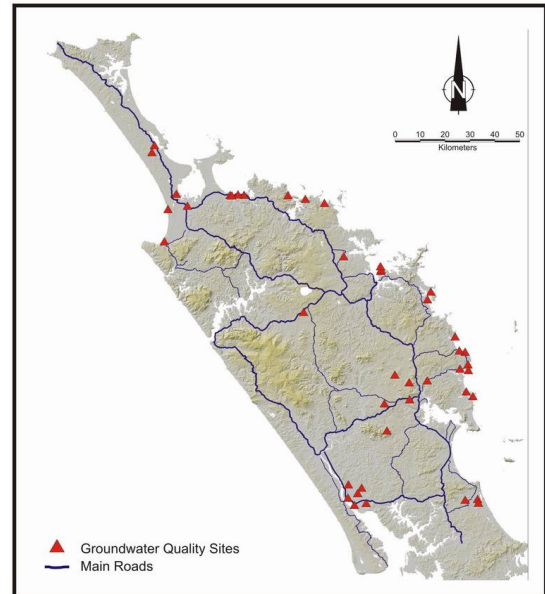




## Groundwater Quality Monitoring

The Northland Regional Council participates in the National Groundwater Monitoring Programme (NGWMP), which is a joint project between the Institute of Geological and Nuclear Sciences (IGNS) and Regional Councils. The focus of this research is to determine national groundwater quality trends.

Seven sites are situated in Northland, and have been sampled every three months since September 1996. These sites are located at Houhora, Paparore, Ahipara, Kaikohe, Tutukaka, Glenbervie and Tara as shown on the map. Samples from each site are analysed for major cations, anions, nutrients and trace elements such as iron.



The regional council also operate a regional Groundwater Quality Monitoring Programme (GWQMP), which commenced in November 2002. The data gained from this monitoring will improve understanding of the region's groundwater aquifer system and help assess the sustainable management of the groundwater resources. The primary aim of the regional GWQMP is to gain a perspective on baseline water quality of the different aquifers in Northland and identify any trends in groundwater quality over time as a result of the climate, land use and groundwater abstraction.

As part of the regional GWQMP 29 sites are sampled (in addition to those sampled for the National Groundwater Monitoring Programme) on a three monthly basis. Twenty-two of these sites are located in coastal aquifers, which are analysed for saltwater and bacterial indicators every six months and chemical properties (the same set as for the national programme) on the sampling runs in between. Groundwater levels are also recorded at each site, where access is available. The remainder of the sites are located in basalt aquifers, these sites are sampled quarterly and analysed for a full range of determinants. All the GWQMP sites are listed in the table below.

Coastal	General
Mangawhai Heads east Mangawhai Heads west Mangawhai Village Sandy Bay Taupo Bay Tauranga Bay Te Ngairi Bay Tapeka Point Pataua Bay Whananaki Bay Taiharuru Bay Ngunguru Whangaumu Beach Matapouri Bay Oakura Bay (2) Bland Bay Cable/Mangonui Bay Coopers Beach Waipapakauri Beach Waipapakauri East Houhora	Maunu Basalt Whatitiri Basalt Three Mile Bush Basalt Matarau Basalt Glenbervie Basalt Kerikeri Basalt Maungakarama Basalt

## Results of Groundwater Quality Monitoring

Groundwater quality in Northland is generally high enough that water can be consumed without treatment. Three areas of potential concern are contamination of groundwater resources by nitrate, bacteria and saltwater (saline). The median concentration of each determinant was calculated for each monitoring site and compared to the Maximum Allowable Values (MAVs) in the *'The Drinking Water Standards for New Zealand'* (Ministry of Health, 2005).

To view the *'The Drinking Water Standards for New Zealand'* (MoH 2005) refer to the following website:

<http://www.moh.govt.nz>

The results from the NGWMP and regional groundwater quality monitoring programme indicate that concentrations of the majority of the determinants analysed are well below New Zealand drinking water limits in the aquifers monitored in Northland. However, 12 monitoring sites had median Iron (Fe) concentrations above the aesthetic guideline value for iron of 0.2 mg/L and 13 monitoring sites had median Manganese (Mn) concentration in excess of the aesthetic guideline value for Manganese of 0.04 mg/L. Out of 13 sites which exceed the Manganese aesthetic guidelines, only two sites had median Manganese concentrations above the Maximum Allowable Value for health reasons of 0.4 mg/L.

Most of the bores that have median Iron and Manganese concentrations in excess of aesthetic guideline values intersect groundwater in either basalt or fractured greywacke. High concentrations of Iron and Manganese are common in these rock types within the Northland region. Elevated levels in groundwater can cause staining of pipes and laundry.



NRC staff sampling groundwater bore.

Results of bacterial analysis indicate seven sites in both the coastal and the basalt groundwater systems were above the guideline value. Out of these seven sites three show repeated bacterial contamination in the last three sampling runs. This may be an indication of onsite wastewater contamination. It is important to note that the bacterial limit set in the *'The Drinking Water Standards for New Zealand 2000'* is 1 cfu/100 ml. Therefore any positive result for bacteria exceeds these drinking water standards.

Nitrate ( $\text{NO}_3^-$ ) is considered a broad indicator of groundwater contamination from a variety of sources, including fertilisers, agricultural and human wastes. Nitrate is considered toxic in excessive concentrations. Bottle-fed infants are most at risk, as a high concentration of nitrate affects the ability of the blood to transfer oxygen. High nitrate concentrations in water and diet have been linked to some types of cancers.

The current New Zealand drinking water limit for nitrate is  $11.3 \text{ mg L}^{-1}$  (as  $\text{NO}_3^- \text{N}$ , taken from the *'New Zealand Drinking Water Standards 2000'*). Monitoring has shown that

average nitrate concentrations at all NGWMP and regional network sites are well below this level. Nitrate concentrations are generally higher in the basalt bore than they are in the sands and other geology. This may be a result of the horticultural and agricultural land use in the areas surrounding the basalt aquifers. Elevated nitrate concentrations have been recorded in several sites in Taipa. The results of this monitoring are reported in the **specific groundwater investigation** (refer page 9) section.

Conductivity is an indirect measure of salinity. High levels may indicate salt-water intrusion as the result of lowering groundwater levels. Elevated conductivity values have been recorded at one site in the Ruawai area, which is discussed in the **specific groundwater investigation** (refer page 9) section. Bores monitored in Pataua North and Cable Bay also registered elevated chloride concentrations during the period of low groundwater levels in 2006. This is likely to be a direct result of the influence of saltwater.

In 2005-06, samples from all GWQMP bores were also analysed for Arsenic and Lithium. The results of this monitoring indicate Arsenic and Lithium concentrations are well below 'The Drinking Water Standards for New Zealand' (MoH 2005). Arsenic and lithium analysis will be conducted annually in the future.

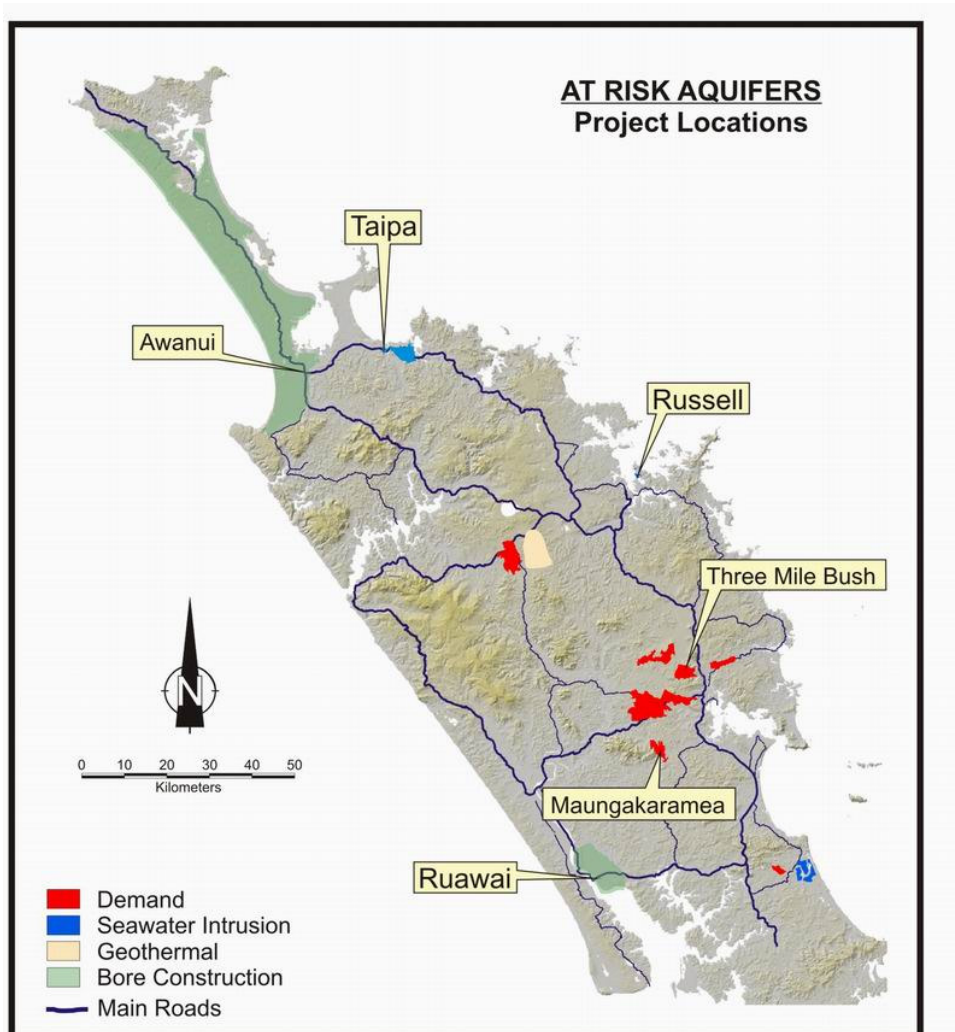
The table below shows the median results for all the parameters tested for as part of the National Groundwater Quality Monitoring Programme since 1996.

Parameter	Kaikohe	Paparore	Tara	Houhora	Ahipara	Glenbervie	Tutukaka
Alkalinity (mg/L)	66	150	28	51.5	35	161	67
Bromide (mg/L)	0.1	0.18	0.085	0.325	0.1	0.06	0.56
Calcium (mg/L)	10.8	34	4.75	5.8	4.2	41.8	3.85
Chloride (mg/L)	10.7	52.5	17.9	32	33	14.7	117
Conductivity (ms/m)	17.7	41	14	21	18	32	58.6
Fluoride (mg/L)	0.03	0.0625	0.05	0.08	0.03	0.07	0.11
Iron (mg/L)	< 0.02	0.06	0.35	1.4	1.4	0.05	< 0.02
Potassium (mg/L)	1.5	2.8	1.55	1.5	1.7	1.5	2.9
Magnesium (mg/L)	6.2	5.7	4.1	3.8	3.4	6.1	7.85
Manganese (mg/L)	< 0.005	0.12	0.01	0.06	0.04	0.006	0.007
Sodium (mg/L)	12.2	42	13.5	29.85	25.5	17.45	96
Ammoniacal-N (mg/L)	< 0.01	0.06	< 0.01	0.02	0.07	< 0.01	< 0.01
Nitrate Nitrogen (mg/L)	3	0.03	2.45	0.03	0.245	0.78	2.1
pH	6.6	7.85	6.4	6.6	6.4	7.3	6.8
Silica (mg/L)	41	41	24.5	40.25	36	25.4	33
Sulphate (mg/L)	2.9	8.75	2.8	8.7	6.75	10.8	27



## Specific Groundwater Investigations

In addition to the routine monitoring carried out as part of the networks mentioned in the **groundwater quality** (refer page 6) section, specific groundwater monitoring projects have been carried out in the Ruawai, Taipa and Russell areas to investigate areas of concern identified in previous monitoring. These investigations also provide better information to the Regional Council to ensure the sustainable management of these groundwater resources, particularly where information is lacking. The map below shows the location of 'At risk aquifers' in Northland, of which three were covered by these specific investigations and the other three had hydro-geological surveys carried out on them in 2005-06. Also age testing of groundwater was carried out in five bores in 2005-2006, as the age of groundwater can have significant management implications.



### Ruawai Groundwater Monitoring

The Ruawai area, located approximately 15 kilometres south of Dargaville, is predominantly an alluvial flood plain consisting mainly of mud, sands and peat. The Northern Wairoa River bounds the area to the west and south, and limestone hills mark the northern and eastern boundaries. The flood plain is heavily drained. The main land uses in the area are horticulture (particularly kumara growing) and agriculture (such as dairy farming).

Historical bore logs in the area indicate groundwater is present across the flood plain at varying depths and quality. Groundwater in the Ruawai area is important as most local

surface water has a high salt content and it is principally used for irrigation, stock water requirements and public water supply.

The main groundwater issues in the area are the potential for:

- intensive horticulture and agricultural activities to degrade water quality; and
- groundwater abstractions resulting in saline (saltwater) intrusion.

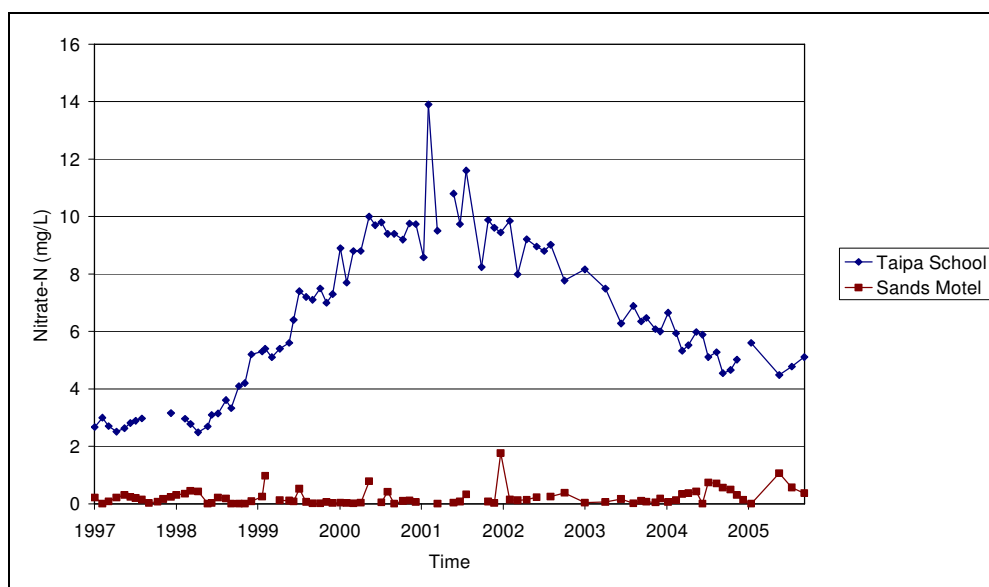
At present six bores are sampled monthly for a range of parameters to determine long term and seasonal variations in groundwater levels and quality, to ensure the sustainable management of the groundwater resource.

The results of sampling over the past year are consistent with the findings of the 2004-2005 sampling, which indicated elevated chloride and sodium concentrations in the south-eastern and northern boundaries of the groundwater system. These results suggest that saltwater intrusion is occurring in the south-eastern and northern zones of the Ruawai aquifer, however, this is not influencing the water quality in the western zone at the site of the Kaipara District Council public water supply bores. Monitoring will continue next financial year.

### Taipa Groundwater Monitoring

Taipa is a coastal aquifer with a saline boundary on the northern and eastern edge of the aquifer. The main source of recharge is rainfall. The Taipa aquifer has similar groundwater issues to Ruawai, including potential for degraded water quality and saline intrusion. Four bores are sampled monthly and analysed for nitrate and saline indicators such as chloride.

The results from this monitoring indicate elevated nitrate levels in a number of bores in the Taipa settlement area. The results from 1997 to June 2006 are shown in the graph below for two bores, Taipa School and Sands Motel. Nitrate levels in groundwater from the Taipa School bore exceeded the drinking water limit of 11.3 mg/L on several occasions in 2001-2002. However levels had dropped below the drinking water standard by May 2002 and have continued to decline. The school does not use groundwater from the bore for drinking. Nitrate levels in groundwater from the Sands Motel bore have been slightly elevated particularly over the last year but remain well under the drinking water limit.



Chloride levels in the bores adjacent to the foreshore have shown no significant variation over the monitoring period. On going monitoring of the nitrate and chloride levels in the Taipa groundwater will continue, however the frequency of monitoring will be reduced.

### Russell Groundwater Monitoring

Russell groundwater resource consists of a gravel and fractured greywacke system in close proximity to the coast. The main sources of recharge to the system are rainfall and onsite wastewater discharges. There are many bores in the area that abstract water for domestic use. The main concern for the Russell aquifer is that reduced recharge due to wastewater reticulation and increased groundwater use will lead to an increased risk of saline (saltwater) intrusion. Previous groundwater modelling suggests that the reticulation of wastewater will significantly increase the risk of saltwater contamination of the Russell groundwater resource during prolong dry periods.

There are currently four monitoring bores in Russell and Matauwhi Bay. Two of these bores are sampled and analysed for saline indicators on a monthly basis. The other two bores are sampled quarterly for a range of determinants and bacteria.

One bore on the Russell foreshore regularly records groundwater level and conductivity. A telemetry system has been installed to enable direct telephone access to these monitoring results, and therefore enable an early warning of any increase in saltwater contamination in the aquifer. Estimation of the depth to the saltwater interface and the conductivity results for the telemetered bore suggest that either this bore needs to be deepened or a new monitoring bore installed closer to the foreshore to provide for warning of saline contamination. This work will be undertaken during 2006-07. Monitoring in Russell will continue next financial year.

### Age testing

The age of groundwater has important implications for management of groundwater resources in Northland. For example, if the age of groundwater in a particular aquifer is found to be approximately 50 years, then water quality now is a result of land use 50 years ago. However there is always a recent component such as bacterial contamination.

During 2005-06 five water samples were collected and analysed to determine the average age of the groundwater (mean residence time) delivered from bores in the Northland region. Samples were collected from groundwater quality monitoring bores at Maungakaramaea, Mangawhai, Whatitiri, Three Mile Bush and Matapouri and analysed for tritium, CFC and SF<sub>6</sub> isotopes.

The initial age estimates are provided below, however, further analysis is required and the bores will be resampled in approximately five years, to ensure accurate interpretation of the results.

Site of bore	Initial Mean Residence Time Estimate (years)
Mangawhai	3 ± 3
Whatitiri	3 or 45
Maungakaramaea	45 ± 3
Three Mile Bush	50 ± 3
Matapouri	40 ± 3

The relatively old age recorded in the Matapouri bore may indicate the sand aquifer is recharged by relatively old water from the surrounding greywacke. The analysis for the Whatitiri sample indicated two possible ages (3 or 45). However due to the depth and geology of the Whatitiri bore the mean residence time is likely to be around 45 years. However, additional sampling and analysis will be required to confirm this.

## Hydro-geological Investigations

Aquifers in Three Mile Bush, Maungakaramea and Kaikohe areas are recognised in the *'Regional Water and Soil Plan for Northland'* as “at-risk” aquifers with respect to groundwater demand and water quality issues. These three areas, highlighted on the “at risk aquifers” map in the **specific groundwater investigations** (refer page 9) section, were prioritised for investigations either because of the lack of information on these areas and/or the large amount of development in the area.

Due to increased drilling activity and potential demand for groundwater in these areas, the Regional Council require better information to ensure the sustainable management of these groundwater resources. Given this hydro-geological investigations were carried out in these areas in 2005-06. The aim of the studies were to:

- Develop an understanding of the aquifer hydrogeology,
- Provide an estimation of the sustainable yield and
- Recommend future actions to enable the sustainable management of the groundwater resources.

An additional investigation is being carried out in the Awanui area to assess the effects of flowing artesian bores on the surrounding groundwater resource.

### Three Mile Bush Groundwater Resources

The Three Mile Bush basalt aquifer is located directly west of Kamo, Whangarei. The study area comprises a 13.2 square kilometre basalt plateau at an elevation of approximately 230 metres above mean sea level. Groundwater from this aquifer is predominately used for horticultural irrigation, stock water and domestic water supply.

The main issues potentially affecting groundwater quality and quantity in the Three Mile Bush area are:

- Groundwater abstraction
- Bore construction and location
- Land use change

The study provided an assessment of the groundwater resources in the area, with the following recommendations:

- Further refinement of sustainable yield in the event of an increase in groundwater demand.
- Groundwater level survey to increase knowledge of groundwater flow.
- Increase in ongoing groundwater level monitoring in the northern part of the aquifer.
- Concurrent monitoring of spring and stream flow at a number of locations within the study area.
- Soil infiltration tests carried out to improve understanding of the groundwater recharge dynamics.
- Groundwater quality monitoring in other bores across the aquifer to identify potential groundwater quality issues.

Additional water level monitoring will commence in the northern part of the aquifer and the existing monitoring of groundwater level and quality, including anions, cations and bacteria, in the Three Mile Bush basalt aquifer will continue in the future.

### Maungakaramea groundwater resources

The Maungakaramea basalt aquifer is located approximately 14 km southwest of Whangarei. The total study area is approximately 10.4 km<sup>2</sup>. Most of the study area is relatively flat, at an elevation of approximately 140 metres above mean sea level. The



centre of the aquifer is a scoria cone, forming a “horseshoe” hill with an elevation of 225 metres above sea level.

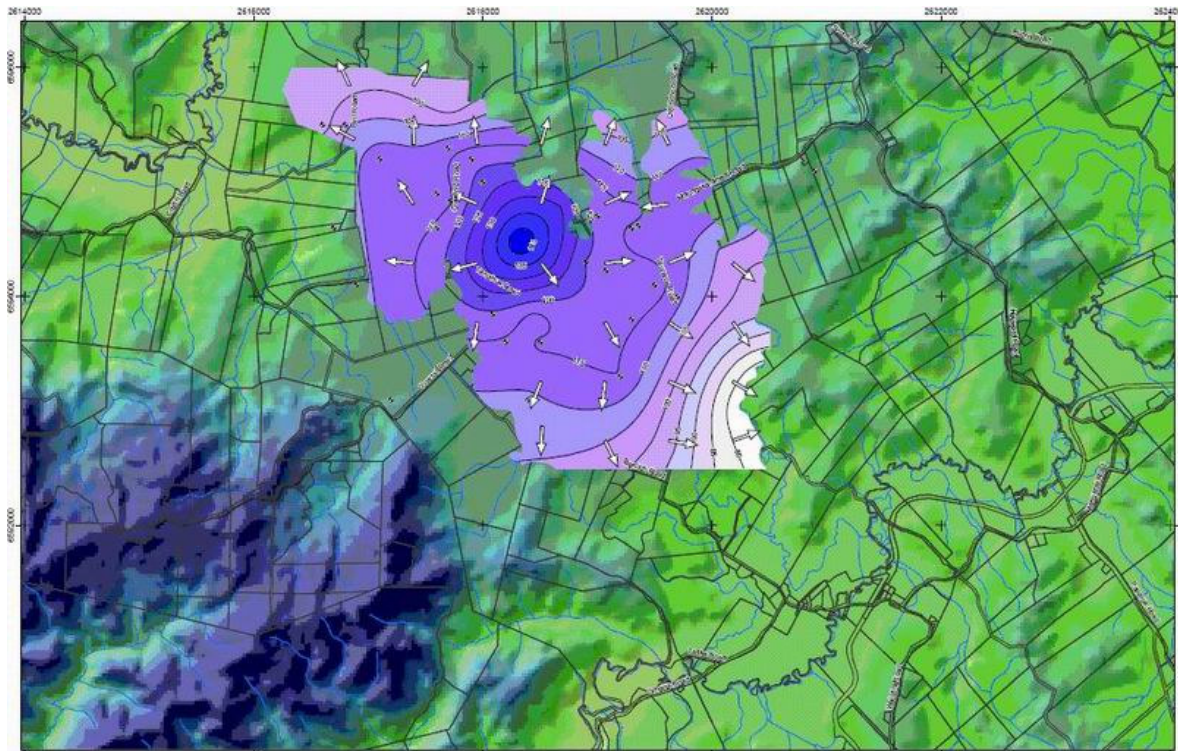
Groundwater is generally used for horticultural irrigation, stock drinking, public and domestic water supply. The main potential groundwater issues are:

- Groundwater abstraction including effects on spring and stream flow
- Land use change

Based on the findings from the study the following recommendations were made:

- Survey groundwater bores and springs to obtain information on flow direction, recharge and sustainable yield estimates
- Increase groundwater quality monitoring to evaluate the existing water quality and long term trends.
- Carry out soil infiltration tests to improve understanding of the groundwater recharge.
- Increase groundwater level monitoring (to daily)

The map below shows the piezometric groundwater surface for the Maungakaramaea cone. The arrows indicate the direction of groundwater flow and the contour lines are piezometric groundwater contours.



Monitoring of groundwater level and quality, including anions, cations and bacteria, in the Maungakaramaea area will continue in the future. In the event of an increase in groundwater demand in the future, further of the above recommendations will be implemented.

### **Kaikohe groundwater resources**

The Kaikohe aquifer underlies the Kaikohe Township. The aquifer comprises of the Kaikohe volcanic centre marked by a scoria cone at Memorial Hill, basalt flows extending to the south and south east of the cone splitting into two main lobes, and underlying older basaltic lava flows with no definable centre. The total aquifer area is 27 square kilometres.



The main issues potentially affecting groundwater quality and quantity in the Kaikohe area are:

- Groundwater abstraction (high allocation), including potential effects on spring/stream flows
- Bore construction and location
- Land use change

Based on the preliminary findings in a draft report, the following recommendations were made:

- Carry out additional pump testing to establish extent of aquifer and interaction with springs and other aquifers
- Gauge streams and springs, together with a groundwater level survey to estimate impacts of abstractions and design minimum flows to be determined
- Conduct a bore and water use survey to refine sustainable yield of the aquifer
- Delineate groundwater subcatchments
- Develop a groundwater model

Monitoring of groundwater level and quality, including anions, cations and bacterial, in the Kaikohe area will continue in the future. A further investigation is currently being carried out to determine recharge characteristics and spring/stream flow relationships in the Kaikohe area. The final report is due to be completed in December 2006.

### **Awanui Artesian Aquifer**

The study area is centred on the Awanui Flats area directly north of Kaitaia. It has been estimated that as many as 500 bores have been historically drilled in to the artesian aquifer in the area. Many of these bores are now abandoned and are free flowing (uncapped). These bores naturally discharge groundwater into existing irrigation drains. It has been estimated that as much as 8,500 cubic metres of groundwater per day is flowing to waste in this area.

The aim of the study is to evaluate the effects of the free flowing bores on the surrounding resource the groundwater resources, and develop a groundwater model to predict the effects of potential management options including progressive bore closure.

Stage one of this study, was to review all existing information and develop a conceptual model of the aquifer. This stage will be completed and reported in April 2006. In the next financial year the information gained in stage one will be used to develop a detailed (computer) model of the aquifer. The detailed (computer) model will be used to assess the effects of different management options on the groundwater resource.

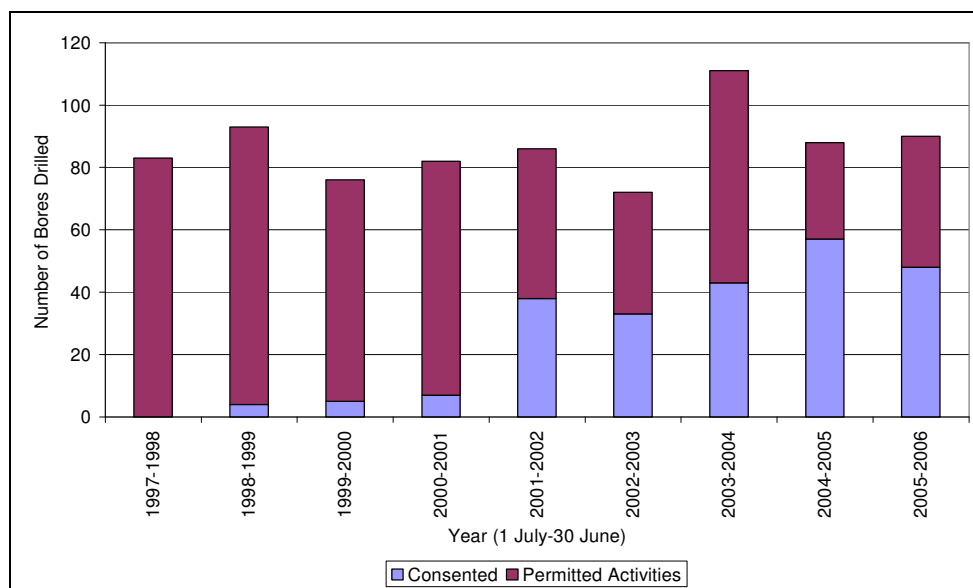
## Compliance Monitoring

The Northland Regional Council maintains a bore log database. All the bore logs provided by drillers are incorporated in this database.

Bore permits (resource consents) were not required for drilling activities prior to 1 April 1999. Since April 1999, bore permits have been required prior to drilling in sensitive groundwater areas identified in the Regional Water and Soil Plan for Northland as 'at risk' aquifers or if drilling in contaminated areas.

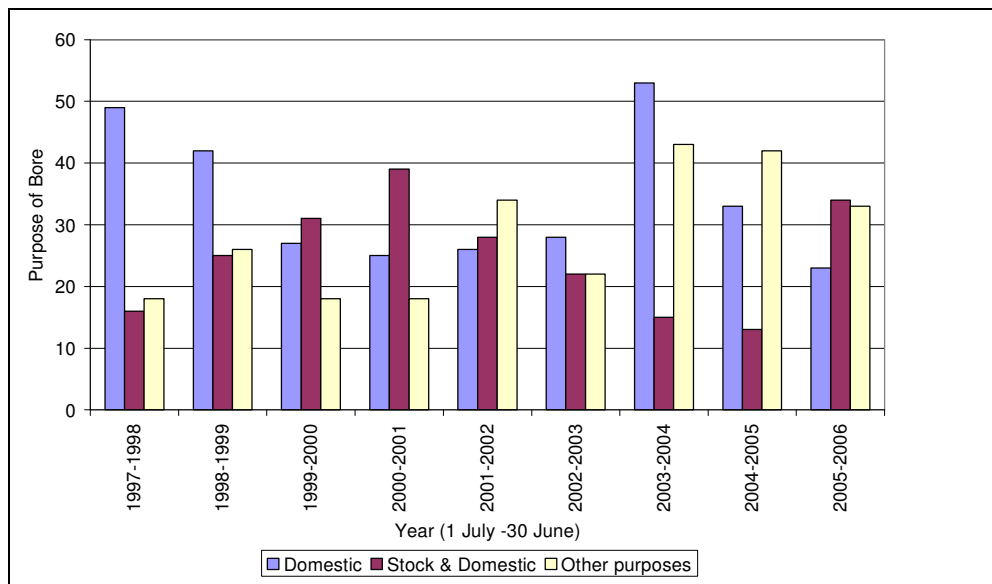
In April 2006, the Regional Water and Soil Plan for Northland Plan Change 1 was notified and included the requirement for bore permits (resource consents) for all drilling activities (aside from temporary bores) throughout the Northland Region. Hearings for the submissions on this Plan Change 1 will be held in September 2006.

There were 90 bores registered on the bore log database in 2005-06, 45 of these bores were consented. The graph below shows the total number of bores drilled every financial year since 1997 including the proportion of consented to non consented (permitted activity) bores.



There is an increase in the number of drilling activities that require a bore permit (resource consent), particularly in 2001-02. This is likely to be a result of increasing subdivision and water intensive land use activities in the areas which require bore permits, as well as three additional 'at risk' aquifers being included in the Regional Water and Soil Plan in 2002.

The graph below summarises the purpose of the bores registered on the database since 1997, showing that there has been an increase in the number of bores drilled for purposes other than stock and domestic use. For example bores installed for irrigation purposes.



### Bore Compliance Monitoring

Bores which require a bore permits are visited by a Regional Council monitoring officer to ensure that the bore is constructed and completed in accordance with the conditions of the consent. Of the 45 consented bores constructed in 2005-06 only minor non-compliances with bore construction were identified. The minor non-compliances include bores lacking a concrete pad, a 30 cm high casing or removable cap and access point where water level readings can be taken. No formal enforcement action was taken in 2005-06 with respect to bore construction.

The photographs below show a poorly constructed and maintained bore (left) and the correct construction of a bore (right) including a concrete pad, 30 cm high casing and removable cap.



Bad bore



Good bore

### Groundwater Take Compliance Monitoring

Groundwater compliance monitoring for resources consents to take groundwater continued through 2005-06. No formal enforcement action was taken due to non-compliances with consent conditions.

### Incidents relating to Bore Construction and Groundwater

An incident of saltwater contamination of the upper freshwater aquifer in the Waitamata formation at Mangawhai was recorded recently on the Regional Councils incident database. Investigation to date indicates that contamination has occurred due to

incomplete hydraulic separation within two newly drilled bores. The new bores intercept artesian (pressurised) saltwater underlying the upper freshwater aquifer. As the new bores were not constructed in such a way to separate these two aquifers, the saltwater is likely to have flowed up inside the bores and resulted in the localised saltwater contamination of the upper freshwater aquifer.

Action is being taken to pressure grout these bores. Investigations will continue to ensure that complete sealing of the artesian saltwater aquifer has been achieved.

### Pumping Tests

The Northland Regional Council has commenced a pumping test programme with the objective of determining aquifer properties such as transmissivity and storage coefficient in different aquifers in the Northland region. Transmissivity is a measure of the rate at which water passes through an aquifer, and the storage coefficient is a measure of the volume of water contained in an aquifer. Pump test sites have been selected and prioritised based on areas where aquifer properties are unknown and/or where there is potential for increased demand.

In 2005-06 pumping tests were carried out in Whatitiri, Waimate North and Maungatapere. Bores within these areas were pumped for at least three days and water levels were monitored through this period and the subsequent groundwater level recovery.

Summary details of the pump tests conducted together with calculated transmissivity values are shown in the table below.

Target Aquifer	Test period (mins)	Transmissivity (m <sup>2</sup> /d)
Whatitiri	4342	49 - 67
Waimate North	2940	8.3 – 15.2
Maungatapere	4320	To be calculated

Due to the rates of abstraction and separation distance from suitable observation bores, no reliable results for storage coefficients were obtained.

## Performance Targets

**To continue to develop and implement a prioritised state of environment monitoring programme based on the Regional Policy Statement and regional plans by:**

- Operating a region-wide hydrometric network for the measurement, recording, and reporting of groundwater levels.
- Operating a region-wide network for the measurement, recording and reporting of groundwater quality trends.

Another performance target relating to compliance hydrological monitoring rather than State of Environment monitoring of hydrology is:

**Monitor compliance with, and the effects of, the exercise of resource consents, Regional Plans and statutory environmental standards by:**

- Collecting water use records and measuring stream flows, groundwater and lake levels associated with significant water abstractions.