GROUNDWATER

Highlights 2001-2002

- Groundwater levels in Northland are recorded continuously at six sites and monthly at another 40 sites.
- Groundwater quality is monitored quarterly at 7 sites throughout Northland.
- Groundwater quality at sampling sites meets ANZECC guidelines for the human consumption of water.
- NRC is currently undertaking investigations into the Ruawai, Taipa and Russell aquifers. Monitoring at Taipa has indicated elevated nitrate levels in a number of bores in the Taipa settlement area. The Taipa School bore has exceeded the nitrate concentration guidelines in the New Zealand Drinking Water Standards 2000 on several occasions.
- Future groundwater monitoring work includes an expansion of the groundwater quality monitoring network.

Annual Plan 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.**

Background

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

Groundwater is predominantly used in areas where there is a productive aquifer system and the surface water quality and/or quantity does not meet the needs of the resource users. The use of groundwater varies throughout Northland and includes domestic and farm requirements, horticultural irrigation, industrial needs and numerous public water supplies.

Monitoring of groundwater resources in the Northland Region can be divided into three main areas. These areas are:

- State of Environment monitoring.
- Compliance monitoring - monitoring of drilling activities and groundwater takes.
- Specific groundwater investigations.

State of Environment Monitoring

The primary objective of the state of environment groundwater monitoring is to collect and analyse information to identify environmental issues and trends in groundwater and promote informed environmental decision-making.

Groundwater Level Monitoring

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 six sites and monthly at another 40 sites. These sites have been chosen to provide adequate regional coverage as well as targeting specific environmental concerns.

The locations of historic (closed) and current groundwater level monitoring sites are shown in Map 5.1.

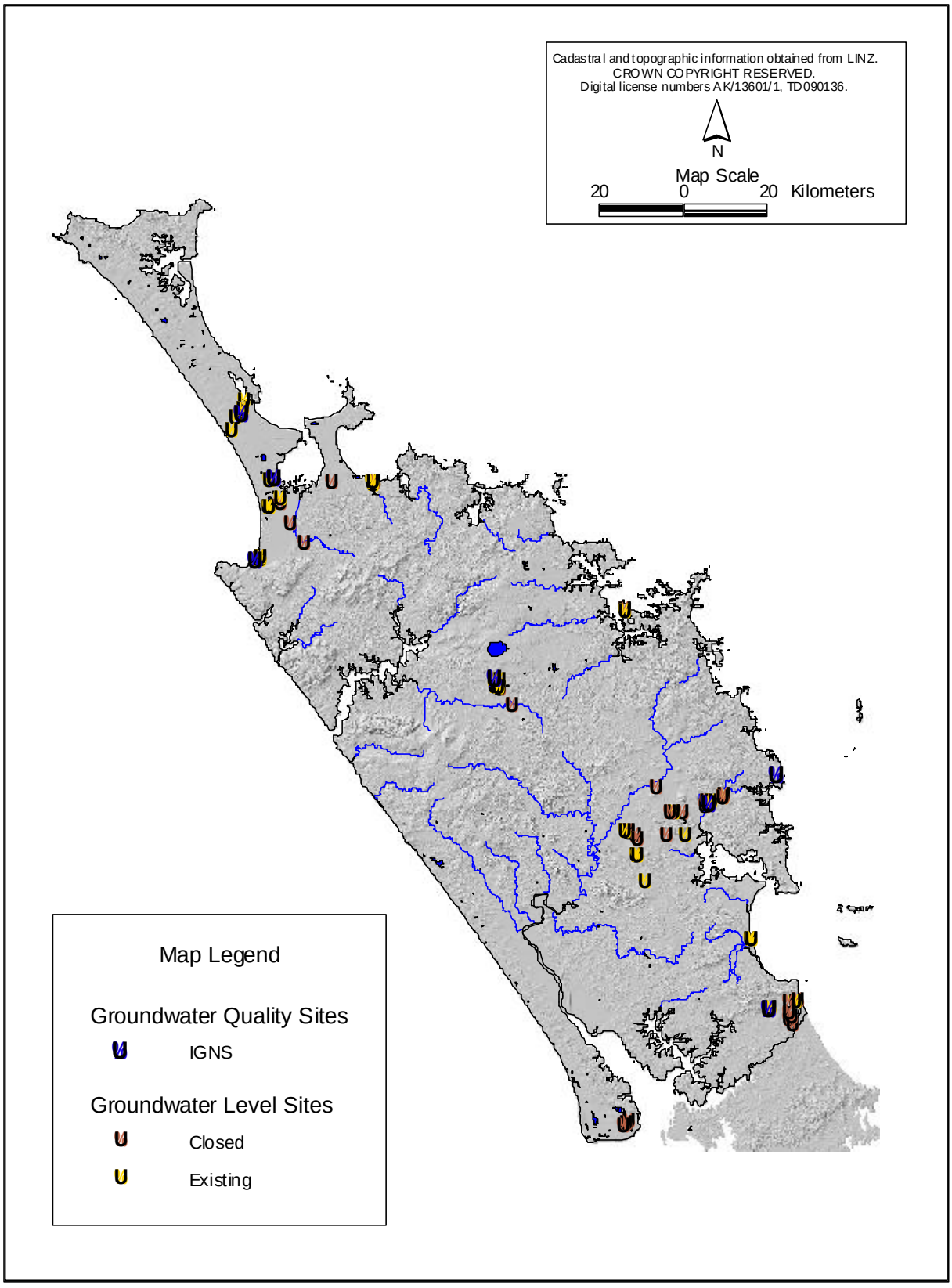
National Groundwater Quality Monitoring Programme

The Northland Regional Council participates in the National Groundwater Monitoring Programme, which is a co-operative effort between the Institute of Geological and Nuclear Sciences (IGNS) and Regional Councils. The primary objective is to gain a national perspective of trends in groundwater quality.

Seven sites have been sampled in Northland beginning in September 1996. These are Houhora, Paparore, Ahipara, Kaikohe, Tutukaka, Whangarei and Tara.

The samples are taken quarterly and analysed for major cations, anions, nutrients and minor elements such as iron and magnesium. The results are entered onto the NRC monitoring database and currently make up the groundwater quality monitoring network.

The location of the National Groundwater Quality Monitoring Programme sites are shown in Map 5.1.



Map 5.1: Current and Historic Groundwater Level Monitoring Sites and Groundwater Quality Monitoring Sites

Results of Groundwater Level Monitoring in Whangarei Basalt 1983 – 2002

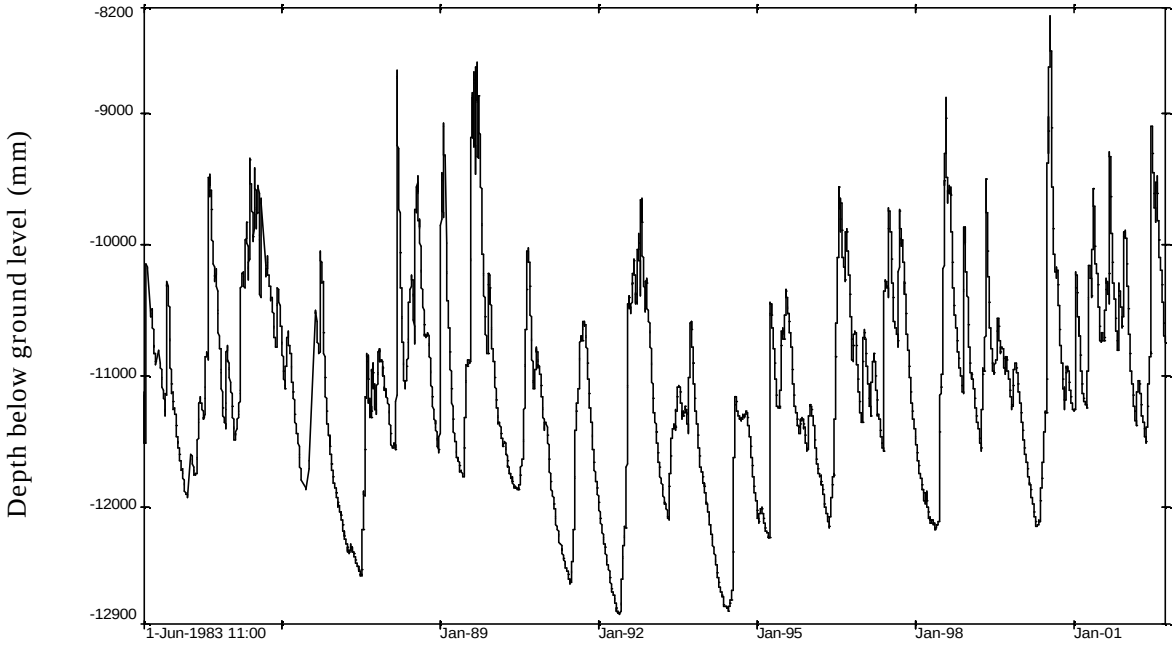


Figure 5.1: Groundwater Level at Puriri Park Monitoring Bore 5472001, Whangarei Basalt Aquifer 1983 – 2002

Figure 5.1 shows groundwater levels in the Whangarei basalt aquifer at Maunu monitoring bore (located at Puriri Park). Below average rainfall from 1990-95 resulted in lower than normal water levels.

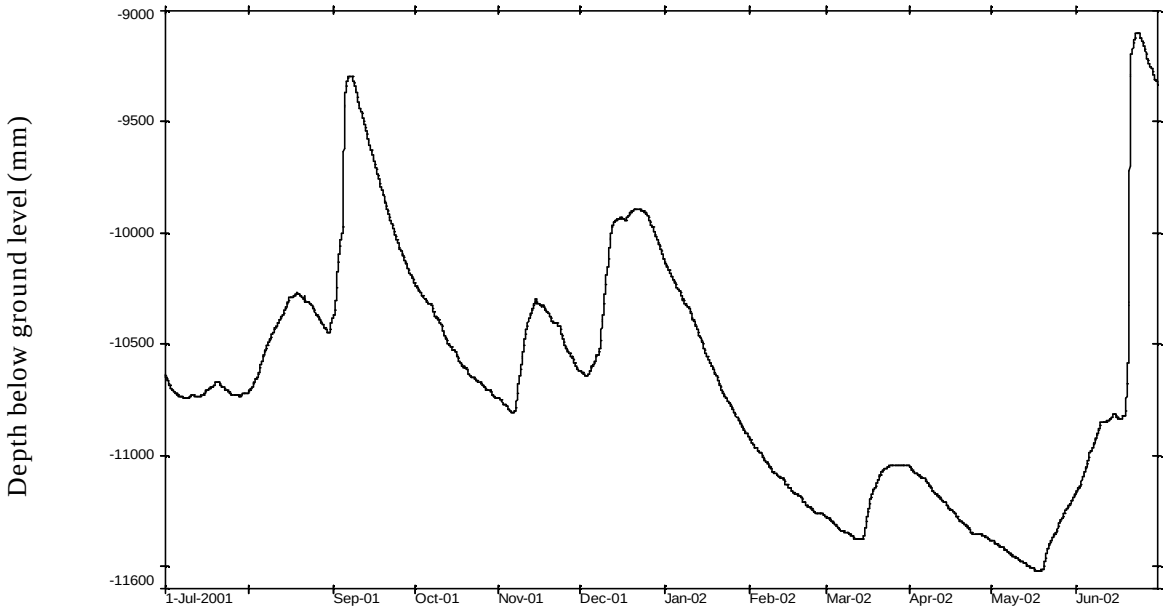


Figure 5.2: Groundwater Level at Puriri Park Monitoring Bore, Whangarei Basalt Aquifer 2001 – 2002.

Figure 5.2 shows the groundwater levels for the 2001-2002 period. Normally, the water level is highest during the winter and then drops over the summer.

Results of Groundwater Quality Monitoring

Groundwater quality in Northland is generally high enough to allow the water to be consumed without treatment. Two areas of potential concern are nitrate contamination of groundwater and salt-water intrusion into groundwater aquifers.

Nitrate-nitrogen is considered a broad indicator of contamination of groundwater from a variety of sources, including fertilisers, agricultural and human wastes. Nitrate is considered to be toxic in excessive concentrations. Most at risk are bottle-fed infants, where a high concentration of nitrate affects the ability of the blood to transfer oxygen. High levels in water and diet have been linked to some types of cancers.

The New Zealand guideline value for nitrate is 11.3 mg L^{1} as NO_3-N. Monitoring results show that average nitrate concentrations at all sites sampled for the National Groundwater Quality Programme fall well below this level.

Conductivity is an indirect measure of salinity. High levels may indicate salt-water intrusion as the result of lowering groundwater levels. All sites fell well within the ANZECC guidelines for drinking water standards. Table 5.1 summarises the results for groundwater quality monitoring since 1998.

Table 5.1: Groundwater quality characteristics for Northland sites

Parameter (average)	Ahipara (Aupouri)	Colville (Aupouri)	Far North (Aupouri)	Glenbervie	Kaikohe	Tara	Tutukaka
Alkalinity	36	54	150	168	57	34	189
Br (mg/L)	0.10	0.35	0.18	0.07	0.06	0.08	0.65
Ca (mg/L)	4.1	5.7	34.1	40.7	10.4	5.8	7.4
Cl (mg/L)	32	31	52	15	12	18	172
Cond (mS/cm)	0.18	0.20	0.41	0.35	0.15	0.14	1.33
F (mg/L)	0.03	0.08	0.07	0.07	0.05	0.05	0.75
Fe (mg/L)	1.37	1.49	0.08	0.06	0.01	0.23	0.77
K (mg/L)	1.7	1.4	2.8	1.5	1.6	1.5	15.7
Mg (mg/L)	3.3	3.8	5.7	6.0	5.1	4.3	9.6
Mn (mg/L)	0.037	0.055	0.113	0.005	0.005	0.005	0.015
Na (mg/L)	26	30	45	19	14	14	279
NH_4-N (mg/L)	0.041	0.006	0.047	0.006	0.005	0.005	0.009
NO_3-N (mg/L)	0.192	0.004	0.019	1.014	3.475	2.374	0.124
pH	6.41	6.95	7.72	7.54	6.81	6.4	7.0
PO_4-P (mg/L)	0.02	0.02	0.06	0.02	0.09	0.06	0.06
SiO_2 (mg/L)	35	40	41	25	47	30	23
SO_4 (mg/L)	7	9	9	11	2	3	259

Current Specific Groundwater Investigations

Ruawai Groundwater Monitoring

The Ruawai area is located approximately 15 kilometres south of Dargaville. The area is predominantly an alluvial flood plain consisting mainly of mud, sands and peats. Groundwater is present across the flood plain. The Northern Wairoa River bounds the area to the west and south, and limestone hills to the

north and east. The flood plain is heavily drained. The main land use in the area is horticulture, particularly kumara growing. Historical bore logs in the area indicate groundwater is present across the flood plain at varying depth and quality. Groundwater is the main source of water in the area due to the high saline content of the surface water. Groundwater is used for irrigation, stock water requirements and the public water supply.

Previously there has been no specific investigations on the groundwater resource in the Ruawai area.

On the eastern side of the floodplain the groundwater is artesian. There has been concern in the past relating to a reduction of artesian pressure in this area, as well as comments of saltwater intrusion into the groundwater system on the southeastern boundary.

Four bores are now being sampled quarterly 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.

Taipa Groundwater Monitoring

Taipa is a coastal aquifer with a saline boundary on the northern and eastern edge. The main source of recharge is rainfall. As a result of concern about low rainfall, increased abstraction and land use change in the surrounding area, the aquifer is monitored for nitrate and saline intrusion.

Seven bores are sampled monthly and analysed for saline indicators such as chloride and nitrate.

The monitoring has indicated elevated nitrate levels in a number of bores in the Taipa settlement area. The Taipa School Bore is the only sites, which has exceeded the nitrate concentration guidelines in New Zealand Drinking Water Standards 2000 on several occasions. The groundwater from the bore is not used for drinking water at the school.

The result s of nitrate nitrogen levels for the Taipa School Bore and the Sands Motel Bore are shown in fig? The nitrate levels in the Taipa School Bore shows an increasing trend, while the Sands Motel shows little change over the five years of monitoring records.

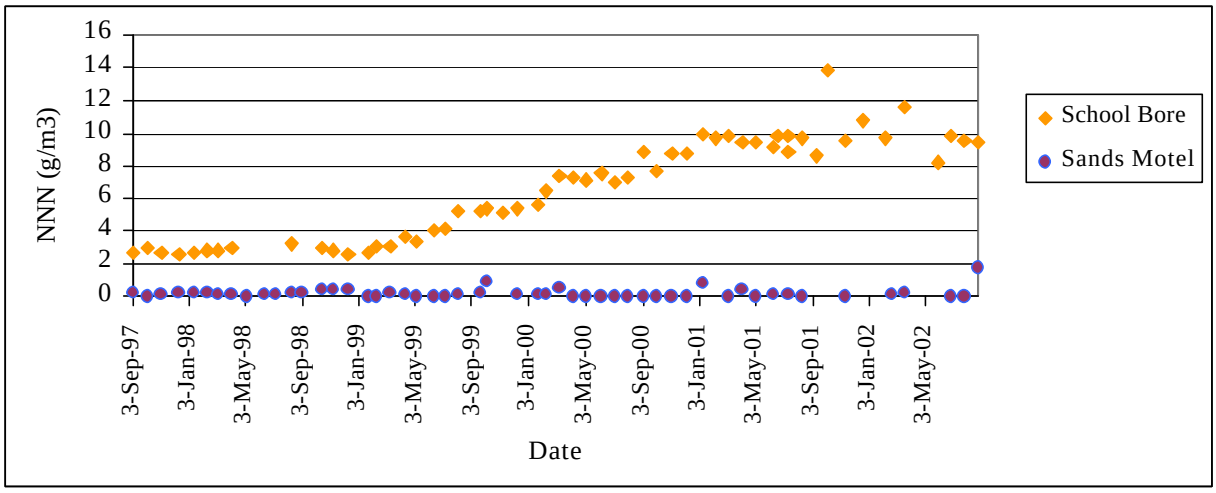


Figure 5.3: Nitrate Nitrogen Levels in the Taipa Aquifer September 1997 to August 2002

As a result of the elevated nitrate levels, groundwater samples from the School Bore were collected and analysed using N-15 isotope tracer. This analysis provides and indication of the source of nitrate in the Taipa School Bore.

The source was identified as being either soil organic matter and / or inorganic fertilisers. The land use in the area is urban with market gardening to the west of the Taipa settlement. The nitrate levels in the groundwater bores closer to the market garden site, and bores located on the market gardening site, are

significantly less than the nitrate levels recently recorded at the School Bore. This suggests there is either significant preferential flow through the Taipa aquifer or the market garden site is not the source of the nitrate in the area.

The chloride levels in the bores adjacent to the foreshore have shown no significant variation over the monitoring period.

All large scale fertiliser users in the area have been contacted and requested to keep fertiliser application diaries. On going monitoring of the nitrate and chloride levels in the Taipa groundwater will continue on a monthly basis.

Russell Groundwater Monitoring

Russell is a sand aquifer system in close proximity to the coast. The main source of recharge in the system is rainfall and water from treated septic tank effluent. There are many bores in the area that abstract water for domestic use. As with the Taipa aquifer, there is concern about a reduction in recharge and increased use leading to saline intrusion.

The reduction in recharge is a direct result of the installation of the reticulated sewage system.

There are currently six monitoring bores in Russell and Matauwhi Bay that are sampled and analysed for saline indicators as well as bacteria, iron, and manganese on a monthly basis.

Two bores along the foreshore regularly record the water level variation and one bore of these bores also continuously monitors conductivity, a salinity indicator.

In addition to this monitoring, the Russell groundwater resource has been modelled using a numerical computer modelling system called MODFLOW. The objectives of this modelling study include:

- assessment of the groundwater recharge and discharge dynamics
- assessment of the effects of the waste water reticulation, and
- a better understanding of the sustainable yield for the groundwater system.

A report on this modelling study will be completed by the December 2002.

Further Groundwater Monitoring in 2002

State of Environment Groundwater Quality Monitoring Network

A comprehensive SoE Groundwater Quality Monitoring Network (GWQMN) will be initiated in November 2002. The data gained from this monitoring will improve understanding of the region's groundwater aquifer system and assess the sustainable management of the groundwater resources.

The primary aims of the SoE Groundwater Quality Monitoring Network is to gain a regional perspective on:

- baseline water quality of different aquifers in Northland and
- determine any trends in groundwater quality over time as a result of the climate, land use and groundwater abstraction.

Eighteen sites will be sampled in addition to those sampled for the National Groundwater Monitoring Programme. Twelve of the sites are located in coastal aquifers. These sites will be sampled quarterly and analysed for saline intrusion and bacteria indicator every six months and a full range for major cations, anions, nutrients and minor elements such as iron and magnesium every subsequent sampling run. The groundwater levels will also be recorded at each site.

The remainder of the sites are located in basalt aquifers. These sites will be sampled quarterly and analysed for a full range of determinands.. The results of the sampling associated with the National Groundwater Monitoring Programme will also be incorporated into the GWQMN.

The location of the sites to be monitored are shown in Table 5.2 and Map 5.2.

Table 5.2: State of the Environment Groundwater Quality Monitoring Network

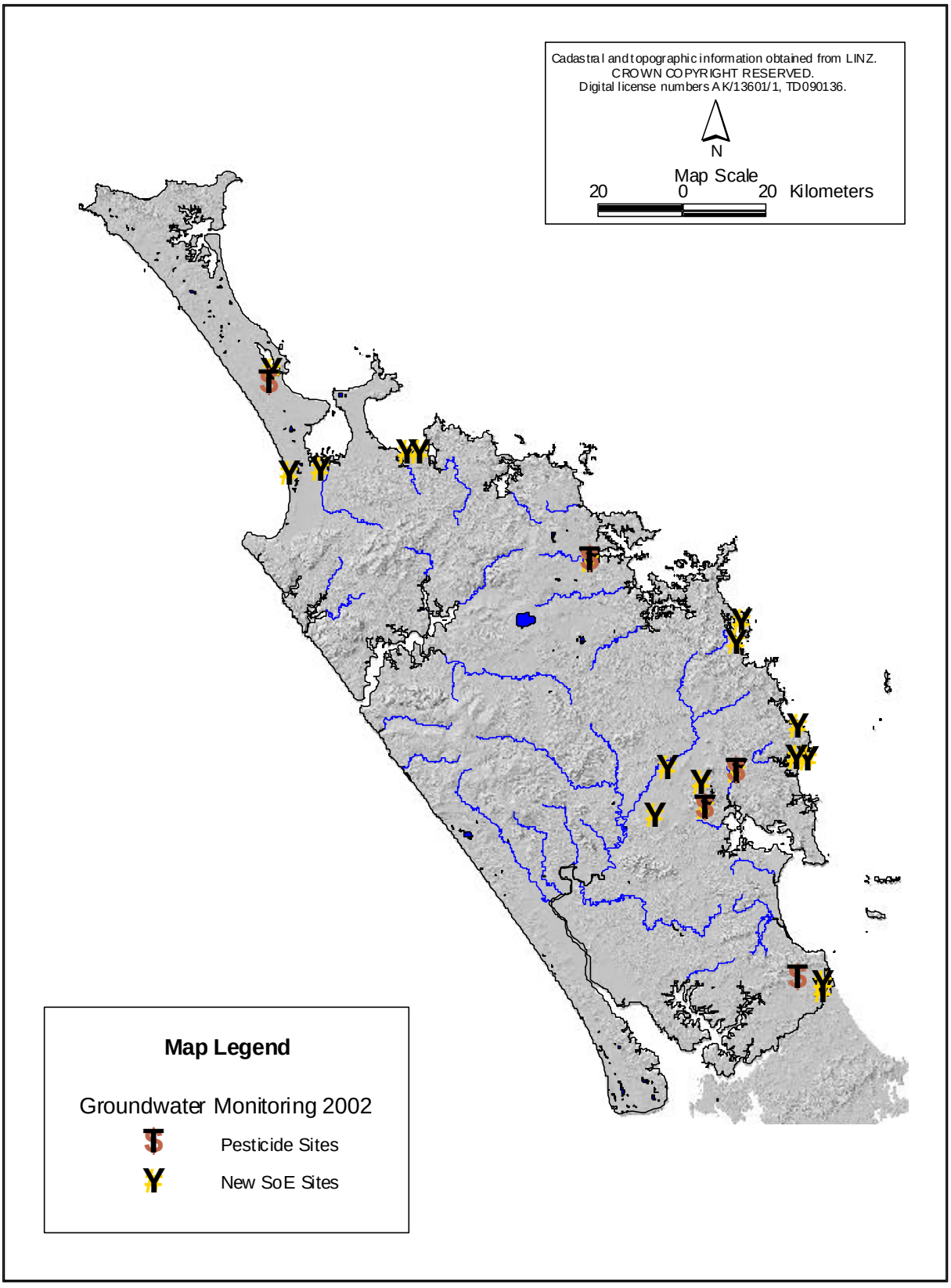
Coastal	General
Mangawhai Heads east, Mangawhai Heads west, Ngunguru, Whangaumu Beach, Matapouri Bay, Oakura Bay, Bland Bay, Cable/Mangonui Bay, Coopers Beach, Waipapakauri Beach, Waipapakauri East, Houhora	Maunu Basalt, Whatitiri Basalt, Three Mile Bush Basalt, Matarau Basalt, Glenbervie Basalt, Kerikeri Basalt

National Survey of Pesticides in Groundwater

The Northland Regional Council participates in the National Survey of Pesticides in Groundwater, which is a co-operative effort between the Institute of Environmental Science & Research Limited (ESR) and Regional Councils. The National Survey occurs every four years. The primary objective is to gain a perspective of pesticide contamination of groundwater in New Zealand.

Six sites will be sampled in Northland in November 2002 and analysed for a range of pesticides using HS Atrazine ELISA Kits as an initial screen. All positive results using ELISA will then be analysed using gas chromatography-mass spectroscopy (GCMS). Fifteen percent of all non-detects will also be analysed using GCMS. The sites for the pesticide analysis are Tara, Glenbervie, Taipa, Kerikeri, Maunu, and Aupouri. The locations of the sites are shown on Map 5.2.

The abstract on results of the 1998 National Groundwater Pesticide Monitoring can be found in the publications page on The Royal Society of New Zealand website: www.rsnz.govt.nz.



Map 5.2: New state of the environment groundwater monitoring sites and pesticide survey sites