State of the Environment Monitoring 2010

Pesticides in shallow groundwater in Taranaki

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Taranaki Regional Council
Private Bag 713
STRATFORD

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Executive summary

Pesticide contamination of groundwater is a subject potentially of national importance as groundwater is widely used for drinking water by about 50 percent of the country's population.

Under the Resource Management Act (1991), Regional Councils have the responsibility to maintain and enhance the quality of regional groundwater resources. The Taranaki Regional Council monitors the attaining of this objective through its State of the Environment groundwater monitoring programmes, which encompasses sampling for pesticides in a collaborative programme with the Institute of Environmental and Scientific Research Ltd (ESR).

In October 2010, the Council engaged again in the 'National Survey for Pesticides in groundwater' programme. Samples were collected by Council's staff and analysed and reported on by Environmental Science and Research (ESR) group.

Samples were analysed for acidic herbicides and a suite of organochlorine, organophosphorous and organonitrogen pesticides. Wells selected in Taranaki were selected on the basis of the likely application of pesticides in the area and on depth – those tapping unconfined shallow aquifers. That is, sites have been selected to give a 'worst case' perspective. Wells that had been sampled in previous surveys were also included in the 2010 survey to give a temporal comparison.

The analysis of the eight samples of shallow groundwater in Taranaki detected no pesticides traces in any of the wells sampled. Based on the results of sampling to date, wells sampled in Taranaki continue to have non-detectable levels of pesticide residuals levels in shallow unconfined aquifers.

This report includes recommendations for the next pesticides in groundwater survey.

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1. Introduction

The Council has in the past participated and continues to participate in a 'National Survey for Pesticides in Groundwater' programme which is coordinated by the Institute of Environmental Science Research – ESR.

In October 2010, the Council engaged again in the National Survey for Pesticides in Groundwater. Samples were collected by Council's staff and analysed and reported on by Environmental Science and Research (ESR) group.

Pesticide contamination of groundwater is potentially a subject of national importance as groundwater is widely used for drinking water by about 50 percent of the country's population. This especially concerns people living in the agricultural and horticultural areas where pesticides are most often used, as about 95 percent of that population relies upon groundwater as their source of drinking water. Improper use of certain pesticides can result in inadvertent contamination of groundwater.

Compared with other regions, pesticide use in Taranaki is relatively small. Previous sampling campaigns undertaken by the Council in 1994, 1995, 2002 and 2006 have only found traces of pesticides in wells located within nurseries but at concentrations that have been well below limits of concern, and no pesticide residues have been detected from any sample sites on dairying land. The volume of pesticides used in dairy farming, which is the dominant land use in the province with over 2,100 dairy farms and about 600,000 dairy cows, is minimal.

2. Pesticides in groundwater

Pesticides include herbicides, insecticides, and fungicides and can be defined as any chemical used to control pests. There is always a risk associated with them to adversely affect the environment and human health. When pesticides are applied there is a potential that some of the product may run off the soil's surface or leach down through the soil to eventually reach the groundwater.

In the past it was thought that soil acted as a protective filter that stopped pesticides from reaching ground water but several studies have shown that this is not necessarily the case; pesticides can reach water-bearing aquifers below ground from applications onto crop fields, seepage of contaminated surface water, accidental spills and leaks, and through improper disposal. Pesticide contamination of soils and waterways would have consequences for human health, the environment, and access to overseas markets as many of the international markets want to know their food is produced in an environmentally-friendly way.

When water tables are high or soils saturated, the distance from the soil surface to the ground water is relatively short and readily available. High water tables and the characteristics of subsurface soil are factors that favour contaminant migration into groundwaters, so monitoring the groundwater for the presence of pesticides in high-risk areas in the province is particularly important for the Regional Council.

Shallow unconfined groundwater systems are particularly vulnerable to contamination from pesticide residues. In Taranaki, in theory, contamination of shallow groundwater is most likely to occur in areas where there are commercial horticultural activities (nurseries, market gardens etc), as these are the areas of most frequent and most intensive pesticide use. Wells located in these areas have been targeted for sampling in

previous sampling campaigns and were re-sampled during 2006, and again in 2010, the survey that is the subject of this report.

3. National Guidelines

Under the Resource Management Act (1991), Regional Councils have the responsibility to maintain and enhance the quality of regional groundwater resources. The Taranaki Regional Council monitors the attaining of this objective through its State of the Environment groundwater monitoring programmes, which include sampling for pesticides in a collaborative effort with the Institute of Environmental and Scientific Research Ltd (ESR).

References to pesticide levels in New Zealand are compared to the NZ Ministry of Health (MOH) drinking water standard (2000) maximum allowable values (MAV). Table 1 shows the MAV for pesticides and Appendix II contains the list of the maximum acceptable values (MAVs) for organic determinants of health significance.

For stock water, there is no guideline for safe pesticide levels and in the absence of this information the Australian and New Zealand Environment and Conservation Council (ANZEC) guideline recommends using the MAV set for NZ drinking water.

The application of agrichemicals in Taranaki is addressed in the Regional Freshwater Plan (RFWP) under Rules 32, 33, 34, and 43 and in the Regional Air Quality Plan (RAQP) under Rules 44 and 46.[1] Appendix VI of the two Regional Plans contains information on good agrichemical spray management practices.

The Council recognises that pesticide application to land represents a potential non-point source contaminant of freshwater and will keep on promoting the careful use of such chemicals in accordance with the manufacturer's instructions.

Table 1 The maximum acceptable values (MAV) for pesticides in drinking water as specified by the Ministry of Health

Category	Concentration (mg/L)	Description
Excessive	> MAV	Occurrence of pesticides exceeds the maximum acceptable value (MAV) for drinking water
High	50 -100 % MAV	Safe for drinking when sampled, but pesticides detected at over half the MAV
Low	< 50% MAV	Pesticides detected, but at less than half the MAV
Non-detect	< detection limit	No pesticides were found at the time of sampling

[1] The RAQP was updated in July 2011. The corresponding rules are now 56-58, and good practices are described in Appendices VI and VII.

4. Previous work

The first National Pesticides in Groundwater Survey (NPGS) was carried out in 1990 by ESR although no wells were sampled in Taranaki on that occasion. The first time that the Council participated in the NPGS programme was in 1994. Following surveys have been conducted in 1995, 1998, 2002, and 2010.

During the 1994 survey, only two wells were sampled (GND0810 and GND0513). Traces of pesticides were detected in well GND0810, which showed a value of 0.2 parts per billion (ppb) for simazine. When comparing the result against the MAV for simazine, the 0.2 value represents a 1/100 concentration of the MAV (which is set at 2.0 ppb).

In 1995 the Council conducted a more widespread programme in which 30 wells were sampled (Figure 1). On this occasion, traces for pesticides were found only in one well (GND0508), whose sample showed values of 2.4 ppb for metalaxyl and 0.1 ppb for simazine. When comparing these results with the MOH drinking water standard, it was noted the MAV for metalaxyl was 100.0 ppb (42 times more than the sample result), with the same value for stock water. Well GND0508 is owned by the Council as one of the wells utilised for groundwater monitoring piezometer on Carrington Rd, New Plymouth. The levels of pesticide detected in this well are believed to be the result of weed-spray activities along the roadside shoulder at the time. No pesticides were detected in the remaining twenty-nine wells sampled in this survey (TRC 1995).

During the 1998 survey, two wells were sampled, GND0810 and GND0451. After the laboratory results came back, an indication of pesticides was identified in GND0810, which showed a result of 0.03 parts per billion (ppb) for simazine. (MOH MAV for simazine is 2.0 ppb).

In the 2002 survey 6 wells were sampled. Five out of the six wells sampled were located on properties used for horticultural purposes and one well on a dairy farm in an area away from horticultural activities. Well GND0508 which gave positive results in the 1995 survey, could not be sampled in 2002 because it was dry.

Samples were initially screened in the laboratory using enzyme-linked immunosorbent assay (ELISA) test kits. Two samples from the 2002 survey gave a weak positive ELISA screen test results. The positive screen results came from wells GND0810 and GND0865. Samples from these wells were re-analysed by GCMS, but no detectable levels of pesticides were found by this method. The ELISA test results were considered "false positives".

In December 2006, the Council sampled groundwater in six selected shallow wells distributed throughout the region for pesticide residues. Five out of the six wells sampled were located on properties used for commercial horticulture, while one well was located on a dairy farm. Wells GND0809, GND0810, GND0827, GND0834, GND0865 and GND0904 were sampled. Figure 3 shows the location of these sites.

Laboratory tests were conducted by the Council's partner in this programme (Institute of Environmental and Scientific Research Ltd (ESR) – Christchurch). Specific tests for pesticides of the groups:

- organonitrogen herbicide (*eg. Simazine and metalaxyl*)
- acid herbicide (*eg. 2,4,5-T and picloram*)

- organochlorine pesticide (*e.g. DDT and heptachlor*)
- organophosphorus pesticide groups (*e.g. diazinon and azinphos methyl*)

were performed on the samples; these test covered the pesticides most commonly used and of major consequences to the environment .

The analysis performed showed no pesticides of any kind detected in any of the six wells sampled in the 2006 survey.

5. Methodology

The most intense use of pesticides usually takes place in spring and their levels are expected to be highest in shallow groundwater around late spring-early summer. Sampling is consequently carried out around then in order to capture peak levels. Shallow groundwater was sampled from wells tapping into the most superficial aquifers around areas where pesticide use is high.

Eight wells were sampled in 2010, an increase of 33% in the numbers of sampled sites. In the 2002 (Figure 2) and 2006 surveys six wells had been sampled. Table 2 shows the well use of the landuse around the sampling point.

Table 2 Landuse and well use

Well code	Land use	Well use	Repeat
GND0810	Nursery	Nursery	Y
GND0809	Dairy farm	Stock water	Y
GND0827	Dairy farm	Stock water - Domestic	Y
GND0834	Dairy farm	Stock water	Y
GND0865	Life-style block - dairy	Stock water	Y
GND0904	Lavender plantation	Not in use	Y
GND0814	Horticultural	Farm uses	New
GND1090	Horticultural	Green house	New

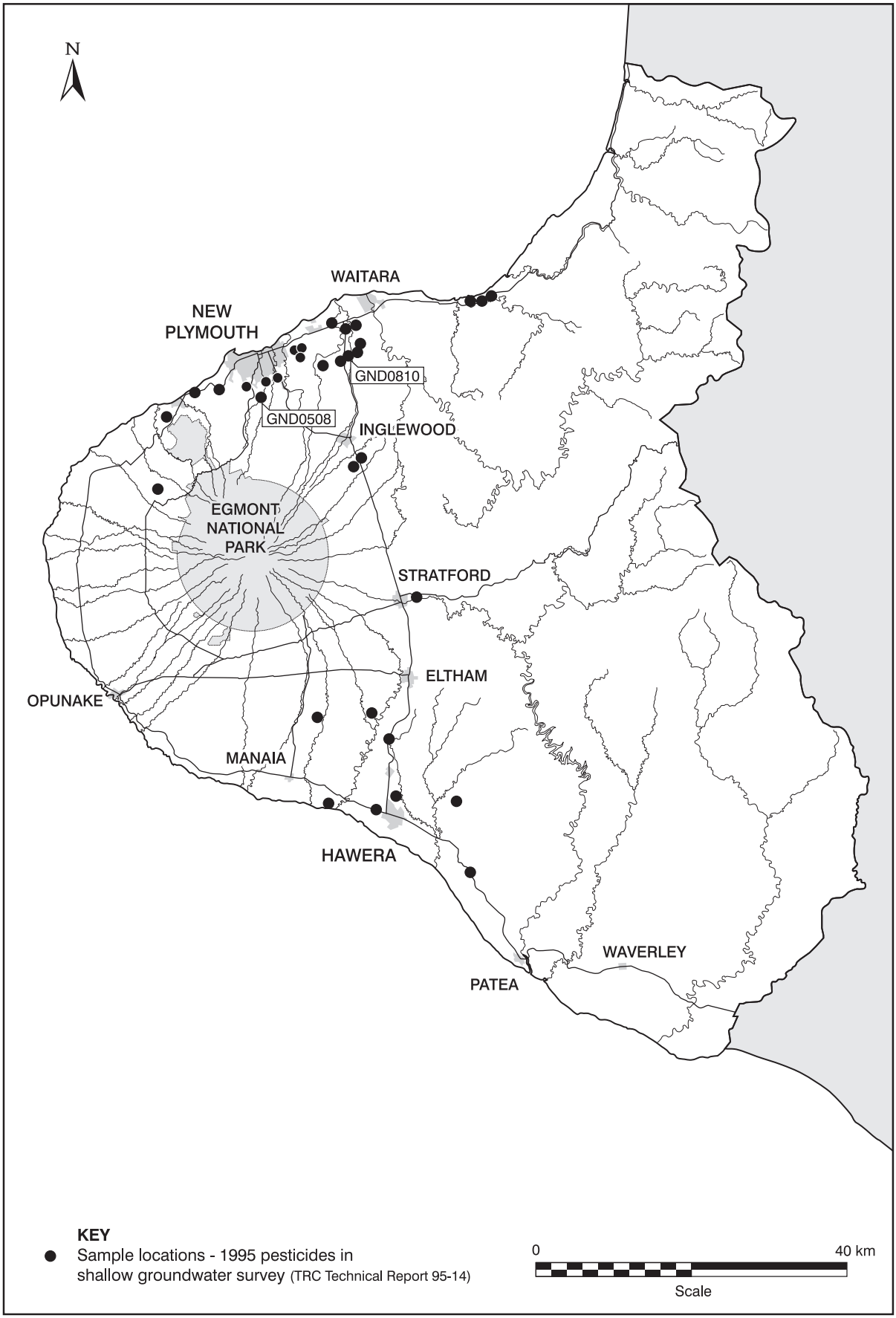


Figure 1 Sampling locations – 1995 pesticides in shallow groundwater survey

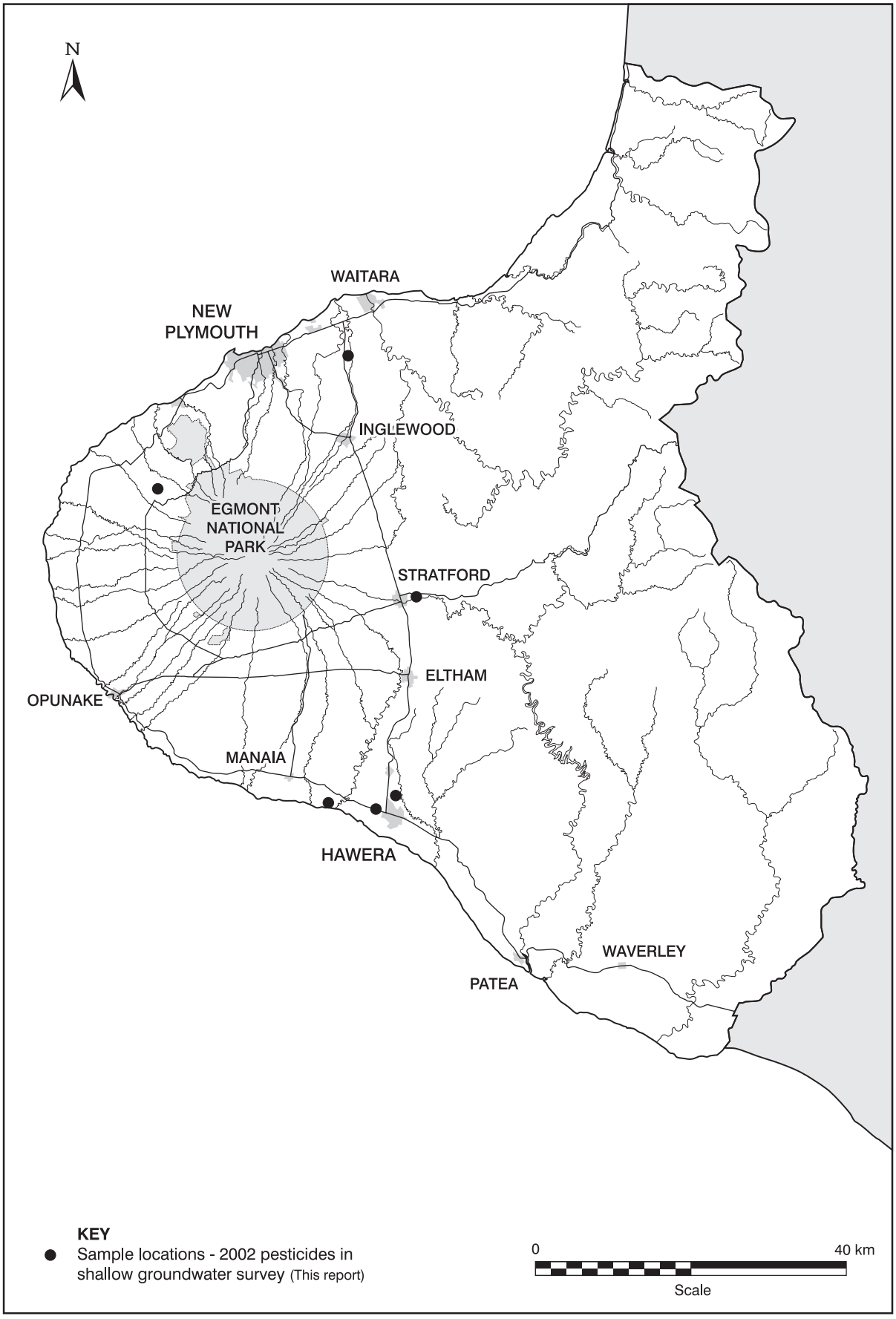


Figure 2 Sampling locations – 2002 pesticides in shallow groundwater survey

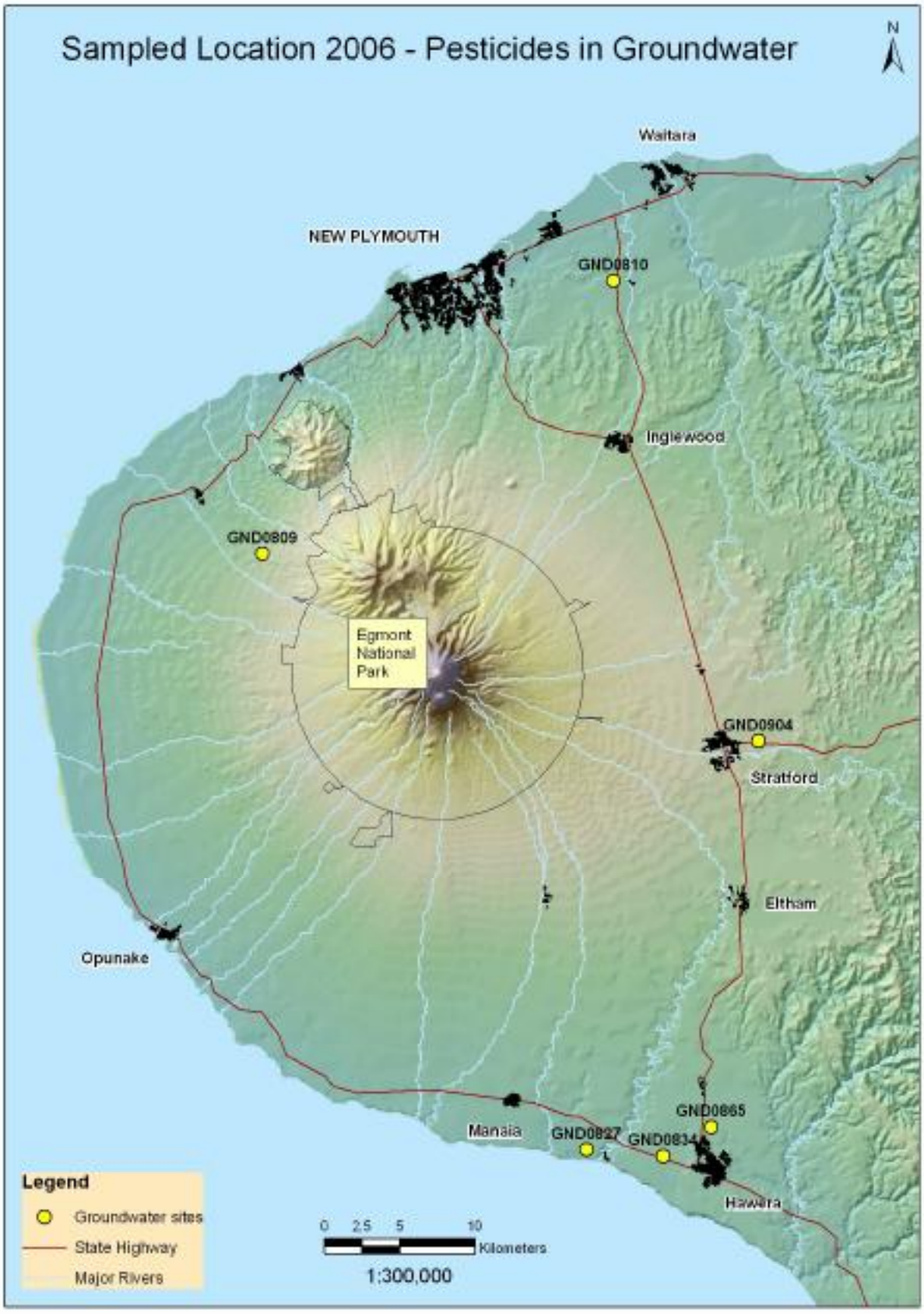


Figure 3 Sampling locations – 2006 pesticides in shallow groundwater survey

6. 2010 Pesticides in groundwater survey

Table 2 shows the wells in the province that were sampled during this survey. Figure 4 depicts the location of these wells. At the national level, 162 wells were sampled.

Wells selected in Taranaki were selected on the basis of the likely application of pesticides in the area and on depth – those tapping unconfined shallow aquifers. Wells that had been sampled in previous surveys were also included in the 2010 survey to give a temporal comparison.

Borelogs available for sampled wells, the guidelines for sampling, and field sheets used can be found in Appendices I, IV and V respectively.

All samples were analyses for acidic herbicides and a suite of organochlorine organophosphorous and nitrogen pesticides (OC/OP/ON) using gas chromatography with mass spectrometry detector (GC-MS). The acid herbicide analysis involved solid phase extraction and derivatisation of the extract with diazomethane followed by GC-MS analysis using single ion monitoring. Samples from 6% of all wells were collected in duplicate as blind duplicate samples for quality control processes.

Each well was classified for presence or absence of pesticides. T-tests were carried out for the presence/absence data and the variances were tested for homogeneity using the F statistic to determine whether the variances should be pooled or kept separate (Close, 2010).

7. Results

The analysis of the eight samples of shallow groundwater in Taranaki detected no pesticides traces in any of the wells sampled. Well information for these wells can be found in Appendix I. Results are shown in Table 3.

Table 3 Results for pesticides analysis on the wells sampled in Taranaki – 2010

Well code	Well use	Pesticides detected
GND0810	Nursery	NO
GND0809	Stock water	NO
GND0827	Stock water - Domestic	NO
GND0834	Stock water	NO
GND0865	Stock water	NO
GND0904	Not in use	NO
GND0814	Farm uses	NO
GND1090	Green house	NO

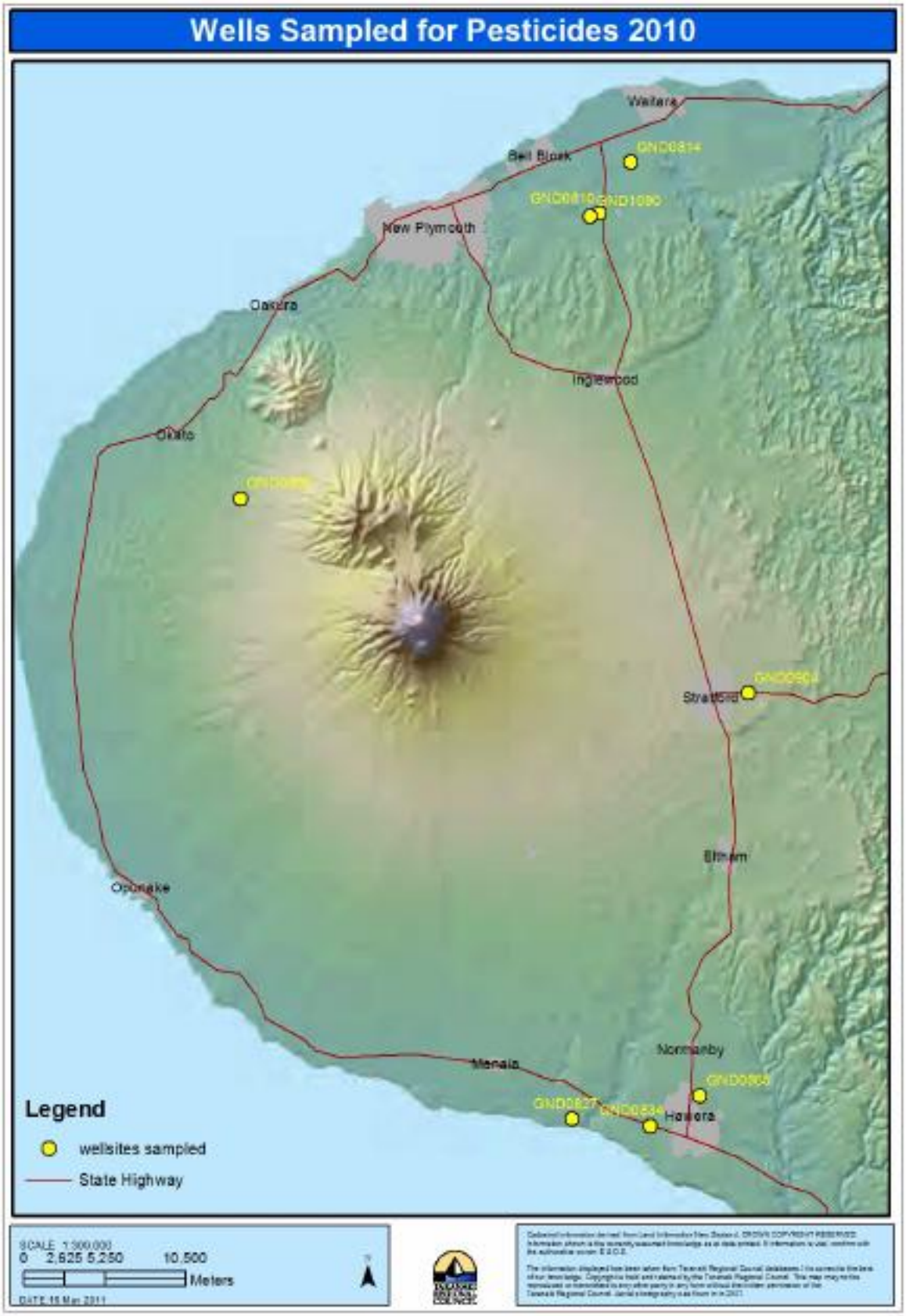


Figure 4 Sampling locations- 2010 pesticides in shallow groundwater survey

8. Discussion

The effectiveness and validity of pesticide in groundwater surveys depends on the correct identification of *at risk areas* and the presence of suitable wells for sampling aquifers underlying those areas. Given that land use activities often change with time, it is important to recognise any new commercial horticultural, market gardening and forestry operations as potential target areas for sampling. It is likely then, that future surveys will include new wells for sampling.

In the future, a plan for additional sampling wells should be carefully carried out to ensure that there is also sampling of shallow aquifers at sites known to sustain application or storage of pesticides such as golf courses and nurseries in the region, as horticultural activities are not ubiquitous.

The 2010 Pesticides in shallow groundwater programme included two additional sampling sites and just like in previous years, the results have all indicated concentrations of pesticides in groundwater below detection limits.

9. How do we compare with other regions?

A total of 162 samples from all regions in New Zealand were sampled in the 2010 survey. A total of 38 wells (24%) were found to have at least one type of pesticides in them; 15 wells were positive for the presence of two or more types of pesticides. Twenty two different pesticides were detected in the sampled wells (Close, 2011).

There were no pesticides detected in semi-confined and confined wells. There were one or more wells with pesticides detected in 9 of the participating regions. Along with Taranaki, pesticides were not detected in sampled wells from Bay of Plenty (6 wells), Hawkes Bay (11 wells), Marlborough (17 wells) and Canterbury (5 wells).

10. Conclusion

No detectable levels of pesticides from the organonitrogen herbicide, acid herbicide, organochlorine pesticide, or organophosphorus pesticides groups were detected in any of the eight groundwater samples collected within Taranaki in the 2010 Pesticides in groundwater survey.

Compared to confirmed results obtained in 2002, and 2006 surveys, the results indicate that pesticide levels continue to be below the detection levels in all wells sampled in our region. Therefore, based on all results to date, Taranaki continues to have no known pesticide levels of any significance in shallow unconfined aquifers.

11. Recommendations

Recommendations from the previous report in 2007 were implemented during the 2010 campaign.

It is recommended that the Council continues a monitoring programme for pesticides residuals in groundwater.

It is recommended that the Council in agreement with ESR consider for future pesticides in groundwater surveys in the region, that the next survey in the region encompass suitable wells located in or around nurseries, forestry, and golf courses as they are potential *at risk* areas.

It is also recommended that the Council continues to apply regional rules for the application of pesticides as part of the review of the Regional Freshwater Regional Plan (2011-2012).

Bibliography

Close, M. E., M. Flintoft and S. Graw, 2007. National Survey of Pesticides in Groundwater. Institute of Environmental Science and Research Limited. Client report CSC0705. May 2007

Close, M and Skinner A. National Survey of Pesticides in Groundwater 2010. Environmental Science and Research. April 2011.

Holland, P. and Rahman, A. 1999. Review of trends in agricultural pesticides use in New Zealand. MAF Policy Report 99/11. 53pp.

Close, M. E. and Rosen, M. R. 2001. 1998/99 National Survey of Pesticides in Groundwater using GCMS and ELISA. NZ Jour. Marine and Freshwater Research, 2001, Vol. 35: 205-219.

Close, M. E. Survey of Pesticides in New Zealand. New Zealand Journal of Marine and Freshwater Research, 1996: Vol 30: 455^461. 0028-8330/96/3004-0455 . The Royal Society of New Zealand 1996

Pattle Delamore Partners Ltd. Audit of Taranaki Regional Council State of the Environment Groundwater Programmes. 27 pages. October 2011

TRC 1995. Report on an investigation of pesticides in shallow groundwater in Taranaki. Taranaki Regional Council technical report 95-14, June 1995. 31pp.

TRC 2002. State of the Environment Monitoring 2002. Pesticides in shallow groundwater in Taranaki. Taranaki Regional Council technical report 2003-21, June 2003. ISSN: 0114-8184.

TRC 2007. State of the Environment Monitoring 2002. Pesticides in shallow groundwater in Taranaki, Taranaki Regional Council Technical Report 2007-113. June 2008. ISSN: 1178-1467

Wilcock, R. J. 1989. Patterns of pesticide use in new Zealand. Part 1, North Island 1985-1988. Water Quality Centre Publication No. 15. DSIR.

Ministry of Health. Drinking-water Standards for New Zealand 2005.

Appendix I

Sampled wells – Well card information

Site Code	**GND0809**
Description	**GROUNDWATER**
Location	Donaldson RJ, Oxford Rd, Okato
NZTM Easting / Northing	1680099 / 5657548
River Number	381000
River	Kaihihi
Comment	Pesticides in shallow groundwater sampling site. Well in creek bed. PESTICIDES IN SHALLOW GROUNDWATER SAMPLING SITE 1080 Sampling Well; Litho & Drill date unknown Kiwi Dairy #2653, Qualarc & rpt by C. Fowles.
Uses	Investigation
Altitude	240 m
Dist. from coast	10 km
Bio Category	
Bio Habitat	
Last updated	1 Nov 2007 by Peter Nolly

(18 Dec 2006)

Site Code	**GND0810**
Description	**Water well - Tawa Glen Gardens**
Location	Mountain Road, Lepperton
NZTM Easting / Northing	1703365 / 5675705
River Number	394000
River	Waiongana
Site Access	Drive up the driveway up to the Y intersection; take the right up to the border with the property to the north. Walk 30 metres downhill
Comment	PESTICIDES IN SHALLOW GROUNDWATER SAMPLING SITE Augered well, to be used for pesticide sample Nursery purposes; well is covered with wooden lid
Uses	Investigation
Altitude	80 m
Dist. from coast	6 km
Bio Category	
Bio Habitat	
Last updated	14 Nov 2011 by Andres Jaramillo

(10 Oct 2010)

Entrance (10 Oct 2010)

Soil Profile (10 Oct 2010)

Well access (10 Oct 2010)

Aerial view (10 Oct 2010)

Site Code	**GND0814**
Description	**GROUNDWATER WELL - Hunger, Richmond Rd**
Location	Hunger, 175 Richmond Rd, Lepperton
NZTM Easting / Northing	1705391 / 5678963
River Number	394000
River	Waiongana
Site Access	Drive on the driveway to the cowshed; well to the left hand side of the fance on adjacent plot behind the fence.
Comment	From Bell Block-Brixton Report (Old) Levels monitored, quality Surveyed in the 2010 Pesticides in Groundwater Survey This well may be the same as GND000072, no much information about it could be found but depth is the same, hence aquifer information given the location can be used if needed.
Uses	Investigation
Altitude	45 m
Dist. from coast	Not recorded
Bio Category	Control
Bio Habitat	
Last updated	14 Nov 2011 by Andres Jaramillo

Aerial view (5 Jun 2010)

Site Code	**GND0827**
Description	**GROUNDWATER SEM**
Location	McCallum-well, Rainie Rd, Inaha
NZTM Easting / Northing	1701591 / 5618033
River Number	351000
River	Inaha
Site Access	Well is in corner of paddock immediately behind swimming pool.
Uses	Investigation, State Environment Monitoring
Altitude	35 m
Dist. from coast	0.4 km
Bio Category	
Bio Habitat	
Last updated	1 Nov 2007 by Peter Nolly

(19 Jul 2006)

(19 Jul 2006)

Site Code	**GND0834**
Description	**GROUNDWATER SEM**
Location	Greig, 424 Main South Rd, R.D. 12, Hawera 4672
NZTM Easting / Northing	1706701 / 5617616
River Number	349000
River	Waihi 5 (Waihi)
Comment	Pesticides in shallow groundwater sampling site. SEM nitrate site. West well of 2 adjacent wells about 2m from fence line. PESTICIDES IN SHALLOW GROUNDWATER SAMPLING SITE. Sampled for Cadmium, Phosphates, Nitrates and Flouride in March 2009.
Uses	Investigation, State Environment Monitoring
Altitude	84 m
Dist. from coast	2.1 km
Bio Category	
Bio Habitat	
Last updated	11 Mar 2009 by Andres Jaramillo

(19 Jul 2006)

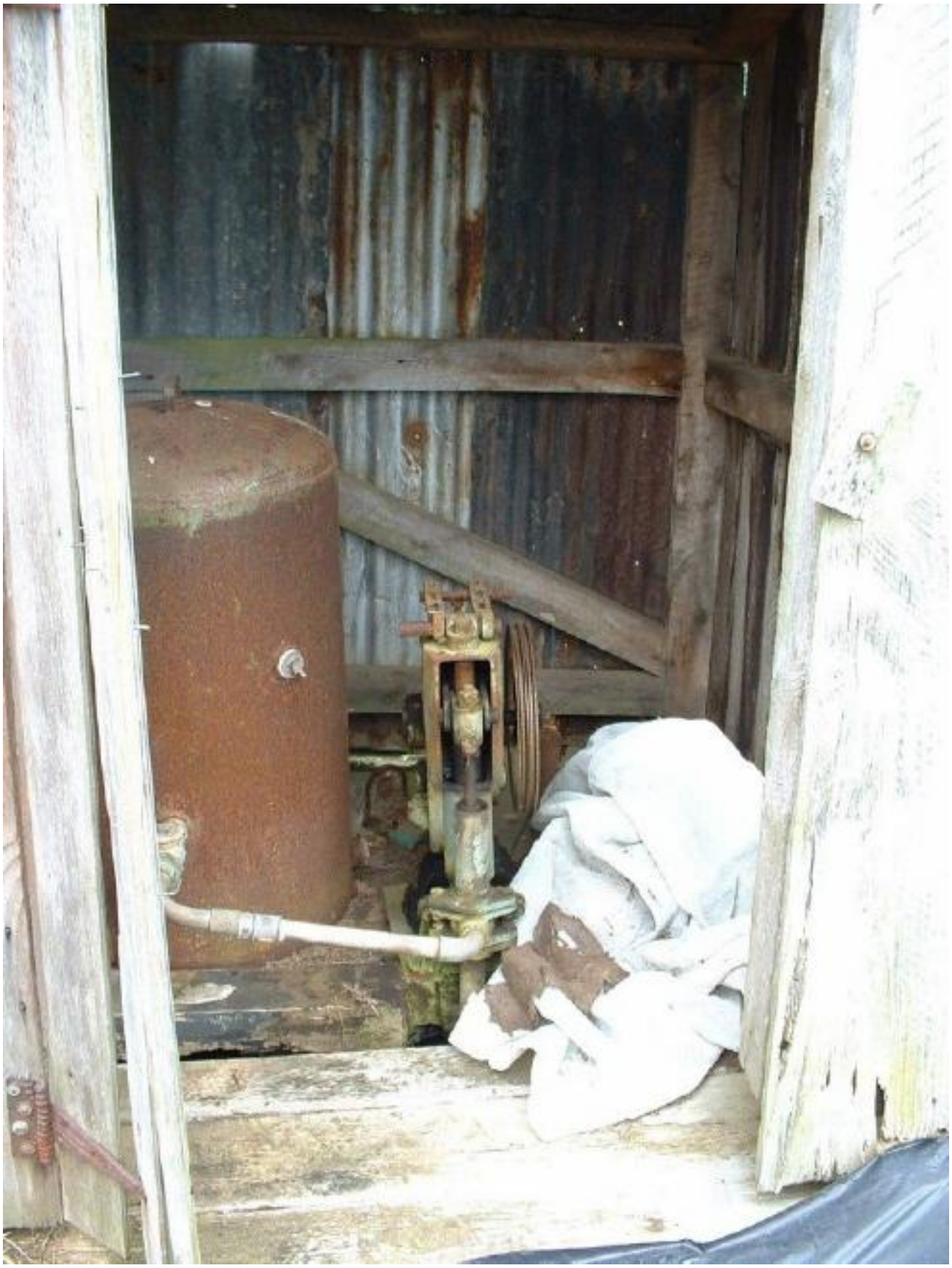
(19 Jul 2006)

Sampling Point (4 Mar 2009)

Site Code	**GND0865**
Description	**Well for horticultural purposes - Consent 2366**
Location	Van Riemsdijk, Cnr Albert & Arthur St, Hawera [formerly Eden Gardens]
NZTM Easting / Northing	1709907 / 5619544
River Number	348010
River	Tawhiti 1 (Tangahoe)
Comment	Pesticides in shallow groundwater sampling site. Old well - poor condition PESTICIDES IN SHALLOW GROUNDWATER SAMPLING SITE Site was used for Pesticide survey. ND.
Uses	Investigation, Consent Monitoring
Altitude	96 m
Dist. from coast	4.8 km
Bio Category	
Bio Habitat	
Last updated	9 Jan 2009 by Andres Jaramillo

Close-up (No date)

Tower (No date)



Shed (No date)

Site Code	**GND0904**
Description	**GROUNDWATER**
Location	Waterson,T, East Rd, Stratford [ex Tippet]
NZTM Easting / Northing	1713008 / 5645166
River Number	343000
River	Patea
Comment	Pesticides in shallow groundwater sampling site PESTICIDES IN SHALLOW GROUNDWATER SAMPLING SITE From Ring Plains Survey Yield 53 L/min
Uses	Investigation
Altitude	280 m
Dist. from coast	33 km
Bio Category	
Bio Habitat	
Last updated	1 Nov 2007 by Peter Nolly

Site Code	**GND1090**
Description	**GROUNDWATER SEM**
Location	Jordan RF, 456 Corbett Rd, Lepperton
NZTM Easting / Northing	1702757 / 5675537
River Number	394000
River	Waiongana
Site Access	Enter diveway. Go past house and track to well is on right. Can see shed from drive.
Comment	Used for domestic & hydroponic glasshouses. For horticultural use
Uses	State Environment Monitoring, Investigation
Altitude	75 m
Dist. from coast	7.2 km
Bio Category	
Bio Habitat	
Last updated	1 Nov 2007 by Peter Nolly

(26 Jul 2006)

(10 Oct 2010)

(10 Oct 2010)

(10 Oct 2010)

Appendix II

Maximum acceptable values (MAVs) for organic determinants of health significance

Guideline Values and Other Chemicals

Table A2.1: Guideline values (GVs) for aesthetic determinands

Determinand	GV	Units	Comments
aluminium	0.10	mg/L	Above this, complaints may arise due to depositions or discoloration.
ammonia	1.5 0.3	mg/L	Odour threshold in alkaline conditions. For control of chloramine formation in chlorinated water.
calcium			See hardness.
chloride	250	mg/L	Taste, corrosion.
chlorine	0.6–1.0	mg/L	Taste and odour threshold (MAV 5 mg/L)
2-chlorophenol	0.0001 0.01	mg/L	Taste threshold. Odour threshold.
colour	10	TCU	Appearance.
copper	1	mg/L	Staining of laundry and sanitary ware (PMAV 2 mg/L)
1,2-dichlorobenzene	0.001 0.002	mg/L	Taste threshold. Odour threshold (MAV 1.0 mg/L)
1,4-dichlorobenzene	0.0003 0.006	mg/L	Odour threshold. Taste threshold (MAV 0.4 mg/L)
2,4-dichlorophenol	0.0003 0.04	mg/L	Taste threshold. Odour threshold.
ethylbenzene	0.002 0.08	mg/L	Odour threshold. Taste threshold (MAV 0.3 mg/L)
hardness (total) (Ca + Mg) as $CaCO_3$	200 100–300	mg/L	High hardness causes scale deposition, scum formation. Low hardness (<100) may be more corrosive. Taste threshold.
hydrogen sulphide	0.05	mg/L	Taste and odour threshold.
iron	0.2	mg/L	Staining of laundry and sanitary ware.
magnesium			See hardness.
manganese	0.04 0.10	mg/L	Staining of laundry. Taste threshold (MAV 0.4 mg/L)
monochlorobenzene	0.01	mg/L	Taste and odour threshold (MAV 0.3 mg/L)
odour (threshold odour number)	3		Odour should be acceptable.
pH	7.0–8.5		Should be between 7.0 and 8.0. Most waters with a low pH have a high plumbosolvency. Waters with a high pH: have a soapy taste and feel. Preferably pH <8 for effective disinfection with chlorine.

Determinand	GV	Units	Comments
sodium	200	mg/L	Taste threshold.
styrene	0.004	mg/L	Odour threshold (MAV 0.03 mg/L)
sulphate	250	mg/L	Taste threshold.
taste			Should be acceptable to most consumers.
temperature			Should be acceptable to most consumers, preferably cool.
toluene	0.03 0.04	mg/L	Odour. Taste threshold (MAV 0.8 mg/L)
total dissolved solids	1000	mg/L	Taste may become unacceptable from 600–1200 mg/L.
trichlorobenzenes (total)	see below		(MAV 0.03 mg/L)
1,2,3-trichlorobenzene	0.01	mg/L	Odour threshold.
1,2,4-trichlorobenzene	0.005	mg/L	Odour threshold.
1,3,5-trichlorobenzene	0.05	mg/L	Odour threshold.
2,4,6-trichlorophenol	0.002 0.3	mg/L	Taste threshold. Odour threshold (MAV 0.2 mg/L)
turbidity	2.5	NTU	Appearance. For effective terminal disinfection, median turbidity <1 NTU, single sample <5 NTU.
xylene	0.02	mg/L	Odour threshold (MAV 0.6 mg/L)
zinc	1.5	mg/L	Taste threshold. May affect appearance from 3 mg/L.

Table A2.2: Determinands for which health concerns have been raised but for which no maximum acceptable value (MAV) has been set*

Name	Remarks
asbestos	Toxicological information suggests that oral ingestion (unlike inhalation) is unlikely to be a health risk.
brodifacoum	
bromochloroacetic acid	DBP[1]
bromochloroacetonitrile	DBP[1]
chloroacetones	DBP (chlorination)[1]
2-chlorophenol	Aesthetic GV of 0.0001 mg/L (taste)[1]. DBP (chlorination).
chloropicrin	DBP (chlorination)[1]
chlorothalonil	Pesticide[2]
dialkyltins	[1]
dibromoacetic acid	DBP (ozone)[1]
dichloramine	DBP (chlorination)[1]
3,4-dichloroaniline	Degradation product of propanil[1]
1,3-dichlorobenzene	[1]

Name	Remarks
1,1-dichloroethane	[1]
2,4-dichlorophenol	Aesthetic GV of 0.0003 mg/L.[1] DBP (chlorination).
1,3-dichloropropane	[1]
dioxins	Many congeners. Very low water solubility. Not in WHO list of determinands of health concern.
fenitrothion	Pesticide[3]
glyphosate	Pesticide[3]
iodine	[1]
methamidophos	Pesticide[2]
methomyl	Pesticide[2]
monobromoacetic acid	DBP (ozone)[1]
MX	DBP (chlorination)[3]
phorate	Pesticide[2]
propoxur	Pesticide[2]
quintozene	Pesticide[2]
3,3′,4,4′-tetrachloroazobenzene	Degradation product of propanil[1]
trichloroacetonitrile	
trichloramine	DBP (chlorination)[1]

Notes

* DBP indicates a disinfection by-product. Any difficulty in meeting a MAV must never be a reason to compromise adequate disinfection. Trihalomethanes are DBPs. Some DBPs may also have other sources.

1 WHO (2004) states that data are not adequate to permit recommendation of health-based MAV.

2 WHO (2004) states that unlikely to occur in drinking-water.

3 WHO (2004) states that this determinand occurs in drinking-water at concentrations well below those at which toxic effects are observed.

Appendix III

Good agrochemical spray management practices

Good agrichemical spray management practices

1. Introduction

This Appendix has been developed from various sources of information, including information sheets from MAF, and regional plans developed by other regional councils. The material relating to spray management is based on information contained in New Zealand Standard 8409: Agrichemical Users Code of Practice, June 1995, developed by the New Zealand Agrichemical Education Trust.

This Appendix has been included in the Plan in a simple and convenient form for general public information and education purposes. The information contained in this Appendix also provides general guidance on the best practicable option for preventing or minimising adverse effects on the environment from the application of agrichemicals. It provides a general indication of the nature of the conditions that might be attached to a resource consent for the application of agrichemicals.

2. Any person discharging aquatic herbicides:

- Should use only herbicides with label claims for use in or over bodies of water.
- For spraying of emergent plants should not submerge treated plants.
- Should always proceed upstream while spraying flowing watercourses, to avoid any build-up of herbicide concentration in the water.
- Should notify landowners whose stock have access to the waterway, or who use the waterway for potable water.
- Should apply agrichemicals to lakes in periods of the year when water temperatures are low, the weed is growing, but when there is not a high standing crop, in order to avoid adverse effects on aquatic life.
- Should apply agrichemicals to parts of the water body at intervals of at least ten days and not simultaneously over the whole area. Fish then have an opportunity to move to untreated areas if the dissolved oxygen content drops significantly.
- Water that has been treated with aquatic herbicides should not be used for the following purposes, until the times specified have elapsed after treatment.

  Standing water: bathing, human consumption, fish farming, and livestock watering (24 hours); overhead irrigation (10 days);

  Flowing water should not be used for the above purposes for 24 hours. Though it is difficult to determine the distance downstream from the treated stretch that the limitation should apply, the general criteria are:
  - Near-static water (flowing not more than 1 km in 24 hours): the limitation should apply to the treated section and 1 km downstream;
  - Faster flowing water: the limitation should apply over the treated stretch and the distance treated water would move in 24 hours, or up to the point of discharge into the main body of receiving water.

3. Any person discharging aquatic herbicides by spray application:

- Should undertake an accredited or recognised course in the use of agrichemical sprays.
- Should not spray if the wind speed over the area to be sprayed is less than one metre per second.
- Should have particular regard to wind speed and direction during the application of spray.

- Should discharge sprays during periods of positive air movement away from sensitive receiving environments (including water courses, places of public assembly, and public amenity areas).
- Should have particular regard to selection of nozzle size and pressure of spray units, to prevent or minimise the potential for spray drift.
- Should dilute spray solutions to the proper concentration for application.
- Should dispose of surplus spray solution and spray containers according to recommendations of the manufacturer or supplier, as stated in the directions on the product container label.
- Should keep specific records of the type of each spray applied, the volume of spray used, the volume of product concentrate used, the date, and the locality.
- Should use only those agrichemicals currently licensed for use by the Pesticides Registration Board.
- Should apply sprays strictly in accordance with the manufacturer's instructions, as stated on the product container label.
- Should preferably use sprays of low volatility or low toxicity.
- Should use equipment generating a droplet size greater than 50 microns in diameter, and preferably greater than 250 microns.

Appendix IV

Guidelines for sampling 2010

National Survey of Pesticides in Groundwater 2010 - Sampling Procedures

Sampling for the National Survey is fairly straightforward.

You will receive the sample bottles (one 500 mL solvent washed bottle and one 1 litre solvent washed glass bottles for each well being sampled) from AsureQuality with chain of custody sheet enclosed in a chilly bin with ice pack and packing material for the return trip.

For councils that are sampling more than 7 wells, there is an additional set of sample bottles. This is for the collection of a blind duplicate sample, which is a quality control measure for the laboratory analysis. There is no additional cost for the collection of the blind duplicate sample. Please collect the blind duplicate sample as an extra sample from one of the wells at the same time as collecting the normal sample. There are further instructions relating to the blind duplicate samples later.

Before sampling the bore or well:

1) Collect the water level information, this information can be very important.

2) Make sure that at least 3 times the casing volume of water has been purged from the bore.

3) If the bore is a domestic water supply fitted with a down hole pump, make sure the pump is running and allow it to run at least 15 minutes before sampling.

If you are using your own pump for sampling such as a Grundfos MP1 pump, flush the well for at least 15 minutes at a high flow rate before sampling the well. This should also be adequate to rinse the pump between wells. Turn the flow rate down for 2-3 minutes before sampling.

4) Sample as close to the well-head as possible, but NEVER on the downstream side of holding tanks.

5) If you have a pH meter or conductivity meter, make sure that these reading have stabilised before taking the sample.

When sampling the well:

1) Label the bottles before you get your hands or the bottles wet.

2) Make sure your hands are clean and do not touch near the top of the sample bottles.

3) For the pesticide bottles:

The glass bottles for the pesticide analyses have been washed and rinsed according to a strict protocol. It is important that the samples are collected directly into the bottles and not into a bucket or other container before filling the sample bottles.

a) Rinse the bottles 3 times with water to be sampled

b) Fill the bottles completely full allowing as little air space as possible. Make sure that one 1-litre and one 500 mL bottle are sampled for each well selected for pesticide analysis.
DO NOT FREEZE THE BOTTLES, OTHERWISE THEY WILL BREAK.

Blind Duplicates:

There will be a number of "Blind Duplicate" samples collected (about 7% of the total number of samples). If you are sampling more than 7 wells then you will be asked to collect a Blind Duplicate sample. The Blind Duplicate samples should be labelled as for the other samples but the well number on the bottle should be **fictitious** and the time should be omitted. Both the real and fictitious well number should be recorded on the ESR sampling sheet and note that a Blind Duplicate has been collected.

Collect the bottle for the sample and the Blind Duplicate alternatively, that is, the first 1 litre bottle for the sample, followed by the first 1 litre bottle for the Blind Duplicate, then the 500mL bottle for the sample followed by a 500 mL bottle for the Blind Duplicate.

Sampling Sheets:

Please fill in a sampling sheet for each well sampled. Indicate on this sheet if there has been a blind duplicate taken and the fictitious well number. Do not send this sheet to AsureQuality,

Send copies of the sampling sheets to Alex Skinner at ESR, PO Box 29-181, Christchurch.

Once all the samples have been collected:

The glass bottles should be packed in the containers and packaging received in, and couriered to AsureQuality at the following address:

AsureQuality Limited
Wellington Laboratory
1C Quadrant Drive
Gracefield
Lower Hutt

Attention: Sample Reception

Any queries regarding the pesticide sampling should be directed at Murray Close, ESR, Christchurch. (Phone : (03) 351 0014; Fax : (03) 351 0010 or email : murray.close@esr.cri.nz), or Alex Skinner ESR, Christchurch (Phone: (03) 351 6019 or email: alexandra.skinner@esr.cri.nz).

Some important things to consider when sampling are:

1. Please do not sample on a Thursday or Friday. If you do this, the samples will then most likely hang around either your lab or AsureQuality's until Monday morning. Please sample on Monday to Wednesday and then send the samples back to Agriquality immediately via courier.

2. Allow any disused bores to run until at least 3 times the casing volume has been cleared from the bore, if possible, or at least until the parameters such as conductivity and pH have stabilised. Sampling bores that are constantly in use will cut down on purging time.

3. Please try to avoid sampling in the pouring rain so that the risk of contamination is minimised.

4. Please try to keep the bottles provided clean, and rinse them 3 times with the sample water before collecting the sample.

If you have any questions about sampling or if the procedures conflict with your current sampling protocols, please contact me and we can try to resolve the issues as quickly as possible.

Thanks for participating in the programme; it could not exist without your support. Any questions or comments are welcome.

Sincerely,

Murray Close

Appendix V

Field sheet for 2010 Survey

Sampling Sheet for 2010 Survey of Pesticides in Groundwater

Regional/District Council:.....

Person collecting sample:.....

Grid reference : NZMS 260 .....

Council well number:.....

Well owner:.....

Address:.....

.....

Surrounding land use:.....

.....

Well use:.....

Well diameter:..... Well depth:.....

Screened interval:..... Pumped: Y/N

Sampling point:.....

Water level:.....

Date of sampling:..... Time:.....

Time of pumping before sampling:.....

Well volumes (if possible): .....

Field measurements (if any):.....

.....

Type of aquifer:.....

Name of aquifer (if any):.....

.....

Comments:.....

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