Regional Groundwater Monitoring Network

Northern Ireland

Review of 2004 monitoring data

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Department of Enterprise, Trade and Investment
Geological Survey of Northern Ireland

Environment & Heritage Service
www.ehsni.gov.uk

Report Status: Final

Report Date: September 2005

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Executive Summary

Water sampling and analysis was undertaken at 88 groundwater sources throughout Northern Ireland in 2004. The sources represent the combined regional groundwater and nitrate vulnerable zones monitoring network for Northern Ireland.

Changes were made to the network between 2003 and 2004 with some sources no longer suitable for sampling due to access reasons or pump failures.

Nitrate concentrations were variable but generally low outside of areas already designated as Nitrate Vulnerable Zones. For some sources, only occasional high concentrations are detected suggesting very local diffuse or point source impact.

Significant anthropogenic impact as indicated by the presence of pesticides, solvents or hydrocarbons appears limited around the sources sampled. The presence of some compounds (mainly pesticides) is detected, generally at very low concentrations with very few exceedences above relevant drinking water standards. The four most commonly occurring pesticides were atrazine, simazine,MCPA and MCPP, as has been found in previous years.

Microbiologically, positive detections of total and/or faecal coliforms were made at 33% of the 88 sources tested.

1.0 Introduction

The Northern Ireland groundwater quality monitoring network was established in 2000, to allow systematic collection of groundwater data on a region-wide scale. This report reviews data collected during 2004. Where appropriate, reference to results collected in previous years is also made.

2.0 Network Details

In 2004, 88 sites were monitored on at least one occasion. The majority of sites are private boreholes located on agricultural premises and industrial sites although some public water supply sources were also monitored.

3.0 Sampling Frequency

The standard sampling frequency as programmed is shown in table 1 below. This full set of sampling was not completed for a small number of the sites either due to access problems or difficulty in obtaining water samples. For a small number of sites where their primary role is for nitrate monitoring, no annual or microbiological analyses was undertaken

Suite	Parameters	Frequency
Quarterly	Major ions + nitrogen species	Quarterly
Wellhead	DO,pH,Redox, EC, Temp, Ammonium	Quarterly
Annual	Pesticides, Hydrocarbons, Metals, others	Annual
Microbiological	Total Coliforms,Faecal Coliforms	Biannual

Table 1 Standard Sample Suites

4.0 Water Chemistry

This report summarises the data for selected parameters, concentrating on those which are entirely or partly of anthropogenic origin. Additional data is available within the monitoring database relating to other parameters such as major ions (calcium, magnesium, sulphate, etc.) which can be accessed if required.

4.1 Nitrate

Of the 88 sources sampled at least once in 2004, 21 sites (24 %) showed nitrate concentrations above 25 mg NO_3/l in at least one sample, with six of these sites (7 %) with concentrations above the Drinking Water Standard (DWS) of 50 mg NO_3/l. Mean nitrate concentrations for 2004 showed a total of 17 sites (19 %) above 25 mg NO_3/l. The majority of sites with a mean concentration greater than 25 mg NO_3/l are associated with designated Nitrate Vulnerable Zones (NVZs). The highest nitrate concentration (almost 115 mg NO_3/l) was found at station g450 (Jerretspass) in April 2004. The mean concentration for this site was below 48 mg NO_3/l, showing a peak in nitrate concentration in spring 2004. A more detailed assessment at this site would be required to establish the reason for such a significant increase at

this time. Four (5 %) of the 17 sites were above the 50 mg NO_3/l DWS. Three of these four sites were within NVZs. Consistently high concentrations occurred at site g278 (Figure 7) with a mean concentration of 98 mg NO_3/l, the greatest concentration occurred in early January 2005 (107 mg NO_3/l).

Of all sources sampled, 29 % showed nitrate concentrations consistently below the detection limit of 0.58 mg NO_3/l.

The monitoring data from six areas designated as NVZs is shown in figures 1 to 6. Data for the Clogh Mills NVZ was supplied by the Water Service from monitoring undertaken at their abstraction wells. The six areas are; Clogh Mills (Figure 1), Comber (Figure 2), Knockloughrim (Figure 3), Whitehead (Figure 4), Dromore (Figure 5) and Kilrea (Figure 6),

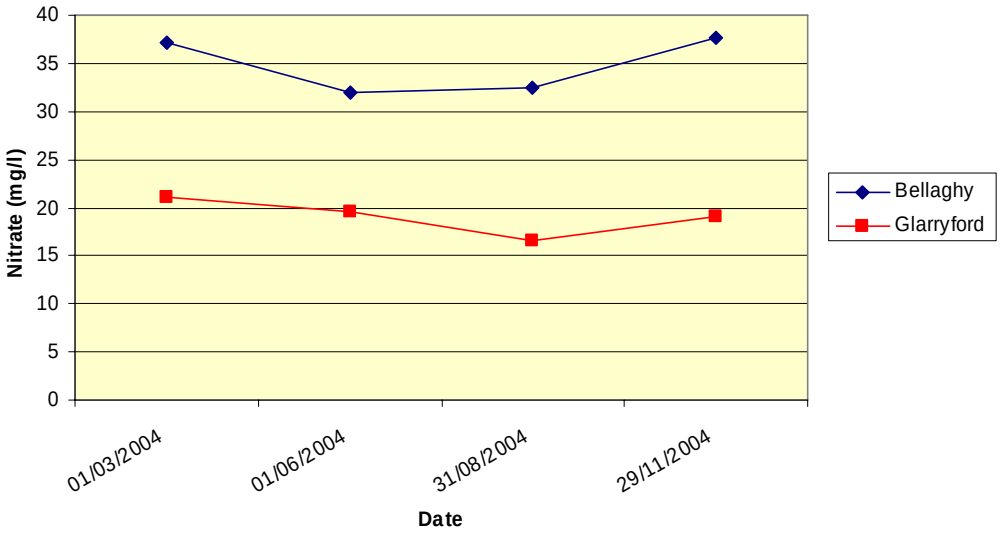


Figure 1. Nitrate concentrations (mg/l) at sources sampled in Clogh Mills NVZ

In the Clogh Mills NVZ (Figure 1), the Bellaghy public water supply (PWS) source had higher nitrate concentrations throughout 2004 compared with the Glarryford source, as has been found in previous years. At both sites, concentrations remained below the DWS of 50 mg NO_3/l. A possible seasonal trend is indicated with concentrations reducing during spring and summer and increasing again in autumn/winter.

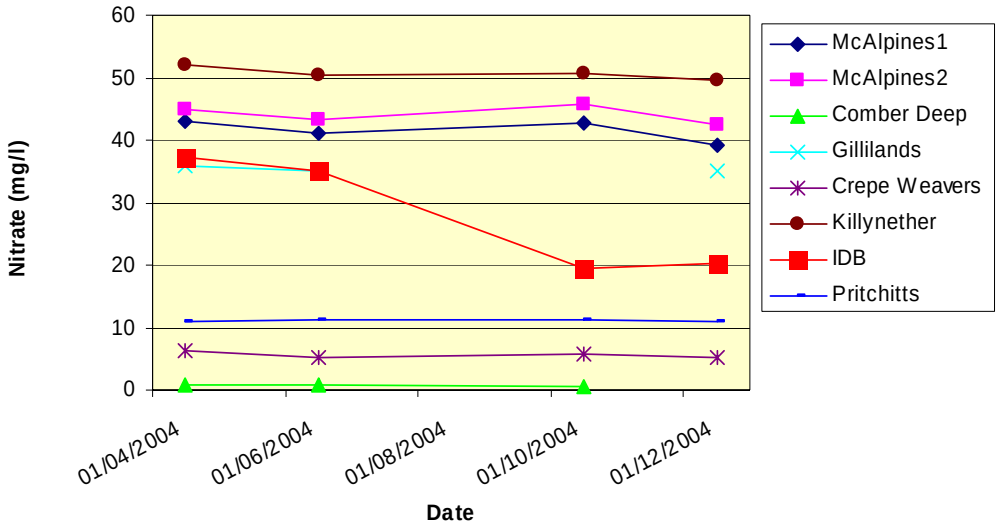


Figure 2. Nitrate concentrations (mg/l) at sources sampled in Comber NVZ

Within the Comber NVZ, concentrations remain relatively constant at the majority of sources (Figure 2). At the IDB source concentrations fall during the second half of the year. The exact reasons for this are uncertain but may be due to changes to the source abstraction rate. Only the Killynether source showed concentrations exceeding the DWS of 50 mg NO_3/l. The McAlpines No 2 source remained below the DWS, compared to 2003 when it exceeded the DWS for part of the year.

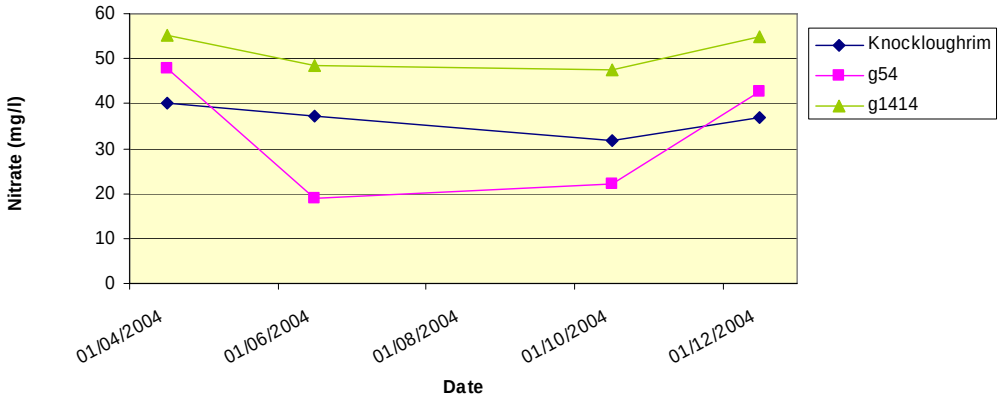


Figure 3. Nitrate concentrations (mg/l) at sources sampled in Knockloughrim NVZ

At the Knockloughrim NVZ, nitrate concentrations at site g1414 exceeded the DWS for part of the year (Figure 3). For all sites, concentrations were generally lower during spring/summer, rising again in the later part of the year.

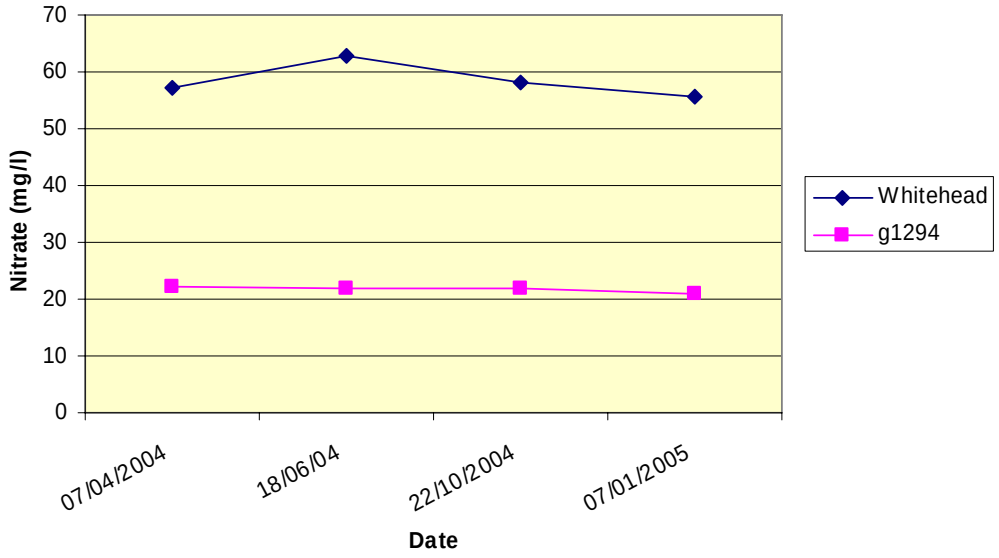


Figure 4. Nitrate concentrations (mg/l) at sources sampled in Whitehead NVZ

Figure 4 shows that nitrate concentrations at site g1294, which is just outside the Whitehead NVZ, remained constant throughout the year. Abstracted groundwater at the Whitehead private source within the NVZ showed consistently high concentrations throughout the year above the DWS of 50 mg NO_3/l.

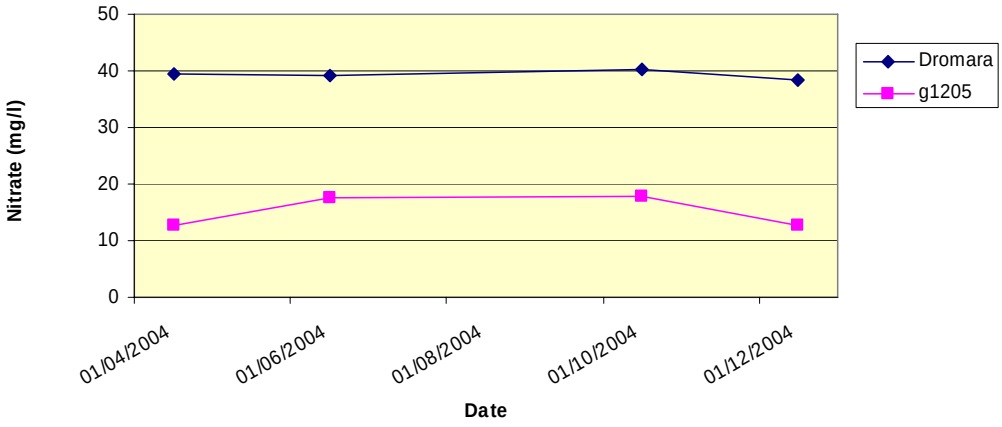


Figure 5. Nitrate concentrations (mg/l) at sources sampled in Dromore NVZ

Concentrations at site g100 (Dromara) remained fairly constant at around 40 mg NO_3/l (Figure 5). In contrast nitrate concentrations at site g1205 (just

outside the designated NVZ area) remained low (less than 20 mg NO_3/l) throughout 2003.

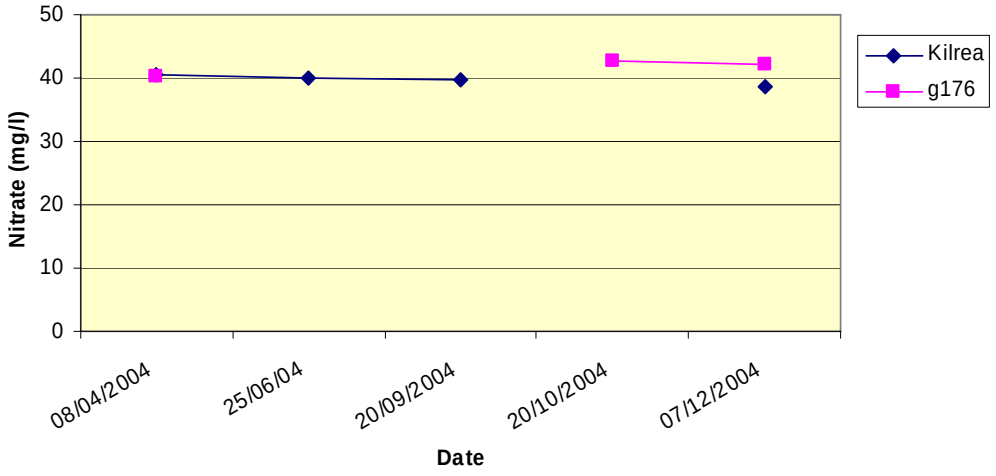


Figure 6. Nitrate concentrations (mg/l) at sources sampled in Kilrea NVZ

Nitrate concentrations remained below the DWS at Kilrea (g169) throughout 2004 (Figure 6), in comparison to 2003 when the DWS was exceeded on all monitoring occasions. Concentrations at g176 remained similar to that found in 2003.

Map 1 shows the mean nitrate concentrations recorded for each source in 2004 with Map 2 showing the maximum concentration recorded.

Overall, nitrate concentrations remained fairly constant at the majority of sites. Where peaks in concentrations did occur they happened during different times of the year at different sites. Most peaks occurred during April 2004 and the least in June 2004. Trends in nitrate concentrations can be influenced by a variety of factors including rainfall/recharge patterns, agricultural land use activities within the local catchment over the year and abstraction rates.

4.2 Phosphorus

Phosphorous was measured annually at each source. It can be present naturally but can also be indicative of agricultural contamination. In 2004, five sources showed phosphorus concentrations greater than the detection limit of 0.073 mg/l. One of these five sites, g1450, had a significant phosphorus concentration of 1.45 mg/l. Although this is below the DWS of 2.2 mg/l, it is a relatively high concentration for groundwater. The greatest concentration at the other four sites was 0.443 mg/l. Such levels can be of concern if the groundwater is discharging into a river or lake. Concentrations greater than 0.02 mg/l may contribute to surface water eutrophication.

4.3 Ammonium

Ammonium is measured using both a field test kit at the well-head and as ammoniacal nitrogen in the laboratory. The laboratory results showed that only two samples were in excess of the DWS of 0.5 mg/l, these were from stations g123 and g463 with concentrations of 0.63 mg/l NH_4 and 1.35 mg/l NH_4 respectively. Stations g123 and g463 also had concentrations above the DWS in 2004.

4.4 Chloride

Chloride occurs naturally in groundwater but elevated levels can indicate impact from a pollution source or activity such as sewage disposal, de-icing of roads or mixing with saline or connate water (saline intrusion). Sources located near to the coast can be expected to have generally higher background concentrations due to sea spray or saline intrusion.

The range of mean chloride concentrations for 2004 for all sources are shown in Figure 7.

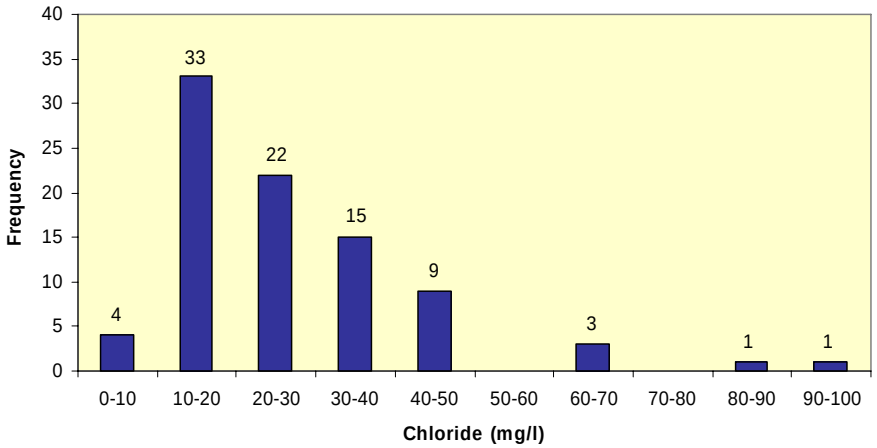


Figure 7. Mean chloride concentrations (mg/l) for 2004

Figure 7 shows that all the results were significantly below the DWS of 250 mg/l for chloride. The highest concentrations occurred at site g777 (McAlpines No.1) and site g782 (Gilliland) which had maximum concentrations of 90 mg/l and 97 mg/l respectively.

Within the Sherwood Sandstone in the Enler Valley, significant groundwater abstraction takes place for public, industrial and agricultural supply and the potential exists for intrusion of saline water from Strangford Lough. For those sources monitored in 2004, those closest to the coast do generally show higher chloride concentrations however they are still less than 100mg/l,

significantly below the DWS of 250 mg/l. The highest recorded chloride value for 2004 for each monitoring point is shown on Map 3.

4.5 Iron and Manganese

Iron and manganese occur naturally in groundwater and background levels can vary significantly depending on the nature of the rock forming the aquifer. Concentrations of iron and manganese are influenced by the oxidised state of the water with solubility increasing in anaerobic conditions. Elevated concentrations can, therefore, indicate local pollution where the oxidation state has been diminished.

Generally, as Figure 8 shows, where iron is elevated manganese is also elevated. Also, iron concentrations are generally higher than manganese concentrations; this can be seen by comparing the scales of the iron and manganese concentrations in Figure 8. There are sites, however, where manganese concentrations can be elevated and iron concentrations are low. For example site g156 (Shelton Bridge) where the mean iron concentrations was 0.4 mg/l and the mean manganese concentration was 1.2 mg/l. The same relationship was found for this site in 2003.

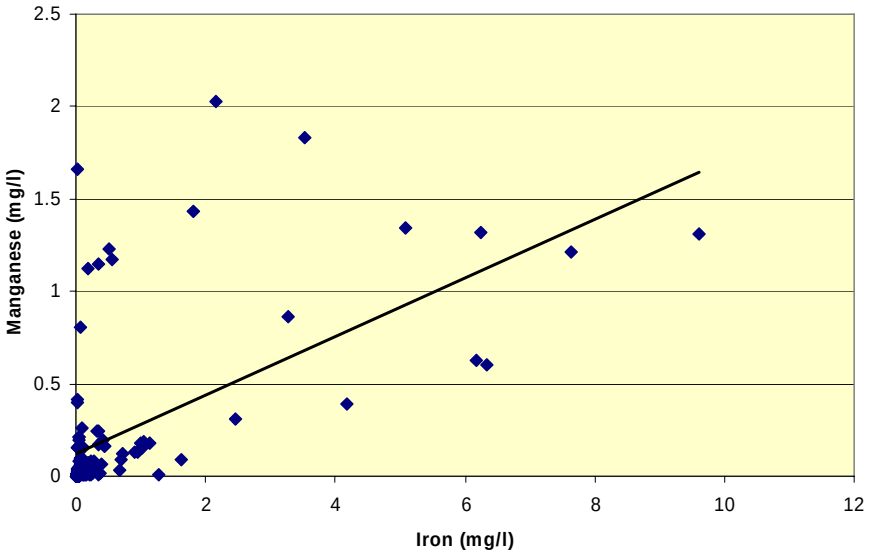


Figure 8. Regression analysis showing the relationship between iron and manganese concentrations.

For the purposes of presentation two results were omitted from the regression analysis. These two samples were taken from site g463 near Keady and had extremely high concentrations of iron and manganese; 287 mg/l and 304 mg/l for iron and 2.79 mg/l and 2.13 mg/l for manganese.

Figures 9 and 10 show the mean concentrations of iron and manganese at sources sampled.

In 2004 25 % of the mean iron concentrations for individual sources exceeded the DWS of 0.2 mg/l and 43% of the mean concentrations of manganese exceeded the DWS of 0.05 mg/l.

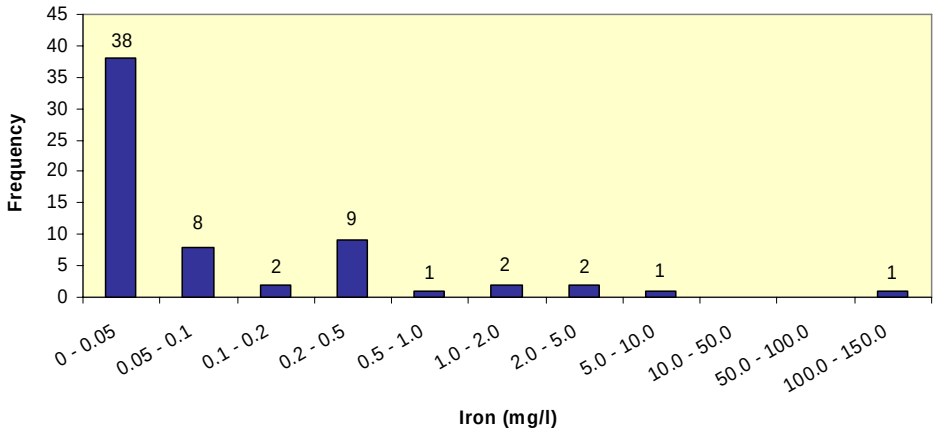


Figure 9. Frequency distribution of mean iron concentrations for 2004

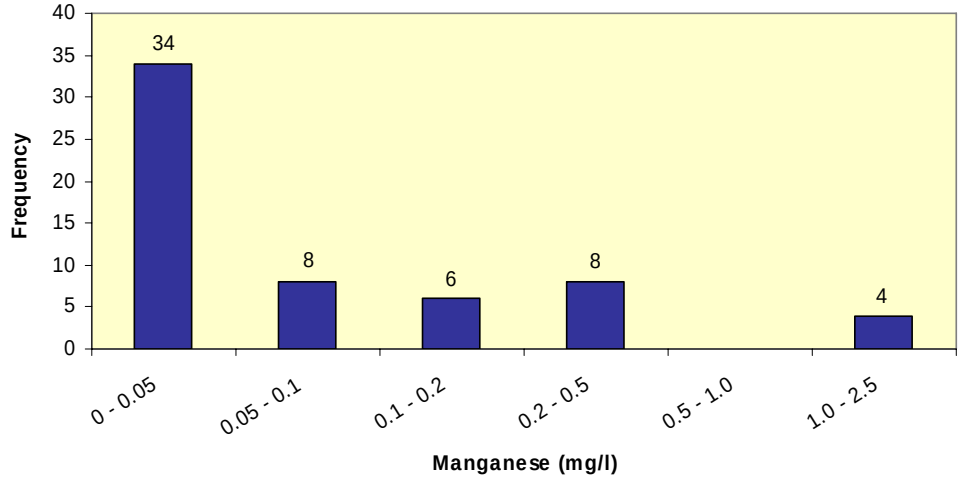


Figure 10. Frequency distribution of mean manganese concentrations for 2004

4.6 Fluoride

Out of the 73 sources monitored for fluoride in 2004 none of the samples were over the DWS of 1500 µg/l. Ninty-five % of sites had concentrations under 300 µg/l. The highest concentration (1490 µg/l) was found at station g123 in County Fermanagh. This borehole is located within carboniferous limestone where higher concentrations of fluoride are generally found. The three other sites with concentrations greater than 300 µg/l were g675A, g438 and g1483 which had concentrations of 774 µg/l, 555 µg/l and 306 µg/l respectively.

4.7 Pesticides

For the majority of sites, on one occasion over the year, a wide range of pesticide compounds were analysed for, the majority of which were not found above the generally very low detection limits. Of particular interest are compounds commonly used in sheep dip formula's, such as Flumethrin, Cypermethrin, Diazinon and Propetamphos. One sample (site g30) showed the presence of Diazinon, but the concentration was well below the 0.1 µg/l DWS for pesticides (see Table 2). The remaining three compounds were not present in any samples.

Ten pesticide compounds were detected only once and on each occasion the compound concentrations were well below the DWS for pesticides of 0.1 µg/l. These compounds and their associated concentrations are shown in Table 2

Compound	Concentration (µg/l)
2,4,5-TP	0.0060
Bromacil	0.0152
Chlorpyriphos	0.0018
Clopyralid	0.0273
Diazinon	0.0051
Hexachlorobenzene	0.0024
Ioxynil	0.0103
Isodrin	0.0175
MCPB	0.0065
Monuron	0.0461

Table 2 Pesticide compounds detected on one occasion only

Sixteen pesticide compounds were detected at more than one source with some sources showing several pesticides present. Three different compounds were detected in exceedence of the 0.1 µg/l DWS on five occasions (Figure 11).

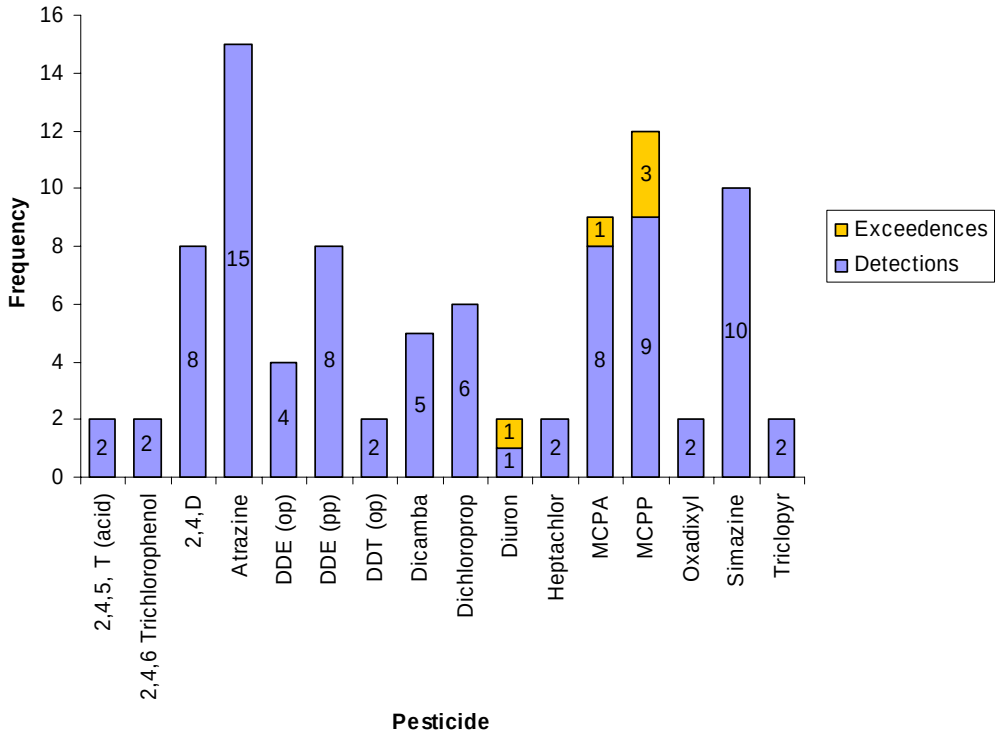


Figure 11. Pesticide detections and exceedences
(N.B on the chart, exceedences are not included in the number of detections)

The compounds shown in Figure 11 are described below:

2, 4, 5 T (acid) is a herbicide used for the selective control of weeds. It was found above the detection limit at two sources; both concentrations (0.0028 µg/l and 0.0037 µg/l) were well below the DWS.

2, 4, 6 Trichlorophenol is used for a variety of purposes including as a herbicide and a wood preservative. It was found at two sources just above the detection limit of 0.005 µg/l, well below the DWS.

2, 4 D is a commonly used herbicide. This compound was detected at eight sources. All were well below the DWS with concentrations ranging from 0.0039 µg/l at station g2 to 0.0292 µg/l at station g831.

Atrazine is a general herbicide used in agriculture and in the past for weed clearance on paths and rights-of-way. It does not break down readily and is a significant concern UK-wide with respect to groundwater contamination. Atrazine was found above the detection limit at 15 sources; more occasions than any other compound. However, none of these were in exceedence of the DWS. Concentrations ranged from 0.0012 µg/l to 0.064 µg/l. Its general use in non-agricultural situations, along with simazine, has been banned in the UK since 1993 but due to its

persistance was expected to continue to show up in monitoring for some time.

DDE (op) is a non-agricultural insecticide. It was found at four sources just above the detection limit of 0.0033 µg/l, all well below the DWS.

DDE (pp) is a by-product of pesticide manufacturing and was detected at eight sources. Concentrations ranged from 0.0025 µg/l to 0.0041 µg/l all below the DWS.

DDT (op) was used as an agricultural insecticide. It was found at two sources just above the detection limit of 0.0078 µg/l, well below the DWS.

Dicamba is a herbicide used primarily in non-agricultural environments, e.g. fence-rows and roadways. This compound was detected at five sources; all concentrations were well below the DWS.

Dichloroprop is a herbicide commonly used for weed clearance on rights-of-way and roadside verges. Concentrations were detected at six sources. At each source the concentration was below the DWS. The highest concentration (0.0926 µg/l) was found at station g102.

Diuron is a herbicide used for weed and pest control. This compound was found above the detection limit on two occasions. At station g2 it was found just above the DWS at a concentration of 0.103 µg/l. At station g98 it was found below the DWS at a concentration of 0.0171 µg/l.

Heptachlor is an insecticide and was used on food crops and in homes. There were only two occurrences of this compound. Both just above the detection limit of 0.0040 µg/l and well below the DWS.

MCPA is a herbicide compound widely used in agriculture and for general use. It was found above the detection limit at nine sources. At one source, g105, MCPA was found in exceedence of the DWS at a concentration of 0.521 µg/l.

MCPP (Mecoprop) is a compound employed for uses similar to those of MCPA. It was found in exceedence of the DWS at three sources: station g438 at 0.11 µg/l, station g463 at 0.219 µg/l and station g105 at 0.286 µg/l. Site g105 also had the highest concentration of MCPA. The nine other sources where MCPP was found above the detection limit were all below the DWS. At six of these sources MCPA was also detected.

Oxadixyl is a fungicide used on seeds and on turf/lawns. Two sources, g1830 and g1833, showed the presence of this compound above the detection limit, both below the DWS.

Simazine is a general herbicide used for similar purposes as atrazine and eight of the sources where detections of atrazine were made also showed the presence of simazine. Ten detections of simazine were found with

concentrations ranging from 0.0012 µg/l to 0.0133 µg/l, all below the DWS. Alongside atrazine, simazine has been banned for use in non-agricultural situations since 1993.

Triclopyr is a herbicide used in forestry for the control of weeds. Detections were found at two sources both below the DWS. At source g30 the concentration was 0.0051 µg/l and at station g77 the concentration was 0.0081 µg/l.

The majority of these pesticide compounds were detected at concentrations significantly below the DWS of 0.1 µg/l with five occasions of exceedence. The four most commonly occurring pesticides were atrazine, simazine, MCPA and MCPP. These pesticides were also the most commonly occurring compounds in 2003. Given the very low limits of detection for most pesticides and the inherent difficulties in sampling and analysing at such concentrations, caution should be exercised when considering the significance or otherwise of 'detections' where they are significantly below the DWS.

4.8 Solvents and hydrocarbons

At the majority of sites no solvents or hydrocarbons were detected. Where they were detected, concentrations were generally significantly below the relevant DWS. The solvents and hydrocarbons that were most frequently detected are described below.

Benzo 1,12, perylene was detected at 16 sites, *Benzo 11,12, fluoranthene* was detected at 12 sites, *Benzo 3,4, fluoranthene* was detected at 8 sites and *Benzo 3,4, pyrene* was detected at 10 sites. These parameters are all components of polycyclic aromatic hydrocarbons (PAH's). All four parameters were detected at low concentrations at site g105 (concentrations ranged from 0.4 ng/l to 0.6 ng/l). Higher concentrations (ranging from 0.8 ng/l to 2.2 ng/l) of all four parameters were also detected at site g1831. The 2.2 ng/l concentration at site g1831 was for Benzo 3,4 fluoranthene and was the highest concentration found at any site for any of these parameters. On five occasions benzo 1,12 perylene, benzo 11,12, fluoranthene and benzo 3,4, pyrene were found at the same sources. Benzo 1,12, perylene and benzo 11,12, fluoranthene were most commonly detected at the same sources, 11 times in total.

Fluoranthene is a PAH that can be found in substances such as coal tar. Fourteen samples recorded concentrations above the 0.3 ng/l detection limit. The highest concentration recorded was 10 ng/l at station g105, significantly below the DWS for total PAH's of 0.2 µg/l.

Hydrocarbons. The general analysis for hydrocarbons identified 29 sources with concentrations above the limit of detection of 0.03 mg/l. The highest concentration was 0.257 mg/l at station g250.

Indeno(1,2,3-cd)pyrene is a PAH. It was detected at eight sources. Concentrations ranged from 0.2 ng/l at station g113 to 1.8 ng/l at station g1831.

m-, o- and p- creosol's are components of pesticide products, disinfectants, cleaning agents, creosote and tar. M-creosol was detected at three sites, o-creosol at one site and p-creosol at seven sites. At site g166 all three parameters were detected with concentrations ranging from 0.069 µg/l to 0.163 µg/l. The concentration of 0.163 µg/l was for m-creosol and was the highest concentration for any of these parameters.

PCB 101 is a polychlorinated biphenyl congener, the only PCB congener detected. PCB 101 was detected at six sources at very low concentrations ranging from 0.0018 µg/l to 0.0031 µg/l.

Phenol is used primarily in the production of phenolic resins which are used in the plywood adhesive, construction, automotive and appliance industries). Phenol was detected at 16 sources, concentrations ranged from 0.043 µg/l at station g284C to 0.985 µg/l at station g166.

A number of other solvents and hydrocarbons were found at a very small number of sources, Table 3 lists the remaining solvents and hydrocarbons detected.

Parameter	Station	Concentration (µg/l)
2,4,6-Trichlorophenol	g166	0.005
	g251	0.006
2,4-Dichlorophenol	g166	0.027
2,6-Dichlorophenol	g166	0.027
2-Chlorophenol	g166	0.147
4-Chlorophenol	g102	0.012
	g166	0.012
Dibromochloromethane	g77	7.700
Dichlorobromomethane	g77	18.000
	g831	0.300
	g59A	0.200
Tetrachloroethene	g675A	0.700
Tribromomethane	g77	1.200
Trichloroethene	g299	2.800
	g801	1.100
	g675A	0.200
Trichloromethane	g77	34.500
	g801	0.600
Trihalomethanes	g77	61.400
Methyl-tert.butyl-ether	g6	0.200
	g156	0.100
	g265	0.100

Table 3 Solvents and hydrocarbons detected in 2004 with associated station number and concentration.

It can be seen from Table 2 that a number of different parameters were found at stations g77 and g166; 5 at each site.

Station g77 contained dichlorobromomethane, dibromochloromethane, tribromomethane, trichloromethane and trihalomethanes. These parameters are by-products associated with water chlorination.

Station g166 contained 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2,6-dichlorophenol, 2-chlorophenol and 4-chlorophenol. These parameters can enter the environment as effluent from chlorination processes involving water treatment. 2,4,6, trichlorophenol is particularly associated with the chlorination of phenol-containing waste waters. It was also noted previously that m-, o- and p-creosols were present at site g166.

Other hydrocarbon compounds, such as benzene and toluene, were analysed for but none were above the limit of detection. Tetrachloroethene and trichloroethene, chlorinated solvents associated with a variety of processes such as degreasing and industrial dry-cleaning, were detected at low concentrations at a very small number of sources.

As with pesticides, given the very low limits of detection for most of the substances listed above and the inherent difficulties in sampling and analysing at such concentrations, caution should be exercised when considering the significance or otherwise of 'detections' where they are significantly below the DWS

4.9 Selected Metals

Aluminium was found above the limit of detection of 13 µg/l at seven sources. None were found to be above the DWS of 200 µg/l. The highest concentration (172 µg/l) was at source g1831, Brackaghmore, County Tyrone, this site also had the highest aluminium concentration (150 µg/l) in 2003. Samples from this source had relatively low alkalinity; an average of 109 HCO_3 mg/l (the same as in 2003).

Arsenic was found above the detection limit of 0.12 µg/l at 52 sources. Arsenic can occur naturally within certain rock types. Two of these sources had concentrations above the DWS of 10 µg/l; site g65 at Castlederg had a concentration of 14.1 µg/l and site g270 at Glack had a concentration of 34.5 µg/l. The particular geological strata in which g65 and g270 are set is known to contain both dispersed and vein-hosted arsenic-rich minerals.

Cadmium was found at 40 sources above the limit of detection of 0.012 µg/l. Cadmium can occur naturally within certain rock types The highest concentration was 0.79 µg/l, well below the DWS of 5 µg/l.

Lead was found above the 0.14 µg/l detection limit at 36 sources, however the highest concentration of 2.35 µg/l was well below the DWS of 25 µg/l.

Mercury was found above the detection limit of 0.046 µg/l at four sources. All four sources had concentrations well below the DWS of 1 µg/l. The highest concentration was 0.14 µg/l at g146.

Nickel occurred above the 0.5 µg/l limit of detection on 33 occasions. It was only found above the 20 µg/l DWS once; this was at station g463 in the Ordovician/Silurian where the concentration was 46.2 µg/l. This source had nickel concentrations above the DWS in previous years; however the DWS for nickel was lowered at the end of 2003 from 50 µg/l to only 20 µg/l. Station g463 also had the highest concentrations of ammonium, iron and manganese.

4.10 Uranium

Naturally occurring uranium can be found in many rock types. The majority of the 58 uranium detections were in the Ordovician/Silurian and Devonian/Carboniferous hydrogeological units. The detection limit for uranium is 0.054 µg/l and 84 % of sources above this concentration were in the 1-3 µg/l range. The two highest concentrations were found at two sources in County Tyrone, one (site g72) in Carboniferous sandstone had a concentration of 7.01 µg/l and the other (site g146) in Carboniferous limestone/mudstone had a concentration of 7.64 µg/l.

No DWS is currently specified for uranium but there is a WHO guide level of 2 µg/l. In the United States concentrations up to 20 µg/l are not considered to be a risk.

5.0 Microbiology

Of the 88 sites tested for microbiology in 2004, 29 sites (33 %) showed the presence of total coliforms on at least one occasion. Thirteen of these sites containing numbers greater than 10 cfu/100ml and 28 sites (32 %) showed the presence of faecal coliforms, with 11 of these sites with numbers greater than 10 cfu/ 100 ml.

The three highest counts of total and faecal coliforms were over 3000 cfu/100ml occurring at sites g30, g123 and g505. These extremely high counts occurred during the summer (June and July) 2004. Site g30 also had high total and faecal coliform counts (> 300 cfu/100 ml) during December 2004, as did site g54. Site g30 had the highest count of total and faecal coliforms in 2003 as well and although lower than 3000 cfu/100 ml, they did exceed 300 cfu/100 ml. Total and faecal coliforms numbers in the remaining counts ranged from 1 cfu/100 ml to 61 cfu/100 ml.

6.0 Comparison with Previous Years

Nitrate concentrations have remained variable across the area. Since 2001 the percentage of samples with concentrations above 25 mg NO_3/l has steadily increased; 2001 – 13 %, 2002 – 17 %, 2003 – 20 % and 2004 - 24 %. The number of samples over the 50 NO_3/l DWS for nitrate has, since 2001, remained quite stable. In 2001 only 3 % of samples were found to have concentrations greater than 50 NO_3/l. In 2002 and 2003, 8 % of samples were greater than 50 NO_3/l. In 2004 the percentage dropped very slightly to 7 %. The number of samples below the limit of detection dropped in 2004 to 29 %, the number of samples below the limit of detection in previous years had been fairly consistent; 2001 – 35 %, 2002 – 33 % and 2003 – 34 %.

In common with previous years, the majority of groundwater samples had mean chloride concentrations between 10-30 mg/l. One site had mean chloride concentrations of 80-90 mg/l and one site had mean concentrations of 90-100 mg/l. For all sites, concentrations remain below the 250 mg/l DWS.

Apart from a very high mean concentration of iron at one site in 2004 (148 mg/l) the range of iron and manganese concentrations remained very similar to those found in previous years with the majority of sites having concentrations between 0.00 and 0.05 mg/l for both iron and manganese. However, in 2004, the number of exceedences of the DWS for iron and manganese showed an increase from previous years (Figure 12). This could be partly explained by an increase in the number of sources sampled. As noted previously elevated iron and manganese can be related to natural background concentrations.

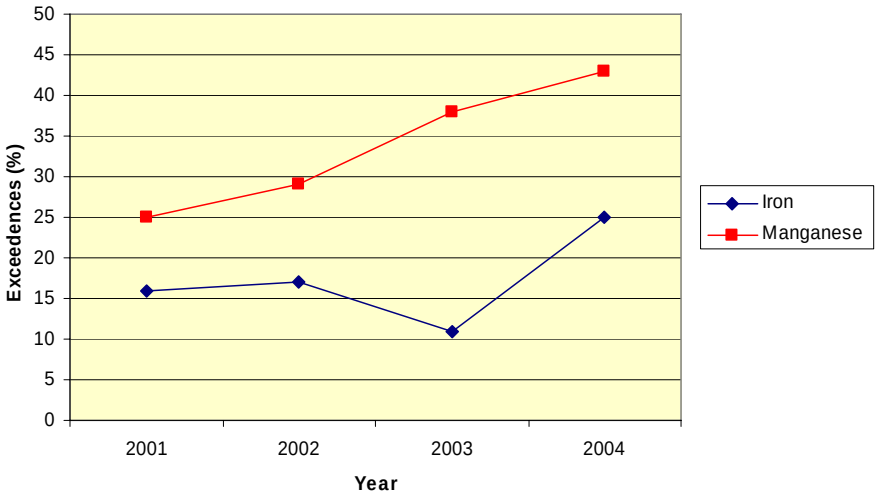


Figure 12. Exceedences of the DWS for iron and manganese 2001 to 2004

The pesticides most frequently detected from 2001-2004 were atrazine, simazine MCPA and MCPP. The number of exceedences of the individual

pesticide DWS of 0.1 µg/l from 2001 to 2004 has been variable; in 2001 there were eight exceedences, in 2002 there were three exceedences, in 2003 there were seven exceedences and in 2004 there were five exceedences. MCPP has consistently had the most occasions of exceedence from 2001-2004. MCPA exceeded the DWS once in 2001, 2003 and 2004 and diuron exceeded the DWS once in 2002, 2003 and 2004.

The percentage of sites with a presence of total and faecal coliforms has decreased slightly from 2003 to 2004. In 2003, 40 % showed the presence of total coliforms and 36 % showed the presence of faecal coliforms. In 2004, 33 % showed the presence of total coliforms and 32 % showed the presence of faecal coliforms. However, the highest counts of coliforms have increased to > 3000 cfu/100 ml in 2004, from > 300 cfu/100 ml in 2003. In 2001 the highest count was 140 cfu/100 ml and in 2002 the highest count was 62 cfu/100 ml.

7.0 Conclusions

Nitrates in groundwater resulting from either diffuse (agricultural) pollution or point source impact around the well-head were generally low however ~ 19% of sites did show concentrations above half the drinking water standard (25 mg NO_3/l). There were a small number of sources (6 in total) where concentrations exceeded the DWS of 50 mg NO_3/l on at least one occasion. Exceedences of the DWS were mainly associated with existing NVZ designated areas.

Using the mean concentrations of the sources sampled in 2004, the number of exceedences of the DWS for iron and manganese were calculated as 25 % and 43 % respectively. The numbers of exceedences in 2004 were higher than in the previous three years. However, such exceedences are not necessarily associated with pollution and may represent the general background quality of groundwater in the area where the sources were sampled.

The impact from anthropogenic activities as indicated by the presence of agricultural use compounds, reflect the generally rural setting of many of the monitored sources. Herbicides accounted for the majority of detections, however there were few examples of the relevant DWS being exceeded. Two compounds found in exceedence of the DWS (diuron and MCPA) have also been found to be among the compounds most frequently exceeding the DWS in UK groundwaters (PEWG 2000). A report by the Northern Ireland Drinking Water Inspectorate (2003) showed that MCPA has consistently been the most frequent pesticide to exceed regulatory standards since 1999. Previous Groundwater Quality Monitoring Reviews (2001-2003) have identified MCPP as the most common compound to exceed standards. Compounds associated with sheep dip were only found at one source and at a concentration well below the DWS. Solvents and hydrocarbon compounds were detected at a very small number of sources. There were no exceedences of any of the relevant DWS's. Compounds associated with the chlorination of water, such as dibromochloromethane, tribromomethane, trichloromethane and

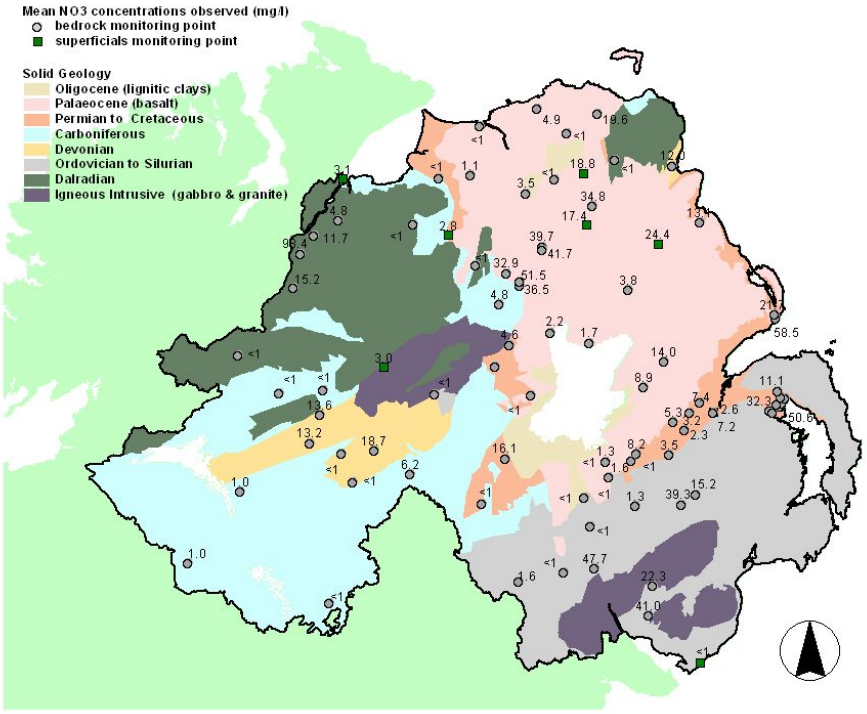
trihalomethanes were all detected at station g77 which is situated in Staffordstown just north of Lough Neagh.

Evidence of microbiological contamination was found at a significant percentage of the sources sampled in 2004. This probably reflects their vulnerable location with respect to proximity of potentially polluting sources such as septic tanks and slurry stores and the generally limited well-head protection afforded to the majority of sources.

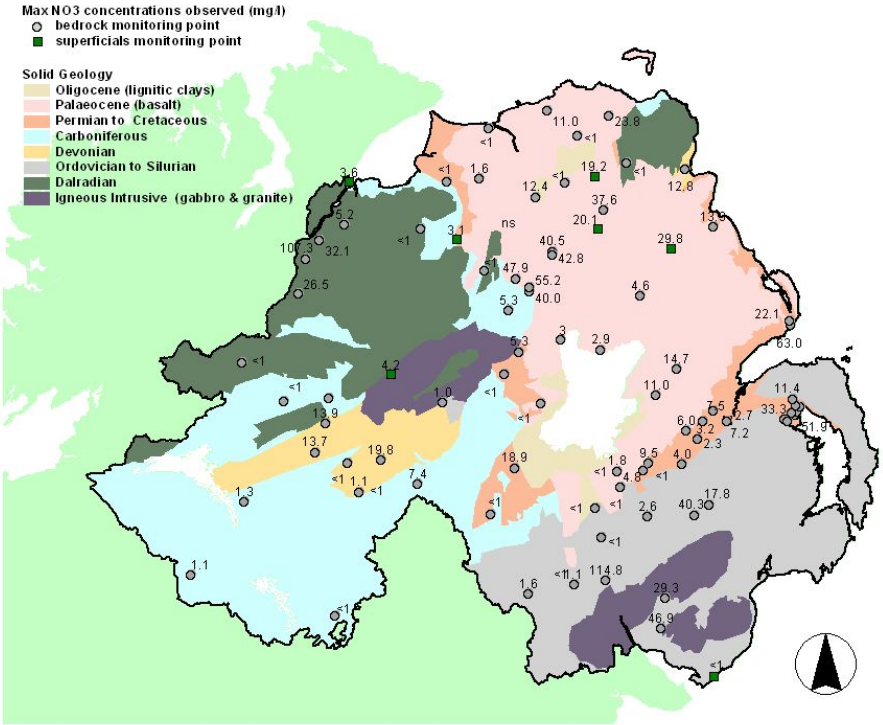
References

Environment and Heritage Service (EHS). 2004. Northern Ireland Drinking Water Quality 2003. A report by the Northern Ireland Drinking Water Inspectorate.

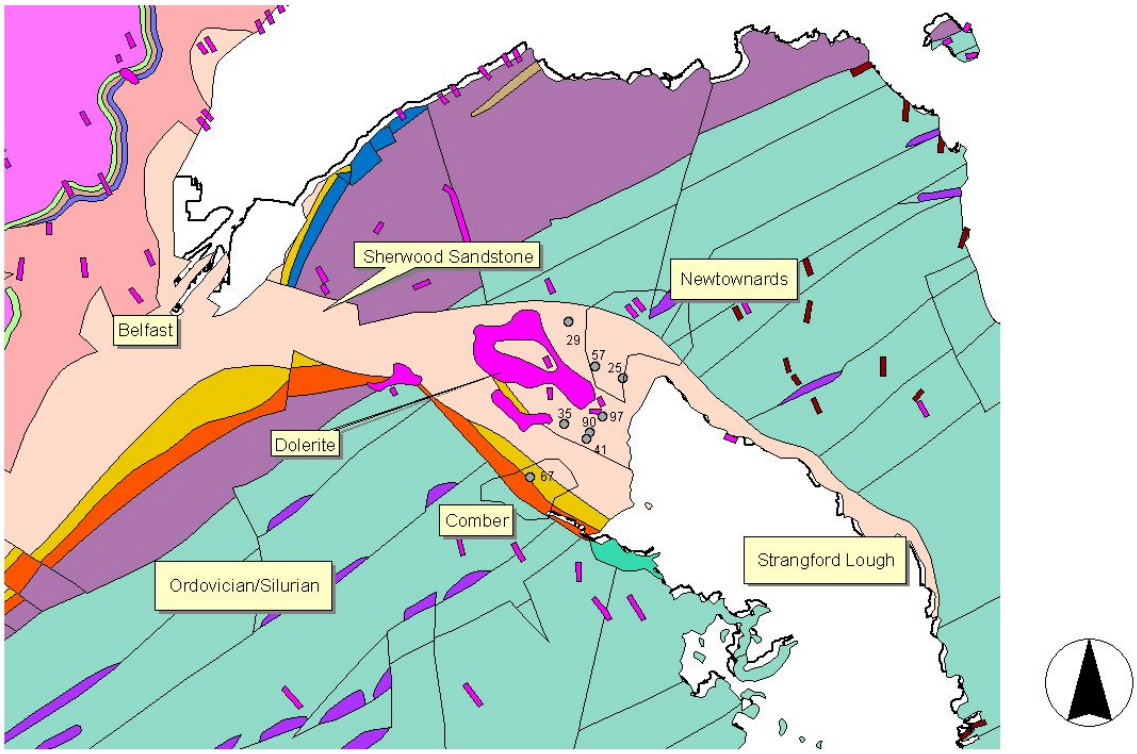
Pesticides in the Environment Working Group (PEWG) 2000. Monitoring of Pesticides in the Environment.



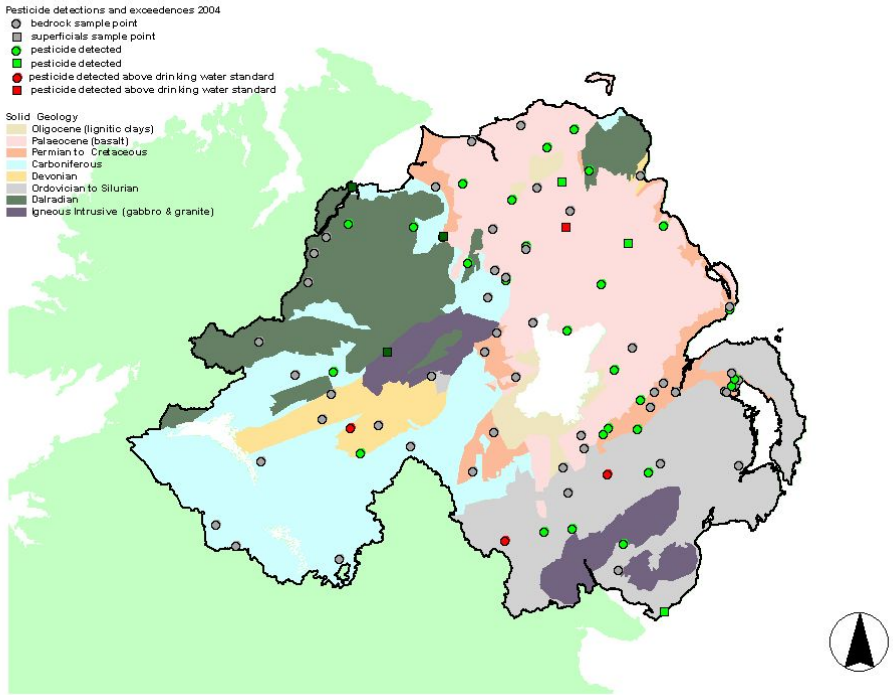
Map1 Mean Nitrate (NO_3 mg/l) Concentrations



Map 2 Maximum Nitrate (NO_3 mg/l) Concentrations



Map 3 Chloride concentrations (mg/l) in the Enler Valley



Map 4 Pesticide detections and exceedences