10 Corrective Action

Section 3.4 of DWSNZ:2000 discusses the action that should be taken in the event of a transgression of a microbiological maximum acceptable value (MAV) in the distribution zone. The section states, 'When transgression of the microbiological standards occurs there must be an immediate response. This should be documented in all cases.' Although compliance with the standards is based on the gathering of data over a 12-month period, any results where *E. coli* are detected must be acted upon immediately.

The DWSNZ:2000 also notes that a number of measures are available. Some of these, such as 'boil water' notices, are only intended to be temporary. They provide a measure of protection in an emergency situation and should not become a long-term solution. Corrective and remedial action should be continued until the problem is resolved and verified by demonstrating that 100 mL samples do not contain *E. coli* for three consecutive days.

10.1 Responses to transgressions

Table 10.1 is a summary of all distribution zones in which a transgression was reported during 2001.

Table 10.1: Corrective action following distribution zone transgressions

Population Band	Transgressions Reported	Corrective action							
		Adequate		Inadequate		Unknown		Unresolved	
		DZs	%	DZs	%	DZs	%	DZs	%
<500	238	104	44%	55	23%	79	33%	66	28%
500–999	39	25	64%	8	21%	6	15%	10	26%
1000–4999	32	25	78%	4	13%	3	9%	5	16%
5000–19,999	6	4	67%	1	17%	1	17%	0	0%
20,000–49,999	2	2	100%	0	0%	0	0%	0	0%
50,000–99,999	2	2	100%	0	0%	0	0%	0	0%
>100,000	3	3	100%	0	0%	0	0%	0	0%
Total	**322**	**165**	**51%**	**68**	**21%**	**89**	**28%**	**81**	**25%**

Of the 322 zones in which transgressions were reported, 165 (51%) were dealt with in an appropriate and timely manner. The proportion of appropriate and effective corrective actions increased with increasing zone population, with fully adequate responses in all zones serving 20,000 or more people. This means that problems are dealt with at the larger plants better than at the smaller ones, as one would expect. During 2001, 21% of zones that transgressed were reported to have received inadequate corrective action in that the corrective action was inappropriate, delayed or not carried out at all. Of these, the five zones serving 1000 or more people were: Te Puke (Western Bay of Plenty District Council), Balclutha (Clutha District Council), Ashley/Sefton Rural (Hurunui District

Council), Kaikoura Urban[*4] (Kaikoura District Council) and Woodville (Tararua District Council). A further four zones in this population band—Kawerau and Upper Valley Road (Kawerau District Council), Ashhurst (Palmerston North City Council) and Lyttelton Middle (Banks Peninsula District Council)—were unable to report if corrective action had been carried out or not.

There were occasions when the corrective actions listed were delayed rather than being an immediate response. This is inconsistent with the protection of public health. There were also numerous instances where HPOs were not aware of there being a transgression until the survey was completed (ie, incidents not reported by the water supplier to the DHB). The DWSNZ:2000 requires transgressions to be reported immediately to the Medical Officer of Health.

Several of these zones were also listed under the same category in the 2000 report. Kawerau, Kaikoura and Hurunui District Councils have failed to conduct prompt corrective action following bacteriological transgressions in the Kawerau and Upper Valley, Kaikoura Urban and Ashley/Sefton Rural zones respectively in both 2000 and 2001. The presence of *E. coli* in drinking-water is indicative of faecal contamination, and consequently, the presence of faecal pathogens. In the light of recent overseas water-borne outbreaks of pathogenic *E. coli* O157:H7 which caused several fatalities, and the fact that this pathogen was detected in some water supplies in New Zealand recently, water suppliers would be wise not to be blasé in their response to bacteriological transgressions in their drinking-water supplies.

Many of the zones in which inadequate or unknown corrective actions were reported noted that the cause of the transgression remained unresolved. Five of the 81 zones that fell into this category: supplied more than 1000 people. These were: Hauraki Plains East (Hauraki District Council), Ashley/Sefton Rural (Hurunui District Council), Burnham Camp (a Ministry of Defence supply in the Selwyn District), Warrington Township (Dunedin City Council) and Twizel (Mackenzie District Council). It is not possible from the survey data to determine whether the causes of the transgression were not resolved or simply not documented. However, the detection of *E. coli* requires:

- immediate investigation to determine their source or the reason for their occurrence (eg, chlorinator breakdown, main break)
- prompt action taken to remedy the problem
- subsequent resampling to evaluate the effectiveness of the action.

The procedure in the event of a sample not meeting the microbiological criteria is discussed in the DWSNZ:2000. Effective investigation and corrective action is critical to the protection of the public from water-borne infections.

It is evident that compliance testing is being used as a means of detecting problems in the water treatment process instead of, as is preferable, a periodic quality control check for compliance with the drinking-water standards. Water suppliers should aim to have a quality assurance system in place that gives early indication of problems before they become serious enough to become a hazard to health. To this end, the Ministry of Health recommends that all water suppliers develop PHRMPs for all drinking-water supplies (see Section 7.3 of this report). For further information about quality assurance systems, refer to

4 The Kaikoura urban drinking water supply was unchlorinated for 5 days before a routine water sample was taken. The on-going failure of the chlorinator was entirely due to the firm contracted to manage the treatment plant.Another 2 days elapsed before the microbiological transgression was notified to the Medical Officer of Health.It was only at this point in time that immediate corrective action was put in place by the Engineer.

Chapter 3 of the *Guidelines for Drinking-water Quality Management for New Zealand* (Ministry of Health 1995b).

10.2 'Boil water' notices

'Boil water' notices were issued in 130 zones serving approximately 77,000 people during 2001, which represents a decrease of almost 20% since 2000. This included permanent 'Boil Water' notices that were reported in 54 supplies serving approximately 4700 people (Appendix 10). It is recognised that many small supplies do not have treatment and the water quality in these supplies is likely to be contaminated. Customers served by these supplies should be informed of the need to boil water. Indeed, many water suppliers do take this responsible approach. However, the notification of a permanent 'boil water' notice should not be seen as a viable alternative to adequate drinking-water treatment, especially those operated by local authorities, which should have the resources to install adequate treatment. Seventeen of the zones under permanent 'boil water' notice were operated by the following local authorities: Manawatu District Council, Masterton District Council, Tasman District Council, Marlborough District Council, Kaikoura District Council, Waimate District Council, Waitaki District Council, Clutha District Council and Southland District Council.

When 'boil water' notices are necessary, it is important to advise, by mail, the whole population within the distribution zone. Notices in the newspaper, telephone notification or radio announcements may be more appropriate for larger than for smaller populations, and can be a very rapid method of notification, but omitting a mail notice will result in some residents being left out.

Recommendations

That water suppliers put in place risk management plans to detect problems or likely problems before they become a hazard to public health.

That water suppliers notify all water quality transgressions to the DHB immediately after they occur.

That local authorities install adequate water treatment instead of resorting to permanent 'boil water' notices for LA-operated drinking-water supplies.

That water suppliers undertake immediate corrective action in the event of a transgression and ensure they have response protocols in place for *E. coli* contamination of drinking-water supplies.

That water suppliers who failed to take immediate and appropriate corrective action should review their corrective action procedures.

11 Disinfection

Comparison of the data from the answer about current disinfection on the plant monitoring 1 screen and the disinfectant fields in WINZ shows discrepancies for 334 plants. In these instances, the information from the questionnaire has been taken as the more accurate because the data in WINZ may be several years old. However, it should be noted that the WINZ database will not be amended automatically from this survey; any amendments will need to be authorised by the appropriate DHB. Since drinking-water supplies can change, it is important to register such changes as they occur. Where the disinfection question was unanswered, an attempt was made to obtain this information from the DHB. However, for the purposes of this discussion, if there was no record of disinfection treatment the plants were considered as having no disinfection process.

11.1 The effect of disinfection status on microbiological quality

Table 11.1 provides an overview of the disinfection status of the treatment plants covered by this survey as they relate to microbiological quality. 'Microbiological failure' refers to plants that were monitored but failed to meet the microbiological criteria, whereas 'microbiological non-compliance' includes plants that were not monitored and those for which compliance data were not available.

Of the 2035 treatment plants, 962 (47%) were disinfected, an increase over the previous year. These plants supplied approximately 76% of the population, which is 3% more than in 2000. The remaining population was supplied by plants that were not known to be disinfected.

Table 11.1: Disinfection status

Disinfection Status	Total Treatment Plants *			Microbiological Compliance #			Microbiological Non-compliance #			Microbiological Failure #		
	No.	Pop.	TPs	No.	Pop.	TPs	No.	Pop.	TPs	No.	Pop.	TPs
Disinfected	962	76%	47%	287	82%	30%	675	18%	70%	85	2%	9%
Untreated	1054	24%	52%	174	84%	17%	880	16%	83%	26	2%	2%
Unknown	19	0.04%	1%	0	0%	0%	19	100%	100%	1	7%	5%
Total	**2035**			**461**	**82%**	**23%**	**1555**	**18%**	**76%**	**111**	**2%**	**5%**

* percentage of the total number of treatment plants or population
\# percentage of the number of treatment plants or population for that particular disinfection status

Tables 11.2 and 11.3 examine disinfection status and microbiological quality as a function of the population bracket of the treatment plant. Microbiological non-compliance includes treatment plants in which *E. coli* were detected in water as it left the plant and those that were inadequately monitored. No account of *Cryptosporidium* compliance is made here because parasite removal is largely achieved by physical removal rather than by disinfection.

Compliance in plants receiving disinfection treatment was about double that of non-disinfected plants although the total population served by compliant plants in 2001 was approximately equal.

Table 11.2: Compliance of treatment plants with disinfection

Population Band	Treatment Plants (Disinfected)			*E. coli* Compliance			*E. coli* Non-compliance *			*E. coli* Failure		
	No.	Pop.	TPs	No.	Pop.	TPs	No.	Pop.	TPs	No.	Pop.	TPs
<500	683	50%	41%	154	23%	23%	529	77%	77%	51	13%	7%
500–999	76	75%	74%	18	25%	24%	58	75%	76%	17	22%	22%
1000–4999	122	77%	74%	63	55%	52%	59	45%	48%	15	12%	12%
5000–19,999	48	68%	74%	30	62%	63%	18	38%	38%	2	7%	4%
20,000–49,999	13	44%	46%	6	45%	46%	7	55%	54%	0	0%	0%
50,000–99,999	12	78%	80%	8	68%	67%	4	32%	33%	0	0%	0%
100,000+	8	88%	80%	8	100%	100%	0	0%	0%	0	0%	0%
Total	**962**	**76%**	**47%**	**287**	**82%**	**30%**	**675**	**18%**	**70%**	**85**	**2%**	**9%**

* *E. coli* non-compliance includes no or inadequate monitoring and use of a non-registered laboratory as well as *E. coli* (transgression) failure.

The proportion of treatment plants using disinfection that did not comply with the *E. coli* criteria generally declined as the population bracket increased. Of the 81 disinfected plants serving populations of 5000 and more people, 29 did not comply with the microbiological requirements of the DWSNZ:2000. Most of these failed to monitor adequately although *E. coli* were detected in two supplies as previously indicated: Billah Street, Tokoroa (South Waikato District Council) and Alpha Street, Cambridge (Waipa District Council).

As with treatment plants that used disinfection, the compliance rate of the untreated plants increased with increasing population. Eight of the 37 treatment plants without disinfection that served populations of 5000 failed to comply microbiologically with the DWSNZ:2000. *E. coli* were detected in one of these: Whakarewarewa Forest Springs plant serving Okareke and Rotorua Eastern Suburbs (Rotorua District Council).

Table 11.3: Compliance of treatment plants without disinfection

Population Band	Treatment Plants (Untreated)			*E. coli* Compliance			*E. coli* Non-compliance*			*E. coli* Failure		
	No.	Pop.	TPs	No.	Pop.	TPs	No.	Pop.	TPs	No.	Pop.	TPs
<500	967	49%	59%	131	12%	14%	836	88%	88%	19	4%	2%
500–999	27	25%	26%	1	4%	4%	26	96%	96%	1	6%	4%
1000–4999	42	23%	26%	13	34%	31%	29	66%	66%	6	21%	14%
5000–19,999	17	32%	26%	10	57%	59%	7	43%	43%	1	5%	6%
20,000–49,999	15	56%	54%	14	96%	93%	1	4%	4%	0	0%	0%
50,000–99,999	3	22%	20%	3	100%	100%	0	0%	0%	0	0%	0%
100,000+	2	12%	20%	2	100%	100%	0	0%	0%	0	0%	0%
Total	**1073**	**24%**	**53%**	**174**	**84%**	**16%**	**899**	**16%**	**16%**	**27**	**2%**	**3%**

* *E. coli* non-compliance includes no or inadequate monitoring and use of a non-registered laboratory as well as *E. coli* (transgression) failure.

Groundwater sources were used in each of the seven treatment plants serving communities of more than 1000 people with untreated drinking-water in which *E. coli* were detected during 2001. Four of these—Alexandra Bore and Waihou River Spring (South Waikato District Council), Ashley Rural Plant (Hurunui District Council) and Reefton Plant (Buller District Council)—considered the source to be secure groundwater but had not verified this. It is possible that the water suppliers considered that the groundwater did not require treatment because it was groundwater. However, a groundwater that is contaminated with *E. coli* cannot, by definition, constitute secure groundwater. The water supplier may need

to consider disinfection of the groundwater if compliance cannot be achieved with improved management.

11.2 Methods of disinfection

The various methods of disinfection used by communities of different population bands is shown in Table 11.4.

Table 11.4: Disinfection methods used for different population bands

Population Band	Chlorinated			Ozonated			UV treated			Untreated secure g/w		
	No.	Pop.	TPs	No.	Pop.	TPs	No.	Pop.	TPs	No.	Pop.	TPs
<500	268	0.7%	16%	20	0.04%	1.2%	406	0.5%	25%	11	0.04%	1%
500–999	70	0.7%	68%	0	0%	0%	6	0.1%	6%	0	0%	0%
1000–4999	114	4%	70%	0	0%	0%	8	0.2%	5%	5	0.1%	3%
5000–19,999	48	6%	74%	0	0%	0%	0	0%	0%	12	2%	18%
20,000–49,999	13	7%	46%	1	0.4%	4%	0	0%	0%	12	8%	43%
50,000–99,999	12	12%	80%	0	0%	0%	0	0%	0%	3	3%	20%
100,000+	8	44%	80%	0	0%	0%	0	0%	0%	2	6%	20%
Total	**533**	**75%**	**26%**	**21**	**0.5%**	**1.0%**	**420**	**0.8%**	**21%**	**45**	**20%**	**2%**

A total of 533 or 26% of all treatment plants serving 75% of the population used chlorine during 2001, which makes it the most widely used disinfection method for drinking-water in New Zealand. The use of chlorine to treat drinking-water has increased slightly since 2000. Most treatment plants serving communities of 500 or more people used chlorine to treat the drinking-water supply. However, chlorination was not so common in smaller plants, with only 16% of communities of <500 being supplied with chlorinated water.

The next most popular disinfection method was UV treatment, which was used in 420 treatment plants. In the past two years there has been a large increase increase in the number of plants using UV treatment systems. A further 68 UV treatment systems were commissioned during 2001. Almost half of these were in schools, of which there were 222 reported by the end of 2001. However, UV was only used in treatment plants supplying small populations and was not used as a means of water treatment for communities of 5000 and more people.

The number of plants using ozone treatment increased by seven to 21 during 2001. Extraction of water from a secure groundwater supply was the only form of treatment in 41 (2%) plants, including several large community supplies.

No plants were recorded as using ClO_2 during 2001.

In terms of the proportion of the population covered by this survey, 75% were supplied with chlorinated water, 20% were secure groundwater, 5% received water with no disinfection treatment, 0.5% were supplied with ozonated water and 0.8% received water that was UV-treated.

Table 11.5 presents an overview of the effectiveness of disinfection systems in the treatment plants covered by the survey. Of the 2035 treatment plants surveyed, 1073 (53%) received no disinfection treatment. Of these, 45 supplies were drawn from secure groundwater sources. A further 533 (26%) were chlorinated, UV irradiation was used in

420 (21%) plants and ozone was used in 21 plants. In summary, 95% of total population was supplied with water that was either chlorinated or extracted from secure groundwater sources.

The number of groundwater supplies classified as secure decreased from 61 to 45 during the past year, which corresponded to a decrease of 2% in the proportion of the population supplied from secure groundwater sources. The reduction in secure groundwater supplies was due to the increased awareness of the requirements for the determination of secure status by water suppliers and HPOs and also to the downgrading of three supplies to non-secure groundwater following the detection of *E. coli* during 2001.

Table 11.5: Effectiveness of disinfection methods

Method of Disinfection	Total Treatment Plants			Microbiological Compliance			Microbiological Non-compliance			*E. coli* Failure		
	No.	Pop.*	TPs*	No.	Pop.#	TPs#	No.	Pop.#	TPs#	No.	Pop.#	TPs#
Chlorinated	533	75%	26%	186	82%	35%	347	18%	65%	71	2%	13%
Ozonated	21	0.5%	1%	0	0%	0%	21	100%	100%	1	2%	5%
UV treated	420	0.8%	21%	101	28%	24%	319	72%	76%	14	5%	3%
Untreated secure g/w	45	20%	2%	42	97%	93%	3	3%	7%	1	1%	2%
Untreated other	1028	5%	51%	132	6%	13%	896	94%	87%	26	2%	3%
Total	**2035**			**461**	**82%**	**23%**	**1586**	**18%**	**78%**	**85**	**1%**	**4%**

* % of the total number of treatment plants or population
\# % of the number of treatment plants or population for that particular disinfection status

Table 11.5 also indicates microbiological compliance, microbiological non-compliance and *E. coli* failure for each method of disinfection. '*E. coli* failure' refers to plants in which *E. coli* have been detected, and is a subset of 'microbiological non-compliance', which also included plants that could not demonstrate adequate monitoring.

Compliance differs widely for the different types of treatment. Of the 45 supplies for which having a secure groundwater supply was the only form of treatment, only 44 complied. In population terms, 97% of people with a secure groundwater supply received drinking-water that complied with the *E. coli* standard. However, microbiological compliance of secure groundwater supplies compared favourably to other forms of treatment. Compliance was achieved by 35% of chlorinated supplies. This is equivalent to 82% compliance for the population that received chlorinated drinking-water in 2001. Compliance was achieved in none of the 21 ozonated supplies, mostly due to no or inadequate monitoring. In comparison, compliance was achieved in 101 (24%) of the 420 UV-treated supplies, which represented 28% of the population served by UV treatment plants. Non-compliance of UV-treated supplies was mostly caused by failure to monitor for *E. coli*, although *E. coli* were detected in 14 of the 128 UV-treated supplies that were monitored during the year.

Water supplies that were neither treated nor extracted from secure groundwater sources comprised 51% of supplies, although this category of water was used to supply only 5% of the population. Only 13% of these supplies complied bacteriologically; non-compliance was mostly due to a lack of monitoring in the predominantly small communities. However, 102 of the 132 supplies in this category served small communities that were exempt from treatment plant monitoring. All of the remainder were groundwater supplies. These will fall into one of two categories:

- supplies that might prove to be secure groundwater if their security were to be assessed

- supplies that are subject to contamination but in which *E. coli* were not detected during 2001.

It might be worthwhile for the water suppliers to determine whether any of these supplies (listed in Appendix 11) fall into the former category, as a secure groundwater source is a valuable asset.

Table 11.6 shows the compliance of treatment plants that used each disinfection method for different population bands. The numbers of compliant plants are then presented as a percentage of the total number of plants using some form of disinfection for that population band.

Table 11.6: Disinfection methods by population band in complying treatment plants

Population Band	Chlorinated		UV-treated		Ozonated		Untreated Secure Groundwater		No or Unknown Treatment	
	No.	Compliant*	No.	Compliant	No.	Compliant	No.	Compliant	No.	Compliant
<500	59	22%	95	23%	0	0%	11	100%	120	13%
500–999	17	24%	1	17%	0	-	0	-	1	4%
1000–4999	58	51%	5	63%	0	-	5	100%	8	22%
5000–19,999	30	63%	0	-	0	-	10	83%	0	0%
20,000–49,999	6	46%	0	-	0	0%	11	92%	3	100%
50,000–99,999	8	67%	0	-	0	-	3	100%	0	-
100,000+	8	100%	0	-	0	-	2	100%	0	-
Total	**186**	**35%**	**101**	**24%**	**0**	**0%**	**42**	**93%**	**132**	**13%**

* percentage compliance is calculated using the total number of plants using each type ot treatment for each population band (from Table 11.4)

Ozone or UV treatment can provide good disinfection when operated properly in the treatment of water of satisfactory physical quality. However, care should be taken when selecting treatments that do not provide residual disinfection, particularly where post-treatment contamination is likely or is known to occur or in those zones with aged or lengthy reticulation systems, which are prone to bio-fouling. Even before the reticulated water quality is considered, suppliers must take greater care with implementation of the disinfection process. Ultraviolet treatment systems were installed by some water suppliers for reasons of cost and convenience at the possible expense of effective microbiological treatment. The water supplier must understand the importance of regular maintenance and operational checks if any protection is to be gained from UV treatment. As UV treatment is particularly susceptible to failure in turbid or coloured water, careful consideration should be given before installing ultraviolet systems for surface water sources that can sometimes have poor physical condition. This is particularly pertinent for schools, many of which have recently installed UV treatment.

There are several causes of disinfection failure:

- inappropriate type of disinfection system
- ineffective control system
- inadequate control/supervision/maintenance.

Unlike most other disinfectants, UV treatment does not leave a residual disinfectant in the water. Consequently, there is nothing to inhibit bacterial regrowth in the reticulation system or to protect against micro-organisms if the water supply is susceptible to post-treatment contamination.

There are several types of disinfectant dosing systems. Some types offer better control of the disinfection process than others.

The best protection is offered by the automatic dosing systems that analyse the residual disinfectant downstream of the dosing point and which adjust the disinfectant dose rate to maintain a constant residual concentration. In chlorinated systems these are known as 'continuous free available chlorine monitors'. These systems adjust for water flow and variable water quality.

Flow proportional systems administer disinfectant at a rate proportional to the water flow through the treatment plant. However, they do not compensate for the extra disinfectant demand caused by poor water quality, such as might be expected after heavy rain when river turbidity levels increase. Consequently, they afford little protection against microbiological contamination at the times when it is likely to be at its worst.

Constant dose systems apply disinfectant at a constant rate. This results in fluctuations in disinfectant concentration with varying water flows through the treatment plant and offers the least protection when the water usage is highest. As with flow proportional systems, these afford little protection against microbiological contamination at the times when it is likely to be at its worst.

Sporadic or hand dosing offers little protection. It is generally used in circumstances when water quality is known to be poor, such as in a surface water supply during heavy rain. While this practice is likely to offer some protection during these events, there is no protection at other times when microbiological contamination may, and frequently does, occur without obvious indication of contamination.

Recommendations

That water suppliers advise the DHBs of changes to water supply and treatment when they occur so that WINZ can be amended accordingly.

That water treatment in plants that do not comply with the microbiological criteria, particularly those supplying larger communities, be reviewed by the local authorities/water suppliers and improved to comply with the DWSNZ:2000.

That the management of groundwater supplies that fail the *E. coli* compliance criteria be reviewed and regraded.

That a study of the factors adversely affecting the microbiological quality of UV-treated drinking-water in New Zealand is undertaken to allow advice to be given to water suppliers as to when UV treatment is suitable for a supply.

That water suppliers assess whether any of the supplies listed in Appendix 11 are likely to be eligible to become secure groundwaters; if so, their determination of security is to be encouraged.

12 The Drinking-Water Standards for New Zealand: 2000

On 1 January 2001, the DWSNZ:1995 were replaced by the DWSNZ:2000. Consequently, this report assesses compliance of water supplies in 2001 against the requirements specified in the DWSNZ:2000. Local authorities and water suppliers should note that it is no longer applicable to refer to the DWSNZ:1995, which are now defunct. This should be particularly noted by those LAs which, as recently as 1999, still referred to the NZDWS:1984 in their annual plans long after that standard had been replaced by the DWSNZ:1995.

The following section has been included in this report to summarise the differences between the DWSNZ:1995 and the DWSNZ:2000 that are most pertinent to microbiological compliance. These are included to assist LAs and water suppliers understand some of the ramifications of the new standards. However, it should be noted that, because some amendments to the DWSNZ:2000 have been mooted, this discussion may be incomplete and is not intended as a substitute for thorough reading of the new standards.

12.1 Some of the implications of microbiological compliance of the DWSNZ:2000

The main bacterial indicator of faecal contamination has been changed from faecal coliforms to *E. coli*. This change has little consequence for water suppliers, however, because the DWSNZ:1995 allowed *E. coli* to be used in place of faecal coliforms anyway and the DWSNZ:2000 allows monitoring of faecal coliforms or total coliforms instead of *E. coli*.

However, the change in the referee methods used for drinking-water compliance testing will have implications for the laboratories. The new referee methods are specified in Section 11.1.1 of the DWSNZ:2000 and are described as follows.

***E. coli*:** Enzyme Substrate Coliform Test (APHA 9223 B)

- Presence/Absence
- Multi-Well MPN (Quantitray)
- MPN (multiple tube technique)

Faecal coliforms: Multiple tube fermentation (APHA 9221 E)

Total coliforms: Multiple tube fermentation (APHA 9221 B)

Laboratories wishing to use other methods for drinking-water compliance testing after September 2002 will have to calibrate their methods against one of the referee methods listed above before this date. However, some methods may have already been validated, so they will need to check with the Ministry of Health first to see if their method has already been calibrated against one of the referee methods.

The minimum frequencies of compliance sampling has also changed. Table 3.1 of the DWSNZ:2000 specifies the minimum sampling frequencies for *E. coli* for water leaving the treatment plant. These frequencies specify the number of samples to be taken per quarter

(three months) to fit in with the WINZ requirement for compiling the data on a quarterly basis. The changes to the minimum sampling requirements for various types of supplies have been modified as follows:

- secure groundwater supplies – the reduction to 1/quarter after the initial 12 monthly samples no longer applies
- supplies* serving fewer than 500 people – minimum sampling reduced from 1/week to 3/quarter (1/month)
- non-chlorinated supplies* serving 501–5,000 people – minimum sampling reduced from 2/week to 13/quarter (1/week)
- chlorinated supplies* serving 501–5,000 people – minimum sampling reduced from 1/week to 10/quarter
- supplies* serving more than 10,000 people that are not fully chlorinated – minimum sampling increased from 2/week to 92/quarter (daily)
- supplies serving fewer than 100 people in one to three buildings and that have only a short reticulation system (eg, most school supplies) are exempt from *E. coli* testing of water leaving the treatment plant.

The sampling requirement has become more prescriptive in that Table 3.1 of the DWSNZ:2000 also specifies the maximum interval between successive samples and also the minimum number of days of the week on which sampling is to be conducted (i.e. 3 days per week means that samples must not all be taken on Mondays, for example, but on at least three different days during the quarter).

The maximum interval between successive samples and the minimum number of days of the week on which sampling is to be conducted in the distribution zone is specified in Table 3.2b of the DWSNZ:2000. The minimum sampling frequency in the distribution zone is largely unchanged.

The DWSNZ:2000 refer to protozoa instead of *Giardia* and *Cryptosporidium*. *Giardia* compliance has been removed from the new standards, which focus on *Cryptosporidium*. The rationale for this is that any treatment that will kill or remove *Cryptosporidium* will also remove *Giardia*, making the old *Giardia* compliance criteria superfluous.

As with the previous standards, protozoa compliance is dependent on the type of treatment, but the protozoa compliance requirements have been generally tightened up and described below.

- Filtration without coagulation – the filtration process must now be validated by demonstrating a 4-log removal$^{\Psi}$ of particles in the 3–15μm size range.
- Coagulation – turbidity monitoring is unchanged but the stringency has increased. The 95th percentile limit of 0.5 NTU will drop to 0.1 NTU in 2005 and the maximum turbidity spike will drop from 1.0 NTU to 0.5 NTU at the same time.
- Disinfection without filtration – chlorination is no longer acceptable for protozoa compliance. The C.t values for ozone and chlorine dioxide are now temperature-dependent (see Table 13.1 of the DWSNZ:2000).

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* not including secure groundwater supplies

$^{\Psi}$ this is likely to be changed to a 3-log removal in the revision of the DWSNZ:2000

The criteria for the demonstration of groundwater security have also been revised. The new requirements are that the supply must:

- have a secure well-head
- be able to demonstrate an absence of *E. coli* in 12 consecutive monthly samples and maintain a sampling programme to demonstrate continued compliance with the E. *coli* requirement

and either

- demonstrate that less than 0.005% of the water shall have been present in the aquifer for less than one year (using the tritium and/or CFC methods)

and/or

- demonstrate that variations in the groundwater characteristics shall not exceed a coefficient of variation of more than:
    - 3.0% in conductivity
    - 4.0% in chloride concentration
    - 2.5% in nitrate concentration (by standardised variance)

  when measured 12 times at regular intervals for 1–3 years.

More emphasis has been placed on quality assurance in the new standards. External calibration of equipment used to monitor water treatment processes (eg, particle counters, turbidity meters, chlorine/ozone/chlorine dioxide analysers etc) is now specified.

12.2 The transition from the DWSNZ:1995 to the DWSNZ:2000

The 2001 annual survey, for the first time, uses the compliance requirements of the DWSNZ:2000. The new standards have incorporated several changes into compliance criteria at both the distribution zone and treatment plant level.

To understand the implications of the changes it is first necessary to describe the relevant changes to the drinking-water standards.

The following aspects of the DWSNZ:2000 have made compliance more difficult to achieve in the distribution zone:

- the tolerance for bacteriological transgression has decreased slightly
- there is now a prescribed minimum number of days of the week upon which monitoring samples must be taken
- there is now a prescribed maximum number of days between successive monitoring samples.

The following aspects of the DWSNZ:2000 have made compliance easier to achieve at the treatment plant:

- a reduction in the minimum frequency of *E. coli* monitoring for surface and non-secure groundwater supplies serving 10,000 people or fewer

- some supplies serving 100 or fewer people (mostly schools) are now exempt from *E. coli* monitoring at the treatment plant
- there is now some tolerance for treatment plants in which *E. coli* are detected whereas, previously, a single transgression resulted in non-compliance.

The following aspects of the DWSNZ:2000 have made compliance more difficult to achieve at the treatment plant:

- the minimum frequency of *E. coli* monitoring for surface and non-secure groundwater supplies serving 10,001 to 100,000 people has increased
- an increase in the minimum frequency of *E. coli* monitoring to maintain secure groundwater status from one per two months to one per month
- there is now a prescribed minimum number of days of the week upon which monitoring samples must be taken and a prescribed maximum number of days between successive monitoring samples
- compliance with the protozoan compliance criteria is now much more stringent for plants using filtration without coagulation because their ability to remove particles in the 3–15 μm size range now needs to be demonstrated
- the requirement for continuous turbidity monitoring for treatment plants using a coagulation/filtration process now applies to those plants serving more than 10,000 people.

As a result of these changes it is not valid to compare directly the level of compliance in previous reports that were based on the DWSNZ:1995 with compliance with the DWSNZ:2000. A supply that complied with the DWSNZ:1995 but not with the DWSNZ:2000 does not necessarily reflect a reduction in the level of treatment nor a decrease in drinking-water quality but may merely reflect a change in the stringency of the compliance criteria.

Consequently, the data are presented in two different ways. The present status of the water supplies was reported against the DWSNZ:2000 – this provides a snapshot of the present status and will serve for comparisons in future reports. However, for the purposes of comparison with the previous year's results, the 2001 data, where possible, was converted to compliance with the DWSNZ:1995.

The effect of the shift to the compliance criteria of the DWSNZ:2000 has been a decrease in distribution zone compliance caused mainly by the days-of-the-week requirement for monitoring. This requirement also reduced the degree of adequate monitoring at the zones. The effect is illustrated in Tables 12.1 and 12.2 which give a direct comparison between compliance with the DWSNZ:2000 and compliance that would have been achieved using the DWSNZ:1995.

The effect of the shift to the treatment plant compliance criteria of the DWSNZ:2000 has been a small net decrease in both *E. coli* and *Cryptosporidium* compliance (refer to Tables 12.3 and 12.4). With regard to *E. coli* compliance, the increase caused by exempton from monitoring for some of the supplies serving less than 100 people was balanced against other supplies that failed to comply with the DWSNZ:2000 due to the days-of-the-week requirement for monitoring. The decrease in *Cryptosporidium* compliance was particularly evident in the small supplies and was caused mostly by the need to assess particle removal for plants using cartridge filtration to comply with the DWSNZ:2000.

Table 12.1: Comparison between distribution zone compliance using the DWSNZ:1995 and the DWSNZ:2000 by health district

Health district	Total no. DZs	*E. coli* compliance					
		DWSNZ:1995			DWSNZ:2000		
		No.	% pop	% DZs	No.	% DZs	% pop
Northland	251	33	86%	13%	30	81%	12%
Auckland	223	60	98%	27%	59	98%	26%
Waikato	189	69	81%	37%	69	81%	37%
Tauranga	52	3	74%	6%	3	74%	6%
Rotorua	96	29	66%	30%	25	21%	26%
Whakatane	41	6	54%	15%	5	53%	12%
Gisborne	55	4	91%	7%	4	91%	7%
Taranaki	88	16	74%	18%	13	69%	15%
Hawkes Bay	118	27	93%	23%	27	93%	23%
Wanganui	52	12	86%	23%	11	18%	21%
Manawatu	88	13	85%	15%	12	77%	14%
Wairarapa	33	1	58%	3%	0	0%	0%
Hutt Valley	52	36	100%	69%	36	100%	69%
Nelson	68	23	89%	34%	23	89%	34%
Marlborough	84	9	78%	11%	9	78%	11%
West Coast	75	13	74%	17%	13	74%	17%
Canterbury	241	66	78%	27%	46	7%	19%
S. Canterbury	60	14	81%	23%	11	79%	18%
Otago	158	23	58%	15%	11	4%	7%
Southland	85	18	11%	21%	18	11%	21%
Total	**2109**	**475**	**85%**	**23%**	**425**	**70%**	**20%**

Table 12.2: Comparison between distribution zone compliance using the DWSNZ:1995 and the DWSNZ:2000 by population band

Population Band	Total no. DZs	*E. coli* compliance					
		DWSNZ:1995			DWSNZ:2000		
		No.	% pop	% DZs	No.	% pop	% DZs
<500	1717	254	25%	15%	232	23%	14%
500–999	117	35	31%	30%	30	26%	26%
1000–4999	162	94	62%	58%	82	56%	51%
5000–19,999	72	52	77%	72%	48	69%	67%
20,000–49,999	31	30	95%	97%	25	77%	81%
50,000–99,999	5	5	100%	100%	4	78%	80%
100,000+	5	5	100%	100%	4	80%	80%
TOTAL	**2109**	**475**	**85%**	**23%**	**425**	**70%**	**20%**

Table 12.3: Comparison between treatment plant compliance using the DWSNZ:1995 and the DWSNZ:2000 by health district

Health District	Total No. TPs	*E. coli* compliance						*Cryptosporidium* compliance					
		DWSNZ:1995			DWSNZ:2000			DWSNZ:1995			DWSNZ:2000		
		No.	pop	TPs	No.	pop	TPs	No.	pop	TPs	No.	pop	TPs
Northland	252	12	79%	5%	123	90%	49%	95	66%	38%	14	60%	6%
Auckland	192	17	99%	9%	20	99%	10%	37	99%	19%	7	97%	4%
Waikato	179	20	63%	11%	43	71%	24%	29	24%	16%	15	14%	8%
Tauranga	49	11	97%	22%	3	81%	6%	11	43%	22%	5	43%	10%
Rotorua	90	13	68%	14%	20	30%	22%	14	18%	16%	6	16%	7%
Whakatane	38	5	61%	13%	7	53%	18%	4	58%	11%	4	58%	11%
Gisborne	56	2	47%	4%	2	47%	4%	1	47%	2%	1	47%	2%
Taranaki	80	8	81%	10%	27	87%	34%	25	74%	31%	0	0%	0%
Hawkes Bay	123	24	94%	20%	31	94%	25%	41	93%	33%	22	92%	18%
Wanganui	54	5	74%	9%	11	79%	20%	9	18%	17%	4	12%	7%
Manawatu	89	20	94%	22%	13	40%	15%	26	86%	29%	9	86%	10%
Wairarapa	35	4	72%	11%	3	50%	9%	5	62%	14%	0	0%	0%
Hutt Valley	31	9	99%	29%	11	99.8%	35%	6	98%	19%	5	98%	16%
Nelson	74	11	93%	15%	18	94%	24%	27	39%	36%	8	38%	11%
Marlborough	87	6	78%	7%	8	80%	9%	11	6%	13%	1	4.8%	1%
West Coast	73	5	44%	7%	15	45%	21%	15	19%	21%	1	16%	1%
Canterbury	249	16	79%	6%	34	76%	14%	25	71%	10%	11	71%	4%
S. Canterbury	61	6	64%	10%	9	26%	15%	4	49%	7%	0	0%	0%
Otago	143	17	59%	12%	44	7%	31%	6	2%	4%	3	1%	2%
Southland	80	14	82%	18%	19	35%	24%	8	16%	10%	3	15%	4%
Total	**2035**	**225**	**89%**	**11%**	**461**	**82%**	**23%**	**399**	**77%**	**20%**	**119**	**74%**	**6%**

Table 12.4: Comparison between treatment plant compliance using the DWSNZ:1995 and the DWSNZ:2000 by population band

Population band	Total No. TPs	*E. coli* compliance						*Cryptosporidium* compliance					
		DWSNZ:1995			DWSNZ:2000			DWSNZ:1995			DWSNZ:2000		
		No.	pop	TPs	No.	pop	TPs	No.	pop	TPs	No.	pop	TPs
<500	1650	41	0.1%	2%	285	0.4%	17%	279	0.4%	17%	26	0.1%	2%
500–999	103	23	0.2%	22%	19	0.2%	18%	10	0.1%	10%	4	0.04%	4%
1000–4999	164	66	3%	40%	76	3%	46%	40	2%	24%	28	1%	17%
5000–19,999	65	45	6%	69%	40	5%	62%	34	5%	52%	27	4%	42%
20,000–49,999	28	25	15%	89%	20	12%	71%	16	10%	57%	14	9%	50%
50,000–99,999	15	15	15%	100%	11	11%	73%	11	11%	73%	11	11%	73%
100,000+	10	10	50%	100%	10	50%	100%	9	48%	90%	9	48%	90%
Total	**2035**	**225**	**89%**	**11%**	**461**	**82%**	**23%**	**399**	**77%**	**20%**	**119**	**74%**	**6%**

13 References

Board of Health. 1984. *Drinking-Water Standards for New Zealand*. Wellington: Board of Health.

Millar JA and Hasell SK. 1994. *Systematic Microbiological Surveillance of Drinking-water for 1992 and 1993*. Report FW94/7. Christchurch: Institute of Environmental Science and Research Ltd.

Ministry of Education. 1998. *Health and Safety Code of Practice for State Primary, Composite and Secondary Schools*. Wellington: Ministry of Education.

Ministry of Health. 1995a. *Drinking-Water Standards for New Zealand: 1995*. Wellington: Ministry of Health.*

Ministry of Health. 1995b. *Guidelines for Drinking-water Quality Management for New Zealand*. Wellington: Ministry of Health.

Ministry of Health. 1996. *Microbiological Quality of Drinking-Water in New Zealand 1995*. Wellington: Ministry of Health.

Ministry of Health. 1997. *Annual Review of the Microbiological Quality of Drinking-Water in New Zealand 1996*. Wellington: Ministry of Health.

Ministry of Health. 1998. *Annual Review of the Microbiological Quality of Drinking-Water in New Zealand 1997*. Wellington: Ministry of Health.

Ministry of Health. 1999. *Annual Review of the Microbiological Quality of Drinking-Water in New Zealand 1998*. Wellington: Ministry of Health.

Ministry of Health. 2000a. *Annual Review of the Microbiological Quality of Drinking-Water in New Zealand 1999*. Wellington: Ministry of Health.

Ministry of Health. 2000b. *Drinking-Water Standards for New Zealand: 2000*. Wellington: Ministry of Health. **

Ministry of Health. 2001a. *Annual Review of the Microbiological Quality of Drinking-Water in New Zealand 2000*. Wellington: Ministry of Health.

Ministry of Health. 2001b. *Register of Community Drinking-water Supplies in New Zealand*. 2001 Edition. Wellington: Ministry of Health.

Nokes CJ. 1995. *Systematic Microbiological Surveillance of Drinking-water for 1994*. Report FW95/30. Christchurch: Institute of Environmental Science and Research Ltd.

http://www.stats.govt.nz/domino/external/Web/nzstories.nsf/1167b2c70ca821cb4c2568080081e089/6453c1f4afce6e68cc256b1e007b742b?OpenDocument

* Referred to in the text as DWSNZ:1995.
** Referred to in the text as DWSNZ:2000.