Proposed Drinking-water Standards for New Zealand 2021

DRAFT

The Standards

Water suppliers are required to provide their consumers with safe water, ie, water that is unlikely to cause harm either immediately or over a period of time. To assist in determining when a drinking water is safe to consume, these standards set limits on the concentration of determinands in the water (maximum acceptable values, MAV) and specify expected outcomes from the treatment of the water. Compliance with these standards is necessary, but not sufficient, for establishing that drinking-water is safe.

The standards apply to all supplies, regardless of the nature of the source water in use, and number of people served by the supply. All consumers on a supply should receive water that meets these standards and therefore the standards must be met at all points in a distribution system.

While the standards establish limits on the composition of the water all consumers should receive, they do not specify the monitoring required to show, to an acceptable level of confidence, that they are being met. Monitoring requirements and other compliance criteria are contained in the **compliance rules** (see doc???).

The standards do not promote drinking-water as a means of addressing dietary deficiencies. Consequently, they do not specify minimum determinand concentrations required to achieve beneficial health effects. In particular, they do not specify the concentration of fluoride required for benefiting dental health, nor do they state a requirement for water fluoridation.

Maximum acceptable values

The MAV of a micro-organism is its concentration in drinking-water above which there is a significant risk of contracting a waterborne (enteric) disease. MAVs are not given for all microorganisms of health significance (pathogens). Instead, MAVs are provided for representative organisms: *Escherichia coli (E. coli)*, representative of bacteria, and *Cryptosporidium* plus *Giardia*, representative of protozoa. *E. coli* is used an indicator bacterial risk. Its presence is evidence of recent faecal pollution and therefore of the possible presence of pathogens.

The MAV of a chemical determinand is the highest concentration of the determinand expected, on the basis of present knowledge, not to cause any significant risk to the health of the consumer over 70 years of consumption of 2 litres per day of that water. MAVs for carcinogenic determinands are conservatively set, where possible, as the concentration in drinking-water associated with an estimated excess lifetime cancer risk of 10^{-5} (or one additional case of cancer per 100 000 of the population ingesting drinking-water containing the substance at the guideline value for 70 years).

Wherever possible, the MAVs are derived from World Health Organization (WHO) guideline values adjusted for a 70 kg bodyweight, where bodyweight is required in the calculation. Some MAVs have been set in the absence of a WHO guideline value, for one of two reasons.

a. The WHO has derived a health-based value, but not established a formal guideline value, often because the determinand occurs at concentrations well below those of health concern. Where there is evidence of the determinand being detected at concentrations near the health based value in New Zealand waters, the MAV has been set at the WHO's health-based value (bodyweight corrected).

b. A determined is, or has been, registered or approved for use in New Zealand but the WHO provides neither a guideline value nor a health-based value. In these cases, the MAV calculation is based on toxicological data considered appropriate by another international body or the *Australian Drinking-water Guidelines*.

MAVs are not provided for emerging contaminants for which there is no WHO guideline or health-based value.

Advances in scientific knowledge may lead to changes in the MAVs. When evidence for these changes becomes available, revised MAVs will be included in later editions of the Standards.

Treatment outcomes

Treatment outcomes are values for water quality determinands that can influence the presence of health significant determinands, but have no MAV. Consequently, their value cannot be controlled through compliance with a MAV.

Treatment outcomes are applicable to supplies of all sizes. They must be met for a water supply to be compliant with the Standards. The details for demonstrating that a treatment outcome is met, to a satisfactory level of confidence, are specified in the relevant compliance rules.

Maximum acceptable value Tables

MAVs for microbiobiological determinands

Determinand	MAV[1]
Escherichia coli[2]	Less than 1 in 100 ml of sample
Viruses	
Total pathogenic protozoa	Less than one infectious (oo)cyst per 100 L of sample[3]

1. These are maximum acceptable values for regulatory purposes. They do not represent a dose/response relationship that can be used as the basis for determining acceptable concentrations of pathogens in drinking-water.
2. Indicator organism.
3. The methods available for enumerating pathogenic protozoa are becoming less expensive and more reliable, but they are not yet suitable for routine monitoring of treated water quality. Although new methods of assessing the infectiousness of protozoa by using human cell cultures have been developed, they are not yet suitable for routine monitoring of *Cryptosporidium* contamination of drinking-water. The referee method cannot identify the species of *Giardia* or *Cryptosporidium*; nor can it determine the viability or infectivity of detected cysts or oocysts (ie, (oo)cysts). Until the methodology improves, results are to be reported as verified (oo)cysts.

MAVs for inorganic determinands

Determinand	MAV	Units	Notes
Aluminium	1	mg/L	Health-based value derived by WHO, but no guideline value established. Concentrations near the MAV in some NZ supplies.
Antimony	0.02	mg/L	
Arsenic	0.01	mg/L	For excess lifetime skin cancer risk of 6×10^{-4}. Limited by analytical and treatment difficulties.
Barium	1.5	mg/L	
Boron	2.4	mg/L	
Bromate	0.01	mg/L	For excess lifetime cancer risk of 7×10^{-5}.
Cadmium	0.003	mg/L	

Chlorate	0.7	mg/L	Disinfection must never for compromised.
Chlorine	5	mg as Cl_2/L	Disinfection must never for compromised.
Chlorite	0.8	mg/L	Disinfection must never for compromised. DBP
Chromium	0.05	mg/L	Total chromium
Copper	2	mg/L	
Fluoride	1.5	mg/L	
Lead	0.01	mg/L	
Manganese	0.4	mg/L	Health-based value derived by WHO, but no guideline value established. Concentrations near the MAV in some NZ supplies.
Mercury	0.006	mg/L	Inorganic mercury
Monochloramine	3	mg as Cl_2/L	
Nickel	0.08	mg/L	
Nitrate, short term	50	mg/L	
Nitrite, short term	3	mg/L	
Nitrate and nitrite	The sum of the ratio of the concentration of each to its respective MAV should not exceed 1		
Perchlorate	0.08	mg/L	Disinfection must never for compromised.
Selenium	0.04	mg/L	
Uranium	0.03	mg/L	

MAVs for organic determinands [Cyanotoxin MAVs are not included. They are being updated by the Cawthron institute and will be added later]

Determinand	MAV	Units	Notes
Acrylamide	0.0005	mg/L	For excess lifetime cancer risk of 10^{-5}.
Alachlor	0.02	mg/L	Pesticide. For excess lifetime cancer risk of 10^{-5}.
Aldicarb	0.01	mg/L	Pesticide
Aldrin + dieldrin	0.00004	mg/L	Pesticide. Sum of, not each.
Atrazine	0.1	mg/L	Pesticide. Sum of atrazine and its metabolites
Azinphos methyl	0.1	mg/L	Pesticide.
Benzene	0.01	mg/L	For excess lifetime cancer risk of 10^{-5}.
Benzo(a)pyrene	0.0007	mg/L	For excess lifetime cancer risk of 10^{-5}.
Bromacil	0.4	mg/L	Pesticide.
Bromodichloromethane	0.06	mg/L	DBP. For excess lifetime cancer risk of 10^{-5}.
Bromoform	0.1	mg/L	DBP
Carbofuran	0.008	mg/L	Pesticide
Carbon tetrachloride	0.005	mg/L	
Chlordane	0.0002	mg/L	Pesticide
Chloroform	0.4	mg/L	DBP
Chlorotoluron	0.04	mg/L	Pesticide
Chlorpyriphos	0.04	mg/L	Pesticide
Cyanazine	0.0007	mg/L	Pesticide
2,4-D	0.04	mg/L	Pesticide
2,4-DB	0.1	mg/L	Pesticide
DDT + isomers	0.001	mg/L	Pesticide. Sum of all isomers

Determinand	MAV	Units	Notes
Di(2-ethylhexyl)phthalate	0.009	mg/L	
1,2-Dibromo-3-chloropropane	0.001	mg/L	For excess lifetime cancer risk of 10^{-5}.
Dibromoacetonitrile	0.08	mg/L	DBP
Dibromochloromethane	0.15	mg/L	DBP
1,2-Dibromoethane	0.0004	mg/L	For excess lifetime cancer risk of 10^{-5}.
Dichloroacetic acid	0.05	mg/L	DBP
Dichloroacetonitrile	0.02	mg/L	DBP
1,2-Dichlorobenzene	1.5	mg/L	
1,4-Dichlorobenzene	0.4	mg/L	
1,2-Dichloroethane	0.03	mg/L	For excess lifetime cancer risk of 10^{-5}.
1,2-Dichloroethene	0.06	mg/L	Total of cis and trans isomers
Dichloromethane	0.02	mg/L	
1,2-Dichloropropane	0.05	mg/L	
1,3-Dichloropropene	0.02	mg/L	Total of cis and trans isomers. For excess lifetime cancer risk of 10^{-5}.
Dichlorprop	0.1	mg/L	Pesticide
Dimethoate	0.008	mg/L	Pesticide
1,4-Dioxane	0.06	mg/L	For excess lifetime cancer risk of 10^{-5}.
Diuron	0.02	mg/L	Pesticide
EDTA (editic acid)	0.7	mg/L	
Endrin	0.001	mg/L	Pesticide
Epichlorohydrin	0.0005	mg/L	
Ethylbenzene	0.3	mg/L	
Fenoprop	0.01	mg/L	Pesticide
Hexachlorobutadiene	0.0007	mg/L	
Hexazinone	0.4	mg/L	Pesticide
Hydroxyatrazine	0.3	mg/L	Atrazine metabolite
Isoproturon	0.01	mg/L	Pesticide
Lindane	0.002	mg/L	Pesticide
MCPA	0.8	mg/L	Pesticide. Health-based value derived by WHO, but no guideline value established. Occasionally found in NZ bores, at concentrations an order of magnitude below the MAV.
Mecoprop	0.01	mg/L	Pesticide
Metalaxyl	0.3	mg/L	Pesticide
Methoxychlor	0.02	mg/L	Pesticide
Metolachlor	0.01	mg/L	Pesticide
Metribuzin	0.07	mg/L	Pesticide
Molinate	0.007	mg/L	Pesticide
Monochloroacetic acid	0.02	mg/L	DBP
Nitrilotriacetic acid (NTA)	0.2	mg/L	
N-nitrosodimethylamine (NDMA)	0.0001	mg/L	
Oryzalin	0.4	mg/L	Pesticide
Oxadiazon	0.2	mg/L	Pesticide
Pendimethalin	0.02	mg/L	Pesticide
Pentachlorophenol	0.009	mg/L	Pesticide. For excess lifetime cancer risk of approximately $10^{-5.}$
PFHxS[2] + PFOS[3]	0.00007	mg/L	Sum of
PFOA[4]	0.00056	mg/L	
Picloram	0.2	mg/L	Pesticide
Pirimiphos methyl	0.1	mg/L	Pesticide
Primisulfuron methyl	0.9	mg/L	Pesticide

Determinand	MAV	Units	Notes
Procymidone	0.4	mg/L	Pesticide
Propazine	0.07	mg/L	Pesticide
Pyriproxifen	0.4	mg/L	Pesticide
Simazine	0.002	mg/L	Pesticide
Sodium dichloroisocyanurate (as cyanuric acid)	40	mg /L	
Styrene	0.03	mg/L	
2,4,5-T	0.01	mg/L	Pesticide
Terbacil	0.04	mg/L	Pesticide
Terbuthylazine	0.008	mg/L	Pesticide
Tetrachoroethene	0.05	mg/L	
Thiabendazole	0.4	mg/L	Pesticide
Toluene	0.8	mg/L	
Trichloroacetic acid	0.2	mg/L	DBP
Trichloroethene	0.03	mg/L	
2,4,6-Trichlorophenol	0.2	mg/L	For excess lifetime cancer risk of $10^{-5.}$
Triclopyr	0.1	mg/L	Pesticide
Trifluralin	0.03	mg/L	Pesticide
Trihalomethanes(THMs)	The sum of the ratio of the concentration of each to its respective MAV should not exceed 1		DBP
Vinyl chloride	0.0003	mg/L	For excess lifetime cancer risk of $10^{-5.}$
Xylenes (total)	0.6	mg/L	
1080	0.035	mg/L	Pesticide. Short-term exposure.

1 Aminomethylphosphonic acid.
2 PHFxS – perfluorohexane sulfonate
3 PFOS - perfluorooctane sulfonate
4 PFOA - perfluorooctanoic acid

MAVs for radiological determinands

Determinand	MAV	Unit
Total alpha activity	0.5	Bq/L excluding radon
Total beta activity	1	Bq/L excluding potassium-40
Radon	100	Bq/L

Treatment outcomes

Treatment outcome 1: Plumbosolvency

Plumbosolvent water is able to dissolve lead and metals from fittings or plumbing, resulting in the presence of metals of health concern in consumers' drinking-water.

The water provided to consumers must not be plumbosolvent. The concentration of lead in samples taken for assessing plumbosolvency must not exceed the MAV in more than 10% of samples under the following conditions:

- the sampling point is in the distribution zone
- the sample volume is no more than 150 ml.
- the sample is drawn from the sampling point without flushing
- the water has stood in the tap for six hours.

The number of samples that need to be taken is specified in the appropriate compliance rule.

Treatment outcome 2: Organic content

The water provided to consumers must be low in organic content. Organic matter in the water adversely affects chemical disinfectant efficacy and demand, UV disinfection efficacy, disinfection by-product formation, taste and biofilm formation

The UV absorbance of the water at 254 nm just prior to the point of disinfection must be no more than 0.06 AU.

(Compliance rules for UV disinfection will require lower UV absorbance values than required by this more general treatment outcome.)

Commentary

1. Maximum Acceptable Values

The World Health Organization Guideline values

In the past, the World Health Organization (WHO) guideline values (GVs) have been the basis of New Zealand's maximum acceptable values (MAV), where this is possible. The same approach is taken with this proposal.

The WHO first develops health-based values (HBV) for determinands it identifies as potential candidates for establishment of a formal GV. Once the HBV is calculated the appropriateness of creating a formal GV is determined. A common reason for the WHO not creating a formal GV for a determinand is that the HBV is well above the concentrations of the determinand usually found in drinking-water. Some caution is needed in accepting the WHO's reason for not establishing a GV. Conditions in specific jurisdictions may mean that determinand concentrations in that jurisdiction are different from those considered typical by the WHO.

Calculation of MAVs included in the New Zealand standards

Many of the WHO GVs require a value for bodyweight in the HBV calculation. The WHO, because of its global responsibilities, uses a bodyweight of 60 kg for this calculation. The typical adult bodyweight in New Zealand is greater than this and a value of 70 kg is used for the MAV calculations. This results in some MAVs being slightly more permissive than the corresponding WHO GV.

In addition to determinands for which the WHO has published GVs, there are two other groups of determinands for which MAVs are proposed that do not have corresponding GVs.

a. Determinands for which HBVs are calculated, but no GV is published

   The WHO may calculate a HBV, but not assign a formal GV, usually for the reason noted above. The WHO HBVs for aluminium, manganese and MCPA are used as the basis for a proposed MAV for these determinands (bodyweight corrected) because ESR is aware of instances in New Zealand, in which their concentrations have been close to the HBV (Al, Mn) or within order of magnitude of the HBV (MCPA).

   Another argument says that any determinand for which there is a HBV and that has been allowed into New Zealand should be assigned a MAV. The rationale is that even if there are presently no records of detection, or detections have been at extremely low levels, there is no certainty that the determinand will not be detected at health significant concentrations in the future. If this approach were to be taken, there would be a substantial number of MAVs for determinands that are rarely, if ever, detected.

   A requirement for water suppliers to report to the Regulator the detection of any determinands without a MAV would provide a mechanism for identifying the need for new MAVs.

b. Determinands for which there is no HBV calculation

   Prior to the preparation of the DWSNZ 2000, the Ministry of Health identified a suite of pesticides for which it derived provisional MAVs. These pesticides were registered for use in New Zealand, but there were no WHO GVs or HBVs. The MAVs were included in the 2000 and subsequent editions and revisions of the DWSNZ. The Taumata Arowai Establishment Unit requests that the MAVs for these determinands be reviewed and updated where necessary. This has been done. Only two changes to MAVs were required (azinphos methyl 0.004 to 0.1 mg/L and metalaxyl 0.1 to 0.3 mg/L)

Pesticides and perfluorinated fire fighting chemicals

There are other pesticides registered for use in New Zealand that have no WHO HBV or GV, nor do they have a MAV. There are no records of detection in New Zealand environmental waters. This could indicate that these determinands are genuinely absent, or that there has been insufficient monitoring to detect them. No attempt has been made to provide MAVs for these determinands.

The WHO has not published HBVs or GVs for any of the perfluorinated fire-fighting compounds. These have been detected in some New Zealand groundwaters at elevated levels, indicating the need for MAVs for these substances. In the absence of guidance from the WHO, adoption of the guidelines from the Australian Drinking-water Guidelines (ADWG) is proposed. The Australian guidelines are based on the findings of an extensive review of the literature by Food Standards Australia New Zealand.

Calculating MAVs where a WHO HBV is unavailable

Central to the calculation of a MAV is the tolerable daily intake, which estimates the amount of a determinand that can be ingested without harm, per kilogram of bodyweight. When the WHO calculates a HBV, a value for the TDI (or equivalent) used in the calculation is reported. In the absence of a HBV calculation, the TDI used is that considered the most appropriate by an international body in its calculations, usually the Joint Meeting on Pesticide Residues (JMPR). Failing the availability of data from an international body, data from the derivation of the guidelines values in the Australian Drinking Water Guidelines is used.

Provisional MAVs

The WHO labels some of its GVs as "provisional" often because of uncertainty about the toxicological data from which the GV is derived and indicating that there may be a need for revision in the future. Similarly, in the past some MAVs have been labelled as "provisional" (PMAVs).

The proposal here is that the PMAV designation be discarded, so that only MAVs are provided for determinands. The rationale is that while a PMAV may need to be updated in future because of new scientific evidence, fresh evidence may also require the revision of a MAV. The only distinction is the degree of confidence in the value at the time of derivation. In practice, the PMAV is treated in the same way as the MAV; compliance with it is still required.

Summed MAV ratios

The WHO currently sets a GV of 1 for the sum of the ratios of the concentration of each determinand to its respective MAV for four THMs and nitrate/nitrite. This is to account for additive toxicity. Currently, New Zealand adopts this approach and extends it include the haloacetic acid and acetonitrile DBP families. This is not done by WHO.

Suggestions have been received that:

- The extensions to haloacetic acids and acetonitriles be dropped, as the approach is not suggested by the WHO for these determinands, nor used by Australia, the UK or the USA. Without WHO endorsement, the suggestion of removing these extensions is reasonable. It does not affect the table above. It will be a matter of ensuring that the requirement is omitted from the appropriate compliance rules.
- The approach for nitrate/nitrite be retained, because it is used by WHO and Australia. This is now included as a separate determinand in the inorganics MAV table for consistency with the trihalomethane entry, and to avoid dependence on a compliance rule.
- Consideration be given to dropping the summed MAV ratios approach for THMs (individual THM MAVs would be retained). The rationale is that other jurisdictions (Australia, UK and the USA) do not use the summed ratios approach. Instead, they state a specific total concentration for THMs (TTHM), either 0.1 mg/L (100 µg/L) or 0.08 (80 µg/L mg/L. Note that if 0.1 mg/L were to be adopted, it would effectively reduce the maximum allowed concentrations of both chloroform and dibromochloromethane to concentrations less than their individual MAVs.

  The proposal here is that the summed ratios be retained because it is included in the WHO guidelines, but consideration be given to other approaches for taking account of the effects of the TTHM concentration in future revision of the standards. The ADWG recommend that although only the TTHM guideline must presently be met, consideration should be given to including guidelines for individual THM in future revisions of the ADWG.

There are difficulties that arise with the use of ratios when a laboratory's limit of detection for a THM is not greatly different from its MAV and the test result is reported as "not detected". It can result in the MAV of 1 being exceeded without real justification. Water suppliers need to be made aware of this, but the standards is not the appropriate place.

Radiological MAVs

The WHO provides GVs for total alpha and total beta activity. The MAVs for these determinands have been updated to the most recent GVs.

The WHO no longer provides a GV for radon. International research has shown that 90% of the dose attributable to radon in drinking-water comes from inhalation rather than ingestion. Therefore, controlling the inhalation pathway rather than the ingestion pathway is the most effective way to control doses from radon in drinking-water. Consequently, it is more appropriate to measure the radon concentration in air than in drinking-water. The WHO states that screening levels for radon in water should be set on the basis of the national reference level for radon in air and the distribution of radon in the national housing stock, hence the absence of a GV.

No national survey of radon in buildings is presently planned for New Zealand. In the meantime, to provide control on the contributions of radon from the water supply continued use of the existing MAV for radon of 100 Bq/L is proposed.

2. Treatment outcomes

Introduction

Clause 46(1) of the WSB allows for the inclusion of "outcomes of drinking-water treatment" in addition to water composition (the MAVs) as a second potential component of the Standards. The bill does not provide a definition for treatment outcomes or a description of their purpose.

In the absence of direction from the Bill, the following working definition is suggested to help in deciding what might be included as a treatment outcome and what the purpose of treatment outcomes might be.

> *Definition*: Treatment outcomes are values for universally applicable water quality determinands that can influence the presence of health significant determinands, but have no MAV. Their value cannot be controlled through compliance with a MAV.

Five possible treatment outcomes were initially considered, but on the basis of the above definition, only two are now proposed as treatment outcomes. The five are discussed below.

Turbidity and FAC/FACE

Setting treatment outcomes for turbidity and FAC/FACE should be redundant. Requirements controlling these determinands will be part of the compliance rules for bacteria and protozoa at the treatment plant or in the distribution zone.

Should turbidity be included as a treatment outcome to help in guiding water quality requirements for supplies serving fewer than 50 people? If the above definition of treatment outcome is acceptable, inclusion of turbidity, even for the very small systems, as a treatment outcome would seem to be inconsistent with the definition. Turbidity relates to treatment efficacy, making it different from plumbosolvency and organic content.

$TOC/A_{254}/T_{254}$

Currently, there is no maximum level set for the organic content of a water supply. This is despite excessive levels of organic matter in the water adversely affecting chemical disinfectant efficacy and demand (and therefore economics of operation), UV disinfection efficacy, disinfection by-product formation, taste and biofilm formation. There is an aesthetic value for colour, but a water supplier is only required to take all reasonably practicable steps to comply with aesthetic values; aesthetic compliance is not mandatory. Compliance requirements associated with UV treatment and limitations on the concentrations of DBPs in the treated water provide an indirect control over the organic content of the water.

With chlorination being mandatory, and DBP monitoring likely to be at reduced frequency for smaller supplies because of cost, it would seem wise to put direct limitations on the level of organic matter in the water.

The organic content of the water can be of health significance, but as there is no way of controlling it directly through compliance with a MAV, specifying it as a treatment outcome provides a mechanism for controlling it.

Natural organic matter (NOM) is composed of a wide range of substances of ill-defined structure, so it is impossible to specify a particular substance for monitoring. Monitoring of bulk properties of the water would be required: eg, total or dissolved organic carbon (TOC or DOC), the UV absorbance of the water at 254 nm or the UV transmittance of the water at 254 nm.

Work undertaken by ESR in the late 1990s provides guidance on levels of NOM that might be considered acceptable. Based on measurements of DBP concentrations, TOC and A_{254nm} made on samples from throughout the country, the study showed that at TOC concentrations $\leq$ 1 mg/L, or A_{254} values $\leq$ 0.03 AU, DBP concentrations were less than their MAV in 99 to 100% of samples. More than 90% of samples contained DBP concentrations less than their MAV when a higher upper limit on the organic content was considered, ie, the A_{254} value was $\leq$ 0.06 AU.

Despite the advantages of controlling the organic content of a water and there being relatively cheap options for its measurement, it may prove impracticable. There are limitations on the amount of organic matter conventional treatment systems can remove, and new technologies (membranes) may be too expensive for small supplies. It may be possible to ease this problem by using the 0.06 AU limit rather than the more stringent 0.03 AU.

Ideally, before implementation of this proposal, a survey to check on levels of organics through the country would be helpful in understanding how realistic it would be to expect supplies to meet level of organics proposed.

pH

The pH is currently an aesthetic determinand, but it has health-significant effects. It influences the efficacy of chlorine disinfection (taken into account through the calculation of the FACE) and it influences corrosion rates.

As some products of corrosion (heavy metals) are health significant, it seems that there is a need for some control within the standards to reduce levels of corrosion products to an acceptable level. Regarding the corrosiveness of a water as a problem of aesthetics does not seem the right way to look at this. Moreover, pH is only one factor (albeit an important one) in influencing corrosion, so considering pH alone in assessing corrosiveness is inadequate.

For these reasons, the possibility of controlling corrosiveness/plumbosolvency through its introduction as a treatment outcome is discussed in the next section.

Plumbosolvency

Plumbosolvency is proposed as a treatment outcome for the following reasons:

a. The current approach of making consumers aware of the need to flush water that has been standing in plumbing from taps, is considered to be only partially effective, ie, there is a need to find a more effective tool for reducing exposure to toxic metals derived from materials in contact with the water.

b. There is currently no specific requirement for water to be non-plumbosolvent, although corrosion products such as lead and copper are required not to exceed their MAV for the water to be compliant with the Standards. Because pH is regarded as an aesthetic determinand, it is not taken into account in determining compliance.

c. The need to have the plumbosolvency of a water at a level that will not result in unsafe concentrations of metals is universal, regardless of supply size.

d. Making non-plumbosolvency a desirable treatment outcome, makes it part of the Standards and therefore a factor for which compliance can be required.

Possible approaches to assessing plumbosolvency

Assessing plumbosolvency presents a challenge. A 2009 publication by Health Canada (https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-controlling-corrosion-drinking-water-distribution-systems.html) provides a review of what has been determined about corrosion, the factors affecting it, and how it might be assessed for regulatory purposes. Three approaches to assessing corrosiveness are discussed in the Canadian report.

a. *Corrosivity indices*

Probably the best known of these is the Langelier saturation index (LSI), which like all the other indices, is based on the tendency of the water to dissolve or precipitate calcium carbonate. Calcium carbonate equilibria-based indices have been used as indicators of corrosiveness on the premise that precipitated calcium carbonate on a surface offers protection against dissolution of the surface. There is substantial empirical evidence contradicting this underlying assumption.

Although there is no indirect way (eg, index calculation) to satisfactorily assess the corrosiveness of a water, the degree of dissolution of materials by water can be determined empirically. The methods are of two types: those that use the reticulated water and attempt to standardise the conditions of the test (using test coupons or rigs), and those in which the reticulated water is used, but no attempt is made to standardise conditions. In these methods, the corrosiveness of the water is assessed by taking samples from a large number of consumers' systems.

b. *Test rigs*

A test rig and its use is allowed by the current DWSNZ as a means of attempting to standardise the conditions under which the corrosiveness of a water is assessed. Little use has been made of this approach and it is understood that it is not favoured by the Taumata Arowai Estabishment Unit for the next edition of the standards.

c. *Monitoring at the tap*

This is the approach used by the USEPA with its Lead and Copper Rule. Samples are taken from a defined number of sampling locations and if the 90th percentile concentration exceeds the

action level for either of the two metals, the water supplier is required to take actions to reduce the plumbosolvency/cuprosolvency of the water.

The potential drawback to this approach in the New Zealand context is the increased level of monitoring required over that presently required for metals. This may not be a concern if the number of samples required is scaled, based on the number of people served, as is done by the USEPA.

While sampling at the tap is favoured by the USEPA, there are complications for its use in New Zealand:

i. Unlike the USA, where the primary source of exposure to lead through drinking water is corrosion of old lead laterals and mains, in New Zealand the data available to date show that in most (there may be some exceptions) New Zealand supplies the primary sources of lead are taps and their associated fittings. The problem of metals in the water, when derived from consumers' plumbing, cannot be controlled solely by the water supplier.

ii. The amount of lead, eg, released from taps is influenced by the quality of water (controllable by the water supplier) and the quality of the materials used in the taps (outside the water supplier's control).

iii. Establishing a sampling protocol that thoroughly flushes the sampling point, avoids the contribution of the tap to the water quality. In New Zealand, this is most likely to result in low metal concentrations being detected in the sample. The water will then be classified as non-plumbosolvent, with no remedial actions being required. Regardless of the classification, without steps to reduce the water's plumbosolvency, consumers will still be exposed to heavy metals in the first small volume of water drawn from their taps.

While the present requirement for flushing taps may seem ineffective, it was implemented to address the problem identified in iii. The use of a test rig (to avoid the problem in ii) is cumbersome, but it offers a way of standardising conditions so that variation in the quality of consumers' fittings is avoided. A possible compromise is to require a particular type of tap to be used in the sampling points and to specify the time the water must stand in the tap before the sample is drawn.

Of the three approaches for assessing corrosiveness (a, b and c), c is probably the most promising given the problems that appear associated with a and b. However, further work (probably including surveys) is required to establish how it will be best implemented[1]. This is outside the scope of this work.

Conclusion

Non-plumbosolvency of drinking water has tended to be regarded as an aesthetic property because of its link to the pH value of the water, which is included in the aesthetic guidelines. However, pH is only one of the factors determining the exposure of consumers to heavy metals. For this reason, non-plumbosolvency should be included as part of the standards, so that it plays a part in compliance. Establishing it as a desirable treatment outcome is one way in which this could be done.

Given that the toxic effects of lead are worse than those of copper, the corrosiveness should be assessed with respect to the leaching of lead by the water, in preference to copper.

[1] *For this treatment outcome to be properly and fairly implemented, a study is needed to determine the appropriate parameters: primarily the standing time and the permitted percentage of exceedances.*