Administrative Report

Chemical fact sheet reviews for the *Australian Drinking Water Guidelines*:

- Lead replacements in plumbing products (bismuth, silicon, selenium copper alloys)
- Lead
- Manganese

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Administrative Report: Chemical fact sheet reviews for the *Australian Drinking Water Guidelines*

Summary

The National Health and Medical Research Council (NHMRC) has updated or developed guidance in the *Australian Drinking Water Guidelines* (the Guidelines) regarding several chemicals that have been prioritised for review.

The reviews have resulted in new or updated guidance in the Guidelines, including:

- a new information sheet on metals and metalloids leaching from plumbing products
- a new fact sheet for bismuth
- a new combined fact sheet for silicon and silica
- updated fact sheets for lead, selenium and manganese, and
- consequential edits to align advice across the Guidelines.

This document summarises the guideline development process for these updates.

Background

NHMRC issues guidelines under section 7(1) of the *National Health and Medical Research Council Act 1992* (the Act). NHMRC maintains the Guidelines through a rolling review process to ensure they provide an up-to-date evidence-based framework for the management of drinking water quality.

The Guidelines form part of the National Water Quality Management Strategy, an Australian Government initiative in partnership with state and territory governments. The Guidelines are intended as a consistent source of authoritative guidance on drinking water quality management and allow states and territory governments to adapt the guidance to local needs.

Part V of the Guidelines contains fact sheets for over 200 chemicals that are typically present in Australian drinking water supplies. The fact sheets contain information on relevant aspects of the chemicals in drinking water, including but not limited to:

- health-related advice (e.g. a health-based guideline value and/or public health advice, health considerations, exposure information and risk summaries)
- supporting information (e.g. guidance on analytical measurements or sampling, water treatment and risk management options).

Since the current version of the *Australian Drinking Water Guidelines* (the Guidelines) was published in 2011, updates to specific sections of the Guidelines, including chemical fact sheets, have been undertaken as part of a 'rolling review' process. Suggestions for potential updates or the development of new advice are considered in response to new evidence, stakeholder needs and available resources. Updates are prioritised and delivered with advice from the Water Quality Advisory Committee (the Committee).

Review of prioritised fact sheets (including lead and selenium)

NHMRC has worked with previous terms of the Committee to prioritise work on several chemical fact sheets in the Guidelines by developing screening criteria. The screening process and consultation with the former enHealth Water Quality Working Group (now known as the enHealth Water Quality Expert Reference Panel) resulted in agreement on chemicals prioritised for review.

The prioritised chemicals included: ammonia, antimony, cadmium, copper, cyanide, lead, nickel, nitrate and nitrite, selenium, sodium, uranium, bromate, chlorate, haloacetic acids, haloacetonitriles and trihalomethanes.

Contracted reviews (of existing guidance and guidelines only) for the prioritised chemicals commenced in May 2021. For both the lead and selenium reviews, it was found that although there were suitable candidate health-based guideline values for both chemicals that could be adopted/adapted to the Australian context, a substantial body of evidence had been published that had not been taken into consideration. Further review of the recent literature was recommended to support the update of the lead and selenium fact sheets.

Review of lead replacements in copper alloy plumbing products (bismuth, selenium and silicon)

In July 2021, the Australian Building Codes Board (ABCB) determined to limit the lead content of plumbing products in contact with drinking water to 0.25% (ABCB 2021, 2023). The Decision Regulation Impact Statement (RIS) recommended work be undertaken with health authorities on what limits should be placed, if any, on the use of lead substitutes. This change in regulation was proposed in response to building pressure from health agencies, including NHMRC, to improve public health outcomes in relation to lead in drinking water.

In preparation for these upcoming changes in regulation, NHMRC met with ABCB and enHealth in May 2021 to discuss the available data, timeframes and NHMRC processes required to develop public health advice for the Guidelines. Following this, enHealth requested that NHMRC prioritise a review of the health evidence for proposed lead replacements in plumbing products such as bismuth, selenium and silicon copper alloys and to develop public health advice for these and any future lead replacements that might appear on the market.

This report describes the process undertaken to review the evidence and develop public health advice for the chemicals that might be expected to leach from them into drinking water (bismuth, selenium and silicon). As part of this project, an extended review of the selenium and lead fact sheets was also undertaken to review the recent literature. Contracted reviews of the available evidence commenced in late 2022.

Review of manganese fact sheet

In mid-2023, public health authorities in the Northern Territory requested a review of the health-based guideline value for manganese in drinking water following reported exceedances of manganese in the drinking water of remote communities in the Northern Territory. Several international reviews had been published examining the potential toxicity of manganese in drinking water, and as a result lower drinking water guideline values had been implemented by other public health authorities (Health Canada 2019, WHO 2022). The review of manganese in drinking water was prioritised by the Committee and the enHealth Water Quality Expert Reference Panel at

meetings held between July and December 2023. An evidence review of recent guidance/guidelines on manganese was undertaken by NHMRC in late 2023 – early 2024.

Development of guidance

Methodological framework

As part of a broader organisational effort to improve the processes used to develop NHMRC guidelines, NHMRC has designed a streamlined methodological framework (the Framework) to guide the rolling revision of chemical fact sheets in the Guidelines.

The Framework is intended to provide greater consistency and alignment with the 2016 *NHMRC Standards for Guidelines* and international best practice in evidence review methods and guideline development. It is also intended to:

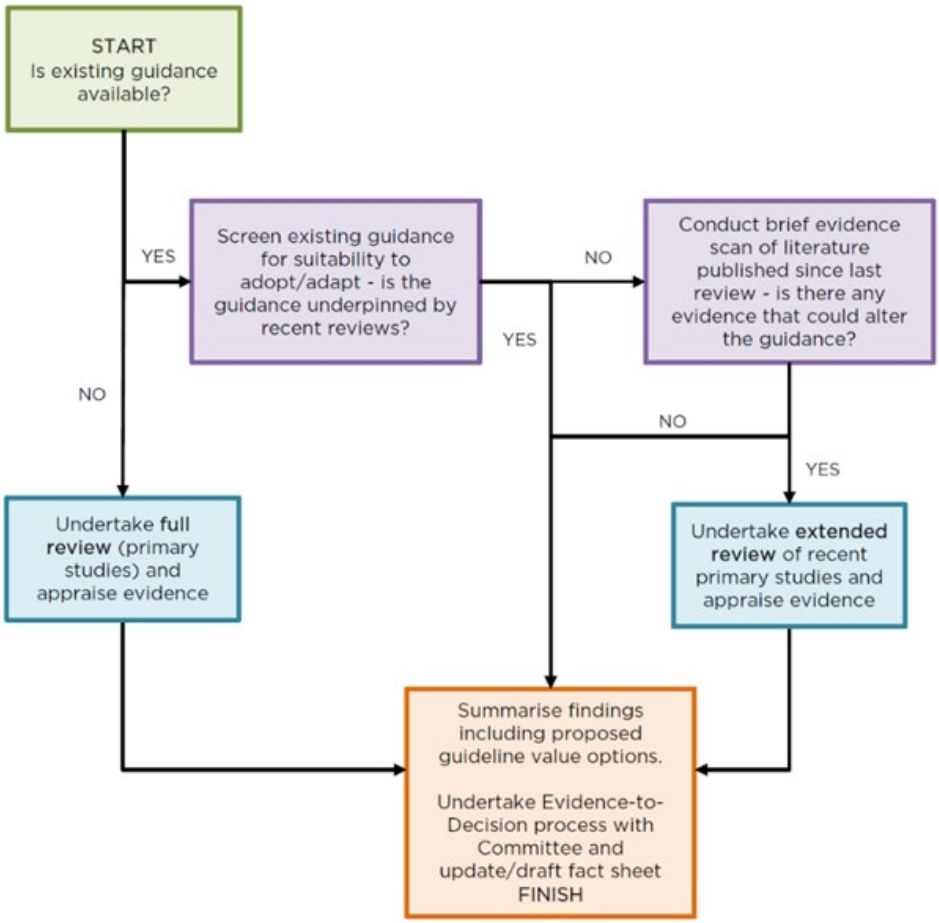
- make efficient use of limited project resources (e.g. funding, team and Committee capacity)
- make greater use of recent reviews undertaken by other jurisdictions and reduce duplication of effort
- minimise the timeframes required to undertake a chemical fact sheet review (depending on whether recent reviews are available)
- allow a more responsive approach to changes in international guidance
- allow more reviews to be undertaken in-house using templates and tools
- help inform future funding bids by identifying chemicals that may require additional funding for contracted evidence reviews.

The Framework provides the option to undertake different levels of review depending on the available evidence (see **Figure 1**). The Framework outlines a staged approach that preferences a transparent adopt/adapt process for evaluating existing health advice (such as international health-based guideline values) in the first instance instead of undertaking a more comprehensive review of primary studies. Other features of the Framework include:

- the option to undertake an evidence scan to check for emerging evidence of concern since the existing guideline was published (if it was not reviewed recently)
- the option to undertake reanalysis of key study findings from existing guidelines if appropriate and advised by the Committee
- the flexibility to customise the review process for each chemical using template research protocols for the different levels of review.

Existing guidance for a chemical may not always be available or appropriate to use for the Australian context. In these cases, a full review of recent primary studies is required and additional resources will be needed to undertake the review.

Figure 1. **Simplified decision tree for undertaking evidence evaluation reviews using the Framework**



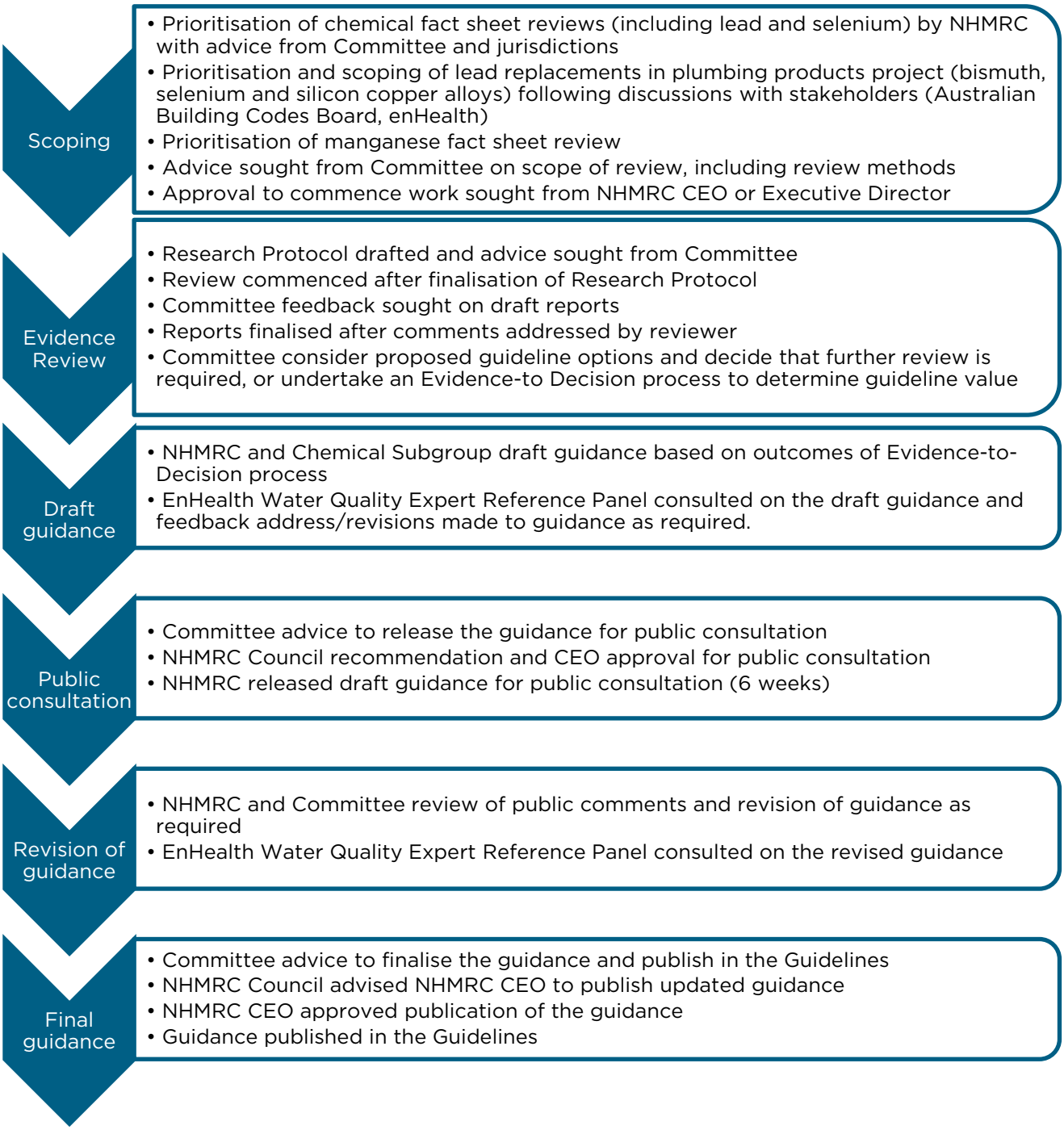
Text alternative of Figure 1

Start – Is existing guidance available?

1) Yes – Screen existing guidance for suitability to adopt/adapt – is the guidance underpinned by recent reviews?
    a) Yes - Summarise findings including proposed guideline value options. Undertake Evidence-to-Decision process with Committee and update/draft fact sheet. FINISH
    b) No – Conduct brief evidence scan of literature published since last review – is there any evidence that could alter the guidance?
        i) Yes – Undertake extended review of recent primary studies and appraise evidence
            (1) Summarise findings including proposed guideline value options. Undertake Evidence-to-Decision process with Committee and update/draft fact sheet. FINISH
    c) No - Summarise findings including proposed guideline value options. Undertake Evidence-to-Decision process with Committee and update/draft fact sheet. FINISH
2) No – Undertake full review (primary studies) and appraise evidence
    a) Summarise findings including proposed guideline value options. Undertake Evidence-to-Decision process with Committee and update/draft fact sheet. FINISH

Testing of the Framework as part of the rolling revision of the Guidelines has been underway since 2020, starting with prioritised chemical fact sheets (including lead and selenium). Key steps of the guidance development process for the Guidelines are summarised in **Figure 2**.

Figure 2. Overview of current rolling review process for updating/developing chemical fact sheets using Framework



Contracted evidence reviews

SLR Consulting Australia was contracted in 2021 and 2022 to:

- undertake a review of existing guidance/guidelines for a number of prioritised chemical fact sheets, including lead and selenium. The scope of this review was limited to searching, selecting and reviewing suitable existing guidance/guidelines for potential adoption/adaption in Australia.
- undertake a review of the evidence for selected lead replacements in plumbing products. This involved:
    - undertaking a full review of the primary literature for bismuth and silicon and their copper alloys as there were no existing drinking water guidelines for potential adoption/adaption.
    - undertaking an extended review for selenium and lead, as the first stage of review process did not find suitable guidance/guidelines to adopt/adapt in Australia without further review of the recent literature.

The reviewer applied the methodological framework as part of the evidence reviews by:

- customising a draft research protocol template provided by NHMRC for each chemical. The research protocol outlines the review scope and parameters for searching, selecting and appraising the evidence.
- confirming any amendments to the draft research protocol with the Committee at a meeting. The Committee confirmed the research questions and other technical details required for the reviews.
- finalising the research protocol (and any amendments) and seeking approval from NHMRC before commencing the review
- undertaking a review of evidence for each chemical as per the Framework (Figure 1), for example:
    - if recently published guidance/guidelines are available, assessing the methods used by the organisation/agency with an Assessment Tool provided by NHMRC that assesses administrative and technical criteria to determine if they are suitable to adopt/adapt
    - if undertaking a review of primary studies, assessing the study quality (risk of bias) using a risk of bias tool adapted from the Office of Health Assessment and Translation (OHAT 2019) and determining the level of certainty in the body of evidence.
- undertaking an evidence scan to support the development or update of supporting information in each chemical fact sheet
- deriving candidate guideline options for each chemical in drinking water using Australian assumption values and uncertainty factors
- presenting the findings of the review in an Evidence Evaluation and Technical Report for Committee consideration.

The reviewer did not make recommendations for health-based guideline values but provided candidate guideline options for consideration by the Committee. These options were based on:

- existing guidance/guidelines that were found suitable to adopt/adapt to the Australian context, with a critical discussion of the underlying key toxicological studies used by each agency to derive their guidance/guidelines
- key toxicological studies (animal or human) that the reviewer found to be of sufficient study quality to derive a health-based guideline value.

Further details on how each evidence review was undertaken is provided in the Research Protocols and Evidence Evaluation Reports for each chemical.

NHMRC review of manganese in drinking water

NHMRC staff conducted a targeted review of recently published guidance/guidelines on manganese to support an update to the chemical fact sheet in the Guidelines. The targeted review focused on recent manganese guidance published by the World Health Organization (2021, 2022), Health Canada (2019) and the European Food Safety Authority (2023).

The methodological framework was applied as part of the evidence reviews by:

- customising a draft NHMRC research protocol template for manganese. The research protocol outlined the review scope, research questions and parameters for searching, selecting and appraising the evidence.
- confirming any amendments to the draft research protocol with the Committee. The Committee confirmed the research questions and other technical details for the review.
- finalising the research protocol (and any amendments) and seeking approval from the Committee before commencing the review
- undertaking a review of evidence for manganese as per the Framework (Figure 1). As recently published guidance/guidelines were available, the methods used by the organisation/agency were assessed with an Assessment Tool developed internally that assesses administrative and technical criteria to determine if existing guidance/guidelines are suitable to adopt/adapt.
- undertaking an evidence scan to support the development or update of supporting information in the fact sheet
- deriving candidate guideline options for manganese in drinking water using Australian assumption values and uncertainty factors as advised by the Committee
- presenting the findings in an Evidence Evaluation Report for Committee consideration.

The review did not make recommendations for health-based or aesthetic guideline values but provided candidate guideline options for consideration by the Committee. These options were based on existing guidance/guidelines that were found suitable to adopt/adapt to the Australian context, with a critical discussion of the underlying key toxicological studies used by each agency to derive their guidance/guidelines.

Further details on how the evidence review was undertaken is provided in the Research Protocol and Evidence Evaluation Report for manganese.

Evidence-to-Decision process

Evidence reviews provide a comprehensive summary of the evidence but do not include recommendations (e.g. health-based guideline values). The term 'decision' is used to mean the resulting judgement of the evidence made by NHMRC and the Committee. NHMRC, with advice from the Committee, developed Evidence-to-Decision tables for each chemical based on the results of the Evidence Evaluation Reports and relevant criteria from existing Evidence to Decision frameworks (e.g. GRADE and WHO-INTEGRATE frameworks as outlined in Alonso-Coello *et al*. (2016) and Rehfuess *et al*. (2019)).

The Evidence-to-Decision tables (**Appendix A**) helped to inform Committee discussion and support transparent consideration of the findings from the evidence reviews undertaken by the reviewer (e.g. evidence profiles for candidate guideline values). While the certainty of the evidence for the different guideline options determined which guideline values were selected for each chemical, other public health considerations such as consumer values and preferences, equity, feasibility and resource impacts were also noted in the discussions.

Candidate guideline options were reviewed and considered by the Committee before discussing and reaching consensus on the preferred options at a follow up Committee meeting. This process was repeated during the guideline development process whenever confirmation of the health-based or aesthetic guideline values was required based on information received through targeted and/or public consultation. Guideline recommendations were then updated as required on the advice of the Committee. This process is summarised in **Table 1** below.

Table 1. **Evidence to decision summary**

Committee meeting	Members agreed
December 2023 Committee meeting	Members agreed that: • no health-based guideline values should be set for bismuth and silicon or their copper alloys at this time, as health effects are expected to occur at levels much higher than concentrations expected in Australian drinking water. Members agreed that the derivation of the levels at which health effects are expected to occur (rounded to 10 mg/L for bismuth and 100 mg/L for silicon) should be provided in the fact sheet. • the health-based guideline value for selenium should be lowered from 0.01 mg/L to 0.004 mg/L based on health considerations. • the health-based guideline value for lead should be lowered from 0.01 mg/L to 0.005 mg/L based on health considerations. • health-based guideline values are reported to one significant figure for consistency with the existing Guidelines.

March 2024 Committee meeting	Members agreed that:
	• health-based guideline values for bismuth (10 mg/L) and silicon (100 mg/L) should be established based on health considerations. These changes to the guideline recommendations for bismuth and silicon were made to address feedback from members of the enHealth Water Quality Expert Reference Panel who raised concerns about potential confusion from end users.
	  • the health-based guideline value for manganese should be lowered from 0.5 mg/L to 0.1 mg/L based on health considerations.
	  • the aesthetic guideline value for manganese should be lowered from 0.1 mg/L to 0.05 mg/L based on providing safe clear, untainted water to consumers; managing the risks of manganese precipitates in the water distribution system and at the customer's tap; and readily achievable concentrations following water treatment.
	  • health-based and aesthetic guideline values are reported to one significant figure for consistency with the existing Guidelines.

Drafting of guidance

The NHMRC Project Team drafted or updated fact sheets for each chemical based on the discussions with the Committee and the outcomes of the evidence-to-decision process. In addition, a number of consequential edits to other sections of the Guidelines were proposed to

ensure consistency across the Guidelines and alignment with any proposed changes in health-based and/or aesthetic guideline values (**Appendix B)**.

For the lead replacements in plumbing products review, an information sheet was also developed to provide general advice on managing risks from chemicals leaching from plumbing products. This included advice developed by enHealth in 2021 on preventative flushing regimes and in-premises sampling approaches (enHealth 2021).

The Chemical Subgroup reviewed the draft guidance and provided feedback before full Committee review and discussion at a committee meeting.

A timeline of the overall guideline development process is provided in **Table 2**.

Table 2. Timeline for chemical fact sheet reviews

Key guidance development steps	Timeframes
SLR Consulting Australia contracted to undertake review of existing guidance/guidelines for 11 prioritised chemicals (including selenium and lead fact sheets)	June 2021
Finalisation of research protocols for lead and selenium reviews with contracted reviewer (SLR Consulting Australia) and the Committee	June 2021
Stage 1 reviews (adopt/adapt existing guidance) of lead and selenium undertaken by reviewer	July 2021 – May 2022
Request from enHealth to review lead replacements in plumbing products	June 2021
NHMRC Chief Executive Officer (CEO) approval to commence review of potential health impacts of bismuth, selenium and silicon copper alloys on drinking water quality	October 2021
Committee consideration of finalised lead and selenium Stage 1 review reports and proposed approach to undertake review of bismuth, selenium and silicon copper alloys and continue review of selenium and lead fact sheets.	13 September 2022
SLR Consulting Australia contracted to undertake review of lead replacements in plumbing products (bismuth, selenium and silicon copper alloys, lead)	December 2022

Key guidance development steps	Timeframes
Finalisation of research protocols for bismuth, selenium and silicon copper alloys review and extended review of lead with contracted reviewer (SLR Consulting Australia) and Committee feedback	February - March 2023
Full reviews of bismuth and silicon copper alloys, extended reviews for selenium and lead undertaken by reviewer. Draft reports reviewed by the Committee and comments addressed before final reports provided to NHMRC.	March – November 2023
Committee and enHealth Water Quality Expert Reference Panel support for prioritising a review of the health-based guideline value for manganese.	July - August 2023
Committee consideration of guideline options and evidence-to-decision process for bismuth, silicon, selenium and lead.	November – December 2023
Draft research protocol for manganese prepared and circulated to Committee for review and approval.	December - January 2024
Targeted review of recent guidance/guidelines on manganese undertaken by NHMRC. Draft evidence report reviewed by the Committee and comments addressed before report finalised.	December 2023–April 2024
NHMRC drafted guidance (lead and lead replacements in plumbing products) with advice from Chemical Subgroup	December 2023 – March 2024
Committee consideration of guideline options and evidence-to-decision process for manganese.	March 2024
Review of draft guidance (lead and lead replacements in plumbing products) by the Committee with subsequent revisions	March– April 2024
NHMRC drafted revised manganese chemical fact sheet with advice from the Chemical Subgroup for Committee review and approval.	April 2024

Key guidance development steps	Timeframes
enHealth Water Quality Expert Reference Panel (WQERP) consultation on draft guidance (see **Appendix C**) and subsequent revisions of guidance.	April - May 2024
NHMRC Council out of session advice to NHMRC CEO to release draft guidance for public consultation	29 May 2024
NHMRC CEO approval to release draft guidance for public consultation	12 July 2024
Public consultation open (6 weeks)	26 July – 6 September 2024
NHMRC and Committee review of submissions and revision of guidance as required (see **Appendix D**)	September – December 2024
enHealth WQERP consultation on final guidance (see **Appendix C**)	January 2025
Finalisation of guidance with advice from the Committee	February 2025
Advice from NHMRC Council to publish final guidance in Guidelines (excluding revised lead and manganese chemical fact sheets)	26-27 March 2025 (234th session)
NHMRC Council out of session advice to publish final guidance in Guidelines (revised lead and manganese chemical fact sheets)	May 2025
NHMRC CEO final approval to publish guidance in Guidelines	May 2025
Publication of guidance in Guidelines	**June 2025**

enHealth WQERP – Environmental Health Standing Committee Water Quality Expert Reference Panel

Water Quality Advisory Committee advice

The NHMRC Water Quality Advisory Committee (the Committee) provides expert advice to NHMRC on public health issues related to drinking water quality. The primary role of the Committee is the rolling review of the Guidelines.

Following the Framework, the Committee provided advice at several meetings or out of session during different stages of the review and guideline development processes, including advice on:

- the draft research protocols for each chemical review
- the draft evidence evaluation reports (initially through a subgroup of the Committee (the Chemical Subgroup) and then the full Committee)
- the candidate guideline options presented in the evidence review reports and evidence to decision tables
- the draft guidance documents (initially through the Chemical Subgroup and then full Committee)
- responses to address enHealth Water Quality Expert Reference Panel feedback and finalise the guidance for public consultation and publication
- responses to address public consultation feedback and any subsequent revisions to the guidance
- finalisation of the guidance for publication
- proposed edits to advice from NHMRC Council.

enHealth consultation

The enHealth Water Quality Expert Reference Panel provided expert feedback on the draft guidance. Panel membership included jurisdictional representatives working in the field of drinking water quality and public health who can provide feedback on the feasibility and accuracy of NHMRC advice.

The enHealth Water Quality Expert Reference Panel was formally consulted on the draft guidance on separate occasions in April - May 2024 prior to public consultation, in January 2025 prior to final publication and in May 2025 to confirm several minor edits to the lead and manganese fact sheets following the March 2025 Council session. A number of amendments to the draft guidance were made with advice from the Panel as a result of feedback provided.

Further details on the issues raised by the enHealth Water Quality Expert Reference Panel on the draft guidance and how these issues were addressed are provided in **Appendix C**.

Public consultation

NHMRC Council considered the draft guidance out of session in June 2024 and advised the NHMRC CEO to release the draft guidance for public consultation. The CEO approved the draft guidance to be released for public consultation in July 2024.

Public consultation was held from 26 July to 6 September 2024. Feedback was sought on the overall approach, implementation and feedback on draft information and fact sheets. NHMRC received 21 submissions from water utilities, small council utilities, regulators, water associations and citizens.

NHMRC worked with the Committee to ensure due consideration was given to the issues raised during public consultation. A summary of this process, including the key issues raised and how these were addressed, is provided in the public consultation summary report provided at

Appendix D. Full public consultation submissions are provided at Appendix E where permission has been given to publish.

NHMRC Council

At the 234th NHMRC Council session on 27 March 2025, Council requested NHMRC make minor edits to the lead and manganese fact sheets, including edits to the wording of the guideline recommendations. The requested revisions were made to the fact sheets with advice from the Water Quality Advisory Committee and support from the enHealth Water Quality Expert Reference Panel.

NHMRC Council considered the revised lead and manganese fact sheets and several additional consequential edits out of session in May 2025 and advised the NHMRC CEO to publish the guidance in the Guidelines. The CEO approved the publication of the guidance in May 2025.

Contributors

The Committee, in particular the Chemical Subgroup, led the development of the guidance. This work was undertaken over multiple terms of the Committee through 2021 to 2024. Committee membership during this period is outlined below.

Water Quality Advisory Committee

2018-2021 Water Quality Advisory Committee (2 January 2019 to 31 December 2021)

- Professor Fred Leusch (Chair), School of Environment and Science, Griffith University
- Ms Miranda Cumpston, Monash University and University of Newcastle
- Dr David Cunliffe, South Australian Department for Health and Wellbeing
- Mr Cameron Dalgleish, Tasmanian Department of Health
- Dr Dan Deere, Water Futures Pty Ltd
- Professor Cynthia Joll, Curtin Water Quality Research Centre, Curtin University
- Professor Stuart Khan, Water Research Centre, University of New South Wales
- Associate Professor Susan Petterson, Water & Health Pty Ltd / Griffith University
- Professor Craig Simmons, Australian Research Council / National Centre for Groundwater Research and Training, Flinders University
- Ms Carolyn Stanford (Consumer Rep), Stanford Marketing, Victoria
- Dr Katrina Wall, New South Wales Health Department
- Dr Nick Fletcher (Observer), Food Standards Australia New Zealand
- Ms Amy Lea (Observer), Department of Agriculture, Water and the Environment
- Mr Marcus Walters (Observer until 2020), Department of Agriculture, Water and the Environment

- Mr Adam Lovell (Observer), Water Services Association of Australia.

2022-2025 Water Quality Advisory Committee (29 April 2022 to 31 December 2025)

- Professor Nicholas Ashbolt (Chair), University of South Australia
- Dr David Cunliffe, South Australian Department for Health and Wellbeing
- Mr Cameron Dalgleish, Tasmanian Department of Health
- Professor Cynthia Joll, Curtin Water Quality Research Centre, Curtin University
- Professor Fred Leusch (from September 2023), School of Environment and Science, Griffith University
- Mr Peter Rogers, Water and public health expert
- Ms Nicola Slavin (from October 2022), Northern Territory Department of Health
- Dr Bala Vigneswaran, Water and public health expert
- Associate Professor Harriet Whiley, Flinders University
- Ms Sonia Colville (Observer until December 2023), Department of Climate Change, Energy, Environment and Water (DCCEEW)
- Ms Yulia Cuthbertson (Observer from December 2023), Department of Climate Change, Energy, Environment and Water (DCCEEW)
- Dr Kerry Nugent (Observer until December 2022), Australian Industrial Chemicals Introduction Scheme (AICIS)
- Dr Nobheetha Jayasekara (Observer from May 2023), Australian Industrial Chemicals Introduction Scheme (AICIS)
- Mr Laurence Wilson (Observer), National Indigenous Australians Agency (NIAA)
- Mr Adam Lovell (Observer until December 2023), Water Services Association of Australia.

Chemical Subgroup

Initial review of draft reports, drafting of guidance documents and subsequent revisions were undertaken by Committee members who were part of the Chemical Subgroup over the period from 2021 - 2024.

The following members of the 2018 – 2021 Water Quality Advisory Committee formed the Chemical Subgroup until 2021:

- Professor Stuart Khan (Subgroup Chair), Water Research Centre, University of New South Wales
- Professor Cynthia Joll, Curtin Water Quality Research Centre, Curtin University
- Professor Fred Leusch, School of Environment and Science, Griffith University
- Dr Nick Fletcher (Observer), Food Standards Australia New Zealand
- Dr David Cunliffe (from July 2020), South Australian Department for Health and Wellbeing.

The following members of the 2022-2025 Water Quality Advisory Committee formed the Chemical Subgroup until 2024:

- Professor Cynthia Joll (Subgroup Chair), Curtin Water Quality Research Centre, Curtin University
- Mr Cameron Dalgleish, Tasmanian Department of Health
- Professor Fred Leusch (from September 2023), School of Environment and Science, Griffith University.

NHMRC Project Team

This work was managed by the Water Team in the Public Health section of the Research Translation branch up until December 2023. The work has since been managed by the Environmental Health section, which now sits in the Research Quality and Advice branch.

Declarations of Interest

Appointees to committees of NHMRC are required to disclose their interests consistent with Section 42A of the Act, and instructions issued under sections 16A and 16B of the Public Governance, Performance and Accountability Rule 2014 (made under subsection 29(2) of the *Public Governance, Performance and Accountability Act 2013*). Prospective members were specifically asked to identify, to the best of their ability, interests including:

- financial interests: an interest must be declared when benefits or losses either in money or in-kind have occurred or may occur at a level that might reasonably be perceived to affect a person's judgement in relation to fair decisions about evidence and their participation in group decision-making
- other relationships: an interest must be declared when a strong position or prejudice or familial connection or other relationship held by a person could reasonably, or be perceived to, affect a person's judgement in relation to fair decisions about evidence and their participation in group decision-making including making an effort to arrive at a consensus
- affiliations to or associations with any organisations or activities that could reasonably be perceived to be an influence due to a competing interest, either for or against the issues being considered by the committee
- any other influences that might reasonably be considered likely to affect the expert judgement of the individual, or lead to the perception by others that the judgement of the individual is compromised.

Under the *Public Governance, Performance and Accountability Act 2013*, members have a responsibility to declare any interests to the whole committee, and members have a joint responsibility to decide on the management of any perceived or real conflict. No unmanageable conflicts were identified by the Committee or NHMRC.

Throughout the project, members were reminded of their obligation to consider any interest that may have arisen since the last meeting or with any particular agenda items. All disclosures and determinations about interests were recorded in the minutes of the Committee meetings. Members' relevant expertise and a summary of their disclosed interests were accessible on the

NHMRC website throughout the duration of the project. Declarations of interest were routinely raised at meetings of the Committee and the Chemical Subgroup during drafting of the guidance. Members of the Committee did not raise any concerns regarding these interests.

The relevant expertise of the Committee and a summary of their disclosed interests during the term of their membership is at **Appendix F**.

Project funding

This work was funded by NHMRC with contributions from the Commonwealth and the jurisdictions through the Australian Health Protection Principal Committee.

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Appendix A – Evidence to decision tables

Evidence to decision table – Bismuth (CAS 7440-69-9)

The Evidence to Decision (EtD) table below is intended to capture key factors considered by NHMRC and the Water Quality Advisory Committee when comparing and deciding on potential guideline options. This is in alignment with NHMRC Standards for Guidelines. This table has been updated or amended to capture additional information provided through stakeholder feedback from targeted/public consultation and any changes to advice made as a result by NHMRC and the Water Quality Advisory Committee. Please note NHMRC and the Water Quality Advisory Committee consider potential impacts of different guideline values, but ultimately the decision about the guideline values is based on what is considered the best available health evidence.

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for bismuth) – Provide information on level at which health effects might occur >10 mg/L	OPTION 2: – Establish new health-based guideline value for bismuth in drinking water of 10 mg/L
Example recommendation	*No guideline value is considered necessary for bismuth in drinking water, as concentrations are likely to be considerably lower than the level that can cause health effects.*	*Based on health considerations, the concentration of bismuth in drinking water should not exceed 10 mg/L.*

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for bismuth) – Provide information on level at which health effects might occur >10 mg/L	OPTION 2: – Establish new health-based guideline value for bismuth in drinking water of 10 mg/L
Health evidence profile	Bismuth is known to be toxic at high doses; however, there is currently no guideline value for bismuth in drinking water because typical levels usually found in drinking water supplies have not presented a health risk. It is noted that until recently plumbing materials containing bismuth were not in common use but this might change with the introduction of new regulations regarding the limit of lead in plumbing materials that come into contact with drinking water. If this option is selected, relevant information from the evidence review in Option 2 will be used to develop a fact sheet, including health information and a concentration at which health effects might occur if exceeded.	No existing health-based guidance/guideline values for bismuth for potential adoption/ adaption were identified. The dose response information in humans is insufficient for derivation of guidance/guideline values for bismuth. A review of primary animal studies identified a single study of sufficient quality that could be considered for potential guideline derivation. Sano et al. (2005) conducted an acute and repeat dose oral (gavage) toxicity study using bismuth metal (pure metal) in rats (this is likely the most relevant form of bismuth reminiscent of the type of bismuth exposure that might occur to bismuth alloys – see Section 5.2.2 of the Bismuth Evidence Evaluation Report). The study was well conducted and included all standardised endpoints which are typically investigated in such studies. The repeat dose study established a 28-day No Observed Adverse Effect Level (NOAEL) as the highest dose tested (i.e. 1,000 mg Bi/kg bw/d in female/male rats). On its own, the study is judged to not have a serious risk of bias based on the majority of key domains having a low risk of bias. Adaption of the identified NOAEL of 1,000 mg Bi/kg bw/d using default assumptions and applying a composite uncertainty factor of 300 (see Section 5.2.2 of Bismuth Evidence Evaluation report) would result in a health-based guideline value of 10 mg/L (rounded to 1 significant figure).
Exposure profile	Insufficient leaching data from plumbing materials were identified.	

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for bismuth) – Provide information on level at which health effects might occur >10 mg/L	OPTION 2: – Establish new health-based guideline value for bismuth in drinking water of 10 mg/L
Health benefits vs harms	Given the lack of leaching data it is uncertain whether this option will be protective of public health or not. Publication of a fact sheet including uncertainties around actual risks may help build awareness and drive health research in this area.	This guideline option will be protective of public health in the absence of leaching data while ensuring testing of products before they enter the market. It will also allow generation of datasets to help clarify the level of risk to consumers.
Values and preferences (consumers, communities)	To NHMRC's knowledge, consumers have not previously raised any concerns about bismuth in drinking water supplies. It is noted that this might change once it is known that there are new 'lead-free' plumbing materials on the market. It is reasonable to assume that consumers and communities would expect that: • supplied drinking water is safe to drink at the tap, regardless of whether leaching of chemicals from plumbing occurs beyond the point of supply or not • that new/emerging risks to public health from drinking water are considered by NHMRC and appropriate action is taken depending on the risks to public health and that all guideline options under consideration will be protective of public health • plumbing materials available for sale in Australia (particularly 'lead-free' WaterMark products) will have been tested rigorously and found to be compliant with Australian standards, and will be safe to install and use under typical conditions • that the materials used to replace lead in plumbing will not leach chemicals into drinking water that might cause harm to public health.	

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for bismuth) – Provide information on level at which health effects might occur >10 mg/L	OPTION 2: – Establish new health-based guideline value for bismuth in drinking water of 10 mg/L
Acceptability (other key stakeholders)	Given that the health evidence will have been reviewed and a justification for not setting a guideline value published in a fact sheet, this guideline option will provide some certainty that bismuth copper alloys are safe for use as potential lead replacements in plumbing materials for: • health regulators and/or drinking water authorities • water and construction/plumbing and manufacturing industries • consumers. However, given as there is uncertainty about exposure as there is insufficient leaching data available, it might be unacceptable to some stakeholders to not set a guideline value that might protect health in the absence of exposure data. A health-based drinking water guideline value for bismuth has not been established by similar international agencies, which may support consumer acceptability for this option.	This guideline option will provide the greatest confidence in bismuth copper alloys as safe lead replacements in plumbing materials for: • health regulators and/or drinking water authorities • water and construction/plumbing and manufacturing industries • consumers. Potential impacts of this guideline option on stakeholders: • increased (and potentially unnecessary) monitoring requirements may be unacceptable to water providers given that levels of bismuth in typical drinking water supplies in Australia have not previously presented any health risks • increased regulatory burden for health regulators and/or drinking water authorities as a result of increasing monitoring requirements may be unacceptable; however, this option will be most protective of public health in the absence of leachability data so might be more acceptable from the health protection perspective. • testing requirements for industry will increase as a new health-based guideline value will be embedded in the testing requirements for AS/NZS 4020; however, this might be balanced by the sector having greater confidence in product safety.

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for bismuth) – Provide information on level at which health effects might occur >10 mg/L	OPTION 2: – Establish new health-based guideline value for bismuth in drinking water of 10 mg/L
Feasibility	This guideline option is feasible as no changes to current practice are required. If industry adopt a potential product testing limit for bismuth of 12 mg/L, this would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques.	This guideline option is technically feasible. The concentration of the candidate health-based guideline value of 10 mg/L would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques. If industry implement a product testing limit for bismuth of 10 mg/L, this would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques.
Health equity impacts	Lead leaching has been an issue in communities and it may also be an issue in the early years of occupancy of new houses that have used currently available fittings. Replacement of ageing/lead plumbing with 'lead-free' options will be required in all new builds from May 2026 and is intended to improve health outcomes for the Australian population by minimising exposure to lead.	Lead leaching has been an issue in communities and it may also be an issue in the early years of occupancy of new houses that have used currently available fittings. Replacement of ageing/lead plumbing with 'lead-free' options will be required in all new builds from May 2026 and is intended to improve health outcomes for the Australian population by minimising exposure to lead. This option will be most conservative and protective of public health for the general population.

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for bismuth) – Provide information on level at which health effects might occur >10 mg/L	OPTION 2: – Establish new health-based guideline value for bismuth in drinking water of 10 mg/L
Resource impacts	None.	Resources will be required to monitor and test for bismuth in water supplies and in plumbing materials if a new guideline value for bismuth is introduced in the Guidelines. In addition: • increased costs of testing for bismuth by water providers (including those who already have limited resources), noting that it is unlikely that water treatment will be required given typical low levels observed in Australian source waters • costs to water providers and manufacturers might flow on to consumers • there may be resource impacts on industry testing of new plumbing materials for bismuth leaching • it is unclear what the resource impacts on the implementation of a new guideline value on AZ/NZS 4020 would be, including the impacts on the WaterMark certification process for plumbing products.
Decision	• In December 2023, Members agreed that no health-based guideline value should be set for bismuth or bismuth copper alloys, as health effects are expected to occur at levels much higher than concentrations expected in Australian drinking water supplies. Members agreed that the derivation of the levels at which health effects are expected to occur for bismuth (rounded to 10 mg/L) should be provided in the fact sheet. Members also agreed that the health-based guideline value should be reported to one significant figure for consistency with rounding conventions outlined in the Guidelines. • In March 2024, Members agreed to establish a health-based guideline value for bismuth of 10 mg/L based on health considerations. This change to the guideline recommendation for bismuth was made to address feedback from members of the enHealth Water Quality Expert Reference Panel who raised concerns about potential confusion from end users.	

References

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Evidence to decision table – Silicon (CAS 7440-21-3)

The Evidence to Decision (EtD) table below is intended to capture key factors considered by NHMRC and the Water Quality Advisory Committee when comparing and deciding on potential guideline options. This is in alignment with NHMRC Standards for Guidelines. This table has been updated or amended to capture additional information provided through stakeholder feedback from targeted/public consultation and any changes to advice made as a result by NHMRC and the Water Quality Advisory Committee. Please note NHMRC and the Water Quality Advisory Committee consider potential impacts of different guideline values, but ultimately the decision about the guideline values is based on what is considered the best available health evidence.

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for silicon) – Provide information on health effects that might occur >100 mg/L	OPTION 2: – Establish new health-based guideline value for silicon in drinking water of 100 mg/L
Draft recommendation	*No guideline value is considered necessary for silicon in drinking water, as concentrations are likely to be considerably lower than the level that can cause health effects.*	*Based on health considerations, the concentration of silicon in drinking water should not exceed 100 mg/L.*

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for silicon) – Provide information on health effects that might occur >100 mg/L	OPTION 2: – Establish new health-based guideline value for silicon in drinking water of 100 mg/L
Health evidence profile	There is currently no advice on silicon copper alloys or silicon in the Guidelines, presumably because typical levels usually found in drinking water supplies have not as yet presented a health risk. It is noted that until recently plumbing materials containing silicon copper alloys were not in common use but this might change with the introduction of new regulations regarding the limit of lead in plumbing materials that come into contact with drinking water. There is a silica (SiO_2) fact sheet and an aesthetic guideline value of 80 mg/L based on scale build up on surfaces (e.g. glass). No health guideline has been set for silica as there are currently no data linking silica to adverse health outcomes. If this option is selected, relevant information from the evidence review in Option 2 will be used to develop a fact sheet, including health information and a concentration at which health effects might occur if exceeded.	One existing health-based guidance value for silicon for potential adoption/ adaption was identified (EVM 2003). The identified guidance value was based on a total diet study in rats by Takizawa et al. 1988 that found no adverse effects in rats fed silica in the diet over a 2-year period. This study was found to have moderate certainty in the study findings. Adaption of the NOAEL from Takizawa et al. 1998 of 11.75 mg silicon/kg/day was used as the point of departure in the potential guideline derivation resulting in a potential guideline value for silicon of 100 mg/L (rounded to 1 significant figure from 120 mg/L). The relative source contribution was adjusted from 0.1 to 0.3 based on estimated daily intake in European diets. A composite uncertainty factor of 100 adjusted for extrapolation from animal to humans (x10), and for human variability (x10) was applied.
Exposure profile	Insufficient leaching data from plumbing materials were identified.	
Health benefits vs harms	Given the lack of leaching data it is uncertain whether this guideline option will be protective of public health or not. Publication of a fact sheet including uncertainties around actual risks may help build awareness and drive health research in this area.	This guideline option will be protective of public health in the absence of leaching data while ensuring testing of products before they enter the market. It will also allow generation of datasets to help clarify the level of risk to consumers.

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for silicon) – Provide information on health effects that might occur >100 mg/L	OPTION 2: – Establish new health-based guideline value for silicon in drinking water of 100 mg/L
Values and preferences (consumers, communities)	It is reasonable to assume that consumers and communities would expect that: • supplied drinking water is safe to drink at the tap, regardless of whether leaching of chemicals from plumbing occurs beyond the point of supply or not • that new/emerging risks to public health from drinking water are considered by NHMRC and appropriate action is taken depending on the risks to public health and that all guideline options under consideration will be protective of public health • plumbing materials available for sale in Australia (particularly 'lead-free' WaterMark products) will have been tested rigorously and found to be compliant with Australian standards, and will be safe to install and use under typical conditions • that the materials used to replace lead in plumbing will not leach chemicals into drinking water that might cause harm to public health.	

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for silicon) – Provide information on health effects that might occur >100 mg/L	OPTION 2: – Establish new health-based guideline value for silicon in drinking water of 100 mg/L
Acceptability (other key stakeholders)	Given that the health evidence will have been reviewed and a justification for not setting a guideline value published in a fact sheet, this guideline option will provide some certainty that silicon copper alloys are safe for use as potential lead replacements in plumbing materials for: • health regulators and/or drinking water authorities • water and construction/plumbing and manufacturing industries • consumers. However, given as there is uncertainty about exposure as there is insufficient leaching data available, it might be unacceptable to some stakeholders to not set a guideline value that might protect health in the absence of exposure data. A health-based drinking water guideline value for silicon has not been established by similar international agencies, which may support consumer acceptability for this option.	This guideline option will provide the greatest confidence in silicon copper alloys as safe lead replacements in plumbing materials for: • health regulators and/or drinking water authorities • water and construction/plumbing and manufacturing industries • consumers. Potential impacts of this guideline option on stakeholders: • initial increased (and potentially unnecessary) monitoring requirements may be unacceptable to water providers given that levels of silicon in typical drinking water supplies in Australia have not previously presented any health risks • increased regulatory burden for health regulators and/or drinking water authorities as a result of increasing monitoring requirements may be unacceptable; however, this option will be most protective of public health in the absence of leachability data so might be more acceptable from the health protection perspective. • testing requirements for industry will increase as a new health-based guideline value will be embedded in the testing requirements for AS/NZS 4020; however, this might be balanced by greater confidence in product safety.
Feasibility	This guideline option is feasible as no changes to current practice are required. If industry adopt a potential product testing limit for silicon of 100 mg/L, this would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques.	This guideline option is technically feasible. The concentration of the candidate health-based guideline value of 100 mg/L would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques. If industry implement a product testing limit for silicon of 100 mg/L, this would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques.

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for silicon) – Provide information on health effects that might occur >100 mg/L	OPTION 2: – Establish new health-based guideline value for silicon in drinking water of 100 mg/L
Health equity impacts	Lead leaching has been an issue in communities and it may also be an issue in the early years of occupancy of new houses that have used currently available fittings. Replacement of ageing/lead plumbing with 'lead-free' options will be required in all new builds from May 2026 and is intended to improve health outcomes for the Australian population by minimising exposure to lead.	Lead leaching has been an issue in communities with a and it may also be an issue in the early years of occupancy of new houses that have used currently available fittings. Replacement of ageing/lead plumbing with 'lead-free' options will be required in all new builds from May 2026 and is intended to improve health outcomes for the Australian population by minimising exposure to lead. This option will be most conservative and protective of public health for the general population.
Resource impacts	None.	Resources will be required to monitor and test for silicon in water supplies and in plumbing materials if a new guideline value for silicon is introduced in the Guidelines. In addition: • increased costs of testing for silicon by water providers (including those who already have limited resources), noting that it is unlikely that water treatment will be required given typical low levels observed in Australian source waters • costs to water providers and manufacturers might flow on to consumers • there may be resource impacts on industry testing of new plumbing materials for silicon leaching • it is unclear what the resource impacts on the implementation of a new guideline value on AZ/NZS 4020 would be, including the impacts on the WaterMark certification process for plumbing products. • there may be implications for the maximum impurity level of treatment chemicals.

Criteria	OPTION 1: – Maintain status quo (no health-based guideline value for silicon) – Provide information on health effects that might occur >100 mg/L	OPTION 2: – Establish new health-based guideline value for silicon in drinking water of 100 mg/L
Decision	• In December 2023, Members agreed that no health-based guideline value should be set for silicon or silicon copper alloys, as health effects are expected to occur at levels much higher than concentrations expected in Australian drinking water supplies. Members agreed that the derivation of the levels at which health effects are expected to occur for silicon (rounded to 100 mg/L) should be provided in the fact sheet. Members also agreed that the health-based guideline value should be reported to one significant figure for consistency with rounding conventions outlined in the Guidelines. • In March 2024, Members agreed to establish a health-based guideline value for silicon of 100 mg/L based on health considerations. This change to the guideline recommendation for silicon was made to address feedback from members of the enHealth Water Quality Expert Reference Panel who raised concerns about potential confusion from end users. • In December 2024, in light of several public consultation submission requests, Members agreed to combine the fact sheets for silicon and silica. This was determined to be a scientifically correct approach as the health-based guideline value for silicon was derived using toxicological data from a study that examined the health effects from silica exposure. A draft combined fact sheet was completed, including both the aesthetic-based guideline value of 80 mg/L for silica (equivalent to 37 mg/L silicon), and the health-based guidance value of 100 mg/L for silicon (equivalent to 210 mg/L silica).	

References

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Evidence to decision table – Selenium (CAS 7782-49-2)

The Evidence to Decision (EtD) table below is intended to capture key factors considered by NHMRC and the Water Quality Advisory Committee when comparing and deciding on potential guideline options. This is in alignment with NHMRC Standards for Guidelines. This table has been updated or amended to capture additional information provided through stakeholder feedback from targeted/public consultation and any changes to advice made as a result by NHMRC and the Water Quality Advisory Committee. Please note NHMRC and the Water Quality Advisory Committee consider potential impacts of different guideline values, but ultimately the decision about the guideline values is based on what is considered the best available health evidence.

Criteria	OPTION 1: – Maintain the current health-based guideline value for selenium of 0.01 mg/L	OPTION 2: – Lower health-based guideline value for selenium in drinking water to 0.004 mg/L
Example recommendation	*Current wording: Based on health considerations, the concentration of selenium in drinking water should not exceed 0.01 mg/L.*	*Based on health considerations, the concentration of selenium in drinking water should not exceed 0.004 mg/L.*

Criteria	OPTION 1: – Maintain the current health-based guideline value for selenium of 0.01 mg/L	OPTION 2: – Lower health-based guideline value for selenium in drinking water to 0.004 mg/L
Health evidence profile and supporting information	The current health-based guideline value of 0.01 mg/L for selenium in drinking water was derived using an acceptable daily intake of 0.24 mg/day. The underpinning study by Longnecker *et al*. 1991 was a 2-year study on 140 people where no health effects were reported with the level of selenium intake. The current fact sheet for selenium was last endorsed in 1996. It was prioritised for review by NHMRC with advice from the jurisdictions and the Water Quality Advisory Committee as there were concerns that it may no longer be considered protective of public health.	An initial screening review of existing health-based guidance/guidelines for selenium identified a number of potential guideline values that were found suitable to adopt/adapt for the Australian context. However, an evidence scan of the published literature identified a number of primary studies that required review. A follow-up review of the primary literature published since 2010 found one human study that could be considered for potential guideline derivation. There is high confidence in the evidence for selenium exposure and mild effects of selenosis (i.e. alopecia). A lowest observed adverse effect level (LOAEL) of 255 µg Se/day (as diet and supplemental selenium) was determined from a human controlled trial by Lippman et al. 2009. These findings are supported by a separate review recently published in 2023 by the European Food Safety Authority (EFSA). EFSA determined an upper daily limit for selenium of 255 µg Se/day based on selenosis, finding a high level of certainty in the Lippman et al. 2009 cohort study. The review also found that while there was evidence of potential other health effects (such as risk of Type 2 diabetes), there was insufficient dose-response information to determine a suitable NOAEL or LOAEL for other potential health effects of selenium exposure.
Exposure profile	Many Australian distributed drinking water supplies contain relatively low selenium levels (i.e. typically <2 µg/L), which are lower than both guideline options. It is noted, however, there are some locations around Australia where communities rely on source waters that due to their geological origin may contain selenium concentrations higher than the current guideline value (e.g. up to 12 µg/L observed in NT and QLD). It is also noted that lowering the guideline value will increase the number of exceedances observed around the country. It is noted that exposure to selenium may also theoretically occur from leaching of selenium from low-lead plumbing materials. Insufficient leaching data regarding selenium in plumbing materials were identified in the review.	

Criteria	OPTION 1: – Maintain the current health-based guideline value for selenium of 0.01 mg/L	OPTION 2: – Lower health-based guideline value for selenium in drinking water to 0.004 mg/L
Health benefits vs harms	As this guideline value is based on an older review and does not consider more recent studies that have resulted in changes in advice by international organisations, it is uncertain whether this guideline option would be considered protective of public health. Given the lack of leaching data for selenium copper alloys used in plumbing products, it is also unclear if this guideline value would be protective of public health in this exposure scenario. Publication of a fact sheet including uncertainties around actual risks from leaching from plumbing may help build awareness and drive research in this area.	This guideline option is the most conservative option and will be protective of public health. Given the lack of leaching data for selenium copper alloys used in plumbing products, it is also unclear if this guideline value would be protective of public health in this exposure scenario. However, in the absence of leaching data, a lower health-based guideline value will ensure testing of products to ensure they do not exceed this level before they enter the market. It may also allow generation of datasets to help clarify the level of risk to consumers from in-premises leaching. Publication of a fact sheet including uncertainties around actual risks from leaching from plumbing may help build awareness and drive research in this area.
Values and preferences (consumers, communities)	The values and preferences of consumers regarding selenium in drinking water, or selenium leaching from 'lead-free' plumbing materials on the market is unknown. However, it is reasonable to assume that consumers and communities would expect that: • supplied drinking water is safe to drink at the tap, regardless of whether leaching of chemicals from plumbing occurs beyond the point of supply or not • that new/emerging risks to public health from drinking water are considered by NHMRC and appropriate action is taken depending on the risks to public health and that all guideline options under consideration will be protective of public health • plumbing materials available for sale in Australia (particularly 'lead-free' WaterMark products) will have been tested rigorously and found to be compliant with Australian standards, and will be safe to install and use under typical conditions • that the materials used to replace lead in plumbing will not leach chemicals into drinking water that might cause harm to public health.	

Criteria	OPTION 1: – Maintain the current health-based guideline value for selenium of 0.01 mg/L	OPTION 2: – Lower health-based guideline value for selenium in drinking water to 0.004 mg/L
Acceptability (other key stakeholders)	This guideline option will be less acceptable to many stakeholders who are responsible for regulating public health and/or drinking water. Selenium was flagged as a priority chemical for review in 2016 by most jurisdictional health authorities on the enHealth Water Quality Expert Reference Panel as the underpinning health advice was considered out of date.	This guideline option will provide the most certainty in the safest level of selenium in drinking water for: • health regulators and/or drinking water authorities • water and construction/plumbing and manufacturing industries • consumers. Potential impacts of this guideline option on stakeholders that might influence acceptability include: • increased water treatment requirements to meet the guideline value • increased reporting of exceedances, as there could potentially be more drinking water supplies that will now exceed the guideline value • changed product testing requirements for industry; however, this might be balanced by greater confidence in product safety • health-based guideline values for selenium set by similar international agencies. Further information on selenium leaching data will provide greater certainty that the proposed guideline value will be protective of health from this exposure scenario.
Feasibility	This guideline option is feasible as no changes to current practice are required.	This guideline option is technically feasible. The concentration of the candidate health-based guideline value of 0.004 mg/L would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques. If industry implement a product testing limit for selenium of 0.004 mg/L, this would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques.

Criteria	OPTION 1: – Maintain the current health-based guideline value for selenium of 0.01 mg/L	OPTION 2: – Lower health-based guideline value for selenium in drinking water to 0.004 mg/L
Health equity impacts	Unclear.	Unclear. This option will be most conservative and protective of public health for the general population but depending on geographical and geological location the impacts of implementing this guideline option might be felt more in communities that have limited resources.
Resource impacts	No changes to current practice are required.	Additional resources might be required to meet the lowered health-based guideline value for selenium if it is introduced in the Guidelines, such as: • increased costs of treatment to remove excess selenium by water providers in areas where there are exceedances of selenium in source waters, noting that it is unlikely that additional water treatment will be required in most Australian supplies • additional costs to water providers and manufacturers might flow on to consumers • it is unclear what the resource impacts on the implementation of a lowered guideline value for selenium on AZ/NZS 4020 would be, including the impacts on the WaterMark certification process for plumbing products • there will be a flow on effect on the maximum impurity levels of selenium in water treatment chemicals – this might have additional resource impacts to achieve these purity standards.
Decision	• In December 2023, Members agreed that the health-based guideline value for selenium should be lowered from 0.01 mg/L to 0.004 mg/L based on health considerations. Members also agreed that the health-based guideline value should be reported to one significant figure for consistency with rounding conventions outlined in the Guidelines.	

References

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Evidence to decision table – Lead (CAS 7439-92-1)

The Evidence to Decision (EtD) table below is intended to capture key factors considered by NHMRC and the Water Quality Advisory Committee when comparing and deciding on potential guideline options. This is in alignment with NHMRC Standards for Guidelines. This table has been updated or amended to capture additional information provided through stakeholder feedback from targeted/public consultation and any changes to advice made as a result by NHMRC and the Water Quality Advisory Committee. Please note NHMRC and the Water Quality Advisory Committee consider potential impacts of different guideline values, but ultimately the decision about the guideline values is based on what is considered the best available health evidence.

Criteria	OPTION 1: – Maintain the current health-based guideline value for lead of 0.01 mg/L – Update supporting information in current fact sheet	OPTION 2: – Lower health-based guideline value for lead in drinking water to 0.005 mg/L – Update supporting information in current fact sheet
Draft recommendation	Current wording: *Based on health considerations, the concentration of lead in drinking water should not exceed 0.01 mg/L.*	New wording: *Based on health considerations, the concentration of lead in drinking water should not exceed 0.005 mg/L.*

Criteria	OPTION 1: – Maintain the current health-based guideline value for lead of 0.01 mg/L – Update supporting information in current fact sheet	OPTION 2: – Lower health-based guideline value for lead in drinking water to 0.005 mg/L – Update supporting information in current fact sheet
Health evidence profile	The current health-based guideline value of 0.01 mg/L was endorsed in 1996. It is based on metabolic studies in infants that established a lead intake of 0.0035 mg Pb/kg body weight per day that does not result in an increase in lead retention (Ziegler et al. 1978, Ryu et al. 1983). The World Health Organization (WHO) guideline value for lead in drinking water has been 0.01 mg/L since 1993. This was originally based on the same metabolic studies as the NHMRC advice, but is no longer considered a health-based guideline value as it has been established that there is no longer a safe level of lead due to neurodevelopmental effects in infants (JECFA 2011a,b). WHO continues to recommend a provisional guideline value of 0.01 mg/L that is based on treatment performance and analytical achievability, while encouraging lead levels to be minimised as much as practically possible. It is noted that the current NHMRC fact sheet for lead acknowledges the development of blood lead level advice by NHMRC and states that the current guideline value of 0.01 mg/L should be regarded as an interim value pending the findings of a review. NHMRC reviewed the health effects of lead in 2015 and recommended that investigation of potential sources of lead exposure should be investigated if blood lead levels exceed 5 mg/dL. This 2015 advice is considered as part of the review in Option 2 and forms the basis of the proposed health-based guideline value. As the level of lead intake used in the current guideline derivation is no longer considered safe based on neurodevelopmental effects observed in infants exposed to low levels of lead, it is uncertain whether the current NHMRC health-based guideline value for lead of 0.01 mg/L is still protective of health.	An initial screening review of existing health-based guidance/guidelines for lead identified a number of potential guideline values that were found suitable to adopt/adapt for the Australian context, including the 2015 NHMRC advice on blood lead levels. However, as the potential guideline candidates were either not informed by recent reviews or not considered health-based, it was determined that an additional review of the recent literature was warranted. A follow-up review of the primary literature published since 2013 found that there is highest confidence in the body of evidence for an association between exposure to lead and neurobehavioural effects (including reductions in intelligence quotient). However, the results of these studies do not appear to alter the dose response relationship and conclusions already established by NHMRC in 2015 for blood lead levels. Deriving a candidate drinking water guideline for lead with the general aim of reduction / minimisation of lead exposures to a target of <5 µg/dL results in a health-based guideline value of 0.005 mg/L. This approach would be consistent with current Australian science policy to minimise exposure to lead in the most sensitive population groups (infants, children and pregnant women). It is noted that a 2021 European Union directive published since the initial screening of existing guidance/guidelines has lowered the level of lead in drinking water to 0.005 mg/L, to be implemented by 2036. It is also consistent with health advice and approach for lead in drinking water published by Health Canada in 2019.

Criteria	OPTION 1: – Maintain the current health-based guideline value for lead of 0.01 mg/L – Update supporting information in current fact sheet	OPTION 2: – Lower health-based guideline value for lead in drinking water to 0.005 mg/L – Update supporting information in current fact sheet
Exposure profile	Leaching data from plumbing systems indicates that lead leaching is site specific and occurs in-premises. It is also dependent on water quality characteristics and the type of plumbing materials used.	
Health benefits vs harms	There have been concerns that the current guideline value does not provide adequate protection against potential lead leaching in-premises.	This guideline option is the most conservative option and will be protective of public health at the tap.
Values and preferences (consumers, communities)	Human exposure to lead is an ongoing concern to consumers and communities, particularly to those who live in communities where drinking water supplies (including rainwater tanks) can be exposed to lead dust or where plumbing infrastructure may include historic lead pipes. It is noted that the introduction of new 'lead-free' plumbing materials on the market may alleviate some concerns and could reduce overall exposure to lead. It is reasonable to assume that consumers and communities would expect that: • supplied drinking water is safe to drink at the tap, regardless of whether leaching of chemicals from plumbing occurs beyond the point of supply or not • that new/emerging risks to public health from drinking water are considered by NHMRC and appropriate action is taken depending on the risks to public health and that all guideline options under consideration will be protective of public health • plumbing materials available for sale in Australia (particularly 'lead-free' WaterMark products) will have been tested rigorously and found to be compliant with Australian standards, and will be safe to install and use under typical conditions • that the materials used to replace lead in plumbing will not leach chemicals into drinking water that might cause harm to public health.	

Criteria	OPTION 1: – Maintain the current health-based guideline value for lead of 0.01 mg/L – Update supporting information in current fact sheet	OPTION 2: – Lower health-based guideline value for lead in drinking water to 0.005 mg/L – Update supporting information in current fact sheet
Acceptability (other key stakeholders)	Given that the health evidence will have been reviewed and a justification for not setting a guideline value published in a fact sheet, this guideline option will provide some certainty that low lead plumbing materials are safe for use for: • health regulators and/or drinking water authorities • water and construction/plumbing and manufacturing industries • consumers. However, given as there is uncertainty about exposure as there is insufficient leaching data available, it might be unacceptable to some stakeholders to not set a guideline value that might protect health in the absence of exposure data. As a lower health-based drinking water guideline value for lead has been established by similar international agencies, consumer acceptability for this option is likely to be lower.	This guideline option will provide the greatest confidence in plumbing materials that contain lead for: • health regulators and/or drinking water authorities • water and construction/plumbing and manufacturing industries • consumers. Factors that might impact acceptability of this guideline option for stakeholders: • increased regulatory burden for health regulators and/or drinking water authorities as more exceedances might be detected as a result of lowering the guideline value; however, this option will be most protective of public health so might be more acceptable from the health protection perspective. • testing requirements for industry will increase as a new health-based guideline value will be embedded in the testing requirements for AS/NZS 4020; however, this might be balanced by greater confidence in product safety. • a similar health-based guideline value has been established by other international agencies.
Feasibility	This guideline option is feasible as no changes to current practice are required.	This guideline option is technically feasible. The concentration of the candidate DWG of 0.005 mg/L would be achievable with existing treatment technologies and readily measurable with current commercial analytical techniques. The implementation of low-lead replacement plumbing products will also support feasibility of achieving the candidate DWG of 0.005 mg/L across the general population.

Criteria	OPTION 1: – Maintain the current health-based guideline value for lead of 0.01 mg/L – Update supporting information in current fact sheet	OPTION 2: – Lower health-based guideline value for lead in drinking water to 0.005 mg/L – Update supporting information in current fact sheet
Health equity impacts	Lead leaching has been an issue in communities and it may also be an issue in the early years of occupancy of new houses that have used currently available fittings. Replacement of ageing/lead plumbing with 'lead-free' options will be required in all new builds from May 2026 and is intended to improve health outcomes for the Australian population by minimising exposure to lead. Current guideline value may not be protective of most sensitive populations.	Lead leaching has been an issue in communities and it may also be an issue in the early years of occupancy of new houses that have used currently available fittings. Replacement of ageing/lead plumbing with 'lead-free' options will be required in all new builds from May 2026 and is intended to improve health outcomes for the Australian population by minimising exposure to lead. This option will be most conservative and protective of public health for the general population, including groups that may be most sensitive (e.g. infants, children and pregnant women) or more exposed to lead leaching due to socioeconomic factors.
Resource impacts	None.	It is unclear what the resource impacts on the implementation of a new guideline value on AZ/NZS 4020 would be, including the impacts on the WaterMark certification process for plumbing products. There may be a flow on impact on the maximum impurity levels of lead in water treatment chemicals, which may have additional resource impacts to achieve these purity standards.
Decision	• In December 2023, Members agreed the health-based guideline value for lead should be lowered from 0.01 mg/L to 0.005 mg/L based on health considerations.	

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Evidence to decision table – Manganese (CAS 7439-96-5)

The Evidence to Decision (EtD) table below is intended to capture key factors considered by NHMRC and the Water Quality Advisory Committee when comparing and deciding on potential guideline options. This is in alignment with NHMRC Standards for Guidelines. This table has been updated or amended to capture additional information provided through stakeholder feedback from targeted/public consultation and any changes to advice made as a result by NHMRC and the Water Quality Advisory Committee. Please note NHMRC and the Water Quality Advisory Committee consider potential impacts of different guideline values, but ultimately the decision about the guideline values is based on what is considered the best available health evidence.

Health-based guideline value

Criteria	OPTION 1: Maintain status quo – Current health-based guideline value of 0.5 mg/L (NHMRC 2011)	OPTION 2: Establish new health-based guideline value for manganese in drinking water of 0.1 mg/L (note – aesthetic guideline value discussed separately)
Example recommendation	*Manganese would not be a health consideration unless the concentration exceeded 0.5 mg/L.*	*Based on health considerations, the concentration of manganese in drinking water should not exceed 0.1 mg/L.*

Health evidence profile	The current health-based guideline value of 0.5 mg/L was last endorsed by NHMRC Council in 2011. It is based on a total dietary intake of manganese of 10 mg/day as recommended by WHO in 1973. WHO reviewed their drinking water guideline value in 2021 based on emerging evidence that oral intake was potentially important for manganese toxicity. This reassessment considered more recent epidemiological data that indicated the potential for adverse effects in populations exposed to manganese concentrations lower than the previously established WHO health-based value for drinking water. The WHO guideline value was amended in 2022 to a provisional guideline value of 0.08 mg/L based on neurological effects in neonatal rats. This updated guideline value was designated as provisional due to the high level of uncertainty in the database, as reflected in the composite uncertainty factor of 1,000. As the level of manganese intake used in the current guideline derivation is much higher than the recently derived safe levels of manganese intake for different age cohorts of 2–8 mg/day by EFSA (2023) it is uncertain whether the current NHMRC health-based guideline value for manganese of 0.5 mg/L is protective of children's health. In particular, EFSA recommend only 2 mg/day for infants aged ≥4 months to <1 year as they absorb more and excrete less manganese. The current factsheet states that "Owing to the low solubility of manganese in gastric juices, only 3–8% of ingested manganese is absorbed by the gastrointestinal tract." However, in a nutrient balance study in infants, Dörner et al. (1989) reported apparent relative retention of manganese	A targeted review of recent guidance/guidelines published by WHO (2021, 2022), Health Canada (2019) and EFSA (2023) identified neurotoxicity as an endpoint of concern following oral exposure to manganese (NHMRC 2024). Some of these studies assessed neurodevelopmental endpoints in early life that were supported by corresponding neurochemical findings. Both WHO and Health Canada agreed that results from the most robust animal dose–response studies identified a neurodevelopmental lowest observable adverse effect level for manganese of 25 mg/kg bw/day in rats following oral exposure in early life. These studies characterised parameters of executive function that reflect effects reported in human epidemiological studies, such as behavioural hyperactivity and learning deficits following early-life exposures. The quality of the human epidemiological studies is variable, particularly with respect to the reliability of exposure estimates. No single study shows a clear causal relationship between manganese dose and neurotoxicity. However collectively human epidemiological studies provide qualitative support that neurotoxicity is also relevant in humans. Evidence also suggests that the cognitive and neurobehavioural effects in children following exposure to manganese may be related to effects on the dopaminergic system during development. Infants, and especially neonates, have greater manganese absorption and a reduced capacity for biliary excretion compared to adults. As a result, neonates and young children will acquire a higher body burden of manganese from a given exposure than will adults; this, along with the important neurodevelopmental processes occurring in neonates, renders them particularly susceptible to manganese-induced toxicity.

Criteria	OPTION 1: Maintain status quo – Current health-based guideline value of 0.5 mg/L (NHMRC 2011)	OPTION 2: Establish new health-based guideline value for manganese in drinking water of 0.1 mg/L (note – aesthetic guideline value discussed separately)
	from breast milk of 37% and 16%–31% from infant formula. EFSA note the scarcity of data regarding the maturation processes of manganese homeostatic mechanisms in human infants, and that the available data are inadequate to determine whether infants have a similar capacity as older age groups to regulate manganese body burden. Neurotoxicity is a well-established adverse effect of excess manganese exposure. However, data to identify critical dietary intakes associated with increased risks of neurotoxicity are lacking in both animals and humans.	

Exposure profile	Manganese is present in air, food, consumer products, soil and drinking water; however, the main source of exposure is through diet, the main contributors being grain-based products and teas. The current NHMRC factsheet estimates that the average dietary intake of manganese is 2–4 mg per day (NHMRC 2011). The current manganese fact sheet reports that in major Australian reticulated supplies, manganese concentrations can range up to 1.41 mg/L, with typical concentrations less than 0.01 mg/L. For regional NSW, a median value of 0.005 mg/L was found over a nine-year period (NHMRC 2011). A summary of recent distributed drinking water supply monitoring data for manganese: • Mean concentration **<0.002 – 0.026 mg/L** and maximum concentration of **0.055 mg/L** was recorded across urban and regional Western Australia during 2022–2023 (Water Corporation 2023). • Average manganese concentrations of **<0.005–0.03 mg/L** in town centres and **<0.005–0.3 mg/L** in 72 regional First Nations communities of the Northern Territory during 2021–2022. Exceedances were noted in Pine Creek urban centre (**0.7 mg/L),** and regional towns Nauiyu (**0.8 mg/L**) and Nganmarriyanga (**0.3 mg/L**) that rely on bore water (Power & Water Corporation 2023). • Average concentrations of **<0.001–0.006 mg/L** were measured in the bulk water supplied to councils and water retail distributors in South-East Queensland by Seqwater from February 2023–January 2024 (Seqwater 2024). • Mean concentration in Adelaide's metropolitan distribution system (customer tap water quality) measured **0.0015 mg/L** and a maximum of **0.0075 mg/L** during 2022–2023. All regional drinking water distributions systems including those supplying First Nations communities (regional customer tap water quality) recorded mean concentrations in the range **<0.0001–0.0208 mg/L** during 2022–2023 (South Australian Water Corporation 2023). • Manganese concentrations measured in drinking water derived from the six major Melbourne storage reservoirs following primary treatment processes were in the range **0.0001–0.0138 mg/L** during 2022 (Melbourne Water 2023). • Average concentration measured at participating customers' taps was **0.004 mg/L** (range **<0.001–0.183 mg/L**) in Canberra during 2022–2023 (Icon Water 2023). Other factors that might influence the extent of manganese toxicity specific to drinking water exposure, include the bioavailability of differing chemical forms and valence states present in drinking water. For example, when reducing conditions are present in groundwater, higher concentrations of dissolved manganese (II) are favoured; up to 1300 µg/L in neutral groundwater and 9600 µg/L in acidic groundwater have been reported (ATSDR, 2012). Surface water supplies such as lakes and reservoirs can become seasonally stratified, limit mixing can cause the lower sections of the water body to become anoxic. This allows release of dissolved Mn(II) into the water column from manganese oxides present in sediments at the bottom of the water body. In addition, low levels of manganese in source or treated water can accumulate in the distribution system and periodically release manganese to result in high levels at the tap. Releases of manganese can also occur periodically due to physical or hydraulic disturbances to the system (e.g. mains breaks or hydrant flushing) or changes in water chemistry (e.g. changes in pH, temperature, chlorine residual, and source water type/blending).

Criteria	OPTION 1: Maintain status quo – Current health-based guideline value of 0.5 mg/L (NHMRC 2011)	OPTION 2: Establish new health-based guideline value for manganese in drinking water of 0.1 mg/L (note – aesthetic guideline value discussed separately)
Health benefits vs harms	The current guideline value may not provide adequate protection against possible neurotoxic effects in developing infants and children, or adults.	While there is some uncertainty in the studies used to inform this guideline option, this guideline option is conservative and precautionary with uncertainty factors incorporated to account for study deficiencies. It is considered to be protective of health for the general population, including infants and children who are most sensitive.
Values and preferences (consumers, communities)	It is reasonable to assume that all consumers and communities would expect that: • supplied drinking water is safe and aesthetically pleasing to drink, • that new/emerging risks to public health from drinking water are considered by NHMRC and appropriate action is taken depending on the risks to public health and that all guideline options under consideration will be protective of public health. Communities and consumers might perceive the aesthetic qualities of manganese in drinking water supplies more than the health effects. At levels as low as 0.02 mg/L, manganese as insoluble manganese oxides in water supplies may cause discoloured water, staining of laundry and plumbing fixtures and accumulate as oxide deposits in the distribution system, which may slough off as a black precipitate. In contrast, soluble manganese (II) is colourless and visually undetectable at concentrations as high as 506 mg/L (WHO 2021). The US EPA (2024a) note that manganese may introduce a black to brown colour, black staining and a bitter metallic taste that affects the aesthetic qualities of drinking water. Removal of manganese from drinking water will support greater consumption of drinking water and remove the need to purchase bottled drinking water for cooking and drinking thus removing an unnecessary economic burden for communities that do not receive aesthetically acceptable drinking water.	

Criteria	OPTION 1: Maintain status quo – Current health-based guideline value of 0.5 mg/L (NHMRC 2011)	OPTION 2: Establish new health-based guideline value for manganese in drinking water of 0.1 mg/L (note – aesthetic guideline value discussed separately)
Acceptability (other key stakeholders)	There might be some concerns that NHMRC is not aligning with international advice on manganese from agencies such as WHO and Health Canada if the current guideline value is retained. Water providers responsible for implementing the Guidelines in regions where the manganese concentration in source or drinking water is high may be less willing to commit resources to implement and monitor lower guideline values if there is uncertainty in the evidence base for any proposed changes.	The proposed lower guideline option for manganese will be the more conservative option and may be more acceptable to stakeholders such as health regulators from a health protection perspective. However, the acceptability of this guideline option to stakeholders who implement the Guidelines may be affected by the certainty of the underpinning evidence. Stakeholders who may have higher resource impacts if this guideline option is implemented may find it less acceptable if the justification for a change in practice is based on low quality evidence. It is noted that many water providers currently monitor and report on whether drinking water meets the aesthetic guideline value of 0.1 mg/L for manganese. The lower guideline option, while inherently more conservative and health protective, was found to be underpinned by key studies that were assessed by EFSA (2023) as having a higher level of uncertainty in their study quality, such as risk of bias in terms of blinding, randomization and allocation concealment that may have impacted the study outcomes. However, there may be increased confidence in the lower guideline value due to the high composite uncertainty factor (1,000) applied in the guideline derivation to account for deficiencies in study design and extrapolation to humans. The WHO and Health Canada applied that same uncertainty factor (1000) to the data to derive a health-based guideline value for manganese. Other factors that might affect acceptability of a lower guideline value for stakeholders include: • increased regulatory burden for health regulators and/or drinking water authorities as more exceedances in drinking water supplies might be detected as a result of lowering the guideline value. • monitoring requirements for water providers may increase, especially in areas with higher levels of manganese in source waters. • lower health-based guideline values have been established by other international agencies.

Criteria	OPTION 1: Maintain status quo – Current health-based guideline value of 0.5 mg/L (NHMRC 2011)	OPTION 2: Establish new health-based guideline value for manganese in drinking water of 0.1 mg/L (note – aesthetic guideline value discussed separately)
Feasibility	This guideline option is feasible as no changes to current practice are required.	This guideline option is technically feasible using current commercial and analytical techniques. Manganese concentrations in drinking water are easily lowered to less than 0.05 mg/L using common water treatment methods, including oxidation/filtration, adsorption/oxidation, softening/ion exchange and biological filtration methods. In well-operated and optimised systems, manganese concentrations can be reduced to less than 0.02 mg/L (Health Canada 2019, WHO 2022). Table A5.1 in the WHO guidelines (2022) includes the following water treatment methods for the removal of naturally occurring manganese from source waters and the manganese concentrations that can be achieved: • Dissolved manganese (II) can be removed through cation exchange in zeolite softening processes to <0.05 mg/L. • Precipitation and softening to <0.02 mg/L. • Oxidation of manganese using ozone followed by filtration to <0.05 mg/L. • Adsorption/oxidation including manganese greensand and other filter media coated with manganese oxides to <0.02 mg/L. • Oxidation using potassium permanganate followed by low pressure membrane filtration to <0.01 mg/L. Selection of the appropriate treatment system for manganese removal depends on the form of manganese (dissolved or particulate) present in the source water (Health Canada 2019, WHO 2022).

Criteria	OPTION 1: Maintain status quo – Current health-based guideline value of 0.5 mg/L (NHMRC 2011)	OPTION 2: Establish new health-based guideline value for manganese in drinking water of 0.1 mg/L (note – aesthetic guideline value discussed separately)
Health equity impacts	There is uncertainty if this guideline option is protective of health for more sensitive populations (e.g. bottle-fed infants), particularly those who may be more exposed to manganese based on their geographic location and local water sources and treatment options. Currently, some rural and remote communities in Australia may only have access to water containing unsafe levels of manganese that may affect the long-term health of children and other sensitive populations.	This guideline option is more conservative than the current NHMRC advice and is considered protective of public health for the general population. This includes groups that may be more sensitive (e.g. bottle-fed infants) and populations who may be more exposed to manganese from their local water sources.

Criteria	OPTION 1: Maintain status quo – Current health-based guideline value of 0.5 mg/L (NHMRC 2011)	OPTION 2: Establish new health-based guideline value for manganese in drinking water of 0.1 mg/L (note – aesthetic guideline value discussed separately)
Resource impacts	None. There would be no change in practice if the current guideline value is retained.	The proposed guideline option may have resource impacts for the water sector where utilities are not currently meeting (or aiming for targets lower than) the current aesthetic guideline value of 0.1 mg/L to limit consumer complaints related to discoloured water and visible particulates in their drinking water. Additional monitoring and treatment programs (including infrastructure) may be required to treat drinking water supplies to meet lowered guideline values, particularly in areas where lowering the guideline value may result in increased exceedances detected in communities. The cost of water treatment to remove manganese from drinking water may be challenging for water providers or communities relying on local bore water or water sources affected by seasonality and other weather events. For instance, Power and Water Corporation (2020, 2023) report: • A peak in water quality complaints during May, may be due to the change in weather and subsequent stratification during the dry season. These layers in the Darwin River Reservoir mix once the surface temperature cools during a monsoonal event or when the dry season trade winds and cool nights arrive producing discoloured water throughout the reservoir and allowing low quality anoxic water from the depths of the reservoir to mix with surface waters and to be drawn into the supply. • After heavy rainfall, the Katherine River experiences sudden inflows of runoff water that impact its quality and the ability for it to be adequately treated to the required drinking water standards. • Most regional towns in the Northern Territory rely on groundwater that is only treated with chlorine or UV radiation to remove microorganisms. Water providers may be have limited capacity to cover increased operational costs if there is lower certainty in the evidence for a lower guideline value. Resulting costs for additional treatment of drinking water supplies or investment in appropriate treatment technologies may be borne by local water providers or communities. This may have flow on costs to consumers.

Criteria	OPTION 1: Maintain status quo – Current health-based guideline value of 0.5 mg/L (NHMRC 2011)	OPTION 2: Establish new health-based guideline value for manganese in drinking water of 0.1 mg/L (note – aesthetic guideline value discussed separately)
Decision	A. In March 2024, Members agreed that the health-based guideline value for manganese should be lowered from 0.5 mg/L to 0.1 mg/L based on health considerations. Members also agreed that the health-based guideline value should be reported to one significant figure for consistency with rounding conventions outlined in the Guidelines.	

Aesthetic guideline value – manganese

Criteria	OPTION 1: Maintain status quo – aesthetic guideline value of 0.1 mg/L (NHMRC 2011).	OPTION 2: Establish new aesthetic guideline value for manganese in drinking water within the range 0.01–0.1 mg/L
Example recommendation	*Based on aesthetic considerations, the concentration of manganese in drinking water should not exceed 0.1 mg/L, measured at the customer's tap.*	*Based on aesthetic considerations, the concentration of manganese in drinking water should not exceed [selected concentration] measured at the customer's tap.*
Evidence profile	The current aesthetic guideline value of 0.1 mg/L is based on practical experience and has been reported by utilities to be acceptable to customers. The discretionary target of 0.01 mg/L at the treatment plant is also based on experience; that although manganese accumulates in distribution systems, a plant producing 0.01 mg/L generally does not generate customer complaints, while a concentration of 0.02 mg/L or more tends to lead to various problems (NHMRC 2011).	The aesthetic guideline value for the manganese concentration in drinking water is 0.02 mg/L in Canada and 0.05 mg/L in the USA and European Union (US EPA 2024, EU 2024, Health Canada 2019). These values are based on the level at which manganese precipitates can discolour water, stain laundry, form deposits in plumbing, and alter palatability and consumer acceptability. WHO states that insoluble manganese can cause aesthetic effects at 0.02 mg/L (WHO 2022). The US EPA notes the following aesthetic effects above 0.05 mg/L – black to brown colour; black staining; bitter metallic taste (US EPA 2024). The current Australian fact sheet suggests a discretionary target of 0.01 mg/L at the water treatment plant (NHMRC 2011).
Exposure profile	See Exposure Profile for health-based guideline value for some information on levels of manganese in Australia. In addition: • The regional NT communities of Nauiyu and Nganmarriyanga recorded an average manganese concentration of **0.3 mg/L** during 2021–2022 which exceeded the aesthetic guideline value. Maximum concentrations of **0.8 mg/L** and **0.3 mg/L** were recorded in Nauiyu and Nganmarriyanga respectively which rely on bore water, and **0.7 mg/L** in the Pine Creek urban centre. Average manganese concentrations of **<0.005–0.03 mg/L** in town centres and **<0.005–0.3 mg/L** in 72 regional First Nations communities of the Northern Territory were reported during 2021–2022 (Power & Water Corporation 2023). • No exceedances of the manganese aesthetic guideline value (0.1 mg/L) were detected in the six regions tested by Water Corporation over the 2022-2023 report period. Mean concentrations ranging between **<0.002 – 0.026 mg/L** and a maximum concentration of **0.055 mg/L** were recorded across urban and regional Western Australia during 2022–2023 (Water Corporation 2023). Consumer complaints regarding colour and taste of drinking water may provide an indication of exposure to manganese if the chemical is at least partly responsible for changes in aesthetic water quality, however soluble manganese(II) will not be visible to consumers.	

Criteria	OPTION 1: Maintain status quo – aesthetic guideline value of 0.1 mg/L (NHMRC 2011).	OPTION 2: Establish new aesthetic guideline value for manganese in drinking water within the range 0.01–0.1 mg/L
Values and preferences (consumers, communities)	Aesthetic issues with manganese in drinking water can be a problem in some regional areas of Australia and can be the cause of some consumer complaints about discoloured drinking water. Lowering the aesthetic guideline value will likely be supported by consumers (noting that this might depend on a willingness to pay), particularly those communities that experience regular issues with aesthetic water quality caused by manganese. It is likely that removal of soluble and insoluble manganese from drinking water will make the water more appealing to consumers as manganese salts will not discolour the water or laundered clothing and the water will not have an unusual taste. An EU technical report (WHO 2017) notes that at levels exceeding 0.1 mg/L (100 µg/L), manganese in water supplies causes an undesirable taste in beverages and the US EPA notes that concentrations above 0.05 mg/L will have a noticeable bitter metallic taste (US EPA 2024a).	
Acceptability (other key stakeholders)	This option will be more acceptable to some water providers who already have challenges meeting the current aesthetic guideline value.	Lowering the aesthetic guideline value will have varying levels of acceptability for different stakeholders depending on the resulting impacts, including: • increased regulatory burden for health regulators and/or drinking water authorities as more exceedances in drinking water supplies might be detected as a result of lowering the guideline value. • monitoring and water treatment requirements for water providers may increase, especially in areas with higher levels of manganese in source waters.

Criteria	OPTION 1: Maintain status quo – aesthetic guideline value of 0.1 mg/L (NHMRC 2011).	OPTION 2: Establish new aesthetic guideline value for manganese in drinking water within the range 0.01–0.1 mg/L
Feasibility	Some water providers already have challenges meeting the current aesthetic guideline value of 0.01 mg/L.	This guideline option is technically feasible using current commercial and analytical techniques. Manganese concentrations in drinking water are easily lowered to less than 0.05 mg/L using common water treatment methods, including oxidation/filtration, adsorption/oxidation, softening/ion exchange and biological filtration. In well-operated and optimised systems, manganese concentrations can be reduced to less than 0.02 mg/L (Health Canada 2019, WHO 2022). Table A5.1 in the WHO guidelines (2022) includes the following water treatment methods for the removal of naturally occurring manganese from source waters and the manganese concentrations that can be achieved: • Dissolved manganese(II) can be removed through cation exchange in zeolite softening processes to <0.05 mg/L. • Precipitation and softening to <0.02 mg/L. • Oxidation of manganese using ozone followed by filtration to <0.05 mg/L. • Adsorption/oxidation including manganese greensand and other filter media coated with manganese oxides to <0.02 mg/L. • Oxidation using potassium permanganate followed by low pressure membrane filtration to <0.01 mg/L. Selection of the appropriate treatment system for manganese removal depends on the form of manganese (dissolved or particulate) present in the source water (Health Canada 2019, WHO 2022).
Equity impacts	Consumers and communities that regularly experience exceedances of the current aesthetic guideline value of 0.1 mg/L often do not have the required water treatment capabilities to remove manganese to an acceptable level. Further reduction of the aesthetic guideline value may exacerbate this inequity if there isn't a resulting improvement in treatment capabilities.	

Criteria	OPTION 1: Maintain status quo – aesthetic guideline value of 0.1 mg/L (NHMRC 2011).	OPTION 2: Establish new aesthetic guideline value for manganese in drinking water within the range 0.01–0.1 mg/L
Resource impacts	This aesthetic guideline option will have little impact on stakeholders who are currently meeting the current value of 0.1 mg/L. Water providers or communities who struggle to meet this value will have continued issues to maintain/meet this level.	Lowering the aesthetic guideline value may have resource impacts on the water sector, where utilities are not currently meeting (or aiming for targets lower than) the current aesthetic guideline value of 0.1 mg/L to limit consumer complaints related to discoloured water and visible particulates in their drinking water. Additional monitoring and treatment programs (including infrastructure) may be required to treat drinking water supplies to meet lowered guideline values, particularly in areas where lowering the guideline value may result in increased exceedances detected in communities. The cost of water treatment to remove manganese from drinking water may be challenging for water providers or communities relying on local bore water or other sources affected by seasonality and other weather events (see examples in the health-based guideline table above). Water providers may have limited capacity to cover increased operational costs if there is lower certainty in the evidence for a lower guideline value. Resulting costs for additional treatment of drinking water supplies or investment in appropriate treatment technologies may be borne by local water providers or communities. This may have flow-on costs to consumers.
Decision	• In March 2024, Members agreed the aesthetic guideline value for manganese should be lowered from 0.1 mg/L to 0.05 mg/L based on providing safe clear, untainted water to consumers; managing the risks of manganese precipitates in the water distribution system and at the customer's tap; and readily achievable concentrations following water treatment. Members also agreed that the aesthetic guideline value should be reported to one significant figure for consistency with rounding conventions outlined in the Guidelines.	

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Appendix B – Proposed edits to Australian Drinking Water Guidelines – consequential edits related to lead replacements in plumbing products and manganese

Text in **red and bold** are proposed edits to the existing text in the *Australian Drinking Water Guidelines* (the Guidelines).

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
1.	Chapter 4 Section 4.2.4 Verification of drinking water quality	66	Edit bullet point to: • At least daily testing of chlorine residuals should be carried out to check the effectiveness of the disinfection system. This can be done using a simple diethyl-phenylenediamine (DPD) colour comparator. **It is important to note that some organic contaminants and many strong oxidising agents interfere with all methods for the measurement of free and total chlorine, potentially resulting in an overestimation of the free and total chlorine residuals (see Fact Sheet on Chlorine and Fact Sheet on Monochloramine).**	New text added to clarify the interaction of manganese with the DPD test.
2.	Section 5.7.3 Deposits due to iron and manganese bacteria	98	Edit heading to: Deposits due to iron- and manganese-**oxidising** bacteria	Text added to correct description of bacteria.
3.	5.7.4 Corrosion problems due to iron and sulphur bacteria.	99	Edit heading to: 5.7.4 Corrosion problems due to iron- and **sulfur-metabolising** bacteria.	Text added to correct description of bacteria and nomenclature of sulfur.
4.	5.7.4 Corrosion problems due to iron and sulphur bacteria.	99	Edit text to: Iron- and sulfur-**metabolising** bacteria contribute to the corrosion of iron and steel well pipes and drinking water mains, with corrosion starting from either inside or outside. Microorganisms may cause corrosion by: • depleting dissolved oxygen • producing corrosive metabolites • producing sulphuric acid from sulphides or elemental sulfur • participating in the electrochemical cathodic process.	Text added to correct description of bacteria.

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
5.	6.3 Chemical quality of drinking water	105	A number of chemicals, both organic and inorganic, ~~including some pesticides~~, are of concern in drinking water from the health perspective because they are toxic to humans or are suspected of causing cancer. Some can also affect the aesthetic quality of water. The presence of chemicals in drinking water may result from: • natural leaching from soils, rocks and mineral deposits into source waters • land-use activities in catchments leading to exacerbation of natural processes such as mobilisation of salts • run-off from agricultural operations within drinking water catchments • biological processes including growth of cyanobacteria and algae in waterways and reservoirs • contamination of source water by treated effluent discharge and other point sources within the catchment • carry-over of small amounts of treatment chemicals • addition of chemicals such as chlorine and fluoride • generation of disinfection by-products due to reaction between organic and inorganic chemicals in water and disinfectants like chlorine • corrosion and leaching of substances such as metals and metalloids from ~~of~~ pipes, ~~and~~ fittings and other plumbing products in contact with drinking water.	Text edited to remove superfluous text. Text added to provide additional relevant examples.
6.	6.3.1 Inorganic chemicals	105	Inorganic chemicals in drinking water include metals and metalloids, usually occurring as dissolved salts, principally carbonates, chlorides and sulfates, attached to suspended material such as colloids and clay particles, or as complexes with naturally occurring organic compounds. Metals of concern can be released from plumbing ~~related sources and~~ products, in both dissolved and particulate form, via chemical or biochemical reactions (e.g. microbially-influenced corrosion) within the water and through physical abrasion of surfaces. Unless otherwise stated, the guideline value refers to the total amount of the substance present, regardless of its form (~~e.g. in solution or attached to suspended matter~~ i.e. both dissolved or particulate forms).	Text amended to describe leaching of metals from plumbing products.

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
7.	Section 8.8 Contaminants in drinking water treatment chemicals	140	Update information on contaminants in treatment chemicals based on any new guideline values as required.	Update to incorporate any new guideline values as required.
8.	Chapter 9 Overview of monitoring 9.1 Introduction	151	The Framework for Drinking Water Quality Management (the Framework), outlined in Chapters 2-4, is based on a preventive strategy that encompasses total system management from catchment to consumer to assure safe drinking water. A central aspect of this approach is the use of monitoring to confirm the effectiveness of the preventive measures and barriers to contamination, and to enhance understanding of system performance. This is achieved through the collection of data that increase understanding of the entire water supply system, including the hazards and risks that are present, the performance of treatment barriers, and the integrity of the distribution system. **Most of the monitoring information in this chapter relates to the operation of reticulated drinking water systems up to the point of supply (typically the water meter). However, water quality may be impacted beyond the point of supply, including through leaching of substances from plumbing products into drinking water, which may present a potential health risk to consumers at the tap (See Section 5.5 on Opportunistic pathogens; Section 9.6 on Water quality issues beyond the point of supply). Information Sheet 4.1 (Metal and metalloid chemicals leaching from plumbing products) provides further information on leaching of substances from plumbing products, actions to reduce exposure and guidance on in-premise sampling.**	Text amended to describe leaching of metals from plumbing products and cross reference relevant sections in the Guidelines.
9.	Table 9.5 Generic frequencies for monitoring non-microbial drinking water quality as supplied to the customer	171	New row for metals with potential for leaching to be annually sampled Annually: Bismuth, silicon, antimony, chromium, copper, nickel Comments: Annual sampling, unless pipework material has been considered as part of the nominated sampling frequency.	Silicon and bismuth added to Table 9.5 of the ADWG, as per existing metals with potential for leaching, including antimony, chromium, copper, and nickel.

10.	9.6 Water quality issues beyond the point of supply	172	Under most jurisdictional legislation and arrangements within Australia, the responsibility of water suppliers ends at the point of supply to the customer, typically the water meter. The primary responsibility for ensuring that water supplied beyond the water meter remains safe and aesthetically acceptable rests with various stakeholders including: • building and site owners or managers • plumbing and building regulators • plumbers • ~~plumbing material~~ manufacturers and suppliers of plumbing materials and products • private individuals Under the catchment-to-consumer tap preventive management framework promoted by these Guidelines, however, water quality should be managed up to the point of consumption, usually the customer tap, to account for water quality changes that may arise as a result of the internal plumbing arrangements on customer properties. This management may be achieved by liaison between the water supplier and the stakeholders listed above. Both the microbial and chemical quality of drinking water can deteriorate within buildings due to poor design and management of internal plumbing systems. While internal plumbing systems are largely outside of the control of water suppliers ~~and the quality and nature of internal plumbing and fittings can cause system-specific impacts, and it is reasonable to expect that water suppliers be aware of these issues.~~ (which can include water utilities, local councils or private water managers) and relevant health authorities and/or drinking water regulators, they should be aware of broader system-specific impacts such as: • incompatibility between the chemistry of drinking water as supplied and plumbing products • in-premise water conditions including microbial water quality (see Section 5.5 on Opportunistic pathogens) • the quality and nature of internal plumbing and fittings. The two most common issues are: • ~~plumbosolvency – that is, mobilisation of lead into solution from lead pipes and brass fittings (which may contain traces of lead), and the solder used to join pipes, as a result of the supply of plumbosolvent water. The issue of plumbosolvency is rare in Australia. Similar issues can arise with the corrosion of pipes and fittings containing copper (cupprosolvency), leading to "blue" water~~	Text amended to describe leaching of metals from plumbing products, clarify roles and responsibilities and cross reference relevant sections in the Guidelines.

			• Leaching of metals – metals of concern can be released from plumbing products, in both dissolved and particulate form, via chemical and biochemical reactions and through physical abrasion of surfaces. This is particularly evident when there have been periods of stagnation where drinking water is sitting in contact with plumbing products for extended periods of time (e.g. days to weeks). This is seen particularly in schools after lengthy holiday breaks, where water to drinking fountains/bubblers has remained stagnant in pipes. For example, children returning to school after a break have consumed water with elevated levels of copper (Scholz et al. 1995; Walker 1999; Brodlo et al. 2005). Long periods of stagnation may also occur within sections of a building's water distribution system, such as specific outlets that are not used frequently. Plumbing products that have deteriorated or corroded are more prone to releasing metals to drinking water (enHealth 2021). • Lead may be introduced into drinking water from plumbing products. Lead-based drinking water pipes are quite rare in Australia, having not been installed since the 1930s, while lead-based solder was phased out of use in Australia in the 1990s, with Australian Standards limiting lead in solders to less than 0.1% within drinking water distribution systems. However, historically brass plumbing products used in Australia were permitted to contain up to 4.5% lead (enHealth 2021), and while lead free plumbing products that typically contain no more than 0.25% lead are available, were not in common use. From 1 May 2026, only copper alloys containing no more than 0.25% lead are permitted for use in plumbing products in Australia (ABCB 2021, 2023). a. Copper pipes are a common component of plumbing systems, and copper is also a major component of brass plumbing products, and as a result, copper may be present in drinking water. Elevated levels of copper in drinking water arising from corrosion of copper pipes used in plumbing systems can result in blue or green staining of plumbing fittings or basins. b. Although reported less frequently, metals such as chromium, nickel, antimony and cadmium may also be present in drinking water due to their use in the manufacture of a variety of plumbing pipework and other products. • Elevated water hardness can cause scaling of both pipes and the water elements in kettles and hot water ~~services resulting from the supply of very hard water.~~ Such deposits can have indirect impacts on water safety including ingress of contamination due to reducing flow rates, increasing pressure and increasing the likelihood of the failure of backflow prevention measures.	

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
			Further information about risks from chemicals leaching from plumbing products, actions to reduce exposure and in-premise water sampling is provided in Information Sheet 4.1 (Metal and metalloid chemicals leaching from plumbing products). Other possible impacts on water quality past the point of supply include the following: • The supply of very soft water or unbuffered desalinated water into areas not traditionally supplied with water of reduced softness or salinity may exacerbate corrosion, particularly in hot water systems. • Microbial and chemical contamination can be associated with distribution systems in large buildings. This risk ~~arises particularly~~ increases where ~~large volumes of~~ water ~~are~~ is stored for extended periods in on site header tanks, or ingress of untreated water occurs through faults in the pipe network, or there are cross-connections with non-drinking water supplies. See also Section 5.2 on Microorganisms in drinking water and Section 5.5 on Opportunistic pathogens. • ~~Drinking water that sits unused in pipe networks for extended periods of time may have elevated levels of metals. This is seen particularly in schools after lengthy holiday breaks, where water to drinking fountains has remained stagnant in pipes, with the result that children have consumed water with elevated levels of copper (Scholz et al. 1995, Walker 1999, Brodlo et al. 2005).~~	

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
11.	9.6 Water quality issues beyond the point of supply *Role of building and site owners and managers and plumbing oversight agencies*	172	The ~~*Trade Practices Act 1974*~~ Commonwealth *Competition and Consumer Act 2010*, and related state and territory legislation, requires plumbing and fittings to be fit for purpose, and that purpose includes being fit for the safe conveyance, storage and use of water, including ~~of a~~ its chemistry as supplied within a particular area. Building and site owners, and managers and plumbing oversight agencies, are responsible for ensuring that the plumbing systems and fittings used within their areas of responsibility are fit to convey drinking water without leading to exceedances of water quality guidelines. In addition, these stakeholders should liaise with standards-setting bodies and water suppliers to ensure that the procedures for approving plumbing products ~~materials~~, fittings and systems are adequate, and that any products that are used comply with the requirements of the ~~*AS/NZS 4020:2005: Testing of Products for Use in Contact with Drinking Water*~~ National Construction Code (NCC), Volume Three – Plumbing Code of Australia (PCA), developed and maintained by the Australian Building Codes Board (ABCB) (ABCB 2022). . Building and site owners, and managers including residential strata body corporate managers and plumbing regulatory agencies, should ensure that building plumbing systems are constructed and managed in a manner that is fit for purpose, taking into consideration factors such as water quality, temperature and rates of water turnover (to prevent stagnation). It is not unusual for new products (even if WaterMark certified) to initially leach chemicals into water in contact with them until such time as the products become conditioned, and a protective patina establishes on the inner surface of the fitting/fixture. A patina on metals and metallic alloys is a coating of various chemical compounds such as oxides, carbonates, sulfides, or sulfates formed on the wetted surface during exposure to water. This initial leaching reduces over time and virtually ceases once the patina is established. It is not well established how long the initial leaching period lasts, but it is widely accepted that this is largely affected by certain water parameters such as pH, hardness, corrosivity, alkalinity and temperature. Reducing potential exposure to the leaching of metals from plumbing products can be achieved at the tap by undertaking preventative flushing regimes as outlined in Information Sheet 4.1 (Metal and metalloid chemicals leaching from plumbing products). To further minimise the risk of leaching, all plumbing works undertaken in Australia must be conducted by a licensed plumber, and licensed plumbers must use products that are WaterMark Certified in applications involving drinking water. The WaterMark Certification Scheme is administered by the ABCB and more information is available from local councils or plumbing regulators.	Text amended to describe leaching of metals from plumbing products, clarify roles and responsibilities and update references.

12.	9.6 Water quality issues beyond the point of supply *Role of water suppliers*	173	Although Australian water suppliers are not responsible for the actions related to water quality management beyond the point of supply, they should be aware that the drinking water that they supply may interact with internal plumbing and cause unintended water quality issues (either aesthetic or health-related). The ~~*Trade Practices Act 1974*~~ *Competition and Consumer Act 2010*, and related state and territory legislation, requires water supplied by water suppliers to be fit for purpose, including the conveyance, storage and use of that water within approved plumbing assets, fittings and plumbed-in systems available in water supply areas. In effect, this means that water suppliers have obligations if they are aware of potential negative impacts of mains water on correctly designed and installed plumbing systems. Some recommended actions that water suppliers can take to minimise the risks associated with interaction of internal plumbing and supplied drinking water are: • Liaise with relevant state-based plumbing authorities to ensure that plumbers use only ~~materials~~ products that meet the requirements of the ~~AS/NZS 4020:2005: Testing of Products for Use in Contact with Drinking Water~~ Plumbing Code of Australia (ABCB 2022) • Liaise with standards-setting bodies and plumbing regulators to ensure that the procedures for approving and testing plumbing ~~materials~~ products, fittings and systems are adequate to manage any short-, medium- and long-term risks associated with those ~~materials~~ products, fittings and systems when carrying the water supplied in any particular supply area. • Prepare information for customers on water quality issues that may have an adverse impact on their internal plumbing. This could be done in collaboration with relevant health authorities and/or drinking water regulators. • Provide advice to customers with large, reticulated networks on water quality issues that may arise from having stagnant water within their pipe networks. • Develop and disseminate information to schools, highlighting ~~in particular~~ issues related to stagnant water within pipe systems, and suggesting that drinking fountains/bubblers and other water-using devices be flushed before school returns after holiday periods. • Ensure, wherever practicable, that each property is separately metered so that areas of low flow can be identified. • In liaison with building and site owners, and managers and plumbing oversight agencies, consider undertaking investigative monitoring studies	Text amended to describe leaching of metals from plumbing products and update references.

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
			to examine the interactions of water as supplied with the plumbing and fittings used in the water supply area. Useful additional references on this issue include Rajaratnam et al. (2002), WHO and World Plumbing Council (2006), and WHO (201~~0~~1).	
13.	9.13 References	182	Add to the start of the existing reference list for Chapter 9 **ABCB (2021). Lead in plumbing products in contact with drinking water. Final Regulation Impact Statement 2021. Australian Building Codes Board, July 2021.** ABCB (2022). National Construction Code 2022 Volume 3 – Plumbing Code of Australia. Commonwealth of Australia and the States and Territories 2022, published by the Australian Building Codes Board.**ABCB (2023). WaterMark Certification Scheme – Notice of Direction 2022/1.1: Acceptable copper alloys for the manufacture of Lead Free plumbing products. Australian Building Codes Board, May 2023.** enHealth (2021). enHealth Guidance – Reducing exposure to metals in drinking water from plumbing products. Environmental Health Standing Committee (enHealth) of the Australian Health Protection Principal Committee, December 2021. **WHO (World Health Organization) (201~~0~~1). *Water Safety in Buildings*. World Health Organization, Geneva.**	Text amended to reference publications from the Australian Building Codes Board and enHealth.
14.	Chapter 10 Monitoring for specific characteristics in drinking water 10.1 Introduction	185	Insert text at the end of section 10.1 i.e. after the 4th paragraph: **Most of the information in this chapter relates to monitoring of distribution systems up to the point of supply (typically the water meter). However, water quality may be impacted beyond the point of supply through the leaching of substances from plumbing products into drinking water, presenting a potential risk to health of consumers of tap water. The principles for evaluating short-term chemical and aesthetic water quality outlined in Tables 10.2 and 10.4 (Section 10.2.2) apply to in-premise water systems as well as distribution networks. Section 9.6 provides further information on water quality beyond the point of supply. Information Sheet 4.1 (Metal and metalloid chemicals leaching from plumbing products) provides further information on leaching of substances from plumbing products, actions to reduce exposure and guidance on in-premise sampling.**	Text amended to describe leaching of metals from plumbing products and cross reference relevant sections in the Guidelines.

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
15.	Table 10.6 Guideline values for physical and chemical characteristics	204–216	Update Table 10.6 with new health-based/aesthetic guidance values for bismuth, silicon, selenium, lead and manganese as required.	Update to include new health-based or aesthetic guideline values.
16.	Table 10.6 Guideline values for physical and chemical characteristics	205, 207, 215	Include footnote 'f' reference in the entries for the following pesticides to align with other pesticide values included for information purposes only: • Carbophenothion • Chloroxuron • Thiophanate	Edit for consistency.
17.	Table 10.6 Guideline values for physical and chemical characteristics and Carbendazim fact sheet	205, 215	Ensure consistent terminology for both carbendazim and thiophanate-methyl across both Table 10.6 and fact sheet	Edit for consistency.
18.	Table 10.6 Guideline values for physical and chemical characteristics and Heptachlor fact sheet	210	Ensure consistent terminology for both heptachlor and heptachlor epoxide across both Table 10.6 and fact sheet	Edit for consistency.
19.	Table 10.6 Guideline values for physical and chemical characteristics and Lanthanum fact sheet	210	List lanthanum as La(III) to be consistent with chromium Cr(VI)	Edit for consistency.
20.	Table 10.6 Guideline values for physical and chemical characteristics	215	Provide abbreviation for trichloroethylene (TCE) in Table 10.6 for consistency with other commonly abbreviated compounds	Edit for consistency.

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
21.	Table 10.6 Guideline values for physical and chemical characteristics	216	List all trihalomethanes included in the trihalomethanes fact sheet for consistency in Table 10.6	Edit for consistency.
22.	Table 10.6 Guideline values for physical and chemical characteristics	216	Correct xylene to xylenes to be consistent with the xylenes fact sheet.	Edit for consistency.
23.	Part IV Disinfection with chlorine INFORMATION SHEET 1.3 Practical considerations section	228	Advantages of chlorination include its common and long-standing use and the availability of reliable dosing and monitoring equipment. Reliable and robust field kits for measuring chlorine residuals within the distribution system are also available. **It is important to note that some organic contaminants and many strong oxidising agents interfere in all methods for the measurement of free and total chlorine, potentially resulting in an overestimation of the free and total chlorine residuals.**	Clarification that oxidised forms of manganese can interfere with the DPD test
24.	Part IV Disinfection Information Sheets **Chloramines** INFORMATION SHEET 1.4 Practical considerations section	233	Amend text to: Chloramination has a long history of use and was introduced in Brisbane in 1935. Robust and reliable dosing and monitoring equipment is available. Reliable field kits for measuring residuals within the distribution system are ~~also~~ available; these kits generally measure concentrations of chloramines as total chlorine **(DPD colorimetric method APHA – A Method 4500-Cl Part F 2023). It is important to note that some organic contaminants and many strong oxidising agents interfere in all methods for the measurement of free and total chlorine, potentially resulting in an overestimation of the free and total chlorine residuals.** There have been reports of false free chlorine readings with tablet-based methods (UWRAA 1990). The DPD-Ferrous titrimetric method is less prone to false readings (see Monochloramine Fact Sheet).	Clarification that oxidised forms of manganese can interfere with the DPD test

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
25.	PHYSICAL AND CHEMICAL CHARACTERISTICS Chlorine Fact Sheet Measurement section	512	Amend text to: The concentration of chlorine in drinking water can be determined by several methods including the amperometric titration method (APHA Method 4500-Cl Part D 2023), DPD ferrous titrimetric method (APHA Method 4500-Cl Part F 2023) and the DPD colorimetric method (APHA Method 4500-Cl Part G 2023). The methods are subject to interferences **(e.g. strong oxidising agents and some organic contaminants as described in the Standard Methods (APHA 2023))** and vary in complexity, sensitivity, precision and accuracy. Water utilities should consider Standard Methods when selecting a method (APHA 2023). The chlorine concentration should be determined immediately after sampling as chlorine is not stable in water.	Clarification that oxidised forms of manganese can interfere with the DPD test
26.	PHYSICAL AND CHEMICAL CHARACTERISTICS Copper Fact Sheet Derivation of Guideline section	552	Insert cross reference to Section 9.6 and the new Information Sheet on metals and metalloids leaching from plumbing products. Updated text in final paragraph: In premises with a history of copper corrosion, water that has been in stagnant contact (6 hours or more) with copper pipes and fittings should not be used in the preparation of food or drink. Copper levels can be effectively reduced by flushing the taps for 1 minute **(see Section 9.6 and Information Sheet 4.1).**	Edit to insert cross-referencing
27.	PHYSICAL AND CHEMICAL CHARACTERISTICS Monochloramine Fact Sheet Measurement section	807	Amend text to: The concentration of monochloramine in drinking water can be determined by the DPD ferrous titrimetric method (APHA Method 4500-Cl Part F 2023) or by amperometric titration (APHA Method 4500-Cl Part D 2023). **The methods may be subject to interferences (e.g. strong oxidising agents and some organic contaminants as described in the Standard Methods (APHA 2023)).** The limit of determination is typically 0.1 mg/L for the DPD method and can be lower for amperometric titration. Water utilities should refer to the Standard Methods when selecting a method (APHA 2023).	Clarification that oxidised forms of manganese can interfere with the DPD test

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
28.	PHYSICAL AND CHEMICAL CHARACTERISTICS Taste and Odour fact sheet	969	Amend text: Inorganic compounds are generally present in water in substantially higher concentrations than organic compounds. Taste thresholds for some commonly occurring inorganic ions are about ~~0.1~~ 0.05 mg/L for manganese, 0.3 mg/L for iron, 3 mg/L for copper, 3 mg/L for zinc, 250 mg/L for chloride, and 250-500 mg/L for sulfate. ~~Most~~ Some of these ions (e.g. manganese, sulfate) have health effects at concentrations higher than their taste thresholds. In most cases, the customer would reject the water for aesthetic reasons before it would be of health concern.	Text updated to align with updated advice on manganese and existing advice in other fact sheets.

29.	PHYSICAL AND CHEMICAL CHARACTERISTICS Temperature Fact Sheet	978	**General description** Temperature is primarily an aesthetic criterion for drinking water. Generally, cool water is more palatable than warm or cold water. In general, consumers will react to a change in water temperature. Complaints are most frequent when the temperature suddenly increases. The turbidity and colour of filtered water may be indirectly affected by temperature, as low water temperatures tend to decrease the efficiency of water treatment processes by, for instance, affecting floc formation rates and sedimentation efficiency. Chemical reaction rates increase with temperature, and this can lead to greater corrosion of pipes and fittings in closed **systems resulting in elevated concentrations of leachates from plumbing products (see Section 9.6).** Scale formation in hard waters will also be greater at higher temperatures. **Health considerations** **Warm and hot water in contact with plumbing products increases the rate of corrosion of metallic components. There is also a likelihood that non-metallic components can leach into water with elevated temperatures. A lot of materials used in plumbing products contain chemicals that have health-based guideline values. It has been shown that concentrations of these substances can approach and exceed their relevant health-based guideline values under certain conditions such as elevated temperatures within plumbing systems. Water used for consumption and food preparation should only be sourced from a cold water tap (except for water from devices used for preparation of tea and coffee). Further information on leaching from plumbing products is available in Information Sheet 4.1 (Metal and metalloid chemicals leaching from plumbing products).** The effectiveness of chlorine as a disinfectant is influenced by the temperature of the water being dosed. Generally higher temperatures result in more effective disinfection at a particular chlorine dose, but this may be counterbalanced by a more rapid loss of chlorine to the atmosphere (AWWA 1990). Chlorine reacts with organic matter in water to produce undesirable chlorinated organic **disinfection** by-products, ~~and~~ **with** higher temperatures increas**ing** the rate of these reactions **and the formation of these by-products**. Temperature can directly affect the growth and survival of microorganisms. In general, the survival time of infectious bacteria and parasites is reduced as the temperature of the contaminated water increases. *Naegleria fowleri*, which can cause amoebic meningitis, grows between 18°C and 46°C and is likely to occur in nondisinfected water supplies that reach 30°C seasonally. *Legionella pneumophila* (which causes Legionnaires' disease) and related bacteria are found in hot and cold water systems, with colonisation occurring in stagnant water at temperatures	Text amended to describe leaching of metals from plumbing products and add cross-referencing to relevant sections in the Guidelines.

Edit no.	Guidelines section	Page no.	Suggested edit	Comments
			between 20°C and 45°C. Increased temperatures can also promote the growth of taste- and odour-producing organisms in lakes and storage reservoirs, and in distribution systems.	
30.	DRINKING WATER TREATMENT CHEMICALS – various fact sheets, e.g.: Calcium hypochlorite Chlorine Potassium permanganate Sodium hypochlorite	1072-1128	Update relevant sections with information about oxidised manganese interfering with assays for chlorine residuals using the indicator chemical DPD, where appropriate.	Clarification that oxidised forms of manganese can interfere with the DPD test
31.	General	various	Update description of 'sulphate' and 'sulphide' to 'sulfate' and 'sulfide' throughout Guidelines consistent with IUPAC nomenclature, e.g.: • p93, p98 (x2) - Replace 'sulphate' with 'sulfate'. • p98, p99 - Replace 'sulphide' with 'sulfide' and 'sulphides' with 'sulfides'. • Monochloramine Fact Sheet, p807 - Replace 'sulphite' with 'sulfite'. • p114 - Replace 'disulphide' with 'disulfide'. • p97, p99 (x4) include Heading 5.7.4 (p99) and TOC (p viii) - Replace 'sulphur' with 'sulfur'. • p99 - Replace 'sulphuric' with 'sulfuric'.	Updates to align with IUPAC nomenclature
32.	Glossary	1191	DPD (diethyl-phenylenediamine) added	Clarify abbreviation used throughout Guidelines
33.	5.7.3 Deposits due to iron and manganese bacteria	101	Bacteria can attach to the deposits. If disturbed, these will increase the heterotrophic bacteria colony count of the water. ~~These problems will generally not occur if the concentration of manganese is below 0.1 mg/L. (See fact sheet in Part V on Manganese).~~	Clarification noting the revised fact sheet is no longer appropriate to cross-reference.

Appendix C – enHealth feedback on draft guidance

The enHealth Water Quality Expert Reference Panel was formally consulted on the draft public consultation guidance in April – May 2024, including:

- a new information sheet on lead replacements in plumbing products
- new fact sheets on bismuth and silicon
- updated fact sheets for lead, selenium and manganese
- a number of proposed consequential edits to the Guidelines.

NHMRC sought feedback on the following:

1. Is the draft guidance relevant, accurate and easy to understand?
2. Do you support the approaches taken to review the evidence and develop the guidance?
3. Do you have any other comments about implementation or feasibility of the proposed health-based guideline values?

Members also had the opportunity to provide specific comments and/or tracked changes in the documents provided with a summary of feedback provided in Tables 3 and 4.

The enHealth Water Quality Expert Reference Panel was subsequently again consulted on the draft guidance in January 2025 following the public consultation to review and confirm the finalised guidance for publication into the Guidelines (see Table 5).

Summary of feedback received (April – May 2024)

Feedback received on the draft guidance material was overall supportive of the material developed and the proposed revisions to current fact sheets. In some instances, specific edits were made to clarify or simplify language used. Some common areas of feedback included:

- clarifying the proposed guideline recommendation for bismuth and silicon, given that a level at which health effects may occur was provided but a health-based guidance value was not established, stating that this may be confusing for end users
- raising the likelihood of impacts to resourcing in order to manage expected increases in exceedances for chemicals where a lower guideline value has been proposed (particularly for lead and manganese)
- the need for consistency in terminology throughout the guidance material, particularly relating to alignment of descriptions used by the Australian Building Codes Board (ABCB)
- confirming, where appropriate, the detection/reporting limits for the measurement tests identified and typical levels found in Australian drinking water
- whether additional data specific to in-premise concentrations of lead replacements in plumbing products were available for inclusion in the fact sheets.

A summary of the feedback from the jurisdictions to the specific questions and responses are provided in **Table 3** (lead replacements in plumbing products) and **Table 4** (manganese) below.

Table 3. 2024 enHealth Water Quality Expert Reference Panel comments on the draft guidance (lead and lead replacements in plumbing products)

#	Fact sheet	Relevant section	Feedback received	Action/Response
Question 1: Is the draft guidance relevant, accurate and easy to understand?				
1.	-	-	The Draft guidance (attachments A-F) are relevant, accurate and easy to understand – taking into account suggested changes in said documents.	Noted. Edits made where accepted.
2.	-	-	For the most part the guidance is relevant, accurate and comprehensible for non-technical readers.	Noted.
Question 2: Do you support the approaches taken to review the evidence and develop the guidance?				

#	Fact sheet	Relevant section	Feedback received	Action/Response
3.	-	-	I support the approaches taken to review the evidence to develop the guidance.	Noted.
4.	-	-	The approaches to review the evidence and develop the guidance is consistent with NHMRC methods and is supported.	Noted.
Question 3: Do you have any other comments about implementation or feasibility of the proposed health-based guideline values?				
5.	-	-	I have no specific comments about the implementation or feasibility of the proposed HBGV.	Noted.
6.	-	-	The main thing we wonder about is the impact of moving the lead HBGV from 0.01 to 0.005 mg/L. We are comfortable with the methodology for deriving the lower value, but note that compliance is likely to be a challenge in many parts of Australia, given the preponderance of legacy plumbing materials in everywhere but new builds.	Noted.
General comments:				

#	Fact sheet	Relevant section	Feedback received	Action/Response
7.	General	-	The ABCB refers to the lead substitutes as Lead Free (with no hyphen, but capitals, and they don't appear to use the term low lead). The specific change made by the ABCB is for copper alloy plumbing products, and they do not seem to use the word brass at all. I have taken the approach that a specific mention of a replacement product should be to that metal/metalloid copper alloy plumbing product (e.g. selenium copper alloy), but a collective reference to all of these possible copper alloys can simply be as lead replacements in plumbing products. Suggested edits include: • Replace 'low lead' with 'Lead Free'. • Replace 'lead brass' to 'lead containing copper alloys'. • Replace '"Lead- Free" brasses' with 'Lead Free copper alloys'. • Replace 'lead brass' with 'copper alloys'. • Do not use the following terms – 'bismuth brass', 'selenium brass', 'silicon brass', 'graphite alloys', 'indium brass', 'gallium brass' and 'manganese/zinc alloys'.	Accepted. Updated text for consistency and as appropriate to balance with need for plain language. Some amendments made to align better with terminology used by ABCB (e.g. using Lead Free, copper alloy instead of brass).
8.	General	-	Noting that the factsheets typically provide information on reticulated water values, given the focus on building guidance on internal plumbing is there scope (or ability) to provide typical in premises values like those added for lead?	Accepted. Limited to no data has been identified for lead replacements in premises as yet. If data becomes available during the consultation process it will be considered for inclusion in the fact sheet.

#	Fact sheet	Relevant section	Feedback received	Action/Response
9.	General	-	Understanding that to characterise and confirm the assumptions made with any certainty, in house sampling will be required across an extended period. Furthermore, the novel lead replacement materials are relatively new and may not have degraded to a notable extent in the Australian context. For example, galvanised pipes which degrade over several years before causing discoloration of water is well understood, whereas the recent uptake of lead replacements means there is less information about performance under Australian conditions. There has been discussion that leaching of metals from plumbing fittings follows an inverted bell curve where the leaching pattern is greater at the start and end of the lifetime of the fitting.	Noted. Sampling is likely to be more consistent with the change to establishing health-based guideline values for bismuth and silicon.
10.	General	-	Is there opportunity for the WQAC or WQERP to work with water agencies, WSAA, WaterRA etc. to explore typical levels of metals and metalloids within household plumbing similar to what has been included in the lead fact sheet update?	Noted. Additional work with external agencies to generate in-premise water quality data is out of scope of this update; however, if relevant data is provided by stakeholders (such as during public consultation) it can be considered by NHMRC and the Committee when finalising the guidance.

#	Fact sheet	Relevant section	Feedback received	Action/Response
11.	General	-	In 2018, lead and other plumbing related metals were found in a number of drinking water fountains across Geelong at concentrations exceeding health-based guideline values. Interestingly, upon investigation, the drinking water fountains were found to have fittings with the WaterMark markings which should indicate that the products protect community health and safety. Following the numerous lead detections, the Australian Building Codes Board (ABCB) commissioned a research project into potential sources of lead in plumbing products and materials to better understand the nature and extent of the issue in Australia. This event shows that while the WaterMark Certification Scheme plays an important role in reducing lead and other metals in plumbing fittings it is no guarantee of final water consumed being lead free and/or protective of community health and safety. During the drinking water fountain issue, the robustness of the WaterMark certification process was raised. It is recommended that there is input to the guidance from the ABCB who manages and administers the scheme. The guidance should emphasise a whole of system approach to assessing potential risks of metal leaching and ensuring the appropriate selection of plumbing fixtures and follow up verification of in premises water quality.	Noted. Edits have been made in Section 9.6 to clarify the role of building and site owners and managers and plumbing oversight agencies. Input to guidance from the ABCB is out of scope of this particular update; however, the ABCB will be invited to comment on the draft guidance during public consultation and if required NHMRC will work to ensure that advice is consistent across agencies.
12.	Bismuth	TREATMENT OF DRINKING WATER "A single study investigated the use of absorption on the algae Spirogyra to remove various heavy metals (including 76% reduction of bismuth concentrations) from coal mine wastewater (Vetrivel et al. 2017)."	Consider summarising the conclusions from Vetrivel 2017 or remove this sentence completely as it is not very relevant for drinking water.	Accepted. Text amended to remove reference.

#	Fact sheet	Relevant section	Feedback received	Action/Response
13.	Bismuth	HEALTH CONSIDERATIONS "For instance, one form of Pepto Bismol Ultra® (bismuth subsalicylate) contains approximately 303 mg of bismuth per tablet, with a maximum suggested dose of 8 tablets a day for adults. Similarly, bismuth subcitrate contains 108 mg of bismuth per tablet (Poddalgoda et al. 2020)."	Consider expressing the mass of bismuth in a daily defined dose (DDD) of a formulation, not mass of bismuth per tablet. DDDs are defined by the WHO and represent the average or typical dose prescribed for a pharmaceutical. Speaking in terms of number of tablets can be confusing as the number of tablets for a dose can change with time and between manufacturers.	Noted. Text updated to remove reference to proprietary information as conversion to therapeutic dosages is beyond the scope of this review.
14.	Bismuth	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER "Concentrations of bismuth in drinking water in Western Australia (sample size >170) were found to be below the level of reporting (<0.005 µg/L) (Hinwood et al 2015)."	Is this an average figure or were all of the samples <0.005 ug/L? Might add value to put it in context?	Accepted. Text updated to reflect that bismuth was not detected in all samples tested.
15.	Bismuth	DERIVATION OF GUIDELINE "A health-based guideline value has not been established for bismuth at this time based on the low levels of bismuth found in Australian reticulated drinking water supplies."	Amend text to: 'A health-based guideline value has not been established for bismuth at this time as concentrations are likely to be considerably lower than the level that may cause health effects.' It's a subtle change, but an important one. Stating that it may be lower than levels we find in the retic, may influence risks assessment whereby it is not tested for.	Accepted in-principle. Section has been updated to reflect setting a health-based guideline value for bismuth in drinking water.
16.	Bismuth	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER	Is the data from WA the result of reticulation samples? Suggest the fact sheet acknowledges the limitation of applying WA information to other parts of Australia given the potential variation in local characteristics of groundwater and other sources such as desal water.	Noted. Text updated to reflect data from WA as an example only.

#	Fact sheet	Relevant section	Feedback received	Action/Response
17.	Bismuth	"No health based guideline is considered necessary … as concentrations are likely to be considerably lower than the level that may cause health effect"	Yet there is a maximum recommended level set later in the text. This appears contradictory. The guideline also presumes that levels will never be found that exceed the maximum recommended level. Is this a safe presumption?	Text updated to reflect establishing health-based guideline values for bismuth and silicon in drinking water. A conservative and preventative approach has been taken to ensure consistency and avoid potential discrepancies across water suppliers.
18.	Bismuth Silicon		Could NHMRC explain its rationale for proposing a value 'at which health effects are expected to occur' but not making this value a health-based guideline value? I note the decision of WQAC members of December 2023 that '*no health-based guideline values should be set for bismuth and silicon or their brasses at this time, as health effects are expected to occur at levels much higher than concentrations expected in Australian drinking water*.' I understand there are many other characteristics that already have a health-based guideline value even though detections are very rare or very low concentrations	Text updated to reflect establishing health-based guideline values for bismuth and silicon in drinking water. A conservative and preventative approach has been taken to ensure consistency and avoid potential discrepancies across water suppliers.
19.	Bismuth Silicon	DERIVATION OF GUIDELINE "A health-based guideline value has not been established for bismuth/silicon at this time based on the low levels of bismuth found in Australian reticulated drinking water supplies."	Amend text to: A health-based guideline value has not been established for bismuth/silicon at this time as concentrations are likely to be considerably lower than the level that may cause health effects. Note: Stating that it may be lower than levels we find in the reticulated system, may influence risks assessment whereby it is not tested for.	Accepted in-principle. Text has been updated to reflect establishing health-based guideline values for bismuth and silicon in drinking water.
20.	Silicon	GENERAL DESCRIPTION "Silicon is a ubiquitous element present in the environment and occurs naturally in foods as silicon dioxide (SiO_2, silica) and silicates."	Should this [silica] be silicon or silica?	No change made. SiO_2 is commonly known as silica.

#	Fact sheet	Relevant section	Feedback received	Action/Response
21.	Silicon	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER "However, concentrations of silicon can be calculated from the concentration of silica reported. For example, in 2019-2020, the Northern Territory reported average concentrations of silica of 11 to 104 mg silica/L (equating to 5.2 – 49 mg silicon/L). In Western Australia in 2019-2020, mean concentrations of silica ranged from 0.6 to 90 mg/L (equating to 0.28 – 42 mg silicon/L) (SLR 2023)."	I suggest including the calculation conversion factor here.	Accepted. Text updated to include conversion calculation.
22.	Silicon	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER "However, concentrations of silicon can be calculated from the concentration of silica reported. For example, in 2019-2020, the Northern Territory reported average concentrations of silica of 11 to 104 mg silica/L (equating to 5.2 – 49 mg silicon/L). In Western Australia in 2019-2020, mean concentrations of silica ranged from 0.6 to 90 mg/L (equating to 0.28 – 42 mg silicon/L) (SLR 2023)."	Is the higher range in NT due to groundwater use?	No change. Reason for range not detailed in the Annual Report.
23.	Silicon	HEALTH CONSIDERATIONS "Limited epidemiological data suggests that silicon (as silica or metasilicate) in drinking water may have a protective effect on humans (Burton et al. 1980, Gillette-Guyonnet et al. 2007, Jacqmin-Gadda et al. 1996, Najda et al. 1991)."	In what way is silicon protective?	Text removed - the evidence evaluation report suggests that there may be a protective effect against aluminium and cognitive impairment, however there is limited information available in the review, given the focus was on establishing possible guideline values.

#	Fact sheet	Relevant section	Feedback received	Action/Response
24.	Silicon	DERIVATION OF GUIDELINE “A level has been determined to provide advice on the concentration of silicon in drinking water at which negative health effects are expected to occur.	Is it appropriate to indicate the equivalent concentration for silica, or to spell out the silica - silicon conversion factor under "Typical Values in Australian Drinking Water"?	Accepted. Text amended to describe silica / silicon conversion factor.
25.	Selenium	GUIDELINE “Based on health considerations, the concentration of selenium in drinking water should not exceed 0.004 mg/L.”	The proposed guideline value is 10 times lower than current WHO provisional guideline of 0.04 mg/L, which is provisional because of uncertainties in the health database. I note selenium is an essential trace element. Is a safety factor of 3 appropriate?	No changes made. Evidence review report considered a safety factor of 3 appropriate to balance the essentiality of selenium. Essentiality of selenium needs to be balanced with the potential for adverse effects. A safety factor of 3 is based on the findings of the evidence review report (i.e. the effect was a mild effect and the LOAEL is a minimal LOAEL. Additionally, an uncertainty factor for human variability was not included as the study was conducted in a large population of men and there is no indication that females or children are more susceptible).
26.	Selenium	MEASUREMENT	For selenium we are checking with our major lab if the limit of reporting would pose an issue for determining if results are below the proposed guideline value. This is just for noting and it may be possible to achieve a lower limit of reporting, but we would need to confirm.	Noted.

#	Fact sheet	Relevant section	Feedback received	Action/Response
27.	Selenium	MEASUREMENT "Selenium can be measured in drinking water from 0.001 mg/L through inductively coupled plasma mass spectrometry (US EPA Method 200.8), inductively coupled plasma atomic emission spectroscopy (SLR 2022) or hydride generation followed by atomic absorption spectroscopy (APHA Method 3500-Se)."	The LOR at the lab is 0.0001 mg/L for selenium in drinking water via ICPMS.	Noted. Text amended to include range.
28.	Selenium	DERIVATION OF GUIDELINE	LOAEL quoted as mg/day. Comment: In the other Fact Sheets we give a NOAEL with the units of mg/kg body weight/day - which then forces one to incorporate the 70kg adult body weight into the equation. We don't do this for LOAEL?	Noted that it isn't consistent with other LOAEL/NOAEL used but daily intakes can be used to derive a guideline value in the absence of a bw dose. The primary study (Lippman et al 2009) does not provide mg/kg bw/day.
29.	Selenium	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER	Note: In Victoria there is significant variation in water agencies reporting of selenium values in their drinking water quality annual reports available on their respective websites. The values reported indicate typical water levels at or below the limit of detection. However, a change in health-based guideline values will encourage water agencies to increase efforts to assess risk, monitor and report in their risk management plans. This may involve investigations into different contributing sources and typical levels in Victorian water sources.	Noted.
30.	Selenium		Support the use of updated information to inform the health-based guideline value.	Noted.

#	Fact sheet	Relevant section	Feedback received	Action/Response
31.	Lead	Approximately 80% of the daily intake of lead is from the ingestion of food, dirt and dust. Food contains small but significant quantities of lead, which can increase when acidic food is stored in lead-glazed ceramic pottery or lead-soldered cans."	It says 80% from food dirt and dust, but then food is small amount? Should the order be dirt, dust then food if they are more significant? Or is that only in contaminated areas?	No change made. Dust and dirt are only considered to be significant sources of lead if contaminated.
32.	Lead	TREATMENT OF DRINKING WATER "For example, all repairs or installations of plumbing products in Australia should be undertaken by a licenced plumber having regard to materials in contact with drinking water being certified against relevant Australian standards, such as the WaterMark Certification Scheme, AS/NZS 4020 Testing of products for use in contact with drinking water."	Other references to the standard had the year referenced.	Noted. Text updated.
33.	Lead	MEASUREMENT "The limit of reporting ranges from 0.0002 to 0.05 mg/L depending on the laboratory test method."	The lab's LOR for lead in drinking water via ICPMS is 0.0001 mg/L.	Noted. Text amended to state 'typical' range.
34.	Lead	HEALTH CONSIDERATIONS "The International Agency for Research on Cancer has concluded that inorganic lead compounds are probably carcinogenic to humans (Group 2A - limited human data but sufficient evidence in animals) (IARC 2006). Organic lead compounds are not classifiable as to their carcinogenicity to humans (Group 3)"	Group 3 IARC reference required	Accepted. Text amended.

#	Fact sheet	Relevant section	Feedback received	Action/Response
35.	Lead	GENERAL DESCRIPTION "Australian Building Codes Board as a plumbing product or material in contact with drinking water with a weighted average lead content of not more than 0.25%.	Add reference	Accepted. Reference added.
36.	Lead	GENERAL DESCRIPTION "Food contains small but significant quantities of lead, which can increase when acidic food is stored in lead-glazed ceramic pottery or lead-soldered cans."	Are lead-glazed ceramic pottery or lead-soldered cans still common?	Noted. Text updated with contemporary information.
37.	Lead	DERIVATION OF GUIDELINE As per current NHMRC advice on blood lead levels (NHMRC 2015b), and a relative source contribution that assumes that 20% of the total lead intake can be attributable to water consumption, this translates to a blood lead level attributable to exposure from lead in drinking water of 1 µg/dL (i.e. 5 µg/dL x 0.2 = 1 µg/dL).	Amend '…this translates to a blood lead level attributable to exposure from lead…' to '…this translates to a blood lead level assigned to exposure from lead…'. It may not be the correct term to use, but it is somewhat verbose to use attributable in two different contexts in the same sentence?	Accepted. Text amended.
38.	Lead	DERIVATION OF GUIDELINE "This approach is consistent with current Australian science policy to minimise exposure to lead in the most sensitive populations (infants, children, and pregnant women)."	Reference required.	Accepted. Reference added.

#	Fact sheet	Relevant section	Feedback received	Action/Response
39.	Lead	"Lead can be present in drinking water, most commonly due to leaching from household plumbing systems containing lead."	The information provided should note that roof harvested water due to its typically acidic and soft nature can be contaminated lead from sources such as lead flashing and solder from solar panels etc. Information such as this will help to provide guidance on a wide range of water supply types where lead may not meet health-based guidance values.	No change made. Text mentions household plumbing systems which would include rainwater tanks and associated plumbing. Furthermore, guidance on the use of rainwater tanks (including lead flashing and solar panels) is available on the enHealth webpage.
40.	Lead	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER "In major Australian reticulated drinking water supplies, total lead concentrations can range up to 0.01 mg/L, with typical concentrations less than 0.005 mg/L. A review found that mean levels in reticulated supplies in Australia appear to be lower than or similar to those in other developed countries (SLR 2023). The concentration of lead in water within premises may be higher, especially in older buildings, due to exposure of the water to lead-containing plumbing products. A review found several Australian and international studies that detected up to 0.162 mg/L of lead in drinking water due to leaching from lead-containing plumbing materials including taps and lead service lines, suggesting that leaching of lead from lead-containing plumbing materials can be substantial (SLR 2023)."	Note: 1. A limited review of reporting by Victorian water agencies indicates typical values equal to or less than 0.001 mg/L. However, some locations exceeded the proposed health-based guideline value. These can be found in water agencies drinking water quality annual reports available on their respective websites. 2. This is the only new or revised factsheet with information on typical water quality data for internal plumbing. Similar information for other plumbing associated metals and metalloids should be considered where available.	Noted. In-premises data for new lead replacement products is not currently publicly available. If data becomes available during the consultation process it will be considered for inclusion in the fact sheet.
41.	Lead		Support the use of updated information to inform the health-based guideline value.	Noted.

#	Fact sheet	Relevant section	Feedback received	Action/Response
42.	Information sheet	BACKGROUND "As mentioned in Section 9.6, some plumbing products used within premises such as residential buildings, hospitals and schools have the potential to leach metals and metalloids into drinking water under certain conditions. This is likely to occur past the point of water supply (i.e. the water meter) as leaching most likely occurs within the plumbing system in-premises."	Terminology switches between chemicals as in the title and metals here. Can a consistent term be used?	Accepted. Updated text for consistency and as appropriate. The information sheet is intended to be expanded with other chemicals over time.
43.	Information sheet	BACKGROUND "As mentioned in Section 9.6, some plumbing products used within premises such as residential buildings, hospitals and schools have the potential to leach metals and metalloids into drinking water under certain conditions. This is likely to occur past the point of water supply (i.e. the water meter) as leaching most likely occurs within the plumbing system in-premises."	Might be helpful to say why 'leaching most likely occurs within the plumbing systems in-premises'.	Accepted. Text amended to clarify.
44.	Information sheet	BACKGROUND "The leaching of lead brass in plumbing has historically received the most attention given the known health effects of lead exposure (see the Lead Fact Sheet and NHMRC 2015)."	Here it mentions lead brass and lead free brass, later refers to ABCB requirements for copper alloy plumbing products, and later silicon brass etc. can this be more consistent?	Accepted. Updated text for consistency and as appropriate to balance with need for plain language.

#	Fact sheet	Relevant section	Feedback received	Action/Response
45.	Information sheet	SAMPLING IN-PREMISES "• Building commissioning – to determine the presence of metals in a building as part of the commissioning process. The 6-hour stagnation (6HS) is the most appropriate methodology."	Are the abbreviations in this section necessary (6HS, RDT, 30MS) in ADWG? I think these terms were used in the enHealth guidance.	Accepted. Text updated.
46.	Information sheet	BACKGROUND	The term metalloids does not seem to be used in ADWG so we are not sure why it is retained here.	No change. Silicon is classed as a metalloid.
47.	Information sheet	REDUCING EXPOSURE TO CHEMICALS LEACHING FROM PLUMBING PRODUCTS *Flushing*	Include following text at end of section: 'Extensive flushing is also advisable towards the end of commissioning of newly constructed or renovated plumbing systems. This is required because plumbing works can leave significant amounts of "swarf" or metal filings within the drinking water pipes. Flushing to remove these needs to be done after aerators or flow restrictors are removed to ensure they are not entrapped within drinking water outlets.'	Accepted.
48.	Information sheet	SAMPLING IN-PREMISES • "demonstrating that a flushing program is not required or confirming that one is required"	For simplicity, amend text to: • 'assessing if a flushing regime is required or not.'	Accepted. Text amended.
49.	Information Sheet	REDUCING EXPOSURE TO CHEMICALS LEACHING FROM PLUMBING PRODUCTS *Flushing* "In other buildings with vulnerable occupants, such as children, infants and pregnant women…"	We have described this above for children and infants….so we need to make this point about other vulnerable populations (such as the elderly and immunocompromised).	Accepted. Text amended.

#	Fact sheet	Relevant section	Feedback received	Action/Response
50.	Information sheet	REVIEW OF BISMUTH, SELENIUM AND SILICON BRASSES	Include reference to this information in the relevant factsheets where available for the reader to seek further information.	Partially accepted. Text updated to provide reference to the relevant fact sheets. References to the Information Sheet is already provided in the relevant chemical fact sheets.
51.	Information sheet	SAMPLING IN-PREMISES "*Plumbing systems are site-specific and advice should be sought from the relevant health authority or drinking water regulator before implementing a sampling program. The design and implementation of a water sampling program is complex and careful planning should be undertaken to ensure that meaningful results are generated*".	Sampling internal plumbing requires specific knowledge which health authorities or drinking water regulators may or may not have. If the guidance is not provided in the ADWG then the reference should be made to applicable guidance such as enHealth (other industry guidance) and also inclusive of water agencies and local councils prior to suggesting contacting relevant health authorities or drinking water regulators.	Partially accepted. References are made to enHealth guidance throughout, which has been developed for the Australian context. Text edited to include other water professionals.
52.	Information sheet	TREATMENT "Some in-premises water treatment units, such as filtration or reverse osmosis units, may be effective at removing metals or metalloids from drinking water."	Research shows that in many cases POU filtration systems are not appropriately selected (how to quantify the loading and LRVs for chemical removal?) or maintained resulting in systems underperforming without knowledge of the users. Is it possible to have stronger text which discourages people from using POU filtration in this context given the complexity of validating to demonstrate metal removal in a domestic setting? Elaborate and emphasise the instructions to include aspects such as installation, maintenance, and operation.	Partially accepted. Some edits made to clarify that advice should be sought to determine if treatment is appropriate.
53.	Information sheet	TREATMENT "Manufacturer's instructions should be followed to ensure the filtration units remain effective."	Elaborate and emphasise that instructions includes installation, maintenance and operation. Amend text to: 'Manufacturer's operational and maintenance instructions should be followed to ensure the filtration units remain effective.'	Accepted. Text amended.

#	Fact sheet	Relevant section	Feedback received	Action/Response
54.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY "This is seen particularly in schools after lengthy holiday breaks, where water to drinking fountains has remained stagnant in pipes."	Could NHMRC consider using 'bubblers/fountains'? I think this is used elsewhere in ADWG. In some regions, one term or the other is commonly used.	Accepted. Text updated.
55.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY *Role of building and site owners and managers and plumbing oversight agencies* "A patina on metals and metallic alloys is a coating of various chemical compounds such as oxides, carbonates, sulphides, or sulphates formed on the wetted surface during exposure to water."	Suggest 'sulfide' is used rather than 'sulphide'. This is consistent with the use elsewhere in ADWG (generally!) and the International Union of Pure and Applied Chemistry (IUPAC)	Accepted. Text updated. For consistency, amendments to other sections of the Guidelines have also been proposed.
56.	ADWG edits	6.3 CHEMICAL QUALITY OF DRINKING WATER	Include • generation of disinfection by-products due to interaction between organic chemicals in water and disinfectants like chlorine.	Accepted. Text updated.
57.	ADWG edits	6.3.1 INORGANIC CHEMICALS "Unless otherwise stated, the guideline value refers to the total amount of the substance present, regardless of its form (e.g. in solution or attached to suspended matter)."	Note: If compliance monitoring only measures freely dissolved fraction, it may be underestimating values for comparison with guideline?	Accepted. Text amended to simplify.

#	Fact sheet	Relevant section	Feedback received	Action/Response
58.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY	Consider adding a reference to Section 9.6 in the Lead and Copper factsheets. The individual factsheets currently talk about how lead can be "leaching from household plumbing products" and how "Copper is relatively resistant to corrosion and is used in domestic water supply pipes and fittings" but falls short of mentioning some important themes from 9.6, such as "water quality should be managed up to the point of consumption, usually the customer tap". "Catchment to tap" is appropriately mentioned in the subheadings for some of the microbial factsheets. Consider doing likewise for lead and possibly copper, to make expectations clear.	Partially accepted. Cross references added to fact sheets for Lead and Copper. Approaches to strengthen 'Catchment to tap' risk management message in Section 9.6 for chemicals to be considered following public consultation or as part of the rolling review of the Guidelines.
59.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY	Amend sentence as follows: •Elevated water hardness can cause scaling of pipes, and water elements in kettles and hot water services.	Partially accepted. Similar text included.
60.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY "Microbial and chemical contamination can be associated with distribution systems in large buildings. This risk increases where large volumes of water are stored for extended periods in on site header tanks…"	Note that the volumes do not have to be large for microbial and chemical contamination to occur. In theory, smaller volumes of water are exposed to a proportionally greater area of biofilm/pipe/tank.	Noted. Text updated to remove size of water volume.

#	Fact sheet	Relevant section	Feedback received	Action/Response
61.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY "Building and site owners, and managers and plumbing oversight agencies, are responsible for ensuring that the plumbing systems and fittings used within their areas of responsibility are fit to convey drinking water without leading to exceedances of water quality guidelines."	Note: Not sure if this is the position of plumbing regulators. They will see their responsibility as being to ensure plumbing products are compliant with plumbing regulations and standards and that people licensed under plumbing laws comply with the requirements of their licence. I'm not sure that entails a higher order responsibility for water quality in private plumbing. I suggest getting a plumbing regulator to review this statement.	Noted. Current text has been retained by Committee to emphasise the shared responsibility in the sector to ensure safety. The guidance will be available for review by plumbing agencies during public consultation.
62.	ADWG edits	6.3 CHEMICAL QUALITY OF DRINKING WATER "A number of chemicals, both organic and inorganic, including some pesticides, are of concern in drinking water from the health perspective because they are toxic to humans or are suspected of causing cancer."	Remove following text: "including some pesticides". Why specifically mention pesticides, when other organic and inorganic chemicals are of equal concern?	Accepted. Text removed.
63.	ADWG edits	6.3.1 INORGANIC CHEMICALS	The obvious question is why we don't have a Section 6.3.2 Organic chemicals? I get this is related to lead replacements, but the introduction mentions organic chemicals and we allude to them in the dot points above [Section 6.3].	There is an existing Section 6.3.2 Organic Compounds in the Guidelines. It has not been included for review, as there are no proposed edits to that section.
64.	ADWG edits	6.3.1 INORGANIC CHEMICALS "Unless otherwise stated, the guideline value refers to the total amount of the substance present, regardless of its form (e.g. in solution or attached to suspended matter)."	Amend text as follows: 'Unless otherwise stated, the guideline value refers to the total amount of the substance present, regardless of its form (i.e. dissolved or particulate fraction).' Note: Using dissolved and particulate is consistent with how we reference this in other parts of the ADWG.	Partially accepted. Text updated for consistency and clarification.

#	Fact sheet	Relevant section	Feedback received	Action/Response
65.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY “Under the catchment-to-consumer tap preventive management framework promoted by these Guidelines, however, water quality should be managed up to the point of consumption, usually the customer tap, to account for water quality changes that may arise as a result of the internal plumbing arrangements on customer properties.”	Remove following text: “however”. I think the sentence reads better without this word?	Not accepted. Preceding text describes responsibility of water suppliers being at the point of supply to the customer however this paragraph is suggesting that water quality should be managed to the point of consumption.
66.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY	Include Water Suppliers in bulleted list. We have a subsection on "role of water suppliers" which clearly outlines some obligations upon them. So it makes sense to include them here.	Accepted. Text updated.
67.	ADWG edits	9.1 INTRODUCTION “Most of the monitoring information in this chapter relates to the operation of reticulated drinking water systems up to the point of supply (usually the water meter). However, water quality may be impacted beyond the point of supply through leaching of substances from plumbing products into drinking water, which may present a potential health risk to consumers at the tap. Section 9.6 provides further information on water quality beyond the point of supply. Information Sheet 4.1 (Chemicals leaching from plumbing products) provides further information on leaching of substances from plumbing products, actions to reduce exposure and guidance on in-premise sampling”.	The update while covering the metals aspect of plumbing could be enhanced by noting the potential microbial aspects of internal plumbing such as opportunistic pathogens and referring to the relevant locations in Chapter 5.	Noted. Text amended and reference to Chapter 5 added. Any further information about microbial water quality may be considered in a future update.

#	Fact sheet	Relevant section	Feedback received	Action/Response
68.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY *Role of water suppliers* "While internal plumbing systems are largely outside of the control of water suppliers, it is reasonable to expect that water suppliers be aware of these issues".	The underlined text is new to the guidelines and should also include reference to health authorities and drinking water regulators as needing to be aware of such issues to ensure completeness as not all water will be supplied by a utility. The department often receives calls from the public regarding internal plumbing issues from community and utility supplies. Furthermore, there is sustained and in some cases growing use of private water in certain residential and school developments.	Partially accepted, noting that the underlined text is not new to the Guidelines. Text amended to clarify.
69.	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY	Following the new text "in-premises water conditions including microbial water quality" link to the relevant sections in Chapter 5 regarding opportunistic pathogens etc.	Accepted. Text amended.

Table 4. 2024 enHealth comments on the draft guidance (manganese)

#	Fact Sheet	Relevant section	Feedback received	Action/Response
Question 1: Is the draft guidance relevant, accurate and easy to understand?				
1.	-	-	The draft guidance is relevant, accurate and easy to understand and therefore suitable to go to consultation.	-
2.	-	-	Yes	-
Question 2: Do you support the approaches taken to review the evidence and develop the guidance?				
3.	-	-	The approaches taken in the review are supported.	-
4.	-	-	Yes	-
Question 3: Do you have any other comments about implementation or feasibility of the proposed health-based guideline values?				
5.	-	-	Implementation may elicit some feedback during consultation – particularly by water providers that are near the current HBGV. Local regulators will need to work closely with the providers to ensure that suitable transition arrangements are in place for halving the HBGV and what that means for compliance moving forward. This is possibly more a discussion for enHealth WQERP but should be noted.	Noted.
6.	-	-	[There are] many small and remote drinking water supplies, with poor source water quality, operated by small, poorly resourced local governments. Some of these will, from time to time, struggle to achieve the proposed HBGV for manganese. However, as the correct methodology has been used to establish this HBGV, it is defensible and should stand.	Noted.
General comments:				

#	Fact Sheet	Relevant section	Feedback received	Action/Response
7.	ADWG edits	-	The main changes suggested revolve around Mn interfering with the DPD method by overestimating the Cl concentration. I think there is value in making this point in each of the Fact Sheets, rather than just make it once in Information Sheet 1.4 and then cross referencing that in the other Information Sheets.	Accepted. Consequential changes to be made in other fact sheets where relevant.
8.	Manganese	GENERAL DESCRIPTION	With manganese commonly measured across Australia, is there potential to include a typical range for Australian conditions?	Accepted. Additional information will be included if it is made available or identified during public consultation.
9.	Manganese	GENERAL DESCRIPTION "At manganese concentrations above 0.02 mg/L, an increase in consumer complaints is common."	I'm thinking that this is as a result of discolouration, rather than taste and odour? If so, should we say that?	Partially accepted. Text moved to sentence about coating/ooze. EPA has an aesthetic guideline value of 0.05mg/L to limit issues with taste, and precipitates. Text derived from current fact sheet with no reference.
10.	Manganese	GENERAL DESCRIPTION Oxidised forms of manganese (e.g. permanganate) can interfere with the commonly used DPD method for determining chlorine residual, potentially resulting in an overestimation of the chlorine residual (see Information Sheet 1.4 on Chloramines).	Perhaps expand "DPD method" for clarity.	Accepted. Diethyl-phenylenediamine inserted for clarity.
11.	Manganese	GENERAL DESCRIPTION Oxidised forms of manganese (e.g. permanganate) can interfere with the commonly used DPD method for determining chlorine residual, potentially resulting in an overestimation of the chlorine residual (see Information Sheet 1.4 on Chloramines).	I've made some comments and changes in the Consequential amendments around this. It appears (at least to me) that we are referencing around in circles. It is an equally important point to make in all relevant places - rather than just refer back to Information Sheet 1.4. Also see line 7 above	Accepted. Cross references inserted into other fact sheets for relevant water treatment chemical fact sheets.

#	Fact Sheet	Relevant section	Feedback received	Action/Response
12.	Manganese	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER "In major Australian reticulated drinking water supplies, manganese concentrations have been found up to 0.8 mg/L, with typical concentrations less than 0.03 mg/L. Mean concentrations of manganese in reticulated drinking water supplies measured below 0.03 mg/L across urban and regional Western Australia and in Northern Territory town centres (Water Corporation 2023, Power and Water Corporation 2023)."	Victorian data can be found in some water agency annual water quality reports.	Accepted – this section is not meant to be exhaustive but additional information will be included when it is made available or identified during public consultation. Added: Manganese concentrations measured in drinking water derived from the six major Melbourne storage reservoirs following primary treatment processes were in the range 0.0001–0.0138 mg/L during 2022 (Melbourne Water 2023).
13.	Manganese	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER "In major Australian reticulated drinking water supplies, manganese concentrations have been found up to 0.8 mg/L, with typical concentrations less than 0.03 mg/L. Mean concentrations of manganese in reticulated drinking water supplies measured below 0.03 mg/L across urban and regional Western Australia and in Northern Territory town centres (Water Corporation 2023, Power and Water Corporation 2023)."	Why only NT and WA data? For example, Sydney Water has this on the website https://www.sydneywater.com.au/water-the-environment/how-we-manage-sydneys-water/safe-drinking-water/water-analysis.html As do Hunter Water What's in your water - Hunter Water Additionally, we have looked at the last 10 yrs of data from regional NSW which shows a median of 0.0025mg/L.	Accepted – this section is not meant to be exhaustive but additional information will be included when it is made available or identified during public consultation.

#	Fact Sheet	Relevant section	Feedback received	Action/Response
14.	Manganese	TREATMENT OF DRINKING WATER "Manganese concentrations in drinking water source waters may be lowered to below 0.05 mg/L by using common water treatment methods, including oxidation/filtration, adsorption/oxidation, softening/ion exchange and biological filtration (see also Section 8.3.5, Health Canada 2019, WHO 2022). Manganese levels below 0.02 mg/L can be achieved with a well operated and optimised system. However, selection of the appropriate treatment for manganese removal depends on the form of manganese present (dissolved or particulate) (Health Canada 2019, WHO 2022)."	Is there anything to add on for management in distribution systems? Obviously desirable to limit input into distribution but for example the WHO guidance talks about minimising hydraulic disturbances, stable chemistry and mains cleaning.	Accepted. Additional text inserted to highlight the importance of the distribution system. "Ensuring stable water chemistry, regular maintenance to remove accumulated oxides and minimising physical or hydraulic disturbances of the distribution system are also key to limiting manganese in drinking water."
15.	Manganese	MEASUREMENT "The manganese concentration in drinking water can be determined using inductively coupled plasma atomic emission spectroscopy, inductively coupled plasma mass spectrometry and graphite furnace atomic absorption spectroscopy with detection limits ranging between 0.005–50 µg/L (APHA Method 3500-Mn, Health Canada 2019, WHO 2021, USEPA 2024b)."	In all other sections, we use mg/L. We now introduce ug/L. Should it be constant?	Not accepted. Values kept the same. We could use <0.05mg/L rather than the range but this does not reflect the sensitivity of these methods nor fit with the recommendation to aim for <0.02mg/L. At lower concentrations in other fact sheets we have changed the units to ug/L where required.

Summary of feedback received

Feedback from consultation in January 2025 on the draft guidance material was supportive and included minor clarifications and additional references to support the fact and information sheets. A summary of the feedback from the jurisdictions are provided in **Table 5** below.

Table 5. 2025 enHealth Water Quality Expert Reference Panel comments on the draft guidance post public consultation (lead and lead replacements in plumbing products)

#	Fact Sheet	Relevant section	Feedback received	Action/response
1	Information sheet	BACKGROUND REDUCING EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS	I've had an idea that we should not be referring to AS4020 – instead we should broadly refer to the Plumbing Code of Australia and contained in the National Construction Code (ABCB 2022). By stating that compliance is required against the PCA, it calls up AS4020 or NSF372. I think this is more appropriate, as I envisage when the HBGV for Pb and Mn are updated in AS4020, then all references we use to that will need updating. Plus it places the onus on the user rather that NHMRC merely specifying one requirement of the whole certification process. This is particularly important as the %w/w Pb component of an alloy must be certified against NSF372 – there is no test method prescribed in AS4020 for that purpose.	Noted and accepted. References to AS/NZS 4020:2018 Testing of products for use in contact with drinking water removed. Updated text reflects that plumbing materials in contact with drinking water be compliant with the lead free requirements of the Plumbing Code of Australia (ABCB 2022).
2	Information sheet	RISKS FROM EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS "There are a number of measures already in place, such as requirements to test under Australian regulations, which preventatively manage health risks from plumbing products."	First sentence: Recommend to elaborate on 'requirements to test…' (to test what, for example?)	Noted. Sentence removed.

#	Fact Sheet	Relevant section	Feedback received	Action/response
3	Information sheet	RISKS FROM EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS "While the introduction of Lead Free plumbing products, defined by the Australian Building Codes Board as a plumbing product or material in contact with drinking water with a weighted average lead content of not more than 0.25% (ABCB 2023), will reduce the risk of exposure to lead leaching into drinking water, it is important to confirm that any chemicals used to replace lead in plumbing products do not leach into water at unsafe levels."	Has ABCB tested the alternative Lead free plumbing products for stability and leachability under all water conditions?	Noted. This is outside of NHMRC's remit. New guideline values can be incorporated in testing protocols if adopted by ABCB.

#	Fact Sheet	Relevant section	Feedback received	Action/response
4	Information sheet	RISKS FROM EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS "While the introduction of Lead Free plumbing products, defined by the Australian Building Codes Board as a plumbing product or material in contact with drinking water with a weighted average lead content of not more than 0.25% (ABCB 2023), will reduce the risk of exposure to lead leaching into drinking water, it is important to confirm that any chemicals used to replace lead in plumbing products do not leach into water at unsafe levels. In the absence of information on specific copper alloys, the available information on the relevant chemicals used to replace lead in plumbing products that may reasonably be expected to leach into drinking water, should be considered when setting acceptable limits in lead replacement plumbing products."	Paragraph 2: first two sentences are very long, suggest breaking up into shorter sentences.	Accepted. Text updated.
5	Information sheet	REDUCING EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS "For example, by ensuring plumbing products are safe for use in drinking water, the health risks can be reduced before a product is available on the market."	Second sentence: Suggest slight re-word at the start, to: 'For example, to help ensure plumbing products are safe...' . Is an inspection required to ensure components used are certified compliant to AS's?	Partially accepted. Text edited. Specific requirements of the Plumbing Code of Australia outside of NHMRC's remit.

#	Fact Sheet	Relevant section	Feedback received	Action/response
6	Information sheet	REDUCING EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS *Flushing* “Extensive flushing is also advisable towards the end of commissioning of newly constructed or renovated plumbing systems.”	Last paragraph: Extensive flushing is "advisable".. should this use stronger language to ensure the removal of swarf or metal filings?	Noted and not accepted. Current text is appropriate. The use of 'Extensive flushing' suggests that a sufficient quantity of water is passed through systems to ensure debris is removed.
7	Information sheet	REDUCING EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS *Flushing* “In other buildings with vulnerable occupants, such as pregnant women, flushing frequency and duration will depend on the likelihood of stagnation, and the length and complexity of the plumbing system.”	Paragraph starting with: 'In other buildings with vulnerable occupants such as pregnant women..' suggest adding infants here.	Accepted. Text updated to include infants as an example of a vulnerable occupant."
8	Information sheet	REDUCING EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS *Treatment* “Buyers of point-of-use filtration devices should look for filters that have been validated to demonstrate metal removal.”	Second last sentence: Suggest to include what is an example of 'validation' that buyers can look out for.	Noted. This falls outside of ADWG remit to specify the specific validations available for point-of-use filtration validated to remove metals.

#	Fact Sheet	Relevant section	Feedback received	Action/response
9	Information sheet	REDUCING EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS *Flushing section*	Duplication of the dot points regarding the use of cold taps for drinking / cooking, flushing for 10 sec and for 2 min for longer periods of non use.	Accepted. Text updated to remove duplication of flushing protocols in both households and buildings with vulnerable occupants.
10	Information sheet	IN-PREMISE SAMPLING "The Environmental Health Standing Committee (enHealth 2021b) of the Australian Health Protection Principal Committee has published *Reducing exposure to metals in drinking water from plumbing products, 2021* that details all considerations and recommended methodologies for taking samples."	The Australian Health Protection Principal Committee (AHPPC) is now called Australian Health Protection Committee.	Accepted. Text updated to include current name of Committee (Australian Health Protection Committee).
11	Information sheet	IN-PREMISE SAMPLING "A sampling program to test for metals should be initiated: in response to any of the following scenarios: • during commissioning of new or renovated buildings, excluding sole occupancy dwellings, to ensure the system can supply safe water (e.g. new hospitals or large multi-occupancy commercial buildings)"	What is the rationale for excluding sole occupancy dwellings from testing?	No action - this advice is taken from the enHealth guidance – Lead in drinking water from some plumbing products.
12	Information sheet	IN-PREMISE SAMPLING	Suggest the review of the paper M.Sahoo (1999) A review of Bismuth and Selenium modified copper alloys for plumbing applications	Noted and no changes made. NHMRC were unable to gain access to a copy of M. Sahoo (1999) thus unable to assess its relevance to the text.

#	Fact Sheet	Relevant section	Feedback received	Action/response
13	Information sheet	BACKGROUND “In light of concerns about the health effects of lead, there have been efforts to reduce exposure by reducing the allowable limit of lead in plumbing materials (ABCB 2023). As a result, there is an increasing availability of alternative plumbing products (such as Lead Free plumbing products) on the Australian market.”	ABCB does not capitalize "lead free" so we should not either except when referring to the Watermark labelling	Accepted. Text updated to remove capitalisation of 'lead free'.
14	Information sheet	REDUCING EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS *Flushing section*	The advice in the dot points below are repeated. I realise the context is slightly different but it should be re-written to prevent the repetition.	Accepted. Text updated to remove duplication of flushing protocols in both households and buildings with vulnerable occupants.
15	Information sheet	IN-PREMISE SAMPLING “The Environmental Health Standing Committee (enHealth 2021b) of the Australian Health Protection Principal Committee has published Reducing exposure to metals in drinking water from plumbing products, 2021 that details all considerations and recommended methodologies for taking samples.”	These abbreviations are not needed as these terms are only repeated once	Noted. No change required.

#	Fact Sheet	Relevant section	Feedback received	Action/response
16	Information sheet	IN-PREMISE SAMPLING "The Environmental Health Standing Committee (enHealth 2021b) of the Australian Health Protection Principal Committee has published Reducing exposure to metals in drinking water from plumbing products, 2021 that details all considerations and recommended methodologies for taking samples."	Not sure whether this should refer to the current or former name of this committee?	Accepted. Text updated to include current name of Committee (Australian Health Protection Committee).
17	Information sheet	REFERENCES "Standards Australia (2011). Water quality - Sampling - Part 13: Guidance on sampling of sludges, ISO 5667-135:2011, May 2011."	I cannot see the use of this reference within this document, so it should be removed. Also, the WHO documents are not referenced either.	Accepted. Reference updated to read *Standards Australia (1998). Water quality - Sampling - Part 5: Guidance on sampling of drinking water used for food and beverages processes, ISO 5667-5:1998, February 1998*.
18	Information sheet	RISKS FROM EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS "There are a number of measures already in place, such as requirements to test under Australian regulations, which preventatively manage health risks from plumbing products."	Should we specify regulations?	Accepted. Regulations are not required to be specified, as text has been removed.

#	Fact Sheet	Relevant section	Feedback received	Action/response
19	Information sheet	RISKS FROM EXPOSURE TO METAL AND METALLOID CHEMICALS LEACHING FROM PLUMBING PRODUCTS "While the introduction of Lead Free plumbing products, defined by the Australian Building Codes Board as a plumbing product or material in contact with drinking water with a weighted average lead content of not more than 0.25% (ABCB 2023), will reduce the risk of exposure to lead leaching into drinking water, it is important to confirm that any chemicals used to replace lead in plumbing products do not leach into water at unsafe levels."	This is already stated in the previous page.	Accepted. Text removed.
20	Bismuth	HEALTH CONSIDERATIONS "The clinical toxicology database for bismuth is limited; however, a review of the evidence found case reports of neurotoxicity (encephalopathy) and nephrotoxicity from oral exposure to large amounts of bismuth salts resulting from overdoses of medications (SLR 2023)."	Clinical tox database has limited data- suggest refering to TGA's DAEN medicines - Database of Adverse Events notifications, that has 59 cases reported between the period of 1981-2024. Also suggest refering to the chapter on Bismuth in the Handbook on the Toxicology of metals Volume II, 5th ed, 2022 It appears there is evidence for human case reports: suggestion to consider the paper: Effects of Bismuth Exposure on the Human Kidney - A systematic Review (L E Pelepenko et al. December 2022) https://pmc.ncbi.nlm.nih.gov/articles/PMC9774474/ Provides a review of studies of case reports from 1961-2021, including chronic exposure.	Noted and no changes made. The information in the fact sheet has resulted from considering the best available evidence from a recent review of the relevant literature by SLR Consulting to derive a potential health-based guideline value.

#	Fact Sheet	Relevant section	Feedback received	Action/response
21	Bismuth	DERIVATION OF GUIDELINE "300 is the safety factor in using results of an animal study as a basis for human exposure (10 for interspecies extrapolation, 10 for intraspecies variations and an additional safety factor of 3 for limitations in the current toxicological database). No additional safety factor was applied for use of a short-term study, as the NOAEL corresponded to the assumed NOAEL observed in a 2-year chronic study (noting there is some uncertainty in the reporting of the chronic study)."	As per Safety Factor Criteria in Chapter 6 of ADWG, consideration should be given for an additional factor of data from a sub chronic study in th absence of reliable data of chronic studies. A 28 day repeat oral study to chronic study has had no safety factor applied even after the statement of some uncertainty in reporting of the chronic study. Also suggest using human data (if therapeutic data is available) to derive health based guidelines to reduce the uncertainty.	Noted and no changes made. SLR considered and agreed that no additional uncertainty factor was applied for use of a short-term study, since the 2-year chronic toxicity / carcinogenicity NOAEL from Preussman and Ivankovic (1975) was in a similar range to the NOAEL from the 28-day study by Sano et al. (2005).
22	Silicon and silica	N/A	No issue with Attachment C as revised.	Noted.
23	Silicon and silica	GUIDELINE "Based on health considerations, the concentration of silicon in drinking water should not exceed 100 mg Si/L (equivalent to 210 mg/L SiO2). To minimise an undesirable scale build up on surfaces, the aesthetic value for silica in drinking water should not exceed 80 mg SiO2/L."	suggest including the equivalence of SiO2/L to Si/L in mg and vice versa	Accepted. Health-based guidance value for Silicon in drinking water (100 mg Si/L) includes an equivalence to Silica (210 mg SiO_2/L). The aesthetic-based guidance value for Silica in drinking water (SiO_2 mg/L) includes an equivalence to Silicon (37 mg Si/L).

#	Fact Sheet	Relevant section	Feedback received	Action/response
24	Selenium	GENERAL DESCRIPTION "Selenium and selenium salts are widespread in the environment. Selenium is released from natural and human-made sources (such as the burning of coal). Selenium is also a by-product of the processing of sulfide ores, chiefly in the copper refining industry."	As per current factsheet in ADWG, need to include the statement that food is a major exposure source. Selenium exposure can come from food and medicinal sources, suggest reviewing the following articles: (1) Genchi G etal, Biological Activity of Selenium and Its Impact on Human Health. Int J Mol Sci. 2023 Jan 30;24(3):2633. doi: 10.3390/ijms24032633. PMID: 36768955; PMCID: PMC9917223; and (2) Revised reference values for selenium intake J Trace Elem Med Biol. 2015 Oct:32:195-9. doi: 10.1016/j.jtemb.2015.07.005. Epub 2015 Jul 17.	Partially accepted. Text edited to clarify and suggested references included.
25	Selenium	HEALTH CONSIDERATIONS "Selenium is an essential element for many species, including humans. Signs of selenium deficiency in humans are not well established but may include effects on the cardiovascular system, immune system, endocrine system and male reproductive system."	The current ADWG version of the Selenium fact sheet has the Australian recommended dietary intake to maintain health included. This version has omitted it, but then in the derivation of guideline section, reference is made to the recommended amount of Selenium in the North American diet. Consider reviewing/referring to the Nutrient Reference Values for Australia & NZ, including the recommended dietary intakes for selenium: https://www.eatforhealth.gov.au/nutrient-reference-values/nutrients/selenium	Not accepted. The NHMRC Selenium Nutrient Reference Values are currently under review and have not been used to derive the health-based guideline value for selenium in drinking water.
26	Selenium	HEALTH CONSIDERATIONS "Selenium compounds are readily absorbed in humans. Selenium is metabolised in the liver then distributed to other organs and tissues such as the pancreas, nervous system, skin and hair, bone, muscle, lungs and kidneys. The toxicity of selenium may vary among the different selenium compounds and additional research may be required to clarify the importance of the chemical form on overall toxicity (SLR 2023)."	Second paragraph, commencing with: 'Selenium compounds are readily absorbed in humans'. Consider including that this relates to water soluble selenium compounds, as it is stated in the current ADWG version (which also highlights selenate is more toxic).	Not accepted. Text has been updated based on findings from recent SLR review.

#	Fact Sheet	Relevant section	Feedback received	Action/response
27	Selenium	DERIVATION OF GUIDELINE "The health-based guideline value of 0.004 mg/L (rounded) for selenium in drinking water was derived as follows: 0.004 mg/L = 0.255 mg/day x 0.1 2 L/day x 3"	Consider reviewing the derived health based guideline for Se of 0.004 mg/L as it is an order of magnitude lower than US EPA and Health Canada values of 0.05mg/L and UK DWI guideline of 10 microgram/L. CDC's ATSDR states a Chronic oral MRL of 0.005mg/kg/day based on an NOAEL of 0.015mg/kg/day for disappearance of symptoms of selenosis. https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=153&tid=28	Not accepted. The proposed health-based guideline value of 0.004 mg/L has resulted from considering the best available evidence from a recent review of the literature, including considering the suitability of adopt/adapting existing guideline values from other jurisdictions such as the US EPA, Health Canada and ATSDR.
28	Selenium	DERIVATION OF GUIDELINE "0.255 mg/day is the adjusted minimal lowest observed adverse effect level (LOAEL) for mild selenosis (alopecia and dermatitis) in adult males receiving supplementary selenium in the diet (Lippman et al. 2009). The minimal LOAEL for mild selenosis of 0.2 mg/day as added selenium was adjusted by adding this to the dietary selenium intake likely to have been ingested by the adult male participants in the large HCT study (i.e. 0.055 mg/day, which is the normal recommended amount of selenium in the North American diet to prevent selenium deficiency as reported in NIH (2021)) (SLR 2023)."	Not sure what it means that "the LOAEL is a minimal LOAEL"? And why a safety factor of 3 was applied.	Noted. Justification for uncertainty factor of 3 is provided in the guideline derivation section of the fact sheet and was selected using the expert judgement of the reviewer and agreed to by the Water Quality Advisory Committee.

#	Fact Sheet	Relevant section	Feedback received	Action/response
29	Selenium	DERIVATION OF GUIDELINE "3 is the safety factor applied as the effect was mild and the LOAEL is a minimal LOAEL. Consideration was given to balancing the essentiality of selenium with the potential for adverse effects. An uncertainty factor for human variability was not included as the study included a large population of 8,752 adult males and there is no indication that females or children are more susceptible to the effects of selenium."	The proposed guideline value is 10 times lower than current WHO provisional guideline of 0.04 mg/L, which is provisional because of uncertainties in the health database. I note selenium is an essential trace element. Is a safety factor of 3 appropriate?	Noted. The proposed health-based guideline value of 0.004 mg/L has resulted from considering the best available evidence from a recent review of the literature, including considering the suitability of adopt/adapting existing guideline values from other jurisdictions such as WHO. Justification for uncertainty factor of 3 is provided in the guideline derivation section of the fact sheet and was selected using the expert judgement of the reviewer and agreed to by the Water Quality Advisory Committee.
30	Selenium	TYPICAL VALUES IN AUSTRALIAN DRINKING WATER "Some remote areas of Australia have recorded higher concentrations. For example, in 2004 mean values of selenium concentrations for various water supply systems in the Northern Territory ranged from 0.0002 – 0.012 mg/L, with the high values reported in Kings Canyon and Daly Waters (PWNT 2004)."	Will only hold true if this is true of the range given?	Noted and accepted. Values updated to reflect those within included Power and Water Corporation reference.

#	Fact Sheet	Relevant section	Feedback received	Action/response
31	Lead	GENERAL DESCRIPTION "Lead may be found as a contaminant in a wide range of foods; however dietary exposures are considered to be lower than levels found to be of negligible risk of causing adverse health effects (FSANZ 2019)."	Last paragraph: After 'Lead may be found as a contaminant in a wide range of foods..' consider including the following from the current ADWG fact sheet: 'which can increase when acidic food is stored in lead-glazed ceramic pottery..', and include lead crystal.	Not accepted. Text edited to reflect more recent exposure sources identified in SLR review report.
32	Lead	GENERAL DESCRIPTION "Lead may be found as a contaminant in a wide range of foods; however dietary exposures are considered to be lower than levels found to be of negligible risk of causing adverse health effects (FSANZ 2019)."	Consider removing the word 'negligible' from the last sentence of the last paragraph	Accepted. Text edited to clarify.
33	Lead	DERIVATION OF GUIDELINE "Since bottle-fed infants would likely receive up to 100% of their lead from formula made up with drinking water, as opposed to only 20% used for young children, the exposure modelling for young children who have a much higher overall exposure to lead through other exposure pathways (e.g. dirt and dust) is considered to be protective for bottle-fed infant exposures."	This sentence is too long and is hard to follow. It would benefit from re-writing.	Accepted. Text edited to clarify.

#	Fact Sheet	Relevant section	Feedback received	Action/response
34	Manganese	HEALTH CONSIDERATIONS "Reviews by the World Health Organization (WHO) and Health Canada found that several human epidemiological studies suggest an association between exposure to manganese in drinking water and neurological effects (e.g. intellectual impairment and poorer neurobehavioural function, including memory, attention, motor function and hyperactivity). Although these epidemiological studies could not establish the level at which oral manganese intake can lead to neurotoxiTec effects, collectively they provide support that neurotoxicity is a critical effect in humans (WHO 2021, WHO 2022, Health Canada 2019)."	Regarding studies suggesting an association between exposure to manganese in drinking water and neurological effects (paragraph 3), it should be clarified if this is in relation to high or lower levels of manganese. Further, the current ADWG fact sheet highlights the low solubility of manganese once ingested, its relatively short biological half life, and it being regarded as one of the least toxic elements by oral route - consider if this should be included/adapted for balance. The estimated average dietary intake (which is specified in the current fact sheet) could be included. Also, consider referring to the Nutrient reference values for Australia & NZ which includes recommended adequate intakes by life stages including for infants: https://www.eatforhealth.gov.au/nutrient-reference-values/nutrients/manganese	Not accepted. Fact sheet has been updated to reflect more recent information identified in SLR review report. The NHMRC Manganese Nutrient Reference Values are not included as they have not been recently reviewed and have not been used to derive the health-based guideline value for manganese in drinking water.
35	Manganese	DERIVATION OF GUIDELINES "0.85 L/day is the average amount of breast milk consumed by an infant (enHealth 2012) (value found to remain valid in the 2024 review (NHMRC 2024))."	It might be confusing to refer to breast milk when we are considering guideline value for bottle fed infants	Noted and accepted. Text updated to explain that the 0.85 L/day volumetric consumption value for infants used in the derivation of the health-based guidance value for manganese is based on the consumption of breast milk. See 4.3 Breast Milk, 4.3.3 Recommendations (pg 56) of enHealth Australian exposure factor guide (enHealth 2012).

#	Fact Sheet	Relevant section	Feedback received	Action/response
36	ADWG edits	9.6 WATER QUALITY ISSUES BEYOND THE POINT OF SUPPLY *Role of water suppliers* “Prepare information for customers on water quality issues that may have an adverse impact on their internal plumbing.”	Regarding the following recommended action that water suppliers can take: 'Prepare information for customers on water quality issues that may have an adverse impact on their internal plumbing': This could be done in collaboration with relevant health authorities.	Accepted. Text edited to clarify.

Appendix D – Public consultation summary report

Background

The *Australian Drinking Water Guidelines* (the Guidelines) are intended to provide a framework for the good management of drinking water supplies. The Guidelines are designed to provide an authoritative reference on what defines safe, good quality water, how it can be achieved and how it can be assured. NHMRC maintains the Guidelines through a rolling revision process to ensure they represent the latest scientific evidence on good quality drinking water.

NHMRC has previously sought advice from the NHMRC Water Quality Advisory Committee (the Committee) and the Environmental Health Standing Committee (enHealth) Water Quality Expert Reference Panel to prioritise work related to the rolling review of the Guidelines. This includes prioritising the development of advice regarding several proposed lead replacement in plumbing products (bismuth, selenium and silicon copper alloys) and the review of a number of existing fact sheets (including lead, selenium and manganese).

NHMRC drafted new and revised guidance material for inclusion in the Guidelines. The draft guidance material for public consultation included:

- a new information sheet on chemicals leaching from plumbing products
- new chemical fact sheets on bismuth and silicon
- revised chemical fact sheets on selenium, lead and manganese
- proposed edits to the Guidelines to align advice and ensure consistency.

NHMRC sought public comment on the draft guidance between 26 July 2024 and 6 September 2024. Stakeholders were invited under paragraph 13(d) of the NHMRC Act 1992 to make submissions to NHMRC about the draft guidance.

Consultation Questions

The questions asked during public consultation were as follows:

1. Do you have any comments on the overall approach taken to develop the draft guidance?
2. Do you have any comments about the implementation or application of the draft guidance?
3. Do you have any specific comments on the draft information sheet for Chemicals leaching from plumbing products?
4. Do you have any specific comments on the draft chemical fact sheet for Bismuth?
5. Do you have any specific comments on the draft chemical fact sheet for Silicon?
6. Do you have any specific comments on the draft chemical fact sheet update for Selenium?
7. Do you have any specific comments on the draft chemical fact sheet update for Lead?
8. Do you have any specific comments on the draft chemical fact sheet update for Manganese?
9. Do you have any specific comments on the proposed consequential edits to the Australian Drinking Water Guidelines?

Public Submissions

NHMRC received 21 public consultation submissions from stakeholders including water utilities, regulators, water associations and citizens. High level details of respondents are listed below, with organisations named where permission has been given to do so.

- Central Highlands Water
- Department of Health Tasmania
- MidCoast Council
- WIW Alliance - Whitsunday, Isaac and Mackay Regional Councils
- Water Corporation
- Department of Health Western Australia
- Queensland Water Directorate
- 8 water providers or organisations
- 2 industry bodies or commercial businesses
- 4 individuals

Full submissions are published in the Administrative Report for this guideline update where permission has been given to do so (see Annex 1).

Responses to public submissions

The public consultation submissions raised a number of key issues for consideration by NHMRC with advice from the Committee.

A high level summary of these issues is provided in **Table 1** below, along with the response from NHMRC and the Committee. Minor edits, clarifications and cross-references to other sections of the Guidelines were actioned where accepted. Note that comments on issues unrelated to the public consultation were not considered as part of this process and are not included in the Table below.

Table 1: Key issues raised in public consultation

Key issue	Response
Concerns about the feasibility of implementing the new guideline values	Noted. NHMRC and the Committee acknowledged several issues that industry may experience in the implementation of new guideline values, such as additional monitoring and upgrade costs. State and Territory health authorities and/or drinking water regulators hold responsibility for the application and adoption of new guideline values, as well as any upgrade or transitional requirements.
Suggestion to combine the silicon and silica fact sheets	Accepted. A combined chemical fact sheet for silicon and silica has been created as per suggestions. The combined fact sheet includes both the aesthetic-based guideline value of 80 mg/L for silica (equivalent to 37 mg/L silicon), and the health-based guidance value of 100 mg/L for silicon (equivalent to 210 mg/L silica).
Concerns about the lack of leachability data	Noted. NHMRC and the Committee noted the absence of leachability data; however, the health-based guideline values are set based on health effects, not leachability. They are the most appropriate values based on credible and reliable science.

Key issue	Response
Suggestions regarding engagement with the Australian Building Codes Board (ABCB), amendments to testing standards (AS/NZ 4020:2018) and to align timing of implementing NHMRC health advice with the new lead-free requirements	Not accepted. Early engagement with the ABCB occurred and discussions resulted in NHMRC embarking on the process of drafting updated guidance on lead replacements in plumbing products into the Guidelines. The Committee made a submission to the ABCB during the consultation period for the Regulatory Impact Statement. Industry testing standards, such as AS/NZ 4020:2018, are outside the remit of NHMRC and lead responsibility of ABCB. The requirement to use lead free plumbing will not be retrospective, and as such, older style materials will still be in installations. Once mandated, it means that new installations must be lead free.
Suggestion to retain the aesthetic guideline value for manganese of 0.1 mg/L in line with the health-based guideline value	Not accepted. The aesthetic guideline value for manganese was lowered from 0.1 mg/L to 0.05 mg/L based on providing safe clear, untainted water to consumers; managing the risks of manganese precipitates in the water distribution system and at the customer's tap; and readily achievable concentrations following water treatment.
Request to clarify that selenium in drinking water is likely to occur past the point of water supply, most likely within premises similar to lead leaching	Accepted. Text amended to note selenium in drinking water is likely to occur past the point of water supply (i.e. the water meter) as any leaching of selenium from some Lead-Free plumbing products would most likely occur within premises.
Request for clarifications to sections on devising the health-based and aesthetic-based guidelines in several fact sheets	NHMRC and the Committee addressed requests for clarifications where required. The proposed health-based guideline values within the updated chemical fact sheets have resulted from considering the best available evidence from a recent review of the literature, including considering the suitability of adopt/adapt existing guideline values from other jurisdictions.
Request to clarify that the lead and manganese fact sheets are to minimise exposure in bottle fed infants (0 to 2 years)	Accepted. Text within the revised lead chemical fact sheet, and the revised manganese chemical fact sheet has been updated to reflect health considerations are made to minimise lead and manganese exposure in bottle-fed infants (0 to 2 years old)
Suggestion to add silicon and bismuth to Table 9.5 of the *Australian Drinking Water Guidelines*	Accepted. Silicon and bismuth are to be added to Table 9.5 of the ADWG, as per existing metals with potential for leaching, including antimony, chromium, copper, and nickel. This inclusion shall be supported by commentary including the requirement for annual sampling, unless pipework material has been considered as part of the nominated sampling frequency.

Appendix E – Public consultation comments

Table 1: Public consultation comments (provided in full where permission has been given)

#	Organisation	Public submission
1. Do you have any comments on the overall approach taken to develop the draft guidance?		
1	Department of Health Tasmania	The overall approach for drafting the factsheets was thorough. The objectives of the review were clear. The search strategy, data scan and analysis were clearly presented.
2	MidCoast Council	MidCoast Council appreciates the proactive approach taken by NHMRC in reviewing the current guidelines for lead and lead replacement products including manganese and selenium and developing new guidelines for other lead replacement products including bismuth and silica to protect Public Health. The supporting evidence provided in developing the draft guidelines including the evaluation and technical reports was very informative.
3	An individual	The guideline development process for chemicals leaching from plumbing products would benefit from an increased analysis of the likely human exposure. The review seems to rely on a lot of assumptions, including the actual composition of the plumbing material, whether a chemical would leach from the plumbing product at all, and if so, the state of that chemical. It is not clear what evidence has been used to support the assumption that bismuth, selenium and silicon will leach out from plumbing products at detectable concentrations. The toxicological evidence has been reviewed in some detail however there is not as much of an emphasis on the exposure evaluation. A risk assessment usually encompasses both a dose-response analysis and an exposure evaluation. In the absence of any measured leachate data, modelled data should be used to better inform potential human exposures. The need for a drinking water guideline for bismuth for example, may actually be redundant if the chemical does not significantly leach into the water. Additionally, the Administrative Report does not adequately cover the alternative public health measures that were considered prior to developing guidance for chemicals leaching from lead-replacement plumbing products. Noting that the guidelines are adopted in state and territory legislation, it is not clear what evidence has been used to justify taking a regulatory approach in the first instance. Are there alternative policy options that can minimise the level of these chemicals present in drinking water without setting a guideline value? For example, a preventative approach which limits the amount of each chemical permitted in the plumbing product may be more effective at reducing the human health risk. Compliance with the drinking water guidelines is tested at the point of supply, rather than in households were many of these lead-replacement products are intended to be fitted. The draft guidance does not clearly demonstrate how the establishment of a drinking water guideline value for bismuth, for example, would be protective of human health at the point of the tap.

#	Organisation	Public submission
4	Water Corporation	The use of the infant weight to calculate the new guideline value for manganese and lead is a deviation from current methodology for guideline calculations. Nitrate has a known acute health impact requiring an infant guideline, however, more information on the long-term developmental impacts from manganese (in particular) and lead exposure is needed. The consequence of using infant weight in the calculation would place an increased strain on the limited capital funding available and potentially draw funding away from more critical contaminants of concern.
5	Department of Health Western Australia	Firstly, as a general comment, the approach taken relies heavily on the information in the reports cited as SLR (2022) and SLR (2023). As far as can be ascertained they are available from links on the consultation page, but nowhere else. Please ensure that these reports continue to be publicly available and maintained on the NHMRC web site after close of consultation. Secondly, the "Administrative Report" document makes some claims in its text that are worth reviewing. For the "Evidence to decision tables" for bismuth, silicon and lead, the heading Health Equity states, six times over: "Lead leaching has been an issue in communities with ageing infrastructure and plumbing in existing houses". Noting that this statement is uncited, and that all communities everywhere have ageing infrastructure, please provide the source of this information of lead leaching being a specific issue associated with ageing infrastructure. It is not clear if the authors are discussing a situation that is common in Australia, or if it is a specific referral to the circumstances at Flint Michigan. If Flint Michigan is relevant to Australia, pls explain how specifically, and say so with citations, given that the remainder of ADWG and the new text goes to some trouble to point out that Australia by and large does NOT have a problem with lead in old pipes, as far as is known, it is to do with relatively new builds. NB – the statement is also not meaningful given that nothing in the new text about leaching, or the new lead fact sheet, even remotely implies that lead is an issue with ageing infrastructure. The new text is all about the problem being created by the materials the plumbing is made from, and the age of the fixtures is noticeably absent from the factors listed as a causative factor. We recommend that this inconsistency is rectified and the simplest way to do so is to delete the unnecessary text (six instances if it) from the draft administrative report.
2. Do you have any comments about the implementation or application of the draft guidance?		

#	Organisation	Public submission
6	Central Highlands Water	Regarding the reduction in the health based guideline value for lead from 0.01 to 0.005 mg/L - this is a substantive change by halving the guideline value. The limit of detection most commonly applied by contracted laboratories is 0.001 mg/L, so the revised guideline value is approaching the test capability. Based on past datasets, there is a small proportion of lead values that sit between 0.005 and 0.01 mg/L, seemingly with no obvious explanation as to the source of the lead. The operational response options to such 'trace' lead detections by a water utility would be very limited as present. It is suggested that any change to the lead guideline value is enacted AFTER low lead containing brass components are commonly available, and mandated for use, so that water utilities have a pragmatic pathway to respond to lead detects by replacing fittings/components that may be leaching lead.
7	MidCoast Council	It is assumed that the implementation of the guidelines would be similar to other metals and will be included in the NSW Health's Drinking Water Monitoring Program. We would like to be notified if this is not the case. The leachability data for all the lead replacement products must be determined in an Australian context once they are used. In addition, more data on the health effects of consumption of bismuth and silica from intake through drinking water will also be available once the guidelines are introduced. It will be beneficial to review guidelines and fact sheets following the availability of the above data. MidCoast Council has optimised the treatment process across all of its water supply schemes and is confident that we will be able to achieve the proposed guideline values in the parameters that we currently monitor.

8	WIM Alliance – Whitsunday, Isaac and Mackay Regional Councils	Unified Regulatory Response - WIM Alliance Below summarises the implications (including costs) to the water treatment infrastructure operated by Regional Councils within the WIM Alliance (Whitsunday, Isaac and Mackay), relating to the proposed changes to the Australian Drinking Water Guidelines (ADWG). Bismuth is not currently tested so there shall be an external cost for laboratory testing. There would be an internal cost including: •Amending documentation relating to bismuth including the DWQMP and the Chain of Custody. •Evaluating monthly results over a two-year period and determining the ongoing monitoring frequency depending on risk. A change in frequency would also require documentation changes to be repeated. •Operational cost implication to water schemes. Silicon is not currently tested so there shall be an external cost for laboratory testing. There would be an internal cost including: •Amending documentation relating to silicon including the DWQMP and the Chain of Custody. •Evaluating monthly results over a two-year period and determining the ongoing monitoring frequency depending on risk. A change in frequency would also require documentation changes to be repeated. •Operational cost implication to water schemes. Selenium is currently being tested quarterly but the limit of reporting (5 µg/L) is greater than the proposed limit (4 µg/L) so there may be a cost implication in conducting a more sensitive test. There is uncertainty in whether the new limit can be achieved since historical data has not used a test method of suitable sensitivity. Potential for non-compliances with the health limit at Eton Township (Mackay Region) Lead is currently being tested quarterly, with a suitable limit of reporting. Historical data indicates the proposed limit of 0.005 mg/L is already being achieved. There shall be no impact from this change. Manganese can be elevated in source waters, either due to stratification or drought. There shall be a significant cost implication in meeting the lower health limit, including: •The requirement to import water by tanker to the small townships if the manganese in the source water is highly variable. •Capital improvement to multiple water treatment plants, including chemical dosing, contact time, change in filter media, automation and online analysers. •Operator training •Increased operational monitoring.

#	Organisation	Public submission
		•Delayed rollout of centralised monitoring and control •Increased contractor costs for maintenance of online analysers •Additional Operator at the small towns •Change in DWQMP for affected water treatment plants including operational control point and quality control point limits. •Reassessment of risks •Potential non-compliances in the health limit at St Lawrence (Isaac Region) •Operational cost implication to water schemes.
9	An individual	It is not clear what evidence has informed assessment of the broader impacts of the draft guidance or whether a cost-benefit or impact analysis has been undertaken for the proposed guidance. Given that the drinking water guidelines are adopted as part of state and territory legislation, it would seem prudent that an evidence-based impact analysis be undertaken. This would help determine the potential regulatory burden on businesses and inform a cost-benefit approach to setting the new guideline values, i.e. whether the cost outweighs the benefit. The evidence-to-decision tables provided in the Administrative Report should show how they align with the requirements of the Australian Government Office of Impact Analysis.
10	Water Corporation	The intent of the guideline updates is to allow for detection of leaching from plumbing fittings into the drinking water supply. However, as water utilities do not undertake water quality sampling after the customer's property boundary, the impacts of leaching from customer plumbing fittings may not be adequately captured by the proposed ADWG updates.

#	Organisation	Public submission
11	Department of Health Western Australia	Following on from comments under question 11, we have concerns about two aspects of the text under “In-premise sampling” for information sheet 4.1, specifically: “Proactive testing of drinking water for metals is not generally required unless there are specific concerns (see below). Similarly, other than at building commissioning, building and asset managers do not need to test drinking water from their plumbing system without good reason.” Firstly, stating that monitoring is not required is incompatible with good risk management advice. The ADWG has gone to the trouble of redrafting itself on this subject, highlighting this risk, and yet indicates that monitoring is not required. This will likely be interpreted by body corporate managers as an excuse to do nothing, no matter what is going on. Elsewhere in ADWG, monitoring is not required under circumstances when a risk has already been assessed and found to be (for example) minor, of no imminent concern, or not relevant to that system. The fact sheet will be significantly benefit from deleting those two sentences, such that the text “The water sampling methods described below will help to identify metals of concern in a plumbing system. They can also help to find the sources of those metals.” … is immediately followed by: “A sampling program to test for metals should be initiated for any of the following reasons:” Secondly, this section does not provide advice on who is best placed to do such monitoring if it occurs. It could be the water supply authorities, if they wish to voluntarily venture downstream of the meter, or the building owners themselves. The ley issue is what does information sheet 4.1 say about how it will be implemented, in relation to the AS3500 series of standards, the Plumbing Code in Australia and the activities of the health, building and plumbing regulatory agencies in each jurisdiction. We therefore recommend that information sheet 4.1 be redrafted to refer more clearly to this aspect. Although the detail of these actions is beyond the scope of the current redraft, the fact that such actions are required is not. We recommend inserting a paragraph along the lines of: “Details of suitable risk management protocols to comprehensively deal with the issue of chemical leaching from plumbing products downstream of the property meter should be developed between each jurisdiction’s health authority, water regulator, plumbing regulator, ABCB and other building regulators in a manner that is as consistent as possible across Australia.”
3. Do you have any specific comments on the draft information sheet for Chemicals leaching from plumbing products?		

12	Department of Health Tasmania	Check grammar. Check references. Background: Suggest re-wording first paragraph to simplify and clarify. Third paragraph: 'Leaching of chemicals...' Suggest a change to 'Leaching of chemicals into drinking water CAN RESULT IN increased ..' 'The leaching of lead containing...' should this read, 'The leaching of lead FROM copper ..' The first sentence makes it sound like plumbing products have a protective effect, this is not really the case. Suggest a re-word to turn the sentence around. Also, look at the wording in the lead factsheet to keep consistent. Second paragraph: 'low-lead' and 'Lead Free' Is there a definition of what these terms mean and how do they differ from each other? Sentence starting 'Further information on the ....' Should it read '....levels that health effects are NOT expected ...' Third paragraph: '....types and composition of PLUMBING products...' First paragraph: 'in-premises' Include a definition of what this means, i.e. water beyond the water meter. Also, look at the wording in the lead factsheet to keep consistent. The lead factsheet uses the term 'within premises'. Second paragraph: '...reasonably be expected to leach from the ...' Do you mean the chemicals that are expected to replace lead in copper alloy plumbing products? First paragraph: '...health risks from plumbing PRODUCTS and to ...' Sentence starting 'For example, health risks..' Suggest turning the sentence around eg 'plumbing products are required to be safe so a risk to health is negligible'. Also, look at the wording in the lead factsheet to keep consistent. Use of the word 'significant' in the last sentence. Significant against what? May be change the word to 'acceptable'. Use of the term 'outlet'. The beginning of this section uses the term 'tap'. Describe the difference between an outlet and a tap. Last paragraph: 'This is required because...' What requirement is this? The previous sentence just says it is advisable. Two-thirds of the way down, include an introductory sentence on filters. Are the first two sentences saying the same thing? Define '6HS' and 'RDT'

#	Organisation	Public submission
13	MidCoast Council	This is a very valuable addition to the guidelines and provides information on managing drinking water quality past the point of supply.
14	An individual	Slight change to this sentence, but a very important one: "Rainwater may also dissolve more metals from plumbing products due to the slight acidity [and very low hardness] of the rainwater" Based on the toxicology of metals, which are mainly an issue for persons in their early neurodevelopmental stages, is "the elderly and immunocompromised" a necessary inclusion? I would not see it worth singling out. Pregnancy, yes. But the other at risk group is bottle fed infants, infants, toddlers and children in general. Suggest replace "the elderly and immunocompromised" with "bottle fed infants, infants, toddlers and children". Why does that fact sheet not recommend routine sampling from representative randomised customer tap sampling within buildings? This Information Sheet provides an opportunity to fix that major anomaly in Australia's guidelines compared to benchmark jurisdictions - a correction that is long overdue. It is acknowledged that water utilities are only responsible for water 'to the meter'. However, state and local governments are responsible for plumbing regulation; just as they are responsible for potable water supply. The two are related. The Information Sheet provides no logical reason for not sampling at taps. The Information Sheet states that in-premise plumbing is the primary source of metals, but does not recommend verification of metal concentrations at taps. In fact its states: "Proactive testing of drinking water for metals is not generally required unless there are specific concerns (see below). Similarly, other than at building commissioning, building and asset managers do not need to test drinking water from their plumbing system without good reason". This is not an evidence-based position. It is a pragmatic position that acknowledges that water utilities testing water set up testing sites on their side of the water meters. But from a public health perspective, verification of drinking water quality should occur at the point of exposure for parameters that change during distribution. Benchmark jurisdictions do test at taps so the numerous reasons given as to why testing at taps is not simple are proven to be surmountable. Testing at both water meter/interface sampling points and taps is the sampling regime that evidence would support. This testing should be ongoing since plumbing products can change, as can water quality, which means verification at one point in time is not sufficient evidence of possible future risks. This Information Sheet should provide guidance on how to select customer tap sampling sites for testing for parameters that change significantly in concentration within premises, and how to utilise the results. Such guidance is readily available, in English, from benchmark jurisdictions. The question as to 'who is responsible' for testing and response is a question for state and local governments to address in collaboration with building and plumbing agencies. The ADWG need not address that. But it needs to provide evidence-based advice. Not doing that is a major omission that is not supported by the local evidence or by routine longstanding practice from international jurisdictions. Given the widespread use of ongoing routine in-premise tap verification sampling globally, failure to include this implies selective use of evidence by the NHMRC. Why does the fact sheet not recommend managing the corrosivity of the water? The science on corrosivity is long-established and many benchmark jurisdictions require water to be stabilised. Much of Australia's surface water and shallow groundwater is 'aggressive' on the hardness scale and is inherently predisposed to leaching metals. Simple changes to hardness and pH, and if required orthphosphate addition, are proven solutions to this problem and support an evidence-based recommendation. Water suppliers should monitor and report on the corrosivity of their water and manage it to ensure that it is not prone to leaching. This recommendation sits with the above - benchmark jurisdictions use the customer tap monitoring to help inform the success of their corrosivity control programs and adjust water quality accordingly. Given the widespread use of corrosivity control globally, failure to include this implies selective use of evidence by the NHMRC.

15	Department of Health Western Australia	Firstly, the chapter heading and all NHMRC documentation text refers to “Chemicals leaching from plumbing products”, whereas the detail only relates to metals such as bismuth, selenium, lead and manganese, as well as silicon. It is unquestionably true that the overarching concept of “Chemicals leaching from plumbing products” should include organic substances such as bisphenol A, dialkyltins, plasticisers or or even PFAS, and yet these are never mentioned, despite there being a significant amount of plastic products used in plumbing systems, PFAS having a high profile in the media, and issue of Iplex piping also currently having a high profile in the media. Notwithstanding anything NHMRC or ADWG may later do about PFAS, the fact remains that the current heading of “Chemicals leaching from plumbing products” seems to ignore the fairly obvious point that organic chemicals are also chemicals. Please either review the new text to either: • make it clearer that you are only talking about metals (and silicon), or • say something about how risks from organic chemicals and plastic pipes can be managed, or • defer publishing this until NHMRC has finalised any new text about PFAS, bisphenol A or other organic chemicals leached from plastic pipe products. Secondly, the text assumes that the issue of leaching from plumbing products relates solely to large plumbing networks that are within buildings, be they houses or larger buildings or building complexes. The issue also arises in large plumbing networks that are outdoors, in particular long networks of drinking fountains/bubblers at municipal parks, beachfront areas, outdoor plazas or outdoor sporting facilities where the issue of flushing also arises and the outdoor facility has extensive plumbing networks downstream of the water meter. These are usually managed by local councils or sports venue operators and including them in text about chemical leaching is very desirable. To be comprehensive, we recommend that the information sheet acknowledge this and set out some commentary on any risks from water that is in contact with metal surfaces in the interior components of plumbed-in boil water devices, and whether flushing is recommended, and if so under what circumstances. Fourthly, in relation to the published advice about flushing times, it appears to be based on the concept that the flushing time is adequate to flush out the potential contaminant, with an implication that the contaminant originated in a fitting within a few metres upstream of the tap being flushed, if ten seconds is adequate flushing time. That is all fine and quite reasonable, however, if the contaminant originated in any other part of the (stagnant or unused) plumbing network back to the property meter, then, even if it was a domestic house, ten seconds flushing would most likely be inadequate to obtain fresh water from the street network to the tap, it would simply move the contaminant closer to the tap, but not all the way, especially if the plumbing network was otherwise unused. Ten seconds flushing would only be adequate if the contaminant originated in the tap itself or within two or so metres of it, and yet nowhere in the text of this chapter does ADWG indicate that any part of a plumbing network is more or less likely to generate the contaminant than any other part. Specifically, it does not state that it is only tap fittings that can source contamination, yet the solution provided only works if that assumption is true. We recommend that the text either:

		Set out which parts of the building plumbing network are more likely to generate the problems, or if it can not do so because the entirety of the plumbing network is equally likely may do so, or the products that leach metals may be anywhere in the building, then it should provide a management solution that will actually clear the building plumbing network back to the meter. NB – the advice provided about selecting a tap "furthest away from the incoming supply" and flushing that tap will only flush out the direct like between that tap and the meter. It will NOT flush out any other stagnant side branch in that plumbing network that is not directly between the flush point and the meter, and no amount of flushing at that furthest away point will change that fundamental hydraulic fact or be effective in tree-like or dendritic pipe networks where the water lies dormant. NB – the fact that the advice in question was imported from the NHMRC 2021b EnHealth paper does not change the issue. Finally, under "Flushing" and buildings with vulnerable users, we recommend that the text recognize the reality that many households with children in cities in Australia are located not in stand-alone houses with minor plumbing systems but in major high rise residential apartment complexes with complex hot and cold plumbing networks over multiple levels of the building. Therefore, it would be desirable for "building and asset managers" to also refer to residential strata body corporate managers as a major category of stakeholder that is likely to be responsible for not only carrying out such flushing advice but for having significant drinking water quality risk management plans for those premises. "Proactive testing of drinking water for metals is not generally required unless there are specific concerns (see below). Similarly, other than at building commissioning, building and asset managers do not need to test drinking water from their plumbing system without good reason." Firstly, stating that monitoring is not required is incompatible with good risk management advice. The ADWG has gone to the trouble of redrafting itself on this subject, highlighting this risk, and yet indicates that monitoring is not required. This will likely be interpreted by body corporate managers as an excuse to do nothing, no matter what is going on. Elsewhere in ADWG, monitoring is not required under circumstances when a risk has already been assessed and found to be (for example) minor, of no imminent concern, or not relevant to that system. The fact sheet will be significantly benefit from deleting those two sentences, such that the text "The water sampling methods described below will help to identify metals of concern in a plumbing system. They can also help to find the sources of those metals." … is immediately followed by: "A sampling program to test for metals should be initiated for any of the following reasons:" Secondly, this section does not provide advice on who is best placed to do such monitoring if it occurs. It could be the water supply authorities, if they wish to voluntarily venture downstream of the meter, or the building owners themselves. The ley issue is what does information sheet 4.1 say about how it will be implemented, in relation to the AS3500 series of standards, the Plumbing Code in Australia and the activities of the health, building and plumbing regulatory agencies in each jurisdiction. We therefore recommend that information sheet 4.1 be redrafted to refer more clearly to this aspect. Although the detail of these actions is beyond the scope of the current redraft, the fact that such actions are required is not.

#	Organisation	Public submission
		We recommend inserting a paragraph along the lines of: "Details of suitable risk management protocols to comprehensively deal with the issue of chemical leaching from plumbing products downstream of the property meter should be developed between each jurisdiction's health authority, water regulator, plumbing regulator, ABCB and other building regulators in a manner that is as consistent as possible across Australia."
4. Do you have any specific comments on the draft chemical fact sheet for Bismuth		
16	Department of Health Tasmania	Overall: Check grammar. Check references. General description: Suggest including a sentence about elemental bismuth and its natural occurrence. Health considerations: First three paragraphs: Include dose levels to provide context. Third paragraph: 'The toxicology database..' Do you mean the CLINICAL toxicology database? Fourth paragraph: Expand on this study a bit. It is an acute oral study with an identified NOAEL. Can also reference the other Leussink study here. Fifth paragraph: Are the forms of bismuth found in drinking water likely to be less bioavailable than the forms of bismuth used in medicinal preparations? Derivation of guideline value: For the identified study, include a bit more detail eg it is a carcinogenicity study.
17	MidCoast Council	MidCoast Council does not measure bismuth in any of its water supplies as would many other water supply authorities, since there are no guideline values currently set in the ADWG. However, the evidence evaluation sheet provided by the NHMRC consultation paper shows that it is very unlikely that exposure to bismuth could happen from source water. Considering the above, availability of treatment technologies for bismuth removal, and reliable methods to quantify bismuth in drinking water we are confident that our water supplies will be able to meet the above targets.
18	Water Corporation	The Water Corporation does not currently monitor for Bismuth in source or treated drinking water. The Corporation's current laboratory analysis service provider has a limit of reporting for Bismuth of 0.5µg/L, which is notably different to the limit of reporting ranges identified as 'standard' in the Bismuth fact sheet (0.001 and 0.01µ/L).
19	Department of Health Western Australia	Nothing under the headings of "Typical values in Australian drinking water" and "Treatment of drinking water" allude to the fact that the fact sheet was created to relate to bismuth being a component of copper alloys in plumbing systems downstream of the property meter. The lead fact sheet draws it out, so it is suggested that the bismuth one does so likewise. (The same issue applies to the selenium fact sheet).

#	Organisation	Public submission
5. Do you have any specific comments on the draft chemical fact sheet for Silicon?		
20	Department of Health Tasmania	Overall: Check grammar. Check references. General description: Include an introductory sentence clarifying the difference between silica, silicon and silicone. Include a sentence that silicon is thought to be essential. Second paragraph is taken word-for-word from UK EVM, so it needs referencing. Third paragraph: Multiple use of the word 'alloys' in the first sentence is a bit confusing. Typical values...: Suggest including the conversion factor to prevent individuals making calculation errors. Health considerations: 'There is limited evidence...' Do you mean 'There is LITTLE evidence..' '...in a dose of up to 4 mg/day...' Should this be '4 g/day'? Include a sentence along the lines of, 'The toxicological database for silicon is limited.' Derivation of guideline value: Query - how is the silicon dose derived from the silica NOAEL identified in the Takizawa study? The Takizawa paper does not calculate corresponding silicon doses. UK EVM derived 1165 mg/kg bw/day and EFSA derived 1170 mg/kw bw/day. Describe how silicon equivalent dose is calculated or use the dose of 1165 mg/kg bw/day and state 'based on silicon doses reported by EVM' Provide more detail on the identified study, eg a carcinogenicity study, NOAEL is also the highest dose tested. Third dot point: 'The tolerable daily intake is ..' This is not a TDI, it is safe upper level for supplements, derived by the EVM.
21	MidCoast Council	Mid Coast Council does not currently measure silica concentrations in drinking water or source water except for source water in one of its supply systems. According to the reference material provided for NHMRC submissions, the mean values for concentrations of silica in drinking water in Victoria, Northern Territory, and Western Australia range between 2.3- 90 mg/L. The above together with the limited source water data MidCoast Council currently holds, council will likely be able to achieve the proposed target. Most of the publications reviewed for this report did not identify any adverse effects from exposure to silicon in humans, rats, mice, and rabbits apart from occasional case reports of renal stones. However, this can change as a result of silicon leaching from lead-free plumbing material. It would be beneficial to evaluate the leachability data of lead-free plumbing products and their effects once these products are in use. There is also very limited information found on treatment options for silicon.
22	An individual	The proposed guideline value for silicon appears to be based on toxicology studies using silica. Given silicon does not usually exist in a pure state in the environment, the guidance should be clearer about how the proposed guideline value for silicon differs to the existing guideline value for silica.

#	Organisation	Public submission
23	Water Corporation	Silica is currently included in the ADWG with an aesthetic guideline of 80mg/L (37.4mg/L silicon equivalent). Given the methodology to determine silicon concentrations is a calculation, by converting silica (SiO2) to silicon, it may be appropriate to combine the silica and silicon factsheets unless the expectation is that silica and silicon is independently analysed and reported? Suggest silica be prioritised with the expectation that if silica levels are reaching the equivalent silicon health guideline, that a targeted sampling program for silicon should commence. Some regional areas of Western Australia report high levels of silica which reach/exceed the silica aesthetic guideline. However, the highest silica value ever recorded in the distribution system (equivalent to 47mg/L silicon) was well below the proposed silicon health guideline of 100mg/L.
24	Department of Health Western Australia	Please see below a number of comments: Firstly, the administrative report and new text imply, by omission more than anything else, that the current fact sheet for silica will remain as is and there will be a new fact sheet for silicon. If that is the case, then we recommend that the new silicon fact sheet link to the existing silica fact sheet and generate consequential edits in the silica fact sheet so that they cross reference each other. Having said that, consideration should be given for merging the two facts sheets (silicon and silica) into one, because: Most of the references to silicon in drinking water in the new fact sheet are in fact references to silica. The fact sheet expects that most data about silicon in drinking water would be derived from a measurement of silica and then converted over by calculation The NOAEL (1175 mg/kg bw/day) for silicon is clearly identified as being the NOAEL for silica in rats, so why is this not a fact sheet for silica, and why is the health-related guideline value for silicon not for silica? Please review the fact sheet and the assumptions underlying the calculation to see if it could be better cast as a fact sheet for silica (which would have a health-related guideline value of NNN mg/L and an aesthetic guideline value of 80 mg/L). If a separate fact sheet for silicon is desirable, then better cross linkages into the silica fact sheet are recommended.
25	Department of Health Western Australia	Secondly, the new fact sheet does not appear to contemplate silicon being in water other than as the silica species. The fact sheet appears to ignore that silicon is deliberately added to drinking water as a component of FSA (fluosilicic acid) used in almost all major Australian drinking water fluoridation programs. We recommend that information be provided to clarify, just like for chlorine, that silicon is a component of added FSA, the likely species of silicon in drinking water, and the differences between the health-related guideline value and the quantities typically deliberately added by water authorities, otherwise the fact sheet may be misused by anti-fluoridation activists to prove how “toxic” FSA is.
6. Do you have any specific comments on the draft chemical fact sheet update for Selenium?		

#	Organisation	Public submission
26	Department of Health Tasmania	Overall: Check grammar. Check references. Typical values: '...with exceedances recorded..' Exceedances of what? Treatment of drinking water: '..but only at low pH.' Can you specify, eg 'pH below 7'? Health considerations: Make a comment and reference the NHMRC NRVs. Third paragraph: There is a lot of information in this one sentence. Can it be expanded on it a bit more? eg give doses for context, may be omit reference to occupation exposure as this would be due to inhalation of dust, mention over-supplementation, clarify 'nutritional toxicity' Fourth paragraph: Lippman study, include that this was a HCT. Sixth paragraph: .'selenium compounds may be genotoxic at ..' Clarify whether this is in vitro or in vivo, or both. Derivation of guideline value: Provide more detail on the identified study, eg a large, long term HCT
27	MidCoast Council	Selenium results for samples collected at the point of supply for all MidCoast Council Water Supply Systems are below the laboratory's lowest detection limit. However, the laboratory's lowest detection limit changed from <0.002 mg/L to <0.007 mg/L in early 2020. Selenium concentrations <0.003 mg/L are achievable in all of MidCoast Council's water supply systems since selenium concentrations in Australia are <0.002 except for some parts of the Northern Territory according to the supporting information provided by NHMRC. The supporting information from NHMRC also states that selenium removal by coagulation with alum is less effective and the most effective means of selenium removal is by ferric chloride coagulation and lime softening. Aluminium chlorohydrate is used as a coagulating agent in all of MidCoast Council's water treatment plants. There was no discussion on the effectiveness of alternative inorganic and organic coagulants on the removal of selenium. However, we are confident that we will be able to achieve the guideline values.
28	Water Corporation	There are localities in regional Western Australia with a unique geochemistry and naturally have selenium in the source at or above the proposed guideline values. The reduced guideline level is a significant change given the health implications of exposure are relatively benign. A drinking water sample exceeded the lower proposed guideline limit of 0.004mg/L at two locations in regional WA in the last 4 years. One of those locations now has Electrodialysis Reversal (EDR) membrane technology which is highly effective in removing selenium from bore water sources. The Water Corporation's current laboratory analysis service provider has advised it is now able to achieve a minimum limit of reporting for selenium of 0.001mg/L (current LoR is 0.003mg/L). The fact sheet lists the limit of reporting ranges as 0.0001mg/L to 0.001mg/L.

#	Organisation	Public submission
29	Department of Health Western Australia	Looking at the table of changes proposed for ADWG (v3.5, 2018) for lead and selenium, viz: • Selenium health-related guideline value changes from 0.01 mg/L to 0.004 mg/L • Lead health-related guideline value changes from 0.01 mg/L to 0.0054 mg/L Thinking about how this reads to a lay person, it appears to imply that selenium in water is a greater health risk than lead, as the change drops it to 0.004 mg/L for selenium and for lead it only drops it 0.005 mg/L. That is, the new Guidelines appears to permit more lead in drinking water than that for selenium. And yet … lead is the parameter that is ultra toxic and lead management and lead toxicity is basically driving these changes to ADWG, both from NHMRC's point of view and that of the general public. Selenium does not appear to be that toxic nor does it have the public profile of lead, nor does selenium reduction appear to be driving the changes in composition plumbing products. The question may well be raised as to why selenium is being promoted as a lead replacement component of new plumbing products when you are positing a health-related guideline value for selenium lower than that of lead, the contaminant being replaced. Can you please review the numbers used in deriving the new value for selenium and ensure that if you publish guidance that makes selenium look like more of an issue than lead, that you add some significant contextualising information to the fact sheets understandable to the public explaining what is happening and assisting health agencies to explain to members of the public why the guideline value for selenium is stricter than that of lead. The lead fact sheet draws it out, so it is suggested that the selenium one does so likewise. (The same issue applies to the bismuth fact sheet). Finally, nothing under the headings of "Typical values in Australian drinking water" and "Treatment of drinking water" allude to the fact that the fact sheet was created to refer to selenium being a component of copper alloys in plumbing systems downstream of the property meter.
7. Do you have any specific comments on the draft chemical fact sheet update for Lead?		
30	Central Highlands Water	Only in relation to the timing of the proposed change to the health based guideline value for lead (to 0.005 mg/L) as outlined in previous section. It is suggested that any change to the lead guideline value is enacted AFTER low lead containing brass components are commonly available, and mandated for use, so that water utilities have a pragmatic pathway to respond to lead detects by replacing fittings/components that may be leaching lead.

#	Organisation	Public submission
31	Department of Health Tasmania	Overall: Check references. Use wording from this factsheet for plumbing products factsheet to maintain consistency. Typical values in: 'within premises'. Plumbing products factsheet uses 'in-premises' Second paragraph: '...due to exposure of the water..' Suggest re-wording to, 'due to CONTACT of the water..' Health considerations: Second paragraph: 'Infants, foetuses and pregnant women are ..' Suggest re-wording to ' young children, infants, and unborn babies...' Pregnant women are not susceptible, it is the baby that they are carrying that is susceptible. Also, NHMRC lead advice information uses the term 'unborn babies'. Derivation of guideline value: Second paragraph: same comment as above for 'unborn babies'.
32	MidCoast Council	As the supporting literature states there are numerous studies on lead leaching from plumbing materials and the health effects of lead. MidCoast Council appreciates and understands the importance of the new guidelines value in minimising public health risk.
33	Water Corporation	Lead has been recorded above the proposed reduced health guideline of 0.005mg/L in a drinking water sample from two regional areas of WA in the last 4 years. Electrodialysis Reversal (EDR) membrane technology has now been installed in one of those regions primarily for removal of nitrate, however this technology is effective in lead removal.
34	An individual	There are some major omissions in this fact sheet. Firstly, why is the USEPA's MCLG of zero not mentioned? Why is only the EU DWD included? Secondly, why is it not acknowledged that the recommended lead levels in guidelines are derived based on both pragmatism and health-based evidence? 5 and 10 µg/L are compromise guideline values. This should be openly stated. The health-based guideline value, if it were readily achievable, would be less, and lead has no known threshold, hence the USEPA MCLG of 'zero' µg/L. In the absence of the widespread use of lead services lines, Australia does not have the pragmatic justification for adopting a higher guideline value since 5 µg/L lead is rare in Australian water samples, so a lower value is readily achievable unless something is seriously abnormal. Hence acknowledgement of the non-threshhold nature of lead should be included, as should reference to the USEPA MCLG of non-detect should be included. There should be an expression of a goal of minimising lead and achieving below the limit of detection. Failure to include that implies selective use of evidence by the NHMRC.
35	Department of Health Western Australia	No, but please refer to relevant comments on the selenium fact sheet.
8. Do you have any specific comments on the draft chemical fact sheet update for Manganese?		

#	Organisation	Public submission
36	An individual	Could the specifics related to what form of Manganese the proposed guideline values relate to be included in the fact sheet. The various other international guideline values (e.g. WHO2021,2022; Health Canada 2019) as listed in the documents for Manganese refer commonly to total concentrations. The proposed fact sheet does not specify which form specifically, although it does indicate various measurement techniques for dissolved or total forms. This in itself requires additional advice, given the common notation to separate dissolved forms from particulate forms in drinking water treatment relate to passing samples through a 0.45um filter., and not just a change of measurement technique. It would make the fact sheet clearer in this regard if the required health guideline referenced the required form (total or dissolved) to avoid confusion and ensure the correct form is measured and reported for the proposed health guidelines
37	Department of Health Tasmania	General description: Is there one form of manganese that is more likely to be present in drinking water than other forms? Seventh paragraph: 'Manganese can be found NATURALLY in many foods...' Health considerations: Make a comment and reference the NHMRC NRVs. Fourth paragraph: Can this be clarified. Do you mean that infants are more susceptible because of the immaturity of the biliary excretion pathway for this age group? EFSA note that the data is inadequate to determine whether infants have similar homeostatic mechanisms as older age groups. '...are more susceptible to the ...' Do you mean, more susceptible than other age groups? Derivation of guideline: Aesthetic guideline: It is not completely clear what aesthetic guideline you want followed. Health-based guideline: Third dot point: an intake of 0.85 L/day is different to enHealth's recommendation, explain reasonings for adjusted intake. Review history: Provide more detail on why the guideline value has changed as otherwise it raises the question why you are going from an MTDI to a neurotoxic endpoint. eg '... review of the available evidence completed in 2024, that identified neurotoxicity as the critical health endpoint from a number of key international authoritative reviews.' Check references. References are no in alphabetical order.
38	MidCoast Council	Mid Coast Council operates five water supply systems. The manganese concentrations of source water used in three of these water supply systems are higher than the other water supply systems. However, we have invested in appropriate treatment processes for manganese removal and routinely monitor for manganese concentrations in source and treated water. MidCoast Council's data indicates that all our supplies will be able to achieve the proposed guidelines.

#	Organisation	Public submission
39	Water Corporation	The proposed guideline changes will require increased focus on optimising oxidation and filtration to achieve state-wide compliance, with some water treatment plants requiring additional management and investment to reduce manganese levels. Source management may ultimately impact supply as water sources could be turned off due to elevated manganese levels as water levels get closer to the sediment. There will be a significant operational impact on resources with the proposed reduced ADWG limits triggering enhanced monitoring processes more frequently.
40	An individual	This is great!
41	Department of Health Western Australia	The report could provide more explanation, and this could equally be clarified in the factsheet about why bottle-fed babies in Australia are more vulnerable as opposed to breastfed and bottle-fed babies with bottled water. Some of the assumptions made in relation to the numbers used for several of the determining factors, e.g., the proportion of intake from water, selection of body weight and daily water intake could be further justified in the report and factsheet. For instance, the chemical composition of a range of infant formulas on the Australian market indicate between 5.0 – 35.0 ug of manganese per 100 mL of the prepared formula. This would equate to 0.05 to 0.35 mg/L manganese solely from the dry formula, regardless of what was in the tap water. Therefore, it would be worth clarifying that the 0.5 proportionality factor remains valid in the Australian context. In relation to the body weight used and water intake value used for deriving the 0.1 mg/L guideline, the values are taken from enHealth 2012. Although a well-established information source, it would be worth clarifying that the values used in the report remain valid in Australia today as the data often comes from 2008 or earlier.

42	Queensland Water Directorate (qldwater)	Background qldwater understands that the National Health and Medical Research Council (NHMRC) is inviting feedback on guidance material developed for the Australian Drinking Water Guidelines (the Guidelines) on lead replacements in plumbing products, Lead and Manganese and the proposed consequential edits to the Australian Drinking Water Guidelines (ADWG). Feedback Form of Manganese – Total or Dissolved qldwater seeks further clarification on the form of Manganese that the health guidelines relate to. International Drinking Water Guidelines specify Total Manganese as the health target. The ADWG does not specifically state this. Under the Measurement of Manganese in the draft guideline update, two processes for measuring, one for total and one for dissolved are stated. This is consistent with the AWWA Standard Methods for Water and Wastewater. It does not however, specify the general acceptance in the Water industry that dissolved elements are typically determined by filtering samples thought a 0.45µm filter. Typically, results that are obtained by most utilities from external labs for Manganese are via Standard Water Analysis (SWA), and Heavy Metal Analysis, which is a measure of the Total Manganese. The SWA typically come back as <0.001 and are stated as dissolved Manganese. If the sample is chlorinated, any dissolved Manganese in the water will oxidise to particulate and be removed from the analysis, which may be important as this will occur during transport to labs. Heavy Metal analysis will digest the sample and extract all Manganese for analysis – that is, Total Manganese. As such, qldwater seeks urgent clarification if the guideline is referring to Total Manganese as per most international guidelines. Treatment for Manganese Currently, some Queensland urban water providers note that their source waters have naturally occurring Manganese at varying concentrations. Some have continual challenges; others are seasonal depending on whether derived from ground water or surface water sources, and source turnover (for example, stratification effects). With the current guidelines the limits can be achieved through various treatment processes and/or blending of water sources. However, to meet the new guidelines will initially require limiting the use of some water sources on a general basis, but if these limited use sources are required to be used due to alternative sources not be available at certain times (due to water security and supply challenges), the guideline values are unlikely to be consistently met. Naturally occurring seasonal changes will also cause spikes, again making the guidelines limits challenging. Furthermore, any Manganese that is not removed via the treatment processes (mainly dissolved and colloidal MnO2 forms) will be oxidised by the chlorine added during final disinfection. This will typically precipitate the Manganese on the network pipework floor or other infrastructure. Water sampled and analysed after chlorine dosing will typically return low levels as the majority will not specifically be in the water sample – it will be contained in the sludge and or slime in the reservoir or pipework. Any Manganese that is not precipitated may also be scavenged by the microorganisms to create the pipework brown slimes on the pipework that we are all aware of, even though sample may show low levels in the water sample. Excess Manganese may show up as a discolouration in the water (brown tinge) which leads to customer complaints and public concern.

#	Organisation	Public submission
		It is qldwater's concern that the new guidelines will make some source waters across Queensland unusable, at a time where there are increasing challenges to water security. This comes at a time when water service providers do not have the resources to access or develop alternative sources. In Queensland, most water services providers are local councils. A report released by the Queensland Audit Office (29 January 2024) notes that 48 of the state's 77 councils are financially unsustainable, up from 45 in 2021. Legacy Manganese Any precipitated Manganese after treatment (mainly by oxidation by chlorination typically) and distributed to the network will either remain as sludge/sediment, be scavenged by Manganese microorganisms and held within the slimes. The sediment may be stirred up due to hydraulic changes (for example, main breaks, fire hydrant tests or use). This will spike the distribution of Manganese resulting in water discolouration and other water quality impacts. During these times, it is likely that the level will be higher than the proposed guidelines as total. However, it will be difficult to determine during these events, and following flushing the sediment formations will generally be flushed out of the immediate area. The slimes caused by micrograms do not cause significant issue in our drinking water networks. Local network service providers do not have the resources (funding or access to contractors in remote and regional areas) to scour their networks and clean water reservoir floors annually, noting that this would significantly improve the issue (but not totally prevent it). Noting that the main issue is the slime will scavenge Manganese over time. A change in water quality conditions in the network can (and does) cause the slime microorganisms to re-release the Manganese back into the water column as a dissolved form, which begins to reoxidise to colloidal MnO2 with the residual chlorine. This results in network-wide dirty water complaints, and flushing does not specifically or easily remove it. Flushing may increase the issues due to sediment forms to be introduced at the same time. We also note that the changes to network chemistry can be triggered by several factors, including, a change in water source that has different chemistry including pH, changes to oxidation-reduction potential (due to chlorine corrections in the network) and temperature changes. An example of this is if a reservoir (which are typically smaller steel reservoirs in regional supplies) is scoured or emptied for maintenance in warmer season, and fresh water used to refill and distribute to the network, this can cause a temperature shift that can disrupt the slime chemistry. This is a particular concern across Queensland given our climatic factors and water storage mechanisms (the number of reservoirs is higher in Queensland than other states). Queensland water service providers will also need to amend their Drinking Water Quality Management Plans (DWQMP) which is a reference document on what defines safe, good quality water, how it can be achieved and how it can be assured. This will require further resourcing. For Drinking water services are regulated in Queensland under the Water Supply (Safety and Reliability) Act 2008 and the Public Health Act 2005. All registered drinking water service providers must have an approved DWQMP relevant to their current drinking water service(s) that document how they manage the safety of drinking water supplied to their customers. While qldwater does not dispute the need for improving the ADWG Guidelines for the benefit of our communities, the new limits will require significant changes to water treatment processes and infrastructure upgrades long-term. Short-term some providers may be required to disconnect certain water sources, potentially resulting in intermittent water supply incidents We are also aware that the changes to the ADWG have not been well communicated across the smaller and remote water services providers – with the NHMRC consultation to date focusing on the larger utilities (mostly outside Queensland). qldwater can assist the NHMRC to communicate the changes and also facilitate communication events (such as webinars).

#	Organisation	Public submission
9. Do you have any specific comments on the proposed consequential edits to the Australian Drinking Water Guidelines?		
43	WIM Alliance – Whitsunday, Isaac and Mackay Regional Councils	A key point made by the WIM Alliance was the need for both State and Federal government funding to support the Water Supply Scheme upgrades if changes to the ADWG where to occur. Additionally, a grace period by drinking water supply state regulators will be required to allow time for Councils to obtain funds and make the required infrastructure changes to meet the new health limits under the ADWG.
44	Department of Health Western Australia	The only comment is in relation to the silica fact sheet – it should be cross linked to the new silicon fact sheet (see comments thereunder for more detail).

Appendix F – Declarations of interest

The declarations of interest of Committee and Working Group members at the time of their involvement in the development of the guidance are listed in the tables below.

Consideration of the declarations of interests of members of the Water Quality Advisory Committee during the period 2018-2021 were undertaken according to NHMRC committee policy at the time.

2018-2021 Water Quality Advisory Committee

Professor Frederic Leusch (Chair)

Position: School of Environment and Science, Griffith University

Area of expertise: Environmental Toxicology; Chemical pollutants in the environment; Endocrine disruption; Bioanalytical tools in water quality assessment; Chemical risk assessment and guideline development.

Declaration of interest:

- Deputy Head (Research), School of Environment and Science
- Associate Editor (Toxicology) for Environmental Science and Technology (2020-present)
- Associate Editor (environmental toxicology) for Chemosphere 2014 – 2018
- Appointments: Health and Environmental Sciences Institute –Animal Alternatives for EDC Testing Workgroup 2014 – present; Project Review Team – Water Research Australia 2012 – present; Board Member – SETAC 2015 – present.
- Member of: Australasian College of Toxicology and Risk Assessment; International Water Association; Society of Environmental Toxicology and Chemistry.
- Conference organisation: Chair – SETAC Australasia Conference 2012; Co-Chair: Micro Pool & Ecohazard 2011; Organising Committee: EmCon & WiOW 2016 – Emerging Contaminants and Micropollutants in the Environment; SETAC AP 2014; SETAC Australasia 2013; Discussion Leader – Disinfection By-Products Gordon Research Conference 2015.
- Committees: Chair of Steering Committee – Bioanalytical Risk Assessment Validation and Experimentation – Australian Water Recycling of Excellence 2015 – present; NHMRC's Fluoride Reference Group 2014 – 2017; European Commission Seventh Framework Programme – Demonstration of Promising Technologies to Address Emerging Pollutants in Water and Waste Water 2014 – 2015; Water Research Foundation – Screening Endocrine Activity of Disinfection By-Products 2010 – 2014.
- Involved in the Commonwealth Games Independent Expert Panel.
- Has provided expert advice to Californian and Australian water utilities on recycled water quality and micropollutants of emerging concern.
- Published numerous research papers, conference publications, reports and book chapters.
- Presentations at international and national conferences, seminars and workshops.
- ARC Linkage grants include many water utilities in Australia (including Water Quality Research Australia).

Ms Miranda Cumpston

Position: Monash University and University of Newcastle

Area of expertise: Evidence-based public health and systematic review.

Declaration of interest:

- As part of previous role with the Australian Clinical Trials Alliance undertook activities in collaboration with NHMRC and other partners, including public advocacy in relation to the conduct and funding of clinical trials in Australia.
- Editor at Cochrane Public Health, University of Newcastle, which receives infrastructure funding from NHMRC.
- Editor of *Cochrane Handbook for Systematic Reviews of Interventions* and author of other publications that advocate for the use of systematic reviews in policy.
- Received Australian Government Research Training Program (RTP) Scholarship to undertake a PhD in evidence synthesis methods at the Research Methodology Division, School of Public Health and Preventive Medicine, Monash University.
- Employed by NHMRC between April and June 2018, contributing to the development of the NHMRC *Guidelines for Guidelines*.
- Publications of numerous journal articles.
- Guest lectures on evidence synthesis and clinical practice guideline development to Melbourne School of Professional and Continuing Education, University of Melbourne (various courses) in 2018 and 2019.

Dr David Cunliffe

Position: South Australian Department for Health and Wellbeing

Area of expertise: Water regulator, microbiology, risk assessment

Declaration of interest:

- Principal water quality specialist with the SA Department for Health and Wellbeing. A regulator with over 35 years of experience dealing with public health aspects of drinking water, recycled water and recreational water.
- Contributed to a range of national and international guidelines on drinking water quality, safe use of recycled water and recreational water quality.
- Member of the NHMRC/ARMCANZ Drinking Water Review Coordinating Committee formed in 1998; later a member and then chair of the Water Quality Advisory Committee until the end of 2015. Chair of the working group that developed the Framework for Management of Drinking Water Quality. Member of the Joint Steering Committee for the development of the Australian Guidelines for Water Recycling and chair of the Health Risk and Drinking Water Augmentation working groups.
- Member of WHO Water Quality Committees since 2001 and current chair of the WHO Drinking-Water Coordinating Committee. Attendance of meetings and associated expert working groups (e.g toxic cyanobacteria). Attendance at meetings on recreational use of water. Contributed to the 2nd, 3rd and 4th editions of the Guidelines for Drinking Water Quality and the Guidelines for Safe Use of Wastewater, Excreta and Greywater. Lead editor and scientific adviser for WHO texts on “Potable Reuse”, “Water Safety in Buildings” and “Water Safety in Distribution Systems”. Contributed to WHO texts on “Developing Drinking-water Quality Regulations and Standards” and “Legionella and the Prevention of Legionellosis”.
- Member of international expert panels on drinking water quality in Singapore and Hong Kong.
- Published on drinking water quality, recycled water, desalination, and rainwater quality.

Mr Cameron Dalgleish

Position: Tasmanian Department of Health

Area of expertise: Environmental science, water quality and risk management, auditing, public health

Declaration of interest:

- Health regulator for drinking water safety in Tasmania; administering legislation, policy and guidelines. Cover both drinking water quality and fluoridation with a working understanding of the implementation of the ADWG framework.
- An environmental scientist specialising in water chemistry with 20 years' experience in the water industry. Previously worked across construction, natural resource conservation, environmental management and as a health regulator.
- Member of the enHealth Water Quality Expert Reference Panel and the National Recycled Water Regulators Forum.
- Secretariat of the Tasmanian Fluoridation Committee.
- Publication of journal articles, reports, fact sheets, guidelines and presentations at national conferences, seminars and workshops.
- Public Servant: State Water Officer, Department of Health Tasmania. Areas of expertise: environmental science, water quality and chemistry, risk management, auditing, public health.

Dr Dan Deere

Position: Independent Consultant Director Water Futures; Visiting Fellow,Water Futures, The University of New South Wales

Area of expertise: Water Quality and Risk Management, water and recycled water auditing

Declaration of interest:

- Consultant – Water Futures Visiting Fellow – UNSW
- Current projects for: University of Technology Institute for Sustainable Futures 2019 – present; Monash Medical School (DHHS): 2019 – present; University of Bristol, Kathmandu University and Haramaya University (funded by UK Aid): 2020-present; University of Adelaide, (for Seqwater): 2019 – present; University of Adelaide and Australis Consulting (for Central Coast Council): 2019 – present; University of New South Wales, Monash University and Natural Logic (for Water Research Australia): 2019 – present; New Zealand Ministry of Health and Department of Internal Affairs: 2019 – present; Hastings District Council and New Zealand Ministry District Health Board: 2017 – present; Hong Kong Water Supplies Department: 2017 – present; NT Government (Power Water with Department of Local Government, Housing and Community and Department of Health): 2018 – present; NSW Health: 2019 – present; Department of Health and Human Services, EPA and Department of Environment, Land, Water and Planning: 2019 – present; Department of Health and Human Services, EPA and Department of Environment, Land, Water and Planning: 2019 – present; University of Queensland: 2009 – present.
- Current major unfunded projects/activities: World Health Organization Guidelines for Safe Recreational Water Environments Working Group; National Health and Medical Research Council Guidelines for Managing Risks in Recreational Water, Water Quality Advisory Committee; COVID-19 technical support for multiple agencies in Australia and internationally on an as needs basis relating to general microbiology and WASH aspects. This to date has been in the US, UK, China, HK, Australia and NZ.

- Additional minor funded activities past and present include peer reviews, training, workshop facilitation, regulatory audits of water suppliers for health departments, contributions to research projects and specific technical assessments and validation, with the work mostly related to microbial pathogens.
- Occasionally undertakes work for members of the Australian Water Industry as a consultant. This includes Health Departments, Water Agencies and Water Utilities and related to water quality risk assessment and management and other aspects of water quality science. This also involves Water Research Australia: Drinking water catchment source assessment tool; Hong Kong Development Bureau and Department of Health: assessment of risks from using seawater for non-potable uses; NSW Health: support for councils to implement the ADWG Framework; Power Water (Northern Territory): Catchment source water assessments to identify pollution sources; Vic DHHS: Drinking water supply risk management plan regulatory audits for water utilities (funded by the utility but undertaken for DHHS); SA Health/SA Water: Drinking water supply risk management plan regulatory audit for SA Water; Queensland Health: Advising Qld councils on implementing Health-based Targets; NSW EPA and Sydney Water: QMRA relating to biosolids application as part of guideline revision; Vic EPA: QMRA relating to recreational water guidelines; NSW IPART: Drinking water supply risk management plan regulatory audits for water utilities (funded by the utility or IPART but undertaken for IPART); WHO: Western Pacific Regional Office Water Safety Plan Training of Trainers Program for AusAID (DFAT) and UK AID.
- Occasionally provides expert witness statements in court for the interpretation of the Australian Drinking Water Guidelines or Guidelines for Managing Risks in Recreational Water in relation to water quality protection.
- Member of Seqwater Water Security Program - Independent Review Panel, NSW Health Cryptosporidium and Giardia Expert Panel, the Australian Water Association, the International Water Association and Water Research Australia.
- Publications include numerous journals and technical reports and presented at international and national conferences, seminars, webinars and workshops. Focus is on providing practical guidance founded in objective, best available evidence for water quality management.

Professor Cynthia Joll

Position: Professor, Curtin Water Quality Research Centre, Curtin University

Area of expertise: Analytical chemist with a focus on disinfection by-products, both in terms of formation, detection and analysis of the chemicals

Declaration of interest:

- 2006 – 2018, Deputy Director, Curtin Water Quality Research Centre, Curtin University. 2019 – Present, Professor within the Curtin Water Quality Research Group, Curtin University. The Curtin Water Quality Research Centre is a Strategic Research Alliance with the Water Corporation of WA. Curtin University is also a research member of Water Research Australia.
- Chief Investigator on a current ARC Linkage project on nitrogen compounds in wastewater treatment. Chief Investigator on past ARC Linkage projects on disinfection by-products in drinking water systems with partner organisations Water Corporation of WA and Water Research Australia. Future applications to ARC for research support.
- Publications of numerous journal articles, book chapters and reports.

Professor Stuart Khan

Position: Water Research Centre, The University of New South Wales; Fellow, Australian Academy of Technological Sciences and Engineering (FTSE)

Area of expertise: Trace Chemical Contaminants in Water; Risk Assessment and Risk Management; Environmental Engineer

Declaration of interest:

- Lectures at the University of New South Wales on topics closely related to the activities of the Water Quality Advisory Committee and the Recreational Water Quality Advisory Committee including water and wastewater quality and analysis.
- Works closely with many Australian and international water industry participants including water utilities, health regulators, environment regulators and private consultants.
- Committee/Advisory member of: Sydney Independent Metropolitan Water Advisory Panel; WHO – Water Quality and Technical Advisory Group 2015 – present; Water Quality Research Australia – Project Quality Review Team 2012 – present; U.S. WateReuse – Technical Advisory Committee 2015 – 2017; Gold Coast Commonwealth Games Independent Expert Panel – Water Quality and Monitoring Programme 2016 – present; the National Water Grid Advisory Body 2020 – present (The Advisory Body provides independent expert advice to the Australian Government via the Deputy Prime Minister on specific water infrastructure policy, projects and investment priorities).
- Member of: Australian Water Association; International Water Association; Engineers Australia.
- Honorary (unpaid) role as an adviser to the Parramatta River Catchment Group.
- Past Committee/Advisory member of: U.S. WateReuse Foundation – Project Advisory Committee 2010 – 2014; Australian Water Recycling Centre of Excellence – Project Advisory Committee 2011 – 2014; CSIRO and NSW Environmental Trust – Project Advisory Committee 2010 – 2013; South East Queensland Urban Water Security Research Alliance – Project Advisory Committee – Purified Recycled Water Project 2008 – 2012.
- Consultant: undertook work for members of the Australian Water Industry in relation to water quality.
- Provided expert opinion to Water Research Australia on PFAS chemicals. This includes contribution to a current water industry fact-sheet on these chemicals and their relevance to the water industry. In the past, made comments to the media regarding the safety and risks associated with PFAS in drinking water.
- Journal Editorships: Associate Editor – Environmental Science – Water Research and Technology; Journal of Water Supply – Research Technology.
- Participation in national and international academic and industry conferences.
- Publication of numerous journal articles, reports and book chapters; also presentations at international and national conferences, seminars and workshops.
- Recipient of research grants from government and non-government agencies – including Australian Research Council and Water Research Australia. Applications for NHMRC funding are much less frequent, but not excluded.

Associate Professor Susan Petterson

Position: Associate Professor, School of Medicine, Griffith University; Director, Water & Health Pty Ltd; Editor, Journal of Water and Health

Area of expertise: Quantitative Microbial Risk Assessment Specialist and risk assessment software development

Declaration of interest:

- Associate Professor at School of Medicine, Griffith University.
- Director of Water & Health Pty Ltd
- Editor: Journal of Health and Water (IWA Publishing)
- Consultant to: Viega Plumbing on opportunistic pathogens; the City of Edmonton, Canada – on recreational water; expert testimony for AGL Macquarie on opportunistic pathogens; NSW Health – in drinking water QMRA; Queensland Urban Utilities – applying QMRA to assess overflow impacts on recreational sites.
- Advisor for WHO Water Sanitation Hygiene and Health on risk assessment and microbial aspects in water.
- Member of the independent peer review panel (human health) for Sydney Water.
- Member of Sydney Independent Metropolitan Water Advisory Panel
- Peer Review of QMRA undertaken for recreational water quality at Hunter Beaches for Hunter Water.
- Current projects for: Global Water Pathogens Project; Public Health Agency of Sweden 2012 – present; Sydney Water Corporation 2012 – present; NSW Health 2012 – present; WHO 2009 – present.
- Past projects for: Government of Alberta, Canada 2013 – 2014; INTARES EU 2011 – 2014; Water Research Australia 2011 – 2013; Swedish Water and Wastewater Association – Stockholm Water Ltd 2011.
- Publications on numerous journals and reports; also presentations at international and national conferences, seminars and workshops.
- IWES course presentation.

Professor Craig Simmons

Position: Fellow, Australian Academy of Technological Sciences and Engineering (FTSE); Executive Director for Maths, Chemistry, Physics and Earth Sciences at the Australian Research Council (secondment); National Centre for Groundwater Research and Training, School of the Environment, Flinders University; Adjunct Professor, The University of Western Australia

Area of expertise: Groundwater Hydrology, Hydrological, Environmental, Earth and Applied Engineering Sciences

Declaration of interest:

- Foundation Director at the National Centre for Groundwater Research and Training
- Executive Director at the Australian Research Council
- Matthew Flinders Distinguished Professor of Hydrogeology and Schultz Chair of the Environment – Flinders University; Fellow of the Australian Academy of Technological Sciences & Engineering; Adjunct Professor – The University of Western Australia.
- Committee member of: Alternate Deputy Chair Statutory Independent Scientific Committee (IESC) on Coal Seam Gas and Large Coal Mining Development; Chair – IESC Research Subcommittee; Deputy Chair of the ATSE's Water Forum; Chair – Roundtable for Oil and Gas Projects in South Australia; Chair, Alligator Rivers Region Technical Committee; Member – Research Advisory Committee, Goyder Institute for Water Research South Australia; Member –

Engineering and Medicine Roundtable on Unconventional Hydrocarbon Development, US National Academies of Sciences; Member – Agency reference Group, Office of Groundwater Impact Assessment, QLD; Member – Steering Committee, SA NRM research and Innovation Network.
- Member of: Australian Institute of Company Directors; National Groundwater Association of the U.S.A; International Association of Hydrogeologists; American Geophysical Union; Geological Society of America; Hydrological Society of South Australia.
- Editorial boards: Australian Journal of Water Resources; International Journal of Water Conservation Science and Engineering; International Journal of Environmental Modeling and Assessment; Groundwater; Journal of Hydrology; Vadose Zone Journal.
- Publications of numerous journal articles, book chapters and reports; presentations at international and national conferences, seminars and workshops.
- Honorary Professor Australian National University.

Ms Carolyn Stanford (Consumer Representative)

Position: Stanford Marketing

Area of expertise: Marketing and Communication

Declaration of interest:

- Consultancy fees to Stanford Marketing from Goulburn-Murray Rural WaterCorp for marketing and communication services.
- Development of Goulburn – Murray Water publications.
- Development of various guidelines, standards, educational material or fact sheets for Coliban Water 1999 – 2005.

Dr Katrina Wall

Position: Water Unit Health Protection NSW Health

Area of expertise: Health Regulation, water quality risk management and environmental microbiologist

Declaration of interest:

- Employed by NSW Health as Senior Project Officer in the Drinking Water Risk Management Water Unit, Environmental Health Branch since 2008. Provide water quality advice, policy and regulation for NSW.
- Represented NSW on the enHealth Water Quality Expert Reference Panel 2016-2018, providing advice and national guidance on water quality and public health.
- Represents NSW Health on the NSW Carp Advisory Group, 2017-current, provides advice and NSW policy position to the National Carp Control Program.
- NSW sewage surveillance for SARS-CoV-2 steering committee member.
- Corporate member of the International Water Association and WaterRA including participation in project advisory committees, and personal member of the Australian Water Association.
- Member of the Project Advisory Committee to Water Research Australia project 1109 Health Based Targets guidance.
- Published journal articles conference proceedings and reports, presented at international and national conferences, seminars and workshops.

- Development of various guidelines, factsheets and educational materials on water quality.
- PhD supported by AWWARF project 2618 Water quality improvements during ASR as part of the Bolivar ASR Project.

Dr Nick Fletcher (Observer)

Position: Food Standards Australia New Zealand

Area of expertise: Toxicology and risk assessment

Declaration of interest:

- Member of: Joint FAO/WHO Expert Committee on Food Additives (JECFA) advisory panel; New Zealand Environmental Protection Agency Hazardous Substances and New Organisms Committee.
- Manager Risk Assessment Chemical Safety and Nutrition, Food Standards Australia New Zealand.
- Senior Associate (Toxicology) Coffey Environments 2012-2013.

Ms Amy Lea (Observer)

Position: Department of Agriculture, Water and the Environment

Area of expertise: National Water Policy and Reform

Declaration of interest:

- Australian Government national water quality policy.

Mr Adam Lovell (Observer)

Position: Water Services Association of Australia (WSAA)

Area of expertise: Peak industry body representing the urban water industry

Declaration of interest:

- Water Services Association of Australia (WSAA) – Executive Director.
- Global Water Research Coalition (GWRC) – Board Chair. The GWRC is a non-profit organisation that serves as a focal point for the global collaboration for research planning and execution on water and wastewater related issues.

Mr Marcus Walters (Observer until 2020)

Position: Department of Agriculture, Water and the Environment

Area of expertise: National Water Policy and Reform

Declaration of interest: No interests declared

2022-2025 Water Quality Advisory Committee (declared interests as of May 2025)

Professor Nicholas J. Ashbolt (Chair)

Position: Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Food and Environments, University of South Australia

Disclosed Interests:

- Executive Dean, Faculty of Science and Environment, Southern Cross University (2019-2023).
- WHO Technical Advisory Group on Water Quality and Health (since 2015-current), for input into drinking, recreational and reuse guidance documents and microbial pathogen performance of on-site drinking water treatment devices.
- Water Research Foundation (WRF) Academic Advisory Committee (2016-2019) and Project Advisor Committee (PAC, 2019-2022) for WRF 5040, Successful Implementation of Decentralized Reuse and Treatment Systems.
- National Water Research Institute (NWRI) expert panel member (2015-2021) on various non-potable water risk management and regulation projects.
- Editor in Chief voluntary role as part of his professional contributions as a Fellow of the International Water Association.
- Led water microbiology research into premise plumbing pathogens (e.g. Legionella pneumophila, Pseudomonas aeruginosa, non-tuberculous mycobacteria) and the role of free-living amoeba hosts that also supported viable human enteric viruses through treatment processes and environmental dissemination.
- Numerous national and international research grants and collaborations.
- Has consulted on wastewater reuse.
- Royalties from patents managed by Macquarie University, Australia.
- Partner works for company Water^3.
- Senior editor for HealthStream, a quarterly newsletter from Water Research Australia (WaterRA) that summarizes international literature relevant to the drinking water industry and notes recent outbreaks or investigations.
- Travel, accommodation and workshop paid by SUEZ CIRSEE (Paris) for role as a mentor for their Health and Environment postgraduate conference, Cannes, France June 26-28, 2023 and technical advisory team with four other invited senior academics across England, France and Australia.

Dr David Cunliffe

Position: Principal Water Quality Adviser, Health Regulation and Protection, SA Health

Disclosed Interests:

- Provide specialist advice and policy on public health aspects of water quality including management and provision of drinking water, management and use of recycled water and use of recreational waters.
- Contribution to WHO Drinking Water Guidelines leading to publication of background documents (e.g on toxic cyanobacteria in 2021), specialist texts and two addenda to the 4th edition of the guidelines.
- Occasional invitations to provide keynote presentations at international meetings.
- Published a number of scientific research journal articles.

- Contributed to: WHO (2021) Water, sanitation, hygiene, and waste management for SARS-CoV-2, the virus that causes COVID-19, NRMMC/EPHC/NHMRC (2008) Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2). Augmentation of Drinking Water Supplies, enHealth Guidance on the Use of Rainwater Tanks and Numerous fact sheets and guidance documents for the SA Department for Health and Wellbeing on drinking water and recreational waters.
- Membership of the program committees including for the Singapore International Water Week and Australian Water Association Annual Conference OzWater.
- Membership of the International Water Association and Australian Water Association.
- Membership of the Hong Kong Drinking Water Safety Advisory Committee from 2018.
- Membership of Guideline Development Group WHO Guidelines on Recreational Water Quality Volume 1 Coastal and Fresh Water (1998-2021)
- Chair of the enHealth Water Quality Expert Reference Panel since 2017.
- Chair of the External Audit Panel Singapore Public Utilities Board since 2020.
- Chair of the WHO Drinking Water Guideline Coordinating Committee.

Mr Cameron Dalgleish

Position: State Water Officer, Tasmanian Department of Health

Disclosed Interests:

- Health regulator for drinking water safety in Tasmania; administering legislation, policy and guidelines for both drinking water quality and fluoridation. A working understanding of the implementation of the ADWG framework.
- An environmental scientist specialising in water chemistry with over 20 years' experience in the water industry. Previously worked across construction, natural resource conservation, environmental management and as a health regulator.
- Appointments: Member of the enHealth Water Quality Expert Reference Panel, the National Recycled Water Regulators Forum and the Australian Water Association. Secretariat of the Tasmanian Fluoridation Committee.
- Department of Health Tasmania Member Representative to Water Research Australia.
- Has published journal articles, reports, fact sheets, guidelines and presentations at national conferences, seminars and workshops.
- Public Servant: State Water Officer, Department of Health Tasmania.
- Project contributor for the development of Operator Competencies in the water industry and development of a WaterVal granular media filter validation protocol, both coordinated by Water Research Australia.
- Areas of expertise: Environmental science, water quality and chemistry, risk management, auditing, public health.
- Holds stock market investments, and partner is a joint investor in managed fund investments. Neither have influence in the selection of shares purchased on their behalf.

Professor Cynthia Joll

Position: Discipline Lead of Chemistry, Curtin University

Disclosed Interests:

- Previously Deputy Director, Curtin Water Quality Research Centre, Curtin University. The Curtin Water Quality Research Centre was a Strategic Research Alliance with the Water Corporation of WA. Member representative for Curtin University to Water Research Australia. Currently, Professor and Leader of the Curtin Water Quality Research Group.
- Chief Investigator on past ARC Linkage projects on disinfection by-products in drinking water systems, and other drinking water and wastewater projects, with partner organisations Water Corporation of WA and Water Research Australia.
- Current, past and future projects funded by water utilities on wastewater treatment, water recycling, and drinking water treatment and distribution, including formation of disinfection by-products and analysis of their concentrations in drinking water distribution systems.
- Published numerous research papers, conference publications, reports, books and book chapters on wastewater treatment, water recycling, source water quality and drinking water treatment and distribution, including disinfection by-products.
- Participation in national and international academic and industry conferences.
- Current, past and future projects funded by industry partners, government (e.g. NESP) and CSIRO on PFAS in drinking waters, wastewaters, water recycling and manufactured and waste products (e.g. for recycling purposes).
- Lectures at Curtin University on environmental chemistry, water chemistry and analytical chemistry.
- Travel support to attend research meetings of Water Research Australia where topics such as drinking water treatment and disinfection by-products have been discussed.
- Current, past and future projects funded by the water industry relating to corrosion and metal concentrations in drinking water distribution systems.

Professor Frederic Leusch (Member from September 2023)

Position: School of Environment and Science, Griffith University

Disclosed Interests:

- Several consultancies funded by water industry, specifically on contaminants of emerging concern.
- ARC Linkage grants include many water utilities in Australia (including Water Research Australia).
- Previous member of the Project Review Team for Water Research Australia, which reviews research projects submitted for Water RA funding and provide advice on suitability to Water RA's research agenda.
- Received travel support from Water Research Australia to present on research supported by Water RA at their annual research conference.
- Teaches on water quality issues at Griffith University and has given lectures at various institutions on water quality issues and various drinking water guidelines.
- Previously involved on the Commonwealth Games Independent Expert Panel on water quality, providing advice on water quality and monitoring programme for the 2018 Commonwealth Games.
- Many publications on water quality, all published in peer-reviewed journals.
- Independent Advisory Panel Member in the Faure New Water Scheme, Cape Town, South Africa.

- Member of the Advisory Committee on the Environmental Management of Industrial Chemicals (IChEMS Advisory Committee) July 2024 – current.

Mr Peter Rogers

Position: Water and public health expert

Disclosed Interests:

- Former Principal Policy Development Officer – Water and Wastewater Portfolio, Northern Territory Department of Health.

Ms Nicola Slavin (Member from October 2022)

Position: Principal Policy Officer, Northern Territory Department of Health

Disclosed Interests:

- Northern Territory representative on enHealth Water Quality Expert Reference Panel and the National Recycled Water Regulators Subgroup.
- Northern Territory representative on enHealth Expert Reference Panel on Aboriginal and Torres Strait Islander Environmental Health.

Dr Bala Vigneswaran

Position: Water and public health expert, Department of Climate Change Energy the Environment and Water

Disclosed Interests:

- Previously served in New South Wales regional councils for over five years in positions concerning water resources, water treatment processes and system compliance.

Associate Professor Harriet Whiley

Position: Associate Professor in Environmental Health, Flinders University

Disclosed Interests:

- Holds an indirect, non-pecuniary interest through my role as SA Branch Committee Member for the Australian Water Association (2021-2022).
- Holds an indirect financial interest through my ongoing research collaborations with Enware, a manufacturer and distributer of commercial and industrial plumbing products.
- Flinders University representative for Water Research Australia.
- Numerous past, present and current research projects on water quality which have received both grant and industry funding. This includes research on biofilms, opportunistic pathogens, rainwater, plumbing materials and risk management approaches.
- Has published in academic journals and industry magazines on topics such as lead and water quality risks.
- Has presented at academic and industry conferences and workshops.
- Holds an indirect, non-pecuniary interest through her role on the Legionella Management Advisory Group.
- Deputy Director of the ARC ITTC for Biofilm Research & Innovation.

Ms Yulia Cuthbertson (Observer from December 2023)

Position: Department of Climate Change, Energy, the Environment and Water

Disclosed Interests:

- Represents interests of the Department of Climate Change, Energy, the Environment and Water and the Water Quality team from the National Strategies and Assessments section of the Water Policy Division in particular.

Dr Nobheetha Jayasekara (Observer from May 2023)

Position: Australian Industrial Chemicals Introduction Scheme

Disclosed Interests: No interests declared.

Mr Laurence Wilson (Observer)

Position: National Indigenous Australians Agency

Disclosed Interests: No interests declared.

Dr Kerry Nugent (Observer until December 2022)

Position: Australian Industrial Chemicals, Introduction Scheme

Disclosed Interests:

- Member of Government standard setting committee

Mr Adam Lovell (Observer until December 2023)

Position: Water Services Association of Australia (WSAA)

Disclosed Interests:

- Water Services Association of Australia (WSAA) - Executive Director
- Peak industry body representing the urban water industry
- Global Water Research Coalition (GWRC) – Board Chair
- The GWRC is a non-profit organisation that serves as a focal point for the global collaboration for research planning and execution on water and wastewater related issues.

Dr Sonia Colville (Observer until December 2023)

Position: Department of Climate Change, Energy, the Environment and Water

Disclosed Interests: No interests declared.