**Explanatory Paper on Draft Revisions to Public Health Components of the Australian Guidelines for Water Recycling: Managing Health and Environmental Health Risks (Phase 1)**

1. **SCOPE OF CHANGES**

The revision is restricted to updating components relating to human health risks based on data and information published since the Phase 1 document was finalised in 2006. This includes a range of Australian data produced to support application of the guidelines.

The primary changes are to Chapter 3 (Managing Health Risks in Recycled Water), Chapter 5 (Monitoring) and Appendix 2 (Calculating Microbial Targets) with limited changes to Chapters 1 (Introduction) and 2 (Management Framework) and Appendix 3 (Preventive Measures). The environmental risk components (e.g. Chapter 4 Managing Environmental Risks) have not been reviewed. The principles and the basic structure of the Guidelines are strongly supported and have not been changed.

Chapter 4 and 6 (Consultation and Communication); Appendices 1 (Case Studies), 4 (Environmental Risk Assessment), 5 (Environmental Reference Tables), 6 (Nutrient and Buffer Strips) and 7 (Communication Case Studies) have not been changed and are not included in the consultation draft. They will be retained in the final version. These Chapters and Appendices can be downloaded from the existing guidelines at: <https://www.waterquality.gov.au/guidelines/recycled-water>

1. **DRIVERS OF REVISION**

Regulators of recycled water schemes including members of the National Recycled Water Regulators Forum have raised the need to update the guidelines for a number of years. The need for an update was prompted by a number of factors including:

* ensuring consistency with the *Australian Drinking Water Guidelines* (ADWG), the World Health Organization (WHO) *Guidelines for Drinking-water Quality* (GDWQ) and the WHO publication *Potable Reuse: Guidance for Production of Safe Drinking-water* regarding data used to calculate log reduction targets.
  + the draft text on health based targets proposed for inclusion in the ADWG uses norovirus rather than rotavirus as a reference pathogen for enteric viruses. This is due to uncertainties about rotavirus disease burdens following the introduction of the rotavirus vaccine. The draft text uses an updated 2009 dose response for *Cryptosporidium* and updated disease burdens from illnesses caused by enteric pathogens. The updated disease burdens were derived specifically to support the introduction of health-based targets into the ADWG and incorporate a greater focus on use of Australian data (Gibney et al 2014).
  + the WHO text on *Potable Reuse: Guidance for Production of Safe Drinking-water* also uses norovirus as a reference pathogen, the updated dose response for *Cryptosporidium* and the updated disease burdens developed by Gibney et al 2014.
  + the updated dose response for *Cryptosporidium* is included in the GDWQ and the other changes are expected to be considered as part of the review process leading to the 5th edition of the GDWQ.
* Availability of new Australian data for informing determination of default pathogen concentrations in sewage (Deere and Khan 2016; King et al 2017).
* A more developed and sophisticated understanding of log reductions achievable by treatment technologies and validation of these reductions. This is based on work led initially by the Victorian Department of Health and Human Services and then advanced by the NatVal/WaterVal project coordinated by the Australian Water Recycling Centre of Excellence and more recently by WaterSecure (both of these entities have now ceased operating).
* Additional information generated from Australian research on exposures associated with uses of recycled water (Sinclair et al 2014 and 2016).
* Additional information arising from practical experiences associated with recycled water schemes following publication of the Phase 1 document. This includes experience with cross-connections.
* Development and potential inclusion of a water safety continuum into the ADWG as part of the proposed introduction of HBTs.

1. **SPECIFIC CHANGES**
   1. **Chapter 1 Introduction**

Minor updates to reflect the later date of preparation of this revision. For example, reference to the later Phase 2 modules has been included together with augmentation of drinking water supplies being a potential end-use. When the original version of the Phase 1 document was published the Phase 2 modules had not been drafted. The module on Augmentation of Drinking-water Supplies was originally outside of the scope of the AGWR and was a later inclusion.

* 1. **Chapter 2 Framework for management of recycled water quality and use**
* Moved Tables 2.1 (Characteristics of recycled water systems), 2.3 (Examples of sources and potential hazards), 2.4 (Examples of potential hazardous events), 2.8 (Examples of potential critical control points and operational criteria) and Boxes 2.8 (Examples of process-control programs) and 2.9 (Posssible corrective actions) to Appendix 3 (Preventive measures) to reduce detail in the Chapter.
* Updated Section 2.9 on Validation to include reference to the Vic Dept of Health and Human Services protocol and the WaterVal/Water Secure framework.
  1. **Chapter 3 Managing health risks in recycled water**
* The chapter has been updated using new data (largely from 2015-2016) to refine default concentrations of pathogens in sewage (virtually no change). Unlike the existing data used in the 2006 version the new data has been published (Deere and Khan 2016; King et al 2017)
* There have been a number of changes to calculating HBTs including performance targets (i.e. Log reduction values (LRVs)). All of these changes reflect new information published since 2006.
  + Rotavirus has been replaced by norovirus as the reference pathogen for enteric viruses (Gibney et al 2014, 2015).
  + A new dose response for *Cryptosporidium* published by WHO (Medema et al 2009) has been included. This dose response was included in the 4th edition of the WHO GDWQ (originally published in 2014) and in the draft text on HBTs for proposed introduction into the ADWG.
  + New disease burdens determined in a project designed to support the proposed introduction of HBTs into the ADWG (Gibney et al 2014).

The main impact of these changes has been to existing Table 3.7 (Log reductions for priority uses of recycled water from treated sewage) and Table 3.8 (Treatment processes and on site controls for designated uses of recycled water from treated sewage) and the calculations included in Appendix 2 (Calculation of microbial health-based performance targets). The consequences of these changes are discussed below in section 4.2

* The discussion of disability adjusted life years (DALYs) has been refined in Section 3.1.1 and Box 3.1 (Disability Adjusted Life Years) has been revised. The concept of a water safety continuum as developed for the ADWG has been included as a concept for assessing overall risk particularly for established schemes. The continuum has not been used to modify performance targets. The discussion of risk assessment (Section 3.2) has been revised/refined.
* Table 3.2 (Dose response relationships for reference pathogens) has been updated as above and moved to Appendix 2 (Calculation of microbial health-based performance targets).
* Table 3.3 (Intended uses and associated exposures for recycled water) (now Table 3.2) has been updated with the addition of new exposure data for domestic car washing, window and paving washing and occupational hosing down activities. Data included is from Australian studies (Sinclair et al 2014 and 2016).
* Table 3.4 (Indicative log removals of enteric pathogens and indicator organisms) (now Table 3.3) has been changed to include validated LRVs. The basis for validation of specific processes is included. Relatively recent information generated by the NatVal/WaterVal project is referenced. The old Table 3.4 included very broad ranges of microbial log removals which were not particularly useful and were frequently misused.
* Table 3.6 (Numbers of micro-organisms in raw sewage) (now Table 3.5) has been updated using more recent data from Navarro and Jimenez (2011), Soller et al (2015) and Deere and Khan (2016).
* Table 3.7 (Log reductions for priority uses of recycled water from treated sewage) has been updated based on changes to HBT calculations and expanded slightly to include additional end-uses. The virus LRVs have been reduced marginally (0.2 log) while those for *Cryptosporidium* and *Campylobacter* increase by 0.6 log and 0.7 log respectively. Given that LRVs are rounded to the nearest 0.5 log the nett impact is an increase in LRVs of 0.5 log for protozoa and bacteria and no change to the LRVs for viruses in the Phase 1 document. The principle causes of these increases is introduction of the new dose response for *Cryptosporidium* (r=0.2 increased from 0.059) and an increased disease burden per case of campylobacteriosis (0.024 DALY increased from 0.0046 DALY largely due to identification of irritable bowel syndrome as a potential sequela of campylobacteriosis).
* Table 3.8 (Treatment processes and on-site controls for designated uses of recycled water from treated sewage) has been reformatted and changes have been included in line with the changes in Table 3.7.
* The text in 3.5.4 Chemical hazards has been shortened considerably with deleted text replaced by a cross-reference to the module on drinking water augmentation for further details. Section 3.5.4 was written before the decision was taken to develop the drinking water augmentation module. Technical information on chemical hazards is included in the later module where it is more relevant.
* Additional text has been added on stormwater to improve balance of the text in dealing with the three main sources of recycled water. Discussion of treated sewage and grey water (Section 3.7) has been integrated rather than discussing them in two separate sections. For example Table 3.10 which was in Section 3.7 is now Table 3.6 in Section 3.4.2.
  1. **Chapter 5 Monitoring**
* The discussion of validation has been modified in-line with changes to Chapter 2. Table 5.2 (Examples of validation monitoring for health risks) has been deleted and replaced with a Table listing components of a validation protocol (based on the Victorian and NatVal/WaterVal Frameworks).
* Table 5.3 (Microbial indicators) has been deleted (too much unnecessary detail).
* Table 5.4 (Examples of operational monitoring and supporting programs for health risks) has been replaced with a new Table 5.3 (Examples of operational monitoring parameters for pathogen removal by indicative treatment processes) that aligns more closely with Table 3.3 (Indicative pathogen LRV potentially attributable to treatment barriers).
* Tables 5.5 (Examples of verification monitoring) and 5.6 (Typical sampling program for operational monitoring of health protection barriers and verification of health water quality targets) have been deleted and replaced with shorter discussions in the text. Table 5.5 is considered to be too detailed and Table 5.6 is too prescriptive.
* There have been no changes to Sections 5.4 (Monitoring of management of environmental risks) or Sections 5.5 to 5.9
  1. **Appendix 2**
* Has been updated in line with changes to Chapter 3.
  1. **Appendix 3**
* Has been expanded to include detailed information from Chapter 2 (as above).

1. **IMPLICATIONS OF THE REVISIONS**
   1. **Benefits**

The Phase 1 document will be consistent with related guideline documents including the GDWQ, the WHO text *Potable Reuse: Guidance for Producing Safe Drinking-water* and the ADWG, if the proposal to introduce HBTs is endorsed. It is expected that the WHO *Guidelines for Safe Use of Wastewater, Greywater and Excreta* will be updated and changes to calculations underpinning HBTs are likely.

The revised document will also include Australia data produced since 2006 to support application of the guidelines.

* 1. **Potential challenges**

The main challenge is the 0.5 log increase in the performance targets for protozoa. For high exposure schemes using high levels of treatment this could require small enhancements of existing treatment processes. In many cases this could be achieved by enhanced operation of existing processes. Lower exposure schemes using non-treatment measures to reduce exposure could require minor enhancements of these non-treatment measures.

The 0.5 log increase in the performance targets for bacteria is unlikely to have a substantial impact. Controls directed at protozoa and viruses are generally effective in providing more than required LRVs for bacteria.

Inclusion of the continuum for water safety supports a flexible approach to the introduction of any required modifications/enhancements. If the continuum is applied immediate impacts would be minimised with the potential introduction of future enhancements to be agreed between proponents and relevant regulators.

* 1. **Implications of not proceeding with the revisions**

The Phase 1 document is 14 years old; some of the information is dated and in some cases supporting processes such as validation of technologies has become more sophisticated. The original intent of developing the AGWR was to support a consistent Australia wide approach to water recycling. This relies on confidence in the scientific basis of the AGWR. This will be weakened if the document loses currency and if reliance on other documents increases (e.g. validation frameworks and protocols).

Related documents such as the ADWG and the GDWQ are revised on an ongoing basis which can lead to points of alignment being lost (e.g. selection of reference pathogens, dose response models etc.) and consistency being compromised.

1. **POTENTIAL CONSEQUENTIAL ACTIONS/REVISIONS TO PHASE 2 MODULES**

At this stage the proposed revisions only deal with the Phase 1 component of the AGWR. Depending on the outcomes of consultation on these revisions there could be implications for the calculation of performance targets in the Phase 2 modules for drinking water augmentation and stormwater harvesting and reuse. Subsequent modifications could be considered at a later date to deal with these implications and to maintain consistency within the various modules of the AGWR. These could be limited to the replacement of rotavirus with norovirus as a reference pathogen for viruses and changes to the required LRVs for protozoa and bacteria. Changes to the text would be minor.

The following changes would be consistent with the revisions proposed for the Phase 1 document:

* **Augmentation of drinking water supplies**Required performance targets would change from  
  8 log reduction protozoa, 9.5 log reduction of enteric viruses, 8 log reduction of bacteria *to*   
  8.5 log reduction protozoa, 9 log reduction of enteric viruses, 9 log reduction of bacteria.  
  This would involve changes to one page (41) of the module and is unlikely to have a significant impact.
* **Stormwater harvesting and reuse**Required performance targets would change as shown in the following Table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Use** | | **Log reduction targets** | | |
| **Viruses** | **Protozoa** | **Bacteria** |
| **Municipal use with unrestricted access** | **Old** | 1.3 | 0.8 | 1.3 |
| **New** | 1.1 | 1.3 | 2.0 |
| **Dual reticulation or irrigation of commercial food crops** | **Old** | 2.4 | 1.9 | 2.4 |
| **New** | 2.2 | 2.5 | 3.1 |

Changes would need to be included in Appendix 3.1 including Tables A3.3 and 3.6.

1. **REFERENCES**

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