



Welcome to DWI Research News

This newsletter is intended to provide a brief summary of recent outputs of the Water Quality and Health evidence programme. The contents section to the right lists the projects covered, and provides useful links to our evidence plan, which lays out the aims and objectives of our research programme, and a quick link to Defra's E-tendering site to register your interest in our future competitions.

Recently published DWI research

National assessment of the risks to water supplies posed by low taste and odour threshold compounds

Contamination of water supplies can result in taste and odour problems in drinking water. Incidents in the UK such as in North East London during 2010 ([CIR 2010](#)) highlighted some chemicals that had the potential to cause taste and odour issues. The purpose of this research was to create a prioritised list of substances that could potentially cause a taste and odour incidence at low concentrations to help inform water company risk assessments. The research was undertaken by Cranfield University.

Once the initial list was established the project considered the possible entry routes into the water system. Inverse modelling was used to estimate the usage required to generate taste and odour causing concentrations in the raw and treated drinking water.

The variability in taste and odour thresholds and gaps in usage information for the anthropogenic compounds were uncertainties identified in the data. The assessment concluded that exposure to these compounds at their taste and odour threshold concentrations were not associated with significant risks of toxicity.

The [full report](#) is available to download (PDF 2.48MB)

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[DWI's Evidence Plan](#) (PDF 90KB)

[Defra's E-tendering site](#)



Effect of UV on the Chemical Composition of Water

Ultraviolet (UV) disinfection has been used in water treatment for many years. Its implementation in the UK is increasing and is often used for *Cryptosporidium* inactivation. The aim of this project was to increase our understanding of the impact of UV disinfection on the chemical composition of water, with specific reference to potential formation or removal of disinfection-by-products (DBPs).

WRc plc were selected to undertake this review, and they found that the potential formation of DBPs as a result of treatment by appropriately designed and maintained UV systems is low. The most significant DBPs are nitrite (formed from nitrate) and bromate (formed from prechlorinated supplies containing bromide); the formation of both can be minimised by appropriate water treatment and UV system design.

89 public supplies using UV were identified and these treated a total of about 1500 MI/d.

The full extent of UV treatment of private supplies is unclear from Local Authority (LA) returns to DWI. UV treated private supplies used for commercial purposes appear to account 97-98% of volume treated. Whilst it is unlikely that formation of DBPs is a significant risk for private supplies, the risk might be greater for supplies used

for commercial purposes where water treatment might include prechlorination or the UV system might incorporate medium pressure (MP) lamps.

This research indicates that there is a very low risk of DBP formation where validated, appropriately operated UV installations are employed.

The [full report](#) is available for download (PDF 1.52MB)

Risk Assessment of VTEC infections in England and Wales

Of all the newly emerged potentially waterborne diarrhoeal pathogens of the past few decades, *E. coli* O157 is probably the most important, due to the severity of the disease especially in the young and the elderly. The class of pathogen has several different names, and is frequently called Verocytotoxigenic *E. coli* (VTEC) in the UK, and more recently the term Shiga toxin producing *E. coli* (STEC) is gaining ground.

The purpose of this study was to establish the risks to consumers of UK water supplies from *E. coli* O157 and other STEC in drinking water. It involved literature searches and gathering data from a selection of local authorities and water companies in England and Wales. The study was undertaken by the University of East Anglia and WRc.

Unfortunately there were too few studies reporting levels of *E. coli* O157 in raw water to be used to make a direct risk assessment. So instead the O157:indicator *E. coli* ratio was estimated for each catchment included in the risk assessment.

Risk assessment for public supplies showed that all water utilities are able to provide water with an annual risk of less than 1 case per 10000 person years. It is likely that the estimated risks for the public water supplies are over-estimates as they used a very conservative estimate of chlorination.

Risk assessment for private supplies showed the mean annual risk in adults consuming unboiled tap water from private supplies is 5 cases per 10000 person years. However, almost all of this risk is experienced by people whose water quality fails the statutory *E. coli* standard. When the modelling was restricted to those supplies that complied with current standards, the mean annual risk was estimated to be only 0.8 cases per 10,000 person years.

The [full report](#) is available to download (1.25MB)

A review of incidence of outbreaks of diseases associated with Private Water Supplies from 1970 - 2009

Many Private Water Supplies (PWS) in England and Wales fail to meet the standards for microbiological parameters. This means that there may be risks of waterborne infections in the population supplied. This project updated the information available on outbreaks associated with private supplies in England and Wales and considered the impact of the implementation of the PWS regulations 1991 on the incidence of outbreaks.

The methodology used involved identifying PWS outbreaks which occurred between 2000 and 2009 from published literature, archives, records, HPA databases and an electronic survey. The review included an assessment of the strength of evidence for the association between illness and drinking water from PWS.

This project identified that the same problems of poor conditions around PWS, animal contamination, inadequate treatment and poor management have continued to affect PWS since 1970. There is a potential for this to improve following the implementation of the 2009 regulations bringing in a risk assessment approach to addressing issues with PWS.

There are a number of barriers to accurately measure the burden of infectious intestinal disease associated with PWS, and therefore new approaches are required. DWI will consider the recommendations for future work.

The [full report](#) is available to download from our website (467KB)

Volatile Organic Compounds – Understanding the risks to drinking water

Volatile Organic Compounds (VOCs) are compounds that contain the element carbon and have a high vapour pressure at room temperature. This project, undertaken by WRc plc, was set up to provide a national assessment for England and Wales of the risks posed to drinking water by selected VOCs identified in the United States for possible group regulation.

Although the toxicological reviews identified a number of gaps within the toxicological databases, the findings showed that all of the VOCs considered in the study had Risk Characterisation Ratios (RCRs) significantly below 1. Therefore none are anticipated to be of concern to human health as a result of potential exposure through drinking water.

In particular, for ethylene oxide and 1,3 butadiene which are both highly

volatile, the literature review found no quantifiable residues of butadiene in drinking water and the extreme worst case estimates of drinking water concentrations for both substances were well below 1µg/L.

The [full report](#) is available to download on our website (PDF 2.65MB)

Free-living protozoa and opportunistic pathogens in distributed water

This study was primarily funded by the Water Research Foundation in the US, with DWI providing a small amount of funding.

It's aim was to improve understanding of the role of amoebae in the protection and proliferation of pathogens in distribution systems. Considering all free-living protozoa (FLP) gave a more complete picture.

Many knowledge gaps were identified, and more focus should be placed on understanding the ecology of both FLP and opportunistic pathogens in the environment and in distributed water and premise plumbing. The occurrence survey confirmed the ubiquity of FLP in all types of water tested.

The issue of protozoa and their interaction with pathogens is an important and expanding area of research that is of wide interest to public health within and outside the drinking water industry. The



complexity of FLP-bacteria interactions is such that issues could be site specific. Premise plumbing is where FLP-pathogen interactions are likely to be highest, and the risks from exposure to them greatest. This is especially true in large complex systems that recycle hot or warm water, and part of the solution must lie with high volume customers and building owners or operators.

The [summary report](#) (684KB) is available to download from our website. For details of obtaining the full report, please visit the [WRF website](#)

Effective Microbial Control Strategies for Main Breaks and Depressurization

The purpose of this project was to understand better the risks posed during main breaks and depressurisation events in order to protect public health. This was achieved by evaluating the effectiveness of disinfection and operational practices to mitigate microbial risks, and to identify parameters to quantify the level of control needed to mitigate the risks.

Four categories of breaks were developed and summarised: Type 1 – positive pressure maintained during excavation and repair; Type 2 – positive pressure maintained during excavations, followed by controlled shut down for repair; Type 3 – loss of

pressure at break site/possible local depressurisation; Type 4 – catastrophic failure, loss of pressure and break site, and widespread depressurisation. Responses were proposed for each type of burst. The Quantitative Microbial Risk Assessment (QMRA) included data on likely level of microbial contamination, infectivity and dilution within the distribution system and removal of inactivation by the remedial steps. A risk of less than 1×10^{-4} illness per person per year was used as a benchmark. The study provides supporting evidence that the current disinfection regime recommended by the Technical Guidance Note (TGN) 3 for repairs where contamination may have occurred provides a robust level of protection.

The [summary report](#) (PDF 586KB) is available to download from our website. For details of the full report, please visit the [WRF website](#)

Understanding the significance of chromium in drinking water

Chromium is a transition metal that is widely distributed in the earth's crust. It is used in a variety of industrial processes e.g., chromium and its salts are used in the leather tanning industry, the manufacture of catalysts, pigments and paints, fungicides, the ceramic and glass industry, and in photography, and for chrome alloy and chromium

metal production, chrome plating, and corrosion control.

It can exist in a range of oxidation states, though principally occurs as chromium III and chromium VI. Chromium III is an essential nutrient but the toxicity of chromium VI is more complex. Knowledge of levels of chromium III and VI in UK drinking water was relatively limited. The overall aim of this project was to increase knowledge of levels of chromium III and VI.

WRc undertook a literature review of the toxicokinetics and toxicity of chromium, reviewed their fate in water treatment and supply, undertook a set of seasonal surveys, and Enviro developed an analytical methods for chromium VI, chromium III and total chromium.

Overall the research findings are reassuring and consistent with existing knowledge of total chromium in drinking water. Most supplies contained either no detectable concentrations or concentrations well below 1 µg/L. On no occasion was total chromium detected above the WHO provisional guideline value. Where chromium was detected it tended to be as chromium VI and only at low levels.

The [full report](#) is available to download from our website (3.46MB)



Understanding the implication of the EC's proposals relating to Radon in drinking water for the UK

The European Commission has agreed a new Directive (2013/51/Euratom), which lays down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption. The new Directive sets out parametric values, and frequencies and performance characteristics for analytical methods for monitoring radioactive substances in water intended for human consumption.. The proposals for tritium and total indicative dose have already been implemented in the UK but the directive specifies new requirements for radon.

The purpose of this project was to assess the implications of the new Directive for the UK and to provide DWI with recommendations on how it might take forward guidance to help suppliers of drinking water determine whether they need to act on radon in their area, while minimising the sampling burden on the industry.

The findings of the research showed there is relatively limited data on radon in drinking water supplies. The data that are available show if radon is present it is generally at low concentrations. The lowest concentrations are generally observed

in large public water supplies especially those derived from surface sources and areas where indoor radon levels in air are low. The highest concentrations of radon in water tend to occur in smaller, mainly private water supplies obtained from ground water sources in areas where levels of radon in air are most likely to be high.

One of the main outputs of the research report is radon in water risk maps for England and Wales, Scotland and Northern Ireland. These maps were produced using the limited available data on measurements of radon in drinking water supplies, combined with hydrogeological data and radon in air mapping to assess radon hazard.

The findings of the research have been used to inform revision of the public and private drinking water quality regulations to transpose the new Directive requirements. The research has also been used as the basis of interim advice to water companies and local authorities in relation to risk assessment and future monitoring for radon in drinking water.

The [full report](#) is available to download from our website (2.42MB)