Summary

i Reasons

The Drinking Water Inspectorate (DWI) wished to gain a better understanding of the disinfection technologies currently in use on commercial activities across England and Wales, including alternative technologies, and their suitability for ensuring safe drinking water. Additionally, they would like to identify alternative technologies which are being used internationally and assess their suitability for use in England and Wales.

ii Objectives

- To discuss and define what the term ‘commercial activities’ implies within the context of the project.
- To collate and analyse information regarding the types of disinfection technologies used on private and public water supplies in England and Wales, and the types of activities fed by private water supplies
- To evaluate disinfection technologies used on private and public water supplies in England and Wales. This included a multi-criteria analysis to systematically compare and rank the performance of selected disinfection methods
- To provide an overview of alternative disinfection technologies used internationally and to make recommendations about their suitability for use in England Wales

iii Benefits

The results of this report will enable the DWI to provide more effective guidance to local authorities and water companies on the use of widespread and alternative disinfection technologies and whether alternative methods are suitable for ensuring safe drinking water.

iv Conclusions

Context of the term commercial applications

In the context of the private water regulations for England and Wales, a commercial activity/premise/application is where potable water derived from a private supply system is consumed by a commercial activity. Examples include during food or drink production intended for human consumption, or a hotel using a private water supply for domestic purposes. In contrast, public applications or activities are where potable water from a private supply is available for public consumption. This includes public buildings such as education providers, hostelries and exhibitions.

DWI and WRc agreed that the distinction between public and commercial applications is often unimportant from a regulatory or public health perspective. Therefore, it was decided that both were within the project scope. Moreover, it was agreed that public water supplies were within the project scope, defined in this context as situations where activities practice disinfection of a public water supply before onsite distribution.

Local authority surveys and water company enquiries

In England and Wales, local authorities act as regulators for private water supplies, with DWI acting as technical advisors. A total of 118 English and Welsh local authorities responded to two surveys sent out during the project. All 10 technologies noted by survey respondents as being used for the disinfection of private water supplies were selected for inclusion in subsequent project stages.

The two most-widespread technologies for disinfection of private water supplies were UV irradiation and hypochlorite, mentioned as being in use in respectively 77% and 41% of local authority areas across both surveys. Chlorine dioxide was in use in 12% of local authority areas, while the seven remaining technologies - hypochlorite generated by onsite electrolysis of brine (OSE), chlorine gas, chloramines, ozone, hydrogen peroxide, reverse osmosis and ceramic candle filters (CCFs) - were in use in ≤8% of areas.

CCFs were installed as the sole form of disinfection on private water supplies within three local authority areas. In two of these local authority areas, samples treated by CCFs had failed water quality regulations, which raises concerns about the use of this method as a sole treatment/disinfection step on private water supplies.

A wide variety of activities using private water supplies were mentioned by survey respondents; the three commonest categories being types of accommodation, tenanted properties let on a commercial basis and businesses selling food and drink.

Responses from four municipal water supply companies highlighted that care homes and hospitals are likely to practice onsite disinfection of public water supplies, using technologies including reverse osmosis, chlorine dioxide and hydrogen peroxide dosing.

Multi criteria analysis (MCA) of disinfection technologies used in England and Wales

Six criteria were used in the final MCA: operational cost, ease of asset management, disinfection byproducts (DBPs), efficacy against microorganisms (split into three sub-criteria, relating to bacteria, protozoa and viruses), footprint and health and safety. The highest weighting of 0.45 (0.15 for each sub-criterion) was given to microbial efficacy, reflecting its critical importance for public health.

Hypochlorite solution was the highest ranked disinfection technology, primarily due to its strong scores in microbial efficacy, operational cost, and ease of asset management. However, this chemical can result in relatively high concentrations of DBPs. UV irradiation ranked second. It

performed well across multiple criteria but with relatively high operational costs and asset management challenges.

Chlorine dioxide, reverse osmosis, ozone, and chlorine gas were all regarded as effective disinfectants, but their overall ranking was lower than UV irradiation and hypochlorite because they performed comparatively poorer for certain criteria, such as ‘ease of asset management’.

Chloramines and CCFs were the lowest ranked technologies, reflecting their relatively low scores under ‘microbial efficacy’. The MCA outcome indicates both technologies are best suited as supplements to other disinfection technologies, rather than as a primary disinfectant.

Disinfection technologies used overseas

The suitability of physical, chemical, thermal, solar and combination treatment approaches used overseas were assessed as potential disinfection methods for use in England and Wales. Of these, ultrafiltration technologies, mixed oxidant solution and peracetic acid warrant further investigation. Bromine is a promising alternative to chlorine, but there are concerns over the formation of high levels of brominated DBPs.

v Recommendations

- Modified risk assessment and/or guidance should be considered where CCFs or chloramines are the sole disinfectant technology for private or public water supplies in England and Wales.

- Ultrafiltration technologies, mixed oxidant solution and peracetic acid warrant further investigation before application to public and private water supplies in England and Wales.

- Clarify the potential health risks associated with bromine (including brominated DBP formation) ahead of bromine being considered for use as a disinfectant in England and Wales.