

Executive summary

EDCs are a diverse group of chemicals that have the potential to alter the normal functioning of the hormonal system across a wide range of wildlife and in humans (especially during early development). Their presence in a variety of applications and direct pathways for release to environment also means that EDCs could reach drinking water through typical use of EDC containing products. Continuous domestic release of many of these chemicals (particularly to wastewater systems) gives rise to pseudo-persistence in the environment, and they have frequently been found within the sewerage system and rivers. Peer-reviewed and grey literature verifies the occurrence of 17-Beta-estradiol (E2), Nonyl phenol (NP) and Bisphenol A (BPA) in both surface and groundwater. The rate of incidence of these three EDCs in wide scale surface/groundwater monitoring programmes such as the Chemical Investigation Programme (CIP) and BGS surveys suggests that their occurrence could be expected at low levels in drinking water sources across England and Wales. Limited information is currently available on concentrations of these substances in source/treated water or their removal using advanced drinking water treatment technologies. Thus, understanding the potential risk of compliance to proposed drinking water standards requires consideration. This project aims to close the knowledge gap on quantities of these substances used, their presence in surface and groundwater and the potential scale of the risk for drinking water across England and Wales.

In 2016 the completion of a regulatory fitness evaluation for the Drinking Water Directive¹ (98/83/EC) (DWD) found that the DWD was largely successful in delivering the provision of high-quality drinking water across Europe. Levels of compliance were noted to be high, yet one specific area of attention has been the list of pollutants/parameters that are reported². This list has not been updated since 1998 (the year the DWD was implemented) and does not consider any emerging contaminants. To ensure safe drinking water for all EU citizens, a number of policy options were recently identified by the EC³, including a) Update of the parameters in Annex I according to scientific progress and following recommendations of the WHO Guidelines; b) Updating the list of parameters in the Annex I to longer list C (including all parameters potentially harmful); or c) Reduction of the number of parameters in Annex I to a minimum list, with the same limit values than those specified under the current Annex I of the DWD.

The EC has since proposed to revise the Directive in order to improve the quality of drinking water and update parameters monitored and set over 20 years ago. An outcome of this evaluation is recommendations for three endocrine- disrupting compounds: 17-Beta-estradiol: 0.001 µg/L; Nonyl phenol: 0.3 µg/L; and Bisphenol A: 0.1 µg/L. The proposed standards for these three EDCs are being used as precautionary benchmarks, (close to the environmental quality standard (EQS) for aquatic protection), to indicate possible estrogenic activity in drinking water as they are already known to be found in surface (source) water.

Since the project started, BPA will now (as of October 2020) be added to the DWD with a health-based parametric value of 2.5 µg/l so we have evaluated possible risk of exceedance in relation to both the original (0.1 µg/L) and newly proposed (2.5 µg/L) standards for BPA. The other substances NP and E2 do not have benchmark values specified in the latest version of the DWD but will instead be added to a "watchlist".

The purpose of proposing chemical benchmark values (CBV) is to determine if (pre-treatment) drinking water sources are impacted by treated effluent or other sources known to contain EDCs. If any of the three EDCs are detected above the CBV in surface waters, then a risk may be posed to drinking water supplies and thus the need to revisit the efficacy of treatment or source control. If the three EDCs are not found to exceed the proposed drinking water standards at the source water intake then there is little need to model potential drinking water risk further at a greater level of detail; in this situation, measurements would need to be taken post-treatment in drinking water to confirm that removal in treatment is adequate.

¹ Staff Working Document on the REFIT Evaluation of the Drinking Water Directive 98/83/EC SWD (2016) 428 final.

² highlighted by the 2014 implementation report of the DWD, available at: <http://www.safe2drink.eu/dwd-evaluation/>

³ Study supporting the revision of the EU Drinking Water Directive, Final Impact assessment, November 2017. EC.

This project seeks to identify situations/locations in England and Wales where there is a risk to compliance with proposed DWD standards for NP, BPA and E2 and where additional monitoring may be necessary. The study outcomes will allow Defra and DWI to develop informed and effective policy approaches to manage the risks identified.

The outputs from this project indicate the following conclusions in relation to these three EDCs and key areas within England and Wales where the highest potential risk of exceeding the proposed values in drinking water:

- **For NP the likelihood of exceeding the proposed standard in drinking water supplies appears to be relatively low.** The data available both within the literature but also from the modelling of surface water concentrations indicates that exceedances of the proposed drinking water standard are infrequent apart from in very low flow conditions. Furthermore, NP has not been detected in groundwater monitoring data from the Environment Agency and the chemical properties of the substance indicate that it is unlikely to migrate to groundwater supplies. Restrictions on use are also likely to further reduce environmental concentrations of NP;
- **For E2 there is some evidence to indicate that it does occur in river sources above the benchmark value.** E2 has not been detected in drinking water above the proposed standards, although this is based on limited analytical data. This is consistent with bench scale studies that report high removal of E2 during by water treatment. When undertaking the modelling assessment for treated drinking water derived from surface water (Task 3) we see no exceedances of the 1ng/l proposed DWD standard when using the average/mean concentration estimates. However, in simulated low flow situations, around half of the abstraction points exceed the 1ng/l proposed DWD standard even after applying drinking water treatment, predominantly in the Thames, Anglian and Midlands regions.; and
- **For BPA, of the three EDCs examined in this study, appears to present the highest likelihood of exceeding the original proposed value in drinking water supplies in England and Wales. Whilst considering the proposed standard of 2.5 µg/l and mean concentrations, all the river reaches with abstraction points in England and Wales are at low risk.** In low flow conditions, the majority of the river reaches are at low risk with 38% at medium risk and no reaches identified as at high risk. Highest risk areas for groundwater within England and Wales appear to be in proximity to limestone aquifers of the South east, Anglian and Midland regions which agrees with the results from the surface water modelling of concentrations of BPA at drinking water abstractions points.

Recognising that this study takes a first step to risk assess water bodies used for abstraction, it must be noted that the results presented in this report should be interpreted with care especially those from the surface water modelling. As noted from the systematic literature review, data to corroborate estimates of the three EDCs is sparse and as such there is a high level of uncertainty in the predictions made. Overall, for all the EDCs, there is a paucity of data on occurrence of these substances in drinking water sources in the UK and the effectiveness of drinking water treatment processes. Further monitoring is suggested for all three EDCs.