

the Stage 1 DBPR and IESWTR in 1994. Congress affirmed the phased microbial and disinfection byproduct rulemaking strategy in the 1996 SDWA Amendments by requiring that EPA develop these three sets of rules on a specific schedule that stipulates simultaneous promulgation of requirements governing microbial protection and DBPs.

In March 1997, the Agency established the Microbial and Disinfection Byproduct (M-DBP) Advisory Committee under the Federal Advisory Committee Act (FACA) to collect, share, and analyze new information and data available since the 1994 proposals of the Stage 1 DBPR and the IESWTR, as well as to build consensus on the regulatory implications of the new information. The Advisory Committee consisted of 17 members representing EPA, State and local public health and regulatory agencies, local elected officials, drinking water suppliers, chemical and equipment manufacturers, and public interest groups. The Advisory Committee met five times in March through July 1997 to discuss issues related to the IESWTR and the Stage 1 DBPR. The Advisory Committee reached consensus on a number of major issues that were incorporated into the Stage 1 DBPR and the IESWTR.

The Stage 1 DBPR and IESWTR, finalized in December 1998, were the first rules to be promulgated under the 1996 SDWA Amendments (USEPA 1998c and 1998d). The Stage 1 DBPR applies to all community and nontransient noncommunity water systems that add a chemical disinfectant to water. The rule established maximum residual disinfectant level goals (MRDLGs) and enforceable maximum residual disinfectant level (MRDL) standards for three chemical disinfectants—chlorine, chloramine, and chlorine dioxide; maximum contaminant level goals (MCLGs) for three THMs, two haloacetic acids (HAAs), bromate, and chlorite; and enforceable maximum contaminant level (MCL) standards for TTHM, five haloacetic acids (HAA5), chlorite, and bromate calculated as running annual averages (RAAs). The Stage 1 DBPR uses TTHMs and HAA5 as indicators of the various DBPs that are present in disinfected water. Under the Stage 1 DBPR, water systems that use surface water or ground water under the direct influence of surface water and use conventional filtration treatment are required to remove specified percentages of organic materials, measured as total organic carbon (TOC), that may react with disinfectants to form

DBPs. Removal is achieved through enhanced coagulation or enhanced softening, unless a system meets alternative compliance criteria.

EPA finalized the IESWTR at the same time as the Stage 1 DBPR to ensure simultaneous compliance and address risk tradeoff issues. The IESWTR applies to all water systems that use surface water or ground water under the direct influence of surface water that serve at least 10,000 people. The purpose of the IESWTR is to improve control of microbial pathogens in drinking water, specifically the protozoan *Cryptosporidium*.

The Filter Backwash Recycle Rule (FBRR) and the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) round out the first group of regulations balancing microbial and DBP risks. EPA promulgated the FBRR in 2001 (USEPA 2001c) and the LT1ESWTR in 2002 (USEPA 2002b) to increase protection of finished drinking water supplies from contamination by *Cryptosporidium* and other microbial pathogens. The LT1ESWTR extends protection against *Cryptosporidium* and other disease-causing microbes to water systems that use surface water or ground water under the direct influence of surface water that serve fewer than 10,000 people. While the Ground Water Rule, proposed in May 2000, (USEPA 2000h) will add significant protection from pathogens in vulnerable ground water systems, it does not pose as many risk-risk tradeoff considerations as the surface water rules because only a small percentage of ground water systems subject to the Stage 2 DBPR have high DBP levels.

EPA reconvened the Advisory Committee in March 1999 to develop recommendations on issues pertaining to the Stage 2 DBPR and LT2ESWTR. The Advisory Committee collected, developed, and evaluated new information that became available after the Stage 1 DBPR was published. The Information Collection Rule provided new data on DBP exposure, and control; it also included new data on occurrence and treatment of pathogens. The unprecedented amount of information collected under the Information Collection Rule was supplemented by a survey conducted by the National Rural Water Association, data provided by various States, the Water Utility Database (which contains data collected by the American Water Works Association), and Information Collection Rule Supplemental Surveys. This large body of data allowed the Advisory Committee to reach new conclusions regarding DBP exposure and new treatment options.

After analyzing the data, the Advisory Committee reached three significant conclusions that led the Advisory Committee to recommending further control of DBPs in public water systems. The data from the Information Collection Rule show that the RAA compliance calculation allows elevated DBP levels to regularly occur at some locations in the system when the overall average at all locations is below the MCL. Customers served at those sampling locations that regularly exceed the MCLs are experiencing higher exposure compared to customers served at locations that consistently meet the MCLs.

Second, the new data demonstrated how single samples can be substantially above the MCLs. The new information showed that it is possible for customers to receive drinking water with concentrations of DBPs up to 75% above the MCLs even when their water system is in compliance with the Stage 1 DBPR. Studies have shown that DBP exposure during short, critical time windows may adversely impact reproductive and developmental health.

Third, data from the Information Collection Rule revealed that the highest TTHM and HAA5 levels are not always located at the maximum residence time monitoring sites specified by the Stage 1 DBPR. These sites were required for monitoring by the Stage 1 DBPR because previous data suggested that water in the distribution system for the maximum residence time would have the highest TTHM levels. The fact that the locations with the highest DBP levels varied in different public water systems indicates that the Stage 1 DBPR monitoring sites may not be representative of the high DBP concentrations that actually exist in distribution systems, and additional monitoring is needed to identify distribution system locations with elevated DBP levels. This information encouraged the Advisory Committee to recommend additional measures to identify locations with high LRAAs. Section IV provides a complete discussion of the new occurrence data.

The analysis of the new data also indicates that certain technologies are effective at reducing DBP concentrations. Bench- and pilot-scale studies for granular activated carbon (GAC) and membrane technologies required by the Information Collection Rule provided information on the effectiveness of the two technologies. Other studies found UV light to be highly effective for inactivating *Cryptosporidium* and *Giardia* at low doses without promoting the formation of DBPs (Malley *et al.* 1996; Zheng *et al.*