

estimates of WTP to avoid morbidity prior to death.

EPA estimated aggregate cancer risk from contaminated drinking water for populations served by drinking water intakes on water bodies to which MP&M facilities discharge. EPA based this analysis on six carcinogenic pollutants for which drinking water criteria have not been published. This analysis excludes seven carcinogens for which drinking water criteria have been published. EPA assumed that public drinking water treatment systems will remove these seven pollutants from the public water supply. To the extent that treatment for these seven pollutants may cause incidental removals of the six pollutants without criteria, the analysis may overstate cancer-related benefits.

Calculated in-stream concentrations serve as a basis for estimating changes in cancer risk for populations served by affected drinking water intakes. EPA estimates that baseline MP&M discharges from in-scope facilities are associated with virtually zero annual cancer cases. The national-level analysis finds that the final regulation would lead to a marginal reduction in these cancer cases resulting from consumption of contaminated drinking water; correspondingly, monetary benefits estimated from reduced consumption of contaminated drinking water are essentially zero.

EPA also estimated cancer risk from the consumption of contaminated fish for recreational and subsistence anglers and their families. EPA based this analysis on thirteen carcinogenic pollutants found in MP&M effluent discharges. Estimated contaminant concentrations in fish tissue are a function of predicted in-stream pollutant concentrations and pollutant bioconcentration factors. EPA used data on numbers of licensed fishermen by state and county, presence of fish consumption advisories, number of fishing trips per person per year, and average household size to estimate the affected population of recreational and subsistence anglers and their families. The analysis uses different fish consumption rates for recreational and subsistence anglers to estimate the change in cancer risk among these populations.

EPA estimated that baseline MP&M discharges from in-scope facilities are associated with 0.03 annual cancer cases. The national-level analysis shows that final option would lead to a marginal reduction in cancer cases among recreational and subsistence angler populations. The monetary benefits estimated from consumption of

less contaminated fish by these populations are essentially negligible.

The previous findings from the national analysis of changes in cancer risk associated with the final rule differ from the Ohio case study results. Based on the Ohio case study, the final option is expected to eliminate less than 0.01 cancer cases annually in the State of Ohio (see section IX.H of today's final rule for a detail). This reduction translates into approximately \$14,500 (2001\$) in annual benefits due to reduced cancer risk from consumption of contaminated fish tissue and drinking water. The difference in the findings of the national- and Ohio analyses results primarily from more comprehensive information on MP&M and non-MP&M facility discharges used in the Ohio case study analysis (see section IX.A. of today's final rule for additional details). The national-level analysis accounts only for the pollutant exposures from MP&M sample facilities. In contrast, the Ohio case study approach accounts for a broader baseline of pollutant exposure, including more thorough and detailed coverage of discharges from MP&M facilities and also estimated exposures from non-MP&M sources. As a result, this analysis more accurately reflects baseline health risk conditions.

## 2. Reductions in Non-Cancer Adverse Human Health Effects Other Than Those Related to Lead Exposure

The final rule can potentially generate non-cancer human health benefits (e.g., reduction in systemic effects, reproductive toxicity, and developmental toxicity) from reduced contamination of fish tissue and drinking water sources. The common approach for assessing the risk of non-cancer health effects from the ingestion of a pollutant is to calculate a hazard quotient by dividing an individual's oral exposure to the pollutant, expressed as a pollutant dose in milligrams per kilogram body weight per day (mg/kg-day), by the pollutant's oral reference dose (RfD). An RfD is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure that likely would not result in the occurrence of adverse health effects in humans, including sensitive individuals, during a lifetime. Toxicologists typically establish an RfD by applying uncertainty factors to the lowest- or no-observed-adverse-effect level for the critical toxic effect of a pollutant.<sup>1</sup> A hazard quotient less than

one means that the pollutant dose to which an individual is exposed is less than the RfD, and, therefore, presumed to be without appreciable risk of adverse human health effects. A hazard quotient greater than one means that the pollutant dose is greater than the RfD. Further, EPA guidance for assessing exposures to mixtures of pollutants recommends calculating a hazard index (HI) by summing the individual hazard quotients for those pollutants in the mixture that affect the same target organ or system (e.g., the kidneys, the respiratory system).<sup>2</sup> HI values are interpreted similarly to hazard quotients; values below one are generally considered to suggest that exposures are not likely to result in appreciable risk of adverse health effects during a lifetime, and values above one are generally cause for concern, although an HI greater than one does not necessarily suggest a likelihood of adverse effects.

To evaluate the potential benefits of reducing the in-stream concentrations of 76 pollutants that cause non-cancer health effects, EPA estimated target organ-specific HIs for drinking water and fish ingestion exposures in both the baseline and post-compliance scenarios. Specifically, EPA calculated target-organ specific HIs for pollutants predicted in each MP&M discharge reach, such that one HI was calculated for each target organ/exposure pathway (fish consumption and drinking water)/reach combination. EPA then combined estimates of the numbers of individuals in the exposed populations with the HIs for the populations to determine how many individuals might be expected to realize reduced risk of non-cancer health effects in the post-compliance scenario. This analysis was limited in two primary ways. First, hazard indices estimated in this analysis may understate the actual potential for adverse health effects because possible additional sources of pollutants, such as background pollutants and MP&M pollutants from upstream dischargers, were not considered in the analysis. Second, EPA used mean individual exposure parameters and not the distribution of exposure parameters to estimate hazard indices for the populations affected by MP&M discharges.

The results of EPA's analysis suggest that hazard indices for individuals in the exposed populations may decrease

<sup>1</sup> U.S. EPA, 1993, "Reference Dose (RfD): Description and Use in Health Risk Assessments, Background Document 1A," <http://www.epa.gov/iris/rfd.htm>.

<sup>2</sup> "Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures. Risk Assessment Forum Technical Panel," EPA/630/R-00/002. U.S. EPA, August 2000. <http://www.epa.gov/nceawww1/pdfs/chem mix/chem mix 08 2001.pdf>.