

3. Benefits of the Regulatory Options

FDA assumes that both option 1 and option 2 would compel all bottled water facilities to come into compliance with the 30 µg/L uranium standard. Uranium carries two distinct risks: An increased risk of cancer and kidney toxicity. In addition, treatment technologies put in place to remove uranium will also reduce the concentration of other bottled water contaminants. However, EPA was unable to quantify the effect of uranium on kidney toxicity and the effect of uranium treatment technology on cocontaminants due to lack of information, and FDA has not found any information made available that would allow the quantification of these effects since EPA's 2000 analysis.

Cases of Cancer Avoided

Exposure. According to the *Bottled Water Reporter*, Americans consumed a per capita average of approximately 73.8 liters of bottled water in 2001 (Ref. 3). This is approximately 18 percent of the per capita consumption of water from all sources estimated by the EPA (Ref 2). Bottled water consumption has been increasing at a rate of approximately 7 percent per year in the United States over the past 11 years, and this trend may continue (Ref 3).

Risk and Valuation of Risk. In September 1999, EPA updated a series of coefficients they developed to express the incremental lifetime risk of cancer morbidity or mortality per unit of intake. They then combined this per

unit risk to the average and 90th percentile annual and lifetime intake of water from all sources (including bottled water, but they adjusted for bottled water that did not originate in the municipal water supplies they regulated) to calculate: (1) The total morbidity and mortality cancer risk due to drinking water containing uranium, and (2) the reduction in risk due to their proposed NPDWR for uranium. We adjust these values based on our calculation of the average annual intake of bottled water described above. The mortality risk coefficient per µg of uranium ingested is 3.97E-11, and the morbidity coefficient is 6.13E-11 (Ref. 4). In other words, for each g of uranium ingested the lifetime risk of getting cancer increases by approximately 6 in 100 billion, while the lifetime risk of dying from cancer increases by approximately 4 in 100 billion.

This risk estimate is applied to the decrease in Uranium ingested due to options 1 and 2. Between 0.9 percent and 1.4 percent of bottled water is expected to initially have uranium concentrations over 30 µg/L. Based on 2001 total bottled water consumption, this translates into between 49 million and 76 million gallons of bottled water possibly above the standard. In the Radionuclides rule, EPA expected that the reduction in uranium concentration in the out of compliance municipal water facilities would yield an annual decrease in the number of new fatal and nonfatal statistical³ cancer cases of 0.82

from an affected number of gallons of approximately 73 million.

For the calculations below, we assume that every bottled water consumer has an equal chance of drinking water from a facility that would be out of compliance with the standard. This makes the calculation much simpler, and since the mortality and morbidity risk coefficients are linear and are not based on past exposure, the total reduction in risk is identical. If out-of-compliance bottled water facilities have uranium concentrations roughly equal to the EPA estimates, then applying this assumed reduction and the total annual per capita consumption attributable to the affected bottled water facilities yields a total number of fatal and nonfatal cancer cases avoided of between 0.55 and 0.85 per year for both options 1 and 2. We use a 6 percent growth rate to take into account an increase in exposure and population, in relation to the 7 percent discount rate used for the cost calculations. We also assume that the cancer mortality will occur 20 years in the future. The central estimate is somewhat sensitive to these assumptions, so we test different assumptions in the net benefits section below. Using standard valuation techniques for cancer morbidity and mortality yields an expected present value benefit of between \$8,700,000 and \$13,500,000. The calculations summary is in Table 4 of this document.

TABLE 4.—BENEFITS CALCULATIONS

Options	Cases of Cancer Avoided: EPA Method 1	Cases of Cancer Avoided: EPA Method 2	Present Value (\$) of Annual Cancer Cases (low-high)	Total Present Value (\$) (low-high)
1 and 2	.85	.55	629,000 (494,000–764,000)	11,112,000 (8,731,000–13,493,000)

A final source of uncertainty we need to account for is the upper and lower bound estimated by EPA for their cancer risk coefficients. In the 2000 analysis, EPA assumes an uncertainty cancer risk interval extending one order of magnitude above and below their risk coefficients. Applying this uncertainty interval to the benefits we have already calculated yields a final benefits interval of between \$870,000 and \$135,000,000. Although EPA does not include a probabilistic confidence interval associated with this additional source of uncertainty, they do state that the central tendency values they use for

their main calculations are more likely (Ref. 2).

Sensitivity to Assumptions and Uncertainty: Benefits

These benefits calculations are subject to considerable uncertainty. The uncertainty interval used in the analysis is due to the uncertainty in the incidence and concentration of naturally occurring uranium and uncertainty in the uranium risk coefficients. However, the main uncertain benefits that we do not quantify are; (1) The reduction in kidney disease due to reducing uranium concentration in bottled water, and (2) the reduction in cocontaminants due to

the adoption of treatment technologies for uranium. Therefore, the quantified cancer benefits probably underestimate the true positive impact of the uranium standard.

4. Net Benefits

Table 5 below presents the total costs and benefits for all three options:

³A statistical cancer case refers to expectations. For example, if this risk of contracting cancer sometime during one's life increases for each

person by 1 in a million, and the affected population consisted of 1 million people, it is expected that the number of eventual cancer cases

observed would increase by 1. However, 1 is only the measure of central tendency in a distribution of effects.