



Massachusetts  
Department  
of  
ENVIRONMENTAL  
PROTECTION

# technical update

## Default Fish Ingestion Rates and Exposure Assumptions for Human Health Risk Assessments

Update to: Appendix B, Part I Food Consumption, 1. Freshwater Fish of *Guidance for Disposal Site Risk Characterization – In Support of the Massachusetts Contingency Plan* (1996)

### 1.0 Introduction

Contamination in waterbodies can lead to elevated levels of contaminants in aquatic organisms, including sportfish. When a 21E disposal site contaminates a fishable waterbody, a quantitative risk assessment must evaluate recreational anglers' exposures to contamination from consuming those fish. The recreational angler and those that share in eating the fish caught by the recreational angler, such as their family, make up the receptor group addressed by this technical update.

### 2.0 Recommended Fish Ingestion Rates

In accordance with 310 CMR 40.0923 of the MCP, any risk characterization should evaluate a full and unrestricted use of the resource. In the case of lakes, ponds, rivers and streams, the full and unrestricted use of the resource includes the consumption of fish caught by recreational anglers. The following default consumption rates should be used in risk assessments to characterize freshwater recreational angler fish ingestion in Massachusetts.

#### 2.1 Default Adult Fish Ingestion Rate: 32 grams per day (g/d)

The recommended adult ingestion rate of 32 g/d is based on an overview of creel studies, Environmental Protection Agency (EPA) guidance, default values used by other states, and published peer reviewed studies. Assuming a fish meal size of 8 ounces (approximately 224 grams) (EPA 2000), 32 g/d equals approximately one meal of fish per week. This is a conservative exposure estimate which is consistent with a full and unrestricted use of the fish resource.

#### 2.2 Default Child Fish Ingestion Rate: 16 grams per day (g/d)

The recommended child ingestion rate of 16 g/d was derived using a ratio from the United States Department of Agriculture (USDA) data of national consumption rates for children and adults. That USDA data was used to calculate that child consumption is about one-half that of adults. The adult consumption rate above was therefore multiplied by .5 to calculate an ingestion rate for children ages 1 to 6 years old. This approach was also used for the Housatonic River Human Health Risk Assessment (EPA 2005, Appendix C of Vol. IV, pp 4-53 – 4-54).

### 3.0 Basis for the Default Fish Ingestion Rates

The recommended fish ingestion rates of 32 g/d for adults and 16 g/d for young children are based on professional judgment, considering a combination of:

- The range of fish ingestion estimates published in the literature; and
- The regulatory requirements of the Massachusetts Contingency Plan, which include:
  - Consideration of "subpopulations which may be at increased risk due to increased sensitivity, particular behavior patterns or current or past exposures to chemicals in the environment." [310 CMR 40.0921(3)]

- "The selection of site-specific exposure frequency and exposure duration should be representative of the full extent of site activities consistent with the identified Site Use." [310 CMR 40.0923(1)(c)]
- "In estimating the Exposure Point Concentration, the objective shall be to identify a conservative estimate of the average concentration contacted by a receptor at the Exposure Point." [310 CMR 40.0926(3)]

The default ingestion rates recommended in this technical update are not based on a statistical analysis of the published data, in part because the published estimates represent diverse subpopulations and management goals. Nevertheless, to put the recommended values in perspective, fish ingestion rates that have been developed for similar regulatory risk assessment purposes are summarized in Section 5 below.

#### 4.0 Discussion of Exposure Variables and Assumptions

Many variables contribute to the range of contaminant levels ingested with fish tissue, including the size and type of fish, the cooking preparation, and the cooking methods. Because these site-specific and cooking-specific variables are most often unknown in a risk assessment situation, conservative default assumptions should be used. To be protective of human health, risk characterizations should assume that the preparation of the fish leaves the skin on, that the fat remains on the fish, and that there is no loss of contaminant due to the cooking method.

The default ingestion rates recommended in this document are annualized. The default fish ingestion rates recommended in this document should be used with an exposure frequency of 1 event/day.

Economic, ethnic, and cultural differences lead to a wide range of fish consumption levels by recreational anglers. Subsistence anglers who fish to provide a primary source of protein for themselves and their families have higher intakes of fish than those discussed here. If subsistence anglers may be using a waterbody at a 21E disposal site, site-specific activity and use information must be collected for the subsistence angler population in order to best protect this receptor group.

These ingestion rates are recommended for freshwater resources. While the rates recommended here may be appropriate for some tidal waters, a site evaluation should be conducted to ensure that the consumption rate of fish and shellfish from the tidal resource is not higher than the default. If an evaluation concludes that fish and shellfish consumption from a tidal resource may be greater than the default, a site-specific ingestion rate should be determined.

#### 5.0 Comparison with Other Relevant Fish Ingestion Rates

The new Massachusetts recommended adult ingestion rate of 32 g/d falls approximately at the mean (32.5 g/d) of the published recreational freshwater angler ingestion rates cited in a national overview below (Moya 2004). The updated value is slightly higher than the previous Massachusetts recommended fish ingestion value of 26 g/d, which was developed by MassDEP's Office of Research and Standards (ORS) and published in Appendix B of the Guidance for Disposal Site Risk Characterization. That recommendation was derived from the Maine Angler Survey (Ebert et al. 1993).

The new default rate is also within the range of other local and federal fish ingestion rates used for risk assessment, as seen in the following sources for comparison.

##### 5.1 National Overview (Moya 2004)

The available data that has been published on recreational fish ingestion vary greatly in reported consumption rates, as shown in an overview of both marine and freshwater fish consumption data (Moya 2004). Average published freshwater ingestion rates in

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the Moya 2004 overview range from 5 to 70 g/d for recreational freshwater anglers and 57 to 271 g/d for the Native American angling populations.

## 5.2 Federal Recommendations (USEPA)

The most recent USEPA Exposure Factors Handbook in support of the Superfund Program (1997) also provided a range of recommended values for freshwater angler fish consumption, from a low of 13 g/d based on the 95th percentile of the consuming anglers on rivers and streams only (not all waters) from Ebert et al. 1993 study to a high of 39 g/d based on the 96th percentile of the West et al. 1989 study. Other EPA recommendations as cited in California EPA 2001 are summarized in Table 1 below.

**Table 1: Fish Consumption Values Recommended in U.S. EPA Documents**

Source	Target Population	Default Consumption Rate (g/day)	Statistic of Dispersion
1989 Exposure Factors Handbook	recreational fishers	30	Median
		140	90th%
1989 Risk Assessment Guidance for Superfund Vol. I, Part A (RAGS)	finfish consumers (residential exposure)	38 (averaged over 3 days)	Median
		132	95th%
1991 RAGS Supplemental Guidance	recreational fishers	54 (2 meals/week)	Mean
	subsistence fishers	132 (4 meals/week)	95th%
1997 Exposure Factors Handbook	recreational fishers: Marine (Pacific coast)	2.0 6.8	mean 95th%
	Freshwater – ME; NY; MI; MI ME; NY; MI	5; 5; 12; 17 13; 18; 39	means 95th or 96th%
U.S. EPA, 2000a (fish advisory guidance, Volume I, 3rd edition)	recreational use	17.5	90th%
	subsistence use	142.4	99th%

The consumption rate values in Table 1 vary widely, reflecting differences due to climate, recreational versus subsistence ingestion rates, and marine versus freshwater fisheries.

## 5.3 Local Example (EPA's GE/Housatonic Human Health Risk Assessment)

The EPA's peer-reviewed risk assessment of adult and child consumers on the Housatonic River is generally relevant for Massachusetts freshwater anglers. The final Reasonable Maximum Exposure (RME) rate used for adults at the Housatonic River in the GE/Housatonic Human Health Risk Assessment was 31 g/d (EPA 2005, Appendix C of Vol. IV, pp 4-50 – 4-56).

The fish consumption rates for children ages 1-6 at the Housatonic River were one-half the adult intake rate. A child to adult intake rate ratio of 1:2 is consistent with ingestion rates reported in the U.S. Department of Agriculture's (USDA) 1994-1996 and 1998 *Continuing Survey of Food Intakes by Individuals* (CSFII) (USDA 2000). Those ingestion rates ranged from 23 to 205 g/d for child and from 47 to 506 g/d for adults. (EPA 2005)

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## 5.4 The State of California Approach

The California EPA recommends the use of a range of consumption values for risk assessment, stating:

“Until reliable data become available which describe consumption of freshwater sport fish in California, it is recommended that the rounded unadjusted values from the Santa Monica Bay study of 21 grams per day for the median, 50 grams per day for the mean, 107 grams per day for the 90<sup>th</sup> percentile, and 161 grams per day for the 95<sup>th</sup> percentile rate be used to estimate consumption from both marine and freshwater sources of sport fish and shellfish in California. These values are most applicable to fishers that consume sport fish and shellfish on a regular and frequent basis (*i.e.*, at least once a month). For cases where the target population is the general fishing population and fish is not a major exposure pathway, the adjusted (weighted) results of 30.5 grams per day for the mean value and 85.2 grams per day at the 95<sup>th</sup> percentile can be used.” (California EPA 2001).

With an unadjusted mean of 50 g/d, the majority of the California EPA recommended values are significantly higher than the 32 g/d adult rate proposed by MassDEP. The differences between the California EPA and MassDEP values are primarily due to the California inclusion of marine fish and shellfish and the warmer California climate that leads to more frequent fishing throughout the year.

## 6.0 Summary

In summary, the MassDEP default ingestion rates of 32 g/d for adults and 16 g/d for children are well within the range of values shown in published creel surveys and recommended by other government agencies. These intake rates are considered appropriate for any freshwater fishery in Massachusetts that could potentially support commensurate recreational fishing activities, at present or in the future.

## 7.0 References

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