

Calculating Human Health Criteria Part 1: Criteria Equations and Variables

**Proposed Rule Withdrawn on
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The Human Health Water Quality Criteria (HHC) are chemical-specific concentrations applied to surface waters. The HHC are developed to protect human populations from unacceptable risks to chemical exposures from surface-water.

- Assumes a lifetime (70 year) exposure for carcinogens, and up to 70 years for non-carcinogens.
- Assumes daily exposures through consumption of fish/shellfish from state waters and drinking untreated surface (fresh) water.
- Includes a Risk Level for cancer effects and a “no effects” Hazard Quotient level for non-carcinogens.

What Variables are Used to Calculate Human Health Criteria?

Variable	Abbrev.	Description	Value Used for Current Criteria	Value Used for Proposed Criteria	How are the Numeric Criteria Affected by the Change in Values?
Bioconcentration Factor	BCF	The bioconcentration factor is the degree to which a chemical in water is concentrated in fish tissue.	Chemical-specific	Remains the same	No change
Body Weight	BW	The average adult body weight of a person exposed to the chemical.	70 kilograms (kg) (about 154 lbs)	80 kilograms (kg) (about 176 lbs)	Increases each criterion proportional to the change in values.
Cancer Slope Factor	CSF	A value that expresses the potency of a carcinogen. CSF values are published or otherwise recommended by EPA.	Chemical-specific	Remains the same except where updated by EPA	No change except where updated by EPA. For updated values, the affect on each carcinogen's criterion is chemical-specific.
Drinking Water Intake	DI	The amount of drinking water consumed from untreated surface water each day. Drinking water is a chemical intake pathway (fish/shellfish consumption is the other chemical intake pathway from surface water). DI only applies to criteria for freshwater.	2 liters/day (about one-half gallon per day)	Remains the same	No change
Fish Consumption Rate	FCR	The amount of fish/shellfish consumed each day. Fish/shellfish consumption is a chemical intake pathway from surface water (drinking water is the other chemical intake pathway in freshwater).	Population average of 6.5 grams/day (about one-quarter ounce per day)	Representative of population averages: 175 grams/day (about 6 ounces per day)	Decreases each criterion. For each marine criterion, the decrease is proportional to the change in values. For freshwater, the decrease in each criterion is influenced by the chemical-specific bioconcentration factor (BCF) as well as the drinking water intake (DI). Chemicals with large BCFs have large decreases in criteria.
Reference Dose	RfD	Estimated value of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Applies to non-carcinogens. RfD values are published or otherwise recommended by EPA.	Chemical-specific	Remains the same except where updated by EPA	No change except where updated by EPA. For updated values, affect on each non-carcinogen criterion is chemical-specific.
Relative Source Contribution	RSC	A value that expresses the proportion of a reference dose that is considered allowable through surface water exposure (drinking water and fish/shellfish consumption). RSC is applied to non-carcinogens only.	1.0	Remains the same	No change
Risk Level	RL	The risk of one additional occurrence of cancer after a 70-year lifetime of daily exposures. RL is applied to carcinogens only.	10 ⁻⁶ (one-in-one million)	10 ⁻⁵ (one-in-one hundred thousand)	Increases each carcinogen criterion proportional to the change in values.

The Criteria Equations ... And Two Examples of Criteria Calculations

4 Equations to Calculate Human Health Criteria

	Freshwater Criteria (Consumption of Organisms and Water)	Marine Criteria (Consumption of Organisms Only)
Criteria for Carcinogens	$\frac{RL \times BW}{CSF \times [(FCR \times BCF) + DI]}$	$\frac{RL \times BW}{CSF \times FCR \times BCF}$
Criteria for Non-Carcinogens	$\frac{RfD \times RSC \times BW}{(FCR \times BCF) + DI}$	$\frac{RfD \times RSC \times BW}{FCR \times BCF}$

Example 1: Freshwater Criterion Calculation for Aldrin, a Carcinogenic Chemical

$$\text{Aldrin Criterion} = \frac{0.00001 (10^{-5}) \times 80 \text{ kg}}{17 (\text{mg/kg-d})^{-1} \times [(0.175 \text{ kg/d} \times 4,670 \text{ L/kg}) + \frac{2}{\text{L/d}}]} = 0.000000057 \text{ mg/L} = 0.000057 \text{ ug/L}$$

Example 1: Marine Criterion Calculation for Pyrene, a Non-Carcinogenic Chemical

$$\text{Pyrene Criterion} = \frac{0.03 \text{ mg/kg-d} \times 1.0 \times 80 \text{ kg}}{0.175 \text{ kg/d} \times 30 \text{ L/kg}} = 0.457 \text{ mg/L} = 457 \text{ ug/L}$$

Note: CSF units are (mg/kg-d)⁻¹; RfD units are mg/kg-d; BCF units are L/kg; for FCR, 175 g/d = 0.175 kg/d