Florida Department of Environmental Protection

# Proposed Revisions to Florida's Human Health-Based Water Quality Criteria

## Treasure Coast Regional Planning Council Meeting
## June 17, 2015





# Background

- A Human Health Ambient Water Quality Criterion (HHC) is the highest concentration of a pollutant in water that is not expected to pose a significant risk to human health
- Two types of HHC:
  - Protection from ingesting aquatic organisms
  - Protection from ingesting aquatic organisms and water
- Objective:  set criteria that allow Floridians to safely eat Florida fish and drink local tap water their entire lives

# Florida Rulemaking History

**2012**

- DEP held workshops on HHC, and proposed criteria developed using Probabilistic Risk Analysis (PRA).

**2012**

- DEP convened the Human Health Peer Review Committee (HHPRC) to review and comment on the state's approach.

**2013**

- FDEP revised its approach based on HHPRC feedback and held additional workshops.

**2013**

- FDEP presented HHC to the ERC on April 23, 2013.
- The ERC voted to continue the rulemaking **and provided specific directions on areas to address**.

**2014**

- FDEP updated the HHC based on feedback from ERC, and submitted draft technical document to EPA for review on Feb. 14, 2014 .

# April 2013 ERC Feedback

- The department should evaluate regionalized or state-level fish consumption patterns
- If possible, consider use of a statistical approach that better takes into consideration usual fish consumption rates
  - National Cancer Institute methodology
- Review and if possible develop parameter-specific relative source contributions (RSC) for non-carcinogens
- Re-evaluate the averaging period for non-carcinogenic chemicals

# Florida Rulemaking History

**2014**

- May 2014 EPA published draft revised national HHC recommendations, and requested that the state wait until after the comment period ended for an EPA response.

**2015**

- **On June 29, 2015 EPA published revised national HHC recommendations.**

**2015**

- September 3, 2015, EPA provided written comments on FDEP's Feb. 2014 HHC.

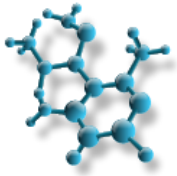
**2016**

- January 2016 EPA, posted supplemental information on their website, explaining the calculation of the revised bioaccumulation factors (BAFs).

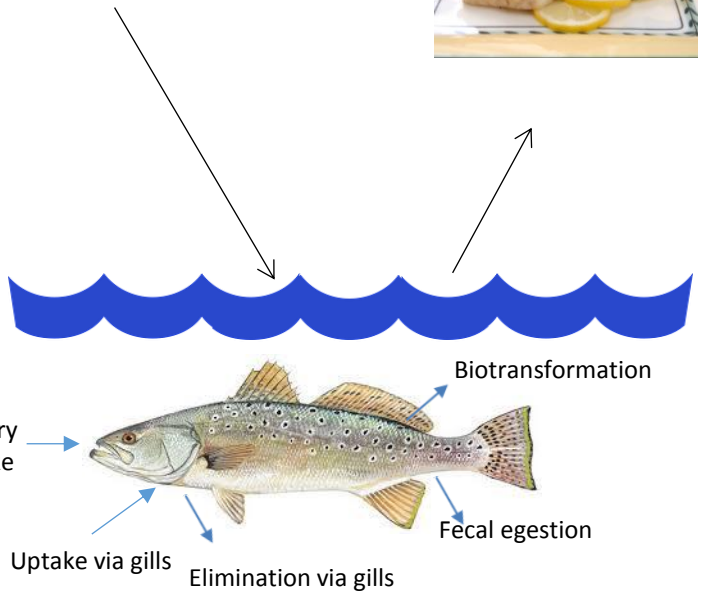
# Deriving Human Health Criteria

## Function of toxicity, exposure, sensitivity, and risk

### Pollutant toxicity



- Cancer Potency
- Reference dose



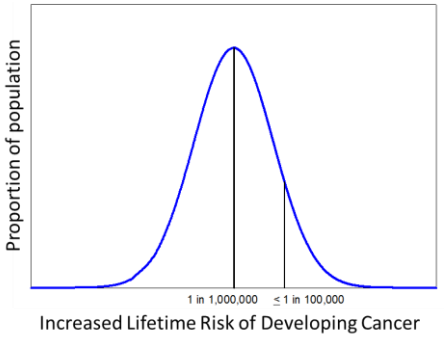

### Exposure

### Other Factors

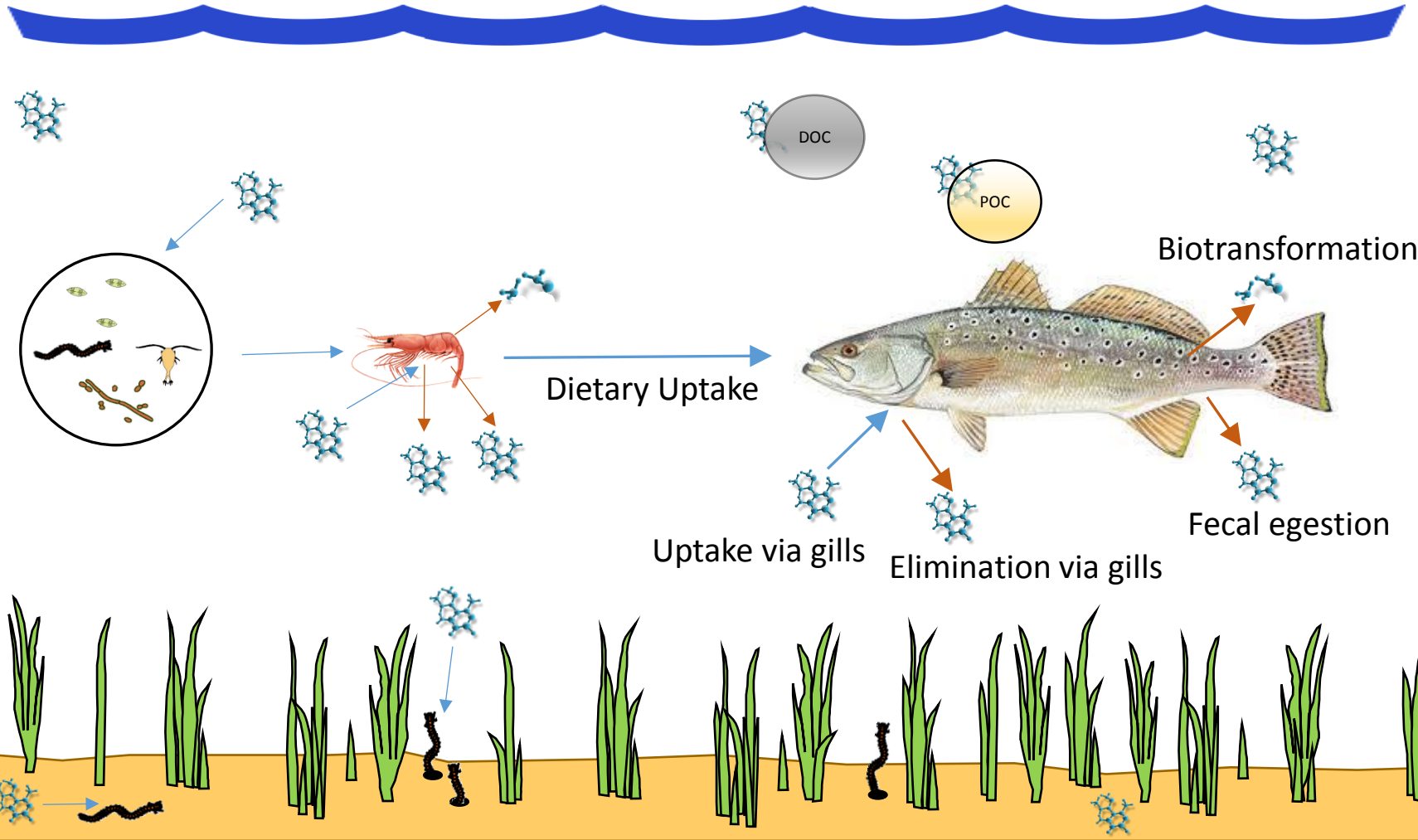
#### Body Weight

#### Non-CWA Exposure

### Risk



# Bioconcentration versus Bioaccumulation



# Human Health Criteria
## Input Comparison

| Assumption/Input | FL's Existing Criteria | 2015 National Recommendation | Florida Approach |
|---|---|---|---|
| **Body Weight (BW)** | 70 kg<br>(Mean) | 80 kg<br>(Mean) | Distribution based on the same source as EPA's 2015 Recommendation |
| **Drinking Water Consumption (DI)** | 2.0 L/day<br>(86th Percentile) | 2.4 L/day<br>(90th Percentile) | Distribution based on the same source as EPA's 2015 Recommendation |
| **Fish Consumption Rate (FCR)** | 6.5 g/day<br>(Mean consumption) | (Mean) 90th Percentile<br><br>TL2: (3.1) 7.6 g/day<br>TL3: (3.6) 8.6 g/day<br>TL4: (2.3) 5.1 g/day<br>Total: (9.2) 21.3 g/day | Trophic level specific distributions for Gulf Coast, Atlantic, and Inland South and a distribution for proportion FL population in each region<br>(Source: EPA Analysis of NHANES data, 2014) |
| **Bioconcentration (BCF) Bioaccumulation (BAF)** | Parameter specific BCF<br>(lab tests) | Parameter specific BAFs by trophic level[1] | Parameter specific BAFs by trophic level[1]<br>(Adjusted for FL Conditions) |
| **Toxicity (RfD and CSF)** | IRIS values | Latest values following hierarchy of sources[2] | Latest values following hierarchy of sources (Same as EPA) |
| **RSC (non-carcinogens)** | 0.2-1.0<br>(Most at 1.0) | 0.2-0.8<br>(Most at 0.2) | 0.2-0.8<br>(Same as EPA) |
| **Cancer Risk** | 1:1,000,000 | 1:1,000,000[3] | 1:1,000,000 and 1:100,000 |

1. BCF where there were insufficient data to derive BAFs for all three trophic levels.
2. DOH concurred with EPA's approach and concluded they followed a defensible approach.
3. EPA guidance allows states to set risk level between 1:1,000,000 and 1:100,000 based on state policy, provided highly exposed populations are protected at 1:10,000

# Policy Choices on Setting Criteria

- Florida Statutes for waste cleanup state (376.30701, F.S.) that levels should represent "extremely low risk"
  - one in a million, $10^{-6}$, 1.0E-6 increase
- Florida Department of Health issues fish consumption advisories at levels that represent "very low risk"
  - One in one hundred thousand, $10^{-5}$, 1.0E-5 increase

**Conclusion: The average Floridian should be protected at the extremely low risk, the higher risk population should be protected at better than the very low risk, and subsistence fisherman should be protected at better than the low risk ($10^{-4}$) or one in ten thousand**

# Florida BAFs and BCFs

- EPA specifically encourages States to use local or regional data on the organic carbon content of applicable waters when adopting criteria into their water quality standards (USEPA, 2003)
- Additionally, EPA encouraged States and authorized Tribes to use local or regional data on the lipid content and consumption rates of consumed aquatic species
  - The use of such locally or regionally derived data is encouraged over national-scale data because local or regional consumption patterns of fish and shellfish (and thus the amount of lipid consumed from aquatic organisms) can differ from national consumption patterns

# Florida BAF Calculation

- **Florida BAF values were normalized to the trophic level lipid content and adjusted by the fraction (of the chemical) freely dissolved in water based on DOC and POC concentrations**
- **FDEP used IWR Run 50 data to calculate DOC and POC medians for Florida waters**
  - Data collected between 1980 and 2015
  - Data handling conducted consistent with EPA's analysis of nationwide data
  - Median values calculated based on WBID medians

| Parameter | FL Median (kg/L) |
|---|---|
| Dissolved Organic Carbon (DOC) | $1.2 \cdot 10^{-5}$ |
| Particulate Organic Carbon (POC) | $6.0 \cdot 10^{-7}$ |

| Trophic Level | FL Trophic Level Lipid Content (%) |
|---|---|
| 2 | 1.8 |
| 3 | 1.5 |
| 4 | 2.0 |

# HHC Equations

- Non-cancer Effects:

$$SWQC(\mu g/L) = \frac{\left[RfD\ \left({}^{mg}/_{kg \cdot d}\right) x\ RSC\right] \times BW(kg) \times 1{,}000(\mu g/mg)}{DI\ (L/d) + \Sigma_{i=2}^{4}[FCR_i\ \left({}^{kg}/_{d}\right) \times BAF_i\ \left({}^{L}/_{kg}\right)]}$$

- Cancer Effects:

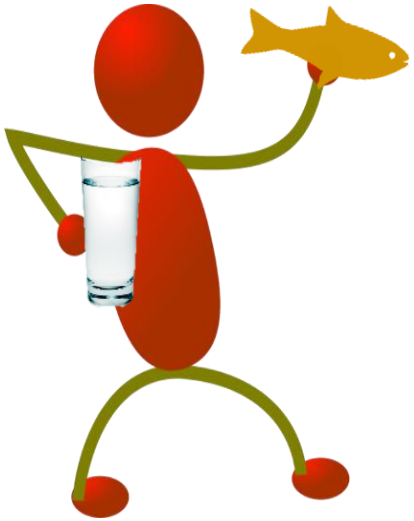
$$SWQC(\mu g/L) = \frac{[Risk/CSF\ \left({}^{mg}/_{kg \cdot d}\right)] \times BW\ (kg) \times 1{,}000\ (\mu g/mg)}{DI\ (L/d) + \Sigma_{i=2}^{4}[FCR_i\ \left({}^{kg}/_{d}\right) \times BAF_i\ \left({}^{L}/_{kg}\right)]}$$

Where:

*SWQC* = surface water quality criterion (mg/L)
*RfD* = parameter-specific reference dose (mg/kg-day)
*RSC* = Relative source contribution factor to account for non-water sources of exposure
*CSF* = Cancer slope factor (mg/kg-day)
*Risk* = Incremental life-time increased cancer risk ($10^{-6}$ or $10^{-5}$)
*BW* = body weight (kg)
*DI* = drinking water intake, from surface water sources (L/day)
$FCR_i$ = fish consumption rate for aquatic TLs 2, 3, and 4 (kg/day)
$BAF_i$ = bioaccumulation factor for aquatic TLs 2, 3, and 4 (L/day) or BCF for all trophic levels

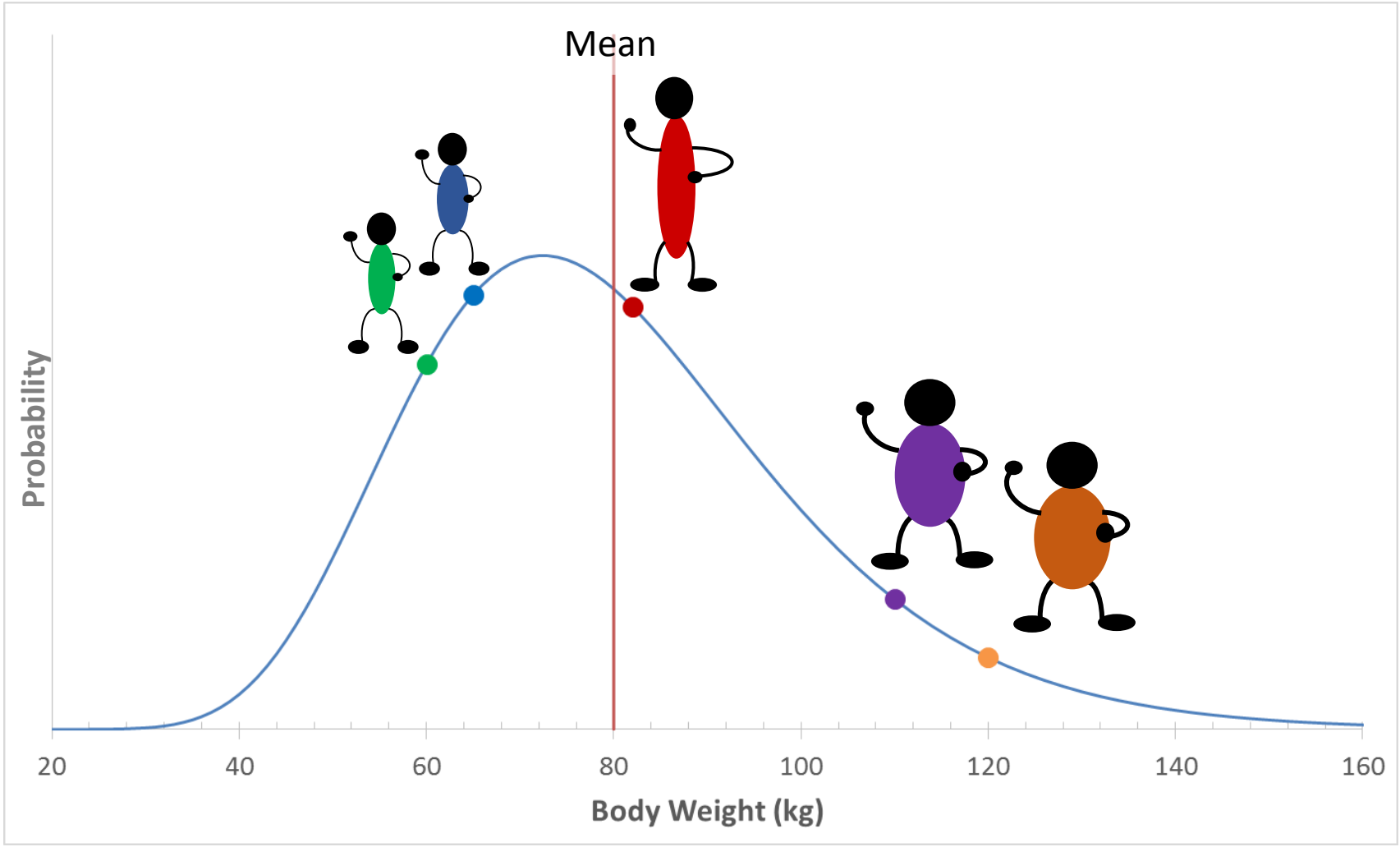
$\Sigma^{4}_{i=2}$ = summation of values for aquatic trophic levels (TLs), where the letter *i* stands for the TLs to be considered, starting with TL2 and proceeding to TL4.

# Deterministic Approach

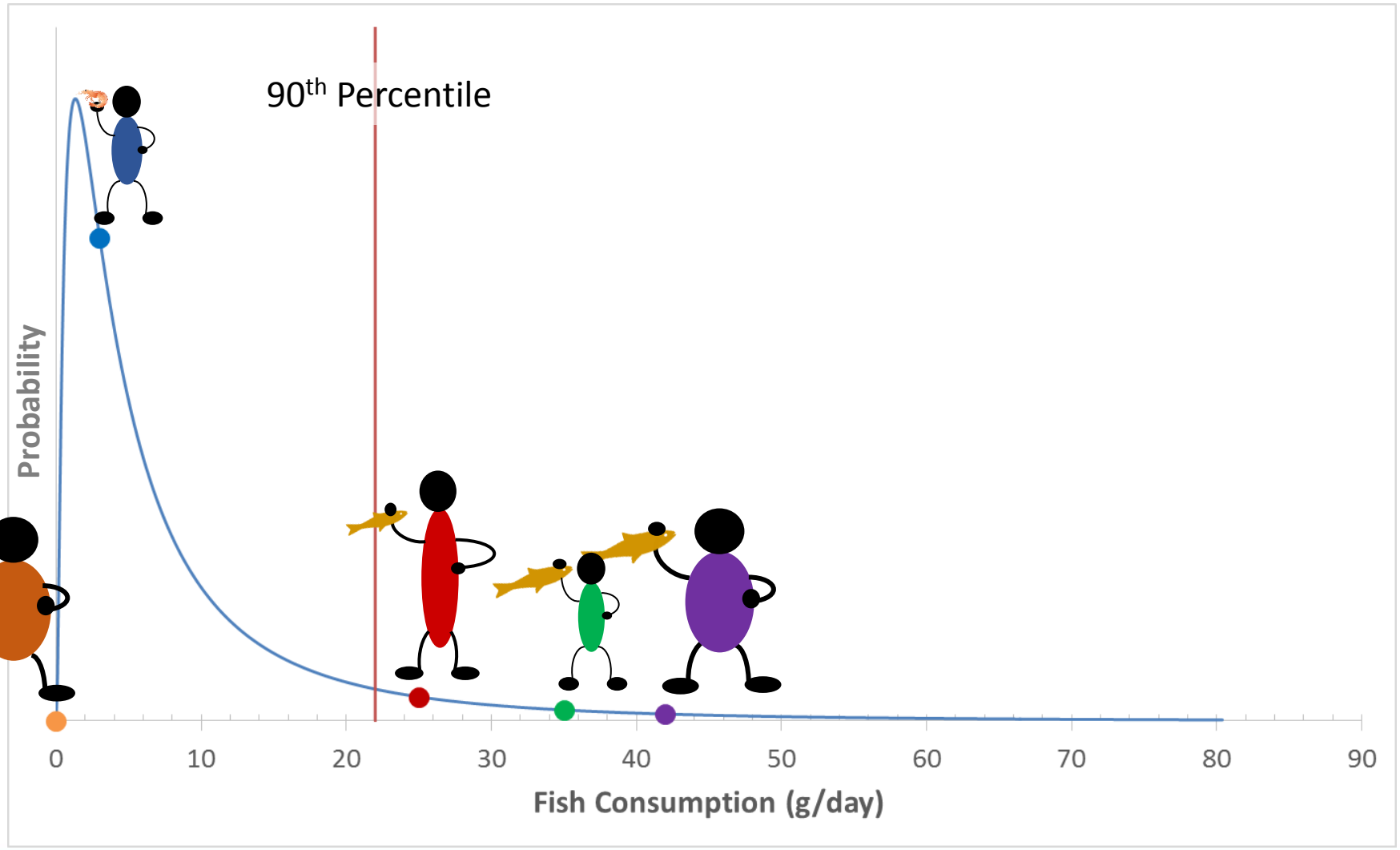


Body weight: 80 kg
Drinking Water: 2.4 L/day
Fish consumption: 22 g/day

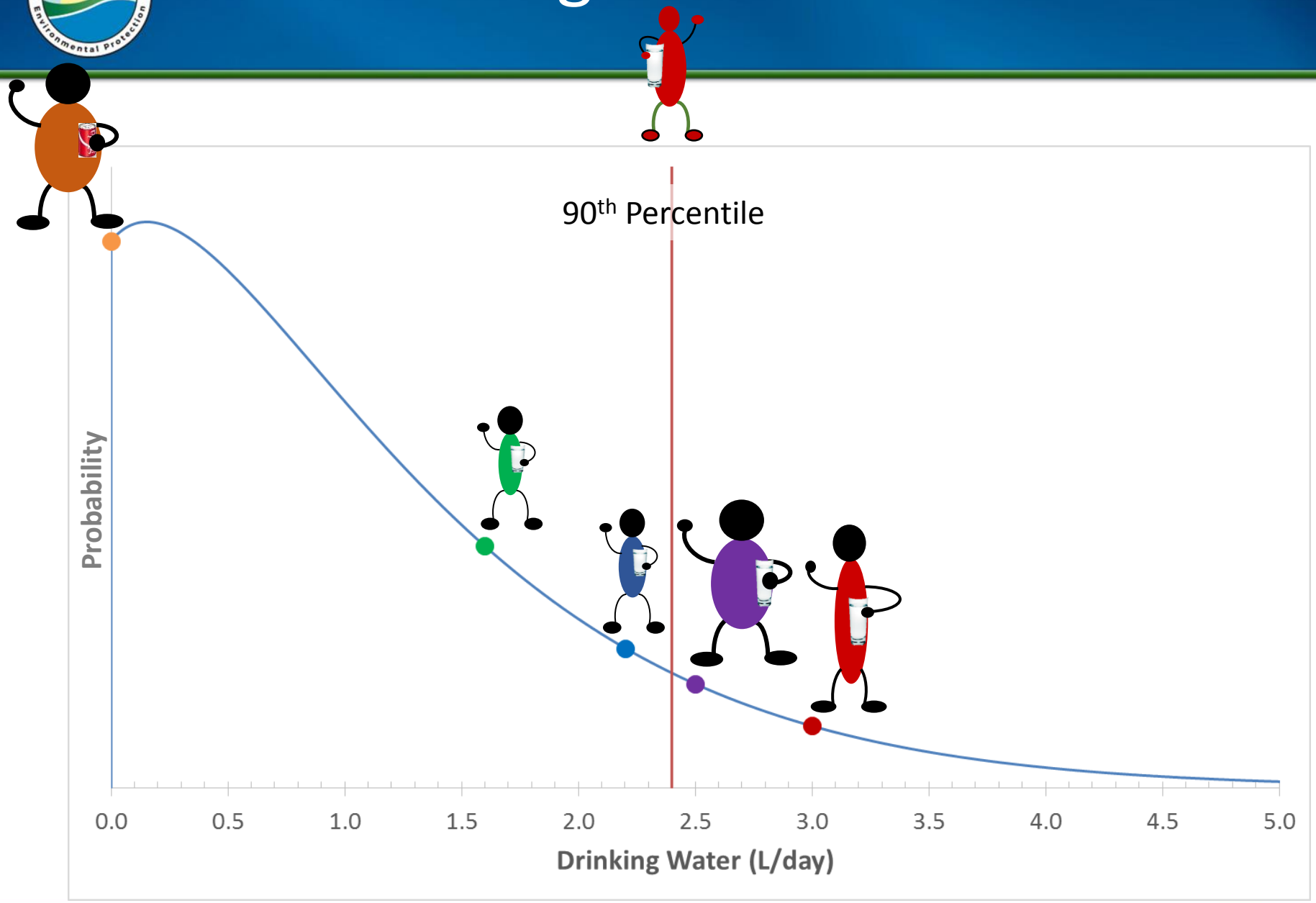
# Body Weight Variation



# Fish Consumption Variation



# Drinking Water Variation



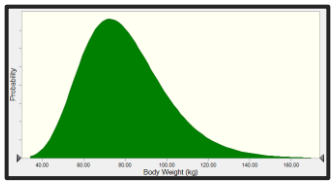
# Probabilistic Alternative

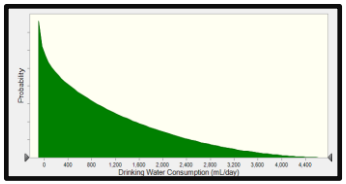
- Variability within the population affects exposure and risk
- Populations are better described using distributions than point values
  - Risks are calculated for the target population based on these distributions
  - Provides a more complete assessment of risk to the entire population
- Probabilistic approach can help focus the discussion on risk
  - Still requires selection and description of target populations
  - Still need to make policy decisions regarding acceptable risk levels

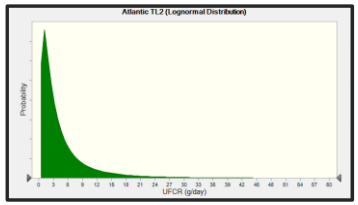
# Input Distribution Sources

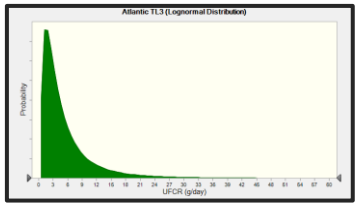
- **Body weight: EPA *2011 Exposure Factors Handbook Table 8-25***
- **Drinking water: EPA *2011 Exposure Factors Handbook* Table 3-23**
- **Fish consumption: EPA 2015, *Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (NHANES 2003-2010)***
  - **Trophic Level 2: EPA 2015 Table E-13**
  - **Trophic Level 3: EPA 2015 Table E-14**
  - **Trophic Level 4: EPA 2015 Table E-15**

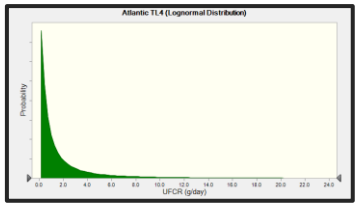
# Probabilistic Risk Analysis Monte Carlo



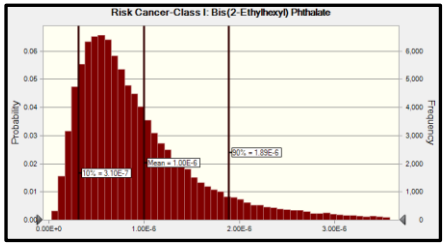



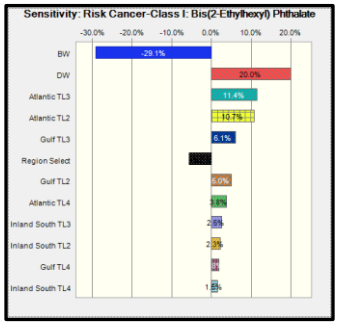

Inputs

Inputs

Model (Mathematical Functions)

Outputs

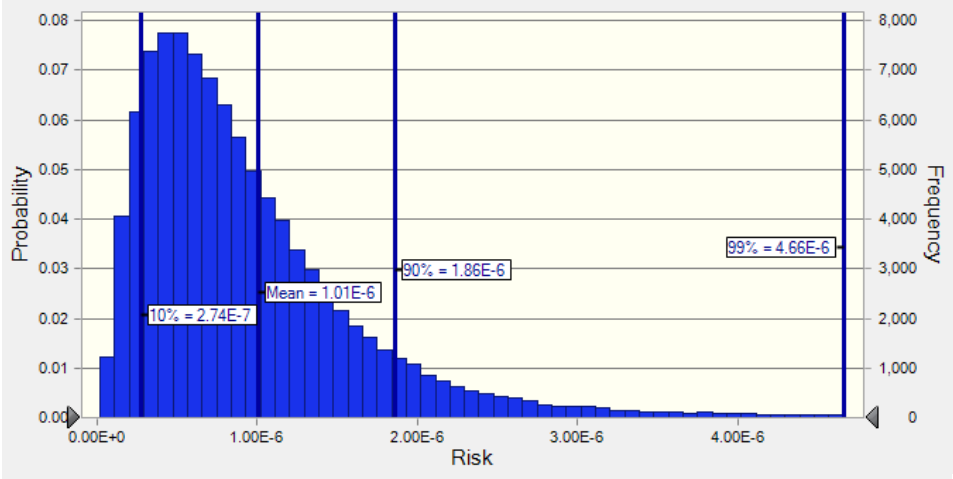


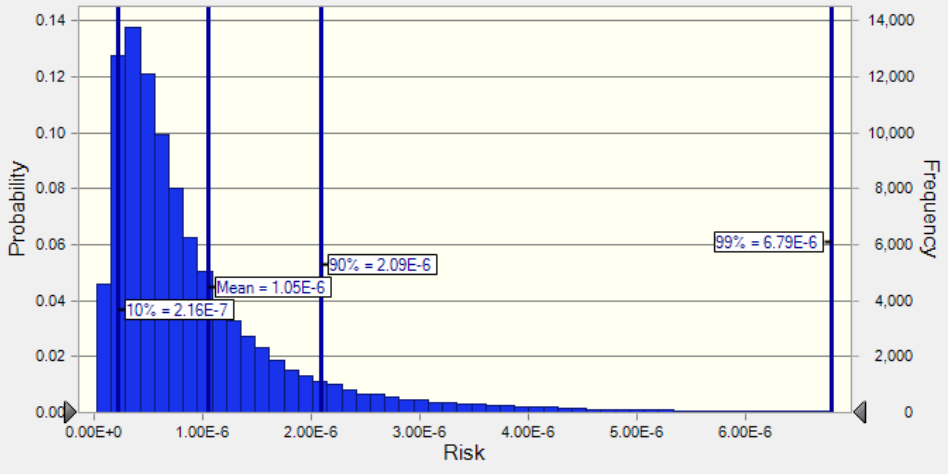
# Example Carcinogen Risk Assessment

## Pentachlorophenol

Class I
Criterion: 0.067 µg/L




Class III
Criterion: 0.11 µg/L



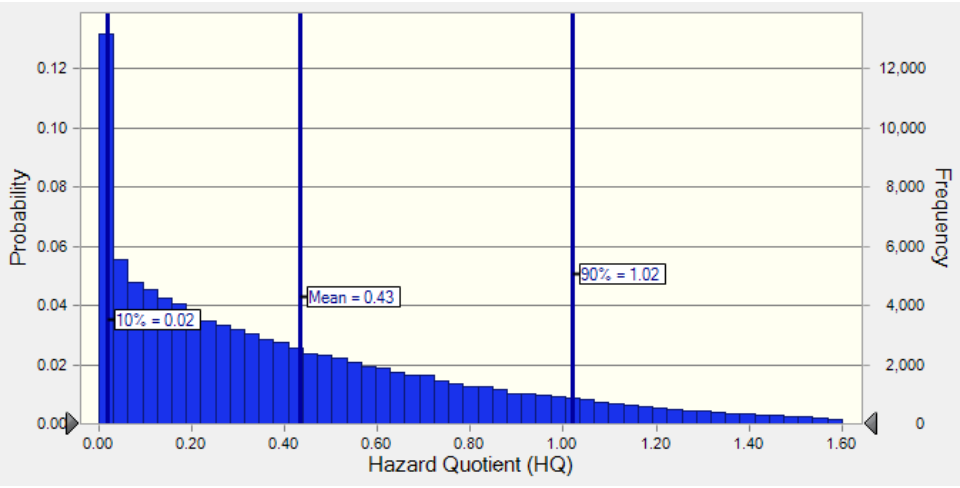

Risk objectives:

1. Mean Risk ≤ 1E-6 ($10^{-6}$) ✓
2. 90$^{th}$ Percentile risk ≤ 1E-5 ($10^{-5}$) ✓
3. High end risk ≤ 1E-4 ($10^{-4}$) ✓

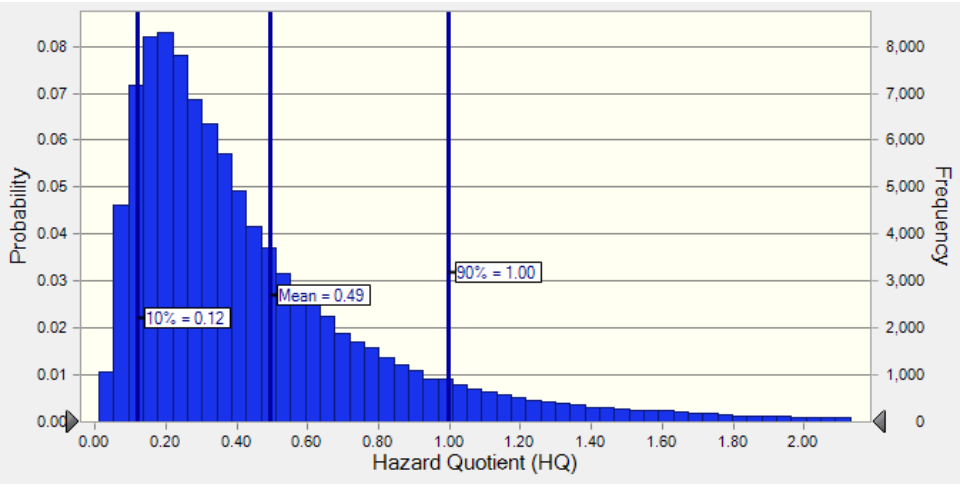
# Example Non-Carcinogen Risk Assessment

## Chloroform

Class I
Criterion: 61 µg/L




Class III
Criterion: 2300 µg/L




Risk objective: Hazard Quotient ≤ 1.0

# Criteria Duration

- **HHC for carcinogenic compounds historically expressed as annual averages based on long-term studies (≥ 1 year), while HHC for non-carcinogens previously expressed as single-sample maximums because they were presumed to be more short-term effects**
- **Given EPA's use of duration specific uncertainty factors to approximate chronic exposures, the department proposes HHC for non-carcinogens also be expressed as annual averages**
  - **No minimum sample size for annual average**

# Summary

- Revised 43 existing human health criteria using newest scientific data
  - approximately half of the revised criteria are higher than the existing criteria, while the other half are lower than the existing criteria
- Proposed human health criteria for 39 new compounds
- Proposed criteria are based on regional or Florida-specific data where possible

# More Info

http://www.dep.state.fl.us/water/wqssp/health.htm

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