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TISSUE SCREENING LEVEL GUIDELINES FOR ISSUANCE OF PUBLIC HEALTH ADVISORIES FOR SELECTED CONTAMINANTS

and

Supporting Documentation

Louisiana Department of Environmental Quality
Louisiana Department of Health and Hospitals
Louisiana Department of Wildlife and Fisheries
Louisiana Department of Agriculture and Forestry

Tissue Screening Levels (TSL) are "screening values which are defined as concentrations of contaminants in fish or shellfish tissue that when exceeded may pose potential public health concern and that are used as thresholds against which levels of contamination in similar tissue collected from the ambient environment can be compared.""If the mean concentration of a contaminant in fish / shellfish tissue exceeds the TSL, then the waterbody, contaminant(s), and / or fish / shellfish species of potential concern are further evaluated. The screening process provides a rapid measure for identifying waterbodies, chemicals, and fish / shellfish species of potential concern." It is important to note that the screening process does not replace or supersede the formal advisory process as set forth in Louisiana's *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish*.

"The EPA-recommended risk-based methods for developing screening values are presented in the U.S. EPA's "*Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories*" (EPA, 2000). Methods presented in the EPA guidance document were used in conjunction with the assumptions presented in Table 1" of *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish* "to develop Louisiana fish-tissue screening levels."

"The protocol is designed to provide standardized guidelines regarding the development and issuance of fish and shellfish consumption advisories while allowing for the incorporation of site-specific data that are reliable and validated." "The TSL will be revised as needed to ensure that the advisory process is based on the most current toxicity and exposure information available."[1]

[1]Quoted text from "*Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish*". LDEQ, LDHH, LDWF, and LDAF (2010).

SELECT TISSUE SCREENING LEVELS [1]

Contaminant	Noncarcinogenic Screening Level [2] (ug/kg)	Carcinogenic Screening Level [3] (ug/kg)	FINAL SCREENING LEVEL (ug/kg)
Cadmium	2300	---	**2300**
Methylmercury	230	---	**230**
Polychlorinated biphenyls (PCB)	---	270	**270**
Total TEQ	1.6	3.6 (ppt)	**1.6 ppt**
Chlordane	1200	1600	**1200**
DDD	---	2300	**2300**
DDE	---	1600	**1600**
DDT	---	1600	**1600**
Dieldrin	130	34	**34**
Endosulfan	14,000	---	**14,000**
Endrin	700	---	**700**
Heptachlor	1200	120	**120**
Hexachlorobenzene	1900	340	**340**
Lindane	700	420	**420**
Mirex	470	300	**300**
Toxaphene	---	500	**500**

[1]Both noncarcinogenic and carcinogenic risk-based screening levels are presented. The lower of the two values shall be used as the tissue screening level

[2]The noncarcinogenic screening levels are based on a target hazard quotient (THQ) of 1.0. If multiple noncarcinogens that affect the same target organ or have the same critical effect are present in the tissue, the noncarcinogenic screening levels may need to be adjusted downward to account for potential additive health effects.

[3]The carcinogenic screening levels are based on a target risk (TR) of 1E-04. If multiple carcinogens are present, the carcinogenic screening levels may need to be adjusted downward to prevent the total cancer risk from exceeding 1E-04.

A TSL may be calculated using an appropriate toxicity value and the equations and assumptions presented in this document. The TSLs presented here are based on default assumptions but TSLs can also be developed using site-specific exposure data if available, reliable and validated. Similarly, different TSLs may be used when toxicity factors are updated. Other toxicity factors such as ATSDR's chronic oral Minimal Risk Levels (MRLs), may be used to develop TSLs where appropriate to protect sensitive sub-populations. All TSLs are subject to the Agencies' approvals.

Adjust TSL for Additive Health Effects (if warranted)

If more than one COC is present in fish/shellfish tissue, the screening process should include the calculation of a total hazard index for each target organ/critical effect and/or a total cancer risk prior to screening a waterbody from further consideration in the advisory process.

Noncarcinogens.

If multiple noncarcinogenic COC are present in fish/shellfish tissue that have the same target organ or elicit the same critical effect, a total hazard index shall be calculated for each target organ/critical effect. The target organ/critical effect identified for this evaluation should be the target organ/critical effect on which the RfD is based. This information can be obtained from IRIS. The total hazard index for each target organ/critical effect can be calculated as follows:

$$THI = [(C_1/TSL_1) + (C_2/TSL_2) + \ldots + (C_i/TSL_i)$$

where:

THI = total hazard index for a target organ/critical effect
C_i = arithmetic mean concentration in tissue for the i^{th} contaminant;
TSL_i = tissue screening level for tissue for the i^{th} contaminant.
The THI should be less than or equal to one (1.0) for each target organ/critical effect. If the THI exceeds unity, then proceed to the development of an advisory (see Section 2.2 in the *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish*).

Refer EPA's Integrated Risk Information System for the target organs and critical effects.

Carcinogens.

If multiple carcinogens are present calculate a total cancer risk as follows:

$$TCR = [(C_1/TSL_1) + (C_2/TSL_2) + \ldots + (C_i/TSL_i) \times 10^{-4}$$

where:

TCR = total cancer risk
C_i = arithmetic mean concentration in tissue for the i^{th} contaminant; and
TSL_i = tissue screening level for tissue the i^{th} contaminant.

The TCR should be less than or equal to 1×10^{-4}. If the total cancer risk exceeds 1×10^{-4}, then proceed to the development of an advisory (Section 2.2 of the above mentioned Protocol)

Supporting Documentation for the Calculation of the Tissue Screening Levels

Noncarcinogenic TSL = $\frac{THQxBWxATx365days/yr}{EFxEDx(1/RfD_o xIRF)}$

Where:

Parameter	Definition (units)	Input value
TSL	Tissue screening level (mg/kg)	***
THQ	Target hazard quotient	1
BW	Body weight (kg)	70
AT	Averaging time (years)	30
EF	Exposure frequency (days/year)	365
ED	Exposure duration (years)	30
RfD	Reference dose (mg/kg-day)	Chemical-specific
IRF	Fish ingestion rate (g/day)	30

Carcinogenic TSL = $\frac{TRxBWxATx365days/yr}{EFxEDx(CSFxIRF)}$

Parameter	Definition (units)	Input value
TSL	Tissue screening level (mg/kg)	***
TR	Target cancer risk	1E-04
BW	Body weight (kg)	70
AT	Averaging time (years)	70
EF	Exposure frequency (days/year)	365
ED	Exposure duration (years)	30
CSF	Cancer slope factor (risk per mg/kg-day)	Chemical-specific
IRF	Fish ingestion rate (g/day)	30

To convert from mg/kg (ppm) to ug/kg (ppb), multiply by 1000.

To convert from mg/kg (ppm) to ng/kg (ppt), multiply by 1,000,000.

Select Toxicity Factors: Reference Doses and Cancer Slope Factors [a]

Contaminant	Reference Dose (mg/kg-day)	Cancer Slope Factor [(mg/kg-day)$^{-1}$]
Cadmium	1E-03	---
Methylmercury	1E-04	---
Polychlorinated biphenyls (PCB)	---	2E+00
Chlordane	5E-04	3.5E-01
DDD	---	2.4E-01
DDE	---	3.4E-01
DDT	---	3.4E-01
Dieldrin	5.5E-05	1.6E+01
Endosulfan	6E-03	---
Endrin	3E-04	---
Heptachlor	5E-04	4.5E+00
Hexachlorobenzene	8E-04	1.6E+00
Lindane	3E-04	1.3E+00 [b]
Mirex	2E-04	1.8E+00 [b]
Toxaphene	---	1.1E+00
Total TEQ [c]	7E-10	1.56E+05

[a]The toxicity values presented here are reference doses and cancer slope factors from EPA's Integrated Risk Information System (IRIS) ,except where noted, Other toxicity values such as ATSDR's chronic oral Minimal Risk Levels (MRLs), may be applied as appropriate to protect sensitive sub-populations (e.g., use of cadmium and endosulfan MRLs). All toxicity factors are subject to the Agencies' approvals and can be revised when current values are updated. [b]Obtained from EPA's Health Effects Assessment Summary Tables (HEAST).

[c]Includes dioxin, furan, and PCB congeners with 2,3,7,8-TCDD-like activity.

Dioxin, Furan, and PCB Congener Toxicity Equivalent Factors (TEF)

Congener	**TEF**
Chlorinated dibenzo-p-dioxins	
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0003
Chlorinated dibenzofurans	
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.03
2,3,4,7,8-PeCDF	0.3
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.0003
Non-ortho substituted PCBs	
PCB 77	0.0001
PCB 81	0.0003
PCB 126	0.1
PCB 169	0.03
Mono-ortho substituted PCBs	
PCB 105	0.00003
PCB 114	0.00003
PCB 118	0.00003
PCB 123	0.00003
PCB 156	0.00003
PCB 157	0.00003
PCB 167	0.00003
PCB 189	0.00003
Reference: Van den Berg *et al*., 2006. The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds. Tox. Sci. Advance Access, 7 July.	

Calculation of the Total TEQ for Dioxins, Furans, and/or PCB Congeners

Polychlorinated dibenzodioxins (PCDD), dibenzofurans (PCDF), and polychlorinated biphenyls (PCB) shall be evaluated using the total TEQ approach. The TEF values presented above in combination with the site-specific tissue data shall be used to calculate a total toxic equivalent concentration (TEQ) in each species of concern as follows:

$$\text{Total TEQ} = \sum_{n1} [PCDD_i \times TEF_i] + \sum_{n2} [PCDF_i \times TEF_i] + \sum_{n3} [PCB_i \times TEF_i].$$

where:

Parameter	**Definition**
Total TEQ	Total Toxic Equivalent Concentration
PCDD	Concentration of PCDD congener in tissue
PCDF	Concentration of PCDF congener in tissue
PCB	Concentration of PCB congener in tissue
TEF	Congener-specific toxic equivalent factor

The total TEQ for each species shall be compared to the TSL for Total TEQ.