NU-WEST INDUSTRIES, INC.

Revised Nu-West Proposal for Site-Specific Selenium Criteria

Idaho DEQ Rulemaking

July 25, 2017

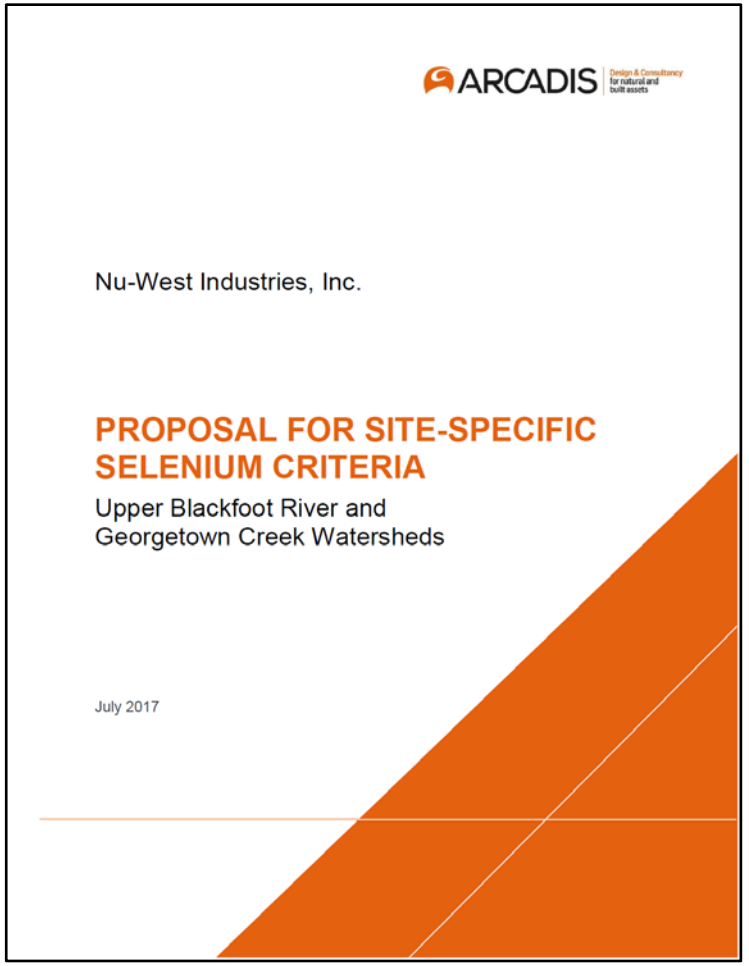
Boise, Idaho

Discussion Topics

Nu-West Revised Se SSC Proposal

(*July 21, 2017 version*)

- Comments
- Revisions
- Technical and Regulatory Basis for SSC



Summary of Revised Tissue SSC Elements

Tissue Element	June 2017 Proposal	
	SSC (mg Se/kg dw)	Rationale
Egg/Ovary	**25.3^{UBR} / 21.0^{GTC}**	Most sensitive GMCV

Summary of Revised Tissue SSC Elements

Tissue Element	June 2017 Proposal		July 2017 Proposal	
	SSC (mg Se/kg dw)	Rationale	SSC (mg Se/kg dw)	Rationale
Egg/Ovary	**25.3^{UBR} / 21.0^{GTC}**	Most sensitive GMCV	**24.5^{UBR} / 21.0^{GTC}**	Most sensitive species (SMCV) (*O. mykiss* in UBR; *S. trutta* in GTC)

Summary of Revised Tissue SSC Elements

Tissue Element	June 2017 Proposal		July 2017 Proposal	
	SSC (mg Se/kg dw)	**Rationale**	**SSC (mg Se/kg dw)**	**Rationale**
Egg/Ovary	**25.3^{UBR} / 21.0^{GTC}**	Most sensitive GMCV	**24.5^{UBR} / 21.0^{GTC}**	Most sensitive species (SMCV) (*O. mykiss* in UBR; *S. trutta* in GTC)
Muscle	**14.3**	Most sensitive GMCV	**12.8**	Most sensitive species (*O. mykiss*)

Summary of Revised Tissue SSC Elements

Tissue Element	June 2017 Proposal		July 2017 Proposal	
	SSC (mg Se/kg dw)	Rationale	SSC (mg Se/kg dw)	Rationale
Egg/Ovary	**25.3^{UBR} / 21.0^{GTC}**	Most sensitive GMCV	**24.5^{UBR} / 21.0^{GTC}**	Most sensitive species (SMCV) (*O. mykiss* in UBR; *S. trutta* in GTC)
Muscle	**14.3**	Most sensitive GMCV	**12.8**	Most sensitive species (*O. mykiss*)
Whole Body	**11.6**	Most sensitive GMCV	**12.5**	Most sensitive species (*O. mykiss*), using genus-specific conversion factor

Proposed Se SSC:

- Reflects the fish-centric nature of USEPA (2016) criterion
- Reflects the limited fish assemblage at each Site
- Protects all resident aquatic life
- In accordance with USEPA and Idaho regulatory guidance

Regulatory Basis for SSC Approach

40 CFR § 131.11 (*Criteria*):

In establishing criteria, States should:

(1) Establish numerical values based on:

(i) 304(a) Guidance; or

(ii) 304(a) Guidance modified to reflect site-specific conditions; or

(iii) Other scientifically defensible methods

USEPA (1994) Recalculation Guidance:

- For sites that support only a narrow mix of species relative to the criteria dataset, if data are available for at least one species in each family that occurs at the Site, the lowest species-specific toxicity value is used for the SSC for the Site.

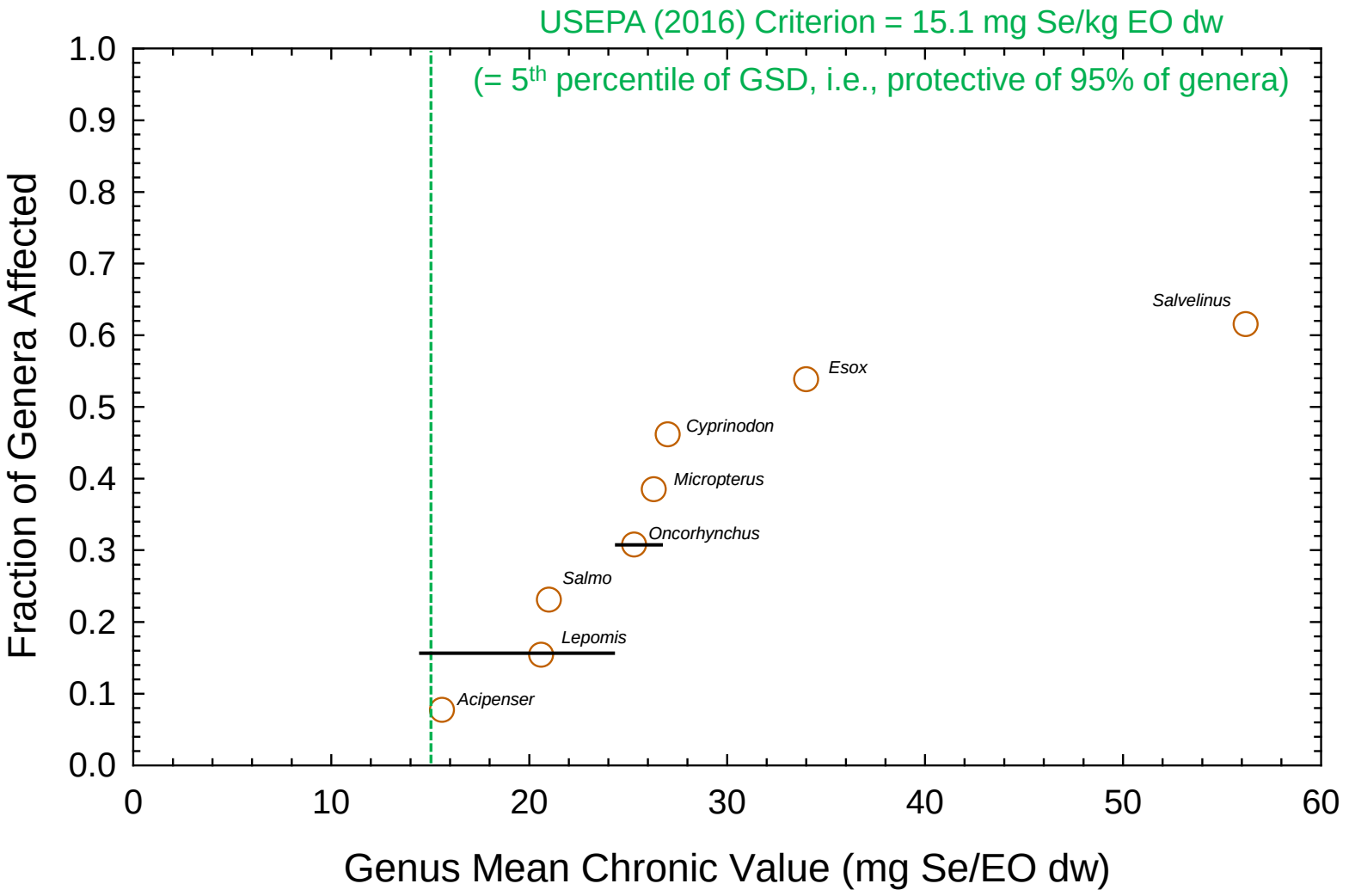
Regulatory Basis for SSC Approach

Idaho Administrative Code (IDAPA 58.01.02)

Acceptable procedures for developing SSC:

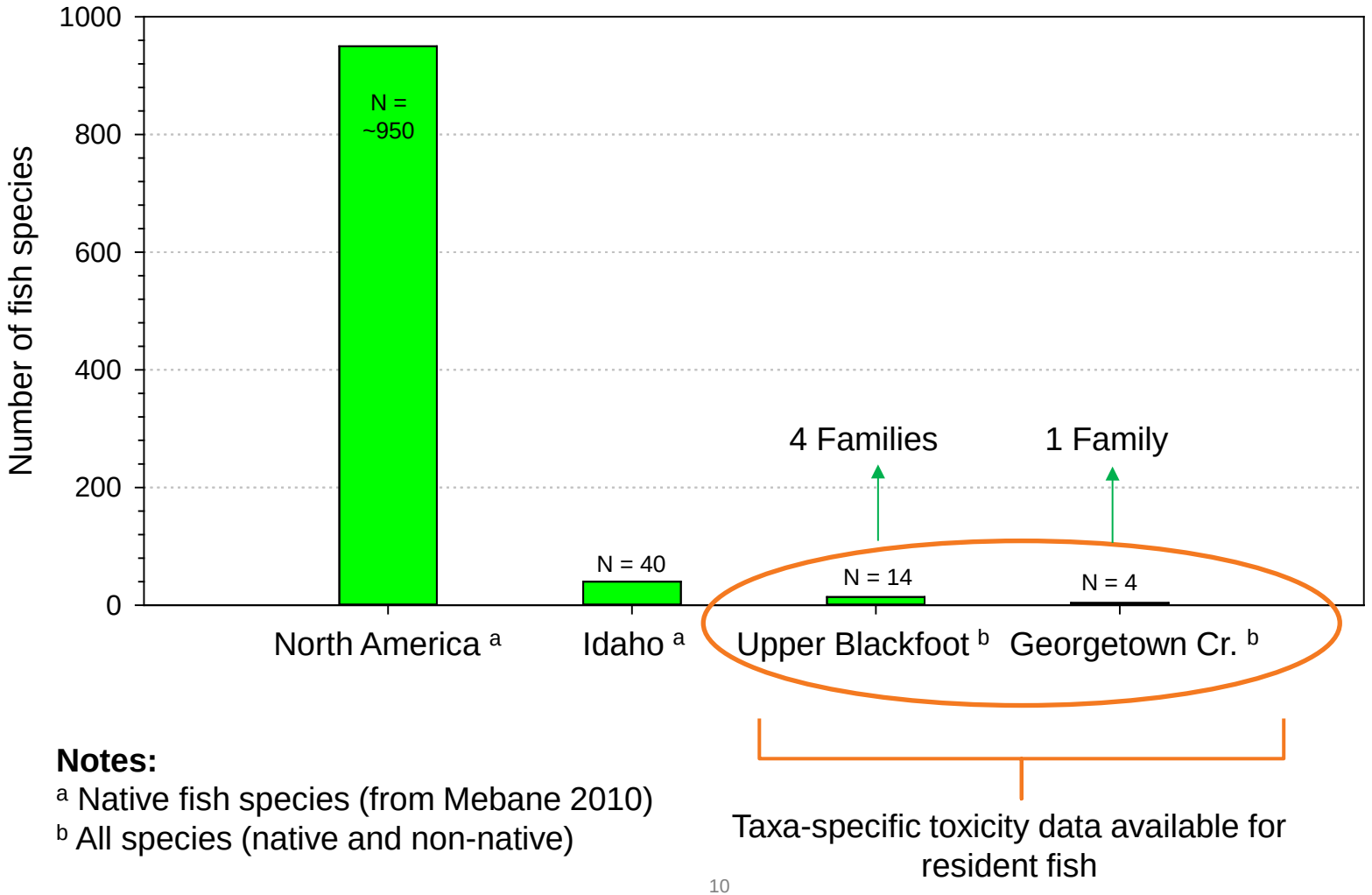
- Recalculation Procedure
- Other scientifically defensible procedures
  - *Deviations from EPA procedures (including Recalculation Procedure) need to be based on sound scientific rationale*
  - *Data, testing procedures and application factors used to develop site-specific criteria shall reflect the nature of the pollutant, designated and existing beneficial uses, and the most sensitive resident species of a water body.*

USEPA (2016) Se Criterion



N = 15 genera

Fish diversity: N. America, Idaho, and “Sites”

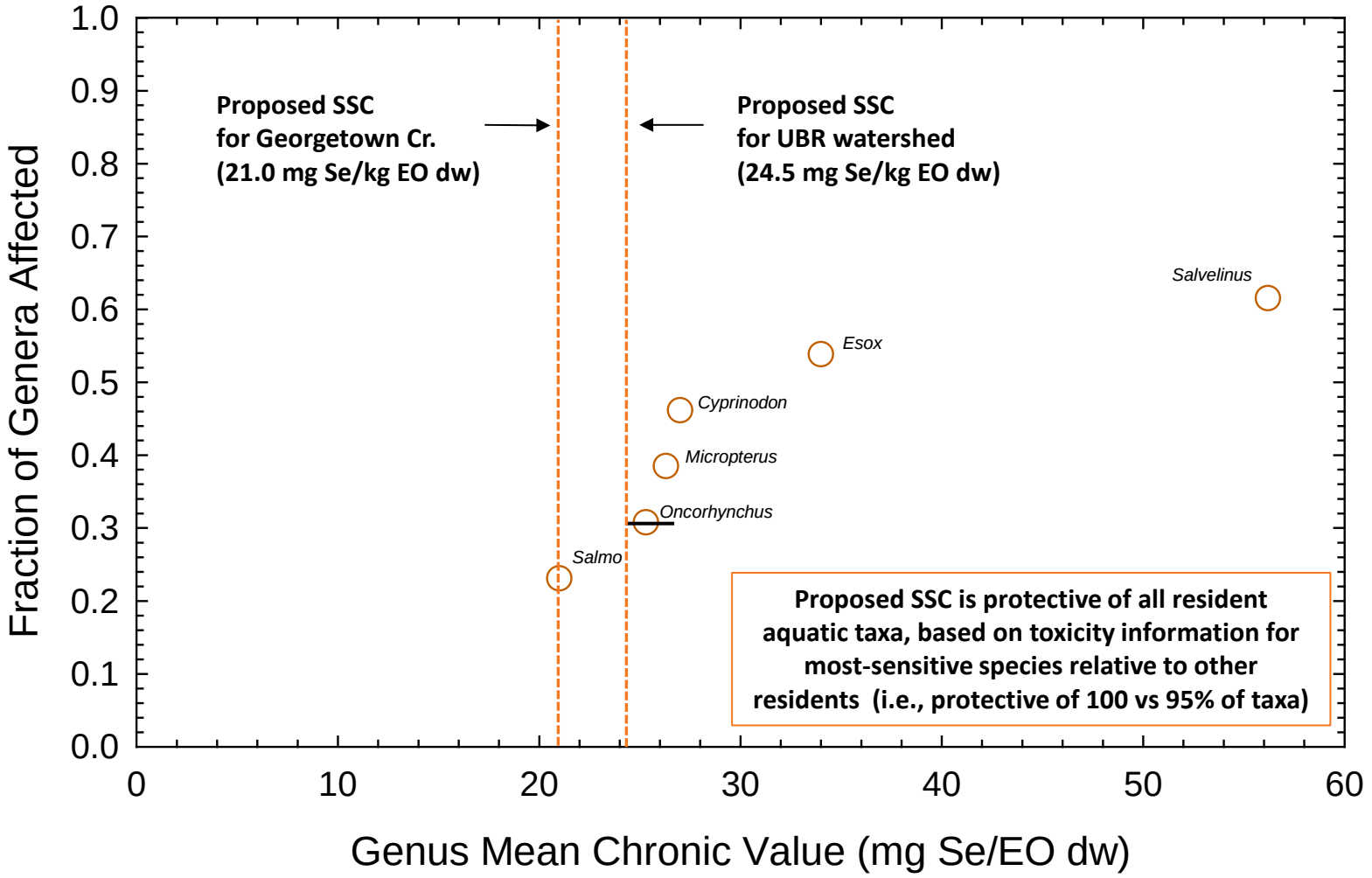


Notes:

[a] Native fish species (from Mebane 2010)

[b] All species (native and non-native)

Proposed Se SSC



Proposed Se SSC Elements

Primacy

Egg/Ovary
(24.5 mg/kg dw in UBR)
(21.0 mg/kg dw in GTC)

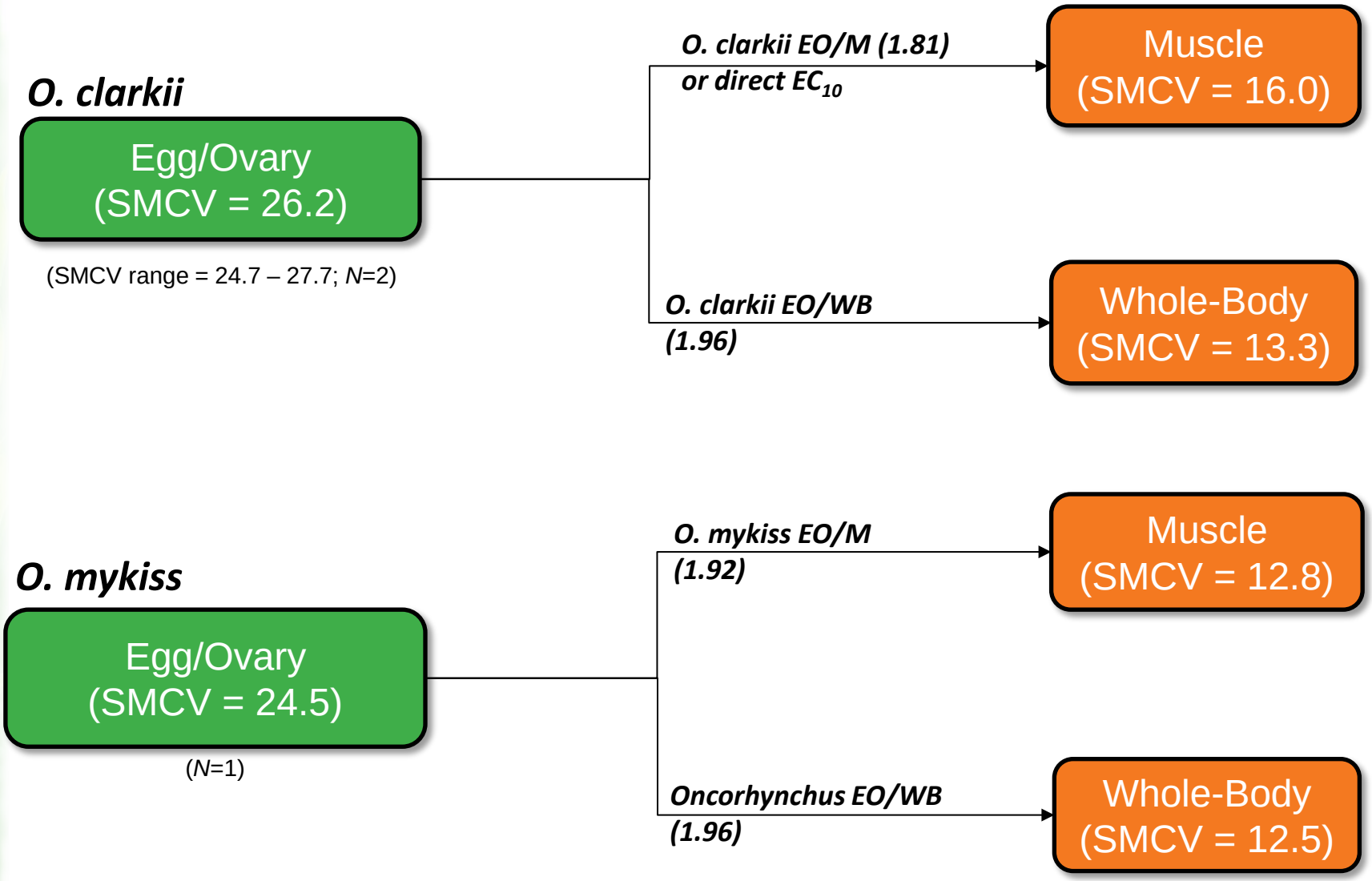
Whole-Body (12.5 mg/kg dw)
Muscle (12.8 mg/kg dw)

Tissue Conversion Factors
(Taxonomically-Based)

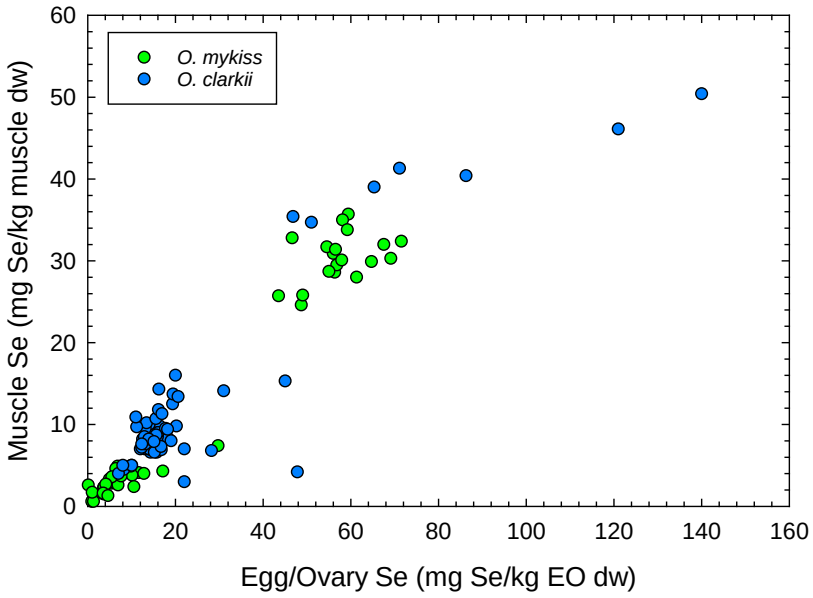
Water Column Elements
(site-specific)

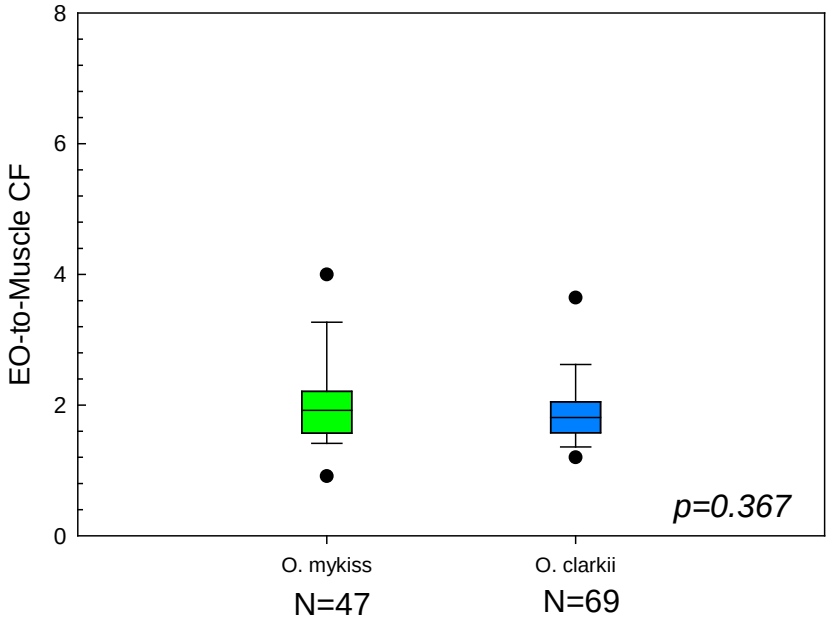
Bioaccumulation Modelling

Oncorhynchus Tissue Conversion Factors

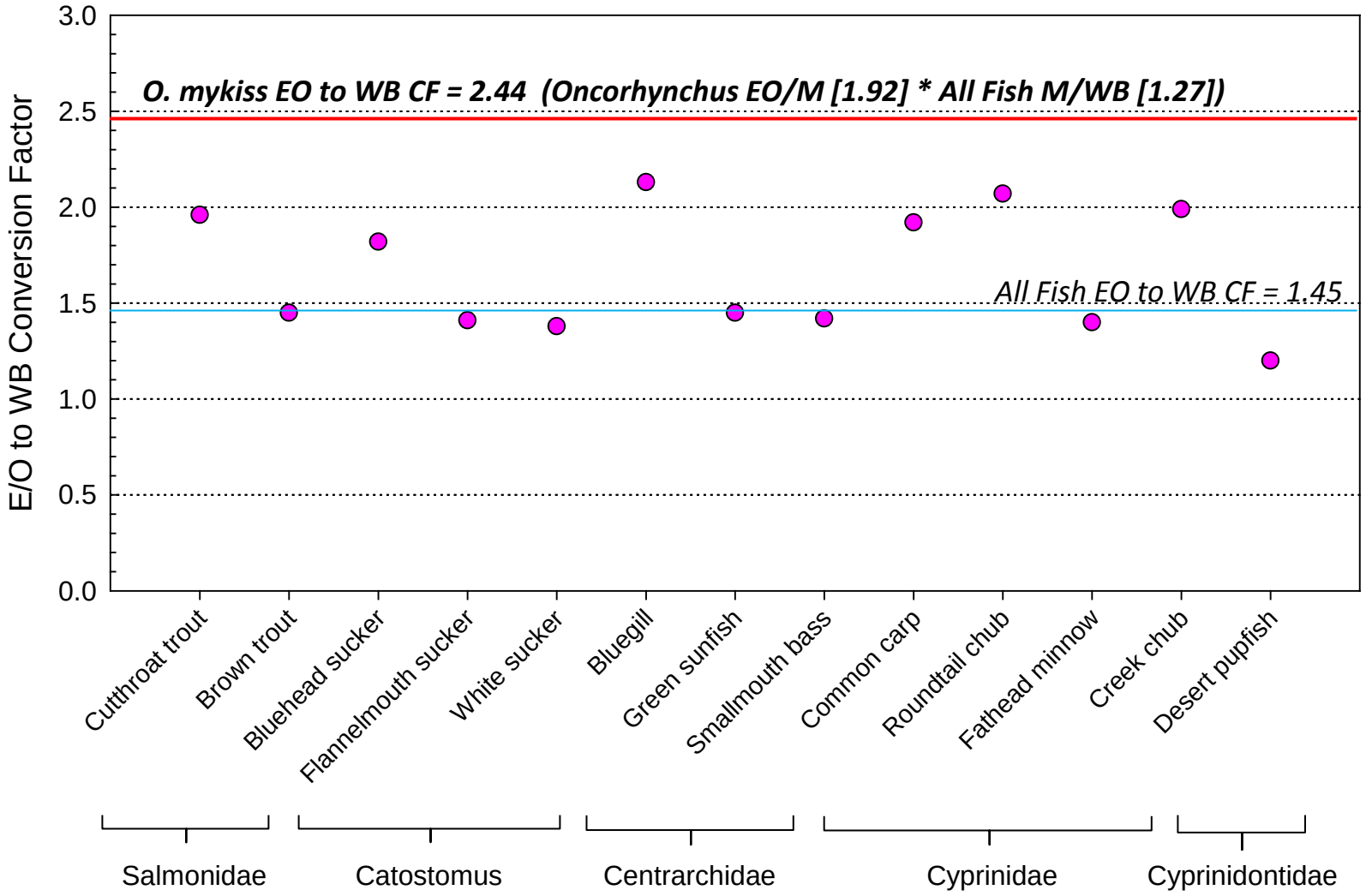


Oncorhynchus Tissue Conversion Factors





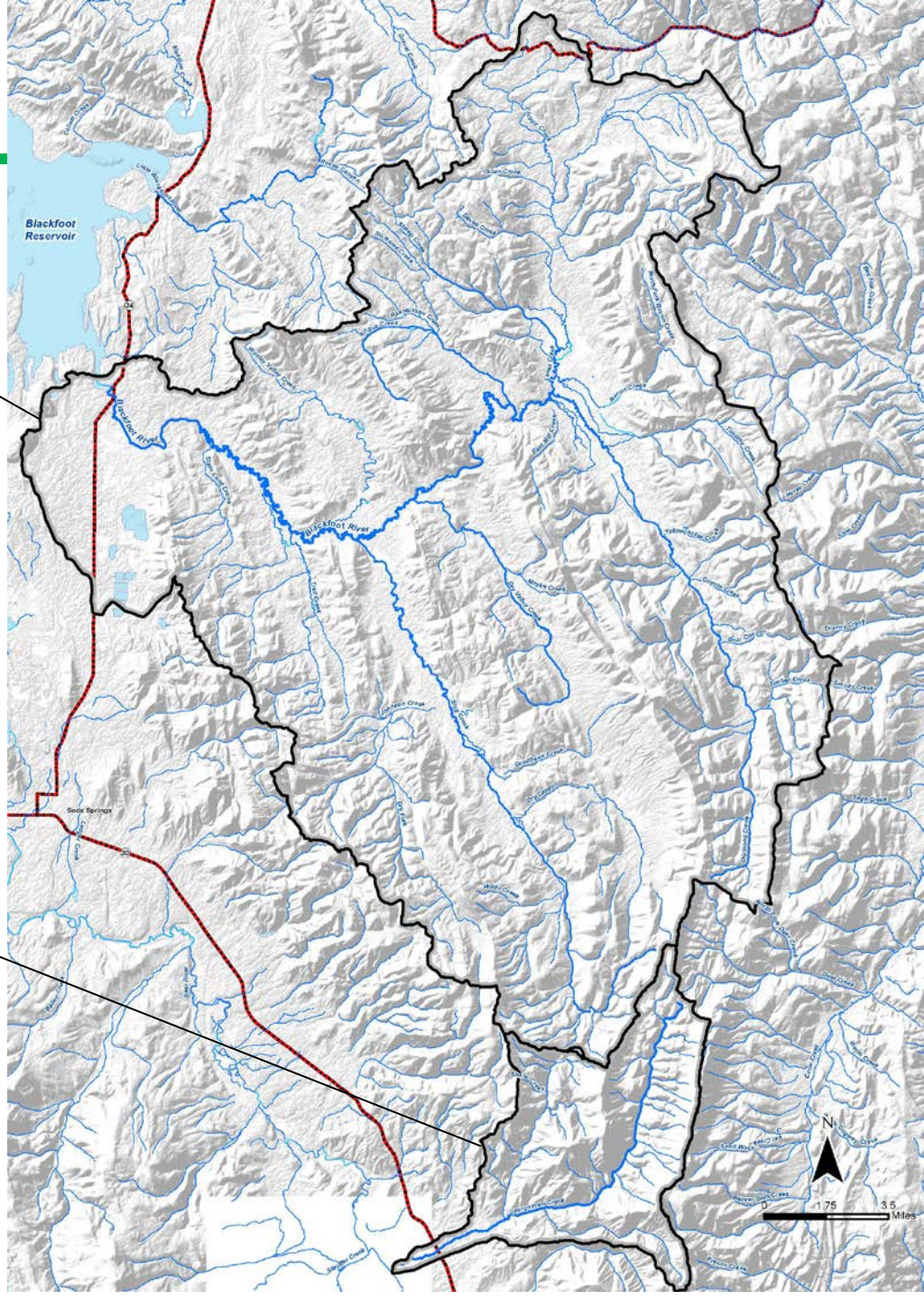
USEPA (2016) Tissue Conversion Factors



Definition of Sites

Subsection of Blackfoot Sub-Basin:
Blackfoot River – confluence of Lanes and Diamond Creeks to Blackfoot Reservoir (unit US-10), and all tributaries thereof

Georgetown Creek:
Source to mouth (unit B-22), and all tributaries thereof



Site-Specific Water Column Calculations

Options for Site-Specific Water-Column Values

Mechanistic Bioaccumulation Model: $C_{target} = \frac{Tissue_{criterion}}{TTF^{composite} \times EF \times CF}$

Empirical Fish Bioaccumulation Factor: $C_{target} = \frac{Tissue_{criterion}}{BAF}$

Table K-11. Comparison of mechanistic bioaccumulation and BAF approaches.

Mechanistic bioaccumulation modeling	Bioaccumulation Factor (BAF)
Knowledge of the aquatic system needed	No information on aquatic system needed
Choice of input parameters at discretion of state or tribe	No input parameters to choose
Species-specific	Species-specific
Can be applied at different sites if site *EF* can be estimated.	Site-specific
Fish tissue sampling not required for translation	Fish tissue and water sampling required

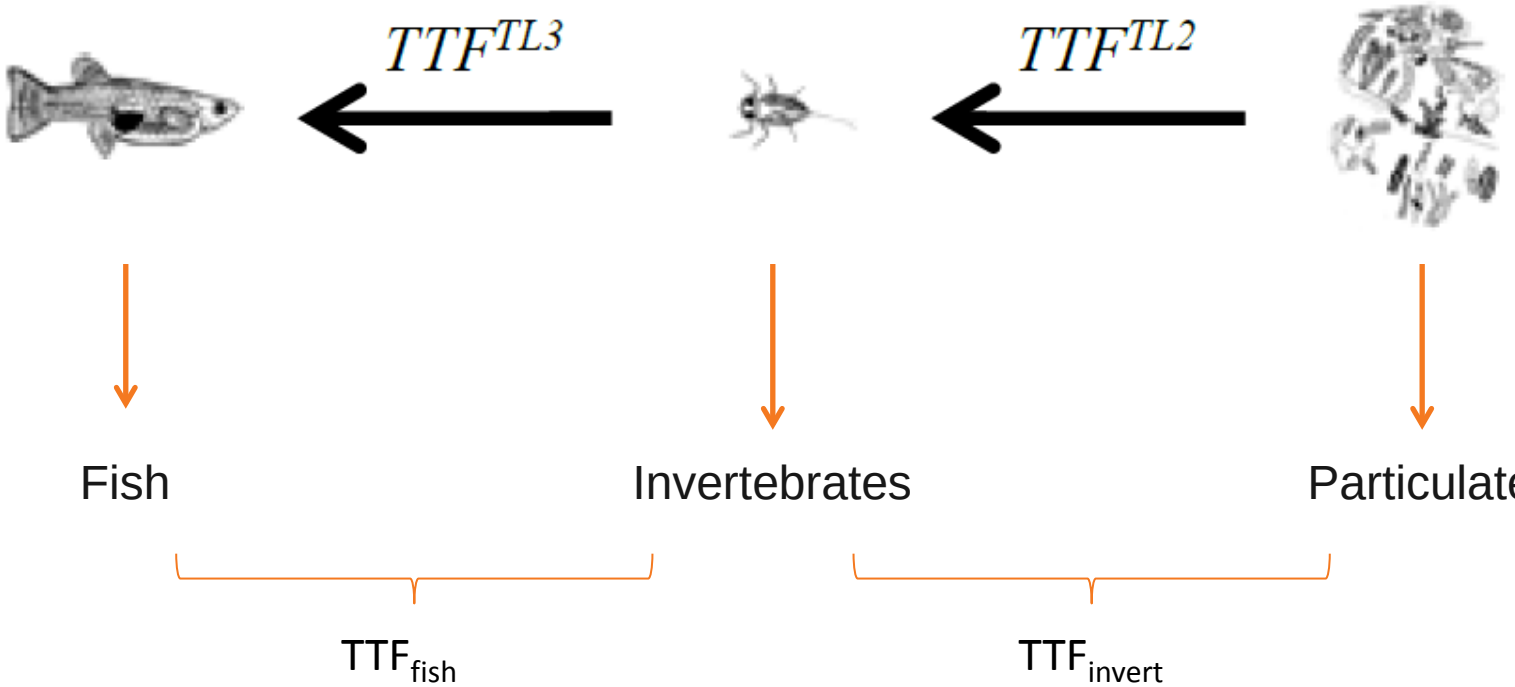
Table K-11
USEPA (2016)

Hypothetical Food-Web Scenarios (EPA 2016)

Figure K-2 EPA (2016)

A) Three trophic levels (simple):

$$TTF^{composite} = TTF^{TL3} \times TTF^{TL2}$$



Mechanistic Bioaccumulation Model

EPA-Recommended Tissue Criterion
or Site-Specific Tissue Criterion

$$C_{water} = \frac{\textbf{Tissue Criterion}}{TTF_{Fish} \times TTF_{Invert} \times EF}$$

TTF_{Fish} = [Trout Se] / [Invert Se]

TTF_{invert} = [Invert Se] / [Particulate Se]

EF = Site-Specific [Particulate Se] / Site-Specific [Water Se]

$$C_{water} = \frac{\text{Tissue Criterion}}{\frac{\text{Fish Se}}{\cancel{\text{Invert Se}}} \times \frac{\cancel{\text{Invert Se}}}{\cancel{\text{Particulate Se}}} \times \frac{\cancel{\text{Particulate Se}}}{\text{Water Se}}}$$

$$C_{water} = \frac{\text{Tissue Criterion}}{\frac{\text{Fish Se}}{\text{Water Se}}}$$

Mechanistic Bioaccumulation Model* = **Empirical Fish BAF Method**

$$C_{water} = \frac{\text{Fish Tissue Criterion}}{\text{(Fish Se / Water Se)}} = C_{water} = \frac{\text{Fish Tissue Criterion}}{\text{(Fish Se / Water Se)}}$$

** When TTFs are calculated without mixed trophic levels (e.g., see Appendix K of USEPA [2016])*

Sheep Cr., Angus Cr., No Name Cr.

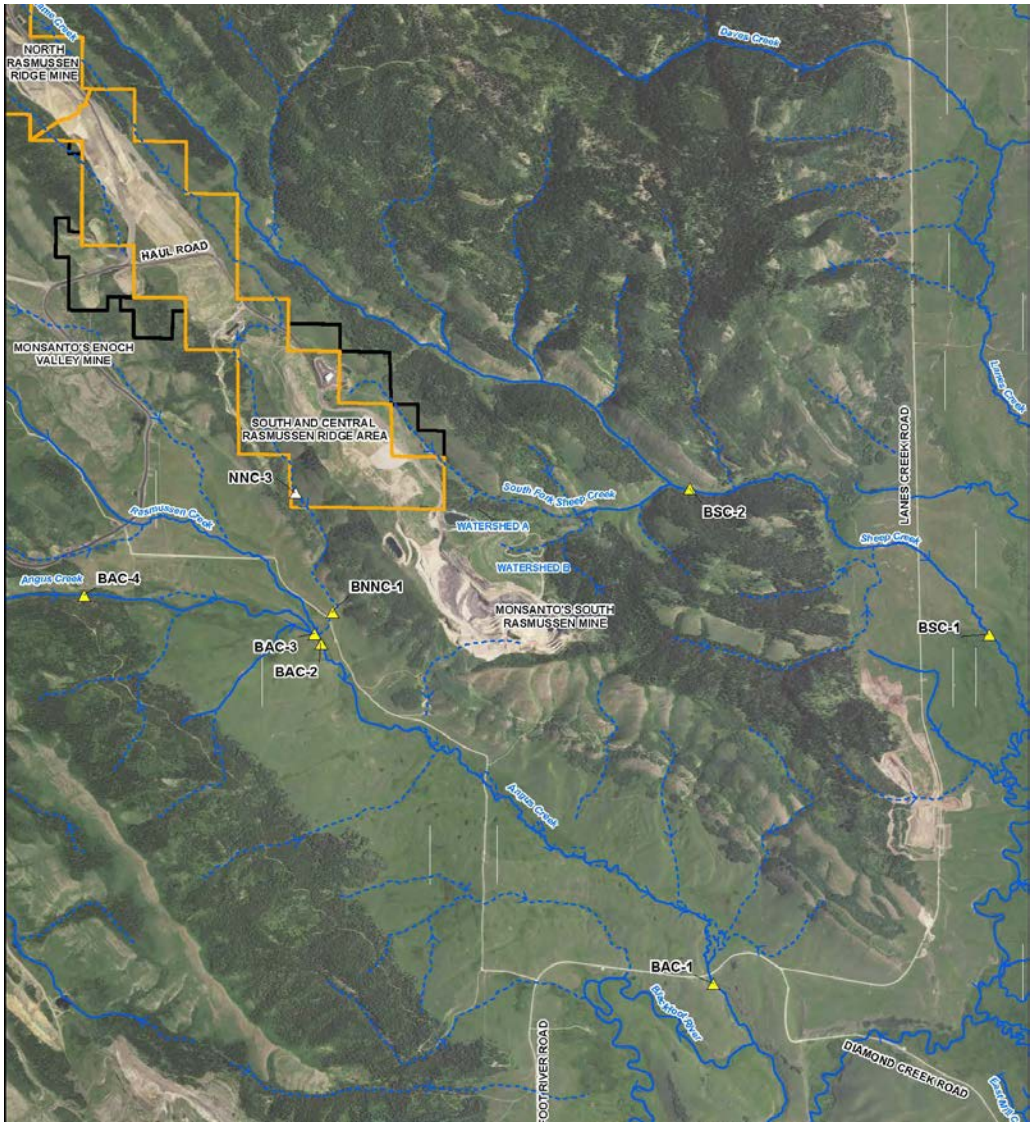


Table 11. Summary of surface water, fish tissue, site-specific bioaccumulation factors, and site-specific water-column value for Sheep Creek.

Location	Surface Water	Whole-Body Fish Tissue				Fish Bioaccumulation Factors		C_{target}
	Dissolved Se[1] (µg Se/L)	Cutthroat Trout (mg Se/kg WB dw)		Sculpin (mg Se/kg WB dw)		Cutthroat Trout BAF	Sculpin BAF	Cutthroat Trout
		N	Average	*N*	Average			
2014								
BSC-1	3.09	9	6.57	10	8.15	2.13	2.64	5.87
BSC-2	3.58	5	7.32	7	6.66	2.05	1.86	6.11
2015								
BSC-1	1.75	8	6.06	10	8.67	3.47	4.97	3.60
BSC-2	2.59	10	4.51	10	8.41	1.74	3.25	7.17
2016								
BSC-1	2.40	7	4.97	10	7.39	2.07	3.08	6.04
BSC-2	3.10	3	4.43	10	7.50	1.43	2.42	8.75
C_{target}[2] =								**6.3**

Notes:

[1] Average dissolved Se calculated from spring high flow (e.g., average of May and early June samples) and late summer (September) base-flow surface water samples.

[2] Site-specific dissolved Se water-column value for Sheep Creek (average for locations, years, cutthroat trout)

N = Number of individual whole-body fish replicates.

C_{target} = site-specific dissolved Se water-column value.

Table 12. Summary of surface water, fish tissue, site-specific bioaccumulation factors, and the site-specific water-column value for Angus Creek.

Location	Surface Water	Whole-Body Fish				Fish Bioaccumulation Factors		C_{target} (µg Se/L)	
	Dissolved Se[1] (µg Se/L)	Cutthroat Trout (mg Se/kg WB dw)		Sculpin (mg Se/kg WB dw)		Cutthroat Trout BAF	Sculpin BAF	Cutthroat Trout	Sculpin
		N	Average	*N*	Average				
2014									
BAC-1	0.99	3	9.20	--	--	9.29	--	1.35	--
BAC-2	2.00	--	--	10	9.32	--	4.66	--	2.68
BAC-3	1.70	3	6.47	7	6.50	3.80	3.83	3.29	3.27
BAC-4	1.78	--	--	6	6.27	--	3.53	--	3.54
2015									
BAC-1	0.68	10	7.44	--	--	10.94	--	1.14	--
BAC-2	1.17	--	--	--	--	--	--	--	--
BAC-3	0.59	--	--	10	8.24	--	14.08	--	0.89
BAC-4	0.98	--	--	10	6.43	--	6.58	--	1.90
2016									
BAC-1	1.10	3	6.30	--	--	5.72	--	2.18	--
BAC-2	2.10	5	7.98	5	8.20	3.80	3.90	3.29	3.20
BAC-3	0.93	3	4.18	10	5.86	4.52	6.33	2.76	1.97
BAC-4	1.68	--	--	6	9.04	--	5.40	--	2.32
C_{target}[2] =								**2.4**	

Notes:

[1] Average dissolved Se calculated from spring high flow (e.g., average of April and May samples) and late summer (September) base-flow surface water samples.

[2] Site-specific dissolved Se water-column value for Angus Creek (average of locations for cutthroat trout and sculpin).

N = Number of individual whole-body fish replicates.

C_{target} = site-specific dissolved Se water-column element.

Table 13. Angus Creek fish-tissue data, No Name Creek surface-water data, and the site-specific water column value for No Name Creek.

Year	Angus Creek Fish[1] (mg Se/kg WB dw)	No Name Cr Water[2] (µg Se/L)	Fishless Stream Translator[3]	No Name Creek C_{target} (µg Se/L)[4]
2014	9.26	29.43	0.31	39.74
2015	7.44	19.43	0.38	32.65
2016	7.49	39.43	0.19	65.78
C_{target} (No Name Creek)				**46.1**

Notes:

[1] Average of cutthroat trout and sculpin whole-body fish tissue (mg Se/kg WB dw) from lower Angus Creek (BAC-2 and BAC-1).

[2] Average of spring surface water data from lower No Name Creek near the confluence with Angus Creek.

[3] Fishless Stream Translator = Angus Creek fish tissue (mg Se/kg WB dw) / No Name Creek surface water (µg Se/L).

[4] Site-specific water column value for No Name Creek to protect most proximate downstream fish populations.

Georgetown Creek

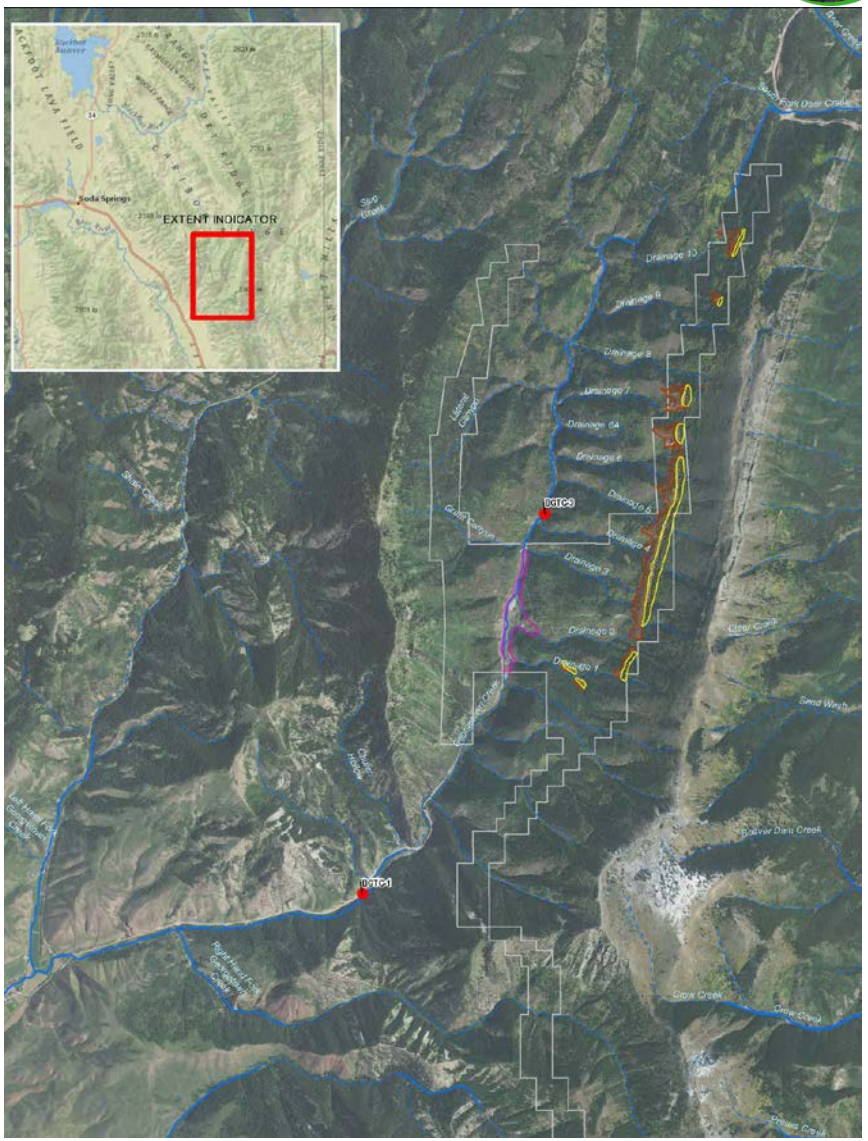


Table 10. Summary of surface water, fish tissue, site-specific bioaccumulation factors, and site-specific water-column values for Georgetown Creek.

Location	Surface Water	Whole-Body Fish Tissue				Fish Bioaccumulation Factors		C_{target}	
	Dissolved Se[1] (µg Se/L)	Brook Trout (mg Se/kg WB dw)		Rainbow Trout (mg Se/kg WB dw)		Brook Trout BAF	Rainbow Trout BAF	Brook Trout	Rainbow Trout
		N	Average	*N*	Average				
2015									
BGTC-1	4.50	10	8.95	--	--	1.99	--	6.28	--
BGTC-3	2.68	7	11.47	--	--	4.29	--	2.91	--
2016									
BGTC-1	5.80	10	9.55	10	8.47	1.65	1.46	7.59	8.56
BGTC-3	2.98	9	9.85		--	3.31	--	3.78	--
C_{target}[2]							**BGTC-1 =**	**7.5**	
							BGTC-3 =	**3.4**	

Notes:

[1] Average dissolved Se calculated from spring peak flow (e.g., average of May and early June) and late summer (September) base-flow surface water samples.

[2] Site-specific dissolved Se water-column value for reaches of Georgetown Creek. Reach-specific values were calculated to account for significantly different fish BAFs between BGTC-1 and BGTC-3 (*p*-value <0.001 for brook trout) and hydrologic differences between upper and lower Georgetown Creek.

N = Number of individual whole-body fish replicates.

C_{target} = site-specific dissolved Se water-column value (µg/L).

Discussion