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EcoTox

Nu-West Industries, Inc./
Nu-West Mining, Inc.

Proposal for Updated Site-Specific Selenium Criteria

Development of Updated Whole-Body Tissue Elements for the Upper Blackfoot River and Georgetown Creek Subbasins

July 2026

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TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 1

2 BACKGROUND 4

3 TISSUE CONVERSION METHODS 5
3.1 Conversion Factor Methods 5
3.1.1 Median Ratio-Based Conversion Factors 5
3.1.2 Regression-Based Conversions 6
3.2 Paired Tissue Dataset 6

4 DEVELOPMENT OF UPDATED WHOLE-BODY TISSUE ELEMENTS 7
4.1 Genus *Oncorhynchus* 7
4.1.1 Egg to Whole-Body Conversion Factors 7
4.1.2 Two-Step Tissue Conversion Factors 10
4.2 Genus *Salmo* 14
4.2.1 Egg to Whole-Body Conversion Factors 14
4.2.2 Egg to Muscle Conversion Factors 17

5 CONCLUSIONS AND RECOMMENDATIONS 19
5.1 Conclusions 19
5.1.1 Genus *Oncorhynchus* 19
5.1.2 Genus *Salmo* 20
5.1.3 Protectiveness of the Se SSC 20
5.2 Recommendations 21

6 REFERENCES 23

LIST OF FIGURES

Figure 1. Cutthroat trout egg/ovary to whole-body ratios for hatchery (*n*=16) and non-hatchery fish (*n*=25). 8
Figure 2. Cutthroat trout egg/ovary to whole-body ratios for hatchery and non-hatchery fish relative to (A) egg/ovary Se concentrations and (B) whole-body Se concentrations. 8
Figure 3. Relationships between egg/ovary Se and whole-body Se for cutthroat trout (A) with hatchery fish and (B) without hatchery fish.. 9
Figure 4. Relationships between egg/ovary Se and muscle Se for (A) rainbow trout, (B) Westslope cutthroat trout, and (C) combined *Oncorhynchus* spp. 11
Figure 5. Relationships between whole-body Se and muscle Se for (A) rainbow trout and (B) Yellowstone cutthroat trout. 12
Figure 6. Relationship between whole-body Se and muscle Se for combined rainbow trout and Yellowstone cutthroat trout samples. 12
Figure 7. Relationship between egg/ovary Se and whole-body Se for the pooled *Oncorhynchus* dataset. 13
Figure 8. Brown trout egg/ovary to whole-body ratios for hatchery (*n*=8) and non-hatchery fish (*n*=28). 16
Figure 9. Relationship between egg/ovary Se and whole-body Se for brown trout (A) with hatchery samples and (B) without hatchery samples. 17
Figure 10. Relationship between whole-body and muscle Se for brown trout. 18

LIST OF TABLES

Table 1. Summary of current tissue and water-column elements and proposed revisions to the whole-body elements for Se SSC in UBR and Georgetown Creek subbasins. 2

Table 2. Egg/ovary to whole-body conversion factors (CFs) for 13 fish species, from EPA (2016). 6

Table 3. Maternal transfer toxicity studies for *Oncorhynchus*, from EPA 2016. 7

Table 4. Egg/ovary (EO)-based Se SSC translated to whole-body (WB) values using median ratio and regression-based CFs for cutthroat trout with and without hatchery fish. ...9

Table 5. Egg/ovary (EO)-based Se SSC converted to muscle (M) values based on ratio- and regression-based CFs for rainbow trout and cutthroat trout. 11

Table 6. Summary of egg/ovary (EO)-based Se SSC converted to whole-body (WB) values using median CFs and regressions for Oncorhynchus spp., excluding hatchery samples. 13

Table 7. Summary of egg/ovary (EO)-based Se SSC converted to whole-body (WB) values using median ratio and regression-based CFs for brown trout. 17

Table 8. Summary of egg/ovary (EO)-based Se SSC converted to muscle (M) values using median ratio and regression-based CFs for brown trout. 19

Table 9. Proposed update to the Site-specific Se criteria for UBR subbasin. 21

Table 10. Proposed update to the Site-specific Se criteria for Georgetown Creek subbasin. ...22

LIST OF MAPS

Map 1. Site location map

LIST OF APPENDICES

Appendix A. Resident Fish Species of the Upper Blackfoot River and Georgetown Creek Subbasins

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*

Appendix C. Protectiveness of the Updated Whole-Body Elements to Other Resident Fish Species

ABBREVIATIONS AND ACRONYMS

AWQC	ambient water quality criteria
BAF	bioaccumulation factor
Benchmark	Benchmark Environmental LLC
CF	conversion factor
DEQ	Idaho Department of Environmental Quality
EcoTox	EcoTox LLC
dw	dry weight
EC_{10}	10% effect concentration
EO	egg/ovary
EO/M	egg/ovary to muscle
EO/WB	egg/ovary to whole-body
EPA	U.S. Environmental Protection Agency
g	grams
GMCV	genus mean chronic value
IDAPA	Idaho Administrative Procedures Act
kg	kilogram
L	liter
LOEC	lowest observed effect concentration
mg	milligram
mg/kg dw	milligrams Se per kilogram egg, dry weight
NOEC	no observed effect concentration
Nu-West	Nu-West Industries, Inc./Nu-West Mining, Inc.
OLS	ordinary least squares
SD	standard deviation
Se	selenium
SMCV	species mean chronic value
TLS	total least squares
SSC	site-specific criteria
WB	whole-body
WB/M	whole-body to muscle
UBR	Upper Blackfoot River
YCT	Yellowstone cutthroat trout
µg	microgram

1 Executive Summary

Nu-West Industries, Inc./Nu-West Mining, Inc. (Nu-West) is proposing updated site-specific selenium (Se) criteria for two subbasins in southeast Idaho: Upper Blackfoot River (UBR) and Georgetown Creek (hereafter referred to as "Sites"; Map 1). The proposed updates are limited to the whole-body (WB) tissue element of the site-specific criteria (SSC) for each Site and are supported by additional analysis of tissue-to-tissue conversion factors (CFs) used to translate the egg/ovary (EO)-based Se criterion into corresponding WB concentrations. No changes are proposed to the EO, muscle, or water-column elements, or the hierarchy and implementation of the multi-element Se criterion.

The current Se SSC for these Sites were developed by applying the most sensitive resident species approach to U.S. Environmental Protection Agency's (EPA) national recommended Se criterion for aquatic life (EPA 2016). The EPA (2016) Se criterion includes fish tissue (EO, WB, and muscle) and water-column elements, with precedence given to fish tissue elements because they represent a more direct and sensitive measure of exposure and potential for effects than water-column elements. Among the fish tissue elements, EO supersedes other tissues because the EPA (2016) criterion is based on reproductive studies that link larval effects to Se concentrations in eggs or ripe ovaries. EPA (2016) applied tissue-to-tissue CFs to convert EO-based effect concentrations into corresponding WB and muscle Se concentrations.

This proposal provides updates to the WB element of the Se SSC based on additional evaluation of tissue CFs for the most-sensitive resident fish for which the current Se SSC are based: rainbow trout (*Oncorhynchus mykiss*) and Yellowstone cutthroat trout (*O. clarkii bouvieri*) in the UBR subbasin and brown trout (*Salmo trutta*) and rainbow trout in the Georgetown Creek subbasin. The additional evaluations presented in this proposal provide a more robust analysis of the EO-to-WB (EO/WB) Se relationship for resident fish and support updated WB elements based on a weight of evidence approach.

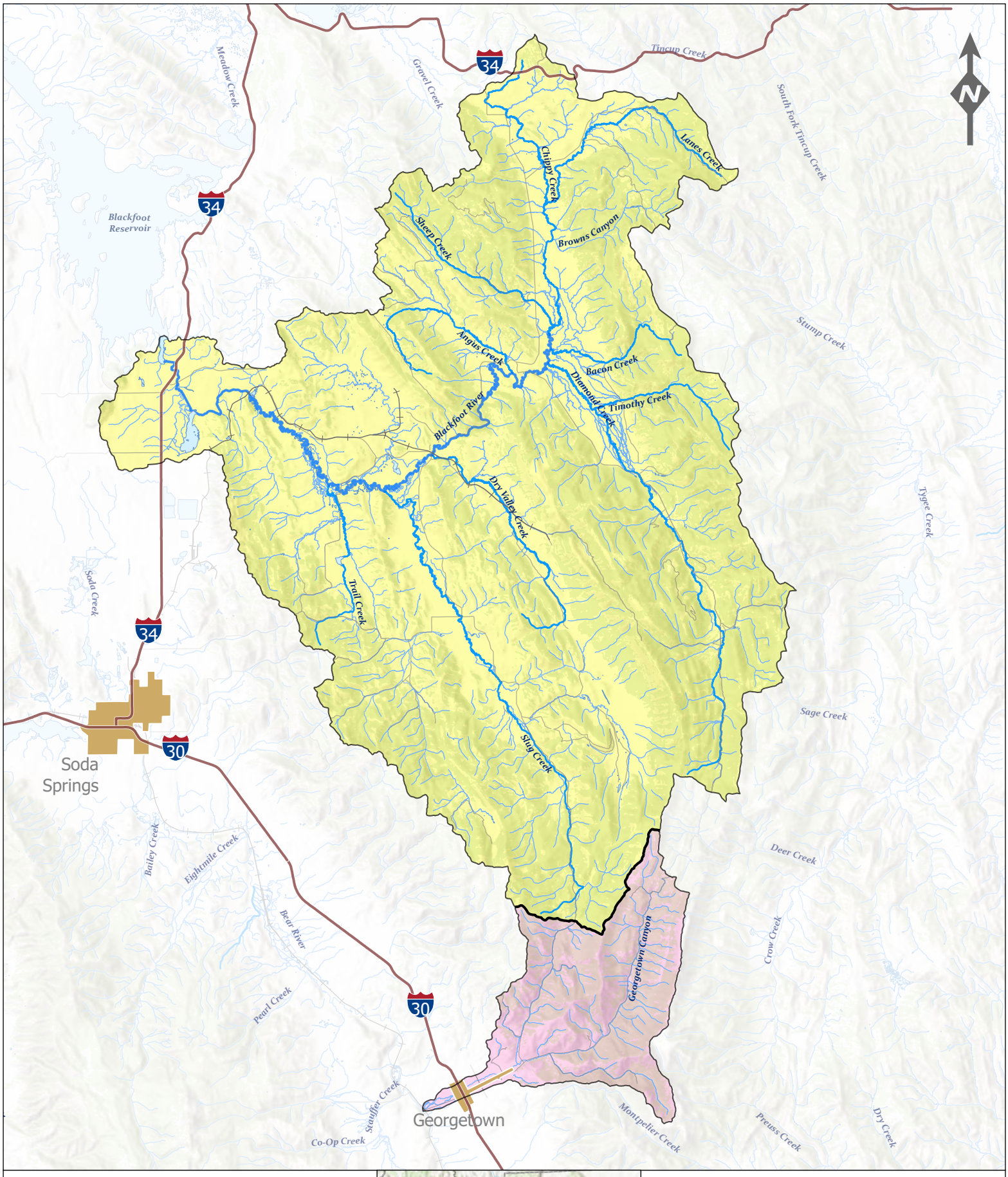
The current Se SSC were derived by using CFs from EPA (2016) to convert the most sensitive EO-based effect concentration for resident trout (24.5 milligrams Se per kilogram egg, dry weight [mg/kg dw]) into WB (12.5 mg/kg) and muscle (12.8 mg/kg) elements. The current WB element was derived by applying an EO/WB CF of 1.96 for cutthroat trout from EPA (2016), which included paired EO and WB tissues for both hatchery fish and wild fish. As presented in this document, excluding hatchery fish from the CF calculation is supported because the hatchery fish 1) exhibit a significantly different relationship between EO and WB Se concentrations than wild fish, 2) span a Se concentration range well below the EO-based Se criterion, and 3) a suitable and representative dataset is available after excluding hatchery samples. Excluding the hatchery samples is further supported by concurrence between multiple evaluations conducted following EPA (2016) methods for deriving tissue CFs.

Updated WB elements of 17.1 mg/kg and 13.9 mg/kg for the UBR and Georgetown Creek Sites, respectively, are proposed as more scientifically rigorous elements based on the additional analyses of tissue CFs described in this proposal; other elements of the Se SSC remain unchanged (Table 1).

Table 1. Summary of current tissue and water-column elements and proposed revisions to the whole-body elements for Se SSC in UBR and Georgetown Creek subbasins.

Fish Tissue (mg/kg dw)			Water Column (µg/L)
Egg-Ovary	**Whole-Body**	**Muscle**	**Water Lotic**
No changes 24.5[1], 21.0[2]	Proposed Changes ~~12.5~~ 17.1[1], 13.9[2]	No changes 12.8[1,2]	No changes BAF calculation[3]

Notes:
1. Applicable to the UBR subbasin
2. Applicable to the Georgetown Creek subbasin
3. Water column values are derived using the empirical bioaccumulation factor (BAF) method


Tincup Creek
Gravel Creek
Meadow Creek
South Fork Tincup Creek
Lanes Creek
Chippy Creek
Sheep Creek
Browns Canyon
Blackfoot Reservoir
Stump Creek
Angus Creek
Bacon Creek
Diamond Creek
Timothy Creek
Blackfoot River
Dry Valley Creek
Tygee Creek
Soda Creek
Trail Creek
Sage Creek
Slug Creek
Soda Springs
Deer Creek
Bailey Creek
Eightmile Creek
Crow Creek
Bear River
Georgetown Canyon
Pearl Creek
Montpelier Creek
Preuss Creek
Dry Creek
Stauffer Creek
Co-Op Creek
Georgetown
34
30
N
Road
Railroad
Highway
Georgetown Creek Site
Upper Blackfoot River Site
Idaho
Wyoming
MAP LOCATION
Nevada
Utah
Colorado
SITE LOCATION MAP
SCALE:
0 2 4 6 Miles
0 3 6 9 Kilometers
MAP: 1
Benchmark Environmental LLC
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2 Background

In 2017, the Idaho Department of Environmental Quality (DEQ) conducted rulemaking to 1) update the statewide aquatic life criteria in accordance with the EPA (2016) recommended Se criterion and 2) adopt Se SSC for specific Idaho waters including the UBR and Georgetown Creek subbasins (DEQ Docket No. 58-0102-1701). The statewide Se criterion and the current Se SSC were approved by the Idaho Legislature on March 18, 2018, and by EPA on July 9, 2019 (EPA 2019). The technical and regulatory basis for the current Se SSC for the UBR and Georgetown Creek Sites was provided in the Nu-West (2017) proposal for Se SSC and consisted of the following core steps:

- Geographic definition of each Site
- Determination of resident fish species that occur at each Site
- Recalculation of the EPA (2016) Se criterion based on the most sensitive resident fish
- Demonstration of the protectiveness of the Se SSC to resident fish

The geographic boundaries for each Site were defined at the watershed scale in accordance with EPA guidance on SSC (1994, 2013) and existing water body units in Idaho Administrative Procedures Act (IDAPA) 58.01.02 § 150.09. The two Sites are shown on Map 1 and described below.

- UBR subbasin: Blackfoot River – confluence of Lanes and Diamond Creek to Blackfoot Reservoir (unit US-10), and all tributaries thereof
- Georgetown Creek subbasin: Georgetown Creek – source to mouth (unit B-22), and all tributaries thereof

A limited number of fish species occur at each Site as documented over time by numerous fish surveys and a comprehensive fisheries dataset (Nu-West 2017; Appendix A). The UBR Site supports four families of fish: salmonids (trout), cyprinids (minnows), catostomids (suckers), and cottids (sculpin), while the Georgetown Creek Site supports two: salmonids and cottids. The naturally limited number of fish species and knowledge of all species occurring in these waters is the supporting basis and rationale for use of the most sensitive species approach to derive the fish tissue elements for each Site (EPA 2019, Nu-West 2017).

The most sensitive EO-based EC_{10}s[1] for resident trout were selected as the Se SSC for both Sites. In the UBR subbasin, this was an EO-based EC_{10} of 24.5 mg/kg for the genus *Oncorhynchus* and in the Georgetown Creek subbasin, an EO-based EC_{10} of 21.0 for the genus *Salmo*. These values were demonstrated to be protective of all resident fish species based on reviews of toxicity data presented in EPA (2016) and by others (Nu-West 2017).

Because the proposed update to the current Se SSC is restricted to the WB element, the technical and regulatory basis that underlies the current Se SSC is still applicable. Specifically, no changes are proposed to 1) the EO element of the EO-based Se SSC, 2) the Site boundaries for the Se SSC, or 3) the list of resident fish species that occur at each Site. Therefore, the proposed updates to the WB element do not affect the protectiveness of the Se SSC previously established (Nu-West 2017), and adopted by DEQ, and approved by EPA (EPA 2019).

[1] The EO-based EC_{10} is the concentration of Se in the egg and/or ripe ovary that is estimated to have a 10 percent effect on offspring resulting from maternally transferred Se.

3 Tissue Conversion Methods

Fish are the most sensitive aquatic taxon to Se effects, with larval responses (mortality, teratogenicity, and edema) to maternally transferred Se being the most sensitive effect. Consequently, both EPA's 2016 Se criterion and the current and proposed updated Se SSC for UBR and Georgetown Creek were derived and expressed on an EO basis. EPA converted the national recommended EO criterion to WB and muscle criterion elements using tissue-to-tissue conversion CFs derived from relationships between paired tissue Se measurements. In accordance with EPA (2016), CFs can be derived using either median ratios between paired tissues or total least squares (TLS) regression. The two approaches have strengths and weaknesses depending on how the data are distributed and so both approaches were evaluated to provide a more robust analysis of the data. This section presents the methods, paired tissue datasets, and data analyses used to support the updated WB elements for the UBR and Georgetown Creek Sites.

3.1 Conversion Factor Methods

EPA (2016) describes two approaches for converting EO-based effect concentrations (EC_{10}s) into corresponding WB and muscle concentrations: 1) median ratios of matched tissue pairs and 2) regression-based conversions. EPA (2016) used the median ratio CF approach to derive the WB and muscle elements for the national criterion but also recognized advantages of regression-based approaches.

3.1.1 Median Ratio-Based Conversion Factors

To derive CFs based on median ratios, EPA first confirmed a statistical relationship between paired tissue measurements for each species using ordinary least squares (OLS) linear regression of the matched pairs of measurements. If the regression slope was positive and significantly different from zero ($p \leq 0.05$), EPA calculated the ratio between matched tissue pairs and used the median ratio as the CF for the species. Tissue ratios and CFs were developed for EO to WB (EO/WB) and EO to muscle (EO/M) conversions. In addition, for fish species without sufficient data to directly calculate an EO/WB CF, but which had sufficient data to calculate both EO/M and WB to muscle (WB/M) CFs, EPA applied a two-step approach in which EO concentrations were converted to muscle concentrations using an EO/M CF and these muscle concentrations were then converted to WB concentrations using a WB/M CF.

EPA (2016) derived median ratio CFs directly from matched pairs of EO and WB measurements for 13 species of fish (Table 2). The EO Se SSC of 24.5 mg/kg for the UBR subbasin was converted to a WB value of 12.5 mg/kg by applying an EO/WB CF of 1.96 derived as the median EO/WB ratio from 41 matched tissue measurements for cutthroat trout (Appendix B). However, EPA (2016) noted that hatchery fish samples[2] included in the cutthroat trout (and brown trout) EO/WB calculations resulted in high variability in the EO/WB ratios compared to variability observed for other species. EPA identified inclusion of hatchery fish as a cause of the high variability in the EO/WB ratios and noted that excluding hatchery fish reduced the standard deviation of the EO/WB CF from 2.03 to 0.62. The reduced variability after excluding hatchery fish increases precision in the EO/WB Se relationship for wild fish, particularly considering the differences observed between hatchery and wild fish and the very low Se concentrations in hatchery fish relative to the Se criterion and concentrations observed in background streams (Section 4.1.1).

[2] Hatchery samples refer to fish reared in hatcheries as opposed to natural streams.

Table 2. Egg/ovary to whole-body conversion factors (CFs) for 13 fish species, from EPA (2016).

Common Name	Scientific Name	CF	*n*	Standard Deviation
Cypriniformes				
Bluehead sucker	*Catostomus discobolus*	1.82	7	0.19
Flannelmouth sucker	*Catostomus latipinnis*	1.41	7	0.20
White sucker	*Catostomus commersonii*	1.38	42	0.36
Desert pupfish	*Cyprinodon macularius*	1.20	6	0.10
Common carp	*Cyprinus carpio*	1.92	5	0.49
Roundtail chub	*Gila robusta*	2.07	7	0.29
Fathead minnow	*Pimephales promelas*	1.40	44	0.75
Creek chub	*Semotilus atromaculatus*	1.99	12	1.00
Perciformes				
Bluegill	*Lepomis macrochirus*	2.13	27	0.68
Green sunfish	*Lepomis cyanellus*	1.45	38	0.23
Smallmouth bass	*Micropterus dolomieu*	1.42	6	0.19
Salmoniformes				
Brown trout	*Salmo trutta*	1.45	38	1.81
Cutthroat trout	*Oncorhynchus clarkii*	1.96	41	2.03

Given the differences in EO/WB ratios between hatchery and wild cutthroat trout observed in the EPA analysis, additional evaluations were conducted to ensure the WB criterion element of the Se SSC incorporates the most appropriate paired tissue data for estimating Se concentrations among tissues. The additional evaluations were performed with and without the hatchery data using median ratio and regression-based methods in accordance with EPA (2016).

3.1.2 Regression-Based Conversions

Regression analysis is another approach that can be used to characterize the relationship between Se concentrations in paired tissues. A detailed comparison and discussion of the advantages and disadvantages of the median ratio and TLS regression approaches is provided in EPA Appendix N (2016). The regression approach calculates a best-fit line between tissue pairs and includes a slope and y-intercept; regression-based CFs represent the ratio between paired tissue concentrations determined from the regression line at the EO-based criterion concentration.

To calculate regression-based CFs in the current evaluation, TLS regressions using log-transformed tissue concentrations were used in accordance with EPA (2016).

3.2 Paired Tissue Dataset

Reviews of published and unpublished literature, as well as on-line monitoring databases, were conducted to ensure available paired tissue data for *Oncorhynchus* and *Salmo* were included in the analysis (Appendix B; Detering et al. 2025). In accordance with EPA (2016) and Idaho DEQ guidance (DEQ 2022), EO samples from gravid females with matched WB or muscle measurements were prioritized. Conversion factors were derived based on available matched pairs of EO, WB, and muscle data for members of the genera *Oncorhynchus* and *Salmo* following EPA (2016) methods for calculating CFs as summarized above.

4 Development of Updated Whole-Body Tissue Elements

This section presents additional evaluations of the EO/WB Se relationship for the genera *Oncorhynchus* and *Salmo* using available paired tissue Se measurements and following EPA (2016) tissue conversion methods described in Section 3.

4.1 Genus *Oncorhynchus*

The Se SSC for the UBR subbasin was set to the most sensitive species mean chronic value (SMCV) within the genus *Oncorhynchus*. While EPA (1985, 2016) uses the genus mean chronic value (GMCV) as the toxicological metric for criteria calculations to avoid over-representing highly tested taxonomic groups in deriving ambient water quality criteria (AWQC), the most sensitive SMCV was selected for the UBR Se SSC to provide additional conservatism. The Se SSC for the UBR equals the most sensitive EC_{10} for rainbow trout (24.5 mg/kg EO; Table 3), which is also comparable to the most sensitive EC_{10} for cutthroat trout (24.7 mg/kg EO). As discussed by EPA (2016), there is low uncertainty in the *Oncorhynchus* chronic value because the available *Oncorhynchus* EC_{10}s from individual studies span a narrow range of 24.5 to 27.7 mg/kg EO and incorporate a range of sensitive early-life stage endpoints.

Table 3. Maternal transfer toxicity studies for *Oncorhynchus*, from EPA 2016.

Genus	Species	Study EC10 (mg Se/kg EO dw)	SMCV (mg Se/kg EO dw)	GMCV (mg Se/kg EO dw)
Oncorhynchus	Rainbow trout[1,2,3]	24.5	24.5	25.3
	Cutthroat trout[4,5]	24.7	26.2	
		27.7		

Notes:
1. Holm (2002)
2. Holm et al. (2003)
3. Holm et al. (2005)
4. Rudolph et al. (2008)
5. Nautilus Environmental (2011)

The Se SSC of 24.5 mg/kg EO was converted to WB and muscle values using tissue CFs derived from paired tissue Se concentrations and applied based on a taxonomic hierarchy recommended by EPA (2016) and summarized in the following sections.

4.1.1 Egg to Whole-Body Conversion Factors

Within the genus *Oncorhynchus*, no additional direct measurements of paired EO and WB concentrations were available other than data presented in EPA (2016). The substantial difference in the EO/WB relationship between hatchery and wild cutthroat trout samples is clear when comparing EO/WB ratios between the two types of fish. The median EO/WB ratio for hatchery fish (4.32, n=16) is 3-fold greater and significantly different (p<0.001 Mann-Whitney) than for non-hatchery fish (1.43; n=25) (Figure 1). In addition, hatchery egg concentrations (<3.3 mg/kg) are significantly lower than the EO criterion concentration (24.5 mg/kg EO; Figure 2). As described by EPA (2016), CF data bracketing the criterion concentrations helps reduce uncertainty when using either the median ratio or regression-based approaches for translating Se concentrations between tissue types. The very low WB Se concentrations in

the hatchery fish (<1 mg/kg; Figure 2) are also inconsistent with typical background concentrations observed in aquatic systems, including cutthroat trout sampled in background streams within the UBR and Georgetown Creek subbasins for which the Se SSC were developed.

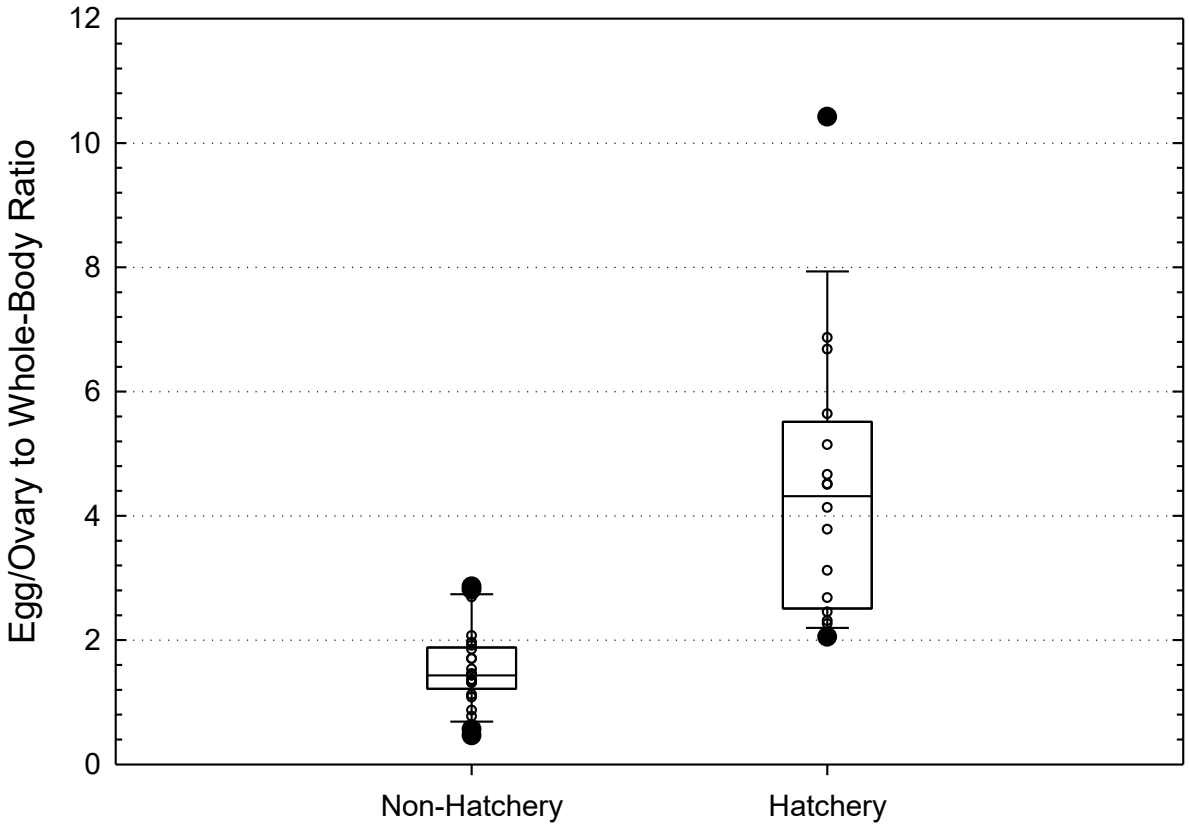


Figure 1. Cutthroat trout egg/ovary to whole-body ratios for hatchery (*n*=16) and non-hatchery fish (*n*=25).

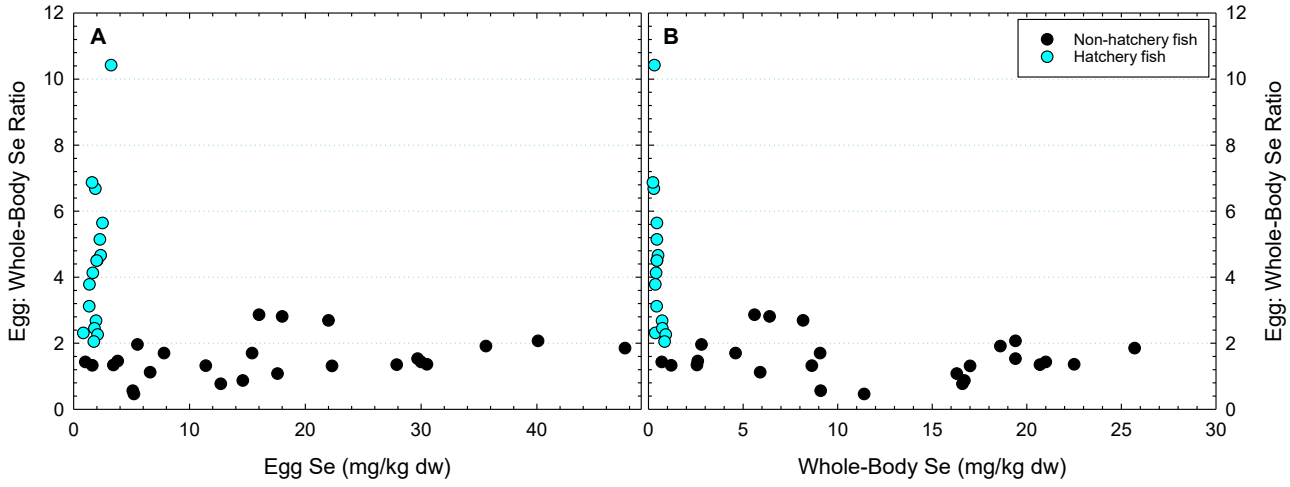


Figure 2. Cutthroat trout egg/ovary to whole-body ratios for hatchery and non-hatchery fish relative to (A) egg/ovary Se concentrations and (B) whole-body Se concentrations.

As discussed, the EO-based Se SSC of 24.5 mg/kg EO was converted into a WB value of 12.5 mg/kg WB using the CF of 1.96 from EPA (2016), which included the hatchery fish data. The corresponding regression-based approach (using log-transformed data) estimates a substantially lower ratio of 1.23 based on TLS regression with a WB value of 19.9 mg/kg WB. Excluding the hatchery fish still results in a statistically significant relationship (p<0.001; n=25) with a median ratio of 1.43 and WB value of 17.1 mg/kg WB. The regression-based approach excluding the hatchery fish estimates a similar ratio of 1.46 which results in a WB value of 16.8 mg/kg WB. The strong concurrence between the two approaches after excluding the hatchery data is consistent with the observation that the hatchery data differ from data for wild fish and thus the EO/WB relationship observed in hatchery fish is not representative of that observed in wild fish (Figure 3 and Table 4).

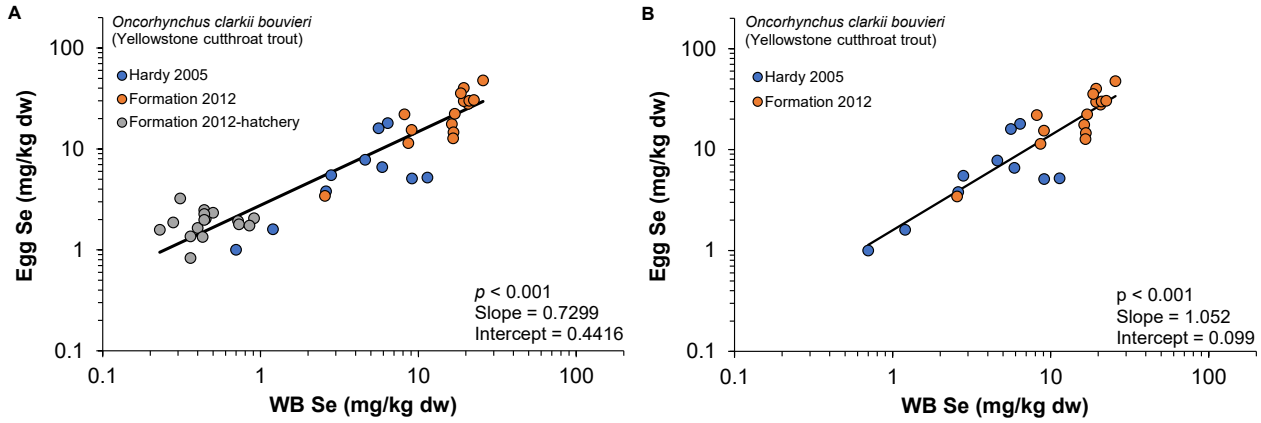


Figure 3. Relationships between egg/ovary Se and whole-body Se for cutthroat trout (A) with hatchery fish and (B) without hatchery fish. Panel A is the EPA (2016) dataset used to derive the egg/ovary to whole-body CF of 1.96 for the current whole-body element of 12.5 mg/kg dw.

Table 4. Egg/ovary (EO)-based Se SSC translated to whole-body (WB) values using median ratio and regression-based CFs for cutthroat trout with and without hatchery fish.

Egg Se SSC (mg Se/kg EO dw)	Median EO/WB Ratio Approach		Regression-based Approach		
	Median EO/WB ratio	WB Se Value (mg Se/kg WB dw)	Regression Coefficients	Regression-based CF	WB Se Value (mg Se/kg WB dw)
Including hatchery fish					
24.5	1.96	12.5	m = 0.7299 b = 0.4416	1.23	19.9
Excluding hatchery fish					
24.5	1.43	17.1	m = 1.052 b = 0.099	1.46	16.84

The differences with hatchery fish included between converted WB concentrations using the median ratio approach (12.5 mg/kg) versus the regression approach (19.9 mg/kg) also relates to the significant difference between hatchery and non-hatchery samples. The number of hatchery samples with high CFs at low EO and even relatively lower WB concentrations creates 1) a shallower slope (0.730) and 2) a more skewed distribution at low EO and WB concentrations that are even more distant from the criterion

concentration (24.5 mg/kg EO). As noted, this difference is attenuated when hatchery cutthroat trout are excluded (17.1 vs 16.8 mg/kg WB using median ratio and regression approaches, respectively).

The remaining EO/WB data for *Oncorhynchus* after excluding hatchery fish consists of Yellowstone cutthroat trout (YCT) samples collected from the UBR subbasin to which the Se SSC apply (Hardy 2005) and YCT samples collected from natural streams within the adjacent Salt River subbasin (Formation 2012). The YCT data from Hardy (2005) and Formation (2012) indicate a comparable relationship between EO and WB Se and include multiple samples bracketing the EO criterion concentration (Figure 3). Incorporating tissue data from site-specific fish and at the EO criterion concentration provides a robust dataset for deriving a site- and species-specific tissue CF.

4.1.2 Two-Step Tissue Conversion Factors

An alternative approach to the direct conversion of EO concentrations to WB concentrations is a two-step approach in which EO data is first converted to muscle data and then the muscle data is converted to WB data. The primary advantage of the two-step approach is that it can potentially include additional data as for some species there tends to be more data available for EO/M relationships and WB/M relationships than for EO/WB relationships. The primary disadvantage of this approach is that there is uncertainty associated with each step that is compounded when multiple steps are involved. In the case of the genus *Oncorhynchus*, the two-step approach allows for evaluation of considerably more data than the one-step approach and therefore provides important weight of evidence regarding the most appropriate tissue conversion to use in the SSC.

4.1.2.1 Egg to Muscle Conversion Factors

The muscle tissue element of the Se SSC for the UBR subbasin was set to the SMCV for rainbow trout (12.8 mg/kg muscle) as this was the most sensitive muscle chronic value available for the genus *Oncorhynchus* in EPA (2016). No additional direct measurements of EO and muscle Se data were available for rainbow trout beyond the studies presented in EPA 2016 (Figure 4A), but additional studies with cutthroat trout are available (Figure 4B). The slopes of the regressions are comparable (range of 1.0-1.1) among the rainbow trout dataset, Westslope cutthroat trout dataset, and the combined rainbow trout and Westslope trout dataset (Figure 4C, Table 5).

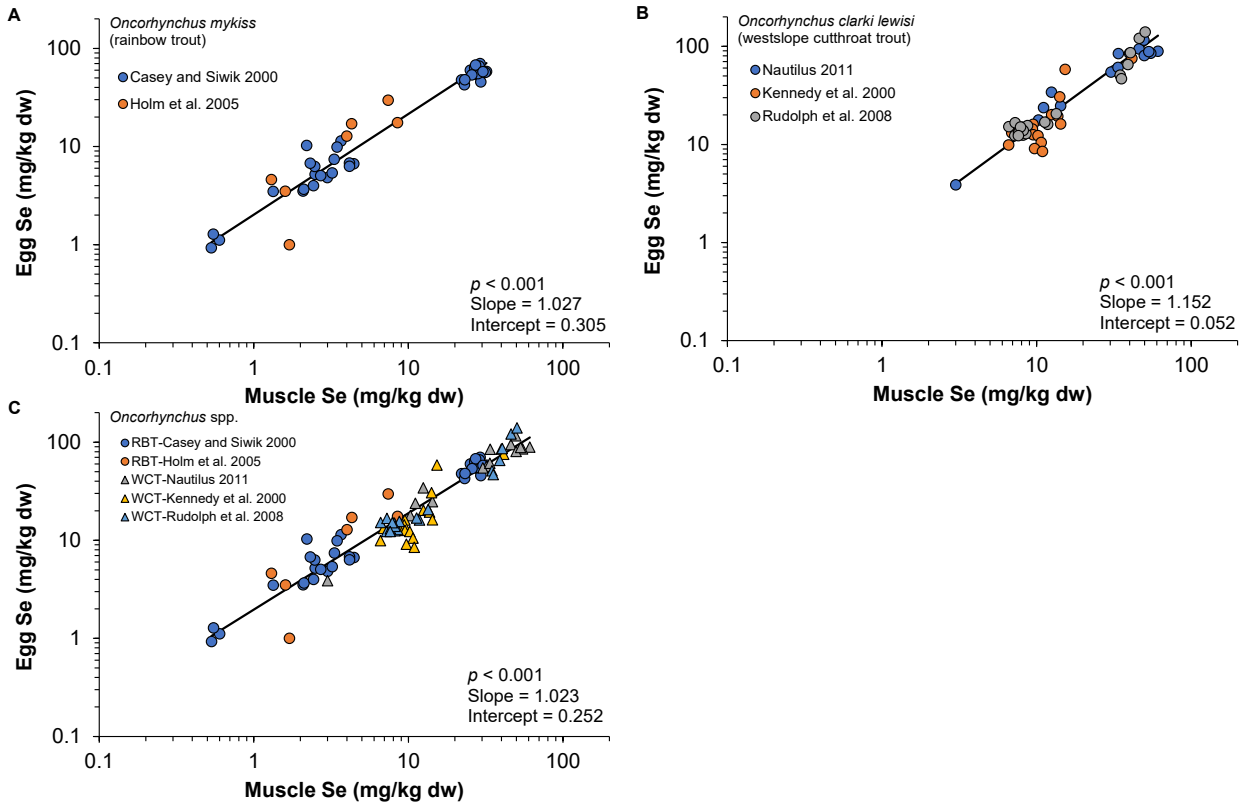


Figure 4. Relationships between egg/ovary Se and muscle Se for (A) rainbow trout, (B) Westslope cutthroat trout, and (C) combined *Oncorhynchus* spp.

Table 5. Egg/ovary (EO)-based Se SSC converted to muscle (M) values based on ratio- and regression-based CFs for rainbow trout and cutthroat trout.

EO Se SSC (mg Se/kg dw)	Median EO/M Ratio Approach		Regression Approach		
	Median EO/M ratio	Muscle Se Value (mg Se/kg dw)	Regression	Regression -based CF	Muscle Se value (mg Se/kg dw)
O. mykiss					
24.5	2.09	11.7	m=1.027 b=0.305	2.15	11.4
O. clarki lewisi					
24.5	1.70	14.4	m=1.152 b=0.052	1.69	14.5
Oncorhynchus spp.					
24.5	1.83	13.4	m=1.023 b=0.252	1.90	12.9

4.1.2.2 Muscle to Whole-Body Conversion Factors

Muscle to WB CFs are a third type of tissue conversion described by EPA (2016). When paired muscle and WB Se concentrations are available for a species or higher taxonomic classification, it allows for additional estimation of either WB or muscle values based on direct calculations of EO/WB or EO/M CFs. As such, muscle concentrations presented in the previous section can be converted to WB concentrations using paired measurements of muscle Se and WB Se for individual or combined species

within the genus *Oncorhynchus*. Similarly, WB concentrations with paired EO concentrations but without paired muscle concentrations can be converted into paired muscle concentrations. While direct CFs are available to derive *Oncorhynchus*-specific WB and muscle values, the evaluations presented in this section provide additional weight of evidence for assessing relationships between tissue types and thus the WB tissue element.

Additional paired measurements of WB and muscle Se concentrations were available for both rainbow trout (n=51) and cutthroat trout (n=43). The cutthroat trout paired measurements include 30 samples from the UBR subbasin, so they are site- and species-specific with respect to the most sensitive species for the UBR subbasin. The rainbow trout and cutthroat trout WB vs. muscle regressions are shown in Figure 5 followed by the regression for rainbow trout and cutthroat trout samples combined in Figure 6.

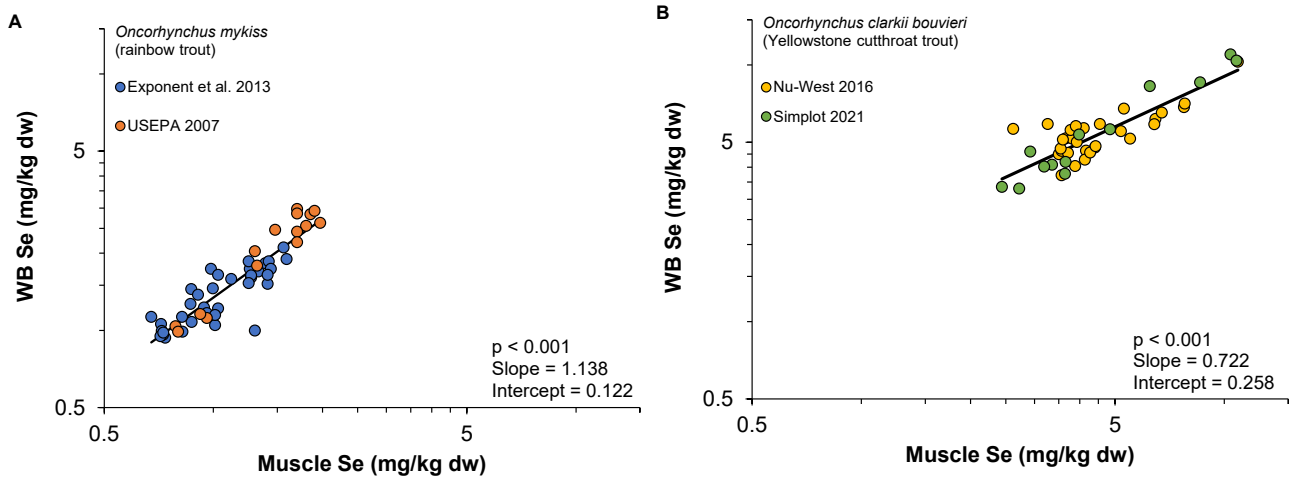


Figure 5. Relationships between whole-body Se and muscle Se for (A) rainbow trout and (B) Yellowstone cutthroat trout.

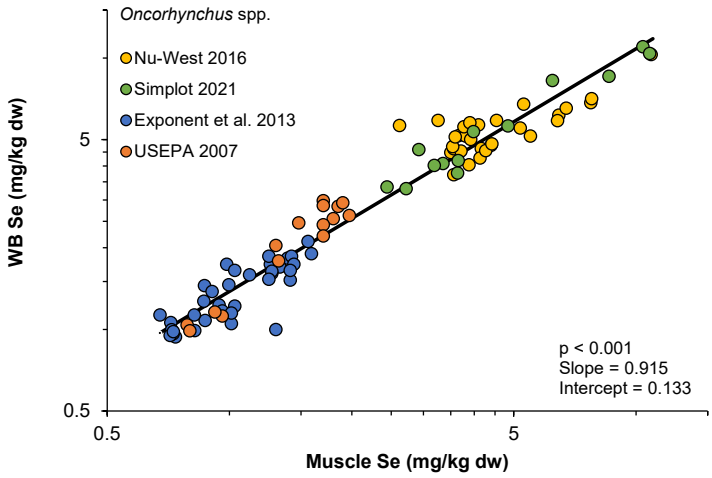


Figure 6. Relationship between whole-body Se and muscle Se for combined rainbow trout and Yellowstone cutthroat trout samples.

Given the significant relationship between WB and muscle Se for *Oncorhynchus* (Figure 6), EO and muscle pairs (Figure 4) can be converted into EO and WB pairs to provide an additional assessment of the EO/WB relationship for the genus *Oncorhynchus.* Excluding hatchery samples, the two-step conversion provides 125 pairs of EO and WB measurements for rainbow trout, Yellowstone cutthroat trout, and Westslope cutthroat trout samples that span a wide Se concentration range for each tissue type and exhibit a statistically significant relationship ($p < 0.001$; Figure 7).

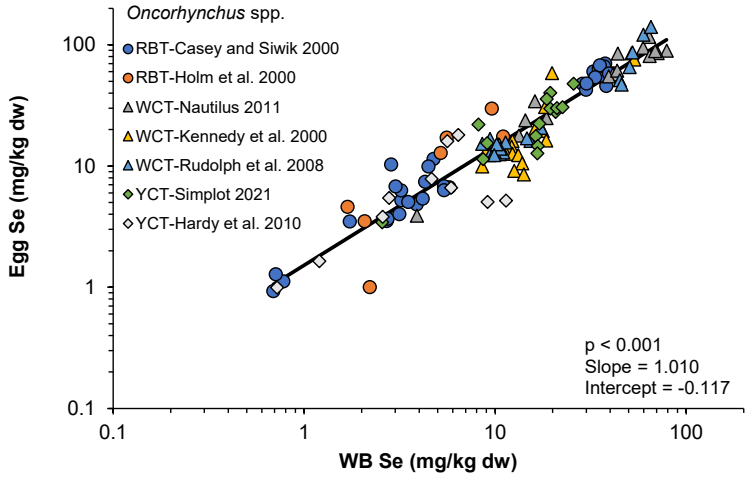


Figure 7. Relationship between egg/ovary Se and whole-body Se for the pooled *Oncorhynchus* dataset.

The EO/WB relationship for cutthroat trout without hatchery data is comparable between the one-step approach (Figure 3B) and the two-step approach that incorporates additional *Oncorhynchus* data (Figure 7), with similar converted WB concentrations using both median ratio (17.1-17.4 mg/kg WB) and regression-based CFs (16.8-18.2 mg/kg WB; Table 6). The strong agreement between the two approaches provides a strong basis for excluding hatchery data in deriving EO/WB CFs for the genus *Oncorhynchus* and thus an updated WB element for the UBR subbasin.

Table 6. Summary of egg/ovary (EO)-based Se SSC converted to whole-body (WB) values using median CFs and regressions for Oncorhynchus spp., excluding hatchery samples.

EO Se SSC (mg Se/kg EO dw)	Median EO/WB Ratio Approach		Regression Approach		
	Median EO/WB Ratio	WB Se (mg Se/kg WB)	Regression Coefficients	Regression-based CF	WB Se (mg Se/kg WB)
Egg/Ovary to Whole-Body					
24.5	1.43	17.1	m = 1.052 b = 0.099	1.45	16.84
Egg/Ovary to Muscle, Muscle to Whole-Body					
24.5	1.41	17.4	*m* = 1.010 *b* = -0.117	1.35	18.21

In summary, the hatchery samples discussed above for the genus *Oncorhynchus* are inconsistent with samples collected from natural waters as they exhibit a significantly different relationship than observed

in non-hatchery samples and thus add variability and uncertainty to the WB conversion. Additionally, the Se tissue concentrations in hatchery samples are well below the egg-based criterion concentration, and so are not considered critical or appropriate for deriving CFs as per EPA guidance and the additional analyses described above.

Excluding the hatchery samples is supported by the current evaluation, and a suitable and representative dataset for species within the genus *Oncorhynchus* is still available for deriving a CF. While regression and median ratio approaches are equally valid for translating the EO-based Se SSC into a WB value, EPA (2016) ultimately selected the median ratio approach for deriving the national recommended tissue elements. In the current evaluation, the translated WB values are comparable between the two approaches and paired tissue datasets. Therefore, the recommended WB element is 17.1 mg Se/kg WB dw for the UBR subbasin, consistent with the EPA (2016) methods for translating the EO-based Se criterion into a WB value.

No change is proposed to the muscle element of the Se SSC for the UBR subbasin. As discussed above, the current value (12.8 mg/kg dw) was set to the most sensitive muscle-based chronic value available for the genus *Oncorhynchus* in EPA (2016). The data review and analysis conducted as part of the re-evaluation of the WB element (Table 5) further support retaining this value as the most sensitive muscle-based value for resident fish in the UBR subbasin.

4.2 Genus *Salmo*

Brown trout are not resident to the UBR subbasin but have been collected in the lower portion of Georgetown Creek near the confluence with the Bear River. While members of the genus *Oncorhynchus* also occur in Georgetown Creek (rainbow trout and cutthroat trout), the current Se SSC for Georgetown Creek was set to the most sensitive EO-based EC_{10} for brown trout (21.0 mg/kg EO) because it is more sensitive than EO-based EC_{10}s for members of the genus *Oncorhynchus* (Table 2). No updates are proposed to the EO-based Se SSC for Georgetown Creek. However, when converted to a WB concentration using the median ratio derived from hatchery and wild fish (1.96; Section 3.1.1), the WB element for *Oncorhynchus* (12.5 mg/kg WB) was lower than the direct WB value for *Salmo* (13.2 mg/kg WB[3]) from EPA (2016) and thus was adopted as the current WB value for Georgetown Creek. Given the technical support for an updated WB value of 17.1 mg/kg WB for the genus *Oncorhynchus*, further evaluations were conducted to derive an updated WB element for Georgetown Creek that is supported by available tissue-to-tissue conversion data and protective of resident fish. Only direct EO/WB CFs were evaluated for *Salmo*, as EO/M data for eggs or ripe ovaries were not available to allow evaluation of the two-step approach for the *Salmo* WB element.

4.2.1 Egg to Whole-Body Conversion Factors

For the genus *Salmo*, a total of 41 matched pairs of EO and WB Se measurements were compiled from EPA 2016 (n=38) and the scientific literature (n=3; Appendix B). Using 38 pairs of EO and WB measurements, EPA (2016) calculated a median ratio-based CF of 1.45 (Table 2), which translates to a

[3] This value represents a maternal WB no observed effect concentration (NOEC) based on direct WB measurements from EPA (2016); the lowest observed effect concentration (LOEC) based on direct WB measurements was 13.6 mg/kg. EPA (2016) determined that the direct WB dataset for maternal-transfer effects was not amenable to estimating regression-based effect concentrations.

WB concentration of 14.5 mg/kg WB for the genus *Salmo*. However, EPA (2016) also identifies subsets of EO and WB pairs for *Salmo* that showed substantial differences in the EO/WB relationships and thus contributed significant variance to the EO/WB CF for *Salmo* relative to other species (Table 2). This section provides an updated evaluation of the available paired tissue data for the genus *Salmo* and proposes an updated WB element for the Georgetown Creek Site following EPA (2016) methods.

The compiled tissue dataset for *Salmo* consists of EO and WB pairs from two studies, Formation (2011)[4] and Osmundson et al. (2007). EPA (2016) identified that 1) ratios for three of the four fish samples from Osmundson et al. (2007) were 4- to 6-fold greater than the median ratio and 2) Formation (2011) data consisted of both wild fish (n=28) and hatchery fish (n=8), with ratios for hatchery fish that were 4- to 7-fold lower than the median ratio. EPA also noted that excluding these potentially anomalous data reduces the standard deviation from 1.81 to 0.47.

In the current evaluation, tissue data from Osmundson et al. (2007) were excluded because the EO data are unripe ovary tissues that are not appropriate for implementing the Se criterion or developing tissue CFs as per EPA (2021) and Idaho DEQ (2022) guidance. Also, one tissue pair from the Formation study was excluded because spawning status was not available (Appendix B). The remaining samples, including hatchery fish from Formation (2011), were evaluated based on the tissue conversion methods described for *Oncorhynchus*.

Similar to the EO/WB evaluation for the genus *Oncorhynchus* (Section 4.1.1), tissue pairs for the genus *Salmo* were evaluated with and without hatchery samples (Figure 8). Hatchery samples exhibit a significantly different relationship between EO and WB Se compared to samples from natural streams, with a median EO/WB ratio for hatchery samples (0.30) that is 5-fold lower and significantly different than the median ratio for wild samples (1.51; p<0.001 Mann-Whitney).

[4] The EO and WB tissue pairs from Formation (2011) were also presented in NewFields (2009) and both sources are referenced when describing these tissue pairs in EPA (2016).

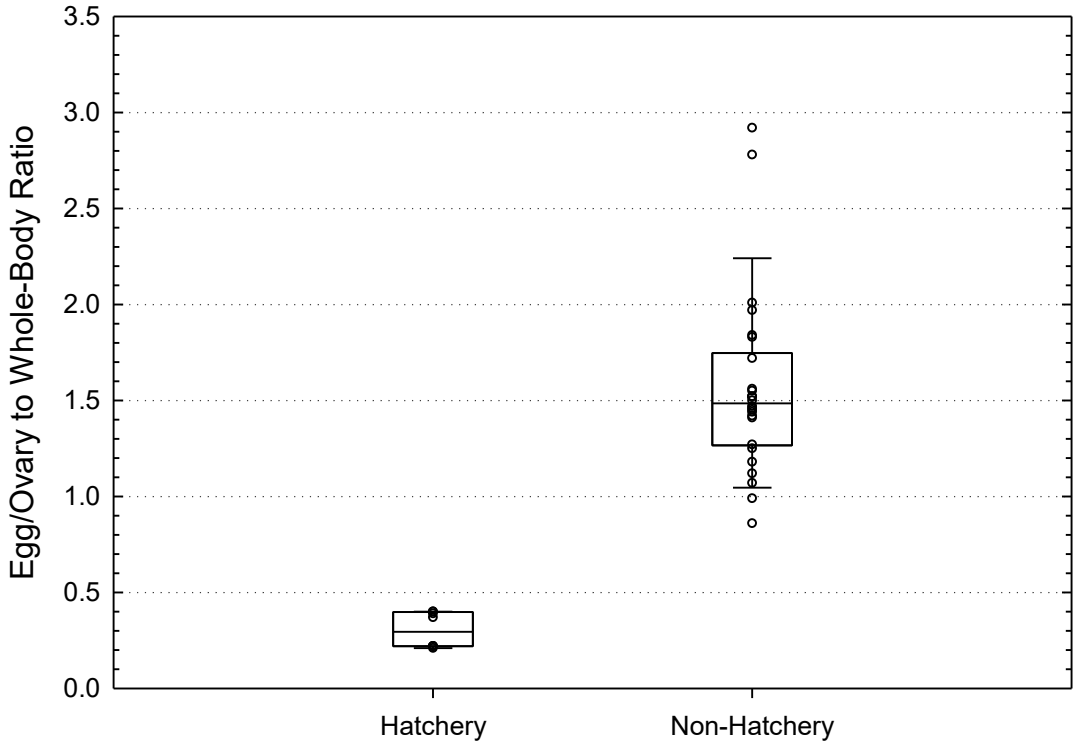


Figure 8. Brown trout egg/ovary to whole-body ratios for hatchery (*n*=8) and non-hatchery fish (*n*=28).

Excluding the hatchery samples for brown trout is also supported by the rationale described above for *Oncorhynchus,* as the hatchery samples 1) exhibit a significantly different relationship between EO and WB Se concentrations than wild fish, 2) span a concentration range well below the EO-based Se criterion for brown trout (21.0 mg/kg), and 3) a suitable and representative dataset is available after excluding the 8 hatchery samples. Figure 9 presents the TLS regressions on log-transformed EO and WB Se concentrations with and without hatchery samples (panels A and B, respectively). The EO-based Se concentration converted to corresponding WB concentrations is presented in Table 7. The median ratio- and regression-based approaches after excluding the hatchery and non-ripe ovary samples yield comparable WB concentrations of 13.9 and 12.4 mg/kg, respectively. These translated WB concentrations are also comparable to the NOEC and LOEC of 13.2 and 13.6 mg/kg, respectively, for direct WB measurements presented in EPA (2016).

Using the median ratio-based approach as per EPA (2016), the proposed updated WB element for the Georgetown Creek subbasin is 13.9 mg/kg. This value is more conservative than a WB value of 14.5 mg/kg derived using the EPA (2016) CF of 1.45 (with hatchery samples) and similar to the direct WB NOEC and LOEC described above.

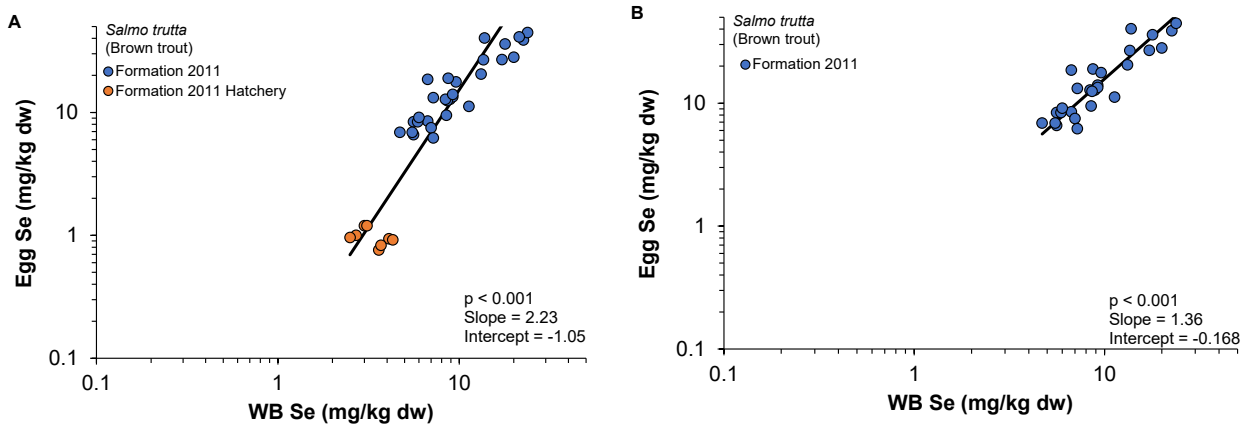


Figure 9. Relationship between egg/ovary Se and whole-body Se for brown trout (A) with hatchery samples and (B) without hatchery samples.

Table 7. Summary of egg/ovary (EO)-based Se SSC converted to whole-body (WB) values using median ratio and regression-based CFs for brown trout.

EO Se SSC (mg Se/kg EO dw)	Median EO/WB Ratio Approach		Regression Approach		
	Median Egg/WB CF	WB Se Element (mg Se/kg WB dw)	Regression Coefficients	Regression -based CF	WB Se Element (mg Se/kg WB dw)
Including hatchery fish					
21.0	1.45	14.5	m = 2.229 b = -1.046	1.82	11.5
Excluding hatchery fish					
21.0	1.51	13.9	m = 1.365 b = -0.168	1.70	12.4

4.2.2 Egg to Muscle Conversion Factors

The muscle tissue element for the Georgetown Creek subbasin was set to the SMCV for rainbow trout (12.8 mg/kg muscle) as this was the lowest muscle reproductive chronic value in EPA (2016) for resident fish in Georgetown Creek. Because the methods and available tissue data for converting the EO criterion to muscle or WB elements vary among species, the rankings of translated WB and muscle elements also vary for the 5th percentile-based AWQC (EPA 2016). As part of the updated analysis of tissue CFs, the brown trout EO to muscle translation was further evaluated based on the available tissue CF data and EPA (2016) methodology, as summarized below.

EPA (2016) converted the brown trout EO value of 21.0 mg/kg into a reproductive muscle value of 18.5[5] mg/kg by applying a two-step CF in which EO data was first converted to WB data and then the WB data was converted to muscle data, as shown in Eq. 1 and Eq. 2:

$$Brown\ Trout\ \frac{EO}{M}\ CF\ (1.14) = \frac{Brown\ Trout \frac{EO}{WB}\ CF\ (1.45)}{All\ Fish \frac{M}{WB}\ (1.27)} \qquad Eq.\ 1$$

[5] Using the data and formula presented in Eq. 2 herein and Table 3.6 in EPA (2016), we calculate a brown trout muscle value of 18.42 mg/kg versus the 18.5 mg/kg value presented in EPA (2016).

Where:

EO/WB	=	Median brown trout EO-to-WB ratio, calculated with hatchery fish and non- ripe ovary tissue samples.
M/WB	=	Median muscle-to-WB ratio calculated from all available fish tissue data.

EPA (2016) translated the brown trout EO value of 21.0 mg/kg into a reproductive muscle value of 18.5 mg/kg using the EO/M CF of 1.14 (Eq. 1), as follows:

$$Brown\ Trout\ Muscle\ (18.5\ mg/kg) = \frac{Brown\ Trout\ EO\ Chronic\ Value\ (21.0\ mg/kg)}{Brown\ Trout \frac{EO}{M} CF\ (1.14)} \qquad Eq.\ 2$$

The "all fish" M/WB value of 1.27 in Eq. 1 represents the median M/WB ratio from eight species within the class *Actinopterygii* and was applied in the absence of brown-trout specific EO/M or M/WB data. Further review of scientific literature and databases was therefore conducted to address uncertainty associated with applying an aggregated CF to a species-specific EO value. For brown trout, EO/M data were not available, but brown trout M/WB tissue pairs (n=20) were identified from Osmundson and Skorupa (2011) and the Idaho DEQ fish database (IDEQ 2024). The brown trout M/WB tissue pairs are significantly correlated (p<0.001) with a positive slope (0.871) and thus appropriate for deriving a species-specific CF in accordance with EPA (2016) guidance (Figure 10).

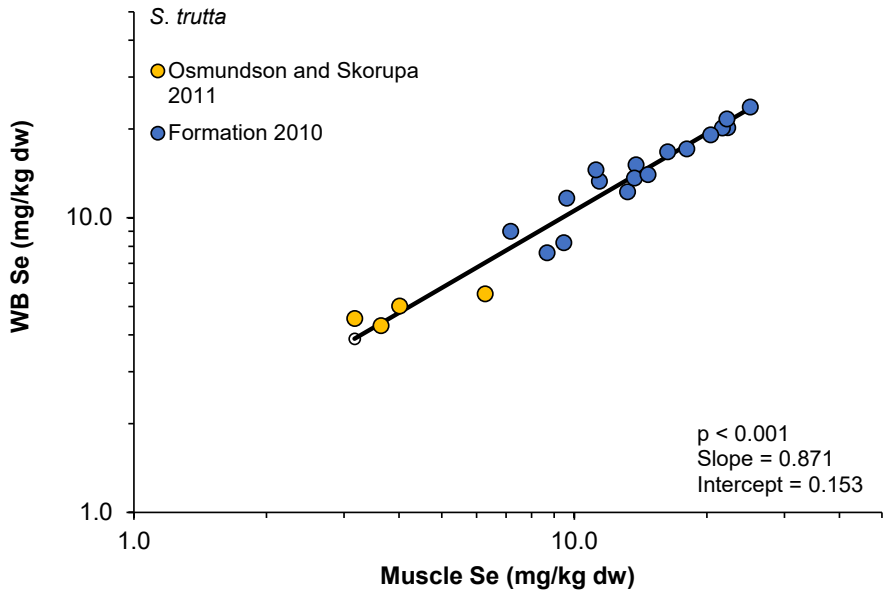


Figure 10. Relationship between whole-body (WB) Se and muscle Se for brown trout.

The median brown trout M/WB ratio from the tissue pairs in Figure 10 is 1.03. When applied to the median brown trout EO/WB CF of 1.51 (Table 7), the EO/M CF is 1.47, which yields a brown-trout

specific muscle value of 14.3 mg/kg. This value is more conservative than the 18.5 mg/kg chronic muscle value in EPA (2016) and was derived using a more scientifically rigorous approach consistent with the more reliable taxonomic hierarchy method outlined in EPA (2016). Table 8 summarizes the brown trout tissue-to-tissue CFs and translated muscle values as presented in EPA (2016) and based on the updated brown trout-specific CFs presented herein.

Table 8. Summary of egg/ovary (EO)-based Se SSC converted to muscle (M) values using median ratio and regression-based CFs for brown trout.

Egg Se SSC (mg Se/kg EO dw)	Median EO/WB CF	Median M/WB CF	Final EO/M CF	Muscle Value (mg Se/ kg dw)
EPA (2016) Egg-to-Muscle				
21.0	1.45	1.27	1.14	18.50
Updated Egg-to-Muscle				
21.0	1.51	1.03	1.47	14.28

While the updated brown trout muscle value of 14.3 mg/kg is based on a more scientifically rigorous approach than the 18.5 mg/kg from EPA (2016) as it incorporates species-specific CF data, this value is greater than the current muscle element of 12.8 mg/kg for the Georgetown Creek subbasin, which is the lowest reproductive muscle value for *O. mykiss* in EPA (2016). Because *O. mykiss* are also resident fish in Georgetown Creek, no changes are proposed to the current muscle element.

5 Conclusions and Recommendations

5.1 Conclusions

The current evaluations of EO/WB tissue conversions for species within the genera *Oncorhynchus* and *Salmo* lead to several genus-specific conclusions.

5.1.1 Genus *Oncorhynchus*

Within the genus *Oncorhynchus*, paired EO and WB Se data for hatchery fish (n=16) exhibited a significantly different relationship (p<0.001) than for non-hatchery fish (n=25) and comprised EO concentrations (<3.3 mg/kg) that are more than 7-fold lower than the EO-based SSC. Consequently, including the hatchery samples in the translation of the EO-based SSC to a WB value introduces undue uncertainty and yields notably different WB values based on whether the median ratio- or regression-based approach is used (12.5 vs 19.9 mg/kg, respectively). Excluding the hatchery samples still provides a sufficient dataset of EO/WB tissue pairs (n=25) consisting of cutthroat trout samples collected from the UBR basin that span a wide EO concentration range and bracket the EO-based Se SSC of 24.5 mg/kg. The median ratio- and regression-based approaches excluding the hatchery samples yield comparable WB values of 17.1 and 16.8 mg/kg, respectively. In a separate two-step approach that incorporated additional tissue pairs (n=125), WB values of 17.4 and 18.2 mg/kg were derived which aligned with the WB values calculated with the EO/WB CF that excluded hatchery samples.

In summary, an update to the WB element of the Se SSC for the UBR subbasin is supported by a weight-of-evidence evaluation in which multiple statistical approaches applied to paired tissue data from multiple

studies converge on translated WB values between 16.8 and 18.2 mg/kg. While both median ratio- and regression-based approaches are valid for tissue-to-tissue conversions, the updated WB value of 17.1 mg/kg proposed for the UBR subbasin (Section 5.2) is based on the median EO/WB ratio without hatchery data. This is also consistent with EPA's approach for the Se AWQC, and the approach for the existing Se SSC.

5.1.2 Genus *Salmo*

Within the *Salmo* genus, significant differences were also observed in the EO/WB relationship between hatchery (n=8) and non-hatchery fish (n=28), with a median EO/WB ratio for hatchery samples (0.30) that is substantially lower and significantly different than the median ratio for wild samples (1.51; p<0.001). The hatchery samples also comprise EO concentrations (≤1.20 mg/kg) that are well below the EO-based SSC of 21.0 mg/kg and thus introduce unnecessary uncertainty in the translated WB value. Excluding the brown trout hatchery data provides a suitable and representative dataset, which yields a median EO/WB ratio of 1.51 and a translated WB value of 13.9 mg/kg.

5.1.3 Protectiveness of the Se SSC

Importantly, the proposed update to the WB elements does not affect the protectiveness of the Se SSC previously established and approved for the UBR and Georgetown Creek subbasins (Nu-West 2017, EPA 2019). Both the EPA (2016) Se AWQC and the Se SSC for the UBR and Georgetown Creek subbasins were established to protect against larval effects (mortality, deformities, and edema) associated with maternally transferred Se in the eggs. The most sensitive Se effect levels from which the Se AWQC and SSC were derived are thus expressed as EO concentrations. As discussed, no updates are proposed to the EO or muscle elements of the Se SSC, the list of resident fish, Site boundaries, or the hierarchy and implementation of the multi-element criterion.

To confirm that the updated WB elements remain protective of all resident fish species, a focused evaluation was conducted and is presented in Appendix C. Each tissue element is set to the most sensitive resident species for that tissue; at the UBR Site the WB element (17.1 mg/kg dw) is based on the genus *Oncorhynchus* (rainbow trout), and at the Georgetown Creek Site the WB element (13.9 mg/kg dw) is based on the genus *Salmo* (brown trout), while the muscle element (12.8 mg/kg dw) remains based on rainbow trout at both Sites. For the salmonid resident species, the WB concentration corresponding to each species' EO threshold (the EO threshold divided by the species' EO/WB conversion factor; Section 4) is at or above the proposed WB element, such that a fish meeting the WB element remains below its species-specific EO threshold. For the non-salmonid resident families, the available WB effect and no-effect concentrations are also at or above the proposed WB elements, evaluated at the family level consistent with Nu-West (2017, Section 5.1–5.4). These families are less sensitive to Se than salmonids, consistent with EPA's (2016) finding that salmonids are among the most sensitive fish to Se. The proposed WB elements are therefore protective of all resident fish species, consistent with the protectiveness previously established and approved (Nu-West 2017; EPA 2019).

5.2 Recommendations

Nu-West proposes updated WB elements for the Se SSC for the UBR and Georgetown Creek Sites. The proposed updates are supported by a weight-of-evidence evaluation conducted on paired tissue measurements in accordance with EPA (2016) methods.

The proposed update is limited to the WB element of the Se SSC for each Site, with no changes proposed to the EO, muscle, or water-column elements, or the hierarchy and implementation of the multi-element criterion. For the updated WB element applicable to the UBR subbasin, Nu-West proposes an update to the current Se SSC at IDAPA 58.01.02 § 287.01 (Subsection Blackfoot Subbasin) as follows:

Table 9. Proposed update to the Site-specific Se criteria for UBR subbasin. *

Chronic			
Egg-Ovary (mg/kg dw)	**Fish Tissue (mg/kg dw)**		**Water Column (µg/L)**
Egg-Ovary	Whole-Body	Muscle	Water Lotic
No changes 24.5[1]	Proposed change ~~12.5~~17.1[2]	No changes 12.8[2]	No changes 11.9[3,4,5]

Notes:

*Please note that this table and its notes are taken, in its entirety and verbatim, from IDAPA 58.01.02 § 287.01. The proposed updates are shown in strikethrough and underlined text in Table 9. No additional updates are proposed.

[1] Egg-ovary supersedes any whole-body, muscle, or water column element when fish egg-ovary concentrations are measured. Single measurement of an average or composite sample of at least five (5) individuals of the same species. Not to be exceeded; DEQ will evaluate all representative egg-ovary data to determine compliance with this criteria element.

[2] Fish whole-body or muscle tissue supersedes water column element when both fish tissue and water concentrations are measured. Single measurement of an average or composite sample of at least five (5) individuals of the same species where the smallest individual is no less than seventy-five percent (75%) of the total length (size) of the largest individual. Not to be exceeded; DEQ will evaluate all representative whole-body or muscle data to determine compliance with this criterion element.

[3] Water column values are derived using the empirical BAF method. For comparative purposes only, the example value displayed in this table represents the lotic water column value for Sheep Creek based on the average BAF for Cutthroat Trout among all sampling locations and years.

[4] Lotic Water Column Equation=

$$\frac{Tissue_{criterion}}{BAF}$$

where $Tissue_{criterion}$ is the fish tissue element (whole body), and BAF is the bioaccumulation factor derived by dividing site-specific field-collected samples of fish tissue (whole body) by site-specific field-collected samples of water.

[5] Water column values are the applicable criteria element in the absence of steady-state condition fish tissue data. In fishless waters, surface water from the fishless waters and fish tissue from the nearest downstream waters are used for bioaccumulation modeling. Fish tissue supersedes any site-specific water column values when fish are sampled downstream of fishless waters.

For the updated WB element applicable to the Georgetown Creek subbasin, Nu-West proposes an update to the current Se SSC at IDAPA 58.01.02 § 287.02 (Subsection of Bear Lake Subbasin) as follows:

Table 10. Proposed update to the Site-specific Se criteria for Georgetown Creek subbasin. *

Chronic			
Egg-Ovary (mg/kg dw)	**Fish Tissue (mg/kg dw)**		**Water Column (µg/L)**
Egg-Ovary	Whole-Body	Muscle	Water Lotic
No changes 21.0[1]	Proposed change ~~12.5~~13.9[2]	No changes 12.8[2]	No changes 3.8[3,4,5]

Notes:

*Please note that this table and its notes are taken, in its entirety and verbatim, from IDAPA 58.01.02 § 287.02. The proposed updates are shown in strikethrough and underlined text in Table 10. No additional updates are proposed.

[1] Egg-ovary supersedes any whole-body, muscle, or water column element when fish egg-ovary concentrations are measured. Single measurement of an average or composite sample of at least five (5) individuals of the same species. Not to be exceeded; DEQ will evaluate all representative egg-ovary data to determine compliance with this criteria element.

[2] Fish whole-body or muscle tissue supersedes water column element when both fish tissue and water concentrations are measured. Single measurement of an average or composite sample of at least five (5) individuals of the same species where the smallest individual is no less than seventy-five percent (75%) of the total length (size) of the largest individual. Not to be exceeded; DEQ will evaluate all representative whole-body or muscle data to determine compliance with this criterion element.

[3] Water column values are derived using the empirical BAF method. For comparative purposes only, the example value displayed in this table represents the lotic water column value for Georgetown Creek, upstream of the intermittent reach, based on the average BAF for Brook Trout in all sampling locations and years.

[4] Lotic Water Column Equation=

$$\frac{Tissue_{criterion}}{BAF}$$

where $Tissue_{criterion}$ is the fish tissue element (whole body), and BAF is the bioaccumulation factor derived by dividing site-specific field-collected samples of fish tissue (whole body) by site-specific field-collected samples of water.

[5] Water column values are the applicable criteria element in the absence of steady-state condition fish tissue data. In fishless waters, surface water from the fishless waters and fish tissue from the nearest downstream waters are used for bioaccumulation modeling. Fish tissue supersedes any site-specific water column values when fish are sampled downstream of fishless waters.

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Appendix A. Resident Fish Species of the Upper Blackfoot River and Georgetown Creek Subbasins

This appendix summarizes the fish-survey data and resident-species determinations previously presented in Nu-West's 2017 Proposal for Site-Specific Selenium Criteria for the Upper Blackfoot River (UBR) and Georgetown Creek subbasins (Nu-West 2017). It is provided in response to EPA's request to confirm the fish species present in the present-day waters with proposed site-specific selenium criteria (SSC) and to address tributaries for which fish data are limited. The information presented here is a summary of that previously presented and approved information; no new survey data or analyses are introduced, other than a brief note of more recent tributary surveys that confirm the established resident-species list.

The proposed update to the SSC is limited to the whole-body (WB) tissue element and does not change the Site boundaries or the list of resident fish species established in Nu-West (2017) and approved by EPA (EPA 2019). The resident-species basis therefore carries forward unchanged, and the survey record summarized below continues to support it.

Consistent with EPA guidance on SSC (USEPA 1994, 2013), a "Site" may be a state, region, watershed, waterbody, or segment of a waterbody. The two Sites addressed by this proposal are defined at the watershed scale based on existing water body units in the Idaho Administrative Procedures Act (IDAPA) 58.01.02 § 150.09:

- UBR subbasin: Blackfoot River – confluence of Lanes and Diamond Creeks to Blackfoot Reservoir (unit US-10), and all tributaries thereof; and
- Georgetown Creek subbasin: Georgetown Creek – source to mouth (unit B-22), and all tributaries thereof.

The mainstems of the Blackfoot River and Georgetown Creek are designated as Cold Water and Salmonid Spawning for the protection of aquatic life. Tributaries of each waterway are non-designated and are presumed to support cold water aquatic life (IDAPA 58.01.02).

For purposes of the Recalculation Procedure, the terms "occur at the Site" and "resident" include species and life stages that are usually present at the Site; present only seasonally due to migration; present intermittently as they periodically extend their ranges into the Site; or were present in the past (or are present in nearby waters) and are expected to be present when degraded conditions improve (IDAPA 58.01.02 § 010.85 and § 257.01). The resident fish species occurring at each Site were determined from comprehensive survey and stocking records, the duration and breadth of which provide a high degree of certainty in the resident-species list for each Site.

Resident Fish in the Upper Blackfoot River Subbasin

The UBR subbasin supports Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*), rainbow trout (*O. mykiss*), brook trout (*Salvelinus fontinalis*), and various non-game species (minnows, sculpins, and suckers). As presented in Nu-West (2017), the resident-species list was developed from an extensive, multi-decadal fisheries record; in total, more than 80,000 survey results (e.g., fish counts by species) are available for the Blackfoot River and its tributaries between 1959 and 2016, compiled in Nu-West (2017, Appendix A). Rather than reproduce that compendium here, the principal survey programs summarized in the 2017 proposal are listed below:

- Idaho Department of Fish and Game (IDFG) – intensive fishery, population, spawning, and creel surveys on the UBR and its tributaries (1959–2016), using creel surveys, visual estimates, boat and wading electrofishing, and fish traps.
- IDFG stocking records (1967–2016). Only rainbow trout have been stocked in the UBR since the mid-1990s, and only sterile rainbow trout since 2000–2001, as part of a management program to protect the native Yellowstone cutthroat trout gene pool (IDFG 2007).
- Idaho DEQ Beneficial Use Reconnaissance Program (BURP) – single- and multi-pass electrofishing surveys on nearly all tributary streams in the UBR subbasin (1993–2016) following BURP protocols (IDEQ 2013).
- GEI Consultants/Arcadis – quantitative multi-pass depletion electrofishing on ten tributary streams in the UBR subbasin (2013–2016) on behalf of Nu-West.
- U.S. Forest Service (USFS) – single- and triple-pass electrofishing surveys on tributaries throughout the UBR (2000–2002 and 2012).

Across these independent datasets the resident assemblage was consistently confirmed. The UBR Site supports four fish families – salmonids, cyprinids, catostomids, and cottids. Selenium-sensitive taxa such as sturgeon and centrarchids were confirmed absent. The resident-species list, reproduced from Nu-West (2017, Table 1), is presented in Table A-1.

Table A-1. Resident fish species that occur in the Upper Blackfoot River subbasin (summarized from Nu-West 2017, Table 1).

Family	Genus	Species	Common Name
Salmonidae	*Oncorhynchus*	*O. mykiss*	Rainbow trout
		O. clarkii bouvieri	Yellowstone cutthroat trout
	Salvelinus	*S. fontinalis*	Brook trout
Cyprinidae	*Rhinichthys*	*R. cataractae*	Longnose dace
		R. osculus	Speckled dace
		R. falcatus	Leopard dace
	Richardsonius	*R. balteatus*	Redside shiner
	Gila	*G. atraria*	Utah chub
	Couesius	*C. plumbeus*	Lake chub
	Lepidomeda	*L. copei*	Northern leatherside chub
	Cyprinus	*C. carpio*	Common carp
Catostomidae	*Catostomus*	*C. ardens*	Utah sucker
		C. platyrhynchus	Mountain sucker
Cottidae	*Cottus*	*C. bairdii*	Mottled sculpin
		C. beldingii	Paiute sculpin

Resident Fish in the Georgetown Creek Subbasin

Brook trout and rainbow trout dominate the fish community in Georgetown Creek. Bonneville cutthroat trout (*O. clarkii utah*), a subspecies endemic to the Bear River drainage, were sampled throughout Georgetown Creek in the 1990s and, while observed only in limited numbers in lower Georgetown Creek in more recent surveys, remain a resident species because their re-establishment is an IDFG management objective (Teuscher and Capurso 2007). Brown trout (*Salmo trutta*) and sculpin have been observed in lower Georgetown Creek near its confluence with the Bear River. As presented in Nu-West (2017), the resident-species list was developed from the following surveys:

- IDFG – single- and multi-pass electrofishing surveys on Georgetown Creek and Left Hand Fork (1981, 1994, 1997, 2003, 2006–2008, and 2012), plus stocking records (rainbow trout only, and sterile, since 1995).
- Idaho DEQ BURP – backpack electrofishing at four locations on Georgetown Creek and one on Left Hand Fork (1997–2013).
- USFS – single- and triple-pass electrofishing surveys on Georgetown Creek and Left Hand Fork (1994, 2000, 2001, and 2007).
- GEI Consultants/Arcadis – seasonal quantitative multi-pass electrofishing at four locations on Georgetown Creek and one on Left Hand Fork (2015–2016) on behalf of Nu-West.

The Georgetown Creek subbasin is a smaller drainage with fewer fisheries records than the UBR, but the resident-species list was consistently confirmed across these surveys. The Site supports two fish families – salmonids and cottids – and sturgeon and centrarchids were confirmed absent. The resident-species list, reproduced from Nu-West (2017, Table 2), is presented in Table A-2.

Table A-2. Resident fish species that occur in the Georgetown Creek subbasin (summarized from Nu-West 2017, Table 2).

Family	Genus	Species	Common Name
Salmonidae	*Oncorhynchus*	*O. mykiss*	Rainbow trout
		O. clarkii utah	Bonneville cutthroat trout
	Salvelinus	*S. fontinalis*	Brook trout
	Salmo	*S. trutta*	Brown trout
Cottidae	*Cottus*	*C. spp.*	Sculpin

Confirmation of Resident Species Since 2017

Since the 2017 proposal, limited additional aquatic surveys have been conducted in tributaries within both subbasins — in tributaries to the Blackfoot River in the UBR subbasin (Arcadis 2024; Benchmark 2025) and in tributaries to Georgetown Creek in the Georgetown Creek subbasin (Arcadis 2023). These surveys confirmed that no fish species occur beyond those previously established for the Sites (Tables A-1 and A-2), consistent with the resident-species lists approved by EPA in 2019. The resident assemblages are naturally limited cold-water communities. Accordingly, no change to the resident-species lists or Site boundaries is warranted, and the lists of resident fish established in Nu-West (2017) and approved by EPA (EPA 2019) remain valid for the updated WB element.

Upper Tributaries with Limited Fish Data

The historical record provides broad tributary coverage in both subbasins (e.g., Idaho DEQ BURP and IDFG surveyed nearly all UBR tributaries, and GEI/Arcadis and USFS surveyed additional tributaries in both subbasins), and the recent surveys noted above (Arcadis 2023, 2024; Benchmark 2025) provide further tributary coverage in both subbasins. For any upper or headwater tributaries with limited or no fish data, it is reasonable to assume that their species composition is a subset of – and contains no species beyond – those on the resident-species lists in Tables A-1 and A-2. Upper tributaries are smaller, colder, higher-gradient, and in places intermittent or naturally barriered, conditions that restrict fish occurrence to those cold-water taxa (salmonids and, where present, sculpin) already accounted for at each Site. As discussed in Nu-West (2017), some of the tributaries are naturally fishless due to persistent, intermittent

low-flow conditions and a lack of permanent connection to downstream, fish-bearing waters. Collectively, these tributaries cannot support species absent from the downstream resident-species lists.

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Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	0.53	0.93	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	0.60	1.12	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	0.55	1.28	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	1.34	3.49	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	2.08	3.51	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	2.11	3.67	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	2.43	4.00	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	3.00	4.82	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	2.71	5.05	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	2.49	5.21	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	3.22	5.38	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	2.48	6.28	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	4.16	6.31	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	4.44	6.67	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	2.32	6.77	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	4.16	6.79	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	3.32	7.41	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	3.46	9.90	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	2.20	10.28	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	3.67	11.41	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	23.08	42.56	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	29.44	45.64	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	22.08	47.69	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	23.20	47.95	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	28.48	53.33	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	25.76	53.85	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	27.80	54.87	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	25.72	55.13	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	28.20	55.38	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	26.52	55.64	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	27.04	56.67	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	31.44	56.92	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	30.40	57.95	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	32.04	58.21	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	25.20	60.00	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	26.88	63.33	--

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*, cont'd

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	28.76	66.15	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	27.24	67.69	--
Rainbow Trout	Casey and Siwik 2000	ripe/gravid female	--	29.08	70.00	--
Rainbow Trout	Exponent et al. 2013	not available	0.94	0.74	--	--
Rainbow Trout	Exponent et al. 2013	not available	0.95	0.71	--	--
Rainbow Trout	Exponent et al. 2013	not available	0.96	0.73	--	--
Rainbow Trout	Exponent et al. 2013	not available	0.98	0.73	--	--
Rainbow Trout	Exponent et al. 2013	not available	0.99	0.82	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.00	0.72	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.00	1.30	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.05	1.01	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.06	0.72	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.08	0.87	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.13	0.67	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.13	0.82	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.15	1.01	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.17	0.96	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.22	1.03	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.23	0.94	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.27	0.86	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.38	0.91	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.45	0.87	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.46	1.00	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.52	1.41	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.53	1.25	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.59	1.12	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.61	1.27	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.64	1.27	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.65	1.03	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.65	1.41	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.70	1.33	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.74	0.98	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.74	1.26	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.74	1.44	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.83	1.39	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.86	1.25	--	--

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*, cont'd

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Rainbow Trout	Exponent et al. 2013	not available	1.86	1.42	--	--
Rainbow Trout	Exponent et al. 2013	not available	1.90	1.59	--	--
Rainbow Trout	Exponent et al. 2013	not available	2.11	1.56	--	--
Rainbow Trout	Holm et al. 2005	ripe/gravid female	--	1.70	1.00	--
Rainbow Trout	Holm et al. 2005	ripe/gravid female	--	1.60	3.50	--
Rainbow Trout	Holm et al. 2005	ripe/gravid female	--	1.30	4.60	--
Rainbow Trout	Holm et al. 2005	ripe/gravid female	--	4.00	12.80	--
Rainbow Trout	Holm et al. 2005	ripe/gravid female	--	4.30	17.10	--
Rainbow Trout	Holm et al. 2005	ripe/gravid female	--	8.50	17.50	--
Rainbow Trout	Holm et al. 2005	ripe/gravid female	--	7.40	29.70	--
Rainbow Trout	USEPA 2007	not available	0.99	0.80	--	--
Rainbow Trout	USEPA 2007	not available	1.04	0.79	--	--
Rainbow Trout	USEPA 2007	not available	1.12	0.96	--	--
Rainbow Trout	USEPA 2007	not available	1.16	0.92	--	--
Rainbow Trout	USEPA 2007	not available	1.79	1.32	--	--
Rainbow Trout	USEPA 2007	not available	2.04	1.30	--	--
Rainbow Trout	USEPA 2007	not available	2.21	1.70	--	--
Rainbow Trout	USEPA 2007	not available	2.43	1.70	--	--
Rainbow Trout	USEPA 2007	not available	2.47	1.48	--	--
Rainbow Trout	USEPA 2007	not available	2.56	1.80	--	--
Rainbow Trout	USEPA 2007	not available	2.63	1.97	--	--
Rainbow Trout	USEPA 2007	not available	2.84	1.85	--	--
Rainbow Trout	USEPA 2007	not available	2.86	1.70	--	--
Rainbow Trout	USEPA 2007	not available	2.93	1.90	--	--
Rainbow Trout	USEPA 2007	not available	2.98	1.70	--	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	10.90	8.50	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	9.70	9.10	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	6.60	9.90	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	10.70	10.50	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	10.20	12.30	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	9.50	12.60	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	6.90	13.20	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	8.70	13.20	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	9.40	14.40	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	9.50	16.10	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	14.30	16.20	--

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*, cont'd

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	13.70	19.40	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	12.50	20.20	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	14.10	30.60	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	15.30	58.40	--
Westslope Cutthroat Trout	Kennedy et al. 2000	ripe/gravid female	--	41.30	75.40	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	3.00	3.88	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	10.29	17.80	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	11.09	23.80	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	14.32	24.80	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	12.47	34.20	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	30.31	54.70	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	31.95	56.80	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	33.61	61.10	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	49.71	80.60	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	33.82	84.60	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	39.96	85.00	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	54.76	85.30	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	53.16	88.50	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	61.00	89.20	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	45.95	94.50	--
Westslope Cutthroat Trout	Nautilus 2011	ripe/gravid	--	49.44	116.00	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	7.22	12.30	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	7.62	12.30	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	8.16	12.50	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	8.52	12.90	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	7.64	13.10	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	7.70	13.90	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	8.20	13.90	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	8.12	14.90	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	8.03	15.00	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	7.86	15.10	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	6.61	15.20	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	8.74	15.60	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	11.80	16.10	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	7.25	16.70	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	11.30	16.90	--

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*, cont'd

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	35.40	46.80	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	34.70	51.00	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	39.00	65.30	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	40.40	86.30	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	46.10	121.00	--
Westslope Cutthroat Trout	Rudolph et al. 2008	ripe/gravid female	--	50.40	140.00	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	2.56	--	3.43	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	8.63	--	11.40	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	16.60	--	12.70	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	16.70	--	14.60	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	9.07	--	15.40	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	16.30	--	17.60	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	8.17	--	22.00	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	17.00	--	22.30	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	20.70	--	27.90	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	19.40	--	29.70	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	21.00	--	30.00	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	22.50	--	30.50	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	18.60	--	35.60	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	19.40	--	40.10	--
Yellowstone Cutthroat Trout	Formation 2012	ripe/gravid female	25.70	--	47.60	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.36	--	0.83	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.43	--	1.34	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.36	--	1.36	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.23	--	1.58	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.40	--	1.65	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.85	--	1.74	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.73	--	1.79	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.28	--	1.87	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.72	--	1.93	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.44	--	1.98	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.45	--	2.03	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.91	--	2.06	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.44	--	2.26	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.50	--	2.33	--
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.44	--	2.48	--

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*, cont'd

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Yellowstone Cutthroat Trout	Formation 2012 - hatchery	ripe/gravid female	0.31	--	3.23	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	0.70	--	1.00	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	1.20	--	1.60	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	2.60	--	3.80	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	9.10	--	5.10	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	11.40	--	5.20	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	2.80	--	5.50	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	5.90	--	6.60	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	4.60	--	7.80	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	5.60	--	16.00	--
Yellowstone Cutthroat Trout	Hardy 2005	ripe/gravid female	6.40	--	18.00	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	3.72	3.56	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.04	3.88	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.28	4.13	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.49	3.50	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.54	3.71	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.56	4.27	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.63	3.56	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.64	4.16	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.72	3.54	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.77	4.40	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	4.83	4.42	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.01	3.92	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.12	3.59	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.16	3.81	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.16	5.50	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.18	3.66	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.52	5.19	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.58	3.77	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.64	2.62	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.67	4.10	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.78	3.90	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.88	6.41	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.89	3.26	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	5.89	4.54	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	6.16	6.46	--	--

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*, cont'd

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Yellowstone Cutthroat Trout	Nutrien 2021	not available	6.53	6.73	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	6.76	5.29	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	6.85	7.74	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	7.08	7.78	--	--
Yellowstone Cutthroat Trout	Nutrien 2021	not available	10.30	10.90	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	3.30	2.72	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	3.35	2.44	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	3.77	3.64	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	4.02	3.19	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	4.09	3.35	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	4.19	3.65	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	4.60	2.92	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	5.36	3.98	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	5.62	4.84	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	8.27	6.23	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	8.56	8.58	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	10.40	10.80	--	--
Yellowstone Cutthroat Trout	Simplot 2021	not available	11.00	10.40	--	--
Brown Trout	Osmundson and Skorupa 2011	not available	4.55	--	32.20	--
Brown Trout	Osmundson and Skorupa 2011	not available	5.52	--	32.50	--
Brown Trout	Osmundson and Skorupa 2011	not available	5.02	--	35.60	--
Brown Trout	Osmundson and Skorupa 2011	not available	4.30	--	37.80	--
Brown Trout	Simplot 2021	ripe/gravid female	7.20	--	6.20	--
Brown Trout	Simplot 2021	ripe/gravid female	5.60	--	6.60	--
Brown Trout	Simplot 2021	ripe/gravid female	4.70	--	6.90	--
Brown Trout	Simplot 2021	ripe/gravid female	5.50	--	6.90	--
Brown Trout	Simplot 2021	ripe/gravid female	7.00	--	7.50	--
Brown Trout	Simplot 2021	ripe/gravid female	5.60	--	8.40	--
Brown Trout	Simplot 2021	ripe/gravid female	5.90	--	8.40	--
Brown Trout	Simplot 2021	ripe/gravid female	6.70	--	8.50	--
Brown Trout	Simplot 2021	ripe/gravid female	6.00	--	9.10	--
Brown Trout	Simplot 2021	ripe/gravid female	8.50	--	9.50	--
Brown Trout	Simplot 2021	ripe/gravid female	11.30	--	11.20	--
Brown Trout	Simplot 2021	ripe/gravid female	8.60	--	12.50	--
Brown Trout	Simplot 2021	ripe/gravid female	8.40	--	12.80	--
Brown Trout	Simplot 2021	ripe/gravid female	8.90	--	12.80	--

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*, cont'd

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Brown Trout	Simplot 2021	mature pre-spawn female	7.20	--	13.20	--
Brown Trout	Simplot 2021	ripe/gravid female	9.20	--	13.40	--
Brown Trout	Simplot 2021	ripe/gravid female	9.20	--	14.00	--
Brown Trout	Simplot 2021	ripe/gravid female	9.60	--	17.70	--
Brown Trout	Simplot 2021	mature pre-spawn female	6.70	--	18.60	--
Brown Trout	Simplot 2021	mature pre-spawn female	8.70	--	19.00	--
Brown Trout	Simplot 2021	ripe/gravid female	13.20	--	20.50	--
Brown Trout	Simplot 2021	ripe/gravid female	13.60	--	26.80	--
Brown Trout	Simplot 2021	ripe/gravid female	17.20	--	26.90	--
Brown Trout	Simplot 2021	ripe/gravid female	20.00	--	28.10	--
Brown Trout	Simplot 2021	ripe/gravid female	17.90	--	36.00	--
Brown Trout	Simplot 2021	mature pre-spawn female	22.60	--	38.80	--
Brown Trout	Simplot 2021	ripe/gravid female	13.80	--	40.30	--
Brown Trout	Simplot 2021	not available	21.40	--	41.20	--
Brown Trout	Simplot 2021	mature pre-spawn female	23.80	--	44.70	--
Brown Trout	Simplot 2021 - hatchery	ripe/gravid female	3.60	--	0.76	--
Brown Trout	Simplot 2021 - hatchery	ripe/gravid female	3.70	--	0.83	--
Brown Trout	Simplot 2021 - hatchery	ripe/gravid female	4.30	--	0.92	--
Brown Trout	Simplot 2021 - hatchery	ripe/gravid female	4.10	--	0.94	--
Brown Trout	Simplot 2021 - hatchery	ripe/gravid female	2.50	--	0.96	--
Brown Trout	Simplot 2021 - hatchery	ripe/gravid female	2.70	--	1.00	--
Brown Trout	Simplot 2021 - hatchery	ripe/gravid female	3.00	--	1.20	--
Brown Trout	Simplot 2021 - hatchery	ripe/gravid female	3.10	--	1.20	--
Brown Trout	Formation 2011	not available	7.61	8.67	--	--
Brown Trout	Formation 2011	not available	8.23	9.46	--	--
Brown Trout	Formation 2011	not available	23.74	25.1	--	--
Brown Trout	Formation 2011	not available	20.22	22.3	--	--
Brown Trout	Formation 2011	not available	15.12	13.8	--	--
Brown Trout	Formation 2011	not available	12.26	13.2	--	--
Brown Trout	Formation 2011	not available	11.64	9.61	--	--
Brown Trout	Formation 2011	not available	9.00	7.17	--	--
Brown Trout	Formation 2011	not available	17.13	18	--	--
Brown Trout	Formation 2011	not available	13.64	13.7	--	--
Brown Trout	Formation 2011	not available	16.76	16.3	--	--

Appendix B. Paired Selenium Tissue Data for *Oncorhynchus* and *Salmo*, cont'd

Species	Date Source	Spawning Status	WB Se (mg/kg dw)	Muscle Se (mg/kg dw)	Egg Se (mg/kg dw)	Ovary Se (mg/kg dw)
Brown Trout	Formation 2011	not available	14.01	14.7	--	--
Brown Trout	Formation 2011	not available	13.31	11.4	--	--
Brown Trout	Formation 2011	not available	14.54	11.2	--	--
Brown Trout	Formation 2011	not available	20.19	21.7	--	--
Brown Trout	Formation 2011	not available	19.11	20.4	--	--
Brown Trout	Formation 2011	not available	21.62	22.2	--	--

Appendix C. Protectiveness of the Updated Whole-Body Elements to Other Resident Fish Species

This appendix demonstrates that the updated whole-body (WB) elements of the Se SSC remain protective of all resident fish species at the Upper Blackfoot River (UBR) and Georgetown Creek Sites, in response to EPA's request to describe how applying the muscle and WB elements to other fish species ensures that those species' egg-ovary (EO) concentrations will not exceed their species-specific thresholds. The proposed update is limited to the WB elements (UBR: 12.5 to 17.1 mg/kg dw; Georgetown: 12.5 to 13.9 mg/kg dw); while the EO elements (24.5 mg Se/kg EO dw for rainbow trout at the UBR Site; 21.0 mg Se/kg EO dw for brown trout at the Georgetown Creek Site) and the muscle element (12.8 mg/kg dw for rainbow trout at both Sites) are unchanged.

Approach

The Se SSC is a multi-element criterion applied under a hierarchy in which the EO element supersedes the WB and muscle elements when EO concentrations are measured (IDAPA 58.01.02 § 287). Consistent with EPA (2016), the EO tissue is the most direct indicator of Se toxicity, because the effects of concern result from maternal transfer of Se to the eggs. The WB and muscle elements are surrogate tissues derived from the EO threshold, and the element for each of these tissues is set to the value for the resident species that is most sensitive in that tissue. Each SSC element is derived from a species' EO threshold using an EO-to-tissue conversion factor (CF); because CFs vary among species, the most sensitive species can differ by tissue.

Two complementary lines of evaluation are presented. First, for the salmonid resident species, the protectiveness of the updated WB element is evaluated by translating each species' EO threshold (EC_{10} or species mean chronic value [SMCV] from EPA 2016) to a corresponding WB value (translated WB value = EO threshold ÷ the species' EO/WB CF). Second, for the non-salmonid resident species, protectiveness is evaluated at the family level following the approach in Nu-West (2017, Section 5.1–5.4). EO/WB CFs are from Table 2 of this proposal (EPA 2016); for the *Oncorhynchus* and *Salmo* genera, the updated EO/WB CFs derived in Section 4 are applied.

Upper Blackfoot River Site (Oncorhynchus Basis)

At the UBR Site, the WB element (17.1 mg/kg dw) is based on rainbow trout, the most sensitive resident species on a WB basis. The translated WB value for each resident salmonid's EO threshold is at or above the proposed WB element (Table C-1); consequently, meeting the WB element maintains each species below its EO threshold.

Table C-1. Translated WB values of resident-salmonid EO thresholds relative to the proposed UBR WB element (17.1 mg/kg dw).

Resident species	EO threshold (mg/kg dw)	EO/WB CF	Translated WB value (mg/kg dw)	Protective?
Rainbow trout (O. mykiss)	24.5	1.43	17.1	Basis (most sensitive WB)
Yellowstone cutthroat trout (O. clarkii bouvieri)	24.7	1.43	17.3	Yes (17.3 ≥ 17.1)
Brook trout (Salvelinus fontinalis)	—	—	—	Less sensitive (see below)

Notes: Translated WB value = EO threshold ÷ EO/WB CF. EO thresholds are the lowest egg/ovary-based EC_{10} for each species (EPA 2016). The Oncorhynchus EO/WB CF (1.43) is the updated median ratio derived in Section 4 (24.5 ÷ 17.1). EO = egg-ovary; WB = whole body; dw = dry weight.

Georgetown Creek Site (Salmo Basis)

At the Georgetown Creek Site, the WB element (13.9 mg/kg dw) is based on brown trout, the most sensitive resident species on a WB basis, while the muscle element (12.8 mg/kg dw) is based on rainbow trout, the most sensitive resident species on a muscle basis. The translated WB values of the other resident salmonids' EO thresholds are greater than the proposed WB element (Table C-2).

Table C-2. Translated WB values of resident-salmonid EO thresholds relative to the proposed Georgetown Creek WB element (13.9 mg/kg dw).

Resident species	EO threshold (mg/kg dw)	EO/WB CF	Translated WB value (EO ÷ CF)	Protective?
Brown trout (Salmo trutta)	21.0	1.51	13.9	Basis (most sensitive WB)
Rainbow trout (O. mykiss)	24.5	1.43	17.1	Yes (17.1 ≥ 13.9)
Bonneville cutthroat trout (O. clarkii utah)	24.7	1.43	17.3	Yes (17.3 ≥ 13.9)

Notes: Translated WB value = EO threshold ÷ EO/WB CF. EO thresholds are the lowest egg/ovary-based EC_{10} for each species (EPA 2016). The Salmo EO/WB CF (1.51) is the updated median ratio derived in Section 4 (21.0 ÷ 13.9); the Oncorhynchus CF is 1.43. EO = egg-ovary; WB = whole body; dw = dry weight.

Protectiveness to Other Resident Families

EPA (2016) identifies salmonids (*Oncorhynchus* and *Salmo* genera) among the most sensitive fish to Se, and the Nu-West (2017) proposal established that salmonids are the most sensitive resident fish at each Site. The following evaluation of the resident brook trout and the resident non-salmonid families applies the family-level approach presented in Nu-West (2017, Section 5.1–5.4); the resulting Se SSC was subsequently approved by EPA (EPA 2019). The non-salmonid families occur primarily at the UBR Site (suckers, cyprinids, and sculpin); sculpin are the only non-salmonid residents in the Georgetown Creek subbasin.

Family Salmonidae (Genus Salvelinus)

Brook trout (*Salvelinus fontinalis*) are resident at both Sites. EPA (2016) presents EO-based chronic values for two Salvelinus species — Dolly Varden (SMCV 56.2 mg Se/kg EO dw) and brook trout (EC_{10} >48.7 mg Se/kg EO dw; Holm et al. 2005) — yielding a Salvelinus genus mean chronic value of 56.2 mg Se/kg EO dw. These thresholds are more than twice the *Oncorhynchus* EO threshold (24.5 mg Se/kg EO dw), confirming that brook trout are substantially less sensitive than the salmonid threshold and are protected by the proposed WB elements (Golder 2009; Holm et al. 2005).

Family Cyprinidae

Cyprinids (dace, shiners, chubs, and common carp) are resident at the UBR Site. EPA (2016) concludes that cyprinids are not among the most sensitive families to Se. For fathead minnow (*Pimephales promelas*), maternal-transfer effect concentrations for larval survival and deformities were estimated at 35–65 mg Se/kg WB dw (GEI 2008), and field studies document cyprinid persistence at Se-contaminated sites (Young et al. 2010). The proposed UBR WB element (17.1 mg/kg dw) is well below these WB effect levels, and EPA (2016) notes that native chubs, shiners, and dace are insensitive to Se relative to salmonids. In addition, de Bruyn et al. (2023) found no effects to redside shiners at egg concentrations of

28 mg Se/kg dw or muscle concentrations of 22.5 mg/kg dw (WB was not measured), further indicating that cyprinids are less sensitive than salmonids. Cyprinids are therefore protected (Schultz and Hermanutz 1990; GEI 2008; Young et al. 2010).

Family Catostomidae (Genus Catostomus)

Suckers (Utah sucker and mountain sucker; genus Catostomus) are resident at the UBR Site. EPA (2016) presents an EO-based no-effect level of >40.3 mg Se/kg EO dw for white sucker (de Rosemond et al. 2005) and WB no-effect levels for suckers of >10.2 mg/kg WB dw (flannelmouth sucker) and >42 mg/kg WB dw (razorback sucker) (Beyers and Sodergren 2001a, b). These unbounded no-effect levels indicate that suckers are insensitive to Se and are protected by the proposed WB element.

Family Cottidae (Genus Cottus)

Sculpin (mottled and Paiute sculpin; genus Cottus) are resident at the UBR Site and in the lower reach of Georgetown Creek. EPA (2016) does not present cottid toxicity data; however, Lo et al. (2014) observed no effects on slimy sculpin reproduction up to 22 mg Se/kg EO dw. Field studies indicate that sculpin are insensitive to Se: in NAMC (2008), WB Se in shorthead sculpin (*Cottus confusus*) was not significantly correlated with sculpin population density up to WB Se of approximately 18 mg/kg dw, and sculpin populations remained healthy. Formation and HabiTech (2012) reported no statistical relationship between sculpin population density and sculpin-tissue Se up to >25 mg/kg WB dw. The proposed WB elements (17.1 mg/kg dw at the UBR Site and 13.9 mg/kg dw at the Georgetown Creek Site) are below these WB concentrations, confirming that sculpin are protected.

Table C-3. Family-level chronic Se values for brook trout and non-salmonid resident families (from EPA 2016, as presented in Nu-West 2017, Section 5.1–5.4), relative to the proposed WB elements.

Family (Genus)	Resident species	Chronic Se value (mg/kg dw)	Tissue basis / relative sensitivity
Salmonidae (*Salvelinus*)	Brook trout	GMCV 56.2 (Dolly Varden); brook trout EC_{10} >48.7 (EO)	EO; >2× *Oncorhynchus* (24.5) — protected
Cyprinidae (*Pimephales*, surrogate)	Dace, shiners, chubs, common carp	35–65 (WB, fathead minnow); EO <25.6 (high uncertainty)	WB; 17.1 < 35–65 — protected
Catostomidae (*Catostomus*)	Utah & mountain sucker	White sucker EO >40.3; flannelmouth WB >10.2; razorback WB >42	EO/WB; unbounded no-effect — protected
Cottidae (*Cottus*)	Mottled & Paiute sculpin	Slimy sculpin EO >22; field sculpin WB to ~18 (NAMC) and >25 (Form. & HabiTech), no population effect	EO/WB; 17.1 (and 13.9) below — protected

Notes: Values are from EPA (2016) as presented in Nu-West (2017, Section 5.1–5.4; Tables 6–9); sculpin field data from NAMC (2008) and Formation and HabiTech (2012). ">" denotes an unbounded no-effect concentration (no effects observed up to the listed value). EO = egg-ovary; WB = whole body; EC_{10} = 10% effect concentration; SMCV/GMCV = species/genus mean chronic value.

The proposed WB elements are therefore protective of all resident fish species, consistent with the protectiveness previously established and approved (Nu-West 2017; EPA 2019).

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