Bellevue Summer Electrofishing 2012

Final Report

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Prepared for

City of Bellevue
Utilities Department
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Executive Summary

Four urban streams in the City of Bellevue were sampled for fish presence/absence during the summer of 2012. Previously sampled sites included two sites on Kelsey Creek, one site on West Tributary, and one site on Yarrow Creek. New sampling occurred at one site on Lewis Creek.

Results from both Kelsey Creek sites (RM 0.2 and 1.4) showed relatively low native fish diversity and an absence of juvenile coho. This may indicate that urban impacts are influencing fish populations in this creek. However, Kelsey Creek (RM 1.4) provides excellent rearing habitat for juvenile coho; other factors, such as lack of adult Coho returning in 2011 and changing flow regimes, may have contributed to lack of juvenile coho seen in 2012.

Results from West Tributary (RM 0.4) showed relatively higher native fish diversity compared to all other sites; however, this site also had a low coho-to-cutthroat ratio, indicating that urban impacts may still be affecting this restored site. Data from 2012 at this site showed that native fish diversity has remained somewhat consistent relative to past studies.

Fish passage is hydrologically blocked downstream of the sampling sites on Yarrow Creek (RM 1.13) and Lewis Creek (RM 1.7), preventing anadromous species access to the upper reaches. As expected, results showed very low diversity, with only cutthroat trout caught during sampling at both sites.

Additional studies are recommended to further evaluate the effectiveness of existing and future capital projects for improving fish habitat and the success of salmonid supplementation efforts. Below is a detailed list of recommendations for the City of Bellevue to facilitate these actions.

- Compare diversity, size, and relative abundance of fish species across all years for sites with historical data.
- Conduct electrofishing at low, middle, and upper reaches of creeks during the same sampling events to determine if priority fish are utilizing different habitats than in previous years. This may help determine more accurately the presence/absence of fish within a watershed.
- Determine fish condition index at electrofishing sites to determine relative health of priority fish species. The index could then be compared to other Western Washington urban streams where similar data have been collected.
- Collect gut content data from priority salmonid species at current BIBI sites to determine if aquatic or terrestrial prey items dominate. These data would help determine prey species availability and use by salmonids. Data collected can help determine if riparian and/or substrate improvements are necessary. Also, compare size of coho and cutthroat fish populations to similar Puget Sound lowland reference streams.
- Continue a consistent electrofishing program that visits the same sites during the same time of year to increase robustness of data for determination of status and trends of priority fish species.
- Add additional electrofishing dates earlier in the year at these same sites every five years to help determine seasonality of fish species use (e.g., May).

- Implement a study to evaluate selected electrofishing sites that have shown historical changes in species diversity and density. The study should include key water quality parameters such as temperature and flow conditions; however, other parameters may also need evaluation.

Data collected for native and non-native fish species presence, status, and trends in urban streams can be a useful tool in determining the health of urban streams. Implementing the recommendations mentioned above would help the City of Bellevue continue to ascertain if changes in fish populations and density are due to regional population trends, natural environmental changes, beneficial habitat modifications, or changes in land use in their local urban streams.

1.0 Introduction

Electrofishing was conducted at four urban streams in the City of Bellevue in July 2012. These streams included, Kelsey Creek, West Tributary of Kelsey Creek, Lewis Creek, and Yarrow Creek (Figure 1). The City of Bellevue (The City) had not sampled any sites on Lewis Creek prior to the summer of 2012. Historical data exist for the sampling sites on Kelsey Creek, West Tributary, and Yarrow Creek.

The purpose of electrofishing at these locations was to develop a baseline for fish species presence/absence and diversity, and evaluate trends in previously sampled locations. These sites were chosen to help evaluate and determine the effectiveness of habitat restoration or the significance of urban impacts. These sites can be revisited in coming years to determine if cumulative changes (habitat, public or private operations, and land use regulations) are having positive or detrimental effects on fish population structures.

This report describes the methods used for sampling, results from electrofishing in the summer of 2012, and recommendations for future actions. The data presented in this report represent a reference point from which the City can determine any possible changes in the status and trends of fish populations in response to local or larger environmental change.

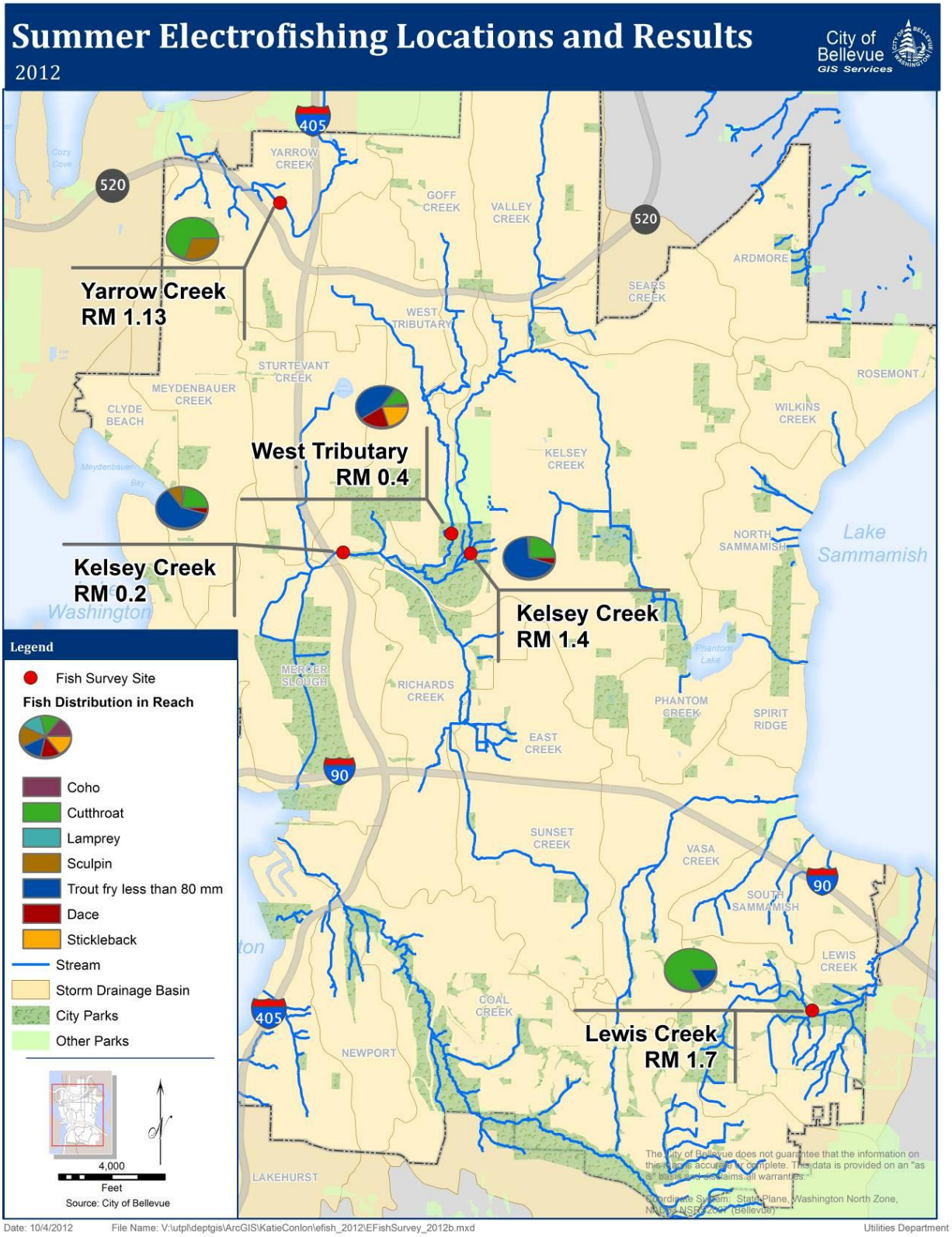

Figure 1. Map showing locations and results of electrofishing sites sampled in July 2012.

2.0 Methods

Electrofishing was performed on July 17, 19, and 24, 2012 (Table 1). Two sites were sampled on Kelsey Creek (RM 0.2 and 1.4), along with one site on West Tributary (RM 0.4), one site on Yarrow Creek (RM 1.13) and one site on Lewis Creek (1.7).

Methods of sampling in 2012 were similar to past efforts by the City. Electrofishing was conducted using a Smith-Root Backpack Electrofisher Model 12b. Settings on the electrofishing equipment for Kelsey Creek (RM 0.2) and West Tributary were most effective at 200 volts (v), 70 Hertz (Hz), and 6 milliseconds (ms). Voltage was lowered to 100 v for Kelsey Creek (RM 1.4) to reduce adverse effects. Settings were at 200 v, 60 Hz, and 6 ms for Yarrow and Lewis Creeks.

At Kelsey Creek (RM 1.4) and West Tributary (RM 0.4), block nets were placed at the bottom and top of each reach and a single pass was made with the electrofisher. At Kelsey Creek (RM 0.2) and Lewis Creek (RM 1.7), block nets were placed only at the top (upstream) of each reach and a single pass was made with the electrofisher. A single pass was made with the electrofisher at Yarrow Creek (RM 1.13); however, no block nets were used at the site. One person utilized the electrofishing backpack and two people with long-handled dip nets followed closely alongside to capture stunned fish[1]. Team members followed the electrofishing team with buckets of fresh stream water. Fish were tracked by habitat type (riffle or pool) and captured fish were placed in corresponding buckets. Captured fish were temporarily anesthetized on site using a dilute solution of MS-222 (Tricaine methanesulfonate) in water for identification and fork length measurements. Fish were then allowed to recover in fresh stream water supplied with an aerator until fully recovered. Once recovered, they were released upstream of the reach above the block net. Fish were captured as authorized under Washington State Scientific Collection Permit #12-231.

Temperature (^{o} C), dissolved oxygen (milligrams per liter [mg/L]), conductivity (microsiemens per centimeter [µs/cm]), and pH were recorded using an YSI water quality probe deployed at each stream reach. Air temperature, reach length, and time fished were also recorded. Field sheets for 2012 sampling can be found in Appendix A.

[1] Two netters were used throughout each reach. Netters were consistently swapped out and the team was comprised of a combination of experienced netters, inexperienced netters, and volunteers.

Table 1. Survey dates and site summary for 2012 electrofishing.

Date	Stream Name	River Mile (RM)	Reach Length (feet)	Site Description
July 17, 2012	Kelsey Creek	0.2	208	Located below the railroad trestle near 121st Ave NE and downstream of double box culvert that passes under 121st Ave. Medium gradient with mainly higher velocity riffles and few pools. Conductivity typical at 221 µs/cm. Woody debris and boulders present throughout reach. Stream banks dominated by salmonberry, blackberry, ferns, and alder.
July 17, 2012	Kelsey Creek	1.4	204	Located at the habitat restoration site behind the horse pasture at Kelsey Creek Farm. Low gradient with lower conductivity at 159 µs/cm. Medium velocity travelling through numerous large woody debris and boulders. Mostly riffles and glides in reach. Stream banks dominated by reed canary grass interspersed with newly planted native vegetation. Some larger alder present.
July 19, 2012	West Tributary	0.4	408	Located at the restoration reach at Kelsey Creek Farm. Reach extends from vehicle bridge at entrance downstream to next pedestrian bridge adjacent to the playground. Low gradient, slow velocity with typical conductivity at 191 µs/cm. Large woody debris present amongst mostly riffles and glides. Shoreline edges with grasses and maturing native vegetation plantings.
July 19, 2012	Yarrow Creek	1.13	224	Located on City of Bellevue property across from WSDOT maintenance facility on Northup Way in Bellevue. Fish passage is hydrologically blocked below sampling site. Lower gradient with typical conductivity at 200 µs/cm. Woody debris present with stream banks dominated by salmonberry, fern, and English ivy.
July 24, 2012	Lewis Creek	1.7	229	Located in the Lewis Creek Ravine, down the trail from Lakemont Park. Fish passage is hydrologically blocked below sampling site (RM 0.75). High gradient, medium velocity with typical conductivity at 176 µs/cm. Woody debris and boulders prevalent throughout reach. Mature cedar, alder, and maple trees alongside stream banks. Vine maple, ferns, and salmonberry also common.

3.0 Results

3.1 Water Quality Measurements

Water quality parameters at all of the electrofishing stations showed relatively typical values for urban streams. Temperature and dissolved oxygen values for all sites ranged from 13.4° C to 16.8 ° C and 7.10 mg/L to 12.3 mg/L, respectively (Table 2). These values were characteristic for sampling during summer. However, dissolved oxygen at Kelsey Creek (RM 0.2) showed a relatively low value, which could be the result of poor placement of the probe, human error in recording, or a natural occurrence. Conductivity and pH values for all sites ranged 159 µs/cm to 221 µs/cm and 7.35 to 8.08, respectively.

Table 2. Water quality parameters for electrofishing sites during July 2012.

Site	Temperature (° C)	DO (mg/L)	pH	Conductivity (µs/cm)
Kelsey Creek (RM 0.2)	16.8	7.10	7.35	221
Kelsey Creek (RM 1.4)	16.7	11.07	8.08	159
West Tributary (RM 0.4)	16.1	11.65	7.42	191
Yarrow Creek (RM 1.13)	15.4	11.83	7.93	200
Lewis Creek (RM 1.7)	13.4	12.3	7.88	176

3.2 Species Distribution and Density

Six species of fish were captured during the 2012 electrofishing surveys (Figure 2). These included cutthroat (*Oncorhynchus clarkii*), juvenile coho (*O. kisutch*), three-spined stickleback (*Gasterosteus aculeatus*), sculpin, dace, and lamprey. It should be noted that all members of the genus *Cottus*, *Rhinichthys*, and *Lampetra* were categorized simply as sculpin, dace and lamprey, respectively. However, habitat characteristics of the reaches sampled and an examination of photos collected indicate that long-nosed dace (*Rhinichthys cataractae*) and western brook lamprey (*Lampetra richardsoni*) were the species likely present in these creeks.

Trout species less than 80 mm are difficult to determine in the field if they are rainbow or cutthroat trout. Therefore, Figure 1 shows the category "Trout fry less than 80 mm" to encompass these fish. However, no adult rainbow trout were caught during the survey. Therefore, for the purposes of this study, these fish were considered cutthroat trout and included into the total numbers captured. Other non-fish species captured during electrofishing included crayfish at Kelsey Creek (RM 0.2), West Tributary, and Yarrow Creek. Salamanders were also captured at Lewis Creek.

Figure 2 shows that West Tributary contained the highest density of fish species amongst all sites and was the only site where juvenile coho and stickleback were captured. Cutthroat, dace, and lamprey were caught at both Kelsey Creek sites; Kelsey Creek (RM 0.2) was the only site where sculpin were taken. Only cutthroat were captured at Yarrow and Lewis Creek.

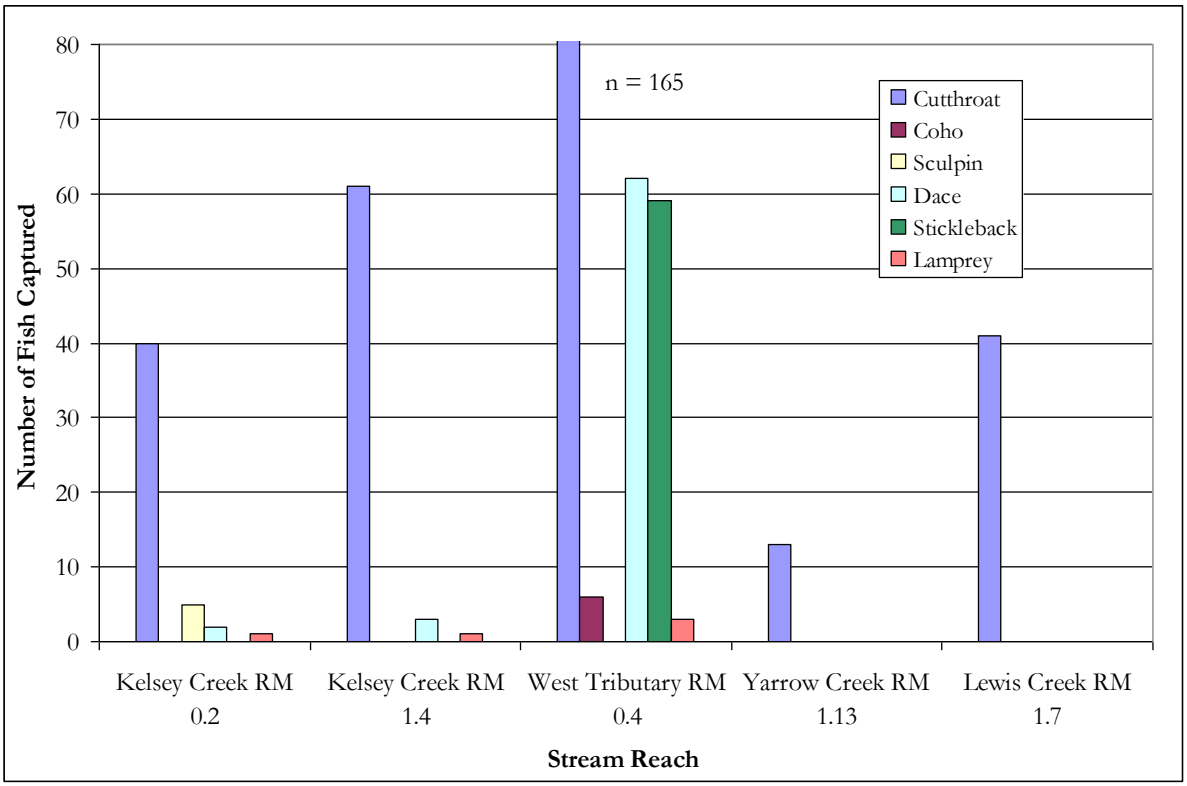

Figure 2. Species distribution by stream reach for 2012 sampling.

Relative percentage of each fish species captured by site can be seen in Figure 1. Kelsey Creek (RM 0.2) showed cutthroat as the highest percentage captured at 83 percent (including fry < 80 mm), with sculpin, dace and lamprey at 10 percent, 4 percent, and 2 percent, respectively. Kelsey Creek (RM 1.4) showed cutthroat dominating the catch at 94 percent, with dace and lamprey at 5 percent and 2 percent, respectively. Cutthroat made up 56 percent of the catch at West Tributary. Dace and stickleback made up 20 percent of the catch, while juvenile coho and lamprey made up 2 percent and 1 percent of the catch at West Tributary, respectively. Cutthroat dominated 100 percent of the catch at Yarrow and Lewis creeks with no other species captured.

Although attempts were made to delineate the number and species of fish captured by habitat type (pool or riffle), habitat types at all sampling locations were determined to be riffles. Therefore, results from this part of the study will not be further discussed.

Table 3 shows the estimated density of fish species caught for each site. Fish density analysis was determined by normalizing the total fish count per linear foot for each reach[2]. West Tributary showed the highest density of cutthroat at 0.40 fish/foot, while Yarrow Creek showed the lowest density at 0.06 fish/foot. It should be noted that the density of cutthroat at Kelsey Creek (RM 1.4) was considerably higher than the other Kelsey Creek site (RM 0.2) lower in the system. West Tributary showed a density of coho at 0.01 fish/foot, and was the only location where coho were caught. Density of sculpin at Kelsey Creek (RM 0.2) was 0.02 fish/foot, while no sculpin were captured at any other sites.

[2] Comparison of relative abundance data between sites should be considered only on a gross level as differences in collection technique and netting efficiency can vary.

West Tributary showed a coho-to-cutthroat ratio of 0.04. No coho were captured at other study sites (ratios = zero). Absence of coho in Yarrow and Lewis creeks was due to downstream fish barriers blocking access by anadromous fish into both reaches.

Table 3. Estimated density (fish/foot) of fish species caught and ratio of coho to cutthroat for all sites.

Site	Total Reach Length (feet)	Cutthroat (fish/foot)	Coho (fish/foot)	Sculpin (fish/foot)	Coho to Cutthroat Ratio
Kelsey Creek (RM 0.2)	208	0.19	0	0.02	0
Kelsey Creek (RM 1.4)	204	0.30	0	0	0
West Tributary (RM 0.4)	408	0.40	0.01	0	0.04
Yarrow Creek (RM 1.13)	224	0.06	0	0	0
Lewis Creek (RM 1.7)	229	0.18	0	0	0

3.3 Cutthroat Length Distribution

West Tributary showed the highest number of cutthroat captured in comparison to the other sites and showed a wide range of lengths (31 mm to 225 mm; Table 4). Mean lengths of cutthroat were relatively similar for both Kelsey Creek sites and West Tributary (70.7 mm to 74.9 mm), with Kelsey Creek sites showing a smaller range of sizes. Mean lengths at Lewis Creek were higher at 107.8 mm, yet showed a relatively similar range to West Tributary. Yarrow Creek had the lowest number of cutthroat, although this site had larger fish in general when compared to all other sites, with a mean length of 123 mm.

Table 4. Number caught, mean length (mm), length range (mm), and standard deviation (stdev) of lengths for cutthroat across all sites sampled.

Site	Number of Cutthroat Caught	Mean Length (mm)	Range (mm)	Stdev
Kelsey Creek (RM 0.2)	40	70.7	38-144	18.5
Kelsey Creek (RM 1.4)	61	74.9	39-173	34.4
West Tributary (RM 0.4)	165	74.9	31-225	28.2
Yarrow Creek (RM 1.13)	13	123[3]	50-190	46.9
Lewis Creek (RM 1.7)	41	107.8	43-250	41.2

[3] Lengths were not officially taken with a fish measuring board. Lengths (with corresponding range and standard deviation) were derived from photographs of individual fish in a photo-aquarium fitted with a ruler.

Figure 3 shows cutthroat length frequency distribution for both Kelsey Creek sites (RM 0.2 and RM 1.4). The frequency distributions suggest that three year-classes of cutthroat trout were present in the upper site, while two year-classes were found in the lower site. However, it is likely that all three age-classes can move about the Kelsey Creek system freely. It should be noted that higher numbers of larger fish (110–173 mm) were seen higher in the Kelsey Creek system at RM 1.4 than at RM 0.2.

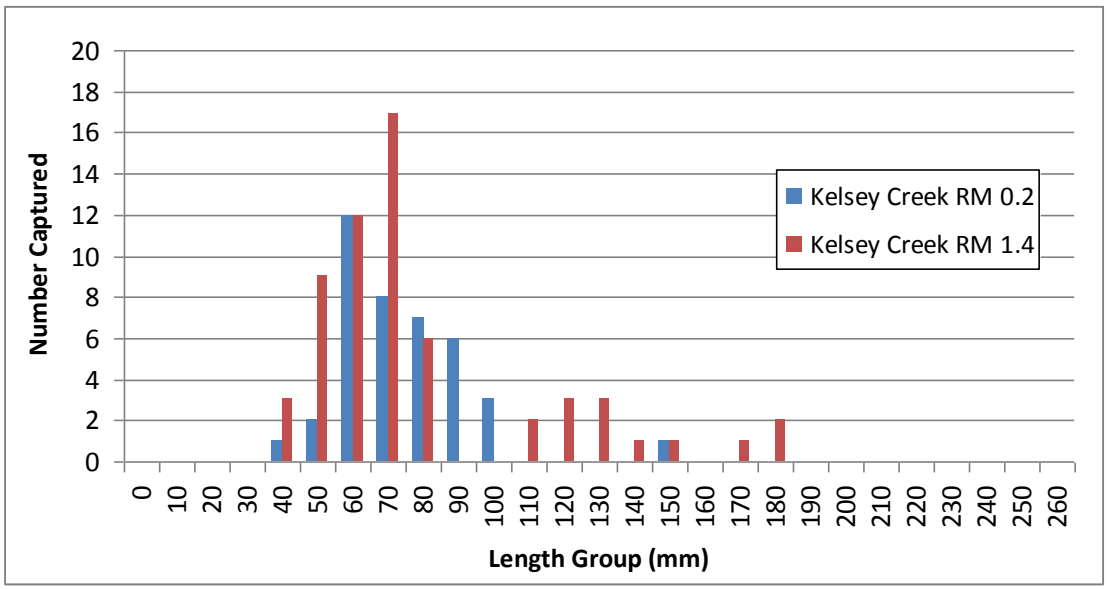

Figure 3. Length frequency distribution for cutthroat at Kelsey Creek sites (RM 0.2 and 1.4).

Figure 4 shows cutthroat length frequency distribution for West Tributary (RM 0.4). The frequency distribution suggests that at least three year-classes of cutthroat trout were present. Higher numbers of smaller fish (50 to 80 mm) were seen at West Tributary, as well as relatively higher numbers of mid-sized fish (100 to 150 mm).

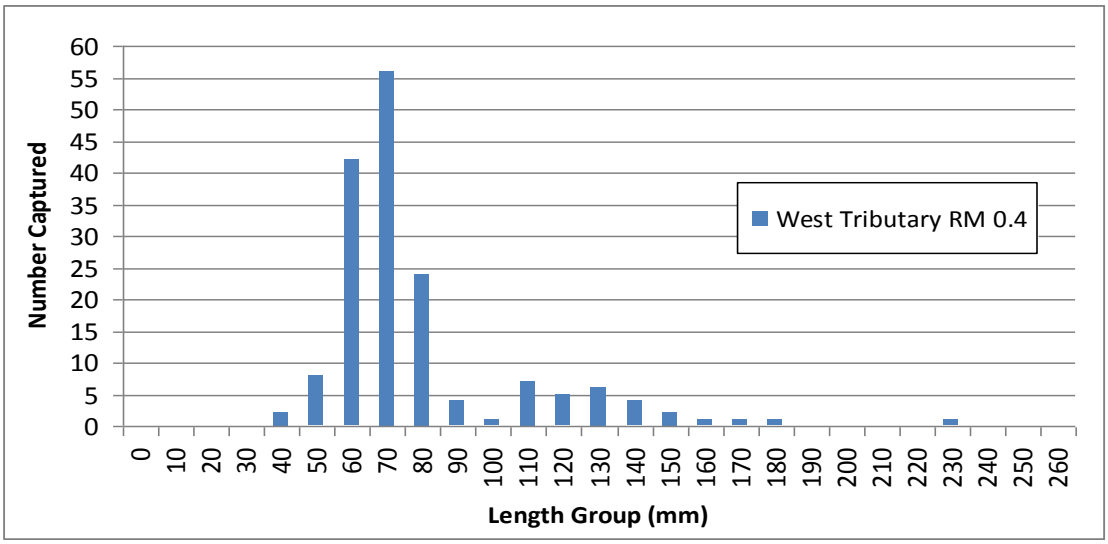

Figure 4. Length frequency distribution for cutthroat at West Tributary (RM 0.4).

Figure 5 shows cutthroat length frequency distribution for Yarrow Creek (RM 1.13). Although the sample size is low, the frequency distribution suggests that three year-classes of cutthroat are present at Yarrow Creek (RM 1.13).

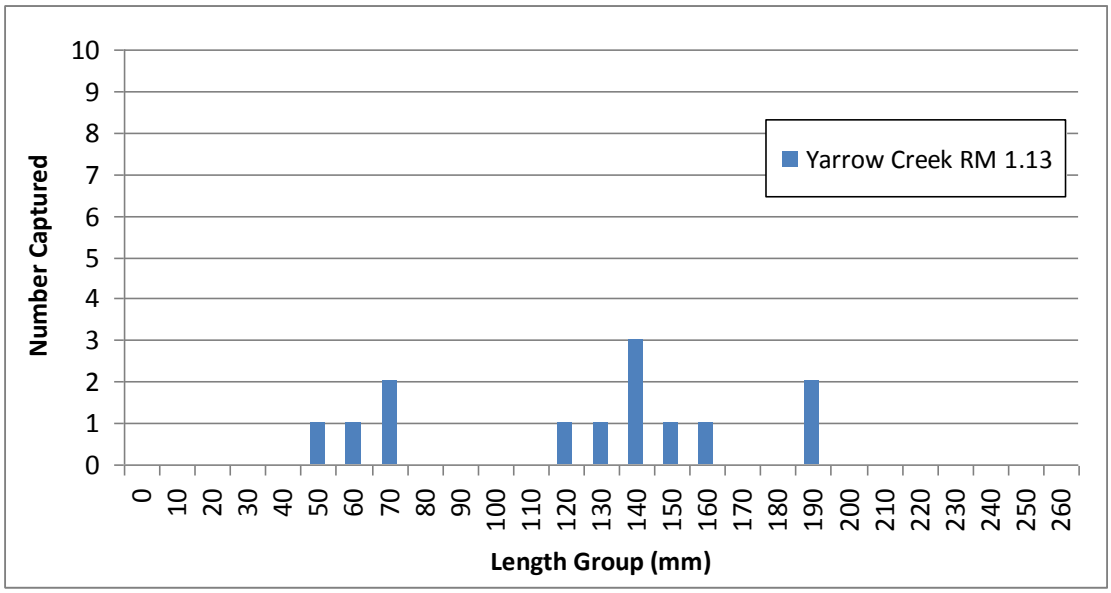

Figure 5. Length frequency distribution of cutthroat at Yarrow Creek (RM 1.13).

Figure 6 shows cutthroat length frequency distribution for Lewis Creek (RM 1.7). The frequency distribution suggests that four (or more) year-classes are present. Relatively higher numbers of medium-sized fish (100 to 140 mm) were found at Lewis Creek with a good representation of larger fish (190 to 250 mm).

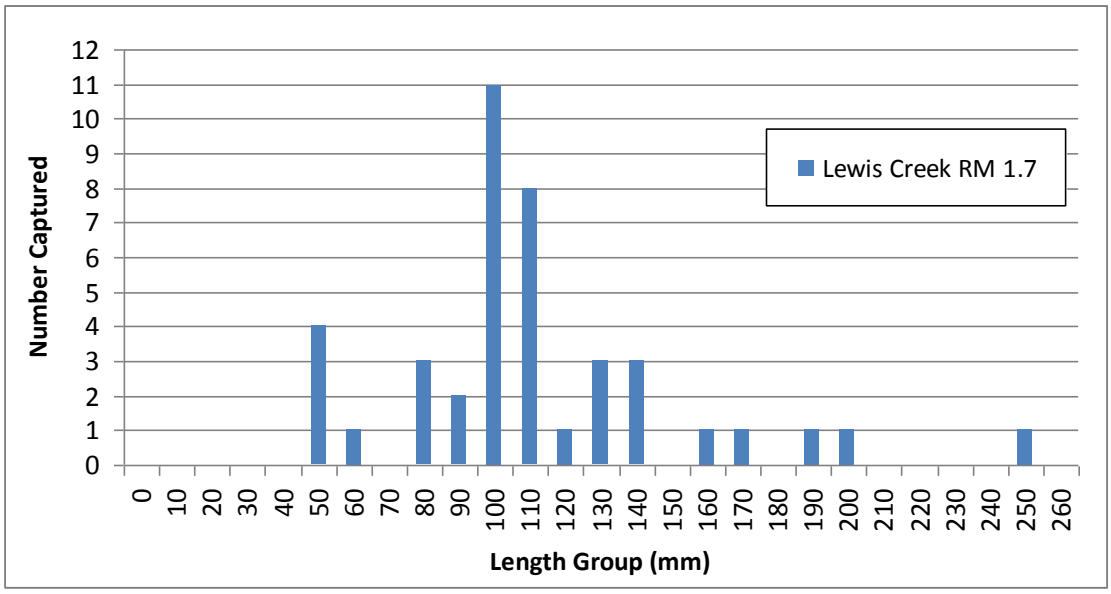

Figure 6. Length frequency distribution of cutthroat at Lewis Creek (RM 1.7).

3.4 Coho Length Distribution

Juvenile coho were caught at only the West Tributary site during the summer of 2012. Six total juvenile coho were caught ranging in size from 70 to 79 mm, with a mean length of 74.2 mm. Figure 7 shows coho length frequency distribution for West Tributary RM 0.4. Although the sample size is very low, the frequency distribution represents one year-class (0+ age) for this site, as expected.

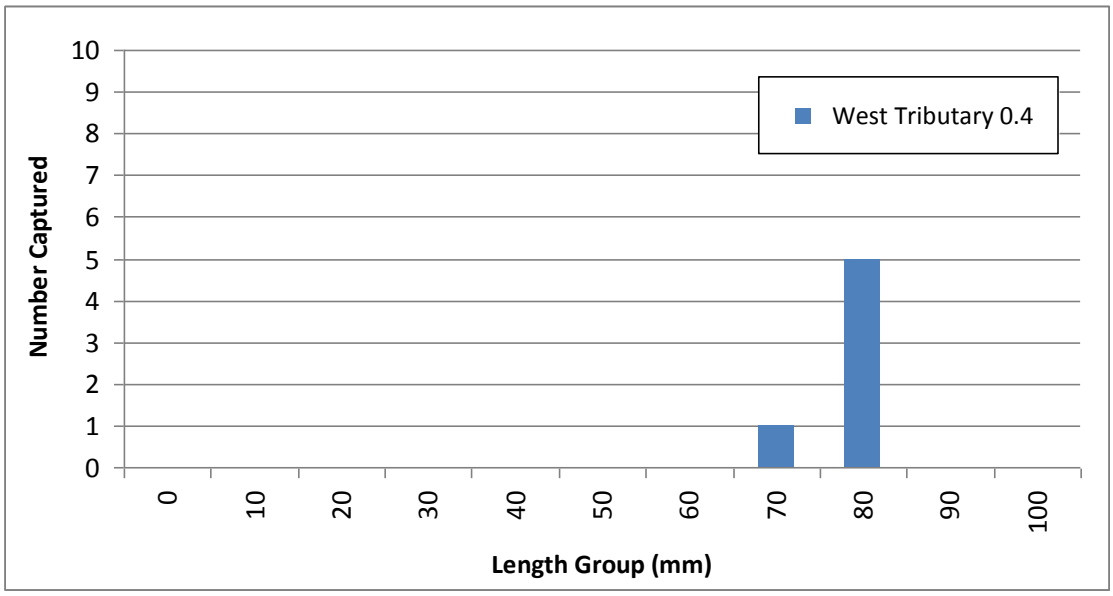

Figure 7. Length frequency distribution of coho at West Tributary (RM 0.4).

3.5 Native and Non-Native Species

Six native fish species—cutthroat, coho, sculpin, dace, lamprey, and three-spined stickleback—were captured during the survey. No other native species were captured during 2012 sampling events. West Tributary (RM 0.4) showed the highest diversity of native species with only sculpin absent from catches (Table 5). Both Kelsey Creek sites (RM 0.2 and 1.4) showed similar native species diversity, with Kelsey Creek (RM 0.2) being the only site where native sculpin were captured. Yarrow and Lewis Creeks showed the lowest native diversity among all sites, as only native cutthroat were seen. Many Puget Sound lowland streams contain other native species including, but not limited to, sculpin, dace, lamprey, largescale suckers, and possibly other salmonid species. Yarrow Creek and Lewis Creek showed relatively diminished diversity of native species, indicating possible urban impacts.

Slight differences in native species composition between 2012 sampling and past sampling events for both Kelsey Creek sites are likely due to the timing of survey events, netting efficiency, and possible identification variances.

Non-native fish species were absent during 2012 sampling events at all sites (Table 6); however, non-native species may still be present in the streams. Non-native species were captured at Kelsey Creek and West Tributary sites in previous years, which could be attributed to differences in habitat availability, flow regimes, maturation of habitat restoration sites, or environmental fluctuations between years.

Table 5. Native species documented in Bellevue streams during 1983, 1996–1997, 2002, 2007, 2010–2012 summer fish surveys.

Common Name	Scientific Name	Year	Kelsey Creek									West Tributary			Valley Creek		Coal Creek				Yarrow Creek	Richards Creek				Lewis Creek
		River Mile	0.2	1.06	1.4	1.8	2.1	2.59	3.81	3.83	3.97	0.4	1.01	2.2	0.2	0.82	0.79	2	2.4	4.07	1.13	0.5	0.65	0.77	0.9	1.7
Coho Salmon	*Oncorhynchus kisutch*	1983	x			x	x																			
		1996	x		x		x				x		x		x	x		x								
		1997	x								x					x									x	
		2002					x											x	x							
		2007		x			x								x	x										
		2010										x			x											
		2011							x	x							x			x						
		2012										x									x					x
Cutthroat Trout	*Oncorhynchus clarki*	1983	x			x	x											x	x							
		1996	x		x		x	x			x		x		x	x		x	x						x	
		1997	x								x					x									x	
		2002		x	x		x					x			x			x	x			x				
		2007		x		x	x		x	x					x	x										
		2010			x	x	x					x			x								x			
		2011							x	x							x			x	x					
		2012	x		x							x														
Rainbow Trout	*Oncorhynchus mykiss*	1983	x			x	x																			
		1996																								
		1997	x																						x	
		2002																								
		2007																								
		2010																								
		2011																								
		2012																								
Sculpin	*Cottus spp.*	1983																x	x							
		1996	x															x								
		1997	x													x									x	
		2002																x	x							
		2007																								
		2010																								
		2011															x									
		2012	x																							
Three-spine stickleback	*Gasterosteus aculeatus*	1983	x			x	x																			
		1996																								
		1997																							x	
		2002		x								x										x				
		2007		x																						
		2010										x											x	x		
		2011																								
		2012										x														

Common Name	Scientific Name	Year	Kelsey Creek									West Tributary			Valley Creek		Coal Creek				Yarrow Creek	Richards Creek				Lewis Creek
		River Mile	0.2	1.06	1.4	1.8	2.1	2.59	3.81	3.83	3.97	0.4	1.01	2.2	0.2	0.82	0.79	2	2.4	4.07	1.13	0.5	0.65	0.77	0.9	1.7
Western Brook Lamprey	*Lampetra richardsoni*	1983																								
		1996						x											x						x	
		1997														x									x	
		2002		x								x			x			x				x				
		2007		x		x			x	x					x											
		2010				x						x			x											
		2011															x									
		2012	x		x							x														
Largescale Sucker	*Catostomus macrocheilus*	1983																								
		1996			x		x						x													
		1997																								
		2002																								
		2007		x																						
		2010										x														
		2011																								
		2012																								
Dace (longnose or speckled)	*Rhinichthys spp.*	1983																								
		1996	x		x								x													
		1997	x																							
		2002			x		x					x														
		2007		x		x	x																			
		2010				x						x														
		2011																								
		2012	x		x							x														
Trout Fry (<80 mm)		1983																								
		1996	x										x		x	x										
		1997	x								x					x									x	
		2002		x	x		x					x			x			x	x			x				
		2007		x		x	x		x	x					x	x										
		2010			x	x	x					x			x								x			
		2011							x	x							x			x	x					
		2012																								

= did not sample
= sampled, no fish seen
x = sampled, fish seen

Table 6. Non-native species documented in Bellevue streams during 1983, 1996-1997, 2002, 2007, 2010-2012 summer fish surveys.

Common Name	Scientific Name	Year	Kelsey Creek									West Tributary			Valley Creek		Coal Creek				Yarrow Creek	Richards Creek				Lewis Creek
		River Mile	0.2	1.06	1.4	1.8	2.1	2.59	3.81	3.83	3.97	0.4	1.01	2.2	0.2	0.82	0.79	2	2.4	4.07	1.13	0.5	0.65	0.77	0.9	1.7
Bluegill	*Lepomis macrochirus*	1983																								
		1996	x				x				x				x											
		1997																								
		2002					x																			
		2007																								
		2010				x	x					x														
		2011																								
		2012																								
Largemouth Bass	*Micropterus salmoides*	1983																								
		1996																								
		1997									x															
		2002																								
		2007																								
		2010			x																					
		2011																								
		2012																								
Pumpkinseed	*Lepomis gibbosus*	1983																								
		1996																								
		1997																								
		2002					x																			
		2007																								
		2010																								
		2011																								
		2012																								
Crappie (black or white)	*Pomoxis spp.*	1983																								
		1996																								
		1997																								
		2002																								
		2007																								
		2010			x	x																				
		2011																								
		2012																								
Carp	*Cyprinus carpio*	1983																								
		1996																								
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		2010			x																					
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4.0 Discussion and Recommendations for Future Actions

Non-native fish were absent at both Kelsey Creek sampling sites (RM 0.2 and 1.4). Native cutthroat were found at both sites (Tables 5 and 6), while juvenile coho were absent. Variations in fish diversity and counts at Kelsey Creek (RM 1.4) could also be due to stream construction activities that occurred in 2011 and fish may not have reestablished. However, relatively low native species diversity and an absence of juvenile coho at both sites also indicates that urban impacts may be influencing fish populations in these sections of the creek. A low coho to cutthroat ratio (in this case, zero) indicates that these sites on Kelsey Creek are likely influenced by urban impacts as seen in Lucchetti and Fuerstenberg (1993) where a coho-to-cutthroat ratio of >2 indicates excellent habitat, 1 to 2 indicates good habitat, and < 1 indicates urban impacts and/or limited access for anadromous fish. In healthy streams, juvenile coho account for 2 to 10 times the number of juvenile cutthroat. As urbanization continues, juvenile and adult resident cutthroat become more dominant and eventually surpass coho in both total numbers and biomass, which appears to be the case for these sites (Anderson 2011).

Although Kelsey Creek (RM 1.4) provides what appears to be excellent rearing habitat for juvenile coho (Appendix B), other factors may contribute to the lack of coho captured during the study, including low escapement in previous years, flow regimes, natural variances in water chemistry, or juvenile coho may simply have been utilizing other areas of the Kelsey Creek system. Comparing 2012 results to past data on Kelsey Creek on a gross watershed scale show that juvenile coho presence has been relatively consistent, and cutthroat presence has been very consistent (Table 5). Overall, the low numbers of coho adult spawners returning combined with low juvenile and marine survival rates and occurrence of pre-spawn mortality are attributing to the decline of coho species in Bellevue streams, putting coho at a severe risk of extirpation.

Non-native fish were absent at West Tributary, but five native fish species were found (cutthroat, juvenile coho, sculpin, dace, lamprey and stickleback; Tables 5 and 6). This sampling site was located in maturing habitat restoration area with plenty of large woody debris, glides, and riffles (Appendix B). This site showed higher native species diversity than all other sites, indicating that this specific site on West Tributary may exhibit less urban impacts than other sites. However, a low coho-to-cutthroat ratio (0.4) indicates that this site on West Tributary may be influenced by urban impacts in surrounding areas of the watershed. Comparing 2012 results to past data on the lower reaches of West Tributary show that juvenile coho presence has been consistent, and cutthroat presence has been very consistent (Table 5).

Native cutthroat was the only fish species caught at the Yarrow Creek (RM 1.13) site in 2011 and 2012. Fish passage is hydrologically blocked downstream of this site preventing anadromous species access to the upper reaches of Yarrow Creek. The absence of juvenile coho, for example, would therefore be expected for future sampling at this site until the blockage was removed. However, cutthroat showed a strong presence with three year-classes, indicating that Yarrow Creek (upstream of the barrier) is likely a relatively healthy urban stream capable of sustaining not only cutthroat trout populations, but other anadromous salmonid species as well.

In the first year of sampling, native cutthroat was the only fish species caught at the Lewis Creek (RM 1.7) site in 2012. Fish passage is also hydrologically blocked below this site. Unless the blockage is

removed, future sampling will likely show similar results to 2012. The population of cutthroat at Lewis Creek (RM 1.7) showed a strong presence of four (or more) year-classes, indicating that the upstream reaches of Lewis Creek is a relatively healthy urban stream capable of sustaining other anadromous salmonid species. The Lewis Creek watershed historically supported other salmonid species as evidenced by the observations of kokanee (*Oncorhynchus nerka*), sockeye (*O. nerka*), and coho in the lower reaches of the creek below the barrier (Kerwin 2001).

It is recommended that the City continue studies on each of the preceding reaches to help further evaluate the effectiveness of existing and future capital projects for improving fish habitat and passage, and the success of salmonid supplementation efforts. Continued studies to track the diversity, size, and abundance of native and non-native fish species for use as an indicator of overall stream health is also advised. Below is a detailed list of recommendations for the City of Bellevue to facilitate these actions.

- Compare diversity, size, and abundance of fish species across all years for sites with historical data.
- Conduct electrofishing at low, middle, and upper reaches of creeks during the same sampling events to determine if salmonids and native fish are utilizing different habitats than in previous years. This may help determine more accurately the presence/absence of fish within a watershed.
- Determine fish condition index at electrofishing sites to determine relative health of priority fish species. The index could then be compared to other Western Washington urban streams where this particular data has been collected.
- Collect gut content data from priority salmonid species at current BIBI sites to determine if aquatic or terrestrial prey items dominate. These data will help determine prey species availability and use by salmonids. Data collected can help determine if riparian and/or substrate improvements are necessary. Also, compare size of coho and cutthroat fish populations to other Puget Sound lowland reference streams.
- Continue a consistent electrofishing program that visits the same sites during the same time of year to increase robustness of data for determination of status and trends of priority fish species.
- Add additional electrofishing dates earlier in the year at these same sites every five years to help determine seasonality of fish species use (e.g., May).
- Implement a study to evaluate selected electrofishing sites that have shown historical changes in species diversity and density. The study should include key water quality parameters such as temperature and flow conditions; however, other parameters may also need evaluation..

Data collected for native and non-native fish species presence, status, and trends in urban streams can be a useful tool in determining the health of urban streams. Changes in these attributes can also be used to determine if cumulative alterations in land use, habitat restoration activities, and supplementation efforts are influencing fish populations. However, fish use (or lack thereof) in urban streams can be due to many variables, including temporal and spatial changes, habitat type and condition, water quality, and climate. Changes to any one of these variables, without collecting data on each of them, make it difficult to determine what might be causing changes in fish densities and species composition. However, collecting consistent data on habitat change, fish use, and diets (both temporally and spatially), would help ascertain if changes in fish populations and density are due to natural environmental changes, beneficial habitat modifications, or changes in land use. Implementing the recommendations mentioned above would help the City of Bellevue further answer these questions about its local, urban streams.

5.0 Literature Cited

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Kerwin, J. 2001. Salmon and Steelhead Habitat Limiting Factors Report for the Cedar – Sammamish Basin (Water Resource Inventory Area 8). Washington Conservation Commission. Olympia, WA.

Lucchetti, G., and R. Fuerstenberg, Robert. 1993. Management of coho salmon habitat in urbanizing landscapes of King County, Washington, USA. Pages 308–317 in L. Berg and P. Delaney, editors. Proceedings of a workshop on coho salmon. Canadian Dept. of Fisheries and Oceans, Vancouver, British Columbia.

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Appendix A – 2012 Field Sheets

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Start time: 10:00am
End time: 12:030 pm

(1)

Electroshocking Field Form

Date: 7/17/12
Stream: Kelsey Cr. Park Farm
River Mile: 1.4
Site Name: Restoration Reach

Names:
Visibility: Clear
Air Temp:
Water Temp: 16.7 °C
eSetting:
v: Hz: 70 mS: 6

DO: 11.07 mg/L
pH: 8.08
Conductivity: 158.6 µs/cm

Reach Length: 204 ft.
Pool: —
Riffle: 204 ft
Total Time: (813 sec)
Start Time: 40 sec
End Time: 853 sec
Netter Success:
Low/Moderate/High

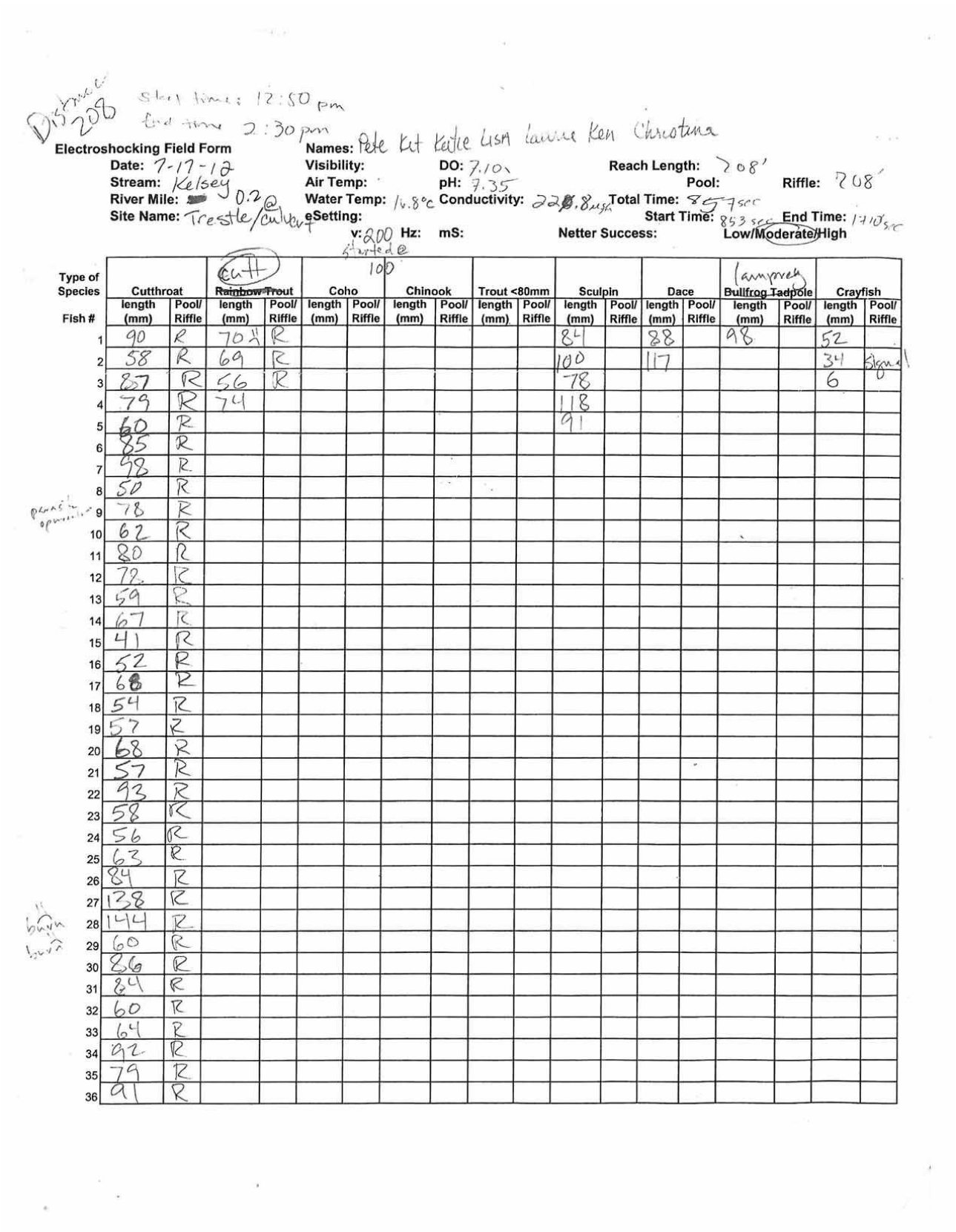
Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		~~Bullfrog Tadpole~~ Dace		~~Crayfish~~ Lamprey	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
1	168	R													50	R	125	
2	104*	R													107	R		
3	62	R											Pregnant		54	R		
4	39	R																
5	171	R																
6	173	R																
7	50	R																
8	64	R																
9	110	R																
10	41	R																
11	115	R																
12	41	R																
13	116	R																
14	47	R																
15	47	R																
16	54	R																
17	64	R																
18	149	R																
19	68	R																
20	138	R																
21	76	R																
22	80	R																
23	66	R																
24	60	R																
25	53	R																
26	56	R																
27	68	R																
28	59	R																
29	41	R																
30	64	R																
31	124	R																
32	39M	R	Mortality															
33	63	R																
34	72	R																
35	57	R																
36	61	R																

* Some opercular damage

Kelsey Cr. Park Farm (RM 1.4)
Restoration Reach

(2)

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		Bullfrog Tadpole		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
37	55	R																
38	42	R																
39	57	R																
40	121	R																
41	68	R																
42	65	R																
43	65	R																
44	60	R																
45	64	R																
46	72	R																
47	129	R																
48	67	R																
49	44	R																
50	78	R																
51	119	R																
52	63	R																
53	39	R																
54	80	R																
55	56	R																
56	Scott	→	got away															
57	63	R																
58	57	R																
59	58	R																
60	61	R																
61	49	R																
62																		
63																		
64																		
65																		
66																		
67																		
68																		
69																		
70																		
71																		
72																		
73																		
74																		
75																		
76																		
77																		



Start time: 12:50 pm
End time: 2:30 pm

Electroshocking Field Form

Names: Pete Kat Kaitie Lisa Laurie Ken Christina

Date: 7-17-12 | Visibility: | DO: 7.10 | Reach Length: 208'
Stream: Kelsey | Air Temp: | pH: 7.35 | Pool: | Riffle: 208'
River Mile: [redacted] 0.2 @ | Water Temp: 14.8°C | Conductivity: 228.8 µS/cm | Total Time: 857 sec
Site Name: Trestle/culvert | eSetting: | | Start Time: 853 sec | End Time: 1710 sec
v: 200 Hz: started @ 100 | mS: | Netter Success: | Low/Moderate/High

Type of Species	Cutthroat		~~Rainbow Trout~~ (cutt)		Coho		Chinook		Trout <80mm		Sculpin		Dace		Bullfrog Tadpole (lamprey)		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
1	90	R	70	R							84		88		98		52	
2	58	R	69	R							100		117				34	Signal
3	87	R	56	R							78						6	
4	79	R	74								118							
5	60	R									91							
6	85	R																
7	98	R																
8	50	R																
9	78	R																
10	62	R																
11	80	R																
12	72	R																
13	59	R																
14	67	R																
15	41	R																
16	52	R																
17	68	R																
18	54	R																
19	57	R																
20	68	R																
21	57	R																
22	93	R																
23	58	R																
24	56	R																
25	63	R																
26	84	R																
27	138	R																
28	144	R																
29	60	R																
30	86	R																
31	84	R																
32	60	R																
33	64	R																
34	92	R																
35	79	R																
36	91	R																

pencils opposite

2" brown bars

Comments: Scour pools, Natural Scour Pools

Electroshocking Field Form

Date: 7/19/12
Stream: West Trib
River Mile: 0.4
Site Name: Kelsey Cr Farm Restoration Reach

Names:
Visibility:
Air Temp:
Water Temp: 16.1
eSetting:
v: Hz: mS:

DO: 11.65
pH: 7.42
Conductivity: 190.7

Reach Length: 409 ft (Many Glide)
Pool: Riffle:
Total Time:
Start Time: End Time:
Netter Success: Low/Moderate/High

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		3-Spine Stickleback ~~Bullfrog Tadpole~~		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
1	172	R			70	R							52 pregnant	R	60	R	58	R
2	142	R			75	R							51	R	48	R	57	R
3	58	R			73	R							46	R	56	R	37	R
4	64	R			79	R							48	R	38	R	21	R
5	56	R			77	R							51	R	47	R	42	R
6	50	R			71	R							50	R	51	R	20	R
7	69	R											51	R	35	R	49	R
8	Cel	R											50	R	52	R	36	R
9	61	R											49	R	39	R	45	R
10	75	R											55	R	51	R	22	R
11	Cel	R											47	R	36	R	18	R
12	64	R											53	R	55	R	24	R
13	54	R											60	R	36	R	33	R
14	62	R											99	R	46	R		
15	57	R											54	R	37	R		
16	52	R											61	R	56	R		
17	67	R											48	R	43	R		
18	53	R											98	R	40	R		
19	54	R											58	R	52 pregnant	R		
20	67	R											26	R	41	R		
21	103	R											56	R	52	R		
22	56	R											57	R	49	R		
23	110	R											59	R	36	R		
24	61	R											51	R	47	R		
25	135	R											59	R	54	R		
26	113	R											51	R	51 pregnant	R		
27	40	R											55	R	38	R		
28	64	R											54	R	54	R		
29	140	R											50	R	55	R		
30	62	R											56	R	51	R		
31	68	R											68	R	39	R		
32	70	R											56	R	53	R		
33	108	R											64	R	47	R		
34	60	R											98	R	49	R		
35	67	R											65	R	53 pregnant	R		
36	101	R											83	R	54 pregnant	R		

(2)

West Trib RM 0.4
7/19/12

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		3-Spine Stickleback Bullfrog Tadpole		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
37	65	R											93	R	50	R		
38	75	R											86	R	49	R		
39	63	R											65	R	51	R		
40	57	R											60	R	50	R		
41	68	R											63	R	48 pregnant	R		
42	63	R											65	R	51	R		
43	55	R											60	R	40	R		
44	62	R											64	R	41	R		
45	114	R											58	R	54	R		
46	69	R											53	R	52	R		
47	70	R											85	R	55	R		
48	91	R											59	R	37	R		
49	112	R											93	R	44 pregnant	R		
50	63	R											71	R	52	R		
51	70	R											61	R	51	R		
52	139	R											57	R	29	R		
53	66	R											61	R	42	R		
54	121	R											54	R	32	R		
55	58	R											55 pregnant	R	53	R		
56	64	R											81 dirty	R	31	R		
57	64	R											49	R	31	R		
58	79	R											62	R	31	R		
59	77	R											63	R	28	R		
60	72	R											74	R				
61	162	R											58	R				
62	62	R											64 different	R				
63	62	R																
64	105	R																
65	80	R																
66	123	R																
67	65	R																
68	110	R																
69	60	R																
70	69	R																
71	70	R																
72	65 different	R																
73	59	R																
74	58	R																
75	130	R																
76	65	R																
77	48	R																

(3)

West Trib RM 0.4
7/19/12

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		Bullfrog Tadpole		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
78	76	R																
79	58	R																
80	73	R																
81	76	R																
82	64	R																
83	60	R																
84	58	R																
85	69	R																
86	58	R																
87	74	R																
88	109	R																
89	60	R																
90	65	R																
91	67	R																
92	65	R																
93	63	R																
94	124	R																
95	47	R																
96	52	R																
97	60	R																
98	61	R																
(cross reference) 99	225	R																
100	81	R																
101	153	R																
102	125	R																
103	80	R																
104	80	R																
105	76	R																
106	51	R																
107	72	R																
108	56	R																
109	59	R																
110	71	R																
111	84	R																
112	73	R																
113	119	R																
114	73	R																
115	68	R																
116	48	R																
117	65	R																
118	67	R																

(4)

West Trib RM 0.4
7/19/12

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		Bullfrog Tadpole		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
119	96	R																
120	78	R																
121	64	R																
122	50	R																
123	57	R																
124	62	R																
125	84	R																
126	60	R																
127	65	R																
128	69	R																
129	61	R																
130	57	R																
131	50	R																
132	58	R																
133	53	R																
134	75	R																
135	60	R																
136	55	R																
137	66	R																
138	53	R																
139	110	R																
140	79	R																
141	74	R																
142	55	R																
143	54	R																
144	65	R																
145	149	R																
146	79	R																
147	74	R																
148	113	R																
149	64	R																
150	47	R																
151	50	R																
152	65	R																
153	57	R																
154	60	R																
155	67	R																
156	68	R																
157	55	R																
158	136	R																
159	128	R																

(5)

West Trib 7/19/12 continued

Electroshocking Field Form 0.4

Names:

Date: Visibility: DO: Reach Length:

Stream: Air Temp: pH: Pool: Riffle:

River Mile: Water Temp: Conductivity: Total Time:

Site Name: eSetting: Start Time: End Time:

v: Hz: mS: Netter Success: Low/Moderate/High

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		Bullfrog Tadpole		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
160 A	78	R																
161 2	87	R																
162 3	59	R																
163 A	57	R																
164 B	63	R																
165 B	65	R																
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
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21																		
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24																		
25																		
26																		
27																		
28																		
29																		
30																		
31																		
32																		
33																		
34																		
35																		
36																		

NO BEACH NETTING

Electroshocking Field Form

Date: 7/19/12
Stream: Yarrow Cr
River Mile: 1.13
Site Name:

Names:
Visibility:
Air Temp:
Water Temp: 15.4°C
DO: 11.83
pH: 7.93
Conductivity: 199.9
eSetting:
v: 200 Hz: 60 mS: 6

Shock Time: 429 seconds
Reach Length:
Pool: Riffle:
Total Time:
Start Time: 1:30pm End Time:
Netter Success: Low/Moderate/High

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		Bullfrog Tadpole		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
1	✓																✓	
2	✓																	
3	✓																	
4	✓																	
5	✓																	
6	✓																	
7	✓																	
8	✓																	
9	✓																	
10	✓																	
11	✓																	
12	✓																	
13	✓																	
14																		
15																		
16																		
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29																		
30																		
31																		
32																		
33																		
34																		
35																		
36																		

1, 2, 3, 4, 5

* Lengths determined from photos of fish in photo aquarium (w/ruler attached).

Electroshocking Field Form

Date: 7/24/12 | Names: | | | |
Stream: Lewis Creek | Visibility: | DO: 12.30 mg/L | Reach Length: 229 ft. |
River Mile: 1.7 | Air Temp: | pH: 7.88 | Pool: | Riffle:
Site Name: Ravine | Water Temp: 13.4°C | Conductivity: 176.1 µS/cm | Total Time: 923 sec
eSetting: | | | Start Time: 9:30am | End Time: 11:15am
v: 200 Hz: 60 mS: 6 | Netter Success: | Low/Moderate/High

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		Bullfrog Tadpole		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
1	101	R																
2	186	R																
3	134	R																
4	95	R																
5	56	R																
6	43	R																
7	109	R																
8	108	R																
9	138	R																
10	103	R																
11	130	R																
12	157	R																
13	45	R																
14	93	R																
15	102	R																
16	158	R																
17	98	R																
18	130	R																
19	104	R																
20	92	R																
21	200	R																
22	250	R																
23	92	R																
24	125	R																
25	93	R																
26	90	R																
27	95	R																
28	43	R																
29	110	R																
30	96	R																
31	76	R																
32	50	R																
33	120	R																
34	99	R																
35	136	R																
36	79	R	burnmark															

(2)

Lewis Creek RM 1.7
7/24/12

Type of Species	Cutthroat		Rainbow Trout		Coho		Chinook		Trout <80mm		Sculpin		Dace		Bullfrog Tadpole		Crayfish	
Fish #	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle	length (mm)	Pool/ Riffle
37	100	R																
38	80	R	gill parasite															
39	88	R																
40	100	R																
41	100	R																
42																		
43																		
44																		
45																		
46																		
47																		
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Appendix B – Project Photos

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Electrofishing on Kelsey Creek RM 0.2
(Start of Reach)

Example of cutthroat captured at Kelsey Creek RM 0.2

Electrofishing on Kelsey Creek RM 0.2
(Top of end of reach)

Example of sculpin (top) and dace (bottom) caught at Kelsey Creek RM 0.2

Electrofishing on Kelsey Creek RM 1.4
(Start of Reach)

Measuring cutthroat captured at
Kelsey Creek RM 1.4

Lamprey redd on Kelsey Creek RM 1.4
(Mid-reach)

Top end of reach at Kelsey Creek RM 1.4

Electrofishing on West Tributary RM 0.4 (Start of Reach)

Example of cutthroat (top) and juvenile coho (bottom) captured at West Tributary RM 0.4

Top end of reach on West Tributary RM 0.4

Example of lamprey (top) and stickleback (bottom) captured at West Tributary RM 0.4

Example of two age classes of cutthroat captured at Yarrow Creek RM 1.13

Electrofishing at Lewis Creek RM 1.7 (Start of reach)

Example of two age classes of cutthroat caught at Lewis Creek RM 1.7