

# **Bull Trout and Pygmy Whitefish Spawning Survey Protocol**

**Seattle Public Utilities  
Heidy Barnett and Dwayne Paige**

## **1.0 Introduction and Background**

Bull trout spawning surveys are conducted in the Cedar and Rex rivers, several associated floodplain channels and in Chester Morse Lake tributaries each fall. Adfluvial bull trout reside most of the year in Chester Morse Lake (CML) and move into these reaches to spawn each fall. The Cedar River Watershed Habitat Conservation Plan (CRW-HCP, 2001) states that bull trout redd surveys will be conducted in years 1-8 of the plan (2000 – 2007). This document details objectives for these surveys and outlines methodology for data collection associated with bull trout spawning surveys.

Seattle Public Utilities (SPU) manages CML for high quality drinking water for the City of Seattle, downstream fish flows and a small amount of power generation. Adfluvial bull trout use the lowest portions of the rivers that drain into CML for spawning. In some years, redds placed near the lake will be inundated as the lake level rises with winter rains and spring snowmelt. Redds are then covered with a fine layer of sediment and the fate of incubating eggs or emerging alevins from these sites is unknown. SPU surveyors conduct bull trout surveys to document the number of redds placed within this zone as well as understand what proportion of the overall spawning locations these redds comprise.

## **2.0 Objectives**

- Determine the number of bull trout redd locations in areas affected by lake inundation on the Cedar and Rex rivers.
- Determine temporal distribution of bull trout spawning in the Cedar River, Rex River, Rack Creek, and Shotgun Creek as well as associated floodplain and tributary habitat.
- Determine spatial distribution of bull trout spawning in the Cedar River, Rex River, Rack Creek, and Shotgun Creek as well as associated floodplain and tributary habitat.
- Determine temporal and spatial distribution of the pygmy whitefish spawning run.
- Investigate spawning use for bull trout and pygmy whitefish in remote reaches.
- Investigate trends in the abundance of the adult population residing in CML.

## **3.0 Bull Trout Spawning Survey Methods**

Specific methods for conducting bull trout surveys are outlined below.

### **3.1 Equipment Needed**

- 2 surveyors
- Redd marker bags (muslin bags located in Harmon House storeroom)
- Biodegradable flagging (orange)
- Flagging (choose a color for the given year and stick with it on all surveys)
- Sharpies or other marking pen

- Field notebook and datasheets (J:\SSW\WS541\Secure\Fish and Wildlife\Field Data (survey forms)\Bull Trout Data Sheets, file: Small spawning form.xls).
- Weather sheet (J:\SSW\WS541\Secure\Fish and Wildlife\Field Data (survey forms)\Bull Trout Data Sheets, file: Survey form environmental tables.doc)
- Thermometer
- Walking Stick
- Waders, warm field gear, raingear, hat, polarized sunglasses
- Measuring device – (can use measuring tape, but they tend to break due to the water), you can put tick marks on walking stick to use as a measuring tool
- GPS unit
- Maps if needed

### 3.2 Timing of Surveys

Surveys are initiated the last week of September each year and continue until late December or in some cases early January. The date of last survey is the last week of December if no redds were found during the previous week. If redds are found during that week, then one additional week of surveys at the beginning of January is needed. SPU attempts to survey several reaches twice per week while others may be surveyed once (see Section 3.3). The reasons for conducting surveys twice a week in some reaches are a) importance to reservoir management, b) high numbers of redds in these reaches.

Generally, two surveyors walk the stream and carefully locate all bull trout redds. Survey protocol dictates surveying a given reach of habitat weekly and in most cases this goal is met. A periodic high flow during some years necessitates postponing surveys due to unsafe conditions for surveyors. Immediately after flows recede, the reach is surveyed for bull trout redds.

### 3.3 Reaches to Survey

Reaches designated along the Cedar and Rex rivers help plan surveys and signify natural breaks along the rivers (Figure 1 and 2). At a minimum, weekly surveys are conducted on the following reaches: Cedar River (Reach 1, Reach 2, Reach 3, and Reach 10), Rex River (Reach 1), Rack Creek, and Shotgun Creek. Often sidechannel reaches (Reach 7 and 8) and other mainstem reaches (Reach 4, 5 and 6) are surveyed while walking back downstream to the Camp 18 bridge from Reach 10 on the Cedar River. Other reaches are surveyed once or twice during the peak of the spawning run to look for bull trout redds. These reaches include: Boulder Creek, Cabin Creek, upper Rex River, upper Cedar River (near Seattle Creek, near Roaring Creek), Bridge Creek, Damburat Creek, and Lost Creek.

When recording reaches surveyed on datasheets, use the following nomenclature as it helps with data entry.

#### Cedar River

Reach 1 = Inzone-C18

Reach 2 = C18-UP

Reach 3 = New Main

Reach 4 = Middle

Reach 5 = Old Middle

Reach 6 = Mid-Roar

Reach 7 = E\_LB2  
Reach 8 = OM\_RB\_Alder  
Reach 9 = WBC 4  
Reach 10 = WBC 5

Rex River

Reach 1 = Inzone-Morse  
Reach 2 = Morse-300  
Reach 3 = 300-UP

Figure 1. Cedar River reaches designated and used during all bull trout surveys.

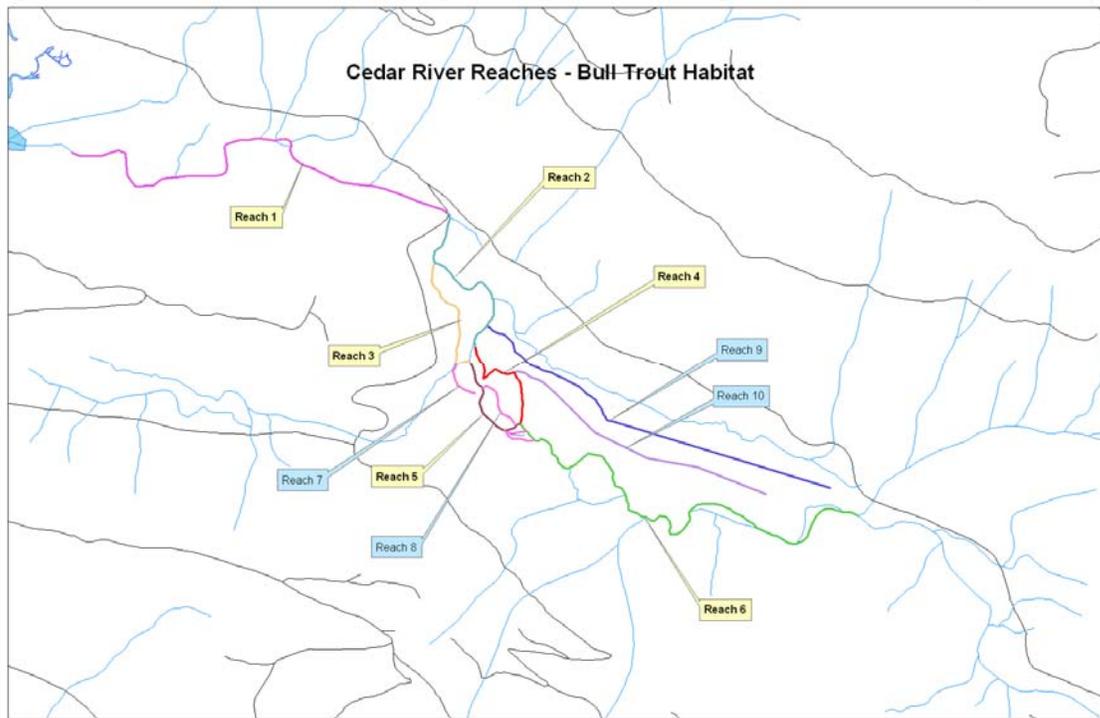
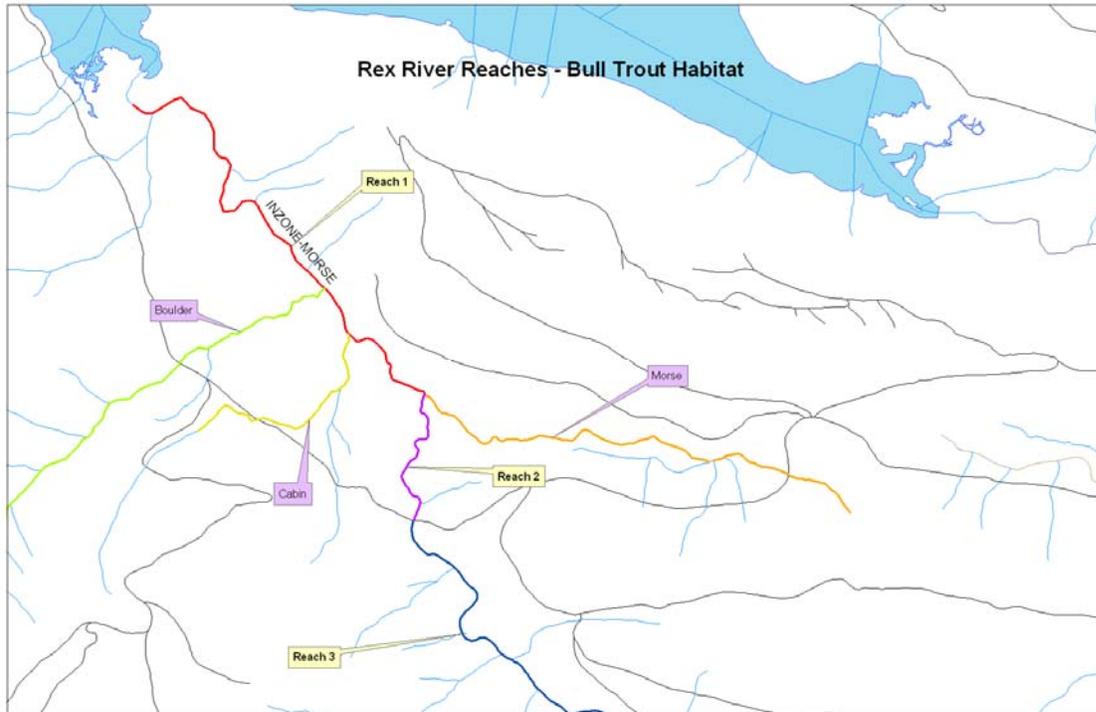


Figure 2. Rex River reaches.



### 3.4 Data Collection

Datasheets are printed on rite-in-the-rain paper in the office and fit in standard field 3 ring notebooks. When you arrive at the survey site, begin filling in the datasheet (Appendix A).

Stream = Cedar, Rex, Rack, Shotgun, Cabin, Lost, Damburat, Bridge

Section = describe the section you are surveying. If it fits in the reach breaks noted in Section 3.3, list these.

Date = Date of the survey

Observers = initials of each surveyor

Species = Circle the species of interest on the survey. BLT (bull trout), KOK (kokanee), COH (coho), RBT (rainbow trout), CUT (cutthroat trout)

H2O clarity = usually "clear". However, if the water is turbid due to rain or has tanins making visibility more difficult, use it.

T (air) = air temperature at beginning of survey

T (water) = water temperature at the beginning of the survey

Weather = use environmental tables referenced in Section 3.1

Surveyors walk in a zigzag pattern across wide reaches of the river and along the bank when the entire wetted channel can easily be viewed from shore. When a redd is located in the field the site is marked with a rock-filled cloth bag at the end of the tailspill on the redd (see photos in Section 3.5). Mark the redd number (R1 for first redd of the day, and ascend sequentially for each subsequent redd) and the date of the survey on the cloth bag. Next, fill the bags with rocks and tie the opening closed. Secure a length of biodegradable orange flagging by tying the strings of the bag around it. The bags color up with algae quickly and sometimes the flagging is easier to see in the field. In addition, hang a piece of flagging noting the date at the bank. Try to hang the flag perpendicular to the head of the redd (most upstream location on redd). This may

help determine superimposition on later surveys. It is important to make the above markings (bag and flagging) because they enable surveyors to determine new redd sites in the immediate vicinity of a previously identified redd and aid in identifying superimposition sites through the year. If the same surveyor does not return to the site the following survey, this will also help with overcounting redds because all counted redds are clearly marked with a bag (Dunham et al. 2001).

Data recorded for each redd includes the following: width of the “head” of each redd, the width of the “pit” at center of the redd, the width of the “tailspill”, and total “length” of the redd. The head measurement is taken at the top of the redd across the top where the fish dug (this is a difficult measurement and subject to observer bias). The pit width is taken at the widest part of the pit and should not vary considerably by observer. The width of the tailspill is taken at an average width location and is again subject to observer bias. Total length of the redd is taken from the most upstream portion of the redd to the most downstream point on the tailspill (should not be subject to observer bias). All measurements are recorded in inches.

The substrate at the site is characterized using the following table. Observers should pick up a rock that represents the dominant substrate that the fish chose to use (prior to digging) and record it as the dominant particle. Repeat for the second most dominant particle size chosen by the fish (prior to digging). In order to find these sizes, you will have to look at gravels surrounding the redd site rather than at the gravel disturbed by the fish.

PARTICLE	Millimeters	CODE
Sand	< 2	1
Very Fine	2 -4	2
Fine	4 -5.7	3
Fine	5.7 - 8	4
Medium	8 -11.3	5
Medium	11.3 - 16	6
Coarse	16 -22.6	7
Coarse	22.6 - 32	8
Vry Coarse	32 - 45	9
Vry Coarse	45 - 64	10
Small	64 - 90	11
Small	90 - 128	12
Large	128 - 180	13
Large	180 - 256	14
Small	256 - 362	15
Small	362 - 512	16
Medium	512 - 1024	17
Large	1024 -2048	18
Vry Large	2048 -4096	19

The location of each redd is noted relative to station flagging at the bank. In 2002, the river was stationed using a hipchain, and lime green flagging was hung intermittently noting distances along the river. The flagging is updated during the first bull trout spawning survey of each year. This flagging system made it easier for surveyors to quickly note the location of each redd and facilitated easy interchange with GIS software to display redd locations. Simply pace from the redd to the nearest station flagging and note the distance in the “Location” column of the

datasheet. If you are working in a reach without station flagging, use a GPS unit to locate the coordinates for each redd or place carefully using aerial photographs.

### 3.5 Redd Identification

Bull trout redds are counted in a manner to avoid overcounting. SPU attempts to have an experienced surveyor on the crew at all times as this is suggested to reduce false identifications as well as omissions (Muhlfeld et al. 2006). It is important to perform consistent surveys through time as these surveys provide SPU and others interested in regional bull trout recovery efforts a basic indication of the trends in adult abundance through time. Severe overcounting of redds, or severe omissions of redds can heavily influence the dataset and provide less valuable data to managers (Muhlfeld et al. 2006). Follow the below guidelines to help keep redd counts consistent between years. All surveyors will be trained by an experienced surveyor that has worked in the Cedar River Municipal Watershed in previous years. Surveyors who have been at the site on previous surveys often can quickly remember previous redds and make redd count calls easier. If you did not perform the previous survey, it is especially important to follow the below guidelines.

The easy redd: classic pit and tailspill in clearly disturbed gravels with no other fish activity nearby. These are always a new redd for the survey.



The messy, yet still easy to call redd: you observe fish actively digging at a site. These fish may be using a site you previously marked (as in photo below) but you observe the female digging and can call a new redd at the site. These redd are often too difficult to measure due to disturbance caused from other redds in the area.



Some situations can be more difficult and require careful consideration before calling a new redd. Use the below guidelines in these cases.

- 1) **If you are unsure whether the redd is a redd or test**, call it a test. Look for loose eggs at the site and gently tap the tailspill to determine if it is “soft” or not. Do not dig in the site to disturb eggs, simply use your walking stick to gently tap the tailspill material as well as the gravel next to the redd. A site that has been disturbed by a spawning bull trout will move easily and not produce large amounts of sediment when tapped. SPU does not record test sites (but did in previous years).
- 2) If you are unsure of **superimposition** – do not call a new redd. Tips that might lead you to conclude that superimposition occurred include: a) a buried marker bag at the site from a previous redd, b) clearly new gravels on top of an old tailspill, c) seeing fish actively working at the site. The photo below shows that the new redd (with bright gravels) ends at a previously marked bag. This bag has sediment resting on top of it. The gravel age of the redd behind the bag is much “older” (meaning algae is growing on it) than the new redd. Surveys conclude that a superimposition event has occurred at this site.



- 3) When counting redds that occur in a “**chain**”. Bull trout often use the pit of a previous redd as an egg pocket and then bury eggs leading to a chain of redds in an upstream direction. We do not know if a single female makes the entire chain or if multiple fish are using the site. In order to call a new redd, look for: a) new gravels in the tailspill material (not colored by algae, completely free of sediment), b) buried marker bags at the site, c) fish active on the new redd site, d) clear headwall cut that hasn’t yet collapsed or sloughed away (with time, these definite boundaries fade). The photo below shows two redds in the center, one just upstream of the other. The tailspill of the upstream redd fills the pit of the downstream redd leading to “chaining”. Each site is a separate redd.



- 4) **If redds are side by side with no space between them.** In order to count two redds, you must see 2 definite pits and 2 definite tailspills. If any one of these components is missing, count the redd as a single site. The photo below shows a redd site that is recorded as only one redd. Although it is extremely large, we could not tell that two different fish worked this redd.



- 5) **If you haven't visited the site regularly.** "Chaining" becomes more difficult to decipher when a site is not visited frequently. Look for clear indications that gravel ages in the tailspill are different (one is more colored than the other). If you cannot clearly determine this to be the case, call the redd a single site. The disturbed gravel holds a different color than undisturbed gravel for some time and shown in the below photo. We did not find this site until late in the year and were not sure when fish spawned.



## 4.0 Pygmy Whitefish Spawning Survey Methods

### 4.1 Equipment Needed

- 2 surveyors
- Field notebook and datasheets (J:\SSW\WS541\Secure\Fish and Wildlife\Field Data (survey forms)\pygmy whitefish, file: PWF data sheet.doc).
- Weather sheet (J:\SSW\WS541\Secure\Fish and Wildlife\Field Data (survey forms)\Bull Trout Data Sheets, file: Survey form environmental tables.doc)
- Thermometer
- Walking Stick
- Waders, warm field gear, raingear, hat, polarized sunglasses
- Measuring device – (can use measuring tape, but they tend to break due to the water), might put tick marks on walking stick to use as a measuring tool
- GPS unit
- Maps if needed

## 4.2 Timing of Surveys

Pygmy whitefish typically appear in the Cedar and Rex rivers at the beginning of December, but have been observed as early as mid November. Surveys for bull trout in the same reaches are ongoing through this time period. Once pygmy whitefish appear in the rivers, surveys for this species will begin.

## 4.3 Data Collection

Surveys occur simultaneously with bull trout spawning surveys. Data sheets are printed on rite-in-the-rain paper and have the same heading information as bull trout spawning sheets. Reference Section 3.3 for that information. An SPU biologist who has conducted pygmy whitefish surveys in the past should train new crews in the field.

When a school (or individual) pygmy whitefish is encountered during a survey data collection begins. The “school no.” begins at 1 for the day and ascends numerically for each subsequent sighting of a school.

Surveyors must next estimate the number of fish (No. of fish) in a particular school. In order to do this, both surveyors should watch a certain group of fish closely and try to count the number in an area (typically a basketball sized area). Alternatively, you can count 50 fish and get an estimate in your head for the area these fish take up within the school. Once the eye is calibrated to know the approximate number of fish within a given area, estimate the overall size of the school and multiply to determine an estimate for the number of fish in the school. Do not assume that all schools have fish at the exact same density. Some pygmy whitefish schools may be located in deeper water so that fish are stacked up on top of one another while others are moving through a shallow riffle. Surveyors should recalibrate by counting fish within a set area if a given school has significantly different fish densities. Each surveyor should get an independent estimate for the number of fish at each school and both numbers should be recorded to get a range of the estimate of fish. For example, one surveyor may estimate 250 fish and the other 300 fish. The data should be recorded as “250-300” for that school. If both surveyors estimate the same number, just record that number.

**Size of fish in school:** Often carcasses will be located along the river and can help to calibrate your eye. Give an estimate for the average size of a fish in the school. This is done because past surveys show some variability between years.

**Substrate:** Use the particle table listed in Section 3.3 to note the dominant and subdominant size of particles that the school is over.

**Depth of Water:** Estimate the depth of water where the school is located. You can use your walking stick to measure it if the school moves off due to your presence. Record the data in inches.

**Site/Habitat Type:** Describe the macrohabitat type at the site (pool, riffle, glide).

**Behavior:** Note what the fish are doing if unusual. The typical data recorded for this entry include: school, moving through riffle, individual, carcass.

Field Location: Use green flagging used in bull trout surveys to determine distance along the survey route. You can also use the GPS unit to get locations for each school.

One survey each year should be done to investigate the uppermost extent of pygmy whitefish use in the Cedar and Rex rivers. On these surveys, walk from the inundation zone upstream to Roaring Creek on the Cedar River and from the inundation zone upstream to the 300 road (or above if needed) on the Rex river.

## **5.0 References**

Dunham, J. and B. Reiman. 2001. Sources and magnitude of sampling error in redd counts for bull trout. *North American Journal of Fisheries Management* 21: 343-352.

Muhlfeld, C., M. Taper, D. Staples, and B. Shepard. 2006. Observer error structure in bull trout redd counts in Montana streams: implications for inference on true redd numbers. *Transactions of the American Fisheries Society* 135: 643-654.



