

***PRELIMINARY DRAFT***  
**PACKWOOD LAKE TRIBUTARY  
FISH PASSAGE**



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Energy Northwest

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PACKWOOD LAKE TRIBUTARY  
FISH PASSAGE, 2004**

***SECTION 1: INTRODUCTION***

The Packwood Lake Hydroelectric Project (Project) manipulates Packwood Lake levels based on the Federal Energy Regulatory Commission (FERC) license conditions for the Project. Concerns were expressed that drawdown of Packwood Lake level resulting from Project operations may modify stream connectivity, fish passage, and total habitat in tributaries upstream of Packwood Lake. The goal of this study was to establish if changes in lake elevation would interfere with upstream migration of resident rainbow trout into lake tributaries.

***Project Operation***

Lake Creek is located at the outlet of Packwood Lake and flows to the northwest approximately 5.3 miles to the upper Cowlitz River where it enters at approximately River Mile (RM) 129.2. The total area drained by Lake Creek and Packwood Lake amounts to approximately 12,288 acres (19.2 square miles) at the drop structure and 16,960 acres (26.5 square miles) upstream of the confluence of Lake Creek and the Cowlitz River. The total surface area of the lake is 452 acres (0.7 square miles). The approximate natural lake elevation (El) is 2,857 ft MSL, which is approximately 1,800 ft above the powerhouse. The Project seasonally regulates the lake level so that it is at El 2,857 ft  $\pm$  6" in summer recreation months and drawn down to no lower than El 2,849 ft MSL during winter months. This provides 8 ft vertical storage usable by the project. When lake level rises above the drop structure crest elevation (2858.5 ft MSL), the flow passes over the drop structure into Lake Creek downstream of the lake.

Article 37 of the license requirements states that, "Licensee shall operate the project so that the maximum operating water surface level shall be at elevation 2,858.5 feet and the minimum operating water surface level shall be at elevation 2,849.0 feet. During the period each year between May 1 and September 14, the Licensee shall maintain the water surface level at elevation 2,857 feet, unless conditions prevail that are beyond the control of the Licensee." Although the license allows the project to be operated to achieve a lake elevation of 2,858.5 ft during the winter period (September 15 – April 30), Energy Northwest tries to keep the upper lake elevation at 2857 +/- 6 inches (the same as the summer period).

To minimize generation losses by the spill of water over the dam, the Packwood staff has developed a practice of drawing down the lake beginning September 15. A lake level of 2849 or 2850 is normally reached by October 1, which is the beginning of the outage. During October the project is shutdown and maintenance is performed. The low lake level usually assures that no spill occurs. By the completion of the outage, the lake level has risen back to some mid-point level and operations begin again. October was chosen for the outage because it is one of the low-inflow months.

***SECTION 2: METHODS***

EES Consulting, Inc. surveyed the mouths of the main fish-bearing tributaries to Packwood Lake on September 28, 2004. This date was chosen because the drawdown was nearly complete, and the lake level was close to the lowest that it would achieve in 2004.

Surveying included recording heights and distances of the water surface elevation (WSE) at the mouth of the creek; bed profile extending out from the mouth as far as possible, and bed profiles

continuing upstream to full pool elevation, where feasible. All creeks were surveyed using a Topcon auto level. Substrate was also recorded. Tributaries surveyed included Osprey, Crawford, Muller, and Upper Lake creeks (Figure 1).

### **SECTION 3: RESULTS**

Waters edge (WE) was established as 2,851.54 ft as measured at the intake structure staff gage. Measurements were taken farther out into the water so as to include the maximum drawdown. Streamflow was low on all streams, presenting a “worse-case” scenario. Maps of stream profiles include: water surface elevation as measured on September 28 (2,851.54 ft); minimum lake level (2,849 ft); and maximum lake level (2,857 ft). Streamflows were extremely low during the survey.

#### **3.1 Osprey Creek**

Osprey Creek enters Packwood Lake from the west. Figure 2 profiles the stream elevation for Osprey Creek in the drawdown zone. Osprey Creek drains into Packwood Lake over a sand and silt delta that extends out into the lake. Passage into Osprey Creek is possible at a lake elevation of 2851.54; however, if the lake were to drop to elevation 2851.2, the delta would be fully exposed and upstream fish passage would not be possible unless the stream were to downcut through the delta. Downcutting through the delta would be possible at higher flows which could mobilize the existing substrates.

#### **3.2 Muller Creek**

Muller Creek enters Packwood Lake from the south and is southwest of Upper Lake Creek and Crawford Creek. The predominant substrates in the inundation zone were silt, sand and mud (see Photos 2 and 3). At the lake elevation at the time of surveying, Muller Creek was passable to upstream migrants. Based upon the channel profile and the substrates in the inundation zone, upstream passage for resident rainbow trout would be possible at all lake elevations. The substrates in this area would be sufficiently mobilized so that downcutting of the delta would occur (see Figure 3).

#### **3.3 Upper Lake Creek**

Upper Lake Creek is the largest tributary to Packwood Lake and enters the lake on the south end between Muller and Crawford creeks. At the time of the survey, upper Lake Creek consisted of two channels which skirted either side of a point that extended into the inundation zone (Figure 4). Upstream, Lake Creek entered a wooded area with a well-defined channel. The substrate consisted exclusively of mud and sand in the inundation zone (see Photo 4). Fish passage for Lake Creek is passable at all lake elevations within the range of 2,849 – 2857. Because the substrate consists exclusively of sand and mud, Lake Creek readily downcut through the substrate; during the time of the survey, Lake Creek had cut a channel down approximately 1.5 – 2 ft from the surrounding area, leaving walls of this height on either side of both channels (see Photo 5).

#### **3.4 Crawford Creek**

Crawford Creek enters Packwood Lake from the south and is situated northeast of upper Lake Creek. Although the delta consists of primarily sand, mud and silt, Crawford Creek is underlain

with gravels. At the elevation surveyed, upstream passage of resident rainbow trout was not possible (Figure 5, Photo 6). It did not appear that upstream passage would be feasible at lake elevations less than approximately 2856 due to low flows, and small barriers throughout the inundation zone. At higher flows and a lower lake elevation, resident rainbow would most likely be swept downstream from this area.

#### **SECTION 4: DISCUSSION**

The major rainbow trout spawning tributaries are Osprey, Muller and Upper Lake Creeks. Rainbow trout are also known to spawn in Trap Creek and occasionally in Beaver Bill Creek (a tributary to upper Lake Creek) and a small tributary SE of Trap Creek. Spawning has not been quantified in Crawford Creek (Table 1) by WDFW, although observations in 2004 indicate that the heaviest spawning occurred in this creek.

Surveying of major tributaries to Packwood Lake indicate that a drawdown of Packwood Lake to 2,549 ft would not impact upstream fish passage into upper Lake Creek or Muller Creek; a drawdown to less than 2,851.2 ft could impact upstream fish passage into Osprey Creek; and any drawdown to less than approximately 2,856 ft could impact upstream fish passage into Crawford Creek, if fish were volitionally attempting to ascend this creek and spawn. Since Beaver Bill Creek is a tributary to upper Lake Creek, any fish able to ascend upper Lake Creek would also be able to access Beaver Bill Creek, provided there are no barriers present in between the two. Data are unavailable for Trap Creek or the small tributary SE of Trap Creek. Our assessment of passage feasibility is based on the surveyed elevations of the inundation zone; water depth is also a factor in upstream passage, and flows can be low enough to impede or prevent that passage. The creeks are generally at their highest before and during the spawning period in late-spring and early summer period due to snowmelt and flows would not be an issue during this period.

Based upon the data provided by WDFW, peak spawning apparently occurs from mid-June through early July. According to Article 37 of the license, Packwood Lake levels are to be at full elevation (2,857 ft +/- 6 in) by May 1 of each year. Although the exact timing of when rainbow trout enter Packwood Lake tributaries for spawning is unknown, it appears reasonable to assume that current project operations, as dictated by the license, would have the lake full prior to upstream migration. It is also unknown at what time of year the juvenile rainbow trout leave the tributaries to forage in Packwood Lake or what impact project operations could have on their migration if it were to occur during the drawdown.

Year	Osprey Cr	Trap Cr	Muller Cr	Up. Lake Cr	Beaver Bill Cr	Small Tributary SE of Trap Cr	Total
All 1979	-	-	194	-	-	-	194
06/18/81	16	18	67	5	-	-	106
06/29/82	-	0	0	0	-	0	0
06/20/83	0	-	0	-	-	-	0
All 1984	-	-	55	317	-	40	412
06/26/85	3	0	14	200	-	0	217
06/27/86	-	-	13	112	-	-	125
06/09/87	-	-	78	332	-	-	410
06/16/88	-	180	61	721	-	4	966
06/14/89	490	160	180	405	82	5	1322

<b>Year</b>	<b>Osprey Cr</b>	<b>Trap Cr</b>	<b>Muller Cr</b>	<b>Up. Lake Cr</b>	<b>Beaver Bill Cr</b>	<b>Small Tributary SE of Trap Cr</b>	<b>Total</b>
06/15/90	24	5	149	60	-	-	238
06/19/91	314	94	399	363	-	0	1170
06/20/95	1	0	86	166	-	-	253
06/28/96	0	3	299	238	-	-	540
06/25/97	29	13	590	214	-	-	846
06/24/98	28	9	374	220	-	-	631
07/06/99	19	30	155	107	-	-	311
06/29/00	355	27	249	153	-	-	784
06/25/02	138	60	414	265	-	8	885
06/25/03	181	6	201	305	-	0	693
06/29/04	37	17	245	485	3	0	787
<b>Total</b>	<b>1,635</b>	<b>622</b>	<b>3,823</b>	<b>4,668</b>	<b>85</b>	<b>57</b>	<b>10,890</b>
<b>Mean</b>	<b>109</b>	<b>39</b>	<b>182</b>	<b>246</b>	<b>43</b>	<b>6</b>	<b>519</b>
<b>Minimum</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>
<b>Maximum</b>	<b>490</b>	<b>180</b>	<b>590</b>	<b>721</b>	<b>82</b>	<b>40</b>	<b>1,322</b>

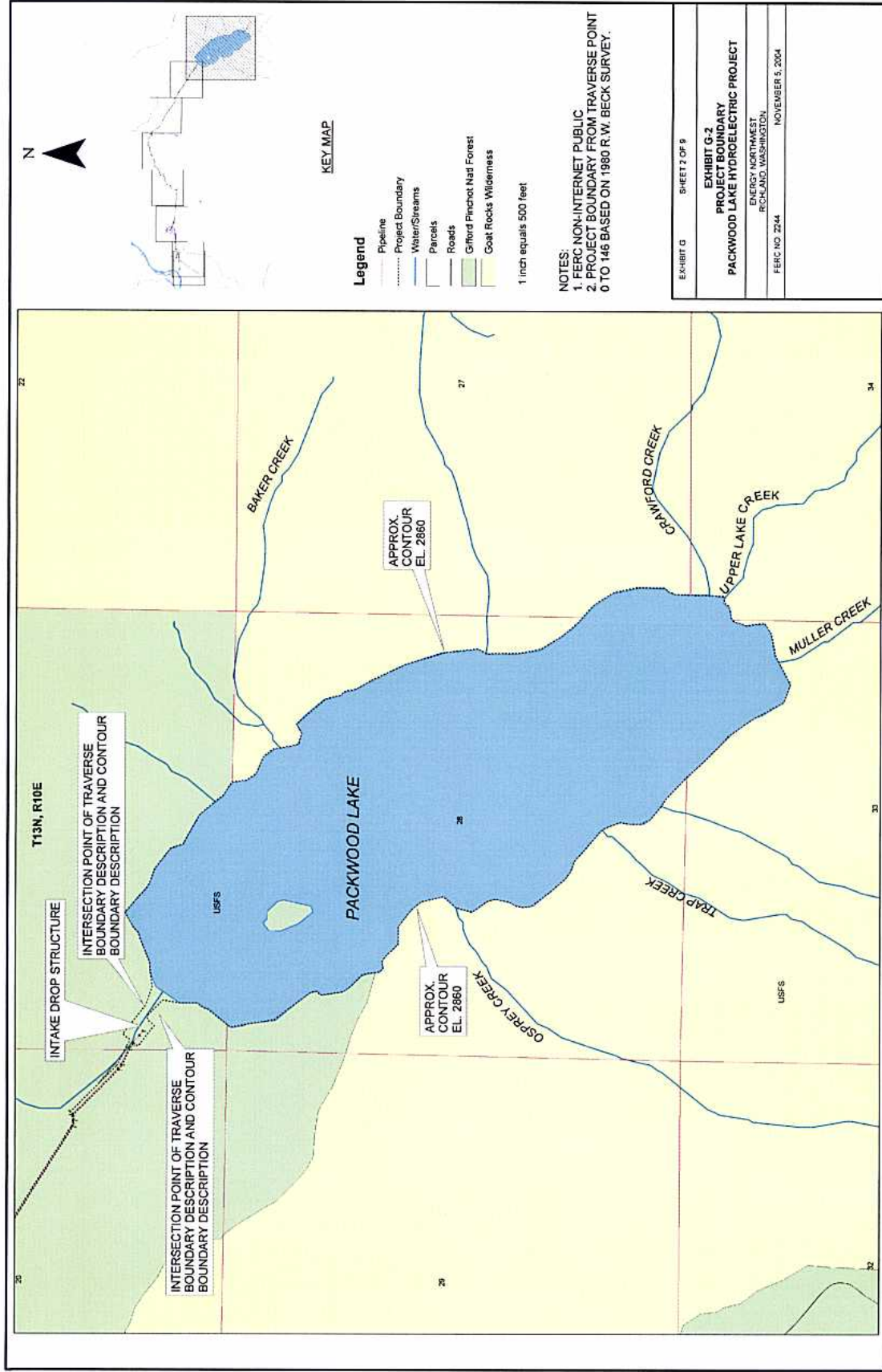
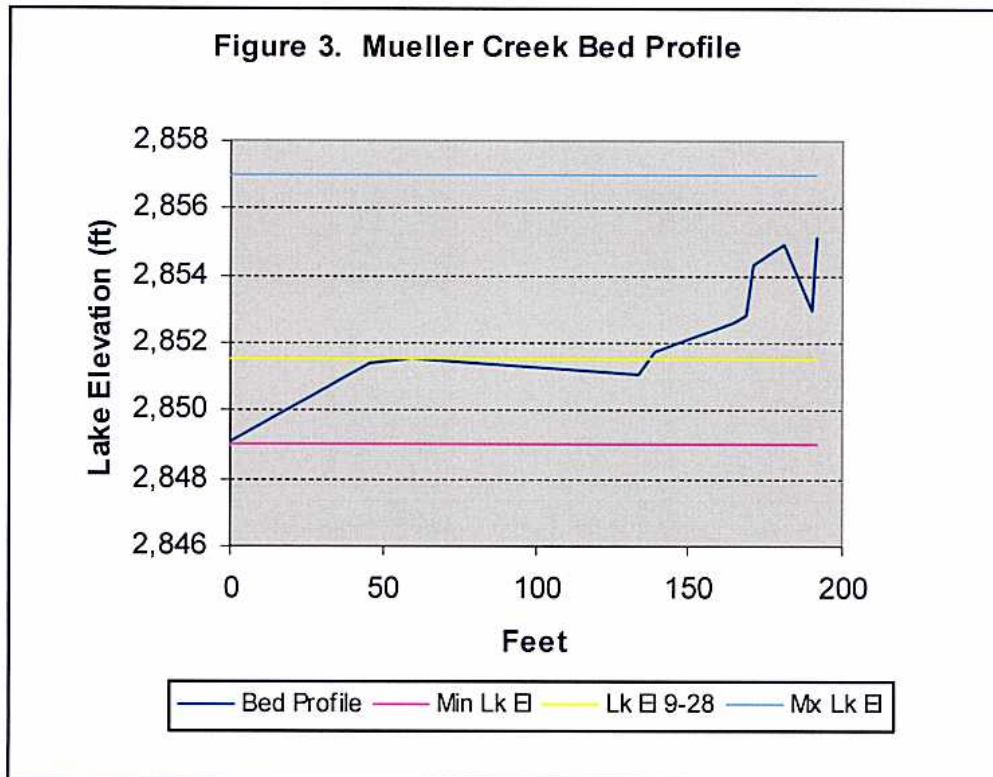
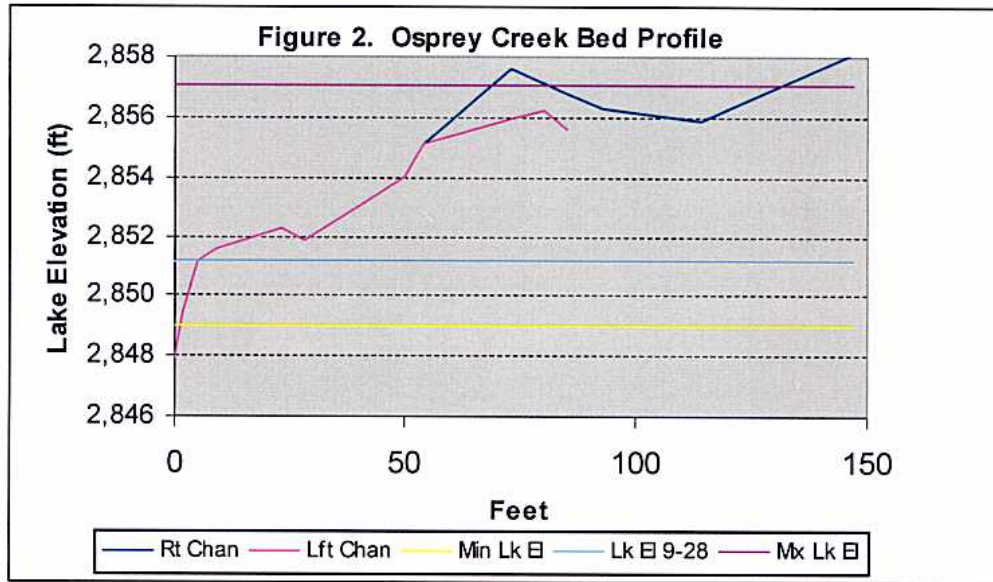


Figure 1.



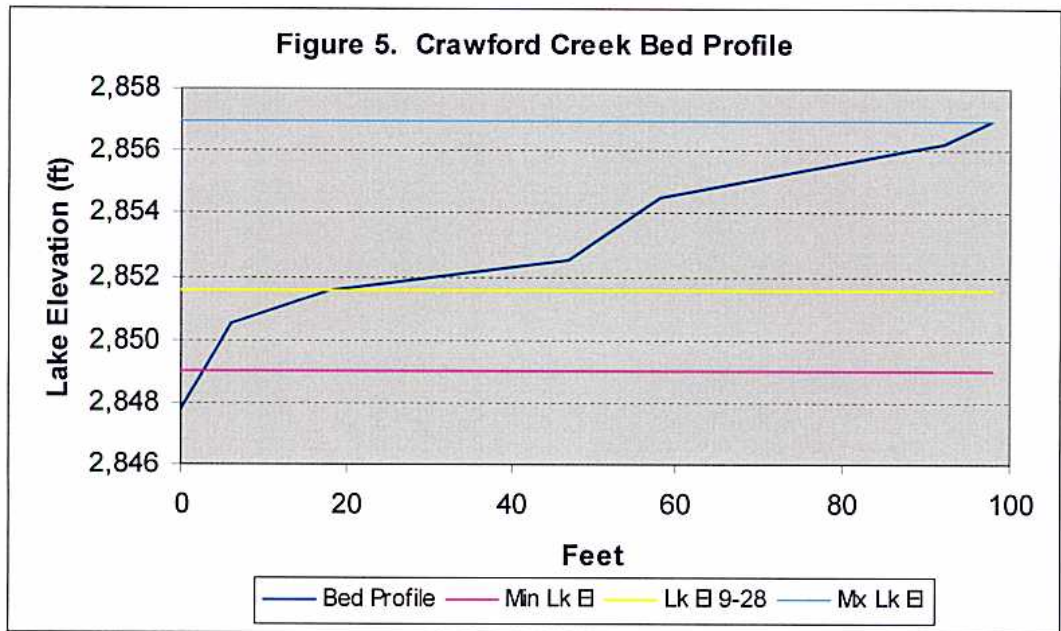
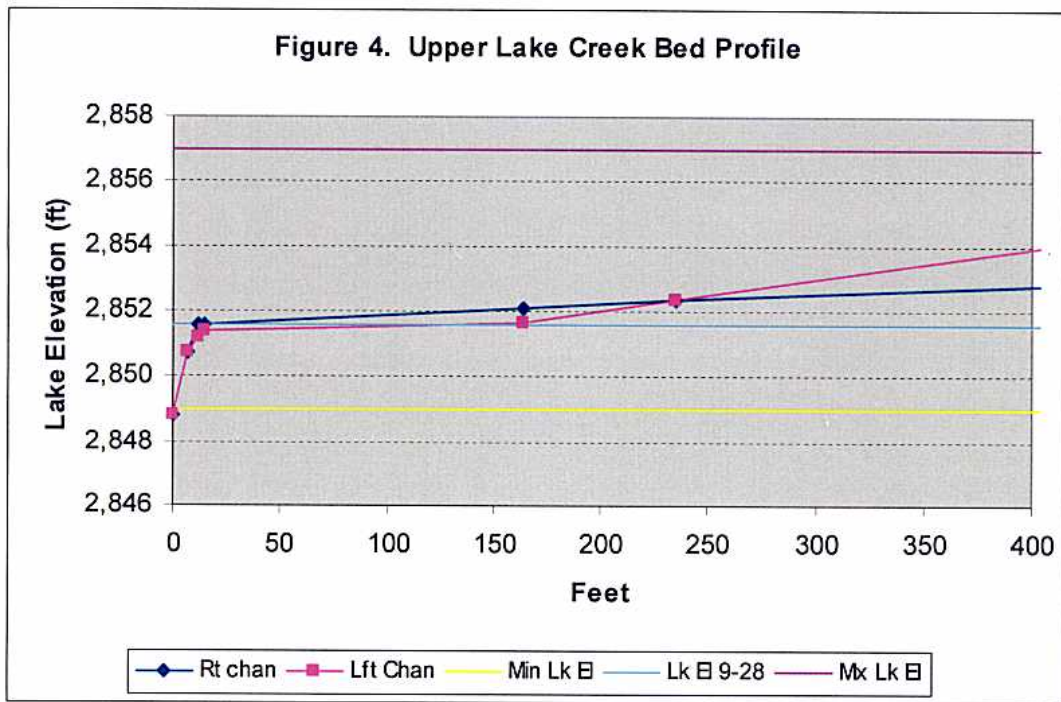




Photo 1. Mouth of Osprey Creek



Photo 2. Mouth of Muller Creek



Photo 3. Mouth of Muller Creek



Photo 4. Upper Lake Creek at Mouth



Photo 5. Downcutting of Lake Creek through sediment in the inundation zone



Photo 6. Mouth of Crawford Creek

***SECTION 5: LITERATURE CITED***

Energy Northwest. 2004. Packwood Lake Hydroelectric Project. FERC No. 2244. Pre-Application Document. Supplement No. 1. December 6, 2004.

Washington Department of Fish and Wildlife. 2004. Memo from Bob Lucas to John Weinheimer regarding Packwood Lake spawner surveys.