

Lake Chelan Kokanee Spawning Ground Surveys 2011 Final Report



Spawning kokanee (*Oncorhynchus nerka*) in Company Creek – Chelan County PUD, 2005. (Photo by Brad Buchsieb)

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Introduction

Annual kokanee (*Oncorhynchus nerka*) and chinook (*Oncorhynchus tshawytscha*) salmon spawning ground surveys have been conducted within the Lake Chelan drainage by the Chelan County Public Utility District (District) since 1984. The District conducts these surveys as part of the Lake Chelan Fishery Plan (LCFP), which is included in Article 404 of the new Project License (FERC Project No. 637). The purpose of the District's spawning surveys within the basin is to document the annual trends of kokanee and chinook spawning populations and the effects of management actions within the Lake Chelan drainage.

Kokanee were stocked into Lake Chelan in 1917 and became the dominant sport fish in the lake until the mid 1970s. Kokanee populations declined after introductions of opossum shrimp (*Mysis relicta*) in 1967 (Brown 1984). Mysids were introduced to provide additional forage for kokanee; however, they appeared to be competitors with younger age classes of kokanee for the limited food sources in the lake. Mysids are generally not available to kokanee as forage, because they prefer to inhabit deeper water during daylight hours while kokanee feed near the surface (Peven 1989).

Chinook were originally introduced into Lake Chelan by the Washington Department of Fish and Wildlife in the mid 1970s and again in the 1990s to provide for a "trophy" fishery. The chinook grew well for the first few seasons, but their growth appeared to be tied to the abundance of kokanee (Brown 1984). The chinook have established an adfluvial population, with adult fish being observed on the spawning grounds and taken in the sport fishery.

Study Area and Methods

Most tributaries of Lake Chelan are generally steep and short (Figure 1). The Stehekin River is the principle tributary feeding the lake. The Stehekin is a relatively large glacial stream with the headwaters originating in the Cascade Mountains. The drainage covers an area of 321 square miles. The monthly mean flow for the Stehekin ranged between 412 and 3,861 cubic feet per second, based on data from water years 2001-2009 (*Water Watch*) courtesy of the U.S. Geological Survey. Kokanee spawn in the Stehekin River and primarily in two tributaries of the Stehekin: Company and Blackberry creeks (Figure 3). Except for the Stehekin River, kokanee do not travel far up the other Lake Chelan tributaries to spawn. The steep gradient of the streams usually confines kokanee spawning to the lower quarter mile. Kokanee run timing along Lake Chelan starts in the Stehekin Valley and progresses down lake throughout the spawning migration. The down lake streams included in the annual spawning ground surveys are Fish, Prince, Safety Harbor creeks (all on the north shore) and 25-Mile and First creeks on the south shore.

In 2011, district personnel conducted surveys between 8 September and 13 October approximately every 7 days (Table 1). Surveys consist of walking in or along streams and counting all live kokanee and chinook. Large masses of kokanee congregating in pools are estimated. Data collected during these surveys are used to determine spawner days and escapement.

Spawner days are the total number of days spent in a stream by a population of fish in order for them to spawn. The estimated number of spawner days for each stream is determined by graphing the number of live fish counted over time and then by calculating the area of the resulting polygons (McNeil 1964; Neilson and Geen 1981; Shepherd et al. 1986).

Escapement is the number of adult fish returning to a stream that escape mortality from harvest and natural attrition, and comprise a spawning population (WDFW 2000). Kokanee escapement is calculated by dividing the estimated number of spawner days by the average time of spawner residence in the stream. The average spawner residence for kokanee is estimated to be 15 days (Brown 1984). The escapement for chinook spawners is estimated by using the same method used for kokanee (McNeil 1964; Neilson and Geen 1981; Shepherd et al. 1986). The average spawner resident time for chinook is estimated to be 13 days. According to Neilson and Geen (1981), a spawner resident time of 13 days is considered to be high and as a result, the escapement estimates are conservative.

Results and Discussion

Kokanee Spawners

Escapement is considered to be a better indicator of run size than peak counts. Escapement indicates the total number of fish that spawn in a stream during the entire spawning season. Peak counts only indicate the maximum number of spawners observed in a stream at one time during the spawning season.

Stehekin River Tributaries

Company Creek

In 2011, surveyors counted 16,980 kokanee in Company Creek during the first survey on 8 September, with a peak count of 21,176 kokanee on 22 September (Table 1). The estimated escapement for Company Creek was 33,341 kokanee (Table 4). In 2010, Company Creek had a peak count of 29,291 kokanee and an estimated escapement of 52,824 (Tables 3 & 4).

Blackberry Creek

In 2011, surveyors counted 4,462 kokanee in Blackberry Creek during the first survey on 8 September, with a peak count of 5,788 kokanee on 22 September (Table 1). The estimated escapement for Blackberry Creek was 9,257 kokanee (Table 4). In 2010, Blackberry Creek had a peak count of 4,627 kokanee with an estimated escapement of 9,324 (Tables 3 & 4).

Table 1. Kokanee spawners in Stehekin River tributaries, 2011.

Tributaries	Survey Dates			
	8-Sep	14-Sep	22-Sep	28-Sep
Company Creek	16,980	16,291	21,176	18,257
Blackberry Creek	4,462	4,739	5,788	5,193

Lake Chelan Tributaries

Fish Creek

In 2011, Fish Creek had a peak count of 397 kokanee on 28 September (Table 2). The estimated escapement was 340 kokanee (Table 4). In 2010, Fish Creek had a peak count of 393 kokanee with an estimated escapement was 551 kokanee (Tables 3 & 4). In 2009, no kokanee were observed in Fish Creek.

Prince Creek

In 2011, Prince Creek had a peak count of 91 kokanee on 22 September (Table 2). The estimated escapement was 61 kokanee (Table 4). In 2010 Prince Creek had a peak count of 11 kokanee with an estimated escapement of 15 (Tables 3 & 4). The access for kokanee spawners has been blocked a short distance from the mouth due to habitat improvement structures placed in the stream. No spawners were observed above these structures. For more information about the habitat improvement structures please refer to Stone and Fielder (2004).

Safety Harbor Creek

In 2011, Safety Harbor Creek had a peak count of 139 kokanee on 28 September (Table 2). The estimated escapement was 202 kokanee (Table 4). In 2010, Safety Harbor Creek had a peak count of 15 kokanee with an estimated escapement of 26 (Tables 3 & 4). Safety Harbor Creek experiences heavy recreational use by hikers and campers. Recreators create swimming holes by blocking the water flow with rock dams. These rock dams make it difficult for spawning kokanee to ascend upstream. In 2011, Chelan County PUD survey staff again removed parts of the rock dams to allow kokanee better access.

25-Mile Creek

In 2011, 25-Mile Creek had a peak count of 1,115 kokanee on 23 September (Table 2). The estimated escapement was 1,991 kokanee (Table 4). Kokanee spawners were observed much further upstream of the culvert that passes under the South Lake Shore Road. Log jams that had blocked the stream a short distance above the culvert were also gone. Spawners returned to historic areas that had been used in the past. Larger kokanee spawners and increased stream flow in 2011 versus 2010 allowed spawners to access the culvert in large numbers. In 2010, 25-Mile Creek had a peak count of 63 kokanee with an estimated escapement of 86 (Tables 3 & 4). No kokanee were observed above the culvert in 2010. In 2009, the peak count was 110 kokanee with an estimated escapement of 143. In 2009, kokanee spawners were observed a short distance above the culvert that passes under the South Lake Shore Road. The distance in drop from the culvert to the pool below has increased over the last several years. During low water flow years, it may be more difficult for kokanee to enter the culvert and access spawning areas further upstream.

First Creek

In 2011, First Creek had a peak count of 348 kokanee on 6 October (Table 2). The estimated escapement was 605 kokanee (Table 4). In 2010, First Creek had a peak count of 69 with an estimated escapement of 100. In 2009, the peak count was 80 kokanee with an estimated escapement of 56 (Tables 3 & 4).

Grade Creek

In 2011, Grade Creek had a peak count of 3 kokanee on 13 October (Table 2). The estimated escapement was 2 kokanee (Table 4). Prior to 2011, no kokanee had been observed in Grade Creek since 2005.

Gold Creek

In 2011, Gold Creek had a peak count of 32 kokanee on 13 October (Table 2). The estimated escapement was 16 kokanee (Table 4). Prior to 2011, no kokanee had been observed in Gold Creek since 2005.

Mitchell Creek

In 2011, Mitchell Creek had a peak count of 18 kokanee on 6 October (Table 2). The estimated escapement was 15 kokanee (Table 4). Prior to 2011, no kokanee had been observed in Mitchell Creek since 2006.

Table 2. Kokanee spawners in Lake Chelan tributaries by date, 2011.

Survey Dates											
Tributaries	8-Sep	14-Sep	16-Sep	22-Sep	23-Sep	28-Sep	30-Sep	6-Oct	13-Oct	19-Oct	
Fish Creek		13		336		397					
Prince Creek	0	0		91		41					
Safety Harbor	0	8		134		139			51		
25-Mile Creek			388		1,115		1,061	1,036	543	310	
First Creek			34		305		344	348	227	106	
Grade Creek	No surveys conducted								3		
Gold Creek									32		
Mitchell Creek									18	14	

Table 3. Peak kokanee spawner counts in the Lake Chelan drainage, 2001-2011

Spawning Area	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Company Creek	10,058	16,388	26,320	35,445	26,951	14,649	7,149	6,619	5,473	29,991	21,176
Blackberry Creek	6,966	13,046	20,596	17,100	13,158	6,437	4,841	1,605	1,291	4,627	5,788
Safety Harbor		101		2	20	119	5	21	74	15	139
25-Mile Creek	122	465	112	17	727	284	12	320	110	63	1,115
First Creek	84	375	0	34	462	44	0	144	80	69	348
Mitchell Creek		12	0	0	0	10	0	0		0	18
Gold Creek		1	0	0	14	0	0	0		0	3
Grade Creek		65	0	0	13	0	0	0		0	32
Prince Creek		269	73	184	246	72	57	2	14	11	91
Fish Creek		359	49	261	351	0	220	10	0	393	397
Total	17,230	30,375	47,028	52,598	41,318	21,533	12,007	8,709	7,028	34,765	29,107

Table 4. Estimated kokanee escapement in the Lake Chelan drainage, 2001-2011.

Spawning Area	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Company Creek	23,255	33,349	54,376	58,231	63,256	32,927	19,182	16,246	8,185	52,824	33,341
Blackberry Creek	16,138	23,962	46,797	36,125	29,177	12,815	10,523	4,622	2,440	9,325	9,257
Safety Harbor		101		1	18	149	4	20	84	26	202
25-Mile Creek	162	654	136	15	1,022	319	22	519	143	86	1,991
First Creek	80	557	0	20	566	30	0	200	56	100	605
Mitchell Creek		14	0	0	0	7	0	0		0	15
Gold Creek		1	0	0	7	0	0	0		0	16
Grade Creek		73	0	0	7	0	0	0		0	2
Prince Creek		269	73	235	245	93	45	2	12	15	61
Fish Creek		361	49	390	482	0	172	8	0	551	340
Total	39,635	58,623	101,309	94,392	94,039	46,240	29,732	21,607	10,908	62,361	45,830

Chinook Spawners

Company Creek

In 2011, Company Creek had a peak count of 28 chinook spawners with an estimated escapement of 32. In 2010, Company Creek had a peak count of 27 chinook spawners with an estimated escapement of 28 (Table 5).

Blackberry Creek

In 2011, Blackberry Creek had a peak count of 4 chinook spawners with an estimated escapement of 4. In 2010, Blackberry Creek had a peak count of 2 chinook spawners with an estimated escapement of 3 (Table 5).

Table 5. Peak chinook spawner counts and estimated escapement in Company Creek and Blackberry Creek, 2001-2011.

Peak Counts	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Company Creek	6	3	2	2	18	0	2	7	33	27	28
Blackberry Creek	4	3	14	18	17	3	3	5	5	2	4

Escapement	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Company Creek	11	5	3	3	19	0	3	9	49	28	32
Blackberry Creek	7	5	20	41	17	5	5	8	10	3	4

Fish Stocking

Article 6(d) and Section 4.6.3 of Chapter 6 of the Comprehensive Plan requires Chelan PUD to make available to the WDFW sufficient funding to rear annually the following resident fish at the Chelan Hatchery for stocking in Lake Chelan:

1. Approximately 5,000 pounds of salmonid fingerlings (for example: 500,000 fish at 100 fish/lb., presently kokanee).
2. Approximately 33,000 pounds of catchable-sized salmonids (for example: approximately 100,000 fish at 3 fish/lb., presently Westslope cutthroat trout and triploid rainbow trout).

As provided in Article 6(d) (1), the estimated cost to Chelan PUD of these activities is \$30,000 per year (in 2003 dollars).

Article 6(d) (2) and Section 4.6.3 of Chapter 6 of the Comprehensive Plan provide that:

(2) If WDFW, after coordination with the National Park Service, United States Department of Agriculture Forest Service, and United States Fish and Wildlife Service, and after consultation with the Lake Chelan Fishery Forum, decides, at any time during the term of the New License or any subsequent annual licenses, to reduce or eliminate fish stocking into Lake Chelan, the resulting savings shall be available to WDFW for other Lake Chelan fish management activities. Funds to be made available from reductions in fish production shall be determined as equivalent to the proportion of fish production poundage reduced. The funds

saved shall be calculated as follows: take the number of pounds of fish production reduced, divide by the 38,000 pounds of fish initially to be produced, and multiply by the \$30,000 (as adjusted under section 19 of the Agreement up to the year of the decision to reduce production). For example, if 5,000 pounds of kokanee production was eliminated, \$3,950 would be available for other fish management activities ($5,000/38,000 \times \$30,000$ escalated = \$3,950 escalated).

The historic stocking effort for kokanee stocking in Lake Chelan from 1994 to the present is shown below (Table 6).

Table 6. Numbers of kokanee stocked into Lake Chelan from 1994 to 2011.

Year	Number	Date released	Release location	Stock used
1994	756,315	April, May	25-Mile Ck	LW, OR
1995	452,400	May	25-Mile Ck	LW
1996	71,060	April	25-Mile Ck	LW
1997	505,659	May	25-Mile Ck	LW
1998	933,021	April, May	Lake & 25-Mile Ck	LW
1999	329,322	April	Lake	LW
2000	478,266	April	Lake	LW
2001	286,831	April	Lake	LW
2002	467,291	May 6, 21, 24	Lake	LW
2003	499,953	May 9, 17, 22	Lake	LW
2004	515,838	May, June	Lake	LW
2005	478,956	May 10, 17, June 13	Lakeside & Mill Bay	LW
2006	0	n/a	n/a	n/a
2007	91,643	May	Lake	LC, LW
2008	227,000	May	Yacht Club	LC
2009	189,524	June	Yacht Club	LC
2010	83,070	May 6	Yacht Club	LC
2011	0	n/a	n/a	n/a
Total	6,363,149			

Key for fish stock:

OR = Oregon (unspecified)

LW = Lake Watcom (Washington)

LC = Lake Chelan (Washington)

Summary and Conclusions

Company, Blackberry, Safety Harbor, 25-Mile, and First creeks have been surveyed consistently since 1981. Between 1984 and 1989, these creeks comprised approximately 97.1% to 99.6% of the kokanee escapement when all streams with spawning habitat were surveyed (Peven 1990). From 1981 to 2005, there has been an overall steady increase in the estimated kokanee escapement for Company, Blackberry, Safety Harbor, 25-Mile, and First creeks. However, the estimated kokanee escapement for 2006 decreased greatly possible due to a flood event that occurred in the fall of 2003 in the Stehekin valley (Figure 2), which likely scoured many of the kokanee redds in Company and Blackberry creeks. From 2006 through 2009 kokanee escapement in Company and Blackberry creeks had steadily decreased. The estimated escapement for these aforementioned streams in 2009 was 10,908 kokanee. In 2010, the escapement increased substantially to 62,361. In 2011, the escapement was 45,396, the second highest since 2006 (Table 4). 2011, also saw the highest escapement since 2005 for 25-Mile and First creeks with a combined escapement of 2,596. The majority of kokanee spawners are either 3 or 4 year old fish (2+ and 3+ fish) (Peven 1990).

Mysids are present in Lake Chelan. Mysids may compete with younger age classes of kokanee for food and can have a substantial impact on the kokanee population in the lake. Large predatory fish such as chinook and lake trout can also adversely affect a kokanee population.

Acknowledgements

Several District employees assisted with spawning surveys this fall. Todd West assisted with manpower and administrative support. Bob Nielsen coordinated transportation arrangements for the field work in the Stehekin Valley. Fish and Wildlife personnel conducting the surveys included: Barry Keesee, Lance Keller and Jeff Osborn.

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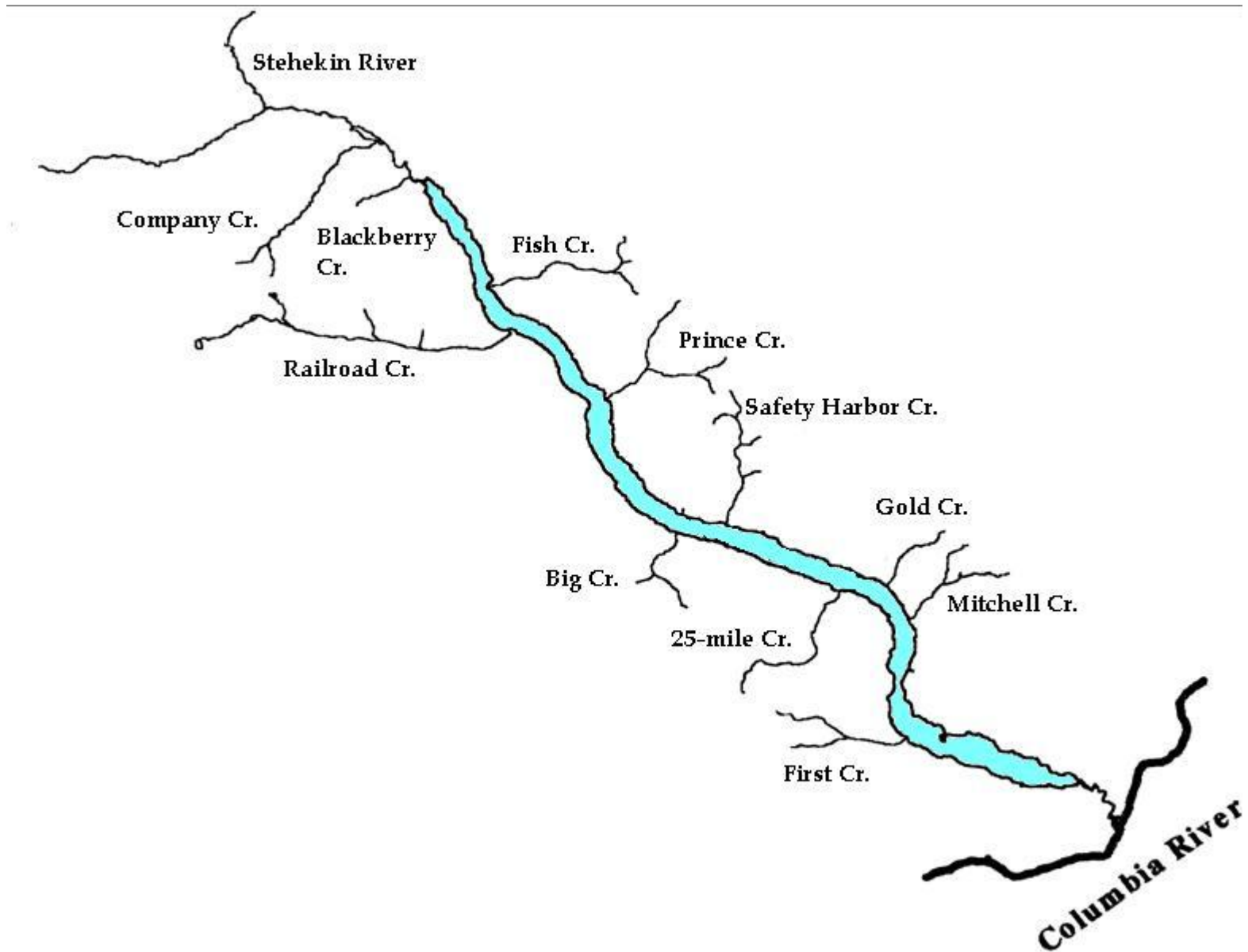


Figure 1. Lake Chelan drainage with associated kokanee and chinook spawning streams.

Total Estimated Kokanee Escapement for Company, Blackberry, Safety Harbor, 25-Mile, & First Creeks, 2001-2011.

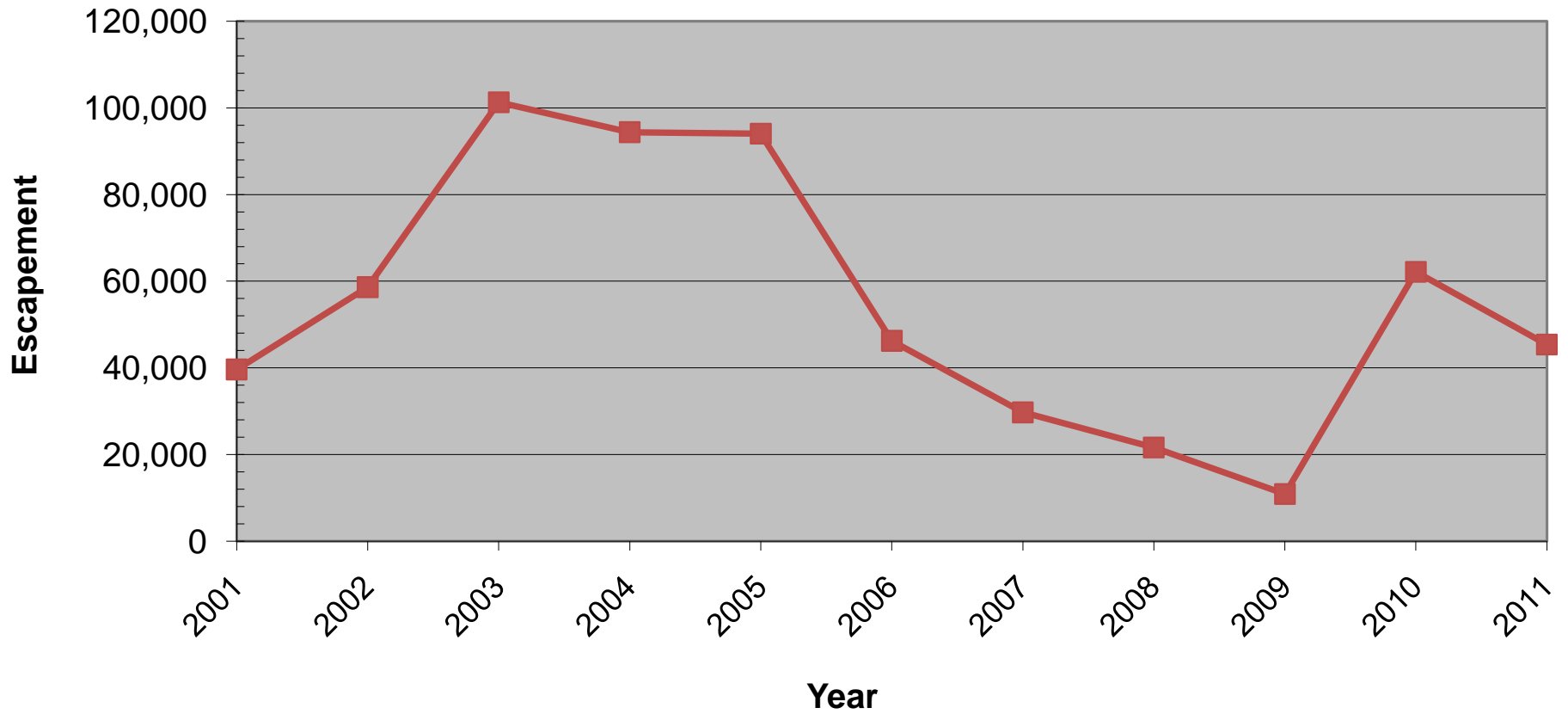


Figure 2. Total Estimated Kokanee Escapement for Company, Blackberry, Safety Harbor, 25-Mile, and First Creeks, 2001-2011.

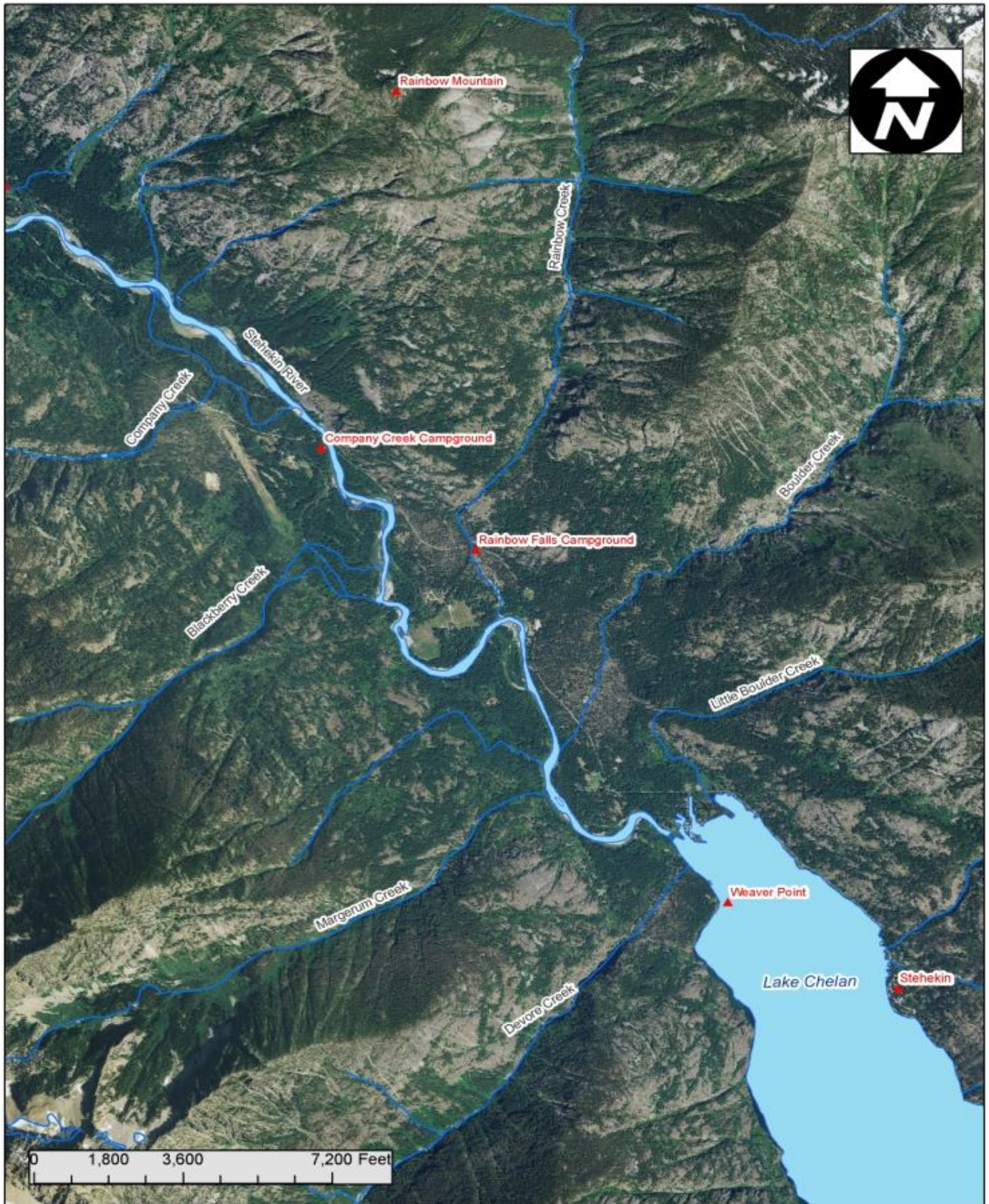


Figure 3. Stehekin Area drainage with associated kokanee and chinook spawning streams.