

Refuge Recreation Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. 2012.

Lower Klamath Lake and Tule Lake National Wildlife Refuges

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Outline of Report

This report provides a general summary of the economic impacts and net benefits associated with the hunting of waterfowl and general wildlife viewing activities at Lower Klamath Lake and Tule Lake National Wildlife Refuges. The purpose of this report is to provide information that can be used by members of the Klamath Basin Restoration Agreement (KBRA) to better understand the economic contributions that the refuge makes to the local area. The refuges are situated in an arid environment and dependent on the local water authorities for much of their water. The water that the refuges receive is used in multiple ways to maximize support to the waterfowl that depend on the refuge as a principle resting and feeding area during spring and fall migrations along the Pacific flyway. The management of this water in the Upper Klamath Basin has a strong effect on the refuge and its ability to maximize productive habitat for migratory waterfowl, particularly for the Lower Klamath Lake Refuge. In turn, this has an effect on the number of recreational visitors to the refuge and their related economic impact on the regional economy. The refuge's relationship to the amount of water received with and without the KBRA along with projected waterfowl numbers is addressed in a separate report.¹ This report focuses on the economic contribution that visitor spending has on the local economy and how these expenditures may be affected under KBRA alternatives. Furthermore, this report also considers the economic net benefit realized by visitors, above and beyond the amounts they spend.

Overview of Refuge Complex

The Klamath Basin National Wildlife Refuge Complex consists of six refuges (see map below): Upper Klamath, Lower Klamath, Tule Lake, Clear Lake, Bear Valley, and Klamath Marsh Refuges. Historically the Klamath Basin was dominated by approximately 185,000 acres of shallow lakes and freshwater marshes that supported peak populations of over six million water birds. In 1905, the U.S. Bureau of Reclamation initiated the Klamath Reclamation Project to convert the lakes and marshes of the Lower Klamath and Tule Lake areas to agricultural lands. As these wetlands receded, the reclaimed lands were opened to agricultural development and settlement. Today, less than 25 percent of the historic wetlands remain.

¹ Effects of the Klamath Basin Restoration Agreement on Lower Klamath, Tule Lake, and Upper Klamath National Wildlife Refuges, Dave Mauser, Supervisory Wildlife Biologist, U.S. Fish and Wildlife Service, Klamath Basin National Wildlife Refuge, Tim Mayer, Regional Hydrologist, Water Resources Branch, US Fish and Wildlife Service, Portland, OR.

The Refuge Complex was established in 1908 to conserve much of the Klamath Basin's remaining wetland habitat. However, Upper Klamath, Lower Klamath, Tule Lake, and Clear Lake Refuges exist within the U.S. Bureau of Reclamation (Reclamation) Klamath Project and were subject to conversion from wetland habitats to farmland. Under the Kuchel Act of 1964, wetland reclamation was stopped and the refuges were, "...dedicated to wildlife conservation and for the major purposes of water fowl management, but with full consideration to optimum agricultural use that is consistent therewith."

This report focuses on the economic impacts associated with waterfowl hunting and wildlife visitation to Lower Klamath Lake and Tule Lake National Wildlife Refuges. These two refuges account for the vast majority of visits to the Klamath Basin Refuges, as documented in Table 1. Combined, these two Refuges account for over 95 percent of all visits to the Refuge Complex in 2009. In addition to accounting for the majority of recreational visits both Lower Klamath Lake and Tule Lake Refuges could be affected by the passage and implementation of the KBRA as both Refuges are hydrologically connected to the irrigation districts.²

Lower Klamath NWR

Lower Klamath Refuge was established in 1908 by President Theodore Roosevelt as the nation's first waterfowl refuge. Lower Klamath Refuge is located in rural northeastern California and southern Oregon. This 46,000-acre refuge is a varied mix of shallow freshwater marshes, open water, grassy uplands, and croplands that are intensively managed to provide feeding, resting, nesting, and brood rearing habitat for waterfowl and other birds. Approximately 5,000 acres are leased by cereal grain farmers within the Public Lease Lands program administered by the U.S. Bureau of Reclamation (Reclamation). Permit holders farm another 5000-7000 acres of grass hay in cooperation with the U.S. Fish and Wildlife Service (FWS). Lower Klamath Refuge is one of the most biologically productive refuges within the Pacific Flyway.

Approximately 80 percent of the flyway's total migrating waterfowl pass through the Klamath Basin on both spring and fall migrations, with 50 percent of those birds using the Lower Klamath Refuge. This refuge provides habitat for 25 species of special concern listed as threatened or sensitive by California and Oregon. The refuge is also a fall staging area for 20 to 30 percent of the central valley population of sandhill crane. From 20,000 to 100,000 shorebirds use refuge wetlands during the spring migration. Wintering wildlife populations include 500 bald eagles and 30,000 tundra swans. Spring and summer nesting wildlife include many colonial water birds, such as: white-faced ibis; great blue and black-crowned herons; great and snowy egrets; double-crested cormorants; western, Clark's and eared grebes; American white pelican; and several species of terns and gulls.

² Upper Klamath Lake and Klamath Marsh Refuges both lie upstream of Basin waters, while Clear Lake and Bear Valley would be minimally impacted as neither Refuge receives compact waters.

Final

All refuge waters are delivered through a system of diversion or irrigation canals associated with Reclamation's Klamath Project. Consequently this leaves the refuge vulnerable to periodic water shortages due to an over-allocated system. Lower Klamath Refuge is open to both waterfowl and pheasant hunting. In addition this refuge has a marked 10-mile auto tour route which allows visitors year round access to great wildlife viewing opportunities. The refuge also has a number of photo blinds which are strategically situated for great early-morning photography.

Tule Lake NWR

Tule Lake Refuge is located in the fertile and intensely farmed Tule Lake Basin of northeastern California. It was established in 1928 by President Calvin Coolidge as a "preserve and breeding ground for wild birds and animals." This 39,116-acre refuge is mostly open water and crop land. Approximately 17,000 acres are leased by potato, onion, horse radish, alfalfa, and cereal grains farmers within the Public Lease Lands program administered by the U.S Bureau of Reclamation. Permit holders farm an additional 1,900 acres in cooperation with the U.S. Fish and Wildlife Service (FWS).

The endangered Lost River and shortnose suckers live in or use this refuge. The refuge is a significant staging area for migrating waterfowl during spring and fall migrations. It is used primarily by white-fronted, snow, Ross, and cackling Canada geese, all of which nest in the Arctic tundra.

Tule Lake hunting opportunities consist of two large marsh units accessible by boats, a spaced-blind hunt in dry fields, and open free-roam areas offering field hunts over harvested grain and smaller marsh units. A 10-mile auto tour route allows for wildlife observation throughout the year.

Table 1. Reported Visitation for Klamath Basin Complex National Fish and Wildlife Refuges

Visitor Use Category	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Tule Lake NWR										
Visitor Center Visits	11,716	10,413	10,319	10,818	11,273	10,742	10,880	11,702	10,745	11,138
Total Visitors	67,500	60,000	60,000	100,000	102,600	170,067	168,065	179,434	170,390	173,140
Total Hunting Visits	4,077	4,273	4,496	5,666	3,847	4,097	5,106	5,020	3,217	4,518
Total Wild. Observ. Visits	37,800	33,600	33,604	85,000	72,800	144,340	142,300	151,600	144,050	146,300
Lower Klamath NWR										
Total Visitors	91,125	81,000	81,000	135,000	151,000	203,500	197,400	213,275	199,695	207,230
Total Hunting Visits	6,449	8,224	8,567	9,513	9,681	9,487	9,337	8,732	7,943	9,041
Total Wild. Observ. Visits	58,500	52,000	52,000	110,000	120,000	168,300	179,950	175,950	165,700	171,840
Upper Klamath NWR										
Total Visitors	4,500	4,500	4,500	4,500	4,990	4,152	4,170	4,070	4,025	3,840
Total Hunting Visits	250	250	250	250	270	245	315	385	470	505
Total Fishing Visits	2,100	2,100	2,100	2,100	2,140	1,940	1,900	1,850	1,780	No Report
Total Wild. Observ. Visits	2,000	2,000	2,000	2,000	2,000	1,820	1,720	1,686	1,565	1,440
Clear Lake NWR										
Total Visitors	900	900	1,000	1,050	1,041	1,060	1,100	1,120	1,064	1,226
Total Hunting Visits	110	110	110	110	105	98	112	210	185	185
Total Wild. Observ. Visits	850	850	875	875	874	820	810	830	1,020	1,020
Bear Valley NWR										
Total Visitors	65	80	100	90	90	85	100	100	125	190
Total Hunting Visits	65	80	90	90	90	85	100	100	125	190

Source: Klamath Basin Refuge Complex, U.S. Fish and Wildlife Service

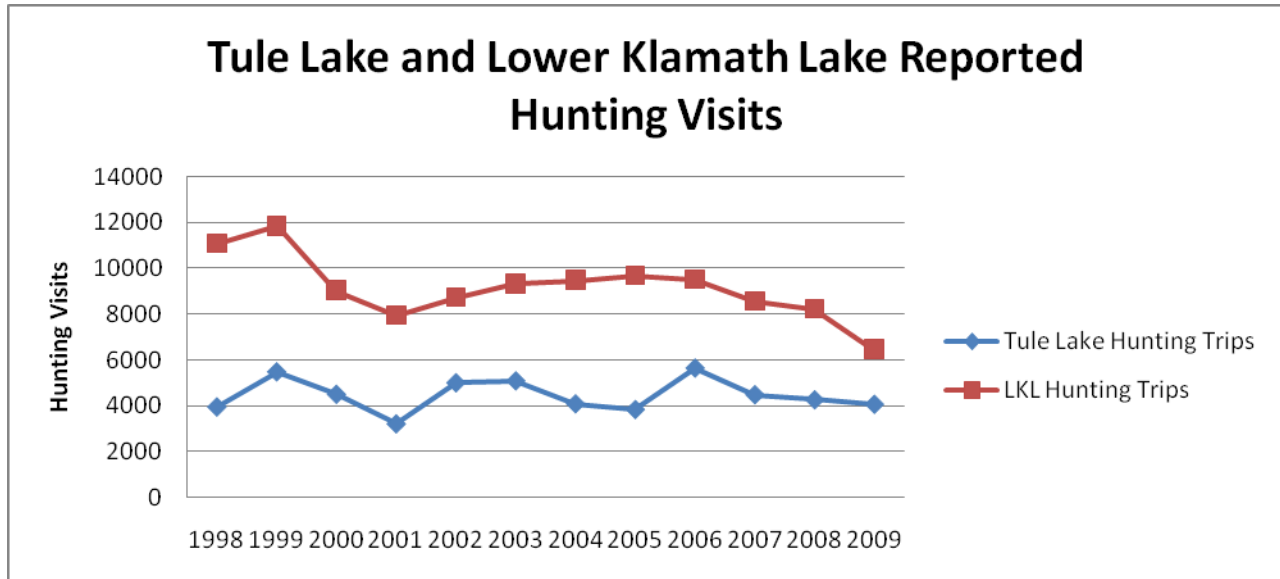
NED Analysis

Methodology and Assumptions

Estimating Waterfowl Hunting and Wildlife Watching Visits to the Refuge

The Klamath Lakes National Wildlife Refuge collects extensive data on public visitation, which is used in this study. The methods used to collect data vary by type of activity. To estimate the number of hunting participants, the Refuge conducts “bag checks.” This consists of two parts. Part one is to conduct a “car count”, which is just what it sounds like; once all hunters have entered the Refuge staff drive the entire area and count the number of cars parked in the hunting areas. Part two is the actual bag check, where staff set up a check point to contact hunt parties as they leave the area. The information collected includes: the specific unit hunted, number of hunters in the party, number of vehicles in the party, and number of each species taken. The data collected is put into a spreadsheet that calculates a hunter-per-car average based on hunters and cars physically checked then multiplies that by the cars counted in part one- this is our “calculated number of hunting trips” for that day. At the end of each month the estimated number of hunting trips for all bag check days is totaled and multiplied by an average of days (number of actual hunt days in the month divided by the number of bag check days completed), this gives our monthly calculated total. The monthly totals are added at the end of the season for a season total.

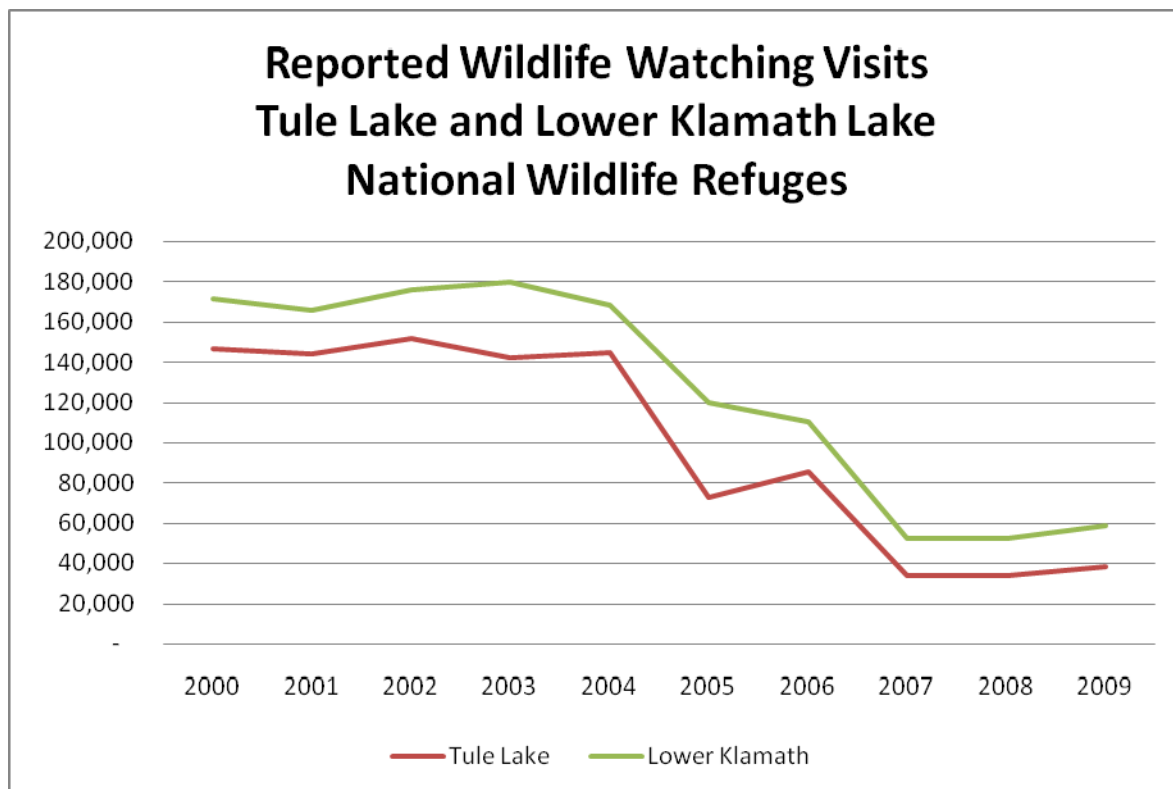
Figure 1, below, shows the total reported number of hunting visits to both Lower Klamath Lake and Tule Lake Refuges over the past ten years. Total trips to the Lower Klamath Lake refuge have declined slightly over time, from a peak of nearly 12,000 trips in 1999 to a recent low of about one-half that number in 2009. In contrast, the reported number of hunting trips on Tule Lake refuge remained relatively stable over the years at roughly 4,000 trips per season.

Figure 1. Total Reported Hunting Visits, Tule Lake and Lower Klamath Lake NWRs

Source: Klamath Basin National Wildlife Refuge Complex

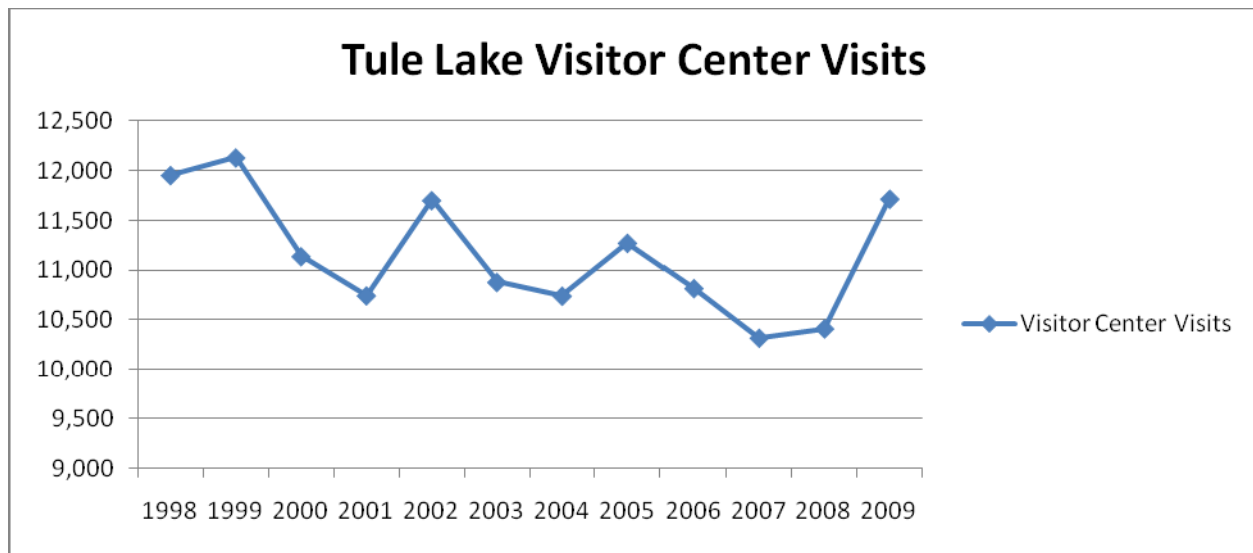
Estimating the annual number of wildlife watching visits is much more difficult. This is because the Refuges do not have clearly defined access points that would make the counting of visitors easy. Several State and local roads bisect the refuges with numerous pull-offs for wildlife watching. The Complex does maintain a series of roads on the refuges for visitor access but because there are multiple points of entry and exit, estimating the annual number of wildlife watchers is difficult. The imprecision of this estimate is illustrated in Figure 2, below.

This figure shows a dramatic decline in the total number of wildlife viewing trips to the refuge over the past ten years. The refuge looked more closely at these self-reported numbers and determined that earlier estimates included wildlife viewing trips that were not the principle reason for traveling through the refuge. In other words, these earlier estimates included brief stops by vehicle passengers who were merely driving through the refuge on their way to other off-refuge activities. Over the previous three years, the estimates have leveled off. During this period, the Refuge estimates that there were approximately 35,000 visits to Tule Lake and 54,000 visits to Lower Klamath Lake. Combined, these annual visits total nearly 90,000. Importantly however, a visitor may visit both refuges during a single wildlife viewing trip, so the actual number of visitors participating in wildlife watching visits to the refuges is smaller than the combined total.

Figure 2. Total Reported Wildlife Watching Visits, Tule Lake and Lower Klamath Lake NWRs

Source: Klamath Basin Refuge Complex, 2010.

The Complex also maintains and operates a visitor center within the Tule Lake refuge. This center provides a visitor with maps and information about the refuges. The visitor center also keeps an accurate count of the number of people who visit. This data is shown in Figure 3. The exhibit shows that the annual number of visitors to the visitor center over the past ten years has averaged about 11,000 with little year-to-year deviation. While these estimates are pretty reliable for estimating the total number of visitors to the visitor center, it likely significantly undercounts the actual number of wildlife watching visits as many participants may not stop in the visitor center. There are many plausible reasons for this assumption, including wildlife watchers who visit Tule Refuge either early in the morning or late at evening when waterfowl activity is more observable but when the visitor center is closed, visitors to the Lower Klamath Lake Refuge, which is relatively distant from the visitor center but that has a well established and popular auto tour with numerable pull-outs for wildlife viewing, and simply those visitors that never intended to visit the center either out of non-interest or because they have previously visited the Center.

Figure 3. Total Tule Lake Visitor Center Visits

Source: Klamath Basin Refuge Complex

Given the general uncertainties involved in estimating the actual number of wildlife viewing visits to the two refuges, this analysis assumes that the yearly number of wildlife viewing visits to the two refuges is one-half of the combined estimate for the two refuges. Absent any additional data on the number of visits and visitors to the refuges, it is thought that this estimate represents a reasonable compromise between an upper-bound estimate that relies on the combined estimated number of visits for the two refuges and a lower-bound estimate that would have reflected the number of visitor center visits only. In the most recent year of data (2009), this approach yields a total annual estimate of 48,150. Assuming an even distribution of viewing visits over the course of a year, this implies a daily visit estimate of 132 wildlife viewers, which seems reasonable given the scale of the Refuges.

Visitation Data Adjustments

People pursue many different activities while traveling. Their visits to a national wildlife refuge may be their primary purpose for travelling to the region or just part of a longer trip. Counting brief visits as full recreation days would vastly overestimate hours of visitation, and visitor spending attributable to the refuge. In this study, a full recreational day is considered as eight hours³. Thus, a visitor who spends 4 hours at a refuge has spent half of a recreational visitor day (RVD), and half of their expenditures for the day will be attributed to the refuge.

³The U.S. Forest Service considers a recreation day as 12 hours long. However, unlike National Forest activities, almost all refuge uses are daylight activities.

The average length of time visitors participate in each activity is used to determine the number of RVDs for that activity. For this analysis, it is assumed that both a typical hunting trip and wildlife viewing trip lasts for about 4 hours. This estimate was initially provided by staff at the Klamath Basin Refuge Complex and was used in the 1994 characterization of the Refuge in the U.S. Fish and Wildlife Service’s Banking on Nature report.

For example, if a typical waterfowl hunt on the refuge is 4 hours, the number of RVDs for the refuge would be the total number of visits multiplied by 4 hours/8 hours. Refuge public-use officers estimate the average lengths of stay for each activity available on the refuge and the typical behavior pattern of visitors.

Data were further adjusted to estimate the breakdown between resident hunters and non-residents. In 2004, the Refuge estimated that 70 percent of the waterfowl hunters and 40 percent of wildlife watching visitors came to the Refuge from outside the area. This analysis adopts a similar assumption. Table 2 summarizes the major data adjustment assumptions adopted in this analysis. Table 3 provides an estimate of the total number of recreational visitor days based on the data adjustments.

Table 2. Key Data Adjustments

Activity	Data Source	Average Hours per Visit	Percent Resident	Percent Non-Resident
Waterfowl Hunting Visits	Klamath Refuge survey of hunters	4 hours	30 percent	70 percent
Wildlife Watching Visits	Klamath Refuge count of visitor center visits	4 hours	60 percent	40 percent

Source: Klamath Basin Refuge Complex and Banking on Nature, Division of Economics, US FWS, 2004.

Table 3. Recreational Visits and Calculated Visitor Days, Tule Lake and Lower Klamath Lake NWRs

Recreational Visits and Calculated Visitor Days
Lower Klamath Lake and Tule Lake NWR

		2009 Visits	Avg Hrs per Visit	Visitor Days	Resident Days	Non- Resident Days
Lower Klamath Lake	Hunting	6,449	4	3,225	967	2,257
	Wildlife Viewing	29,250	4	14,625	8,775	5,850
	Total	35,699		17,850	9,742	8,107
Tule Lake	Hunting	4,077	4	2,039	612	1,427
	Wildlife Viewing	18,900	4	9,450	5,670	3,780
	Total	22,977		11,489	6,282	5,207
Combined	Hunting	10,526	4	5,263	1,579	3,684
	Wildlife Viewing	48,150	4	24,075	14,445	9,630
	Total	58,676		29,338	16,024	13,314

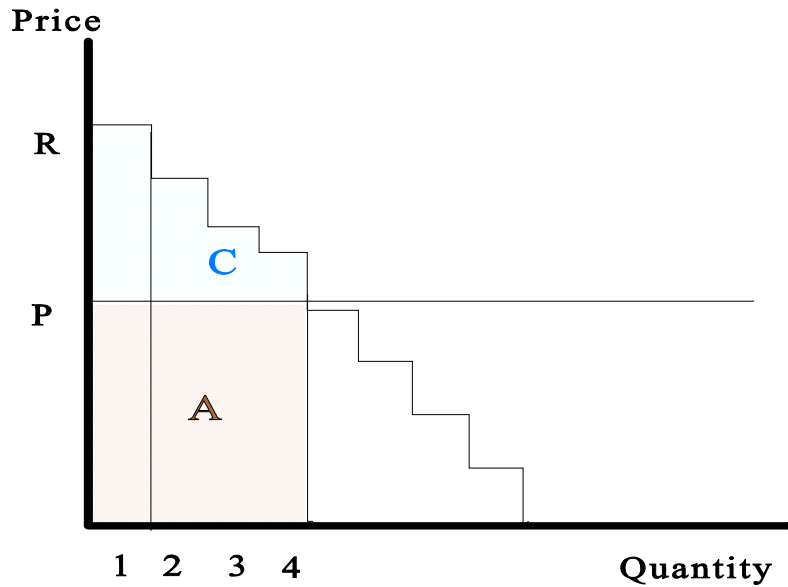
Source: Division of Economics, U.S. Fish and Wildlife Service, 2011.

Net Economic Value

This economic analysis provides an estimate for the net economic value experienced by hunters at the Lower Klamath Lake and Tule Lake National Wildlife Refuges. Net economic value refers to the value individuals place on the goods and services that they consume above and beyond the financial cost to them.

There are two components to the value of any commodity — what you pay for the commodity and the additional benefit you derive over and above what you paid. If there were no additional benefit, you would most likely not buy it since you could spend your money on an alternative good that would give some additional benefit. Surveys of the general population bear this out: Almost always, respondents are willing to pay more than they are currently paying for recreational opportunities. Economists call the additional benefit *consumer surplus* (or *net economic value*) and illustrate it with an individual's demand curve, as shown in Figure 4. The curve shows the price a person would pay for an additional unit of a given good. The person would be willing to pay price R for the first unit of the commodity. Once he has one unit, he would probably be willing to pay somewhat less for the second unit, even less for the third, etc. If he were able to actually buy the good at price P, the person would save the amount \overline{RP} — the difference between what he'd have been *willing to pay* and what he *actually* paid for the first unit. \overline{RP} is his consumer surplus for the first unit. Figure 4 shows that at price P, the person would buy 4 units of this good, and would have to pay 4 times P dollars. P times 4 is the area of rectangle A. The commodity's benefit that the person *does not pay for* is represented by stepped triangle C. Triangle C is the total consumer surplus for this good.

Figure 4. Net Economic Benefit



The consumer surplus estimates used in this report come from two different sources. The estimate associated with wildlife watching is derived from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.⁴ The survey was designed to estimate the net economic value associated with a day of wildlife watching in each state by both State residents and non-residents. Mean and median values were reported for each State. Table 4 below shows the reported values for both the States of California and Oregon, updated to 2012 dollars.

Table 4. Wildlife Watching Economic Values per Day (\$2012)

Wildlife Watching Economic Values per Day (\$2012)				
(US National Fish Hunt Survey)	State Resident		Out of State	
	mean	median	mean	median
California	\$ 82.61	\$ 50.23	\$ 106.05	\$ 70.33
Oregon	\$ 53.58	\$ 16.74	\$ 108.28	\$ 55.82
average	\$ 68.09	\$ 33.49	\$ 107.16	\$ 63.07

Source: Net Economic Values of Wildlife-Related Recreation in 2006, Report 2006-5, July 2009.

⁴ U.S. Fish and Wildlife Service, Net Economic Values of Wildlife-Related Recreation in 2006, Report 2006-5, July 2009.

Unfortunately, the National Survey did not measure the economic net benefits associated with waterfowl hunting. To derive an estimate for this activity, this report relies on the values cited in the U.S. Fish and Wildlife Service's *Economic Analysis of the Migratory Bird Hunting Regulations for the 2008-2009 Season*.⁵ This analysis cited a consumer surplus value per day of hunting waterfowl along the Pacific flyway between \$42 and \$58 (\$2007). Adjusting these estimates to 2012 dollars gives a range between \$45.44 and \$62.75 per day.

Net economic value (consumer surplus) was estimated for the refuges by multiplying recreational visitor days by the net economic value for that activity. Table 5 shows the results of this analysis.

Table 5. Net Economic Value (\$2012) – 2009 Refuge Visitation

		Resident Recreational Visitor Days	Non-Resident Recreational Visitor Days	Net Benefit Lower Bound	Net Benefit Upper Bound
Lower Klamath Lake	Hunting	967	2,257	\$ 146,521	\$ 202,338
	Wildlife Viewing	8,775	5,850	\$ 662,831	\$ 1,224,442
	Total	9,742	8,107	\$ 809,352	\$ 1,426,780
Tule Lake	Hunting	612	1,427	\$ 92,629	\$ 127,916
	Wildlife Viewing	5,670	3,780	\$ 189,883	\$ 791,178
	Total	6,282	5,207	\$ 282,512	\$ 919,094
Combined	Hunting	1,579	3,684	\$ 239,150	\$ 330,254
	Wildlife Viewing	14,445	9,630	\$ 852,714	\$ 2,015,619
	Total	16,024	13,314	\$ 1,091,863	\$ 2,345,873

Source: U.S. Fish and Wildlife Service Division of Economics, 2011.

Estimating the Effect of the No Action and Alternative Actions for the KBRA on Hunting and Wildlife Viewing Visits to the Lower Klamath Lake and Tule Lake National Wildlife Refuges

The first step in estimating the effect of the KBRA on refuge visitation was to initially estimate the relationship between the number of waterfowl on the refuge and the number of hunting visits and wildlife viewing visits. It is assumed that the greater the number of waterfowl on the refuges, the greater the number of visits, all other things equal. Specifically, it is hypothesized that harvesting success rates for hunters should rise as waterfowl numbers increase and that an

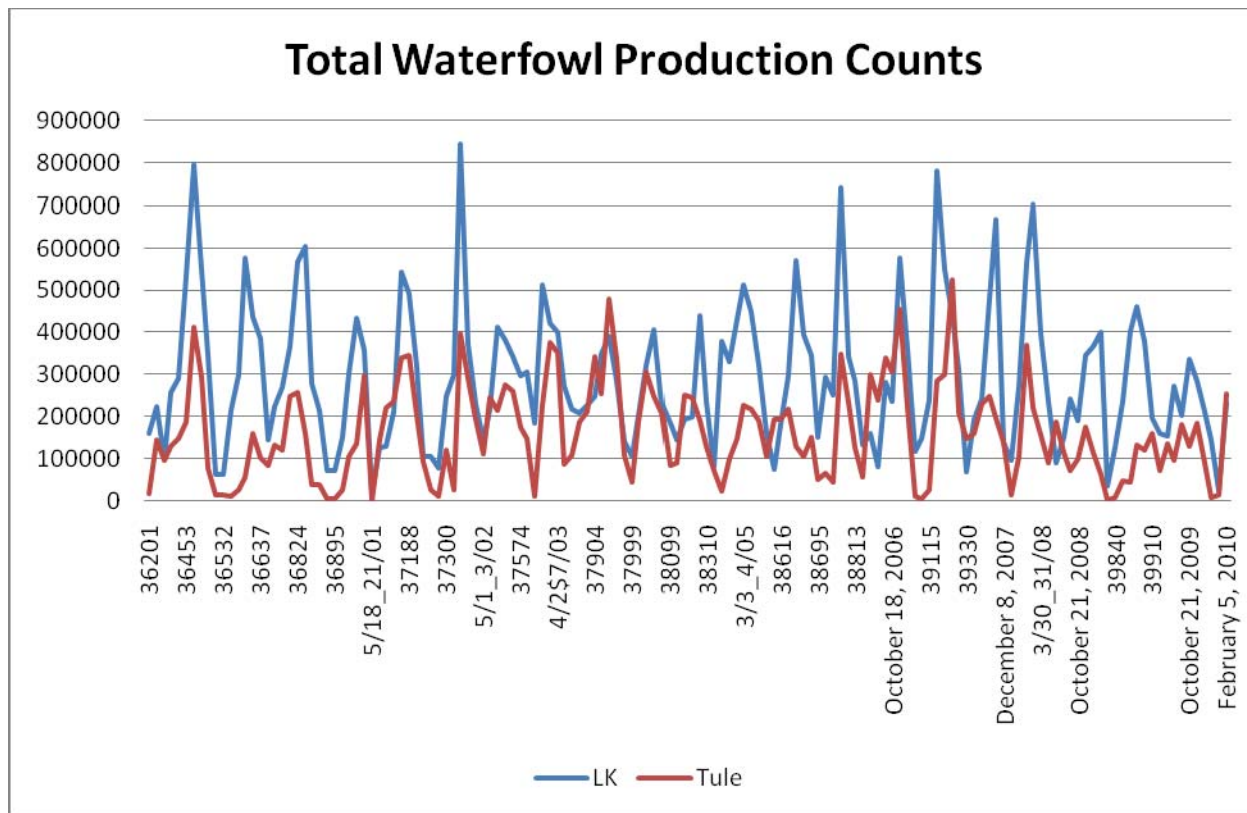
⁵ U.S. Fish and Wildlife Service, Division of Economics. *Economic Analysis of the Migratory Bird Hunting Regulations for the 2008-2009 Season*. April, 2008. Available at: <http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/HuntingRegulations/Mig%20bird%20R egs%20analysis%202008.pdf>.

increased abundance of waterfowl should also attract more wildlife viewers. Throughout every year, the refuge conducts a waterfowl productivity survey. The results of these surveys were compared to the reported number of hunting visits and wildlife viewing visits to determine the extent that visitation varied with the number of observed waterfowl. In the end, this analysis found a meaningful correlation between hunting trips and waterfowl numbers but failed to detect any meaningful relationship between the number of wildlife viewing trips and waterfowl numbers.

Figure 5 shows the results of the reported waterfowl counts for both refuges over the past ten years. Waterfowl numbers peak during the fall months. At this time, the waterfowl are in the midst of their migration from as far north as Alaska. The refuge offers excellent habitat for feeding and foraging so they can gain the necessary energy to continue their migration to their wintering grounds. The figure shows that fall counts are generally in excess of one-half million birds for Lower Klamath Lake and somewhat less for Tule Lake. These numbers change seasonally. By the beginning of the calendar year, most of the birds have left the refuges.

Figure 5. Waterfowl Production Survey Results: Lower Klamath Lake and Tule Lake NWR

February 1999 through February 2010.



Source: Klamath Basin National Wildlife Refuge Complex.

<http://www.fws.gov/klamathbasinrefuges/cenfindex.html>. Accessed November 2010. (Need help on formatting dates.)

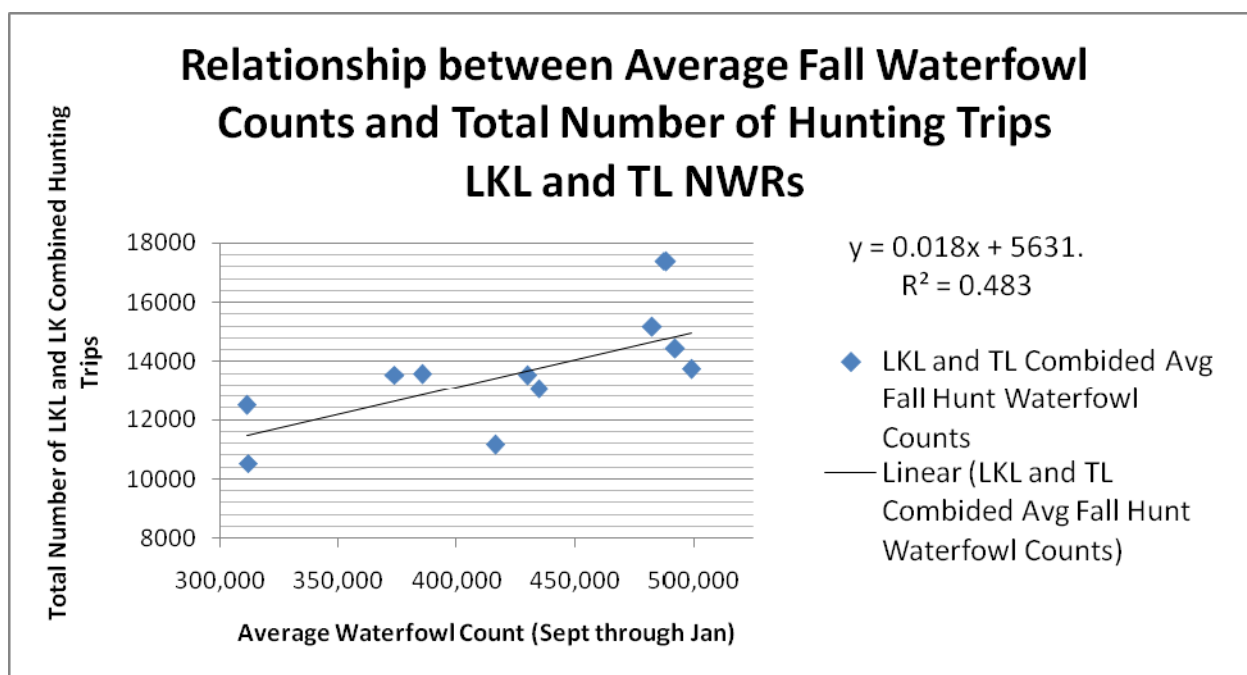
Estimating the Relationship between Waterfowl Production Counts and Hunting Visits

This analysis considered several different ways in which the reported number of hunting visits may be correlated to the estimated number of waterfowl. In the end, the simplest relationship proved to be the most correlated. Specifically, there appears to be a relatively strong correlation between the total number of annual hunting visits to the refuge and the average number of waterfowl found on the refuges throughout the fall hunting months of September through January.

Figure 6 shows the relationship between the average count of waterfowl taken during the hunting season months of September through January on the Refuges along with the total reported number of hunting trips taken during the season on the Refuges. While the number of hunting

trips is obviously affected by many other factors such as weather and transportation costs, the average seasonal count of waterfowl explains 48 percent of the variation in the reported number of hunting trips. This relationship is used to estimate how the total number of hunting trips will be affected by both the No Action and KBRA alternatives based on another FWS report that estimates the hydrological effects of the restoration on Refuges and their waterfowl.

Figure 6. Relationship between Average Fall Waterfowl Counts and Total Number of Hunting Trips

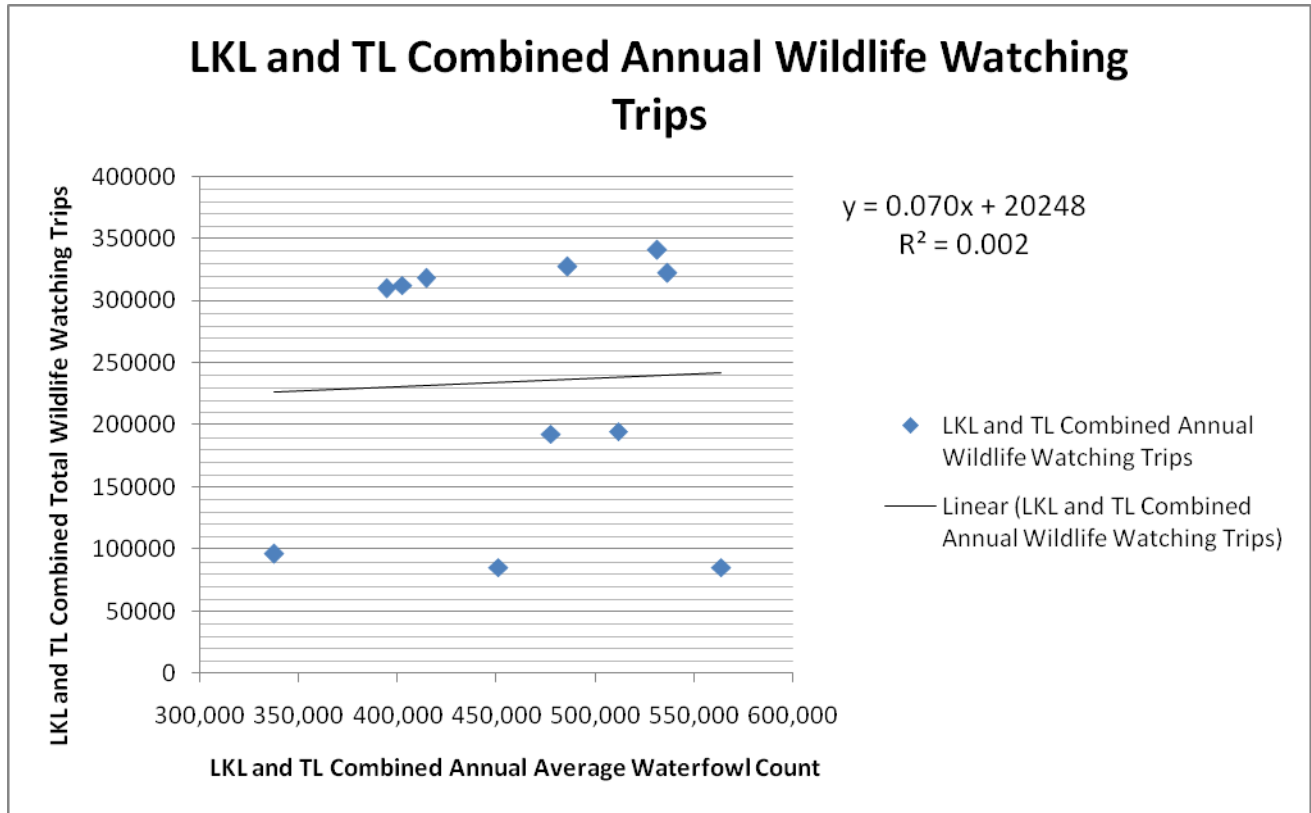


Source: Division of Economics, USFWS, 2011.

Estimating the Relationship between Waterfowl Production Counts and Wildlife Viewing Visits

This analysis was unable to find any meaningful relationship between wildlife viewing visits and the reported number of waterfowl. Figure 7 shows the results of this relationship. Lack of any detectable relationship may be affected by the fact that the Complex’s estimate of wildlife viewing visits is highly subjective and not based on specific counts or observations.

Figure 7. Relationship between Average Fall Waterfowl Counts and Total Number of Wildlife Watching Trips



Estimating the Effects on Refuge Visitation and Associated Expenditures with and without the KBRA

In an accompanying report on the effects that the KBRA may have on the Klamath Basin Refuges, the U.S. Fish and Wildlife Service estimated how the number of waterfowl counted on the refuges would be affected by the amount of water delivered to the refuge and the associated amount of wetted habitat acres.⁶ To estimate the economic effects associated with the various alternatives, this analysis uses the estimated number of waterfowl associated with each alternative to project the net economic value of hunting activities using the relationship described above. The results of this analysis are presented in below. All tables reflect 2012 dollars.

⁶ Mauser, Dave and Tim Mayer, U.S. Fish and Wildlife Service, **Effects of the Klamath Basin Restoration Agreement on Lower Klamath, Tule Lake, and Upper Klamath National Wildlife Refuges**; Table 10 and 11. Modeled water availability, habitats flooded, and projected waterfowl (Sep-Oct), and summer (Aug) nongame waterbirds supported on Lower Klamath NWR under the No Action Alternative and KBRA Alternative. Driest year types are represented by the lowest percentiles. 2011.

Results

Alternative 1 – No Action Alternative

As explained earlier in this report, economic net benefits reflect the difference between the total value of the experience to the visitor and the actual amount of money spent (expenditures). As mentioned above, these estimates only include effects for waterfowl hunting, as no detectable relationship was discovered between waterfowl numbers and wildlife viewing trips. Table 6 shows the estimated lower and upper-bound estimates for the No Action alternative, under different water scenarios. The economic surplus calculated for a normal water year (the 50th percentile shown in Table 6) was estimated to range between \$351, 720 and \$485,708.

Table 6. Economic Net Benefits for Alternative 1 – No Action Alternative

Alternative 1 – No Action Alternative				
Percentiles	Waterfowl	Estimated Hunting Trips	Net Benefit (lower-bound)	Net Benefit (upper-bound)
-	9,228	5,805	\$ 263,766	\$ 364,248
0.05	20,570	6,017	\$ 273,429	\$ 377,593
0.10	27,350	6,145	\$ 279,206	\$ 385,570
0.15	31,120	6,215	\$ 282,418	\$ 390,006
0.20	48,790	6,547	\$ 297,473	\$ 410,797
0.25	74,682	7,032	\$ 319,534	\$ 441,261
0.30	86,046	7,245	\$ 329,216	\$ 454,632
0.35	91,397	7,345	\$ 333,775	\$ 460,928
0.40	100,743	7,521	\$ 341,738	\$ 471,925
0.45	108,391	7,664	\$ 348,255	\$ 480,923
0.50	112,458	7,740	\$ 351,720	\$ 485,708
0.55	117,515	7,835	\$ 56,029	\$ 491,658
0.60	125,662	7,988	\$ 362,970	\$ 501,244
0.65	131,723	8,102	\$ 368,134	\$ 508,376
0.70	137,849	8,216	\$ 373,354	\$ 515,583
0.75	144,344	8,338	\$ 378,887	\$ 523,226
0.80	151,973	8,481	\$ 385,388	\$ 532,202
0.85	157,597	8,587	\$ 390,179	\$ 538,819
0.90	161,402	8,658	\$ 393,421	\$ 543,296
0.95	168,295	8,787	\$ 399,294	\$ 551,406
1.00	177,838	8,966	\$ 407,425	\$ 562,635

Alternative 2 – Full Facilities Removal of Four Dams

Table 7 shows the estimates for Alternative 2. During a normal water year, the economic surplus associated with waterfowl hunting activities was estimated to range from \$516,867 to \$713,769. Table 8 shows the net difference between the two alternatives. Compared to the No Action Alternative, Alternative 2 would result in a difference of \$165,147 to \$228,061 per year in economic surplus for waterfowl hunters in a normal water year.

Table 7. Economic Net Benefits for Alternative 2 – Full Facilities Removal of Four Dams

Alternative 2 – Full Facilities Removal of Four Dams

Percentiles	Waterfowl	Estimated Hunting Trips	Net Benefit (lower-bound)	Net Benefit (upper-bound)
0.00	212,970	9,625	\$ 437,358	\$ 603,971
0.05	264,390	10,589	\$ 481,169	\$ 664,472
0.10	276,120	10,809	\$ 491,163	\$ 678,273
0.15	281,275	10,906	\$ 495,556	\$ 684,339
0.20	287,507	11,023	\$ 500,865	\$ 691,671
0.25	291,474	11,097	\$ 504,245	\$ 696,339
0.30	294,735	11,158	\$ 507,024	\$ 700,176
0.35	297,751	11,215	\$ 509,594	\$ 703,724
0.40	299,374	11,245	\$ 510,976	\$ 705,634
0.45	302,341	11,301	\$ 513,504	\$ 709,125
0.50	306,288	11,375	\$ 516,867	\$ 713,769
0.55	307,203	11,392	\$ 517,647	\$ 714,846
0.60	308,635	11,419	\$ 518,867	\$ 716,531
0.65	308,635	11,419	\$ 518,867	\$ 716,531
0.70	308,635	11,419	\$ 518,867	\$ 716,531
0.75	308,635	11,419	\$ 518,867	\$ 716,531
0.80	308,635	11,419	\$ 518,867	\$ 716,531
0.85	308,635	11,419	\$ 518,867	\$ 716,531
0.90	308,635	11,419	\$ 518,867	\$ 716,531
0.95	308,635	11,419	\$ 518,867	\$ 716,531
1.00	308,635	11,419	\$ 518,867	\$ 716,531

Table 8. Net Difference in Economic Net Benefits between Alternative 1 and Alternative 2

Net Difference between Alternative 1 and Alternative 2

Percentiles	Waterfowl	Estimated Hunting Trips	Net Benefit (lower-bound)	Net Benefit (upper-bound)
-	203,742	3,820	\$ 173,593	\$ 239,723
0.05	243,820	4,572	\$ 207,740	\$ 286,879
0.10	248,770	4,665	\$ 211,957	\$ 292,703
0.15	250,155	4,691	\$ 213,138	\$ 294,333
0.20	238,717	4,476	\$ 203,392	\$ 280,875
0.25	216,792	4,065	\$ 184,712	\$ 255,078
0.30	208,689	3,913	\$ 177,808	\$ 245,544
0.35	206,354	3,869	\$ 175,818	\$ 242,796
0.40	198,631	3,724	\$ 169,238	\$ 233,710
0.45	193,950	3,637	\$ 165,250	\$ 228,202
0.50	193,830	3,634	\$ 165,147	\$ 228,061
0.55	189,688	3,557	\$ 161,618	\$ 223,187
0.60	182,973	3,431	\$ 155,897	\$ 215,286
0.65	176,912	3,317	\$ 150,733	\$ 208,155
0.70	170,786	3,202	\$ 145,513	\$ 200,947
0.75	164,291	3,081	\$ 139,980	\$ 193,305
0.80	156,662	2,938	\$ 133,479	\$ 184,329
0.85	151,038	2,832	\$ 128,688	\$ 177,712
0.90	147,233	2,761	\$ 125,446	\$ 173,235
0.95	140,340	2,631	\$ 119,573	\$ 165,124
1.00	130,797	2,453	\$ 111,442	\$ 153,896

Alternative 3 – Partial Facilities Removal of Four Dams

Under Alternative 3, the economic surplus associated with waterfowl hunting activities during a normal water year was assumed to be the same as Alternative 2. Thus, the per year difference in economic net benefits would also be the same.

RED Analysis

Data on visitation to the National Wildlife Refuges and visitor expenditures is used to calculate total direct effects of NWR visitation on the regional economy under different alternatives. This section provides additional information on the calculations of these direct effects that were then used in the regional economic analysis.

Methodology and Assumptions

Visitor Expenditures

Daily expenditure information for this study was extracted from the NSFHWR trip expenditure database (U.S. Department of the Interior et al. 2007 and 2002). Each respondent who said she or he had participated in an activity was asked about the trips she had taken to pursue the activity in the reporting period. A migratory bird hunter, for example, would be asked in what states he had hunted. For each State a series of questions would reveal how many days he had hunted chiefly for migratory birds and how much he had spent or his share of spending during those days in that state. Respondents were asked to determine expenditures in nine categories which were then aggregated to four categories for analysis. To convert this individual state total to expenditures per day per trip, the total was divided by the number of days the respondent said he had chiefly pursued that activity.

Four Categories

Food:

- Food, drink, and refreshments

Lodging:

- At motels, cabins, lodges, or campgrounds

Transportation:

- Public transportation, including airplanes, buses, and car rentals
- Round-trip cost of transportation by private vehicle

Other:

- Guide fees
- Pack trip or package fees
- Public land-use or access fees
- Private land-use or access fees, not including leases
- Equipment rental

Visitation is classified into resident and non-resident visits as described earlier in the net economic value discussion. This breakdown is important to understand as the expenditures by non-resident visitors are a direct net stimulus into the regional economy as opposed to the expenditures of resident visitors, who likely would still have spent a significant portion of their expenditures in the regional economy had they pursued another activity.

Respondents were classified as non-residents if their state of residence differed from the state where the activity occurred. Because some of the State sample sizes were somewhat small, this report followed the methodology developed in previous Banking on Nature reports and combined the survey expenditure data for all of the States in the U.S. Fish and Wildlife Service's Region 1 (WA, OR, CA, NV, and HI) to estimate expenditures by visitor activity.

Lodging expenditures appear very low in this data, ranging from \$2.54 per day to \$36.44 per day (in the lower 48 states, updated to \$2012). Often, lodging expenditures are only a few dollars per day. In the NSFHWR, a trip does not necessarily begin at the respondent's residence. If someone were visiting relatives, for example, and spent a day of that visit hunting at the refuge, only the expenditures related to the time spent hunting is included. The trip would be a one day trip from the relatives' home and would have no lodging costs associated with it, even though the hunter had made an extensive trip away from his home. Hunting would be the primary purpose of the side trip but not of the entire trip away from home. Many people also camp or own recreational vehicles or hunting cabins and so have minimal lodging costs that may be spread among several individuals. Table 9 shows the estimated breakdown for visitor expenditures in 2012 dollars by major expenditure category.

The calculated daily expenditures reported in Table 9 are used to estimate the total amount of dollars spent by Refuge visitors. These estimates are presented in Table 10. The table shows the breakdown of direct expenditures for the year 2009 by activity.

Table 9. Refuge Visitation Economic Expenditures (\$ 2012)

Economic Sector	Migratory Bird Hunting		Wildlife Watching	
	Resident	Non-Resident	Resident	Non-Resident
Lodging	\$ 2.54	\$ 12.78	\$ 9.12	\$ 36.44
Food/drink	\$ 16.75	\$ 50.25	\$ 11.74	\$ 38.66
Other transport	\$ 25.39	\$ 107.57	\$ 9.27	\$ 33.09
Air transport	\$ -	\$ 11.95	\$ 1.51	\$ 3.59
Other	\$ 13.25	\$ 18.33	\$ 3.13	\$ 14.95
Total	\$ 57.93	\$ 200.87	\$ 34.76	\$ 126.73

Source: 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, U.S.

Fish and Wildlife Service. Expenditures updated to 2012 dollars using Western Region Consumer Price Index, U.S. Census.

Table 10. 2009 Visitors Direct Expenditures Associated with Waterfowl Hunting and Wildlife Watching on Lower Klamath Lake and Tule Lake National Wildlife Refuges (\$2012)

		Resident RVD	Non-Resident RVD	Resident Daily Exp.	Non-Resident Daily Exp.	Total Resident Exp.	Total Non-Resident Exp.	Grand Total Exp.
Lower Klamath Lake	Hunting	967	2,257	\$ 57.93	\$ 200.87	\$ 56,035	\$ 453,400	\$ 509,435
	Wildlife Viewing	8,775	5,850	\$ 34.76	\$ 126.73	\$ 305,047	\$ 741,361	\$ 1,046,408
	Total	9,742	8,107			\$ 361,082	\$ 1,194,761	\$ 1,555,842
Tule Lake	Hunting	612	1,427	\$ 57.93	\$ 200.87	\$ 35,425	\$ 286,635	\$ 322,060
	Wildlife Viewing	5,670	3,780	\$ 34.76	\$ 126.73	\$ 197,107	\$ 479,033	\$ 676,140
	Total	6,282	5,207			\$ 232,532	\$ 765,668	\$ 998,200
Combined	Hunting	1,579	3,684	\$ 57.93	\$ 200.87	\$ 91,460	\$ 740,035	\$ 831,495
	Wildlife Viewing	14,445	9,630	\$ 34.76	\$ 126.73	\$ 502,154	\$ 1,220,394	\$ 1,722,548
	Total	16,024	13,314			\$ 593,614	\$ 1,960,429	\$ 2,554,043

Source: US FWS Division of Economics, 2011.

Expenditure Data Adjustments

Based on the information provided by Refuge staff, this analysis assumes that one-half of the reported daily expenditures associated with the total number of reported hunting and wildlife watching visits is directly related to the existence of the Refuges and the natural resources they provide.

Results

Alternative 1 – No Action Alternative

Table 11 shows the calculated total direct expenditures that are used in the RED analysis. Data on number of waterfowl and estimated hunting trips under different water scenarios are based on Mauser and Mayer (2011) as discussed earlier in this report. Resident and non-resident expenditures are calculated using the average expenditure data discussed above. As discussed earlier in this report, only waterfowl hunting trips are considered in this analysis, based on the lack of evidence of a statistical relationship between number of waterfowl and wildlife watching visitation. In an average water year, the total direct expenditures under the No Action Alternative are \$611,444.

Alternative 2 – Full Facilities Removal of Four Dams

Table 12 shows the calculation of total direct expenditures under Alternative 2. In an average water year, Alternative 2 would result in a total of \$ 898,543 in direct expenditures from waterfowl hunting visitation. This is a difference of 193,830 additional waterfowl, 3,634 hunting trips, and \$ 287,099 in direct expenditures compared to Alternative 1, as shown in Table 13.

Alternative 3 – Partial Facilities Removal of Four Dams

The impacts for the Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative would be the same as under the Full Facilities Removal of Four Dams Alternative.

Table 11. Economic Impacts for Alternative 1 – No Action Alternative – Hunting (\$2012)

Percentiles	Waterfowl	Estimated Hunting Trips	Resident Expenditures	Non-Resident Expenditures	Total Direct Expenditures
0.00	9,228	5,805	\$ 50,437	\$ 408,104	\$ 458,541
0.05	20,570	6,017	\$ 52,285	\$ 423,056	\$ 475,340
0.10	27,350	6,145	\$ 53,389	\$ 431,993	\$ 485,383
0.15	31,120	6,215	\$ 54,004	\$ 436,963	\$ 490,967
0.20	48,790	6,547	\$ 56,882	\$ 460,257	\$ 517,140
0.25	74,682	7,032	\$ 61,101	\$ 494,390	\$ 555,491
0.30	86,046	7,245	\$ 62,952	\$ 509,370	\$ 572,323
0.35	91,397	7,345	\$ 63,824	\$ 516,425	\$ 580,249
0.40	100,743	7,521	\$ 65,347	\$ 528,745	\$ 594,092
0.45	108,391	7,664	\$ 66,593	\$ 538,827	\$ 605,420
0.50	112,458	7,740	\$ 67,255	\$ 544,189	\$ 611,444
0.55	117,515	7,835	\$ 68,079	\$ 550,855	\$ 618,934
0.60	125,662	7,988	\$ 69,407	\$ 561,595	\$ 631,002
0.65	131,723	8,102	\$ 70,394	\$ 569,585	\$ 639,979
0.70	137,849	8,216	\$ 71,392	\$ 577,661	\$ 649,053
0.75	144,344	8,338	\$ 72,450	\$ 586,223	\$ 658,673
0.80	151,973	8,481	\$ 73,693	\$ 596,280	\$ 669,973
0.85	157,597	8,587	\$ 74,610	\$ 603,694	\$ 678,303
0.90	161,402	8,658	\$ 75,230	\$ 608,710	\$ 683,939
0.95	168,295	8,787	\$ 76,353	\$ 617,797	\$ 694,149
1.00	177,838	8,966	\$ 77,907	\$ 630,377	\$ 708,284

Table 12. Economic Impacts for Alternative 2 – Full Facilities Removal of Four Dams – Hunting (\$2012)

Percentiles	Waterfowl	Estimated Hunting Trips	Resident Expenditures	Non-Resident Expenditures	Total Direct Expenditures
0.00	212,970	9,625	\$ 83,631	\$ 676,690	\$ 760,321
0.05	264,390	10,589	\$ 92,009	\$ 744,475	\$ 836,484
0.10	276,120	10,809	\$ 93,920	\$ 759,939	\$ 853,858
0.15	281,275	10,906	\$ 94,760	\$ 766,734	\$ 861,494
0.20	287,507	11,023	\$ 95,775	\$ 774,950	\$ 870,725
0.25	291,474	11,097	\$ 96,421	\$ 780,179	\$ 876,600
0.30	294,735	11,158	\$ 96,952	\$ 784,478	\$ 881,431
0.35	297,751	11,215	\$ 97,444	\$ 788,454	\$ 885,898
0.40	299,374	11,245	\$ 97,708	\$ 790,594	\$ 888,302
0.45	302,341	11,301	\$ 98,192	\$ 794,505	\$ 892,697
0.50	306,288	11,375	\$ 98,835	\$ 799,708	\$ 898,543
0.55	307,203	11,392	\$ 98,984	\$ 800,914	\$ 899,898
0.60	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019
0.65	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019
0.70	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019
0.75	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019
0.80	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019
0.85	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019
0.90	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019
0.95	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019
1.00	308,635	11,419	\$ 99,217	\$ 802,802	\$ 902,019

Table 13. Net Difference in Economic Impacts Between Alternative 1 and Alternative 2

Percentiles	Waterfowl	Estimated Hunting Trips	Direct Expenditures
-	203,742	3,820	\$ 301,780
0.05	243,820	4,572	\$ 361,143
0.10	248,770	4,665	\$ 368,475
0.15	250,155	4,691	\$ 370,527
0.20	238,717	4,476	\$ 353,585
0.25	216,792	4,065	\$ 321,110
0.30	208,689	3,913	\$ 309,108
0.35	206,354	3,869	\$ 305,649
0.40	198,631	3,724	\$ 294,210
0.45	193,950	3,637	\$ 287,277
0.50	193,830	3,634	\$ 287,099
0.55	189,688	3,557	\$ 280,964
0.60	182,973	3,431	\$ 271,018
0.65	176,912	3,317	\$ 262,040
0.70	170,786	3,202	\$ 252,966
0.75	164,291	3,081	\$ 243,346
0.80	156,662	2,938	\$ 232,046
0.85	151,038	2,832	\$ 223,716
0.90	147,233	2,761	\$ 218,080
0.95	140,340	2,631	\$ 207,870
1.00	130,797	2,453	\$ 193,735