WHITEWATER BOATING RECREATION ECONOMICS TECHNICAL REPORT FOR THE SECRETARIAL DETERMINATION ON WHETHER TO REMOVE FOUR DAMS ON THE KLAMATH RIVER IN CALIFORNIA AND OREGON

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I. INTRODUCTION

The Klamath Hydroelectric Settlement Agreement (KHSA) and Klamath Basin Restoration Agreement (KBRA) define a framework for the largest dam removal and river basin restoration project that would ever be undertaken in the U.S. The KHSA and KBRA are the result of more than 50 entities, including federal agencies, California and Oregon, Indian tribes, counties, irrigators and conservation and fishing groups coming together to develop a resolution for many complex water-related issues that have plagued the Klamath River Basin for many years.[1,2] In particular, the KHSA specifies the process for the removal of four dams (Iron Gate, J.C. Boyle, Copco No. 1 and Copco No. 2) on the Klamath River and requires the Secretary of the Interior (Secretary) to make a decision on whether these actions "will advance restoration of the salmonid fisheries of the Klamath Basin" and "is in the public interest."[3]

As part of the Secretary's decision making process, a benefit-cost analysis is being conducted to document the potential economic effects from adoption of the KHSA and KBRA. This report contributes one component to the overall benefit-cost analysis by analyzing the effects to whitewater boating along the Klamath River. Specifically, this analysis provides an estimate of the economic effects to whitewater boating on the Klamath River from 2012 through 2061 from implementation of the KHSA and subsequent removal of the four dams. The economic effects analyzed include changes in economic value (i.e., consumer surplus) and changes in economic expenditures associated with whitewater boating (i.e., changes in expenditures associated with outfitter fees, food, lodging, etc.).

This analysis applies a benefits-transfer (BT) approach to estimate the change in economic value from implementation of the KHSA. In general, BT involves the use of existing data or information for analysis in settings other than what it was originally collected. Economic value is calculated by combining estimates of consumer surplus for whitewater boating use from previously conducted studies with estimates of the number of whitewater boating user-days for the study site (i.e., Klamath River). Estimates of whitewater boating user-days are developed for the No Action Alternative (i.e., KHSA and KBRA not implemented) and the Full Facilities Removal of Four Dams Alternative (i.e., KHSA and KBRA are implemented). The difference between estimates of whitewater boating user-days under the two alternatives combined with a per user-day consumer surplus estimate of whitewater boating broadly represent the change in economic value. These differences are calculated for each over the period of analysis (2012 – 2061). Changes in economic expenditures are calculated in an analogous way; except

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[1] Although the KHSA and KBRA are separate agreements, the KBRA requires the Secretary's determination to be in favor of the KHSA before it can be adopted. If the Secretary's determination is against the KHSA then the KBRA will not be implemented.

[2] For additional information about the KHSA and KBRA see http://klamathrestoration.gov/.

[3] Klamath Hydroelectric Settlement Agreement, Section 3.3.1.

that estimates of expenditures associated with whitewater boating on the Klamath are used instead of consumer surplus and user-days are differentiated between use from local and non-local users.

The remainder of this report proceeds as follows. Section II provides a general overview of whitewater boating on the Klamath River and presents estimates of historical whitewater boating activity. Section III describes the different approaches for estimating the economic value of recreational activities such as, whitewater boating. Section IV presents the estimates of the projected change in economic value and Section V presents estimates of the change in economic expenditures. Section VI concludes.

II. WHITEWATER BOATING ON THE KLAMATH RIVER

Klamath River

The Klamath River basin is located in southeastern Oregon and northwestern California. The Klamath River begins just below Upper Klamath Lake near Klamath Falls, Oregon and flows roughly 260 miles to the Pacific Ocean just south of Klamath, California (FERC 2007). For the purposes of the analysis of whitewater boating recreation, the Klamath River is broadly divided into the Upper Klamath River (UKR) and Lower Klamath River (LKR), where the UKR is defined as the section of the Klamath River upstream of Iron Gate Dam and the LKR is defined as the stretch downstream of Iron Gate Dam.

A majority of the UKR is not suitable for whitewater boating due to the reservoirs behind dams on this stretch of the river. However, there are approximately 30 miles of the UKR that provide whitewater boating opportunities and roughly 123 miles for the LKR.[4] The UKR can be divided into five distinct river reaches: Link River Bypass, Keno, J.C. Boyle Bypass, Hell's Corner, and Copco No. 2 Bypass. Similarly, the boatable portion of the LKR can be described as the section of the Klamath River below Iron Gate dam to the confluence with the Salmon River.[5]

The two reaches on the UKR upstream of J.C. Boyle Reservoir (Link River Bypass and Keno) provide approximately six miles of river suitable for whitewater boating. The Link River Bypass reach contains one short Class III/IV rapid and one Class II/III ledge drop.[6] Previous studies by PacifiCorp did not detect any measurable use; however, there have been anecdotal accounts of boating use occurring in this reach (FERC 2007). The Klamath River downstream of Keno dam provides approximately five miles of river suitable for whitewater boating and is rated Class III difficulty. There is little reported boating use on this reach, which may be due to limited access, short run length, and sharp volcanic riverbed rock that is hard on boaters and their equipment (FERC 2007).

The three reaches downstream of the J.C. Boyle Reservoir to Iron Gate dam (J.C. Boyle Bypass, Hell's Corner, and Copco No. 2 Bypass) are also capable of providing whitewater boating opportunities. The J.C. Boyle Bypass reach is roughly five miles in length and runs downstream from the J.C. Boyle dam to the J.C. Boyle Powerhouse. Although this reach has the potential to offer Class III-IV+ rapids, suitable boating conditions occur infrequently and only when the upstream storage (Upper Klamath Lake, Keno, and J.C. Boyle reservoirs) capacity is full and the J.C. Boyle powerhouse capacity is exceeded (FERC

[4] PacifiCorp. February 2004. Final Technical Report, Klamath Hydroelectric Project, Recreation Resources. FERC Project No. 2082.
[5] PacifiCorp. February 2004. Final Technical Report, Klamath Hydroelectric Project, Recreation Resources. FERC Project No. 2082.
[6] Rating scale as defined by American Whitewater using the International Scale of River Difficulty. See http://www.americanwhitewater.org/content/Wiki/safety:start#vi

2007). This reach is typically dewatered with low base flows (100 to 300 cfs) and the majority of the year there is almost no boating use on this stretch of the UKR.

The Bureau of Land Management manages whitewater boating use along the Hell's Corner reach, a 16.4 mile reach beginning below J.C. Boyle Reservoir to the Fishing Access Site 1 take-out. This reach is designated as a Wild and Scenic River and provides Class III to IV+ rapids during daily peaking flows from the PacifiCorp hydropower operations (between 10AM and 2PM). Acceptable whitewater boating flows range from 1,300 cfs to 3,000 cfs,[7] but outside of daily peaking flows the flow rates within this reach do not meet the acceptable range for whitewater boating opportunities.

Commercial boating activity on the Hell's Corner reach is allowed by permit only. The BLM has a commercial capacity of ten outfitters or 200 clients per day on this reach, and no limit for private boating. However, BLM has established 250 persons per day as the overall whitewater boating carrying capacity of Hell's Corner reach. Whitewater boating use, particularly rafting, in this reach depends upon the operations of J.C. Boyle Powerhouse upstream. Furthermore, the timing and duration of the releases are also critical for commercial operators so they can offer their clients reasonable trip itineraries (FERC 2007). This allows commercial outfitters to offer trips in the late summer and early fall months.

The final reach of the UKR is the Copco No. 2 Bypass reach, a reach approximately 1.3 miles long with the potential to offer Class IV whitewater boating opportunities at acceptable flows ranging from 600 to 1,400 cfs.[8] Undocumented whitewater boating use may occur along this reach. However, the level of use may be minimal due to the reaches' short length, low observed flows, and limited public access opportunities to the reach.

Whitewater boating opportunities primarily exist on the 123 mile segment of the LKR (Klamath River downstream of Iron Gate dam to the confluence with the Salmon River) where the river flows through lands mostly managed by the USFS (Klamath National Forest and Six Rivers National Forest). Depending on the section of the river and flows, there are opportunities for play, standard, and big water boating on mostly Class II and III rapids. Whitewater boating opportunities become more problematic downstream of the Trinity River confluence after the river turns northwest into strong prevailing winds where Class III rapids give way to small riffles and a generally slow current (Cascade Outfitters 2010). Furthermore, there are fewer access points along this reach compared to reaches upstream and most of this reach flows through land within the boundaries of the Yurok Tribe Indian Reservation. In general, the conditions on the LKR make it more suited for relaxed floats and/or multi-day trips as compared to the UKR.

Whitewater Boating Use on Klamath River

Whitewater boating use on the Klamath River is comprised of both private users and users that purchase guide services from a whitewater boating outfitter (commercial users). The portions of the Klamath River are under the management of the Bureau of Land Management (BLM) and U.S. Forest Service (USFS) require a commercial whitewater boating outfitter to obtain an operational permit to provide whitewater boating services on these sections. Private boaters are exempt from these requirements. When trips are provided by permitted outfitters, they are required to submit a "trip card" at the time the trip is taken. The trip card records information about the trip such as, length of

[7] Recreation Sub-team. 2011. Acceptable Flow for Recreational Activities.
[8] Recreation Sub-team. 2011. Acceptable Flow for Recreational Activities.

trip, launch location, take-out location, and number of passenger taking the trip (excluding guides). The BLM and USFS historical record of trip cards submitted by commercial outfitters served as the primary source of information used to develop an estimate of commercial whitewater boating use on the Klamath River. Additional sources of information documenting historical whitewater boating use on the Klamath River included analyses prepared as part of Pacificorp's FERC Relicensing (PacifiCorp, 2004) and the Klamath National Forest River Management Report (2009), where the BLM and USFS trip cards also served as the underlying input to the commercial whitewater boating use estimates reported in these analyses.

Table 1 and Table 2 provide an estimate of commercially guided whitewater boating trips on the UKR (2001-2009) and LKR (2000-2009), respectively. These estimates were developed from a recent review of BLM and USFS trip card records. The values for the UKR are based on BLM trips cards and the USFS for the LKR. One-day trips are the most common trip length for the UKR. The stretch of the UKR under BLM's management that is associated with any documented whitewater boating use, Hell's Corner reach, is roughly seventeen miles long and can be boated in one day. Permitted outfitters do offer multi-day trips on the UKR, but the data show that these are less common. Single-day trips are also the most common trip on LKR, but permitted outfitters do offer multi-day trips of various lengths and they occur more frequently when compared to the UKR. The conditions on the LKR make it more favorable for relaxed floats and/or multi-day trips. The data show that multi-day trips on the LKR are typically between two and three days, but four day trips and trips up to nine days have been observed.

Table 1. Commercially Guided Whitewater Boating Trips on the UKR (2001-2009)

	Trip Length in Days				
Year	1	2	3	4	Total
2001	274	17	5	0	296
2002	283	20	2	0	305
2003	248	20	1	1	270
2004	306	31	2	0	339
2005	317	27	0	0	344
2006	243	27	4	0	274
2007	276	28	1	0	305
2008	248	20	1	0	269
2009	220	7	1	0	228
Total	2,415	197	17	1	2,630

Table 2. Commercially Guided Whitewater Boating Trips on the LKR (2000-2009)

	Trip Length in Days									
Year	1	2	3	4	5	6	7	8	9	Total
2000	254	48	80	13	7	1	1	0	0	404
2001	309	68	68	28	3	1	0	0	0	477
2002	242	49	68	10	6	1	1	0	0	377
2003	301	55	57	21	6	1	2	0	0	443
2004	224	47	55	13	6	1	0	1	1	348
2005	366	48	58	15	5	0	0	0	0	492
2006	230	33	44	8	1	2	0	0	0	318
2007	255	47	45	12	1	0	1	3	0	364
2008	237	26	38	18	2	0	0	0	0	321
2009	235	27	44	11	4	1	1	0	0	323
Total	2,653	448	557	149	41	8	6	4	1	3,867

Additional information on the number of passengers, trip length, and trip date from the BLM and USFS trips cards were combined with the trips information presented in Table 1 and Table 2 to estimate the number commercial whitewater boating user-days. A user-day is defined as one user engaging in whitewater boating for any part of a day. For example, three people taking a two day whitewater boating trip would equate to six user-days (3 users x 2 days = 6 user-days).

Table 3 and Table 4 summarize monthly commercial whitewater boating user-days for the UKR and LKR, respectively. Peak use on the UKR primarily occurs in July and August. Measurable use is also observed in May, June, and September, but is typically considerably lower than the peak months. Some use has been observed outside of the five months from May through September, but is generally a fraction overall annual use. A similar pattern is observed for the LKR, where the bulk of the use is from May through September with July typically being the peak for monthly whitewater boating use during the year.

Table 3. Estimate of Monthly Commercial Whitewater Boating User-Days on the UKR (2001-2009)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2001	0	0	0	15	129	634	871	1,304	310	27	0	0
2002	0	7	0	0	91	637	1,229	1,093	303	9	0	0
2003	0	0	0	0	144	303	1,181	1,190	217	40	0	0
2004	0	0	0	7	204	654	1,323	1,116	400	96	0	0
2005	0	0	0	27	136	613	1,297	1,275	240	50	0	0
2006	0	0	0	0	111	556	1,560	1,025	328	108	26	0
2007	0	0	0	0	98	620	1,259	1,140	354	34	0	0
2008	0	5	0	0	130	618	1,160	1,052	311	59	0	0
2009	0	0	13	0	126	462	724	857	219	4	0	0

Table 4. Estimate of Monthly Commercial Whitewater Boating User-Days on the LKR (2000-2009)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2000	0	0	28	41	301	1,871	3,918	3,983	281	26	0	0
2001	0	22	27	19	258	2,545	4,044	3,202	560	67	0	0
2002	0	0	6	12	373	1,826	4,250	3,116	197	3	0	0
2003	0	0	19	16	256	2,802	4,473	3,419	158	0	0	0
2004	0	0	2	16	440	1,847	4,242	2,942	213	6	0	0
2005	0	0	22	13	169	2,317	4,501	3,315	358	0	0	0
2006	0	0	0	0	212	2,095	3,935	1,899	65	20	0	0
2007	0	0	0	17	527	2,687	3,608	1,784	170	58	28	0
2008	0	0	0	8	580	2,036	4,124	1,635	204	0	56	0
2009	0	0	0	0	635	2,269	3,687	1,373	130	136	0	0

The BLM and USFS trip card data used to estimate commercial whitewater boating user-days for the UKR (2001-2009) and the LKR (2000-2009) were supplemented by analyses prepared as part of Pacificorp's FERC Relicensing (PacifiCorp, 2004) and the Klamath National Forest River Management Report (2009) to generate an estimate of commercial whitewater boating use for the Klamath River from 1994 through 2009. The underlying sources of information used to determine commercial whitewater boating user-days in these other analyses were also the BLM and USFS trip card records. Table 5 provides an annual estimate of commercial whitewater boating user-days for the Klamath River between 1994 and 2009.

In addition to commercial use, Table 5 also provides an estimate of private and total whitewater boating use from 1994 through 2009. The estimate of commercial, private and total user-days for the UKR from 1994 to 2000 are based on analysis completed for Pacificorp's FERC Relicensing (PacifiCorp, 2004)[9], while estimates of commercial, private, and total user-days for the LKR from 1994 to 1999 are based on figures reported in the Klamath National Forest River Management Report (2009). Analysis of the data presented in Pacificorp (2004) show that on average 93 percent of the total annual whitewater boating user-days for the UKR between 1994 and 2000 are associated with commercial use. For the LKR, the Klamath National Forest River Management Report (2009) show that on average 70 percent of total annual whitewater boating user-days on the LKR between 1994 and 1999 are associated with commercial use. To arrive at an estimate of total user-days for the UKR for the years 2001 to 2009 and the LKR for the years 2000 to 2009, it was assumed that the percentage of commercial user-days for the UKR and LKR over these time periods were similar to previous years (i.e., 93 percent for UKR and 70 percent for LKR). For example, dividing the annual estimate of UKR commercial user-days for the years from 2001 to 2009 by 93 percent results in the annual estimate of total user-days. Similarly for the LKR, dividing the annual estimate of commercial user-days for the years from 2000 to 2009 by 70 percent results in the annual estimate of total user-days. Annual private user-days for the UKR from 2001 to 2009 and for the LKR from 2000 to 2009 are computed by subtracting annual commercial user-days from annual total user-days.

[9] See Table 2.7-41, Final Technical Report, Klamath Hydroelectric Project, Socioeconoimcs Resources. FERC Project No. 208,. PacifiCorp, February 2004.

The LKR receives greater use than the UKR, both in terms of private and commercial use. Over the period of available data (1994-2009), the average annual number of user-days for the UKR was 4,414 and 14,392 for the LKR. The estimates of whitewater boating use presented in Table 5 show that use in more recent years has been lower than the overall average for both the UKR and LKR. However, the lower use levels exhibited by the data in recent years does not necessarily imply a long term trend of decreased use as several factors can contribute to the level of use in a particular year (e.g., condition of the economy and weather).

Table 5. Estimate of Whitewater Boating User-days on the Klamath River (1994-2009)

	Upper Klamath River[1]			Lower Klamath River[2]			Klamath River		
Year	Commercial	Private	Total	Commercial	Private	Total	Commercial	Private	Total
1994	4,471	735	5,206	8,491	3,639	12,130	12,962	4,374	17,336
1995	5,763	602	6,365	12,203	5,230	17,433	17,966	5,832	23,798
1996	5,963	244	6,207	10,280	4,406	14,686	16,243	4,650	20,893
1997	5,509	317	5,826	10,529	4,512	15,041	16,038	4,829	20,867
1998	4,081	314	4,395	11,298	4,842	16,140	15,379	5,156	20,535
1999	4,614	283	4,897	11,885	5,094	16,979	16,499	5,377	21,876
2000	5,100	269	5,369	10,449	4,478	14,927	15,549	4,747	20,296
2001	3,290	243	3,533	10,744	4,605	15,349	14,034	4,848	18,882
2002	3,369	249	3,618	9,783	4,193	13,976	13,152	4,442	17,594
2003	3,075	228	3,303	11,143	4,776	15,919	14,218	5,003	19,221
2004	3,800	281	4,081	9,708	4,161	13,869	13,508	4,442	17,950
2005	3,638	269	3,907	10,695	4,584	15,279	14,333	4,853	19,186
2006	3,714	275	3,989	8,226	3,525	11,751	11,940	3,800	15,740
2007	3,505	259	3,764	8,879	3,805	12,684	12,384	4,065	16,449
2008	3,335	247	3,582	8,643	3,704	12,347	11,978	3,951	15,929
2009	2,405	178	2,583	8,230	3,527	11,757	10,635	3,705	14,340
Average (1994-2009)	4,102	312	4,414	10,074	4,317	14,392	14,176	4,630	18,806

[1] Estimates for the Upper Klamath for 1994 to 2000 are based on figures reported in Table 2.7-41 of the Final Technical Report, Klamath Hydroelectric Project (FERC Project No. 2082), Socioeconomic Resources, February 2004

[2] Estimates for Lower Klamath for 1994 to 1999 are based on figures reported in the Klamath National Forest River Management Report, 2009, by Dave Payne.

III. VALUING WHITEWATER BOATING RECREATION

The whitewater boating activity observed on the Klamath River demonstrates that individuals hold positive economic values for this activity. In this context, economic value refers to the dollar amount an individual would be willing-to-pay (WTP) above and beyond expenditures incurred to engage in whitewater boating. The separate issue of evaluating the economic impacts of the expenditures associated with whitewater boating on the Klamath River is addressed in Section V.

The primary economic method for estimating economic values for recreation activities is the travel cost model (TCM). The TCM is a demand-based model of use of a recreation site or sites where a site could be a river for whitewater boating, a reservoir, a campground, a hiking trail, refuge for wildlife viewing, or other areas used to engage in a recreation activity. The travel costs or expenditures one incurs (e.g., entrance fees, fuel, and travel time) to a recreation site serve as a proxy for the "price" one pays for the enjoyment of engaging in a recreation activity.

In general, TCMs can be separated into models that estimate demand for a single site and models that estimate demand across multiple sites. Single-site travel cost models use trips taken by individuals to one site during a period of time (e.g., a fishing season, hunting season, or period of time suitable for whitewater boating) and the costs associated with taking those trips to estimate a demand function for the site. The variation in price (i.e., trip cost) is observed from users living at different distances from the site, where the price is greater for individuals that live further away.[10] Multi-site travel cost models are called Random Utility Maximization (RUM) models. RUM models consider an individual's discrete choice of a recreation site among a set of many possible sites to engage in a particular recreation activity, where an individual's site choice depends on the characteristics of all the sites. For example, someone deciding which river to choose to go rafting may consider trip cost, water flows, and site amenities. The site choice a person makes reveals trade-offs made between one site characteristic for another site characteristic. The inclusion of trip cost implicitly reveals how trade-offs are made between money and other site characteristics, therefore, enabling values to be estimated for the differences in site characteristics.

The estimation of either a single-site travel cost or multi-site RUM model requires primary data collection through the use of surveys designed to collect information from individuals that engaged in the recreation activity. In particular, the surveys would collect responses about the number of trips an individual has taken, the site or sites where the trips were taken, the costs incurred for the trips, the origin of the trip, and the characteristics of the individual taking the trip. The data is then used to estimate a model or set of models where the results are used to calculate economic values. Economic values can correspond to the value one receives from engaging in a recreational activity, the value of different site characteristics or levels of quality, the value of the loss of access to a site, or the value of the addition of a new site.

One limitation of single-site travel cost or multi-site RUM models is the inability to estimate economic values for site conditions that were not experienced by users because model estimation is based on historical data of actual choices under site conditions faced at that time. An economic method to address this issue would be to use a combined Revealed Preference – Stated Preference (RP-SP) modeling approach. A combined RP-SP model would require collecting survey data from individuals about their past recreational use, but would also involve collecting additional information about how individuals state they would change site choice and/or level of use under hypothetical site conditions or potential future site conditions (e.g., the conditions on a river after removing a dam).

[10] A variation in the single-site models use the number of trips taken to a site originating from a multiple geographic areas (e.g., zip code or county) around a site to estimate value. These models are commonly referred to as "zonal" travel cost models because trips from an origin zone are aggregated together instead of using trips taken by individuals. One may need to estimate a zonal travel cost model if data collection efforts do not permit the collection of trip totals from individuals or if existing data only has sufficient enough information to determine an originating "zone" for the trips.

Estimating a site specific RUM model or combined RP-SP model of recreational use can be time consuming and costly due to the necessary survey data collection requirements. However, absent the ability to collect primary data for the estimation of a site specific model of recreation demand for whitewater boating on the Klamath River, economic values can be estimated using benefits transfer (BT). BT is described as the use of existing data or information for analysis in settings other than what it was originally collected. BT of existing data or information can entail the transfer of a function, array of values, or a single value and may apply to one site characteristic or a suite of characteristics (e.g., characteristics can represent site quality or lost access to/closure of a site).

This analysis of whitewater boating recreation on the Klamath River applies a BT approach to estimate the change in economic value (i.e., consumer surplus) resulting from the Full Facilities Removal of Four Dams Alternative (i.e., KHSA and KBRA are implemented). Estimates of consumer surplus for whitewater boating user-days were derived from analysis conducted for PacifiCorp's FERC Relicensing[11] and combined with estimates of the number of whitewater boating user-days to calculate a measure of economic value. Estimates of whitewater boating user-days are developed for the No Action Alternative and the Full Facilities Removal of Four Dams Alternative. The difference between the estimates of whitewater boating user-days under the two alternatives combined with a per user-day consumer surplus estimate of whitewater boating are used to obtain the estimate of the change in economic value.

IV. ESTIMATED CHANGES IN ECONOMIC VALUE FOR WHITEWATER BOATING ON THE KLAMATH RIVER

In general, the whitewater boating economic analysis for the Full Facilities Removal of Four Dams Alternative can be described as comparing the economic value of whitewater boating activity that would occur if the dams remained in place to the economic value of whitewater boating activity that would occur without the dams. The change in economic value (i.e., consumer surplus) for whitewater boating on the Klamath River resulting from the Full Facilities Removal of Four Dams Alternative is estimated via benefits transfer (BT). Calculation of the total present value of the change in economic value for the period of analysis can be given by the following:

$$\Delta \boldsymbol{CS_{PV}} = \sum_{\boldsymbol{t=2012}}^{\boldsymbol{2061}} (\boldsymbol{CS_t^0} - \boldsymbol{CS_t^1})/(\boldsymbol{1}+\boldsymbol{d})^{\boldsymbol{t-2012}} \quad (1)$$

where CS_t^0 is economic value (consumer surplus) under the No Action Alternative in year *t*, CS_t^1 is economic value (consumer surplus) under the Full Facilities Removal of the Four Dams Alternative in year *t*, *d* is the discount rate where all values are discounted back to the base year of 2012, and the period of analysis is fifty years from 2012 through 2061. The economic value (consumer surplus) in year *t* under the No Action alternative is defined as:

$$\boldsymbol{CS_t^0} = \boldsymbol{T_t^0} \times \boldsymbol{VPD_0}, \quad (2)$$

and economic value (consumer surplus) in year *t* under the Full Facilities Removal of Four Dams Alternative is:

$$\boldsymbol{CS_t^1} = \boldsymbol{T_t^1} \times \boldsymbol{VPD_1}, \quad (3)$$

[11] See Appendix 4B – Recreation Value Assessment, Final Technical Report, Klamath Hydroelectric Project, Socioeconoimcs Resources. FERC Project No. 2082, PacifiCorp, February 2004.

where T_t is the number of whitewater boating user-days in year *t* and *VPD* is the economic value per whitewater boating user-day (i.e., consumer surplus per user-day). Combining equations 1, 2, and 3 and assuming the per user-day value of whitewater boating under the No Action Alternative and Full Facilities Removal of Four Dams Alternative are equal yields[12]:

$$\Delta \boldsymbol{CS_{PV}} = \sum_{\boldsymbol{t=2012}}^{\boldsymbol{2061}} \left[\boldsymbol{VPD}\left(\boldsymbol{T_t^0} - \boldsymbol{T_t^1}\right)\right] / (\mathbf{1} + \boldsymbol{d})^{\boldsymbol{t-2012}}. \quad (4)$$

Equation 4 expresses that the total present value of the change in economic value for whitewater boating is calculated by summing the discounted economic value of the differences in the annual number of whitewater boating users-days between the No Action Alternative and Full Facilities Removal of the Four Dams Alternative.

To estimate the annual number of whitewater boating user-days under the No Action Alternative for the period of analysis (i.e.,T_t^0), the historical estimate of whitewater boating user-days for the UKR and LKR presented in Table 5 were used. The historical data show that on average 4,414 user-days occurred on the UKR per year and 14,392 user-days on average per year for the LKR. This amounts to roughly an average of 18,806 whitewater boating user-days for the entire Klamath River. For this analysis, it was assumed that the range of historical use captured by the sixteen years worth of data would serve as an appropriate proxy of potential future whitewater boating use over the period of analysis. Analysis conducted for PacifiCorp's FERC Relicensing assumed a "slight increase" in annual whitewater boating user-days when projecting use into the future.[13] However, a similar assumption was not made for this analysis because the estimates of the historical use observed between 2003 and 2009 did not demonstrate this type of upward trend. Furthermore, while the estimates of historical whitewater boating use presented in Table 5 show that use in more recent years has been lower than the overall average for both the UKR and LKR, the lower use levels exhibited by the data in recent years also do not necessarily imply a long term trend of decreased use. Several factors can contribute to the level of whitewater boating use in a particular year such as, the condition of the economy, weather, and water available in the river. Therefore, to estimate a range of potential annual whitewater boating activity, a 95 percent confidence interval was computed using the sixteen years of historical data reported in Table 5. It was assumed that this would provide a reasonable approximation of the range of potential of use that could be observed in any given year from 2012 through 2061 when considering the multitude of factors that can affect the annual level of use.

Separate estimates of annual whitewater boating user-days were computed for the UKR and LKR, and the resulting estimates were summed to arrive at an overall estimate for the entire Klamath River. Table 6 provides the estimate of annual whitewater boating use projected under the No Action Alternative over the period of analysis. As Section II describes, these figures are based on the historical trip card data collected by the BLM and USFS for the portions of the Klamath River under the respective agency's management and do not account for any potential use that could occur on other segments of the Klamath River not under the management of the BLM or USFS. For the UKR, limited whitewater boating activity is believed to occur in reaches other than the Hell's Corner reach that is under the management of the BLM (see Section II for additional detail). To the extent that the figures given in

[12] This was assumed to be a reasonable assumption absent site specific survey data on whitewater boating use revealed under current conditions and stated whitewater boating use under projected conditions from the Full Facilities Removal of Four Dams Alternative.

[13] See Table 3.7-40. Projected annual changes in activity participation in the study area, Final Technical Report, Klamath Hydroelectric Project, Recreation Resources. FERC Project No. 2082.

Table 6 do not capture all whitewater boating activity projected under the No Action Alternative, the overall level of whitewater boating use on the UKR and LKR will be underestimated.

Table 6. Estimate of Annual Whitewater Boating User-days on the Klamath River Under No-Action Alternative (2012-2061)

	Annual User-days		
	Average	Min	Max
Upper Klamath River			
Commercial	4,105	3,600	4,610
Private	309	271	347
Total	4,414	3,871	4,958
Lower Klamath River			
Commercial	10,074	9,445	10,703
Private	4,317	4,048	4,587
Total	14,392	13,493	15,290
Klamath River			
Commercial	14,179	13,045	15,313
Private	4,626	4,319	4,934
Total	18,806	17,364	20,247

Under the Full Facilities Removal of Four Dams Alternative, whitewater boating activity on the UKR would be negatively affected because of the dependence of water releases from the J.C. Boyle Dam to provide sufficient and predictable flows. With implementation of this alternative, the four dams would remain in place through 2019. Whitewater boating use during the period from 2012 through 2019 would be the same as under the No Action Alternative because the dams would still be in place and conditions for whitewater boating are expected to be similar to conditions under the No Action Alternative. Because whitewater boating on the UKR (i.e., primarily the Hell's Corner reach) depends on the operations of the J.C. Boyle Powerhouse, where the timing and duration of the releases are critical for commercial operators in offering their clients reasonable trip itineraries (FERC 2007), dam removal is expected to have a negative effect on whitewater boating use. Under the Full Facilities Removal of Four Dams Alternative, it is assumed that dam removal activities start at the beginning of 2020 and any estimated negative effects on whitewater boating use would be experienced from 2020 through 2061.

Analysis of predicted hydrology modeling shows that the average number days with acceptable flows for whitewater boating on the Hell's Corner reach are estimated to decline by 47.3 percent during the five month period from May through September.[14] These five months are when the majority of whitewater boating activity occurs annually on this reach of the UKR (see Table 3). For the three most active months, the number of days with acceptable flows for the Hell's Corner reach is estimated to decline by 29.5, 36.4, and 88.2 percent in June, July and August, respectively.[15] The combination of the decline in the number of days with acceptable flows, particularly during the three months when most of the use is observed (June, July, and August), and the lack of consistency and predictability of days with acceptable flows could make it more challenging for outfitters to continue offering trips for this reach of the Upper

[14] Recreation Sub-team. 2011. Acceptable Flow for Recreational Activities.
[15] Recreation Sub-team. 2011. Acceptable Flow for Recreational Activities.

Klamath River in the future. The change in conditions that are assumed to cause difficulties for whitewater boating outfitters and have an effect on commercial whitewater activity may not necessarily pose the same challenge to private users. However, private use on the Hell's Corner reach is a small fraction of overall use (see Table 5) and this reach of the UKR requires advanced skills to navigate. Therefore, it is assumed that the small number of private users would be similarly affected from the uncertainty over the consistency and predictability of acceptable flow conditions.

It is assumed that the level of whitewater boating activity on the LKR would not be affected in any measurable way because sufficient flows for whitewater boating are not dependent on water releases from any of the four dams that would be removed. Additionally, analysis of the predicted hydrology for the Klamath River under the No Action Alternative and Full Facilities Removal of Four Dams Alternative shows the average number of days with acceptable flows for whitewater boating on the LKR would not change in any measurable way.[16]

To estimate how whitewater boating use on the UKR could affected from dam removal, it was assumed that the change in the number of monthly user-days is correlated with the estimated change in average monthly days with acceptable flows resulting from dam removal. In particular, the average number days with acceptable flows for whitewater boating on the Hell's Corner reach is estimated to decline each month during the five month period from May through September (the months when the majority of whitewater boating activity occurs on the UKR), and for the three most active months the number of days with acceptable flows for the Hell's Corner reach is estimated to decline by 29.5, 36.4, and 88.2 percent in June, July and August, respectively.[17] First, the monthly level of use under the No Action Alternative was determined by applying the weighted-average of monthly user-days to total user-days observed from 2001 to 2009 (see Table 3) to the annual levels of use projected for the period of analysis. The change in monthly user-days was then assumed to be equal to the percentage change in the average number of days with acceptable flows for the same month (e.g., monthly user-days and number of days with acceptable flows for whitewater boating in July are estimated to decline by 36.4 percent). However, for months with a percentage change in days with acceptable flows greater than 75 percent, it was assumed all use-days would be lost for that month. For example, the average number of days with acceptable flows for the month of August is estimated to decline by 88.2 percent, which is estimated to result in approximately two days per month after the dams are removed.[18] The assumption of a complete loss only holds for the months of August, September, October, November, and December.[19] As such, for January through July monthly user-days are assumed to decline in proportion to the percentage decline in the monthly average number of days with acceptable flows. The monthly estimates were summed to compute annual whitewater boating user-days.

Table 7 provides the estimate of annual whitewater boating use projected under the Full Facilities Removal of Four Dams Alternative. As described previously, no change in use is expected from 2012 through 2019 because the dams would still be in place, but use would be affected beginning in 2020

[16] Recreation Sub-team. 2011. Acceptable Flow for Recreational Activities.
[17] Recreation Sub-team. 2011. Acceptable Flow for Recreational Activities.
[18] Recreation Sub-team. 2011. Acceptable Flow for Recreational Activities.
[19] As given in Recreation Sub-team, 2011, the average number of days with acceptable flows after dam removal is estimated to be 2.3, 4.1, 0, 1.1, and 4.3 for August, September, October, November, and December, respectively. Given the infrequent number of days per month and uncertainty around the specific time of the month acceptable flow conditions would occur, the assumption of a complete loss of use for these months is believed to be reasonable. Furthermore, as Table 3 indicates the level of use after August decreases significantly and represents a small fraction of use over the entire year.

when dam removal activities are scheduled to start. Total average annual whitewater boating user-days for the UKR are estimated to decline by 2,763 user-days. As described previously, it is assumed that the level of whitewater boating activity on the LKR would not be affected in any measurable way.

Table 7. Estimate of Annual Whitewater Boating User-days on the Klamath River Under Full Facilities Removal of Four Dams Alternative (2012-2061)

	Annual User-days					
	Years: 2012 - 2019			Years: 2020 - 2061		
	Average	Min	Max	Average	Min	Max
Upper Klamath River						
Commercial	4,105	3,600	4,610	1,535	1,346	1,724
Private	309	271	347	116	101	130
Total	4,414	3,871	4,958	1,651	1,448	1,854
Lower Klamath River						
Commercial	10,074	9,445	10,703	10,074	9,445	10,703
Private	4,317	4,048	4,587	4,317	4,048	4,587
Total	14,392	13,493	15,290	14,392	13,493	15,290
Klamath River						
Commercial	14,179	13,045	15,313	10,074	9,445	10,703
Private	4,626	4,319	4,934	4,317	4,048	4,587
Total	18,806	17,364	20,247	14,392	13,493	15,290

Combining the annual estimate of the change in whitewater boating user-days for the UKR and LKR with the corresponding estimate of value per user-day (*VPD*) results in an estimate of the annual undiscounted change in economic value (i.e., $VPD(T_t^0 - T_t^1)$ from equation 4). The value per whitewater boating user-day utilized for this analysis is based on the estimate of the average value per user-day for whitewater boating used in an analysis conducted for PacifiCorp's FERC Relicensing[20], where separate values for the UKR and LKR were derived due to the difference in whitewater boating experiences for the two segments of the river. The PacifiCorp analysis had a value per user-day of $122 (2003 dollars) for the UKR and $48 (2003 dollars) for the LKR. Adjusting each value to 2012 dollars resulted in a value per user-day applied for this analysis of $149 and $58 for the UKR and LKR, respectively. Applying a discount rate of 4.125%[21] to the annual values and summing over the period of analysis gives an estimate of the total discounted present value of the change in economic value for whitewater boating on the Klamath River resulting from the Full Facilities Removal of Four Dams Alternative.

Table 8 summarizes the estimated change in economic value for whitewater boating on the Klamath River from implementation of the Full Facilities Removal of Four Dams Alternative. Total discounted losses are estimated to range from $5.4 million to $6.9 million, with a median estimate of $6.1 million.

[20] See Appendix 4B – Recreation Value Assessment, Final Technical Report, Klamath Hydroelectric Project, Socioeconoimcs Resources. FERC Project No. 2082, PacifiCorp, February 2004. PacifiCorp's use of visitor day is analogous to user-day used in this analysis.

[21] Bureau of Reclamation. 2010. "Change in Discount Rate for Water Resources Planning." *Federal Register* Vol 75 No. 249. Wednesday, December 29, 2010. Page 82066.

All of the estimated losses are associated with changes in conditions that are expected to only affect the UKR, where whitewater boating for the LKR is estimated to be the same as under the No Action Alternative (i.e., no loss occurs). Because the Full Facilities Removal of Four Dams Alternative would not be implemented until 2020, whitewater boating activity between 2012 and 2020 would be similar to the No Action Alternative and therefore, would not be lost. Appendix 1 provides details on the annual estimated losses and the total discounted present value of losses over the period of analysis (2012 – 2061).

Table 8. Summary of Estimated Loss in Economic Value to Whitewater Boating from the Full Facilities Removal of Four Dams Alternative

	Estimated Loss in Consumer Surplus		
	Low	Middle	High
Upper Klamath River	($5,387,765)	($6,144,105)	($6,900,446)
Lower Klamath River	$0	$0	$0
Total	($5,387,765)	($6,144,105)	($6,900,446)

V. ESTIMATED CHANGES IN ECONOMIC EXPENDITURES FOR WHITEWATER BOATING ON KLAMATH RIVER

This section estimates the changes in annual expenditures associated with whitewater boating on the Klamath River from implementation of the Full Facilities Removal of Four Dams Alternative. Individuals visiting the Klamath River to engage in whitewater boating recreation spend money in the region purchasing gas, food and drink, lodging, guide services, and other items. The expenditures associated with these trips generate economic activity within the local region measured in terms of total industry output, labor income, and employment.

When measuring the effect of changes in annual expenditures for the local regional economy, it matters where the expenditures come from. If the expenditures are from users from outside of the local region (i.e., non-local users), it generates increased economic activity in the local region and would be considered a loss to the local economy if it did not occur. If the expenditures are from users within the local region (i.e., local users), their expenditures may or may not generate increased economic activity in the local region.

Whether expenditures from local users results in increased economic activity within the local region depends on whether the local users would have engaged in a substitute activity outside of the local region if the primary activity was not available (e.g., the local user would engage in whitewater boating on another river outside of the local area if the Klamath River was not available). Expenditures from local users associated with whitewater boating activity that would not have occurred within the local area if the Klamath River was not available would be considered an increase in local economic activity. However, expenditures by local users for a substitute activity that occurs within the local area if the Klamath River was not available do not result in an increase in economic activity. Therefore, these expenditures would not be considered a loss to the local economy because the expenditures would still occur within the local economy, but be associated with a different type of activity. Figure 1 describes the rationale for the inclusion of expenditures associated with whitewater boating use by local and non-local users in estimating total expenditures.

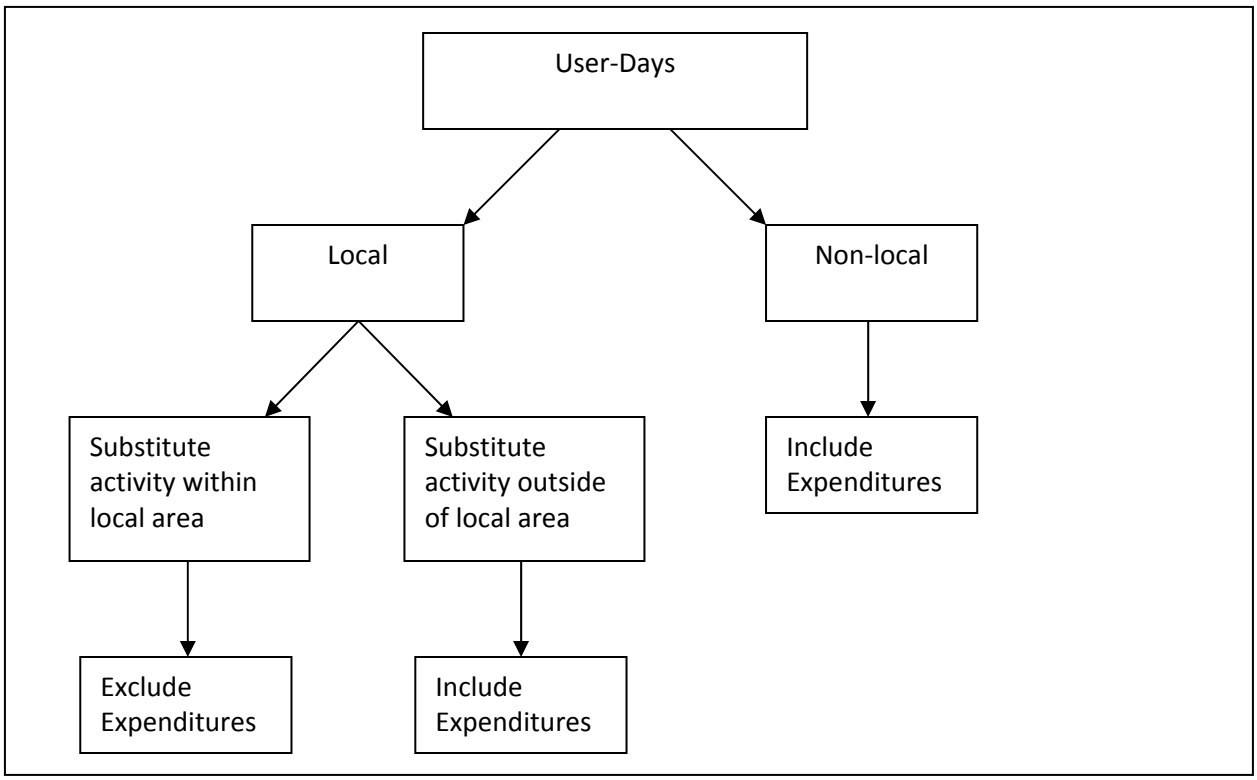

Figure 1. Rationale for Inclusion of Expenditures of Local and Nonlocal Users

In addition to differentiating use by local and non-local users, expenditures per user-day are differentiated by private and commercial users. Commercial use is associated with the use of whitewater boating outfitter for the trip, while private use are those trips taken without an outfitter. Significant portions of the Klamath River require commercial whitewater boating outfitters to obtain a permit from Bureau of Land Management (BLM) for use on the UKR and from the U.S. Forest Service (USFS) for use on the LKR. Due to the difference in whitewater boating experience between the UKR and LKR, outfitters charge different fees for trips taken on the two segments of the river. As such, a separate estimate of the average outfitter fee paid per user-day was developed for the UKR and LKR. The per user-day estimate of outfitters guide fees was based on an analysis of outfitters fees charged by outfitters permitted to provide trips on the UKR and LKR and historical information on the length of commercially guided trips taken on these two segments of the river (see Table 1 and Table 2). The primary difference between total expenditures per user-day for private and commercial use is the exclusion of outfitter guide fees for private user-days. The estimates of expenditures per user-day for expenditures other than outfitter fees (e.g., accommodations, food, gas, supplies, and shuttle services) are based on a study of whitewater boating activity on the UKR by Johnson and Moore (1993), adjusted to 2012 dollars. For the UKR, the average expenditures per user-day for private and commercial use are $176 and $333, respectively. For the LKR, average expenditures per user-day are $176 and $306 for private and commercial use, respectively. Table 9 provides a more detailed description of the per user-day expenditure estimates used for this analysis.

Table 9. Expenditures per User-day for Whitewater Boating on the Klamath River ($ 2012)

	Upper Klamath River				Lower Klamath River			
	Local		Nonlocal		Local		Nonlocal	
Expenditure	Private	Commercial	Private	Commercial	Private	Commercial	Private	Commercial
Outfitter Fees	$0	$157	$0	$157	$0	$130	$0	$130
Gasoline/fuel	$26	$26	$26	$26	$26	$26	$26	$26
Meals/food	$59	$59	$59	$59	$59	$59	$59	$59
Accommodations	$59	$59	$59	$59	$59	$59	$59	$59
Retail/supplies	$21	$21	$21	$21	$21	$21	$21	$21
Shuttle Services	$11	$11	$11	$11	$11	$11	$11	$11
Total	$176	$333	$176	$333	$176	$306	$176	$306

To estimate total direct expenditures, total user-days are differentiated by local vs. nonlocal and commercial vs. private user in order to apply the appropriate expenditure estimate from Table 9. The percentage of total use that is associated with local and non-local users was based on survey results in Johnson and Moore (1993) that showed 78 percent of total whitewater boating activity on the UKR is by non-local users. This same percentage was assumed to apply for activity on the LKR. Furthermore, the number of local user-days was adjusted to account for those local users that would have engaged in a substitute activity outside of the local area if the Klamath River was not available (see Figure 1). Following Johnson and Moore (1993), it was assumed that 11 percent of the local user-days would have been substituted to an activity outside of the local region if the Klamath River was not available. As such, expenditures associated with these user-days represent increased economic activity to the local region and should be included in the estimation of total direct expenditures. The expenditures associated with the other 89 percent of local user-days would have still occurred in the local area if the Klamath River was not available and therefore, do not represent an increase in overall economic activity in the local region and should not be included.

Table 10 provides the estimate of total annual direct expenditures for the UKR and LKR under the No Action Alternative. Estimated total average annual expenditures for the Klamath River are $4.2 million, where $1.1 million is associated with the UKR and $3.1 million with the LKR.

Table 10. Estimate of Total Annual Direct Expenditures Associated with Whitewater Boating on the Klamath River ($ 2012)

	Local						Non-local						Local and Non-local		
	User-days			Total Expenditures			User-days			Total Expenditures			Total		
	Ave.	Low	High	Ave.	Low	High	Ave.	Low	High	Ave.	Low	High	Ave.	Low	High
Upper Klamath															
Outfitter Fees	-	-	-	$15,588	$13,669	$17,506	-	-	-	$502,410	$440,564	$564,257	$517,998	$454,232	$581,764
Gasoline/fuel	-	-	-	$2,731	$2,395	$3,067	-	-	-	$88,025	$77,189	$98,861	$90,756	$79,584	$101,928
Meals/food	-	-	-	$6,326	$5,547	$7,104	-	-	-	$203,885	$178,787	$228,984	$210,211	$184,334	$236,088
Accommodations	-	-	-	$6,291	$5,516	$7,065	-	-	-	$202,756	$177,797	$227,715	$209,047	$183,313	$234,780
Retail/supplies	-	-	-	$2,294	$2,012	$2,576	-	-	-	$73,941	$64,839	$83,043	$76,235	$66,850	$85,619
Shuttle services	-	-	-	$1,185	$1,039	$1,331	-	-	-	$38,199	$33,497	$42,902	$39,385	$34,536	$44,233
Total	971	852	1,091	$34,414	$30,178	$38,651	3,443	3,019	3,867	$1,109,217	$972,672	$1,245,762	$1,143,631	$1,002,850	$1,284,412
Lower Klamath															
Outfitter Fees	-	-	-	$31,666	$29,690	$33,642	-	-	-	$1,020,637	$956,943	$1,084,331	$1,052,303	$986,633	$1,117,973
Gasoline/fuel	-	-	-	$8,904	$8,348	$9,460	-	-	-	$286,992	$269,082	$304,902	$295,896	$277,430	$314,362
Meals/food	-	-	-	$20,624	$19,337	$21,911	-	-	-	$664,738	$623,254	$706,222	$685,362	$642,591	$728,133
Accommodations	-	-	-	$20,510	$19,230	$21,790	-	-	-	$661,056	$619,802	$702,310	$681,566	$639,032	$724,099
Supplies	-	-	-	$7,479	$7,013	$7,946	-	-	-	$241,073	$226,029	$256,118	$248,553	$233,041	$264,064
Shuttle services	-	-	-	$3,864	$3,623	$4,105	-	-	-	$124,544	$116,771	$132,316	$128,408	$120,394	$136,421
Total	3,166	2,969	3,364	$93,047	$87,240	$98,854	11,225	10,525	11,926	$2,999,040	$2,811,881	$3,186,198	$3,092,087	$2,899,121	$3,285,052
Total UKR and LKR				$127,461	$117,418	$137,504				$4,108,256	$3,784,553	$4,431,960	$4,235,718	$3,901,971	$4,569,464

Note: Numbers may not sum due to rounding.

To estimate the total annual direct expenditures for whitewater boating lost due to implementation of the Full Facilities Removal of Four Dams Alternative, estimates of expenditures per user-day were combined with estimates of the number of whitewater boating user-days under this alternative. From 2012 through 2019, total annual direct expenditures for whitewater boating under the Full Facilities Removal of Four Dams Alternative would be the same as the No Action Alternative because the dams would still be in place and the level of whitewater boating use would not change. As described in Section IV, average annual whitewater boating user-days for the UKR are estimated to decline by 2,763 user-days beginning in 2020 and continue through 2061. Therefore, annual expenditures related to the decrease in whitewater boating activity would also be lost to the regional economy. All expenditures from the decreased use by non-local users would be lost because these expenditures represent economic activity that would no longer occur in the local area. However, only those expenditures from the decreased use by local users that would occur outside of the local area absent the Klamath River (i.e., 11 percent of total local user-days lost) represent economic activity that would no longer occur in the local area. The expenditures associated with the other local user-days lost (i.e., 89 percent of total local user-days lost) would still occur in the local area and therefore, do not represent a loss in economic activity to the local area. As described previously, the level of whitewater boating activity on the LKR is not expected to be affected in any measurable way and therefore, expenditures associated with whitewater boating use on the LKR would not change. Table 11 summarizes the annual loss of direct expenditures to the local regional economy from decreased whitewater boating activity resulting from the implementation of the Full Facilities Removal of Four Dams Alternative, where average annual lost expenditures was estimated as $715,903.

Table 11. Summary of Estimated Annual Whitewater Boating Expenditure Losses Resulting from the Full Facilities Removal of Four Dams Alternative

	Annual Expenditures			
	2012-2019	2020-2061		
		Average	Low	High
Upper Klamath				
Outfitter Guide Fees	$0	($324,262)	($284,345)	($364,179)
Gasoline/fuel	$0	($56,812)	($49,819)	($63,806)
Meals/food	$0	($131,590)	($115,391)	($147,789)
Accommodations	$0	($130,861)	($114,752)	($146,970)
Retail/supplies	$0	($47,722)	($41,848)	($53,597)
Shuttle services	$0	($24,654)	($21,619)	($27,689)
Total – UKR	$0	($715,903)	($627,775)	($804,030)
Lower Klamath				
Outfitter Guide Fees	$0	$0	$0	$0
Gasoline/fuel	$0	$0	$0	$0
Meals/food	$0	$0	$0	$0
Accommodations	$0	$0	$0	$0
Retail/supplies	$0	$0	$0	$0
Shuttle services	$0	$0	$0	$0
Total – LKR	$0	$0	$0	$0
Total – Klamath River	$0	($715,903)	($627,775)	($804,030)

Note: Numbers may not sum exactly due to rounding.

VI. SUMMARY

This report presents an analysis of the estimated economic effects to whitewater boating on the Klamath River from 2012 through 2061 from implementation of the Full Facilities Removal of Four Dams Alternative relative to the No Action Alternative. The economic effects analyzed include changes in economic value (i.e., consumer surplus) and changes in economic expenditures associated with whitewater boating (i.e., changes in expenditures associated with outfitter fees, food, lodging, etc.). Under the No Action Alternative, the mean total discounted economic value of whitewater boating on the Klamath River was estimated at $32.7 million ($ 2012) over the 50 year period of analysis. The mean total discounted economic value of whitewater boating under the Full Facilities Removal of Four Dams Alternative was estimated to be $26.5 million. This represents a loss in economic value of approximately $6.1 million over the 50 year period. In terms of expenditures in the local region related to whitewater boating activity, average annual expenditures under the No Action Alternative were estimated to be $4.2 million and $3.5 million for the Full Facilities Removal of Four Dams Alternative. The dam removal alternative is estimated to result in approximately an average annual loss of $716 thousand in expenditures associated with whitewater boating to the local region. It should be noted that annual losses under the Full Facilities Removal of Four Dams Alternative would not begin until 2020, the year when dam removal is projected to start, while whitewater boating activity between 2012 and 2020 would be similar to the No Action Alternative and would not be lost. Additionally, the Full Facilities Removal of Four Dams Alternative is only expected to have an effect on the UKR (primarily the Hell's Corner reach) and not have any measurable effect on whitewater boating on the LKR.

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APPENDIX 1 – ESTIMATES OF ANNUAL AND TOTAL ECONOMIC VALUE OF WHITEWATER BOATING ON THE KLAMATH RIVER

Table A1. Estimate of Annual and Total Economic Value of Whitewater Boating on the Klamath River Under the No Action Alternative (2012-2061)

		Lower Estimate			Middle Estimate			Upper Estimate		
Year	Discount Factor[1]	User-days	Undiscounted	Discounted	User-days	Undiscounted	Discounted	User-days	Undiscounted	Discounted
2012	1.00	17,364	$1,359,363	$1,359,363	18,806	$1,492,418	$1,492,418	20,247	$1,625,473	$1,625,473
2013	0.96	17,364	$1,359,363	$1,305,511	18,806	$1,492,418	$1,433,295	20,247	$1,625,473	$1,561,078
2014	0.92	17,364	$1,359,363	$1,253,792	18,806	$1,492,418	$1,376,513	20,247	$1,625,473	$1,499,235
2015	0.89	17,364	$1,359,363	$1,204,122	18,806	$1,492,418	$1,321,982	20,247	$1,625,473	$1,439,842
2016	0.85	17,364	$1,359,363	$1,156,419	18,806	$1,492,418	$1,269,610	20,247	$1,625,473	$1,382,801
2017	0.82	17,364	$1,359,363	$1,110,607	18,806	$1,492,418	$1,219,314	20,247	$1,625,473	$1,328,020
2018	0.78	17,364	$1,359,363	$1,066,609	18,806	$1,492,418	$1,171,009	20,247	$1,625,473	$1,275,410
2019	0.75	17,364	$1,359,363	$1,024,355	18,806	$1,492,418	$1,124,619	20,247	$1,625,473	$1,224,883
2020	0.72	17,364	$1,359,363	$983,774	18,806	$1,492,418	$1,080,066	20,247	$1,625,473	$1,176,358
2021	0.70	17,364	$1,359,363	$944,801	18,806	$1,492,418	$1,037,278	20,247	$1,625,473	$1,129,756
2022	0.67	17,364	$1,359,363	$907,372	18,806	$1,492,418	$996,186	20,247	$1,625,473	$1,085,000
2023	0.64	17,364	$1,359,363	$871,426	18,806	$1,492,418	$956,721	20,247	$1,625,473	$1,042,016
2024	0.62	17,364	$1,359,363	$836,903	18,806	$1,492,418	$918,820	20,247	$1,625,473	$1,000,736
2025	0.59	17,364	$1,359,363	$803,749	18,806	$1,492,418	$882,420	20,247	$1,625,473	$961,091
2026	0.57	17,364	$1,359,363	$771,907	18,806	$1,492,418	$847,462	20,247	$1,625,473	$923,017
2027	0.55	17,364	$1,359,363	$741,328	18,806	$1,492,418	$813,889	20,247	$1,625,473	$886,451
2028	0.52	17,364	$1,359,363	$711,959	18,806	$1,492,418	$781,646	20,247	$1,625,473	$851,333
2029	0.50	17,364	$1,359,363	$683,755	18,806	$1,492,418	$750,681	20,247	$1,625,473	$817,607
2030	0.48	17,364	$1,359,363	$656,667	18,806	$1,492,418	$720,942	20,247	$1,625,473	$785,217
2031	0.46	17,364	$1,359,363	$630,653	18,806	$1,492,418	$692,381	20,247	$1,625,473	$754,110
2032	0.45	17,364	$1,359,363	$605,669	18,806	$1,492,418	$664,952	20,247	$1,625,473	$724,235
2033	0.43	17,364	$1,359,363	$581,675	18,806	$1,492,418	$638,609	20,247	$1,625,473	$695,544
2034	0.41	17,364	$1,359,363	$558,631	18,806	$1,492,418	$613,310	20,247	$1,625,473	$667,989
2035	0.39	17,364	$1,359,363	$536,500	18,806	$1,492,418	$589,013	20,247	$1,625,473	$641,526
2036	0.38	17,364	$1,359,363	$515,247	18,806	$1,492,418	$565,679	20,247	$1,625,473	$616,112

2037	0.36	17,364	$1,359,363	$494,835	18,806	$1,492,418	$543,269	20,247	$1,625,473	$591,704
2038	0.35	17,364	$1,359,363	$475,231	18,806	$1,492,418	$521,747	20,247	$1,625,473	$568,263
2039	0.34	17,364	$1,359,363	$456,405	18,806	$1,492,418	$501,078	20,247	$1,625,473	$545,751
2040	0.32	17,364	$1,359,363	$438,324	18,806	$1,492,418	$481,227	20,247	$1,625,473	$524,130
2041	0.31	17,364	$1,359,363	$420,959	18,806	$1,492,418	$462,163	20,247	$1,625,473	$503,367
2042	0.30	17,364	$1,359,363	$404,283	18,806	$1,492,418	$443,854	20,247	$1,625,473	$483,425
2043	0.29	17,364	$1,359,363	$388,267	18,806	$1,492,418	$426,270	20,247	$1,625,473	$464,274
2044	0.27	17,364	$1,359,363	$372,885	18,806	$1,492,418	$409,383	20,247	$1,625,473	$445,881
2045	0.26	17,364	$1,359,363	$358,113	18,806	$1,492,418	$393,165	20,247	$1,625,473	$428,217
2046	0.25	17,364	$1,359,363	$343,926	18,806	$1,492,418	$377,590	20,247	$1,625,473	$411,253
2047	0.24	17,364	$1,359,363	$330,301	18,806	$1,492,418	$362,631	20,247	$1,625,473	$394,961
2048	0.23	17,364	$1,359,363	$317,216	18,806	$1,492,418	$348,265	20,247	$1,625,473	$379,314
2049	0.22	17,364	$1,359,363	$304,649	18,806	$1,492,418	$334,468	20,247	$1,625,473	$364,287
2050	0.22	17,364	$1,359,363	$292,580	18,806	$1,492,418	$321,218	20,247	$1,625,473	$349,856
2051	0.21	17,364	$1,359,363	$280,989	18,806	$1,492,418	$308,493	20,247	$1,625,473	$335,996
2052	0.20	17,364	$1,359,363	$269,858	18,806	$1,492,418	$296,272	20,247	$1,625,473	$322,685
2053	0.19	17,364	$1,359,363	$259,167	18,806	$1,492,418	$284,534	20,247	$1,625,473	$309,902
2054	0.18	17,364	$1,359,363	$248,900	18,806	$1,492,418	$273,262	20,247	$1,625,473	$297,625
2055	0.18	17,364	$1,359,363	$239,040	18,806	$1,492,418	$262,437	20,247	$1,625,473	$285,834
2056	0.17	17,364	$1,359,363	$229,570	18,806	$1,492,418	$252,040	20,247	$1,625,473	$274,511
2057	0.16	17,364	$1,359,363	$220,475	18,806	$1,492,418	$242,055	20,247	$1,625,473	$263,636
2058	0.16	17,364	$1,359,363	$211,741	18,806	$1,492,418	$232,466	20,247	$1,625,473	$253,191
2059	0.15	17,364	$1,359,363	$203,353	18,806	$1,492,418	$223,257	20,247	$1,625,473	$243,161
2060	0.14	17,364	$1,359,363	$195,297	18,806	$1,492,418	$214,412	20,247	$1,625,473	$233,528
2061	0.14	17,364	$1,359,363	$187,560	18,806	$1,492,418	$205,918	20,247	$1,625,473	$224,277
Total		**868,211**	**NA**	**$29,766,715**	**940,287**	**NA**	**$32,680,291**	**1,012,362**	**NA**	**$35,593,868**

[1]Discount factor based on discount rate of 4.125% - Bureau of Reclamation, 2010.

Table A2. Estimate of Annual and Total Economic Value of Whitewater Boating on the Klamath River Under the Full Facilities Removal of Four Dams Alternative (2012-2061)

		Lower Estimate			Middle Estimate			Upper Estimate		
Year	Discount Factor[1]	User-days	Undiscounted	Discounted	User-days	Undiscounted	Discounted	User-days	Undiscounted	Discounted
2012	1.00	17,364	$1,359,363	$1,359,363	18,806	$1,492,418	$1,492,418	20,247	$1,625,473	$1,625,473
2013	0.96	17,364	$1,359,363	$1,305,511	18,806	$1,492,418	$1,433,295	20,247	$1,625,473	$1,561,078
2014	0.92	17,364	$1,359,363	$1,253,792	18,806	$1,492,418	$1,376,513	20,247	$1,625,473	$1,499,235
2015	0.89	17,364	$1,359,363	$1,204,122	18,806	$1,492,418	$1,321,982	20,247	$1,625,473	$1,439,842
2016	0.85	17,364	$1,359,363	$1,156,419	18,806	$1,492,418	$1,269,610	20,247	$1,625,473	$1,382,801
2017	0.82	17,364	$1,359,363	$1,110,607	18,806	$1,492,418	$1,219,314	20,247	$1,625,473	$1,328,020
2018	0.78	17,364	$1,359,363	$1,066,609	18,806	$1,492,418	$1,171,009	20,247	$1,625,473	$1,275,410
2019	0.75	17,364	$1,359,363	$1,024,355	18,806	$1,492,418	$1,124,619	20,247	$1,625,473	$1,224,883
2020	0.72	14,941	$998,328	$722,492	16,043	$1,080,701	$782,105	17,144	$1,163,073	$841,719
2021	0.70	14,941	$998,328	$693,870	16,043	$1,080,701	$751,122	17,144	$1,163,073	$808,373
2022	0.67	14,941	$998,328	$666,382	16,043	$1,080,701	$721,365	17,144	$1,163,073	$776,349
2023	0.64	14,941	$998,328	$639,983	16,043	$1,080,701	$692,788	17,144	$1,163,073	$745,593
2024	0.62	14,941	$998,328	$614,629	16,043	$1,080,701	$665,343	17,144	$1,163,073	$716,056
2025	0.59	14,941	$998,328	$590,280	16,043	$1,080,701	$638,984	17,144	$1,163,073	$687,689
2026	0.57	14,941	$998,328	$566,896	16,043	$1,080,701	$613,671	17,144	$1,163,073	$660,445
2027	0.55	14,941	$998,328	$544,438	16,043	$1,080,701	$589,359	17,144	$1,163,073	$634,281
2028	0.52	14,941	$998,328	$522,869	16,043	$1,080,701	$566,011	17,144	$1,163,073	$609,154
2029	0.50	14,941	$998,328	$502,155	16,043	$1,080,701	$543,588	17,144	$1,163,073	$585,021
2030	0.48	14,941	$998,328	$482,262	16,043	$1,080,701	$522,054	17,144	$1,163,073	$561,845
2031	0.46	14,941	$998,328	$463,157	16,043	$1,080,701	$501,372	17,144	$1,163,073	$539,587
2032	0.45	14,941	$998,328	$444,809	16,043	$1,080,701	$481,510	17,144	$1,163,073	$518,211
2033	0.43	14,941	$998,328	$427,187	16,043	$1,080,701	$462,434	17,144	$1,163,073	$497,682
2034	0.41	14,941	$998,328	$410,264	16,043	$1,080,701	$444,115	17,144	$1,163,073	$477,966
2035	0.39	14,941	$998,328	$394,011	16,043	$1,080,701	$426,521	17,144	$1,163,073	$459,031
2036	0.38	14,941	$998,328	$378,402	16,043	$1,080,701	$409,624	17,144	$1,163,073	$440,846

2037	0.36	14,941	$998,328	$363,411	16,043	$1,080,701	$393,396	17,144	$1,163,073	$423,381
2038	0.35	14,941	$998,328	$349,014	16,043	$1,080,701	$377,811	17,144	$1,163,073	$406,609
2039	0.34	14,941	$998,328	$335,188	16,043	$1,080,701	$362,844	17,144	$1,163,073	$390,501
2040	0.32	14,941	$998,328	$321,909	16,043	$1,080,701	$348,470	17,144	$1,163,073	$375,031
2041	0.31	14,941	$998,328	$309,156	16,043	$1,080,701	$334,665	17,144	$1,163,073	$360,173
2042	0.30	14,941	$998,328	$296,909	16,043	$1,080,701	$321,407	17,144	$1,163,073	$345,905
2043	0.29	14,941	$998,328	$285,146	16,043	$1,080,701	$308,674	17,144	$1,163,073	$332,202
2044	0.27	14,941	$998,328	$273,850	16,043	$1,080,701	$296,446	17,144	$1,163,073	$319,041
2045	0.26	14,941	$998,328	$263,001	16,043	$1,080,701	$284,702	17,144	$1,163,073	$306,402
2046	0.25	14,941	$998,328	$252,582	16,043	$1,080,701	$273,423	17,144	$1,163,073	$294,264
2047	0.24	14,941	$998,328	$242,576	16,043	$1,080,701	$262,591	17,144	$1,163,073	$282,606
2048	0.23	14,941	$998,328	$232,966	16,043	$1,080,701	$252,188	17,144	$1,163,073	$271,410
2049	0.22	14,941	$998,328	$223,737	16,043	$1,080,701	$242,198	17,144	$1,163,073	$260,658
2050	0.22	14,941	$998,328	$214,873	16,043	$1,080,701	$232,603	17,144	$1,163,073	$250,332
2051	0.21	14,941	$998,328	$206,361	16,043	$1,080,701	$223,388	17,144	$1,163,073	$240,415
2052	0.20	14,941	$998,328	$198,186	16,043	$1,080,701	$214,538	17,144	$1,163,073	$230,891
2053	0.19	14,941	$998,328	$190,335	16,043	$1,080,701	$206,039	17,144	$1,163,073	$221,744
2054	0.18	14,941	$998,328	$182,794	16,043	$1,080,701	$197,877	17,144	$1,163,073	$212,959
2055	0.18	14,941	$998,328	$175,553	16,043	$1,080,701	$190,038	17,144	$1,163,073	$204,523
2056	0.17	14,941	$998,328	$168,598	16,043	$1,080,701	$182,509	17,144	$1,163,073	$196,420
2057	0.16	14,941	$998,328	$161,919	16,043	$1,080,701	$175,279	17,144	$1,163,073	$188,639
2058	0.16	14,941	$998,328	$155,504	16,043	$1,080,701	$168,335	17,144	$1,163,073	$181,166
2059	0.15	14,941	$998,328	$149,344	16,043	$1,080,701	$161,666	17,144	$1,163,073	$173,989
2060	0.14	14,941	$998,328	$143,428	16,043	$1,080,701	$155,262	17,144	$1,163,073	$167,096
2061	0.14	14,941	$998,328	$137,746	16,043	$1,080,701	$149,111	17,144	$1,163,073	$160,476
Total		**766,443**	**NA**	**$24,378,950**	**824,232**	**NA**	**$26,536,186**	**882,021**	**NA**	**$28,693,421**

[1]Discount factor based on discount rate of 4.125% - Bureau of Reclamation, 2010.

Table A3. Estimate of Change in Annual and Total Economic Value for Whitewater Boating on the Klamath River Resulting from the Full Facilities Removal of Four Dams Alternative (2012-2061)

		Lower Estimate			Middle Estimate			Upper Estimate		
Year	Discount Factor[1]	User-days Lost	Undiscounted	Discounted	User-days Lost	Undiscounted	Discounted	User-days Lost	Undiscounted	Discounted
2012	1.00	0	$0	$0	0	$0	$0	0	$0	$0
2013	0.96	0	$0	$0	0	$0	$0	0	$0	$0
2014	0.92	0	$0	$0	0	$0	$0	0	$0	$0
2015	0.89	0	$0	$0	0	$0	$0	0	$0	$0
2016	0.85	0	$0	$0	0	$0	$0	0	$0	$0
2017	0.82	0	$0	$0	0	$0	$0	0	$0	$0
2018	0.78	0	$0	$0	0	$0	$0	0	$0	$0
2019	0.75	0	$0	$0	0	$0	$0	0	$0	$0
2020	0.72	(2,423)	$361,035	$261,282	(2,763)	$411,717	$297,961	(3,103)	$462,400	$334,640
2021	0.70	(2,423)	$361,035	$250,931	(2,763)	$411,717	$286,157	(3,103)	$462,400	$321,383
2022	0.67	(2,423)	$361,035	$240,990	(2,763)	$411,717	$274,820	(3,103)	$462,400	$308,651
2023	0.64	(2,423)	$361,035	$231,443	(2,763)	$411,717	$263,933	(3,103)	$462,400	$296,423
2024	0.62	(2,423)	$361,035	$222,274	(2,763)	$411,717	$253,477	(3,103)	$462,400	$284,680
2025	0.59	(2,423)	$361,035	$213,469	(2,763)	$411,717	$243,435	(3,103)	$462,400	$273,402
2026	0.57	(2,423)	$361,035	$205,012	(2,763)	$411,717	$233,792	(3,103)	$462,400	$262,571
2027	0.55	(2,423)	$361,035	$196,890	(2,763)	$411,717	$224,530	(3,103)	$462,400	$252,169
2028	0.52	(2,423)	$361,035	$189,090	(2,763)	$411,717	$215,635	(3,103)	$462,400	$242,179
2029	0.50	(2,423)	$361,035	$181,599	(2,763)	$411,717	$207,092	(3,103)	$462,400	$232,585
2030	0.48	(2,423)	$361,035	$174,405	(2,763)	$411,717	$198,888	(3,103)	$462,400	$223,371
2031	0.46	(2,423)	$361,035	$167,496	(2,763)	$411,717	$191,009	(3,103)	$462,400	$214,522
2032	0.45	(2,423)	$361,035	$160,860	(2,763)	$411,717	$183,442	(3,103)	$462,400	$206,024
2033	0.43	(2,423)	$361,035	$154,488	(2,763)	$411,717	$176,175	(3,103)	$462,400	$197,862
2034	0.41	(2,423)	$361,035	$148,367	(2,763)	$411,717	$169,195	(3,103)	$462,400	$190,023
2035	0.39	(2,423)	$361,035	$142,490	(2,763)	$411,717	$162,493	(3,103)	$462,400	$182,496
2036	0.38	(2,423)	$361,035	$136,845	(2,763)	$411,717	$156,055	(3,103)	$462,400	$175,266

2037	0.36	(2,423)	$361,035	$131,424	(2,763)	$411,717	$149,873	(3,103)	$462,400	$168,323
2038	0.35	(2,423)	$361,035	$126,217	(2,763)	$411,717	$143,936	(3,103)	$462,400	$161,654
2039	0.34	(2,423)	$361,035	$121,217	(2,763)	$411,717	$138,234	(3,103)	$462,400	$155,250
2040	0.32	(2,423)	$361,035	$116,415	(2,763)	$411,717	$132,757	(3,103)	$462,400	$149,100
2041	0.31	(2,423)	$361,035	$111,803	(2,763)	$411,717	$127,498	(3,103)	$462,400	$143,193
2042	0.30	(2,423)	$361,035	$107,374	(2,763)	$411,717	$122,447	(3,103)	$462,400	$137,520
2043	0.29	(2,423)	$361,035	$103,120	(2,763)	$411,717	$117,596	(3,103)	$462,400	$132,072
2044	0.27	(2,423)	$361,035	$99,035	(2,763)	$411,717	$112,938	(3,103)	$462,400	$126,840
2045	0.26	(2,423)	$361,035	$95,112	(2,763)	$411,717	$108,463	(3,103)	$462,400	$121,815
2046	0.25	(2,423)	$361,035	$91,344	(2,763)	$411,717	$104,167	(3,103)	$462,400	$116,990
2047	0.24	(2,423)	$361,035	$87,725	(2,763)	$411,717	$100,040	(3,103)	$462,400	$112,355
2048	0.23	(2,423)	$361,035	$84,250	(2,763)	$411,717	$96,077	(3,103)	$462,400	$107,904
2049	0.22	(2,423)	$361,035	$80,912	(2,763)	$411,717	$92,271	(3,103)	$462,400	$103,629
2050	0.22	(2,423)	$361,035	$77,707	(2,763)	$411,717	$88,615	(3,103)	$462,400	$99,524
2051	0.21	(2,423)	$361,035	$74,628	(2,763)	$411,717	$85,105	(3,103)	$462,400	$95,581
2052	0.20	(2,423)	$361,035	$71,672	(2,763)	$411,717	$81,733	(3,103)	$462,400	$91,795
2053	0.19	(2,423)	$361,035	$68,832	(2,763)	$411,717	$78,495	(3,103)	$462,400	$88,158
2054	0.18	(2,423)	$361,035	$66,106	(2,763)	$411,717	$75,386	(3,103)	$462,400	$84,666
2055	0.18	(2,423)	$361,035	$63,487	(2,763)	$411,717	$72,399	(3,103)	$462,400	$81,311
2056	0.17	(2,423)	$361,035	$60,972	(2,763)	$411,717	$69,531	(3,103)	$462,400	$78,090
2057	0.16	(2,423)	$361,035	$58,556	(2,763)	$411,717	$66,776	(3,103)	$462,400	$74,997
2058	0.16	(2,423)	$361,035	$56,237	(2,763)	$411,717	$64,131	(3,103)	$462,400	$72,026
2059	0.15	(2,423)	$361,035	$54,009	(2,763)	$411,717	$61,590	(3,103)	$462,400	$69,172
2060	0.14	(2,423)	$361,035	$51,869	(2,763)	$411,717	$59,150	(3,103)	$462,400	$66,432
2061	0.14	(2,423)	$361,035	$49,814	(2,763)	$411,717	$56,807	(3,103)	$462,400	$63,800
Total		**(101,768)**	**NA**	**($5,387,765)**	**(116,055)**	**NA**	**($6,144,105)**	**(130,341)**	**NA**	**($6,900,446)**

[1]Discount factor based on discount rate of 4.125% - Bureau of Reclamation, 2010.