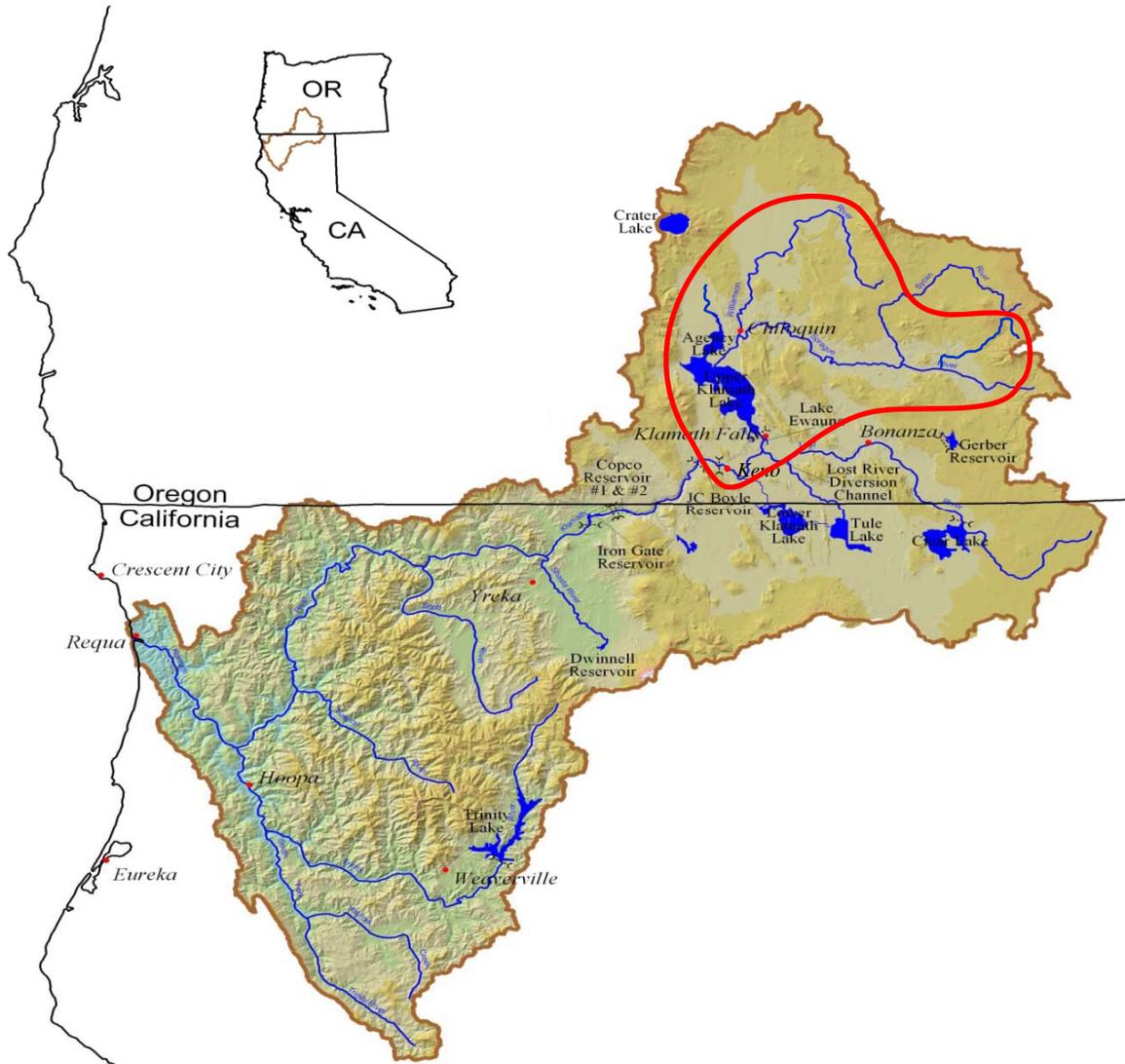


# Projected Restoration Actions and Associated Costs Under the Klamath Basin Restoration Agreement for the Upper Klamath River Basin Above Keno, Oregon

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## **Projected Restoration Actions and Associated Costs Under the Klamath Basin Restoration Agreement for the Upper Klamath River Basin Above Keno, Oregon**

- We outlined projected restoration activities for the Upper Klamath River Basin (above Keno), focusing on the geographic scope identified in the Klamath Basin Restoration Agreement (KBRA). Elements of the KBRA budget (Appendix C-2) covered here include row numbers 3, 4, 5, 6, 8, 9, 11, 12, and 90. These activities are intended to improve conditions affecting fish production, survival, and recovery in and above Keno Reservoir and Upper Klamath Lake, with an emphasis on valley-floor rivers and streams. Consequently, areas targeted for these activities are predominately privately-owned, but some publicly managed lands are included. In addition to providing direct benefits to the Upper Klamath Basin, the significant improvements to water quality and nutrient/organic loads expected to result from these actions will benefit the Klamath River for many miles downstream of Keno.
- We did not prioritize restoration activities. Instead, we identified suites of activities by sub-basin that will be fed into the process producing the Phase I Fisheries Restoration Plan under KBRA Section 10.1, which will finalize and prioritize Phase I habitat restoration actions. The Phase I plan will also be informed by an extensive evaluation of past restoration projects that is presently under way, a product of funding by the National Fish and Wildlife Foundation and the Oregon Watershed Enhancement Board.
- Restoration activities and associated costs listed in this document represent the consolidated knowledge and opinions of many Klamath Basin professionals. Users of this information should consider that:
  - Targeted activities and associated costs integrate current scientific understanding, professional judgment, and project experience from a number of experts in fisheries, restoration, and other disciplines from throughout the Klamath Basin representing a variety of sources (e.g., Tribes, watershed councils, non-governmental organizations, and government agencies).
  - Consistent with the basin-wide commitment to adaptive management expressed in the KBRA, the nature, scope, and priority of restoration actions will likely change as scientific understanding and experience with restoration measures reveal more effective or efficient approaches.
- Monitoring needs are substantial and very important to the long-term, successful implementation of this Upper Basin restoration initiative. Monitoring costs are not included in this document, which is meant to detail on-the-ground project work. Monitoring costs covered by the KBRA are detailed in Appendix C-2 rows 37-59.
- Costs were calculated including a 30% “Implementation Cost” to provide necessary support (staff, environmental compliance, permitting, fiscal management, contract management, etc.), without which the necessary work cannot be accomplished. Costs are listed 2007 dollars to be consistent with Appendix C-2 of the KBRA, which also uses 2007 dollars.
- Increased capacity for key organizations at the local level will be very important to successfully implement restoration activities of the magnitude needed to meet the social, economic, and ecosystem goals of the Klamath Basin Restoration Agreement, the Klamath Hydroelectric Settlement Agreement, the Oregon Plan for Salmon and Watersheds, and Oregon’s Water Quality Management Plan for TMDL attainment.

			KBRA Restoration Needs for Basin Above Keno					
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
<b>Williamson River</b>								
Main Stem	Riparian Corridor Management	Fence construction and offstream watering	25	50	\$1,320,000	\$396,000	\$1,716,000	Miles. Cost to build fence is \$4 per foot; used \$5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	56	112	\$562,909	\$168,873	\$731,782	Miles. Costs based on a 4 person crew @ \$40 per hour working full time for 9 months per year, plus \$60,000 for supplies including vehicles, fencing materials, etc., which totals \$3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Riparian corridor management agreements	38	1,386	\$2,079,360	\$623,808	\$2,703,168	Riparian acres. 38 miles of river at 0.057 miles (300 ft) wide = 1,386 acres * \$1,500/acre. Acreage, and \$/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22).
	Stream Channel Restoration	Levee removal, setback, or breaching	1	2	\$300,000	\$90,000	\$390,000	Miles. Levees on lower Williamson River; costs of \$150,000 per mile based on recent projects completed by KFFWO.
		Physical habitat improvements	12	12	\$420,000	\$126,000	\$546,000	Miles. \$35,000 per mile to increase rearing capacity using large wood and to increase spawning habitat with gravel placement. Emphasis on maximizing productivity and capacity for early life stages of anadromous fish to facilitate reintroduction.
	Lower Williamson Delta Adaptive Management	Native vegetation management		5,500	\$450,000	\$135,000	\$585,000	Acres. Establishing desirable native plant species (e.g., culturally and ecologically significant species like wocus), and eradicating non-native species. One FTE for 6 months per year estimated at \$60,000 salary = \$30,000 per year for 10 years plus supplies of \$15,000 per year.
Improve quality of and connectivity among endangered sucker nursery habitats			5,500	\$291,360	\$87,408	\$378,768	Acres. Includes future earthwork and other activities to improve existing habitats and hydrologic connectivity allowing larval fish better access to all nursery areas within the Delta. Cost of moving 58,272 cubic yards of material at \$5 per cubic yard; based on previous work in Delta.	
Tributaries	Riparian Corridor Management	Fence construction and offstream watering	2.2	4.4	\$116,160	\$34,848	\$151,008	Miles. Spring Ck, Larkin Ck. Cost to build fence is \$4 per foot; used \$5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	5	10	\$50,260	\$15,078	\$65,338	Miles. Costs based on a 4 person crew @ \$40 per hour working full time for 9 months per year, plus \$60,000 for supplies including vehicles, fencing materials, etc., which totals \$3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Riparian corridor management agreements	2.5	91.2	\$136,800	\$41,040	\$177,840	Riparian acres. 2.5 miles of river at 0.057 mi (300 feet wide) = 91.2 acres * \$1,500/acre. Acreage, and \$/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22).
	Stream Channel Restoration	Channel narrowing	2.1	2.1	\$252,000	\$75,600	\$327,600	Miles. Larkin Ck and Sunnybrook Ck. Cost estimates based on KFFWO experience @ \$120,000 per mile. Planning and review required, final delineation may change.
		Physical habitat improvements	5	5	\$175,000	\$52,500	\$227,500	Miles. \$35,000 per mile to increase rearing capacity using large wood and to increase spawning habitat with gravel placement. Emphasis on maximizing productivity and capacity for early life stages of anadromous fish to facilitate reintroduction.
<b>Totals</b>							<b>\$8,000,000</b>	

			KBRA Restoration Needs for Basin Above Keno					
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
<b>Sprague River mainstem</b>								
Main Stem	Riparian Corridor Management	Fence construction and offstream watering	65.0	130	\$3,432,000	\$1,029,600	\$4,461,600	Miles. North Fork (10 miles), South Fork (15 miles), and Sycan below Coyote Bucket (12 miles), main stem (28 miles). Cost to build fence is \$4 per foot, used \$5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	110	220	\$1,105,714	\$331,714	\$1,437,429	Miles. Costs based on a 4 person crew @ \$40 per hour working full time for 9 months per year, plus \$60,000 for supplies including vehicles, fencing materials, etc., which totals \$3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Grazing management		1 FTE	\$500,000	\$150,000	\$650,000	Salary. Cost covers one grazing management specialist to assist landowners with developing ranch management plans that meet landowner needs and maintain/enhance the riparian corridor conditions. Could be a consultant or a staff member, 5 years full time, part-time thereafter, will cover Sprague River tributaries as well.
		Improving dryland range to reduce need for riparian pastures		19,000	\$3,075,000	\$922,500	\$3,997,500	Acres. 19,000 acre estimate = 8,000 acres dryland range ripped and re-seeded @ \$75 per acre, plus juniper removal and re-seeding on 11,000 acres of uplands @ \$225 per acre. Intent is to increase dry rangeland alternatives to riparian grazing, may increase water infiltration rate, and may reduce ET water loss via juniper. Planning and review required, final delineation may change.
		Riparian corridor management agreements	85	6,202	\$9,302,400	\$2,790,720	\$12,093,120	Riparian acres. Assumes riparian corridor 0.114 miles (600 feet) wide by 85 miles long = 6,202 acres * \$1,500/acre. Acreage, and \$/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22). Includes Sprague tributaries.
	Stream Channel Restoration	Levee removal, setback, or breaching	20	30	\$4,500,000	\$1,350,000	\$5,850,000	Miles. Cost is \$150,000 per mile based on previous completed KFFWO projects. Focus is on reconnecting floodplains and re-establishing associated hydrologic processes.
		Whole channel reconstruction	10	15	\$8,298,240	\$2,489,472	\$10,787,712	Miles. Fifteen miles on South Fork Sprague, extrapolated costs from Crane Creek project. Extensive planning is required, including manging flood risk to Bly, final delineation may change.
		Physical habitat improvements	22	22	\$2,640,000	\$792,000	\$3,432,000	Miles. Includes measures to enhance fish use of thermal refugia (e.g. overhangs, narrowing, structural complexity), enhance rearing capacity (e.g. large wood, off channel habitats, structural complexity), enhance spawning habitats (e.g. gravel placement), site-specific narrowing or channel re-alignment. Cost estimated at \$120,000 per mile. Extensive planning and review required, final delineation may change.
		Spring improvement, enhancement, and reconnection		20	\$1,521,380	\$456,414	\$1,977,794	Number of springs. Includes revegetating and reconstructing outlet channels, substrate treatments, and morphological changes to spring ponds. Guidance from FLIR and TIR coverages.
	Fish Passage	Barrier and impediment removal		2	\$300,000	\$90,000	\$390,000	Number of impediments. Fish passage impediments will be eliminated by modifying two diversions on the South Fork Sprague.
<b>Totals</b>							<b>\$45,077,150</b>	

			KBRA Restoration Needs for Basin Above Keno					
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
<b>Sprague River tributaries</b>								
Tributaries	Riparian Corridor Management	Fence construction and offstream watering	38	76	\$2,006,400	\$601,920	\$2,608,320	Miles. Fivemile (2 miles), Fishhole (7 miles), Meryl (5 miles), Trout (3 miles), Snake (2 miles), Deming (3 miles), Whiskey (6 miles), Brown Ck/Spring Ck (4 miles), Sycan from Torrent to Coyote Bucket (6 miles on Teddy Powers Meadow and Sycan Ford). Cost to build fence is \$4 per foot, used \$5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	66	132	\$663,429	\$199,029	\$862,457	Miles. Costs based on a 4 person crew @ \$40 per hour working full time for 9 months per year, plus \$60,000 for supplies including vehicles, fencing materials, etc., which totals \$3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Riparian corridor management agreements	52	1,897	\$2,845,440	\$853,632	\$3,699,072	Riparian acres. Assumes riparian corridor 0.057 miles (300 feet) wide by 52 miles long = 1,897 acres * \$1,500/acre. Acreage, and \$/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22). Includes Sprague tributaries.
	Stream Channel Restoration	Levee removal, setback, or breaching	8	16	\$2,400,000	\$720,000	\$3,120,000	Miles. Levees on Five Mile (2 miles), Fishhole (4 miles), Merrill (1 mile), Trout (2 miles), Whiskey (4 miles), Sycan (1 mile), Deming (1 mile), Brown (1 mile). Cost is \$150,000 per mile based on previous completed KFFWO projects. Focus is on reconnecting floodplains and re-establishing associated hydrologic processes.
		Whole channel reconstruction	10	10	\$3,000,000	\$900,000	\$3,900,000	Miles. Brownworth (0.5 miles), Paradise (0.5 miles), Ish Tish (1 mile), Deming (4 miles), Mercer (1 mile), Fivemile (1 mile), Whiskey (1 mile), Trout (1 mile). Extensive planning and review required, final delineation may change.
		Physical habitat improvements	15	15	\$1,800,000	\$540,000	\$2,340,000	Miles. Includes measures to enhance fish use of thermal refugia (e.g. overhangs, narrowing, structural complexity), enhance rearing capacity (e.g. large wood, off channel habitats, structural complexity), enhance spawning habitats (e.g. gravel placement), site-specific narrowing or channel re-alignment. Cost esimated at \$120,000 per mile. Extensive planning and review required, final delineation may change.
		Spring improvement, enhancement, and reconnection		20	\$1,000,000	\$300,000	\$1,300,000	Number of springs. Includes revegetating and reconstructing outlet channels, substrate treatments, and morphological changes to spring ponds.
	Fish Passage	Barrier and impediment removal		6	\$450,000	\$135,000	\$585,000	Number of impediments. Fishhole and Whiskey cks.
	Water quality improvement	Treatment wetlands for irrigation drainwater		3	\$60,000	\$18,000	\$78,000	Number of wetlands. Cost per treatment wetland \$20,000, covers Sprague main stem and tributaries. Planning and review required, final delineation may change.
<b>Totals</b>							<b>\$18,492,850</b>	

			KBRA Restoration Needs for Basin Above Keno					
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
<b>Wood River mainstem</b>								
Main Stem Wood	Riparian Corridor Management	Fence construction and offstream watering	12.5	25	\$660,000	\$198,000	\$858,000	Miles. Cost to build fence is \$4 per foot, used \$5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	21	42	\$211,091	\$63,327	\$274,418	Miles. Costs based on a 4 person crew @ \$40 per hour working full time for 9 months per year, plus \$60,000 for supplies including vehicles, fencing materials, etc., which totals \$3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Grazing management		1 FTE	\$500,000	\$150,000	\$650,000	Salary. Cost covers one grazing management specialist to assist landowners with developing ranch management plans that meet landowner needs and maintain/enhance the riparian corridor conditions. Could be a consultant or a staff member, 5 years full time, part-time thereafter, will cover Wood River tributaries as well.
		Riparian corridor management agreements		720	\$1,080,000	\$324,000	\$1,404,000	Riparian acres. Acreage needed to complete work started by KBRT. Acreage, and \$1,500/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22).
	Stream Channel Restoration	Levee removal, setback, or breaching	3	3	\$450,000	\$135,000	\$585,000	Miles. Does not include the 2 miles above mouth (may be added later, pending analysis). Includes 3 miles immediately south of Weed Road. Costs are based on Wayne Ranch and similar projects completed by KFFWO.
		Physical habitat improvements	15.4	15.4	\$539,000	\$161,700	\$700,700	Miles. \$35,000 per mile to increase rearing capacity using large wood and to increase spawning habitat with gravel placement. Emphasis on maximizing productivity and capacity for early life stages of anadromous fish to facilitate reintroduction.
Wood River Tributaries	Riparian Corridor Management	Fence construction and offstream watering	13	26	\$686,400	\$205,920	\$892,320	Miles. Sun Ck (2 miles), Annie Ck (6 miles), and Crooked Ck (5 miles). Cost to build fence is \$4 per foot, used \$5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	19	38	\$190,987	\$57,296	\$248,283	Miles. Costs based on a 4 person crew @ \$40 per hour working full time for 9 months per year, plus \$60,000 for supplies including vehicles, fencing materials, etc., which totals \$3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
	Stream Channel Restoration	Physical habitat improvements		7	\$75,000	\$22,500	\$97,500	Miles. \$52,000 for upper 5 miles of Crooked Creek, \$21,000 for two miles of Fort Creek.
		Whole channel reconstruction		3	\$1,658,202	\$497,461	\$2,155,663	Miles. Sun Ck (2 miles), Annie Ck (1 mile). Costs based on Crane Ck and similar projects completed recently by KFFWO.
<b>Totals</b>							<b>\$7,865,880</b>	

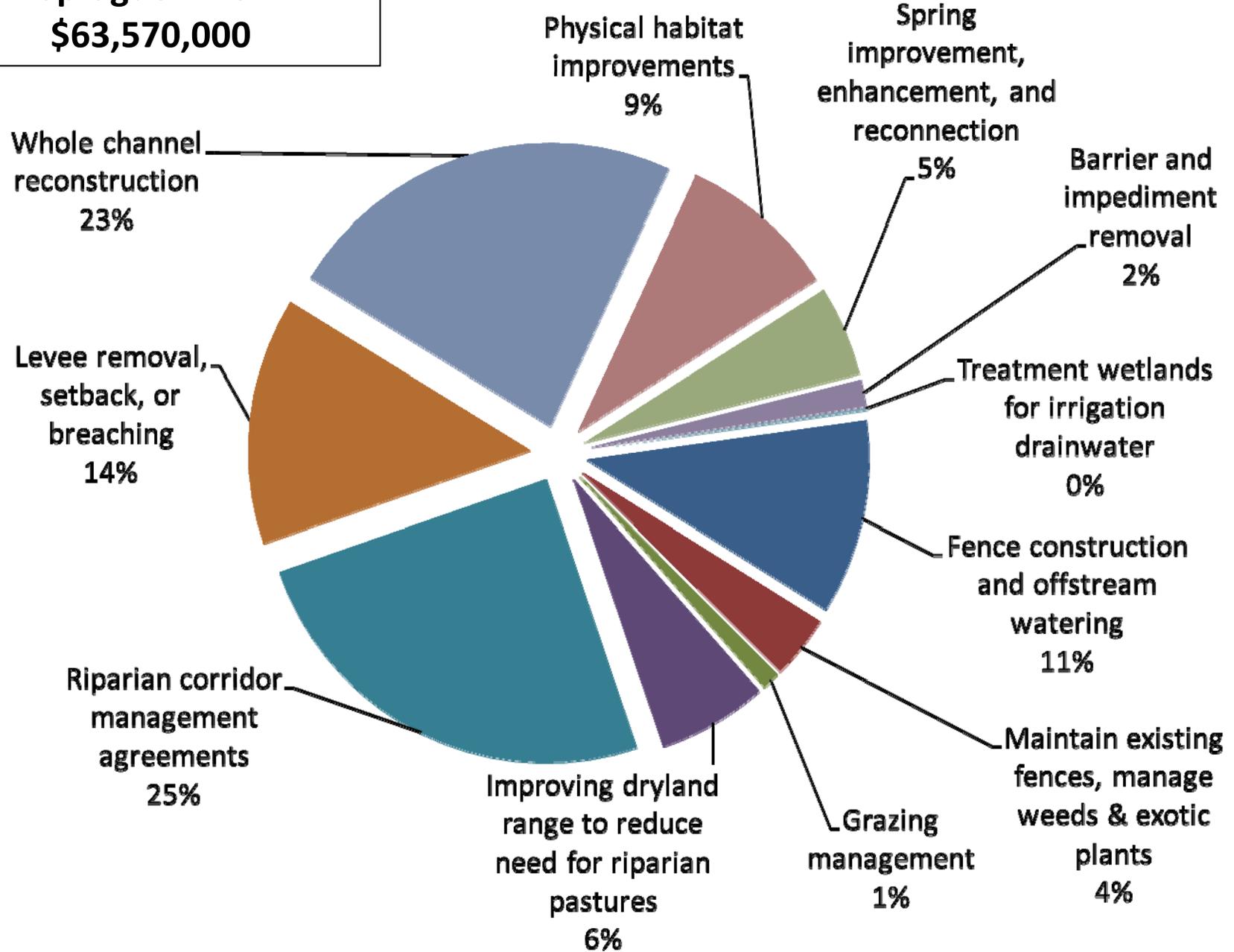
			KBRA Restoration Needs for Basin Above Keno					
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
<b>Wood River tributaries</b>								
Sevenmile Creek/Canal System	Riparian Corridor Management	Fence construction and offstream watering	3	6	\$158,400	\$47,520	\$205,920	Miles. Short Ck and Crane Ck (not including Forest Service; fence is needed only between McQuiston Road and start of Federal property at Barnes Ranch). Cost to build fence is \$4 per foot, used \$5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	23	46	\$231,195	\$69,358	\$300,553	Miles. Costs based on a 4 person crew @ \$40 per hour working full time for 9 months per year, plus \$60,000 for supplies including vehicles, fencing materials, etc., which totals \$3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
		Riparian corridor management agreements		175	\$262,500	\$78,750	\$341,250	Riparian acres. Includes Fourmile system. Acreage needed to complete work started by KBRT. Acreage, and \$1,500/acre estimated value (based on existing Federal agreement mechanisms), may be modified by OPWAS (KBRA Sec 16) and/or GCP (KBRA Sec 22).
	Stream Channel Restoration	Whole channel reconstruction	3.0	4.5	\$2,489,715	\$746,915	\$3,236,630	Miles. Lower channelized 3 miles on Sevenmile Ck above federally ownership will be restored to 4.5 miles of channel. Costs are based on other recent, similar projects competed by KFFWO. Extensive planning and review are needed, actions will undergo NEPA process, final delineation may change.
Fourmile Creek/Canal System	Riparian Corridor Management	Fence construction and offstream watering	1	1	\$26,400	\$7,920	\$34,320	Miles. Fourmile Creek above Fourmile Canal. Cost to build fence is \$4 per foot; used \$5 per foot to account for offstream watering facility cost.
		Maintain existing fences, manage weeds & exotic plants	8	16	\$80,416	\$24,125	\$104,540	Miles. Costs based on a 4 person crew @ \$40 per hour working full time for 9 months per year, plus \$60,000 for supplies including vehicles, fencing materials, etc., which totals \$3,096,000 over 10 years. Costs are allocated across Wood, Williamson, and Sprague river sub-basins, weighted by stream miles.
	Stream Channel Restoration	Whole channel reconstruction	1.5	2.3	\$1,239,156	\$371,747	\$1,610,903	Miles. Changing lower channelized portion of Fourmile Ck. Costs are based on other recent, similar projects competed by KFFWO.
<b>Totals</b>							<b>\$5,834,120</b>	

KBRA Restoration Needs for Basin Above Keno								
Reach	Restoration target	Activities	Miles of Stream	Miles, acres, or number of activity	Estimated Cost	Implementation Costs @ 30%	Total with implementation costs	Details
<b>Upper Klamath Lake</b>								
Upper Klamath/ Agency Lake	Lake-fringe Wetlands Restoration	Floodplain wetland restoration and storage		10	\$9,615,385	\$2,884,616	\$12,500,001	Miles. Ten miles of levee material to be removed and utilized for additional habitat features such as raised channels or island habitats. Effort will be coordinated with Sevenmile Creek channel reconstruction in the Wood River. Costs based on similar activities at the Williamson River Delta. Extensive planning and review are needed, actions will undergo NEPA process, final delineation may change.
	Physical habitat improvement	Enhance endangered sucker spawning habitat in springs		10	\$153,846	\$46,154	\$200,000	Number of spawning sites. Improvements mostly involve adding gravel to springs used by endangered suckers.
<b>Totals</b>							<b>\$12,700,000</b>	

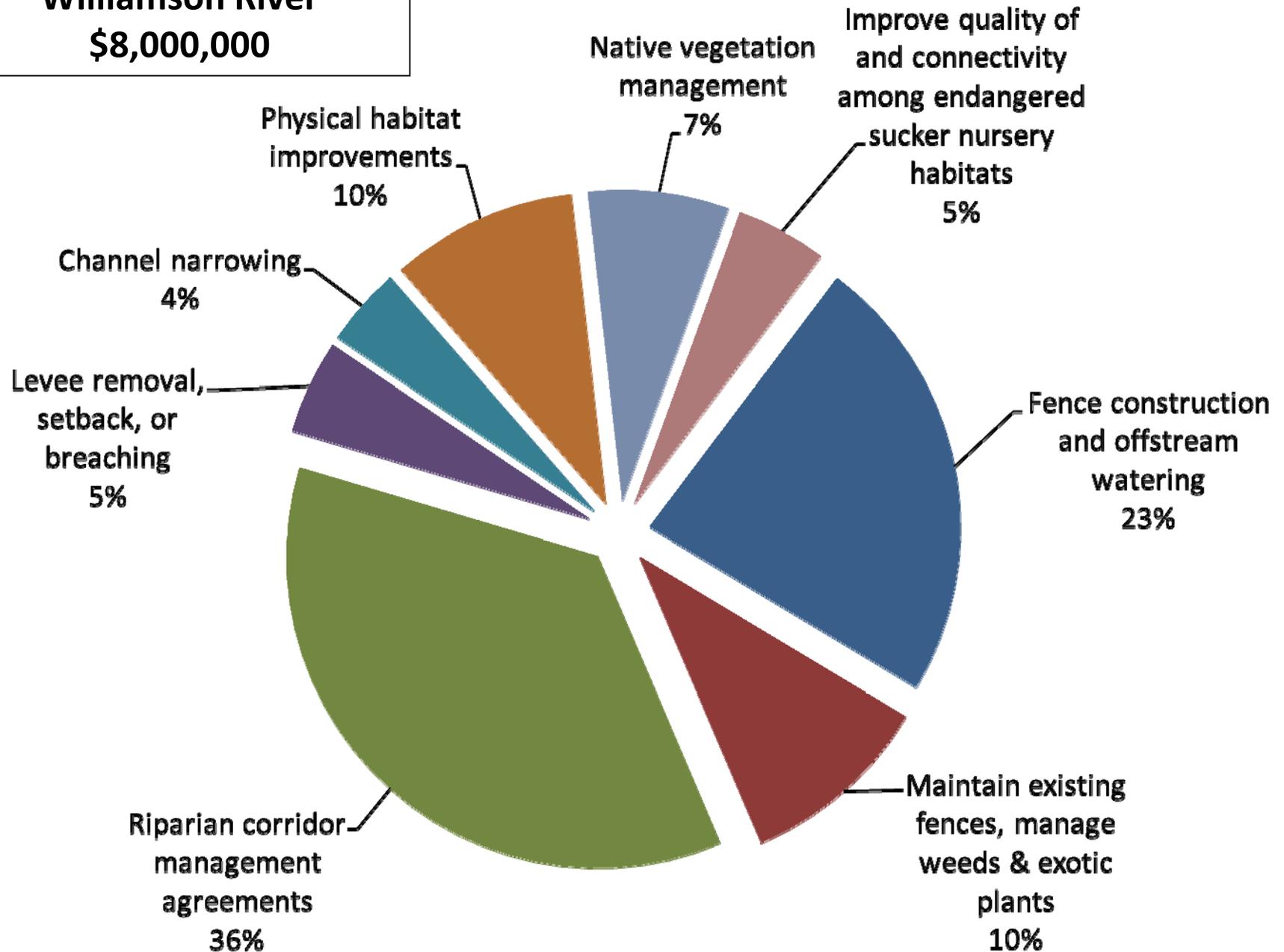
In or Above Keno Reservoir								
In or above Keno Reservoir	Organic and nutrient load reduction and management	Study of management and reduction of organic and nutrient loads		1	\$3,846,154	\$1,153,846	\$5,000,000	Estimated 10% of the total cost in KBRA as available for study and 90% for implementation of a treatment strategy in or above Keno Reservoir, which includes Upper Klamath Lake.
		Implement recommended organic and nutrient reduction actions			\$34,615,385	\$10,384,616	\$45,000,000	Likely to be combination of treatment wetlands, engineered water treatment facilities, physical removal of particulate organics, treatments to precipitate nutrients (alum, clay, etc.). Cost certain to be large, precise estimates will follow appropriate studies. Intent is to improve conditions in the Klamath River, as well as in the lake and reservoir.
	Wetlands	Restore wetlands on Keno Reservoir		TBD from study	\$3,846,154	\$1,153,846	\$5,000,000	Location, size, and nature of wetlands to be determined based on above mentioned water quality improvement studies.
<b>Totals</b>							<b>\$55,000,000</b>	

Fish Entrainment Reduction at Diversions								
Williamson, Sprague, and Wood rivers	Fish Passage and Entrainment	Screening pumps and diversions		100	\$2,307,692	\$692,308	\$3,000,000	Number of diversions. Based on ODFW inventories on Wood, USFWS and OWRD records on Sprague. Inventories are incomplete for some areas, number and cost requires some refinement.
Upper Klamath Lake		Screening pumps and diversions		20	\$384,616	\$115,385	\$500,000	Number of diversions. Approximate number, number and cost requires some refinement.
Keno Reservoir		Screening pumps and Klamath Irrigation Project diversions			\$19,230,769	\$5,769,231	\$25,000,000	Screening of pumps in Keno Reservoir, and major diversions for Klamath Irrigation Project. Studies of best screening approaches under way, costs here are placeholders pending study results.
<b>Totals</b>							<b>\$28,500,000</b>	

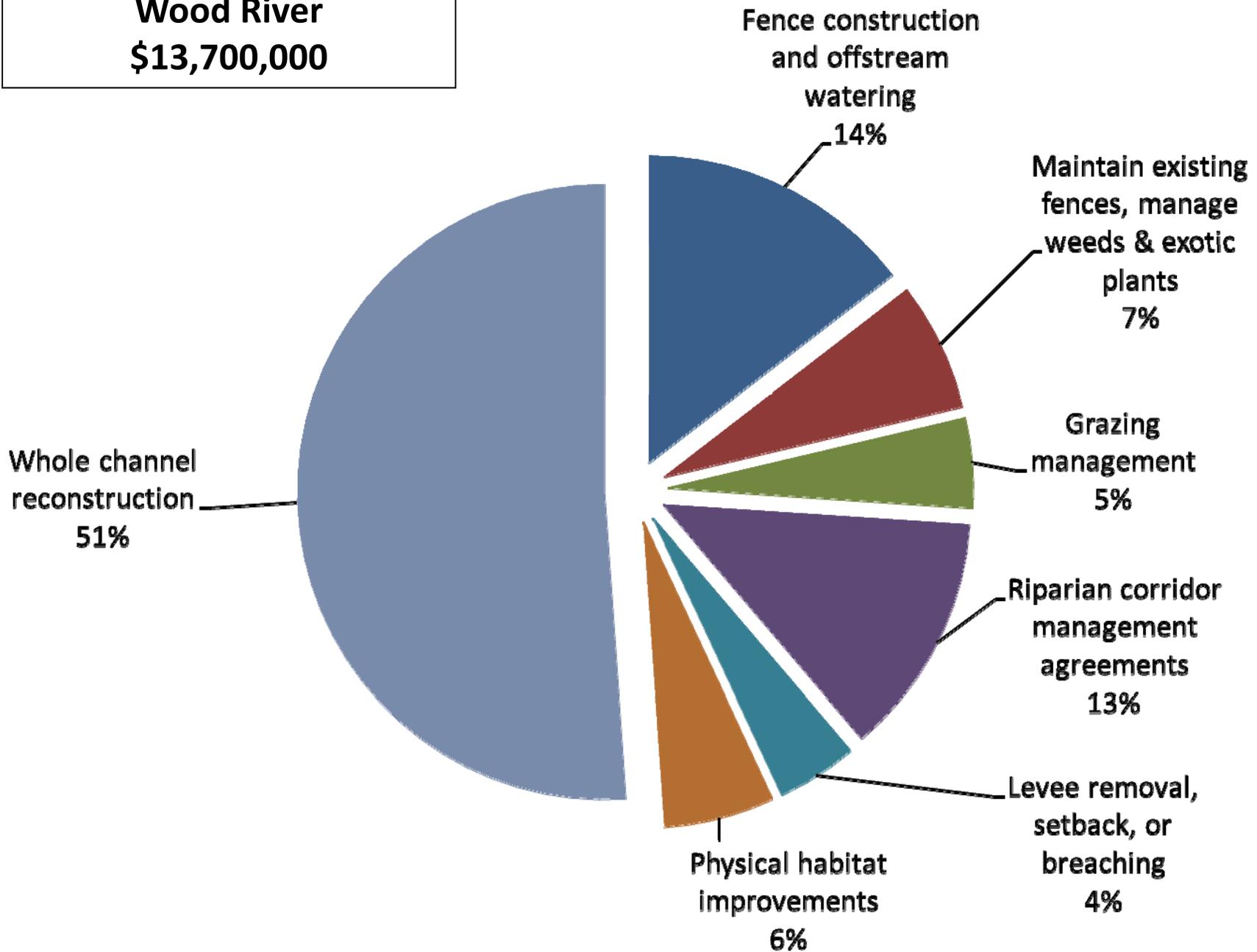
**Sprague River**  
**\$63,570,000**



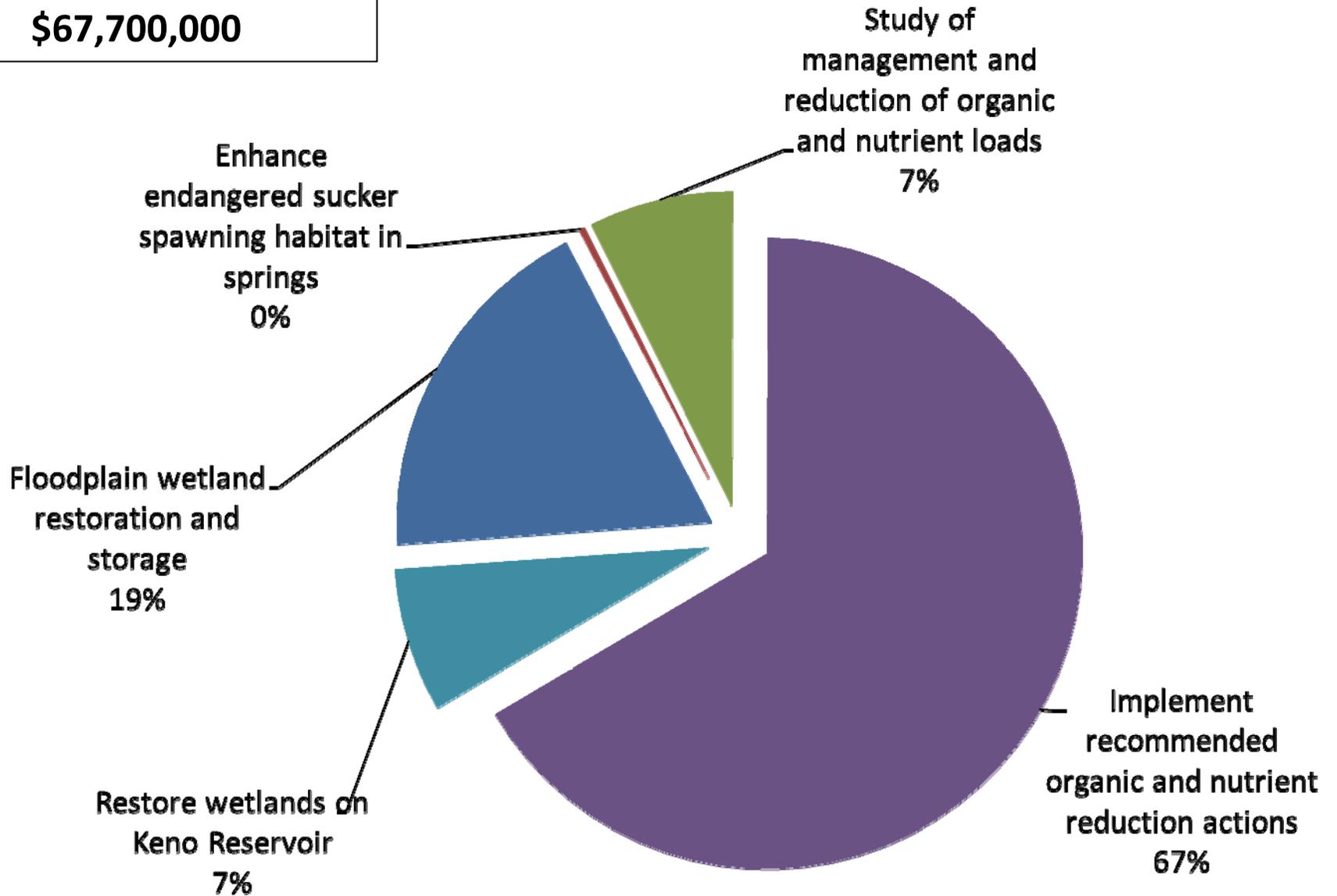
**Williamson River  
\$8,000,000**



**Wood River  
\$13,700,000**



**Keno Reservoir and Upper  
Klamath Lake  
\$67,700,000**



**Fish Entrainment  
Reduction at Diversions  
\$28,500,000**

