PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project	
Evaluate, restore and enhance 14 miles of instream and riparian habitat on Lower Crab Creek.	
BPA project number	**20083**
Contract renewal date (mm/yyyy)	**n/a**
Multiple actions? (indicate Yes or No)	**Yes**
Business name of agency, institution or organization requesting funding	
U.S. Fish and Wildlife Service	
Business acronym (if appropriate)	**USFWS**
Proposal contact person or principal investigator:	
Name	**Kate Terrell**
Mailing address	**517 S. Buchanan Street**
City, ST Zip	**Moses Lake, WA 98837**
Phone	**(509) 765-6125**
Fax	**(509) 765-9043**
Email address	**Kate_Terrell@fws.gov**

NPPC Program Measure Number(s) which this project addresses

7.6, 7.7, 7.9, and 7.10

FWS/NMFS Biological Opinion Number(s) which this project addresses

West Coast Steelhead Briefing Package, Steelhead Conservation Efforts: A Supplemental to the Notice of Determination for West Coast Steelhead Under the Endangered Species Act.

Other planning document references

1992 Washington State Salmon and Steelhead Stock Inventory, and Draft Mid-Columbia Tributary Compensation Plan, Steelhead Conservation Efforts: A Supplement to the Notice of Determination for West Coast Steelhead Under the Endangered Species Act.

Short description

Evaluate, rehabilitate and enhance 14 miles of in-stream and riparian habitat along Lower Crab Creek. This will enhance spawning habitat for adult anadromous salmonids and improve the rearing and resting habitat for juveniles. Habitat improvements may result in increased production and survivability of juveniles. Improvements along the riparian buffer will benefit wildlife species as well.

Target species

Species that will be affected include chinook (*Oncorhynchus tshawytscha)*, steelhead (*Oncorhynchus mykiss)*, resident fish species as well as waterfowl, raptors and ungulates.

Section 2. Sorting and evaluation

Subbasin

Crab Creek

Evaluation Process Sort

CBFWA caucus	CBFWA eval. process	ISRP project type

X one or more caucus		If your project fits either of these processes, X one or both		X one or more categories	
X	Anadromous fish	X	Multi-year (milestone-based evaluation)	X	Watershed councils/model watersheds
X	Resident Fish	x	Watershed project eval.		Information dissemination
X	Wildlife				Operation & maintenance
					New construction
					Research & monitoring
				X	Implementation & mgmt
					Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
9502800	Restore Moses Lake Recreational Fisheries	

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
N/A	This is a new project	

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	NEPA Compliance	a	Complete environmental compliance prior to beginning survey.
2	Survey project site	a	Complete a Rosgen Type habitat survey.
3	Develop a restoration plan	a	Develop designs for instream and riparian restoration sites.
		b	Comply with ESA, NEPA, SHIPO, county and state agencies.
4	Implement restoration plan	a	Install approximately 7 miles of instream habitat.
		b	Re-establish approximately 10 miles of riparian vegetation.
5	Develop and implement a monitoring plan	a	Develop monitoring plan
		b	Implement monitoring plan

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measurable biological objective(s)	Milestone	FY2000 Cost %
1	09/1999	10/1999	NEPA Compliance	no	1.43
2	10/1999	06/2000	Survey Project Site	yes	73.05
3	04/2000	09/2000	Develop a Restoration Plan	yes	25.52
4	10/2001	09/2004	Implement Restoration Plan	yes	
5	11/2001	on going	Implement monitoring Plan	yes	
				Total	100

Schedule constraints
It will be necessary to complete all instream work during the work window established by the Washington State Department of Fish and Wildlife. A heavy snow pack could delay the survey.
Completion date
2004

Section 5. Budget

FY99 project budget (BPA obligated):	$n/a

FY2000 budget by line item

Item	Note	% of total	FY2000 ($)
Personnel		55.25	58,704.00
Fringe benefits		13.24	14,064.00
Supplies, materials, non-expendable property	Survey Equipment	7.16	7,613.00
Operations & maintenance			
Capital acquisitions or improvements (e.g. land, buildings, major equip.)			
NEPA costs	Cost Share		
Construction-related support	See capital acquisitions		
PIT tags	# of tags:		
Travel	Cost Share		
Indirect costs	Contract Administration	16.78	17,825.00
Subcontractor			
Other	Training	4.24	4,500.00
		TOTAL BPA REQUESTED BUDGET	102,706.00

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
USFWS			
	Vehicle GSA	1.9	2,000.00
	Environmental Compliance	1.43	1,516.00
		Total project cost (including BPA portion)	106,222.00

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	327,200	419,000	419,000	419,000

Section 6. References

Watershed?	Reference
	Adkison, M.D. 1995. Population differentiation in Pacific salmon: Local adaptation, genetic drift, or the environment? Canadian Journal for Fisheries and Aquatic Sciences. 52:2762-2777.
	Bugert, R. M., G. W. Mendel, and P.R. Seidel. 1997. Adult returns of subyearling and yearling fall chinook salmon released from a Snake River hatchery or transported downstream. North American Journal of Fisheries Management. 17:638-651.
	Columbia Basin Fish and Wildlife Authority. 1998. FY 1999 Draft Annual Implementation Work Plan. Volume I. Submitted to the Northwest Power Planning Council. Volume I. Version May 13. 174 p.
X	Cunningham, D., and G. Rothwell. 1971. Water Quality Report: Crab Creek December 1970-March 1971. Washington State Department of Ecology, Olympia, Washington.
X	Daubenmire, R. 1988. Steppe vegetation of Washington. Washington State University Cooperative Extension. Pullman, WA. 131 p.
X	Embrey, S. S., and E.K. Block. 1995. Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the Columbia Basin Project, 1991-92. U.S. Geological Survey, Tacoma, WA.
X	Evermann, B.W. and J.T. Nichols. 1909. Notes on the fishes of Crab Creek, Washington, with description of a new species of Trout. Proceedings of the Biological Society of Washington. June 25th XXII: 91-94.
X	Foster, J. H., W.L. Myers, L. Faulconer, L. Hoppis, G. Van Lom, and D. S. Galbreath. 1982. An inventory of fish, wildlife and habitat in the Columbia Basin Project Area, Washington: Phase I. U.S. Bureau of Reclamation Washington Department of Game Habitat Management Division Applied Wildlife Ecology Section. 792 p.
	Furniss, M.J., T.D. Roeeofs, and C.S. Yee. 1991. Road Construction and maintenance. Pages 297-324. American Fisheries Society Special Publication. Vol 19.
	Hankin, D.G. and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal and Aquatic Science. 45:834-844.
	Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream channel reference sites: An illustrated guide to field technique. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p, Fort Collins, CO.
X	Jones, J.L., and R.J. Wagner. 1995. Water-quality assessment of the Central Columbia Plateau in Washington and Idaho. Analysis of available nutrient and pesticide data for ground water, 1942-92. U.S. Geological Survey, Tacoma, WA.
	Meehan, W.R., and T.C. Bjornn. 1991. Salmonid distributions and life histories. Pages 47-82. American Fisheries Society Special Publication. Vol. 19.
	Milner, A.M., and R.G. Bailey. 1989. Salmonid colonization of new streams in Glacier Bay National Park, Alaska. Aquiculture and Fisheries Management. 20: 179-192.
	National Marine Fisheries Service. 1996a. Making Endangered Species Act Determinations of effect for Individual or Grouped Actions at the Watershed Scale. Prepared by the National Marine Fisheries Service, Environmental and Technical Services Division, Habitat Conservation Branch.
	National Marine Fisheries Service. 1996b. Factors for Decline: A supplement to the notice of determination for west coast steelhead under the Endangered Species Act. National Marine Fisheries Service. Portland, Oregon.
X	Pascual, M.A. and T.P. Quinn. 1995. Factors affecting the homing of fall chinook salmon from Columbia river hatcheries. Transactions of the American Fisheries Society. 124:308-320.
	Platts, W.S. 1991. Livestock Grazing: In influences of Forest and Rangeland Management on

	Salmonid. Fishes and their Habitat, W.R. Meehan, editor. Special Publication 19. American Fisheries Society. Bethesda, Maryland. 389-424 p.
X	Plotnikoff, R. W. 1995. Ambient Monitoring Instream Biological Assessment: Progress Report of 1993 Pilot Survey. Washington State Department of Ecology. Environmental Investigations and Laboratory Service Program. Ambient Monitoring Section, Lacy, Washington.
	Quinn, T.P., and K. Fresh. 1984. Homing and straying in chinook salmon (*Oncorhynchus tshawytscha)* from Cowlitz River hatchery, Washington. Canadian Journal of Fisheries and Aquatic Sciences. 41:1078-1082.
	Rosgen, D. 1996. Applied River Morphology. Wetland Hydrology, Pagosa Springs, Colorado.
X	Sullivan, A.E. 1994. Selected small and ephemeral streams in arid Central Washington State: A historical perspective with recommendations for salmon habitat enhancement. Central Washington University, Ellensburg, WA. 176 p.
	Unwin, M.J., and T.P. Quinn. 1993. Homing and straying patterns of chinook salmon (*Oncorhynchus tshawytscha)* from a new Zealand hatchery: Spatial distribution of strays and effects of release date. Canadian Journal of Fisheries and Aquatic Sciences. 50:1168-1175.
X	U.S. Geological Survey. 1996. Organochlorine pesticides and PCBs in aquatic ecosystems of the Central Columbia Plateau. USGS Fact Sheet 170-96.
X	U.S. Fish and Wildlife Service. 1981. Lower Crab Creek. Fish and Wildlife Coordination Act Report. Submitted to the Bureau of Reclamation Ephrata, Washington. Ecological Services. Olympia Field Office. Olympia, Washington. 25 p.
X	Wagner, R. J., J.C. Ebbert, L.M. Roberts and S.J. Ryker. 1996. Agricultural pesticide applications and observed concentrations in surface waters from four drainages in the Central Columbia plateau. Washington and Idaho, 1993-94. U.S. Geological Survey, Tacoma, Washington.
X	Washington State Department of Ecology. 1998. Proposed 303(d) list for Impaired and Threatened Surface Waters Requiring Additional Pollution Controls. Olympia, Washington.
	Washington Department of Fish and Wildlife. 1992. 1992 Washington State Salmon and Steelhead Stock Inventory. Olympia, Washington.

PART II - NARRATIVE

Section 7. Abstract

The Lower Crab Creek Restoration Project is located in the shrubb-steppe region of Washington State. The project area begins at O'Sullivan Dam and continues down stream to Highway 26 for fourteen miles through private land and the Columbia National Wildlife Refuge. O'Sullivan Dam is the upper most reach for anadromous salmonids in the Crab Creek Watershed.

Historically anadromous salmonids spawned and reared within the Crab Creek Drainage. Chinook and steelhead are currently spawning and rearing in Red Rock Coulee, a tributary to Crab Creek. Very little information has been collected on current fish use. A watershed assessment is necessary to evaluate the fish use and the condition of the instream and riparian habitat.

The primary goals of this project are instream restoration and riparian habitat rehabilitation along Crab Creek, to improve spawning habitat for adult anadromous salmonids and to improve rearing and resting habitat for juveniles. Habitat improvements should result in increased production and survivability of juvenile salmonids. These improvements will also benefit a variety of wildlife species including migratory song bird, waterfowl, and several mammalian species.

To achieve these goals, a Rosgen (1996) modified Hankin and Reeves (1988) type habitat survey will be conducted, a restoration plan will be developed and implemented. Restoration of the site will include the rehabilitation of approximately 7 miles of instream habitat and the revegetation of 6 miles of riparian vegetation. The restoration project will be implemented over five years. The first year will entail a site survey and the development of a

restoration plan. Years two through five will be comprised of the implementation of the restoration plan and the development of monitoring and interpretive education plans. Once construction is complete, an interpretive trail will be installed. Monitoring will be accomplished by installing permanent cross sections, photo monitoring points and stream surveys.

Section 8. Project description

a. Technical and/or scientific background

Location

The proposed project will survey approximately 14.5 miles of Crab Creek beginning at it's crossing of State Highway 26 near the town of Corfu, Washington and proceeding north, ending near Morgan Road on the Columbia National Wildlife Refuge. Areas to be surveyed lie within section 6 of T 15 N, R 28 E, sections 1, 2, 3, 4, 9, 10, 16, 20, 21, 29, 31, 32 of T 16 N, R 28 E, section 6 of T 15 N, R 29 E, section 36 of T 17 N, R 28 E, and section 31 of T 17 N, R 29 E

History of the project

The Lower Crab Creek watershed is located in central Washington State's Columbia Basin. Crab Creek begins in Lincoln County and flows southwest draining into the Columbia River near the present day town of Schwana, Grant County (Figure 1). It is the longest tributary of its size in the United States. Today, upstream fish passage is prohibited above O'Sullivan Dam which creates the impoundment known as Potholes Reservoir, just below Moses Lake. O'Sullivan Dam is the designated split between Upper and Lower Crab Creek. This lower section of the creek contains approximately 40 linear miles of perennial stream habitat.

Lower Crab Creek is in the shrub-steppe region of Washington State, represented by the *Artemisia tridentata-Agropyron* zonal series (Daubenmire 1988). Native upland vegetation consists of big sagebrush dominating the shrub component with various bunch grasses in the understory. Historically, riparian areas along creeks and wetlands consisted of several woody species including peach leaf willow (*Salix amygdaloides*), coyote willow (*S. exigua*), red-osier dogwood (*Cornus stolonifera*), golden currant (*Ribes aureum*), Wood's rose (*Rosa woodsii*), and black cottonwood (*Populus trichocarpa*).

Cattle were first brought into the area in 1834. Livestock numbers quickly rose and wild horse herds became established (Daubenmire 1988). Grazing was the primary land use activity early on in the basin. Due to the harsh arid conditions, farming was not practical and many early pioneer farms were abandoned. Uncontrolled grazing soon took its toll on rangeland and riparian areas. By 1916, much of the shrub-steppe was over grazed and in poor condition (Daubenmire 1988).

The most significant landscape changes took place in the Basin beginning in the 1950's with the U.S. Bureau of Reclamation's Columbia Basin Project (Project). This multipurpose project was designed to provide irrigation water, hydropower generation, flood control and recreation (Foster et al. 1982). The Project begins at Grand Coulee Dam, located on the Columbia River, where water is drawn and feeds irrigation needs throughout the Columbia Basin through a series of canals. Irrigation wastewater flows back into the Columbia River through several natural and artificial canals.

The availability of irrigation waters resulted in a conversion of much of the native shrub-steppe habitat to cropland. Stream discharge increased dramatically as a result of additional water from wasteways and groundwater recharge (Embrey and Block 1995). Impacts to Crab Creek include augmented flows, flood plain conversion to cropland resulting in channel constriction, continued removal of riparian habitat for grazing and cropping, and increased water temperatures from loss of shading and Project water inputs. Much of Lower Crab Creek has been severely channelized thus closely resembling a canal.

Fisheries and Aquatic Resources

Prior to irrigation development at the turn of this century, Crab Creek contained resident

salmonids even though channels naturally dewatered in several locations, especially above Moses Lake (Evermann and Nichols 1909). Currently, the quality of Crab Creek's fisheries is poor and the current status of distribution and abundance is at risk. In the lower 20 miles, Chinook salmon, steelhead, mountain whitefish (*Prosopium williamson*) and an array of centrarchid, cadets and cyprinids have been observed (Columbia Basin Fish and Wildlife Authority 1998, CBFWA). Currently, chinook and steelhead spawning are being monitored in Red Rock Coulee. In the proposed study area of Lower Crab Creek, very little fisheries information exists.

In 1979, U. S. Fish and Wildlife Service (USFWS) biologists conducted fisheries surveys below Potholes Reservoir utilizing electrofishing, seines and concussion sampling in the creek upstream of state highway 26. They only recorded carp (*Cyprinus carpio*) and a few juvenile catfishes (*Ictalurus* spp.) (USFWS 1981). Presently, carp are ubiquitous throughout the Crab Creek system and their bottom feeding behavior and abundance undoubtedly contribute to the turbidity problem affecting the water quality. Angler activity in Crab Creek below Potholes Reservoir is low. A 1978 survey by the USFWS indicated that approximately 100 angler-days of sport fishing occurred above state highway 26 and this fishing activity was largely limited to bow fishing for carp (USFWS 1981).

Instream invertebrate sampling at McManamon road by Plotnikoff (1995) revealed very low taxa richness. In this study, zero stonefly *(Plecoptera)* and only three of each taxa from mayfly *(Ephemeroptera)* and caddis *(Trichoptera)* were found in the pool and riffle habitats sampled. Abnormally high discharge in late summer has been suggested as the primary factor in precluding development of these macroinvertebrate taxa.

Discharge

The natural hydrograph oscillation of Lower Crab Creek has been modified by the Potholes Reservoir Dam and subsequent water delivery schedule for Project consumers. At the U. S. Geological Survey gage number 12472600 near the confluence with the Columbia River, the mean monthly discharge has averaged 150 to 260 cfs from 1959-96. A relatively flat hydrograph occurs from November to late July with flows averaging 160-190 cfs. Higher mean flows (190-260 cfs) occur from August through the end of October. Stream survey activity should not coincide with the high flow period. In a normal discharge year, habitat delineation would underestimate the percentage of pools found during the remainder of the year.

Inputs from tributaries and agricultural wasteways such as Owl Creek, Red Rock Coulee Creek, and the Royal Branch Canal Wasteway significantly augment Lower Crab Creek flows. Annual mean discharge just below Potholes Reservoir at McManamon road is 22 cfs (USFWS 1981).

Water Temperature

Summer water temperatures in Lower Crab Creek near Beverly can reach 90 °F. The upper reaches sustain lower water temperatures; 73°F and 82°F have been recorded near McManamon road (Plotnikoff 1995, USFWS 1981).

Water Quality

An extensive water quality investigation by Embrey and Block (1995) revealed that water quality is relatively good in Crab Creek. They reported that concentrations of dissolved constituents,

including nutrients and trace elements were small and with few exceptions, did not exceed various standards and criteria for humans or aquatic life. Embrey and Block (1995) also reported that median trace element concentrations were less than analytical reporting limits and did not appear to threaten human or wildlife health.

Temperature, pH, and dieldrin are above Washington State limits within the project area (Washington Department of Ecology 1998). Turbidity is very high due to irrigation returns from the Columbia Basin Project. Other sources of water quality information include: Cunningham and Rothwell (1971), Jones and Wagner (1995), U.S. Geological Survey (1996), and Wagner et al. (1996).

b. Rationale and significance to Regional Programs

In 1997, the National Marine Fisheries Service (NMFS) listed the Upper Columbia River steelhead ecological significant unit (ESU) as endangered (62 FR 43937). This ESU occupies the Columbia River Basin and its tributaries upstream from the Yakima River, Washington, to the United States border with Canada.

Naturally reproducing fall Chinook salmon, resident rainbow trout and possibly anadromous steelhead trout have become established in Red Rock Coulee Creek, a tributary of Lower Crab Creek near Beverly, Washington. Although Red Rock Coulee Creek has limited spawning and rearing habitats, this small tributary provides evidence that salmonids can inhabit and naturally reproduce in the Crab Creek watershed. Aquatic biota composition upstream from this tributary is largely unknown.

Locating, assessing and improving salmonid fish habitats in watersheds that have historic use but now are thought to be devoid of resident/anadromous fish provides an exciting potential for improving diminished fish runs. This is especially true in tributaries where instream flows are now augmented by the Columbia River Basin Irrigation Project (Sullivan 1994). Direct wastewater and indirect groundwater discharge inputs from irrigation development has increased the potential for colonization by salmonids, in many tributaries.

The inherent ability of salmonids to stray from natal streams and colonize new habitats is comprehensive, derived from a variety of factors (Adkison 1995, Bugert et al. 1997, Pascual and Quinn 1995, Quinn and Fresh 1984, Unwin and Quinn 1993). The colonization potential for anadromous fish populations in tributaries associated with irrigation return is largely unknown. Immigration or straying of anadromous salmonids into Alaskan glacial streams that have been historically salmonid-free has been linked to factors such as water temperature, sediment loading and stream discharge (Milner and Bailey 1989).

This proposed study will identify, quantify and assess the status of resident and anadromous fish in Crab Creek. Long-term monitoring sites will be established so that quantified changes in water quality and instream habitat can be determined.

c. Relationships to other projects

The proposed project will compliment several other projects that are either active or in the proposal stage. They all have the common goal of enhancing habitat for fish and wildlife species in the Crab Creek Watershed.

Restore Moses Lake Recreational Fishery, BPA #9502800, will improve fisheries in Moses Lake and provide enhanced recreational angling opportunity for resident fish stocks. The objectives of this study are to: 1) identify factors contributing to the decline of the Moses Lake fishery, 2) identify management actions that will restore the recreational fishery, 3) implement those actions, and 4) monitor and evaluate their success (CBFWA 1998). This project will provide anglers displaced from traditional fisheries on protected salmonids an alternative means of fishing.

The U.S. Fish and Wildlife Service's Columbia National Wildlife Refuge has proposed the acquisition of property along lower Crab Creek owned by Steve and Linda Rasor, in Grant County. The Rasor Ranch encompasses approximately 4.5 linear miles of Lower Crab Creek and flood plain, much of which has been severely altered by agricultural practices. The objectives of this project are to: 1) remove farming and livestock operations from

damaged wetland, riparian, and upland areas, 2) restore of wetland, riparian, and upland areas, 3) control noxious weed, 4) Install fencing, and 5) implement compatible wildlife oriented public use and education.

Ducks Unlimited is taking the lead on a cooperative restoration and enhancement effort to restore riparian habitat along Crab Creek and its associated wetlands. The project is currently in the conceptual stage . The proposal will be submitted under the North American Wetlands Conservation Act (NAWCA) early summer of 1999. Project areas will include the Eagle Lakes area, Washington Department of Fish and Wildlife's Windmill Ranch, Columbia National Wildlife Refuge's Marsh Unit 3, and several private land owners.

d. Project history (for on going projects)

This is a new project.

e. Proposal objectives

Our primary goal is to identify and quantify fisheries resources and the associated instream, wetland, and riparian habitats conditions in the study area. Data collected will provide the means to assess the watershed and its functions in an ecosystem type approach.

During the first year of funding, several water quality and stream site reference stations will be set-up and maintained. These stations will provide baseline data for assessing future physical, chemical and biological changes within the study area. A Watershed Assessment (WA) will also be completed during the first fiscal year from information obtained by conducting a Rosgen (1996) modified Hankin and Reeves (1988) type stream survey. The WA document will list and discuss the current fish assemblage, identify limiting factors for native resident/anadromous fish, and suggest restoration projects that will improve these fisheries resources. Successive funding years will be directed towards improving instream and riparian habitat conditions by implementing restoration projects outlined in the WA.

The following descriptions and citations will be used to collect baseline data.

Baseline data

1. Water quality: Setup three water sampling stations
   a. Morgan Lake road- upstream boundary of study area
   b. McManamon road- middle of study area
   c. Highway 26- downstream boundary of study area

2. Sample weekly during irrigation season: Collecting the following data
   a. Dissolved oxygen
   b. Conductivity
   c. pH
   d. Turbidity
   e. Thermographs (recording hourly)
   f. Stream crest gage (maximum discharge between sample dates)

3. Establish permanent stream site reference stations (Harrelson et al. 1994); Locations and number of sites will be determined from the stream survey

4. Include all the information and citations in a watershed assessment.

Watershed Assessment-

A.. Complete a survey of the project site and combine this with available information**.**

A Rosgen (1996) modified Hankin and Reeves (1988) style survey will be conducted looking at geomorphic and habitat characteristics including the following parameters.

1. Stream Description

2. Valley Morphology
3. Plan View Morphology
4. Channel Sinuosity
5. Channel Slope
6. Bed Features
7. Entrenchment Ratio
8. Width/Depth Ratio
9. Dominant Channel Materials
10. Gradient
11. Meander Width Ratio
12. Total available stream habitat for pool, riffles and glides
13. Measurements of overhead cover (densiometer)
14. Determine locations for permanent stream site reference stations

B. Conduct a qualitative and quantitative fisheries investigation

1. Record sampling locations from stream survey data
2. Blocked beach type seining will be primary methodology
3. Temporal fish distributions: summer vs. winter
4. Sample and compare at least 10 separate pool, riffle and glide habitats
5. Estimate total biomass by using fish density and habitat data collected

C. Determine if upstream fish passage is hindered or blocked for juvenile and adult salmonids (Furniss et al. 1991)

D. Temperature assessment for salmonids from thermograph data (Meehan and Bjornn 1991).

1. In addition to the water quality monitoring sites, four to five additional thermographs will be placed below major water inputs
2. Preset thermographs to record every hour

E. Spatially locate, critique and measure (discharge and water temperature) all water inflows and outflows during the stream survey.

F. Spatially locate, critique and estimate all sediment inputs to the creek

G. Once all the survey data has been collected, a restoration plan for the project site will be developed. This plan may include the following:

1. Introduction of large woody debris into the system.
2. Reestablishing channel meanders.
3. Establish a high pool/riffle ratio.
4. Establish a lower width/depth ratio.
5. Increase cover.
6. Increase stream stability.
7. Improve instream habitat for salmonids.
8. Improve riparian vegetation.

H. Designs will be developed to implement the restoration plan. These designs will be Rosgen style bio-engineering. This will incorporate large woody debris, rock, rock reconfiguration, and vegetation.

Phases II. and III. - (FY 2001 - 2004)

A. Biological assessment on permit applications will be submitted to the local, state, and federal agencies.

B. Install instream structures along approximately 7.0 miles of Crab Creek. Structures may include the following:

1. Installation of root wad revetments.
2. Installation of sunken habitat structures.
3. Installation of rock veins.
4. Re-slope stream banks.
5. Reconfigure existing rip-rap.
6. Establish planting benches.

C. Establish a monitoring plan. This will include the following parameters:

1. Riparian vegetation.
2. Deposition pattern.
3. Debris occurrence.
4. Meander pattern.
5. Sediment supply.
6. Bed stability.
7. Width/Depth ratio.

g. Facilities and equipment

The U.S. Fish and Wildlife Service will supply all the facilities and vehicles to perform the surveys and develop the restoration and monitoring plans. This proposal is a request for funds for personnel and some survey equipment to complete the project.

h. Budget

Item	USFWS	BPA
Personnel and Benefits		
1. Survey		54,576.00
2. Design		18,192.00
3. NEPA and BA's	1,516.00	
Vehicles	2,000.00	
Training		
1. 2 people to Rosgen: Applied Fluvial Geomorphology		4,500.00
Survey Equipment		
1. 2 Laser Range Finders		560.00
2. 2 Camlines		360.00
3. 2 pair of Silvey Pins		300.00
4. Camera		200.00
5. Temperature Sensors		1,120.00
6. Seines		1,200.00
7. Stake Bag		26.00
8. Compasses		162.00
9. Water Sampling Kit		425.00
10. Thermometer		60.00
11. Hydrolab		3,200.00

Administration Overhead		17,825.00
Total		**3,516.00 102,706.00**

U.S. Fish and Wildlife **= $ 3,516.00** ***(3.31% of the total)***
Bonneville Power Administration **= $102,706.00 (*96.69% of the total*)**

SECTION 9: Key Personnel:

Kate Terrell is a fish and wildlife biologist with the U. S. Fish and Wildlife Service in Moses Lake, Washington. She joined the U. S. Fish and Wildlife Service in 1992. Prior to working for the USFWS, she worked for the Oregon Department of Fish and Wildlife and the U. S. Forest Service. She obtained her bachelors of science from the University of Oregon. Her work currently focuses on habitat restoration using Rosgen style techniques in anadromous systems. Currently, she is working with private land owners, local groups and other agencies in the Chewuch, Entiat, Wenatchee, Okanogan and Methow Rivers as well as Swale, Rattlesnake and Chumstick creeks. This work focuses on the development and implementation of restoration plans which include meander reconstruction, instream habitation and riparian rehabilitation.

Tom Dresser is a fish and wildlife biologist with the U.S. Fish and Wildlife Service in Moses Lake, Washington. He received an associate degree in wildlife management from North Dakota State University - Bottineau, bachelor's degrees from the University of Idaho (both fish and wildlife), and a master degree in fisheries from the University of Idaho. Tom joined the U.S. Fish and Wildlife Service in 1998. Prior to joining the USFWS, he worked for the U.S. Army Corps of Engineers, Arizona Game and Fish Department, and University of Idaho. His current work focuses on habitat restoration in anadromous systems and FERC relicensing.

Bill Stewart is a fish and wildlife biologist with the U.S. Fish and Wildlife Service in Moses Lake, Washington. He received his bachelor's degree in environmental and forest biology from the State University of New York College of Environmental Science and Forestry, and a master's degree from Washington State University.

Section 10. Information/technology transfer

Results from this project will be presented at workshops throughout eastern Washington. The focus of these workshops will be the private land owner. This project will be used as a demonstration site to teach landowners about the benefits of habitat restoration and working with the Endangered Species Act. In addition to the workshops, an interpretive trail will be developed to assist local schools to use the site as an outdoor classroom to teach students about natural resources management. This will include aquatic, riparian, and up-land habitats.