PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Anadromous Salmonid Transit System

BPA project number: 20053
Contract renewal date (mm/yyyy): ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Morrison-Knudsen Corp

Business acronym (if appropriate) MK

Proposal contact person or principal investigator:

Name	Gary West
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NPPC Program Measure Number(s) which this project addresses
Section 5 Juvenile Salmon Migration, Specifically 5.0B and 5.0E

FWS/NMFS Biological Opinion Number(s) which this project addresses
Not Applicable

Other planning document references
Not Applicable

Short description
MK and co-investigators are proposing a conceptual plan to bypass emigrating salmonids around Snake River dams which includes EPC of the bypass system of conduits and channels, tests on fingerlings/smolt response, and suggested routes for the system.

Target species
Chinook and sockeye salmon, and steelhead trout. Testing will be performed using anadromous smolts provided by the Idaho Fish & Game Department

Section 2. Sorting and evaluation

Subbasin
Snake River

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type

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

Section 3. Relationships to other Bonneville projects

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

Project #	Project title/description
	None

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
0		

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
	None	

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Developing Conceptual Plan & Economic Assessment	a	Thorough review of literature related to this project.
		b	Develop cost analysis of the project.
		c	Prepare reconnaissance report to the NPPC.
2	Assessing Biological Requirements	a	Assess migratory and residence habitat needs of target species.
		b	Assess migratory behavioral needs.
3	Engineering Design of Migratory Conduit	a	Collect engineering data.
		b	Develop conduit design, drawings and

			specifications.
		c	Develop conduit accessory support systems.
		d	Prepare design specification for an engineered stream.
4	Testing Biological Performance of Migrants	a	Procure and construct working model of conduit and engineered stream.
		b	Performance testing of fingerlings and smolts.
5	Documenting Test Methods and Results	a	Report Preparation & Presentation

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	10/1999	2/2000			9.19%
2	11/1999	3/2000			10.08%
3	12/1999	2/2000			19.43%
4	3/2000	5/2000			33.75%
5	6/2000	9/2000			27.55%
				Total	100.00%

Schedule constraints
Funding is primary constraint

Completion date
The MK & Co-PIs Team estimates that FY 2000 is the last year requiring funding for the Phase I scope of this work.

Section 5. Budget

FY99 project budget (BPA obligated):

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel	5946 man-hours @ $36. per hour	%31	213,400
Fringe benefits	35% of Personnel Cost	%11	74,690
Supplies, materials, non-expendable property	Working Model @ Hagerman	%19	134,633
Operations & maintenance	included above	%0	
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		%0	
NEPA costs		%0	
Construction-related support	included above	%0	
PIT tags	# of tags: 1000	%0	1,000
Travel	5% of Personnel Cost	%1	10,000
Indirect costs	65% of Personnel Cost	%20	138,710
Subcontractor	Biological Consultants	%13	87,913
Other	CADD & ODC	%5	38,177

TOTAL BPA FY2000 BUDGET REQUEST	$698,523

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
Idaho Fish & Game	Hagerman Facility & Service	%3	27,500
Fish Passage, Inc	Consulting Service	%2	20,000
Dr. Brannon	Consulting Service	%4	30,000
Jon Mason	Consulting Service	%2	15,000
MK Company	Engr & Mgmt Service	%6	50,000
	Total project cost (including BPA portion)		$841,023

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	$0	$0	$0	$0

Section 6. References

Watershed?	Reference
☐	Brannon, E.L. 1995. Chinook Salmon and Steelhead Smolt Migration. SOAC report to Bureau of Reclamation, Yakima, WA. pp 23.
☐	Dauble, D.D. 1998. Habitat requirements of Columbia River salmonids: What's missing? pages 109-113; E. Brannon and W. Kinsel editors. Procedings of Columbia River Anadromouos Rehabilitation and Passage Symposium.
☐	Us Army Corps of Engineers Reconnaissance Report. 1994. Columbia River Salmon Mitigation Analysis System Configuration Study, Phase I. Seattle District. pp 68.
☐	

PART II - NARRATIVE

Section 7. Abstract

Recovery of Snake River anadromous salmon and steelhead runs is a major objective of NMFS's Recovery Plan and the Northwest Power Planning Council's regional multispecies framework. Successful recovery of these important runs must include adequate passage of downstream migrating smolts. Alternatives to facilitate emigration through the lower Snake River include barge and truck transportation of smolts, altering the flow regime to increase reservoir velocities partial drawdown of reservoirs to reduce travel time, and breaching of the dams. We believe the fifth alternative, submitted previously in various forms, regarding a by-pass conduit and/or channel around the dams needs to be given serious reconsideration. Morrison-Knudsen and the co-investigators (MK & Co-Pls) are proposing a study related to a by-pass concept as it applies to the four lower Snake River dams. The MK & Co-PIs proposal has two primary goals. One is to develop the conceptual plan for a smolt transit system, the other is to plan the route on which the by-pass system would be deployed. The design of the by-pass system of conduits and channel and basic tests on fingerling and smolts response to transit conditions in the by-pass system, are included as the specific proposal.

Section 8. Project description

a. Technical and/or scientific background

Anadromous salmonid species in the Columbia River system have not responded well to development that has altered the migratory corridor of the Columbia and Snake river systems. Delays, predation, problems associated with nitrogen supersaturation and difficulties while passing the hydroelectric dams and reservoirs, have caused major losses of migrating salmonids that have reduced the production of both wild and hatchery fish in the system. Present smolt transportation involving trucking and barging of smolts has not demonstrated substantial improvements in survival and creates other problems, such as homing impairment, and a commitment to a perpetual transportation program as long as the hydro system lasts. Flushing flows or partial drawdown of the reservoirs offers only partial solutions with no corroborating evidence to substantiate the expected benefit, and will result in the reduction of river uses for power, transportation and irrigation.

The most recent alternative being considered to recover salmon and steelhead populations in the river system is the breaching of dams. The particular dams considered at the present time include the four on the lower Snake River. Dam breaching, of course, results in the permanent reduction of those facilities from the river. Such a measure as dam breaching concludes that societal benefits in the Pacific Northwest resulting from the economic development of the river are to be subjugated for the societal benefits of the recovered salmonid runs expected to occur thereafter.

We propose another alternative, in which the present river operation will not be altered, but that smolt migration through the system will be both enhanced and replicate historical migratory conditions in rate and timing through the system. It is best for all interests associated with the Columbia River system to seek a “common ground” and resolve their differences or the Columbia Basin will lose both its salmon resources and economic opportunity for the future. The present status of the salmon and steelhead runs in the Columbia underscores the need to give a priority to the biological health of the salmonid resources. There is a “common ground” that will allow the restoration of the salmon and steelhead in the Columbia River system, and still permit the economic benefits that such a river can provide for the Pacific Northwest. We propose an alternative that will provide benefits to the migratory anadromous salmonids without sacrificing the economic status of the river.

In the broader picture, the concept of an emigrant transit system is a combination of migratory habitat and conduit transportation propositions that have made previously, and were reported in the 1995 Columbia River Anadromous Salmonid Rehabilitation and Passage Symposium held in 1995 Richland, WA. The anadromous migrant transit system proposed is a combination of engineered migratory habitat and a closed conduit that will allow the transportation of migratory salmonids in a system conducive to both the slower movement of migrating fingerling fall chinook as well as the rapid transit of spring chinook and steelhead smolts. It is a system that provides secure volitionary migration adjacent or inside the present corridor, without any reduction of river development or potential. The proposed system is meant to address the migratory needs of those fish in the lower Snake River. The by-pass stream and conduit system will transport smolts and fingerlings from Lower Granite past Ice Harbor, at a speed comparable to their historic transport rate, away from the hazards and problems associated with the present migratory corridor.

The concept of migratory habitat underscores the fact that migration also must occur in the appropriate environment. These species, and the stocks making up their Columbia River population structure, have evolved under the historic natural flow regime of the river system. The altered flow dynamics, new abundance of competitor/predator species, excessive and unnatural levels of dissolved nitrogen, unnatural physical barriers, and the extreme temporal distortion in marine entry are challenges that are difficult or even impossible for salmonids to adapt. It is imperative to recognize that salmonid migration can not effectively occur independent of the migratory pathway, residence provisions, and transit time, to include the slow fingerling-type downstream movement and the rapid transit of yearling smolts.

We are proposing only the conceptual plan and details of the salmonid emigration transit system, which we identify as Phase I of the broader plan. The phase I plan of action proposed will include a preliminary economic assessment of the rearing and migratory habitat channel, development of the biological and engineering design requirements for the system, and basic comparative evaluation of the conduit/channel versus river transport. If these analyses and design specifications warrant further development, the next phases would include completed design and construction of the trial system between Lower Granite Dam and Little Goose Dam (Phase II). If that proves feasible, we would then propose completion of the system to Ice Harbor, with the appropriate design and construction completed as part of the final (Phase III) plan of action. However, these phases are stand along projects and would be justified in separate proposals. The present proposal in only the Phase I study.

b. Rationale and significance to Regional Programs

The proposal describes the conceptual plan for an independent salmonid emigrant transit system from Lower Granite Pool to below Ice Harbor Dam. The assessment includes initial biological and engineering evaluations that would be required for such a system, if there is ultimate acceptance and installation of the transit system.

With the development of the Snake River for economic benefits, habitat and the migratory corridor were drastically altered, with the result that anadromous salmonid species in the system were seriously depleted. Moreover, the prospect for recovery does not appear to be an option unless the migratory passage problem is addressed. We believe barging and trucking of smolts have not demonstrated adequate promise to justify dependence on those systems. Flushing flows and partial drawdown proposals have limited demonstrable evidence that suggests such changes will provide better survival, and they reduce the present use of the river for power production, transportation, and recreation during those periods of partial drawdown. Finally, dam breaching is being offered as another option, but at considerable cost to the economic status of the present system.

The proposed bypass channel and conduit system would provide marked advantages over the present conditions, and prospect of conditions in the long-term future. These advantages are:

- The transit system would promote the historic balance of anadromous salmonids that existed in the lower Snake.
- Natural migratory behavior and volitional rate of transit would be provided that is consistent with the historic patterns of migration in the system.
- The mortality associated with spillway and turbine passage would be reduced.
- Major losses from predation between dams would be substantially reduced.
- Problems associated with nitrogen supersaturation would be avoided.
- Storage for flushing flows and partial reservoir drawdown would be eliminated.
- River operations for shipping, irrigation, and hydropower would not be impacted.

We believe the system that approaches the problem from a biologically sound perspective, and addresses the economic concerns with minimum impact is the best "common ground" resolution to the present crisis in the Columbia River Basin.

c. Relationships to other projects

The current option of barging and trucking of smolts have not demonstrated adequate promise to justify dependence of those systems. Flushing flows and partial drawdown proposals have limited demonstrable evidence that suggests such changes will provide better survival, and they reduce the present use of the river as a functional working river during those periods of flow alteration. Finally, dam breaching is being offered as another option, but at considerable cost to the economic status of the present system.

It is obvious that the options being considered have serious consequences to the present system without prospect for total resolution of the problem presently facing anadromous Snake River salmonids.

Reduction of salmonid habitat in the Columbia and disruption of the natural migratory pathway has encouraged escalation of competing species through altered river dynamics with major cost to salmonid resources. We believe a solution rests with the transit system we are proposing.

d. Project history (for ongoing projects)

Not Applicable

e. Proposal objectives

The Phase I Conceptual Design and Assessment, to be completed in twelve (12) months, will include the following five (5) Objectives:

(1) **Developing the Conceptual Plan and Economic Assessment**: The Team will collect and organize pertinent data for the preliminary development of a conceptual plan of the proposed emigrant transit system in Little Goose reservoir, based on the U.S. Army Corps of Engineers reconnaissance completed in 1994 (Columbia River Salmon Mitigation Analysis System Configuration Study). The performance and progress of this work will be reviewed by MK & Co-PIs.

(2) **Assessing Biological Requirements**: The Team will conduct biological and engineering research in preparation for the design, construction, and operation of the working model test facility. The testing program criteria and requirements will be defined by the fishery biologists which will provide the basis for the design of the working model test facility.

(3) **Engineering Design of Migratory Conduit**: The Team will prepare equipment and material procurement specifications and construction drawings. The design team will consult on a regular basis with fishery biologists and representatives of the Idaho Fish and game Department. A Test Facility Work Plan will be prepared which will describe the design basis for the facility, construction requirements, and test operations/maintenance requirements.

(4) **Testing Biological Performance of Migrants**: The team will complete the procurement and construction of the working model test facility. The work includes mobilization of the construction team at the Hagerman Fish Hatchery site, assembly of the test facility, operations support during testing, and dismantling the installation at the conclusion of testing.

(5) **Documenting Test Methods and Results**: The Team will prepare a technical report containing a record of the project.

Phase II (pending successful Phase I) would be prototype trials using conduit and engineered channel between Lower Granite and Little Goose if Phase I justifies continuation. This section will provide comparisons of survival, imprinting, passage time, design and operation considerations. Basic trials with the prototype would include survival evaluation of smolt performance through the channel compared with in-river migratory success.

Phase III (pending successful Phase II) would be the integration of the full length habitat channel design, plan for construction, and construction of the migrant transit system from Little Goose to Ice Harbor Dam.

f. Methods

The approach to satisfy the five objectives will include specific tasks associated with each objective, and the methods used to accomplish work associated with each listed task.

In Objective 1, the development of a conceptual plan and economic assessment, there are three tasks.

Task a. Make a thorough review of relevant experiences associated with the project. Methods will include a review of the literature on fish passage, guidance, and diversions around dams, as it applies to the transit system. (References – The fisheries Engineering Research Program reports of the US Army Corps of Engineers beginning in 1956 and other relevant research data to the present).

Task b. Develop basic cost analysis of the project. Methods will assess materials, earthen or lined open channels, grade, configuration, structures, excavations, reinforcements, pressure levels, pumps, aeration, systems, temperature controls, security, and operational requirements (Reference – US Army Corps of Engineers Reconnaissance report in 1994 – Columbia River Salmon Mitigation Analysis System Configuration Study, Phase I).

Task c. Prepare a reconnaissance report to the NPPC. The method will be based on results of Objective 1 studies, and the US Army Corps of Engineers Reconnaissance report in 1994 (Reference – Columbia River Salmon Mitigation Analysis System Configuration Study, Phase I).

In Objective 2, assessing the biological requirements of emigrating salmonids, there are two tasks.

Task a. Assess migratory and residence habitat needs of target species. Method will include criteria based on habitat definitions around depth, velocity, cover, temperature preferences, and feeding requirements (References – Bjornn and Reiser 1991, Chapman and Bjornn 1969, Chapman et al. 1994, Dauble 1998, Don Chapman Consultants Inc. 1989).

Task b. Assess migratory behavioral needs. Methods will include criteria associated with imprinting, temperature preferences, and migratory stimuli (Reference – Brannon, 1995, Brannon and Quinn 1990).

In objective 3, the engineering design of migratory conduit specifications and materials, there are four tasks.

Task a. Conduct preliminary engineering research to obtain information for use in the design of the test facility, including pump and pipe materials types, sizes and pricing options; existing power and water supply locations; access routes and work areas. A preliminary site plan will be prepared as a working document for use by the project team during the research and planning stage of the project.

Task b. Develop conduit design, drawing and specifications. Methods will include development of cross-sectional area, materials, fixtures, structures, and linkages associated with the enclosed conduit element.

Task c. Develop conduit accessory support systems. Methods will include the anchoring system design, flow/velocity control measures and pump, water exchange mechanisms, temperature control devices, security, and monitoring systems.

Task d. Prepare design specifications of an engineered stream. Methods will include determination of cross-sectional area, slope and configuration, habitat materials based on Objective 2 results, control structures and enumeration capability.

In Objective 4, on testing biological performance of migrants in a model closed conduit and open channel, there are two tasks.

Task a. Procurement and construction of a model conduit and engineered stream model. Methods will include the development of the model system for testing on the IDF&G Hagerman hatchery site. Specification of the model will be based on Objective 3 studies, and will be constructed in an oval loop to simulate a continuous conduit. An engineered stream section will be designed separate from, but complementary to the conduit for simulating the habitat parameter specifications under Objective 3.

Task b. Performance testing of fingerlings and smolts. Methods will include assessment of migrant behavior in the conduit to include, rheotactic performance, speed of movement, readiness to feed, and physical well being after traversing various lengths of migratory reaches. Physical

well being will involve distribution behavior after entering the engineered stream, search for cover, readiness to feed, readiness to continue migratory behavior, and mortality.

In Objective 5, the test results, conclusions and recommendations will be published.

Task a. This task includes documentation of all test methods and findings resulting from the tests performed in the fish transit conduit facility. A technical report will be prepared which will contain a record of the project and, assuming the outcome is positive, will include a proposal for the preparation of a Phase II Development Plan. This plan will consist of a conceptual design for the prototype fish transit system proposed for installation in Little Goose Reservoir, together with a proposed scope of work, a development schedule and budget for the design of this facility.

g. Facilities and equipment

There are several requirements that such a fish transit system must have, but in essence the features must be conducive to smolt migration. Water used in the conduit and engineered channel would have to represent the composition of sources in the adjacent river to assure that imprinting for the adult return migration in the mainstream isn't disrupted.

To provide assessment of the concept in a model system will be undertaken at the IDF&G Hagerman Hatchery where sufficient space, water, and equipment are available for study. IDF&G personnel, graduate students, and the Co-PIs will participate in the testing protocol, and will be supported by the University of Idaho Fish Culture Experiment Station at Hagerman.

The working model will be constructed at the Hagerman site by MK engineers. The model will be constructed in a manner to allow simulation of the pressures, velocities, conduit size, transit times, and engineered habitat to assess the efficiency of the system and its effect on fish condition.

Research stocks of migrants will be provided to the study by IDF&G. Test fish will include spring chinook or steelhead as the species that rapidly migrates through the Snake River corridor, and fall chinook as the species that undertakes a slower feeding migration downstream.

h. Budget

(Replace this text with your response in paragraph form)

Section 9. Key personnel

Gary W. West, Principal Investigator, is a Project Manager for Morrison Knudsen Corporation. Mr. West will be assigned full time during the execution of this project, and his duties include coordinating design criteria of individual components with overall working model concept.

Ernest Brannon, PhD, Fishery Consultant, is a Professor of Fisheries Resources and Animal Science, and the Director of the Aquaculture Research Institute at the University of Idaho, Moscow. Dr. Brannon will design experiments to measure stress in smolts and fingerlings, and supervise a graduate student assigned to carry out the experiments.

Terry Holubetz, Fishery Consultant, is an independent consultant who worked in production and migration studies of juvenile salmonids with Idaho Department of Fish & Game. Mr. Holubetz will work with MK to verify the design of the monitoring and testing equipment.

William Kinsel, PhD, Fluids Mechanics Consultant, is a Professor of Mechanical Engineering at Washington State University, Richland. Dr. Kinsel will verify the hydraulic design of the combined open channel/closed conduit working model.

John Richard “Dick” Woodworth, Project Consultant, is a principal in Fish Passage, Inc.
Mr. Woodworth will be available to provide historical perspective to the project.

Jon Mason, P.E., Process Consultant, is a Professor of Construction Management at Boise State University, Boise. Mr. Mason will develop scale-up factors for the working model.

Jim Winner, Project Biologist, is a Project Biologist for Morrison Knudsen Corporation. Mr. Winner will assist with biological assessments, design criteria, and operation of the working model.

Section 10. Information/technology transfer

A report on the conceptual foundation of the transit system and results of the tests will be submitted to all fisheries management entities in the Columbia River Basin. Extension information will be developed on the project and entered on thr Internet. Also, demonstrations of the working model at Hagerman will be scheduled for interested parties and the NPPC to observe the system dynamics with migrating fish.

Congratulations!