Statement of Work

Colorado River Study

By

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I. INTRODUCTION

A. Background

Changes in the character of the aquatic habitat of major rivers in the Upper Colorado River Basin have resulted in severe depletions in the populations of several native fish species. The Colorado River Fishery Project (CRFP) was created both to document the distribution, abundance, and habitat preferences of these fish populations and to determine reasons for their decline. Information from their study will allow researchers and managers to evaluate effects of past changes in the aquatic habitats of the basin and also reasonably predict the effects of proposed future changes.

Water and Power Resources Service (WPRS) in funding CRFP has initiated a progressive, cooperative process of determination of water use plans in the UCRB which are attainable under both societal and biologic constraints.

Specifically, WPRS has expressed the desire to gain the ability to predict the cumulative effects of a variety of water management options upon flows and water quality conditions in the UCRB. Ultimately, effects of these flows and water quality states upon endangered fish species might be analyzed, given suitable predictive evaluation methodologies.

A major component in these predictive evaluation processes is use of the Incremental Flow Methodology as developed and used by the Instream Flow Group (IFG) of the USFWS in Fort Collins, Colorado. Use of this methodology

requires both detailed measurements of the physical characteristics of selected habitats and the known or estimated preferences of the target fish species for depth, velocity, substrate grade, and temperature. Determination of these preferences for native fish is a major goal of CRFP. From this information base, the IFG computer-based system known as PHABSIM is used to predict Weighted Usable Area (WUA), an estimate of the preferred physical habitat for target fish species at study sites chosen to represent major homogeneous reaches of the river system. (See Attachment I.) WUA calculated for various flow regimes provides information useful in analyzing responses of the physical habitat to changes in flow, and allows reasonable estimates of the effects of past and future flow regime alterations.

IFG has also recently developed a water quality predictive model known as SSAMIV for use in conjunction with PHABSIM in more comprehensive management situations. (See Attachment II.)

This computer-based system requires chemical, hydraulic, geologic, and meteorological data to predict 1) behavior of selected water quality parameters as they pass through a river system or 2) behavior of these parameters at point locations under altered flow, temperature, or loading conditions.

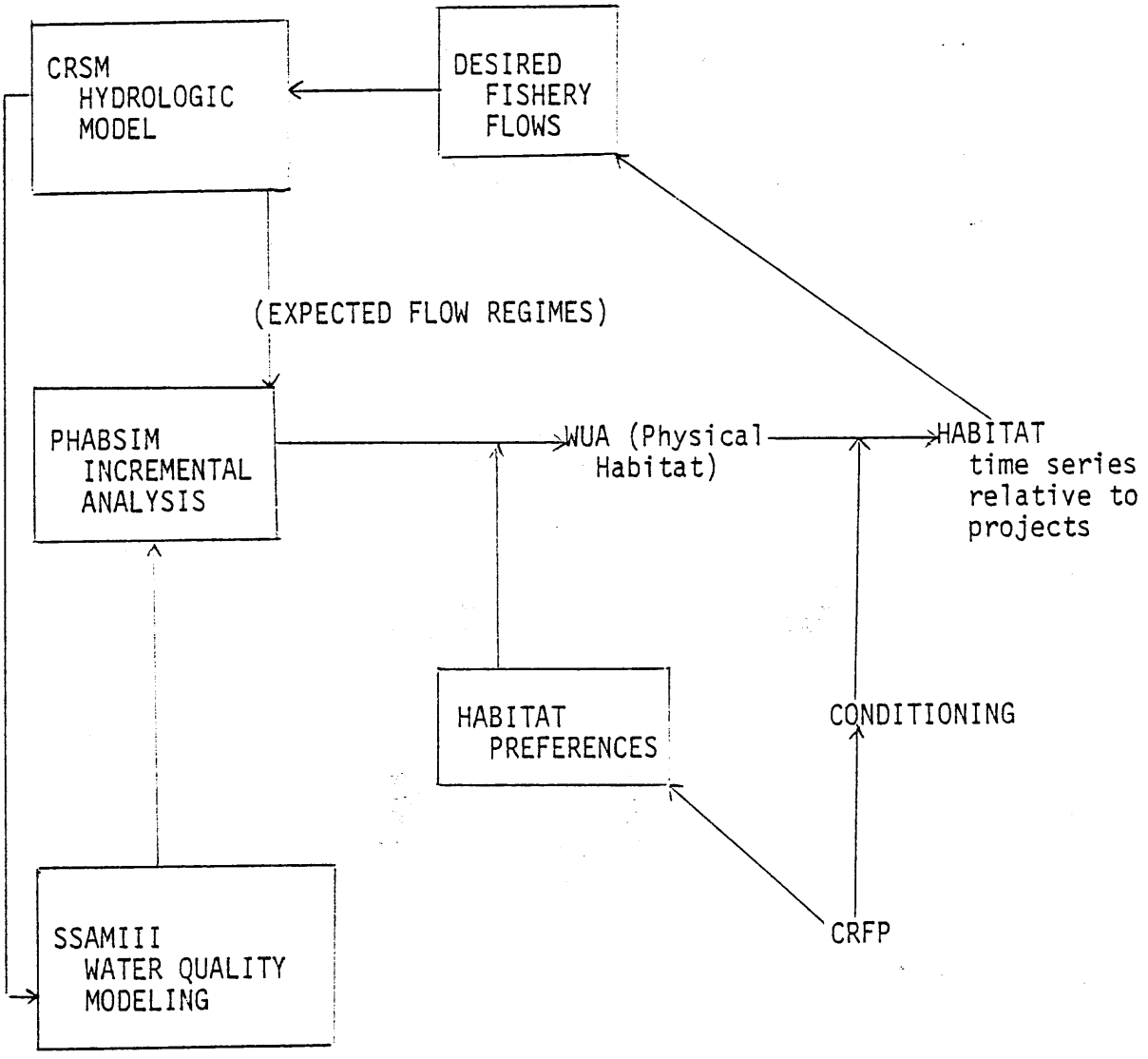
Typically, given the known or suspected tolerances of fish or invertebrate species for certain pollutants, concentrations of these pollutants may be predicted and impacts assessed. If temperature is identified as an important factor in spawning, migration initiation, insect emergence, or

disease promotion, its values may be predicted at specified points in the basin. If varying flow regimes, climatic conditions or source alterations such as dam releases or heated effluents are to be analyzed, SSAMIV may be used to predict temperatures under the new conditions.

In a large and highly-regulated River Basin such as the Upper Colorado, impacts of releases at certain points may appear in the release patterns of several upstream and downstream reservoirs. These resulting release patterns will constitute new flow conditions at other evaluation sites, with a basin-wide water-use pattern eventually emerging from each initial plan. Prediction of such patterns with respect to the existing and potential water use demands and constraints is best accomplished using a computer-based modeling system. The study plan for implementation of impact evaluation in the UCRB, then, depends heavily upon provision of historic and expected flow regimes (flow patterns depicted as mean or median flows) from a selected water balance model.

B. Structure

Structurally the analysis proposal is of the following form:



In this system, expected flow regimes from the CRSM hydrologic model are evaluated with respect to their water quality (initially only temperature and salinity) consequences using a computer-based model. When the model is verified and should other water quality parameters be identified by CRFP bioassey work as being detrimental to the fishes' survival, each parameter will be analyzed by the water quality model. If water quality conditions are expected to be acceptable, the resulting flow regimes will be incrementally analyzed using the PHABSIM (Physical Habitat Simulation) computer system, described in detail in Attachment I.

Note the dependence upon CRFP in the systematic process; their fisheries data base will be needed in two ways. First, to provide criteria (preferences for depth, velocity, substrate and cover) for the target species (humpback chub and Colorado squawfish); CRFP has structured its sampling design and data collection effort to complement the need for better quality data in this area. Second, from analyses of the recent population and community characteristics of these fish, and from knowledge of recent hydrologic events, relationships may be demonstrated which may be used to condition the WUA values to arrive at more definitive indicators of habitat value.

Also note the feedback loop between WUA and the hydrologic model. This represents a potential for first identifying desirable flow regimes (for endangered fish) at specific basin points, based upon results from the incremental analysis. These flows could then be evaluated, using the hydrologic simulation model, against competing basin demands and constraints. If possible, subsequent release patterns might be conditioned upon desirable fishery flows and the results used in planning processes with reasonable assurance of meeting both societal and biologic needs.

Both the water quality and PHABSIM components require field work during summer and fall, 1980, before adequate analysis may be made at several locations in the basin. These efforts are described in detail in the study plan. It should be emphasized here that results of one summer's field effort and subsequent analysis will not provide WPRS with a fully addressable framework for analysis of water project operations and endangered fish needs. The level of effort and usability of the tools

developed are compatible with IFG's ability to supervise field work and expedite computer processes at this time. We expect the proposed work to provide analytic capabilities at the most critical reaches by March 1981. Development of an integrated water management system for endangered fish in the UCRB will be based upon this and further work (done in successive years) envisioned by the contracting parties.

C. Objectives

1. By November 1980, to have collected, using approved techniques, the physical habitat data required as input to the hydraulic simulation programs (IFG4 or WSP) of the PHABSIM system.

   These data will be collected at each of the six sampling sites described in the detailed study plan on page.

2. By November 1980, to have acquired by approved field collection techniques and searches of relevant literature, data necessary to fulfill input requirements of the SSAMIV water quality model at the stream segments detailed in the study plan on pages 12 and 13.

3. By November 1980, to have evaluated and selected a hydrologic model and become proficient in its use.

   In the remaining project year, this model or model system will be used to provide simulations of time series of flow events to be evaluated using the PHABSIM and SSAMIV models.

4. By March 1981, to have run the individual PHABSIM and SSAMIV model components using available preference criteria and historic flow levels. Results of these runs will demonstrate suitability of the current database and areas for improvement during the remainder of the project.

5. By December 1981, to develop linkages between or among the selected simulation models facilitating data transfer and output-input coupling.

6. By December 1981, to bring the analysis system to a workable and usable state, suitable for analysis purposes in the Upper Colorado River Basin. Actual use of this framework system will depend heavily upon provision of endangered species criteria data from CRFP and proposed and historic flow regimes from a modeling effort conducted jointly (or with joint approval) by WPRS and FWS.

II. STUDY PLAN

A. PHABSIM

1. General. Data needs for use in the PHABSIM computer system are based on channel characteristics at each of from five to as many as perhaps twelve cross sections per site to include:

a) cross section coordinates sufficient in number to define channel characteristics and to include both channel margins;

b) velocities measured at each point of variation or at equally spaced points sufficient in number to define the velocity distribution;

c) water surface elevations to be measured with a surveying instrument to within .01 ft at each cross section on both banks;

d) measurements along both channel margins and at the water's edges of the distances between cross sections;

e) estimates of substrate grade at each cross-sectional vertical; and

f) estimates of discharge at the measured reach at each time of measurement.

Use of surveying equipment and reference of all elevations to a single benchmark ensures use of each data set in either of IFG's currently available hydraulic simulation programs. This could be of value if a particular site is visited at only one or perhaps two flows for any of several reasons.

2. Site Selection, General. Through past experience, IFG has recommended that a systematic site-selection process be undertaken on all PHABSIM studies. The process is described in detail in Bovee and Milhous (1978) and will be presented in updated form in Instream Flow Information Paper Number 12 (in press). Generally, it is suggested that potential measurement sites be considered as portions of larger stream segments or as limited critical or unique reaches. The latter may be selected directly and measurements taken without regard to representativeness.

   If longer homogeneous segments are to be simulated, it is necessary to perceive them as being comprised of reaches short enough to be sampled. Any of these shorter reaches, then, might be measured and its properties applied to the specified longer reach. This process is applicable only when certain assumptions have been met. In particular, care should be taken not to include consideration of anomalous or unique subreaches, or those along transitional zones.

3. Site Selection, Specific. From the meeting on March 17 and 18 in Grand Junction, Colorado, it was determined that the rationale for initial consideration of segments (called "strata" by CRFP personnel) would be squawfish or humpback chub spawning and rearing of young. Based upon this criterion, Segments A, C, and F from the CRFP study were suggested on the Green River and the strata enclosed by river miles 0-48, and 71-86 were suggested for the Colorado River. In addition, the Black

Rocks and Westwater Canyon areas were suggested, based on the captures of humpback chubs at those areas. Further, it was suggested that the upper and lower-most five miles of each segment be considered "transitional" and removed from consideration as potential sampling sites.

Because of logistic problems involved in measurement of a reach in Westwater Canyon, no commitment was made to study that area during summer 1980.

Of the remaining five segments, each was considered representative of its entire stratum (after elimination of transitions) except for areas noted as being entirely anomalous, such as Black Rocks or certain limited areas within major reaches. Anomalous reaches in their respective segments are listed below:

Stratum or River Segment (mi)	Anomalous Miles
Green River	
A	none
C	12-20 (below Nefertiti)
F	horseshow bend (164, 175-176)
Colorado River	
0-48	the loop (5-11)
71-86	mile 35 and miles 77-86

The remaining river miles were then randomized, and four random miles selected at each stratum. These were to be evaluated both on aerial phototgraphs (1:31, 680 CIR from BLM) and on-site during the April 14-19 reconnaissance trip.

The following river miles were drawn randomly for each segment on the Green and Colorado Rivers:

Stratum or River Segment (mi)	Randomly Selected Miles			
Green River				
A	24	52	56	73
C	20	21	24	29
F	135	144	148	160
Colorado River				
0-46	24	27	36	38
71-86	73	75	79	80

In-the-field observation of the Colorado River reaches led to preferences for stations at mi. 39 in downstream reach (miles 0-46) because it corresponded with a good hydraulic control point and because it was considered accessible by boat during the high flow regime. This reach was characterized by steep sandstone cliffs or slopes along approximately 2/3 of the right bank. The left bank was a sandbar separated from the floodplain by a dense band of tamarisk. Four star-bolts and one fence post were emplaced on cliffs or colluvial areas on the right bank.

Upstream from Moab, Utah, site selection was strongly influenced by accessibility because the recurrent rapids were probably

not navigable by aluminum boats at high water. The reach beginning at mi 72 was selected because it was within boatmotoring distance of the boat launch and terminated downstream at a marginal flow control point.

Seven cross sections in the Black Rocks area were established in the middle of the reach. Cross sections were emplaced here to represent both the deep-water areas and the shallow side-channel areas.

Field reconnaissance of the Green River study strata led to the selection of three potential study site locations.

Within stratum (segment) "A," river mile 56 was chosen to represent the Labyrinth Canyon segment. This study site is located 4 miles above Mineral Bottom and is characterized by alluvial bars, islands, cliff areas, and a meandering thalweg. Six transects were established over flow control points and existing aquatic habitat.

Stratum (segment) "C" was represented by river mile 21. This site was chosen both because it was located upstream of Nephertiti rapids and because it represented the typical hydraulic environment of Gray's Canyon. In addition, Rattlesnake Rapids restricted upstream movement at a relatively low flow and would not be passable at high flow. This study site has a cobble/boulder substrate, high cliffs on the right bank and a small floodplain

on the left. Included within the section are riffles and pool hydraulic features, characterized by six cross sections.

Stratum (segment) "F" was represented by river mile 143 between Jensen and Ouray, Utah. This site includes representative river features (sand substrate, meandering thalweg, alluvial islands) and is suspected to have a rather fluid bed. Six transects were used to describe the hydraulic and habitat conditions. Access was through the Ouray National Wildlife Refuge.

4. Field Measurements. Actual field measurements will begin on the descending runoff limb, probably in early July of 1980. Initial visits to the sites were made during early Spring, 1980, to determine actual workability of the sites and to suggest location changes if necessary. Cross section locations were determined at pre-runoff low-flow levels to ensure full representation of the reach.

At some areas, headpins, star-bolts, or fence posts were driven and preliminary surveying done to save time during the actual intensive measurement period in July-October. Only partial field crews were needed during this reconnaissance phase.

After peak runoff, and at the highest flow level safely workable, full field crews will begin intensive sampling at the sites,

completing each in one or two days and moving to the next. Complete equipment and manpower availability are necessary during this period. At an intermediate flow level, crews will again sample each site. Experience has shown that this level is the most difficult to obtain because it lies on the most steeply sloped area of the descending runoff hydrograph and passes quickly. The third, and lowest flow measurement may be taken at any time between establishment of base flow and winter freeze-up. To obtain the lowest possible level, however, it is desirable to measure during the latest peak irrigation period when flows reach their annual low.

5. Data Compilation and Entry. After completion of all field work, copies of data sheets will be sent to the project supervisor and originals retained at IFG. Hydraulic simulation data will be entered into data files on the WPRS CDC Cyber computer at the Denver Federal Center. Data from each study site will support a calibrated IFG4 and/or WSP (IFG2) data file suitable for use in the PHABSIM system.

The hydraulic simulation data files will be used as partial basis for calculation of WUA using the HABTAT program. WUA values for any flow within the allowable predictive range may be produced. Initially, WUA's associated with historic median monthly hydrographs will be run and results compared with known or suspected conditions of the endangered fish populations at that time.

Analyses of flow regimes resulting from hydrologic model runs may be made at user demand. At some point before project completion, IFG, WPRS and CRFP personnel should collectively determine if development of certain desirable hydrographs for critical life stages of endangered species is feasible. Such hydrographs could be input to the hydrologic model as water demands along with their appropriate priorities.

B. SSAMIV

1. General. Input requirements of the SSAMIV model are less field-intensive than those of the PHABSIM system. In fact, the majority of the input data are available from public record sources such as U. S. meteorological records, U. S. Geological Survey gage data records, and map analyses. Site- or reach-specific data necessary to calibrate the SSAMIV output for such parameters as temperature and dissolved oxygen are already being collected by CRFP collection crews and could be greatly enhanced by use of continuous monitoring devices (thermographs) at selected locations during 1980.

Because general agreement exists on the ability to predict temperatures on a mean monthly basis, the goals of the data collection effort will be to maximize our ability to do so throughout the Basin. While increased salinity may have an effect upon squawfish spawning or rearing, it is most feasible at this time to defer salinity modeling to WPRS abilities in that area.

Therefore, during the 1980 field season, emphasis will be placed upon temperature sampling with the objective of providing 1) daily fluctuations in temperature at each PHABSIM sampling site at each of the three target flows, and 2) climatologic conditions at sites not suspected to share conditions with major population centers.

2. Sampling Sites. Specifically, for objective one, 30 day thermographs will be emplaced at each PHABSIM sampling site, in turbulent areas known by measurements to display the same temperature as the main channel area.

These temperature records will reflect daily patterns at several distinct flow levels. To more fully characterize transitional zones and areas not near the PHABSIM sampling sites, additional thermographs will be placed at specified areas and tended by either CRFP fishery collection field crews or the IFG field crews. These locations are:

Green River

a) Upper desolation canyon, at an area selected to demonstrate general characteristics of canyon width, depth and vegetative cover. The thermographs will be tended by CRFP fishery personnel on their routine fish collection trips or by BLM rangers on their patrols from Sandwash.

b) At the upper transition of labrynth canyon, to demonstrate the continuum of conditions between the flat plain near Green River, Utah, and the deeply incised canyon areas downstream. This area will also be tended by CRFP fish collection crews.

Colorado River

a) Near Westwater Utah, in the highly braided, agriculturalized reach below the BLM ranger station. This is a rather unique area, which might display rapid warming due to the extreme width of the channel. Thermographs here would be tended by IFG personnel.

b) Westwater Canyon. If possible, one thermograph should be emplaced within the canyon to demonstrate changes in conditions there. CRFP fisheries personnel and BLM rangers regularly float the canyon, and have agreed to tend the thermographs.

c) Near Cisco, Utah. At an accessible site, to characterize temperature patterns in the reach between Westwater and Moab Canyons and to determine the local effects of the Dolores River.

d) Near Moab Utah, to determine input temperature conditions to the canyon reach below Potash. IFG field crews will tend thermographs at locations 3 and 4.

These continuous monitoring sites, in association with the six PHABSIM measurement sites, should provide a longitudinal characterization of both gradual and abrupt changes in the temperature patterns of both rivers.

3. Climatological Monitoring Stations. Regional climatologic information necessary for use in temperature modeling has already been obtained for the Grand Junction, Colorado area. On-site determinations of wind speed, long- and short-wave solar radiation, cloud cover and shading factor should be determined at locations with unique or anomalous characteristics.

   Specifically, these sites should reflect characteristics within desolation or Gray's Canyon and those in Labrynth Canyon on the Green River. On the Colorado River, monitoring stations should be placed in either Moab Canyon, or in the canyon below Potash.

   At each of these sites a recording thermograph, anemometer and pyrheliometer will be emplaced during the low-flow period and monitored for approximately one month. Also, shade factor relative to sunlight limitation in canyons of varying width and depth will be determined for use at other canyon locations in the basin.

4. Data Reduction and Analysis - SSAMIV. This phase will proceed throughout fiscal year 1981 and will result in the completion

of an operating temperature model and capabilities to predict mean monthly temperatures at all sampling points. Calibration standards for temperature predictions will be set before final outputs are used in analysis of project operations.

IFG personnel will provide all manpower necessary for data reduction, input and calibration.

C. Water Budget Modeling

1. General. To achieve maximum economy of time and resources, a basin wide water budget model will be selected from commonly available sources such as U. S. Corps of Engineers (COE) and WPRS. The available models will be evaluated for applicability to the Colorado River System, ease of implementation on the WPRS computer system, flexibility to add and remove components such as growth scenarios and capability to implement fishery related reservoir operation rules.

Consideration will be given to the Colorado River Simulation Model (CRSM) developed by the WPRS Engineering and Research Center (ERC), to both HEC-3 and HEC-5 developed by the COE, and to other models found through a search of the relevant literature.

Once a hydrologic model has been selected, preparation of the necessary data bases will begin. Assuming that both hydrologic

data and water demand data are available from WPRS, this effort should be confined to reformatting in the most extreme case. No field data collection is envisioned in this study.

Effective and accurate use of any model depends on informed use. Once the selected model is operationally implemented on the WPRS computer system, a period of learning is anticipated to guarantee its informed use. This learning period is expected to include the first baseline run of the model to allow for learning by experience.

WPRS personnel will be consulted concerning the range and scope of management options and criteria to be evaluated with the water budget model. Issues that will be covered include future facilities, present and future system demands and the most likely management criteria for future operations. If it is determined that a large number of model runs are necessary to bound the range of management options considered important, WPRS assistance will be solicited in making such extensive runs of the model.

When the array of considerations to be evaluated has been selected, the water budget model will be run to generate flow time series at the selected study reaches.

To evaluate changes in fishery habitat that have resulted from past changes in Colorado River system flows, historical flow

levels will be analyzed. Historical flow data will be acquired for the study reaches and manipulated to provide input to the PHABSIM computer system. Synthetic flow data reflecting specified levels of historical, present and future developments will be acquired or generated as necessary using the selected hydrologic model.

D. Sediment Sampling

Persuant to suggestions in the May 27 review of the initial Statement of Work, and to maximize effectiveness of time spent in the field, we will attempt to sample sediment during summer, FY 80, at our PHABSIM sampling sites. Completion of the suggested sampling activities will depend on availability of equipment and cooperation with WPRS specialists in this area. Mr. James Blanton, sedimentation section, ERC, Denver, should be available on a limited basis (2-4 hours per month) as a source of guidance and to ensure availability of equipment.

Sampling at our highest flow level (approximately 20,000 cfs) will be excessively difficult; therefore, we propose to sample three flows from about 4,000 to 10,000 cfs, as conditions permit.

As suggested in the SOW review, the following samples will be taken at each sampling site at a minimum of two distinct flows.

1. Depth integrated suspended samples at equally spaced verticals at one cross section within each reach for each flow measured.

From these, the total concentration and size gradation should be determined.

2. Bed material samples of the sand and smaller size material at five locations at the same section in each reach for each flow measured and size gradation of the samples.

3. An estimate of the percentage of bed covered by the gravel and larger cobble size material and an estimate of the size variation of the larger materials.

Equipment suggested for collection of these data are:

1. A DH 49 and DH 59 for the suspended sampling (plus metal rods, handles, and pint milk bottles).

2. A Ponar sampler or clam shell for bed material sampling in shallow water at low velocities.

3. BMH-60 for sampling bed material of sand size of finer in deep water from a boat.

The collections will result in considerable volume of samples, none of which may be processed under the current project scope. We request further assistance from ERC personnel in providing storage space for the samples and in determining their future processing and analysis.

E. Integration of system components into an evaluation package

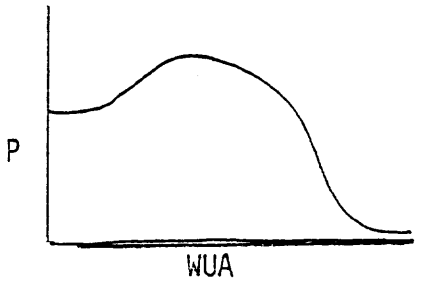
The process described in the systems diagram (Page 4), will be followed with addition of the following activities.

First, with the objective of evaluating water planning alternatives, it will be necessary to define a technique for depicting impacts resulting from as many as 50 years of project operations. The suggested time series analysis allows consideration of particular projects as probability functions.

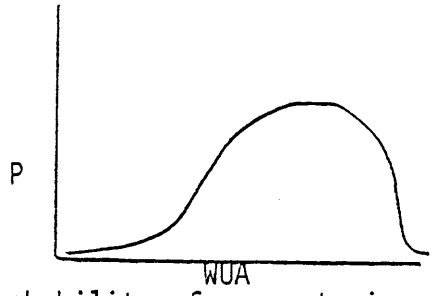
In actual use, a time series of monthly discharges for each site of interest will be generated, using the selected hydrologic model. These flow levels will be evaluated with respect to their water quality (temperature and salinity) consequences. If these parmaters remain suitable, the flow time series will be translated into WUA time series, perhaps only for the months identified as critical to a particular life history stage of the target species.

The resulting WUA time series will then be reduced to a probability function for each proposed project operation.

Remembering that WUA's will be calculated only for flows during critical months, the probability function may take the following form:



for a similar water plan, another function may be generated;



Indicating a lower probability of encountering very low WUA's.

At this point, it will be helpful to produce similar time series for historic conditions (using gage or historic data) and to compare the resultant WUA series with known or suspected population attributes of endangered fish during those historical periods.

From this conjunctive consideration of WUA and fish population attributes, it should be possible to define a desired flow regime or monthly probability function for the PHABSIM study sites. This flow condition might then serve as a guideline or standard against which various water plans might be evaluated. This process would involve use of the desired fishery hydrograph as a demand, with its appropriate priority, in the computer.

Development of the fishery hydrograph again, would depend heavily upon the results of CRFP and other ongoing fishery studies, both in providing habitat preference information and in providing insights into the relationships between WUA and fish population characteristics.

F. Program Linkage Creation

To facilitate computer operations with respect to data input, we propose the development of a system of program linkages. These programs would

greatly reduce the time spent inputting time series of monthly flows into the water quality model and subsequently into PHABSIM.

III. REPORTS

Quarterly progress reports will be submitted to the Project Leader within 15 days after the completion of each quarter during project duration. Completion reports for each project phase will contain the following information:

1. Summary of individual activities on a man-day basis;

2. Summary of specific activity completion;

3. Notation of probable difficulty areas and recommended remedies;

4. Presentation of data collected (field notes) refined (office forms) or generated (hand or computer comptuations).

The primary purposes of quarterly reports will be:

1. to document study phase completion, and

2. to flag areas of concern and focus attention upon corrective or alleviative measures.

Quarter/Year	Progress Report Target
3,4/80	PHABSIM, water quality sediment field work completion. Water budget model selection, familiarization.
1/81	PHABSIM, SSAMIV calibration, water budget familiarization, and historical runs.
2/81	Water budget model time series, initial model linkages PHABSIM use on historical or predicted data, some time series, after evaluation of SSAMIV.
3/81	Continue model linkages, create hydrologic time series and analyze using PHABSIM and SSAMIV. Possible continuation of field collection required.
4/81	Reduce and analyze field data, continue above modeling processes, bring analysis and linkage refinements.
1/82	Write final completion report.

IV. PERSONNEL

A. IFG Personnel

The following positions are required for field and office activities during fiscal years 1980 and 1981:

Description	Component	Time Allocation (Quarter(s)/Year)
Coordinator	All	3,4/80 1-4/81 1/82 full to ½ time
Assistant	PHABSIM sediment (field, office) SSAMIV (field)	3,4/80 1,2/81 full to ½ time
Programmer	PHABSIM, SSAMIV (office)	1-4/81 ½ time
Water Budget Specialist	Hydrologic Model, PHABSIM SSAMIV linkages	1-4/81 ½ time
Temporary technicians (6)	PHABSIM, SSAMIV (field)	4/80 1/81 intermittent

B. Technical Advisory Personnel

Regular members of a primary technical advisory panel will be available for consultation. In addition to those formally engaged in the project (FWS, IFG and WPRS personnel) the following individuals are requested for the specified periods of time through the first quarter of FY 81.

Name	Agency	Office Phone Number	Time Requested Location
Jim Blanton or Dave Mueller	WPRS, ERC	FTS 234-2036	10 days (office)
Bob George	WPRS, ERS	FTS 234-4299	5 days (office)
Bob Main	WPRS, ERC	234-4086	7-10 days (office)
Jim Thomas	WPRS, ERC	234-5216	5 days (office)
Jay Hokenstrom	WPRS	234-5132	2 days (office)
Jerry Miller	WPRS, Region SLC	588-5454	3 days (field)
Tom Burke	WPRS, Vernal, Utah		21 dyas (field)
Pat Koelsch	WPRS, Grand Junction	323-0304	21 days (field)

Services of other individuals may be requested as the project progresses.

V. PROJECT SCHEDULE

0	1/81	2/81	3/81	4/81	5/81
WATER BUDGET MODEL					
Evaluate and select water model	Generate baseline time series	Generate other time series			
Learn use of selected model		Obtain historic flow data	Build model linkages and habitat index value display programs	Generate and analyze habitat value index functions	Prepare final report
PHABSIM					
Conduct field work	Data reduction and calibration		Run historic or proposed flow data analyses with available preference curves	Develop habitat suitability time series	Prepare final report
			Develop desired flows generate WUA time series		
WATER QUALITY					
Field sampling	Data reduction and calibration	Evaluate water quality with respect to proposed flows	Build model linkages, incorporate new parameters		Prepare final report
SEDIMENT					
Field collection only					

VI. BUDGET

WORK GROUP PROJECTED EXPENDITURES BY QUARTER

FISCAL 1980

	1	2	3	4	TOTALS
(1) Work Months			7	7	
(2) Salaries ($) TEMP			6,000	6,000	12,000
COORD			5,500	5,500	11,000
(3) Travel ($)			5,000	5,000	10,000
(4) Printing/Dissem. ($)					
(5) Local contracts ($) (other than ADP)				4,750	4,750
(6) Contract Services ($) (ADP)			1,500	1,500	3,000
(7) DC - let contracts ($)					
(8) Equipment ($)			5,000	5,000	10,000
(9) Supplies ($)					
Totals					50,750

WORK GROUP PROJECTED EXPENDITURES BY QUARTER

FISCAL 1981

		1	2	3	4	TOTALS
(1)	Work Months	6	6	6	6	24
(2)	Salaries ($)	11,356	11,356	11,356	11,356	45,424
(3)	Travel ($)	2,000	1,000	1,000	1,000	5,000
(4)	Printing/Dissem. ($)					
(5)	Local contracts ($) (other than ADP)	4,750	4,750	4,750	4,750	19,000
(6)	Contract Services ($) (ADP)	2,000	2,000	1,000		5,000
(7)	DC - let contracts ($)					
(8)	Equipment ($)	850	850	850	1,050	3,600
(9)	Supplies ($)					
Totals						78,024

REPORT DATE: June 30, 1980

TASK REVIEW

Project WPRS PL: _____

Work Plan No. _____ Task No. Region 6 TL: VanDerwalker

Upper Colorado River Basin Studies PO: Stalnaker

Task Schedule Status (Circle One) A B C D E

Funding Source	Estimated Total Cost	Estimated FY80 Cost	Actual Cost to Date	Actual FY80 Cost to Date
WRPS	153.0 K	56.628 K		

A.	Milestones	Due Date	Completion Date or Comment No.
1.	SOW	06/30/80	
2.	Quarterly Reports	09/30/80	
3.	Quarterly Reports	12/31/80	
4.	Quarterly Reports	03/31/81	
5.	Quarterly Reports	06/30/81	
6.	Quarterly Reports	09/30/81	
7.	Final Report	12/31/81	

Milestone Comments:

B. Other comments or changes to Annual Work Plan:

1) Addition to work plan starting end of 3rd quarter, FY 80 (06/23/80).

2) Region 6 task, not in AWP at WELUT.

Hazard Analysis for Collection of Cross-sectional Data and Water Quality Sampling

A. Description of Activities

Field activities for hydrualic data collection will require on-river boat travel to three sites on the Green River and three sites on the Colorado River. This travel will be accomplished with outboard motor boats in most locations but use of a jet-powered river boat has been requested for use in reaching the most downstream (mile 39) Colorado River station.

At the study sites, surveying and water measurement crews will gather data using various techniques. Survey crews will establish head pin and water surface elevations, above-water channel geometry, and relative bearings of cross sections. The survey, or bank crew will also clear brush from survey lines and generally facilitate movement along the banks. Bank crew members will emplace fence posts, rebar, masonry bolts, and expansion bolts using appropriate driving devices. Two bank crew members will tend the ends of the cross-section cable at all times.

At the beginning of measurement of each cross section, all crew members will tend to running the cable across the channel by boat, tightening it with come-alongs and initiating boat measurements of depth and velocity. The boat crews (always a minimum of two members) will then proceed across the cable taking boat-based measurements of depth and velocity.

The work, especially at high water, requires attention to detail and procedure, as well as appreciation of the size and power of the river.

Water quality measurements will be collected using thermographs or grab samples taken near the water's edge. Climatologic data will be collected using anemometers or pyrheliometers which will be emplaced in rather precipitous canyon areas, well above levels normally accessible to campers or river runners.

B. Potential Hazards

1. Driving to and from work under variable road and weather conditions.

2. On-river travel, perhaps at high speed, to and from study sites, in either jet boat or boutboard-driven boat.

3. Maintenance of footing while walking in and along rivers.

4. Dangers of working with a high-tension cable across river channel.

5. Exposure to variable weather and terrain conditions for extended periods.

6. Exposure of hands to cold water and low air temperatures during the collection of water quality and sediment samples.

7. Possibility of snake and insect bites.

8. Injury potential would include the following: cuts, bruises, broken bones, drowning, sunstroke, heat exhaustion, strained muscles, colds from getting wet, and hypothermia.

9. Required safety equipment and standard operating procedures for small craft have been covered in the S. O. P. and hazard analysis for the operation of the Bureau of Reclamation inboard set boat. Concerns expressed in this analysis apply to any activities done on large or unwadable streams.

C. Safety Procedures

1. Caution - Caution will be exercised at all times when working in or around any stream or field situation where a potential hazard exists.

2. Life Jackets - These will be worn at all times when crews are in the boats or on the banks in precipitous areas, with no exceptions.

3. Safety Sun Glasses - These will be worn when conditions dictate, such as when driving masonry bolts and fenceposts, when working in brushy areas, whenever sunlight is intensive or glaring, or where there is a reasonable probability of eye injury.

4. Snake Bite and First Aid Kits - These items will be available at all times while in the field and will be carried in the vehicle.

5. Steel-toe Waders/Hip Boots/Hiking Boots - These will be worn at all times when working in the field for foot protection.

6. Insect Repellent and Sunscreen Lotions - These will be available for use at all times and utilized as conditions warrant.

7. Maintenance of Proper Diet and Fluid Balance - All crew members will be encouraged to avoid dehydration by concious water intake at least each hour during the work day.

8. Appropriate Clothing, Adverse Weather Conditions - Appropriate and/or protective clothing will be worn according to existing weather conditions and the anticipated work activity. Shirts will be worn when working in brushy areas and both a shirt and hat will be worn whenever exposure to the sun is severe and prolonged. Headnets are suggested in areas with mosquitos.

Certain precautions will be taken when personnel are working in snow or under cold, adverse weather conditions to guard against hypothermia. General rules and guidelines to follow concerning this type of situation are included as an attachment to this analysis.

D. Vehicles

Vehicles utilized for all work activities will be driven at recommended speeds for the type of vehicle, and occupants will wear seat belts at all times. Each vehicle will be inspected for required safety items prior to its use in the work program. It is recommended that any vehicle used in the field be equipped with a two-way radio for safety purposes. All personnel involved will qualify for a federal driver license and take the defensive drivers training course before operating the vehicles in the field.

E. Activity Schedule

As the exact dates of each sampling trip will not be known more than two weeks in advance of the trip, the precise activity schedule cannot be given.

Therefore, designated individuals will be first contacts for inquiries about the locations of field crews, and to initiate action if the crews fail to return on designated dates. Each field crew supervisor will provide a detailed activity schedule to the assigned contact upon arrival in either Grand Junction or Vernal. This schedule will provide:

1. Dates of arrival at telephone locations;

2. Calls to be made from those locations;

3. Dates and times of travel between sampling stations;

4. Dates and times of arrival and departure at the sampling stations; and

5. Projected activities during each sampling or travel day by morning, afternoon, and evening periods.

The primary contacts in Vernal and Grand Junction should disseminate a short statement throughout local agency offices, informing personnel that inquiries regarding the field crews should be directed to the contact or his assignee.

The principal contacts are:

Steve McCall, WPRS Environmental Specialist
764 Horizon Drive
Grand Junction, CO 81501
FTS telephone number: 323-0304

Lee Swenson, WPRS Environmental Specialist
P.O. Box 420
Duschesne, UT 80421
Commercial telephone number: 801-738-2441

F. Safety and Communication Plan for Cables Spanning the Green and Colorado Rivers During Hydraulic Measurements

The preferred method of obtaining depth and velocity measurements in unwadable rivers requires the positioning of a taut, 1/8" beaded aircraft cable across the entire wetted river channel. The 16 foot boat is then attached to this cable using a quick-release bracket, and the boat is stopped at each measurement position. The cable is hard to see from up and downstream, even when flagged with fluorescent surveyor's tape.

Because of the volume of powered boat travel on the lower Green and Colorado Rivers (from Moab to Green River, Utah, inclusive), the following steps will be taken to preclude accidents involving powered craft and the cable. (Unpowered rafts are not expected to be a serious problem from past experience.)

1. Outfitters in the Vernal-Green River-Moab area will be informed of our activity schedule. Those operating powered craft will be advised of our locations and in turn will provde schedules of their excursions.

2. Warning signs will be placed at the Loma, Westwater, and Potash boat ramps on the Colorado and at launch sites near Jensen, Sandwash, Green River, and Mineral Bottom on the Green River, stating our locations and the presence of the cable at specified times.

3. Warning bouys will be placed at least one mile upstream and downstream from our measurement sites and an individual with a two-way radio unit stationed on the bank.

4. One crew member at the measurement site will operate the other two-way radio set and receive notice of an approaching craft.

5. Crew members at each end of the cable will release the tension on the cable (it can be readily retightened) to allow powered craft to pass over it.

G. Emergency Numbers

The following is a list of emergency numbers for several key areas within the project which personnel could utilize if a particular situation dictated such an action:

Duchesne, Utah	
Duchesne County Sheriff	738-2424
Duchesne Valley Medical Center	738-2426
Roosevelt, Utah	
Uinta County Sheriff	722-4583
Duchesne Valley Hospital	722-2443
Ambulance Service	722-4558
Vernal, Utah	
Uintah County Sheriff	789-2511
Uintah County Hospital	789-3342
Ambulance Service	789-6030
Grand Junction, Colorado	
Mesa County Sheriff	242-3322
Mesa Memorial Hospital	243-1331
St. Mary's Hospital	242-1550
Moab, Utah	
Grand County Sheriff	259-8115
Allen Memorial Hospital	259-7191
Ambulance Service	259-7403

Medical and Sheriff in Green River, Utah, area are in Moab.

I. Checklist of Equipment

1. Leveling and Water Measurement

_____ Cloth tape
_____ Level
_____ Tripod
_____ Two stadia rods
_____ Wading rod, top set
_____ AA flow meter
_____ Marsh McBirney flow meter (check attachment screws)
_____ Flow meter notes
_____ Level book
_____ Post driver
_____ Rebar (enter number)
_____ Note pad
_____ Thermometer
_____ Camera
_____ Fence posts (enter number)
_____ Star bolts complete with ring eyes (enter number)
_____ Come-alongs (2)

2. Boat-mounted Equipment

_____ Mounting bracket
_____ A-reel and mounting wing-nuts
_____ Extension boom
_____ Cable and reel (checked)
_____ Chicago cable pullers (enter number)
_____ Lag bolts and wind-nuts for attachment

3. Sediment Sampling

_____ Hip boots
_____ Sediment sampler
_____ Bottles and caps
_____ Thermometer
_____ DH 48 sampler
_____ I.D. tags
_____ Camera
_____ Cable attachment

4. Water Quality and Climatologic Sampling

_____ Hip boots
_____ Sample bottles
_____ I.D. tags
_____ Ice
_____ Thermographs
_____ Cooler
_____ Thermometer
_____ Camera

5. Protective Equipment

_____ Flashlight
_____ First aid kit (including snake bite) and instructions
_____ Safety sun glasses
_____ Life jackets (enter number)
_____ Appropriate clothing for existing weather conditions and anticipated activity
_____ Extra set of clothing
_____ Waterproof matches
_____ Small ax
_____ Shovel
_____ Insect repellent
_____ Sunscreen lotion

6. Vehicle

_____ Tires checked
_____ Spare tire
_____ Headlights
_____ Turn signals
_____ Park lights
_____ Emergency flasher
_____ Mirrors
_____ Winch and cable
_____ 4-wheel drive
_____ Signal flares
_____ Foot brake
_____ Emergency brake
_____ Steering
_____ Horn
_____ Wipers
_____ Defroster
_____ Tools
_____ Regulations
_____ Seat belts
_____ Radio
_____ Jack
_____ Trailer hitch

7. Aluminum Boat Motors and Trailer

_____ Boat check for leaks, drain plug, transon condition
_____ Large motor check out (25___ 35___)
_____ Gas tank
_____ Small motor check out (9.9___)
_____ 50:1 oil (2 pints)
_____ Low-end lube (1 full tube)
_____ 4 spark plugs
_____ 10 shear pins plus cotter keys
_____ Spare prop
_____ 5-gallon gas can
_____ Bail bucket
_____ Oars (check oarlocks ___)
_____ Life vests (enter number)

8. Tool Kit

_____ Socket set (with plug socket)
_____ Screw drivers
_____ Vice grips (enter number)
_____ Duct tape
_____ Electricians tape
_____ Fuel line tubing
_____ Bailing wire
_____ Channel locks
_____ Crescent boxend wrench sets
_____ Feeler guages
_____ Allen wrenches
_____ Funnel

Prepared by: _____ _____
Date

Approval: _____ _____
Supervisor Date

Reviewed by: _____ _____
Field Supervisor Date

Noted: _____ _____
Supervisor Date