FY-2002 PROPOSED SCOPE OF WORK for: **Project #:107**
Gunnison River / Aspinall Unit Temperature Model: Phase II

Lead Agency 1: Hydrosphere Resource Consultants, Inc.
Submitted by: John Carron, Ph.D., Principal Investigator
Hydrosphere Resource Consultants, Inc.
1002 Walnut, Suite 200
Boulder, Colorado 80302
Phone 303-443-7839
Fax 303-442-0616
jcc@hydrosphere.com

Lead Agency 2: Bureau of Reclamation
Submitted by: Amy Cutler, M.E., Principal Investigator
Bureau of Reclamation
125 South State Street
Salt Lake City, UT 84138
Phone 801-524-3654
Fax 801-524-5499
acutler@uc.usbr.gov

Date: November 2, 2001; revised January 10, 2002

Category:
_ Ongoing project
x Ongoing-revised project
_ Requested new project
_ Unsolicited proposal

Expected Funding Source:
x Annual funds
_ Capital funds
_ Other (explain)

I. Title of Proposal:

Gunnison River / Aspinall Unit Temperature Modeling: Phase II

II. Relationship to RIPRAP:

Submitted as part of the Colorado River Action Plan: Gunnison River

III. Study Background/Rationale and Hypotheses:

Records indicate that Colorado pikeminnow historically were found in the Gunnison River as far upstream as the city of Delta (Quarterone, 1993). Basin hydrology has been significantly altered by the construction and operation of the Aspinall Unit (Blue Mesa, Morrow Point and Crystal Reservoirs), and by diversion and return flow features primarily related to irrigation in the areas surrounding Montrose and Delta. Cool stream temperatures resulting from changes to the basin hydrology (Stanford, 1994) have been identified as a significant impediment to re-establishment of pikeminnow habitat in the

Gunnison River near Delta (Osmundson, 1999). Results of Osmundson's work indicate that increasing mean water temperatures at Delta by 1 °C in June, September and October, and by 2 °C in July and August, would increase the mean annual thermal units (ATU) from 32 to 46 units. Such an increase would put stream temperatures at Delta at a level similar to sites on the Yampa and Colorado Rivers which have abundant populations of pikeminnow.

Results of Phase I of this study (Hydrosphere, 2001) indicate that the Aspinall reservoirs have significantly altered river temperatures, and that warmer river temperatures near Delta could be achieved through a temperature control device (TCD) at Blue Mesa Dam. The conclusions from Phase I indicate that:

1. Stream temperatures near Delta are significantly impacted by Aspinall operations, and do not return to ambient conditions until somewhere downstream of Delta.

2. Blue Mesa Reservoir is the primary cause of cold-water releases from the Aspinall Unit. Crystal releases are warmer than those of Blue Mesa, indicating that Morrow Point and Crystal actually warm the river relative to Blue Mesa release temperatures.

3. Warmer water is physically available in Blue Mesa, and could be released downstream with a TCD. Models of all three reservoirs would be useful in determining the impacts of such a structure on the thermal regimes of the reservoirs.

4. Tributary inflows do impact stream temperatures at Delta, but not with a frequency or magnitude to render potential reservoir control ineffective.

5. Warmer releases from Crystal would result in warmer river temperatures at Delta. Generally, release temperatures from Crystal would need to be increased about 3 °C to warm the river at Delta by 2 °C.

6. Stream temperatures at Delta show a strong statistical correlation to release temperatures and atmospheric conditions; thus, a statistical model can be used in lieu of a more costly physically-based model of the river.

IV. Study Goals, Objectives, End Product.

Goal: Our program goal for FY2002 is to develop reservoir temperature models using CE-QUAL-W2, and a stream temperature model of the Gunnison River below Crystal Reservoir using a multivariate statistical model. The models will be used to gain a more complete quantitative understanding of the impacts that a temperature control device at Blue Mesa would have on both stream and reservoir temperatures. The models will also be used to determine what impacts the draft flow recommendations to the Recovery Program would have on temperatures.

Objectives:

1. Confirm results from Phase I indicating that a temperature control device at Blue Mesa Dam would result in warmer release temperatures from Crystal Dam.

2. Determine if an increase in release temperatures from Crystal Dam would result in a significant increase in stream temperatures in the area around Delta, Colorado?

3. If so, determine how much warmer the release waters would need to be to meet the targets identified in Osmundson's 1999 report?

4. Deteremine how wet/normal/dry year inflows to Aspinall Unit impact reservoir stratification and releases, and how these variations would impact use of a TCD?

5. Determine time when temperature targets can be met in a wet/normal/dry year.

6. Determine impact of TCD on reservoir heat budget.

7. Determine the most feasible TCD options to achieve temperature targets.

8. Determine reservoir and release temperature response to flow recommendation.

V. Study Area

The study area includes the Gunnison River and its tributaries from Blue Mesa Reservoir downstream to approximately its confluence with the Uncompahgre River.

VI. Study Methods/Approach and Deliverable from each Lead Agency:
Phase II of the study will include model development, model calibration, scenario

development, and scenario simulation tasks. These tasks are outlined individually by agency below.

Hydrosphere:

Aspinall Reservoirs Model(s) Development and Calibration. Hydrosphere will build temperature models for the Aspinall Units using CE-QUAL-W2. The model will be calibrated against data from the period 1997-2000. This period was selected because it represents a good range of potential hydrologic conditions (wet vs. dry years), and there is ample data to develop and calibrate both the reservoir and river models over the period.

Gunnison River Model Development and Calibration. Hydrosphere will build a multivariate statistical model to predict changes in river temperatures under the various scenarios. Phase I results indicate that a strong correlation exists between river temperatures at Delta and several atmospheric and hydrologic variables. Additionally, because the temperature recommendations of Osmundson were based on average

monthly temperatures, we feel a more rigorous and costly mechanistic model of the Gunnison River is unwarranted. The proposed model will be capable of predicting monthly mean stream temperatures at locations downstream of Crystal Reservoir.

Deliverable and Report. Hydrosphere will provide the Recovery Program and Reclamation (Amy Cutler) with all the raw input data, data analysis methodology, calibration methodology, final model data and models needed to run the scenarios. Part I of the Final Report will be completed by Hydrosphere. Part I of the report will include all W2 model calibration processes, discussion, and model inputs in electronic format.

Reviews: Hydrosphere will review all scenario development and analysis from the Bureau.

Bureau of Reclamation:

Data set for W2 and Reviews: Bureau will review all input data sets for the W2 model and calibrations.

Scenario analysis: The scenarios will be run based on hydrologic inputs corresponding to the 1997-2000 period. Reclamation will address the following issues in each scenario:

1. Compare and contrast reservoir and release temperature responses to the proposed flow recommendations.

2. Compare and contrast the placement of TCDs at Blue Mesa, Morrow Point, and Crystal.

3. Determine the time when temperature targets can be met on a wet/dry year.

4. Identify release water temperatures with different flow patterns at Crystal to meet target temperatures at Delta.

5. Determine the most feasible TCD option to achieve temperature targets.

6. Determine if TCD impacts reservoir heat budgets.

We anticipate scenarios run over a period of 4 years each. The period of simulation will be 1997-2000, which encompasses both relatively wet (1997) and dry (2000) years, and for which there is ample meteorological, flow, and water temperature data to develop and calibrate the models. Aspinall operations are likely to change in the coming years as a result of federal reserved water rights applications and the recently drafted flow recommendations for the Recovery Program. To provide a more realistic estimate of stream and reservoir temperatures under future operations, some model scenarios will use the latest flow recommendations when developing model release patterns.

Deliverable and Report. Reclamation will prepare part II of the Final Report. Part II will include background on scenario development and all scenario descriptions and analyses.

The Draft report will be formally reviewed by at least three external reviewers, as required by the Recovery Program. At least one of these reviewers will be an expert in the field of river / reservoir temperature modeling and control. Any request by reviewers for compensation is not covered by the proposed budget.

VII. Task Description and Schedule (Based on funding starting February 1, 2002):

Task 1 – Model input data (April 2002, Hydrosphere)

Task 2 – Aspinall Reservoirs Model(s) Development and Calibration (August 2002, Hydrosphere).

Task 3 – Gunnison River Model Development and Calibration. (August 2002, Hydrosphere).

Task 4 – Scenario Analysis (February 2003, Reclamation).

Task 5 – Draft Report (May 2003, Reclamation and Hydrosphere).

Task 6 – Final Report (September 2003, Reclamation and Hydrosphere).

VIII. FY-2002 Work

– Deliverables/Due Dates (Based on funding starting February 1, 2002) :

Progress Report #1: Model Development. (June 2002, Hydrosphere).

Progress Report #2: Model Calibration. (August 2002, Hydrosphere).

– Budget

TASK	HYDROSPHERE	USBR	TASK TOTAL
1. Data Processing	$8,840	$0	$8,840
2. Reservoir Model Development and Calibration	$31,830	$3,700	$35,530
3. River Model Development and Documentation	$8,800	$1,850	$10,650
4. Scenario Development and Simulation	$1,200	$2,950	$4,150
5 & 6. Draft and Final Report	$9,000	$1,680	$10,680
Other Expenses (Travel, Copies, Equipment, etc.)	$1,400	$640	$2,040
FUND TARGET TOTAL	$61,070	$10,820	$71,890

FY-2003 Work

– Deliverables/Due Dates (Based on funding starting February 1, 2002) :

Progress Report #3: Scenario Analysis. (February 2003, Reclamation).

Draft Report (May 2003, Reclamation and Hydrosphere)

Final Report and Model Files (September 2003, Reclamation and Hydrosphere)

– Budget

TASK	HYDROSPHERE	USBR	TASK TOTAL
1. Data Processing	$0	$0	$0
2. Reservoir Model Development and Calibration	$0	$0	$0
3. River Model Development and Documentation	$0	$0	$0
4. Scenario Development and Simulation	$1,830	$10,000	$11,830
5 & 6. Draft and Final Report	$3,740	$6,000	$9,740
Other Expenses (Travel, Copies, Equipment, etc.)	$1,484	$640	$2,124
FUND TARGET TOTAL	$7,054	$16,640	$23,694

IX. Budget Summary

	Hydrosphere	USBR	Total
FY-2002	$61,070	$10,820	$71,890
FY-2003	$ 7,054	$16,640	$23,694
TOTAL	$68,124	$27,460	$95,584

Total Labor Costs by Agency and Labor Category			
Hydrosphere Staff Category	**Days**	**Cost/day**	**Total Cost**
Senior Project Engineer	40.5	$800	$32,400
Project Engineer	45	$680	$30,600
Staff Engineer	4	$560	$2,240
Total Hydrosphere Labor Costs:			$65,240
USBR Staff Category	**Days**	**Cost/day**	**Total Cost**
Engineer (UCRO)	70	$374	$26,180
Total USBR Labor Costs:			$26,180
Total Labor Costs:			$91,420

X. Reviewers

Gerry Roehm/Angela Kantola
Upper Colorado River Endangered Fish Recovery Program
P.O. Box 25486, DFC
Denver, CO 80225-0486
303-969-7322

XI. References:

Hydrosphere Resource Consultants. 2001. Gunnison River / Aspinall Unit Temperature Study - Phase I Final Report.

Osmundson, D.B. 1999. Longitudinal Variation in Fish Community Structure and Water Temperature in the Upper Colorado River. Final Report, Recovery Action Plan, Project # 48-A. U.S. Fish and Wildlife Service.

Stanford, J.A. 1994. Instream Flows to Assist the Recovery of Endangered Fishes of the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Biological Report #24.

Quarterone, F. 1993. Historical Accounts of Upper Colorado River Basin Endangered Fish. Final Report. Colorado Division of Wildlife, Denver.