COLORADO RIVER RECOVERY PROGRAM Project No.: 146
FY-2010-2011 PROPOSED SCOPE OF WORK for:

Stationary PIT detection system in the Maybell Canal, Yampa River, CO

Lead Agency: U.S. Bureau of Reclamation

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Date: Dec 22, 2010; revised March 31, 2011; atk added project number 4/13/11

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

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

I. Title of Proposal: Monitoring of Potential Colorado Pikeminnow Entrainment in the Maybell Canal, Yampa River, CO

II. Relationship to RIPRAP:

Green River Action Plan: Yampa and Little Snake rivers
II. Restore habitat

II.A.2. Reduce /eliminate entrainment of Colorado pikeminnow at diversion structures.

II.A.2.a. Identify and evaluate existing structures for entrainment of Colorado pikeminnow.

II.A.2.b. Develop and implement remedial measures, as necessary, to reduce or eliminate entrainment.

Required by Yampa River Programmatic Biological Opinion

III. Study Background/Rationale and Hypotheses:

The Maybell Ditch is a gravity-fed, 12 mile (19 km) long irrigation ditch on the Yampa River located near the town of Maybell, CO. Since the ditch intake is unscreened and can divert a relatively large volume of water (129 cfs), it constitutes a potential entrainment hazard for endangered Colorado pikeminnow *Ptychocheilus lucius* that occupy the adjacent mainstem Yampa River. Evaluation of entrainment potential of Yampa River diversion structures is recommended in the Yampa Management Plan (Roehm 2004) and a required reasonable and prudent measure in the Yampa Programmatic Biological Opinion (USFWS 2005).

Hawkins (2009) used canoe electrofishing and hoopnets to evaluate entrainment potential of the Maybell Ditch in 2007 and 2008. Although eight species of fish (including three native species) were captured during the study, no endangered fish were captured. Results in 2008 showed, however, that adult roundtail chub *Gila robusta* were entrained in the Maybell Ditch during the migration period for Colorado pikeminnow. Both roundtail chub and Colorado pikeminnow are cyprinid species, share a common morphology, and occupy similar habitat; therefore, occurrence of large adult roundtail chub in the Maybell Ditch suggests that the rarer Colorado pikeminnow could also become entrained in the ditch.

Hawkins (2009) determined that the results of his study were not conclusive regarding occupancy of Maybell Ditch by endangered fishes because the ability to detect the presence of Colorado pikeminnow and other taxa was low due to the limited sampling window and sampling efficiency. He recommended a more rigorous approach to obtain less ambiguous results on entrainment of Colorado pikeminnow during their migration period. The Service concurred with this recommendation as a means of complying with the Yampa PBO (USFWS 2005). Based on recommendations from the Recovery Program Biology Committee in October 2009, the Program

Director's Office recommended use of a stationary PIT detection system in the Maybell Ditch to obtain more conclusive results on entrainment of Colorado pikeminnow (Chart 2009).

IV. Study Goals, Objectives, End Product:

Goal: Determine likelihood of Colorado pikeminnow entrainment in the Maybell Canal, Yampa River near Maybell, Colorado.

Objectives:

1) Working with a private landowner and the Maybell Irrigation District, obtain access to the Maybell ditch to construct, operate and maintain a PIT detection system for two irrigation seasons, 2011 and 2012.

2) Construct and install PIT system in the Maybell Ditch prior to first irrigation season

3) Dismantle and remove PIT system at close of second irrigation system

4) Based on the monitoring results, assess the potential for entrainment of Colorado pikeminnow in the Maybell ditch and estimate the range of Colorado pikeminnow that might be entrained.

End Products:

1) Operational PIT detection system in the Maybell Ditch (PIT system components will be available for deployment in other locations at the close of the study).
2) Annual reports on operations during 2011 and 2012.
3) Final report on entrainment of Colorado pikeminnow in the Maybell Ditch, CO, based on two years of monitoring during the irrigation season.

V. Study area

The study area is near the top of the 19 km (12 mile) Maybell Ditch, near the town of Maybell on the Yampa River in Moffat County, CO (Figure 1). The PIT system will be located on the Maybell Ditch immediately upstream of the first lateral irrigation head gate on land owned by Mr. Darryl Steele of Maybell, CO through prior agreement with the Recovery Program.

VI. Study Methods/Approach

To determine whether entrainment of Colorado pikeminnow has taken place, the antenna system will be configured with two antennae to detect timing and direction of movement of

individual tagged fish. "Antenna 1" will be immediately upstream of "antenna 2" (i.e., within a few feet of each other; Figure 3), so that the direction of movement of an individual fish can be determined by the order in which tag detections were recorded by the multiplexer. We consider fish entrained when they are detected at either antenna. The system will be operated during the entirety of irrigation seasons (late April-early May to October) in 2011 and 2012, which encompasses Colorado pikeminnow migration periods.

System Requirements: Through discussions held with the Recovery Program Biology Committee at its August 2010 meeting, we identified the following requirements for the proposed Maybell Ditch PIT system:

1) The system should consist of two pass-through antennae loops to determine direction of fish movement and provide system redundancy.

2) The system should include a satellite uplink for remote data collection and system diagnostics.

3) The system should operate from April through October for two irrigation seasons in 2011 and 2012.

4) The system should be shut down from November through March.

5) The system will be dismantled at the end of the second operating season and delivered to a nearby Recovery Program cooperator office.

We will install a satellite modem on the system so that diagnostic information and tag data can be downloaded remotely. This will be done at no charge to the program as key components are already available, however monthly satellite communication fees are necessary. We have also included some funding for time and travel for personnel from Colorado State University as periodic operation and maintenance of the system may be necessary in the event of an uplink failure or other emergencies.

Site Selection: We identified the following requirements for deployment of a PIT detection system on the Maybell Ditch:

1) The site needs to be vehicle accessible for initial installation, routine maintenance, data retrieval, seasonal start up and shut down, and final deconstruction of system.

2) The site must be relatively free of ambient electromagnetic noise which would interfere with operation of the PIT system.

3) Solar power is required from April through October.

4) Antenna loops need to be pass-through and be a large enough open loop to ensure no constriction of water flow.

5) Location must be upstream of any lateral irrigation head gates in order to help eliminate the possibility of fish entrained in these channels before being detected.

6) It is desirable to install the system on private land to avoid vandalism.

On November 3rd, 2010, Dave Speas, John Hawkins, and Peter MacKinnon met with Darryl Steele to visit a site he had identified as a possibility for a stationary PIT-tag detection site. The site proved to meet all of our criteria. We determined there is adequate vehicle access for system installation and maintenance but the road may be impassable in heavy rain and snow. However, alternative access is available by river through a boat launch located on state land near Highway 40, assuming that flows are adequate to operate a jet boat. This boat launch is within 1-2 river miles of the antenna site.

We used a solar pathfinder to determine the availability of direct sun to power the system for the duration of the required operating period, April through October. The solar test was conclusive and indicated there was adequate sun to run a solar system to power the detection system. We tested the site for ambient electronic noise and measured the ditch to determine the size of the antenna loops. The site happened to be very close to some high voltage overhead power lines creating the possibility of unfavorable ambient electronic noise levels. Initial tests with a test antenna and multiplexer indicated that there would be negligible negative effect on the system; however the test was not run for an adequate period of time, due to test equipment failure, to conclusively rule out the possibility of excessive noise interference. We revisited the site on November 16th with functioning test equipment. We could not access the exact site as the road was impassable due to snow melt and a very slick muddy road. Noise measurements were obtained on BLM land on the east bank of the Yampa River but underneath the same power lines that pass above the actual proposed site on the west bank. We are confident that the conditions at the BLM site are representative at the proposed Maybell Ditch site, and it is evident that we can construct the detection system in the proposed site with negligible effect from the power lines. After measuring the size of the ditch and potential depth of the water we determined a hybrid pass-through antenna loop would be the best option for the ditch. Finally, the site is located upstream from all lateral irrigation head gates, so it is impossible for entrained fish to enter irrigated fields before reaching the detection system.

Proposed System Design:

Solar Power system: 2 X 160 Watt solar panels with a 256 amp hour battery bank. This power system is capable of powering the detection system for 5 days without any sun. The system will be slightly different (less panels) to the ones pictured (Figure 2) but will be mounted in a similar manner.

Antenna Design: Antenna loops will be two rectangles constructed from schedule 80 PVC to house the antenna wiring. These loops will be located upstream of all lateral irrigation head

gates (Figure 3). The mounting in the stream will be best as a hybrid pass through/pass by antenna where the bottom of the antenna is secured to the substrate and the loop will float according to the water height (Figure 4, 5). This will allow debris to float over the antenna loop. This method has been very successful in other irrigation canal/ditch installations. The size of the loops will be 4' X 16'. The electronics enclosure will be a sealed job box where the multiplexer, solar controller and batteries will be housed. The enclosure will be placed at the solar panel mounting (Figure 2). The entire set up will be fenced with a temporary fence using t-posts and fencing wire to keep cattle from disturbing the solar set-up (Figure 6). The proposed site for the installation of the antenna loops will be in the irrigation ditch upstream of the first point of water extraction from the irrigation ditch (Figure 7).

We propose installing the system as soon as the road is passable in the spring 2011 and definitely before the irrigation ditch is opened (normally on April 25 or within a week later). Prior to operation, the system will be tested for read range and other measures of functionality and efficiency. The Larval Fish Laboratory (LFL) field crew (Colorado State University [CSU], under project 125, Yampa River nonnative fish control) will be present to assist in at least part of this process and learn how to operate the system, perform basic diagnostics and download data.

Operation and maintenance: In coordination with Darryl Steele, the system will be accessed at least once per month during April-October 2011 and 2012 by the LFL crew. The crew will contact Mr. Steele prior to each visit (unless Mr Steele indicates this is not necessary) and then download accumulated data, perform basic diagnostics, remove debris and coordinate with USU personnel (by phone or e-mail) to perform minor adjustments or repairs. The crew will make the data available to USBR as soon as possible after each visit. If necessary, USU will visit the site to perform major repairs should they be necessary.

Data Analysis: PIT detection data from stationary systems typically consists of detected fish tag numbers and a date and time stamp for each detection that is specific to each antennae loop, plus frequent test-tag numbers resulting from the system's self testing procedure. We will edit and summarize this data for the entire study period, identify fish tag numbers and species, and interpret fish observations in relation to years, seasons, and determine likelihood of entrainment (see **Approach**).

VII. Task Description and Schedule

FY 2011:

Task 1: November 2010: Initial site visit to acquaint landowners with project personnel, select antennae location and collect antennae system design information.

Task 2: November 2010-March 2011: Develop solar-powered PIT detection system

Task 3: Installation, testing and activation of PIT system in Maybell Ditch; instruct CSU

personnel on download/ operation/maintenance of system.

Task 4: April-October 2011: Operate system; download antennae data, perform diagnostics, repair system if necessary; system shut-down

Task 5: December 2011: Annual report – including a tabular summary of all PIT tags detected.

FY 2012:

Task 1: April-October 2012: Activate and operate system; download antennae data, perform diagnostics, repair system if necessary; system shut-down and disassembly (end of irrigation season)

Task 2: December 2012: Annual report.

Task 3: March 2013: Draft report submitted; comments reviewed; final report submitted to Recovery Program coordinator.

VIII. FY-2011 Work

Deliverables/Due Dates:

1) PIT detection system installation: March 2011
2) Annual report: December 2011

FY11 Budget

Task/item	**Cost/unit**	**Units/days**	**Total**
Task 1: Site visit			
Electrical Engineer Per diem	$46.00	2	$92.00
Lodging	$77.00	1	$77.00
Mileage	$0.50	282	$141.00
Travel subtotal			$ 310.00
Salary	$480.00	2	$960.00
USU fringe	42.9%		$411.84
Salary subtotal			$1371.84
Total task 1			$1,681.84
Task 2: Develop PIT system			
Electrical Engineer Salary	$480	12	$5760.00
USU fringe	42.9%		$2471.04

Task/item	Cost/unit	Units/days	Total
Salary subtotal			$8231.04
Equipment			
Multiplexer	$8,700	1	$8,700.00
PVC, supplies	$3000	1	$3000.00
Internal wiring, capacitors	$2,800	1	$2,800.00
Underwater cable to multiplexer	$1,000	1	$1,000.00
Anchors	$250	4	$1000.00
Extra cables	$1000	1	$1000.00
PIT equipment box	$500	1	$500.00
Misc. supplies	$1,500	1	$1,500.00
Solar system	$7,000	1	$7,000.00
Subtotal equipment			$26,500.00
Task 2 total			$34,731.04
Task 3: Install, test PIT system/train personnel			
Electrical Engineer Per diem	$46.00	4	$184.00
lodging	$77.00	4	$308.00
Vehicle mileage	$0.50	800	$400.00
Trailer rental	$37	4	$148.00
Travel subtotal			$1040.00
USU Salary	$480	4	$1920.00
USU Fringe	42.9%		$823.68
USU Salary subtotal			$2743.68
CSU support			
Biologist	$375***/d	4	$1500
Mileage	$0.48	500	$240
Per diem	$52/d	4	$208
CSU subtotal			$1,948
Task 3 total			$5,731.68
Task 4: operate and maintain system, acquire data, etc*			
Electrical Engineer: Contingency trip for repairs			

Task/item	**Cost/unit**	**Units/days**	**Total**
Per diem	$46.00	2	$92.00
Lodging	$77.00	1	$77.00
Mileage	$0.50	882	$441.00
Travel subtotal			$610.00
Salary	$480	2	$960.00
USU Fringe	42.9%		$411.84
USU Salary subtotal			$1371.84
CSU technical support			
Technician	$15***/hr	16	$240
Technician	$15***/hr	16	$240
CSU subtotal			$480
Task 4 total			$2,461.84
Task 5: Annual Report	Hourly rate	Hours	Total
Principle investigator (USBR)**	$34.00	8	$272.00
Fringe benefits	108.8%		$296.00
Task 5 total			$568.00
Task 1-5 subtotal			$44,606.40
CESU overhead	17.5%		$7,806.12
FY11 Sub-Total			$52,412.52
Uplink communication fee	$50/mo.	6 mo.	$300
FY11 Total			**$52,712.52**

*Task is to be partially carried in conjunction with project 125 (Colorado State University, Yampa River nonnative fish control) at no additional charge.
**Task covered under project 2, USBR program management; not included in total for FY11.
***Includes fringe

FY-2011 Work

Deliverables/due dates

1) November 2012: PIT system components delivered to nearest Recovery Program office.
2) December 2012: Annual report.
3) March 2013: Final report submitted to Recovery Program coordinator.

FY12 Budget

Task/item	Cost/unit	Units/days	total
Task 1: operate and maintain system, acquire data, etc*			
Electrical Engineer: Contingency trip for repairs			
Per diem	$46.00	2	$92.00
Lodging	$77.00	1	$77.00
Mileage	$0.50	882	$441.00
Travel subtotal			$610.00
Salary	$480	2	$960.00
USU Fringe	42.9%		$411.84
Salary subtotal			$1371.84
USU task 1 subtotal			$1,981.84
CSU technical support			
Technician	$15***/hr	16	$240
Technician	$15***/hr	16	$240
CSU subtotal			$480
Task 1 total			$2,461.84
Task 2 Annual report			
Principle investigator (USBR)**	$34.00	4	$136.00**
Fringe benefits**	108.8%		$147.97**
Task 2 total			$283.97**
Task 3: Final report			
Principle investigator (USBR)**	$34.00/hr	40	$1360.00**
Fringe benefits**	108.8%		$1479.68**
USBR subtotal**			$2,839.68**
CSU support			
Biologist	$375***/d	8	$3,000
Task 3 total			$6,364.68

Task/item	Cost/unit	Units/days	total
Task 1-3 subtotal (minus USBR)			$5,461.84
CESU overhead	17.5%		$955.82
Subtotal FY12			$6,417.66
Uplink communication fee	$50/mo	Mo.	$300
Total FY12			**$6,717.66**

*Task is to be partially carried in conjunction with project 125 (Colorado State University, Yampa River nonnative fish control) at no additional charge.
**Task covered under project 2, USBR program management; not included in total for FY12.
***Includes fringe benefits

IX. Budget Summary
FY-2011: **$52,712.52** (USU: $49,559.62; CSU: $2,853)
FY-2012 **$6,717.66** (USU**:** $2,328.66; CSU: $4,089)

Total: $59,430.18

X. Reviewers: Tom Chart, Tom Pitts

XI. References

Chart, T. 2009. Letter to Patty Schrader-Gelatt, USFWS Ecological Services Office, Grand Junction, CO dated Nov. 23, 2009.

Hawkins, J. 2009. An evaluation of fish entrainment into the Maybell Ditch on the Yampa River, Colorado, 2007 and 2008. Report to the Upper Colorado River Endangered Fish Recovery Program, Lakewood, CO.

Roehm, G. W. 2004. Management plan for endangered fishes in the Yampa River Basin and environmental assessment. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6). Denver.

USFWS (U.S. Fish and Wildlife Service) 2005. Final programmatic biological opinion on the Management Plan for Endangered Fishes in the Yampa River Basin dated January 10, 2005. Mountain-Prairie Region (6). Denver, Colorado.

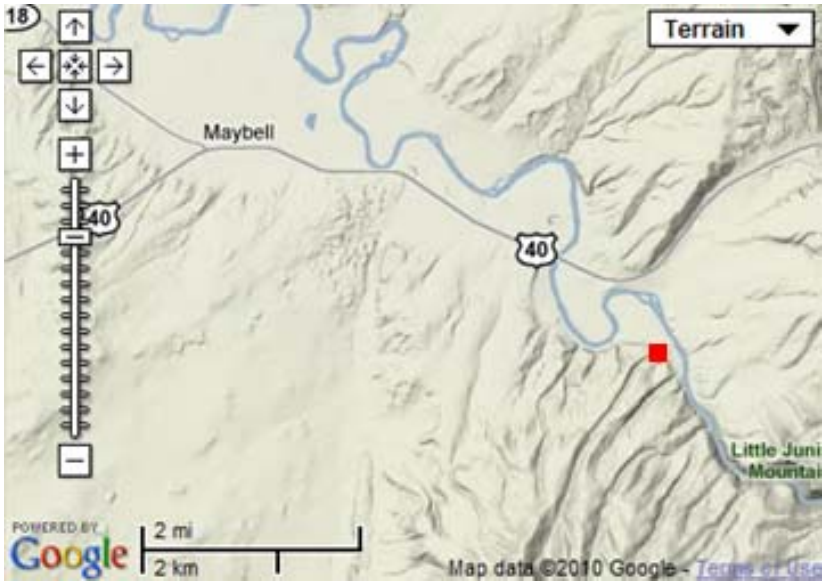

Figure 1. Approximate location of proposed Maybell Ditch PIT detection system (red symbol), Yampa River near Maybell, CO (Moffat County).

Figure 2. Solar panels and electronics enclosure in Shinumo Creek, Grand Canyon. The Maybell Ditch system will be similar but with fewer panels and the mounting frame will be raised off the ground.

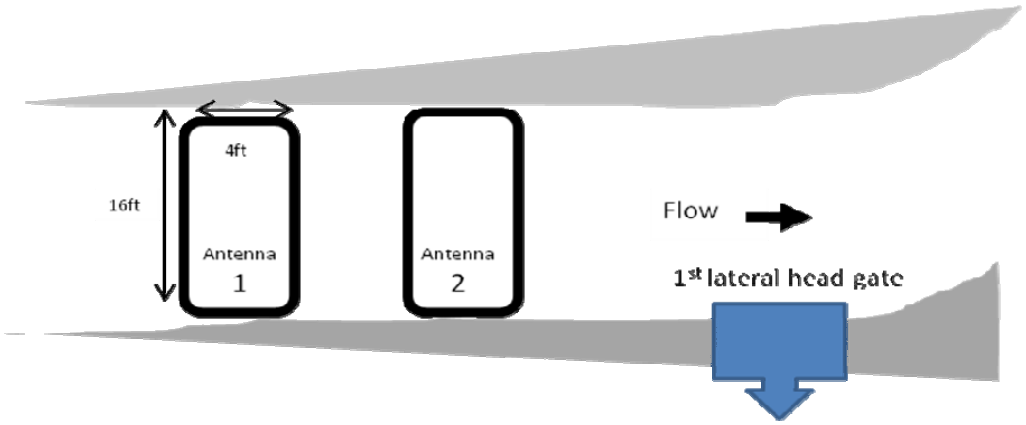

Figure 3. Schematic (not to scale) of proposed PIT detection system for the Maybell Ditch. Antenna 2 is located immediately downstream of antenna 1 (ca. several feet) but upstream of all lateral irrigation head gates.

Figure 4. Antenna loop secured on the bottom of the loop to function as a hybrid pass through/pass by antenna.

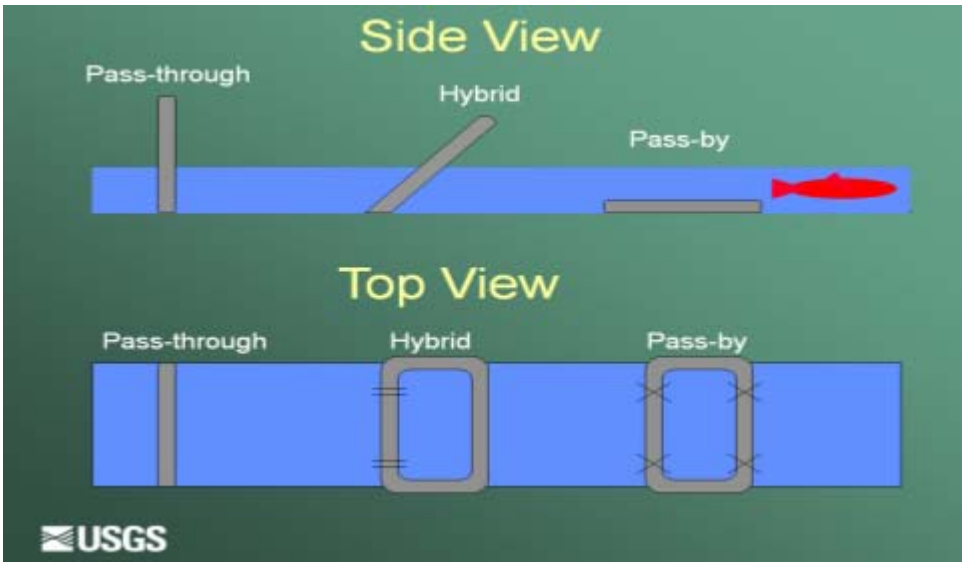

Figure 5. Different methods for securing the antenna loops. Note hybrid method for the proposed Maybell Ditch system.

Figure 6. Temporary fence around solar set up on San Rafael River.

Figure 8. Maybell irrigation ditch where the antenna loops will be installed.