

SJRIP O&M of Existing PIT Tag Antennas
2022 Project SOW
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BACKGROUND:

PIT tags are implanted in various fish species captured through various projects directly supported by the SJRIP, or funded through other agencies and projects (CDP&W, BOR, BLM, NMG&FD, and UDWR). Stationary PIT Tag antennas have been installed at various locations in the San Juan River Basin to passively detect fish as they swim above, through, or underneath the antennas. These antennas require periodic maintenance and support to keep them running and operational. Additionally, cell and satellite service is required to access the antennas and download data and perform diagnostics. Locations and numbers of antennas at various sites are listed below:

Existing Sites:

- 1) PNM Weir and Fish Passage
 - a. One pass-over antenna, modified with a concrete base is located below the weir
 - b. Four pass-through antennas are located in the fish passage.
 - c. One pass-under antenna is located above the fish passage at the trash rack intake
 - d. All six antennas are served by a single master controller located in a protected shed at the fish passage facility. The master controller is accessed using a Verizon cell data modem.

Antennas installed here are serving multiple uses, including giving us a lot of detections (meeting a broad goal of getting more recaptures), and giving us information on how, when, and where the fish passage is being used, or not as the case is. The antennas installed in the fish passage are providing information on species, timing, direction of movement, and success of passage, for fish that enter the passage. Fish detected on the antennas below the weir are providing information on species, timing, and success of fish finding the fish passage that are trying to move upstream. These antennas are being used in a "design" to test the effectiveness of PNM passage.

- 2) Hogback Irrigation Canal and Fish Weir, ~ 20 miles upstream of Shiprock, NM
 - a. Seven pass-through antennas are installed at various locations in the Hogback Fish Weir facility and canal.
 - b. Five antennas are served by a master controller and bank of batteries in a protected shed at the Hogback Irrigation Site that controls the various gates connected to the fish weir. The master controller is accessed using a Verizon cell data modem.
 - c. Two antennas are located approximately 0.5 mi upstream of the fish weir near the canal headgate. These antennas are served by a master controller and bank of

- batteries (connected to 110 AC power source) located at the antennas. This site is accessed using a Verizon cell data modem.
- d. Six antennas are located in the Hogback Bypass and raft-launch channel that is south of the canal. These antennas are served by the same Master Controller and power source used to operate the antennas at the head of the headgates.
 - e. Six antennas are located in the fish passage to the south of the bypass channel. These antennas are served by the Master Controller that serves the bypass channel. These antennas provide full river coverage at this site, especially at flows < 2,000 cfs and also provide information on the effectiveness of that fish passage.

Antennas installed at Hogback Canal are being used in a "design" to give us information on how many, when, where, and how fish use the Hogback canal and fish weir. These antennas have been used under controlled experimental conditions and have given us some good information. If VFD pumps are replaced in the canal we can get good information on how the weir works under more normal operating conditions. Antennas were installed at the canal intake, in the canal downstream of the fish weir, in the fish bypass channel, in the fish bypass that leads back to the river, and in the fish passage. Under this design, in theory, we can evaluate numbers of fish that enter the intake, numbers of fish that are entrained or bypassed back to the river, direction of fish movement, fish that use the fish passage, as well as date and timing of movements.

Antennas installed at Hogback Bypass were installed primarily due to proximity to existing infrastructure and antennas in the Canal portion of the project. These antennas are not part of a design, but are giving us information on recaptures (i.e., survival), timing of fish movements, and potential information about use of the fish passage right next to it. There were two arrays of antennas installed at this site so, theoretically, movement direction as well as date and time can be evaluated at this bypass. Since this site is protected by a radial gate just upstream that regulates the amount of water than can go through this channel the antennas cannot be flushed out during high water.

- 3) TNC Phase II Restoration Site ~ 20 miles west of Shiprock
 - a. Four pass-over antennas are installed in a secondary channel created by restoration activities conducted by TNC.
 - b. The four antennas are served by a single master controller and solar-energy supplied battery bank on an island created by the restoration activities. The site is accessed using a satellite data modem.

Antennas installed at TNC Restoration site were incorporated as a component of the evaluation of this habitat restoration and were installed in the secondary channel near the downstream mouth. Antennas were not installed as part of a "design" but can be used to provide information on movements of fish, timing, as well as simply increasing total number of detections river-wide. There are two arrays of antennas at this site so, theoretically, movement direction can be evaluated. For fish that are detected here there is little more that can be said other than they were present at a certain date and time since there is no comparison being made to main channel sites, control sites, or other restoration sites.

- 4) McElmo Creek, ~ 25 miles upstream of Bluff, UT
 - a. Five pass-over antennas were installed in McElmo Creek approximately 200m upstream of the confluence with the San Juan River.
 - b. The antennas are served with a multiplexing antenna controller and the controller is accessed using a Verizon cell data modem.

- c. Four more antennas, along with a master controller and solar panel, were installed at the bridge crossing on McElmo Creek as part of a rehabilitation project for the bridge conducted by Utah Department of Transportation.

Antennas were initially installed in 2014 at McElmo Creek near the mouth where it joins the San Juan. These antennas were installed as part of a "design" to look at fish movements (all fish) in and out of McElmo Crk. There are two arrays of antennas at this site so movement direction can theoretically be evaluated. These antennas are continuing to function even though they are past their planned life-span, albeit at a reduced level of effectiveness due to burial by sediment and two of the 5 antennas being flushed away from floods.

McElmo Creek Bridge--These antennas were installed as part of a rework of the bridge abutment and, since the contractor had heavy equipment and was going to be using large rip rap to create a new channel, it was relatively easy and cheap to install a series of antennas. Antennas installed at the McElmo Creek Bridge were not installed as part of a "design", although there are two arrays of antennas, one upstream and the other downstream of the Bridge. Thus movement direction and ability of fish to swim up the channel can be assessed. Additionally, when combined with antennas approximately 300 yards downstream at the mouth of McElmo, the antennas can be used to assess direction, timing, and movements of fish that come in and out of McElmo Creek.

- 5) Piute Farms Waterfall—Submerged pass-over antennas located at the Piute Farms Waterfall on the San Juan River near Goulding, AZ.
 - a. Two semi-permanent antennas are installed on the river right part of the Piute Farms Waterfall near Goulding, AZ.
 - b. The antennas are served by a solar system, master controller, and satellite communications system.

A single semi-permanent concrete antenna has been installed at the Piute Farms Waterfall downstream of the falls along with another antenna that is bolted to the wall of the waterfall on river right. These antennas were installed as part of a design to determine species, timing, and numbers of fish visiting the Piute Farms Waterfall and are precluded further movement upstream.

- 6) Shiprock Bridge Secondary Channel--This site consists of a restored secondary channel that has a concrete inlet at the mouth. We installed a three-array system in October of 2018 as part of the concrete apron, which reduces risk of antennas being destroyed by flooding. Antennas installed here of a three-array system that provides information on species and timing of use, as well as direction of movement in and out of the secondary channel.
 - a. Three antennas grouted into concrete near the entrance to the secondary channel.
 - b. The system is served by a solar system, master controller, and cell phone modem communications.

Three antennas were installed in Fall of 2019 at the restored secondary channel near Shiprock, NM. These antennas give some idea of fish use of the secondary channel. This site has been vandalized and has had modifications made to the diversion, especially to irrigate illegal hemp farming, but is still operational.

- 7) Autonomous Antenna Systems—Three autonomous antennas have been installed in the main channel of the San Juan River near McElmo Creek, Powerline, and Phase II Restoration site. These single antennas, along with solar charging systems and

electronics, were installed in summer of 2021 with the goal of obtaining increased numbers of remote detections at these sites. The sites consist of a single, 20-foot antenna, that is installed perpendicular to the shoreline, and is completely submerged at flows of ~500cfs. The antennas do not have communication systems and must be downloaded manually.

These autonomous antennas will hopefully provide more PIT tag detections at these sites. The antenna at the RERI Phase II Restoration site could provide comparable detection data with that collected in the backwater and the secondary channel. The antenna near McElmo creek may provide data on fish using the creek and/or possibly spawning in that area (razorback suckers). The site near Powerline will hopefully provide data on fish that are using that portion of the river that is rarely sampled.

Proposed sites:

1) 2) Four-Corners Bridge---The Four-Corners Bridge is being reworked due to erosion of rip rap on the bridge abutment on the upstream side of the north abutment. Antennas could be installed at this site as part of the repair work on the rip rap. River-wide antennas would be ideal, but incorporating the antennas into the rip rap at the foot of the bridge is more likely. These antennas would not be part of a "design" but could provide more detections of fish in this portion of the river as well as information on a potential spawning bar for Colorado pikeminnow that may be located just upstream. Since this would not be a multiple-array system the data would only provide information on species, number, and timing of movements.

METHODS:

- 1) Stationary PIT tag antennas will be contacted periodically (bi-weekly) to check the settings, download the data, and perform diagnostics of the systems. Sometimes problems arise (batteries drain down due to lack of sun, antennas are washed away, wires are cut) that cannot be solved remotely. In these cases a site visit must be conducted by a technician to repair the system. The SOW and budget include the replacement of one antenna during the work period. If an antenna is not replaced the funding will be used to purchase additional PIT tags or submersible antennas to be used by other biologists.
- 2) Installation of antennas is usually covered under separate SOWS for each site. These costs will be in addition to equipment and labor costs from Biomark.

TASKS – 2022

1. Maintain and operate stationary and portable PIT tag antennas
2. Replace one PIT tag antenna (location unknown, probably waterfall)

FY 2022 BUDGET

O&M of Existing Antenna Systems, Replacement of one Antenna, and Data Management

A) Labor

Position	Salary total/hr	No. persons	Total Hours	Total cost
BOR Technical Representation for Contracts and Agreements	\$80.00	1	40	\$3,200.00
BioMark or USU Staff (contract)	\$80.00	1-2	100	\$6,400.00
Total				\$9,600.00

B) Travel

Position	Destination	Purpose	Days	Lodging per day/total	Per diem per day/total	Mileage*
Reclamation Technical representative	Farmington, Shiprock	Project evaluation or field trips	2 trips @ 5 days/trip	\$100/\$500	\$40/\$400	\$0
BioMark/USU representative	Boise, ID; Kennewick, WA; various	Field trips O&M Antennas	2 trips @ 5 days/trip	\$100/\$1000	\$40/\$400	\$2750
Total				\$1,500.00	\$800.00	\$2,750.00

*mileage of 5,000 mi at \$0.55/mile

Total	\$14,650.00
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**Budget Summary
FY-2022**

Category	Total
Labor	\$9,600.00
Travel	\$5,050.00
Equipment	\$1,000
Total FY2022 Budget	\$15,650.00

How can the technical aspects of this SOW be improved?

Zeigler (NMDGF): Line 167: I am not opposed to increasing the number of antennas in the system, however this proposed site (at the Four-Corners Bridge) may not be an ideal location unless it can be installed as a river-wide antenna. I would really like to see the PI determine one or two locations below Four-Corners Bridge where river-wide antennas could be installed.

What is this SOW's contribution to recovery?

Zeigler (NMDGF): The PIT tag antennas throughout the upper San Juan River have provided valuable information on movement, passage, and survival of Colorado Pikeminnow and Razorback Sucker. This information has directly influenced management actions and recovery of both species. Continued O&M for these antennas is needed. However, I would like the Program to investigate potential locations in the lower San Juan for river-wide antennas.

Response: This is a great comment and one we have been working on for several years. We attempted a river-wide PIT-tag installation just upstream of the Mexican Hat boat launch in November 2013. It was not successful for a variety of reasons. Since that attempt we have investigated other locations, but never made a decision to attempt a river-wide antenna again. The system would be expensive and would have to be maintained. An installation would likely require coffer damming the river and the use of several pieces of heavy equipment. We are close to having almost river-wide antennas at the Hogback Diversion and this should be completed in Fall of 2021. In 2021 we installed three single antenna units in the San Juan River at McElmo Crk., Powerline, and the Phase II Restoration site. These were relatively cheap and easy to install. We installed these antennas in response to the findings that determining the direction of fish movement at antenna sites is not as important as increasing the number of detections and getting data. I recommend that we wait to see what detections are like at these other units before deciding to complete a full-river installation.