Beaver & Willis Irrigation Diversion
Construction Project
Final Report
Mancos Conservation District
May 21, 2011

CWCB GRANT PURCHASE ORDER INFORMATION
Colorado Water Conservation Board (CWCB)
P.O. # OE PDA 12000000031
October 26, 2011

INTRODUCTION AND BACKGROUND

This report summarizes the project history and construction per the approved CWCB Scope of Work submitted for this CWCB grant. Photographs of pre- and post- construction are also provided.

In 2009, the Southwest Basins Roundtable granted $24,753 to the Mancos Conservation District (MCD) for the Mancos River Diversion Project – Phase I to map diversion structures within the Mancos River Watershed, to evaluate options for restoring flows, and to produce designs for new diversion structures. The mapping assessment of diversion structures identified numerous diversions that were in need of rehabilitation or reconstruction due to the level of required on-going maintenance or an inability of the diversion to divert its full water right. These in-channel activities, and in some cases the diversion structure itself, impaired river function and fisheries habitat.

In 2010 and 2011, the MCD engaged Basin Hydrology, Inc. to prepare detailed construction plans for the Beaver, Willis and Bolen diversions. These three ditch companies applied for and received approval for NRCS EQIP funds to offset some of the rock and concrete costs. The NRCS required that the designs be approved by NRCS engineers. Due to additional costs associated with submitting detailed design reports to the NRCS for approval, design reports were only submitted for the Beaver and Willis. A construction plan was produced for the Bolen, but was not submitted as a Design Report to NRCS for approval.

The MCD then applied for a Healthy Rivers Fund grant for $19,900 in April 2011 to cover the cost of obtaining NRCS approval for the Bolen diversion and to offset some of the actual construction costs for all diversions. Due to insufficient funds in 2011, the Healthy Rivers Fund grant request was denied. However, the CWCB suggested that the MCD submit the request for funding to the CWCB's Watershed Restoration Program. The Bolen Ditch Company chose not to pursue NRCS approval or funding due to lack of ditch company funds and therefore they could not utilize the awarded monies from the CWCB's Watershed Restoration Program. Consequently, the CWCB allowed the Beaver and Willis to share those funds. Of the $19,900 amount, $14,400 was allocated to construction and approximately $5,500 was budgeted for project administration.

PROJECT OBJECTIVES AND DELIVERABLES

As stated in the October 2011 Scope of Work, the four project objectives were:

- Construct in-channel diversion structures.
- Provide construction staking and oversight.
- Prepare as-built plans of completed structures (basically the same as design plans).
- Provide fiscal and grant Project Administration.

The project was fully completed in April 2012, successfully achieving each of the stated objectives. The projected long term benefits to the Mancos River of the completion of this project are passage of high flows, increased channel bed and bank stability in the vicinity of each diversion, reduced bank erosion, increased fish movement past these diversions, and increased use of deep water habitat (pools) by trout and native fish. The projected long term benefits to irrigators from the completion of this project are the ability to clean diversion channels through use of newly installed sluice gates, and the ability to divert the full water right associated with each ditch, when available, with reduced maintenance costs.

PRE-PROJECT DIVERSIONS

Prior to this project, the Beaver diversion's method of diverting water from the river channel consisted of an in-channel gravel berm that required reconstruction after high flow events. During low flow periods, the Beaver could generally divert its full water right by constructing a gravel berm across the channel which basically diverted the entire river to its heading. As a result of this berm having to be reconstructed each year, channel bed and bank disturbances occurred. The berm created a fish barrier and dewatered approximately 170 feet of channel between the ditch inlet and where the heading's overflow system (a pipe and channel) returned water back to the channel.

The Willis could not divert its full water right during low flow periods due to the lack of a formal in-channel diversion structure. The Willis diversion's method of diverting water to an old and non-adjustable heading consisted of hand placed rocks in the river with one bank of the diversion inlet channel comprised of a collection of hand-placed rocks, tree limbs and fabric.

POST-PROJECT DIVERSIONS

At both the Beaver and the Willis diversions, cross vane rock structures were placed in the river channel to establish water elevations during low-flow periods so that water would be diverted to diversion headings. These rock structures are intended to provide stable diversion systems that pass high flows, reduce bank erosion, allow fish passage and provide deep water habitat (pools).

Mark Oliver (Basin Hydrology, Durango) provided construction staking and construction oversight during construction at both diversions. Dave Derfus (D&D River and Dirt Works, Durango) was the construction contractor for both diversions. T&M Dirt Works (Mancos) delivered the rock and the concrete blocks to both projects.

Due to the required water elevation for full water right diversion at the Beaver's existing heading structure, the new in-channel structure's elevation had to be higher than is desirable for sediment transport. The heading structure was only a few years old and could not be modified. The elevation difference between this required water elevation and the down stream channel is ~ 3.5 to 4.0 feet. This amount of drop required the use of three cross vane-type structures to minimize the amount of drop over each structure. During non low flow periods, the cross vane structures

will allow fish movement through the reach and the excavated scour pools will provide deep water habitat during low flow periods and winter.

Large angular sandstone rock (~ ¾ CY to 1.4 CY size) obtained from Mesa Sandstone's quarry, just west of Mancos, comprised the in-channel structures. At the entrance to the diversion inlet channel, pre-cast concrete blocks (2'x2'x6') with a tongue and groove system for interlocking purposes were used. They were obtained from Four Corners Materials in Farmington, NM. Their purpose is to define the width and elevation at the diversion ditch inlet and to provide a solid structure for the ditch company to install a frame system. Approximately 148 CY yards of rock and 35 concrete blocks were used for the new in-channel diversion system at the Beaver Ditch heading. Construction was completed in approximately 5½ days. A copy of the construction plan is attached (Attachment A). This plan largely represents the as-built conditions. Pre and post construction photographs are included below.

In order to limit the amount of water entering the diversion inlet ditch during high flows and to provide a low elevation scour area to reduce the amount of sedimentation at the ditch inlet, the Beaver ditch company had a steel frame and headgate built and installed in April 2012.

The Willis diversion required the installation of an in-channel diversion structure, an embankment to define the right bank of the diversion inlet channel and a new heading structure. A cross vane structure was constructed using large sandstone rock of similar size as was used at the Beaver diversion. The elevation of the spill rocks of the cross vane structure were based on the elevation required to divert the ditch's full water right during low flow periods. A deep scour pool was excavated below the cross vane for high flow energy dissipation and to provide for fish habitat during low flow periods and winter. Excavated channel materials were placed river-left between the river's low flow channel and the diversion inlet channel to construct a flood plain feature between the cross vane structure and the downstream riparian community.

Concrete blocks (the same as those used at the Beaver diversion), were used to construct a restricted opening at the diversion inlet channel, to define the right bank of the diversion inlet channel, a sluice opening and a new heading structure. Rather than mechanical gates, the groove portion of the concrete blocks was notched out using a masonry blade on a demolition saw in order to define the entrance to the diversion inlet channel, the sluice gate adjacent to the heading and the heading gate. The notch is approximately 2½" wide to accommodate a 1½" wide board. Several 2"x 8" boards were cut to the appropriate length so that each opening can be closed off or have a restricted opening. The sluice opening is intended to provide sufficient drop from the diversion inlet opening to the sluice to scour the inlet ditch of accumulated fines. Approximately 32 CY yards of rock and 35 concrete blocks were used. Construction was completed in approximately 4 days. A copy of the construction plans is attached (Attachment B). This plan largely represents the as-built conditions. Pre and post construction photographs are included below.

FINAL PROJECT BUDGET

Below is the final project budget, showing all project expenses. Administrative funds were lower than expected. The remaining grant funds were applied to project construction, divided equally between the two diversion construction projects.

Final Budget: Mancos River - Beaver & Willis Diversion Construction

Budget & Timeline Table

Task	Description	Start Date	Completion Date	Project Tasks	Project Expenses	CWCB Funds	Other Funding Cash*		Other Funding In-Kind*	Total
							NRCS	Ditch Co.		
1	Beaver Diversion Construction	10/24/2011	5/1/2011	Mesa Sandstone: rock	8,118.81	$ 8,197.00	$ 16,543.15	$ 850.78	$ -	$ 25,590.93
				Four Corners Materials:block	2,381.40					
				T&M Dirtworks: rock and block delivery	2,422.50					
				Basin Hydrology: construction oversight	3,024.95					
				D&D River and Dirt Works: install rock, block	6,900.00					
				T&M Dirtworks: excavated gravel relocation	630.00					
				Mackey Construction: Headgate fabrication	561.70					
				Boyd's Welding: Headgate, frame installation	1,296.57					
				T&M: Dirtworks	255.00					
				subtotal	**25,590.93**					
2	Willis Diversion Construction	10/24/2011	11/15/2011	Mesa Sandstone: rock	2,351.47	$ 8,196.00	$ 6,122.00	$ 1,182.45	$ -	$ 15,500.45
				Four Corners Materials: concrete blocks	2,455.82					
				T&M Dirtworks: rock and block delivery	2,100.00					
				Basin Hydrology: construction oversight	2,957.16					
				D&D River and Dirt Works: install rock, block	5,550.00					
				SW Seed: seed mix	46.00					
				Edythe Hurst: Raking in seed.	40.00					
				subtotal	**15,500.45**					
3	Project Administration	10/24/2011	12/15/2011	Basin Hydrology: grant admin, draft report	1,918.00	$ 3,506.40	$ -	$ -	$ 200.00	$ 3,706.40
				Ann Oliver: grant coordination, final report	1,588.40					
				subtotal	**3,506.40**					
	TOTALS				**44,597.78**	**$ 19,899.40**	**$ 22,665.15**	**$ 2,033.23**	**$ 200.00**	**$ 44,797.78**

$200 - Lea Cody (District Manager Mancos Conservation District; 10 hrs @ $20/hr for billing & PA-Board coordination)
Basin Hydrology, Inc. rates ($90/hr, $0.60/mile)
Ann Oliver rates ($65/hr, $0.60/mile)

PRE & POST CONSTRUCTION PHOTOGRAPHS

Beaver Diversion

PRE: Downstream view of ditch inlet (left), diversion berm and river channel (right).

POST: Downstream view of ditch inlet and upstream rock structure (partial, see image below).

POST: Downstream view of upstream rock structure and channel.

POST: Upstream view of ditch inlet and upstream rock structure.

PRE: Upstream view of diversion berm and river channel.

POST: Upstream view of cross vane structures.

POST: Hillside view of diversion inlet and cross vane structures (river flow is right to left).

Willis Diversion

PRE: Downstream view of ditch inlet (left) and river channel (right).

POST: Downstream view of ditch inlet (left) and river channel (right).

PRE: Downstream view of ditch inlet (left) and hand-placed diversion rocks (right).

POST: Downstream view of ditch inlet (left) and river channel (right).

PRE: Upstream view of diversion inlet channel and river.

POST: Upstream view of diversion inlet, diversion channel and cross vane structure.

PRE: Downstream view of non-functional heading structure.

POST: Downstream view of new heading (left) and sluice opening (right).