DIAMOND FORK RESTORATION

Flow Measurement Construction:

Installation of Ramp Flumes and Data Loggers

Prepared for:

Utah Reclamation Mitigation and Conservation Commission

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Background

The Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) requested that Allred Restoration, Inc. assist in developing a method for measuring streamflow that is being diverted from the Diamond Fork River into a series of created wetlands and channels, near the mouth of Diamond Fork Canyon. This report summarizes the installation of two flumes that were installed to allow measurement of (1) the flow being diverted from the river, and (2) the flow that is returning to the river below the wetlands.

Flume Type Selection and Location

Several types of flumes and weirs are available to measure flow in channels and ditches. Each type has advantages and disadvantages that must be weighed against the site characteristics and the goals of the measurement program. For this project, ramp flumes were determined to offer the best combination of measurement accuracy and ease of installation at our site.

Two EZ-Flow ramp flumes (model EF10) were installed at the project site at the locations shown in Figure 1. These flumes are capable of measuring flows between 0.1 and 10 cfs. The first flume (flume #1) was installed during the initial wetland construction phase. It is located just below the new diversion structure on the Diamond Fork River. This flume measures the total flow that is diverted from the river into the project. The second flume (flume #2) was added later during the summer of 2010. It is located below the wetlands to measure the return flow to the river.

Flume Instrumentation

After the initial installation of flume #1, some shifting of the flume occurred. As a result, the flume did not provide an adequate backwater effect to allow accurate measurement of the flow. Thus, the flume was repositioned in July of 2009 to ensure measurement accuracy. The flume operated as planned for the rest of the summer and fall of 2009.

In the early spring of 2010, the decision was made to instrument the flume to allow accurate measurement of the flow on a continuous basis. In order to allow continuous measurement of flow through flume #1, a new stilling well was attached to the flume (Figure 2). The stilling well is connected to the flume via an open tube that allows the water level in the well to exactly match the water level at the stage plate of the flume.

The stilling well provides a protected location to suspend a pair of Solinst Gold data loggers, which were provided by the Mitigation Commission. The data loggers are suspended in the tube of the stilling well,

with one submerged in the water to record water pressure changes, and another suspended above the water to record atmospheric pressure changes (Figure 3). These two measurements combine to allow accurate measurement of the water levels in the stilling well, and the associated flow quantities in the flume. The data loggers are attached to a "Direct Read Wellhead" via "Direct Read Cables" that allow connection of a computer for programming and downloading of data without removal of the data logger (as shown in Figure 3).

The instrumentation equipment is protected from the elements and from vandalism by a lockable steel box that was custom-built by Ipaco in Logan, Utah. This steel box is bolted directly to the flume, covering the stilling well and associated instrumentation. The box design includes a lid and lid-support that allows the lid to act as a table for the computers that are used to program the data loggers and download the data (Figure 4).

The instrumentation in Flume #1 was calibrated at a flow very near zero, which provides an ideal reference elevation on the stage plate of the flume. The Solinst data loggers record pressures which vary with flow depth. By correcting for changes in atmospheric pressure, the recorded pressures can provide a good record of the water surface elevation in the flume over time. The characteristics of the flume determine the rating relation, which is essentially a table of water surface elevations in the flume and the flow volumes that are associated with those elevations. The rating curve, for both ramp flumes used in Diamond Fork, is shown in Figure 5.

Flume #2 was installed in June of 2010 below the constructed wetlands, at the location indicated in Figure 1. This flume was installed using the same procedures outlined previously for Flume #1. Calibration of this flume was difficult because the flow at the downstream end of the project is difficult to control. An approximate calibration was completed at a discharge of roughly 0.3 cfs. A better calibration can be completed next season.

Flume and Instrumentation Performance

The data loggers have been used throughout most of the summer of 2010. Flume #1 has been performing well and providing a solid record of irrigation flows delivered to the project. Flume #2, located below the wetlands, has had flow only a few times this summer. Return flow from the wetlands has been rare since installation, due to the lack of sufficient irrigation water for the wetlands. The newly-constructed wetlands are leaking a substantial amount of flow into the groundwater system. As a result, return flow is only seen when large volumes of water are applied to the wetlands.

Figure 1. Aerial image taken in 2009, showing recently completed construction and location of two ramp flumes.

Figure 2. Photograph of ramp flume #1 with the stilling well attached.

Levelogger®
Model 3001

Levelogger Deployment

Direct Read Cable Deployment

Use this method when you would like direct communication via a field laptop or Leveloader Gold or, while your Levelogger is taking water level readings downhole. Pre-program Leveloggers (Gold, Barologger, or Junior) in the office using an Optical Reader, or, in the field, use a laptop and PC Interface Cable (USB or RS-232 connection), or a Leveloader to program, view or download data.

Barologger Suspended in Air
- Typically 1 Barologger per 30 km (20 mile) radius and/or every 300 m (1000 ft.) of elevation change from well to well

Direct Read Cable
- Lengths up to 1500 ft. (450m)

Submerged Levelogger Gold or Junior

Leveloader Gold connected to a Direct Read Wellhead using a Direct Read Connector Cable.

Figure 3. Data logger deployment schematic, as used for the Diamond Fork project flumes (from Solinst website). A second Levelogger Gold was used in place of the Barologger.

Figure 4. Lockable steel box that protects the instrumentation equipment. The lid and triangular support provide a sloping table for field computers.

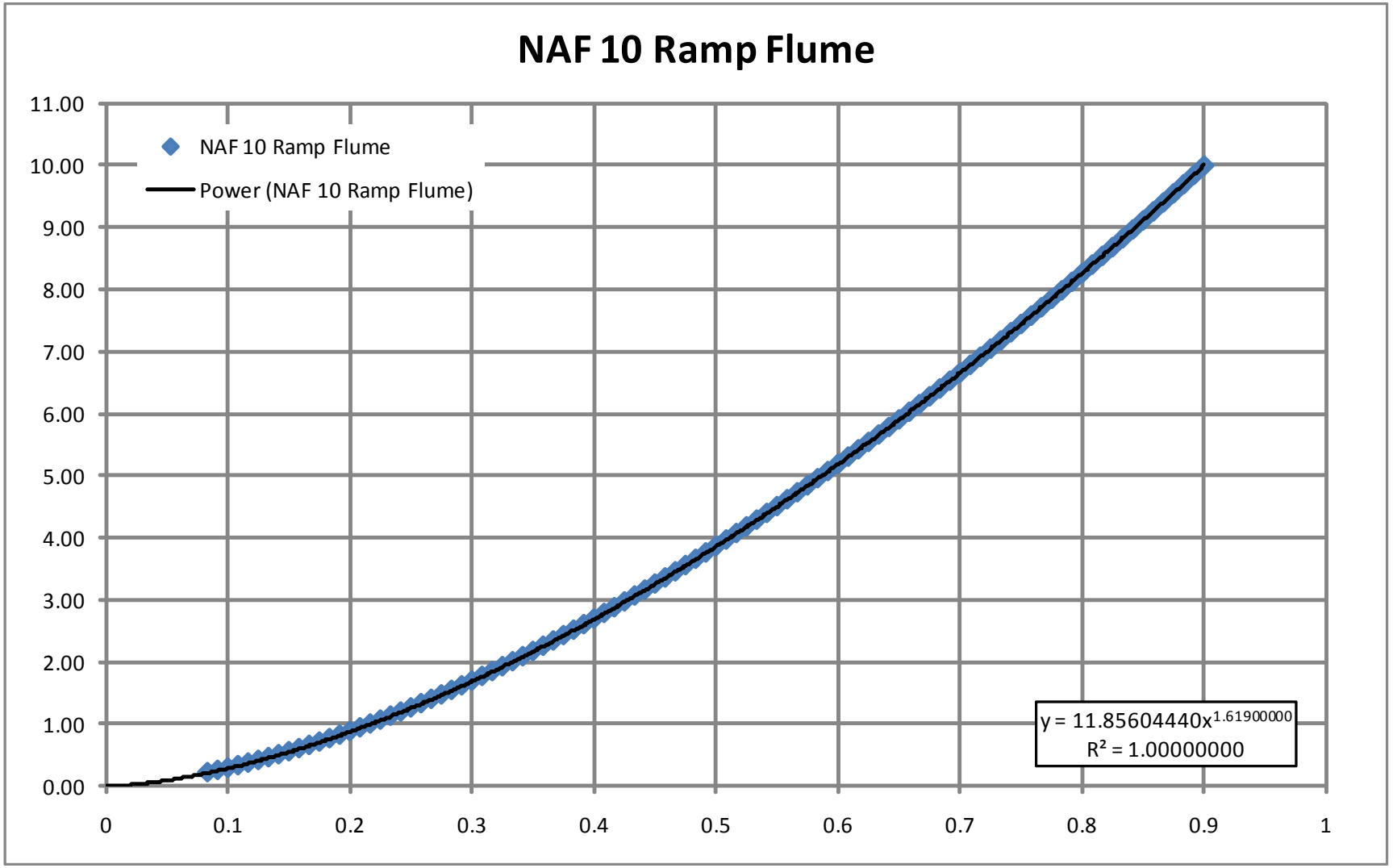

Figure 5. Rating relation for the ramp flumes at Diamond Fork. The X data are water depth in feet, and the Y data are discharge in cubic feet per second.