Final

SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM
WATER TEMPERATURE MONITORING

2013 ANNUAL REPORT

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INTRODUCTION

As part of the San Juan River Basin Recovery Implementation Program (SJRIP), water temperature and hydrology studies have been undertaken since 1992. This report summarizes the water temperature data collected from October 2012 to October 2013 as part of the long-term monitoring program.

Objectives

1. ***Monitor water temperature at nine existing locations in the San Juan River, NM and UT (*Figure 1*).***

Logger locations were modified beginning in October 2011. These modifications better meet the objective in the Long Range Plan to monitor water temperature changes as a result of management actions. One logger was added in the San Juan River upstream of the Animas River confluence near County Road 5500 (near the Lee Acres RV Park) in April 2012. This location provides data for the San Juan River upstream of the Animas River in the reach being used to release razorback sucker. A second logger was added in McElmo Creek approximately 0.2 miles upstream of its confluence with the San Juan in October 2011.

It was proposed in the 2012 annual report that monitoring of the San Juan River at Navajo Dam be discontinued. This recommendation was based on several factors: 1) this location was originally chosen when the tailwater fishery was part of the San Juan Seven Year Research Program; the tailwater is no longer included in San Juan River annual work plans; 2) coordination with the dam tenders adds logistical considerations for the location; 3) the logger at Archuleta provides upstream water temperature data that are very close to the releases from Navajo Dam; and 4) recorded temperatures at the dam have been questionable due to fluctuating water levels during releases. Results from FY2013 (see Results section) continue to demonstrate the unreliability of data collected from this location.

2. ***Add FY2013 data to the water temperature database, which can be accessed at the SJRIP website.***

The database for water temperatures has been updated to include FY2013 data. These data are in the same format as the database for previous years.

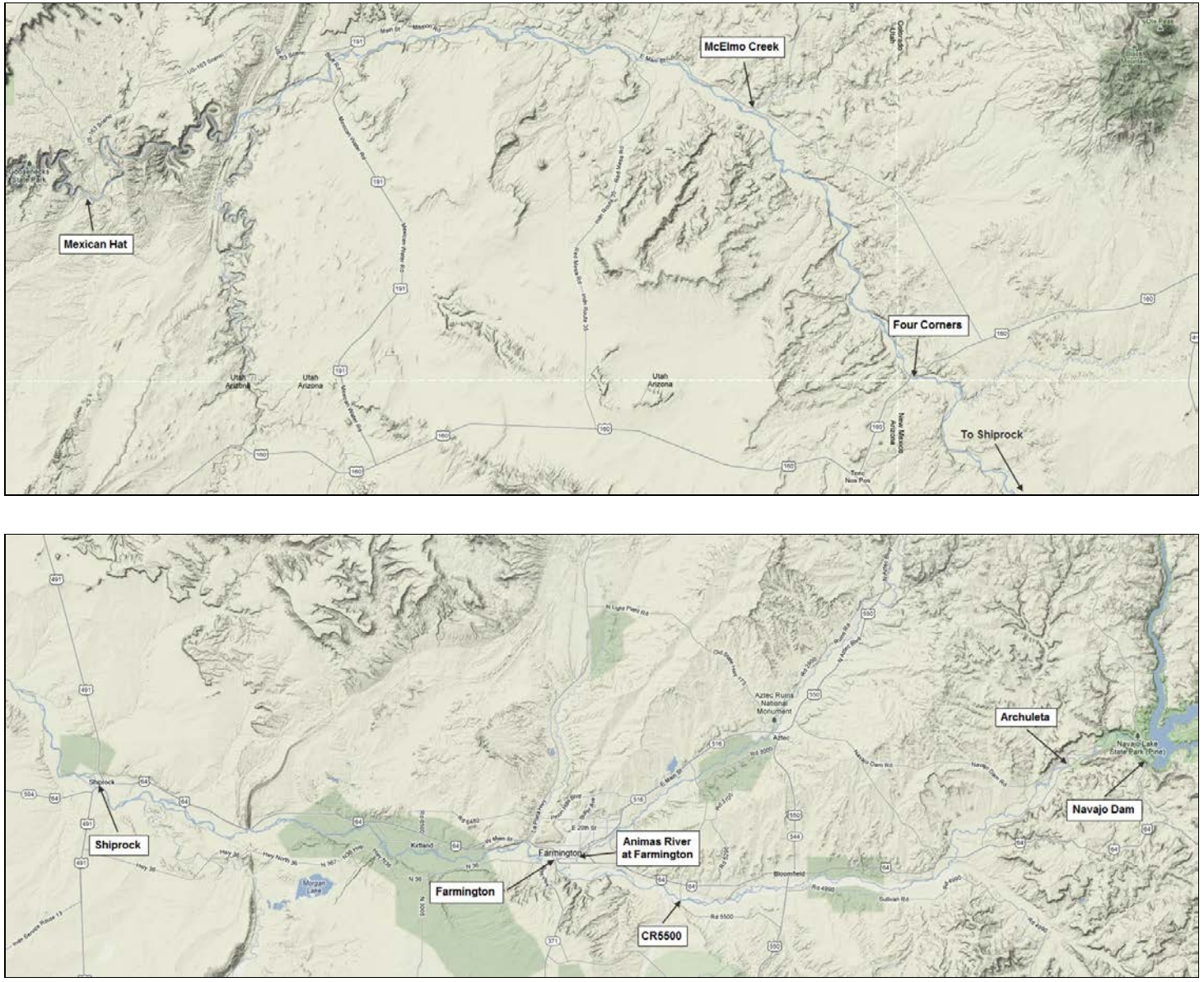

Figure 1. Water temperature monitoring locations. Map courtesy of Google maps.

METHODS

Water temperature has been recorded since the summer of 1992 at the locations shown in Table 1 (not including the two locations established in 2011). Those data are found in reports posted to the San Juan River Recovery Implementation website. At the request of the Bureau of Reclamation and the San Juan River Recovery Implementation Program, we installed Onset Corporation HOBO Water Temp TidbiT v2 loggers with built-in thermocouple temperature sensors in October 2011 in the locations described in Table 1. These loggers are accurate to ±0.2°C. Water temperature was recorded every 15 minutes. Each logger was placed in a small enclosure that is secure and hard to detect by individuals without knowledge of the deployment location. This system has been used in locations with high public use without loss of the logger or enclosure. The enclosures consisted of a steel post driven flush with the stream bed and a PVC protective housing for the logger attached to the post by steel cable (Figure 2). These housings can withstand streambed movement and protect the logger from stream debris. Two loggers (labeled primary and secondary) were installed at each location as insurance against malfunction, vandalism, and/or data loss and were spaced at least 30 feet apart.

HOBOware Pro software was used to deploy and download data from the loggers. This software has built-in capability to summarize data into daily values from the individual 15-minute measurements. Data were downloaded four times on a three-month time interval (winter, spring (prior to runoff), summer (after runoff), and fall). After each field visit, data were transferred to Miller Ecological Consultants (MEC)'s office where data were checked for quality and any erroneous or suspected incorrect data removed. Data were added to the Microsoft Access database that contains all 15-minute data from each site. The database also contains tables that summarize daily maximum, minimum and mean temperature for each site. Daily average water temperatures at each site were then plotted along with the daily hydrograph of the San Juan River. Discharge data were obtained from the USGS gages listed in Table 1.

Table 1. Water temperature monitoring locations.

Location	River Mile	UTM Zone	UTM Northing (m)	UTM Easting (m)
Near Navajo Dam	225.0	13S	4076511	266784
Archuleta – San Juan at USGS gage location	218.6	13S	4076301	259235
CR5500 – San Juan at CR5500 bridge near Lee Acres RV Park*	188.9	12S	4064363	759478
Farmington – San Juan at USGS gage location	180.1	12S	4067579	747929
Shiprock – San Juan at USGS gage location	148.0	12S	4073096	706294
Four Corners – San Juan at USGS gage location	119.4	12S	4096658	675400
Mexican Hat – San Juan near Bluff gage location	52.1	12S	4112151	600678
Animas at Farmington – Animas River at USGS gage location	n/a	12S	4067756	749902
McElmo Creek at confluence with San Juan*	n/a	12S	4120599	660513

*Established in 2011/2012.

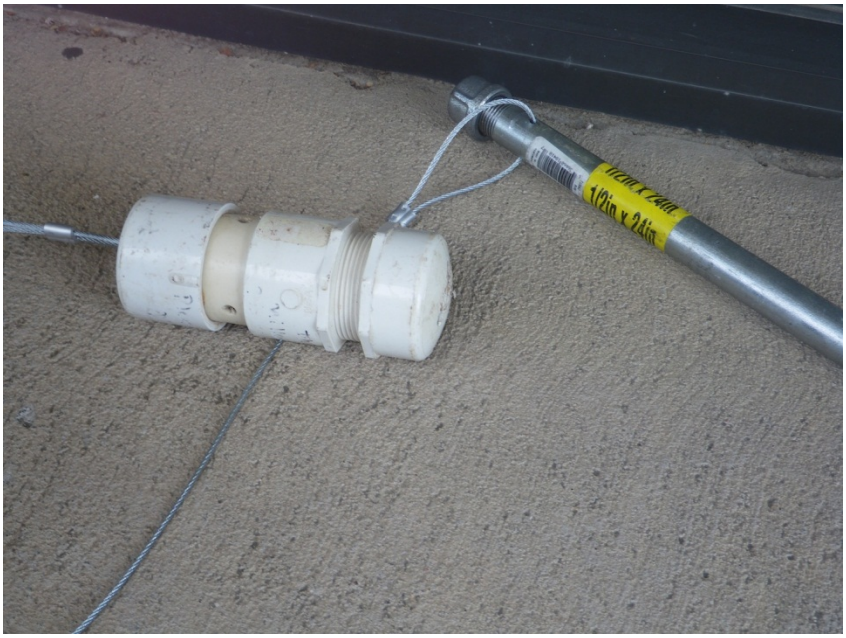

Figure 2. Example data logger housing, closed and ready for deployment.

RESULTS & DISCUSSION

For some of the loggers, data from the primary logger were suspect for several dates, so we used data from the secondary loggers as needed. There were several instances where a logger was found buried in the streambed or was out of the water. During the February 2013 field visit, both loggers at Navajo Dam were out of the water. The primary loggers at the Animas River location and the Shiprock location were buried. Both loggers at the Mexican Hat location were missing and had to be replaced. During the April 2013 field visit, the primary loggers at the Animas River, Shiprock, McElmo Creek, and Mexican Hat locations were found out of the water. During the July 2013 field visit, the primary logger at the Animas River location was out of the water. The secondary logger at Four Corners was missing, as was the primary logger at Mexican Hat. McElmo Creek was completely dry during the July 13 visit, but based on the data appeared to have water again by July 21. During the October 2013 field visit, primary loggers were missing at CR5500, Animas River, and Mexican Hat, and the secondary logger at Farmington was also missing. There were also a few instances where, based on the large fluctuation in temperature on a daily basis, we suspected that a primary logger was out of the water and then resubmerged. During these times, we compared the primary logger data to the secondary logger data and used the secondary data where appropriate.

At the Mexican Hat location, a total of four loggers were lost. This resulted in a lack of data from October 2012 to March 2013 and from mid-July 2013 to mid-October 2013. We compared the available temperature data from the loggers to the temperature data from USGS gage 09379500 (San Juan River near Bluff), which is approximately 1200 feet upstream. Average daily temperatures were very similar, so we used the temperature data from the Bluff gage to fill in the missing data for Mexican Hat.

As stated above, during the February field visit, both loggers at the Navajo Dam location were out of the water. Because of this (and based on analysis of the previous year's data), a decision was made to remove the loggers at that time. The recorded average daily temperatures were several degrees below zero for many days, suggesting that the loggers were actually recording air temperature instead of water temperature (Figure 3).

Use of both primary and secondary loggers allowed for nearly continuous temperature records from October 2012 to October 2013, with a couple of exceptions. The first exception was at McElmo Creek, where the stream was seemingly dry from July 12 to July 21. The second exception is that there are no data for the Mexican Hat location from January 15 to February 6 (due to ice) and from September 14 to September 19.

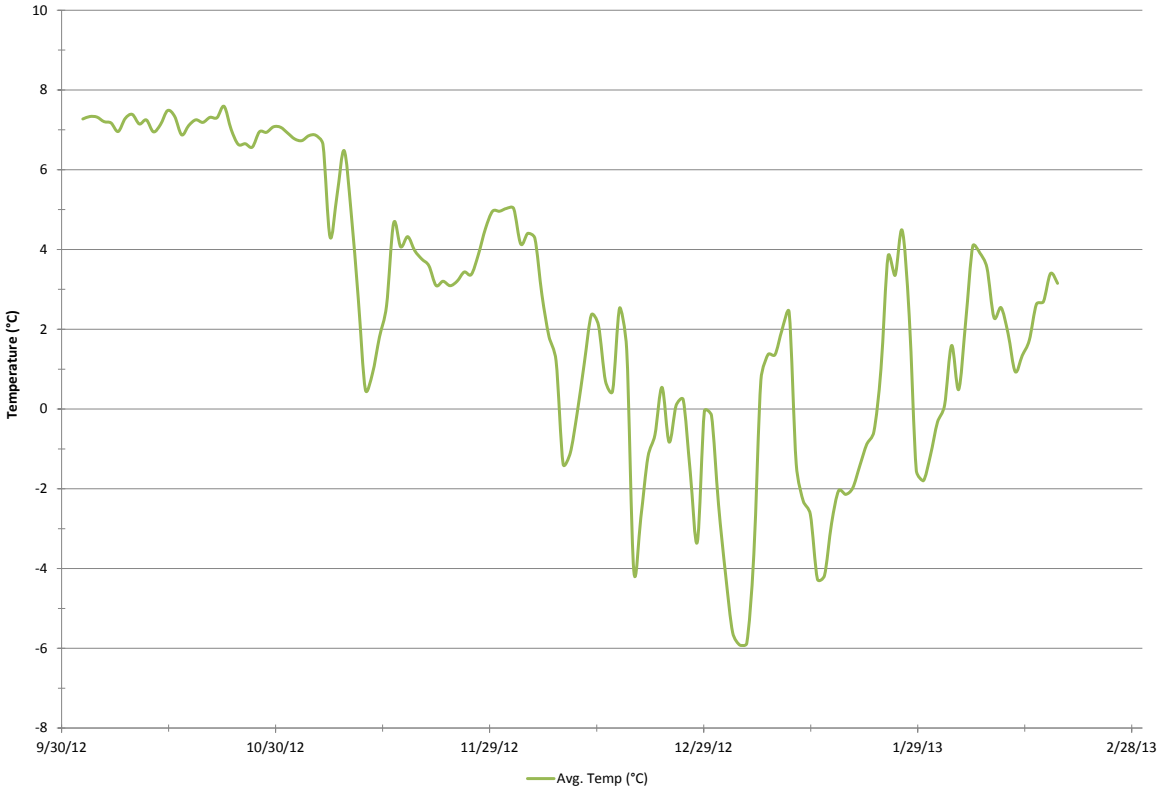

Figure 3. Average daily water temperature at Navajo Dam.

There was no large release of water from Navajo Dam in 2013 like that which occurred in 2012. Average daily flow at the Archuleta gage peaked at 1070 cubic feet per second (cfs) on July 9, 2013 (Figure 4). This was much lower than the peak of nearly 5200 cfs that came from the release in 2012. Water temperature did decrease with large increases in flow in July 2013. For example, when flows began to increase on June 13, average daily water temperature was 12.5°C. By July 4, average daily water temperature had decreased to 7.9°C. Similar temperature fluctuations were observed at CR5500 (Figure 5). On June 13, average daily water temperature was 21.4°C; by July 4 it was 14.7°C. Beginning in March, water temperatures at CR5500 were substantially warmer than those at Archuleta (Figure 6). The peak average daily temperature at Archuleta occurred on June 10 and was 13.6°C. For CR5500, average daily temperature peaked at 22.3°C on June 14. It appears likely that water temperatures would have peaked in July (similar to the downstream sites, see below) had the peak releases not occurred.

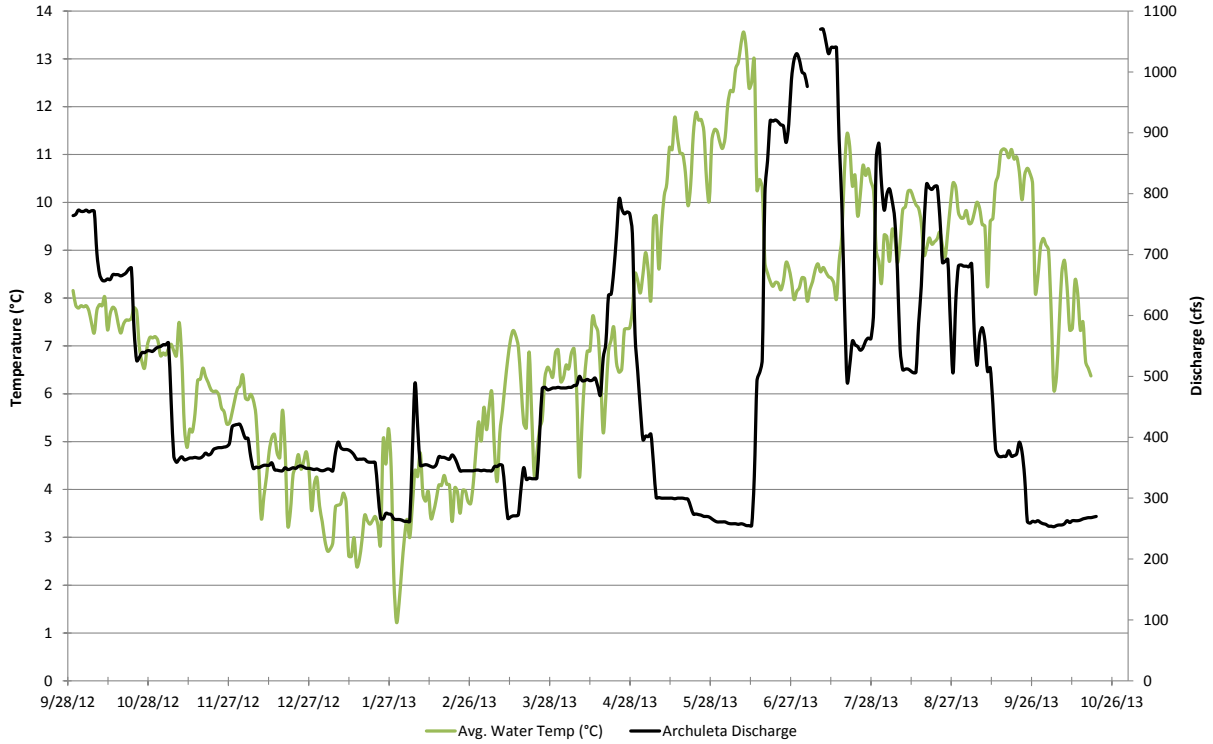

Figure 4. Average daily water temperature at Archuleta compared to discharge at Archuleta.

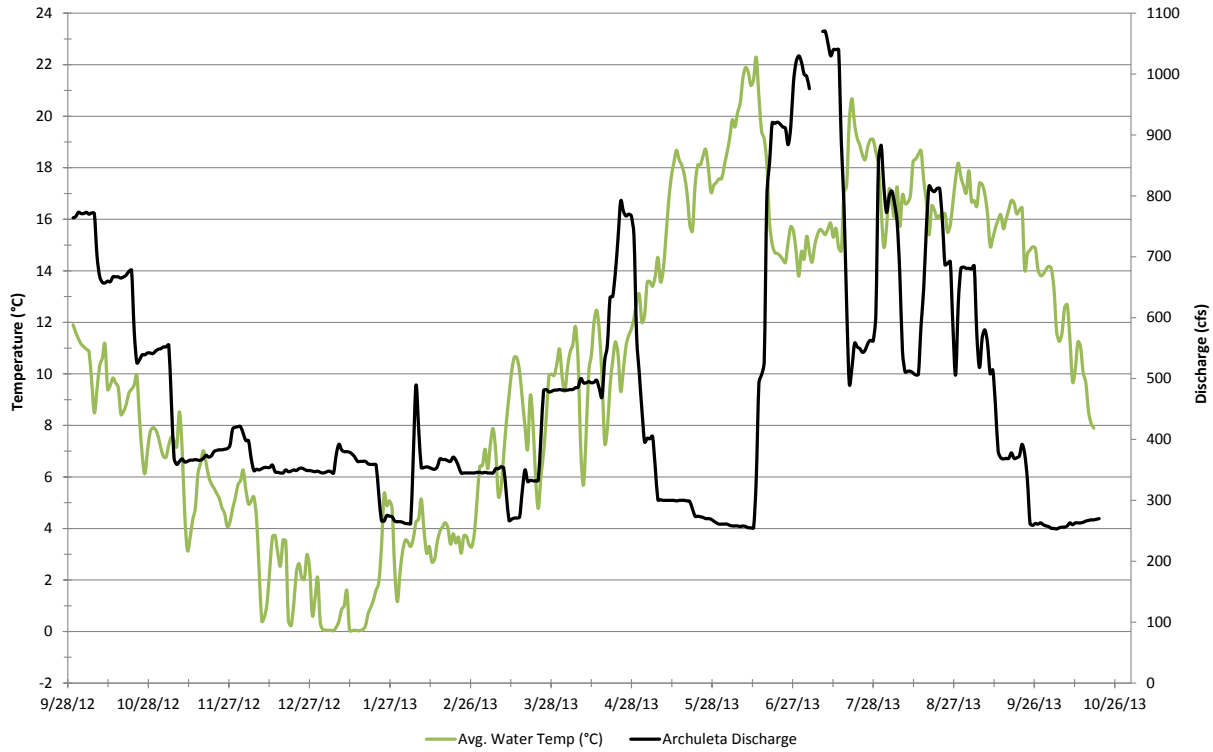

Figure 5. Average daily water temperature at CR5500 compared to discharge at Archuleta.

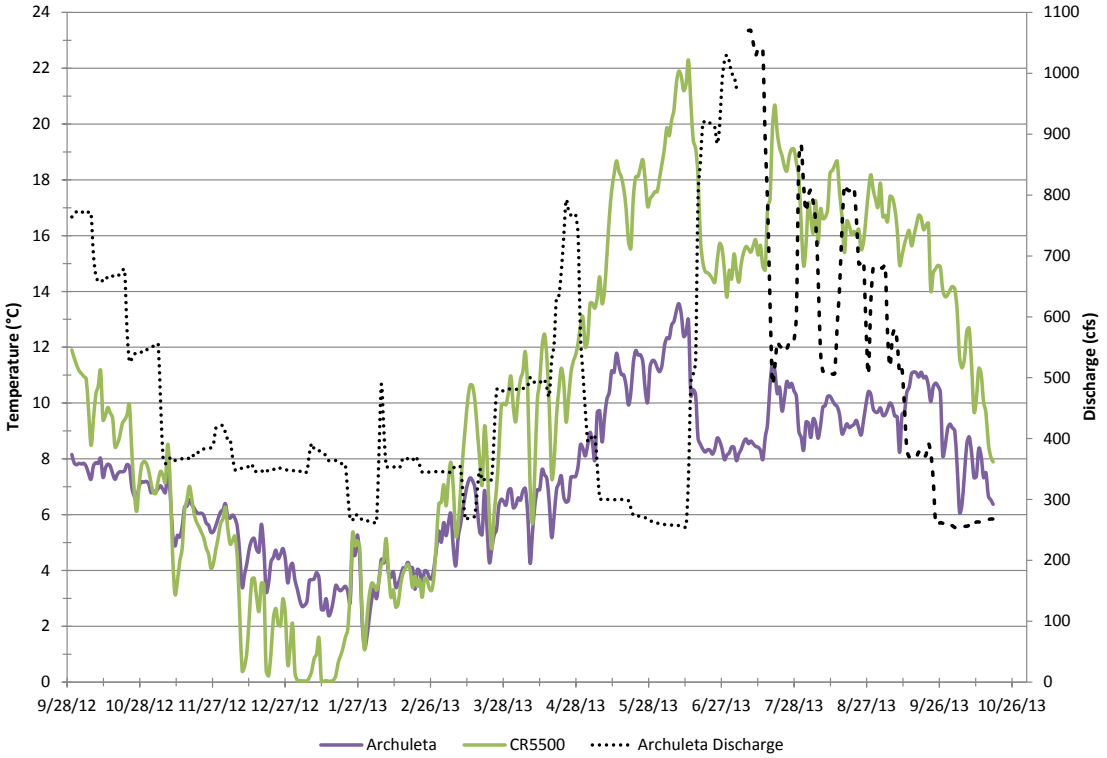

Figure 6. Average daily water temperature at Archuleta and CR5500 compared to discharge at Archuleta.

Flows in the Animas River began to increase in April with several large flow events occurring through May (Figure 7). Water temperature correspondingly fluctuated with flow during this period. Once flows subsided in June, temperature rose steadily throughout the month, and then fluctuated a bit in July and August, corresponding to larger flow events. Storm events in September produced flows larger than those observed during typical snowmelt runoff. While these high September flows resulted in decreased water temperatures, temperatures had already started to decline from summer maximums. Had the storm events occurred in July or August then the effect on water temperature could have likely been much greater. The maximum average daily temperature was 26.1°C and occurred on July 14, 2013.

Temperatures in the Animas River were slightly warmer than the San Juan River at either CR5500 or Farmington until May, when flows in the Animas River began to increase (Figure 8). Cooler temperatures in the Animas River correspondingly cooled temperatures in the San Juan River below its confluence with the Animas, and temperatures in the San Juan below Farmington were even cooler than those upstream at CR5500. This is in contrast to 2012, where flows from the Animas River warmed the San Juan and moderated the effect of the cold water release. By mid to late June, temperatures in the Animas River were warmer than those in the San Juan River by as much as 8°C.

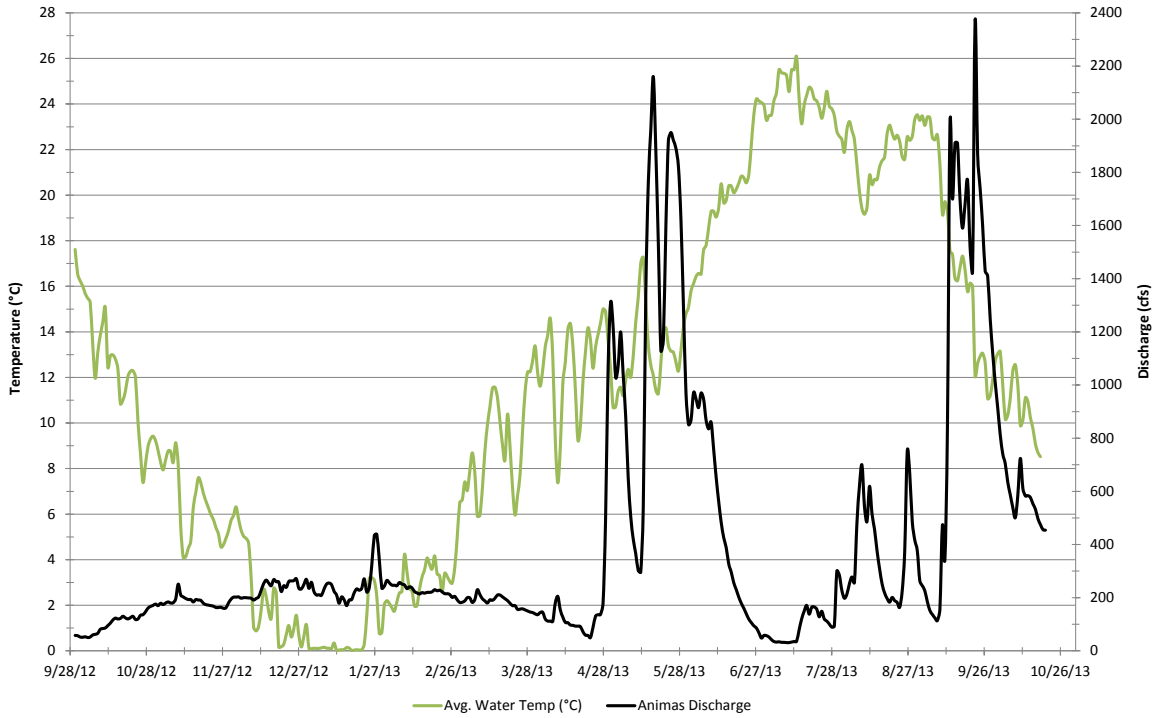

Figure 7. Average daily water temperature on the Animas River near Farmington compared to discharge on the Animas River.

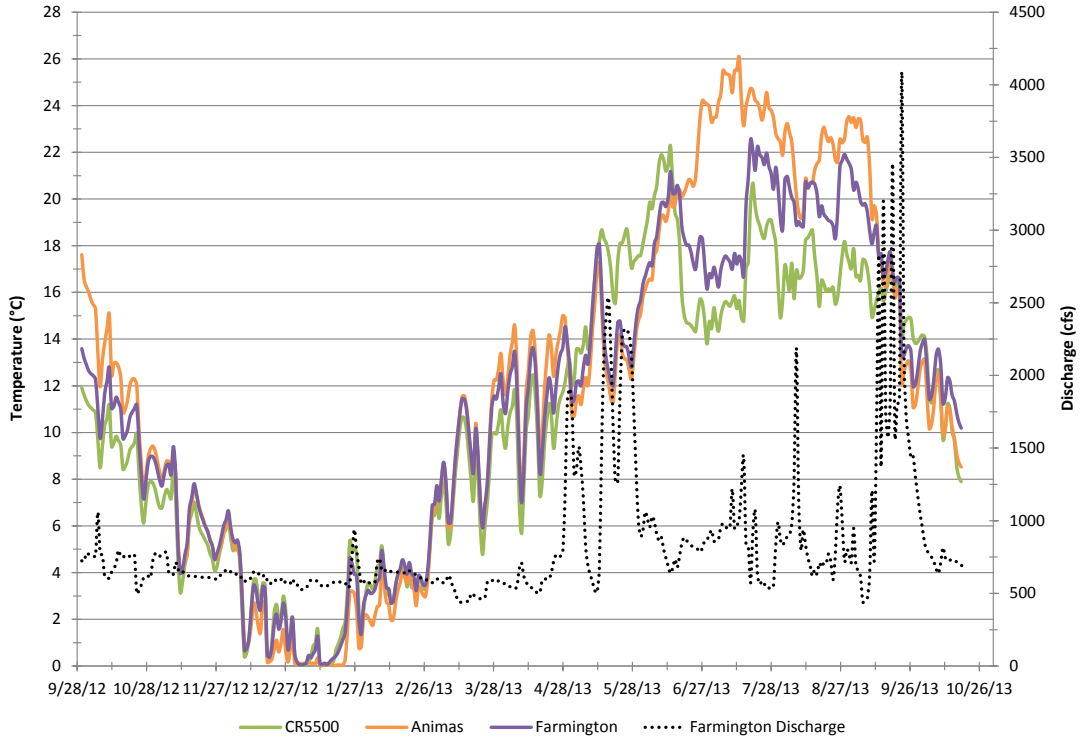

Figure 8. Average daily water temperature at CR5500, Animas River, and Farmington compared to discharge at Farmington.

At Shiprock, average daily water temperatures fluctuated with changes in flow (Figure 9). The maximum average daily temperature was 24.6°C and occurred on July 26. The large storm events in September did not appear to drastically affect temperature. At Four Corners, the maximum average daily temperature was 25.3°C and occurred on July 26 (Figure 10). A very large storm event (larger than those in September) occurred on August 26 and resulted in very high flows that were not observed upstream at Shiprock.

At McElmo Creek, water temperatures were similar to those in the San Juan River at Four Corners (Figure 11). The exception was in May where temperatures in McElmo Creek were colder than those in the San Juan. No flow data were available for McElmo Creek so it is not possible to know if temperature fluctuations were tied to large flow events, but this seems likely. The temperature loggers are close enough to the mouth of McElmo Creek that high flows in the San Juan may be backing up in McElmo Creek and influencing water temperature. Average daily temperature peaked at 25.8°C on July 26.

At Mexican Hat, the maximum average daily water temperature was 27.1°C and occurred on July 3 (Figure 12). Temperature patterns were similar to those observed at other locations.

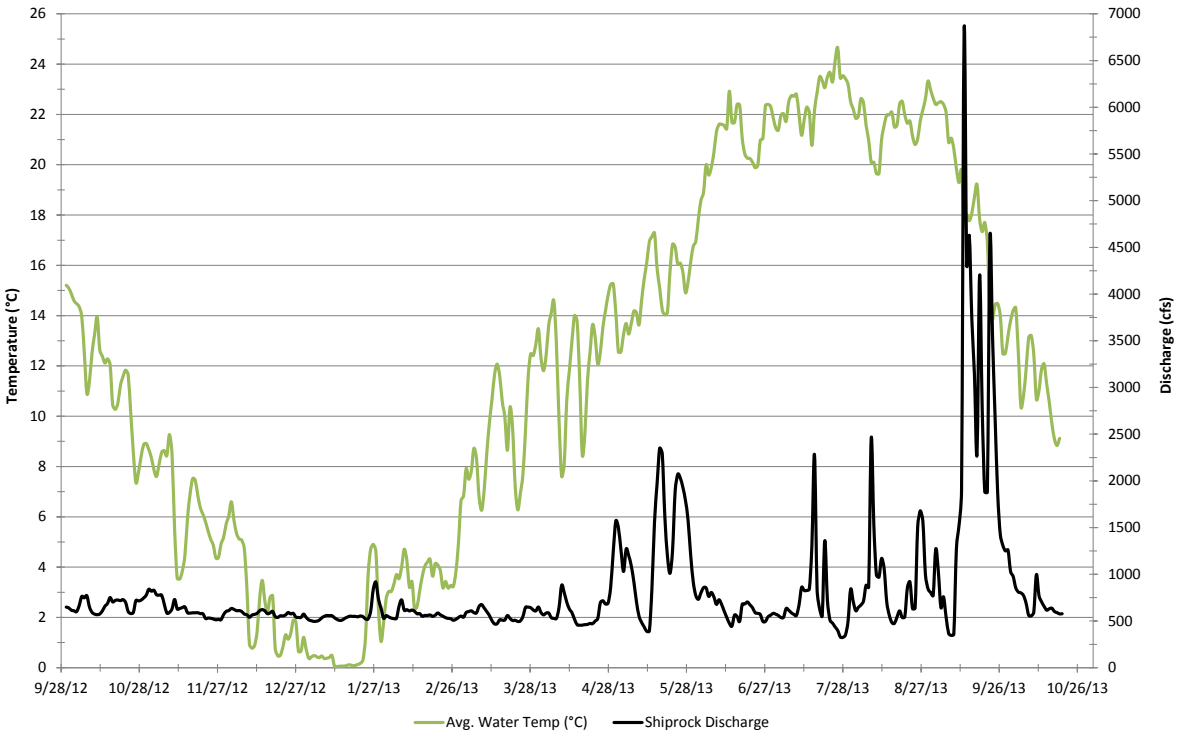

Figure 9. Average daily water temperature at Shiprock compared to discharge at Shiprock.

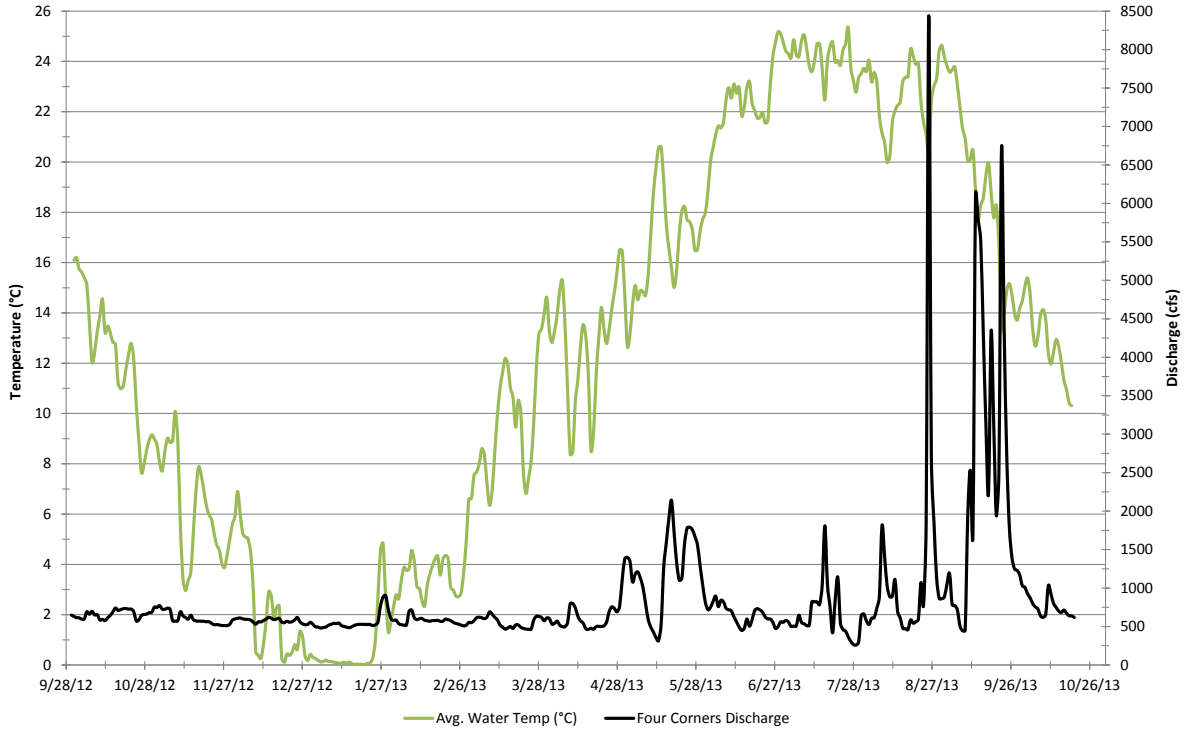

Figure 10. Average daily water temperature at Four Corners compared to discharge at Four Corners.

Figure 11. Average daily water temperature on McElmo Creek.

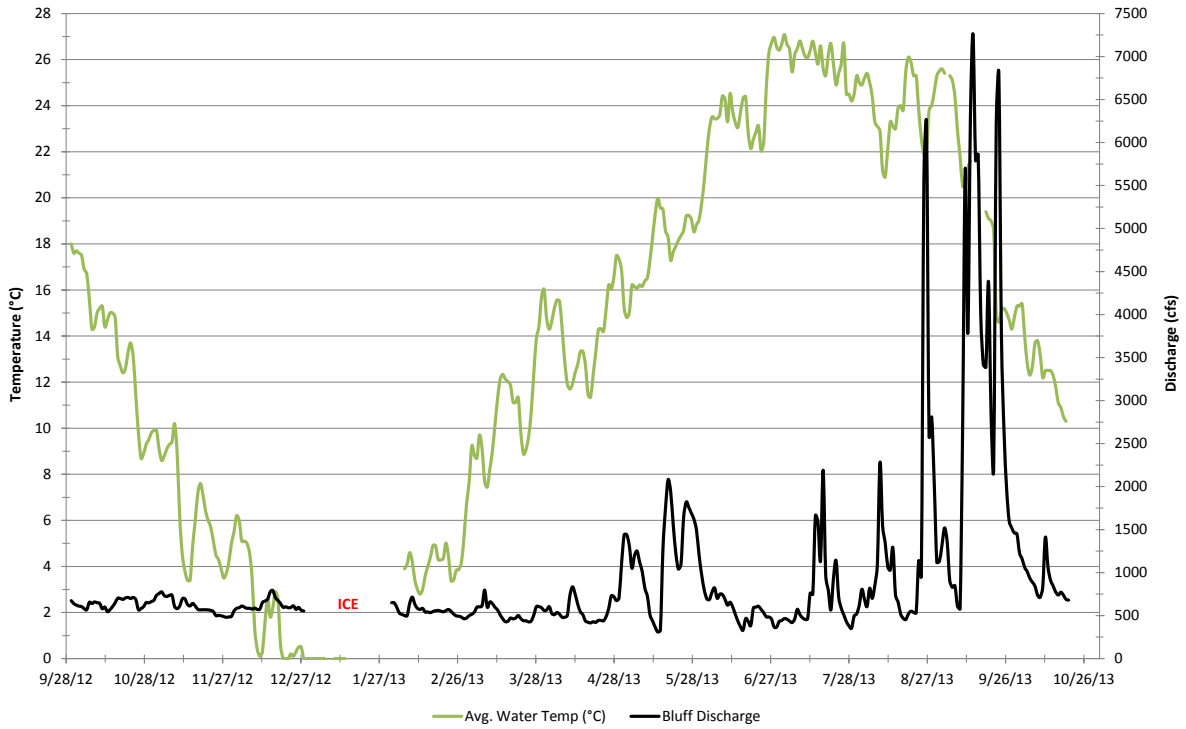

Figure 12. Average daily water temperature at Mexican Hat compared to discharge at Bluff.

In summary, water temperature monitoring in FY2013 shows that cold water releases from Navajo Dam can affect water temperatures downstream and the effect depends on the amount of the release and the time of year in which it is released. The most pronounced change in water temperature is in the river from Navajo Dam downstream to the Animas River. The effect was most pronounced here because of proximity to the dam and because the largest release occurred in July when water temperatures should have been peaking. Note that downstream of the Animas River confluence, the effect on water temperature in the San Juan River from the Navajo Dam release is likely less than the effect of flows coming in from the Animas River. The effect of the release is negligible at Shiprock, Four Corners, and Mexican Hat. This is in contrast to 2012, where the peak release from Navajo Dam had a clear temperature impact as far downstream as Mexican Hat.

Recommendations

Water temperature monitoring provides documentation of annual thermal regimes in the San Juan River. Water temperature monitoring is one component of the habitat monitoring program specified in the San Juan River Recovery Implementation Program Long Range Plan. These monitoring data could be used for investigation of impacts of water temperatures on the San Juan River fish community. Further, the collection of water temperature data may be more useful as real-time information in addition to the

annual summary. We make the following recommendations for the FY2014 water temperature monitoring.

1) Integration of the water temperature database, San Juan River and Animas River hydrology, and larval fish monitoring data should occur to determine if there are trends in the number and size of larvae associated with water temperature and discharge.

2) The water temperature monitoring program should be converted to real-time data collection conducted by USGS at the following gages: San Juan River at Archuleta (USGS 09355500), Animas River at Farmington (USGS 09364500), San Juan River at Farmington (USGS 09365000), San Juan River at Four Corners (USGS 09371010). These gages in addition to the current gage at Bluff, Utah would provide a more reliable water temperature database that could be accessed in real-time. The other water temperature monitoring locations should be discontinued as loss of loggers continues to occur. In 2013, 8 loggers were lost. The conversion to USGS data collection would also remove the need to assemble and house an annual database. The data archive functions would be part of the USGS function.

3) An annual data summary should still be provided for the Program as part of the habitat monitoring program.