Flow Data Analysis Report

2011-2013

Agreement #10-447-551

Scott River Groundwater Study Plan Implementation

Mainstem Scott River Streamflow gaging Water Years 2011-2013

Abstract
The primary purpose of this streamflow data collection effort is to identify the summer water supply in the Scott River. Winter run-off events can exceed the ability to measure discharge, remove equipment from the river, and top the banks of the river. The summer data collected under this project is valuable for developing an understanding of the water supply in the Scott River, and the interaction of surface water and groundwater in the Scott River Valley. Flow data in the mainstem Scott River is collected primarily between June and November, as this is the period when the river if wadeable for discharge measurements.

This project collected streamflow data during the summer low flow period of 2011-2013, and captured water supply conditions in a wet and two dry (back to back) years. Additionally, extended low flow conditions caused by drought allowed for data collection at two locations through the winter of 2014. All data collected has been provided to U.C. Davis for incorporation into their Scott Valley Hydrologic Model. This data will be utilized to validate the UC Davis Model, which will be used to explore various water supply management scenarios developed by the Scott Valley Groundwater Advisory Committee.

Introduction
Summary
The Siskiyou RCD operates four mainstem flow stations, and four tributary flow stations in the Scott River Watershed. Mainstem locations are; the Scott River below SVID (RM 47), the Scott River Above Etna Creek (RM 42.5), the Scott River below Etna Creek, and the Scott River at Serpa Lane (RM36). Tributary locations are Patterson Creek, Mill Creek, Shackleford Creek and Kidder Creek. All tributary stations are located above all diversions. The California Department of Water Resources operates additional flows stations as well. See **Map 1, Scott River Flow gaging stations** for station locations.

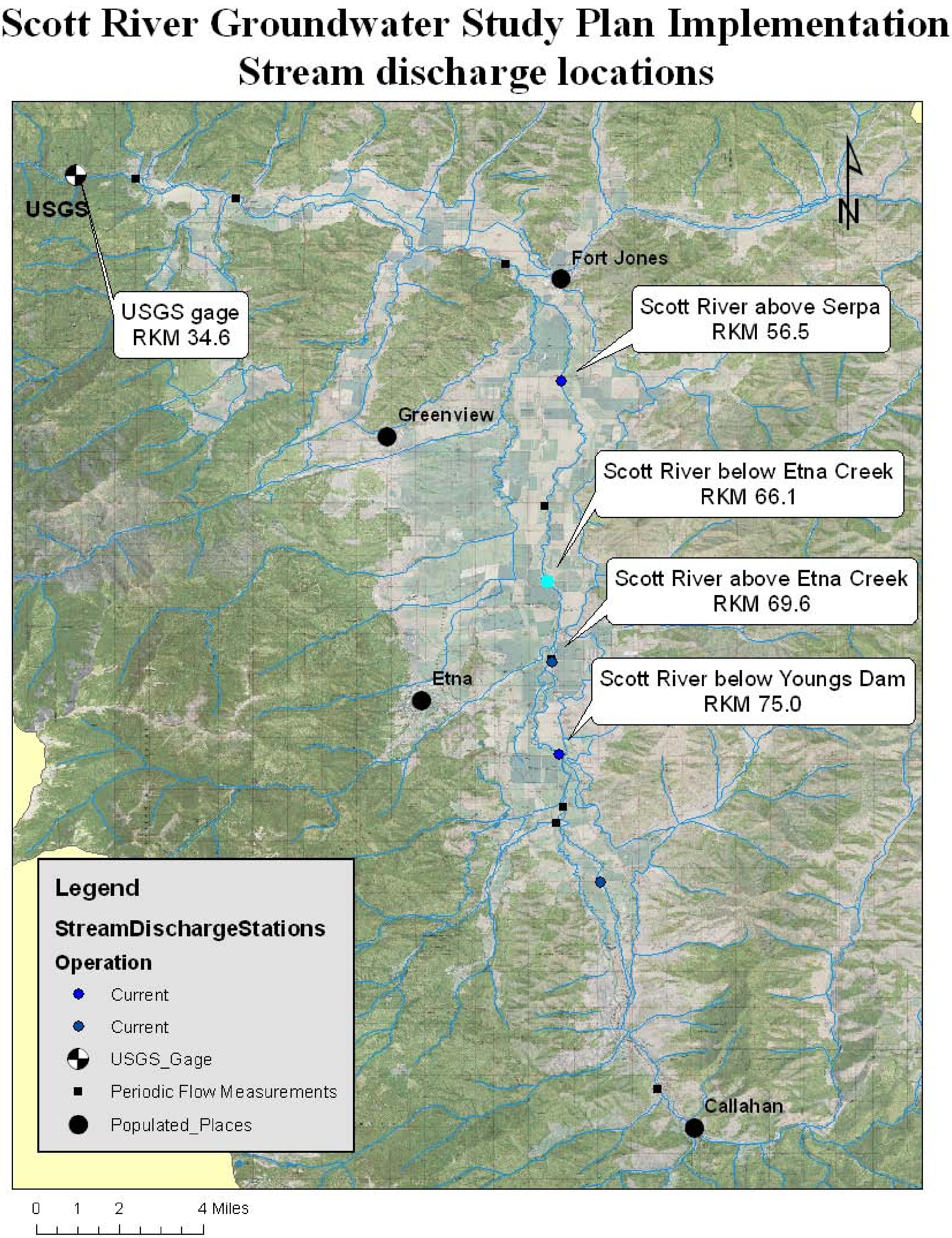
The mainstem flow stations are operated primarily during the summer low-flow period. High winter run-off events damage and/or remove the staff and attached dataloggers. In addition, experience has shown that the Scott River in these locations is only wadeable up to around 500 cfs (~1,00 cfs at the USGS gage). The RCD doesn't have access to a boom for measurements from a bridge, and the only station near a bridge is the station at Serpa Lane. For this reason only wading measurements can be taken.

All streamflow data collected under this agreement has been provided to Dr. Thomas Harter (U.C. Davis) for incorporation into the Scott River Hydrologic Model.

Table I. Location of Scott River Flow Stations.

ID	LOCATION	Agency	X_COORD	Y_COORI	Description
F28100	South Fork	CDWR	516036	4571388	S. Fork rd Bridge
F26050	East Fork	CDWR	516770	4573142	E. Callahan Rd. Bridge
Kidder	Kidder Creek	RCD	501985	4596770	Lower FGS property line
Mill	Mill Creek	RCD	500830	4600836	Upstream from Eastlick Ditch
Shackleford	Shackleford Cr.	RCD	499663	4603980	Upstream from Upper Diversion
Mill	Shackleford-Mil	RCD	502990	4607910	Upstream from highest diversion
FCC (CDEC)	French Creek	CDWR	511887	4584280	Upstream from Hwy 3
11519500	USGS Gage RM 18	USGS	498843	4609686	USGS Gage site RM 18
DDC (CDEC)	Sugar Creek	CDWR	512932	4575036	Sugar Creek at Darbee Ditch
F25890	Sugar Creek near Callaha	CDWR	512073	4575580	Sugar Creek below Old Fay Ditch
SB	Scott River below Etna C	RCD	512327	4594521	Scott River downstream of Etna Creek
Serpa	Scott River Above Serpa	RCD	512888	4601888	Scott River Upstream of Serpa Lane Bridge
SVID	Scott River at SVID	RCD	512739	4587395	Scott River downstream of SVID Diversion Structure
SA	Scott River Above Etna	RCD	512739	4591845	Scott River upstream of Etna Creek

Scott River Groundwater Study Plan Implementation
Stream discharge locations



Map 1 Locations of streamflow stations

Methodology
Equipment List

Onset water level logger
SonTek Flow Tracker
HoboWare Pro Software

Streamflow Gaging

Onset Computer Company Water Level loggers were placed in a vented PVC tube attached to a T- post placed in the river bed in the deepest section of pools. One Water Level logger was placed in the atmosphere below Youngs Dam to allow for barometric compensation. Onset HoboWare Pro was utilized to convert absolute pressure recorded by the level logger into river stage heights.

Instream discharge measurements were at appropriate control points directly above or below the gaged pool. Stream velocity was measured using a Sontek Flow Tracker current meter. Selected transacts were broken into cells in which the depth and velocity was measured. The discharge of the individual cells (q) was kept to less than 5% of the entire discharge (Q) when possible by reducing cell size. (Rantz, 1982). In some locations this desired condition (q/Q<.05) was impossible to meet due to low flows and/or a high percent of the flow occurring in the stream's thalweg.

Rating curves were developed using log log equations for each flow regime per USGS (Rantz, 1982). In general, rating curves are for the low-flow period, as the highest discharge where the river is still wadeable is approximately 300-400 cfs, depending on channel configuration.

Picture 1 – (left) a staff gage in a monitored pool

Picture 2 – (right) The equipment utilized (L to R) 1) current meter, 2) staff gage (background), 3) two Onset Water Level Loggers (foreground), and Laptop.

Data Analysis

Rating Curve development

Using the USGS protocol, rating curves were developed for each location annually. Some locations have two rating curves, one for higher run-off periods and one for the summer base-flow period. Discharge measurements were plotted against staff measurements on a log-log graph. The log-log relationship is used to develop a rating curve for each station. At each location a shift was applied to the water level data collected by the datalogger, to make it match the staff readings. All discharge data, rating curves, and processed data are provided in **Appendix A.**

This data collection effort is important for determining the timing and location of reaches of the Scott River switching from gaining to losing, and vice versa. Figures 1-3 show each mainstem location for the period of July 15th – September 30th. Flow data is compiled into total acre-feet for each two-week period.

Figures 1-3 show the summer baseflows at each location for the water years 2011, 2012, and 2013

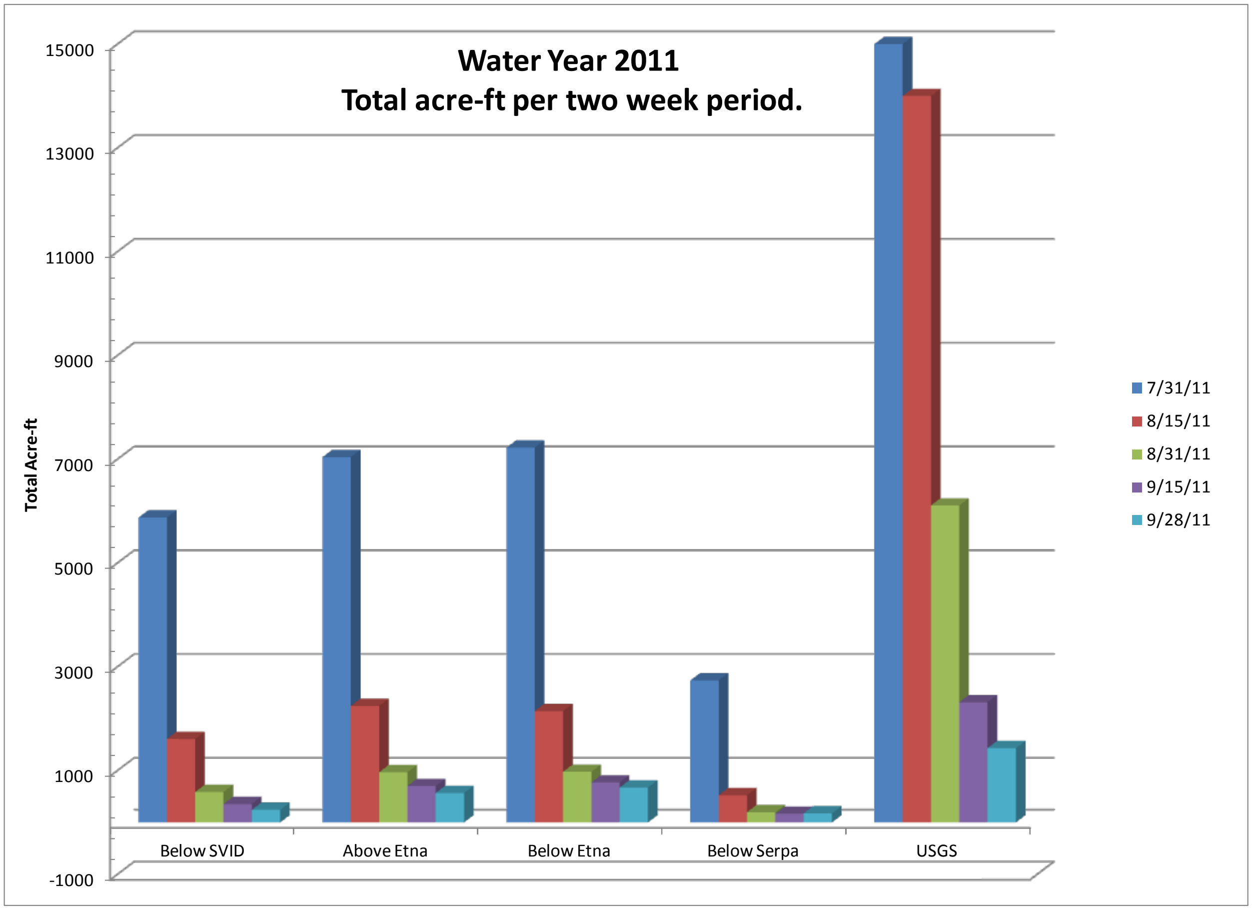


Figure 1. Scott River streamflow (acre-ft) during water year 2011, summer baseflow period.

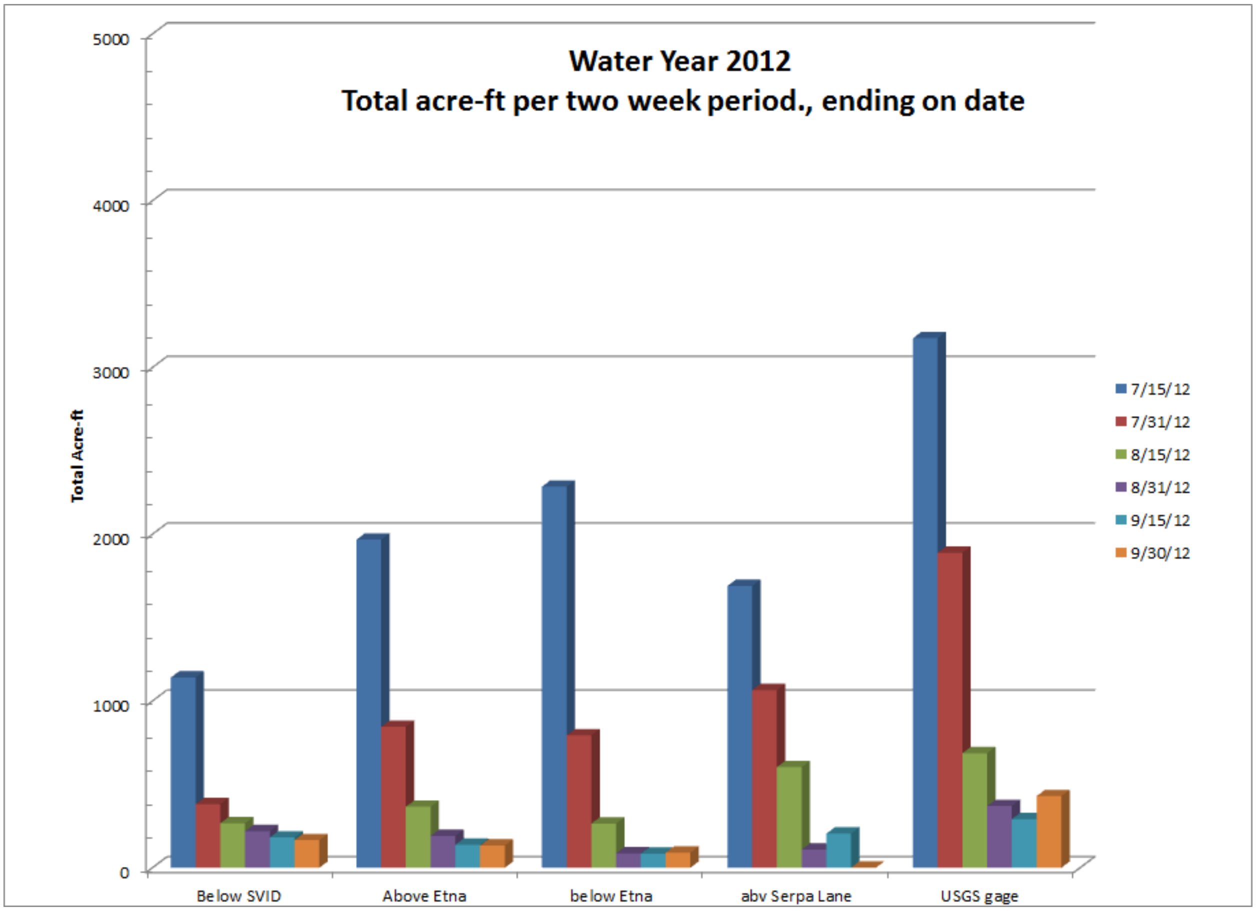


Figure 2. Scott River streamflow (acre-ft) during water year 2012, summer baseflow period.

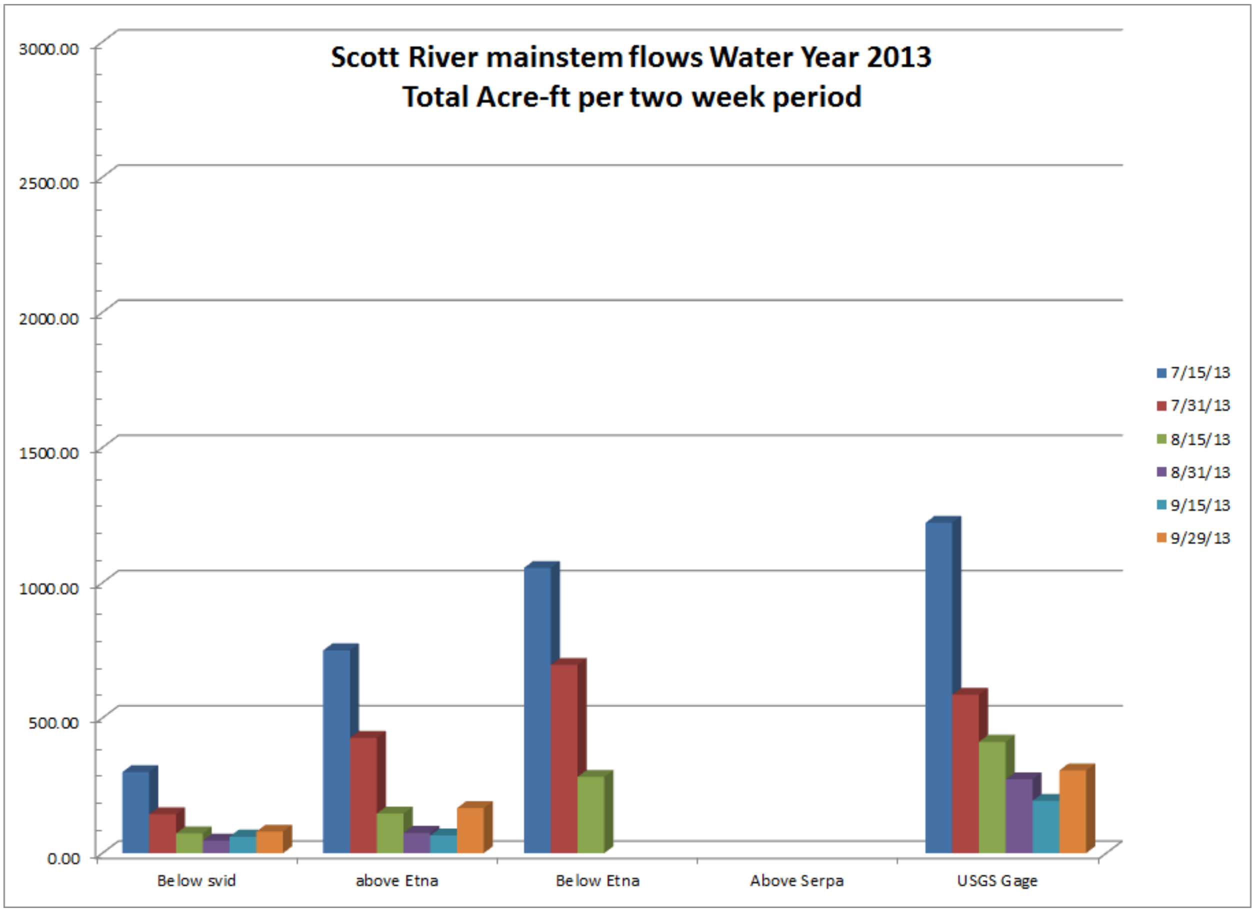


Figure 3. Scott River streamflow (acre-ft) during water year 2013, summer baseflow period. The datalogger located at Serpa Lane a malfunction during this time period.

Summary by location

Scott River below the Scott Valley Irrigation District (SVID) Diversion Structure

This station is located in a pool directly downstream of the Scott Valley Irrigation District Diversion Structure, and has been in operation since 2008. This location is important to the Scott River Water Trust for tracking water forbearance transactions with the Scott Valley Irrigation District.

Figure 4. below shows the Scott River flows at SVID for the low-flow period of 2010-2013. The summer low flow period is shown here because the higher winter runoff cannot be captured at this location.

During the period from Mid-July through late September or early October this location has had flows of less that 10 cfs. **Figure 5.** Shows the lowest flow period of July – September.

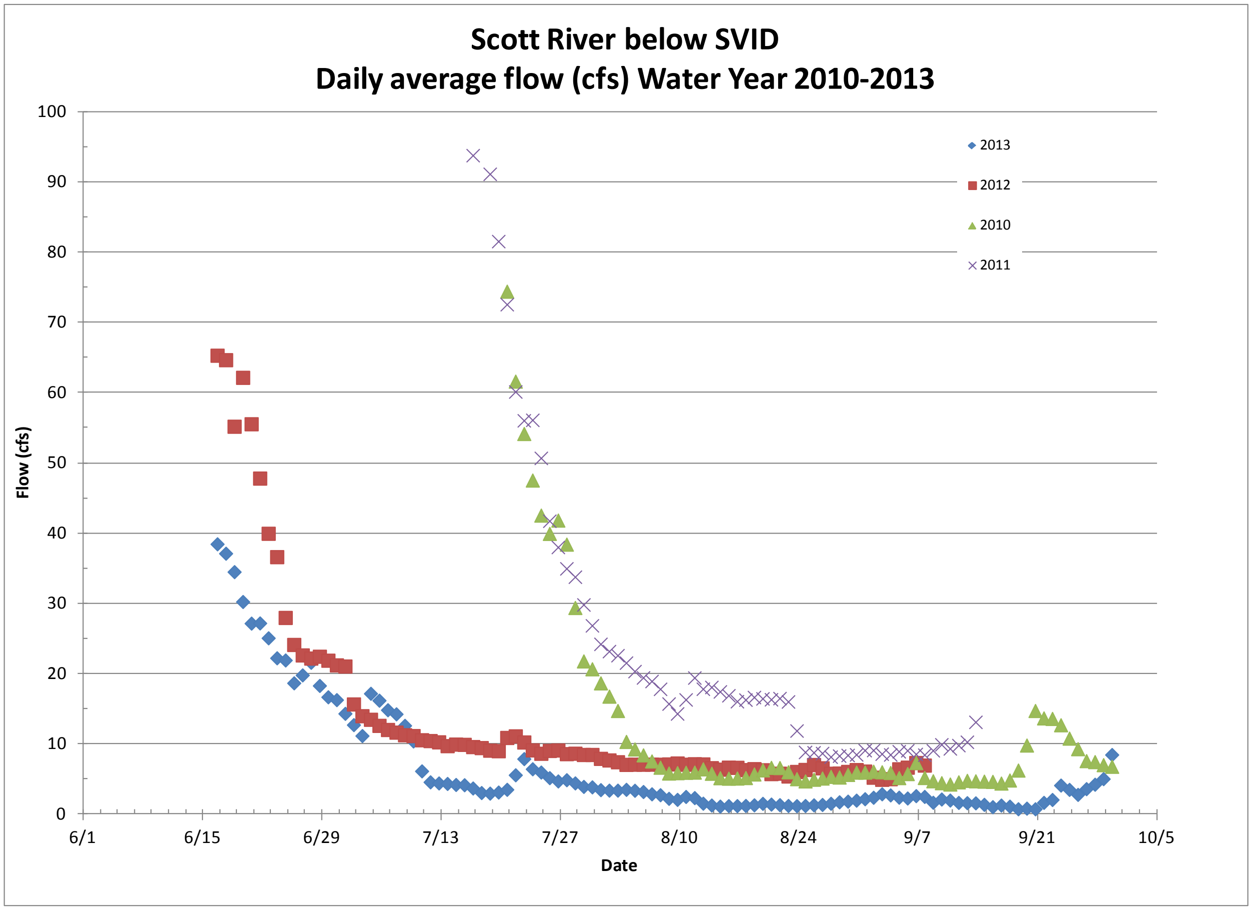


Figure 4. Calculated discharge at the flow station located downstream of the Scott Valley Irrigation District Diversion Structure.

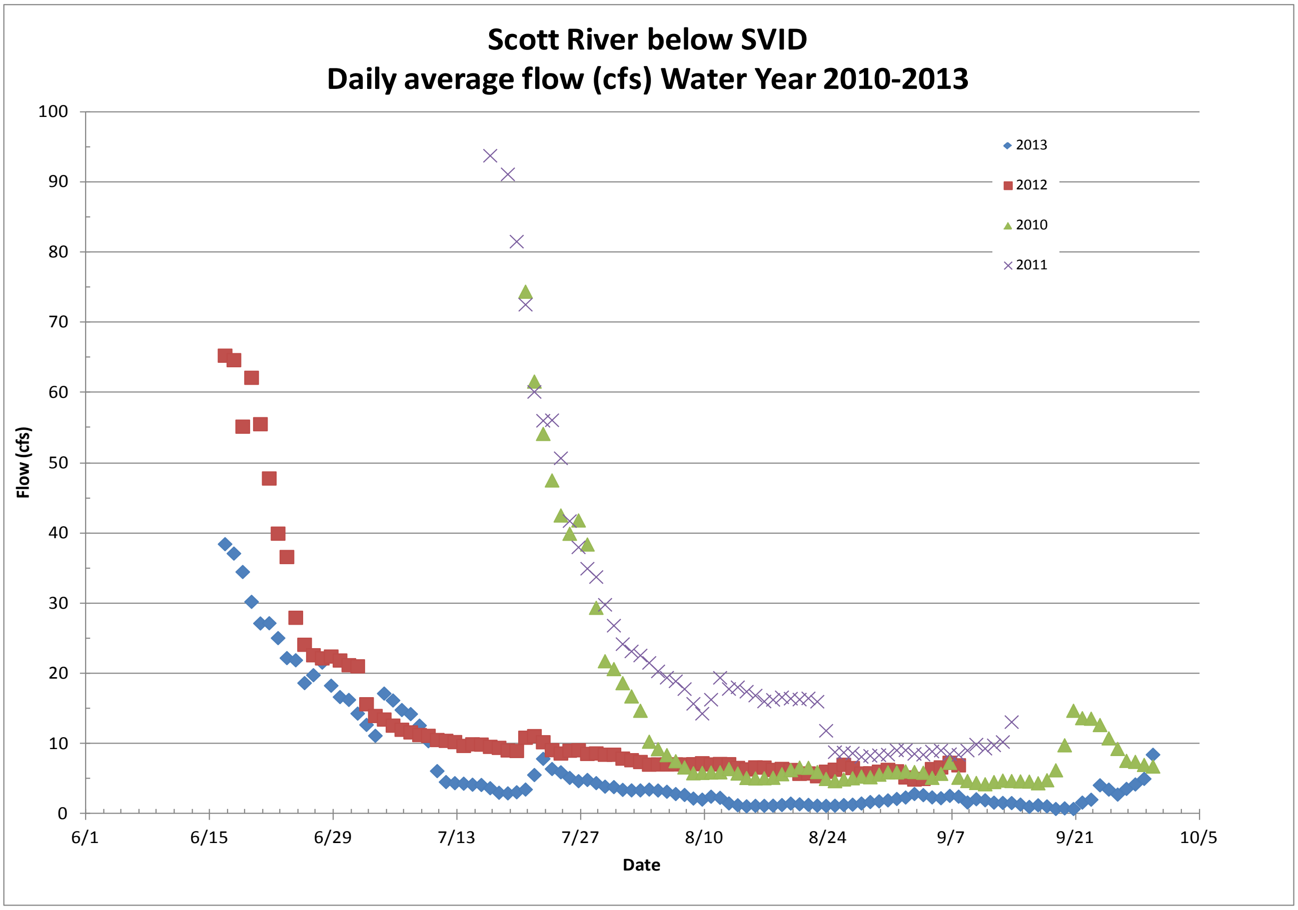


Figure 5. Summer baseflow at Scott River Below SVID.

During 2013 the Scott Valley irrigation district diversion was completely shut down from 9/7/2013 though 11/10/2013. There is no noticeable increase in streamflows until the first rain event that occurred on September 20th, 2013.

Scott River Above Etna Creek

This station is located approximately 1 mile upstream of the mouth of Etna Creek.

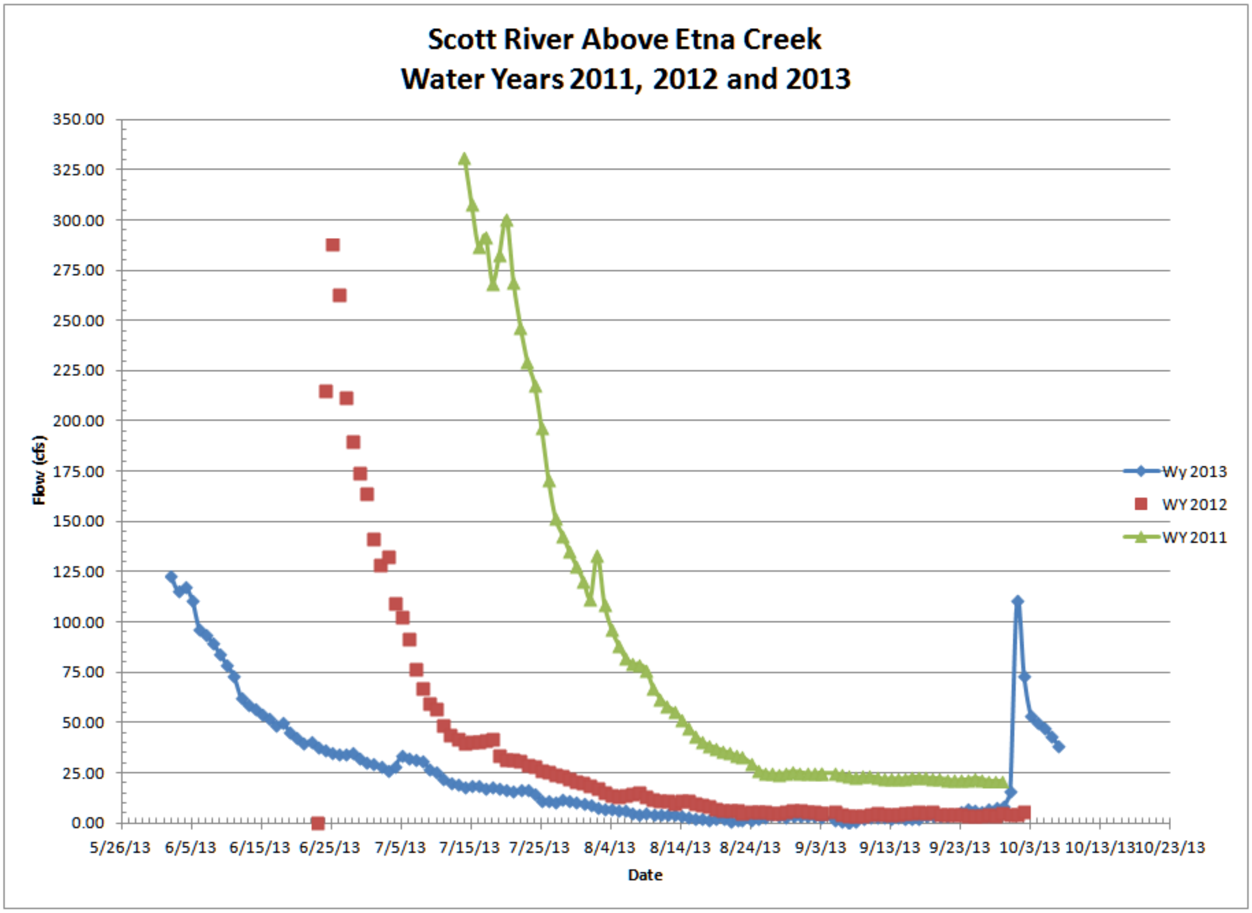


Figure 6. Scott River Above of Etna Creek water years 2011-2013.

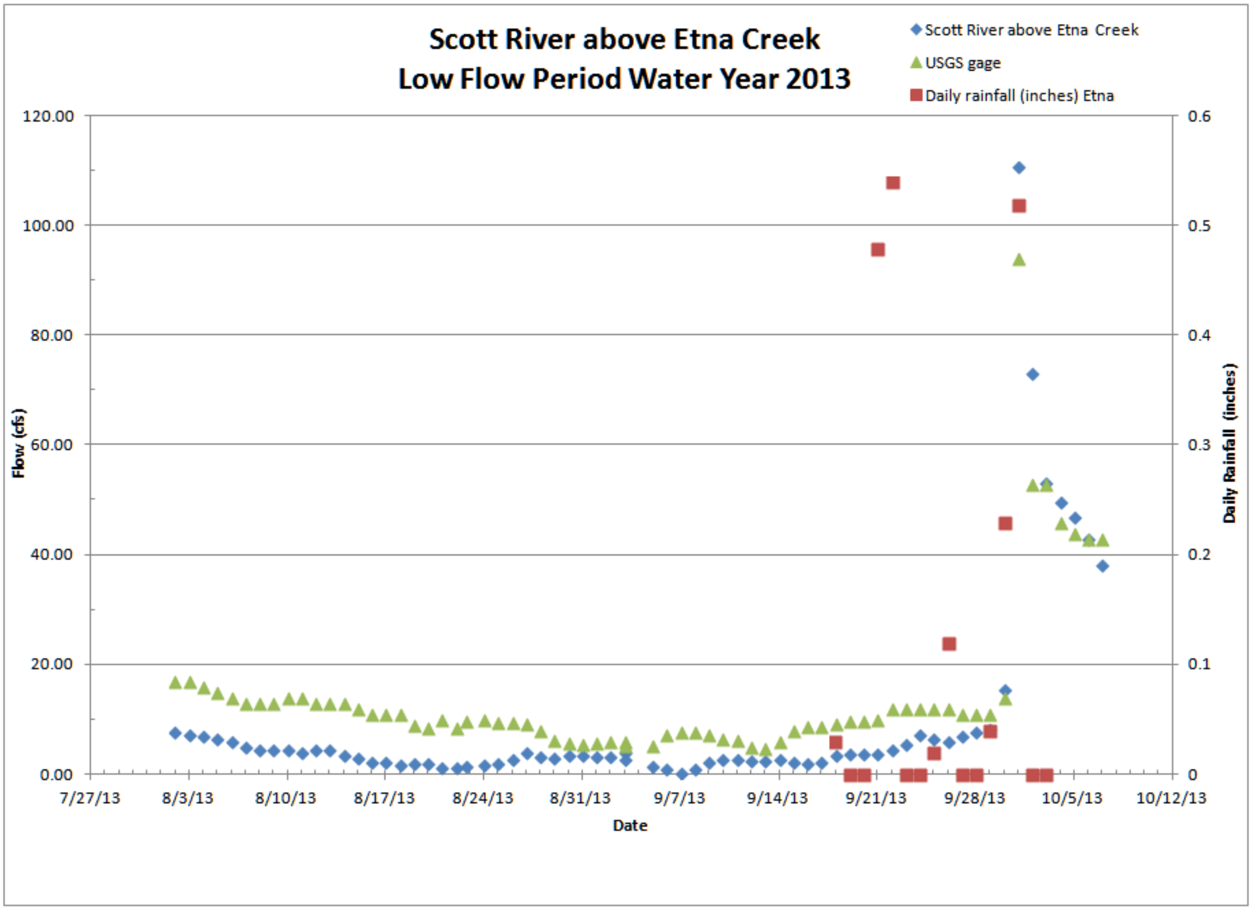


Figure 7. Scott River above Etna Creek low flow period of Water Year 2013.

Scott River below Etna Creek
This station is located in a pool 1.75 miles downstream of the mouth of Etna Creek. This is the approximately furthest upstream the Scott River has been known to dry.

The gaging pool was an isolated, disconnected pool from 8/22/13 until rainfall on Sept 30th reconnected the Scott River.

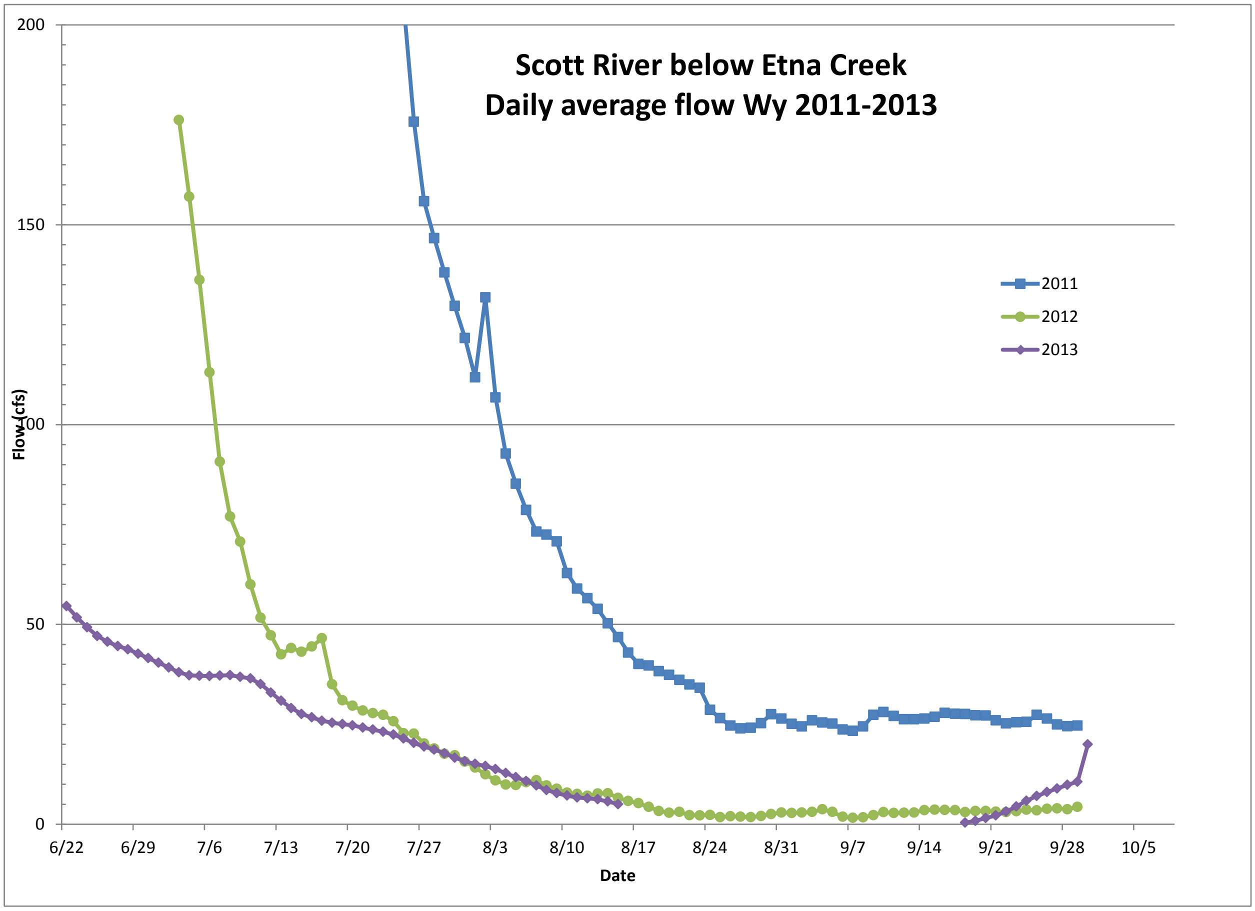


Figure 8. Scott River downstream of Etna Creek water years 2011-2013.

Comparison of Above and Below Etna Creek

Figures 9-11 show the flows above and below the confluence of Etna Creek in Water years 2011, 2012, and 2013. During all of these years, Etna Creek was no longer flowing at the mouth by July 1st.

Water Year 2011 was a wet year, and it appears that there is more water downstream of Etna Creek than above Etna Creek. This could be due to subsurface contributions from Etna Creek, contributions from groundwater, or a combination of the two. During the baseflow period of late August and September, flows averaged 25 cfs. In contrast, during the dry years of 2012 and 2013, flows ranged from less than 5 to zero cfs below Etna Creek in 2013. During both 2012 and 2013 there was less flow observed downstream of Etna Creek than above it. This appears to indicate that this is a losing reach under some groundwater conditions.

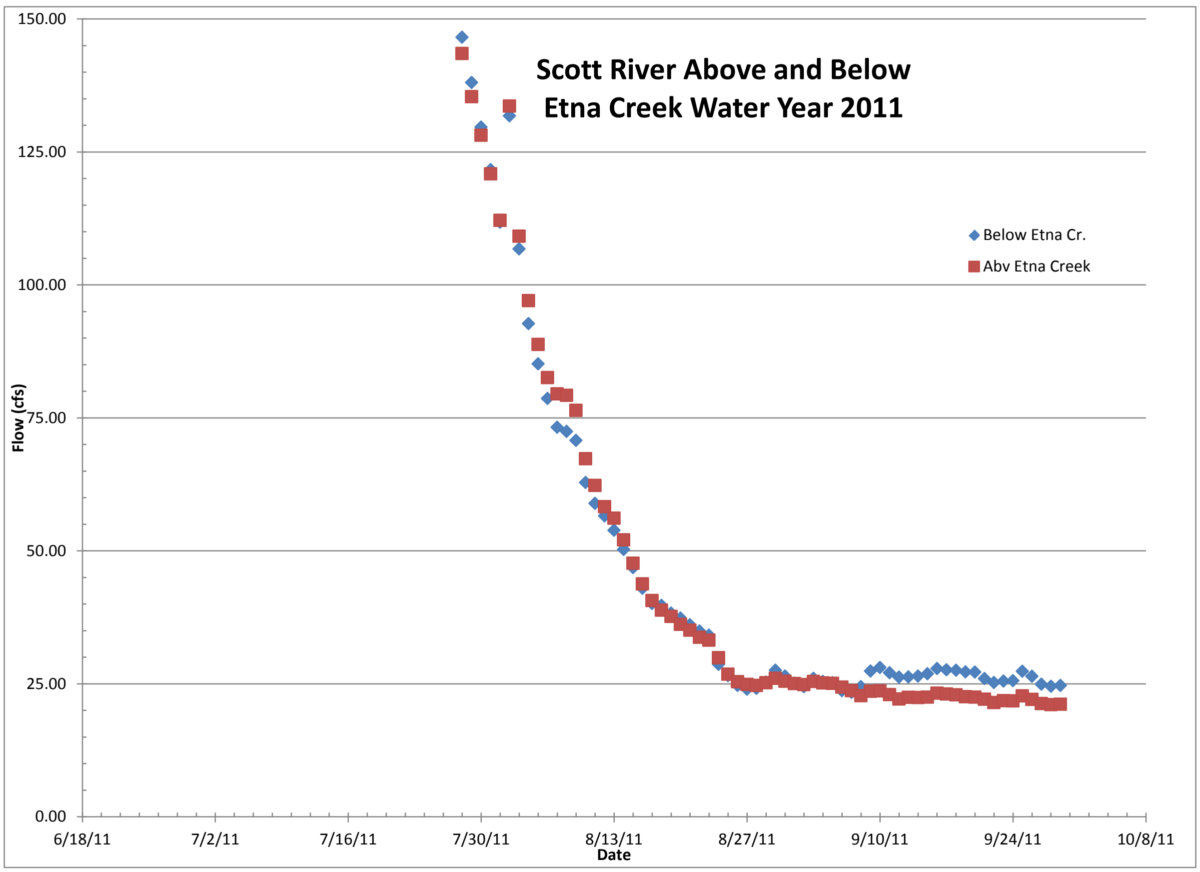


Figure 9. Scott River above and below the mouth of Etna Creek, Summer 2011

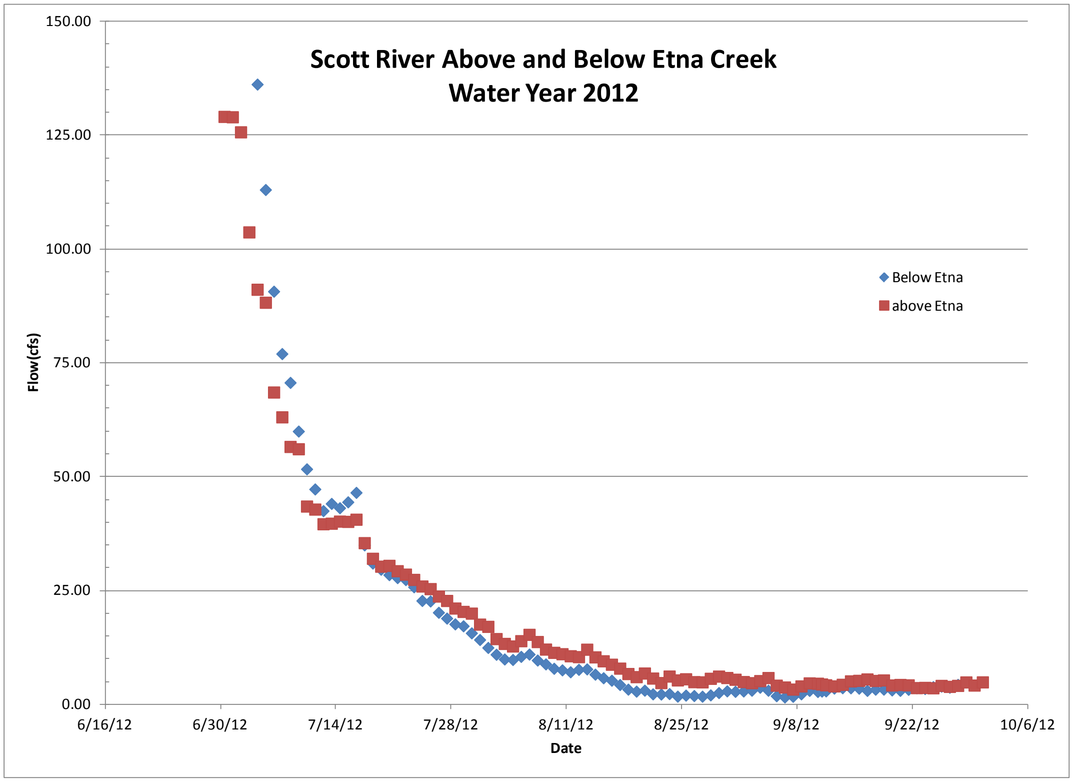


Figure 10. Scott River above and below the mouth of Etna Creek, Summer 2012

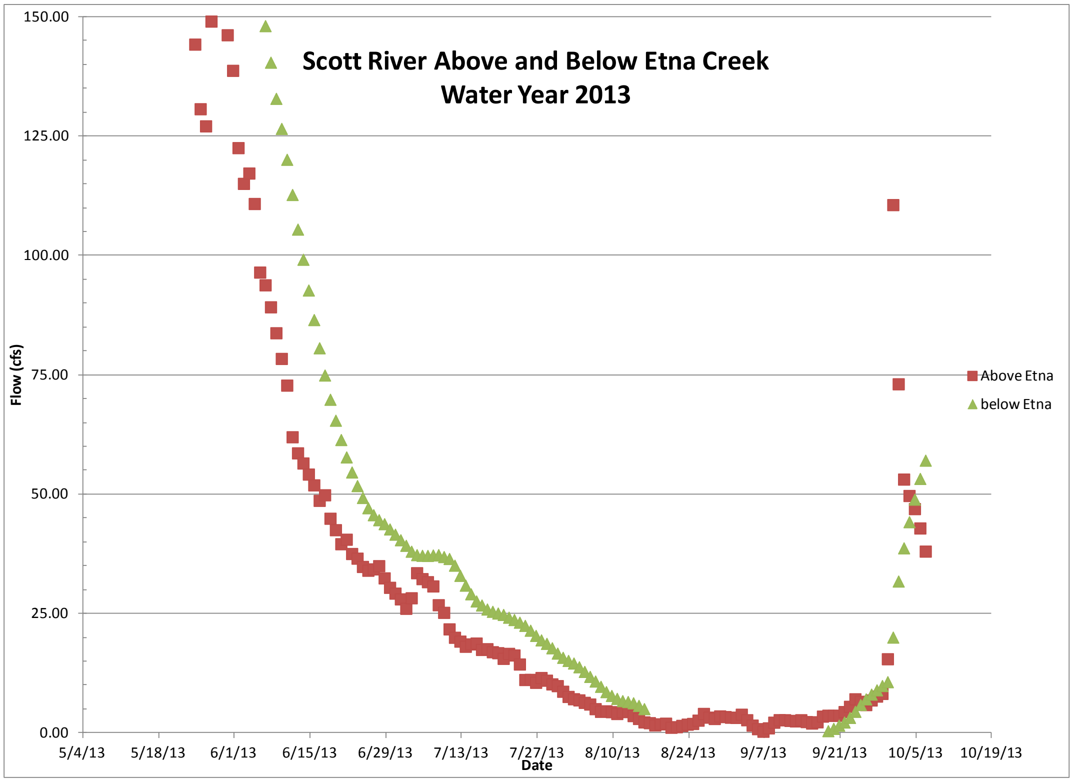
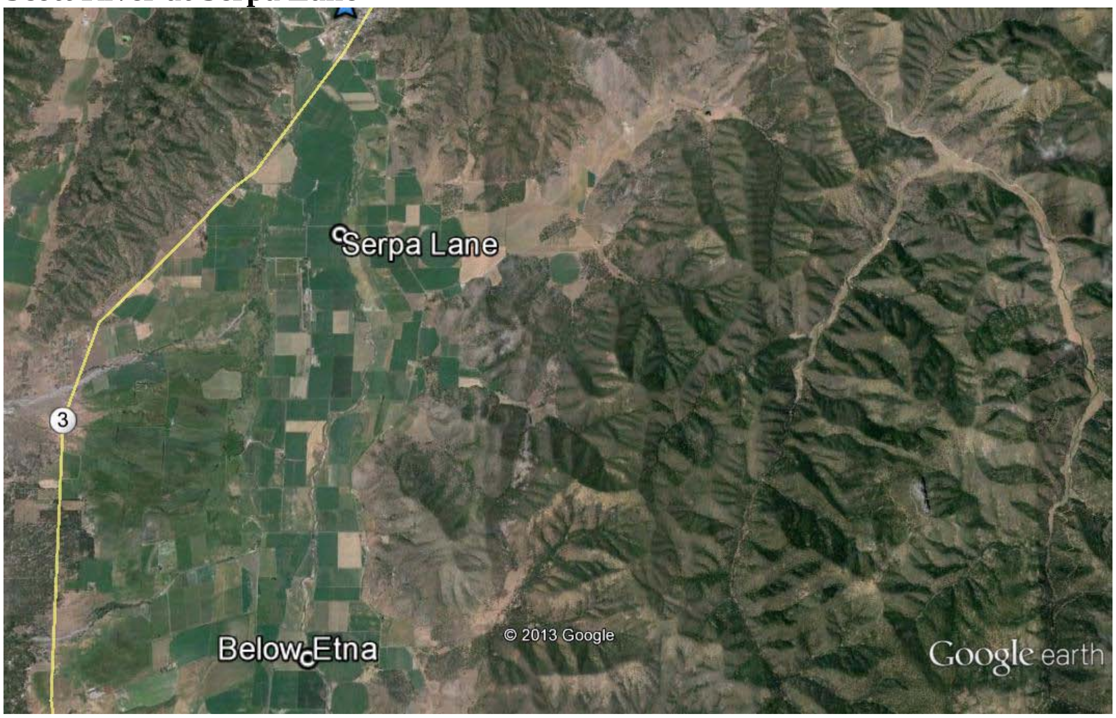


Figure 11. Scott River above and below the mouth of Etna Creek, Summer 2013

Scott River at Serpa Lane



Scott River at Serpa Lane is located 5 miles downstream of the gage located below Etna Creek. Figure 12 shows the summer flow data collected for water year 2011 and 2012. A datalogger error in August 2013 caused all data during the period of 6/17-8/22/2014 to be lost, in addition the river was dry at this location from around 8/20/2014 until the rains on September 30th 2014 reconnected the river.

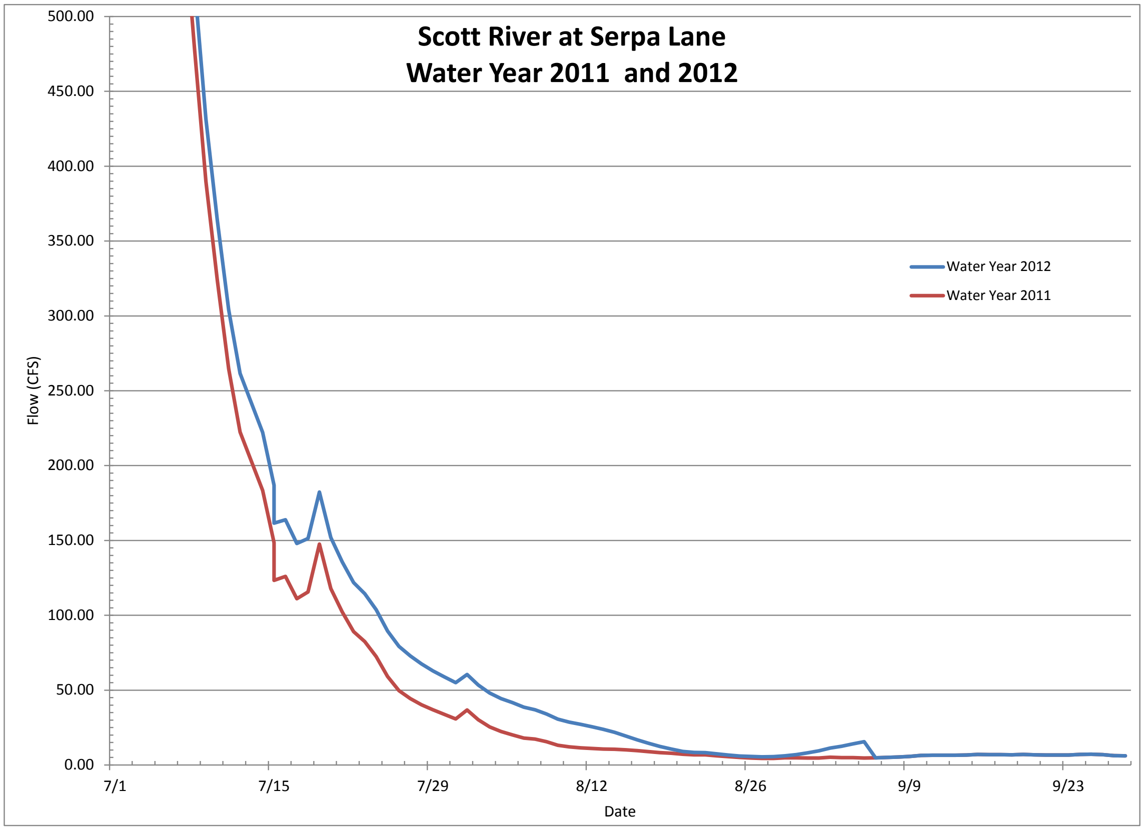


Figure 12. Daily Average Flows, Scott River at Serpa Lane, Water Year 2011 and 2012.

Flow Conditions during the Fall of 2013.
The flow stations above and below Etna Creek were removed in early October 2013, in anticipation that winter flow events would remove the stations and the equipment would be lost. However, the fall and winter 2013-2014 was dry, with no significant rainfall until the middle of February 2014.

Data collected at the site below SVID, Serpa Lane, and the USGS Gage below Fort Jones captures these low flow conditions.

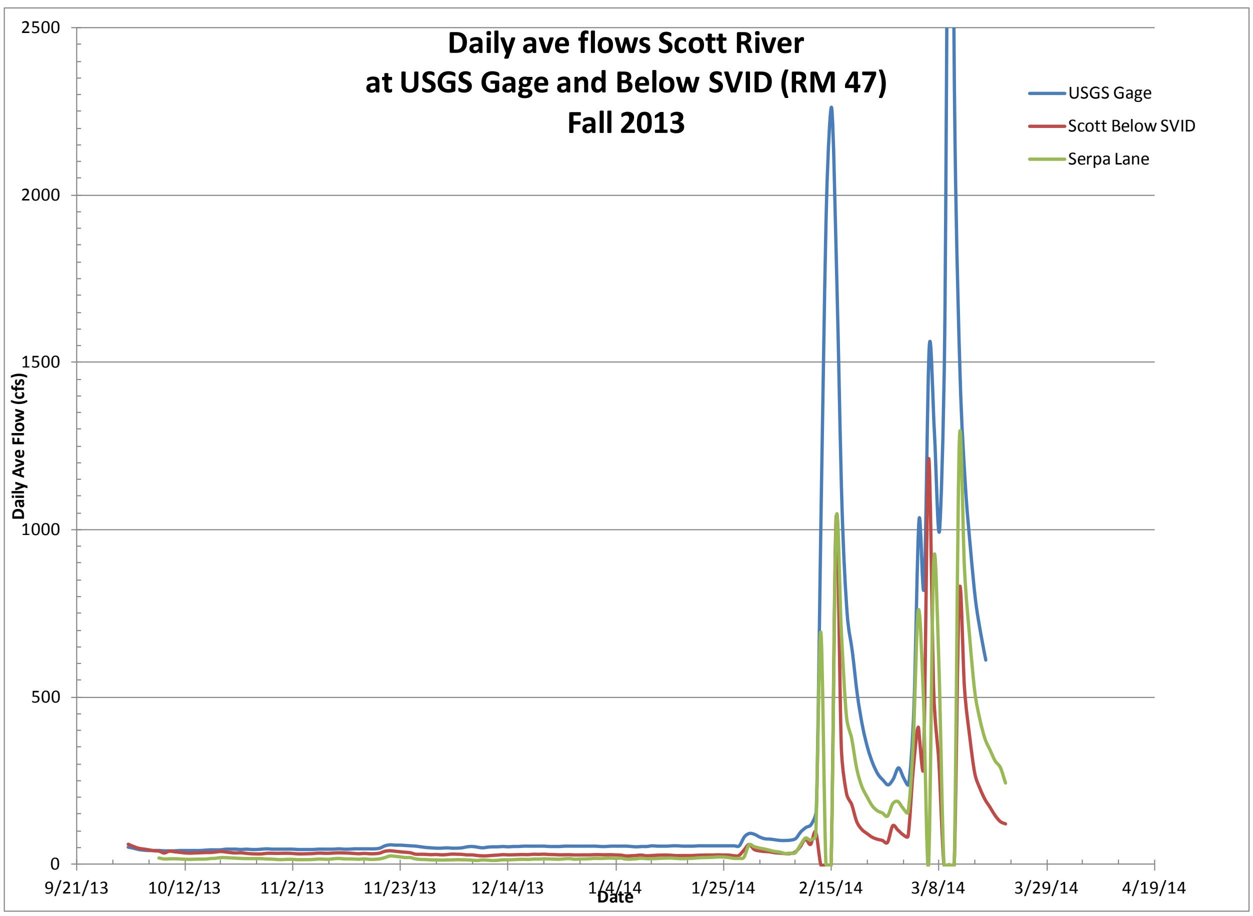


Figure 13. Daily average flows in the Scott River September 2013-March 2014.

This data shows that despite lack of rainfall and recharge in the aquifer, the Scott River was still a gaining reach overall during this time period. However, the reach from SVID to Serpa Lane was a losing reach until significant rainfall in March recharged the aquifer. With the exception of Shackleford Creek, no perennial tributaries to the Scott River located in this reach were connected prior to the rain event of early

February. Shackleford was only connected for approximately two days around November 25th, 2013. Beginning on February 9th, 2014 the tributaries downstream of the SVID flow station were flowing.

Summary

Flow data was collected during the summer of 2011, 2012, and 2013. Data collection began between May and July, depending on when the river conditions were wadeable, and continued into the winter months. The station located downstream of the SVID diversions has the longest data set for each period of time, as this station has proven to be stable through most winter run-ff events. The major limitation to developing flow data has been the maximum wadeable discharge, which is around 500 cfs at the site. While stage data can be collected beyond that cfs range, it exceeds the ability to develop a rating curve.

All flow data was provided to Dr Thomas Harter of UC Davis, and has been incorporated into the Scott River Hydrologic Model.

Conclusions

Flow data collected in the mainstem during the summer and winter of 2014 appears to indicate that the reach of the Scott River between SVID and the Serpa Lane bridge is a losing reach during base flow, switches to a gaining reach on a certain level of aquifer recharge is attained.