# Middle Truckee River
# Total Maximum Daily Load (TMDL)
# Suspended Sediment Monitoring Report
# Water Year 2014
# Nevada County, California

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**Middle Truckee River Total Maximum Daily Load (TMDL)**
**Suspended Sediment Monitoring Report, Water Year 2014**
**Nevada County, California**

 Project Assignment No.: 210011

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# EXECUTIVE SUMMARY

The Middle Truckee River is currently listed by the California State Water Resources Control Board as being impaired by excessive sediment. Water quality is of particular concern because the river is habitat for two federally-listed fish species, cui-ui and Lahontan cutthroat trout. The Lahontan Regional Water Quality Control Board (Lahontan Water Board) has developed a Total Maximum Daily Load (TMDL) for suspended-sediment concentration (Middle Truckee River Sediment TMDL) to attain sediment-related water quality objectives in the Middle Truckee River, the segment of the Truckee River extending from the outflow of Lake Tahoe at Tahoe City to the California-Nevada state line near Farad, California (Amorfini and Holden, 2008). This report is the fourth annual report of a multi-year study to: a) document suspended-sediment loads in selected tributaries to the Middle Truckee River; b) evaluate the relationship between streamflow, suspended-sediment concentration, and suspended-sediment loads in these tributaries, and; c) document changes in these relationships over time in response to land management, sediment control strategies, and other implementation measures outlined in the TMDL.

Measurements and observations on three tributaries (Cold Creek, Trout Creek, and Donner Creek) were completed at four stations over four consecutive years, water years 2011 to 2014 (WY 2011 – WY 2014)[1]. Monitoring, analysis and computations have been used to characterize suspended-sediment production and delivery (i.e. loads) from watersheds with differing land cover, and compare suspended-sediment loads for WY 2014 to measurements and estimates from previous years. We also have compared suspended-sediment loads and load durations to the target 90$^{th}$ percentile 25 mg/L suspended-sediment concentration benchmark set forth in the TMDL.

On Trout Creek and Cold Creek, we calculated suspended-sediment loads using two methods: 1) establishing relationships between instantaneous suspended-sediment loading rates and instantaneous streamflow (“streamflow-suspended sediment rating curve”), then applying that relationship to the near-continuous streamflow record, and; 2) establishing relationships between instantaneous suspended-sediment concentration and turbidity (“turbidity-suspended sediment rating curve”), and applying that relationship to the near-continuous turbidity record. In the absence of a continuous-logging turbidity meter, loading on Donner Creek was calculated using only the streamflow-based rating curve method.

[1] Most hydrologic and geomorphic monitoring occurs for a period defined as a water year, which begins on October 1 and ends on September 30 of the named year. Water year 2014 began on October 1, 2013 and ended on September 30, 2014.

Our conclusions can be summarized as follows:

- Water year 2014 was a third year in a row with below-average precipitation. Below average snowpack and early snowmelt in March and April 2014 resulted in the lowest total annual runoff in years.
- While total suspended-sediment loads computed for each tributary were low relative to previous years, they continued to illustrate similar trends observed in previous years such that Donner Creek continues to exhibit higher yields or loads normalized by watershed area when compared to Cold Creek and Donner Creek. These results may be linked to the land-uses in this watershed which are dominantly urban with high hydrologic connectivity of impervious surfaces.
- Comparison of results between two computational methods of suggests that a continuous record of turbidity is better able to capture discrete events or more accurately assess changes in loading during an event, thereby providing more accurate estimates of daily and annual suspended-sediment loading.
- Three monitoring stations in the Donner/Cold Creek watershed provide an opportunity to evaluate loading and yields between stations. Based on this analysis, monitoring results continue to highlight abundant loading and suspended sediment yield-rates that occurs along the last 0.5 mile of stream along Donner Creek between State Route 89 and the confluence with the Truckee River. Town of Truckee draft stormwater maps show heavily trafficked, impervious areas that drain directly to Donner Creek in this reach.
- In water year 2014, load duration curves for Cold Creek, Donner Creek and Trout Creek showed that these streams met the target 90$^{th}$ percentile suspended-sediment concentration of less than or equal to 25 mg/L established in the Middle Truckee River Sediment TMDL.
- Comparisons of discharge-based sediment rating curves to historical data currently do not indicate improvements in loading to the Middle Truckee River over time, and bed condition monitoring work[2] show an overall fining of the bed at nearly all locations monitored.
- While Donner Creek loads to the Middle Truckee River are significant, there appears to be other larger sources when total loads are evaluated at Boca Bridge. These may include urban stormwater outfalls through the Town of Truckee corridor, ungaged tributaries upstream of Truckee, and possibly ungaged regulated tributaries downstream of Truckee.

Results from suspended-sediment monitoring continue to show compliance with the Middle Truckee River sediment TMDL, while results from other metrics and studies indicate that beneficial uses in the Middle Truckee River continue to be impaired. Recent bioassessment studies conducted by Herbst and others (2013) show that beneficial uses including “Cold Freshwater Habitat” and “Spawning

[2] As presented by Donaldson and Shaw (2012) and Kulchawik and others (2014)

Reproduction and Development" are likely to not be fully supported in the Middle Truckee River due to impacts on the base of the food web and excess deposited fine sediment.  These results suggest that the TMDL for suspended-sediment requires review and possible revision, or perhaps that the suspended sediment concentrations and loading thresholds outlined in the TMDL are not be the best indicator of impairment.

# 1. INTRODUCTION AND PROJECT PURPOSE

## 1.1 Introduction

This report is the fourth and final annual report of a multi-year study of the relationship between channel conditions, streamflow, suspended-sediment concentrations, and sediment loads in watersheds tributary to the Middle Truckee River, the segment of the Truckee River extending from the outflow of Lake Tahoe at Tahoe City to the California-Nevada state line near Farad, California (**Figure 1)**. This work is being conducted by Balance Hydrologics (Balance) for the Truckee River Watershed Council (TRWC), with funding provided by the State of California, Department of Water Resources (DWR) through Proposition 50, in order to support implementation of the Total Maximum Daily Load (TMDL) for Sediment, Middle Truckee River Watershed (Middle Truckee River Sediment TMDL), established by the Lahontan Regional Water Quality Control Board (Lahontan).

Both non-native and native fish species are found in the Truckee River and its tributaries. Common native fish include Paiute sculpin, Lahontan redside shiner, Tahoe sucker, specked dace, mountain whitefish, and mountain sucker. The cui-ui and Lahonton cutthroat trout (LCT) are also found in the Truckee River; these species are federally-listed as endangered and threatened, respectively (Amorfini and Holden, 2008). The Middle Truckee River between the Trout Creek and Gray Creek tributaries has been designated a Wild Trout Water by California Department of Fish and Game (CDFG) to support regulated angling of non-native rainbow and brown trout. In 1992, the SWRCB reclassified the Middle Truckee River from intermediate to impaired for excessive sediment and placed it on the 303(d) list under the Clean Water Act (Amorfini and Holden, 2008; Lahontan, 2008). Effects of excessive sediment on aquatic habitat have been well-documented in the literature.

In response to the 303(d) listing, the Lahontan Water Board developed a TMDL for sediment to attain sediment-related water quality objectives for protection of in-stream aquatic life and beneficial uses (Amorfini and Holden, 2008). The Middle Truckee River Sediment TMDL establishes sediment load allocations for particular subwatersheds and intervening areas, with the total sediment load allocation for the entire Middle Truckee River watershed set at 40,300 tons per year as measured on the Truckee River at Farad (see **Figure 1**). The TMDL consists of a number of indicators and target values for each indicator. However, the only *direct* indicator is suspended-sediment concentration (SSC) in the Truckee River, with a target of less than or equal to 25 milligrams per liter (mg/L) as an annual 90th percentile loading at Farad, the downstream terminus of the Middle Truckee River segment at the Nevada state line. This target was established based on a review of the scientific literature, analysis of suspended-sediment measurements taken in the Truckee River over a 30-year period, and continuous monitoring of turbidity during water years 2002 and 2003. Additional *indirect* indicators include successful implementation and maintenance of best management practices (BMPs) for road sand application and erosion control on ski slopes, as well as for restoration activities such as decommissioning of dirt roads and repair of legacy sites. In order to evaluate the effectiveness of control measure implementation, targeted tributaries or subwatersheds of concern must be monitored, in addition to monitoring the Truckee River at Farad.

This study evaluates relative suspended-sediment contributions from targeted Middle Truckee River tributaries and compares current trends in suspended-sediment loads to historical measurements. Methods used in this monitoring program adhere to the project Sampling and Analysis Plan (on file with TRWC), unless otherwise noted.

**Figure 2** shows the locations of the four Middle Truckee River monitoring stations specifically used for this study and two additional sediment gaging stations associated with the Town of Truckee's Truckee River Water Quality Monitoring Program. Balance installed two of the gaging stations and monitored continuous streamflow and turbidity and collected suspended-sediment samples over a range of flows at the following stations from WY 2011 through WY 2014.

1. Cold Creek at Teichert Bridge (CCTB), Truckee, California

2. Trout Creek at Donner Pass Road (TCDP), Truckee, California

Balance staff also collected suspended-sediment samples over a range of flows at two locations on Donner Creek during WY 2014:

3. U.S. Geological Survey (USGS) streamflow gaging station: Donner Creek at Highway 89, (DC89; USGS 10338700) Truckee, California

4. Donner Creek at West River Street (DCWR), Truckee, California

The hydrologic setting and description for each of these gaging stations is presented in greater detail in subsequent sections.

Similar studies being carried out on the mainstem of the Truckee River by CDM Smith and Balance Hydrologics began in January 2013. As part of that work, suspended-sediment loads were computed for two USGS stations: 1) Truckee River near Truckee (USGS 10334800), and; 2) Truckee River at Boca Bridge, (USGS 10344505). Results from WY 2014 are reported in CDM Smith and Balance Hydrologics (2014).

## 1.2 Project Purpose

This report presents monitoring results from WY 2014, the fourth and final year of a multi-year monitoring program at three tributaries to the Truckee River and the second year of monitoring at station DCWR. The objectives of this report are to:

- Describe what, where, and how measurements were made for parameters such as streamflow, suspended-sediment concentration, turbidity, specific conductance, and water temperature[3];
- Interpret the resulting flow, turbidity and suspended-sediment monitoring data;
- Report and summarize daily and annual streamflows and suspended-sediment loads for all four stations, and;
- Compare WY 2014 suspended-sediment loads with loads from: a) previous water years collected as part of this and other concurrent studies and, b) historical loads computed from previous studies.

## 1.3 Hydrologic Setting

As shown in **Figure 1**, the Truckee River Basin is a closed basin, typically separated into three sections: 1) The Upper Truckee River Basin includes the waters of Lake Tahoe and all tributaries draining to the lake, 2) The Middle Truckee River flows out of Lake Tahoe at Tahoe City, and then passes through Truckee, to the Nevada State line, and 3) The Lower Truckee River flows from the state line east through Reno, Nevada, finally discharging into Pyramid Lake.

The hydrology of the Middle Truckee River Basin has been described in detail by others (Amorfini and Holden, 2008, Nichols Consulting Engineers, 2008; MacGraw and others, 2001). In this section, we describe the hydrologic setting for the three tributaries monitored as part of this study.

### 1.3.1 Cold Creek

Cold Creek is a tributary of Donner Creek in the Town of Truckee, California. The drainage area is approximately 12.6 square miles at the gaging station, located approximately 1,500 feet upstream from the confluence with Donner Creek. The watershed ranges in elevation from 5,940 feet in Truckee to

[3] Water temperature and specific conductance were measured on a monthly basis, or sometimes more frequent basis; while these two parameters are important in evaluating aquatic habitat conditions, they are not pertinent to the focus of this report and are not discussed further herein.

8,836 feet[4] at the crest of the Sierra Nevada Mountains and receives a total average-annual precipitation of 48.9 inches (USGS Streamstats, 2013). Most of the annual precipitation is received as snow during the winter months of November through March, with occasional early fall rainstorms, rain-on-snow events, and summer thunderstorms. Consequently, the annual pattern of streamflow tends to be dominated by spring snowmelt, punctuated by increases from occasional rain events.

The Cold Creek watershed[5] is underlain primarily by early- to mid-Tertiary volcanic rocks with some exposure of Cretaceous granitic rocks (Sylvester and others, 2007). The watershed is characterized by landforms and deposits typical of glaciation. For instance, valley sideslopes include moraine deposits comprised of boulders and non-cohesive sand and gravels, while valley bottoms are filled with similar materials derived from glacial outwash and alluvium (Birkeland, 1963). Historical land use within the Cold Creek watershed was directly linked to the geologic setting. Beginning in the 1960s, the glacial deposits along the valley floor and the near-channel environment were mined for sand and gravel during construction of Interstate 80 (I-80). As a result, the channel in the lower watershed was realigned and later modified to contain and convey floods. Current land uses include the Union Pacific railroad, forestry and recreation under California State Parks and US Forest Service management, and staging for highway maintenance. Vegetation varies with elevation, aspect and soil type but is primarily a conifer forest with areas of scrub and brush, with expanses of granitic bedrock exposed in the upper watershed.

### 1.3.2 Donner Creek

Donner Creek drains a 29.1-square mile watershed at the USGS gage at Highway 89; this area increases to 29.5 square miles at West River Street where it discharges to the Truckee River. The Cold Creek watershed accounts for almost half of this area (12.6 square miles). In addition, approximately 14.3 square miles of the upper watershed for Donner Creek drains to Donner Lake, which is regulated by a small dam. Thus, while streamflow in Donner Creek is influenced by snowmelt and rainstorms, it is also regulated by detention in and controlled releases from Donner Lake as described in more detail below.

The Donner Creek watershed ranges in elevation between 5,890 feet at the mouth of Donner Creek and 8,836 feet at the crest of the Sierra Nevada Mountains. Total average-annual precipitation over the watershed is 46.9 inches (USGS Streamstats, 2013). Vegetation varies with elevation, aspect and soil type, but is primarily a conifer forest with areas of exposed bedrock, scrub and brush. Similar to Cold

[4] All elevations are presented relative to mean sea level (msl).

[5] Also identified on USGS maps and known locally as 'Coldstream Canyon'

Creek, the larger Donner Creek watershed is underlain primarily by early- to mid-Tertiary volcanic rocks, with some exposure of Cretaceous granitic rocks (Sylvester and others, 2007). The watershed was significantly influenced by past glaciations, which left behind large-scale moraine features, deposits and outwash (Birkeland, 1963). Historic land uses within the Donner Creek watershed include mining, construction of the Union Pacific railroad and timber harvesting. Construction of I-80 and other local roads resulted in channel realignment and modifications. Today, the lower watershed below Donner Lake includes portions of I-80, as well residential and commercial areas of Truckee, which drain through stormwater outfalls to the reach of Donner Creek downstream of Highway 89. To assess suspended-sediment contributions from these urban sources, the study added another station at West River Street and monitoring began in WY 2012.

As mentioned above, Donner Creek is regulated at Donner Lake. The lake is allowed to fill to the maximum elevation of 5,935.8 feet, typically between April 16 and June 15, with releases to maintain a 2.0 cfs minimum streamflow downstream of the lake. If the lake elevation is less than 5,932 feet, then no water can be released during the months of June, July, and August. The water-surface elevation of Donner Lake must be lowered to 5,926.9 feet by November 15 each year to meet flood control requirements. The lake lowering results in increased streamflow downstream of Donner Lake during the months of September, October and November. During normal operations, all inflows between November 15 and April 15 pass through the lake without detention (Berris and others, 2001).

### 1.3.3 Trout Creek

Trout Creek drains a mostly low-density residential area in the upper watershed and a small urban component in the lower watershed with contributions from Interstate-80. The watershed ranges in elevation between 5,820 feet at the confluence with the Truckee River and 7,412 feet at the divide with Donner Creek. This watershed is located slightly east of the crest of the Sierra Nevada Mountains and as a result, differs slightly in its precipitation regime. Total average-annual precipitation over the watershed is 37.4 inches (USGS Streamstats, 2011). Similar to the Donner Creek/Cold Creek watershed, most of the annual precipitation is received as snow during the winter months, and annual streamflow is dominated by spring snowmelt with occasional increases from rain events.

The Trout Creek watershed is underlain by mid- to late-Tertiary volcanic rocks and also exhibits landforms and deposits characteristic of past glaciations (Sylvester and others, 2007). The upper watershed's southern boundary is controlled by a glacial moraine crest which separates Trout Creek from Donner Lake (Birkeland, 1963). The lower watershed, where Trout Creek formed an alluvial fan at the confluence with the Truckee River, has also been subject to considerable disturbance due to construction of the Union Pacific Railroad and development of the Town of Truckee. The Town is currently implementing a phased restoration of the lower reaches of Trout Creek through the downtown area, extending to the confluence with the Truckee River.

## 1.4 Prior Work

### 1.4.1 Stream gaging

The USGS has intermittently operated a stream gage on Donner Creek at Donner Lake (USGS 10338500) from WY 1910 to the present. Flows recorded at this gage have been regulated by the dam on Donner Lake since 1928. Mean annual flows after 1928 have ranged from 7.7 to 83.3 cubic feet per second (cfs). The peak instantaneous flow for the period of record was measured at 863 cfs on January 2, 1997.

The USGS operates another stream gage on Donner Creek at Highway 89 (USGS 10338700). This gage is downstream from both the Donner Lake gage and the confluence with Cold Creek, and has a contributing area of 29.1 square miles. The period of record for this gage is from March 1993 through the current water year. Mean annual flows for the period of record have ranged from 26 to 142 cfs. The peak instantaneous flow for the period of record was measured at 2,500 cfs on January 2, 1997. This study utilizes this station (Donner Creek at Highway 89, DC89) for evaluation of suspended-sediment loads in Donner Creek.

### 1.4.2 Sediment load monitoring

In supporting development of the Middle Truckee River Sediment TMDL, McGraw and others (2001) used historical data to develop a relationship between streamflow and suspended-sediment load and estimate annual sediment loads for 10 major tributaries to the Truckee River, including Donner Creek and Trout Creek. Based on this information, the Lahontan Water Board (Amorfini and Holden, 2008) established the Middle Truckee River Sediment TMDL, identified a sediment loading capacity, and computed annual suspended-sediment loads for WY 2004 using sediment rating curves from McGraw and others (2001). Thus, data on WY 2004 sediment loads are available for Donner Creek and Trout Creek, but not for Cold Creek, although sediment contributions from the Cold Creek subwatershed are embedded in the historical Donner Creek data.

River Run Consulting (2007) completed a watershed assessment for Cold Creek. The report discusses sediment sources and developed estimates of suspended-sediment loads based on surveyed sediment sources as well as work completed by McGraw and others (2001).

### 1.4.3 Bioassessment

Herbst and others (2013) used a large number of patch-scale or small-scale area samples along the Middle Truckee River to evaluate changes in macroinvertebrate communities in relation to the cover of fine and sand particles on the bed. Their results suggests clear and significant shifts in reduced density and body size distribution, lower diversity, losses of sensitive organisms, but high proportions of tolerant taxa, and altered food web structure. These results also suggest that while tributaries may be meeting the standards for suspended-sediment loading in recent years, the biological communities continue to show impacts.

### 1.4.4 Bed Conditions Assessment

Prior to Herbst studies, Balance Hydrologics completed baseline bed conditions monitoring in WY 2010 and WY 2011 (Donaldson and Shaw, 2012) and repeated in WY 2014 (Kulchawik and others, 2014 Draft). Monitoring included bed conditions mapping, repeat cross-section surveys, and pebble counts to calculate bed surface material grain-size distributions at three representative reaches along the mainstem of the Truckee River using standard and acceptable hydrographic practices.

# 2. STATION DESCRIPTIONS

Measurement of streamflow and establishment of a streamflow record is the first step towards computation of a sediment load. This chapter provides descriptions of the stream gaging stations used in this study. The streamflow gaging instrumentation and methods used to create a record of streamflow are described in **Appendix A**. The different types of sediment transport and the methods and equipment used to collect suspended-sediment samples or measure turbidity are described in **Section 3**.

## 2.1 Cold Creek at Teichert Bridge (CCTB) Description

The location of the Cold Creek gaging station (CCTB) is illustrated in **Figure 2**. Balance installed a near-continuous stream gage at this site on October 8, 2010. The gaging station is located below a bridge and on the right (east) bank of the Teichert Quarry property, approximately 1,500 feet upstream from the confluence with Donner Creek at latitude/longitude 39º19'13.1"N, 120º13'36.7"W (WGS84). The watershed area above the gaging station is approximately 12.6 square miles. Water-level (stage) at this gage is occasionally affected by ice.

## 2.2 Trout Creek at Donner Pass Road (TCDP) Description

The location of the Trout Creek gaging station (TCDP) is illustrated in **Figure 2.** Balance installed a near-continuous stream gage at this site on January 21, 2011. The station was installed on the north bank, approximately 150 feet upstream from Donner Pass Road and about 0.91 miles upstream from the confluence with the Middle Truckee River. The gaging station is located at 39°19'50"N, 120°10'55"W (WGS84). The watershed area above the gaging station is approximately 4.6 square miles. Stage at this gage is occasionally affected by ice.

## 2.3 Donner Creek at Highway 89 (DC89; USGS 10338700) Description

The location of the Donner Creek at Highway 89 (DC89) gaging station is shown in **Figure 2.** The period of streamflow record for this gage is from March 1993 (WY 1993) through the current water year and operated and maintained by the USGS. The station is located at 39°19'15.5"N, 120°12'28.6"W (WGS84), approximately 50 feet upstream from the State Highway 89 box culvert and approximately 0.59 miles upstream from the confluence with the Middle Truckee River. The watershed area above the DC89 gaging station is 29.1 square miles and includes the Cold Creek subwatershed (12.6 square miles). This report uses a watershed area of 14.8 square miles for computation of suspended-sediment yields at this gage, specifically excluding the upper watershed including Donner Lake (14.3 square miles). As in previous studies, we have assumed that the lake is an effective trap for sediment emanating from the upper watershed[6]. Stage at this location is regulated and is occasionally affected by ice.

## 2.4 Donner Creek at West River Street (DCWR) Description

The location of the Donner Creek at West River Street (DCWR) station is shown in **Figure 2.** This station does not include instrumentation; it is used for collection of suspended sediment samples and limited streamflow measurements. Both sampling and measurements are conducted at the West River Street Bridge, approximately 0.57 miles downstream from the Donner Creek at Highway 89 station and approximately 150 feet upstream of the confluence with the Middle Truckee River at the point 39°18’59” N, 120°12’3.7”W (WGS84). The watershed area above this gaging station is 29.5 square miles and includes the Cold Creek subwatershed. There are no natural tributaries that enter Donner Creek between DC89 and DCWR; however, there are at least 6 stormwater outfalls. For the purposes of computing suspended-sediment yields at this gage, this report uses streamflow[7] reported upstream at USGS 10338700 and a watershed area of 15.2 square miles which excludes the upper watershed area and Donner Lake for the same reasons described above.

## 2.5 Other Stations in the Middle Truckee River Gaging Network

The USGS operates other real-time gaging stations on the Middle Truckee River above and below the gaging stations used for this report (**Figure 2**), including:

- Truckee River near Truckee, USGS 10338000
- Truckee River at Boca Bridge near Truckee, USGS 10344505

In WY 2014, both of these gages were used as part of the Town of Truckee’s Truckee River Water Quality Monitoring Program to develop estimates of sediment loading upstream and downstream from the tributaries assessed in this report (CDM Smith and Balance Hydrologics, 2014).

[6] Balance Hydrologics field staff have made several observations at the dam outlet when Donner Lake is spilling, and during storm conditions to Donner Creek to support this assumption.

[7] Balance hydrologists have made several manual measurements of streamflow at DCWR over a range of stage and found that they roughly equal flows reported by USGS.

# 3. FLUVIAL SEDIMENT MEASUREMENTS

This chapter describes the different types of sediment transport and the methods and equipment used to collect suspended-sediment samples or measure turbidity, the basis of evaluating suspended sediment loads.

## 3.1 Types of Fluvial Sediment

We distinguish two types of sediment in transport, bedload and suspended sediment. Bedload includes sediment that rolls or saltates along the streambed, commonly within the lowermost three inches of the water column. Movement can be either continuous or intermittent, but is generally much slower than the mean velocity of the stream. Suspended sediment consists primarily of fine sand, silt, and clay supported by turbulence within the water column and transported at a rate approaching the mean velocity of flow. This study supports the Middle Truckee River Sediment TMDL through collection and interpretation of suspended-sediment samples; bedload sediment is not sampled for this study.

## 3.2 Suspended-Sediment Sampling Equipment

Balance staff used standard equipment and methods adopted by the Federal Interagency Sedimentation Project (FISP) to make measurements of suspended-sediment transport. This equipment included a hand-held DH-48 suspended-sediment sampler with a 1/4-inch nozzle for use when flows were wadeable, and a bridge board with a D-95 suspended-sediment sampler for high (unwadeable) flows.

## 3.3 Suspended-Sediment Sampling and Analysis

Suspended-sediment samples were collected at channel locations exhibiting the most ideal characteristics (i.e., straight reach) for the flow event sampled, but always in close proximity to the gaging station. Streamflow was measured or estimated each time sediment was sampled. Suspended-sediment samples were collected using the Equal Transit Rate (ETR) method: each sample is collected by raising and lowering the sampler at a number of equally-spaced verticals across the stream channel; collection in each vertical is integrated across the full depth of the water column; and a constant transit rate is maintained while raising and lowering the equipment until the sample bottle is just less than full (Edwards and Glysson, 1999). Suspended-sediment samples are collected from between three and eight verticals, and each vertical is executed within 5 to 15 seconds, for a total of 30 to 60 elapsed seconds per sample. Following this protocol to expedite sampling avoids the confounding effects of significant changes in sediment transport rates due to rapidly fluctuating streamflows.

Each sample is then transferred to a clean 500 milliliter (mL) or 1,000 mL high-density polyethylene (HDPE) bottle and transported to High Sierra Water Lab, near Truckee, California for analysis of total suspended solids (TSS) using EPA method 160.2 (gravimetric method). McGraw and others (2001) evaluated the relationship between TSS and suspended sediment concentration (SSC) at monitoring sites in the Middle Truckee River watershed, and found a nearly one-to-one relationship between the two parameters, suggesting that both TSS and SSC are reliable for calculating suspended-sediment loads, especially at flows of less than 500 cfs[8]. For the remainder of this report, we use the term SSC when referring to suspended-sediment concentrations of samples collected for this study.

Use of the suspended-sediment data to calculate suspended-sediment transport rates ('loads') is explained in the next chapter.

## 3.4 Turbidity Monitoring

Turbidity was measured at the Cold Creek (CCTB) and Trout Creek (TCDP) stations using Optical Back-Scatter (OBS 3+) submersible turbidity probes with a range of up to 4,000 NTUs. Near-continuous turbidity values, measured in nephelometric turbidity units (NTUs), were recorded every 15 minutes together with measurements of stream stage.

Near-continuous turbidity was also recorded every 15 minutes at Truckee River near Truckee (USGS 10338000) and Truckee River at Boca Bridge (USGS 10344505) as part of a concurrent study (CDM Smith and Balance Hydrologics, 2014).

[8] The fundamental difference between SSC and TSS analytical methods is the use of the sample; a TSS analysis generally entails withdrawal of an aliquot of the original sample for subsequent analysis, while the SSC method uses the entire water-sediment mixture to calculate SSC values.

# 4. CREATING A RECORD OF SUSPENDED-SEDIMENT LOAD

In this section, we describe the two methods used in this study to calculate annual records of suspended-sediment load: 1) through use of site-specific, streamflow-to-suspended-sediment load relationships ('rating curves'); and 2) based on the relationship between the continuous record of turbidity and suspended sediment concentration (SSC).

## 4.1 Calculating Suspended-Sediment Load from a Streamflow-Based Rating Curve

Suspended-sediment samples collected in the field are correlated with instantaneous streamflow, either from concurrent manual measurements or from the electronic record. Samples are analyzed at the laboratory for TSS (mg/L), and then the results are converted to suspended-sediment loads by multiplying the TSS concentration by the instantaneous streamflow (cfs) and applying a factor of 0.0027 to convert the units into tons/day. This approach allows SSC loading data to be graphed against instantaneous streamflow data to develop a relationship using best-fit, empirical equations (power function). The resulting relationship is then applied to the (15-minute) record of streamflow to compute a 15-minute record of suspended-sediment load.

The error associated with streamflow-based, suspended-sediment rating curves has been reviewed in the literature and is generally assumed to have an inherent uncertainty of at least 25 to 50 percent (Walling, 1977, MacDonald and others, 1991). Significant scatter in instantaneous rates of suspended sediment loads can produce results differing by an order of magnitude at any given discharge.

In order to address variation and error in sediment load computations, we evaluated potential temporal patterns in the data. Data was separated by season (e.g., pre-snowmelt peak runoff vs. post-snowmelt peak runoff) and position on the storm hydrograph (e.g., rising limb vs. falling limb). Where differences were observed, separate relationships (equations) were developed. Since ongoing sampling efforts may help extend the existing rating curves and improve their accuracy, the data presented in this report should be considered provisional and subject to revision when additional data becomes available.

## 4.2 Calculating Suspended-Sediment Load from a Continuous Record of Turbidity

At the two gaging stations with a continuous record of turbidity (i.e., CCTB and TCDP), measurements of instantaneous turbidity (NTU) at the time of suspended-sediment sample collection (SSC, in mg/L) results in a definable relationship that, according to the literature (MacDonald and others, 1991), can explain at least 80 percent of the variation in suspended-sediment concentrations. The continuous record of turbidity can then be converted into a 15-minute record of suspended-sediment concentration (mg/L per 15 min.) and, through application of the streamflow record, converted into a daily suspended-sediment discharge (tons/day). Because turbidity can fluctuate independent of streamflow variations, continuous turbidity monitoring can help identify discrete events not related to rainfall or snowmelt runoff, such as bank failures. For Cold Creek and Trout Creeks, where near-continuous turbidity data were available, turbidity values were used as a second technique, in addition to the streamflow-to-suspended-sediment load method described above, to estimate suspended-sediment loading in WY 2014.

We note that several factors can complicate collection and interpretation of continuous-logging turbidity data: a) algal growth on the optical sensor; b) ice or debris collecting on the probe; c) sedimentation of the probe; and/or d) probe exposure above the water column (unsubmerged) due to extreme low-flows. To reduce the chances of these conditions and to minimize instrument error, Balance staff made frequent visits in WY 2014 to evaluate site conditions and instrument integrity. Furthermore, the station equipment was upgraded during the summer of 2012 to provide real-time internet monitoring of field data resulting in faster identification and correction of these conditions when they occurred.

# 5. WATER YEAR 2014 HYDROLOGIC SUMMARY

Balance staff visited the stream gages monthly and made additional visits during rain and snowmelt events to observe water levels (stage), conduct flow measurements, and collect suspended-sediment samples. This chapter begins with a description of WY 2014 precipitation and snowmelt trends and concludes with a description of flow conditions during the period, including peak flows, baseflows, and other relevant observations.

## 5.1 Annual Precipitation

Precipitation data used for this study was evaluated from two precipitation stations, both operated by the USDA Natural Resources Conservation Service: 1) Station 'Truckee 2' in Placer County at 6,400 feet (CDEC Station ID: TK2), and; 2) the Central Sierra Snow Laboratory (CSSL), at 6,950 feet near Donner Pass (CDEC Station ID: CSSL). See **Figure 2** for locations of these stations. These stations provide precipitation measurements covering the range of elevations present in the gaged watersheds considered in this study. Data from CSSL provides context for evaluating snowpack and snow-melt water-equivalency in relation to the spring snowmelt hydrology.

Cumulative annual precipitation for Truckee, California is illustrated in **Figure 3** for WY 2011, WY 2012, WY 2013, and WY 2014. Snowpack as snow-water equivalent is presented in **Figure 4** for WY 2011, WY 2012, WY2013, and WY 2014. Approximately 23 inches of precipitation were recorded for WY 2014, which was drier than WY 2012 (24.9 inches) and WY 2013 (25.9 inches) and the third consecutive year with precipitation well below the annual average of 40.3 inches. In fact, WY 2014 was about 57 percent of the long-term average for the TK2 station (CDEC, 2013). WY 2014 also had below average snowpack with less than 40 percent of the long-term average on April 1, 2014, typically the highest snowpack of the year. This value was starkly in contrast to the very high snowfall and snowpack during WY 2011 when the CSSL recorded over 240 percent of the long-term average snowpack on April 1 of that year (see **Figure 4**).

WY 2014 began with mostly dry conditions, but was notable for the numerous rain-on-snow events throughout the winter and spring. Such events were recorded on January 29-30, 2014, February 8-10, 2014, and March 6, 2014. The below-average snowpack limited the volume of runoff in the tributaries to the Truckee River during these events, and also resulted in an early peak snowmelt runoff period between late March and early April, depending on the tributary.

Rainfall amounts and intensities vary geographically with localized storms and the effects on streamflows differ. For instance, a severe thunderstorm on August 7, 2014 resulted in significant rainfall along the Sierra Crest but was largely isolated to the Donner/Cold Creek watershed east of the crest. The runoff from this event caused a limited increase in streamflow in Cold Creek, but a major turbidity plume, likely the result of gully and bank erosion and bank failures in the upper watershed. Turbidity was the highest measured in the 4-years of monitoring and propagated downstream through the Truckee River. Turbidity in adjacent monitored tributaries was not elevated and also highlights the importance of tributary monitoring.

Dry conditions persisted through the end of the water year and resulted in the lowest stream levels in years. In fact, the combination of a significantly below average snowpack and only limited summer precipitation, Lake Tahoe water levels fell below the natural rim by October 2014.

## 5.2 Cold Creek at Teichert Bridge (CCTB): Hydrology

**Form 1** presents daily and peak flow values for WY 2014 at the Cold Creek at Teichert Bridge station (CCTB). **Table 1** documents observations and measurements made during site visits. Daily streamflow is illustrated in **Figure 5**.

WY 2014 began with baseflow of less than 0.5 cfs in Cold Creek, similar to WY 2013 and likely the result of continued below average precipitation. Streamflow gradually increased through the fall resulting from rain. A rain-on-snow event on January 29-30, 2014 resulted in a peak flow of 73 cfs. A rain-on-snow event on February 8-9, 2014 resulted in the annual peak flow of 196 cfs on February 9, 2014. Streamflow receded to a winter baseflow near 15 cfs, before another rain-on-snow event occurred on March 6, 2014 and resulted in a peak flow of 142 cfs. The below average snowpack caused a relatively early snowmelt peak in April 17, 2014 with peak flow less than 100 cfs. Flows fluctuated between 30 cfs and 70 cfs as daily mean temperatures rose and some rainfall was recorded into late spring. The spring-melt flow recession was rapid with baseflows below 1 cfs by July and small increases in flow as the result of a few summer thunderstorms. A severe and isolated thunderstorm on August 7, 2014 resulted in peak flow of 9.7 cfs. Similar to the beginning of the water year, baseflows fell below 0.5 cfs through the end of the water year and reached an annual low daily mean of 0.2 cfs by mid-September. The annual mean flow for Cold Creek at Teichert Bridge in WY 2014 was 12 cfs, equal to total annual runoff of 8,892 acre-feet.

## 5.3 Donner Creek at Highway 89 (DC89; USGS #10338700): Hydrology

Streamflow for Donner Creek at Highway 89 (DC89) is reported by the USGS; data are provisional at the time of this report and subject to revision. **Appendix B1** presents USGS-reported daily flows for WY

2014 at Donner Creek above Highway 89. **Table 2** documents Balance observations and measurements made during site visits to the gage. The WY 2014 streamflow hydrograph for DC89 is illustrated in **Appendix B2.**

Donner Creek is a regulated creek and streamflow typically increases between September and late October, with releases averaging about 100 cfs. This year, however, releases were less than 50 cfs. Upon cessation of Donner Lake releases in WY 2014, baseflow averaged around 3 to 5 cfs through November and December. A rain-on-snow event on January 29-30, 2014 resulted in a peak flow of 64 cfs, slightly less than the peak measured on Cold Creek on the same day. Antecedent dry conditions likely promoted streambed infiltration between these two gaging stations. A rain-on-snow event on February 8-9, 2014 resulted in the annual peak flow of 327 cfs on February 9, 2014. Streamflow receded to a winter baseflow near 25 cfs, before another rain-on-snow event occurred on March 6, 2014 and resulted in a peak flow of 147 cfs. The below average snowpack caused a relatively early snowmelt peak in Donner Creek on April 12, 2014 with a peak snowmelt runoff of 156 cfs. This peak snowmelt runoff date is slightly earlier than Cold Creek and likely reflects differences in elevation and land-uses along Donner Creek. Flows fluctuated 30 cfs and 100 cfs as daily mean temperatures rose and some rainfall was recorded into late spring. The spring-melt flow recession continued into June and baseflows fell to 4 cfs by July with small increases in flow as the result of a few summer thunderstorms. A severe and isolated thunderstorm on August 7, 2014 resulted in peak flow of 20 cfs. Releases from Donner Lake began in early September and continued through end of the water year between 25 cfs and 60 cfs. The annual mean flow for Donner Creek at Highway 89 in WY 2014 was 27 cfs, equal to annual runoff of 19,624 acre-feet.

## 5.4 Donner Creek at West River Street (DCWR): Hydrology

**Table 3** documents observations and measurements made during site visits to Donner Creek at West River Street. The Donner Creek drainage area increases by 0.4 square miles between Highway 89 and West River Street. The expanded area does not include any natural tributaries; however it does include a number of stormwater outfalls within the Town of Truckee. In an effort to evaluate differences in streamflow between Highway 89 and West River Street, three streamflow measurements were made over a range of flows during WY 2012 and the results were compared to streamflows measured at the Donner Creek at Highway 89 station, as reported by the USGS. There was no appreciable difference between streamflow at the two stations. Thus, the USGS streamflow record at the DC89 station and the pattern of annual streamflow described above (Section 5.3) for DC89 are assumed to be applicable to DCWR and has been used for interpretation of hydrology and computation of sediment loading at DCWR.

## 5.5 Trout Creek at Donner Pass Road: Hydrology

**Form 2** presents daily and peak flow values for the Trout Creek at Donner Pass Road (TCDP) gage for WY 2014. **Table 4** documents observations and measurements made during site visits to the gage. Daily streamflow is illustrated in **Figure 6**.

WY 2014 began with baseflow between 0.4 cfs and 0.5 cfs. Baseflow was maintained through the fall with small peaks resulting from minor rainfall. Streamflow during the period November 17, 2013 through December 30, 2013 was affected by ice, so mean daily flow for this period was correlated with a nearby stream gage of similar elevation and size (Sagehen Creek near Truckee, California, USGS 10343500). A rain-on-snow event on January 29-30 resulted in a peak flow of 10.7 cfs. A rain-on-snow event on February 8-9, 2014 resulted in the annual peak flow of 40 cfs on February 9, 2014. Streamflow receded to slightly higher baseflow before another rain-on-snow events occurred on March 6, 2014 and resulted in a peak flow of 13.3 cfs. Trout Creek's lower watershed elevation, greater distance east from the Sierra Nevada crest, and more urbanized watershed likely contributed to an earlier snowmelt runoff peak (March 29, 2014) relative to other tributaries. After peak snowmelt runoff occurred, streamflow receded through the spring and summer months with only several notable increases as the result of thunderstorms. Construction activity for creek restoration efforts required removal of the gaging station on July 1, 2014. On this day, daily mean flow was roughly 0.2 cfs. Based on occasional and informal field observations, streamflow appears to have remained at this level or lower through the rest of the water year. The annual mean flow for Trout Creek at Donner Pass Road in WY 2014 was 1.6 cfs, equal to annual runoff of 827 acre-feet.

# 6. WATER YEAR 2014 SUSPENDED-SEDIMENT LOAD AT A STATION

This chapter summarizes and compares the suspended-sediment loads calculated for each of the gaging stations monitored in WY 2014. Loads were computed using streamflow-based methods at all four stations and turbidity-based methods at the two stations equipped with turbidity probes: Cold Creek and Trout Creek.

Langlois and others (2005) studied the relationship between streamflow and suspended-sediment concentration in snowmelt-dominated systems on the eastern (Nevada) side of Lake Tahoe. They found that the relationship differs during the rising and falling limbs of the snowmelt-dominated hydrograph, with greater loading measured on the rising limb than on the falling limb for a given streamflow. Because of this 'hysteresis' effect, they concluded that streamflow-based sediment rating curves are poor predictors of suspended-sediment dynamics in the snowmelt-dominated streams of the region, *unless* these relationships can be defined with adequate sampling and monitoring. In an effort to address this concern, we evaluated our data on a temporal scale to identify such trends in our streamflow-based sediment-rating curves. Use of a continuous record of turbidity is an alternative approach for computation of a more accurate record of annual sediment loading.

In the sections below, we describe how suspended sediment loading was computed using both streamflow-based rating curves and continuous records of turbidity. When using streamflow-based rating curves to compute loads, we identified separate relationships or rating curves for each station where the data supports a segmented approach, such as when hysteresis is observed or for different event-types (e.g., runoff from snowmelt vs. thunderstorm).

## 6.1 Cold Creek at Teichert Bridge: Suspended-Sediment Load

**Table 5** summarizes observations and instantaneous loading calculations for the Cold Creek at Teichert Bridge (CCTB) gage. **Form 3** presents WY 2014 daily and annual suspended-sediment loads computed by the two different methods for this station. The relationship between streamflow and suspended-sediment load is shown in **Figure 7.** The relationship between turbidity and SSC is shown in **Figure 8.** Daily suspended-sediment loads calculated using each method are graphically compared in **Figure 9**.

To date, we have not identified in the Cold Creek record any hysteresis effects related to streamflow-based suspended-sediment loading of the kind Langlois and others (2005) observed in streams east of Lake Tahoe. However, our data (**Figure 7)** does suggest unique relationships in the streamflow-to-suspended-sediment data for different hydrologic event types such as the snowmelt runoff period when compared with rain-on-snow events. Data collected over the four year study suggest that sediment loading from rain-on-snow events can be roughly 2 to 10 times greater than during snowmelt runoff. Furthermore, some severe thunderstorms have been shown to produce sediment loading orders of magnitude higher than most other events. In calculating a record of suspended-sediment load for the CCTB station, three relationships were derived to describe load rating in WY 2014 and were applied to the record of streamflow.

Using the streamflow-based suspended-sediment rating curve, we estimate WY 2014 annual suspended-sediment loading in the Cold Creek subwatershed to be 58 tons (4.6 tons/sq. mile), with a maximum daily load of 18.9 tons on August 8, 2014 (33 percent of total annual load). Using the continuous turbidity record as a proxy for suspended sediment concentration and loading, we estimate the annual suspended-sediment loading to be 61 tons (4.8 tons/sq. mile), with a computed maximum daily load of 12.5 tons on August 8, 2014 (20 percent of total annual load), the result of an isolated, severe thunderstorm in the upper watershed. In general, the two methods appear to track similar trends, but the loads computed using a continuous record of turbidity captures the variability in suspended-sediment transport rates which is unrelated to streamflow.

## 6.2 Donner Creek above Highway 89: Suspended-Sediment Load

The Donner Creek at Highway 89 (DC89) gaging station operated by the USGS is **not** equipped with a continuous-logging turbidity meter. **Table 6** summarizes observations and instantaneous loading calculations for this station, computed using a streamflow-to-sediment-discharge rating curve. **Form 4** presents the calculated WY 2014 daily and annual suspended-sediment loads. The relationship between streamflow and suspended-sediment transport rate is shown for DC89 in **Figure 10**.

After four years of data collection at the Donner Creek at Highway 89 station, the suspended-sediment sampling results suggest different sediment transport relationships associated with different event types, in which higher loads are measured during rain-on-snow events as compared to the snowmelt runoff period and even higher loads associated with severe summer thunderstorms. Donner Creek receives a significant portion of stormwater runoff from a stormwater collection system—conveying runoff to the stream faster relative to natural surfaces (i.e., Cold Creek watershed), often laden with recently-applied road traction sand. It may be these dynamics in runoff conveyance to the creek that generates higher loading rates during rain-on-snow events and summer thunderstorms.

In previous years, we evaluated how releases from Donner Lake affect suspended-sediment loading in Donner Creek. We found that annual Donner Lake releases did not generate considerable loading, but instead exhibited loading rates similar to snowmelt runoff.

Based solely on a streamflow-based sediment rating curve, we estimate the annual suspended-sediment load in Donner Creek at Highway 89 to be 181 tons (12.2 tons/sq. mile)[9] in WY 2014, with a maximum daily load of 26.7 tons on February 9, 2014 (15 percent of total annual load). Worth noting was a daily load of 14 tons (8 percent of total annual load) on August 8, 2014, the result of a turbidity plume generated upstream in Cold Creek from a severe, but isolated thunderstorm.

### 6.3 Donner Creek at West River Street: Suspended-Sediment Load

The loading calculations for the Donner Creek at West River Street (DCWR) station utilizes suspended-sediment samples collected at this location and streamflow measured at the USGS station (DC89) a short distance upstream. **Table 7** summarizes observations and instantaneous loading calculations for DCWR computed using a streamflow-to sediment-discharge rating curve. **Form 5** presents WY 2014 daily and annual suspended-sediment loads. The relationship between streamflow and suspended-sediment load is shown in **Figure 11.** The daily suspended-sediment load at DCWR is shown graphically in **Figure 12**, which also presents the daily suspended-sediment load at the upstream station (DC89) for comparison.

Since our computations for the DC89 and DCWR stations used the same record of streamflow, it is not surprising that the DCWR data shows similar relationships or sediment rating curves. We estimate the WY 2014 annual suspended-sediment load in Donner Creek at West River Street to be 285 tons (18.8 tons/sq. mile)[10], with a maximum daily load of 93 tons on February 9, 2014 (33 percent of total annual load). We also note that roughly 18 tons (6 percent of total annual load) was measured on August 8, 2014 as the result of an isolated thunderstorm in the Cold Creek watershed which caused a turbidity plume to propagate downstream through Donner Creek and into the Truckee River. The annual load at this station is higher than the upstream station: Donner Creek at Highway 89 and is likely the result of additional stormwater outfalls located between these stations. Based on the Town of Truckee stormwater maps, these outfalls appear to drain large urbanized or impervious surfaces such as shopping centers, State Highway 89 and portions of Interstate-80.

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[9] Normalized loads computed for DC89 exclude the upper watershed area above Donner Lake.

[10] For reasons discussed in detail in Section 2.3, normalized sediment loads computed for DCWR exclude the upper watershed area above Donner Lake.

## 6.4 Trout Creek at Donner Pass Road: Suspended Sediment Load

**Table 8** summarizes observations and instantaneous loading calculations for the Trout Creek at Donner Pass Road (TCDP) gage. **Form 6** presents WY 2014 daily and annual suspended-sediment loads for this station, computed by the two different methods. The streamflow-to-suspended-sediment load rating curve is shown in **Figure 13.** The turbidity-to-suspended-sediment concentration rating curve is shown in **Figure 14.** Daily suspended-sediment loads calculated using each method are graphically compared in **Figure 15**.

Using a streamflow-based sediment rating curve, we estimate the WY 2014 annual suspended-sediment loading in Trout Creek to be 7.7 tons (1.7 tons/sq. mile) with a maximum daily load of 3.4 tons on February 9, 2014 (39 percent of total annual load). In comparison, using the continuous record of turbidity, total loading is calculated to be 6.8 tons (1.5 tons/sq. mile) with a maximum daily load of 1.6 tons on February 9, 2014 (24 percent of total annual load). While these loads represent a partial water year (October 1, 2013 through July 1, 2014) we believe they represent close to the complete annual loads based on observations of low flow conditions during the remaining months of the water year.

## 6.5 Comparison of suspended-sediment yields across stations, WY 2014

In this section, we describe sediment loads normalized by: 1) watershed area (tons/square mile), and 2) runoff volume (tons/1,000 acre-feet of runoff) to compute yields and facilitate comparison between watersheds of different drainage areas and/or differing hydrology. Consistent with the preceding sections, we report suspended-sediment loads and yields at TCDP and CCTB as computed from continuous turbidity records, whereas other stations (DC89 and DCWR) suspended-sediment loads and yields are based on streamflow-based methods in the absence of turbidity probes at these stations. We reiterate that all sediment yields computed for Donner Creek in this report exclude the upper watershed area above Donner Lake.

### 6.5.1 Suspended-sediment loads normalized by watershed area, WY 2014

A comparison of suspended-sediment loads between stations for WY 2014 is shown in **Figure 16a**. When normalized by watershed area[11], Cold Creek exhibited a yield of approximately 5 tons/square mile according to both the streamflow and turbidity-based methods. Donner Creek exhibited a yield of 12 tons/square mile at Highway 89, but increased downstream to 19 tons/square mile at West River Street.

[11] In this case, the reported yields are based on the entire watershed area upstream of the station (with the exception of the area above Donner Lake Dam)

Trout Creek exhibited significantly less sediment yield, about 1.5 tons/square mile, regardless of the method used. These yields suggest that Donner Creek exhibits the highest yields of the three sampled. Data also show that yields increase in Donner Creek a short distance downstream of Highway 89. Increases in yields may be the result of additional urban inputs (e.g., road sand) as numerous urban stormwater outfalls are identified through the lower section of Donner Creek.

### 6.5.2 Suspended-sediment loads normalized by runoff volume, WY 2014

A secondary technique of evaluating suspended-sediment loads between stations is to normalize loads by runoff volume (**Figure 16b)**. Cold Creek yielded roughly 4 tons/1,000 acre-feet, regardless of method used. Donner Creek showed slightly higher yields at Highway 89, between 4.3 tons/1,000 acre-feet. Increases in yield in Donner Creek between Highway 89 and West River Street (6.8 tons/1,000 acre-feet is likely attributed to urban sediment inputs as described above. Finally, between 4 and 5 tons/1,000 acre-feet were measured on Trout Creek, depending on method used.

### 6.5.3 Suspended-sediment loads normalized by intervening areas of nested stations: Donner/Cold Creek watershed

In an effort to better identify source areas for suspended-sediment in the Donner/Cold Creek watershed, we evaluated loading from the intervening areas using the three nested stations (CCTB, DC89, and DCWR). **Figure 17** depicts these intervening areas and the sediment loads (tons) and yields (tons/square mile) for these intervening areas**.** Loads for each area are computed using the difference between the loads calculated for a station and the station above (e.g. DC89 – CCTB = DC89 below CCTB). Similarly, yields are computed using these values divided by the intervening areas. CCTB has a contributing watershed area of 12.6 square miles, while the area between CCTB and DC89 has a contributing watershed area of 2.2 square miles, and the area between DC89 and DCWR has a contributing watershed area of roughly 0.4 square miles. Based on this approach, WY 2014 data suggest Cold Creek generated 61 tons or 4.8 tons/square mile, Donner Creek at Highway 89 exhibited 120 tons or 55 tons/square mile, and Highway 89 downstream to the confluence of the Truckee River Donner Creek exhibited a significant increase in loading and yield from a very localized area (104 tons or 260 tons/square mile).

Higher sediment yields to Donner Creek downstream of Highway 89 appear to be attributed to urban stormwater. The Town of Truckee has preliminarily identified 24 stormwater outfalls to Donner Creek below Donner Lake (**Figure 18**). These stormwater outfalls collect runoff from a generally small area, but from areas that are mostly impervious surfaces and include measurable sections of Highways I-80, State Route 89, commercial services at the Donner Pass Road interchange with Interstate-80, Donner

Creek Mobile Home Park, Sierra College, Deerfield Plaza, McDonalds, and the Truckee Crossroads Plaza. While only 9 stormwater outfalls were identified downstream of Highway 89, they all drain a very concentrated area of urban runoff with limited opportunities for sediment storage or settling (see **Figure 18**). Because each of these areas collects measurable fines from road-sand applications during the winter months it is logical that they might produce higher sediment loading to this reach during snowmelt runoff or after a major rain-on-snow event.

## 6.6 Comparison of suspended-sediment loads across all years and stations, WY 2011, WY 2012, WY 2013, and WY 2014

After four years of data collection we can compare loads across water years for each station. For this analysis, we compare loads between watershed and normalized loads by watershed area (square miles) to account for varying watershed sizes. **Table 9** compares suspended-sediment loads and yields across all stations for all years. **Figure 19** illustrates suspended-sediment loads, normalized by watershed area for each station and across all four water years.

From these comparisons, we can draw four salient conclusions:

- In every year, Donner Creek at West River Street exhibited higher suspended-sediment yields than other stations evaluated for this study;
- Trout Creek has relatively little contribution of suspended-sediment loads to the Middle Truckee River when normalized by watershed area; in fact, yields are an order of magnitude less than yields measured in Donner Creek;
- Cold Creek can be a significant contributor of suspended-sediment to the Middle Truckee River, but appears to only be in years when a major rain-on-snow or similar event occurs and can generate landslides, bank failures, and gully erosion, such as the December 2, 2012 (WY 2013) event.
- Sediment loading and yields are variable year-to-year in the Cold Creek and Trout Creek watersheds, whereas variability in loading and yields is limited in Donner Creek. This may be an indication of an unlimited sediment supply with high connectivity to the channel in urban areas. In contrast, a wider range of factors and limitations on sediment production is present in Cold Creek and Trout Creek, where unique circumstances (e.g., heavy rainfall and gully erosion) are required for efficient sediment delivery to the channels.

An additional consideration when comparing these data is water year type (i.e., wet years versus dry years). For instance, WY 2011 was a year with the third highest snowpack on record and resulted in significant snowmelt runoff well into the summer months. However, in dry years such as WY 2013 it can take only one major rain-on-snow event to trigger transport of measurable suspended-sediment yields to be equal or comparable to yields with high snowmelt runoff.

Events such as rain-on-snow events have been shown to generate gully erosion and landslides in the glacially eroded watershed of Cold Creek[12] (River Run Consulting, 2007). Additionally, much of the Cold Creek watershed is underlain by weakly consolidated volcanic rocks and highly erodible soils. Existing and historical disturbances in the watershed may also be important sediment sources (River Run Consulting, 2007). Erosion from these geologic or anthropogenic sources can provide a sustained or persistent source of sediment during an event. In contrast, rain-on-snow events may produce an initial increase in loading as a “first flush” in urbanized watersheds such as Donner Creek, below Donner Lake Dam, but loading may not be sustained through the event as sources become exhausted and runoff is maintained over flushed pavement.

This multi-year study provides for evaluation of suspended-sediment loading over a range of year types, watershed sizes, and land-uses, and captures variability and provides context for prioritizing best management practices to reduce excessive suspended-sediment to the Middle Truckee River. Efforts to reduce suspended-sediment loading to these creeks are on-going and include floodplain restoration in Cold Creek (Weld, 2012), Trout Creek (Weld, 2007) and enhanced street sweeping practices and frequency by the Town of Truckee and CalTrans.

[12] Coldstream Canyon is the name given to the larger watershed drained by Cold Creek.

# 7. COMPARISON OF WY 2014 SUSPENDED-SEDIMENT LOADS WITH TMDL BENCHMARKS AND HISTORICAL DATA

In this section, we utilize 15-minute, continuous records of streamflow and turbidity to compute suspended-sediment load durations for WY 2014. We then compare these values to the benchmark load limit of 25 mg/L at Farad as established under the Middle Truckee River Sediment TMDL (Amorfini and Holden, 2008). We note that the benchmark for the Truckee River was established by the Lahontan Water Board based on a literature review of suspended-sediment targets and criteria to protect aquatic life beneficial uses. The Lahontan Water Board identified 25 mg/L as being at the lower end (most protective) of the range of concentration to protect juveniles, larvae, and eggs, as well as adult fish. The suspended sediment target is expressed as an annual 90$^{th}$ percentile value; therefore, up to 10 percent of the data could fall above 25 mg/L and still be within the benchmark limit. The 90$^{th}$ percentile was chosen because it allows for seasonal or short-term variability while still fully supporting aquatic life beneficial uses under USEPA policy (Amorfini and Holden, 2008).

Because the benchmark limit is expressed as a concentration (mg/L), but the regulatory framework is a load (total daily maximum load or TMDL) we convert concentrations into daily (tons/day) or annual (tons/year) suspended-sediment loads for comparison between tributaries or watersheds. This conversion is accomplished by first converting the 15-minute turbidity (NTU) values for each tributary into SSC (mg/L), then multiplying each value by the corresponding 15-minute streamflow (cfs) for that creek. We can then apply these loads in the form of a load duration curve to evaluate the occurrences and percentage of time which loads equal or exceed the TMDL standard for a particular tributary.

We also compare streamflow-to-suspended-sediment rating curve data, developed as part of this study, with historical rating curve data (McGraw and others, 2001) for the two watersheds (i.e., Donner Creek and Trout Creek) where such data are available for comparison. Changes in the relationship between streamflow and suspended-sediment load can be identified by a “shift” in the suspended-sediment rating curve. Because changes in SSC with time may result from landscape processes or human disturbances in the watershed (Warrick and Rubin, 2007), suspended-sediment rating curves are perhaps the best tool for establishing sediment baselines prior to restoration or BMP implementation, and also for assessing changes in fine sediment supply due to implementation of restoration activities and BMPs (Hecht, 2008). As sediment supply within a watershed diminishes, SSC at a given streamflow will also diminish. Therefore, tracking changes in the relationship between suspended sediment loads and streamflow allows for an evaluation of restoration or BMP effectiveness at a cumulative, watershed scale.

## 7.1 Cold Creek at Teichert Bridge: Suspended Sediment Loading in WY 2014

**Figure 20** illustrates a suspended-sediment load duration curve for Cold Creek using the continuous 15-minute record of turbidity from WY 2014. Benchmark load limits based on the 25 mg/L target established for the Truckee River were also computed for Cold Creek. From **Figure 20**, we can draw three main conclusions from these data:

- Instantaneous loading rates (converted to daily rates) ranged between < 0.001 tons/day and 72 tons/day in WY 2014 over the range of streamflows recorded;
- Higher instantaneous loading rates were associated with the rain-on-snow events (February 9, 2014, March 6, 2014) and a severe thunderstorm on August 7, 2014.
- Suspended-sediment loading in Cold Creek exceeded the TMDL benchmark during approximately 1.0 percent of the year, well within the 90$^{th}$ percentile benchmark limit for the TMDL;

## 7.2 Donner Creek: Suspended Sediment Loading in WY 2014

We divide this section into two subsections to differentiate the two stations on Donner Creek where we measure suspended sediment: 1) Donner Creek at Highway 89 (DC89) and; 2) Donner Creek at West River Street (DCWR), 0.58 miles further downstream. **Figure 21** illustrates suspended-sediment load duration curves for both of these gages, developed using the streamflow-based sediment-load rating curves as continuous records of turbidity were unavailable for these stations. Note that the load duration curves reflect the difference in loading identified with the rising limb relative to the falling limb of the hydrograph (see **Figure 19**). As stated in Section 5.4, simultaneous streamflow measurements conducted on Donner Creek at West River Street and at Highway 89 suggested that flows there were nearly identical. Therefore, the USGS record of flow was used to compute loadings at West River Street and to calculate a benchmark load limits for both stations based on the 25 mg/L target.

### 7.2.1 Donner Creek at Highway 89 (DC89)

As calculated using the streamflow-based sediment rating curve, suspended-sediment loading at the DC89 station was well below the established benchmark in WY 2014. Only about 0.8 percent of the data exceeded the suspended-sediment benchmark, well within the 90$^{th}$ percentile. The observed exceedances were attributable to runoff from a severe thunderstorm over Cold/Donner Creek watershed on August 7, 2014 and a rain-on-snow event on February 9, 2014.

### 7.2.2 Donner Creek at West River Street (DCWR)

Suspended-sediment loadings immediately downstream at DCWR were also mostly below the established benchmarks in WY 2014 (**see Figure 21**). At this station, about 1.0 percent of all data exceeded the benchmark, still well within the 90th percentile.

We note that a load duration curve populated with loads calculated from a standard sediment rating curve may not be as useful as loads computed from a continuous record of turbidity. As such, an evaluation of temporal variability or identification of non-storm loading events cannot be assessed. Future efforts by the Town of Truckee may include instrumenting this station with a turbidity probe.

## 7.3 Trout Creek at Donner Pass Road Suspended Sediment Loading in WY 2014

**Figure 22** illustrates a suspended-sediment load duration curve for Trout Creek computed using a turbidity-based sediment rating curve. The benchmark load limit based on the 25 mg/L suspended-sediment target is also illustrated. We draw three main conclusions from these data:

- Loading exceeds the TMDL benchmark across a range of different streamflows. When the data is examined more carefully, these exceedances are associated with a rain-on-snow event that occurred on February 9, 2014;
- Instantaneous loading rates ranged between <0.01 and 35 tons per day in WY 2014, over the range of flows recorded;
- 0.8 percent of the WY 2014 data for Trout Creek exceeded the 25 mg/L benchmark, indicating that suspended-sediment loads in this stream were well within the 90$^{th}$ percentile in WY 2014.

## 7.4 Discussion of Suspended-sediment Loads from Different Years

McGraw and others (2001) and Amorfini and Holden (2008) reported estimated annual suspended-sediment loads and streamflow-sediment discharge relationships in 10 major tributaries of the Middle Truckee River. Their work includes data for Donner Creek and Trout Creek from WY 1997 (last major flood) and WY 2004 (average year), allowing for a comparison of sediment loading under current and historical conditions. These comparisons are provided for each stream in the sections below. For a full description of the conditions and analysis associated with the historical data, please refer to Amorfini and Holden (2008). Unfortunately, no historical data for Cold Creek exists for comparison.

### 7.4.1 Donner Creek: historical annual flow and suspended-sediment loads

Comparative current and historical annual flow statistics and suspended-sediment loads for Donner Creek in **Table 10** provide insight regarding sediment transport and suspended-sediment loads in the watershed over time.

From Table 10, annual runoff volume appears to be dependent on annual precipitation, as expected. However, annual suspended-sediment loads do *not* correlate well with total annual precipitation. Rather, differences in suspended-sediment loads between years may be attributed to characteristics of hydrologic events occurring in those years as noted above. For instance, WY 1997 was an average rainfall year, but included an extreme rain-on-snow event on January 3, 1997 that resulted in some of the largest peak flows on record for the Truckee region and a total runoff volume of 84,600 acre-feet and total suspended-sediment loads of 2,250 tons. In contrast, WY 2011 was a very wet year with the fourth largest snowpack on record. Although WY 2011 resulted in significantly more runoff (101,300 acre-feet) than WY 1997, total annual load in WY 2011 (804 tons) was less than half of the load in WY 1997 (2,250 tons). McGraw and others (2001) have noted many storm-triggered landslides in tributaries to the Middle Truckee River as a result of the 1997 event which may account for the magnitude in loads that year. Furthermore, in this four-year study, we have identified less suspended-sediment loading during periods of snowmelt runoff relative to a rain-on-snow event, which can also account for the differences in loads between these two years.

Historical and current sediment rating-curve data can also be compared to assess if there are potential shifts in the relationship between streamflow and sediment transport rates over time for a particular station. For instance, a shift to the right in the rating curve indicates reduced suspended-sediment loading at a given discharge due to a reduction in sediment sources in the watershed, perhaps associated with implementation of erosion- or sediment-control BMPs. **Figure 23** presents historical (WY 1996, WY 1997, and WY 2000) and current (WY 2011, WY 2012, WY 2013, and WY 2014) suspended-sediment load data for Donner Creek at Highway 89.

Overall, recent sediment loading rates at this station plot within the same range of flows as historical loading rates. We are detecting temporal trends that may explain the high variability of loads at a given streamflow. For example, we are finding that Donner Creek exhibits higher loading during rain-on-snow events (see **Figure 10**) as compared to the loads measured over the same flow range during snowmelt runoff. These trends may have a significant impact on suspended-sediment loading in the Middle Truckee River given the increased frequency of rain-on-snow events over the past several years. Separately, recent efforts under this study have sampled SSC and associated loading rates at higher streamflows than historical studies. The inclusion of these data points at the upper end of the rating curve indicates that a threshold exists at which the rate of loading increases more markedly above roughly 300 cfs at this station. This pattern has been observed in other streams where areas further from the channel become hydrologically connected over the duration of an event or storm and provide additional sources of sediment as flows increase. These patterns either did not exist before or were not recognized in earlier studies, but are important indicators of stormwater processes, with associated implications for stormwater management and interpretation of data in this watershed.

### 7.4.2 Trout Creek: Comparison with historical annual flow statistics and suspended-sediment loads

**Table 11** compares historical (WY 1997 and WY 2004) and recent (WY 2011 through WY 2014) annual flow statistics and suspended-sediment loads for Trout Creek. We note the challenge in comparing current and historical data for Trout Creek because historical sediment loads were computed using a synthetic record of flow in the absence of a streamflow station. Based on the results shown in Table 11, we conclude that:

- Total annual suspended-sediment loads for Trout Creek ranged widely, from a low of 6.8 tons (WY 2014) to a high of 61 tons (WY 1997) and reflects the differences between a dry year and a wet year, respectively;
- Suspended-sediment yields were greatest in WY 1997, but relatively similar to WY 2011. These data indicate that suspended-sediment loading in Trout Creek is higher during wet years when snowmelt runoff is the dominant peak flow event type, in contrast to WY 1997 when one very major rain-on-snow event occurred.

**Figure 22** presents historical and recent data for Trout Creek used for assessing potential sediment-rating curve shifts. The WY 2011 through WY 2014 data shows considerable scatter but was found to be associated with event type, whereas higher loads are measured during rain on bare ground events and rain on snow events. Historical data may not have been evaluated based on event type and therefore, it's difficult to evaluate if trends in loading have degraded or remained the same.

# 8. COMPARSION OF WY 2014 TRIBUTARY LOADS WITH THE MIDDLE TRUCKEE RIVER AT THREE STATIONS

Because Donner Creek, Cold Creek, and Trout Creek were identified as important tributaries to the Middle Truckee River and evaluated for their loading contributions, we find it helpful to put these tributaries in context of the larger system. Since January 2013 (WY 2013), Balance has been monitoring near-continuous turbidity for the Town of Truckee on the Middle Truckee River at two USGS streamflow gaging stations: 1) Truckee River near Truckee or upstream of Donner, Cold, and Trout Creeks, and 2) Truckee River at Boca Bridge or downstream of the same tributaries in this study.[13] WY 2014 was the first full water year data were collected at these stations. In addition, Lahontan Regional Water Quality Control Board collects near-continuous turbidity for the Truckee River at Farad, where the TMDL benchmark is established. These three monitoring locations are identified on **Figures 1 and 2**. Below we provide annual loads and yields and provide context for loads measured in this study relative to the larger Middle Truckee River Basin. In depth analysis and results from the Truckee River study can be found in CDM Smith and Balance Hydrologics, 2014.

## 8.1 Suspended-Sediment Loads in the Middle Truckee River

**Table 12** provides a summary of annual flow statistics and suspended-sediment loads tributaries evaluated for the Middle Truckee River at three stations in WY 2014. **Figure 25** illustrates these loads relative to the total load as measured on the Middle Truckee River at Boca Bridge in WY 2013 and WY 2014, when data were available for all locations. We note that loads are computed using a record of near-continuous turbidity for every station with the exception of Donner Creek (both Highway 89 and West River Street).

As listed in Table 12, we measured a total annual load of 457 tons in the Middle Truckee River upstream of the confluence with Donner Creek in WY 2014. Given that the Middle Truckee River is regulated at Lake Tahoe, we suspect this load originates from tributaries between Lake Tahoe and Donner Creek and possible in-channel sources along this reach. Tributaries include: Bear Creek, Squaw Creek, Deer Creek, Silver Creek, Pole Creek, Deep Creek, Cabin Creek, and several unnamed smaller tributaries. While these tributaries are many, we identified almost 300 additional tons of suspended-sediment were discharged to the Middle Truckee River from Donner Creek alone. This load increased the total load in the Middle Truckee River to 742 tons in WY 2014. When normalized by watershed area, we continue to see almost

[13] Work is carried out under a subcontract through CDM-Smith.

twice the yield from Donner Creek (19 tons/square mile) relative to upstream tributaries (10 tons/square mile).

Further downstream at Boca Bridge, we measured a total annual load of 1,625 tons in WY 2014, which more than doubled in the Middle Truckee River over 10 river miles. In between, we identify the following tributaries: Trout Creek, Prosser Creek, Martis Creek, Union Creek, and Little Truckee River. With the exception of Trout Creek, all of these tributaries are regulated by dams. Trout Creek contributes a very small proportion (6.8 tons) of this load in WY 2014. If we assume the dams on the other regulated tributaries act as sediment traps, we suspect sources of suspended-sediment may originate from in-channel sources such as bank failures, gully erosion, and bed scour and/or urban outfalls through the town of Truckee.

**Figure 25** illustrates the proportions of the loads measured on the Middle Truckee River at Boca Bridge in both WY 2013 and WY 2014. From this pie-chart, we see that contributions from tributaries can change from year to year and likely determined by occurrence and frequency of event types (i.e., rain-on-snow events) as we discussed earlier in this report. Furthermore, we identified that while Donner Creek contributed between 18 and 26 percent of the total loads measured at Boca Bridge, a larger proportion of the total load may originate from sources upstream of the Town of Truckee, areas within the Town of Truckee Corridor as well as regulated reaches. For instance, in WY 2013, 42 percent of the total load at Boca Bridge originated from tributaries upstream from Donner Creek. In WY 2014, 54 percent of the total load at Boca Bridge originated from ungaged areas through the Town of Truckee corridor and the regulated reaches. This pie-chart illustrates that while Donner Creek is a measurable component of suspended-sediment loads, additional study may be needed to identify other sources along the Middle Truckee River.

Finally, we note that while the contributing watershed area nearly doubles between Boca Bridge and at Farad, suspended-sediment loads for the Middle Truckee River at Farad in WY 2014 increased only 25 percent (2,169 tons). Tributaries between these stations include Gray Creek and Bronco Creek. We also note that the geology and climate also change significantly as the river flows further east. For instance, much of this reach is bedrock controlled and downstream of areas affected by glaciation. Furthermore, watershed areas contributing to this reach are further east of the Sierra Crest and can be subject to drier conditions, less rainfall and snowpack.

# 9. BIOASSESSMENT RESULTS IN CONTEXT OF SEDIMENT MONITORING

A monitoring program directed by Dr. David Herbst of U.C. Santa Barbara – Sierra Nevada Aquatic Research Laboratory evaluated fine sediment deposition and resulting impairment to macroinvertebrates within the Middle Truckee River (Herbst, 2011 and 2013). The results of these studies strongly supported that beneficial uses are impaired in the Truckee River. We summarize below the key results from the bioassessment studies.

In 2010, Herbst (2011) conducted a “reference-test” study comparing several sites along the Truckee River to similar eastern Sierra streams with less watershed disturbance (Carson River, Walker River, and Markleeville Creek) using the Eastern Sierra Index of Biological Integrity (IBI). IBI is a scientific tool used to identify and classify water pollution problems, in this case, using biosurveys. Compared to similar reference streams, the Middle Truckee River consistently scored lower on the Eastern Sierra IBI. All sampling sites on the Middle Truckee River scored below the “not supporting of beneficial uses” or “partially supporting” thresholds. Reference streams scored as “supporting” or “partially supporting”.

Based upon work conducted in 2010, the TRWC worked with Balance and Dr. Herbst and completed additional monitoring in 2011 to more specifically examine the relationship between sediment deposition and biological communities and co-locating surveys with on-going bed conditions monitoring (Donaldson and Shaw, 2012). A “patch-scale” study (Herbst, 2013) was completed to examine the relationship between deposited fine- sediment and biological condition of the benthic community. There were significant differences in biological conditions where fine-sediment deposition exceeded 20 percent. At 80 percent or greater sediment coverage there were very significant decreases in biological condition. Biological condition was defined by the decrease in the quantity and quality of food resources, meaning that both the number and size of benthic macroinvertebrates decreased with increasing sediment coverage. Separately, the benthic macroinvertebrate community shifted towards organisms tolerant of pollution or more tolerant of poor water quality.

These studies indicate that beneficial uses including “Cold Freshwater Habitat” and “Spawning Reproduction and Development” are likely to not be fully supported in the Middle Truckee River due to impacts on the base of the food web and excess deposited fine sediment. These results are in direct contrast to the TMDL threshold and may imply that suspended-sediment concentration may not be an effective monitoring component by itself or the Middle Truckee River TMDL standards for impairment may require further review and revision.

# 10. LIMITATIONS

This report was prepared in general accordance with the accepted standard of practice existing in Northern California at the time the investigations were performed. No other warranty is made or implied.

Funding for this project has been provided in full or in part through an agreement with the California Department of Water Resources (DWR). The contents of this document do not necessarily reflect the views and policies of the SWRCB, nor does mention of trade names of commercial products constitute endorsement or recommendations for use.

Readers are asked to contact Balance Hydrologics if they have additional relevant information, or wish to propose revisions or modified descriptions of conditions, such that the best data can be applied at the earliest possible date.

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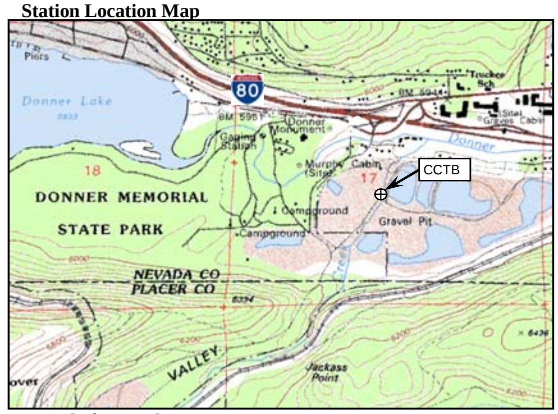
# FORMS

| | |
|---|---|
| **Water Year:** | **2014** |
| **Stream:** | Cold Creek |
| **Station:** | at Teichert Bridge (CCTB) |
| **County:** | Nevada County, California |

# Form 1. Annual Hydrologic Record, WY 2014

## Station Location Map




## Station Location / Watershed Descriptors

Location: 39º 19' 13.1"N, 120º 13' 36.7"W (WGS84), in Truckee, California. Gage is located approximately 1,500 feet upstream from the confluence with Donner Creek.
Land use includes former quarrying, timber harvesting, open space, Union Pacific RR, Caltrans road maintenance area and rural residential; Flows are unregulated; no diversions are known to occur upstream,
Drainage area is 12.6 square miles.

## Mean Annual Flow

Mean annual flow for WY 2014 is 12 cfs, WY 2013 is 21 cfs; for WY 2012 is 21 cfs; for WY 2011 is 60 cfs.

## Peak Flows (WY 2014)

| Date | Time (24-hr) | Gage Ht. (feet) | Discharge (cfs) | Date | Time (24-hr) | Gage Ht. (feet) | Discharge (cfs) |
|---|---|---|---|---|---|---|---|
| 1/30/14 | 1:15 | 2.72 | 73 | | | | |
| **2/9/14** | **20:00** | **3.82** | **196** | | | | |
| 3/6/14 | 8:00 | 3.41 | 142 | | | | |
| 4/17/14 | 21:15 | 3.07 | 94 | | | | |

Extreme for period of record (WY2011-2013) is 1,004 cfs on December 2, 2012

## Period of Record

Staff plate, turbidity probe, and water level recorder were installed on October 8, 2010.
Gaging is sponsored by the Truckee River Watershed Council

## WY 2014 Daily Mean Flow (cubic feet per second)

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.4 | 0.6 | 1.0 | 1.3 | 3.6 | 21.7 | 21.8 | 41.6 | 19.6 | 2.0 | 0.4 | 0.3 |
| 2 | 0.4 | 0.6 | 1.0 | 1.3 | 3.4 | 21.5 | 20.4 | 48.2 | 18.9 | 1.8 | 0.3 | 0.3 |
| 3 | 0.4 | 0.6 | 1.0 | 1.3 | 3.6 | 27.3 | 20.1 | 50.5 | 18.3 | 1.7 | 0.4 | 0.3 |
| 4 | 0.4 | 0.6 | 1.0 | 1.4 | 3.5 | 29.8 | 20.0 | 49.3 | 17.2 | 1.6 | 0.6 | 0.2 |
| 5 | 0.4 | 0.6 | 1.0 | 1.3 | 3.3 | 33.2 | 19.8 | 45.1 | 17.3 | 1.4 | 0.7 | 0.3 |
| 6 | 0.4 | 0.6 | 0.9 | 1.3 | 3.3 | 86.1 | 22.3 | 38.3 | 17.1 | 1.3 | 0.6 | 0.3 |
| 7 | 0.4 | 0.5 | 1.1 | 1.4 | 3.4 | 50.6 | 27.3 | 32.2 | 16.0 | 1.2 | 1.2 | 0.3 |
| 8 | 0.4 | 0.5 | 1.1 | 1.4 | 13.4 | 40.9 | 34.8 | 32.8 | 15.0 | 1.1 | 2.8 | 0.3 |
| 9 | 0.4 | 0.6 | 1.1 | 1.5 | 132.2 | 38.3 | 46.1 | 57.4 | 13.5 | 1.0 | 0.8 | 0.2 |
| 10 | 0.5 | 0.5 | 1.1 | 1.5 | 97.8 | 41.1 | 48.6 | 44.6 | 12.0 | 0.9 | 0.7 | 0.3 |
| 11 | 0.4 | 0.6 | 1.2 | 1.8 | 42.9 | 36.6 | 48.2 | 36.0 | 10.6 | 0.8 | 0.7 | 0.2 |
| 12 | 0.5 | 0.6 | 1.1 | 1.7 | 28.0 | 32.1 | 52.7 | 34.4 | 9.3 | 0.8 | 0.6 | 0.2 |
| 13 | 0.4 | 0.6 | 1.2 | 1.6 | 27.7 | 29.7 | 49.7 | 36.3 | 8.1 | 0.7 | 0.5 | 0.2 |
| 14 | 0.5 | 0.6 | 1.2 | 1.5 | 42.5 | 28.2 | 43.6 | 40.7 | 7.1 | 0.7 | 0.5 | 0.2 |
| 15 | 0.5 | 0.6 | 1.2 | 1.5 | 32.8 | 27.7 | 49.1 | 49.6 | 6.3 | 0.6 | 0.5 | 0.2 |
| 16 | 0.5 | 0.6 | 1.2 | 1.5 | 28.9 | 28.5 | 51.9 | 50.4 | 5.7 | 0.6 | 0.5 | 0.2 |
| 17 | 0.5 | 0.6 | 1.2 | 1.5 | 24.9 | 30.4 | 62.7 | 43.9 | 5.2 | 1.0 | 0.5 | 0.2 |
| 18 | 0.5 | 0.7 | 1.2 | 1.5 | 22.0 | 27.9 | 66.4 | 39.4 | 4.9 | 0.8 | 0.4 | 0.3 |
| 19 | 0.6 | 0.7 | 1 | 1.6 | 20.0 | 25.6 | 64.4 | 34.2 | 4.4 | 0.6 | 0.4 | 0.4 |
| 20 | 0.5 | 1.0 | 1.1 | 1.5 | 18.5 | 25.3 | 55.4 | 30.9 | 3.9 | 0.6 | 0.4 | 0.3 |
| 21 | 0.5 | 1.0 | 1.2 | 1.5 | 17.3 | 25.4 | 51.4 | 27.7 | 3.6 | 0.7 | 0.4 | 0.3 |
| 22 | 0.5 | 0.8 | 1.3 | 1.5 | 16.6 | 24.9 | 46.1 | 30.4 | 3.3 | 0.6 | 0.4 | 0.4 |
| 23 | 0.5 | 0.8 | 1.3 | 1.5 | 16.1 | 24.4 | 36.8 | 32.3 | 3.1 | 0.5 | 0.4 | 0.3 |
| 24 | 0.5 | 0.8 | 1.3 | 1.7 | 15.7 | 24.9 | 35.3 | 36.4 | 2.9 | 0.5 | 0.3 | 0.3 |
| 25 | 0.4 | 0.8 | 1.3 | 1.6 | 15.7 | 25.6 | 39.0 | 40.3 | 2.7 | 0.4 | 0.3 | 0.3 |
| 26 | 0.4 | 0.9 | 1.3 | 1.6 | 16.2 | 24.9 | 32.3 | 38.3 | 2.7 | 0.4 | 0.4 | 0.4 |
| 27 | 0.4 | 0.9 | 1.3 | 1.6 | 25.0 | 22.8 | 29.6 | 34.3 | 2.6 | 0.4 | 0.4 | 0.9 |
| 28 | 0.7 | 0.9 | 1.3 | 1.7 | 21.8 | 21.2 | 29.4 | 28.3 | 2.4 | 0.4 | 0.3 | 0.6 |
| 29 | 0.6 | 1.0 | 1.3 | 9.5 | | 26.3 | 33.3 | 23.8 | 2.2 | 0.4 | 0.3 | 0.5 |
| 30 | 0.6 | 1.0 | 1.3 | 23.0 | | 26.0 | 37.3 | 21.9 | 2.1 | 0.5 | 0.3 | 0.4 |
| 31 | 0.6 | | 1.4 | 5.0 | | 23.4 | | 20.7 | | 0.6 | 0.3 | |
| MEAN | 0.5 | 0.7 | 1.2 | 2.6 | 25.0 | 30.7 | 39.9 | 38 | 9 | 1 | 0.6 | 0.3 |
| MAX. DAY | 1 | 1.0 | 1 | 23.0 | 132.2 | 86.1 | 66 | 57 | 20 | 2 | 2.8 | 0.9 |
| MIN. DAY | 0.4 | 0.5 | 0.9 | 1.3 | 3.3 | 21.2 | 19.8 | 20.7 | 2.1 | 0.4 | 0.3 | 0.2 |
| cfs days | 15 | 21 | 36 | 80 | 700 | 952 | 1196 | 1171 | 258 | 27 | 17 | 10 |
| ac-ft | 29 | 42 | 72 | 158 | 1389 | 1889 | 2372 | 2322 | 512 | 53 | 34 | 19 |

## Monitor's Comments

1. Daily mean values are based on 15-minute measurements of stage; several stage shifts have been applied to account for changes in sedimentation (scour and fill) over the course of the monitoring program.
2. Data are subject to revision, should additional measurement or observer account warrant adjustment of the new rating curve.
3. Real-time provisional data available at www.balancehydro.com/truckee/cold/index/php

| Water Year 2014 Totals: | | |
|---|---|---|
| **Mean flow** | **12** | (cfs) |
| **Max. daily flow** | **132** | (cfs) |
| **Min. daily flow** | **0.21** | (cfs) |
| **Annual total** | **4,483** | (cfs-days) |
| **Annual total** | **8,892** | (ac-ft) |

**Balance Hydrologics, Inc. PO Box 1077, Truckee, CA 96161 phone: (530) 550-9776, Berkeley (Main Office) (510) 704-1000**
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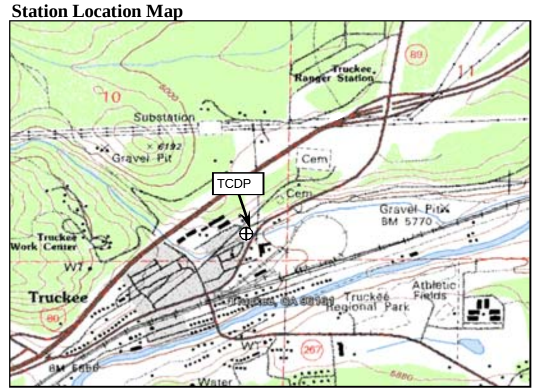
| | |
|---|---|
| **Water Year:** | **2014** |
| **Stream:** | Trout Creek |
| **Station:** | Donner Pass Road (TCDP) |
| **County:** | Nevada County, California |

# Form 2. Annual Hydrologic Record, Partial WY 2014

### Station Location Map




### Station Location / Watershed Descriptors

Location: 39° 19' 50" N, 120° 10' 55" W (WGS84), near Truckee, California. Gage is located along the north bank of the channel, approximately 150 feet upstream of Donner Pass Road bridge
Land uses includes urban, residential, former quarrying, Interstate Highway 80, and open space.
Flows are unregulated; no diversions are known to occurr upstream.
Drainage area is 4.6 square miles.

### Mean Annual Flow

Mean daily flow for partial WY 2014 is 1.6 cfs, WY 2013 is 2.2 cfs, WY 2012 is 2.5 cfs; partial WY 2011 is 14.8 cfs.

### Peak Flows (Partial WY 2014)

| Date | Time (24-hr) | Gage Ht. (feet) | Discharge (cfs) | Date | Time (24-hr) | Gage Ht. (feet) | Discharge (cfs) |
|---|---|---|---|---|---|---|---|
| 1/30/14 | 0:00 | 4.11 | 10.7 | 3/6/14 | 8:30 | 4.12 | 13.3 |
| 2/1/14 | 8:15 | 3.94 | 6.0 | 3/10/14 | 16:15 | 3.96 | 7.1 |
| **2/9/14** | **8:45** | **4.81** | **39.6** | 3/29/14 | 15:45 | 3.96 | 7.2 |
| 2/13/14 | 20:45 | 4.05 | 9.4 | 4/6/14 | 19:45 | 3.91 | 5.89 |

Extreme for period of record (partial WY2011-WY2014) is 80.9 cfs on December 2, 2012

### Period of Record

Staff plate, turbidity sensor and water level recorder were installed on January 21, 2011. Gaging is sponsored by the Truckee River Watershed Council, Prop 50 funding (California State Water Resources Control Board).

### Partial WY 2014 Daily Mean Flow (cubic feet per second)

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.41 | 0.66 | *0.6* | 0.53 | 3.19 | 3.40 | 3.41 | 1.55 | 0.45 | 0.18 | | |
| 2 | 0.41 | 0.62 | *0.6* | 0.53 | 1.63 | 3.38 | 3.29 | 1.42 | 0.44 | | | |
| 3 | 0.42 | 0.62 | *0.7* | 0.55 | 1.04 | 3.96 | 3.55 | 1.31 | 0.42 | | | |
| 4 | 0.43 | 0.56 | *0.6* | 0.55 | 0.96 | 4.81 | 3.88 | 1.23 | 0.41 | | | |
| 5 | 0.43 | 0.61 | *0.9* | 0.52 | 0.82 | 4.04 | 3.99 | 1.22 | 0.36 | | | |
| 6 | 0.44 | 0.57 | *0.9* | 0.56 | 0.68 | 8.72 | 4.41 | 1.50 | 0.34 | | | |
| 7 | 0.40 | 0.55 | *0.6* | 0.59 | 0.72 | 5.30 | 4.40 | 1.36 | 0.34 | | | |
| 8 | 0.40 | 0.55 | *0.4* | 0.56 | 3.56 | 4.13 | 4.55 | 1.23 | 0.29 | | | |
| 9 | 0.50 | 0.56 | *0.4* | 0.58 | 30.90 | 3.76 | 4.60 | 1.53 | 0.27 | | | |
| 10 | 0.50 | 0.55 | *0.5* | 0.64 | 19.97 | 5.01 | 4.16 | 1.32 | 0.24 | | | |
| 11 | 0.48 | 0.56 | *0.5* | 0.84 | 8.87 | 3.99 | 3.78 | 1.41 | 0.23 | | | |
| 12 | 0.46 | 0.55 | *0.5* | 1.12 | 5.96 | 3.33 | 3.46 | 1.19 | 0.23 | | | |
| 13 | 0.50 | 0.54 | *0.5* | 0.78 | 6.24 | 3.03 | 3.14 | 1.02 | 0.24 | | | |
| 14 | 0.50 | 0.53 | *0.5* | 0.71 | 7.14 | 2.84 | 2.88 | 0.92 | 0.27 | | | |
| 15 | 0.48 | 0.56 | *0.5* | 0.69 | 5.25 | 2.67 | 2.66 | 0.85 | 0.29 | | | |
| 16 | 0.49 | 0.56 | *0.5* | 0.66 | 5.41 | 2.51 | 2.47 | 0.78 | 0.26 | | | |
| 17 | 0.49 | *0.5* | *0.5* | 0.63 | 4.16 | 2.39 | 2.19 | 0.74 | 0.29 | | | |
| 18 | 0.47 | *0.5* | *0.5* | 0.65 | 3.45 | 2.27 | 1.96 | 0.74 | 0.30 | | | |
| 19 | 0.47 | *0.6* | *0.5* | 0.64 | 3.09 | 2.13 | 1.84 | 0.75 | 0.25 | | | |
| 20 | 0.46 | *0.9* | *0.5* | 0.62 | 2.74 | 2.03 | 1.70 | 1.16 | 0.21 | | | |
| 21 | 0.46 | *0.8* | *0.5* | 0.60 | 2.52 | 1.95 | 1.60 | 1.19 | 0.19 | | | |
| 22 | 0.45 | *0.6* | *0.5* | 0.58 | 2.35 | 1.86 | 1.88 | 0.94 | 0.19 | | | |
| 23 | 0.46 | *0.6* | *0.5* | 0.61 | 2.18 | 1.76 | 1.71 | 0.78 | 0.18 | | | |
| 24 | 0.45 | *0.6* | *0.5* | 0.63 | 2.04 | 1.67 | 1.50 | 0.70 | 0.16 | | | |
| 25 | 0.44 | *0.5* | *0.5* | 0.64 | 1.95 | 1.65 | 2.37 | 0.62 | 0.16 | | | |
| 26 | 0.44 | *0.6* | *0.5* | 0.62 | 1.98 | 2.23 | 2.87 | 0.64 | 0.22 | | | |
| 27 | 0.45 | *0.6* | *0.5* | 0.63 | 3.85 | 2.52 | 2.91 | 0.57 | 0.25 | | | |
| 28 | 0.65 | *0.6* | *0.5* | 0.67 | 3.31 | 2.46 | 2.39 | 0.52 | 0.23 | | | |
| 29 | 0.55 | *0.6* | *0.5* | 3.03 | | 4.49 | 2.03 | 0.59 | 0.11 | | | |
| 30 | 0.63 | *0.6* | *0.4* | 3.71 | | 4.25 | 1.75 | 0.50 | 0.09 | | | |
| 31 | 0.70 | | 0.52 | 1.78 | | 3.68 | | 0.44 | | | | |
| MEAN | 0.5 | 0.6 | 0.5 | 0.9 | 4.9 | 3.3 | 2.9 | 1.0 | 0.3 | | | |
| MAX. DAY | 0.7 | 0.9 | 0.9 | 3.7 | 30.9 | 8.7 | 4.6 | 1.5 | 0.5 | | | |
| MIN. DAY | 0.4 | 0.5 | 0.4 | 0.5 | 0.7 | 1.7 | 1.5 | 0.4 | 0.1 | | | |
| cfs days | 15 | 18 | 17 | 26 | 136 | 102 | 87 | 31 | 8 | | | |
| ac-ft | 29 | 35 | 33 | 52 | 270 | 203 | 173 | 61 | 16 | | | |

### Monitor's Comments

1. Daily mean values are based on 15-minute measurements of stage, several stage shifts have been applied to account for scour and fill.
2. This station can be affected by ice; the period 11/17/13 through 12/30/13 was estimated using correlation to streamflow at Sagehen Creek (USGS 10343500) and are represented in italics.
3. Mean daily values are based on 15-minute measurements of stage; several stage shifts have been applied to account for ice and changes in sedimentation at the gage over the course of the monitoring program.
4. Data are subject to revision, should additional measurement or observer account warrant adjustment
5. This station was removed on July 1, 2014 to facilitate construction/restoration of Trout Creek

| Water Year (partial) 2014 Totals: | | |
|---|---|---|
| **Mean flow** | **1.6** | (cfs) |
| **Max. daily flow** | **30.9** | (cfs) |
| **Min. daily flow** | **0.20** | (cfs) |
| **Annual total** | **440** | (cfs-days) |
| **Annual total** | **872** | (ac-ft) |

**Balance Hydrologics, Inc. PO Box 1077, Truckee, CA 96161 phone: (530) 550-9776, Berkeley (Main Office) (510) 704-1000**
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**Water Year:** 2014
**Stream:** Cold Creek
**Station:** at Teichert Bridge (CCTB)
**County:** Nevada County

# Form 3. Annual Suspended-Sediment Load Record WY 2014

### WY 2014 Daily Suspended-Sediment Load *(tons)*
### Streamflow-based sediment rating-curve method

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.11 | 0.11 | 0.26 | 0.10 | 0.01 | 0.00 | 0.00 | |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.11 | 0.10 | 0.31 | 0.09 | 0.00 | 0.00 | 0.00 | |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.15 | 0.10 | 0.33 | 0.09 | 0.00 | 0.00 | 0.00 | |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.17 | 0.10 | 0.32 | 0.08 | 0.00 | 0.00 | 0.00 | |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.19 | 0.10 | 0.29 | 0.08 | 0.00 | 0.00 | 0.00 | |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 1.37 | 0.12 | 0.23 | 0.08 | 0.00 | 0.00 | 0.00 | |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.33 | 0.15 | 0.19 | 0.08 | 0.00 | 0.00 | 0.00 | |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.25 | 0.21 | 0.19 | 0.07 | 0.00 | 18.85 | 0.00 | |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 10.64 | 0.23 | 0.30 | 0.39 | 0.06 | 0.00 | 0.10 | 0.00 | |
| 10 | 0.00 | 0.00 | 0.00 | 0.00 | 2.07 | 0.26 | 0.32 | 0.29 | 0.05 | 0.00 | 0.00 | 0.00 | |
| 11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.22 | 0.31 | 0.22 | 0.04 | 0.00 | 0.00 | 0.00 | |
| 12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.19 | 0.35 | 0.20 | 0.04 | 0.00 | 0.00 | 0.00 | |
| 13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.17 | 0.33 | 0.22 | 0.03 | 0.00 | 0.00 | 0.00 | |
| 14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.16 | 0.28 | 0.25 | 0.03 | 0.00 | 0.00 | 0.00 | |
| 15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.15 | 0.32 | 0.33 | 0.02 | 0.00 | 0.00 | 0.00 | |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.16 | 0.35 | 0.33 | 0.02 | 0.00 | 0.00 | 0.00 | |
| 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.17 | 0.55 | 0.28 | 0.02 | 0.00 | 0.00 | 0.00 | |
| 18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.16 | 0.52 | 0.24 | 0.02 | 0.00 | 0.00 | 0.00 | |
| 19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.14 | 0.49 | 0.20 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.14 | 0.37 | 0.18 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.14 | 0.34 | 0.15 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.13 | 0.30 | 0.18 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.13 | 0.22 | 0.19 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.13 | 0.21 | 0.22 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.14 | 0.24 | 0.25 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.13 | 0.2 | 0.23 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.12 | 0.17 | 0.20 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.11 | 0.17 | 0.16 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 29 | 0.00 | 0.00 | 0.00 | 0.28 | | 0.15 | 0.20 | 0.13 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 30 | 0.00 | 0.00 | 0.00 | 0.74 | | 0.14 | 0.23 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | **Qss** |
| 31 | 0.00 | | 0.00 | 0.02 | | 0.12 | | 0.11 | | 0.00 | 0.00 | | **Annual** |
| TOTAL | 0.0 | 0.0 | 0.1 | 1 | 15.4 | 6 | 8 | 7 | 1 | 0.1 | 19.0 | 0.0 | **58** |
| Max.day | 0.0 | 0.0 | 0.0 | 1 | 10.6 | 1.4 | 1 | 0 | 0.1 | 0.0 | 18.9 | 0.0 | **19** |

### WY 2014 Daily Suspended-Sediment Load *(tons)*
### Continuous record of turbidity

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.07 | 0.13 | 0.26 | 0.10 | 0.01 | 0.00 | 0.00 | |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.07 | 0.06 | 0.35 | 0.11 | 0.01 | 0.00 | 0.00 | |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.10 | 0.07 | 0.37 | 0.12 | 0.01 | 0.00 | 0.00 | |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.12 | 0.07 | 0.31 | 0.09 | 0.01 | 0.00 | 0.00 | |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.15 | 0.07 | 0.37 | 0.09 | 0.01 | 0.00 | 0.00 | |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 3.36 | 0.08 | 0.21 | 0.09 | 0.01 | 0.00 | 0.00 | |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.29 | 0.12 | 0.14 | 0.09 | 0.01 | 1.07 | 0.00 | |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.18 | 0.21 | 0.14 | 0.08 | 0.01 | 12.52 | 0.00 | |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 12.35 | 0.16 | 0.35 | 0.45 | 0.08 | 0.01 | 0.10 | 0.00 | |
| 10 | 0.00 | 0.00 | 0.00 | 0.01 | 3.46 | 0.17 | 0.31 | 0.23 | 0.07 | 0.00 | 0.02 | 0.00 | |
| 11 | 0.00 | 0.00 | 0.00 | 0.01 | 0.41 | 0.14 | 0.30 | 0.16 | 0.06 | 0.01 | 0.01 | 0.00 | |
| 12 | 0.00 | 0.00 | 0.00 | 0.01 | 0.16 | 0.12 | 0.37 | 0.16 | 0.06 | 0.00 | 0.01 | 0.00 | |
| 13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.11 | 0.28 | 0.20 | 0.04 | 0.01 | 0.01 | 0.00 | |
| 14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.10 | 0.21 | 0.21 | 0.03 | 0.01 | 0.01 | 0.00 | |
| 15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.10 | 0.28 | 0.27 | 0.03 | 0.00 | 0.01 | 0.00 | |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.10 | 0.32 | 0.31 | 0.04 | 0.00 | 0.01 | 0.00 | |
| 17 | 0.00 | 0.00 | 0.00 | 0.01 | 0.10 | 0.11 | 1.04 | 0.31 | 0.03 | 0.03 | 0.01 | 0.00 | |
| 18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.10 | 0.73 | 0.33 | 0.03 | 0.02 | 0.01 | 0.00 | |
| 19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.09 | 0.60 | 0.29 | 0.02 | 0.00 | 0.01 | 0.00 | |
| 20 | 0.00 | 0.01 | 0.00 | 0.00 | 0.06 | 0.09 | 0.38 | 0.31 | 0.02 | 0.01 | 0.00 | 0.00 | |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.10 | 0.32 | 0.26 | 0.02 | 0.00 | 0.00 | 0.00 | |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.10 | 0.26 | 0.19 | 0.02 | 0.00 | 0.00 | 0.00 | |
| 23 | 0.00 | 0.00 | 0.01 | 0.00 | 0.05 | 0.10 | 0.22 | 0.21 | 0.02 | 0.00 | 0.00 | 0.00 | |
| 24 | 0.00 | 0.00 | 0.01 | 0.01 | 0.05 | 0.11 | 0.20 | 0.29 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 25 | 0.00 | 0.00 | 0.01 | 0.01 | 0.05 | 0.10 | 0.17 | 0.41 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 26 | 0.00 | 0.00 | 0.00 | 0.01 | 0.06 | 0.09 | 0.13 | 0.36 | 0.01 | 0.00 | 0.00 | 0.00 | |
| 27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.09 | 0.13 | 0.28 | 0.01 | 0.00 | 0.00 | 0.01 | |
| 28 | 0.00 | 0.00 | 0.00 | 0.01 | 0.07 | 0.09 | 0.13 | 0.18 | 0.01 | 0.00 | 0.00 | 0.01 | |
| 29 | 0.00 | 0.00 | 0.00 | 1.39 | | 0.20 | 0.16 | 0.12 | 0.01 | 0.00 | 0.00 | 0.01 | |
| 30 | 0.00 | 0.01 | 0.00 | 2.18 | | 0.10 | 0.18 | 0.11 | 0.01 | 0.00 | 0.00 | 0.00 | **Qss** |
| 31 | 0.00 | | 0.00 | 0.08 | | 0.17 | | 0.12 | | 0.00 | 0.00 | | **Annual** |
| TOTAL | 0 | 0.1 | 0.1 | 4 | 18.4 | 7 | 8 | 8 | 1 | 0.2 | 13.8 | 0.1 | **61** |
| Max.day | 0.0 | 0.0 | 0.0 | 2 | 12.4 | 3 | 1 | 0 | 0 | 0.0 | 12.5 | 0.0 | **13** |

Daily values are based on calculations of suspended-sediment load at 15-minute intervals.
Streamflow-based suspended-sediment load computation uses a correlation between streamflow and suspended-sediment concentration and is based on a provisional streamflow record
Turbidity-based suspended-sediment load computation uses a correlation between instantaneous turbidity (NTU) and suspended-sediment concentration (mg/L) and is converted to tons/day

**Balance Hydrologics, Inc. PO Box 1077, Truckee, CA 96161, (530) 550-9776, Berkeley, CA (main office) (510) 704-1000**

**Water Year:** 2014

**Stream:** Donner Creek
**Station:** at Highway 89 (DC89, USGS 10338700)
**County:** Nevada County

# Form 4. Annual Suspended-Sediment Load Record WY 2014

## WY 2014 Daily Suspended-Sediment Load *(tons)*
## Streamflow-based suspended-sediment Rating Curve Method

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.44 | 0.03 | 0.02 | 0.02 | 0.06 | 0.22 | 0.58 | 0.47 | 0.22 | 0.03 | 0.02 | 0.02 | |
| 2 | 0.43 | 0.02 | 0.02 | 0.02 | 0.06 | 0.22 | 0.56 | 0.56 | 0.22 | 0.03 | 0.02 | 0.03 | |
| 3 | 0.43 | 0.02 | 0.02 | 0.02 | 0.06 | 0.28 | 0.55 | 0.58 | 0.23 | 0.03 | 0.02 | 0.03 | |
| 4 | 0.42 | 0.02 | 0.02 | 0.02 | 0.05 | 0.30 | 0.55 | 0.58 | 0.21 | 0.03 | 0.02 | 0.04 | |
| 5 | 0.38 | 0.03 | 0.02 | 0.02 | 0.05 | 0.33 | 0.57 | 0.53 | 0.21 | 0.03 | 0.02 | 0.17 | |
| 6 | 0.32 | 0.03 | 0.03 | 0.02 | 0.05 | 4.73 | 0.60 | 0.44 | 0.20 | 0.03 | 0.02 | 0.39 | |
| 7 | 0.26 | 0.03 | 0.03 | 0.02 | 0.05 | 0.57 | 0.61 | 0.36 | 0.19 | 0.03 | 0.03 | 0.38 | |
| 8 | 0.23 | 0.03 | 0.03 | 0.02 | 2.55 | 0.44 | 0.49 | 0.36 | 0.18 | 0.03 | 14.19 | 0.36 | |
| 9 | 0.20 | 0.03 | 0.04 | 0.02 | 26.70 | 0.41 | 0.53 | 0.66 | 0.16 | 0.03 | 7.07 | 0.35 | |
| 10 | 0.18 | 0.03 | 0.03 | 0.02 | 18.95 | 0.45 | 0.78 | 0.62 | 0.14 | 0.02 | 0.03 | 0.45 | |
| 11 | 0.15 | 0.02 | 0.02 | 0.02 | 8.87 | 0.39 | 1.40 | 0.73 | 0.12 | 0.02 | 0.04 | 0.57 | |
| 12 | 0.13 | 0.02 | 0.02 | 0.02 | 1.77 | 0.33 | 3.44 | 0.71 | 0.10 | 0.02 | 0.04 | 0.56 | |
| 13 | 0.11 | 0.02 | 0.02 | 0.02 | 1.65 | 0.30 | 3.56 | 0.73 | 0.09 | 0.02 | 0.04 | 0.55 | |
| 14 | 0.10 | 0.02 | 0.02 | 0.02 | 2.24 | 0.28 | 3.18 | 0.82 | 0.07 | 0.02 | 0.04 | 0.55 | |
| 15 | 0.09 | 0.02 | 0.02 | 0.02 | 1.67 | 0.27 | 2.33 | 1.01 | 0.06 | 0.02 | 0.04 | 0.51 | |
| 16 | 0.08 | 0.02 | 0.02 | 0.02 | 1.44 | 0.28 | 1.16 | 1.05 | 0.06 | 0.02 | 0.04 | 0.52 | |
| 17 | 0.07 | 0.02 | 0.02 | 0.02 | 1.11 | 0.31 | 0.91 | 0.90 | 0.06 | 0.03 | 0.04 | 0.53 | |
| 18 | 0.07 | 0.02 | 0.02 | 0.02 | 0.88 | 0.29 | 0.95 | 0.82 | 0.05 | 0.02 | 0.04 | 0.50 | |
| 19 | 0.06 | 0.02 | 0.02 | 0.02 | 0.76 | 0.26 | 0.90 | 0.64 | 0.05 | 0.02 | 0.03 | 0.48 | |
| 20 | 0.06 | 0.03 | 0.02 | 0.02 | 0.70 | 0.25 | 0.71 | 0.46 | 0.04 | 0.02 | 0.03 | 0.46 | |
| 21 | 0.05 | 0.03 | 0.02 | 0.02 | 0.64 | 0.25 | 0.65 | 0.39 | 0.04 | 0.02 | 0.03 | 0.45 | |
| 22 | 0.05 | 0.02 | 0.02 | 0.02 | 0.58 | 0.26 | 0.58 | 0.42 | 0.04 | 0.02 | 0.03 | 0.44 | |
| 23 | 0.05 | 0.02 | 0.02 | 0.02 | 0.54 | 0.25 | 0.45 | 0.53 | 0.03 | 0.02 | 0.03 | 0.38 | |
| 24 | 0.04 | 0.02 | 0.02 | 0.02 | 0.49 | 0.24 | 0.42 | 0.68 | 0.03 | 0.02 | 0.02 | 0.34 | |
| 25 | 0.04 | 0.02 | 0.02 | 0.02 | 0.46 | 0.25 | 0.49 | 0.74 | 0.03 | 0.02 | 0.03 | 0.33 | |
| 26 | 0.04 | 0.02 | 0.02 | 0.02 | 0.45 | 0.24 | 0 | 0.72 | 0.03 | 0.02 | 0.03 | 0.34 | |
| 27 | 0.04 | 0.02 | 0.02 | 0.02 | 0.50 | 0.22 | 0.3 | 0.66 | 0.04 | 0.02 | 0.03 | 0.34 | |
| 28 | 0.05 | 0.02 | 0.02 | 0.02 | 0.25 | 0.20 | 0.34 | 0.57 | 0.04 | 0.02 | 0.03 | 0.33 | |
| 29 | 0.04 | 0.02 | 0.02 | 0.70 | | 0.43 | 0.37 | 0.39 | 0.03 | 0.02 | 0.03 | 0.32 | |
| 30 | 0.04 | 0.02 | 0.02 | 0.80 | | 0.67 | 0.42 | 0.27 | 0.03 | 0.02 | 0.02 | 0.32 | **Qss** |
| 31 | 0.04 | | 0.02 | 0.07 | | 0.60 | | 0.25 | | 0.02 | 0.03 | | **Annual** |
| TOTAL | 4.7 | 0.7 | 0.7 | 2.1 | 73.6 | 14.5 | 29 | 18.6 | 3.0 | 0.8 | 22.1 | 11.1 | **181** |
| Max.day | 0.4 | 0.0 | 0.0 | 0.8 | 26.7 | 4.7 | 4 | 1.0 | 0.2 | 0.0 | 14.2 | 0.6 | **27** |

## WY 2014 Daily Suspended-Sediment Load *(tons)*
## Continuous Record of Turbidity

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | |
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| 30 | | | | | | | | | | | | | **Qss** |
| 31 | | | | | | | | | | | | | **Annual** |
| TOTAL | | | | | | | | | | | | | |
| Max.day | | | | | | | | | | | | | |

A continuous record of turbidity is not available for this gaging station

Daily values are based on calculations of streamflow at 15-minute intervals as reported by the USGS for station 10338700; streamflow values are provisional and subject to change (USGS)
Sediment loads calculated using the standard rating curve method is based on provisional streamflow data and suspended sediment samples collected between WY 2011 - WY 2013; preliminary and subject to revision

**Balance Hydrologics, Inc. PO Box 1077, Truckee, CA 96161 phone: (530) 550-9776, Berkeley (Main Office) (510) 704-1000**
www.balancehydro.com

**Water Year:** 2014
**Stream:** Donner Creek
**Station:** at West River Street (DCWR)
**County:** Nevada County

# Form 5. Annual Suspended-Sediment Load Record WY 2014

## WY 2014 Daily Suspended-Sediment Load *(tons)*
## Streamflow-based suspended-sediment Rating Curve Method

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | Qss Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.43 | 0.04 | 0.02 | 0.02 | 0.07 | 0.22 | 0.56 | 0.46 | 0.22 | 0.04 | 0.02 | 0.03 | |
| 2 | 0.42 | 0.02 | 0.02 | 0.02 | 0.06 | 0.22 | 0.54 | 0.54 | 0.22 | 0.03 | 0.02 | 0.03 | |
| 3 | 0.42 | 0.02 | 0.02 | 0.02 | 0.06 | 0.28 | 0.53 | 0.56 | 0.23 | 0.03 | 0.02 | 0.03 | |
| 4 | 0.42 | 0.02 | 0.03 | 0.02 | 0.06 | 0.30 | 0.54 | 0.56 | 0.22 | 0.03 | 0.03 | 0.04 | |
| 5 | 0.38 | 0.04 | 0.02 | 0.02 | 0.06 | 0.33 | 0.55 | 0.51 | 0.22 | 0.03 | 0.03 | 0.18 | |
| 6 | 0.32 | 0.04 | 0.03 | 0.02 | 0.06 | 11.95 | 0.57 | 0.43 | 0.21 | 0.03 | 0.02 | 0.39 | |
| 7 | 0.27 | 0.03 | 0.03 | 0.02 | 0.06 | 0.55 | 0.58 | 0.36 | 0.20 | 0.03 | 0.03 | 0.38 | |
| 8 | 0.23 | 0.03 | 0.03 | 0.02 | 6.35 | 0.43 | 0.48 | 0.36 | 0.19 | 0.03 | 17.64 | 0.36 | |
| 9 | 0.21 | 0.03 | 0.05 | 0.02 | 92.68 | 0.40 | 0.51 | 0.64 | 0.17 | 0.03 | 9.43 | 0.35 | |
| 10 | 0.18 | 0.03 | 0.04 | 0.02 | 50.22 | 0.44 | 0.70 | 0.56 | 0.15 | 0.03 | 0.12 | 0.43 | |
| 11 | 0.16 | 0.03 | 0.03 | 0.03 | 2.38 | 0.38 | 1.18 | 0.68 | 0.12 | 0.03 | 0.04 | 0.55 | |
| 12 | 0.14 | 0.03 | 0.03 | 0.03 | 1.50 | 0.33 | 3.08 | 0.65 | 0.10 | 0.03 | 0.04 | 0.54 | |
| 13 | 0.12 | 0.03 | 0.03 | 0.03 | 1.39 | 0.31 | 3.20 | 0.66 | 0.09 | 0.03 | 0.04 | 0.54 | |
| 14 | 0.11 | 0.03 | 0.03 | 0.02 | 1.93 | 0.29 | 2.82 | 0.72 | 0.08 | 0.03 | 0.04 | 0.53 | |
| 15 | 0.10 | 0.03 | 0.03 | 0.02 | 1.41 | 0.28 | 2.02 | 0.85 | 0.07 | 0.03 | 0.04 | 0.50 | |
| 16 | 0.08 | 0.03 | 0.02 | 0.03 | 1.19 | 0.29 | 1.00 | 0.86 | 0.07 | 0.03 | 0.04 | 0.50 | |
| 17 | 0.07 | 0.02 | 0.02 | 0.02 | 0.90 | 0.31 | 0.82 | 0.73 | 0.06 | 0.04 | 0.04 | 0.51 | |
| 18 | 0.07 | 0.02 | 0.02 | 0.02 | 0.70 | 0.29 | 0.81 | 0.70 | 0.06 | 0.03 | 0.04 | 0.49 | |
| 19 | 0.07 | 0.03 | 0.02 | 0.02 | 0.69 | 0.27 | 0.77 | 0.58 | 0.05 | 0.03 | 0.04 | 0.47 | |
| 20 | 0.06 | 0.03 | 0.02 | 0.02 | 0.67 | 0.26 | 0.66 | 0.45 | 0.05 | 0.03 | 0.04 | 0.45 | |
| 21 | 0.06 | 0.03 | 0.02 | 0.02 | 0.61 | 0.26 | 0.6 | 0.38 | 0.04 | 0.03 | 0.03 | 0.44 | |
| 22 | 0.06 | 0.03 | 0.02 | 0.02 | 0.56 | 0.27 | 0.6 | 0.41 | 0.04 | 0.03 | 0.03 | 0.43 | |
| 23 | 0.05 | 0.03 | 0.02 | 0.02 | 0.52 | 0.25 | 0.44 | 0.52 | 0.04 | 0.03 | 0.03 | 0.38 | |
| 24 | 0.05 | 0.02 | 0.02 | 0.02 | 0.48 | 0.25 | 0.41 | 0.64 | 0.04 | 0.03 | 0.03 | 0.34 | |
| 25 | 0.05 | 0.02 | 0.02 | 0.02 | 0.45 | 0.25 | 0.5 | 0.67 | 0.03 | 0.03 | 0.03 | 0.33 | |
| 26 | 0.04 | 0.02 | 0.02 | 0.02 | 0.44 | 0.24 | 0 | 0.65 | 0.04 | 0.03 | 0.04 | 0.34 | |
| 27 | 0.04 | 0.02 | 0.02 | 0.02 | 0.48 | 0.22 | 0 | 0.63 | 0.04 | 0.03 | 0.04 | 0.34 | |
| 28 | 0.05 | 0.02 | 0.02 | 0.02 | 0.26 | 0.20 | 0.3 | 0.55 | 0.04 | 0.02 | 0.03 | 0.33 | |
| 29 | 0.05 | 0.02 | 0.02 | 1.33 | | 0.42 | 0.37 | 0.38 | 0.04 | 0.02 | 0.03 | 0.32 | |
| 30 | 0.05 | 0.02 | 0.02 | 1.56 | | 0.64 | 0.41 | 0.27 | 0.04 | 0.03 | 0.03 | 0.32 | |
| 31 | 0.05 | | 0.02 | 0.08 | | 0.58 | | 0.25 | | 0.03 | 0.03 | | |
| TOTAL | 4.8 | 0.8 | 0.8 | 3.6 | 166.2 | 21.7 | 26 | 17 | 3.2 | 0.9 | 28.1 | 10.9 | **285** |
| Max.day | 0.4 | 0.0 | 0.1 | 1.6 | 92.7 | 11.9 | 3 | 0.9 | 0.2 | 0.0 | 17.6 | 0.6 | **93** |

## WY 2014 Daily Suspended-Sediment Load *(tons)*
## Continuous Record of Turbidity

A continuous record of turbidity is not available for this gaging station

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | Qss Annual |
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| TOTAL | | | | | | | | | | | | | |
| Max.day | | | | | | | | | | | | | |

Daily values are based on calculations of streamflow at 15-minute intervals as reported by the USGS for station 10338700; streamflow values are provisional and subject to change (USGS)
Sediment loads are calculated using the standard rating curve method is based on provisional streamflow data and suspended-sediment samples collected in WY 2012; preliminary and subject to revision

**Balance Hydrologics, Inc. PO Box 1077, Truckee, CA 96161 phone: (530) 550-9776, Berkeley (Main Office) (510) 704-1000**
www.balancehydro.com

**Water Year:** 2014
**Stream:** Trout Creek
**Station:** Donner Pass Road (TCDP)
**County:** Nevada County

# Form 6. Annual Suspended-Sediment Load Record, WY 2014

## WY 2014 Daily Suspended-Sediment Load *(tons)*
### Streamflow-based suspended-sediment rating curve method

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | Qss Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.03 | 0.01 | 0.00 | 0.00 | | | |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.02 | 0.01 | 0.00 | | | | |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.03 | 0.01 | 0.00 | | | | |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.03 | 0.01 | 0.00 | | | | |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.01 | 0.00 | | | | |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.60 | 0.04 | 0.01 | 0.00 | | | | |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.04 | 0.01 | 0.00 | | | | |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.34 | 0.03 | 0.04 | 0.01 | 0.00 | | | | |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 3.42 | 0.03 | 0.04 | 0.01 | 0.00 | | | | |
| 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.04 | 0.03 | 0.01 | 0.00 | | | | |
| 11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.03 | 0.03 | 0.01 | 0.00 | | | | |
| 12 | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.02 | 0.03 | 0.01 | 0.00 | | | | |
| 13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.02 | 0.02 | 0.01 | 0.00 | | | | |
| 14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.02 | 0.02 | 0.00 | 0.00 | | | | |
| 15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.02 | 0.02 | 0.00 | 0.00 | | | | |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.02 | 0.02 | 0.00 | 0.00 | | | | |
| 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.01 | 0.00 | 0.00 | | | | |
| 18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.01 | 0.01 | 0.00 | 0.00 | | | | |
| 19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | | | | |
| 20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 | | | | |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 | | | | |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | | | | |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | | | | |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | | | | |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.00 | 0.00 | | | | |
| 26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.00 | 0.00 | | | | |
| 27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.02 | 0.00 | 0.00 | | | | |
| 28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 | 0.00 | 0.00 | | | | |
| 29 | 0.00 | 0.00 | 0.00 | 0.26 | | 0.14 | 0.01 | 0.00 | 0.00 | | | | |
| 30 | 0.00 | 0.00 | 0.00 | 0.23 | | 0.03 | 0.01 | 0.00 | 0.00 | | | | |
| 31 | 0.00 | | 0.00 | 0.01 | | 0.03 | | 0.00 | | | | | |
| TOTAL | 0.1 | 0.1 | 0.1 | 0.6 | 4.7 | 1.4 | 0.6 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | **7.7** |
| Max.day | 0.0 | 0.0 | 0.0 | 0.3 | 3.4 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **3.4** |

## WY 2014 Daily Suspended-Sediment Load *(tons)*
### Continuous record of turbidity

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | Qss Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.06 | 0.02 | 0.01 | 0.00 | | | | |
| 2 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.04 | 0.04 | 0.01 | 0.00 | | | | |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.07 | 0.03 | 0.01 | 0.00 | | | | |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.07 | 0.04 | 0.01 | 0.00 | | | | |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.03 | 0.01 | 0.00 | | | | |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.22 | 0.04 | 0.01 | 0.00 | | | | |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.06 | 0.04 | 0.01 | 0.00 | | | | |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.42 | 0.04 | 0.04 | 0.01 | 0.00 | | | | |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 1.64 | 0.02 | 0.04 | 0.02 | 0.00 | | | | |
| 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.56 | 0.10 | 0.03 | 0.01 | 0.00 | | | | |
| 11 | 0.00 | 0.00 | 0.01 | 0.04 | 0.16 | 0.08 | 0.03 | 0.01 | 0.00 | | | | |
| 12 | 0.00 | 0.00 | 0.00 | 0.02 | 0.09 | 0.03 | 0.03 | 0.01 | 0.00 | | | | |
| 13 | 0.00 | 0.00 | 0.00 | 0.01 | 0.15 | 0.01 | 0.04 | 0.01 | 0.00 | | | | |
| 14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.01 | 0.02 | 0.01 | 0.00 | | | | |
| 15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.01 | 0.03 | 0.01 | 0.00 | | | | |
| 16 | 0.01 | 0.00 | 0.00 | 0.00 | 0.07 | 0.01 | 0.03 | 0.01 | 0.00 | | | | |
| 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.01 | 0.02 | 0.01 | 0.00 | | | | |
| 18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.02 | 0.00 | 0.00 | | | | |
| 19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.01 | 0.02 | 0.00 | 0.00 | | | | |
| 20 | 0.00 | 0.01 | 0.00 | 0.00 | 0.02 | 0.01 | 0.01 | 0.02 | 0.00 | | | | |
| 21 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.01 | 0.00 | | | | |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | | | | |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | | | | |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | | | | |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.05 | 0.01 | 0.00 | | | | |
| 26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.03 | 0.01 | 0.00 | | | | |
| 27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.02 | 0.02 | 0.00 | 0.00 | | | | |
| 28 | 0.02 | 0.00 | 0.00 | 0.00 | 0.04 | 0.02 | 0.02 | 0.00 | 0.00 | | | | |
| 29 | 0.03 | 0.00 | 0.00 | 0.18 | | 0.07 | 0.02 | 0.00 | 0.00 | | | | |
| 30 | 0.03 | 0.00 | 0.00 | 0.11 | | 0.02 | 0.01 | 0.00 | 0.00 | | | | |
| 31 | 0.00 | | 0.00 | 0.02 | | 0.02 | | 0.00 | | | | | |
| TOTAL | 0.2 | 0.1 | 0.1 | 0.4 | 3.7 | 1.1 | 0.8 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | **6.8** |
| Max.day | 0.0 | 0.0 | 0.0 | 0.2 | 1.6 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **1.6** |

Daily values are based on calculations of sediment loads at 15-minute intervals.
Sediment loads are calculated using the standard rating curve method is based on a record of flow; as measured by Balance Hydrologics (station TCDP); data are preliminary and subject to revision
Sediment loads are calculated using a continuous record of turbidity is based on correlation between instantaneous turbidity (NTU) and suspended-sediment concentration (mg/L) and converted to tons/day
This station was removed on July 1, 2014 to facilitate construction/restoration of Trout Creek

**Balance Hydrologics, Inc. PO Box 1077, Truckee, CA 96160, (530) 550-9776, Berkeley, CA (main office) (510) 704-1000**
www.balancehydro.com

# TABLES

## Table 1. Station Observer Log: Cold Creek at Teichert Bridge (CCTB), water year 2014

| *Site Conditions* | | | | *Streamflow* | | | *Water Quality Observations* | | | | | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time (observer time) | Observer | Stage | Hydrograph | Measured Discharge | Instrument Used | Estimated Accuracy | Water Temperature | Field Specific Conductance | Adjusted Specific Conductance | Turbidity | Additional sampling? | |
| | | *(feet)* | *(R/F/S/B)* | *(cfs)* | *(AA/PY)* | *(e/g/f/p)* | *(oC)* | *(μmhos/cm)* | *(at 25 oC)* | *(NTU)* | *(Qbed, etc.)* | |
| 11/8/2013 12:15 | cs | 0.54 | B | 0.47 | PY | g,f | -- | -- | -- | -- | -- | Sunny, warm, water clear, turbidity probe cleaned at 12:00 |
| 1/29/2014 13:15 | cs | 0.84 | R | -- | -- | -- | -2.20 | 36 | 72 | 3.1 | Qss | Moderate rain, largest storm event in months, water mostly clear, runoff expected to increase, snow levels are about 8,000 ft. |
| 1/29/2014 16:15 | cs | 1.18 | R | -- | -- | -- | -- | -- | -- | 11.5 | Qss (2) | Heavy rain, water turbid, snow levels at 7,000, collected two Qss samples: 16:15 + 16:16 |
| 2/8/2014 12:30 | cs | 1.18 | R | -- | -- | -- | -- | -- | -- | 0.9 | Qss | Heavy rain, snow levels 6,500 and rising, rain on snow event, water currently clear, turbidity probe cleaned |
| 2/8/2014 16:45 | cs, ds | 1.58 | R | 14.8 | PY | g | -- | -- | -- | 3.7 | Qss | Heavy rain, some ice in flow, lots of organic debris, snow level 7,000 |
| 2/9/2014 15:45 | cs, ds | 3.65 | U | 154 | AA | g | -- | -- | -- | 21.3 | Qss | Steady rain |
| 2/10/2014 15:15 | cs | 2.80 | F | 75.7 | AA | g | -- | -- | -- | 5.7 | Qss | Sunny, post-storm observations, falling limb, water mostly clear |
| 3/6/2014 9:30 | bkh | 3.20 | F | | | | -- | -- | -- | | Qss | Peak occurred at sunrise, rain-on-snow event; falling limb, slightly turbid |
| 4/8/2014 16:15 | cs | 1.97 | R | 30.0 | PY | g | -- | -- | -- | 2.2 | Qss | Sunny, water clear, snowmelt pattern started |
| 4/16/2014 19:30 | ds, pk | 2.68 | R | 61.0 | AA | g | 4.2 | 27 | 45 | 1.1 | Qss | Water mostly clear, diurnal peaks, some snow remaining along Sierra crest, removed wood at staff (shift?) |
| 4/18/2014 7:30 | cs | 2.69 | F | 63.4 | PY | g | -- | -- | -- | 1.9 | Qss | Sunny, peak snowmelt likely few days earlier, water mostly clear |
| 8/4/2014 15:45 | bkh | 0.70 | R | -- | -- | -- | -- | -- | -- | -- | -- | Steady rain, water clear, homeless encampment under bridge at gaging station |
| 8/8/2014 10:15 | bkh | 0.86 | F | -- | -- | -- | 12.8 | 42 | 117 | 400 | Qss | Major t-storm over the upper watershed previous evening, major turbidity event as the result of debris flow, bank failures or landslide; DO=77%, pH=7.54 |
| 8/22/2014 15:00 | bkh | 0.50 | B | -- | -- | -- -- | -- | -- | -- | -- | -- | Extreme low flows; turbidity probe is above water; lowered into water column |

Observer Key: (ds) is David Shaw, (bkh) is Brian Hastings, (cs) is Collin Strasenburgh, (pk) is Peter Kulchawik
Streamflow gaging station operated by USGS; Flow values are provisional, as reported by the USGS for station 10338700
Stage: Water level observed at outside staff plate
Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), or baseflow (B)
Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductance
Turbidity: as measured using a desktop turbidity meter
Additional Sampling: Qss = Suspended sediment

## Table 2. Station Observer Log: Donner Creek at Highway 89 (DC89), USGS 10338700, water year 2014

| Site Conditions | | | Streamflow | | | Water Quality Observations | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time (observer time) | Observer | Hydrograph | USGS flow | Instrument Used | Data Approved? | Water Temperature | Field Specific Conductance | Adjusted Specific Conductance | Turbidity | Additional sampling? | |
| | | (R/F/S/B) | (cfs) | (AA/PY) | (A/P) | (oC) | (µmhos/cm) | (at 25 oC) | (NTU) | (Qbed, etc.) | |
| 1/29/2014 12:25 | CS | R | 4.8 | USGS | P | 3.6 | 92 | 154 | 0.9 | Qss | Moderate rain started at 11:00, high snow levels, first signficant event of WY14, Urban outfalls with moderate runoff, water mostly clear |
| 1/29/2014 14:15 | CS | R | 8.1 | USGS | P | -- | -- | -- | 12.2 | Qss | Moderate rain, water moderately turbid, very turbid waters from urban outfalls downstream |
| 1/29/2014 16:25 | CS | R | 12.0 | USGS | P | -- | -- | -- | 23.3 | Qss | Water turbid, coarse debris in flow, moderate-heavy rain |
| 2/8/2014 11:45 | CS | R | 19.0 | USGS | P | -- | -- | -- | 16.7 | Qss | Heavy rain since sunrise, rain on snow event; 2-4 inches predicted, urban outfalls flowing dirty; water is slightly turbid in channel |
| 2/8/2014 16:10 | DS, CS | R | 53.0 | USGS | P | -- | -- | -- | 70.8 | Qss | Steady rain continues, well connected runoff from streets |
| 2/9/2014 15:00 | DS, CS | | 267 | USGS | P | -- | -- | -- | 25.0 | Qss | Steady rain, possible sandbar moving through gage site; urban outfalls heavy flow, but less turbid |
| 2/10/2014 15:45 | CS | F | 166 | USGS | P | -- | -- | -- | 3.7 | Qss | Sunny, post storm (7 inches); roads dry, water mostly clear |
| 3/6/2014 7:45 | BKH | F | 138 | USGS | P | -- | -- | -- | 17.2 | Qss | Heavy rain overnight, moderately turbid flow, rain on snow event |
| 4/16/2014 19:45 | DS, PK | | 72.0 | USGS | P | 5.1 | 37 | 59 | 0.3 | Qss | Near peak snowmelt runoff; water mostly clear |
| 8/8/2014 10:30 | BKH | F | 7.3 | USGS | P | 15.8 | 82 | 100 | 650 | Qss | Major t-storm over Cold Stream Canyon; signficant turbidity plume in Cold-Donner Creeks; DO = 64%, 6.4 mg/L, pH 7.34, this event was isolated to this area and triggered multiple bank failures and gully erosion in the upper watershed. |

Observer Key: (ds) is David Shaw, (bkh) is Brian Hastings, (cs) is Collin Strasenburgh
Streamflow gaging station operated by USGS; Flow values are provisional, as reported by the USGS for station 1033870(
Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), or baseflow (B)
Data approval: USGS provides provisional (P) data on their real-time website but typically requires 6-12 months before data are reviewed, corrected if necessary and approved (A)
Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductanc
Turbidity: as measured using a desktop turbidimeter
Additional Sampling: Qss = Suspended sediment

**Table 3. Stream gaging observer log:**
**Donner Creek at West River Road (DCWR): water year 2014**

| *Site Conditions* | | | *Streamflow* | | | | *Water Quality Observations* | | | | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time (observer time) | Observer | Hydrograph | Streamflow | Instrument Used | Estimated Accuracy | USGS streamflow (10338700) | Water Temperature | Field Specific Conductance | Adjusted Specific Conductance | Additional sampling? | |
| | | *(R/F/S/B)* | *(cfs)* | *(AA/PY)* | *(e/g/f/p)* | *(cfs)* | *(oC)* | *(µmhos/cm)* | *(at 25 oC)* | *(Qss, Qbed)* | |
| 1/29/2014 12:30 | cs | R | -- | -- | -- | 4.8 | 2.8 | 87 | 151 | Qss | Moderate rain, water mostly clear; urban outfalls flowing turbid, noticeably turbid waters below 89 bridge; but clearing up at confluence |
| 1/29/2014 14:20 | cs | R | -- | -- | -- | 8.5 | -- | -- | -- | Qss | Increasing flow; water very turbid |
| 1/29/2014 16:30 | cs | R | -- | -- | -- | 12 | -- | -- | -- | Qss | Heavy rain, water very turbid, coarse debris in suspension; |
| 2/8/2014 11:50 | cs | R | -- | -- | -- | 20 | -- | -- | -- | Qss | Heavy rain, rain on snow; water turbid, rising stage |
| 2/8/2014 16:00 | ds, cs | R | -- | -- | -- | 51 | -- | -- | -- | Qss | Truckee River is more turbid than Donner Creek at this time |
| 2/9/2014 14:45 | ds, cs | R | -- | -- | -- | 247 | -- | -- | -- | Qss | Steady rain; high water, could not wade to center; moderately turbid |
| 2/10/2014 15:50 | cs | F | -- | -- | -- | 174 | -- | -- | -- | Qss | Post-rain conditions; all urban outfalls are now dry, water mostly clear |
| 3/6/2014 8:00 | bkh | F | -- | -- | -- | 138 | -- | -- | -- | Qss | Heavy rain overnight; cloudy, moderately turbid |
| 4/16/2014 20:15 | ds, pk | S | -- | -- | -- | 73 | 5.3 | 36 | 57 | Qss | Mostly clear, snowmelt peak runoff? |
| 8/8/2014 10:45 | bkh | F | -- | -- | -- | 7.3 | 17.8 | 85 | 100 | Qss | Major t-storm over Cold Stream Valley headwaters; turbidity very high; DO = 86%, 8.1 mg/L, pH 8.24 |

Observer Key: (ds) is David Shaw, (bkh) is Brian Hastings, (cs) is Collin Strasenburgh
Streamflow gaging station: Donner Creek at Highway 89, operated by USGS; Flow values are provisional, as reported by the USGS for station 10338700
Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), or baseflow (B)
Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductance
Turbidity: as measured using a desktop turbidimeter
Additional Sampling: Qss = Suspended sediment

**Table 4. Station observer log:**
**Trout Creek at Donner Pass Road (TCDP), water year 2014**

| Date/Time (observer time) | Observer | Stage | Hydrograph | Measured Discharge | Instrument Used | Estimated Accuracy | Water Temperature | Field Specific Conductance | Adjusted Specific Conductance | Turbidity | Additional sampling? | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Site Conditions* | | | | *Streamflow* | | | *Water Quality Observations* | | | | | *Remarks* |
| | | (feet) | (R/F/S/B) | (cfs) | (AA/PY) | (e/g/f/p) | (oC) | (µmhos/cm) | (at 25 oC) | (NTU) | (Qbed, etc.) | |
| 10/28/2013 16:45 | BKH | 3.52 | B | -- | -- | -- | -- | -- | -- | -- | -- | 6-8" of new snow overnight, water clear; removed garbage from gaging pool and riffle, no change to stage, cleaned probe |
| 11/8/2013 13:00 | CS | 3.50 | B | 0.5 | PY | G,F | -- | -- | -- | -- | -- | Sunny, 55 deg F, leaf dams present in channel, but not affecting stage; cleaned and raised probe. |
| 12/12/2013 12:30 | BKH | 3.50 | B | -- | -- | -- | -- | -- | -- | -- | -- | Creek frozen at gage; some flow under ice, very cold conditions last two weeks, recent snowfall |
| 1/27/2014 11:45 | BKH | 3.52 | B | -- | -- | -- | -- | -- | -- | -- | -- | Turbidity issues identified online; clean and raised probe, precip expected over weekend, riffle free of ice/snow. |
| 1/29/2014 12:45 | CS | 3.59 | R | -- | -- | -- | -2.5 | 81 | 162 | 17.0 | Qss | Water turbid, moderate rain, first significant storm in months, expected to continue thru day, rain on bare ground in town |
| 1/29/2014 14:30 | CS | 3.67 | R | -- | -- | -- | -- | -- | -- | 139.0 | Qss | Water very turbid, urban runoff visible; moderate rainfall, potential for icing at riffle crest (artificial stage jumps) |
| 1/29/2014 17:00 | CS | 3.88 | R? | -- | -- | -- | -- | -- | -- | 78.0 | Qss | Water turbid, moderate to heavy rain, snow levels falling |
| 1/30/2014 12:15 | BKH | 3.75 | F | 2.5 | PY | G | -0.1 | 83 | 156 | -- | -- | Temperatures near freezing, light snow, removed slush/ice from gage at 12:00, water mostly clear |
| 2/8/2014 12:00 | CS | 3.67 | R | -- | -- | -- | -- | -- | -- | 77.0 | Qss (2) | Sensors free of ice, collected two samples @12:00 turbidity varied 77-82 NTU |
| 2/8/2014 15:30 | DS, CS | 3.75 | F | 2.8 | PY | G | -- | -- | -- | 203.0 | Qss (2) | Steady rain; water is very turbid, water flowing over ice in channel, collected 2 turbidity samples, 2nd sample @ 15:50, 138 NTU |
| 2/9/2014 14:00 | DS, CS | 4.71 | S | 36.9 | AA | F | -- | -- | -- | 11.0 | Qss | Light rain; clearing after event, no ice at gage, heavy downpour during flow measurement, ice dam break after sampling, resulted in turbidity spike, stage fluctuated as result of ice dam. |
| 2/10/2014 16:15 | CS | 4.34 | F | 20.1 | AA | G | -- | -- | -- | 14.0 | Qss | Sunny, warm, ice dam upstream of gage, water mostly clear, no snow on ground |
| 3/6/2014 8:30 | BKH | 4.12 | F | 13.3 | PY | G | 2.0 | 74 | 132 | 6.3 | Qss | Heavy rain overnight; high snow levels, water slight turbid; different colored sand in channel--Caltrans using different sand on roads. |
| 3/29/2014 13:35 | BKH | 3.86 | U | -- | -- | -- | -- | -- | -- | 3.9 | Qss | |
| 4/8/2014 17:45 | CS | 3.83 | S | 4.3 | PY | G | -- | -- | -- | 1.1 | Qss | Sunny, warm, water clear, 4/6/14 may have been peak snowmelt for Trout Creek, willow starting to bud |
| 4/18/2014 8:15 | CS | 3.70 | F | 2.0 | PY | G,F | -- | -- | -- | 1.5 | Qss | Water clear, abundant brown algae growing on sensors, cleaned probe |
| 7/1/2014 8:15 | BKH | 3.43 | B | -- | -- | -- | -- | -- | -- | -- | -- | Removed gage to facilitate channel restoration/construction |

Observer Key: (ds) is David Shaw, (cs) is Collin Strasenburgh, (bkh) is Brian Hastin
Stage: Water level observed at outside staff plate
Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), or baseflow (E
Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. If estimated, from rating curve (R) or visual (
Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy giv
Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conducta
Turbidity: as measured using a desktop turbidimete
Additional Sampling: Qss = Suspended sedimen

**Table 5. Suspended-sediment concentration and calculated loading rates: Cold Creek at Teichert Bridge (CCTB), water years 2011-2014**

| | *Site Conditions* | | | | | | *Suspended Sediment* | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sample Date:Time** | **Observer(s)** | **Gage Height** | **Streamflow Discharge** | **Streamflow Value Source** | **Stream Condition** | **Event Type** | **Suspended-Sediment Concentration** | **15-minute Turbidity** | **Suspended-Sediment Transport Rate** |
| | | *(ft)* | *(cfs)* | *M,R,E* | *R,F,B,U,S* | | *(mg/l)* | *(NTU)* | *(tons/day)* |
| ***WY2011*** | | | | | | | | | |
| 10/24/10 10:52 | ds | 2.86 | 88 | R | R | rain | 52.00 | 26.03 | 12.33 |
| 10/24/10 11:50 | ds | 3.16 | 112 | R | R | rain | 95.33 | 37.74 | 28.78 |
| 10/24/10 12:19 | ds | 3.25 | 119 | R | R | rain | 98.00 | 43.54 | 31.43 |
| 10/24/2010 15:45 | ds | 4.55 | 260 | R | R | rain | 247.1 | 104.8 | 173.1 |
| 10/24/2010 16:15 | ds | 4.68 | 292 | R | R | rain | 235.3 | 112.3 | 185.2 |
| 10/25/10 8:35 | ds | 2.37 | 58 | R | F | rain | 11.14 | 16.42 | 1.74 |
| 10/26/10 9:10 | ds | 1.74 | 19.9 | R | F | rain | 2.40 | 10.50 | 0.13 |
| 11/7/10 11:27 | ds | 1.41 | 8.30 | R | R | | 1.71 | 0.70 | 0.04 |
| 12/9/10 14:30 | ds | 2.09 | 35.7 | R | R | | 4.00 | *1.25* | 0.38 |
| 12/14/2010 10:15 | ds | 2.43 | 55.2 | R | R | | 3.80 | 3.78 | 0.57 |
| 12/14/2010 11:00 | ds | 2.47 | 56.4 | R | R | | 3.00 | 3.77 | 0.46 |
| 1/28/11 15:10 | ds, cs | 1.84 | 21.0 | M | B | | 1.00 | 0.60 | 0.06 |
| 2/23/11 12:45 | ds, cs | 1.75 | 17.5 | R | B | | 1.71 | 1.05 | 0.08 |
| 3/10/11 14:05 | cs | 1.84 | 14.3 | R | B | | 1.20 | 0.86 | 0.05 |
| 3/15/11 10:25 | ds, bkh | 2.09 | 35.0 | R | R | | 4.00 | 1.58 | 0.38 |
| 4/6/11 12:55 | cs, bkh | 2.76 | 76.0 | M | B | | 3.20 | 1.60 | 0.66 |
| 4/18/11 10:45 | ds | 3.65 | 147 | E | F | | 13.60 | 6.39 | 5.39 |
| 5/5/11 13:00 | cs, bkh | 3.45 | 130 | M | R | snowmelt | 2.60 | 2.39 | 0.91 |
| 5/27/11 13:15 | cs | 3.26 | 110 | M | F | rain | 1.80 | 1.18 | 0.53 |
| 6/6/11 12:45 | cs, bkh | 3.88 | 176 | M | F | rain | 4.40 | 2.76 | 2.09 |
| 6/14/11 12:05 | cs, bkh | 4.55 | 254 | M | F | snowmelt | 17.6 | 5.14 | 12.0 |
| 6/16/11 20:25 | cs | 4.90 | 300 | M | R | snowmelt | 16.0 | 6.78 | 12.9 |
| 6/23/11 15:00 | cs, bkh | 5 | 287 | M | R | snowmelt | 40.8 | 7.93 | 31.6 |
| 7/15/11 11:55 | ds | 2.9 | 87.4 | M | B | snowmelt | 2.6 | 3.75 | 0.61 |
| 8/5/11 11:30 | bkh | 1.82 | 24.0 | M | B | thunderstorm | 0.82 | 1.33 | 0.05 |
| 9/20/11 16:45 | bkh | 0.78 | 2.0 | M | B | rain | 1.2 | 1.0 | 0.01 |
| ***WY2012*** | | | | | | | | | |
| 10/18/11 16:45 | bkh | 0.93 | 3.2 | M | B | | 1.00 | 0.90 | 0.01 |
| 11/16/11 12:00 | cs | 0.85 | 2.2 | M | B | baseflow | 0.80 | 0.64 | 0.005 |
| 12/13/11 15:30 | cs | 0.83 | 3.1 | M | B | | 1.20 | 0.72 | 0.01 |
| 1/20/12 22:18 | cs | 3.00 | 105 | R | R | rain on snow | 125 | 40 | 35 |
| 1/27/12 14:45 | cs | 1.65 | 15 | M | B | | 2.8 | 1.14 | 0.11 |
| 3/13/12 17:45 | cs, bkh | 1.23 | 6.8 | M | U | rain | 1.2 | 0.72 | 0.02 |
| 3/15/12 13:00 | cs | 1.96 | 25.0 | M | R | rain | 7.5 | 4.13 | 0.51 |
| 3/16/12 11:30 | bkh, ds | 3.05 | 89 | M | U | rain | 9.50 | 5.57 | 2.28 |
| 4/23/12 14:56 | cs, bkh | 3.70 | 169 | M | R | rain | 12.4 | 10.8 | 5.6 |
| 4/23/12 19:05 | cs, bkh | 4.45 | 258 | M | R | rain | 88 | 50 | 61 |
| 4/26/12 9:25 | bkh | 5.60 | 530 | R | R | rain | 182 | 100 | 260 |
| 4/26/12 11:50 | cs, bkh | 5.50 | 510 | R | R | rain | 113 | 63 | 155 |
| 4/26/12 15:45 | cs, ds | 5.1 | 384 | R | F | rain | 51 | 37.1 | 52.8 |
| 5/4/12 16:30 | cs | 3.18 | 103.0 | M | R | rain | 4.4 | 5.5 | 1.22 |
| 6/4/12 16:50 | bkh | 3.2 | 107.0 | R | U | | 27 | 21.88 | 7.79 |
| 8/15/12 17:15 | cs | 0.53 | 0.74 | M | B | | 0.60 | 1.28 | 0.001 |
| 8/15/12 17:16 | cs | 0.53 | 0.74 | M | B | | 0.60 | 1.28 | 0.001 |

## Table 5. Suspended-sediment concentration and calculated loading rates: Cold Creek at Teichert Bridge (CCTB), water years 2011-2014

| | *Site Conditions* | | | | | | *Suspended Sediment* | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sample Date:Time** | **Observer(s)** | **Gage Height** | **Streamflow Discharge** | **Streamflow Value Source** | **Stream Condition** | **Event Type** | **Suspended-Sediment Concentration** | **15-minute Turbidity** | **Suspended-Sediment Transport Rate** |
| ***WY2013*** | | | | | | | | | |
| 11/17/2012 9:30 | CS | 0.79 | 1.9 | M | R | rain | 1.20 | 1.19 | 0.01 |
| 11/17/2012 13:47 | CS | 1.35 | 9.37 | M | R | rain | 22.00 | 8.48 | 0.6 |
| 11/30/2012 11:00 | CS, BKH | 4.50 | 270 | R | R | rain | 191.0 | 102.0 | 138.9 |
| 11/30/2012 11:02 | CS, BKH | 4.50 | 270 | R | R | rain | 189.2 | 102.0 | 137.7 |
| 12/2/2012 8:00 | CS, DS | 6.10 | 559 | R | R | rain on snow | 345.0 | 149.7 | 519.8 |
| 12/2/2012 15:16 | CS, BKH | 5.20 | 393 | R | F | rain on snow | 143.0 | 133.3 | 151.3 |
| 12/5/2012 14:30 | BKH, DS | 4.35 | 242 | M | F | rain on snow | 30.4 | 24.3 | 19.8 |
| 3/12/2013 15:45 | CS | 1.61 | 17.2 | M | B | snowmelt | 1.60 | 0.92 | 0.1 |
| 3/14/2013 18:15 | BKH | 2.00 | 29 | R | B | | 4.80 | 2.15 | 0.4 |
| 3/20/2013 14:00 | CS | 2.36 | 46 | M | U | rain | 4.00 | 2.50 | 0.5 |
| 4/29/2013 12:15 | CS | 2.70 | 70 | M | U | snowmelt | 3.20 | 2.65 | 0.6 |
| 5/10/2013 16:15 | CS | 2.85 | 79.7 | R | U | snowmelt | 5.20 | 4.17 | 1.12 |
| 5/12/2013 18:30 | CS | 3.20 | 106.3 | M | R | snowmelt | 16.80 | 5.45 | 4.81 |
| 6/25/2013 13:00 | CS | 2.02 | 31.0 | M | R | rain | 6.00 | 4.50 | 0.50 |
| 7/24/2013 17:30 | CS | 0.60 | 1.1 | M | B | baseflow | 1.20 | 1.27 | 0.003 |
| 7/24/2013 17:31 | CS | 0.60 | 1.1 | M | B | baseflow | 1.20 | 1.27 | 0.003 |
| ***WY2014*** | | | | | | | | | |
| 1/29/2014 13:15 | CS | 0.84 | 2.0 | R | R | rain on snow | 3.33 | 1.37 | 0.018 |
| 1/29/2014 16:15 | CS | 1.18 | 5.2 | R | R | rain on snow | 6.00 | 5.24 | 0.084 |
| 1/29/2014 16:16 | CS | 1.18 | 5.2 | R | R | rain on snow | 6.25 | 5.24 | 0.088 |
| 2/8/2014 12:30 | CS | 1.18 | 5.9 | R | R | rain on snow | 2.00 | 1.53 | 0.032 |
| 2/8/2014 16:30 | CS, DS | 1.57 | 14.2 | M | R | rain on snow | 3.33 | 2.87 | 0.127 |
| 2/9/2014 15:15 | CS, DS | 3.65 | 162.0 | R | F | rain on snow | 28.00 | 23.50 | 12.226 |
| 2/10/2014 15:00 | CS | 2.80 | 76.5 | M | F | rain on snow | 8.00 | 8.00 | 1.650 |
| 3/6/2014 9:30 | BKH | 3.20 | 130.3 | R | F | rain | 14.50 | 14.50 | 5.092 |
| 4/8/2014 16:35 | CS | 1.97 | 30.5 | M | R | snowmelt | 1.60 | 1.20 | 0.132 |
| 4/16/2014 19:10 | DS, PK | 2.67 | 59.0 | R | R | snowmelt | 2.80 | 2.00 | 0.445 |
| 4/18/2014 7:45 | CS | 2.68 | 61.7 | M | F | snowmelt | 2.00 | 2.30 | 0.333 |
| 8/8/14 10:15 | BKH | 0.86 | 2.2 | R | F | thunderstorm | 415 | 386.00 | 2.5 |

Notes

Observer Key: ds = Dave Shaw, bkh = Brian Hastings, cs = Collin Strasenburgh

Streamflow is the measured or 15-minute recorded flow when sediment was sampled, and usually differs from the daily streamflow.

Streamflow Value Source: M = measured; R = rating curve; E = estimated

Stream Condition: R = rising, F = falling, B = baseflow, U = uncertain, S = steady

Turbidity is the 15-minute recorded value when sediment was sampled; turbidity values in *italics* are estimates from laboratory analysis

Suspended-sediment load (tons/day) is calculated by multiplying SSC by streamflow (cfs) and a conversion factor of 0.0027

Values are preliminary and subject to revision

**Table 6. Suspended-sediment concentrations and calculated loading rates
Donner Creek at Highway 89 (DC89), USGS 10338700, water years 2011-2014**

| Sample Date:Time | Observer(s) | Gage Height | Streamflow Discharge | Streamflow Value Source | Stream Condition | Event Type | Suspended-Sediment Concentration | 15-minute Turbidity | Suspended-Sediment Discharge Rate |
|---|---|---|---|---|---|---|---|---|---|
| *Site Conditions* | | | | | | | *Suspended Sediment* | | |
| | | *(ft)* | *(cfs)* | *M,R,E* | *R,F,B,U,S* | | *(mg/l)* | *(NTU)* | *(tons/day)* |
| ***WY 2011*** | | | | | | | | | |
| 5/5/2011 13:30 | bkh, cs | -- | 290 | R | R | early snowmelt | 1.4 | n/a | 1.1 |
| 5/27/11 14:45 | cs | 4.55 | 180 | R | F | rain | 1.4 | n/a | 0.7 |
| 6/6/11 14:00 | cs, bkh | 5.28 | 401 | R | S | rain | 6.0 | n/a | 6.5 |
| 6/6/11 14:12 | cs, bkh | 5.28 | 443 | R | S | rain | 4.8 | n/a | 5.7 |
| 6/14/11 10:52 | cs, bkh | 5.74 | 629 | R | F | snowmelt | 11.2 | n/a | 19.0 |
| 6/14/11 11:00 | cs, bkh | 5.74 | 627 | R | F | snowmelt | 10.4 | n/a | 17.6 |
| 6/16/11 20:35 | cs | 5.75 | 595 | R | F | snowmelt | 11.6 | n/a | 18.6 |
| 6/23/11 15:45 | cs, bkh | -- | 763 | R | R | snowmelt | 29.6 | n/a | 60.9 |
| 6/23/11 15:52 | cs, bkh | -- | 765 | R | R | snowmelt | 31.2 | n/a | 64.3 |
| 7/15/11 12:22 | ds | 4.27 | 159 | R | F | snowmelt | 2.2 | n/a | 0.9 |
| 8/5/11 12:10 | bkh | 3.42 | 30 | R | B | sunny | 4.8 | n/a | 0.4 |
| ***WY 2012*** | | | | | | | | | |
| 10/5/2011 10:17 | bkh | 4.20 | 110 | R | S | Donner Lake release | 2.0 | n/a | 0.6 |
| 11/16/11 12:45 | cs | 3.25 | 12 | R | S | Donner Lake release | 1.2 | n/a | 0.04 |
| 12/13/11 16:00 | cs | 3.20 | 9 | R | B | Donner Lake release | 1.6 | n/a | 0.04 |
| 1/20/12 13:55 | bkh | -- | 8 | R | R | rain | 2.4 | n/a | 0.1 |
| 1/27/12 15:20 | cs | -- | 44 | R | S | post-rain | 3.0 | n/a | 0.4 |
| 3/2/12 14:35 | bkh | -- | 31 | R | S | post-rain | 4.4 | n/a | 0.4 |
| 3/13/12 18:08 | cs, bkh | -- | 18 | R | S | rain | 3.6 | n/a | 0.2 |
| 3/14/12 15:35 | bkh | -- | 20 | R | R | rain | 2.4 | n/a | 0.1 |
| 3/15/12 13:20 | cs | -- | 37 | R | R | rain | 4.0 | n/a | 0.4 |
| 3/16/12 12:07 | bkh, ds | -- | 125 | R | R | rain | 7.0 | n/a | 2.4 |
| 4/23/2012 15:20 | cs, bkh | -- | 324 | R | R | rain | 5.6 | n/a | 4.9 |
| 4/23/12 19:25 | cs, bkh | -- | 361 | R | R | rain | 61.0 | n/a | 59.4 |
| 4/26/12 9:10 | bkh | -- | 925 | R | R | rain | 183.0 | n/a | 456.2 |
| 4/26/12 12:00 | cs, bkh | -- | 1070 | R | R | rain | 73.0 | n/a | 210.5 |
| 4/26/12 16:00 | | -- | 1060 | R | F | rain | 37.0 | n/a | 105.7 |
| 5/4/12 17:00 | cs | -- | 201 | R | F | rain | 2.0 | n/a | 1.1 |
| 8/14/12 18:38 | bkh | | 12 | R | F | thunderstorm | 98.0 | n/a | 3.2 |
| 9/28/12 12:42 | bkh | | 9 | R | R | Donner Lake release | 6.0 | n/a | 0.1 |
| ***WY 2013*** | | | | | | | | | |
| 10/1/12 9:00 | bkh | | 54 | R | R | Donner Lake release | 8.0 | n/a | 1.2 |
| 10/2/12 8:25 | bkh | | 105 | R | S | Donner Lake release | 6.0 | n/a | 1.7 |
| 10/16/12 10:45 | bkh | | 90 | R | S | Donner Lake release | 2.4 | n/a | 0.6 |
| 11/17/12 10:17 | CS | | 13 | R | R | rain | 2.4 | n/a | 0.1 |
| 11/17/12 14:42 | CS | | 26 | R | R | rain | 11.8 | n/a | 0.8 |
| 11/18/12 9:15 | DS | | 34 | R | F | post rain | 3.0 | n/a | 0.3 |
| 11/18/12 14:45 | BKH | | 32 | R | F | post rain | 3.2 | n/a | 0.3 |
| 11/30/12 10:45 | CS, BKH | | 426 | R | R | rain | 156.0 | n/a | 179 |
| 12/2/12 8:50 | CS, DS | | 988 | R | R | rain | 349.0 | n/a | 929 |
| 12/2/12 8:51 | CS, DS | | 988 | R | R | rain | 375 | n/a | 1000 |
| 12/2/12 14:40 | CS, BKH | | 824 | R | F | rain | 125.0 | n/a | 278 |
| 12/5/12 15:20 | BKH | | 509 | R | F | rain | 14.0 | n/a | 19.2 |
| 3/12/13 16:25 | CS | | 60 | R | S | snowmelt | 1.6 | n/a | 0.3 |
| 3/20/13 12:15 | CS | | 122 | R | R | rain | 4.0 | n/a | 1.3 |
| 4/29/13 13:30 | CS | | 82 | R | S | snowmelt | 3.6 | n/a | 0.8 |
| 5/6/13 7:10 | BKH | | 86 | R | S | snowmelt | 7.2 | n/a | 1.7 |
| 5/12/13 19:15 | CS | | 118 | R | S | snowmelt | 14.0 | n/a | 4.5 |
| 6/25/13 11:45 | CS | | 33 | R | R | rain | 3.6 | n/a | 0.3 |
| 7/24/13 17:00 | CS | | 5 | R | S | baseflow | 1.6 | n/a | 0.0 |
| 9/10/13 10:00 | BKH | | 105 | R | S | Donner Lake release | 3.5 | n/a | 1.0 |
| ***WY 2014*** | | | | | | | | | |
| 1/29/2014 12:45 | CS | | 4.8 | R | R | rain on snow | 2.0 | n/a | 0.03 |
| 1/29/2014 14:15 | CS | | 8.1 | R | R | rain on snow | 13.0 | n/a | 0.3 |
| 1/29/2014 16:25 | CS | | 12.0 | R | R | rain on snow | 19.0 | n/a | 0.6 |
| 2/8/2014 11:45 | CS | | 19.0 | R | R | rain on snow | 10.7 | n/a | 0.5 |
| 2/8/2014 16:10 | DS, CS | | 53.0 | R | R | rain on snow | 28.0 | n/a | 4.0 |
| 2/9/2014 15:00 | DS, CS | | 267 | R | R | rain on snow | 32.0 | n/a | 23.0 |
| 2/10/2014 15:45 | CS | | 166 | R | F | rain on snow | 5.6 | n/a | 2.5 |
| 3/6/2014 7:50 | BKH | | 138 | R | F | rain on snow | 21.6 | n/a | 8.0 |
| 4/16/2014 19:45 | DS, PK | | 72.0 | R | R | snowmelt | 4.0 | n/a | 0.8 |
| 8/8/2014 10:30 | BKH | | 7.3 | R | F | t-storm | 583 | n/a | 11.5 |

Streamflow is the measured or 15-minute recorded flow when sediment was sampled, and usually differs from the daily streamflow.
Streamflow Value Source: M = measured; R = rating curve; E = estimated
Stream Condition: R = rising, F = falling, B = baseflow, U = uncertain, S = steady
Turbidity is unavailable for this station
Suspended-sediment load (tons/day) is calculated by multiplying SSC by streamflow (cfs) and a conversion factor of 0.0027
Values are preliminary and subject to revision

**Table 7. Suspended-sediment concentrations and calculated loading rates**
**Donner Creek at West River Street (DCWR), USGS #10338700, water years 2012-2014**
*USGS #10338700*

| | Site Conditions | | | | | Suspended Sediment | | |
|---|---|---|---|---|---|---|---|---|
| **Sample Date:Time** | **Observer(s)** | **Streamflow Discharge** | **Streamflow Value Source** | **Stream Condition** | **Event Type** | **Suspended-Sediment Concentration** | **15-minute Turbidity** | **Suspended-Sediment Discharge Rate** |
| | | *(cfs)* | *M,R,E* | *R,F,B,U* | | *(mg/l)* | *(NTU)* | *(tons/day)* |
| ***WY 2012*** | | | | | | | | |
| 1/20/12 22:00 | cs | 70 | R | R | rain | 101 | n/a | 19.1 |
| 1/27/2012 15:30 | cs | 47 | R | S | post-rain | 2.5 | n/a | 0.3 |
| 3/2/2012 15:00 | bkh | 31 | M | S | rain | 5.2 | n/a | 0.4 |
| 3/13/2012 18:16 | cs, bkh | 18 | R | S | rain | 5.2 | n/a | 0.3 |
| 3/14/2012 15:15 | bkh | 20 | M | R | rain | 3.6 | n/a | 0.2 |
| 3/15/2012 13:30 | cs | 37 | R | R | rain | 8.8 | n/a | 0.9 |
| 3/16/2012 12:45 | bkh, ds | 120 | M | R | rain | 10.5 | n/a | 3.4 |
| 4/23/2012 15:30 | cs, bkh | 271 | R | S | rain | 6 | n/a | 4.4 |
| 4/23/2012 19:33 | cs, bkh | 361 | R | R | rain | 66.7 | n/a | 64.9 |
| 4/26/2012 9:00 | bkh | 873 | R | R | rain | 204 | n/a | 480 |
| 4/26/2012 12:10 | cs, bkh | 1060 | R | R | rain | 92 | n/a | 263 |
| 4/26/2012 16:15 | cs | 1050 | R | F | rain | 39.6 | n/a | 112 |
| 5/4/2012 17:10 | cs | 204 | R | F | rain | 1.6 | n/a | 0.9 |
| 8/14/2012 18:42 | bkh | 12 | R | F | thunderstorm | 64 | n/a | 2.1 |
| ***WY 2013*** | | | | | | | | |
| 11/17/2012 10:21 | CS | 13 | R | R | rain | 4.46 | n/a | 0.2 |
| 11/17/2012 14:50 | CS | 26 | R | R | rain | 15.58 | n/a | 1.1 |
| 11/18/2012 9:30 | DS | 34 | R | F | post rain | 2 | n/a | 0.2 |
| 11/18/2012 14:15 | BKH | 32 | R | F | post rain | 2 | n/a | 0.2 |
| 11/30/2012 10:30 | CS, BKH | 426 | R | R | rain | 172 | n/a | 197.5 |
| 12/2/2012 9:00 | CS, DS | 988 | R | R | rain | 396.19 | n/a | 1055 |
| 12/2/2012 14:15 | CS, BKH | 824 | R | F | rain | 133.3 | n/a | 296.0 |
| 12/5/2012 15:30 | DS, BKH | 509 | R | F | rain | 16 | n/a | 22.0 |
| 3/12/2013 16:30 | CS | 60 | R | S | snowmelt | 1.6 | n/a | 0.3 |
| 3/20/2013 12:05 | CS, BKH | 122 | R | R | rain | 6 | n/a | 2.0 |
| 4/29/2013 13:35 | CS | 82 | R | S | snowmelt | 3.6 | n/a | 0.8 |
| 5/6/2013 7:15 | BKH | 86 | R | S | snowmelt | 9.6 | n/a | 2.2 |
| 5/12/2013 19:20 | CS | 118 | R | S | snowmelt | 12.8 | n/a | 4.1 |
| 6/25/2013 11:50 | CS | 33 | R | R | rain | 4 | n/a | 0.4 |
| 7/24/2013 16:50 | CS | 5 | R | S | baseflow | 2 | n/a | 0.0 |
| 9/10/2013 10:15 | BKH | 105 | R | S | Donner Lake release | 2 | n/a | 0.6 |
| ***WY 2014*** | | | | | | | | |
| 1/29/2014 12:30 | cs | 5 | R | R | rain on snow | 2 | n/a | 0.03 |
| 1/29/2014 14:20 | cs | 9 | R | R | rain on snow | 23 | n/a | 0.6 |
| 1/29/2014 16:30 | cs | 12 | R | R | rain on snow | 26 | n/a | 0.8 |
| 2/8/2014 11:50 | cs | 20 | R | R | rain on snow | 20.7 | n/a | 1.1 |
| 2/8/2014 16:00 | ds, cs | 51 | R | R | rain on snow | 51.3 | n/a | 7.1 |
| 2/9/2014 14:45 | ds, cs | 247 | R | R | rain on snow | 34 | n/a | 22.6 |
| 2/10/2014 15:50 | cs | 165 | R | F | rain on snow | 8.7 | n/a | 3.9 |
| 3/6/2014 8:00 | bkh | 138 | R | F | rain | 27.5 | n/a | 10.2 |
| 4/16/2014 20:15 | ds, pk | 73 | R | S | snowmelt | 4 | n/a | 0.8 |
| 8/8/2014 10:45 | bkh | 7 | R | F | thunderstorm | 729 | n/a | 14.3 |

Notes
Observer Key: ds = Dave Shaw, bkh = Brian Hastings, cs = Collin Strasenburgh
Streamflow is the measured or 15-minute recorded flow when sediment was sampled, and usually differs from the daily streamflow.
Streamflow values are reported from USGS #10338700, Donner Creek at Highway 89
Streamflow Value Source: M = measured; R = rating curve; E = estimated
Stream Condition: R = rising, F = falling, B = baseflow, U = uncertain, S = steady
Turbidity is unavailable for this station
Suspended-sediment load (tons/day) is calculated by multiplying SSC (mg/L) by streamflow (cfs) and a conversion factor of 0.0027

**Table 8. Suspended-sediment concentration and load rates: Trout Creek at Donner Pass Road (TCDP), water years 2011-2014**

| | *Site Conditions* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sample Date:Time** | **Observer(s)** | **Gage Height** | **Streamflow discharge** | **Streamflow Value Source** | **Stream Condition** | **Event Type** | **Suspended-Sediment Concentration** | **15-minute Turbidity** | **Suspended-Sediment Load** |
| | | *(ft)* | *(cfs)* | *M,R,E* | *R,F,B,U* | | *(mg/l)* | *(NTU)* | *(tons/day)* |
| ***WY 2011*** | | | | | | | | | |
| 1/21/2011 16:05 | bkh, cs | 4.06 | 4.49 | M | F | rain on snow | 1.56 | 0.85 | 0.02 |
| 3/2/11 13:10 | ds | 4.01 | 3.35 | M | R | rain on snow | 35.00 | 44.00 | 0.32 |
| 3/2/11 13:50 | ds | 4.01 | 3.38 | M | R | rain on snow | 8.50 | 12.70 | 0.08 |
| 3/10/11 14:45 | cs | 4.13 | 6.07 | M | U | rain on snow | 68.00 | 35.00 | 1.11 |
| 3/10/11 14:46 | cs | 4.14 | 6.07 | M | U | rain on snow | 71.00 | 43.00 | 1.16 |
| 3/14/11 15:30 | bkh | 4.24 | 9.63 | M | R | rain | 13.60 | 8.77 | 0.35 |
| 4/2/11 16:20 | bkh | 4.53 | 29.08 | M | R | snowmelt | 32.00 | 26.40 | 2.51 |
| 4/18/11 11:10 | ds | 4.71 | 45.50 | M | U | rain | 6.80 | 8.98 | 0.83 |
| 5/5/11 12:02 | cs, bkh | 4.86 | 38.11 | M | U | snowmelt | 2.80 | 3.30 | 0.29 |
| 5/27/11 11:45 | cs | 4.68 | 24.80 | M | F | snowmelt | 2.40 | 1.96 | 0.16 |
| 6/5/2011 23:09 | cs | 4.82 | 36.19 | M | R | rain | 22.40 | 10.01 | 2.18 |
| 6/6/11 11:45 | cs | 5.02 | 47.77 | M | U | rain | 6.40 | 5.46 | 0.82 |
| 6/14/11 13:47 | cs | 4.61 | 23.25 | M | R | snowmelt | 3.00 | 3.01 | 0.19 |
| 6/23/11 17:15 | cs | 4.32 | 10.62 | M | F | snowmelt | 3.20 | 2.63 | 0.09 |
| 7/13/11 17:15 | bkh | 4.07 | 5.08 | M | F | snowmelt | 1.60 | 2.24 | 0.02 |
| 7/29/11 9:20 | cs | 4.00 | 3.12 | M | R | snowmelt | 3.20 | 2.30 | 0.03 |
| 9/2/11 16:15 | bkh | 7.42 | 1.46 | M | B | | 2.40 | 2.63 | 0.01 |
| 9/13/11 8:55 | bkh | 7.45 | 2.00 | M | B | | 3.60 | 10.84 | 0.02 |
| 9/13/11 17:00 | bkh | 7.50 | 2.66 | M | B | rain | 21.20 | 58.00 | 0.15 |
| ***WY 2012*** | | | | | | | | | |
| 10/5/11 9:45 | bkh | 7.66 | 4.29 | M | F | rain | 26.40 | 16.90 | 0.31 |
| 10/18/11 15:00 | bkh | 7.43 | 1.12 | M | B | baseflow | 2.40 | 1.70 | 0.01 |
| 11/16/11 13:15 | cs | 3.73 | 1.46 | M | R | baseflow | 1.20 | 1.68 | 0.00 |
| 12/13/11 14:45 | cs | 3.64 | 1.04 | M | B | baseflow | 0.80 | 1.40 | 0.00 |
| 1/20/12 13:35 | bkh | 3.78 | 1.78 | R | R | rain on snow | 7.00 | 9.00 | 0.03 |
| 1/20/12 21:45 | cs | 4.60 | 20.30 | R | R | rain on snow | 76.00 | 76.80 | 4.16 |
| 1/27/12 13:00 | cs | 3.84 | 2.16 | M | F | baseflow | 3.20 | 2.50 | 0.02 |
| 2/15/12 13:15 | cs | 3.78 | 1.86 | M | F | snowmelt | 2.80 | 2.58 | 0.01 |
| 3/2/12 15:30 | bkh | 3.76 | 1.72 | R | U | baseflow | 2.00 | 1.66 | 0.01 |
| 3/13/12 17:00 | cs, bkh | 3.85 | 2.50 | M | R | rain on snow | 2.40 | 2.26 | 0.02 |
| 3/14/12 14:38 | bkh | 3.91 | 3.28 | M | R | rain on snow | 3.60 | 5.21 | 0.03 |
| 3/15/12 11:54 | cs | 4.24 | 9.01 | M | R | rain on snow | 17.00 | 11.20 | 0.41 |
| 3/15/12 11:55 | cs | 4.24 | 9.01 | M | R | rain on snow | 18.14 | 11.20 | 0.44 |
| 3/16/12 10:40 | bkh, ds | 4.43 | 14.45 | M | U | rain on snow | 7.00 | 9.40 | 0.27 |
| 4/12/12 10:05 | ds | 4.17 | 7.30 | R | U | | 8.00 | 15.00 | 0.16 |
| 4/22/12 16:30 | bkh | 4.42 | 17.73 | M | R | snowmelt | 4.00 | 3.45 | 0.19 |
| 4/23/12 19:53 | cs, bkh | 4.54 | 23.70 | M | U | snowmelt | 6.67 | 6.30 | 0.43 |
| 4/26/12 11:20 | cs, bkh | 4.68 | 28.20 | M | U | rain | 14.00 | 8.00 | 1.06 |
| 5/4/12 15:15 | cs | 4.10 | 6.75 | M | F | snowmelt | 6.00 | 2.04 | 0.11 |
| 6/4/12 16:26 | bkh, jo | 3.87 | 2.95 | R | R | rain | 6.50 | 11.00 | 0.05 |
| 7/23/12 16:05 | | | 1.05 | R | F | thunderstorm | 46.00 | 36.00 | 0.13 |
| 8/15/12 16:00 | cs | 3.55 | 0.52 | M | B | thunderstorm | 1.75 | 3.57 | 0.00 |
| 8/15/12 16:01 | cs | 3.55 | 0.52 | M | B | thunderstorm | 1.50 | 3.57 | 0.00 |

**Table 8. Suspended-sediment concentration and load rates:**
**Trout Creek at Donner Pass Road (TCDP), water years 2011-2014**

| Sample Date:Time | Observer(s) | Gage Height | Streamflow discharge | Streamflow Value Source | Stream Condition | Event Type | Suspended-Sediment Concentration | 15-minute Turbidity | Suspended-Sediment Load |
|---|---|---|---|---|---|---|---|---|---|
| | | *Site Conditions* | | | | | | | |
| | | *(ft)* | *(cfs)* | *M,R,E* | *R,F,B,U* | | *(mg/l)* | *(NTU)* | *(tons/day)* |
| ***WY 2013*** | | | | | | | | | |
| 10/22/12 14:15 | bkh | 3.66 | 0.87 | R | U | rain | 59.33 | 60.19 | 0.14 |
| 11/17/12 10:45 | cs | 3.92 | 3.72 | R | F | rain | 95.00 | 58.11 | 0.95 |
| 11/17/12 11:15 | cs | 3.92 | 3.72 | R | F | rain | 60.00 | 48.45 | 0.60 |
| 11/17/12 15:30 | cs | 4.02 | 4.77 | M | R | rain | 52.00 | 22.87 | 0.67 |
| 11/18/12 14:00 | bkh | 3.92 | 2.68 | R | R | rain | 7.00 | 4.49 | 0.05 |
| 11/30/12 10:00 | cs, bkh | 4.67 | 25.22 | M | R | rain | 97.17 | 74.50 | 6.60 |
| 11/30/12 10:15 | cs, bkh | 4.67 | 25.22 | M | R | rain | 88.00 | 46.06 | 5.98 |
| 12/2/12 9:15 | cs, ds | 4.98 | 54.21 | M | R | rain on snow | 68.00 | 37.01 | 9.94 |
| 12/2/12 13:45 | cs, bkh | 5.05 | 60.18 | M | F | rain on snow | 23.00 | 18.89 | 3.73 |
| 12/5/2012 15:45 | bkh | 4.41 | 20.81 | R | U | rain on snow | 6.00 | 5.24 | 0.34 |
| 3/12/13 17:00 | cs | 3.85 | 4.91 | M | R | snowmelt | 1.60 | 2.22 | 0.02 |
| 3/14/13 17:45 | bkh | 4.09 | 11.68 | M | R | snowmelt | 10.00 | 6.57 | 0.31 |
| 3/20/13 12:45 | cs | 4.14 | 12.06 | M | R | rain | 6.00 | 4.04 | 0.20 |
| 4/29/13 14:15 | cs | 3.68 | 2.21 | M | B | snowmelt | 3.60 | 2.99 | 0.02 |
| 5/6/13 7:00 | bkh | 3.80 | 3.74 | R | R | | 27.20 | 22.19 | 0.27 |
| 5/6/13 12:30 | cs | 3.89 | 5.23 | M | U | | 9.20 | 7.51 | 0.13 |
| 5/6/2013 12:31 | cs | 3.89 | 5.23 | M | U | | 9.80 | 7.51 | 0.14 |
| 5/10/13 16:45 | cs | 3.72 | 2.51 | M | B | snowmelt | 3.20 | 3.23 | 0.02 |
| 6/25/13 13:30 | cs | 3.64 | 1.45 | M | R | rain | 4.00 | 5.59 | 0.02 |
| 7/24/13 16:30 | cs | 3.43 | 0.19 | M | B | baseflow | 2.40 | 4.19 | 0.00 |
| 9/12/13 19:40 | bkh | 3.38 | 0.09 | R | R | thunderstorm | 37.50 | 15.00 | 0.01 |
| ***WY 2014*** | | | | | | | | | |
| 1/29/14 12:45 | cs | 3.56 | 0.79 | R | R | rain on snow | 11.00 | 2.81 | 0.02 |
| 1/29/14 12:46 | cs | 3.56 | 0.79 | R | R | rain on snow | 8.65 | 2.81 | 0.02 |
| 1/29/14 14:30 | cs | 3.64 | 1.39 | R | R | rain on snow | 94.20 | 66.36 | 0.35 |
| 1/29/14 17:00 | cs | 3.62 | 1.28 | R | R | rain on snow | 88.46 | 30.10 | 0.31 |
| 2/8/14 11:15 | cs | 3.68 | 1.67 | R | R | rain on snow | 80.00 | 83.40 | 0.36 |
| 2/8/14 12:00 | cs | 3.67 | 1.61 | R | F | rain on snow | 52.67 | 67.10 | 0.23 |
| 2/8/14 12:01 | ds, cs | 3.67 | 1.61 | R | F | rain on snow | 54.00 | 67.10 | 0.23 |
| 2/8/14 15:25 | ds, cs | 3.74 | 2.81 | M | U | rain on snow | 206.00 | 140.00 | 1.56 |
| 2/8/14 15:50 | ds, cs | 3.79 | 3.20 | R | U | rain on snow | 116.00 | 119.00 | 1.00 |
| 2/9/14 13:45 | ds, cs | 4.70 | 36.30 | M | U | rain on snow | 6.00 | 9.65 | 0.59 |
| 2/10/14 16:00 | cs | 4.31 | 19.40 | R | U | rain on snow | 12.00 | 9.57 | 0.63 |
| 3/6/14 8:10 | bkh | 4.15 | 13.00 | R | F | rain on snow | 9.20 | 9.80 | 0.32 |
| 3/29/14 13:35 | | 3.85 | 4.75 | R | R | | 4.80 | 5.00 | 0.06 |
| 4/8/14 17:50 | cs | 3.83 | 4.30 | M | R | snowmelt | 2.80 | 4.00 | 0.03 |
| 4/18/14 8:21 | cs | 3.68 | 2.00 | M | S | snowmelt | 1.63 | 2.10 | 0.01 |

Notes

Observer Key: ds = Dave Shaw, bkh = Brian Hastings, cs = Collin Strasenburgh

Streamflow is the measured or 15-minute recorded flow when sediment was sampled, and usually differs from the daily streamflow.

Streamflow Value Source: M = measured; R = rating curve; E = estimated

Stream Condition: R = rising, F = falling, B = baseflow, U = uncertain, S = steady

Turbidity is the 15-minute recorded value when sediment was sampled; turbidity values in *italics* are estimates from laboratory analysis

Suspended-sediment load (tons/day) is calculated by multiplying SSC by streamflow (cfs) and a conversion factor of 0.0027

Values are preliminary and subject to revision

**Table 9. Comparison of annual flow and suspended-sediment loads and yields Cold Creek, Trout Creek, and Donner Creek, water years 2011 through 2014.**

| Station | Water Year[1] | Watershed Area | Annual Flow[2] | | | | Peak Flow | | | Suspended Sediment Load[3] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean Daily Flow | Maximum Daily Flow | Minimum Daily Flow | Total Flow Volume | Peak Flow | Peak Stage | Date Time | **Suspended Sediment** | **Percent exceedance for TMDL standard** | **Normalized Suspended Sediment (yield)** | **Normalized Suspended Sediment (yield)** |
| | | | *(cfs)* | *(cfs)* | *(cfs)* | *(ac-ft)* | *(cfs)* | *(ft)* | *(mm/dd/yyyy)* | ***(tons)*** | ***(%)*** | ***(tons/1,000 ac-feet)*** | ***(tons/sq. mile)*** |
| **Cold Creek at Teichert Bridge (CCTB)** | | | | | | | | | | | | | |
| | WY 2011 | 12.6 | 60 | 335 | 0.9 | 42,624 | 447 | 5.73 | 6/22/2011 | **508** | **1.5** | **12** | **40** |
| | WY 2012 | | 21 | 384 | 0.2 | 15,374 | 546 | 5.89 | 4/26/2012 | **327** | **1.5** | **21** | **26** |
| | WY 2013 | | 21 | 407 | 0.17 | 14,884 | 1004 | 6.6 | 12/2/2012 | **610** | **1.3** | **41** | **48** |
| | WY 2014 | | 12 | 132 | 0.21 | 8,892 | 196 | 3.82 | 2/9/2014 | **61** | **1.0** | **7** | **5** |
| | | | | | | | | | | | **Average:** | **20** | **30** |
| **Donner Creek at Highway 89 (DC89)** | | | | | | | | | | | | | |
| | WY 2011 | 14.8 | 140 | 774 | 5 | 101,308 | 921 | -- | 6/29/2011 | **804** | **--** | **8** | **54** |
| | WY 2012 | | 48 | 862 | 3.1 | 34,925 | 1,090 | -- | 4/26/2012 | **406** | **1.1** | **12** | **27** |
| | WY 2013 | | 58 | 676 | 3.7 | 42,125 | 1,150 | -- | 12/2/2012 | **498** | **0.5** | **12** | **34** |
| | WY 2014 | | 27 | 240 | 3.5 | 19,624 | 327 | | 2/9/2014 | **181** | **0.8** | **9** | **12** |
| | | | | | | | | | | | **Average:** | **10** | **32** |
| **Donner Creek at West River Street (DCWR)** | | | | | | | | | | | | | |
| | WY 2011 | 15.2 | -- | -- | -- | -- | -- | -- | -- | **--** | **--** | **--** | **--** |
| | WY 2012 | | 48 | 862 | 3.1 | 34,925 | 1,090 | -- | 4/26/2012 | **564** | **2.1** | **16** | **37** |
| | WY 2013 | | 58 | 676 | 3.7 | 42,125 | 1,150 | -- | 12/2/2012 | **819** | **2.3** | **19** | **54** |
| | WY 2014 | | 27 | 240 | 3.5 | 19,624 | 327 | | 2/9/2014 | **285** | **1.0** | **15** | **19** |
| | | | | | | | | | | | **Average:** | **17** | **37** |
| **Trout Creek at Donner Pass Road (TCDP)** | | | | | | | | | | | | | |
| | *WY 2011* | *4.6* | *15* | *63* | *1.1* | *3,469* | *70* | *5.16* | *4/21/2011* | ***52*** | ***2.7*** | ***15*** | ***11*** |
| | WY 2012 | | 2.5 | 23.3 | 0.2 | 1,814 | 54 | 5.21 | 1/21/2012 | **10.6** | **0.8** | **6** | **2** |
| | WY 2013 | | 2.2 | 31.5 | 0.2 | 1,587 | 81 | 5.18 | 12/2/2012 | **13.4** | **1.6** | **8** | **3** |
| | *WY 2014* | | *1.6* | *31.0* | *0.2* | *872* | *40* | *4.81* | *2/9/2014* | ***6.8*** | ***0.8*** | ***8*** | ***1*** |
| | | | | | | | | | | | **Average:** | **9** | **5** |

Notes:

1 Water years begin in October and end in September of the named water year; Data in *italics* (TCDP) represent partial water years (partial WY 2011: January 21-September 30, 2011, partial WY 2014: October 1, 2013- July 1, 2014)

2 Annual and Peak flow statistics based on 15-minute record of flow for stations managed and maintained by Balance Hydrologics, Inc. The Donner Creek (USGS 10338700) station is managed and maintained by USGS;
Donner Creek streamflow affected by regulation (Donner Lake); watershed area for Donner Creek stations exclude area above Donner Lake Dam (14.3 sq. miles) and includes Cold Creek.

3 Cold Creek and Trout Creek suspended-sediment loads are based on conversion of a continuous (15-min) record of turbidity to suspended sediment concentration.
Donner Creek suspended sediment loads are based on a standard streamflow-based sediment rating curve method

4 Donner Creek is assumed to have the same flow rate at West River Street as at Highway 89 during most condition, as based on concurrent measurements of flow at the two stations.

**Table 10. Comparison of annual flow and suspended-sediment loads**
**Donner Creek at Highway 89 (DC89), USGS 10338700, water years 1997, 2004, 2011, 2012, 2013, and 2014.**

| Year[1] | Annual Flow[2] | | | | Peak Flow[3] | | | Suspended Sediment Load[4] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean Daily Flow | Maximum Daily Flow | Minimum Daily Flow | Total Flow Volume | Peak Flow | Peak Stage | Date Time | Suspended Sediment | Normalized Suspended Sediment | Normalized Suspended Sediment |
| | *(cfs)* | *(cfs)* | *(cfs)* | *(ac-ft)* | *(cfs)* | *(ft)* | *(24-hr)* | *(tons)* | *(tons/1,000 ac-feet)* | *(tons/sq. mile)* |
| **Donner Creek at Highway 89** | | | | | | | | | | |
| WY 1997 | 117 | 2,380 | 3.6 | 84,679 | 2,500 | 12.76 | 1/2/1997 | 2,253 | 27 | 148 |
| WY 2004 | 55 | 245 | 3.1 | 39,546 | 268 | 5.28 | 3/22/2004 | 380 | 10 | 25 |
| WY 2011 | 140 | 774 | 5.0 | 101,308 | 921 | -- | 6/29/2011 | 804 | 8 | 54 |
| WY 2012 | 48 | 862 | 3.1 | 34,925 | 1,090 | -- | 4/26/2012 | 384 | 11 | 26 |
| WY 2013 | 58 | 676 | 3.7 | 42,125 | 1,150 | -- | 12/2/2012 | 498 | 12 | 34 |
| WY 2014 | 27 | 240 | 3.5 | 19,624 | 327 | -- | 2/9/2014 | 181 | 9 | 12 |
| *mean* | *74* | | | *53,701* | *1,043* | | | *750* | *13* | *50* |
| *median* | *56* | | | *40,836* | *1,006* | | | *441* | *10* | *30* |

Notes:

1 WY 1997 and WY 2004 data are reported from Amorfini and Holden (2008) using sediment rating curve reported from McGraw and others (2001); WY 2011 - WY 2014 data were collected by Balance Hydrologics

2 Annual flow statistics based on record of flow managed and maintained by USGS at the Donner Creek at Highway 89 station (USGS 10338700); flows are affected by regulation (Donner Lake)

3 Donner Creek peak flow and stage for WY 1997 is estimated by USGS; all Donner peak flows are affected by regulation at Donner Lake

4 Suspended sediment loads are based on grab samples analyzed for suspended sediment concentration and standard rating curve method (Qss = 1.78*(Q^3.31) for 1996, 1997 (McGraw and others, 2001);

WY 1997 and WY 2004 normalized suspended-sediment load (tons/sq. mile) are based on a watershed area of 15.2 sq. miles as delineated from the confluence with Truckee River, but excluding watershed area above Donner Lake Dam (14.3 sq. miles)

WY 2011-WY 2014 normalized suspended-sediment load (tons/sq. mile) is based on a watershed area of 14.8 sq. miles as delineated from Highway 89, but excluding watershed area above Donner Lake Dam (14.3 sq. miles)

**Table 11. Comparison of annual flow and normalized suspended-sediment loads**
**Trout Creek at Donner Pass Road (TCDP), water years 1997, 2004, 2011 (partial), 2012, 2013, and 2014 (partial)**

| Year[1] | Annual Flow[2] | | | | Peak Flow[3] | | | Suspended Sediment Load[4] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean Daily Flow | Maximum Daily Flow | Minimum Daily Flow | Total Flow Volume | Peak Flow | Peak Stage | Date Time | Suspended Sediment | Normalized Suspended Sediment | Normalized Suspended Sediment |
| | *(cfs)* | *(cfs)* | *(cfs)* | *(ac-ft)* | *(cfs)* | *(ft)* | *(24-hr)* | *(tons)* | *(tons/ac-feet)* | *(tons/sq. mile)* |
| WY 1997 | 8.0 | 195 | 3.3 | 5,809 | -- | -- | -- | 61 | **11** | **12** |
| WY 2004 | 4.1 | 9.4 | 3.0 | 3,002 | -- | -- | -- | 21 | **7** | **4** |
| partial WY 2011 | *15* | *63* | *0.4* | *6,777* | 70 | 5.16 | 4/21/2011 | *59* | **9** | **13** |
| WY 2012 | 2.5 | 23 | 0.2 | 1,814 | 54 | 5.14 | 1/20/2012 | 10.6 | **6** | **2** |
| WY 2013 | 2.2 | 32 | 0.2 | 1,587 | 81 | 5.18 | 12/2/2012 | 13.4 | **8** | **3** |
| partial WY2014 | 1.6 | 31 | 0.2 | 872 | 40 | 4.81 | 2/9/2014 | *6.8* | **8** | **1** |
| *mean* | *5.5* | | | *3,310* | | | | *29* | *8* | *6* |
| *median* | *3.3* | | | *2,408* | | | | *17* | *8* | *4* |

Notes:

1 WY 1997 and WY 2004 data are reported from Amorfini and Holden (2008) and based on sediment rating curves from McGraw and others (2001); WY 2011 - WY 2013 data were collected by Balance Hydrologics

2 Annual flow statistics for WY 1997 and WY 2004 are synthesized from a record of flow at Sagehen Creek near Truckee [Trout Creek Q = 0.24*(Sagehen Q)+2.6563], McGraw and others (2001);
The Sagehen Creek gage is managed and maintained by USGS (USGS 10343500); Annual flow statistics are based on continuous gaging record managed and maintained by Balance Hydrologics;
WY 2011 is a partial water year (January 21 - September 30, 2011), WY 2014 is a partial water year (October 1, 2013 - July 1, 2014)

3 Because WY 1997 and WY 2004 represent annual flow data based on a synthetic daily record, peak flow data are unavailable.

4 WY 1997 and WY 2004 suspended-sediment loads are based on grab samples analyzed for suspended-sediment concentration and standard rating curve method (Qss = 1.30*(Q^2.05), McGraw and others, 2001;
WY 2011 through WY 2014 suspended-sediment loads are based on continuous record of turbidity and laboratory analysis of suspended-sediment concentration (SSC);
WY 1997 and WY 2004 normalized suspended-sediment yields (watershed area, sq. mile) are based on a watershed area delineated at Trout Creek confluence with Truckee River
(4.89 sq. miles, McGraw and others, 2001); watershed area delineated at Donner Pass Road (4.6 sq. miles) for WY 2011 - WY 2013

## Table 12. Preliminary comparison of annual flow and suspended-sediment loads and yields Middle Truckee River and tributaries, water year 2014

| Station | Watershed Area | Annual Flow | | | | Peak Flow | | | Suspended Sediment Load | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean Daily Flow | Maximum Daily Flow | Minimum Daily Flow | Total Flow Volume | Peak Flow | Peak Stage | Date Time | Suspended Sediment Load | Percent exceedance for TMDL standard | Normalized Suspended Sediment | Normalized Suspended Sediment |
| | | *(cfs)* | *(cfs)* | *(cfs)* | *(ac-ft)* | *(cfs)* | *(ft)* | *(mm/dd/yyyy)* | *(tons)* | *(%)* | *(tons/1,000 ac-feet)* | *(tons/sq. mile)* |
| **Truckee River above Truckee (10338000)** | 46 | 147 | 606 | 12.2 | 106,135 | 724 | 2.91 | 2/9/2014 | 457 | 0.6 | 4.3 | 9.9 |
| **Donner Creek at West River Street** | 15.2 | 27 | 240 | 3.5 | 19,624 | 323 | 4.91 | 2/9/2014 | 285 | 1.0 | 14.5 | 18.8 |
| **Donner Creek at Highway 89 (10338700)** | 14.8 | 27 | 240 | 3.5 | 19,624 | 323 | -- | 2/9/2014 | 181 | 0.8 | 9.2 | 12.2 |
| **Cold Creek at Teichert Bridge** | 12.6 | 12 | 132 | 0.21 | 8,892 | 196 | 3.82 | 2/9/2014 | 61 | 1.0 | 6.9 | 4.8 |
| **Trout Creek at Donner Pass Road** | 4.6 | *1.6* | *30.9* | *0.2* | *872* | 40 | 4.81 | 2/9/2014 | *6.8* | *0.8* | *7.8* | *1.5* |
| **Truckee River at Boca Bridge (10344505)** | 82.4 | 380 | 1042 | 76 | 274,989 | 1,270 | 7.66 | 2/9/2014 | 1,625 | 1.1 | 5.9 | 19.7 |
| **Truckee River at Farad (10346000)** | 142.4 | 414 | 928 | 83.8 | 299,480 | 1,280 | -- | 2/9/2014 | 2,169 | 1.0 | 7.2 | 15.2 |

Notes:

1 Annual and peak flow statistics based on 15-minute record of flow; Stations on Cold and Trout Creek managed and maintained by Balance Hydrologics, Inc.; stations TURB-MC1 and TURB-MC2 are managed and maintained by CDM Smith, while stations at Donner Creek (USGS 10338700), Truckee River above Truckee (USGS 10338000), Truckee River at Boca Bridge (USGS 10344505), and Truckee R. at Farad (USGS 10346000) are managed and maintained by USGS. Station at Donner Creek at West River Street, streamflow statistics are based on USGS 10338700 and confirmed by correlation to direct flow measurement comparisons at both stations

2 Truckee River above Truckee (USGS 10338000) streamflow affected by regulation at Lake Tahoe. For the purposes of load comparisons, watershed area for this station excludes Lake Tahoe

3 Donner Creek streamflow affected by regulation at Donner Lake; watershed area for Donner Creek stations exclude area above Donner Lake Dam (14.3 sq. miles) for purposes of comparing loads.

4 Truckee River at Boca Bridge (USGS 10344505) streamflow affected by regulation at Lake Tahoe, Donner Lake, Prosser Reservoir, Boca Reservoir, and Martis Reservoir. For the purposes of load comparisons, watershed areas for this station excludes Lake Tahoe and area above Donner Lake Dam, Prosser Dam, Boca Dam, and Martis Dam.

5 Truckee River at Farad (USGS 10346000) streamflow affected by regulation by Lake Tahoe, Donner Lake, Prosser Reservoir, Boca Reservoir, and Martis Reservoir. For the purposes of load comparisons, watershed area for this station exlcudes areas above dams

6 Values in italics are based on streamflow-sediment rating curve if turbidity is not measured at a station or turbidity wasn't collected for the full year; Trout Creek loads were measured for partial WY2014: Oct. 1, 2013 - July 1, 2014

7 Funding for Truckee River monitoring is provided by the Town of Truckee and carried out as part of the Town of Truckee's Truckee River Water Quality Monitoring Program.

# FIGURES

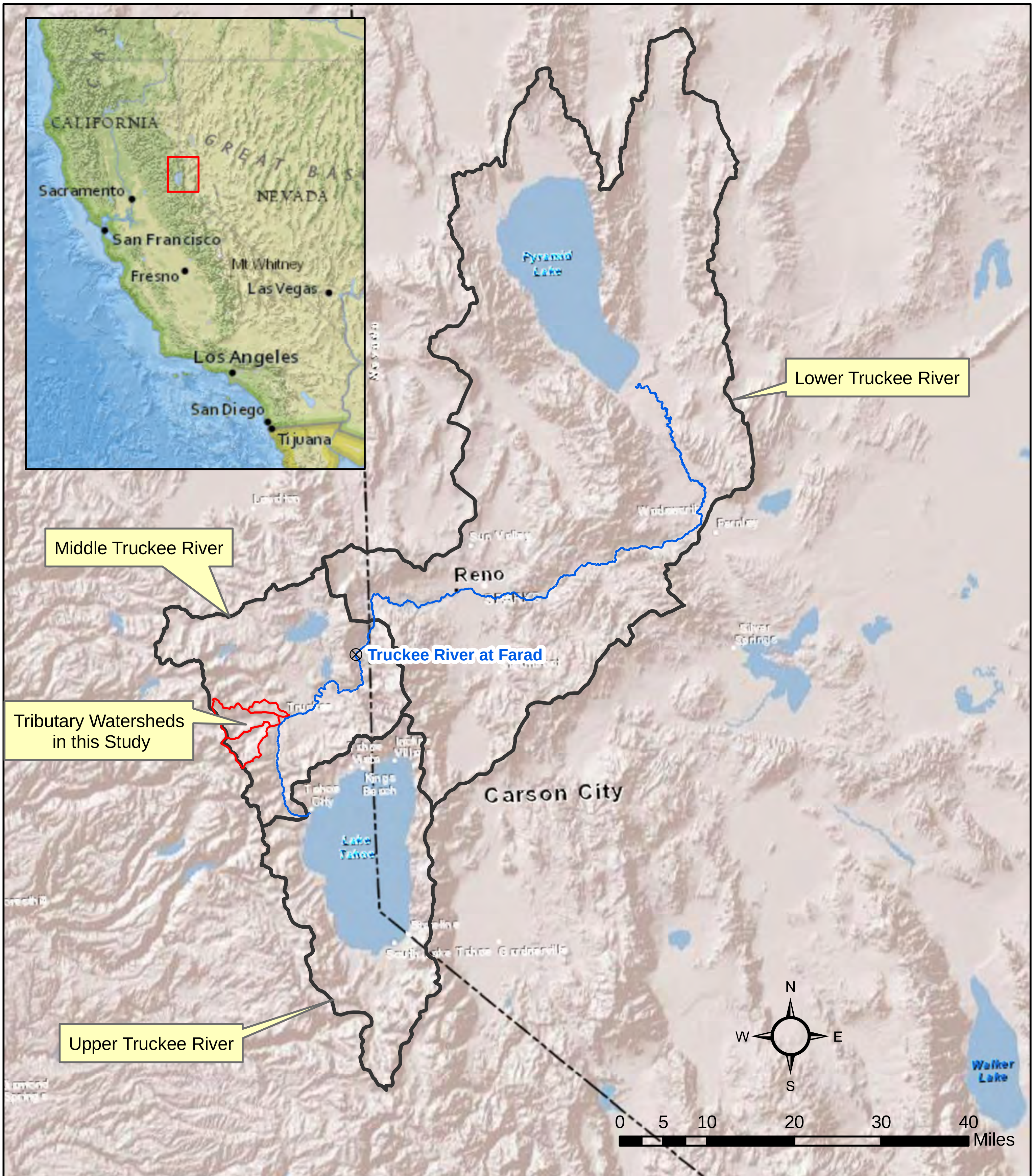



**Figure 1. Truckee River Basin, California-Nevada.**

The Truckee River originates above Lake Tahoe (Upper Truckee), flows out of Tahoe, through the Town of Truckee to the State Line (Middle Truckee), and through Reno-Sparks and discharges to Pyramid Lake (Lower Truckee).

210011 Figure 1 overview.mxd

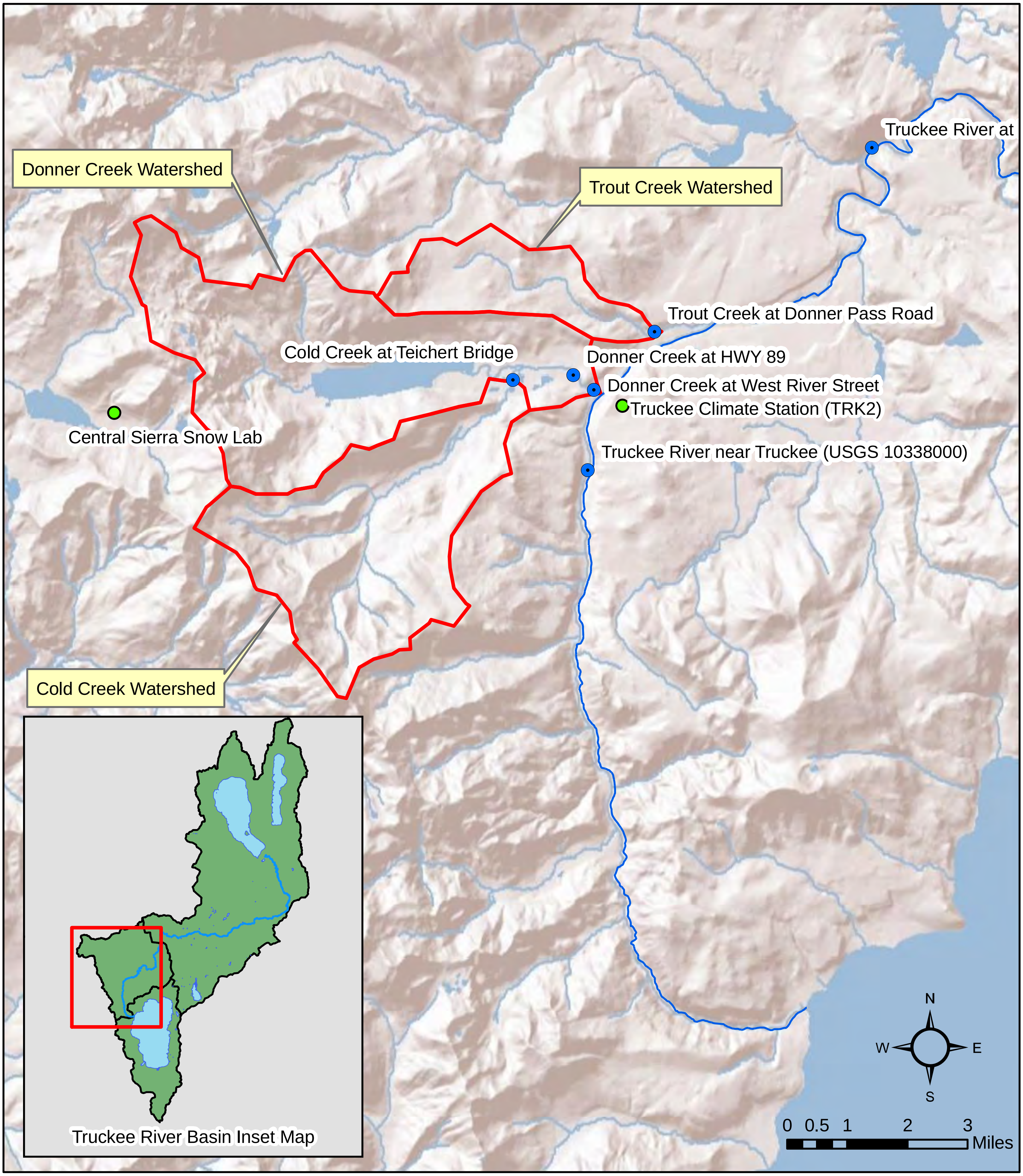
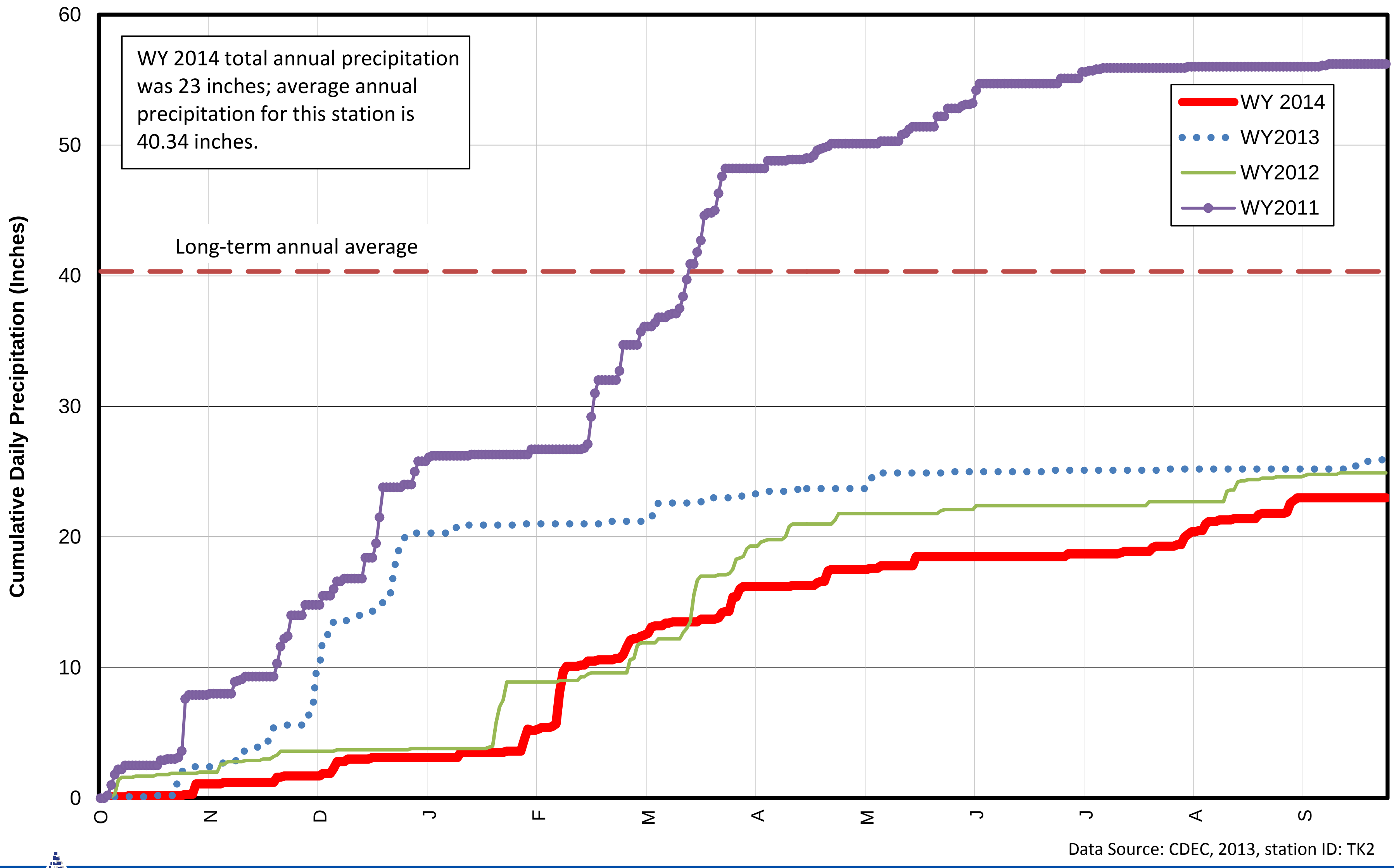


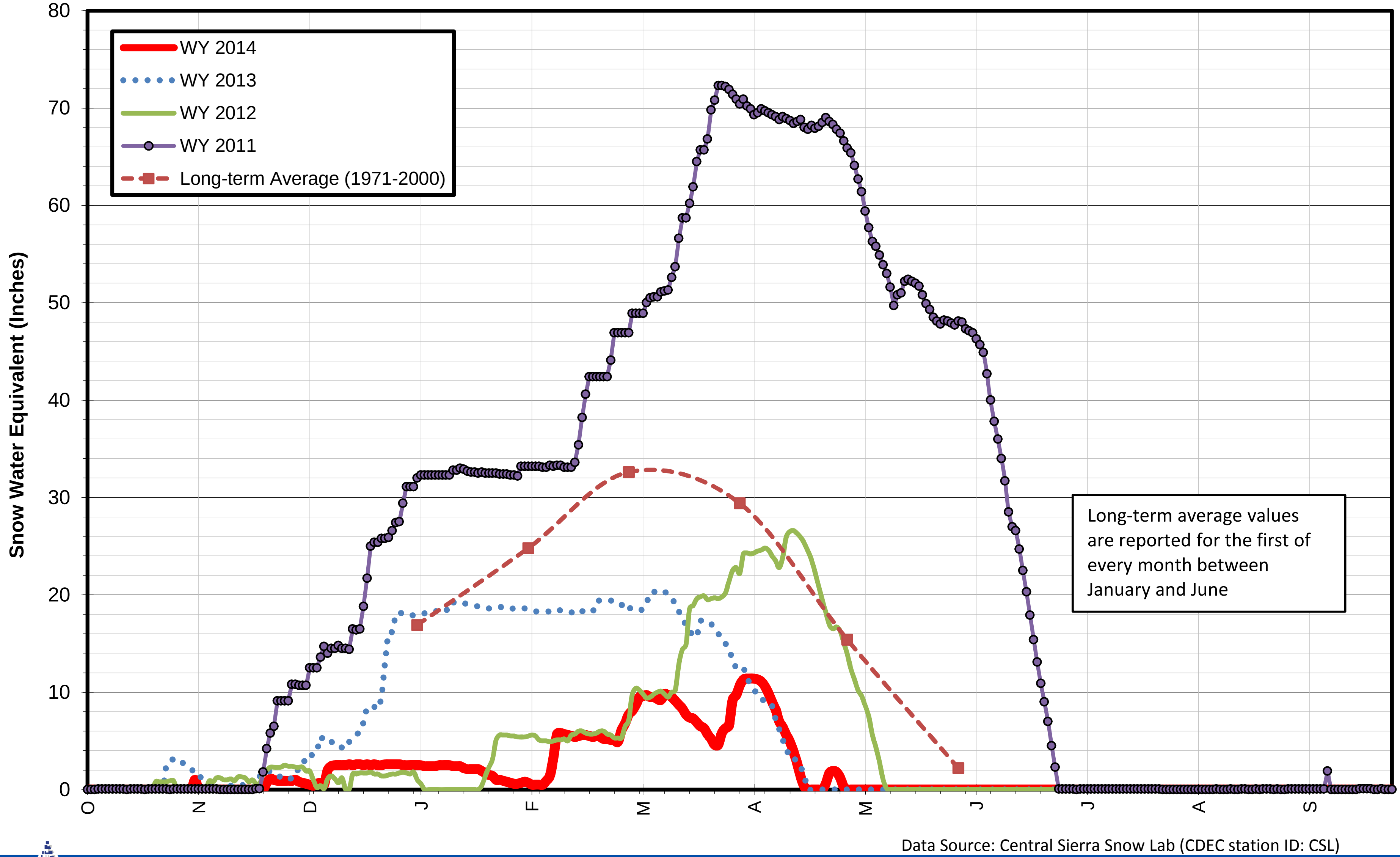

**Figure 2. Middle Truckee River, Nevada and Placer Counties, California**
Tributaries to the Middle Truckee River described in this study include Cold Creek, Donner Creek, and Trout Creek. Other hydrologic and climate stations referred to in this study are also shown.

Balance Hydrologics, Inc.




Balance Hydrologics, Inc.

**Figure 3.** **Cumulative daily precipitation near Truckee, California, water years 2011, 2012, 2013, and 2014.** The station (TRK2) located approximately 2 miles south of Truckee, California at 6,400 feet elevation. Total precipitation in WY 2014 was 57 percent of the long-term average.




Balance Hydrologics, Inc.

**Figure 4.** **Snow-water equivalent (SWE), Central Sierra Snow Lab, Soda Springs, California, water years 2011, 2012, 2013, and 2014.** The Central Sierra Snow Lab is located approximately 7.5 miles west of the Cold Creek gaging station at 6,950 feet elevation. WY 2014 exhibited snowpack much below long-term averages and eariler spring peak snowmelt runoff for the third consecutive year in a row.

210011 annual rainfall snowfall

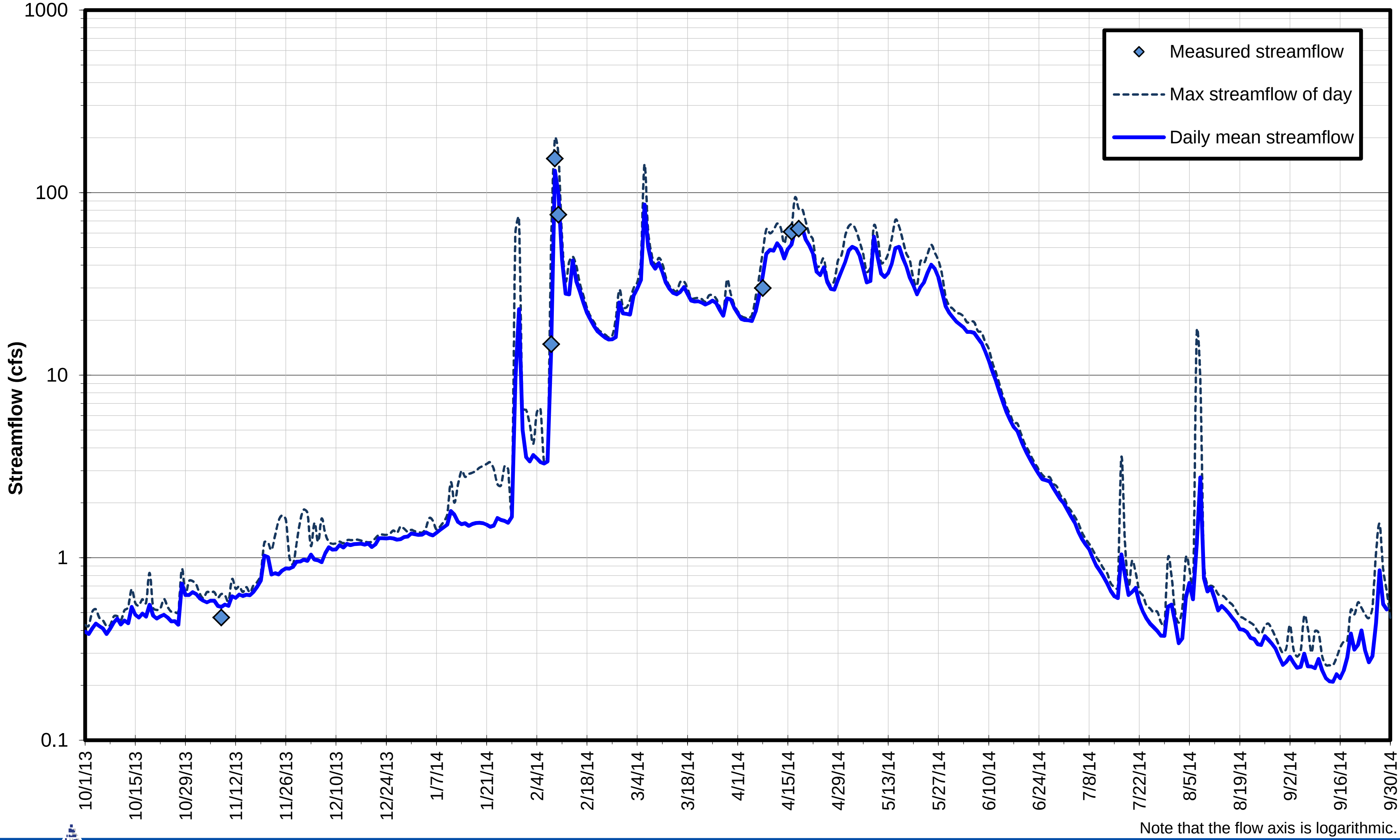



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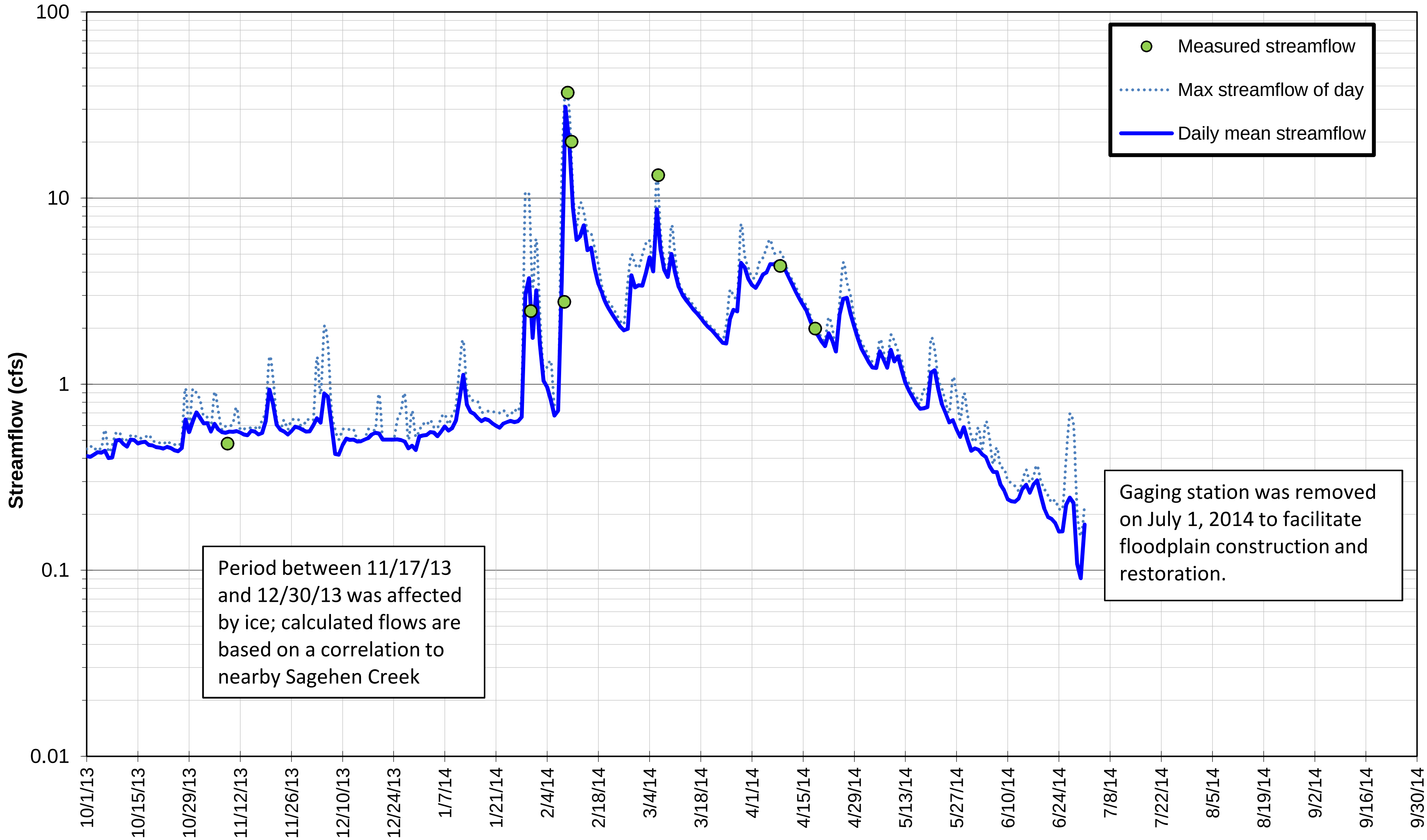
**Figure 5.** **Streamflow hydrograph, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water year 2014.** The peak streamflow for WY 2014 was 196 cfs recorded on February 9, 2014 during a rain-on-snow event. Peak flow during spring snowmelt runoff was 94 cfs and occurred on April 17, 2014.




Note that the flow axis is logarithmic.

Balance Hydrologics, Inc.

**Figure 6.** **Streamflow hydrograph, Trout Creek at Donner Pass Road (TCDP), Truckee, California, partial water year 2014 (October 1, 2013 - July 1, 2014).** The peak streamflow for WY 2014 was 39.6 cfs and occurred February 2, 2014 during a rain-on-snow event. Peak snowmelt runoff was roughly 5 cfs and occurred on March 29, 2014.

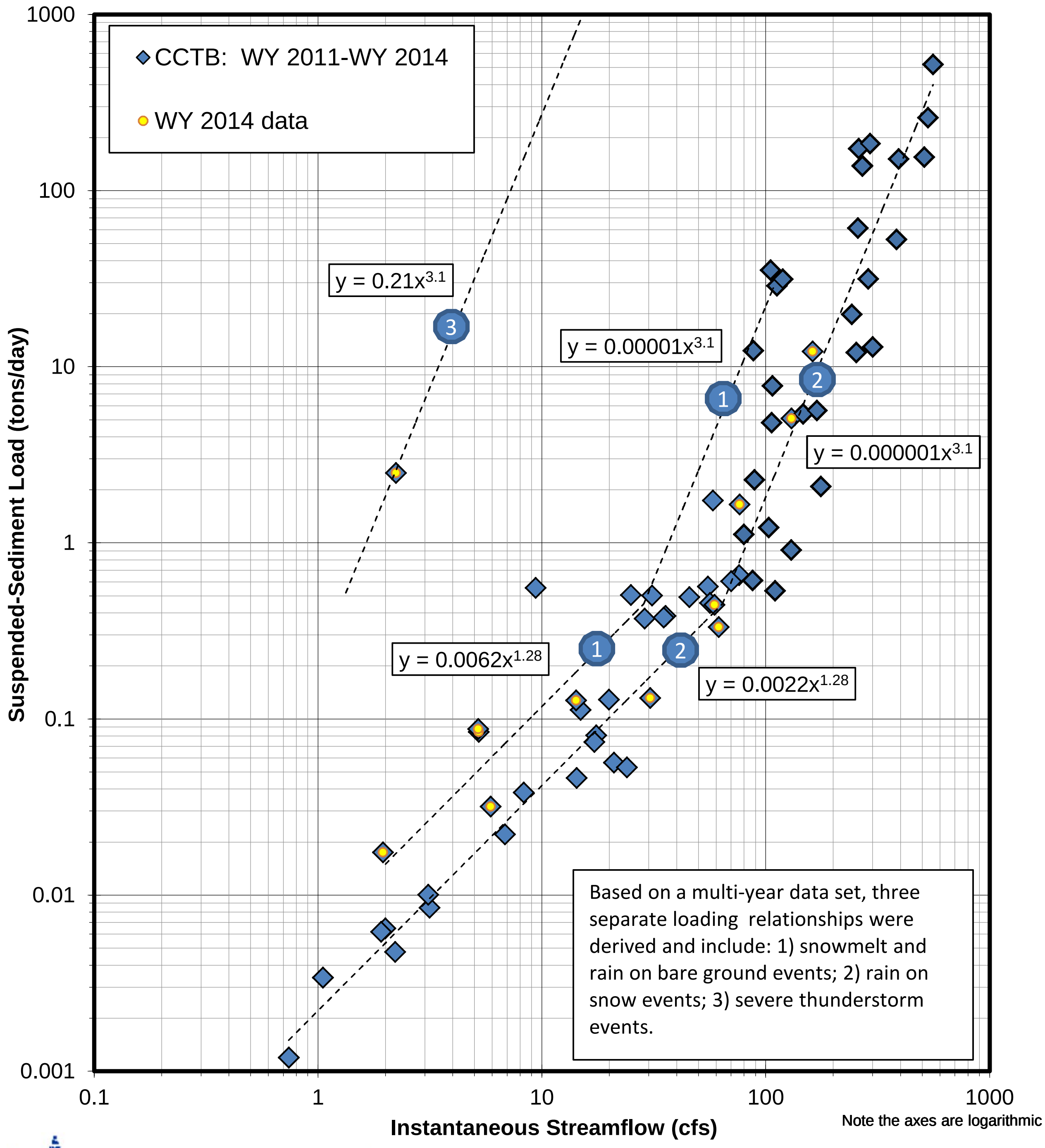



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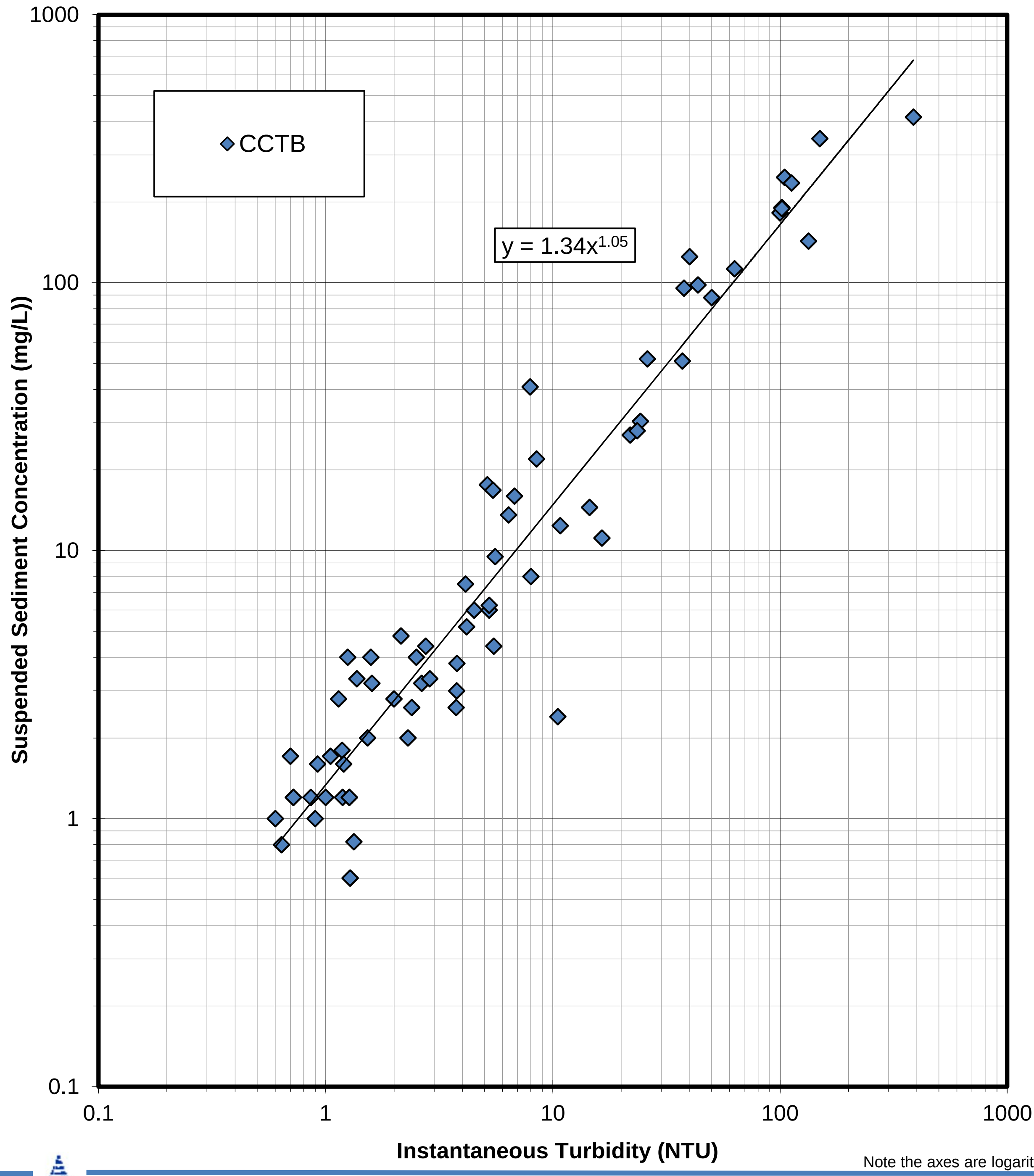
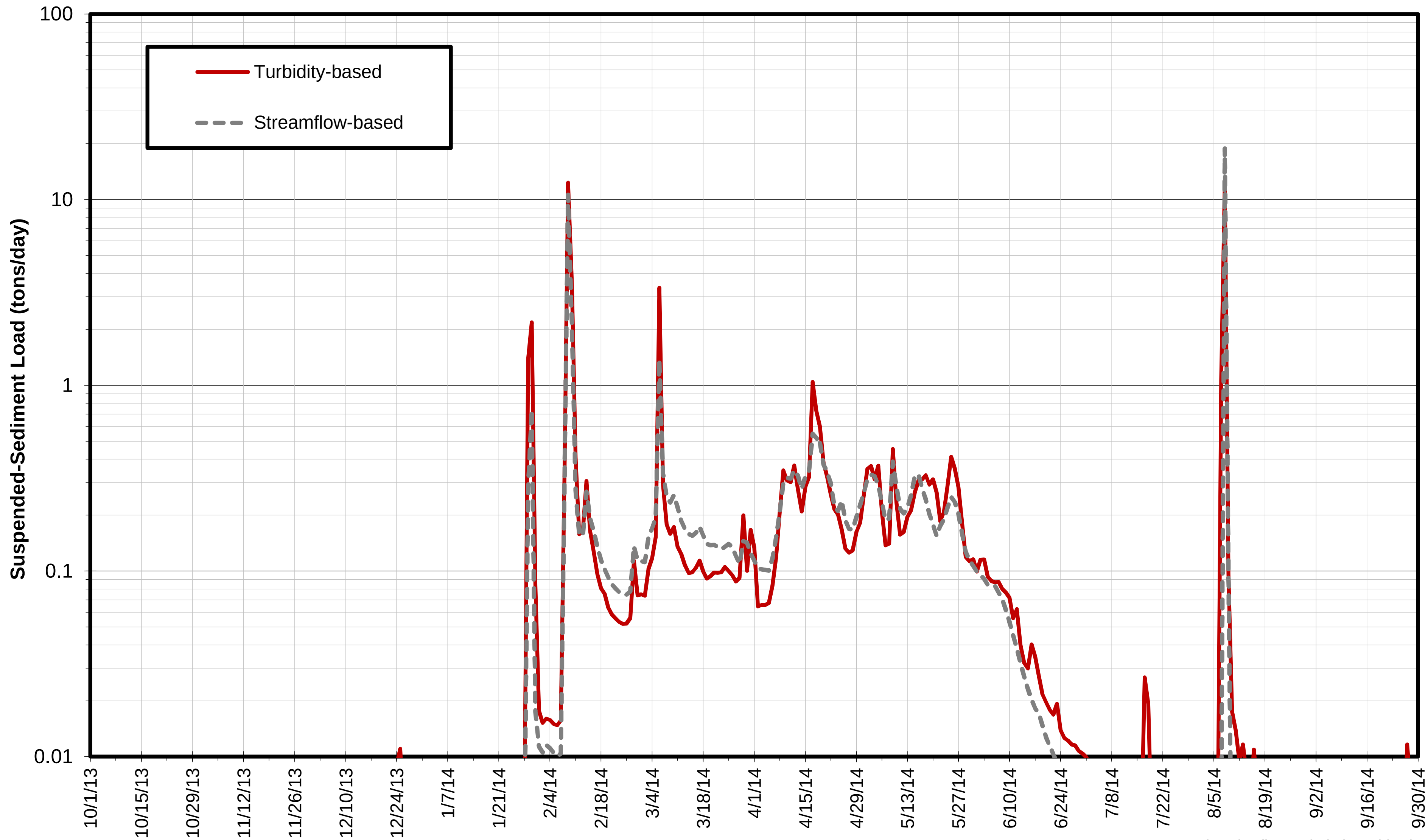
**Figure 7. Relationship between streamflow and suspended-sediment load, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water years 2011-2014.** As is typical, more suspended sediment is transported at higher streamflows. The equations derived here are applied to the streamflow record to calculate suspended-sediment loading.




Note the axes are logarithmic

**Figure 8. Relationship between turbidity and suspended-sediment concentration, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water years 2011-2014.** The equation derived here is applied to the continuous record of turbidity to calculate suspended-sediment loading.




Note that the flow axis is logarithmic.

Balance Hydrologics, Inc.

**Figure 9. Daily suspended-sediment load calculated based on turbidity and streamflow, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water year 2014.**
Peak loading event occured on August 8, 2014 as the result of a severe thunderstorm. This event was isolated to this area and triggered multiple bank failures and gully erosion in the upper watershed.

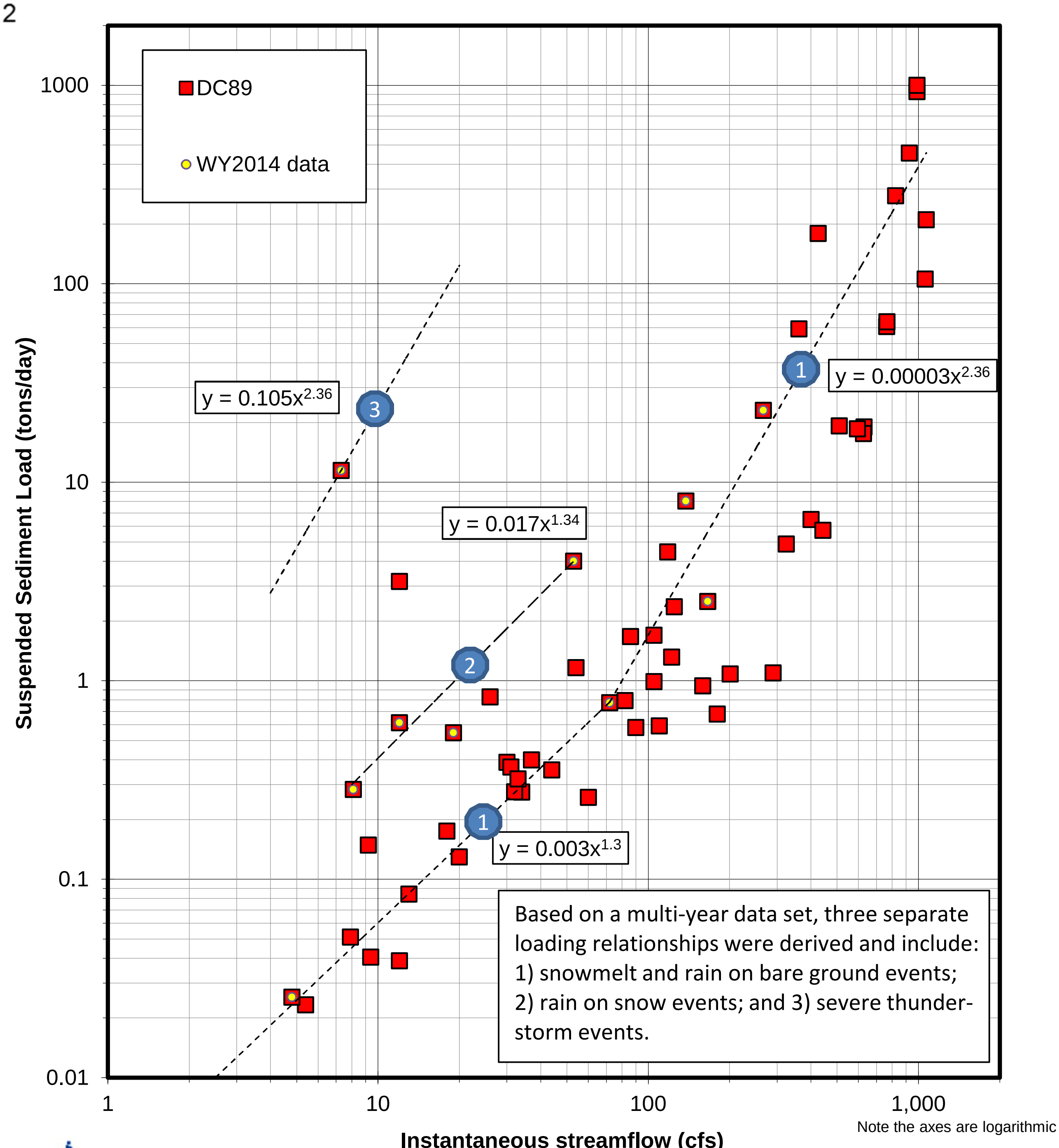
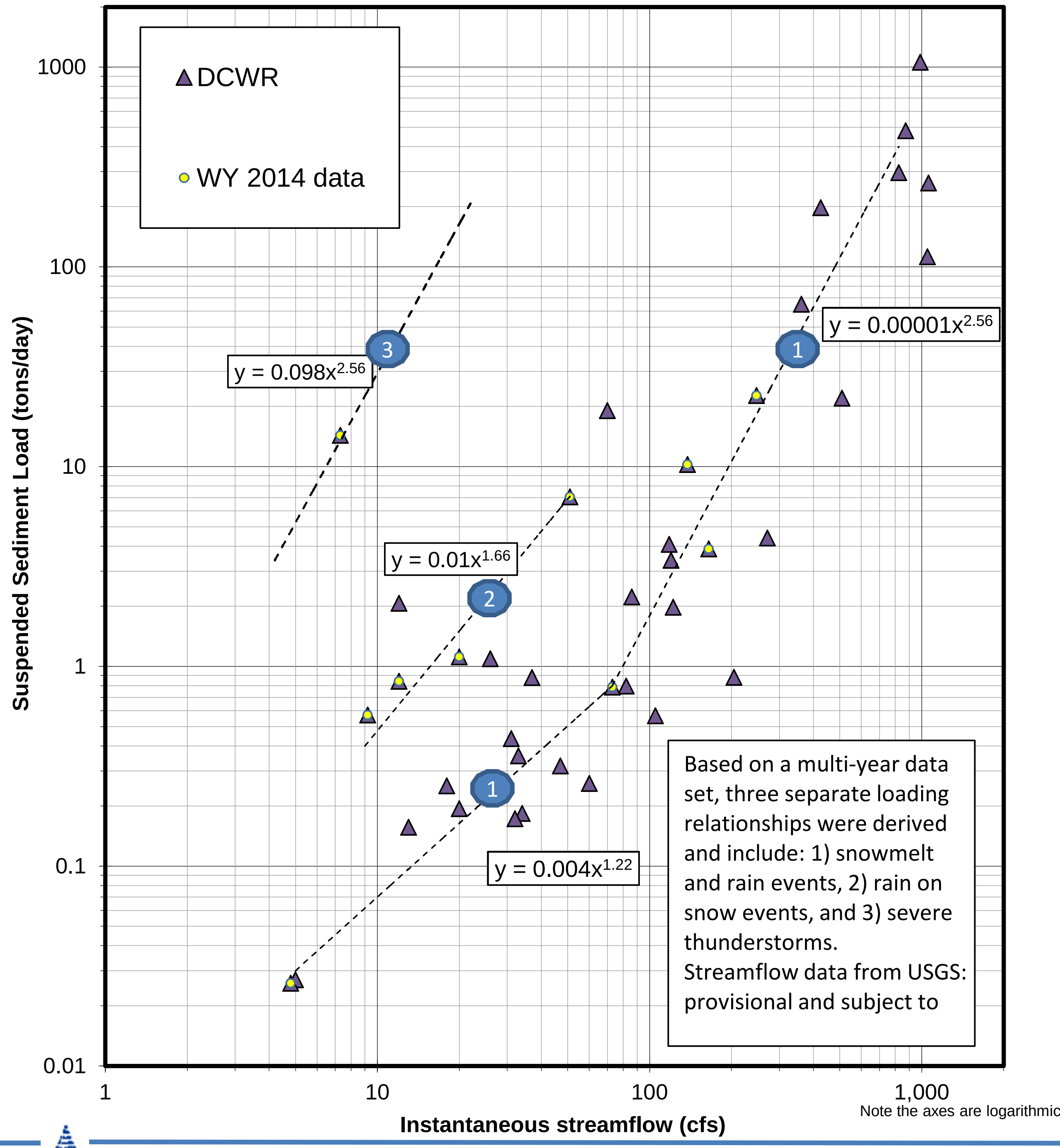
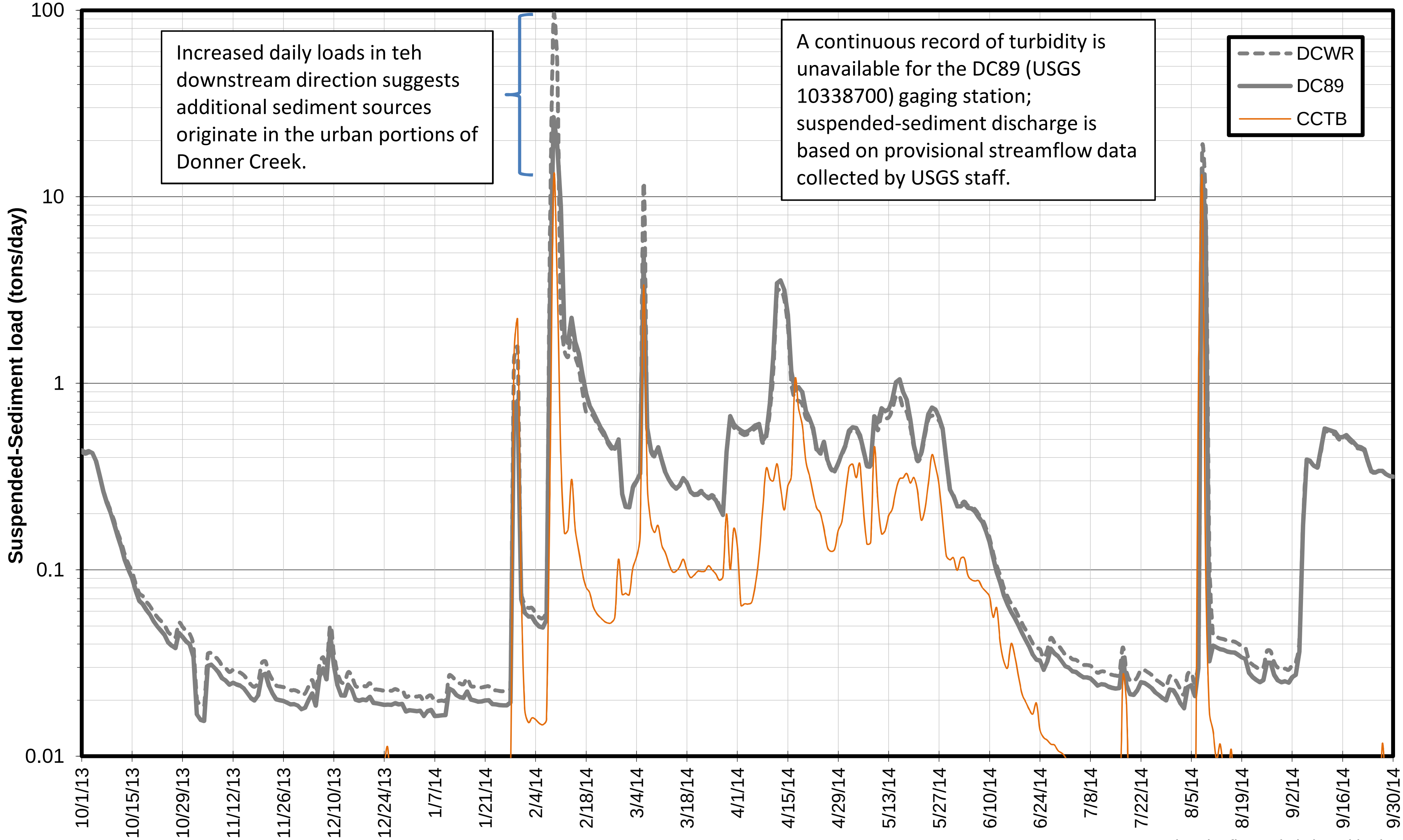



**Figure 10. Relationship between streamflow and suspended-sediment load, Donner Creek at Highway 89 (DC89), Truckee, California, water years 2011-2014.** As is typical, more suspended-sediment is transported at higher streamflows. The equations derived here are applied to the streamflow record to calculate suspended-seidment loading.




Balance Hydrologics, Inc.®

**Figure 11. Relationship between streamflow and suspended-sediment load, Donner Creek at West River Street (DCWR), Truckee, California, water years 2012-2014.**




Note that the flow axis is logarithmic.

Balance Hydrologics, Inc.

**Figure 12. Daily suspended-sediment loads, Donner Creek at Highway 89 (DC89) and Donner Creek at West River Street (DCWR), Truckee, California, water year 2014.** The suspended-sediment load for the DCWR station was calculated based on the provisional streamflow record for DC89 station, a short distance upstream. Cold Creek is shown for comparison (data based on near-continuous turbidity).

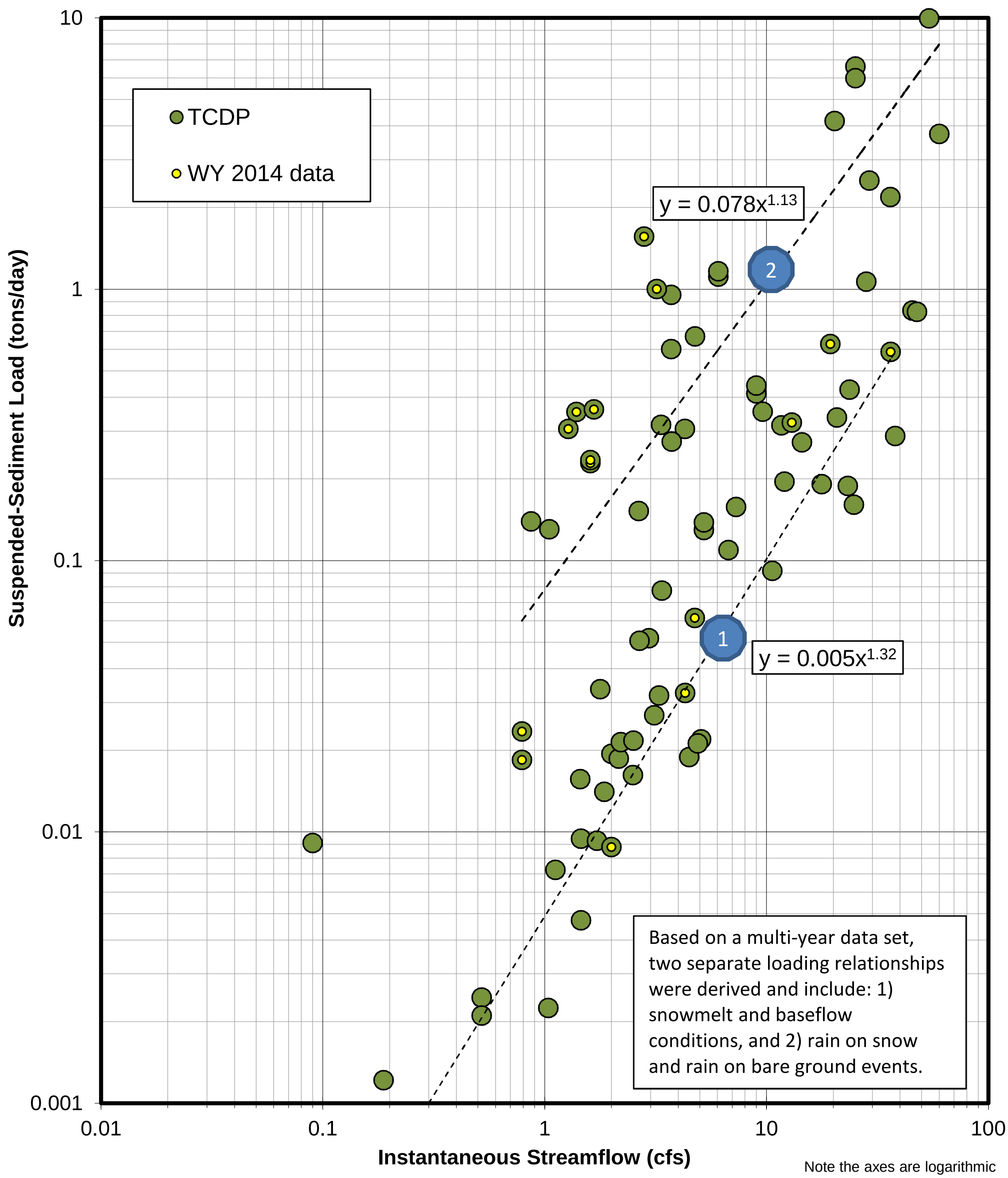



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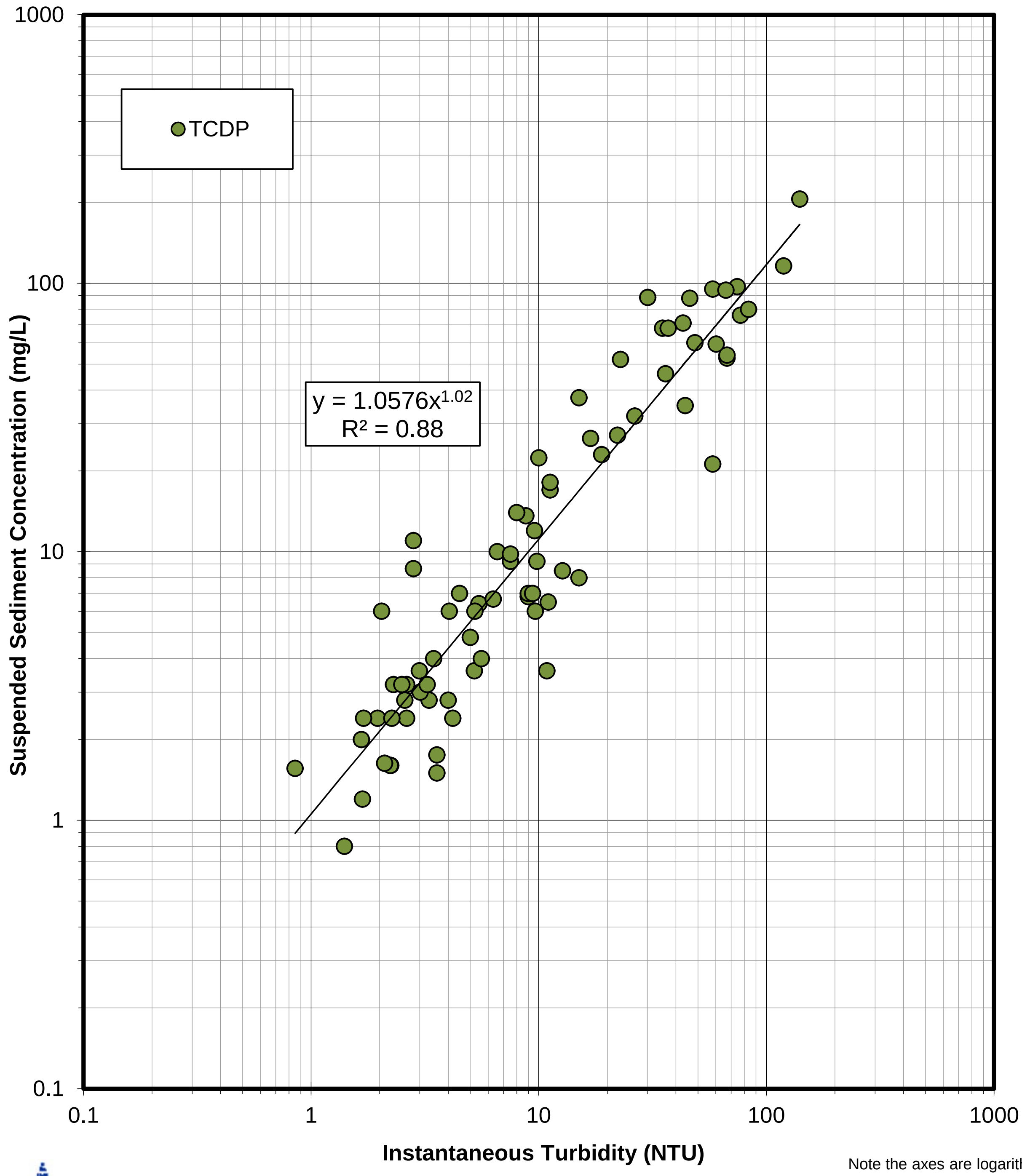
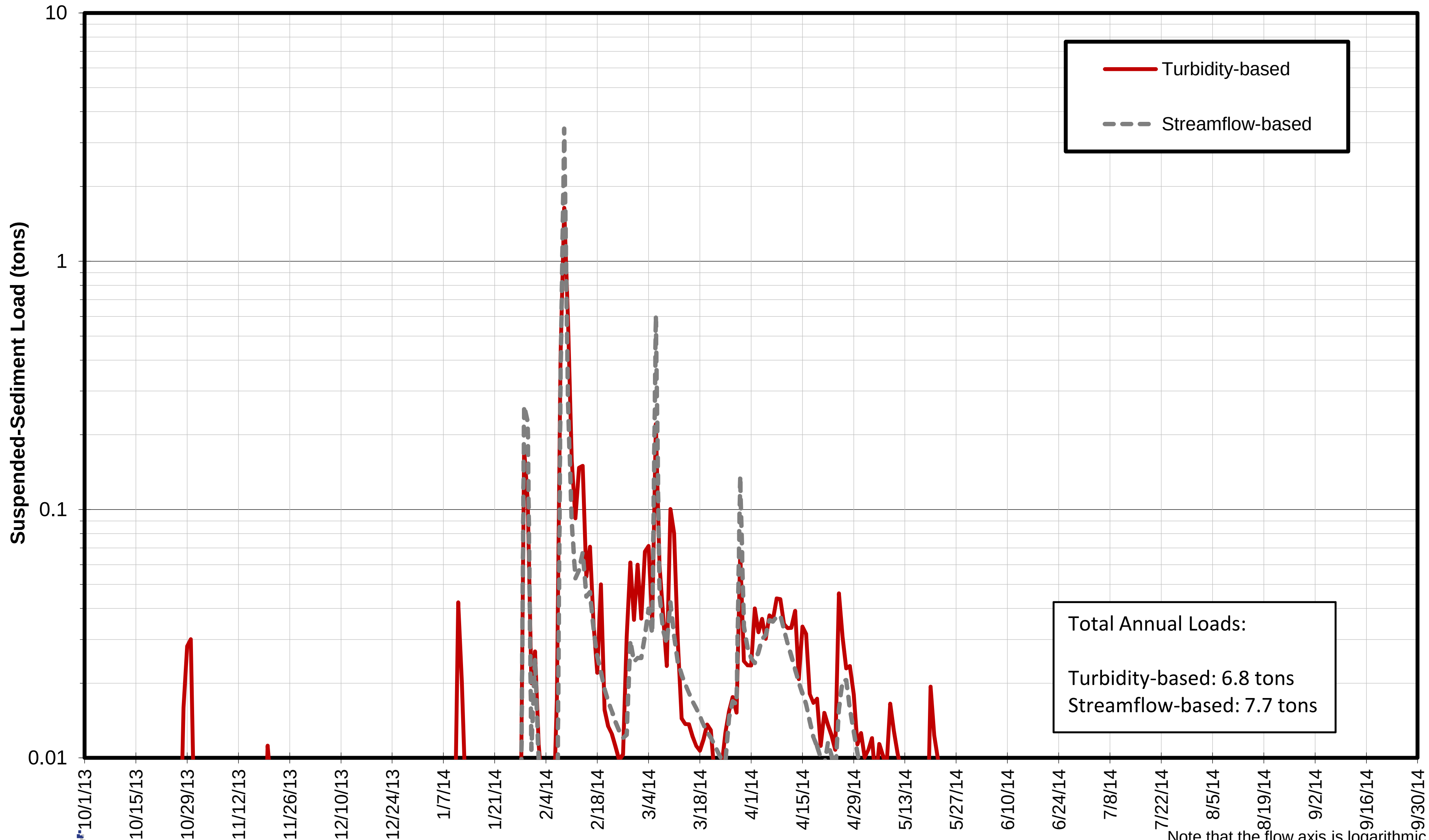
**Figure 13. Relationship between streamflow and suspended sediment load, Trout Creek at Donner Pass Road (TCDP), Truckee, California, water years 2011-2014.**




Note the axes are logarithmic

Balance Hydrologics, Inc.®

**Figure 14. Relationship between turbidity and suspended - sediment concentration, Trout Creek at Donner Pass Road (TCDP), Truckee, California, water years 2011-2014.**




Note that the flow axis is logarithmic.

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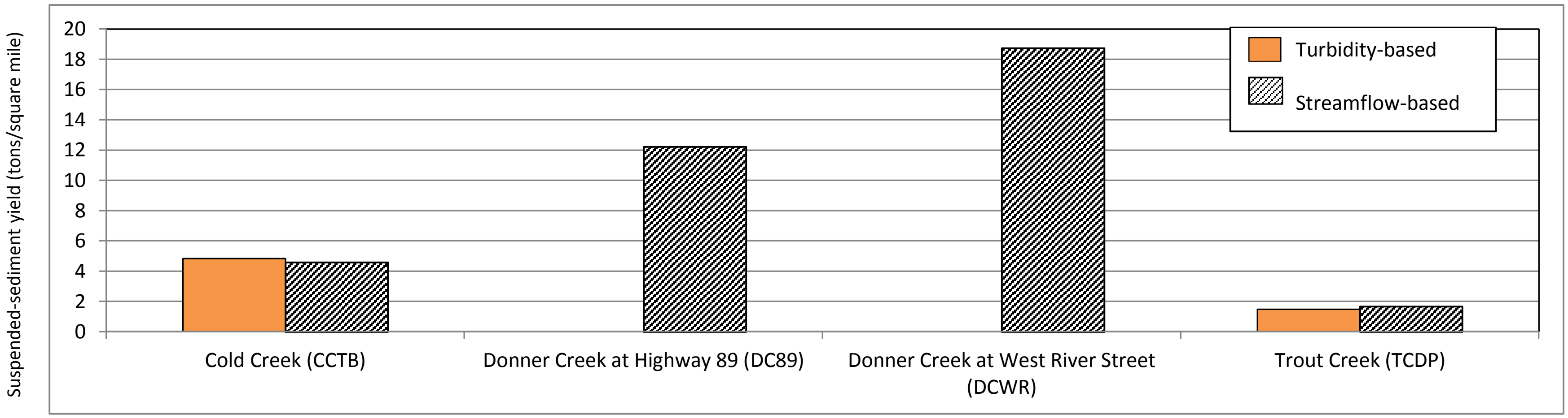
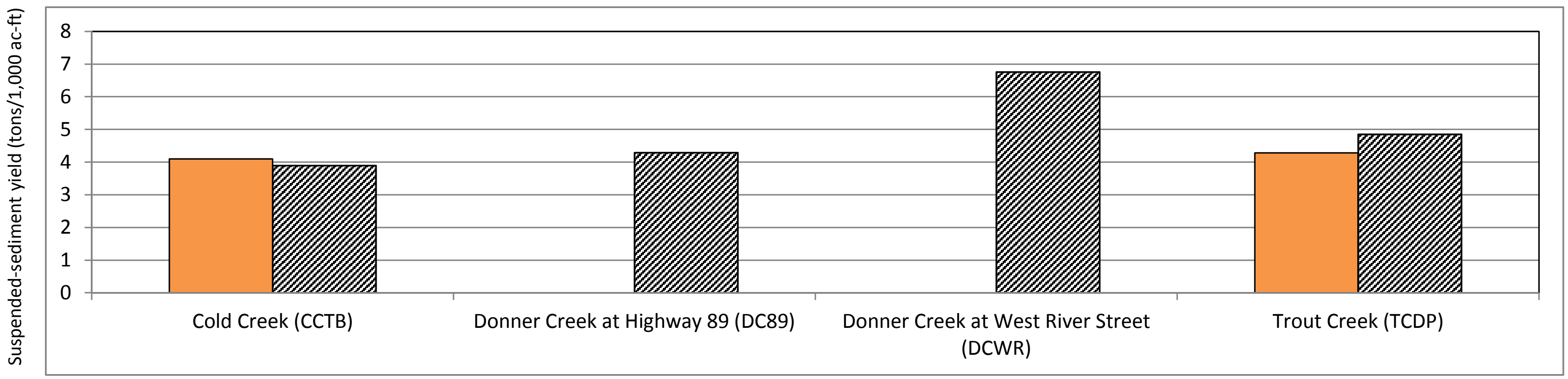
**Figure 15.** **Daily suspended-sediment load, Trout Creek at Donner Pass Road (TCDP), Truckee, California, partial water year 2014 (October 1, 2013 - July 1, 2014).** A comparison between both methods suggests a continuous record of turbidity may better capture discrete events and spring snowmelt runoff; while the standard sediment rating curve may overpredict loading on recessional limbs of storms and snowmelt runoff.



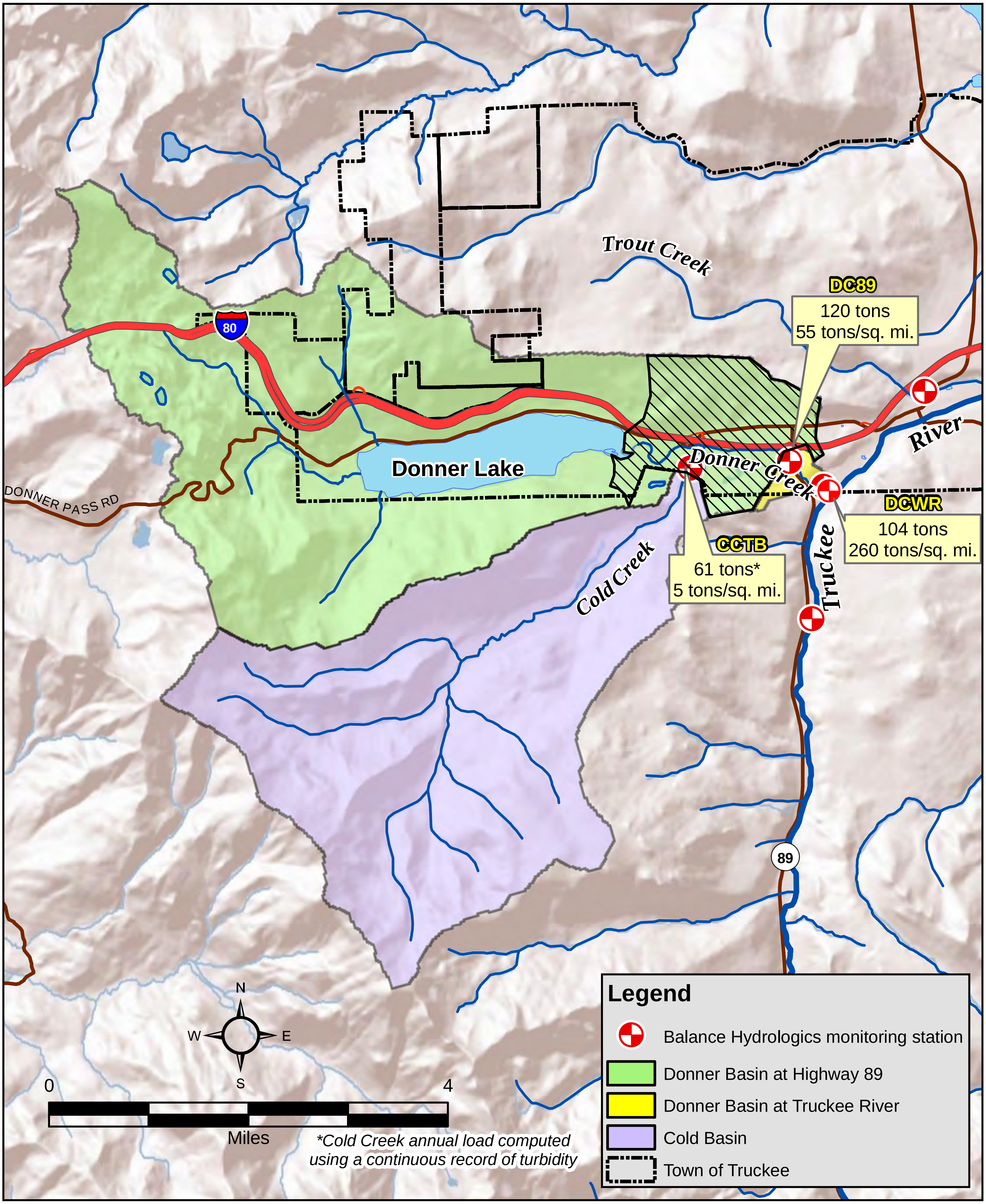

**(16a) Suspended-sediment loads, normalized by watershed area**




**(16b) Suspended-sediment loads, normalized by hydrology**

Balance Hydrologics, Inc.

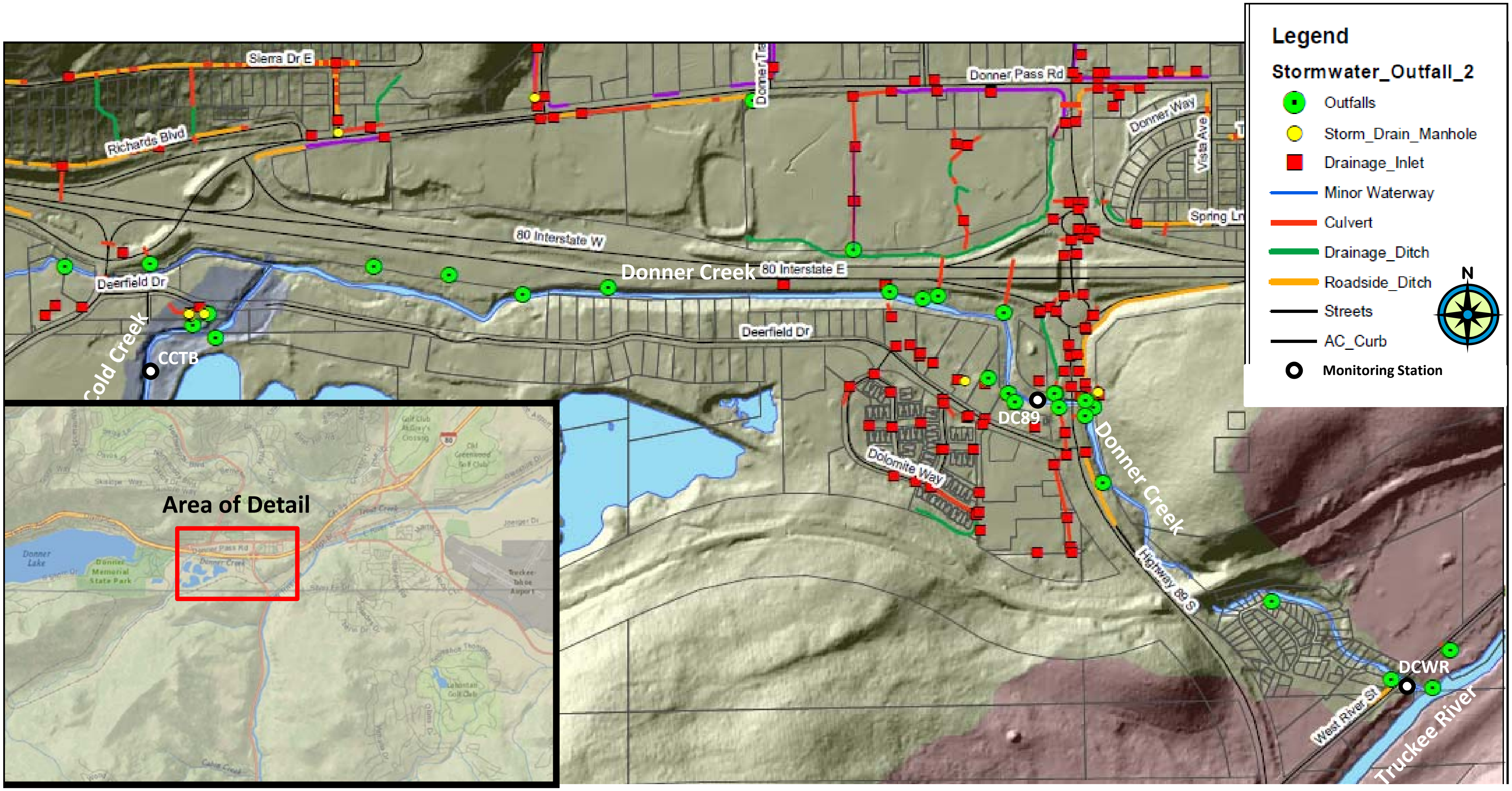
**Figure 16. Total annual suspended-sediment loads across all stations, normalized by watershed area (a) and runoff volume (b), Donner Creek, Cold Creek, and Trout Creek, near Truckee, California, water year 2014.** Data suggests Donner Creek exhibits high production rates of suspended-sediment relative to other tributaries.




Balance Hydrologics, Inc.

**Figure 17. Comparison of suspended-sediment loads and yields between stations, Donner and Cold Creek watersheds, Water Year 2014.**

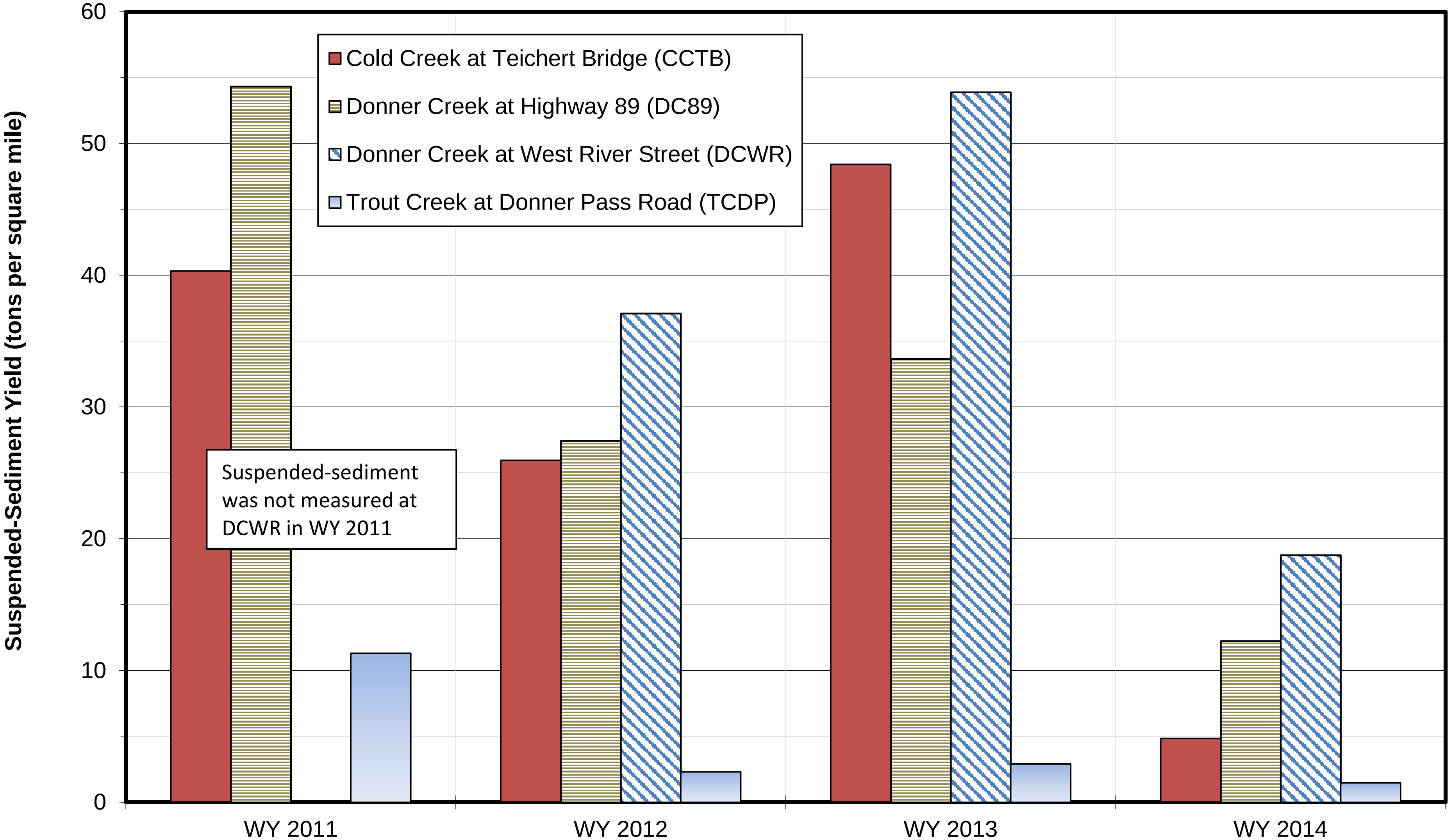
210011 Figure 17 sed-load comparison.mxd




Map Source: Town of Truckee, 2011

Balance Hydrologics, Inc.

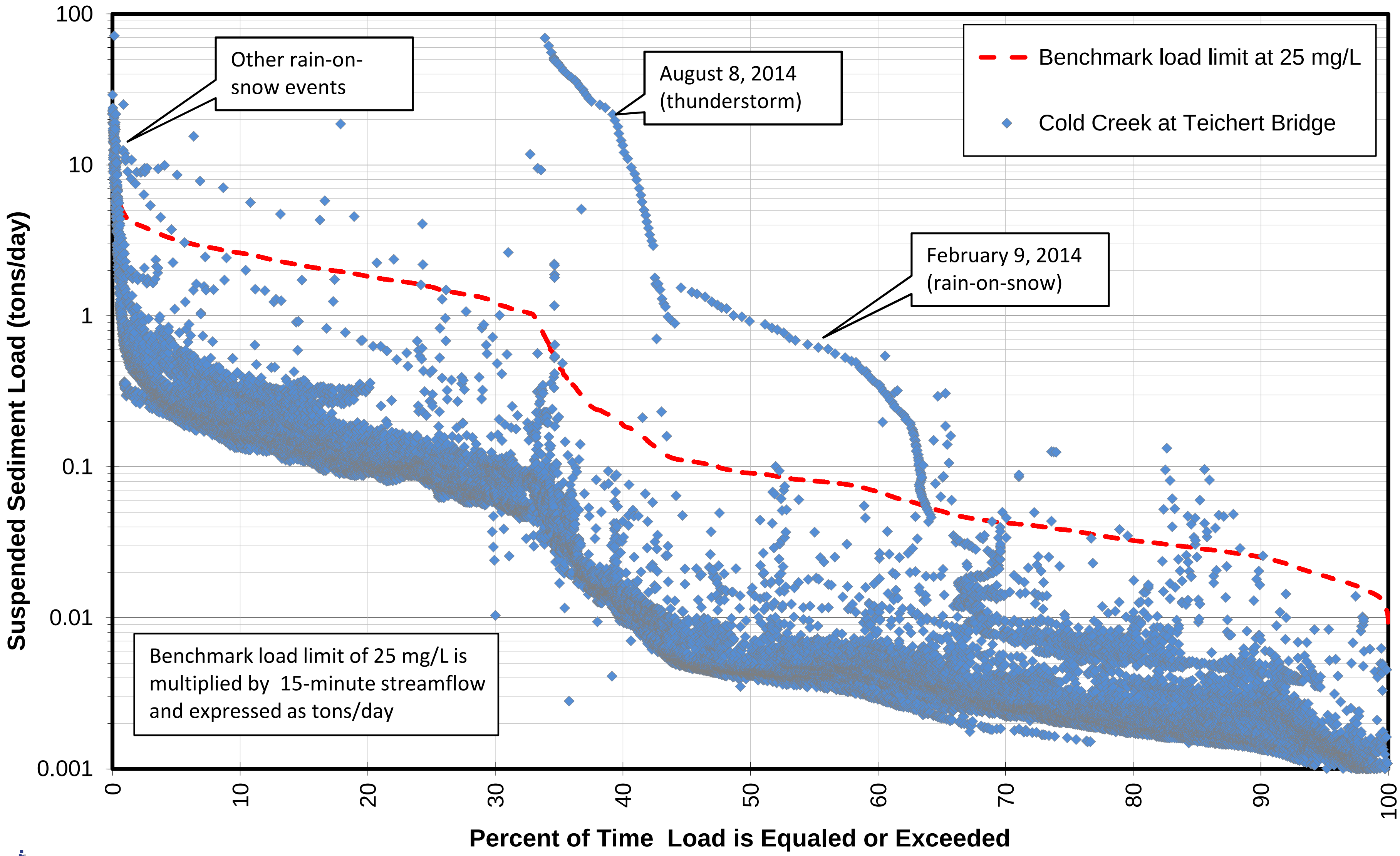
**Figure 18.** **Stormwater drainage (preliminary), Donner Creek below Cold Creek, Town of Truckee, California.** As many as 22 stormwater outfalls have been identified along Donner Creek between Donner Lake Dam downstream to the confluence with the Truckee River.




Balance Hydrologics, Inc.

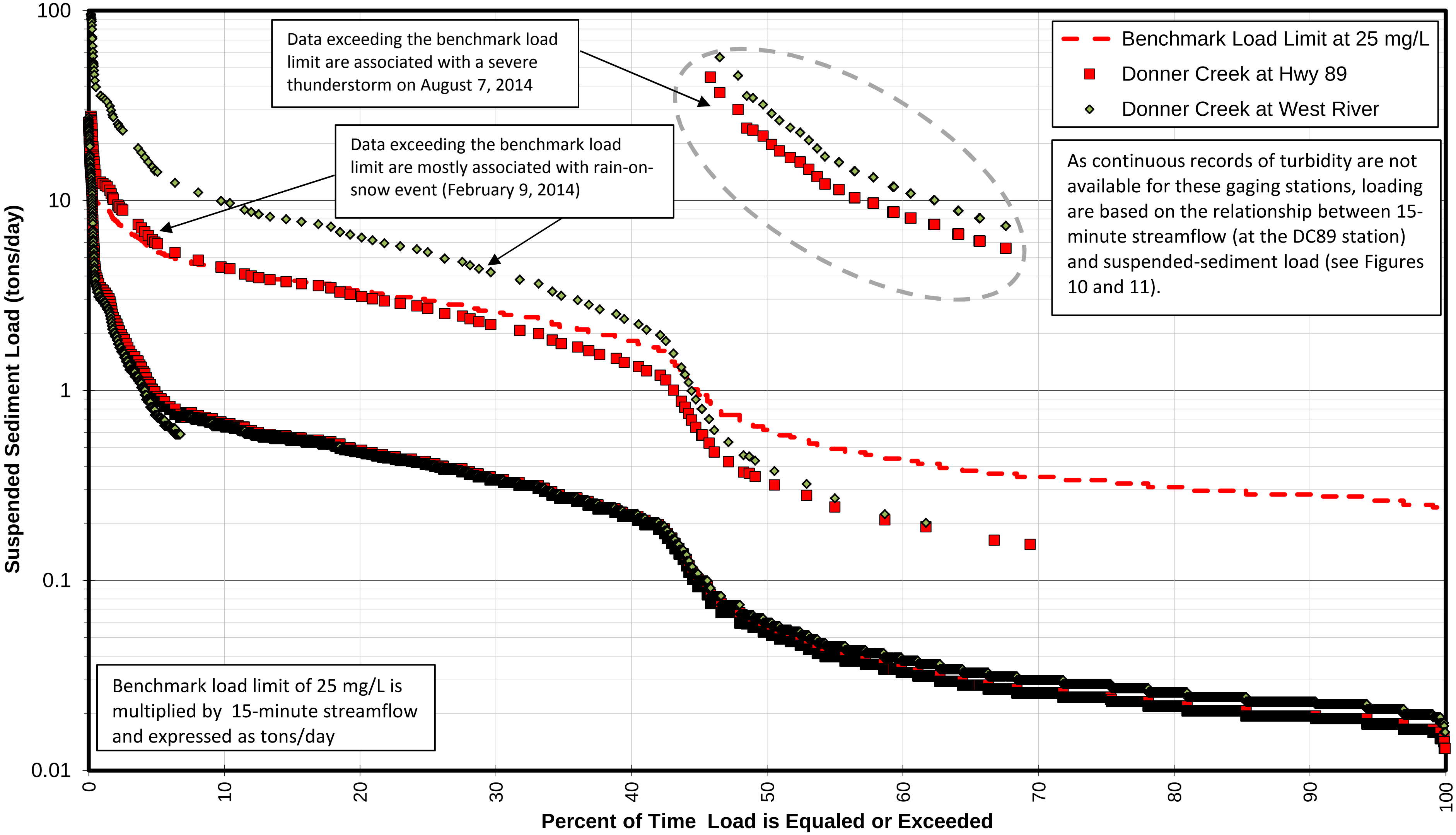
**Figure 19. Comparison of suspended-sediment loads across all stations and across all years, normalized by watershed area, Donner Creek, Cold Creek, and Trout Creek, near Truckee, California,.** Increases in yield over time may be the result of event types or isolated watershed disturbances. For instance, a WY 2013 rain-on-snow event may have triggered gully erosion or landslides in Cold Creek watershed.

210011 compare all WY14




Balance Hydrologics, Inc.

**Figure 20.** **Suspended-sediment load duration curve, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water year 2014.** The 25 mg/L benchmark was exceeded only 1 percent of the total time, and was within the 90th percentile and therefore met the TMDL. Single events such as the August 7, 2014 thunderstorm resulted in a significant suspended-sediment loading event the following day.




Note that the flow axis is logarithmic.

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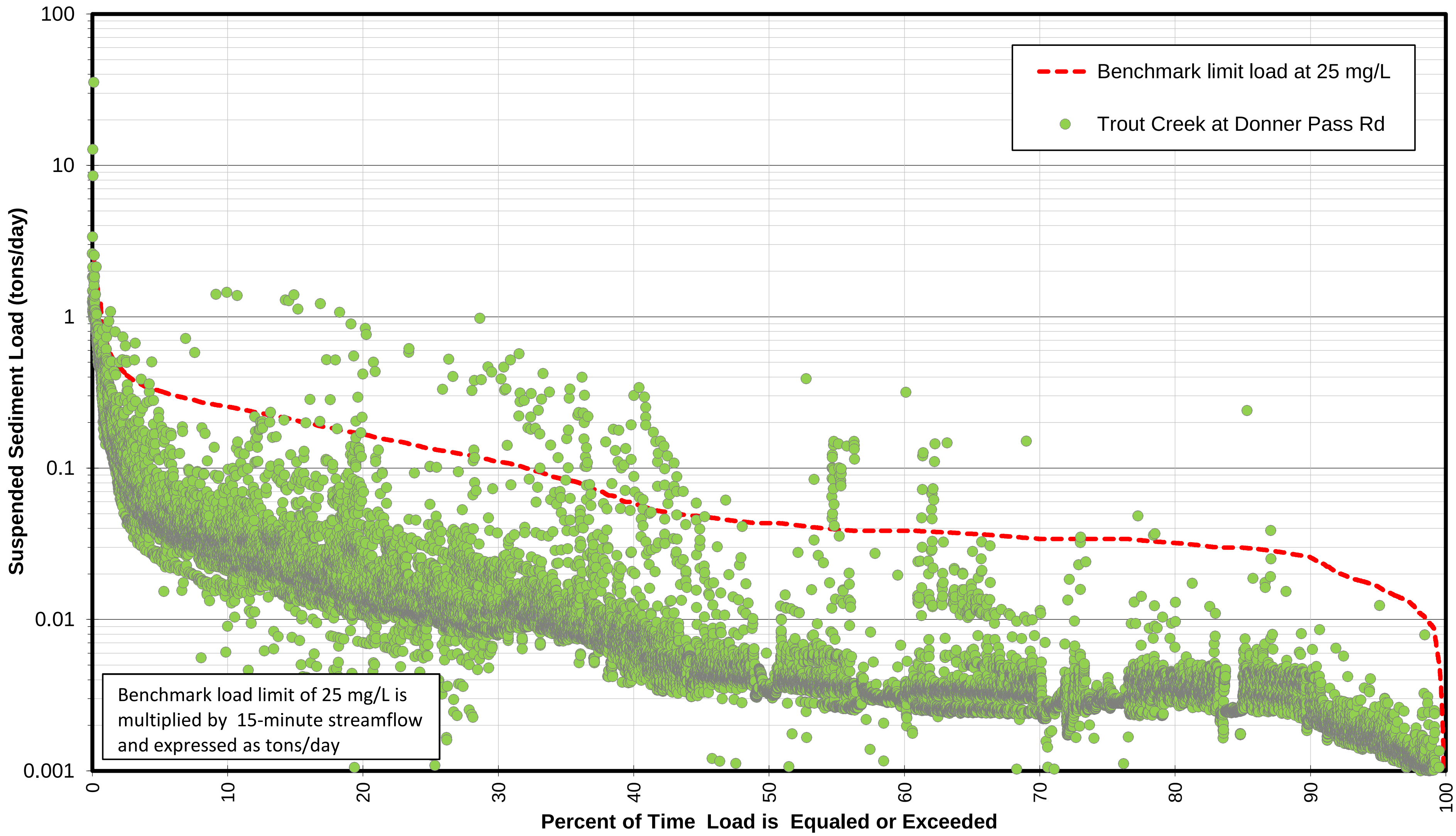
**Figure 21. Suspended-sediment load duration curves, Donner Creek at Highway 89 (DC89) and Donner Creek at West River Street (DCWR), Truckee, California, water year 2014.** Total loads and yields for these stations were higher than other tributaries; however, relative to the benchmark, these data show compliance with the TMDL.




Note that the flow axis is logarithmic.

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**Figure 22.** **Suspended-sediment load duration curve, Trout Creek at Donner Pass Road (TCDP), Truckee, California, partial water year 2014** Most of the time, suspended-sediment loads are well below the benchmark load limit for the Truckee River at Farad, The 25 mg/L benchmark load limit was exceeded less than 1.0 percent of the total time, based on 15-minute data.

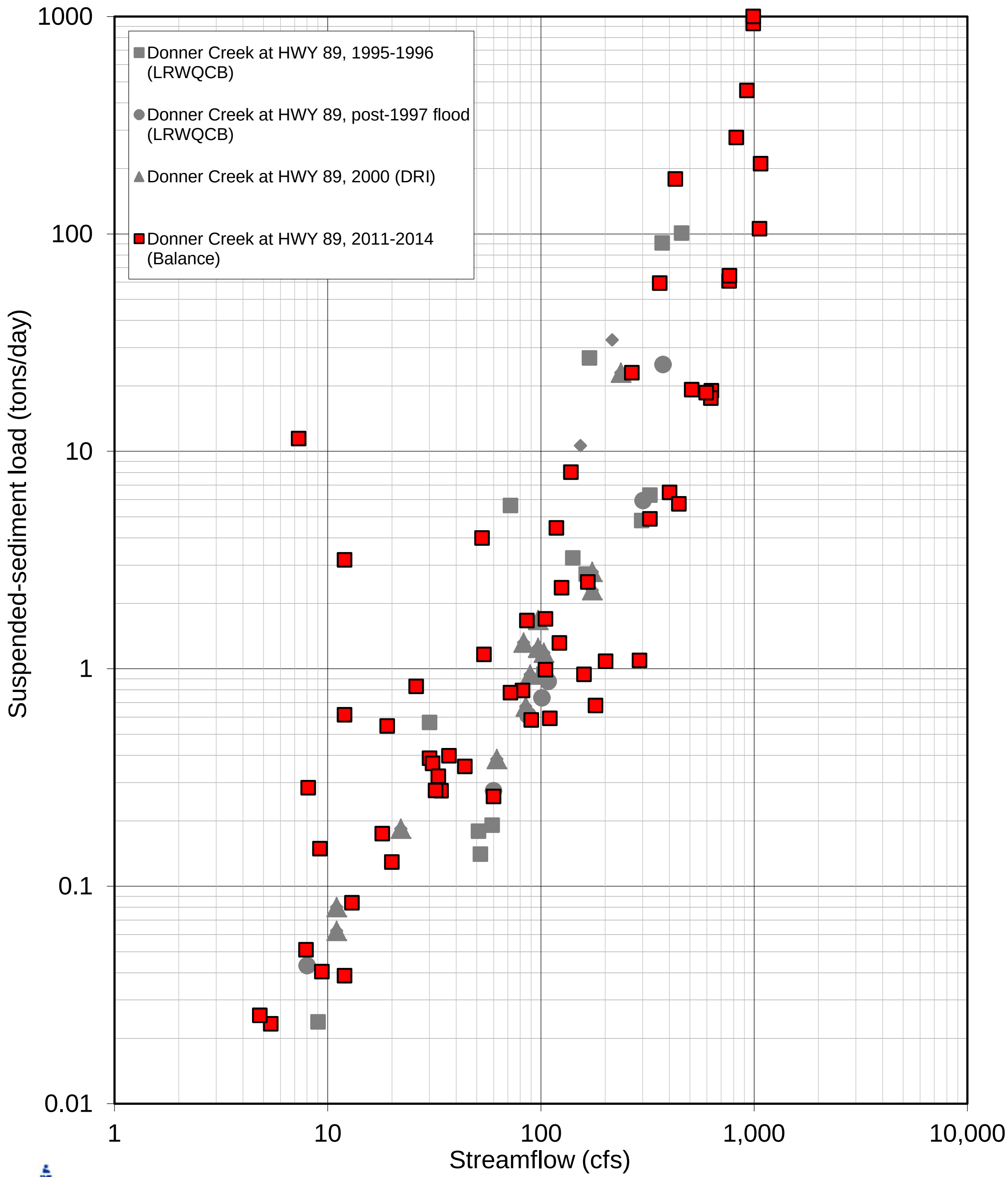


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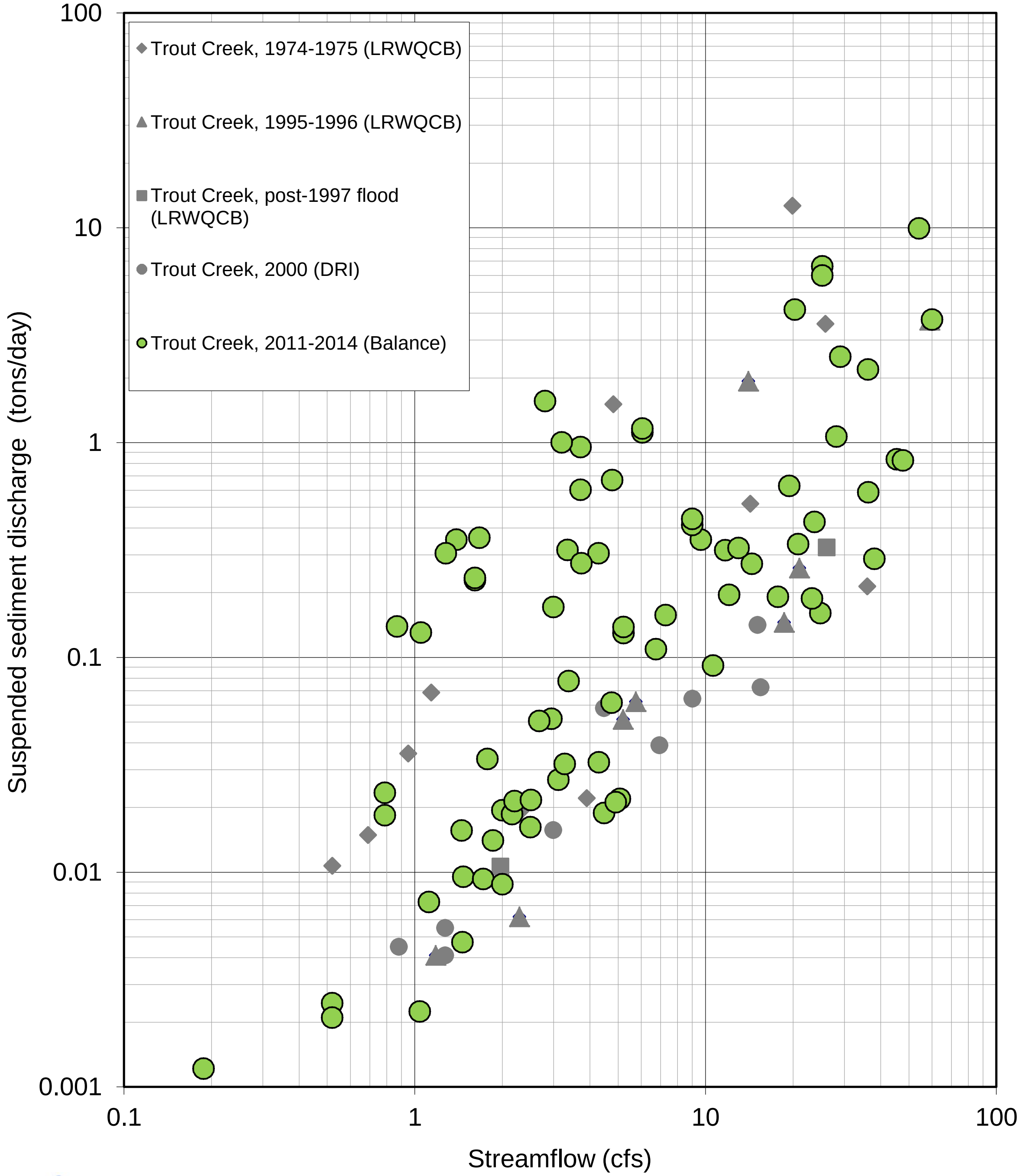
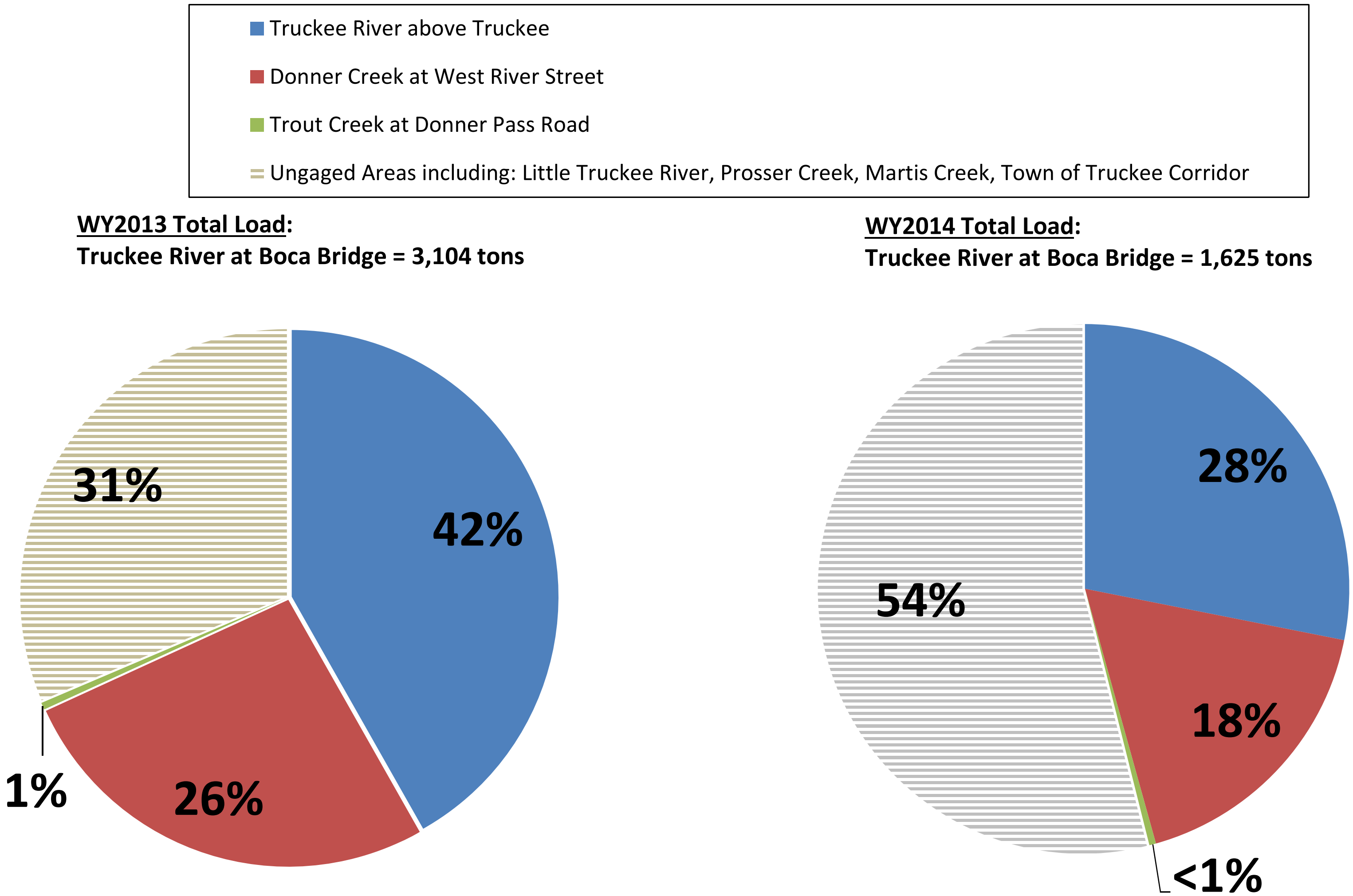
**Figure 23.** **Relationship between streamflow and suspended-sediment load for Donner Creek at Highway 89 (DC89), Truckee, California, water years 1996, 1997, 2000, 2011, 2012, 2013, and 2014.** Recent suspended-sediment loading rates at this station appear to be similar to historical loading rates, perhaps with the exception of intermediate flows.




Balance Hydrologics, Inc.®

**Figure 24. Relationship between streamflow and suspended-sediment load, Trout Creek at Donner Pass Road (TCDP), Truckee, California, water years 1974, 1975, 1996, 1997, 2000, 2011, 2012, 2013, and 2014.** Large scatter in both current and historical data may be related to event type, when higher loading may occur during rain on snow events




Balance Hydrologics, Inc.

**Figure 25. Total suspended -sediment loads for Middle Truckee River at Boca Bridge, evaluated by source areas, Water years 2013 and 2014.** Based on these data, contributions from tributaries can change from year to year . In both years, Donner Creek accounted for a significant proportion of the total load measured at Boca Bridge; however, these loads were less than the proportion from upstream sources in the Truckee River.

# APPENDICES

# APPENDIX A

## Streamflow gaging: Instrumentation and description of practice

# APPENDIX A. DEVELOPING A RECORD OF STREAMFLOW

## Station Instrumentation and Maintenance

The stream gages on Cold Creek and Trout Creek are equipped with Type C staff plates[1], continuous-logging, optical backscatter turbidity sensors (OBS 3+), and Druck® pressure transducers connected to a Campbell Scientific datalogger. Two pressure transducers are used at each station to improve data quality and to provide redundancy in the event that one sensor malfunctions or becomes blocked. Prior to installation, pressure transducers were tested and calibrated over the range of anticipated flow depths at each site. Sensor calibration while operating is documented by recording water levels at the time of each visit, as well as the height of any observed high-water marks deposited since the last visit. These observations are then compared with the electronic record upon downloading. Turbidity sensors were also calibrated prior to installation using laboratory standards covering the range of anticipated turbidity levels. The optical window in the sensor is cleaned frequently. The dataloggers operate on a solar-powered 12-volt battery contained within a locked, water-resistant and sealed, hard-case enclosure.

Balance staff made roughly monthly visits to each gaging station during WY 2012. During periods of rain or peak snowmelt, high-flow measurements were made more frequently. When manual flow and stage measurements were made, observers also recorded recent high-water marks (if visible), downloaded the dataloggers, inspected the probes, and replaced datalogger batteries and desiccant as necessary. In the event that any component is malfunctioning (i.e., pressure transducer), it is repaired or replaced as soon as possible.

The stream gage on Donner Creek at Highway 89 is operated and maintained by the USGS Carnelian Bay Field Office. The quality of the data from this gage is rated as fair by USGS, +/- 8 percent of actual streamflow, and is provided to the public initially as provisional data. Maintenance and calibration of this stream gage is managed by USGS staff.

[1] Type C is 2.5 inches wide, graduated to hundredths and marked at every foot and every tenth.

## Creating a Record of Streamflow

Balance utilizes standard streamflow equipment appropriate for the conditions encountered in the field, following standard USGS hydrographic practice (Carter and Davidian, 1968). This includes both hand-held, low-flow (Price Pygmy) and high-flow (Price Type-AA, or "Standard") bucket-wheel current meters. When conditions prevent safe entry into the stream, stream velocity-float measurements are conducted and a subsequent channel survey performed for the water level observed. Alternatively, when low-flow conditions prevail, alternative methods, acceptable by the USGS, are employed.

Based on periodic site visits, staff plate readings, and flow measurements, Balance creates and maintains a stage-to-discharge relationship ("stage-discharge rating curve") for each Balance-operated station where monitoring is conducted. Datalogger records of stream stage are corrected for instrument drift. The stage record obtained using the datalogger and pressure transducers is converted to a flow record using the station-specific stage-discharge rating curve. Stage shifts, usually caused by scour or deposition or ice and snow, are applied to the record of flow when necessary.

# APPENDIX B1

## USGS annual hydrologic record, Donner Creek at Highway 89 (USGS 10338700), Truckee, California, water year 2013

| | |
|---|---|
| **Water Year:** | **2014** |
| **Stream:** | Donner Creek |
| **Station:** | above Highway 89 |
| **County:** | Nevada County, California |

# Appendix B1. Annual Hydrologic Record, WY 2014

**Station Location / Watershed Descriptors**

Location: 39° 19' 15.5" N, 120° 12' 28.6" W (WGS84), near Truckee, California. Gage is located upstream of the Highway 89 bridge on the south bank
Land use includes former quarrying, timber harvesting, open space, Union Pacific RR, Interstate highway, and rural residential; Flows are regulated at Donner Lake Dam
Topographic drainage area is 29.1 square miles.

**Mean Annual Flow**

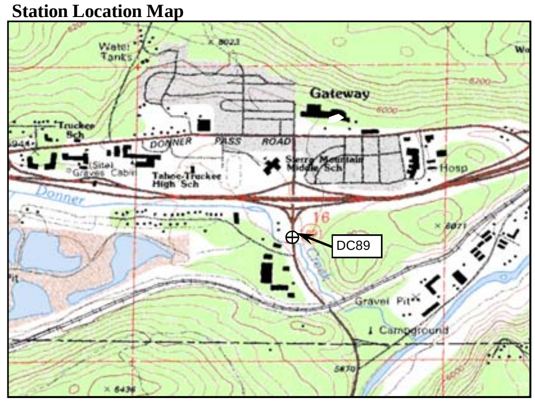
Mean daily flow for WY 2014 is 27 cfs.

**Peak Flows (WY 2014)**

| Date | Time (24-hr) | Gage Ht. (feet) | Discharge (cfs) | Date | Time (24-hr) | Gage Ht. (feet) | Discharge (cfs) |
|---|---|---|---|---|---|---|---|
| 1/30/14 | 0:30 | 3.95 | 64 | | | | |
| **2/9/14** | **19:45** | **4.92** | **327** | | | | |
| 3/6/14 | 7:00 | 4.29 | 147 | | | | |
| 4/12/14 | 20:30 | 4.34 | 156 | | | | |
| 5/15/14 | 20:00 | 4.08 | 107 | | | | |

Extreme for period of record (WY1993-WY2014) is 2,500 cfs (estimated) on January 2, 1997

**Station Location Map**




**Period of Record**

Gaging station is operated by USGS
WY1993- to current water year

## Appendix B1. Annual hydrologic record, Donner Creek at Highway 89 (DC89), USGS 10338700, Truckee, California, water year 2014

**WY 2014 Daily Mean Flow (cubic feet per second)**

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 46.0 | 6.5 | 3.9 | 3.9 | 9.8 | 27.0 | 57.3 | 49 | 27.1 | 6.0 | 4.5 | 5.1 |
| 2 | 45.3 | 3.8 | 4.0 | 3.9 | 9.5 | 26.8 | 55.7 | 56 | 27.1 | 5.9 | 4.2 | 5.3 |
| 3 | 45.8 | 3.6 | 4.3 | 3.9 | 9.5 | 32.4 | 54.7 | 58 | 27.9 | 5.7 | 4.0 | 5.5 |
| 4 | 45.0 | 3.5 | 4.6 | 3.7 | 9.0 | 34.4 | 55.4 | 57 | 26.7 | 5.6 | 4.9 | 6.7 |
| 5 | 42 | 6.0 | 4.1 | 3.9 | 8.6 | 37.3 | 56.9 | 53 | 26.6 | 5.5 | 5.0 | 21.3 |
| 6 | 36 | 6.0 | 5.3 | 3.9 | 8.6 | 95.6 | 58.5 | 46 | 25.8 | 5.3 | 4.5 | 42.3 |
| 7 | 31 | 5.8 | 5.7 | 3.7 | 9.2 | 56.9 | 59.3 | 40 | 24.5 | 5.3 | 5.6 | 41.8 |
| 8 | 28 | 5.6 | 5.2 | 3.7 | 41.1 | 46.3 | 50.4 | 40 | 23.3 | 5.3 | 8.0 | 39.9 |
| 9 | 26 | 5.3 | 7.9 | 3.7 | 239.7 | 44.0 | 53.2 | 64 | 21.4 | 5.1 | 5.9 | 39.1 |
| 10 | 23 | 5.2 | 6.0 | 3.7 | 186.8 | 47.4 | 68.5 | 60 | 19.3 | 5.1 | 6.2 | 46.8 |
| 11 | 20 | 5.1 | 5.0 | 4.8 | 125.6 | 42.2 | 92.6 | 69 | 16.6 | 5.0 | 7.2 | 56.7 |
| 12 | 18 | 5.1 | 4.5 | 4.7 | 104.9 | 37.5 | 138.9 | 67 | 14.5 | 5.0 | 7.1 | 56.1 |
| 13 | 16 | 5.0 | 4.5 | 4.5 | 101.6 | 35.0 | 141.3 | 69 | 13.1 | 4.9 | 7.0 | 55.4 |
| 14 | 15 | 4.9 | 4.9 | 4.4 | 116.1 | 33.1 | 134.5 | 73 | 11.6 | 4.8 | 6.9 | 54.9 |
| 15 | 14 | 4.8 | 4.7 | 4.4 | 102.4 | 32.1 | 116.5 | 82 | 10.6 | 4.8 | 6.8 | 52.3 |
| 16 | 12 | 4.6 | 4.3 | 4.7 | 96.1 | 33.0 | 84.8 | 84 | 9.9 | 4.8 | 6.8 | 52.4 |
| 17 | 11.0 | 4.4 | 4.3 | 4.3 | 86.2 | 35.4 | 73.4 | 79 | 9.4 | 6.3 | 6.8 | 53.3 |
| 18 | 10.7 | 4.3 | 4.3 | 4.3 | 78.1 | 33.9 | 79 | 75 | 8.8 | 5.0 | 6.6 | 51.5 |
| 19 | 10.1 | 4.5 | 4.3 | 4.2 | 72.1 | 31.1 | 77 | 62 | 8.2 | 4.6 | 6.5 | 49.9 |
| 20 | 9.7 | 5.4 | 4.4 | 4.3 | 66.3 | 30.2 | 68 | 48 | 7.6 | 4.5 | 6.4 | 48.0 |
| 21 | 9.1 | 5.5 | 4.2 | 4.3 | 61.7 | 30.3 | 63 | 42 | 7.1 | 4.7 | 5.6 | 47.5 |
| 22 | 8.7 | 4.9 | 4.2 | 4.3 | 57.5 | 31.1 | 57 | 44 | 6.6 | 5.3 | 5.4 | 46.5 |
| 23 | 8.3 | 4.6 | 4.1 | 4.1 | 54.3 | 30.1 | 47 | 53.6 | 6.3 | 5.1 | 5.2 | 41.7 |
| 24 | 8.0 | 4.3 | 4.1 | 4.1 | 50.5 | 29.2 | 45 | 65.8 | 6.3 | 5.0 | 5.1 | 37.8 |
| 25 | 7.5 | 4.3 | 4.1 | 4.1 | 47.8 | 29.8 | 50 | 69.8 | 5.7 | 4.8 | 5.2 | 37.3 |
| 26 | 7.2 | 4.3 | 4.1 | 4.1 | 46.9 | 28.7 | 42 | 68.9 | 6.2 | 4.6 | 6.2 | 37.9 |
| 27 | 7.0 | 4.2 | 4.2 | 4.1 | 50.6 | 26.8 | 39 | 63.1 | 7.0 | 4.5 | 6.1 | 38.0 |
| 28 | 8.2 | 4.1 | 4.1 | 4.2 | 30.4 | 25.0 | 38 | 56.5 | 6.7 | 4.4 | 5.5 | 36.8 |
| 29 | 7.9 | 4.1 | 4.1 | 14.2 | | 44.8 | 41 | 41.8 | 6.5 | 4.4 | 5.2 | 36.2 |
| 30 | 7.5 | 4.1 | 3.9 | 23.4 | | 63.8 | 45 | 31.7 | 6.2 | 4.7 | 5.1 | 36.0 |
| 31 | 7.3 | | 3.9 | 11.2 | | 59.1 | | 29.7 | | 4.7 | 5.1 | |
| MEAN | 19 | 4.8 | 5 | 5.3 | 67.2 | 38.4 | 68 | 58 | 14 | 5 | 5.8 | 39.3 |
| MAX. DAY | 46 | 6.5 | 8 | 23.4 | 239.7 | 96 | 141 | 84 | 28 | 6 | 8.0 | 56.7 |
| MIN. DAY | 7.0 | 3.5 | 3.9 | 3.7 | 8.6 | 25.0 | 38 | 30 | 6 | 4.4 | 4.0 | 5.1 |
| cfs days | 592 | 144 | 141 | 165 | 1881 | 1190 | 2042 | 1797 | 425 | 157 | 180 | 1180 |
| ac-ft | 1174 | 285 | 280 | 327 | 3731 | 2361 | 4049 | 3564 | 843 | 311 | 358 | 2341 |

**Monitor's Comments**

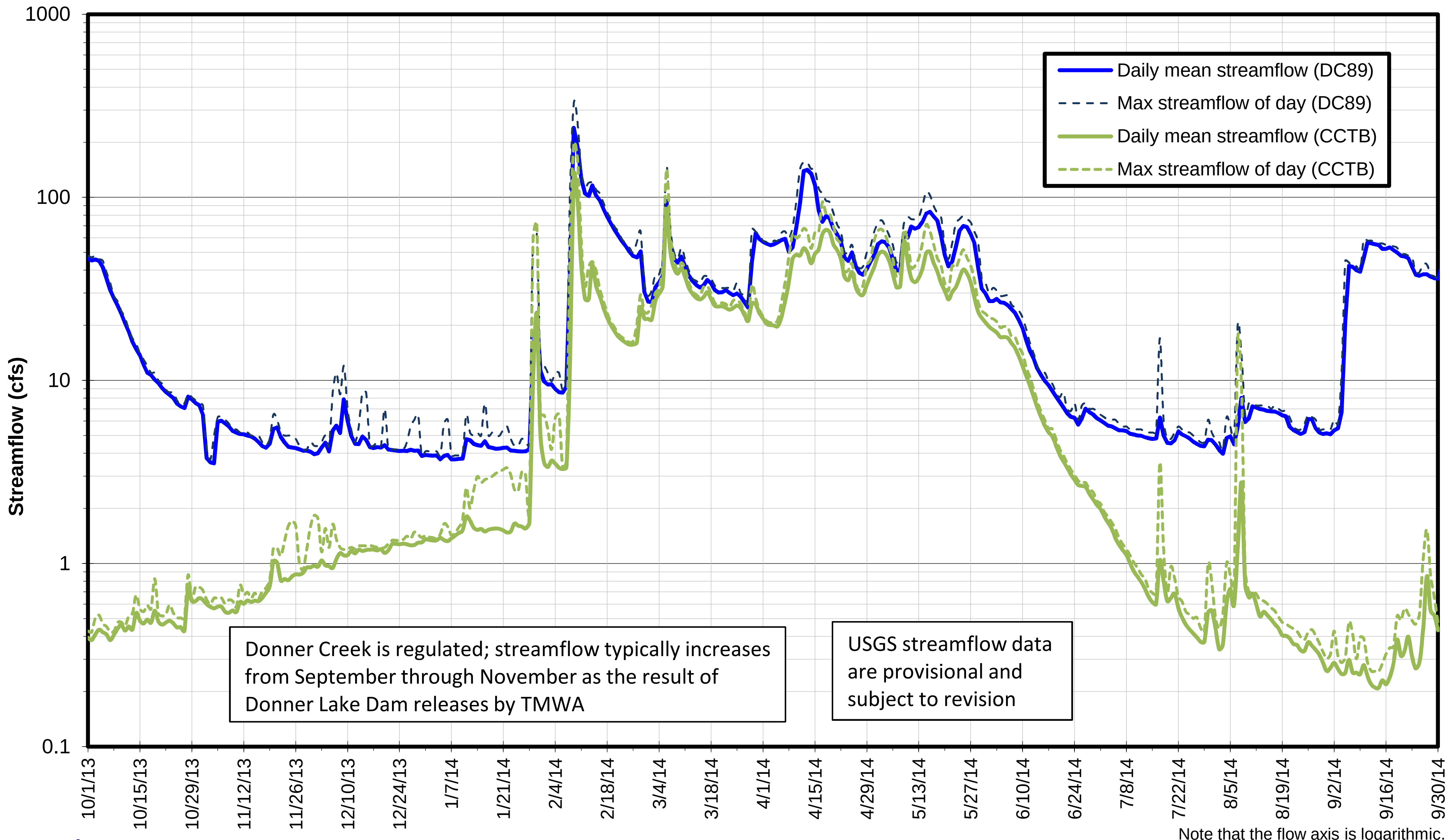
1. USGS provisional data, subject to revision
2. Gaging station location: 39° 19' 15.5" N, 120° 12' 28.6" W (WGS84), in Truckee, California. Gage is located approx. 0.59 miles upstream from the confluence with Truckee River
3. Drainage area is 29.1 square miles above the gaging station; land use includes historical quarrying, timber harvesting, Union Pacific RR portions of Interstate Highway 80, residential and commercial zoned areas, and open space.
4. About half the drainage area is regulated by Donner Lake Dam
5. Streamflow includes contributions from Cold Creek
6. Gaging station period of record: WY1993 to current water year
7. Real-time data available at http://www.waterdata.usgs.gov/ca/nwis

| Water Year 2014 Totals: | | |
|---|---|---|
| **Mean flow** | **27** | (cfs) |
| **Max. daily flow** | **240** | (cfs) |
| **Min. daily flow** | **3.5** | (cfs) |
| **Annual total** | **9,893** | (cfs-days) |
| **Annual total** | **19,624** | (ac-ft) |

**Data provided by United State Geological Survey (USGS), Truckee Field Office**

# APPENDIX B2

## USGS streamflow hydrograph, Donner Creek at Highway 89 (USGS 10338700), Truckee, California, water year 2013




Balance Hydrologics, Inc.

**Appendix B2. Streamflow hydrograph, Donner Creek at Highway 89 (USGS 10338700), Truckee, California, water year 2014.** Streamflow at Donner Creek at Highway 89 (DC89) includes the Cold Creek tributary. For comparison, the streamflow hydrograph for Cold Creek at Teichert Bridge (CCTB) is shown. Timing and magnitude of peak flows and trends are consistent between both gages. Differences in baseflow at the beginning and end of the record are related to annual releases to Donner Creek from Donner Lake.

210011 DC89 Daily Sums WY2014