Middle Truckee River
Total Maximum Daily Load (TMDL)
Suspended Sediment Monitoring Report
Water Year 2012
Nevada County, California

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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 second 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 all three tributaries (Cold, Trout and Donner Creek) continued during water year 2012, with expansion of the monitoring program to include real-time data access via the internet and additional suspended-sediment sampling on Donner Creek at West River Street, the confluence with the Truckee River. Monitoring, analysis and computations are used to characterize suspended-sediment production and delivery (i.e. loads) from watersheds with differing land cover, and compare suspended-sediment loads for water year 2012 to measurements and estimates from previous years. We also compare suspended-sediment loads and load durations to the target 90th percentile 25 mg/L suspended-sediment concentration benchmark set forth in the TMDL.

On Trout Creek and Cold Creek, we calculate 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. Our conclusions can be summarized as follows:

- Water year 2012 was a below-average precipitation year, with annual precipitation only roughly 62 percent of the long-term average; however, the annual peak flow this year was larger than in water year 2011. Streamflows quickly receded after the limited and early snowmelt in April 2012 and, regionally, summer baseflows were at their lowest levels since 2009.
- The two methods of calculating suspended-sediment loads produced generally consistent results. Total annual suspended-sediment loading from Cold Creek during water year 2012 was calculated to be 213 tons using the streamflow-based method, and and 327 tons using the turbidity-based method. Total suspended-sediment loading from Donner Creek and Cold Creek combined, calculated using the streamflow-based method, was 406 tons at Highway 89. However, loading increased to 564 tons only a short distance downstream immediately above the confluence with the Truckee River. Total suspended sediment loading from Trout Creek during water year 2012 was calculated to be 15.5 tons using the streamflow-based method, and 10.6 tons using the turbidity-based method.
- In water year 2012, load duration curves for Cold Creek, Donner Creek and Trout Creek showed that these streams met the target 90th percentile suspended-sediment concentration of less than or equal to 25 mg/L established in the Middle Truckee River Sediment TMDL.

1. INTRODUCTION AND PROJECT PURPOSE

1.1 Introduction

This report is the second annual report of a multi-year study of the relationship between streamflow and 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, State Water Resources Control Board (SWRCB) 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 Water Board).

Excessive sediment and its effects on aquatic habitat have been well documented in the literature. 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 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 RWQCB, 2008).

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 (**Figure 1**) set at 40,300 tons per year. 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 used for this study. Balance installed two of the gaging stations, then monitored continuous streamflow and turbidity and collected suspended-sediment samples over a range of flows and at each station during water year 2012 (WY 2012). [1]

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 2012:

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

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.

[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. For example, water year 2012 began on October 1, 2011 and ended on September 30, 2012.

1.2 Project Purpose

This report presents monitoring results from water year 2012, the second year of a multi-year monitoring program at three of the gaging stations and the first year of monitoring at station DCWR. The objectives of this report are to :

- Briefly describe what, where, and how measurements were made for parameters such as streamflow, suspended-sediment concentration, turbidity, specific conductance, and water temperature[2];
- Interpret the resulting flow, turbidity and suspended-sediment monitoring data;
- Summarize and report daily and annual streamflows, and suspended-sediment loads for all four stations, and;
- Compare WY 2012 suspended-sediment loads with historical loads and those computed for this study based on WY2011 monitoring results (Hastings and others, 2012).

1.3 Hydrologic Setting

As shown in **Figure 1**, the Upper Truckee River Basin includes the waters of Lake Tahoe. The Middle Truckee River flows out of Lake Tahoe at Tahoe City, then flows through Truckee, with this segment terminating at Farad, California, the border with Nevada. 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). 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 to 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 8,836 feet[3] at the crest of the Sierra Nevada Mountains and receives a total average-annual precipitation of 48.9 inches (USGS Streamstats, 2012). 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.

[2] 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.
[3] All elevations are presented relative to mean sea level (msl).

Consequently, the annual pattern of streamflow tends to be dominated by spring snowmelt, punctuated by increases from occasional rain events.

The Cold Creek watershed[4] 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). Historic 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 highway 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, 2012). 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 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

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

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 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. Subsequently, 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 residential area within the Town of Truckee, slightly east of the crest of the Sierra Nevada Mountains. 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. 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). For instance, the upper watershed's southern boundary is controlled by a glacial moraine crest which separates Trout Creek from Donner Lake (Birkeland, 1963). Most of the upper watershed is occupied by the Tahoe Donner residential subdivision, one of California's largest single developments. 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 maximum annual peak flow 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 maximum annual peak flow for the period of record was measured at 2,500 cfs on January 2, 1997. This study utilizes the downstream Donner Creek at Highway 89 (DC89) gaging station 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 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).

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 **Chapter 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.

On August 29, 2011, stream restoration activities began on the lower reach of Trout Creek, requiring temporary relocation of the Trout Creek station beginning on September 2, 2011. Balance staff and the Town of Truckee identified a suitable location on the right (west) bank, approximately 35 feet upstream from Jibboom Street, or approximately 850 feet upstream from Donner Pass Road. The new site was upstream from several stormwater outfalls previously included in the gaging record. The temporary gage was restored to its original location two months later on November 3, 2011.

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 record for this gage is from March 1993 (WY 1993) through the current water year. This USGS-operated gaging 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[5]. 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.** Monitoring began at this station in January 2012. 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 large stormwater outfalls. For the purposes of computing suspended-sediment yields at this gage, this report uses a watershed area of 15.2 square miles for DCWR, excluding the upper watershed area and Donner Lake.

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

[5] Balance hydrologists have made several observations at the dam outlet when Donner Lake is spilling to Donner Creek to support this assumption.

In WY 2013, both of these gages will be 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..

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 Program (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[6]. 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.

[6] 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), 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 2012.

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 2012 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[7] resulting in faster identification and correction of these conditions when they occurred.

[7] Real-time data can be viewed at http://www.balancehydro.com/onlinegaging.php

5. WATER YEAR 2012 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 2012 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: CSL). These stations provide precipitation measurements covering the range of elevations represented by the gaged watersheds considered in this study. In addition, CSSL and Truckee 2 data provide context for evaluating snowpack and snow-melt water-equivalency in relation to the spring snowmelt hydrology.

WY 2012 monthly precipitation for Truckee, California is illustrated in **Figure 3,** while the WY 2012 snowpack as snow-water equivalent is presented in **Figure 4**. Approximately 25 inches of precipitation were recorded for WY 2012, about 62 percent of the long-term average annual precipitation of 40.34 inches for the TK2 station (CDEC, 2012). In terms of snowfall, WY 2012 was one of the lowest years on record, in contrast to the very high snowfall for WY 2011 (see **Figure 4**). WY 2012 began with several small rain events in the fall, a 1.5-inch storm on October 5, 2011, followed by rain November 3-10 (0.9 inches) and November 18-20 (0.7 inches). Late November and most of December were dry and cold with limited snow showers and snow accumulation. A measurable rain-on-snow event occurred January 19-21, 2012 (3.1 inches).

After a relatively dry period in late January and most of February, some significant snowfall events were recorded through March, with more than 28 percent of the WY 2012 annual precipitation occurring that month. The spring was unusually early – the snowpack had melted by late April. Peak snowmelt also occurred in April, approximately 30 days earlier than the historical average peak runoff. The summer was relatively warm, punctuated with a few afternoon thunderstorms, notably on June 4, July 23, and August 14-15. Rainfall amounts and intensities varied geographically with these localized storms and the effects on streamflows differed among gaging stations.

5.2 Cold Creek at Teichert Bridge (CCTB): Hydrology

Form 1 presents daily and peak flow values for WY 2011 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 2012 began with baseflow of approximately 1.2 cfs, which increased to approximately 41 cfs during the rainfall of October 4-10, 2011, before slowly returning to slightly-higher baseflow conditions in late October. A subsequent dry period with cold nights and warm days from late November through mid-January resulted in diurnal, ice-affected baseflows. A rain-on-snow event January 19-21, 2012 resulted in a mid-winter peak flow of 234 cfs. Heavy, wet snow and rapid snowmelt resulted in an early spring peak flow of 99 cfs on March 16. The annual peak flow of 546 cfs occurred on April 26, coincident with peak snowmelt. It should be noted that the WY 2012 annual peak flow was higher than in WY 2011, even though total precipitation was significantly less. This response can be attributed to the combination of rapid warming and rainfall in mid- to late-April, which resulted in rapid runoff of the remaining snowpack. After the annual peak occurred, streamflow receded through the summer months and by late July, baseflow was lower than in October 2011. Summer baseflows were between 0.2 and 0.3 cfs through the end of the water year, with occasional small increases in flow from thunderstorms. The annual mean flow for Cold Creek at Teichert Bridge in WY 2012 was 21 cfs, equal to annual runoff of 15,374 acre-feet.

We note that California State Parks and the TRWC implemented a floodplain restoration project immediately upstream of CCTB in September and October 2012. Construction required a temporary streamflow diversion; however, flows at CCTB were not affected.

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 flow values for WY 2012 at Donner Creek above Highway 89. **Table 2** documents Balance observations and measurements made during site visits to the gage. The WY 2012 streamflow hydrograph for DC89 is illustrated in **Appendix B2.** Below, we briefly describe the annual streamflow hydrograph at this station.

WY 2012 began with flows of approximately 100 cfs, associated with regulated releases from Donner Lake. Early October rainfall increased flows only slightly to a peak flow of 143 cfs on October 10, 2011. Donner Lake releases were slowly ramped down between October 23 and November 14 to baseflow levels near 11 cfs. Ice-affected flows between December 3, 2011 and January 19, 2012 required USGS to estimate mean daily flows at 6 to 9 cfs during this period. A rain-on-snow event resulted in a mid-winter peak flow of 324 cfs on January 21, 2012. Heavy wet snow on March 16 resulted in an early spring peak flow of 134 cfs. The annual peak flow of 1,090 cfs occurred on April 26, coincident with peak snowmelt.[8] Similar to Cold Creek, the WY 2012 annual peak flow was slightly higher than in WY 2011, likely attributable to rapid warming in April causing rapid runoff of the remaining snowpack. After the annual peak occurred, streamflow receded through the summer months to baseflows between 3 cfs and 5 cfs, with occasional small increases in flow from thunderstorms. Annual releases from Donner Lake began on September 27, 2012, resulting in rapid increases in streamflow for the few remaining days of WY 2012. The annual mean flow for Donner Creek at Highway 89 in WY 2012 was 48 cfs, equal to annual runoff of 34,925 acre-feet.

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

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 and the results were compared to streamflows measured at the Donner Creek at Highway 89 station, as reported by the USGS. There was a 1:1 relationship (no appreciable difference) between streamflows 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, was also used for interpretation of hydrology and computation of sediment loading at DCWR. **Table 3** documents observations and measurements made during site visits to Donner Creek at West River Street.

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 2012. **Table 4** documents observations and measurements made during site visits

[8] Streamflow on Donner Creek was regulated from April 24- 27 to facilitate emergency repairs to the Coldstream Road bridge during a storm event. Immediately following bridge repair, the dam gates were re-opened to allow floodwaters to pass, potentially elevating the peak streamflow for the year, which occurred during this period.

to the gage. Daily streamflow is illustrated in **Figure 6**. Short intervals between December 2, 2011 and January 16, 2012 were affected by ice. For these periods, mean daily flow was correlated with a nearby stream gage (Sagehen Creek near Truckee, California, USGS 10343500).

Baseflow in Trout Creek averaged 1 cfs at the beginning of WY 2012. Rainfall generated a rapid and ephemeral peak flow of approximately 4.7 cfs on October 5, 2011, with subsequent rain-related increases in streamflow through early November. A subsequent dry period with cold nights and warm days resulted in ice-affected flows from December 2, 2011 through January 16, 2012, as noted above. A rain-on-snow event resulted in a peak flow of 54 cfs on January 21, 2012, the annual peak flow for this station in WY 2012. Peak snowmelt increased flows to about 30 cfs on April 26, coincident with peak snowmelt at other stations but lower than the peak attained on January 21. Trout Creek's lower watershed elevation, greater distance east from the Sierra Nevada crest, and more urbanized watershed likely contributed to the difference in hydrology between this station and the one on Cold Creek. After peak snowmelt occurred, streamflow receded through the summer months and by late June flow was below the October 2011 baseflow level of about 1.0 cfs. Late summer baseflows were between 0.1 cfs and 0.2 cfs. Increases in flow from occasional thunderstorms were relatively-large, as compared to responses observed in Cold Creek. Baseflows gradually increased in the final weeks of the water year as deciduous riparian vegetation began to go dormant. The annual mean flow for Trout Creek at Donner Pass Road in WY 2012 was 2.5 cfs, equal to annual runoff of 1,814 acre-feet.

6. WATER YEAR 2012 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 2012. Loads were computed using streamflow-based methods at all four stations and turbidity-based methods at the two stations equipped with turbidity probes (i.e., CCTB, TCDP).

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. Having a continuous record of turbidity is one way to compute a more accurate record of annual sediment loading. Streamflow-based sediment rating curves do, however, still provide a unique tool for evaluating changes in sediment loading over time. It should also be noted that watersheds in the Middle Truckee River have differing geology and have been subjected to different land-uses than those on the east side of Lake Tahoe and, therefore, may have different sediment production and transport dynamics.

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., snowmelt vs. thunderstorm). As stated previously, the values presented in this report are preliminary and subject to revision. Continued monitoring should allow us to refine our streamflow-based sediment rating curves.

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 2012 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 rain-on-bare-ground and rain-on-snow events (as opposed to snowmelt runoff). Data collected in WY 2011 and WY 2012 suggest that sediment loading from fall or summer rain-on-bare-ground events and rain-on-snow events can be an order of magnitude greater than during snowmelt runoff for streamflows greater than 50 cfs. In calculating a record of suspended-sediment load for the CCTB station, the equation derived in Figure 7 for the higher load rating was applied to the record of streamflow covering the storms on October 10-12, 2011, and January 20-21 and June 4, 2012.

Using the streamflow-based suspended-sediment rating curve, we estimate WY 2012 annual suspended-sediment loading in the Cold Creek subwatershed to be 213 tons (17 tons/sq. mile), with a maximum daily load of 66 tons on April 26, 2012, coincident with peak snowmelt. Using the continuous turbidity record as a proxy for suspended sediment concentration and loading, we estimate the annual suspended-sediment loading to be 327 tons (26 tons/sq. mile), with a computed maximum daily load of 124 tons on April 26, 2012. A comparison between the two methods suggests that the continuous record of turbidity captures higher loading rates during most peaks as well as small loading events unrelated to changes in streamflow. These may be associated with but not limited to: streambank failures, construction activities, in-stream disturbances or illegal discharges.

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 2012 daily and annual suspended-sediment loads. The relationship between streamflow and suspended-sediment load is shown for DC89 is shownin **Figure 10.**

After two years of data collection at the Donner Creek at Highway 89 station, the suspended-sediment sampling results suggest the same of hysteresis effect associated with sediment loading that Langlois and others (2005) observed for watersheds east of Lake Tahoe. Data for DC89 suggest that during the snowmelt season there is an order of magnitude greater loading on the rising limb of the hydrograph as compared to the falling limb of the hydrograph. Similarly, we found that the rising limb of annual Donner Lake releases generated loading rates similar to the rising limb of the hydrograph during snowmelt. Additionally, through discrete sampling, we found that significant sediment loading occurs during summer thunderstorms (**Figure 10**). We stress that our conclusions concerning these relationships are preliminary; additional data would increase our level of confidence.

Based solely on a streamflow-based sediment rating curve, we estimate the annual suspended-sediment load in Donner Creek at Highway 89 to be 406 tons (27.4 tons/sq. mile)[9] in WY 2012, with a maximum daily load of 178 tons on April 26, 2012, coincident with peak snowmelt.

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 2012 daily and annual suspended-sediment loads. The relationship between streamflow and suspended-sediment load is shownin **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 both with the rising and falling limb of the snowmelt hydrograph, and separately for summer thunderstorms - albeit, based on less data, since WY 2012 was the first year of monitoring at DCWR. With that caveat, we provide preliminary results of suspended-sediment loading calculations and in Section 6.5 below, make some limited comparisons with DC89.

We estimate the WY 2012 annual suspended-sediment load in Donner Creek at West River Street to be 564 tons (35.9 tons/sq. mile)[10], with a maximum daily load of 221 tons on April 26, 2012, coincident with peak snowmelt.

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 2012 daily and annual suspended-

[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.

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 standard streamflow-based sediment rating curve, we estimate the WY 2012 annual suspended-sediment loading in Trout Creek at 15.5 tons (3.4 tons/sq. mile) with a maximum daily load of 0.9 tons on April 26, 2012. In comparison, using the continuous record of turbidity, total loading is calculated to be 10.6 tons (2.3 tons/sq. mile) with a maximum daily load of 0.9 tons on January 20-21, 2012.

It is important to note the order-of-magnitude error associated with these estimates, arising out of the wide variability in data points used to establish these relationships. For example, a comparison between the two methods (**Figure 15**) suggests that annual loads computed using the continuous record of turbidity are lower than the annual loads computed using the streamflow-based rating curve method; which is opposite from results at the CCTB station. Similarly, the continuous record of turbidity captures higher peaks in sediment loading related to rainfall, as well as peaks unrelated to changes in streamflow. These differences may be associated with but not limited to: streambank failures, construction activities, urbanization effects on sediment loading or illegal discharges. In contrast, the streamflow-based approach computes higher suspended-sediment loads during peak snowmelt. With continued monitoring and additional data, our understanding of the relationships between hydrology and sediment loading in Trout Creek will likely improve.

6.5 Comparison of suspended-sediment yields between stations, WY 2012

In this section, we normalize sediment loads at each station by: 1) watershed area (tons/square mile), and 2) runoff volume (tons/acre-feet). These normalized "unit" values facilitate comparison between watersheds of different drainage areas and/or differing hydrology. In this section, 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 yields are based on streamflow-based methods because these stations are not equipped with turbidity probes. **Table 9** compares suspended-sediment loads and yields between stations for WY 2011 (a partial year for the TCDP station) and WY 2012. **Figure 16** compares suspended-sediment loads between stations for WY 2012, normalized by watershed area. Loads shown in **Figure 16** are computed using streamflow-based rating curves and continuous records of turbidity, where the latter are available (i.e., CCTB, TCDP). We reiterate that all sediment yields computed for Donner Creek in this report exclude the upper watershed area above Donner Lake (14.3 sq. miles).

The data suggest the following conclusions:

- In general, suspended-sediment loads vary widely amongst the compared watersheds, with differences due to the type of rainfall year (dry, average, wet), and variations in drainage area, geology, and land-uses;
- WY 2012 was a below-average or dry year, as reflected by lower runoff volumes and lower suspended-sediment loads as compared to WY 2011, an above-average or wet year;
- In WY 2012, the unit suspended-sediment yield from the Cold Creek watershed is on the order of 26 tons/square mile, compared to roughly 2.3 tons/square mile for the Trout Creek watershed;
- In WY 2012, the unit suspended-sediment yield from Donner Creek at Highway 89 is roughly 27.4 tons/square mile, whereas only 0.58 miles downstream at West River Street, the yield increases to 37.1 tons/square mile
- In WY 2012, the suspended-sediment yields, normalized by runoff volume, were roughly twice as high at the Trout Creek and Cold Creek stations as at the Donner Creek stations (0.02 vs. 0.01 tons/ acre-feet).

Historically, reports have suggested that most, if not all, of the suspended-sediment loads calculated for Donner Creek at Highway 89 originated from Cold Creek (e.g., River Run Consulting, 2007). However, preliminary data from this study may refute these earlier conclusions. Due to the 'nested' study design (CCTB is a component of DC89, and both CCTB and DC89 are components of DCWR), we were able to estimate loads at each station by subtraction. **Figure 17** presents the results in terms of sediment loads (tons) and yields (tons/square mile). Our estimates suggest that significant loading occurs in the lower Donner Creek/Cold Creek watershed. For instance, lower Donner Creek and the area downstream of Cold Creek, but upstream of Highway 89 (2.2 square miles) produced 79 tons of sediment in WY 2012, a yield of 35.9 tons/square mile, slightly more than the 26 tons/square mile yield from Cold Creek. Furthermore, Donner Creek and the area downstream of Highway 89 to the confluence of the Middle Truckee (0.4 square miles) produced 158 tons of sediment in WY 2012, a yield of 395 tons/square mile, more than 15 times the yield from Cold Creek.

Higher sediment loads and yields from the lower Donner Creek/Cold Creek watershed may be attributable to the more urban land-uses. The Town of Truckee has identified 19 stormwater outfalls in this reach of Donner Creek, discharging runoff from large impervious surfaces such as portions of Highways I-80 and 89, Sierra College, Deerfield Plaza, and the SaveMart/CVS plaza. Because each of these areas collects measurable fines from road-sand applications during the winter months it is logical that they would produce higher loadings to this reach during snowmelt runoff or after a major thunderstorm. In fact, Balance hydrologists observed visibly turbid runoff discharging from these same stormwater outfalls in WY 2012, generating turbidity plumes immediately downstream of Highway 89.

7. COMPARISON OF WY 2012 SUSPENDED-SEDIMENT LOADS WITH TMDL BENCHMARKS AND HISTORICAL DATA

In this chapter, we utilize 15-minute, continuous records of streamflow and turbidity to compute suspended-sediment load durations for WY 2012. 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 values to protect juveniles, larvae, and eggs, as well as adult fish. The suspended sediment target is expressed as an annual 90th percentile value; therefore, up to 10 percent of the data could fall above 25 mg/L and still be within the benchmark limit. The 90th 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), we can compare loadings between tributaries by converting concentrations into in daily (tons/day) or annual (tons). suspended-sediment loads. 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 also compare WY 2012 streamflow-to-suspended-sediment rating curves with historical rating curves (McGraw and others, 2001) for the two watersheds (i.e., Donner Creek and Trout Creek) where such data are available for comparison. Any 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 2012

Figure 18 illustrates a suspended-sediment load duration curve for Cold Creek using the continuous 15-minute record of turbidity from WY 2012. Benchmark load limits based on the 25 mg/L target established for the Truckee River were also computed for Cold Creek. We can draw four main conclusions from these data:

- Generally, suspended-sediment loading in Cold Creek increases with higher-streamflow (lower-frequency) events; however, loading may vary by more than two orders of magnitude at a given streamflow;
- 15-minute loading rates ranged between < 0.001 tons/day and 333 tons/day in WY 2012 over the range of streamflows recorded;
- Only 1.5 percent of the WY 2012 turbidity data for Cold Creek exceeded the 25 mg/L benchmark limit for the Middle Truckee River, indicating that suspended- sediment loads in this stream were well below the 90th percentile benchmark limit for the TMDL;
- When suspended-sediment loads in Cold Creek exceeded the 25 mg/L benchmark, the exceedances were ephemeral and mostly associated with peak snowmelt runoff, rain-on-snow events, or rain-on-bare-ground events (e.g. fall or summer thunderstorms).

7.2 Donner Creek: Suspended Sediment Loading in WY 2012

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 19** 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. As stated in Section 5.4, limited streamflow measurements at West River Street suggested that flows there were nearly identical to those reported by the USGS at the Highway 89 station. 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 2012. Only about 1.1 percent of of the data exceeded the 25 mg/L suspended sediment target, well within the 90th percentile. The observed exceedances were attributable to runoff from a summer thunderstorm on August 14-15, 2012, and to some of the high-flow (low-frequency) streamflows that occurred on the rising limb of the snowmelt hydrograph in April 2012.

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 2012 (**see Figure 19**). At this station, about 2.1 percent of all data exceeded the 25 mg/L benchmark, still well within the 90th percentile. As at DC89, exceedances were attributable to runoff from the thunderstorm on August 14-15, 2012 and to high flows during the spring snowmelt.

The difference between the load duration curves for these two stations is a function of the sediment rating curves, as considerably more data has been collected for the DC89 station (30 vs. 14 observations).. Continued monitoring at the DCWR gage will provide additional data and facilitate more detailed comparisons between the two stations. While it is difficult at this time to discern the range in variability associated with these loading estimates, continued development of seasonal or temporal streamflow-based sediment rating curves should allow us to better discern distinct loading episodes.

7.3 Trout Creek at Donner Pass Road Suspended Sediment Loading in WY2012

Figure 20 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 four main conclusions from these data:

- Suspended-sediment loading in Trout Creek increases with higher-streamflows (lower-frequency) events, but may vary by as much as two orders of magnitude at any given streamflow, depending on storm and runoff characteristics;
- 15-minute sediment loading rates ranged between <0.01 and 16.4 tons per day in WY 2012, over the range of flows recorded;
- 0.75 percent of the WY 2012 data for Trout Creek exceeded the 25 mg/L benchmark, indicating that suspended-sediment loads in this stream were well within the 90th percentile in WY 2012, and;
- When suspended-sediment loading rates in Trout Creek exceeded the 25 mg/L benchmark, the exceedances were ephemeral and associated with rain-on-snow events (January 20-21, February 25-27, and March 31, 2012) and rain-on-bare-ground events (October 4-10 and November 5-9, 2011; June 21 and July 23, 2012).

7.4 Discussion of Suspended-sediment Loads from Different Years

McGraw and others (2010) 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 water years 1996, 1997, 2003 and 2004, allowing for a comparison of sediment loading under current and historical conditions. For a full description of the conditions and analysis associated with the historical data, please refer to Amorfini and Holden (2008).

7.4.1 Donner Creek/Cold 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.

Based on the data, 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. For instance, McGraw and others (2001) reported WY 1996 as a wet year, with over 210 percent of average precipitation and a peak flow that coincided with peak snowmelt in the Middle Truckee Basin. In contrast, WY 1997 was an average year (100 percent of average precipitation), but the year included an extreme event on January 3, 1997 that resulted in some of the largest peak flows on record for the Truckee region.

McGraw and others (2001) have noted many storm-triggered landslides in tributaries to the Middle Truckee River as a result of the 1997 event. Accordingly, when suspended-sediment loads are normalized by runoff volume or watershed area, Donner Creek exhibited 3 to 6 times more loading in WY 1997, relative to water years 2004, 2011 and 2012. As noted previously, the yields reported by McGraw and others (2001) were adjusted for this report to reflect a smaller watershed area of about 15.2 square miles (excluding the upper watershed above Donner Lake), of which 12.6 square miles comprises the Cold Creek tributary.

Figure 21 presents historical (WY 1996, WY 1997, and WY 2000) and current (WY 2011 and WY 2012) suspended-sediment load data for Donner Creek at Highway 89. Recent sediment loading rates at this station appear to be comparable to historical rates. However, WY 2011 and WY 2012 data show more scatter, or a wider range of suspended-sediment loadings at a given streamflow. Continued monitoring at these stations may show stronger evidence of seasonal or temporal trends similar to those preliminary identified in WY 2012: higher loading rates during rain-on-snow or rain-on-bare-ground events; and hysteresis during the snowmelt period, when higher sediment loading is observed on the rising limb than on the falling limb of the hydrograph. Further evaluation of these phenomena during runoff events is warranted.

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 and WY 2012) annual flow statistics and suspended-sediment loads for Trout Creek. Note that the historical loadings were calculated using streamflow-based sediment rating curves, whereas the current loadings were computed based on continuous records of turbidity.

In addition, 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; more specifically, correlation with mean daily flows in Sagehen Creek near Truckee (USGS 10343500). Although Sagehen Creek has an extensive period of record, its watershed location and characteristics are significantly different from Trout Creek. Finally, WY 2011 was a partial record (January 21-September 30, 2011). These conditions should be considered when reviewing the comparisons discussed below.

Based on the results shown in Table 11, we conclude that:

- WY 2012 exhibited the lowest annual suspended-sediment load (10.6 tons, turbidity-based) of the four years: partial WY 2011 (52 tons, turbidity-based), WY 1997 (61 tons), and WY 2004 (21 tons);
- Low suspended-sediment loading in WY 2012 was likely related to the below-average annual precipitation and runoff for this watershed. The total runoff volume in Trout Creek for WY 2012 was only 1,814 acre-feet, significantly less than other years;
- When suspended-sediment loads are normalized by runoff volume, sediment loads in Trout Creek are similar across all years (0.01 tons/acre-feet);
- When suspended-sediment loads are normalized by watershed area, WY 2012 exhibited the lowest sediment yield (2.3 tons/square mile) of the four years, roughly 20 percent of hat measured in partial WY 2011 (11.3 tons/square mile).

Finally, we compare recent and historical streamflow-based sediment rating curves for Trout Creek to assess if there are potential shifts in the relationship between streamflow and sediment transport rates. For instance, a shift to the right in the rating curve may show reduced suspended-sediment loading at a given discharge due to a reduction in sediment sources in the watershed or implementation of erosion- or sediment-control BMPs. **Figure 22** presents historical and recent data for Trout Creek. The WY 2011 and WY 2012 data suggest that the rating curve has shifted to the left, such that sediment loads are higher at a given flow today. However, the recent data still fall within the range of variability exhibited by the historical data. Continued monitoring and additional data will allow for more informed evaluation of these trends.

8. FUTURE MONITORING

The USGS (1998) has emphasized that because geologic properties, climatic conditions, and geomorphic and hydrologic processes are highly variable in space and time, suspended-sediment concentration-to-turbidity, or suspended-sediment concentration-to-streamflow relations should be based on local, frequent sample collection and, if possible, on multi-year data sets. Future comparisons - between water years and of contemporary data to historical data sets - will likely result in fresh insights and more definitive conclusions. Balance continues to operate and maintain the gaging stations on Cold Creek and Trout Creek in WY 2013 and will continue to collect suspended sediment data at the USGS-operated Donner Creek at Highway 89 station and at the Donner Creek at West River Street station.

In WY 2013, Balance Hydrologics will use similar methods for the Town of Truckee[11] to augment the suspended-sediment collection program at two new stations: 1) Truckee River near Truckee (USGS 10338000), located upstream from the Town of Truckee; and 2) Truckee River at Boca Bridge, (USGS 10344505), located downstream from the Town of Truckee. These additional locations will be used to evaluate differences in sediment loads upstream and downstream of the Town of Truckee, consistent with the Town's Stormwater Management Plan and the Truckee River Water Quality Monitoring Plan (Nichols Consulting Engineers, 2008). Monitoring is scheduled to begin in November 2012.

In addition, the following actions will likely add value to the current monitoring program:

1. Observations and collection of suspended-sediment samples in Donner Creek below Donner Lake and at the Highway 89 station during regulated releases (September, October and November) will help address uncertainties in streamflow-related turbidity during the fall period; and

2. Initial observations and sampling in Donner Creek at West River Street suggest higher turbidity and sediment concentrations, as compared to Donner Creek at Highway 89. Turbidity may also occur in discrete events unrelated to increases in streamflow at these sites. Future monitoring in Donner Creek may benefit from continuous-logging turbidity meters at these two stations.

[11] Under a subcontract with CDM-Smith

9. 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 State Water Resources Control Board (SWRCB). 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:	**2012**
Stream:	Cold Creek
Station:	at Teichert Bridge (CCTB)
County:	Nevada County, California

Form 1. Annual Hydrologic Record, WY 2012

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 WY2012 is 21 cfs.
Mean annual flow for WY2011 was 60 cfs.

Peak Flows (WY 2012)

Date	Time (24-hr)	Gage Ht. (feet)	Discharge (cfs)	Date	Time (24-hr)	Gage Ht. (feet)	Discharge (cfs)
1/21/12	1:00	4.25	234	4/30/12	19:45	4.30	258
3/16/12	7:00	3.19	99	5/9/12	19:30	3.73	154
4/23/12	20:15	4.34	265	5/14/12	19:00	3.95	178
4/26/12	**10:00**	**5.89**	**546**	6/4/12	16:15	3.26	116

Extreme for period of record (WY2011-2012) is 546 cfs on April 26, 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 2012 Daily Mean Flow (cubic feet per second)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
1	1.4	1.9	2.5	2.5	7.1	5.1	37.5	206.9	56.2	5.2	1.0	0.3
2	1.4	1.9	2.5	2.6	6.8	6.2	32.5	158.2	54.8	4.9	1.0	0.3
3	1.4	1.8	2.3	2.8	6.5	6.3	32.9	119	49.0	4.6	0.9	0.3
4	1.5	2.0	2.3	2.8	6.6	6.3	36.2	100	61.4	4.2	0.9	0.3
5	3.5	1.8	2.4	2.7	6.3	6.6	31.6	94	50	3.9	0.9	0.3
6	3.3	1.8	2.3	2.6	5.9	6.7	29.5	91	38	3.6	0.8	0.4
7	3.0	1.9	2.3	2.9	5.8	6.1	28.7	92	32	3.3	0.8	0.3
8	3.7	1.9	2.4	3.0	5.9	6.2	30.0	94	32	3.1	0.7	0.3
9	4.1	1.9	2.0	2.9	5.7	6.4	33.1	108	29	2.9	0.7	0.3
10	14.5	1.9	2.1	3.1	5.6	7.0	37.7	110	26	2.7	0.7	0.3
11	25.7	1.9	2.1	3.0	6.0	7.0	38.5	101	24	2.5	0.6	0.3
12	8.4	2.1	2.0	3.1	5.9	6.6	33.9	103	24	2.3	0.6	0.3
13	5.7	2.1	2.2	3.1	6.0	6.7	31.2	111	24	2.1	0.6	0.3
14	5.1	2.2	2.2	3.0	5.8	8.0	28.3	132	24	2.0	0.7	0.3
15	4.4	2.2	2.2	2.7	5.8	26.7	28.1	125	23	1.9	0.8	0.3
16	3.8	2.3	2.1	2.6	5.8	83.7	31.3	129	21	1.7	0.7	0.3
17	3.5	2.2	2.0	2.7	5.7	52.7	38.4	106	19	1.6	0.7	0.3
18	3.2	2.3	1.9	2.6	5.5	33.4	55.5	87	18	1.5	0.6	0.3
19	2.9	2.3	2	2.3	5.3	25.9	73.3	82	15	1.5	0.6	0.3
20	2.7	2.3	1.9	17.4	5.2	24.6	101.7	84	13	1.4	0.5	0.3
21	2.6	2.4	1.9	66.5	5.2	37.3	136	85	12	1.3	0.5	0.2
22	2.5	2.4	1.6	14.9	5.4	43.2	162	76	10	1.3	0.4	0.2
23	2.4	2.3	1.7	7.8	5.4	40.4	191.1	68	10	1.7	0.4	0.3
24	2.2	2.4	1.6	8.9	5.7	34.0	199.7	58	9	1.4	0.4	0.2
25	2.2	2.5	1.6	8.9	6.1	31.6	177.6	49	9	1.3	0.4	0.3
26	2.2	2.4	1.6	9.4	5.7	28.5	383.8	40	8	1.3	0.3	0.3
27	2.1	2.4	1.5	15.0	5.7	26.2	193.8	35	7	1.3	0.3	0.3
28	2.1	2.4	1.7	10.8	5.5	26.0	165.8	37	7	1.2	0.3	0.2
29	2.0	2.4	1.8	9.1	4.1	24.5	163.2	40.3	6	1.2	0.3	0.2
30	2.0	2.5	2.0	8.2		32.9	187.4	43.9	6	1.2	0.3	0.3
31	1.9		2.3	7.5		47.0		49.4		1.1	0.3	
MEAN	4.1	2.2	2.0	7.6	5.8	22.9	91.7	91	24	2	0.6	0.3
MAX. DAY	26	2.5	3	66.5	7.1	83.7	384	207	61	5	1.0	0.4
MIN. DAY	1.4	1.8	1.5	2.3	4.1	5.1	28.1	35.2	5.6	1.1	0.3	0.2
cfs days	127	65	63	237	168	710	2751	2815	716	71	19	8
ac-ft	252	128	125	470	334	1408	5456	5584	1421	141	37	17

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

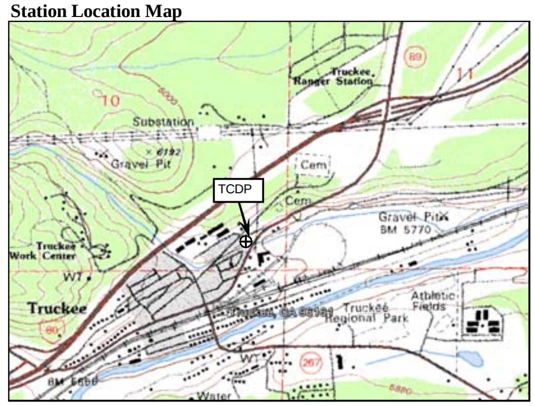
Water Year 2012 Totals:		
Mean flow	**21**	(cfs)
Max. daily flow	**384**	(cfs)
Min. daily flow	**0.2**	(cfs)
Annual total	**7,751**	(cfs-days)
Annual total	**15,374**	(ac-ft)

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

Water Year:	**2012**
Stream:	Trout Creek
Station:	Donner Pass Road (TCDP)
County:	Nevada County, California

Form 2. Annual Hydrologic Record, WY 2012

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 WY 2012 is 2.5; partial WY 2011 is 14.8 cfs.

Peak Flows (WY 2012)

Date	Time (24-hr)	Gage Ht. (feet)	Discharge (cfs)	Date	Time (24-hr)	Gage Ht. (feet)	Discharge (cfs)
1/21/12	**0:45**	**5.21**	**54.0**	4/10/12	17:45	4.42	14.7
3/16/12	6:00	4.46	15.8	4/22/12	20:30	4.56	24.3
3/22/12	20:00	4.43	13.7	4/26/12	14:30	4.71	30.1
3/30/12	18:15	4.49	18.2				

Extreme for period of record (partial WY2011) is 69.6 cfs on April 21, 2011.

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).

WY 2012 Daily Mean Flow (cubic feet per second)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
1	1.04	1.19	1.31	1.14	1.72	2.75	8.03	8.51	1.64	0.87	0.29	0.17
2	1.08	1.08	1.23	1.16	2.47	1.96	7.45	7.68	1.64	0.84	0.27	0.20
3	1.08	1.08	1.15	1.19	2.55	1.94	8.67	7.09	1.58	0.75	0.26	0.19
4	1.08	1.32	1.17	1.17	2.36	2.13	8.25	6.70	2.38	0.70	0.25	0.18
5	2.89	1.66	1.12	1.19	2.36	2.61	6.88	6.11	2.81	0.69	0.23	0.23
6	1.57	1.31	1.08	1.14	2.88	2.20	6.50	5.56	2.30	0.66	0.20	0.54
7	1.33	1.35	1.12	1.08	1.61	2.21	6.29	4.98	2.05	0.61	0.15	0.39
8	1.21	1.76	1.15	1.04	1.34	2.67	7.21	4.64	1.89	0.57	0.21	0.29
9	1.12	1.96	--	1.06	1.38	2.38	8.58	4.36	1.79	0.50	0.21	0.25
10	1.35	1.88	1.08	1.02	1.64	2.34	9.76	4.14	1.70	0.47	0.21	0.20
11	1.39	1.70	1.12	--	2.00	2.21	8.46	3.92	1.63	0.44	0.21	0.30
12	1.14	1.89	1.15	--	2.00	2.32	7.33	3.65	1.55	0.37	0.19	0.26
13	1.10	1.65	1.03	--	1.83	2.48	6.83	3.55	1.48	0.32	0.21	0.22
14	1.09	1.53	1.12	0.93	1.71	3.63	6.30	3.46	1.46	0.33	0.35	0.22
15	1.08	1.43	1.05	0.92	1.66	9.09	7.57	3.38	1.38	0.34	0.47	0.21
16	1.08	1.42	1.08	0.97	2.35	13.22	9.00	3.04	1.28	0.34	0.38	0.25
17	1.18	1.45	1.05	0.93	2.16	9.00	10.48	2.86	1.22	0.36	0.35	0.28
18	1.07	1.57	1.03	0.99	1.61	5.78	12.23	2.86	1.14	0.37	0.37	0.33
19	1.07	1.58	1.05	1.18	1.56	4.68	14.41	2.69	1.13	0.45	0.31	0.33
20	1.05	1.52	1.05	5.86	1.53	4.74	16.69	2.55	1.11	0.46	0.24	0.35
21	1.04	1.50	1.00	15.27	1.61	6.62	17.93	2.39	1.04	0.37	0.23	0.37
22	1.03	1.49	--	4.98	1.95	9.08	18.40	2.25	0.98	0.30	0.23	0.39
23	1.04	1.55	0.88	3.36	2.13	8.61	17.16	2.16	1.13	1.17	0.21	0.45
24	1.07	1.49	0.82	2.98	2.43	7.10	14.96	2.11	1.21	1.52	0.20	0.46
25	1.11	1.55	0.87	2.52	2.41	6.18	12.66	2.24	1.12	0.80	0.21	0.49
26	1.09	1.52	0.94	2.41	2.04	4.99	23.26	2.33	1.08	0.63	0.20	0.49
27	1.11	1.44	0.97	2.73	1.89	4.47	14.18	2.17	1.04	0.57	0.21	0.47
28	1.11	1.34	1.15	3.32	2.13	4.63	11.71	1.98	0.92	0.47	0.19	0.48
29	1.15	1.21	1.30	2.22	2.26	4.98	10.13	1.85	0.88	0.42	0.22	0.44
30	1.25	1.29	1.32	1.82		9.91	9.14	1.73	0.86	0.35	0.20	0.45
31	1.43		1.20	2.17		10.48		1.61		0.32	0.17	
MEAN	1.2	1.5	1.1	2.4	2.0	5.1	10.9	3.7	1.4	0.6	0.2	0.3
MAX. DAY	2.9	2.0	1.3	15.3	2.9	13.2	23.3	8.5	2.8	1.5	0.5	0.5
MIN. DAY	1.0	1.1	0.8	0.9	1.3	1.9	6.3	1.6	0.9	0.3	0.2	0.2
cfs days	37	45	32	67	58	157	326	115	43	17	8	10
ac-ft	74	89	63	132	114	312	647	227	86	34	15	20

Monitor's Comments

1. Due to construction, this gaging station required temporary relocation for the period 9/2/11 through 11/3/11.
2. This station can be affected by ice; the period 2/16/12 through 2/28/12 was estimated using correlation to streamflow at Sagehen Creek (USGS 10343500)
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 of the new rating curve.
5. "--" indicates daily data are unavailable as a result of instrument error or ice-affected streamflow
6. Real-time data are available at www.balancehydro.com/truckee/trout/index.php

Water Year 2012 Totals:		
Mean flow	**2.5**	(cfs)
Max. daily flow	**23.3**	(cfs)
Min. daily flow	**0.20**	(cfs)
Annual total	**915**	(cfs-days)
Annual total	**1814**	(ac-ft)

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www.balancehydro.com

Water Year: 2012

Stream: Cold Creek
Station: at Teichert Bridge (CCTB)
County: Nevada County

Form 3. Annual Suspended-Sediment Load Record WY 2012

WY 2012 Daily Suspended-Sediment Load *(tons)*
Streamflow-based sediment rating-curve method

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	Qss Annual
1	0.00	0.00	0.01	0.01	0.03	0.02	0.25	9.86	0.43	0.02	0.00	0.00	
2	0.00	0.00	0.01	0.01	0.02	0.02	0.20	4.66	0.42	0.02	0.00	0.00	
3	0.00	0.00	0.01	0.01	0.02	0.02	0.21	2.12	0.36	0.01	0.00	0.00	
4	0.00	0.00	0.01	0.01	0.02	0.02	0.24	1.26	4.27	0.01	0.00	0.00	
5	0.01	0.00	0.01	0.01	0.02	0.02	0.20	1.08	0.70	0.01	0.00	0.00	
6	0.01	0.00	0.01	0.01	0.02	0.02	0.18	0.97	0.25	0.01	0.00	0.00	
7	0.01	0.00	0.01	0.01	0.02	0.02	0.17	1.02	0.20	0.01	0.00	0.00	
8	0.01	0.00	0.01	0.01	0.02	0.02	0.18	1.12	0.20	0.01	0.00	0.00	
9	0.01	0.00	0.00	0.01	0.02	0.02	0.21	1.76	0.17	0.01	0.00	0.00	
10	0.30	0.00	0.01	0.01	0.02	0.03	0.25	1.71	0.15	0.01	0.00	0.00	
11	0.47	0.00	0.00	0.01	0.02	0.03	0.26	1.35	0.14	0.01	0.00	0.00	
12	0.03	0.00	0.00	0.01	0.02	0.02	0.22	1.44	0.14	0.01	0.00	0.00	
13	0.02	0.00	0.01	0.01	0.02	0.02	0.19	1.83	0.14	0.01	0.00	0.00	
14	0.02	0.01	0.01	0.01	0.02	0.03	0.17	3.00	0.14	0.00	0.00	0.00	
15	0.01	0.01	0.01	0.01	0.02	0.17	0.17	2.56	0.13	0.00	0.00	0.00	
16	0.01	0.01	0.01	0.01	0.02	0.80	0.19	2.75	0.11	0.00	0.00	0.00	
17	0.01	0.01	0.00	0.01	0.02	0.40	0.26	1.52	0.10	0.00	0.00	0.00	
18	0.01	0.01	0.00	0.01	0.02	0.21	0.43	0.87	0.09	0.00	0.00	0.00	
19	0.01	0.01	0.00	0.01	0.02	0.15	0.71	0.80	0.07	0.00	0.00	0.00	
20	0.01	0.01	0.00	3.20	0.02	0.14	1.51	0.85	0.06	0.00	0.00	0.00	
21	0.01	0.01	0.00	14.92	0.02	0.25	3.34	0.87	0.05	0.00	0.00	0.00	
22	0.01	0.01	0.00	0.09	0.02	0.30	5.41	0.66	0.04	0.00	0.00	0.00	
23	0.01	0.01	0.00	0.03	0.02	0.28	8.61	0.56	0.04	0.00	0.00	0.00	
24	0.01	0.01	0.00	0.04	0.02	0.22	9.40	0.45	0.04	0.00	0.00	0.00	
25	0.01	0.01	0.00	0.04	0.02	0.20	6.47	0.35	0.03	0.00	0.00	0.00	
26	0.01	0.01	0.00	0.04	0.02	0.17	66.0	0.27	0.03	0.00	0.00	0.00	
27	0.00	0.01	0.00	0.07	0.02	0.15	8.19	0.23	0.03	0.00	0.00	0.00	
28	0.00	0.01	0.00	0.05	0.02	0.15	5.26	0.25	0.02	0.00	0.00	0.00	
29	0.00	0.01	0.00	0.04	0.01	0.14	5.10	0.28	0.02	0.00	0.00	0.00	
30	0.00	0.01	0.00	0.03		0.21	8.15	0.31	0.02	0.00	0.00	0.00	
31	0.00		0.01	0.03		0.34		0.36		0.00	0.00		
TOTAL	1.0	0.2	0.2	19	0.6	5	132	47	9	0.2	0.0	0.0	**213**
Max.day	0.5	0.0	0.0	15	0.0	0.8	66	10	4.3	0.0	0.0	0.0	**66**

WY 2012 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	0.02	0.01	0.01	0.02	0.02	0.13	7.21	0.59	0.03	0.00	0.00	
2	0.01	0.00	0.01	0.01	0.02	0.02	0.10	3.81	0.51	0.03	0.00	0.00	
3	0.01	0.00	0.00	0.01	0.02	0.02	0.10	2.04	0.36	0.02	0.00	0.00	
4	0.01	0.00	0.01	0.01	0.02	0.02	0.11	1.28	1.65	0.02	0.00	0.00	
5	0.02	0.00	0.01	0.01	0.02	0.02	0.08	1.10	0.42	0.02	0.00	0.00	
6	0.01	0.00	0.00	0.01	0.02	0.02	0.08	0.99	0.20	0.02	0.00	0.00	
7	0.01	0.00	0.01	0.01	0.02	0.02	0.08	1.07	0.18	0.02	0.00	0.00	
8	0.02	0.00	0.01	0.01	0.02	0.02	0.09	1.12	0.16	0.01	0.00	0.00	
9	0.02	0.00	0.00	0.01	0.02	0.02	0.11	2.48	0.15	0.01	0.01	0.00	
10	0.94	0.00	0.00	0.01	0.01	0.02	0.14	2.19	0.13	0.01	0.00	0.00	
11	0.41	0.00	0.00	0.01	0.02	0.02	0.14	2.11	0.12	0.01	0.00	0.00	
12	0.05	0.00	0.00	0.01	0.02	0.02	0.11	2.13	0.13	0.01	0.01	0.00	
13	0.02	0.01	0.00	0.01	0.02	0.02	0.10	3.19	0.12	0.02	0.01	0.00	
14	0.02	0.01	0.00	0.01	0.02	0.03	0.13	8.53	0.12	0.04	0.01	0.00	
15	0.02	0.01	0.00	0.01	0.02	0.83	0.30	6.59	0.11	0.02	0.01	0.00	
16	0.01	0.01	0.00	0.01	0.02	3.16	0.13	5.76	0.09	0.01	0.00	0.01	
17	0.01	0.01	0.00	0.01	0.01	0.79	0.17	2.57	0.09	0.02	0.00	0.00	
18	0.01	0.01	0.00	0.01	0.01	0.14	0.47	1.47	0.30	0.01	0.00	0.00	
19	0.01	0.01	0.01	0.01	0.01	0.09	1.31	1.24	0.08	0.01	0.00	0.00	
20	0.01	0.01	0.00	4.20	0.01	0.11	4.89	1.16	0.07	0.00	0.00	0.00	
21	0.01	0.00	0.00	13.60	0.01	0.21	8.78	1.32	0.10	0.00	0.00	0.00	
22	0.01	0.01	0.00	0.07	0.02	0.23	12.43	1.09	0.07	0.00	0.01	0.00	
23	0.01	0.01	0.00	0.03	0.02	0.17	18.92	0.68	0.05	0.01	0.01	0.00	
24	0.01	0.01	0.00	0.03	0.01	0.12	11.59	0.48	0.05	0.01	0.00	0.00	
25	0.01	0.01	0.00	0.08	0.02	0.10	6.05	0.30	0.06	0.01	0.00	0.00	
26	0.01	0.01	0.00	0.04	0.01	0.08	123.61	0.23	0.05	0.01	0.01	0.00	
27	0.01	0.01	0.00	0.07	0.02	0.08	8.77	0.20	0.06	0.01	0.00	0.00	
28	0.01	0.01	0.00	0.04	0.01	0.08	7.92	0.23	0.05	0.01	0.00	0.00	
29	0.01	0.01	0.00	0.03	0.02	0.08	8.08	0.27	0.05	0.02	0.00	0.00	
30	0.01	0.00	0.00	0.02		0.17	14.32	0.32	0.05	0.02	0.00	0.00	
31	0.01		0.01	0.02		0.26		0.39		0.01	0.00		
TOTAL	2	0.2	0.1	18	0.5	7	229	64	6	0.4	0.1	0.0	**327**
Max.day	0.9	0.0	0.0	14	0.0	3	124	9	2	0.0	0.0	0.0	**124**

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: 2012

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

Form 4. Annual Suspended-Sediment Load Record WY 2012

WY 2012 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	0.51	0.17	0.05	0.04	0.17	0.04	0.61	2.41	0.38	0.04	0.02	0.02	
2	0.50	0.15	0.05	0.04	0.16	0.19	0.59	1.83	0.51	0.04	0.02	0.02	
3	0.49	0.14	0.05	0.04	0.15	0.15	0.71	1.37	0.34	0.04	0.02	0.02	
4	0.53	0.13	0.05	0.04	0.14	0.15	0.86	1.12	0.48	0.04	0.02	0.02	
5	0.61	0.12	0.04	0.04	0.14	0.15	0.85	1.07	0.45	0.03	0.02	0.02	
6	0.58	0.11	0.04	0.04	0.13	0.15	0.79	1.02	0.28	0.03	0.02	0.02	
7	0.56	0.10	0.04	0.04	0.13	0.14	0.77	1.03	0.25	0.03	0.02	0.02	
8	0.57	0.09	0.04	0.04	0.12	0.14	0.78	1.04	0.24	0.03	0.02	0.02	
9	0.57	0.09	0.04	0.04	0.12	0.14	0.83	1.26	0.22	0.03	0.02	0.02	
10	0.62	0.08	0.04	0.04	0.12	0.14	0.92	1.11	0.20	0.03	0.02	0.02	
11	0.69	0.08	0.04	0.04	0.12	0.15	0.97	0.91	0.19	0.03	0.02	0.02	
12	0.58	0.08	0.04	0.04	0.12	0.12	0.91	1.11	0.19	0.03	0.02	0.02	
13	0.60	0.07	0.04	0.04	0.12	0.09	0.87	1.29	0.19	0.03	0.02	0.02	
14	0.60	0.07	0.04	0.04	0.12	0.11	0.81	1.65	0.19	0.03	0.33	0.02	
15	0.56	0.07	0.04	0.04	0.12	0.39	0.80	1.51	0.16	0.03	0.02	0.02	
16	0.54	0.07	0.04	0.03	0.11	2.35	1.00	1.58	0.11	0.03	0.02	0.02	
17	0.51	0.06	0.04	0.03	0.11	0.41	1.24	1.15	0.10	0.02	0.02	0.02	
18	0.49	0.07	0.04	0.03	0.11	0.27	2.00	0.95	0.11	0.02	0.02	0.02	
19	0.50	0.07	0.04	0.03	0.10	0.22	2.82	0.94	0.09	0.02	0.02	0.02	
20	0.48	0.07	0.04	0.63	0.10	0.21	7.01	0.88	0.08	0.02	0.02	0.02	
21	0.52	0.07	0.04	1.43	0.10	0.27	15.84	0.76	0.07	0.02	0.02	0.02	
22	0.52	0.06	0.03	0.25	0.10	0.31	26.08	0.57	0.07	0.02	0.02	0.02	
23	0.48	0.06	0.03	0.24	0.10	0.29	25.54	0.49	0.07	0.20	0.02	0.02	
24	0.47	0.06	0.03	0.23	0.10	0.25	11.80	0.42	0.06	0.08	0.02	0.02	
25	0.49	0.06	0.03	0.22	0.11	0.23	14.94	0.36	0.06	0.02	0.02	0.02	
26	0.45	0.06	0.03	0.22	0.10	0.21	178	0.31	0.05	0.03	0.02	0.02	
27	0.37	0.06	0.03	0.25	0.11	0.20	26.5	0.28	0.05	0.03	0.02	0.02	
28	0.32	0.06	0.03	0.22	0.11	0.21	3.86	0.29	0.05	0.02	0.02	0.05	
29	0.27	0.06	0.03	0.20	0.06	0.19	1.16	0.30	0.04	0.02	0.02	0.17	
30	0.23	0.06	0.04	0.19		0.39	1.56	0.31	0.04	0.02	0.02	0.45	**Qss**
31	0.20		0.04	0.18		0.74		0.34		0.02	0.02		**Annual**
TOTAL	15.4	2.5	1.2	4.9	3.4	9.0	332	29.7	5.3	1.1	0.9	1.2	**406**
Max.day	0.7	0.2	0.1	1.4	0.2	2.3	178	2.4	0.5	0.2	0.3	0.5	**178**

WY 2012 Daily Suspended-Sediment Load *(tons)*
Continuous Record of Turbidity

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
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18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
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 in WY 2011 and 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: 2012
Stream: Donner Creek
Station: at West River Street (DCWR)
County: Nevada County

Form 5. Annual Suspended-Sediment Load Record WY 2012

WY 2012 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	0.42	0.15	0.05	0.04	0.15	0.04	1.25	1.37	0.32	0.04	0.02	0.02	
2	0.42	0.13	0.05	0.04	0.14	0.25	1.18	1.00	0.89	0.04	0.02	0.02	
3	0.41	0.12	0.04	0.04	0.13	0.13	1.59	0.76	0.29	0.03	0.02	0.02	
4	0.44	0.11	0.04	0.04	0.13	0.13	2.17	0.77	0.40	0.03	0.02	0.02	
5	0.50	0.10	0.04	0.04	0.12	0.13	2.12	0.79	0.38	0.03	0.02	0.01	
6	0.48	0.10	0.04	0.04	0.12	0.13	1.88	0.79	0.24	0.03	0.02	0.02	
7	0.46	0.09	0.04	0.03	0.11	0.12	1.80	0.78	0.21	0.03	0.02	0.02	
8	0.47	0.08	0.04	0.03	0.11	0.12	1.86	0.77	0.21	0.03	0.02	0.02	
9	0.47	0.08	0.04	0.03	0.11	0.12	2.07	0.86	0.19	0.03	0.02	0.02	
10	0.51	0.07	0.04	0.03	0.11	0.12	2.47	0.78	0.17	0.03	0.02	0.02	
11	0.56	0.07	0.04	0.03	0.11	0.13	2.72	0.76	0.17	0.03	0.02	0.02	
12	0.48	0.07	0.04	0.03	0.10	0.11	2.37	0.78	0.16	0.03	0.02	0.02	
13	0.49	0.07	0.04	0.03	0.11	0.08	2.22	0.83	0.16	0.03	0.02	0.02	
14	0.49	0.06	0.04	0.03	0.10	0.09	1.97	0.95	0.16	0.03	2.32	0.02	
15	0.47	0.06	0.04	0.03	0.11	0.72	1.95	0.90	0.14	0.03	0.02	0.02	
16	0.45	0.06	0.04	0.03	0.10	6.14	2.73	0.91	0.10	0.02	0.02	0.02	
17	0.43	0.06	0.04	0.03	0.10	0.34	3.57	0.78	0.09	0.02	0.02	0.02	
18	0.41	0.06	0.03	0.03	0.10	0.23	5.37	0.79	0.10	0.02	0.02	0.02	
19	0.42	0.06	0.03	0.03	0.09	0.19	7.20	0.76	0.08	0.02	0.02	0.02	
20	0.40	0.06	0.03	1.33	0.09	0.18	15.44	0.72	0.07	0.02	0.02	0.02	
21	0.43	0.06	0.03	2.06	0.09	0.23	31.3	0.61	0.07	0.02	0.02	0.02	
22	0.43	0.06	0.03	0.21	0.09	0.26	48.0	0.47	0.06	0.02	0.02	0.02	
23	0.40	0.06	0.03	0.21	0.09	0.25	47.49	0.41	0.06	3.26	0.02	0.02	
24	0.39	0.05	0.03	0.20	0.09	0.22	24.20	0.35	0.06	0.62	0.02	0.02	
25	0.40	0.05	0.03	0.19	0.09	0.20	29.4	0.30	0.05	0.02	0.02	0.02	
26	0.37	0.05	0.03	0.19	0.09	0.18	221	0.27	0.05	0.03	0.02	0.02	
27	0.31	0.05	0.03	0.21	0.09	0.17	21	0.24	0.05	0.03	0.02	0.02	
28	0.27	0.05	0.03	0.19	0.09	0.18	2.5	0.24	0.04	0.02	0.02	0.06	
29	0.23	0.05	0.03	0.17	0.06	0.17	0.79	0.25	0.04	0.02	0.02	0.26	
30	0.20	0.05	0.03	0.16		0.68	0.97	0.27	0.04	0.02	0.02	0.87	**Qss**
31	0.17		0.03	0.16		1.72		0.29		0.02	0.02		**Annual**
TOTAL	12.8	2.2	1.1	5.9	3.0	13.8	490	21	5.0	4.6	2.9	1.7	**564**
Max.day	0.6	0.1	0.0	2.1	0.2	6.1	221	1.4	0.9	3.3	2.3	0.9	**221**

WY 2012 Daily Suspended-Sediment Load *(tons)*
Continuous Record of Turbidity

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	
1													
2													
3													
4													
5													
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24													
25													
26													
27													
28													
29													
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 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: 2012

Stream: Trout Creek
Station: Donner Pass Road (TCDP)
County: Nevada County

Form 6. Annual Suspended-Sediment Load Record, WY 2012

WY 2012 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	0.01	0.01	0.01	0.01	0.01	0.03	0.16	0.17	0.01	0.00	0.00	0.00	
2	0.01	0.01	0.01	0.01	0.03	0.02	0.14	0.15	0.01	0.00	0.00	0.00	
3	0.01	0.01	0.01	0.01	0.03	0.02	0.18	0.13	0.01	0.00	0.00	0.00	
4	0.01	0.01	--	0.01	0.02	0.02	0.16	0.12	0.02	0.00	0.00	0.00	
5	0.03	0.01	0.01	0.01	0.02	0.03	0.12	0.10	0.03	0.00	0.00	0.00	
6	0.01	0.01	--	0.01	0.03	0.02	0.11	0.09	0.02	0.00	0.00	0.00	
7	0.01	0.01	0.01	0.01	0.01	0.02	0.11	0.07	0.02	0.00	0.00	0.00	
8	0.01	0.01	0.01	0.01	0.01	0.03	0.14	0.07	0.02	0.00	0.00	0.00	
9	0.01	0.02	--	0.01	0.01	0.02	0.18	0.06	0.01	0.00	0.00	0.00	
10	0.01	0.02	--	0.01	0.01	0.02	0.22	0.05	0.01	0.00	0.00	0.00	
11	0.01	0.01	0.01	--	0.02	0.02	0.17	0.05	0.01	0.00	0.00	0.00	
12	0.01	0.02	0.01	--	0.02	0.02	0.14	0.04	0.01	0.00	0.00	0.00	
13	0.01	0.01	--	--	0.01	0.02	0.12	0.04	0.01	0.00	0.00	0.00	
14	0.01	0.01	0.01	0.00	0.01	0.05	0.11	0.04	0.01	0.00	0.00	0.00	
15	0.01	0.01	0.01	--	0.01	0.20	0.15	0.04	0.01	0.00	0.00	0.00	
16	0.01	0.01	0.01	0.01	0.02	0.35	0.19	0.03	0.01	0.00	0.00	0.00	
17	0.01	0.01	0.01	0.01	0.02	0.19	0.24	0.03	0.01	0.00	0.00	0.00	
18	0.01	0.01	--	0.01	0.01	0.09	0.31	0.03	0.01	0.00	0.00	0.00	
19	0.01	0.01	0.01	0.01	0.01	0.07	0.41	0.03	0.01	0.00	0.00	0.00	
20	0.01	0.01	0.01	0.18	0.01	0.07	0.51	0.03	0.01	0.00	0.00	0.00	
21	0.01	0.01	0.01	0.61	0.01	0.12	0.57	0.02	0.01	0.00	0.00	0.00	
22	0.01	0.01	--	0.07	0.02	0.20	0.59	0.02	0.01	0.00	0.00	0.00	
23	0.01	0.01	0.00	0.04	0.02	0.18	0.53	0.02	0.01	0.01	0.00	0.00	
24	0.01	0.01	0.00	0.03	0.02	0.13	0.42	0.02	0.01	0.01	0.00	0.00	
25	0.01	0.01	0.00	0.02	0.02	0.10	0.32	0.02	0.01	0.00	0.00	0.00	
26	0.01	0.01	0.01	0.02	0.02	0.07	0.87	0.02	0.01	0.00	0.00	0.00	
27	0.01	0.01	0.01	0.03	0.02	0.06	0.39	0.02	0.01	0.00	0.00	0.00	
28	0.01	0.01	0.01	0.04	0.02	0.07	0.29	0.02	0.01	0.00	0.00	0.00	
29	0.01	0.01	0.01	0.02	0.02	0.07	0.23	0.02	0.00	0.00	0.00	0.00	
30	0.01	0.01	0.01	0.01		0.24	0.19	0.01	0.00	0.00	0.00	0.00	
31	0.01		0.01	0.02		0.24		0.01		0.00	0.00		
TOTAL	0.2	0.3	0.2	1.2	0.5	2.8	8.3	1.6	0.3	0.1	0.0	0.0	**15.5**
Max.day	0.0	0.0	0.0	0.6	0.0	0.3	0.9	0.2	0.0	0.0	0.0	0.0	**0.9**

WY 2012 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	0.01	0.01	0.01	0.01	0.01	0.01	0.10	0.05	0.01	0.01	0.00	0.00	
2	0.01	0.00	0.01	0.01	0.01	0.01	0.05	0.07	0.01	0.01	0.00	0.00	
3	0.01	0.01	0.00	0.01	0.02	0.01	0.10	0.04	0.01	0.01	0.00	0.00	
4	0.10	0.01	--	0.01	0.02	0.02	0.05	0.04	0.04	0.01	0.00	0.00	
5	0.14	0.14	0.00	0.01	0.01	0.02	0.04	0.03	0.02	0.01	0.00	0.00	
6	0.02	0.02		0.01	0.01	0.01	0.06	0.03	0.01	0.01	0.00	0.00	
7	0.02	0.01	0.00	0.01	0.01	0.01	0.04	0.03	0.01	0.00	0.00	0.00	
8	0.01	0.05	0.00	0.01	0.02	0.03	0.04	0.03	0.02	0.00	0.00	0.00	
9	0.01	0.01	--	0.01	0.01	0.01	0.07	0.03	0.02	0.00	0.00	0.00	
10	0.01	0.01	--	0.00	0.01	0.01	0.06	0.03	0.01	0.00	0.00	0.00	
11	0.01	0.02	--	--	0.01	0.01	0.05	0.03	0.01	0.00	0.00	0.00	
12	0.01	0.01	0.00	--	0.01	0.01	0.04	0.02	0.01	0.00	0.00	0.00	
13	0.01	0.01	--	--	0.01	0.02	0.04	0.02	0.01	0.00	0.00	0.00	
14	0.01	0.01	0.00	0.00	0.01	0.05	0.04	0.02	0.01	0.00	0.00	0.00	
15	0.01	0.01	0.00	--	0.01	0.22	0.05	0.02	0.01	0.00	0.00	0.00	
16	0.01	0.01	0.00	0.00	0.02	0.41	0.06	0.02	0.01	0.00	0.00	0.00	
17	0.01	0.01	0.00	0.00	0.01	0.25	0.08	0.02	0.01	0.00	0.00	0.00	
18	0.01	0.01	--	0.00	0.01	0.07	0.10	0.02	0.01	0.01	0.01	0.00	
19	0.01	0.01	0.00	0.01	0.01	0.04	0.15	0.02	0.01	0.00	0.00	0.00	
20	0.01	0.01	0.00	0.87	0.01	0.03	0.18	0.02	0.02	0.01	0.00	0.00	
21	0.00	0.01	0.00	0.90	0.01	0.04	0.19	0.02	0.03	0.00	0.00	0.00	
22	0.00	0.01	--	0.07	0.02	0.10	0.20	0.02	0.02	0.00	0.00	0.00	
23	0.01	0.01	0.01	0.06	0.03	0.08	0.17	0.02	0.01	0.06	0.00	0.00	
24	0.01	0.01	0.00	0.03	0.06	0.05	0.11	0.01	0.01	0.03	0.00	0.00	
25	0.01	0.01	0.00	0.02	0.08	0.04	0.08	0.01	0.01	0.01	0.00	0.00	
26	0.01	0.01	0.00	0.02	0.05	0.04	0.40	0.01	0.01	0.01	0.00	0.00	
27	0.01	0.01	0.00	0.02	0.07	0.03	0.10	0.01	0.01	0.01	0.00	0.00	
28	0.01	0.01	0.01	0.02	0.01	0.04	0.08	0.01	0.01	0.01	0.00	0.00	
29	0.01	0.01	0.01	0.01	0.02	0.04	0.06	0.01	0.01	0.00	0.00	0.00	
30	0.01	0.01	0.01	0.01		0.20	0.06	0.01	0.01	0.00	0.00	0.00	
31	0.01		0.01	0.01		0.65		0.01		0.00	0.00		
TOTAL	0.4	0.4	0.1	2.1	0.6	2.6	2.9	0.7	0.4	0.2	0.1	0.1	**10.6**
Max.day	0.1	0.1	0.0	0.9	0.1	0.6	0.4	0.1	0.0	0.1	0.0	0.0	**0.9**

Daily values are based on calculations of sediment loads at 15-minute intervals.
Periods of missing or erroneous data are indicated by "--"; missing or erroneous data may result from freezing (ice), fogging of the turbidity optical window or debris (e.g., leaf) caught on instrument or extreme low water
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

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 2012

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.)*	
10/18/2011 16:30	bkh	0.93	B	3.1	PY	g	10.6	40	57	0.93	Qss	Sunny, warm, water clear, no leaf dams, leaves/branch caught on turbidimeter. Removed and cleaned window at 16:15. GH @ 16:15 = 0.925, GH @ 16:45 = 0.93
10/31/2011 13:05	cs	0.80	B	--	--	--	7.3	43	67	--	--	Sunny, cold nights (20's), warm days (50's), no precip in past two weeks, water clear. Turbidity window wiped and position changed to avoid capturing early am light scattering. Small amount of biofouling on turbidity window. GH @ 13:05 = 0.8. PC time = 13:01, logger time = 12:58, watch time = 13:01.
11/16/2011 11:45	cs	0.85	B	2.2	PY	g	4.4	39	65	0.01	Qss	Sunny, 50 degrees, no precip in past 1.5 weeks, water clear. Spin test on PY a little slow. Turbidity window cleaned at 11:10, noticed small stick lodged in proximity of window. Leaves floating in channel. No snow or ice on banks. Turbidity sensor in direct sunlight at 12:15. rotated meter to face downstream to aviod catching leaves or sticks., GH @ 11:10 =0.85, GH @ 12:00 = 0.85'
11/29/2011 14:00	cs	0.87	B	--	--	--	--	--	--	--	--	Water clear, 2" of snow on rocks in channel and banks, no ice in channel, turbidity window wiped at 1357. PC time = 13:53, DL time = 14:50, watch time = 13:53.
12/13/2011 15:15	cs	0.83	B	2.7	PY	g	0.7	39	--	0.52	Qss	Sunny, cold, water clear, no ice. Turbidity window wiped at 15:30. Excavator parked at bridge with no signs of disturbance. GH @ 15:00 = .83, GH @ 15:35 = .83
12/27/2011 14:30	cs	0.73	B	1.40	PY	g	1.1	43	--	--	--	Overcast, 45 degrees, water clear, no precip for month of december, small ice chunks occasionally floating by, no ice at probes or in flow x section. Window of turb probe wiped at 13:30. Probe about 1" below water surface. New boulders installed on east bank directly u/s of staff plate. May affect high flow staff plate readings. GH @ 13:30 = 0.73, GH @ 14:30 = 0.73, GH @ 14:49 = 0.73
1/13/2012 15:00	cs	0.94	B	2.56	PY	g	--	--	--	--	--	Sunny, 45 degrees, water clear, no ice on banks, no snow on ground, no precip in past 7 weeks, turbidity window wiped at 14:52. Data offloaded. DL time = 15:46, PC time = 14:49, watch time = 14:50. GH @ 14:45 = 0.94, GH @ 15:23 = 0.94
1/16/2012 13:30	cs	0.88	B	--	--	--	--	--	--	--	--	Water clear, sunny, no ice in channel, dessicant changed, logger clock changed from 14:22 to 14:27
1/20/2012 14:21	bkh	0.84	B	--	--	--	--	--	--	--	--	Light rain all day, water clear, teichert security onsite
1/20/2012 22:15	cs	3.00	R	--	--	--	--	--	--	76.3	Qss	Moderate/heavy rain all day, increasing at time of sampling, water brown, 8500' snow levels, large ice chunks (4'x4'x12") slamming downstream. Entire Teichert lot is a muddy rocky mix with sheet flows going to north side of property. GH @ 22:15 = 3.0 +/- .04
1/27/2012 14:30	cs	1.64	B	14.9	PY	g	1.9	26	46	0.66	Qss	Sunny, 45 degrees, water clear, no ice on banks, large rain event (2" rain 8500' snow levels) followed by 18-24" snow 1/20-1/22. light rain 1/26 (7500' snow levels). Leaves floating in channel, signs of bedload transport since rainfall event. Changed out deisccant in logger. turbidity window wiped at 1455. GH @ 1411 = 1.65 +/-.02, GH @ 1457 = 1.63+/-.02
2/9/2012 17:00	cs	1.10	B	--	--	--	--	--	--	--	--	Water clear, overcast, 50 degrees, no precip in past few weeks, less than 6" of snow on ground, no ice in channel, turbidity window wiped at 1702. PC time = 1658, logger time = 1758, watch time = 1658. data offloaded
2/16/2012 14:00	cs	1.13	B	6.02	PY	g	0.8	32	60	--	--	Sunny, 40 degrees, water clear, slight wind, about 4" of snow fell night of 2/12 and another 4" of snow fell evening of 2/14/12. No ice in channel, snow on banks. Turbidity window wiped at 13:47. GH @ 1347 = 1.13 +/- .01, GH @ 1425 = 1.14 +/- .01.
2/27/2012 15:30	cs	1.16	B	--	--	--	--	--	--	--	--	Heavy snow, cold. 12" of snow in past 12 hours. Water clear. Turbidity window wiped. Noticed slush accumulating near probe (in eddy). More snow would cause erroneous readings of stage and turbidity.
3/9/2012 13:15	cs	1.22	B	--	--	--	--	--	--	--	--	Sunny, 50 degrees, water clear, no ice in channel, some snow on banks, turbidity window wiped.
3/13/2012 17:30	cs, bkh	1.23	U	6.87	PY	g	2.6	39	68	0.06	Qss	Light wet snow/rain all day, chain controls over pass, roads wet in Truckee, runoff entering Donner Creek from I-80 and Chevron area, rain predicted through Friday, water clear, no ice in channel, turbidity window wiped, some snow on banks. GH = 1.23 @ 1725
3/15/2012 12:45	cs	1.96	R	24.0	PY	g	1.9	23	40	4.11	Qss	Light rain, 45 degrees, water slightly turbid, lots of large organic material in suspension, Teichert lot melt contributing to creek, but runoff is clear. GH @ 1222 = 1.94 +/- .02, GH @ 1305 = 1.98 +/- .02
3/16/2012 11:45	bkh, ds	3.05	U	87.0	PY	f	1.1	23	42	87.0	Qss	Wet snow/heavy snow, 36 degrees, near peak flow for the day, water mostly clear, some organics in suspension. GH = 3.07 +/- .1 @ 1122, GH = 3.05 +/- .06 @ 1155
3/22/2012 13:15	cs, bkh	2.30	U	40.7	PY	g	4.2	29	49	--	--	Overcast, 45 degrees, windy, water clear, no ice, about 8" of snow on Teichert Lot and melting rapidly. No snow or ice affecting channel/stage, cleaned turbidity probe at 13:30, new boulder fell into channel u/s of probes, causing a small hole at probes. Data offloaded. PC time = 12:51, Logger time = 12:50, Watch time = 12:51. GH @ 12:50 = 2.3 +/- .08, GH @ 13:30 = 2.3 +/- .05
3/30/2012 12:30	bkh, cs	1.96	R	--	--	--	--	--	--	--	--	Wired up modem. CS worked on moving boulder that was upstream of probes. Water clear, control on pool clear of any debris, data downloaded, removed PT's for calibration. PC Time = 1242, DL time = 12:41, Watch time = 1242. Reset program to reflect mult and offsets found on paper work in enclosure, changed PT2 mult and offset. GH @ 1335 = 2.0 +/- .02, GH @ 1230 = 1.96 +/- .02
4/17/2012 14:45	cs, bkh	2.13	U	34.5	PY	g	7.0	37	58	--	--	Partly cloudy, 60 degrees, water clear, no snow along banks, willows still dormant. About 2' of snow in upper watershed last week, turbidity window wiped at 1510, snowmelt could begin this week. GH @ 1436 = 2.13 +/- .04, GH @ 1507 = 2.14 +/- .04.
4/23/2012 14:45	cs, bkh	3.70	R	165	AA	f	--	--	--	3.04	Qss	Warm, 70 degrees, partly cloudy, thunderstorms on horizon, just beginning to rain, 4 days of above average temps increased snowmelt. Real time gage = 130 cfs and rising, lots of small twigs and leaves in water. GH @ 1430 = 3.68 +/- .1, GH @ 1457 = 3.73 +/- .15

Table 1. Station Observer Log:
Cold Creek at Teichert Bridge (CCTB), water year 2012

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.)	
4/23/2012 19:00	cs, bkh	4.45	R	261	AA	f	2.4	19	33	40.02	Qss	Sunny, 65 degrees, approaching peak melt, water brown, rising rapidly, barely wadeable, thunderstorms this afternoon from about 3-5 pm, lots of coarse particulate matter in suspension. GH @ 1842 = 4.4 +/- .1, GH @ 1905 = 4.5 +/- .1.
4/26/2012 9:25	bkh	5.60	R	--	--	--	--	--	--	72.00	Qss	Moderate rain, about .6" rain in past 24 hours, Snow level 8,000', water turbid, sample collected from REW at high flow x section. GH @ 930 = 5.6-6.0' and pillowing up on plate.
4/26/2012 11:50	cs, bkh	5.50	R	--	--	--	--	--	--	56.91	Qss	Light rain, windy, GH = 5.5' + .5' (pillowing), water brown, about .7" rain in past 24 hours, snow level 8,000', sample collected from LEW.
4/26/2012 15:25	cs, ds	5.10	F							30.14	Qss	
5/4/2012 16:15	cs	3.18	R	101	AA	g	6.6	27	42	4.56	Qss	Sunny, 50 degrees, windy, water clear, light rain 5/3/12, no snow on ground, water surging at staff plate, cleaned turbidity meter at 16:45. GH @ 1545 = 3.15 +/- .05, GH @ 1640 = 3.2 +/- .05
5/23/2012 14:15	cs	2.70	U	61.9	PY	f	--	--	--	--	--	Sunny, 65 degrees, water clear, willows full of leaves, turbidity window wiped at 14:31. GH @ 1357 = 2.7 +/- .04, GH @ 1431 = 2.72 +/- .04
6/3/2012 13:45	cs	2.20	B	39.0	PY	g	12.7	30	40	--	--	Sunny, 70 degrees, breezy, water clear, willows full of leaves, turbidity window wiped at 13:55. Large willow branch lodged against sensor housing. GH @ 13:24 = 2.2 +/- .02, GH @ 13:55 = 2.2 +/- .02
6/4/2012 16:50	bkh	3.20	U	--	--	--	4.8	17	28		Qss	GH = 3.16-3.24' and surging at plate.
6/15/2012 15:30	cs, bkh	1.75	B	20.3	PY	g	--	--	--	--	--	Water clear, re-calibrated PT (see next line), sunny, 78 degrees, turbidity probe angle moved to avoid morning light scattering (pointed directly downstream). GH @ 13:15 = 1.75 +/- .01, GH @ 13:45 = same
6/15/2012 13:22	cs, bkh	1.76	B	--	--	--	--	--	--	--	--	Recalibrated PT's. Removed PT's and turbidity probe. Cleaned housing of sediment. PT housing was full of sediment. PT's were full of sediment.. Reoriented turbidity meter to point directly downstream. PT1 Offset = .0165, Multiplier = 2.3276. PT2 Offset = -.0825, multiplier 2.356. Depths confirmed. DL time = 1350, PC time = 1351, watch time = 1351.
7/19/2012 14:30	cs	0.72	B	1.50	PY	f,g	13.6	63	83	--	--	Overcast, 65 degrees, light rain in vicinity (no runoff), turbidity window 1-2" below water surface, cleaned at 1416, water clear. GH = .72' @ 1417
7/31/2012 12:45	cs	0.64	B	--	--	--	--	--	--	--	--	Turbidity sensor cleaned, water clear
8/3/2012 13:30	bkh	0.62	B	--	--	--	--	--	--	--	--	Water clear, low flow, lots of algae on bed. Real-time turb = <10NTU. No disturbances observed on site. Turbidity probe cleaned. Staff plate is bent upstream below stage .70'. Reading more shallow stage than acutal stage.
8/6/2012 17:00	bkh	0.55	B	--	--	--	--	--	--	--	--	Cleaned turbidity probe, tested turbidity with desktop meter (.1-.5 NTU) and probe read .8 NTU. Lots of algae on rocks.
8/7/2012 13:30	cs	0.58	B	--	--	--	--	--	--	--	--	Water clear, low flow, lots of algae on bed, cleaned turbidity probe.
8/15/2012 16:45	cs	0.54	B	0.79	PY	f,g	18.5	80	91	0.18	Qss	Sunny, t-storms building, 85 degrees, t-storms past few days. Lots of filamentous green algae in bed and floating on top. Turbidity probe cleared of algae at 1630. staff plate straightened (no change in stage). Very large t-storm to NE at time of sampling. GH @ 16:30 = .54, GH @ 1715 = .53
8/15/2012 17:00	cs	0.53	B	0.75	PY	f,g	18.5	80	91	0.01	Qss	Sunny, t-stroms building, 85 degrees, t-storms past few days. Lots of filamentous green algae in bed and floating on top. Turbidity probe cleared of algae at 1630. staff plate straightened (no change in stage). Very large t-storm to NE at time of sampling. GH @ 16:30 = .54, GH @ 1715 = .53
8/20/2012 9:15	bkh	--	B	--	--	--	--	--	--	--	--	Sunny, 80 degrees, construction has begun upstream. Turbidity reading was elevated online but was only related to algae on probe.
8/28/2012 12:00	cs	0.47	B	0.32	PY	f	14.6	65	83	--	--	Sunny, 75 degrees, water clear, lots of brown and white algae on rocks. Trubidity probe about 1-2" below water surface, probe cleaned at 1130. Construction has began in flood plain u/s, but no diversion is in place and no work taking place in channel. GH @ 1130 = .47, GH @ 1200 = .47
9/5/2012 15:05	bkh	0.44	B	--	--	--	--	--	--	--	--	Cleaned turbidity probe, water clear, construction ongoing upstream.
9/18/2012 8:30	bkh	0.40	B	--	--	--	--	--	--	--	--	Water clear, turbidity pulse last 2 days. Cleaned ntu probe, not much algae on probe window. Likely a real turbidity spike. Construction was absent, but looks like right bank has been graded and preparing for root-wads to be placed. Pipes arrived = stream diversion?
9/21/2012 14:45	cs	0.36	B	0.19	py	p	15.4	64	80	--	--	Sunny, 80 degrees, water clear, construction diversion being installed upstream, measured flow just u/s of southern property fence, built leaf dams to direct flow, flow measurement missed about 10% of flow. GH @ 1345 = .37, GH @ 1500 = .36

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 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
Additional Sampling: Qss = Suspended sediment

Table 2. Station Observer Log:
Donner Creek at Highway 89 (DC89), USGS 10338700, water year 2012

Site Conditions				*Streamflow*			*Water Quality Observations*					*Remarks*
Date/Time (observer time)	Observer	Stage	Hydrograph	USGS flow	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.)*	
10/5/2011 10:17	bkh	4.20	U	110	USGS	--	--	--	--	1.55	Qss	
11/16/2011 12:45	cs	3.25	U	12.0	USGS	--	--	--	--	0.36	Qss	Sunny, 50 degrees, water clear, gage reading estimated because water line is about .15' below bottom of staff plate. USGS flow preliminary
12/13/2011 16:00	cs	3.20	U	9.4	USGS	--	--	--	--	0.60	Qss	Sunny, cold, water clear, no ice on banks, gage reading estimated because water line is about .2' below bottom of staff plate, USGS flow preliminary
1/20/2012 13:55	bkh	--	U	7.9	USGS	--	--	--	--		Qss	Light rain, water mostly clear, sample collected at gage, McDonalds culvert flowing dirty at .25-.35 cfs. Turbidity plume continues to d/s of 89 bridge.
1/20/2012 22:00	cs	--	R	70	USGS	--	--	--	--	72.9	Qss	Moderate/heavy rain all day, increasing at time of sampling, water brown, sample collected below bridge but above stormwater pipe that comes from tmcc campus entrance (likely more reflective of DCWR)
1/27/2012 15:20	cs	ice	U	44	USGS	--	--	--	--	0.38	Qss	Sunny, 45 degrees, water clear, sample collected at gage, McDonalds pipe flowing dirty at about .05cfs. No ice.
2/15/2012 12:45	cs	--	B	20	USGS	--	--	--	--	--	--	Water clear, sunny, 35 degrees, 4" snow overnight, roads melted, TMCC pipe not flowing, McDonalds pipe flowing very dirty about .02cfs. No sample collected
3/2/2012 14:30	bkh	--	B	31	USGS	--	--	--	--	0.82	Qss	Sunny, 42 degrees, 2' of snow in last 5 days, stormdrain inlet at Shell station is dry, lots of snow on banks, road runoff @ HWY 89 and Savemart. TSS @ 1435, water mostly clear, turbidity under bridge originates from McDonalds outflow (about 5-10gpm), cloudy on right bank under bridge.
3/13/2012 18:08	cs, bkh	--	U	18	USGS	--	--	--	--	6.02	Qss	Light rain/snow all day, water slightly turbid, no snow on roads. McDonalds pipe very dirty and flowing at about .1cfs, Sample collected d/s of shell station pipe, which was flowing very dirty at about .05cfs. Lots of road sand in delta outlet of shell station pipe.
3/14/2012 15:35	bkh	--	U	20	USGS	--	--	--	--	2.0	Qss	Light/moderate rain, significant runoff from hwy 80 on ramp. (about .25cfs and turbid). Sample collected above bridge. About 10gpm stromwater from Deerfield culvert, about 8-10gpm from shell station. Both very turbid and creating turbidity cloud in Donner Creek. Water in Donner Ck mostly clear, light rain.
3/15/2012 13:20	cs	--	U	36	USGS	--	--	--	--	6.31	Qss	Light steady rain for past 3 days. Water slightly turbid. Shell station pipe (u/s of sample location) flowing at about .1cfs and very dirty. McDonalds pipe (d/s of sample location) very dirty and flowing at about .1cfs.
3/16/2012 12:08	bkh, ds	--	U	129	USGS	--	--	--	--	7.50	Qss	Wet snow. Water slightly turbid. Deerfield stormwater pipe flowing at about .5-1 cfs.
4/23/2012 15:20	cs, bkh	--	R	324	USGS	--	8.50	46	68	2.56	Qss	Thunderstorms, 70 degrees, rain showers, water slightly turbid, unable to wade entire channel due to high flows, TSS sample captured 3/4 of channel, McDonalds pipe turbid and flowing at about 25-30gpm. SCT = 170 @ 25 and 125 @ 11.8 degrees.
4/23/2012 19:25	cs, bkh	--	R	361	USGS	--	--	--	--	39.0	Qss	Water brown, sample collected at USGS gage on REW, water too swift to wade, 65 degrees, potentially peak snowmelt this evening. McDonalds pipe flowing clear at <5gpm.

Table 2. Station Observer Log:
Donner Creek at Highway 89 (DC89), USGS 10338700, water year 2012

Site Conditions				Streamflow			Water Quality Observations					Remarks
Date/Time (observer time)	Observer	Stage	Hydrograph	USGS flow	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.)	
4/26/2012 9:10	bkh	--	R	925	USGS	--	--	--	--	75.0	Qss	Rain, about .6" rain in last 24 hours, water brown, lots of debris and wood in transport, culverts are flowing at >.5 cfs and moderately turbid, TSS samples from REW at USGS staff plate.
4/26/2012 12:00	cs, bkh	--	R	1070	USGS	--	--	--	--	40.1	Qss	Light rain, breaks of sun, windy, about .7" of precip in past 24 hours, sample collected at LEW above shell station pipe. Shell station pipe is underwater. McDonalds pipe flowing at about 20gpm. Water brown.
4/26/2012 16:00	ds, cs	--	U	1060	USGS	--	--	--	--	--	Qss	Emergency bridge repair upstream at Cold Stream Road; Donner Lake releases are variable, stormwater drains running relatively clear
5/4/2012 17:00	cs	--	U	201	USGS	--	--	--	--	1.19	Qss	Sunny, windy, 50 degrees, light rain on 5/3/12, water clear, mcdonalds pipe flowing clear at about .05cfs.
8/14/2012 18:39	bkh	--	U	3.9	USGS	--	--	--	--	--	--	Thunderstorm: 0.5 inches at TKE; 1.33 inches at Martis Dam in last 24 hrs; very turbid; turbid plume entering Truckee River at confluence
9/28/2012 12:42	bkh		R	9.0	USGS	--	--	--	--	--	Qss	TMWA beginning to release water from Donner Lake, streamflow increased from 3 cfs, water clear with some algae and leaves in suspension

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 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
Additional Sampling: Qss = Suspended sediment

Table 3. Stream gaging observer log:
Donner Creek at West River Road (DCWR): water year 2012

Site Conditions				*Streamflow*				*Water Quality Observations*					*Remarks*
Date/Time (observer time)	Observer	Stage	Hydrograph	Streamflow	Instrument Used	Estimated Accuracy	USGS streamflow (10338700)	Water Temperature	Field Specific Conductance	Adjusted Specific Conductance	Turbidity	Additional sampling?	
		(feet)	*(R/F/S/B)*	*(cfs)*	*(AA/PY)*	*(e/g/f/p)*	*(cfs)*	*(oC)*	*(µmhos/cm)*	*(at 25 oC)*	*(NTU)*	*(Qss, Qbed)*	
1/27/2012 15:30	cs	--	S	--	--	--	47	--	--	--	0.69	Qss	Water clear
2/15/2012 12:35	cs	--	S	--	--	--	23	--	--	--	--	--	Water clear, 4-inches of snow overnight; no samples collected
3/2/2012 15:00	bkh	--	S	30.2	PY	g	31	1.8	58.0	104	--	Qss	Visible turbidity increases at HWY89, water slightly turbid at DCWR, Qss collected @ 14:50
3/13/2012 18:16	cs	--	S	--	--	--	18	--	--	--	10.0	Qss	Snowing; not accumulating on roads, water moderately turbid, Qss collected d/s bridge @ 18:16
3/14/2012 15:15	bkh	--	S	19.4	PY	g/f	20	--	--	--	--	Qss	Light rain, water slightly turbid, Qss collected @ 15:00
3/15/2012 13:30	cs	--	R	--	--	--	37	--	--	--	12.5	Qss	Light steady rain past 3-days, water moderately turbid, Qss collected @ 13:30
3/16/2012 12:45	bkh, ds	--	S	118	AA	g/f	120	--	--	--	--	Qss	Measurable flow from urban outfalls; snow/rain; turbid, Qss collected @ 12:15
4/23/2012 19:33	bkh, cs	--	U	--	--	--	361	--	--	--	27.6	Qss	Water brown, turbid, Qss (grab) collected from left bank @ 19:33; water too swift to wade
4/26/2012 9:00	bkh	--	R	--	--	--	873	--	--	--	--	Qss	Possible peak annual flow; significant rain overnight; very turbid; Qss (grab) collected from left bank
4/26/2012 12:10	cs	--	Peak	--	--	--	1060	5.1	40	66	46.6	Qss	Sunbreaks, windy, Qss (grab) collected from left bank, water turbid
4/26/2012 16:15	cs	--	Peak	--	--	--	1050	--	--	--	28.6	Qss	Qss (grab) collected from left bank
5/4/2012 17:10	cs	--	S	--	--	--	204	--	--	--	1.42	Qss	Sunny, windy, water clear; Qss collected @ 17:10
8/14/2012 18:42	bkh	--	F	--	--	--	12.0	--	--	--	--	Qss	Thunderstorm (1.33 inches, Martis Dam last 24 hrs); water very turbid, Qss collected @ 18:42

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 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
Additional Sampling: Qss = Suspended sediment

Table 4. Station observer log:
Trout Creek at Donner Pass Road (TCDP), water year 2012

Site Conditions				Streamflow			Water Quality Observations					Remarks
Date/Time (observer time)	Observer	Stage (feet)	Hydrograph (R/F/S/B)	Measured Discharge (cfs)	Instrument Used (AA/PY)	Estimated Accuracy (e/g/f/p)	Water Temperature (oC)	Field Specific Conductance (µmhos/cm)	Adjusted Specific Conductance (at 25 oC)	Turbidity (NTU)	Additional sampling? (Qbed, etc.)	
11/3/2011 14:15	cs	3.74	B	1.3	PY	f	--	--	--	--	--	Gage removed from Jibboom Street at 12:30. Gage moved back to Donner Pass Road at 14:00. Turbidity sensor will show high readings until 14:30 due to upstream leaf dam removal and upstream Qmeas. Windy, overcast, 45 degrees, 2" of snow forecasted for evening hours. Leaf dams prominent in channel. Lots of leaves drifting in water column that could cause errors in turbidity readings. GH @ 14:00 = 3.74, GH @ 1430 = 3.74
11/4/2011 15:40	bkh	3.74	B	--	--	--	--	--	--	--	--	Water clear, ice around staff plates and stilling well, 6"-8" snow overnight, leaves are swirling around turbidimeter in eddy, turbidimeter window about 1" below water surface and water depth is 4"-5", expect more leaves to fall, bet at gaging location is very mobile...likely scour and fill in storms. PT2 needs to be replaced. GH @ 1540 = 3.74'
11/8/2011 16:15	cs	3.80	B	--	--	--	--	--	--	--	--	Leaf dams upstream in Qmeas x section were broken, causing a plume of leaves and sediment downstream until 16:45. Turbidity window cleaned at 16:30. Lots of leaves still floating around turbidity sensor.
11/14/2011 13:56	cs	3.75	B	--	--	--	--	--	--	--	--	Turbidity window wiped, leaves still floating around in channel, construction stockpiles have been removed, rocks rearranged and soil has been sprayed with hydromulch since 11/8 visit
11/16/2011 13:45	cs	3.73	B	1.5	PY	g	2.6	90	157	1.19	Qss	Sunny, 50 degrees, no precip in past 1.5 weeks, leaves still floating in channel. Potential for dams to build up at riffle crest d/s of pt's. no leaf dams, snow, or ice were observed at time of sampling, turbudity window wiped at 1347. GH @ 1320 = 3.73', GH @ 1347 = 3.73'
11/28/2011 8:55	ds	3.75	B	--	--	--	--	--	--	--	--	Turbidity window wiped
11/29/2011 13:18	cs	3.78	B	--	--	--	--	--	--	--	--	Sunny, water clear, leaf dams in channel u/s of gage, turbidity window wiped at 1336. Signs of recent leaf dam break just u/s of gage. Sticks removed from channel just u/s of gage, causing elevated turbidity and stage readings. Piece of cardboard removed from channel at riffle crest just d/s of gage at grade control. could cause a slight decrease in stage. Data downloaded. LL time 1319, PC time 1319, watch time 1319. GH @ 1318 = 3.78, GH @ 1338 = 3.77
12/5/2011 15:15	cs	3.76	B	--	--	--	--	--	--	--	--	Sunny, cold, ice building up above and below staff plate. No ice at sensors or plate. Ice on right bank seems to be directing flows to the left bank. Small ice dam downstream at riffle crest. Broke that and stage dropped to 3.70' in 10 minutes. turbidity window wiped at 1515.
12/8/2011 9:08	ds	3.68	B	--	--	--	--	--	--	--	--	Ice at margins, across riffle, and piled up on right side bar. Thin ice at probes (probably melting daily). Broke ice at probes and wiped turbidity meter
12/9/2011 15:15	cs	3.68	B	--	--	--	--	--	--	--	--	Ice at margins, across riffle, and piled up on right side bar. Thin ice at probes (probably melting daily). Broke ice at probes and wiped turbidity meter
12/13/2011 14:30	cs	3.64	B	1.1	PY	f	0.2	87	--	0.53	Qss	Sunny, cold, water clear, majority of channel covered in ice. Turbidity probe/staff plate/PT free of ice. Turbidity window wiped at 13:10. Broke ice at downstream riffle crest to measure flow, stage dropped once ice was cleared. GH @ 1400 = 3.64, GH @ 1440 = 3.61
12/19/2011 11:45	cs	3.63	B	--	--	--	--	--	--	--	--	Sunny, no precip in past 3 weeks, water clear, no ice around sensors, broke ice in vicinity, added a large rock to downstream riffle, cleaned turbidity sensor, GH increased after rock was installed. GH @ 1145 = 3.63, GH @ 1200 = 3.67
12/27/2011 13:00	cs	3.68	B	--	--	--	--	--	--	--	--	Ice across entire channel, could be affecting stage at PT. Broke ice and cleared channel. No ice around turb probe, but thin ice at staff plate/PT. Turbidity probe cleaned at 13:15. stage dropped to 3.66' at 13:15 once ice was cleared. GH @ 1300 = 3.68, GH @ 1315 = 3.66
1/4/2012 16:10	bkh	3.70	B									wiped turbidity probe, water was clear, ice along right bank, sunny warm
1/6/2012 8:41	cs	3.78	B	--	--	--	--	--	--	--	--	Thin ice at staff plate and turbidimeter. Seems to be ice buildup downstream that is backing up to the staff plate. Reading at top of ice was 3.78'. Didn't break ice
1/6/2012 16:45	cs	3.70	B	--	--	--	--	--	--	--	--	Ice from morning hours has melted and backwatering has subsided.
1/13/2012 16:15	cs	3.70	B	1.2	PY	g/f	--	--	--	--	--	Sunny, 45 degrees, water clear. Broke ice at flow meas x section. Wiped turbidity window at 13:48. small amount of algae on window. Returned at 16:00 to measure flow. No ice obstructing flow, no ice at sensors. Sediment in bed is very mobile, especially at riffle crest d/s of gage. GH @ 1348 = 3.7, GH @ 1600 = 3.70, GH @ 1630 = 3.71. Offloaded data. DL time = 15:54, Watch time = 15:54, PC time = 15:53
1/16/2012 12:45	cs	3.65	B	--	--	--	--	--	--	--	--	Water clear, cleaned turbidity window, turned window slightly downstream to aviod sunlight scattering, broke ice. No change in stage after breaking ice.
1/20/2012 8:30	bkh	3.73	U	--	--	--	--	--	--	--	--	36 degrees, ice across entire channel, excluding area around turbidity meter and gage, 3" snow overnight turned to rain at 3am, on and off showers all morning, slush on roadways, water slightly cloudy
1/20/2012 13:30	bkh	3.77	R	--	--	--	0.4	141	262	12.0	Qss	Flow over ice, water slightly turbid, light rain, GH @ 1330 = 3.77, GH @ 1335 = 3.78, GH @ 1345 = 3.88, turbidity window wiped at 1338.
1/20/2012 14:30	bkh	3.88	U	--	--	--	--	--	--	--	--	Moderate rain in truckee

Table 4. Station observer log:
Trout Creek at Donner Pass Road (TCDP), water year 2012

Date/Time (observer time)	Observer	Stage (feet)	Hydrograph (R/F/S/B)	Measured Discharge (cfs)	Instrument Used (AA/PY)	Estimated Accuracy (e/g/f/p)	Water Temperature (oC)	Field Specific Conductance (µmhos/cm)	Adjusted Specific Conductance (at 25 oC)	Turbidity (NTU)	Additional sampling? (Qbed, etc.)	Remarks
Site Conditions				*Streamflow*			*Water Quality Observations*					*Remarks*
1/20/2012 21:45	cs	4.60	R	--	--	--	--	--	--	111.8	Qss	Moderate/heavy rain all day, increasing at time of sampling, water brown, large ice chunks (3'x3'x6") barreling downstream, GH @ 21:45 = 4.6 +/- .04
1/27/2012 12:30	cs	3.84	B	2.3	PY	g,f	0.2	77	144	1.7	Qss	12:05 broke ice and moved rock at riffle crest to clear flow x section. Stage dropped about .02'. Water slightly cloudy, sunny, 40 degrees, turbidity window wiped at 12:16. potential shift in stage from last weeks heavy rain event. Foam floating on surface. no ice obstructing flows or around sensors. ice still in shade on south bank. GH @ 1215 = 3.84, GH @ 1300 = 3.83
1/31/2012 18:43	cs	3.78	B	--	--	--	--	--	--	--	--	Overcast, 1" of snow in forecast overnight, water clear, ice on right bank breaking up. No ice or snow obstructing flows, turbidity window wiped. Put new desiccant in logger housing.
2/9/2012 16:10	cs	3.74	B	--	--	--	--	--	--	--	--	Water clear, overcast, 50 degrees, little or no snow on ground, no precip in past several weeks, south side of channel covered in ice, chunks are falling off and floating downstream. Logger time = 1616, PC time = 1616, watch time = 1616. Data offloaded. Turbidity window wiped at 1610, GH @ 1634 = 3.74. GH @ 1610 = 3.74
2/13/2012 9:17	ds	3.78	B	--	--	--	--	--	--	--	--	Water clear, rusty tint, minor suds, snow on rocks, no ice except for a 1' high ice dam at u/s end of bridge
2/15/2012 13:30	cs	3.78	B	1.9	PY	g	0.9	83	152	1.6	Qss	Sunny, 35 degrees, 4" of snow overnight, roads melting/slushy/dry, water slightly cloudy. Very little urban runoff. Turbidity sensor wiped at 1318. Turned meter slightly upstream to avoid sunlight scattering on window. GH @ 1315 = 3.78, GH @ 1345 = 3.78
2/27/2012 17:00	cs	3.78	U	--	--	--	--	--	--	--	--	Snowing hard, 12" of snow in last 12 hours. Snow/slush accumulating around sensors. Snow cleared and turbidity window wiped. Moved rocks to direct more moving water toward sensor. Stage seemed to be unaffected by my activities. No ice in channel. Snow in channel d/s of gage. water clear.
3/2/2012 15:30	bkh	3.76	B	--	--	--	-0.3	76	144	1.0	Qss	Cooling, some high clouds, water clear, ice on right bank, staff plate and probes free of ice, some fine sediment accumulated at x section at gage due to ice constriction, cleaned turbidity probe.
3/8/2012 14:00	cs	3.82	B	--	--	--	--	--	--	--	--	Water clear, turbidity window wiped
3/13/2012 16:45	cs, bkh	3.85	B	2.5	PY	g	1.1	86	--	1.3	Qss	Water mostly clear, light rain/snow mix, temp 37 degrees, some runoff on pavement in town. No ice at gages or in channel. No snow. GH = 3.85 @ 1640, GH = 3.86 @ 1700
3/14/2012 14:45	bkh	3.91	R	3.3	PY	g	0.6	88	163	4.4	Qss	Rain, water slightly turbid, temp 47 degrees, no snow or ice in channel, steady light rain with moderate bursts. Snow level 7500' and rising. GH @ 1435 = 3.9, GH @ 1455 = 3.91
3/15/2012 8:55	bkh	4.16	U	--	--	--	--	--	--	--	--	water turbid, rainfall consistently moderate. Sheet runoff from roadways.
3/15/2012 9:38	bkh	4.18	U	--	--	--	--	--	--	--	--	Water moderately turbid. Much of the fines on roadways and parking lots were likely flushed into system on Monday.
3/15/2012 11:45	cs	4.24	R	8.8	PY	g	-0.1	67	125	12.6	Qss	Light rain since Monday, temp 45 degrees, water turbid, no ice in channel, lots of large debris floating in channel (leaves, garbage). TSS rep taken. GH @ 1126 = 4.23 +/- .01, GH @ 1150 = 4.24 +/- .01, GH @ 1200 = 4.24 +/- .01
3/16/2012 11:00	bkh, ds	4.43	U	13.7	PY	g	0.1	61	114	11.3	Qss	Rain/snow mix, temp 37 degrees, rain for past several days, just turning to snow at time of sampling, water turbid, channel is free of ice and snow, removed corrugated metal from riffle at gage just prior to q meas. GH @ 1043 = 4.43 +/- .02, GH @ 1103 = 4.43 +/- .02
3/22/2012 11:45	cs, bkh	4.19	U	6.8	PY	g	1.7	74	133	--	--	Overcast, 45 degrees, water clear, turbidity window wiped at 1142 and turb dropped from 8 to 2.6 NTU, no major runoff from snowmelt, streets are dry. evaluate grade control d/s of gage.... could have changed last storm.GH @ 1130 = 4.19 +/- .01, GH @ 1200 = 4.19 +/- .01. Data offloaded. PC time = 1139, DL time = 1040, Watch time = 1139
3/27/2012 11:53	cs, bkh	4.03	U	--	--	--	--	--	--	--	--	water clear, installed new solar panel.
3/30/2012 10:45	cs, bkh	4.13	U	6.3	PY	g	2.2	77	137	--	--	Partly cloudy, 50 degrees, rain last night. Flows came up last night/morning. Water clear, expecting rain/snow tonight. GH @ 1017 = 4.13 +/- .02, GH @ 1045 = 4.13 +/- .02
3/30/2012 11:45	cs, bkh	4.14	U	--	--	--	--	--	--	--	--	Replaced one probe. Data downloaded. PC time = 1045, DL time = 9:45, watch time = 10:45. PT's pulled at 10:40. Probes calibrated at 11:20. New offsets and multipliers set. New stage good within .03'. Uploaded new program and wired modem. New program TCDP_2012.csc. Turbidity probe wiped at 11:40
4/6/2012 14:15	cs	4.13	U	--	--	--	--	--	--	--	--	Water clear, GH +/- .01, Turbidity probe cleaned, sunny, 40 degrees.
4/12/2012 10:05	ds	4.17	U	--	--	--	--	--	--	7.5	Qss	Water turbid, can barely see channel bed, connected modem to datalogger, Scott Brown changed DL time to PST (sync with PC). Turbidity probe wiped at 10:53, water clear by 10:53. GH @ 1001 = 4.17 +/- .01, GH @ 10:50 = 4.17 +/- .01.
4/17/2012 14:15	cs, bkh	4.24	U	10.0	PY	g	6.0	50	80	--	--	Partly cloudy, 60 degrees, water slightly turbid, but mostly clear. Downstream control looks good. Willows are not leafing yet. Filamentous green algae on rocks on bed. Cleaned NTU probe at 14:25 - noticed strings of attached algae growing near probe. GH @ 1405 = 4.24 +/- .02, GH @ 1420 = 4.25 +/- .02

Table 4. Station observer log:
Trout Creek at Donner Pass Road (TCDP), water year 2012

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.)	
4/22/2012 16:15	bkh	4.42	R	17.5	AA	g	--	--	--	2.3	Qss	Sunny, 73 degrees, warm days and non freezing nights, water slightly turbid. GH @ 1600 = 4.42 +/- .02, GH @ 1625 = 4.43 +/- .02
4/23/2012 19:45	cs, bkh	4.54	U	20.9	AA	g	9.6	79	115	4.1	Qss	Sunny, 60 degrees, water slightly turbid, turbidity window wiped, bubbles floating on water surface, willows budding, GH @ 1942 = 4.54 +/- .02, GH @ 1953 = 4.54 +/- .02
4/26/2012 11:30	cs, bkh	4.68	U	28.1	AA	g	5.6	70	113	7.6	Qss	Rain, 45 degrees, about .7" rain in past 24 hours, snow level 8,000', water turbid, but still able to see bed surface, willows budding, no snow on ground in truckee, rain is showery with moderate spurts, organic debris in suspension. GH @ 1117 = 4.68 +/- .02, GH @ 1136 = 4.69 +/- .02
5/4/2012 15:00	cs	4.10	U	6.7	PY	g	10.4	85	121	0.9	Qss	Sunny, windy, 50 degrees, warm temps last week, light rain on 5/3/12, cooler today, turbidity window wiped at 14:55, water clear. GH @ 1445 = 4.1 +/- .01, GH @ 1520 = 4.09 +/- .01
	cs, bkh		U	--	--	--	--	--	--	--	--	Water clear, turbidity window wiped
5/17/2012 14:25	cs	3.86	U	--	--	--	--	--	--	--	--	Water clear, 60 degrees, turbidity window wiped
5/23/2012 13:30	cs	3.78	B	2.3	PY	g,f	--	--	--	--	--	Sunny, 65 degrees, water clear, willows full of leaves, lots of biofouling on turbidity probe. Probe wiped at 13:26, GH @ 1330 = 3.78 +/- .01, GH @ 1345 = 3.78 +/- .01
5/31/2012 11:30	bkh	3.72	B	--	--	--	--	--	--	--	--	Turbidity window wiped
6/1/2012 8:00	cs	3.71	B	--	--	--	--	--	--	--	--	Turbidity window wiped
6/3/2012 14:15	cs	3.71	B	1.7	PY	g	16.3	124	151	--	--	Sunny, 70 degrees, breezy, water clear, turbidity probe wiped at 14:10, GH @ 1410 = 3.71 +/- .01, GH @ 1430 = 3.71 +/- .01
6/4/2012 16:25	bkh, jo	3.87	B	--	--	--	--	--	--	--	Qss	Snow and rain. Water slightly turbid.
6/13/2012 14:30	bkh	3.68	B	--	--	--	--	--	--	--	--	Water clear, turbidity window wiped
6/15/2012 16:15	cs	3.67	B	1.4	PY	g	--	--	--	--	--	Sunny, 78 degrees, water clear, turbidity window wiped at 16:00. GH = 3.67 +/- .01 @ 16:00
7/9/2012 16:30	bkh	3.53	B	0.5	PY	f	18.0	152	177	--	--	Water clear, sunny, 82 degrees, alage on bed, low velocities. GH @ 1605 = 3.53, GH @ 1630 = 3.53
7/19/2012 15:15	cs	3.53	B	0.5	PY	f	14.0	143	184	--	--	Overcast, light showers in vicinity (no runoff), water clear, turbidity window wiped at 1522, very low flows GH = 3.53 @ 1502
7/31/2012 11:30	cs	3.53	B	--	--	--	--	--	--	--	--	Turbidity sensor lowered, pointed upstream, and cleaned. Water level very low, water clear.
8/7/2012 12:30	cs	3.49	B	--	--	--	--	--	--	--	--	Cleaned turbidity sensor, shaded turbidity probe from mid-day sun.
8/14/2012 17:30	bkh	3.52	B	--	--	--	--	--	--	--	--	Water clear, isolated t-storms in truckee with mod-heavy rain (mostly over martis valley)
8/15/2012 15:30	cs	3.55	B	0.5	PY	g,f	18.3	173	200	1.2	Qss	Water clear, sunny, t-storms building to NE, 85 degrees, white/brown slime growing on rocks, turbidity probe cleared of algae, large t-storm in Truckee previous day with localized heavy rain about 1/2 mile to east.
8/15/2012 15:45	cs	3.55	B	0.5	PY	g,f	18.3	173	200	1.2	Qss	Second streamflow measurement
8/20/2012 12:30	cs	3.52	B	--	--	--	--	--	--	--	--	Water clear, sunny, 80 degrees, lots of white algae blobs growing on rocks, turbidity window wiped.
8/28/2012 13:00	cs	3.50	B	0.3	PY	f	13.8	148	192	--	--	Water clear, sunny, 75 degrees, rocks covered in brown algae, turbidity window wiped, GH @ 1245 = 3.5, GH @ 1310 = 3.5
8/31/2012 15:15	bkh	3.48	B	--	--	--	--	--	--	--	--	Cleaned turbidity probe, cleaned wall. Last several days spikes of high NTU unrelated to turbidity (possibly leaves), abundant algae on bed
9/5/2012 14:30	bkh	3.50	B	--	--	--	--	--	--	--	--	Removed leaf from turbidity probe, cleaned probe window. Leaf may have caused periodic high ntu readings over past week.
9/6/2012 0:00	cs			--	--	--	--	--	--	--	--	Installed screen around turbidity sensor to block leaves
9/21/2012 11:45	cs	3.52	B	--	--	--	--	--	--	--	--	Cleaned turbidity probe, lots of leaves floating in channel. Potential leaf dam buildup at d/s grade from time to time.

Observer Key: (ds) is David Shaw, (cs) is Collin Strasenburgh, (bkh) is Brian Hastings, (jo) is Jonathan Owe
Stage: Water level observed at outside staff plat
Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), or baseflow (
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 visua
Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy gi
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
Additional Sampling: Qss = Suspended sedimer

Table 5. Suspended-sediment concentrations and loading rates: Cold Creek at Teichert Bridge (CCTB), water years 2011 and 2012

	Site Conditions					*Suspended Sediment*		
Sample Date:Time	Observer(s)	Gage Height	Streamflow Discharge	Streamflow Value Source	Stream Condition	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)*
WY 2011								
10/24/10 10:52	ds	2.86	88	R	R	52.0	26.0	12.3
10/24/10 11:50	ds	3.16	112	R	R	95.3	37.7	28.8
10/24/10 12:19	ds	3.25	119	R	R	98.0	43.5	31.4
10/24/2010 15:45	ds	4.55	260	R	R	247	105	173
10/24/2010 16:15	ds	4.68	292	R	R	235	112	185
10/25/10 8:35	ds	2.37	58	R	F	11.1	16.4	1.74
10/26/10 9:10	ds	1.74	20	R	F	2.4	10.5	0.13
11/7/10 11:27	ds	1.41	8	R	R	1.71	0.70	0.04
12/9/10 14:30	ds	2.09	36	R	R	4.00	*1.25*	0.38
12/14/2010 10:15	ds	2.43	55	R	R	3.80	3.78	0.57
12/14/2010 11:00	ds	2.47	56	R	R	3.00	3.77	0.46
1/28/11 15:10	ds, cs	1.84	21	M	B	1.00	0.60	0.06
2/23/11 12:45	ds, cs	1.75	18	R	B	1.71	1.05	0.08
3/10/11 14:05	cs	1.84	14	R	B	1.20	0.86	0.05
3/15/11 10:25	ds, bkh	2.09	35	R	R	4.00	1.58	0.38
4/6/11 12:55	cs, bkh	2.76	76	M	B	3.20	1.60	0.66
4/18/11 10:45	ds	3.65	147	E	F	13.6	6.39	5.39
5/5/11 13:00	cs, bkh	3.45	130	M	R	2.60	2.39	0.91
5/27/11 13:15	cs	3.26	110	M	F	1.80	1.18	0.53
6/6/11 12:45	cs, bkh	3.88	176	M	F	4.40	2.76	2.09
6/14/11 12:05	cs, bkh	4.55	254	M	F	17.6	5.14	12.0
6/16/11 20:25	cs	4.90	300	M	R	16.0	6.78	12.9
6/23/11 15:00	cs, bkh	5	287	M	R	40.8	7.93	31.6
7/15/11 11:55	ds	2.9	87	M	B	2.6	3.75	0.61
8/5/11 11:30	bkh	1.82	24	M	B	0.82	1.33	0.05
9/20/11 16:45	bkh	0.78	2.0	M	B	1.2	1.0	0.01
WY 2012								
10/18/11 16:45	bkh	0.93	3	M	B	1.00	0.90	0.01
11/16/11 12:00	cs	0.85	2	M	B	0.80	0.64	0.005
12/13/11 15:30	cs	0.83	3	M	B	1.20	0.72	0.01
1/20/12 22:18	cs	3.00	105	R	R	125	40	35.4
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	1.2	0.72	0.02
3/15/12 13:00	cs	1.96	25.0	M	R	7.5	4.13	0.51
3/16/12 11:30	bkh, ds	3.05	89	M	U	9.5	5.6	2.28
4/23/12 14:56	cs, bkh	3.70	169	M	R	12.4	10.8	5.65
4/23/12 19:05	cs, bkh	4.45	258	M	R	88.0	50.0	61.2
4/26/12 9:25	bkh	5.60	530	R	R	182	100	260
4/26/12 11:50	cs, bkh	5.50	510	R	R	113	63.0	155
4/26/12 15:45	cs, ds	5.1	384	R	F	51	37.1	52.8
5/4/12 16:30	cs	3.18	103.0	M	R	4.4	5.5	1.22
6/4/12 16:50	bkh	3.2	107.0	R	U	27	21.9	7.8
8/15/12 17:15	cs	0.53	0.74	M	B	0.6	1.3	0.001
8/15/12 17:16	cs	0.53	0.74	M	B	0.6	1.3	0.001

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

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 and 2012

Sample Date:Time	Observer(s)	Gage Height	Streamflow Discharge	Streamflow Value Source	Stream Condition	General Conditions	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	n/a	59.4
4/26/12 9:10	bkh	--	925	R	R	rain	183	n/a	456
4/26/12 12:00	cs, bkh	--	1070	R	R	rain	73	n/a	211
4/26/12 16:00		--	1060	R	F	rain	37	n/a	106
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
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	R	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

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 data are not available at this station; this station is not equipped with a turbidity probe
Suspended-sediment load (tons/day) is calculated by multiplying SSC by streamflow (cfs) and a conversion factor of 0.0027

Table 7. Suspended-sediment concentrations and calculated loading rates: Donner Creek at West River Street (DCWR), water year 2012

	Site Conditions						*Suspended Sediment*		
Sample Date:Time	**Observer(s)**	**Gage Height**	**Streamflow Discharge**	**Streamflow Value Source**	**Stream Condition**		**Suspended-Sediment Concentration**	**15-minute Turbidity**	**Suspended-Sediment Discharge Rate**
		(ft)	*(cfs)*	*M,R,E*	*R,F,B,U*		*(mg/l)*	*(NTU)*	*(tons/day)*
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

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 data are not available at this station; this station is not equipped with a turbidity probe.

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 and 2012

Sample Date:Time	Observer(s)	Gage Height	Streamflow discharge	Streamflow Value Source	Stream Condition	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	4.5	M	F	1.56	0.85	0.02
3/2/11 13:10	ds	4.01	3.4	M	R	35	44	0.32
3/2/11 13:50	ds	4.01	3.4	M	R	8.5	12.7	0.08
3/10/11 14:45	cs	4.13	6.1	M	U	68	35	1.11
3/10/11 14:46	cs	4.14	6.1	M	U	71	43	1.16
3/14/11 15:30	bkh	4.24	9.6	M	R	13.6	8.8	0.35
4/2/11 16:20	bkh	4.53	29	M	R	32.0	26.4	2.51
4/18/11 11:10	ds	4.71	46	M	U	6.80	8.98	0.83
5/5/11 12:02	cs, bkh	4.86	38	M	U	2.80	3.30	0.29
5/27/11 11:45	cs	4.68	25	M	F	2.40	1.96	0.16
6/5/2011 23:09	cs	4.82	36	M	R	22.4	10.0	2.18
6/6/11 11:45	cs	5.02	48	M	U	6.40	5.46	0.82
6/14/11 13:47	cs	4.61	23	M	R	3.00	3.01	0.19
6/23/11 17:15	cs	4.32	11	M	F	3.20	2.63	0.09
7/13/11 17:15	bkh	4.07	5.1	M	F	1.60	2.24	0.02
7/29/11 9:20	cs	4.00	3.1	M	R	3.20	2.30	0.03
9/2/11 16:15	bkh	7.42	1.5	M	B	2.40	2.63	0.01
9/13/11 8:55	bkh	7.45	2.0	M	B	3.60	10.8	0.02
9/13/11 17:00	bkh	7.50	2.7	M	B	21.2	58.0	0.15
WY 2012								
10/5/11 9:45	bkh	7.66	4.3	M	F	26.4	16.9	0.31
10/18/11 15:00	bkh	7.43	1.1	M	B	2.40	1.70	0.01
11/16/11 13:15	cs	3.73	1.5	M	R	1.20	1.68	0.00
12/13/11 14:45	cs	3.64	1.0	M	B	0.80	1.40	0.00
1/20/12 13:35	bkh	3.78	1.8	R	R	7.00	9.00	0.03
1/20/12 21:45	cs	4.60	20	R	R	76.0	76.8	4.16
1/27/12 13:00	cs	3.84	2.2	M	F	3.20	2.50	0.02
2/15/12 13:15	cs	3.78	1.9	M	F	2.80	2.58	0.01
3/2/12 15:30	bkh	3.76	1.7	R	U	2.00	1.66	0.01
3/13/12 17:00	cs, bkh	3.85	2.5	M	R	2.40	2.26	0.02
3/14/12 14:38	bkh	3.91	3.3	M	R	3.60	5.21	0.03
3/15/12 11:54	cs	4.24	9.0	M	R	17.0	11.2	0.41
3/15/12 11:55	cs	4.24	9.0	M	R	18.1	11.2	0.44
3/16/12 10:40	bkh, ds	4.43	14	M	U	7.00	9.40	0.27
4/12/12 10:05	ds	4.17	7.3	R	U	8.00	15.0	0.16
4/22/12 16:30	bkh	4.42	18	M	R	4.00	3.45	0.19
4/23/12 19:53	cs, bkh	4.54	24	M	U	6.67	6.30	0.43
4/26/12 11:20	cs, bkh	4.68	28	M	U	14.0	8.0	1.06
5/4/12 15:15	cs	4.10	6.8	M	F	6.00	2.04	0.11
6/4/12 16:26	bkh, jo	3.87	3.0	R	R	6.50	11.0	0.05
7/23/12 16:05			1.1	R	F	46.0	36.0	0.13
8/15/12 16:00	cs	3.55	0.5	M	B	1.75	3.57	0.00
8/15/12 16:01	cs	3.55	0.5	M	B	1.50	3.57	0.00

Notes

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

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

Table 9. Comparison of annual flow and suspended-sediment loads and yields Cold Creek, Trout Creek, and Donner Creek, water years 2011 and 2012.

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	Normalized Suspended Sediment
			(cfs)	*(cfs)*	*(cfs)*	*(ac-ft)*	*(cfs)*	*(ft)*	*(mm/dd/yyyy)*	*(tons)*	*(%)*	*(tons/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	0.01	40.3
	WY 2012	12.6	21	384	0.2	15,374	546	5.89	4/26/2012	327	1.5	0.02	26.0
Donner Creek at Highway 89 (DC89)													
	WY 2011	14.8	140	774	5	101,308	921	--	6/29/2011	804	--	0.01	54.3
	WY 2012	14.8	48	862	3.1	34,925	1,090	--	4/26/2012	406	1.1	0.01	27.4
Donner Creek at West River Street (DCWR)													
	WY 2011	15.2	--	--	--	-- --	--	--	--	--	--	--	--
	WY 2012	15.2	48	862	3.1	34,925	1,090	--	4/26/2012	564	2.1	0.02	37.1
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*	*0.01*	*11.3*
	WY 2012	4.6	2.5	23.3	0.2	1,814	54	5.21	1/21/2012	10.6	0.8	0.01	2.3

Notes:

1 Water years begin in October and end in September of the named water year; WY 2011 is a partial water year (January 21--September 30, 2011) for TCDP

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)

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

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

	Annual Flow[2]				Peak Flow[3]			Suspended Sediment Load[4]		
Year[1]	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)*
Donner Creek at Highway 89										
WY 1997	117	2,380	3.6	84,679	2,500	12.76	1/2/1997	2,253	**0.03**	148
WY 2004	55	245	3.1	39,546	268	5.28	3/22/2004	380	**0.01**	25
WY 2011	140	774	5.0	101,308	921	--	6/29/2011	804	**0.01**	54
WY 2012	48	862	3.1	34,925	1,090	--	4/26/2012	384	**0.01**	26
mean	*90*			*65,115*	*1,195*			*955*	*0.01*	*63*
median	*86*			*62,113*	*1,006*			*594*	*0.01*	*40*

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 and WY 2012 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 2011-2012: (Qss = 0.021*(Q^0.74)) for flows less than 200 cfs; (Qss = 0.00000002*(Q^3.36)) for flows greater than 200 cfs. (Hastings and others, this report);
Separate sediment rating curves were developed and applied for the rising limb hydrograph of Donner Lake releases (0.0158*(Q^1.03) and rain on bare ground events (0.00075*Q^3.36) (See this report)
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 2011-2012 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), and 2012

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	**0.01**	**12**
WY 2004	4.1	9.4	3.0	3,002	--	--	--	21	**0.01**	**4**
partial WY 2011	*15*	*63*	*0.4*	*6,777*	70	5.16	4/21/2011	*59*	**0.01**	**13**
WY 2012	2.5	23	0.2	1,814	54	5.14	1/20/2012	10.6	**0.01**	**2.3**
mean	*7.3*			*4,351*				*38*	*0.01*	*8.0*
median	*6.1*			*4,406*				*40*	*0.01*	*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 and WY 2012 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 for WY 2011 and WY 2012 are based on continuous gaging record managed and maintained by Balance Hydrologics; WY 2011 is a partial water year (January 21 - September 30, 2011)

3 Because WY 1997 and WY 2004 represent annual flow data based on a synthetic 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 and WY 2012 suspended-sediment loads are based on continuous record of turbidity and laboratory analysis of suspended-sediment concentration (SSC); SSC = 1.07*(NTU)^0.96
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); WY2011 watershed area delineated at Donner Pass Road (4.6 sq. miles)

FIGURES

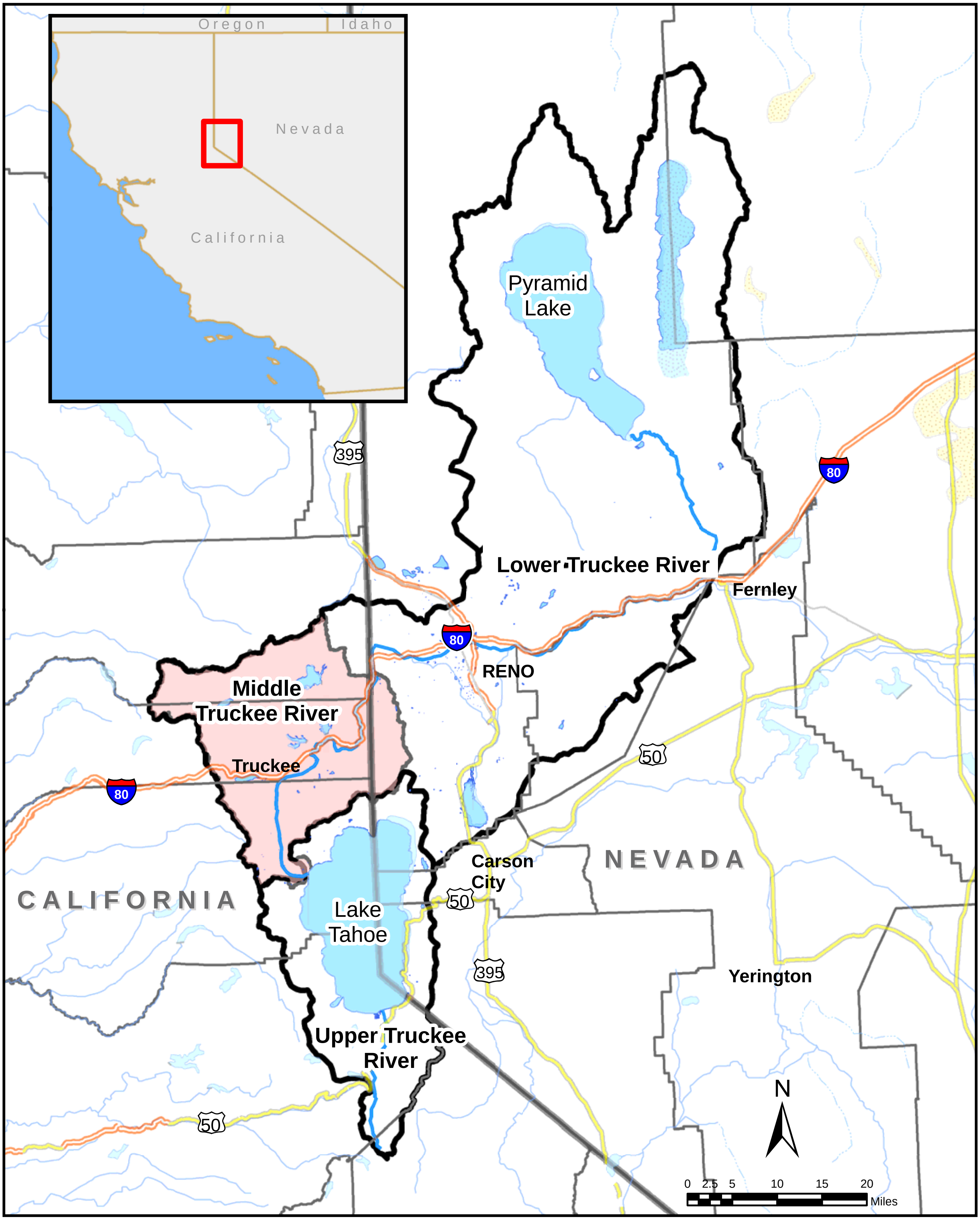

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Figure 1. **Truckee River Basin, California and Nevada**

The Middle Truckee Basin is delineated from the Lake Tahoe outlet downstream to the California-Nevada border.

209116 streamgage locations.mxd

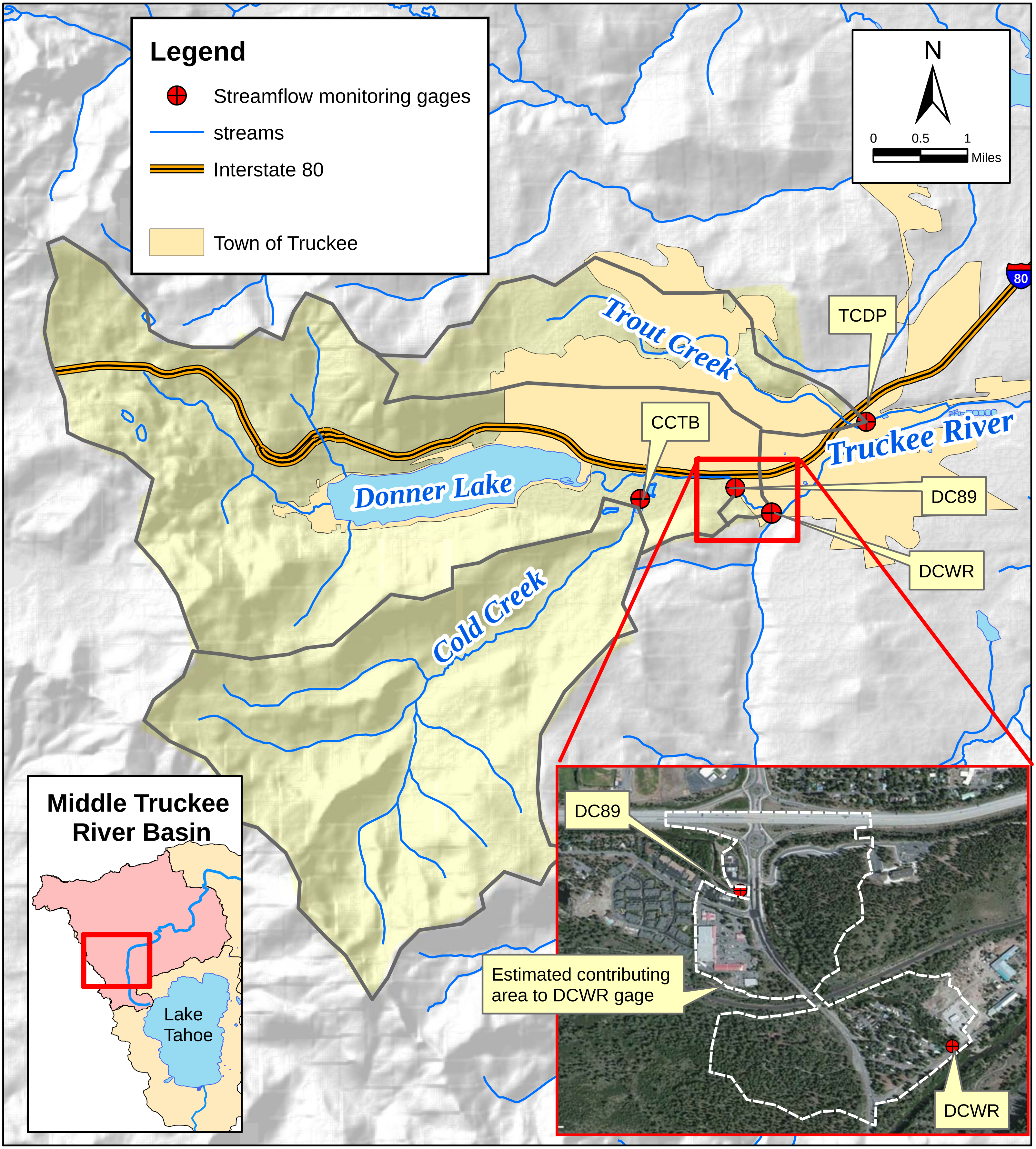
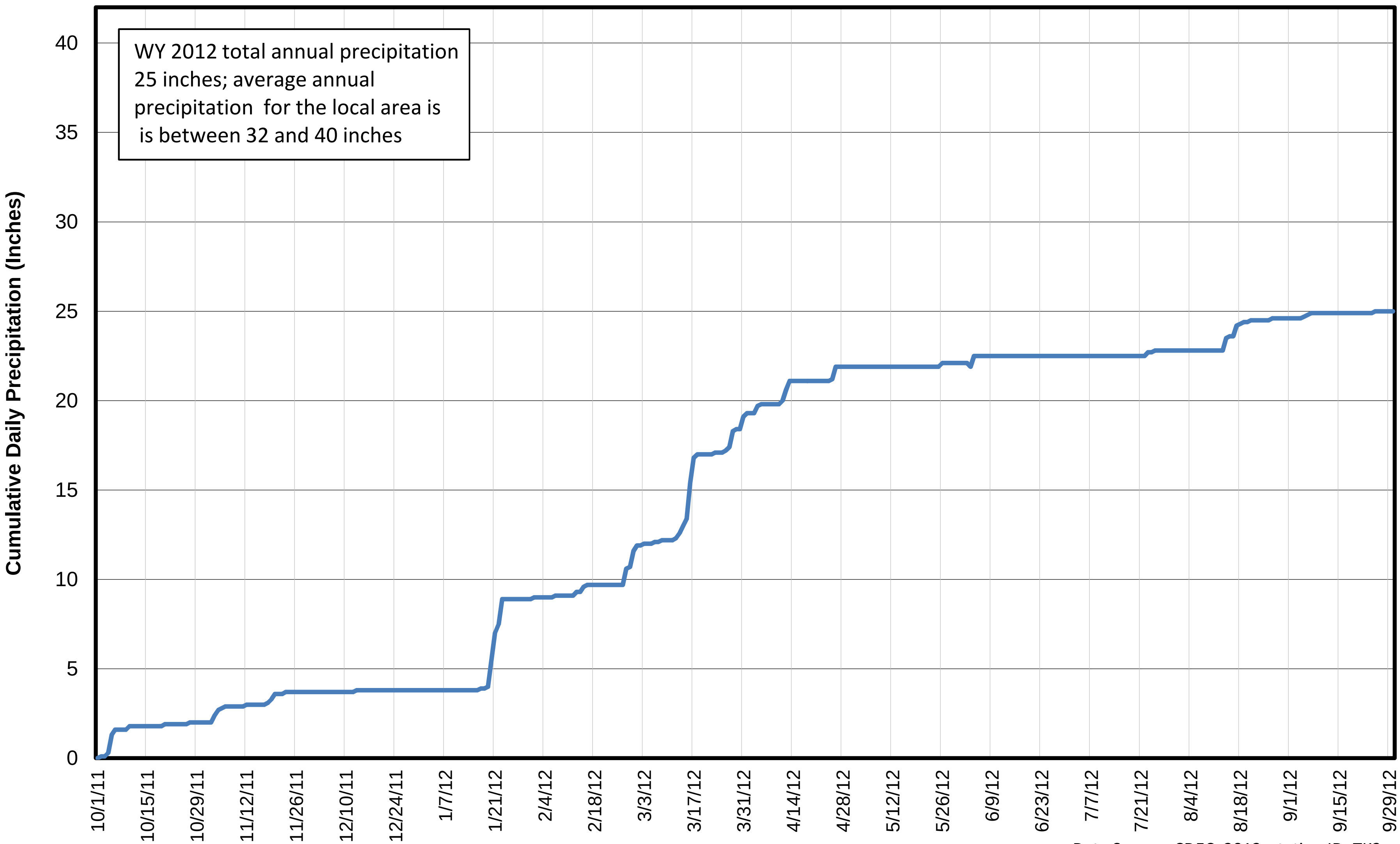


Figure 2. **Middle Truckee River, California and Nevada. Locations of streamflow gages and watersheds evaluated for this study**

Balance Hydrologics, Inc.

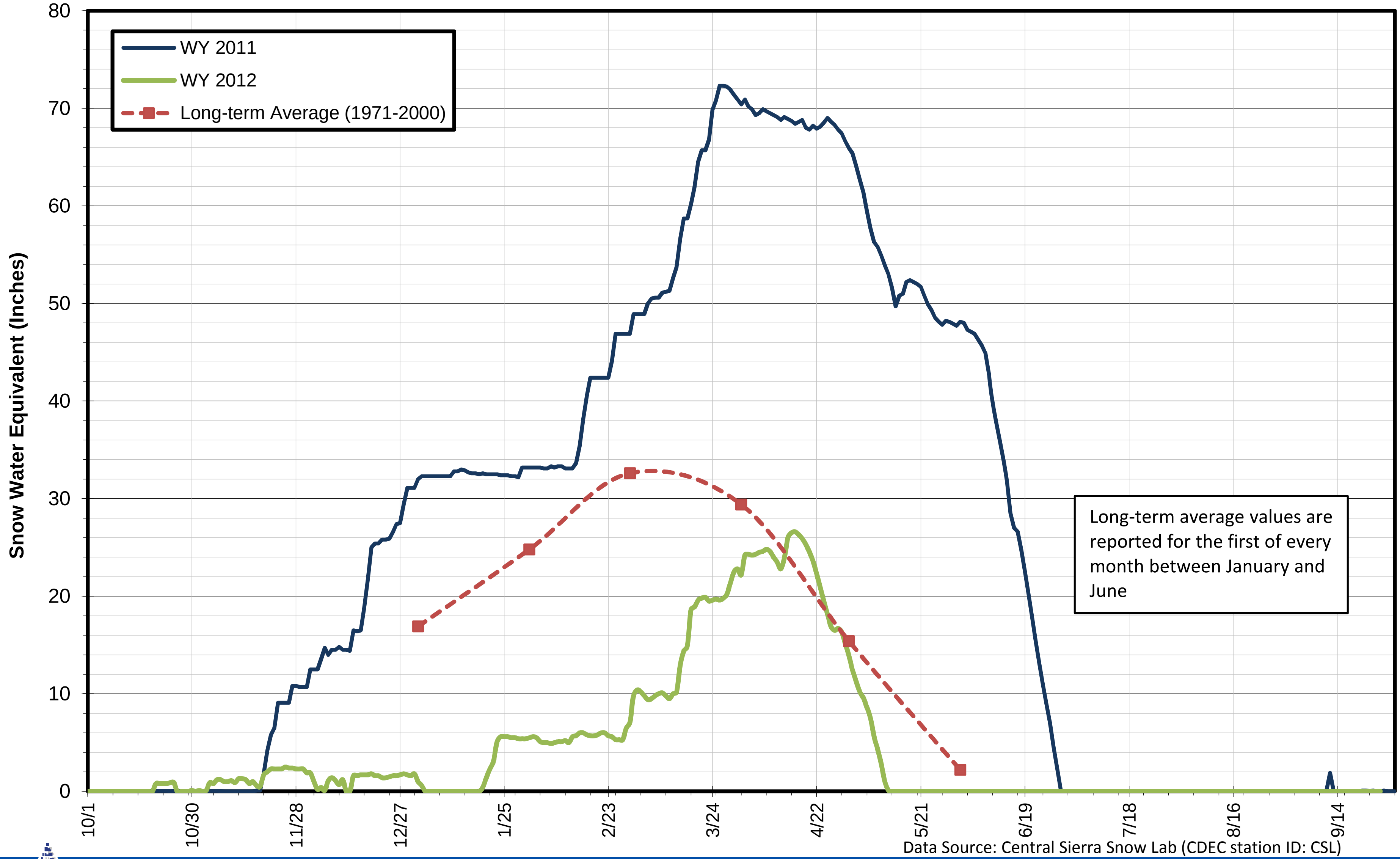


Data Source: CDEC, 2012, station ID: TK2

Balance Hydrologics, Inc.

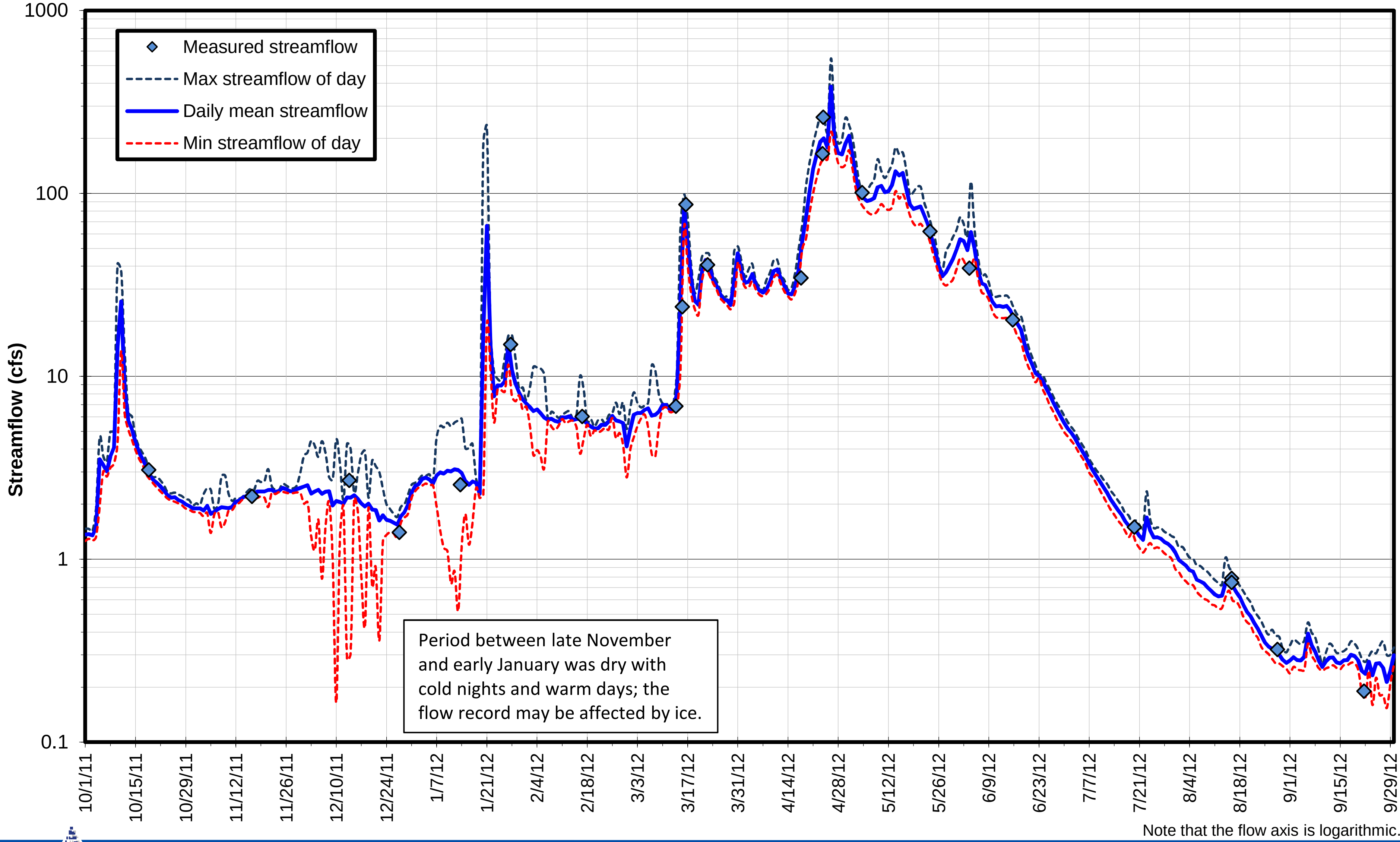
Figure 3. **Cumulative daily precipitation, near Truckee, California, water year 2012.** The station located approximately 2 miles south of Truckee, California at 6,400 feet elevation. Total annual rainfall in WY 2012 was well below average, with most of the annual precipitation falling in late January and late February through early April.

210011 DMS and SSL data



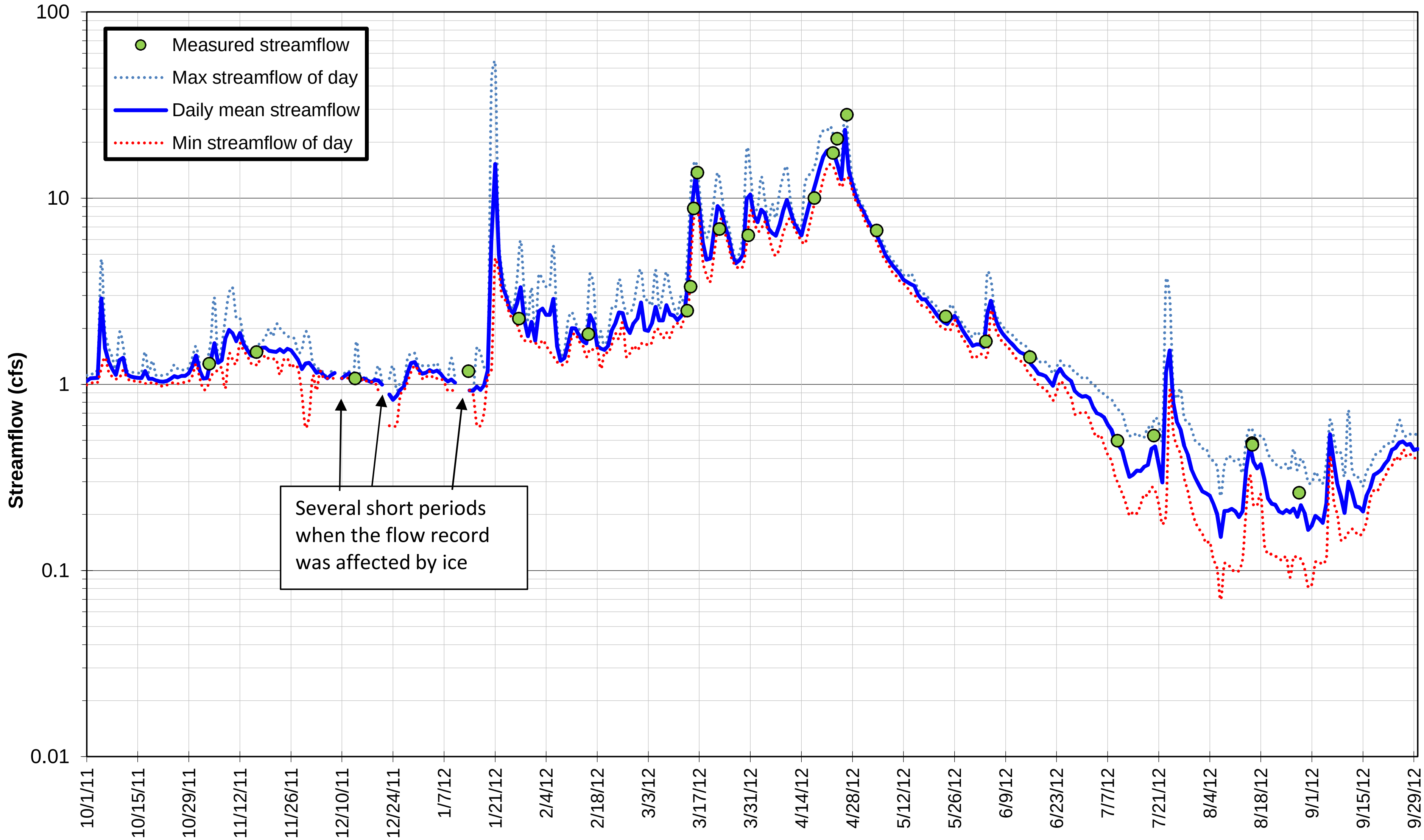
Balance Hydrologics, Inc.

Figure 4. Snow-water equivalent, Central Sierra Snow Lab, Soda Springs, California, water years 2011 and 2012 compared. The Central Sierra Snow Lab is located approximately 7.5 miles west of the Cold Creek gaging station at 6,950 feet elevation.



Balance Hydrologics, Inc.

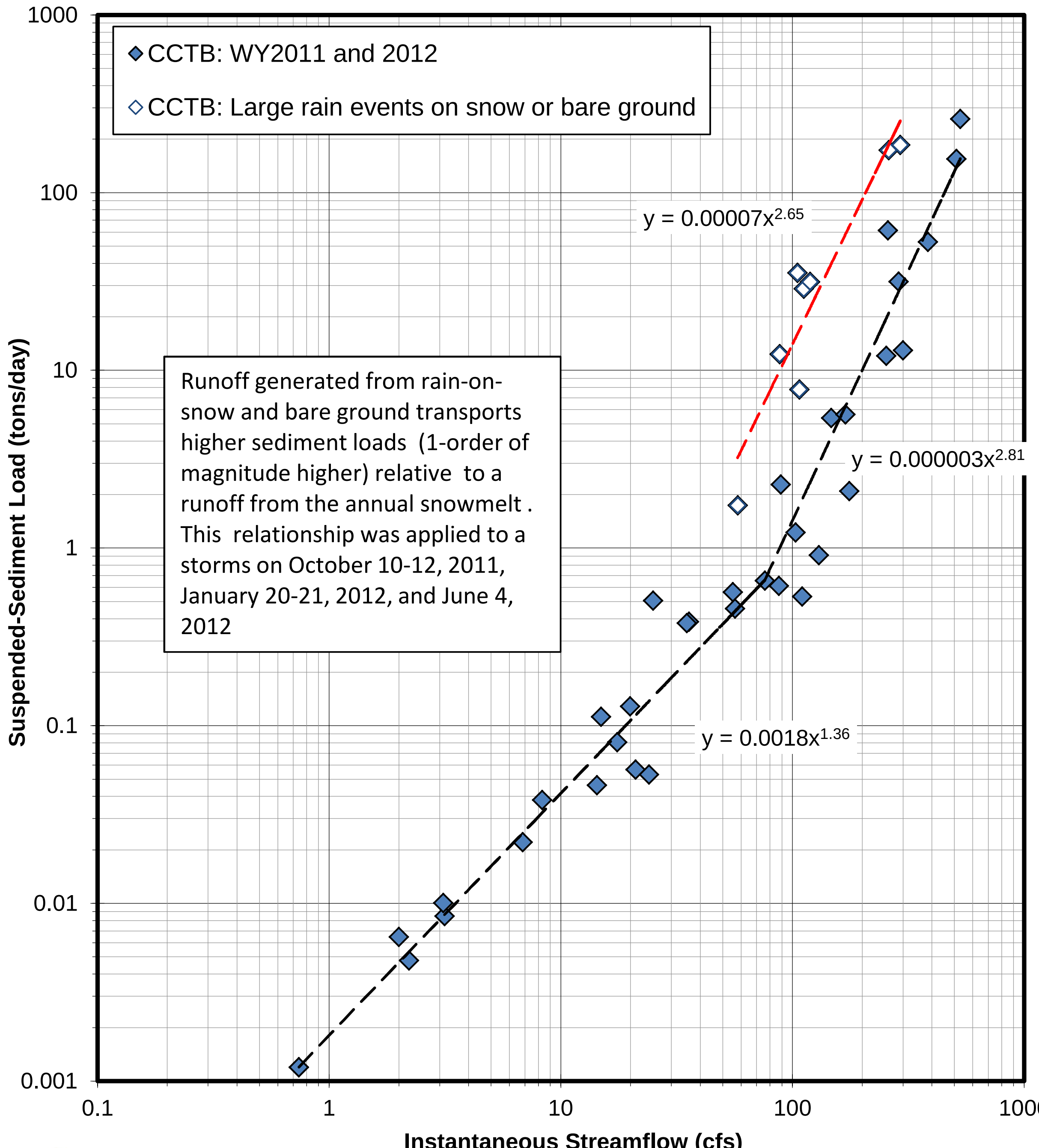
Figure 5. **Streamflow hydrograph, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water year 2012.** The peak streamflow for WY 2012 was 546 cfs recorded on April 26, 2012 and coincident with peak snowmelt. A rain-on-snow event on January 21, 2012 generated a peak streamflow of 229 cfs.



Note that the flow axis is logarithmic.

Balance Hydrologics, Inc.

Figure 6. **Streamflow hydrograph, Trout Creek at Donner Pass Road (TCDP), Truckee, California, water year 2012.** The peak streamflow for WY 2012 was 54 cfs and occurred January 21, 2012 and was associated with a rain-on-snow event. Peak snowmelt runoff occurred April 26, 2012, consistent with other nearby creeks.



Note the axes are logarithmic

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Figure 7. Relationship between streamflow and suspended-sediment load, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water years 2011 and 2012. 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, shown in Figure 9.

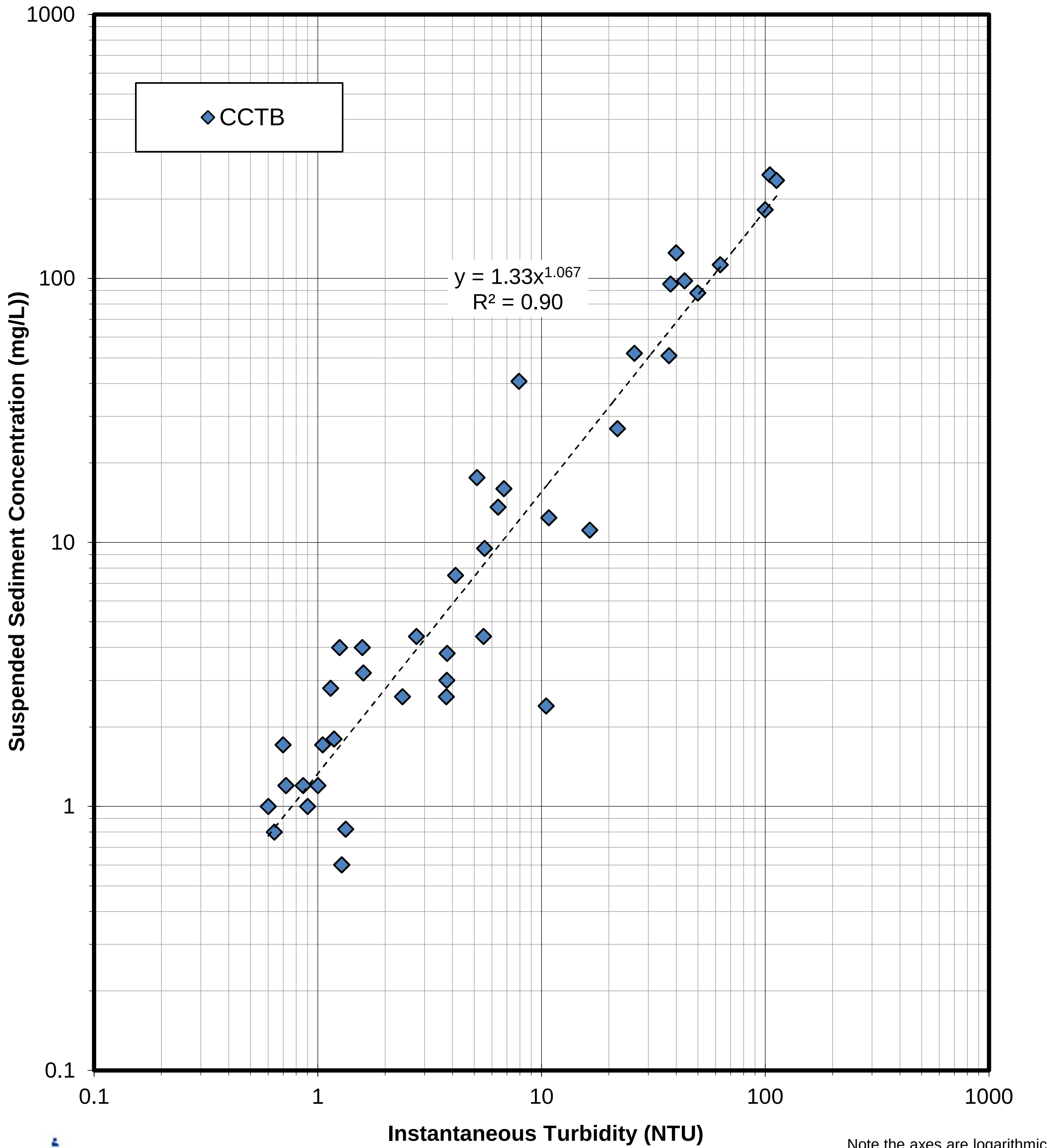

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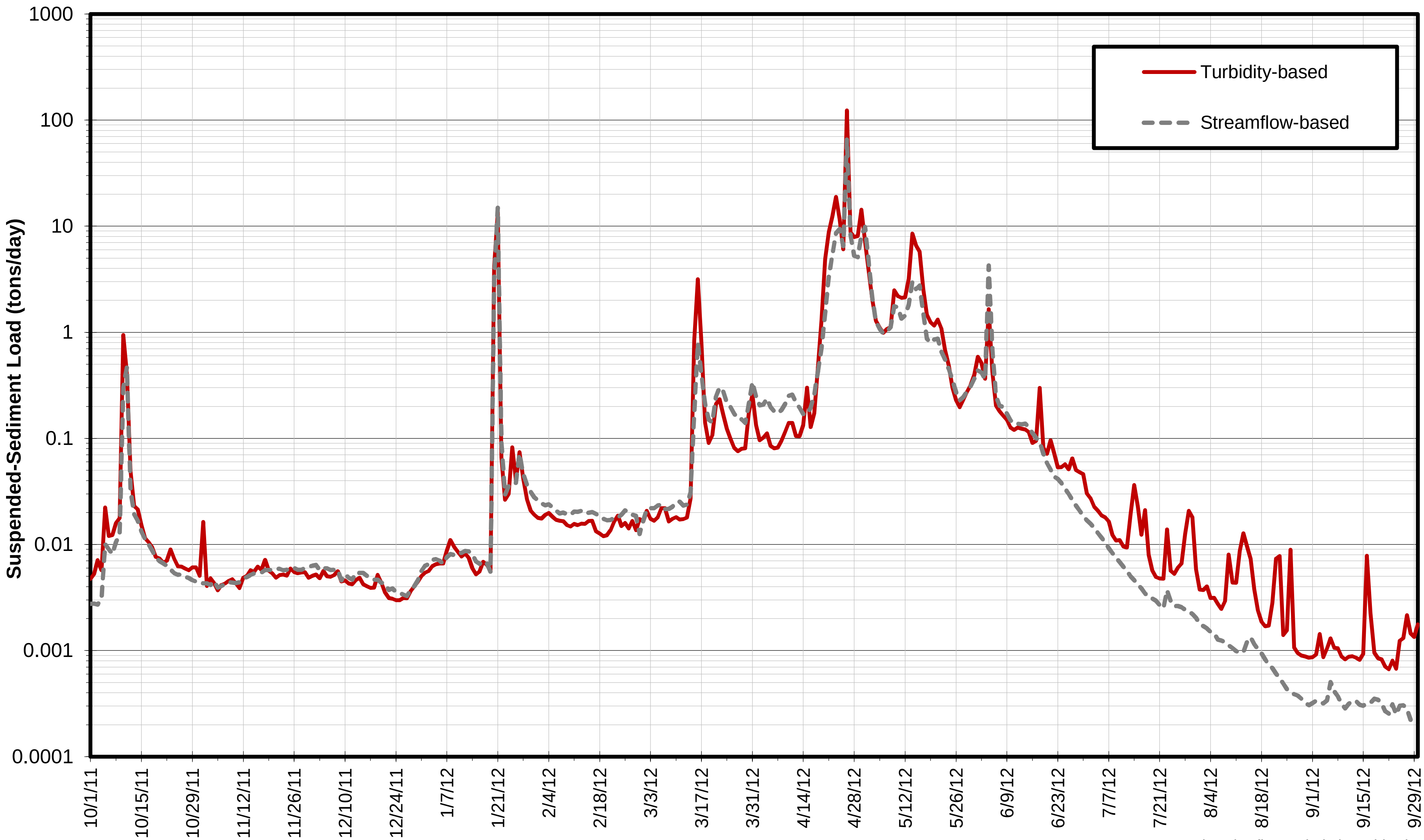
Figure 8. Relationship between turbidity and suspended-sediment concentration, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water years 2011 and 2012. The equation derived here is applied to the continuous record of turbidity to calculate suspended-sediment loading, as shown in Figure 9.



Note that the flow axis is logarithmic.

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Figure 9. **Daily suspended-sediment load calculated based on turbidity and streamflow, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water year 2012.** A comparison between the two methods suggests that the turbidity-based method captures higher sediment loads during most peak flow events and summer base flow periods.

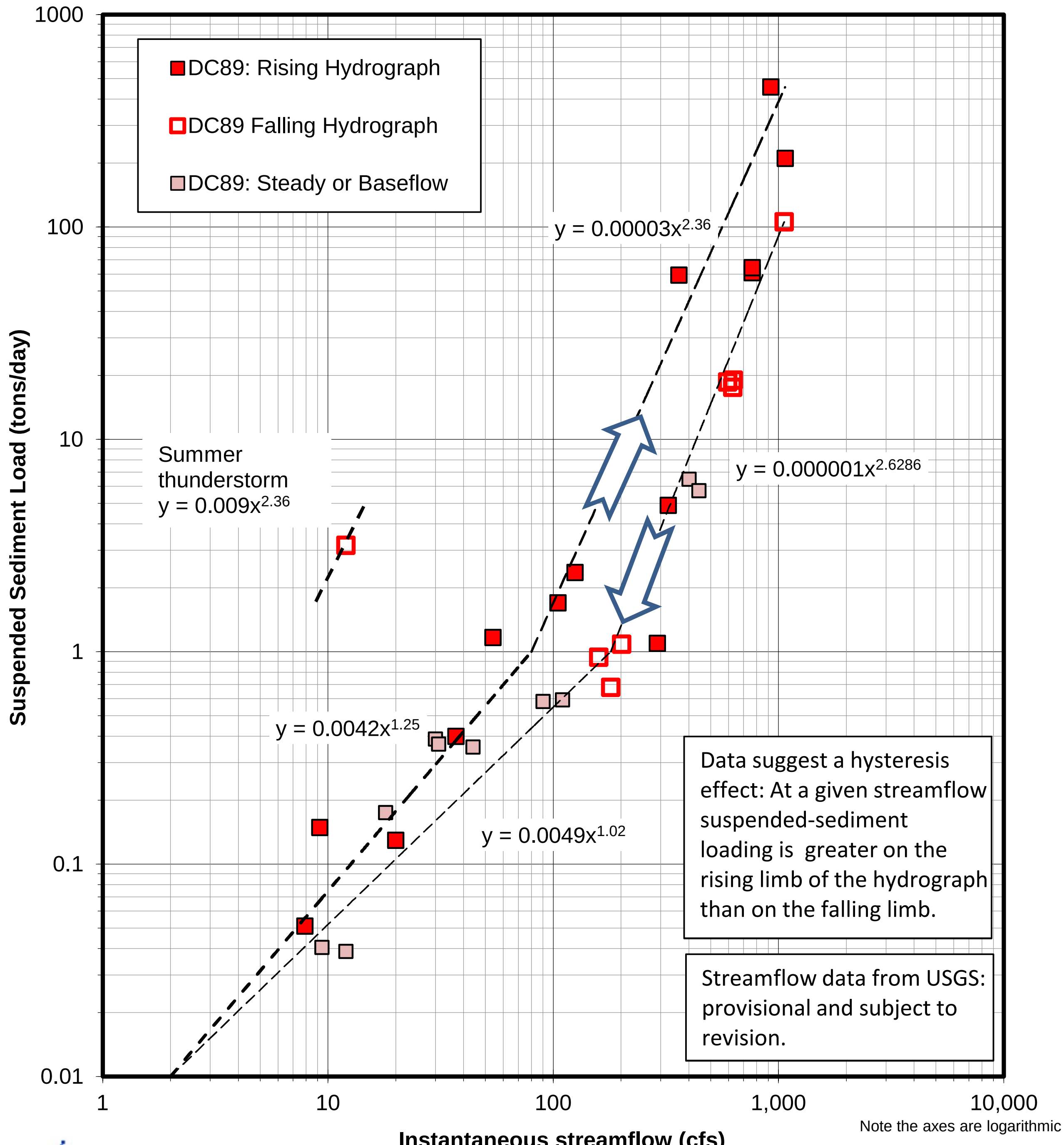

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Figure 10. Relationship between streamflow and suspended-sediment load, Donner Creek at Highway 89 (DC89), Truckee, California, water years 2011 and 2012. The data appear to show a hysteresis effect at this station. The equations derived here are applied to the streamflow record, where applicable, to calculate suspended sediment loading as shown in Figure 12.

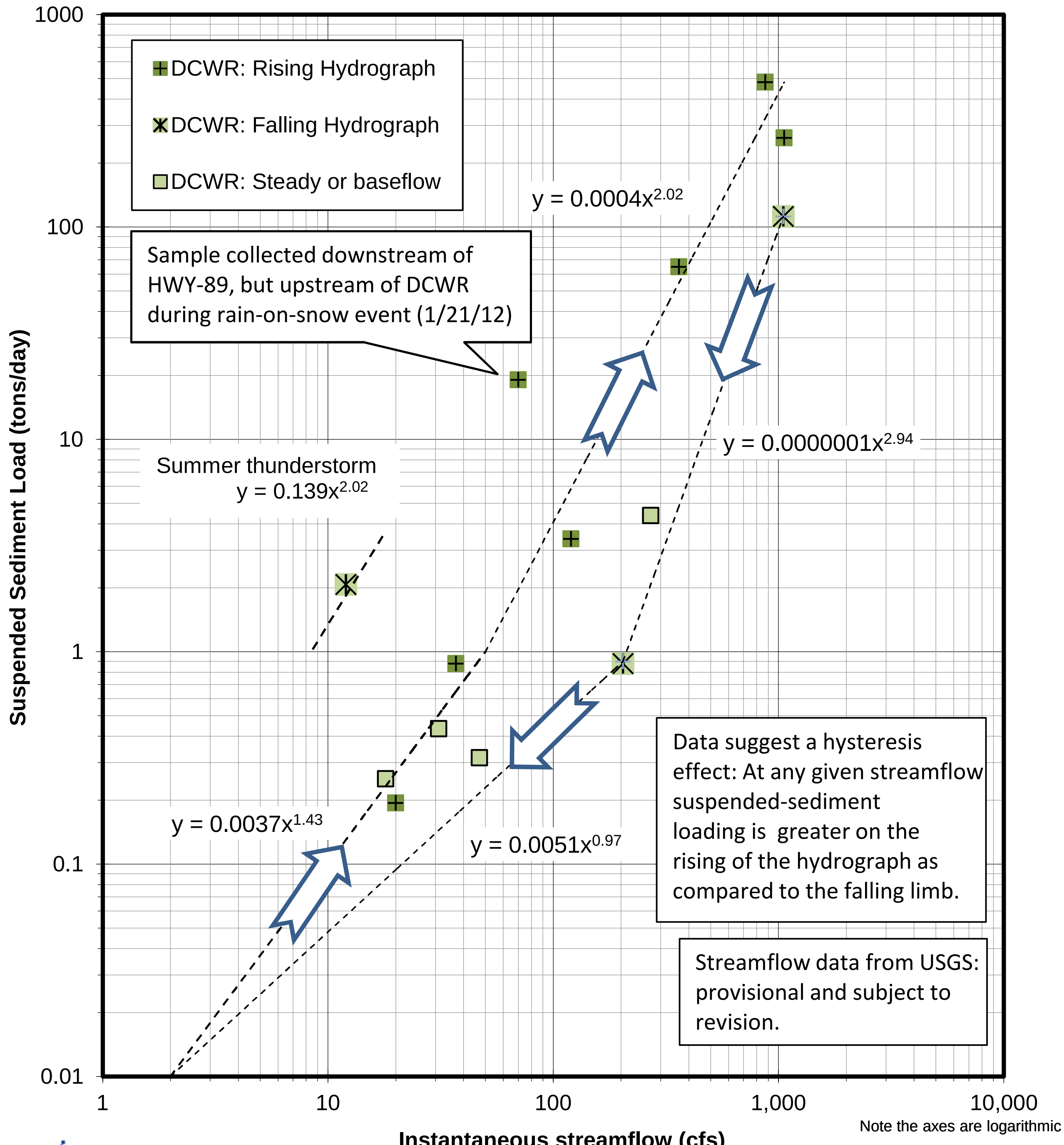

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Figure 11. **Relationship between streamflow and suspended-sediment load, Donner Creek at West River Street (DCWR), Truckee, California, water years 2011 and 2012.** The data appears to show a hysteresis effect at this station. The equations derived here are applied to the record of streamflow, where applicable, to compute a record of suspended-sediment loading, as shown in Figure 12.

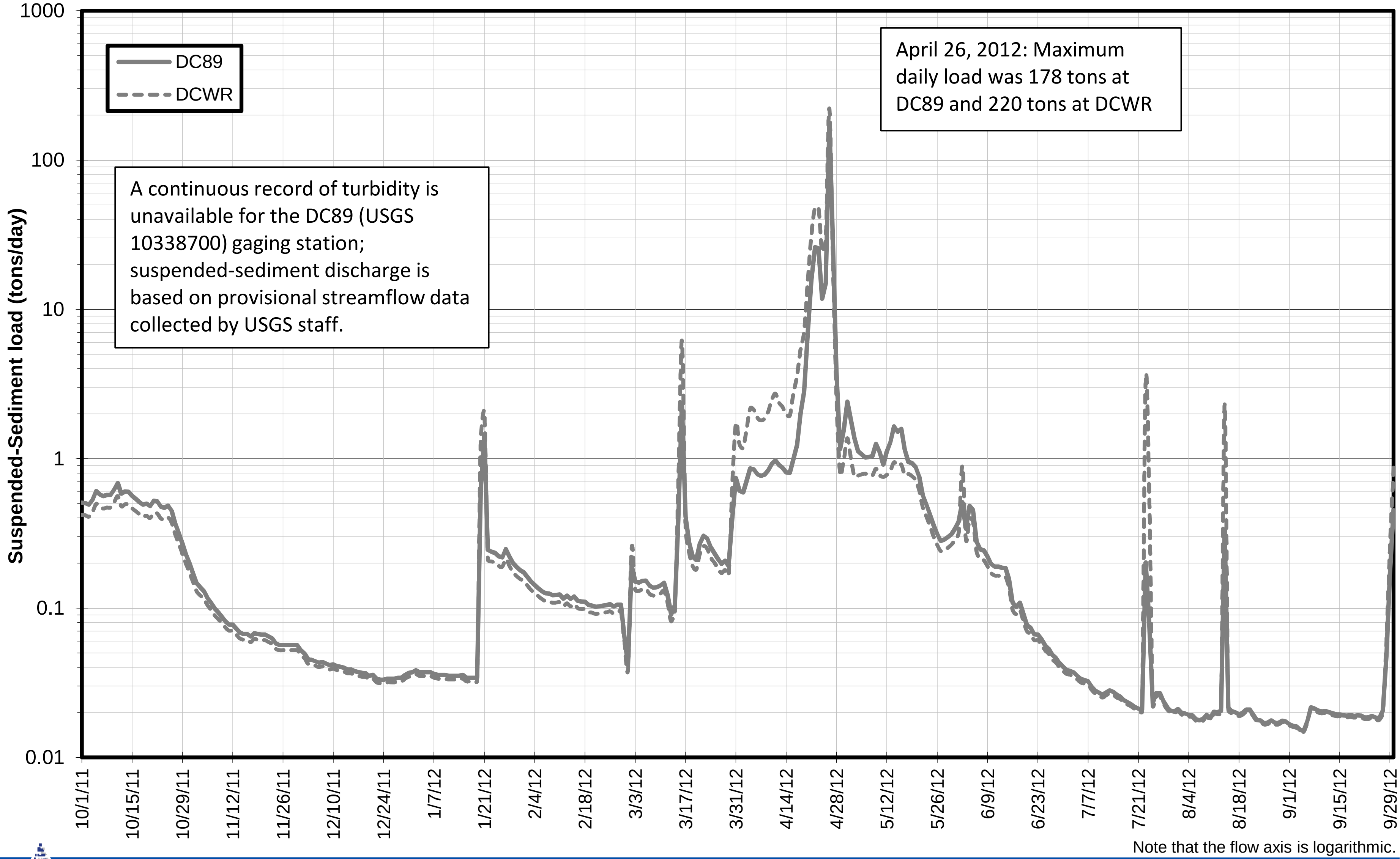

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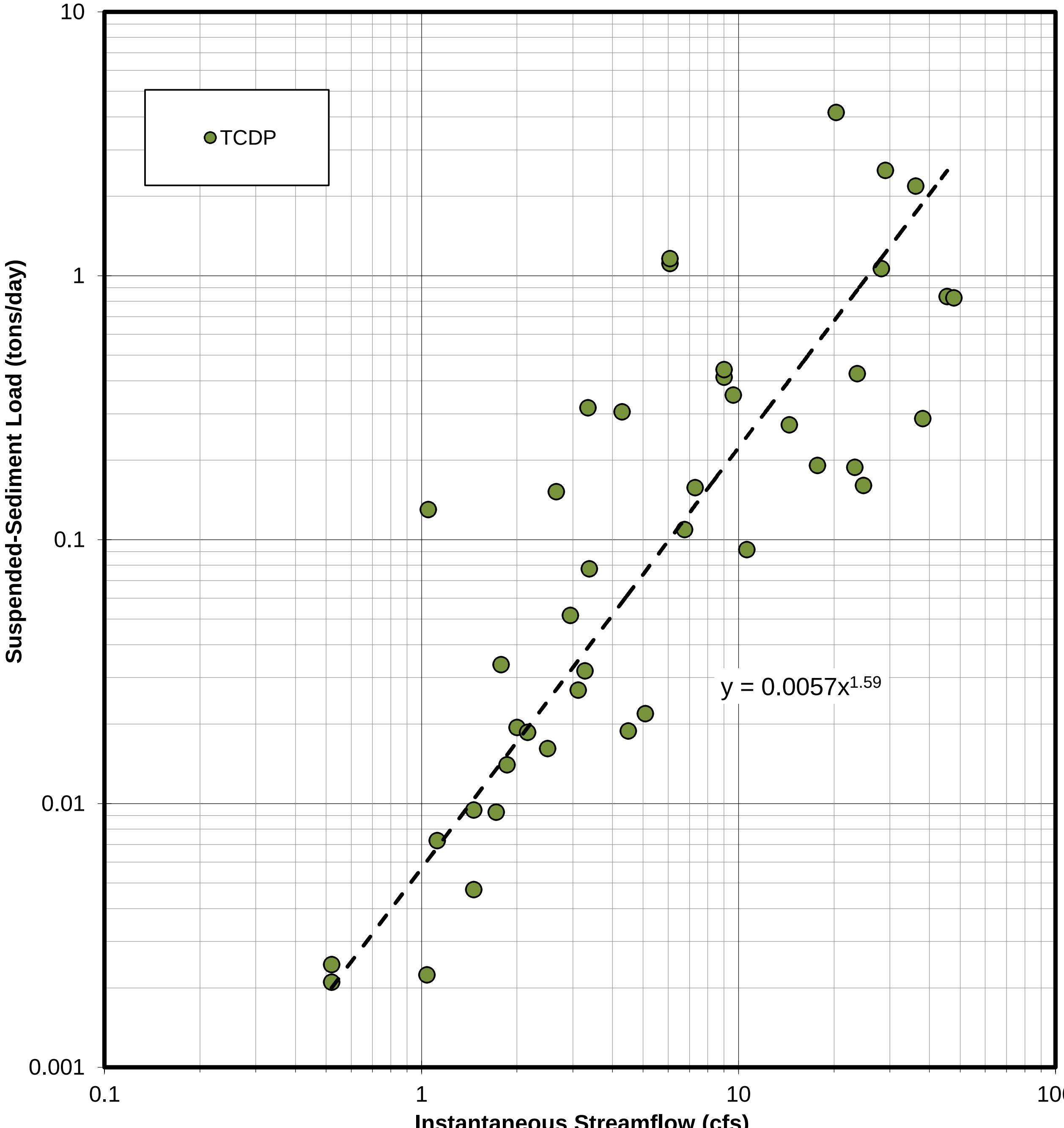
Figure 12. Daily suspended-sediment loads, Donner Creek at Highway 89 (DC89) and Donner Creek at West River Street (DCWR), Truckee, California, water year 2012. The suspended-sediment load for the DCWR station was calculated based on the provisional streamflow record for DC89 station, a short distance upstream.



Note the axes are logarithmic

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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 and 2012. The equation derived here is applied to a record of streamflow to calculate sediment loading, as shown in Figure 15.

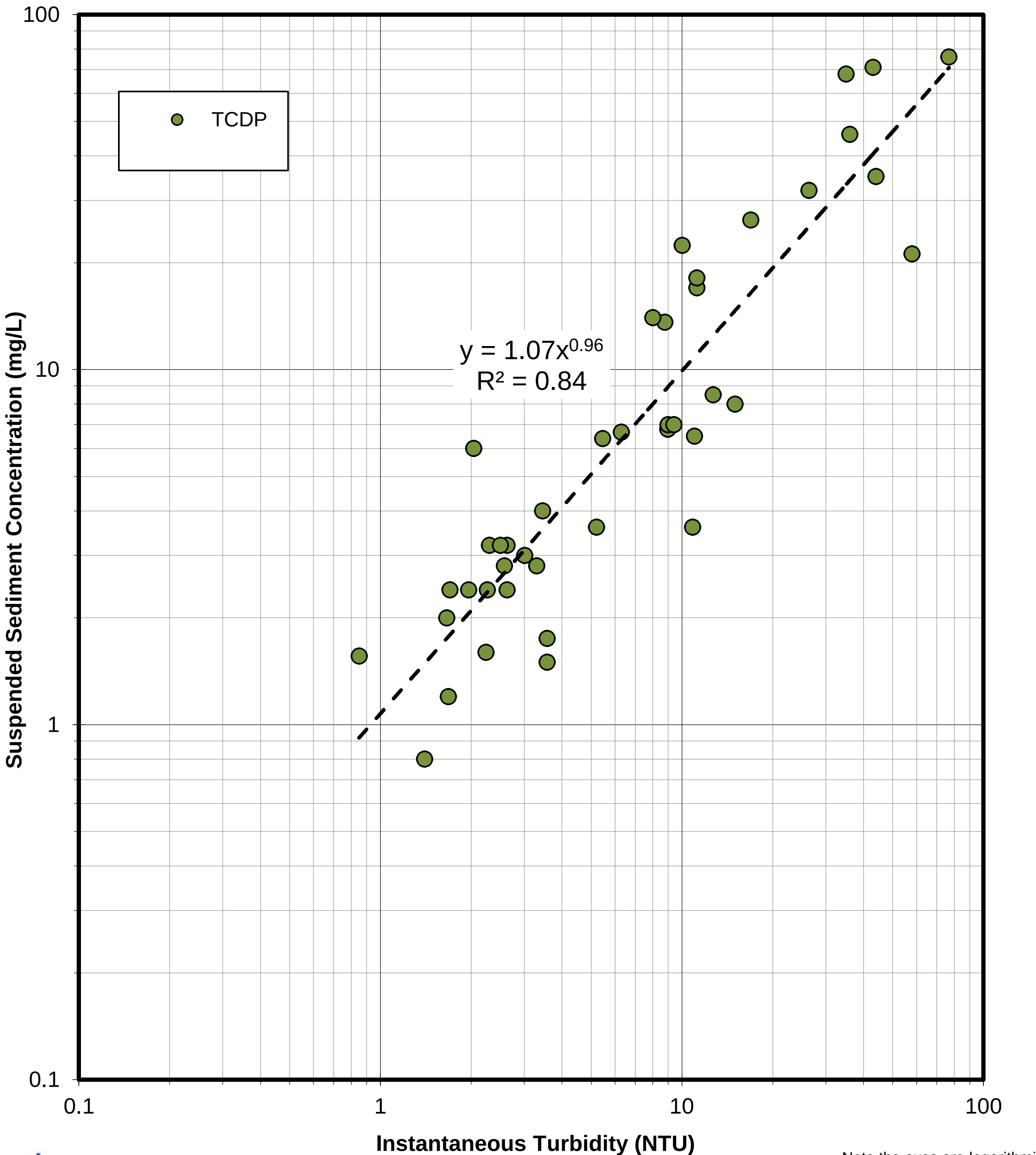

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Figure 14. **Relationship between turbidity and suspended - sediment concentration, Trout Creek at Donner Pass Road (TCDP), Truckee, California, water years 2011 and 2012.** The equation derived here is applied to the continuous record of turbidity to calculate a record of sediment loading, as shown in Figure 15.

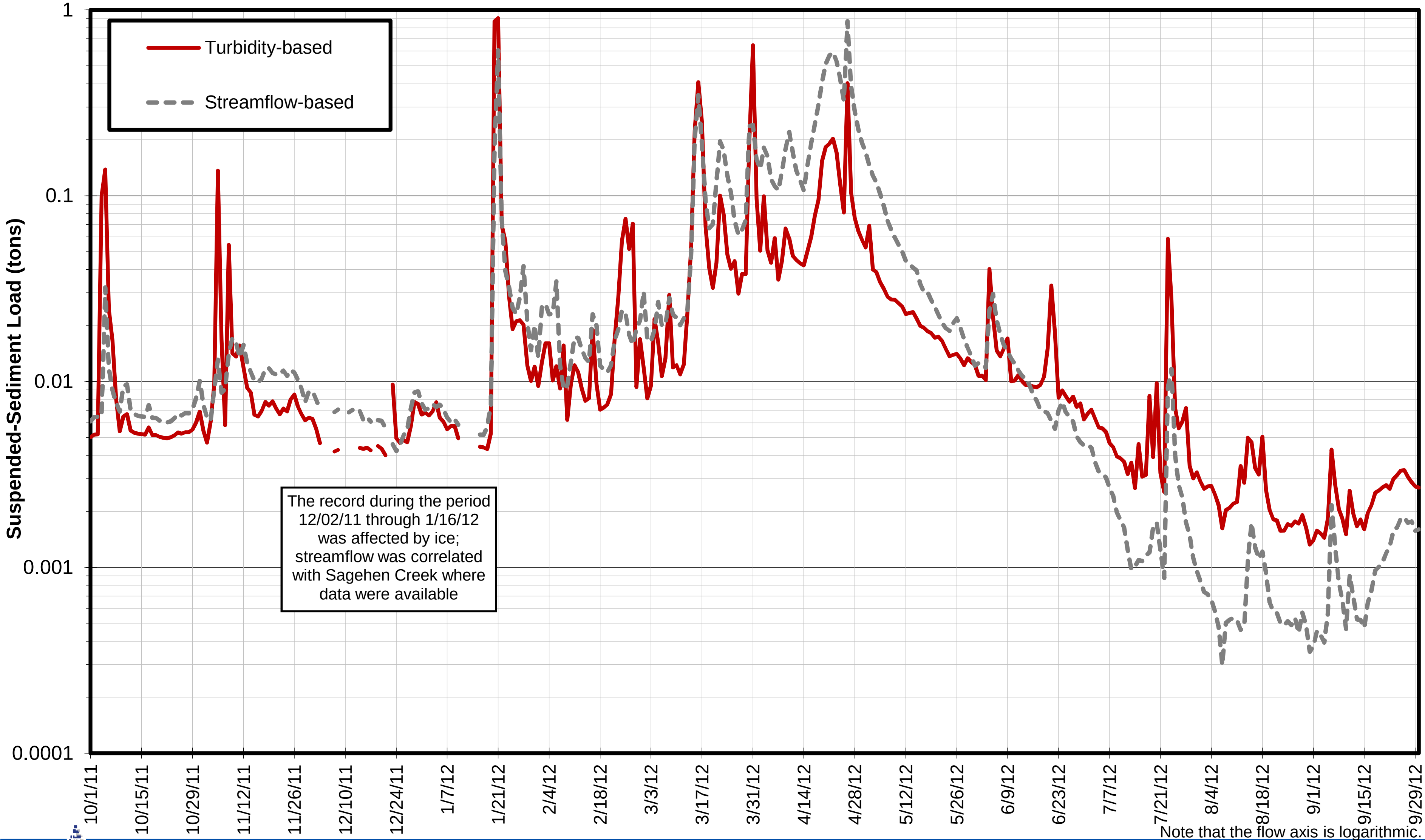

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Figure 15. **Daily suspended-sediment load,Trout Creek at Donner Pass Road (TCDP), Truckee, California, water year 2012.** A comparison between the two methods suggests that the turbidity-based method caputures higher sediment loading during most peak flow events, but results in lower sediment loading during the summer baseflow.

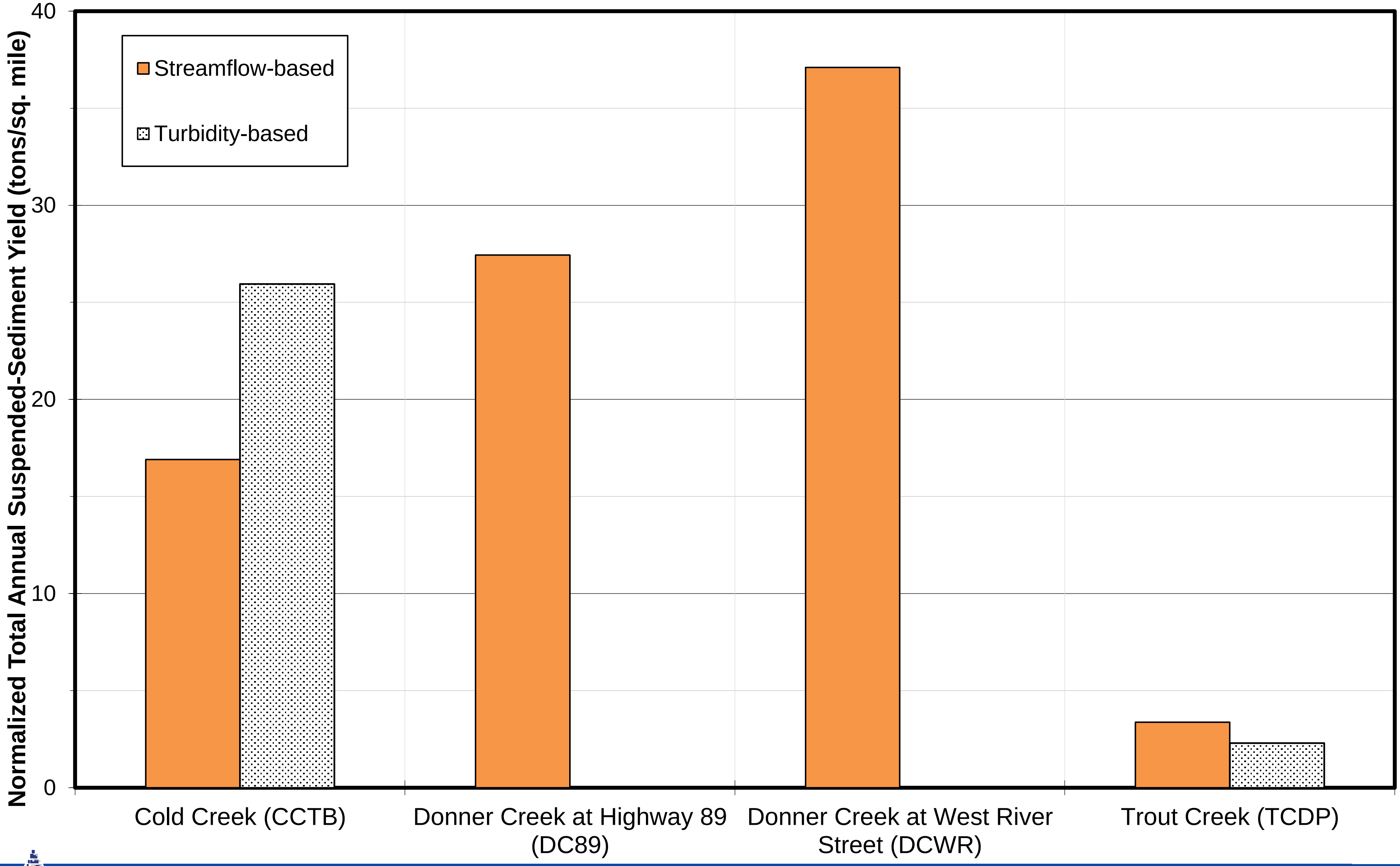

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Figure 16. **Total annual suspended-sediment yields , normalized by watershed area, Donner Creek Cold Creek, and Trout Creek, Truckee, California, water year 2012.** Donner Creek yields exclude the watershed area above the dam at Donner Lake (14.3 sq. mi).

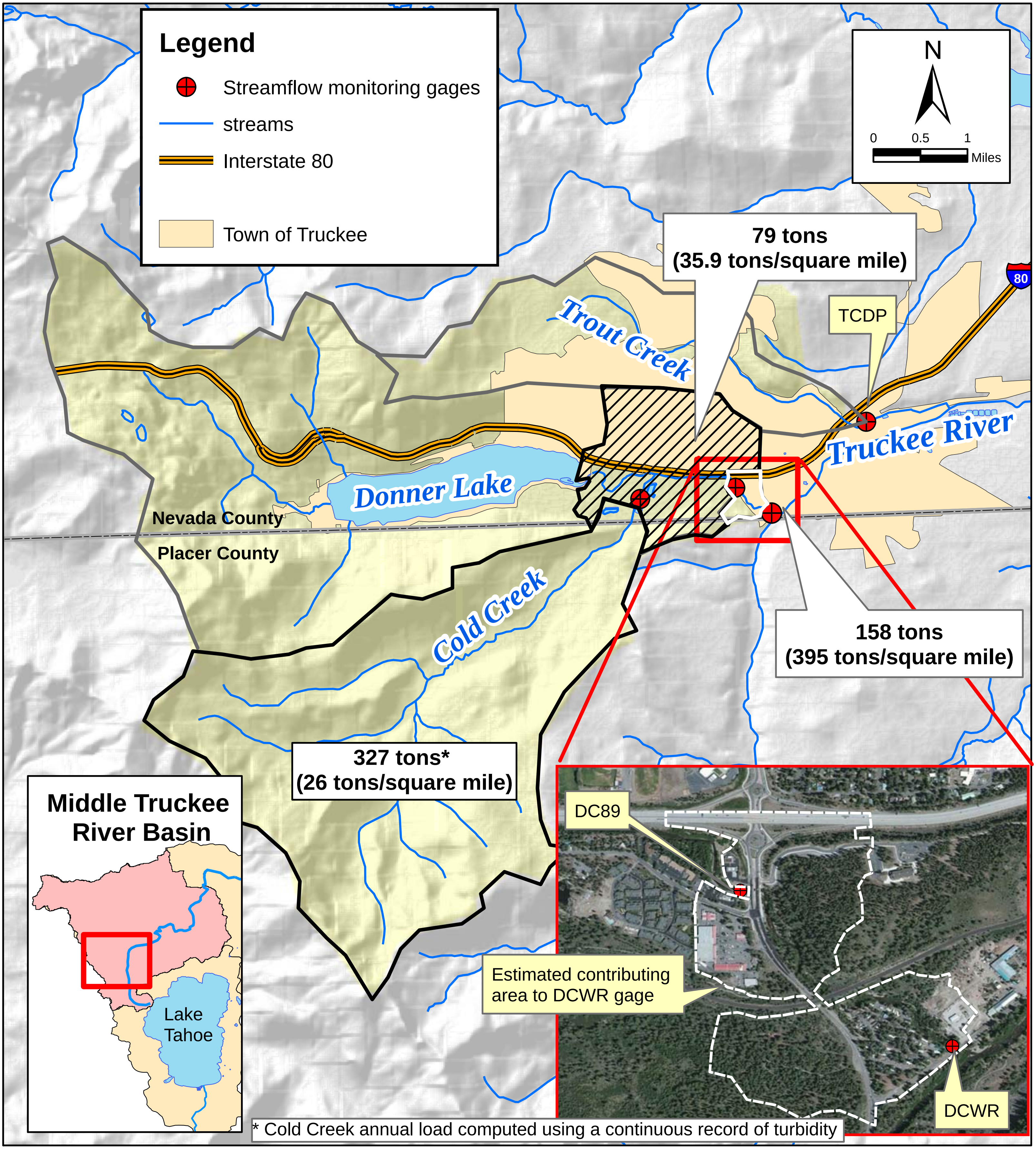
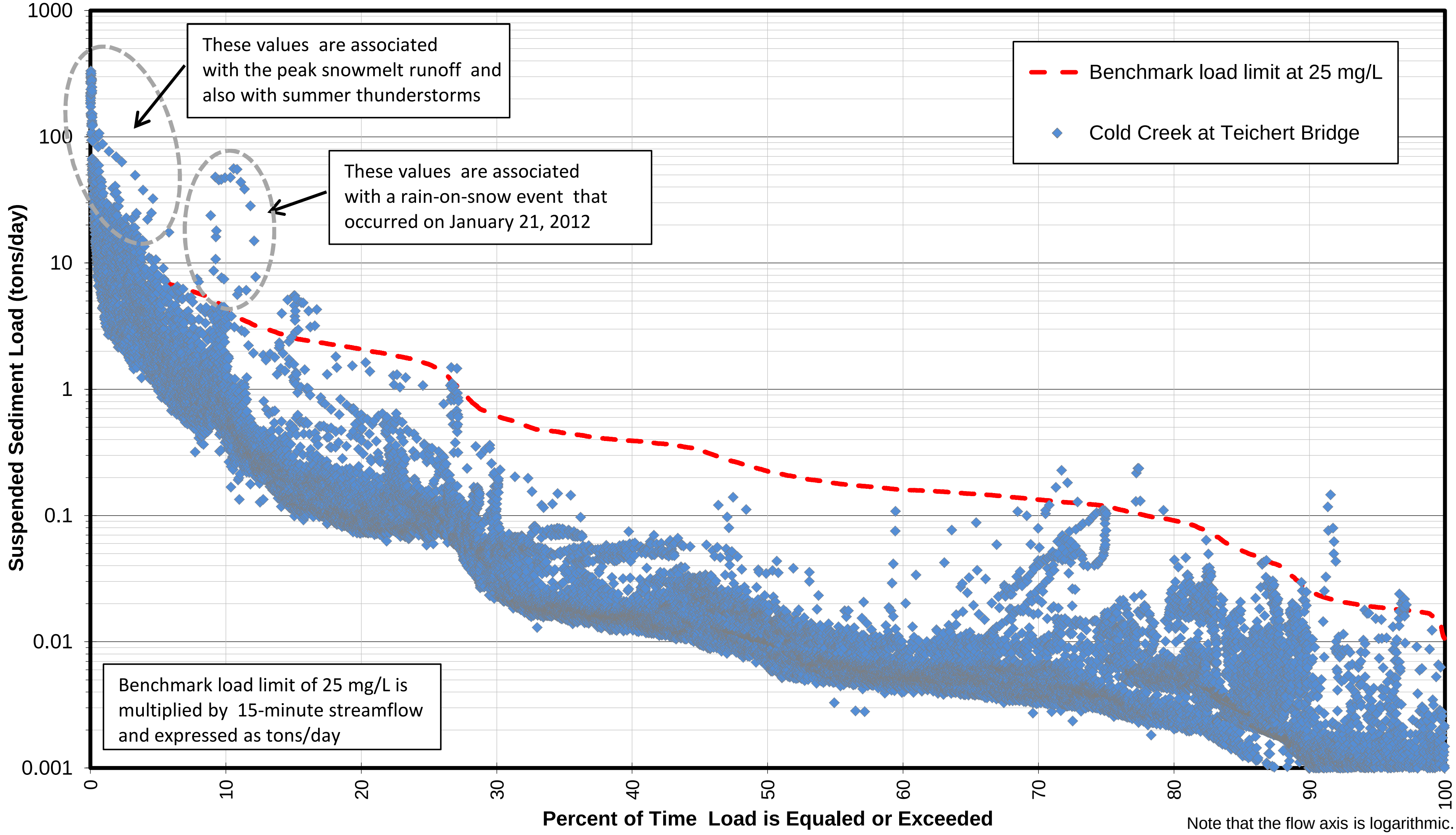


Figure 17. Comparison of suspended-sediment loads and yields between stations, Donner Creek and Cold Creek watersheds, water year 2012.
WY 2012 data suggests significant suspended sediment loads originate from urban areas (Town of Truckee) in the lower portion of Donner Creek watershed



Note that the flow axis is logarithmic.

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Figure 18. **Suspended-sediment load duration curve, Cold Creek at Teichert Bridge (CCTB), Truckee, California, water year 2012.** Most of the time suspended-sediment loads are well below the benchmark load limits for the Truckee River at Farad. The 25 mg/L benchmark was exceeded less than 1.5 percent of the total time, based on 15-minute data and during specific times such as rain-on-snow, peak flow, and rain on bare ground events.

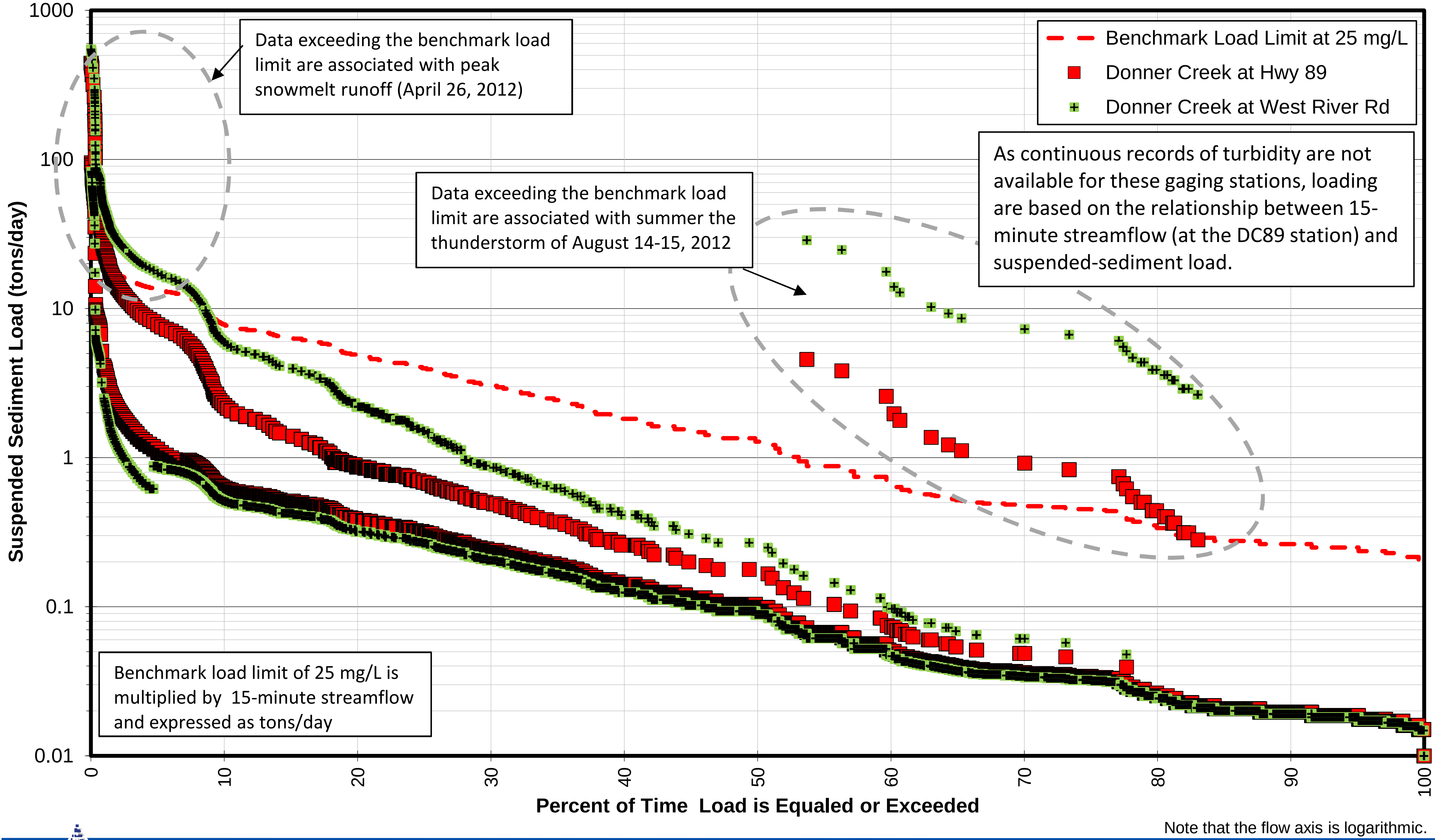

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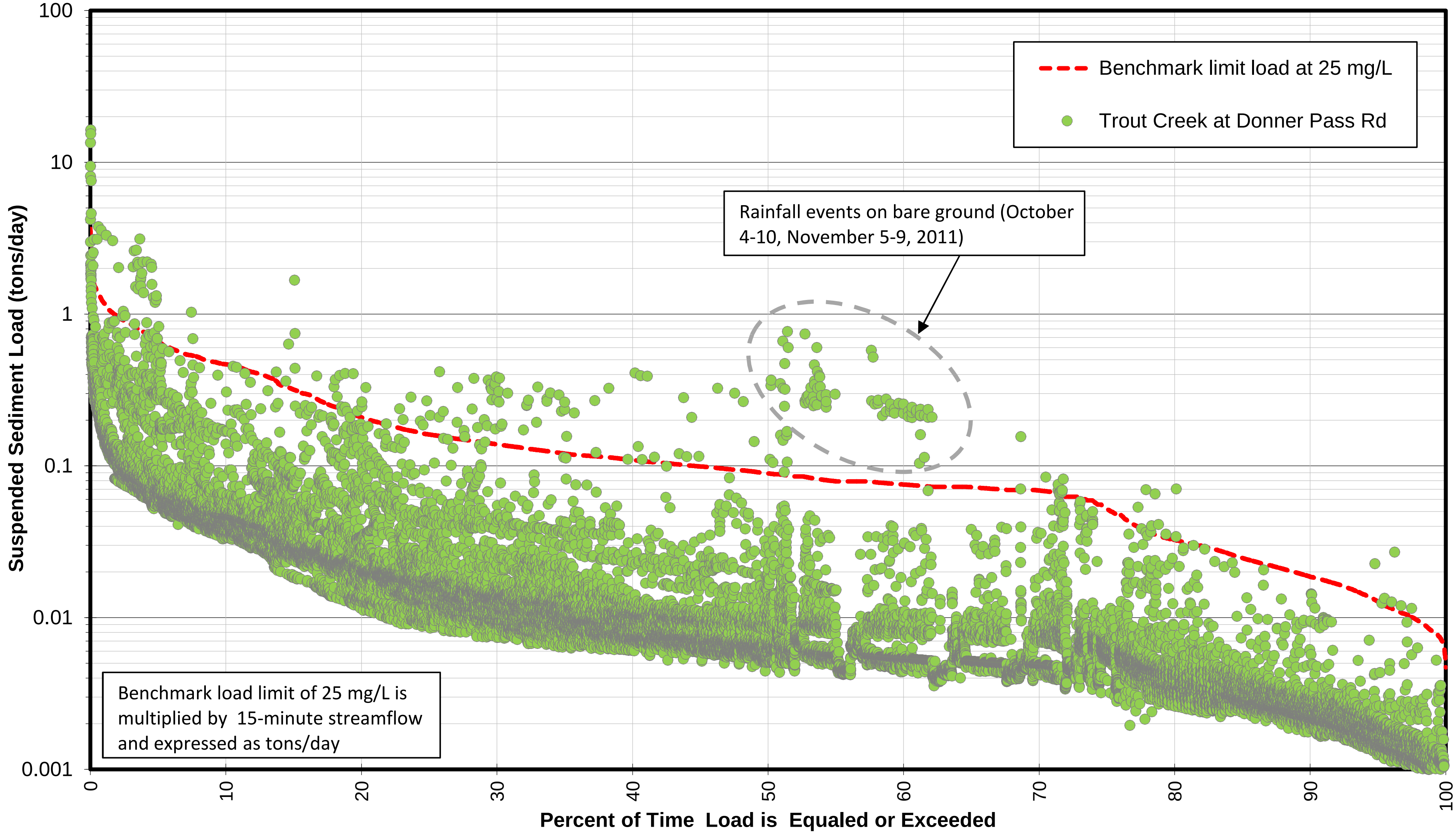
Figure 19. Suspended-sediment load duration curves, Donner Creek at Highway 89 (DC89) and Donner Creek at West River Street (DCWR), Truckee, California, water year 2012. The suspended-sediment loads for both stations are mostly below the benchmark load limits (DC89: 1.1 percent exceedance; DCWR: 2.1 percent exceedance), with the exception of the least frequent, higher magnitude streamflows and summer thunderstorms. The difference between the two load duration curves is a function of the current streamflow-based sediment rating curves.



Note that the flow axis is logarithmic.

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Figure 20. **Suspended-sediment load duration curve, Trout Creek at Donner Pass Road (TCDP), Truckee, California, partial water year 2012** 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 percent of the total time, based on 15-minute data and occurred during specific times such as rainfall on bare ground.

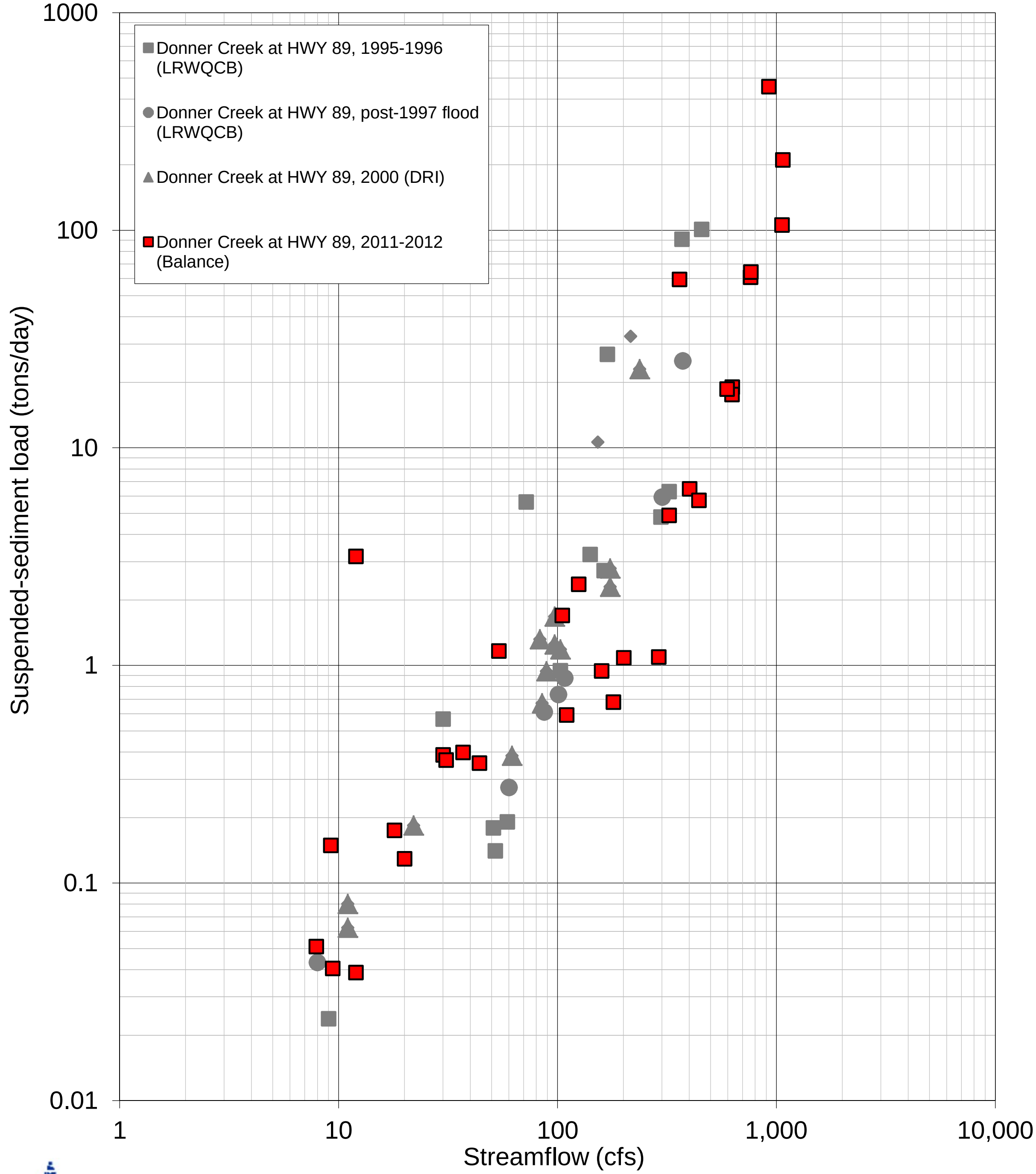

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Figure 21. **Relationship between streamflow and suspended-sediment load for Donner Creek at Highway 89 (DC89), Truckee, California, water years 1996 and 1997, water year 2000, and water years 2011-2012.** Recent suspended-sediment loading rates at this station appear to be similar to historical loading rates.

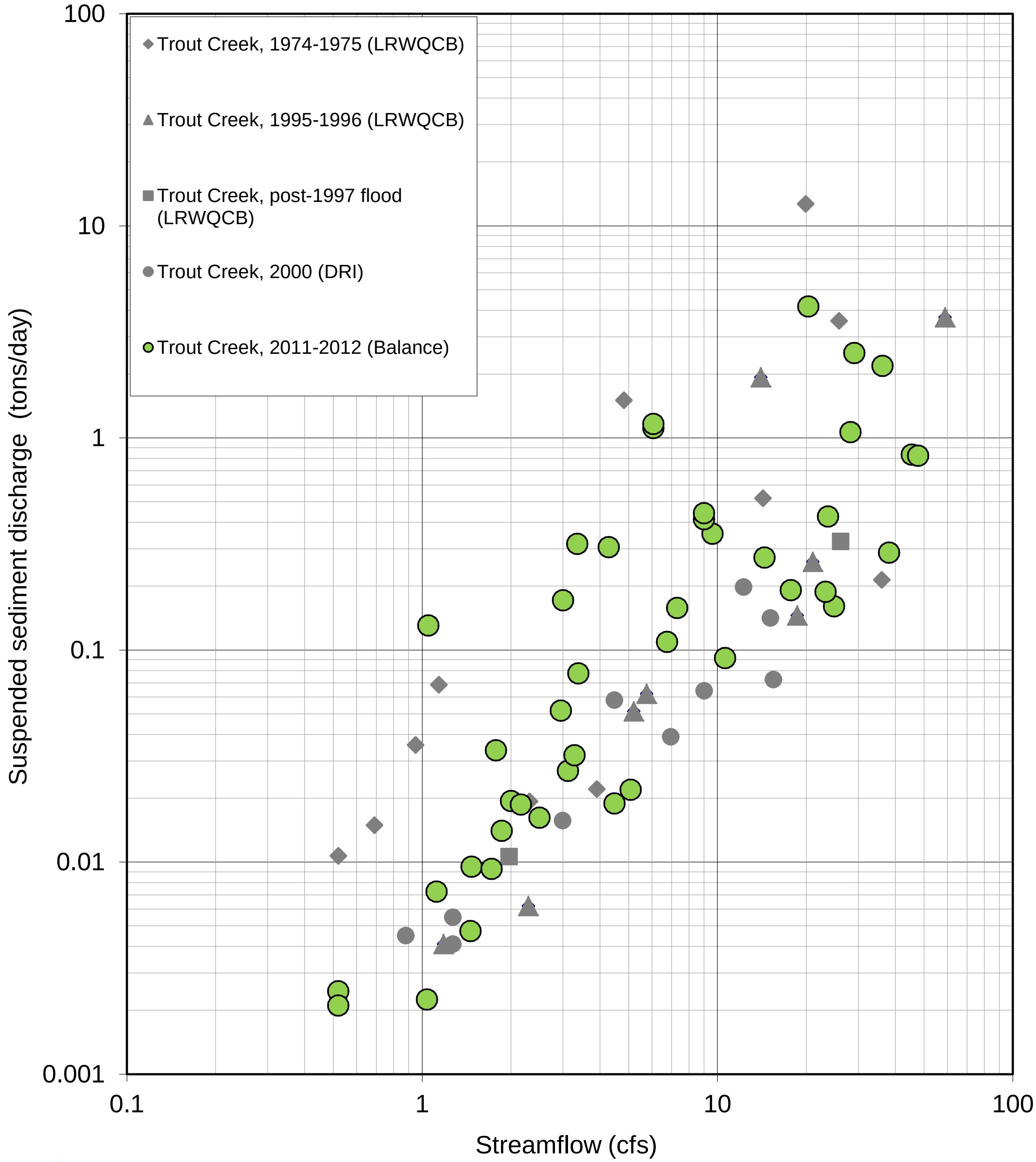

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Figure 22. **Relationship between streamflow and suspended-sediment load, Trout Creek at Donner Pass Road (TCDP), Truckee, California, water years 1974-1975, water years 1996 and 1997, water year 2000, water years 2011 and 2012.**

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, water year 2011 (USGS 10338700)

Appendix B1. Annual hydrologic record, Donner Creek at Highway 89 (DC89), USGS 10338700, Truckee, California, water year 2012

WY 2012 Daily Mean Flow (cubic feet per second)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
1	94.5	32.3	10.1	7.3	32.9	8.1	53.7	264	71.0	7.5	4.2	3.3
2	93.8	27.9	9.7	7.5	30.7	28.4	52.4	240	69.3	7.4	4.0	3.2
3	91.9	26.2	8.8	7.3	28.7	28.7	60.5	215	63.9	7.3	3.9	3.2
4	98.6	24.8	8.8	7.3	27.2	28.2	70.5	199	89.8	6.9	3.8	3.1
5	113	22.4	8.6	7.3	26.0	29.0	69.8	195	84.5	6.6	3.8	3.1
6	107	20.8	8.4	7.3	24.8	29.1	65.7	191	52.4	6.5	3.6	3.5
7	104	19.1	8.5	7.1	24.0	26.9	64.4	190	46.8	6.3	3.5	4.3
8	106	18.0	8.3	7.0	23.9	26.2	65.4	190	45.9	5.9	3.6	4.2
9	106	16.8	8.1	7.0	23.4	26.3	68.9	205	41.8	5.5	3.8	4.1
10	115	15.7	8.2	7.0	23.4	27.0	75.2	193	37.5	5.4	3.6	4.0
11	127	15.0	8.0	6.9	23.6	28.2	78.9	173	36.0	5.2	4.0	4.1
12	108	15.0	7.9	6.9	22.2	23.3	73.8	191	35.9	5.4	4.0	4.0
13	112	14.1	7.8	6.9	23.2	17.4	71.3	208	35.3	5.5	4.1	3.9
14	111	13.3	7.6	6.9	22.1	20.2	67.3	228	35.3	5.4	5.0	3.9
15	105	13.0	7.6	7.0	22.9	37.4	66.8	222	29.7	5.2	4.3	3.8
16	100	13.0	7.4	6.7	21.4	117.2	78.6	226	20.9	5.0	4.0	3.8
17	95.8	12.5	7.3	6.7	21.2	76.8	90.2	201	19.5	4.8	4.0	3.8
18	91.9	13.1	7.2	6.7	21.1	51.5	110	182	20.8	4.6	3.9	3.8
19	93.3	13.0	7.2	6.7	20.1	41.8	127	176	17.5	4.5	3.9	3.8
20	89.9	12.9	6.9	25.8	20.0	39.7	181	164	14.8	4.3	4.1	3.8
21	97.5	12.9	7.0	104.2	19.6	51.1	261	140	14.3	4.2	4.1	3.8
22	96.6	12.5	6.6	46.3	19.7	57.4	322	106	12.9	4.1	3.8	3.7
23	89.2	12.1	6.5	45.1	19.9	55.1	324	92.1	12.9	4.9	3.5	3.7
24	87.6	11.2	6.5	44.2	20.1	48.1	227	79.2	12.0	4.3	3.5	3.8
25	90.5	11.0	6.6	42.0	20.4	44.2	247	67.2	11.0	4.6	3.4	3.7
26	83.6	11.0	6.6	41.4	19.7	40.4	862	58.8	10.4	5.3	3.4	3.6
27	69.1	11.0	6.6	46.8	20.2	37.5	602	53.1	9.5	5.3	3.5	4.1
28	59.9	11.0	6.7	41.9	20.3	39.3	294	54.0	9.1	4.7	3.4	7.2
29	50.8	11.0	6.7	37.9	12.5	36.5	201	56.1	8.4	4.3	3.4	18.6
30	43.3	11.0	7.0	35.7		45.0	222	58.9	7.9	4.1	3.5	41.6
31	37.8		7.2	34.1		62.8		63.9		4.0	3.5	
MEAN	93	15.8	8	21.9	22.6	39.6	172	158	33	5	3.8	5.6
MAX. DAY	127	32.3	10	104.2	32.9	117	862	264	90	8	5.0	41.6
MIN. DAY	37.8	11.0	6.5	6.7	12.5	8.1	52	53	8	4.0	3.4	3.1
cfs days	2871	474	236	679	655	1229	5152	4883	977	165	118	168
ac-ft	5695	939	469	1347	1300	2437	10220	9685	1938	327	234	334

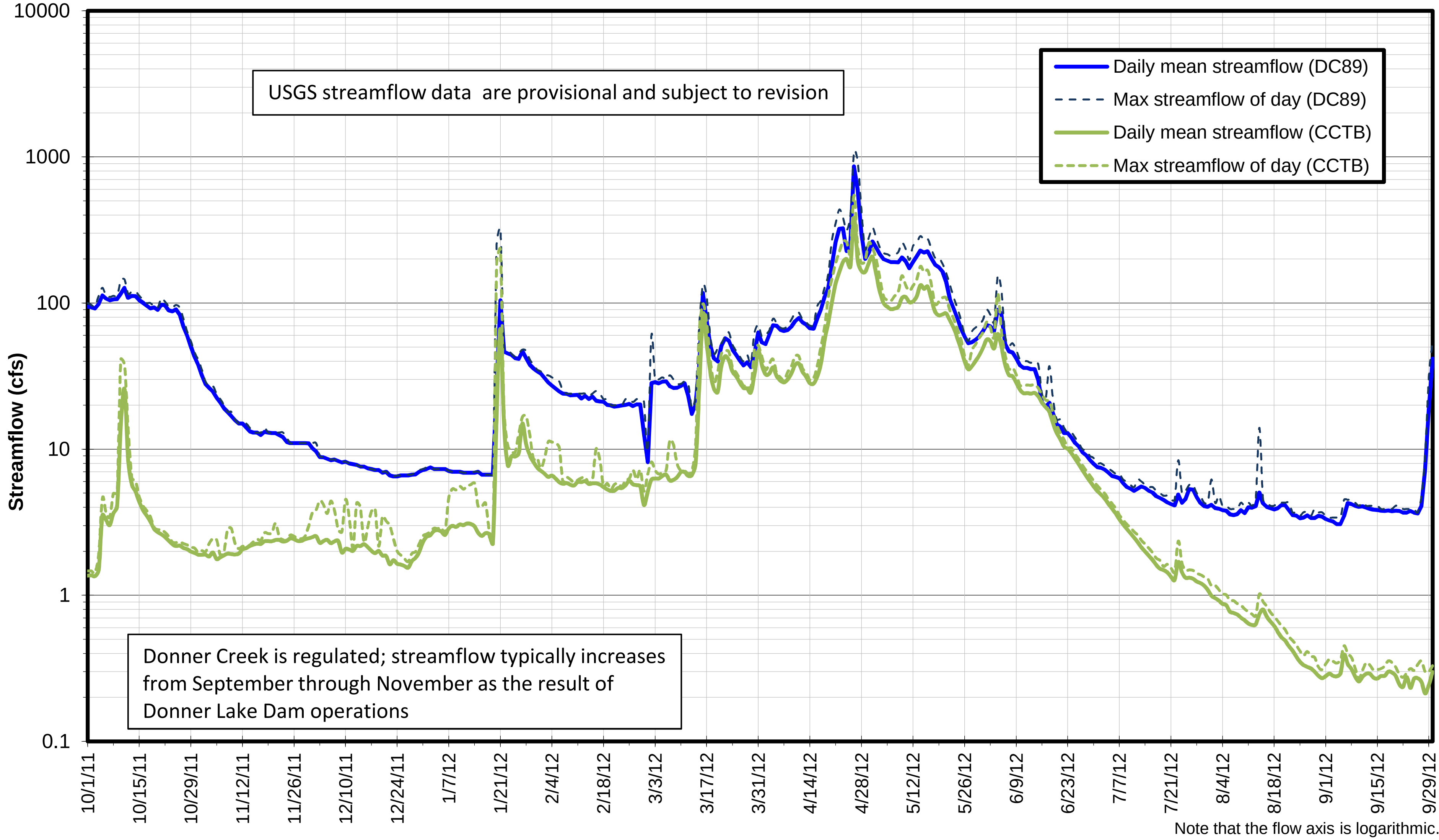
Monitor's Comments

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 2012 Totals:		
Mean flow	**48**	(cfs)
Max. daily flow	**862**	(cfs)
Min. daily flow	**3.1**	(cfs)
Annual total	**17,608**	(cfs-days)
Annual total	**34,925**	(ac-ft)

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

APPENDIX B2
USGS streamflow hydrograph, Donner Creek at Highway 89, water 2011 (USGS 10338700)



Balance Hydrologics, Inc.

Appendix B2. Streamflow hydrograph, Donner Creek at Highway 89 (USGS 10338700), Truckee, California, water year 2012. 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.