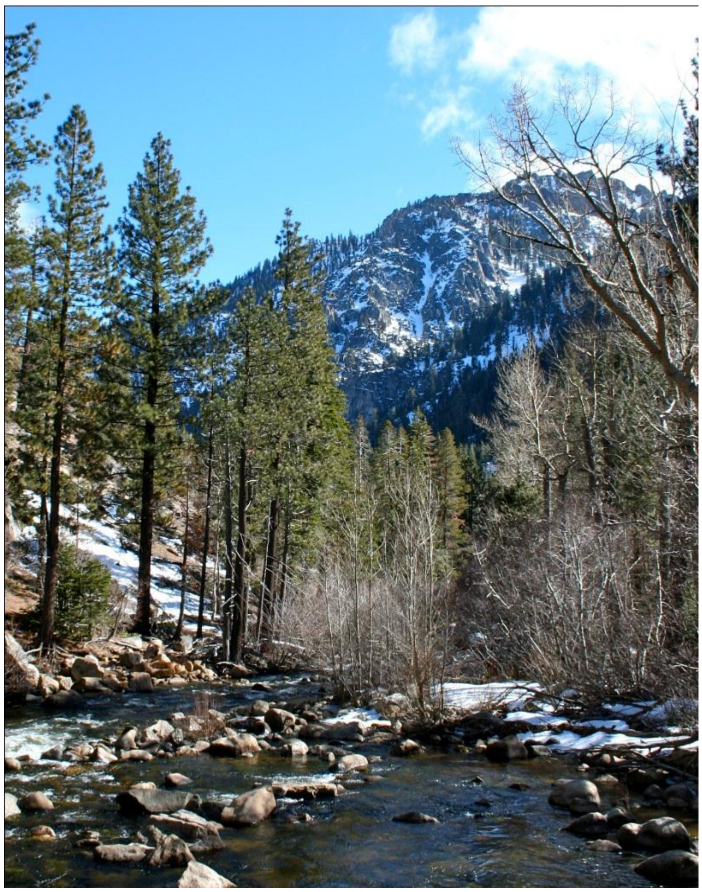
Alpine Watershed Group
Volunteer Water Quality Monitoring Program

2010 Monitoring Data Report



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Introduction

This report summarizes the data collected by the Alpine Watershed Group's Volunteer Water Quality Monitoring Program in the Upper Carson River watershed of Alpine County. Fourteen water quality monitoring sites were tested for various water quality characteristics including chemical, physical and biological attributes. The program involves 21 volunteer monitors, who collectively conduct the field sampling for this monitoring program.

The information included in this report covers the water quality data collected since the program's inception in 2004. The program's last data report (dated April 2008) covered information through 2007. Therefore, this report will summarize all data collected since 2004 and more thoroughly examine the 2008 through 2010 data.

Background

Alpine Watershed Group

The Alpine Watershed Group (AWG) is a community-based organization working to protect and restore watersheds in Alpine County, California. Alpine County encompasses the headwaters of these five watersheds (in order of acreage in Alpine County, largest to smallest) - the Upper Carson, North Fork Mokelumne, North Fork Stanislaus, South Fork American, and Upper Truckee Rivers. AWG strives to involve all stakeholder interests including land managers, scientists, ranchers, local, state, and federal agencies, conservationists, recreationists, and tribal representatives.

The Alpine Watershed Group's mission is to preserve and enhance the natural system functions of Alpine County's watersheds for future generations. The group works by inspiring participation to collaborate, educate, and proactively implement projects that benefit and steward the county's watersheds.

Volunteer Water Quality Monitoring Program

The Volunteer Water Quality Monitoring Program (Monitoring Program) began in 2004 in an effort to augment the water quality data available for the Upper Carson River watershed. The focus of the project is on measuring chemical, physical habitat and biological parameters in order to assess land use impacts on water quality and watershed health. Citizen monitoring also serves to inform and engage the community in effective watershed stewardship. Currently there are 21 dedicated volunteers involved in the program. Volunteers have received trainings in water sampling, data collection and habitat assessment.

The primary goal of the program is to collect baseline water quality data for long-term monitoring of water quality trends of Alpine County's streams. The program's objectives include the following:

- Monitor the chemical, physical and biological status and trends of Alpine County's streams
- Screen for water quality problems and habitat issues typically associated with common land use practices
- Determine pre-restoration conditions for the proposed floodplain restoration project at the site of the former U.S. Forest Service Guard Station
- Evaluate the effectiveness of stream restoration projects and land management practices
- Provide useful data for decision makers and the public
- Involve local citizens and community partners as watershed stewards

The Monitoring Program provides data that can be used to examine changes over time to water quality, habitat, land uses, and general watershed conditions.

Study Site Description

Upper Carson River Watershed

The Upper Carson River watershed originates in Alpine County, California and terminates at the Carson Sink in Nevada. The river consists of two forks, the East Fork and the West Fork. These forks converge into the main stem of the Carson River near the town of Genoa, Nevada.

The majority of Alpine County is managed by state and federal agencies with 96% of the county designated as public land, primarily administered by the U.S. Forest Service and the Bureau of Land Management. The population of the county is approximately 1,200 people, which translates to a population density of 1.5 people per square mile.

The watershed is host to a variety of land uses including agriculture, logging, mining, recreation, and residential. Historically, the area contained numerous mines and logging operations that supported the Comstock Mining Region in the Virginia Range, Nevada. These land uses have had adverse impacts on the water quality of the Upper Carson River. The West Fork of the Carson River is listed as impaired under Section 303(d) of the federal Clean Water Act. Impairments include elevated levels of nitrogen, phosphorus, sodium and bacteria (SWRCB, 2006).The Upper Carson River Watershed Water Quality Monitoring Program that was conducted from 2004-2007 emphasized the importance of continuing and expanding monitoring efforts throughout the watershed (CWSD, 2007).

Monitoring Locations

Monitoring sites for this program are located throughout the Upper Carson River watershed in Alpine County. Table 1 below lists the monitoring sites for 2010 in the Upper Carson River watershed.

Table 1. Water Quality Monitoring Sites

Watershed	Site ID	Site Name	Parameters Monitored
East Fork Carson River	SVC-HWY4	Silver Creek on Highway 4	Ambient
	EF-CRR	East Fork near Carson River Resort	Ambient
	HSC-GHS	Hot Springs Creek at Grover Hot Springs	Ambient; Bacteria
	HSC-HSR	Hot Springs Creek at Hot Springs Road	Bacteria
	MVC-LIB	Markleeville Creek at Library	Ambient; Bacteria
	MVC-CP	Markleeville Creek at Coyen Park	Bacteria
	MC-GS	Markleeville Creek at Guard Station	Bioassessment
	MVC-FSCG	Markleeville Creek at Forest Service Campground	Bacteria; Bioassessment
	MBC-CONF	Millberry Creek at confluence	Bacteria
West Fork Carson River	RLC-BLR	Red Lake Creek at Blue Lakes Road	Ambient
	WF-PKT	West Fork at Pickett's Junction	Ambient
	WF-WDFD	West Fork in Woodfords	Ambient
	WF-PNSV	West Fork at Painsville	Ambient

The map below (Figure 1) identifies the location of each site in the Upper Carson River watershed. More information about the parameters monitored at each site is included in the Methods section below.

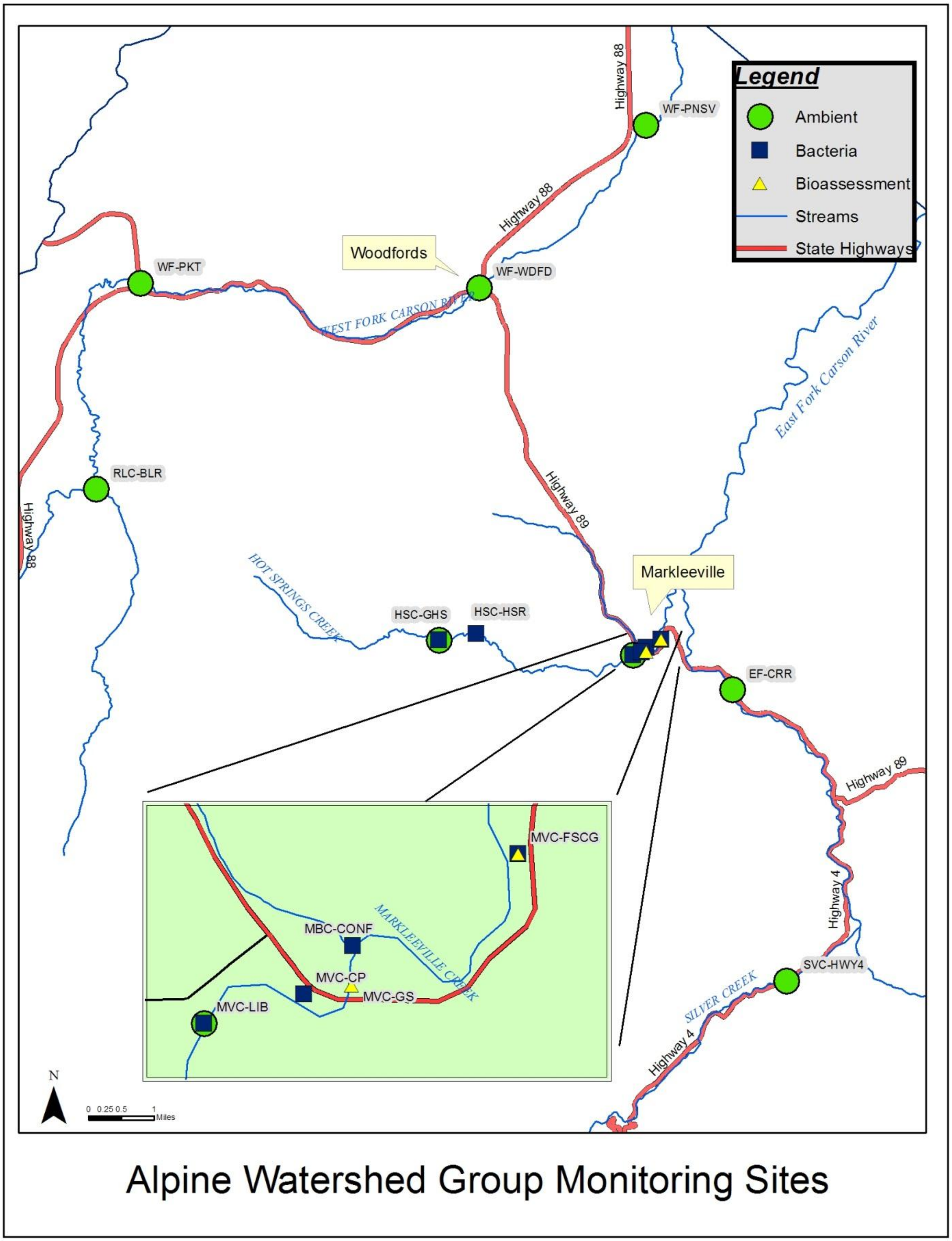

Figure 1. Monitoring Site Map

Methods

Types of Sampling and Assessment

Monitoring activities include the collection of specific biological and chemical water quality data as well as the physical evaluation of stream condition, wildlife habitat and other visual observations of stream health. There are three primary components of the Monitoring Program:

- Ambient monitoring – On a quarterly basis, volunteers conduct water quality monitoring for certain chemical constituents and physical attributes which are considered vital signs of stream health. These parameters include water temperature, dissolved oxygen, pH, conductivity and turbidity. Also included when possible is the sampling for nutrients (nitrogen and phosphorus). A Stream Walk Survey is conducted at each site annually. This includes photo monitoring and a visual survey of habitat features.
- Bacteria sampling – This effort involves the collection of water samples which are analyzed in the lab for total coliform and *Escherishia coli* (*E. coli*). A partnership with the Lahontan Regional Water Quality Control Board has allowed for more extensive sampling (including number of locations and sampling frequency).
- Bioassessment – This procedure is conducted at 2-3 sites annually. It involves the collection of benthic macroinvertebrate (aquatic insect) samples, stream flow measurement and an assessment of other in-stream habitat characteristics such as canopy cover, stream sinuosity and stream substrate composition. These assessments are conducted to evaluate stream sites associated with the proposed Markleeville Creek Restoration Project at the site of the former U. S. Forest Service Guard Station.

The following table identifies the specific water quality monitoring parameters involved and the purpose for each:

Table 2. Monitoring Parameters

Parameter	Purpose
Visual surveys	To characterize in-stream conditions, riparian habitat, and upland environment of monitoring site vicinity over time.
Photo Monitoring	To observe changes in watershed conditions over time.
Temperature	To determine areas of concern for thermal pollution.
Dissolved Oxygen	To determine health of aquatic ecosystem, to identify areas of concern for hypoxia/anoxia.
pH	To determine if stream will support aquatic life.
Conductivity	To identify potential input of dissolved solids or salts.
Turbidity	To identify areas of increased erosion.
Nutrients	To identify areas of increased nitrogen and phosphorus input.
Fecal Indicator Bacteria (FIB)	To identify areas of concern for public health risk and possible areas of non-point source pollution.
Bioassessment	To determine the ability of the stream to support aquatic communities.

Monitoring Schedule

The Monitoring Program has been collecting ambient data on quarterly basis since the fall of 2004 when the program began, totaling 28 monitoring events to date. Monitoring sessions are scheduled on the second Saturday of the months of March, June, September and December. For the 2010 field season, monitoring sessions fell on the following dates:

- March 13
- June 12
- September 11
- December 11

Bacteria sampling occurred in partnership with the Lahontan Regional Water Quality Control Board. Volunteers performed bacteria sampling once every two weeks from June through November.

Bioassessments are conducted once annually in the fall at 2-3 monitoring sites along Markleeville Creek. In 2010, the assessment was performed on September 14 and 15.

Field and Lab Methods

All field and lab methods are conducted in accordance with the *Quality Assurance Project Plan* (QAPP) (AWG, 2007). The QAPP has been approved by the State Water Resources Control Board and Technical Advisory Committee for the Monitoring Program. The QAPP describes the standard operating procedures (SOP) which are based on protocols from the State Water Resources Control Board's Clean Water Team (CWT), Surface Water Ambient Monitoring Program (SWAMP) and U.S Environmental Protection Agency (EPA). Table 3 below is a summary of methods involved in the data collection process for each parameter.

The Water Quality Control Plan for the Lahontan Region (Basin Plan) (CRWQCB, 1995) establishes specific water quality objectives for the region. The following table also lists the objectives that have been identified for the East and West Forks of the Carson River. Certain parameters do not have objectives specified in the Basin Plan (denoted by N/A in the table). For these parameters, additional information is presented in the Results and Discussion section regarding general water quality thresholds for healthy aquatic systems.

Table 3. Monitoring Methods

Parameter	Unit	Method	Basin Plan Water Quality Objective
Visual Survey	N/A	EPA Stream Habitat Walk form, CWT Visual Assessment SOP 4.2.1.3	N/A
Photo Monitoring	N/A	digital camera, CWT SOP 4.2.1.4	N/A
Water Temperature	degrees Celcius (º C)	Hand-held meter, CWT SOP 3.1.2.1	N/A
Dissolved Oxygen	milligrams per liter (mg/l)	LaMotte DO Kit, Winkler Titration method, CWT SOP 3.1.1.2	7.0 mg/L
pH	pH unit	Hanna pH meter, CWT SOP 3.1.4.3	Acceptable range = 6.5 – 8.5 *
Conductivity	micromhos (mhos)	Oakton TDS meter, CWT SOP 3.1.3.1	N/A
Turbidity	Nephelometric Turbidity Units (NTU)	Sample bottle, grab sample procedure CWT SOP 3.1.5.4; In-house lab, turbidity meter	Varies by water body *
Nutrients	milligrams per liter (mg/l)	Sample bottle, grab sample procedure CWT SOP 3.1.5.4; Lab analysis	Varies by water body *
Bacteria	# colonies/ 100 mL water	Sample bottle, grab sample procedure CWT SOP 3.1.5.4; Lab analysis	30-day log mean of 20 colonies/100 ml water
Bioassessment	N/A	SWAMP Bioassessment Sampling Procedure; Lab analysis	N/A

** More detailed information provided in Results and Discussion Section for specific parameter.*

These protocols are described for volunteer training and reference in the *Water Quality Monitoring Field Procedures Manual* (AWG, 2009). More detailed information regarding sample handling, analytical methods and detection limits can be found in the QAPP.

Results and Discussion

Data analysis for this program is a collaborative effort between the Alpine Watershed Group staff and the Technical Advisory Committee. The data has been summarized for each parameter in the form of box-and-whisker plots which display the following information about the data for a select time period – minimum, maximum, mean, median and 1st and 3rd quartile values. When possible, data is compared to either Basin Plan water quality objectives or other identified thresholds for healthy aquatic systems.

For some parameters, data is also displayed in the form of line graphs, charting parameter change over time. Data collected in this program represent discrete points in time, not necessarily reflecting the variability that occurs between monitoring sessions. Therefore, the data are symbolized by points on the graph connected by dotted lines in order to easily view the variations for each monitoring site. Any breaks in the continuity of the graph lines indicate a gap in data collected.

USGS Stream Flow

Data available from the United Station Geological Survey (USGS) regarding annual daily discharge provides valuable background information. There are two USGS gages located in the Upper Carson River watershed – 1) on the East Fork (USGS gage #10308200) located just downstream from the confluence with Markleeville Creek and 2) on the West Fork (USGS gage #10310000) located in Woodfords upstream of the Highway 89 bridge. The graphs below display the average daily discharge in cubic feet per second (cfs) for the East and West Forks from 2005-2010.

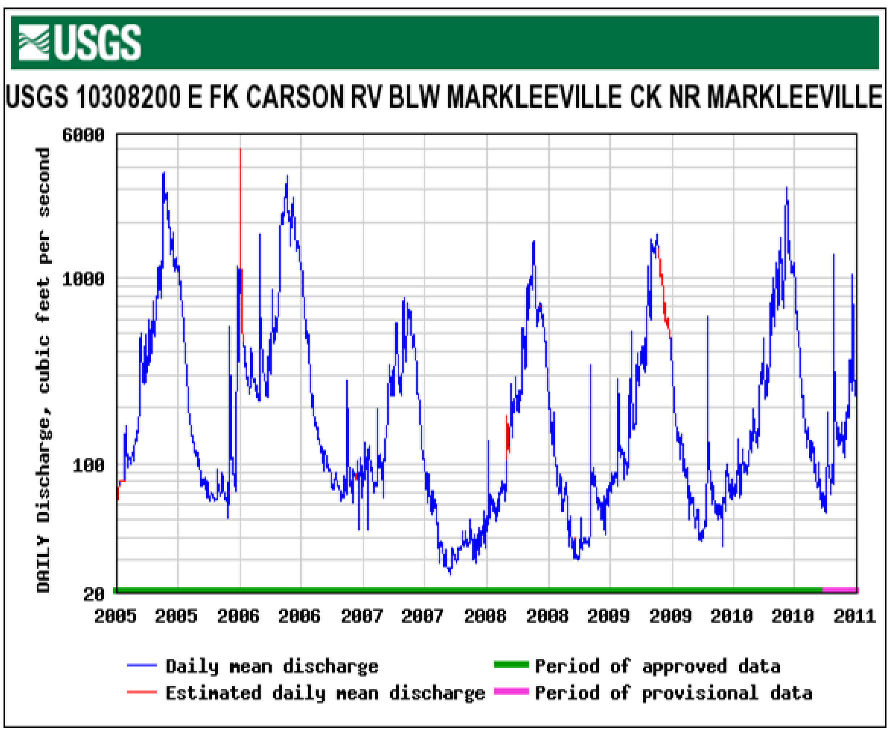

Figure 2. East Fork Carson River Stream Discharge, 2005-2010.
Source: USGS Surface-Water Database

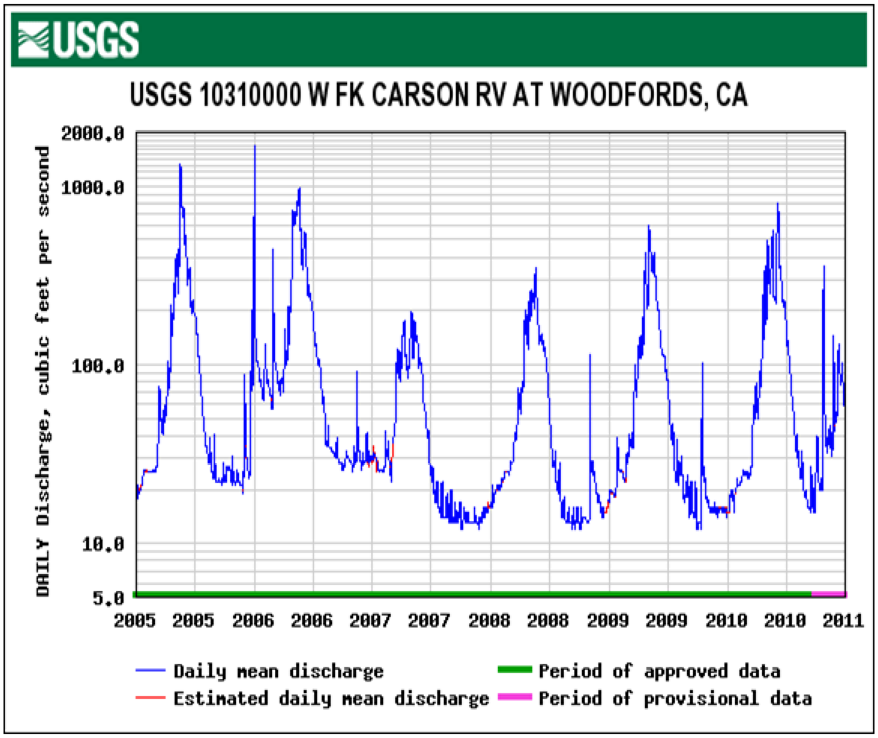

Figure 3. West Fork Carson River Stream Discharge, 2005-2010.
Source: USGS Surface-Water Database

Both streams demonstrate similar fluctuations in discharge annually. However the scale of discharge for each stream varies drastically. Over the past six years, the maximum annual flows for the East Fork have ranged from 738 - 3760 cfs and the minimums 25 - 63 cfs. Whereas the West Fork maximums have been between 197 -1690 cfs and the minimums ranged from 12 - 25 cfs. The peak water flow is generally seen in the months of May or June while the lowest flows are generally seen around October.

The Monitoring Program's quarterly sessions are scheduled consistently on the second Saturday of the months of March, June, September and December. Therefore, the data presented in this report does not necessarily reflect the streams at either the absolute low or high flow conditions.

Water temperature

Water temperature is an important water quality monitoring parameter, as most aquatic organisms depend upon a specific range of temperatures to maintain optimal health (SYRCL, NHI, 2007).Water temperature also directly affects many other water quality parameters including chemical composition, gas solubility and aquatic organism respiration rates.

In order to assess the temperatures seen in the data, it is helpful to compare the maximum for each site to the threshold for healthy aquatic habitat. Although the Basin Plan does not identify a water quality objective for water temperature, the temperature threshold for adult rainbow trout survival is a maximum temperature of 24º C (SYRCL and NHI, 2007). As seen in Figure 4 below, the maximum water temperatures recorded only reach 20º C at the EF-CRR (discussed further below).

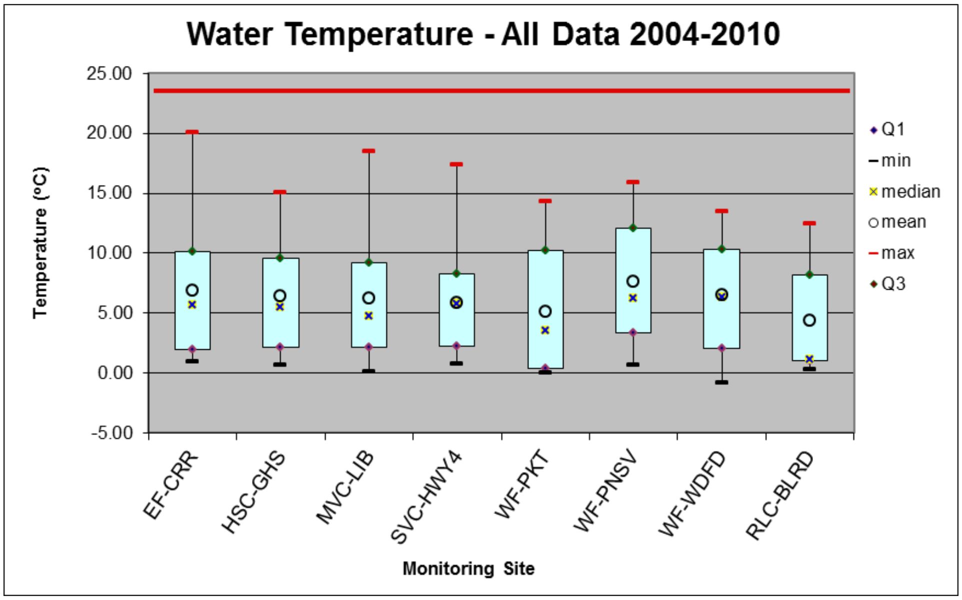

Figure 4. Water temperature, 2004-2010, all sites

The graph below (Figure 5) displays the temperature changes over time for two monitoring sites in the East Fork drainage as they are a good representation of seasonal water temperature variations. Data over the past four years shows the expected seasonal variation which fluctuates between 0-20 º C, which is within normal ranges and is therefore sufficient to support aquatic life.

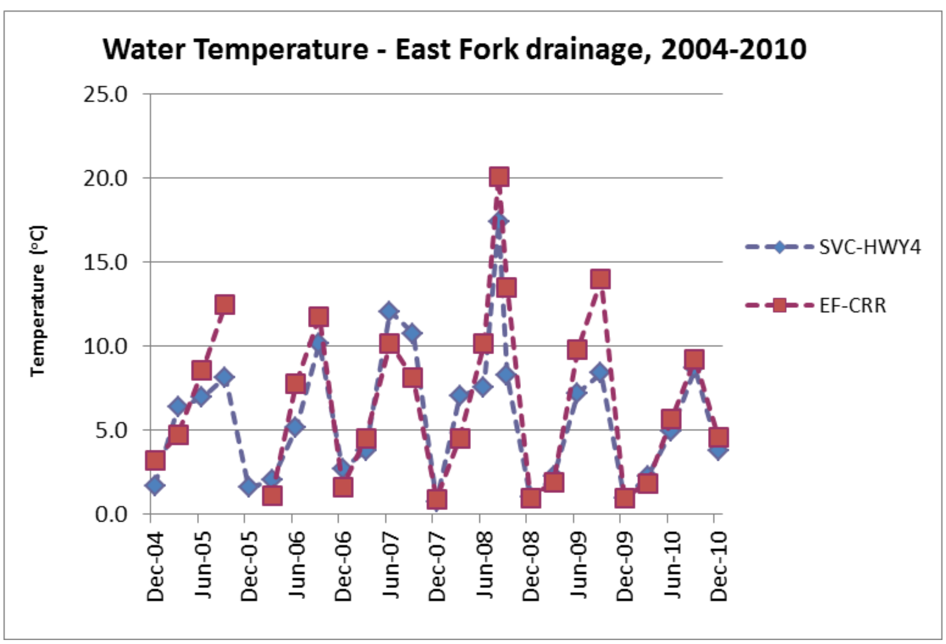

Figure 5. Water temperature, 2004-2010, Silver Creek and East Fork monitoring sites

Figure 5 illustrates the highest water temperature recorded for the Monitoring Program at 20° C at the EF-CRR site which occurred in August 2008. On that same date, the SVC-HWY4 site also reached a peak temperature of 17.4° C. It must be noted that this is the only August data for the program as the regular quarterly monitoring sessions occur in June and September. The highest water temperatures captured annually in the Monitoring Program occur in the month of September. This implies that the highest annual water temperatures are likely not being captured by the quarterly monitoring sessions. It is recommended that the Monitoring Program conduct additional data collection for water temperature during the summer when water temperatures might be at their maximum.

Dissolved Oxygen

Dissolved oxygen is the amount of oxygen dissolved in water. Most aquatic organisms are adversely affected by low dissolved oxygen (DO) levels. The Basin Plan identifies the water quality objective of 7.0 mg/L as the minimum level necessary for healthy aquatic systems. Levels below that threshold can stress salmonids and other organisms, and levels below 4 mg/L can cause mortalities (SYRCL and NHI, 2007).

DO levels recorded over a three year period were all within acceptable ranges for aquatic life, with the exception of one significant outlier at the MVC-LIB site (Figure 6). In June of 2005, a reading of 3.8 mg/L was recorded at this site. The air temperature at the time of the recording was 15° C with a water temperature of 10.2° C. Algae growth on rocks within the stream was noted in the comments section of the data sheet. These combined environmental conditions could have contributed to a low DO measurement or measurement error.

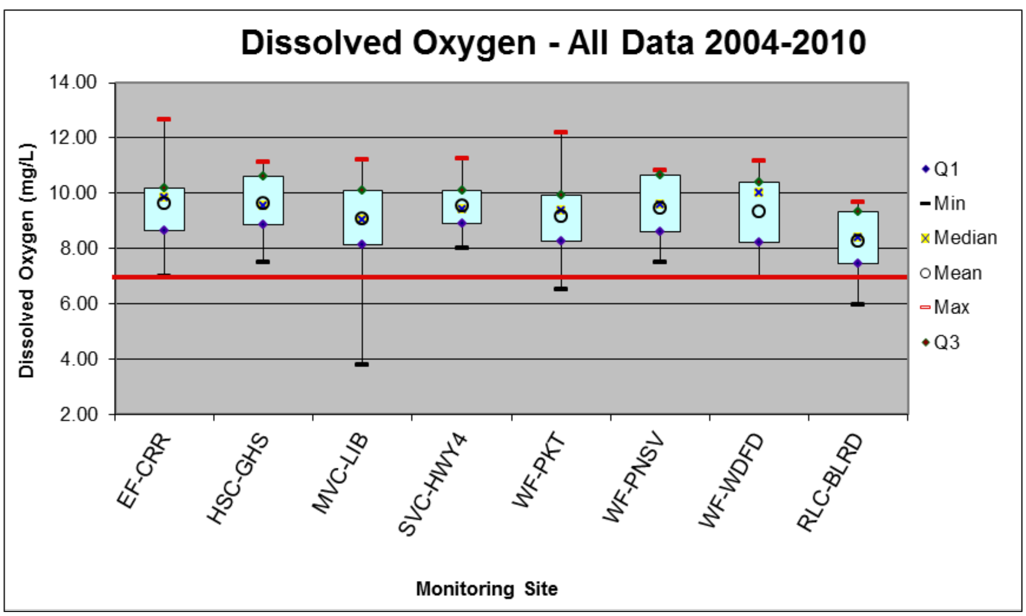

Figure 6.Dissolved oxygen, 2004-2010, all sites

Figure 7 below illustrates dissolved oxygen levels at the three monitoring sites in the West Fork drainage. The graph demonstrates the typical seasonal variation which follows a similar trend for all monitoring sites - higher DO during the winter/spring and lower DO during late summer/fall when the flow is low and the temperatures are higher.

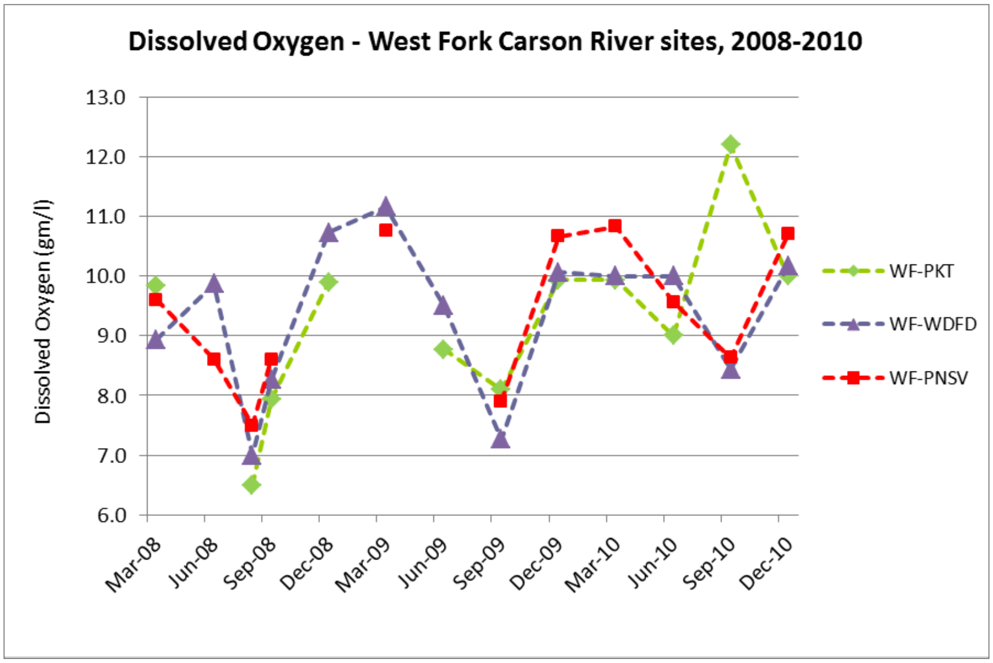

Figure 7: Dissolved oxygen, 2008-2010, West Fork Carson River sites

pH

pH measures the acidity or alkalinity of a solution which is based on the hydrogen ion concentration. The higher the pH level, the more alkaline (or basic) the water is. As with water temperature, most aquatic organisms thrive within a specific range of pH (SYRCL and NHI, 2007).

According to the Basin Plan, changes in normal ambient pH levels shall not exceed 0.5 units for any water bodies designated as COLD in the beneficial uses listing for the Lahontan Region (CRWQCB, 1995). However, normal ambient pH levels have not been defined for these watersheds. Therefore this analysis will apply the objective identified for most surface waters in the Basin Plan - a pH range of 6.5 to 8.5. The pH levels outside of this range can cause stress and even mortality to some aquatic organisms.

The majority of the pH data collected over the past six years falls within optimal ranges for aquatic species health (Figure 7). Three outliers were recorded at three different sites (WF-PKT, WF-PNSV and RLC-BLR) on independent occasions. Investigation of data collected on the dates of the outlier readings reveals no other significant variations or outliers within the remaining set of parameters. Therefore, the existing data set offers no explanation for the outliers recorded.

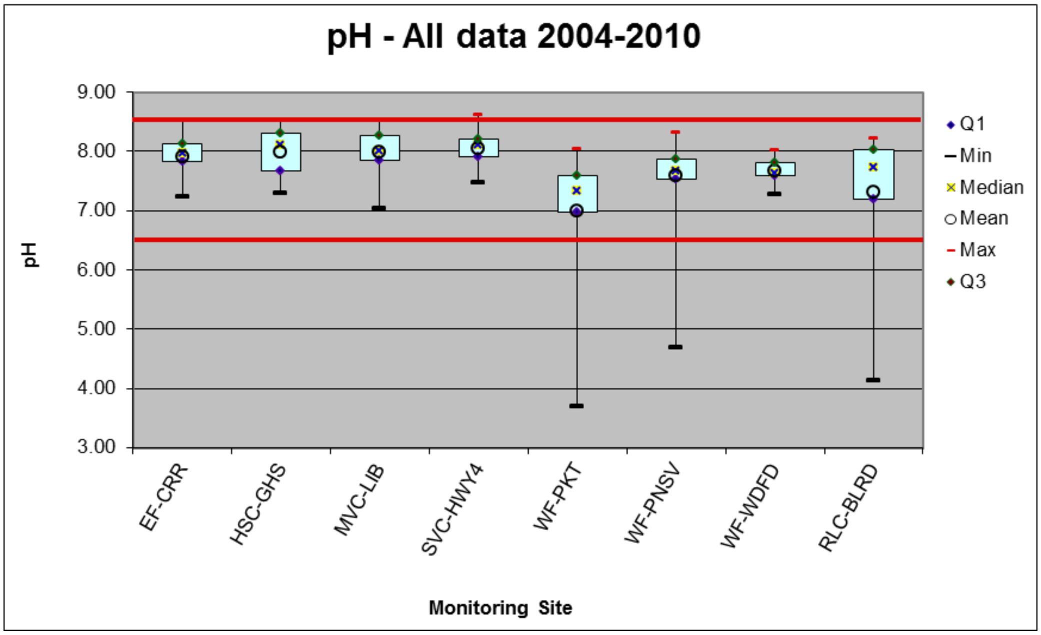

Figure 7.pH, 2004-2010, all sites

Looking at the data for the monitoring sites in the Markleeville Creek watershed specifically, the seasonal variation in the data becomes apparent. The lowest pH levels represented by this data are seen in June and the highest in September or December.

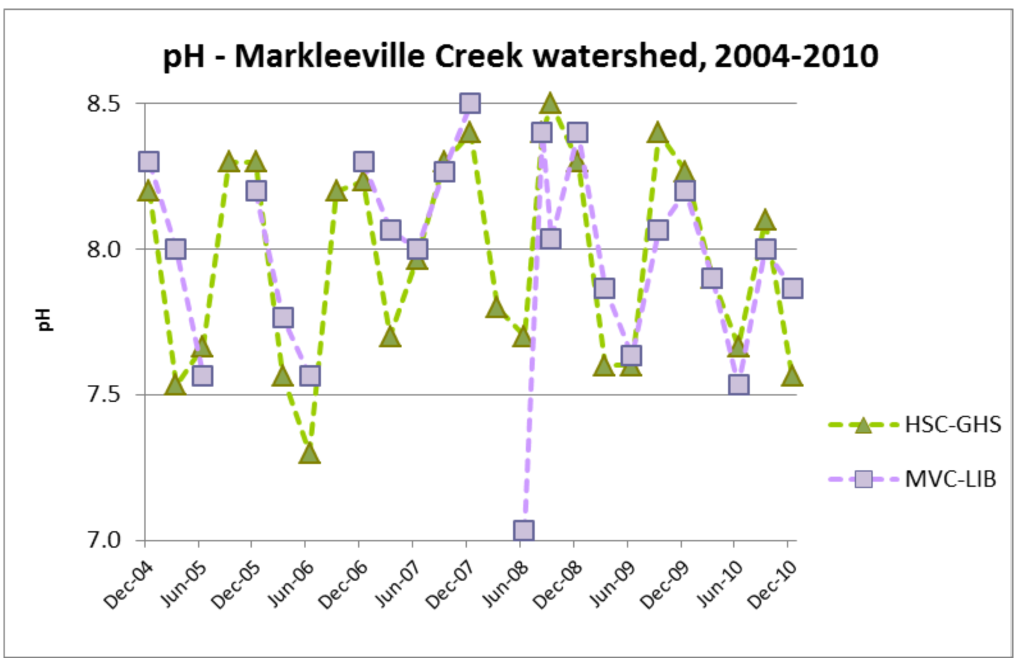

Figure 8.pH, 2004-2010, Hot Springs and Markleeville Creek monitoring sites

Conductivity

Conductivity is the ability of water to conduct an electrical current. It is influenced by the concentration of inorganic dissolved solids (such as chloride, nitrate, sodium and magnesium) in the water. Although these substances are some of the building blocks for aquatic life, extremely high levels can negatively affect organisms. For example, conductivity is inversely related to dissolved oxygen in a stream, hence elevated conductivity levels will decrease DO. Most aquatic organisms tolerate a wide range of conductivity levels (SYRCL and NHI, 2007).

Monitoring sites in the Markleeville Creek drainage (HSC-GHS and MVC-LIB) exhibit elevated levels due to the natural influx of minerals from the Grover Hot Springs pools (Figure 9). The highest levels were recorded during low-flow periods when the Grover Hot Springs pools contributed a larger percentage of Markleeville Creek's base flow.

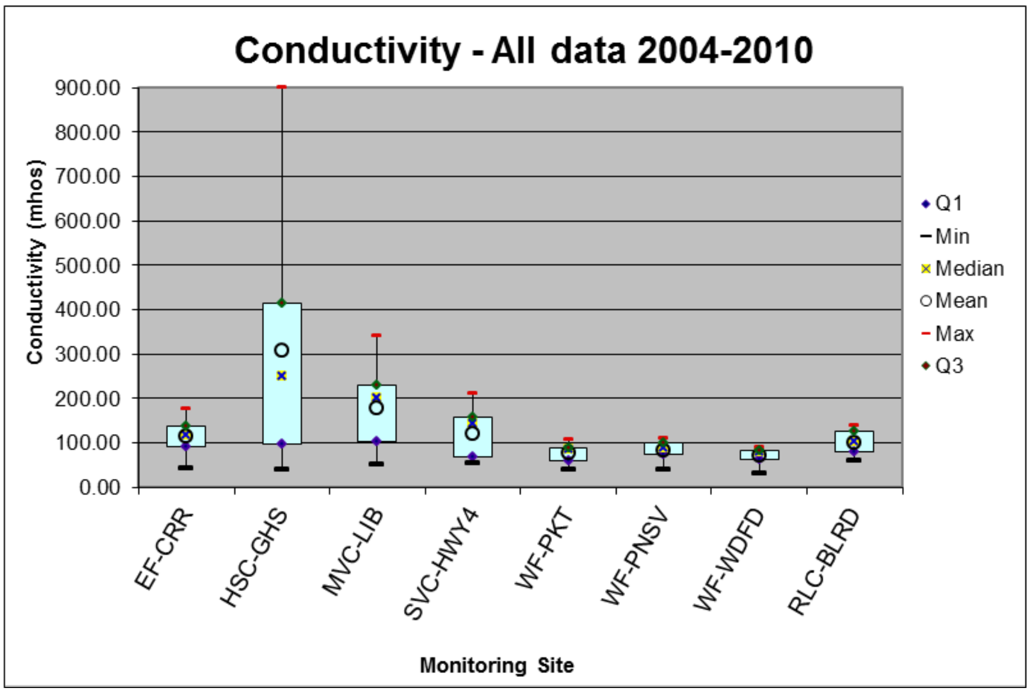

Figure 9.Conductivity, 2004-2010, all sites

Turbidity

Turbidity measures water clarity according to its ability to transmit light. Suspended solids contained in the water (such as silt, clay and organic material) influence the level of turbidity. Turbidity can be used as an indicator of elevated soil erosion in the watershed (SYRCL and NHI, 2007). Aquatic organisms can be adversely affected by elevated turbidity levels. Trout that are not accustomed to high turbidity levels can be adversely impacted by levels above 18 NTU (Bash and Berman, 2001).

The Basin Plan defines water quality objectives for the Upper Carson River as follows: *East Fork - increases in turbidity shall not exceed natural levels by more than 10%; West Fork -*

turbidity shall not be raised above a mean of monthly means value of 2 NTU. However, the natural level has not been defined for the East Fork, and there is not enough data available to calculate the mean of monthly means for the West Fork. Therefore, this analysis will use the 18 NTU level described above to define a healthy stream system.

Turbidity readings conducted as part of the Monitoring Program generally fell within acceptable ranges for aquatic life tolerances with the exception of one recording during higher flows in June 2006 at the monitoring site on the East Fork of the Carson River (Figure 10).

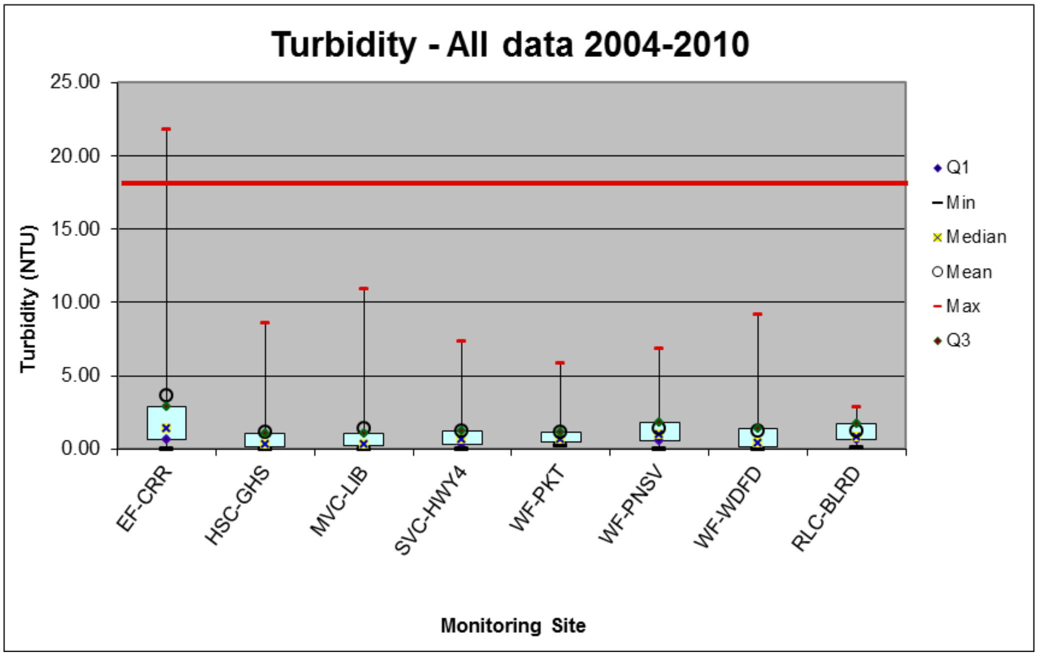

Figure 10.Turbidity, 2004-2010, all sites

The level of turbidity in streams is generally related to flow and sediment inputs. Levels of turbidity will usually rise as flows increase, especially in areas of greater sediment input such as eroding banks, dirt roads and construction sites that do not incorporate sediment control measures. When the data are graphed against the stream flow levels (Figure 11), it becomes apparent that the peaks in turbidity are directly related to stream discharge.

As discussed in the section on stream discharge, peak flows generally occur in May or June. Given that the Monitoring Program only samples in March and June, there is a chance that the peak flow and therefore the peak turbidity is not being captured. It is recommended that the Monitoring Program conduct additional data collection for turbidity during the spring when turbidity might be at its maximum.

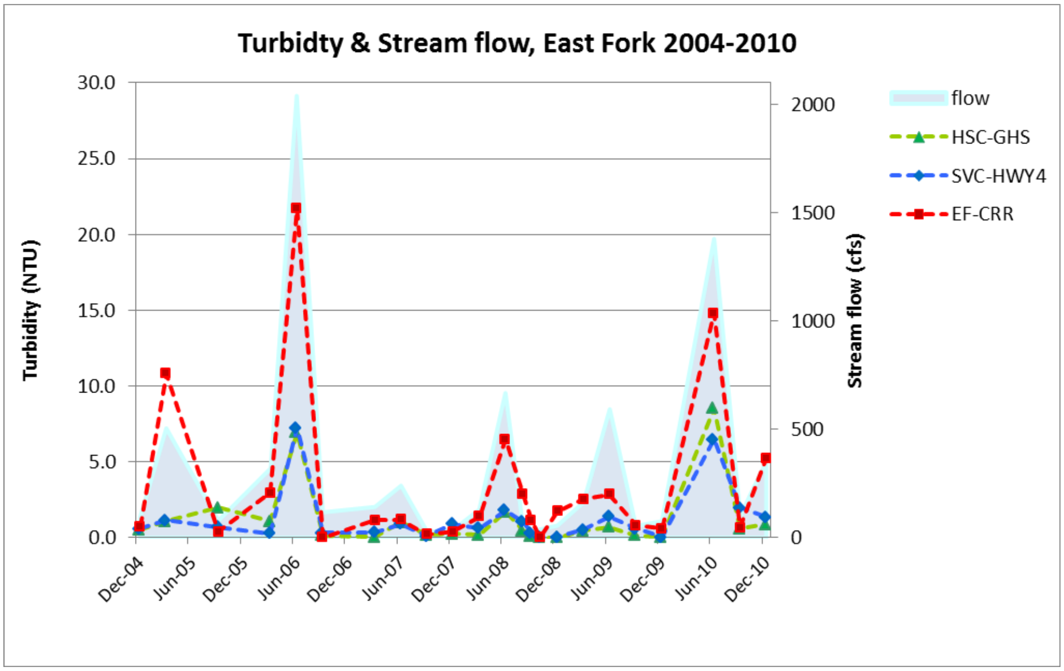

Figure 11.Turbidity and Stream Flow, 2004-2010, East Fork Carson River sites

Nutrients

Nutrients such as nitrogen and phosphorus occur naturally in streams and are basic elements for the growth of organisms. However, excessive amounts can cause algal blooms and oxygen deficiencies (SYRCL and NHI, 2007). As explained earlier in this report, the West Fork of the Carson River is listed as impaired for nitrogen and phosphorous. However, the Basin Plan presents water quality objectives for both the East and West Forks of the Carson River. These are indicated in each of the respective narratives below.

Alpine Watershed Group staff and volunteers collected nutrient samples in 2008 and 2010 on a total of six occasions. Given the limited amount of data, the results are presented in table form rather than graph form. A data point at the detection limit (as indicated in each table's caption) represents a value less than the detection limit. For example, a nitrogen sample reading of 0.20 is an unknown value less than 0.20. Therefore, a data point at the detection limit cannot be definitively reported as significant. It must also be noted that the laboratory's detection limit for 2010 was lower than in 2008 (see respective table for details).

Nitrogen

The following are the Basin Plan's water quality objectives for nitrogen:

- East Fork Carson - 0.20 mg/L (annual average)
- West Fork at Woodfords - 0.15 mg/L (mean of monthly means)
- West Fork at Stateline - 0.25 mg/L (mean of monthly means)

Table 4 below summarizes the data collected between 2008 and 2010. The numbers displayed in red indicate all readings that exceed the threshold.

Date	East Fork				West Fork			
	SVC-HWY4	EF-CRR	HSC-GHS	MVC-LIB	RLC-BLRD	WF-PKT	WF-WDFD	WF-PNSV
8/10/08	0.2	0.2	0.2	0.2		0.2	0.2	0.2
9/13/08	0.2	0.3	0.2	0.2		0.2	0.2	0.2
10/24/08	0.3	0.6	0.5	0.5		0.3	0.3	0.3
12/13/08	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2
6/12/10	0.07	0.089	0.07	0.07	0.14	0.1	0.07	0.099
9/11/10	0.07	0.07	0.07	0.07		0.07	0.07	0.07

Table 4: Nitrogen, all sites, 2008 and 2010
2008 Detection limit: 0.2 mg/l; 2010 Detection limit: 0.07 mg/l

Looking first at the East Fork, data show elevated levels at all sites on the October 2008 monitoring day and at one site in September 2008 (denoted in red). Much of the data fell below the detection limits. In 2010, data for all monitoring sites falls within acceptable levels.

For the West Fork, the October 2008 monitoring data again shows elevated levels at all sites. In December 2008 only one site (RLC-BLRD) showed an elevated level of nitrogen. Similar to the East fork, all monitoring sites falls within acceptable levels in 2010.

Phosphorus

The Basin Plan's water quality objectives for phosphorus are as follows:

- East Fork Carson - 0.02 mg/l (annual average)
- West Fork at Woodfords - 0.02 mg/l (mean of monthly means)
- West Fork at Stateline - 0.03 mg/l (mean of monthly means)

Date	East Fork				West Fork			
	SVC-HWY4	EF-CRR	HSC-GHS	MVC-LIB	RLC-BLRD	WF-PKT	WF-WDFD	WF-PNSV
8/10/08	0.02	0.02	0.02	0.02		0.02	0.02	0.02
9/13/08	0.02	0.02	0.06	0.02		0.02	0.02	0.02
10/24/08	0.02	0.02	0.02	0.02		0.02	0.02	0.02
12/13/08	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
6/12/10	0.04	0.07	0.06	0.05	0.03	0.03	0.03	0.03
9/11/10	0.02	0.02	0.02	0.01		0.01	0.01	0.01

Table 5: Phosphorus, all sites, 2008 and 2010
2008 Detection limit: 0.02 mg/l; 2010 Detection limit: 0.01 mg/l

As shown in Table 5 above, only one site on one date exceeded the water quality objective during the 2008 monitoring season (HSC-GHS in September). In 2010, measurements at all sites except WF-PNSV exceeded the water quality objective in June. The measurement at WF-PNSV fell right at the detection limit.

Fecal Indicator Bacteria

Bacteria are organisms which live naturally in streams and other water bodies and aid in decomposition of organic material. Bacterial analysis of water allows for the identification of different forms of coliform. *Escherishia coli* (*E. coli*) is one form of coliform which serves as an indicator of fecal contamination. Elevated levels of fecal bacteria can be a health risk to humans (SYRCL and NHI, 2007).

According to the Basin Plan, the water quality objective for bacteria states "The fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100 ml, nor shall more than 10 percent of all samples collected during any 30-day period exceed 40/100 ml." As demonstrated in the graph below (Figure 12), fecal coliform levels in the lower Markleeville Creek watershed (MVC-FSCG) exceeded the objective during the months of July, August, September and October. MVC-LIB only exceeded the objective during the month of August.

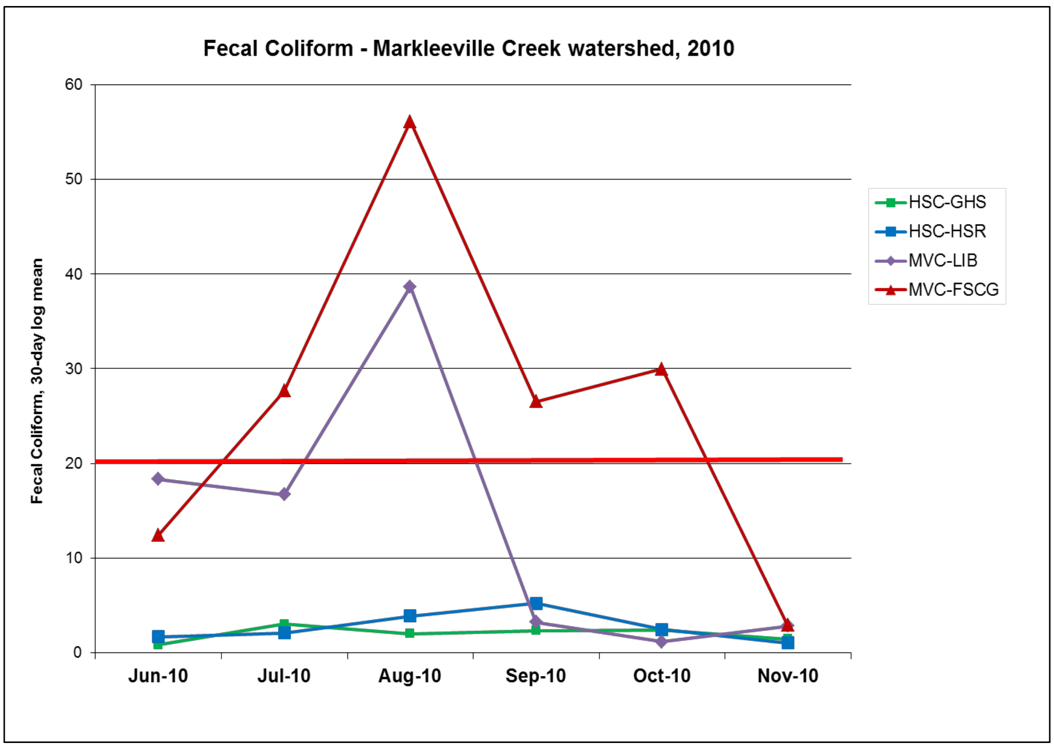

Figure 12.Fecal Coliform, Markleeville Creek watershed, 2010

Monitoring sites were selected at various points along the Markleeville Creek watershed in order to determine the possible locations of pollution input. Data shows a significant increase in bacteria levels as you move downstream between the HSC-HSR and MVC-LIB sites. Introducing additional sampling sites in future years will help to locate the potential source.

Bioassessment

Bioassessment stream studies include the collection of benthic macroinvertebrate (aquatic insect) samples as well as information regarding the physical stream habitat (both riparian and in-stream characteristics). Benthic macroinvertebrates are an integral part of a stream ecoysytem, serving as an essential food source for other aquatic organisms such as fish. Study of the BMI population enhabiting a stream reach provides information about water quality and instream habitat complexity.

Samples collected in this study are analyzed for relative abundance and diversity of the BMI taxa present in the stream. Various metrics based on abundance and diversity are then incorporated into an Index of Biological Integrity, allowing for the analysis to result in a quantitative score indicating overall health of the BMI community. Health of the BMI community serves as a powerful indicator of water quality and habitat integrity for the given sampled stream reach.

Data for this parameter is still pending for this parameter. Lab analysis for the benthic macroinvertebrates often takes 6-8 months for processing. The bioassessment data and findings will be included in a separate data summary once complete.

Conclusion

Summary of Findings

The following are a summary of findings for the parameters monitored by the Alpine Watershed Group's Volunteer Water Quality Monitoring Program from 2004-2010:

- Ambient parameters - With the exception of the few outliers discussed in the Results and Discussion section, the standard set of water chemistry monitoring parameters (water temperature, DO, pH, conductivity and turbidity) recorded over the six year reporting period are within normal ranges for cold mountain streams.
- Nutrients – On several occasions, nitrogen and phosphorus data exceeded the identified Basin Plan objectives.
- Bacteria - Fecal coliform levels in the lower Markleeville Creek watershed (MVC-FSCG) exceeded the objective during the months of July, August, September and October. MVC-LIB exceeded the objective during the month of August.

Recommendations

The following list represents the proposed changes to the Monitoring Program's work plan and procedures:

- Addition of monitoring sessions in July and/or September in order to capture the data when stream flows are at their lowest points.
- Conduct additional nutrient sampling and analysis at a greater frequency if possible.
- Continue partnership with Lahontan Regional Water Quality Control Board in order to maintain bacteria monitoring efforts.

- When collected data falls outside normal levels, promptly confirm that meters function properly and monitoring procedure has been observed. Repeat measurement if there is believed to be an error in equipment or procedure.
- Enhance data review process to ensure complete and accurate data collection.

These recommendations will be considered by AWG staff and Technical Advisory Committee for implementation over the next year.

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