Truckee River Watershed Council
Annual Monitoring Data Report

Submitted to Sierra Nevada Alliance
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The Adopt a Stream of the Truckee River Watershed Council is a volunteer based water quality monitoring program. Aspects of the program have been in place since 1999, however the program has recently expanded. The purpose of this report is to present data (showing) the current condition of the Truckee River watershed, outline our monitoring objectives, and relate our data back to those monitoring objectives.

The Truckee River Watershed

The watershed area covered under the Adopt a Stream program is the Middle Truckee River. This includes all drainages to the Truckee River, from below the dam at Lake Tahoe to the California/Nevada state line. The watershed includes 26 major sub-basins (or sub-watersheds) and covers an area of 435 square miles. A map of the watershed, including monitoring locations, is included as Figure 1.

The Truckee River watershed has a 170-year history of significant human disturbance. Timber harvests (including multiple clear cuts) began early to support silver mining and the transcontinental railroad; railroad construction and operation were (and still are) the source of many watershed problems; the native trout fishery (Lahontan cutthroat trout) was fished to extinction as a food source for California expansion by 1930; gravel mining to support large scale road construction including Interstate 80 have left behind degraded areas; and the largest subdivision in the United States – Tahoe Donner - was built in the 1960s and 1970s before stormwater and erosion regulation. A series of dams in the Truckee River system were established for water supply and flood control.

More recent impacts of concern in the Truckee River watershed include extensive construction particularly in the Town of Truckee and Martis Valley, which is predicted to last another 6-10 years. Ski resorts are expanding to year-round resorts with an increase in golf course use and residential development. Additionally, the flow regime in the Truckee River may see significant changes as the Truckee River Operating Agreement is implemented.

The Truckee River and three tributaries (Bronco Creek, Gray Creek, and Squaw Creek) are listed as impaired for excessive sediment under the Clean Water Act. The primary pollutant of concern in the watershed is excessive sediment. Sediment sources include road and highway salting and sanding, construction, ski runs, and natural sediment sources including landslides and debris flows.

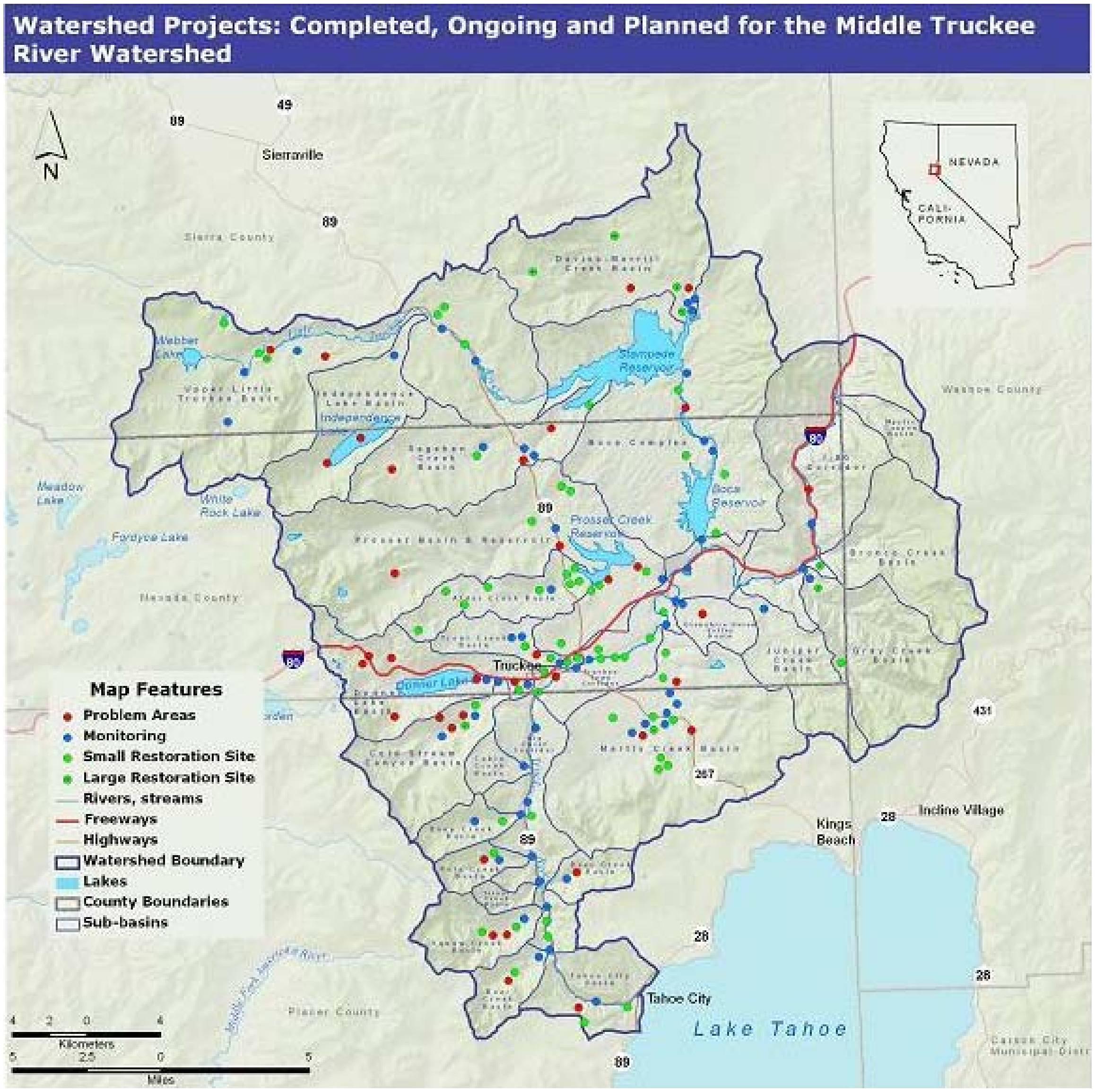

Figure 1. Middle Truckee River watershed with major stream sub-basins indicated. Figures 2 and 3 show monitoring locations more clearly. Map created by Digital Mapping Solutions.

Monitoring goals and objectives

The primary goals of the Adopt a Stream program are:

- To determine how common land use practices in the Truckee River watershed affect water quality and habitat function.
- To screen for water quality problems typically associated with common land use practices in the Truckee River watershed.
- To empower citizens to be responsible stewards and decision-makers.

- To design and execute scientifically credible studies to assess the condition of the Truckee River ecosystem.

- To support the Truckee River sediment TMDL monitoring program.

- To support the Biological Resources Monitoring Plan for the Truckee River Operating Agreement (TROA)

The Adopt a Stream (AS) program is designed to supplement existing agency monitoring efforts in the Truckee River watershed. The focus of AS is on measuring chemical, habitat and biological parameters in order to assess land use impacts on water quality and watershed health.

The primary objectives of AS are:

1. To better understand and document the relationship between water quality, hydrologic function, river system management, and land use.

2. To identify land use practices that negatively impact the Truckee River watershed, the extent of impact, and the geographic locations of concern.

3. To engage and educate residents about local watershed processes and strengthen their understanding of watershed stewardship.

4. To enhance the quality and quantity of data available for resource managers and decision makers in the Truckee River watershed.

5. To provide documentation linking water quality problems to land use practices in the Truckee River watershed.

6. To provide data that can be used to help monitor the implementation of the Truckee River sediment TMDL.

7. To collect data to help provide pre-Truckee River Operating Agreement (TROA) implementation data, and to establish a program that will help to track changes in the condition of biological resources in the Truckee River watershed once TROA is implemented.

Funding Sources

The launch of the Adopt a Stream program was made possible by the Sierra Nevada Alliance. Support for biological monitoring also came from the Department of Water Resources.

Program Description

TRWC has conducted water quality monitoring since 1999. Parameters monitored, timing, and frequency have all changed over the years as the monitoring program has matured. All monitoring activities are contained under the umbrella of “Adopt a Stream”; however there are three components to the monitoring program:

1. Snapshot Day. This program has existed since 2001 and is a one-day watershed wide (Lake Tahoe and Truckee River) monitoring event. Basic physical and chemical parameters are measured. The focus of Snapshot Day is to cover as much geographic area as possible in order to capture a “snapshot” in time of water quality for the entire Truckee River watershed. Several different groups are involved in Snapshot Day, the Truckee River Watershed Council manages the event for the Middle Truckee River watershed. Snapshot Day takes place in the spring of each year during snowmelt run-off (high flow).

2. Adopt a Stream – Quarterly Monitoring. Year round monitoring began in 2007. Volunteer teams have adopted ten streams in the Truckee River watershed and monitor them quarterly for basic physical and chemical parameters.

3. Truckee River Aquatic Monitors (TRAM). This group has collected bioassessment and basic habitat data since 1999. Five to eight streams are monitored each year, with a different selection of streams monitored each year. Streams are only monitored once in any given year.

This report will include data from all three components of Adopt a Stream.

Field and Lab methods

Monitoring dates, locations, and parameters monitored can be found in Table 1 for physical and chemical monitoring and Table 2 for bioassessment sites. Figure 2 shows ambient monitoring locations and Figure 3 shows bioassessment sites.

Table 1. Sites monitored for basic physical and chemical parameters (temperature, electrical conductivity, dissolved oxygen, pH, turbidity). Each year, some of these sites are tested for nutrients and/or coliform bacteria. All sites listed here are monitored on Snapshot Day (spring runoff), the Quarterly Sites are also monitored at other times of year.

Site ID	**Site Name**
Quarterly Sites - including Snapshot Day	
MTR-ALDR	Alder Creek
MTR-BEAR	Bear Creek
MTR-BOCA-01	Little Truckee at Boyington Mill
MTR-COLD-00	Cold Creek
MTR-DONN-01	Donner Creek at Hwy 89
MTR-MART-00	Martis near mouth
MTR-PROS-01	Prosser Creek below dam
MTR-SAGE-02	Sagehen Creek at Field Station
MTR-SQCR-00	Squaw Creek
MTR-TROU-00	Trout Creek near Mouth
Snapshot Day Only Sites	
MTR-BIGC	Truckee River in Big Chief Corridor
MTR-BOCA-00	Little Truckee Below Boca Dam
MTR-BOCA-02	Worn Mill Creek
MTR-CABN	Cabin Creek subbasin
MTR-DEEP	Deep Creek
MTR-DMCB	Davies Creek
MTR-DONN-03	Donner Creek 3
MTR-GLEN-00	Union Creek below Glenshire
MTR-GLEN-01	Union Creek at outflow of Glenshire Pond
MTR-GRAY	Gray Creek
MTR-I80C	Truckee River in I-80 Corridor-Floriston
MTR-INDE	Independence Creek
MTR-MART-01	Martis at COE boundary
MTR-POLE-00	Pole Creek
MTR-PROS-02	Prosser Creek

MTR-SAGE-00	Sagehen Creek
MTR-SILV	Silver Creek
MTR-TOWN	Truckee River in Town Corridor
MTR-TR01	Truckee River near Tahoe City
MTR-TROU-01	Trout Creek in Town
MTR-TROU-02	Trout Creek in Tahoe Donner
MTR-ULTB	Upper Little Truckee

Table 2. Bioassessment sites and years monitored.

Stream	**Location**	**Years monitored**
Bear Creek	Near confluence with Truckee River	2002, 2003, 2004, 2006
Cold Creek	Near horseshoe bend in railroad	2000
Lower Cold Creek	Near confluence with Donner Creek	2008
Cold Stream	0.5 mile upstream of confluence with Little Truckee River	2002
Davies Creek	Just below confluence with Merrill Creek	2003, 2005, 2006, 2008
Deep Creek	1.75 miles from confluence with Truckee River	2005
Deer Creek	About 1 mile upstream of confluence with Truckee River	2004
Donner Creek	Immediately downstream of Highway 89	2005, 2008
Gray Creek	Near mouth	2001, 2002, 2005, 2006
Independence Creek	Below road crossing, near campground	2007
Independence Creek tributary	About 2.5 miles downstream of lake, 1.3 miles upstream of confluence with Little Truckee (at road crossing)	1999, 2001
Juniper Creek	About 1.3 miles upstream of confluence with Truckee River	2004
Upper Little Truckee River	Along highway 89, approximately 0.6 miles downstream of turnoff to Kyburz Flat	1999
Little Truckee River	Between Boca and Stampede – downstream of USGS gage	2006, 2007
Lower Martis Creek	Near confluence with Truckee River	2006
East Martis Creek	Immediately upstream of dirt road crossing	2003, 2008
Martis Creek - Main	In Wildlife Area (upstream of Hwy 267)	2001, 2002, 2003, 2004, 2005, 2007
Martis Creek	Main branch, downstream of highway 267	2000
West Martis Creek	Below golf course, on USACE land	2003
Upper Perazzo Creek	About 1.5 miles upstream of confluence with Little Truckee River	2003
Perazzo Creek	Near confluence with Little Truckee River	2005, 2008
Pole Creek	About 1.4 miles upstream of confluence with Truckee River	2004
Prosser Creek	Below the dam – just upstream of I-80	2003, 2007, 2008
Lower Sagehen Creek	Downstream of highway 89	1999, 2000
Sagehen Creek	Just downstream of the field station	2004, 2006, 2007
Squaw Creek	Lower end of Squaw Meadow	2002, 2003, 2007
Trout Creek	Lower – near mouth	2000, 2003, 2007

Trout Creek at Bennett	At Bennett Flat	2003
Truckee River at Granite Flat	Granite Flat Campground	2001, 2004
Truckee River at Horseshoe Bend	Near Hirschdale	2001, 2004

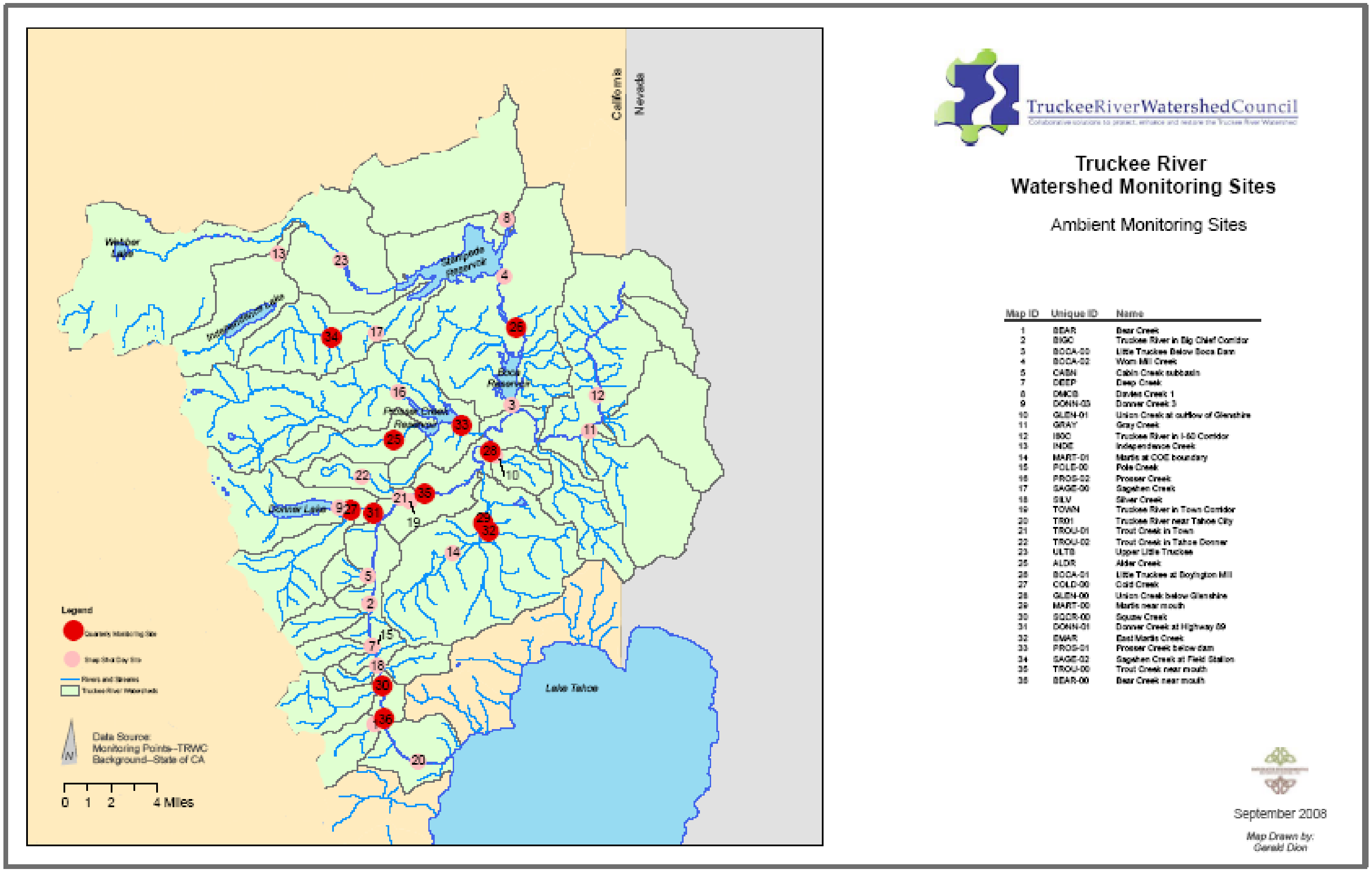

Figure 2. Locations for ambient monitoring. Red dots indicate sites monitored quarterly and pink dots indicate sites monitored annually. Map created by Integrated Environmental Services.

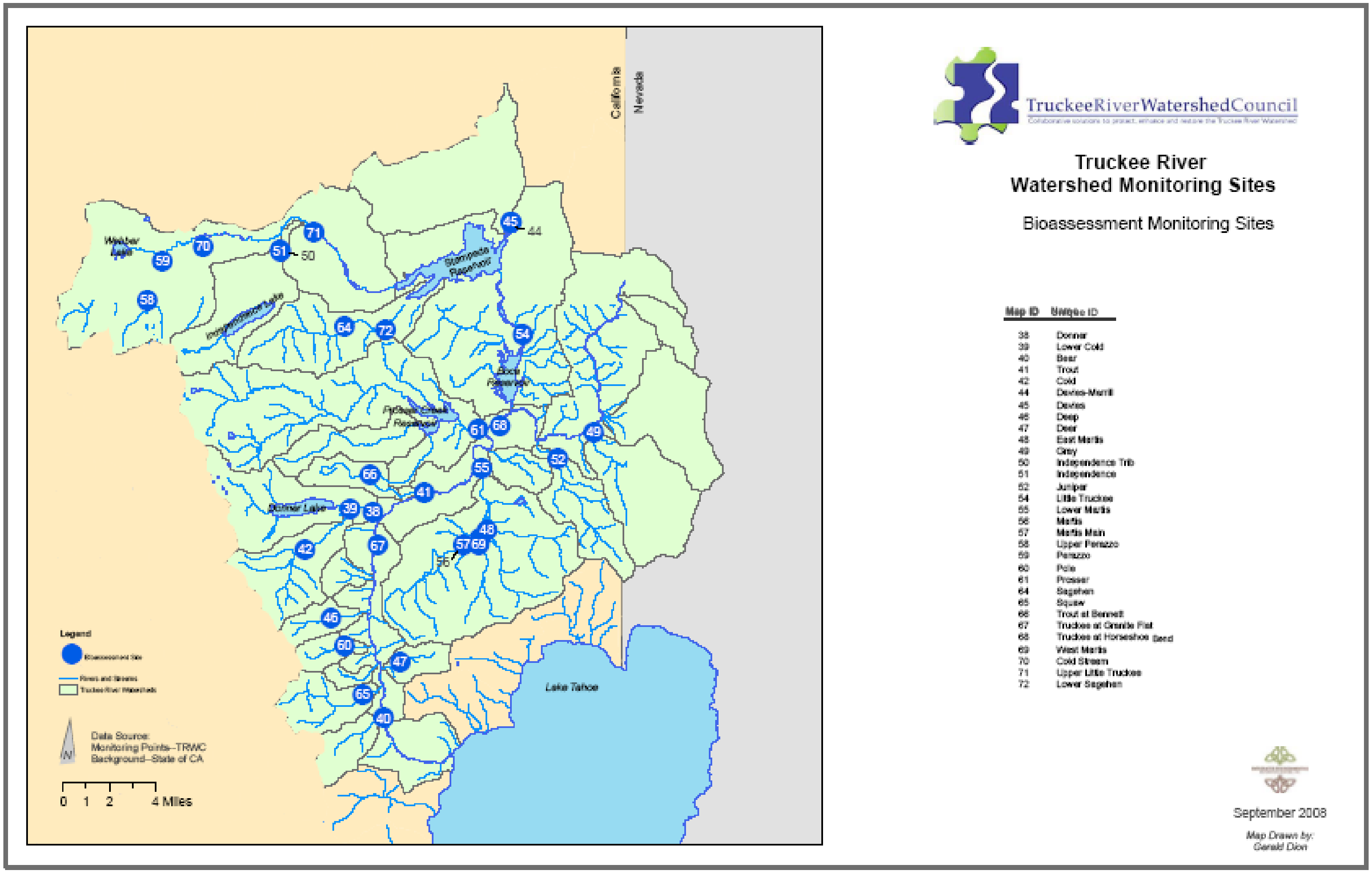

Figure 3. Locations for bioassessment monitoring. Table 2 shows years these sites were monitored.

Ambient parameters are measured using a variety of methods:

Table 3. Field methods.

Dissolved Oxygen	Winkler Titration method, Chemet, or YSI meter	In Field
pH	Meter or pH strips	In Field
Conductivity	Hand held conductivity meter	In Field
Turbidity	Turbidity Meter – kept in office	Grab sample
Temperature	Thermometer (-5 to 50 C)	In Field
Nutrients	NH_3-N, NO_3 & NO_2-N, SRP, TP	Grab sample
Benthic Macroinvertebrates	CSBP	Grab sample

Nutrient samples are analyzed by High Sierra Water Lab, located in Truckee.

Benthic macroinvertebrate samples are collected by volunteers and are processed one of two ways. TRWC volunteers identify the samples from about 3 streams per year and the remainder are sent out for professional identification, typically to the California Department of Fish and Game Aquatic Bioassessment Laboratory. There are two important differences in samples identified by volunteers and those identified by professionals – number of organisms and taxonomic resolution. Volunteers identify a subsample of 300 organisms from each stream whereas professionals identify 900 organisms. Volunteers identify organisms to family level and professionals identify organisms to genus or species. These differences affect many of the standard metrics calculated from the data. Therefore, in the results section data from volunteer- and professionally-identified samples are presented separately where appropriate.

Results and Analysis

The following parameters were monitored.

1.) Temperature: To identify areas of concern for thermal pollution.
2.) Dissolved Oxygen: To determine health of aquatic ecosystem. Dissolved oxygen availability affects photosynthesis, and the metabolic rates of organisms and their sensitivity to toxic wastes, parasites, and diseases in addition to their distribution. Also used to identify areas of concern for hypoxia/anoxia.
3.) Conductivity: To determine potential sources of dissolved solids or salts. High conductivity indicates impaired water quality. Common anthropogenic sources in the Truckee River watershed include wastewater discharge and road salt and sand.
4.) pH: To determine if stream will support aquatic life. pH can be affected by many types of sources, both natural and anthropogenic.
5.) Turbidity: To identify areas of increased erosion. Turbidity measures the amount of suspended particles in the water.
6.) Nutrients: Nitrogen and phosphorus are used to identify sources of nutrient loading. Excess nutrients, particularly phosphorus, can lead to algal blooms and eventual anoxic conditions.
7.) Benthic Macroinvertebrates: To determine the ability of the water body to support aquatic communities. Different types of benthic macroinvertebrates respond differently to pollution in aquatic ecosystems. By sampling the stream community directly, it is possible to determine water quality.

The Status and Trends part of the Results and Analysis section is a presentation of monitoring results for all sites. The reason for including these plots is to show the range of stream conditions observed in the Middle Truckee River watershed since 2001. These data allow for comparisons between sites in basic water quality parameters.

The second part of the Results and Analysis section will focus on relating data back to the Monitoring Plan objectives.

Status and Trends

Box plots of ambient monitoring parameters can be found in Figures 4-8. These plots show the range of variability and central tendency for the standard parameters of water temperature, electrical conductivity, dissolved oxygen concentration, and pH. These plots include data from sampling events throughout the year, although the majority of measurements have been taken in May during spring run-off (on Snapshot Day) because year-round monitoring did not start until 2007 (See Table 1 for list of Quarterly sites).

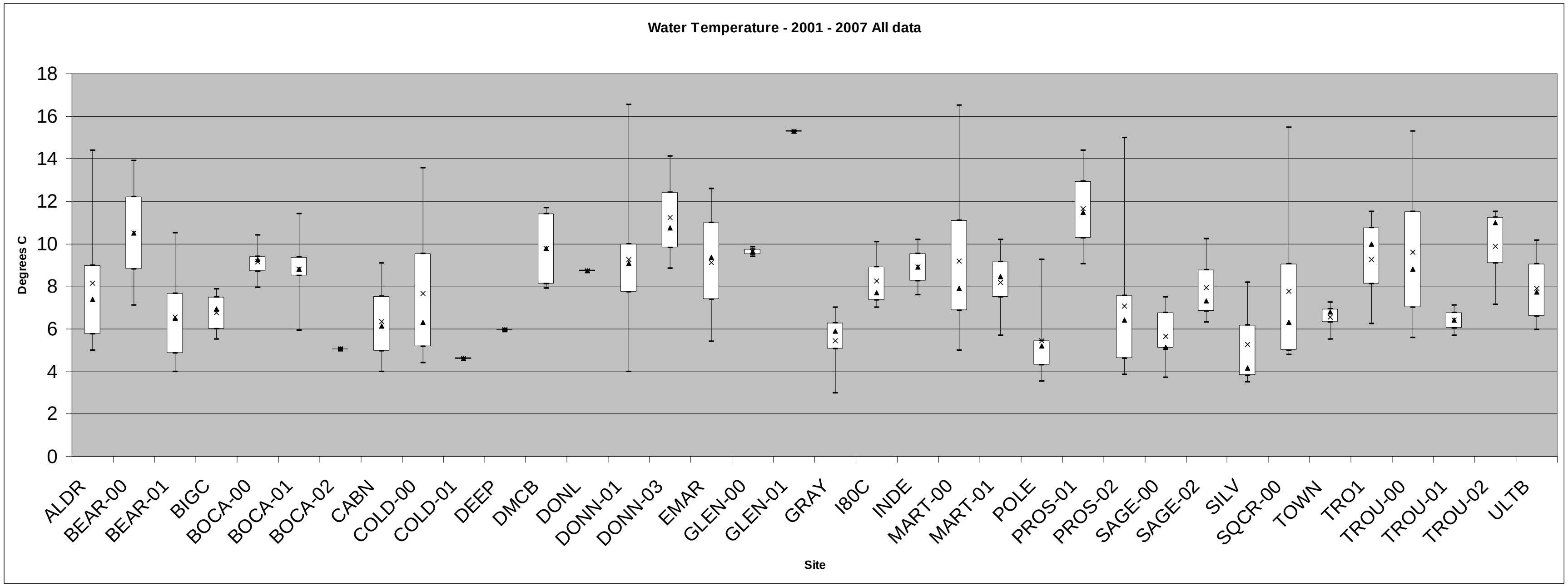

Figure 4. Water temperature measurements for all Middle Truckee River monitoring sites.

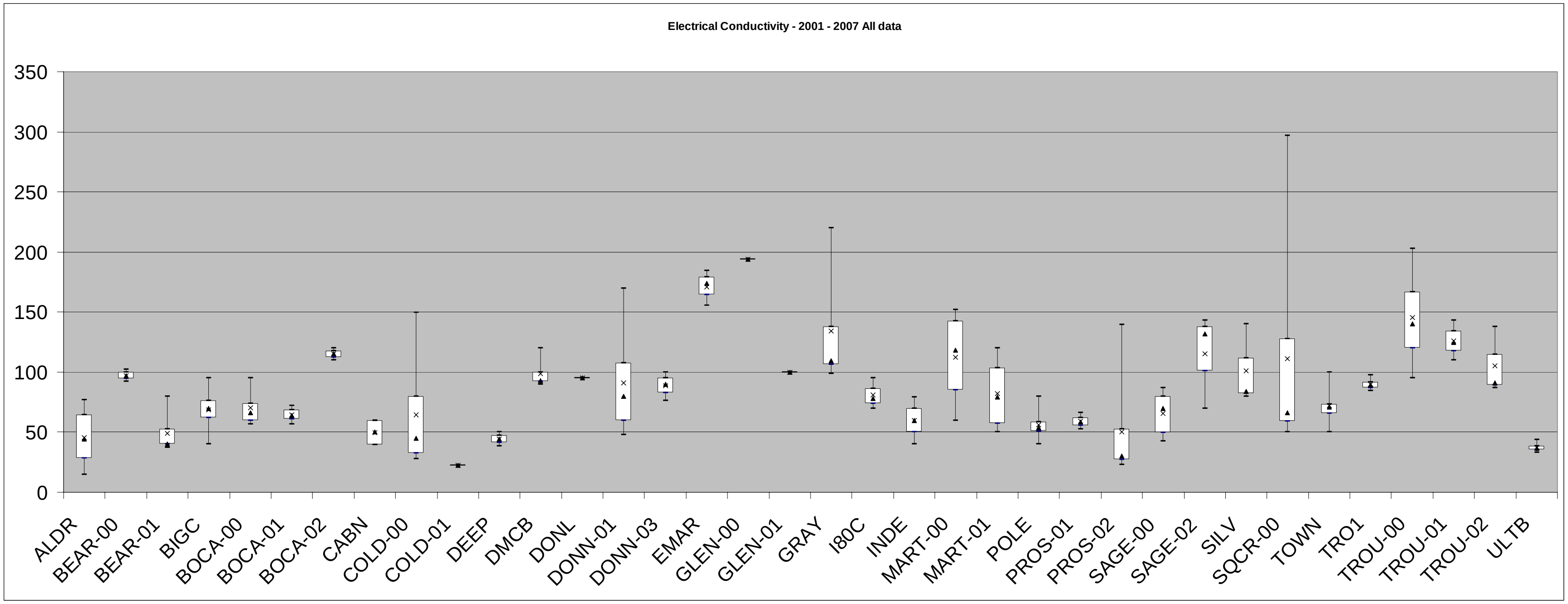

Figure 5. Electrical conductivity measurements for all Middle Truckee River monitoring sites.

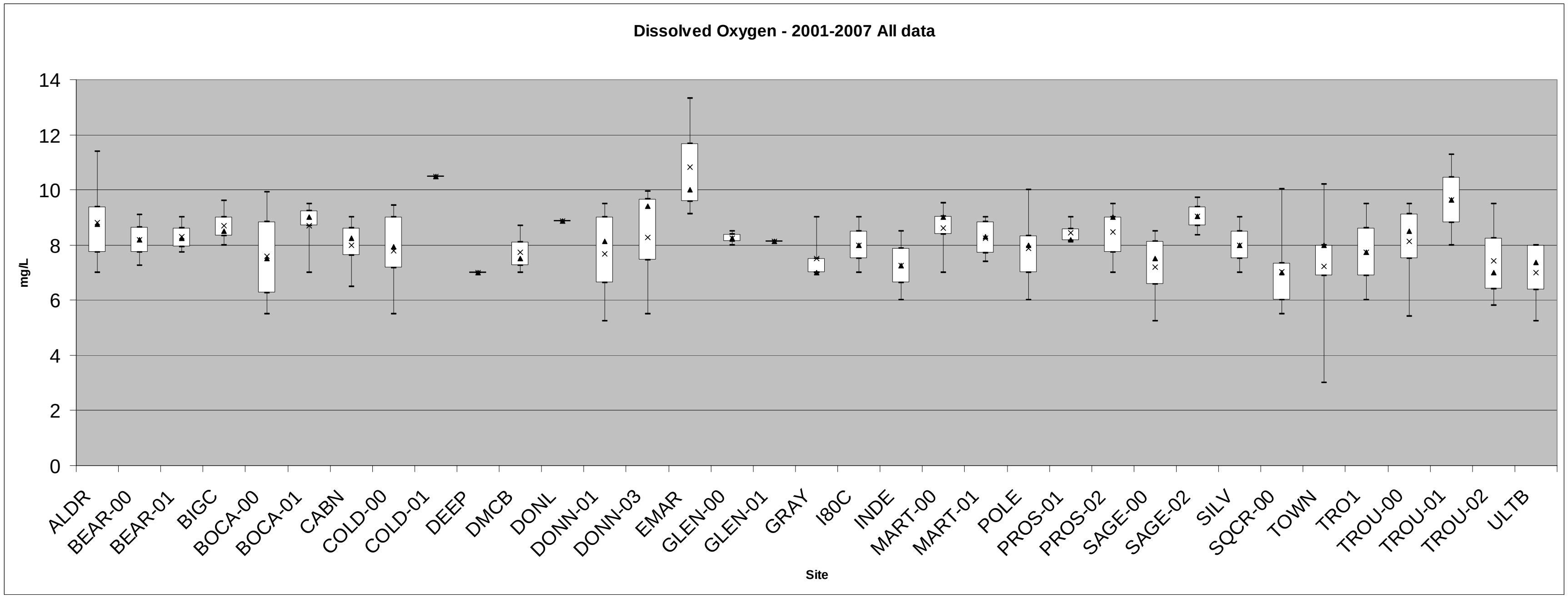

Figure 6. Dissolved oxygen measurements for all Middle Truckee River monitoring sites.

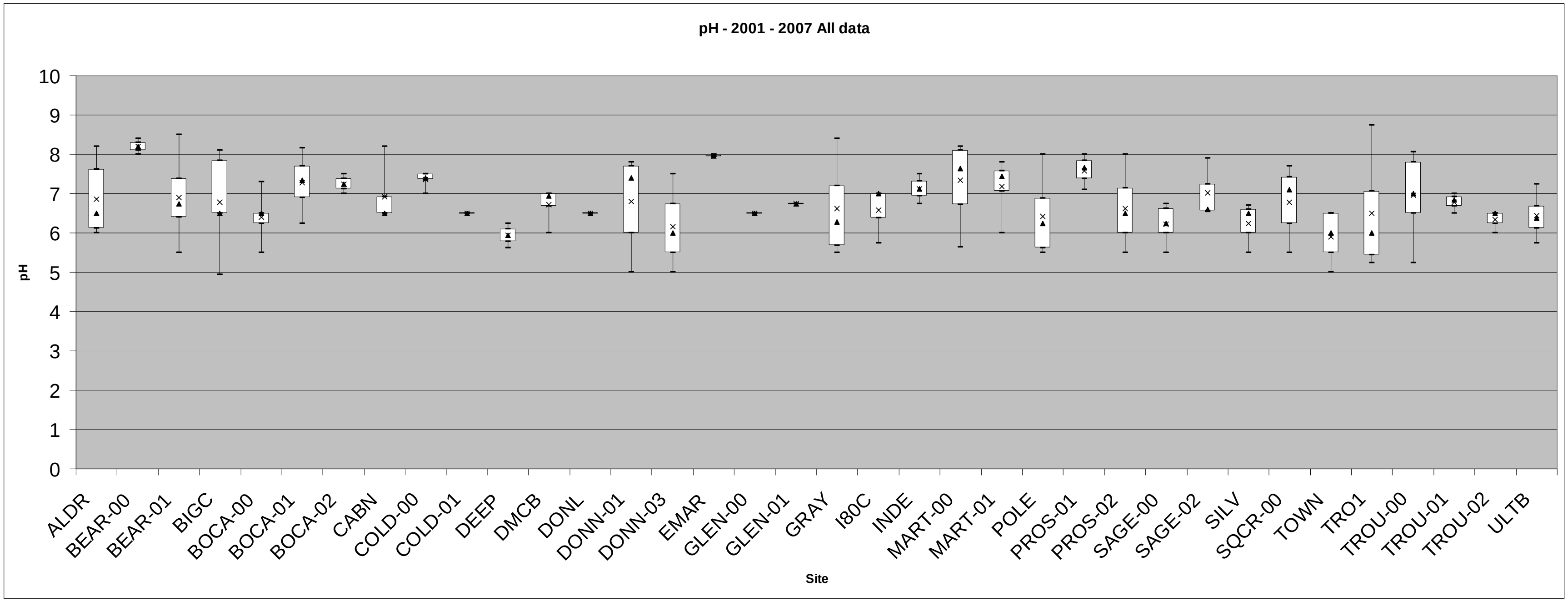

Figure 7. pH measurements for all Middle Truckee River monitoring sites.

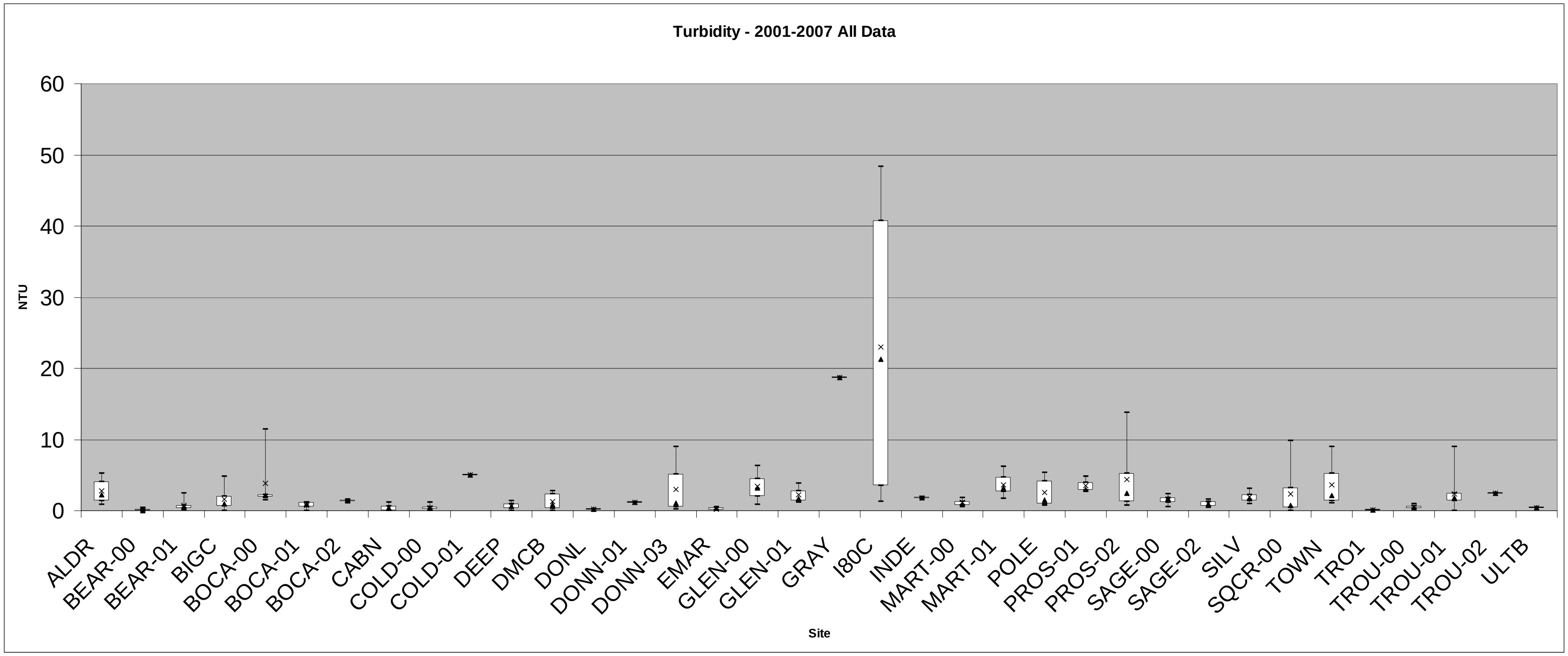

Figure 8. Turbidity measurements for all Middle Truckee River monitoring sites.

Water Temperature

Figure 4 shows water temperature data. All data are included in this figure, so some measurements are taken from the summer or fall when water temperature is higher than during the spring run off. Year round measurements were not taken until 2007 – from 2001-2006 monitoring only occurred during spring run-off on Snapshot Day. Furthermore, only a subset of sites are monitored during the summer months. The sites that show the greatest variability in water temperature are those sites that are monitored year round (See Table 1).

During monitoring events, we have typically found that water temperature in the Middle Truckee River watershed is sufficient to support aquatic life (Figure 2, Table 4).

Table 4. Temperature ranges required for rainbow trout *(Oncorhynchus mykiss)* survival and reproduction. These temperature ranges are representative of those required by most salmonids.

Species	**Growth**	**Maxima**	**Spawning***	**Embryo Survival****
Rainbow Trout	19°C (66 °F)	24°C (75 °F)	9°C (48 °F)	13°C (55 °F)

* The optimum or mean of the range of spawning temperatures reported for the species.
** The upper temperature for successful incubation and hatching reported for the species.
Adapted from EPA's Draft Volunteer Stream Monitoring: A Methods Manual.

Electrical Conductivity

Figure 5 shows the results of monitoring for electrical conductivity. Conductivity is used as an indicator of dissolved solids (e.g., minerals or salts), with higher levels associated with degraded water quality. Anthropogenic sources that affect conductivity include road salts and sand and other urban runoff. Conductivity is expected to be higher during low flow because the ions that conduct electricity become concentrated. Therefore, measurements taken during spring run-off may be lower than during other times of year. As with water temperature, the data shown in Figure 3 are mostly taken during spring run-off, although a subset of sites are monitored year round (Table 1). Most monitoring sites have low electrical conductivity.

Squaw Creek, Trout Creek, and Gray Creek all show quite a bit of variability, with some recorded values that are elevated over what is typically seen in the Middle Truckee watershed. Gray Creek is an undeveloped watershed although there are significant natural erosion sources in the watershed (Northwest Hydraulic Consultants, 2006). Squaw Creek and Trout Creek are both highly urbanized watersheds so high conductivity may be related to anthropogenic activity such as road salt and sand or stormwater run-off. Trout Creek and Squaw Creek are part of the quarterly monitoring program.

Dissolved Oxygen

Figure 6 shows the results of monitoring for dissolved oxygen. As with the other parameters discussed, dissolved oxygen is expected to vary seasonally. Colder water can hold more dissolved oxygen, therefore concentration should be higher during spring run off than during summer base flows. Overall, monitoring indicated that oxygen levels are fairly good in the Middle Truckee watershed. Cold, clean water usually has levels of dissolved oxygen averaging above 6.0 mg/L, and single-measurement levels below 5 mg/L are considered dangerous for cold water aquatic life. Only one measurement below 5 has been recorded for the Middle Truckee watershed – from the "TOWN" monitoring location in downtown Truckee. This was taken during spring run-off in 2004, but may have been inaccurate since it was measured with a Chemet kit, which can be misinterpreted more easily than the Winkler titration.

pH

Figure 7 shows the results of pH measurements. Low pH indicates acidic water, high pH indicates basic water, with a measurement of 7 being neutral. In the Middle Truckee River watershed, pH is typically very consistent with measurements between 6-8. Very low or very high pH measurements are dangerous for aquatic life. A pH value of 6-8 will support the widest range of biota.

Turbidity

Figure 8 shows the results of monitoring for turbidity. Turbidity is a measure of the amount of suspended particles in the water. Algae, suspended sediment, organic matter and some pollutants can all increase turbidity in water. Suspended particles diffuse sunlight and absorb heat, which can increase temperature and decrease light available for algal photosynthesis. Turbidity caused by suspended sediment can be an indicator of erosion. If sedimentation is extreme, fish and invertebrate populations can be affected. Because erosion is higher during high flows, spring run off measurements will tend to be higher than during low flow.

Gray Creek consistently has very high turbidity. Most of the erosion in this watershed is natural (NHC, 2006). A TMDL for Gray Creek has been developed in conjunction with the Truckee River TMDL. However, because most of the erosion sites are untreatable, this site will probably continue to yield high turbidity measurements.

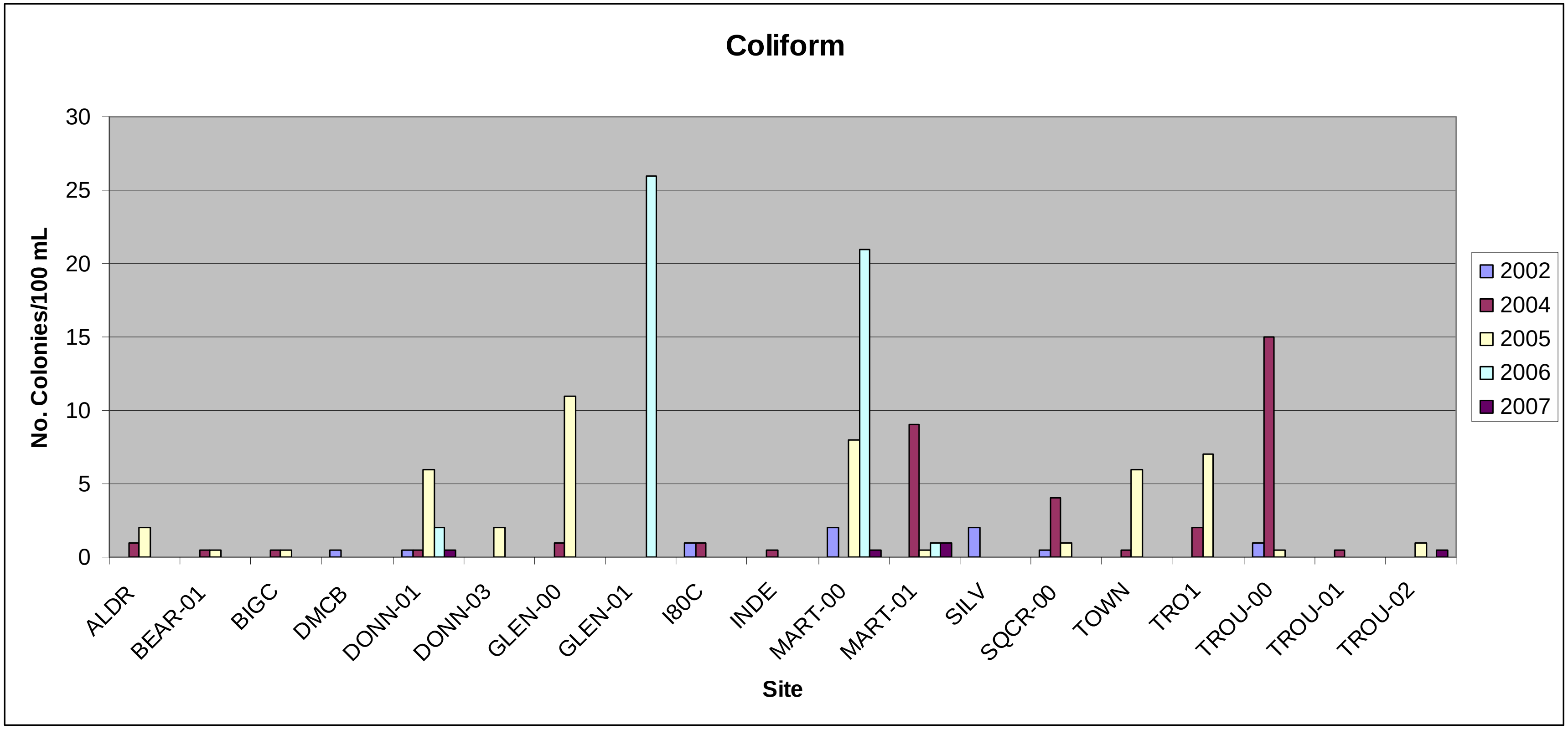

Figure 9. Coliform data. All data collected during spring run-off. A measurement of 0.5 CFU/100 mL is used to show “non-detect”.

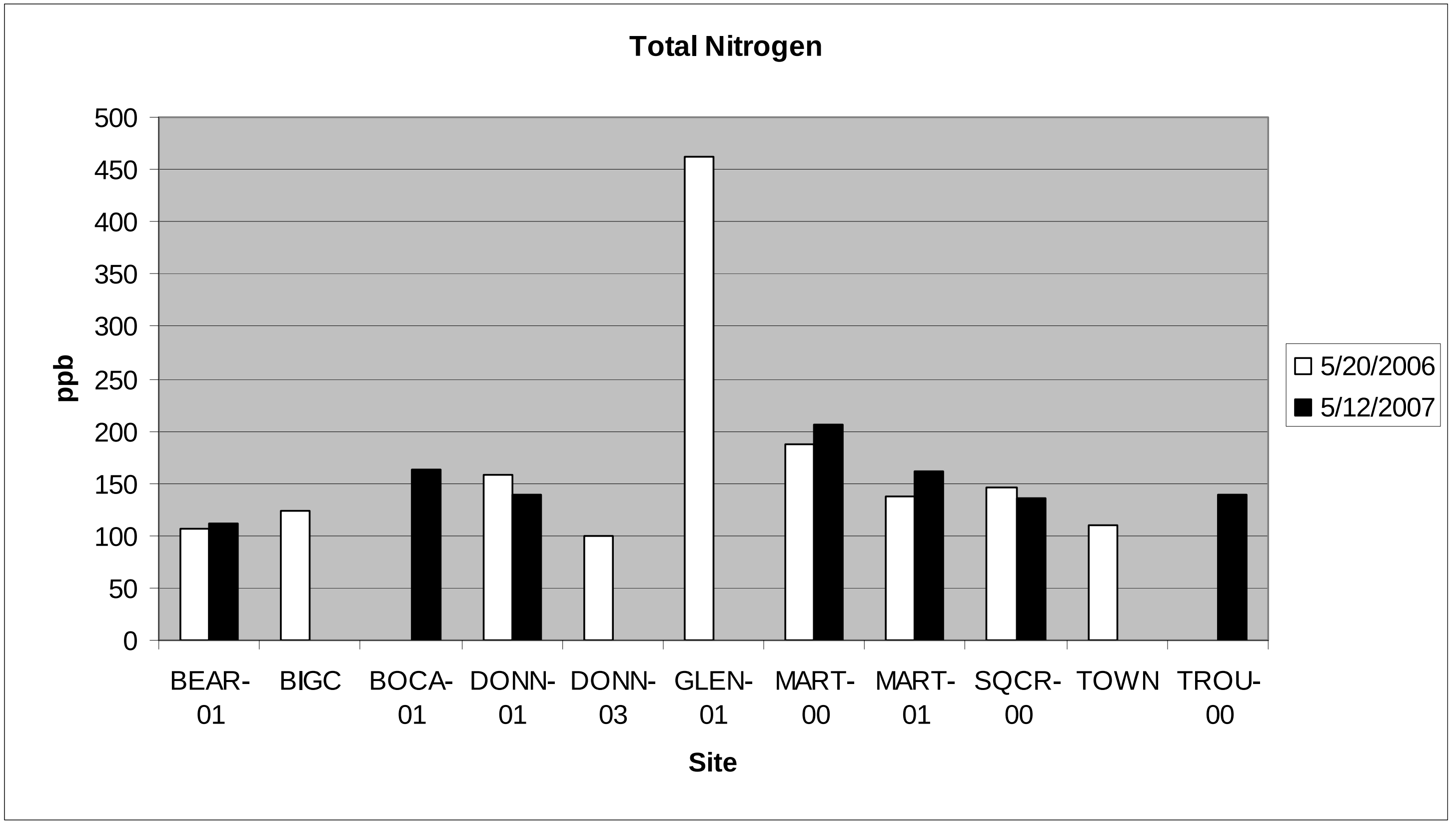

Figure 10. Total nitrogen data. Complete nitrogen data are only available from 2006 and 2007.

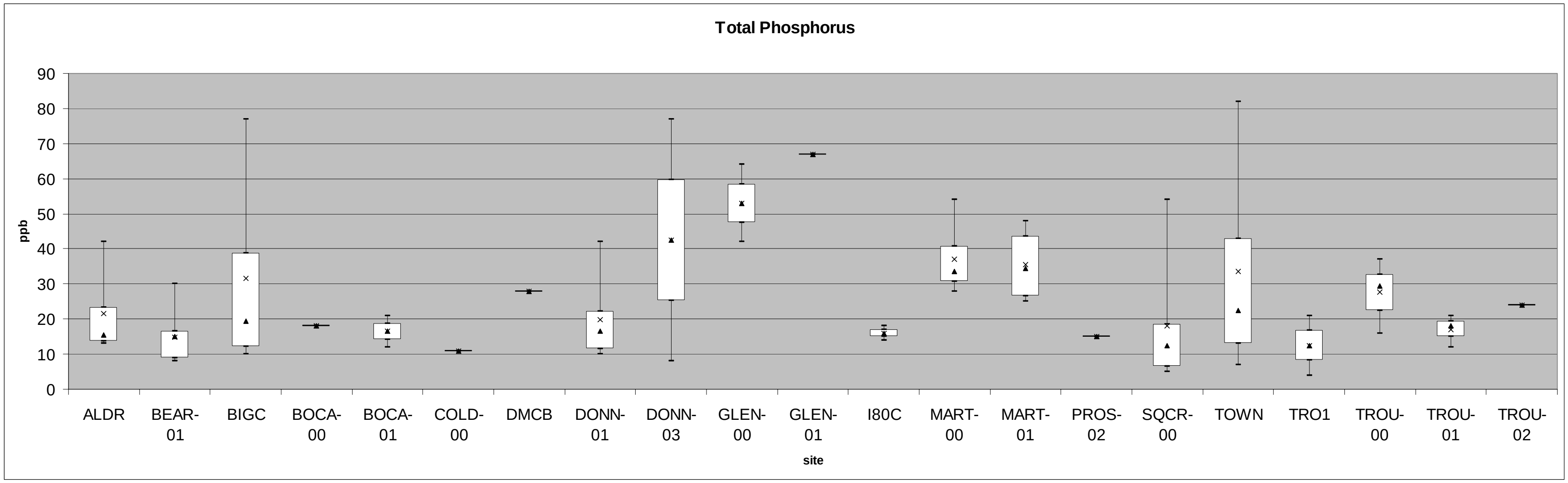

Figure 11. Total phosphorus data. All data collected during spring run-off.

Laboratory Results

Figures 9-11 show some of the results of nutrient and bacterial monitoring. These samples are processed by professional laboratories after volunteers collect grab samples in the field.

Coliform

Coliform are a group of bacteria that are mostly found in the feces of warm-blooded animals, including humans, pets, livestock, beavers, and birds. Coliform is only monitored during spring runoff, and samples are taken from only a subset of sites. Figure 9 shows the results of coliform monitoring since 2001. Most coliform monitoring has yielded measurements of "non-detect" – represented by a bar indicating 0.5 colonies/100 mL on Figure 7.

None of the samples have been dangerously high, although the Union Valley Creek (GLEN-00 and GLEN-01) consistently have measurable numbers of colonies, as does Martis Creek (MART-00 and MART-01). Union Valley Creek drains the Glenshire Pond, which has a sizeable waterfowl population. Additionally, it is a popular dog walking site. Lower Martis Creek (MART-00) is also an extremely popular dog walking site. Upper Martis (MART-01) drains a golf course, which probably attracts a large Canada Goose population. Upper Martis has only had high coliform in one year (2004), however. coliform monitoring will continue at all these sites during spring run-off.

Nutrients

Each year, samples are taken from a subset of sites during spring run-off and analyzed for forms of nitrogen and phosphorus. Nitrogen and phosphorus are necessary to support aquatic life, however high concentrations of either of these nutrients lead to declines in water quality.

Nitrogen

Nitrogen occurs in several different forms: nitrate, nitrite, ammonia, and TKN or Total Kjeldahl Nitrogen. Until 2006, funding was not available to monitor all forms of nitrogen, therefore we only have total nitrogen concentration data from 2006 and 2007. Figure 10 shows the total nitrogen data. GLEN-01 had a very high nitrogen concentration in 2006. Unfortunately the site was not monitored in 2007. This site is being added to our regular monitoring program. GLEN-01 is located on Union Valley Creek, below the outflow from the Glenshire Pond. The Glenshire Pond is extremely eutrophic.

Phosphorus

Phosphorus is also critical for stimulating algal growth in aquatic systems. Phosphorus is naturally present in the environment, particularly in volcanic rocks. Anthropogenic sources include various soaps and detergents, fertilizers, and other household chemicals. Figure 11 shows results from 2001-2007, all measurements were taken during spring run-off. High phosphorus concentrations have been found at the Union Valley Creek sites (GLEN-00 and GLEN-01), Donner Creek at Donner Lake outflow (DONN-03), and sites along the mainstem Truckee River (BIGC, TOWN). See Figure 24 and associated text for discussion of phosphorus standards.

Bioassessment Data

Figures 12-16 show some results from monitoring benthic macroinvertebrate (BMI) communities. Because taxonomic resolution affects most metrics, the data analyzed professionally and by volunteers are presented separately. See discussion in "Methods" section for explanation of differences in the analyses.

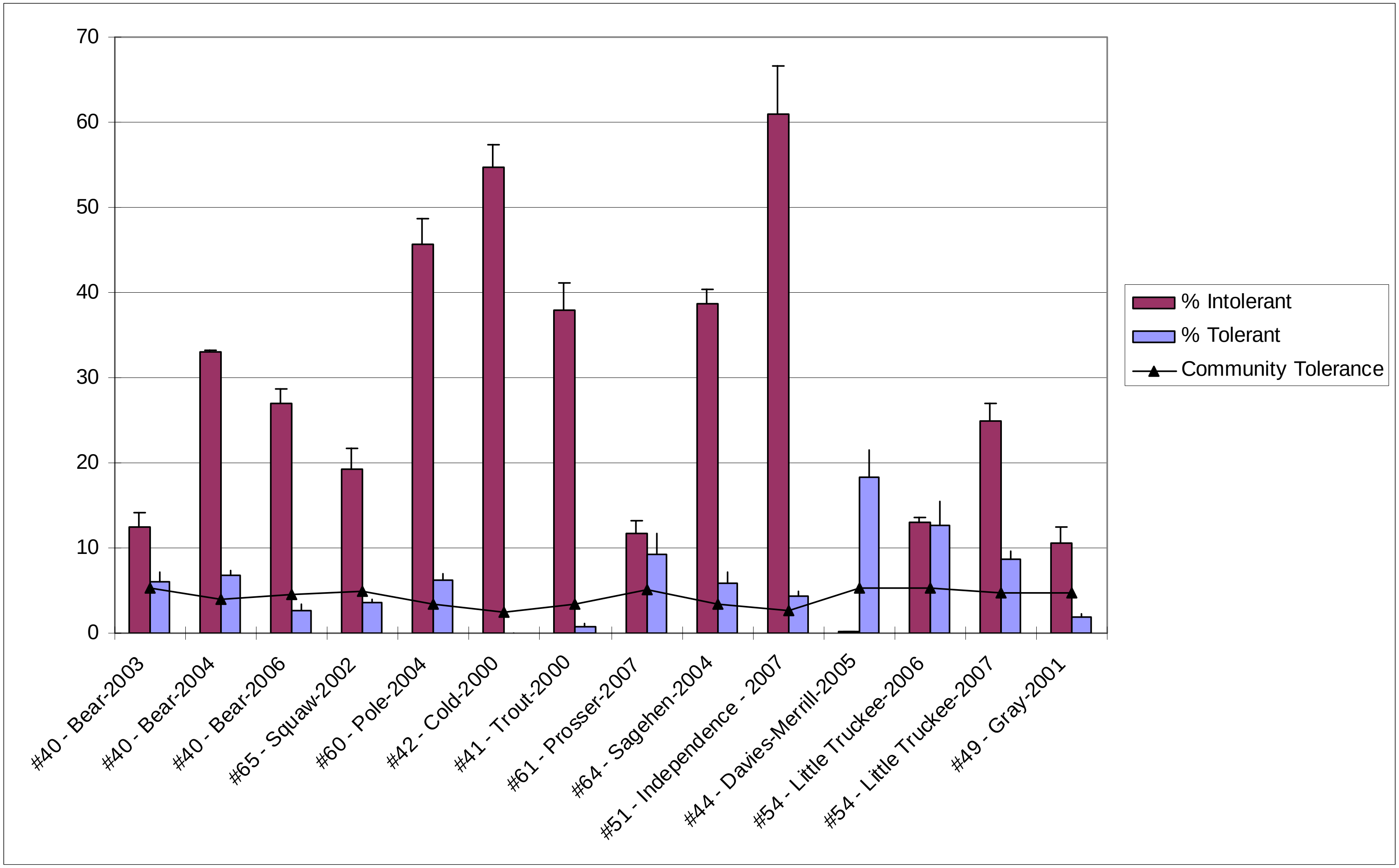

Figure 12. Measures of pollution tolerance – taxonomy done professionally. Sites organized upstream to downstream (from where tributary enters Truckee River). # corresponds to location on Figure 3. See Figure 13 for samples taken from the Martis Creek sub-basin.

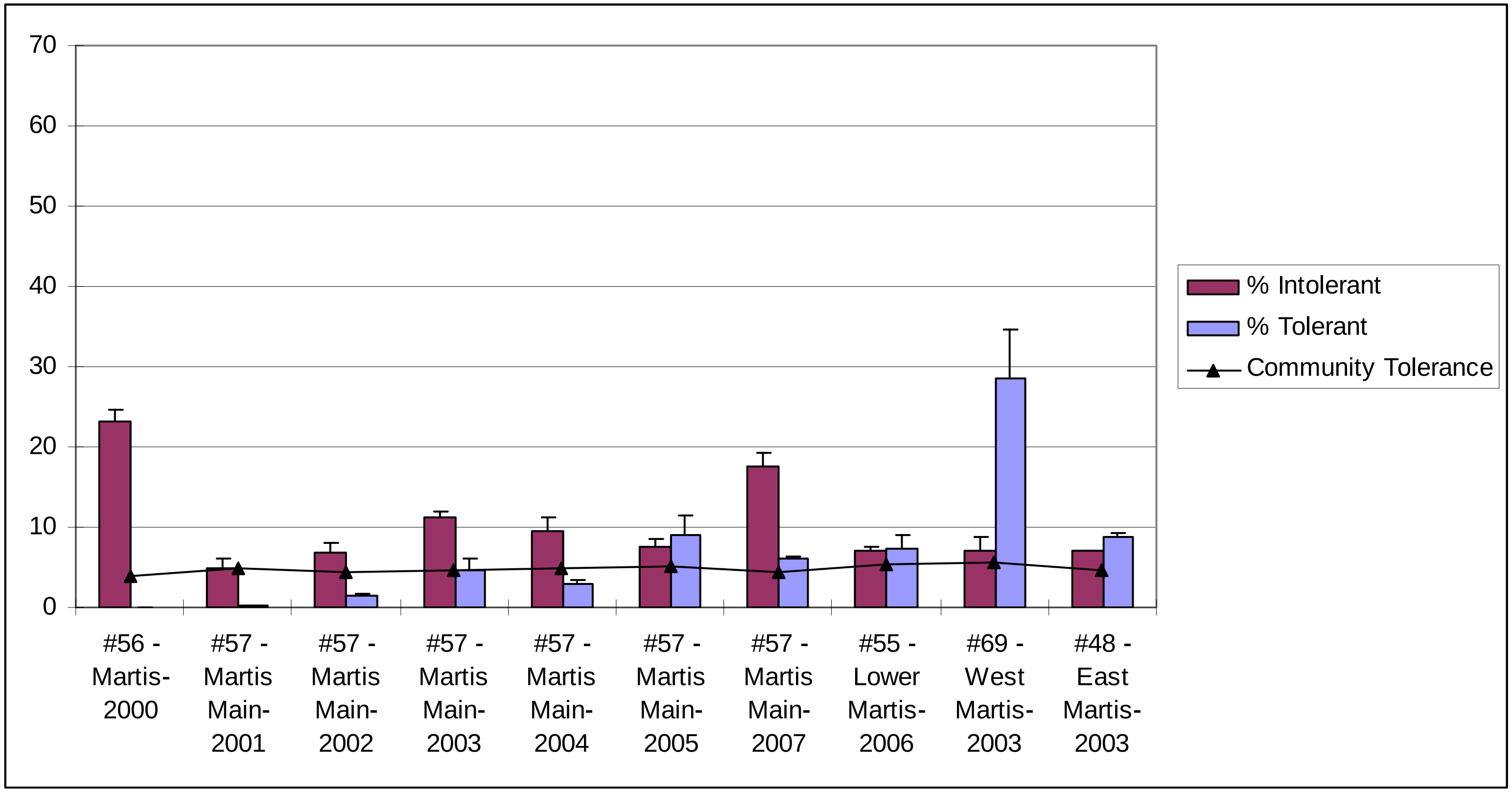

Figure 13. Measures of pollution tolerance – taxonomy done professionally. Samples taken from the Martis Creek sub-basin. # corresponds to location on Figure 3. See Figure 12 for samples taken from other sites in the Middle Truckee River watershed.

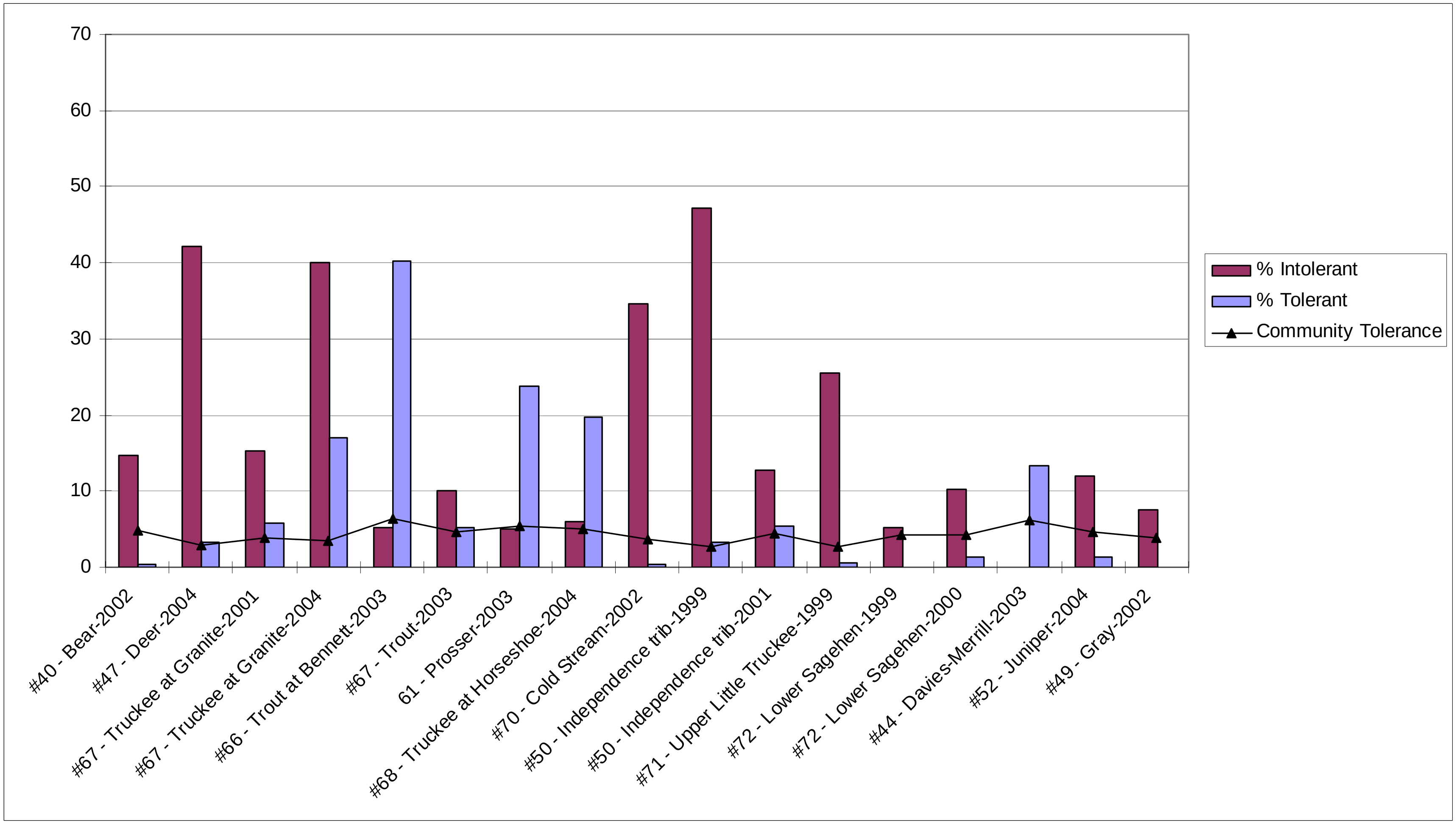

Figure 14. Measures of pollution tolerance – taxonomy done by volunteers. Sites organized upstream to downstream (from where tributary enters Truckee River). # corresponds to location on Figure 3.

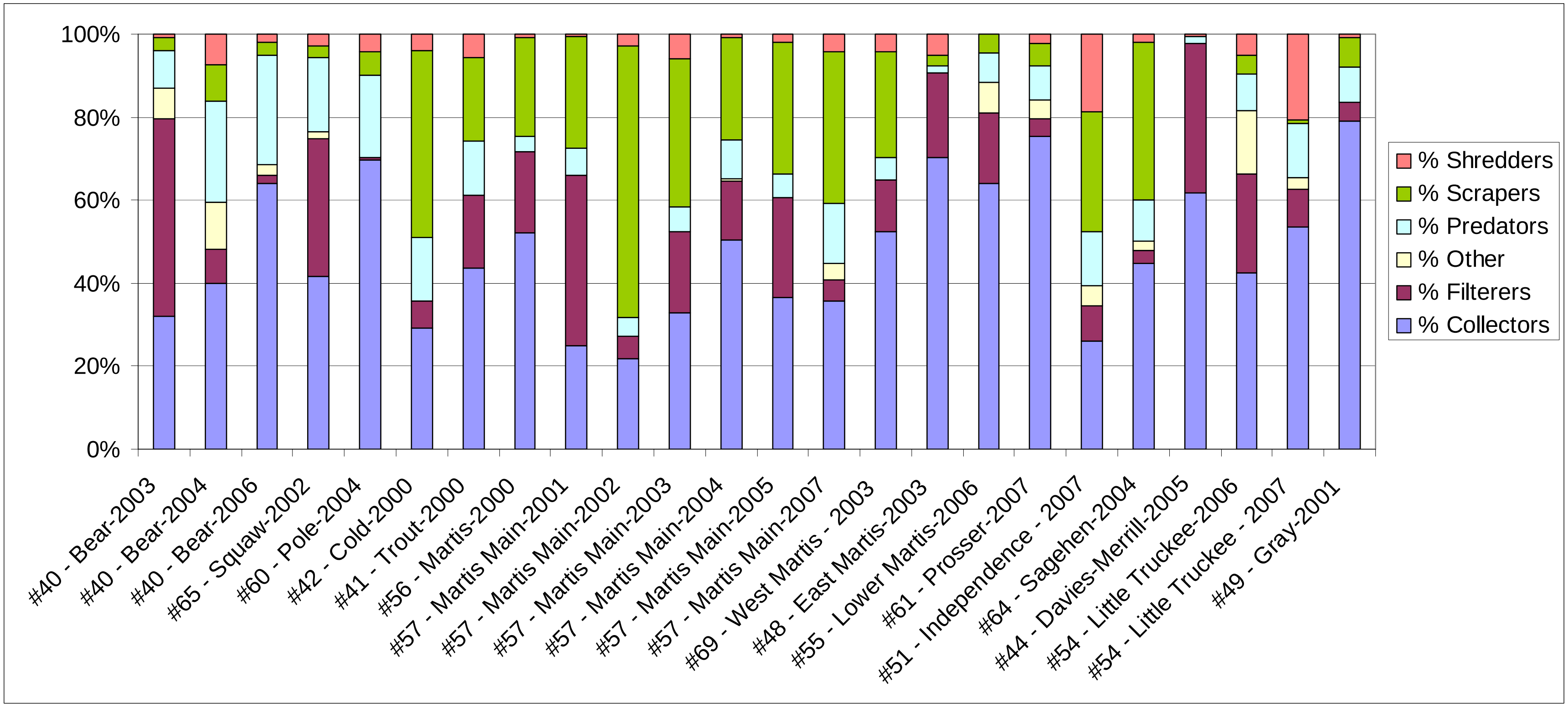

Figure 15. Functional feeding groups – taxonomy done professionally. Sites organized upstream to downstream (from where tributary enters Truckee River). # corresponds to location on Figure 3.

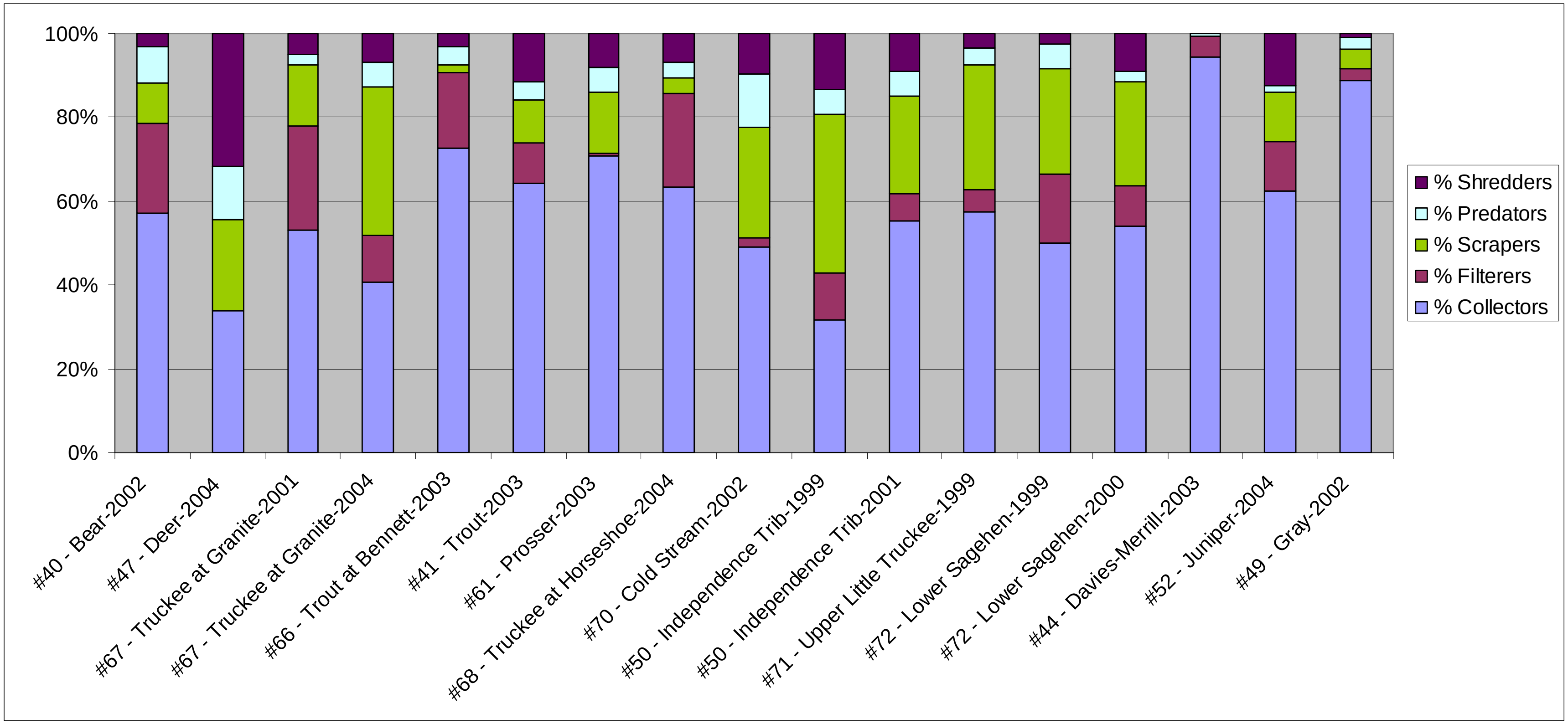

Figure 16. Functional feeding groups – taxonomy done by volunteers. Sites organized upstream to downstream (from where tributary enters Truckee River). # corresponds to location on Figure 3.

Tolerance related metrics

Figures 12-14 show % Intolerant, % Tolerant, and Community Tolerance values for streams sampled in the Truckee River Watershed. % Intolerant refers to the percent of organisms that are sensitive to pollution. Each family, genus, or species of aquatic macroinvertebrates is assigned a "tolerance value" that ranges from 0-10. If an organism has a tolerance value that is low on the scale, that means it is only able to live in high quality water. The "% Intolerant" metric is defined as the percent of the sample that is composed of organisms with a tolerance value of 0, 1, or 2.

The "% Tolerant" metric is defined as the percent of the sample composed of organisms with tolerance values of 8, 9, or 10. These are organisms that are capable of surviving in poor quality water. Typical values for the Truckee River watershed are usually 5% or less.

Community Tolerance is a composite measurement of the overall tolerance value for the stream community. It takes into account numbers of individuals and tolerance values. Lower tolerance values indicate better water quality because more organisms that are sensitive to pollution are present.

In general, Figures 12-14 indicate good water quality - % Intolerant numbers are relatively high, % Tolerant are relatively low, and Community tolerance is mostly less than 5. However, there are some notable exceptions. From Figures 12 and 13, Martis 2005, Davies 2005, Little Truckee River 2006, and Lower Martis Creek 2006 all show low % Intolerant and high % Tolerant. A large scale restoration project began on Davies Creek in the fall of 2005 (after these data were collected), so metrics should improve over time as sedimentation into the creek is decreased and habitat value is improved. Lower Martis and the Little Truckee River sites are located below dams. TRWC will continue to monitor Martis Creek, and there are some small restoration efforts underway that may help to improve aquatic habitat. A large scale watershed assessment of the Martis Creek watershed may take place in the near future that will help to identify a cohesive restoration plan.

Functional Feeding Groups.

Available food sources in a stream vary depending upon the distance from the headwaters. The River Continuum Concept addresses how this different availability of food sources will affect the types of organisms that will be found at different points along a stream. Figure 17 shows a conceptual model of the River Continuum Concept.

In headwater streams, the input of organic matter is primarily from terrestrial sources, these streams tend to be small and shaded, so very little sunlight can reach the stream to stimulate primary productivity (plant and algae growth). Leaves falling from streamside vegetation will provide the majority of the food base to these types of stream. Therefore, we predict to see many "shredders" and "coarse particulate organic matter collectors", organisms that feed off of leaves or other types of terrestrial inputs. Some grazers will be present as well as some predators.

Further down the stream in "mid-reach" sections, the streams are larger and solar radiation can reach the water. The food base becomes a mix of terrestrial and in-stream primary productivity. Aquatic plants and algae form a significant part of the food web. The types of functional feeding groups that should be found in these types of streams are primarily grazers that feed on the algae and plants, and a wider range of collectors than are seen in the headwaters. More medium and fine particulate matter is present in the mid-reach streams. Shredders are found in much lower abundance, and a small number of predators will be present.

In very large river systems (like the lower Mississippi) the energy base for the food web is primarily leakage from upstream. In these systems, fine particulate organic matter collectors dominate the species assemblage, and a small number of predators will be present.

Locally, most of our streams would be considered headwater streams. The main stem of the Truckee River would even be considered a headwater stream according to how streams are classified, but has many of the characteristics of a mid-reach stream. In the tributary streams, we should see communities that have large percentages of both shredders and collectors, with small numbers of scrapers and predators.

Figure 15 shows the percentages of functional feeding groups seen in samples analyzed by a professional laboratory and Figure 16 shows the same data for samples analyzed by volunteers. Generally speaking, most streams are dominated by collectors with low percentages of shredders. A lack of shredders often indicates that inputs of terrestrial vegetation as a food source are lacking. The percent of grazers – called scrapers on Figures 15 & 16 - should be low in our headwater streams, which is mostly the case. High levels of grazers typically indicate significant algal populations. In low water years, the grazer populations can increase.

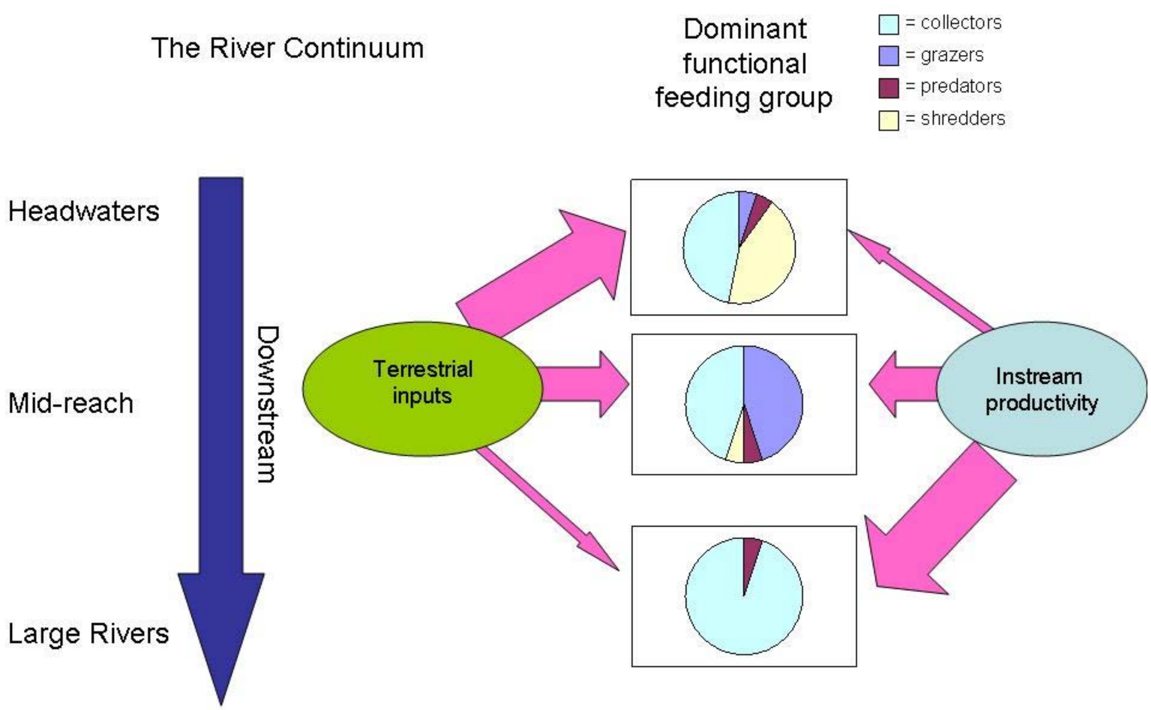

Figure 17. River Continuum Concept. Functional feeding groups of benthic macroinvertebrates change in abundance from headwater streams down to large rivers.

Monitoring Program Objectives

In developing the Adopt a Stream program, the Truckee River Watershed Council developed a series of monitoring objectives, which were refined with assistance from the Sierra Nevada Alliance. Because this is the first year of the developed program, much of our data collected relating to specific objectives is "baseline" or current condition data. Over time, as our focused data collection efforts increase, we will be better able to address our stated monitoring objectives.

In this report, we will address each of our monitoring objectives with data collected thus far.

Objectives:

1. To better understand and document the relationship between water quality, hydrologic function, river system management, and land use.

2. To identify land use practices that negatively impact the Truckee River watershed, the extent of impact, and the geographic locations of concern.

5. To provide documentation linking water quality problems to land use practices in the Truckee River watershed.

Objectives 1, 2, & 5 are focused on trying to understand how different land uses may be affecting different water quality parameters. They are broadly stated, so in this report we will try to look at specific aspects of how we can use our data to attempt to understand these relationships.

One land use change that is occurring in the Truckee River watershed is increased urbanization. The urban areas are fairly concentrated in a handful of sub-basins: Bear Creek, Squaw Creek, Donner Creek, and Trout Creek (Figure 18). Urbanization is predicted to affect some ambient parameters more than others. In particular we expect to see:

- Increased temperature in more urbanized areas because of lack of streamside vegetation
- Increased electrical conductivity in more urbanized area because of influences of roads and urban run-off
- Increased turbidity in more urbanized areas because of increased erosion

Temperature, turbidity, and conductivity are all fairly sensitive to flow, so the data have been broken out into high flow and low flow sampling events. Because of the history of our monitoring program, there are more high flow data available than low flow data.

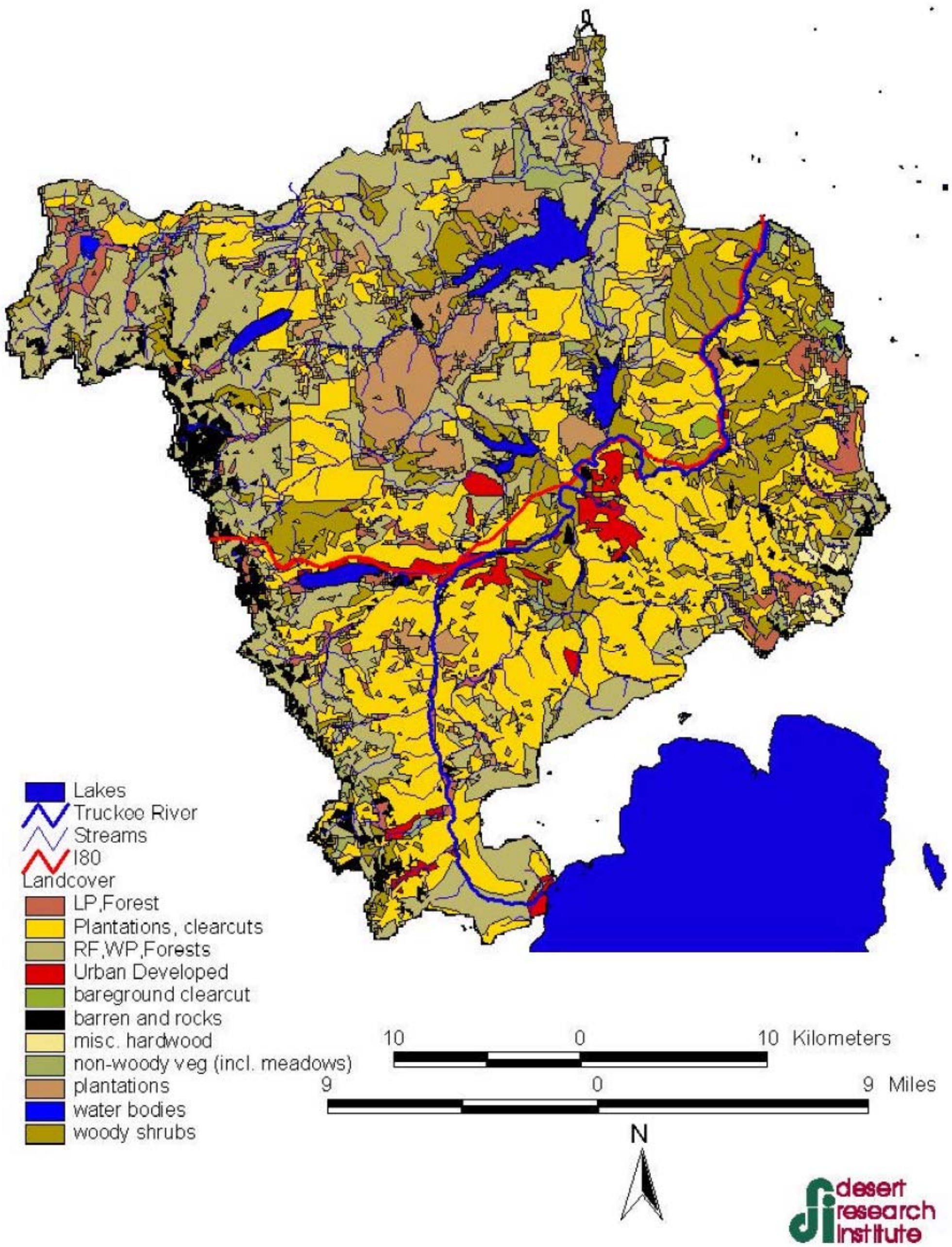

Figure 5. Land cover data layer.

Figure 18. Land cover map, taken from McGraw, et al., 2001.

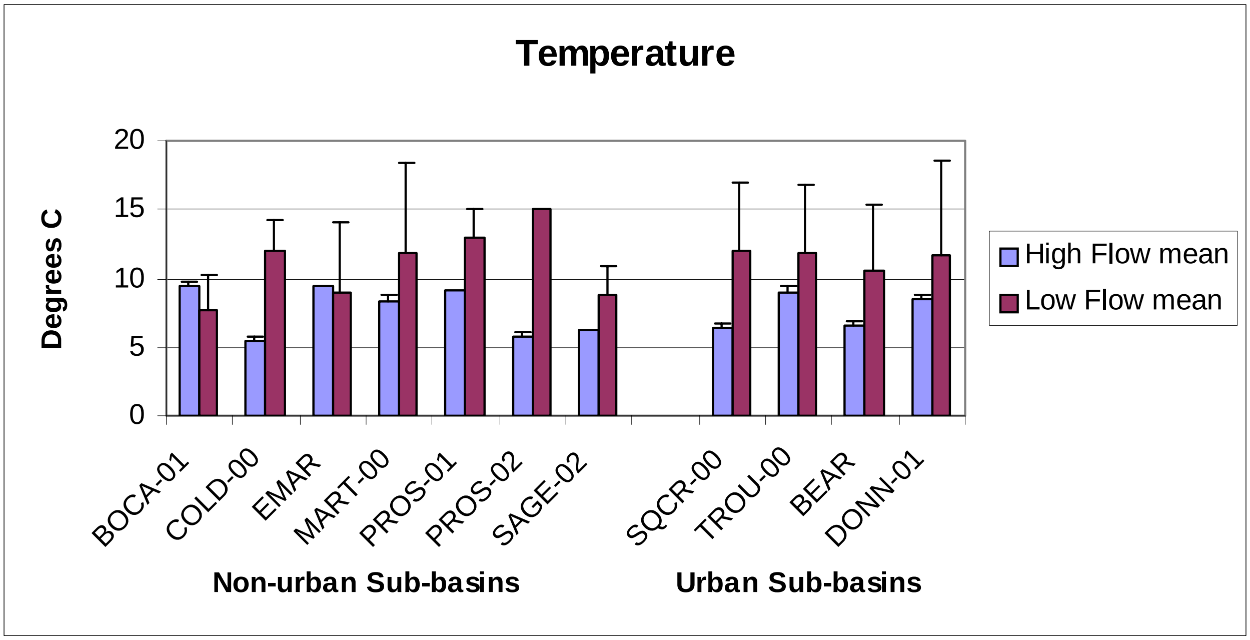

Figure 19. Water temperature for non-urban and urban sub-basins, separated by time of year.

There are not data available for all streams for both high and low flow times of year – therefore data from only a subset of monitored streams are shown in Figure 19. There does not appear to be any difference between the non-urban and urban streams. The difference in water temperature would probably be most apparent during low flow times of year. Additionally, there are many differences between these watersheds other than degree of urbanization that would be expected to affect water temperature.

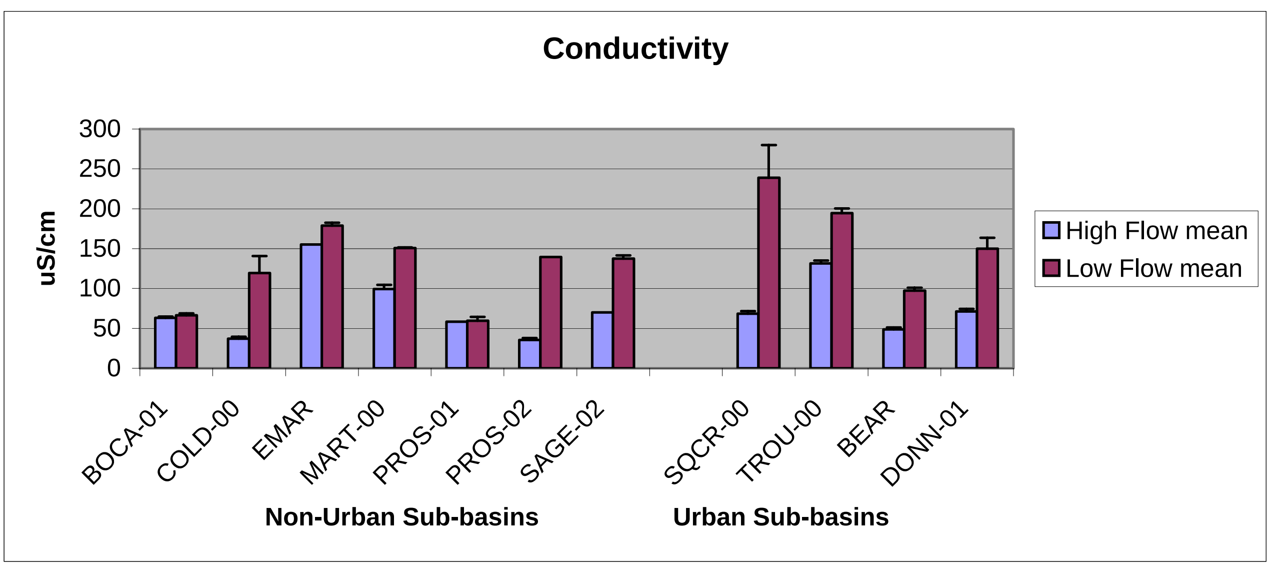

Figure 20. Electrical conductivity for non-urban and urban sub-basins, separated by time of year.

Urban run-off tends to cause increases in electrical conductivity, particularly from road salt and sand. Conductivity is also greatly affected by flow – as flow decreases the concentration of ions increases. Therefore we expect to see higher conductivity levels during low flow times of year.

Overall, this does seem to be the case (Figure 20). There is not a clear difference between urban and non-urban streams.

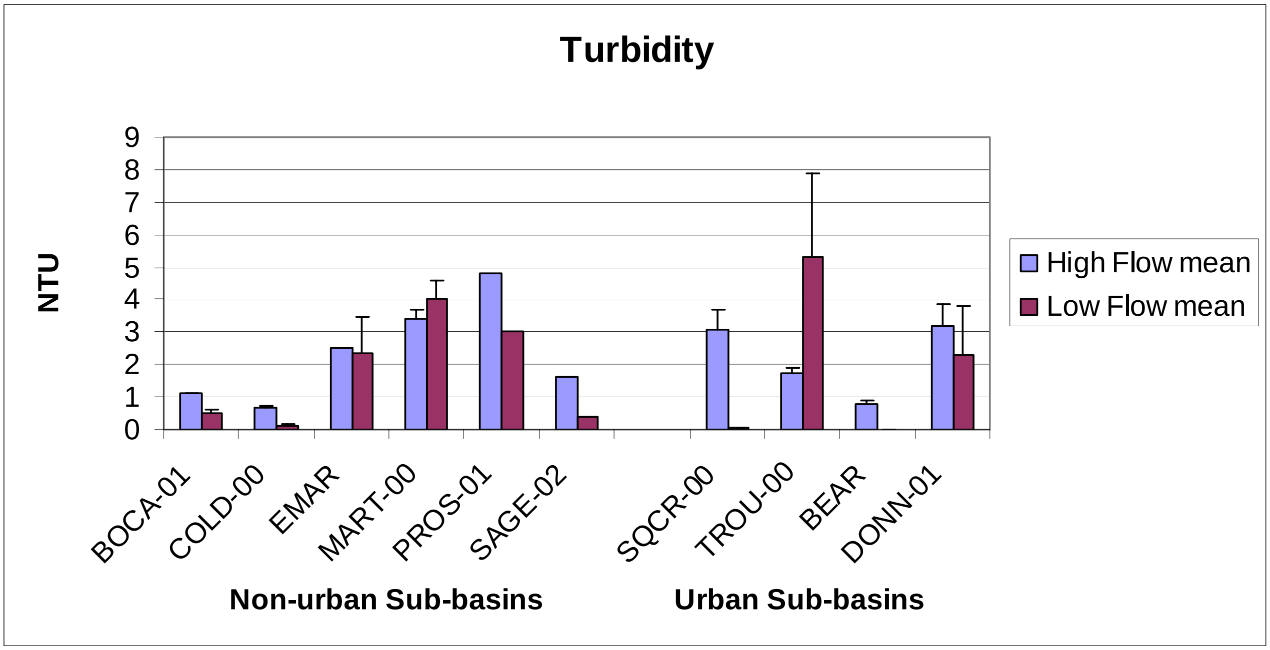

Figure 21. Turbidity for non-urban and urban sub-basins, separated by time of year.

Turbidity tends to be higher during high flow events because more fine particles are stirred up when creeks are running high. There is not a clear difference between non-urban and urban watersheds in turbidity measurements (Figure 21). There is also not necessarily a clear relationship between flow and turbidity levels.

Urban vs. Non-Urban summary

There are not clear differences between the urban and non-urban monitoring sites for temperature, electrical conductivity, or turbidity as seen in our data. The lack of difference may be due to the fact that we do not yet have a very large low flow data set, which is when we may be more likely to see differences in these parameters. Urbanization will increase in these watersheds, so we will continue to monitor these sites. However, new development will be subjected to stricter stormwater management than older developments, and the goal of regulation is to protect water quality.

Objective:

1. To better understand and document the relationship between water quality, hydrologic function, river system management, and land use.

Relating back to Objective 1, another land use that we are tracking is the change in watershed condition that is achieved through restoration projects. Most of our restoration projects are either in the planning phase or in very early implementation. Therefore, we are looking at the data collected thus far as baseline or pre-project data. The majority of restoration projects are aimed at reducing fine sediment. Because we are interested in improving aquatic habitat through restoration, bioassessment data will be a good indicator of whether or not our restoration goals are being achieved.

Table 5. Sub-basins targeted for restoration, restoration goals, and metrics expected to improve after restoration.

Sub-basin	Restoration Goals	Metrics to monitor
Upper Little Truckee River (Perazzo Meadows)	Reduce erosion, improve meadow and riparian habitat	% Chironomidae, % Baetidae, Community Tolerance, water temperature
Trout Creek	Reduce erosion, improve riparian habitat, reduce flood risk	% Chironomidae, % Baetidae, Community Tolerance, water temperature
Prosser Creek below Prosser Dam	Improve aquatic habitat	Temperature
Davies Creek	Reduce erosion, improve meadow and riparian habitat	% Chironomidae, % Baetidae, Community Tolerance, water temperature
Cold Creek	Reduce erosion	% Chironomidae, % Baetidae, Community Tolerance, water temperature
Squaw Creek	Reduce erosion, improve meadow, aquatic, and riparian habitat	% Chironomidae, % Baetidae, Community Tolerance, water temperature, dissolved oxygen

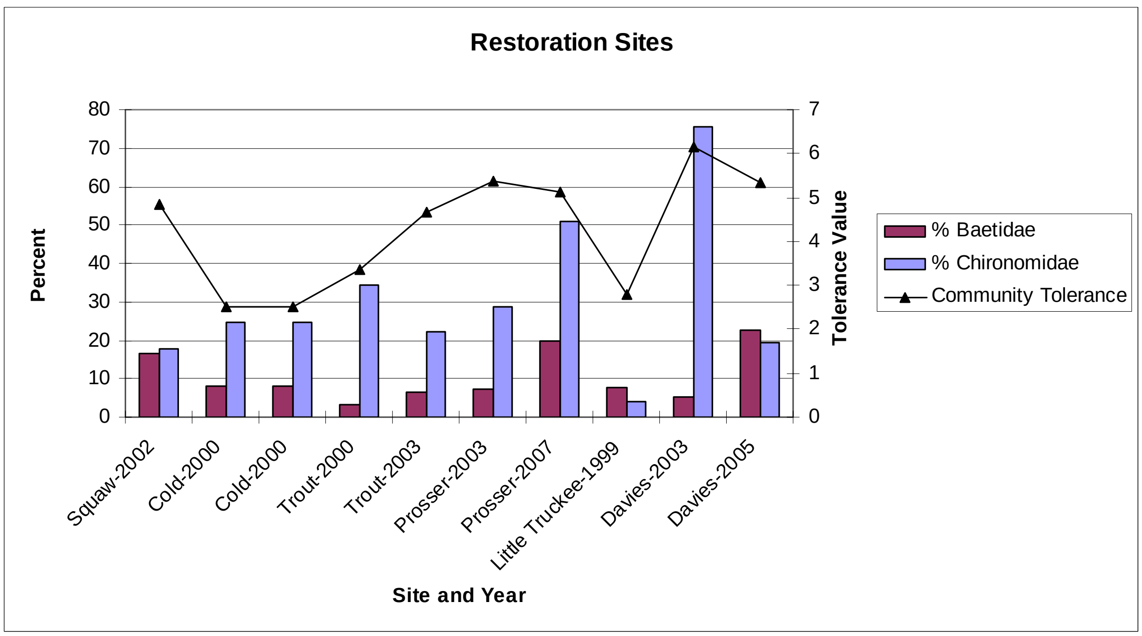

Figure 22. Bioassessment data from streams targeted for restoration – sediment related metrics.

Mayflies in the family Baetidae and true flies in the family Chironomidae can persist in streams that have an abundance of fine sediment. In the Truckee River watershed it has been found that abundance of these families of insects decreases as the level of fine sediment in a stream decreases. Therefore, these are important metrics to track to determine if a biologically significant decrease in fine sediment is being achieved by restoration actions.

Community tolerance is a good overall metric that collapses data about how “tolerant” the overall condition of the biological community. We would expect that community tolerance would decrease as stream condition improves with restoration activities.

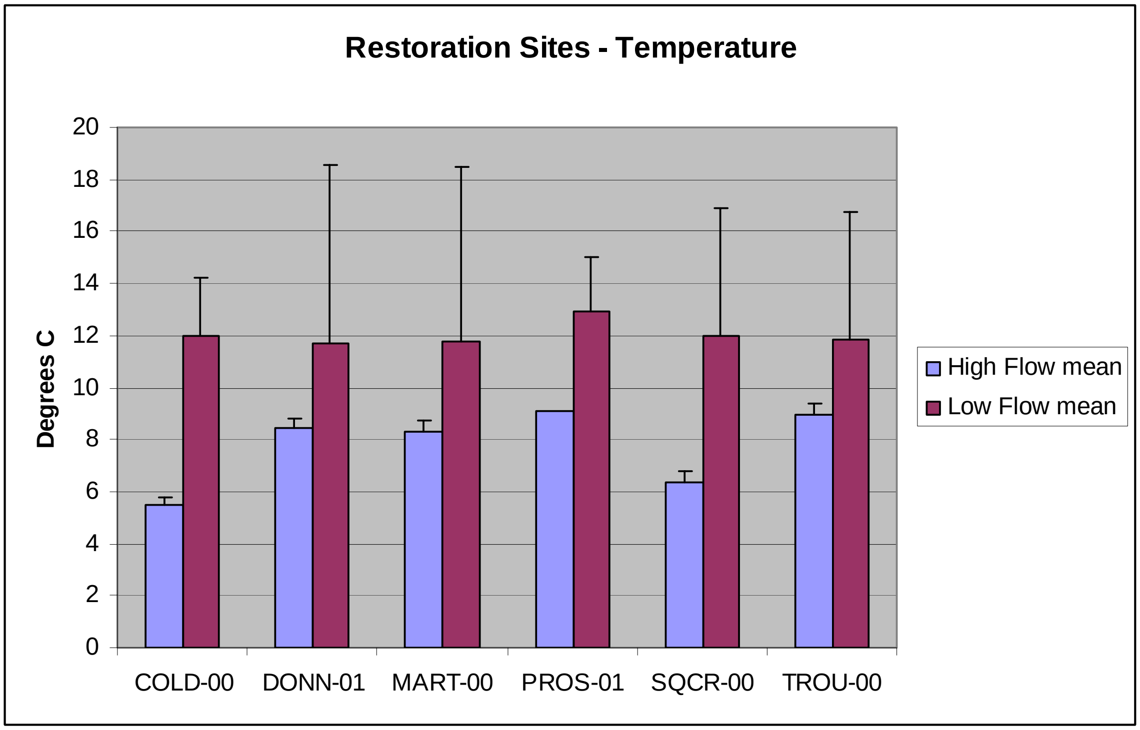

Figure 23. Water temperature data for streams targeted for restoration. DONN-01 is included because restoration work in Coldstream Canyon (COLD-00) should affect this site as well.

Temperature should be affected by restoration actions. Fine sediment increases water temperature as it absorbs heat. Reducing erosion should lead to a decrease in water temperature at restoration sites. Any increases in streamside vegetation will increase shading, leading to a decrease in water temperature. These data will be compared to post-project data in the future.

Objective:

2. To identify land use practices that negatively impact the Truckee River watershed, the extent of impact, and the geographic locations of concern.

At present, the best way to address Objective 2 is to look for “hot spots” or areas that exhibit poor water quality in more than one aspect. This will help us to pin-point locations of concern, and we may be able to then identify the causes of poor water quality.

Union Valley Creek (from Glenshire) consistently shows elevated nutrients – nitrate, soluble reactive phosphorus, and total phosphorus. It has also had positive results for coliform bacteria. This stream drains the Glenshire Pond which is a shallow eutrophic body of water in the subdivision of Glenshire. This stream will be added to our quarterly monitoring program in 2008.

Squaw Creek has had consistently high nitrate levels, and has had a high phosphorus reading. A sediment TMDL has been developed for this stream, but continued monitoring of other constituents such as nitrogen concentration should continue. The stream runs through a ski area, parking lot, and golf course, although the golf course is under very strict management for fertilizer application.

Martis Creek has shown slightly elevated soluble reactive phosphorus at both monitoring stations. Additionally, total phosphorus at the lower station has consistently been high. This sampling site is just above where Martis Creek enters Martis Lake. There have been concerns over nutrient levels in the lake, particularly phosphorus. A preliminary study of phosphorus in the Martis watershed was undertaken by the Truckee Tahoe Sanitation Agency, however it was determined that further study was necessary. Currently, a comprehensive water quality monitoring plan for Martis Valley is being developed by Placer County. Nutrient monitoring should be incorporated into this plan.

Objective:

3. To engage and educate residents about local watershed processes and strengthen their understanding of watershed stewardship.

Over 80 volunteers participated in the monitoring program in 2007 and 2008. Thirty volunteers have committed to regular monitoring of a stream and 10 have committed to regular participation in the bioassessment team. Education is stressed at monitoring trainings and events and the level of awareness among participants has increased.

Objective:

4. To enhance the quality and quantity of data available for resource managers and decision makers in the Truckee River watershed.

The Town of Truckee and Placer County are in the process of developing water quality monitoring plans for portions of the Truckee River watershed. The Truckee River Watershed Council is participating in the citizen's advisory committee and is providing data to the Town to assist in their development of the new monitoring program.

Objective:

5. To provide documentation linking water quality problems to land use practices in the Truckee River watershed.

To address this objective, we looked at how our data compare against established water quality standards. The easiest standards to compare against are those established for nutrient concentrations.

Table 6. California State Water Quality Objectives for the Truckee River Hydrologic Unit

Surface Water	Site ID	Total P (µg/L)	NO3-N (µg/L)	Total N (µg/L)	TKN (µg/L)
Trout Creek at Mouth	MTR-TROU-00	40	50	150	100
Squaw Creek at Mouth	MTR-SQCR-00	20	50	180	130
Bear Creek at Mouth	MTR-BEAR	20	50	150	100
Truckee River at Lake Tahoe outlet	MTR-TR01	10	20	120	100

The selected standards shown in Table 6 are taken from the Lahontan Regional Water Quality Control Board Basin Plan for the Truckee River watershed.

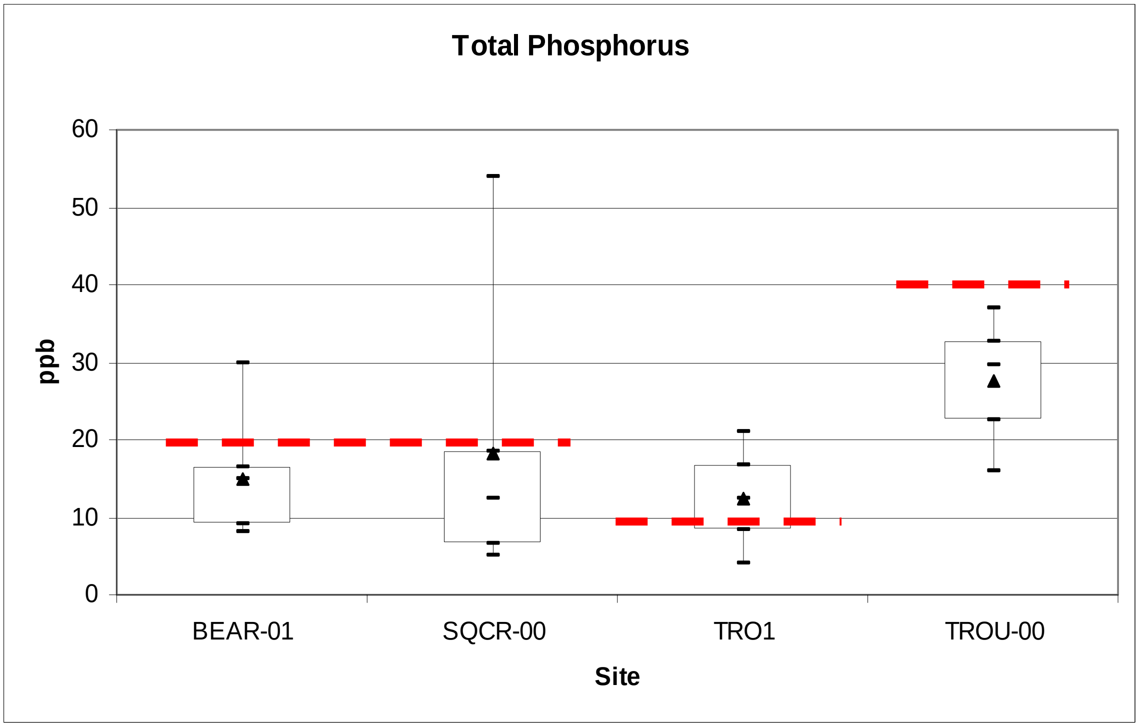

Figure 24. Total phosphorus for streams with established standards, indicated by the red dashed lines.

As can be seen in Figure 24, Bear Creek, Squaw Creek and the Truckee River at Tahoe City have all exceeded the state standard for phosphorus during at least one monitoring event.

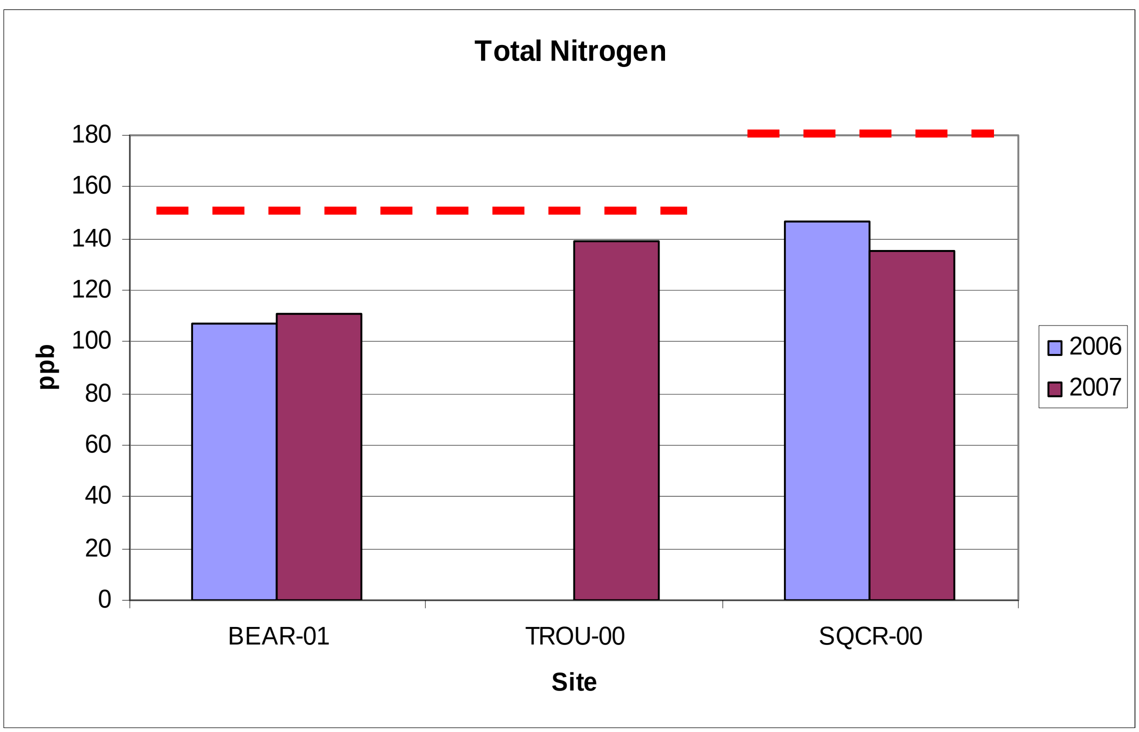

Figure 25. Total nitrogen for streams with established standards, indicated by the red dashed lines.

Total nitrogen data are only available from 2006 and 2007. During these years, none of the streams monitored exceeded their established standards.

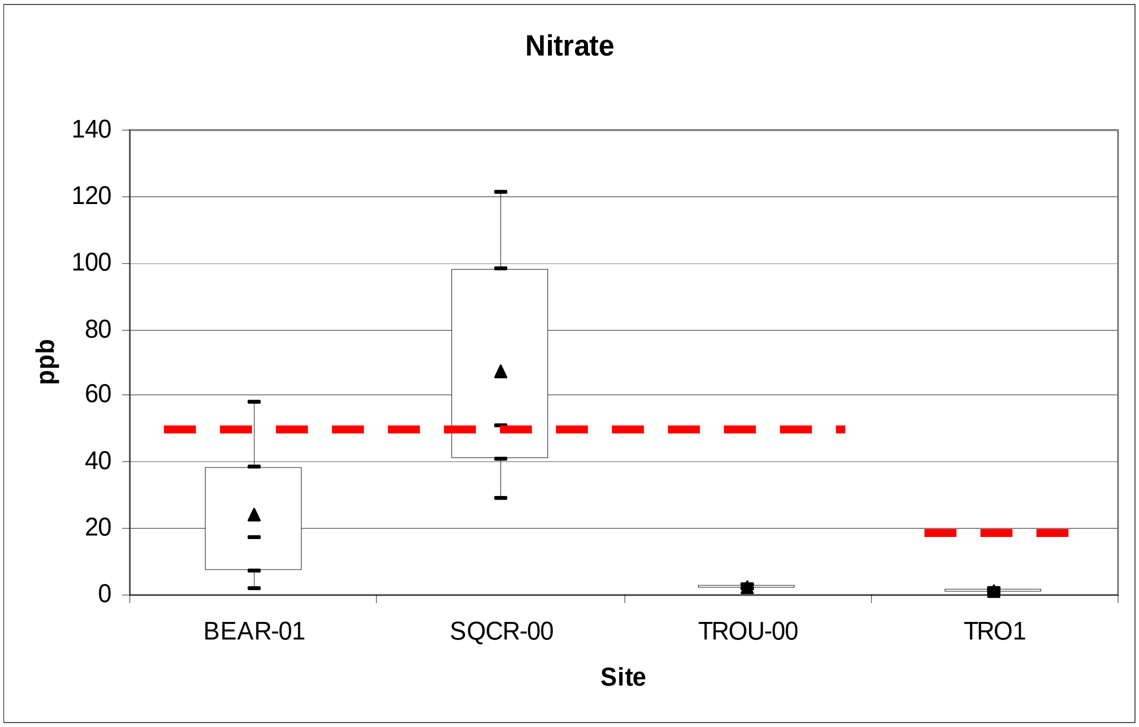

Figure 26. Nitrate for streams with established standards, indicated by the red dashed lines.

Nitrate has been monitored since 2001 in the Middle Truckee River watershed. Both Bear Creek and Squaw Creek have exceeded their established standards during this time period.

These streams will be continued to be monitored. Implementation of the Squaw Creek TMDL may help to reduce exceedances of State Standards for nutrients. Additionally, restoration is planned for Squaw Creek although it is likely to be several years before implementation.

6. To provide data that can be used to help monitor the implementation of the Truckee River sediment TMDL.

The Truckee River Watershed Council recently received Proposition 50 grant funding to help implement monitoring in support of the Truckee River sediment TMDL. This program will be developed over the next several months and will include our existing monitoring efforts to the extent possible.

Objective:

7. To collect data to help provide pre-TROA implementation data, and to establish a program that will help to track changes in the condition of biological resources in the Truckee River watershed once TROA is implemented. (TROA sites)

The Truckee River Operating Agreement (TROA) is a plan for river management that is currently under environmental review. TROA will have affects on dam operations in the Middle Truckee

River watershed and one of the goals of TROA is to improve aquatic habitat in the river. There is a Biological Resources Monitoring Plan (BRMP) that has been developed with several stakeholders to monitor the impacts of TROA on biological communities in the river. TRWC was approached by member of the BRMP team to assist with BMI monitoring. Therefore, we have begun to collect data from sites below dams that will be affected by TROA. The dams included in TROA are: Lake Tahoe, Donner Lake, Prosser, Boca, and Stampede. Martis dam is not part of TROA.

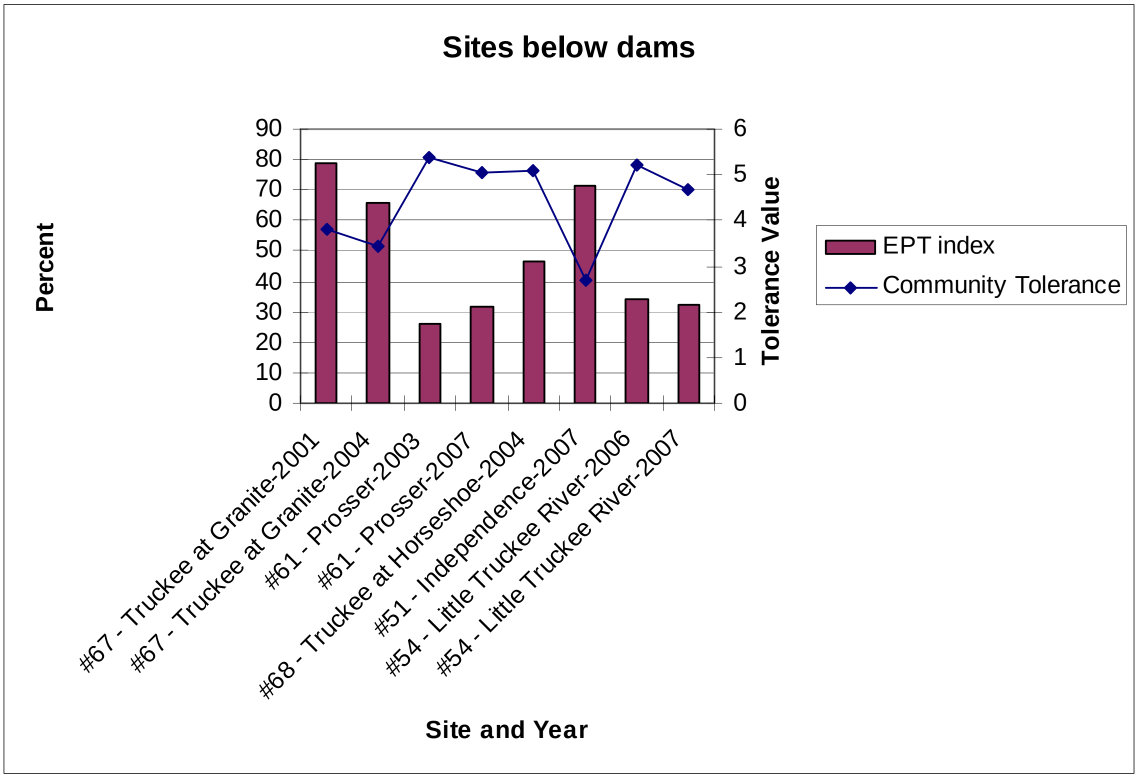

Figure 27. Community composition data for sites below dams.

One commonly used metric of community composition is the “EPT Index”. This metric is simply the percent of the sample composed of insects in the order Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Organisms in these orders tend to be less tolerant of poor water quality than other taxa. Additionally, this metric can be compared using both professionally and volunteer identified data. Community tolerance is also a good metric for looking at the overall biotic condition of the stream. Some of these below-dam sites are in fairly good condition based on these metrics, with the exception of Prosser Creek and the Little Truckee River.

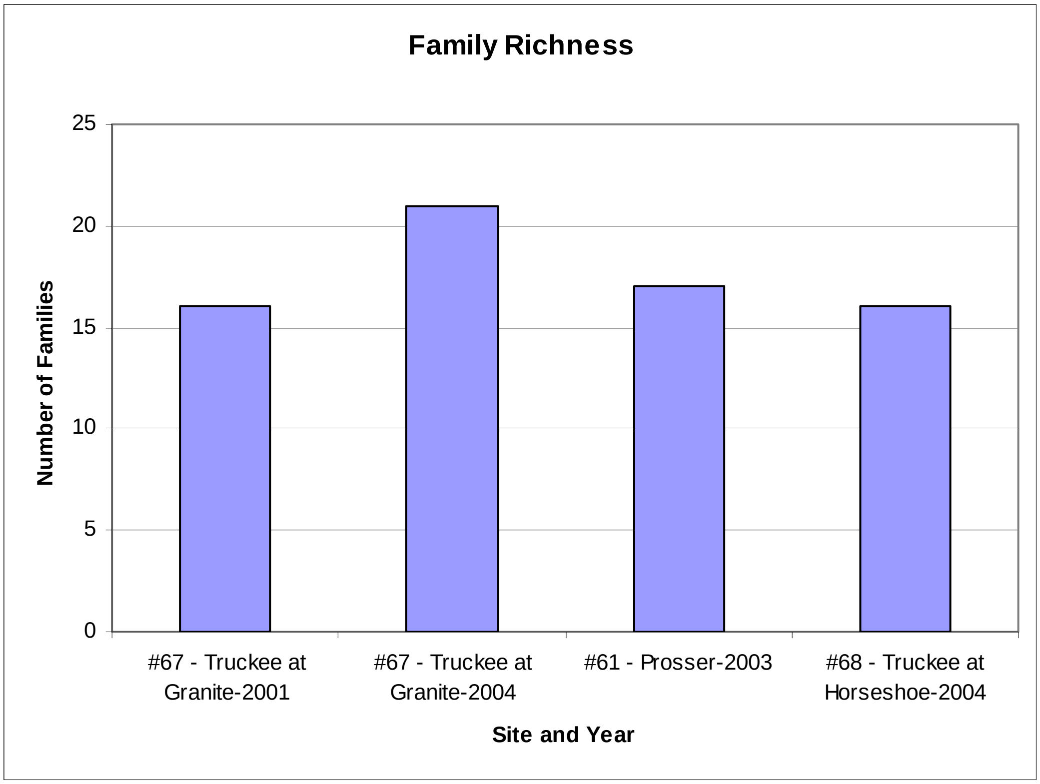

Figure 28. Taxonomic richness – data analyzed by volunteers.

Community richness is another metric that is a good indicator of ecosystem function. A more diverse community is typically more robust. One of the goals of the Truckee River Operating Agreement (TROA) is to ensure that dam operations have a minimal effect on biological resources in the Truckee River. Therefore, we would expect that family richness in streams or river segments most directly affected by dams would increase after TROA is implemented. Because of the differences in taxonomic resolution and number of organisms counted, volunteer and professionally identified samples are not easily compared.

Conclusion

In general, our monitoring data indicate that the overall condition of the Middle Truckee River watershed is fairly good. However, there are some reasons for concern as discussed in this report. The good news is that there is significant citizen interest in participating in water quality monitoring in our watershed. We anticipate being able to sustain and grow our current monitoring program. As we continue to monitor against our objectives, we will be able to build a robust data set to better understand our watershed.

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