19th Annual Snapshot Day Report

A Lake Tahoe Basin and Truckee Watershed Citizen Monitoring Event

(May 17 & 18, 2019)

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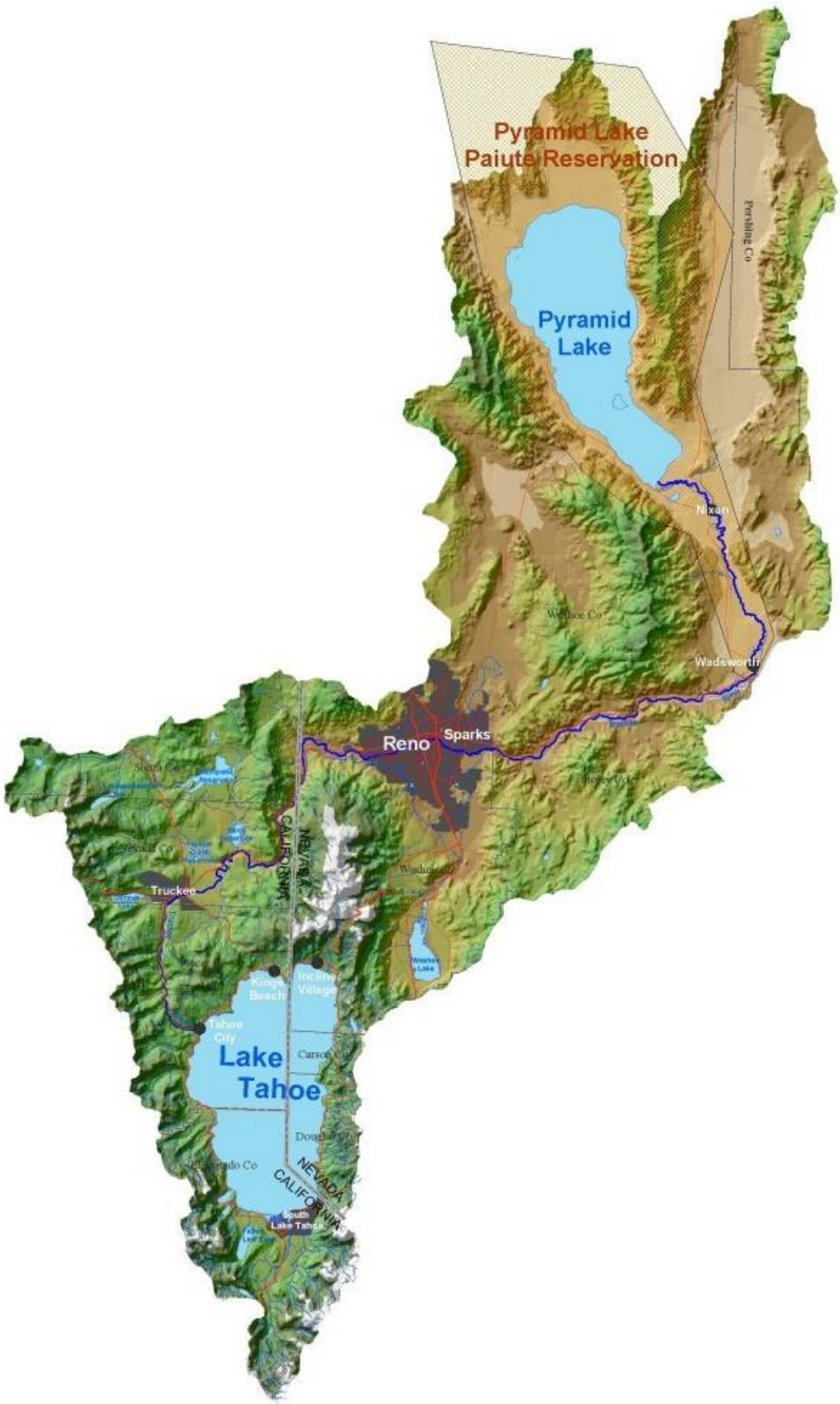


Figure 1: Truckee River Watershed from Lake Tahoe, CA, to Pyramid Lake, NV.

Introduction

What is Snapshot Day?

Snapshot Day is a one-day, volunteer-based event designed to collect data indicating watershed health at a single point in time. In small teams, community volunteers visit various pre-determined sites to collect water samples and water quality data. The sampling area includes the Truckee River Watershed, from south of Lake Tahoe to the terminus at Pyramid Lake. The 19th Annual Snapshot Day was held on May 17, 2019, in the Lower Truckee River region and May 18, 2019, in the Middle Truckee River and North and South Lake Tahoe regions. Snapshot Day is sustained by support from dedicated staff, the funding of a few grants and donations, and by hundreds of citizens who value the public involvement to protect the watershed they live in. It is important to note that citizen monitoring is designed to supplement existing agency monitoring efforts. All information is provided to the regulatory and resource management agencies whose responsibility it is to protect water quality in the Truckee River Watershed.

What are the objectives of Snapshot Day?

While there is a great deal of high-quality agency and university-sponsored monitoring taking place in the Tahoe-Truckee region, there is still insufficient information to assess the status of all aquatic resources in the Truckee River Hydrologic Unit, which includes the Lake Tahoe Basin and the Truckee River Watershed. With proper training and quality assurance, community members can help fill this void by providing valuable information for watershed management and pollution prevention.

The primary goals of this effort are two-fold:

1. Promote environmental education and stewardship.
2. Collect valuable water quality information.

Regarding collecting water quality data, this effort aims to:

- Screen for water quality problems, including the identification of sources of pollution and detection of illegal activities (e.g., chemical spills, filling of wetlands, diversions, illicit discharges, destruction of stream environment zones (SEZs), non-compliance with ordinances or regulations in place to protect natural resources, etc.);
- Provide water quality data that may be compared to water quality standards set by the TRPA for the Tahoe Basin and the States of California and Nevada;
- Provide water quality data that may be used in status and trend analyses; and
- Provide some pre- and post-project data for evaluating the effectiveness of restoration activities.

Snapshot Day 2019

2019 Event Summary

Snapshot Day provides an annual opportunity to highlight the contributions of community science to maintaining the environmental health of the Tahoe-Truckee region. Snapshot Day 2019's data analyses demonstrate good water quality overall for the Tahoe-Truckee watershed. Most samples collected met the standards set for the region and some water quality parameters such as turbidity and dissolved oxygen content were in fact lower than at the previous year's event.

In 2019, Snapshot Day reached its 19th anniversary for the Truckee-Tahoe region. It remains one of the longest-running citizen watershed monitoring events on the West Coast of the United States. Snapshot Day continues to highlight successful engagement with the public in active watershed stewardship while providing valuable data to the responsible agencies. As previous data sets are compiled and data storage is improved, this program can show long-term trends and better assist agencies in watershed conditions analyses.

Volunteers and Locations

Snapshot Day 2019 was a collaborative effort between the North Shore Lake Tahoe, South Shore Lake Tahoe, Middle Truckee River near the town of Truckee and Lower Truckee River from the Nevada Stateline to East of Sparks, NV. Table 1 summarizes the number of volunteers and sites per region at Snapshot Day 2019. The tributaries sampled for each region are found in Table 2. A complete list of site names and codes for Snapshot Day 2019 can be found in Appendix B.

Table 1: Number of volunteers and sites visited on Snapshot Day 2019.

	Volunteers	Sites
South Shore Lake Tahoe	90	34
North Shore Lake Tahoe	21	14
Middle Truckee River	33	23
Lower Truckee River	139	5
Totals for 2019	**283**	**76**

This collaborative effort was sponsored by the Incline Village General Improvement District (IVGID), the Tahoe Water Suppliers Association (TWSA), the League to Save Lake Tahoe, the Truckee River Watershed Council (TRWC) and the Nevada Division of Environmental Protection (NDEP). For an expanded list of involved organizations, resource partners and education partners, please see Appendix A.

Snapshot Day is a bi-state event and as such falls under two statewide citizen monitoring programs: the California State Regional Water Quality Control Board's (SWQCB) *Clean Water Team*, (http://www.swrcb.ca.gov/water_issues/programs/swamp/cwt_volunteer.shtml); and the Nevada Division of Environmental Protection water and education outreach activities (https://ndep.nv.gov/water/rivers-streams-lakes/water-education-and-outreach/snapshot-day). Through this bi-state collaborative, Snapshot Day can achieve a larger watershed approach to successful data collection.

Table 2: A list of tributaries visited per region at Snapshot Day 2019.

Lake Tahoe Tributaries, South Lake Tahoe Region	
Angora Creek	Lake Tahoe
Bijou Drainage	Meeks Creek
Burke Creek	North Zephyr Creek
Cold Creek	Tallac Creek
Edgewood Creek	Taylor Creek
Fallen Leaf Lake	Trout Creek
Heavenly Creek	Upper Truckee River
Tahoe Keys	South Zephyr Creek
Lake Tahoe Tributaries, North Lake Tahoe Region	
Blackwood Creek	Lake Forest Creek
Burton Creek	McKinney Creek
Dollar Creek	Quail Creek
General Creek	Secret Harbor Creek
Griff Creek	Snow Creek
Hatchery Creek	Tahoe City Urban Ditch
Homewood Creek	Watson Creek
Truckee River Tributaries, Middle Truckee River Region	
Alder Creek	Martis Creek
Bear Creek	Prosser Creek
Cold Stream	Silver Creek
Donner Creek	Squaw Creek
East Martis Creek	Summit Creek
Glenshire Pond	Trout Creek
Little Truckee River	Truckee River, Main Stem
Truckee River Tributaries, Lower Truckee River Region	
Hunter Creek	Truckee River, Main Stem
Thomas Creek	White's Creek

Methods of Data Collection

All observations, photos, field measurements and samples were taken on May 17 and 18, 2019, between 9 am and 12 pm; this maintains the 'Snapshot' aspect of the project. Any samples submitted past 1 pm are assessed at that time to determine what the value is of samples submitted. Each volunteer team leader is required to attend at least one training session before the field day. Team leader trainings cover protocols for visual observations, photo documentation, water quality field measurements and collecting water samples to be sent to a laboratory for analysis. Training for the team leaders is usually taught by the coordinator for the corresponding region, with assistance as needed from the cooperating resource and regulatory agencies.

It is important to remember that the measurements made on Snapshot Day were designed to represent a single point in time and do not necessarily represent average conditions. Monitoring results include both the field measurements collected by volunteers and nutrient and bacteria analyses conducted by designated laboratories. Data is compiled by each regional coordinator and available electronically upon request – for more information, visit http://tahoetruckeesnapshotday.org/.

Visual observations and photo documentation are performed in accordance with procedures developed by the California State Water Resources Control Board Clean Water Team. The standardized observation form, the *California Stream and Shore Walk Visual Assessment Form*, has been slightly revised to better apply to the region. At least three photos are taken at each sampling site: streambed conditions; the view across the stream; and the view upstream from the starting point. However, volunteers are encouraged to photograph as much as possible, especially their team members in the field.

A variety of instruments and kits are used on Snapshot Day. Much of the equipment has been purchased through the years with grants or donations; the remainder of the equipment is borrowed each year from various partners. All the instruments and kits are calibrated and tested at a quality control session held before the event. For additional information on the monitoring equipment used see Appendix C.

Water Quality Standards

The U.S. Environmental Protection Agency (EPA) has recommended criteria for nutrients and turbidity. Nevada, California and the Tahoe Regional Planning Agency (TRPA) have specific water quality standards and indicators generally more stringent in certain watersheds and creeks, such as the Tahoe Basin, than elsewhere in the Truckee River Watershed. Table 3 lists some of these standards for the Tahoe Basin and a portion of the Middle Truckee River region. The selected standards shown in Table 4 are from the Nevada Division of Environmental Protection for the Lower Truckee River Watershed.

Table 3: Lake Tahoe water quality standards as set by the Lahontan Regional Water Quality Control Board (RWWCB).

Parameter	California Standard – Lahontan Region
Temperature	Shall not exceed 15°C, surface waters of Fallen Leaf Lake (CA)
pH	7.0 – 8.4
Conductivity	Shall not exceed 95 µS/cm average in Lake Tahoe (CA and NV)
Dissolved Oxygen	dissolved oxygen concentration shall not be depressed by more than 10 percent, below 80 percent saturation, or below 7.0 mg/L at any time, whichever is more restrictive
Turbidity	Shallow water shall not exceed 3 NTU near tributaries and 1 NTU not directly influenced by streams (TRPA)
Algae	Lahontan RWQCB waters shall not contain biostimulatory substances (nutrients) that cause algae to become a nuisance or to affect the water's beneficial uses (CA)
Total Nitrogen	Mean annual concentration in May is 0.087 mg/L but the maximum allowable is a mean of no more than 0.21 mg/L (Lahontan Region, CA)
Soluble Inorganic Nitrogen	Mean of no more than 0.06 mg/L for most tributaries to Lake Tahoe, Nevada side of Lake Tahoe (NDEP)
Total Phosphorous	Annual average of no more than 0.05 mg/L for most tributaries, Nevada side of Lake Tahoe and no more than 0.008 mg/L for most tributaries, California side of Lake Tahoe; maximum allowable for California side is 0.018 mg/L (Lahontan Region, CA)
Soluble Reactive Phosphorous	Annual average of no more than 0.007 mg/L (combination of organic and inorganic) for Lake Tahoe, Nevada side (NDEP) and 0.009 mg/L for Lake Tahoe, California side (Lahontan Region, CA)
Fecal Coliform	Log mean of 20 CFU (30-day period)
*E. coli**	Shall not exceed 100 CFU/100mL

For additional information on water quality objectives in the Lahontan region in California, refer to the Lahontan Regional Water Quality Control Board (Lahontan) *Basin Plan* at the following website: www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml.

**E. coli* standards are set state-wide and apply to the Lahontan Region. For additional information on California state-wide water quality objectives, refer to: https://www.waterboards.ca.gov/plans_policies/docs/bacteria.pdf.

Table 4: Lower Truckee River and Pyramid Lake water quality standards as set by Nevada Division of Environmental Protection.

Parameter	Truckee River at Idlewild (LTR-IDL)	Truckee River at Wadsworth (LTR-WADS)	Truckee River at the Pyramid Lake Paiute Reservation
Temperature	≤13ºC (month dependent)	≤14ºC (month dependent)	S.V.[a] ≤14ºC (month dependent) this S.V. is Apr-Jun
pH	6.5-9.0 S.V.	6.5-9.0	6.5-9.0 S.V.
Dissolved Oxygen	≥5 mg/L (April-October)	≥5 mg/L (April-October)	S.V. ≥6.0 mg/L (Nov-Jun)
Turbidity	≤10 NTU S.V.	≤10 NTU	≤10 NTU S.V.
Total Nitrogen	N/A	≤1.2 mg/L	≤1.2 mg/L S.V.
Nitrate	≤2.0 mg/L S.V.	≤2.0 mg/L	≤2.0 mg/L S.V.
Nitrite	≤0.04 mg/L S.V.	≤0.04 mg/L	≤0.04 mg/L S.V.
Total Phosphates	Annual average ≤ 0.10 mg/L	Annual average ≤ 0.05 mg/L	Annual average ≤ 0.05 mg/L
Orthophosphate	≤0.05 mg/L S.V.	N/A	N/A
Chlorides	≤250 mg/L S.V.	≤250 mg/L	≤250 mg/L S.V.
Fecal coliform	≤1000 No./100ml S.V.	≤1000 No./100ml	≤1000 No./100ml S.V.
E. coli	≤410 No./100ml single value or ≤126 No./100ml annual geometric mean	≤410 No./100ml single value or ≤126 No./100ml annual geometric mean	≤410 No./100ml single value or ≤126 No./100ml annual geometric mean

[a] S.V. – Single Value

For additional information on water quality standards in Nevada refer to the following website: www.leg.state.nv.us/NAC/NAC-445A.html#NAC445ASec11704

Data Results

This section gives an overview of the parameters measured and the data results. All the measured parameters are explained, and some abnormal measurements are highlighted for each of the parameters. Specific sites in figures are referred to by code, which can be cross-referenced by site names in Appendix B. In general, site codes follow the same pattern of abbreviated region and site name. Some codes include proximity to the mouth of that tributary, with “at mouth” being the lowest number and numbers increasing for upstream sites. For example, Griff Creek at mouth in the North Lake Tahoe region is coded as: NLT-GRIF-00.

Water Temperature

Cooler water temperatures are considered better habitat for aquatic life in mountain streams and lakes since colder water contains more dissolved oxygen, an essential ingredient for fish and invertebrates. Higher temperatures promote nutrient solubility and can occur because of low-flow (shallow) conditions and a lack of canopy (vegetation) cover along stream banks, which acts to shade and thus prevent solar heating of the water.

In many Sierra streams, propagation of cold-water fish (e.g., trout) is a designated beneficial use of the water. In such streams, numerical and narrative water quality standards generally are set at levels that will “support the beneficial use” of a cold-water fishery. Such streams generally require cooler temperatures and higher dissolved oxygen content than water in streams and lakes that do not have “cold-water fishery” as a designated beneficial use. Rainbow trout, for example, prefer cooler water temperatures for growth and spawning and temperatures higher than 25°C are considered lethal.

In 2019, all 76 sites were sampled for water temperature. The lowest recorded temperature was 2.4°C at Summit Creek (MTR-SUMM) in the Middle Truckee River region. The highest recorded temperature was 11.9°C at Trout Creek new Bellevue Avenue (SLT-TROU-01) in the South Lake Tahoe region. Figure 2 below represents the lowest and highest temperatures for each of the four regions sampled during the 2019 event. Every site sampled in 2019 had temperatures below the California standard of 15°C and the Nevada standard of 14°C and therefore all sites were within the temperature range needed to support Rainbow Trout.

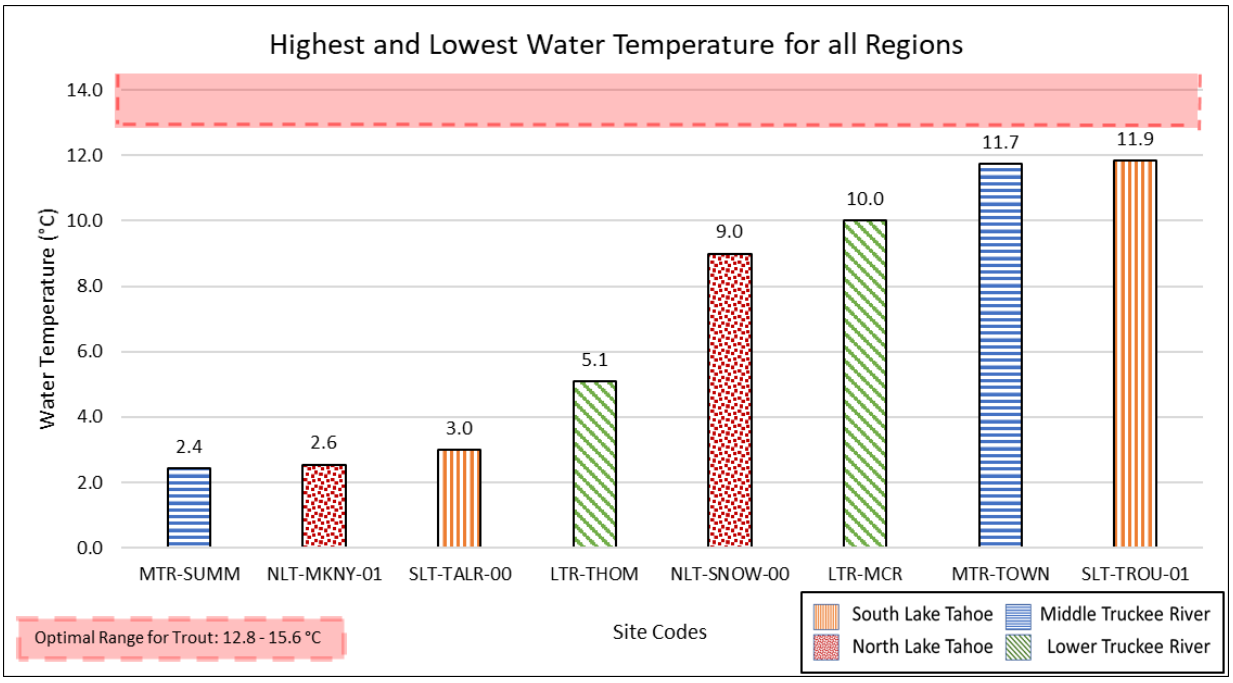


Figure 2: Highest and lowest water temperature readings for all regions at Snapshot Day 2019

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the amount of gaseous oxygen (O_2) dissolved in water. Dissolved oxygen is necessary to support aquatic life. Stress occurs in aquatic life, especially fish, when dissolved oxygen levels drop too low.

Low dissolved oxygen concentrations are typically the result of:

- Warming water: warmer water can dissolve and hold less oxygen than cooler water.
- Excess nutrients: too many nutrients in the water can fuel algae and bacteria growth, which consume oxygen upon decay.
- Slow or stagnant water: movement allows for oxygen and water to mix; slow or stagnant water thus has less dissolved oxygen than water in motion.

Water quality objectives for dissolved oxygen vary from region to region. The standard for the Lake Tahoe basin states that "dissolved oxygen concentration shall not be depressed by more than 10 percent, below 80 percent saturation, or below 7.0 mg/L at any time, whichever is more restrictive." Waters of the Truckee River in Nevada have a dissolved oxygen standard of above 5.0 mg/L or 6.0 mg/L depending on the reach of the river. Measurements below 5 mg/L are considered dangerous for cold-water aquatic life.

Dissolved oxygen content was measured at all 76 sites in 2019 and the lowest measurement was 0 mg/L at Hatchery Creek at Star Harbor (NLT-STAR-01) in the North Lake Tahoe region. All five sites in the Lower Truckee region were above the minimum standard value. In the Lake Tahoe Basin and Middle Truckee River watershed, 16 of the 71 sites had a reading below 7.0 mg/L, nine sites measured exactly 7.0 mg/L and three sites were below 5 mg/L: Hatchery Creek at Star Harbor (NLT-STAR-01); Bijou Creek at Mouth (SLT-BJCR-00); and Tahoe City Urban Ditch at Lake (NLT-TCUD-00). Figure 3 below shows the 32 sites with dissolved oxygen levels measured to be less than 8mg/L in 2019.

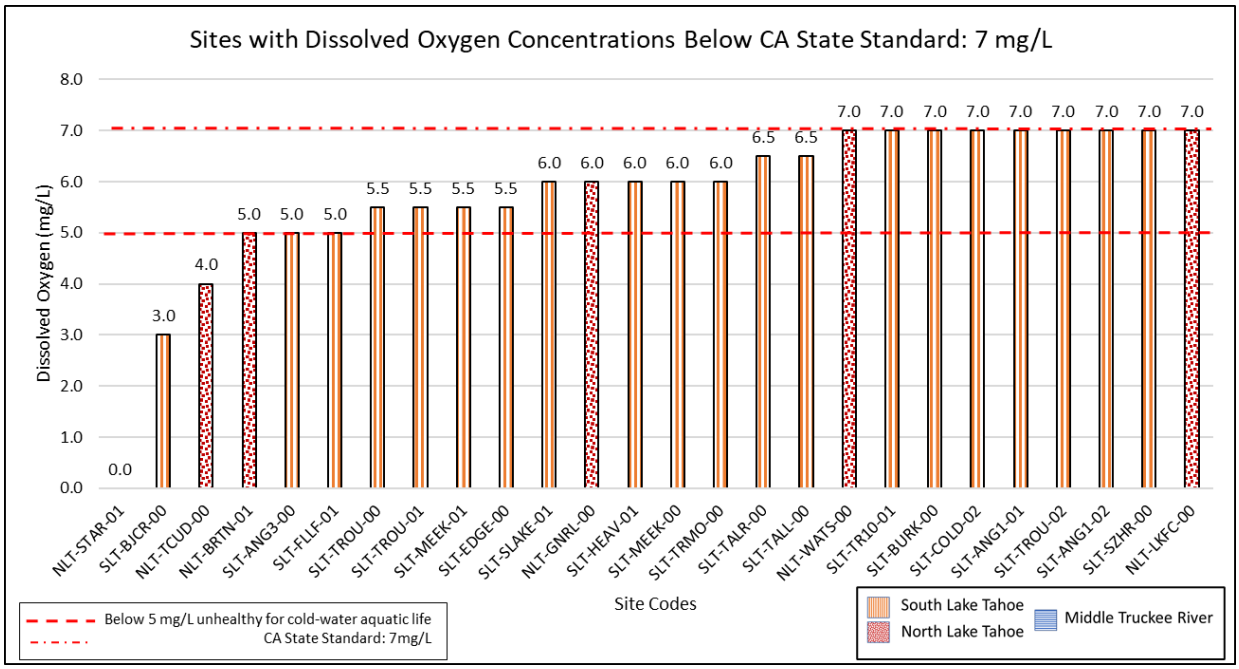


Figure 3: 2019 sites with dissolved oxygen concentrations below the CA Standard: 8mg/L.

pH

pH is a measurement of the degree to which water is “acidic” or “basic”. pH is measured on a scale of 0 (very acidic) to 14 (very basic) with 7 in the middle as “neutral”. Most aquatic life prefers a pH close to 7. Water within the Lake Tahoe Basin should not be below 7.0 or above 8.4; waters in the Truckee River in Nevada should not be below 6.5 or above 9.0.

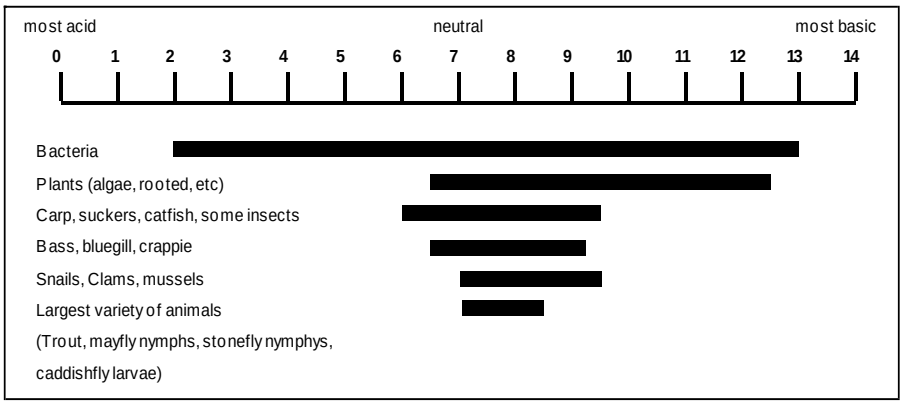


Figure 4: pH ranges that support aquatic life.

Figure 4 displays the pH ranges that support aquatic life and indicates that the optimal range for the largest variety of animals is 6 – 8. Of the 76 sites monitored in 2019, 13 sites had a pH below the optimal range and five sites had a pH above the optimal range. Figure 5 below shows the sites with pH measurements outside of the 7.0 – 8.5 range.

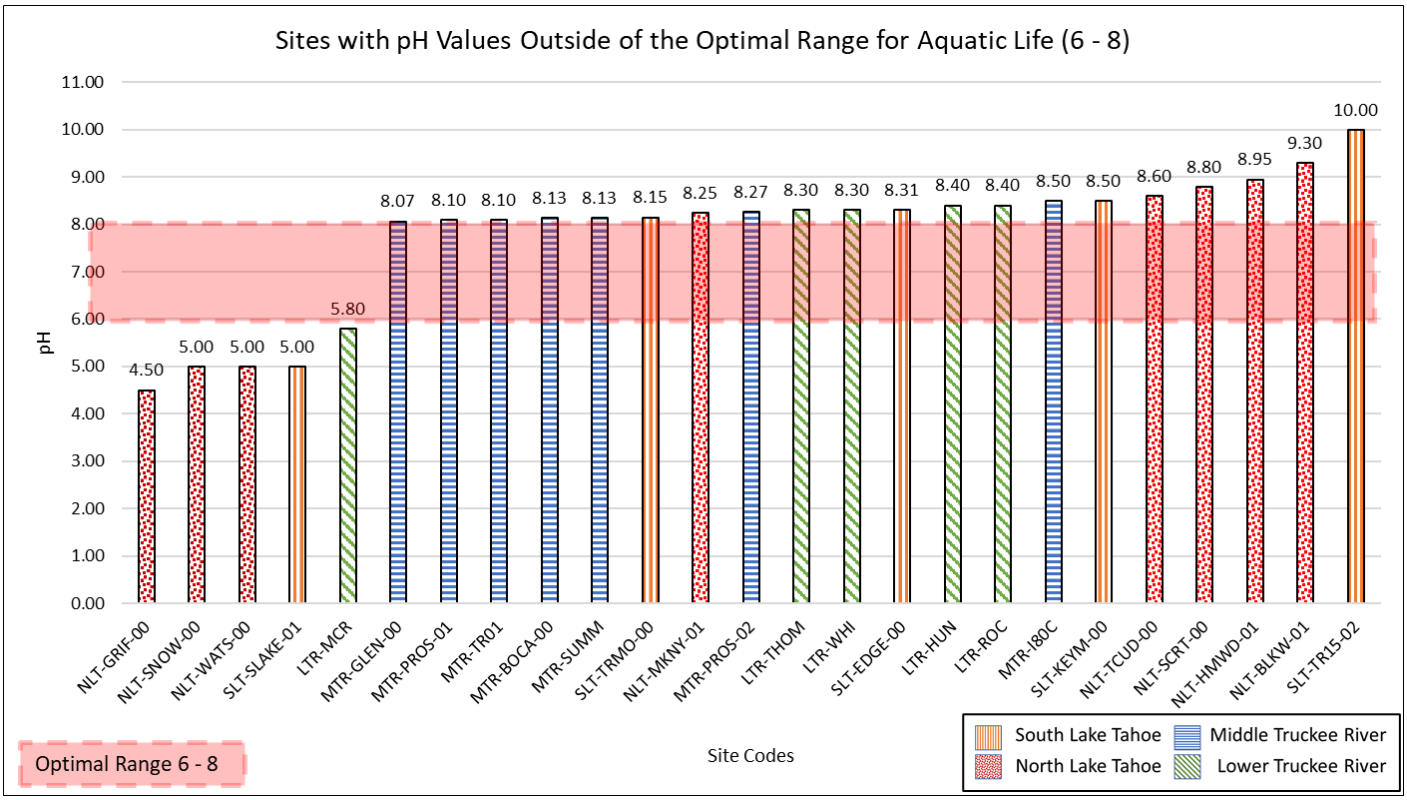


Figure 5: 2019 Snapshot Day sites with pH values outside the optimal range for aquatic life.

The lowest pH level measured at Snapshot Day 2019 was 4.5, recorded at the mouth of Griff Creek (NLT-GRIF-00) in North Lake Tahoe, while the highest level was 10, recorded at the Upper Truckee River near the South Tahoe Airport (SLT-TR15-02) in South Lake Tahoe. In the Lower Truckee region, one site, Truckee River at McCarran Ranch (LTR-MCR), was measured at 5.8, which is below the established range (6.5 – 9) for Nevada.

Lahontan recognizes that some waters in the region may have natural pH levels outside the 6 - 8 range, and this is commonly found in the tributaries to Lake Tahoe. Four sites with below optimal pH ranges in 2019 also measured low in past years: Snow Creek at Mouth (NLT-SNOW-00); Burton Creek at Star Harbor (NLT-BRTN-01); Kahle Beach (SLT-SLAKE-06); and Trout Creek at Mouth (SLT-TROU-00).

Turbidity

Turbidity is a measure of the cloudiness of the water or the number of fine particles suspended in the water column. Turbidity is measured in NTUs (Nephelometric Turbidity Units); high NTU levels indicate poor water clarity, low NTU levels indicate high clarity. Algae, suspended fine sediment particles, organic matter and some pollutants can cloud the water making it more turbid. High sediment loads can clog the gills of fish, negatively affect gravel beds and smother fish eggs and benthic invertebrates. The sediment can also carry pathogens, pollutants and nutrients that affect Lake Tahoe's water quality.

The U.S. EPA's recommended criteria for turbidity in streams in Eco-Region II (forested mountains in the western U.S.), is at or below 1.3 NTU. The California portion of the Truckee River Watershed is located within this Eco-Region; however, the State of Nevada outside of the Tahoe Basin is located right outside this Eco-Region. The TRPA and Lahontan have a nearshore turbidity standard of 1-3 NTUs (measured monthly) in Lake Tahoe. The standard for the Lower Truckee River and associated tributaries in the State of Nevada is 10 NTU.

All but one site was sampled for turbidity in 2019. For the Lake Tahoe region and the Middle Truckee River regions, 70 out of 71 samples were analyzed for turbidity and 16 sites had a reading above 3 NTU. The highest turbidity reading for these regions was 18.30 NTU from Upstream of Glenshire Pond (MTR-GLEN-02). In the Lower Truckee River region, all five samples were analyzed for turbidity and all were below 10 NTU, with the highest being Truckee River at McCarran Ranch (LTR-MCR) with 8.3 NTU. Figure 6 below shows the Lake Tahoe Basin and Middle Truckee River region sites that exceeded the California standard of 3 NTU.

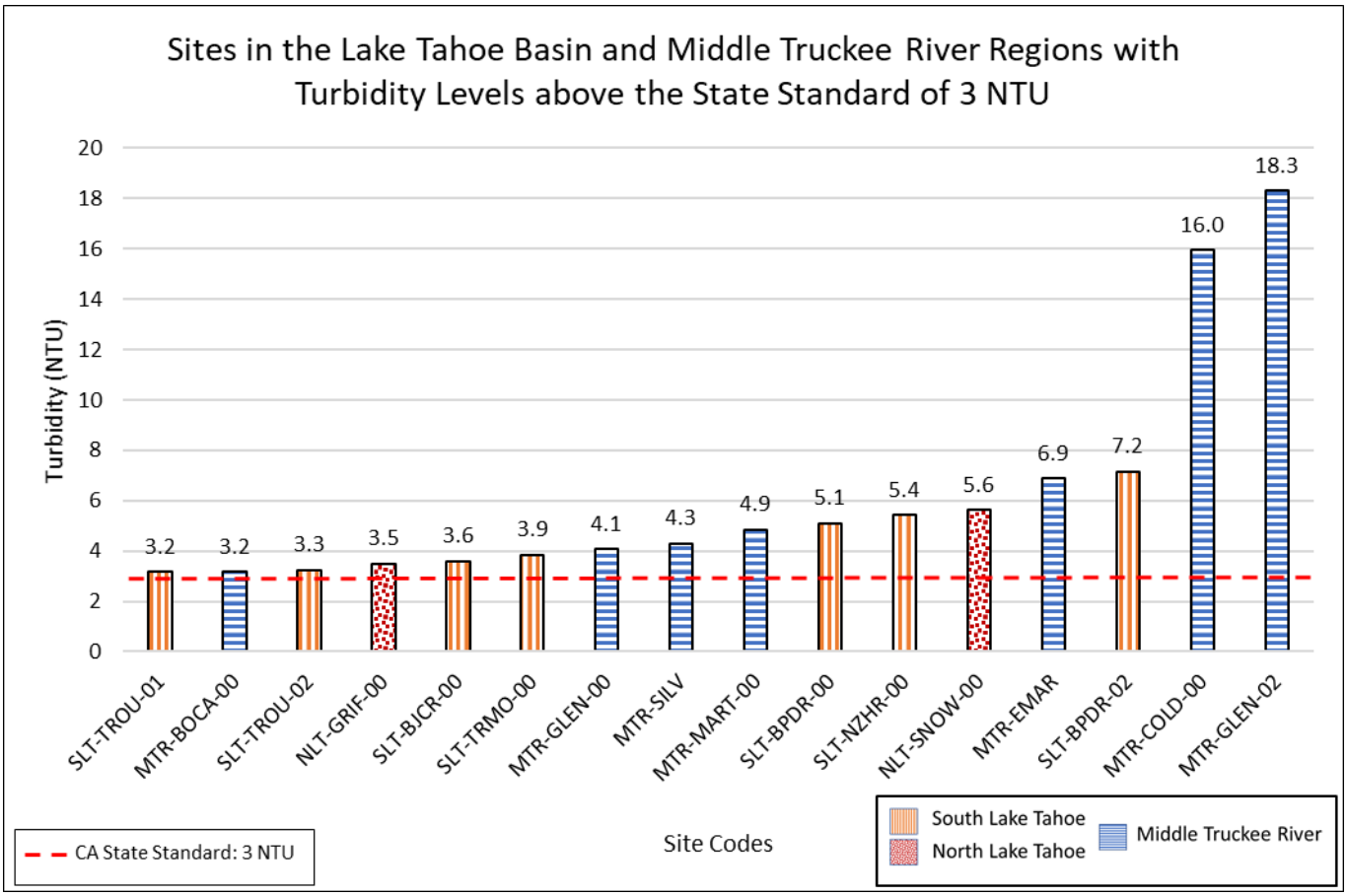


Figure 6: 2019 sites with turbidity readings exceeding the CA state standard of 3 NTU.

Streamflow

Streamflow is the measure of the volume of water flowing past a stationary point, which varies with precipitation and snowmelt. Streamflow can have a significant impact on water quality; during low flow conditions, high water temperature, low levels of dissolved oxygen and elevated presence of toxins can all be exacerbated. High flow conditions can increase erosion and transfer of sediment. Streamflow conditions can also impact fish habitat and other aquatic organisms and may affect the ability of fish to spawn and reproduce.

The graphs below show streamflow data collected by the U.S. Geological Survey (USGS) at three separate monitoring locations during May of 2018 and 2019: the Upper Truckee River south of Lake Tahoe (Figure 7); the Middle Truckee River at the Town of Truckee (Figure 8); and the Lower Truckee River in Reno (Figure 9). Data presented shows the flow conditions were higher at all regions during this sample year compared to 2018, which was an average precipitation year.

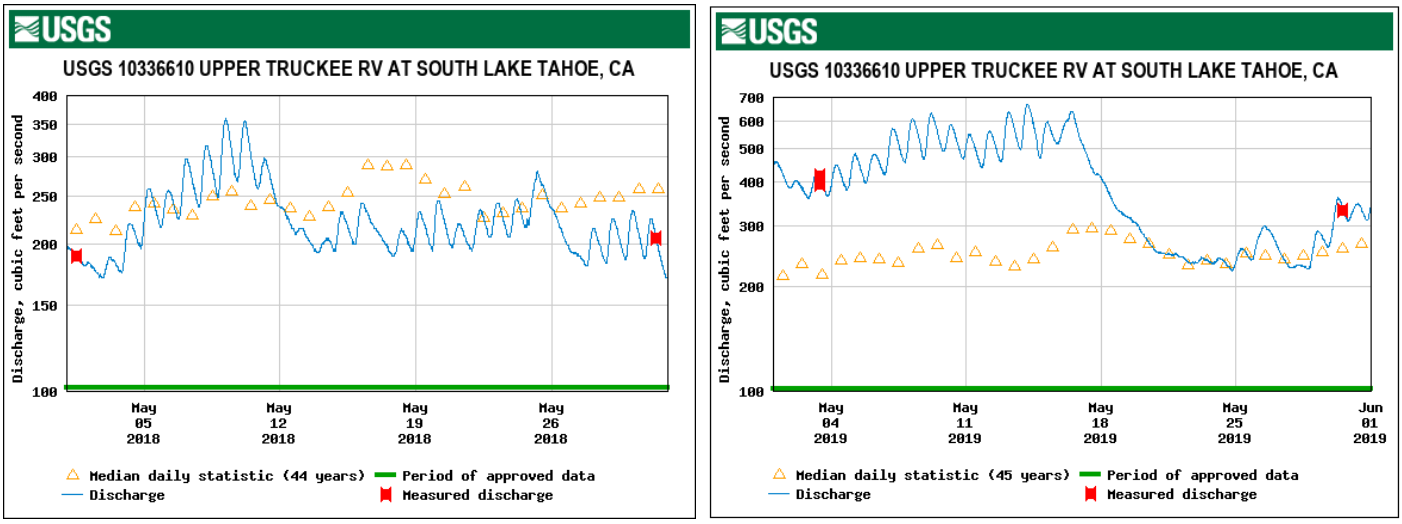


Figure 7: Streamflow data from the Upper Truckee River south of Lake Tahoe, California, during the month of May for the years of 2018 (left) and 2019 (right). Date of Snapshot Day: 05/18/2019.

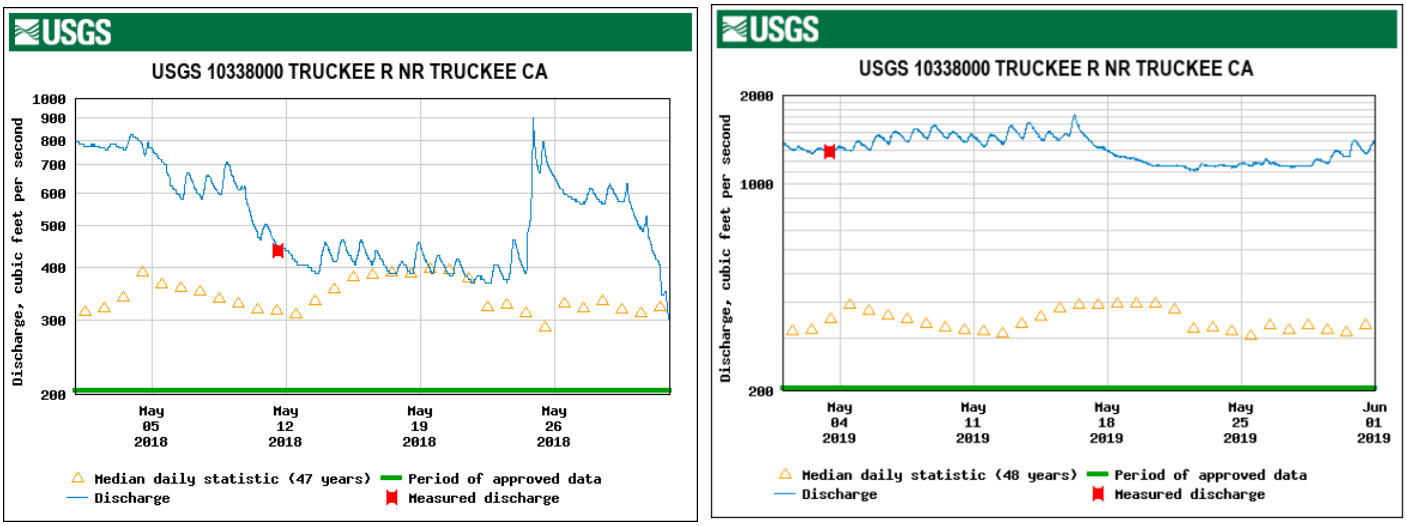


Figure 8: Streamflow data from the Middle Truckee River at the Town of Truckee, California, during the month of May for the years of 2018 (left) and 2019 (right). Date of Snapshot Day: 05/18/2019.

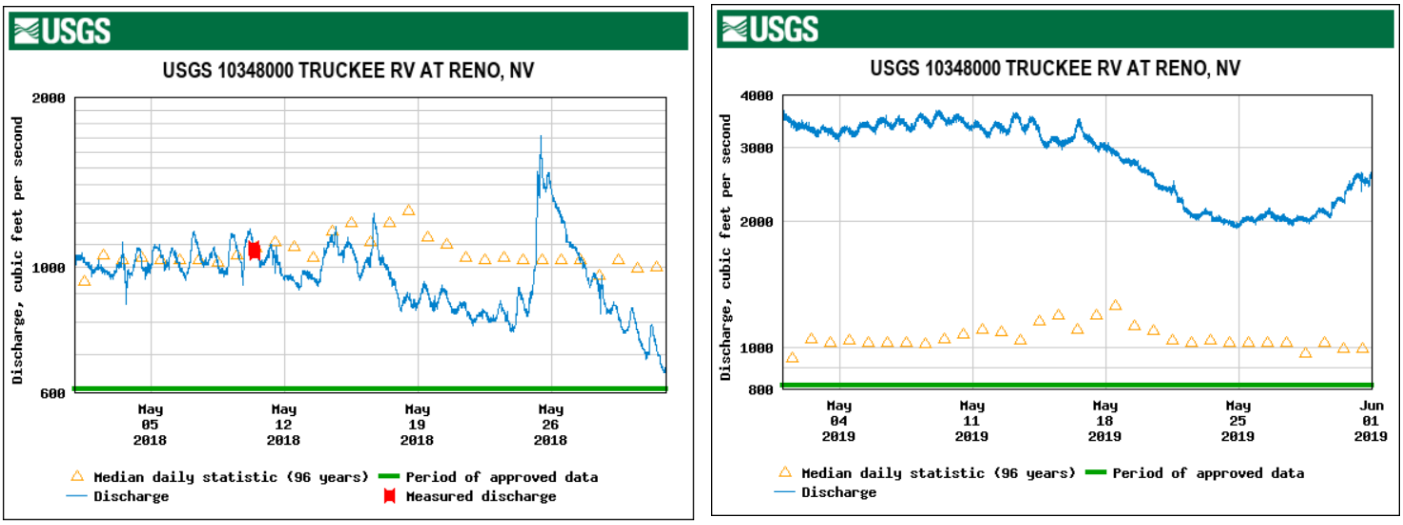


Figure 9: Streamflow data from the Lower Truckee River at Reno, Nevada, during the month of May for the years of 2018 (left) and 2019 (right). Date of Snapshot Day: 05/17/2019.

At Snapshot Day 2019, streamflow at 60 out of 76 sites visited were observed to be moderate to turbulent with only one site classified as flooding: Donner Creek at the confluence with the Truckee River (MTR-DONN-00) in the Middle Truckee River region. Almost all the sites classified as low flow (ranging from "Dry Creek Bed" to "Slow / Smooth") were in the South Lake Tahoe region. Figure 10 below illustrates the location of sites within various streamflow classifications.

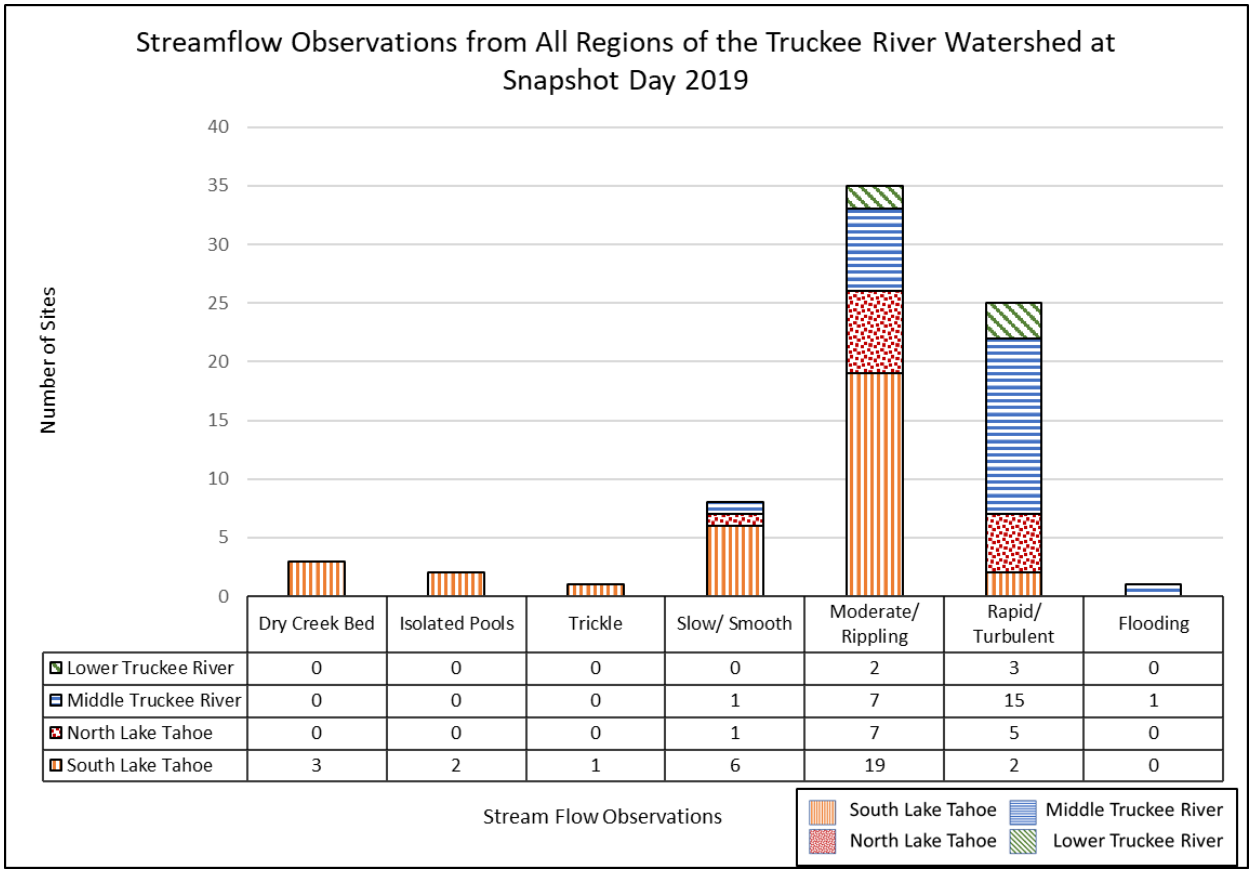


Figure 10: The number and location of 2019 Snapshot Day sites within the various streamflow classifications.

Conductivity

Table 5: Acceptable conductivity for different water types.

Water Type	**Conductivity** µS/cm (micro Siemens per centimeter**)**
Distilled Water	0.5 - 3.0
Melted snow	2 - 42
Potable water in the U.S.	30 - 1500
Irrigation Supply Water	< 750

Conductivity is a measure of water's ability to pass an electric current. In water, conductivity is affected by the presence of inorganic dissolved solids such as chloride, nitrate, calcium, sulfate and others. Conductivity in rivers and streams is mainly influenced by the geology through which the water flows.

Electrical conductivity is also sensitive to stream flows. At high flows, the charged particles that makeup conductivity are diluted and so conductivity should be lower. At low flows, the particles are more concentrated, and conductivity will often be higher. Primary sources of charged particles in the Truckee River watershed are road sands, road deicers and natural sources. Typically, urban areas or sites adjacent to high-traffic roads will show higher conductivity readings.

Abrupt changes in conductivity may indicate that new water sources or wastewaters are being diverted into a stream or river. Acceptable ranges for water conductivity are dependent on the water type. Table 5 displays acceptable conductivity ranges for several water types. Conductivity was measured at all but 3 sites for Snapshot Day 2019. The lowest conductivity recorded was 1 µS/cm, measured at the mouth of General Creek (NLT-GNRL-00) in North Lake Tahoe. The highest conductivity recorded was 1,250 µS/cm at the mouth of Taylor Creek (SLT-TALR-00) in South Lake Tahoe. Figure 11 below shows the highest and lowest conductivity values from each region in 2019.

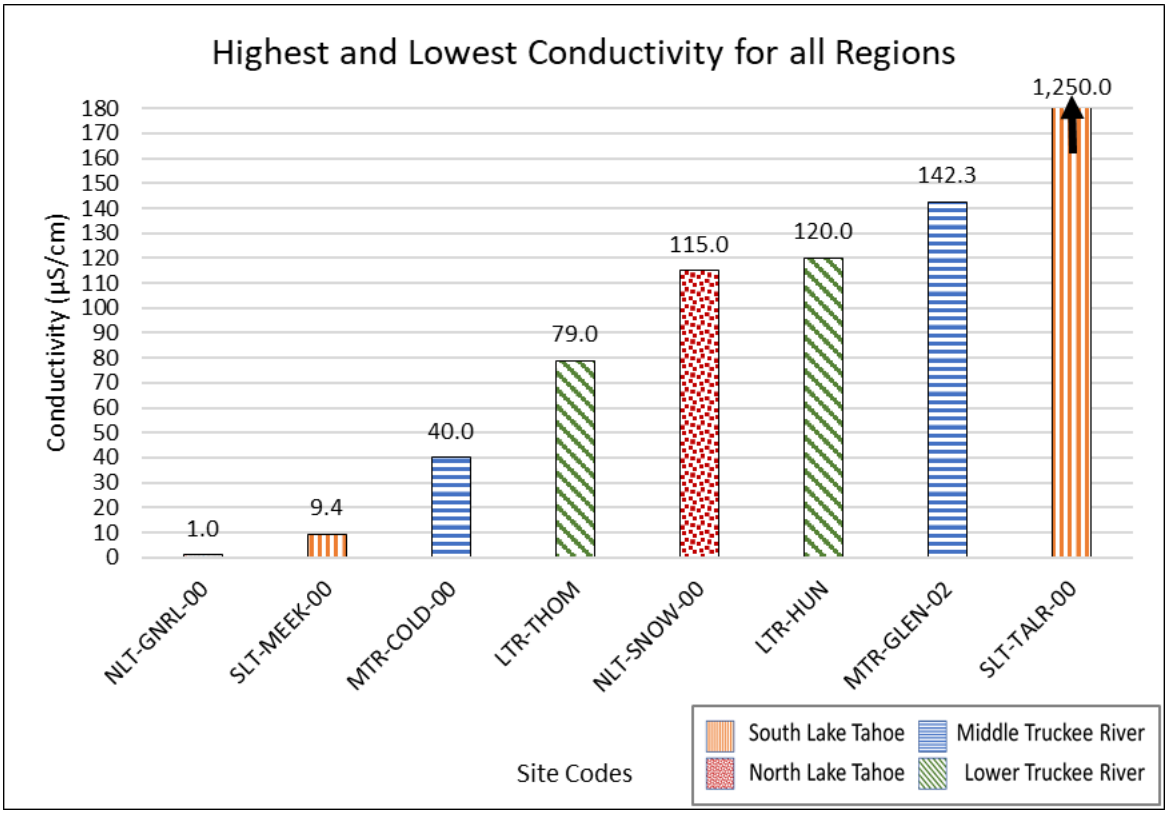


Figure 11: Highest and lowest conductivity values from Snapshot Day 2019 by region.

Fecal Coliform Bacteria

Coliform bacteria are found in the feces of warm-blooded animals, including humans, pets, livestock, beavers and birds. Fecal coliform is measured in colony forming units (CFUs) counted per 100 milliliters of water (CFU/100ml). CFUs are roughly equivalent to the number of bacteria cells. The Lahontan standard for fecal coliform is 20 CFU/100ml for a single occurrence based on a logarithmic mean of five samples taken within 30 days. By using 20 CFU/100 ml as guidance for a tolerable threshold of coliform, we can determine if that threshold is exceeded for the Tahoe/Truckee regions. The standards for the Lower Truckee River in Nevada are significantly higher than the Lahontan standards. Standards for the Lower Truckee River for fecal coliform are established at ≤1000 CFU/100ml.

Escherichia coli (*E. coli*) is the major species in the fecal coliform group. Of the five general groups of bacteria that comprise the total coliforms, only *E. coli* is generally not found growing and reproducing in the environment. Consequently, *E. coli* is considered to be the species of coliform bacteria that is the best indicator of fecal pollution and the possible presence of pathogens. As a result, testing for coliform bacteria can be a reasonable indication of whether other pathogenic bacteria are present. The *E. coli* standard for the Lower Truckee River is ≤410 CFU/100ml; the standard for California is ≤100 CFU/100ml.

Fecal coliform was measured at 60 locations on Snapshot Day 2019. In the Lake Tahoe and Middle Truckee River regions, eight samples had readings greater than 20 CFU/100ml and 22 samples had zero bacteria recorded. The site with the highest coliform reading was Trout Creek at Mouth (SLT-TROU-00) in the South Lake Tahoe region with 511 CFU/100ml. In the Lower Truckee River, no sites exceeded the 1000 CFU/100ml standard with the highest reading being 100 CFU/100ml at White's Creek (LTR-WHI). Figure 12 below shows the eight sites with fecal coliform levels exceeding 20 CFU/100ml.

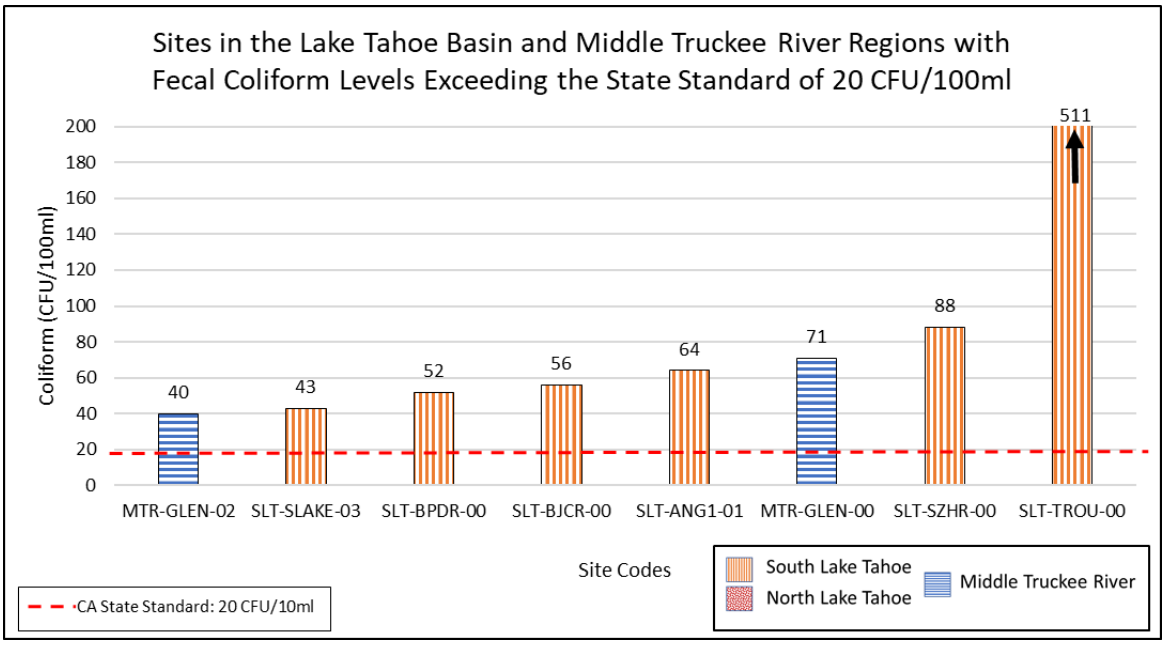


Figure 12: Sites in the Lake Tahoe Basin and Middle Truckee River Regions with fecal coliform levels exceeding the CA state standard of 20 CFU/100ml.

E. coli was analyzed at 34 sites on Snapshot Day 2019. In the Lower Truckee River, no sites exceeded the 410 CFU/100ml standard with the highest reading being 197 CFU/100ml at White's Creek (LTR-WHI). In the Tahoe Basin and Middle Truckee River regions, one site exceeded the California state standard of 100 CFU/100ml: Trout Creek at Mouth (SLT-TROU-00) in the South Lake Tahoe region with 448 CFU/100ml.

Nutrients

At Snapshot Day 2019, 63 water samples were collected and analyzed for Nitrogen and 45 water samples were collected and analyzed for Phosphorus, both of which are of most concern for algal growth and water clarity. Along with excess algal growth, nutrient concentrations that are too high can lead to odors, discolored waters, loss of clarity and nighttime oxygen depletion. The maximum amount of Total Nitrogen (TN) according to the Lahontan and Nevada standards is 0.21 mg/L and 1.2 mg/L, respectively. For Total Phosphates, the maximum allowable amount according to Lahontan and Nevada is 0.018 mg/L and 0.05 mg/L, respectively.

Discrepancies in sample analysis throughout the regions is attributed to laboratory availability. The most accurate comparison of nutrient concentrations is to compare the highest concentrations, as the detection limits for each of the regions vary.

The highest level of Nitrogen from Snapshot Day 2019 was in the South Lake Tahoe region at the mouth of Bijou Creek (SLT-BJCR-00) measuring 1.26 mg/L Total Nitrogen (TN). In addition to this site, 11 other sites in the South Lake Tahoe and Middle Truckee River regions exceeded the Lahontan standard of 0.21 mg/L TN. All North Lake Tahoe and Lower Truckee River sites were below the respective standards for Total Nitrogen. Figure 13 below shows the highest levels of the various Nitrogen tests recorded in each of the regions for Snapshot Day 2019.

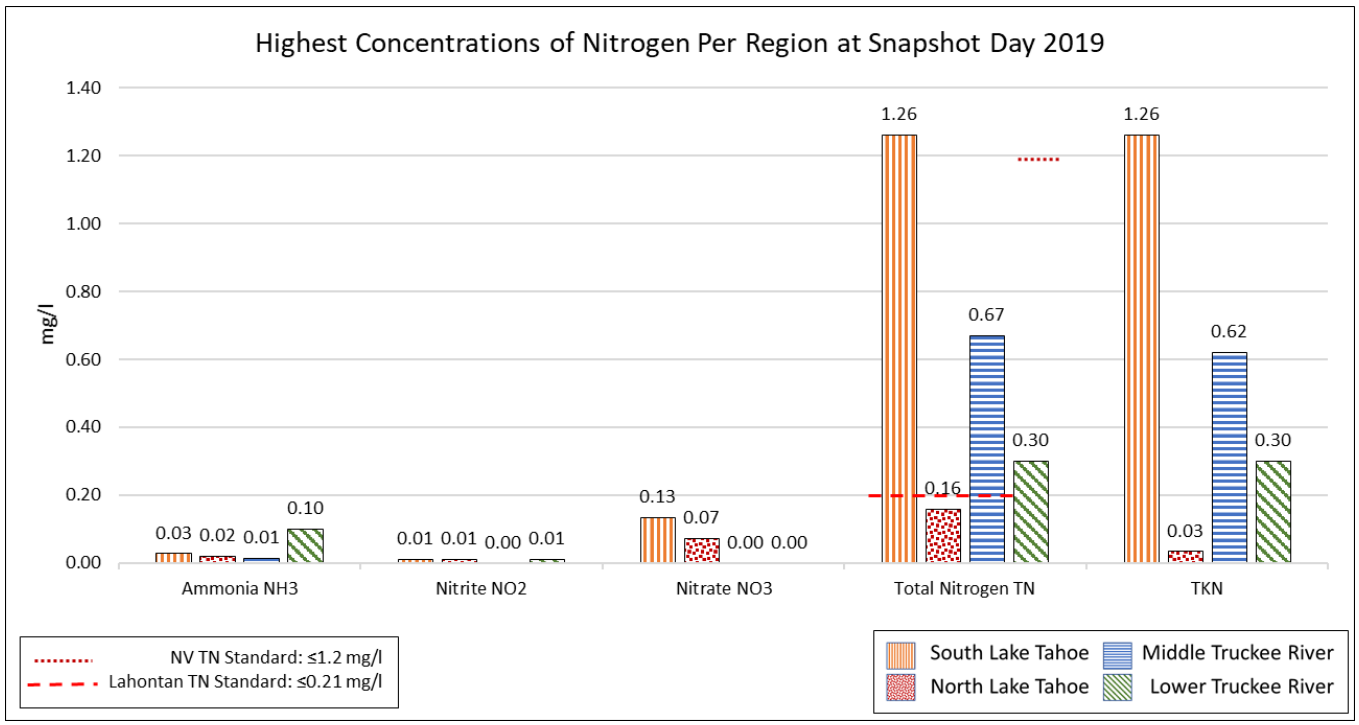


Figure 13: Highest levels of Nitrogen recorded in each region at Snapshot Day 2019.

The Lower and Middle Truckee River region samples were analyzed for Total Phosphorous while the Lake Tahoe region samples were analyzed for Orthophosphate. For Orthophosphate, the highest levels were detected in Lake Tahoe at Timber Cove Beach (SLT-SLAKE-03) in the South Lake region and at Hatchery Creek at Star Harbor (NLT-STAR-01) in the North Lake region, measuring 0.32 mg/L and 0.034 mg/L, respectively. For Total Phosphorus, the highest levels were detected at upstream of Glenshire Pond in the Middle Truckee River region and at Thomas Creek (LTR-THOM) in the Lower Truckee River region, measuring 0.125 mg/L and 0.13 mg/L, respectively. Figure 14 below shows the highest levels of Orthophosphate and Total Phosphorus recorded for each region at Snapshot Day 2019.

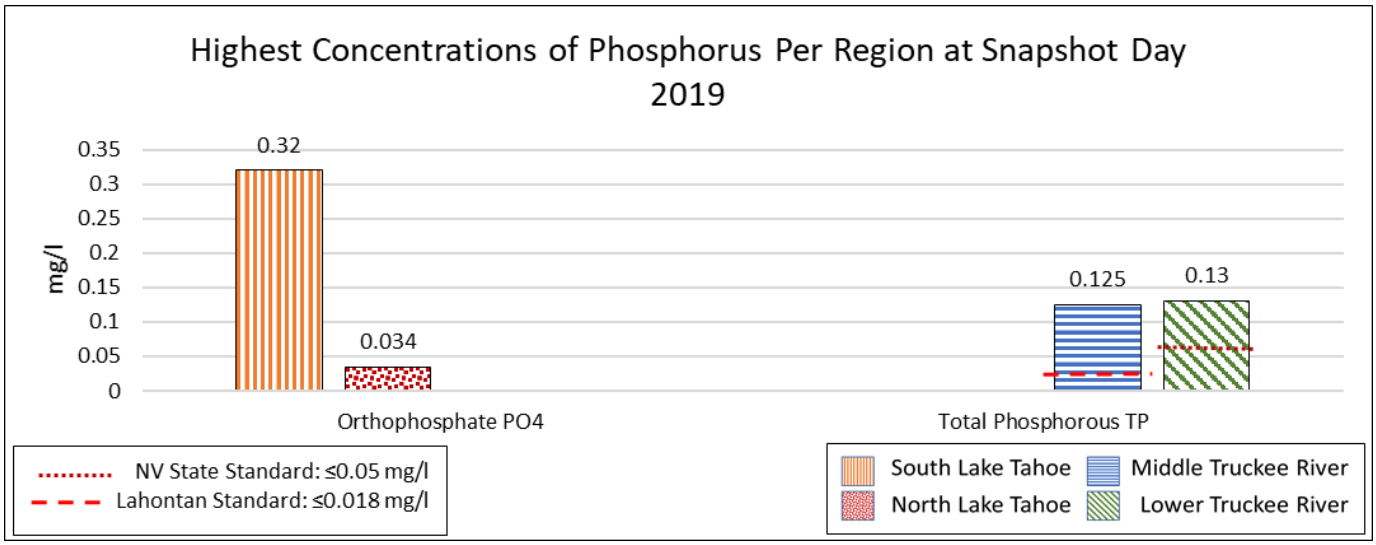


Figure 14: Highest concentrations of Phosphorus recorded in each region at Snapshot Day 2019.

Average nutrient results for reach region from Snapshot Day 2019 are provided in Figure 15 below. All Nitrite analyses in all regions were non-detect, as were the all the Ammonia and Nitrate analyses from the Middle Truckee River region.

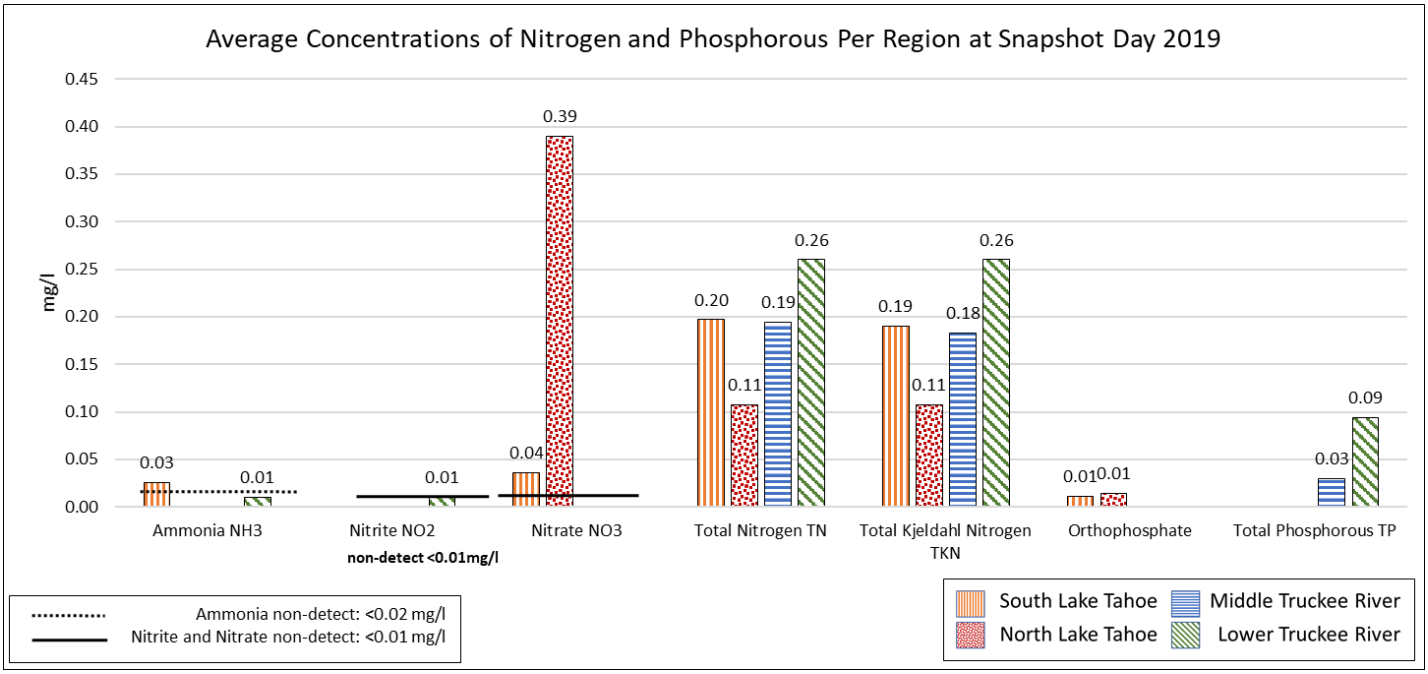


Figure 15: Average concentrations of Nitrogen and Phosphorus recorded in each region at Snapshot Day 2019.

Visual Observations

Visual observations were recorded at all 76 sample sites from Snapshot Day 2019. Visual observations included cloud cover, precipitation, wind, water clarity, in-stream flow (Figure 10), sample color, sample odor, and presence of other items observed at the sample sites. Visual observations at most of the Snapshot Day 2019 sites represented good water quality. Just six sites, four of which are located in the South Lake Tahoe region, reported trash present. Nine sites, in the Middle Truckee, North and South Lake regions, had reports of foam or suds present. Only two sites, both in the Lower Truckee River region, reported murky water (<4 inches visibility). Tables 5 and 6 below show the reported sample odors and number of additional objects observed at the Snapshot Day 2019 sites.

One site in the South Lake Tahoe region, Bijou Creek Drainage at Mouth (SLT-BPDR-00), had considerably poorer visual observations compared to the rest of the 2019 sites. This site had cloudy water (<4 inches visibility), low flow, amber colored sample water, a sewage smell and the presence of all of the following: algae/water plants, oily sheen, foam/suds and litter/trash. Bijou Creek drains into Ski Run Marina, which is where the sampling was conducted. Ski Run Marina is a man-made, channelized marina with a full fleet of rental boats, a known infestation of aquatic invasive plants, and high tourist traffic, which may explain the poor water quality conditions observed.

Table 5: Reported sample odors from Snapshot Day 2019 sites.

None	Fresh algae	Chlorine	Rotten eggs	Sewage	Other
71	4	0	0	1	0

Table 6: Number of sites with reported presence of other observations from Snapshot Day 2019.

Algae or other water plants	Oily Sheen	Foam or suds	Litter or trash	Other
24	1	9	6	5

Discussion

Compared to many other watersheds in the nation, data collected within the Truckee River watershed is indicative of good overall water quality. The Truckee River watershed is fed by mountain streams and snowmelt conditions with heavily forested headwaters and urban concentrations (Reno/Sparks) located only in the lower portion of the watershed. The presence of concentrated urban development and high amounts of impervious surface areas increases urban runoff into the watershed. These land-use conditions can have an impact on water quality as reflected in the much higher concentrations of Phosphorus in the lower Truckee watershed as compared to the headwater regions. Turbidity and Nitrogen levels in this region, however, were below the state standards and only slightly elevated compared to the rest of the watershed sites.

Data collected show that at least a portion of the sites monitored did not meet the standards set by the Lahontan Regional Water Quality Control Board (California) or the Nevada Division of Environmental Protection (Nevada). See Tables 3 and 4 for California and Nevada standards, respectively. The data collected for Snapshot Day 2019 shows approximately 21% of the sites monitored having elevated levels of turbidity, a slight decrease from 22% in 2018, despite it being an above average water year with elevated stream flows in all regions. Additionally, 45% of the water samples collected had dissolved oxygen levels below the standard. Overall, the dissolved oxygen content was not far below the established standard of 8 mg/L and is not a cause for concern.

One site in South Lake Tahoe, Trout Creek at Mouth (SLT-TROU-00), had significantly high Fecal Coliform levels (511 CFU/100 ml). During Snapshot Day 2019, the mouth of Trout Creek was not flowing into Lake Tahoe and its streamflow was classified as “isolated pools”. However, the site just half a mile upstream of the mouth site, Trout Creek at Bellevue Avenue (SLT-TROU-01), was reported to have moderate to rippling flow and a Fecal Coliform measurement of 6 CFU/100ml. The elevated Fecal Coliform levels at the mouth of Trout Creek was likely caused by substantial waterfowl presence in the entire lower Trout Creek area. In the week leading up to Snapshot Day 2019, there were significant rain events that may have washed much of the fecal material downstream, resulting in a low reading at the upstream site and a concentrated reading at the mouth site where it was not flowing out into the Lake proper.

As previous data sets from the past 19 years are compiled and data management is improved, this program will have the ability to show long-term trends and better assist agencies in protecting water quality in the Tahoe-Truckee watershed.

The annual Snapshot Day event is partner-driven, and participation is through an almost entirely volunteer basis. The collaboration and continued dedication of those involved, from dedicated staff to engaged volunteers, makes Snapshot Day a success each year. The ongoing success of this type of event exemplifies the value of citizen science and shows how community members can provide invaluable data collection and learn about their watershed at the same time.

For more information about how to get involved with water quality monitoring activities, contact the agencies and organizations listed in Table 6, below.

Table 6: Truckee Tahoe Snapshot Day agency partner list and contact information.

Region	Agency	Contact Name	Phone Number
North Lake Tahoe	Tahoe Water Suppliers Association	Sarah Vidra	(775) 832-1284
South Lake Tahoe	League to Save Lake Tahoe	Emily Frey	(530) 541-5388
Middle Truckee River (Tahoe City to Nevada State Line)	Truckee River Watershed Council	Eben Swain	(530) 550-8760 x7
Lower Truckee River (Nevada Stateline to Pyramid Lake)	Nevada Division of Environmental Protection	Patricia Tierney	(775) 687-9454

References

Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion II, U.S. Environmental Protection Agency, December 2000

California State Water Resources Control Board Clean Water Team website: http://www.swrcb.ca.gov/water_issues/programs/swamp/cwt_volunteer.shtml

EPA's Volunteer Stream Monitoring: A Methods Manual, U.S. Environmental Protection Agency

Nevada Administrative Code (NAC), Chapter 445A, Nevada Division of Environmental Protection, 1995 Revision

Standard Methods for Water and Wastewater Collection, 21st Edition, 2007

The California Streamside Biosurvey: An Introduction to Using Aquatic Invertebrates as Water Quality Indicators, California State Water Resources Control Board, September 2001

Water Quality Control Plan for the Lahontan Region, California Regional Water Quality Control Board, Lahontan Region, 1993 Revision

Water Supply Outlook, Natural Resource Conservation Service website, www.nrcs.us.gov

Appendices

Appendix A – Resource Partners

2019 Snapshot Day Sponsors

- California State Water Resource Control Board
- Lahontan Regional Water Quality Control Board
- Lake Tahoe Community College
- League to Save Lake Tahoe
- Nevada Division of Environmental Protection
- Nevada Division of State Lands
- Nevada State Health Laboratory
- Pyramid Lake Paiute Tribe
- Tahoe Environmental Research Center
- Tahoe Regional Planning Agency
- Tahoe Water Suppliers Association
- Truckee River Watershed Council
- United States Geologic Survey
- Incline Village General Improvement District

Citizen Monitoring Working Group Snapshot Day Planning Committee

- Eben Swain (Truckee River Watershed Council)
- Patricia Tierney (Nevada Division of Environmental Protection)
- Emily Frey (League to Save Lake Tahoe)
- Sarah Vidra (Incline Village General Improvement District)
- Joe Hill (Incline Village General Improvement District)
- Madonna Dunbar (Tahoe Water Suppliers Association)
- Adam Jensen (Tahoe Regional Planning Agency)

Organizations Hosting Snapshot Day 2019

- Incline Village General Improvement District
- League to Save Lake Tahoe
- Nevada Division of Environmental Protection
- Truckee River Watershed Council
- Tahoe Water Suppliers Association
- Lahontan Regional Water Quality Control Board
- Nevada Division of State Lands
- Pyramid Lake Paiute Tribe
- University of Nevada, Reno, Electrical Engineering Department
- U.S. Geological Survey, Carnelian Bay Field Station
- Lake Tahoe Community College

Laboratory Analyses (Nutrients and Bacteria)

- South Lake Tahoe Public Utility District
- Nevada State Health Laboratory
- Lahontan Regional Water Quality Control Board Laboratory
- United States Geologic Survey
- Incline Village General Improvement District
- High Sierra Water Lab

Equipment and Contact

- California State Water Resource Clean Water Team, Erick Burres
- Incline Village General Improvement District, Sarah Vidra
- League to Save Lake Tahoe, Emily Frey
- Nevada Division of Environmental Protection, Patricia Tierney
- Tahoe Environmental Research Center, Anne Liston
- Truckee River Watershed Council, Eben Swain
- United States Geological Survey, Paul Honeywell

Education Partners

- Alpine Academy
- Dilworth Middle School
- Galena High School
- High Desert Montessori
- Lake Tahoe Boys and Girls Club
- Lake Tahoe Community College
- Mountain View Montessori
- Natchez Elementary School
- Pyramid Lake High School
- Reed High School
- Spanish Springs High School
- TRiO Upward Bound
- Washoe County Online School

Resource Partners

- Desert Research Institute
- Nevada Division of Environmental Protection
- U.S. Geological Survey
- Great Basin Institute
- WET Laboratory
- Washoe County School District
- Sierra Nevada Journeys
- City of Sparks Public Works
- City of Reno Public Works
- City of South Lake Tahoe
- Incline Village General Improvement District
- Stantec
- The Nature Conservancy
- Nevada Dept. of Wildlife
- Nevada Dept. of Transportation
- Truckee Meadows Water Authority
- Pyramid Lake Environmental Staff
- Waste Management

Special thanks to

- Anne Liston, UC Davis-Tahoe Environmental Research Center, for hosting Calibration Day
- Bruce Warden and Mary Fiore-Wagner, Lahontan, for bacteria and turbidity analyses
- Nevada Division of Environmental Protection, for funding nutrient analysis for the Lower Truckee River monitoring sites
- Nevada Division of State Lands, for funding nutrient analysis
- Nevada State Health Lab, for Lower Truckee River laboratory analyses
- Paul Honeywell, U.S. Geologic Survey, Truckee CA office, for coordinating bacterial analysis
- Kristine Lebo, IVGID, for turbidity analysis
- Scott Valentine, Lake Tahoe Community College, for hosting the South Lake Tahoe event
- Soroptimist International of the Tahoe Sierra, for funding the event
- Truckee Meadows Water Reclamation Facility, for nutrient analysis, Lower Truckee River
- Waterman's Landing, for hosting the North Lake Tahoe event
- Dan Arce, South Tahoe Public Utility District for nutrient analysis
- **And all the volunteers that make Snapshot Day possible!**

Appendix B – Site Names and Codes

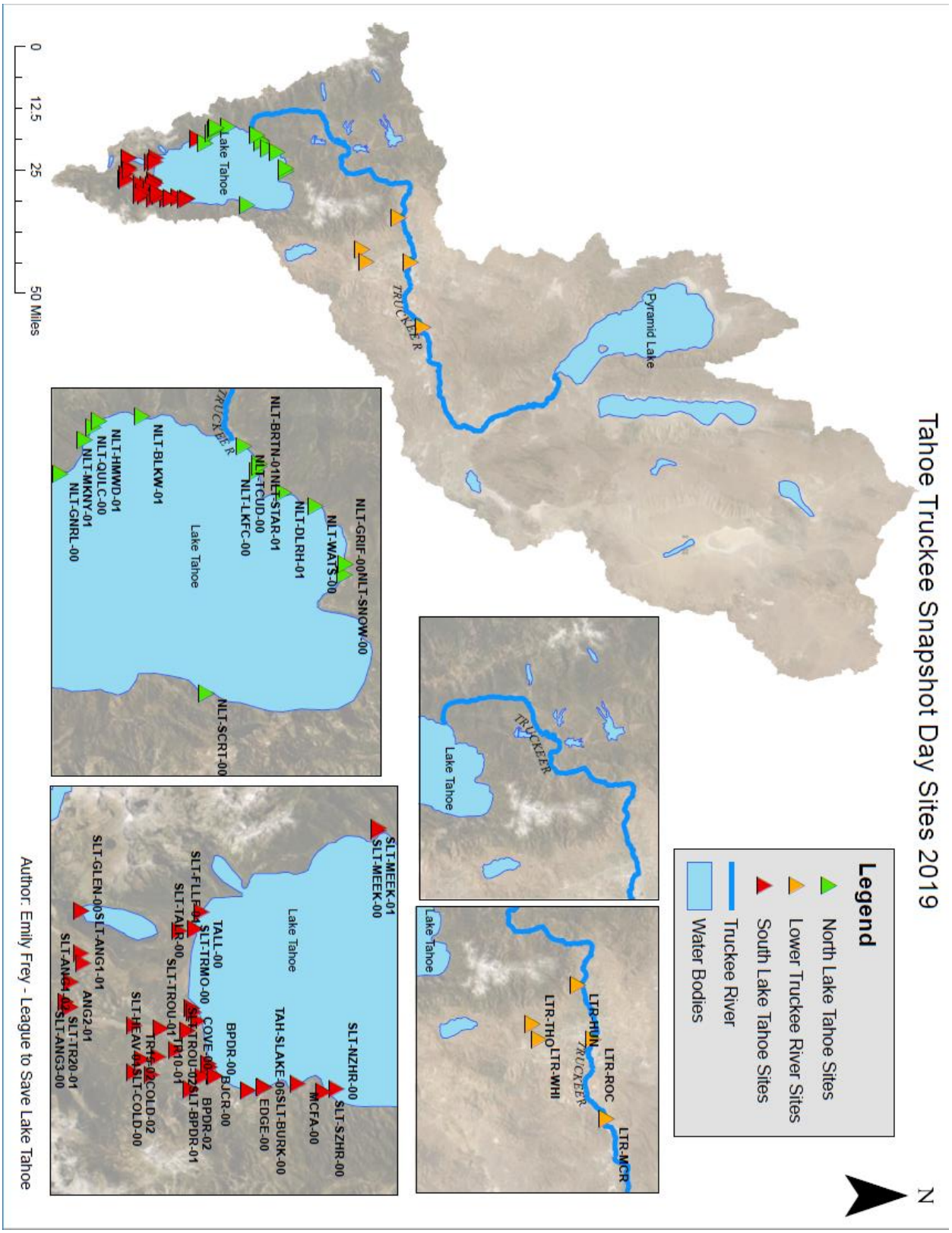
2019 Snapshot Day site and site codes are listed below.

Site Name	Site Code
South Lake Tahoe	
Angora Creek above Lake Tahoe Boulevard	SLT-ANG1-02
Angora Creek at Upper Truckee River Confluence	SLT-ANG3-00
Angora Creek at View Circle	SLT-ANG1-01
Angora Creek at Washoe Meadows State Park	SLT-ANG2-01
Bijou Creek at Mouth	SLT-BJCR-00
Bijou Park Drainage at Hansen's Resort	SLT-BPDR-02
Bijou Park Drainage at Mouth	SLT-BPDR-00
Bijou Park Drainage at Werner Salas Drive	SLT-BPDR-01
Burke Creek at Mouth	SLT-BURK-00
Cold Creek above Pioneer Trail	SLT-COLD-02
Cove East	SLT-COVE-00
Edgewood Creek at Mouth	SLT-EDGE-00
Fallen Leaf Lake	SLT-FLLF-01
Glen Alpine Creek at Fallen Leaf Lake	SLT-GLEN-00
Heavenly Creek above Pioneer Trail	SLT-HEAV-01
Heavenly Creek at Trout Creek Confluence	SLT-HEAV-00
Lake Tahoe at Kahle Beach	SLT-SLAKE-06
Lake Tahoe at Ski Run Marina	SLT-SLAKE-01
Lake Tahoe at Timber Cove	SLT-SLAKE-03
Meeks Creek at Meadow	SLT-MEEK-01
Meeks Creek at Mouth	SLT-MEEK-00
North Zephyr Creek at Mouth	SLT-NZHR-00
South Zephyr Creek at Mouth	SLT-SZHR-00
Tahoe Keys East Channel	SLT-KEYM-00
Tallac Creek above Highway 89	SLT-TALL-01
Tallac Creek at Mouth	SLT-TALL-00
Taylor Creek at Mouth	SLT-TALR-00
Trout Creek at Bellevue Avenue	SLT-TROU-01
Trout Creek at Grinding Stone	SLT-TROU-02
Trout Creek at Mouth	SLT-TROU-00
Upper Truckee River at Airport	SLT-TR15-02
Upper Truckee River at Elks Club Drive	SLT-TR20-01
Upper Truckee River at Mouth	SLT-TRMO-00
Upper Truckee River below Lake Tahoe Boulevard	SLT-TR10-01
North Lake Tahoe	

Blackwood Creek at Highway	NLT-BLKW-01
Burton Creek at Star Harbor	NLT-BRTN-01
Dollar Creek at Highway	NLT-DLRH-01
General Creek at Mouth	NLT-GNRL-00
Griff Creek at Mouth	NLT-GRIF-00
Hatchery Creek at Star Harbor	NLT-STAR-01
Homewood Creek at Highway	NLT-HMWD-01
Lake Forest Creek at Mouth	NLT-LKFC-00
McKinney Creek at Highway	NLT-MKNY-01
Quail Creek at Mouth	NLT-QULC-00
Secret Harbor Creek at Mouth	NLT-SCRT-00
Snow Creek at Mouth	NLT-SNOW-00
Tahoe City Urban Ditch at Lake	NLT-TCUD-00
Watson Creek at Mouth	NLT-WATS-00
Middle Truckee River	
Tahoe Donner Clubhouse	MTR-TROU-02
ACOE boundary at Lahontan	MTR-MART-01
Alder Creek	MTR-ALDR
Bear Creek - West of Confluence with Truckee	MTR-BEAR-00
Cold Stream Canyon Basin	MTR-COLD-00
Donner at Confluence	MTR-DONN-00
Donner Creek at 89	MTR-DONN-01
Downstream of Dam	MTR-DONN-03
East Martis at Bridge	MTR-EMAR
I80 at Floriston	MTR-I80C
LTR at Boyington	MTR-BOCA-01
LTR below Boca Dam	MTR-BOCA-00
Mainstem below Tahoe Dam	MTR-TR01
Martis Creek at Mouth	MTR-MART-00
Prosser Creek at 89	MTR-PROS-02
Prosser Creek below Dam	MTR-PROS-01
Silver Creek above 89	MTR-SILV
Squaw - West of Confluence with Truckee	MTR-SQCR-00
Summit Creek - ~ 1/4 mile above Confluence	MTR-SUMM
Trout Creek at Mouth	MTR-TROU-00
Truckee river in-Town	MTR-TOWN
Union Valley Creek	MTR-GLEN-00
Upstream of Glenshire Pond	MTR-GLEN-02
Lower Truckee River	
Hunter Creek	LTR-HUN
Thomas Creek	LTR-THOM
Truckee River at McCarran Ranch	LTR-MCR
Truckee River at Rock Park	LTR-ROC

White's Creek	LTR-WHI

Appendix C – Map of Monitoring Sites



Note: GPS coordinates are not currently available for the Middle Truckee River region sites.

Appendix D – Monitoring Equipment

Most monitoring teams are assigned the following field instruments:

- Armored Envirosafe thermometers (alcohol filled, 0.5°C resolution);
- Standard pH indicator strips (0.5 pH unit resolution) or handheld Hannah pH meters (0.02 unit resolution);
- Handheld Oakton TDS Tester Conductivity meters (10 µS/cm resolution) or Oakton Conductivity Low+ meters (1 µS/cm resolution); and
- Chemetrics Dissolved Oxygen kits (colorimetric, indigo carmine dye reaction, 1 mg/L resolution below 6 mg/L and 2 mg/L resolution above 6 mg/L)

Turbidimeters, used at the staging locations, were supplied by the Truckee River Watershed Council, the Tahoe Regional Planning Agency and the Lahontan Regional Water Quality Control Board.

Nutrient and bacteria samples are kept shaded in tote bags from the point of collection until samples are turned in at the event staging sites. At that point they are stored in coolers until arrival at the lab for analysis. Bacteria samples are collected in sterile Whirl-packs; nutrient and turbidity samples are collected in clean plastic sample bottles.

Bacteria samples collected in the Lake Tahoe Basin are transported from the event staging areas to either the Lahontan Water Quality Lab in South Lake Tahoe or the U.S. Geologic Survey office in Truckee. Bacteria samples collected from the Lower Truckee River are transported to the Nevada State Health Laboratory. The need for multiple labs for such a large area is to ensure sample analysis within the allotted 4-hour holding time. Quality assurance is comparable as each lab uses the same method, SM9222 from Standard Methods for Water and Wastewater Analysis, 21 Edition, 2007.

Nutrient samples collected in the Lake Tahoe Basin are delivered to South Tahoe Public Utility District in South Lake Tahoe directly after the event to allow enough time for analysis within the allotted hold time of 48 hours. Nutrient samples collected from the Lower Truckee River are taken to the Nevada State Health Lab for analysis. Nutrient samples collected from the Middle Truckee River are processed in-house by the Truckee River Watershed Council.