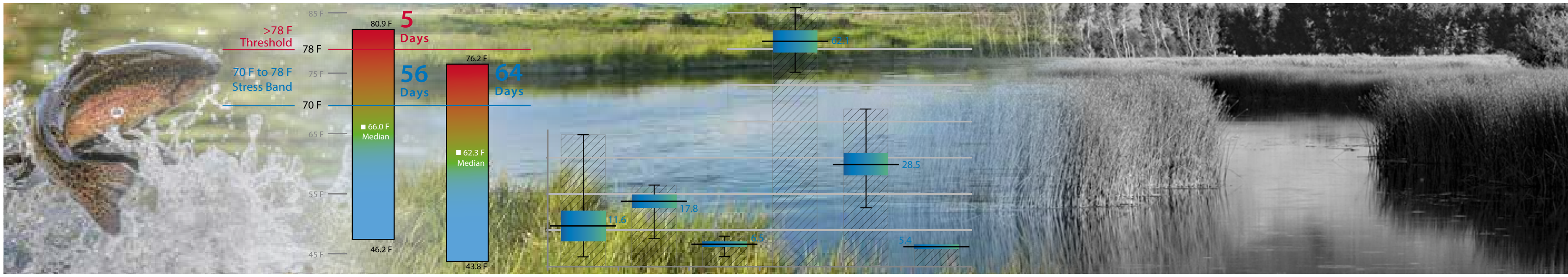
2018

Silver Creek Annual Report

Ecosystem Sciences Foundation



Ecosystem Sciences Foundation

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2018 Annual Report

Silver Creek Watershed

Photo: Shutterstock / CSNafzger

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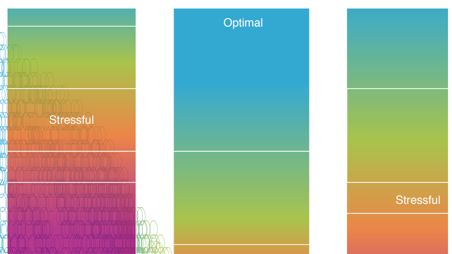
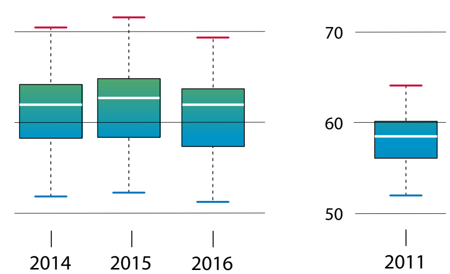




Silver Creek Watershed

Ecosystem Sciences Foundation (ESF) has been working in the Silver Creek watershed since 2009, when it partnered with The Nature Conservancy to develop a *Restoration and Enhancement Strategy* for the Silver Creek watershed. The strategy identified numerous actions to be taken, including addressing data gaps on stream flow, temperature and sediment conditions. To address these data gaps and improve our understanding of the Silver Creek system, ESF began its monitoring program in 2010. This past year, ESF and its partners continued to gather critical data on stream flows, temperature, sediment and dissolved oxygen. In addition, ESF conducted statistical analyses of temperature and dissolved oxygen monitoring results.

To date, our Silver Creek program has enjoyed support from numerous stakeholders. Most of the land within the watershed is privately owned; consequently, landowners in the watershed recognize the need to protect the ecological health of the watershed, as well as their rights as landowners. Our partners and stakeholders have been integral in helping us achieve our vision of providing direction for stewardship of the Silver Creek watershed and in designing and promoting appropriate stream restoration and enhancement actions.

The significant conclusions and findings from 2018 are:

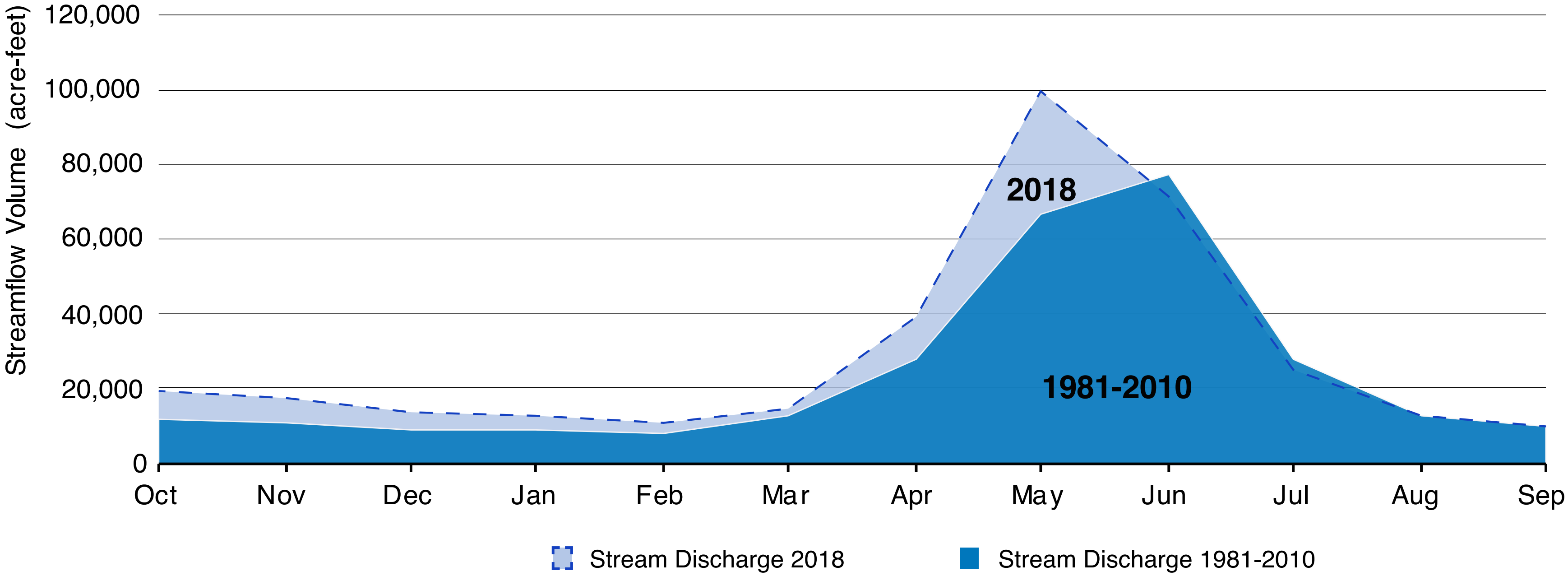
- After the historic water year of 2017, Silver Creek flows returned to close to average discharge within the system. The 2018 snowpack, run-off and groundwater levels were close to normal.
- With some exceptions, temperatures in the Silver Creek system were similar when compared to the last several years. Several areas saw temperatures above the stressful limit for fish for prolonged periods.
- Dissolved oxygen (DO) monitoring indicated that in some areas of Silver Creek, concentrations have become so low that they stress all life stages of trout, especially in Butte Creek and Lower Silver Creek. However, these conditions are generally limited to early morning hours. In the afternoon, DO levels rise rapidly. Cold tributary creeks like Grove, and Upper Loving Creek maintained higher DO levels than Butte Creek and Lower Silver Creek.
- Sediment monitoring indicate notable changes in the distribution and movement of sediment at selected cross-channel transects.

For more details please visit: www.savesilvercreek.com

The information that is presented in this report reflects summarized analysis of all data. We are presenting the most important aspects of the past season's work in a way that tells a story of the stream system and watershed. The information presented here is a result of detailed, scientifically rigorous analysis, and reflects a considerable amount of field work to collect. The website has additional information on programs in the watershed, including raw and tabulated data.

Winter Snow + Water Year 2018

The water year for 2017-18 featured snow pack levels slightly above the most recent 30 year average. In April 2018, snow water equivalent (SWE) levels within the Big Wood Basin were measured at 99% of the median measured 1981-2010. We calculate the total streamflow volume for the Big Wood River at Hailey (USGS gauge #13139510) to be 121% above the median from streamflow measured from 1981-2010. This is good news for the Silver Creek system that relies almost entirely on groundwater levels within the Wood River Valley Aquifer system, in which three-quarters of inflow is received directly from tributaries and streamflow losses. As a spring-fed system, Silver Creek's water comes from groundwater upwelling at springheads and streambed groundwater inputs for consistent flow. In 2018, monitoring within Silver Creek's tributaries showed a moderate increase in spring and stream flows. Additionally, none of the springs dried up mid-summer, which has been documented in low water years. Well water monitoring within the South Valley Groundwater District found that groundwater depth and artesian pressure was sustained at most wells throughout the June to November 2018 timeframe. The consistent, cool groundwater inputs that continued throughout the summer months led to a reduction in average and maximum stream temperatures at most locations when compared to some monitoring years. These benefits underscore the importance of groundwater as the ecological driver of the Silver Creek ecosystem.



Big Wood River stream flows (measured in acre-feet) for 2018 as compared to the most recent 30 year mean (1981-2010).

April 1, 2018

Idaho Water Supply Outlook Report

Big Wood Basin **99%** of median snowpack

Big Wood Basin **91%** of average precipitation

Streamflows up to **121%** of average

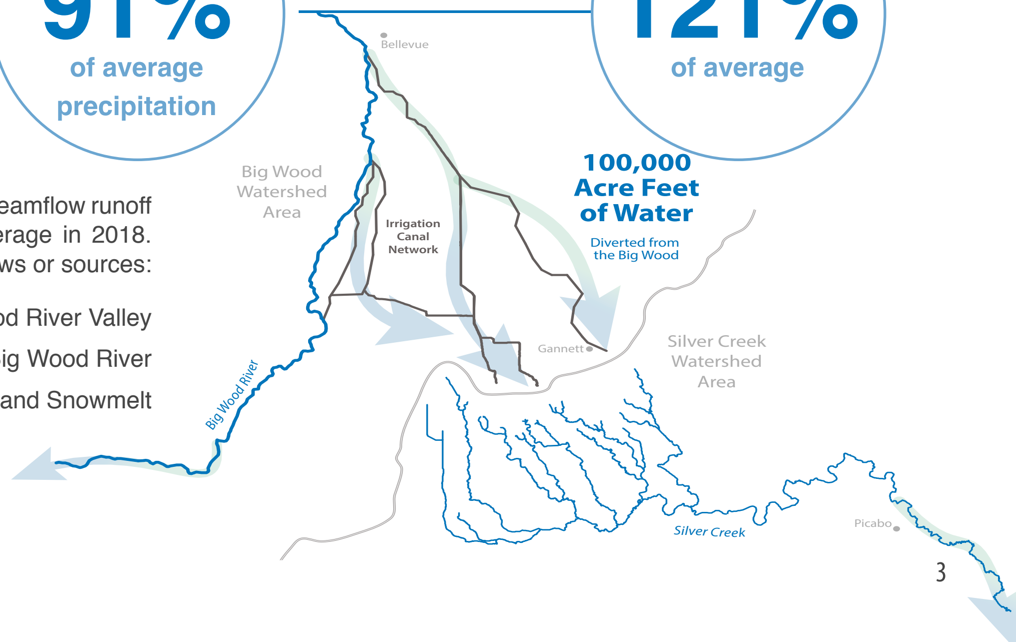
In 2018, the Big Wood basin received average precipitation between Oct 1 and April 1.

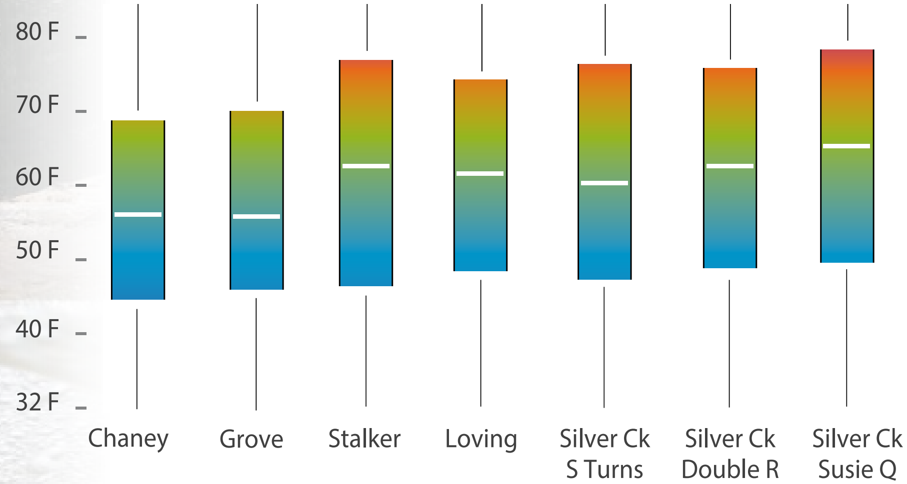
Snowpack conditions, forecast streamflow runoff and groundwater flows were average in 2018. Major Silver Creek water inflows or sources:

1) Groundwater inflows, Wood River Valley

2) Irrigation diversions from the Big Wood River

3) Precipitation and Snowmelt





Summer Stream Temperatures: The graph above indicates the maximum, average and minimum summer stream temperatures on selected areas of Silver Creek over a six-year period (2011-2017). This year, 43 stream temperature loggers and 13 springhead loggers were monitored throughout Silver Creek and its tributaries to record critical information and track changes in the system.

Stream Temperature

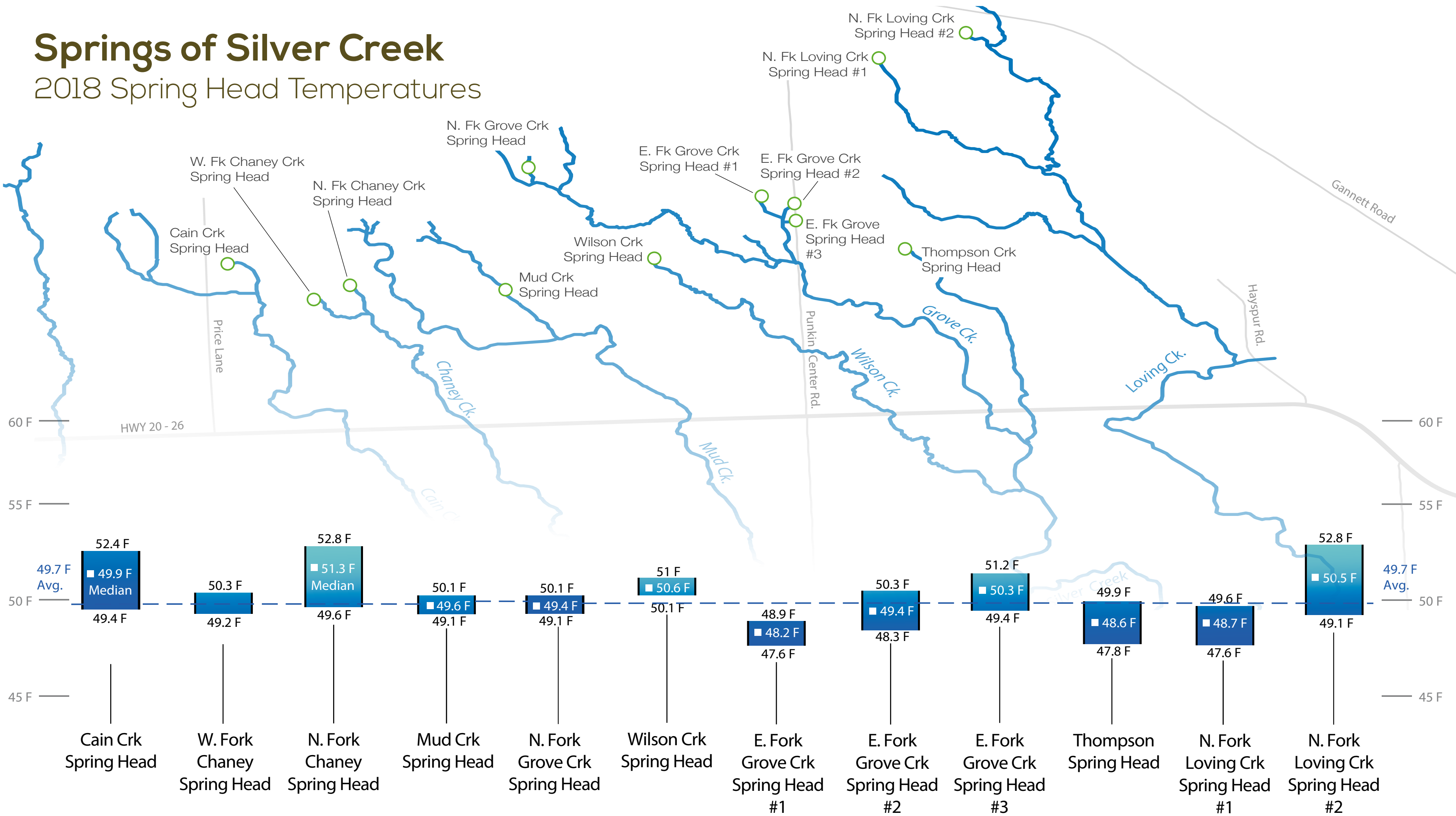
In 2018, we deployed 13 springhead and 43 stream temperature loggers in key locations throughout the Silver Creek watershed. It is important to monitor the springs that feed Silver Creek because they are the primary source of water to the system. These springs provide consistent, cool water to Silver Creek's tributaries that can mitigate against changes in air temperature and climatic conditions.

For the 13 spring head loggers, median temperatures were near 49.7°F throughout the summer of 2018. As opposed to a few previous years, no springheads dried up during mid-summer. The record 2016-17 water year partially carried over to the 2017-2018 water year, increasing groundwater levels and allowing for both a longer durations of high springhead flows and reduced extraction of groundwater for agricultural use. This helped to maintain higher spring flows year-round. As a spring-driven system, these springs are critical to the health and persistence of Silver Creek.

Temperature monitoring within Silver Creek and its tributaries found average and maximum stream temperatures relatively normal at most locations, when compared to temperatures measured from 2013-2016. These stream temperatures illustrate the connection between the near-normal water-year, and carry-over from 2017, which led to a slight increase

Springs of Silver Creek

2018 Spring Head Temperatures

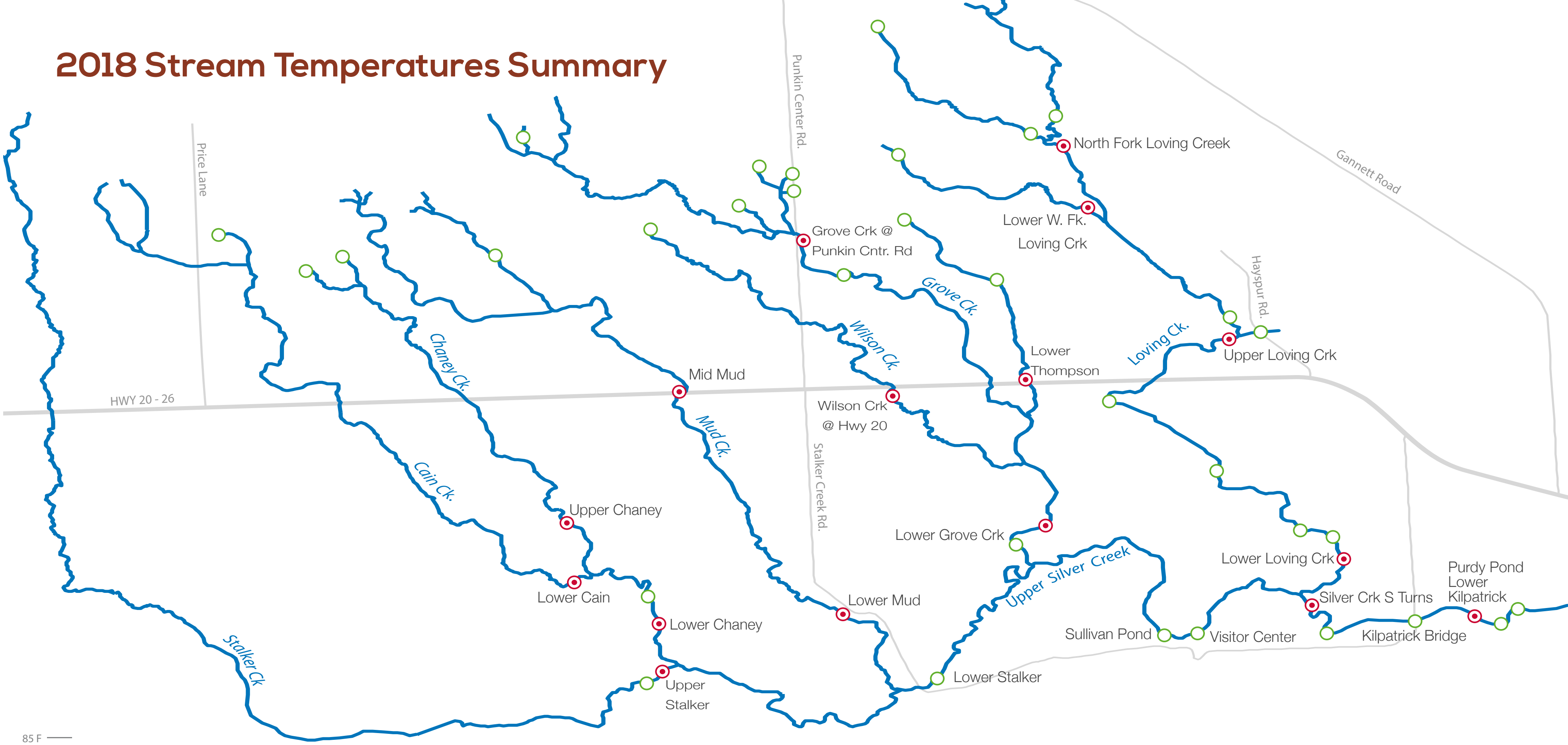


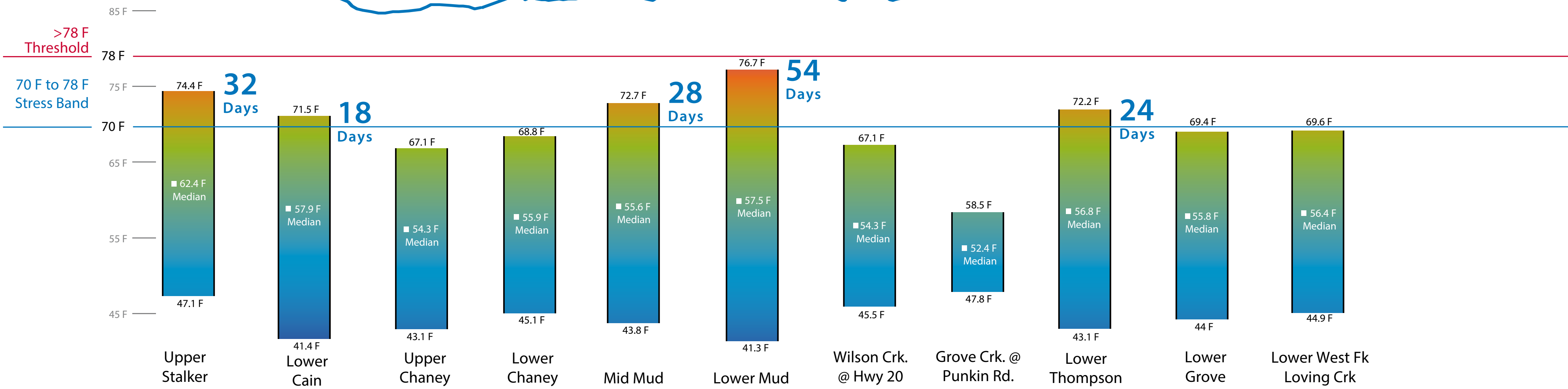
Spring Head Temperature Bands The above graphic depicts the summarized spring head temperature data for the entire summer season. The data were analyzed for the summer season to illustrate the spring temperatures that occurred for the period of June through September, 2018. Each graph displays the total temperature range from June 1 to September 30; the absolute high and low temperatures are given, and the median water temperature is shown for that particular spring.

in the duration and quantity of groundwater. The most notable decrease in temperature was measured in Chaney Creek, which the remained below the stress band (70°F) for trout throughout the monitoring period in 2017 and 2018; average temperatures decreased by 2-4°F and maximum temperatures decreased by 4-10°F from those measured previously. In contrast, water temperatures in both Stalker and Cain Creek increased, by about 3°F and 1°F respectively, as compared to previous monitoring years.

A possible explanation for this increase in stream temperature is that in lower run-off years, a larger percentage of the creek water is coming from springs that bring deep, confined aquifer water to the surface. In 2018, there was shallower, warmer groundwater entering the stream, leading to higher temperatures.

2018 Stream Temperatures Summary





Stream temperature bands The above graphic depicts the summarized stream temperature data for the entire summer season for a selected group of data loggers and locations. The data were analyzed for the summer season to illustrate the high temperatures that occurred throughout the stream system for the period of June through the end of September, 2018. Each graph displays the total temperature range for the 2018 season; the absolute high and low temperatures are given, and the median stream temperature is shown for that particular stream.

Locations of Stream Temperature Logger Array

This map illustrates the Silver Creek stream and tributary system along with the locations of the stream temperature loggers. The temperature loggers are expressed in two categories for discussion and analysis purposes:

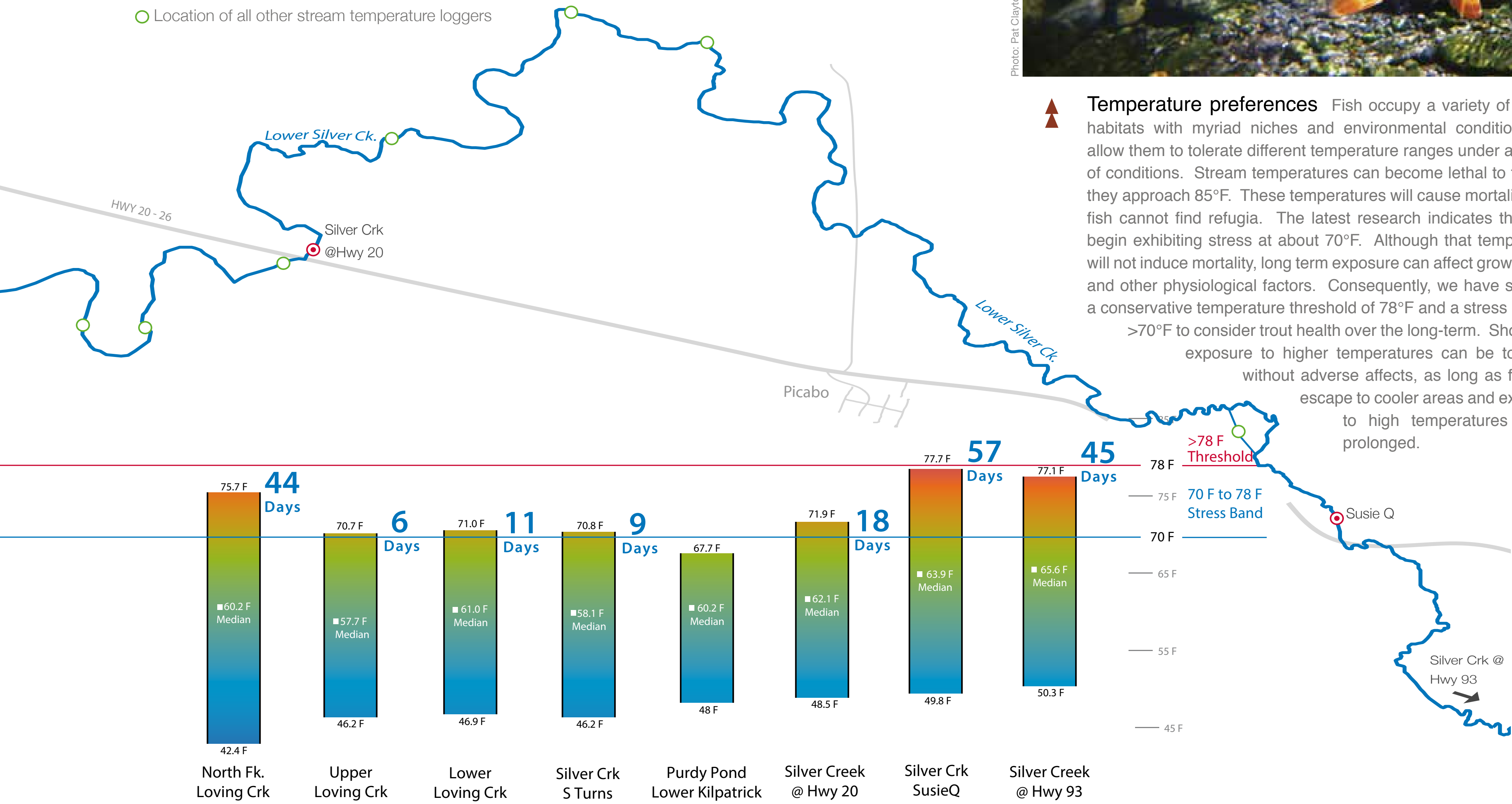
◉ Location of stream temperature loggers illustrated in bottom graphic of seasonal temperatures

○ Location of all other stream temperature loggers

Stream temperatures are logged at one-hour intervals over a twenty-four-hour period for as long as the logger is left in place. The array of stream temperature loggers in the Silver Creek system is designed to capture temperature differences for each stream and tributary segment, from the spring source to Lower Silver Creek at the Highway 93 crossing.

Photo: Pat Clayton

Temperature preferences Fish occupy a variety of stream habitats with myriad niches and environmental conditions that allow them to tolerate different temperature ranges under a variety of conditions. Stream temperatures can become lethal to trout as they approach 85°F. These temperatures will cause mortality if the fish cannot find refugia. The latest research indicates that trout begin exhibiting stress at about 70°F. Although that temperature will not induce mortality, long term exposure can affect growth rates and other physiological factors. Consequently, we have selected a conservative temperature threshold of 78°F and a stress band of >70°F to consider trout health over the long-term. Short-term exposure to higher temperatures can be tolerated without adverse affects, as long as fish can escape to cooler areas and exposure to high temperatures is not prolonged.



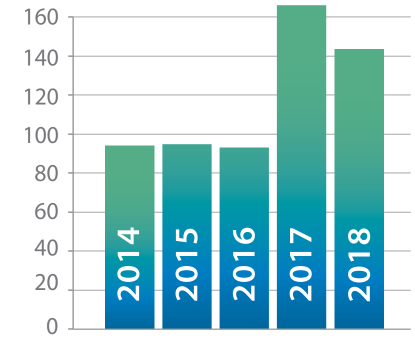
The overall median temperatures throughout the summer were within the preference range for trout (around 55-60 degrees) in Cain, Chaney, Mud, Wilson, Grove, Thompson, and the upper reaches of Loving Creek. Stalker Creek, Lower Loving Creek and Lower Silver Creek all had median temperatures above 60°F. Additionally, the number of days that temperatures were within the stress band for trout (70°F-78°F) increased compared to measurements taken in 2017; 12 sites having multiple days within the stress band. In 2018, there were no sites where temperatures exceeded the upper stress threshold (78°F) for trout.

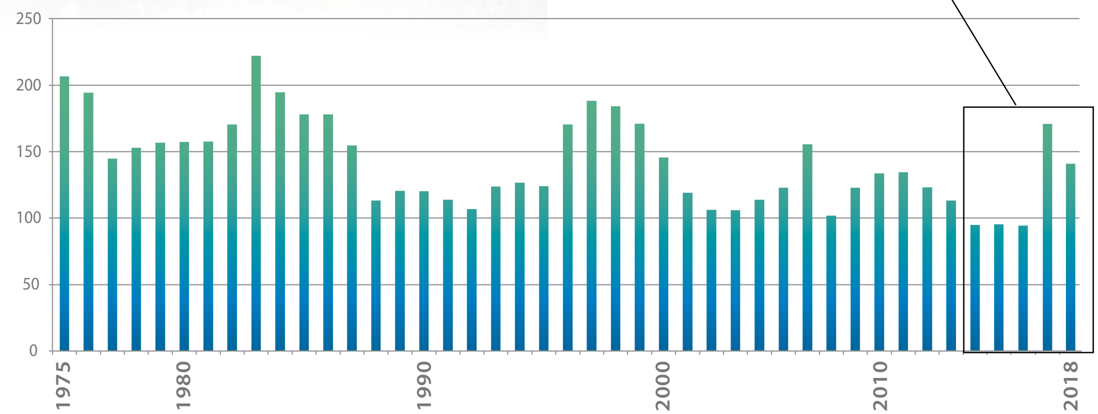
Stream Hydrology

Monitoring streamflows is important, as it helps build our understanding of the volume and origin of water entering Silver Creek's tributaries and its potential influence on water temperature, dissolved oxygen and other water quality parameters.

Total annual discharge at Sportsman's Access in 2018 was above average and flows were above the 30-year average. Silver Creek's tributaries varied slightly but in general were similar to average flows recorded since monitoring began in 2011. It was an above average water year for Silver Creek and its tributaries. Similarly, the Big Wood River had an above average annual discharge in 2018.

Annual average streamflows (cfs) at USGS gage (Sportsmans Access) 1975 - 2018.





Silver Creek annual average streamflows (cfs) at USGS gage (Sportsmans Access) 1975 - 2018.

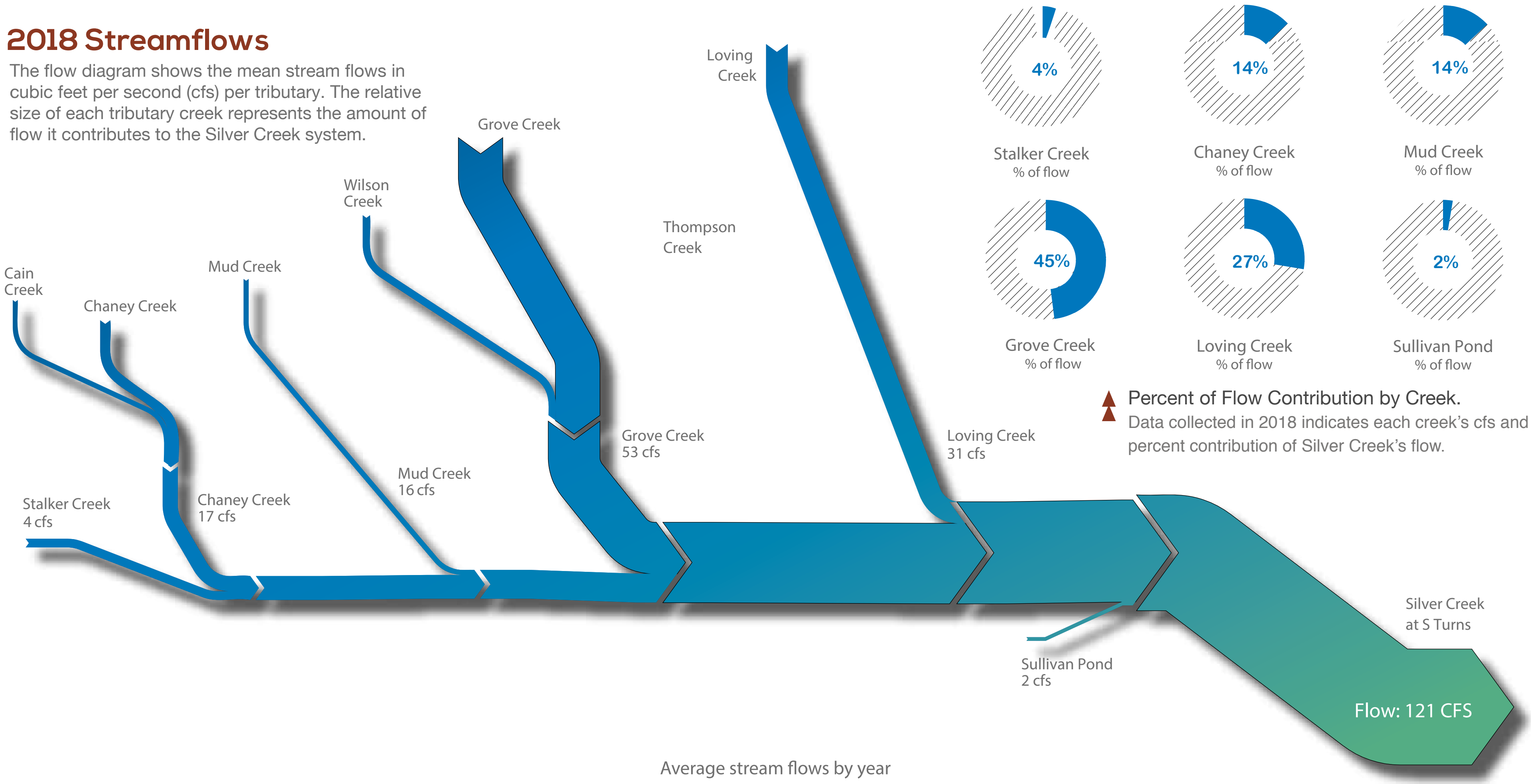
Big Wood River Average Annual Discharge at Hailey gage (cfs):

2014	309.7
2015	311.5
2016	406.4
2017	1,003.0
2018	478.6

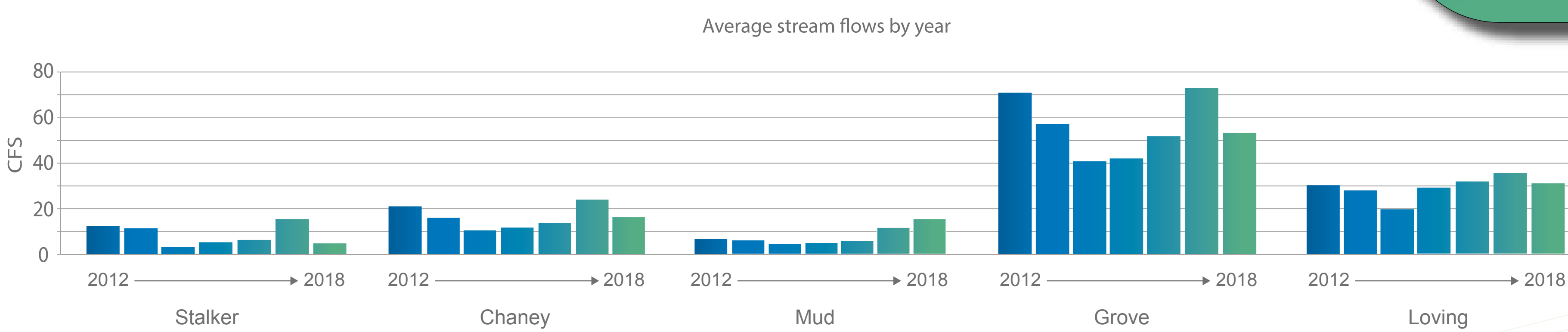
The 2018 water year resulted in above-average flows in the Big Wood River, Silver Creek, and its tributaries. These systems are connected by a common groundwater system that is dynamic and complex.

2018 Streamflows

The flow diagram shows the mean stream flows in cubic feet per second (cfs) per tributary. The relative size of each tributary creek represents the amount of flow it contributes to the Silver Creek system.



Percent of Flow Contribution by Creek. Data collected in 2018 indicates each creek's cfs and percent contribution of Silver Creek's flow.



Annual average streamflows by creek for 2012-2018. Data collected from 2012 - 2018 shows each creek's average flow. The overall increase in streamflows (2017) affects many critical components of the aquatic ecosystem. Measurements were not continuous, but were distributed throughout the spring, summer and fall.

Water Quality

Dissolved Oxygen

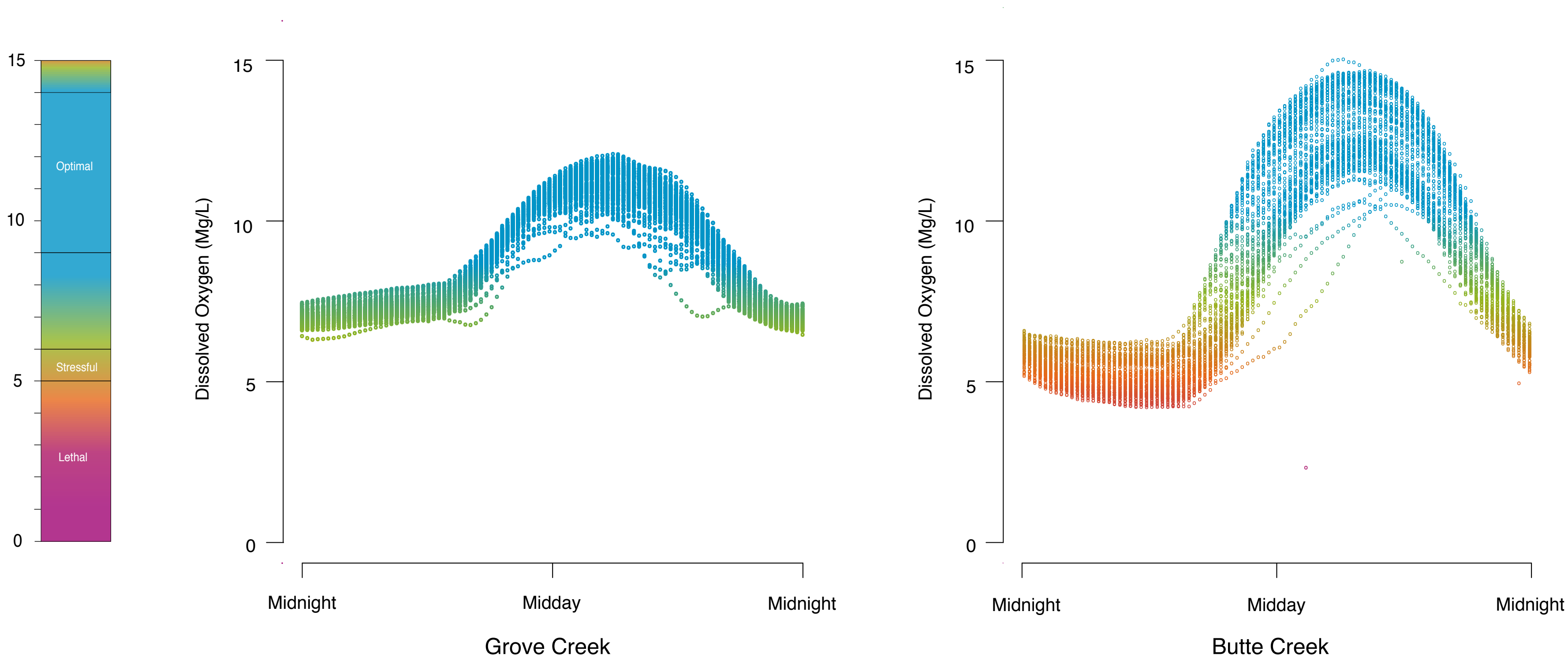
Since 2016, dissolved oxygen (DO) has been measured continuously from June through October at 6 sites. In 2017 and 2018, additional sensors were deployed and placed in various sites. Data was recorded using optical sensors that record DO and temperature values every 15 minutes.

Similar to past year's results, the data indicated that not all of Silver Creek's waterways exhibit the same pattern of DO values and that DO levels stress fish in certain locations at certain times of the day. Seasonal fluctuations also occur, as changes in sunlight, temperature, flow and aquatic plant growth vary throughout the year.

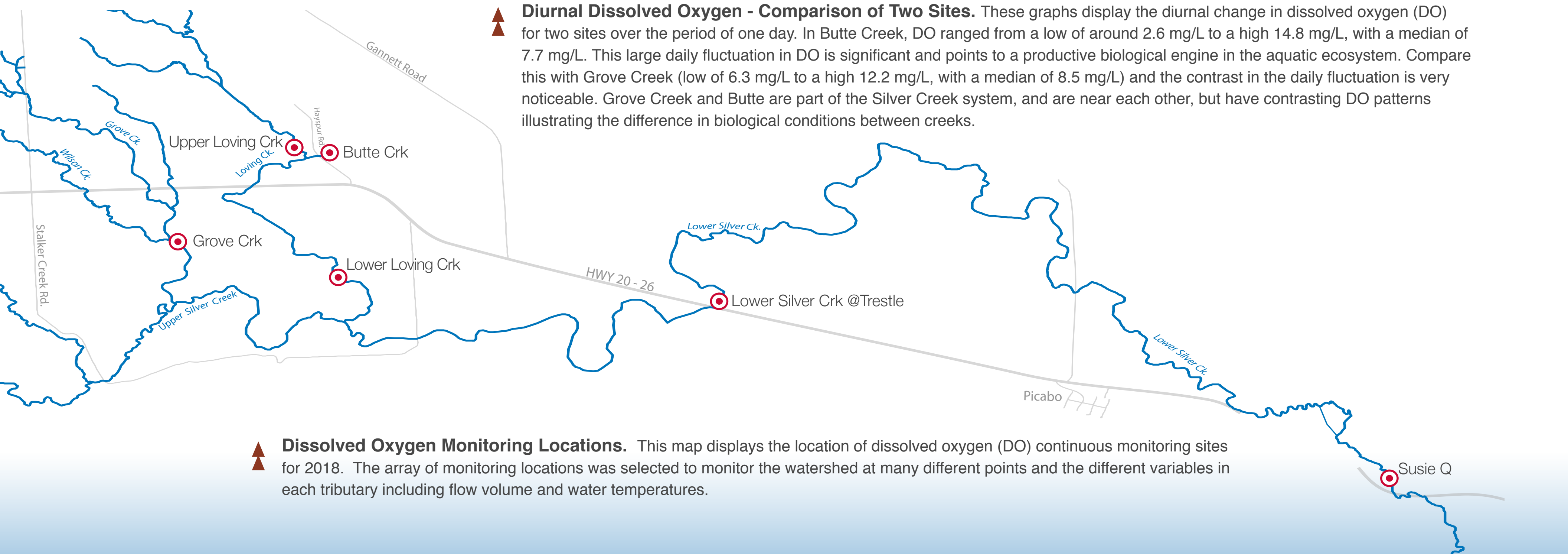
In many areas of the Silver Creek system the daily fluctuations in DO are significant, which points to a productive biological engine in the aquatic ecosystem. As aquatic plant life within the stream utilizes photosynthesis to create energy, oxygen is produced. This process raises DO levels, which peak in the afternoon.

Overnight, plants continue to respire without photosynthesis, which requires oxygen (this demand is called biological oxygen demand) that they take from the water. This daily process causes DO levels to be lowest just before dawn and highest in the afternoon, exhibiting a distinct diurnal cycle. As shown by the diurnal graphs presented, not all cycles are the same. The sensor placed at Grove Creek is near to the Butte Creek sensor location. Despite their proximity in geographic space, their DO levels vary significantly (see diurnal plots on the facing page). This is due to a combination of factors, including volume, temperature, nutrient concentrations, and aquatic plant life, among others.

When DO readings fall into the stressful range for fish, they will seek refuge in areas that have higher DO concentrations. Fish eggs are buried in gravels and lack the mobility to escape these conditions. At the selected sites, 11% of all DO measurements were between stressful to lethal levels for fish and their eggs (1st quartile at Butte: 5.7mg/L; Lower Loving Creek: 6.5mg/L). The seasonal graphs on the following pages present all data points taken during the 2018 season.

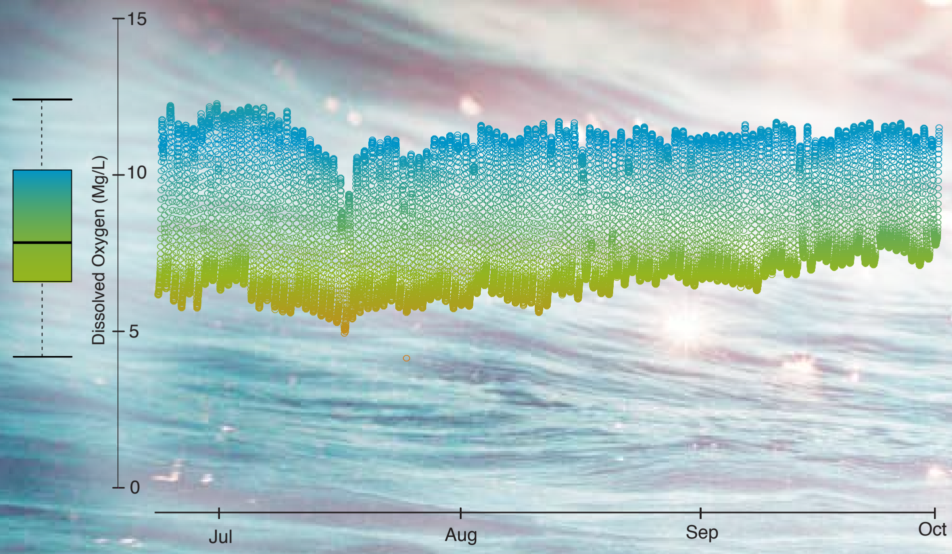


Diurnal Dissolved Oxygen - Comparison of Two Sites. These graphs display the diurnal change in dissolved oxygen (DO) for two sites over the period of one day. In Butte Creek, DO ranged from a low of around 2.6 mg/L to a high 14.8 mg/L, with a median of 7.7 mg/L. This large daily fluctuation in DO is significant and points to a productive biological engine in the aquatic ecosystem. Compare this with Grove Creek (low of 6.3 mg/L to a high 12.2 mg/L, with a median of 8.5 mg/L) and the contrast in the daily fluctuation is very noticeable. Grove Creek and Butte are part of the Silver Creek system, and are near each other, but have contrasting DO patterns illustrating the difference in biological conditions between creeks.

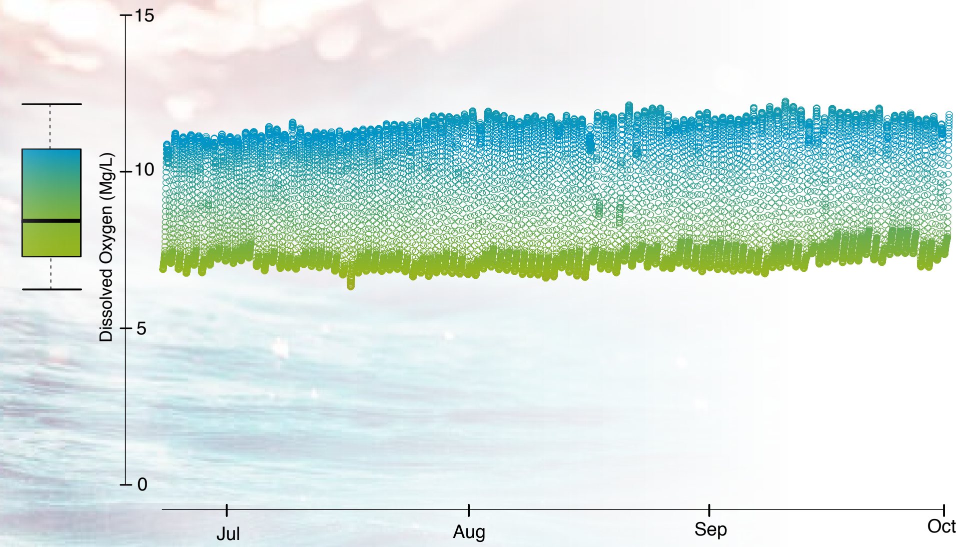


Dissolved Oxygen Monitoring Locations. This map displays the location of dissolved oxygen (DO) continuous monitoring sites for 2018. The array of monitoring locations was selected to monitor the watershed at many different points and the different variables in each tributary including flow volume and water temperatures.

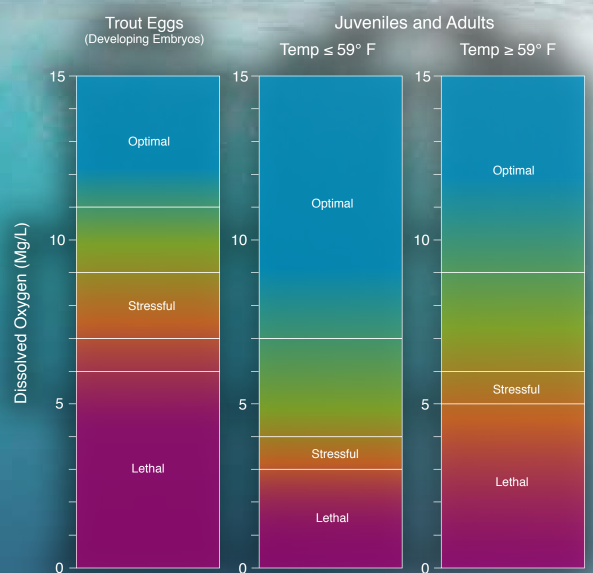
Dissolved Oxygen Results



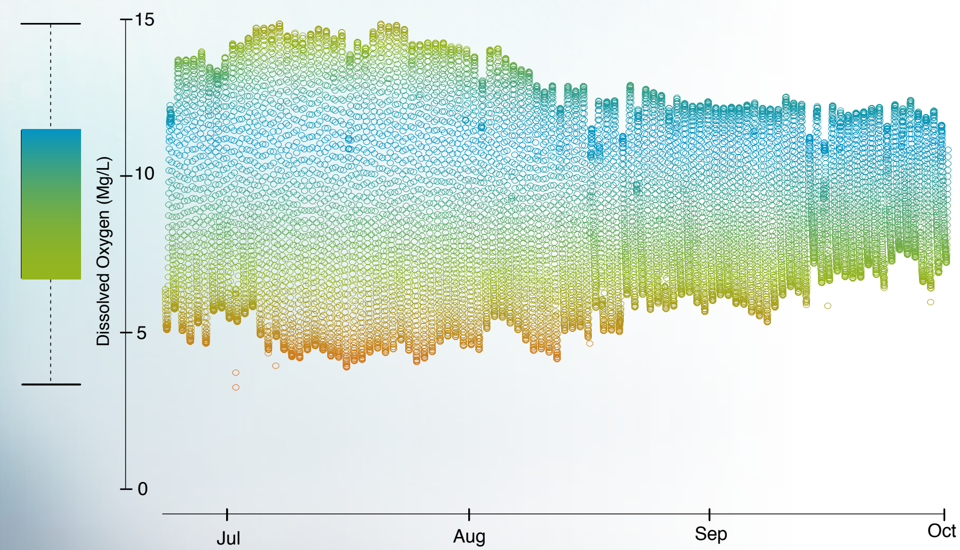
Upper Loving Creek



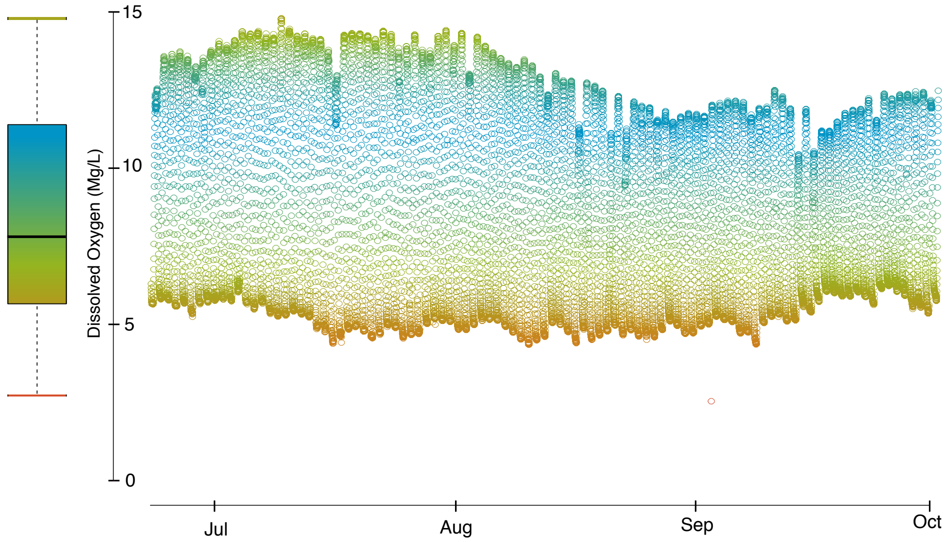
Grove Creek



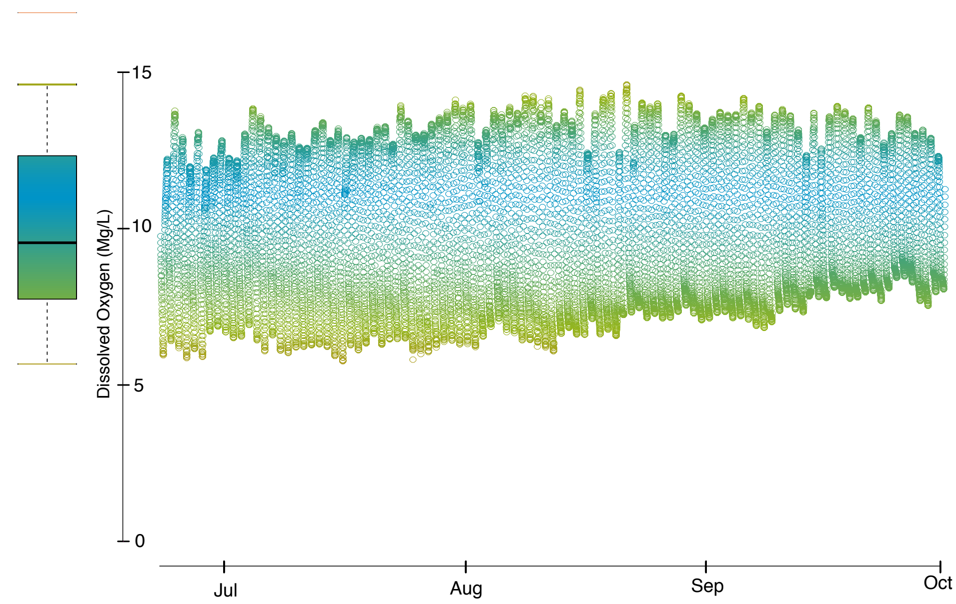
Average Dissolved Oxygen Requirements for Salmonids. Trout, depending on thier particular life stage (egg, Juvenile, Adult), have differing requirements and thresholds for dissolved oxygen levels. Water temperature also plays a major role in dissolved oxygen levels. (Adapted from EPA's Chapman, 1986, and USFWS's Raleigh et al 1984, and Raleigh et al 1996).



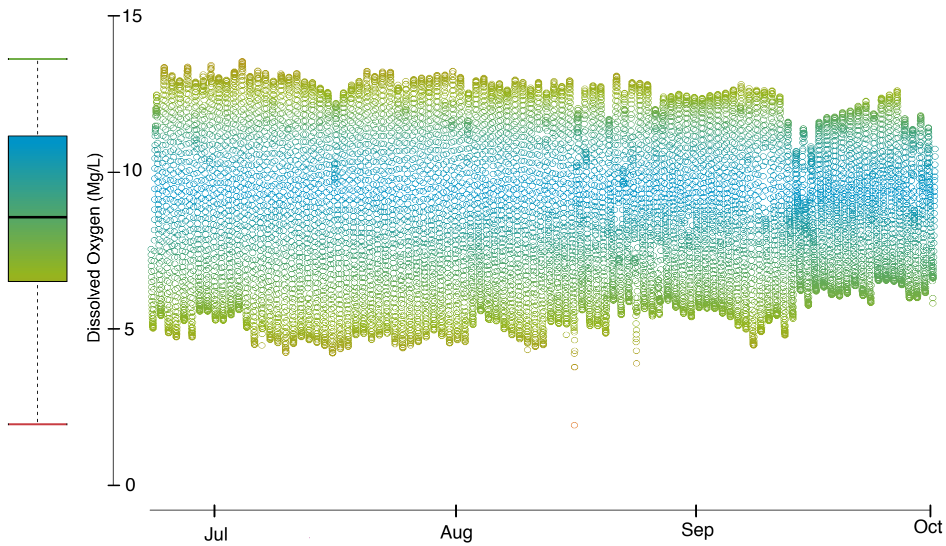
Lower Stalker Creek



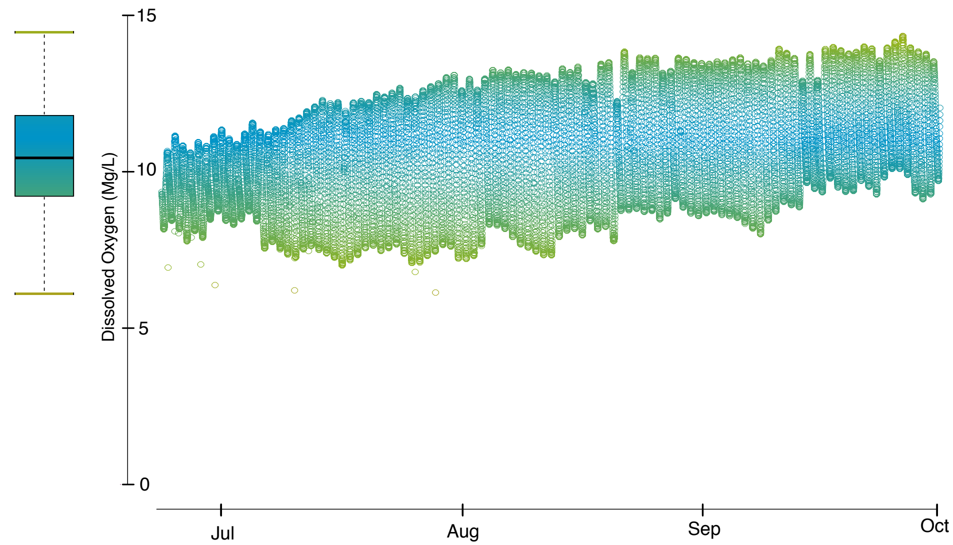
Butte Creek



Lower Silver Creek at Trestle

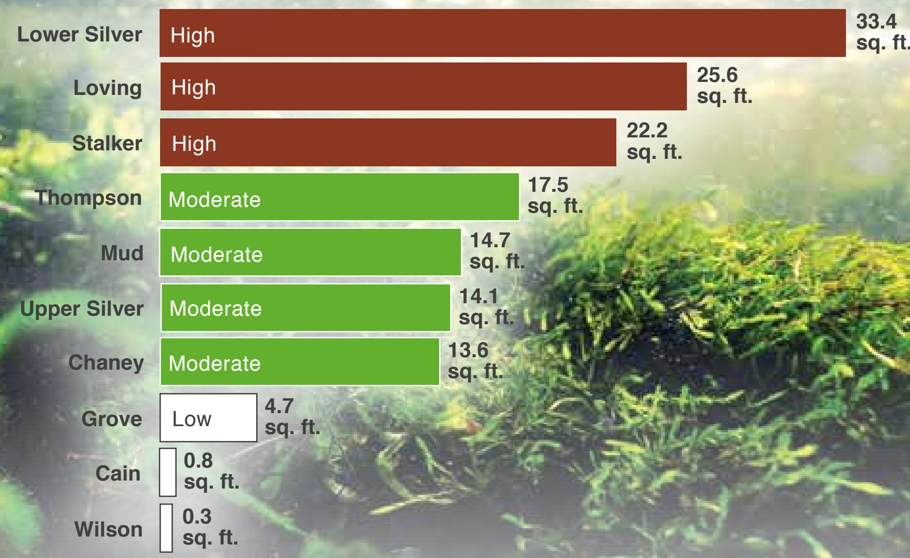


Lower Loving Creek



Susie Q

Stream Sediment



Average Sediment Accumulated by Stream
In 2011, sediment area was measured at 60 cross sections to estimate each stream's condition. Transects were averaged for each creek to categorize streams into high, medium and low. For example, the average area of sediments for all transects on Lower Silver is 33.4 square feet (sq. ft.).

"Legacy" sediments were deposited during the earlier years of intensive livestock grazing when stream banks were trampled and riparian vegetation was removed. It was during these years that the greatest amounts of sediment accumulated in the streams. In time, grazing and farming practices have improved and the volume of sediment entering the streams has diminished.

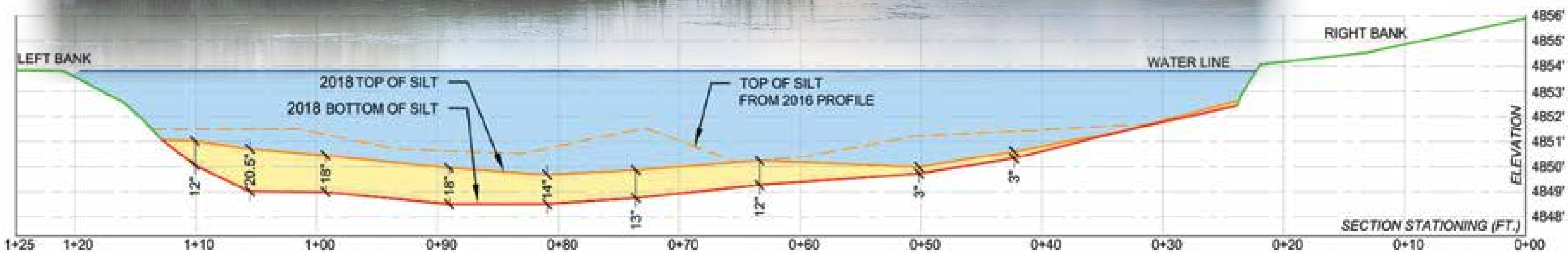
However, new sediment enters the streams each year as overland runoff during spring rain and snowmelt and windborne deposits. In order to characterize sediment conditions throughout the watershed, we established 60 cross channel transects in Silver Creek and all its tributaries.

To determine if sediment is being exported, accumulating or simply in balance from one year to the next, we measure changes at selected transects.

In 2018, sediment monitoring occurred at five sites on Silver Creek, starting at the Preserve and moving downstream. At each location, the depth and extent of sediment in the stream channel was surveyed. The focus on revisiting locations within Lower Silver Creek is twofold: 1) to monitor sediment post implementation of the Kilpatrick Pond Restoration Project and 2) to monitor post project performance of Kilpatrick pond near Double RR ranch.

Monitoring shows that while some sediment was re-deposited, many locations have significantly less sediment than was present before dredging was performed.

Cross Channel Sediment Transects - Lower SIlver Creek, 2018 The aerial image below depicts the location of cross-channel sediment transects on Lower Silver Creek that were surveyed in 2018. The TNC Preserve is on the far left and proceeds downstream to Kilpatrick bridge and pond and then to the RR Ranch. The work utilized precision drone flight for high quality imagery and topography. The drone capture images 225' above ground level (AGL) with 0.7 inch per pixel resolution and utilizes post process imaging with ground control points from GPS to produce high quality orthomosaic photos and underwater topography. (Data and imagery in cooperation with N. Schutte Consulting).



Cross Channel Sediment Transect Comparison The graphic above depicts a cross-channel view of transect #68 on the TNC Preserve just upstream from Kilpatrick bridge. The site was surveyed in 2016 and 2018. It demonstrates a decrease of approximately 55 sq. ft. of sediment at this stream channel cross-section. This change is a result of sediment movement and export within the reach.

Next Steps

eDNA Monitoring

In partnership with the National Genomics Center for Wildlife and Fisheries Conservation, Ecosystem Sciences Foundation would like to conduct Environmental DNA (eDNA) sampling in Silver Creek and its tributaries in 2019. The collection of eDNA has become a common tool among researchers to detect the presence of macrobial species (i.e. fishes, amphibians, mollusks, crustaceans, and insects) based on the presence of their DNA in air, water and soil. The use of eDNA sampling has been found to be a simple and efficient tool for determining a species' presence in an ecosystem and is often as effective as traditional sampling techniques. Of interest, eDNA can be used to detect species that are rare, difficult to find, or are in low densities within the ecosystem. For streams, conducting eDNA sampling is non-invasive and generally involves filtering several liters of water from the area of interest and then testing for DNA signatures. This permits rapid collection of large numbers of samples, each with a high probability of species detection. In the Silver Creek watershed, eDNA sampling would be used to estimate the abundance and distribution of rainbow trout, brown trout and other fish species. This study will provide important information about Silver Creek's fish species for both conservation and recreational purposes. Please consider a donation to support this innovative project!

Fish Habitat Analysis and Mapping

Fish habitat features and redd counts were surveyed on nearly all the tributaries in Silver Creek in fall 2015 and spring 2016. However, due to lack of funding, the mainstem of Silver Creek has not been surveyed yet. ESF is seeking funds to conduct redd counts in the mainstem Silver Creek during the spring season and fall seasons in 2019. Our goal is to create a database of redd locations for brown and rainbow trout, as well as a map that identifies redd locations and delineates habitat such as: spawning areas, early rearing and nursery areas, side channels, pools, undercut banks, resting and feeding zones, and an evaluation of streambank conditions.

Monitoring and Maintenance

Over the past 8 years, the Silver Creek Program has monitored stream hydrology, water temperature, sedimentation and most recently dissolved oxygen. Combined, these parameters are indicators of ecosystem health much like checking our own body temperature and circulatory system. Monitoring is paramount to understanding ecological processes and relationships, identifying trends and establishing effective strategies for enhancement. However, monitoring is a long-term scientific tool that must be done consistently over time; the more data collected, the more meaningful the results. As our monitoring program continues, it is necessary to periodically replace temperature sensors and redeploy DO sensors, which comes at a capital cost. We are seeking additional funding to maintain our monitoring equipment and continue these important programs.

Funding

To continue our ongoing monitoring work and perform new analyses, as described above, our Silver Creek Program needs additional funding. Our program is heavily based on monitoring and data analysis; we have found that these activities alone are rarely funded through traditional grant programs. Please consider a donation to continue this important work. A substantial volunteer effort goes into the Silver Creek program each year and your donations directly support the Program. Thank you for your support!

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