2015

UPPER GALLATIN RIVER WATERSHED

WATER QUALITY REPORT

Kristin Gardner, PhD | Executive Director, Gallatin River Task Force
Stephanie Lynn | Education and Communications Coordinator, Gallatin River Task Force

January 2016

The continuous monitoring work of the Gallatin River Task Force would not be possible without the support of the Big Sky Resort Area Tax District, the Montana Department of Environmental Quality, donors, and numerous volunteers. Thank you for helping to protect and preserve the health of the Upper Gallatin River Watershed, an irreplaceable and highly valued natural and community resource.

GALLATIN RIVER
TASK FORCE

EXECUTIVE SUMMARY

Over 2015, the Gallatin River Task Force (Task Force) and its volunteers collected more than 8,000 data points! This data was collected to assess water quality, macroinvertebrate (stream insect) populations, and streamflow at sixteen sites in the Upper Gallatin River Watershed. The Task Force analyzes this data to assess and track the health of the Upper Gallatin River and its tributaries.

Results indicated healthy levels of dissolved oxygen and temperature for trout and stream insects at all sites. Nitrate levels were elevated at several sites on the West Fork of the Gallatin River (West Fork) and the Middle Fork of the West Fork (Middle Fork). High nitrate levels can increase algal growth and adversely impact fish and stream insect populations. Human sources of nitrate in river water include human and animal waste, stormwater runoff, and fertilizer.

Fine sediment sampling indicated that the Middle Fork just before it joins the North Fork had more streambed sediment than is healthy for fish and aquatic insects. Fine sediment can smother trout spawning grounds and aquatic insect habitat. Excess fine sediment can originate from natural and human aggravated land disturbances, erosion from construction areas and unpaved roads, and road traction sand. The Task Force is embarking on multiple projects over the next few years to address elevated nitrate and fine sediment in the Upper Gallatin River Watershed.

Chloride levels were elevated at four sites in the West Fork Watershed during the winter sampling event in January. Human sources of chloride include discharge from pools and hot tubs, wastewater, and road salt. Chloride levels were not high enough to affect aquatic life. The Task Force will continue monitoring chloride at all sites and will investigate potential sources.

Stream insect populations collected at four sites on the Upper West Fork indicated healthy insect populations and good water quality. Streamflow in the Upper Gallatin was well below the 84-year average during spring runoff and summer baseflow at the Gallatin Gateway US Geological Survey (USGS) gauge at the mouth of Gallatin Canyon. This was a result of a below average snowpack and an earlier than usual snowmelt.

Task Force staff members, Stephanie Lynn and Andrea Saari, measuring levels of fine sediment at the Bucks site on the mainstem Gallatin (Figure 1A). Photo credit: Rich Addicks

INTRODUCTION

The Gallatin River Task Force (Task Force), formerly known as the Blue Water Task Force, is a nonprofit watershed group headquartered in Big Sky, Montana. Our mission is to partner with our community to inspire stewardship of the Gallatin River Watershed.

For the past 15 years, the Task Force and volunteers have collected routine watershed and aquatic insect data on the Upper Gallatin River and its tributaries. The Upper Gallatin River flows south from the headwaters at Gallatin Lake in Yellowstone National Park to the Spanish Creek confluence, just before the river exits Gallatin Canyon. During its 30-mile journey, the river flows through canyon, valley, and meadow, as well as a mix of public and private land.

The Task Force and partners use this monitoring data to evaluate the health of the Upper Gallatin River Watershed. In addition, this data helps to plan restoration projects to improve water quality as well as fish, macroinvertebrate (aquatic insect), and near-stream habitat.

MONITORING PROGRAM

The Task Force Community Water Quality Monitoring program utilizes trained volunteers to monitor sixteen sites in the Upper Gallatin River Watershed. Seven sites are on the mainstem Upper Gallatin River, one site is on the Taylor Fork (Figure 1A), and eight sites are located on tributaries within the West Fork Watershed (Figure 1B). These sites capture the potential impacts of changing geology and land use. All sixteen sites are monitored four times a year to track changes in water quality across hydrological regimes, such as high flow versus low flow, and biological regimes, such as the growing season versus the dormant season.

The following water quality parameters are measured at each site: **pH**, **temperature, dissolved oxygen**, **turbidity**, **chloride**, **nitrate**, **E. coli**, and **total coliform**. In the summer, we add **total nitrogen**, **total phosphorous**, **fine sediment**, and photo documentation of **algae** to our regime at each site. See the Glossary on page 8 for further description of these parameters and their usefulness in assessing river health. All words in **bold blue font** are defined in the Glossary.

Task Force volunteer, Meredith Hardy, measuring dissolved oxygen at the Big Horn site on the mainstem Gallatin (Figure 1A). Photo credit: Rich Addicks

Every summer the Task Force assesses **macroinvertebrate** or aquatic insect populations at four sites. This year, we collected macroinvertebrates along the Big Sky Golf Course to gather **baseline** information before the Upper West Fork restoration project breaks ground.

In addition, the Task Force maintains four **streamflow** stations in the West Fork Watershed that continuously measure **stream stage** (water level), **temperature**, and **conductivity** (Figure 1B). Streamflow is calculated from a relationship between stream stage and streamflow measurements. The data from the streamflow stations is streamed real-time on the Task Force website.

For more information:

Kristin Gardner | 406-993-2519 | kristin@gallatinrivertaskforce.org

Visit: gallatinrivertaskforce.org/stream-data/

2015 MONITORING RESULTS

Over the past year, the Task Force staff, board, and volunteers collected more than 8,000 data points! Thank you to the hardworking volunteers who braved sun, rain, and snow to measure the vital signs of our rivers and streams.

WATER QUALITY

In general, our results supported historical findings. Two of our monitoring sites located downstream of the Little Coyote bridge (Community and WF above SF, Figure 1B) demonstrated high **nitrate** concentrations (Figures 2B and 2H). The Upper West Fork has continually exhibited nitrate above recommended levels. Potential human sources of nitrate include fertilizer and wastewater.

Throughout the year, **chloride** levels were also elevated above background in the Upper West Fork (Figures 2B, 2D, and 2F). Elevated nitrogen and chloride in the Upper West Fork were likely derived from wastewater. During our winter sampling events, **chloride** levels were elevated throughout the watershed (Figures 2A and 2B), but were well below the concentration that is toxic to aquatic life (>230 mg/l). Elevated chloride in the winter likely originates from salt used for winter maintenance carried by runoff to rivers and streams

E.coli levels were above state recommended levels at Bighorn and WF above SF in September. E. coli is a bacteria that lives in the lower intestines of mammals. Potential sources of E. coli include wastewater and animal waste.

The Lower Middle site (Figure 1B) on the Middle Fork just upstream from the confluence with the North Fork demonstrated fine sediment levels that impair habitat for fish and aquatic insects. **Fine sediment** can smother fish spawning grounds and aquatic insect habitat.

Task Force staff member, Stephanie Lynn, and volunteer, Adam Johnson, measuring fine sediment at the Lower Middle site (Figure 1B). Photo credit: Rich Addicks

2015 MONITORING RESULTS CONT.

MACROINVERTEBRATES

In August 2015, **macroinvertebrates** (aquatic insects) were assessed at four sites along the Upper West Fork, where it flows through the Big Sky Golf Course. The species distribution and number of aquatic insects at all sites suggested both good water quality and habitat. A detailed report of the aquatic insect analysis is available on the Task Force website.

STREAMFLOW

In 2015, **streamflow** in the Upper Gallatin was below average due to lower than average snowfall and low elevation snowmelt two to three weeks earlier than usual (early March compared to late March/early April). Streamflow peaked at 4,020 cubic feet per second (**cfs**) on the Upper Gallatin at the USGS Gallatin Gateway Gauge on June 2nd, 2015 (Figure 3) (USGS data).

Task Force staff member, Stephanie Lynn, collects macroinvertebrates along the Big Sky Golf Course. Photo credit: Patti Lynn

PROTECTING AND IMPROVING WATER QUALITY:
WHAT INDIVIDUALS CAN DO

In 2016, the Gallatin River Task Force will implement multiple restoration and education projects to address nitrogen and sediment issues within the Upper Gallatin Watershed. These include two large scale restoration projects that will break ground in the fall: 1) streambank restoration and streamside vegetation enhancement on the Upper West Fork along the Big Sky Golf Course and 2) a demonstration project at the Moose Creek Flat campground, the first of multiple projects to reduce erosion at river access sites along the mainstem Gallatin.

For more information on these and other planned restoration activities:
visit gallatinrivertaskforce.org/our-programs/

In addition to restoration work, Big Sky residents and visitors have the opportunity to take action to improve water quality. Collectively, our choices determine the future of cold, clean, and abundant water in the Upper Gallatin.

Individual opportunities to reduce nitrogen in our streams include:

- Maintaining streamside vegetation or restoring it
- Limiting herbicide and pesticide use
- Using native plants in landscaping and limiting lawn areas that require more water and fertilizer
- Leaving streamside vegetation alone or restoring it
- Conserving water used in landscaping
- Having a professional inspect your septic system annually
- Picking up and disposing of pet waste
- Moving animal feed lots and corrals away from streams

Individuals can reduce sediment pollution in our watershed by:

- Maintaining streamside vegetation or restoring it
- Following construction best management practices such as those illustrated at stormwater.montana.edu
- Recreating responsibly by staying on designated trails and following seasonal trail closures

Educational brochures are available in hardcopy at the Task Force office or on our website, including:

- Trout Friendly Landscaping Brochure
- Watershed Restoration Plan Brochure
- Water Quality in the Upper Gallatin - What it Means to You
- Septic Smart (coming in 2016)

GLOSSARY

Algae and algal growth: a general term for simple aquatic plants that range in size from microscopic to large seaweeds. The decay of excess algae depletes the amount of oxygen dissolved in water that fish and other aquatic organisms need to survive. In addition, algal overgrowth is unsightly and destroys fish and aquatic insect habitat.

Baseflow: the portion of streamflow that does not come from runoff, but instead results from water slowly seeping from the ground into the river. Baseflow is the primary source of running water in a stream during periods of dry weather.

Baseline: either 1) a minimum or 2) initial data point(s) used to make comparisons before or after a change.

CFS: "cubic feet per second", which is the unit of measurement for streamflow.

cfu/100 mL: "colony forming units per 100 milliliters", which is the unit of measurement for E. coli concentration.

Chloride: water-soluble salts that can be toxic to aquatic life at very high concentrations (> 230 mg/L). Man-made sources of chloride include discharge from hot tubs and pools, wastewater, and road salt.

Channel Morphology: the shape of a riverbed.

Conductivity: a measure of the ability of water to carry an electrical current. Pure water is not an effective conductor of electricity. The conductivity of water increases with the amount of inorganic dissolved ions (charged particles) such as chloride, nitrate, sulfate, and phosphate anions (negatively charged particles) or sodium, magnesium, calcium, iron, and aluminum cations (positively charged particles). Most rivers have a fairly constant range of conductivity under normal circumstances. Conductivity naturally varies with precipitation, geology, temperature, and proximity to the ocean. For example, rain or snowmelt reduces conductivity by adding more freshwater and lowering the concentration of dissolved ions. Human activity can affect conductivity as well. Leaking wastewater, rich in chloride, phosphate, and nitrate raises the conductivity of water while oil spills lower the conductivity.

Dissolved Oxygen (DO): the amount of oxygen dissolved in water. Trout and aquatic insects depend on high oxygen levels. Montana Department of Environmental Quality standards vary depending on whether fish found within the water body are in an "early life stage." During every month of the year, some species of fish found in the Gallatin are in an "early life stage"; therefore, we chose to compare our results to the 7-day mean standard of 9.5 mg/L (MTDEQ Department Circular DEQ-7, 2012, Administrative Rule of Montana 17.30.637(1)(d)).

Escherichia coli (E. coli): a bacterium commonly found in the lower intestines of warm-blooded animals. Most E. coli strains are harmless, but some can cause severe illnesses, especially in young children and the elderly. The Montana Department of Environmental Quality set the primary standard for E. coli as 126 cfu/100mL during the warm months from April 1st thru October 31st and 630 cfu/100 mL the rest of the year (Administrative Rule of Montana 17.30.620 (2)(ii)).

Fine Sediment: rock or other naturally occurring material that is broken down by weathering and erosion and is less than 4 millimeters in diameter. Excess fine sediment negatively impacts **channel morphology,** aquatic life, and recreational use. Sources of fine sediment include: natural land disturbance, erosion from construction areas and unpaved roads, disturbance of riparian (near-stream) areas, and road traction sand. Studies suggest that impacts to fish spawning habitat and macroinvertebrates begin to occur above 20% percent fines [Hunter, 1973; Tappel and Bjornn, 1983; Burton and Harvey 1990]. Therefore, we compared our data to 20%.

Macroinvertebrates: aquatic organisms that are large enough to be seen with the naked eye and lack a backbone. Benthic macroinvertebrates live among the rocks on the streambed. Macroinvertebrates are a useful indicator of water quality, as some are very sensitive to different types of pollution. The presence of sensitive species such as mayflies, stoneflies, and caddisflies suggests clean water.

mg/L: "milligrams per liter," a unit of measurement for the concentration of a substance in a liquid.

Nitrate and Total Nitrogen (TN): nitrate, a form of nitrogen readily usable by plants and animals, is a subset of total nitrogen, which is the total of all forms of nitrogen. Excess nitrogen increases **algal growth**, which can have negative impacts including reduced dissolved oxygen levels, unsightly conditions, and poor habitat conditions for fish and other aquatic organisms. Sources of nitrogen in rivers and streams include organic matter, the atmosphere, geology, human and animal waste, and fertilizer. For the **TMDL** study, the Montana Department of Environmental Quality (MTDEQ) used a nitrate water quality criterion of 0.1 mg/L to indicate impairment during the growing season, July 15th to September 30th. Therefore, we compared our data to the 0.1 mg/L standard. As of 2014, the MTDEQ assesses nitrogen impairment by the level of total nitrogen concentration believed to prevent growth of undesirable **algae**. This standard is 0.3 mg/L (MTDEQ Department Circular DEQ-12A, 2014; ARM 17.30.637(1)(e)).

Parameter: a physical, chemical, or biological characteristic that is measureable and helps define a system.

pH: a measurement of how acidic or basic a substance. pH is measured on a scale from 0-14, from most acidic to most basic. Acidic values are from 0-7. Basic numbers range from 7-14. Natural factors (e.g. photosynthesis, limestone, needle/leaf decomposition) and human factors (e.g. industrial pollutants, acid rain) can affect pH. Fish require pH levels between 6.5 and 9.

Riparian: the transition zones between land and water; of or relating to wet areas adjacent to rivers and streams.

Stream Stage: the water level above some arbitrary point in the river. A relationship between stream stage and measured **streamflow** (volume of water in a river at a specific point in time) is used to determine streamflow at times when stage is measured but streamflow is not measured.

Streamflow: volume of water flowing in a river at a specific point in time commonly measured in cubic feet per second (cfs).

Temperature: can affect fish, aquatic insects, and **algal growth**. Westslope Cutthroat trout prefer a habitat where temperature ranges from 10.3 - 17 degrees Celsius (50-63 degrees Fahrenheit) [Bear et al., 2005]. For this reason, we chose a critical value of 17 degrees Celsius to compare our results.

Total Coliform: a group of closely related bacteria that are (with a few exceptions) not harmful to humans.

Total Phosphorus (TP): although phosphorus is an essential nutrient for plants and animals, a small excess of phosphorus has negative water quality effects, similar to those of nitrogen. These effects include algal blooms, undesirable plant growth, and low dissolved oxygen. Sources of phosphorus include runoff from fertilized landscapes, animal waste and manure, commercial cleaning preparations, soil, and rocks. The Montana Department of Environmental Quality has set the water quality standard at a level believed to prevent the growth of undesirable algae or 0.03 mg/L [MTDEQ Department Circular DEQ-12A, 2014; ARM 17.30.637(1)(e)].

Total Maximum Daily Load (TMDL): a regulatory term describing the maximum amount of a pollutant that a body of water can receive while still meeting state water quality standards. The Montana Department of Environmental Quality is required to develop TMDLs for all water bodies in Montana that are deemed impaired. The Task Force was the local liaison for the Upper Gallatin TMDL study in the West Fork Watershed that occurred between 2005 and 2010. TMDLs were developed for the South Fork, Middle Fork, and West Fork. The Upper Gallatin TMDL report is available on the Task Force website.

Turbidity: a measurement of water clarity.

Watershed: an area of land defined by high elevation ridges and peaks, where water drains downwards to the same body of water (river, lake, bay) in the low-lying areas of the landscape.

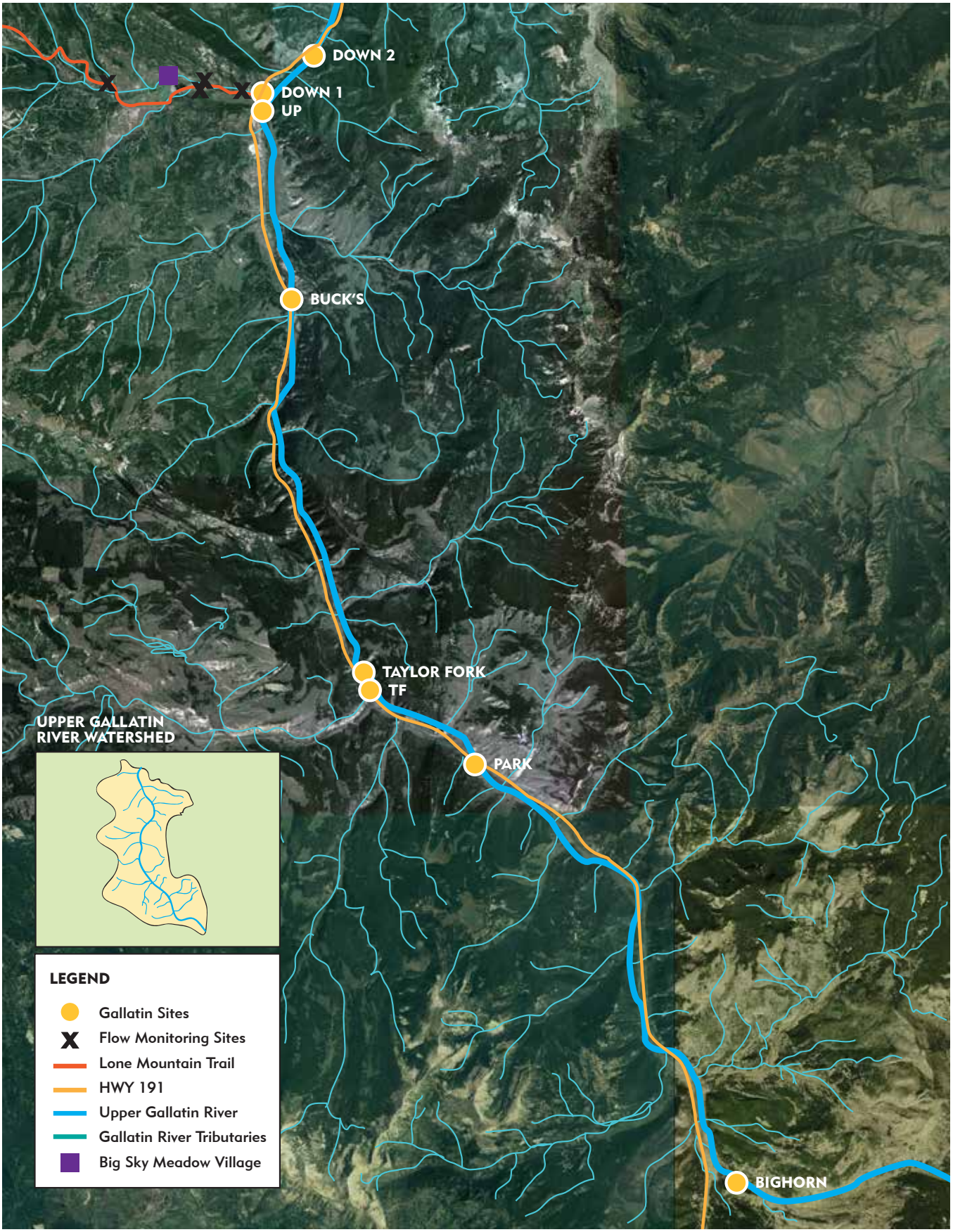


FIGURE 1A: The Gallatin River Task Force monitors seven sites on the mainstem Upper Gallatin River and one site on the Taylor Fork (orange circles) beginning near the headwaters within Yellowstone National Park and continuing downstream to just below the West Fork confluence.

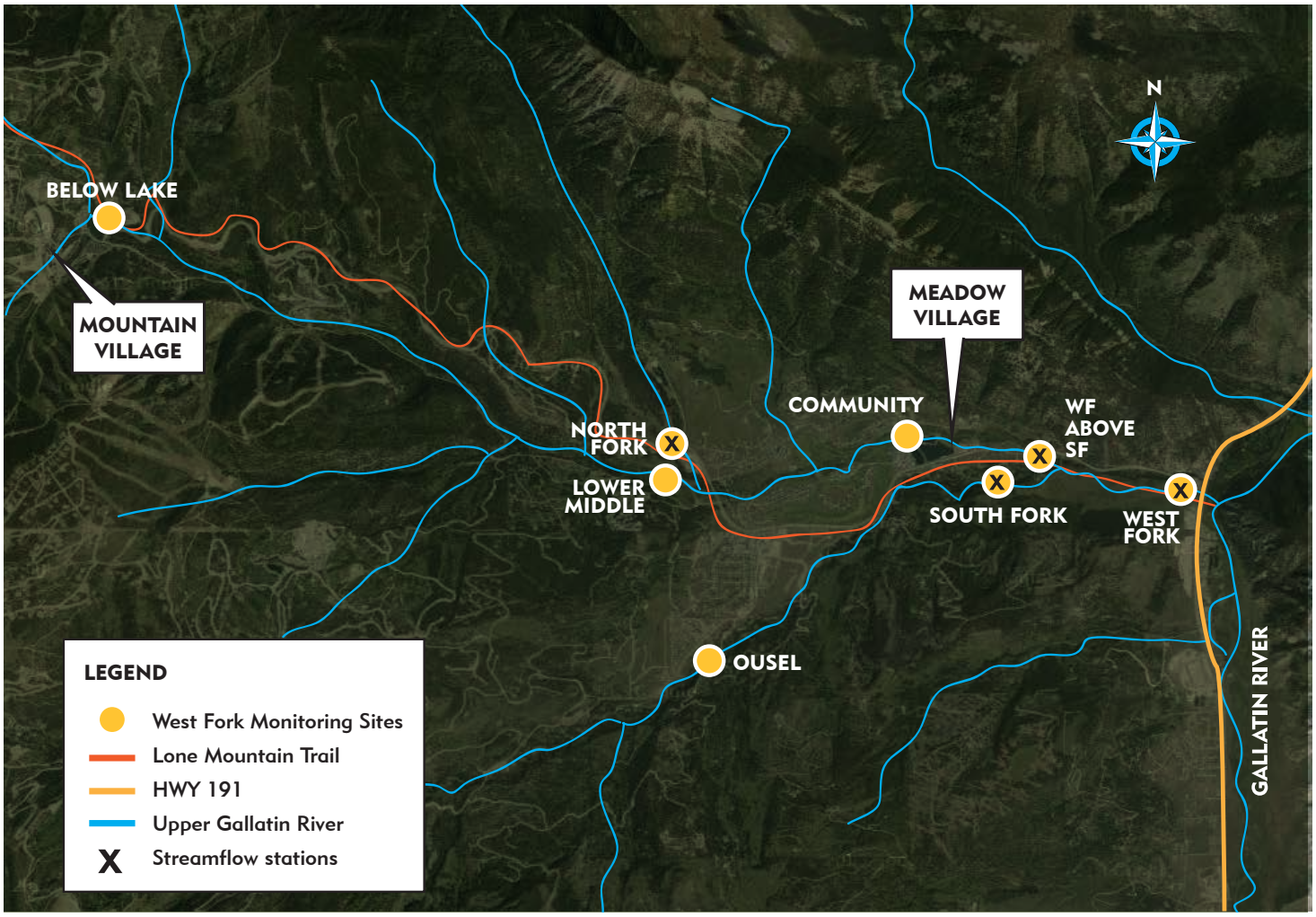
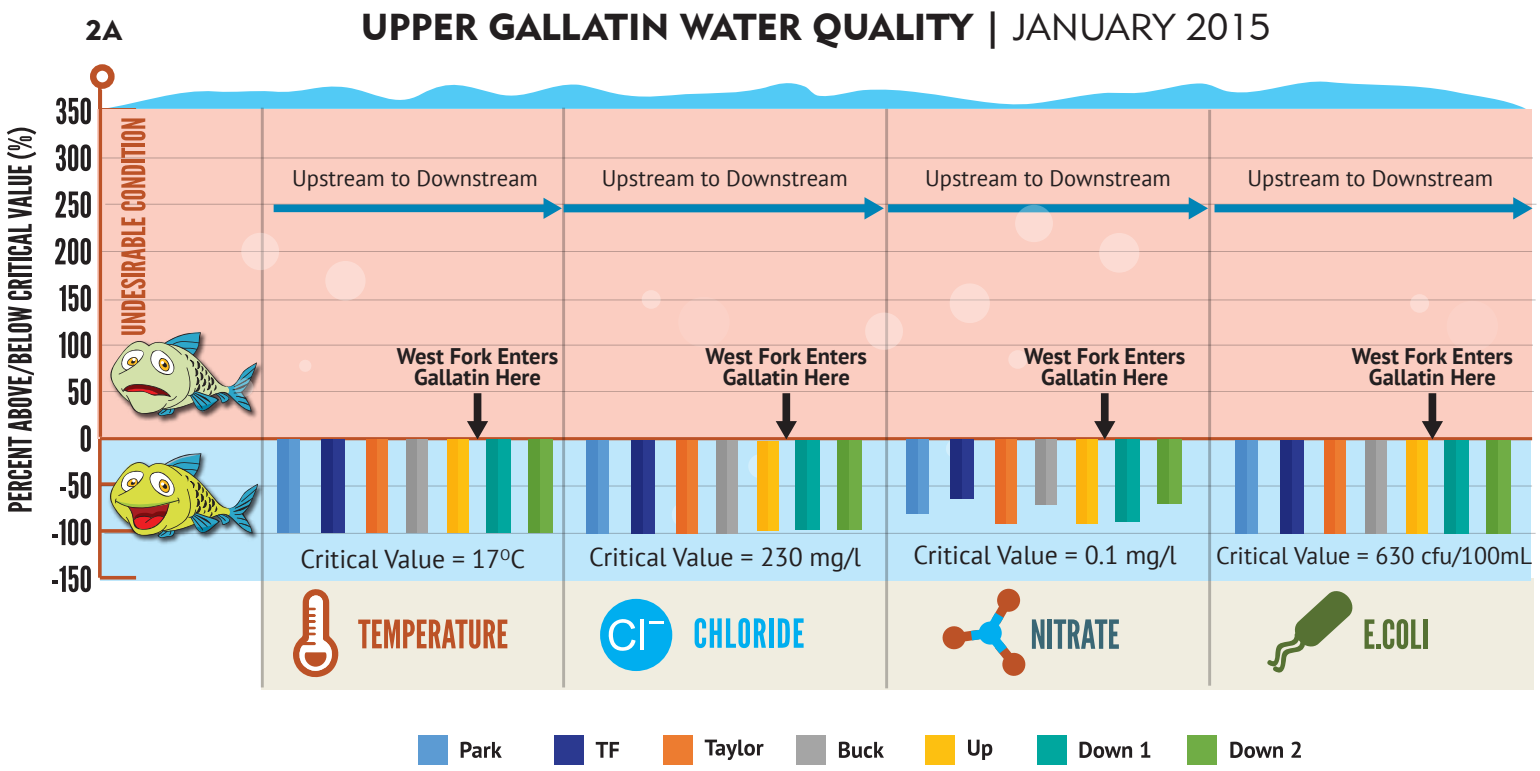
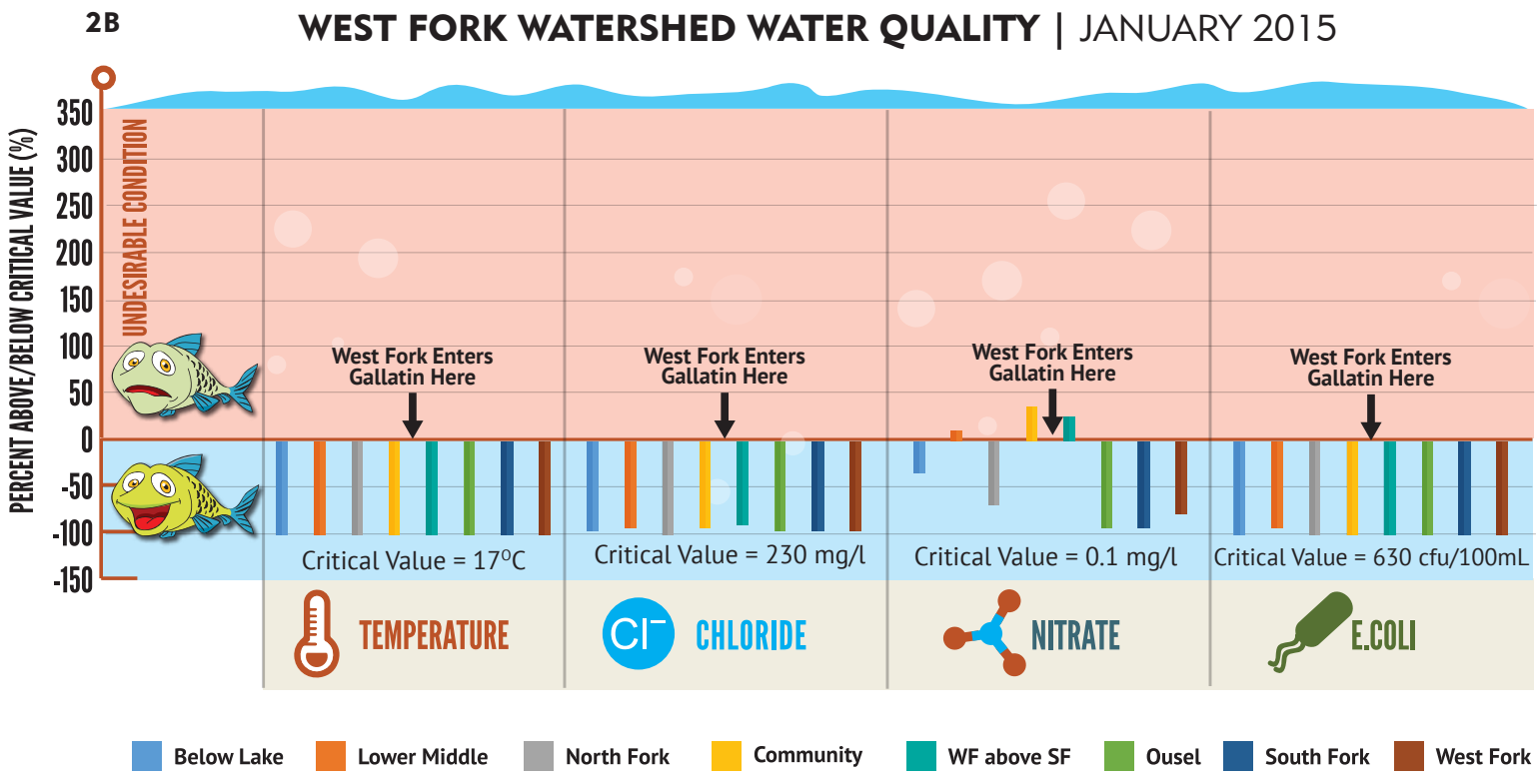
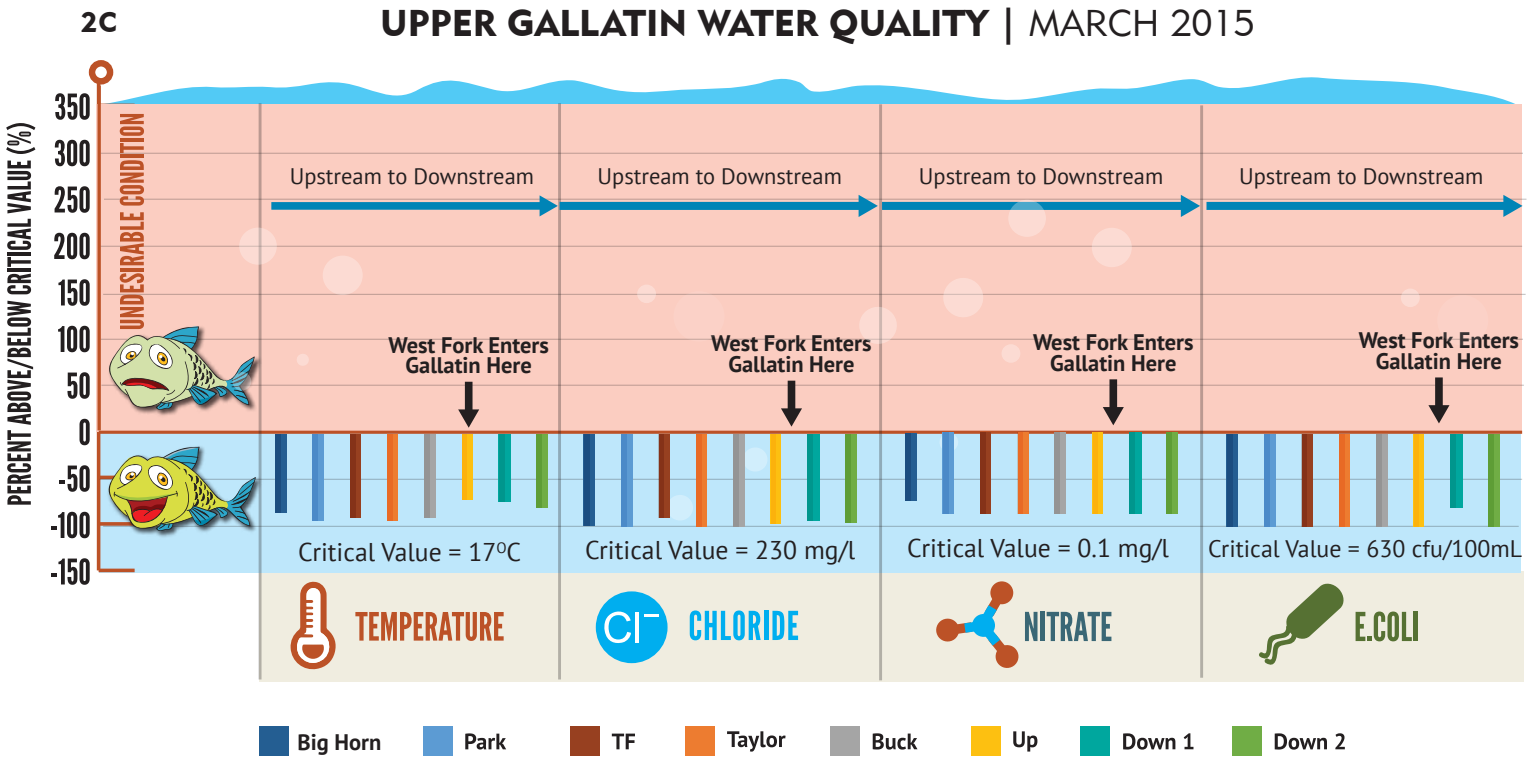


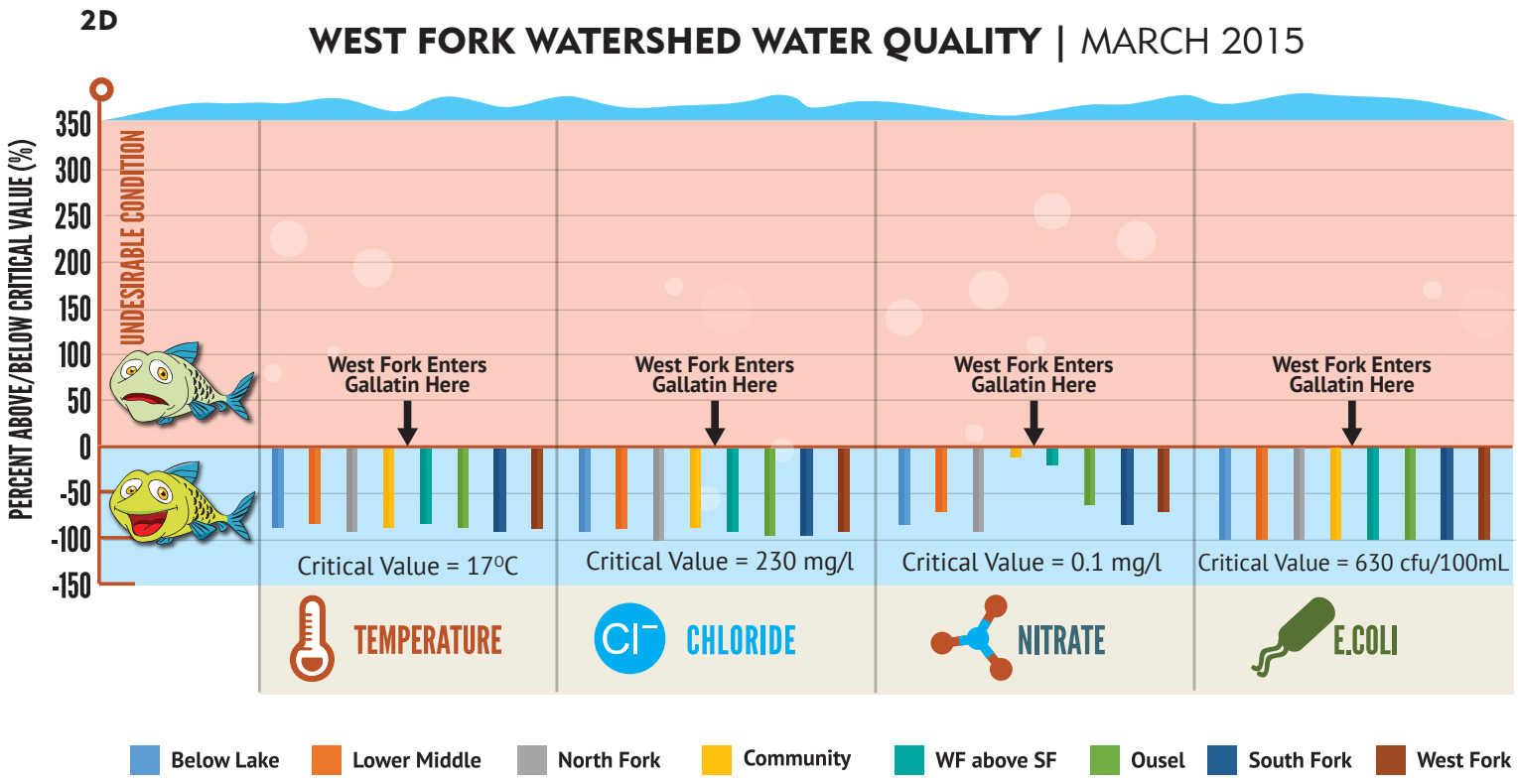
FIGURE 1B: The Gallatin River Task Force monitors eight sites for water quality (orange circles) and four sites for continuous streamflow (black x's) in the West Fork Watershed.



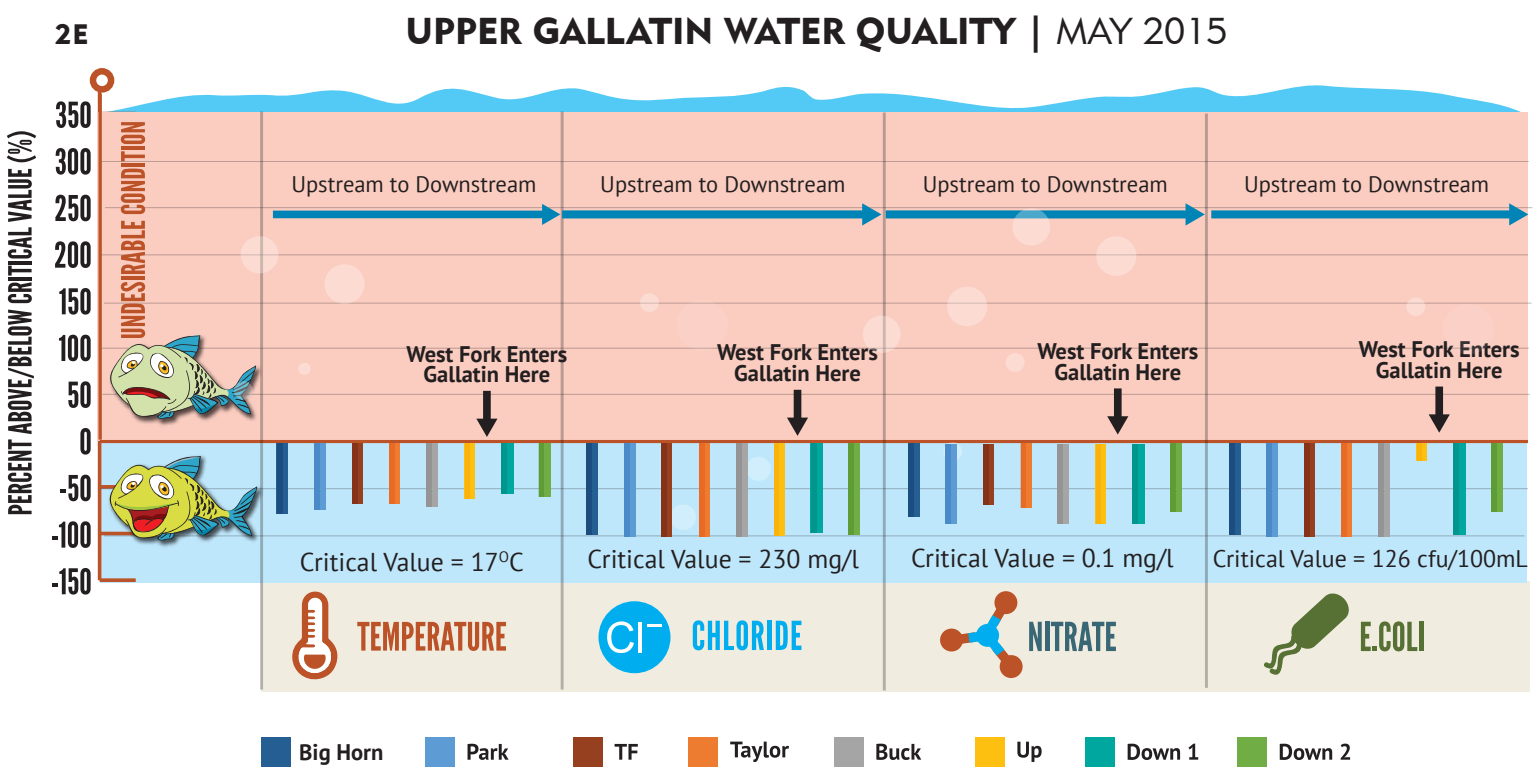


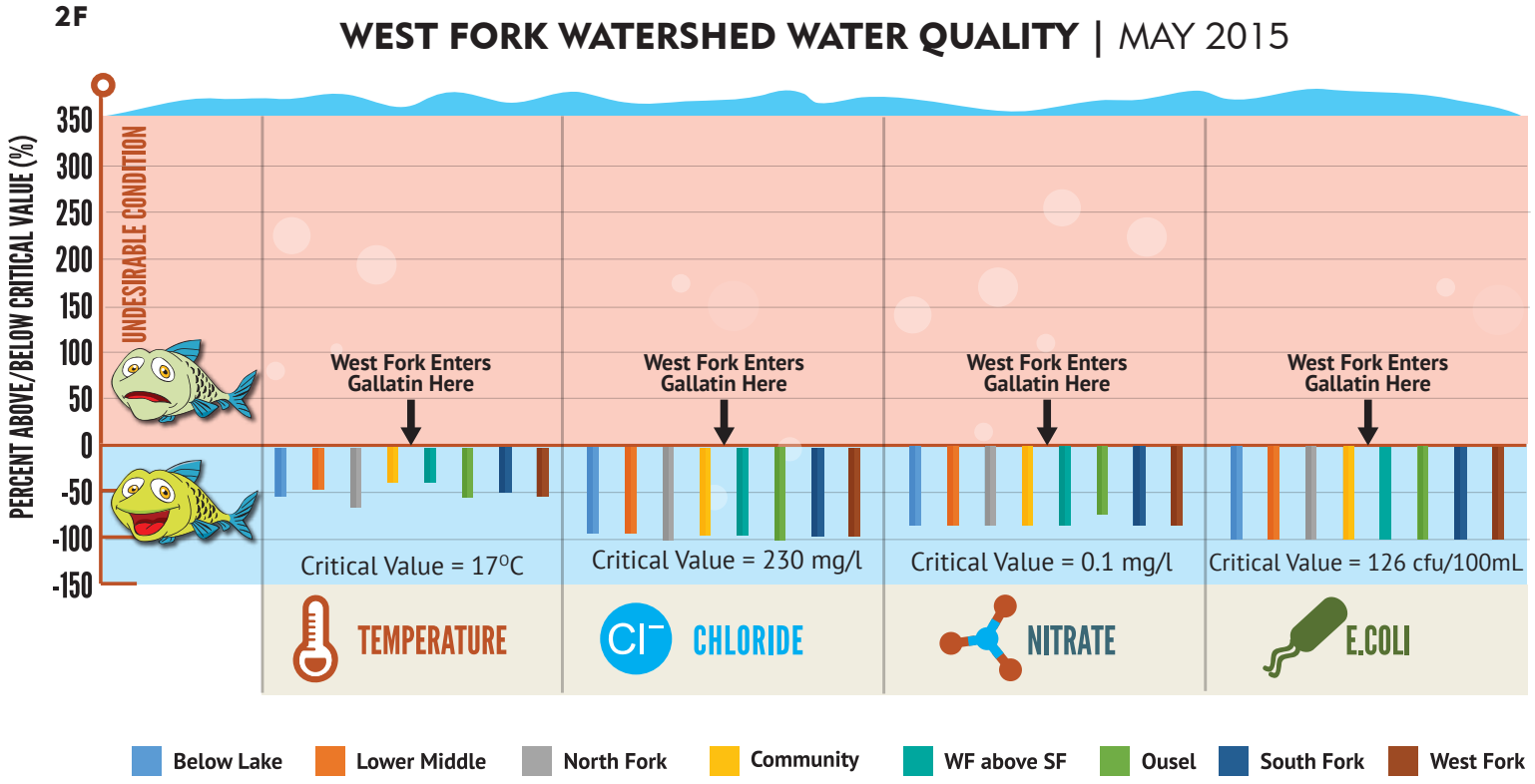
FIGURES 2A & 2B: Water quality data collected in January 2015 in the Upper Gallatin (2A) and in the West Fork Watershed (2B). Sites correspond with the sites shown in Figures 1A and 1B. Critical values for each parameter are explained in the Glossary on page 8.



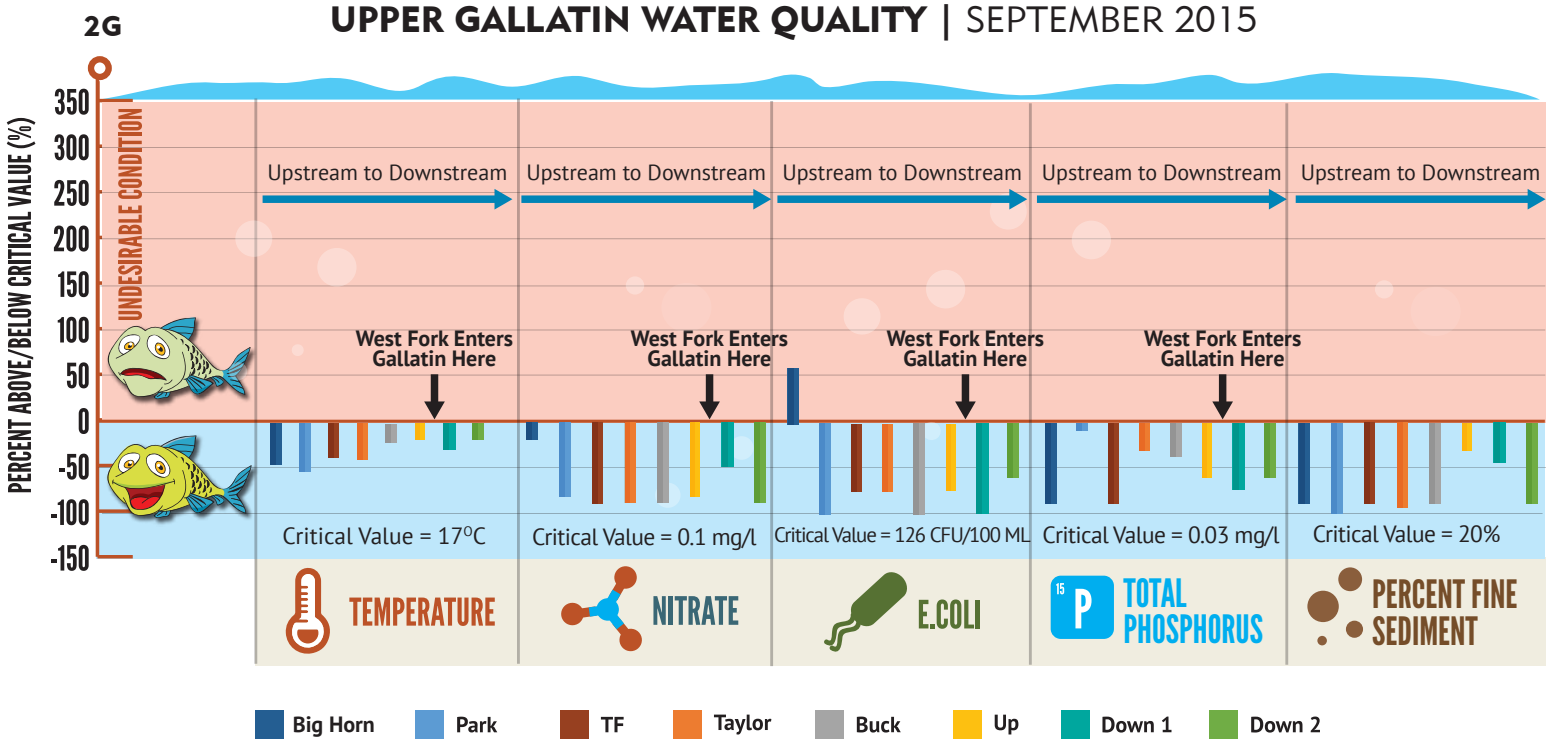


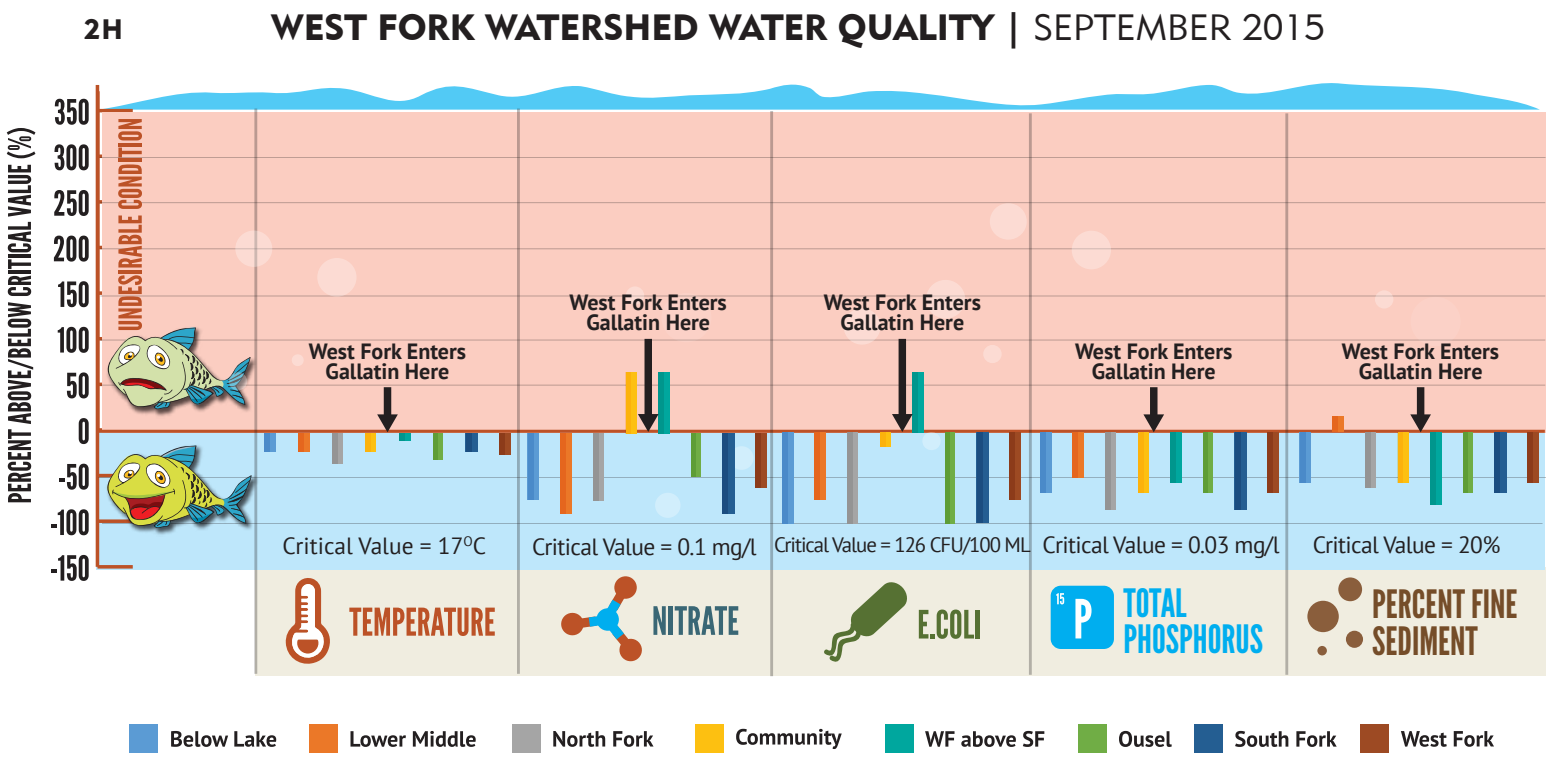
FIGURES 2C & 2D: Water quality data collected in March 2015 in the Upper Gallatin (2C) and in the West Fork Watershed (2D). Sites correspond with the sites shown in Figures 1A and 1B. Critical values for each parameter are explained in the Glossary on page 8.





FIGURES 2E & 2F: Water quality data collected in May 2015 in the Upper Gallatin (2E) and in the West Fork Watershed (2F). Sites correspond with the sites shown in Figures 1A and 1B. Critical values for each parameter are explained in the Glossary on page 8.





FIGURES 2G & 2H: Water quality data collected in September 2015 in the Upper Gallatin (2G) and in the West Fork Watershed (2H). Sites correspond with the sites shown in Figures 1A and 1B. Critical values for each parameter are explained in the Glossary on page 8.

2015 STREAMFLOW IN THE UPPER GALLATIN AT THE USGS GALLATIN GATEWAY GAUGE

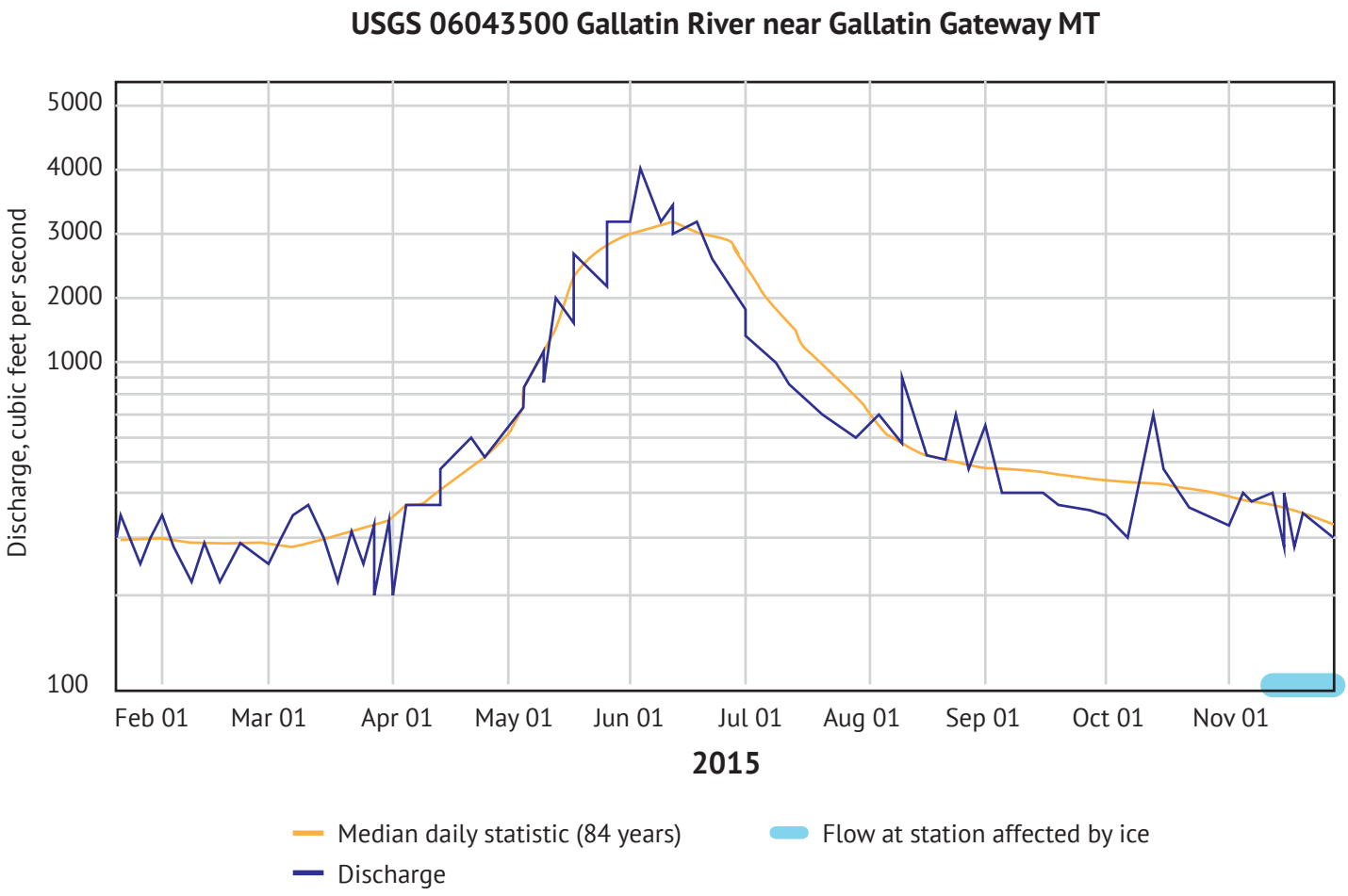


FIGURE 3: Streamflow in the Upper Gallatin River over 2015 (black line) was generally below average (orange line) during snowmelt and the growing season at the US Geological Survey gauge at the mouth of Gallatin Canyon.

GALLATIN RIVER
TASK FORCE

47855 GALLATIN RD (HWY 191), SUITE 4
PO BOX 160513 | BIG SKY, MONTANA 59716
GALLATINRIVERTASKFORCE.ORG | (406) 993-2519