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Headwaters Edition

Blacktail Creek and the Highland Mountains. Photo by Evan Norman.

Restoration of Blacktail and Basin Creeks

Rayelynn Brandl

Silver Bow Creek has become for some, the archetype of Superfund. The example of the death of this stream and the community's desire to see it reborn is the quintessential hero story. Silver Bow Creek, however, is only one of many streams within the Summit Valley that help to form the headwaters of the Clark Fork and Columbia Rivers. Two other streams are noteworthy, both in their contributions to the waters of the Clark Fork and their stories of survival within the Superfund landscape. Blacktail Creek and Basin Creek are survivors of Superfund to be sure, but their stories can also be stories of vibrant, thriving streams restored to health following this era.

Blacktail Creek has been impacted by historic mining practices and the mere fact that it runs directly through an urban setting. Historically, also known as Blacktail Deer Creek and Bell Creek, it is an example of a municipal stream that is fairly intact, supporting fish and riparian wildlife along its course through the Summit Valley. The damages to this creek include: deposits of slag and mine tailings from historic smelter activity from the Bell Smelter; channelization through the city; impacts and sedimentation from roads; tailings within the floodplain; and fish entrapment due to aging culverts. Given its impacts and the fact that the stream continues to support

cutthroat trout, restoration dollars spent on this stream are likely to yield high returns, in other words, a good bang for the buck.

The Natural Resource Damage Program has allocated \$957,000 for restoration projects along Blacktail Creek. The nature of these projects depends on the specific reach and the type of impacts. Some projects are fairly simple and will not require large amounts of cash, however, the projects may be stalled due to the need to comply with federal regulations for flooding and mapping of the floodplain.

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The Director's Letter

Rayelynn Brandl



The *Headwaters Edition* of the Montana Steward is intended to open our eyes to the wonders of the Summit Valley's waters. This valley is unique in that waters from this area can be part of three watersheds and two oceans, depending on where the water falls. The Continental Divide is perched prominently in our backyard. Indeed, the Summit Valley can be considered the beginning of it all.

Being the Butte-proud citizens that we are, we make large claims such as "Silver Bow Creek is the Headwaters of the Columbia River." This claim is mostly true, however, there are more waterways and other tributaries that form the Columbia's Headwaters, including a few important streams right here in the Summit Valley.

Dr. A will help us to understand what a headwaters region is, and throughout this edition, we will examine the local geography and history of other creeks within our valley. We will temporarily turn our attention away from the restoration of Silver Bow Creek and the Clark Fork River to illuminate the need for restoration of other important tributaries, Blacktail Creek and Basin Creek. Of course, there are many other streams along the Clark Fork that also need attention, however, we will save these stories for another edition.

Our hope for this edition is to help our readers understand that all the waterways of our valley need attention, conservation, and restoration to some extent. Silver Bow Creek has dominated the conversations about restoration within this valley, and now is the time to turn our attention to the others. In order to achieve our vision of a fully restored, functional, headwaters region, we must address the needs of the other waters within our valley.

CFWEP Program Updates

Chris Doyle

CFWEP is an extremely busy organization and we just completed our 2017 year of outreach. All of our programs and outreach events are geared towards helping people learn about science and our watershed, and about the restoration that is taking place to ensure that we have a healthy stream system in the future. It is our mission to help the citizens of our watershed become stewards and members of a scientifically-literate community.

Butte Broadcasting's Treat Street, Evel Knievel Days, Science Fair, Kids College, Big Hole River Kids Day, and many area tours.

The REP program, partially funded by the Natural Resource Damage Program, is the staple program of CFWEP. In this program, students between Butte and Missoula learn about the history of the damages to our watershed, and about the current restoration and remediation taking place to fix this damage. This is a five-day program, with four of those days spent in the classroom, and one full day spent out in the field engaging in real science on restoration sites. In 2017, the REP program served students in seven different schools: East Middle School, Butte High School, Butte Central Elementary School, Fred Moodry Middle School, Granite School, E.F. Duvall Middle School, and Drummond High School.

In Missoula, we served all Missoula County Public Schools' 5th grade students. Our Missoula program also includes summer osprey nest monitoring and song bird banding.

The BRIC Program is funded by the National Institute of Health through a Science Education Partnership Award. CFWEP collaborates with Dr. Marisa Pedulla from Montana Tech on her bacteriophage program. Students from 24 schools around Montana spend three days learning about phages (viruses that kill bacteria),

This publication's content is the result of collaborative efforts between many passionate and dedicated individuals. Each member of the CFWEP staff team contributed time and effort to bring this publication to life. **We'd like to extend special thanks to The Butte Archives, The Montana Standard, Pat Cuneen, Ron Davis, and Jocelyn Dodge.**

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including collecting soil samples form their local environment to test for a specific phage. Students test their soil samples to see if they contain a specific phage. If a new phage is identified within the sample, the student gets to place their discovery in an international database at phagesdb.org. In 2017, the BRIC Program staff traveled over 11,000 miles.

Our Trout in the Classroom program reached 577 students, most of whom live in the Blackfoot Valley. Our Storm Water Education program served almost 300 students in the community of Butte through storm drain marking and community cleanup events. Our Beaver Mimicry Project (which works on both Basin Creek and Blacktail Creek) reached over 100 students. CFWEP also leads educational tours around uptown Butte and at the Bell Diamond Mine Overlook. In 2017, we served almost 300 people through these educational tours.

One of our other special events is the Annual Southwest Montana Kids Fly Fishing and Conservation Camp. This year was the 9th Annual Fly Fishing Camp and our most successful to date. We had 30 campers with us for four days and three nights. The campers ranged between the ages of 12-17 and came to us from around the state. The campers learned about the history of the watershed and the

fisheries within it, as well as about the restoration and remediation taking place in the Clark Fork Watershed. The students fished on newly restored sections of Silver Bow Creek and the Clark Fork River, as well as other waters such as Rock Creek, Georgetown Lake, Storm Lake, Warm Springs Creek, and Flint Creek. We are looking to grow the camp in the next year so that we can have two separate camps, allowing us to serve more kids.

Now that we are done with our fall semester and the 2017 year, we will be spending the next few months working on reviewing our curriculum and getting ready for spring. BRIC outreach visits will be still going on in December and January, and all the way through May, 2018. TTC visits will start in January and will run through March. The REP Program will start back up in April and will run into May. We are always in need of volunteers, especially for our REP field trips and Cleanup Blacktail Stream (CUBS) Day on May 24, 2018. Please contact us if you would like to participate with either of these events.

With our 2017 student numbers added to our total numbers from CFWEP's start in 2005, our programs have now reached over 48,000 students, representing more than 172,000 student contact hours.

Big Sky Watershed Corps

Evan Norman



Evan Norman, Big Sky Watershed Corps Member.

In October of 2015, I submitted an application to be a Big Sky Watershed Corps Member through the AmeriCorps program. AmeriCorps is a program for young professionals to grow in different capacities and gain on-the-job skills. When I interviewed to be a service member for the Big Sky Watershed Corps, I didn't

know where I would be placed. Based on my interests and previous experiences, my program manager forwarded me along to the Clark Fork Watershed Education Program (CFWEP). At first, I thought I was signing up to work for a website that was difficult to pronounce. Only half of that last statement proved to be true.

Southwest Montana Fly Fishing and Conservation Camp Receives Sustaining Grant

Kayla Lappin



The Clark Fork Watershed Education Program (CFWEP) received a \$15,000 grant to be distributed over the next three years from the Dennis and Phyllis Washington Foundation for CFWEP's annual Southwest Montana Fly Fishing Camp. In addition to the grant, \$1,200 was raised at CFWEP's annual fundraiser on October 27, 2017. CFWEP would like to thank the Dennis and Phyllis Washington Foundation, Montana Resources, local businesses, and individual supporters for their generosity.

Unlike any other camp in the state, the Southwest Montana Fly Fishing Camp brings kids to fish on recently restored Superfund sites within the Clark Fork Watershed. Kids fish on Silver Bow Creek and the Clark Fork River, waterways once declared unfishable. Kids learn about why these waters are now fishable and about the restoration efforts on Silver Bow Creek and the Clark Fork River. A tour of Montana Resources also teaches kids about responsible mining practices.

Also unique to the camp are need-based scholarships. Kids who cannot afford the \$75 fee can apply for a full fee waiver. "We don't want to see any kids miss out on the camp because they can't afford the camp fee," said Chris Doyle, the CFWEP staff member who directs the camp.

The 2018 camp will take place end of July-beginning of August, at Camp Watanopa on Georgetown Lake. The camp is \$75 and includes a 3-night, 4-day stay on Georgetown Lake, plus one additional instructional day at Montana Tech on August 2nd. All lodging, meals, fly rods, fly reels, flies, and transportation are included. Registration is limited to 30 kids and early registration is encouraged. To register for the camp or apply for a camp scholarship, please contact Chris Doyle at 406-496-4790.

Adult volunteers are also needed. If you are interested in volunteering please contact Chris at the above number or email him at cdoyle@mtech.edu.

After looking at the background of the programs this organization offered, I drove from Boise, Idaho, to Butte, Montana, in January of 2016 in -10° F weather. Showing up in Butte to teach about Butte America is as difficult as it sounds. The elevation of the town was obvious as I walked up to Montana Tech for work every day and attempted to mountain bike once the snow melted. My first few weeks consisted of observing the watershed, learning what headframes were, discovering the history of Silver Bow Creek, and learning about the remediation caps on the hill. While familiarizing myself with Superfund and Butte, I delved into the other programming which CFWEP delivers.

While working for CFWEP, I had the opportunity to see much more of the state than I otherwise would have. This was special for me, having grown up in Juneau, Alaska, where it is landlocked on one side and has water on the other. The only way in and out of Juneau is by boat or plane. On the other hand, throughout Montana, there is no shortage of roads that connect to

one another. During classroom visits, I like to explain that we travel from Libby on the Idaho border to Baker on the North Dakota border, and to all of the towns in between. Since we spend the majority of our time traveling in the Clark Fork Watershed, this area became the most familiar to me.

By the time I was familiar with our watershed, I had already finished my first AmeriCorps term of service, so I signed up for another term in 2017. From this two-year experience, I understand the importance of communicating stewardship and awareness of what is going on in one's backyard to students, teachers, friends, family, and citizens. I worked on growing CFWEP programming and outreach activities for local schools, and created new ways to communicate about the projects and information that CFWEP delivers. After 6,000 beneficiaries, 2,000 data points collected, 2 miles of stream banks improved with students and volunteers, and multiple organized events, it was a whirlwind and worthwhile two years.

CFWEP Fundraiser Update

Kayla Lappin

CFWEP's annual fundraiser took place on October 27, 2017. This year's theme was the Black and Orange Ball in honor of Halloween. While our fundraiser helps all of our programs, most of the funds collected are used for Clean Up Blacktail Stream (CUBS) Day, the Southwest Montana Fly Fishing and Conservation Camp, and K-12 teacher support, such as busing costs, classroom supplies, etc.

The Southwest Montana Fly Fishing and Conservation camp received 16 sponsorships for campers totaling \$1,200, which is the record number of sponsorships ever received at our fundraiser. Our silent auction garnered support from 34 local businesses and individuals, and raised over \$1,900. Live auction items brought in an additional \$525.

We would like to thank the following businesses for their support and contributions to our fundraiser. Without their generosity, many of our programs would not be possible:

Quarry Brewing	Casagrande's Steakhouse
Staggering Ox	Uptown Café
Hanging 5	Rib and Chop House
Montana Club	The StoneFly Fly Shop
Broadway Pizza	Wagner's Nursery and Landscaping
Montana Therapeutic Massage	Florence Coffee
Donivan's Restaurant Pub and Casino	Sacajawea Hotel
Fairmont Hot Springs	Homestake Lodge
5518 Designs	Pink Gloves Boxing
Montana Tech Digger Athletics	Artistic Designs Hair Salon
Pour House Pub	UpTop Clothing
Thompson Distributing	Lucky We Live Montana
Park 217	Great Harvest Bread
	Buffalo Wild Wings

Meet Jocelyn Dodge, Beaverhead-Deerlodge Recreation Forester

Interviewed By: Evan Norman



Jocelyn Dodge

Tell us a little about yourself and your position.

I obtained a recreation management degree from the University of Montana, and have worked for my entire career of 35 years in recreation management fields, and I love it. I love working with the public, and love being able to see things that the public appreciates, and the community and visitors appreciate and benefit from. I have worked for the U.S. Forest Service for 27 years in the Beaverhead-Deerlodge Forest. In the early 1990s, it was known as the Deerlodge Forest; it was combined with the Beaverhead-Deerlodge Forest to form Beaverhead-Deerlodge Forest. Prior to working for the Forest Service, I worked

for city and county recreation departments in Missoula and Flathead counties. Currently, I am responsible for the recreation management of the old Deerlodge Forest boundary, which is 1.2 million acres of land.

How did partnerships change Thompson Park into what it is today?

The biggest change I've seen is an overall growth in outdoor recreation in Butte and the Southwest Montana area. Thompson Park has flourished into a destination area. Thompson Park was once an area that was pretty well ignored by the Forest Service and Butte-Silver Bow. In 1922, the park was designated by Congress, which turned out to be the only nationally designated municipal recreation area in the United States. The mayor of Butte and the U.S. Secretary of Agriculture signed a unique agreement that gave recreation management responsibilities to the City of Butte, while the U.S. Forest Service retained resource management responsibilities.

In the 1930s, the facilities, roads, and trails envisioned were constructed by the Works Progress Administration (WPA). During the same time period, Mountain Bell Telephone Company was responsible for installing the water fountains that are on Montana Highway 2 (Harding Way) to help old Ford Model T's get over the pass. These fountains also served as a source of clean drinking water for Butte citizens. It started the first volunteer and partnership opportunities in the park.

What hasn't changed are the continued partnerships in the park. Boy Scouts who are earning Eagle Scout rank and local youth groups have had opportunities to learn and gain pride for the work they do. They have also received an understanding of how a National Forest is managed for multiple uses, as well as for the protection of natural resources.

We need these young voices and eyes on the forest to spot vandalism or additional maintenance that may be required to keep areas open to the public. These individuals could eventually decide on a career in natural resources from these experiences, whether that's recreation, timber, wildlife, or fire.

Tell us a little about the work with AmeriCorps.

Thompson Park was reconstructed with partnerships and grants through the Natural Resource Damage Program (NRDP), Forest Service Capital Investment funds, Recreational Trails Program funds, the Resource Advisory Council, 21st Century Funding and National Forest Foundation grants. AmeriCorps St. Louis has been working with us for 17 years, and the above partnerships and grants have provided work opportunities to service members. The partnership with AmeriCorps St. Louis came after I responded within 30 minutes to their executive director about whether anyone in Montana had a project for them. They came out that summer and helped work on the forest fires of the year 2000. Butte Ranger District, Jefferson Ranger District, and other recreation managers saw the importance of the group and embraced them as a partner along with the Montana Conservation Corps. They were a well-received group, loved the Montana experience, and the partnership continues to be built on. Funding for a host site, materials, trail maintenance, equipment, and stipends allow AmeriCorps service members and other volunteers to work on a variety of different projects. Many of these AmeriCorps folks pursue work in fire and disaster mitigation with other state or federal agencies.

Who have you worked with to help sustain recreation?

We work with a variety of user groups and businesses to provide recreation opportunities. Our partnerships include motorized and non-motorized user groups from the Butte, Whitehall, Philipsburg, Anaconda and statewide groups. Most of our partnerships assist with maintaining and improving year-round trail and camping opportunities. Groups such as the Mining City Trail Riders and the Mile High Nordic Ski Education Foundation help to groom winter trails, while groups such as the Montana Wilderness Association and Upper Clark Fork Back Country Horsemen help with trail maintenance in and out of wilderness areas. We have a strong relationship with mountain bicyclists to maintain trails and help develop winter trail riding for fat biking – a growing sport in southwest Montana. There has, and will continue to be, a strong reliance on partnerships to provide and maintain recreational opportunities.

What is unique about the Whitehall-Pipestone area?

Whitehall-Pipestone is a popular area for motorized recreation and a non-motorized opportunity for mountain bikers. With outdoor recreation as a top three economic driver in Montana, we look at how to manage areas for recreation while also protecting resources. We strive to do this with partners; we work with them to understand through education the need to build trails in a certain way, for example, away from streams.

It is important to understand how different areas require different management strategies; and to understand why we need to protect stream crossings, whether that be a road or a trail, for the protection of west slope cutthroat stream habitat. This area allows motorized use, and with the granitic soils of the area, erosion control features are a much greater requirement for routes. Motorized recreation groups and clubs have done a great job of understanding the need for maintenance and changes in routes in order for motorized use to continue; they understand the impacts of use, and how these impacts can be reduced long term. We use Facebook and Twitter to update our users about blowdowns or muddy trails, which aligns well with US Forest Service's "leave no trace" ethic.

What are some challenges to new recreational sites?

The challenges of creating new recreational sites are dwindling budgets and the high cost of construction for new sites. In recent years, there has been a consolidation of offices, reduced budgets, and a backlog of maintenance on existing sites that reduce opportunities for expanding recreation facilities. The Forest Service needs to maintain and upgrade the sites we have before we think of adding new ones. For instance, Thompson Park once had campgrounds and picnic sites that deteriorated to where you couldn't maintain them. It's hard to paint rotten boards. The decision to reconstruct our existing sites or create new sites is sometimes dependent on whether or not we can partner with other agencies and/or groups to take on some of the maintenance. The improvements in Thompson Park could not be completed without the incredible partnership with Butte-Silver Bow. Neither the U.S. Forest Service nor Butte-Silver Bow could take care of the whole area on their own, including the 25 miles of rehabilitated trails and the Milwaukee Railroad Trail.



Montana Conservation Corps (MCC) builds new trails in Thompson Park. Photo courtesy of *The Montana Standard*.

What is the background of the Basin Creek area and what are the recreation plans for it?

Basin Creek used to be a destination for Butte; it was frequented by locals similar to the popularity of Thompson Park or the Nine Mile house on Montana Highway 2. The ability to open the area up for recreation exists because of the construction of the new Butte-Silver Bow Water Treatment Facility. Now the question is, how can we make a connection for outdoor recreation between Basin Creek and Thompson Park? The Beaverhead-Deer Lodge Forest Plan requires the Basin Creek Municipal Watershed to be protected. There are limitations on the scope of what can happen in that area, including the use of existing trails and roads. We are determining how to use those existing trails and roads to tie Thompson Park into the Basin Creek reservoir area. Currently, there is no public entry into the Basin Creek Municipal Watershed. District Ranger, Dave Sabo, continuously looks at how we manage this area including how we protect the watershed area, how we meet the forest plan, and how we provide accessibility. There is always the challenge of balancing and protecting natural resources of U.S. Forest Service lands with the public use of that land. There are plans for that area to be open in late spring or early summer of 2018, with limited access.

How should a trail user handle an obstacle on the trail?

There are many different ways to handle an obstacle on the trail. The first is to try not to go around it, which can create a new, unplanned trail. The biggest challenge users face while traveling on a trail includes coming upon a fallen log or a boggy area, and then they decide to go around it. This creates a braided trail and could extend the movement of water, which causes erosion concerns.

These days, motorized users typically carry a chainsaw. Cutting down trees in your way on the trail is just fine. The one issue we have is users only cutting the obstacle wide enough only for them to get by, and not providing a wide enough clearing for other users. When an obstacle is not cleared wide enough, U.S. Forest Service crews have to go in there to clear it again. Ten feet is the average clearing limit, which includes 3-5 feet on both sides depending on the trail type. Trails are multi-use; keep in mind a biker has their head down, and a horse's head is much higher. Cutting down a tree that has partially fallen to eye-height for a bicyclist, can become a hazard because it was not cut back enough. Social media and training have been helpful to communicate this information.

If someone would like to work more formally as a volunteer, the U.S. Forest Service offers chainsaw certifications, and workshops for trails maintenance, such as constructing drain dips to keep water off the trail, which is important in the southwest Montana area.



Jocelyn Dodge at the Graham Canyon Trail in Thompson Park. Photo courtesy of *The Montana Standard*.

Any notes on safety in the local area?

Listen to your inner voice. On windy days lots of dead trees are susceptible to downfall since the mountain pine beetle came through this forest. These dead trees also leave more water in the soil, leaving live trees unstable and susceptible to windfall or downfall from heavy spring and fall snows. Pay attention to weather conditions, if the wind starts going, pay attention. Head back or move to an area that is more out in the open.

As far as safety around other users, pay attention to your speed and the others around you. Every horse and dog reacts differently to trail users so learning how to **Share the Trail** is important for keeping trails open for multiple uses. For example, if you meet up with a horse, you want to move to the downhill side so the horse doesn't feel threatened that you are a mountain lion or another predator looking down on it. ATV's and dirt bikes, shut off the engine, take off the helmet if you can. Dogs and mules are all different. Courtesy is the biggest thing to remember to continue sharing the trail to minimize any problems and maintain safety. We educate people on conflicts, designing trails with minimal blind corners. We have sponsored workshops for the bike and the horse community that accomplish what we need for teaching trail etiquette.

Best, easiest ways to be stewards?

Citizens need to understand that our agency is based on multiple uses. The most difficult thing for the public to understand is how to maintain that balance. We look at growing outdoor recreation opportunities, but the design needs to assure that those resources are protected. We design trails to reduce conflict, provide a challenge, ensure safety, and create something that can be maintained long-term. There needs to be education, one-on-one work with individuals and groups to answer questions, and workshops that focus on the balance that we are trying to achieve in the area.

What is one message you would like to share with locals and visitors?

I manage the recreation program for the public and that includes all users, but at the same time, the public needs to take responsibility so that those opportunities can continue in the future. Connecting youth and adults with the land is important for understanding and minimizing our impacts, and for providing for continued recreational opportunities. Outdoor recreation is important for our economy, not just as a business, but also for enhancing the quality of life for all of us. We are challenged to use social media to get youth connected to the outdoors and gain an appreciation that will carry on when they are adults. We want the public to be engaged because they are the ones who can communicate their interests to leaders and decision-makers at all levels.

Butte Receives Public Art Installations through Stormwater Art Project

Kayla Lappin



Mike Marcum and Chris Bradley of The StoneFly Fly Shop with Butte High Student and Artist, Clayton Heggem.

CFWEP has teamed up with Butte-Silver Bow to increase stormwater awareness in the Butte community through the Butte Stormwater Art Project. Since 2016, four signal boxes have been wrapped with artwork created by local artists. Wraps were installed by Tillo Graphics, who donated their labor to the project. The vinyl wraps on the signal boxes last an average of 10 years.

Through our Stormwater Art Project, we hope to increase public awareness of stormwater drainage around Butte. "Many of the signal boxes in Butte are located next to storm drains," said CFWEP director, Rayelynn Brandl. "Butte community members often don't realize that Butte's stormwater is untreated, and eventually makes its way into Blacktail or Silver Bow Creek. The wraps feature art that we hope will remind Butte citizens of the connections between our storm drains and our creeks," said Brandl.

The very first signal box art installation was sponsored by CFWEP in 2016 and is located at the corner of Montana Street and Park Street. It features a photograph taken by Brian Varner. Following this installation, a call to local artists was made in June of 2017 for additional artwork ideas; the project received 11 submissions. Since June, three additional signal boxes have been sponsored and wrapped.

The signal box at the corner of Mercury Street and Main Street features a photograph taken by Dr. Robert Pal, assistant professor of Biology and the Director of Restoration at Montana Tech. This signal box is sponsored by Headframe Spirits.

Artwork from 5518 Designs' owner, Jon Wick, is featured on the signal box at the corner of Montana and Mercury Street. Jon Wick and 5518 Designs is also the sponsor of this wrap.



Dr. Robert Pal. Signal box sponsored by Headframe Spirits.



Mark LaFond of Tillo Graphics, Jon Wick of 5518 Designs (sponsor and artist), and Rayelynn Brandl, CFWEP Director.

Another signal box at the corner of Harrison Avenue and Amherst Avenue is sponsored by The StoneFly Fly Shop. It features artwork from Clayton Heggem, a student at Butte High School.

CFWEP is looking for additional sponsors for the remaining 30 signal boxes around Butte. Sponsorships can be made at two levels; a \$300 level and a \$600 level. Sponsors will be featured on the signal boxes themselves, on the CFWEP Facebook page, in CFWEP publications, and on the CFWEP and Butte Stormwater websites. If you are interested in becoming a sponsor, please visit cfwep.org/stormwaterart or contact Kayla Lappin at klappin@mtech.edu or 406-221-6198.

The call for art is ongoing, and community members are encouraged to submit their art at any time. Selected artists are eligible to receive a \$200 stipend for their art. Art submitted to the project must relay a message of connectedness to our waterways and can have an ecological, aquatic, or riparian focus. The project envisions art honoring the unique ecology and beauty of the Summit Valley, our water resources, and the outdoor areas we all know and love. All ages are welcome to submit art to the project. For a complete application please visit cfwep.org/stormwaterart or contact Kayla Lappin at klappin@mtech.edu or 406-221-6198.

Why a Creek is a Creek and a River is a River

Dr. Arlene Alvarado

We have all heard of streams, brooks, creeks, tributaries, and rivers. But, what exactly is the difference between these terms, and what are the accepted definitions of these terms according to leading experts? First, let's agree that we will keep our focus on what these terms mean for us here in the United States, understanding that they may not hold the same meaning for other countries, or even within various cultures of the same country. Second, the U.S. Geological Survey (USGS) states there are "no official definitions for generic terms as applied to geographic features." So please consider this a work in progress with no end in sight.

Most sources agree that the term, *stream*, is used to describe all freshwater that flows in a clearly defined channel from higher to lower elevations on the surface of the planet; so, brooks, creeks, and rivers are all types of streams. A *brook* is flowing freshwater considered by some to be smaller than a creek and found flowing in rugged terrain, but brook is also used as a synonym for creek. *Creeks* are flowing freshwater that serve as tributaries for other creeks or rivers; they are typically smaller than a river.

A *tributary* is a stream that feeds into a river, rather than ending in a lake, pond or ocean; tributaries can be the size of brooks, creeks or rivers. The smaller stream is usually considered a tributary of the larger one. By common standards, the stream will keep the name of the stream that had the most volume of water at the confluence, but sometimes history or other factors can also affect the stream's name.

Rivers are defined as flowing freshwater on Earth's surface with considerable water volume, most of which flows towards an ocean, sea or lake, or into another river. Rivers grow as more and more tributaries drain into them. Similar to how a snowball rolling downhill gets larger as it descends. Rivers display increases in the width and depth of the water on their way down in elevation. When one river joins another, it is common to keep the name of the river that had the highest volume of water at the confluence, though again, other factors may come into play that override this standard.

Most would agree that a river has more water volume than a brook or creek. However, since many streams were named prior to any scientific consensus of definitions,

it is possible to see a "river" flowing into a "creek;" for example, in Northern Virginia, Little River flows into Goose Creek. Scientifically speaking, however, the name is not as important as the location and physical features of the stream in terms of understanding its behavior and ecological contributions.

The development of the concept of **stream order** was a welcomed outcome of the work of two scientists, Robert E. Horton (1945) and Arthur N. Strahler (1952, 1957). The stream order concept applied a quantitative approach to understanding stream hierarchy, that is, the rank of streams relative to the headwaters (source). With the stream order concept, numerical designations are assigned to streams to indicate where in the watershed system a certain stream segment lies. Interestingly, this concept has also been applied to other phenomenon that displays branching; for example, the study of the hierarchy of biological structures, such as trees and animal respiratory and circulatory systems. Most rivers contain this dendritic drainage network, but can also flow in rectangular, trellis, or radial patterns within the watershed.

First-order streams, designated with the number 1, are the upland streams. These are the smallest streams of the world that flow or feed into larger streams, but do not themselves have streams flowing into them. They generally begin from groundwater springs on steep slopes, flowing quickly to their confluence. Thereafter, downstream segments are defined at the confluence, the place where two streams join. When two, first-order streams create a confluence, the combined waters rise in rank to second-order, being designated with the number 2. When two, second-order streams join, the combined waters rise in rank to third-order, designated with



Strahler's Stream Order (hierarchy of streams). www.bedfordcountyconservation.com/Watersheds/watersheds_page2_stream%20order.htm

the number 3, and so on. For a confluence that includes streams of different rank order, the highest numbered order is kept. For example, when a first-order stream joins a fourth-order stream, the downstream segment is designated as a fourth-order stream.

First- through third-order streams are **headwater streams**; fourth- through sixth-order streams are considered "medium" streams; streams that are seventh-order or higher are categorized as rivers. According to several authors, over 80% of streams are between first- and third- order streams, or headwater streams. The highest ranking river in the world is the Amazon River with a rank of 12 at its mouth. In the United States, our highest ranked river is the Mississippi River with a rank order of 10; it is estimated to receive water drained from over a million square miles. In our watershed, the Clark Fork River is a seventh-order stream, draining over 25,000 square miles.

The stream order concept is important for scientists because it gives them a common language to use to communicate their findings and recommendations. These designations work to standardize all flowing freshwater, regardless of whether that body of water is being called a stream, brook, creek, tributary or river. In addition to helping hydrologists, it also helps biologists studying what types of life might be or should be present in a particular part of a stream. For example, aquatic insect species that thrive in first-, second- or third-order streams that have rocky, gravelly substrates and high levels of dissolved oxygen, are not likely to be found in higher order streams that lack these features. Stream order concept, therefore, provides scientists with an idea of the contributions from particular waterways within a drainage network, which is very important in the study of water and water management practices.

Headwaters of Blacktail and Basin Creeks

Abby Peltomaa

Overview of Blacktail and Basin Creeks

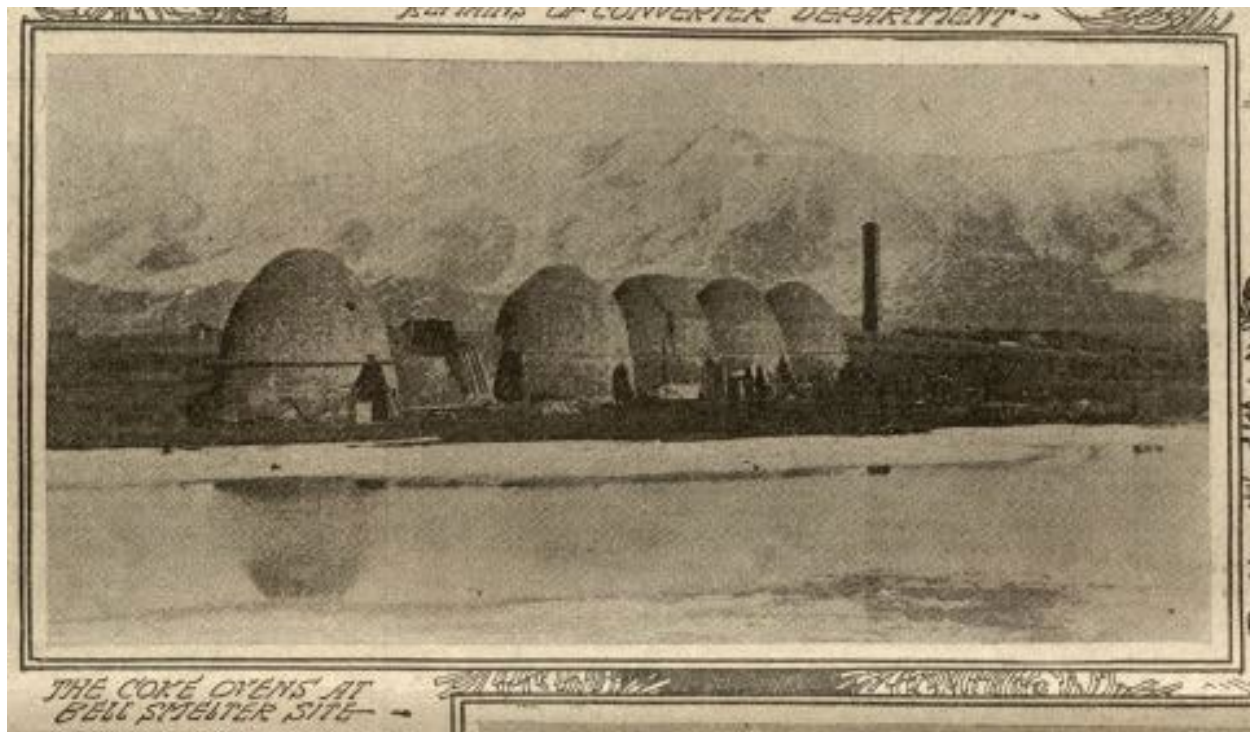
Blacktail Creek is a 17-mile long waterway that begins in the Highland Mountains, south of Butte, Montana. From its headwaters in the Highlands, the Blacktail flows north through Thompson Park, the Butte Country Club, then through Father Sheehan Park. Thereafter, Blacktail Creek had formed a confluence with Silver Bow Creek when Silver Bow was still a naturally flowing creek. When open pit mining started, some of Silver Bow Creek's waters were diverted. After Montana Resources restarted the mine in the 1980's, Silver Bow Creek's waters were fully diverted. Silver Bow Creek's channel is still used today to catch stormwater and snowmelt runoff. Blacktail Creek and the historic Silver Bow Creek channel come together at Texas Avenue across from the Chamber of Commerce. The single stream continues on as Silver Bow Creek with Blacktail Creek primarily supplying the flow of water. Please see the *Blacktail and Basin Watershed Geography* map on page 10.

Basin Creek also begins in the heart of the Highland Mountains, and flows north for 16 miles before draining into Blacktail Creek at Father Sheehan Park. Basin Creek is the key tributary for Blacktail Creek, and thus Silver Bow Creek. Both Blacktail Creek and Basin Creek are the two major contributors to this watershed. Ultimately, water from each creek feeds Silver Bow Creek and the Clark Fork River.

The Basin Creek Watershed covers 42.0 square miles, while the Blacktail Creek Watershed covers 48.9 square miles. Together they cover 90.9 square miles. The Basin Creek Watershed has a mean annual precipitation of 17.24 inches, and the Blacktail Creek Watershed has a mean annual precipitation of 17.01 inches.



Lake Avoca. Photo courtesy of *The Montana Standard*.



Coke Ovens at Bell Smelter Site. Photo courtesy of the *The Montana Standard*.

History of Blacktail and Basin Creeks

Blacktail Creek

Scientists envision that prior to European settlers arriving in the Summit Valley, our area was a pristine ecosystem consisting of many creek drainages, dense conifer stands, abundant wetlands, and lush riparian areas encouraged by numerous beavers. In 1881, Charles Meader constructed the Bell Smelter along Blacktail Creek. The town or neighborhood known as Meaderville was named after the Bell's owner. The Holiday Inn Express is currently located at the original smelter site. The smelter operated on and off from 1881 to 1886, processing copper ores from the Bell Mine and treating some Liquidator Mine ores in the later years. Ores were first processed using open heap roasting in coke ovens, although blast furnaces and a concentrator plant were later adopted for roasting the ore. Despite the short life of the Bell Smelter, Blacktail Creek was nicknamed, and often still referred to, as Bell Creek by locals. The flume for the stack still exists, buried underneath the ground running north.

In 1895, Blacktail Creek was dammed to create Lake Avoca, a popular boating and water recreation area. The lake had a pavilion and a park, as well as boats available to use in the summer months. Children would play hockey and ice skate in the winter on the lake. Lake Avoca was drained in 1939, and the present day Butte Country Club was established where it once was. Blacktail Creek again flowed freely, however, as a straight channel.



Clean Up Blacktail Stream Day, 1970. Photo courtesy of *The Montana Standard*.

Butte citizens had often used Blacktail Creek as a dumping ground, which prompted Lou Parrett, a local teacher, to gather his students from Webster-Garfield School and start cleaning the creek in 1970. Thus CUBS, Clean Up Blacktail Stream Day, was born; Mr. Parrett and his students cleaned the creek annually for many years. CFWEF has undertaken the event over the past four years, with Mr. Parrett's blessing. Next year will mark our fifth annual CUBS event on May 24, 2018.

Basin Creek

Basin Creek and its surrounding drainages served as historic beaver habitat. Again, scientists envision this area as having large beaver complexes with expansive and lush riparian habitats. The Salish people were known to fish in the area, following the fish as they moved upstream to spawn in the high mountain waters. When French Canadians from the Hudson's Bay Fur Trading Company settled in the area, they called it "the land of the shining mountains." In the late 1890s, Basin Creek was dammed to create two reservoirs for drinking water in Butte. Beavers were trapped off to prevent giardia in the reservoir. The reservoirs were so pristine that no filtration was necessary until 2011.

The French settled in Basin Creek, establishing dairy farms and gardens. They also created road houses with big stables to provide rest for the horses and their teamsters who were moving ore over the Continental Divide. These road houses were located at the Four, Five, and Nine Mile, marking the southern roadway leaving Butte toward Whitehall. Timber cutting also occurred throughout the Basin Creek watershed for the mines of Butte.

Blacktail and Basin Creeks Today

Native westslope cutthroat trout inhabit Blacktail Creek. To ensure the success of this population, the aquatic habitat needs to be improved. To be successful, these trout need the 5 C's: cold, clear, clean, complex, and connected waters. Part of on-going restoration work on Blacktail Creek includes removal of fish passage barriers that are currently in place along the creek.

Westslope cutthroat trout are also present in Basin Creek, as well as in the reservoirs. These could once again be great fisheries, with a few restoration dollars to enhance habitat and create recreational access. Connectivity to the upper part of Basin Creek is crucial in providing more space for the trout to spawn, which would allow them to remain a self-sustaining population. Further restoration projects could also establish better connectivity with Basin Creek and Blacktail Creek, as well as other waters downstream.

One project that can aid in fisheries is the Watershed Restoration Council's (WRC) Blacktail Watershed Restoration and Monitoring project (nicknamed, the beaver mimicry project). CFWEF is a primary partner with the WRC and scientist Amy Chadwick of Great West Engineering. Beaver mimicry work has been on-going in the Highland Mountains on the upper part of Blacktail Creek for three



Collecting Timber on Basin Creek. Photo courtesy of Butte-Silver Bow Archives.

years now. Beaver dam analogues are built using site materials including soil, rock, and wood posts. These structures are semi-permeable and filter sediment out of the water, thus improving water quality for fish and other organisms in the creek. The structures also increase groundwater storage and stream flows, again, providing better habitat for fish. Some other goals of this project are to increase floodplain connectivity; reduce flow thus increasing the sinuosity of the stream; increase riparian species, such as willows and aspens; and provide more wetland and stream habitat. Encouraging willow and aspen growth can also help prevent forest fires. Please see *Blacktail Watershed Restoration and Monitoring Project* in this edition for more information regarding the project and our partners.

Restoration efforts in the Blacktail Watershed include the Basin Creek Water Treatment Plant, which was built in response to the 2011 revocation of the filtration waiver for Basin Creek Reservoir. The \$30 million water treatment plant uses ceramic-membrane filtration. Part of the funds were appropriated by the Butte Natural Resource Damage Program Council (BNRC) with the stipulation that the reservoir area be opened to the public. Basin Creek Reservoir is slated to have some accessibility by June, 2018. Eventually, bikes, paddleboats, canoes, kayaks, and swimmers will be allowed in the reservoirs.

We are currently rewriting the history of these creeks to be a story of restoration success. Please see *Restoration of Blacktail and Basin Creeks* in this edition for more information regarding other efforts that are on-going and how you can get involved.



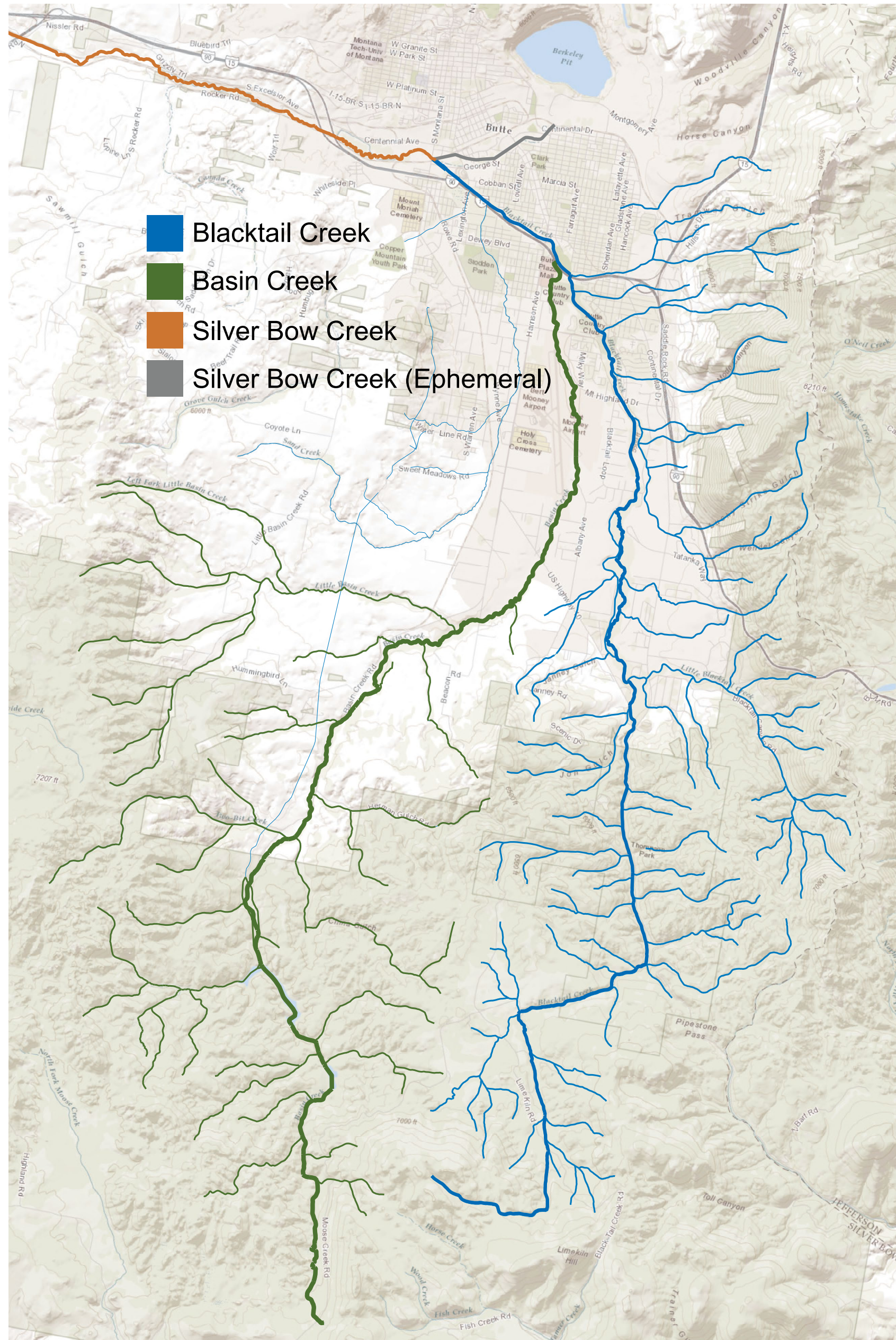
Basin Creek. Photo courtesy of *The Montana Standard*.



Basin Creek Reservoirs. Photo courtesy of Google Maps.

Editor's Note: Information for this article was gathered from earlier articles by Susan Dunlap, "Blacktail: Butte's forgotten creek is a promising fishery," published in February of 2016, and Mike Smith's, "Big bonus: Basin Creek Reservoir expected to open to recreation next year," published in April of 2017. Permission for photographs was graciously allowed by the Butte-Silver Bow Public Archives and The Montana Standard.

Blacktail and Basin Creeks Watershed Geography



Shapefile Source: Montana Hydrology Dataset Project. Background: ArcGIS® Software by Esri/Adobe® Illustrator®.
By: Evan Norman and Kayla Lappin.

Blacktail Watershed Restoration and Monitoring Project

Evan Norman

Historically, beavers were the construction engineers who provided abundant wetlands throughout southwest Montana. A wetland can be an extravagant oasis for plants, birds, trout, amphibians, ungulates, and rodents, including the beaver. The remnants of these wetland areas now hold historic beaver dam complexes that built natural valleys of sediment and debris. Pressure from climate change and the absence of beaver has depleted groundwater in many of these valleys. This water shortage has changed many ecosystems from aquatic to terrestrial. Enter beaver dam analogues (BDA), or beaver mimicry techniques, for restoration.

BDAs are constructed with conifer stakes, boulders, and sedge sod in the stream channel. These structures serve as a flow impediment, reducing stream energy, pooling water, and reconnecting side channels. When installed, earthen materials act as a ramp for water to advance on and spill down. Willows and conifer limbs are weaved between the stakes parallel to streamflow to further disperse flow. Variations of these structures can be built with machinery, but the simplest structures only require tools that can be carried to the project location. The materials needed are site-sourced, which is why BDAs are known as a low-impact restoration technique.

Ideally, BDAs are built in drainages with historic beaver activity, allowing for the potential of beaver to return. Subsequently, existing beaver dams have already shaped the landscape to an appropriate stream slope and valley width for restoration. Ideal beaver habitats have slopes of 1-3% (Oregon, et. al, 1998) and are located in average valley widths greater than 150 feet (Vore, 1993). Stream slopes that are steep can be problematic because they increase flow velocities as well as water pressure on BDA structures. Furthermore, shallow gradients provide an opportunity for the structures to deposit sediments and move water laterally. Wide, gently sloping valleys provide the space for water to

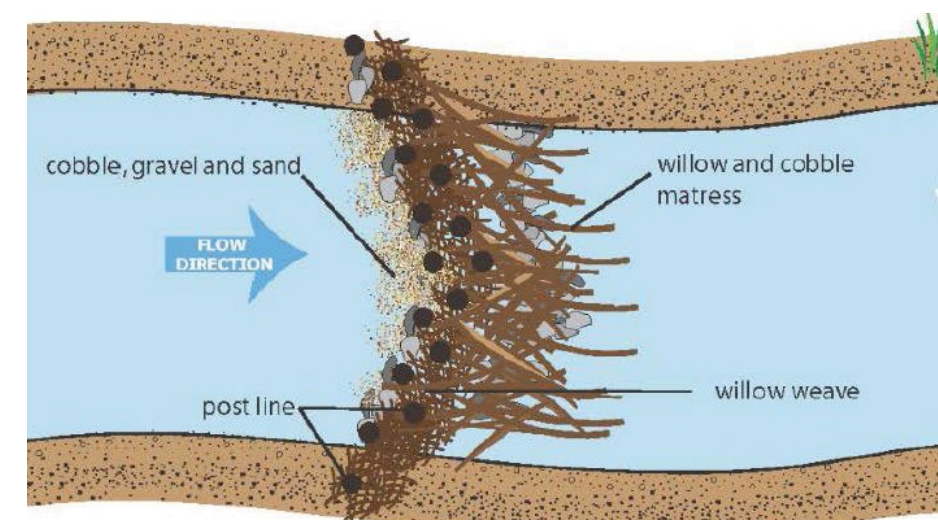


Beaver dam analogue on Blacktail Creek. Photo by Evan Norman.

infiltrate into valley soils to recharge groundwater, and promote riparian and woody vegetation growth. Aspen, cottonwood, willow, and alder can then establish roots in these saturated soils to provide future shade and bank stability.

BDAs near Butte are on headwater streams in private parcels on upper Blacktail Creek, above the Basin Creek Reservoir, and in the Browns Gulch Project Area, northwest of Butte. The structures support small drainage areas and assist in naturally storing sizeable volumes of water that come from storm events and snowmelt. The structures above Basin Creek Reservoir provide an additional source of storage for municipal use and for Silver Bow Creek streamflow.

Throughout this project, the Clark Fork Watershed Education Program has installed and monitored BDAs alongside partners. These partners include Great West Engineering, Montana Fish Wildlife and Parks, the Watershed Restoration Coalition, Water and Environmental Technologies,



Beaver dam analogue structure. Source: Portugal, EP., Wheaton, JM., Bouwes, N. 2015. Pine Creek Design Report for Pilot Restoration. Prepared for the Confederated Tribes of Warm Springs. Logan, UT, 35 pp. Portugal et al. (2015).

and Montana Tech. Butte-Silver Bow County, the U.S. Forest Service, and private landowners have allowed access for restoration and monitoring to occur. These projects are made possible through a Wildlife Conservation Society Climate Change Adaptation Grant and restoration dollars through the Montana Department of Justice, Natural Resource Damage Program.

In order to effectively judge how BDAs impact sites, partners are measuring treatment and control reaches in each of the project's active drainages. Monitoring efforts are focused on streamflow volumes, groundwater levels, macroinvertebrate and fish populations, vegetation growth, and topography changes. Continuous temperature and pressure transducers track water depth and temperature flux.

Frequent site visits for maintenance and monitoring will continue throughout 2018 with watershed expansion in the future. You can track monitoring information, access research articles, or find additional project and watershed background at cfwep.org/beavermimicry.

BDAs have gained popularity as an ecological restoration technique. These structures help contribute the benefits that come from keystone species like beaver. Beaver, however, can have unwanted effects on tree growth, culverts, and road integrity. The issues that beaver present can be counteracted using management practices that protect engineering designs and woody vegetation growth. We can restore wetlands by mimicking the beaver's effects on the ecosystem.



Beaver on Silver Bow Creek. Photo by CFWEF.

Voices of the Watershed: Ron Davis

Rayelynn Brandl

Editor's Note: This edition of the Montana Steward centers around the headwater streams within the Summit Valley. Today, much controversy remains about the restoration of Silver Bow Creek. Some residents request that the once free-flowing stream from Texas Avenue to Montana Street be fully restored. While others request that we simply leave things alone, let the dead section of the stream remain dead, accept the decisions and remedy to date, and allocate our funding elsewhere. Another perspective, still, is to complete remediation and restoration activities within the Silver Bow Creek corridor, and to also amend the free-flowing stream plan to one that contains a series of connected wetlands, an improved trail system and a new methodology for better stormwater control. Our intention with this interview and the additional pieces within this edition is to illuminate various perspectives on the choices surrounding Superfund. As always, CFWEF remains neutral in our stance, letting the science speak for itself. The facts are that there are tailing wastes impounded within the historic Silver Bow Creek corridor, and that the groundwater beneath those tailings is contaminated. To have a functioning ecosystem in this area, the tailings and groundwater issues will need to be addressed in some fashion. We believe that an informed, active, and engaged citizenry will always produce the best solutions possible.

Start by telling us a little bit about yourself. We know you have been in broadcasting all of your career and have been the voice of Butte radio for a long time. Fill in a few more details for us.



Ron Davis

I have been in broadcasting all of my life, and have lived here in Butte all of my life, with the exception of one year. I started in this building (the KOPR station) on September 15, 1979, as a high school student. I have found that this voice and this venue have empowered me to be an advocate for my community. It would be a shame if I didn't use this gift to help improve Butte. I have tried to do just that, both within my role as a broadcaster and as a private citizen.

As far as family goes, I am the 7th child of seven children. I grew up in the Greeley neighborhood, in the shadow of the concentrator, as we say. My dad was a miner with the company and my mother was a nurse. My grandfather Jim worked in the card room at the mine, meaning that he worked in the Human Resources department and was responsible for hiring and firing. When my dad Wayne Davis, or Winnie, as most people called him, went to work at the mine, my grandfather made him be a boilermaker. My dad also ran shovels, worked on the hoists, and eventually was a "white hat," working in safety. He was one of the last men to be laid off from the mine.

My son became a mining engineer, wanting to follow in both his grandfathers' footsteps. He is currently a short-range planner for a mine in Elko, Nevada. He called me one day and told me that after he first started working in Elko, some of the old-timers at the Elko mine, who had worked in Butte, started sharing stories with him about his grandfather. They said that they had nothing but respect for him, and that it was clear to the workers he was always there for them.

You have been a long-time, vocal advocate for better restoration in Butte. You have had many guests on your Party Line show and have been involved in quite a few community planning/listening sessions about what to do in the Silver Bow Creek Corridor. Can you tell us more about your efforts and why you are so passionate about this issue?

First of all, I am not a formal member of the Restore Our Creek Coalition (ROCC). I help them with their events and certainly am willing to volunteer my time, but I want Restore Our Creek to be independent from me. I felt that after our lawsuit against the State of Montana to rename the Metro Storm Drain as Silver Bow Creek, I was a persona non grata and it would not be good for ROCC if I was deeply involved. I am passionate because I think that Butte deserves better. We have big impacts here, and it seems to me that we are constantly being asked to settle for less.

Ah yes, the lawsuit to rename the Metro Storm Drain, which is the historic creek channel of Silver Bow Creek. Why the decision to sue over the name?

In my lifetime, that was a creek. I fished there, played in the stream there, and waded through the stench at times; I also ruined more than one pair of shoes doing so. But anyway, in my neighborhood, right behind where the Town Pump [on Harrison Avenue by the Civic Center] is now located, Silver Bow Creek was a free-flowing stream. It wasn't until around 1992 that the water stopped flowing there, and that the municipality of Butte, the EPA and the DEQ started referring to the channel as a storm drain. By 1994, they were pretty much exclusively referring to it as the MSD or Metro Storm Drain.

So, why sue? I started having discussions with various political leaders, business owners, and concerned citizens about the fact that it seemed Butte was not getting a fair shake with the clean-up. When I looked around, Missoula was getting beautiful parks, and here Butte was stuck with an ugly "storm drain" coursing through the center of our city. Initially, there were several of us involved in the discussions about the best strategies to force the issue with the State of Montana, EPA, and BP/ARCO. Eventually, the Silver Bow Creek Headwaters Coalition was formed, consisting of myself, Sister Mary Jo MacDonald, and Fritz Daly.

In our research, we found that in 1911 the State of Montana recorded and named all of its waterways. Silver Bow Creek was a named waterway on maps and within descriptions of Butte during this time. Therefore, it was a named waterway of the State of Montana. There is a statutory process set up to determine waterway names and should a name change be desired, there is to be a series of public meetings and involvement of the citizens. When Butte-Silver Bow, EPA, DEQ, and BP/ARCO unilaterally started referring to Silver Bow Creek as the Metro Storm Drain, they did not go through the proper process of making that name change, and most certainly did not involve the public.

We contacted Jim Goetz who agreed to take our case. He thought that it would be best to take the suit to district court and sue the State of Montana over the name. We were not suing for clean-up. Rather we were suing to have this section of Silver Bow Creek recognized by the agencies as a creek, specifically, a waterway of the state. The State of Montana didn't argue that this section had always been called Silver Bow Creek. The State of Montana argued that because of the impoundment of the creek for the tailings pond, the expansion of the Berkeley Pit, and the installation of the sub-drain system that captures contaminated groundwater, the waterway was "rendered so unnatural" that it was no longer qualified to hold its original name of Silver Bow Creek.

We were in court for a long time. The Silver Bow Creek Headwaters Coalition filed our suit on November 4, 2010. When Judge Brad Newman finally issued his decision on August 21, 2015, we couldn't have been happier. He ruled that the section of Silver Bow Creek had always been referred to as Silver Bow Creek, and was indeed a waterway, despite the fact that it had been so altered by historic mining activity. It wasn't a storm drain, rather, a creek.

What was your hope in pursuing the lawsuit? In other words, what did you hope would come of official recognition that this area was indeed a waterway or creek?

We felt that the agencies were using the MSD name illegally, which degraded the status of Silver Bow Creek and allowed them to not treat this area the way they were treating other waterways. We felt that by degrading Silver Bow Creek to a storm drain, the EPA and the State of Montana were allowing BP/ARCO to only have to do the minimum to protect human health and the environment. Since this area was "only a storm drain," they wouldn't be required to restore the area like the sections they did below Montana Street, thereby, allowing BP/ARCO to get away with doing much less in this area. When we filed the lawsuit, we had one goal, and one goal only—to make Butte a better and more environmentally safe place to live. We held to the ideal that the decisions made about Silver Bow Creek were forever decisions and had forever consequences. Therefore, it was important that responsible decisions be made. Allowing the State of Montana and other agencies to continually degrade this area did not sit well with me. I had to use my voice to raise awareness that this corridor, right in the middle of our city, was not getting the restoration it deserved.

Did you accomplish what you set out to do with the lawsuit?

In many ways, yes, we did. We won the judgment. In my mind, the summary judgment couldn't have been written any better. Judge Newman recognized that this section was indeed Silver Bow Creek, and that despite all of the impacts from historic mining, it continued to be a waterway – acting now as an ephemeral stream. As a result of the lawsuit, we now have a lot more people involved in raising awareness of local environmental issues and asking for better solutions for Butte. Restore Our Creek is a great example of public involvement.

We have a ways to go to achieve the vision I have for this area, which is to have a fully restored creek with beautiful trees and willows through this corridor. We can have wetlands in the area – mind you, actual wetlands, not mosquito ponds. We have to create and envision solutions that work for the whole valley, thinking of the creeks as a complex of streams that are connected to one another.

What is message you would like our readers to gain from this interview?

Become involved. Get informed about the issues. Agree with me or disagree with me, but I want us to engage more. Leadership in local and state government need to hear from their citizens. Who is fighting for us, for our community, and for our kids' futures? We call ourselves **Butte Tough**. It is time we take on the fight. We are the ones that need to fight for ourselves – stand up for a better clean-up and make sure we get the restoration we deserve.

Topographic Maps of Historic and Present-Day Butte



Figure 1. U.S.G.S. Montana Butte Special Map, 1904. Map courtesy of the Butte-Silver Bow Archives.



Figure 2. Butte topographic map 2017. Created using ArcGIS® software by Esri.

Honoring Some of CFWEP's Best Teachers

Rayelynn Brandl

2017 Teacher of the Year: Christina Pavlovich



Christina Pavlovich

Ms. Christina (Chris) Pavlovich is a 5th-grade teacher at East Side Intermediate in Livingston, Montana. She has been teaching for 10 years, and has a passion for place-based and project-based learning. She ties science in her classroom directly to local place, and then generalizes or compares to other, more distant places. This way, students can personally connect with what is studied. The Science and Engineering practices, part of the framework for the Next Generation Science Standards (NGSS), are paramount in her classroom. Students engage in each practice deeply in order to understand their watershed and the organisms within it.

When asked, "What inspires you to be a teacher?" Ms. Pavlovich said, "For me, the evolution of knowledge is one of the most important endeavors of a lifetime. Those who I teach will surpass me in knowledge and know more than I will ever know. What we teach will evolve into ideas that cannot yet be described. That's incredible."

She has created an after-school program for her students in the Yellowstone Watershed that resembles some of CFWEP programming. Her program is called Watershed Warriors. During school hours, all 5th-grade students (around 100 per year) receive 4+ hours of watershed education per year. The program meets 100% of NGSS as well as standards in Common Core Math, Common Core ELA, and Indian Education for All. The mission of Watershed Warriors is the application of studies, access to water recreation, and stewardship with the core tenant that if you "give a human being something to love, they will protect it."

Ms. Pavlovich hopes that by engaging students and adults in deeper understanding about our watershed and its resources, the experience will spark love, and eventually, stewardship. The second part of Watershed Warriors is spent after school in W2O (Watershed Warriors

Organization). Students attend hour-long, after-school meetings twice a month and tie flies, cast fly rods, interact with community scientists, and complete art projects. The sessions are planned and run by middle school and high school mentors who are current Watershed Warriors.

Over the past ten years, Ms. Pavlovich has engaged in multiple professional development programs offered by CFWEP. She currently serves as a member of our leadership team with the Montana Partnership with Regions for Excellence in STEM (MPRES) project. As a leadership team member, she plans and provides training for science teachers throughout the state of Montana. Ms. Pavlovich's dedication and alignment to the core ideology of CFWEP made her an easy choice for our 2017 Teacher of the Year Award.

CFWEP Legacy Teachers: Kathy Foley, Mary Anne Hansen, Bob Orrino and Darcy Schindler

Each of our *legacy teachers* has been working with CFWEP since the beginning of our program in 2005. Each of these teachers exemplify what it means to fully embrace the CFWEP programming, and have worked to ensure that our curriculum is enriched by other experiences. Every legacy teacher has completed numerous professional development offerings with CFWEP. These offerings have often been long-term, job-embedded, and included leadership development. The legacy teachers have each demonstrated dedication to improving their craft and ensuring high-quality science instruction within their classrooms. Our legacy teachers have been critical to our success, ensuring that our program mission of creating scientifically literate citizens is met.

Kathy Foley

Ms. Kathy Foley is a 7th-grade science teacher at East Middle School in Butte, Montana. Ms. Foley has demonstrated exceptional leadership with our programming, ensuring that her students are not only fully informed and excited about our visits, but also that new staff members at East Middle School are also excited to host CFWEP in their classroom. She has helped new teachers learn the programming basics, ensuring a legacy of CFWEP at East Middle School. Ms. Foley has also extended our curriculum and has involved her students in additional stewardship activities throughout the community, including volunteer clean-up actions.

Ms. Foley was an instrumental leader for our Professional Learning Community project at East Middle School. This project lasted an entire year, with weekly meetings intended to deepen inquiry lessons presented in the classroom. Through her leadership, her team developed a series of lessons that were presented at the National Science Teachers Association conference in Phoenix, Arizona, and are now included as part of the CFWEP online curriculum materials.

Mary Anne Hansen

Ms. Mary Anne Hansen is a 7th-grade teacher at E.F. Duvall Middle School in Deer Lodge, Montana. Ms. Hansen has been a champion of our programming, ensuring that Deer Lodge students are aware of their stake in the clean-up and restoration of the Clark Fork River. She has also extended our curriculum and has involved her students in additional stewardship activities throughout the community of Deer Lodge. Ms. Hansen has helped to bridge her students' understanding of the historic mining issues that impacted the Clark Fork River system and the ranching community of Deer Lodge. She aspires to help her students create a balanced mindset, looking to improve and enhance their lands.

Bob Orrino



Bob Orrino

Mr. Bob Orrino is a 7th-grade science teacher at Anaconda Junior/Senior High School in Anaconda, Montana. Mr. Orrino has extended our curriculum and has involved his students in additional stewardship activities throughout the community of Anaconda. He enjoys extending the history pieces, especially as related to Anaconda History. Mr. Orrino has worked to ensure that his students are engaged in topics about the restoration activities beyond our 5-day visit, including learning about fish habitats, restoration of native fish populations, local ecology field trips, and the history of mining and smelting in Anaconda.

Darcy Schindler



Darcy Schindler

Mr. Darcy Schindler teaches 7th-grade science and 10th-grade biology/advanced ecology at Drummond High School. Mr. Schindler utilizes the restoration of the Clark Fork as the foundation of his science courses. He has involved his students in additional stewardship activities throughout the community of Drummond. Of note, Mr. Schindler has involved his students in long-term monitoring of the Clark Fork River, and has worked to ensure that his students are made aware of the restoration activities in their area. His 10th-grade students take the CFWEP curriculum deeper, often pursuing research questions of their own that are related to the health of the watershed.

CFWEP Legacy Principal: Larry Driscoll

Mr. Larry Driscoll was a Vice-Principal at East Middle School in Butte when the CFWEP programming started there. He immediately saw the benefits of engaging his students in local issues that were relevant and important to their lives. Through his leadership as vice-principal, and eventually, as principal of East Middle School, he ensured that his staff team participated in any and all available professional development opportunities related to CFWEP programming. He also joined many of the professional development opportunities and participated in programming alongside his teaching staff.

Mr. Driscoll has worked to ensure that protocols for engaging CFWEP and his teachers are followed and easily implemented, and are retained following the tenure of any given CFWEP staff member, teacher, or administrator. Mr. Driscoll is passionate that all of his students are given ample time to study the ecological effects and benefits of mining in our community.

CFWEP 2017 Volunteers of the Year

Chris Doyle & Abby Peltomaa

Tom Mocilac



Tom Mocilac teaches fly tying at the Southwest Montana Fly Fishing and Conservation Camp.

One of our 2017 volunteers of the year is Tom Mocilac from Whitehall, Montana. Tom came to CFWEP in 2013 through our Southwest Montana Kids Fly Fishing and Conservation Camp. He is an avid fly fisherman and his son, Stone, participated in the 2013 camp, and several years after became one of our graduates and camp counselors. Tom has been a volunteer at the camp every year since 2013. He helps CFWEP run the fly-tying and fly-casting portions of our camp. He spends all year tying flies for the kids. This year we had 30 kids attend and Tom donated 30 flies for each camper to take home. His dedication to the program and the kids is what makes the camp so special for all those who attend. He inspires young kids to want to know more about fly fishing and the art of fly tying. Some of the campers now have their own fly tying gear because of Tom. We recognize Tom for his outstanding dedication to the Southwest Montana Kids Fly Fishing and Conservation Camp, and his support of CFWEP and the young members of our local communities.

Ask Dr. A: What are Headwaters?

Arlene Alvarado



Headwaters refers to the fact that all rivers start somewhere. The place where a river starts is the head of the river; the place where a river ends is the mouth of the river. According to the United States Geological Survey (USGS), the headwaters of a river is the furthest place from the mouth of that river. Therefore, the longest tributary or stem of a river is typically considered its headwater source.

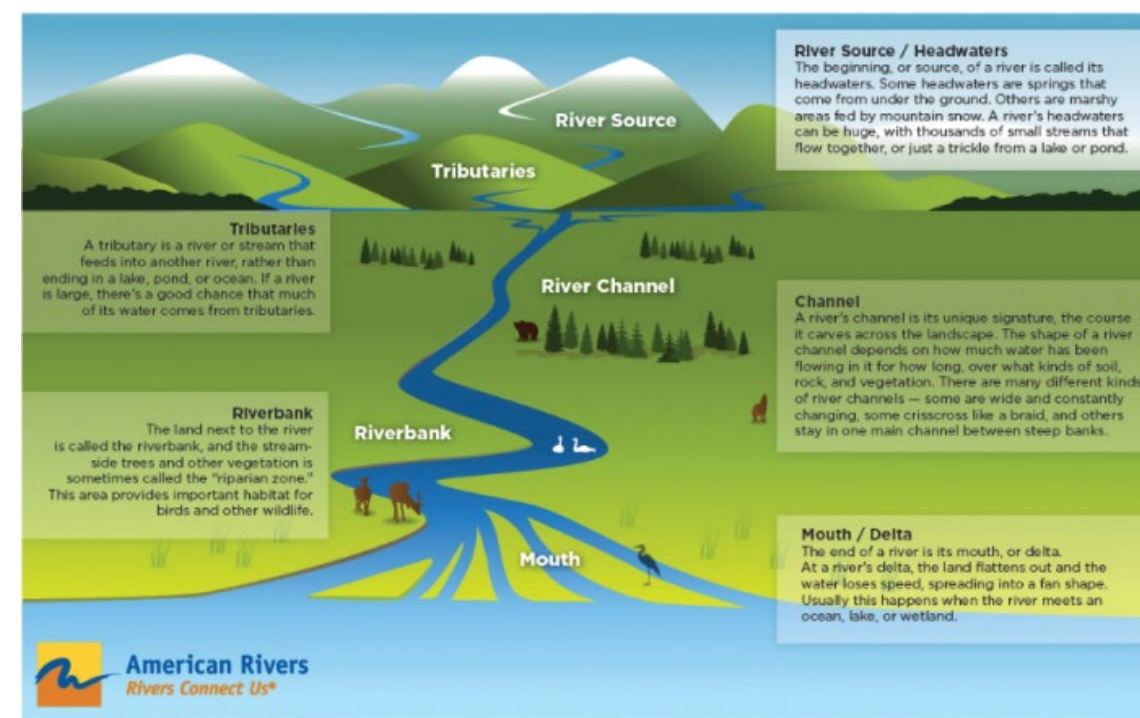
Rivers have three general parts: the source, the course, and the mouth. The **source** is the place where the river's waters start; the **course** is the path the river takes and includes its floodplains and wetlands; and the **mouth** is the end of the river where it drains into another body of water. It can drain either into freshwater in the form of another river or a lake or reservoir, or into saltwater in the form of a bay, sea or ocean.

Measure the distance from the furthest headwaters to the river's mouth and you have the length of the river's course. Rivers can travel thousands of miles – the Amazon River, for example, travels about 4,300 miles; our watershed's Columbia River travels almost 1,400 miles. Because of this, the waters of a river often traverse very different landscapes, starting in high elevation and ending in lower elevation. For that reason, rivers are broken into three general courses (reaches) for study.

The **upper course** (reaches) of a healthy river where headwaters start is steep, has very fast-moving water, contains many rapids, and

RIVER ANATOMY

The United States has more than 250,000 rivers – a total of 3.5 million miles. No two of these rivers are the same. Each river is unique to its landscape, winding through low foothills and valleys, rushing clear and cold from mountain forests, or sweeping warm and muddy down desert canyons. No matter how different our rivers are, however, they share some basic features:



River Anatomy, from American Rivers. americanrivers.org.

has clean, clear, cold water with lots of dissolved oxygen. The river bed of the upper course contains large rocks, coarse gravel, and pebbles. The **middle course** of the river has a gentler slope which reduces the water's flow, has more pools, has a higher diversity of plants and animals, and has rooted plants near shorelines. The river bed of the middle course consists of small gravel and sand and the channel is wider compared to the upper course. The **lower course** has the gentlest slope, reducing the water's flow further; a wider, deeper channel; and a muddy- and silt-covered river bed.

The differences in the physical features of a river's three courses significantly affect the biological features – the types of animals and plants found in and around the water. For example, the upper and middle courses support an abundance of aquatic insects that require high dissolved oxygen concentrations and the cold-water fish that thrive

Sara Rouse

Sara Rouse has volunteered with CFWEP for over ten years. She really enjoys the opportunity to help out with CFWEP's field trips. Sara's positive attitude and expertise have ensured that hundreds of students in our watershed have learned about the importance of riparian areas. Our students enjoy working with her and often ask about careers in the U.S. Forest Service because of her influence. Sara is very passionate about our youth's education and loves interacting with students in the field, as they put all of their new-found knowledge into practice.

Sara has worked in the Beaverhead-Deerlodge National Forest for the past 10 years as a soil scientist. Her primary workload consists of collecting field data to complete environmental analysis for any management actions occurring on National Forest land; timber harvest, mining, grazing, etc. She also supports fire suppression efforts using her knowledge and skills as a READ (resource advisor), a BAER (Burned Area Emergency Response) team member, and a Public Information Officer on the Northern Rockies Central Montana Type II Incident Management Team.

Sara lives in Philipsburg, Montana, with her three children. Together they enjoy outdoor activities, and are always busy with school sports and 4-H. Sara is also an active member of the Granite Headwaters Watershed Group and a member of the Philipsburg Public Schools Board.

on a steady diet of these insects and smaller fish. The lower course supports lots of phytoplankton, mollusks, and crayfish, but few types of aquatic insects; it also supports those fish that rely more on plankton- and algae-based food webs and that can tolerate higher turbidity and temperatures.

Historically, prior to immigrant settlement, it was probably accurate to consider Silver Bow Creek the headwaters of the Clark Fork River. Technically, however, if we follow the "rule" for headwaters, today it would be more accurate to designate Blacktail Creek as the Clark Fork River's headwaters since the flow of Silver Bow Creek's waters was altered by Butte's hard-rock mining activity. It is unclear, however, if there has ever been an instance in which a designated headwater source was modified to account for human activities.

Continued from pg. 1, Restoration of Blacktail and Basin Creeks

Restoration Plans on Blacktail Creek by Reach

In the Highland Mountains, Blacktail Creek is impacted by sanding and sediment from the road along Highway 2. Fish passage is difficult in this reach as culverts have aged, with erosion below the culverts creating waterfalls of sorts from the outlets. Fish are unable to pass these areas as the distance is too high for the fish to jump upstream and through the culvert. Sedimentation from road sanding is a normal occurrence in streams located near roadways that are sanded during the winter months. In order to alleviate these sedimentation issues, installing

plan for this reach. As Blacktail Creek makes its way through the Country Club Golf Course toward Father Sheehan Park, the creek is cut off from its natural floodplain. When Lake Avoca (located at the present-day Butte Country Club Golf Course) was drained and the dam on Blacktail Creek breached in 1939, the original Blacktail Creek channel was gone. The solution at the time was to simply heap the lake bed materials onto the banks of the former channel. This heaping created a severely incised channel through the golf course. Addressing the incising and reconnecting the stream to its floodplain is no small task. Estimates for the restoration in this

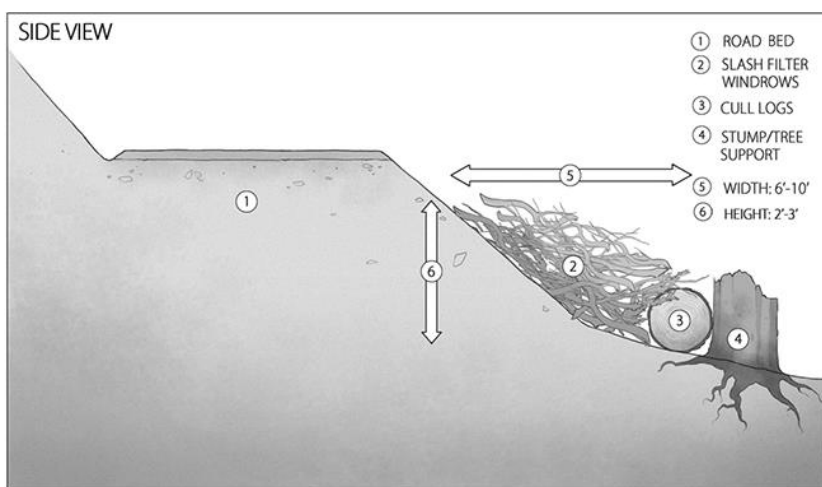
portion of the creek likely have contaminated bed sediments that may need to be removed should connectivity between the creek and the wetlands be restored.

This reach of Blacktail Creek is considered part of Butte Area One. Some of the money allocated by the Butte Natural Resource Council for alluvial groundwater connection to surface flow may be available for this area. To start to improve this reach, the Blacktail Creek berm, near the Butte Chamber of Commerce, will need to be removed. Other improvements of this reach include reducing sedimentation, improving fish passage, and addressing the potential issues from the mine tailings impoundment in the floodplain.

erosion; and ensuring easier fish passage, will create major rewards within this section. The rewards are higher quality of water within the reservoir, which is then less costly to treat, and increased recreational opportunities for the public.

Flooding and Floodplain Mapping

The hurdle facing most of the restoration projects for these streams is the completion of a detailed floodplain map for the Federal Emergency Management Agency (FEMA). The detailed mapping requires surveying the current conditions of the floodplain, and modeling the conditions that may be affected by the planned restoration project.



Side view of a slash windrow. uidaho.edu

slash windrows along the roadway would be an easy solution to catch sediment leaving the roads. Also in this area, the need for natural water storage is paramount. Beaver mimicry devices have been installed to help alleviate this issue. See *Blacktail Watershed Restoration and Monitoring Project* on page 11 of this edition for more details about this project.

Further downstream toward Continental Drive, fish passage again becomes an issue due to aging culverts. Culvert replacement within the creek traveling through both private and public properties is planned. Jon Gulch, a former tributary of Blacktail Creek, no longer connects to Blacktail, which leads to some wetland loss and fish entrainment. Within this area, the most likely restoration plans are replacing culverts, addressing sedimentation, and studying connectivity.

Nutrient loading issues present themselves in the reach that moves through the Blacktail Loop area. Nutrient loading is defined as the quantity of nutrients, mainly nitrogen and phosphorus, that are added to bodies of water. With excessive nutrient loading, algae and aquatic plants grow to the point of causing harm to the water body. Resident education and public outreach regarding how best to upgrade aging septic systems and otherwise mitigate nutrient loading from other sources, such as fertilizers, is part of the restoration

area alone is \$1.5 million. In order to complete this project, it will be necessary to create partnerships with other funders.

Once Blacktail Creek leaves Father Sheehan Park, the effects of historic smelting, and the more recent effects of channelization and filling of wetland areas (done in order to accommodate the 1962 construction of Interstate 90) are obvious. In this 1.5 mile reach from Harrison Avenue to Montana Street, the stream is very slow moving and drops approximately 12 feet in elevation, leading to a very shallow, slow stream that is a rather poor habitat for trout.

Other difficulties in this area include the fact that Butte's sanitary sewer system runs adjacent to the stream below the walking trail, creating a difficult endeavor for restoration. Another concern in this area is the addition of waters carrying zinc from Grove Gulch near Kaw Avenue. Zinc affects fish mortality rates and can be toxic to native cutthroat trout. The zinc influx near this area may need to be further addressed in order to ensure fish survivability.

In the section from Lexington Avenue to the confluence with Silver Bow Creek at the Chamber of Commerce, the entire reach was straightened to improve flow and velocity in order to help flush the sanitary waste that was once deposited in the stream. Mine wastes were also present in this area. The wetlands adjacent to this



Canadian geese and goslings on Blacktail Creek. Photo by Rayelynn Brandl.

Restoration Plans on Basin Creek by Reach

Another notable creek within Summit Valley is Basin Creek. This creek also has its origins in the Highland Mountains. Today, Basin Creek basically stops at the Basin Creek Reservoir. However, a remnant of Basin Creek that acts more like a perennial or seasonal stream remains flowing through the city of Butte during high flow times. Restoration activities are planned exclusively for the upstream reaches of Basin Creek. Maintaining improved water quality upstream of the reservoir not only ensures drinking water quality for Butte residents, but also ensures that the prime fish habitat upstream of the reservoir is maintained. There are ample opportunities for improving recreation and public use upstream of the reservoir. Improvements such as increasing natural storage of water in the high mountain parks; decreasing sediment and

The mapping and hydrologic modeling can be expensive, with some estimates nearly doubling the costs of any proposed projects. Given the likely rewards for the restoration of these streams, attention to overcoming these hurdles is critical.

Restoration dollars spent on Blacktail and Basin Creeks will improve the water quality of Silver Bow Creek and the Clark Fork River. The dollars spent on both of these relatively intact streams will reap great rewards for improved habitat, increased recreational activity, and economic vitality for Summit Valley. The story of restoration within these two tributaries is certain to be one of success.