

Low flows HOT TROUT



CLIMATE CHANGE IN THE CLARK FORK WATERSHED

CLARK FORK WATERSHED



AUTHORS:
Christine Brick
 PhD Staff Scientist, Clark Fork Coalition

Brianna Randall
 Water Policy Director, Clark Fork Coalition

Deborah Oberbillig
 Deborah Richie Communications

MAP AND RESEARCH ASSISTANCE:
Rachel Corley, VISTA Volunteer, CFC

DESIGNER:
Joanna Yardley, my-design.net

COVER PHOTO:
 Westslope cutthroat trout in the Blackfoot River during low flows.
Pat Clayton, Fish Eye Guy Photography

This report was made possible by support from the **Mountaineers Foundation**.

Copyright © 2008 Clark Fork Coalition

CLIMATE CHANGE MATTERS IN OUR BASIN

Decades of data and observations now point to a clear conclusion: the Clark Fork River basin is now experiencing a very real shift in climate. During the next 100 years, this shift is expected to accelerate, contributing to physical, ecological, social, and economic changes, many of which have already begun.

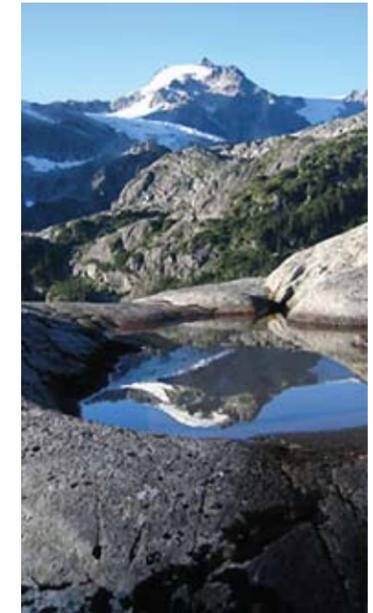
Scrolling through the months and the metrics from the 1950s, we now see that March in western Montana is hotter, more precipitation comes as rain, spring snowmelt arrives earlier, extreme wildfires are more frequent, and glaciers are making hastier retreats. And the projections years out show much of the same.

While not all the associated impacts are bad—for example, we can expect a longer growing season and improved survival of deer and elk over the winter—we will also experience more forest disease and insect infestation, more wildfire, and higher temperatures in our rivers leading to habitat degradation for our native fish. Some studies have estimated that we could lose between 5 and 30 percent of trout habitat in western Montana over the next century. With less storage of water as snow in the mountains, we can also expect impacts to our “snowpack economy”—agriculture, recreation and tourism, hydroelectric power generation, and forest and range industries.

What does it all mean for our way of life in the Clark Fork watershed? *Low Flows, Hot Trout* takes a look, delivering a plain-language synthesis of the key findings from years of data-gathering in our watershed, blended with anecdotal observations by a broad spectrum of river basin citizens, from realtor to rancher, fishing guide to firefighter.

We designed this report to be accessible to the public, informative to those whose livelihoods are directly tied to the river, and illuminating to policymakers looking for effective responses.

The bottom line is this: things can be done and everyone can make a difference, from simple at-home fixes that improve energy and water use to large-scale policy changes that stimulate renewable energy production and river-sensitive growth management. The following pages give a snapshot of what we can do to protect our hometown creeks, our local economies, and our celebrated way of life in the changing climate of the Clark Fork watershed.



I. THE SCIENCE AND WHAT IT MEANS

Temperature	4
Precipitation	7
Stream Flow	9
Glaciers	10
Forests and Fires	12
Fish	16
Wildlife	18

II. ACTIONS AND POLICIES TO SHAPE OUR FUTURE

Growth	20
Water Use	22
Water Wise	26
Restoration	28
Recreation	30
Down the Road	32
Leading the Way	34

report overview

Intro

CLIMATE CHANGE MATTERS IN OUR BASIN



We hear about it daily: Global warming. Greenhouse effect. Climate change. The terms themselves sound immense, distant, and daunting, as do the headlines that bring news of shrinking sea ice at the North Pole, burning forests in the Amazon, and the spread of infectious tropical diseases. When we consider the great debate over national and international climate policy, it's tempting to detach from this seemingly vast and complicated dilemma, and retreat into the local landscapes and daily rhythms with which we are more familiar.

But for those of us living in the Clark Fork watershed, even those rhythms are shifting—touched by climate change in starkly visible ways. Alongside the far-off planetary emergencies we read about every day are changes that we experience right here in our own backyards: drought, extreme heat, intense wildfires, smoky summer skies, declining snowpack, early runoff, and streams closed to fishing.

For many of us, these changes are putting a lifetime of patterns out of sync and creating conditions tangibly different from what we cherish about living in western Montana and northern Idaho. They're also delivering a powerful, sensory-based message that climate change is happening here. It's happening now. And it may drastically reshape how we experience our hometown rivers and streams—our ribbons of life.

So what does it all mean for the Clark Fork basin? Just as importantly, what does the future hold for inhabitants of this 22,000-square-mile area and the waterways that define its landscape, culture, and economy?

These questions are becoming the most important ones faced by the basin's citizens right now—not only because our local encounters with climate change could up the ante on debates about how we use water and deal with the fast pace of growth along our rivers, lakes, and streams. But because they may also add urgency to the need for deep and comprehensive restoration of the degraded reaches that make our watershed vulnerable to changing conditions.

As this report shows, climate change in the Clark Fork River basin is a largely unfamiliar challenge. It presents a different picture of our tomorrow. And it may suggest a new course, in terms of water and wildlife management measures, policy responses, and restoration priorities.

The Clark Fork Coalition and National Wildlife Federation teamed up to bring you *Low Flows, Hot Trout*, recognizing that climate change is an international issue with backyard implications for us all. Our intention in the following pages is to localize a pressing world-wide situation and to bring climate change down to the watershed level. And our hope is that, by looking at one watershed's story through the lens of climate change, we will help build awareness and spark dialogue in other communities where people are concerned about the uncertain future of their irreplaceable waters.

Please join us in taking a look at where we are along the spectrum of a warming West. By getting a glimpse of where we are headed, we can work together to illuminate the path toward solutions.

Tom France

Regional Executive Director
Northern Rockies Office
National Wildlife Federation

Karen Knudsen

Executive Director
Clark Fork Coalition



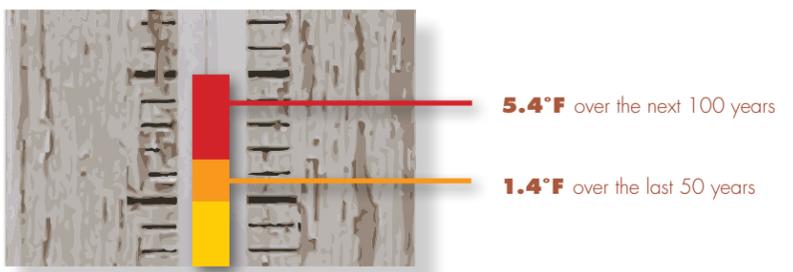
Climate Change? Or Just A Stretch Of Bad Weather?

In western Montana you'll often hear locals say: "If you don't like the weather, wait five minutes." Our basin is notorious for fast-changing, hard-to-predict weather. So why is it any different when it comes to predicting our climate?

Climate is the long-term average of the day-to-day, year-to-year, and even century-to-century weather patterns. It might be easier to visualize if we compare it to predicting human lifespan. It's pretty difficult to pin down exactly how long a single person will live, just like it's hard to forecast the exact weather you might see in a week. But if we have demographics about a large group of people, we can confidently predict their average lifespan, just like we can predict climate changes based on a large amount of average weather information.

Global factors that determine climate—such as solar influx, ocean circulation, and atmospheric composition—can be measured, modeled, and statistically analyzed to make predictions on future climate trends. Still, it's not easy to tease out climate trends from all that noisy weather data. That's why it takes 20 years, or even longer, to be certain that a change in our annual weather is also a real change in climate.

In the Clark Fork basin, most of the trends we see now have only become distinct over the past two decades. While it will likely take more time before our climate trends are deemed statistically significant, we can augment local observations with records from neighboring western states, from North America, and from the around the globe. Combined, this vast amount of data points to more than just wild weather fluctuations—it shows that we're living in a changing climate.

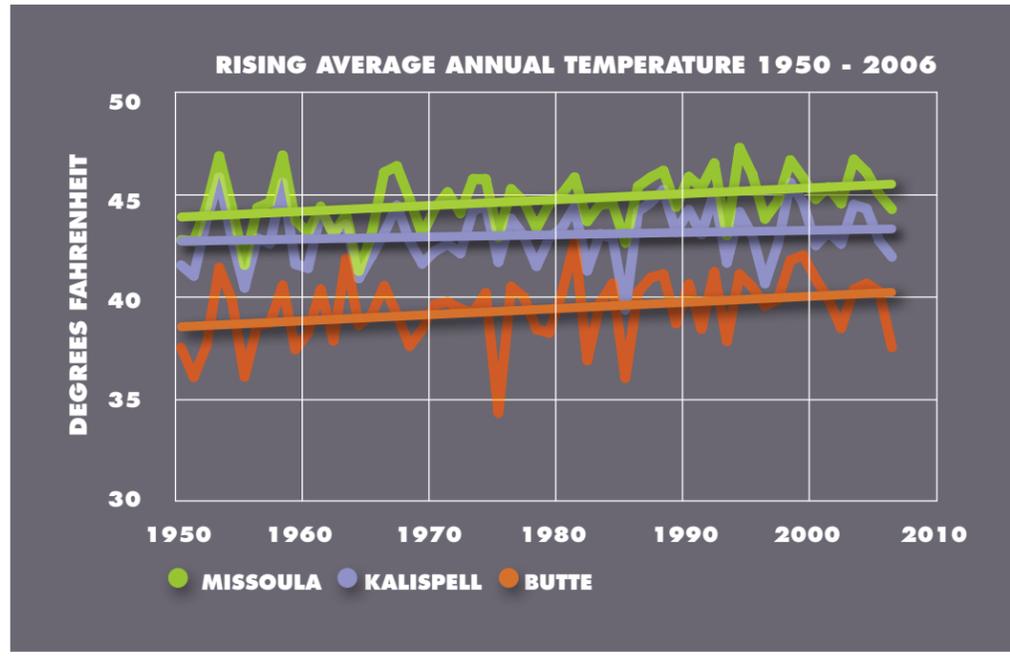


THE BIG PICTURE WARMING TREND "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level," says the Intergovernmental Panel on Climate Change (IPCC) in its report, *Climate Change 2007*. The IPCC scientists also concluded that "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations," and "very likely...not due to known natural causes alone."

In plain words? Temperatures in western North America, on average, are 1.4 degrees warmer than 50 years ago. Globally, 11 of the years between 1995 and 2006 ranked among the 12 warmest of the last century.

And in the future? It's likely going to get even warmer. If greenhouse gas emissions continue to increase, and factoring in all other natural causes, the consensus of a suite of climate models predicts **an additional temperature increase of more than 5 degrees Fahrenheit** over the rest of the century.

TEMPERATURE



THE CLARK FORK WATERSHED IS GETTING HOTTER, TOO. The trends seen globally and nationally are observed right here in our basin. Since 1950, average temperatures in our area have increased about 1 degree in the Kalispell area, and closer to 2 degrees in Butte and Missoula.

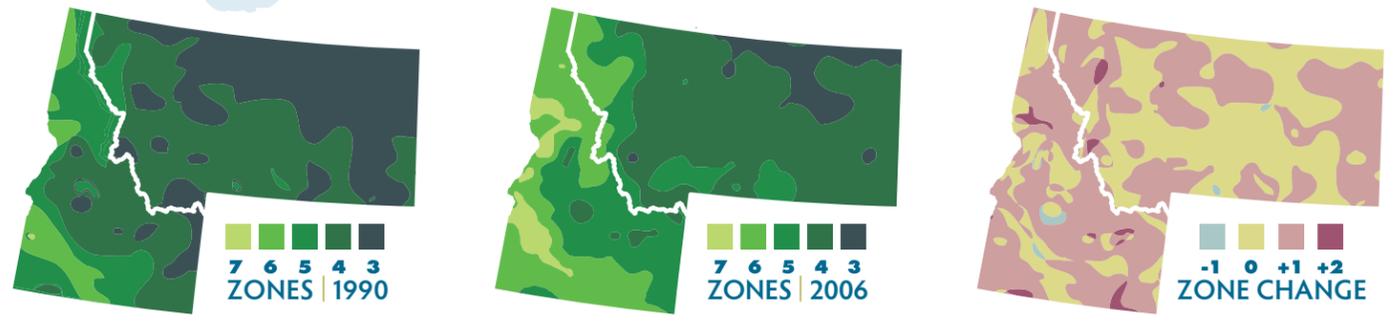
Notable details from temperature records show that our minimum temperatures are increasing a bit more than maximum temperatures, which can impact when and where snow falls. Plus, January and March are the months with the largest increase in temperatures. The data from our basin fits the IPCC's predictions that western North America is likely to warm more than the global average, and that this warming is likely to be more pronounced during the winter.



what do we know?

THE SCIENCE & WHAT IT MEANS

PERCIPITATION



source: the national arbor day foundation

STRETCHING OUR GROWING SEASON If you've been the proud gardener of tasty red tomatoes lately instead of a bumper crop of green ones, you might have noticed that western Montana's growing season is longer. Missoula, for instance, **gained 15 more frost-free days** over the past 50 years. In fact, just between 1990 and 2006, the **USDA plant hardiness zones shifted by one full zone** throughout most of our watershed. (Hardiness zones are based on average annual low temperatures, designated in 10-degree increments.)

How does that play out on the ground? With both pros and cons. Our agricultural economy will benefit from a longer growing season unless water becomes a limiting factor—a distinct possibility in the summer months. We'll see a wider range of plant species survive in our gardens and on our farms, and overall forest productivity will increase slightly. But higher temperatures also breed more—and new—insect pests, and the distribution of our native species will shift over time, moving northward or upward in elevation. Some high elevation plant species may disappear entirely.

Certainty of Climate Science

For 30 years, **Professor Steve Running** has mapped changes in forest ecosystems using satellite imagery. He's one of the world's experts on climate change and a lead author of the IPCC's "Climate Change 2007" report, which earned him a shared Nobel Peace Prize. We asked Running how climate science has evolved.



"First, I think the biggest difference in this topic from ten years ago is that back then we believed global warming would occur, but it was off in the future. Now, we understand that the current warming trend started in the 1980s, and have lots of published data to prove it."

Running explained that the research papers documenting earlier snowmelt, earlier river peaking and warmer Rocky Mountain spring temperatures have all been published since 2002. That's because it takes at least 20 years to recognize any long-term trends, and to separate "weather" from "climate."

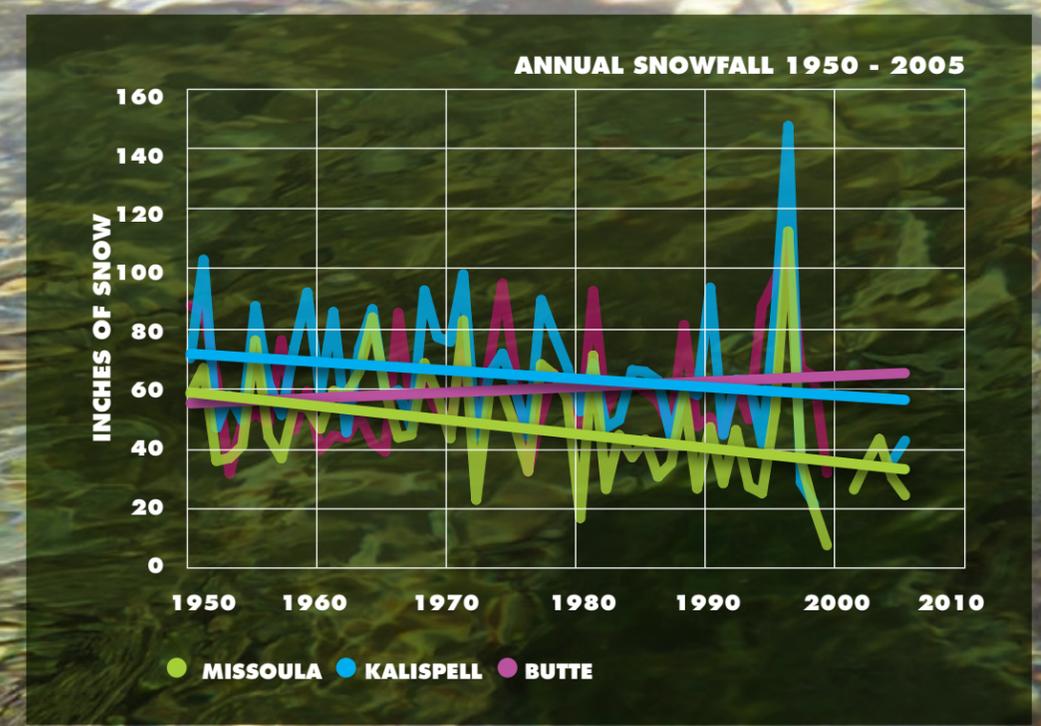
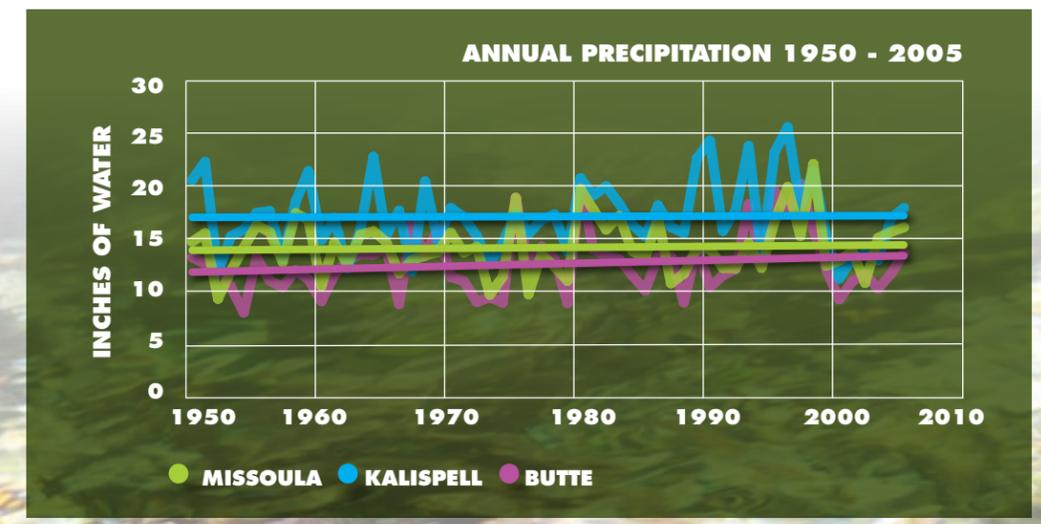
When presenting his climate data, Running also relays the message that it's time to focus on solutions, down to each person's daily actions.

"When we moved to Missoula 28 years ago, I insisted on being within bike commuting distance," he said. "In the future, more people may want to live where they can minimize car commuting."

Dr. Steve Running
 IPCC Panel
 School of Forestry
 University of Montana

More Rain, Less Snow

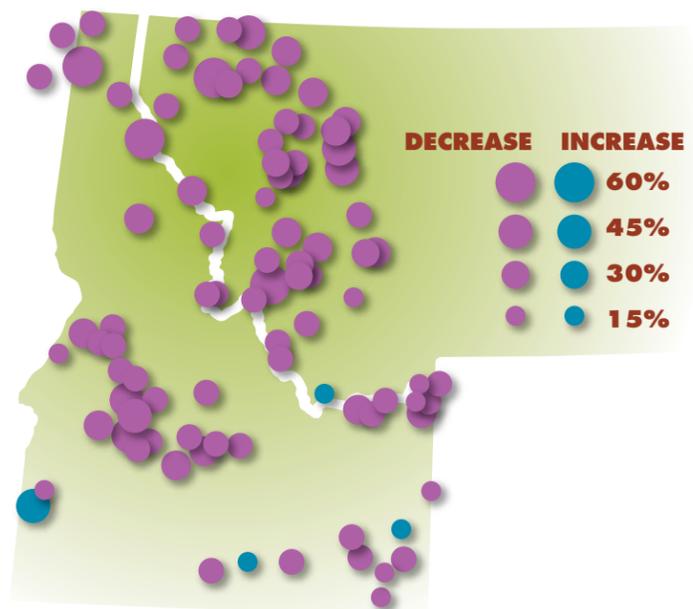
Although our average annual precipitation remained steady or even increased slightly in the Clark Fork basin over the past 50 years, more of that moisture came down as rain instead of snow in Missoula and Kalispell. The trend didn't hold in Butte, perhaps due to its higher elevation.



Wetter Winters and Drier Summers

What will we see falling from the clouds in the future? First, it's important to note that climate models yield less conclusive results for precipitation than for temperature in our region. In its *Climate Change 2007* report, the IPCC predicts no significant change for western Montana's total precipitation over the next century. However, the timing and type of precipitation may shift: the report predicts a **10% increase in precipitation during the winter months**, and a **10 to 15% decrease in summer precipitation**. As temperatures increase, more of our winter precipitation may be coming as rain, especially at lower elevations.

TRENDS IN APRIL 1ST WATER EQUIVALENT SNOWPACK 1950 - 2000



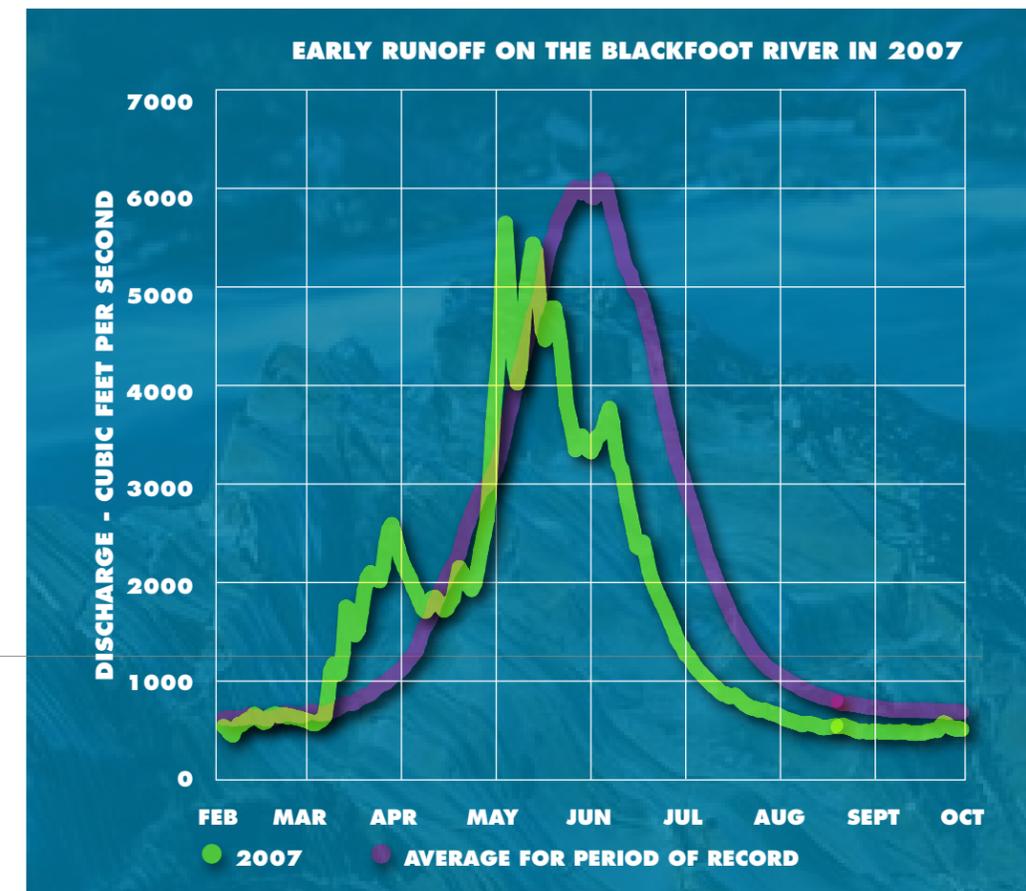
source:mote,2003, climate impacts group, university of washington

SHRINKING SPRING SNOWPACK Much of our basin's economy relies on the seasonal cycle of snow and runoff: agriculture, hydropower, fisheries, recreation and tourism. So, the amount of water stored in our mountain snowpack on April 1st is a vital gauge for predicting not only the summer's streamflows, it also forecasts the economic health of our communities. And this number has declined over the past half-century in the Clark Fork basin—**snowpack in our mountains on April 1st decreased 30% on average from 1950-2000.**

Earlier and faster spring runoff means less water storage in the mountains, less recharge for our aquifers, and less groundwater keeping streams cool during hot, dry summers. If this trend continues, our streams will become warmer, significantly changing the habitat for fish and other aquatic life. With drier summers predicted ahead, we need to consider new ways to carefully manage our precious water supply between all the different users, including fish and wildlife.



STREAM FLOW



LOW FLOWS: THE NEW "NORMAL"? Flow years like we saw on the Blackfoot River in 2007 are becoming more and more common: an early pulse of runoff after a warm spell in March, followed by peak flows in early May—weeks ahead of the historic average peak flow. Then, with most of the snow gone from our mountaintops, a long period of below-average flow from late-June through September.

Long-term streamflow trends in the Clark Fork basin are still hard to decipher from the substantial year-to-year variation. But the **flow data from our basin and from around the northern Rockies all point toward earlier runoff in the spring.**

A recent study in the journal *Science* investigated changes in the hydrologic cycle in the western U.S. Similar to previous studies, it found decreasing water storage in snowpack, increasing winter temperatures in the northern Rockies, and declining river flows in the Columbia River—the mega-basin that the Clark Fork feeds. Taking those results one step further, scientists compared their observations with predictions from climate models, and concluded that 60% of the climate-related trends seen in flow, snowpack, and winter air temperatures over the past 50 years are attributable to human-caused release of greenhouse gases to the atmosphere.

Goodbye Glaciers

We can literally watch the extinction of the 7,000 year-old glaciers that give Glacier National Park its name—they're vanishing right before our eyes. **Only 27 of an estimated 150 glaciers remain** since the park was established in 1910. Although these glaciers have been gradually melting since the end of the Little Ice Age around 1850, the rate of melting has accelerated rapidly over the last decade. In fact, the mean annual summer temperature in Glacier National Park has increased three times more than the global average. Scientists predict that **by 2030 the park's glaciers will survive only in memory.**

The Clark Fork's other high-mountain ecosystems are also feeling the effects of rising temperatures. Due to earlier snowmelt, less snow at lower elevations, and longer growing seasons, treelines are steadily advancing upward into subalpine meadows and alpine tundra. But with nowhere left to go for the already-high alpine flora and fauna, this unique habitat—and the wildlife that depend upon it—may disappear completely from the western U.S..

GRINNELL GLACIER



CIRCA 1940



2006

source: glacier national park archives

source: karen holzer (usgs)



Shifting Snowlines

As owner and manager of Discovery Ski Area for the past 25 years, Peter Pitcher pays close attention to winter temperatures. His first-hand observations point to a progressively warmer Southwest Montana, even for a ski area at with a summit at 8,100 feet.

"The frequency and length of extremely cold weather has decreased dramatically," he says.

He recalls a late February lingering cold spell in the 1980s when some of the area's ranchers lost 50 percent of their calves. Even summers once held their store of winter weather—with six-inch snowstorms in July or August.

While Arctic blasts still funnel into Montana, the winter temperature at Discovery has not dipped below negative 30 degrees for several years. Pitcher also notes that cold spells are shorter than they used to be, which means he hasn't had to close the ski area due to frigid winter storms in recent years. However, when it comes to snowfall over the last quarter-century, Pitcher can't see a clear pattern: some years there's lots of snow and other years very little.

"Though I count myself as one of the skeptics on some of the global warming conclusions," he says, **"I do believe that most of us can agree that we want clean air and water, that we want fuel efficient vehicles and appliances, and that we are willing to make sacrifices to achieve these objectives."**

Peter Pitcher

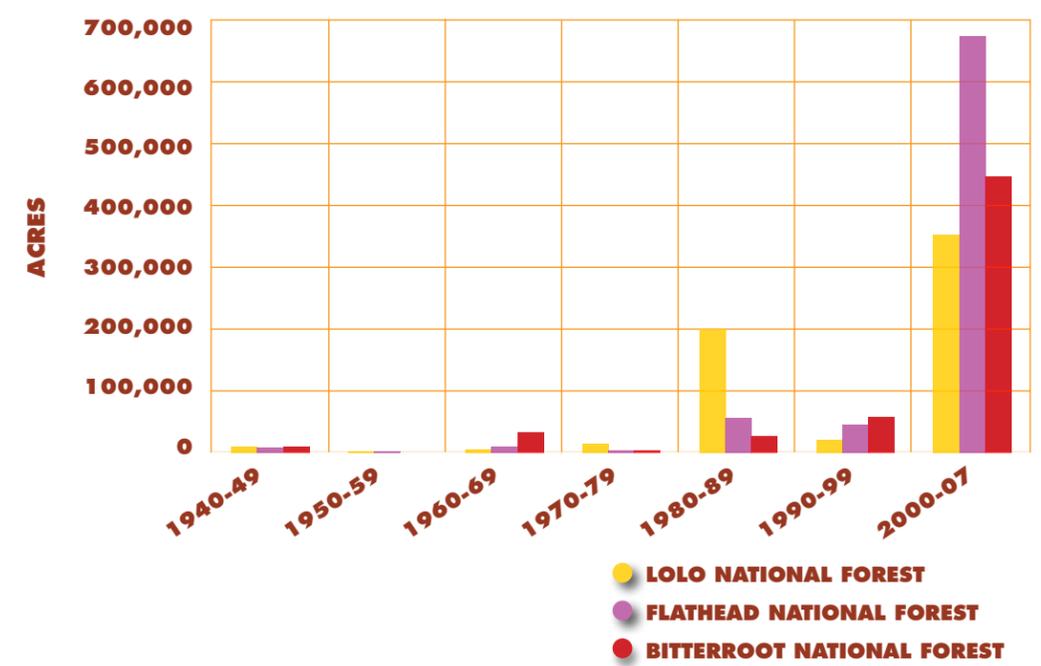
Resort Owner of Discovery Ski Area
Near Philipsburg and Anaconda



Catastrophic Wildfires: Climate Change Or Past Policy?

- FACT 1:** In the latter half of the 20th century, the Forest Service's fire suppression policy led to dangerous levels of unburned woody fuel, while also reducing the number of fires.
- FACT 2:** The combination of dense stands and warming temperatures is spurring massive pine beetle attacks that kill or weaken trees, making millions of acres ripe for burning.
- FACT 3:** Research shows that fire activity is more related to temperature—especially early warming in the spring—than to previous fire suppression history or age of timber stands.
- FACT 4:** In the western U.S., warmer summers since the mid-1980's are linked to a 78-day increase in the length of the fire season and a four-fold increase in major wildfires compared with the period between 1970 and 1986.
- FACT 5:** Drier summers mean that large wildfires and smoky skies will increasingly be a part of the Montana landscape.

BURNED ACRES BY DECADE



Wildland Firefighters Face Bigger Fires Near More Homes

When Wayne Williams first started fighting wildland fires in 1977, western Montana's wildland-urban interface—the zone where structures intermingle with undeveloped lands—was small. Back then, Williams and others in the initial attack crew would be called upon to catch the blaze while it was still small and manageable. The majority of new fire starts were caught within the first 24 hours.

Today, wildland firefighters in the changing climate of the Clark Fork watershed face a dual challenge: hotter summers and more severe fires, and an expanding urban interface. With more homes and communities encroaching on forested lands, the priority for fighting fires has shifted to first protecting any threatened homes. This means that fires further from towns may continue to burn until more resources arrive, leading to smokier summer skies.

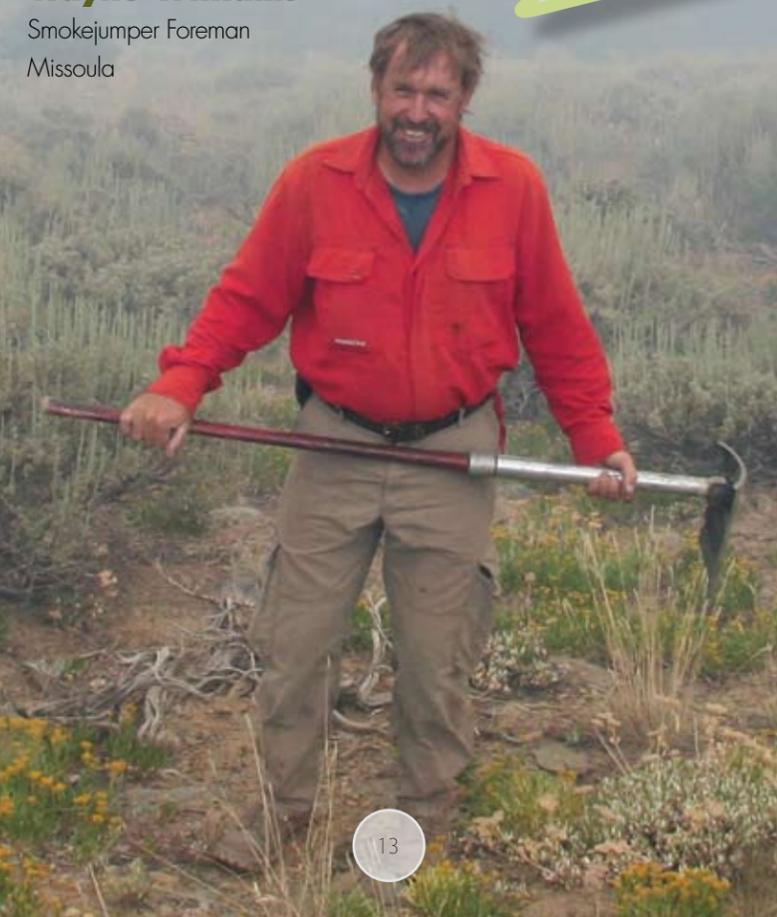
"While clearing and thinning to create 'defensible spaces' around homes helps firefighters, it's not a guarantee your home will survive a fire," says Williams. "Nor is it an invitation to build in the interface between undeveloped and developed lands."

Williams points out that the growing urban interface complicates firefighting strategy, places a greater demand on resources, and, at times, poses more risk to the firefighters.

"The solution is to live in town if you can," says Williams.

Wayne Williams

Smokejumper Foreman
Missoula





The Fallout from Burning Forests

Forests and fires create an unrelenting cycle in terms of climate change. Trees take carbon dioxide out of the atmosphere and convert it to wood fiber, helping reduce greenhouse gases in the atmosphere while the forests are growing. But when they burn, the stored carbon is released back into the atmosphere as CO₂, causing the Earth to warm. Larger and more frequent fire means more CO₂ in the atmosphere, more warming, and possibly even more fire.

Impacts from the hot-burning, all-consuming fires that we've seen in recent years ripple widely across the ecosystem. Severe fires destroy even the organic matter of the soil, leaving an erodible mineral substrate inhospitable for plant re-germination. Hot fires leave the remaining soil hydrophobic, so that rain slides right off rather than soaking in, taking sediment with it. In the wake of large fires, rivers and streams are inundated with sediment and silt, damaging habitat for fish and other aquatic life.

Recovery from severe fires takes several generations, and the re-growth process creates a different type of habitat initially. In small measures, this leads to a more diverse forest. But on a large scale, widespread impacts to vegetation may substantially change habitat for wildlife. It remains to be seen which species adapt and which won't.

Meanwhile, the communities near the Clark Fork's burning forests face recreation restrictions on public lands for weeks—even months—in the summer. Tourists take their money elsewhere, and air quality health alerts keep people inside. And there's also the stress of evacuation alerts. In especially bad years, whole towns must be evacuated, such as Seeley Lake in 2007.

UP IN SMOKE

FIRES IN MONTANA COST \$84.3 MILLION IN FY 2008 (TALLIED THROUGH AUGUST 2007), WITH \$36.1 MILLION OF THAT COMING FROM THE MONTANA STATE TREASURY.

THE U.S. FOREST SERVICE PLANS TO SPEND \$1.9 BILLION—45% OF ITS ANNUAL BUDGET—FIGHTING FIRE NATIONWIDE IN THE SUMMER OF 2008.

IN 2000, 20% OF THE U.S. FOREST SERVICE BUDGET WENT TO FIGHTING FIRE.

BETWEEN 2000 AND 2008, THE FOREST SERVICE BUDGET FOR OTHER PROGRAMS DECLINED 35%.



FISH

Hot Trout

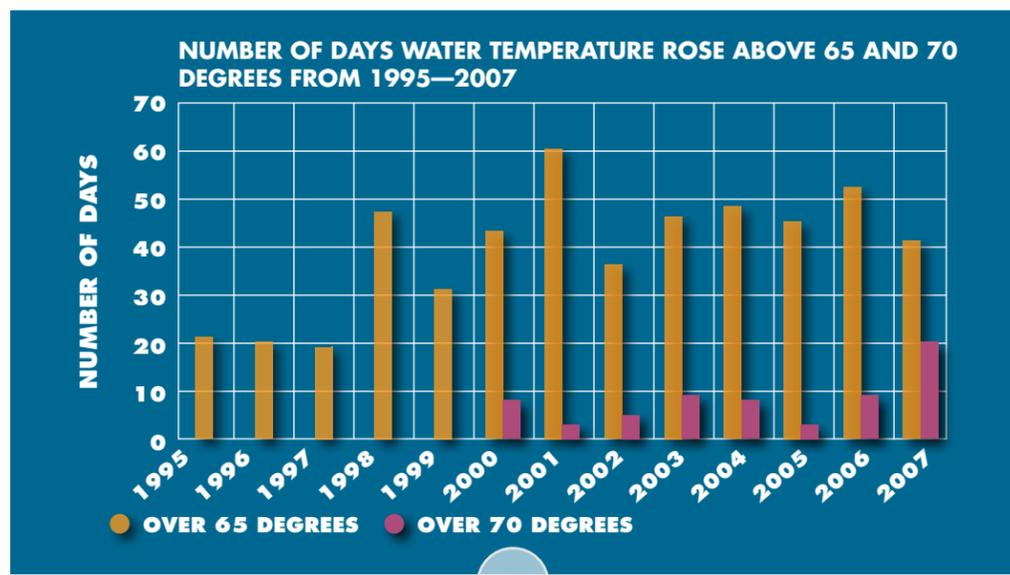
Will we still be fishing for trout in 100 years? It might be a risky bet to say yes. One study estimates that due to warmer temperatures alone, **we could lose between 5 to 30% of trout habitat in western Montana over the next century, and sensitive species like bull trout could be all but gone.**

Our native trout are especially vulnerable to warmer water temperatures, since they depend on clear, cold water for all life stages from eggs to juveniles to adults. And the temperatures we've seen lately in mid- to late-summer are even lethal for more temperature-tolerant non-natives, such as rainbow and brown trout. Adding insult to injury, warmer waters breed trout-unfriendly bacterial pathogens and parasites like whirling disease.

Another recent study looked at how the IPCC temperature predictions might impact bull trout, already listed as "threatened" on the Endangered Species Act. As lower elevation streams warm up during the summer, bull trout will survive only in cooler waters at higher elevations. As these habitat patches shrink, and as populations of trout become isolated from each other, the species as a whole will begin to die out. The study predicted a loss of 27 to 99% of large-enough habitat patches by the end of the century.



HOT WATER IN ROCK CREEK



source: montana fish, wildlife & parks unpublished data

CHANGING TROUT SPECIES IN ROCK CREEK TROUT GREATER THAN 13 INCHES

YEAR	RAINBOW TROUT	BROWN TROUT
1993	86%	14%
2004	21%	79%

Although the overall numbers of trout have increased since the early 1980's in Rock Creek, the species distribution has shifted markedly from rainbows to browns. This is due to a combination of factors, including the fact that warmer waters favor whirling disease, which creates more favorable conditions for brown trout rather than rainbow trout.

Stressed-Out Trout (and Trout-Lovers)

Not only are hot trout becoming uncomfortably common in the watershed—so are the number of river closures during fishing season on favorite rivers like the Blackfoot, Clark Fork and Bitterroot.

"When Fish, Wildlife & Parks first came out with its drought policy plan, we thought this would be an issue about every five years. Instead we're seeing elevated temperatures in traditional trout waters almost every year," says fisheries biologist Pat Saffel.

The drought plan calls for angling restrictions after three consecutive days of temperatures that are too warm for trout: native bull and westslope cutthroat trout struggle when temperatures approach 65 degrees. Non-natives like rainbow and brown trout thrive in waters up to the mid-60s, and become stressed when temperatures hit the mid-70s.

In addition to creating hotter waters, lower streamflows could also cause more whirling disease due to higher parasite concentrations. In 50 years, says Saffel, we could be looking at a more monogamous trout fishery, featuring species such as brown trout. To maintain diversity, we need healthy riparian areas where trees shade the waters and reduce the stress on the fishery.

Keeping water in the stream—by working with landowners on efficient irrigation, conservation and water leasing—is also critical. Saffel recently witnessed a success story on a stream that used to go dry every summer. As part of the Superfund restoration of the upper Clark Fork River, a portion of Warm Springs Creek now flows again year round.

"We sampled the creek and it's already loaded with fish," Saffel said. **"Every bit we can do is worth doing."**



Pat Saffel
Regional Fisheries Manager
Montana Dept. Fish Wildlife & Parks

WILDLIFE

Adapt Or Disappear? The Outlook For Wildlife

As our climate warms, many of our critters' home ranges will shift northward or upward in elevation. And, just like the Clark Fork basin's alpine vegetation, animals that thrive at the highest elevations will be the hardest hit. As patches of alpine habitat shrink, disappear, or become more fragmented, species like wolverine, which depend on spring snow in the mountains for denning and rearing young, may simply disappear in the Clark Fork basin. Species that can't adapt by colonizing new areas, or species that depend on very specific food sources—such as the lynx, which rely on snowshoe hares—may decline or die out. Meanwhile, species that are masters at adapting, such as whitetail deer, will likely thrive.



GRIZZLY BEARS Grizzlies are the epitome of an omnivore—they'll eat anything from ladybugs to plants to mammals. But one of their most critical pre-hibernation foods, the nut of the whitebark pine tree, is rapidly disappearing. For the past few decades, the trees have suffered from white pine blister rust. Now, on top of this disease, pine bark beetles have been attacking whitebark pines for the past 10 years. Warmer temperatures have allowed beetles to move upslope from lodgepole forests to the higher elevation whitebark pine stands.

The calorie-packed nuts of the whitebark pine are important for bears getting ready for hibernation, especially for female bears birthing cubs. This high elevation food source has become more important to bears' diet as roads and human settlements divide up their habitat and diminish their lower elevation

foods. Because bears are resourceful scavengers, we face conflicts between hungry bears, humans, or livestock. Losing the whitebark pine will probably lead to more of these conflicts as bears seek substitute foods.

DEER AND ELK Milder winters spell good news for ungulates such as deer and elk. Shallower snowpack means less die-off for ungulates, and easier access to browse deciduous twigs—like willows and aspen—that used to be buried by deep winter snow. Predators such as wolves may also benefit from an increase in deer and elk populations, although carnivores that depend primarily on winter-killed carrion, such as wolverines, may be out of luck.

BIRDS Since many of our favorite birds require highly specific habitats and food sources, they literally are "canaries in the coal mine" with their vulnerability to changes in climate. **For instance, 90 percent of all bird species in Montana depend on wetlands or streamside vegetation to survive.** So, with persistent droughts, loss of habitat from humans draining wetlands and removing riparian vegetation, and competing uses for our freshwater, it's no surprise the five fastest-declining bird species in Montana all depend on water.

The belted kingfisher, which needs clear water to see its prey, is among the fastest disappearing of all Montana birds, declining 88 percent since 1967. Great blue herons require large cottonwood trees to nest in, and have declined 81 percent statewide. The killdeer, a common shorebird, is down 80 percent, and the population of the blue-winged teal, a small duck, has dropped 72 percent.

Sportsman Ready to Make Changes to Protect the Outdoors

For Ryan Busse, hunting and fishing is more than a pastime—it's his livelihood. From his standpoint as a member of the hunting industry, Busse believes that if we don't reverse the development and energy consumption that cause global warming, the outdoor industry will wither right along with the wildlife habitat.

Busse's passion for the outdoors has taken him to Washington, D.C., where he lobbied to protect the Rocky Mountain Front from oil and gas development, and landed him a spot on the Board of Montana Conservation Voters. Since moving to Kalispell in 1995, Busse has spent countless hours fishing and hunting in wild places. He believes we must face the causes of climate change head-on to ensure these special places remain intact.

For instance, Busse points out that while Montana's small population may not consume the most energy in the region, we are nonetheless major suppliers of the type of energy that's accelerating global warming.

"It's time for Montana to start shipping wind and solar energy instead of natural gas and coal," Busse says.

He's ready to roll up his sleeves and make major changes. But first, Busse says, we need to move beyond the debate he hears locally over how much of climate change is human-caused.

"If a doctor tells a patient that they are going to have a heart attack soon, does it make sense to demand an exact date for the heart attack before taking action to prevent it?" asks Busse.



Ryan Busse
Hunting Guide
Kalispell

what should we do?

ACTIONS & POLICIES TO SHAPE OUR FUTURE

IT'S ACTION TIME

We've seen the numbers. Now it's time to explore how the Clark Fork's citizens, businesses, and elected officials can respond to the emerging climate patterns that are visibly changing our watershed.

The two intertwining means for tackling climate change include **mitigating actions that contribute to climate change**, such as reducing Montana's greenhouse gas emissions, and **adapting to the changing patterns** by using our resources more wisely.

Why should we mitigate and adapt right now? Because as we all know, the Clark Fork basin is one of the best places to live. The quality of life, the natural beauty, the emerging economic opportunities—these are too special to write off to poor planning amidst a changing climate. There's a groundswell of innovation out there to help us protect what we cherish about living here. The time is ripe for action, and our watershed is primed to lead the way to solutions.

Growing Fast in a Changing Climate

Rapid, unplanned development in our river valleys is one of the biggest contributors to local greenhouse gas emissions, and one of the biggest drains on our basin's resources.

How then should our Clark Fork communities grow wisely in a climate that has increased wildfires, less winter snowpack, and boiling-hot Julys? We need strategic and intentional planning efforts, which rely on community-supported decisions on where we put new infrastructure. For instance, we can work to minimize sprawl, build fewer homes in the fire-prone wildland-urban interface, give streams room to roam and protect buildings from flooding, create better public transportation, and encourage development in areas that already have access to drinking water, sewer, and roads.



A GLIMPSE OF GROWTH PATTERNS IN THE CLARK FORK

Growth rates in the 1990s skyrocketed in western Montana, with populations growing as fast as 44% in Ravalli County and 26% in Flathead and Lake Counties. From 2000 to 2007, many of these counties continued to grow well ahead of the 6% state growth rate average.

- 25,857** MORE PEOPLE BETWEEN 2000 AND 2007
- 3,781** NEW HOUSING LOTS WERE APPROVED IN 2007 ALONE
- 81%** OF NEW HOMES WERE BUILT WITH INDIVIDUAL SEPTIC SYSTEMS
- 58,000** WELLS ARE RECORDED IN THE CLARK FORK BASIN
- 40%** OF THOSE WELLS WERE INSTALLED SINCE 1990
- 30,400** WELLS ARE LOCATED WITHIN ONE MILE OF A STREAM

GROWTH

Laura Merrill

Realtor
Bitterroot Valley

Bitterroot Real Estate Depends on Natural Resources

The Bitterroot Valley's economy is closely entwined with its natural beauty, something that Realtor Laura Merrill doesn't take for granted. For 17 years, she has connected buyers with the scenic rivers, mountain views, and fishing opportunities they're looking for in the Bitterroot.

"Our valley relies on tourism and recreation," she says. "The fishing in the Bitterroot is huge. It brings people into the restaurants, hotels and stores."

Today, Merrill is seeing climate-related changes impacting the Bitterroot's economy. For instance, although the Valley's real estate season used to be strong for ten months, now she only sells houses effectively from March through June.

"When our selling seasons are cut short because of hot weather, smoky skies, stressed fish and angling closures, it translates to a diminished economy, and real estate opportunities are diminished too," she says.

On the positive side, Merrill notes a "sea change in the Bitterroot," as people recognize the need for planning and zoning to guide development in a way that conserves the qualities that attract people to the Valley. For instance, Merrill believes that establishing clear, easy to regulate streamside setbacks will protect the rivers as well as the homes alongside them.

"We've forgotten the danger of flooding," she says. "People are building closer and closer to streams because they think it can't flood here, but it can. It's actually healthy for a flood to rejuvenate the riversides."

As Merrill takes her clients on the back roads of the valley, she often educates buyers about how to protect the natural values of properties.

"When people move in, we need to help them make the best decisions to preserve our natural resources," Merrill says.



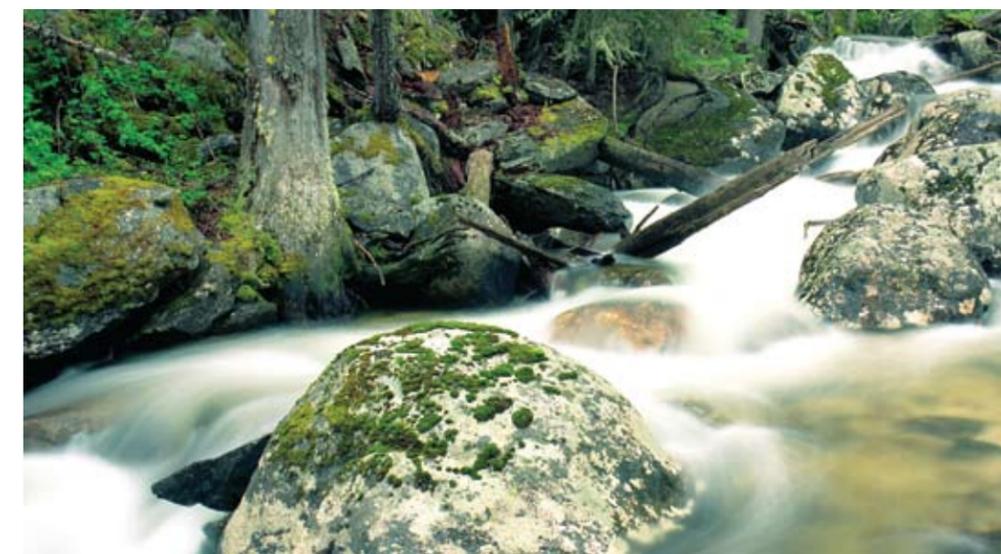
WATER USE

Protecting Our Ribbons Of Life

In the Clark Fork basin, our water is precious. And watching our water—as the rain falls (or doesn't) and the streams rush by (or trickle down)—is one of the most tangible ways we can personally observe the climate changes taking place in our basin.

Water is also a perfect medium for demonstrating how Clark Fork communities can be leaders in pioneering wise resource use. We'll likely have less water in the future, especially in summer and fall. Shifting our water use, even just slightly, is a logical step for western Montanans adapting to climate change. Enabling fair, flexible water transfers, as well as better enforcing who takes water when, will be important steps toward protecting all water users—including fish and wildlife—far into the future.

By "living within our water means," we can be proactive in crafting solutions that value, protect, and conserve this liquid gold. Now is the time for residents of the watershed to critically examine when, how, and why we're using ground and surface water, particularly in the driest months when the demand is also the greatest for agriculture, recreation, hydropower, and our flora and fauna.



HOW DO WE USE WATER IN THE CLARK FORK?

NUMBER OF DAMS: 208

TOTAL NUMBER OF SURFACE WATER RIGHTS (WATER DIVERTED FROM STREAMS AND RIVERS): 25,839

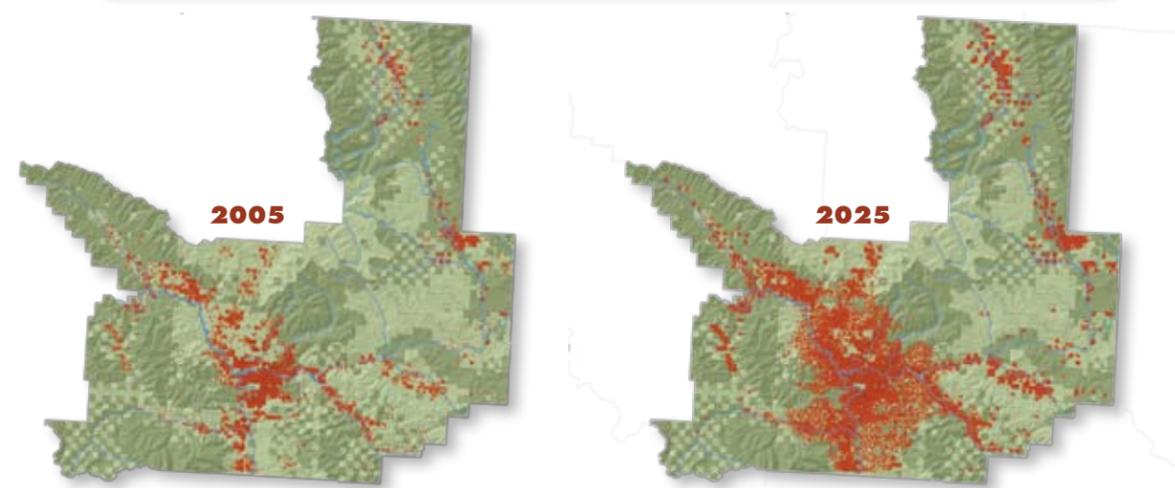
AMOUNT OF DIVERTED SURFACE WATER USED FOR AGRICULTURE: 95%

MILES OF CHRONICALLY OR PERIODICALLY DEWATERED MAINSTEM RIVERS:
38 MILES OF THE BLACKFOOT
17 MILES OF THE BITTERROOT
87 MILES OF THE UPPER CLARK FORK

AMOUNT OF WATER TRANSFERRED FROM AGRICULTURAL USE TO "INSTREAM FLOW" FOR THE SUMMER OF 2008: 390 CUBIC FEET PER SECOND

The majority of crops in the Clark Fork basin—like hay and alfalfa—are watered by diverting water from streams and rivers onto fields. This has pros and cons: flood irrigation can provide "return flows" to nearby streams after it seeps into the ground, but is not always the most efficient way to use water.

Partnering with water right holders on water conservation and streamflow restoration tools will be the key to keeping streams flowing and ranches sustainable for the long-haul. We'll also need to make sure state policies reflect today's changing demands for water, rather than relying solely on water use systems developed in the 19th century.



THE NUMBER OF STRUCTURES PRESENT IN MISSOULA COUNTY IN 2005, AND THE STRUCTURES PROJECTED FOR 2025

Maps courtesy of the Sonoran Institute

More people = More water, roads, energy

Missoula County, the watershed's most populated region, is expected to reach 108,000 residents by 2010, and double in population around 2050. Citizens and public officials are in the process of generating long-range transportation and growth scenarios to envision the best possible Missoula 50 years down the road.

Why bother with transportation planning? **One-third of Montana's total greenhouse gas emissions comes from transportation.** Clark Fork communities can mitigate this by clustering new growth around existing town centers, and creating more efficient, carbon-neutral ways for all of us to commute: bus routes, car-shares, bike lanes. Recent surveys show that urban dwellers use 2.5 times less carbon than suburban residents. Why? By driving less, period.

LIVING WITHIN OUR WATER MEANS

1. Boost water conservation measures in homes and businesses, as well as on ranches and farms.
2. Enable creative re-use of water like applying "grey water" (i.e. water used in the kitchen) to lawns, crops, or gardens.
3. Encourage flexible transfers of water between different valuable uses.
4. Link land-use decisions to water availability, especially in fast-growing counties that rely on groundwater for new development.
5. Promote local watershed groups and water districts that initiate restoration, conservation, and education efforts.
6. Create space for public dialogue and policy changes for water use.

what should we do?

ACTIONS & POLICIES CAN SHAPE THE FUTURE

WATER USE



Riverside Ranching: The View From the Little Blackfoot

Jeff Janke grew up on a ranch his parents homesteaded in Avon, Montana. He still grows hay in the valley, and also manages his log home construction business. Familiar with the Little Blackfoot River's ebbs and flows, Janke puts his knowledge to good use as a board member of the Deer Lodge Conservation District and the Little Blackfoot Watershed Group.

"We've pretty much always had 11 months of winter up here," says Janke.

Though he hasn't seen any on-the-ground trends that add up to climate change, Janke does point out that the watershed seems drier than it used to be. The main indicator for him is the **"super dry fire season that goes on and on."**

Another of Janke's observations is that the water seems cleaner between Missoula and Deer Lodge than it was a few decades ago. He attributes this to increased awareness of new land management tools, less fertilizer use, and more streambank restoration projects.

Certain sections of the Little Blackfoot River get pretty low in the late summer months, when both local ranchers and the river's fish depend on its water. To try and improve streamflows near his property, Janke entered into an agreement with the Montana Water Trust in 2005 to leave a portion of his water right in the river.

Although Janke does see an increased role in the future for groups like conservation districts and local watershed groups, he readily acknowledges the challenges of asking ranchers to improve water quality or quantity.

"It's a lot easier to manage someone else's place," Janke jokes.

He believes that regulations and voluntary actions must go hand-in-hand if we want to protect our watershed.

Jeff Janke

Rancher
Avon, Montana

Can We Keep a Balanced Water Budget in the Basin?

If we compare the amount of water in our basin to a bank account, it's pretty easy to see where the "income" or supply of water comes from: our snowpack, streams, and groundwater. Pinpointing all of the "withdrawals" and different demands for that water is more challenging, especially in the face of shifting land use and a changing climate.

The big question for the coming decades is: how do we keep a balanced water budget, especially if our water "income" dwindles and the "withdrawals" increase?

The answer: use our existing supply of water more wisely. It's much **cheaper and easier to conserve water** we already have than to find and deliver water from new sources. For instance, instead of building an expensive new dam that smothers one of our rivers, we can spend less money and recover the 50% or more of water lost in old or leaky irrigation delivery systems by lining canals and ditches. It's a win-win for fish, farmers, communities, and the river.

The same is true for our towns, too. By putting a bit of creativity into water management, we can stretch our residential water supply to impressive lengths. A 2005 report by the Pacific Institute shows that current "off-the-shelf" technologies—like low-flow faucets and toilets, and drip irrigation for outdoor lawn and gardens—would **cut total urban water use by 30 percent.**



what should we do?

ACTIONS & POLICIES CAN SHAPE THE FUTURE

WATER WISE



WATER CONSERVATION

RESIDENTIAL:

- ✓ **PROVIDE FREE AUDITS FOR THE WATER USE OF YOUR HOME, AS WELL AS THE ENERGY USE, TO ENSURE EFFICIENCY.**
- ✓ **PROVIDE FREE WATER METERS THAT MEASURE CONSUMPTION, AND CHARGE BASED ON WATER USE, NOT A FLAT RATE.**
- ✓ **COST-SHARE LAWN REMOVAL OR REDUCTION PROGRAMS. PAY HOMEOWNERS A PORTION OF COSTS TO PLANT DROUGHT-RESISTANT VEGETATION OR ZERISCAPE THEIR YARD.**
- ✓ **GIVE REBATES FOR INDOOR FIXTURE REPLACEMENTS, SUCH AS LOW-FLOW SHOWERHEADS, TOILETS, AND CLOTHES WASHERS.**
- ✓ **INCREASE COSTS FOR OUTDOOR WATERING DURING THE HOTTEST PART OF THE DAY.**

AGRICULTURAL:

- ✓ **USE INCENTIVES TO ENCOURAGE WATER RIGHT HOLDERS TO LEAVE A PORTION OF THEIR WATER IN DEWATERED STREAMS DURING THE LATE SUMMER MONTHS.**
- ✓ **PROVIDE COST-SHARE PROGRAMS FOR IRRIGATION DISTRICTS TO UPGRADE AND IMPROVE WATER DELIVERY SYSTEMS LIKE CANALS AND DITCHES, WHICH OFTEN LOSE 50-75% OF THEIR WATER THROUGH SEEPAGE.**
- ✓ **WORK COLLABORATIVELY WITH LANDOWNERS ON SITE-SPECIFIC LAND-MANAGEMENT PLANS THAT MAY INCLUDE INSTALLING STOCK WATERING WELLS, CENTER PIVOTS OR OTHER SPRINKLER SYSTEMS, OR CHANGING A POINT OF DIVERSION TO REDUCE WATER WITHDRAWALS.**

Kathy Hadley

Executive Director
National Center for
Appropriate Technology
Butte

Irrigation Efficiency Can Keep Fish Wet

Kathy Hadley, a ranch-owner near Galen and the executive director of the National Center for Appropriate Technology in Butte, works to help people save energy and resources, an increasingly vital role when it comes to climate change.

She points to irrigation challenges along a 100-mile stretch of the upper Clark Fork River as a prime example of where technology, conservation and innovation are starting to make a difference. Maintaining summer crops and pastures takes water—and this water usually comes straight out of the river or its tributaries.

Most of this 100-mile stretch of river is considered “periodically dewatered” by Montana Fish Wildlife and Parks, meaning that many summers there’s not enough water to support fish.

“If every irrigator used water efficiently, we’d have a much better chance of more water remaining in the streams and rivers,” says Hadley.

Water efficiency and conservation come in many forms, from upgraded sprinkler heads that distribute water evenly to using monitoring devices for soil moisture to prevent over-irrigating.

Energy efficiency programs offered by Northwestern Energy can lead to cost-saving changes, as well. An energy audit for the ranch that Hadley and her husband run near Galen pinpointed a flaw in their pumping system. When fixed, it reduced both their water use and their electric bill.

Some fixes for the good of the river will cost money, Hadley points out. For instance, certain irrigation ditches divert river water late in the summer to provide drinking water for cattle. A stock-watering well could serve the thirsty cows, and also keep water in the river. The Hadleys not only kept water in the river with their well, they also saved energy by installing a solar-powered well pump.

“If we can help other ranchers put in wells so they could turn off ditches later in the summer,” Hadley says, **“that would be positive for the rancher, the river, the fishery and society.”**

RESTORATION

Buffering The Impacts Through Restoration

Healthy forests, streams, wetlands, and grasslands are invaluable buffers from the impacts of climate change. Plus, these ecosystems store carbon in the watershed, helping to offset our greenhouse gas emissions.

One way to ensure we protect these critical ecosystems is to continue our shift from extractive resource industries to the industry of restoration. The Clark Fork watershed is well on its way to modeling just how this "restoration economy" will work: with over **\$600 million of Superfund cleanup and restoration monies** flowing into the upper Clark Fork between Butte and Milltown, **creating repaired, thriving ecosystems is primed to be an engine for economic growth.**

This massive restoration project—which includes reconstructing much of the upper Clark Fork river channel, removing Mike Horse and Milltown dams, and restoring the confluence of the Blackfoot and Clark Fork Rivers—gives us a unique chance to put a river back together using innovative, landscape-level conservation tools.

RESTORATION IN ACTION ON NINEMILE CREEK

Ninemile Creek, a drainage located 25 miles west of Missoula, is an important spawning tributary to the middle Clark Fork River, and home to a growing community. It's also been hit hard by a century of mining, logging, and ranching.

Now, however, the Ninemile is a prime example of how to bring about collaborative, on-the-ground changes that benefit our local streams and communities. Check out the numbers on this restoration in action, spearheaded by Trout Unlimited:

- ✓ **2,500 VOLUNTEER HOURS LOGGED**
- ✓ **4 MILES OF STREAM CHANNEL RECONSTRUCTED**
- ✓ **18,000 NATIVES PLANTED**
- ✓ **3 CULVERTS REPLACED**
- ✓ **298 FISH MEASURED (IN LENGTH)**
- ✓ **4 MILES OF ROADS IMPROVED**
- ✓ **60,000 CUBIC YARDS OF MINE TAILINGS REMOVED**
- ✓ **7 PARTNERING ORGANIZATIONS**
- ✓ **\$610,000 OF STATE, FEDERAL AND PRIVATE GRANT FUNDS**

MILLTOWN DAM BEFORE THE MARCH 28, 2008 BREACH



Mike Kustudia, CRTAC

Adapting On Land: The Future of Forest Management

The boon of our "restoration economy" extends to our national forests, too. In 2008, the **U.S. Forest Service sent \$4.7 million to Montana and Idaho to treat decaying forest roads** through the Legacy Roads Initiative, one-third of which will funnel to forests in the Clark Fork basin. The road remediation projects will improve water quality and wildlife habitat, and create roughly 65 jobs in Montana.

Forest management will become even more challenging in the coming decades, especially if increased temperatures create more dense stands prone to disease, insects, and fire. This will call for complex management strategies such as stewardship logging, where timber sales on Forest Service lands restore streams, remove roads, or otherwise improve the landscape. In turn, new management techniques create jobs for skilled workers, furthering the restoration economy we can model throughout the country.



Preserving Agricultural Lands

Not only is agriculture the largest industry in Montana, our basin's farms and ranches also act as protective barriers from climate change—many types of crops can soak up carbon from the atmosphere. But wide-open agricultural lands are dwindling in the Clark Fork basin. Take Ravalli County: over the last two decades, agricultural lands have decreased by 18% or 50,000 acres. If development continues at its current rate, **the Bitterroot Valley could lose another 40,000 acres of farmland by 2025.**

Establishing local farm protection programs, such as open space funds or a farmland mitigation ordinance, can help ensure that new subdivisions contribute to conserving these valuable lands. A mitigation ordinance, for instance, would discourage development on fertile soils, or require that lost agricultural land is mitigated by permanently protecting farmland of equal value.

what should we do?

ACTIONS & POLICIES CAN SHAPE THE FUTURE

RECREATION



Anaconda Anglers Urge Good Stewardship

Becky Guay and **Doug Buskirk** mark the days until the first insects hatch on favorite streams within striking distance of the couple's Anaconda home—Warm Springs Creek, the Little Blackfoot River, and Rock Creek.

Doug has fished for 50 years, 31 of them in Montana, and guided across the state for 20 years. Like other avid anglers, he keeps seasonal logs that record insect hatches, daily temperatures and spawning times.

"The salmonfly hatch in Rock Creek used to be in late April or early May. Now it's April 1st, two to three weeks ahead of where it was 15 years ago," Doug said.

When insects hatch earlier, trout have to feed earlier. Spawning times are moving up, too. **"Every year, you notice a little change on the streams and rivers, but it's all adding up to a huge change,"** Buskirk points out.

Guay grew up in Anaconda, eventually returning to her hometown where she became an elected official. She recalls a different climate growing up, with longer winters and deep snow.

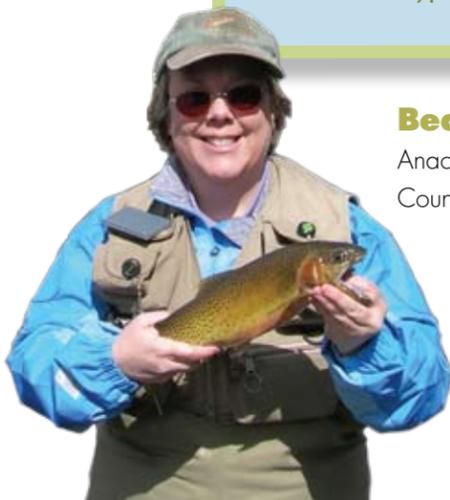
The couple's biggest concern relating to climate change is the increasingly longer stretch of warm waters and low flows that often start in early July, instead of mid-August.

As she sees the stressed fish resulting from low flows and warm water, Guay urges anglers to weigh in with local, state, and federal representatives. She knows from experience that public comment matters on policies that affect fisheries, from forest management plans to energy policies.

"On the river, it's more important than ever for anglers to use good stewardship, to be mindful of the types of fish we keep and to practice catch-and-release," says Guay.

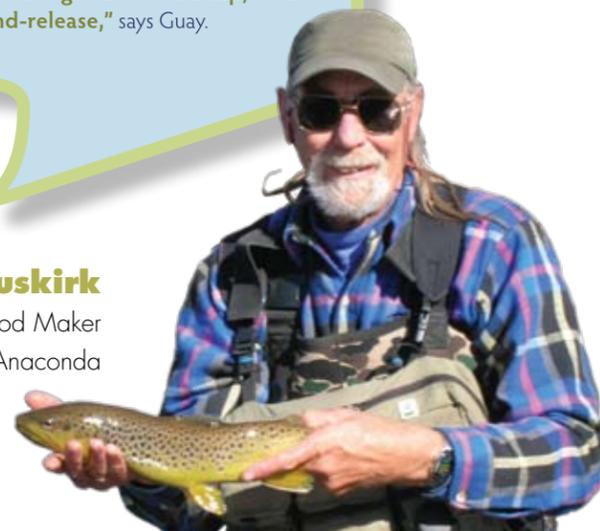
Becky Guay

Anaconda-Deer Lodge
County Chief Executive



Doug Buskirk

Custom Fly-Rod Maker
Anaconda



Keeping Recreation and Tourism Industries Afloat

Climate change impacts will also reverberate through our basin's second-largest industry: tourism. Wildfires aren't conducive to pleasant summer vacations, and dry streams or fishing-restriction-laden rivers don't attract many anglers.

One way to adapt to these scorching summers is to encourage visitors to come to Montana earlier. Many fishing outfitters in the basin are opening up shop in March, a month earlier than usual. River-rafting companies may want to advertise for trips in June, rather than August.

Ski resorts might not have the option of opening earlier in the season for snow sports, but could consider hosting more summer and fall recreation opportunities, like mountain biking, camping or birding.

Stepping Up as Voices for Change

Though we have a start on mitigating and adapting to climate change, the Clark Fork watershed needs more local, regional, and national policies that promote wise resource use, like creating incentives for green-building or stewardship logging projects. We also need regulations that focus on **discouraging activities that contribute to making the problems worse**, such as building new coal-fired power plants.

What does this mean in the Clark Fork basin? New national policies are needed to overcome barriers to investing in energy and irrigation efficiency. Yet local and regional efforts are just as important, if not more so, to protect the water and wildlife in our hometowns. To generate action and new ideas, **residents can encourage elected officials**—from the local councilperson to the President—to support proactive policies that value the water, energy, lands, and economy in the Clark Fork basin, and maintain its vital resources for future generations.



HOMEGROWN FUELS: OPPORTUNITIES FOR MONTANA'S RENEWABLE ENERGY FUTURE

The Clark Fork basin is primed to help realign the state and the country's energy sources toward renewables such as wind power, innovative fish-friendly hydropower, solar power, and biomass fuels. Developing these sources will become increasingly important as we try to reduce CO₂ and other greenhouse gases in the coming years. Check out the "winds of change" already blowing through:

- ✓ **MONTANA CURRENTLY HAS 50 WIND POWER PROJECTS IN VARIOUS STAGES OF PRODUCTION, WHICH COULD TOTAL MORE THAN 4,000 MEGAWATTS OF WIND ENERGY, ENOUGH TO POWER 3 MILLION HOMES.**
- ✓ **WIND ENERGY CURRENTLY PROVIDES ONLY 1 OR 2 PERCENT OF THE NATIONAL ENERGY SUPPLY. BUT IT ACCOUNTS FOR 8% OF NORTHWESTERN ENERGY'S SUPPLY IN OUR STATE, THANKS TO THE 135-MEGAWATT FACILITY IN JUDITH GAP, MONTANA, COMPLETED IN 2005.**
- ✓ **BUTTE WAS CHOSEN AS THE SITE OF A NEW \$25 MILLION WIND-TURBINE MANUFACTURING PLANT. ONCE CONSTRUCTED IN THE FALL OF 2008, THE PLANT WILL EMPLOY 150 PEOPLE.**
- ✓ **THE COLLEGE OF TECHNOLOGY IN MISSOULA AND MONTANA TECH IN BUTTE BOTH OFFER A 2-YEAR ONLINE ENERGY TECHNOLOGY DEGREE, WHICH INCLUDES EXPLORING WIND POWER. STUDENTS ARE TESTING NEW WIND TECHNOLOGIES THROUGHOUT THE BASIN.**



Chad Harder

The Governor's Take on the Clark Fork's Climate Challenges

Looking at big-picture, long-term changes in the Clark Fork watershed, Governor Schweitzer sees **"increased demand on our diminishing water resources"** as the biggest hurdle in the face of a changing climate.

The Governor also notes that keeping western Montana's water clean will be an important priority. Specifically, he's concerned about cumulative impacts from the proliferation of septic systems, which can leach nutrients and chemicals into our groundwater and rivers.

"We'll need better-engineered systems to clean our wastewater," says Schweitzer.

In the face of more droughts and warmer climates, the Governor underscores the importance of creating workable local policies, especially in our counties, to ensure the best possible land- and water-use policies.

"We need to make sure we're managing rivers as whole watersheds, not just on a stream-by-stream basis," says Schweitzer.

This means better understanding groundwater-surface water connections in Montana, especially as people continue to drill more wells in high-growth basins like the Bitterroot and the Flathead.

To protect water users of all types, including fish and wildlife, Schweitzer also wants to enhance the **"supply"** of water in the basin by using voluntary incentive plans to encourage irrigators to line leaky ditches and canals.

In addition to water resources, the Governor highlights how our basin and our state can lead the way with innovative renewable energy technologies.

"Wind is our best bet, and we're attracting wind energy faster than any other state in the union," says Schweitzer.

Another renewable source the Governor sees as big potential for western Montana communities is cellulosic-based fuels. Cellulosic ethanol, produced from biomass like agricultural plant wastes, sawdust or paper pulp, has a net energy content three times higher than corn ethanol, and reduces greenhouse gas emissions by 90 percent when compared to gasoline.

"By coupling our burgeoning restoration economy with the production of cellulosic-based fuel, we could create renewable energy that's good for the local community, and good for the watershed."

Brian Schweitzer

Governor of Montana
Helena



what should we do?

ACTIONS & POLICIES CAN SHAPE THE FUTURE

LEADING THE WAY

POLICIES THAT PROTECT OUR WATERWAYS, WILDLIFE, AND COMMUNITIES

- ✓ **WESTERN CLIMATE INITIATIVE - MONTANA JOINED 6 WESTERN STATES AND 2 CANADIAN PROVINCES IN AGREEING TO REDUCE OUR COMBINED GREENHOUSE GAS EMISSIONS TO 15 PERCENT BELOW 2005 LEVELS BY 2020.**
- ✓ **RENEWABLE ENERGY STANDARDS - MONTANA WAS THE FIRST STATE IN THE NORTHWEST TO ADOPT A RENEWABLE ENERGY STANDARD. INVESTOR-OWNED UTILITIES MUST SUPPLY 15% OF THEIR ENERGY FROM RENEWABLE SOURCES BY 2015.**
- ✓ **CLEAN AND GREEN TAX INCENTIVES - THE 2007 LEGISLATURE PASSED TAX BREAKS FOR PRODUCERS OF BIO-DIESEL, SOLAR AND WIND POWER, AS WELL AS MANUFACTURERS OF RENEWABLE ENERGY COMPONENTS.**
- ✓ **CLIMATE CHANGE ADVISORY COMMITTEE - ESTABLISHED BY GOVERNOR SCHWEITZER, THIS COMMITTEE RELEASED 54 RECOMMENDATIONS IN 2007 FOR SPECIFIC ACTIONS MONTANA CAN TAKE TO REDUCE OR SEQUESTER GREENHOUSE GAS EMISSIONS.**

How Can We All Help Make a Difference?

The best part of using multi-pronged solutions to address climate change in the watershed is that proactive responses can happen on an individual, everyday scale. This translates to different decisions for people living and working in different reaches of the watershed:

- ✓ A rancher in the Ninemile Valley may change irrigation practices to leave more water in the creek in late summer.
- ✓ A guide working in the Bitterroot may take anglers on the river in June instead of August, and educate clients on climate stresses facing the fishery.
- ✓ A businessman in Missoula may decide to bike or bus to work, saving gas money.
- ✓ A newcomer to the Flathead may decide to build her home further from the creek to protect against floods, or further from the forest to protect against wildfire.

We hope you'll join us in building change from the ground up, using the power of each person's grassroots decisions to show other watersheds, and other Westerners, the ecologic and economic benefits of wise resource use in a warming watershed.



New Generation Steps Up to the Climate Challenge

Emily Rolston worries about the future of the Clark Fork River and the mountains that define her hometown.

"Global warming is huge and extremely overwhelming," she says. **"I've asked myself how changing anything in my life will matter, but I'm finding that every change makes a difference."**

For her senior high school project, Emily is reducing her carbon footprint. Along with four other students, she's installed compact fluorescent light bulbs, low-flow showerheads, and power strips. They've started recycling, taking shorter showers, and make sure to carpool, walk or bike to school.

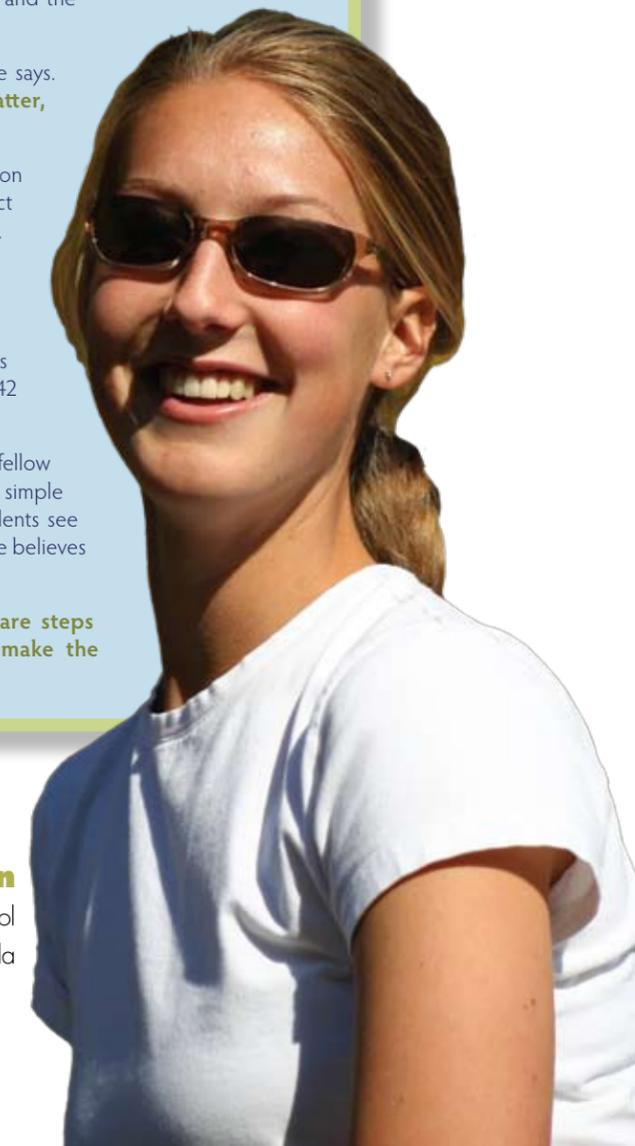
Next come the math calculations. For instance, a shower typically uses 2.5 gallons of water per minute, and each gallon uses 3 ounces of carbon. Run a shower for two minutes less a day, and you save 342 pounds of carbon a year.

On Earth Day, Emily shared her group's carbon savings with fellow students, and provided a list she has tailored for teenagers on simple actions to shrink their carbon footprint. When high school students see how each of them can save enough carbon to fill a football field, she believes they will be inspired to take up the challenge.

"It's important for kids in Montana to know that there are steps to create change," Emily says. **"We're the generation to make the difference."**

Emily Rolston

Senior, Hellgate High School
Missoula



sources

PAGE 4: IPCC, 2007: Climate Change 2007: The Physical Science Basis. *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

PAGES 5 & 7: Data from the Western Regional Climate Center: <http://www.wrcc.dri.edu/summary/climsmmt.html>

PAGE 6: The Arbor Day Foundation: http://www.arborday.org/media/map_change.cfm

PAGE 8: IPCC, 2007: Climate Change 2007: The Physical Science Basis. (See page 4 reference)

Graphic adapted from: Mote, P.W., 2003: Trends in snow water equivalent in the Pacific Northwest and their climatic causes, *Geophys. Research Letters* 30(12): 1601.

PAGE 9: Data from USGS National Water Information System: <http://waterdata.usgs.gov/mt/nwis/sw>

Barnett, T., D. Pierce, H. Hidalgo, C. Bonfils, B. Santer, T. Das, G. Bala, A. Wood, T. Nozawa, A. Mirin, D. Cayan, M. Dettinger, 2008. Human-induced changes in the hydrology of the western United States. *Science* 319(5866): 1080-1083.

PAGE 10: Photos from USGS Northern Rocky Mountain Science Center: http://nrmsc.usgs.gov/repeatphoto/gg_overlook.htm

Hall, M., D. Fagre, 2003. Modeled climate-induced glacier change in Glacier National Park, 1850-2100. *Bioscience* 53(2): 131-140.

PAGE 12: Forest Service Northern Region Geospatial Library: <http://www.fs.fed.us/r1/gis/ThematicTables.htm#Fire> and <http://www.fs.fed.us/r1/lolo/gislib/index-gis-downloads.htm> (Data are not comprehensive but are the best available for years 1940 to 2001. Data from 1984 to 2007 on the Flathead meet agency data standards; older data is less certain.)

Westerling, A., H. Hidalgo, D. Cayan, T. Swetnam, 2006. Warming and earlier spring increases western U.S. forest wildfire activity, *Science* 313(5789): 940-943

Logan, J., J. Powell, 2001. Ghost forests, global warming, and the mountain pine beetle (Coleoptera: Scolytidae), *American Entomologist* 47: 160-173. See also <http://www.usu.edu/beetle/>

PAGE 14: Neary, Daniel G.; Ryan, Kevin C.; DeBano, Leonard F., eds. 2005. (revised 2008). Wildland fire in ecosystems: effects of fire on soils and water. *Gen. Tech. Rep. RMRS-GTR-42-vol.4. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.* 250 p.

PAGE 15: Montana Legislative Fiscal Division <http://leg.mt.gov/css/fiscal>

PAGES 16 AND 17: Rock Creek data from Montana Fish, Wildlife, and Parks (unpublished)

O'Neal, K., 2002, Effects of Global Warming on Trout and Salmon in U.S. Streams. *Report by Defenders of Wildlife and Natural Resources Defense Council.*

Rieman, B., D. Isaak, S. Adams, D. Horan, D. Nagel, C. Luce, D. Myers, 2007: Anticipated Climate Warming Effects on Bull Trout Habitats and Populations Across the Interior Columbia River Basin. *Trans. American Fisheries Soc.* 136: 1552-1565.

PAGE 18: IPCC, "North America," prepared by C. B. Field and others, in *Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M. L. Parry and others, eds.(Cambridge, UK: Cambridge University Press, 2007)

Wolverine: http://www.defenders.org/resources/publications/programs_and_policy/science_and_economics/global_warming/navigating_the_arctic_meltdown_wolverine.pdf

Lynx: <http://www.sciencedaily.com/releases/2004/07/0407040706080358.htm>

Grizzly Bear: see Logan and Powell, 2001, page 12 reference

Birds: National Audubon Society 2007 State of the Birds report <http://stateofthebirds.audubon.org/cbid/report.php>

PAGE 21:

► U.S. Census Data: http://factfinder.census.gov/servlet/SAFFPopulation?_event=Search&_name=&_state=04000US30&_county=&_cityTown=&_zip=&_sse=on&_lang=en&pctxt=fph

► Unpublished communications with Public Water and Subdivisions Bureau at Montana Department of Environmental Quality. April, 2008.

► Unpublished communications with Water Resource Division at Montana Department of Natural Resources and Conservation. April, 2008.

► Maps produced by John Dibari of the Sonoran Institute and the Lincoln Institute for Land Policy: <http://sonoran.org/>

► "Envision Missoula" – Project Overview: http://www.co.missoula.mt.us/transportation/ev_overview.htm

► Smart Growth Network: <http://www.smartgrowth.org/>

PAGE 22: Unpublished communications with Instream Flow Specialists at Montana Department of Fish Wildlife and Parks. April, 2008.

Unpublished communications with Water Resource Division at Montana Department of Natural Resources and Conservation. April, 2008.

Unpublished communications with Columbia Basin Water Transactions Program. April, 2008. <http://www.cbwtp.org>

Unpublished communications with Instream Flow Specialists at Montana Department of Fish Wildlife and Parks. April, 2008.

PAGE 26: National Center for Appropriate Technology: <http://www.ncat.org/>

PAGE 28: Unpublished communications with Western Mines Coordinator at Trout Unlimited. May, 2008.

PAGE 29: "Growth and Change in the Bitterroot Valley and Implications for Area Agriculture and Ag Lands," by Larry Swanson, prepared for the Ravalli County Right to Farm and Ranch Board and Bitter Root Land Trust, April, 2006: <http://www.crmw.org/Reports.aspx>

Unpublished communications with Wildlands CPR. April, 2008.

<http://www.wildlandscpr.org/our-news/forest-service-allocates-4-7-million-montana-idaho-projects-designed-improve-water-quality>

PAGE 32: Montana Climate Change Advisory Committee: <http://www.mtclimatechange.us/>

Montana Department of Environmental Quality: Wind in Montana

<http://www.deq.state.mt.us/Energy/Renewable/WindWeb/indexWindinMT.asp>

PAGE 34: Mayors Climate Protection Center: <http://www.usmayors.org/climateprotection/agreement.htm>

Montana Environmental Information Center: <http://www.meic.org/energy/>

University of Montana Sustainability Center: <http://www.umt.edu/asum/sustainability.htm>

PAGE 35: Climate Solutions: <http://climatesolutions.org/>
We Can Solve It: <http://www.wecansolveit.org/content/solutions>



Jackie Corday



THE CLARK FORK COALITION
WORKS TO PROTECT AND
RESTORE THE CLARK FORK
WATERSHED.



CLARK FORK COALITION
"YOUR VOICE FOR THE RIVER"
140 S. 4TH ST. WEST
MISSOULA, MT 59801
WWW.CLARKFORK.ORG



THE NATIONAL WILDLIFE
FEDERATION INSPIRES AMERICANS
TO PROTECT WILDLIFE FOR OUR
CHILDREN'S FUTURE.

NATIONAL WILDLIFE FEDERATION
NORTHERN ROCKIES OFFICE
240 NORTH HIGGINS, SUITE 2
MISSOULA, MT 59802
WWW.NWF.ORG

