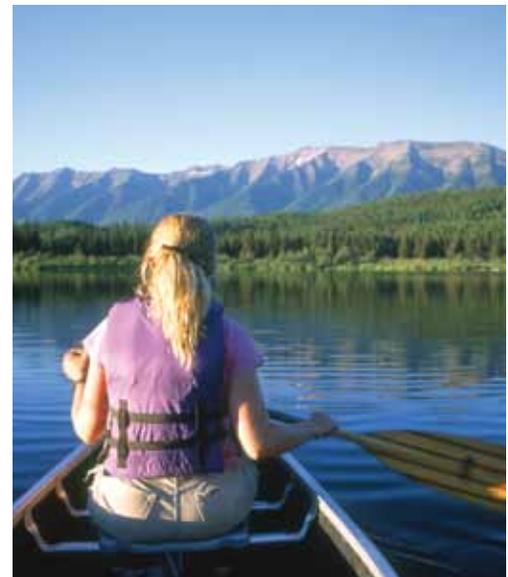
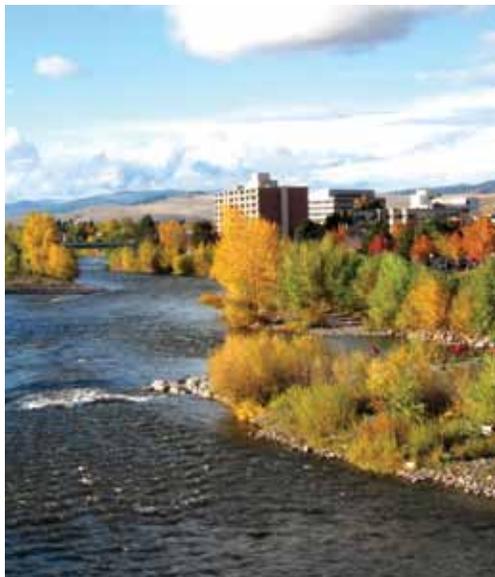

MISSOULA COUNTY CLIMATE CHANGE PRIMER



STRATEGIES TO CARE FOR OUR COMMUNITY, LAND & WATER



How is climate change affecting Missoula County? What are the trends for the coming decades?

How can we reduce risk, and protect our valued way of life?

Highlights from a Climatewise Community Workshop in Missoula:

A countywide and citizen-driven project convened by
the Clark Fork Coalition in partnership with the Geos Institute and Headwaters Economics



WHY PREPARE FOR CLIMATE CHANGE NOW?

Climate change presents an uncertain future—with potentially high costs—for Missoula County. Our economy and the high quality of life that draw and keep people here could be in jeopardy due to changes in average temperature, stream flows, and precipitation. Preparing for climate change is similar to preparing for other potential events, such as fire or drought.

At risk is much of what makes our community unique—recreational opportunities, cool, clear, and fish-filled rivers, local agriculture, healthy, functioning forests, vast wilderness, and wildlife. We also face threats to our roads and bridges, public safety, and public health—particularly for the young and elderly.

Already, Missoula County is experiencing some unsettling symptoms. Average annual temperatures are rising. Our snowpack is declining, and our mountains store less water. The spring thaw comes earlier and so does peak runoff. Our late summer flows are lower, and the water is warmer.

Scientists anticipate that these trends will intensify. We can expect to see larger wildfires, more insect infestations, greater stress on our native fish and wildlife, and outbreaks of invasive species and disease. Scenarios also include higher chances of severe weather, including a potential for increased flooding.

While we cannot know the exact trajectory of change, we can prepare for the future based on a reasonable range of expected scenarios—and we should. This approach is similar to how we plan for uncertainty when we buy insurance for our homes and cars.

Recently, close to 100 Missoula County residents took the first important steps to prepare for climate change impacts at a two-day workshop in 2011. They learned about the recent climate science and what parts of the local economy might be vulnerable to coming changes, then developed strategies designed to address risks and help shape a livable future for our children and community.

We live in a challenging, yet exciting era, with numerous opportunities for innovation and creative solutions. We invite you to read and explore the workshop outcomes, and join the effort.



MISSOULA COUNTY CLIMATE CHANGE PRIMER

- 2** [The Climatewise Workshop](#)
- 3** [Values, Risks, & Strategies](#)
- 3** [Why Act Now?](#)
- 4** [This Primer is for Everyone](#)
- 5** [What Does the Science Tell Us?](#)
- 5** [A Closer Look at Risks, Strategies, & Actions](#)
- 6** [Local Impacts of Global Climate Change](#)
- 7** [Wildfire & Severity and the WUI](#)
- 8** [Declining Snowpack & Dewatering](#)
- 9** [Increased Flooding](#)
- 10** [Declines in Native Fish & Wildlife](#)
- 11** [Where to Go from Here](#)

THE CLIMATEWISE COMMUNITY WORKSHOP

APPLYING SCIENCE AND CITIZEN POWER FOR LOCAL SOLUTIONS TO GLOBAL CLIMATE CHANGE

In 2011, some 100 dedicated residents and local experts came together to brainstorm ways to maintain our quality of life even as change occurs. Now, we've gathered their many ideas and conversations into a list of strategies to help local groups and citizens to prepare for potential threats from climate change.

The local community workshop, convened by the Clark Fork Coalition, drew public officials, conservation organizations, landowners, and specialists in forestry, wildlife, water, agriculture, business, engineering, public health, and other relevant subjects.

The community workshop was one step in the "ClimateWise" process developed by the Geos Institute, a nonprofit based in Oregon. This process helps the community to brainstorm proactive measures based on the best available science to prepare for climate change, and encourages people to work in cross-sector groups to increase community cohesion.

Headwaters Economics, an independent, nonprofit research group in Bozeman, Montana, augmented the climate science with an analysis of current socio-economic trends and statistics for Missoula County, including its vulnerabilities to climate change.

This primer shares highlights from the workshop and from the accompanying climate science and socio-economic reports developed for workshop participants. In addition, an interactive website at www.clarkfork.org contains graphics that let viewers visualize and explore the threats and strategies identified by workshop participants.



VALUES, RISKS & STRATEGIES

WHAT VALUES MATTER MOST

At the workshop, participants identified 24 qualities that they value about Missoula County and wish to protect. The top five values are:

- Ecosystem services like clean water and clean air.
- Outdoor recreation opportunities.
- Positive, compassionate community, and quality of life.
- Native fish, wildlife, and plants.
- Local food, agriculture, and open space.

HIGHEST RISKS

The group also identified five major risks that could negatively impact Missoula County's exceptional economic, social, and environmental values:

- Local impacts from global climate change.
- Wildfire severity tied to growth in the wildland-urban interface.
- Declining snowpack and dewatering of rivers.
- Increased flooding and declines in water quality.
- Declines and disruptions in native fish and wildlife populations.

TOP 3 STRATEGIES TO PROTECT OUR WAY OF LIFE

Participants compiled a list of strategies and actions to address the five major risks outlined above. The top three strategies are to:

- Conserve water.
- Educate local citizens on risks of climate change.
- Conserve energy.

For detailed lists of values, risks, and strategies, please visit www.clarkfork.org



THE URGENCY & OPPORTUNITY

WHY ACT NOW?

Equipped with locally specific, science-based information on climate change, Missoula County residents have a window of opportunity to take proactive measures.

The sooner we take concerted actions to strengthen the health of both natural and human communities, the better chance we have of sustaining the high quality of life that matters to all of us.

By working together as a community, we can conserve resources and apply innovative and cost-efficient solutions that will lead us down a positive economic and ecological path as we adjust to the coming changes.

THIS PRIMER IS FOR EVERYONE

Every person who cares about the future of Missoula County has a stake in this process. We invite you to join the Clark Fork Coalition and its partners to prepare for climate change at the local level.

HOW CITIZENS AND GROUPS CAN USE THIS CLIMATE CHANGE PRIMER:

POLICY MAKER: Use these strategies as a first step toward action and policy.

LAND OR WATER MANAGER: Identify high priority places and projects for restoration. Find new partners across ownership boundaries.

OUTFITTER AND GUIDE: Evaluate the risks to the future of fishing, hunting and outdoor adventures, and become involved in solutions and outreach.

RANCHER/FARMER: Consider the risks to water for irrigation and land for agriculture, and become involved in drought response plans and other cooperative measures.

BUSINESSPERSON: Share these strategies with clients and colleagues. Consider addressing impacts from climate change in your strategic or yearly plans. Take steps to reduce water and energy use at your place of business.

TEACHER OR PARENT: Recognize that education is essential to preparing for climate change. Share these strategies and actions with schools and youth groups to increase knowledge in young adults and enhance curriculums.

STUDENT: Present these strategies to your teacher and peers through a book report or research paper. Take the initiative to conserve water and energy in your classroom.



CLIMATEWISE RESOURCES

available at www.clarkfork.org

1. Interactive graphics of threats and strategies identified at the workshop.
2. "Future Climate Conditions in Missoula County and the Western Montana Region," by Geos Institute, 2011.
3. "The People, Economy, Land, and Resources of Missoula County and Potential Vulnerabilities to Climate Change," by Headwaters Economics, 2011.

CLIMATE CHANGE IN MISSOULA COUNTY:

WHAT DOES THE SCIENCE TELL US?

Decades of data and observations point to a clear conclusion: Missoula County is experiencing a very real change in climate.

Average temperature has increased 2-4°F over the last century in the Rocky Mountains. In turn, more of our precipitation falls as rain. Spring snowpack and moisture content is lower throughout the western U.S.

Hydrologists have also documented many changes in our rivers and streams. We're witnessing earlier spring runoff, declines in stream flows, longer periods of low flows, and rising water temperatures.

Changes in average temperature and snowpack could affect our livelihoods and economy in many ways. When too much of our precipitation comes as rain instead of snow in the winter, we lose our well-timed delivery of water in the summer months. We depend on these late-season streamflows for irrigation, healthy fisheries, and river recreation—all critical components of our local economy and way of life.

Climate change also threatens to increase the hazards of flooding. With unseasonably warm springtime temperatures, flooding becomes more likely. These types of changes in water quantity can have devastating impacts on local infrastructure and agriculture.

While the threats are serious, Missoula County may be in better shape than some other parts of the country. Yet it is important to understand that we do not live in a vacuum, either. For example, heat, devastating drought, and sea level change in other parts of the country could compel more people to move to western Montana as "climate refugees."

To better understand how worldwide and regional trends are affecting Missoula County, the Geos Institute and the U.S. Forest Service Pacific Northwest Research Station provided analyses and presentations of global change at local scales. The results from three climate models selected to best represent the region were summarized for this process, and the full climate science report is available online at www.clarkfork.org.



COMMUNITY WORKSHOP RESULTS

A CLOSER LOOK AT THE RISKS, STRATEGIES, AND ACTIONS

Workshop participants identified the top five risks to the future of Missoula County's lands, waters and communities. They broke into groups based on these risk categories, and devised a list of strategies and actions to address each risk.

The following pages provide a snapshot of the workshop discussion surrounding each risk category. Please see the enclosed insert sheets with this report for detailed lists of strategies and actions as suggested by participants, and visit www.clarkfork.org for an interactive display of the information.

RISK ONE - LOCAL IMPACTS FROM GLOBAL CLIMATE CHANGE

How will global change affect Missoula County at the local level?

We live in a global economy. When orange crops freeze in Florida, or hurricanes wipe out banana plantations in Mexico, prices soar in our local grocery stores.

Compared to other parts of the United States, Missoula County will be spared from some of the worst climate change scenarios, due to our intact headwaters, high peaks, and near-pristine aquifer.

However, our local quality of life will likely make our region an even more desirable location for newcomers, especially as they seek to escape sea level rise and hurricanes in coastal areas, intolerable heat and drought in the southwest, or increased flooding in the Pacific Northwest.



LOCAL IMPACTS FROM GLOBAL CHANGE

The breakout group focusing on this risk identified five top concerns:

- 1. Climate Refugees:** More people may move to Missoula County to escape hard-hit parts of the nation.
- 2. Land Conversion For Energy Production/Transmission:** Demands for domestic energy production may lead to more lands dedicated to these uses.
- 3. Water Quantity:** A growing population will consume more water at a time when water resources are becoming more scarce.
- 4. Higher Land Prices:** More people coming to Missoula County will drive land prices up and make it tougher for local agriculture.
- 5. Low-Income Populations Hit Hardest:** Higher energy and food prices will stretch already tight budgets. Threats to our health (like smoky air from wildfires) affect all, but disproportionately hurt those with compromised health (elderly, very young), or without healthcare.

RISK TWO - WILDFIRE SEVERITY & MORE HOUSES IN THE WILDLAND-URBAN INTERFACE

What can we expect from more severe wildfires and an increased number of homes in the wildland-urban interface?

Climate models predict larger, more frequent, and severe wildfires. The reason? Spring will come earlier—lengthening the fire season. Higher average temperatures, drought, and beetle outbreaks may also contribute to severe fire conditions.

Despite the likely trend of increased severe wildfire, construction of new homes in the wildland-urban interface (WUI) continues. The WUI is defined here as private forestlands that

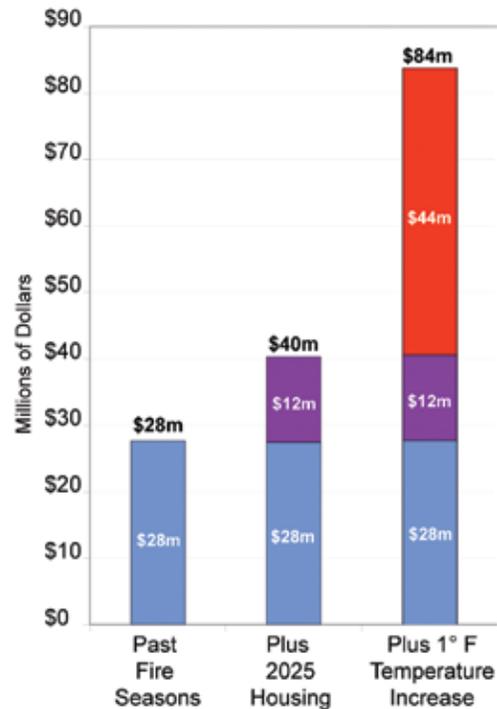
are within 500 meters of public forestlands.

Past and current trends suggest people will continue to move to rural parts of the county, build homes on or close to fire-prone landscapes, and place more people and property in the path of wildfire. If development continues apace, firefighting costs could rise dramatically and put a dent in taxpayer pocketbooks. (See chart below).

WILDFIRE SEVERITY & THE WILDLAND-URBAN INTERFACE

The breakout group focusing on this risk identified four top concerns:

- 1. Human Safety:** Risk of harm from wildfires to people living in the WUI, firefighters, and recreationists.
- 2. Air Quality:** More smoke increases respiratory illness and asthma.
- 3. Costs:** Fire suppression costs could skyrocket, especially if development continues in the wildland-urban interface.
- 4. Property Damage:** Extreme fires can damage or destroy infrastructure and property, especially impacting rural communities, and leading to increased insurance costs and declines in property values.



AVERAGE ANNUAL COST OF PROTECTING HOMES FROM WILDFIRES IN MONTANA



RISK THREE - DECLINING SNOWPACK & DE-WATERING OF RIVERS

How could dwindling snowpack affect water quantity?

While variations exist from year to year in our snowpack and stream flows, the overall pattern is becoming clear. Climate change has already caused declines in average snowpack, especially at lower elevations, and these declines are expected to continue.

With precipitation coming more in the form of rain than snow, our runoff is expected to move more quickly, with less water filtering through our soils to groundwater. As the water table becomes lower, we'll see less recharge to our streams, and lower flows in major rivers like the Bitterroot, Blackfoot, and Clark Fork. In the

driest summer months, groundwater nourishes stream flows and the streamside ribbons of life alongside them.

In turn, abundant streamflow helps to recharge valley-bottom aquifers, which are the major source of pure drinking water for most people in Missoula County. The City of Missoula is fortunate to rest above a prolific aquifer that supplies drinking water to more than 65,000 households. Indeed, it's the sole source of the city's drinking water. Keeping the water abundant and free of contaminants is critical.



DWINDLING SNOWPACK AND DEWATERING

The breakout group focusing on this risk identified three top concerns:

- 1. Competition And Conflict Over Water:** Water shortages may lead to increased local competition for water, as well as the selling of water to outside markets.
- 2. Low Flows And Poor Timing:** Less water and early runoff harm fisheries, wetlands, agriculture, tourism, recreation, and residential users.
- 3. Warmer Waters:** When streams lose water, temperatures also rise, affecting water quality and causing harm to native fish.

RISK FOUR - INCREASED FLOODING & CHANGES IN WATER QUALITY

How might extreme weather events and flooding affect water quality?

Flooding—like wildfire—is a natural part of the ecology in Missoula County that can also have adverse effects. Climate change has the potential to generate larger floods, increasing impacts on infrastructure, property, and natural systems.

Warmer temperatures in spring may cause rain to fall on snow, which in turn leads to big spikes in runoff and flooding. Sudden floods could wash pollutants from streamside development into channels, harming water quality. Efforts to reduce excessive erosion and keep pollutants out of our rivers are even more important.



INCREASED FLOODING & CHANGES IN WATER QUALITY

The breakout group focusing on this risk identified three top concerns:

- 1. Bigger Floods/Increased Costs:** Flood damage to properties could rise significantly.
- 2. Infrastructure Loss:** Bridges, roads, and culverts could be swept away or damaged.
- 3. Development Of Unprotected Floodplains:** Where floodplains are open to development, more houses and buildings would result both in increased costs and impacts to water quality.

RISK FIVE - DECLINES & DISRUPTIONS IN NATIVE FISH & WILDLIFE

How does a changing climate put pressure on native species?

Our wildlife face many of the same risks as people from climate change. The difference is that they cannot pack up and leave—especially our mountain wildlife. While some species may shift their ranges to higher elevations and latitudes in response to warming, animals like pika and mountain goat have nowhere else to go.

The more we know about the individual needs of native species, the better we can help fish and wildlife be resilient in the face of climate change. Bull trout, for instance, need clean, cold

and connected waters. And, since 95% of all wildlife species in Missoula County depend on riparian habitat, efforts to maintain and restore connected, clean water will also benefit a wide range of fish and wildlife.

Not all species will suffer from climate change. Weeds tend to flourish with disturbance and disruption. Already, Missoula County is battling a growing list of exotics like leafy spurge, spotted knapweed, and new invaders like purple loosestrife and Eurasian watermilfoil.



FISH & WILDLIFE DECLINES AND DISRUPTIONS

The breakout group discussing species shifts and disruptions identified three major concerns, including:

- 1. Species Declines Impact People, Too:** Wildlife and fishing are tied to direct services that we benefit from every day, e.g., insect pollinators for our crops, hunting revenues for conservation, and pest control.
- 2. Aquatic Species At Risk:** Anticipated declines in water quality and supply lead to loss of coldwater fishes and many other aquatic species.
- 3. Habitat Fragmentation:** More people moving to the County could lead to increased development, thereby breaking up wildlife habitat at a time when species need to shift to new areas with suitable climate conditions.

WHERE TO GO FROM HERE?

TAKING THE NEXT STEP TOGETHER

The citizens who came together in 2011 demonstrated the many possibilities for creative, positive, and economically viable solutions that protect our natural heritage and minimize impacts to our economy, resources, and way of life.

Participants articulated a host of simple strategies to protect the people, water, and lands of Missoula County. Over and over, the same strategies emerged in different groups. The top three strategies for action across five risk categories were:

CONSERVE WATER: Scientists and citizens agree—water will be the primary medium through which climate change will affect our fish and wildlife, rivers, forests, and human communities. At the workshop, participants agreed that conserving water—whether through irrigation efficiency upgrades, floodplain preservation, or headwaters rehabilitation—should be a high priority as we work to address the impacts of climate change on our region.

EDUCATE LOCAL CITIZENS ON RISKS OF CLIMATE CHANGE: Increasingly, groups working to address climate change impacts are coming to an understanding that education is protection. When adults and young people understand more about how increased average temperatures and changes in precipitation can impact local economies and communities, more citizens will be willing and ready to embrace new practices.

CONSERVE ENERGY: When households, businesses, and government take steps to save energy, they save money, decrease the need for additional energy development, and maintain open space for people and wildlife. Today, residents of Missoula County have a unique opportunity to keep our economy robust and diverse, our rivers cool and connected, our fish and wildlife healthy and plentiful, and our lifestyle the way we like it—with friends nearby, but with plenty of elbowroom, too.



HOW YOU CAN HELP

Visit www.clarkfork.org to learn more about how different groups are addressing climate change throughout Missoula County. Join the dialogue, comment on workshop outcomes and reports, and connect with other efforts by joining ADAPT, the Coalition-led working group.

