Big Hole Watershed Drought Resilience Plan

December 2019

Prepared by:

BIG HOLE WATERSHED COMMITTEE
Conservation Through Consensus.

Acknowledgments

This Drought Resilience Plan is the result of several years of the Big Hole Watershed Committee's participation in collaborative drought planning processes with a number of partners, advisors, and stakeholders. It is intended to be used as a roadmap to guide future drought resiliency projects in the Big Hole Watershed. This DRP is modeled after the 2016 Beaverhead County Drought Resilience Plan authored by Christopher Carparelli for the Beaverhead Conservation District and Watershed Committee.

A sincere thank you to those involved in the partnership effort that brought this plan to completion in the name of building community resilience to drought.

This Drought Resilience Plan was created, reviewed, and improved by the following:

Big Hole Watershed Committee
Tana Nulph, Associate Director; Pedro Marques, Executive Director

Montana Department of Natural Resources and Conservation
Ann Schwend, Water Planner

Table of Contents

Acronyms and Abbreviations

AF	acre feet
BAC	Basin Advisory Council
BAER	Burned Area Emergency Response
BCD	Beaverhead Conservation District
BDNF	Beaverhead-Deerlodge National Forest
BHWC	Big Hole Watershed Committee
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
cfs	cubic feet per second
CIRC	Climate Impacts Research Consortium
CMIP5	Coupled Intercomparison Model Project Phase 5
CoCoRaHS	Community Collaborative Rain, Hail, and Snow Network
CPC	NOAA Climate Prediction Center
CVA	Centennial Valley Association
CWA	Clean Water Act
CWPP	County Wildfire Protection Plan
DAC	Montana Governor's Drought Advisory Committee
MDEQ	Montana Department of Environmental Quality
DES	Disaster and Emergency Services
DMP	Drought Management Plan
DNRC	Montana Department of Natural Resources and Conservation
DRP	Drought Resilience Plan
ENSO	El Niño Southern Oscillation
EPA	U.S. Environmental Protection Agency
ET	evapotranspiration
FAA	Federal Aviation Administration
FAO	Food and Agriculture Organization
FSA	Farm Service Agency
MFWP	Montana Department of Fish, Wildlife and Parks
GHCN	Global Historical Climatology Network
gpm	gallons per minute
GRACE	Gravity Recovery and Climate Experiment
GWAAMON	Groundwater Assessment Act Monitoring Network
GWIC	Groundwater Information Center
GWIP	Groundwater Investigation Program
HUC	Hydrologic Unit Code
MBMG	Montana Bureau of Mines and Geology
MCO	University of Montana Climate Office
MSU	Montana State University
NASA	National Aeronautics and Space Administration
NDMC	National Drought Mitigation Center
NDRP	National Drought Resilience Partnership
NDVI	Normalized Difference Vegetation Index
NGO	Non-governmental organization
NIDIS	National Integrated Drought Information System
NIFC	National Interagency Fire Center

NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
PDM	Pre-Disaster Mitigation Plan
PDO	Pacific Decadal Oscillation
PDSI	Palmer Drought Severity Index
RAWS	Remote Automatic Weather Station
RISA	Regional Integrated Sciences and Assessment
SNOTEL	Snow Telemetry
SON	September-October-November
SST	sea surface temperature
SWE	snow water equivalent
SWSI	Surface Water Supply Index
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
UMW	University of Montana-Western
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDM	U.S. Drought Monitor
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WaterSMART	Sustain and Manage American Resources for Tomorrow
WGA	Western Governors' Association
WMCE	Western Montana College climate station
WPIC	Water Policy Interim Committee
WRCC	Western Regional Climate Center
WRP	Watershed Restoration Plan

Executive Summary

This plan was created as a result of the Big Hole Watershed Committee (BHWC)'s participation in the National Drought Resilience Partnership (NDRP) and with support from the U.S. Bureau of Reclamation's (BOR) WaterSMART (Sustain and Manage American Resources for Tomorrow) Drought Planning funding opportunity. The purpose of this plan is to articulate the local vulnerabilities to drought within the Big Hole River watershed of Southwest Montana, identify strategies for addressing those vulnerabilities, and support access to resources for projects that aim to foster local drought knowledge and resilience.

This plan provides background information about the Big Hole Watershed and BHWC (Section 2), a description of the operational and administrative frameworks relevant to drought planning and management (Section 3), a list of existing tools for monitoring drought conditions (Section 4), a drought vulnerability assessment of the Big Hole Watershed (Section 5), a list of proposed and existing mitigation actions (Section 6), a description of our current response plan and proposed response actions, the Big Hole River Drought Management Plan (DMP) (Section 7), and a description of the DRP update process (Section 8).

Section 1: Introduction

About Drought Resilience Planning

The purpose of Drought Resilience Planning is to prepare a geological area, in this case a watershed, for drought, using a written document called a Drought Resilience Plan (DRP) to advise and guide a proactive planning process. This process includes stakeholder engagement, resource inventory, vulnerability assessment, identification of monitoring and resource needs, public education and outreach, and a plan update process. A DRP outlines both proactive measures to mitigate for the effects of drought and response actions for when drought occurs. In the Big Hole Watershed, our water supply is limited to what we receive from snowpack and precipitation, and since an off-stream storage reservoir has been ruled out for cost and resource reasons, proactive mitigation efforts such as risk assessment, preparedness, and natural water storage are our best means of building community and resource resilience to drought in our watershed.

The Bureau of Reclamation's Drought Planning Guidelines

The BOR's WaterSMART Drought Planning grant funds watershed groups and other entities to develop or update drought plans. The BOR's guidelines requires six elements to be included in drought plans in order to qualify for WaterSMART funding: operational and administrative framework (Section 3), drought monitoring (Section 4), vulnerability assessment (Section 5), mitigation actions (Section 6), response action (Section 7), and plan update process (Section 8). Priority is given to projects that are supported by existing drought plans or drought planning efforts and that focus on building resilience to drought rather than response actions only.

In addition, this plan contains recommendations for drought resilience projects that do not qualify for funding under BOR's WaterSMART program in order to offer a holistic view of the potential mitigation and response actions that are possible.

Who Develops and Implements the Drought Resilience Plan?

Drought Resilience Plans can be developed by any management agency or non-governmental organization (NGO) involved in water supply issues. This plan, the Big Hole River DRP, was developed by BHWC with guidance from the Montana Department of Natural Resources and Conservation (DNRC) and input from Big Hole Watershed stakeholders. BHWC is a nonprofit watershed group comprised of local residents who represent ranching, the fishing outfitting and guiding industry, local businesses and governments, concerned citizens, and sportsmen.

The entities responsible for implementation of this plan vary based on the nature of the project, the agency jurisdiction,

and the stakeholders involved, but BHWC has the capacity, knowledge, and drive to complete as many of these projects as possible.

What is the Goal of the Big Hole Watershed Drought Resilience Plan?

The goal of this DRP is to identify the watershed's primary vulnerabilities to drought, outline drought mitigation and forecasting resources, and propose projects to mitigate vulnerabilities. The plan documents local stakeholders' drought vulnerability concerns and identifies resources that can be used to improve drought resilience.

About the Big Hole Watershed Committee

Established in 1995, BHWC is a 501(c)(3) nonprofit conservation organization dedicated to fostering sustainability through education, management and restoration of the Big Hole River and surrounding watershed. Our mission is to seek understanding and agreement among groups and individuals with diverse viewpoints on water use and management in the Big Hole Watershed. We have a 22-member governing board representing ranching, the fishing outfitting and guiding industry, local businesses, residents, and local government. Agency representatives serve as technical advisors, providing valuable input to guide BHWC's management decisions and restoration efforts.

Since 1995, BHWC has introduced and implemented the Big Hole River DMP, supported the Upper Big Hole Arctic Grayling CCAA, updated irrigation infrastructure, worked to prevent livestock depredation by predators, facilitated the development and adoption of floodplain maps, and restored streams and wetlands. Perhaps most importantly, we've served as a hub for community conversations and the go-to organization for restoration and conservation issues.

We believe in conservation through collaboration, which is why we strive to include everyone in our community in our conversations and our decisions. Our committee makes their decisions based on consensus: for any motion to move forward, the decision must be unanimous amongst a quorum of board members. We also believe in shared sacrifice: if everyone gives up what they can for the good of the resource, we will all be better off for it. This model of shared sacrifice has served us well since our inception and fosters a spirit of community and cooperation amongst stakeholders with varying perspectives.

We pride ourselves on being an organization that gets things done. In 2019 alone, BHWC completed several stream and riparian restoration projects, raised $41,000 for the Burma Road project near Glen, hosted 10 monthly meetings and one wildlife event, and worked hard to identify and solve conservation issues that matter to local residents and businesses.

A History of Drought in the Big Hole Watershed

Drought was the catalyst that spurred the creation of BHWC. In the late 1980s and early 1990s, the Big Hole watershed experienced severe drought. In 1988, the Big Hole River was dry at Wisdom for 24 consecutive days. Grayling numbers were dwindling and people began to take notice. Preferring local solutions over federal regulations, a group of Big Hole ranchers petitioned then Governor Racicot for help to find a solution to the intensifying water issues in the Big Hole. BHWC was formed in 1995 and set about to its first task: creating the Big Hole River Drought Management Plan (DMP), first published in 1997. The plan designated voluntary water conservation efforts and mandatory fishing restrictions based on flow and temperature during times of drought.

BHWC reviews the DMP annually and updates it as needed based on recommendations made by the Big Hole River Drought Subcommittee. The subcommittee includes BHWC boar and staff, agency and NGO partners, and local stakeholders. BHWC prints and distributes the plan regularly and also provides access to it via our website, bhwc.org. Since the plan's creation, habitat quality and fishery populations have improved and the river has never again run dry like it did in 1988. Arctic grayling are recovering and in 2014, the USFWS ruled them unwarranted for listing under the Endangered Species Act and cited successful conservation efforts as the driver of their recovery.

Recognizing that the Big Hole River is a headwaters tributary and we are very much dependent on snowpack and

precipitation, BHWC has invested the bulk of its energy and resources in improving natural water storage abilities throughout the watershed. We've done this in a variety of ways, from stream and wetland restoration, to beaver mimicry projects, to investigating cloud seeding technology. We've also worked to improve communications and water conservation efforts among Big Hole Watershed stakeholders—an ongoing effort.

We've also been working at the state level to produce long-term solutions for Montana's resource needs. In 2018, then-Executive Director of BHWC, Jennifer Downing, raised the question of how to coordinate information and entities regarding Montana's stream gage infrastructure at MWCC's Annual Meeting. With the support of MWCC, Jen spearheaded a mission to influence Montana's State Legislature to create legislation to address the issue of long-term stream gage funding and support. Her efforts resulted in the creation of Senate Bill 32: "An Act Creating a Stream Gage Oversight Work Group; Revising Duties of the Drought and Water Supply Advisory Committee" in the 2019 legislative session. MWCC and BHWC's current Executive Director, Pedro Marques, continue to participate with the stream gage working group to identify long-term stream gage solutions.

How to Get Involved

Join BHWC at monthly meetings (the third Wednesday of each month except July and December) and visit our website, http://bhwc.org to sign up for our email updates and biannual newsletter. Our monthly public meetings include committee updates, community discussion, and presentations on topics relevant to our watershed and community. All perspectives are welcome.

Section 2: Watershed Background

Geography

The Big Hole Watershed encompasses the Big Hole River and its surrounding landscape in Southwest Montana. The watershed includes parts of four counties: Beaverhead, Madison, Butte-Silver Bow, and Anaconda-Deer Lodge. The Big Hole Watershed is a stronghold of traditional cattle ranching, rural communities, and expansive public lands. Nearly 2,000 residents call the Big Hole valley home, spread among its nearly 2 million acres. In general, the valley bottom remains privately-owned. Highlands are publicly-owned by state and federal agencies, the majority U.S. Forest Service (USFS) Beaverhead-Deerlodge National Forest (BDNF). Elevations range from 5,000 to 6,500 feet at the valley bottom to more than 10,000 feet at the highest peaks. The nearby 158,000-acre Anaconda-Pintler Wilderness at the north end of the watershed was established in 1964 as part of the original Wilderness Act and includes some of the highest peaks in the drainage at well over 10,000 feet. The Big Hole River is a headwater tributary of the Upper Missouri River. It is nestled against the Continental Divide and is solely reliant on snowpack and precipitation for its water sources. The Big Hole River starts at Skinner Meadows Road near the town of Jackson, flows almost 155 miles through the towns of Wisdom, Wise River, Dewey, Divide, Melrose, and Glen, where it meets the Beaverhead River and flows into the Jefferson River near Twin Bridges to form the Missouri Headwaters. Notable tributaries are listed in Figure 7.

Land Use

The Big Hole Watershed has a total area of approximately 1.79 million acres, with roughly 69% being Federal lands (USFS, BLM, NPS), 4% State lands (DNRC, MFWP), and 27% private lands. The Big Hole River valley is a high elevation basin at the headwaters of the Upper Missouri River characterized by open lands, big sky and big mountains, free-flowing river, and traditional ranching culture. Unlike many other watersheds in the West, our area remains relatively undeveloped. The primary land uses in the Big Hole Watershed are cattle/sheep ranching and hay production.

The Big Hole River is also a blue ribbon trout fishery that is renowned for hosting the last fluvial population of Arctic grayling in the lower 48 states. The Big Hole Watershed supports other fish species such as rainbow trout, brown trout, brook trout, Westslope Cutthroat trout, mountain whitefish, burbot, longnose dace, longnose sucker, Rocky Mountain sculpin, and white sucker as well as grayling. The majestic scenery, thriving fishery, and abundance of public access make

the fishing outfitting and guiding business (and associated tourism) a staple of the economy in the Big Hole Watershed. The outfitting and guiding industry experiences severe impacts from drought, including mandatory fishing restrictions to protect the fishery during times of drought (as characterized by low streamflows and high stream temperatures which can stress and kill fish).

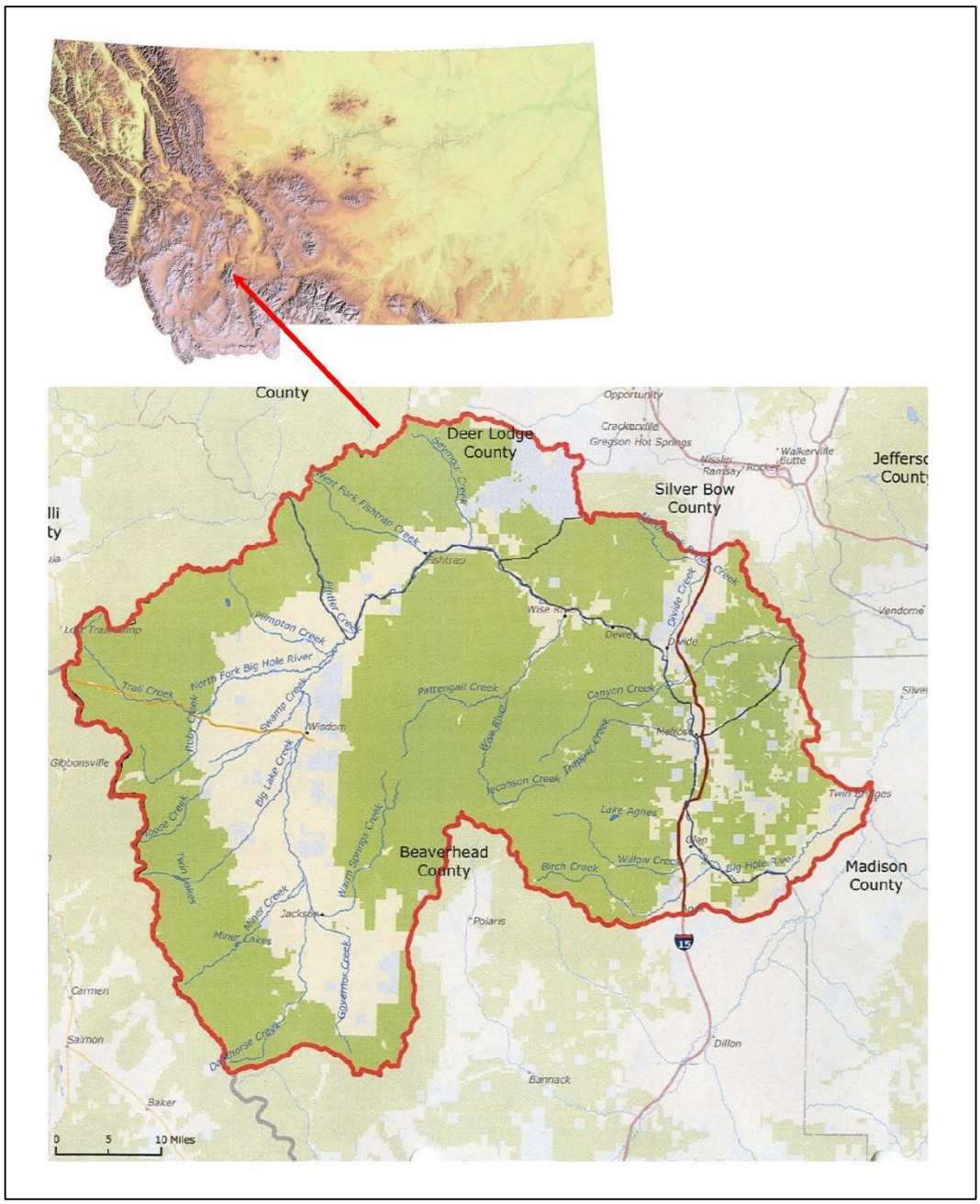


Figure 1. Map of the Big Hole Watershed.

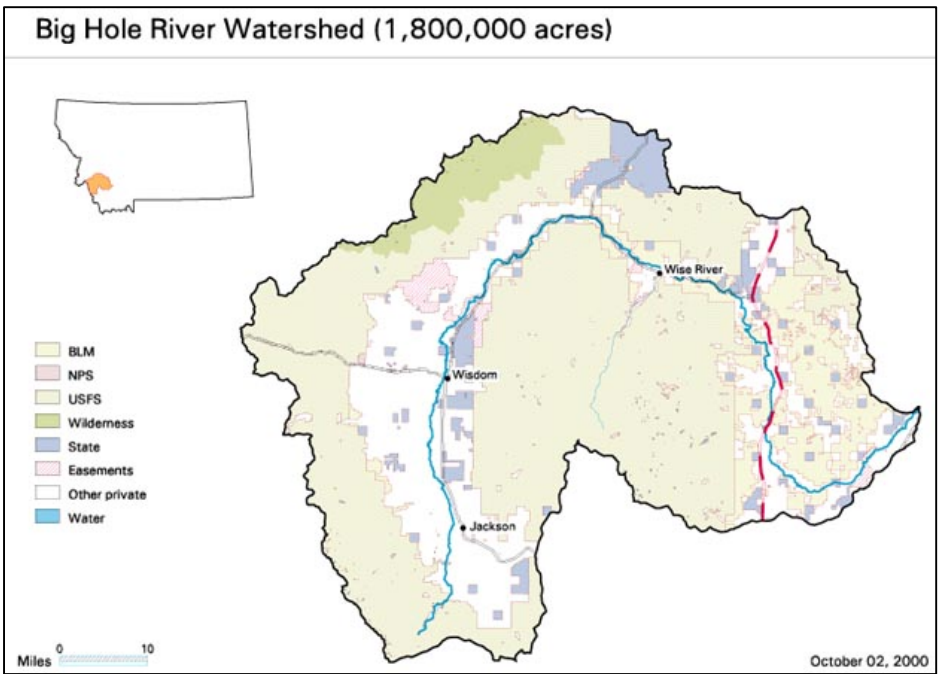


Figure 2. Map of land ownership in the Big Hole Watershed.

Climate

Present

As of December 2019, Big Hole Basin snowpack is approximately 96% of average (1981-2010 median). February 2019 broke records across Montana for snowfall and cold temperatures. March was the opposite; we experienced minimal snowfall. Seasonal April conditions led to low to mid-elevation runoff. Snowpack went isothermal by the end of April, even at high elevations. Most of our rainfall occurs between May and June, while June-August is the critical time period when moisture is most needed.

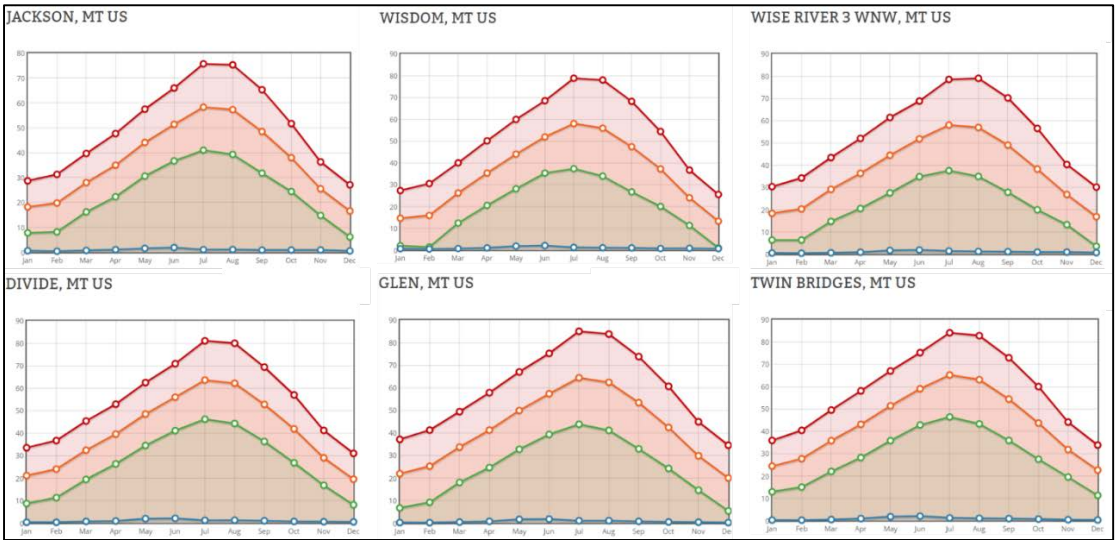


Figure 3. 1981-2010 monthly climate normals for Jackson, Wisdom, Wise River, Divide, Glen, and Twin Bridges GHCN sites. Red line: Average monthly maximum temperature. Green line: Average monthly minimum temperature. Orange line: Average monthly temperature. Blue line: Average monthly precipitation.
Available at: https://www.ncdc.noaa.gov/cdo-web/datatools/normals

Past

The Big Hole Watershed is known for its cold, long winters and temperate summers. Winter temperatures can reach -40 degrees Fahrenheit, while summer temperatures rarely exceed 90 degrees Fahrenheit. Rainfall is minimal and usually occurs between May and June. Snowpack accumulation and timing of runoff vary, making drought planning and streamflow forecasting challenging. The Big Hole River is a headwaters tributary, meaning it is entirely dependent on snowpack and precipitation to maintain streamflows; it has no off-stream storage and no major river tributaries.

PERIOD OF RECORD MONTHLY CLIMATE SUMMARY – PERIOD OF RECORD : 01/01/1923 TO 06/09/2016

See details below from Western Regional Climate Center:

WISDOM, MONTANA (249067)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	26.4	31.1	38.5	49.2	60.3	68.6	79.4	77.8	67.6	55.0	38.0	28.0	51.7
Average Min. Temperature (F)	1.2	3.3	10.8	21.2	28.7	36.1	38.2	34.7	27.8	21.3	12.3	3.6	19.9
Average Total Precipitation (in.)	0.70	0.52	0.74	0.95	1.64	1.96	1.09	1.03	0.99	0.83	0.76	0.77	11.97
Average Total SnowFall (in.)	11.8	8.3	8.6	4.5	2.5	0.5	0.0	0.0	0.5	1.9	7.8	10.8	57.0
Average Snow Depth (in.)	9	10	8	1	0	0	0	0	0	0	2	5	3

Percent of possible observations for period of record.

Max. Temp.: 98.7% Min. Temp.: 98.6% Precipitation: 98.6% Snowfall: 76.4% Snow Depth: 50.3%

Figure 4: Monthly climate summary for Wisdom, MT from 01/01/1923 to 06/09/2016.

Figure 5. The Big Hole River was dry at Wisdom for 24 consecutive days in 1988.

Future

The CMIP5 is a long-range climate forecasting tool currently used by several government agencies, NGOs, and academic institutions to predict possible climate scenarios based on global climate models. The models show varying predictions regarding how precipitation will change in the near-future. The CMIP5 is available at: https://pcmdi.llnl.gov/mips/cmip5/.

The USDA's 2014 Climate Change Adaptation Plan uses input from 11 USDA sub-agencies to create a vulnerability assessment, review the elements of USDA's mission that are at risk from climate change, and provide actions and steps to

be taken to build resilience to climate change. The plan listed projected impacts to American agriculture that are expected to occur in the near-future:

- **Agricultural Impacts:**
  - Increased soil erosion caused by extreme precipitation events;
  - Regional and seasonal changes in water availability;
  - Increased number of invasive weeds;
  - Increased number of diseases and insect pests;
  - Potential changes in timing of pollinator lifecycles;
  - Shifts in the timing and type of crops produced to account for changing temperatures (both an impact and a mitigation strategy);
  - Changes in availability and price of feed-grain for livestock;
  - Changes in pasture and forage crop production and quality; and
  - Changes to animal health, growth, and reproduction.

The effects described above will likely have an impact on crop and livestock growth and yields, but the magnitude of these potential impacts is not fully understood at this point in time.

Forestry Impacts: The Climate Change Adaptation Plan also states that U.S. forest ecosystems will change in the near-future as a result of altered disturbance regimes, e.g. wildfire, insect infestations, erosion and flooding, and drought-induced tree mortality. These changes may cause instances of both ecosystem services lost and gained. According to the plan, "Establishing a foundation for managing forest ecosystems in the context of climate changes as soon as possible will ensure that a broad range of options will be available for managing forest resources sustainably." The Climate Change Adaptation Plan is available at:
https://www.usda.gov/oce/climate_change/adaptation/USDA_Climate_Change_Adaptation_Plan_FULL.pdf.

Hydrologic Impacts: According to the 2017 Montana Climate Assessment, Montana will experience the following hydrologic impacts in the near-future:

- Reduced snowpack at mid and low elevations over the next century (caused by increasing spring temperatures);
- Earlier snowmelt and peak runoff period, resulting in lower late-season water availability in snowpack dependent watersheds like the Big Hole Watershed;
- Increasing groundwater demand as higher temperatures cause decreased surface water availability;
- Exacerbated drought conditions, including more multi-year and decadal-scale droughts and more frequent drought for longer duration during late summer and early fall; and
- Far-reaching social and ecological impacts as a result of the effects of increased temperatures on Montana's snowpack, streamflow, and groundwater.

The 2017 Montana Climate Assessment is available at:
http://montanaclimate.org/sites/default/files/thumbnails/image/2017-MCA-Water-Chapter-lr.pdf.

El Niño Southern Oscillation Impacts

The El Niño Southern Oscillation (ENSO) is a series of climatic changes that occurs when sea surface temperatures (SST) interact with atmospheric circulation patterns in the equatorial Pacific region. ENSO occurs every two to seven year and has global impacts. There are three possible ENSO phases: ENSO-neutral, warm phases (El Niño), and cool phases (La Niña). El Niño conditions develop when SSTs are warmer than average in the equatorial Pacific for an extended period of time. El Niño phases can have varying effects with some consistent trends. La Niña is characterized by cooler than average SSTs in the mid-latitude Pacific region for an extended period of time. It is vital to consider ENSO when making seasonal climate predictions for southwest Montana, as it can have major implications for Montana's climate trends and impacts.

ENSO Impacts on the Big Hole Watershed:

- La Niña: La Niña can enhance the possibility of below-average winter temperatures and above-average late-winter and early-spring precipitation. In the Big Hole Watershed, La Niña can cause above-average stream flows and delay the beginning of hay production.

- El Niño: El Niño events are more common in winter and increase the likelihood that temperatures will be above average and snowpack will be below average in the Big Hole Watershed. El Niño events may also result in above-average late-spring and early-to-mid-summer precipitation in the Big Hole Watershed. Impacts of El Niño in the Big Hole Watershed include above average range and forage production, higher likelihood of summer wildfires, and increased amounts of invasive weeds.

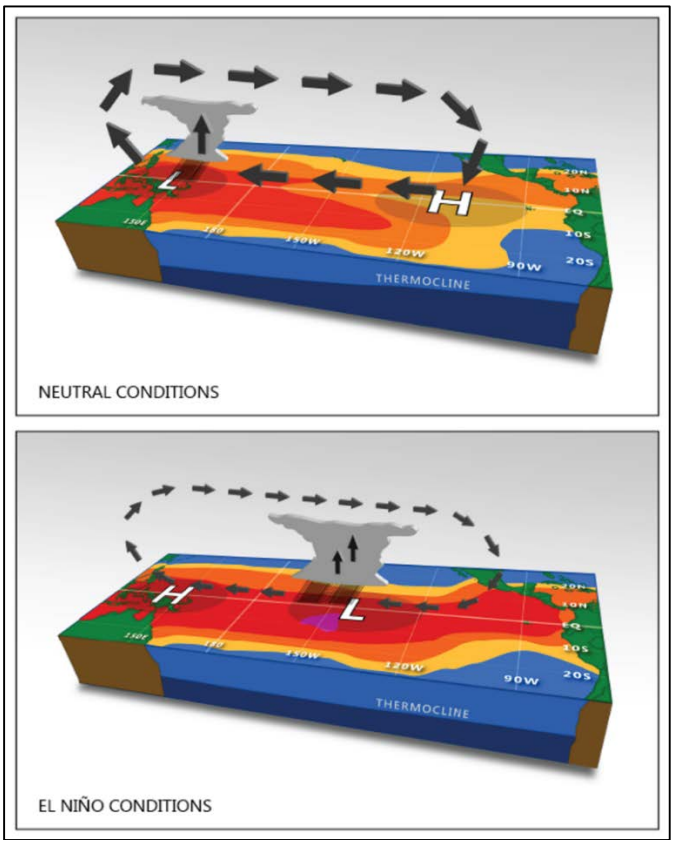


Figure 6. Above: ENSO neutral conditions. Below: El Niño conditions.
Available at: https://www.climate.gov/news-features/blogs/enso/en-so.

Pacific Decadal Oscillation

Another globally considered climate pattern is the Pacific Decadal Oscillation (PDO), which is influenced by changes in mid-latitude Pacific Ocean SSTs. The PDO's period of oscillation varies irregularly on interannual to interdecadal timescales. PDO can either increase or subdue the climatic effects of ENSO depending on the phase. A tool for analyzing the effects of ENSO and PDO on seasonal temperature and precipitation trends in Montana is available at: http://tools.adaptivehydro.com/.

Infrastructure

Irrigation

Irrigation methods in the Big Hole Watershed include flood, hand-line, wheel-line, and center pivot. Many irrigators in the middle and lower watershed have converted to irrigating with pivot sprinklers, but flood irrigation is still a common practice and provides important late-season recharge to the aquifer as well as habitat for migratory birds. Flood irrigation is a more common method of irrigation in the Upper Big Hole Valley. In 2008, BHWC published a report titled *Lower Big Hole Irrigation Infrastructure Survey and Prioritization* that created a matrix outlining necessary irrigation updates along the lower river. Some of these projects have been completed, while others have yet to be addressed.

Irrigation Infrastructure Needs:

1. BHWC to update prioritization list, secure funding, and complete remaining projects.
2. BHWC to identify irrigation infrastructure needs in the middle and upper watershed.

Water Rights

Overview

A water right allows for the legal use of water and is required for anyone in Montana who uses more than 35 gallons per minute (gpm) or 10 acre-feet (AF) per year of groundwater. Groundwater wells that use less than this amount are considered to be "exempt" and do not require water rights.

Water rights in Montana are administered by the DNRC. Water rights that were established before July 1, 1973 are administered by the Adjudication Bureau, while water right established after that date are administered through the New Appropriations Program. The DNRC's Water Rights Bureau is responsible for establishing new water rights and changing existing water rights as well as holding hearings and maintaining records related to water rights (http://dnrc.mt.gov/divisions/water/water-rights).

The State of Montana adheres to the prior appropriation doctrine system, which states that water right priority is determined by, "first in time, first in right". In 1992, the entire Upper Missouri River Basin, including the Big Hole Watershed, was closed to all new surface water right appropriations when DNRC designated the basin as over-allocated. The Water Adjudication Bureau and the Montana Water Court are currently working on adjudicating all claims to pre-July 1, 1973 water rights.

A Note on the Salish-Kootenai Water Compact

The CSKT-Montana Compact is the result of more than a decade of negotiations to resolve the Tribes' claims to reserved water rights within the State. Montana's 2015 Legislature ratified the Compact (MCA 85-20-1901). As of the writing of this DRP, the Compact is awaiting congressional approval. Passage of the Compact would result in granting 308 CSKT-MT Compact rights. Not passing the Compact would result in enforcement of 10,109 instream flow tribal rights that impact 2.5 million irrigated acres owned by 10,127 water right holders. Not passing the Compact would impact 45,485 individual water rights in 41 of Montana's 56 counties and in 51 of the 85 adjudicated basins. (DNRC). If the Compact is passed, it will only require adjudication of 0.6% (308 rights) of the total rights that would need to be adjudicated if the Compact was not passed. With no compact, water rights in the basins that are already adjudicated would have to be re-adjudicated, setting Montana's water right adjudication process back decades and costing the state and water right holders millions of dollars we do not have. Individual water right holders in the Big Hole Watershed would have to defend each of their rights against every Tribal right that impacts them. Each water right holder would have to object as an individual and defend their rights against the Department of Justice and the Tribe. This is no-win scenario, which is why BHWC supports the passing of the CSKT Water Compact and has encouraged our state Legislators do support the Compact as well.

Stream	Number of Claims	Earliest Private Priority Date	Latest Private Priority Date	Earliest Public Priority Date	Latest Public Priority Date
Big Hole River	1,140	1858	1983	1858 (BLM)	1985 (MFWP)
Wise River	87	1875	1977	1906 (USFS)	1985 (MFWP)
Mudd Creek	27	1889	1973	1906 (USFS)	1906 (USFS)
Camp Creek	90	1858	1960	1858 (BLM)	1985 (MFWP)
Lost Creek	23	1880	1929	1889 (State Board of Land Commissioners)	1983 (BLM)
Moose Creek	152	1865	1966	1906 (USFS)	1985 (MFWP)
Bear Creek	18	1886	1971	1906 (USFS)	1985 (MFWP)
Canyon Creek	18	1900	1906	1906 (USFS)	1985 (MFWP)
Willow Creek	80	1875	1966	1858 (BLM)	1985 (MFWP)
Rock Creek	273	1880	1975	1880 (State Board of	1985 (MFWP)

				Land Commissioners)	
Tucker Creek	40	1875	1976	1906 (USFS)	1938 (USFS)
York Gulch	8	1897	1977	1906 (USFS)	1906 (USFS)
Big Swamp Creek	94	1886	1932	1906 (USFS)	1938 (BLM)
Fishtrap Creek	120	1884	1964	1906 (USFS)	1985 (MFWP)

Figure 7. Water right claims for key streams in the Big Hole Watershed.
Available at: http://dnrc.mt.gov/divisions/water/water-rights/records-unit.

Section 3: Operational and Administrative Framework

Overview

There are many different entities involved in forecasting, managing, and sharing information related to drought, including federal and state agencies, NGOs, and academia. Many of these entities have articulated their own drought plans and have comparable goals and concerns regarding drought. Collaborative coordination groups allow for the sharing of drought information and coordination of drought mitigation and response activities.

Collaborative Coordination Groups

Beaverhead County Interagency Coordination Group

The Beaverhead Interagency Coordination Group consists of federal, state, and local agencies as well as nongovernmental organizations. The group holds quarterly meetings that include round-table discussions with updates from each group. The sole purpose of this coordination group is maintain communication between decision makers in Beaverhead County.

Montana Governor's State Drought Advisory Committee

The Drought Advisory Committee (DAC) meets monthly at 9:30 AM on the third Thursday of the month from April to October. These meetings are usually held in Helena, but participants are able to join the meeting online and via the phone. The meetings are organized and hosted by DNRC. The meetings always include presentations by personnel from NWS, NRCS Montana Snow Survey, BOR, USGS, and DNRC and sometimes include presentations by MFWP, FSA, MCO, MSU Extension, and USACE. Much of the information from the presentations given at DAC meetings is publicly available on the NWS website, which is available at: http://www.wrh.noaa.gov/tfx/hydro/DGT.php?wfo=tfx and the DNRC drought website, which is available at: http://www.drought.mt.gov.

Missouri Headwaters Partnership

The purpose of the Missouri Headwaters Partnership (MHP) is to act as a regional collaborative organization that promotes economic and ecologic sustainability by supporting the natural resource integrity, water quality, water quantity, and economic and ecologic values of the landscapes and communities of the Missouri River headwaters basin. As a headwaters region, MHP recognizes the significance of included watershed groups' stewardship responsibilities to downstream neighbors. MHP's intent is to provide information, education, and coordination to the individual watershed groups comprising MHP and to pursue funding, collaboration, and support for basin-wide projects that are mutually beneficial for each of the included groups and downstream neighbors. The watershed groups that make up MHP include: the Big Hole River watershed (BHWC), the Beaverhead River watershed (Beaverhead Conservation District/Watershed Committee), the Red Rock River watershed (Centennial Valley Association), the Upper and Lower Gallatin River watersheds (Gallatin River Task Force/Greater Gallatin Watershed Council), the Upper and Lower Jefferson River watersheds (Jefferson River Watershed Council/Lower Jefferson River Watershed Council), the Madison River watershed (Madison Conservation District/Madison Valley Ranchlands Group), and the Ruby River watershed (Ruby Valley Conservation District/Watershed Council).

Montana Stream Gage Working Group

In Montana's 2019 Legislative session, the Water Policy Interim Committee (WPIC) created a working group to

oversee the state's stream gages at the request of Montana's water stakeholders. The working group is tasked with identifying long-term solutions for Montana's stream gages and addressing coordination and funding issues.

Montana Watershed Coordination Council

The Montana Watershed Coordination Council (MWCC) is a nonprofit conservation organization dedicated to uniting and supporting Montana's watershed communities to promote healthy and productive landscapes. MWCC has been cultivating broad-based support for community driven approaches to managing complex land and water issues for over twenty years as the statewide organization representing each of more than 60 watershed groups. More information about MWCC is available at: https://mtwatersheds.org/app/.

National Drought Resilience Partnership

The National Drought Resilience Partnership (NDRP) is a collaborative effort involving federal, state, tribal, and local government entities; non-government organizations (NGOs); and individual stakeholders. It aims to compile and connect technical expertise and financial resources in order to reduce vulnerability to drought at the local level. From the NDRP website: "Federal agencies have mobilized to provide improved information and data, emergency and planning assistance, landscape-scale land management improvements, and investments in new technologies and approaches to water resource management. Continued drought conditions in the West and projections of more extreme droughts in the future underscore the urgency to pursue long term solutions for protecting our water resources and the communities and ecosystems that depend on them." More information about NDRP is available here: https://www.drought.gov/drought/resources/national-drought-resilience-partnership.

Southwest Montana Resource Advisory Committee

The Southwest Montana Resource Advisory Committee (RAC) covers Beaverhead, Jefferson, Madison, and Silver Bow counties and includes lands on the Beaverhead-Deerlodge, Helena, and Gallatin National Forests. RACs were established by the Reauthorization of the Secure Rural Schools and Community Self- Determination Act of 2000 to provide oversite for the portion of Federal funds that are allocated to counties the Act. The Act requires funds to be spent on projects that benefit National Forest lands such as road, trail, and infrastructure maintenance or obliteration, improvements in soil and forest ecosystem health, fish and wildlife habitat restoration and improvements, invasive weed control, and the reestablishment of native animals and plants. RACS are comprised of 15 members representing the general public, businesses, conservation groups, local governments, and more. More information about the Southwest Montana RAC is available at: http://www.fs.usda.gov/main/bdnf/workingtogether/advisorycommittees.

Upper Missouri Task Force

The Upper Missouri Task Force is a collaboration of watershed groups that work together to build capacity and identify priority issues as pertains to drought planning and response. Many of the drought coordinators involved in the Upper Missouri Task Force are also involved in the Missouri Headwaters Partnership.

Western Governors' Association Drought Forum

The Western Governors' Association (WGA) Drought Forum has compiled a collection of best practices, case studies, and insights of western leaders on drought management and response. These resources are collected in the Drought Forum online resource library. The Drought Forum has seven focus areas: data and analysis; produced, reused, and brackish water; forest health and soil stewardship; water conservation and efficiency; infrastructure and investment; working within institutional frameworks to manage drought; and communication and collaboration. More information about the WGA Drought Forum is available at: http://www.westgov.org/initiatives/drought-forum.

NDRP Federal Partners

National Oceanic and Atmospheric Administration

- *National Integrated Drought Information System (NIDIS):* The NIDIS program is housed under NOAA and was authorized by Congress in 2006 (Public Law 109-430) to coordinate and integrate drought research and build upon existing federal, tribal, state, and local partnerships to create a national Drought Early Warning System

(DEWS). The DEWS integrates new and existing partner networks to provide easily accessible and clear climate and drought information to be used by decision makers to improve stakeholder capacity to monitor, forecast, plan for, and manage impact of drought. From the NIDIS website: "NIDIS' goal is to improve the nation's capacity to manage drought-related risks by providing the best available information and tools to assess the potential impacts of drought, and to prepare for and mitigate the effects of drought." NIDIS also participated in the NDRP by providing DEWS workshops and webinars to Upper Missouri watershed coordinators and partners. More information about NIDIS is available at: https://www.drought.gov/drought/.

- *National Weather Service (NWS):* The NWS is responsible for monitoring, forecasting, and researching the Earth's ocean, weather, and climate. The NWS Office in Great Falls serves the Big Hole watershed. The NWS Climate Prediction Center webpage is available at: http://www.cpc.ncep.noaa.gov/products/Drought/.
- *Western Regional Climate Center (WRCC):* WRCC provides climate services at regional and state levels working with NOAA partners in the National Climatic Data Center, NWS, the American Association of State Climatologists, the Regional Sciences and Assessment Program, and other NOAA Research Institutes. WRCC also partners with the Department of Interior Climate Science Centers and Landscape Conservation Cooperatives. WRCC's mission is to act as a repository of historical climate data and information, disseminate high quality climate data and information pertaining to the western U.S., engage in applied research related to climate issues, and improve the coordination of climate-related activities at state, regional and national scales. WRCC serves as a focal point for coordination of applied climate activities in the West and conducts applied research on climate issues affecting the West. More information about WRCC is available at: http://www.wrcc.dri.edu/.
- *Regional Integrated Sciences and Assessments (RISA) program*: The RISA program consists of research teams that are tasked with increasing the nation's capacity to prepare for and adapt to climate variability and change. The RISA that serves the Big Hole Watershed is the Climate Impacts Research Consortium (CIRC) and includes researchers from Oregon State University, University of Oregon, University of Washington, and University of Idaho. More information about CIRC is available at: http://pnwcirc.org/.

Bureau of Reclamation

The BOR offers funding opportunities that support grant planning, DMP and DRP development, and drought mitigation projects. BOR also manages water storage reservoirs, of which there are currently none in the Big Hole watershed. More information about BOR is available at: https://www.usbr.gov/.

U.S. Geological Survey

The USGS stream gaging network and resulting data is critical to water-based decision makers in the state of Montana. There are 10 USGS gages on the Big Hole River, without which, our DMP could not function. USGS's Wyoming-Montana Water Science Center has its main Montana office in Helena. More information about the USGS stream gaging program is available at: https://www.usgs.gov/mission-areas/water-resources/science/usgs-streamgaging-network?qt-science_center_objects=0#qt-science_center_objects.

U.S. Fish and Wildlife Service

USFWS's Montana Partners for Fish and Wildlife program has been instrumental in developing the Upper Big Hole Arctic grayling CCAA and providing critical information regarding fish and wildlife to BHWC and other watershed groups. More information about the partners program is available at: https://www.fws.gov/mountain-prairie/refuges/montanaPFW.php.

Bureau of Land Management

BLM Field Offices in Dillon and Butte serve BLM lands within the Big Hole Watershed. They are tasked with ensuring that the land under their jurisdiction is safely and sustainably managed. BLM works with permittees who graze livestock seasonally on BLM allotments to make sure producers are following guidelines for stocking density and duration of grazing for each allotment. This prevents over-use of rangeland that can have negative impacts on the viability of the ecosystem. The BLM Field Offices also conduct watershed assessments on a rotating ten-year schedule to evaluate longer-term trends in the health of riparian and upland areas. More information on BLM's field offices and grazing program is available here: https://www.blm.gov/programs/natural-resources/rangelands-and-grazing/livestock-grazing.

U.S. Forest Service
Portions of the BDNF that are within the Big Hole Watershed are managed by the USFS Dillon, Wisdom/Wise River, and Butte Ranger Districts. These Ranger Districts are responsible for managing fisheries, wildlife, livestock grazing, wildfire mitigation, and timber harvest on USFS lands. The USFS's Dillon office also houses the Forest Supervisor's Office and the Dillon Interagency Dispatch Center. The Dillon Interagency Dispatch Center is responsible for coordinating wildfire detection and fire crew dispatch for several agencies including USFS, BLM, BOR, USFWS, DNRC and Beaverhead and Madison Counties. More information about the BDNF is available at: http://www.fs.usda.gov/main/bdnf/home.

Natural Resource Conservation Service
The Montana NRCS Snow Survey Program operates out of Bozeman and provides mountain snowpack and precipitation information via the SNOTEL network in order to issue streamflow forecasts for Montana and Wyoming. Common applications of snow survey products include water supply management, flood control, climate modeling, recreation, and conservation planning. The NRCS Montana Snow Survey website is available at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/. The NRCS Dillon Field Office offers services for range management, stock water development, irrigation infrastructure design and repair, irrigation efficiency management, and environmental quality incentives.

Farm Service Agency
The primary mission of the FSA is to assist Montana's farmers and ranchers in securing the greatest possible benefit from programs administered by FSA such as farm loans, commodity price support, disaster relief, conservation, or other available resources. FSA's Dillon Field Office offers a range of drought relief assistance programs to producers. Some of these aid programs go into effect only when certain drought thresholds are reached, according to the USDM. More information about the USDA's FSA programs is available at: http://www.fsa.usda.gov/FSA/stateoffapp?mystate=mtandarea=homeandsubject=landingandtopic=landing.

Environmental Protection Agency
The Big Hole Watershed falls within EPA's Region 8, with headquarters located in Denver, Colorado. EPA is responsible for the protection of water quality and other natural resources. EPA grant funding opportunities, such as CWA Section 319 funding, are used to mitigate water quality impairments that can be exacerbated by drought conditions. EPA's Source Water Assessment Program offers assistance with water quality protection for drinking water. More information is available at: https://www.epa.gov/.

Federal Emergency Management Agency
The Big Hole Watershed is within FEMA's Region 8, with headquarters in Denver, Colorado. FEMA distributes funding for drought and wildfire response through its Hazard Mitigation Grant Program and drought and wildfire mitigation funding through its Pre-Disaster Mitigation Grant Program: http://www.fema.gov/pre-disaster-mitigation-grant-program.

U.S. Army Corps of Engineers
USACE's Omaha District Headquarters manages flood control in the Missouri River Basin. USACE's regulatory offices in Helena and Billings are involved with drought management in the Big Hole Watershed through the CWA Section 404 "dredge and fill" permitting process. More information on how USACE manages drought is available at: http://www.usace.army.mil/Missions/EmergencyOperations/Drought.aspx.

National Drought Mitigation Center
The NDMC is based out of the University of Nebraska-Lincoln. Its mission is to help people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management. It offers several drought monitoring products such as the USDM, the Drought Risk Atlas, and the Drought Impact Reporter. NDMC has been involved in the development and implementation of the NDRP demonstration project both at the national level and within the Upper Missouri Basin of Montana. The NDMC homepage is available at: https://drought.unl.edu/.

State Agencies

Montana Department of Natural Resources and Conservation

The Helena water resources regional DNRC office administers water rights in the Big Hole Watershed according to the prior appropriation doctrine and is currently in the process of adjudication for all pre-July 1, 1973 water rights. DNRC also gathers and shares statewide drought information and puts on the biennial Montana State Water Forum. The DNRC Dillon Unit manages forestry, fire, and grazing on DNRC lands in the Big Hole Watershed. DNRC personnel has been involved in the development and operation of the Upper Big Hole Arctic Grayling CCAA, the Big Hole River Drought Management Plan, and many other conservation efforts in our watershed. DNRC also administers several grants that can be used to promote drought resilience, many of which BHWC has successfully utilized. More information about DNRC is available at: http://dnrc.mt.gov/.

Montana Department of Fish, Wildlife and Parks

MFWP's Fisheries Program is tasked with maintaining the health of Montana's aquatic ecosystems while also providing public access for recreational angling opportunities. Drought impacts to aquatic ecosystems may include habitat loss, increased water temperatures, decreased streamflow, increased stress on fish which relates to increases in diseases and mortality, and increased predation rates. MFWP has established statewide streamflow and temperature thresholds to guide decisions to close and re-open streams to angling; however, in the Big Hole Watershed, BHWC's DMP precedes the State Drought Plan. BHWC regularly works with FWP on designing and implementing restoration projects, operating and updating the Big Hole River DMP, and more. More information about MFWP's policies regarding drought are available at: http://MFWP.mt.gov/fishAndWildlife/habitat/fish/waterManagement/drought.html.

Montana Department of Environmental Quality

The mission of MMDEQ's Water Division is to support and implement measures to conserve Montana's valuable water resources and ensure that clean lakes, streams, and rivers remain part of Montana's natural heritage. In 2009, MDEQ performed water quality sampling throughout the Big Hole Watershed and analyzed the data to produce Total Maximum Daily Load standards (TMDLs). These TMDLs were incorporated into BHWC's Big Hole Watershed Restoration Plans, which identify and prioritize projects to mitigate water quality impairments. These projects and strategies are implemented using CWA 319 funding, which is administered by MDEQ in the State of Montana. BHWC has utilized several 319 funding opportunities to further our stream restoration and drought mitigation efforts. MDEQ recognizes the important link between water quality and quantity and the importance of drought resilience to maintaining water quality. More information on MDEQ's water quality protection policies and efforts are available at: http://MDEQ.mt.gov/Water.

Montana Bureau of Mines and Geology

Montana Bureau of Mines and Geology (MBMG) is a department of Montana Technical University in Butte, Montana. MBMG is tasked with collecting and publishing information on Montana's geology to promote orderly and responsible development of the energy, groundwater, and mineral resources of Montana. The MBMG is a non-regulatory state agency that provides advisory, technical, and informational services on Montana's geologic, mineral, energy, and water resources. More information about MBMG is available at: http://www.mbmg.mtech.edu/.

Montana Climate Office

MCO is an independent, state-designated entity based out of the University of Montana in Missoula that provides climate information and services relevant to Montana. MCO is recognized by the State of Montana as the official steward of climate information in the state. More information about MCO is available at: http://www.climate.umt.edu/.

Montana State University Extension Service

MSU Extension Service agents and subject matter experts serve the needs of local stakeholders in 56 counties and 7 reservations with one mission in mind: "to improve the lives of Montana citizens by providing unbiased, research-based education and information that integrates learning, discovery and engagement to strengthen the social, economic and environmental well-being of individuals, families and communities" (MSU Extension). MSU Extension works with local partners to identify emerging needs and plan and prioritize work to support those needs; the Extension service is especially useful in providing assistance to agricultural producers. More information about MSU Extension is available at: https://www.msuextension.org/.

Local Government

Beaverhead County

- *Beaverhead County Disaster and Emergency Services*: Beaverhead County DES is based in Dillon where it works to prevent or minimize the seriousness of emergencies and disasters and to plan and coordinate the community's response to those emergencies and/or disasters. It requires establishing partnerships among emergency response and management personnel to prevent, respond to, recover from and mitigate emergencies and disasters. Coordination is a key factor of the emergency management program to protect lives, property and resources.
- *Beaverhead Conservation District (BCD)*: BCD is composed of locally elected representatives from Beaverhead County and is responsible for administering the state 310 permitting process. (Any private, or nongovernmental entity that proposes an activity that physically alters or modifies the bed or banks of a perennially flowing stream on public or private land must first acquire a 310 permit from the local conservation district, according to Montana state law.) BCD worked with BHWC and other partners on the development of the Big Hole River Floodplain Maps.
- *Beaverhead County Extension*: The Beaverhead County Extension Service is linked to MSU Extension and provides the citizens of Beaverhead County with research based knowledge and information related to livestock and crops, yards and gardens, invasive weeds, and insects. BCD also offers soil, forage nitrate testing, weed-free hay certifications, private pesticide applicator licensing and training, and beef quality assurance certifications in addition to supporting 4-H programming. More information about Beaverhead County Extension is available at: http://www.beaverheadcounty.org/html/extension_agent.html.

Madison County:

- *Ruby Valley Conservation District/Watershed Council*: RVCD and RWC are committed to uniting agriculture, recreation, conservation, and education to protect the land and preserve the heritage of the Ruby Valley watershed. RVCD worked with BHWC and other partners on the development of the Big Hole River Floodplain Maps. More information about RVCD and RWC is available at: https://rvcd.org/.

Anaconda-Deer Lodge County:

- *Deer Lodge Valley Conservation District (DLVCD):* DLVCD has worked with BHWC to apply for resource restoration grants that require management by a conservation district; the two groups have successfully managed multiple large grants together for restoration projects on the Mount Haggin Wildlife Management Area. DLVCD also worked with BHWC and other partners on the development of the Big Hole River Floodplain Maps. More information is available here: http://www.powellcountymt.gov/county-departments/conservation-districts/.

Butte-Silver Bow County:

- *Mile-High Conservation District (MHCD):* MHCD worked with BHWC and other partners on the development of the Big Hole River Floodplain Maps. More information is available here: https://co.silverbow.mt.us/272/Mile-High-Conservation-District-Board.
- *Butte-Silver Bow Water Utility Services:* BSB Water Utility closely follows the Big Hole River DMP and stops withdrawing water from the Big Hole River to source the municipality of Butte before DMP triggers are reached. Jim Dennehy, BSB Water Utility employee, is on BHWC's governing board and provides valuable input to the committee regarding Butte's water consumption and conservation efforts. In 2017, Jim led a public tour of the newly opened Basin Creek Water Treatment Plant for BHWC and interested parties. More information is available here: https://co.silverbow.mt.us/179/Water-Utility-Services.

Procedural and Planning Documents

Beaverhead County Pre-Disaster Mitigation Plan

The Beaverhead County Pre-Disaster Mitigation Plan (PDM) is currently in the process of being updated; the last update was completed in 2009 by Beaverhead County, the City of Dillon, and the Town of Lima. The 2009 PDM rates wildfire as a high hazard priority and drought as a moderate hazard priority. Local governments with adopted PDMs are eligible to

receive funding for hazard mitigation projects from FEMA's Pre-Disaster Mitigation Grant Program. The 2009 Beaverhead County PDM is available at: http://letsmitigatemontana.com/wp-content/uploads/2013/05/BeaverheadCountyPDMPlanSept2009.pdf.

Beaverhead County Public Lands Resource Use Policy and Plan

The 2010 Beaverhead County Public Lands Resource Use Policy and Plan outlines County policies, goals, and objectives for managing public lands. The purpose of the plan is to protect the interest of the County, its customs and culture, and the health and safety of its residents as well as to communicate County interest and concerns regarding management of public lands to the appropriate agency. The plan is meant to be a guide that facilitates County efforts to provide consistent input on planning and management decisions on public lands. This plan is available at: http://www.beaverheadwatershed.org/wp- content/uploads/2015/08/Beaverhead-County-Public-Land-Resource-Use-Plan-2010.pdf.

Beaverhead County Wildfire Protection Plan

The 2005 Beaverhead County Wildfire Protection Plan (CWPP) identifies circumstances and features of the environment and human activities that impact the potential for severe wildfire in Beaverhead County. The CWPP recognizes that drought is the main influencer of wildfire hazard and assesses wildfire risk factors related to population density and distribution, travel corridors and destinations, wildfire patterns, structure ignitability, and fire protection infrastructure. The Beaverhead CWPP is available at: http://dnrc.mt.gov/divisions/forestry/docs/fire-and-aviation/wui/beaverhead_cwpp.pdf.

Dillon Interagency Dispatch Local Mobilization Guide / Dispatch Operating Plan

This 2015 plan articulates how BLM, USFS, and DNRC collaborate to respond to wildfire and other emergencies in Beaverhead County. The plan describes organizational frameworks, dispatch operations, daily duties, initial attack/response plan elements, emergency operations, local agreements, communications, and other aspects of interagency fire management. This plan is available at: http://gacc.nifc.gov/nrcc/dc/mtddc/dispatch/2015MobGuideWholeDocumentAppendixP.pdf.

Big Hole Watershed Restoration Plans

The Big Hole River has two Watershed Restoration Plans: the Upper and North Fork Big Hole Watershed Restoration Plan (2012) and the Middle and Lower Big Hole Watershed Restoration Plan (2013). Both WRPs were written by BHWC and is designed to systematically protect and restore water quality in the Big Hole Watershed. The WRP is a comprehensive assessment that identifies nonpoint source pollution, its sources, its effects, and outlines a set of strategies to measure and mitigate each pollution source. During drought, water quality impairments can be exacerbated due to increased concentration of contaminants and/or high stream temperatures. The Big Hole WRPs have proven to be an effective tool for mitigating these threats to aquatic ecosystems and water supply by implementing projects such as culvert replacement, bank stabilization, riparian revegetation, channel restoration, and stock water fencing. Creation of a WRP is one of the requirements for entities to be eligible to receive funding under Section 319 of the federal Clean Water Act, which is administered by EPA and in Montana, managed by MMDEQ. The Upper and North Fork Big Hole River WRP can be viewed online at: https://bhwc.org/wp-content/uploads/2016/06/WRP-I-Upper-Big-Hole_Final.pdf. The Middle and Lower Big Hole River WRP can be viewed online at: https://bhwc.org/wp-content/uploads/2016/06/WRP-II_Middle-Lower-Big-Hole_FINAL_8-29-2013.pdf.

Montana DNRC State Water Plan

The 2015 State Water Plan is a compilation of the vision and efforts of regional Basin Advisory Councils (BACs) established in Montana's four main river basins: Clark Fork/Kootenai, Upper Missouri, Lower Missouri, and the Yellowstone. DNRC documented the insights of 80 members of the four BACs into a plan that addresses water management issues on a statewide basis. The 2015 State Water Plan is available at: http://dnrc.mt.gov/divisions/water/management/state-water-plan.

Upper Missouri Drought Resilience Work Plan

The Upper Missouri Drought Resilience Work Plan was the final product of a series of meetings and workshops held in 2015 by the NDRP. These events were attended by stakeholders as well as representatives from watershed groups,

agencies, NGOs, and tribes. The goals of the work plan are to build community capacity for drought planning, provide drought monitoring and forecasting tools, and initiate drought mitigation projects. The Upper Missouri Drought Resilience Work Plan is available at: http://dnrc.mt.gov/divisions/water/management/docs/surface-water-studies/workplan_drought_resilience_missouri_headwaters.pdf.

BLM Dillon Resource Management Plan

The 2006 BLM Dillon Resource Management Plan is the base land use plan for public lands administered by the BLM's Dillon Field Office. The plan identifies a vision for the planning area with the following goals: sustain and, where necessary, restore the health and diversity of forest, rangeland, aquatic and riparian ecosystems; support a sustainable flow of benefits in consideration of the social and economic systems of southwest Montana; and provide diverse recreational and educational opportunities. All of these goals impact drought resilience in the Big Hole Watershed. The BLM Dillon Resource Management Plan is available at: https://eplanning.blm.gov/epl-front-office/eplanning/docset_view.do?projectId=77497andcurrentPageId=116024anddocumentId=103609.

BLM Watershed Assessments

The BLM Dillon Field Office's Watershed Assessments analyze existing resource conditions on BLM-managed public lands. BLM Watershed Assessments evaluate five standards for rangeland health: properly functioning upland and riparian areas, water quality and air quality that meet State standards, promote biodiversity. Land health standards also include recommendations for fuels conditions, invasive species, forest health, and conifer encroachment. BLM Watershed More information about the BLM's water programs is available at: https://www.blm.gov/programs/natural-resources/soil-air-water/water.

USFS Beaverhead-Deerlodge National Forest Plan

The 2009 Beaverhead-Deerlodge Forest Plan established guidance for resource management activities on National Forest lands in the Big Hole Watershed and the rest of the BDNF. The plan details goals, objectives, and standards for vegetation, wildlife habitat, aquatic resources, economic and social values, livestock grazing, wildfire management, soils, and timber management, all of which impact drought resilience in the Big Hole Watershed. The Beaverhead-Deerlodge Forest Plan is available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5052767.pdf.

National Drought Forum Report

The first National Drought Forum was held in December 2012. It convened high-ranking representatives from federal agencies and Governors' associations to discuss methods of improving government coordination to support planning and preparedness for enhancing resilience to drought. The NDRP and this DRP are direct outcomes of the National Drought Forum. The 2nd National Drought Forum was held July 30-31, 2019 in Washington D.C.; as of the time of the publication of this DRP, the full report from the 2nd National Drought Forum has not yet been released. The 2012 National Drought Forum report is available at: http://www.drought.gov/media/pgfiles/2012-droughtForumFullReport.pdf.

Section 4: Drought Monitoring

Overview

Current drought monitoring efforts in the Big Hole Watershed assess the following parameters: snow water equivalent (SWE), streamflow, and precipitation. Air temperature, stream temperature, soil moisture, and weather forecasts are also considered and used to assess current and future drought conditions. There are three commonly used drought indices that account for multiple hydrologic and climatological factors to provide broad spatial assessments of drought conditions on a weekly to monthly basis: the USDM, the Surface Water Supply Index (SWSI), and the Montana County Water Supply and Moisture Status. Drought and water supply conditions are reported by a DNRC Hydrologist at each of BHWC's monthly public meetings.

Snowpack

The NRCS Montana Snow Survey team in Bozeman maintains an automated network of high-elevation Snow Telemetry (SNOTEL) sites in and around the Big Hole Watershed. All SNOTEL and snow course sites measure snow depth and SWE.

Big Hole SNOTEL Sites
Barker Lakes
Basin Creek*
Bloody Dick*
Calvert Creek
Darkhorse Lake
Mule Creek
Saddle Mountain

Figure 8. List of SNOTEL sites with good correlation to water supply in the Big Hole Watershed. *Denotes sites that are technically outside the watershed boundaries. Available at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/.

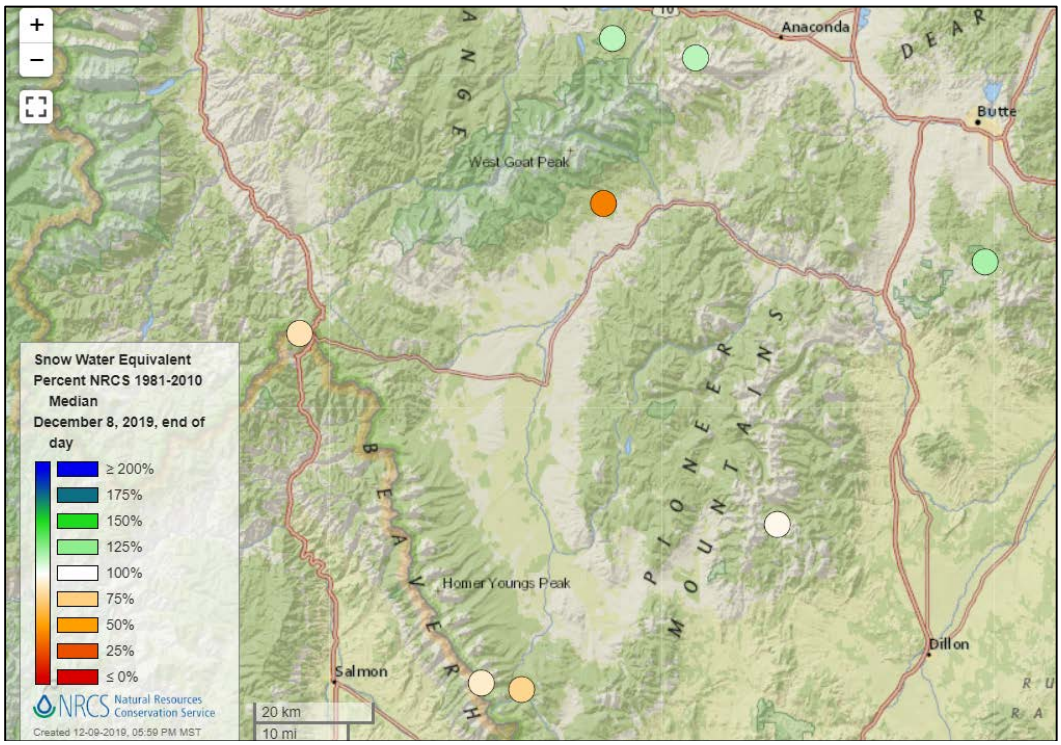


Figure 9. Map of NRCS SNOTEL (dark blue), snow course (light blue), and USGS streamflow (green) monitoring stations. Available at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/.

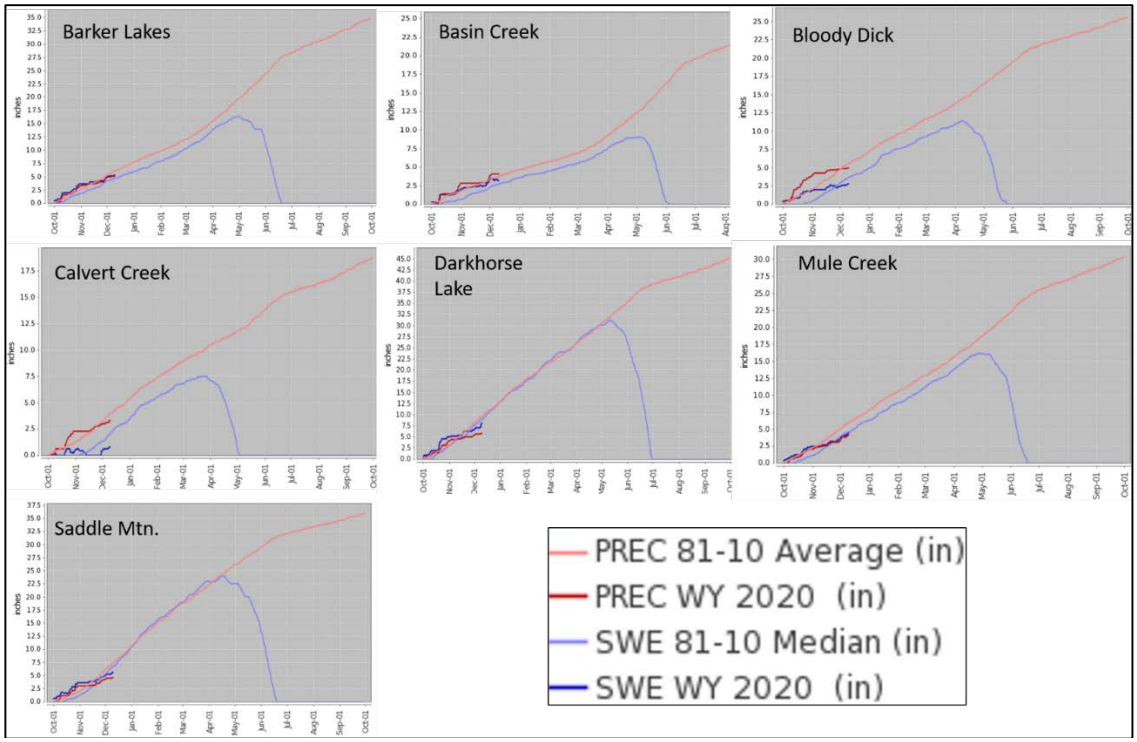


Figure 10. 1981-2010 normal monthly precipitation for high-elevation NRCS SNOTEL sites at Barker Lakes, Basin Creek, Bloody Dick, Calvert Creek, Darkhorse Lake, Mule Creek, and Saddle Mountain.

Snowpack Monitoring Needs:

1. Set up CoCoRaHS network in the Big Hole Watershed so residents can measure and report snow accumulation to develop period of record data.

Streamflow

USGS is the primary source for streamflow information in the Big Hole Watershed. The USGS hydrologic unit code (HUC) for the Big Hole Watershed is 10020004. There are ten USGS stream gaging stations along the Big Hole River that measure gage height and discharge as well as one at the mouth of the Wise River, a major tributary to the Big Hole River.

Gage Number	Hosting Agency	Official Gage Name
06023500	USGS	Big Hole River near Jackson
06023800	USGS	Big Hole River above Spring Creek near Jackson, MT
06024020	USGS	Big Hole River at Miner Creek near Jackson, MT
06024450	USGS	Big Hole River below Big Lake Creek near Wisdom, MT
06024540	USGS	Big Hole River below Mudd Creek near Wisdom, MT
06024580	USGS	Big Hole River near Wise River, MT
41D 07900	DNRC	Wise River near mouth
06025250	USGS	Big Hole River at Maiden Rock near Divide, MT
06025500	USGS	Big Hole River near Melrose, MT
06026210	USGS	Big Hole River near Glen, MT
06026420	USGS	Big Hole River below Hamilton Ditch near Twin Bridges

Figure 11. USGS and DNRC gaging stations on the Big Hole River.
Available at: http://waterdata.usgs.gov/mt/nwis/current/?type=flowandgroup_key=basin_cd.

BOR maintains two Hydromet stream gages in the Big Hole Watershed. Gages are at Maiden Rock and Calvert Creek. BOR Hydromet data is available at: http://www.usbr.gov/gp/hydromet/sites_mt.htm.

DNRC plans to expand its state supported network of stream gaging stations in the coming years. Currently there is one DNRC gaging stations in the Big Hole Watershed near the mouth of the Wise River.

Streamflow Monitoring Needs:

1. Identify long-term solutions to stream gage funding needs (in process with Montana Stream Gage Working Group).
2. Secure donations to cover BHWC portion of Big Hole River stream gage fees.

Precipitation

Multiple automated data networks currently monitor precipitation and air temperature in the Big Hole Watershed, including the NRCS SNOTEL sites listed above; the NOAA Global Historical Climatology Network (GHCN) stations at Wisdom, Wise River, Divide, and Twin Bridges; and the BLM and USFS Remote Automatic Weather Stations (RAWS) stations at Steele Creek and Wise River.

Precipitation Monitoring Needs:

1. Secure funding to implement CoCoRaHS volunteers network in the Big Hole Watershed.
2. Integrate CoCoRaHS data with other monitoring and decision making processes.
3. Identify other precipitation monitoring networks and tools.

Groundwater

MBMG's Groundwater Information Center (GWIC) lists several online groundwater monitoring resources that are available at: http://mbmggwic.mtech.edu/. These include:

- Statewide maps of groundwater monitoring well locations
- Groundwater well hydrographs
- Drought reports about the relationships between groundwater levels and climate variability
- County-wide groundwater well statistics

The *Lower Wise River Water Resources Investigation*, published 2013, inventoried baseline conditions of surface water, groundwater, surface water/groundwater interactions, water temperature, and fisheries. The Wise River is the largest tributary to the Big Hole River. "Overall groundwater hydrographs of the 14 wells sampled show similar patterns, where elevations peak near July with spring runoff and the start of irrigation, and then declined through the rest of the summer, increased again in fall with the onset of fall irrigation, then declined again into the late fall/early winter when they reached base level. Any alterations in this pattern are likely due to local effects such as well pumping or withdrawal in proximity, local groundwater recharge, etc. Annual fluctuation is between 7 and 32 feet." (Downing 2013).

Groundwater Monitoring Needs:

1. Identify opportunities to monitor groundwater and explore the possibility of implementing groundwater targets into management plans.
2. Improve understanding of how ecological conditions and irrigation practices impact groundwater to make the case that ecological restoration and management practices can increase natural water storage.

Air Temperature

Several automated data networks exist to monitor and record air temperature. These include NRCS SNOTEL sites listed above; the NOAA GHCN stations at Wisdom, Wise River, Divide, and Twin Bridges; and the BLM and USFS RAWS network sites at Steele Creek and Wise River. Much of this data is available at: http://www.wrh.noaa.gov/map/?obs=trueandwfo=tfxandbasemap=OpenStreetMapandboundaries=true,falseandobs_popup=true.

Evapotranspiration

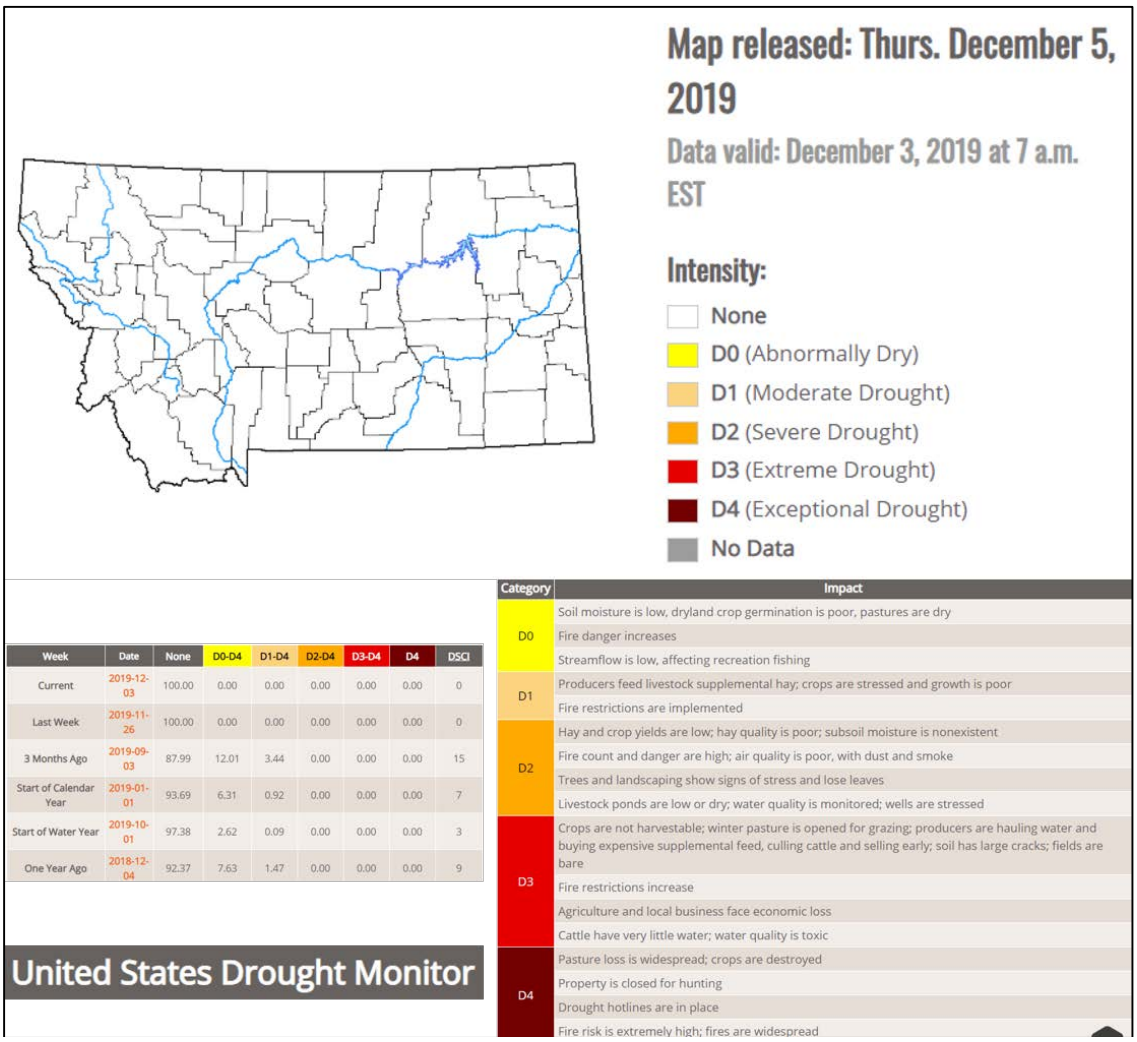
There are no evapotranspiration monitoring networks, such as AgriMet stations, in the Big Hole Watershed.

Evapotranspiration Monitoring Needs:

1. Inform livestock producers about the AgriMet station in Dillon and how to use it to inform management decisions.
2. BOR install AgriMet station in Big Hole Watershed.

Drought Indices

Drought indices used to predict climatological and water supply conditions in the Big Hole Watershed include the USDM, the SWSI, and the Montana County Water Supply and Moisture Status. Other indices include the Palmer Drought Severity Index (PDSI) and NASA's Gravity Recovery and Climate Experiment (GRACE) soil moisture data. Snowpack, streamflow, precipitation, and air temperature data are widely used as straightforward drought severity indicators by comparing current or seasonal conditions with average conditions for a given period of time.



Week	Date	None	D0-D4	D1-D4	D2-D4	D3-D4	D4	DSCI
Current	2019-12-03	100.00	0.00	0.00	0.00	0.00	0.00	0
Last Week	2019-11-26	100.00	0.00	0.00	0.00	0.00	0.00	0
3 Months Ago	2019-09-03	87.99	12.01	3.44	0.00	0.00	0.00	15
Start of Calendar Year	2019-01-01	93.69	6.31	0.92	0.00	0.00	0.00	7
Start of Water Year	2019-10-01	97.38	2.62	0.09	0.00	0.00	0.00	3
One Year Ago	2018-12-04	92.37	7.63	1.47	0.00	0.00	0.00	9

Category	Impact
D0	Soil moisture is low, dryland crop germination is poor, pastures are dry
	Fire danger increases
	Streamflow is low, affecting recreation fishing
D1	Producers feed livestock supplemental hay; crops are stressed and growth is poor
	Fire restrictions are implemented
D2	Hay and crop yields are low; hay quality is poor; subsoil moisture is nonexistent
	Fire count and danger are high; air quality is poor, with dust and smoke
	Trees and landscaping show signs of stress and lose leaves
	Livestock ponds are low or dry; water quality is monitored; wells are stressed
D3	Crops are not harvestable; winter pasture is opened for grazing; producers are hauling water and buying expensive supplemental feed, culling cattle and selling early; soil has large cracks; fields are bare
	Fire restrictions increase
	Agriculture and local business face economic loss
	Cattle have very little water; water quality is toxic
D4	Pasture loss is widespread; crops are destroyed
	Property is closed for hunting
	Drought hotlines are in place
	Fire risk is extremely high; fires are widespread

Figure 12-14. U.S. Drought Monitor map of Montana produced weekly by the National Drought Mitigation Center. Available at: http://droughtmonitor.unl.edu/.

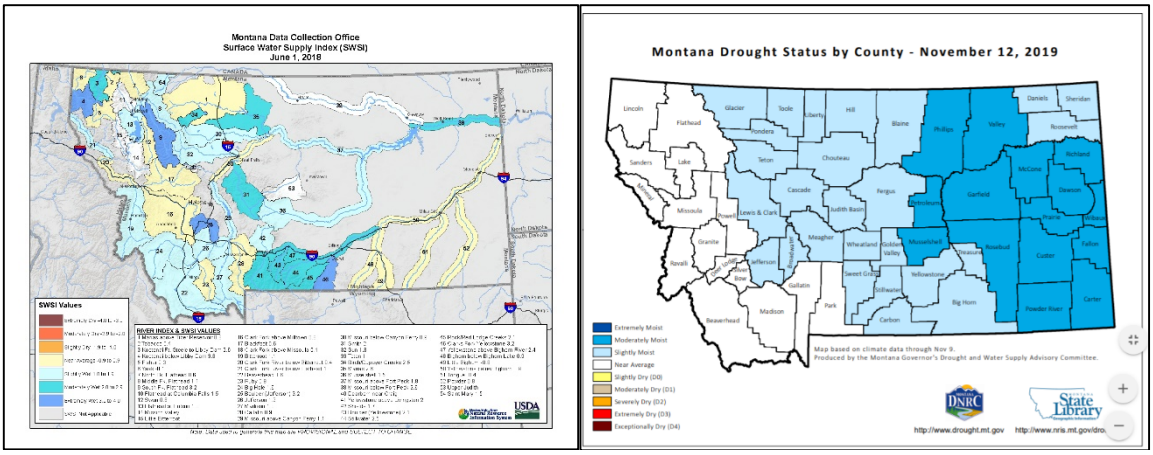


Figure 15-16. Left: The Montana County Water Supply and Moisture Status map. Available at: https://mslservices.mt.gov/geographic_information/maps/drought/. Right: The Montana Surface Water Supply Index map. Available at: https://mslservices.mt.gov/Geographic_Information/Maps/WaterSupply/Statewide/StatewideSWSI.aspx.

Wildfire Risk

The Northern Rockies Coordination Center in Missoula, MT, provides monthly basin-scale wildfire risk indices including dead fuel moisture, Energy Release Component, and Burning Index. The National Interagency Fire Center (NIFC) in Boise, Idaho, publishes monthly and seasonally-significant wildfire potential outlooks.

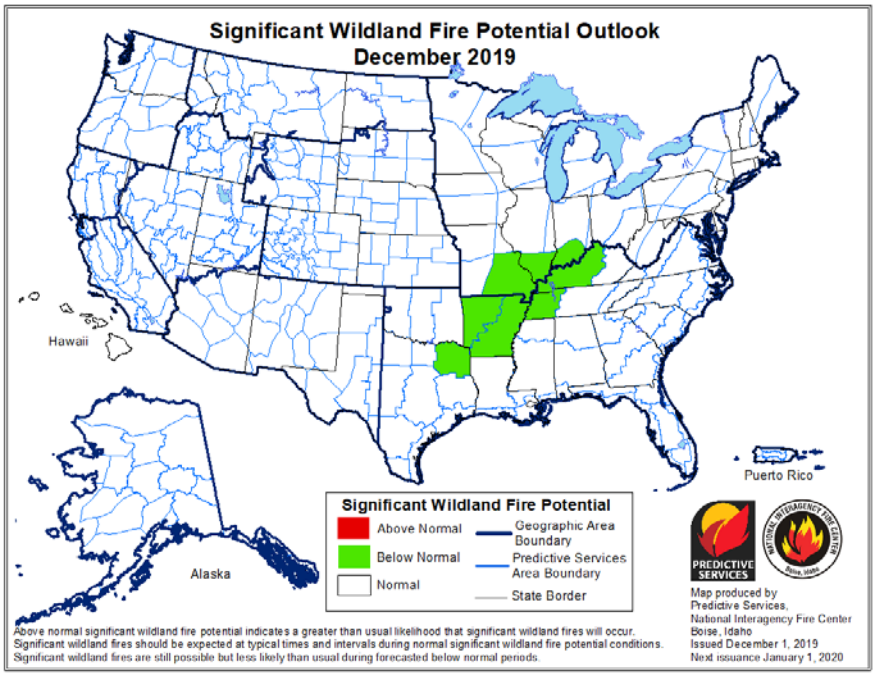


Figure 17. Significant Wildland Fire Potential Outlook Map. Available at: https://www.predictiveservices.nifc.gov/outlooks/monthly_seasonal_outlook.pdf.

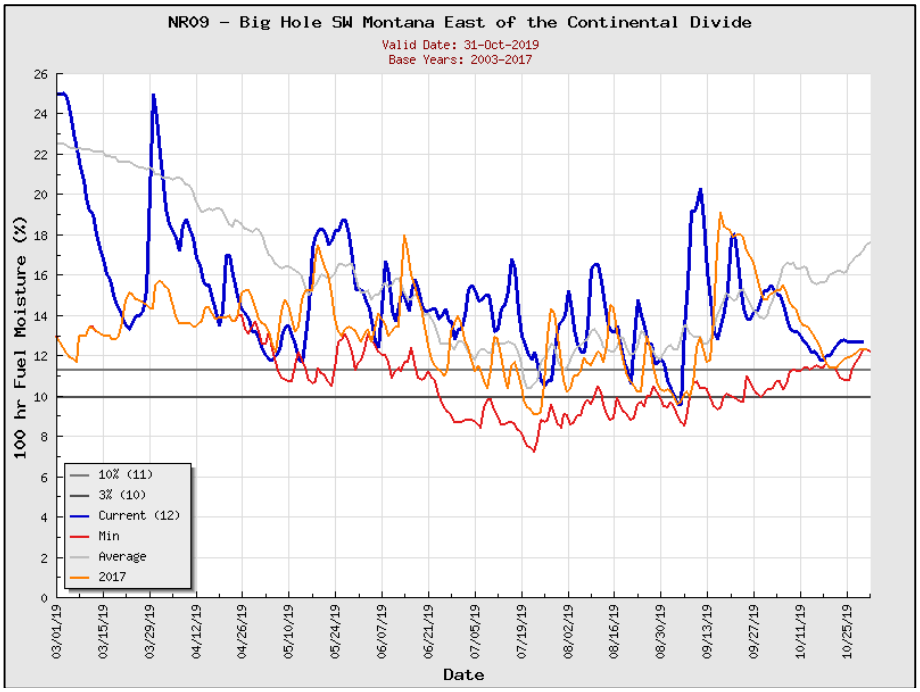


Figure 18. 100 hour fuels in the Upper Missouri Basin. Available at: https://www.wfas.net/plot/plot_sig3.php?SIG=NR09andINDEX=FM100andBEGINDATE=3/1andENDDATE=10/31.

Fuel Moisture Index/Dead Fuel Moisture: A tool that measures the amount of water in a vegetative fuel that is available to wildfire. Dead fuel moisture is expressed as a percent of the dry weight of the fuel being measured.

Energy Release Component (ERC): A measurement of the estimated potential available energy released per unit area in the flaming zone of a fire. Variations in the ERC are caused by changes in the moisture contents of the various fuel classes ERC is expressed in BTU's per square foot.

Burning Index (BI): A measurement of fire intensity that relates to the contribution of fire behavior to the effort of containing a fire. BI is generally ten times the flame length of a fire.

More information about wildfire risk management terms and indices is available at: http://gacc.nifc.gov/rmcc/predictive/fuels_fire-danger/drgloss.htm.

Drought Impacts

Ecological and socioeconomic impacts of drought are generally not reported by established monitoring systems like climatological and hydrologic impacts are, but monitoring these impacts is vital to our understanding of how drought affects our landscapes and communities. Changes in temperature and water supply have direct and indirect impacts on livestock production, the fishing outfitting and guiding industry, fish and wildlife, and many other factors that affect our watershed.

The NDMC's Drought Impact Reporter is an online tool that records and tracks various types of socioeconomic and environmental drought impacts. Anyone can use the Drought Impact Reporter to record ways in which they have been personally or professionally impacted by drought conditions, and the impacts reported will comprise an important repository of drought impact information to be used for future assessment and planning purposes.

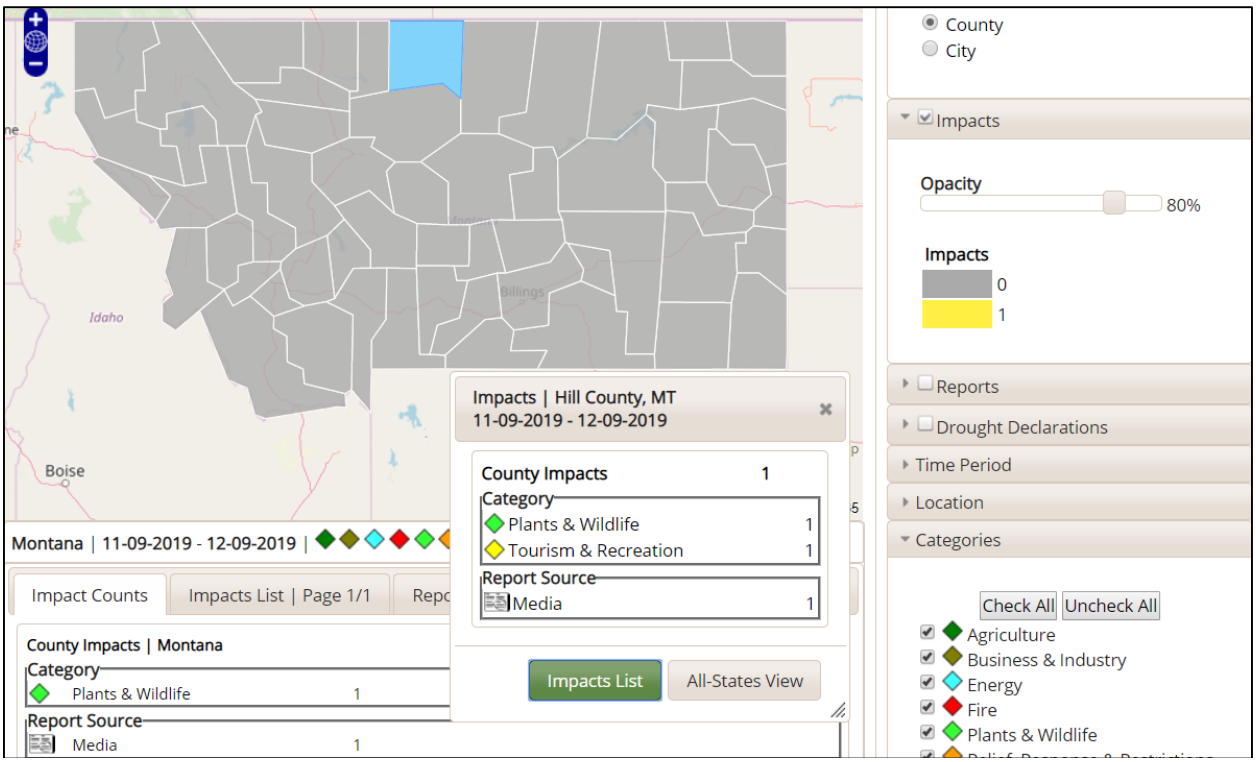


Figure 19. NDMC's Drought Impact Reporter website. Available at: http://droughtreporter.unl.edu/.

Drought Impact Monitoring Needs:

1. The Drought Impact Reporter needs to be promoted and used to produce documentation of qualitative drought impacts. Impacts should be shared along with water supply information by agencies and NGOs to increase knowledge and understanding of drought impacts.

Forecasting and Planning

There are several different hydrologic, climatological, and weather forecasting and planning services available to interested entities, including NRCS Snow Survey forecasts, the National Weather Service predictions; the Climate Prediction Center (CPC); and ENSO outlooks.

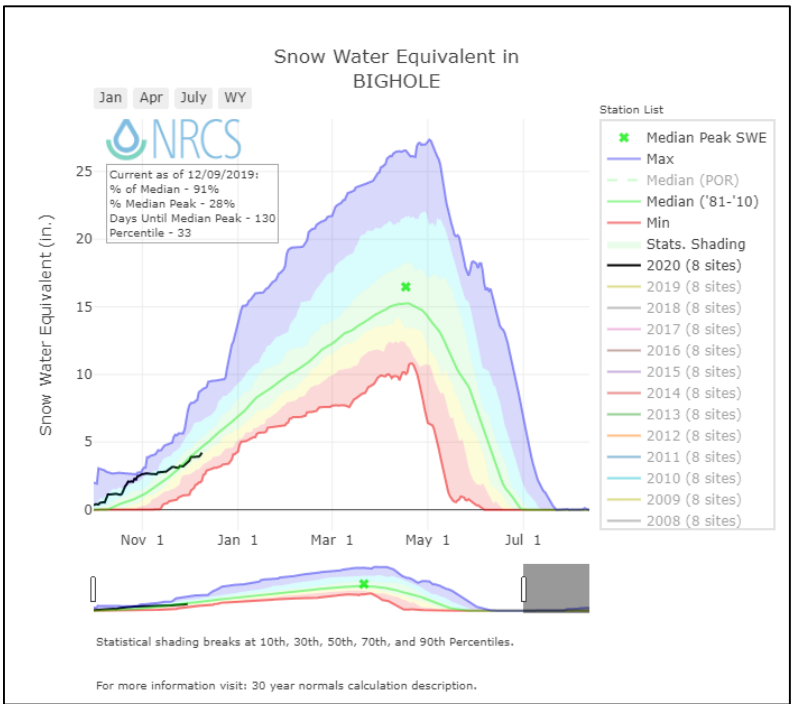


Figure 20. December 2019 NRCS snowpack projections for the Big Hole River Sub-Basin. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/mt/snow/products/4346275a-e3bf-4375-a766-759b7858b06c/.

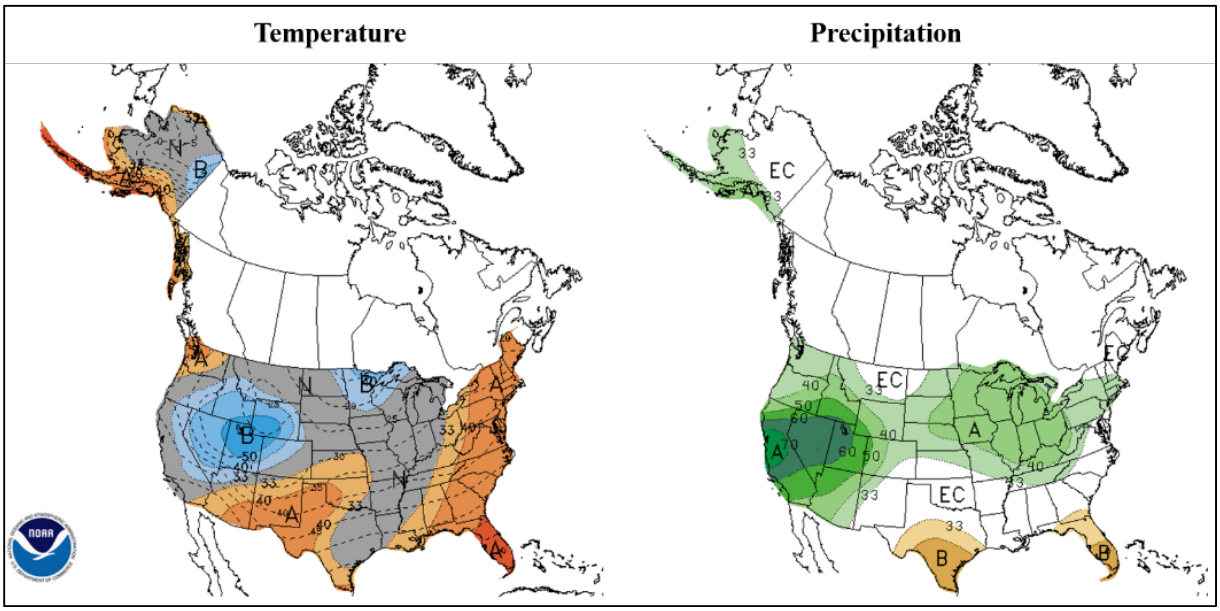


Figure 21. Temperature and precipitation trends for the period of record, current as of December 9, 21019. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/mt/snow/products/4346275a-e3bf-4375-a766-759b7858b06c/.

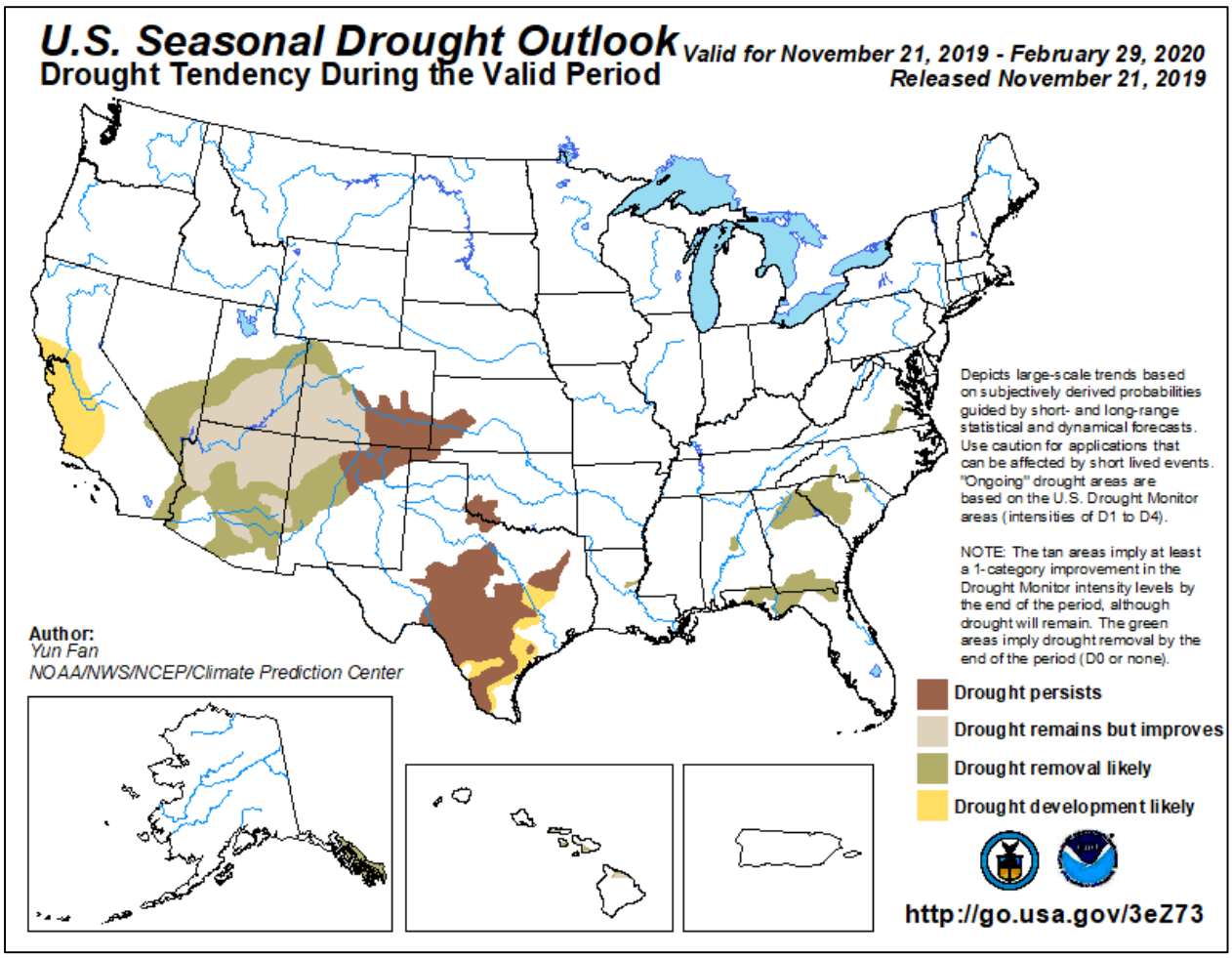


Figure 22. U.S. seasonal drought outlook map produced by CPC. Available at: http://www.cpc.ncep.noaa.gov/index.php.

Forecasting and Planning Needs:

1. More climate information should be available at the watershed scale, rather than state or county designations only.
2. MWCC's Water Monitoring page should be updated to make it easier to access forecasting tools; currently, it has a search filter that makes it difficult to see all the resources that are available for climate forecasting and drought planning.

Section 5: Vulnerability Assessment

Overview

The first step to planning for drought is to identify vulnerabilities to drought in the considered planning area. Identifying and prioritizing the economic and environmental vulnerabilities to drought in the Big Hole Watershed as expressed by local stakeholders and agencies has helped BHWC determine mitigation and response actions, which are outlined in Sections 6 and 7 of this plan. The primary purpose of this DRP is to formally articulate Big Hole watershed drought vulnerabilities and support local efforts to access public and private resources and expertise in order to implement projects that will build our watershed's resilience to drought.

Drought Vulnerabilities as Identified by Local Stakeholders and Agency Advisors

1. ***Lower Big Hole River Irrigation Infrastructure***
   In 2008, BHWC published a document titled, *Lower Big Hole River Irrigation Infrastructure Survey and Prioritization* that identified several irrigation structures that needed repairs or replacement. While some of these have been addressed, many of these projects still need to be completed as faulty headgates and inaccurate or absent measurement devices prevent effective water conservation efforts by lower Big Hole Watershed irrigators.

2. ***Big Hole River Section V DMP Triggers***
   DMP triggers in Big Hole River Sections I-IV are based on the river's wetted perimeter and upper and lower inflection points for those sections. Section V (Notch Bottom to Big Hole River mouth) drought triggers were chosen arbitrarily and are not based on that section's lower inflection point. Section V has not seen as much participation in conservation efforts as the other four river sections; likewise, Section V has not received the attention that upper sections have due to the presence of Arctic grayling. The Big Hole River Drought Subcommittee identified Section V as an opportunity to improve water conservation efforts and involve additional river stakeholders in our drought planning process.

3. ***Wise River Flows***
   In 2018, the Big Hole River Drought Subcommittee identified Wise River as a major tributary of the Big Hole River that is particularly vulnerable to drought. Each year, Wise River streamflows decrease dramatically in late summer. We know this is partially because of the geology of the Wise River floodplain – much of the water from Wise River seeps into the ground above the mouth and returns to the Big Hole River downstream. However, we think there may be some ways to improve flows in Wise River to benefit the Wise River, the Big Hole River, and the fishery.

4. ***Ditches Transport Water to Beaverhead River***
   There are multiple ditches in the lower Big Hole Watershed that remove water from the Big Hole River and return it to the Beaverhead River. The landowners have water rights to divert this water and are using it to create private fisheries, but the removal of water from the Big Hole River system is of concern to the Big Hole River Drought Subcommittee.

5. ***Long-term Stream Gage Funding and Coordination***
   Stream gages are used by irrigators, anglers, outfitters and guides, and conservation groups. They help us keep tabs on river flows and temperatures to ensure that conditions stay suitable for the fishery and for the multiple uses that depend on the river continuing to flow. They also inform management decisions, such as when to irrigate and where to fish. In 2018, MFWP made statewide cuts to their $180,000 annual payment to support USGS gages. A big portion of this ($26,000) applied to the Big Hole River's gages. The annual fee for the 10 Big Hole River USGS gages is just over $60,000/year, split between BHWC, USGS, DNRC, MFWP, and BLM. As agency budgets becomes more restrictive and stream gage funding is cut, it is vitally important to identify long-term solutions to the stream gage funding issue.

6. ***Vulnerabilities Described in Other Plans***
   Several of the planning documents listed in Section 3 describe drought-related vulnerabilities and water supply disruption threats. This DRP recognizes these vulnerabilities and supports the proposed remedies described in those plans.
   - **Wildfire:** Several plans describe wildfire vulnerability factors which are closely related to drought. These plans include the BLM Dillon Resource Management Plan, the BLM Watershed Assessments, the Beaverhead- Deerlodge Forest Plan, the Beaverhead CWPP, and the Beaverhead County PDM. Resource concerns identified in these plans that increase wildfire vulnerability in the Big Hole Watershed include: forest stand density, pine beetles and other insects, conifer encroachment on rangeland and riparian areas, and invasive weeds. Wildfire can cause impacts to public and private structures, irrigation infrastructure, forest water yield and quality, forage production and livestock grazing, and wildlife and fisheries.

Section 6: Mitigation Actions

Overview

This section outlines proactive mitigation actions that can be taken to reduce the impacts of drought. The primary purpose of this plan, along with identifying drought vulnerabilities, is to describe proposed and existing strategies, actions, and programs to build our watershed's resilience to drought. The proposed mitigation actions can be linked to the vulnerabilities laid out in Section 5 of this plan.

Proposed Mitigation Actions

1. ***Develop and Implement Big Hole Forestry Cooperative***
   The BHWC is in the process of developing a Big Hole Forestry Cooperative. The cooperative will be designed and managed in a similar fashion to the Big Hole River Incentive Program but will focus on restoring forest and rangeland health by reducing conifer encroachment into grasslands, restoring aspen stands, and thinning on the private/public interface. The cooperative will begin its work in the hardest-hit areas of the Eastern Pioneers, the Western Highlands, and the McCartney Mountain region.

2. ***Update Irrigation Infrastructure Prioritization and Complete Remaining Projects***
   In 2008, BHWC published a document titled, Lower Big Hole River Irrigation Infrastructure Survey and Prioritization. Several irrigation structures that needed updates were identified in the document and some of those structures have since been updated or repaired. BHWC is now working on summarizing and updating that report and following up on opportunities to improve irrigation infrastructure.

3. ***Update Big Hole Watershed Restoration Plans***
   The Big Hole WRPs are due for an update with focus on expanding natural water storage opportunities in our watershed. Prioritization of water storage projects will prepare BHWC to manage CWA funding and support coordination opportunities with other entities seeking similar outcomes.

4. ***Support Proposed Mitigation Actions from Other Plans***
   Proposed mitigation actions are described in several land management plans, including the USFS Beaverhead-Deerlodge Forest Plan, BLM's Watershed Assessments and Land Health Evaluations, the Upper Big Hole CCAA program, Beaverhead County PDM, the Beaverhead CWPP, and MFWP's Statewide Fisheries Management Plan. These plans propose mitigation efforts related to wildfire, including livestock grazing, invasive weeds management, commercial timber harvest, prescribed fire, and mechanical thinning treatments.

Existing Mitigation Actions

1. ***Stream and Floodplain Restoration***
   DNRC's Montana State Water Plan identifies the need to explore the use of natural water storage and retention to benefit water supplies and ecosystems. Currently, there are many headwaters streams in southwest Montana that have experienced significant losses of riparian vegetation and channel down-cutting over the last century. As a result, many of these streams are cutoff from their historical floodplains. BHWC has invested significant resources into restoring streams and reconnecting them to their floodplains. Stream and floodplain restoration work recently completed by BHWC includes:

   a) *California Creek Restoration*: Aerial emissions from early 20th century smelting activities in Anaconda, together with extensive logging activities to fuel the smelters, have left areas in the Mt. Haggin Uplands of the Anaconda National Priorities List site in a highly degraded state. Some soils in the Mt. Haggin uplands are highly erodible volcanic tuff material, which, due to mining and logging impacts, have eroded off the mountain over time and formed large gullies that transport upland sediments directly into nearby

California Creek, and its main northern tributary, the North Fork of California Creek. That sediment travels downstream into French Creek, Deep Creek, and the Big Hole River in what local residents have observed as a white plume in the Big Hole River that is visible for several miles downstream. This complex project seeks to address sediment pathways from source to stream, enhancing the ability of the landscape to both retain sediment on slopes as well as deposit excess sediment on the floodplain. The entire project area was assessed and priority areas were selected for both upland and riparian area treatment. Completed 2017.

b) *French Gulch and Moose Creek Restoration*: Extensive placer mining in the French Gulch drainage beginning in the 1860's left over 3 miles of French Gulch in the upper Big Hole Watershed in a highly degraded state. The stream was straightened, disconnected from its floodplain, and provided minimal fish or wildlife habitat. This project's objective was to remove placer tailings from the floodplain, re-establish natural stream meanders, and reconnect floodplain and wetlands to reduce sedimentation in French Creek. The project took multiple years of planning by the BHWC and partners, who pulled together 7 different funding sources. Completed 2017. Accomplishments:

- Over 17 acres of floodplain/wetlands created
- Over 30,000 cubic yards (810,000 cubic feet) of mine tailings removed from floodplain
- A new stream channel length over 7,400 feet with pools, woody debris habitat, and bioengineered willow lifts. That's 1800 more feet compared to before!
- 3,215 linear feet of past channel now converted to new wetlands
- 48 fish habitat structures installed
- More than 1,000 feet of road reconstructed
- Increased sinuosity over 30%
- Over 200 pounds of wetland seed broadcast
- Over 2,200 riparian container plants installed
- 30,000 willow stakes and whips planted

Figure 23. French Gulch restoration, 2017.

c) *Lower French Creek Restoration*: This project addressed mining-related impacts, which left the old channel pinned against a high, eroding bank by a man-made dike feature. These human-caused alterations have caused 800+ tons of sediment per year to break away from the bank and fall into the stream, affecting downstream fish and mussel habitat. To fix the problem, we are constructing approximately 4,000 lineal feet of new stream channel east of the current channel through an area of healthy riparian vegetation. This was a much larger project, both in volume and length, than our previous stream restoration projects. Each meander, pool, riffle, bank, and floodplain are highly engineered to ensure a structurally stable stream, while also enhancing wildlife habitat. The project incorporated other water storage techniques as well, including depressional wetlands and floodplain micro-topography. Completed 2019.

d) *Oregon Creek Restoration*: The lower reach of Oregon Creek was impacted by historic gold and silver mining in the late 1800's, leaving it pinned against large placer piles (river cobbles and sediment dug out from the channel bed and stacked next to the stream). These piles of rock confined the channel to a straight, incised, and fast-moving stream. The stream was unable to overtop its banks and spread out onto its adjacent floodplain during the spring runoff or high flow events. Due to the disconnection between the stream and its floodplain, the ability for the stream to store clean, cold water was lost. The mining impacts also left impaired fish and wildlife habitat. This project fixed all of Oregon Creek's alignments in the lower reach, allowing the stream to access its floodplain and naturally store water for the first time in over 150 years. Approximately 1,400 linear feet of new stream channel and 4 acres of new floodplain were constructed in addition to the installation of 8 machine-made, off-stream beaver dams. These manmade beaver dams, or "detention ridges", span the floodplains length, functioning to catch sediment, and slow and store water. They will also enhance the habitat for amphibians, insects, song birds, and more. A slew of other treatments was built into the project to enhance the stream's function and habitat such as dug-out pools, bank stabilizing structures, riffle crests, and willow trenches. Completed 2019.

e) *Big Hole River Incentive Program*: A total of 8 projects were executed through the Big Hole River Incentive Program to improve private properties along the lower Big Hole River. Our river corridor is predominantly private land, so incentivizing landowners to do these types of projects has direct conservation outcomes. The Big Hole is the first watershed in Montana to pursue this incentives payment concept. Main projects have included: repairing, maintaining, and installing fencing around riparian areas; reducing conifer encroachment in riparian areas; bank stabilization projects to reduce sedimentation; and riparian plantings to promote vegetation establishment. Completed 2019.

2. ***Floodplain Mapping***

The Big Hole River Approximate Zone A (also referred to as the "100-year floodplain" or "1% flood probability") were completed spring 2013. The mapping covered 116 miles of Big Hole River from headwaters to mouth, except the portion within Silver Bow County which had been mapped previously. Floodplain mapping provides legally defensible products with which counties can regulate development within the floodplain. Appropriate river floodplain development is critical to protect property, ensure health and safety of the public and responders during floods, maintain the long-term sustainability and health of our river floodplain, and provide protections for water quality, river side vegetation, and more. The BHWC Land Use Planning Committee has led the effort to map the Big Hole River floodplain beginning in 2009. Floodplain maps were created by DTM Consulting and Applied Geomorphology.

3. ***Wildfire Mitigation***

There are several entities responsible for mitigating wildfire risk in the Big Hole Watershed, most notably USFS, BLM, NRCS, and DNRC. Mitigation efforts include prescribed burning, mechanical treatments such as forest thinning, commercial timber harvest, and livestock grazing. More information about wildfire mitigation activities in the Big Hole Watershed can be found in the Beaverhead CWPP, the Beaverhead County PDM, the Beaverhead-Deerlodge Forest Plan, the BLM Watershed Assessments, and the BLM's Resource Management Plans.

4. ***Upper Big Hole Arctic Grayling Candidate Conservation Agreement with Assurances***

In 2009, MFWP joined forces with USFWS, DNRC, and NRCS to create the Upper Big Hole Arctic Grayling Candidate Conservation Agreement with Assurances (CCAA) program. The CCAA introduced a strategic plan for recovering the Big Hole River Arctic grayling as well as providing legal protections for landowners who enroll and participate in the CCAA. Each landowner enrolled in the CCAA program signs on to a site-specific plan for their property developed by MFWP and the landowner that needs to be followed in order to receive legal protection. Plans are extensive and typically include a task list for riparian management plans, riparian and vegetation recovery, weed treatment, irrigation improvement, fish passage, and flow maintenance plans. Each landowner plan is monitored and results are reported annually.

5. ***Participate in identifying long-term funding solutions with Montana Stream Gage Working Group***

Jennifer Downing, previous Executive Director of BHWC, spearheaded an effort to influence the Water Policy

Interim Committee to introduce a stream gage bill to the 2019 Legislature. The resulting bill is called SB32: "An act creating stream gage oversight work group." Since taking over the Executive Director role in 2019, Pedro Marques has continued to worked on the stream gage issue by testifying before the Water Policy Interim Committee and participating with the stream gage working group in developing long-term solutions to stream gage funding issues.

Section 7: Response Actions

Overview

This section outlines proposed and existing drought response actions in the Big Hole Watershed. Response actions are reactionary methods of management that are necessary during times of drought, compared to mitigation efforts which are ways of preparing for possible or future droughts. The proposed response actions in this section are based on the drought vulnerabilities described in Section 5. Existing response actions include the Big Hole River Drought Management Plan, circa 1997.

Proposed Response Actions

1. ***Adjust Big Hole River Drought Management Plan Section V Flow Triggers***
   The Big Hole River Drought Subcommittee proposes to update Section V triggers to make them consistent with triggers in the other four river sections. All of the other river sections' triggers are based on the wetted perimeter, but Section V triggers were chosen arbitrarily. At Jim Olsen's suggestion, the proposed Section V triggers would match Section III triggers; each trigger in Section V would be increased by 50 cfs.

2. ***Add Wise River Section to DMP***
   Wise River is the largest tributary to the Big Hole River. Each summer, it experiences low flows exacerbated by irrigation. Wise River already has a Realtime streamflow gage that was installed in 2015 by the DNRC. BHWC has been monitoring Wise River streamflows, has worked with MFWP to designate a minimum flow target for Wise River (20cfs), and has been working with Wise River irrigators and the DNRC to gain information regarding Wise River's hydrology, irrigation practices, flow trends, and more. The groundwork is laid to add Wise River as a DMP section.

Existing Response Actions

1. ***Big Hole River Drought Management Plan***
   The Big Hole River DMP was created in 1997 by BHWC and many technical advisors and partners. The plan was developed in order to coordinate working together voluntarily to address extreme low flows during drought years. It is implemented in partnership between BHWC, DNRC, and MFWP. The DMP is reviewed and updated annually by a team of conservation groups, irrigators, sportsman, and agency personnel as well as BHWC. It is supported by a network of USGS measurement stations on the Big Hole River.

   The DMP coordinates conservation during periods of drought to protect the fishery. The plan sets flow and water temperature targets on the mainstem Big Hole River, which is divided into five river sections. In a drought year, the plan begins with voluntary conservation participation by river users, particularly fishing and irrigation. The model promotes working together to protect the fishery voluntarily in order to prevent stress on fish during drought. When conditions worsen beyond voluntary conservation targets, state-managed fishing restrictions are put in place and enforced by MFWP. Fishing restrictions may be in place due to high water temperature, low flows, or both. Thresholds and re-opening criteria for each river section to lift fishing restrictions are set in the Big Hole River DMP.

SECTION	FLOW TRIGGERS APRIL 1 - OCTOBER 31	TEMPERATURE TRIGGERS
I: Saginaw Bridge on Skinner Meadows Road to North Fork Big Hole River Mouth	160 cfs - April 1 to June 30 target for Arctic grayling spawning. 60 cfs – Prepare for Conservation 40 cfs - Conservation 20 cfs - MFWP River Closure *Measured at USGS Wisdom Gage (06024450)*	**Step 1:** **MFWP Hoot-Owl Fishing Restrictions:** Hoot-owl fishing restriction will be in place when daily maximum water temperature reaches or exceeds 73° F (23° C) for at least some period of time during three consecutive days. Hoot-owl fishing closure prohibits fishing between the hours of 2:00 p.m. and 12:00 a.m. (Midnight). They will remain in place until September 15 or until re-opening criteria are met.
II: North Fork of Big Hole River confluence to Dickie Bridge	450 cfs - April 1 to June 30 target for Arctic grayling spawning. 170 cfs – Prepare for Conservation 140 cfs - Conservation 100 cfs - MFWP River Closure *Measured at USGS Big Hole River near Wise River Gage (06024580)*	**Step 2:** **MFWP River Closure Due to High Temperatures:** River closure based on water temperature may be implemented if hoot-owl restrictions are inadequate to protect the fishery (e.g., prolonged period where water temperatures exceed 73° F and forecasts are not favorable for cooler temperature, thermal stress in fish observed by biologist, etc.). Closure will remain in place until September 15 or until re-opening criteria are met.
III: Dickie Bridge to MFWP Maiden Rock Fishing Access Site	250 cfs – Prepare for Conservation 200 cfs - Conservation 150 cfs - MFWP River Closure *Measured at USGS Maiden Rock Gage (06025250)*	*Sections temperature measured at*: I: USGS Wisdom Gage II: USGS BHR near Wise River III: USGS Maiden Rock IV: USGS Glen Gage V: USGS Hamilton Ditch Gage
IV: MFWP Maiden Rock to Notch Bottom Fishing Access Sites	290 cfs – Prepare for Conservation 240 cfs - Conservation 190 cfs - MFWP River Closure *Measured at USGS Glen Gage (06026210)*	MFWP Statewide River Restrictions and Closures Contact: Big Hole Watershed Committee Bhwc.org info@bhwc.org 406-960-4855
V: Notch Bottom FAS to confluence of Big Hole River with Jefferson River	200 cfs – Prepare for Conservation 150 cfs - Conservation 100 cfs - MFWP River Closure *Measured at USGS Big Hole River below Hamilton Ditch near Twin Bridges Gage (06026420)*	

Figure 24. Big Hole River Drought Management Plan "Quick Reference". Available at: https://bhwc.org/wp-content/uploads/BHWC-DMP-2019-Quick-Reference_FINAL.pdf.

Angling Restrictions

Angling restrictions are designated by the Big Hole River DMP and enforced by MFWP. Angling restrictions include two steps:

1. MFWP Hoot-Owl Fishing Restrictions: Hoot-owl fishing restriction are put in when daily maximum water temperature reaches or exceeds 73° F (23° C) for at least some period of time during three consecutive days. Hoot-owl fishing closure prohibits fishing between the hours of 2:00 p.m. and 12:00 a.m. (Midnight), the hottest part of the day.
2. MFWP River Closure: Full river closures may be implemented based on high water temperature or low flow. Flow closure triggers are listed by section in the Big Hole River DMP. River sections are closed due to temperature when hoot-owl restrictions are inadequate to protect the fishery (e.g., prolonged period where water temperatures exceed 73° F and forecasts are not favorable for cooler temperature, thermal stress in fish observed by biologist, etc.).

Reopening criteria: Sections are reopened when minimum flow triggers are exceeded for 7 consecutive days and

water temperatures are less than 70° F for 3 consecutive days. If still in place, restrictions based on temperature are lifted September 15 and restrictions based on flow are lifted October 31.

3. ***Montana Fish, Wildlife and Parks Statewide Drought Closure Policy***

MFWP has a statewide river closure policy. MFWP mandates that river closures follow the local drought plan or, when absent, the Montana Statewide Drought Closure Policy. The MFWP Statewide Drought Policy contains triggers for the Big Hole River in three sections; however, the Big Hole River Drought Management Plan supersedes the Montana Statewide Drought Policy. Decisions on MFWP river closures and reopening follow the following process:

1. River closure or restriction recommendations from the MFWP District Biologists;
2. Recommendations reviewed by the Regional Fish Manager, Fish Bureau Chief, Regional Supervisor, and State Drought Commission. Final determination is made by MFWP Director; and
3. River closures or restrictions due to high water temperature are automatically lifted September 15. River closures or restrictions due to low streamflow are automatically lifted October 31. The river may re-open when these dates are reached or when flows and temperatures meet the re-open criteria (whichever comes first).

3. ***Wildfire Response***

Local wildfire response in the Big Hole Watershed is coordinated from USFS's Dillon Interagency Dispatch Center. The 2015 Dillon Interagency Local Mobilization Guide and Dispatch Operating Plan describe how USFS, BLM, and DNRC work together to respond to wildfires and other emergencies. This plan is available at: http://gacc.nifc.gov/nrcc/dc/mtddc/dispatch/ddc_dispatch.htm.

The Northern Rockies Coordination Center in Missoula is responsible for regional coordination of wildfire response activities in Montana, northern Idaho, Yellowstone National Park, North Dakota, and a portion of South Dakota. More information is available at: http://gacc.nifc.gov/nrcc/index.htm.

The National Interagency Fire Center is located in Boise, Idaho and coordinates the national mobilization of resources for wildland fire and other incidents throughout the U.S. Its member agencies include USFS, BLM, NWS, USFWS, the Bureau of Indian Affairs, the National Park Service, and FEMA. Its four primary operational elements include equipment and supply dispatching; overhead and crew dispatching; aircraft dispatching; and intelligence and predictive services. NIFC also coordinates the Burned Area Emergency Response (BAER) program. The BAER objectives are to determine if an emergency condition exists after a fire; alleviate emergency conditions to help stabilize soil; control water, sediment, and debris movement; prevent impairment of ecosystems; mitigate significant threats to health, safety, life, property, and downstream values at risk; and monitor the implementation and effectiveness of emergency treatments. More information about NIFC, its member agencies' fire management directives, and BAER is available at: http://www.nifc.gov/BAER/Page/NIFC_BAER.html.

4. ***Farm Service Agency Programs***

The 2014 Farm Bill made the Livestock Forage Disaster Program (LFP) a permanent program and provides retroactive authority to cover eligible losses back to Oct. 1, 2011. LFP provides compensation to eligible livestock producers that have suffered grazing losses for covered livestock on land that is native or improved pastureland with permanent vegetative cover or is planted specifically for grazing. The grazing losses must be due to a qualifying drought condition during the normal grazing period for the county. LFP also provides compensation to eligible livestock producers that have suffered grazing losses on rangeland managed by a Federal agency if the eligible livestock producer is prohibited by the Federal agency from grazing the normal permitted livestock on the managed rangeland due to a qualifying fire. Livestock producers are eligible for LFP coverage if they own or lease grazing land or pastureland physically located in a county that has met certain USDM thresholds.

FSA's Dillon Field Office offers a range of other drought relief assistance programs to producers including emergency farm loans, noninsured crop disaster assistance, Federal crop insurance, the emergency conservation

program, emergency haying and grazing, and emergency stock water. More information about FSA's drought assistance programs and eligibility is available at: http://www.fsa.usda.gov/FSA/stateoffapp?mystate=mtandarea=homeandsubject=landingandtopic=landing.

5. ***Adaptive Management of Public Lands Grazing***
   Livestock are permitted to graze on public lands managed by BLM, USFS, DNRC, and USFWS. Each agency adapts its grazing management when drought conditions are present. Management adaptation measures may include adjustments in stocking density based on forage production of the landscape; adjustments to duration of grazing based upon observation of forage utilization; and adjustments to grazing permit conditions based on long term trends in range health. Specific questions regarding grazing management during drought should be referred to the appropriate agency.

Section 8: DRP Update Process

Overview

Creating an update process can prevent a DRP from becoming outdated and ensure that goals are being reached. The world of water management has an ever-rotating cast of players, resources, and priorities, making it important to reevaluate and update management plans regularly. Changes occur to personnel, land and water use, populations, infrastructure, availability of monitoring and forecasting tools and information, organizational and administrative frameworks, and more. It is recommended that this plan be updated at least every 5 years to keep it relevant to our changing and adapting watershed. The following guidelines include target dates for implementation of proposed mitigation and response action items (detailed in Sections 6 and 7), timelines for evaluation of effectiveness of implemented action items, and basic guidance for how to update each of the sections of this DRP.

Frequency and Timing

It is recommended that this plan be updated every five years. Updated 30-year climate normal should be included in future updates, as should current contact information and website links.

The update schedule for this DRP is given in the table below:

Update Year	30-year Climate Normal Period	Complete Implementation of Action Items from Plan Year:	Complete Evaluation of Action Items from Plan Year:
2025	1981-2010	2019	xxxx
2030	1991-2020	2025	2019
2035	2001-2030	2030	2025
2040	2001-2030	2035	2030
2045	2011-2040	2040	2035
2050	2011-2040	2045	2040
2055	2021-2050	2050	2045

Figure 25. Proposed Big Hole Watershed DRP update schedule.

Updating the plan during the winter, when stakeholder have more time to participate because they are not busy with the many tasks that come with a career in agriculture, will allow for more in-depth, valuable input from those who experience the most severe impacts from drought. Their participation is critical to the update process because they offer a treasure

trove of technical expertise and local knowledge regarding drought vulnerabilities and impacts.

Procedural Guidelines

It is recommended that future updates to this DRP follow the basic guidelines listed below:

- **Section 2 Watershed Background**
  - Update climate section as needed.
- **Section 3 Operational and Administrative Frameworks**
  - Determine if any of the listed Procedural and Planning Documents have been updated.
- **Section 4 Drought Monitoring**
  - Survey agencies in charge of monitoring networks to see if new sites have been added.
- **Section 5 Vulnerability Assessment**
  - Assess whether vulnerabilities need to be added or removed from list.
- **Section 6 Mitigation Actions**
  - Evaluate completed projects, implemented mitigation actions.
  - BHWC recommends additional mitigation actions.
- **Section 7 Response Actions**
  - Evaluate completed projects, implemented response actions.
  - BHWC recommends additional response actions.

Appendix A: Contacts

Name	Organization, Title	Email	Phone	Office Location
Andy Suenram	BHWC, Board Member	asuenram@swmtlaw.com	406-683-2391	Dillon, MT
Ann Schwend	DNRC, Upper Missouri Water Resource Planner	aschwend@mt.gov	406-444-1806	Helena, MT
Ben LaPorte	BHWC, Program Manager	blaporte@bhwc.org	303-808-5611	Missoula, MT
Bill Kemph	BHWC, Board Member, Fishing Guide	Mtbad@live.com	406-925-0500	Dillon, MT
Chad McNutt	NIDIS, Program Officer		307-233-6787	Casper, WY
Chris Edgington	Montana Trout Unlimited, Jefferson Watershed Project Manager	chris@montanatu.org	406-451-3035	Dillon, MT
Cindy Ashcraft	BHWC Board Member/Rancher	ashranch@3rivers.net	406-596-7007	Twin Bridges, MT
Dean Peterson	BHWC Board Member/Rancher	deanbpeterson@gmail.com	406-660-2366	Wisdom, MT
Eric Thorson	BHWC, Board Member/Fishing Guide Representative	erthors@gmail.com	406-498-6518	Melrose, MT
Eric Trum	MMDEQ, Water Quality Specialist	etrum@mt.gov	406-444-0531	Helena, MT
Erik Kalsta	BHWC, Board Member/Rancher	kaldoch@3rivers.net	406-925-1204	Melrose, MT

Ethan Kunard	Montana Watershed Coordination Council, Executive Director	ethan@mtwatersheds.org		Helena, MT
Evan Norman	Jefferson River Watershed Council	enorman@mtech.edu		Butte, MT
Jarrett Payne	MFWP, Riparian Ecologist/ Arctic Grayling Recovery Program Administrator	Jarrett.payne@mt.gov	406-560-7103	Twin Bridges, MT
Jim Berkey	BHWC/The Nature Conservancy, Board Member/ Southwest Montana Program Director	jberkey@tnc.org	406-543-2751	Missoula, MT
Jim Dennehy	BHWC/BSB Water Utility, Board Member	jdennehy@bsb.mt.gov	406-490-2491	Butte, MT
Jim Hagenbarth	BHWC, Vice-Chairman/Rancher	hagenbarthj@msn.com	406-490-2121	Glen, MT
Jim Magee	USFWS Partners Program, Fish and Wildlife Biologist	James_magee@fws.gov	406-683-3893	Dillon, MT
Jim Olsen	MFWP, Fisheries Biologist (Big Hole River)	jimolsen@mt.gov	406-533-8451	Butte, MT
John Jackson	BHWC, Board Member/Rancher Beaverhead County, Commissioner	jjackson@beaverheadcounty.org	406-660-1659	Jackson, MT
Lucas Zukiewicz	NRCS Montana Snow Survey, Water Supply Specialist	lucas.zukiewicz@mt.usda.gov	406-587-6843	Bozeman, MT
Mark Raffety	BHWC Board Member/Rancher	raffetymark@gmail.com	406-925-2101	Glen, MT
Matt Norberg	DNRC, Surface Water Hydrologist	mnorberg@mt.gov	406-444-6041	Helena, MT
Mike McGinley	Beaverhead County, Commissioner	mmcginley@beaverheadcounty.org	406-683-3750	Dillon, MT
Paul Cleary	BHWC, Board Member	sandpaul68@gmail.com	406-835-2186	Glen, MT
Pedro Marques	BHWC, Executive Director	pmarques@bhwc.org	406-552-2369	Missoula, MT
Peter Frick	BHWC, Board Member	peterfrick@me.com	661-203-8042	Jackson, MT
Phil Ralston	BHWC, Board Member/Rancher	Ralston_ranch@hotmail.com	406-832-3143	Wise River, MT
Randy Smith	BHWC, Board Chairman/Rancher	6sranch@3rivers.net	406-925-1545	Glen, MT
Roy Morris	BHWC, Secretary/Sportsman	roy@montana.com	406-491-4255	Butte, MT
Sean Claffey	The Nature Conservancy, Sagebrush Partnership Coordinator	sean.claffey@tnc.org	406-683-8017	Dillon, MT
Sierra Harris	The Nature Conservancy, Freshwater Conservation Project Manager	sierra.harris@tnc.org	406-602-4148	Bozeman, MT
Steve Luebeck	BHWC, Treasurer/Sportsman	sluebeck@fairmontmontana.com	406-797-3241	Fairmont, MT

Tana Nulph	BHWC, Associate Director	tnulph@bhwc.org	406-267-3421	Divide, MT
Travis Horton	MFWP, Region 3 Fisheries Manager	thorton@mt.gov	406-994-3155	Dillon, MT
Vanna Boccadori	MFWP, Wildlife Biologist/WMA Manager	vboccadori@mt.gov	406-490-0150	Butte, MT

Appendix B: Online Resources

Beaverhead Conservation District	http://beaverheadcd.org/
Beaverhead County	http://www.beaverheadcounty.org/
Big Hole Watershed Committee	https://bhwc.org/
BLM Dillon Field Office	http://www.blm.gov/mt/st/en/fo/dillon_field_office.html
BOR Montana Area Office	http://www.usbr.gov/gp/mtao/
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS)	http://www.cocorahs.org/
Dillon AgriMet Station	http://www.usbr.gov/gp/agrimet/station_dlnm_dillon.html
Dillon Interagency Dispatch Center	http://www.fs.fed.us/fire/dispatch/dillon/
FSA Dillon Service Center	http://offices.sc.egov.usda.gov/locator/app?state=mtandagency=fsa
George Grant Trout Unlimited	http://www.georgegranttu.org/
Montana Bureau of Mines and Geology Groundwater Information Center	http://mbmggwic.mtech.edu/
Montana DNRC Drought Website	http://drought.mt.gov/default.aspx
Montana MFWP Drought Page	http://MFWP.mt.gov/fishAndWildlife/habitat/fish/waterManagement/drought.html
Montana State University Extension	http://www.msuextension.org/
Montana Trout Unlimited	https://montanatu.org/
Montana Watershed Coordination Council (MWCC)	http://mtwatersheds.org/app/
National Drought Mitigation Center (NDMC)	http://drought.unl.edu/
National Drought Resilience Partnership	http://www.drought.gov/drought/content/ndrp
National Integrated Drought Information System (NIDIS)	http://www.drought.gov/drought/
National Interagency Fire Center Burned Area Emergency Response	http://www.nifc.gov/BAER/Page/NIFC_BAER.html
National Weather Service Montana Drought Website	http://www.wrh.noaa.gov/tfx/hydro/DGT.php?wfo=tfx
NDMC Drought Impact Reporter	http://droughtreporter.unl.edu/
NDMC Drought Risk Atlas	http://droughtatlas.unl.edu/
NOAA Climate Prediction Center	http://www.cpc.ncep.noaa.gov/

NOAA RISA Pacific Northwest Climate Impacts Research Consortium	http://cpo.noaa.gov/ClimatePrograms/ClimateandSocietalInteractions/RISAProgram/RISATeams/CIRC.aspx
NRCS Montana Snow Survey	http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/
The Nature Conservancy Southwest Montana	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/montana/placesweprotect/southwest-montana.xml
U. S. Department of Interior Northwest Climate Science Center	https://edit.doi.gov/csc/northwest/
U.S. Drought Monitor	http://droughtmonitor.unl.edu/
University of Montana Climate Office	http://www.climate.umt.edu/
USDA Northern Plains Climate Hub	http://climatehubs.oce.usda.gov/northernplains
USFS Beaverhead-Deerlodge National Forest	http://www.fs.usda.gov/bdnf/
USFS Service Northern Rockies Fire Detection Map	http://activefiremaps.fs.fed.us/activefiremaps.php?sensor=modisandop=mapsandrCode=nrw
USGS Montana Water Data	http://waterdata.usgs.gov/mt/nwis/rt
USGS Northern Rocky Mountain Science Center	http://www.nrmsc.usgs.gov/
Western Regional Climate Center Drought Monitoring	http://www.wrcc.dri.edu/drought-monitoring/
Western Governors' Drought Forum	http://www.westgov.org/initiatives/drought-forum
Western Education/Extension Research Activity Western Water Resources	http://werawater.org/

Appendix C: Relevant Studies and Reports

Big Hole River Channel Migration Zone Maps *(2017). Applied Geomorphology; DTM Consulting.*
The Big Hole River Channel Migration Zone (CMZ) mapping was originally completed in 2005 and was updated in 2017 to foster a deeper understanding of river dynamics, inundation potential, and channel migration potential. The original project was sponsored by BHWC, the Big Hole River Foundation, MMDEQ, and Beaverhead County, Madison County, Anaconda-Deer Lodge County, and Butte-Silver Bow County. The Big Hole River CMZ project was the first large-scale CMZ mapping effort in Montana. The 2015 revision was funded through the 2013 DNRC Reclamation and Development Grants Program and administered by the Ruby Valley Conservation District. Available at: http://geoinfo.msl.mt.gov/data/montana_channel_migration_zones/projects/big_hole_river.aspx.

Big Hole River Drought Management Plan *(1997). BHWC.*
The Big Hole River DMP coordinates conservation during drought to protect the fishery. The plan sets flow and water temperature targets on the mainstem Big Hole River, which is divided into five river sections. The plan includes both voluntary water conservation efforts and mandatory fishing restrictions and is supported by 10 USGS stream gages. The DMP is operated in partnership with MFWP and DNRC. It is reviewed annually by BHWC and partners and updated as needed. Available at: https://bhwc.org/wp-content/uploads/BHWC-DMP-2019-with-Cover_FINAL-1.pdf.

Big Hole River Floodplain Maps *(2013). ATKINS.*
The Big Hole River Approximate Zone A (also referred to as the "100-year floodplain" or "1% flood probability") covered 116 miles of Big Hole River from headwaters to mouth, except the portion within Silver Bow County that had been mapped previously. BHWC's Land Use Planning subcommittee led the effort to map the Big Hole River floodplain beginning in 2009. The subcommittee included representatives from BHWC, Future West, Beaverhead County, Madison

County, Butte-Silver Bow County, Anaconda-Deer Lodge County, DNRC, and MMDEQ. Available at: http://dnrc.mt.gov/divisions/water/operations/floodplain-management/big-hole-floodplain-study-products/big-hole-river-floodplain-study-maps.

Big Hole Water Storage Scoping Project and Water Management Review: Reservoir Storage Alternatives *(2005). Portage Environmental; DTM Consulting; and Mainstream Restoration for BHWC.*
BHWC and the Big Hole River Foundation (BHRF) commissioned a study in the spring of 2004 to evaluate methods of improving in-stream flows in the upper reach of the Big Hole River. Water storage alternatives and water management alternatives specific to the watershed are currently being evaluated by a project team consisting of Portage Environmental Inc., DTM Consulting Inc., and Mainstream Restoration Inc. The project is organized to evaluate water storage and all other water management alternatives in two parallel tasks. The purpose of the water storage task is to identify and analyze sites in the upper Big Hole River Basin that are suitable for reservoir storage of water which may be used to supply the Big Hole River critical grayling reach during periods of low flow. Available from BHWC upon request.

Big Hole Watershed Restoration Plans
The Big Hole Watershed WRPs aid drought mitigation efforts by outlining water quality impairments and priorities throughout the watershed. Water quality and quantity are inextricably linked, because contaminants and temperatures increase as streamflows decrease. Mitigation actions proposed in the WRPs include projects related to sediment reduction, stream restoration, irrigation infrastructure, and more.

- **Upper and North Fork Big Hole Watershed Restoration Plan** *(2012). BHWC.*
  The Upper and North Fork Big Hole Watershed Restoration Plan is a coordinated document that outlines restoration in terms of impacts, goals, objectives, and measures of improvement. The plan serves to coordinate restoration efforts among stakeholders. Available at: https://bhwc.org/wp-content/uploads/2016/06/WRP-I-Upper-Big-Hole_Final.pdf.
- **Middle and Lower Big Hole Watershed Restoration Plan** *(2013). BHWC.*
  The Middle and Lower Big Hole Watershed Restoration Plan is a coordinated document that outlines restoration in terms of impacts, goals, objectives, and measures of improvement. The plan serves to coordinate restoration efforts among stakeholders. Available at: https://bhwc.org/wp-content/uploads/2016/06/WRP-II_Middle-Lower-Big-Hole_FINAL_8-29-2013.pdf.

Lower Big Hole River Irrigation Infrastructure Survey and Prioritization *(2008). BHWC.*
This Lower Big Hole River Irrigation Infrastructure Survey and Prioritization report provides an inventory of irrigation infrastructure along the lower 44.2 miles of the Big Hole River and prioritizes irrigation infrastructure improvement projects that will lead to improved irrigation efficiency and also benefit in-stream flows. A secondary component of this study was to evaluate the extent of floodplain and streambank alterations due to irrigation diversions, floodplain berms and riprap. The results of this assessment were used to develop an irrigation infrastructure improvement priority matrix in which irrigation diversions were ranked based on existing conditions and the potential for improvement, with the goal of providing benefits for both irrigation water management and in-stream flows. Available from BHWC upon request.

Lower Wise River Water Resources Investigation *(2013). BHWC.*
The Lower Wise River Water Resources Investigation inventoried baseline conditions of surface water, groundwater, surface water/groundwater interactions, water temperature, and fisheries. The Wise River is the largest tributary to the Big Hole River and located in southwest Montana. The study begins at the on the Wise River below the confluence of Pattengail Creek and ends at Wise River mouth as it enters the Big Hole River near the Town of Wise River. The Big Hole River is considered to have impaired water quality due to high water temperatures and a number of other issues related to physical habitat. The Wise River is also considered to have impaired water quality, primarily due to high sediment/siltation, metals, and physical habitat alterations. Wise River is a documented important cold water influx for the Big Hole River through surface waters. Available at: https://bhwc.org/wp-content/uploads/2016/06/Wise_River_Report_FINAL_9-26-2013.pdf.

Total Maximum Daily Loads and Water Quality Improvement Plans
Presents Total Maximum Daily Loads (TMDLs) and a framework water quality improvement plan for the Middle and

Lower Big Hole TMDL Planning Area. The plan was developed by MMDEQ. The Montana Water Quality Act requires MDEQ to develop TMDLs for streams and lakes that do not meet Montana water quality standards. TMDLs are the maximum amount of a pollutant a water body can receive and still meet water quality standards, or the level of reduction in pollutant loading that is needed to meet water quality standards. The goal of TMDLs is to eventually attain and maintain water quality standards in all of Montana's streams and lakes, and to improve water quality to levels that support all state-designated beneficial water uses. The Big Hole Watershed has two TMDLs:

- **Upper and North Fork Big Hole River Planning Area TMDLs and Framework Water Quality Restoration Approach** *(2009). MMDEQ.* Available at: http://MDEQ.mt.gov/Portals/112/Water/WQPB/CWAIC/TMDL/M03-TMDL-01a.pdf.
- **Middle and Lower Big Hole Planning Area TMDLs and Water Quality Improvement Plan** *(2009). MMDEQ.* Available at: http://MDEQ.mt.gov/Portals/112/Water/WQPB/CWAIC/TMDL/M03-TMDL-02a.pdf.

Appendix D: References

BHWC (1997-2019). Big Hole River Drought Management Plan. Available at: https://bhwc.org/wp-content/uploads/BHWC-DMP-2019-with-Cover_FINAL-1.pdf.

BHWC (2012). Upper and Nork Fork Big Hole Watershed Restoration Plan. Available at: https://bhwc.org/wp-content/uploads/2016/06/WRP-I-Upper-Big-Hole_Final.pdf.

BHWC (2013). Middle and Lower Big Hole Watershed Restoration Plan. Available at: https://bhwc.org/wp-content/uploads/2016/06/WRP-II_Middle-Lower-Big-Hole_FINAL_8-29-2013.pdf.

.

Carparelli, Christopher (2016). Beaverhead Watershed Drought Resilience Plan. Beaverhead Watershed Committee. Available at: http://www.beaverheadwatershed.org/wp-content/uploads/2017/08/Beaverhead-Drought-Resilience-Plan-2016.pdf.

DNRC (2015). Montana State Water Plan. Available at: http://dnrc.mt.gov/divisions/water/management/docs/state-water-plan/2015_mt_water_plan.pdf.

Downing, Jennifer (2013). *Lower Wise River Water Resources Investigation*. Big Hole Watershed Committee. Available at: https://bhwc.org/wp-content/uploads/2016/06/Wise_River_Report_FINAL_9-26-2013.pdf.