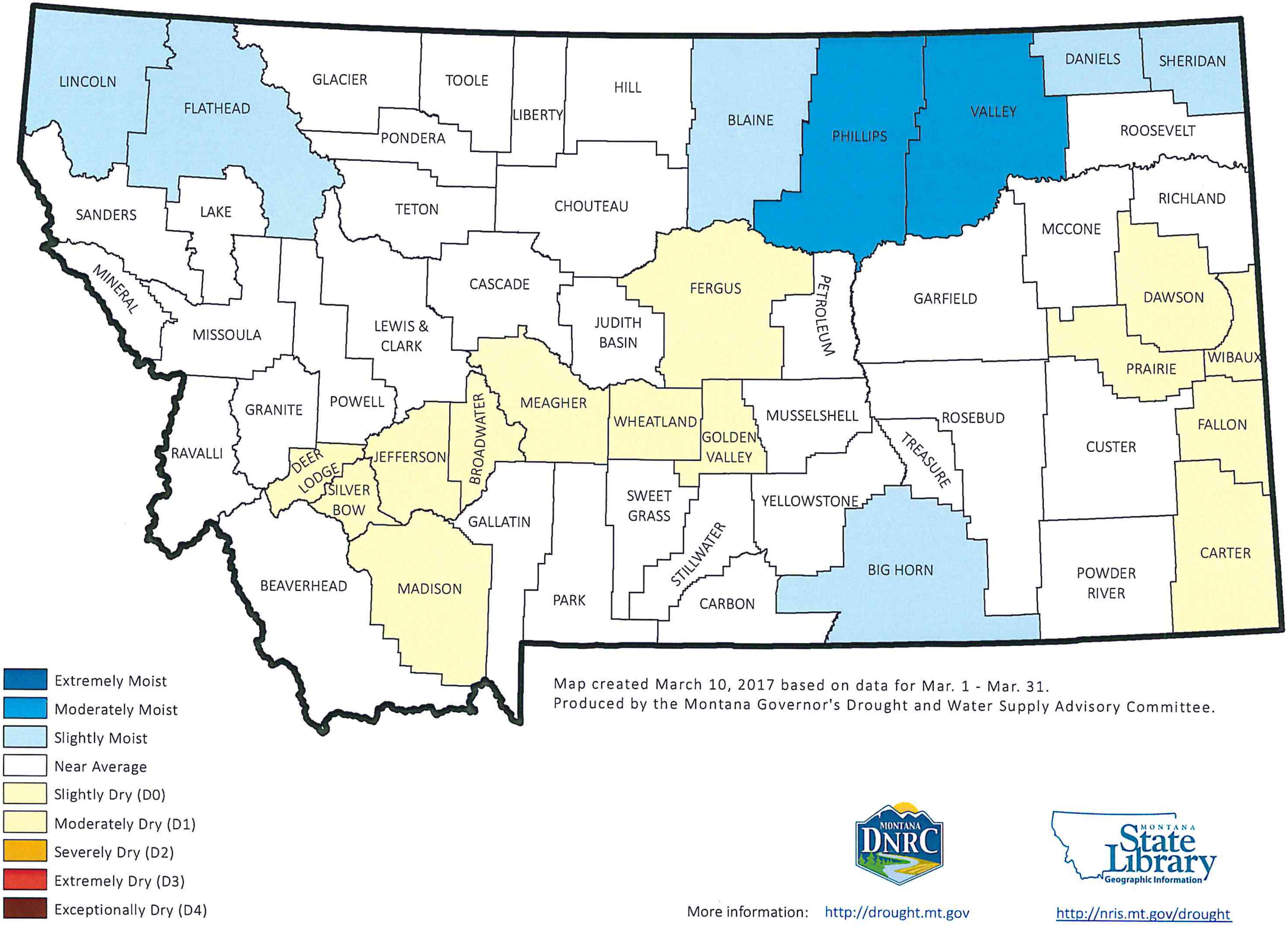
Work Meeting Agenda
Governor's Drought and Water Supply Advisory Committee
Friday, April 28, 2017, 2:30 p.m.
DEQ Metcalf Building, Room 111, DEQ Metcalf Building, 8th Avenue, Helena

2:30	**Welcome – Chair Lt. Governor Mike Cooney**
2:35	Montana Drought Management Plan (MDMP) Update Process - Impact Reports Survey **Ada Montague,** DNRC Staff
2:40	Montana Threat and Hazard Identification and Risk Assessment (THIRA) **Jannel Okeson**, Emergency Planner
2:55	Report from the National Weather Service **Don Britton**, Head Meteorologist, Great Falls, National Weather Service
3:10	Report from the NRCS Montana Snow Survey **Lucas Zukiewicz**, NRCS Montana Snow Survey, Water Supply Specialist
3:25	Report on Flood Conditions **Michelle Phillips**, CFM, DNRC Floodplain Specialist
3:40	Presentation from the Madison Conservation District **Ethan Kunard**, Madison Conservation District Water Programs Manager
3:55	Discussion on Meeting Times **Chair Lt. Governor Mike Cooney** and Committee
4:00	**Adjourn**

Next Meeting: Wednesday, May 24, 2017 2:00 – 4:00 p.m., Room 111, DEQ Metcalf Building, 8th Avenue, Helena

Montana Drought Status by County - April 1, 2017



Map created March 10, 2017 based on data for Mar. 1 - Mar. 31.
Produced by the Montana Governor's Drought and Water Supply Advisory Committee.

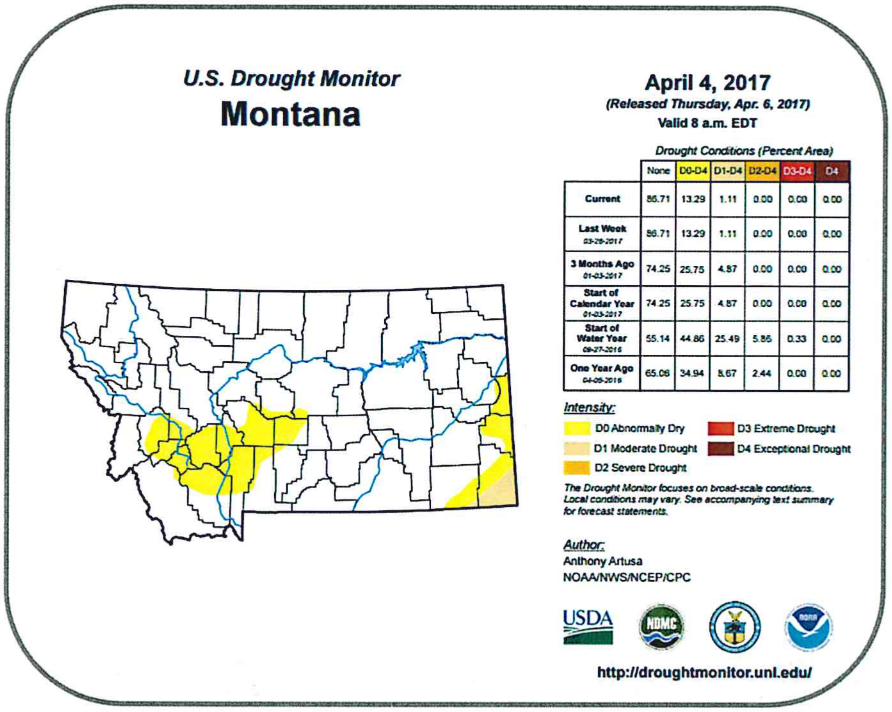
MONTANA DNRC

MONTANA State Library Geographic Information

More information: http://drought.mt.gov

http://nris.mt.gov/drought

Montana — *Current Drought Conditions*



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	86.71	13.29	1.11	0.00	0.00	0.00
Last Week 03-28-2017	86.71	13.29	1.11	0.00	0.00	0.00
3 Months Ago 01-03-2017	74.25	25.75	4.87	0.00	0.00	0.00
Start of Calendar Year 01-03-2017	74.25	25.75	4.87	0.00	0.00	0.00
Start of Water Year 09-27-2016	55.14	44.86	25.49	5.86	0.33	0.00
One Year Ago 04-05-2016	65.06	34.94	8.67	2.44	0.00	0.00

The U.S. Drought Monitor, is a weekly map of drought conditions produced jointly by the National Oceanic and Atmospheric Administration, the U.S. Department of Agriculture, and the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln. The U.S. Drought Monitor website is hosted and maintained by the NDMC. http://droughtmonitor.unl.edu

Highlights for the State

March came in like a lion and left like a lamb, as the saying goes. The first two weeks of the month brought snowpack increases to all basins across the state. The second half of the month saw all valley snows melt with increased temperatures and decreased precipitation. Snowmelt occurred below 7000' east of the Continental Divide and 6000' west of the Divide. By April 1st, most basins in Montana had near to slightly above normal snowpack for the rivers and sub-basins west of the Divide. Exceptions east of the Divide include the Gallatin (87%) and the Smith-Judith-Musselshell combined basin (70%). Read more in the NRCS Montana Water Supply Outlook Report as of April 1st, 2017.

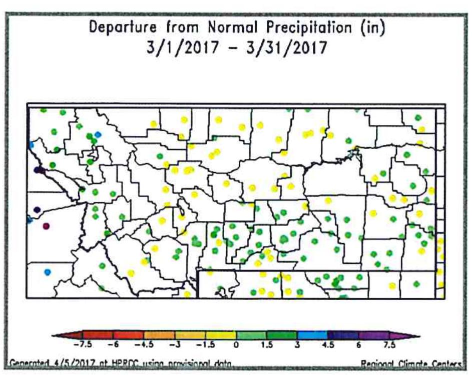
Precipitation was especially abundant along the northwestern part of the state, from Lincoln to Liberty counties. Rain and melting snow did prompt some flood concerns mid-month in northern Idaho and west of Bozeman (read more here), but did not otherwise impact snow supplies.

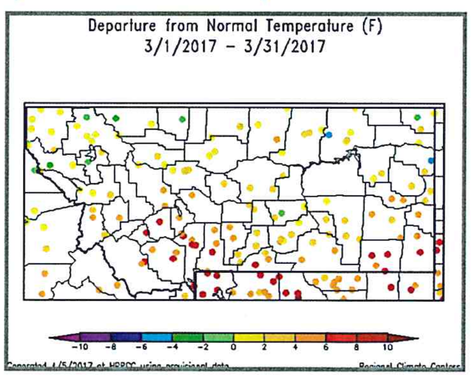
Temperatures for March went from cool to warm by mid-month. Southwest Montana saw temperature increases 2 to 3.5° F above normal. However, for the Water Year (October—September) temperatures have been average across the state.

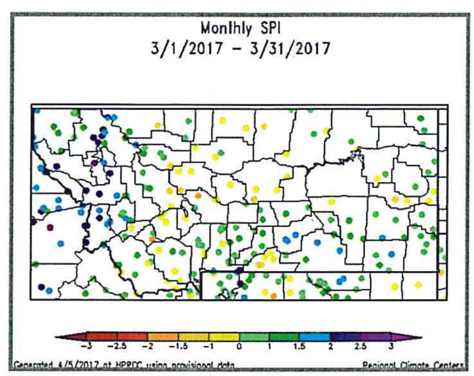
The US Drought Monitor continues to show dry conditions in Carter County and this week they have spread into southeast Power River and north to Fallon and Wibaux. Southwest to southcentral Montana also shows signs of slightly dry conditions.

Montana — *Climate Overview for Last 60 Days*

Temperature and Precipitation Anomalies







PERIOD	AVG TEMP	20TH CENTURY AVERAGE	DEPARTURE	RANK	WARMEST/COOLEST SINCE	RECORD
Mar 2017 1-month period	46.15°F (7.86°C)	41.50°F (5.28°C)	4.65°F (2.58°C)	115th Coolest	Coolest since: 2015	1965
				9th Warmest	Warmest since: 2016	2012

March precipitation was normal to slightly below normal for the entire state. March 2017 was 13th wettest and 111th driest in 122 years.

Temperatures over the 30-day period were warmer than normal across the state. March was the 115th coolest and the 9th warmest.

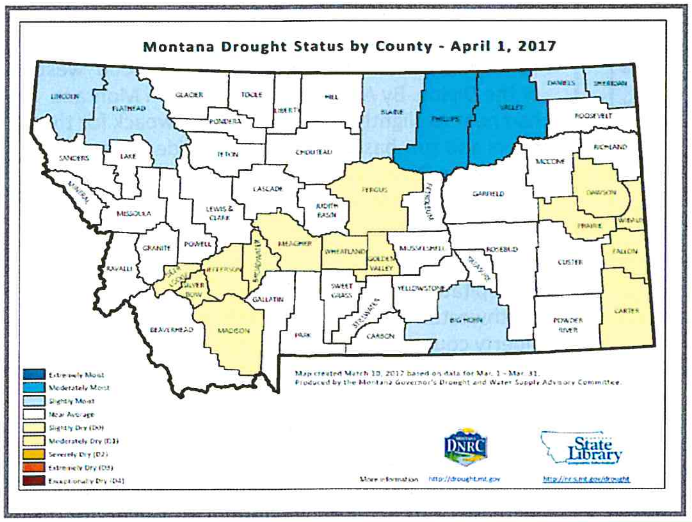
Contact: Ada Montague
(amontague@mt.gov)

Montana — *Drought Indicators*

Montana Drought Status by County

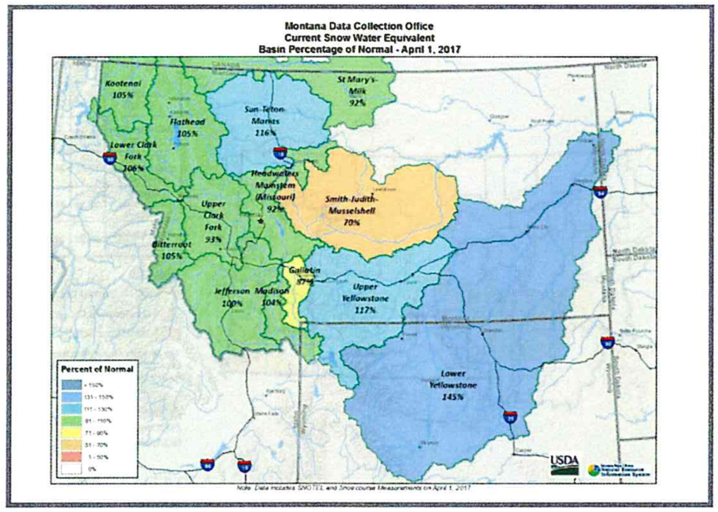
The Montana Drought Status by County is a monthly assessment tool used to monitor the moisture at a county level for the state. Temperature, precipitation, snowpack, reservoirs status, surface water gages, groundwater, crop reports, and field reports are compiled to create this map. To see a historical record go here: https://mslservices.mt.gov/Geographic_Information/Maps/drought/

Do you have impacts to report? We need your on-the-ground reports and you can send them to amontague@mt.gov



Water Resources

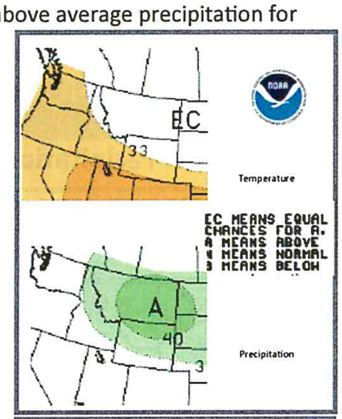
The map below shows the current Snow Water Equivalent (SWE), which gives an indication of how much water is stored in the snowpack in comparison to normal. The Sun-Judith-Muselshell and Gallatin basins are below normal for this time of year. All reservoirs are currently at or above average. The Bureau of Reclamation is currently monitoring Yellowtail Dam due to above average (145% of normal SWE) in the Lower Yellowstone basin. Additional spring rains are hoped to keep river flows at near average for April-July.



Montana — *Short– and Long-term Outlooks*

Weather and Drought Outlooks

For the next month there are equal chances of above, normal, or below average temperatures for the entire state. There is a 40% chance of above average precipitation for the majority of the state, with the area west of the divide looking at a 33% chance of elevated precipitation.



Looking further out, the May-Jun-Jul period continues to hold equal chance of above, normal or below average temperatures for the state. There continues to be a 40% chance of above average precipitation for the majority of the state, with the area west of the divide looking at a 33% chance of elevated precipitation.

Although there is less certainty when looking at predictions beyond the next three months, the same pattern is expected to remain for the majority of the state.

Drought conditions are expected to improve, but should remain closely monitored in 2017 to ensure the lingering effects of the last two years do not persist. Read the National Drought Mitigation Center's Drought and Climate for February 2017 Report to learn more.

Need a Forecast?

Visit your local National Weather Service Weather Forecast Office for the most up-to-date forecast at: http://www.weather.gov

Stay Tuned and In Touch

The next Montana Drought Impacts and Outlook Summary will be released around April 9th. If you need information in the meantime, please reach out to any of the partners listed to the right or contact Ada Montague directly at amontague@mt.gov.

Read the NOAA National Drought Overview at: https://www.ncdc.noaa.gov/sotc/drought/201611#detailed-discussion

Heard Around the State

Our neighbors to the south in Wyoming have benefitted greatly from winter snows and are seeing some of their mountain snowpack set new records. This will mean a high probability of springtime flooding for Montana, especially along the Big Horn and Yellowstone Rivers.

Ice jams are a frequent winter hazard in Montana. For general information on ice jams, check out this info from NOAA: http://www.wrh.noaa.gov/tfx/

Partners

Montana State Climate Office
www.climate.umt.edu
National Weather Service
- **Great Falls Weather Forecast Office**
  www.wrh.noaa.gov/tfx/
- **Missoula Weather Forecast Office**
  www.wrh.noaa.gov/mso/
- **Billings Weather Forecast Office**
  www.wrh.noaa.gov/byz/

Natural Resource Conservation Service, Snow Survey and Water Supply Forecasting
www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/
Montana Bureau of Mines and Geology
data.mbmg.mtech.edu/mapper/
Montana State Library
mslservices.mt.gov
United States Geologic Survey
http://wy-mt.water.usgs.gov/
Bureau of Reclamation, AGRImet
www.usbr.gov/pn/agrimet/h2ouse.html
National Agricultural Statistics Service
www.nass.usda.gov/Statistics_by_State/Montana/

Outlook: The focus for heavy rainfall will shift to the nation's mid-section over the next 5 days. An area of low pressure and its attendant cold front will produce moderate to heavy showers and thunderstorms as it moves from the Mississippi Valley toward southern Canada and the Atlantic Seaboard, though rain from this system will largely bypass the East Coast States. In its wake, another storm system will develop over the south-central U.S. during the weekend and lift slowly northeastward, producing heavy rain from the central Gulf Coast into the central Great Lakes Region; moderate to heavy wet snow is likely in the colder air on the northwest side of the storm over central and southern portions of the Rockies and High Plains. Combined, these two storms are expected to produce a large swath of 1- to 3-inch precipitation totals from the central Plains to the Great Lakes and Mississippi Valley, with excessive rainfall (4-12 inches) possible from the northern Delta into the central Corn Belt. The NWS 6- to 10-day outlook for May 2 – 6 calls for above-normal precipitation across much of the nation east of the Mississippi as well as central and northern portions of the Rockies and High Plains. Conversely, drier-than-normal conditions are expected from Texas into the upper Midwest and from the Great Basin into the Northwest. Colder-than-normal conditions from the western slopes of the Appalachians to the High Plains will contrast with warmer-than-normal readings along the Atlantic Coast as well as California and the Southwest.

Eric D. Luebehusen
Meteorologist
USDA-OCE, World Agricultural Outlook Board
202-720-3361
eluebehusen@oce.usda.gov

MONTANA DISASTER RESPONSE TRAINING

Learn how to position yourself to effectively respond to a disaster/event from Mississippi Emergency Management Agency Officials

MAY 25, 2017
8:00AM – 5:00PM
GREAT NORTHERN HOTEL
HELENA, MT

Breakfast, lunch, & snacks provided
CFM credits are available

MEMA
MISSISSIPPI EMERGENCY MANAGEMENT AGENCY

MONTANA DNRC

MONTANA DISASTER & EMERGENCY SERVICES
DES

REGISTER BY MAY 21
www.floodplain.mt.gov/training

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+ Create Survey

Upgrade to get meaningful results: View all your responses and get powerful analysis. View Pricing →

DWSAC Member Survey

Summary → Design Survey → Collect Responses → Analyze Results

CURRENT VIEW

+ FILTER + COMPARE + SHOW

No rules applied

Rules allow you to **FILTER**, **COMPARE** and **SHOW** results to see trends and patterns. Learn more »

SAVED VIEWS (1)

Original View (No rules applied)

+ Save as...

EXPORTS

SHARED DATA

No shared data

Sharing allows you to share your survey results with others. You can share all data, a saved view, or a single question summary. Learn more »

Share All

RESPONDENTS: 6 of 6

Export All Share All

Question Summaries Data Trends Individual Responses

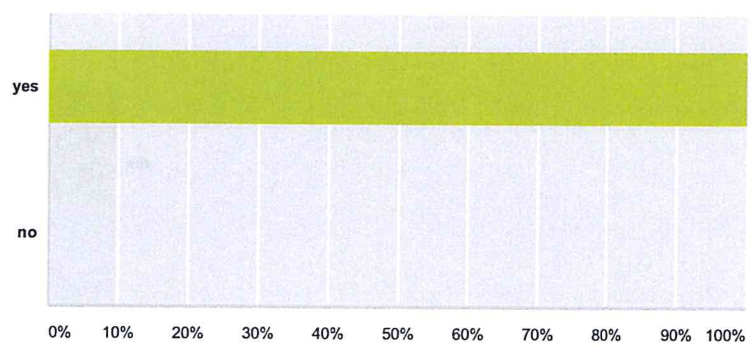
PAGE 1

Q1

Customize Export

Did you know you are a member of the Governor's Drought and Water Supply Advisory Committee (DWSAC)? (More Information on the Governor's DWSAC)

Answered: 6 Skipped: 0



Answer Choices	Responses	
yes	100.00%	6
no	0.00%	0
Total		6

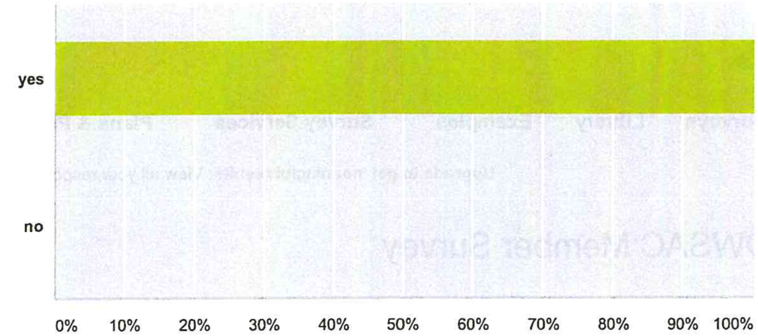
Comments (0)

Q2

Customize Export

Do you know what the DWSAC does?

Answered: 6 Skipped: 0



Answer Choices	Responses	
yes	100.00%	6
no	0.00%	0
Total		6

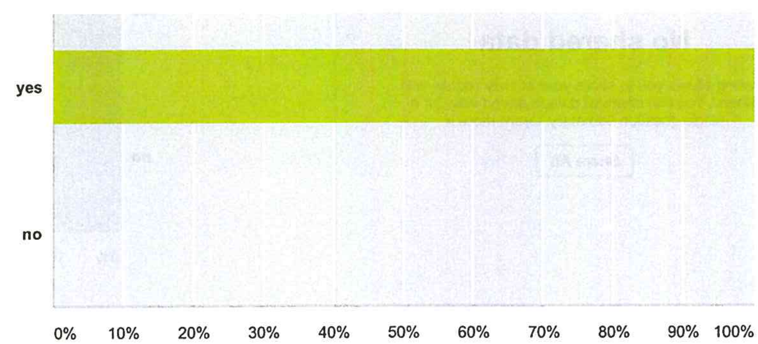
Comments (0)

Q3

Customize Export

Do you know what the Monitoring Sub-Committee (MSC) is? (Learn More About the MSC)

Answered: 6 Skipped: 0



Answer Choices	Responses	
yes	100.00%	6
no	0.00%	0
Total		6

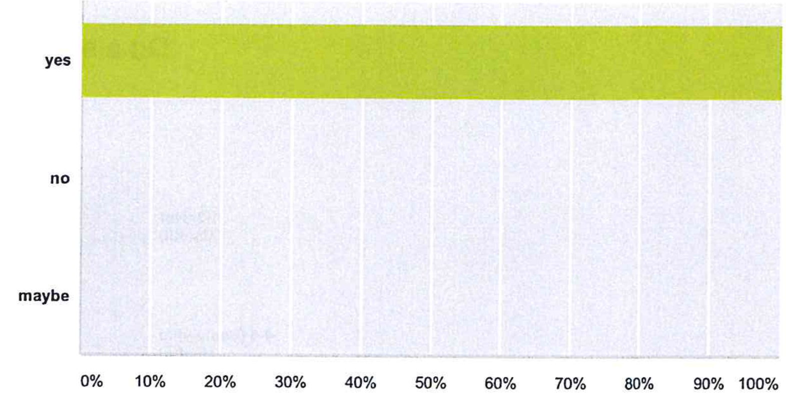
Comments (0)

Q4

Customize Export

Are you interested in having your agency participate in drought and water supply assessment for the state?

Answered: 6 Skipped: 0



Answer Choices	Responses	
yes	100.00%	6
no	0.00%	0
maybe	0.00%	0
Total Respondents: 6		

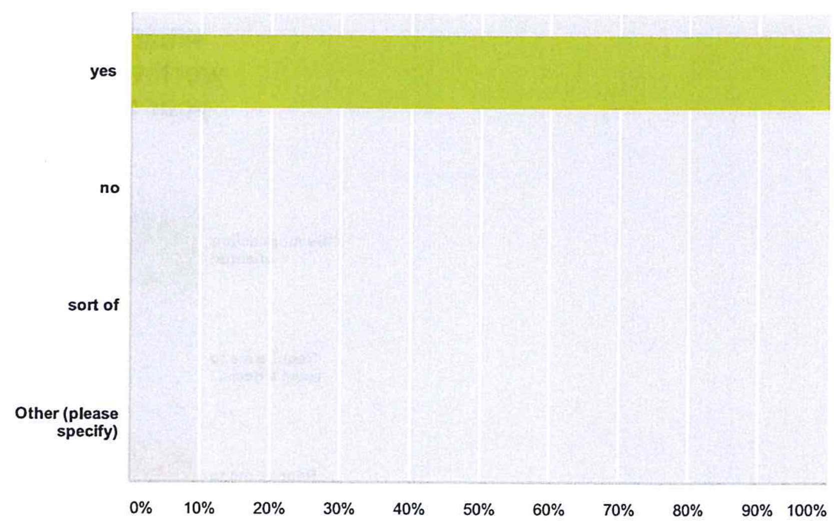
Comments (0)

Q5

Customize Export

Do you think the efforts of the DWSAC are currently worthwhile?

Answered: 6 Skipped: 0



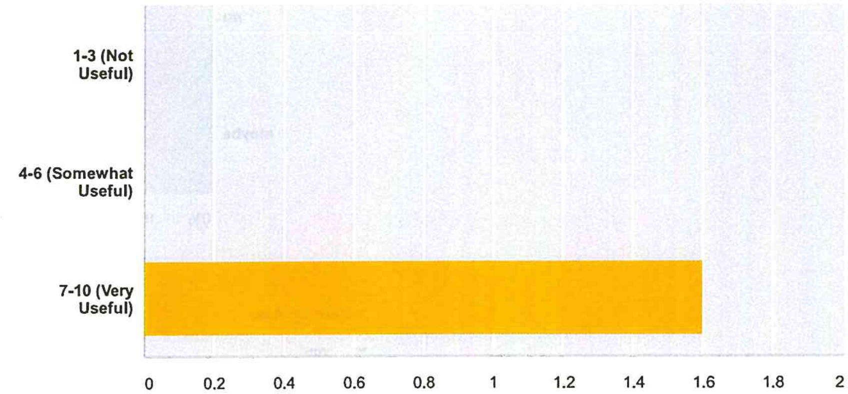
Answer Choices	Responses	
yes	100.00%	6
no	0.00%	0
sort of	0.00%	0
Other (please specify) Responses	0.00%	0
Total Respondents: 6		

Q6

Customize Export

On a scale of 1-10, how worthwhile is this committee?

Answered: 5 Skipped: 1



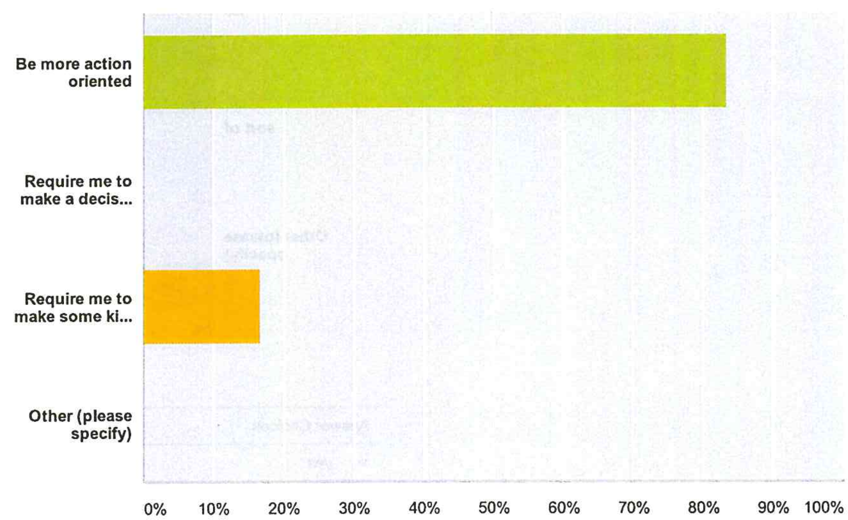
	1	2	3	Total	Score
1-3 (Not Useful)	0.00% 0	0.00% 0	0.00% 0	0	0.00
4-6 (Somewhat Useful)	0.00% 0	0.00% 0	0.00% 0	0	0.00
7-10 (Very Useful)	20.00% 1	20.00% 1	60.00% 3	5	1.60

Q7

Customize Export

What would make this committee more worthwhile to you and justify your time or your staff's time in attending meetings?

Answered: 6 Skipped: 0



Answer Choices	Responses	
Be more action oriented	83.33%	5
Require me to make a decision of some kind	0.00%	0
Require me to make some kind of report	16.67%	1
Other (please specify) Responses	0.00%	0

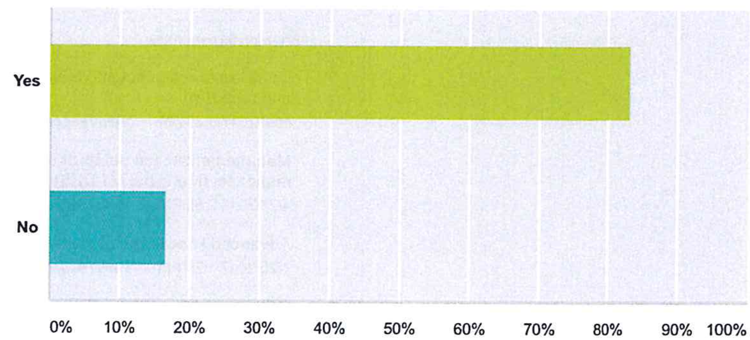
Total	6

Q8

Customize Export

Should this committee continue to meet monthly during the growing season (March - October)?

Answered: 6 Skipped: 0



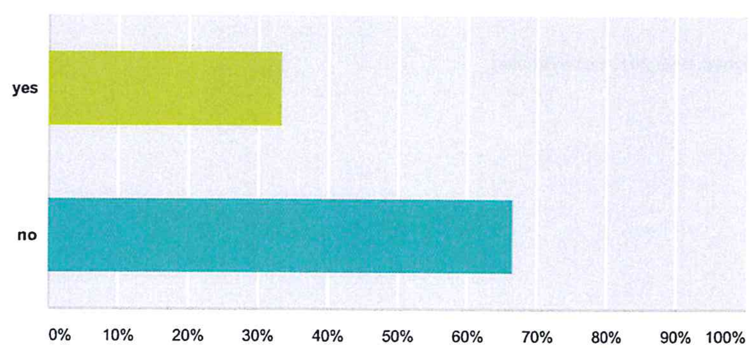
Answer Choices	Responses	
Yes	83.33%	5
No	16.67%	1
Total		6

Q9

Customize Export

Should this committee meet only when there is a potential for drought?

Answered: 6 Skipped: 0



Answer Choices	Responses	
yes	33.33%	2
no	66.67%	4
Total		6

Q10

Export

What is the most important aspect of drought monitoring and response that your agency needs?

Answered: 6 Skipped: 0

Responses (6) Text Analysis My Categories

PAID FEATURE
Use text analysis to search and categorize responses; see frequently-used words and phrases. To use Text Analysis, upgrade to a paid plan .

Upgrade Learn more »

Categorize as... Filter by Category Search responses

Showing 6 responses

Continue to reach out and build capacity at the local level and with local leadership build up into state plan and response
4/28/2017 8:25 AM View respondent's answers

Management action points or other thresholds/indices that provide a good metric for initiating or elevating a response. (Marschal MT DES)
4/27/2017 2:55 PM View respondent's answers

Advanced knowledge of the hydrological conditions throughout the state.
4/25/2017 1:25 PM View respondent's answers

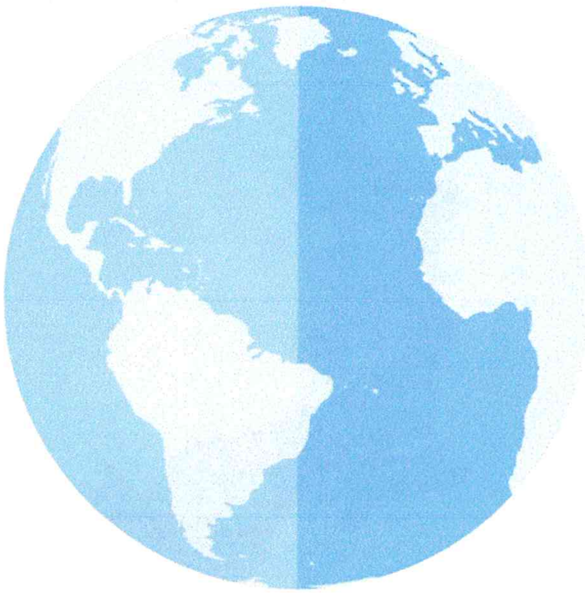
Climate and Stream flow forecasts.
4/25/2017 10:14 AM View respondent's answers

Making sure drought conditions and county drought statuses are updated to keep farmers, ranchers, etc. updated on conditions in their area.
4/24/2017 10:43 AM View respondent's answers

Understanding potential impacts, ahead of drought status, that will create shortages for water users that decrease productivity of our basins with economic consequence
4/19/2017 1:40 PM View respondent's answers

MADISON WATERSHED PLANNING

Climate & Weather Information Overview



Climate (and weather) is one of the components that most heavily influences our water resources. As we move through our Madison Watershed Planning process, we are using the best available data about past, present, and future climate conditions to help us develop solutions and strategies that will address our water resource concerns.

Through management practices and watershed improvements we can help buffer the effects that variable climate might have on our various water uses throughout the community.

The information contained in this handout provides examples of the types of data that can be used to better understand changing conditions throughout the watershed. Although not comprehensive, this data shows some basic weather and climate parameters that can be used to show variability throughout time. Additional information can be found by visiting the website links referenced throughout the handout.

Water Resource Indicators & Data Sources

SNOWPACK—A measure of snow depth in inches. Monitoring for snow pack is conducted by the Natural Resources Conservation Service (NRCS), and is done both manually, as well with telemetry equipment. These monitoring stations are primarily located in mid-elevation mountainous areas.

https://www.wcc.nrcs.usda.gov/snow/

SNOW WATER EQUIVALENT—A measure of the amount of water contained in the snow pack (measured in inches). Monitoring for snow water equivalent is conducted by the NRCS. These measurements are done in conjunction with snow pack.

https://www.wcc.nrcs.usda.gov/snow/

PRECIPITATION—A measure of total rain and snow (adjusted for water content). Weather stations measuring precipitation are managed by several agencies and located throughout the landscape.

https://www.ncdc.noaa.gov/

TEMPERATURE—A measure of ambient air temperature. These weather stations are managed by several agencies, and are located in numerous locations throughout the Madison Watershed.

https://www.ncdc.noaa.gov/

STREAMFLOW—A measurement of water discharged in a stream (measured in cubic feet per second). Flow records exist for the Madison River, but are sparse throughout tributaries in the watershed. The only tributary with current and historic data is Jack Creek.

https://waterwatch.usgs.gov/

SNOWPACK

General Information

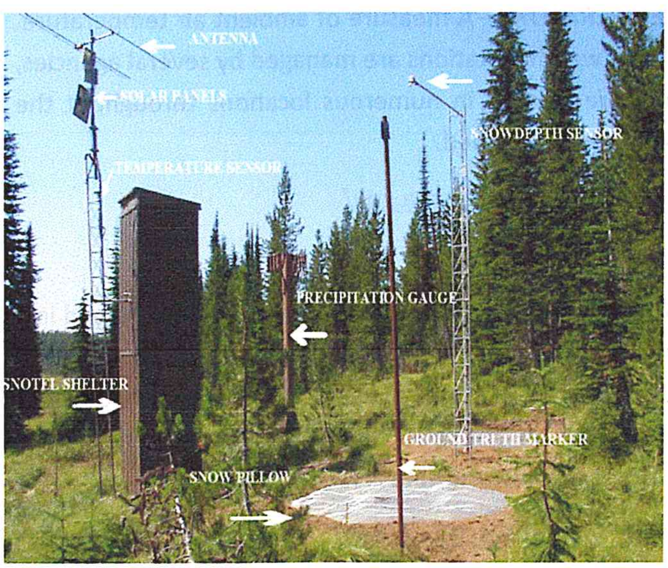
How & Where is the Data Collected?

Snow Course Sites (SNOW)

Beginning in the 1930's, the SCS, now NRCS, selected monitoring sites throughout the mountainous US. Each site is manually measured for snow depth and snow water equivalent. Over time, some of these sites were replaced with SNOTEL instrumentation, while others are still monitored manually. Of the 18 sites In the Madison Watershed that have been historically monitored, only 7 remain active (mostly inside Yellowstone National Park).

SNOTEL Sites

NRCS began installing SNOTEL sites (as shown below) in the late 1960's. SNOTEL stations provide a more efficient way of monitoring snow and precipitation conditions, and the data can be transmitted and viewed online via satellite. There are currently 8 SNOTEL sites in the Madison Watershed



Example Sites in the Madison

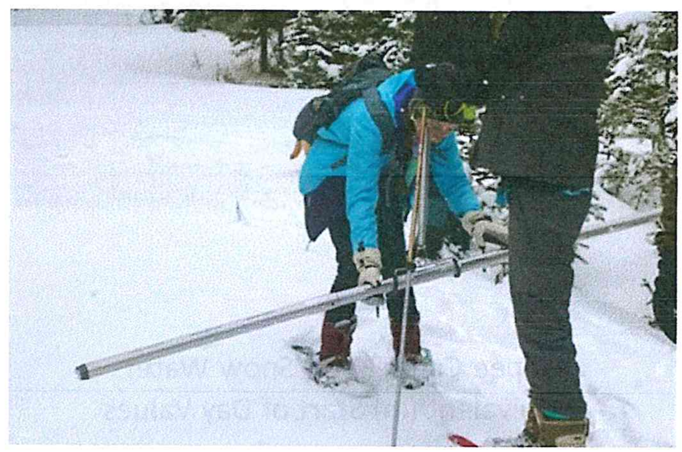
To show an example of how this snowpack data can be used to demonstrate changing conditions throughout the watershed we have selected three sites to use as examples. Lower Twin, Tepee Creek, and West Yellowstone sites have snow course data and modern SNOTEL data available through present day. Each of these sites are located in a different mountain range within the watershed. The table below provides some details about each site location, and the data is then provided on the following pages.

	Lower Twin	**Tepee Creek**	**West Yellowstone**
Location	Tobacco Root Range	Gravelly Range	SE of Madison Range
Elevation	7900 ft.	8000 ft.	6700 ft.
Beginning Year for SNOW	1961	1961	1937
Beginning year for SNOTEL	1981	1972	1967

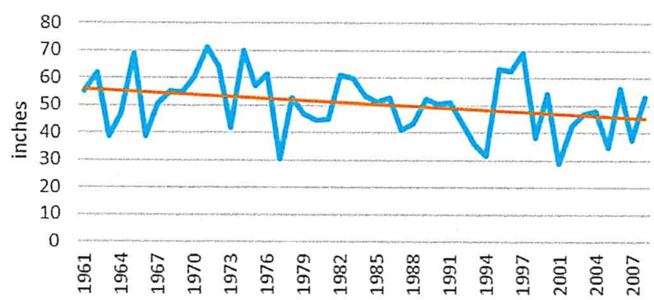
SNOW WATER EQUIVALENT

SNOW COURSE SITES—April 1st Snow Water Equivalent

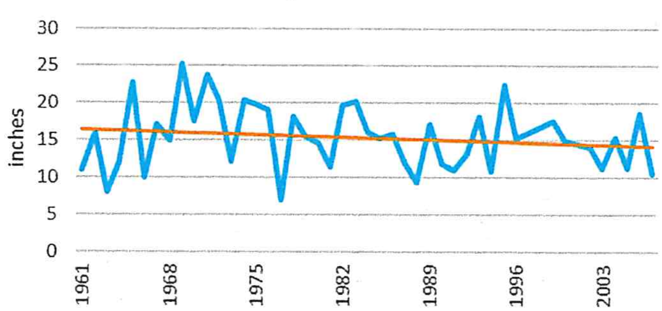
- Snow course (SNOW) data can be used to show historical snow water equivalent. Snow water equivalent uses snow density to calculate the amount of water (in inches) that is present in snow
- The graphs below show the snow water equivalent on April 1st of each year for the period of record on three sites. The April 1st snow water equivalent can be used as an indicator of spring and summer water supply conditions.
- On average, Lower Twin has the highest SWE values of these three sites. The highest recorded value was in 1971 with 71 inches, and the lowest in 2001 with 28 inches.
- The record high for Tepee Creek was in 1969 at 25 inches, and the lowest in 1977 at 7 inches.
- West Yellowstone has the longest history of data starting in 1937. The highest SWE was in 1974 with 19.2 inches and lowest in 2015 with 1.8 inches.



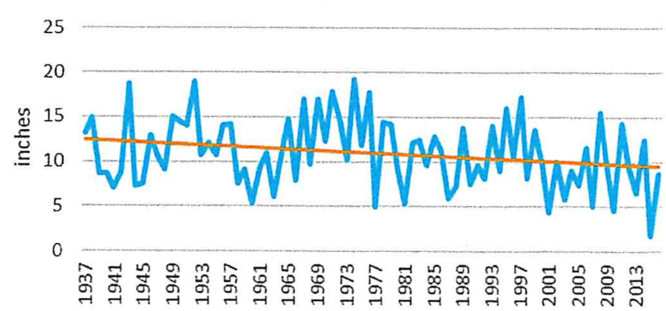
Lower Twin- April 1st Snow Water Equivalent



Tepee Creek- April 1st Snow Water Equivalent



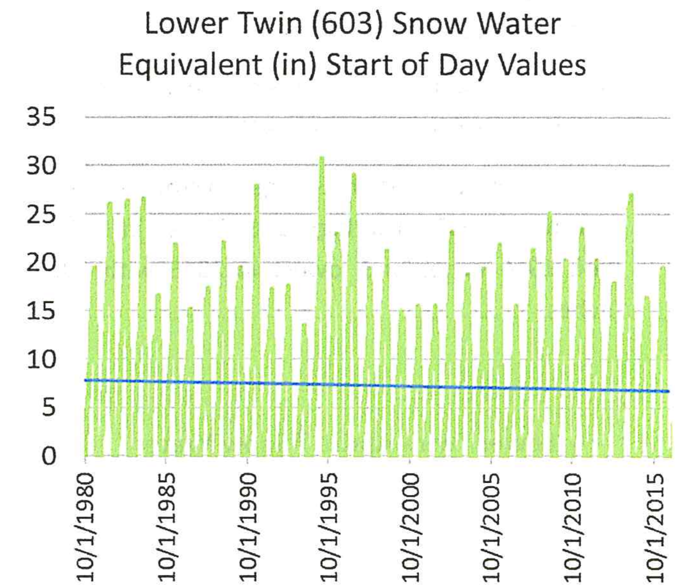
West Yellowstone- April 1st Snow Water Equivalent

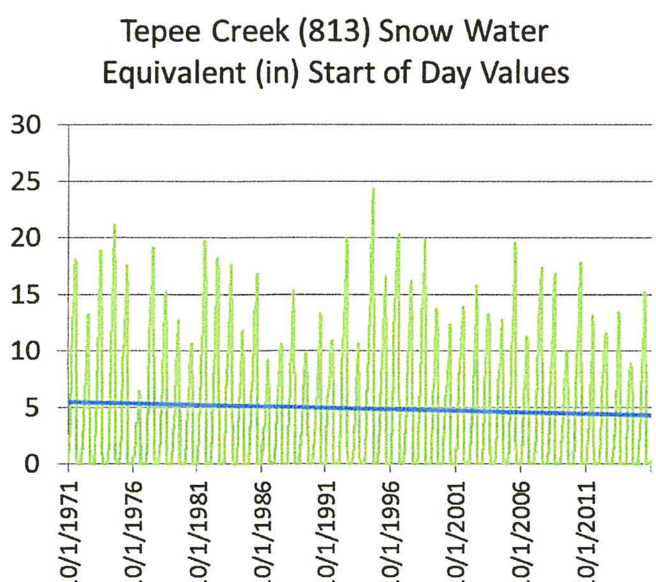


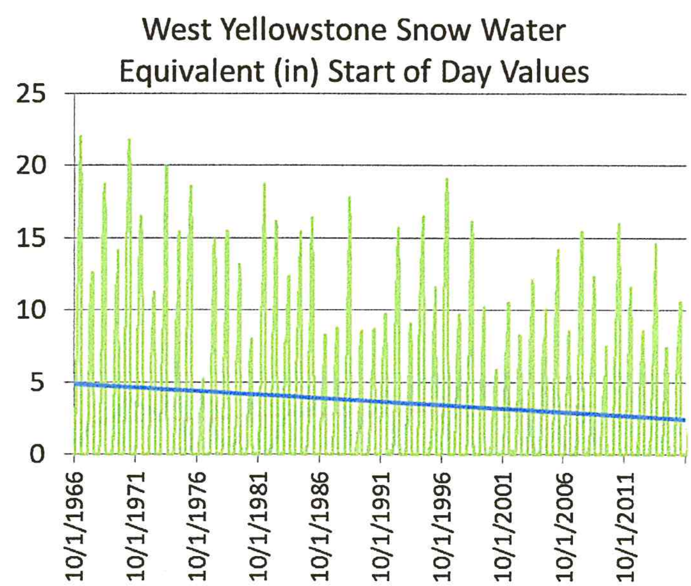
SNOW WATER EQUIVALENT

SNOTEL—Snow Water Equivalent

SNOTEL stations have the benefit of recording real-time data at monitoring sites. Therefore, they can provide much larger datasets for climate related information. The graphs below show an example of daily snow water equivalent obtained at three SNOTEL sites in the Madison Watershed.



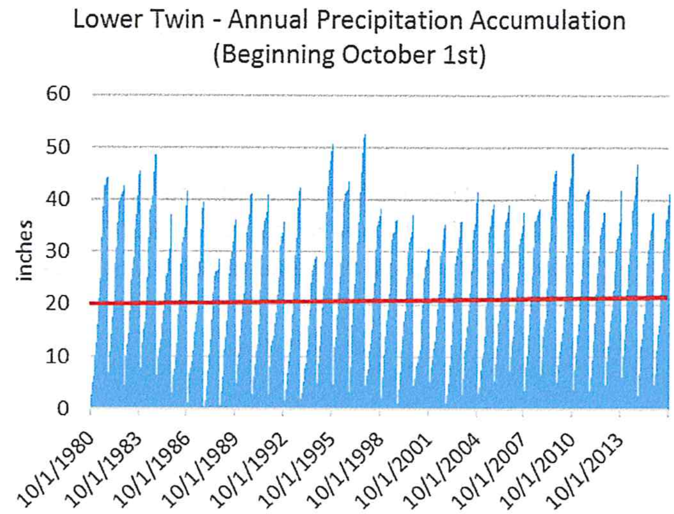


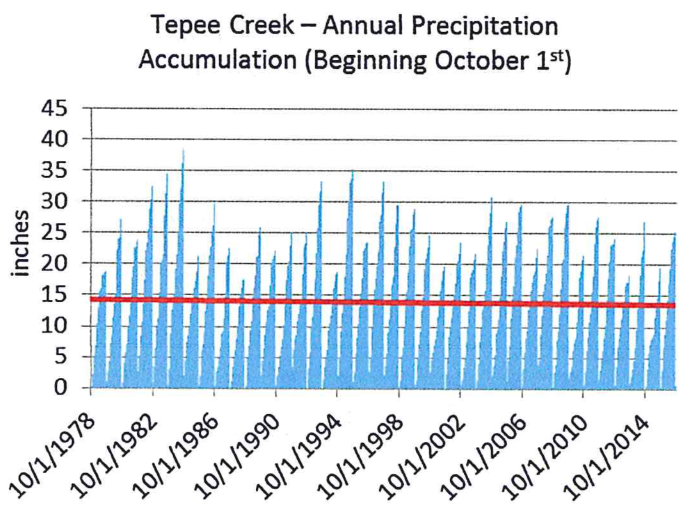


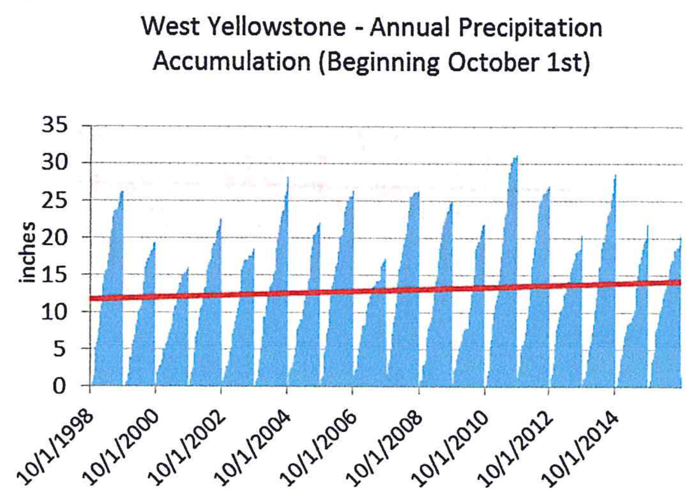
PRECIPITATION

Accumulated Precipitation

- These graphs depict the total accumulated precipitation at each SNOTEL site beginning October 1st of each year.

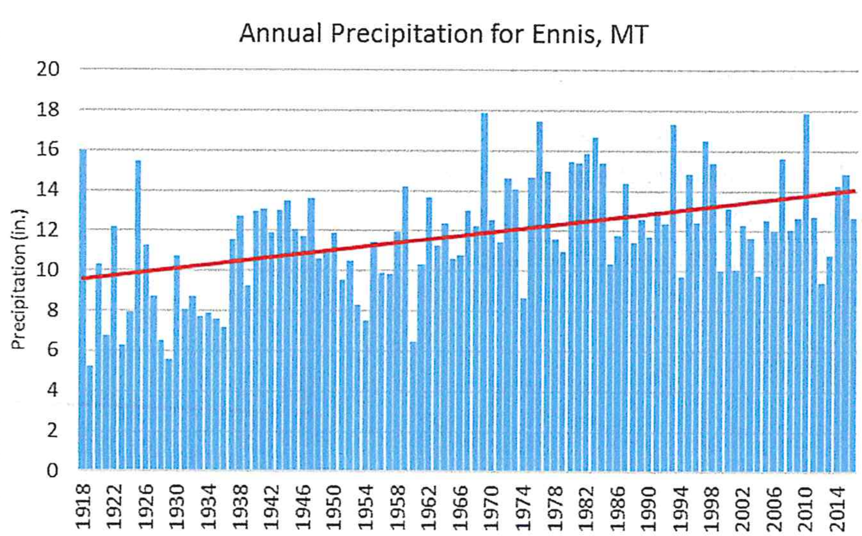






Ennis Annual Precipitation

The National Oceanic Atmospheric Administration (NOAA) provides historical weather data for Ennis, MT beginning in 1918. The data appears consistent with model projections where precipitation will likely continue as normal or increase slightly.

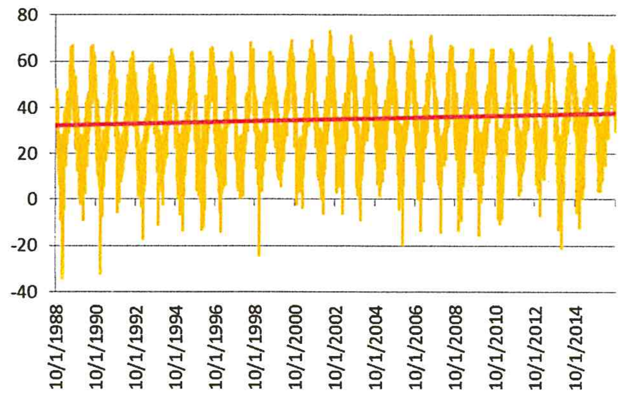


TEMPERATURE

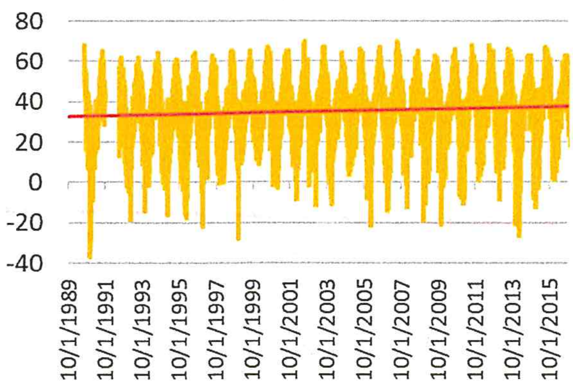
Ambient Air Temperature

- SNOTEL sites can also be used to calculate average temperature for each day of the year. These three graphs depict average temperature over the past 20-30 years

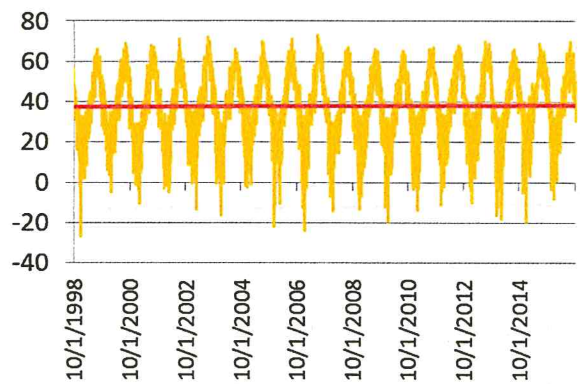
Tepee Creek (813) Air Temperature Average (degF)



Lower Twin (603) Air Temperature Average (degF)



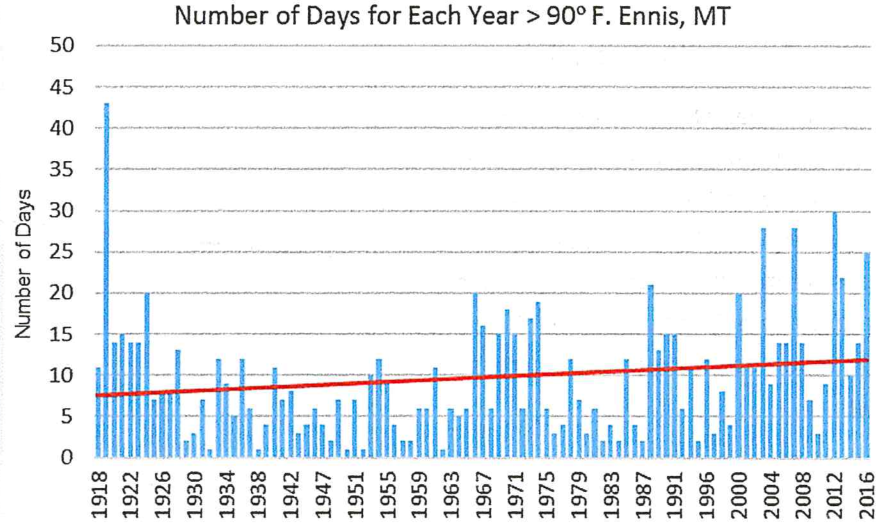
West Yellowstone (924) Air Temperature Average (degF)



Ennis Annual Temperature

NOAA provides a much larger dataset for the town of Ennis. The graph to the right shows the number of days each year that temperatures reached above 90°F.

Number of Days for Each Year > 90° F. Ennis, MT

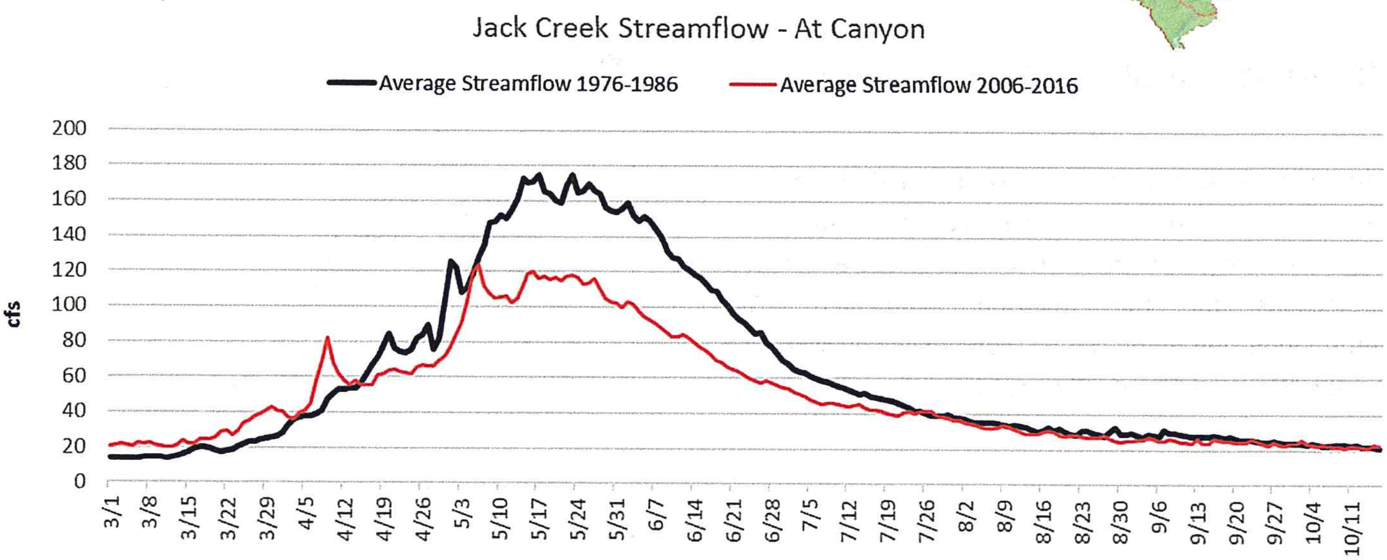


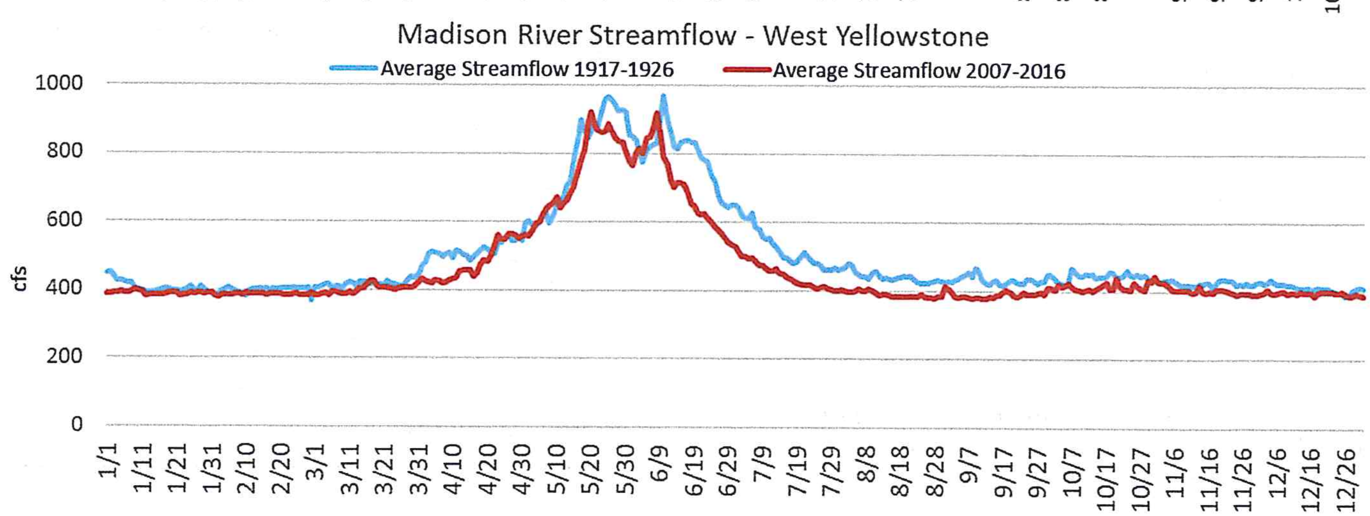
STREAMFLOW

Stream Discharge

- The Jack Creek Canyon site and Madison River—West Yellowstone site represent the only long-term streamflow datasets in the Madison that are not influenced by dam operations.
- USGS operated a gaging station on Jack Creek from 1973-1993, and in 2006 the Madison Conservation District began operation of a gage at the same site. The most notable change in current streamflow verses historic streamflow is the earlier peak flow and runoff. The higher peak flows from the 1976-1986 period might be the result of timber harvesting in the upper portions of the watershed during that time.
- Comparing flows on the Madison River from the most recent decade to the 1917-1926 period also provides evidence of earlier runoff and peak flow events.

Madison River and Jack Creek Sites

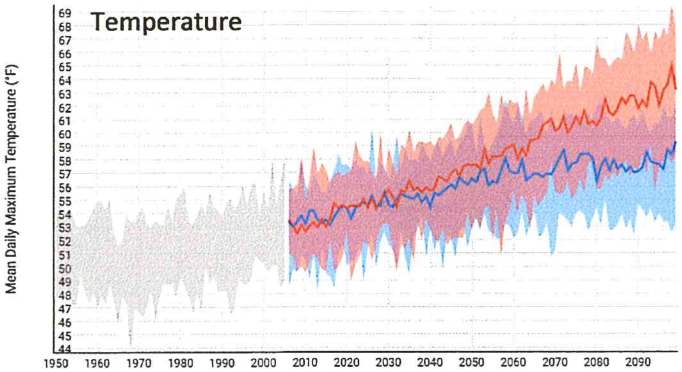


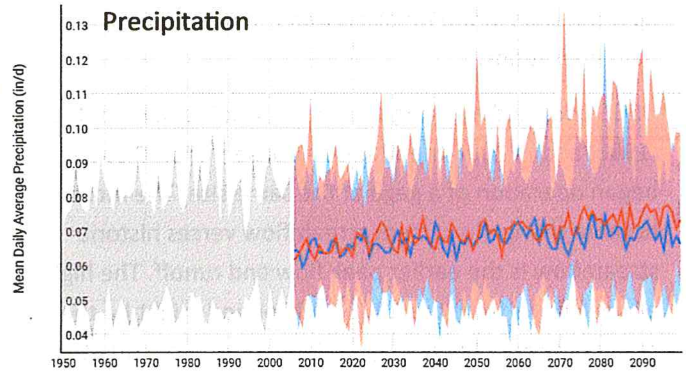


PROJECTIONS—MADISON COUNTY

Temperature, Precipitation, Snowpack, and Runoff Projections

U.S. Climate Resilience Toolkit Information

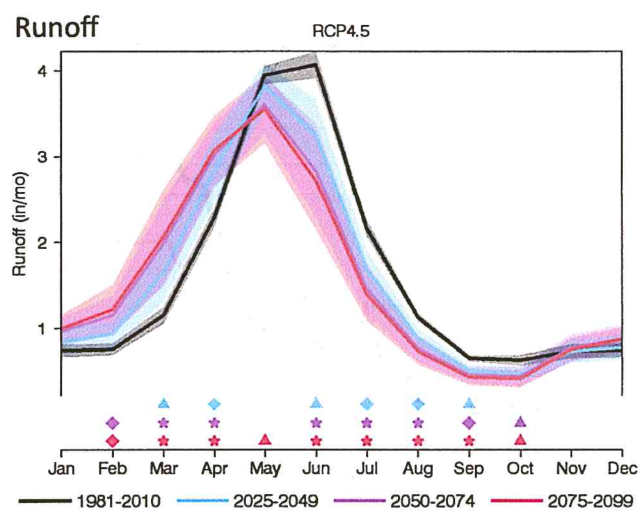




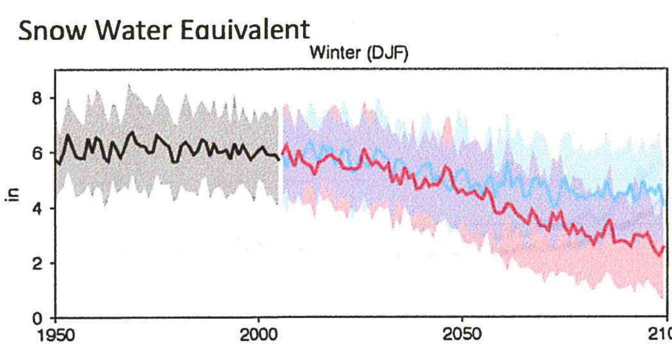
The graphs above from the U.S. Global Change Research Program provide historical data, as well as projected climate trends, for Madison County. There is general agreement that temperature will continue increasing, whereas precipitation is projected to stay relatively the same with the possibility of a slight increase. This information can by searching for the "U.S. Climate Resilience Toolkit."

USGS—National Climate Change Viewer

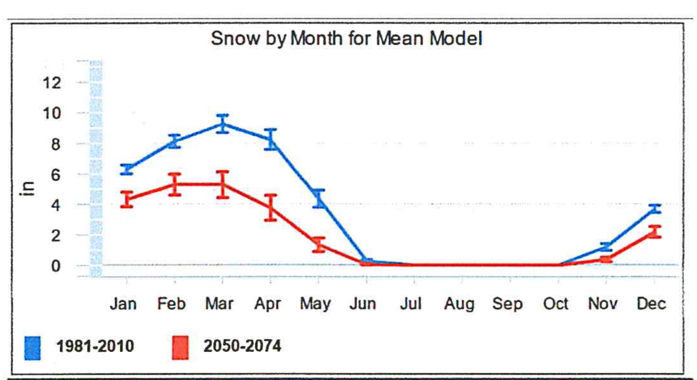
The USGS has additional modeling information available. The graphs (below and right) provide examples of expected changes in snow water equivalent and runoff projections for the Madison Watershed. This information, and more, can be found online by searching for the "National Climate Change Viewer."



(Above: Monthly averages of runoff for four time periods for the RCP4.5)



(Above: Seasonal average time series of precipitation for historical (black), RCP4.5 (blue) and RCP8.5 (red). The historical period ends in 2005 and the future periods begin in 2006.)



Groundwater Information Overview

Introduction

Less than 1% of freshwater on earth is located in streams, rivers, and lakes. An additional 68 % of earth's freshwater is stored in glaciers and ice, leaving the remaining 30% of all freshwater in the form of groundwater aquifers. Groundwater can be a dependable source of water to communities throughout the arid mountain west. With an increased demand in groundwater throughout the Madison Watershed in recent decades, however, the Madison Conservation District is incorporating groundwater management into the scope of our ongoing watershed management plan. The information in this handout is intended to help community members better understand the uses and demands for groundwater in the Madison.

Recently, a diverse group of stakeholders were interviewed to obtain a broad spectrum of concerns related to watershed health in the Madison. One of the reoccurring themes from stakeholders focused on the importance of groundwater supply and groundwater quality throughout the watershed. This feedback was then used to help characterize groundwater uses, demands, and trends in the Madison Valley.

The data within this document was compiled from a number of sources, including: the Montana Department of Environmental Quality (DEQ), Montana Bureau of Mines and Geology (MBMG), and the Montana Department of Natural Resources and Conservation (DNRC).

Community Feedback

The list below summarizes the most common groundwater-related concerns and/or needs brought up by community members during the one-on-one interviews, as well as from feedback solicited during the January 25, 2017 Madison Watershed Planning Meeting.

- A general need for more information about groundwater (e.g., availability, uses, management practices, groundwater level trends, etc.).
- Need to better understand the groundwater and surface water relationship in the Madison and how that affects water supply and water quality.
- Concerns about increased development impacting groundwater with an expanding number of wells and septic systems.

Groundwater Uses in the Madison Watershed

It can be challenging to find consistent information about groundwater use throughout the state. For instance, groundwater claims through the DNRC provide insight into water use and consumptions only for landowners who have filed a water rights claim. Alternatively, the Montana Bureau of Mines & Geology maintains a database of groundwater information for wells that have been filed with the bureau. Individually, these databases don't necessarily create a comprehensive inventory of groundwater use, but together can be used to provide a general characterization.

Below are two figures containing information on groundwater uses from the DNRC's water rights database. In the Madison, there are 3,108 claims for groundwater, consuming a maximum rate of 113,260 gallons per minute. These numbers are broken down by their perspective water uses in the figures below.

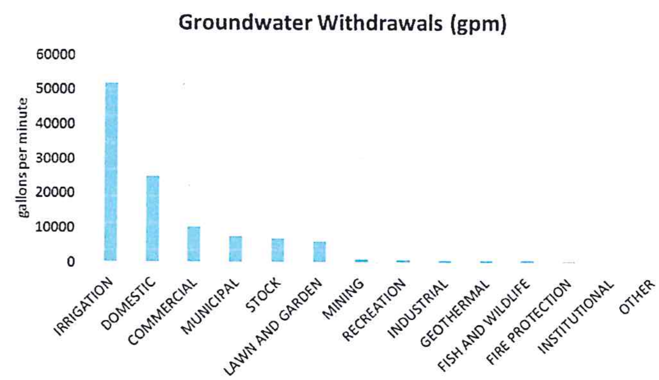


Figure 1: Groundwater withdrawals by use type (MT DNRC)

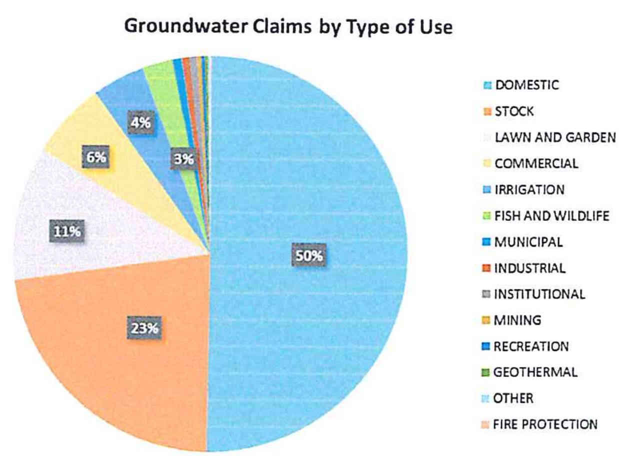


Figure 2: Number of groundwater rights by use type (MT DNRC)

Groundwater Information Overview

Groundwater & Water Use Facts

- Groundwater provides for 95% of domestic water needs in rural Montana
- The average household uses about 200 gallons of water per day for indoor use
- Outdoor watering consists of about 55% of total domestic water use
- Typical livestock water requirements
    - Cattle (non-dairy): 10-15 gallons/day
    - Horse: 10 gallons/day
    - Sheep: 2 gallons/day
- Montana law allows for wells to be exempt from permitting if withdrawals are less then 35 gallons per minute, and not exceeding a volume of more than 10 acre/feet per year.
- Kentucky Bluegrass lawns can require up to 2.5 inches of irrigation water per week during summer
- Irrigation for alfalfa fields vary from 0.5—2 inches of water per week

Well Distribution in the Madison

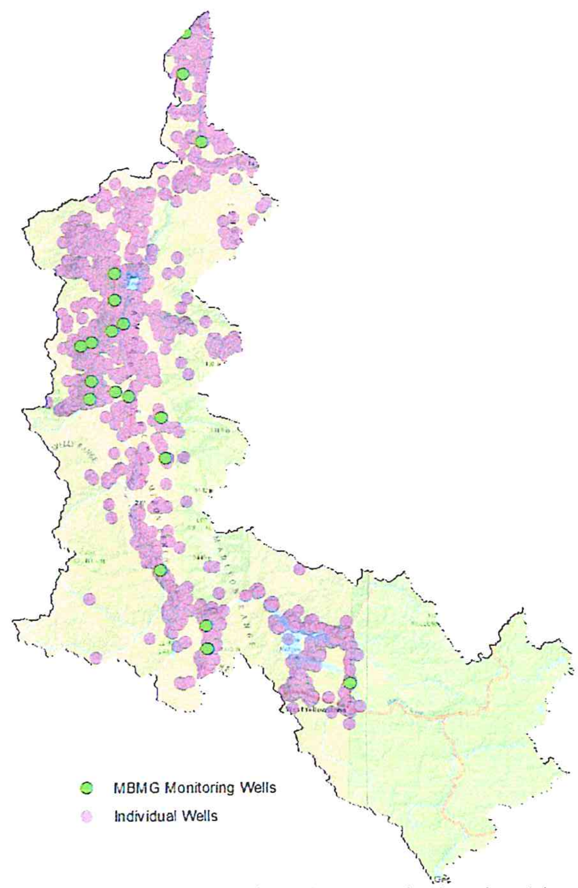


Figure 3: Wells that have been logged into the MBMG database (purple) and monitoring wells used to monitor static water level (green)

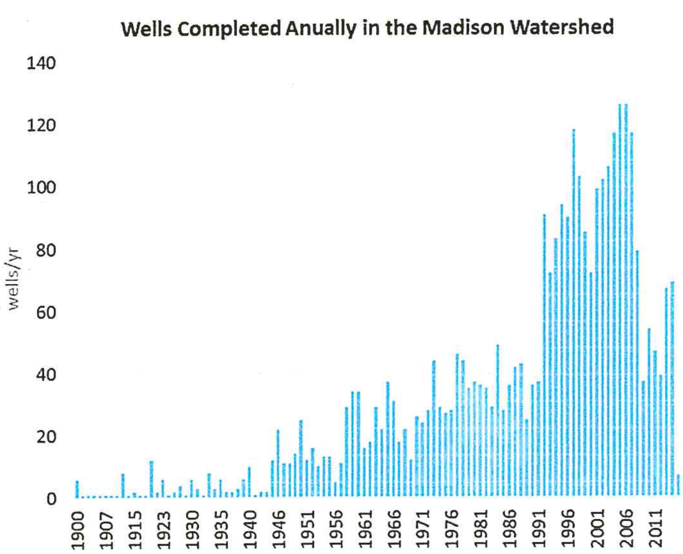


Figure 4: The growing population in the Madison Watershed has resulted in an increased number of wells in recent years (MBMG).

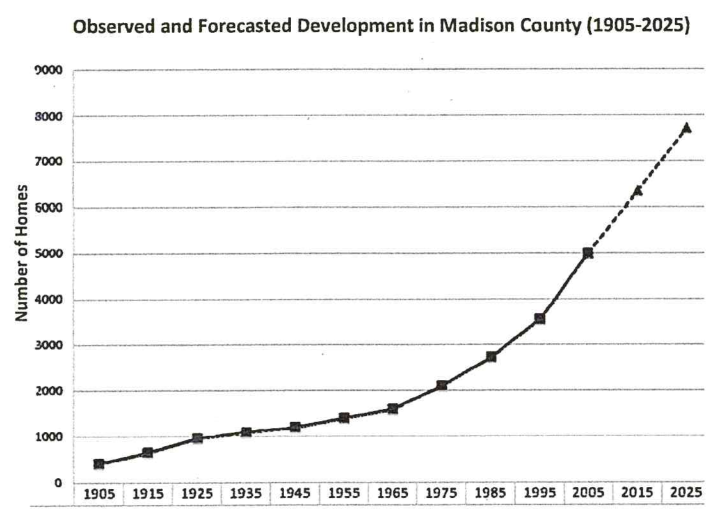
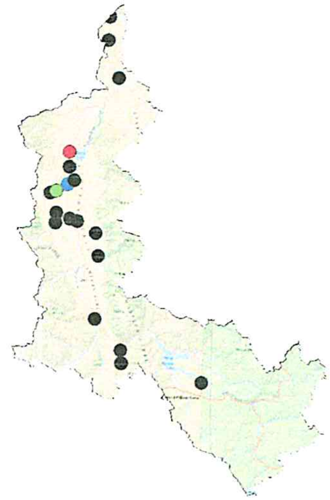


Figure 5: (Above) Population and development in Madison County has steadily increased over the past half-century, correlating to the increase in wells shown in Figure 4 (Madison County Growth Policy, 2012).

MBMG Monitoring Wells

Groundwater Level Monitoring



In addition to storing and managing well log information from throughout the state, the Montana Bureau of Mines & Geology also conducts groundwater monitoring. These wells are visited regularly to collect water level information, and occasionally to collect water quality data. There are several of these monitoring wells throughout the Madison Watershed, and a few examples of the water level monitoring data are provided below. The colored dots on the map (right) correspond to the graphs shown below. Monitoring information is available at the Montana Bureau of Mines & Geology Website: http://data.mbmg.mtech.edu/mapper/mapper.asp?view=Wells&

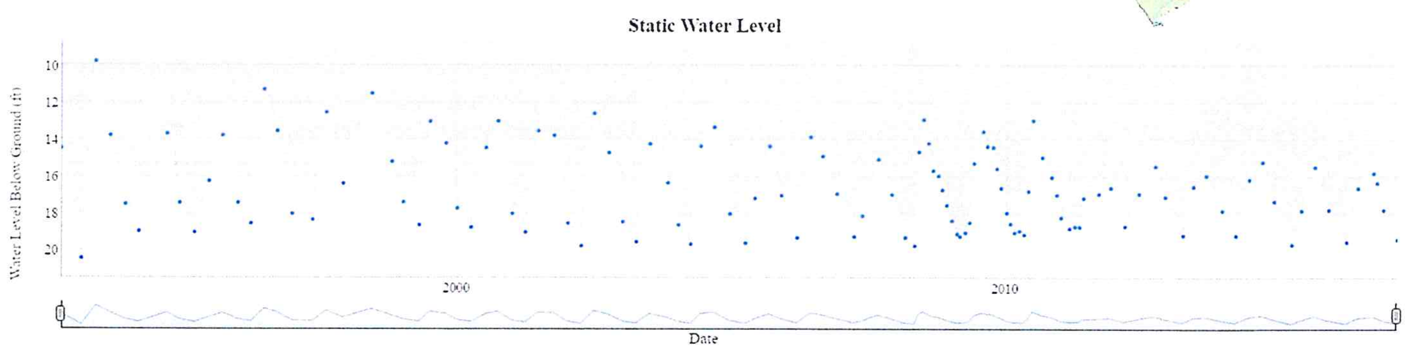


Figure 6: Well 107744— (Red dot on map) Located near McAllister, a mile away from Ennis Lake. Recording since October 29, 1992. Total well depth at 54 ft.

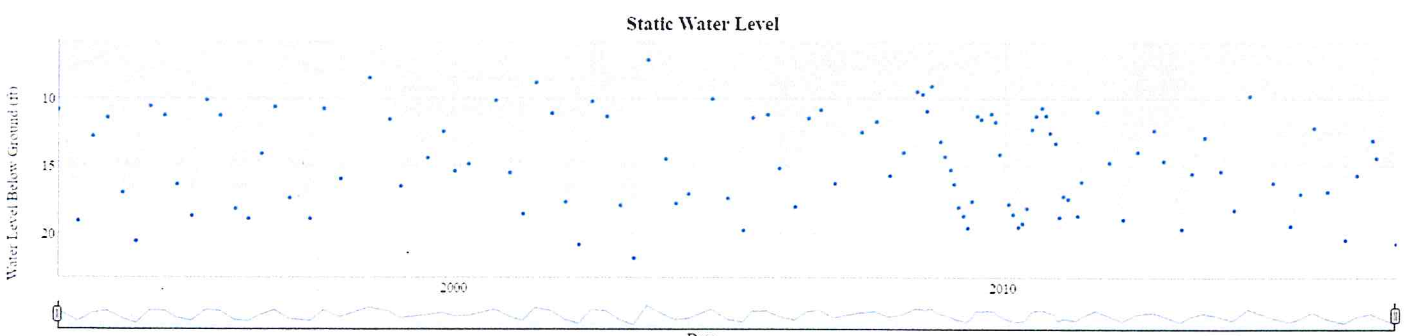


Figure 7: Well 108666—(Blue dot on map) Located in Ennis, around 0.1 mile from the Madison River. Recording since October 29, 1992. Total well depth at 85 ft.

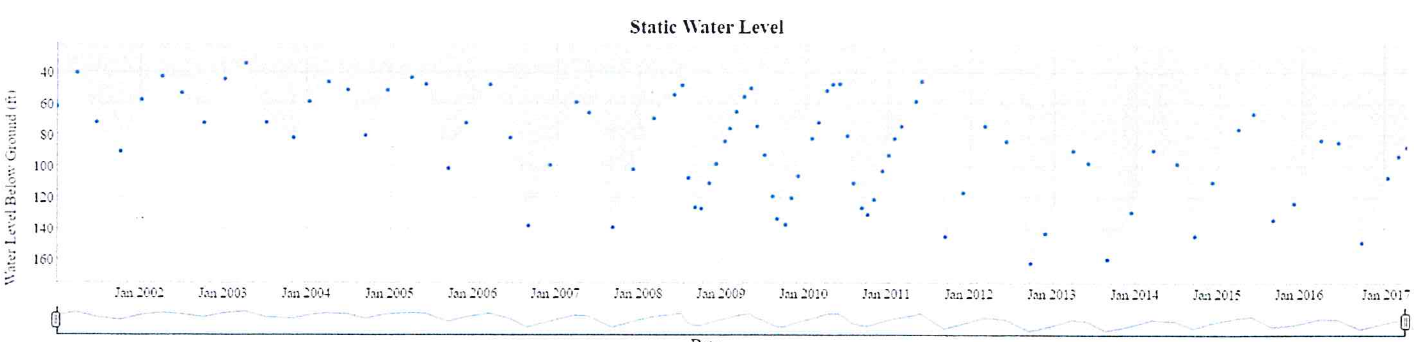


Figure 8: Well 128327—(Green dot on map) Located near Virginia City Ranches. Recording since January 2, 2001. Total well depth at 170 ft.

Groundwater Contaminants

Nutrients, Metals, & Pathogens

Just as surface water (streams and lakes) has potential to be contaminated, groundwater is also susceptible to water quality problems. Similarly, these water quality problems can also originate from natural sources, or can be introduced by land use management activities.

For example, arsenic is present in groundwater throughout certain locations in the Madison Watershed, and it originates largely from the unique geology and geothermal activity near Yellowstone National Park. The images and the graph below provide information about the distribution of arsenic in the Madison.

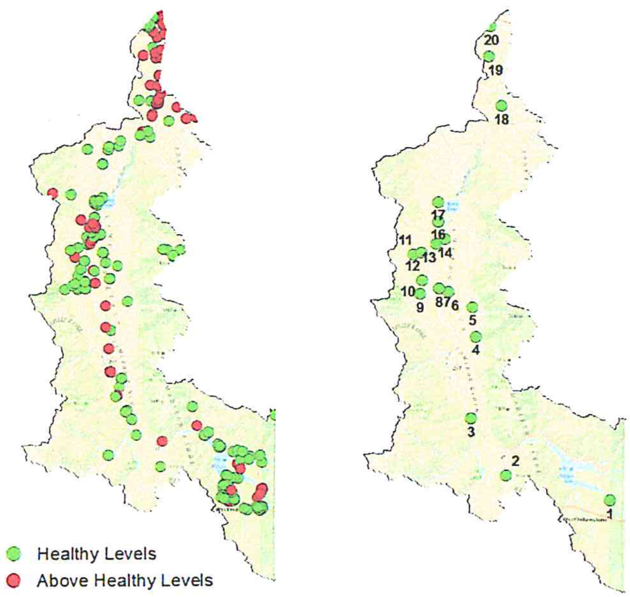


Figure 8: The map on the left shows wells that tested above and below the human health standard for arsenic. The map on the right corresponds to the sites depicted in the graph below (MT DEQ & MBMG).

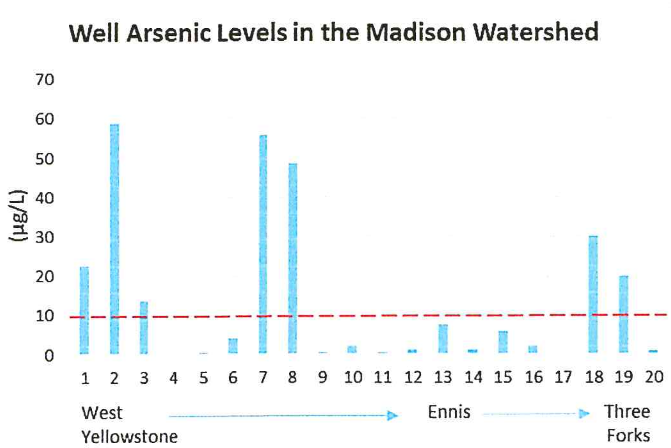


Figure 9: Arsenic levels from wells corresponding to sites on the above map.

Groundwater can also be susceptible to contamination from various land management activities. Products such as oils, road salts, animal waste, and various chemicals, can leach into the soil and enter the water table. Additionally, failing septic systems can be a common source of groundwater contamination causing nutrients and pathogens to enter nearby waterways.

How is septic and groundwater connected?

- *The Drainfield* - The septic tank is connected to a series of underground pipes which evenly distributes the liquid waste (effluent flows) into the soil. The soil acts as a treatment before it moves downward into the groundwater.
- It is important to properly care for your septic system by having it pumped regularly to keep it from contaminating both ground water and surface water.

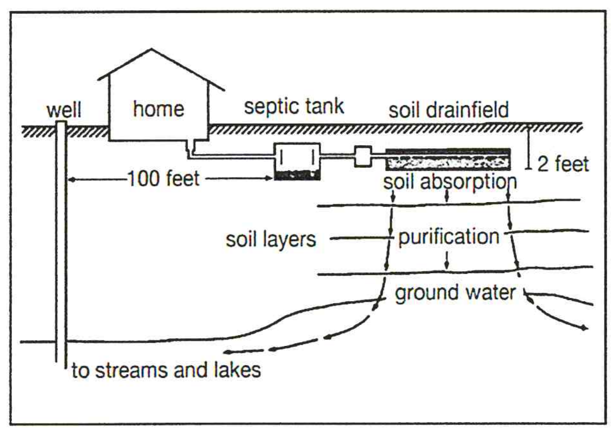


Figure 10: Illustration of a typical septic system (North Carolina State Extension)

It is recommended to have your wells tested regularly due to the risk of groundwater contamination. There are a handful of options when testing the quality of water in your well. For example, Well Educated is a program sponsored by MSU Extension to educate private well owners on the health and maintenance of their well. A sampling kit can be provided to test different aspects of well water quality. The link below contains more information about the water quality parameters you might consider testing in your own well.

http://waterquality.montana.edu/well-ed/index.html

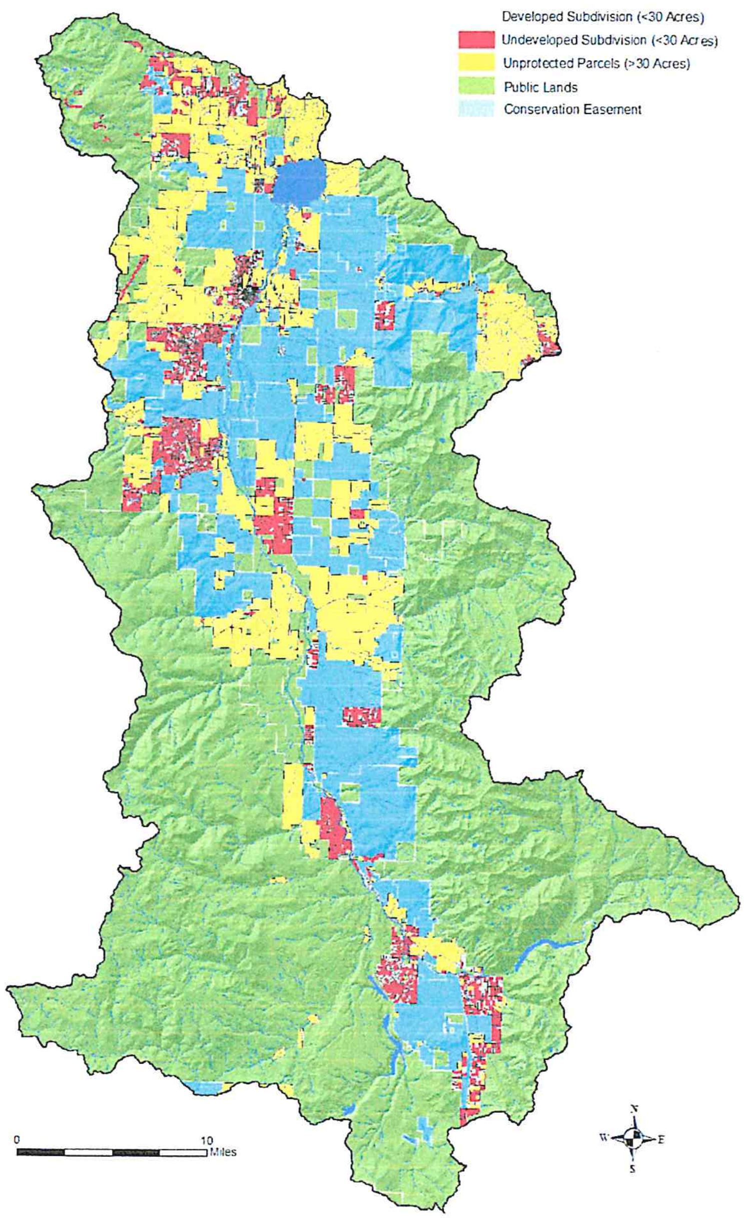
Future Challenges

Future Groundwater Demands

If Madison County continues seeing a 12% per decade population increase, as seen in the most recent decade, there will likely continue to be an increase in out-of-town development. This will result in additional water demands from individual wells. The maps below depict areas that have been subdivided, and then differentiates subdivided parcels that have already been developed (grey) from subdivided parcels that have yet to be developed (red). Additionally, the map on the right illustrates the existing wells on these parcels.

Together, these maps help illustrate the potential demand for groundwater development in the future. These future demands, coupled with climate variability, additional septic infrastructure, and future land management activities, have the potential to negatively impact our groundwater resources over the coming decades.

Subdivisions in the Madison Valley



Subdivisions & Wells in the Madison Valley

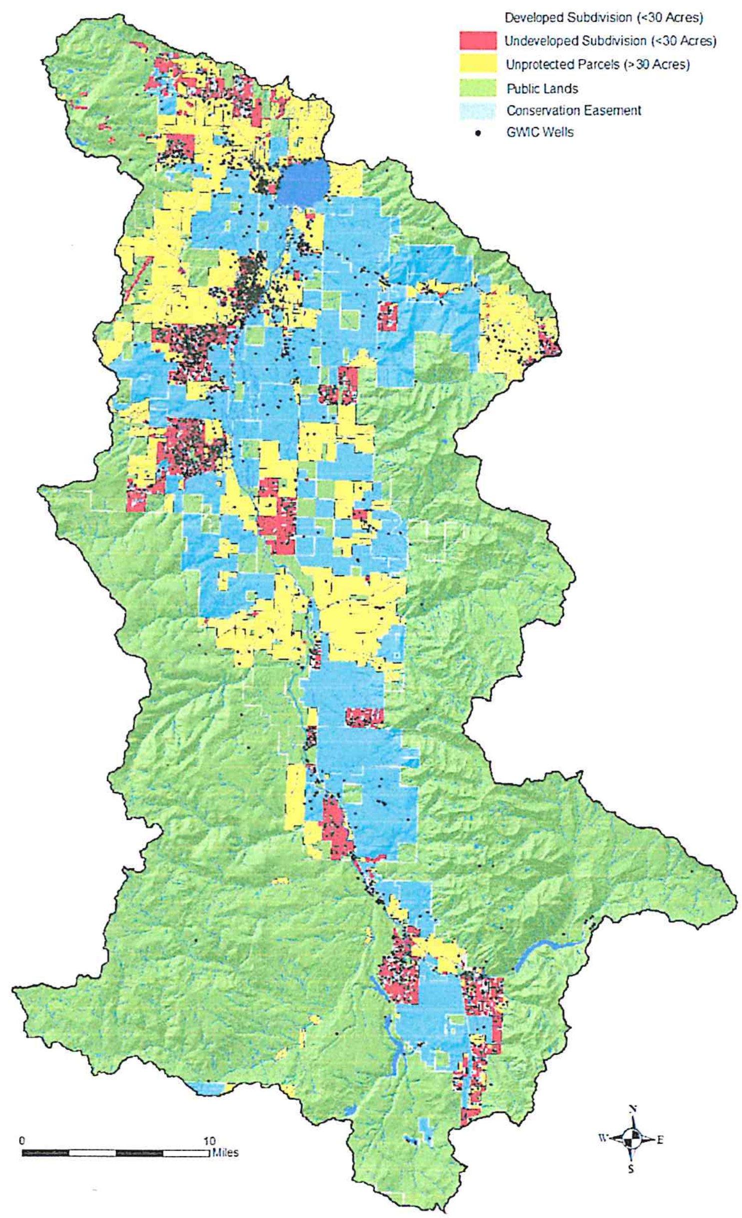


Figure 11: Maps showing subdivision development and existing wells throughout the Madison Valley (Montana Land Reliance and MBMG).

Management Opportunities

Management Improvements & Opportunities

One of the simplest ways to maintain a healthy groundwater system is to conserve water usage. For example, reducing or eliminating outdoor irrigation could cut most household water use in half during the summer season. Additionally, it will be important to properly plan future development and growth to ensure new groundwater withdrawals will not impact existing water users (both surface and groundwater), and do not effect natural systems across the landscape. Furthermore, homeowners should responsibly maintain their septic systems to reduce groundwater contamination from effluent leaching.

Irrigators can also ensure water-use efficiency through irrigation water management. For example, measuring soil moisture content during the irrigation season can help inform irrigation timing and rates, resulting in potential water savings. Other opportunities for agricultural producers might also include the use of more drought-tolerant grass/crop species. Additionally, soil health improvements can help plants use available water more efficiently, and potentially reduce irrigation needs.

Notes:

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