



Big Hole Watershed Committee

Monthly Meeting Minutes

August 17th, 2022 – 7:00 pm at the Divide Grange
Zoom option also provided

In Attendance

In-person: Tana Nulph, BHWC; Ben LaPorte, BHWC; Tom Bowler, Resident; Betty Bowler, Resident; Jim Hagenbarth, Rancher/BHWC; Paul Cleary, Resident/BHWC; Randy Smith, Rancher/BHWC; Jim Dennehy, BSB Water/BHWC; Jarrett Payne, MFWP; Cass Kohler, MFWP; Roy Morris, GGTU/BHWC; Sean Claffey, TNC/Southwest Montana Sagebrush Partnership; Liz Jones, Rancher/BHWC; Cliff Bradley, Montana BioAgriculture; Egan Jankowski-Bradley, Montana BioAgriculture; Diane Hutton, Resident/BHWC; Mark Kambich, Rancher/BHWC; Matt Norberg, DNRC; Sonny Thornborrow, USFS; Sean Lewis, NRCS; Mike Geary, Outfitter/Trout Unlimited; and Karlie Reilly, Granite Headwaters Watershed Group.

Zoom: Tyler Kamp; Breanne (no last name), and iPhone user (no name given).

Meeting Minutes

BHWC monthly meetings are held at the Divide Grange with a virtual (Zoom) option provided thanks to Southern Montana Telephone Company, who donated the internet service. Meeting minutes and recordings are available at <https://bhwc.org/monthly-meetings/> (scroll down for meeting minutes archive). Printed copies are available during in-person meetings. Contact Tana Nulph, BHWC Associate Director, at tnulph@bhwc.org or (406) 267-3421 to suggest additions or corrections.

Reports

Streamflow and Snowpack Report – Matt Norberg, Department of Natural Resources and Conservation

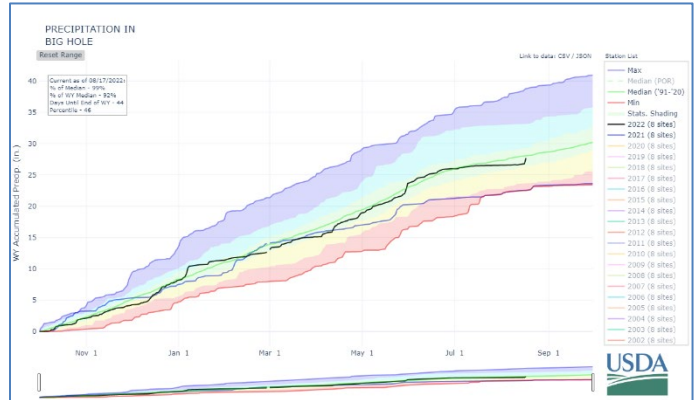
- *Streamflows:* Streamflows in the Big Hole River watershed are below to well below average for this time of year. Hot and dry conditions have brought streamflow levels to near base conditions earlier than the median. Lower streamflows also lend to increased water temperatures and increased biologic

Big Hole Stream Gages			Gage height, feet	Dis-charge, ft ³ /s	Long-term median flow 5/18	Temperature, water, deg C
Station Number	Station name	Date/Time				
■ UPPER MISSOURI RIVER BASIN						
06024450	Big Hole River bl Big Lake Cr at Wisdom MT	08/17 06:45 MDT	1.74	14.5	27.0	14.8
06024540	Big Hole River bl Mudd Cr nr Wisdom MT	08/17 07:30 MDT	2.84	66.2	99.0	--
06024580	Big Hole River near Wise River MT	08/17 06:45 MDT	--	--	---	13.7
06025250	Big Hole River at Maiden Rock nr Divide MT	08/17 06:45 MDT	2.76	266	327	15.3
06025500	Big Hole River near Melrose MT	08/17 07:15 MDT	1.24	207	360	16.6
06026210	Big Hole River near Glen MT	08/17 07:30 MDT	2.16	200	257	17.8
06026420	Big Hole R bl Hamilton Ditch nr Twin Bridges, MT	08/17 06:30 MDT	0.360	86.8	161	18.3

instream growth (i.e., algae). Fishing closures include Hoot Owl restrictions on Section II and Section IV and full fishing closures on Section I and Section V (effective 08/17/22).

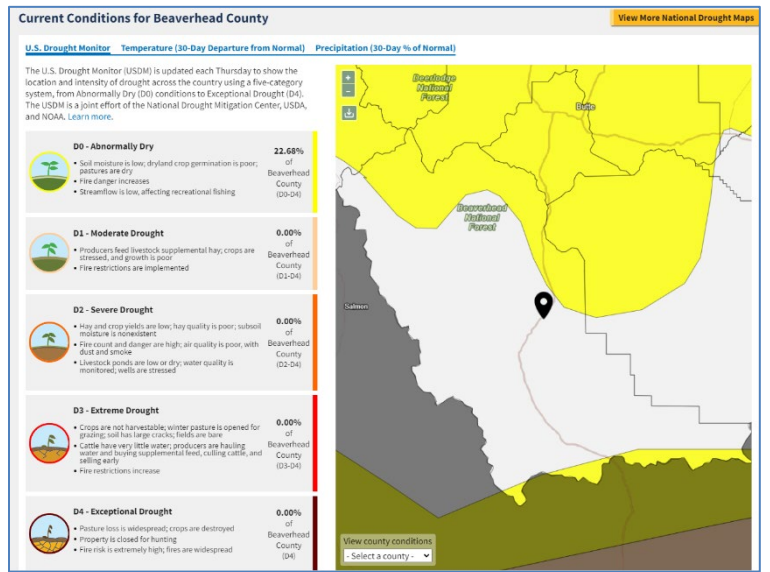
41D 01000	Big Hole River abv Jackson, MT	Upper Missouri Basin	8/17/2022, 6:45 AM	17.28	0.88	10.75
41D 02000	Big Hole River abv Spring Cr nr Jackson, MT	Upper Missouri Basin	8/17/2022, 6:45 AM	20.09	1.51	11.66
41D 05000	Big Hole River at Miner Creek nr Jackson, MT	Upper Missouri Basin	8/17/2022, 6:45 AM	37.35	0.94	12.94
41D 08000	Big Hole River near Wise River, MT	Upper Missouri Basin	8/17/2022, 6:45 AM	134.62	2.48	13.70

- Precipitation:** Precipitation in the Big Hole is currently 99% of median values and 92% of the total Water Year. The Water Year ends on September 30th, with 44 days remaining. According to the graph

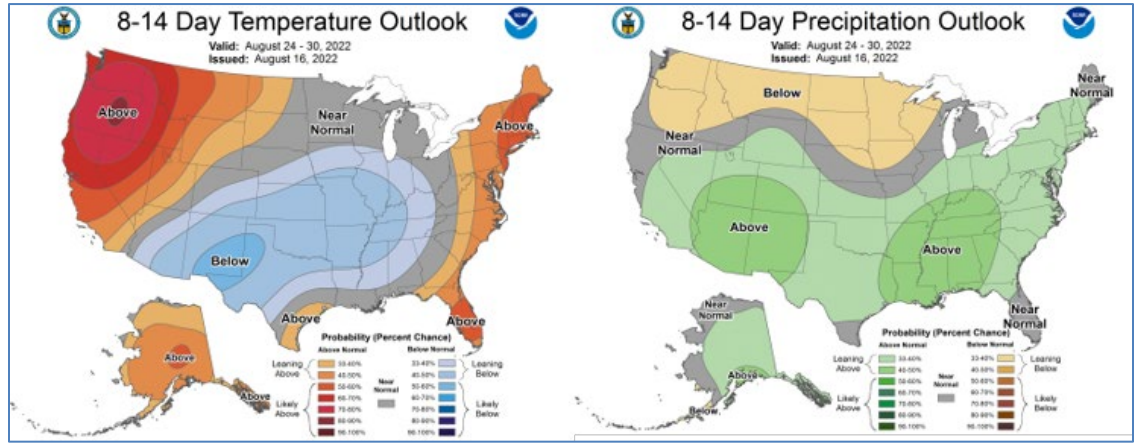


- and reliving nightmares from last year show that 2022 has been much kinder to the Big Hole than 2021 in terms of total precipitation. However, with the exception of some storms lately, July through the beginning of August has been dry which is directly correlated to the steady decline in streamflows. Timing and intensity of precipitation has a direct impact on soil and streamflow conditions.

- Drought Status:** The Big Hole drought status ranges from NONE to D0 (abnormally dry), with the majority of the watershed in no drought status. The Big Hole Watershed made tremendous improvements this spring and early summer due to late season improved snowpack, cooler temperatures, and rainfall. Hot and dry conditions for the last month have dried out soils, range, and forest conditions and without precipitation we could easily slip back into advanced drought conditions.



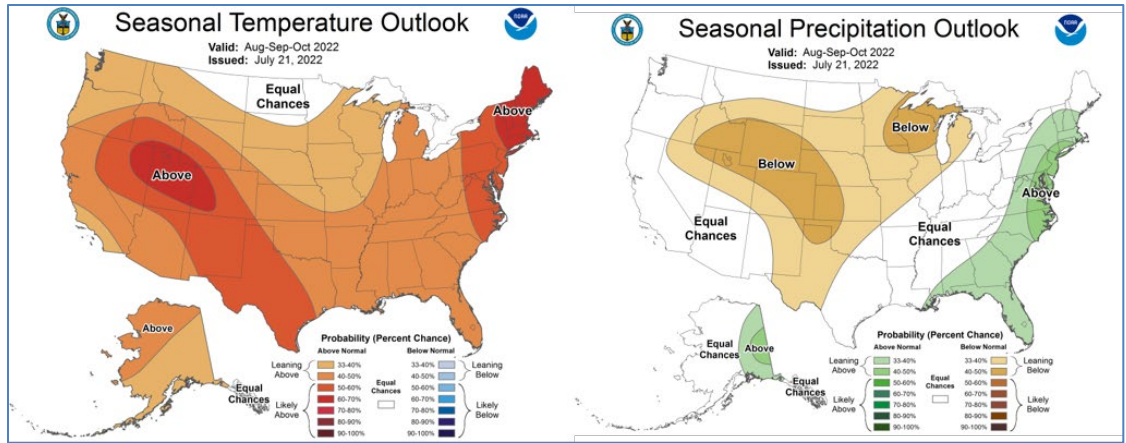
- Outlook:** The 8-14 day outlook predicts above average temperatures and below average precipitation. The dog days of summer appear to continue for the foreseeable future. Localized thunderstorms are always possible, but the predictions continue to call for hot and dry conditions for SW Montana.



- Seasonal Outlook:** The three-month outlook does not shy far from the current conditions, warmer and

drier than normal conditions are predicted to persist into the Fall.

- **ENSO Alert System Status:** La Niña Advisory (from NOAA)



- **Synopsis:** La Niña is expected to continue, with chances for La Niña gradually decreasing from 86% in the coming season to 60% during December-February 2022-23.
- **La Niña three-peat?**
 - La Niña conditions are expected to persist through early winter and potentially through February and gradually transition to neutral conditions. This is only the second time a three-peat La Niña has occurred in the period of record (73 years).
 - What does this mean for the Big Hole? The answer is...we don't know! La Niña conditions in Montana typically mean colder and wetter winters, but the past two years have not played out like that. Does this mean that the La Niña trend is changing for MT? Possibly, but until more data is available, we won't really know, it's still early to be making solid predictions for our upcoming snowpack. The general climatic trend is showing warmer and drier conditions in general with shorter more intense storms. SW Montana has been in shortage the last couple of years especially in late summer. Current long-term predictions do not show this trend changing.

Director's Report – Pedro Marques, Executive Director

- Moving at the speed of trust – trusting in our staff, board of directors, and steering committee
- Drought Plan in full effect – improving communications around drought:
 - Press release and MTPR interview
 - Text DROUGHT to 26989 or email us at info@bhwc.org to join weekly drought update text message list
 - FWP Protocol for calling water defers to local management
 - FWP holds water rights in the Big Hole (about 150 cfs total) from the 1970s – outlining process for calling on water rights
 - FWP says they will defer to local drought plan so as not to undermine the local cooperation and collaboration that is happening in the Big Hole.
 - Is voluntary water conservation and drought management perfect? Of course not. But we are dealing with the reality of overallocated water resources and changing climate/precip patterns that just don't jive with each other. Our continued commitment to voluntary conservation is really the best thing we have going.
- Water Storage Subcommittee – improving the land's ability to store water
 - Have already done a lot of this with natural storage, but beaver mimicry is not going to solve all of our problems in the Big Hole. Need to look at a combination of natural and hard storage.
 - Reviewing old reports (2005) that assessed potential areas/opportunities for water storage
 - New Water Storage Subcommittee met July 18th

- Next up: seeking funds for hard and natural storage modeling effort from RDGP Planning Grant and BoR
 - Hire an engineering firm to develop a model of the upper river
 - Focused on keeping a minimum of 20 cfs at Wisdom year-round
 - Model will allow us to assess what the impacts would be of implementing different strategies for water storage
- Different from 2005: Not looking to identify ONE place to implement water storage in the Big Hole. This alternatives-based model will allow us to have real discussions about which direction to go in. May have to implement multiple large projects to get where we need to go. Need to understand water rights/cost implications for each alternative.
 - Long-haul effort, will require some general capacity funding to keep the ball rolling
- Wise River measurement and BoR funding request
 - Will give us a good idea of where we're losing water, where water is heating up, and where we will need to focus restoration efforts
 - Eagle Rock Ranch – purchased by Western Rivers Conservancy – BHWC provided recommendations to WRC about how they can manage the land before conveying it to the USFS. Exciting new partnership with WRC, USFWS, and USFS.
 - Applied for funds to improve irrigation infrastructure in Wise River area
- Foundation support – Cinnabar, Azeez, High Stakes, Patagonia
- BHWC Map available with donation. First 50 ready to go! Benefit Big Hole Conservation Fund. Order yours here (free with \$30 donation – includes shipping):
<https://bhwc.harnessapp.com/wv2/campaign/7825>
 - We will also have some available at our next monthly meeting (September 21st). If picked up in person, they are \$25.
- Infographic for private FAS; word changes for public signs (BLM, FWP)

Steering Committee Report – Randy Smith, Chair; Jim Hagenbarth, Vice-Chair; Roy Morris, Secretary

- Focused on ensuring BHWC delivers on all of its commitments without staff experiencing burnout.

Wildlife Report – Tana Nulph, Associate Director; Jim Hagenbarth, Rancher; Dean Peterson, Rancher

- 2022 Range Rider program:
 - Funding: Livestock Loss Board, NRCS- WLA/HoTR
 - Found remains of a wolf carcass
 - Identified 2 injured livestock and 1 carcass, but so far none were eligible for reimbursement
 - Multiple wolves photographed/tracked
 - Found grizzly bear tracks in multiple locations

Restoration Report – Ben LaPorte, Program Manager

- Upper Oregon Creek
 - 99 Beaver Dam Analogue structures installed – June 15-29
 - Partners: Watershed Consulting, Montana Conservation Corps, Wild Rockies Field Institute volunteers, Wisconsin church group volunteers
 - Gully check dam installation – August 8-18
 - Partners: Watershed Consulting
 - Up next:
 - MCC revegetation hitch
 - Helicopter seeding and fertilization (25 acres)

- French Gulch Fish Passage:
 - Construction began July 18th
- Elkhorn Mine and Mill:
 - Soils characterization field work complete
 - Mycelium on-site pilot bio-absorption filtration project is beginning
 - Additional MTech adit flight conducted
- Other Happenings:
 - Anaconda Uplands 2022 performance monitoring report
 - Field work and report writing
 - Monthly Wise River monitoring continues
 - Next round of data collection is scheduled for late August
 - Project planning:
 - Smith-Sage Springs Mesic Restoration
 - AFS Spokane conference – Ben is presenting

New Business

- Board Elections – Sean Claffey, The Nature Conservancy
 - **Consensus: The Board reached consensus and welcomed Sean to BHWC. Congratulations, Sean!**

Break – 10 minutes

Meeting Topic:

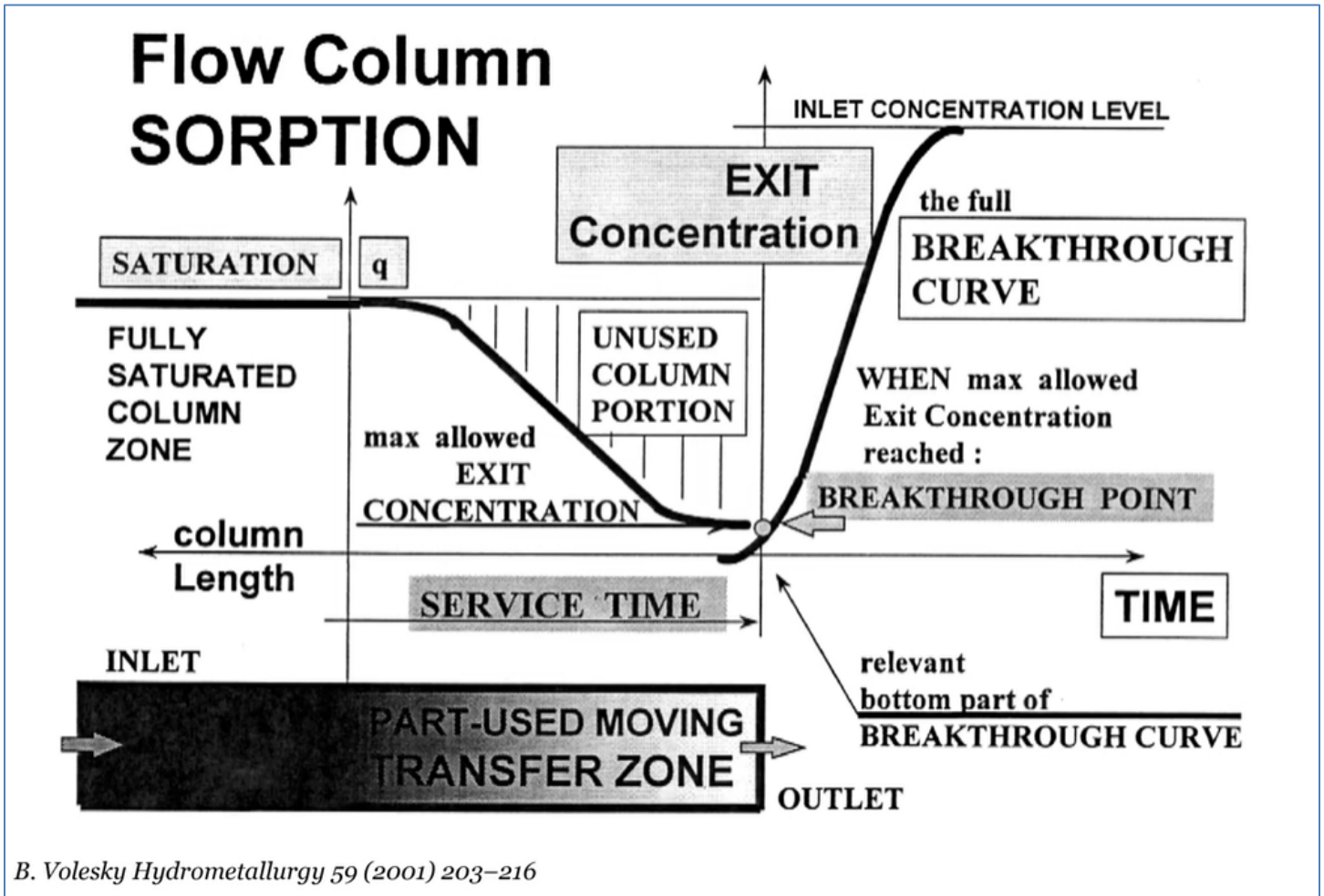
Using Fungi to Remediate Acid Mine Drainage – Elkhorn, Montana

Presented by: Cliff Bradley, CEO and Egan Jankowski-Bradley, Lab & Field Manager

- Biosorption of heavy metals – positively charged metal ions (lead, zinc, copper, etc.) absorb to negatively charged biological material
 - Academic research over many years (decades)
 - Different biosorption materials, testing everything from seaweed to wood waste to activated carbon (not much seaweed in Montana and activated carbon is expensive)
 - Fungi found to be among most efficient; subject of research beginning in the 1980s. Variables addressed by research:
 - Mechanisms
 - Different metals
 - Water condition, pH metal types, concentrations
- Fungal metals biosorption
 - In lab comparisons, fungi better biosorption than most other materials
 - Many different fungal species tested in lab systems
 - *Rhizopus* genus consistently the most effective
 - *Rhizopus*
 - Common soil fungus worldwide
 - Non-pathogenic (used to ferment soybeans into Tempeh)
 - Industrial uses (lactic acid)
 - Project uses domestic US isolates (no importing of exotic organisms)

- Don't actually work with the mushroom form of the fungus, but rather the mycelia, which are interconnected networks of thread-like cells (resembling roots).
- Biological ion exchange
 - *Rhizopus* cell wall structure
 - Negatively charged sites in cell walls bind positively charged metal ions
 - Cells do not need to be alive
 - Lab studies with pure cells – basically all of these studies have been in sterile lab settings to work out the mechanisms. The next step will be applying it to the real world.
 - Binding and mass transfer rates for different metal, ions particle size
 - Capacity for different metal ions, grams metal/gram cells
 - pH and metal concentration other variables to optimize sorption of different metals
 - Single ions versus mixtures
 - Recycling cell mass
 - Fungi can adsorb 25-30% of cell dry weight in metal ions
- Lab Culture to Field Implementation – There have been several paper studies and proposals, but as far as we know, there have been no full-scale implementations of this technology.
 - Challenges/needs for field implementation:
 - Volume of gram cells needed: grams to tons
 - Water treatment: practical systems at mine sites
 - Working with real world contaminated water (can't adjust pH)
 - Scalable
 - Low cost
 - Disposal vs. recycle
 - Measure performance: basically comes down to volume of water treated/volume of total culture.
- The product: fungal biosorption columns
 - Recipe:
 - Corn cob fraction (woody interior pulp of the corn cob, can get very cheap and in bulk – railcars at a time!)
 - Barley flour (food – 5-10% of total mixture)
 - Water
 - *Rhizopus* biomass (spore culture)
- The process:
 - First tested process in beakers
 - Next, scaled up to columns (3" x 2') to test in the laboratory
 - Miniature models of what will be used at Elkhorn
 - Grow *Rhizopus* culture with recipe above, pack it in the columns, allow air flow, and wait 5 days for the spores to expand to fill the columns.
 - Run acid mine drainage (AMD) through columns.
 - Push water through from bottom to top. (If it goes from top to bottom, it will channelize and find the path of least resistance. By pushing it up from the bottom, it contacts every cell throughout the system.)

- The system doesn't require a particular saturation period or water pressure – as soon as the water reaches its saturation point inside the column, it immediately



binds to the fungus.

- Laboratory and field assays
 - Test strips
 - Energy Labs, Helena

Energy Laboratories Analysis Elkhorn Mine Adit Water 8-18-21	
Metals	Parts per million (ppm)
Arsenic	.075
Calcium	31
Copper	.302
Lead	.196
Magnesium	2
Manganese	2.07
Silver	.0007
Zinc	1.91

- Note: While this doesn't seem like much contamination, it's about the volume of AMD seeping from the mine. This stuff builds up over time and some of it can be particularly harmful to fish and aquatic insects.
 - Elkhorn Mine Adit and Stream
 - Pilot scale columns – 6" by 6'
 - Work plan:
 - Implement pilot-scale columns on-site at Elkhorn Mine adit multiple times
 - Will build a diversion basin of about 60 gallons
 - Will pump it into 4 consecutive columns
 - Will test water after each column to see where the "breakthrough" is happening.
 - 2nd week of September – larger demonstration with Ben, Pedro, and anyone else who is interested in seeing this in action!
- Compile data, confirm results with Energy Labs
- Continue work with another grant in coordination with Beaverhead County and the Big Hole Watershed Committee
- Work with USFS and BHWC to incorporate fungal biosorption as one component of remediation plan at Elkhorn mine site
- Remediate other AMD sites in MT

Rhizopus Lab Columns			
2 kilograms of biomass			
Hours	Volume Liters	Zinc ppm	Hardness ppm
	0	1.28	31
1	1.35		
2	3		
3	5.5		
4	8.2		
5	10.8	0.386	5
6	13.5	0.225	
7	17.3		
8	19.9	0.208	7
9	22.5		
10	25.2		
11	27.8		
12	30.65	0.161	
14	33.3		
15	37.6	0.42	
16	40.3	0.39	
17	43	0.35	9
18	46.9	0.37	
20	49.6		
21	52.3	.5	10

Upcoming Meetings

- September 21, 2022: **Sage Grouse and Wildlife Update by Montana Fish, Wildlife and Parks**
 - 7:00 pm at the Divide Grange/Zoom

Adjourn