

Project Title: *Promoting Community Resilience Through Understanding: Social Perceptions of Water Quality and Contamination in the Upper Clark Fork River Watershed*

Project Overview

Undergraduate students at the University of Montana Western (UMWestern), under the supervision of Dr. Arica Crootof, completed a survey of public use of and public perceptions of the Warm Springs Ponds near Anaconda, Montana. Funding for this project was provided by Montana NSF EPSCoR RII Track-1 CREWS Year 2 Seed Funding Award and a Workforce Development Supplemental Seed Award.

This research met the projects' two main objectives (1) to contribute new knowledge regarding the social dimensions of water quality and contamination in the Upper Clark Fork River Watershed in accordance with CREWS *Research Thrust 7: Natural Resource Social Science*, Goal 1.7; and (2) to broaden participation in water quality research by expanding research opportunities for undergraduate students at UMWestern.

From January 2020 to July 2022, 42 undergraduate students at UMWestern contributed to this research project. Students learned how to collaboratively design and implement social science research. Drawing on a literature review covering social-ecological systems, wicked problems, use-inspired research, co-production of knowledge, and social trust in river restoration, students created a collaborative research design that was presented as part of MSU's Rough Cut Seminar Series. To co-design the public survey, our group worked closely with members from the Clark Fork Coalition, Natural Resource Damage Program, University of Montana, U.S. Environmental Protection Agency, Montana Fish, Wildlife, and Parks, as well as Atlantic Richfield Company. Students were trained in survey design, semi-structured interviews, participant observations, thematic coding and analysis, as well as research dissemination. Several students presented research results through a public Zoom presentation on October 7, 2021. In addition to the new knowledge about recreation use of and public perceptions of the Warm Springs Ponds, new undergraduate research curriculum was developed, students gained new research and professional skills and finally, new partnerships were formed.

Why Focus on the Warm Springs Ponds?

After over 30 years of clean-up efforts in and around Butte, Anaconda, and Milltown, MT, a final clean-up plan is needed for the Warm Springs Ponds (currently in maintenance mode). Historic hard rock mining and smelting in and around Butte and Anaconda, MT led to heavy metal contamination in the rivers and the sediment flowing from Butte to Milltown, MT. As part of [U.S. EPA's Superfund](#), clean-up activities have taken place on the Butte Hill, along Silver Bow Creek, within the Upper Clark Fork River, and at Milltown. Today, federal and state agencies and community organizations continue to work together to reduce heavy metal contamination in sediments, surface water, tailings, soils, and groundwater to protect public health and restore the natural environment. [With a final clean-up plan established for Butte and the Berkeley Pit](#), attention is now turning to the Warm Springs Ponds.

The Warm Springs Ponds are used by lots of people in lots of different ways. There is a need to understand who uses the Warm Springs Ponds, how they use the ponds, and why or why not. This research sought to understand the public's use of and opinions about the Warm Springs Ponds. Below, we present our results to share the information we collected with the public, agencies, and organizations to incorporate the public's interests in the planning process moving forward.

What Are the Warm Springs Ponds?

The Warm Springs Ponds are a series of water treatment settling ponds at the headwaters of the Clark Fork River that help trap heavy metals including copper, arsenic, cadmium, lead, and zinc, and limit these heavy metals from entering the River. These ponds were built by the Anaconda Company between 1911 and 1959 and are currently maintained and operated by Atlantic Richfield (a subsidiary of British Petroleum) and cover about 2,500 acres.

While these ponds are locally known for growing trophy-sized trout and providing critical habitat for migratory birds, their main purpose is treatment and containment of mine waste. The ponds system is estimated to hold more than 19 million cubic yards of contaminated sediment, more than 6 times the amount of sediment removed from behind Milltown Dam. These ponds supply water to the Upper Clark Fork River where water quality and temperature are a concern. The water leaving the Warm Springs Ponds, combined with Mill-Willow Bypass and Warm Springs Creek, form the upper Clark Fork River. Fish numbers in the Upper Clark Fork River are currently at an all-time low since the 1960s and 1970s.

Where Are the Warm Springs Ponds?

The Warm Springs Ponds are located about 22 mi west of Butte along Interstate-90 near (Exit 201; Figure 1). Water from Silver Bow Creek flows into the Warm Springs Ponds. The ponds are used to help settle out tailings particles and other solids to reduce heavy metal concentrations. Once the water leaves the Warm Springs Ponds it flows to the confluence of the Mill-Willow Bypass and Warm Springs Creek, which marks the beginning of the Upper Clark Fork River. These ponds lie on the aboriginal territories of the Salish, Pend d'Oreille and Kootenai people.



Figure 1: Map of Warm Springs Ponds near Anaconda, Montana provided by U.S. EPA

Methods

Coproduction of Public Survey with Project Partners

We first conducted semi-structured interviews with representatives from a variety of non-profits (i.e. Clark Fork Coalition, Trout Unlimited), government agencies (i.e. Montana Fish Wildlife & Parks, U.S. Environmental Protection Agency, Natural Resources Damage Program, MT Department of Environmental Quality) and community representatives (i.e. Butte Citizen Technical Advisory Committee (CTEC) and local government officials) to better understand the concerns and interests surrounding the Warm Springs Ponds. Working closely with members from the Clark Fork Coalition, Natural Resource Damage Program, U.S. Environmental Protection Agency, Montana Fish, Wildlife, and Parks, and Atlantic Richfield Company, we worked to co-produce survey questions that met the needs and interests of our project objectives and our partners.

Data Collection & Analysis

The final questionnaire, *Public Survey: Warm Springs Ponds, Montana*, consisted of a mix of 48 closed and open-ended questions. The questions collected data on topics ranging from demographic information, prior knowledge about the Warm Springs Ponds, use of the Warm

Springs Ponds, heavy metal contamination concerns, as well as impressions of the Warm Springs Ponds, and recommendations for the future. The survey was administered through the program SurveyMonkey and was open for 149 days at wpsurvey.org. Posters with a QR code to our website were displayed at the ponds and in nearby communities. The website and survey information were also shared via Facebook groups as well as community organization and agency listservs. A total of 348 responses were recorded from June to August 2021. Students conducted participant observations at the ponds for a total of 120 hours. They were observing who was visiting the ponds and from where (based on license plates) as well as where, when, and how the ponds were being used. This data was used to supplement the online questionnaire data. Quantitative data from close-ended questions were graphed using SurveyMonkey or MS Excel. For the open-ended questions, thematic coding was applied in MS Excel to sort and analyze the variety of responses. Survey responses that did not answer the question asked were either (a) regrouped or (b) not considered.

Study Limitations

Originally the plan was to conduct interviews and the questionnaire in person at the ponds in addition to having an online survey. However, due to COVID-19 complications over the summer of 2020, we moved to remote interviews and an online questionnaire. A benefit of the global pandemic was that we received a year extension on the project that provided more time to co-produce the survey, collect data, analyze data, and disseminate results. Our questionnaire favors local residents and was limited in the amount of time it was available and the accessibility of it being online. While our participant observations helped to supplement data from the online questionnaire, we were limited to 120 hours of observations which is far from exhaustive. Furthermore, recreational use of the ponds was likely down during the summer of due to the heat, drought ('hoot owl' fishing restrictions were in effect), and wildfire smoke.

Results

Public Survey: Warm Springs Ponds, Montana

Percentages displayed below may not equal 100% which may be due to either (a) rounding errors or (b) questions or coding methods that allowed respondents to have multiple answers.

There were 348 people who began filling out the survey, *Public Survey: Warm Springs Ponds, Montana*, and approximately 88% (306 of 348) completed the survey. The majority (97%) of the people who completed the survey were from Montana. Of the 310 survey responses on location, only 3% were from out of state. For this study we targeted the urban areas near the Warm Springs Ponds and most of our responses were from Butte, Anaconda, and surrounding towns. Figure 2 below shows the percentage of respondents from the top 5 locations.

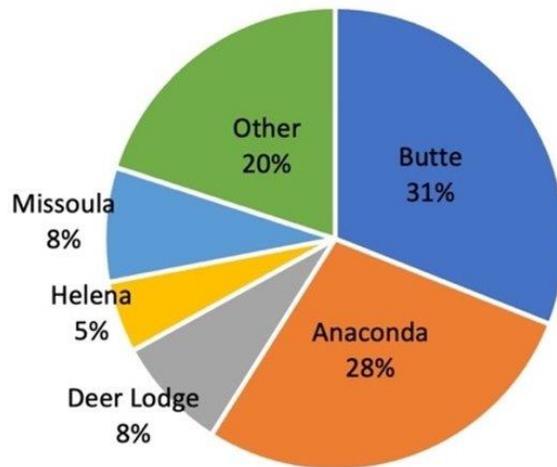


Figure 2. Distribution of survey participants from Montana (N = 312)

To participate in the survey you had to be over the age of 18. The range of participant ages spanned from 21 to 82. The median age was 56 years old. Approximately 90% of the participants (283 of 315) had visited the ponds before taking this survey. Of those who had never visited the ponds (n=30), they didn't visit because (a) not knowing about them, (b) not compelled to stop there, or (c) avoiding the contamination at the Warm Springs Ponds. Of the 265 responses, 55% visited the ponds by themselves, 54% visited with their friends, 58% visited the ponds with older family, and 26% visited with their children (participants could chose more than one option). When asked how frequently survey participants visited the ponds (n=281) we found 35% were 3-5 times per year (*sometimes*), 30% 5-20 times per year (*regularly*), 19% were more than 20 times a year (*frequently*), and 17% were less than 3 times a year (*rarely*) (Figure 3).

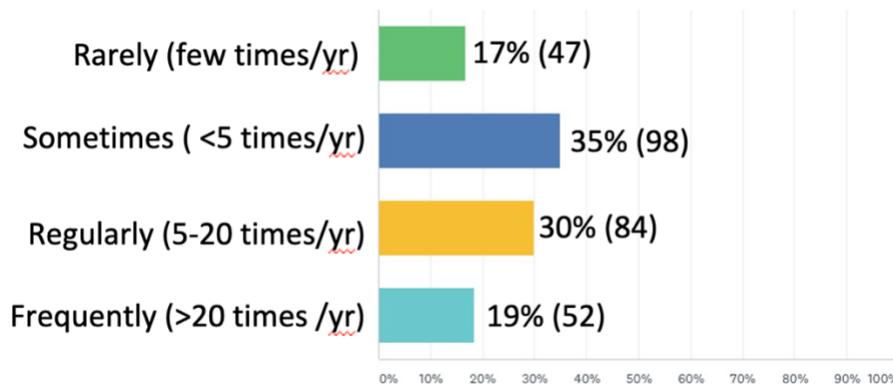


Figure 3: Approximate length of time survey participants spend at the Warm Springs Ponds (n=281)

When asked about the general impression of the Warm Springs Ponds, 82% had positive impressions (32% stated very favorable and 50% said favorable) while 12% had negative impressions (3% stated very unfavorable and 9% said unfavorable) (Figure 4). Approximately

6% of the respondents hadn't been to the Ponds and had no opinion. Of the 216 participants with favorable and very favorable impressions of the Ponds, 41% said it was because of the fishing, 60% said it was because of the wildlife, 42% said it was because of the scenery and habitat, and 40% said because of the trails and hiking opportunities (participants could choose more than one option). Of the 38 participants that answered they had unfavorable or very unfavorable impressions, 18% said it was because of the water quality and treatment; 10% said it was because of the lack of risk management; 4% said it was because of the lack of maintenance and cleanliness of the ponds; and 3% said it was because the fishing needs improvement.

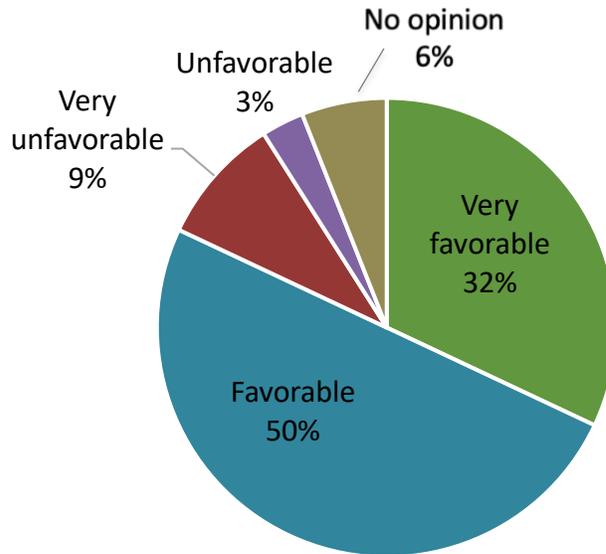


Figure 4. Distribution of Survey Participant's Impression of the Ponds (multiple choice answer, n=317)

We wanted to know how informed survey participants were about the ownership, management, and heavy metal contamination of the Ponds so we asked several prior knowledge questions on these topics. Of the 317 respondents, 97% knew where the Ponds were located (3% had no previous knowledge of where the Warm Springs Ponds were located). The majority (74%) of respondents knew the Warm Springs Settling Ponds are currently owned, maintained and operated by Atlantic Richfield Company (26% did not know this information). When asked if they knew that Montana Fish, Wildlife & Parks runs a designated wildlife management area in the Warm Springs Ponds Operable units 92% of respondents knew with only 8% unaware of this information).

When asked, "how would you best describe your knowledge of the Warm Springs Ponds acting as a settling basin to reduce heavy metal concentrations from Silver Bow Creek into the Upper Clark Fork River and heavy metal contamination of the Warm Springs Ponds", 83% felt knowledgeable with 33% indicating 'very knowledgeable' and 50% "somewhat knowledgeable" compared to 10% that felt 'not very knowledgeable' and 7% having 'no knowledge'. In order from highest to lowest, respondents (n=306) said they got their information about the ponds from: visiting the ponds (55%), news sources (46%), word of mouth (40%), public meetings

(22%), school or university (17%), work (17%), online search engine (11%), other (6%) (respondents could choose more than one answer).

We asked, ‘Before getting this survey, how concerned were you about the human health effects of heavy metal contamination in the Warm Springs Ponds?’ Of the 304 responses, 27% were ‘Very Concerned’, 40% ‘Little Concerned’, 27% ‘Not Very Concerned’, and 6% ‘No Concerns’ (Figure 5).

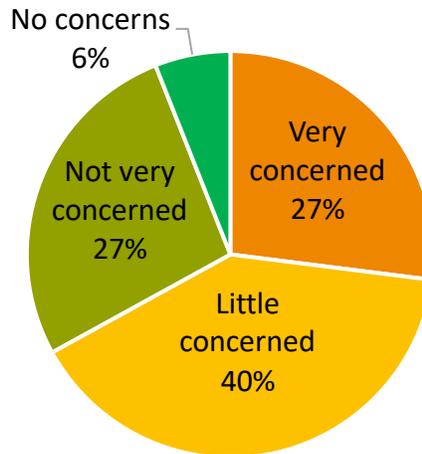


Figure 5. Level of concern of survey participants regarding human health effects of heavy metal contamination in the Warm Springs Ponds (multiple choice question, n=304)

We let survey respondents know that limited studies have been conducted on bioaccumulation of metals in waterfowl at the Warm Springs Ponds. Given this information, we then asked how concerned respondents were regarding the potential for heavy metal accumulation in wildlife and found given four choices, nearly half (49%) chose ‘very concerned’ (Figure 6).

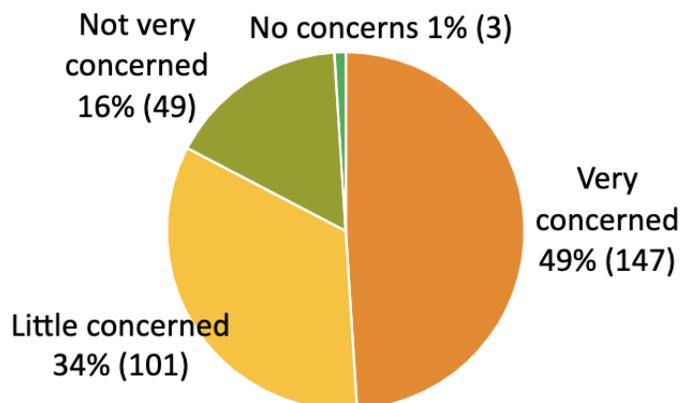


Figure 6 – Distribution of how concerned survey respondents were regarding the potential for heavy metal accumulation in wildlife (multiple choice question, n=306)

We also asked how concerned respondents were about consuming meat from ducks at the Warm Springs Ponds and found 43% were ‘very concerned’ (Figure 7). A reason why there is less concern about eating duck meat, than bioaccumulation could be because many respondents do not consume duck meat from the ponds, and therefore are not concerned, however this is speculative. The authors of the survey realize the wording could be interpreted differently than intended for this question.

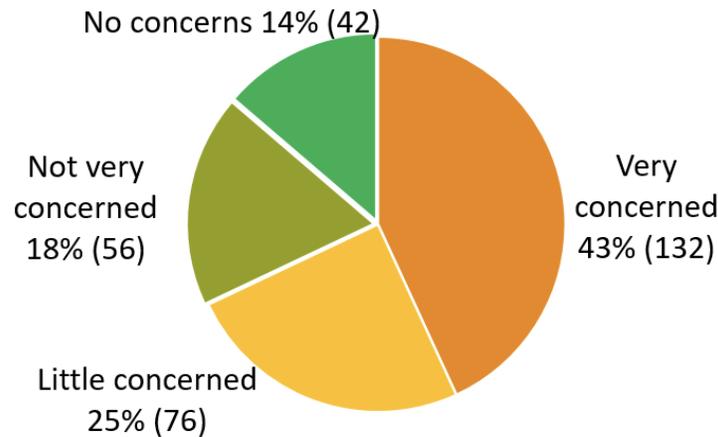


Figure 7 - Distribution of how concerned survey respondents were about consuming meat from ducks at the Warm Springs Ponds (multiple choice question, n=306)

Of the 306 respondents, 73% knew you weren’t allowed to swim in the ponds and 27% said they had no knowledge that they weren’t allowed to swim in the ponds prior to taking this survey. Prior to taking this survey, 82% knew that fishing was limited to catch-and-release only and 18% did not know that fishing is catch-and-release only at the Warm Springs Ponds (n=306).

Table 1 below shows a summary of popular activities performed by the respondents that recreate at the ponds by season. When we asked respondents about other activities they perform at the ponds, we received an additional 98 responses. These included (a) peaceful recreation (20%) which included picnicking, photography, berry picking, leisure drives, and enjoying peaceful surroundings, (b) boating (12%) which included kayaking, canoeing, drift boating, sailing, and paddle boarding, (c) running and walking (7%), work-related trips (7%) as well as swimming, kite skiing, social (1% each).

Activities by Season (participants perform multiple activities)					
Activity	N = 278	Spring	Summer	Fall	Winter
Relaxing	66%	49%	53%	46%	21%
Wildlife Watching	65%	54%	47%	48%	19%
Hiking	62%	46%	47%	43%	16%
Fishing	47%	23%	32%	19%	4%
Dog Swimming	18%	10%	15%	8%	2%
Hunting	17%	-	-	15%	6%

Table 1. Popular recreation activities performed at the ponds by season. The highest percentage for each category is boxed (n=278)

When asked if survey respondents were interested in learning more about the Warm Springs Ponds, 75% (N=301) said that they would like to learn more about the Warm Springs Pond (25% were not interested in learning more). We also asked what topics they would like to learn more about and the distribution of the 248 answers as shown below (Figure 8).

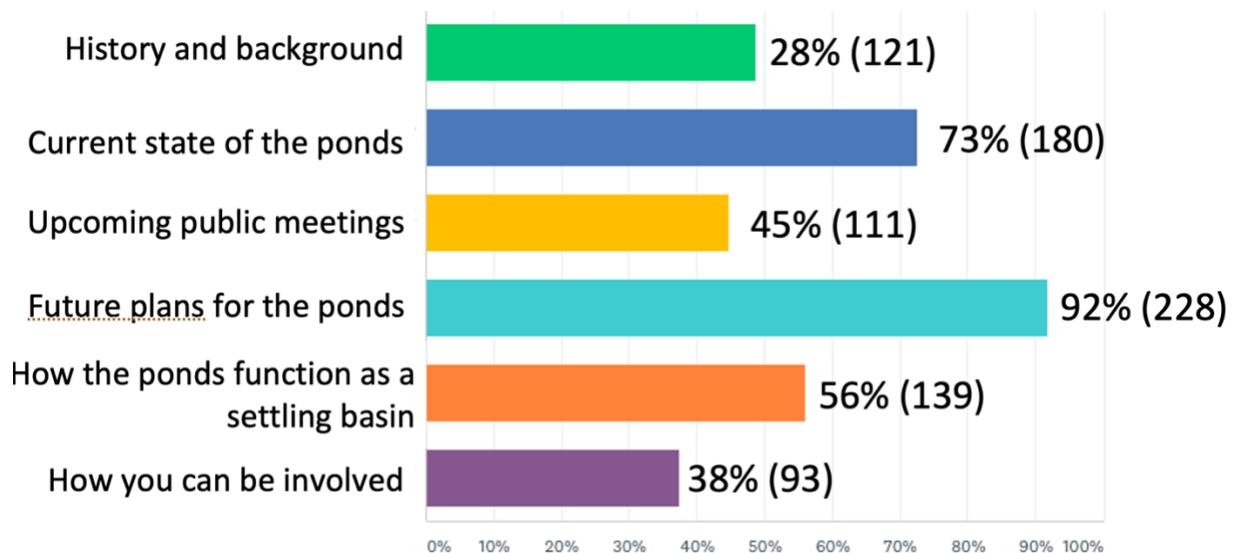


Figure 8. Topics that survey participants would like to learn more about regarding the Warm Springs Ponds (n=301)

Open-Ended Question Responses

As part of the survey, we had several open-ended questions to allow for descriptive responses from survey participants. These responses were thematically coded. Responses were grouped into categories for data analysis. Participant responses could be coded under several categories. For example, an answer such as “Clean contamination, preserve habitats and educate the public about safe usage” was coded under “water quality improvements”, “habitat protection” and “public education”.

We asked, “If there was one thing about the ponds that you could preserve and maintain into the future, what would it be?” and had 247 responses that were coded for analysis. We found the greatest support for wildlife (32%), fishing (28%), and habitat (28%) protection (responses were coded for more than one topic as needed). Recreation opportunities (21%) and public access to the ponds (20%) were also greatly appreciated. 15% of respondents wanted to keep the water quality improvements or settling pond function. 12% of the respondents requested to keep the ponds as they are. 8% wanted to keep the peaceful, quiet nature of the ponds. 3% of respondents wanted to preserve the history and educational resources of the ponds.

We asked, “If you could suggest improvements for the Warm Springs Ponds, what would you recommend?” and had 196 responses that were thematically coded for analysis. 55% of the respondents suggested water quality or land reclamation improvements for the Warm Springs Ponds with 10% requesting complete removal of the contamination and/or ponds. 16% suggested wildlife and habitat improvements. 11% indicated fishing and public access improvements. 9% indicated vegetation, general recreation, and facilities improvements and 9% wanted more research and public education related to the ponds and contamination issues.

We asked, “Are there any concerns or comments you would like us or the agencies to know about the Warm Springs Ponds?” we had 99 responses, 11 of which were questions. Of the 88 concerns analyzed, 25% wanted the ponds preserved. Some of these comments wanted them untouched, while others wanted them persevered and improved upon. For example, several respondents (6%) were concerned that restoration activities would harm fish populations. While 28% of the responses were concerned about the heavy metal contamination and wanted to see improvements made to address water quality issues. 17% had concerns about downstream risks and public health associated with the heavy metal contamination. 2% indicated that they wanted the ponds completely removed. A small number, 5% wanted to see more research on the contamination. Some other concerns included science communication at the ponds, public access, enforcement of rules and regulations, fishing restrictions, public education, maintenance, and clean-up of the recreational area. Several respondents noted the great improvements that have been made to this area for people, fish, and wildlife.

A selection of answers to the open-ended questions are presented below to share the voices of the survey respondents and highlight the range of answers that this survey generated.

Impressions of the Warm Springs Ponds:

- *We love the area and it's public access to the recreational activities that are presently there and we appreciate any additions to this great spot.*
- *Yes, I believe that my wife and I would be the first to lay down in front of bulldozers if it came to that in the future.*
- *The questions in this survey are surprising - you make it sound like a recreation area when it is a place to be avoided.*
- *I don't think that the ponds would be as valuable if any of the parts were taken away. Without the wetland areas and shorelines, the benefits to waterfowl would be gone and a major migration stop, nesting area, and waterfowl hunting location would be lost. Without the ponds and water management on site, the fish and recreational opportunity would be removed. Without the "dryland" areas and security cover provided by the willows and riparian sections of the site, habitat for mammals, etc. would be eliminated and without the access points, roads/travel routes through the site, as well as the features that are maintained by the FWP many recreational opportunities would be lost. I guess that I would prefer to preserve/maintain the site as a whole.*

Wildlife & Habitat Protection

- *Improved habitat for birds and fish*
- *More habitat for shorebirds*
- *Protect people and wildlife*
- *They have huge fish in them, and it needs to be preserved for the wildlife!*
- *We ARE HAPPY & use to have 4-season access to the WS Ponds, but would VERY MUCH APPRECIATE any environmentally sensitive improvements or modifications that would protect and make this area more natural and less of a hazard to visitors including people AND native wildlife*
- *The habitat for the animals. The multiple ponds allow for space for the birds*
- *Keep the birds and wildlife safe and happy*

Keeping The Ponds & Improving Upon Them

- *They are a valuable recreation area as they are. Please don't disturb them*
- *Please keep the ponds. We love them. The birds love them. The wildlife love them*
- *They are some of the best places to watch a variety of birds around Butte...*
- *Warm Springs Ponds are a necessary part of the clean-up of our mining waste and should not be dismantled on a whim. The ponds have been doing a vital service in the clean-up and treatment of the water and as far as I can see they have been a success. Perhaps you should consider adding additional ponds...*

- *The Warm Springs Ponds are "diamonds in the rough". Done properly, further environmental and recreational opportunity improvements will enhance wildlife habitat, tourism and human safety*

Heavy Metal Contamination & Health Risks

- *My concerns are that the ponds would require long term maintenance and that if the dams breached, it would be catastrophic consequences for the river downstream. Once upstream sources are cleaned up. Material should be removed from the ponds and capped*
- *The company that contaminated them fix the issue and put the ponds back to how they are*
- *Knock off the phony claim that any of this is "cleaned up." It's not -- it's covered up. One good earthquake or a serious winter ice event and the Warm Springs Ponds earthen dams can and may fail, sending millions of tons of highly-toxic sediment downstream and negating basically all the remediation work done so far. This is a highly dangerous site with ancient "dams" and should be removed completely*
- *Need better water quality so the fish are safe to eat*

Public Access

- *Open up roads around the ponds for disabled folks to access the ponds*
- *Public access, complete the remediation*
- *Public access via vehicle on at least some of the dikes.*
- *Reduce the contaminates. Closer parking access from the interstate. Currently there is a lot near exit 201, but you cannot get across the river. It would be nice to have a bridge there*
- *Remediate the ponds. Make swim beaches. Specify what area people can fish (nowhere near swim beach). Leave as catch and release. Work at creating great fish spawning area that are closed to recreation. Keep motorized boats out.*
- *More access points*

Infrastructure & Maintenance

- *Need more benches throughout the complex*
- *The pavilions could use some serious clean-up of the accumulated bird poop.*
- *Better road system - more roads. More maintained garbage receptacles, outhouses. Developed swimming areas, beaches*
- *Covered areas to watch the wildlife from*
- *Cleaner more user friendly. Better recreational site for local families*
- *More and better trails & a place to camp*

Fishing

- *Any opportunities for expanded wildlife habitat and fisheries expansion*
- *I see Fish and Game personnel killing fish in nets. If F&G were to work with anglers, I'm sure they may be able to save the lives of many fish*
- *Fishing in the ponds can be really good if you know exactly where to go, I'd like to see more fish throughout the ponds, and id also especially like to see the return of brown trout there*
- *If safe to, allow keeping fish that are caught*
- *Improve wildlife habitat, provide deeper holes & fish structure in the ponds. Improve aesthetics*
- *Keep it stocked with big fish!*

Education & Research

- *The story of the toxic minerals that were there and the damages they caused to people and animals. That it needs to remind us not to do it again*
- *Sees little public notice is presented to public until somethings goes wrong*
- *Keep public informed. I feel the recent work on upper Clark's Fork has had a detrimental effect on the brown trout population. I feel keep it catch and release*
- *It would be most interesting for updates on the birds, waterfowl and turtles visiting the ponds*
- *It would be good to see a study on how much the metals in the pond affect the wildlife. Is it worth the cost to remove the contamination or better to leave it alone? I really haven't seen sufficient information to form an informed opinion*

Participant Observations

Participant observations were used to add supplementary data to the report. Three students conducted over 120 hours of participant observations at the ponds during the summer of 2021.

Results from the participant observations revealed several interesting trends. First, many people visit and use the ponds from out of state. These users were largely not incorporated into our survey as 97% of survey participants were from Montana. During participant observations, 194 cars were seen parked at the ponds. Of the 194 cars seen, 48% of the license plates were from Montana and 51% of the plates were out of state (Figure 9).

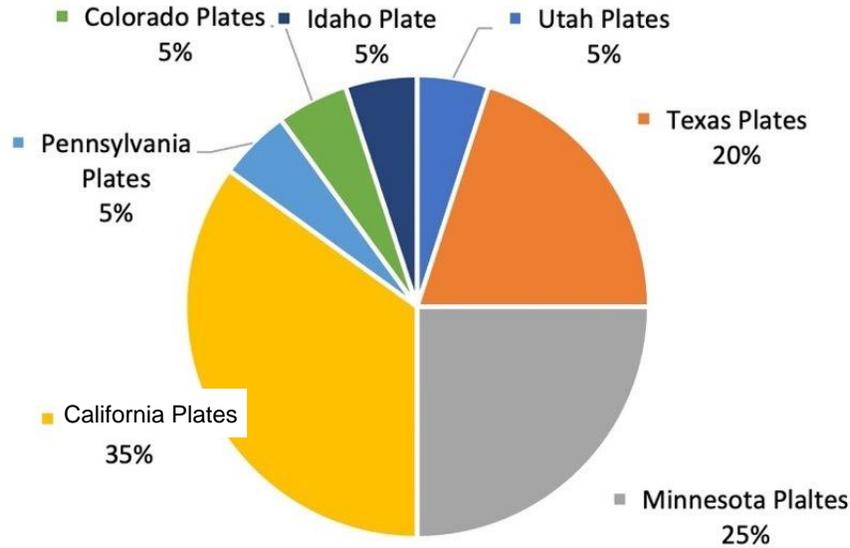


Figure 9. Graph showing the distribution of non-Montana state license plates observed (n=99)

Second, weather appeared to influence use of the ponds. Warm (~80 °F) sunny days had the most observed activity at the ponds. During the summer of 2021, the Warm Springs Ponds experienced poor air quality due to wildfire smoke and there were also fishing restrictions (‘hoot owl’) put in place as of July 1st due to drought conditions. Based on observations, there was less use of the ponds on hot, smokey days as well as after July 1st when the fishing restrictions went into effect. See Figure 10 for a photo of the smoke in the area.



Figure 10. Photo of the smokey conditions taken by a student observer at the Warm Springs Ponds on July 16th, 2021

Third, participant observations indicated that users have location preferences at the Warm Springs Ponds. Approximately 30% of the people observed at the Warm Springs Ponds were seen using Pond 3. Photography was the most prevalent activity observed and was mostly observed at the Rookery.

Fourth and finally, recreation uses not indicated in the survey were observed at the Warm Spring Ponds. Photography was the most observed activity followed by fishing. Additionally, there was a woman training dogs for dog sledding, many people were there walking dogs (both on and off leash), boating, biking, picnicking, bird watching, and motor biking.

Conclusion

The *Public Survey: Warm Springs Ponds, Montana* garnered a lot of interest and helped to better understand both recreational use and public perceptions of the Warm Springs Ponds. The survey confirmed that the Warm Springs Ponds are used by many locals and non-locals for a variety of recreational activities. Our survey indicated a wide spectrum of perceptions about the Warm Springs Ponds with the majority of survey respondents viewing the ponds ‘favorably/very favorably’ (82%) with 59% choosing ‘yes’ they are happy with the Warm Springs Ponds. These respondents largely support keeping the ponds as they are or making improvements to the area to support fishing, wildlife, and recreation including improving water quality and efforts to reduce heavy metal contamination. Our survey also indicated that there are those who view the ponds ‘unfavorably/very unfavorably’ (12%) with 41% choosing ‘no’ they are not happy with the ponds. This group of respondents largely argue to focus on remediation efforts at the ponds to mitigate human and ecosystem contamination as well as risk of contamination. Many of these respondents want to see the area improved for both wildlife and recreation although there are those who argue to have the area closed to the public and the ponds capped to address contamination issues.

We greatly appreciate hearing from so many participants in this survey and we are working to share the results of this study including the perspectives, concerns, and recommendations raised with our partners - Clark Fork Coalition, Natural Resource Damage Program, University of Montana, U.S. Environmental Protection Agency, Montana Fish, Wildlife, and Parks, as well as Atlantic Richfield Company. It is our goal that this data is used to help shape the future of the Warm Springs Ponds.

Acknowledgements

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