

The Staying Power of Perceptions in a Dynamic System: A
Longitudinal Stakeholder Analysis in the Yellowstone River Valley

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By

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ABSTRACT

Understanding how stakeholders conceptualize the dynamic environmental systems they live within and act upon is essential for long-term sustainability planning. For shared resource systems where decision making is increasingly democratized, agencies engage stakeholders to document local understandings of physical processes useful for resource management. For a variety of fiscal, logistical, and policy reasons, most studies are snapshots in time with few agencies able to devote resources for longitudinal studies. Yet for large river systems that regularly change with floods, drought, and floodplain development cycles, one-off social studies are unable to respond to such human-environment dynamism. To explore longitudinal human-water dynamics in the Yellowstone River reach in Montana (US), this study uses interviews with 15 individuals interviewed in 2006, 2012, and 2018 field seasons. The Yellowstone River is the largest undammed river in the US. It is located in the arid Western United States, and experiences annual flooding from mountain snowmelt, regular drought cycles, increased water use from floodplain development, irrigation, and recreation. Interviewees had a history of involvement with the Yellowstone River decision making and/or were riverfront landowners each with the capacity to shape the physical features of this system. This study takes a scholarly approach to expressed participant concerns as empirical evidence that reflects the socio-hydrological phenomenon occurring in the Yellowstone River Valley. Analysis of stakeholder accounts of physical processes pay special attention to expressions of how they understand the physical processes (flood, drought, and erosion) and how they express it should be managed. The benefit of engaging the same stakeholders with the same questions in 2006, 2012, and 2018 affords attention to any patterns of change over time concerning stakeholders' descriptions of riverine

processes. Ultimately, this study brings clarity to the place-based phenomenon taking place in the Yellowstone River through a longitudinal comparative analysis.

PREFACE

Our study uses the research data collected for the Yellowstone River Cultural Inventory. The project was funded by the U.S. Army Corps of Engineers and sponsored by the Yellowstone River Conservation District Council. The project was designed to collect and catalog stories about the physical features, processes, and cultural values of the Yellowstone River using an open-ended interview approach. Interview data were collected in 2006, 2012, and 2018 with a total of 453 interviews (Table 1). Several research articles were published using these data, the most relevant projects to this study were the summary reports for each year which required several phases of analysis. Each interview was audio-recorded, transcribed, coded, analyzed, and summarized to produced summary reports of the data for 2006, 2012, 2018, and a comparative report.

	SEG I: Missouri River to Powder River	SEG II: Powder River to Big Horn River	SEG III: Big Horn River to Laurel	SEG IV: Laurel to Springdale	SEG V: Springdale to Gardiner	TOTAL
2006	66	63	66	54	57	313
2012	7	6	6	5	7	31
2018	21	19	22	24	23	109
TOTAL	94	88	94	83	87	453

I was extensively involved in the coding, analysis, and summarization of several interviews. I joined the YRCI research team in the Summer of 2019. At this time, the YRCI 2006 Summary Report had been published and

the 2012 summary report was in the middle of analysis. For the 2012 interviews, I analyzed, and drafted summaries for each segment of the study area with the assistance of another research assistant. The assistance in the 2012 report, allowed me to familiarize myself with the study area and the study approach. For the 2018 report, the I co-established a codebook, coded approximately half of the interviews, and wrote summary report drafts for categories concerning cottonwoods, invasive species, and community/place. For the comparative reports (forthcoming) of all three field seasons, I drafted summaries for categories of general management, bank stabilization, and cottonwoods: documents ranging from 50-150 pages each.

This thesis acts as a representation of my work during my master's career. There are two different publications in this thesis. As a result of my contributions to the project, the 2018 YRCI Summary report constitutes the first chapter. The second chapter, "The Staying Power of Perceptions in a Dynamic System: A Longitudinal Stakeholder Analysis in the Yellowstone River Valley," is rooted in the curiosities, questions, and interests that developed as I engaged with the larger YRCI data set during my research assistantship. With roughly 500+ hours of experience analyzing the data of the Yellowstone River Cultural Inventory coupled with academic study primarily in the fields of natural resources and geography, I recognized an opportunity for deeper analysis in the longitudinal dimension of the Yellowstone River Cultural Inventory.

Yellowstone River Cultural Inventory – 2018 Summary Report

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Yellowstone River Cultural Inventory – 2018

Preface

Introduction

The Yellowstone River Valley presents challenging interfaces between private and public interests. For instance, flooding in the Yellowstone River Valley in 1996 and 1997 resulted in dozens of property owners seeking permits for bank stabilization projects. However, numerous conservation-minded and environmental groups opposed the “business-as-usual” permitting procedures that reviewed each project as a singular impact to the river, its fisheries, and riparian areas. These groups filed suit, asking the courts to require an assessment of the overall impacts of such projects. As a result, the Cumulative Effects Assessment (CEA) project was put into motion with the expressed purpose of better understanding the overall impacts of human activities on the river and its resources.

One element of the CEA was to document the understandings and goals of local river users and enthusiasts. The first Yellowstone River Cultural Inventory (YRCI) was conducted in 2006 to record and catalog the variety and intensity of different opinions held by the people of the valley. Over 300 individuals were interviewed, and many of the participants allowed the research team to come to their private properties. They represented agricultural, civic, recreational, and residential interest groups. Individuals from the Crow and the Northern Cheyenne tribes were also included. Ironically, even though the CEA had been triggered by floods, the interviews of 2006 were conducted during a time that most people in the valley understood as “drought years.” Many of the participants stressed that the river’s shared resources were scarce and that “not everyone will get what they want, when they want it.” The 2006 participants were promised confidentiality at the time of the interviews, yet many of them later allowed the recordings of their interviews to be archived with the Western Heritage Center of Billings, an affiliate of the Smithsonian Institute.

In 2011, the river flooded again. This flood played a role in the ExxonMobil Pipeline rupture, near Laurel, which spilled over 60,000 gallons of crude oil into the river. Because the conditions for living near, and with, the river had changed, it was important to revisit some of the original participants to see if their comments regarding life along the river might have also changed. A small follow-up YRCI project, involving 31 participants, was conducted during May and early June of 2012. By engaging the interviewees before the 2012 spring “rise” of the river, we were able to make the 2011 spring floods a focus of the interviews. Of the people interviewed in 2012, approximately 81 percent were participants in the 2006 study. New participants were recruited specifically for their ability to speak to questions concerning the 2011 pipeline rupture. Thus, the second YRCI was completed in 2012, and it captured comments that were more flood- and oil spill-sensitive in nature.

The ten-year anniversary of the original YRCI spurred interest in a more rigorous follow-up to the original cultural study. Due to difficulties securing funding, the second

follow-up YRCI was delayed until 2018. Interestingly, the context for this third YRCI was different from the context of 2006 (drought) and of 2012 (floods). Many people of the valley were vexed by the weather of 2015, 2016, and 2017. In the case of 2015, ice had scoured the river bottom near Glendive causing another pipeline rupture. In 2016, the late summer was especially hot and dry, and a fish-kill in Paradise Valley was thought to be the result of higher-than-usual river temperatures (perhaps exasperated by higher-than-usual irrigation out-takes). State authorities closed the river in Paradise Valley in 2016 from recreational activities for a few weeks, unfortunately ones critical to the recreational businesses of the area. Then, in 2017, spring flooding impacted several communities, and within weeks the valley entered one of the driest years on record. These fluctuations from “normal” weather patterns were new contexts to be explored.

Thus, the YRCI 2018 goals were informed by two previous YRCI studies, but they were also adjusted to find opportunities for participants to discuss the changing dynamics of life along the Yellowstone River. The interviews were designed to encourage these discussions: 1) the physical character of the river and how physical processes, such as floods and erosion, should be managed (i.e., bank stabilization techniques); 2) the riparian zone and the degree to which it was recognized and valued; and 3) management of the river’s resources, and noticeable challenges that the past few years had exposed. Over 100 individuals were interviewed in 2018 (see details below).

We define our research approach in detail in the next section, including explanations of how we segmented the river, how we recruited participants, how we collected and managed our data, and how we analyzed the narrative texts. We then identify the primary implications exposed in the YRCI 2018 data. Following the primary implications, details of the findings are provided in the following sections of this report, organized in terms of the primary themes of discussion exposed by the interviews.

The Research Approach

Identification of Geographic Segments: The Yellowstone River is over 670 miles in length. It flows northerly from Yellowstone Lake near the center of Yellowstone National Park in Wyoming. After exiting the park, the river enters Montana and flows through Paradise Valley toward Livingston, Montana, where it turns eastward. It then follows a northeasterly path across Montana to its confluence with the Missouri River in the northwestern corner of North Dakota.

Five geographic segments along the river were originally delineated for purposes of organizing the 2006 inventory. These five segments captured the length of the river after it exited Yellowstone National Park and as it flowed through eleven counties in Montana and one county in North Dakota.

The geographic delineations were determined based on physical and cultural characteristics of the river, especially at junctures that members of the Yellowstone River Conservation District Council, the Yellowstone River Conservation District Council Technical Advisory Committee and the Yellowstone River Conservation

District Council Resources Advisory Committee recognized as important. The 2006 segment delineations were adopted for the 2012 study, and for this 2018 study. The original rationales are reviewed, here:

Segment 1: Working from the confluence with the Missouri River towards the west, the first geographic segment was defined as Missouri River to Powder River. This geographic segment included some of the least populated regions of the entire United States. In this segment, the river is broad and relatively slow-moving, serving an expansive farming community that blends the interests of Montanans and North Dakotans. In 2006, this segment was grappling with concerns regarding habitat and fish passage for paddlefish and Pallid sturgeon. Prairie, Dawson, and Richland Counties of Montana were included in this segment, as was McKenzie County, North Dakota.

Segment 2: The second geographic segment, Powder River to Big Horn River, was delineated to include the inflows of the Big Horn and Tongue Rivers as major tributaries to the Yellowstone River and to include the characteristics of the warm-water fisheries. This segment was delineated to recognize the significant agricultural activities of the area and the historical significance of the high plains cowboy culture. This segment included Treasure, Rosebud and Custer Counties.

Segment 3: By 2006, Billings, known as a regional center for agriculture, business, healthcare and tourism, was notable for its loss of agricultural bottomlands to urban development. Because of its complexity as the only segment with a rural-urban interface, the third geographic segment, Big Horn River to Laurel, only included Yellowstone County. A further consideration for limiting this segment in this manner were the irrigation out-takes that divert water to projects east of Billings, especially in the communities of Shepherd, Huntley, and Worden. Furthermore, it was understood that the river begins its transition to a cold-water fishery in Yellowstone County.

Segment 4: The fourth segment, was defined as Laurel to Springdale, ending at the northeastern edge of Park County. The river in this area was known as fast-moving and supportive of cold-water fisheries. While there was little urban development in this segment, there were some rather obvious landscape transformations where agricultural activities were being converted to amenity landscapes, home sites for retirees and vacationers. The geographic segment included Sweet Grass, Stillwater, and Carbon Counties.

Segment 5: The last geographic segment was defined as Springdale to the boundary with Yellowstone National Park at the town of Gardiner. This segment was entirely within the boundaries of Park County. Severe floods in 1996 and 1997 had caused this county to spend many hours in public debates concerning river management.

For the purposes of the 2006 study, American Indians from the Crow and Northern Cheyenne tribes were included. They were recruited primarily by means of referrals from state agency personnel and Yellowstone River Conservation District Resource Advisory Committee members. Unfortunately, without agreements that would facilitate similar referrals, the 2012 and 2018 field efforts did not include tribal participants.

Interest Groups and Recruitment of Participants: The participants in the 2018 were volunteers, many of whom had participated in either the 2006 and/or 2012 projects. Dr. Gilbertz had maintained an updated database of participants and contact information based on the 2006 and the 2012 efforts. This database included nearly 330 entries. They were full-time residents of the towns and areas between the confluence of the Yellowstone and Missouri Rivers in North Dakota and the town of Gardiner, Montana at the north entrance to Yellowstone National Park. Participants in 2018 were recruited from the original major interest groups identified in 2006: agriculturalists, local civic leaders, recreationalists, and residentialists living near the river. Different recruitment approaches were used with different interest groups in 2006:

Agriculturalists: Individuals representing agricultural interests included farmers and ranchers, identified, and recruited from referrals provided by the local Conservation Districts, the Yellowstone River Conservation District Council, and the Montana Department of Natural Resources and Conservation.

Civic Leaders: Individuals holding civic leadership positions, including city mayors, city council members, county commissioners, flood plain managers, city/county planners, and public works managers, were identified and recruited through public records.

Recreationalists: Individuals who use the Yellowstone River for recreational purposes, including hunters, fishers, boaters, floaters, campers, hikers, bird watchers, rock hunters, photographers, and others who use the river for relaxation and serenity, were identified and recruited from referrals provided by members of the Resource Advisory Committee. Participants were also identified and recruited by contacting various non-governmental organizations such as Ducks Unlimited, Trout Unlimited, the Audubon Society and by contacting local outfitting businesses.

Residentialists: The names of property owners holding 20 acres or less of land bordering the Yellowstone River, or within 500 feet of the bank, were obtained through a GIS search of public land ownership records. Twenty acres was used as a screening threshold to separate the people who lived along the river corridor but whose incomes were from something other than agricultural practices (residentialists) from those who were predominantly farmers or ranchers (agriculturalists). The names were sorted by county and randomized. Recruitment proceeded from the randomized county lists. Other people living very near the river, and whose primary incomes were not generated by agriculture, were also recruited. These additional participants may not have had property that technically

bordered the river and/or they may have owned more than 20 acres. In all cases, the recruits did not consider agricultural as their main source of income.

The 2006 database of names and contacts, organized by segment and by interest groups, had also served another purpose. Between 2010 and 2011, Dr. Gilbertz contacted nearly every one of the 2006 participants to inquire as to which ones would release their 2006 audio-recorded interviews to a permanent archive housed at the Yellowstone Western Heritage Center of Billings. Once contacted, well over 250 of the original participants released their audio-recordings. This database of contact names served as the primary basis for identifying 2018 participants. Indeed, another call from Dr. Gilbertz was not especially surprising to the participants, and in 2018 Dr. Gilbertz recruited participants primarily by telephone. She set individual appointments at times and meeting places convenient for the participants.

As compared to 2006 (with 313 participants), the scale of the 2018 project was cut to approximately one-third (109 participants). However, the scope of the project was held intact, with attention to the original geographic segments and the four original interest groups. A few new participants were recruited because they would be able to speak to the closed river in Paradise Valley in 2016, or to the spring flooding of 2017. In many cases these participants' names were discovered in newspaper accounts of the fish-kill and the floods. As shown in the table below, the 2018 participants included 30 representatives from agriculture (compared to 86 in 2006), 24 representatives in local civic roles (compared to 68 in 2006), 30 representatives with recreational interests (compared to 76 in 2006) and 25 residentialists (compared to 76 in 2006).

Participants in Yellowstone River Cultural Inventory–2018						
	GEO SEG 1: Missouri River to Powder River	GEO SEG 2: Powder River to Big Horn River	GEO SEG 3: Big Horn River to Laurel	GEO SEG 4: Laurel to Springdale	GEO SEG 5: Springdale to Gardiner	TOTAL IN GROUP
AGRICULTURAL	5	7	5	8	5	30
CIVIC	4	2	6	5	7	24
RECREATIONAL	6	6	7	4	7	30
RESIDENTIAL	6	4	4	7	4	25
SEGMENT TOTAL	21	19	22	24	23	109

Description of Interviews and Collection of Participant Comments: The 2006 master protocol, which had been designed from questions provided by the US Army Corps of Engineers and approved by the Office of Management and Budget (OMB

approval # 0710-0001), was utilized as the basis for the 2018 protocol. The 2006 protocol was minimally adapted so that discussions of the river closure in Paradise Valley (2016) and/or the spring flooding of 2017 would fit into the interviews as natural topics of conversation (see Appendix). Finally, because officials with the Montana Department of Natural Resources and Conservation asked if we could specifically probe participants' understanding of the health and longevity of cottonwood forests, we identified and flagged the most likely opportunity for those conversations within the existing protocol.

As was the case in 2006 and 2012, the questions in 2018 were designed to encourage participants to describe, in their own words, the local environs, their personal observations of changes in the river, their uses of the river, and any concerns they have about the future of the river as a shared resource. Open-ended questions were used to encourage participants to speak conversationally. That said, specific questions were adapted to the participants' interest groups. For instance, interviews with agriculturalists began with the question, "How many years have you been in operation here?" while local civic leaders were asked, "How many years have you lived in this community?" Similarly, agriculturalists were asked, "Are there any problems associated with having property this close to the river?" and local civic leaders were asked, "Are there any problems associated with having private or public properties close to the river?" The overriding objective of the approach was to engage the participants in conversations about the river, its importance, and their specific concerns.

Participants were informed that their inputs would be secured in the offices of Drs. Gilbertz and Hall for at least three years, after which the audio-recordings, interview notes and transcripts would be transferred to the Yellowstone Western Heritage Center of Billings, Montana. In this way, knowing it might be at least three years before a transfer of materials would happen, participants were encouraged to be candid in their remarks. All respondents were interested in talking about their perspectives, and they represented a variety of views. Each interview lasted, on average, 45 minutes. One person who spoke with us but wished to remain anonymous, did not grant permission to be recorded. In all other cases, the interviews were audio-recorded and later transcribed, producing over 2000 pages of interview text.

Thematic Analyses and the Structure of this Report: Thematic categories of analyses were identified by two means. To begin, deductive categories were defined so that the 2018 analysis could later be directly compared to findings from 2006 and 2012. These categories allowed the analytical team to explore, in detail, local explanations of (1) the regional contexts of the valley communities, (2) the river's physical processes and human responses to those processes, and (3) natural resources and their management. Next, from an inductive perspective, the 2018 data were approached by means of the question, "What else is in here?" The data revealed other related topics, such as water availability and water quality. Also, and of keen interest to the team, were some conversational moments where the participants commented on, or asked questions about, the interviews: What were we up to? Who was sponsoring our work? and How would the information from the participant be used? As a final category of analysis, those comments and questions were gathered as a dataset.

Once the categories were determined, the next steps in the analysis went as follows: 1) quotes were then taken from each transcript to populate the thematic categories, 2) per category, the quotes were arranged to illuminate commonalities and/or differences, especially as those distinctions might reveal possible alliances or tensions within or across local interest groups, and 3) select quotes were flagged as especially luminary. The analytical findings served as the basis for writing this report. Thematic categories of analysis were grouped together, either as parallel, connected, or related findings. As a result of the analytical work this report is organized as follows: Local Contexts: Valley Communities, Physical Processes and Human Responses, Recreation and Natural Resources, and Reactions and Comments Relating to the CEA and YRCI. Summaries of each major grouping of findings were then written and serve as the overall implications of the 2018 data.

A Note Regarding Participant Quotations in this Report: While the participants in the 2018 YRCI were not promised anonymity, we have shielded them in this report from direct exposure by simply using an initial, rather than a last name. Thus, if a Jane Smith, a civic leader from Billings (Segment 3), had provided a comment for this report, the identifier would simply read as follows: (S, 3, Civ). In a few cases, more than one person joined the interview, thus we indicate two initials or a group designation. Our one request for anonymity is honored as “Anonymous.”

Primary Implications of 2018 Data

In 2018, the participants from the different segments offered details that suggested important similarities and nuanced differences regarding how they think of life along the Yellowstone River. In terms of similarities, in all segments, participants expressed a strong love for the river, regardless of their interest group affiliation. Nearly everyone speaks of the river as an important asset to agriculture and as a recreational venue.

Upriver, especially in Paradise Valley, tourism and out-of-staters who buy land are a continuing fact of life. Residential and commercial development near Billings is considered a foregone conclusion. Some of those same residential development pressures are creeping into conversations in communities such as Hysham. However, the communities of the lower river, near Glendive and Sidney, are much more impacted by the oil and gas industry as compared to residential or commercial development. In the lower segments, they often hope nothing will change. In the mid-regions and the upper river, many see change as inevitable. Nearly everyone is hopeful that the changes will not spoil their relationships with nature, nor with their neighbors—even when the neighbors have unfamiliar faces.

Some participants offer positive evaluations of agencies and management efforts, and they generally express a desire for stable and reasonable regulations. They value experiential knowledge and are sometimes suspicious of “book learning.” Yet, some explicitly call for officials to improve the public’s understanding of the river and its issues.

Participants describe the river as constantly changing and migrating. They relate these changes to the erosion of private property and threats to public infrastructure. Yet, some also discuss the benefits of channel migration. Many are well-versed in terms of bank stabilization techniques, and they understand why landowners wish to protect their property. Recreational users seem most sensitive to the potential harm caused by bank stabilization, although some regard riprap as “good” fish habitat.

There is some awareness among property owners of the use of conservation easements as a means of compensating for river “damages,” but the easements are not generally endorsed as they are viewed as “too permanent.” Most people in the valley are comfortable with the levees and dikes that have protected their communities for decades. Thus, decertification of those levees, and the resulting “insurance requirements” are issues in those communities. The degree to which the communities are willing to work cooperatively with federal authorities regarding local levees varies. The Intake controversy is known throughout the valley. New dams on the Yellowstone River are not considered feasible, even though such proposals are reportedly still being discussed among locals as a means of generating electricity and dealing with drought.

We note that there is still a dearth of conversation wherein participants use the terms “riparian” or “river corridor.” However, the participants are, clearly, attentive to the river and its immediate environs in terms of recreational activities, fisheries, and wildlife. From jetboating to rustic overnight campouts, the river and its islands are

mainstays of recreation. The participants discuss river access as an issue throughout the valley, and new boat ramps are greatly appreciated. They caution other recreationists to put safety first, and fun second.

They describe an abundance of fish species, but they also note the new up-river migrations of some warmwater species. Some feel the fees for fishing could be raised without excluding fishers. The fish-kill in 2016, in the upper river, is still a concern to participants from the Livingston area. Their theories about why the fish died vary. Near Glendive, efforts to save the Pallid sturgeon are still a topic of conversation, but not necessarily visceral in tone.

Participants associate many species of birds with the river. Their comments suggest a significant increase in eagle populations, and perhaps blue jays. However, they note apparent declines in pheasant populations, which several people believe is a result of drought and dewless grasses. Many discuss deer as abundant, but seemingly susceptible to “blue tongue” disease. Access for hunting purposes has diminished, but the block management program is mostly regarded as helpful to hunters and to landowners.

Some participants reported no concerns regarding cottonwood trees, but many others noted the apparent lack of young or seedling trees. Many people report that seedlings appear in locations where flood waters have receded; however, the necessity of flood inundation is not necessarily expressed. They report that beaver, deer, squirrels, disease, and bank erosion are detrimental to the forest, and that livestock grazing is especially devastating to young cottonwood stands.

Other topics commonly discussed include water availability, drought, water quality, pollutants, noxious weeds, and invasive plants.

Participants’ comments about the CEA, the Channel Migration Zone (CMZ) maps, and the YRCI reveal these conclusions: 1) folks with direct involvement with local Conservation Districts (CDs) assume (or hope) the CMZ maps are being used; 2) even those involved with local CDs fail to mention other research products or conclusions of the CEA; 3) beyond those folks directly involved with local CDs, familiarity with the CEA, or the CMZ maps, is quite limited, 3) the interview approach taken in the YRCI resonates with valley residents; and 4) follow-up YRCI interviews are viewed as additional opportunities for thoughtful engagement with managing agencies.

Local Contexts: Valley Communities

Introduction

This section documents regional conversations about participants' communities and the places they call home. These perspectives are divided in to five geographic segments along the river—Segment 1: Missouri River to Powder River, Segment 2: Powder River to Bighorn River, Segment 3: Bighorn River to Laurel, Segment 4: Laurel to Springdale, and Segment 5: Springdale to Gardiner. For each Segment, the discussions are organized as comments describing the local context, the local economies, and individuals' hopes for the future. These comments serve as useful foundations for understanding the findings in the following sections of this report.

Segment 1: Missouri River to Powder River

The people of the Yellowstone River from the Missouri River to the Powder River describe their local communities with pride, as safe, pleasant environments with plenty to do. Local populations are described as rooted and independent yet mutually supportive. Local agricultural and oil industries are touted as significant, though the challenges faced by the next generation of farmers and economic fluctuation and environmental contamination inherent with the oil industry prompt concerns for some. These concerns, along with the challenges faced by small towns in general, lead people in this area to hope for stability above all else. They hope this area will remain a great place to live for the next generation.

Descriptions of Local Context: The people of the Yellowstone River in this area discussed their local communities with pride, explaining that this is a great place to live:

We are in a great, this is a great county. If you have never been to our county fair, you really ought to come because it is the best, and I'm not lying. If I am lying, I am flying, and Popeye is a punk. It is the best county fair in all of eastern Montana or western North Dakota. We have got the best. (M, 1, Civ)

I think living here in eastern Montana is a great place to live. It's a great place to raise a family. People complain that there is nothing to do so they move to Billings. They get to Billings and then you say, 'What did you do last weekend?' 'Oh, nothing.' You got a million things to do, but you still have to get off the couch and go do them. Anyone here has the ability to take a lawn chair down to the river and throw a line in. At least we have a river here, we have something to do. (M, 1, Rec)

We live very close to the river, and I grew up down the river a mile and a half south, and my son lives on that place yet. It was my father's and before that my grandfather's. (B, 1, Ag)

I would say the thing that we have now, that's probably what a lot of people treasure, is peace, quiet, tranquility, and a nice, safe environment to live in. It's an area where when I was growing, I probably knew 90% of the people in this town. I still know 50%. You could walk in the grocery store, and if you forgot your money, 'Ah, don't worry about it. Come back tomorrow and give it to me.' That kind of an attitude.... It's perfect here. We're close to town but we're not in town; we're close to the highway but we're not on a highway. And then we have sustainability here. You know, we grow a garden, we have fruit trees, we can do for ourselves. (V, 1, Res)

I have three children; I have eight grandchildren and I have almost 15 great grandchildren.... They all live right here. (Q, 1, Res)

I have three kids; they were all raised right there [points out the window]. Two of them are gone, one's in Denver, one right now is in Bozeman and probably going to DC. The third one left right after high school and moved to Helena and then Billings, and she came back because she had a kid, my grandson. This is the place to raise kids.... And just yesterday—now that Facebook is involved—there was a little boy, three-year-old maybe, at the mini-mart, no parents. Somebody got on Facebook, and within 12 minutes his mom was there. Small town. They put him behind the counter, gave him a doughnut, and waited for Mom. My daughter was watching her son play out in the school playground after school, and she says, 'You know, I'm just sitting here watching this and I couldn't do this in Billings. I couldn't do this in Helena. He can go across the street and play in the playground, and I don't have to worry about him.' That's a small town now. There are things that take some getting used to... everybody knows everybody.... I went down to the bank to get some cash,...and I said yeah, we need some cash, we're gonna go camping, we've only been four times this year. [The clerk] says, 'No, you've been six.' And I had to stop and think, and she was right. We had been camping six times this year. (T, 1, Rec)

I was in the boat going to feed the guard dogs, and I thought, 'God, this is pretty.' (T, 1, Ag)

I like where I live. Conservative people. Moral people. We don't go steal out of our neighbor's pickup.... I can leave my doors unlocked. It's a pretty nice place to live just because there's a certain peacefulness to it—it's a quality of life.... I like the people very well, I like the community, I like how we live. (T, 1, Civ)

We like it here. We see deer go by here, and we see cats go by here, and we see dogs go by here. One year, the cutest thing I think I ever saw and will ever see, one morning early I looked out the door and there was a mother skunk going down the sidewalk with her tail straight in the air, and I think there was about six little ones behind her, right in single file, with all their tails straight in the air going right down the sidewalk. (P, 1, Res)

I would say [here at the border of Montana and North Dakota] it's more one community now. Growing up in the Cartwright community, it was a very close-knit community with quite a few community activities. But since there's no more school in Cartwright and we all go to Fairview.... I would say it's more one very big community. Fairview is our community. (B, 1, Ag)

We actually call it Mondak. Because it's Montana-Dakota. And there's, for a hundred years there's been talk about another state. Everything from Billings to Bismarck being the state of Mondak. But they decided they wouldn't let us do it because they were afraid we'd become a country, and we'd have like a third of the world's oil, and all of the breadbasket, and all of the nuclear weapons. And so, they didn't want us to be our own. (T, 1, Rec)

These descriptions of a friendly local environment are reflected in discussion of local use of the river. When asked if they noted conflicts between different users or user groups, participants responded:

No, and we're actually both [landowners and recreationalists]. (B, 1, Ag)

For the river? ... I don't think we have a problem around here, not that I've heard of. (H, 1, Rec)

I've been boating and seen people come by in canoes, very friendly, very nice, you know they are having a good day, so as far as conflicts, absolutely not. I have not ran into that. (M, 1, Rec)

Altogether, participants described their area as a great place to live. They supported this point by describing pleasant local environments with plenty of things to do. The small towns are described as safe and trusting with a rooted population and compatible themes of independence and neighbor-helping-neighbor. These sentiments transferred to participants' descriptions of use of the river—a shared, community resource—with minimal conflict.

Local Economy: About the local economy, participants discussed the significance and benefits of the agricultural and oil industries but also shared some concerns for the future related to these industries and the challenges of small towns in general. Here, people described their local economy as dependent on both agriculture and oil—again, related to the use of the river:

Here's some of our irrigation, you can see that pretty well from here.... And some of the oil wells, yep....and the river.... These two elevators over here are fracking sand, for the oil field. And there's an intermodal up there that does the same thing. There's also an oil load-off station up there. So, we have oil, agriculture, all mixed in. (T, 1, Rec)

People in this area elaborated on the significance of the agricultural industry and the related value of the river. They also shared some concerns for the future of this industry

related to recruitment of the next generation of farmers and increased costs of staying in the business:

This whole town would dry up without agriculture. It would just dry out... We lose our schools, our hospitals, everything. Because irrigated land is taxed... three, four, or five times more than dry land... And that's where we get our schools and all the police and all the stuff that runs the town of Sidney. You know, up and down the valley, that's how that works. (B-2, 1, Ag)

I heard a word used at a seminar that I'd gone to, I always heard a guy called a farmer, somebody said he was a producer, and you know I've owned a lot of businesses, I've owned grass seeding, been in oil, in Seattle we were in convenience stores. But you know, you really do produce something, you take something, you put it in the ground, and you produce product.... We've got to eat. And there's just something about being a producer that has a special thing with me.... See, I don't just enjoy what I do; I get to help other folks while I'm doing it. (T, 1, Civ)

Farming, this isn't something we do.... A lot of times it's a way of life. It's a business to me, it's a farming business. It's an enterprise, it has to be profitable. That Yellowstone makes me profitable because it guarantees me a crop. If I will do the things that I need to do—plant, fertilize, build my soils, treat this ground right—it will be very good to us. And it has been. (T, 1, Civ)

Like in a lot of industries, the margins are so slim that you have to get continually bigger and more efficient. And the financial end for younger producers is really tough. A new producer, non-family farmer, is basically excluded because of the financial requirements to be able to get in this. (P, 1, Ag)

In addition to these comments on the significance and challenges of agriculture, people in this area reflected on the local oil industry—its booms and busts, benefits, and drawbacks:

I've been through, I think, four or five oil booms myself. I worked the first one back in '58 to '59, out of Glendive when the first wells came in there. I worked out there as a grunt, whatever they would call, 'Hey you, get a shovel and go do something!' And [after] the boom, a lot of people got hurt badly. (B-2, 1, Ag)

[Boom and busts are] going to happen. Whether we like it or not, it's going to happen. It's just the nature of the beast. (H, 1, Civ)

Richland County has been blessed, not only do we have irrigated grounds.... but, the last quarter in 2017, Richland Country produced 45.25% of all the oil produced in the state of Montana. It wasn't that long ago that we produced almost 80%, but our production is going down.... You know, we were at 220 or 214 rigs in the Williston Basin at the height of the boom, and now I think, Williston has....54 rigs, and I think there's five in Montana....It is a great county, and I don't know if

people understand how important the oil is to us....I would say a third of the income that this city and county makes is from the oil. There are quite a few little companies with 25 to 30 guys....and they are paying taxes. There is a future. (M, 1, Civ)

Having been through booms, I can tell you what the next thing is going to be.... The first thing we had was cocaine. When the money started to dry up a little bit, then it was theft. The money dried up a little more, then it was meth. Now, if the money dried up a little more, it's domestic violence, and...robbery. (T, 1, Rec)

I would say that 90% of the residents, myself included, wished the oil boom never happened. It changed the whole community.... We had our first murder in Sidney, in forever, and it was oil-related. I served as a special deputy sheriff for several years, and the aggressiveness was a lot worse during the oil boom than normal. The worst you ever had before was a couple of cowboys would go out on a Saturday night and get into a little punching contest. You'd walk up to them and say, 'Joe, what the hell are you doing?' And they'd turn around and smile and hug each other and go have another beer. Not that way with the oil guys; they were fighting, pulling knives, guns come out sometimes.... Local businesses couldn't get employees because everybody went to the oil field...Prices increased and rent increased.... There are times that grocery store prices here are twice as high as they are other places. Again, that's an effect of the oil boom.... The guys that liked it were the farmers, that were struggling to make a living, and then all of a sudden, they were multimillionaires.... But it didn't help the normal person here. It really didn't do any good, did just the reverse. (V, 1, Res)

In addition to local discussion of the importance, benefits, and drawbacks of both agriculture and the oil industry, people in this area reflected on the challenges faced by small towns in general in relation to the local economy:

It's not just our town. It's eastern Montana. It's up and down all Montana and it's in North Dakota.... The small towns are just really just disappearing... When I graduated, I had 45 in my class... Now we've got classes of four or five.... [Our youngest daughter] is a beautician in Laurel, in Billings... The middle girl works in the school system....and then our oldest daughter is a nurse in Hettinger, North Dakota... [We used to have] everything a small town would want as far as businesses... two car dealers, a franchise Ford and a franchise Chevy dealer, four gas stations, three grocery stores, a couple of clothing stores. You know, they are all gone except for one grocery store.... Right now, we have got probably 30 to 40 houses for sale in Terry. (H, 1, Rec)

Hopes for the Future: Participants in this area described their general hopes and/or expectation for the future in terms of stability:

I just hope that we don't get more population here. I live here because there is not a big population. I am not a real fan of a lot of people. So, I think it will stay pretty much the same. (M, 1, Rec)

[I want] stability. The fluctuations don't do anybody any good. (V, 1, Res)

Well, I know [our farm] looks pretty good, now, so I hope it looks as good... And I'm sure it will probably about the same or better. (B, 1, Ag)

[I hope] that it's still a very nice quality-of-life place to live. (H, 1, Civ)

Segment 2: Powder River to Bighorn River

The people of the Yellowstone River from the Powder River to the Bighorn River describe their local communities as friendly and quiet small towns, dependent largely on agriculture and some local industries. Given the economic challenges inherent with maintaining small towns and family farms today, people in this area share concerns for the future and discuss personal efforts and wisdom passed down from previous generations related to maintaining these values—specifically in terms of retaining inherited lands. Regarding their hopes and expectations for coming years and future generations, people here discuss stability and some need to adapt to new conditions in a way that preserves those values prized by local communities—for some, this means turning an eye toward the recreational value of the river and adjacent lands.

Descriptions of Local Context: The people of the Yellowstone River in this area—reflecting on their personal and family history in the area—described a peaceful environment of small towns and close-knit communities, supported in large part by agriculture:

[The best thing about living here is] the quiet. Even with the highway and the railroad there, it's still isolation and not having to see streets and all that...[I'm a teacher so] I have the weekends off, I have Christmas break, I have other breaks where I can come home and do projects and get my [farm] things done: shipping, feeding, calving... So yeah, I can make it work. I have good neighbors; that really helps... Everybody is willing to help everybody. Everybody waves to everybody when you are driving down the road, and nobody is afraid to stop and help you if you really need help. That's really nice to have, and it's nice to return the favor as well. (C, 2, Ag)

Billings grew into that industrial hub. Miles City will never be that. That is fine with me, I like it the way it is. Billings is too big for me. (M, 2, Ag)

You have to know that somebody is pretty close to you when the neighbor guy spans you right along with his kids when you all did the wrong thing. And we were wrong. I mean, he never once spanked us that we didn't deserve it, and he didn't spank us some of the times when we did, but that's how close we were. It was a pretty tight community. (D, Parks, 2, Rec)

Well, my great, great grandpa got a lottery to come out here. It wasn't a homestead. He put in for it and got the lottery. So, in 1906, he came out here and rode around for a while and found a spot here next to the river with lots of trees...and struck his claim. And then, over the years, he has bought more land and expanded to where we are to today. I'm the fifth generation to live on here. [The others are] in Billings or Laurel or different parts. They enjoy coming down, camping, driving through the hills, shooting prairie dogs, hanging out. But as far as ranching and cattle, I'd say I'm the only one to show interest that. (C, 2, Ag)

That's how come all them big ranches are up here, because [a long time ago] they bought that land for a nickel an acre, a dime an acre. (H, 2, Ag)

Local Economy: Participants in this area also described the economic challenges of small towns, family farms, and retaining the next generation:

It's unfortunate that out of my six children I only have one that is here. They've all had to move on for careers and better-paying jobs, and so that is one of the issues we have here. It is still a very self-sustaining community. (E, 2, Civ)

I can remember my mom taking us kids to town. The day to go to Miles City was Saturday, and it was just like parade day, with so many people in town.... At one time, there were 21 churches in Miles City, and I think 40-some bars [laughs]. So, the whole microcosm of what went on in Miles City from machinery dealers to dry goods, to groceries, you just name it, it was just everything. And it was all these private-owned [businesses] that made this whole thing click. It was a pretty cool place. Of course, now you have the big conglomerates here like Walmart and Albertsons.... It is, what it is. Our whole society in that regard has changed. It's not, in my estimation, probably not as cool and neat as it once was.... Everybody loved to come to Miles City for one reason or another.... Miles City has changed, and it has grown some, but it hasn't grown out of its small town, old west flavor. A lot of people whine and bellyache that we need to have more businesses. (M, 2, Ag)

While reflecting on the issues faced in this area, some explained that personal will and the wisdom passed down through generations may allow these communities to carry on despite these challenges:

We hope is that [our land] stays in the family. We hated to sell what we had because [the old-timers] always said, 'You can sell any material thing, anything you have, but the land. Don't ever sell the land because there will never be any more land.' And that really stuck in my mind. (L, 2, Ag)

There was grandpa, then twin boys split it. And my generation is the one that there's three of us. And then, there's nine of our kids, and there's 27 great-grandchildren that are reproducing now. That's why we incorporated it. I don't...My folks always said, 'Don't sell the land. God is not making land

anymore. He's not going to make any more land, so don't sell it.' And I will haunt [my kids] if they sell it [laughs]. (M, 2, Rec)

Anyway, I've never been too smart, but I have had more will to get something done. I have kind of a pit bull mentality, and if I decide to do something I am. And that's what it goes like. And I mean that's what it takes.... My dad used to always have a saying, 'Never say whoa in a tight spot.' By God, I took that to heart [laughs]. (M, 2, Ag)

Hopes for the Future: People in this area focused on stability and yet they acknowledged a need for adaptation when talking about their hopes for the future:

I want [the next generation] to have the same thing I have, now. All that everybody else set aside for me, I guess you could say. Everybody conserved and made it still operable. I want to do the same. (C, 2, Ag)

We hope that we farm the best and conserve the rest.... [In Montana,] we're young enough, and have a more conservation-minded population than most other places. ... Because we're tied to the land. (C, 2, Rec)

Well, I don't think we're going to see too much change in ten years. (M, 2, Rec)

We'd like to see [our property] stay in the family.... We realize none of us are probably going to farm it but, you continue to use it as a wildlife-slash-farm to pay the taxes, pay the bills.... We want to see it stay as a small family farm, even though we are not farming it. You know, lease it to the neighbor, but keep it the way it is to use it for future generations. I've got a grandson that's going to turn ten. You know, he's been hunting and fishing with us. So, I'm looking forward to the day to see him be able to sit in our field and shoot a goose. (F, 2, Rec)

I hope we're stabilized, or perhaps growing again from the losses that we've had in railroad traffic.... And then, with Colstrip, plant one and two will be gone [soon].... So, I hope within ten years we have more efficient ways to use coal production for energy. I think it's plenty clean and very affordable, especially the way these things are, so I hope we see some progress in keeping those kinds of enterprises going. Agriculture that is sustainable is important for us. And I think in the next ten years it would be nice to see any kind of new recreational opportunities that we can provide though the river...I think there we've got to sustain everything that we have and find any of those new opportunities. (G, 2, Res)

Segment 3: Bighorn River to Laurel

The people of the Yellowstone River from the Bighorn River to Laurel describe their local community as offering a high quality of life in the form of 'the best of both worlds' — with opportunities presented by the proximity to Billings, a pleasing natural environment, and agricultural tradition found along the river. While the expansion of

Billings has presented local opportunities, some explain that this expansion comes at a cost, especially to farmers already struggling with the challenges of their industry. For these reasons, people in this area share their hope for stability in the future, especially related to the sprawl of Billings.

Descriptions of Local Context: The people of the Yellowstone River in this area reflected on the high quality of life:

People have said to me, 'You've got some skills, why don't you go someplace and explore those?' And I'm thinking... I don't know if I want to leave this area. It's not everything that money can buy, but there's just so much more than you can even imagine!... Montana people really learn to live and enjoy. No one can put a dollar sign on it. I don't think Montanans do. (O, 3, Civ)

[It's] a way of life, I think. Our kids and our grandkids have learned how to work on the farm, on the ranch, they've learned compassion. We've all been out helping pull a calf at three o'clock in the morning when it's colder than the dickens. We all like wildlife and like seeing the eagles and the hawks. We raise pheasants, wild turkeys. We've had moose, bear, elk... It's a great place to get out of bed in the morning and watch the sunrise, hear the geese flying over, and see the sandhill cranes, see the bald eagles flying. So, it's a very positive thing. (W, 3, Res)

My great-grandfather bought this land in 1920. And... my grandfather... moved here shortly after that and took over management of the operation, and the family's been here ever since. So... we're almost at a hundred years in the same family and... we take pride in that. (M, 3, Ag)

Where we live is amazing. Who else gets the opportunity to take care of 100 acres of ground right on the Yellowstone River? It would just be stupid to walk away. But you know, I like Billings. I get angry at our leadership, but I see a lot of innovative people here. I see people who, you know... live in reality for the most part, which is nice. (S, 3, Ag)

When we first moved here it was strictly agriculture, and then you can see along the interstate it's developed as a strip all along it... [Except for] a couple years of my adult life, I've lived with property on the Yellowstone River. I like it rural, but you're close to town, so I feel I have the best of both worlds. (S, 3, Res)

I'm almost 50, and I've been relatively aware of [the river] ...in terms of water and agriculture. And then, with my transition to planning and landscape architecture...I see that we are changing as a community. With the opportunities that we have, literally, I get goose bumps.... Billings always took second place to Bozeman or Missoula and their progressive kind of stance, but I think we have such an opportunity here to make it just a really wonderful place to live, to watch it grow as a community. And one of my kids is back, and I'm hoping my second one will move back and have opportunities for them to be here and want to be here, because it's a good place. (R, 3, Res)

This is valuable land. There's a lot of people that want ten acres west of Billings. But we picked where we lived because we wanted to be insulated a little bit. Like I said, we wanted to be semi-rural but have the conveniences of running back and forth to town. It's so nice at night, you can see all the lights in town. It seems so far away, but it only takes just a minute to get to town. (S, 3, Res)

Local Economy: Related to these descriptions of this area as 'best of both worlds' (urban access and open space for agriculture and wildlife), others offered further descriptions of the population growth and development of the area around Billings:

This farm was divided into twenties...[Now,] some of them have split into tens. You can do that and still be agriculture.... All the neighbors are long-time farmers.... I don't know what could change, [but] it will fill in more along the interstate. And there's this housing subdivision going way down east... That's getting real built up.... There was a hundred and forty kids in eight grades when I was on the school board; now I don't know, they're up to three hundred and something. It's different. It's like an in-town school now. (S, 3, Res)

There's some people that buy some of these places, and they're not buying them for the farm...[If] they want to make money [farming], that's hard—especially given what they paid for it... [laughs]. (K, 3, Ag)

In the Yellowstone Valley 50 years ago, you could stand up on our rims and still see us as a farming country. Now, if you drive out and you look from on top of our rims, Yellowstone Valley is being consumed by residential and businesses. They are taking up our golden valley where it used to be our farmland. (R, 3, Civ)

Development presents opportunities and challenges:

It's tough that the younger generation really don't want to work anymore, but they want the money... And they want to live the life that they want to live without putting forth an effort to say, 'Hey, I'm going to stay here and be married to this thing 24 hours, 7 days a week.' ... And I know the people, personally... I've already talked to the son of one, and he says, 'I hate to say this, but when my parents are gone, we're selling and I'm getting out.' (R, 3, Civ)

The last time it was \$4 wheat prices, you could buy a \$10,000 combine. Now it's a half a million dollar combine, and the same wheat prices!... Because things are changing so fast in agriculture, [my son] is going to have to be able to keep up with the technology. And it's a certain amount of growth that you have to keep going to keep in business. It's a really challenging business, and there's no getting around it.... And I think there's few people left in this world that know where the food comes from. (K, 3, Ag)

Hopes for the Future: Given these challenges, participants in this area expressed a hope (and for some an expectation) for future stability, especially related to urban sprawl onto agricultural lands:

The next 10 years, I can't answer you whether it's going to be good or bad, but there'll be some things that change. It won't change so much in the reach from Laurel to the Shepherd Bridge, because that's already pretty much industrial. You can call it industrial. There is some ag ground against it, but not a bunch. When you get past the Shepherd Bridge, then it turns almost exclusively agriculture. For now, there's not even very many sub-divisions or anything beside it. There's a few, but very, very few. (S, 3, Ag)

The last time we talked about encroachment from urban sprawl and all that, but that's not happening from here east, I don't think. So, it depends on what happens up west... And, uh, yeah. I would hope that it's even better in ten years. (W, 3, Rec)

[I hope it will] stay the same, 'till I'm in the ground... You can write that down, remember that... Obviously, we like it, we've been here thirty years. (S, 3, Res)

Segment 4: Laurel to Springdale

The people of the Yellowstone River from Laurel to Springdale describe their local community as a beautiful, natural environment that supports various recreational and agricultural activities and is home to a friendly, well-dispersed population. Given the enjoyment among locals of the peace and solitude offered by their surroundings, some express concerns about increased development and changes in land ownership, along with other concerns commonly shared about the struggles of small towns and family farms. For these reasons, people in this area share hopes (and for some, expectations) for stability in the future.

Descriptions of Local Context: The people of the Yellowstone River in this area emphasized the beauty of their views and local wildlife in creating a positive environment for their communities. Many spoke of their families having been in the area for generations, and they often reflected on the benefits of recreational opportunities, quiet, open spaces, solitude, and friendly people with little local conflict:

Well, it's just a piece of heaven of right here. I mean, with the mountains and the rivers, we have got the Boulder and the Yellowstone Rivers. We've got Sweet Grass coming in. There's all kinds of fishing, there's all kinds of hunting, there's fresh air, there's blue sky. I mean, God put me here. It's a great place. I raised my family here. We've used the river quite a bit, mostly for fishing, and floating, and hunting geese and ducks. I swim my dogs in it. It's just beautiful. (K, 4, Civ)

We have had moose and bear, and all kinds of animals that come across the river and kind of enjoy our town with us. They kind of tear up the flower beds and a few

things, but that is alright [laughs]. Gives people something to whine about. (E, 4, Civ)

As we're sitting here, we can see the Bear Tooth Mountains in the distance, we can see Granite Peak and all the other mountains. We can see Mount Wood. We can see the beautiful Yellowstone River flowing right down there in front of us....[This view] is what we wanted... We like the outdoors. We go up to Nye and walk up the trails, we go up to Natural Bridge, we go to all kinds of places from here... We were going to build on another street behind us but then someone said this is the best view. (W, 4, Res)

Sometimes you wish it were a little wider, the valley, sometimes you wish it was a little narrower, sometimes you wish there was no pavement. But it's a good place to live. (C, 4, Res)

It's home, and so it's beautiful to me.... It's quiet and serene. My friends are here, everything I know is here. I always tell [my husband] that when I die, he can spread my ashes out on...my favorite site. (F, 4, Rec)

We just love the quality of life here. The town of Big Timber is great, full of good people and good living. (L, 4, Res)

Between Buffalo Mirage and Columbus... It's a long stretch, and it's probably one of the longest ones on the Yellowstone, it's a beautiful, beautiful stretch of river. People that haven't ever floated that stretch, they're just driving down the interstate and looking over there, but it's really, really cool, because you've got these cliffs right alongside you, and there's thousands of swallows. And there's actually spots if the river is low enough, where you're floating underneath the cliffs, they hang out over you. It's just a beautiful stretch... a beautiful little piece that not a lot of people know about. (H, 4, Rec)

I can't find a better view.... I planted over 1,000 trees here, starting back here and the heading to the river and up the river and down the river. After you start investing that much time, and it is starting to develop into what you have been looking for it is harder to let go. (C, 4, Res)

We just like country and the water, and the recreation that goes along with it, fishing, hunting and all that.... We're really lucky to have it, it's a beautiful piece of country. (L, 4, Res)

You know, that's another reason I'm in Big Timber, I don't like to be around a lot of people. I like people, but getting in traffic in a town like Billings, and I've been in all the big towns in this country, and there isn't one... I'm thinking, I'm thinking... there isn't one that I would choose to live in. I will always have to come back to here. Because nobody has the Yellowstone River, nobody has the Boulder, and nobody has the Crazies, and the people here are just special.... There's a mental health aspect of being able to live along the Yellowstone River.

There's just not a lot of people here, and there's space. You can throw your arms out, take a deep breath, and you're not breathing somebody else's air. (K, 4, Civ)

We're next to the mountains and along the river. And because of that, there are a lot of recreational activities we can do. We like to do things outside, so that's important to us. (R, 4, Res)

In our isolated space here, there is really no conflict. We are sitting on 160 plus acres down here and there are five landowners. In this area, there is really no conflict, because one gentleman is farming everybody's ground. (C, 4, Res)

I guess that's mainly just a lifestyle... I don't like to live in town, never have lived in town. You know, I like the out-in-the-open, so I guess that's the main reason. (S, 4, Ag)

We don't like a really close neighbor. We like the view; we like the quiet. (G, 4, Res)

This is the life we chose to live, and I like it. It's something that you can pass on to your kids, and they like it. My daughter works here. I've got two little granddaughters that are being raised here. It's a family thing, and we want to keep it family. (F, 4, Rec)

It's a beautiful river, you know. It's wild. We like living here because of that fact, it's not crowded. There's an island over here, Homestead Isle. And that's a farmer up on the hill...he runs cattle and that's about it. You know, you can hunt over there, there's deer over there. (G, 4, Res)

It's just, this is just a great place, it's clean, we've got clean air, we've got great water, we have forests, we have wildlife, we have hard-working ranchers, we have a culture that is supportive of each other. We wave at each other when we're going down dirt roads and we say hi on the streets. (K, 4, Civ)

In addition to these largely scenic and recreational values, some reflected on the supportive environment for agriculture that brought their families to the area:

My grandpa and grandma...came here back in the early 1900s—1908, I think. And I'm sure that the river was important to them because that's kind of the lifeline. If you don't have water, you can't have water to grow anything. I'm sure that would have been a decision for them to settle here in the creeks, because they homesteaded on lower Deer Creek. (F&W, 4, Civ)

My father, his family homesteaded up here. My mother's side has been here since 1892, or my dad's side, rather. My mother's side has been here since the 1890's also. I'd say I'm a native. (H, 4, Rec)

My grandparents came from Germany in 1910, and had a ranch north of Columbus—farm, I should say it was a wheat farm... My mother's side of the family came to the lower Musselshell from Yugoslavia at about the same time. Stayed there until Fort Peck was built and it flooded their land, and so then they moved here in 1937... There were 10 kids.... My grandfather worked in the mines in Red Lodge...to supplement his income [while my grandmother] was down there raising kids in 40 below zero. It's unbelievable how they survived. Kids today wouldn't even think of doing that. (W, 4, Civ)

Local Economy: Participants from this segment described changes and shared concerns about their local economy in terms of land use, development, and changes in land ownership:

Development is the thing that always worried me, that I would be having people build more houses on their property and taking away what quiet we did purchase to live out here. I don't want neighbors or lights on. They can have all the guns they want just don't point them at me. (C, 4, Res)

I don't look for my grandson to come back here.... It's not a bad place to live.... We've got rivers, we've got mountains, and we've got the interstate on the plus side because you can go someplace and it's a safe highway. You can get on it and take a left and go to Seattle or take a right and go to Boston.... But we've got a lot of empty business places downtown...the days of the little grocery store are gone.... We used to have six car dealerships and you could buy a T.V. set and washer dryers—can't do that anymore. It's all Billings.... I guess, probably, my biggest concern, and I'm seeing more and more of it, are these absentee owners. And to be truthful, with the price of this land, that's the only ones that can afford them. The rancher can't afford them.... So, they're either nature lovers who let the ranch go to hell, or they're the other way, going to set the world on fire and they don't know how to do it. They got the hats, the boots, the chaps, and the spurs, but they don't have a clue what to do with them or how to put them on. (S, 4, Ag)

[Sighs]. When this sells, it'll be sold to some rich guy that'll probably bulldoze the whole place. If the railroad wasn't here you'd have a big mansion somewhere, and that's probably the fate of the place, so I don't foresee anybody being able to buy it for agriculture, and I don't think our daughter... is interested in coming back...to the farm....We don't have anyone that has an interest ...in taking it over....We'll plan on living here until we die, and then it's the daughter's problem [laughs]. (S-2, 4, Ag)

Well, I don't [have concern] as far as the river goes. A primary concern I can see is jobs for these young people to stick around and actually ever end up owning a piece of ground along the river even if they wanted to. If they haven't got some jobs or something to do, they are going to go where there are those things, and it's hard to bring our kids back to this community.... and our kids do really well. Scholarships, just this year, were pushing \$900,000 at our little bitty school. That's a lot of money for those 44 graduates.... But, those kids are going to go learn

something, and they are not coming back to Big Timber....If you can't eat, it doesn't matter what the river is doing if you are starving to death. (F&W, 4, Civ)

I've been in Big Timber since 1978, and I haven't seen a lot of change. The town was 1,600-plus people, and the county was 3,600-plus people, and that hasn't changed. It's almost the same number. But a different culture.... Some people come here and buy up the ranches and then hire a local to run it. Probably as a tax dodge or just a place to escape from where their busy lives are miserable with tons of people.... [When I was a teacher] I painted six ranch buildings on this one ranch...one summer to pay the bills.... It was quite a cattle operation, but [the owners] lived in Chicago. They gave my science team a lot of money. They were wonderful, wonderful people, and they would come out here maybe a week at a time, two or three times a year just to escape Chicago.... My daughter is a physical therapist, right over there, raises her family right along the river. And I would hope that her kids could live in Montana also, but a lot of people have to leave the state to make a living, and they only get to return home during class reunions.... My son almost wanted to buy a license plate that said, 'Montana sucks, go back home and tell all your friends.' ...The people that come here because they love what they see, are going to affect what they see, and change it, and that may be a negative. (K, 4, Civ)

Hopes for the Future: Given what they prize, it is not surprising that locals want stability. Some in this segment talked about development when they discuss the future:

I don't look for much change. Maybe a new roof on the building, but that's not going to change a lot. Some of these trees will come down, new ones will go up in their place. (F, 4, Rec)

10 years from now it's going to be really, really close to the same. As far as this location here. The neighbor to the west, he is in the same position I am, he is going to die there. The guy to the left of me, he is retiring so he is probably going to die there. So, this little window that we have, I don't see anything changing. (C, 4, Res)

I'm hoping it remains pretty much the same... I would like to see the Yellowstone River, and the people along the river, and the whole culture and the whole diversity of it, be the same. (K, 4, Civ)

We've gotten all the paperwork done so it's owned by our kids own it now. So, there's no tax consequences coming, you know. So, they can keep it, and they all intend to hang on to it and keep it. The house next door was my parents' house, so it's mainly a guest house for any of the kids, they keep it pretty occupied. Then the other side is my sister's house, she's just a weekender out of Billings. And my brother has a house two miles up the river... Yeah, it's great. But I can see it just staying this way. They are all part of it and real active in it and want to keep it the same way. (L, 4 Res)

Hopefully, it won't be any different. I like it the way it is. Ten years from now, I don't know, I really don't. I can't see us changing very fast. If we lived closer to Bozeman, I would say we'd change faster, but we're too far away.... If we were closer, we'd get a lot more commuters, but we are not close enough.... Just life goes on, year after year after year. And you hope it stays pretty the same. (R, 4, Res)

Well, we've got a subdivision just right across the street here... That's pretty close...[and] this one on the corner is new, and there's gonna be another one.... [We] could sell houses all the way down that road with no problem at all, but of course we don't want to. (M, 4, Ag)

When they say it's the last best place though, I really believe that. Montana, Wyoming. But even when you start crowding the west coast you kind of start getting back to what we're trying to keep east of the Mississippi—I'm for nice, average well-mannered growth. (W, 4, Civ)

Segment 5: Springdale to Gardiner

The people of the Yellowstone River from Springdale to Gardiner describe their local community as a diverse and scenic natural environment that has supported agriculture and some industry for generations. Moreover, they spoke of it as increasingly supporting recreational and tourism interests. While these changes presented opportunities for some, concerns are expressed particularly among agriculturalists about the loss of 'rural community values and an inability to do things "the cowboy way." These farmers and ranchers also reflected on a common issue with retaining the next generation of agriculturalists. For these reasons, people in this area generally expected increased growth and development and hope to maintain some of "the feel" of their community in the future.

Descriptions of Local Context: In this segment, participants reflected on the value of their diverse and scenic natural environment, which fosters a sense of attachment to this place. Both long-term residents and newcomers appreciate the rural lands and the recreational opportunities:

The world's first national park is a block from where we sit here.... [And] the longest free-flowing river in the lower 48th states is about 50, maybe 80 yards that way. We've got the first shot at [the river] here in Gardiner, when it comes out of Yellowstone Park. The Absaroka-Beartooth wilderness is just up the hill to the east, Gallatin Forest just up the hill to the west. Highest peak in the Gallatin is Electric Peak—I've lived my life under Electric Peak. This river runs through this valley. Yeah, it's just an extraordinary place.... Some of us were smart enough to be born here, and quite a few of us are here by choice. We're fiercely attached to the place.... [Among] the people that choose to come here, there's a pretty deep and common set of values.... [We have] an appreciation for the natural world...because if you need a Walmart and shopping mall, this ain't for you....We don't all need ski lifts and zip lines, you know. It's all right here, on its own terms.

And I don't know, authentic people, the human resources. There are crazy, passionate, well-educated, grounded humans who live here.... They don't call it Paradise for nothing.... Holy cow! It's stunning. I can't believe I get to live here. (B, 5, Civ)

[Out family,] it's been here 50, 60 years probably. Yeah, been over 60.... I've lived here 41 years.... We [explain living here] in the context of our family because it's a legacy ranch, it's a generational thing. Which we kind of feel strongly about trying to preserve, and so I would say usually when we talk about it, we talk about the number of generations that have been here, and how important the land is to us... On this particular ranch, our grandchildren are the fifth generation, but [my husband] can trace his lineage to the first white man in the valley.... My great-great grandfather... came here... looking for gold. Went back and got his family in Pennsylvania, and they came in a covered wagon... 1868 probably, maybe '67. (N, 5, Ag)

My mother's father and folks homesteaded in the Shields in 1893, up in the hills... There's a great-grandchild of my mothers' folks still on the original place. That's kind of unusual.... The old homestead house at the ranch was built by a couple from Louisiana that couldn't read or write, and they laid down the cottonwood logs (D, 5, Res)

We've have been married... 36 years. So that's my length of time here, [my husband] was born and raised here. Right here... His grandparents and his mom and dad came out in the 40's. So, we're not long here, like a lot of ranches that have been here a hundred years plus, but still many generations. (K, 5, Ag)

I started working in the Park in '72. My wife in '74... and having been in the Yellowstone area for 10 years... we got the strong urge to settle here. And it took a while to work it out, because as they say, you can't eat the scenery. So, lots of years of seasonal jobs, but when [my wife] got a permeant job with the Park Service and I got a full-time, year-round job with one of the concessioners, that's when we started looking for a place. And it was pure dumb luck that we got a really nice place on the river. (B, 5, Civ)

My mom grew up in Minnesota right on the Red River, and we had a lake cabin in Minnesota. So, she knew that she wanted to be near the river. And what they really liked about where they eventually selected was that you're one mile from town, but when you were out there, even with all the completed construction, you don't sense that you have neighbors... I mean, you're a mile from the grocery store and about a half a mile from the clinic, but you really don't sense that you're in an urban area. (K, 5, Res)

My father moved here in 1938. He left a paying job in New York City and moved to Livingston and started a fly shop. And it's known world-wide, you know, he set Montana on a course.... Volume 1, Number 1, Sports Illustrated, there's an article about my father.... [The shop] is known world-wide. (B, 5, Rec)

We're only 9 miles out of Livingston, and it's a nice spot right in the middle of the valley—close to the river, good views... What I usually tell people is that it's a valley that is fairly diverse because it is kind of on the edge of the prairie and the mountains.... You don't have to go too far in any direction within in the valley and you're up in the mountains. (C, 5, Rec)

Local Economy: Many people in this segment explained that their community and local economy are in transition. With increased local development (including subdivisions) and the growth of a commercial recreational industry, many described changes in land use and population as presenting opportunities for some, but stress for the agricultural community:

I've lived here since 1968... Obviously, the big one [change] is the economy changed a great deal when the railroad shops left... That's probably the biggest event in the history of this community.... Surprisingly though, even though that employment went away, the population didn't crater. It did fall, but it rebounded and has continued to grow. So obviously, the tourist attraction, the geographic location does have something to do with why the community is still here. (City Staff, Livingston, 5, Civ)

Right now, there's around... 3,900 workers in Livingston; only 1,300 of them work in Livingston... So, if that's a bedroom community, we're already there. (City Staff, Livingston, 5, Civ)

With an influx of new people, I think especially, we are seeing not so much a diminishment of the concern for property rights, but we are also seeing a concern for property values... And that was less of a concern when it was an agricultural economy, it's not so much anymore. And you probably know roughly 6 or 7% of our economy is tied to a combination of agricultural and wood products. It's not much... And I think the reason it's viewed as being more significant is the sheer amount of land that's devoted to it. (C, 5, Civ)

A good friend of mine is a bartender in Livingston, and he's been keeping track of the census of Livingston for the last 70 years, and Livingston has always had 7,000 people. The county has grown, but there has been 7,000 people. The wind sometimes blows out some of the people and it brings in new people, but it has still stayed pretty steady at 7,000. I really don't see it changing... There was a more vibrant retail economy in the 70's and 80's, and even early 90's, than there is today. Now it's a collection of art galleries and secondhand stores. For a person to go and buy slacks, dresses, shoes—just normal things that you have in a household—you can't make those acquisitions in Livingston... [Instead, people go to] Bozeman or Billings. (K, 5, Res)

The dynamic of vacation rentals has changed it a great deal; a lot of neighborhoods in Gardiner have completely flipped from residential to vacation rentals to where they sit empty in the winter. The money is really good; it's become an important

part of our economy. But... school enrollment is declining, neighborhoods are sort of being emptied out, and it's a concern for a lot of folks. How do we maintain the actual community or are we morphing into a theme park? (B, 5, Civ)

The growth of Bozeman is gonna change Montana. It's gonna change the politics in Montana too. Don't ask me how, because I don't what all these new people are going to do, but the next census will change the power they have. (B, 5, Rec)

I've heard how it's changed. The gentleman that I was referring to... he said that in the 40's he could climb Emigrant Peak, and he could look out and... he said that he was lucky to see three lights from Emigrant Peak. And he said that he could go almost a week before he saw a car go down the road, because the interstate was not built yet. So it was the old highway on the East River Road that he would look, but still there weren't that many lights. (K, 5, Res)

When we were first married, we probably knew everyone that lived in the valley, at least probably knew their name... I know my father knew everyone in the valley, probably on a first name basis, but of course there wasn't that many either, like we said... I'm not saying they always got along [laughs]. They knew each other. They fought about water, lots of issues. They were irrigators. I'm not saying they always got along, but they knew everybody, and I think overall they got along pretty well. (N, 5, Ag)

When my nephews from New York used to visit, they used to say we lived in the middle of nowhere. But they don't say that anymore, because we don't live in the middle of nowhere anymore. We're surrounded by subdivisions... I mean, Emigrant is huge compared to what it used to be. So, it's not the middle of nowhere. We used to trail [our cattle]. Years ago, we'd just open the gate and we overnighted them at a neighbor's, and it was a two-day thing. We just don't do that anymore because there's too much traffic. ... And we had a couple bad experiences, and we don't do it anymore. Nobody got hurt, but we had a guy... he was crazy. This one was in the fall, so we had no calves, we were just bringing the cows home. And we hit the Yellowstone Bridge over here at Emigrant and he had come through from one direction and he was screaming, yelling, making gestures... he didn't want to stop, and I made him stop. I got in front of him with my horse and endured, lots. Then when they got off the bridge, I let him go through and he wasn't very far on the other side, and he pulled in to wherever he lived I guess, reached into his back seat and pulled out a baseball bat and came up to the side of the road and just went like this [gesturing]... And in that same cut-off road I had a guy, he had California plates, come through, and he just started bumping the cows. And I again, I got over there with my horse, and I said, 'Sir, you cannot hit the cows as you go through.' 'Oh, I was in a hurry.' So... the liability issue became huge... It's like a lot of things that we've had to change because of various things that go on around us.... There's not much we do 'the cowboy way' here, anymore. (K, 5, Ag)

I think what frustrate me is that what this community used to be a rural community. And I think it's legitimate to say rural community values, and they're a little bit kind of nebulous, but you know what I mean. It's that neighbor helping neighbor, neighbor knows neighbors, and we don't know our neighbors anymore. And that is getting lost. There are still sections as you go down the valley where the neighborhoods are more like they were, but everything is changing. And the people that are coming in, they came because of what it was, and they've changed it. And they don't see that. (K, 5, Ag)

In addition to the impacts of these local demographic, economic, and cultural changes, agriculturalists also discussed the importance of, and difficulty with, retaining the next generation:

We're like a whole lot of families anymore I think, in this position, you know, we're the 65-plus generation, and our kids don't want it anymore. And what do you do with it? Then you've got siblings that can't get along or I don't know, it's awful... One of my good friends, they have a nice place up Mill Creek and their kids don't want it. So, what do you do? You've spent your whole life doing this and you have this real connection to the land and what you've made. (K, 5, Ag)

Specifically related to the economic shift toward recreational uses, such changes in the community result in notable tensions across interest groups in Paradise Valley:

The ranching community has a vested interest in the river. Fishermen, they think they own the river. (D, 5, Res)

Hopes for the Future: For the participants in Segment V, the future is one of growth. One participant summarized the local sentiment perfectly:

It's going to grow, especially if we have problems on the west coast with earthquakes and volcanoes and whatever, riots, which are a real possibility. They can't move west, so I think a lot of them will come to Montana. When I started law practice, I knew practically everybody between here and Gardiner personally. And then the Church Universal came in and changed that, and they started subdividing. And it's a different world now.... It's a changing community right now demographically.... If Livingston is going to grow, that's okay as long as it doesn't change the feel. I think everybody wants it to feel like Livingston, which is hard to do with growth. So, I think it'll take a lot of really good decisions to keep that feel as we feel that pressure from Gallatin County and Bozeman. The real estate market, there, is so much higher than it is here. How do we not default to a Park City, Utah or Vail, Colorado model, where the people that work in the town can't afford to live in the town? That's probably the biggest issue that's facing us over the next decade. (D, 5, Res)

Management Contexts: Public/Private Interfaces

Nearly every participant made detailed comments about dealing with government officials, or what they expected from the various levels of government. Some comments on the personnel, as when this participant described people from the Corps of Engineers:

Most of them don't know a rock from a stone... but part of it is political. (O, 5, Ag)

Others tended to talk about their experiences with the details of regulations in terms of types or categories and how they are enforced. They often expressed concerns about fairness, lacking helpfulness, or feeling threatened:

This house sits on a little knoll. It's the only thing down here that is not in the 100-year floodplain, where this house sits. My grandson was going to put a trailer out back here and he couldn't because... of the floodplain.... I never have seen water there. It's almost come up... but it's never come over. Not as long as I lived here, and I've lived here on this place since '74. (Q, 1, Res)

There are groups out there that think they already have the big picture already in mind—and that's to eliminate all of the people along it [the river]. And we wouldn't even be sitting here talking about it if people hadn't been along the river, would we? In a way they're right, but hey, this is the 21st Century. We're not talking 1793. (F&W, 4, Civ)

I live ten feet from the banks of the Yellowstone. When I did a construction project on my house... of course the bank wanted to know what its risks were, like flooding. If you look at the FEMA map, I'm on the floodplain. They're like, 'Ahh, we're not going to finance this.' So... I looked at the FEMA floodplain map in Paradise Valley and it goes all the way down the river. And guess where the FEMA map draws the line, guess what structure it hits and then there's square lines that go around and then back to the river [that indicate] this is not part of the floodplain. Guess what building it is.... Park High and the middle school. Why? Because they would need flood insurance. So, I'm like okay, this is horse shit... so I called, and I go, 'Okay, I'm calling your B.S. What do I need to do?' ... And they didn't even actually have to come out. They just kind of went, 'Oh, yeah, you're not in the floodplain.'... So, anyway, the flood level... everybody needs to be treated equally... so that at least when we're talking about floods, we know what we're talking about. (R, 5, Rec)

So, they told me, at first, I couldn't rebuild. They were just going to take my stuff away from me. And so, my brother-in-law came...and he said, 'Let's go see this woman.' So, we went to see her, and she said, 'Well, let's go look.' And then she came. The sanitarian, I think, is what she was, or the county planner, or something, and she walked around, and she said, 'Oh, you haven't lost more than half of your

house. You can rebuild'... Well, I learned one thing. Never believe what people tell you. Can you believe that? (S, 5, Res)

In contrast, others discussed progress with covenants, setbacks, and floodplain regulations:

We've got laws that you can't build within 100 yards of the Yellowstone which is great. Years ago, we let them build right up against it... You've got the people that have money that say, 'Oh, I want to live along the river, and you can't stop me.' But we had to pass laws even to say if you build in the floodplain, we are not going to sell you insurance. And I know one guy built in the floodplain, cost him a lot of money... and now he complains that every time the river goes up, he's being flooded. And we're saying, 'We told you not to do that.' ...They're making stricter rules that you can't be along the river someplace, which is a good thing, because our rivers here are for everybody, and if we as citizens do not take a stand, our rivers won't be here for our kids or our grandkids or their grandkids... We can't make everybody happy in what we're trying to do, but this way... we can keep people away from the rivers. (R, 3, Civ)

In Yellowstone County...Our Montana had pretty good luck getting a fairly significant upgrade of the country flood ordinances. We compared a lot of ordinances across the state and took it to Yellowstone County and lo and behold... we developed a fairly good flood ordinance in Yellowstone County. That's important because the degree to which we channelize the Yellowstone River is exactly the degree to which floods will be more dangerous and damaging and human safety in the future. So, it's extremely important on this free-flowing river that counties and FEMA... all the counties develop really strong floodplain ordinances. The result to which they don't do that is going to cost the public a lot of money. (P, 3, Rec)

We have covenants in place that disallow things, which is good. No pig operations, no poultry operations, no mining, someone can't come in and start a gravel mine down here. Farming is allowed, no more than 2 dogs, so they can't have a kennel upstream.... But I don't think those covenants are good for the entire life, I don't know. I will have to study up on that (C, 4, Res)

It has worked out real well, I think. We have always had a good planning board and a good planner and good sanitarian people, you know. But how do you fight the old days? ... And some of it gets argued in too. You fight the system, terrible. But it is an interesting challenge politically. Very interesting. (E, 4, Civ)

I would say the change I've seen is there are more and more people in tune to those issues than before. You know, if you come out here to float the Yellowstone River, the last thing you want to see is a bunch of houses on the river... So... I would say as a fly fisherman's perspective, they'd like to see a corridor where it's protected, and the views are the views. On the other hand, most people that move

out here want to be on the river... Walk through your backyard and go fishing. So, it's kind of a catch 22 there. (T, 5, Civ)

Participants also shared their specific desires for future management efforts:

I'm a firm believer that the government can't protect you from everything. You make too many regulations, and all of a sudden it starts affecting something they didn't intend to. Personally, I would say a buyer beware type of philosophy... my opinion is that they should be made aware of the problem of flooding... And if they do it anyway, shame on them. (V, 1, Res)

These conservation groups all on the river have been issuing permits for various activities and this kind of information provides a lot of knowledge to those people saying, 'We don't want to put this structure in the river here or there. It's going to get wiped out,' or whatever. And... the education should go to the people that are doing the planning because they wouldn't even propose some of this stuff in the first place if they understood what the impacts might be or would be. That's the toughest part.... A lot of our laws came from the west side of the state. Granted they do a lot more development than we do over here... but, overall, in the long run, it sometimes deters development here in our area. We are a rural... farming community, so we don't see a lot of development. A lot of it is a mom and dad who want to divide off some property to gift to their children or their siblings... They have to create a subdivision, and creating a subdivision can be quite costly... I'm hearing its anywhere from 15 to 60 thousand dollars for an application, depending... So, it can be quite costly to do that... It is better to take a proactive approach to the development than trying to be reactive. In this past year I would say majority of the time we were reactive, both in Sidney and the County (H, 1, Civ)

Even though there are some regulations about building in the floodplain, there's still considerable impact of homes that are near enough to the river that they create some impact. So, we need an adequate setback... Just trying to keep the floodplains available to the river to flood on is one of the best things. (D, 3, Rec)

You've got county commissioners looking at that coal plant site going, 'We should do another industrial site there.' You've got zoning permits being given out for storage facilities along the river. You go upstream, and you've got reinforced banks everywhere, so everybody can put their house there where it's going to flood, anyway. See, you can carve out your little spot and do the best you can, but when all this other stuff is happening. There's no resiliency there, there can't be... There's a great article floating around about, I think it's Boise, Idaho... It reminded me a lot of Billings, and how we could rethink this. Because for years, the community just looked at the river as a place to put their trash and site industrial facilities that need water.... And [the article said] some city leaders actually sat down and said, 'We should reimagine what we do with this river.' And they built interconnected networks of parks. They did a lot of work at reestablishing trees... and native vegetation along the river. They turned it into someplace that people

wanted to be. And then all of a sudden, things started to happen. You know, people wanted to come there to float the river, and so businesses popped up with ferrying people between their drop off point and where they come out. And then pretty soon people wanted to build restaurants close to there, and they wanted to build shops close to there, because people would do a float and then they'd come out and they would want to get something to eat. This whole chain happened. But it requires thinking differently. And that's just what I don't see happening around here.... I still think everybody looks at the river as some place to put their garbage... Instead of looking at it for the resource that it is. It really pisses me off in the end, when I think about it, because it's such a waste. (S, 3, Ag)

So, you look at future development patterns and the increasing population, and particularly in the interest of people living here... How we organize ourselves on the landscape, is going to determine the health of our wildlife populations and...fish... I think there's some decisions that have to be made to try to figure out what this place should look like in 50, 100 years and how we see to it, because there is increasing pressure... So, Livingston to Gardiner, what's that gonna look like? We know what it looks like now... you can't freeze it in time, nor should you, but... [what] is it gonna look like if we do nothing? And... what can it look like if we choose to do something? And nothing is always a choice... And it could be a conscious choice, or it could be a deliberate choice to try to get some consensus about hey, you know, how do we feel about setbacks? How do we feel about density? How do we feel about the current incentive system? (B, 5, Civ)

Some offered comments that indicated a scorn for "book learning" as compared to experiential knowledge:

They hired this kid. And he was a smooth talker, and he had a ranch management degree out of Texas. He didn't know a damn thing about ranching, it was all out of a book... and there's more and more of that coming around, you know. And he's done more damage in a year and a half than I can fix in five years, as far as keeping control of your weeds and keeping the upkeep on the ranch. (S, 4, Ag)

Some participants explained that public education, locally sensitive regulations, improved setback, and big-picture planning initiatives are needed, especially to ensure the health of the river:

The sad things with these rivers are, the highways build bridges, the railroads build bridges, and that river has got to go under there. It can't go anywhere else. It has no room to roam; it's getting less and less... I think... in the perfect world you would let the river have enough area to swell and be itself...[But] we're basically trying to keep the river in a certain channel. You know, Paradise Valley is not very wide... That river can affect a lot of things. You know, we basically work hard to keep it in the same channel... It's that same channel that hits the railroad bridges and the highway bridges to go under the highways, and so it's just not... it's not allowed to swell and be natural... Like I say, if it was a hundred years ago and we had better planning and understood that better, then we probably could've done

some things to mitigate that better as far as allowing the river the space to swell and do their thing. (T, 5, Civ)

The sad thing that's happening... there's this huge paradox... in the valley because as they continue to build houses and they don't require a setback or they don't do a moratorium on how close your house can be, houses become sacred. And there is nothing, all stops are pulled out for a house, and okay so do you really care about the health of the river and the ecosystem and everything, or is it each individual person's house that chose to build there? That is another huge philosophical thing, and on that one I'm sorry but the river loses every time. (N, 5, Ag)

I would like to see a better education program that is generalized so that people and students and kids and everybody else are aware of what weeds are doing and how fast they're growing. (C, 3, Civ)

In addition to the personal and informal initiatives for addressing the issue of noxious weeds and invasive plants outlined in the above section, some participants also discuss more formal management efforts. Participants share positive evaluations of county and city efforts. Here, the City of Billings is discussed:

We work with the Yellowstone County Weed Agent, Joe Lockwood. And he will reimburse us up to \$500 for herbicides that we have a receipt for every year. So that's been quite helpful... And he was going to provide us with Pseudomonas bacterial agents to help control the cheat grass this fall, but some government agency put it on hold because they were concerned about... the ecological safety... So, we didn't get to do that this year, but we hope next fall to do that. (W, 3, Rec)

We're cleaning up the Dutch Elm, I have to give the city credit for that. The city has now hit all of our parks within our city boundary and cleaned up a lot of the Dutch Elms around town. (R, 3, Civ)

Others offer their perceptions of regulatory mandates: the first participant is grateful for present rules and the second voices concern related to potential new laws applied to lands with disputed ownership:

I think of Bitterroot Valley... it used to be gorgeous. It is full of knapweed. They have not taken care of it... it's sad. It doesn't have to be [that way] ... We [in Paradise Valley] take good care of [knapweed], could even be better, but we do, are really on top of weeds. And it is a law; it should be. (R, 5, Rec)

Probably a net gain [of land] or we're netting about the same, gaining about what we've lost. But what we're gaining is a gravel bar and spotted knapweed, you know. So... the way I look at it, if we went and got that turned over to us and then the state decides to get stinky about spurge and knapweed, then I'm responsible for it. Right now, that's... I don't know. That's not my land... You know that those weeds... gotta be taken care of. (S, 4, Ag)

Summary

In 2018, the participants from the different segments offered details that suggested important similarities and nuanced differences regarding how they think of life along the Yellowstone River. In terms of similarities, in all segments, participants expressed a strong love for the river, regardless of their interest group affiliation. Nearly everyone speaks of the river as an important asset to agriculture and as a recreational venue.

Upriver, especially in Paradise Valley (Segment 5), tourism and out-of-staters who buy land are a continuing fact of life. Residential and commercial development near Billings is considered a foregone conclusion. Some of those same residential development pressures are creeping into conversations in communities such as Hysham. However, the communities of the lower river, near Glendive and Sidney, are much more impacted by the oil and gas industry as compared to residential or commercial development. In the lower segments they often hope nothing will change. In the mid-regions and the upper river, many see change as inevitable. Nearly everyone is hopeful that the changes will not spoil their relationships with nature, nor with their neighbors--even when the neighbors have unfamiliar faces.

Some participants offered positive evaluations of agencies and management efforts, and they generally express a desire for stable and reasonable regulations. They value experiential knowledge and are sometimes suspicious of "book learning." Yet, some explicitly call for officials to improve the public's understanding of the river and its issues.

Physical Processes and Human Responses

Introduction

This section documents how the people of the Yellowstone River Valley describe the physical character of the river and their efforts to manage impacts to individuals and communities. Their comments offer evaluations of the river's dynamics and of their efforts to control flooding and erosion via bank stabilization strategies, levees, dikes, and dams.

Flooding, Erosion and Flows

When participants reflected on the issue of flooding, they often offered descriptions of causes (ice jams, runoff, groundwater levels) and impacts (damaged farmlands and structures, expensive public infrastructure, and lost recreational opportunities). The participants generally focused on the major flood events of 1996, 1997, and 2011, with some discussion of significant high water in 2017. The impacts of these events vary by location and individual experience. Some voiced concerns about perceived changes in flood patterns, while others pointed to the beneficial aspects of regular flooding. The examples vary by location and by participants' individual experiences:

Once in a while we'll have ice jams, and they back that river up and it gets a little scary, we have a pivot that is a little close to the river... Other than that, ice will take out a fence... and then we put temporary fence in... But generally speaking, there aren't a lot of issues associated with problems... A little fence once in a while... Now at high tide... it's called the June rise in Prairie County. And we'll have trees come down, 100-foot, 150-foot trees with branches and everything, and they'll hit my pumps. Twice we've sunk pumps and that's an expensive little proposition, that's not fun. We just pull it out, rebuild it and fix it, but generally speaking, we're pulled in enough from the banks and I have a boom sitting out front, so we generally can deflect those things. But those would be the only problems associated. (T, 1, Civ)

The ice was really thick and now we're watching the June raise. It's coming. And we may very well flood again because last year it did, it flooded clear across. And we had an awful time just with water, but the whole pasture down there was, we had pelicans swimming on the pasture [laughs]... It's very interesting. (Q, 1, Res)

Then you know, there is some farms that always get a little wet. But it wasn't that bad this year... There isn't anybody down there that got affected as far as homes or anything like that... Most of it is just hay meadows, so it just does good, tears up some trees so they may have to move some trees when they get down there to do some farm or spring work. (M, 1, Civ)

We normally get an ice jam, that's one of the main things that everybody looks for in January, February, March, whatever time of the season that the ice, the river goes out... That's just in everybody's thoughts due to the fact that it has happened in the past, and it is a continual problem. Of course, we're not going to be able to dredge those areas of the river to clean them out... It's a situation that we have to deal with. (E, 2, Civ)

When the ice jammed, we had water back up onto our property, and... we had to go out in the fields and walk them and take all the trash off the alfalfa fields before we could do the haying process... We had a lot of our property under water at that time, on that particular one, and it was just basically because it was backed up into the canal system, and then the drainage and it just spilled over into the farm ground so, but that was pretty unique. (E, 2, Civ)

Usually we get the June raise, you know, and it gets high, and it gets real high sometimes, but it's three or four days and it goes down. Well, what's it been? Two weeks now we've had high water... [And] It's the highest I've ever seen it in the years I've lived here. (T, 2, Ag)

We have groundwater issues, but we've never had flooding issues... Primarily [during high water]. This time of year. ... Since we have such high water, [and] we sit so low, when the river gets so high then we do have groundwater issues with some of the residences especially. (K, 2, Civ)

In 2011, when that thing came down, it ran over the top of a lot of those islands. And so, the fall of 2011 when we hunted, number one, you didn't find any shed horns because it washed them all away. And number two, there was hardly any grass. Just silt sand. So, the mainland where we had hunting was good, but the islands, horrible... Just nothing there for them to eat. They just had nothing. (D&P, 2, Rec)

Of course, when the water, when it floods and the water goes down, it's not a big deal; you've got debris, you've got branches and cottonwood trees that float in, and you may have to go pick that stuff up out of the hay field. (W, 3, Res)

I'm going to bring about what I consider quality of life choices that you make as a community... I think part of the things that we had down at the park were quality of life. They never paid for themselves. But we wanted to keep them for our citizens to enjoy. So, to put a dollar value on the loss of those, I don't have an actuarial, or a way to do that, I don't have that. I just know that we were without some of our basic recreational services for a year or two years. Because once the water receded, then we were left with the cleanup. And the cleanup involved an amount of money which we don't have... So, a lot of those were lost. And how do you put a dollar value on recreation? (Olson, 3, Civ)

Just the high-water worries, you know. I have a daughter who lives right next to the river in Columbus, Montana... And her three kids, I mean they're right next to

the river. And the water is pretty high right now, so whenever there is high water, it starts to make you worry about kids getting a little too close and falling in from the bank... [and] Some of the ranchers have lost some pump houses and stuff like that, you know, on some of the feeder streams that come in. I don't think the Yellowstone has caused them much loss. But like Sweet Grass Creek and Big Timber Creek, I remember years back somebody's pump house got washed away during high water, snowmelt time. (K, 4, Civ)

And then when it does like a year like this, it floods all of the meadows, and now the meadows are come up in spurge and knapweed and thistles. You know, and it had been quite a few years, and the native grass and the clovers were just beautiful pasture, now it's under mud, so. (S, 4, Ag)

I was here in '96 and '97 when we had the floods, and it was first time I'd ever seen the water was in town. It was flooding town, the east end of town. And I've never seen that before. You definitely see how strong that river can be... [and] we heard a lot of horror stories about the valley and Park County for sure. (T, 5, Civ)

Some expressed concern about recent flood events and/or noted changes in flood patterns:

This year was probably the... [year] that caused us the most stress because the river jam was right below Savage this year and it stayed there for like... three or four days, and the water level and the ice actually came up close to some of the houses that are in the lower level of the Savage community... So that's why the water level this year was kind of a concern for us, is because before it's never got up that high. (H, 1, Civ)

It floods here about every 3 years... The river takes a hard turn down there... And so, the whole river sometimes just goes right through my property, while it's jammed up. Fortunately... I have a lot of vegetation that holds the soil down there. So, when it flows over, it doesn't really do anything. Kind of wipes the surface clean... takes a few trees out, but not nearly as many as the beavers do... That's what it's been doing... Now prior to that, I think it might have flooded once every 5-10, I don't know. But the last few years, it's been flooding about every 3 years. (W, 1, Res)

Well, we've had a number of floods... This year it flooded into the island over there and... it came up into the small trees over there, up the trunks about two feet, which is the most we've ever seen. It will flood a lot of times, just so that you can see water at the base of the trees, but this year it was considerably higher... within the last month. It started actually because of the rains, we had runoff earlier than normal. Normally, it's running off now heavily, but it's backed off considerably even with the warm winter, because a lot of the snow is gone up in the mountains because of the rains. So... I would say, a month early it started. It's still heavy, but it's dropped down considerably. (G, 4, Res)

Global warming and climate change came up as topics, albeit on rare occasions:

[Referring to photo] this is taken during pretty high water. Might even be a date on it, yep, June 26th, 1958.... They always call it the June rise, now it's the May rise. You one of them global warming people? (T, 1, Ag)

The other thing that has probably been the biggest change that I've seen in those 30 years has been the effects of climate change. That kind of the gorilla in the room that almost everything else kind of seems to fall, follow from that. I think one of the things we've seen in terms of the fishing certainly, the changes that we've seen is certainly, I guess in technical jargon, the flow regimes. We're just seeing real changes, and typically over those 30 years, you know, smaller runoffs, earlier runoffs, so certainly the seasonal changes. (O, 5, Rec)

In addition to the issues and impacts outlined above, some discussed the beneficial aspects of flooding:

In some areas [flooding] might be somewhat useful, yeah. But it's more from a conservation point than a production point... You need to have some places for the water to go so it doesn't totally inundate other things downstream, or cities, or whatever. You need to have some floodplain to absorb some of it. And it also helps some of this non-irrigated land next to the river—it helps it get a good soaking and green up which helps wildlife. (P, 1, Ag)

Our sloughs will back up with water and they go over the roadway, and then the low spots will fill in. Usually if it floods pretty hard, after it's done the grass is all dead right there. A lot of times it comes back, sometimes weeds will come back in there and we have to come by and spray, take care of. It can bring new cottonwoods in—little saplings will pop up here and there. Sometimes they make it, sometimes they don't. Fortunately, Russian olives grow heavily down there, which we have been trying to keep under control for some years now, along with some other noxious weeds... Oh, it's good and bad, I guess. You know, if it picks up a bunch of logs and trees, it can pile them up down there for us and that can be an inconvenience. It can also take them out, you know, it washes in. We have a field down there that gets hit pretty hard by it because it will bring in a lot of sand, and then it's sandy soil in there. But I guess that's just the price you pay for riverfront property. (C, 2, Ag)

I can just remember once that my aunt and uncle lived here and... they had to get a boat, they had a rowboat because [the river] came clear up to this house. It didn't get it because it was on a little incline. But you just make sure you get the cattle off... You just pay attention... It hasn't been a problem. I mean it is what it is. It's the river. Is it a problem? Well, it's the river. Is it going to get out on that field down there? Some years. Is it going to wash it out? You just have a lot more sand and asparagus the next year, cottonwood trees, whatever it brings in. (M, 2, Rec)

Flooding is part of the natural way things work. The water needs to spread out and by doing that, it slows down some and makes deposits of fine material. (D, 3, Rec)

These rivers were meant to expand and retract. That's how the whole bottom land ecosystem is built, so you know we want it to flood every once in a while, down there. That's good; that brings back the cottonwoods. (S, 3, Ag)

Of course, right now it [the river] is getting flushed out which is fine. But we have to go through that once a year and enjoy cleaning it out a little, getting rid of the stumps and the stuff... And it's kind of interesting to watch that because I don't think there is much we can do to mitigate these flooding situations, except get the hell out of the road. It's about the best thing to do. (E, 4, Civ)

It seems like it needs to scour out the river at some point, being a freestone. And it moves a lot of material around... I don't know what the flooding does. I mean my feeling is that it's not like the lower reaches of the Missouri or... the Mississippi where you know, it moves a lot of soil into a farmland or anything like that. You know, that flooding is probably fairly beneficial. I mean here it seems to have a fairly minimal effect. Of course, if you have 20 acres and you lose 4, then you would say that's a pretty big effect if that's your property, but that's a little bit of rolling the dice and living on a free-flowing river in my opinion. (C, 5, Rec)

General attentiveness to the river's flows is a preoccupation for some:

The river height fluctuates so much... you never know how bad of a breakup it's going to be... people just lined the bridge watching... it was a big deal to watch the river go out. And stand on the bridge, and the chunks of ice would hit the piers, and you're thinking, 'What the heck am I doing standing here?' (H, 1, Rec)

We watch the river, and I get on the USGS website.... They take recordings at the Yellowstone River at Hwy 59, which I think is [near] Miles City. Whatever happens there, 24 hours later, is going to happen to my farm. Whether it's a rise or whether it's going down, 24 hours is the number. So, I prepare for that when that river is coming up. We'll pull our pumps in, and when I see that river going down, we'll move our pumps out. (T, 1, Civ)

It's been at least another foot higher [this year], in fact I watch it very closely this time of year on one of the river flow websites... On the 31st of May it peaked out at... about 11¼ feet, and now it is at about 10¼ feet. So, we watch that very close when it gets into 10 feet and higher, that's when it's in my basement. And it looks like we've got another week and then it will start to drop off... This is called riverflows.net, this particular one. But [the data] all comes through the USGS... So, 63,000 cubic feet is the measurement they have at the water plant, and it was up to nearly 74. That's when it was flowing though my basement pretty good. Now it's just trickling in. (G, 2, Res)

I don't know where he gets it, but [my friend] gets a lot of information on Yellowtail. And he was telling me, it was last Thursday we had our ditch meeting, another increase is coming. It's going to last about a week and taper off. And I think it might be starting to taper down just a little bit. (D, 2, Ag)

Of course, it depends on how much snow is in the high country. This year, it was 161% or 166% or whatever, this is the highest we've ever seen the water, this year. (G, 4, Res)

There's a large volume, an enormous volume of water, yeah. And, actually, I was looking at the flow on the computer, it had more flow than the Missouri River did up at the Fort Robinson Bridge. The flow at Billings was higher, almost twice. But that's because of the enormous amount of snow up in the mountains and the rain. Whereas the Missouri, it drains a larger area, it's a wider river. There's a lot more factors coming into play, slower. (G, 4, Res)

I look at it every day... We had a huge snowpack, and we had water, but I forget what the peak was... I mean I look at the snowpack all winter long. I look at Two Ocean Plateau, which is behind the lake, which really tells the story because the Yellowstone Lake is the control. (B, 5, Rec)

Channel Migration

Our participants also discussed the nature of the river in ways that reflected an awareness of channel migration. However, few used the terminology of the geomorphologist to describe the process:

I've lived here for seventy years, now. [Some] say the river is changing patterns, [making] minor adjustments here and there. But in seventy years, it's been in the same pattern. I have a fishing spot again down on my brother-in-law's, [and] I can tell you the river hasn't changed there in seventy years at all, and that's in a big curve. You'd think that it would really change, but no... [And] I did a little bit of research on it [our property] and thousands of years ago...the river flowed through here, and then it moved about two hundred yards that way. That's where it stayed for a long time. (V, 1, Res)

This is the old prehistoric riverbank that this house sits on. That's where the river used to be, and now it's coming back across this way. (Q, 1, Res)

The riverbank has come quite a little closer, a little bit since we moved here. I suppose maybe five or six feet, something like that. (P, 1, Res)

This thing had been sliding over for years, the natural flow of the river... I don't know, I bet there's five acres. (T, 1, Ag)

The river changes a lot on us – we used to have an island around here in front, a small island. That's gone. Now big islands build up over there a little ways. And

now this, it's starting to build another island over there. The river does some crazy things. (P, 1, Res)

This river is a little bit more volatile, it's ever-changing... the Yellowstone River has its own mind so to speak, you never know when it's going to change. Which, causes, well you better be on the spot. (L, 1, Civ)

It's like a snake winding back and forth.... It's just like a garden hose. (D, 2, Ag)

It was interesting, again as we've gotten older and taken a look at things, the original map of what's there and what the map is now, and we've lost land, but we've also gained some acreage. So that's been interesting, and we've gotten in on what is ownership of what land. And my grandfather would be amazed of the waxing and waning of the land on the river. (M, 2, Rec)

It's pretty much the way it was 12 years ago... other than the high water changing the riverbank, as it does, every year. Every year there's new, depending on where the deadfalls lie, it'll, it'll shoot the water off to, at an angle, and create, it'll take some sand, uh, gravel bars away and create others, so. So, within the stream bed there's a lot of changes that happen every year. (W, 3, Rec)

It's just the nature of the beast, the river changes constantly. (B, 3, Rec)

A river is a live thing, in a sense...It erodes from one side and gives to the other side. (G&W, 3, Rec)

The river is its own...and it is no weakling. It is strong as all. It is amazing what that river can do. And we have seen the channels change every year, every year.... The river changes itself; it's got its own brain; it goes where it wants. (C, 4, Res)

So, you know, the river is constantly changing. It's interesting, and it's fun. To me, it's fun to see the power of water and nature changing. (H, 4, Rec)

The river changes every year... The bottom changes probably more than the edges, just gravel moves... but every year you have to re-learn the river fishing, because some banks, they just change, may be minuscule, may not... Yeah, it's a living river... We haven't killed it yet... Don't think we're gonna either. (B, 5, Rec)

I expect the Yellowstone will run its course. It will do what it wants to do, in spite of all the happy people who are trying to change it and do all these things. But it's going to run its course. It'll change directions, like it has now the last 3 or 4 years it has changed. And you can't do much with that. And I look for it to make a lot of changes. (E, 4, Civ)

It's going away from us; it's going to the south. Of course, a wild river like this goes back and forth. This whole valley, over eons, the river has been up against the south cliffs and up against the north cliffs.... You can see some of the old flood channels from the river between here and the interstate. People don't really

realize what those are, but that's exactly what it is... [And] It'll slough down and... especially if the channel is, as I suspect, heading to the south. Of course, that's a slow process, and we'll be long gone before it's really out of here.... Some of the people around here were thinking it might have gone back to the old channel, through the middle of the island, but I don't think so, it doesn't look like it. (G, 4, Res)

She's a beast. Just keeps moving back and forth, getting wider, more gravel and stuff. (J, 5, Ag)

Several years ago, it flipped. It cut out a small channel. It used to come along the cliff and aim at the west side... but then it blew out a channel, and now it aims on the east side. And the river is almost all over there now. It's fascinating. The river does what it wants to do. It's interesting... it's a living river. (B, 5, Rec)

Some are concerned about property lines, lost acreage, and damaged infrastructures:

There's one... property that is actually in dispute because the river has changed course and the boundary line is the river. Now that the river has moved over, this other guy is claiming the property as his... But they bring it to us because we are supposed to solve it, but there is nothing we can do about it, it's just one of them things. (M, 1, Civ)

The city's got a problem in town here where the river park along there, it's eroding, the bank's been sloughing off. It started in 2011 when we had big flow and boy, the channel has really changed after that. And that's when the bank started sloughing off there. (W, 1, Res)

To me, being along the river is a detriment, not an asset. It's just a big pain in the ass to me. But [my brother] doesn't want to sell [even though] I do. So, I always tell him, 'Well, your part of the farm was right there, it went down the river. So, there's your part.' [laughs]. (D, 2, Ag)

Of course, living by the river, you really couldn't ask for a better place to live. But it does present its own challenges, especially when you are doing farming... I love it... [but] we lose bank every year... it kind of depends on the year. In some spots we've probably lost a good 20 feet... But... what we lose we kind of make up for too... you know we lose ground, and we pick up ground, I guess. (S, 3, Ag)

I'm not saying that the Yellowstone is a bad thing, but it can do a lot of damage to agriculture. Not just me, I mean you take from one Yellowstone Park clear to the end, you know, it can tear a lot of things up... We've probably lost, give or take since I've been here... probably lost 60 acres of our south boundary... The high water. At our turnoff, I could just see the Yellowstone River when I moved here. Now it's right by it. (S, 4, Ag)

We're on the cutting bank... Took half [of the lost 150 yards of land] in '96 and half in '97... This year [2018] we lost a couple of feet. (Anonymous, 4, Ag)

It's [the river is] not an asset... because of the destruction that it does.... Since 2006, there's been quite a bit of land go away since you were last here... So, I would say it's not an asset when it takes your land away. And then when it does like a year like this, it floods all of the meadows, and now the meadows are come up in spurge and knapweed and thistles... and it had been... just beautiful pasture, now it's under mud... So, like I said, it's not an asset... but it's what we got, so. (S-2, 4, Ag)

I have seen some channel changes particularly close to Livingston in the last couple of years... Where 9th Street Island is... the main channel used to be river left, and now it's pretty definitely river right... There's a fishing access... that for most of the season doesn't even touch water. And that channel... you could walk across it now and not get your feet wet. (C, 5, Civ)

It was lovely [living on the river] at first because I had 100 feet of lawn and trees. My side of the river was just a little trickle from the main one. Well, when we had the flood in '96, it cut the island in half... all that water came through, hit the island opposite, came back, and... came right at my house... It just washed out the foundation is what it did, so the front of the house fell down. (S, 5, Res)

There are people who lost 60-80 acres of land in this last 10 years of high water, for sure... We've definitely seen people who owned islands—the islands are gone. But we have constant erosion on Park County roads. (T, 5, Civ)

You lose property, and overtime that can end up being a lot.... It's a just gradual process and you see it over time, 'Wow, we used to have this much to this stock yard and now it's this much.' (K, 5, Ag)

However, participants also discussed positive aspects of the free-flowing nature of the river:

When it's [the river is] eating away on older timber areas, you know, the big cottonwoods slough off, the woody plants end up in the river as structure, and you're familiar with structure in any aquatic area, that's cover for fish and everything else. And while it's doing that, it's depositing on another location, and as soon as enough soil stays long enough, it starts growing willows and starting a new forest. So, that's the continued process. (W, 1, Res)

The wetland, it's basically a filtration system. So, it filters a lot of the chemicals and the things... before it ever hits the streams. It obviously provides drinking water for all of the different animals that come by. And then it sets up a lifecycle, so when the birds fly through or stay there, that they have what they need to rebuild their bodies and the nutrients that they need to continue to a different place.... Montana is third in the duck population for the breeding grounds... So,

it's a very important area, and our waters are very important because of that. (C, 2, Rec)

They graze down on the river bottom... it provides continuous water and usually the water is almost always open... Lots of protection and cover verses calving and wintering out in the hills with all the trees and the brush. The feed down there is unreal, like grasses waist high... the location is nice for us, and we don't have to worry about drifting snow because it's just so protected. Just a nice, natural environment for cows down there... I don't know about money-wise value of it, but you could run more cows down there than you can in the hills. (C, 2, Ag)

The benefit of that is that that the islands are created, they wash away regularly, they are very ephemeral, they come and go, and that siltation and that channel building and channel taking away is how the various species of wildlife evolved along the river and in the river, so the ecological systems really depend on that being a free-flowing river. It also makes it a good fishing river... It requires a free-flowing river to build these channels, yep. (P, 3, Rec)

This river is the longest free-flowing river in the United States. We have got big irrigations outtakes, but there is no real dam on the main stem of the Yellowstone River. There is no other river like this in the country. I compared the Yellowstone length to the Kuskokwim River in Alaska; they are about the same... but if you add Yellowstone Lake, which I do, then Yellowstone is the longest free-flowing river in the United States. [Laughter] So that's bragging rights. (P, 3, Rec)

You know in drought years, everything from the south hills all the way back to the Pryors is moving towards the Yellowstone. In the winter they come to the Yellowstone for all the cover it provides. The wildlife is just amazing. (S, 3, Ag)

I could see the flooding. But it looked like it was natural... it's doing what it's supposed to do. Having floodplains, it floods where it's supposed to. (S, 5, Civ)

Bank Stabilization

The river's migration is understood as problematic for riverfront property owners, and participants had many comments to share regarding bank stabilization efforts. Some want to stop these projects, and they cited impacts on the river and downstream neighbors as their primary reasons. They also discussed the futility and cost of the projects:

We deal with [erosion], definitely.... This year it's cutting the hell out of it up there by our pumps. It's really wanting to tear things up, up there... the river makes a big bend and it's really sandy, so it just cuts the hell out of it... Someday... I'll never see it... my grandkids will never see it, but someday that river will be coming through here unless somebody ripraps it. I don't think nobody will, unless it's a billionaire. (H, 2, Ag)

We should respect the natural force of the river... The river itself is like a wild animal, you can't control it; it's been tried since the white man moved here by... the shoring of the riverside with junk cars and rocks and trees and old tires. And the river usually just does what it wants to do... [and] once you protect one side of the river, the river goes to the other side and tears it up. (C, 3, Civ)

We would say we're not going to do any bank-saving measures. You know, with our little chunk of land, it's probably hard for us to make any huge difference, but you know when you fortify your banks, you're just passing the problem down to the next person. And... these rivers were meant to expand and retract. That's how the whole bottom land ecosystem is built, so you know we want it to flood every once in a while, down there. That's good; that brings back the cottonwoods. It's, if you just try to control it all, we're going to have to control everything, we're going to have to plant all the trees, we're going to have to change those trees... [and] whoever had the farm before my in-laws did, did put some concrete on some banks. That's slowly washing away now. And yeah, we have no plans to put anything back there. (S, 3, Ag)

You can't divert your rivers, you can't dam them, you can't create problems with the flow. Every time you try to straighten a river out, you create more problems. (C, 4, Res)

It's a wonderful river. And I just... I was always afraid that somebody would mess with to the point where we would ruin it. And it's such a healthy stream, just kind of left alone. (E, 4, Civ)

The riprap would cost almost what the property and the house is worth. [Laughs] I mean, yeah, we couldn't afford to. And I don't know that I'd want to... If I knew it would definitely work and was affordable, I guess you could riprap and then fill it in with dirt so it doesn't look like [the] Rock of Gibraltar. But riprap ruins the entire length of the bank. Because, you know, I fish down there, there's little eddies and pools and stuff. You put riprap down there and you've got a sloughway.... It wouldn't do any good here... I'd be sitting here watch the rocks roll away. (G, 4, Res)

It's too expensive... it just doesn't work—you're trying to alter the nature of the river. (A, 4, Ag)

They just have to learn to live with it and how to handle it... just don't fight it... kinda go with the course of it, and take precautions of course, but other than that you gotta learn to live with it... It bugs us a time or two when you can't quite get back on the same road to get to it [laughs]... But you'll finally find a way across it again... That's what they need to learn and not get all excited and pull a bunch of old car bodies and farm machinery down there anymore [laughs]. You know, that's the end of that. (M, 4, Ag)

Some participants explained their personal experience with erosion has been caused or exacerbated by upstream bank modifications:

Anytime you loosen something up, it's going to hang up some place downstream, and it always hangs up on the same side it goes in. It never crosses... So, the railroad, they've altered the river. (T, 1, Ag)

The river's gotta make kind of an s-bend towards the other side and it kicks it back this way, and it just keeps chewing away. (K, 4, Ag)

The old fellow that used to be here... his theory was that ... years ago, when the river got high, they had a bunch of little channels that would run like creeks... Well, the guys that owned land then had a Caterpillar, and they went and pushed gravel into every one of those to block them. And then when they got the real high water... it made sense to me... you know when it gets so much pressure, there has to be a place for it go. (K, 4, Ag)

Several people explained that bank stabilization and channelization contributed to downcutting and scouring of the river bottom. These participants specifically cited the experiences with oil and gas pipeline ruptures at river crossings as contributing to their understandings:

Just before we get to our intake, the water dug, through its natural way, dug the channel down, they think about 13 feet deeper. And so, it... exposed our intake, and that's what's caused the problem... But we had to understand what the river was doing underneath the surface. It was continually gouging and continually gouging... Turbulence of the water coming down, eroded that and exposed it. And the force of the water, I think, is what broke it. I don't know, I never did read the final explanation of that pipeline rupture. (O, 3, Civ)

The things that the fluvial geomorphologist and the conservation districts describe is that the river between Billings and Laurel is the most channelized section of the Yellowstone River, and it is when you float it. So, what we know is if you riprapping or armor a bank of a river like the Yellowstone, which is a free-flowing, gravel bottom river with huge power, and it hits that armored bank and it bounces off and collects its force and hits the bank downstream. So, there's an unraveling of a river as soon as you start riprapping a river. But what caused, I think, that oil pipeline break was because the channel of the river was going down rather than sweeping back and forth as a snake. I don't think any fluvial geomorphologist would argue with me on that. The benefit of that is that that the islands are created, they wash away regularly, they are very ephemeral, they come and go, and that siltation and that channel building and channel taking away is how the various species of wildlife evolved along the river and in the river, so the ecological systems really depend on that being a free-flowing river. It also makes it a good fishing river. (P, 3, Rec)

Where the river's been squeezed it kind of has to run deeper and faster to fit in the river. Any change in one place is going to show up as a change somewhere downstream. Predictable or not. Intended or not... Channeling the river, creating

faster water, somewhere downstream is bound to cause some erosion that may not have happened otherwise. (D, 3, Rec)

Every time you riprap, you're creating a tunnel and it increases the power of the river; you're basically creating a tunnel downstream. (A, 4, Ag)

The Yellowstone River, because of the riprap and everything, the banks are so steep. (S, 4, Ag)

I'm not a hydrologist or anything like that, but to me it appears as though the channel has deepened. (G, 4, Res)

Down there by the bench, the bottom of the pond there was the bottom of the river. And you go over and look, and the river is 6 to 8 feet deeper than it was at that time... I think it was riprap. It scoured the bottom instead of the banks... certainly eroded down three or four feet... just continually. (D, 5, Res)

Other participants landed in ambivalent positions regarding bank stabilization. They often mentioned that the "problems" people face along the river, are not "problems" to the natural world. Yet, they seemingly wished solutions could be found that would help humans without damaging the river's natural processes:

I don't know what you do about it, because that [channel migration] keeps the river healthy.... I understand that. But you have property rights that conflict with that, too, and some people don't understand that's part of the health... I don't know what you do... I mean obviously, when that happens, and your field is in a place where it's going to get eaten away by the river anyway and you have the opportunity, you should let it, the trees will slow that process down. An open field just gets wiped out; the bank just sloughs off. There's no root system there to hold anything in place. (W, 1, Res)

If it's affecting a person's livelihood, if it's affecting a person's home, I believe they should have the right to protect that. But... I have mixed feelings, I guess...because I also believe that the river should be left alone. (H, 1, Civ)

What we're losing up here on this end we're getting down here on this end. So no, we are not going to ever do anything for it... Me personally, I don't think that human beings are smart enough at this point to do anything with that river but mess it up. Yes, there has been old cars up and down the river... I can remember a neighbor... they've spent millions of dollars putting riprap into it. Has it worked? Maybe. I'm not that old yet. The new stuff I kind of like... If you take it out here... it leaves it over here. It just depends upon whose land they leave it on [laughs]. (M, 2, Rec)

I think the riprap is great. Otherwise, I guess we could just turn the whole state from hills to hills back to the state and forget about it because you might as well

not have land there then. I mean you might as well not have private enterprise on it at all. (T, 2, Ag)

Participant: Probably the biggest problem with living along a river is bank erosion and the fact that it keeps trying to take your land away from you... But I suppose probably twice out of every ten years that we'll lose crop, actually lose crop. We'll have damage other years. Uh, one way we keep it to a minimum from what it used to be, when I was a kid, we put in a flood dike all the way around the place. So, with canal gates put in backwards so we can hold back-up water out.... I'm not much for permits.... See, my theory is this, quite honestly, if you own your property... I'm not trying to hurt anybody. All I'm trying to do is hang onto my land and save my crop... What gives people the right to come along and say you can't do that when it's not costing them a penny? (M, 3, Ag)

I mean there's a lot of good that can come from work along the river. I don't think that it should ever... I know a lot of people think that it should be able to meander anywhere it wants to go, but when you're the guy that owns the ground and is trying to raise a family there, etc. I think people just really need to look at landowner rights as well, because as a landowner we really need to protect those rights. (W, 3, Res)

It's a little dangerous for boaters... But as far as an opinion on whether it's good or bad... I, I, I see the people's side of the story, they want the river to take the land as it always has. And then if you own the land, I can see their point, where they'd like to kind of keep their land, so. So, um, I do not have a personal opinion on whether that's something that's right or wrong... The bass like the riprap... actually, there are riprap banks that we do catch a lot of fish on... So... sometimes there's, there is a habitat there that's created... the deeper water makes for some pretty good habitat at times. (W, 3, Rec)

Well, it's a thorny issue. On the one hand it's private property rights and the ability to make a living, and that doesn't seem like that's ever been easy, or ever going to be easy for ag and livestock producers. But the tragedy of the commons is kind of the flipside of that, where if you don't give the river what it needs by armoring the river to protect the cropland, there are consequences downstream and at other times for that sort of thing. (D, 3, Rec)

My personal opinion is, we've got to have a good balance. The City of Billings sits on the Yellowstone River. There is no way we can let the channel of the Yellowstone River migrate through the City of Billings. Can't happen. It's just economically, feasibly, impossible. When we get down the river a ways, and we get out of population, I think it's healthy for the river to migrate. So, taking those two snapshots that are very small, considering the whole river basin, there's just got to be a good balance between armoring, riprapping, and channel migration. There's got to be a good balance. (S, 3, Ag)

It's a necessary thing, yeah... and they did do some here this year or last year to protect the road over here... to kind of push the river back this way, and I think they did a good thing... It definitely is a necessity. (S-2, 4, Ag)

Well, there's the river itself, by its nature and the course of the land it flows through it changes channels and what not a lot. Some of that is good, some of it's bad... It gives and it takes away... I think landowners should have that right to... protect themselves... You've got extremist that want everything to be wild and everything, to leave it how it was before man got here, but man's here and we're not going away, and... as far as the whole ecosystem, we are part of that ecosystem now. How we manage it... there's got to be a balancing act there somewhere. People, I think, should be able to protect their property, but at the same time you can't turn the river into a big ditch. (H, 4, Rec)

Since I've been here, I would say we probably lost 60 acres of our south boundary... In fact, we've just done a project through the conservation service to riprap a bunch of them... Trying to keep this river under control... it just goes every place. And a lot of people want to think of natural boundaries. Well, they don't own property, and it would take our pivots out and everything. So, there's kind of a fine line there with your thinking... I mean I'm not against the Yellowstone River... Don't get me wrong there. It's the only undammed river, which I think years ago... you'd never get it done now. Years ago, if it was dammed, slowed down, and controlled a little bit... But right now, you know, the saying is, 'What the Yellowstone takes, the state gets.' So, if it takes his and forms an island, that's a state property as I understand it. (S, 4, Ag)

Truthfully, if nobody ever would have put riprap in the river, it would be a whole different thing, but we can't go back there... Because people started doing things like putting cars or hauling rock in because they didn't want them to take these spring creeks. At that time, it was because of their livestock and irrigation, and it morphed into fishing and reproduction on the Yellowstone... [But] Everybody that's lived along the river has tried to keep their land intact by the river, for sure. I guess that's the thing, I think sometimes as a society and as a government, you look back at what people did, and you want to judge and criticize and say, 'We're not going to do anything else now because they did that wrong,'... What can you do now? (N, 5, Ag)

As a fishing guide you know, like in the spring and fall, especially when the water is cold, the trout congregate. And they congregate anywhere where there's like a back swirl because there's foam. And that's anywhere there's riprap. So, I kind of like it [laughs]. (P, 5, Rec)

Some described skepticism, or even disagreement, with arguments about negative impacts of riprap. Others regarded weirs as a better means to control erosion:

I guess I don't see... To me, the riprap has been good for the river where they let us put it in... it just stabilizes the river... They talk about working on the river you

muddy the waters, you kill the fish, all these things. What does soil erosion do? ... I mean, I have questions along that line. (T, 2, Ag)

There's a lot of opposition to riprap. And they say it changes the flow downstream, but if you let the bank erode, it also makes changes downstream because the gravel and sand that comes out has to go somewhere. (D, 5, Res)

You don't want to see the Yellowstone or any of these rivers become just cement troughs. I really think that's people's perception of what we're trying to do, you know, we would just cement it and call it all good. No. There is tasteful... I just think people have the idea when they come from someplace who has these rivers that are just cement-lined canals, basically. (F&W, 4, Civ)

If they were ranch owners themselves, I think they would be a lot more heartsick about it. It's recreational land to them. They lease the land, and they're great stewards in that they want it grazed correctly and all that kind of thing, but on the other side of the river is a ranching family and they just religiously are up keeping those banks all the time. Whether you feel that's right or not, they do practice a lot of bank stabilization. (N, 5, Ag)

They are developing things like weir systems that have a better effect, that don't do quite as much damage to the riverside and to the flow of the stream (C, 3, Civ)

Bendway weirs. Some of them work, some of them don't. It really depends on the position of where they're at and how they're built... [And] you know, it's still a mystery... There's a lot of things to factor in... because you're starting to change the dynamic of the flow of the river. Is it going to affect the neighbor on the other side of the river downstream? Or, the same neighbor upstream on the same side, there's a lot of things to consider.... If you're putting in Bendway weirs, and they're on the property line and you start building those eddies... It can start eating on the neighbor's bank right above where you have the weirs in. Some engineers want to armor between the Bendway weirs, some feel that the scouring between the Bendway weirs actually helps the Bendway weirs work better. However, we've seen them scour all the way until it gets behind the Bendway weir and moves the river further into the bank... So... Ma Nature wins. All the time. It's just a matter of how long it is. Water never quits. (S, 3, Ag)

Often, participants expressed frustrations with the permit process. They described it as time-consuming, changing, expensive, and seemingly nonsensical:

We did apply. I don't even know what the permit is. Something-09... That was quite a process. So now we've been just doing what we can. (S, 1, Ag)

I think it was... the Corps of Engineers fighting them about the riprap... They were dumping rock, regular rock rock, off the bank, and the Corps come along and said they can't do it. And the guy said, 'Hey, it's my property.' And we said,

‘Yeah, but the Corps has got control of the river. That’s the problem, or situation.’
(M, 1, Civ)

I’d like to see them leave some of the control of the riverbanks, be a little bit easier in some ways, but maybe that’s from an agriculture standpoint that would make it cheaper to do something. (T, 2, Ag)

Over here at Bighorn, with that high water, it changed the river, it was cutting on them. And they have a sprinkler, and the wheel with the sprinkler is hanging over the river. So, you come along, and you can tell where it’s cutting, and they only let them do like 300 feet or something. So, we took a measure on the river there; they needed 450 feet... So, we tell them, you know, you’re going to just waste the riprap. You might as well let them come on around... [And] I think that’s a good idea of stabilization. I don’t think you can go down the side of the river and stabilize it, you know, miles and miles. But I think you need to do the upper part of the corner, the corner, and then maybe down a little bit. (D, 2, Ag)

Things have changed a lot since the early 70’s... As to what you can do and what you can’t do, according to someone, somewhere... I have a real problem with some of the things they require you to get a permit for on the river... For instance, I had a really good friend of mine that farms west of town on the Canyon Creek ditch, they have to put in a new head gate... inside their inlet... Now, in my opinion, that’s their inlet, they maintain it, they own it... it’s not going to hurt anything. It’s not going to kill a fish... But he said, ‘We were all ready to start, and then we found out that we had to have all these permits.’ He said that it took forever... And, one of the other problems is that they make you do it to their specs... And their specs, there again, in my opinion, they’re not common-sense specs. Because we know what works because ours has stayed all these years. And it wasn’t done to their current specs. But it stayed. (M, 3, Ag)

Today’s rules will not be tomorrow’s rules, and yesterday’s rules do not apply. So that’s the way it goes... See, when we first bought that place, there was some money for riprap and stuff, but then that went away. (K, 3, Ag)

I said we worked with the Corps of Engineers, but they also drug their feet for years and years and years...[before] they were able to finally get some permitting in place and we got some of the work done.... Sometimes I think that they feel like their hands are tied and they are not able to get on fast enough to fix it. (F&W, 4, Civ)

It was cracking the roadway when they finally got all the permits.... And they should have did another hundred yards, but [laughs] they said, ‘This is as far as you can go.’ (O, 5, Res)

Some participants discussed a common work-around that allows them to avoid the permitting process:

They allow us to dig a trench alongside the river... inside on my land and put rock and gravel in there. Then if it washes up to it, then I have that in there... Concrete and... rock from our gravel pit... [I'm allowed to get] just as close to the river as I can without making the track hoe fall into the river. (S, 1, Ag)

Land Uses and Easements

In Segment 1, from the Missouri River to the Powder River, participants remarked that there is not much development along the river:

There are a few [new houses], but not very many. Most of them are along the Highway 16.... And it's a ways away from the river, the river corridor... The Highway 16 corridor for us is probably the most development area in the Sidney area... There's been residential, commercial and industrial development in Richland County over the last ten years. (H, 1, Civ)

You know, in our neck of the woods, in Prairie County, we don't have the issues like Glendive or Miles City does. They built closer to the river... and we don't have that... We respect the river's boundaries, and it respects ours. We just don't have issues with it. (T, 1, Civ)

Unless you have a place like ours, flooding is always such a risk... So, unless you're pretty high, you don't want to build on the river. You could take a long drive around here, and you won't see too many houses... because the river is just too unpredictable. (V, 1, Res)

In Segment 2, from the Powder River to the Big Horn River, participants noted more development than is reported downstream:

A lot more people moving in... like near Sarpy they put in a subdivision... there's some guys from Whitehall, sold some land over there and got a pretty good price... And they must have had to pay pretty good, because they had it put into 160-acre plots. Some people wanted it smaller, and they wouldn't do it, the commissioner. (D, 2, Ag)

But it's kind of like development, you know, everybody is for development, we want to expand and everything, provided it's on you, over the hill from me so I don't see it. You know, then I think everybody is for it except the person who is going to lose... (L, 2, Ag)

In Segment 3, essentially Yellowstone County, the growth of Billings is widely discussed, with some specific comments on the infringement on river habitat and new, wealthy landowners:

I think last year alone, there was 2200 acres that went into development on the west end of Billings... so we [the Conservation District Board] keep a pretty good eye on what goes on with the city and county planning board and what's coming up on the horizons. (S, 3, Ag)

There's the out-of-state landowners that I have two minds about - the guys that buy the big ranches, the rich money people from back east and California, the techno financiers or whatever you call them, they buy the big places, but they also usually protect them. But they often cut everybody else off from using the things. (C, 3, Civ)

It's such a nice view now... [but] that area will subdivide... Oh, it would go fast. Builders would like to have all of that acreage... I don't know how zoning... if they're paying attention, they won't let it, but you never know how that goes. (S, 3, Res)

From Laurel to Springdale, Segment 4, participants did not report much new development, but some observed that development had already restricted the river to some degree and expressed concern for the future:

Fortunately, most people up in this end of the County have built away from it [the river]. If you get down to Park City, of course, those people are pretty intelligent, and they know what's best, so they'll build right on the bank and wonder why the darn kitchen fell off the house [laughs]. It's not really funny for them, but it is. Doggonit. (E, 4, Civ)

When I think about the river, between say Columbus and Billings, if you look at it from the air, you know that at one time that river has been all over that valley. And since man is here, we're kind of keeping it all together and kind of saying, 'This is what you've got. Make your channels, this is where you can go.' (H, 4, Rec)

I just do not want to see it get developed... development is the thing that always worried me, that I would be having people build more houses on their property and taking away what quiet we did purchase to live out here. I don't want neighbors or lights on. (C, 4, Res)

I have seen a lot of change, through the last 50-60 years, and one of the biggest, biggest things I think impact is subdivisions. Because people buy the land and then subdivide it and sell it and bring in all kinds of people who want to change the world... they kind of like to have it their way. They don't want erosion; they don't want a lot of things to happen. 'We are going to save our property, and we will build if we want to build a house over there'... It was always a challenge because people fought us tooth and nail because the rules were set about setbacks and 100-year floodplain and that sort of thing. And of course, if somebody has got 100,000 bucks in their pocket and they got to spend it and they don't want commissioners to get in the way. So, you are the bulldog of the bunch and always wrong. And then it's kind of fun 10 years later to drive by and say, 'I told you so, you son of a gun.' [Laughs] (E, 4, Civ)

Finally, from Springdale to Gardiner, Segment 5, development was one of the major topics of discussion among participants in this area. A brief selection is provided here:

Forever, people here worried about people coming from Bozeman. But Livingston and Park County wasn't growing. We've been 15,000-16,000 people for years, except for this last two years, and the impact of Bozeman now is really hitting Livingston. And we have three or four subdivisions going in right now. There's not a lot for sale in Livingston; it's all being built on... The impacts and the costs of that growth – overpasses and underpasses, highway extensions and new roads – is tremendous... And that Yellowstone River is that damn thing that caused all these tourists to come here. So, you love it, and you hate it... Even with the valley, you know when I was a kid, you didn't even see a light on a house. There just wasn't that many houses up there, and now it's lights everywhere. It's like a little city up the valley. And so, you know, I'm not an engineer per se, to figure all that out, but I think it has to have an impact... So, I don't know. It always worries you. (T, 5, Civ)

I wish for a different circumstance for this ranch all the time. The river is not our friend, we live in the designated surveillance area, so we are highly regulated because of diseased wildlife, and we're surrounded by subdivisions. This is not a good place to ranch... I try always to look at things as half full, but when I get in the half empty mood, I don't think there's going to be any ranching left. I think that it's going to be all tourist-based or rich-people based. There's a possibility that conservation type easements will play a role and some of the land will remain open... but over time I've seen things have to change... because of the state issues. The one place I'm thinking of has narrowed down and narrowed down until now they're just a fishery on the valley floor basically, and they used to have a huge presence up Trail Creek and owned a lot of land. One of the pieces they owned for years, just sold for 25 million. It was only on the market for a day. And rumors abound about what that guy is doing with it, but he's running gravel trucks in there like crazy, working on roads and I don't know if he's paving it. I don't know what he's doing, but it's really scary. So, I don't know. Some of the other, smaller places, their kids aren't here, so is it just gone? Maybe the kids will inherit a money then, because it will eventually sell, but I don't see working lands. And the big pieces of property that have sold, they're still open but I don't call them working lands. They become wildlife safe havens, and in a world of brucellosis, that's bad. The views are still there, but what it means for those of us on the front lines as the elk are coming down the valley, is bad. (K, 5, Ag)

Throughout the valley, participants shared local wisdom about building away from the river. They also emphasized that outsiders often failed to understand:

I'm sure if somebody came in here, they would say this house is in a floodplain. I did my research when I bought and found out it's next to impossible... I went to the library and asked the librarian if they had any information about historic patterns of the river flow... because I was concerned about rocks more than anything else, not the water but the rocks. And she was able to show me... You can just drive out the road here, when you drive down to the intersection, just look

across the river bridge and you'll see all the land from where you're sitting clear over the hills that way is lower than we are. (V, 1, Res)

He built the house... they really, really wanted a house right there [on the river]. Well, have a house. The wind in the winter just rattles his windows, but... Daddy's money, I hate to say. But you know how that goes... California, you know. (T, 1, Rec)

It's just something that our homesteaders years ago, if they built in a creek bottom and the creek come up and washed out their buildings or whatever, then they moved a little higher ground. And over a period of time, people when they come in, they build on a little higher ground. Well, we've gotten to where we don't build on higher ground anymore, and yet a flood can happen anywhere... we do not look at our history and history keeps repeating itself and we just don't think about that, and we need to. (E, 2, Civ)

For others it's a hassle and headache, and then they remind themselves maybe you shouldn't buy houses in those places. So right now, the realtors are saying people are saying, 'I want a house with no basement or up on the other end of town where it is higher,' so there is that kind of discussion going on. But I don't think there is worry about flooding, just about water in the basement as an inconvenience... Some will avoid it if they can. (G, 2, Res)

I guess, your hindsight's real good- foresight you have a little problem with. And that's the thing... if I... [had known] it was going to be that much of a deal, I guess I wouldn't have went there in the first place. But once you're there, you do what you have to do, so... I would say one thing is, even though it's pretty, do not build your house right by the river. And if you put in a basement, put it basically above ground because it will get water in it... That would deter them, I think... the trouble with the river is it's got a mind of its own, and it can change so much... And flood insurance, it may be very expensive if they're close to the river... be prepared. (K, 3, Ag)

A lot of these older ranches that are 100-year ranches, they're already doing that. They've been doing it forever. They already knew it was going to cost them way too much money to try and start riprapping or any of that kind of business. Let the river do what it, because it's going to do it anyway. You're going to get the right flood come down the river, and it's going to do whatever it wants to do. (S, 3, Ag)

And a lot of people build too close, and either ended up losing the house or had to move it back. Because nature always wins... You can't fight it. And the people who are safe now that are 200-300 feet back, give them another 50 years. They are going to start worrying (E, 4, Civ)

Most of the people that were born and raise here know what that river does, and they stay away. (T, 5, Civ)

We studied the floodplain maps in 1995 to try to make sure we weren't picking a bad campsite [the participant's term for his home]. And there was really high water for two years running in the mid-90's, and there were a lot of people downstream who had trouble, but we were okay... The river itself, it takes a little bit of our riverbank now and then.... It's interesting to have those economic and philosophical, introspective discussions... If my campsite flooded out tomorrow, would I expect somebody to bail me out? Or is it just that, you know, I picked this campsite? And I'd like to think that I would accept that liability myself. (B, 5, Civ)

Participants described efforts to responsibly manage riverfront lands often in terms of self-regulation:

Our hopes for the future would be that whoever owns this continues to treat it with respect, always thinking about what's best for the land. When we decided to do the lodge and the cabins, a fishermen said, 'I think you should build it up on the bluff where we can see everything.' It's like, no--we want it out of the view-shed, we want it tucked away. We want it where it's already developed... I don't know, that's just the way we've always tried to manage it. (N, 5, Ag)

This hope was realized for some in conservation easements, but such designations were seen as having both benefits and drawbacks:

Along the bank there is open water, cattails, and it's about 180 acres that we have that we put into a conversation wetlands project, an easement... And there are ducks and geese and all birds, pheasants, and it's just a beautiful area for bird wildlife... We did that because we wanted it to stay the way it was, hasn't been farmed for a long time and it probably would be some good hay acreage or whatever... we decided to put it into this wetland project... It's through the USDA program that they have... [And] It's lifetime, like 90 years. They paid so much for the easement, and my father-in-law did the deal, and so we have been compensated for it. And it will always be that unless I guess some way you can buy it all back out, but that's not our intention, that's why we put it in there... So, the best way not to have anybody build and develop the other side of the farm was put it in the wetlands program... Along with the wildlife stuff. And let people use it like we've always wanted to do. (F, 2, Rec)

Our neighbor leased her ground... And she's letting in erode... The only thing is that she really, really devalued her farm when she did that. Because why would I buy that farm if 60 acres of it can't be used? ...The MARS Group is planting trees and everything on this leased ground. Is that a perpetual lease forever? ...As landowners, we shouldn't be doing these perpetual leases, whether it be out in the hills, or in the mountains, or here. Because do you realize that when my grandkids are dead, that lease is still in place? ... I don't get it. And then she's created problems for us because now [the river] is eating away her farm--it's come in really deep on her—and now it's just washing away the land that I'm renting. We protested it. We didn't want her to do it. But, you know, it didn't matter. I think

they just gave us some time to hear our complaints and it didn't matter, they were going to do it regardless of what we said. (S, 1, Ag)

We did put a conservation easement on the property too which assures that it will be rural for the next bazillion years... On one hand, it definitely limits us... it costs a lot to do that I guess I would say, in the long term. The tax benefits you get when you do it aren't anywhere near what you give up in value down the road. But we would do it again.... If you want to see your family stay on the property for ongoing generations, I would encourage you to do it. If you're not sure about your long-term goals on the property, then I would suggest that people look really hard at whether they should or should not do it. It's got to be a decision made by the family, not just one individual, too, I think. My wife and I both agreed that it was a good idea, and we hope.... Both of our kids, our son and our daughter live on the place, and we hope that they will be there for their entire lives as well. So, it... we're happy we did it... it's a 500-acre chunk of ground that were it not for the conservation easement would be developed into small chunks of prime real estate. So, it's a good feeling to know that it will be 500 acres of rural ground for eternity. And the river is something that we need to... by encouraging the river to stay in a certain point, we gave up a lot of acres in the design of the project. And I think the design turned out really well as far as being wildlife-friendly, fishery-friendly... [but] our easement doesn't anything to do with the river; it just has to do with development. We can do anything on the river, that's approved by the government agencies. (W, 3, Res)

I think we're on an awful good path the way it is... we've got an awful good balance of... containment of the river where it needs contained, and letting it wander where it needs to wander... When you get out of the City of Billings and it heads east, we're seeing more people... putting their ground into these land trusts, where the water will be able to migrate whenever it wants to... they're called channel migration easements... they're kind of the same things as these guys that are putting their land into these, nobody can sub-divide... getting some tax breaks to go ahead and put their land into those things. I think we're going to see a little more of that down the Yellowstone River as time goes on...[[But] I'm not going to tie my place up and devalue my ground to where my children don't have any options to do with it what they want to do. They want to do it, great. But I'm not going to put the hindrances on them. (S, 3, Ag)

Half of our ranch is a conservation easement. Some of it was for inheritance tax purposes, trying to keep the land together and not having to sell it off to pay the taxes. And we want to conserve it. That's a tough question. A lot of people don't like conservation easements, we do... We're anti-building, we'd like to keep some of the open space. So, I'm not against conservation easement, I absolutely am not... We're sort of unusual for ranchers. I think a lot of people think of their land as their retirement... And what's theirs is theirs... Nobody has the right to tell them what to do, but at the same time, if you just look around and see the way that land is being gobbled up... and developed... It's hard to see a house go up on virgin land when there's not very much of it left. It's really hard to see that. And

what we see around us a lot is people building these large homes and after five years they're sick of the wind and the Montana winters and they sell it again. So, their little stint of wanting to be here, but what they did will be here forever... [And] These houses that are just built in the last ten years have all changed hands at least once... The original owners, none of them have stayed. (N, 5, Ag)

For all of its weaknesses, [with an easement] you fundamentally, in perpetuity, make a decision. That's a pretty powerful philosophical statement to try to make. So, if you could pull it off, if you could put everything under conservation easement, and everybody was living, and making an income, and happy, that's nirvana, right? That's what we're trying to do, no question about it. But what we're not saying is, you know, the federal government is going to come in and tell you what to do. We're saying as neighbors we're doing things. (R, 5, Rec)

My guess is that we would not do that [pursue a conservation easement]. Well, I don't know, I guess there's a possibility somewhere down the line you would. For us, right now it feels like it ties our hands. And in a lot of cases, it lowers the value of your place, and mostly I think, if we sold this place, we would want to get the maximum possible so that we had options, whether that was buy something new somewhere else or you know just 50/50 kid-wise or whatever. (K, 5, Ag)

I don't think it will change much, there's always somebody wanting to build a house, but we haven't sold anything. The lot of ours is under conservation easement... 200-300 acres here. Just, we had to get some money to settle the state, and they bought that easement. Then the rest of it my uncle did. He put his old place in conservation easement, then we inherited that, so we got a lot of conservation ground... there's quite a bit of it [around here]. Getting to be quite a bit of it... it's Montana Land Reliance... [And] there's quite a bit [of restrictions]. They limit how many houses you can have. You can't have a gravel pit or wind farm. No commercial timber harvests. Some of it is... Sometimes I wish we didn't have all that on some of that, so we could get some oil leases. (J, 5, Ag)

Participants—especially in Yellowstone and Park Counties—mentioned vigilance and active participation in the regulatory process as a means for private citizens to promote responsible riverfront land use:

The commissioner, one time we went and talked with him, some guy was trying to subdivide this other twenty acres, and they said, 'No, we're trying to keep a greenway along there.' I don't know if I believe them or not, but I agree with it... That's what most people along here want. Anytime they try and do anything, everybody on the river will come to the meeting. We've already had a couple of them. They all are very adamant about keeping a greenway, if you will, along the river. (S, 3, Res)

See, we were not allowed to build down by the river, although I think that there are homes that are being built on the river... And we have reported those homes. (R, 5, Rec)

I've tried being supportive of this process at least with letters to the editor and some op-eds and that sort of thing, but Livingston doesn't have a good growth plan. (O, 5, Rec)

Levees, Dikes, and Dams

Participants from the lower river were well-versed in the issues involving levees and dikes as another approach to manage the physical processes of the river. Yet, some participants from each Segment had comments to make:

My in-laws lived down the street a little ways, and they used to have to buy a new furnace about every two or three years because the river flooded their basement. But KOA and the next campground down built some levees, and so [my in-laws] don't get that anymore.... [And] as long as you're not building a dam completely across the river, and, you know, impeding the flow, it's ok. They're directing the flow when they build a levee like that. I can see their point. Having been flooded umpteen times, you're gonna want to do something. I'm sure they were permitted. (B, 3, Rec)

[After] creating that levee... I believe they did take down half of it, because it just pushed and made it a problem further downstream. (S, 5, Civ)

Since I've been here there haven't been any issues [with the levee west of Glendive]. And from when it was put in many years ago, there hasn't really been any events that's caused any concern. (L, 1, Civ)

However, in Miles City, a local civic leader elaborated on the dike decertification issue and a citizen shared the personal impact of the floodplain designation related to insurance:

Right now, one of the big issues is the dike has been deemed uncertified... I don't think it's the Corps of Engineers that has done that.... The dike has been here for years and years and years and now all of a sudden, it's not good enough.... The Corps of Engineers is wonderful group of people and, you know, they have worked very diligently and very well with Miles City. The biggest and the most negative of everything is FEMA. And that is not a household name that is used in very many praises, I can tell you that. We've had the issue with flood insurance and... people are not going to be able to afford to do anything with their homes... and I guess I care enough about Miles City to where when I ran for City Council, that was one of the main issues was to see that we could possibly get a certified levy... I believe that if Miles City continues on with the project, and we get it certified, I think the real estate and the opportunities for improving the community would increase dramatically... It's going to have to be totally rebuilt... My biggest fear is that the citizens of Miles City will vote it down. In the past... it's always looked at as a north side issue... Now with FEMA becoming involved and with the

remapping of the flood zone and the floodway... it brought a lot of residents that were from the south side... into the mix, and so now it's not just a north side issue, it's a Miles City issue... I would hope that the majority of the [citizens] are starting to see that.... [And I understand] we're channeling, we're narrowing the channel of the river, bottom line... since when they build it... But for sake of the citizens and the homeowners and the population, we're not going to widen the channel of the river... I believe that every community along every river in the state of Montana is looking at Miles City right now to see how we are going through this process and how it's going to be finalized... I would like to see FEMA and the Corps of Engineers do a little more give and take, but I also understand that they have guidelines, and they have their policies they have to conform to, so we are definitely in for a long process. (E, 2, Civ)

It's interesting to see the dike because so many people, you know, poo-poo it in the summertime when nothing is going on, but this time of the year you can see why we need that dike.... This house is in the floodplain.... We have to [get flood insurance]; they require it.... It's kind of a joke for this country, but if you don't buy it now and then have a policy now, if you go to sell it to somebody and they're going to finance it—which everything has to be financed—well then it costs them way more to buy flood insurance. But you can transfer the old policy, so they rope you into buying flood insurance that way... It would probably make a difference between being able to sell it and not sell it... It's very inexpensive, the flood insurance, you know.... We don't intend to ever sell the house. The kids want it when we're done, but you never know. So, you have to prepare. (L, 2, Ag)

In Forsyth, locals reported on the city's dike maintenance issues and progress:

We're 100% confident in the levy... We're involved in the SWIF program... to make sure we meet the standards set by Corps of Engineers right now. So, we've been spending probably close to 20 thousand dollars a year for the last five years at least for maintenance, primarily tree, brush. Homeowners through history were allowed to put material up on the bank of the dike, so we have a program to make sure that they remove anything they've got stored on that dike... But the Corps has not yet said, 'You get that stuff off that dike by July 1st, 2020,' but we're taking the initiative... [Imagine] if some of those huge cottonwood trees were to fall and tear out a hole in that dike... {it would] destroy the integrity of our dike, and then we, community members lose insurance coverage... have you talked to Miles City yet, been down there? ... They lost certification and so people there... have one heck of a problem with the insurance and building, getting building permits. And so, we don't want to let that happen in Forsyth, so we have to maintain the integrity of that dike. So that's what we're working on right now with this, it's called the SWIF program.... We've had a real good relationship with the Corps of Engineers. They come down every year and inspect and tell us where we have weaknesses, what we need to do... it's been a very good relationship and we do what they ask us to do. (K, 2, Civ)

We are pretty comfortable that the dike does protect us from flooding... So, there are some that have purchased flood insurance this year outside of town along the river... But we haven't need to. We just got to keep working with the city to keep that dike in good order... But they are on top of it, it is a top priority in the planning... [and] I don't think the community worries about flooding. I think overall, they are very comfortable with the dike keeping the water on the other side. So, I don't sense those worries. I sense it more in the city when we are working on city planning kinds of things. Yeah, it's working now, but it's going take a lot of money to keep it that way, so I think there is more urgency there. (G, 2, Res)

In Livingston, a local civic leader and citizen discussed a recent issue with the local dike and offered markedly distinct evaluations of the US Army Corps of Engineers' handling of the situation:

Obviously, we all know that the Yellowstone is a living stream; it changes every year depending on the flow... And three years ago, we needed to do some emergency work, placing riprap in that area [around 9th Street Island]. And we are very lucky to have a good relationship with, first of all the state, but then getting the Corps of Engineers on board. In a matter of a phone call, we were given authorization to do some repair work... If we ever get to that point where say it's a common occurrence that is has to be repaired, then I think we'd go to the Corps and say, 'Okay, what do we need to do with this?' We've had some pretty high water over the last few years, but not any real concerns with the bank in that location. It's something we keep on eye and something we have started conversations about, but we are not at a point where we think something needs to be done right now. (City Staff, 5, Civ)

Look, if they think Livingston's going to flood, the Army Corps is going to come in and build an even bigger dike. They have authority over all of us, it seems like. I couldn't believe what they built in Livingston... They came and declared an emergency. They had a dike going right through, on the road through Sacajawea Park... I went with them, [to see] what they were going to do, walking with them. I couldn't believe it. And so, there was a city council meeting... They said, 'Well, we're going to take this dike right across that and right up on that ramp.' I said, 'You cannot do that. That's the clinic. That's where everybody goes. You can't block them off.' 'Oh, yes we can.' Now, there was a woman who used to live here... you didn't really want to cross... because she was going to do you in no matter what... I called her up. When she got done with the Corps, they just shook their head... she made them change it, [and] they got backed off. I mean... they did it, but they didn't do the ramp... There's some advantages to a small community, you can get a hold of people quick... [The Corps is] ridiculous. If I hadn't walked with them, I wouldn't have known, and they would have done it. (B, 5, Rec)

The last major topic related to attempts to control the physical processes of the river is of dams. To begin, participants shared mixed evaluations of the Yellowtail impoundment dam on the Bighorn River, one of the Yellowstone's tributaries:

Since they put Yellowtail Dam in... that water is a little bit warmer as it comes out of there, and the ice isn't near the problem that it used to be like back in the 60s. (T, 1, Civ)

I think the toughest thing is when you are using the Yellowtail Dam to help control water, and they have issues of how high they need the dam to be at Memorial Day for boating up there, versus holding back water so we're not flooding. Of course, the preference down here is you let the water out so you can hold it back this time of year and not let the river get so high. But there are recreationists up there that need the water a little higher so they can access it, so it's just a tough thing that the Corps has to deal with on there. (G, 2, Res)

I don't think we're getting the flood control that we should be getting from Yellowtail Dam, Boysen Dam, and the Cody Dam... I think that they're not letting out enough water on these dams to compensate for these floods that we've been getting... In my opinion... the sportsmen... want a higher water level so they can get their boats in in the spring to go fishing, but I don't think they're letting enough water out of the dams to compensate for the inflow. And so now, half of our place down here is going down the river. And I'm not the only one... But I talked to a federal judge about it, and he said actually... what you need to do is... have all the ranchers file a class action lawsuit.... You know, a lot of people spent three or four hundred thousand dollars riprapping the corners of the river... People have done that. They've lost all the riprap because this water is not being controlled... When they put the dam in, the dam was supposed to be for recreation, irrigation, and flood control... Well, maybe they are doing some flood control, but... with all the technology and satellites they ought to be able to tell what the snow depth is... somebody is not doing their math right. Or there's so much politics involved that they're not letting enough water out to slowly capture this... But... you can't blame Yellowtail because they've got two Wyoming dams sitting up there, and when they get full, what do they do? Dump it down on Montana. (D, 2, Ag)

While the first participant perceived an advantage of Yellowtail related to water temperature, others discussed difficulties with flood control, especially related to balancing this effort with recreational interests. Additionally, some participants discussed the prospect of an impoundment dam on the Yellowstone itself. Especially in Park County, participants reflected on past experiences with proposed dams:

In the 70's... the last time they wanted to build the Allenspur, you know what they wanted to do with the water? They were going to store it up here, send it to eastern Montana to put it in coal slurries... It would never happen now... You'd have to change the law, too. But public wouldn't allow it now. It's a different world...I

mean, I don't know if people understand how lucky we are that we aren't dammed [laughs]. (B, 5, Rec)

Those opposed to the idea of an impoundment dam on the Yellowstone, cited the benefits of a natural, free-flowing river. They also contended that the prospect of dam-building is mostly inconceivable:

I just want people to love the river, to respect it and not do anything to damage the way it flows... How do we protect that river? You know, not use too much water, not riprap too much... Don't put a dam on it. I mean... Froze to Death Creek—one time they wanted to put a dam there. They were going to give this fellow... all this money, and I'll tell you what, there was kind of an uproar in the community over that. [Think about] how good we've got it. And it is god's country. And don't dam the river! ... Whichever way you want to put it that way, don't put a dam on it and then don't damn it the other way either [laughs]. (M, 2, Rec)

We should respect... the nature of its [the river's] natural wildness. We've chosen not to generally dam the river. Which has been, I think, a very good thing. (C, 3, Civ)

Dams or reservoirs seem to be appealing recreationally, but they sure change the nature of the riparian areas and the fishery. So, I hope that those things would be held off, or just not done right on the river. (D, 3, Rec)

Our Yellowstone River is the longest running free river... within the whole United States... which is great. And if people want to put in diversion dams and stuff, we still fight them on that because there's somebody always thinking, 'Well, no, we should stop the flow of water... because sometimes you get high water then you get low water, and we could reserve it.' I think we're thinking out of the box. We leave it alone; Mother Nature wanted it that way... Once we keep it free-flowing and going... We should be doing good. (R, 3, Civ)

Well, the fact that it's a free-flowing river, the longest in the lower United States... is a big thing to me. You know, there's a lot of issues with dams... You've got fish that can't move, you know. Pallid sturgeon in particular, paddlefish, those sort of types of fish have to have that free-flowing water... in order for their eggs to make the grade. (B, 3, Rec)

I don't know that we can mitigate flooding, because it is going to happen. And when we get a year like this with all of that snow up there and all the runoff, my goodness, what are you going to do with it? You can't capture it. And we don't put in dams and things to hold it anymore. It wouldn't do any good anyway, there is too much water. (Egan, 4, Civ)

This is the longest free flowing river in the country, no dams on it or anything, all the way out of Yellowstone Park... I remember 15 or 20 years ago where there was talk about damming it up near Paradise Valley some place, but it never

happened of course. But it's the longest free flowing river in our country... It really hasn't been bothered by mankind... the natural is special, that's for sure. (L, 4, Res)

Just don't stop the river. Don't put a dam on it. (W, 4, Res)

In contrast, participants who voiced a preference for consideration of impoundment dams, cited flood control, water storage, and energy production as major advantages. They acknowledged that this opinion is controversial:

[The dam on the] Big Horn's set up to serve a lot of people... as far as producing energy. And once you put that in place, you have free energy for 100-plus years, and you don't burn coal, you don't burn gas, or nothing. You have got the water that creates the energy.... [But] the Yellowstone has been declared the last wild river in the United States, so people don't want to do anything to it. They already don't want any unnatural diversion.... I know there is good and bad about dams, but I always thought it was, in my mind, a good thing. (Keil, 3, Ag)

The biggest thing is if we had a dam and that would store the water and you wouldn't have these terrible floods, and.... I don't know why [a dam] is such a bad thing. (F&W, 4, Civ)

You know they don't want to damn the Yellowstone, but if you just made these little mountain dams and on the years that there was going to be a horrible drought, here you'd have all this water. On the years it was just going to flood you, you could just hold it back. Two years ago, when all the whitefish died, you couldn't help but think about that. (N, 5, Ag)

Talk about dams inevitably led to a discussion of the diversion dam near Glendive, known as Intake:

I would like to see this Intake issue settled. But I don't think... it'll ever settle... If we get the weir in, I think there will just be another issue... We've spent a lot of money on lawyers. And tell me if this is true, do they get their lawyers for free? This is what I've heard: that the Defenders of Wildlife get their lawyers free. The government pays them up to \$600 an hour per lawyer... I think if you dig into that, you might find out. That would be a question I would like somebody to answer for me, because I think that's totally unfair that the government pays for their lawyers, and I got to pay for my own... [And] they don't realize the jobs and the chaos they're creating to real people... I mean if somebody comes up and asks me, 'Do you want to kill wildlife?' No, I don't want to, but I mean... I think we've come up with a plan, but they don't like the plan, so therefore they just keep fighting it... I don't think they realized that they, they did have a solution that they were happy with where we pump the water.... It's just like they're saying, 'Well, we don't care what you do. You don't do nothing, nothing of importance. Just shut the goddamn river down, you don't need that.' I mean it... I guess I'm a little offended on the personal side, you know, that somebody thinks that what I do for a living isn't

important. To me it's important, but you know... little offended that way, that my business and my growing of food, you know... it's important, it's needed... Somebody always buys it so somebody must be using it... The town has been behind us.... Somebody made the statement that we lose 800,000 fish a year. Really? It would stink so bad if there was 800,000 fish dying. I mean, come on.... The fish screen wasn't that bad of an idea. And I think they...did a pretty good job... I think it's easier for us to control the water going into to the canal now with that system, so I don't look at that as all bad... [And] I think they should let us do what the Corps of Engineers wants to do, the Fish and Game want to do. But they, I don't think they're going to be happy until the dam, or the weir, is gone. I think the fish bypass works... It would keep the fish happy, and it would keep us happy... I believe the Corps and the Fish and Game are on the right track. I think they actually want to help the fish. This other party, I don't think they care about the fish, I think it's just about getting the river open... if they really cared about the fish, let's get this thing built instead of fighting about it...I mean, I don't want to see a species die out, but I don't think they're dying out anyway. I mean, there's two schools of thought on that. There's plenty of them, they planted some. They said they don't breed in captivity, but they planted some so how did they get them? So, they must breed in captivity... Can I tell you, I always thought that we would be not bothered by people like this because we don't have any snow-capped mountains in the background. (S, 1, Ag)

When do you think they'll get done with Intake? ... Did they ever settle that battle? ... I know it's going on a long time, but... I hope they can come to a compromise and get a fish ladder. You know they ought to. I mean, it's sensible... One would think as big as that river is there and the amount of water they take out for irrigation, they should be able to go around. You would think the south end of it anyway... They ought to be able to come up with something. (D&P, 2, Ag)

Intake, down there, is such a travesty. People fish in the canal down there. It's like, really? What's the matter with that picture? For heaven sakes. It just swallows fish.... How the hell does the river keep a viable fish population, at all, in light of what that inlet has done to it? ... And it is disheartening to me that there isn't somebody that is just outraged by it. It's just like, 'Ho, hum. It's been here so long, so what? Who cares?' Man, they need me down there. I would flog them monkeys. (M, 2, Ag)

The one thing that I would really like to see everybody get figured out, is where they pull the water out down there at Glendive for that huge irrigation district down there... the Intake... They should come to a compromise... Tear that dam out, throw some great big old high-dollar, horse-power pumps in there. The government should step up, help pay the bill on the pumps, let the fish go up the river, pump your water, keep the canal full. It's a win for everybody.... The fish passage is not going to work for those fish. Probably work for every other fish on the planet, not going to work for them... They're a weird fish... We ought to be paying attention, they've been here a hell of a lot longer than we've been around. (S, 3, Ag)

Finally, one agriculturalist near Intake expressed his view that this issue has implications beyond the immediate area:

I think [farmers upriver] should be concerned because I think if they get this dam out, they're just going to get theirs next. (S, 1, Ag)

Summary

Participants describe the river as constantly changing and migrating. They relate these changes to the erosion of private property and threats to public infrastructure. Yet, some also discuss the benefits of channel migration. Many are well-versed in terms of bank stabilization techniques, and they understand why landowners wished to protect their property. Recreational users seemed most sensitive to the potential harm caused by bank stabilization, although some regard riprap as “good” fish habitat.

There is some awareness among property owners of the use of conservation easements as a means of compensating for river “damages,” but the easements are not generally endorsed as they are viewed as “too permanent.” Most people in the valley are comfortable with the levees and dikes that have protected their communities for decades. Thus, decertification of those levees, and the resulting “insurance requirements” are issues in those communities. The degree to which the communities are willing to work cooperatively with federal authorities regarding local levees varies. The Intake controversy is known throughout the valley. New dams on the Yellowstone River are not considered feasible, even those such proposals are reportedly still being discussed among locals as means of generating electricity and dealing with drought.

Recreation and Natural Resources

Introduction

Beyond industrial needs (such as irrigation water) discussions of natural resources generally lead to discussion of recreational opportunities, thus we will discuss these topics in the context of one another in this section of the report.

We begin with a simple observation: the local lexicons are ruefully inadequate when it comes to important river areas and functions. For instance, few participants used the word “riparian” on their own or in a meaningful manner. Even when prompted to define the term, they might struggle. Here are some of our few documented uses, or near-uses:

Even as recently as last year, which would have been six years after the oil spill, thereabouts, you could walk down through the riparian area and still smell the oil.... The area between the river and our fields...it's full of Russian olives, cottonwood trees, different types of brush, very good wildlife habitat... I'm sure it limits the erosion with the good grass, and even the Russian olives. The more vegetation, the less erosion I believe, so that's all good, I think. (W, 3, Res)

I think it's very important [to the birding community]. I don't know the figures, but a very large majority... of the native species of birds that... breed and/or winter in Montana, use riparian areas. (D, 3, Rec)

Riparian areas are a mess, they're ruined, there are weeds everywhere... everything is going to grow in the wet land, that's where the life is.... There's not as much upkeep [in the higher lands]. (A, 4, Ag)

Oh, in my mind riparian area is just the area surrounding the river, within the footprint of the river, in my mind. From where we are at, my yard I don't think is the riparian area, but once you get down to the foliage that I have surrounding the water, I believe that would be termed riparian. (C, 4, Res)

I just heard the name, and thought it would be something for birds... So, there's overflow, there's ponds, there's marshes, and it is good for the ducks and the geese, which I harvest and eat. (K, 4, Civ)

As well, attempts to engage discussion about the river corridor elicited a variety of responses. In some cases, the participant seemed familiar with the term, but in other cases they simply admitted to being unfamiliar with the notion:

The river corridor is the lowland along the river, like the land that would be affected by the flooding, the land that would be self-irrigated by it, like the riparian areas, that's the corridor. (R, 4, Res)

I really don't know. I've heard the term, corridor. What they're referring to, I guess that depends on who you talk to probably... I've heard it used, but I really never knew where they were coming from or getting at, I'll put it that way. (S, 4, Ag)

What *do* they mean by 'a river corridor?' (L, 4, Res)

The river corridor is where you can only build within, you can't build up by the river. Yeah, there's a lot of discussion on that. That's been a discussion for our county for a long time. There's a lot of opposition obviously to that, but lots of discussion. (T, 5, Civ)

It's going to change around here a lot. Outside of the river corridor, it might change, too. (B, 5, Rec)

There's definitely a river corridor. Like I say, that river has been all over this valley, especially in this stretch.... It seems silly that we build houses in the river corridor. (N, 5, Ag)

The remaining topics in this section of the report document concerns related to river recreation, fisheries, wildlife, and cottonwood forests.

Recreational Values, Behaviors, and Issues

People along the length of the river reflected on its recreational value and various uses, and the participants often shared stories of time spent with family and friends on the river. River recreation bonds people to one another:

I just turned 66. I spend up to 90 and 100 days right now hunting and fishing. (F&T, 1, Rec)

We don't own a lot, but it's wonderful habitat for the deer and the pheasants and the ducks and the geese... Wildlife observation, I mean just sitting and watching them. (T, 2, Ag)

What our leaders are learning, maybe slowly, is the value of recreation in recruiting people to live in an area... If Billings will start to amplify [recreational opportunities] it is a cord to attract people and to keep people. It pays some money, too, as it employs some people... This all goes together. (G&W, 3, Rec)

Everyone is playing different games. You know, there is lots of rafters on the river, and I am kind of just like an avid nature freak. (Y, 4, Rec)

It's neat that we have the resource... I guide people that have caught huge fish in other places – New Zealand, Belize – but they're here because they want to catch cutthroats, Yellowstone cutthroats... so that's why we're in business. (P, 5, Rec)

This is one of my favorite days [referring to photo]. Grown daughters... We haven't had them just on the river by ourselves for years, so we took them on the river. And as soon as they got in the back of the pickup, they immediately turned

12 and 10 years old. And we caught a ton of smallmouth. Every time the cast came and went, I mean we had a fish. It was wonderful... [My husband] started cleaning the fish, and I knew what was going to happen... The older sister picks it up a fish and whacks the younger one across the head, and the fight was on. And we laughed and giggled, and it was a grand day. And we came home with lots of fish. (M, 2, Rec)

[On one hunting trip we had] a Lewis and Clark adventure... It got down to 5 below that night... and when we go to get the boats out, and all that slush from the night before had now become ice floes. Well, [we] were pulling the boat behind us... You don't want to sacrifice your oars and go pound ice with them--chopping ice with an oar is kind of tough on 'em... [But we knew there might be ice], so we packed extra shotgun shells. You shoot your way out... That breaks ice pretty good [laughs]... and now you're ready to go... But it is not for everybody, I can guarantee you. You gotta be a little bit stupid, and it is what you would probably term, 'A fine and pleasant misery.' ... because you can't wait to get there. And then the memories that are made on it are just incredible... It's been an escape from reality for a few days, you know. You forget about stuff going on at home, and what you should be doing, or what you haven't got done... And it's almost like you're back in the era where nobody else is around. (D&P, 2, Rec)

In some areas, access to river recreation is still generously granted by local landowners, and throughout the valley, many recognized the importance of public access:

Public access is a kind of a foundation in Montana that we've had public access. (C, 2, Rec)

We used to always use the boat ramp at Sundheim Park, which is a very important recreational boat ramp for our area, and it could use some work... when the river gets too low, we go to the confluence and use the boat ramp there. (B, 1, Ag)

The problem with recreating on the river here is, where do you get in? Our nearest ramp is in Fallon, and that's ten miles by water from Terry. And we like to go to the west... Fortunately, at Power River, which is the prime location to go fishing, it's owned by private parties... [and] they are very accommodating to people to let people go in. They could shut that down real quick, too. (H, 1, Rec)

I know enough people around here where if I need to get permission to get next to the river and fish, they'll say yes because they know that I'm going to... leave a bunch of hooks, and snuff cans, and beer cans along the bank. The reason they say no, is because they don't want to have to clean up after people. (K, 4, Civ)

It's really nice because all the ranchers that live along there, they all don't mind us floating the river as long as we're respectful... There were times that it was too late, and we didn't want to be on the river that dark, so we'd jump off and walk through rancher's fields and they'd just wave at us as we go... There was time that they'd come out and offer you something cold to drink. (F, 4, Rec)

We have about 2.5 miles of river frontage. We take great care of it and try to keep it as natural as we can. We like to share it with people.... It's a little lonely around here sometimes. It's a little quiet. So, when they come by on occasion and they put in and they ask if I know what the fish are hitting on or whatever, and I'm glad to help them... It gets busy when the river drops and clears, and there's lots of fishermen... but that's fun too. We welcome them going by.... Most of them are real polite and nice, and they wave, and that's great. We have this island over here is mostly ours... anyway, that's a favorite place for the fisherman to stop for lunch, the guides, they always stop and walk up and have a picnic place in there, and we don't mind... It's not a big deal... doesn't bother us at all. (L, 4, Res)

However, landowners also reported issues with recreationalists on their private land, sometimes to the extent that they have begun restricting access:

This isn't a garbage pit. We take pride in our farm, and when people come out here to go hunting or boating or whatever they do, if I find Pepsi cans or potato chip cans, I'm not very pleased. I don't do that, and I don't expect other people to do it. And that will get a guy's privileges revoked with me. (T, 1, Civ)

This happened a couple times, a guide pulls right here in front of us, and lets his guys get out, and they wander up the beach a little ways, and then take a leak. In sight of us. [Sometimes] we have grandkids here, or my wife. Rude things like that bother me. (L, 4, Res)

We finally got it closed down... Then, they'd sneak down there and never let us know. It just got to be too much trouble... It's the mess that these people make. (M, 4, Ag)

There's always the conflict between the landowners and the people that want access to the river. But... I think everybody understands the other side now, so I don't think it's a terrible conflict right now... amongst native Montanans. I think it's gotten better. Those that come in and buy up land maybe don't understand that dual use.... I think there's a conflict there. (R, 4, Res)

[My neighbor] is doing stuff there, and he put that ugly fence up... and he's put a lock on it... it's stupid. (S, 5, Res)

I think before so many out-of-staters came and bought so much of the property, public access wasn't so much of an issue.... People were neighbors, they were friends, they did business together, and access wasn't such a problem... And there wasn't that many of them either.... When we were young there were no boats on the river. There was a few wade-fisherman. But if you saw anybody on the river, one person, it was a lot. So, that's the change. You've driven across the Yellowstone I'm sure in the summertime, you see what it is now. (N, 5, Ag)

Increased recreational traffic on and near the river varies significantly by location. It is generally true that complaints about crowding are more magnified the further upriver one is when talking with locals:

There's not a lot of boats in the river. And if there are other boats out there it's usually part of our friends that are out there fishing with us. (M, 1, Rec)

I think that we're going to see more recreation on our river, and how we're going to control that, do we need to? If people follow the rules, I don't see that we would have to. (M, 2, Rec)

There's a lot of floaters, like on inner tubes and stuff from Duck Creek Bridge... we've always had that. (S, 3, Res)

We find weekends when people are pent up, and it gets to sixty degrees, and there'll be twenty to thirty boats at an access... that's on the weekend. During the week, we have no competition at all. (W, 3, Rec)

We fish [from Billings] clear to Glendive... It's getting pretty crowded. There's lots and lots of jet boaters everywhere... You'll just have to give a little bit. Most people do, as far as if there's people crowding a hole or whatever, you can just go around them. Find another spot. (B, 3, Rec)

It's a big river. There's lots of access, crowding shouldn't be a problem, really... I've never really seen any problems that way. [however,] I don't use... the upper Yellowstone, south of Livingston, where you get a lot of fly-fishing guides and whatnot up there. I don't know what kind of crowding issues they may have. (H, 4, Rec)

The reality of it is there's a lot of people that go down the river, so the privacy thing isn't what you'd think... which is fine. It's still a good place to recreate. (P, 5, Rec)

The use, for sure, is up. There's no doubt about it... We're loving it to death. I mean you look at all the people who have moved to Bozeman. Bozeman has just exploded. And go and sit at the interstate at eight in the morning and watch those boats roll off the interstate; and it's not dozens, it's hundreds (C, 5, Rec)

The amount of river traffic is horrendous; it's huge. (O, 5, Ag)

Public access is improved by new boat ramps, although some are better than others:

In the Hysham area, by the Myer's Bridge, we've got a nice area there. They put in a new ramp just north of Hysham down by the pump house. It's kind of a shallow one but you can put a boat in there. And so those are the two best boat accesses, you know, for us in our area to put a small boat in. (F, 2, Rec)

The Fish and Game has done pretty well as far as putting in boat ramps and stuff. Occasionally they put one in in a place where it's not very much usable, but you know, that's just the way the Fish and Game operates sometimes. (B, 3, Rec)

I'm just saying out of six ramps I named, there's only one... that's really good. The one that you can use is on the Big Horn, and the rest of them, you have to use an outfit with four-wheel. (W, 3, Rec)

However, not everyone is a fan of more land in the hands of the state:

Another thing I don't understand is why does this state of Montana Fish and Game have to own land? Why do they have to raise... the fees on hunting and have the money that they have? They have too much money in my opinion. Now they're going out and buying private land... More and more and more and more you see it. You know, we criticize Russia because they're socialistic and all their land is owned by the government, but what the hell are we doing over here? We're doing the same exact thing... I believe in private ownership. I think, like your Fish and Game controlling the animals, I agree with that. But I don't think they ought to be owning land ... To me, I don't think that's right. (D, 2, Ag)

The final issues brought out by the participants with direct relevance to recreation are the related issues of safety, local government, and self-regulation:

The river is just too unpredictable... Around here, it's dangerous because there's so many snags and so many things that can catch you that you have to really know what you're doing to be out on it. (V, 1, Res)

That... river does have a mind of its own when it's flowing... [you have] to respect it... There are undercurrents in that river that will pull you under. We've lost a really good friend (H, 1, Civ)

I've had boaters who, for whatever reason, one time went out there when the water was just roaring, I mean it was super high... They went fishing, and threw an anchor out... The anchor hooked on the bottom, and it just sucked the boat right down into the river. Somebody saw them and called in... I got to the Calypso Bridge and put in... I finally found the guy who owned the boat, he had tied his finger to a fishing string so he wouldn't get away from the boat... I cut him loose from that boat, got him in my boat, but we never did find his buddy. Never did... but he should have never been on the water. (H, 1, Rec)

The Yellowstone is a violent river, people don't have the respect they should have for it. (O, 5, Ag)

It may be calm-looking, but you take water for granted. (S, 5, Civ)

A jet boat is only as good as when the motor's running or working properly... even in a jet boat, you don't have much time to react and you're going to be in

trouble... So, I do not go on in when it's May and high water, and honestly, most of the parks and the ramps are flooded anyway. You know, it's pretty hard to get in anyway, so. (W, 3, Rec)

People should just stay off of it because there already [been] three or four that have drowned this year. You better wear a life jacket when you get on there. (W, 4, Res)

Getting on a moving body of water without a life jacket on, you're always taking a risk. Children playing by the river; you never take your eyes off a small child, you turn around and they're gone, it happens. (H, 4, Rec)

Our Sheriff's department has to keep people from being stupid and drowning... a lot of drinking, good time though. No reason people can't have a good time, just can't be stupid... Sheriff's department has to bring in all their reserve deputies. I usually leave town, go somewhere else for a while. (K, 4, Civ)

Fishery Health and Management

The next set of issues related to river recreation centers on fishery health and management. As a beginning, participants mentioned numerous species of interest in their areas and offered general evaluations of fishery health. Many of the comments reflected a positive attitude towards management:

Oh, mostly [I catch] catfish, but you'll catch sauger, and early in the year you'll catch ling and northerns... The good eating fish are catfish, sauger, and walleye. (V, 1, Res)

The fish are fatter this year than I have seen them in a while. They're fat, they're doing good. (F&T, 1, Rec)

I've always remembered [fishing] being pretty good, ever since I was a little kid... Bass and catfish is about all we catch down there. (C, 2, Ag)

When I was younger and I floated the river a lot... back then, the type of fish were basically catfish, some sauger and some goldeyes... Right now, there is really nice walleyes, and there's smallmouth bass. You are starting to see some croppies and largemouth bass. I can't really actually tell you where all of those came from, but I do know that the smallmouth bass, they planted some in the Big Horn River. And the walleyes. ...FWP ended up doing some stocking. The walleyes really have taken off in this area, from Hysham to Rosebud, you might say. (F, 2, Rec)

We target mainly walleye, sauger, small-mouth bass, and catfish.... Fishing on the river has actually improved over the years and uh, and I think their worry now is that the smallmouth bass may affect the fishery, they're getting so prolific. But they're so easy to catch, that's why everybody loves them. And they're so good to

eat, they're just wonderful eating. The Fish and Game changed the limit from five to ten this year, or last year... So anyway, the fishing is great... Walleye fishing is good. Bass fishing is excellent. Catfishing is excellent... So, it's just wonderful. (W, 3, Rec)

Mostly trout... But the bass, I did catch a bass one day. And the Game Warden told us about 6, around 5-6 years ago, the bass were in Park City area and said they'll be up here before long. So that's kind of good. And a friend of mine caught 2 catfish, channel cats, there one day. But mostly, it's just trout. (K, 4, Ag)

This was the best year I've had fishing the river. I don't know why. (O, 5, Rec)

Yet, the participants raised various concerns about fish health and management:

You almost can't tell those [irrigators] that they can't have that water. There should be some way to regulate how much they use. Instead of running it out and back down Canyon Creek or running it out back down the Clark's Fork.... So, you're irrigating, you got it done. Close the head gate.... [Another thing] would be to try to check the amounts of runoff, you know, farm runoff. That's a serious concern. Lot of fertilizer and stuff runs in. That's one of the big ones. (B, 3, Rec)

My conflict is that some people are catch and release, but they don't do it right and they kill more fish than they realize.... The handling, looking at them, taking pictures, and playing them too long, you know. They don't realize. (K, 4, Civ)

Well, there's been times in the last few years where, Fish, Wildlife and Parks will have what they call the 'Hoot Owl' restriction where you can't fish after a certain time of day, because of water temperature and how it stresses the fish and whatnot. I have a tendency to think that FWP maybe overreacts to those situations. I thought what they did by shutting down the whole river a couple years ago, due to those whitefish dying off. I thought that was really stupid.... I don't really worry about the Yellowstone in that regard. (H, 4, Rec)

We actually do now have a statewide protocol to deal with warm water temperatures... I think I've got this factually accurate, that if a stream hits 73 degrees 3 days in a row, it automatically goes to what are called Hoot Owl Closures, so you can fish from midnight until 2 o'clock in the afternoon, but you can't fish from 2 to midnight... So again, the period when water temperatures are the warmest. (O, 5, Rec)

Back in those days, lots and lots of phone calls from people saying, 'When should I come to Montana?' And the answer I gave them in 1995, is not the answer I would give them now. We certainly, typically, have more dependable fishing in the spring and the fall, [but] now, in the last few years, it's been pretty typical for runoff to be starting early.... I think the major thing in terms of climate change on the river is we've just had overall less water, we've had less snowpack, you know, the runoff is shifting earlier. The PKD outbreak in August in 2016 was certainly

the most extreme event... I only lost three days of work... I certainly didn't anticipate the PKD outbreak... but I anticipated low water and warm water and slow fishing... [Due to the] Hoot Owl Closures... we book March, but we don't book August. So that's, you know, that's a pretty dramatic change. (O, 5, Rec)

Many people in the upper river wanted to discuss their understanding of the causes of the incident related to the river closure in 2016. The various theories are not all compatible:

We had all those whitefish that died... that was a parasite... Part of that problem was that parasite evidently had been in the river, but the river was so low that the temperatures were just right, and it basically affected the whitefish and not the trout out there... And they did a good job of, you know, closing it for a month, and everyone washing their boots. (R, 5, Rec)

We were pretty spooked when that happened, because we didn't know, you know, if the trout start dying obviously there's not as many, so. It seemed to kind of peter out. I did see a couple of fish die this summer, and then we got this cool weather again in September and it kind of axed that. (P, 5, Rec)

When they shut the river down because of the fish bug... That impacted us because we have a lot of local angler outfitters... not just local here, but all up and down the river... A lot of people were impacted. That was probably your closest thing to a drought reason why the river was shut down. I'm assuming that bug has always been there but... it showed up and started killing fish because of the low water. It was pretty low that year. And it was hot. I'm not a biologist. I don't know what killed them, but they did die pretty heavily... I know a guy who has an irrigation pump right on the river and they were just packed in there where his intake is. Dead fish all the time. (W, 4, Civ)

I'm actually still involved with... some ongoing research efforts that are still trying to figure out [what happened]... Certainly, when FWP was forced to do the pretty draconian measure of closing the entire drainage completely to all recreational use, that was pretty wild. But again, what really sort of forced them to do that was the fact that we weren't really totally sure... what we were dealing with. So... the fear was there was a new introduction, and if we had hot zone on the Yellowstone, the fear was that recreational traffic was going to transfer it to another drainage, and we'd have pretty much a nuclear meltdown of the fishing industry in Montana. What we do know now is that the PKD organism... it's actually a parasite that has an intermediate host that's bryozoan, basically a little freshwater sponge... The actual organism that's responsible for PKD, the disease, was probably endemic... But, if it's always been here, why did it happen in 2016? So, one of the things was low water or warm water—was that the trigger? Well, it probably contributed, but... we can find cases where it was even lower... So, low water and warm water wasn't the only trigger, although it may have contributed to it. The one thing that's actually sort of interesting... and this is certainly not to the level of having a lot of confidence, but... we actually had a cold snap just before

the PKD outbreak. And now there's some idea that the intermediate host was in that low, warm waters, and one of the things that may have caused the bryozoans to release all those PKD spores into the river was actually that the fact that the water cooled very quickly, which again is totally counterintuitive to what we were seeing that was going on... But the honest answer is I think we are still not really sure exactly why it happened.... The one thing that I think FWP and researchers have told us is that if we're right that it has been epidemic, and if we continue to have the stress factors of low and warm water – which given climate change, we're probably looking at [fish-kills], and river closures are probably something that we should be prepared to see. (O, 5, Rec)

The guy who's head of fisheries in Helena at the time, he flew in with the helicopter, down here with the governor on the river to have his little thing. He's the last one that counted whitefish on the Yellowstone in 2001. Now, how many whitefish do you think there were? 10,800 per mile... 10 miles, that's 100,000. We lost 400 and we shut an entire drainage down. Everything! Everything! And if you don't have a set of criteria, how did you do it? (B, 5, Rec)

Beyond the PKD event, the participants commented on the endangered Pallid Sturgeon:

If you catch one, you've got to let them go. (W, 1, Res)

The sturgeon... you put back. (V, 1, Res)

My friend brings me over this great big ol' steak. A sturgeon steak that he had grilled, I said, 'Dang, how did you get that big of a steak out of a sturgeon?' He said, 'It must have been five feet long.' I said, 'You know, you have to release them over 40 inches.' He said, 'Well, maybe it wasn't that long.' [Laughs] ... I tell you what, locals don't seem to ever read the rules. (F&T, 1, Rec)

Also, management of the paddlefish population was a topic of concern for many:

We don't have near the paddlefish that we used to. That's a resource that's been used to be pretty heavily monitored by tagging, and getting eggs, and all that. Back in the 70's, my dad would take me to Intake, and I would catch-and-release paddlefish... I caught a 126-pound paddlefish one day, by myself... and they probably averaged 60 pounds. It was just an unbelievable fishery. (W, 1, Res)

I'm not sure that they have a really good handle even today on the paddlefish population. One of the big unknowns that they have is that they've got this ten-year waiting period to see whether they ever spawn or not... they're really ten years out on managing. And that's tough to react to. So, that's one of my arguments, why aren't we being proactive and not take that risk? Because at some point, if we go over the edge, you're not going to see any paddlefish. And they're going to have to close it, or greatly reduce opportunity. (W, 1, Res)

I've got a good friend that is a walleye fisherman in Lake Sakakawea. He says them little paddlefish are the cutest things when you get them out of walleye... they're tiny and then walleyes just eat them by the millions. Then you hear, boy the walleyes look pretty good, they set two million more little fingerlings in Lake Sakakawea... Just like, oh those coyotes are so cute, let's hatch a whole bunch and we'll turn them loose in this guy's sheep pasture... You used to be able to catch all the paddlefish you wanted, wasn't a limit on them years ago. Then they made the limit two, and now it's one, and now there's a quota so you might buy a tag and if you're busy doing something that weekend and the quota is used up, you eat your tag... They keep limiting how many fish you can catch because there's less and less. [Laughs] Like throwing wolves in Yellowstone Park and wondering why the elk aren't as thick as they used to be. I mean, there's a lot of no-brainers going on in this country. (T, 1, Ag)

The catch-and-release program... it's Sunday, Monday, and Thursdays, and the only place you can do it is at Intake... When I was younger, one of the best experiences you could have was to go down the river and pull up behind an island or a back water—nobody around—and catch some catfish and throw a paddlefish rig out and catch four or five big paddlefish all by yourself... You cannot do that anymore because of the way the regulations are. And, they say, 'Well, we can't monitor that.' And it's like, they allow people to go down and do catch-and-keep anywhere on the river, but they don't allow catch-and-release. And to me, to regulate catch-and-release, is pretty simple. You can't have a paddlefish in your possession... It just seems so backwards, and they will not listen to me about it. I'm like, why are you not allowing some of the best opportunity for a quiet day of fishing... It's stuff like that, it just doesn't make sense to me. I don't think they grew up with that experience. (W, 1, Res)

If we would have went down maybe a different path when this whole thing started... I don't think we'd be in the same boat that we are right now. It'd be interesting to hear what the biologists on the Snake River... would have to say about the way we were managing this fishery here. I'd have to think that they're going, 'You guys are like way behind the curve on this.' ... It's sad, and I don't want to 'diss' the Fish and Game, but it seems like they're so reactive, compared to proactive... There used to be maybe ten boats in Glendive. Now, there's fifty jet boats. They don't see [the pressures that are] coming— [based on] their netting surveys, everything looks good. So, they don't tend to be very proactive... Even now... they should go smaller barbless hooks and teach people how to release them... Those are just simple things, but they don't seem to push that kind of stuff. And you get over to western Montana, they're all about that... They've educated people about catch-and-release, and it's become kind of a pride thing over there to treat the fishery with a lot of respect... I don't know why the difference is here... The sportsmen do more of that in their own discussions, but with a lot of fisheries, voluntary conservation does not work... You need to have somebody leading the way and educating people... But the education side of it, and I don't know where the Fish and Game comes up with these, they keep saying, 'Oh, people just come here because they want to catch that fish and get that meat.' It's like, 'Really?'

Maybe if you presented the story a little different then they would go, 'God, I went and caught three or four or five fish, let them go, got some great pictures.' And I don't have to deal with this. Well, I'm not going to say it. But paddlefish aren't, in my opinion, as good of eating as even a catfish, or other warm-water species. It just seems awful expensive to cut up a fifty-year-old fish for a bag of meat. (W, 1, Res)

Issues concerning catfish, sauger population, maintenance of the T&Y diversion dam, fish passage, and invasive aquatic species were also found in the data transcripts:

Catfish are a big deal... Most people are letting a lot of the catfish go. But the pressure on the catfish has really come up in the last ten years. That's what a lot of these people are doing. And what's really scary is a four-pound catfish is ten to twelve years old. Most people think it's two or three. No, it's four to ten. You catch a fifteen to twenty-pound catfish? I don't know, it's twenty, twenty-five plus years old. You start keeping a lot of those fish out this system? That's a huge impact. Who's looking at that? Or saying anything about that? Nobody. (W, 1, Res)

We question the sauger limit, you know. They put a one fish limit on it because... they couldn't figure out the movements of the sauger... So, we turned in our tags and a lot of the sauger we caught up here were [originally] tagged clear down by Terry. And they come up across all those dams all the way up here, so it's kind of cool. But they're getting some idea their movement and all that, but they put a one fish limit on it. And I think since they have it, they'll just keep it. Sometimes we think you should be able to at least, you can keep three up at Yellowtail, so we think, you know, we think that maybe they would change it to two. Um, it's pretty hard to feed two or three people with one fish, you know. [All laugh] (W, 3, Rec)

I talked to Fish and Game years ago to come up with an operations plan for this thing, and they just don't do it. And Mike in here is a great guy, biologist guy, but he isn't a water guy. I have talked to FWP water people in Helena, and at one point thought I about had them going, and then they just let it die. I don't understand why it isn't significant. I'm not very good with writing stuff, and I don't know quite how to do it. I tend to get myself in trouble when I write stuff down. There needs to be a full-time, full-fledged agreement between FWP and T&Y irrigation that keeps that fish mover in there... We can't let the Tongue River and T&Y lapse back into bad history or bad habits. Having the fish component in there is part of being a responsible water user. (M, 2, Ag)

I've had my boat checked in every state you can imagine. I've been checked in Idaho, I've been checked in Wyoming, I've been checked in Montana. And I think that the zebra mussels are here, and I don't think there's anything we can do about it... it's like closing the gate after the horses already got out... I think they're wasting their money... [but] I drain, wash. Every time I come out of the water. It only makes good sense... Aquatic vegetation is another problem. You transport it from one place to another. Jet pumps suck that water up inside the motor too. Then

you ride on that jet of water, so. It's a good way to pick up stuff... And transport it... I've been just grilled in Idaho. We were going into Henry's Lake and there were two ladies over there. Boy, they looked back, and there was leaf in the plughole of the boat. They gave me the third degree. It was a leaf off a cottonwood tree. (B, 3, Rec)

Wildlife Health and Management

Participants from the valley also explained their opinions regarding the health and management of various wildlife species found in the river environments. Throughout the valley, individuals suggested increases species diversity and abundance. When asked if they had noted changes in the numbers and health of wildlife, in a general sense, participants almost always responded positively. They offer detailed inventories:

We're getting all of these birds, pelicans and cormorants. You know, we didn't have red squirrels here; we have them now... We have bears now we never had when I was a kid... when I was a kid, there was no raccoons here. There was no squirrels. There was no coyotes, no wolves, no elk... Now you have all of those things. (D, 2, Ag)

There were no squirrels, not when I was a little girl... And now, of course, they're all over... Shoot, we have badgers, skunks of course, coons. There were no coons, but then we got a lot of coons. (M, 2, Rec)

We have more frogs or toads, whatever they are, this year than we have for a while. We didn't have any last year... We had a lot of that early moisture. I think that made a difference too.... I've noticed is there is a lot more turkey on the river, on the other side though. You can hear them gobbling. (S, 3, Res)

We probably got a little more than we had before, once in a while we get an elk... Not that I want them, but I mean once in a while we get them... They come from the north hills. And if it gets dry, they're looking for something green. I've seen a bear a time or two... lots of geese, pheasants, wild turkey... A lot a lot of pheasants. For some reason, I think they stick more down in the valley. (K, 3, Ag)

It all seems to be thriving, I would say. (O, 5, Res)

Many participants also shared their thoughts on specific species. Many noted an increase in the eagle population, reflecting some skepticism of official population estimates:

Back 20, 30 years ago I remember the guy on Fish and Game, he said, 'Well, we've got two nesting pairs of eagles from Billings to Miles City.' Hell, there was two nesting pairs right here on our place, so you know he was full of bullshit. And now there's a lot of nesting bald eagles... a lot more than you would expect. There's a lot more. (D, 2, Ag)

The number of eagles on the river in the last 20 years has just exploded, they are everywhere... I don't want to hear about a shortage of eagles... Bald eagles are rampant. (D&P, 2, Rec)

Another change from when I was young, you know, we used a lot of DDT back then and we didn't have hardly any eagles. We have a lot of eagles now. Our son is an aerial applicator... And he flies the Yellowstone a lot. And he said about every five miles there's an eagle nest now... They do well on the feeding off the fish on the Yellowstone River. (T, 2, Ag)

There's definitely more eagles than 12 years ago. (W, 3, Rec)

We have a lot of eagles too... And in March, I think that's their breeding time, there's always a bunch of eagles around because this is a breeding area for them. They gather... Our new neighbors have chickens and they let them out when they're outside, and the eagles and the hawks are very happy. (S, 3, Res)

The neatest thing that everybody will tell you right now is the eagles have figured out... that if they follow the boaters, they're going to get fed... So, when you anchor up, here come the eagles. (W, 3, Rec)

There are a lot more bald eagles in the past few years, and lots of osprey sightings. (Y, 4, Rec)

We've seen a lot more bald eagles this year, and the American eagles. (M, 4, Ag)

Another bird noted to have increased in abundance, is the blue jay:

Something else I'm seeing now that I've never seen, just in the last few years, I'm seeing blue jays at home... we've got a bunch of blue jays who come and hit our bird feeders. (B, 3, Rec)

The other thing that has moved in that we have noticed is blue jays, within the last couple years. We're from Minnesota originally, we love blue jays. First one showed up here and I heard it, and all of the sudden your memory flashes back, and I thought that sounded just like a blue jay. He sat up in the tree looking at me. My sister lives over in Shepherd, and she's got a half a dozen over there and she's had them for years. I've heard them in Laurel too. (G, 4, Res)

In eastern Montana, pheasants and magpies were reported as in decline:

The pheasant population took a big hit here last year. The chicks didn't have the dew on the grass in the mornings, and that's where they get most of their liquids from. (M, 1, Rec)

What's really noticeable is a lack of female pheasants. They are way, way down. There's quite a few rooster pheasants, but not the hens... We still see about the same amount of eagles and hawks and stuff. (V, 1, Res)

Hailstorms can be hard on both the pheasants and the duck populations. (C, 2, Rec)

I didn't hunt pheasant last year for the first time basically in my life because I figured, let them go... Friends of mine did [the same] ... we just made a conscious effort to, you know, just let them go. I love hunting just as much or more than anybody, but I'm also aware of the numbers of the animals out there too, you know. They did not need harvesting last fall, I didn't feel. So, I just didn't do it. (M, 1, Rec)

We just about eliminated the magpies, seemed like, but here this year we're seeing a few of them... I've had a lot of chickadees in my yard this year where before not so much... There's a lot of robins, but there's a couple I can't identify. They're wrens [?] of some sort. (M, 4, Ag)

Across interest groups, participants offered positive comments concerning efforts to safeguard bird populations and health:

They've taken away the hunting on the Yellowstone River... I don't know what the regulation really is because I don't hunt myself, but they can't hunt on the Yellowstone... [The birds] need a place to rest, and they use it. They really use it. (T, 2, Ag)

Goose hunting, even though you can't hunt the geese off the river, we get thousands upon thousands of geese that come through in the fall and people hunt then, off the river on the land adjacent to the river. So, we hope that that is maintained. (K, 2, Civ)

That segment of the river from the Big Horn River down to Hathaway, on the Yellowstone there is no direct waterfowl hunting on the river proper... I'm fine with that rule. I think it's beneficial for the hunters and also for the small towns along the river because birds tend to congregate there. That brings in income from the hunters... [And] as far as Canada goose goes, there's probably more geese wintering now in that area, that stretch, due to the hunting closure on the river itself. During mild winters they tend to congregate more along that stretch. (C, 2, Rec)

I like it that the river is closed to goose hunting. (F, 2, Rec)

Quite a few of the participants offered comments on deer. Some noted increased or stable populations:

We do have deer... Our mayor, he had a statement in the paper one day, figured it was 400 deer coming in town at night. Well, I know that's not true, because you

couldn't get your car up and down the streets without seeing a deer. They would be pretty noticeable. (P, 1, Res)

You see deer populations come and go over time with disease...or [due to] tough winters...For now, the population seems to be pretty stable. (G, 2, Res)

Others noted declines in deer populations that they attributed to blue tongue, weather or climate, and hunting practices. Criticisms of management efforts, that run counter to the positive evaluations offered above, come from the same people quoted above:

In 2011 we had a bad blue tongue disease of the deer, and the river when it washed out killed a lot of deer. I have not picked up my bow and hunted deer since 2011... But I did put in for some permits this year. I want to get the bow out and go hunting again, but there again is the Fish and Game. They're idiots—all that they are doing is wanting to tag to get a dollar from whoever is putting in for that. They're not worried about the animals; the numbers are way down. You can go downtown and buy three or four "B" tags for does. Well, they are the ones who are producing the deer, so there again I just chose, nope, not going to do it. (M, 1, Rec)

There's been some drop in the white-tailed deer population due to blue tongue, I know there's less that I'm sighting. (C, 2, Rec)

One of the things I've noticed the last, well really the last 10 years, that's been changing, is the rut—the breeding cycle for a lot of big game animals seems to be changing. They can't decide when it's time to actually breed, and when it's not, or they go into and out of it very quickly. (S, 3, Ag)

Another thing we don't see, we used to see deer every day, they would be crossing down there. Now we're lucky to see one deer one a week. (W, 4, Res)

We have hardly any deer here... You know, the whitetail I'm sure had blue tongue. We lost a lot of them to that. And the railroads gets them, too. Basically, we are just about down to nothing there. (K, 4, Ag)

Of course, white tail deer, when there's a drought, white tail deer tend to congregate down to the river, and that gets them too close together and the fleas spread something and then they get some kind of... what is it? Some kind of blue blood disease, I don't know, but they die off. (K, 4, Civ)

In Park County (Segment V), increased bear, elk, and bear activities are a cause for concern:

You know, there's 33 grizzly bears in Tom Miner Basin. My family has a cabin up there... You can't do anything outside them cabin walls without seeing a grizzly bear... And that's kind of weird... It's the largest concentration of grizzly bears in the lower 48 United States, is in Tom Minor Basin. (T, 5, Civ)

So, since we've seen those two around here... we've had numerous reports of other grizzlies... But those grizzlies do not have the fear of humans, and they need that... That gets into a whole other thing [laughs]... You know, there's an area up there in Tom Miner Basin right where the Divide Creek Road takes off... There's probably more grizzly bears in that area, right there, than anywhere else in the lower-48 part of the States. And it's almost too bad, but it's so well-known now that you can go up there almost every night and see 10 or 12 cars there looking, and they normally always see grizzlies. The most I've seen...is nine grizzly bears in one evening. (O, 5, Res)

That is a big concern on my walk that I take up Dry Creek Road... there were four grizzlies. And one just ripped... two of them ripped a deer apart. One was on one hand, one was the other, within a mile from here where I walk... And so...they moved them. And then there was a grizzly at Jeff's that ripped apart two apple trees. You can't leave an apple on a tree. And then in Emigrant at my friend's home across the river, she had one right in her yard. And they're coming down from Tom Miner Basin, which is one of the third largest grizzly inhabited areas in the world. Have you been up there? ... now they're coming on down here... I've seen as many as 19 in one night up there. (R, 5, Rec)

Final comments regarding management suggest at least some members of the public are satisfied with the state authorities:

I think that Fish and Game do a good job with wildlife. (M, 2, Rec)

Fish and Game are the guys I usually wind up talking to. They're more concerned with whether I have a fishing license.... The state of Montana could triple their hunting and fishing licenses and it wouldn't hurt my feelings a bit. Those guys work pretty hard for their money. (B, 3, Rec)

Hunting activities are also connected to access concerns:

It's a challenge. We have a lot of hunters that come out that we know and want to have there. We [also] have a lot of people that sneak in and poach and do stuff that we don't appreciate. So, living on the river, it can be very challenging. (W, 3, Res)

The sportsman has a different idea, than the landowner does.... I don't have a problem with doing a little research and finding out [where I can go] because I do not like confrontations with people, out of respect for them. And, I just don't like the bad feeling in my gut, it ruins the day. So, we do our homework. We check before we go in somewhere so that we don't have a problem. If there is, we have got ourselves covered. (M, 1, Rec)

I just ran into it one time where somebody was trying to keep people off of public land, state land. They had it posted... I had looked at a map... that was before anybody got too serious about GPS and stuff... But I knew it was public lands. So,

I didn't say anything, so I went back to the DNRC and asked them about it. They went and talked to 'em. They got rid of their orange sign. (D&P, 2, Rec)

Some of my neighbors... nobody else can go in there and that type of thing. They don't want anybody down there on the river. They can't keep you off of it when you're on the river, but you can't go over the high-water mark legally... I know there has been confrontations with landowners will sit down there by the bank to make sure they don't get off and walk in their trees and hunt. And where the big problem is that some of the islands... didn't use to be an island and now it's an island and they own it. So now... Because everybody's under the impression that if it's an island, it's open, but actually by description somebody owns them because they weren't an island before... so it's a grey area... So guys that live along the river, some of them will put big signs that say no hunting... I know a couple of them just up on the way to Custer that are real protective of their land. They don't want people on it at all on the river, so they will be down there. (F, 2, Rec)

There is a balance, and it begins with a thing I call virtue and morality. If we just treat one another like we want to be treated, there's room for everybody on this river... We allow hunting... And the balance is that... I respect another man's right to hunt. The state deems that a deer is a public animal, which I agree with, and I like the hunters, because we have an overabundance of deer and antelope. And I'm already feeding them for free... so if we knock some down and thin down the herd, that's a good thing. So, it's a mutual benefit for everybody... There's very good hunting up here if you call sometime and want to hunt. You'd be welcome to come and try your shot at it. We have some federal ground that we lease from the BLM, and there was a schoolteacher that would put his boat in at a dock over in Fallon and come up and build goose blinds on our banks. I saw him down there one day, and he thought I was just going to yell at him or something, he goes, 'Well, how you doing?' And he told me who he was, and he says, 'You know, I can be here.' And I said, 'It's BLM, you certainly can.' (T, 1, Civ)

We've got some guys that come out and hunt [geese] every winter... they have office jobs, and they just love it... But if I don't want another person to go on, they don't go on, that's the way it is... We try to kind of keep it regulated. My son keeps track of who is in on that day and all that, so you don't get people out that are out there that are unaware of each other and may shoot each other. (K, 3, Ag)

[I try to be] really respectful their property... If a gate is open, leave it open; if it's closed, close it behind ya. (C, 2, Rec)

In the fall of the year, we participate in Fish, Wildlife and Parks' block management plan... So we have a lot of hunters... All block management does, is every hunter pays a fee on their license that goes toward the block management fund. So, then you have a contract with FWP, and you allow so many days of hunting, and then you get paid accordingly... Before the program started, nearly all the land, up and down this whole river from Forsyth to Hysham, it's all guided.

And we like block management because the hunters have already paid a nominal fee, and so people that can't afford a guide can still go hunting... It lets families with kids and things go hunting, and they can afford to go... And so... we got paid a little bit for the management of it. (T, 2, Ag)

As a landowner, I'll throw my two cents out... The first year that the neighbors down the creek put it in Block Management, on opening morning, before daylight... I listened, and it was like thump, thump, thump-thump, thump-thump-thump-thump, all in the dark.... There was probably two people per vehicle, and there was 15 vehicles showed up.... Isn't this a recipe to get nothing, except shot? ... The other problem I have with Block Management is the fact that we're adjacent to it... and the next thing you know, you find some yahoo over here.... And I'm like, 'Now would be a good time to look at your GPS and start getting your G-A.S.S out of here.' (D&P, 2, Rec)

Cottonwoods

Participants spoke at length about cottonwood forests and about their theories regarding factors that contribute to new growth and of the forests. We begin by reviewing a couple of statements that explain how cottonwoods can be culturally significant:

The first year we moved here I said, 'Well Adele, we got to go to the river.' And she loved the river too, so we spent our first anniversaries—up until our kids were three or four years old—going down to the river and carving on one of those big old cottonwood trees with our anniversary date. The next spring, if that tree was gone, there would be another one... We would put our names on some big dead logs and sent our anniversary messages down the river... we would always go to the river, have a picnic, fish a little bit, look for asparagus and mushrooms. We don't do anniversary things so much [anymore], but we still go to the river with our grandkids. (F, 2, Rec)

[Referring to a photo of a camping trip when the participants were approaching their teens] If you look closely, you'll see everyone has a stogie. It's called punk wood, cottonwood.... We smoked the roots. Once they're soaked in water, they get real porous. They're a little more potent than a cigar [laughs]. You never smoked punk wood? Hell, I thought every kid had smoked punk wood [laughs] You want to? I got some [All laugh] ... Some of it's not too bad, but some just about rips your tongue off [Laughs].... Here, you roll that up in some magazine paper and make a cigarette out of it. [All laugh] ... Probably pretty toxic with the lead off the print. [Laughs] Well, we couldn't afford anything else... at that time we were only twelve years old. It don't take near as much of it to satisfy the craving either. About one good pull off of it will do. [Everyone Laughing] (P&D, 2, Rec)

Our goal with our interview questions was to explore the extent to which the participants were attentive to the health, longevity, and reproductive success of cottonwoods in their area. Throughout the valley, we found people who spoke fondly of the cottonwood forests, or sometimes of a single tree. Certainly, not every

participant had a great deal to say about the cottonwoods, and at least one participant in every geographic segment remarked that they had not noticed changes in the health of the forest:

We do [have cottonwood trees on our property] No [we haven't noticed any changes] We irrigate with river water so I have cottonwoods in all of my flower beds. (B, 1, Ag)

Cottonwoods always seem to do good. The ash trees will die off but the cottonwoods, they seem to do real well in this climate.... [We have new ones coming up,] all the time... We got some pictures of us hunting with a bunch of cottonwoods on a sand bar this tall; they are all 30 feet tall now. The cottonwoods are just resilient; they'll grow anywhere. (M, 1, Rec)

[Besides the one's by the driveway,] we used to have a lot of them, and they fell into the river... The only ones left you can see them right out this window... But we have a lot of new ones coming.... There's twenty-foot trees down there now, and they actually grew off the roots of the old ones that were there. (S, 3, Res)

We've got plenty of good-sized cottonwoods... [and] there's all kinds of seeding cottonwoods coming up down there. (M, 4, Ag)

No, I don't think I noticed anything, but a lot of them are dying off, and lot of new ones starting. So, I can't see much difference in them. (J, 5, Ag)

However, many participants expressed concerns about the health of the cottonwoods, particularly in relation to an apparent lack or recruitment of seedlings:

Down on the riverbanks, we don't get the tree growth as we did. You can tell it. (H, 1, Rec)

[As for noticing new seedlings,] Not so much. There's an awful lot of big ones, you know. There are places where you see them. But they're not coming back like Gangbusters. (B, 3, Rec)

You know, I could be totally off base, here, but I don't know that I see young growth. It seems to me, I see a lot of big trees, and they are the ones that end up in the river and whatnot, but I just don't know that I see as much young growth as maybe should be there. And I don't know what to attribute that to. (H, 4, Rec)

I've heard that cottonwoods are having all kinds of trouble because they're not being regenerated... the old growth cottonwoods are old, and the new growth cottonwoods aren't coming. I mean, maybe they're getting eaten, or maybe they're being cleared out. Maybe something's causing the new growth from not happening. (K, 4, Civ)

There's a lot of cottonwoods. They're dying out; they're old. (D, 5, Res)

You know, it's hard to track the cottonwood changes, because they are so gradual. And a lot of the cottonwood issues are related to regeneration (C, 5, Civ)

Most participants who commented on their perception of the health and abundance of cottonwoods also offered explanations or theories related to the factors that contribute, positively or negatively, to new recruitment and growth. Most of these comments can be classified as relating to moisture (including drought and flood impacts), wildlife, or human interference:

You know, I do [notice differences]. Yeah, last year we never had any rain, and the leaves weren't as bright green. You could tell stuff like that. (H, 2, Ag)

You know, I want to see some new ones because every year we'll have at least three or four ginormous cottonwoods that will fall over, or a big windstorm will push them over. Something will happen to them, or they will just die. (C, 2, Ag)

Once they get to a certain point, they start dying out, thinning out. Or the river comes along and wipes them all out. A good ice jam is kind of tough on them too. (D, 2, Rec)

Most of them are gone... when we lost our forty acres down there, that was all covered with cottonwoods... I used to go out there and play when I was a kid. It was full of big trees. They're all gone. We only have... ten acres left with some trees on it, and a lot of those trees are dying and falling over. So, we don't have very many trees left. (M, 3, Ag)

I will say this year was a bad year for the cottonwoods because of the drastic high-water season. I mean, our river hit 36,000 cfs this year. So... there's a lot of cottonwood trees that have got uprooted that are just beached in the middle of the river now. And I don't know if that's normal. Maybe that happens every ten years or something. (P, 5, Rec)

I guess some of the mature stands, certainly we've seen loss of some of those... along the river, you know, I've certainly seen us lose some with flooding, and bank erosion, and old age, and all the usual things that happen to cottonwoods. (O, 5, Rec)

No, not really [any changes]. Except the ones that have fallen down during high flood water, you know. (S, 5, Civ)

While floods may present an issue to mature stands, participants widely reported that they understand floods to also be critically important for regeneration:

The cottonwoods? After we have the high tide in June, and if it's an exceptionally high year, it will flood some of our lower pasture ground. And usually in the fall we'll see saplings. In the spring they'll start growing. We see an abundance of cottonwoods... There is so many of them, it's phenomenal... We irrigate... and...

the river has planted, through irrigation, cottonwood seeds on our shelterbelt. So, it's a good trade. (T, 1, Civ)

The only places you see those [seedlings] really coming is where it's had standing water--where it's been, just, really wet. (W, 1, Res)

After a flood, it'll break out some new ground, flat, and then when the river recedes away from it, the cottonwood seed is there, and little cottonwoods will come up all over the place. (F, 2, Rec)

It's the river... [Some years] it goes out on that field down there.... You just have a lot more sand and asparagus the next year, and cottonwood trees, whatever it brings in. (M, 2, Rec)

Usually, if it floods pretty hard, after it's done... It can bring new cottonwoods in, and little saplings will pop up here and there. Sometimes they make it, sometimes they don't. (C, 2, Ag)

The river is high this year, and so a little later on it'll be just a mass of little cottonwoods about this high. And some survive and some don't. And that's what regenerates [the stand].

I think [high water] ... spreads the seed out. (T, 2, Ag)

That was the only good thing about the 2011 flood—there were a lot of new cottonwoods that started...I don't think they come up any other way. I think there has to be a flood. (S, 3, Ag)

Yeah, we do [have new cottonwoods] in the riparian area. I guess, probably, more where we've had flood water.... It seems like that's where they show up. (W, 3, Res)

All those years I sat on the Task Force, and one of the things that we were taught was that flooding is the only way the cottonwoods regenerate... [And] a lot of the cottonwoods... have really been fostered by flood irrigation... so I mean there's a lot of places you look around the ranches, and there's a stand of cottonwoods that runs along the ditch, because the ditch provided the water... [And] I could think of two or three people that I know of that are fishing clients that have also built homes here in the last decade, that's one of the issues that they're dealing with is they aren't exercising a water right because they weren't going to... put hay in a field, but then suddenly they realize that those ten cottonwoods that run down the property line are all starting to die because there's no water in that ditch anymore... [With people] going to sprinklers, some of those ditches are dry... I'm guessing we are probably losing some cottonwoods in some of those areas just because of changes in ownership and land use, and irrigation practices. We are probably losing some of those. (O, 5, Rec)

Some participants discussed the impacts of wildlife and livestock on both young and mature cottonwoods. The most reported wildlife threat to cottonwoods along the length of the river was beaver:

By the time they get big, some beaver comes along and finds them, and takes them away... That's what's so hard on the cottonwoods. (T, 2, Ag)

What we have noticed, here, is we still have beavers and stuff around, so they keep the cottonwoods chewed up... So, we don't see a lot of cottonwoods growing up the creek so much anymore. We try to protect some of them, put some wire around them, keep the beavers off them. (F, 2, Rec)

Beavers are taking mine... Those pesky beavers are about to drop two more cottonwoods, so there's that... The trees are brilliant right now; they're really gorgeous. Other than beavers, mine seem pretty healthy. (B, 5, Civ)

Yes, we do [get young cottonwoods] ... They were doing quite well, until the beaver came along... We need to fence all those in—the young ones, so that doesn't happen again... We have more trouble with the beaver than the river. We had three big trees cut down last year by the beaver... I put wire around the trees now. Eventually I think all of our cottonwood trees will be history. The cedar trees are kind of taking over down there. I don't know why—we've never planted those. (R, 5, Rec)

Other wild species that present issues for the cottonwoods include deer and squirrels:

We have a large deer population in this country, and those deer in the wintertime, they like to go eat those cottonwoods down to the ground. (T, 1, Civ)

The squirrels eat the hell out of them—out of the trees. The squirrels are just horrible on the cottonwoods in town. They eat off all the small branches off the cottonwood trees, and they just tear it apart. (H, 2, Rec)

You know, they get brown spots every once in a while. I blame it on the squirrels. They take off branches for building nests, but I don't know what it is. They get a blight in them once in a while, but basically they stay pretty healthy. (T, 2, Ag)

We do have [cottonwoods] that the goats haven't found yet. The deer tend to like those a lot, too... But, you know, it's amazing, you'll see like these spots where... in a little tiny area, hundreds of cottonwoods would start. There is a reason that there has to be hundreds of them though, because they do seem to be the favorite of every wildlife while they're trying to get up. (S, 3, Ag)

As noted just above, livestock are also reported as having impacts on cottonwood health:

The sad part is, if you're grazing, then the cows will keep those cottonwoods out because everything loves cottonwoods. The Indians... that was their winter food for horses. Everything likes to eat cottonwood. So, if you graze an area along the river where you've got all these young cottonwoods, that's one of the first things they'll eat. And they'll eat them down to nothing... Now, if you have a big ice like in 2011, we had the big floods, we had huge areas of new cottonwoods coming up. And if some of the landowners could've noticed that they might have held off on the grazing... We had thousands of little cottonwood seedlings, and so, I didn't farm it until I waited about 5 years. And now those cottonwoods are probably... 10 feet tall... I waited, and when I went back and tilled the field back, we left three big patches of cottonwoods. It's pretty cool... But, my neighbor says, 'I've got to get in there [and] disc those trees before they get established.' That's what he said. And I understand, it's economics, too. But... when that happens, and your field is in a place where it's going to get eaten away by the river anyway, and you have the opportunity, you should let it happen, the trees will slow that [erosion] process down. (W, 1, Res)

Oh, yeah. Tons of them [down by the river] ...And I noticed that there's not very many new ones coming back... We have two pastures down there and we keep [the cows] in one pasture and not the other one... I've noticed that that's helping some of the new cottonwoods because they are not eating the leaves off of them. And then once the fall comes and the leaves are off, then the cows can go in there. So, that's helping them some, but no I haven't seen much new cottonwoods coming in. (C, 2, Ag)

Some of the participants explained why some property owners are replacing cottonwoods with cotton-less cottonwoods or other species:

The cotton last year wasn't very thick... which made my wife happier than hell... It was nice not having a lot of cotton, because when your swather... plugs up, you got to stop and clean them off. (H, 2, Ag)

These trees here, all these trees were planted. And these are cotton-less cottonwoods. (G, 4, Res)

It is wonderful sitting under them, but as you can see there's cotton flying. It's dirty looking, and it's hard if you have allergies. I have allergies. The worst part is my husband planted every one of these cottonwood trees... We are replanting something else. (F, 4, Rec)

They pollute a lot during springtime when they blossom out. We're finding the cotton plugs up everything; it plugged up our sewers, it plugged up any air conditioners that people used, so we're learning... we do not want them anymore... so we did pass a law that you cannot plant a cottonwood tree... that's a city ordinance... We're still planting cottonwood, but they're the cotton-less trees which are good. (R, 3, Civ)

Other theories about the lack of young cottonwood forests were also brought forth by the participants:

The leaves... fall early, like they're diseased, and they've got brown marks on them and... they fall real early. (H, 1, Rec)

We will have a record high in January, and then two weeks later a record low—it's not consistent. Instead of...cold in the winter and warm in the summer, it spikes so bad, and when it spikes warm, they all bud out, and that cannot be good....It's been probably ten years ago now, but it warmed up really good and the trees were budded out, and then it got down to thirty below... them trees, you could hear them like a gun going off because they were freezing... All the juice from back up in the tree, then when it got thirty below, it was just like a pipe, when pipes freeze when they get water in them and break. And it killed all of them, all the big cottonwoods started dying off after that. It busted something inside them. He said it sounded like people were shooting down there. (T, 1, Ag)

The river is taking them all. They're falling down. I think it's cyclic, somewhat. I don't know what other people are saying. But a lot of these are 150 years old and they're just not a stable tree and they're falling down. But with that said, the Conservation District was out on these islands planting cottonwoods... [but] most of them got washed out and then on the low water years there's cottonwoods everywhere. I think it's nature again.... They're old.... They need a ton of water. They are thirsty. But on the actual river itself, on these islands down there in this part of the river, there are so many cottonwoods out there you can't walk through them now. Five years ago, everyone was saying, 'Oh, no cottonwoods, there's no cottonwoods.' But now, five years later, they're about seven feet tall. They're growing like crazy. (N, 5, Ag)

Other Issues **in The Yellowstone River Valley**

The above sections document how with the people of the explain fitting into this iconic valley. We focused on these primary concerns: regional senses of place and identity, understandings of the river's physical processes, human responses to the river's physical processes, understandings of natural resources, and the numerous intersections where management officials must negotiate the public/private interfaces. As we near the end of our task, it is important to note that the wealth of data generated by discussing the river with more than 100 residents could be mined, seemingly, forever. Beyond the issues addressed above, there are dozens of other untold concerns, large and small, local and regional, personal and public. In the next few paragraphs, we offer just a few examples of three additional themes: water availability, water quality, and noxious weeds and invasive plants. Our presentation of these last concerns is not meant to illuminate the discussions in the detailed manner used in the above sections of this report. Rather, we want to alert readers that these concerns could be more fully examined under different directives.

Water Availability and Drought Vulnerability: Throughout the valley, residents are concerned that water resources may run short. Here are a few of their comments:

We were pretty droughted last year. And even though we're irrigated, we couldn't keep up. The crops were poorly because of the drought. They just didn't produce... and even with that irrigation pivot... it takes... eight hours to go around... And by the time it got around, all the ground was dry again. (B, 1, Ag)

I suppose where irrigation is going to come into it, but I have to imagine there's a lot of other people in my shoes that are either already irrigating or are going to have to irrigate more. It starts to bring up the question, how much water is there going to be in the river come August? (S, 3, Ag)

The use of water, without it we have nothing. Pure and simple. Some of this irrigated ground probably would have stayed as pasture... With our rainfall of maybe 13 inches or less, there is just no productivity without the irrigation water, so it is the lifeblood of this valley. Pure and simple. Without it, the whole economic base would collapse. (P, 1, Ag)

It's my lifeblood. I have a neighbor over here that runs sheep, and when we first moved here that was the first man we met... And he said this, 'Whiskey is for drinking, and water is for fighting,' and that is a true story. We would be devastated without the Yellowstone River and we would fight to the death to keep it. It's important, gotta have it. (T, 1, Civ)

Well it's [the river is] very important, it's our main source of water supply. We have no other alternate water supply source. So yeah, it's very important to us. (L, 1, Civ)

The irrigation from the river is what keeps this community alive. There's just no question about it. You can take all the oil in the world; it isn't going to keep this community alive. (V, 1, Res)

It's important in the fact that it supplies water to the town. (W, 4, Civ)

[Last year] it started out moist and then it just dried up... It does happen every now and then. It was a little harsher than usual, maybe not unusual that it does normally get dry in July and August, but there just wasn't any rain then, so it didn't finish some crops that needed some finishing. (G, 2, Res)

[We're] just coming out of a tough one [drought] in the past year. (S, 3, Ag)

We're short of water, uh, since about 2002, right in there. (M, 3, Ag)

Last year was really, really bad... the pheasant population took a big hit here last year. The chicks didn't have the dew on the grass in the mornings, and that's where they get most of their liquids from. (M, 1, Rec)

Yeah [I worry about drought]. It seems like things kind of are more variable than they used to be. Getting extra rain or extra drought kind of in different times. (D, 3, Rec)

The Yellowstone's not anywhere near the river it was 50 years ago when I first came to this country... there's not anywhere near as much water... I don't know whether the municipalities are taking more, or whether there is just not as much there to take. I know I'm seeing boulders that would have just scared me to death if I had known they were there 20 years ago... Once the flood's over, it drops right down to pretty low levels. Part of that I'm sure is due to irrigation, because once the flood is done, then people start taking water to irrigate. And... I farmed at one time. And an irrigator—it don't make any difference how much of that water he uses, if he's got the right to use it, he's gonna take it all. (B, 3, Rec)

We have seen such a decline in groundwater because of the transition from ag use to urban/suburban development, and it's really profound, you know, a lot of these wells are going dry. It's affecting somebody's yard to irrigate it, to people like me who have a lot of money tied up in nurse stock that we have to keep watered, so yeah, I'm very concerned about the drought and the possibility. (R, 3, Res)

Fires are always on everybody's mind (B, 5, Civ)

I don't... as far as preparing for it, no... I don't think you can do anything. Make sure your fire trucks are full of water is about it, about all you can do. (S, 4, Ag)

Planning or preparing? You know, I could put in collection tanks for the water here, but I don't need to. (C, 4, Res)

I didn't realize how exposed and vulnerable we are... there are moments in time that our community doesn't realize where Public Works is out there scrambling to keep water fed into the system. And there is literally a window of 8 hours of water reserve that we have for community right now. So, if the intake goes down for an oil spill, for example, or mechanical failure or whatever it is, there's a 4 to 5-hour window before water starts to shut down and we're out of water at 8-9 hours, give or take... So, we're involved in a project right now that has identified a significant area to create a water reserve... that would allow us to bank, so to speak, 8 to 9 months' worth of water and provide a secondary source for the community. So, it's a big deal in terms of just protecting future growth for our community, but also just the existing population that we have. (R, 3, Res)

Water Quality and Pollutants: From concerns about debris and litter, to salinity, to agricultural runoff, to municipal stormwater runoff, to sewage and wastewater, to the spills and waste of mining, oil, and other extractive industries, the residents are beginning to wonder about water quality issues:

There was one instance this summer, I was guiding, there were four or five of us guides, and then we all had clients... We pull over for lunch, and one of the fishermen in my buddy's boat took a beer bottle and threw it over his shoulder

onto the beach... We all just kind of looked at each other... and my buddy Jeremy was like, 'I'll go get that.' ... And another one of my friends that was guiding, he was like, 'Hey, bud... How would you like it if someone came and threw a beer bottle in your office?' ... So we try to keep it clean, because we're trying to impress people with the area so they come back. (P, 5, Rec)

It's questionable [the water quality]... I'm catching pretty strong salt out of the Powder... When the Yellowstone's high it gets diluted enough, but when it gets smaller in the fall of the year, if the Powder is running decent and the Yellowstone is low and clear, it's dirty on this side and clear on the other. (T, 1, Ag)

I believe the city [of Billings] is doing some big changes to both their storm water, their sewer, and their water plant right now... [And] what's prompting it is DEQ is saying you can only put so much back into the river. If they actually got their way we would be putting our own water back into the river. Why would we do that, just why not pump it back up to the water plant and send it back through? (Commissioners, 3, Civ)

When I first was here [in Columbus], we didn't have the sewer lagoons, you know, so, at that time, the raw sewage actually went into the Yellowstone, and I'm glad they cleaned all that up. I understand rivers do clean themselves... but this is a much cleaner way to do it... They monitor us quite closely on our effluent system... which is fine. You know, that has to be done well. (W, 4, Civ)

That's very pressing, and we're ramping up our wastewater treatment plant [in Livingston] to bring that up to code, and that's so important to the Yellowstone River that I want to be able to... literally put my cup there and drink it, and we can... I actually think one of the breweries... will brew beer from the effluent that comes out... [And] the system was antiquated back in the 70's, and then you know we're just right on the fine edge of what DEQ was allowing us to do and stuff... [It was] aging and capacity. We weren't at capacity yet, but with what's projected on the hill, we will be able sustain the town at 10,000. I believe 10-12,000 (S, 5, Civ)

And I think the worst thing I could think of that could happen around here is our five-acre tracts out south of town. It's all on wells, shallow wells and septic tanks. Someday that's going to get polluted. Somebody's going to get sick, and it's going to get into the city water. The city has wells out that way... All the while there's still wells out there that were hand-dug that people are using. (D, 5, Res)

Probably for Billings, the storm runoff would be a factor... any of those dark spots in a parking spot are probably caused by motor oil or antifreeze that's dripped off a vehicle. And the water always runs downhill, so I'm sure some of that gets to the river... and I don't believe any of that water is treated before it gets to the river, so. (D, 3, Rec)

As of yesterday, there's no mining in Paradise Valley for 20 years. There will be a bill sponsored in January I believe to make that forever. And I think that will be a big thing... and it didn't matter, Gianforte, Zinke, Tester, they all agree. It doesn't matter if you're Republican or Democrat, they all agree that Park County and the Yellowstone Park is a pretty special place, and there's no mining in Park County up the valley... I mean Governor Bullock fished the Yellowstone River a lot, a lot more than he wants to tell you [laughs]. Daines fishes the Yellowstone River a lot. I've had dinner with Daines at Rib and Chop House after he was fishing. I think it's a special place, yeah. (T, 5, Civ)

We had a lot of oil on our property when the oil spill happened... we had probably fifty acres that got covered in oil... When the oil came in and the water went down, the oil stayed and so that was interesting to say the least... Even as recently as last year, which would have been six years after the oil spill, thereabouts, you could walk down through the riparian area and still smell the oil. (W, 3, Res)

[After the oil spill] we ended up having to sue them... and I'm not satisfied with it... They basically ceased all cleanup activities on our place, pretty quickly... They said they'd re-farm the field for us and plant whatever we wanted there... What they did, is they brought in a mine reclamation crew, not farmers... and tilled the soil about 18 to 24 inches deep... So, they brought entirely sterile soil to the surface of a 25-acre pasture that we count on. And nothing grows there anymore... there is not enough nutrients in the soil to support the plants... I imagine we're going to struggle with that one for probably all of my life. When you think about how long it actually takes to build topsoil, I mean that's millions of years, not a couple of decades. So, you know my best hope with the areas that were damaged by Exxon is that we can just work on just building the soils I guess. I mean that's really all we can do. (S, 3, Ag)

Birds, they're really taking a hit... used to be piles of red-headed woodpeckers; now... there's about two or three woodpeckers in trees and that's it... Used to be thousands of bobolinks... the other day I... was riding out there, I maybe seen five or six. And the meadow larks, they used to be thick everywhere. There's not hardly a lot of meadow larks now... Everybody tells me it's the spray us guys are using. I said, 'Alright, I want you to explain this to me. Go out there twenty miles to the reservoir, ain't no frogs in it; nobody sprays there.' Well, frogs lay their eggs in the water. And when that sun... I don't know. But they're gone... Another thing that's gone are the bees... And I kind of consider that the spray... Probably. Because you know, they're out in the daytime, and guys spray, and then that kills them immediately... that's what I attribute it to. (H, 2, Ag)

Noxious Weeds and Invasive Plants: Knapweed, Russian olives, and thistles seem to dominate conversations about noxious weeds and invasive plants:

Russian olives grow heavily down there, which we have been trying to keep under control for some years now, along with some other noxious weeds... We have

some spotted knapweed down there, a little bit. Every once in a while, we'll get a lot of Canadian thistle and cockleburrs that I like to get those out (C, 2, Ag)

You know, we really do need to do something about the Russian olives because that's taken over a lot of the grazing down there. That's a mess. (M, 2, Rec)

We've tried to pay attention to the knapweed and the bad stuff. If you're Canadian, if you're patriotic, it's Canadian thistle, and if you're unpatriotic, it's Russian thistle. (W, 3, Rec)

We've been vigorously attacking – it was terribly infested with weeds, particularly knapweed and Russian Olives, so we've aggressively hit that last year and we're going to aggressively hit it again this year. (G, 3, Rec)

Riparian areas are a mess, they're ruined, there are weeds everywhere... leafy spurge... thistle. (Anonymous, 4, Ag)

I'll be removing Russian olives probably for the next fifty years of my life if I live that long. I like them, the wildlife likes them, however they just, they've taken over. My attitude has changed significantly in the last ten years... Since we sold our cows probably seven or eight years ago, and since we haven't been grazing it, we've been trying to manage it more for wildlife. It's just amazing how the Russian olives are just taking over. (W, 3, Res)

You can do everything right on your ground, but whatever people are doing upriver will eventually affect you. (S, 3, Ag)

It's harder to deal with the cheatgrass in drought conditions, because a lot of years you don't cut it and if you can cut your hay, dryland hay... every year it helps cut down on it. But if you have like a lot them drought years where we didn't even pull a machine into the field, then the cheatgrass gets carried away. (S, 4, Ag)

We spent another two years vigorously trying to get rid of Russian olives, and we probably got rid of 80% of them, but not all. And it's a continuous battle. (G&W, 3, Rec)

We use sheep to help with the weeds, not spray... I stopped using Tordon after I almost killed a tree in the yard. I probably used too much. You know, 2-4-D is essentially Agent Orange, and the effects don't show up for 30 years... We use sheep and bugs. (Anonymous, 4, Ag)

Well, the best thing on the river bottom is sheep. And the neighbor has sheep. And it used to be just horrible down there; I mean the spurge would be that tall. And he's grazed sheep on that for the last 20, 25 years. And I mean there's a plant here and there... the sheep aren't as good on the spotted knapweed, but animals are the best way, because you're not supposed to spray for it on... places where water... because it'll cause fish to die because they can't breathe... So, animals are the best

because they can get everywhere, you know... those sheep travel back and forth, up and down, and we don't have much spurge up here on top. There's a few spots here and there, but that isn't so bad to... just spot spray... So, animals. Another thing is goats are really, super good. And that would be the best thing to have, you know, a bunch of goats down on the river bottom because... they would clean up the spotted knapweed in addition to the spurge a lot better than the sheep do. (S, 4, Ag)

We had the sheep come in that time and eat the... leafy spurge... And that didn't work out too well... And we used the... bug from Russia I guess they were supposed to be or something, some kind of a bug that we would put with them. They ate the leafy spurge... it's kind of tough to get with a spray... but we try to keep ahead of it by spraying and chopping and all the other things in-between. (M, 4, Ag)

We need to bring in someone to farm [and] to control the weeds... If you're a billionaire, you can do a better job. Tom Brokaw has resources to do stuff I don't... billionaires have the resources to treat their land very well... Anything is possible if you have the financial resources... they could restore it. (Anonymous, 4, Ag)

I know they're trying to get rid of them [Russian olives]. That's another one of them things that's never gonna happen. Not in my lifetime. (B, 3, Rec)

Summary

We note that there is still a dearth of conversation wherein participants use the terms “riparian” or “river corridor.” However, the participants are, clearly, attentive to the river and its immediate environs in terms of recreational activities, fisheries, and wildlife. From jetboating to rustic overnight campouts, the river and its islands are mainstays of recreation. The participants discussed river access as an issue throughout the valley, and new boat ramps are greatly appreciated. They cautioned other recreationists to put safety first, and fun second.

They described an abundance of fish species, but they also noted the new up-river migrations of some warmwater species. Some stated that the fees for fishing could be raised without excluding fishers. The fish-kill in 2016, in the upper river, remained a concern to participants from the Livingston area. Their theories about why the fish died varied. Near Glendive, efforts to save the Pallid sturgeon are still a topic of conversation, but not necessarily visceral in tone.

Participants associate many species of birds with the river. Their comments suggested a significant increase in eagle populations, and perhaps blue jays. However, they noted apparent declines in pheasant populations, which several people believe is a result of drought and dewless grasses. Many discussed deer as abundant, but seemingly susceptible to “blue tongue” disease. Access for hunting purposes has diminished, but

the block management program is mostly regarded as helpful to hunters and to landowners.

Some participants reported no concerns regarding cottonwood trees, but many others noted the apparent lack of young or seedling trees. Many people reported that seedlings appear in locations where flood waters have receded; however, the necessity of flood inundation is not necessarily expressed. They reported that beaver, deer, squirrels, disease, and bank erosion are detrimental to the forest, and that livestock grazing was especially devastating to young cottonwood stands.

Other topics commonly discussed include water availability, drought, water quality, pollutants, noxious weeds, and invasive plants.

Reactions and Comments Relating to the Cumulative Effects Study and the Yellowstone River Cultural Inventory

Introduction

Given that the 2018 Yellowstone River Cultural Inventory (YRCI) builds upon a larger effort that began in 2006 as part of the Cumulative Effects Study, our conversations with the local participants often included discussions about the broad array of data that were being gathered or had been gathered under the umbrella project. The purpose of this section of this report is to provide a few examples of conversational “moments” where the Cumulative Effects Study (CEA), the channel migration zone (CMZ) maps, and the Yellowstone River Cultural Inventory (YRCI) were in clear focus on the part of the participants. The perspectives offered here reflect a variety of perceptions, concerns, and hopes for these efforts. This information may be useful in guiding the use of data already collected and the design of future data collection efforts.

The Cumulative Effects Study and Related Efforts

Some of the participants had been directly involved in the Cumulative Effects Study via the Conservation District Council (CDC), and/or they were serving on the CDC in 2018. Here are four examples of their comment, each revealing with interesting insights:

Example 1:

Interviewer: As you reflect back on your time on the council, are you glad you were involved in that?

Participant: Sure. I thought we got things done... Spent a lot of money... And we got a lot of stuff going, and I thought it got to be where the next step is... I just didn't want to go beyond you know... [And] what's the name of the guy... Don. Don Youngbauer. He was good for that, I thought he was really good for the council. You know he could talk, and he... made all of us think, 'Yeah, we're gonna do this!' Then when you get there, nothing gets done... I wanted to see them put something together. You know, they talked, and they were going to come up with something, and then we were going to put it out. Maybe they did? ... But we did do a lot of good things, like we had the river mapped. You know, they flew the river and that was... people use that map yet. And all those maps that were made, that all came out of the river council, pushing that... And those were all generated by the river council, kind of. (B, 1, Ag)

Example 2:

Interviewer: So, you're serving on the Conservation District Council now, what's your motive for doing that?

Participant: Well, when I started on there, I was talked into it, and it was because they were using federal dollars to study the cumulative effects of everything, basically, on the Yellowstone River System, and as a requirement, they needed interests from not just farming or not just industry and not just outdoors, so they had to have a variety of people sit in on it. And people that kind of knew about the river a little bit. So I got talked into that, and I've stayed on because I think it's a good organization to be involved in. It feels good to try to get a little input with it. But the hardest part now, you know, they've got a lot of information. It's just like anything else, the next step is usually, always the education of the people that are impacted by it. And I think that's... We've talked a lot about that. That needs to be the next phase of that. (W, 1, Res)

Example 3:

Participant: As you know, for 20 years we've spent a lot of time working with the conservation districts along the Yellowstone River. They had a very good effort of trying to understand ecological factors of the Yellowstone River, and it was a good education, I think, for the members of the conservation districts, but it also did some positive things relative to proposing policies that would be more harmonious with taking care of ecological systems on the Yellowstone River. That's an educational thing, so education is a big part of it... We have got good data. We can always get more, that would be helpful. It's available to the public, that's a positive thing. There is still some discussions going on.

Interviewer: What's your hope for what was learned?

Participant: Yeah, with the millions of dollars including the money that was spent on the upper Yellowstone, that was another \$3 million that we spent up there, which has ended up on reports on shelves in somebody's basement. The good thing about the studies we have with the conservation districts on the entire length of the Yellowstone in Montana is that they are very available for public review and use, so they are not sitting on the dark shelf in somebody's basement, so that's a positive thing. I think that the opportunities for units of higher education to focus more on the application of some of that research we have on the Yellowstone is really good. I think that... I would not count on the conservation district providing a lot of leadership. They are very conservative; they're too stuck in their ways. They did some good work, but it was slow and plodding, and where they've done some good things, where there is meaningful benefits for agriculture like getting rid of Russian olive, you could count on them to do some stuff. But really thinking about the long-term future of the comprehensive aspects of the Yellowstone River and its watersheds, I don't think we're going to see that. (P, 3, Rec)

Example 4:

Interviewer: So, the Corps of Engineers helped sponsor—and the state, and local money, too—the big cumulative effect study. And, what do you see as a result of that?

Participant: It was an awful lot of money... I've had some heartburn over how much money was spent on this Cumulative Effects, this whole study. I think it was way too money spent and I think there was a lot of, uh, we've got a lot of awful good data out of this program. But at what cost? ... I don't know what's ever going to happen with all of the information that we got off of this... It's going to be a crying shame if those two big 10-inch stacks of material get stuck on a shelf somewhere and never looked at again. If we can come out of this, out of the backside somewhere, where we're getting to where the government agencies can go to this wealth of information and use it in some way, shape or form that's productive, it'll surely make me feel a lot better... It's nice to know that this flock of birds travels this part of the river, migrates through there, and what species of fish are hanging in what stretch of the river, it's all good to know, but at what cost did that cost us to know that information? Did we need to know it that bad? The taxpayer dollar, could we have maybe used it more efficiently?

Interviewer: So, what would your ideal circumstance be with that information then?

Participant: Well, I don't know... They've shrunk that whole group down now to where it's pretty much a bare-bones group, and they're looking for ways to get it implemented. And coming out of there with some information that can end up on computers and try and get it simplified down where okay, say we have a project... Let's just say, the Burlington Northern Santa Fe is going to put a double set of tracks somewhere down along the river's edge, and, so, their engineers are wanting to know a little more in-depth study for their environmental impact statement. Maybe they could go to this if they could ever, if we could ever get it broke out where it was simplified to where, okay, this reach of the river, we can go to page 896, section 2 and it's going to tell us something that we need to know. Maybe they can use it to help further their environmental impact statement. Or maybe Canyon Creek Ditch Company is going to put in a new head gate and maybe that will help them to figure out how much, let's say their soil is less dense where they're wanting to put this new head gate, say they're moving it half a mile up the creek or something. Those kinds of things would be very helpful... And as an overall view of it, I don't know how much help it's going to be as an overall view, I think it's going to have to be broke down into site-specific stuff. (S, 3, Ag)

Some participants offered similar perspectives even though they were not directly involved with the Conservation District Council (CDC):

[A friend of mine] he's on that board... And one time he said, 'Maybe I better quit because we're not getting much done.' But I said, 'Well, you don't want to quit... Keep it going if you can.' (D, 2, Ag)

It's very interesting because DNRC did a study on the Yellowstone River, I don't know if you've had an opportunity to see that study... It's interesting because we take railroads, highways, and irrigation projects [as] just a way of life, and we don't pay much attention to it. Well, this study showed that where the railroad and the highways narrowed the channel of the river. And... it was very, very interesting because the normal citizen just wouldn't pay attention to that stuff. I mean, who cares? We're too busy trying to make a living and pay our mortgage and our car payments and put our kids though school and put food on the table and clothes on our back. To me, that's what I see with a lot of our citizens, is they are so concerned about everyday life things that some of these issues are just not relevant. But that study opened my eyes a little bit because I travel a lot from Miles City to the western part of the state, and when you drive though Reed Point and that area there, especially between Reed Point and Columbus, when you cross the Yellowstone and see that the channel, how it narrowed it down, and I stop and I think about, well the old Tusler Bridge, the old Milwaukee Bridge east of town kind of did the same thing. And actually, if you stand back a couple of miles, you can see it. So, these are manmade, and the study was basically an awareness that we have channeled the river down, and in a lot of respect though, there hasn't been a problem with that. (E, 2, Civ)

It has become moot, and it isn't even accessible... By the time they get all that material gathered up, it's obsolete. (O, 5, Ag)

In another example, the interviewer probed to see if the person—not involved with the CDC—had heard about the overall work that was done:

Interviewer: Are you familiar with the Yellowstone River Conservation District Council?

Participant: No, I am not.

Interviewer: Okay. How about the Cumulative Effect Study from the U.S. Army Corps of Engineers? They started that I think in 2005 or 2004.

Participant: Okay, I've heard something, but I don't know anything about it...

Interviewer: Would that be stuff you're interested in?

Participant: That would be interesting to know more about it, for sure. You bet. (L, 4, Res)

One participant mentions a citizen-led initiative to act on the data collected through research efforts, including the CEA:

What we tried to do is take the governor's report and go say okay, so they've done nothing. The agencies have done jack shit with this information. DEQ is going to do their next TML when? Maybe next year. Well, do you have baselines? No, we're probably two years out from having, you know, baseline controls. I'm like okay, this is moving rapidly. So, we brought all these scientists together, and we said, you know, instead of you bringing us together, we're going to bring you together and you can look at it. So, we had, if you just look through the agenda, we started by basically really going through the Cumulative Effects Analysis and then we brought in experts for land use, economics, and whatnot...I tell this to locals, it is not the government's job to keep our water clean. It is our job to keep our water clean. It's the government's job to, you know, execute on any laws that we get them to vote on to do it. But, yes. We should use some of our tax dollars to do this stuff. But if you're going to wait around for DEQ, if you think DEQ's job is to keep your water clean, you are going to die in Flint, Michigan. So, we had them in. We [explained that] we did this big citizen science project. And I'd say every first response [from the agencies], minus a couple, were really skeptical. Every state agency, USGS, DEQ, you go through it. [When we had] the second conversation, there was piqued interest. The third, they're involved—like they're actually working with us. So, we're working with USGS, you know, they have much more expensive labs, for example. (R, 5, Rec)

Channel Migration Zone Maps

As a primary product of the CEA, at times it was revealing to inquire about participants' understanding or uses of the CMZ maps. Among the participants who had been involved with the CDC, they expressed general satisfaction that CMZ maps were useful, and one seemed to hope the maps were being put to use:

Example 1:

I don't think we're going to lose a lot [more land]. In fact, I'm on the Yellowstone River Conservation District and there's maps, and we are one of the most iron clad acres on the Yellowstone right where we're at. (S, 4, Ag)

Example 2:

Interviewer: So, you've seen those maps that the Conservation District Council has?

Participant: Hu-uh.

Interviewer: Are we doing a good job of using those or getting those in the hands of people, so they make good decisions?

Participant: I don't know. I think that the people that are doing the planning at the county levels probably need to be using it as much as anybody, especially in the higher populated areas. Billings, Yellowstone County. And they may be using it some, I'm just not aware if they are. (W, 1, Res)

Unfortunately, many participants, across interest groups, were unfamiliar with the CMZ maps:

Example 1:

Interviewer: Have you looked at those channel migration maps that the conservation district has?

Participant: No, I haven't.

Interviewer: I know they're a product of the larger effort here, and they show where they think the channel is going to move.

Participant: Oh, really? (S, 1, Ag)

Example 2:

Interviewer: There are some other people that are doing the physical part of the river, and we now have a set of channel migration maps. Have you guys seen those?

Participants: No. (V, 1, Res)

Example 3:

Interviewer: As the City Planner, are you working with the maps that they did for the Yellowstone, the migration map?

Participant: I do receive them. I haven't worked with them intimately on those. (H, 1, Civ)

Example 4:

Interviewer: So, have you ever seen photos or maps of where the river used to be?

Participant: The only ones I've ever seen that were old were the ones that they did when they were trying to figure out where Lewis and Clark camped. (G, 4, Res)

Example 5:

Interviewer: Have you ever looked at the channel migration maps that the conservation districts sponsored?

Participant: Yeah... My understanding, about every river wants to go west... Is that correct? Every river wants to come to the west side of the bank... And that's what we're seeing, you know, all over Park County. (T, 5, Civ)

Yellowstone River Cultural Inventory

The 2018 data collection effort yielded comments and insights on the YRCI research, itself. New participants, and those who had also previously been interviewed, found ways to ask the field team about the effort or to comment on the YRCI effort:

Example 1:

So, I'm asking you a question: why are you doing this? What's the motivation for this, and who's supporting it besides the University of Missouri, right? It's research? (K, 4, Civ)

Example 2:

Interviewer: Well, that's a great interview, thank you... It's really important to us to collect the thoughts of a lot of different people.

Participant: What are you doing with it then? (S, 1, Ag)

Example 3:

Participant: May I ask a question first?

Interviewer: Yes ma'am.

Participant: Why are we doing this? (M, 2, Rec)

Example 4:

Participant: I was wondering what you were doing.

Interviewer: Well, you know, the original sponsors, we had a bunch of people involved in it originally, and they all said, 'Really, it's

been 12 years? You ought to go back and talk to people again.' So, we are not doing near as many interviews as we did the first time.

Participant: So, are you finding much change?

Interviewer: It depends on where you are on the river [and] we've only been here two days. We've got three more to go, but this conversation sounds pretty familiar, but I would say down in eastern Montana, it's changed in terms of what they're talking about down there.

Participant: I suspect that... What's the change down there? (B, 5, Rec)

Example 5:

Interviewer: Do you have any questions for me or for us, or anything like that?

Participant: Um, you know, I don't know a whole lot about what you got going on here, but I accepted the call... And I'm intrigued because I would love to see what bubbles out of these conversations. I really would. (B, 5, Civ)

Example 6:

Interviewer: What do you like best about that, being near the river there at that piece of property?

Participant: And I knew you were going to ask this question. I just asked my grandchildren that, because I figured that that was going to come up. (M, 2, Rec)

Example 7:

So, what have you seen in the change in the wildlife on the river? What do you guys [researchers] think? (D, 2, Ag)

Example 8:

I appreciate you, and I appreciate having this chance to talk about it. (K, 4, Civ)

Example 9:

Participant: [directed to the students] So, what are you going to be doing? Interviewing?

Interviewer: Well, they are sitting in on interviews, and I'll make them do a little bit of interviewing when they get a little more comfortable. Then they are going to be looking at some of the transcripts from people in different groups and looking at where are the possibilities for overlapping interests and where are the disconnects. Maybe we'll diagram that. I'm not sure what the product will look like.

Participant: That would be helpful—if you could see some trends there. (P, 3, Rec)

Example 10:

I would love to see your work. We'd love to post anything that's kind of focused in Park County area, we'd love to post it on the UpperYellowstone.org website. And then we communicate that at local meetings, and then people go back there. (R, 5, Rec)

Booklets of the 2006 efforts had been distributed to dozens of the participants in the 2006 YRCI. So, among our recurring participants we were curious as to their familiarity with the YRCI findings and products. Their answers varied markedly:

Example 1:

Interviewer: Do you have any questions for us?

Participant: Not really. I have to admit, I got the books that... [you] put out, but I haven't really looked at them. (R, 4, Res)

Example 2:

I think the principle thing that you identified with your previous study was how to go about balancing the wishes and the priorities of individual landowners, who I think have the legal high ground, legal and historical high ground, with changing needs of local municipalities, cities, towns, and counties, along with nonprofits such as YRPA who would like to see a more thoughtful and effective development of facilities along the river to improve the quality of recreation enjoyment. And it's going to take years and probably decades of thoughtful and respectful negotiation. Probably with starting with individual segments and then moving up and down the river, I don't think it would be feasible in one large lump; it would just be too much for any group to do. But cities and counties and towns, have to be willing to throw some of their taxpayers' resources at it, in addition to nonprofits. And with time and persistence and respectful negotiation,

improvements will almost surely accrue, but nobody will be completely happy. (G&W, 3, Rec)

Example 3:

I think... this is something that should be documented. We just have a hard time releasing of too much information about it because the more you release, the better chance you have of spoiling it for our next generation. But somebody should hear about it too. So, it's a catch-22, I guess. (D&P, 2, Rec)

Example 4:

Participant: And while you're here, have you interviewed any commercial guides or anything?

Interviewer: We did! Just before you.

Participant: Oh, okay good, because I want them to be heard. (S, 5, Civ)

As one last example, we quote a person who appeared to be pleased we had taken an hour to collect *his* thoughts:

I remember one time, somebody came up with the idea of studying the Yellowstone River. I went to some of the meetings, and I was really discouraged because it was all agencies and students, and they left out the 105 landowners from border to border in this County and I was kind of not real happy with that. Because a lot of the decisions were being made on their behalf, and they were not contacted. And that kind of bothered me. But that's alright. Life is life. (E, 4, Civ)

Summary

Participants' comments about the CEA, the CMZ maps, and the YRCI reveal these conclusions: 1) folks with direct involvement with local CDs assume (or hope) the CMZ maps are being used; 2) even those involved with local CDs fail to mention other research products or conclusions of the CEA; 3) beyond those folks directly involved with local CDs, familiarity with the CEA, or the CMZ maps, is quite limited, 3) the interview approach taken in the YRCI resonates with valley residents; and 4) follow-up YRCI interviews are viewed as additional opportunities for thoughtful engagement with managing agencies.

Chapter 2: The Staying Power of Perceptions in a Dynamic System: A Longitudinal Stakeholder Analysis in The Yellowstone River Valley

PREFACE TO CHAPTER 2

I assisted in the analysis and summarization of the 2018 summary report, and began to cultivate an interest into deeper analysis of the YRCI data. I recognized several similarities in the voices analyzed in the 2012 and 2018 YRCI Summary Reports to those that I grew up hearing in my small town, categorized as a village, in Missouri. Those whose livelihoods are tied closely or directly to the land have a unique relationship to the environment; a relationship that interests me and I have observed for much of my life. This, in combination with the work I provided to the YRCI comparative report, provoked questions and curiosities about how individual participants change over time, inspiring the development of Chapter Two's work, the second article of this thesis project, "The Staying Power of Perceptions in a Dynamic System: A Longitudinal Stakeholder Analysis in the Yellowstone River Valley.

1.0 Introduction

Rivers, as a shared resource and a hazard, are complex systems that necessitate transdisciplinary study—both multi- and interdisciplinary research as well as stakeholder-engaged research—to manage the dynamics. Scholarly pursuits have cumulated in transdisciplinary fields of Integrated Water Resources Management, Water Resources Systems Analysis, Social-ecological Systems, Complex Systems Science, Coupled Human-Water Systems, and Socio-hydrology that seek synthetic understandings of dynamics within inherently coupled human-water systems (Di Baldassarre, et al., 2019). Among the emerging fields with more explicit inclusion of people (Srinivasan, et al., 2016), socio-hydrology seeks to understand, interpret, and predict how water management decisions and actions affect patterns and phenomena that emerge from two-way feedbacks within human-water systems (Roobavannan, et al., 2018). Socio-hydrology involves assessing social and even cultural dynamics, because understanding people, and systems of rules, norms, and habits that govern behaviors is vital to management (Eaton, et al., 2019; Masterson, et al., 2017). Understanding processes and predicting future scenarios in integrated human-water systems requires knowledge from experts' diverse disciplinary trainings as well as the lived experiences of stakeholders with different vocabularies to be synthesized (Troy, et al., 2015; Wesselink, et al., 2017; Xu, et al., 2018).

Socio-hydrology is criticized as performing the hydrology research better than the socio work (Konar, et al., 2019). Several researchers suggest that socio-hydrology can benefit from place-based tools and methodologies found in socioecological systems and complex system literatures whereas the social and cultural data can match the depth of the

physical research (Blair & Buyteart, 2016; Troy et al., 2015). “Place” has long been described as rooted in experience, replete with apparent ambiguities, definitions of place have focused on the combination of location and meaning: places as locations with meaning (Cresswell, 2013). Place-based research involves understanding the lived experiences of space, time, and personal experience—versus strictly the technical dimensions of space (Rogers, Castree, & Kitchin, 2013). Roobavannan et al. (2018) argues that although predictive confidence in place-based models will be low, there is still a need for social research that matches the temporal scale of physical research.

Under socio-hydrology frameworks, managing water systems benefit from understanding social system dynamics. One source of information about social behaviors in riverine systems are riverfront landowners, particularly for those who work the land and depend on its waters, they are vested sentinels of the river. Riverfront landowners shape riparian lands and have great capacity to influence physical features of hydrological dynamics (U.S. COE & YRCDC, 2015). Landowners’ place-based expertise also provides insight into social dynamics of locally held opinions and insider knowledge of physical and political dynamics that otherwise would not be available to external researchers (Pouladi, et al., 2019; 2020).

Including stakeholders in management efforts is fundamental to increasing the capacity of local users to conserve water supplies and create innovative, equitable, effective, and widely supported strategies to meet the demands of various interest groups (Baldwin & Hamsted 2014; Martinez-Sontos, Aldaya, & Llamas, 2014). Most in-depth place-based hydrology studies are snapshots in time. Yet, hydrological systems are dynamic, operating on multiple spatial and temporal scales (Sivapalan et al., 2014). To

advance socio-hydrology, there is a need for social and cultural research that has longitudinal social validity.

This study utilizes interview data collected over a 12-year time span concerning the hydrological and social dynamics of living along the Yellowstone River reach in Montana. The study is based on panel interviews with 15 individuals from the valley, each of whom were interviewed in 2006, 2012, and 2018 to analyze the social-cultural dynamics of this system over time. Riverfront landowners were interviewed because they represent the actors with a larger capacity to shape the physical features of this system. This study takes a scholarly approach to expressed participant concerns as empirical evidence that reflects the socio-hydrological phenomena occurring in the Yellowstone River Valley. Special attention in analysis is given to how participants expressed understandings of the physical processes (flood, drought, and erosion) and how they say it should be managed. The benefit of a panel interview—engaging the same stakeholders the same interview questions in 2006, 2012, and 2018—affords attention to patterns of change over time concerning stakeholders’ descriptions of riverine processes. Understanding how these 15 stakeholders conceptualize this system over time allows managers to better understand the potential utility of the Yellowstone River Cultural Inventory data in producing long-term plans that are more democratic and better adapted to local conditions (Reed & Bruyneel, 2010). Ultimately, this study aims to bring clarity to the place-based phenomenon taking place in the Yellowstone River through a longitudinal comparative analysis.

2.0 Social Dimensions of Socio-hydrology

Socio-hydrology is one of the most recent trends in water resource management. This discipline builds upon historic approaches to Water Resource Systems Analysis (Brown, et al., 2015), Integrated Water Resources Management (GWP, 2009), and other recent interdisciplinary frameworks such as Social-Ecological Systems, Coupled Human-Water Systems, and Complex System Science (Walker, et al., 2004; Consens, Gunderson, & Chaffin, 2018; Gohari, et al., 2013). Socio-hydrologists understand that we cannot understand, let alone make future predictions of water resource system dynamics without understanding how social issues of economic gain, environmental degradation, and social inequalities play out in society, and how they impact management decisions related to water consumption, allocation, and the valuing of human settlements, infrastructure development, and environmental protection (Roobavannan et al., 2018).

Sivapalan and Blöschl (2015) frame socio-hydrology in the context of co-evolution of human-water systems, with explicit inclusion of human agency in the form of changing human norms, values, and culture. They proposed a study approach of emergent phenomena based on narratives, causal loops, and the development and testing of models using available time series data. They suggest that the first step in framing and modeling human-water interactions is to develop general statements of the phenomenon and setting boundaries for the problem, both in space and in terms of governing variables. The phenomena are often obtained from narratives presented by stakeholder and experts from varying disciplines. These narratives should capture the diversity of values and preferences held in the community. The narratives contain emergent dynamics, patterns, and paradoxes that result from long-term coevolution of couple human-water systems. Phenomena may be generic (i.e., levee effect, adaptation effect, etc.) or place-based

which reflects the unique characteristics of a place and its water history. Narratives have the potential to capture components of culture, i.e., values, beliefs, and norms related to water use, livelihoods, and the environment (Sivapalan and Blöschl, 2015). There is a need for thorough and reliable narrative field data to create reliable place-based models. (Lu et al., 2018; Roobavannan et al., 2018; Sanderson, 2018; Srinivasan et al., 2017). These field data are taken from conversations with community members and, as texts, are commonly qualitative in form. And when these studies cover large geographies, these data are often a single field season.

2.1.1 Longitudinal Qualitative Data

Driven by logistics, resources, and funding cycles, most qualitative studies provide a snapshot of a phenomenon at the time of the research. Alternatively, longitudinal methods expand qualitative perspectives by allowing for a consistent and ongoing approach to analyzing developments (Flick, 2014). This allows researchers to understand change and the aspects that manage or affect that change (Neale & Flowerdew, 2003). A single longitudinal study can result in many publications due to researchers ongoing process of research over time, allowing for ongoing analysis in multiple views (Derrington, 2019). Change, as the primary observation of longitudinal studies, “is a process not an event” (Hall & Hord’s 2011, p. 8). It occurs gradually over time and describes the learning process of individuals as they adapt to change.

There are many challenges to longitudinal studies. Derrington (2019) notes the primary challenges are (1) Participant attrition: the longer the study, the more likely unanticipated events might interfere with the research; and (2) the issue of time: longitudinal studies take a long time and are sometimes unrealistic for funding agencies or

scholars under pressure to publish. Therefore, Derrington (2019) advises that knowledge of the context, topic, and participants assists the qualitative longitudinal researcher in anticipating unexpected events which is necessary to combat participant attrition; as well as frequent communication with participants to allow for efficient and ongoing tracking of participants. To address issues of time, longitudinal study design requires careful, thorough, and intentional timeframe study-design (Derrington, 2019).

Qualitative studies, and particularly longitudinal qualitative studies, are tedious, time consuming, and costly. They require extensive planning and constant analysis and reanalysis. Researchers need self-knowledge and reflection skills to be successful. Thus, strong longitudinal qualitative narrative data is valuable and in constant demand. This study recognizes these challenges and the value of longitudinal research. Hence, an analysis of the longitudinal dimension of the Yellowstone River Cultural Inventory is necessary.

Many people depend on the river to serve their immediate needs including agriculturalists, municipalities, recreationalists, residentialists, and a variety of other local industries in Montana and North Dakota. Jurisdictionally, it is overseen by more than 18 state and federal agencies (i.e., US EPA, US Fish and Wildlife Service, National Park Service, Montana Department of Natural Resource Conservation, Montana Department of Environmental Quality, etc.), conservation districts, city governments, as well as private landowners who own more than 80% of the riparian lands of the Yellowstone River (Auble, et al., 2004). The management challenges presented by the Yellowstone River are local and international. It is politically, economically, and culturally complex.

Over the past 150 years human influences have cumulatively made the river less dynamic and less complex compared to historic conditions. The river's responses to human influence vary substantially by location. In the upper river reaches, bank armoring is a prominent driver of change. In the lower river the most significant impacts occur from shifts in flow patterns caused primarily by tributary reservoirs. Other impacts such as climate trends or constraints imposed by roads and railroads occur on the entire river system (COE & YRCDCs, 2015). As human influence on the river increase, humans act as geomorphic agents in the cycle between humans and their biophysical environment. They change and shape their biophysical environment, and, in turn, their perceptions and behaviors are shaped by their landscape experiences (Gifford, 2007).

3.1 Yellowstone River Cumulative Effects Study: An interdisciplinary study

In 1996 and 1997, the people of the Yellowstone River experienced two consecutive 100-year floods, each damaging infrastructure, homes, and farmland. In the aftermath, scores of property owners requested permits for bank stabilization projects, and the process soon came under scrutiny. It was apparent that permitting did not account for the cumulative impacts of these projects, and a multi-year, multi-faceted research endeavor was launched. From 2002-2015, a series of research projects were conducted in the Yellowstone River Valley, referred to collectively as the Cumulative Effects Analysis (CEA) (COE & YRCDs, 2015). To meet the complexity of this water resource system, research products from this effort document different aspects of change over a 60-year timespan, including river hydrology, hydraulics, geomorphology, fisheries, avian communities, channel changes, and an inventory of human interventions as physical features that intersect the river. They are detailed, both as generalized findings and as specific findings—referred to as Reach Reports.

Another product within the CEA, the Yellowstone River Cultural Inventory (YRCI), collected and cataloged stories about the river to better understand the social complexity of this system. The first YRCI interviews were conducted in 2006, the third of several drought years—and a full decade beyond the flood of 1996. High water concerns were not at the fore in these conversations (Gilbertz, Horton, & Hall 2007). Two additional field seasons were conducted to collect interview data under different conditions: 2012 (post 2011 flooding), and 2018 (a flood year followed by extreme drought) (Fig. 3, 4, & 5) (Gilbertz et al. 2020; 2021). The interview data captured the meanings and purposes behind the nonagency human-geomorphic actors of the valley. They YRCI provides the narratives necessary to describe the socio-hydrology place-based

phenomenon by capturing the diversity of values and preferences held in the community over time.

Offered by the people who live near the river, these interviews documented stakeholders' descriptions of the physical processes of the river, riparian areas, and general river management concerns. Beyond the temporal and spatial dynamics, the people of the valley are connected to place via their personal experience. In the parlance of management, these in-place actors are known as local stakeholders. For natural resource managers to successfully intervene and regulate resource uses and impacts, these managers must grapple with both the material aspects of the river landscape and the symbolic river landscapes as expressed and understood by stakeholders. Through the Cumulative Effects Analysis, managers were able to understand the physical processes of the river and the YRCI project allows managers to incorporate stakeholder perspectives. Including the YRCI project in the COE Cumulative Effects study shows that managers recognize the value in including both aspects of the landscape in natural resource management, the social and the hydrological.

This study is based on interviews with 15 individuals from the valley, each of whom was interviewed in 2006, 2012, and 2018. Our qualitative analysis of the themes and concerns they brought forward allows us to trace the environmental perceptions of river processes and better understand the emergent dynamics, patterns, and paradoxes that result from long-term coevolution of coupled human-water systems. How people talk about the river processes can be used in designing outputs for human-water system models; participants need to see themselves in the model. Our work begins to close the loop that connects humans and the environment: humans respond to natural processes,

natural processes respond to human action, humans respond (again) to natural processes, etc. Our findings offer insight into the cultural responses of this repeating cycle, revealing longitudinal aspects of the place-based phenomenon occurring in the Yellowstone River valley.

4.0 Methods: Research Questions

The first phase of analysis involved interrogating how the 15 stakeholders expressed their understanding of the physical processes of the Yellowstone River as well as how those processes should be managed. For this study, the physical processes of interest were: flooding, drought, and erosion. To capture all relevant information, any utterance that discussed the physical processes, the management of, or consequences of that process were coded in this phase. That included comments such as bank stabilization, water availability, oil spills, and intake. Further analysis analyzed these data for trends and examined how understandings of physical process of the river and their management could be used to inform the emergent socio-hydrology phenomenon of the Yellowstone River physical processes. Therefore, the primary research questions for this study were:

1. How do stakeholders of the Yellowstone River describe the physical processes of the river? In what ways do these **characterizations of physical processes** reflect elements of the place-based phenomenon?
2. How do stakeholders of the Yellowstone River describe how these physical processes of the river should be managed? In what ways do these **characterizations of management** of physical processes reflect elements of the place-based phenomenon?

3. In what ways do these descriptions of the physical processes and their management **change over time**? In what ways do elements of change reveal longitudinal dynamics of the place-based phenomenon?

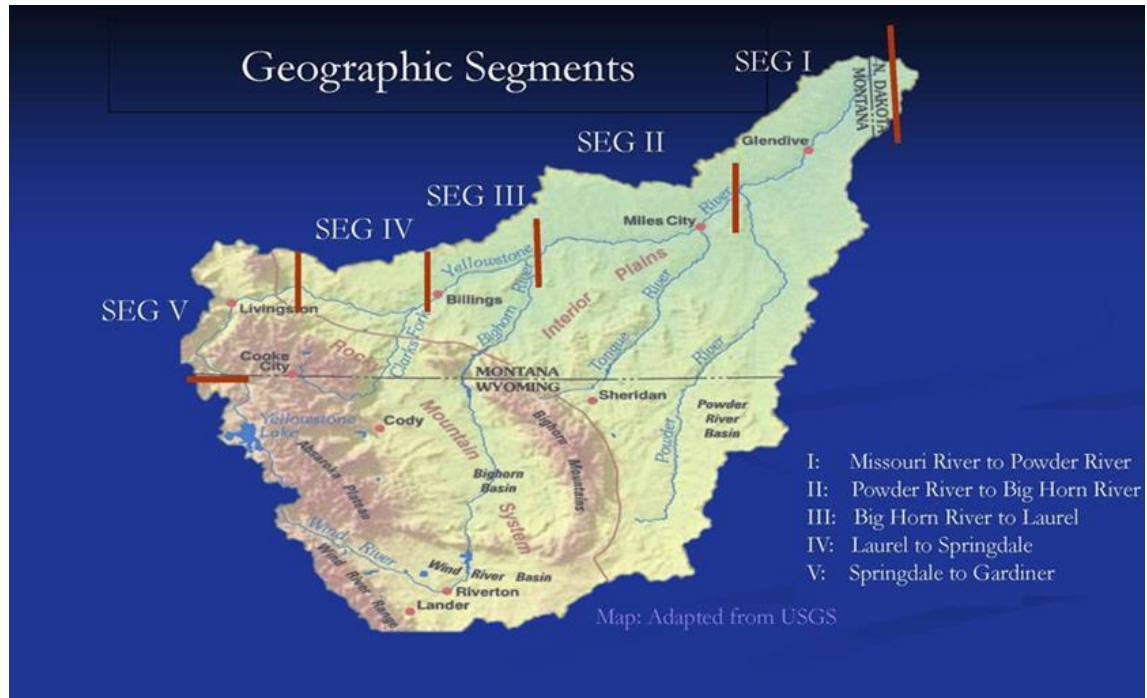
Answering these questions provided us with a better understanding of how stakeholders understand the physical processes of the Yellowstone River over time and what that tells us about the longitudinal dynamics of the place-based phenomenon that is occurring for each physical process. Ultimately, the goal of analysis was to discover the longitudinal value of the YRCI and gain a greater understanding of the socio-hydrology place-based phenomenon occurring on the Yellowstone River over a 12-year period.

4.1 Geographic Extent

The geographic extent of this study is concerned with the main stem of the Yellowstone River, spanning from where the Yellowstone River exits Yellowstone National Park in Montana to the Missouri River confluence in North Dakota. The overall extent was then divided into five geographic segments that were determined through collaborations with local sponsors of the project (Fig. 2). Each segment has its own defining qualities. In general, Segments II and I were more rural areas, agriculture-centered, and concerned with water availability. As you move upriver the segments become more populated, recreation-centered, and concerned with erosion (Gilbert, Horton, & Hall, 2007).

Figure 2

Map of Yellowstone River Cultural Inventory Geographic Study Extent Divided by Geographic Segments (I-V)



4.2 Local Stakeholder Participation

Participants were selected using several approaches, with the explicit goal of ensuring participation from a variety of interest areas and from each of the geographic segments. Researchers found participants through referrals provided by the local Conservation Districts, the Yellowstone River Conservation District Council, and the Montana Office of the Natural Resources Conservation Service. The referrals were specific to four interest groups in each Segment: agriculture, local civic leader, recreation, and residential. Participants were assigned an interest group according to their primary role in the community, although many participants had interests and roles that were shared across interest groups. Those labeled agriculturalist are primarily ranchers and farmers, civic leaders are those who held some type of leadership position in their communities,

recreationalists were individuals who had reputations as avid fishers, hunters, boaters, etc., and residentialists were those who owned 20 acres or less of river-front property. Referrals were based on these categories, to ensure a broad scope of opinions. Our analysis of the YRCI data notes these classifications while being aware of the complex roles’ participants have in their community that may over-lap classifications.

The YRCI data set presently consists of 453 interviews (Table 1, see page 1). Several projects have studied, summarized, and analyzed these data and presented them in technical reports per each individual field season (Gilbertz et al. 2007, 2020, 2021). Our research begins to do the work to understand the comparative longitudinal value of the YRCI by focusing on the 15 individuals who were interviewed in each of the three field years (Table 2). This allowed for analysis of changes in stakeholder discourse of physical processes and their management across time and context while controlling for differences among individuals. These 15 individuals are majority male, white, and between the ages of 30-80 years old.

Table 2: Longitudinal Analysis Participation Table by Segment & Interest Group

	<u>Seg. 1</u>	<u>Seg. 2</u>	<u>Seg. 3</u>	<u>Seg. 4</u>	<u>Seg. 5</u>	<u>Interest Group Total</u>
Agriculturalist:	1	2		2	1	6
Civic Leader:			2		1	3
Recreationalist:		1	1		1	3
Residentialist:	1			1	1	3
Segment Total:	2	3	3	3	4	15

4.3 Interview Data

We used a qualitative approach, based on semi-structured and informant-directed interviews. The location of the interviews was determined by the individuals being interviewed, most often this was in their homes, which ensured convenience and encouraged a more conversation-based interview. Each year the questions were retrofitted to the condition contexts of that year, but generally questions were designed to allow participants to describe what they valued, how they thought the river should be managed, and personal observations concerning the river (Appendix A). Interviews were audio-recorded and transcribed, resulting in approximately 45 hours and 900 pages of local stakeholder commentaries concerning the river's physical processes, managing agencies, and the goals and perspectives of participants.

4.4 Analytical approach to the Textual Data

Analysis of the 45 interview transcripts were coded to themes and organized using QSR NVivo 12.0 analytic software. All interviews were analyzed and coded by one person. The analysis was corroborated by two other researchers who played primary roles in the creation of the YRCI project. Similar to how the YRCI results were presented, findings below are presented using verbatim quotes to keep content intact and to privilege how the voices of the stakeholders' voices were expressed in the field.

Analysis occurred in three phases to address the research questions (Sect. 4.0). In the first phase, interviews were coded for expressions related to (1) physical processes (drought, flood, or erosion) and (2) the management and consequences of such physical processes including bank stabilization, water availability, and intake. Phase two of

analysis analyzed references under each code (node for NVivo) for themes and trends according to frequency and magnitude within each phase one code (node). Phase three summarized these trends and themes into findings that explore the longitudinal value of the YRCI and what that means for defining the socio-hydrology place-based phenomenon.

5.0 Findings

Our findings are organized to illuminate how the 15 stakeholders expressed their understanding of three physical processes: floods, erosion, and drought. First, for each topic, comments were organized into two primary sections: how they describe the physical process, then how participants described the management of that process. Second, within each topic, comments from the 15 participants across three field seasons were arranged from most to least frequent or unique based on the primary author's reading of the entire dataset (N=45). Comments were attributed to participants using a unique letter (A-N), their interest group (Ag., Civ., Rec., Res.), their geographic segment (I-V), and the year of the interview. This format highlighted patterns among participants' comments about physical processes to be apparent over time in order to suggest how aspects of the place-based socio-hydrology phenomenon of the Yellowstone River changed over time.

5.1 Descriptions of Flooding

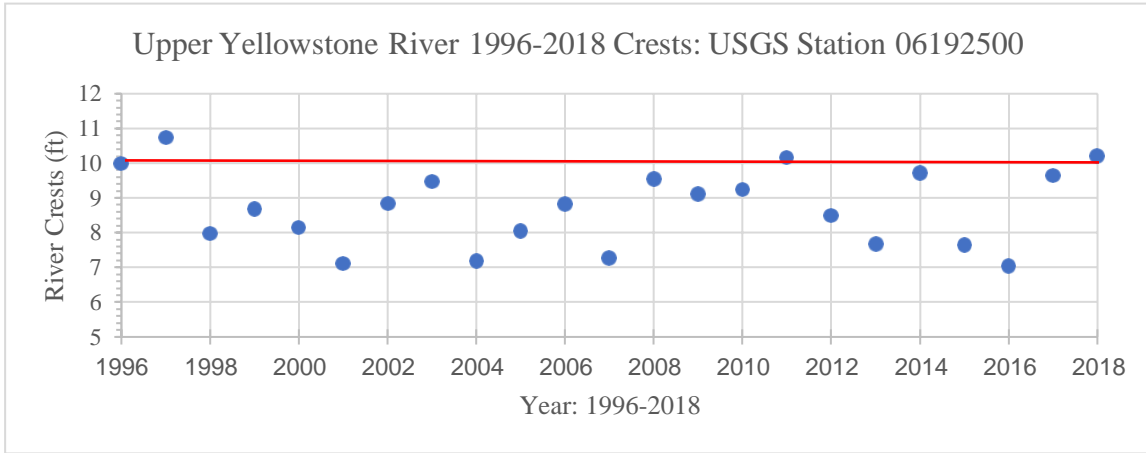
Participants described specific flood events, as well as annual summer flooding in the interviews using place-specific experiences, often of one or two significant flood events, to orient their understanding. These anchoring events are the centerpiece of descriptions of physical processes of flood which are rarely separated from place-specific accounts. The scope of the descriptions varied primarily according to their role in the community and place within the floodplain.

Participant comments about floods ranged from ambivalence to a sustained defiance to acquiescence. The most outspoken participants were those who expressed a lasting defiance to flooding. This group was largely made up of agriculturalists who farmed land along the river. For riverfront farmers, threat of flood and loss of lands was an ever-present worry from flooding from mountain snow-melt in June (June Rise) to the effects of ice jams backing up water in the winter; flooding is a constant hazard.

5.1.1 Examples of Participant Descriptions of Flooding

Figure 3

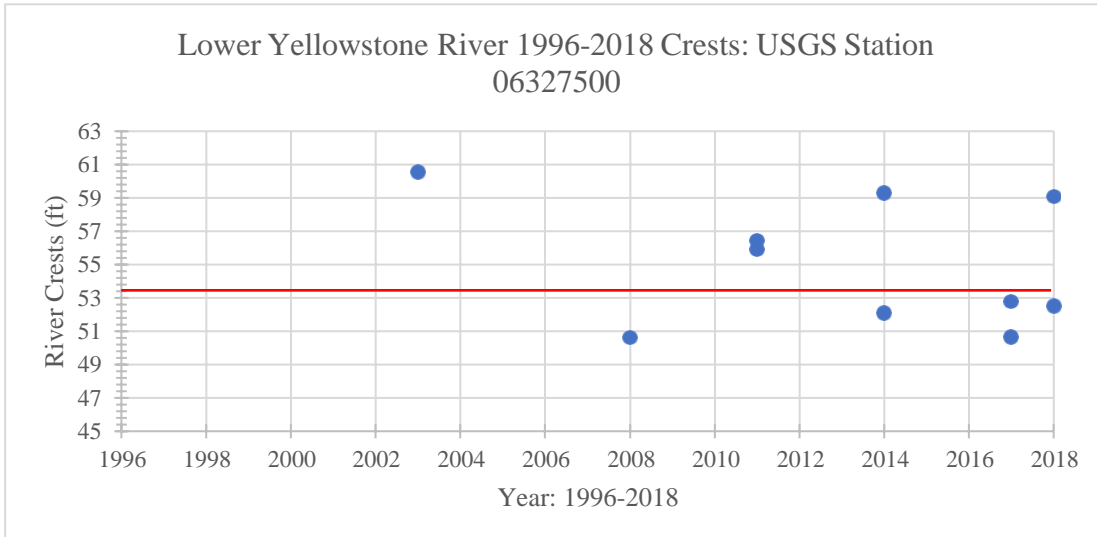
Upper Yellowstone River crests from 1996-2018



Note: USGS Livingston, MT station 06192500, a geographically central location, was selected to represent the Upper Yellowstone River reach. The red line marks the minimum flood stage (10 ft.) for the area according to the National Weather Service. At this height, several roads are covered or partially covered, and some homes are damaged (U.S. Department of Commerce, NOAA).

Figure 4

Lower Yellowstone River crests from 1996-2018



Note: USGS Glendive, MT station 06327500 was selected to represent the Lower Yellowstone River reach. The red line marks the minimum flood stage (53.5 ft.) for the area according to the National Weather Service. At this height, minor flooding begins in a

reach 5 miles above and below Glendive. At 54-60.5 ft, parks, roads, and homes begin to flood (U.S. Department of Commerce, NOAA). Two dots in one year indicates winter ice jams, which this USGS station location is prone to (Appendix B).

Participants described with great detail the damages they experienced due to floods and the hardships of trying to manage their property and livelihoods next to a large dynamic river spanning several years (Figs. 3 & 4). One third-generation farmer characterized living on the river as, *“a detriment, not an asset. It’s just a big pain in the ass to me...every spring right north of here it will take that 10 feet deep, clear to the gravel”* (B, Ag., II, 2006). This sentiment was expressed in all three field seasons with multiple accounts of the effect flooding has had on their farm and *“now a lot of the work that was done 30, 40, 50 years ago is down the river. You know, we lost a lot of production”* (B, Ag., II, 2012). After describing the extra work of fencing and refencing between an ice jam and a June Rise flood in 2018, they discussed how the aggregate loss of fencing and acreage from floods and erosion has pushed them to want to sell their land. Their brother, *“doesn’t want to sell and I do. So, I always tell him, well, ‘your part of the farm was right there, it went down the river. So, there’s your part [laughs]’”* (B, Ag., II, 2018). Another agriculturalist couple echoed similar sentiments, *“Sometimes, you glorify it and sometimes you think, Boy, it is a monster. You learn to accept what it does. If you worry about it, you can’t do anything; especially when it is really doing stuff, everybody is helpless”* (D, Ag., IV, 2006). Throughout the field seasons this sentiment was expressed in the adage that *“while you live on the river, you got to fight it”* (D, Ag., IV, 2012) and in 2018 *“I think you just have to accept the fact the bank will just keep eroding away”* (D, Ag., IV). As beneficial as the waters are for irrigation, the same waters when flooding can

take productive ground and damage property. For those who work the lands closest to the river, these were commonly voiced perspectives.

A smaller group of participants described flooding differently, these perspectives often came from those whose livelihoods were less dependent on river-front lands. Their descriptions were broader in scope, referencing more system-wide notions of river health. A civic leader who moved to the area after the significant flood events of 1996 and 1997 described regular floods as a “*renewal of the ecosystem*” and something “*desirable*,” while recognizing exceptions of extreme events stating:

This river system has been fairly resilient, I think there is a fair amount of seasonal rehabilitation that the river does for itself, but that’s not unlimited in terms of capability, and it’s hard to know what the limits are without bumping up against them.

—Participant A, Civic Leader, Seg. V, 2006

In 2018 they echoed a similar sentiment, “*I don’t know whether my attitude affects what the river’s doing, but generally I see it [flooding] favorably*” (A, Civ., V, 2018). Another self-proclaimed “*river person*” whose family has lived, farmed, and managed an irrigation company for generations provided an alternative perspective on flooding and what they consider “*damage*” in 2006 and 2012 (Box 1):

Box 1: Longitudinal Comparative Segment II Agriculturalist’s Description of Flood

2006

“My whole theory about the river is that we have got to have a new vision on what we expect of our rivers. I want to prove to the world that we can have the irrigated agriculture, but we can also have our rivers and pretty much leave them intact.”

—Participant E, Agriculturalist, Seg II

2012

“I hate to refer to something that happens naturally, from time to time, as damage. I kind of look at it the other way: we’re here and we’re kind of more or less the damage; we’re the newcomers, so it [the river] needs to be able to do kind of what it wants once in a while, and I have always felt like that.”

—Participant E, Agriculturalist, Seg II

In 2006 Participant E was discussing this quote within reference to their work on system-wide river health initiatives, particularly their work on building a diversion dam to aid in fishery health. In 2012 Participant E expressed this sentiment in direct response to a question regarding the “damage” they have seen from flooding. Within different context, the participant expressed a similar priority to support system-wide river health.

Descriptions of significant flood events were found primarily in the 2006 and 2012 field seasons. In the 2018 field season, little to no data were found on significant flood events. There were three flood events primarily discussed in the interviews: the 1996, 1997, and 2011 flood events (Fig. 3 & 4) The flooding events of 1996 and 1997 were both upstream river events. The 1996 flood event was categorized as a 10–25-year event for Billings and Clarks Fork (III-V). The 1997 flooding event was categorized as a 50–100-year event at Billings, a 25-50-year at Boulder River, and a 10-25-year flood for Forsyth and Clarks Fork (III-V) (Thatcher & Boyd, 2008). In alignment with the biophysical effects of the 1996 and 1997 flood events, upstream participants (III-V) described effects of the event in more detail than those in II and I. Many agriculturalists who experienced these consecutive flood events shared stories of damages they experienced on their land. Participants provided rich descriptions of their experience which acted as anchoring events, exemplified in their stories that saw little change between field season concerning the 1996 and 1997 flood events.

Two agriculturalists described their experience of the 1996 and 1997 floods almost verbatim in 2006 and 2012. When asked about flooding no agriculturalist described how an ice jam loosened the rocks and then the subsequent flood washed out their jetty in both 2006 and 2012. In 2006 they discussed this anchoring event as a way to describe the river.

In 2012, this story was prompted after being asked about what type of bank stabilization they have used (Box 2).

Box 2: Longitudinal Comparative Segment IV Agriculturalist's Description of a Flood Event

2006

"We had those ice jams and they kind of jarred the rocks loose and then, when the flood came, it wiped the jetty out."

—Participant D, Agriculturalist, Seg. IV

2012

"The winter just before the 500-year flood, it loosened that remaining jetty up that winter with that big ice jam, moved the rocks. Then that spring that water came up real high, and it washed it out."

—Participant D, Agriculturalist, Seg. IV

Another agriculturalist describes how the flooding event "isolated" them from their "bottom land property" in both years however in 2012 they provided more details to this story (Box 3).

Box 3: Longitudinal Comparative Segment V Agriculturalist's Description of a Flood Event

2006

"In '96 we washed out big time here. It came through here and created a channel through me and so I was isolated from my bottom land property."

—Participant F, Agriculturalist, Seg. V

2012

"In 1996 the river got extremely high. I would say 75% of the Yellowstone River was running into Spring Creek. And it cut me off from about three or four hundred acres of property. I put in root wads along the bank, and we planted willows, and we planted grass, and I did a tremendous amount of work that cost near three-quarters of a million dollars to do it. Then '97 came along and we had another high event, and I lost the whole thing."

—Participant F, Agriculturalist, Seg. V

Discussion of the 2011 flood event was concentrated to just the 2012 field season. This flood event exceeded the 10-year flood level for several weeks in certain locations the peak flow exceeded a 100-year event, primarily in segments III and II but effecting all river segments (COE & YRCDC, 2015). Descriptions of the flood event varied according to geographic segment. Those in segment II described how this flood differed from others they had experienced with phrases such as “*a lot higher and higher a lot longer*” (C, Rec., II, 2012), “*I’ve never seen it [the river] like that*” (B, Ag., II, 2012) and “*brim-full*” (E, Ag., II, 2012). An outspoken agriculturalist from segment II described the damages the flood had on their land, specifically how much work they put into putting their land back into production by fencing, removing trees, etc.:

So, we had trouble, we couldn’t use any of our pasture until probably October. So, it was really a trying year. As long as I’ve lived here, I’ve never seen that much water go down that river in the flood channels and over the fields like it had that year, I’ve never seen it like that. I mean it was just roaring through there.

—Participant B, Agriculturalist, Seg. II, 2012

People from other segments discussed this flood in less detail. A possible explanation was shared by a civic leader in segment V “*’96-’97 floods, the channel morphology changed so much that it has more capacity for water now. So, I suspect we had something close to record flood volume, but we didn’t have floods*” (A, Civ., V, 2012).

5.2 Descriptions of Flood Management

Agriculturalists spoke of flood management as their “*biggest problem*” or “*biggest monster*” (B, Ag., IV, 2006, 2012) and then provided suggestions on how to improve management. Participants often described the solution to flood management as more awareness and education, “*if they could drive around and see, well that is what happened to so and so*” (F, Ag., V, 2012). Other suggestions included better technology

(i.e., dams, levees, new engineering solutions, etc.) or development set-back laws—laws prohibiting development within a certain distance of the river. Several participants discussed set-backs or specifically dams as the “*only way we would have fixed control here*” yet concluded that these were a politically unattainable solution “*that isn’t going to happen*” (D, Ag., IV, 2006).

One outspoken agriculturalist echoed the same sentiment in all three field seasons with little to no change in 2006 and 2012, suggesting poor financial management on a federal level as a source of the problem (Box 4).

Box 4: Longitudinal Comparative Segment II Agriculturalist’s Description of Flood Management	
<u>2006</u>	<u>2012</u>
<p><i>“The biggest monster for soil erosion is the river. The reason they don’t touch it is your environmentalists and it is so costly. It takes a lot of money to rip rap a river. We poop that away every day in Iraq. We don’t take care of our own country and our own people. Just like this river.”</i></p> <p style="text-align: right;">—Participant B, Agriculturalist, Seg. II</p>	<p><i>“I guess what really irritates me is we’ve spent, I think it was like 880 billion in Iraq, 330 billion in Afghanistan, and we’re going to get rid of these satellite FSA offices. To me, it’s just totally ludicrous. You know, it’s really poor management at the top.”</i></p> <p style="text-align: right;">—Participant B, Agriculturalist, Seg. II</p>

In 2018, the participant discussed the topic in a similar sentiment, but this time offered technology as the solution, “*But you know, we have so much technology, why can’t we do a better job than what we’re doing? That’s what I’m saying*” (B, Ag., II, 2018).

Between each field season our study revealed little change in participant priorities and narratives used to describe flooding and its management (Box 5). For example, a civic leader described flood management as a priority in all three field seasons; and their suggestions were based on their work in the community (A, Civ., V). In 2006, their comments quoted below (Box 5) came after discussing their vision for a study the city

was working on. In 2012, their comment quoted below (Box 5) was responding to a question about how they hope to see various river interests being balanced. In 2018 they were discussing a program they have been working on to improve river management. Another participant, who was instrumental in the construction of a diversion dam, maintains a grave concern for river management especially as it relates to fishery health, something very personal to them and their work (E, Ag., II). While their quotes in Box 5 vary, they maintain a priority toward system-wide river health.

Box 5: Longitudinal Comparative Flood Management Descriptions Segment V Civic Leader & Segment II Agriculturalist

<u>2006</u>	<u>2012</u>	<u>2018</u>
<p><i>“So, I think we’re going to have to have some kind-of engineering solution, and I’d really like to see it involve, in a perfect world, some kind of service setback, designated flood-way, flood-plain area.”</i></p> <p>—Participant A, Civic Leader, Seg. V</p>	<p><i>“Most of that obviously has to happen at the county level. You know, in terms of setbacks and everything else. Again, looking back, ideally, I would have put setbacks in place in 1920, but it is hard to do it now.”</i></p> <p>—Participant A, Civic Leader, Seg. V</p>	<p><i>“We try to create awareness and incentives on the part of people who would otherwise make less than informed development decisions, both with respect to structure siting, construction materials design, those kinds of things.”</i></p> <p>—Participant A, Civic Leader, Seg. V</p>
<p><i>“We absolutely need to keep the rivers whole and complete as we can. We can have the irrigated agriculture but we can also have our rivers and pretty much leave them intact. We don’t need to de-water them to death – it’s pointless.”</i></p> <p>—Participant E, Agriculturalist, Seg. II</p>	<p><i>“You know, and we got to take care of this place the best we can or we’re going to spin ourselves right out of here, you know? When we’re in the right place to do something, we take a hold of it and do it. It’s just that flat responsibility to make the world a better place.”</i></p> <p>—Participant E, Agriculturalist, Seg. II</p>	<p><i>“I don’t understand why there isn’t an outcry against irrigation companies that entrain fish. Hell, that Intake is such a travesty. People fish in the canal down there. It’s like, for heaven’s sake! How the river even keeps a viable fish population at all in light of what that inlet has done to it.”</i></p> <p>—Participant E, Agriculturalist, Seg. II</p>

5.3 Descriptions of Erosion

Regular flooding erodes riverbanks. Participant descriptions of erosion, as a physical process, mirrored descriptions of flooding. Agriculturalists who described flooding with acquiescence, expressed similar sentiments toward bank erosion. For example, *“Like somebody told me, if you don’t like losing land and getting flooded, you gotta go get up in the hills and buy a dry land place. You always fight the river a certain amount”* (D, Ag., IV, 2006). Then in 2012 expressing *“We all know it’s got the power. If you don’t cry about it and nobody loses their life over it, I think it’s kind of fascinating.”* And again in 2018 stating *“I really don’t think you can stop the river through our section here. It’s a necessary thing”* (D, Ag., IV, 2018).

Participants expressed their understanding of dramatic erosion and avulsion events over time through detailed place-specific accounts, providing specific measurements and timelines, especially those who have lived on the river for most of their lives. For instance, a residentialist described losing *“probably 80 acres, or maybe more”* since around 1974 (J, Res., I, 2006). One agriculturalist described the dramatic avulsion changes they witnessed *“this island wasn’t even here 25 years ago”* (N, Ag., I, 2018). Another agriculturist couple described major avulsion events in 1996 and 1997, describing erosion at *“the rate of three or four feet a day, sometimes more. Hard to stop it”* (D, Ag., IV, 2012). Another residentialist described losing *“100 feet of lawn in ‘96”* (M, Res., V, 2006).

5.4 Descriptions of Erosion Management: Bank Stabilization

Bank stabilization was often discussed as a technical approach to prevent erosion. Bank stabilization of the Yellowstone River involves placing large boulders (rip rap) on

the bank to deflect the velocity of the water from cutting away at bank soil, this process is known as rip rapping. Since the mid-1970s, all bank stabilization projects are regulated according to the Clean Water Act's Section 404, whereas placing any fill material—like rock—into any stream requires a permit (CWA; 33 USC § 1344). On navigable waterways, bank stabilization is administered by the US Army Corps of Engineers per the 1899 Rivers and Harbors Act with oversight from the US EPA (33 USC § 401). With the Yellowstone River being the longest free flowing river in the continental United States, rip rap is commonly used to combat erosion and so several participants have experience with the bank stabilization permitting process.

Several participants express varying degrees of aversion toward the permitting process at essentially all stages of the process: planning, engineering, and maintaining. Participants explained that getting permission to begin the process was difficult, stating agencies *“are saying you shouldn't rip-rap. This is my home”* (M, Res., V, 2006) or *“we possibly could be able to do some rip-rap, but we're not allowed”* (J, Res., I, 2006).

Participants commonly spoke about failed bank stabilization projects. Many shared these anecdotes with dismay, one agriculturalist described, *“When I washed out, I was pretty upset because I put a lot of work and it cost a terrible amount of money; it was devastating”* (F, Ag., V, 2006). They noted when they spoke with an *“agency personal”* the agent told them *“I could have told you it wouldn't work,”* the participant concluded *“there was an agency difference of opinion”* (F, Ag., V, 2006). Another agriculturalist described *“Anything that they ever put in to protect it before is all gone”* (D, Ag., IV, 2012) referring to the four jetties put in by the previous owners of their land. Each had blown out over a 40-year timeframe, three of which only lasted two years. This anecdote

was repeated by these participants in the 2006 and 2012 field seasons when describing their understanding of erosion and bank stabilization (Box 2).

In addition to the ineffectiveness of bank stabilization, the cost of installation, the engineering, and materials is expensive, *“it’s cheaper to buy another farm than cost of riprapping”* (B, Ag., II, 2012), *“You have to decide if you want to spend the money to fix it or take what comes”* (M, Res., V, 2006). Several participants experience regular erosion that can cost them a significant amount of time and money (Sec. 5.3 & Box 4). Choosing between protecting their home and farmland or risking one’s financial security through investing on uncertain outcomes is an onerous task. This sentiment was shared by many with personal experience in bank stabilization. For example, an agriculturalist couple expressed *“I couldn’t grow enough crops to offset it, I wish I could but it doesn’t work that way”* (D, Ag., II, 2006). Then in 2018 said *“even if the government would pay 80%, at our age, it would never pay-out”* (D, Ag., II).

Commonly coupled with expressions of cost and failed projects, participants discussed the maintenance required and length of the permitting process. The majority expressed these concerns with ambivalence. For instance, one agriculturalist described their experience with bank stabilization projects and resigned to say that *“I have to do yearly maintenance on my work. I have been working off of that premise that I have to maintain what I have got”* (F, Ag., V, 2012). Another recreationalist describes their experience with the permitting process as, *“a lot of hoops and whistles you got to do to put anything on the riverbanks”* but then described the understanding they came to after working with agencies, *“they want it to stay natural. So, they know we are trying to keep it natural”* (C, Rec., II, 2018). Others were more defiant about the bank stabilization

permitting process, especially agriculturalists, who experienced events that require immediate action. One agriculturalist described, *“if you have to get a permit and wait two months to get it, and the river is starting to flood, you need it now, you don’t need it when they decide to do the paperwork”* in 2012. Then in 2018, they described having to push agencies to get the stabilization they needed, *“we wrote and told them, ‘If you don’t let us know within a month, it’s an automatic go-ahead.’ And we’ve sure been working better”* (B, Ag., II, 2018).

5.4.1 Descriptions of Erosion Management: General

Compared to all other physical processes, participants expressed their understanding of erosion management in the greatest detail. At the heart is an active contention between the rights of private property owners versus the system-wide river health. Several recreationalists and civic leaders expressed their understanding of this divide. One recreationalist explained the polarities in this debate in 2012 as *“It’s reactionary in every case, that the rip rap’s going to destroy the river, or the rip rap is going to save my ranch”* (H, Rec, V). In 2006 they suggested more awareness to improve the understanding of downstream effects:

It would make some common sense, from my own personal experience that seeing where some of the projects were done and where the impacts were the greatest, I think some people would accept the fact that there is a sort of bowling pin effect.

—Participant H, Recreationalist, Seg. V, 2006

Another recreationalist echoed a similar sentiment stating *“our best shot is to do as little tinkering with the river as we can, and to try to make it easier for landowners to face the reality that some of their land is going to be taken away”* then explained that a way forward included two things *“one, that the finest engineering is done to mitigate as much of the impact of the project as possible. Two, compensate our landowners for the damage*

that they're going to do because of the project” (I, Rec., III, 2012). One civic leader expressed a political concern in reconciling this debate stating “politically there’s a culture of property rights and courts. The country commission is certainly faced with a difficult balancing act in making decisions regarding things like set-backs” (A, Civ., V, 2006).

Agriculturalists were the most outspoken about private property rights, with claims that they have been forgotten by managers. One agriculturalist expressed this explicitly in both their 2006 and 2018 interviews (Box 6):

Box 6: Longitudinal Comparative Segment II Agriculturalist’s Description of Erosion & Management	
<u>2006</u>	<u>2018</u>
<p><i>“We used to have a two-story house down there and six acres and a set of corrals with a well. It is all gone. Like Al Gore says, we will be importing all of our food, anyway. Like the potato famine in Ireland. Those people have learned to protect their farmers. If this country has a problem, they throw money at it and that may not be the best answer.”</i></p> <p>—Participant B, Agriculturalist, Seg. II</p>	<p><i>“To me we’re not being represented. It’s like, ‘Oh well, so what if half of your farm did go down the river? Tough smash. You knew that when you had it’ Well, we’re the third generation, and there used to be a two-story house down there with six acres of hay on the other side of it, and that house has been gone forever.”</i></p> <p>—Participant B, Agriculturalist, Seg. II</p>

The sentiment of agriculturalists having a lack of representation was shared by a few others, one described how they were taught in a high-school agriculture class that “*you shouldn’t do things that causes erosion*” explaining “*for the life of me I can’t understand how allowing banks to erode and cut add anything valuable to the river*” (F, Ag., V, 2006).

Many agriculturalists expressed they want management to leave them alone stating “*They ought to let you go out there in August when there is not water running by and do*

what you want” (N, Ag., I, 2006). Another agriculturalist claimed, *“All I wanted to do is ranch and do my thing. Private property needs to be protected. I think that somewhere along the line people have to come first. It’s the people’s river”* (F, Ag., V, 2006). Often times agriculturalists would question the decisions management have made *“all of the money that has been put into leveling these fields and to see the river come and take away land and make an island is kind of a waste”* (B, Ag., II, 2006).

Those concerned with system-wide health over private property rights still expressed a need for bank stabilization in very specific cases, *“There’s some places where you do need to do it, but where it takes out edges of fields and things like that, I think that just puts nutrients back in the river and makes it a good river”* (C, Rec., II, 2012). Others also suggested using natural alternatives before hard armoring *“helping Mother Nature along by planting shrubs and trees along the river, that would do a lot of it”* (L, Civ., III, 2018). But many who leaned more toward system-wide river health had a similar sentiment suggested by the *“river person”* stating *“hopefully you’d come to the realization that you’d give the river some room so that when it comes it’s day in June it has someplace to go”* (E, Ag., II, 2006) or put more simply by a residentialist, *“common sense says you should not build right on the riverbank, because rivers do move”* (K, Res., IV, 2012).

Those concerned with system-wide health often cautioned against bank stabilization for the downstream effects *“every time there is a bank stabilization project, it pushes problems downstream. If I were king, I would change how we do bank stabilization”* (A, Civ., V, 2012). These participants often expressed that there should be more responsibility placed on project owners stating bank stabilization projects, *“have*

unintended consequences downstream which he's not responsible for—he should be” (I, Rec., III, 2006). Participants discussed the difficulty getting this idea into practice stating, “a landowner was more willing to deal with damage on his own property rather than say that the guy had to be responsible for what he had done because that meant he would be next. That thinking scares me” (H, Rec., V, 2006).

Overall, participants from all sides expressed a need for management improvement suggesting “*maybe it is education*” (K, Res., IV, 2012) or “*we need to use our best technology to look at the cumulative effects of these impacts*” (I, Rec., III, 2012). Many expressed a need for better planning, “*we had seen a lot of bank stabilization projects without a lot of planning in my view, it wasn't clear how detrimental that would be to the fishing community*” (H, Rec., V, 2006) or:

Most of the rip rap projects have been done wrong—it's because people haven't taken the time to assess 'what am I doing?!', 'what do I want this to look like?', and 'what are the true reasons I am doing this for?'

—Participant E, Agriculturalist, Seg. II, 2006

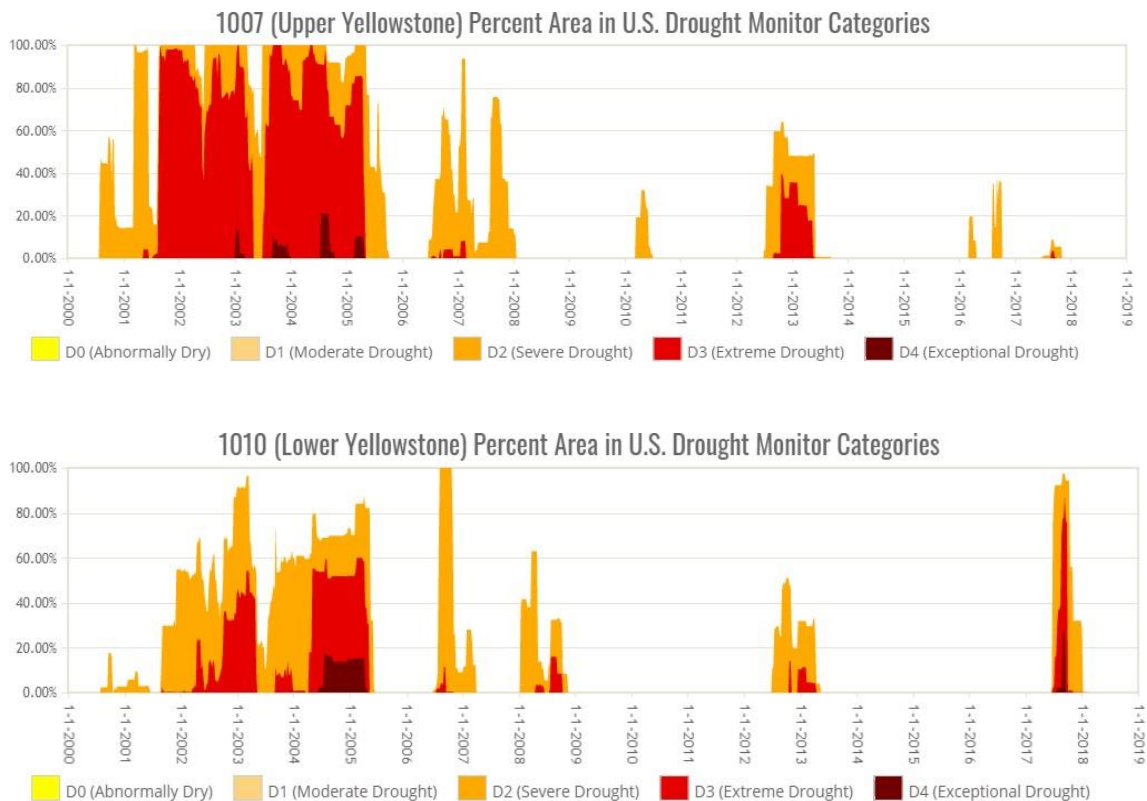
Altogether, participants described erosion by sharing rich stories of their personal experience. This study found that erosion as a physical process was understood by participants in a personal way that led them to describe advice and suggestions to management in detail. Despite the salience of the topic among participants, erosion remained a stated priority for management for several participants across field seasons.

5.5 Descriptions of Drought

Participants experienced extreme and exceptional drought in the three years prior to the 2006 field season and the year before the 2018 field season (Fig. 5). Yet unlike floods, participants did not discuss specific drought events and rarely, if ever, expressed their understanding through place-based experience.

Figure 5

Upper and Lower Yellowstone River Basin in Drought. U.S. Drought Monitor Categories Severe-Exceptional Drought (D2-D4) from 2000-2018.



Source: National Drought Mitigation Center.

Some acknowledged drought as a concern with statements like “*there seems to be less water—a lot*” (J, Res., I, 2006) or “*It is a shame that the valley is changing for the people that live there. It’s harder and harder with the droughts and stuff*” (M, Res., V,

2006). Other's expressed drought as a concern for the future, one civic leader noted in 2006, *"I know we're going to be taking more water out of the river. In the next generation, that will probably cause some problems"* (L, Civ., III, 2006). A recreationalist noted in 2012 *"I expect the river to be lower, shallower, less water. I don't see that changing"* (C, Rec., II.). These comments yielded talk of the future and the area's dependency on water:

So, the farmers, the industry—almost everything you look at around here is water driven. If you find that you have an area that people like and the ability to get water to that, then you've found the next area of growth.

—Participant G, Civic Leader, Seg. III, 2006

Civic leaders and recreationalists showed the most concern toward drought. They remained steadfast in their concern about drought from field season to field season. For example, the same civic leader who made the comment above when asked about how the community values the river, stated six years later in 2012 when asked about how their work as mayor relates to the river, *"the biggest thing I see with the river, it's the water supply"* and in 2018 when asked about the future of river management stated *"the largest question is, how do we maintain enough water in the river for our growth in population"* (G, Civ., III)? The discussion of drought most frequently merged into conversations of population growth, irrigation, and occasionally, climate change.

Many agriculturalists were less outspoken about drought, but one agriculturalist explained a sentiment shared by other less outspoken agriculturalists, *"Irrigation is what it takes to raise livestock in this country"* (F, Ag., V, 2006). They explained they are *"working with [Montana] Fish and Game to figure out a way to keep from totally dewatering streams"* and offer they might *"apply for funds and economic incentives to put in sprinklers to become more efficient"* (F, Ag., V, 2006). Yet another agriculturalist,

a self-proclaimed “river person,” explained “well you have an irrigated farm, why shouldn’t everybody else? Well, enough is enough, go buy one that’s already irrigated, I’ll sell you mine” (E, Ag., II, 2006).

While the primary concerns shared relating to drought included irrigation and population growth, a less frequently shared topic with drought is climate change. In 2006, this concern was expressed as something to address in the future, “As far as the health of the river? I think long term; we’re going to see more dewatering from climate change” (A, Civ., V, 2006) or “I worry about the global warming that everybody’s predicted. We need the water high in the mountains” (L, Civ., III, 2006). In 2012, there was less of a discussion of climate change related to drought, but one recreationalist expressed their concern in 2012 and 2018 almost verbatim (Box 7):

Box 7: Longitudinal Comparative Segment III Recreationalist’s Description of Drought & Climate Change

2012

“It’s very clear and all the climatologists are pretty much in agreement, that we’re going to see weather change, which means our spring runoff will come earlier, we’ll have higher spring runoff, it’ll be gone quicker. And the demands for Yellowstone River water are going to increase.”

—Participant I, Recreationalist, Seg. III

2018

“We need to have an extremely good understanding of the Yellowstone River because of the threats that are facing the Yellowstone River, the most significant one having to do with the use of the diminishing supply of water, which ties to a lot of things, one is population growth and growth of intensive irrigation, irrigated agriculture and global climate change which is going to result in less summer flows of water in the Yellowstone River.”

—Participant I, Recreationalist, Seg. III

In 2018, other participants expressed climate change with reference to current drought issues stating, “We’re seeing real changes, and typically over the last 30 years, smaller runoffs, earlier runoffs, certainly seasonal changes” (H, Rec., V, 2018). One participant

noted that they have “*seen nothing in the local press, and it’s [climate change] not really something that I hear discussed. Seems to me they would need to address that because that drives so many other concerns, including irrigation*” (A, Civ., V, 2018).

5.6 Description of Drought Management

Water rights was the most common subject related to drought management discussed by participants. Water rights in Montana, like much of the western United States, is guided by the prior appropriation doctrine which follows a “first in time is first in right” philosophy. This establishes that a person’s right to use a specific quantity of water depends on when the use of water began. During dry years, the person with the oldest water rights has the priority to use the available water to fulfill their right (DNRC, 2014). One civic leader explained that their city has:

been established with a little bit better water rights, and the fact that it’s older and it allows us to have water for day-to-day use and for potential growth. In my humble estimation, water is going to be more highly regarded going forward than it has in the past.

—Participant G, Civic Leader, Seg. III, 2012

Then in 2018 this participant repeated this sentiment stating, “*If we do have that much water claimed, then we’re ahead of the curve and as we grow, we won’t have to justify additional water coming out of the river*” (G, Civ., III, 2018). The discussion of water rights frequently brought up a debate between agriculturalist and recreationalists with a participant summarizing, “*The older water rights have priority. They can’t very well say you can’t take the water out to irrigate because we want it for fishing, because well, they have the water rights*” (K, Res., IV, 2012). A recreationalist explained in-stream flows in 2006 saying, “*One of the things that is coming down the pike right now is we are looking at water quantity to protect the fish and they may need a cooperative agreement from the*

landowners to maintain their water rights” (H, Rec., V, 2006). They then explained that environmentalists need to find better ways to communicate to landowners rather than just stating “the river meanders from bank to bank and if you lose 160 acres of hay ground...that is just how it supposed to happen” (H, Rec., V, 2006).

Direct management suggestions and detailed accounts of drought were less frequent compared to any other physical process with one participant explaining *“I don’t think there’s anything you can do for drought. You just have to do what you can with what you’ve got. You can’t make it rain [laughs]” (K, Res., IV, 2018).* One participant suggested that there needs to be better monitoring of water rights, *“Farmer Jones that has a water right for so much, nobody’s monitoring that. So, he takes more water and the guy up stream takes more water and suddenly the side channels don’t have any water in them” (I, Rec., III, 2006).* Others provided less specific management practices and more philosophic suggestions. A civic leader discussed the issue of water supply as a top priority in all three field seasons. This participant was a mayor of a town and was retired in the 2018 report. It is important to note that in 2006 and 2012 the topic of water supply was the first topic discussed by the participant (Box 8; 2006 & 2012). In 2018, the quote in Box 8 was one of the last things they discussed in their interview:

Box 8: Longitudinal Comparative Segment III Civic Leader’s Description of Drought Management

<u>2006</u>	<u>2012</u>	<u>2018</u>
<p><i>“I see no developmental issue so important as water. My elders always told me back when that whiskey was for drinking and water was for fighting. I think it’s true now. When you have the amount of people that are finding the Yellowstone Valley and the amount of land that is good land, the only thing that’s going to prevent that from being developed is the use of water.”</i></p> <p style="text-align: right;">—Participant G, Civic Leader, Seg. III</p>	<p><i>“The biggest thing I see with the river, it’s the water supply. Water supply for not only our citizens on a daily use, but for the static source of having a minimal fire flow. It has a high prominence in this area both for our day-to-day living and for allowing us to have the luxury of good-paying jobs in the valley.”</i></p> <p style="text-align: right;">—Participant G, Civic Leader, Seg. III</p>	<p><i>“Whiskey is for drinking; water is for fighting. If we don’t get our eggs in one basket and start figuring out that we should be able to start utilizing our resources rather than just being able to enjoy them like we did, then we’re going to be up against the blade.”</i></p> <p style="text-align: right;">—Participant G, Civic Leader, Seg. III</p>

Another participant echoed similar sentiments stating *“We have to learn how to take care of it or it’s going to go away. It’s like having this great house, you build this house and beautiful everything inside, if you don’t clean it and maintain it, it isn’t going to stay there”* (E, Ag., II, 2006). In 2012 this participant discussed specific management preferences stating taxpayer support for farming *“puts such a false front on what we do—it’s what’s led to de-watering the rivers, price supports, government intervention into trying to help folks stay on the land”* (E, Ag., II, 2012).

Despite the prevalence of drought prior to the 2006 and 2018 field seasons, participants expressed their understanding of drought and its management the least. Those who did discuss drought explain their understanding through concerns about water availability for irrigation, population growth, or recreation/fishery health depending on their role in the community. Of those who expressed concern of drought, civic leaders

most frequently expressed it as a top priority. Between each field season, our study revealed little change in participants' discussion of drought and its management.

6.0 Discussion

Rivers are complex systems. For people to manage rivers requires equally sophisticated treatments of the co-evolution of human-water systems. Following Sivapalan and Blöschl (2015), this study attended to the spoken narratives of 15 riverfront stakeholders over three field seasons to explore the how participants' accounts of physical phenomena like floods, erosion, and drought expressed the possible dynamics, patterns, and paradoxes that result from long-term coevolution of coupled human-water systems. This study found evidence of voiced comments about physical features reflected cultural, political, and biophysical social dynamics related to water use, livelihoods, and the environment.

This case study offers evidence to support that the longitudinal socio-cultural data of the YRCI offer clarity to the human-water system on the Yellowstone River. The narrative knowledge gathered in the YRCI (Gilbertz et al. 2006, 2020, 2021) provides managers with insight into place-specific physical and biological dynamics of the river experienced by those living next to the river. These perspectives offer insider information of nuances in community rules, norms, and habits that govern behaviors not afforded to external researchers or government agents (Pouladi, et al., 2019; 2020).

6.1 Staying Power of Perceptions in a Dynamic System

One key reflection on these findings guides the following discussion. Over 12 years and fluctuating flood, drought, and erosion episodes (Fig. 3, 4, & 5), our case study found little change in priorities expressed and repeated use of anchoring stories within

narrative descriptions of physical processes and management provided by participants. Those who expressed flood and erosion management as their top concern, maintained this concern in all three field seasons (Boxes 4, 5, & 6). Participant descriptions of flood and erosion often contained place-specific stories repeated in multiple field seasons (Boxes 1, 2, & 3). These stories often acted as anchoring stories that participants quickly referenced in near-verbatim anecdotes when asked to describe flood or erosion. Likely due to the nature of drought “events” as slow moving and gradual, those who discussed drought as a physical process did not discuss place-specific events or anchoring stories, they described drought as a primary concern related to population growth, irrigation, and climate change. Those discussing drought (water availability) as a top priority maintained this concern in all three field-seasons (Boxes 7 & 8).

That finding of individual participants’ priorities and anchoring stories of physical processes seeing little change across the 12-year time-period of the YRCI study is meaningful. The reasons why there was little change are beyond the scope of this study, thus we can only speculate why this lack of change was observed. Are these beliefs so entrenched through lived experience that they rarely change? Is there a general lack of educational opportunities about the Yellowstone River and its management for communities within the basin? Was a twelve-year interval not long enough to detect changes in perceptions of physical processes and management? Are these discourses concerning physical processes and management actions so widely circulated that they are reinforced? Or has little change occurred as a result of the Cumulative Affects study? And alternatively have the management changes not reached riverfront stakeholders? Did we speak to participants who had become unengaged with management efforts? Despite the

reason, this finding has implications for management of the Yellowstone River and the utility of the YRCI study and others like it within socio-hydrology research.

One implication for managers who wish to benefit from these social-cultural data is that these data are lasting and useful over time. From this study, the 15 participants' data were reliable for twelve years or more; indicating the potential longitudinal value of the YRCI data for management. This has several implications, three are listed below. First, the value to managers include using stakeholders' stated preferences, perceptions, and opinions to structure, affirm, or evaluate resource management priorities. For example, participants reported strong opinions about the effectiveness, the cost-benefit value, and the long-term impacts of bank stabilization via rip rap. Second, the long-term value of the these data can be viewed as a stagnation of knowledge about the river by its residents. These data can be used to justify a need for outreach and educational programming on topics that managers would benefit from more informed riverfront landowners or recreationalists. They may also be used to structure the topics of outreach programming needed. The geographic specificity of these stakeholders' comments suggest outreach and education programs can be tailored to geography and target specific geographic patterns of educational need. For example, in the riparian lands are valued for more diverse reasons (the fishery, flood retention) in Segment 5 than Segment 1. A final implication of the staying power of these data, is that if administered well (effective in-depth interviewing, appropriate sampling, valid analysis, etc.), studies can be designed to front-load field research and either eliminate or scale back follow-up research. This would yield cost savings. It is important to note, that having analysts "on retention" would maximize the usefulness of these data. Following significant flood, drought event or

regulatory changes, managers could request analysts to re-query the long-term cultural database to generate reports related to new topics of interest.

6.2 Example of Possible Implications of YRCI Narrative Data

Participant narratives of physical processes and management act as mediators between self and the socio-hydrology system, offering descriptions, explanations, and insight about the system and/or individuals' experiences over time. The most highly debated topic provided by participants was erosion management and bank stabilization, which arose in a debate between the rights of private property owners versus those concerned with public-good notions of system-wide river health (Section 5.4). The analysis of this debate over-time reveals the staying power of these narratives and complexity of this system. The narratives expressed by participants are entangled with larger frames of common popular knowledge which can reveal how participants form ideas of right and wrong, true and false, and aesthetically valuable and valueless (Vannini, 2009), i.e., “riprap’s going to destroy the river, or the riprap is going to save my ranch” (H, Rec., V, 2006).

The narratives also provided understanding of place-specific physical and biological dynamics of the river. Participants often used narratives of significant events to provide spatial and temporal details of physical processes (i.e., Section 4.1.1). Participants provided detailed timelines and descriptions of channel morphology. Managers can use this information to better understand their constituents, the river, and identify avenues for decision-making and education. For example, discussion of drought saw less place-specific details. This finding may indicate an opportunity for managers to connect information loops between humans and the environment. The staying power of the

narratives collected, legitimizes the cultural inventory approach to research for long-term planning.

Following the Sivapalan and Blöschl (2015) emergent phenomenon approach, managers could use the YRCI data to set boundaries for the problem they are addressing, both in space (geography) and in term of governing variables (i.e. water rights or streambank permits), and determine tipping points, regime shifts, or system lock-in variables. This can be used to create a perceptual model (Sivapalan & Blöschl, 2015) that describes the human-water system and working hypotheses regarding the underlying causes of the phenomenon (i.e., new development in a floodplain). At this stage, researchers or ambitious managers could create causal loops and focus on identifying the essential system components and their interactions. Additional steps include choosing state variables, determining causal factors that affect state variables, determine functional relationships by which causal factors affect state variables, parameter estimations, and testing the model validity and uncertainty (Sivapalan & Blöschl, 2015). Defining the phenomenon and understanding the social dimensions of the socio-hydrology model is the first step in understanding the human-water interactions. This study provides evidence for the long-term use of the YRCI in understanding the social dimensions of the Yellowstone River system.

6.3 Significance of YRCI Methodology

The research design of the YRCI is unique and significant in two primary ways: the interview protocol and longitudinal component. The open-ended questions asked during interviews and the interviewers' interpersonal aptitude generated candid discussions of the river, the local environs, personal observations, and concerns in

participants' own words. This produced data revealing how participants make meaning, express identity, and construct their reality (Hall et al., 2012; 2016). Following the first field-season in 2006, the relationships built through prolonged engagement with the funding agency and participants enable translation into a longitudinal study.

The goal of the YRCI project was to understand how stakeholders of the Yellowstone River understand the physical processes and their management so to find ways to improve Yellowstone River management approaches. The findings of the YRCI are specific to the location, population size, and time-space geomorphology context of the 12-year time period. However, the successful implementation of a 12-year study is attributed to the unique methodology of the YRCI. The researchers acted as mediators between the community and government agencies tasked to manage the river, building relationships and rapport with both groups through constant collaboration and engagement. Because of this, a rare water-resource longitudinal analysis was possible.

6.4 Limitations

This study is limited by the 15 reoccurring participants analyzed who agreed to participate in each field season. No claims are made concerning the representativeness of this sample. They are self-selected, and not representative of the general population within the river basin as they are majority white, older, males. Many voices are missing. Therefore, management decisions based on this study alone are not advised, future research is needed.

This study is also limited by the study design of the YRCI. Interview protocols were created to meet the objectives established by the funding agency and researchers (Appendix A). The number of study participants and funding provided to the project varied field season to field season. No claims can be made definitively concerning how

individuals change over time, rather study claims were specific to how participants expressed their understanding within the confines of the study in addition to speculations of what it could mean for management given more research.

The YRCI data set had 61 reoccurring participants in 2006 and 2018 (Table 3). This study was limited by the 15 participants interviewed in all three field seasons, but there is opportunity for future comparative analysis work of the 61 reoccurring participants in 2006 and 2018. This analysis could elaborate on themes and trends found in this study and provide more data on the socio-hydrology phenomenon occurring over time in the Yellowstone River.

Table 3:
Recurring Participants in Yellowstone River Cultural Inventory—2006 & 2018

	Seg I:	Seg II	Seg III	Seg IV	Seg V	Total in Group
Agricultural	3	4	3	6	1	17
Civic	1	0	4	2	1	8
Recreational	3	5	4	1	5	18
Residential	5	2	2	6	3	18
Geographic Segment Toatal	12	11	13	15	10	61

This research was also limited by the research analysis approach. Future research could investigate the cultural dimension and aspects of place from a longitudinal perspective in more depth. Due to the study focus concerning the physical processes of

flood, drought, and erosion, this studies analysis was not able to capture the rich stories participants provided of the history of their families and the Yellowstone River. Many participants discussed generational family ties to the area dating back to the mid-1800's and/or stories of development in the area over time. A study of the longitudinal dimension concerning concepts of place and culture could provide fruitful knowledge of the socio-hydrology system of the Yellowstone River.

7.0 Conclusion

Rivers are complex systems that necessitate transdisciplinary study to manage the dynamics of the human-water system; humans respond to natural processes, natural processes respond to human action, and on the cycle continues. The YRCI and the COE Cumulative Effects studies meet this complexity by studying both the longitudinal social and hydrological dimensions of the Yellowstone River. The COE Cumulative Effects study captures the hydrological dynamics; the YRCI offers insight into the cultural responses of the repeating cycle between humans and the environment.

This study analyzed the longitudinal aspect of the place-based socio-hydrology phenomenon occurring in the Yellowstone River valley using and supporting the YRCI data. Our study found evidence of narrative knowledge of place; the physical, biophysical, cultural, and political dynamics. Narrative knowledge shared by participants saw little change in priority and anchor stories over a 12-year, fluctuating flood, drought, and erosion episodes, indicating the staying power of this data. This study provides evidence that the place-based socio-hydrology phenomenon of the Yellowstone River is complex, consistent, and immutable without management intervention.

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Appendix A: 2006, 2012, & 2018 Interview Protocol

Yellowstone River Cultural Inventory Update—2006 Protocol

1. How many years have you been in operation here?
 - a. Do you live here full time?
 - b. IF NOT: How many months a year is your home occupied?
 - c. How do you describe your place to people who have never been here (there)?
2. What was it about this site that made you (your family) want to locate here originally?
 - a. Is the river important to you?
 - b. What do you like best about being near the river?
3. Are there any problems associated having property this close to the river?
 - a. What do you think is the most important problem?
4. Has there ever been erosion damage to your lot?
 - a. (If yes) How much of your place was affected?
 - b. Is there anything that should be or that can be done about erosion?
 - c. Why would that be your course of action?
5. Looking ahead 10 years, what do you expect your place to be like?
 - a. Will the physical facilities change?
 - b. Why is that?
 - c. As you think about the next generation, what are your primary concerns?
6. Some people talk about the river corridor...How is the river corridor different from the river itself? (follow-up to explore “riparian” zone –with or without using that word)
7. Besides what you have already described, what are the various uses of the river?
 - a. How do you think the rights of all users can best be balanced?
8. What keeps you here?
9. Of everything we’ve talked about, what is most important to you?

Yellowstone River Cultural Inventory Update—2012 Protocol

1. How many years have you lived (owned property) here?
 1. Do you live here full time?
 2. IF NOT: How many months a year is your home place occupied?
 3. How do you describe your place to people who have never been here?
2. What was it about this site that made you (your family) want to locate here originally?
 1. Is the river important to you?
 2. What do you like best about being near the river?
3. Are there any problems associated with having property this close to the river?
 1. What do you think is the most important problem?
4. Has there ever been flood damage to your land?
 1. (If yes) How much of your place was affected?
 2. Is there anything that should be or that can be done about flooding?
 3. Why would that be your course of action?
5. Has there ever been erosion damage to your land?

1. (If yes) How much of your place was affected?
2. Is there anything that should be or that can be done about erosion?
3. Why would that be your course of action?
6. Did you notice any impacts from the oil spill in 2011?
 1. (If yes) What types of impacts and how much of your place was affected?
 2. Is there anything that should be or that can be done about the oil spill now?
 3. Why would that be your course of action?
 4. Was the response adequate?
7. Besides what you have already described, what are the various uses of the river?
 1. How do you think the rights of all users can best be balanced?
8. Looking ahead 10 years, what do you expect your place to be like?
 1. Will the physical facilities change?
 2. Why is that?
 3. As you think about the next generation, what are your primary concerns?
9. Some people talk about the river corridor... How is the river corridor different from the river itself? (follow-up to explore “riparian” zone—with or without using that word)
10. What keeps you here?
11. Of everything we’ve talked about, what is most important to you?

Yellowstone River Cultural Inventory Update—2018

Protocol

1. How many years have you lived (owned property) here?
 - a. Do you live here full time?
 - b. IF NOT: How many months a year is your home occupied?
 - c. How do you describe your place to people who have never been here?
2. What was it about this site that made you/your family want to locate here?
 - a. Is the river important to you?
 - b. What do you like best about being near the river?
3. Are there any problems associated having property this close to the river?
 - a. Is there one problem that seems to be “most important”?
4. Has there ever been flood damage to your land?
 - a. (If yes) How much of your place was affected?
 - b. Is there anything that should be, or that can be, done about flooding?
 - c. Why would that be your course of action?
5. Has there ever been erosion damage to your land?
 - a. (If yes) How much of your place was affected?
 - b. Is there anything that should be, or that can be, done about erosion?
 - c. Why would that be your course of action?
6. Have you experienced drought conditions here?
 - a. What needs to happen when droughts occur?
 - b. Are you prepared for drought? (How so?)
 - c. What does the community need to do to prepare for drought?

- d. How do you think droughts should be managed by agencies?
- 7. Some people talk about the river corridor...How is the river corridor different from the river itself?
 - (explore “riparian” and expand “cottonwoods” when possible)
- 8. Did you notice any impacts from the oil spill in 2011?
 - a. (If yes) What types of impacts and how much of your place was affected?
 - b. (If yes) To what extent do you think the land and the river have recovered?
 - c. (If yes) Was the response adequate?
 - d. (Yes or No) Is there anything that should be done about oil spills?
 - e. Why would that be your course of action?
- 9. Besides what you have already described, who are the other river users?
 - a. How do you think the rights of all users can be balanced, best?
- 10. What keeps you here? Looking ahead 10 years, what do you expect your place to be like?
 - a. Will the physical facilities change? Why is that?
- 11. As you think about the next generation, what are your primary concerns?
- 12. Of everything we’ve talked about, what is most important to you?

Appendix B: Yellowstone River Ice James by Segment

Yellowstone River Ice James by Segment (1995-2018)						
<i>Segment</i>	<i>Town</i>	<i>1995-2000</i>	<i>2001-2006</i>	<i>2007-2012</i>	<i>2013-2018</i>	<i>1995-2018 Total</i>
I	<i>Terry</i>	1	0	1	2	4
	<i>Savage</i>	1	1	1	1	4
	<i>Glendive</i>	3	5	4	4	16
	<i>Fairview</i>	0	0	0	1	1
	<i>Sidney</i>	4	1	3	1	9
	<i>Richland</i>	0	1		1	2
	<i>Marsh</i>	0	2	1	0	3
	<i>Colgate</i>	0	0	1	0	1
	<i>Fairview</i>	1	0	0	0	1
	<i>Elks Island</i>	1		0	0	1
	<i>Fallon</i>	1	0	0	0	1
	<i>Segment I Totals:</i>	12	10	11	10	43
II	<i>Miles City</i>	3	2	4	2	11
	<i>Forsyth</i>	2	2	0	1	5
	<i>Rosebud</i>	0	0	0	1	1
	<i>Hathaway</i>	3	1	1	0	5
	<i>Hysham</i>	2	1	0	0	3
	<i>Segment II Totals:</i>	10	6	5	4	25
III	<i>Worden</i>	1	0	0	0	1
	<i>Billings</i>	3	0	0	0	3
	<i>Segment III Totals:</i>	4	0	0	0	4
IV	<i>Laurel</i>	2	0	0	2	4
	<i>Columbus</i>	1	0	0	0	1
	<i>Segment IV Totals:</i>	3	0	0	2	5
V	<i>Livingston</i>	1	0	1	1	3
	<i>Segment V Totals:</i>	1	0	1	1	3
All Segment Totals:		30	16	17	17	80