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RETHINKING DROUGHT: PLANNING FOR WATER SCARCITY AND CLIMATE  
VARIABILITY IN THE CLARK FORK BASIN OF MONTANA

By

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Bachelor of Arts, Whitman College, Walla Walla, Washington, 2006

Thesis

presented in partial fulfillment of the requirements  
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Rethinking Drought: Planning for Water Scarcity and Climate Variability in the Clark Fork River Basin of Montana

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The purpose of this thesis is to capture experiences of past drought and concerns for future drought conditions in the Clark Fork River Basin of western Montana. These findings could be used to inform drought planning in the Clark Fork River Basin and to guide basin-wide drought planning in the American West.

This thesis challenges the assumption of using drought to frame the issue of water deficiency. Deficiencies in precipitation, as a product of natural climate variability, have always existed and will always exist. Water scarcity, on the other hand, is when climate variability and human factors contribute to the lack of an acceptable quantity or quality of water to meet competing water uses.

The findings of this thesis establish a narrative on how drought and water scarcity are experienced by a broad representation of individuals, water uses, and watersheds in the Clark Fork Basin of Montana. Given those findings, this thesis presents an argument for a basin-wide approach to planning for water scarcity. Impacts of water scarcity may transcend small-scale hydrologic boundaries. Large-scale vision is needed to guide the long-term economic, cultural, economic, and ecological vitality of western Montana.

The way to achieve basin-wide planning is not directed from the basin down, but grows from the unnamed watershed tributaries up into a Clark Fork Basin Drought Mitigation Plan. This thesis could establish the foundation for an inclusive and public participatory process that leads to the development of a multi-tier, multi-tool framework that empowers local citizens to adapt to future water scarcity and climate variability.

## **ACKNOWLEDGEMENTS**

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# CHAPTER 1

## INTRODUCTION

Images of drought – desiccated puddles, dry streambeds, and brittle vegetation – in the American West and elsewhere are easily conjured, and often make national headlines. Drought has been described as a “silent and pervasive disaster” (Sheffield and Wood 2011, 9) and an “insidious hazard of nature” (NDMC 2012) that affects more people in the world than any other natural hazard (Wilhite et al. 2007). The impacts of drought have contributed to the downfall of civilizations and “there is evidence to suggest that drought may be a precursor to civil conflict and war” (Gleick 1998; as cited in Sheffield and Wood 2011, 9). Drought may also be one of the most expensive natural hazards in the United States with an annual average cost of \$6-8 billion in damages (FEMA 1995; Whilite 2000; as cited in Sheffield and Wood 2011, 9).

Despite the inherent risks and costs associated with drought, no two droughts are alike in their onset, severity, duration, or impact to local and regional communities. Drought does not have a universally accepted definition, but it is often understood as a deficiency in precipitation over a period of time that causes hardship (NDMC 2012). Given the extensive development of water storage, irrigation networks, and groundwater dependency across Montana and the American West, a deficiency in precipitation may not be a significant concern. One water policy expert in Montana suggested that “drought is an incomplete descriptive word” as it is “one way of experiencing shortage.” Water shortage encompasses many factors such as the timing of peak flows and peak demand, how someone accesses water, or how much water is needed. Instead of drought, water

scarcity and climate variability may be a more appropriate and comprehensive way of framing future water management scenarios.

The pain of water scarcity is fueling communities to develop unique adaptations to the old water rights-related adages of “first in time, first in right” and “use it or lose it” through the process of collaboration. Collaboration brings all interested parties together to share their interests and develop a cooperative approach to mitigating and responding to water scarcity concerns (McKinney and Harmon 2004). Through increased communication and cooperation, communities have found ways to expand the range of actions to cope with water scarcity, adapt to climate variability, and still protect their livelihoods and the health of the ecosystem. After recognizing that everyone has a role to play in protecting the health of the river and rural livelihoods, shared sacrifice has become the new mantra in some relatively small watersheds. While these agreements are not legally binding, nonprofits and state and federal agencies have leveraged money for increasing water use efficiency to incentivize citizen participation in sharing the water shortage.

Not all collaborative drought management agreements are informal. The Governor of Colorado formalized a state agreement when he signed the Colorado Drought Response and Mitigation Plan in 2010. A severe drought in 2002 in Colorado led agencies and decision makers to collaborate, with an extensive public participation process, in the creation of an intensive drought risk assessment and the development of a statewide drought plan (CWCB 2012). This plan increases the efficiency of communication between state and federal emergency response agencies and the local

communities experiencing a water shortage crisis. Those communities can now receive emergency support and response much more quickly than before the plan was in place.

Whether formal or informal, the concept of proactive drought planning is still a developing field, both across the American West and the United States. Slightly over thirty years ago, only three drought plans existed in the country (CWCB 2010). Today the list of drought plans across the country is quite extensive and continually growing (NDMC 2012). Given the national trend toward drought planning, it is clear that communities are becoming more concerned about the affects of drought and see a need for developing a plan to mitigate and cope with drought conditions.

### **Drought and Water Scarcity in the Clark Fork Basin**

The Clark Fork River Basin is a subset of the Columbia River Basin, an international river system, in the Pacific Northwest region of North America. After draining over 22,000 square miles of western Montana and a small portion of British Columbia, the Clark Fork River crosses into Idaho and drains into Lake Pend Oreille. Below the lake, the waters of the Clark Fork mingle with the Pend Oreille River and enter the mainstem of the Columbia River and flow west and south to the Pacific Ocean. The focus of this research is on the Clark Fork Basin that lies within the State of Montana, but it is important to recognize that this large basin is part of a much larger international river system.

Over a third of Montana's population depends on the Clark Fork River and its tributaries to meet their municipal, agricultural, industrial, ecological, recreational water needs (Swanson 2004). In the past 20 years, population growth has accelerated as people

from other states migrate into Montana (Clark Fork Coalition 2005). This rapid growth has and is continuing to change the economic and land-use demographics across the Clark Fork Basin (Clark Fork Coalition 2005). For example, some communities have seen an influx of wealth, but that income is primarily derived from investments, rather than an increase in employment opportunities. In addition, multi-generational family ranches have been subdivided into smaller ranchettes. As those demographics change, the demand for water is expected to increase and the use of water will change, such as more wells for residential use and less large-scale irrigation.

In considering the future of water in the Clark Fork Basin, it is essential to also consider the legacy of water use. From Butte to the confluence of the Blackfoot, the toxic sediments, byproducts of mining, that line the banks of the Clark Fork River create one of the largest Superfund sites in the United States. In the introduction to *The River We Carry With Us*, Emily Miller (2002, 7) writes:

The Clark Fork's bed is lined with proof of human greed, of years of laziness and neglect, our tendency toward excess, our lack of foresight. ...But each cubic foot per second of water that rolls past us offers more than these tales of despair: this same Clark Fork River remains the backbone of this place, life-giving and ancient. The Clark Fork's stories are also stories of inspiration and wonder, of human devotion and family, of the importance and power of beauty, of the remarkable resilience of nature, and maybe even the triumph of hope.

In the eddying currents of past legacies and future uncertainties lies an opportunity for reconciliation and the development of a more resilient watershed.

The inception of the Clark Fork River Basin Task Force (referred herein as Task Force) is one example of pursuing reconciliation and resiliency. During the Federal Energy Regulatory Commission relicensing process for Noxon Dam, the need for a basin-wide dialog on water and water use became apparent and the Task Force was

created in 2001 with the passage of HB 397. The role of the group, pursuant to MCA 85-1-203, was to develop a water management plan that “identifies options to protect the security of water rights, provides for the orderly development of water, and provides for the conservation of water in the future” (Task Force 2004, 1). The water management plan was developed by people representing a diverse group of stakeholder interests, with the assistance of a facilitator from the Montana Consensus Council. After two years of meetings, the Task Force created a plan that was approved by the Legislature and added to the Montana State Water Plan (Task Force 2004).

In 2009, Senate Bill 303 amended MCA 85-1-203 to require the three largest basins, one being the Clark Fork River Basin, to revise their existing water plans to include a drought management component. This drought management component should include a definition of drought, the historic legacy of drought in Montana, and a framework for mitigating drought (MCA 85-1-203 (3) (c)). Revised plans need to be submitted to the Legislature by 2015 and will be updated every 20 years (MCA 85-1-203, (3)).

A drought management component is an inevitable addition to the Clark Fork Watershed Management Plan and the Montana State Water Plan, but the planning process design and scope of this plan have yet to be determined. The information reported in this section will help to guide and inform the development of a drought mitigation and management component.

## **Problem Statement**

The literature on planning for drought is extensive, but offers no panacea. Place-based drought management plans developed for other regions may help inform and guide the planning process in the Clark Fork Basin, but those lessons are not immediately transferable.

Available water supply has always varied season-to-season and year-to-year and reservoirs and other infrastructures have been built to mitigate short-term variability. Given the changing dynamics of population growth and water use, as well as other significant factors such as climate, basin closures, and reserved water compacts that will be discussed more fully in Chapter 4, the long-term water security of various water uses or water sectors may not remain the same as in the past. The question of how future climate variability will mesh with future water demands to influence the long-term water security of communities within the Clark Fork Basin is unknown.

This thesis is an opportunity to identify the factors that are relevant in shaping the perceived scale and scope of drought and water scarcity as problems affecting water security in the Clark Fork Basin that, in turn, will shape how the basin fulfills the state mandated requirement for a drought management component. Establishing a watershed profile, such as the legal or infrastructure constraints and opportunities and perceptions of drought based on geography and water use will define the scope and the scale of the problem. Once the problem is well defined, the planning process and the scope of the intervention, or drought plan, can be explored. Interventions will fail if the parameters of the problem of drought and water scarcity in the Clark Fork Basin are not well defined –

the interventions may not even be solutions to real problems or address the full range of the problem (White 1977).

Prior research has established either very localized or very global perceptions of water scarcity. For example, Brown (2009) assessed single use perspectives (irrigators) in the lower Flathead watershed. Authors Fred Pearce (2006) and Alex Prud'homme (2011), in their respective books, describe water scarcity as an emerging global crisis due to climate change and growing populations with wide spread repercussions. Prud'homme (2011, 126) writes, “[w]hile experts don’t usually predict a massive hydrological apocalypse, they point out that local crises exacerbate many other social conflicts. They warn that two major trends, population growth and climate change, will accelerate water scarcity in coming decades, setting off a ripple effect of changes.” Zetland (2011) also traces the emerging crisis of global water scarcity, but he primarily focuses on a single tool, water markets, to resolve the issue. Currently, little research exists that integrates multiple perceptions of drought and water scarcity and attempts to offer multiple opportunities for increasing water resiliency at a basin-wide scale.

This research will help fill the existing gap by documenting a basin-wide understanding of drought and water scarcity that includes interest- and geographic-based concerns. In collaboration with the Task Force, the following research priorities and objectives were identified:

- To analyze case studies of collaborative drought planning processes and outcomes for emerging trends;
- To identify the watershed profile variables that influence the need for drought planning;

- To identify perceptions of drought and water scarcity; and
- To assess the constraints and opportunities for designing a planning process and a plan that will help the Clark Fork Basin prepare for and respond to water scarcity, drought, and climate variability.

Given these objectives, the major question driving my research is: How could a collaborative planning process develop a plan that helps communities prepare for future drought, water scarcity, and climate variability? Implicit to pursuing this line of inquiry, the following questions must also be addressed and explored:

- What is the context that led to the development and implementation of drought planning in other regions?
- How are drought and water scarcity conditions perceived by water users in the basin?
- How are drought and water scarcity conditions currently mitigated?
- What are the opportunities and opportunities for designing a planning process?
- What coping mechanisms could be improved or developed in order to promote water resiliency in the Clark Fork Basin?

This research will address those questions and outline options that could be considered in a collaborative approach to planning for drought, water scarcity, and climate variability.

## **Outline of Thesis**

Following this introductory chapter, Chapter 2 establishes a conceptual framework of watershed-based collaboration and explores how collaboration can be used to define drought and to develop drought plans. Drought and water scarcity are not just products of climate variability, but also of the political, regulatory, and economic factors

that may hinder access to an acceptable supply or quality of water. Water governance in the Western United States grants individuals a right to use water, but those individual uses create a cumulative feedback that affects all water uses on a much larger scale than the individual. Collaboration has emerged as way for interested parties such as agencies, municipalities, governments, decision-makers, and stakeholders within the watershed to resolve contentious and political disputes through dialog, rather than divisive litigation. This chapter will define watershed-based collaboration, trace its emergence as a dispute resolution and planning tool, and suggest how it could be used to define the problem of and the range of interventions for mitigating drought and water scarcity.

Chapter 3 describes the methodological approach to gathering and analyzing data. Primary source information was gathered through case study analysis, participant interviews, and participatory action research. Secondary source information was gathered through literature reviews on watershed-based collaboration, multi-party negotiation, drought, water scarcity, and water governance.

Chapter 4 establishes the research setting for the Clark Fork Basin. The context of climate, dams, compacts, and other human dimensions influence how the problem of drought and water scarcity is perceived and defined. In addition, the context of water governance will shape, either as a constraint or possible opportunity, the range of interventions and actions that could be taken to increase the water resiliency of the Clark Fork River Basin. This chapter will establish the watershed profile and water governance context for the entire Clark Fork Basin before delving into the profil of the six watersheds that comprise the basin. While basin and watershed are often used interchangeably to reference a drainage area (USGS 2012b), this thesis will always use basin to reference the

entire Clark Fork drainage area and watershed to reference the drainage areas that comprise the basin. In part, these terms will help distinguish the different geographic scales, but primarily the use of basin and watershed will follow the precedent set in the Clark Fork River Basin Water Management Plan (Task Force 2004).

Chapter 5 presents a case study analysis that explores collaborative approaches to drought planning. The first section considers three on-going examples of collaboration. Two of the examples – the Big Hole and Blackfoot watersheds in Montana – are small-scale, watershed-based planning efforts. The third example, the State of Colorado, offers insight on large-scale collaborative drought planning. Each case study offers the context that triggered planning efforts, the process design for drought planning, the collaborative outcome, and the lessons learned. This chapter concludes by examining all three drought plans for emerging trends in collaborative approaches to drought planning.

Chapter 6 focuses on the analysis of perceptions of drought and water scarcity the Clark Fork Basin in western Montana. In order to more accurately reflect the nuance, water sector perceptions – municipal, ecological, industrial, agricultural, recreational, local and tribal government, hydropower – will be analyzed by the entire Clark Fork Basin and by the six watersheds nested within the basin. Those six watersheds, as defined in the Clark Fork River Basin Water Management Plan (2004) are the Upper Clark Fork, Blackfoot, Bitterroot, Middle Clark Fork, Flathead, and Lower Clark Fork. The chapter concludes by reviewing findings in the Clark Fork Basin for emerging common principles and diverging interests.

Chapter 7 offers conclusions and implications, and identifies areas of further research. Maps, charts, and important documents are included in the appendices that follow the list of references.

## CHAPTER 2

### CONCEPTUAL FRAMEWORK

Drought and water scarcity are not just a binary relationship of precipitation and human need, but are complex and multi-faceted issues shaped not only by physical realities, but also by power and economic disparity, policy, and human manipulation of environmental process (i.e. dams, reservoirs, groundwater pumping, and irrigation).

Braden, J.B., et al. (2009, W11301) argue that “the water environment cannot be fully understood predicted, or effectively utilized without a deep understanding of the interactions between the hydrosphere and the social sphere over space and time.”

Perceptions of drought and water scarcity vary not only over time and by geographic scale, but also by stakeholder group, but also within stakeholder groups, depending on factors such as the upstream/downstream relationship, the size of the water right, means of diversion, and seniority of the water right.

Localized water uses are also affected by larger political and economic structures. For example, irrigators switching from flood to sprinkler irrigation in order to increase water use efficiency may become burdened with large payments to the bank. Ditches are relatively cheap to maintain and use, but sprinkler systems require electricity. An increase in the cost of energy could prevent an irrigator from using the sprinkler system, and trigger a switch back to flood irrigation and an increased demand for water.

Environmental issues are not just ecological issues requiring policy solutions, but rather “at their core, social and political problems, [...] and therefore [demand] a theoretical foundation to analyze the complex social, economic, and political relations in which environmental change is embedded” (Neumann 2005, 5).

Water management is “not simply a matter of better understanding flows or contaminants, or optimizing engineered systems” (Braden et al.2009, W11301) but it also requires understanding the cultural association of water use, the cumulative affect of individual uses on the basin, and how infrastructures mediate variability in supply and demand. Given that water flows along hydrologic boundaries, yet policy operates along individual, county, or other right-angled property and jurisdictional lines, collaboration and consensus building have emerged as a way to promote dialogue across jurisdictional lines and along watershed boundaries. Such an integrated and nuanced understanding of the relationship between people and water in a hydrologic unit can lead to better decision making regarding how water is used in increasingly complex situations and in an uncertain future.

This chapter will explore the possible roles of watershed-based collaboration and consensus building in planning for and responding to drought and water scarcity conditions. The first section, “Thinking Like a Watershed Community,” traces the emergence of the watershed perspective. The second section, “Planning Like a Watershed Community,” defines watershed-based collaboration and consensus building and articulates how collaboration and consensus are used as tools for resolving conflict and developing comprehensive water plans. Success, as described by proponents of collaboration, is often measured not just in the quality of the outcome, but also in the long-term relationships and trust that is built among parties in the community. As such, measuring the tangible and intangible benefits of collaboration is challenging. This section will also explore critiques of collaboration and offer a framework for measuring the short- and long-term success.

The first two sections establish a conceptual framework of watershed-based collaboration; whereas, the third and fourth sections delve into the application of watershed-based collaboration to the problems of defining drought and developing a drought mitigation plan. The third section, “Defining the Scale of Drought and Water Scarcity Planning,” asks at what geographic scale, either how big or how small, should the planning take place. The fourth section, “Defining the Scope of the Drought and Water Scarcity,” is a review of literature on drought and water scarcity and explores how those terms are defined, perceived, and how drought and water scarcity affect watershed communities. Since drought and water scarcity are not easily identifiable hazards like tornadoes or hurricanes, collaboration is a tool that can help communities identify common concerns.

### **Thinking Like a Watershed Community**

Watershed-based collaboration emerged as a planning and dispute resolution tool in the 1990s, but, conceptually, planning along watershed boundaries has been around for a long time. Wescoat and Halvorson (2012, 1) write,

“[w]hile local societies no doubt understood physiographic drainage processes from antiquity, the pluvial origin of springs and thus of watershed discharge was not established until the 17<sup>th</sup> century. Once established, watershed concepts acquired expanding significance for landscape mapping and management, from the local- to continental-scale basins.”

This section will trace the evolution of the watershed concept as a way of seeing the landscape and as a way of thinking about water management.

Geographer Denis Cosgrove (1984, 55) wrote “landscape is thus a way of seeing, a composition and structuring of the world so that it may be appropriated by a detached,

individual spectator to whom an illusion of order and control is offered through the composition of space according to the certainties of geometry.” The landscape of the American West, through public sentiment and policy, was composed in a way that quickly transferred vast public wealth into the hands of private citizens. Surveys were conducted along parallels and property lines were drawn geometrically. Such gridded order and delineation of property and resource use was possible in temperate Europe and the eastern United States, but not in the arid American West, at least not in a way to support long-term sustained development and ecological viability.

Even as the United States was in the process of enacting the Homestead Act and other legislation to encourage frontier settlement, the roots of a land ethic and sense watershed community began forming as pragmatic, observant individuals began to make correlations between human actions and the long-term well-being of the landscape. George Perkins Marsh is often described as the father of the environmental movement (Lowenthal 2000). Epithets aside, *Man and Nature*, written by Marsh in 1865, is a comprehensive documentation of the human – environment relationship. In writing the book, Marsh wanted to “indicate the character and...the extent of the changes produced by human action in the physical conditions of the globe we inhabit,” to communicate the dangers of the actions creating such changes, “to suggest the possibility and importance of restoration,” and to illustrate that although humans are “of a higher order than any of the other forms of animated life” both humans and animals “are nourished at the table of bounteous nature” (1865; iii). *Man and Nature* not only outlines the downfalls of short-term, economically beneficial policies of resource utilization, but also recommends an alternative, one that is much more far-sighted.

*Man and Nature* is consistent with the dominating perceptions of the economic utility of the landscape, but deviates in a very important way. Marsh wrote in an era that had just passed the Homestead Act and most of the western frontier remained unsettled wilderness; not many people were concerned with running out of resources. Despite that context, or perhaps because of it, Marsh proposed that since humans rely on the earth and its natural resources for our survival, we should take care of it so that earth can continue to support human inhabitation. While utilitarian in nature, Marsh's proposed framework challenged people to ask not how quickly the American West could be logged, irrigated, and mined, but how the American West could be settled with a sense of permanence and durability.

Perhaps, Marsh could more aptly be described as the father of the intentional, sustained use of natural resources. Because, according to biographer David Lowenthal (2006, 6), "Marsh framed his warnings within an accepted goal of environmental exploitation; he disputed not the desirability of conquering nature but the bungling way it was done," Marsh's teachings were not as controversial as Rachel Carson's *Silent Spring* (1962) would be one hundred years later. Some citizens were concerned that depleted resources would ruin commerce and were willing to entertain ideas of sustained yield. However, they were only willing to implement the conservation efforts that were convenient and beneficial to their own self-interest. George Perkins Marsh and his writings reflect a shift toward the a framework of long-term sustained settlement of the American West, rather than continuing to support policies that encouraged transferring public resources into private hands.

While George Perkins Marsh was laying the foundations for a conservation ethic, John Wesley Powell was subsisting on moldy bacon at the bottom of the Grand Canyon – an adventure that would lay the foundations for watershed management. Powell and Marsh were not quite colleagues; Powell would have been aware of *Man and Nature*, but Marsh died before Powell presented his thesis for the development of the American West, which was largely dismissed and replaced with policies more amenable to rapid distribution of land and individual acquirement of private property.

Land in the West was worthless without water. With water, the market value of land jumped to \$30 an acre with the potential to add \$3 billion dollars to the national bank account (Worster 2001, 473). Settling the West was thus very appealing to politicians and homesteaders alike; everyone wanted a share of the wealth. After surviving two trips down the Grand Canyon, John Wesley Powell produced his seminal *Report on the Lands of the Arid Region of the United States* (herein referred to as the *Report*). In the *Report*, he declared that the current 160-acres-and-a-mule system of settlement would not work west of the 100<sup>th</sup> meridian, a region that received less than 20 inches of rain annually. Much larger homesteads, argued Powell, were needed to support dry land ranching, but 80 acres of irrigated land could support a family farm (Powell 1878; Stegner 1962, 40). By Powell's calculations, even if all the rivers in the American West were dedicated to irrigation, only 20% of the arid region could become irrigable (Stegner 1962).

The West could be settled, but it needed to take place using a controlled and deliberate approach. According to Powell, the central tenets to watershed management included: alignment of political boundaries with watershed boundaries, water as a locally

managed, publicly held resource, and small-scale irrigation projects. Powell (1890, 114) wrote:

Thus it is that there is a body of interdependent and unified interests and values, all collected in one hydrographic basin, and all segregated by well-defined boundary lines...The people in such a district have common interests, common rights, and common duties, and must necessarily work together for common purposes.

Watershed management would unify communities along physical boundaries and promote local, democratic control of resources. The United States' government should sponsor surveys that would assess the land by watershed boundary – how much irrigable land, how many people the watershed could support, and identify potential reservoir sites.

The blueprint for western settlement, outlined in the *Report*, embraced “democracy, localism, [and] community self-reliance;” these ideals are canons of the American West, and yet the public, for several reasons, dismissed the *Report*. Primarily, Powell challenged the mainstream enthusiasm for western expansion. Powell suggested that settlement should take place only after detailed surveys were conducted and a sort of zoning could be established. Such a detailed survey would require \$5.5 million dollars and a freeze on homesteading activities for five years while Powell and his men were compiling data (Worster 2001, 473). Eastern Congressmen did not want to invest that much capital into the frontier and potential homesteaders did not want to wait for a government survey to be completed.

Secondly, his report was incomprehensible to most people. Powell was asking Americans to drastically reshape their perspective toward landscape. Right-angled survey lines are indifferent to physical geography. As such, linear perspectives enable a lack of intimacy and understanding between people and the landscape. The gridded lines draw a

more hierarchical relationship between landscape and humans, humans being the dominant power. Drawing county lines by watershed boundaries and limiting settlement based on water availability threw linear order and expedient settlement of the frontier out the door. The public would not embrace Powell's ideals until many decades after his death, once more people started to realize the shortcomings of the existing land and water management regime.

George Perkins Marsh and John Wesley Powell were both very pragmatic men with very practical, albeit far-sighted, recommendations for western settlement. Frederick Jackson Turner takes a much more reflective approach. Writing in 1893, he had the advantage of looking at the intersection of the "colonization of the Great West" and future American development (as cited in Turner 1920, 1).

Frederick Jackson Turner reviews the history and attitudes associated with settling the frontier. He points to the free land and limitless economic opportunity available in the West. Vast wilderness, perceived as limitless, facilitated a lack of incentives to care for the long-term health of the land. Legislation and infrastructure expedited the disposal of federal lands into private control. Turner observed that growing economic independence from the East and from Europe marked westward settlement. These events did not happen in isolation of public attitude; free land shaped the American ethos, just as our culture shaped the landscape.

The West and the opportunities available influenced American culture. In *The Significance of the Frontier in American History*, Turner (1920, 37) writes,

That coarseness and strength combined with acuteness and inquisitiveness; that practical, inventive turn of mind, quick to find expedients; that masterful grasp of material things, lacking in the artistic but powerful to effect great ends; that restless, nervous energy; that dominant

individualism...--these are traits of the frontier, or traits called out elsewhere because of the existence of the frontier.

Rugged individualism, democracy, and the freedom to pursue economic opportunity are American values founded in our frontier history. These values contributed to widespread deforestation, a loss of species, and other environmental degradations; however, those values are also entrenched in what it means to be an American. Such values have been a “dominant fact” and “American energy will continually demand a wider field for its exercise. But never again will such gifts of free land offer themselves” (Turner 1920, 37). Homesteaders arrived to the West from around the world; in settling the West, they created a uniquely American ethos. The frontier is closed and that ethos and energy must now be directed toward a new frontier: creating a durable and resilient society in the West (Turner 1920).

Fast-forward ninety years, and water resources are a closed frontier. In Montana, many watersheds or areas are closed to the development of new water rights. Even those areas that are still “open,” an individual can no longer install a diversion and start using water, as was the case pre-1973 before the Montana Water Use Act. Going through the process of acquiring a paper water right does not guarantee “wet” water, but simply a place in line if natural conditions provide an above average volume of water. A water right with a contemporary priority date may not be a reliable means of accessing water every year.

In *Sand County Almanac*, Aldo Leopold (1949) integrates pragmatic conservation policy and morality to prescribe what he calls a “land ethic” for the American people. Leopold builds on the practical recommendations of George Perkins Marsh and John

Wesley Powell to suggest that humans are ethically obligated to practice landscape and resource stewardship.

Under the influence of Gifford Pinchot, the first secretary of the United States Forest Service, conservation practices had developed primarily with economic motivation and with an emphasis on developing resources for the best human use. Forests were managed for a sustained yield of lumber with little or no consideration for wildlife habitat. It was very common, among federal land managers, to look at land management much as farmers did: only in terms of utilitarian principles. Even Leopold began his career as a believer in utilitarian conservation; however, with time and experience, he saw an inherent weakness in utilitarian conservation. He felt that “[o]ne basic weakness in a conservation system based wholly on economic motives is that most members of the land community have no economic value” (Leopold 1949, 210). Leopold’s proposed land ethic was an attempt to move away from a purely utilitarian anthropocentric perception of the landscape and represents an increased understanding of the complexity of ecosystems.

An increase in federally managed lands, according to Leopold, could not be the only tool to fulfill conservation needs. Leopold did not disapprove of government conservation; in fact, he believed that a “growth in government conservation is proper and logical, some of it inevitable” (1949, 213). However, Leopold also suggested that the temptation to use government agencies to fulfill all conservation responsibilities possessed several inherent weaknesses. Leopold realized that government conservation was limited to the protection of public lands. Federal agencies had, in Leopold’s day, no jurisdiction or power to regulate habitat quality on private land holdings. Valuable habitat on private land was more and more frequently erased to meet the expanding demands for

agriculture and urban areas. Since two-thirds of the United States is private land, something more than government conservation on public lands was required for the sustained health of ecosystems.

Individual involvement on private lands was necessary to share the burden of conservation responsibilities, but would not be achieved by an extension of federal policy superimposed on existing beliefs. Leopold felt that there was no existing incentive, either regulatory or economic, strong enough to for individuals to reconcile those ideals outside of the national parks and national forests.

To compensate for regulatory shortcomings, Leopold suggested that we needed to re-examine our beliefs and our education in addition to establishing federal land management policy. Without a corresponding overhaul in beliefs, innovative land management policy imposed on citizens was ineffective due to the lack of public support. According to Leopold (as cited in Meine 1988, 363):

Any program, to be effective must be premised first of all on a revision of the national attitude toward land, its life, and its products...[O]wnership and use of land entails obligations and opportunities of trans-economic value and importance... [U]ntil this concept of land becomes an integral part of the national philosophy, conservation can be nothing but makeshift.

Government regulation was implemented with the hope that change would filter from the federal level down to the people who worked and lived on the land. Leopold, on the other hand, felt it was most effective to facilitate change from the ground-up. To be successfully implemented and upheld over time, conservation ideals must be rooted in personal conviction and education, an idea that Leopold summarized as a land ethic.

Leopold did not intend that his land ethic would or should replace government conservation, but rather a land ethic would augment it. Federal legislation, designated

wilderness in particular, was only the first step in an attempt to preserve the stability, integrity, and beauty of the land. Reservoirs of agency-managed land could not possibly encompass enough land to truly achieve permanence of the land ecosystem or resilience of the watershed. The land ethic would integrate conservation responsibilities onto private land. Federal conservation is thus not separate from a land ethic, but is one manifestation of a society possessing a land ethic.

Leopold's land ethic, while very similar to Powell's watershed based planning concept, presents several differences. The most obvious is that, had more people supported him, Powell could have minimized the linear settlement of the West. Montana could have had county lines based on watershed boundaries. The gridded jurisdictional boundaries were firmly in place when Leopold started working for the U.S. Forest Service; a land ethic was a theoretical means of reconciling mismatching management and ecological boundaries. A land ethic also specifically challenged people to think beyond their immediate economic gain and offered a philosophical framework in which to proceed.

Legal scholar Charles Wilkinson (1993) builds on Leopold's call for a land ethic and presents an argument for an "ethic of place" based along watershed boundaries. Resource management, land use, and growing populations have fueled contentious debates over the development and on-going management of the American West. As Wilkinson (1993, 131) observes, "[t]he contentiousness has rarely created satisfactory or lasting results." As a result, Wilkinson (1993, 131) continues, "the process tears at our sense of community; it leaves us more a loose collection of fractious subgroups than a coherent society with common hopes and dreams." Rather than county lines, "the most

relevant boundary lines for an ethic of place in the American West accrue from basin and watershed demarcations. The region is marked off by water, or more accurately by the lack of it” (Wilkinson 1993, 135). An ethic of place is a way of developing a sense of community along hydrologic boundaries and working to build relationships fostered by cooperation and shared vision, rather than animosity.

Marsh, Powell, Turner, Leopold, and Wilkinson were and are very pragmatic resource managers and scholars, but their writing primarily serves a visionary role. Collectively, they predicted and witnessed the transformation of the seemingly endless frontier into a region with major urban areas with finite resources. They saw the end of accessing water by simply digging a diversion and starting to irrigate and an increase in conflict over access and use of resources. To promote sustainable settlement of the West, they called for citizens to gather, along watershed boundaries, to generate a sense of community, to cooperate, and to create a shared, long-term vision for their communities.

### **Planning Like a Watershed Community**

The prescribed ethic of place, or a watershed ethic, cannot be legislated into place, but has to emerge from the ground up. Although Powell, Leopold, and company did not suggest mechanisms for implementing their visions, collaboration and consensus building are two tools, albeit grounded in their own literature, that have emerged as means of implementing and working toward an ethic of place. Collaboration is the practical application of an ethic of place; it creates a space for local voices to develop a long-term vision for the community through a democratic process. The relationship to place is often

what motivates people to collaboration and consensus building. As Brick and Weber (2001, 16) observe:

In short, place is both a physical and political space with powerful implications: Place is almost universally understood by collaborative advocates to be the foundation and catalyst for enlightened self-governance, despite the differing interests that loggers, ranchers, environmentalists, Native Americans, kayakers, hunting guides, county officials, land managers, and other interested citizens bring to the table.

The previous section traced the emergence of looking at landscapes and place by topography, watershed boundaries, and ecosystems rather than just by political boundaries. This section will define collaboration and consensus building, explore how those tools are used in planning processes, resolving disputes, and building community, and offer suggestions for measuring success.

### *Collaboration*

The story of settling the American Frontier is, in large part, the story of transferring public wealth into private hands. In *The Western Confluence*, McKinney and Harmon (2004, 31) observe:

Settlement, and all of the commercial activity it entails, was in large part a process of claiming *public* land, water and other resources for *private* use. Competition for and privatization of these resources drove many of the earliest disputes in the West. Today, these forces continue to provoke debate and generate potential strategies for resolving conflicts over western resources.

Contention over western resources and water is not new. Indeed, the adage of “whiskey is for drinking, water is for fighting over” that is often attributed to Mark Twain still rings true. But the dynamics of resource conflicts have evolved as more people settled in the

American West, urban centers grew, and new values, such as instream flows and environmental quality, have emerged.

Disputes over use of and access to resources can be resolved in any number of ways. McKinney (2001) distills dispute resolution into four succinct trends: who is right, who is more powerful, reconciliation, and public participation. He (2001, 34) suggests that power-based resolution “imposes some type of action and associated cost upon others.” This could take the shape of a ballot initiative – majority rule – or lobbying and other coercive measures. In this case, whoever can garner the most public support or the support of key decision makers wins. Rights-based resolution, McKinney continues, typically relies “upon some independent, legitimate, and fair standard to determine rights or rightness” (2001, 34). In water management, that fair standard is the prior appropriation system. Water use, in times of scarcity, is granted to the person who can claim seniority. Both power- and rights-based decision structures produce win-lose situations and often the tension surrounding the issue and the divide in the community remain.

Out of frustration with rights- and power-based decision structures and the lack of ensuing resolution, in the 1990s, citizens began to assemble to address local issues through dialog and cooperation, rather than litigation. These gatherings arose from:

the growing recognition that lawsuits, lobbying campaigns, administrative appeals, and other straight-line approaches to hard environmental issues are often narrow, usually expensive, and almost always divisive in ways that reverberate beyond the immediate issue in dispute (Snow 2001a, 4).

Management and regulation along existing jurisdictional boundaries, the ones created to expediently settle the West, were not effectively resolving the issues that arose after the

West was settled. Public participation and reconciliation, as dispute resolution trends, emerged, in part out of the frustration with rights- and power-based decision-making.

Public participation provides a space for citizens to provide input in the decision making process. That space, however, may be more symbolic than substantive. McKinney (2001, 36) observes, “[t]he input and advice of citizens may be necessary to develop effective public policy, but they are rarely sufficient to build agreement among diverse interests.” Citizens and stakeholders, during the public input process, often put forth competing viewpoints, leaving decision-makers with the task of making the tradeoffs. Public participation creates a space for individuals or interests with less power or less rights, but it may not be any less divisive or contentious than rights- or power-based decision making structures.

Reconciliation requires collaboration and consensus. As McKinney (2001, 35) writes, “collaboration is not something you do with the enemy to betray your friends. Rather, it refers to a process whereby a group of people work together to achieve a common purpose and share resources.” Collaboration and consensus are often used interchangeably, but the terms describe slightly different, although not mutually exclusive, processes. Collaboration offers a framework for bringing stakeholders, decision-makers, and other interested parties together to negotiate solutions for working together, whereas consensus refers to unanimous decision-making. A collaborative process may require a decision by consensus, or it may serve a more informal and advisory role that strives for consensus.

Collaboration emerged out of frustration with the regulatory gridlock and gained national attention as interested parties, who were willing to work together, reached

agreements and found ways to work together. Many of those collaborations were ad hoc and informal and touted the benefits of long-term relationship building over short-term successes. However, those successes were met with some, albeit justified, skepticism. In the essay “Are Community-Based Watershed Groups Really Effective? Confronting the Thorny Issue of Measuring Success” Douglas S. Kenney (2001, 190) posits that

While many elements of that [relationship building] argument are indeed compelling, ultimately I suspect that most observers believe that any real definition of success must require achievement of – or real progress toward – on the ground goals in resource management or conservation. Only if they are a means to a practical end do the “feel-good” products of collaborative-based processes merit the enthusiasm that many parties, myself included, have expressed.

Successful collaborative decision-making cannot just be measured by the process, but also by the outcome of the collaborative process.

Collaboration can be a legitimate means of building relationships and resolving contentious issues; however, it can also be “used coercively to create local resource management plans in ways that may or may not empower local people” (Brosius et al. 1998, 158). For example, Nevada County once represented the heart of California’s “Gold Country” – logging, ranching, and mining were the economic backbones. The traditional resource based economy has been in the decline since the 1950s, but proximity to scenic amenities and Sacramento was a “magnet for ‘exurban’ migrants” (Walker and Hurley 2004, 740). This migration created a change not only in the physical landscape, as ranches were subdivided, but also in the cultural and political makeup of the county (Walker and Hurley 2004, 740). As a result, contemporary Nevada County “has a predominately conservative population that wants protection of environmental qualities, but without top-down regulation – seemingly fertile ground for collaboration” (Walker

and Hurley 2004, 740) and development of the Natural Heritage 2020 plan, a collaborative approach to county planning. History, however, would come back to prove otherwise. In 1992, the planning director organized stakeholders to make recommendations for the 1995 General Plan. Their recommendations were grounded in allowing growth while also protecting rural qualities of the county.

In 1993, the Board of Supervisors, predominately pro-growth, dissolved the citizen committee and implemented pro-growth policies that fit their goals – an excellent example of containing the collaborative process (Walker and Hurley 2004, 740). The dismissal catalyzed a movement to “campaign against pro-growth political candidates,” but “*not* to reform” the public participation process. The rise and fall of the Natural Heritage 2020 was rooted in the perception that the “environmentalist” Board of Supervisors was using their power to implement their agenda of protecting open spaces and limiting growth. Many community members did not support the goals of Natural Heritage 2020 and felt that supporters were reciprocating the 1992-93 “public participation” plan. This perceived threat to their interests and livelihoods lead to the derailment of Natural Heritage 2020, in part, through the political defeat of the “environmentalist” board in the 2002 elections.

Nevada County offers a case study of how and when the collaborative process may not apply to a situation. The authors suggest that politics and history, in addition to a flawed collaborative process, sealed the demise of Natural Hertiage 2020. A perfect process may not have produced a different outcome, but it could have unfolded in a way that better addressed the history of the county and used diverse stakeholder perspectives to develop not only the plan, but also the goals of Natural Heritage 2020.

Out of the skepticism and out of practical experiences, practitioners of collaborative planning have contributed to a vast body of literature on key principles and frameworks for designing and evaluating a successful collaborative planning process.

Innes and Booher (2010, 89), prolific writers on collaborative planning, write:

Effective collaboration depends on praxis. That is, it depends on extended practical experience deeply informed by theorizing and reflection. Those who engage in collaboration build their capacity and intuition about how to proceed, while at the same time building theory about when and how collaboration can work.

Collaboration, as an organic and place-based process, is often as diverse as the situations in which it is used. The Center for Collaborative Policy (2012) at Sacramento State provides a comprehensive reading list and identifies approximately 50 different theoretical frameworks for designing and implementing a collaborative process (McKinney 2010). Out of that extensive body of literature, the framework identified by Innes (1999) emerges as one of the most comprehensive and reflective in the field of collaborative planning.

The collaborative process can be evaluated using criteria established by Judith E. Innes (1999) in “Evaluating Consensus Building,” a chapter she wrote for *The Consensus Building Handbook: A Comprehensive Guide to Reaching Agreement*. Innes’ criteria will be listed here and then described more fully below. The Innes process evaluation criteria includes: diverse perspectives, purpose driven, self-organizing, civil discourse, adaptive learning, challenge assumptions, sustains participation, and seeks “consensus only after discussion fully explore the issues and interests and significant effort was made to find creative responses to differences” (Innes 1999, 650). While Innes does not suggest that all criteria must be met by all collaborative planning processes, success is more likely as

the process embraces as many of the following categories as possible in a meaningful and on-going manner.

Diverse perspectives: In a later work on collaborative planning, Innes and Booher (2010, 101) write, “[i]nitiators of a collaborative process are often resistant to the idea of inclusion. It is easier to make a decision if one does not include a difficult stakeholder or an interest that seems antithetical to the goals the organizers have.” However, the absence of a key party or interest may undermine the long-term viability of any decision that is reached. In a particularly complex issue, it might be difficult to identify all the relevant interests, and in a divisive issue, everyone may not be willing or ready to work together. It is essential, then, that the list of stakeholder participants is not static, but rather is adaptive and inclusive as new parties are recognized or express an interest in coming to the table.

Disputes over water or other natural resources often do not have an easy either/or solution. Often more than two parties have a stake in the outcome, and it is often unclear who the affected parties are or how many of them should be included. The Confederated Salish and Kootenai Tribes, municipal water providers, environmental organizations, irrigators, hydropower companies, and county commissioners all have a stake in the future of water management in the Clark Fork Basin, yet they all have very different interests, ranging from sovereign to concerned citizen, in water. Power disparities can be managed by creating an inclusive and neutral forum to discuss interests.

The tension between diverse perspectives and decision-making authority, while challenging for a process manager, may actually contribute to the success of collaborative planning. Innes and Booher (2010, 104) write that such tension is:

an essential source of the creativity that allows forward movement in the face of stalemate. ...Being stuck is not only frustrating, it may give stakeholders permission to let go of assumptions, revisit their own attitudes and objectives, and search for new strategies.

In letting go assumptions, participants may find a need for new information, ways to reframe the issue, or other creative and productive ways to move forward. For example, using an example from Fisher, Ury, and Patton (1991), two sisters think they are competing for the same orange. After talking about their interests, not just their need of the orange, it is revealed that one sister needs only the peel and the other just wants to eat the orange. By working together, the sisters created a win-win situation. Had they just split the orange evenly, the sister who wished to eat the orange would have received a smaller benefit than in the first situation.

Purpose driven: The purpose, according to Innes (1999, 648), should be both “practical and shared by the group.” It is not practical to use collaboration for rapid decision-making, for example. Collaboration is better suited to complex situations such as developing a budget or land-use plan (Innes 1999). The purpose, Innes (1999, 648) continues to say, “must be broad enough to allow people with differing perspectives to share it, but concrete and important enough to assure members that their energy is well spent working on it.”

Self-organizing: According to Innes (1999, 648), a self-organizing process “allows participants to set their own ground rules and determine their own tasks, objectives, and discussion topics.” This gives participants a sense of ownership in the process and allows them to customize the process to meet their needs and concerns. Without a sense of ownership in the process, Innes (1999, 648) observes, participants “may assume a less active role in the learning and decision-making taking place.”

Civil discourse: The collaborative process should facilitate respectful dialog and create spaces for participants to speak and listen. Innes (1999, 648) writes that, “[i]n this type of dialog, each participant has the opportunity to assess the sincerity and legitimacy of the others, assess the scientific accuracy of the information, and understand what others are saying.” The role of the process manager is to facilitate the conversation and make sure that all parties have opportunities to speak and that the group understands what is being said.

Shared learning or joint fact-finding: In order to make an informed decision, the participants “must be aware of and learn from facts, scientific knowledge, and first hand experiences relevant to the issue” (Innes 1999, 649). Often, Innes (1999, 649) continues, this learning process takes place “through joint-fact finding, in which stakeholders and experts work together to collect and analyze information.”

Challenge assumptions: Brainstorming sessions should enable and encourage participants to state ideas that may seem crazy or outside of the box. Indeed, as Innes (1999, 649) writes, “[one] of the greater benefits of consensus building is its capacity to identify new directions and new ideas that would not otherwise be considered by an agency official or a chief executive, both of whom must make decisions within existing resource and institutional restraints.”

A local example of thinking outside the box came in the early 1990s, in the midst of a contentious gridlock between irrigators and the Department of Fish, Wildlife, and Parks over the reservation of instream flow water, in the Upper Clark Fork River. After “tense and stiff” meetings, a breakthrough came when a rancher suggested that the Upper Clark Fork be closed to the development of new water rights during a contentious

gridlock as a way of protecting both senior water rights and decreasing the threat to instream flow protection (Snow 2001b, 95). In a state that adheres to a strict policy of prior appropriation, such an idea seemed heretical at first, but then both groups began to see the benefits of basin closure. That suggestion of basin closure, and subsequent agreement, paved the way for the development of a formal Upper Clark Fork Water Management Plan, but that consensus would not have been possible without creative brainstorming.

Sustains participation: Innes (1999, 649) frankly observes that, “[no] process can work if it fails to keep participants engaged.” Humor and informal gatherings are important aspects of keeping participants interested and willing to continue attending meetings. In 2010, Innes and Booher go on to describe the incentives that motivate participants. They (90) write:

Each of the comparatively successful collaborative dialogues had a compelling incentive structure that encouraged the necessary players not only to participate, but to stay at the table and work toward agreement. In the language of negotiation theory, the stakeholders’ BATNA was not as good as the opportunities presented by multi-way dialog.

A stakeholder’s BATNA is their best alternative to negotiation. When the best alternative to negotiation is highly uncertain, such as in litigation, or highly undesirable, then the motivation to participate in on-going collaborative planning processes is very high.

Decision rule: Under this criterion, Innes (1999) emphasizes that a consensus decision should only be reached after participants have had sufficient time for shared learning, for brainstorming, and for discussion. Consensus is often a goal of collaborative planning, however, it is only one possible decision making rule; for the purposes of the comparison of case studies, this thesis will look at how each process approached

decision-making. The decision rule should be clearly established during the process design to eliminate ambiguity when it comes time to make a decision.

Collaborative planning processes, when deliberately designed and implemented, are an experiment in grassroots democracy and policy making. Geographer Gilbert White (1977), a leading scholar on natural hazards, demonstrates that the collaborative framework can be used to reshape the way humans perceive environmental issues and hazards. In shifting from a single use perception of the landscape to multi-purpose, the range of perceived alternatives and costs and benefits is expanded. The economic benefits of an engineered river suitable for transportation can and should be weighed against the social cost of relocating communities and the environmental cost of harnessing a river. White (1977, 10) writes, “to concentrate upon one measure to the exclusion of others and to fail to seek optimal combinations of measures suited to the local landscape is to court economic loss and landscape degradation.” Existing water policies and regulatory frameworks will not be overturned, but through cooperation across jurisdictions at watershed scales, there is an opportunity to democratize water planning to create a sustainable and durable watershed community.

Through cooperation and creative thinking, communities can have a role in planning for their future. As Innes and Booher (2010, 10) argue, “collaborative processes can lead to changes in the larger system that help make our institutions more effective and adaptive and make the system itself more resilient.” Prior appropriation will remain the central dogma of water management, but, as seen in the Upper Clark Fork of Montana, collaboration can lead to interesting new adaptations and increased flexibility within the existing institutional framework.

## **Defining the Scale of Drought and Water Scarcity Planning**

Collaboration, writes Sarah van DeWetering (2001, 2), is a movement that “emphasizes the importance of local participation, sustainable natural and human communities, inclusion of disempowered voices, and voluntary consent and compliance rather than enforcement by legal and regulatory coercion.” Initially, collaboration was seen primarily as an emerging tool for resolving natural resource disputes. However, as Kemmis and McKinney (2011, 15) trace the emergence of collaborative decision making, they observe:

Multiparty collaboration partakes elements of alternative dispute resolution and deliberation, but it also exhibits unique features that justify its treatment as a separate species of democracy. In terms of the evolving ecology of democracy, collaboration seems to have arisen as a direct response to some of the shortcomings of the late 20<sup>th</sup>-century framework of procedural democracy.

Where procedural and unilateral decision making had been failing to address communities’ needs and, in a tangled setting of regulations and jurisdictions, slowing or preventing action, through the act of individuals coming together, communities were reaching agreements and finding new ways of moving forward.

While the role of place and relationship to place is often a factor in bringing participants into a collaborative process, the question of scale – either how big or how small – emerges. Kemmis and McKinney (2011, 9) describe that as the challenge of integrating and addressing the “interests of the one, the few, and the many.” They don’t trace the history of democracy, but argue that westward expansion and a shift from “face to face” democracy to a representative democracy set the stage for the emergence of collaboration and local decision-making. They (2011, 11) go on to say:

Face-to-face democracy had been, to a large extent, re-created in the town meeting democracies of New England... But what the Founders and successive generations of American political leaders had to do in order to make the 'extensive republic' work was to replace face-to-face democracy with a representative form of government (already well-developed in England) where the problem of the one, the few and the many was addressed by allowing sovereignty to be exercised by a subset of the people (the few), chosen by the many through the mechanism of election.

In the American West, increased governance by the few through bureaucratic decision-making was the product of rapid westward expansion. As governance and decision-making moves more toward the few, those structures become less responsive to the needs of the many and "citizens began to feel shut out of those decision processes" (Kemmis and McKinney 2011, 12).

As such, collaboration is an experiment in an alternative form of democracy. Instead of traditional representative democracy, collaboration provides a renewed opportunity for face-to-face democracy and is a "pragmatic response to the slowly accumulating evidence that our historical experiment with proceduralism has had mixed results at best, and at worst, simply does not work" (Kemmis and McKinney 2011, 18). To return to the question of scale, it seems that the foci of environmental conflict has been between the few and the many. Collaborative decision-making has been successful, not by sidestepping or eliminating the decision-making authority of the few, but rather, by bringing the few and the many together. But, as Kemmis and McKinney (2011, 19) observe:

Since its earliest emergence, this form of democracy has been quintessentially organic. While agencies now promote collaboration in a variety of ways, this particular 'wetlands of democracy' has not established its foothold on the landscape at anyone's direction or by anyone's design; in its native form, it has been almost entirely undirected and has most often occurred without any official sanction or any clear way of connecting to the existing decision structure.

Collaboration has succeeded not because of a directive from the few, but rather by popular demand of the many.

Given that resource use often does not align with political or jurisdiction boundaries, hydrologic units have emerged as a “popular scale for watershed governance” and as a way to define the boundaries or geographic scope of collaborative initiatives (Cohen and Davidson 2001, 1). Physical geography marks watershed boundaries, but a drainage area could refer to an unnamed creek or the entire Columbia Basin. Using physical boundaries is a seemingly objective way of bringing the many different layers of governments and interests to the table. Federal agencies and tribes have sovereign interests in water. Municipalities have public health obligation to provide their customers with water for drinking and public health. However, choosing the scale and boundary of watershed planning is a political decision (Blomquist and Schlager 2005; as cited in Cohen and Davidson 2011) and by merely rescaling the geographic boundaries – either down from the “few” or up from the “many” – “does not in and of itself empower local or non-governmental actors and there does not appear to be anything inherently participatory or empowering about rescaling” (Cohen and Davidson 2011, 4).

Another challenge to the watershed approach is accountability and asymmetry to a “policy-shed” since no elected official or agency has complete jurisdiction. A watershed is not a “policy-shed”(Cohen and Davidson 2011, 5) that allows for the “many” to hold the “few” accountable through elections or other traditional means of accountability. Rather than holding those officials accountable through the tradition decision making process, “[i]n the case of the watershed approach, the accountability challenge can be seen as a function of the process through, and the degree to which,

participants and stakeholders have been involved in the decision-making process” (Cohen and Davidson 2011, 3).

Another problem with the watershed scale is the asymmetry between watersheds and problem-sheds. Cohen and Davidson (2011, 4) observe that “watersheds frequently impact – and are impacted by – factors outside of their boundaries. In other words, watershed boundaries (or, for that matter, any other boundaries) rarely encompass all of the physical, social, or economic factors.” Given the challenge of defining scale and other issues such as accountability and asymmetrical boundaries, Cohen and Davidson (2011, 11) go on to argue that “watersheds [should] be re-framed as tools, or choices, that can be marshaled in support of particular policy goals, rather than as mandatory, unquestionable starting points for effective water governance.” This is not just a question of the few or the many, but rather of developing policy at a geographic scale that is small enough for local solutions to emerge from the tributaries, yet large enough that those solutions can grow into a framework capable of addressing the full scope of the problem or the issue. To use a water example, impacts of climate variability may be a global or multi-state problem-shed, yet response mechanisms to that variability may emerge from local actions that are coordinated by a level that fits somewhere in the middle.

### **Defining the Scope of Drought and Water Scarcity**

The above sections analyzed the evolution of rethinking frameworks for making policy and the scale at which policy could or should be made. In a collaborative planning process, one common aspect that brings and keeps participants at the table is a well-defined problem. This section will explore definitions of the problem of drought and the

challenge of getting participants to the table for drought planning. As mentioned earlier, drought does not have a universally accepted definition. Fundamentally, drought is a period of less water precipitation, but the point at which less precipitation becomes problematic is extremely nebulous. Through dialog and shared learning in a watershed-based collaborative planning process, communities gain an opportunity to remove some of the haze and establish common and concrete concerns regarding water shortage.

### *Drought*

Climate is often described as what you expect, but weather is what you get (Climate Change Montana nd). Climate is measured in long-term trends – typically an average over a period of 30 years – while weather describes the day-to-day or week-to-week variations. Averages, however, are purely mathematic. As one Montana Drought Advisory Committee member observed, annual precipitation is often described as either above or below the 30-year average, but in 30 years, he pointed out, only 3 or 4 years might be average. Precipitation levels, then, vary from year to year, and drought is a trend of below average precipitation. Monitoring and recording precipitation trends is very objective and scientific, but defining the point at which drought occurs is very subjective. As such, no universal definition of drought exists. The National Drought Mitigation Center (2012) offers this explanation:

In the most general sense, drought originates from a deficiency of precipitation over an extended period of time--usually a season or more--resulting in a water shortage for some activity, group, or environmental sector. Its impacts result from the interplay between the natural event (less precipitation than expected) and the demand people place on water supply, and human activities can exacerbate the impacts of drought. Because drought cannot be viewed solely as a physical phenomenon, it is usually defined both conceptually and operationally.

This section will explore the many aspects of drought: first, drought as a product of climate variability that can be measured and recorded, and secondly as the way that drought impacts are perceived and experienced by different water users. Collaborative drought planning may be a framework for bringing all interested and affected parties with varying levels of power and decision making authority to one table, but the issue they will be planning for is also a very political, economic, cultural, and environmental one. A main issue in drought planning is determining the values that will identify the acceptable risk of water shortage and the requisite actions.

A very simple definition of drought is “an extreme state of the hydrological cycle” (Sheffield and Wood 2011, 17). The hydrological cycle is the process through which water moves between and across the atmosphere and the surface of the earth. As vapor in clouds, water moves over oceans and continents. Precipitation falls to the earth; through infiltration and runoff, ground and surface water supplies are recharged. Evaporation and transpiration move water from the surface back to the clouds, thus diminishing ground and surface water supply. The cycle of recharging and diminishing water counterbalance each other, but “over time, if the inflows [precipitation] become less than the outflows [evaporation], the store will decrease, resulting in a lack of water or drought” (Sheffield and Wood 2011, 18). It should be noted here that human activity, such as building reservoirs or irrigating, can dramatically alter the rate of recharge or the size of water storage; however, this point will be discussed more fully in the section on perceiving drought.

The absence of a uniform definition of drought is partially due to the uneven spatial distribution of water across the globe. Mount Waialeale, in Hawaii, receives an

annual 389 inches of precipitation (USGS 2012), while the Atacama Desert in South America averages less than 1.5 cm of precipitation a year (NOAA 2011b). Much of this spatial variability can be attributed to “patterns of climate and the underlying land-surface characteristics of elevation, slope, vegetation, land use, and water bodies” (Sheffield and Wood 2011, 18). Mount Waialeale is not the highest point of land in the Hawaiian Islands, but after the trade winds cross thousands of miles in the Pacific, it is the first point high enough to draw moisture from the clouds. The Atacama Desert, on the other hand, is a coastal desert nestled between the Pacific and low hills to the west and the Andes to the east. Clouds pass over the desert and don’t lose precipitation until reaching the Andes.

Topographic features contribute to the spatial distribution of water and climates; climate, as a temporal pattern of atmospheric movement, is a major factor determining the distribution of precipitation. Climate zones can be classified as tropical, temperate, or arid/semi-arid, just to name a few examples, but climate can also describe the predicted range of temperatures and precipitation for an area or region. As Sheffield and Wood write (2011, 30), “it is worthwhile noting here that drought is a temporary aberration of climate and not a permanent phenomenon. This distinguishes it from arid climates, which are dry all the time in absolute terms, but can still suffer from drought when local conditions are drier than normal.” To return to an earlier example, an inch of precipitation in the Atacama Dessert epitomizes an arid climate, but not drought conditions. Mount Waialeale experienced severe drought in 1993 with 244.36 inches of rain (NOAA 2011b). Unlike other natural hazards, such as tornadoes, drought cannot be classified into

globally acceptable categories – 245 inches of rain has very different implications to different regions – and local or regional climate has to be considered in defining drought.

Drought is the presence of extreme regional climate variability. According to Sheffield and Wood (2011, 30),

droughts are initiated by atmospheric circulation and weather systems that conspire to cause lower precipitation and/or higher evaporation than normal in a region...Droughts occur when the usual pattern of weather changes its seasonal timing, its location or persists for longer than normal.

Patterns of atmospheric circulation need to be looked at on a global scale – the oceans are a major driver, triggering a chain of processes that shape local and regional climates. El Niño/La Niña Southern Oscillation, Pacific Decadal Oscillation, Arctic Oscillation, and Atlantic Multidecadal Oscillation are just a few examples of global climate anomalies, but they that have significant influence over the climate and weather in western Montana. By influencing the climate and weather, these oscillations also inherently influence the presence or lack of drought conditions.

The El Niño/La Niña Southern Oscillation, or ENSO, is the “most important driver of global climate” from year to year (Sheffield and Wood 2011, 24). ENSO is a natural climatic variation characterized by anomalies in sea surface pressure and warmer or cooler sea surface temperatures (SST) in the Pacific Ocean. This phenomenon used to be described as either El Niño or La Niña, but use of the term ENSO has become more popular due to the tight coupling of the warming and cooling phases and oscillations of sea surface pressure; however El Niño is still used to describe warming sea surface temperature (positive phase) and La Niña is still associated with cooling (negative phase) (Sheffield and Wood 2011).

In a La Niña year, cooler sea surface temperatures – roughly 1 degree Celsius - cause changes in atmospheric and climatic patterns around the globe. Circulation patterns bring cooling and precipitation via the Pacific jet stream to the Pacific Northwest. Western Montana can expect above average precipitation, mostly as snow, and below average temperatures. The winter of 2010-2011, a La Niña year, was characterized by above average snowpack. The snow melt filled reservoirs, but the melting also led to major flood conditions in many parts of the state (Montana AWRA 2011).

In an El Niño year, warmer sea surface temperatures indicate drier and warmer conditions for the Pacific Northwest and western Montana. As such, El Niño conditions may signal to decision makers and water users that future drought conditions could be on the horizon.

The Pacific Decadal Oscillation, or PDO, is similar to ENSO, but fluctuates on a much longer time scale – two to three decades, rather than year to year. Like ENSO, the PDO is also triggered by warming or cooling of sea surface temperatures and changes in sea surface pressure in the Pacific Ocean (Sheffield and Wood 2011). Warming sea surface temperatures manifest as drier and warmer conditions in the Pacific Northwest, and cooling manifests as colder and wetter conditions. The PDO and ENSO are not isolated phenomenon, but rather have close interactions, with the power to amplify or negate. Sheffield and Wood (2011, 26; citing Gershunov and Barnett 1998 and Wang et al. 2008) write,

[t]he PDO exerts a modulating influence on the ENSO, therefore changing the strength and persistence of the ENSO's effects around the world. For example, the impact of the ENSO on the East Asian winter monsoon is

only robust when the PDO is in its cold phase. Over North America, the impacts of the ENSO are strongest only during the positive PDO phase.

Since the PDO and its interactions with ENSO are such strong regulators of precipitation around the world, monitoring sea surface temperatures in the Pacific Ocean is a tool for predicting annual and long-term precipitation patterns.

The Arctic Oscillation (AO) is an extended pattern of variation in the sea surface pressure in the Arctic Ocean. The AO affects the climate in areas from the Arctic to about 40 degrees north by “deflect[ing] the jet stream further north or south in the Atlantic Ocean, changing the strength of westerly winds and storm tracks, and affecting the climates of North America and Europe” (Sheffield and Wood 2011, 25). Higher than average sea level pressure in the Arctic Ocean triggers colder winters in North America, which are characteristic of the negative phase of the AO. The positive phase, on the other hand, “brings lower-than-normal pressure over the polar region, steering ocean storms northward” (NOAA 2012a). The positive phase was present for most of the 1990s, but recently high and low pressure regimes have alternated from year to year.

Changes in sea surface temperature in the Atlantic Ocean also contribute to the climate and weather patterns experienced in western Montana. The Atlantic Multidecadal Oscillation (AMO) “describes changes in surface temperatures in the North Atlantic over periods of several decades (Kerr 2005; Sheffield and Wood 2011, 26). Primarily this affects the hurricane seasons, but warming in the North Atlantic correlates to wetter conditions across the United States. Conversely, cooling temperatures associated with the positive phase of AMO are associated with drier conditions. One climate expert suggested that in the 2011-2012 winter the Arctic Oscillation muted the presence of La Niña in western Montana and led to much drier conditions.

Climate agencies, such as the National Oceanic and Atmospheric Association, monitor changes in ocean temperature and sea surface pressure to determine oscillation trends. Comparing current conditions to the historic trend enables climate-monitoring agencies to forecast shifts toward the positive or negative phases of large-scale climate patterns. Most forecasts can reliably anticipate conditions 5-6 months out, which is a useful tool for seasonal planning. Ranchers could decide to plant a more drought resistant type of hay or just plant their best fields.

Such forecasting, however, relies on the use of historic climate patterns to discern future trends. The accuracy of such forecasts may decrease significantly in the future. As suggested by one environmental policy analyst, “the one thing we know is that the future won’t be the same as what we’ve seen.” These phenomena have been relatively stable in the past, but, as this person continued, “conditions [in the future] will be less predictable and cyclical.” Climate change is a highly politicized term (Sheffield and Wood 2011) and the historic record of climate data demonstrates that climate variability has always occurred (Climate Change Montana 2012). However, the rate of future variability is much less certain and the dynamics of climate oscillations may stray from historic trends (Sheffield and Wood 2011).

Climate change, or increased climate variability, will not affect all parts of the globe to the same extent or in the same ways (Sheffield and Wood 2011). Local geography will continue to influence how global climate patterns manifest in a region. In general, higher temperatures will increase the cycling of the entire hydrological system. Instead of small, consistent precipitation events, some regions may receive the same annual average, but in fewer events. Sheffield and Wood (2011, 170) describe how this

“will increase the frequency of flash flooding and run-off, but decrease soil moisture and increase drought risk as less water infiltrates into the soil.” An accelerated hydrologic cycle could also shift the timing of precipitation – rain instead of snowfall – or accelerate the rate of snowmelt. Alternatively, some regions could experience drastically less precipitation.

Drought monitoring indices are used to disseminate climate data and climate variability and identify objective thresholds for measuring drought conditions. Drought indices must not only take into account scale, duration, and severity, but also surface water, soil moisture, and precipitation. Integrating all these variables into one index is challenging and many approaches to monitoring drought have been developed. For a comprehensive chart listing popular drought indices, their advantages and disadvantages, please see Appendix 1. Several indices – precipitation percentage of normal, Palmer Drought Severity Index, Surface Water Supply Index, Normalized Difference Vegetation Index, and Regional Drought Area – will be reviewed to illustrate the complexity of describing drought conditions and the limitations associated with each.

One popular drought index, precipitation percentage of normal, emphasizes the amount of precipitation in an area over a given period of time. Precipitation is measured at SNOWTEL sites – sites that measure the snowfall and convert that amount into a water equivalency – and by precipitation gauges. The actual total precipitation is then divided by an average annual value in order to reach the precipitation percentage of normal; as such, precipitation percentage of normal doesn’t actually depict “real” on the ground conditions, but rather portrays how present conditions exist in relationship to a calculated

30-year average record of precipitation (NOAA 2011c). “Normal” can be a problematic term. As Smith and Halvorson (2011, 4) write,

Climate variations are often described as above or below normal conditions. A critical point to keep in mind is that we need to acknowledge that climate variation and even extremes are ‘normal.’

Classifying conditions as “normal” and “not normal” can be misleading and not reflective of historic climate variability. Measuring precipitation and calculating the snow water equivalency is a simple and effective indicator for planning purposes for people in the agricultural communities or emergency response entities for a specific location and season. However, drought “has a spatial extent that describes the area it covers, and a duration that records how long it has persisted. Furthermore, drought varies in its intensity, which changes time and space as the drought develops, persists and recedes” (Sheffield and Wood 2011, 57). Only measuring precipitation may not accurately portray the full effects of drought over time or throughout a region.

The Palmer Drought Severity Index (PDSI) is named for Wayne Palmer who developed, in the 1960s, a system of using temperature and rainfall information to determine dryness (NOAA 2012b). The PDSI value is “calculated as the departure of moisture from normal using a simple water balance model” (Sheffield and Wood 2011, 59). Like precipitation percentage of normal, the PDSI depends on a mathematically created definition of normal, rather than recognizing an expected range of conditions. The PDSI considers evaporation and runoff, as well as precipitation. Measuring inputs and outputs of moisture may portray a more accurate picture of soil conditions than just calculating the precipitation percentage of normal. However, PDSI value “may lag behind emerging droughts by several months; does not account for snow; [and] does not

handle frequent climatic extremes” (Sheffield and Wood 2011, 59). The PDSI, while offering a comprehensive measure of soil moisture, may be better suited for developing a historic record of data, rather than providing up to date information for communities needing to make rapid decisions about whether or not to implement drought response mechanisms. With increased climate variability and the potential for less frequent, but more severe precipitation events, the Palmer Drought Severity Index may become even less relevant and less useful.

The Surface Water Supply Index (SWSI), as implied in the name, measures surface water supply. This includes a “combination of snowpack, streamflow, precipitation, and reservoir storage” (Sheffield and Wood 2011, 59). For communities and water users that rely on surface water, SWSI maps are useful indicators of how much water is still available. SWSI maps are especially relevant in basins with large amounts of water storage – those communities may not actually feel a water shortage until the reservoir level starts to drop, even though below average precipitation levels were present for several months or years. Alternatively, dryland farmers reliant on precipitation and communities without large storage projects may not find SWSI maps particularly useful.

The Normalized Difference Vegetation Index (NDVI) represents the “difference between maximum absorption of visible and near-infrared radiation” (Sheffield and Wood 2011, 60). Data is collected through remote sensing, either by plane or satellite, to measure and map the health and vigor of vegetation. Remote sensing creates maps with both high resolution and large area coverage; both regional and local conditions are depicted. Acquiring this data, however, is difficult and expensive. The Normalized Difference Vegetation Index also has the disadvantage of only being able to portray

conditions without easily allowing “other influences on vegetative health,” such as irrigation, presence of water thirsty crops and foliage, or other land use patterns, to be factored in to the data interpretation (Sheffield and Wood 2011, 60).

Lastly, the Regional Drought Area is an index that measures the “percentage area in drought within a region” (Sheffield and Wood 2011, 60). Drought severity is not only measured by deficiency of precipitation over time, but also by spatial extent. All of the above indices often communicate information visually, either via charts or maps. The maps can illustrate the spatial extent of drought, but do not quantify the area affected by drought conditions. Quantifying the spatial extent of drought is important for recognizing the widespread impact of drought and for declaring and responding to drought conditions as a natural disaster.

The U.S. Drought Monitor attempts to mitigate the shortcomings of each drought index by blending all the indices into one very comprehensive map. The goal of the U.S. Drought Monitor is to develop a coherent nation-wide indicator of drought conditions, rather index-by-index drought identification. A universal approach to identifying drought will address “the lack of a consistent probabilistic basis for some of these indices [described above], which prevents their application across regions and through time” (Sheffield and Wood 2011, 60). As an example, flood risk has been quantified as 10-, 100-, and 500-year flood events to describe the probable frequency and severity. A 500-year flood has the probability of occurring once in 500 years. The U.S. Drought Monitor hopes to ascribe similar severity and probability benchmarks to the other end of the water spectrum.

In Montana, the state Drought and Water Supply Advisory Committee releases monthly drought status maps. The intent, similar to the U.S. Drought Monitor, is to offer comprehensive water supply information that factor in the complex relationship of surface and groundwater, precipitation, snowpack, and water storage, and uses percent of precipitation normal thresholds. The Montana Drought Status map includes county lines; these are the requirements needed by FEMA for disaster relief declaration and assistance.

The indices described above provide only a brief glimpse at the number of different approaches to monitoring and predicting drought. No index is standardized or universally accepted. “This lack of standardization in the characterization of drought is problematic because it does not allow the consistent identification of droughts across regions and through time, with implications for how losses can be calculated and attributed objectively” (Sheffield and Wood 2011, 58). The lack of standardized drought characterization also makes identifying drought thresholds difficult, even though those thresholds are crucial for planning efforts and disaster relief.

In reviewing some of the drought indices that have been developed, it is very apparent that the utility and practical application of each index depends on a community or individual’s situation and need for water. Climate and water supply variability has always and will always be present. Through monitoring, variability can be mapped and, to some extent, predicted. Thresholds for tolerating variability, however, are highly dependent on perception.

Precipitation patterns are cyclical and subject to variations over time and throughout a region. Such patterns in precipitation and river flows are natural processes, but the human demand for water is much more constant or may not align with

precipitation regimes. Much of the human comprehension of drought is based on a relationship to supply and demand on the water resource. Reservoirs and irrigation networks lessen the perceived presence of drought and create a sense of abundance in a water scarce region, but long-term drought reduces the effectiveness of the existing water infrastructure to meet those water needs through reduced stream flow, reduced surface water storage, and negative aquifer recharge. Sheffield and Wood (2011, 13), hydroclimatologists and co-authors of *Drought: Past Problems and Future Scenarios*, point out:

Herein lies one of the problems of drought, in that no single definition of drought is satisfactory because a drought may mean very different things to different sectors and populations. For example, a farmer is interested in the amount of water in the soil that is available to crops. A farmer in an irrigation district may only be interested in reservoir levels as this is the only source of water. Villagers in India who rely on well water are only concerned with the dwindling supplies at the bottom of the well.

In addition to perceptions, drought is also hard to define because the onset and ending are difficult to indentify. Drought is not like hurricanes or tornadoes that can be seen approaching on the horizon and everyone can agree when these storms have arrived and when they have passed. Droughts, on the other hand, may have settled in for a few months before a drought is officially declared (Sheffield and Wood 2011).

To capture the different perceptions of drought, both by sector and over time, the National Drought Mitigation Center conceptualizes drought as having four different classifications: meteorological, agricultural, hydrological, and socio-economical drought (NDMC 2012). The first three types of drought all describe physical deficiencies, whereas the fourth, socio-economic drought, describes the impacts of water shortage. These four types of drought are not triggered into a chain reaction, but represent a

complex web of triggers and drought impacts, as illustrated by the graph in Appendix 2 and explained in the narrative below. Sheffield and Wood (2011, 12) suggest that defining drought by its effect may often be preferred “because they imply a real impact rather than simply a physical lack of water.” The definitions of drought are not rigid, nor does the line between type and impact of drought appear to be succinct; defining drought, even in scientific literature is frustratingly murky and ambiguous, even as the definition strives for clarity and universal application.

Meteorological drought is a reflection of natural climate variability (NDMC 2010). Precipitation patterns are cyclical and subject to variations over time and throughout a region; meteorological drought encompasses the range of variability that represents deficiency in precipitation. Climate patterns, such as ENSO and the PDO, explain this variability and enable climate and weather services to make short and long term forecasts. The extent and duration of meteorological drought can easily be mapped, measured, and predicted by using indices such as precipitation percentage of normal. In addition to a deficiency in precipitation, a meteorological drought could also be a product of higher temperatures and increased evaporation rates. Whether through decreased precipitation or an increase in evaporation, meteorological drought can be summarized as an overall decrease in the input to the hydrological system over a period of time in a region.

Drought is not merely a physical reality, but its existence depends on human need and comprehension. Agricultural drought introduces a human dimension, linking “various characteristics of meteorological drought to agricultural impacts” such as reduced soil moisture for crops (NDMC 2010). As meteorological droughts set in, crops

and vegetation begin to feel the shortage. The Palmer Drought Severity Index strives to model and predict the onset of agricultural drought, but perceived drought conditions may not align with the index. The onset of agricultural drought may be rapid to dryland farmers depending on a few inches of rain. Or the onset may be delayed by irrigation, use of drought resistant crops, or large surface water storage, but long-term meteorological drought may affect even those safety nets as hydrological drought sets in.

Hydrological drought is the manifestation of meteorological drought in the hydrologic system (NDMC 2010). A lag time exists between decreased precipitation and water supply – both surface and groundwater – as the effects of meteorological drought infiltrate through the hydrological system. As precipitation and soil moisture decreases, recharge to surface water supplies diminishes. The Surface Water Supply Index, or SWSI map, measures surface water availability, but high demand on reservoirs, lakes, and streams exacerbate the effect of hydrological drought. Surface water provides irrigators the ability to weather agricultural drought and provides communities with drinking water and sanitation; and low flows reduce hydropower generation capabilities and reduce ecosystem functions.

With meteorological, agricultural, and hydrological drought the NDMC attempts to identify a chain reaction, triggered by decreased precipitation, which can lead to socio-economic drought. According to the NDMC (2012), socio-economic drought “differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts.” Socio-ecological drought is characterized by the relationship between water supply and social and economic needs. When thresholds for tolerating meteorological, agricultural, and

hydrological drought have been breached, socio-economic drought can set in. Socio-economic drought reflects loss of crops and food production, not only is income lost, but, in subsistence agricultural communities, the risk of famine increases. Reduced hydropower generating capabilities could force communities to find new sources of power, thus increasing the cost of power and electricity. Since the consequences of socio-economic drought are financial, political, and emotional, drought indices are an attempt to create neutral and objective drought warning systems, but those indices are biased to work best for specific drought perspectives.

Even though meteorological, agricultural, hydrological, and socio-economic droughts are not rigid classifications, these textbook definitions of drought classifications include the impact of that drought classification. On its website in a section defining agricultural drought, the National Drought Mitigation Center (2012) writes, “[a]gricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and so forth.” Identifying meteorological drought relies heavily on measuring levels of precipitation, but the other types of drought and their impacts are caused by and exacerbated by numerous mechanisms, such as climate and land use. Instead of drought, framing the research question in terms of planning for water security and thresholds of water scarcity is not only a matter of semantics, but may also clarify and broaden the conversation without over simplification.

### *Water Security and Water Scarcity*

Water security is not just measured by precipitation in a year but defined as “the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies” (Grey and Sadoff 2007, 545). Reduced water security, or scarcity, is not just a measurement of decreased precipitation, but also considers factors such as the relationship between supply and demand over time and across a region, individual or community access to water, changing climatic conditions or water demand patterns, and livelihood and resiliency to cope with scarcity. Drought is simply one component of water scarcity.

Resource management “commonly seeks to reduce natural variation in target resources because fluctuations impose problems for the industry that depend on those resources” (Holling and Meffe 1996; as cited in Berkes, Colding and Folke 2003, 19). Reservoirs, such as the Hungry Horse, and irrigation networks insulate various water users from short-term variations in precipitation and stream-flow. Physical processes, no matter how engineered, are still highly variable and unpredictable, especially in the prospect of climate change and climate variability.

Water management, although it seeks to stabilize water supply, may also contribute to perceptions and experiences of water insecurity or shortage. Long-term or multi-year drought reduces stream flows, reduces surface water storage, draws down aquifers, and affects wetlands and fisheries. Long-term drought reduces the effectiveness of the existing water infrastructure to meet users’ water needs. These needs have been

established based on an engineered sense of abundance in a water scarce region, but also vary depending on the need (dry-land or irrigated agriculture, municipal, ecosystem function, etc.) and its perceived need.

In addition to management, the relationship between livelihood and dependency on a resource also influence a stakeholder's perception of access to water security. Livelihood can be described as "the capabilities, assets (including both material and social resources) and activities required for a means of living" (Scoones 1998; as cited in Ostbahr et al. 2008, 5). According to Burton and Kates (1964, 428), still prominent hazard geographers, "considerable cultural variation exists in the conception of natural hazards...we would expect to find a heightened hazard perception in those cases, such as drought in an agricultural region [...], where the hazard is directly related to resource use." For example, prior appropriation dictates that water users with a junior water right turn off the tap in times of shortage while their neighbor, who has a more senior right, can continue full irrigation practices. Many irrigators and ranchers reported that drought represents a significant economic hardship for the junior water right holders who may have to purchase hay for their cattle instead of being able to irrigate and grow their own. People may perceive a situation, such as drought, differently depending on the relationship between the hazard and their livelihood.

Livelihood may create a heightened sense of the presence of a hazard, but it also generates mechanisms for responding to water insecurity. In assessing responses to hazard vulnerabilities, Ostbahr et al. (2008) distinguish between coping and adapting strategies. Coping refers to short-term actions to help a person or group get by, whereas adaptation refers to long-term planning and more transformative responses. People who

are experiencing drought may not describe their responses with such dichotomy, but as a spectrum of “responses taking place in short and long term decision making based upon the consequences for livelihood asset base” (Ostbahr et al. 2008, 1952). Extended periods of and increased frequencies of drought and the economic hardships associated with drought can contribute to ranchers’ decisions to sell their property. Often, wealthier amenity landowners purchase those ranches and thus change the rural agricultural nature of the valley and also the historic use of water (Yung and Belsky 2007).

The relationship between water security and livelihood cannot simply be understood as only affecting agricultural communities. Anglers, recreationists, and environmental advocates and recreation companies, hydropower companies, and municipalities all depend on a supply of water to meet their diverse needs. Water shortages have direct and indirect widespread economic, cultural, ecological, and cultural costs. Losses of hydropower revenues are easy to quantify, but the benefits of a working stream are more challenging to measure. Wildfires generate direct costs to fight the fires and, depending on numerous factors such as geography and soil moisture, indirect costs of reduced groundwater infiltration in the burn area or a loss of tourist revenue as hikers go elsewhere for their vacations. The relationship between different livelihoods and water supply may increase the urgency for drought planning or shape the scope of actions needed for long-term planning. Hydropower generators or irrigators with large, senior water rights still depend on certain water quantities to meet their needs, but they may not be very concerned about continuing to fulfill their water needs in the future. Water rights for instream flows and other junior water right uses may be more vulnerable to water

shortage, and therefore more eager for comprehensive long-term drought mitigation planning.

### *Planning for Drought Conditions*

In the article “Reducing Drought Risk: Bridging Theory and Practice,” Hayes, Wilhelmi, and Knutson (2004) identify nine categories of actions that are addressed in state and local drought management plans. These categories are “assessment programs; legislation/public policy; water supply augmentation/development of new supplies; public awareness/education programs; technical assistance on water conservation and other water-related activities; demand reduction/water conservation programs; and drought contingency plans” (Hayes, Wilhelmi, Knutson 2004, 109). The authors also suggest that drought should be understood temporally in order to address short and long-term risks associated with drought and be addressed through a drought management plan that includes mechanisms to ensure implementation.

Rethinking drought, in a collaborative planning process, as a component of water scarcity does not lessen the importance of climate monitoring and modeling or of developing better drought forecasting indices. Drought, as a matter of climate variability, has always existed and will continue to present itself. The future of climate variability may not be the same as past conditions; safety nets that have been developed over the course of hundreds of years for weathering drought conditions may not work as well or cease to function in the future. Planning for water scarcity, rather than just drought, may help communities and water planners use a collaborative planning process to consider a

more comprehensive range of risks and coping mechanisms associated with water scarcity.

## **CHAPTER 3**

### **METHODOLOGY**

This research utilized a mixed methods approach that utilized case studies, participant interviews, and participatory action research methods. This chapter details those data sources and the methods used to collect and analyze the data.

#### *Case Study Analysis*

This thesis analyzed drought plans from three case studies of drought planning. The case studies are the Big Hole watershed in Montana, the Blackfoot watershed in Montana, and the State of Colorado. The number of case studies was chosen in order to get a wide enough perspective on drought planning without distracting from the primary research focus on the Clark Fork River Basin of Montana.

The three case studies were selected because they utilized a collaborative planning process to create and implement a drought plan, and, more specifically, because each plan approaches the question of scale in different ways. The Big Hole case study illustrates a very small-scale, localized approach to drought planning; and their plan is based on sub-watershed thresholds. The Blackfoot drought plan encompasses the entire watershed and the threshold for low flows is measured at the terminus. While it is also very small-scale and localized, this plan offers insight as to how drought planning could increase in geographic scale. The case study in the State of Colorado spans the entire state, but is simultaneously multi-scalar in that the plan also encourages and integrates local drought planning.

The case studies entailed a level of content analysis, drawing on standard techniques (Innes 1999; Hayes, Wilhelmi, Knutson 2004). That is, specific attention was given to the elemental themes of circumstances of collaboration, if present, planning process design, and outcome. Information on the collaborative planning process was gathered through interviews with three individuals who have been involved in the planning process and/or the on-going implementation of the drought plan. These individuals were asked basic questions on the circumstances that catalyzed drought planning, what was working really well, what challenges to drought planning existed, and what lessons had been learned (See Appendix 3 for interview questionnaire). The case study data were analyzed using the framework for assessing collaborative planning process established by Innes (1999). In addition, drought plans for all three case studies were assessed using the framework for content analysis offered by Hayes, Wilhelmi, and Knutson (2004). When the drought plans were not publicly available, permission to use the document was sought.

### *Participant Interviews*

All interviews, including those conducted for the case study analysis, were conducted in accordance with The University of Montana Institutional Review Board (IRB). In order to maintain the privacy of the interviewees, none of their comments will be attributed to the respective individual. Despite the size of the Clark Fork Basin, the community of professionals and individuals actively thinking about, studying, planning or preparing for drought is relatively small. As such, interview participants will only be described using vague descriptions such as “water planner” or “environmental activist” to

provide some context on their perceptions while also respecting the confidentiality of the participants. A list of their affiliated organizations is in Appendix 4. IRB approval for this research was granted in July 2011 and no interviews were solicited before approval was granted.

Two tiers of open-ended interviews were conducted in this project. The first tier was with key informants in order to gain insight on developing drought management plans and watershed management. The eight key informants interviewed all had intimate experience in drought planning in either Montana or the American West, but the level of involvement ranged from leading the planning process to studying large-scale, multi-state drought planning efforts. The key informants were chosen based on their expertise and accessibility. A snowball-sampling technique was used to randomly build a larger sample size (Hay 2005).

The questionnaire consisted of questions asking interviewees to reflect their experience planning and responding to drought. These participants responded to the same four main questions as the key informants who participated in the case study analysis: what has catalyzed drought planning; what is working well; what challenges to drought planning existed; and what lessons had been learned (review Appendix 3). Those main questions also had sub-questions or prompts to tease out more specific ideas or reflections regarding the collaborative planning process and drought plan outcome. Four interviews were conducted in person, and the remaining two interviews were conducted over the phone since out-of-state travel was not practical. Four interviews were recorded and transcribed and the other two were recorded using detailed note taking.

Once interviews were completed, the content of the interview transcripts were coded for recurring themes and diverging interests. Coding is one way to transform pages and pages of transcripts and notes into meaningful data that can be analyzed. According to Hay (2005, 202):

Coding is intended to make the analysis more systematic and to build up an interpretation through a series of stages, avoiding the temptation of jumping to premature conclusions. It also encourages a thorough analysis of the transcripts, avoiding the charge that qualitative researchers have simply selected a few unrepresentative quotes to support their initial prejudices (sometimes referred to despairingly as ‘cherry picking’).

To avoid ‘cherry picking’ quotations and themes, interviewee responses were compiled and sorted according to the four major questions described above in order to find common themes and divergences. In this way, recurring themes or diverging interests could be analyzed across all key informant perspectives, rather than just by individual interests or perspectives (Hay 2005). By using this analysis approach, the research findings are able to provide a nuanced and comprehensive perception of drought planning approaches.

The second tier of interviews was conducted to assess local, state, and Tribal government, agency, and water user perceptions and vulnerabilities to drought. Water user perspectives were identified by the Task Force (2010) to include: agriculture, municipal, hydropower, industry, recreation, and ecosystem functions. Given the size and diverse nature of the Clark Fork Basin, my initial contact list included both people who could provide insight on place-based concerns and interests as well as broad issue-based perspectives. For example, I approached individuals engaged in ecosystem functions on small tributaries as well as the entire Clark Fork Basin. The Task Force had previously defined this watershed approach in the basin management plan (Task Force 2004).

Watersheds include the Flathead River, Bitterroot River, Blackfoot River, Upper Clark Fork, Middle Clark Fork, and Lower Clark Fork River. The Clark Fork River Basin Task Force and the Montana Watershed Coordination Council were key resources in developing my initial contact list; and snowball-sampling technique was used to generate more contacts.

The questionnaire consisted of 10-15 questions (see Appendix 5). Interviews were conducted in person, when possible, but also by phone. Questions were designed to ask people to define their perception of drought, what triggers coping mechanisms, and concerns that could be addressed in a basin-wide drought management plan. Interviews were either recorded and then transcribed or recorded through detailed note taking. Interviewee responses analyzed using the same content analysis approach as described above in order to analyze common themes across all interest- and geographic-based perceptions of drought. Since many of the interview participants spoke to drought conditions not just in their own watershed but also in other watersheds or in the entire Clark Fork Basin, sorting the interview content allowed the interview content to be analyzed by geography and interest.

#### *Participatory Action Research (PAR)*

Since the need for this research was catalyzed by the need for information on drought by the Clark Fork River Basin Task Force, it was necessary to integrate principles of participatory action research (referred to hereafter as PAR) into the design and implementation of this study. PAR is defined as:

an approach that ideally grows out of the needs of a specific context, research question, or problem, and the relationships between researcher

and research participants...It is also an approach that values the process as much as the product so that the 'success' of a PAR project rests not only on the quality of information generated, but also on the extent to which skills, knowledge, and participants' capacities are also developed (Cornwall and Jewkes 1995; Kesby et al. 2004; Maguire 1987; as cited in Hay 2005, 208).

Guided by the principles of participatory action research, the researcher worked very closely with members of the Task Force throughout the design, implementation, and reflection on the research process and outcome.

For two years, I attended monthly Task Force meetings and facilitated discussions developing the extent of this research. I was also a participant at a Clark Fork River Basin Water Year 2011 Outlook Conference and a Clark Fork River Basin 2011 Water Year in Review Conference. Attending meetings and conferences helped inform my understanding of water needs and concerns in the Clark Fork Basin. During the process of designing research questions and methods, I facilitated discussions during meetings to brainstorm the needs for information. In this way, I did not impose my research agenda on the water community, but rather let the research agenda be guided by their needs.

After interviews had been completed, I once again reached out to the Task Force and the Clark Fork Basin water community. First, I sent a draft of the research findings document (by email or USPS, by request of interviewee) to all interview participants. This review allowed interviewees to verify or correct information. I also turned the synthesis and data analysis into a living document that evolved as interviewees become aware of what other people in the basin are saying about drought. As a result of that feedback, the findings section developed a more nuanced watershed profile in the Clark Fork Basin and in its watersheds.

In order to reach an even broader range of perspectives, both geographic- and interest-based, I also presented my research findings at the May 2012 Clark Fork River Basin Water Supply Outlook Conference. The findings were synthesized into succinct bullet point responses to three questions. Those questions were: what is drought? How is it currently mitigated? And how could drought be addressed in a basin-wide plan? (See Appendix 6 for the facilitation handout). After the presentation, I facilitated a conversation with approximately twenty Conference participants to discuss my findings and include information or viewpoints that may not have been fully represented during the initial interview process. Those comments and feedback have been anonymously integrated into the findings.

## CHAPTER 4

### RESEARCH SETTING – CLARK FORK BASIN

This section establishes the characteristics of the primary research setting: the Clark Fork River Basin and its six sub-watersheds – the Upper Clark Fork, Blackfoot, Middle Clark Fork, Bitterroot, Flathead, and Lower Clark Fork. Such a context is necessary to understanding the underlying dynamics that influence the perceptions of drought that are reported and analyzed in Chapter 6. First, this chapter will establish the watershed profile for the entire basin. Then, it will identify policy and infrastructure that may either provide constraints or opportunities in an effort to developing a basin-wide drought plan. Lastly, it will establish the watershed profile in each of the watersheds that comprise the Clark Fork River Basin.

#### *Watershed Profile: Clark Fork River Basin*

The research setting for this study is the Clark Fork River Basin, a major tributary to the Columbia River, which drains 22,905 square miles of western Montana (Task Force 2004; see Appendix 7 for a map). Upper reaches of the basin form along the Continental Divide to the south and east. The divide between the Whitefish and Cabinet Mountains carves a small corner of northwestern Montana out of the Clark Fork River Basin. That corner of Montana is part of the Kootenai Basin, but it is also part of the larger Columbia Basin. Three major tributaries – the Blackfoot, Flathead, and Bitterroot Rivers – feed into the Clark Fork River as it meanders approximately 300 river miles before crossing the Idaho border and emptying into Lake Pend Oreille (Task Force 2004). From Lake Pend Oreille, the Columbia flows mostly south through Washington before

doglegging east and forming the boundary between Washington and Oregon and entering the Pacific Ocean.

Basin and watershed boundaries are drawn along the ridge tops, but jurisdictional boundaries and land tenure lines were drawn on mostly straight lines. Although most of the basin lies within the boundaries of Montana and is the area covered in this study, it should also be noted that the Clark Fork basin crosses an international border (the Flathead River originates in Canada) and a state border (Idaho-Montana). The Clark Fork River Basin also encompasses parts of eleven counties (Missoula, Flathead, Silver Bow, Ravalli, Lake, Lincoln, Sanders, Mineral, Powell, Granite, and Deer Lodge counties) and the Confederated Salish and Kootenai Tribe's Flathead Indian Reservation. Landownership is a mix of federal, state, tribal, and private claims (Task Force 2004).

The Clark Fork is the largest river by volume in Montana as it crosses into Idaho with a mean annual discharge of 21,818,240 acre-feet (Task Force 2004). Topography and climate contribute to the presence of such a large volume of surface water in such a small area (when compared to the area drained by the Missouri River).

The Continental Divide draws a sharp distinction between eastern and western Montana. Compared to the eastern half of the state, the Clark Fork Basin is relatively wet. Heron, a community in the Clark Fork Basin near the Idaho border, receives average of 34.70 inches of precipitation, which makes it one of the wettest areas in a state that receives an average of 28 inches (Western Regional Climate Center nd). The mountainous topography within the basin contributes to localized variation. Some valleys in the Clark Fork Basin are relatively drier – Deer Lodge in the Upper Clark Fork watershed receives an average of 11 inches and Lonepine in the Flathead watershed

receives an average of 11.47 inches of precipitation (Western Regional Climate Center nd). Most of this precipitation falls as snow in the winter and early spring and then melts late spring and early summer.

Topography influences local variations in precipitation, but climate contributes to seasonal variability. Warming and cooling trends in the Pacific Ocean heavily influence the precipitation regime; these ENSO fluctuations, which were described in an earlier chapter, bring either colder and wetter or warmer and drier conditions to the Clark Fork Basin. ENSO oscillations operate on 3-7 year cycle and typically signs of positive or negative fluctuations start to appear in the fall (Montana Climate Change 2009).

Climate variability and ENSO fluctuations are not new phenomena, but future conditions may not be the same as the historic record. In the past 100 years, the average annual temperature for the state of Montana has increased by 2 degrees Fahrenheit. Winter average annual temperatures have increased by 3.5 degrees Fahrenheit. Average annual precipitation has decreased by 1 inch over the same time span. In the past 45 years that has amounted to a 10-15% decrease in average precipitation. Graphs from Montana Climate Change in Appendix 8 illustrate those changes. In terms of future precipitation regimes, western Montana can expect more precipitation later in the year as rain and less as snowfall (Climate Change Montana 2012).

Collectively, topography and climate determine the precipitation regime in western Montana. The Clark Fork River Basin Management Plan (2004, 3-3) states:

The mountainous terrain and northern latitude of the basin combine to form snow dominated precipitation and runoff regimes. This means that the majority of precipitation in the basin falls as snow in winter and early spring, with streamflows peaking in early summer after snowmelt has occurred. Low flows occur in early fall after the dry summer and in late winter before snowmelt has begun.

Natural snowmelt and surface flows are seasonally and annually variable, but people need a much more consistent water supply.

As a result of the high human dependency and constantly varying flows, many small and large dams have been built to provide a more consistent water supply throughout the year. Twenty-one reservoirs with storage capacities greater than 5,000 acre-feet of water have been constructed and operate in the Clark Fork. The three largest reservoirs are Hungry Horse (S. Fork Flathead River, 3.5 million acre-feet capacity), Flathead Lake (Flathead River, 1.8 million acre-feet capacity), and Noxon Rapids (Clark Fork, 500,000 acre-feet capacity) (Task Force 2004). Collectively, the over twenty dams throughout the basin flatten the annual hydrograph by slowly releasing spring runoff to meet water needs such as irrigation, municipal, ecosystem mitigation, and hydropower generation (Task Force 2004).

Recent dam removal has altered the hydrology of the Clark Fork River yet again and in a way that is not yet fully realized. Milltown Dam was a run-of-river hydropower dam on the mainstem of the Clark Fork just above Missoula and just below the confluence with the Blackfoot River. Milltown was not a storage project nor was it operated for flood control, but it used to impound water in an area with a highly permeable aquifer and the 1,448 acre-feet per year that used to be allocated to hydropower generation was a predictable contribution to downstream flow. Removal of Milltown is physically significant, but the consequences of this change did not emerge in the participant interviews.

Dams influence the physical timing and availability of water, and thus, mitigate short-term deficiencies in precipitation and sense of water shortage. Water availability,

however, may not just be measured by the fullness of a reservoir, but in how water is allocated and used. Legal constraints or obligations may make a watershed or group or individual more vulnerable to experience scarcity. Conversely, policy could lead to a heightened sense of water security. The next few paragraphs will describe some of the legal constraints and obligations in the Clark Fork Basin.

### *Water Governance in Montana: Constraints and Opportunities to Drought Planning*

A mixture of state and federal laws govern water use in Montana. This section provides an overview of the policies and principles that apply to the Clark Fork Basin. In the absence of formal or informal water shortage sharing agreements, these policies are the default regulatory framework for dealing with drought. How these policies affect individuals, communities, or water-interests, will influence their perception of drought or the need for drought planning.

Citizens are granted usufructory rights to water – a right to use, but not to own molecules of water. Oversight of the distribution and regulation of those water molecules is in the hands of state and federal government. Thanks to the miners first settling the American West, the United States has two very different principles governing the usufructory right to water. In the Eastern United States, English Common Law, or the Riparian Doctrine, was the foundation for water use. Riparian law confines “water rights to riparian landowners, and require[s] that the water be restored to its ordinary course” (Getches 1997, 17). Water use is contingent on property ownership – if a stream changes course through avulsion, or migration, a private landowner can lose a riparian water right. Non-riparian landowners do not have any access to surface water, although they do own

rights to the groundwater below the surface of their property. The reasonable use principle, established in *Tyler v. Wilkinson*, allows “each riparian [land owner] the right to make all reasonable uses of the waters so long as those uses did not interfere with the reasonable uses of other riparian” water uses (Getches 1997, 17).

The doctrine of riparian water law was abandoned in Montana and most of the West. Surface water is much more scarce in the American West, a region dominated by aridity and annual precipitation less than 20 inches. David Getches (1997, 21), a leading water law scholar, explains that:

The riparian doctrine was thought to be impractical for the arid region beyond the one-hundredth meridian (a line running south through the middle of North Dakota into Texas). A system that limited rights to owners of land bordering a stream and water use to the watershed origin would have stifled development. Almost all western land was owned by the federal government, yet homesteaders and miners were encouraged to settle there. The early miners and homesteaders were essentially trespassers on the public domain; thus they could have no riparian rights.

In addition, many of the most valuable mineral deposits were not on riparian lands. The federal government did not protest the presence of these “trespassers” using water or take any leadership in developing a water policy for the West. This left the miners to develop their own customary laws regulating water use; these practices would become the foundation of the prior appropriation doctrine. While riparian water law was a square peg in a round hole, prior appropriation was not the only alternative, but one that suited the needs and interests of the miners that established the custom.

Prior appropriation is often summarized by its mantras of “first in time, first in right” and “use it or lose it.” First in time, first in right establishes that water use is based on seniority, giving early settlers and miners the advantage over more recent arrivals. Under this principle, senior water users are entitled to their entire water allocation before

a junior water right holder can turn on the tap, regardless of the upstream/downstream relationship. If a water user does not demonstrate reasonable diligence developing a water right or simply doesn't use water for many years, they may be at risk of losing their water right; hence the phrase "use it or lose it."

A traditional prior appropriation water right typically consists of three major elements. A water user must show intent of beneficial use, a diversion from the watercourse, and application of water to a beneficial use. All three must be pursued with due diligence or else the water right may not be recognized as a legitimate claim (Getches 1997). Intent to use water was originally shown by beginning work on a diversion or ditches. Diverting water from a stream was a very tangible way of showing intent to use water, but over time western states adopted a permitting system that required a user to post a visible notice. Eventually this evolved into requiring water users to apply and receive a permit as the first step in developing a water right. A diversion from the watercourse is also a practical means of measuring how much water the individual intended to use. Beneficial use was traditionally defined as irrigation, hydropower, mining, or other consumptive uses; however, over time, this definition has expanded to include instream flows for fisheries and ecosystem function.

Prior appropriation is a very broad framework for allocating water, but the reality of regulating water is extremely complicated. Over time, extensive case law and statutes have built substantive and nuanced interpretations of using water. An extensive review of water law is not necessary here; however, it is valuable to review decisions and statutes that will be relevant to the Clark Fork Basin as drought planning efforts commence. Those policies relevant to the Clark Fork Basin include the Winters Doctrine, basin

closure, Montana Water Use Act, adjudication, and *Montana Trout Unlimited v. Department of Natural Resources and Conservation*. The enduring legacy of prior appropriation continues to favor the water uses with large, old right over the newer water uses. Often it is those newer uses – the ones most vulnerable in water shortages – that benefit the most from drought planning.

The Winters Doctrine: The 1908 Supreme Court ruling on *Winters v. United States* established the reserved water rights doctrine. Also called the Winters' Doctrine, the ruling recognizes a right to water in the amount necessary to fulfill the purposes of a reservation of land.

The case arose from a dispute between white settlers upstream and the Fort Belknap reservation over the priority date of water. White settlers came to the Milk River area in Montana and, consistent with prior appropriation principles developed a water right for irrigation. They put up a notice of how, when, and where they intended to use water; filed the right with the county; commenced construction of ditches within 40 days; and begin irrigation (*Winters v. United States*). The Fort Belknap Reservation, just downstream, began diverting and irrigating a few years later. When the upstream irrigation project prevented sufficient water from reaching the Reservation, the issue was brought to court.

The white irrigators argued that if the Indians had intended to retain water, it would have been explicitly said in the 1888 Treaty that established the Fort Belknap reservation. They also pointed to the precedent of awarding priority dates based on water use. The Court, on the other hand, decided that

[b]ecause it was government policy to make the Indians 'pastoral and civilized' people and because the reserved lands were arid, the Court

found it inconceivable that either the Indians or the government would agree to the vast land cession unless enough water was reserved to make the remaining lands useful. Although the agreement was silent on the subject, water rights were found to exist by 'necessary implication' (Getches 1997, 309).

The quantity of water in the implied reservation is the amount needed to fulfill the purposes of the reservation. For example, quantity can be calculated by irrigable acreage or maintaining fisheries, if fishing rights were retained or granted. Federally reserved water rights cannot be lost through non-use, as in a strict application of prior appropriation, and the priority date is determined by the date the reservation was made or the treaty signed. Some treaties also recognize a right to continue to hunt and fish in traditional places, in which case, a water right can be awarded a time immemorial priority date.

*Winters v. United States* did not quantify the reserved water right for each reservation of land. Rather, the decision only established a framework for calculating the amount of water and determining the priority date. The Confederated Salish and Kootenai Tribes have been in on-going negotiations with the Montana Reserved Water Rights Compact Commission and the United States to quantify their reserved water right. The Montana Reserved Water Rights Compact Commission is set to sunset on July 1, 2013. The Montana State Legislature has not guaranteed an extension to the life of the Compact Commission so the assured time window to reach an agreement on the quantification of the reserved water right is quickly closing. The Confederated Salish and Kootenai Tribes claim water both on and off the reservation to fulfill rights that were reserved (hunting, fishing, and gathering) and granted (develop agricultural livelihoods) in the Hellgate Treaty of 1855. These claims are not just for water in the Flathead watershed, so as the

CSKT website (2004) aptly states, “however these talks turn out, the end result will impact every user of reservation water and those of the surrounding communities for decades to come.”

Basin Closure: Due to the on-going negotiations, the Montana Supreme Court ruled that part of the Flathead watershed is closed to the development of new water rights, at least until the Tribe’s reserved water right is quantified. Other parts of the Clark Fork Basin have been closed either through legislation (Upper Clark Fork, Blackfoot, and Bitterroot watersheds) or compact agreement, in the case of Glacier National Park (see Appendix 9 for a map of closures). Because of these closures, opportunities to develop new water rights or water uses are significantly limited in many parts of the Clark Fork River Basin. Depending on the specific conditions and language used to establish basin closure, water users could develop groundwater, use stored water, or increasing efficiency to gain “salvage” or previously “wasted” water to adapt to new or increasing demands for water.

Developing salvage water, however, is not an easy solution to increasing water availability. One caution voiced by many interviewees is that conservation measures, when implemented cavalierly and uniformly, may have the unintended consequence of using more water than was historically consumed. A water right grants a right to divert an amount of water from a specific point, for a certain period of time, for a specific use. If the use is irrigation, for example, much of the water that was diverted may return to the stream, depending on factors such as crop consumption, soil, topography, and permeability that may slow the rate of return. Salvage water can only be calculated after

considering historic diversion, historic consumption, local geology, and the amount of water that is actually “saved.”

Montana Water Use Act: The Montana Water Use Act, passed in 1973, created mechanisms for standardizing the process of acquiring individual water rights and centralizing water right records. In this review, it is only essential to call attention to the adjudication process. Prior appropriation principles establish that in times of water shortage junior water right holders – those who are second in time – are second in right, and must stop using water. The adjudication process centralizes the records of who has a water right and when and where water use has historically occurred, but it does not address the enforcement of water rights. “Despite the value of an early priority date, enforcing the priority of a water right is not always easy. In Montana, enforcement is generally the responsibility of the individual water right holder” (Task Force 2004, 7). Enforcement options include the appointment of a water commissioner, bringing the issue to water court or the DNRC for a decision, or seeking mediated dispute resolution. Adjudication may be a means of sorting out records and an aid in making decisions enforcing water rights, but it is not an enforcement framework. Even once the adjudication process has been completed, the cost of enforcing a water right may still be a barrier to enforcement.

Adjudication: Completing the adjudication of water rights may lead to a better understanding of how much water is used or may still be available in the Clark Fork Basin. Adjudication is the process of systematically reviewing in the Montana Water Court with the assistance of the Department of Natural Resources and Conservation Adjudication Bureau, the claims to water established prior to July 1, 1973, when the

permit process pursuant to the Montana Water Use Act took effect (DNRC 2012). Some parts of the Clark Fork Basin are further along in the adjudication process than others, but no final judicial decrees have been issued in any of the Clark Fork watersheds. In theory, the final adjudication decree will establish an order of seniority throughout the entire basin and quantify the amount of water historically used in western Montana. According to the Department of Natural Resources and Conservation (2012):

Downstream states and Canada are demanding water in increasing amounts. Montana cannot defend its water use from other states' demands or calls on water until it has completed the adjudication of all the water rights in Montana and knows how much of our water is currently being claimed and used. Issuing water right decrees for every basin in Montana will help the state establish its historic usage. Decrees protect Montana users and assist in settling disputes among users. Enforcing water rights is only possible with a water right decree in place. Settling water rights is also helpful for the state's economic development.

Adjudication, however, is primarily a system of streamlining water rights records and, alone, will not quantify the historic water use in Montana. A more focused approach of quantifying diversions, water consumption, and return flows may be needed to achieve that. Such careful study and measurement is time consuming and expensive, and may not be feasible, but closer study of hydrologic dynamics may be necessary to understand how much water is available in the basin in an average year, how much is actually consumed, and what might be left for the development of new water appropriations.

*Montana Trout Unlimited v. Department of Natural Resources and Conservation:*

A recent decision by the Montana Supreme Court, *Trout Unlimited (TU) v. Department of Natural Resources and Conservation (DNRC)*, will further complicate the on-going adjudication process. Colloquially referred to as the “TU Decision,” the holding in this case is a turning point in groundwater management in closed basins in Montana because

it recognizes the connectivity between ground and surface water. Groundwater withdrawals can cause a net depletion in surface water either through pre-stream capture or induced infiltration (*TU v. DNRC 2006*). In pre-stream capture, pumping intercepts groundwater on its way to surface water. In induced infiltration, pumping draws down surface water toward the well. Understanding of groundwater has been very limited and a scientific understanding of groundwater has increased only in the past 30-40 years; groundwater policy has just started to catch up with science.

Because prior appropriation granted allocation of water based on an ability to put it to beneficial use, rather than proximity, it created a legal framework for using every drop of water in a river or transferring water out of the home watershed. Prior appropriation, and its canons of no waste and trans-basin diversions, paved the way for large-scale dams and diversion projects. As illustrated in *Cadillac Desert* (Marc Reisner 1986), the 50,000 dams built in America and the billions of dollars spent re-plumbing the eleven western states have only managed to turn an area the size of Missouri into productive irrigated farmland. Our best engineering efforts could not counter the limited and finite water supply available in the West, however, these projects created a perception of an abundance of water in the West and in western Montana.

#### *Watershed Profile: Upper Clark Fork Watershed*

The Upper Clark Fork Watershed, as defined in the Clark Fork River Basin Water Management Plan, encompasses the headwaters of the Clark Fork basin. Along the Continental Divide, the river starts as Silver Bow Creek just above Butte; the Clark Fork, in name, starts further downstream at the confluence of Silver Bow Creek and Warm

Springs Creek near the town of Anaconda. In addition to Warm Spring Creek, major tributaries in the Upper Clark Fork include Flint Creek, Rock Creek, and Little Blackfoot River.

*Watershed Profile: Blackfoot Watershed*

The Blackfoot River is a major tributary to the Clark Fork River, draining roughly 2,290 square miles before its confluence just above Missoula. This watershed is comprised of numerous ponds and lakes and several major tributaries such as the Clearwater River, North Fork Blackfoot River, Landers Fork, and Nevada Creek. At Noxon Dam, only 10% of the volume of the Clark Fork River is contributed by the Blackfoot Watershed (Task Force 2004).

*Watershed Profile: Middle Clark Fork Watershed*

The Middle Clark Fork Watershed drains 1,108 square miles below the confluences of the Blackfoot, Upper Clark Fork, and Bitterroot watersheds and above St. Regis (Task Force 2004). This watershed unit primarily encompasses the mainstem of the Clark Fork River, but major tributaries include the St. Regis River and Ninemile Creek. Milltown Dam used to be at the upper reaches of this watershed, but now there are no major hydropower projects. Annual flows leaving the basin comprise 35% of the flows at Noxon (Task Force 2004).

High mountains to the west make this watershed the driest in the Clark Fork Basin, with an average of 28 inches of precipitation a year; however, groundwater makes this watershed seemingly water-rich. According to the Task Force (2004, 331),

with reported yields as high as 2,300 [gallons per minute], the Missoula Valley contains one of the most prolific alluvial aquifers in the world. This aquifer provides water to most of the area residents, [used to provide water to] the Smurfit-Stone paper mill in Frenchtown, and thousands of acres of irrigation. It has been estimated that basin fill in the southern part of the valley contains about 8 million acre-feet of water.

To put 8 million acre-feet in context, that amount is equal to the average annual volume of the Missouri River as it leaves the state (Montana Water 2012).

*Watershed Profile: Bitterroot Watershed*

Another major tributary to the Clark Fork River is the Bitterroot River. The Bitterroot Mountains to the west, Sapphire Mountains to the east, and the Continental Divide to south frame the borders of this watershed, which drains 2,814 square miles before the confluence with the Clark Fork just below Missoula (Task Force 2004). The Bitterroot is a long and skinny watershed, with few major tributaries except for the West Fork and East Fork, which both enter the mainstem of the Bitterroot above Darby.

*Watershed Profile: Flathead Watershed*

The Flathead is the largest and wettest watershed in the Clark Fork Basin. Several major tributaries, such as the “North, South, and Middle forks of the Flathead, Swan River, Jocko River, Stillwater River; Whitefish River; and Little Bitterroot River,” drain the 8,795 square miles that encompass the Flathead Watershed (Task Force 2004, 3-15). The mountains of Glacier National Park, the expanse of Flathead Lake, and two hydropower facilities are dominant features within the watershed. Hungry Horse, situated on the South Fork of the Flathead, generates hydropower and provides flood control. Kerr Dam is on the mainstem of the Flathead River, just below Flathead Lake.

Like other watersheds in the Clark Fork, precipitation varies locally, but most of the annual average of 37 inches of precipitation falls as snow. Melting snowpack contributes to the surface water availability and groundwater recharge in the watershed. Average volume of water entering the Clark Fork from the Flathead is 9,460 cfs; which makes the Flathead the largest tributary to the Clark Fork, contributing 56% of the volume at the Montana-Idaho state line (Task Force 2004).

#### *Watershed Profile: Lower Clark Fork Watershed*

The Lower Clark Fork Watershed comprises the remaining 2,329 square miles of the Clark Fork Basin before the Idaho border. Although this is a small drainage area, five watersheds drain 21,833 square miles above the Lower Clark Fork; at this point the Clark Fork is a major river with a large flow volume. Upstream activities, such as water use and dam operations, affect and regulate river flows in the Lower Clark Fork (Task Force 2004).

Flows are further regulated by reservoir and dam operations within the watershed – Thompson Falls and Noxon Rapids reservoirs are entirely in the watershed, and most of Cabinet Gorge reservoir is in Montana, although the dam is in Idaho. Thompson Falls and Cabinet Gorge are run of the river dams and Noxon also has storage capacity; collectively these three dams have a generation capacity of 824 MW (Task Force 2004).

## **Chapter Summary**

The Upper Clark Fork, Blackfoot, Middle Clark Fork, Bitterroot, Flathead, and Lower Clark Fork watersheds collectively form the Clark Fork River Basin. Water

leaving the upstream watersheds influence water quantity in the downstream watersheds and downstream needs influence water availability in the upstream watersheds. Water dynamics in the Clark Fork are not just driven by gravity and snowpack, but complex relationships may flow upstream or across hydrologic boundaries or affect watersheds in very different ways. Drought does not affect or manifest uniformly across the Clark Fork Basin or even within the smaller watershed boundaries; and in interviews, participants described varying thresholds of drought conditions, coping with drought, and tools for planning for the future. Despite the diverse viewpoints, both geographic and interest-based, many common interests and concerns emerged.

There are many uncertainties with the future of water in the Clark Fork Basin. Many questions remain yet to be answered: What will the Confederated Salish and Kootenai Tribe Water Compact entail? What happens after the adjudication process is completed? Some water users with a seemingly secure water right, might find themselves more vulnerable to water scarcity, if the actual water use amount is much less than the paper water use amount. How much water in the basin is actually available? And how much is being consumed? How will climate variability manifest in the future?

Until water rights have been settled and until there is a complete understanding of how much water is consumed, how, challenged one participant, can specific plans be developed around specific uses? This is a precedent that has been established by the Montana Supreme Court, but there are “times when there will be drought. It is a question of how do we adapt? There is no singular answer, but we have always adapted.” The information needed to develop a detailed drought plan with specific thresholds and

responses may not be available at the current time, but developing a framework for adaptation and conservation may be achievable.

## CHAPTER 5

### CASE STUDY ANALYSIS

This chapter presents the results from the content analysis of drought planning case studies. The three case studies – the Big Hole watershed, Montana; Blackfoot watershed, Montana; and State of Colorado – draw out lessons that could guide the development of a drought management plan in the Clark Fork River Basin. For each case study, this chapter will present the watershed profile, use Innes' (1999) criteria to analyze the collaborative planning process, use Hayes, Whilhelmi, and Knutson's (2004) criteria to analyze the outcome, and present lessons learned through analysis of interviews and content of the drought management plans. This chapter will conclude by looking across all three case studies to analyze and present universal emerging trends in collaborative drought planning.

#### **Case Study 1: Big Hole Watershed, Montana**

##### *Watershed Profile*

The Big Hole River starts on the east side of the continental divide, near the Idaho-Montana border, and is part of the Missouri-Mississippi River system. Along its 150 winding miles, the Big Hole River drains 2,800 square miles and provides irrigation water and outstanding fishing opportunities to both locals and visitors (Munday 2001).

Growing irrigation demands in the watershed coupled with decreasing precipitation placed increased stress on native species. In particular, the native fluvial Arctic grayling (*Thymallus arcticus arcticus*) population declined as a result of low flows and high water temperatures. This concern culminated in the 1990s with an initiative

address chronically dewatered sections of the watershed and the looming possibility of listing the fluvial Arctic grayling as Endangered under the Endangered Species Act (ESA). The issue of protecting the fluvial Arctic grayling quickly became a controversial issue in the watershed (Sullivan 2008). Many ranchers felt that an ESA listing “could have brought an entirely new set of management regulations to the valley, particularly when drought gripped the river” (Sullivan 2008, 116) and wrested water management out of local control and into the federal courts. Community members, with a neutral facilitator, had already been meeting to discuss the problem of chronically dewatered streams and their conversations evolved into an attempt to reach a consensus-based agreement instead of the traditional, top-down regulatory presence of the ESA. In 1995, the newly formed Big Hole Watershed Committee (BHWC) served as a platform for conversations on managing drought while also protecting biological and community interests (Munday 2001). After two years of meetings, members of the BHWC approved a drought management plan that has been in place with some modifications for over 15 years (BHWC 1997; See Appendix 10 for Big Hole Drought Management Plan).

### *The Process of Collaboration in the Big Hole*

Diverse perspectives: Initially, the irrigators that gathered to discuss the chronic dewatering were not willing to talk to agency or environmental folks, but, slowly over time, the group grew to include “agriculture, municipalities, business, conservation groups, anglers, and affected government agencies” (BHWC 1997, 1).

Common purpose or goal: According to one rancher involved, the BHWC successfully distinguished positions (ESA listing for the fluvial Arctic grayling and a

DNRC labeling as a chronically dewatered stream) from interests (maintaining a healthy fish population and economic viability of the community) and a management plan was developed to protect those interests.

Self-organization: Mediation was not required, but rather requested by locals and supported by the Governor's Office with the assistance of a trained facilitator from the Montana Consensus Council (Munday 2008). The presence of a facilitator also ensured that the process followed "the principles of civil discourse" (Innes 2004, 648) and established a fair and balanced process for all parties involved. As a rancher involved in the planning process observed, these rules of process allowed for stakeholders to discuss the issues and brainstorm without attacking each other.

Shared and continued learning: The BHWC integrated conventional scientific data and unconventional alternatives. Monitoring and technical data was made available by the agencies and explained to the BHWC so that stakeholders could make educated decisions. Through collaboration, the BHWC was also able to explore a wide range of drought mitigation options.

Decision rule: Agreement on the drought management plan was reached after two years of monthly meetings with complete consensus. This timeframe allowed sufficient discussion to take place.

Continued participation and engagement: The technical aspects of the plan and continued modifications reflect the shared learning that took place and continues to take place.

### *The Scope of Managing Drought in the Big Hole*

According to the BHWC, the role of the Big Hole River Drought Management Plan is “to mitigate the effects of low stream flows and lethal water temperatures for fisheries (particularly fluvial Arctic grayling) through a voluntary effort among agriculture, municipalities, business, conservation groups, anglers, and affected government agencies” (BHWC 2008, 1). The scope of the drought management plan is intended to protect both the fluvial Arctic grayling and the economic viability of the community.

Drought management assessment: The drought management plan approved in 1997 was never intended to be a final product. Rather, it was intended to be a starting point “from which modifications can be made based on the lessons learned from research projects ..., increased information from new river gauges, and from experiences gained by implementing this plan” (BHWC 1997, 1). Every January the BHWC reviews the drought management plan for modifications (BHWC 1997). Adaptive management allows for the plan to integrate new information and respond to changing circumstances.

Drought policy or legislation: The Big Hole Drought Management Plan is not policy, but rather provides guidelines that shape the watershed’s approach to drought conditions. Implementation of the drought management plan is voluntary which does not infringe on private property rights or prior appropriation. Prior appropriation water rights are based on seniority and a “use it or lose it” philosophy; voluntary conservation lets irrigators close the ditches without fear of losing their water rights. While voluntary implementation seems to lack an enforcement component, this plan requires a level of

education in the community that may not have been associated with a top-down order requiring minimum stream flows.

Supply augmentation and reduced demand for water: The drought management plan does not specifically mention augmenting water supplies. However, 13 wells and two springs have been developed, in conjunction with the drought management plan, and shift dependency from surface water to groundwater (Munday 2001). This practice has been crucial to the success of maintaining late summer flows (Munday 2001; Sullivan 2008). These new sources of water, in addition to conservation, reduce the overall demand on the river during critical low flow periods.

Public education: This component of the drought management plan “describ[es] the need for a drought management plan, its provisions, and anticipated benefits” and suggests “possible actions people can take to mitigate damage from dry years” (BHWC 1997, 6). Effective communication is required to ensure the flow of knowledge between agencies, the BHWC, and public. The drought management plan explicitly directs how communication will be transmitted, by whom, and how often.

Technical assistance with conservation and other activities: Montana Fish, Wildlife and Parks offers assistance to irrigators willing to reduce water diversions and upgrade infrastructure and the BHWC holds public meetings to share information and discuss conservation measures (BHWC 1997). This financial assistance is crucial to attracting more ranchers to participate in the drought management plan.

Short and long-term drought: The Big Hole River Drought Management Plan encompasses the entire watershed, but acknowledges variations within the river system by dividing the river into four management zones. Mitigation actions are triggered by

graduated flow and thermal thresholds designated for each management zone. The management zones and thresholds recognize the variation that exists within the river basin and matches conservation efforts to the severity of the drought. Each section of the river has three flow thresholds (for example 250 cfs, 200 cfs, and 150 cfs); as flows decrease increasingly aggressive conservation measures are recommended (BHWC 1997). Conservation measures range from a notice to prepare for drought to limited angling to voluntary reduction of water consumption. While low flows and high temperatures are related, the drought management plan addresses these issues separately to allow for greater nuance. The temperature thresholds also have a time component (i.e. temperature exceeds 70 degrees Fahrenheit for more than 8 hours per day for 3 consecutive days and flows reach a certain threshold) and call for additional conservation measures (BHWC 1997). The BHWC is responsible for monitoring snowpack, forecasting flows, and monitoring actual flows on a daily basis. Disseminating climactic data available from climate agencies on the internet and communicating that information to the community allows ranchers to prepare for potential drought in the future and triggers rapid response conservation measures when flows reach critical levels. The Big Hole Drought Management Plan, however, does not specifically address long-term drought beyond acknowledging that conservation practices should be in place until conditions change.

Implementation: The drought management plan clearly identifies the roles and responsibilities of each party. The BHWC roles are to “educate interested and affected parties; develop, adopt, and modify annually the dry year plan; receive, monitor, and act on information regarding stream conditions and snow pack levels throughout the year;

notify interested and affected parties of implementation and secure support; and evaluate the environmental, social, and economic impact of the plan” (BHWC 2008, 1). Agency roles (Montana Fish, Wildlife and Parks; Montana Department of Natural Resources and Conservation; and U. S. Natural Resource Conservation Service) are to “provide accurate and timely information regarding stream conditions and snow pack levels throughout the year; provide technical assistance in reviewing the plan and monitoring its implementation; ensure coordination of effort among all affected government agencies; and contact and inform media of dry year plan implementation and stream flow and temperature status” (BHWC 1997, 1). These roles and responsibilities are clearly defined to prevent confusion or surprises; each group knows and is accountable for their tasks. The responsibilities are also allocated in a way that is consistent with the expertise and mandate of the organization or agency.

### *Lessons Learned*

Based on the interview and drought plan content analysis, the following lessons from the Big Hole watershed emerge. The success of the Big Hole River Drought Management Plan lies in the quality of the process that created it, the scope of the plan, and the quality of the relationships over time. The drought management plan has been in place for nearly 15 years, the BHWC is still active, and the river still supports a fluvial Arctic grayling population, a ranching community, and recreation – all successes which point to the durability of the plan and the relationships between community members.

There are some environmental groups who maintain that the plan has not done enough to support fluvial Arctic grayling recovery and have continued to press for an

ESA listing, which was most recently denied in September 2010 by the U.S. Fish and Wildlife Service (CBD 2010). According to the Center for Biological Diversity “extensive water withdrawals from the Big Hole River continue to threaten the Big Hole population...so few grayling have been found that MFWP have not been able to estimate their populations, suggesting those populations are on the brink of extinction” (CBD 2010).

While an ESA listing may require stricter conservation measures and be perceived as an immediate “environmental success” to some environmental groups, such a listing would not have the same community support as the drought management plan. According to a rancher involved, there is “no comparison” between the relationships between community members before and after the drought management plan was developed. Collaboration and consensus is a long, slow process, but community support continues to build in the Big Hole watershed. The rancher went to say that representatives from national environmental groups have been invited to join the collaborative process, but once involved, they began to understand the larger community interests and found they cannot represent the narrow interests of their constituents and the national environmental groups would become less involved in the collaborative process.

## **Case Study 2: Blackfoot Watershed, Montana**

### *Watershed Profile*

The Blackfoot River is a 1.5 million acre watershed west of the Continental Divide in Montana (US FWS 1997). Part of the Clark Fork River watershed, this sub-basin is home to a diverse array of plant and animal species, including some species that

are either listed or candidates for listing under the Endangered Species Act.

In 2000, circumstances led the Blackfoot Challenge, a local conservation organization and collaborative initiative, to develop a Drought response Plan that has been in place, with modification, for over ten years. The winter of 1999-2000 was a low snow pack year. Snowpack is a natural water storage unit – as the snowpack melts groundwater is recharged and runoff contributes to surface water. A large snowpack that slowly melts helps to ensure a late-irrigation season water supply. As a basin that relies on snowpack for water supply, low snowfall is a warning sign for low surface water availability. The other contributing factor was the Murphy Right held by Fish, Wildlife, and Parks (FWP).

Named for the sponsor of state legislation passed in 1967 which created them, a Murphy Right establishes a water right for instream flow, instead of the traditional water right that requires water to be diverted from a stream course (Montana River Action nd). The 700 cfs Murphy Right, held by FWP and measured at the confluence with the Clark Fork River, was determined to be the amount of water needed to maintain a “wetter riffle” and protect the “‘blue ribbon’ fisheries in the Blackfoot River from severe low flows” (Blackfoot Challenge 2010, 2). Below 700 cfs, riffles disappear and “river productivity rapidly declines and the forage base that sustains thriving trout fisheries is greatly diminished” (Blackfoot Challenge 2010, 2). According to the Blackfoot Drought Response Plan (Blackfoot Challenge 2010, 2), “[t]here are nearly 3,500 water rights of record within the Murphy Right Reach of which 1,270 assert the use of water in excess of 1 cfs. Included in these water rights, there are 258 “junior” to the Murphy Right,” which has a priority date of 1971. Fish, Wildlife, and Parks made a call on the river to enforce

their Murphy Right when the flow on the Blackfoot reached the critical level. Under the Doctrine of Prior Appropriation, Fish, Wildlife, and Parks was entitled to make that call, but, according to one local, many people in the Blackfoot felt that “those [junior water] users won’t solve the problem – the whole watershed needs to be involved” in minimizing the adverse effects of drought years.

### *The Process of Collaboration in the Blackfoot*

Diverse perspectives: In natural resource circles, the people and organizations in Blackfoot have gained national attention for efforts to manage the basin and its resources through collaboration, cooperation, and dialog (Blackfoot Challenge nd). The Blackfoot Challenge became an official organization in 1993, but “private landowners, federal and state land managers, local government officials, and corporate landowners” in the basin have been working together since the 1970s (Blackfoot Challenge nd). A shared vision of protecting natural resources and the rural communities in the basin continues to bring these diverse parties together. When drought became a watershed issue in 2000, the Blackfoot Challenge was a leader in developing a framework to address those concerns.

Common purpose or goal: As touched on above, the common goals were frustration with the outdated and difficult to comprehend Montana drought plan and the belief that, by working together, the entire watershed community could find a better way to plan for and respond to drought.

Self-organization: By 2000, people in the Blackfoot had a history of collaboration and working together to resolve issues, but the decision to pursue a watershed approach

to minimize the hardships and circumstances experienced at the 700 cfs threshold was driven by the local people.

Shared and continued learning: The Blackfoot Drought Response Plan is not a static document. Annual meetings, held near the end of the water year, allow the Drought Committee and the participants in the Drought Response Plan to reflect on their experiences and to integrate lessons learned into the Drought Response Plan. People with technical expertise were closely involved in developing the Response Plan and continue to be involved in the implementation of the Plan.

Continued participation and engagement: The Blackfoot Drought Committee (2010, 1), “comprised of representatives from state and federal agencies, conservation districts, and local conservation organizations as well as local landowners, irrigators, outfitters, and anglers,” was created to oversee the implementation of the Response Plan. The diverse make-up of this committee ensures that diverse interests continue to be represented as the Drought Response Plan is implemented and adapted.

### *The Scope of Managing Drought in the Blackfoot*

The Blackfoot Drought Response Plan (Blackfoot Challenge 2010, 1) describes drought and the impacts of drought in fairly broad terms – drought is simply a “deficiency in precipitation over an extended period of time...that results in shortages of water. Drought is also a normal, recurrent feature of climate.” However, the threshold for tolerating water shortage is very clearly defined at 700 cfs – the flow level that triggered crisis mode in 2000 – and the measurement for success is defined, albeit in somewhat broad terms. The role of the Drought Response Plan (Blackfoot Challenge 2010, 1) is “to

minimize the adverse impacts of drought on fisheries resources and to aid in the equitable distribution of water resources during low flow summers. ... Under the ‘shared sacrifice’ concept, irrigators, outfitters and recreationists have a unique opportunity to have a positive impact on the future and health of the Blackfoot Watershed.”

Drought management assessment: The Drought Committee hosts an annual meeting around the end of the water year in October to “summarize hydrology, drought plan participation, water conserved, and outreach activities” (Blackfoot Challenge 2010, 5). This annual meeting is a chance for water users in the basin to review the successes and discuss possible modifications to the Drought Response Plan.

Drought policy or legislation: The Blackfoot Drought Response Plan formalizes, through consensus and not legislation, an informal and voluntary approach to dealing with water shortage. The central tenet of the Blackfoot Drought Response Plan is the goal of voluntary shared sacrifice among water users in the basin. According to the Blackfoot Drought Response Plan (Blackfoot Challenge 2010, 1), such an approach was selected because it was recognized that:

- drought and the management of low flows are a watershed-wide concern;
- beneficiaries of the drought response effort include interests throughout the watershed;
- the greater benefit to maintaining river flows and sustaining the overall health of the river can only be gained by the cooperative effort of the larger community.

In the Montana Water Code, prior appropriation, the concept of “first in time, first in right” is the enforceable method to dealing with water shortage. It is not a flawless system, but it is the codified approach. Any conservation efforts taken by an upstream senior water user typically benefit a downstream junior water user. The Blackfoot

Drought Response Plan, in part a product of frustration with prior appropriation, recognizes that water shortage is a basin-wide concern that requires a basin-wide solution.

Participation in the Blackfoot Drought Response Plan is voluntary and outside the realm of strict prior appropriation, but it contains enforcement mechanisms for water rights junior to the Murphy Right. The Blackfoot Drought Response Plan (2010, 2) states,

As part of this plan, MT FWP has agreed not to initiate a “call for water” under their senior water right (Murphy Right) on junior water users who meaningfully participate in the Blackfoot Drought Response when flows fall below 700 cfs.

Junior water users who are not participating, or not meaningfully participating, in shared sacrifice are subject to a call for water.

Supply augmentation and reduced demand for water: Shared sacrifice across the watershed among senior and junior water users and large and small water rights creates a water bank of reduced water use “when flows reach predetermined thresholds” (Blackfoot Challenge 2010, 3). Water users with rights junior to the FWP Murphy Right can match their reductions with reductions from senior water rights; collectively, these reductions go into a “water savings bank” (Blackfoot Challenge 2010). Basin-wide water banking creates the opportunity to maintain instream flows during drought conditions in critical habitat, not just within Murphy Reach, but also throughout the basin, particularly in small streams and tributaries to the Blackfoot that may not easily be protected through a formal call. Non-consumptive water users, such as fishing, can also participate in the “shared sacrifice” plan by reducing fishing hours or changing fishing habits during periods of low flows or high temperatures.

Public education: The Blackfoot Drought Response Plan integrates public education and outreach into the roles and responsibilities of the Blackfoot Drought Committee, the group charged with overseeing implementation of the plan. At the start of the calendar year, the Drought Committee meets monthly to monitor “drought indicators such as snowpack, precipitation, soil moisture, and the Surface Water Supply Index” (Blackfoot Challenge 2010, 4). Meeting frequency will increase to weekly as the irrigation season approaches or as conditions dictate. The Blackfoot Drought Committee sends updates to water users via letter and email at least once every two months. If indicators are forecasting drought conditions, the Blackfoot Drought Committee will contact all water users to confirm participation. In addition, “outreach activities (letters, emails, personal communication, posters, signs, press releases, website) continue and are updated with current information to help water users prepare for and respond to drought” (Blackfoot Challenge 2010, 5). An annual meeting near the end of the water year is an opportunity for the community to reflect on participation and outreach activities.

Technical assistance with conservation: Representatives from state and federal agencies are actively involved in the oversight and implementation of the Drought Response Plan. Members of the Drought Committee work closely with participants in the Drought Response Plan to “identify opportunities for water conservation based on individual needs and conditions. Drought management plans vary by participant but common water conservation strategies include pooling water rights and having them in rotation, reducing overall use, reducing instantaneous use, or shutting down” (Blackfoot Challenge 2010, 6). Pooling water rights and using water on rotational basis applies when simultaneous water use would lead to a dewatered stream. It does not require giving up

access to a water right, but coordinating the timing of diversions and use among hydrologic neighbors. Shared sacrifice is not just an ambiguous concept of using less water but a carefully quantified framework based on water right data, such as “flow rate, priority date, and water sources,” to develop a strategy for using less water (Blackfoot Challenge 2010, 6).

Short and long-term drought: Drought, in the Blackfoot watershed, is “a deficiency of precipitation over an extended period of time, usually a season or more that results in shortages of water. Drought is also a normal, recurrent feature of climate that occurs in most climate zones” (Blackfoot Challenge 2010, 1). Drought response implementation is based on flow and temperature triggers. Flow triggers are not associated with a period of time, but only flow rates that are approaching 700 cfs, 700 cfs (the Murphy Right), 600 cfs, and 500 cfs; each threshold triggers a specific set of actions. Temperature thresholds are based on high temperatures for a period of three consecutive days. Responses outlined in the Blackfoot Drought Response Plan are intended to “minimize the adverse impacts of drought on fisheries and to aid in the equitable distribution of water resources during low flow summers” (Blackfoot Challenge 2010, 1). As such, the Drought Response Plan aims to minimize the effects of seasonal drought, rather than the compounded effect of multi-year drought. The Blackfoot Challenge, however, is focused on restoring hydrological function and long-term water security in the basin. The combined effort of the Blackfoot Challenge and the Blackfoot drought Committee seek to respond to and mitigate the adverse effects of both short and long term drought.

Implementation: The Blackfoot Drought Committee, which is coordinated through the Blackfoot Challenge, is responsible for the oversight and implementation of the Blackfoot Drought Response Plan.

### *Lessons Learned*

The drought response plan for the Blackfoot is an essential tool for sharing the burden of water shortage among water users to protect the economic and ecological vitality of the watershed. According to a person involved in implementing the Drought Response Plan, revisions can be made to fine tune components, but a drought response plan is just “a response to a situation, it’s not getting rid of it.” Long-term management is also needed, in addition to a drought response plan. Restoration of hydrologic functions, such as meanders or groundwater recharge, is one option to consider in long-term management. Early irrigation, when stream flow is peaking due to snowmelt, increases soil moisture and prepares a field for hotter, drier months to come. He went on to say, “it’s best to be in good shape for when the low flows happen – you’d prefer to top off rather than catch up [at the end of the summer].” Not only does this mechanism increase soil moisture, but it also helps shift the demand for water toward the timing of peak flows and water availability.

Drought planning does not have one easy formulaic approach or solution. A member of the Blackfoot Challenge recommended that, “drought planning has to be suited for the area, but it is also necessary to communicate with other basins [outside of the Blackfoot] and pass information in a timely manner – not just a press release in the paper.” For example, fishing restrictions due to low flows or high temperatures in the

Bitterroot send more people to the Blackfoot and vice versa. More efficient and increased communication between basins could facilitate better preparation within the basin, while also recognizing that the impacts of drought may spread beyond the area experiencing actual drought conditions.

### **Case Study 3: State of Colorado**

#### *Watershed Profile*

The drought planning efforts that have taken place in Montana are watershed-based initiatives that scale down to tributary and individual scales. The state of Colorado, on the other hand, provides an example of drought planning on a very large, statewide, yet multi-tiered scale. Colorado has what is often described as an “80/20 problem” – 80% of the water is on the west side of the Continental Divide, but 80% of the population is on the east side of the mountains. Trans-basin diversions carry water from the western half of the state to meet the water demands of the people on the eastern half of the state. Despite numerous water projects, some parts of the state are chronically in drought. As one representative from the Colorado Water and Conservation Board reflected, 2002 marked the first time “the whole state was in drought. We realized drought has far reaching effects both economically and socially.” Drought response plans had been evolving for over thirty years at that point, but conditions in 2002 catalyzed an extensive revision and overhaul process (CWCBA 2010).

The information gathering and planning process spanned several years. According to a person close to that process, it was “one of the first times [to have a state] conducting a qualitative and quantitative vulnerability assessment. It was important, in

order to better mitigate drought, to understand where our vulnerabilities are. Drought could be a more frequent phenomenon because of climate change.” The end result of that revision and overhaul process was a 600+ page document defining thresholds, triggers, and responses; developing a framework for increased communication and inter-agency communication; and creating a toolbox of resources for local drought planning. The complete Colorado Drought Mitigation and Response Plan is available online at (see CWCB 2010 in reference list for full citation) and a brochure promoting the plan is attached in Appendix 11.

### *The Process of Collaboration in Colorado*

Diverse perspectives: The drought plan overhaul in Colorado was part of a collaborative process, but the interest groups, stakeholders, and partners represented a much larger geographic scale different than in the Big Hole or the Blackfoot watersheds. The Drought Mitigation and Response Planning Committee comprised many state agencies, the Governor’s Office, universities, federal agencies, climate offices, and the National Drought Mitigation Center. Ski resorts and outfitters were also represented on the planning committee.

Gathering public input and support was also an important part of the drought plan overhaul. The Drought Mitigation and Response Planning Committee developed a Stakeholder and Public Participation Plan (CWCB 2010, 12) “to provide for a meaningful process through which Colorado’s citizens, public officials, and stakeholder groups may effectively participate in the revision of the Colorado Drought Mitigation and Response Plan.” A series of webinars, public meetings around the state, and technical meetings

were held over the course of a year in recognition that “not everyone participates in the same way or at the same time” and to encourage diverse interests and perspectives to participate (CWCB 2010, 12). The planning process is documented in the opening section of the Colorado Drought Mitigation and Response Plan so the planning approach is transparent.

Common purpose or goal: The first drought response plan in Colorado (also one of the first in the United States) was completed in 1981 and then revised in 1986, 1990, 2001, and 2002 (CWCB 2010). The comprehensive overhaul was triggered by the 3 year update cycle, as required by the Federal Emergency Management Agency (FEMA), in the existing response plan, but also a commonly recognized need to modernize and evaluate drought indices, develop and implement a hazard vulnerability assessment, and also to develop a framework for supporting local drought planning efforts (CWCB 2010). After the severe statewide drought in 2002, a drought mitigation plan was also developed in 2007 as a companion to the response plan – the 2010 revision and overhaul was an opportunity to integrate the drought response and mitigation plans.

Self-organization: Even though the update was required by federal regulation, the Colorado Water and Conservation Board saw the update as an opportunity to develop “state of the art planning techniques to prepare Colorado for drought” (CWCB 2010, 2). The Colorado Water and Conservation Board, their many partners, and an extensive public input process shaped the scope and extent of the revision and overhaul.

Shared and continued learning: The make-up of the Colorado Drought Mitigation and Response Planning Committee reflects many different disciplines of expertise and, per FEMA requirements, the Committee reviews the Colorado Plan every three years.

Once drought conditions have subsided, the Colorado Water and Conservation Board and the partners involved will “do a lessons learned debrief.” The three-year review required by FEMA is an opportunity to integrate those lessons.

Decision rule: The Colorado Water and Conservation Board led the planning process and remains the lead entity for maintaining and updating the Colorado Drought Mitigation and Response Plan. However, “the review consists of all partners having the opportunity to comment on all elements” (CWCB 2010, A.39). Comments and revisions will be forwarded to the Governor’s office for approval.

Continued participation and engagement: In September 2012, the two-year anniversary of the Colorado Drought Mitigation and Response Plan, the Colorado Water Conservation Board is hosting a statewide drought conference. The Statewide Drought Conference is an opportunity to

share information and experiences on: advances in drought monitoring, mitigation & impact assessment; drought preparedness innovations; the response & impacts from the 2011 drought – Colorado/Texas/Africa/others; mitigation & implementation; managing drought related risk; opportunities for interagency/intergovernmental collaboration and public/private partnerships on drought response & mitigation efforts (CWCB 2012).

The conference is also an opportunity to learn the latest developments in forecasting the impacts of climate change, future droughts, and explore how the state could adapt to those changes.

### *The Scope of Managing Drought in the Colorado*

Drought policy or legislation: As a statewide planning initiative, the Colorado Drought Mitigation and Response Plan carries support from the Governor’s Office and

must also remain in compliance with federal regulations. The Colorado Drought Mitigation and Response Plan was adopted by the Governor, which empowers the Colorado Water and Conservation Board and the Colorado Division of Emergency Management to perform their roles and responsibilities and oversee implementation. The Colorado Drought Mitigation and Response Plan is also integrated into the State of Colorado Natural Hazards Mitigation Plan. Unlike the plans in the Big Hole and the Blackfoot, the Colorado Drought Mitigation and Response Plan “has the force and effect of law as promulgated by the Governor” (CWCB 2010, A.7).

The four components of the Colorado Drought Mitigation and Response Plan – monitoring, assessment, mitigation, and response – did not require the creation of a new government entity, but rather are designed to more efficiently work within existing framework of agencies. The Drought Task Framework (see Appendix 11, page 3) clarifies the chain of communication from the region in drought up to the Governor’s Office.

Short and long-term drought: The Colorado Drought Mitigation and Response Plan aims to reduce the “adverse effects of a water supply emergency on public health and safety, economic activity, environmental resources, and individual lifestyles” through comprehensive drought management planning (CWCB 2010, E.1). Drought management planning includes preparation for both short and long term drought through pre-meditated preparation (drought mitigation) and immediate actions (drought response). The Colorado Drought Response and Mitigation Plan differentiates these terms by saying “[d]rought mitigation refers to actions taken in advance of a drought that reduce the potential drought related impacts when the event occurs” (CWCB 2010, E.1). Such actions could

include the development of community drought response plans, drought legislation, support for increasing water efficiency and reducing demand, or developing mutual aid agreements. Drought response planning identifies “the conditions under which a drought induced water supply shortage occurs and specifies the actions that should be taken in response” (CWCB 2010, E.2). Drought response actions are triggered as different thresholds are reached and could include “anything from short-term emergency aid to government assistance programs and media relations” (CWCB 2010, E.2). Drought, as depicted in the Colorado Drought Mitigation and Response Plan, is not just a normal aberration of climate, but a natural hazard that requires far-reaching planning and preparation, as well as a framework for immediate actions.

The types of drought, their impacts, the scope of the responses and action defined in the Colorado Drought Mitigation and Response Plan is extensive. Consistent with the National Drought Mitigation Center, the Colorado Drought Mitigation and Response Plan identifies the four types of drought as meteorological, agricultural, hydrological, and socioeconomic. The severity of these types of drought is “generally differentiated by pre-defined trigger points or thresholds” and monitoring conditions is essential for identifying the type and severity of drought and initiating the necessary responses and actions. (CWCB 2010, E.1).

Once the umbrella Drought Task Force has identified the type of drought, meteorological, agricultural, hydrological, or socioeconomic, the corresponding drought impact task forces will be activated. Agriculture, tourism, energy, municipal water, wildfire, and wildlife comprise the six different drought impact task force groups and they are responsible for coordinating both short and long-term actions to minimize the

adverse effects of the different types of drought.

Supply augmentation and reduced demand for water: technical assistance with conservation and other activities; and public education: In a drought emergency, the roles and responsibilities of state and federal agencies are clearly allocated and diagrammed (see Appendix 12 for chart). In addition to augmenting supply, reducing demand, supporting public education, and offering technical assistance, agencies are also tasked with tracking impact related to water shortages, improving water availability monitoring, facilitating watershed and local planning, and supporting programs to reduce the impact of drought. The agencies involved not only represent expertise in agricultural, wildfire, and ecosystem functions, but also specialization in municipal water systems, military affairs, public health and water quality, life threatening situations and federal disasters, energy, tourism, and economic impacts.

Implementation: The Colorado Drought Mitigation and Response Plan offers a very comprehensive framework of actions and responsibilities across geographic scales and levels of government. The role of the Colorado Drought Mitigation and Response Plan (CWCB 2010, vii) is to

provide an effective and systematic means for the State of Colorado to reduce the impacts of water shortages over the short or long term. The [Colorado] Plan outlines a mechanism for coordinated drought monitoring, impact assessment, response to emergency drought problems, and mitigation of long term vulnerability impacts.

The chain of communication, as diagrammed in page three of Appendix 9, is a flow chart of information traveling from local regions up to the Governor and across agency jurisdictions. According to one study participant involved in drought planning in Colorado, this framework

greatly enhances interagency communication. We're having record turnaround time and weekly conference calls. Information quickly flows from [a drought] region up to the Governor's Office and back. Our on the ground response is much quicker. Having clear triggers and actions puts aside bureaucracy in a natural disaster. It puts aside political discussion because we're already decided the action in a non-crisis time in a state and Governor approved plan.

Communities are receiving the information and resources they needed, when they need them. The crisis is not exacerbated by slow agency response time.

Resources and support for local drought planning efforts are built into the umbrella of the Colorado Plan, so even though the Colorado Plan is a statewide initiative, it still has the capacity and flexibility to respond to localized conditions and concerns. There are, as one participant said, "lots of benefits to responding to drought at a state level, but it can be more beneficial if you also coordinate at a local level. We're providing tools for local entities to develop plans and then incorporating those plans into the state plan." Annex A is the response section of the Colorado Drought Mitigation and Response Plan and it can be activated for a county or a specific type of drought. At the time of the interview, two counties had declared an agricultural drought and the necessary steps to respond to and mitigate the situation were being implemented. See Appendix 13 for a chart summarizing thresholds and the correlating actions.

Drought management assessment: As described in the section above, the Colorado Drought Mitigation and Response Plan is reviewed after drought conditions have subsided as well as every three years. The Colorado Drought Mitigation and Response Plan is a document that will continue to evolve and integrate new information and technology.

## *Lessons Learned*

Many of the lessons that have been learned in the past 30 years by Colorado about planning and preparing for drought have been integrated into the 2010 edition of the Colorado Drought Mitigation and Response Plan. Those lessons and conclusions include:

- the diversity, complexity, and ambiguity of drought impacts blurred identification of alternative actions available to decision makers;
- a systematic definition of problem areas and potential solutions was essential to effective government response, so under and overreactions could be minimized;
- both physical and social impact data were needed;
- knowledge of the location, kind, and degree of water shortage provides better identification of impacts;
- timely and accurate data on impact development were crucial to effective response;
- impact identification provides the framework for governmental and public adjustments;
- integration of response by private, public, and governmental entities was needed;
- as the drought intensifies, the maintenance of established channels of responsibility, with an emphasis on water conservation and planning, becomes increasingly important;
- as impact problems and local needs become more serious, better management and integration of effort also intensifies; and
- should drought intensify to the point where impacts exceed the State's response capabilities, an effective state program will help facilitate a request for federal assistance (CWCB 2010, 3).

The updated Colorado Drought Mitigation and Response Plan clarifies drought impacts and the corresponding actions, streamlines communication between agencies, and complies with federal emergency regulations. According to a Colorado Water and Conservation Board representative, this new framework may still be

too new yet for real shortcomings to have emerged, but when anything is created for the first time, parts of it are done just to get things done. For example, some of the data may not be as accurate at a local level, but over time we'll go back and update that. Right now we're really pleased with how our response plan is working, but we may find limitations as drought continues.

Whatever limitations do emerge will be addressed in the three-year review process, per FEMA requirements.

### **Emerging Trends in Collaborative Drought Planning**

Each drought plan in Big Hole River, Blackfoot River, and Colorado is unique, yet common trends have emerged. In all three plans, crisis motivates action and leads to planning efforts that utilize a strong public process. Those communities developed a multi-tiered plan that includes comprehensive definitions of drought and drought impacts, clarifies roles and responsibilities, and integrates adaptive management principles. These drought plan agreements are both formal and informal, yet include incentives for participation or legal enforcement mechanisms. Collectively, these components expand the range of mitigation and response actions that could be taken by communities, agencies, and individuals.

One major challenge to the development of a drought management plan is thinking proactively and anticipating future challenges, rather than simply reacting to circumstances as they arise. Crisis has often been the catalyst for thinking about drought, and while it has brought together some very interesting collaboration efforts in various regions, waiting around for crisis to hit may not be the best approach. Communities, according to one policy expert, “need to prepare ahead of time. Many response mechanisms require long-term planning, but once drought hits, the options become greatly limited.” Proactively planning may increase the range of mitigation and response actions that could be developed in an area. Only after crisis emerges and passes, have communities and regions started to develop long-term mitigation plans. People, this

person went on to say, “don’t often think in long term trends, but rather in immediate and short term supply. Drought planning in the Big Hole, Blackfoot, and Colorado was driven by the emerging crisis in each region and brought local people, agencies, and other interested parties together to create a framework that could help them prepare and respond to future drought.

As a response to crisis, many informal agreements are being developed. “Our existing [water management] framework is set up to past conditions, but there have been interesting adaptations. Groups and individuals are working together without litigation and not sticking to strict legal controls,” observed an environmental policy analyst. She went on to say that in the Big Hole and in the Blackfoot everyone was willing to give up a little in order to work toward a larger, common goal of “having a working stream and meeting many local concerns. This approach can’t be legally mandated, but we can remove some of the barriers, while keeping safeguards to protect legal rights.” Some of those barriers include difficulty in leasing water for instream flows or other uses and protecting instream flow rights. Since no one wants to give something up for free, easing the barriers to informal agreements is one way of encouraging more individuals to participate in sharing the burden of drought.

Informal agreements, however, are not a means of bypassing all regulations, nor are shared sacrifices the ultimate solution to drought emergencies. The Big Hole Drought Management Plan, although partially an alternative to listing the fluvial Arctic grayling on the Endangered Species list, aims to protect the fish and their habitat and stakeholders in the event of a listing. Having a definition of success, while important in all planning efforts, is especially important in developing and implementing informal drought plans.

A shared vision of success is part of what motivates people and communities to address the challenge of planning for the future and to continue to work towards that vision.

Finding and developing a shared vision requires a strong public process. Drought is not just an agricultural issue, but also an economic, environmental, and public health concern. Since drought is so complex, drought management requires widespread community support and collaboration is the best way to achieve that, especially if drought is going to be approached as a shared sacrifice. The design process and implementation should involve anyone with an interest in the issue and to ensure that a diversity of interests is represented. An inclusive framework with widespread participation also prevents burnout, since collaboration cannot be a responsibility shared by only a few people.

The use of the collaboration and a facilitator is not necessary, but is something that could be considered, especially in small-scale drought planning efforts. The Big Hole and the Blackfoot drought plans were both developed through collaboration; yet the Big Hole used a facilitator, while the Blackfoot Challenge “has never employed a professional facilitator” so there is not a correct or standardized way of using collaboration (Weber 2009, 315). Colorado, for example, used many principles of collaboration and an extensive public process to develop a plan that was signed by the Governor. Ultimately, one agency, the Colorado Water and Conservation Board, oversees the implementation of the plan, but many agencies, departments, and offices share actual tasks of implementation across the state. Unlike the plans in the Big Hole or the Blackfoot, the Colorado Drought Mitigation and Response Plan can be enforced by law,

but having significant agency and community support for the plan increases the effectiveness of implementing the plan.

Designing a planning process that is inclusive and motivated by a shared concern may contribute to the development of a comprehensive drought plan, but just because collaboration is used doesn't mean that a successful drought plan will be created. The components of the plan are just as important as the process. A starting point for many drought plans is a comprehensive definition of drought. Drought or water supply shortage does not affect all parts of a county, a watershed, or a state for the same duration, frequency, or severity with the similar impacts. No two droughts are the same and the region affected by drought may expand or shrink as conditions persist or subside. Drought is not just a deficiency in precipitation, but a shortage of water with far-reaching direct and indirect consequences. As one study participant suggested, "drought is an incomplete descriptive word... We may have water when we don't need it and none at the end of the season when we do need it. Drought is one way of experiencing shortage." Timing of precipitation and snowmelt, storage capacities, means of water diversion and delivery, age and size of water right, and use all contribute to how the impact of shortage is experienced and influence the range of response and mitigation actions. Many of those response and mitigation actions are enacted on a local or individual level, but planning efforts can help coordinate and leverage resources.

Drought might not just be a measure of precipitation, but also of climate variability and supply and demand. "Variability," according to one interviewee, "whether natural or man caused, is here and the ability to deal with it is important. It's not just a bunch of wacko environmentalists driving this; it's people on the ground who are

concerned about the resources they rely on. Climate may be more of a variable than it has in the past.” Drought planning efforts should not just be based on past trends, but need to also integrate scenarios for future climate trends.

Water shortage could also be triggered by the relationship between available supply and demand. As one proponent of water marketing observed, “water is a critical resource, as supply goes down the demand increases.” Storing water or changing irrigation practices can balance the relationship between supply and demand, but it could also be balanced with water markets. The water marketer went on to say that “markets are an adaptive and flexible way of changing supply and demand.”

Paying for water raises questions regarding equity because often the largest water users are often the ones least able to pay, such as irrigators. A western water policy expert observed that, “one question being asked across the American West is how to responsibly transfer water from existing uses to new uses, such as urban or environmental, while minimizing the impact to rural communities.” Water marketing may just be one way of allocating water to the “highest and best use.” Communities may decide that the highest and best use is not economic, but ecosystem functions. Water leasing is another mechanism for moving water from one use to another, but the permitting process is arduous.

One way of addressing a hazard that constantly changes in size and scope is through a multi-tiered approach. The Big Hole and Blackfoot watersheds and the State of Colorado define the geographic boundaries of the region that is included in the drought plan. The drought plan actions, however, could be triggered at many different geographic scales. The Big Hole has been divided into three smaller management areas with

thresholds identified for each. Flows in the Blackfoot are only measured at the start of Murphy Reach, but flows at this gauge are indicative of flows in the entire watershed (Blackfoot Challenge 2010). Individuals implement response actions when flow thresholds are reached. While many drought response actions, especially conservation, are initiated at a very local or individual level, the Colorado Drought Mitigation and Response Plan demonstrates a need for a larger scale planning effort to address challenges of bureaucracy, communication, and coordination of resources. The Colorado Drought Mitigation and Response Plan is a link between federal hazard management agencies and the local communities that need the resources.

Another way to address a dynamic hazard is to have a dynamic drought plan. Adaptive management reflects that our scientific understanding of the world is no longer stuck in equilibrium, but that climate and ecosystems are highly variable. Adaptive management is not a means of circumventing environmental laws or foregoing an extensive planning process. Instead, adaptive management is similar to an on-going research project. A hypothesis or plan is developed and then implemented and monitored. Lessons are gleaned from the monitoring and the research approach or plan is adjusted to reflect those lessons. Contingency planning could be another way of thinking about adaptive management – a set of scenarios and corresponding responses are developed, implemented, and monitored. Drought planning is a dynamic and constantly evolving process as forecasting tools and indices are improved, climate science evolves, and mitigation and management needs change.

## **CHAPTER 6**

### **PERCEPTIONS OF DROUGHT AND WATER SCARCITY**

#### **IN THE CLARK FORK BASIN**

This chapter reports the results from analyzing the geographic- and interest-based perceptions of drought and an analysis of the emerging the common principles and diverging interests of drought planning. The results resented are drawn directly from content analysis of the interviews and data collected through PAR methods.

As noted earlier, drought is a product of climate variability that does not affect a large region like the Clark Fork Basin uniformly, nor will it manifest in the same way, at the same time. Defining drought at a certain scale, at different thresholds, or needing certain response actions is a very political, economic, ecological, and cultural debate. Despite those inherent differences and tensions, interview content analysis and PAR data indicate that there are areas of common ground. The geographic- and interest based perceptions also indicated that that there are also major institutional constraints that will shape how drought planning moves forward in the Clark Fork Basin. In order to accurately and objectively report the nuance, this section will report experiences of drought by two geographic tiers: the Clark Fork Basin and its six watersheds, which will consist of the Upper Clark Fork, Blackfoot, Middle Clark Fork, Bitterroot, Flathead, and Lower Clark Fork. Within each geographic area, the interest-based perceptions of drought are analyzed.

## Clark Fork Basin

Many individuals with a basin-wide water perspective describe drought as a normal product of climate variability, but this technical understanding quickly shifts into describing the various impacts of drought. Defining drought, no matter how technical, is influenced by a perception of less water and the impact that will have. As such, definitions of drought vary by watershed, by water use, and by individual. One study participant, an expert in drought forecasting, said:

We used to just have climate and it shaped the flora and fauna found here. But once people developed transportation routes, irrigation infrastructure, and markets and came to depend on a water supply, then we got drought. Drought is the threshold of when this infrastructure begins to suffer.

Precipitation is also a factor to consider, but, as he continued, “we’ve been drought proofing for a long time.” As another participant, an irrigator, said, “we’ve spent 150 years trying to mitigate drought. It’s a fairly refined system, but bringing in other interests, now that’s a sticky question.” Reservoirs and irrigation networks are in place to get through times of decreased precipitation, but how well those safety nets work for individuals or communities or the scope of localized conditions or extent of unique circumstances shapes how drought is perceived. For some water use sectors or users in different watersheds, every year could be a drought year and the only variable is the severity or duration.

Climate variability is one factor that can lead to water shortage. As that variability increases or demands for water increase, the question of water shortage may become a more pressing question. According to a municipal water provider, “water will be the limiting factor to development. If we kept developing like we were before the crash, we’d

be feeling the water pinch much sooner.” Population growth will exacerbate the effects of natural climate variability. One policy-maker suggested that:

Drought is part of what happens in Montana, but issues with drought will get amplified. What do we need to do to prepare for growth? How do we sort out competing uses? We are beyond the age of limits...we will all have to make sacrifices and we need to begin to look at how to responsibly care for the blessings of living in this state.

The questions of preparing for growth and sorting out competing uses are not just for agricultural communities or urban areas or closed basins. “Water,” continued the policy-maker, “tends to accentuate our differences, even when we may have a lot in common. We need to find the 60% [of the issue] that we can agree on. One size does not fit all, so we need to find a threshold that is fair to everyone.”

One drought planning technique already in place is the semi-annual water supply outlook conferences held in Missoula. In April, regional experts on snowpack monitoring and climate forecasting, along with water users and local decision makers, gather to discuss the water supply trends and how to prepare for the coming water year conditions. These same individuals gather again in October or November to reflect on the accuracy of the spring forecast, lessons that were learned, and discuss changes that could be made to help the basin be more prepared. Due to the above average snowpack in the winter of 2010-2011 and the subsequent flooding in the spring of 2011, most of the water supply conferences have centered on how to best prepare and respond to conditions of too much water. Yet many panelists and decision-makers, at the November 2011 Water Year in Review Conference, expressed frustrations with the difficulty of communicating across jurisdictions, of finding the correct person to verify information, and navigating the reams of paperwork and regulations involved in declaring an emergency and acquiring outside

resources. When or if drought conditions reach crisis stage in the Clark Fork Basin, the water supply conference could be an already established tool for facilitating the flow of information between climate scientists, decision makers, and the water users.

### *Upper Clark Fork Watershed*

Descriptions of drought impacts that emerged in the Upper Clark Fork hinged on annual conditions and need. As one irrigator stated, “we have a drought every year...it’s just a matter of degree...and you spend your life hoping for rain.” Drought is not an aberration of climate, but a recurrent phenomenon of varying severity. As such, residents have spent the past 150 years developing ways of coping with drought and, he continued, “[they’ve] gotten kind of good at it.” Coping mechanisms, this irrigator continued, “depend on the type of water use. In irrigation, legal mechanisms are not effective everywhere to bring in a water commissioner to enforce decrees.” Since enforcement can be difficult and expensive, well maintained ditches, small storage projects, and groundwater are more reliable resources for getting through drought conditions. Climate forecasting tools are useful, but local knowledge helps irrigators prepare for the upcoming season. As that irrigator also reported, “locally you can observe what’s in the mountains. Predominately we use stored water, which is easier to predict.”

A drought year may also be characterized by need. Flooding in the early 20<sup>th</sup> century sent contaminated mine tailings down Silver Bow Creek and down the Clark Fork River to Bonner, where Milltown Dam held back the sediment until recently. Remediation efforts have been ongoing and significant resources, both time and money, have been dedicated to this reach of the Clark Fork River and the nation’s largest

superfund site (Snow 2001b). Drought, for restoration and ecological needs, is a diminished wetted perimeter. A wetted perimeter is unique to each stream and uses mathematical techniques for objectively “determining minimum flows for environmental purposes” (Grippel and Stewardson 1998, 1). For remediation needs, a diminished wetted perimeter not only represents ecological hardship, but also a financial loss if the millions of dollars of plants in the riparian zone don’t get enough water.

### *Blackfoot Watershed*

As described in the case study analysis, a Drought Response Plan has been in place in the Blackfoot for almost 15 years. The Blackfoot Drought Response Plan, coupled with long-term restoration projects, has helped the Blackfoot watershed become more resilient to water shortage. However, the Blackfoot watershed communities still have an interest in the development of a Clark Fork basin wide drought plan. Drought in other watersheds is one drought impact not fully addressed in the watershed-wide Drought Response Plan. Fishing restrictions on the Bitterroot River, for example, send more fishermen to the Blackfoot. A basin-wide drought plan could address inter-watershed drought impacts and the Blackfoot Challenge will want to have a say in the development of a basin-wide plan.

### *Bitterroot Watershed*

Two major storage projects, Painted Rocks and Lake Como, regulate downstream flows for irrigation, hydropower, and instream flows. Yet, high demand for a finite resource contributes to the sense of perpetual water shortage in the Bitterroot watershed.

Five interview participants, when asked to define drought or water scarcity, responded that their watersheds don't have water shortages compared to the situation in the Bitterroot.

One participant suggested that, when assessing impacts of drought, the source and application of water also need to be considered, in addition to size and priority date of the water right. Groundwater or stored water is more reliable than surface water. This irrigator went on to say, "sprinklers are more efficient, but if electricity is too expensive, then irrigators switch to flood control which uses double the water and leaves less in the river." Factors external to precipitation and timing of snowmelt, such as energy costs, may also contribute to less water in the river or diminish access to water.

#### *Middle Clark Fork Watershed*

For water users who depend on groundwater as a source of supply, drought is not a pressing concern. One study participant, a municipal water provider, candidly said,

We've only used groundwater and never felt the pain of drought. This doesn't mean that we won't someday because [of the TU decision] connecting ground and surface water [when assessing adverse impacts]. But right now, [we don't] have concerns [with drought] as of right now. We get plenty of water. We turn on our wells and the water is there.

Future groundwater shortages could be triggered by "climate change – less recharge – and increased population and demand, but that's speculating pretty far into the future."

Since the Middle Clark Fork has such a large underground lake that provides large water users, such as the city of Missoula, drought is not a pressing concern on the mainstem of the Clark Fork River, although drought may be seen in the tributaries. The water provider went on to say that for him, personally, drought was when the tributaries

were unable to meet the needs of senior water users and support the fishery. Another factoring contributing to emerging sense of water security in the Middle Clark Fork may be the low recreational demand on this stretch of the river, as compared to other parts of the Clark Fork Basin. To paraphrase one interview participant, someone who works with irrigators to lease water for instream flows, augmenting instream flows in the Clark Fork is a low priority, compared to some of the tributaries. The Clark Fork River typically has enough water for fish and the recreational demands on the river, primarily tubing and not commercial or private boating, are not in similar conflicts with irrigators as in the Blackfoot or the Bitterroot.

#### *Flathead Watershed*

Drought, like in several of the other Clark Fork watersheds, was not described as a deficiency in precipitation, but rather in terms of adverse effect or hardship or lack or access to water. “Drought,” according to one person from the Confederated Salish and Kootenai Tribes, “fundamentally begins with the concept of less water in certain places and at certain times. If that’s true, then we start to think about impacts to our homeland.” If there isn’t an adequate supply of water for agriculture, for forestry, for fisheries, for flora and fauna, then people start to see crops dry, risk of fire increase, and ecosystem function diminish. In addition, less water, for the Confederated Salish and Kootenai Tribe, adversely affects the rights to hunt, fish, and gather that were reserved in the Hellgate Treaty of 1855.

Water shortage caused by deficiency of precipitation, as perceived by interviewees with forestry and irrigation interests, was inevitable and could be dealt with

on a short-term basis. One interview participant said, “We don’t need as much prediction in the Flathead [as in the Upper Clark Fork, for example]. There’s nothing you can do from a forestry perspective – we’re just relying on Mother Nature to provide some rainfall. ...certainly we controlled the level of the reservoir...but we always had enough water.” Drought, for two other interviewees, was a seasonal condition that could be mitigated with full reservoirs. Extended droughts, such as 2-3 years in a row, “are the ones we dread” – more cattle are typically sold to reduce the number of cows that need to be fed and the practical rancher will always keep some grain in the bin for these lean years.

Instead of climate, many interviewees expressed concern regarding the many, often times competing, demands for a finite supply of water. One groundwater hydrologist captured this sentiment by saying:

Water management has always been about getting through the ebbs and flows of supply. Drought isn’t a problem in the Flathead. I’m not worried about it. Not yet. Because of Hungry Horse, because of Flathead Lake, and all the other lakes, water shortages aren’t a problem. But how all the competing uses use water – that’s a big deal. Right now it’s a coin toss between fish and power, in terms of who will shut down the development of new water. Our drought will be a legal drought.

Understanding just how much water is used by whom, during what period, for what purpose, requires not only the completion of the adjudication process, but also more studies on groundwater and measuring diversions and return flows is required before the question of developing “new water” could meaningfully and systematically be addressed. Gathering such information is time consuming and costly. Some watersheds have opted for voluntary, shared sacrifice, and while this may not be the solution everywhere,

according to the hydrologist, drought planning could be an opportunity to ask, “Is there a greater benefit for this water?”

#### *Lower Clark Fork Watershed*

Low flows and drought conditions have a tremendous impact on power production and the cost of energy. For hydropower, less water running through the turbines creates less electricity and forces power companies to find other sources of electricity in order to meet consumer demand. In such a scenario, the economics of supply and demand come into play. According to one hydropower provider, “if [the Clark Fork is] seeing drought, the rest of the Columbia is also feeling the pinch, and alternative sources are going to cost more” and customers will see that increase on their electric bills.

One of those alternative sources of power is wind generation. Wind generation capabilities have grown in the Pacific Northwest, partly due to demand for reduced-emissions energy, but also because of the network of hydropower dams in the region. Hydropower is also becoming more of a backup to the expanding wind power facilities because the dams can increase or decrease output almost instantly in order to compensate for wind fluctuations. Low flows make it harder to respond quickly to changing wind conditions, while still meeting consumer demand. As the population grows and the economy comes back, the demand for power may rise; and it may be challenging to continue to provide the electricity that meets consumer demand.

Noxon Rapids, with a prior appropriation date of 1951, has a relatively young water right, however, “with a turbine capacity of 50,000 cfs, [the volume claimed] is of sufficient size to utilize almost all river flows that occur at the site” (Task Force 2004, 3-

35). Many interview participants representing upstream interests expressed concern that this water right is too large or that it has the potential to limit consumptive water uses to a few weeks a year during peak flows – 30% of the surface water users in the Clark Fork River basin have water rights junior to Noxon Dam (Task Force 2004). Regulations dictate that the water right has to match the capacities of the dam, which puts Avista Corporation, owner of Noxon Dam, “between a rock and a hard place. [They] need to defend their water right, but also don’t want to stop growth” (Interview 2012). To date, Avista has never made a call on their water right and, while the adjudication process is still on-going, making the call is hard to do. Even once the adjudication process has been completed, enforcing the call does not simplify enforcement. The futile call doctrine, for example, is an exception to strict adherence to priority dates. Futile call doctrine prevents a downstream senior water right from making a call on upstream juniors if the water generated by ceasing use will be lost in transport and not reach the senior user due to physical losses such as evaporation or permeable geology. If water engineers and the courts, at some point in the future, decide that the futile call doctrine is applicable in the Lower Clark Fork then the legal dynamics of water rights becomes much murkier and it is difficult to foresee all the ramifications of such a decision.

### **Emerging Common Principles and Diverging Interests**

The Upper Clark Fork, Blackfoot, Middle Clark Fork, Bitterroot, Flathead, and Lower Clark Fork watersheds collectively form the Clark Fork River Basin. Water leaving the upstream watersheds influence water quantity in the downstream watersheds and downstream needs influence water availability in the upstream watersheds. Water

dynamics in the Clark Fork are not just driven by gravity and snowpack, but complex relationships may flow upstream or across hydrologic boundaries or affect watersheds in very different ways. Drought does not affect or manifest uniformly across the Clark Fork Basin or even within the smaller watershed boundaries. In interviews, participants described varying thresholds of drought conditions, coping with drought, and tools for planning for the future. Despite the diverse viewpoints, both geographic and interest-based, many common interests and concerns emerged.

There are many uncertainties with the future of water in the Clark Fork Basin. Many questions remain yet to be answered: What will the Confederated Salish and Kootenai Tribe Water Compact entail? What are the possible impacts of the TU v. DNRC decision and any subsequent legislation on conjunctive water management? What happens after the adjudication process is completed? Some water users with a seemingly secure water right might find themselves more vulnerable to water scarcity if the actual water use amount is much less than the paper water use amount. How much water in the basin is actually available? And how much is being consumed? How will climate variability manifest in the future? Concerns regarding how these uncertainties will affect the people in the basin emerged during the interviews. Although these uncertainties were not a primary focus during the interviews, most of the interview participants put forth suggestions of possible drought planning techniques that would be adaptive to these evolving conditions.

### *Common Principles*

Until water rights have been settled and until there is a complete understanding of how much water is consumed, how, challenged one interview participant, a representative of the Confederated Salish and Kootenai Tribe, can specific plans be developed around specific uses? This is a precedent that has been established by the Montana Supreme Court in the decision to close portions of the Flathead until the Compact is settled. But, he continued, there are “times when there will be drought. It is a question of how do we adapt? There is no singular answer, but we have always adapted.” The information needed to develop a detailed drought plan with specific thresholds and responses may not be available at the current time, but developing a broad framework for adaptation and conservation may be achievable.

One challenge to basin-wide drought planning will be overcoming the lack of urgency to create a proactive plan for mitigating drought and water scarcity. As one interview participant observed, “one of our problems is that our focus is on what do we do when the drought occurs, not what can we do right now? Not just in terms of planning, but also actions that could be take to create more of a cushion for when drought happens. What if we didn’t just try to maximize production, but also try to think about preparing for the lean years?” Rethinking drought may create an opportunity to plan for the future, rather than just respond to an emerging crisis situation. This question of a how to develop a drought mitigation plan was posed because “that’s the way we’re used to thinking about it, used to thinking about extremes. We should be asking how do we plan for variable water supplies?”

Another emerging principle is that drought planning should occur at multiple geographic scales and help increase and facilitate communication across those scales and jurisdictional boundaries. According one policy-maker, “developing a plan for the whole [Clark Fork] basin may be a challenge and an opportunity. It’s not a detriment to look at a larger scale” because local drought conditions may impact other watersheds. But a basin wide plan should be framed as an umbrella for more localized drought-planning efforts that are already in place, or perhaps as developing a toolbox to assist local communities in the development of a drought plan. Another interview participant, representing a conservation district, expanded on this idea by saying, “The plan should provide structure for communication and coordinate goals [at a basin-wide scale] and have the detail necessary for local response and unique basin characteristics.” They went on to describe a framework of nested layers - a Columbia basin entity, a Clark Fork basin entity, then watershed entities, and even more localized entities – that would facilitate communication between spatial scales and respond to needs and concerns at varying levels.

A drought or water scarcity plan for the Clark Fork Basin should also encourage reduced water demand and consumption, but in a very deliberate and thoughtful approach. Many participants suggested increasing irrigation efficiency as a means of reducing the impact of drought and reducing water demand. By tracing together four separate conversations with a policy maker, water rights analyst, instream flow activist, and someone working with irrigators to implement a conservation-based drought response plan it is clear that water conservation is not a simple solution. As one interview participant, a policy maker, observed, “Water demand actually increases in a drought

year.” If water for grass doesn’t come from precipitation, then it will have to come from irrigation. He went on to pose the question, “How do we make policies and programs that help people withstand drought AND reduce water demand in a drought year?” Switching from flood irrigation to pivot irrigation allows the irrigator to apply water much more precisely to a crop. Such precise application of water has the potential to allow irrigators to apply water to their crops in a much more deliberate and measured approach compared to flood irrigation.

Water conservation measures, however, need to be very site specific and take local geology and soil into consideration. Efficiency upgrades, according one study participant working to increase instream flows, need to be:

addressed judiciously and cautiously. Upgrading efficiency may not actually increase late season flows. It can save more water during high water, but may lead to increased use in late season. Because pivots are more efficient, you can grow more grass, which needs more water. Pivot, in aggregation, can consume more water, hurt downstream users, and exacerbate the effects of drought. At first I thought irrigators were bullshitting me, but now I’m seeing it.

Flood irrigation may have late season benefits of increased soil moisture and decreased demand for surface water during the time of typically low flows in the streams. Pivot irrigation does have the potential to use more water, however, whether using pivot or flood irrigation, crops still use water and water evaporates. In the Blackfoot watershed, the Drought Response Committee has found that the increased precision available to pivot causes people to underwater their crops, in many cases. One policy-maker suggested that “there are lots of pieces and parts that make water management very complicated. Small changes may have severe, unintended consequences.” Conservation

measures and irrigation decisions must be very deliberate and made in consideration of the larger geologic, soil, and watershed context.

There is a tension between simply shifting demand – either to a different source or different time of year – and increasing drought resiliency. Switching from surface water to ground water is one way of keeping water in the river, but the switch increases the demand on groundwater resources. In addition, digging new wells is expensive and may not be an option available to everyone. If digging wells is an option, according to an interview participant:

we need a better understanding of groundwater availability and rate of recharge. New wells may be the cause of injury to existing well users, not drought. We need to recognize the connection between surface and groundwater [because of TU decision], and we don't really know how wells are affected by drought, and this will change by geography, geology, recharge rate, depth of well, etc.

Just as irrigation practices and methods of application need to be analyzed in a very deliberate and site-specific manner, so should the means of diverting water.

### *Diverging Interests*

No clear, technical definition of drought or narrative of drought impacts emerged in the interviews. This is consistent with the definition of drought offered by the National Drought Mitigation Center (2012). Definitions and impacts varied by watershed, by water use/need, and by individual, yet climate variability was not a major concern. As one irrigator said, “mostly we just live with what happens.” Another irrigator stated, “we don't have a water supply constrained by climate. In the Flathead, we could still produce a very viable crop on much less water. The [agriculture] world is good at planting to annual circumstances.” Deficiencies in precipitation may not necessarily trigger drought

conditions. “Drought,” according to an individual working to protect ecosystem function, “isn’t an issue until someone feels pain. If there is reduced precipitation, but it doesn’t cause any harm, it might not be drought.” Climate variability may become more of a concern in the future, but it is uncertain to what extent that variability will change or how it will manifest.

Drought is a product of climate variability and people have little control over that, but water scarcity is a product of the relationship between climate and how people use water. Human dimensions will exacerbate the impacts of water shortage due to future climate variability. Many people described conditions that triggered a lack of access to an acceptable quantity or quality of water that was not just climate related but also influenced by water use, operational procedures, or legal frameworks.

As land use is changing, so is water use. Large ranches are divided into small ranchettes, and although water is still being used for irrigation, people who do not know how to irrigate are now using the water (Outlook Supply Conference 2012). Learning to be a good and efficient irrigator is not easy and many of the educational resources that emerged after the Dust Bowl are not as readily available (Outlook Supply Conference 2012).

Water scarcity could be a product of dam operations (Outlook Supply Conference 2012). In one scenario, dam operations cause lake levels to fluctuate drastically. Low lake levels affect tourism and recreation. In the other scenario, bad forecasting leads to decisions that exacerbate a drought. Climate forecasting is the main tool for using and implementing water storage projects. If a flood is forecasted and the reservoirs are

drained in anticipation of high waters that never materialize, a flood situation quickly becomes a water scarcity situation, just because of human decisions.

Water scarcity may also be caused by legal availability. Reservoirs could be full, but, on paper, all of that water could be claimed. As one participant of the Outlook Supply Conference (2012) observed, “there has never been enough water to go around,” especially on small tributaries. In those instances, the irrigators will often get together and develop an informal sharing agreement. Person A will get to water for 3 days, then Person B, and then C. There is not enough water for all of them to irrigate at the same time, but by coordinating their timing, everyone can get water. As land use changes and new people move into the community, those informal agreements deteriorate and priority dates become the enforcement mechanism. Conversely, for some water users, such as Avista, their legal water right standing contributes to a heightened sense of water security.

## **Chapter Summary**

Given the context of climate variability, policy uncertainties, and projected population growth, and diverging perspectives on the definition of drought the future of water in the Clark Fork Basin is quite uncertain. Small changes in the status quo could have widespread ramifications. On the other hand, large changes, such as completion of the Confederated Salish and Kootenai reserved water compact, almost seem too big and too uncertain for most people to comprehend or predict potential impacts.

Despite those uncertainties and constraints to protecting legal rights, there is an opportunity for hope and for pioneering new territory in the realm of drought planning.

Hope lies in the Task Force and their precedent of basin-wide collaborative planning for water development. Given the tensions of conflicting perspectives of drought and water scarcity, the Task Force has the opportunity to convene a diverse geographic- and interest-based conversation on how to manage and use the Clark Fork Basin's water resources for the next 150 years.

The challenge to convening such a conversation, of course, is the challenge of framing the issue broad enough to bring everyone to the table and concise and urgent enough to keep everyone at the table. Based on the analysis of participant interviews and conversations at the water supply conferences and Task Force meetings, drought may not be the common issue. Water scarcity, on the other hand, may be broad enough to bring those diverse interests to the table to develop a more beneficial approach to planning for and mitigating future concerns and uncertainties.

The challenge of urgency still remains and there rests the opportunity for pioneering new ground in the realm of drought planning. Collaborative drought planning in the Big Hole, the Blackfoot, and State of Colorado were all driven by a collective perception of impending crisis, however, in the cases of the Big Hole and the Blackfoot watersheds drought was not the catalyst for collaboration and consensus building. Citizens in both of those watersheds had already begun to gather along hydrologic boundaries to discuss the future of their communities – drought planning and managing the tensions of diverging perspectives on water scarcity was an evolution of those collaborative conversations. The Task Force was brought together in the context of emerging crises to develop a basin-wide water management plan. That plan and the Task Force have both been in place for almost ten years – the evolution of that collaborative

process could be deliberately and proactively tackling the question of planning for drought and water scarcity in a way that engages the entire Clark Fork Basin community.

## **CHAPTER 7**

### **CONCLUSION**

Previous chapters have provided context on water governance, drought, and collaborative approaches to water scarcity planning. Drought perceptions in the Clark Fork Basin have been identified. This thesis research was primarily a process of gathering information and perspectives on drought from diverse water stakeholders, policy-makers and presenting that information in a neutral and inclusive framework. This chapter is an opportunity to present theoretical implications, explore the empirical implications of this research and drought planning in the Clark Fork Basin, and to discuss limitations and opportunities for future research.

#### **Theoretical Implications**

Water is comprised of one atom of oxygen and two of hydrogen moving through the phases of evaporation, transpiration, condensation, and infiltration. The amount of water molecules on the globe today is relatively the same number that existed in the days of the dinosaurs. Ocean cooling and warming, topography, and wind patterns influence the global distribution of water, making the Atacama Desert the driest place in the world and Hawai'i one of the wettest. Local geography enhances that variation even further. Water availability can also be temporal. Climate variability patterns are recorded in glacial ice, tree rings, and, most recently, recorded data. Climate is not a static norm, but a constant fluctuation from warmer to cooler and from drier to wetter conditions. Temperatures and quantities of water can be measured and recorded. Historical analysis can be conducted and forecasts can be made.

Water is objective and predictable until people start to define how water is used and who gets to use that water. Then, as one study participant observed, water is perceived as “something to fight for.” The question of how to allocate water in the American West was shaped by the miners who first settled the West and their need to move water from the river to the areas of mining activity. But many other water uses have emerged and gained legal and cultural recognition. Federal public lands and reservations have implicit water rights. Instream flow is now recognized as a beneficial use in many western states. Groundwater and surface water connectivity is gaining legal recognition. How these competing uses allocate access to water is a very political, cultural, economic, ecological issue.

In contrast, drought defines water shortage and how those shortages are allocated. Drought is generally understood to be drier than normal conditions, but a more specific definition is more difficult to come by, even in a very specific, localized area. For many people, drought is the point at which a lack of water causes hardship. Dams, reservoirs, groundwater, and irrigation networks lessen the impacts of a deficiency in precipitation; and it is when those infrastructures begin to falter that people develop concerns. Using the conceptual framework of collaboration, this thesis examined how drought is not just a climate variability issue, but also a factor that contributes to a water scarcity problem that is exacerbated by human decision-making, regulatory frameworks, and competing water uses.

Collaboration and participatory action research have emerged as frameworks for working through disparities in power, rights and interests. Rather than pursue litigation to solve conflict, collaboration brings all parties together in a neutral forum. Through

conversation and building trust, these groups move past the contention and gridlock to create an acceptable alternative. Using examples of collaboration in the Big Hole and Blackfoot watersheds of Montana and the State of Colorado, this thesis examined how collaboration can be used to approach the challenge of developing an inclusive planning process and creating a framework large enough to respond to the geographic extent of water scarcity and also the very local experiences of climate variability.

Most drought planning efforts are driven by shared crisis. In the Big Hole, the community was concerned that listing the fluvial Arctic grayling on the Endangered Species List would threaten their livelihoods, so they developed a plan that would protect the fish and their livelihoods. In the Blackfoot, frustration with the traditional and existing drought response framework, led to cooperation and a collective effort toward building a stronger community and ecosystem. A statewide drought, in 2000, brought communities, agencies, and individuals across Colorado together to assess their drought vulnerabilities and develop a framework for responding to crisis and minimizing future impacts of drought.

Those droughts that brought diverse water interests together were not just a matter of climate variability. Variability was a contributing factor, but competing needs, high demand, and other human factors intensified the natural deficiency. Drought, in terms of climate variability, is not the problem until someone or some group feels the adverse effect of less water. That threshold is reached when safety nets and infrastructures break down. This thesis, in reviewing drought planning efforts in Montana and Colorado and assessing concerns in the Clark Fork Basin, confirms that deficiencies in precipitation, as a product of climate variability is not a pressing concern to all water uses or individuals.

Rethinking drought as a factor in water scarcity is still a very subjective framework with competing political, ecological, cultural, and economic interests. However, the Clark Fork Basin has an opportunity to proactively support and empower local communities to initiate their own plans for increasing resiliency during water scarcity. A basin-wide vision can help guide and coordinate those efforts, but solutions to water scarcity should come from small-scale, local cooperative planning. Drought is not the common crisis in the Clark Fork Basin, but rethinking drought may create an opportunity to plan for water scarcity and to create a more resilient water future.

### **Empirical Implications**

Using the criteria established by Innes (1999) for evaluating process design and the criteria established Hayes, Wilhelmi, and Knutson (2004) for evaluating the content of drought management plans, this section will explore the qualitative implications of this research.

#### *Planning Process Design*

Diverse interests: By using a research process guided by participatory action research principles, this thesis lays the groundwork for a planning process that is inclusive to the diverse range of water interests in the Clark Fork Basin. As the planning process moves forward, interview participants expressed a strong interest in continued involvement in the development of a drought management plan. Given the range of urgency for such planning to happen, inclusion of diverse perspectives will have to be addressed creatively. For example, diverse geographic- and interest-based perspectives

may not be drawn to the same meeting, but by hosting water forums to attract targeted perspectives, similar to the approach used in Colorado, the Task Force could develop a better understanding of the complexity of water scarcity in the Clark Fork basin.

Common purpose; self-organization: One challenge to drought planning in the Clark Fork Basin is the lack of a cohesive and tangible understanding of drought and a threshold indicating drought conditions. As one of the phone interviews was coming to an end, a groundwater user on the other end expressed confusion regarding my interest in drought planning. After explaining Senate Bill 303, the municipal provider responded, “if that’s what the Governor wants, well, then we’ll put something together. But right now, drought, just isn’t a big concern.” Conversely, for ecosystem functions or on the tributaries, drought may be an annual and pressing concern.

Reframing the planning scope to address water scarcity, rather than drought, may be a way to generate more interest. Of the nineteen interviews with people representing Clark Fork Basin water interests, fifteen of those people described either how human decisions or actions, in addition to climate, were currently contributing to the lack of an acceptable quantity or quality of water or may in the future. Triggers to water scarcity may be very local or more regional. Direct impacts of water scarcity may be very local and case specific, but the indirect impacts of droughts may be much more widespread or difficult to quantify. Lower water years could lead to higher electric bills or simply lead to a shift in fishing habits.

Given concerns for water scarcity and the extent of possible impacts, the geographic scale for scarcity planning should match the problem-scale. Impacts of water scarcity may transcend very local or watershed hydrologic boundaries. Large-scale vision

is needed to guide the long-term economic, cultural, economic, and ecological vitality of western Montana. A basin-wide plan may also be able to leverage resources or policies that would not be possible at a very local scale.

The way to achieve problem-shed planning is not from the problem-shed down to the local, but from solutions that emerge from the tributaries and develop up to the Clark Fork Basin. Many of the actions, both long- and short-term, for improving resiliency in water scarcity are initiated at a very local or individual level. Conservation measures or instream flow leasing cannot and should not be mandated, but a basin, or even a state, plan could ease the burden of pursuing such options, while still protecting the legal rights and interests of local people.

Decision rule: Like Colorado, the planning process could be led by one agency or organization, but should include other agencies, municipalities, representatives from local and tribal governments, water stakeholders, and offer opportunities for public input and involvement. Decision rule need not be consensus, but drought planning will require widespread support.

Shared and continued learning; continued participation and engagement: The semi-annual Water Supply Outlook and Water Year review conferences are a built-in framework for continuing to engage the community and share information. Participants in those conferences include academics, water users, decision makers, and scientists; as such, this forum facilitates the flow of information across disciplines.

Another tool to facilitate education could be the development of a more informative website. The Task Force currently has a website where meeting minutes are posted and the Clark Fork River Basin Water Management Plan is available, but the

website is buried in the Department of Natural Resources and Conservation website and contains little information about the role and purpose of the Task Force. The website is useful for people very familiar with the Task Force, but an overhaul of the website could help the Task Force reach out to a water audience unfamiliar with the on-going collaborative planning process in the basin. Website menu items could include: objectives of the Task Force, past projects, current projects, information on the need for water scarcity planning, and information on how to get involved.

#### *Scope of Managing Drought/Water Scarcity*

Plan assessment: Senate Bill 303 requires updating the drought management component every 20 years. This review window may be too long and inconsistent with the review windows in the case studies. The Big Hole and the Blackfoot watersheds facilitate annual reviews. In Colorado, agency representatives debrief after every drought is over and complete a comprehensive review every three years as per FEMA requirements. The Water Year in Review Conferences in November could be an opportunity for annual lessons to emerge and a formal 3-5 year review could then integrate those lessons and experiences.

Policy/legislation: At such a large planning scale, a water scarcity plan for the Clark Fork Basin may not have the detail of the Big Hole Drought Management Plan, for example. A plan for the Clark Fork could call for policies to increase protection for instream flows or make it easier to lease water for instream flows.

Supply augmentation and reduced demand for water; technical assistance with conservation; short and long term drought: Planning for water scarcity does not have one

easy solution. Rather basin-wide water scarcity planning should create a toolbox of response and mitigation tools that could be utilized by local communities and adapted to fit their specific needs.

This toolbox could include data collection on stream flow, land use characteristics, and historic consumption and demand. More information will be needed before these questions can be addressed at a basin-scale. Until the Confederated Salish and Kootenai Tribe Water Compact negotiation is complete, adjudication is further along, or more groundwater mapping has been completed, the basin will not know how much water is available for new uses or mitigating scarcity. However, better science could lead to increased efficiency at the local level and help local planning develop thresholds for tolerating water scarcity and an associated response.

Policy could also be included in the scarcity planning toolbox. Water marketing or trading can move water to a new use within the basin of origin. One challenge to water marketing is the lack of accurate pricing information and calculating adverse impact as water gets moved around. Pursuing instream flow water rights could become easier and mechanisms for enforcing those rights could be strengthened.

Within a municipal water system there are many possible scarcity coping mechanisms. A municipal use is a large use, but the system can hone in on individual use. The challenge in municipal scarcity planning, as one provider pointed out, is that “conservation incentives and public education could increase reservoir levels or streamflow, but you can’t stop providing water to a bunch of people. There is only so much we can do in planning for drought, and yet there are terrible consequences of drought.” Larger communities, such as Missoula, may have more secure water supplies

because of groundwater and more financial resources to dedicate to developing conservation plans. This water provider continued to say, “small towns might not have time or resources to spend on drought planning.” Small communities may be more vulnerable to water scarcity – a drought and water scarcity planning toolbox may lessen that burden. Although legal constraints prohibit graywater re-use and stormwater capture, water scarcity planning tools for municipalities could include incentives for conservation, such as reducing lawn watering and household water consumption.

In addition, scarcity planning should also include a definition of success. This component to water scarcity planning integrates the theories of an “ethic of place” and collaborative planning processes with a practical discussion on the future of growth and water management in the Clark Fork Basin. As one study participant so aptly stated, “if you don’t have a definition of success, what are you working toward?” The collaborative planning process can provide a forum for shaping a Clark Fork Basin ethic of place.

### **Implications for Future Research**

The scope of this research was based on a need for data on perceptions of drought and framing the issue of drought that emerged through participatory action research. As such, this research was limited to a qualitative analysis of research findings of a relatively small number of interview participants (30) to represent a relatively large basin and diverse interests in water. However, the cross section of geographic- and interest-based perceptions of drought and the watershed profile provided in this research presents a cross section of water perspectives across the basin and provides a platform for future research initiatives.

Areas of future research could include quantifying the impacts of water scarcity to identify triggers and tolerance thresholds of water scarcity, thematic mapping of the problem-sheds of water scarcity impacts, and follow-up research analyzing the progress of planning for water scarcity and building a more water resilient future for the Clark Fork Basin.

In the introduction to a chapter on water wars, Alex Prud'homme observes the similar etymology between the words “river” and “rival.” Prud'homme (2011, 195) writes, “closely related to the word *river* is *rival*, originally ‘one who uses the same stream (or ‘one on the opposite side of the stream’)’...the notion is of the competitiveness of neighbors.” The tension of river neighbors, however, is not always negative. The case studies of collaborative drought planning in the Big Hole watershed, Blackfoot watershed, and the State of Colorado demonstrate the innovation that can emerge. By learning to “think of ourselves as inhabitants of a bioregional homeland, a natural watershed commons,” we can “work to reinvent a sense of well-being in the river course valleys where we choose to live” (Kittredge 2002, 2). Drought planning is not just a rural or an agricultural issue; it is a basin issue that will require a basin-wide effort to develop a solution.

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