JEFFERSON COUNTY, OREGON: A HISTORICAL CASE STUDY OF CONFLICT, COMMUNITY AND A PECULIAR CONFLUENCE OF WATERSHEDS

By
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THESIS ABSTRACT

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Jefferson County, between 2011 and 2016, is investigated in a case study of emergent water resources and environmental conflict. Three major waterways – the Middle Deschutes, Crooked, and Metolius Rivers – are examined through a Four Worlds Framework, aided and reinforced by transdisciplinary sources and theories. Tributary creeks and adjacent interests are identified, and waterway developments are subjected to thorough analysis. The role of the Pelton Round Butte Dam Project – specifically the Selective Water Withdrawal Tower – in water conflict in Jefferson County will be demonstrated as clearly focal: similar conflicts across the watershed have been addressed and shown to be linked to this central conflict. Through a synthesis of environmental conflict resolution theories and pertinent environmental science research, a recommendation has been posited for resolving the water resource conflict. It is an ambitious proposition, yet merits serious consideration by water users. While the environmental conflict may have been emergent during the period in question, there is no doubt that it will amplify if unremedied in the near future.

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CHAPTER I

INTRODUCTION

Jefferson County includes the riparian corridors of three major waterways: the Middle Deschutes River, the Metolius River, and the Crooked River. Smaller tributaries snake through the landscape, and waterway connections frequently implicate transboundary interests. The Middle Deschutes and Whychus Creek join just across the southern Jefferson County line, each with their own diverse interests and developments. These waterways represent transboundary riparian corridors with unique and peculiar features, and will be examined further for environmental conflict interests and actors across county boundaries. The Middle Deschutes River will be the first to be investigated as the main waterway and the central stream of the southern portion of the Deschutes River Basin. An analysis of each unique watershed and the Pelton Round Butte Project will be included in this paper. Before addressing the case study, an examination of existing and pertinent literature will illustrate core theories to this paper, and an explanation of methodologies will demonstrate the framework for case study analysis.

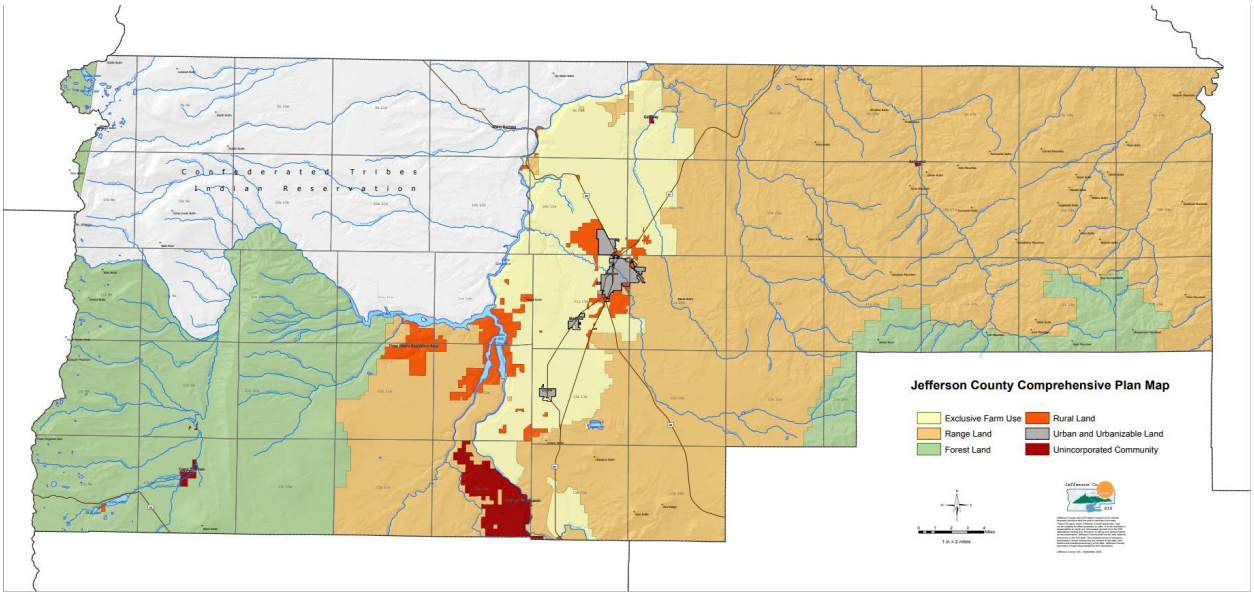


Figure 1. Map of Jefferson County, 2013. (*Jefferson County Comprehensive Plan*, 2013).

CHAPTER II

LITERATURE REVIEW

The following portions of this investigation rely on a framework of understanding environmental conflict resolution and case study analysis as applied to Jefferson County. In this section, academic, peer-reviewed papers will be examined for their applicability and theoretical implications. The main focus of this review is to identify established frameworks for cross-boundary, environmental conflict resolution – key themes that the contributors and content subjects reflect. See Table 1 for a visual aid in understanding the complex theories, and the conflict levels at which they intersect.

The first academic article to be examined is Max-Neef (2005): a comprehensive review of transdisciplinarity as a reflection of higher-level core conflict resolution techniques involving needs- and 'reality'-based solutions (Max-Neef, 2005). Within the paper, the author argues that transdisciplinarity is organized into hierarchical levels, involving increasingly complex transdisciplinary implications and specific key questions faced by parties to a conflict. The first pertinent argument made in Max-Neef (2005) concerns the value of the 'Included Middle'; a recognition of multivalence and non-contradictory realities , wherein elements referred to as A and non-A may appear contradictory at one level of reality, and yet element T may be provided from another level of reality. This argument supports the effort of transdisciplinarity to connect realities across disciplines – or in the case of conflict resolution, across party and interest groups – as a means of resolution and consensus. The second argument being that the object and subject of interdisciplinarity are parties' unity over the levels of reality and perception, respectively (Max-Neef, 2005). This point addresses fundamental themes of modern conflict resolution practice: the separation of individual motives from conflict issues, and the analysis of parties'

perceived realities and associated interests. Finally, the author asks the fundamental question: can society affirm that growth and the environment (A and non-A) are only anthropocentrically-perceived opposites in conventional economics, and resolution can be achieved through biocentric ecological economies (T) which creates a unified development? (Max-Neef, 2005, pp. 14-16). These three points are critical in understanding the varying realities and interests in Jefferson County; particularly the efficacy of conflict resolution and value-development in addressing salient environmental and natural resource conflict. The implication of including transdisciplinarity in environmental conflict resolution is to identify and recognize diverse interests, values and needs. Reference Table 1 for a comprehensive breakdown of these features in environmental resource conflicts.

Max-Neef (2005) – Transdisciplinarity			Wolf (2008) – Four Worlds Framework	
Level	Implications	Key Questions	Conflict Stages	Party Interests
Empirical	Mathematics, Physics, Chemistry, Geology, Soil Sciences, Ecology, Sociology, Economics	What Exists?	Adversarial	Rights
Pragmatic	Architecture, Engineering, Agriculture, Forestry, Industry, Commerce	What are we capable of doing?	Reflexive	Needs
Normative	Planning, Design, Politics, Law	What is it we want to do?	Integrative	Interests
Value	Ethics, Value, Philosophy	What should we do? How should we do what we want to do?	Action	Equity

Table 1. A comparison of theories. (Max-Neef, M.A., 2005) and (Wolf, Aaron T., 2008).

This paper relies on a Four Worlds Framework to interpret and analyze the complex and interconnected environmental conflicts at play in Jefferson County. A Four Worlds Framework simplifies individual and collective conflict processes into four main categories: adversarial,

reflexive, integrative and action. These four categories are tied to the rights, needs, interests and equity, respectively, of parties within a given water conflict (Wolf, 2008, pp. 30-34). As will be shown in the proceeding study, agreements made in the face of resource conflict can be shown to move from adversarial, rights-based negotiations to action based in stakeholder equity. Reasons for integrating the Transdisciplinarity and Four Worlds frameworks include: a recognition of connected, but often incompatible, realities across watersheds, a necessity for a framework to derive a unity of reality and perspective around water resources, and the presentation of ecological economies and their potential for value-generating, water conflict resolution. A transdisciplinary, Four Worlds approach fundamentally acknowledges that all parties in a watershed are threatened by water-resource conflict, and all interests can benefit from water-resource conflict resolution.

Various academic works concerning environmental conflict resolution further intersect nicely with a Four Worlds Framework: Van Vugt's (2009) explanation of four core motives for social dilemmas and four key conditions for successful environmental conflict management; Max-Neef's (2005) discussion of transdisciplinarity as reflecting environmental conflict complexity; and Daniels & Walker's (2012) paper on collaborative learning and systems-thinking featuring 'human activity systems' and explicit bio-physical linkages.

Daniels & Walker (2012) is another high-level concept framework which addresses 'systems-thinking', collaborative learning and facilitation as arms of natural resource conflict resolution (Daniels & Walker, 2012). This article draws from direct professional experience to demonstrate the complexity of environmental policy negotiations: from multiple involved parties, roles and issues to meaningless boundaries, power asymmetries, and changing actors within a given conflict. The authors point out two methods of developing solutions: adaptive and

collaborative learning. The former is useful as participants' adaptation in complex and controversial situations can be both improvisational and planned; structured monitoring, evaluation, and serendipitous discovery all occur together. (Daniels & Walker, 2012, pp. 105-107). This is an important point as it has the potential to draw diverse water conflict stakeholders into productive resolution processes. The latter – collaborative learning – is based on an even earlier thread of conflict resolution theory, and is an interest-based negotiation using participatory communication as a dynamic, interactional and transformative process of dialogue between people, groups, and institutions (Daniels & Walker, 2012, pp. 107-108). Finally, this source provides a key lens for interpreting findings: 'systems thinking'. This lens relies on a distinction between detail and dynamic complexity. Detail complexity, in this case, being the elements of a system and dynamic complexity being the systems' environment, emergent properties, and sources of resilience or adaptation (Daniels & Walker, 2012, 108-113). The perspective of 'systems-thinking' will be directly implicated in interpreting the salient environmental conflict in Jefferson County. Moreover, key points of Daniels & Walker (2012) are cited in the Conclusion Section as a tool for the interpretation of findings.

The fourth academic source this paper relies on heavily is Van Vugt (2009), which describes decision-making regarding common pool resources. A vital environmental conflict resolution resource, this article lays out the key pitfalls and solutions of managing shared environmental resources. The article relies heavily on the work of ecologist Garrett Hardin, who posited that when personal and communal interests are at odds, overexploitation of resources is inevitable (Hardin, 1968). Hardin called this phenomenon the 'tragedy of the commons', a historical trend of the destruction of communal pasture when individual herders act rationally in their own best interests, putting as many cows as possible onto the land (Hardin, 1968). Van

Vugt (2009) lays out four core motives for the successful management of shared environmental resources – information, identity, institutions, and incentives – as well as four key conditions that influence decision-making in social dilemmas: understanding, belonging, trusting and self-enhancing. The intersection of the Van Vugt's (2008) four conditions and four motives are illustrate below in Table 2.

Van Vugt (2009) – Environmental Conflict Resolution	
Core Motives	Key Conditions
Information	Understanding
Identity	Belonging
Institutions	Trusting
Incentives	Self-Enhancing

Table 2. Key conditions and core motive for successful environmental conflict resolution. (Van Vugt, 2009).

The main argument and solution of the article can be surmised best in the authors' own words:

> "…environmental uncertainty caused by a fluctuating resource left individuals to underestimate the damage of their actions and exploit the resource to the point of collapse…[whereas] local information, relevant to specific individuals in their particular circumstances, is far more effective at persuading people to change their behavior… The best information systems are simple but accurate…information is most likely to promote sustainable behavior when given to people who are already committed to the environment but lack the technical know-how to make a green choice…[It was] when people harvested from a common resource – a shared pot of money – and their decisions were made public they behaved more responsibly…Showing people how their behavior comates with that of others produces a similar effect…" (Van Vugt, 2009, p. 42).

Van Vugt (2009) is a treasure-trove of specific information for discerning the issues and potential solutions implicated in cross-boundary natural resource management. This source is crucial to the Conclusion Section of this paper as well, particularly for interpreting the salient water resource conflicts in Jefferson County.

Additional supporting academic sources naturally reflect the interdisciplinarity of water resource conflict resolution. Included are academic papers on the political justification of jointly-managed, transfrontier reserves and their value for conflict prevention and confidence building (Westing, 1998), the inverse roles of drought and equal hazard exposure on effecting intra-ethnic ties and out-group suspicion (De Juan & Hänze, 2021), and building sustainable peace through alternative economic approaches to transboundary conservation (Hwang, 2021). Importantly, academic theories of architecture and energy processes will be applied in the later Recommendations Section. Howard T. Odum's theory of a 'prosperous way down' from the precipitous heights of intensive energy use (Odum & Odum, 2006) intersect cleanly with this case study, and provides a lens to interpret the significant hydroelectric infrastructure developments in Jefferson County. These papers serve to reinforce the ultimate points made in the Conclusion Section and as an effective base of both ecologic and conflict science.

CHAPTER III

METHODOLOGIES

An investigative process was used to identify journalistic, legal and official sources of information concerning water-resource conflict in Jefferson County: several transboundary events to watersheds within the county boundary are included in recognition of environmental conflict complexity. An Events Database – labelled Table 4 - and a Mind Map and Key– labelled Figure 17 and Figure 18 – have been created of the environmental conflicts within the Deschutes River Basin in Jefferson County utilizing both public-access search engines and University of Oregon Library services. Both methods are borrowed from existing conflict resolution literature; an excellent example of an Events Database can be found in Wolf (2008), and Mind Maps are common enough to be considered ubiquitous to conflict resolution studies. Max-Neef (2005) includes a detailed Mind Map to clearly illustrate the intersectionality of fields of study. Both the Events Database and Mind Map can be found in the Appendices section. Selected primary sources in this analysis include local and state newspaper articles, official county documents, non-profit reports and publications, institutional reports from the Oregon Department of Environmental Quality (ODEQ), and Bureau of Land Management (BLM) and US Forest Service (USFS) maps and reports. Secondary sources include peer-reviewed, academic articles examining diverse subjects such as environmental conflict resolution theories, rural responses to restoration activities, and the effects of wetland interconnectivity on watershed ecology and hydrology.

Jefferson County is selected as a geographic frame, in recognition of the transboundary nature of environmental conflict: in this case, focusing on the politically-defined Jefferson County to bound the much larger Deschutes River Basin enables a manageable scope for

addressing transboundary environmental issues throughout this analysis. Jefferson County was specifically selected because of its diverse mix of urban, rural and Native American communities, its diverse and complex ecologic and hydrological zones - from highland forest to lowland grassland, and its associated diverse economic, social, cultural and political interests across the watersheds. Recognizing the centrality of the Deschutes River Basin within Jefferson County through the lens of a Four Worlds Framework, the investigation of environmental conflict naturally leads across county boundaries in this scenario, which in turn allows the identification and implication of transboundary issues as part of an environmental conflict analysis of the county.

The selection of the 2011 to 2016 temporal frame serves many of the same purposes as the geographical boundary: by selecting within the 5-year window necessary to conduct a historical analysis, the applicability and transdisciplinarity of this investigation are strengthened. The period in question also lies within an appropriate scope of study to include the effects of unprecedented water conflict resolution action through the Oregon Statewide Water Roundtables (*Statewide Water Roundtables Fall 2008: Synthesis Report*, 2008) in late 2008 – which recognized developing environmental issues in Jefferson County, and the causes for Oregon Water Resource Commission's Integrated Water Resources Strategy (Oregon Water resources Department, 2012), finalized in 2017 as Oregon's water strategy. Extreme political and environmental events in Oregon at the end of the given period also hint at a salient period of water insecurity in the region, including the armed occupation of Malheur Refuge and the State of Jefferson Movement in 2016. The range of time also allows for the inclusion of policy decisions by a variety of parties, including state institutions, public utility corporations, and local actors. Manageable connections can be made before and after the given timeframe, enabling a

focused and bounded investigation that accommodates the interconnectivity and transboundary nature of environmental conflicts. A brief history of Jefferson County will be included to provide the reader historical reference and orientation, and a more accurate perspective on developments included in the case study. Recent developments outside the temporal frame will also be addressed and are incredibly important for understanding the continued applicability of this paper.

The importance of water in Jefferson County cannot be overestimated: a high prairie agricultural system fed by a dammed river system is indisputably vulnerable to conflict development due to climate change. This existential and developing threat in turn escalates existing conflicts over local water use, species diversity, and water rights. A brief historical overview will explore the importance and use of water resources in Jefferson County, demonstrating further that historic centrality of water to the area. By selecting and implementing a Four Worlds Framework to environmental conflict analysis herein, the various issues within Jefferson County that currently implicate politics, economics, society, and culture will be analyzed and interpreted to provide potential resolution recommendations. By utilizing a Four Worlds Framework, the core setting or issue involved between 2011 and 2016 can be identified as an adversarial transboundary issue which squandered the potential for rights-based restoration potential, interest-based ecosystem services, or equity-based infrastructural action.

The intentional implications of using a Four Worlds Framework, in conjunction with a historical conflict analysis, are the following: to provide an opportunity for illustrating the relationship between elements and actors in conflict involving complex watersheds; demonstrate cause-effect relationships between management decisions and environmental conflicts; argue that the origins of the conflict are socio-historical, while effective solutions are ahistorical; and

focus on the developing effects of hydroelectric infrastructure as indicative of core environmental issues that fuel water conflict. The larger implications of this theory selection to the field of conflict resolution are vital in understanding the applicability of this investigation. Firstly, this theory selection provides a method of examining conflict as a function of the past, and as an intersection of socio-historical and environmental realities. Secondly, to synthesize conflict resolution concepts such as community equity and peacebuilding with scientific perspectives of natural energy processes and resource balancing, Finally, and most importantly to Jefferson County, this analysis posits that conflict resolution practitioners should provide communities with the future ability to re-negotiate land and water management strategies, not only to reduce future conflict fueled by climate change and natural resource scarcity, but to provide said communities more dependable resource availability and the means to self-mediate conflict in the future.

The findings of this paper have been compiled into an Events Database in the Appendices section as an effective means for categorizing and ranking significant events that are reported through the media and official documents. Events have been organized by date and watershed and rated on a -5 to +5 scale of conflict intensity: see Table 3 for a detailed description of the adopted ranking system. The conflict intensity coding definitions were taken directly from contemporary and parallel academic work concerning water resource conflict and cooperation in Oregon (Fesler, 2007). A Mind Map, which translates the Events Database into a visual presentation, is also included in the Appendices section. Mind Maps are a fundamental tool for conflict resolution practitioners globally (Daniels & Walker, 2012), and thus are specifically relevant and particularly useful for presenting complex information sets.

-5	Hostility	Small scale acts of violence, threats, protests, and police force presence
-4	Litigation	Judicial intervention, legal proceedings or management group dissolution, bill or ballot nonpassage, appeal of administrative actions
-3	Dispute	Cooperative group meltdown, regulatory action on violations, halting negotiations, threat of litigation, proposal and permit denials
-2	Disagreement	Roadblocks or temporary failure of settlement or project progress, withdrawal of third party support, petitions
-1	Difference	Voicing opinions of opposition, negotiation or vote delays, report reviews, preliminary rejection of proposals or settlements
0	Neutral	Events have no major effect on party interactions. Does not decrease nor increase conflictive intensity of interaction. Announcements, no comment statements, court rulings, testimony
1	Similarity	Voicing opinions of approval, preliminary proposal approval, compliance with voluntary guidelines, court forced negotiations, votes and deadline extensions
2	Agreement	Progress in stakeholder agreements and minor project support, calls for negotiations, third party support, meetings
3	Assent	Preliminary agreement to settlement and regulatory compliance agreements to participate in negotiations, permit approvals, fixing violations
4	Alliance	Legally binding cooperation actions like regulation approval and lawsuit settlements, management transfer, regulation approvals
5	Solidarity	State bill passage, compacts and management or authority group formation, official agreements signed or ratified between states, municipalities or nations

Table 3. Conflict intensity coding definitions. (Fesler, K., 2007).

To further strengthen the methodology of the case study, several competing or adversarial theories were selected for exploration. This paper does not feature a recommended implementation of riparian negotiation principles – which posits the potential for rights-needs interchange in riparian conflicts (Cohen & Frank, 2009) – despite the inclusion in this investigation of territorial disputes in riparian environments themselves. In this case, Riparian Doctrine directly clashes with the existing Prior Appropriation Doctrine that serves as the foundation of Oregon water law. Prior Appropriation involves the 'first-beneficial-use' rule: those first to use a given water resource are given individual water rights. Riparian Doctrine is

the provision of water rights to those with access or interest within the entire riparian corridor. As Riparian Doctrine and the reality of Prior Appropriation conflict clearly on fundamental issues of water values and water rights, riparian negotiation principles are outside the scope and applicability of this analysis – though significant parallels may be drawn between the Recommendation Section and fundamental characteristics of riparian conflict negotiation: shifting the focus of resolution from interparty rights- to needs-recognition, from time-based over sovereignty-based solutions, for maximizing beneficial use, and developing local social and cultural interests. This investigation, therefore, does not draw directly on riparian negotiation principles but illustrates methods for implementing some of its recommendations in adverse conditions. Demonstrating that the Recommendations Section of this paper can accommodate competing doctrines further strengthens the arguments made herein and indicates more adaptable, yet durable, solutions.

CHAPTER IV

A BRIEF HISTORY OF JEFFERSON COUNTY

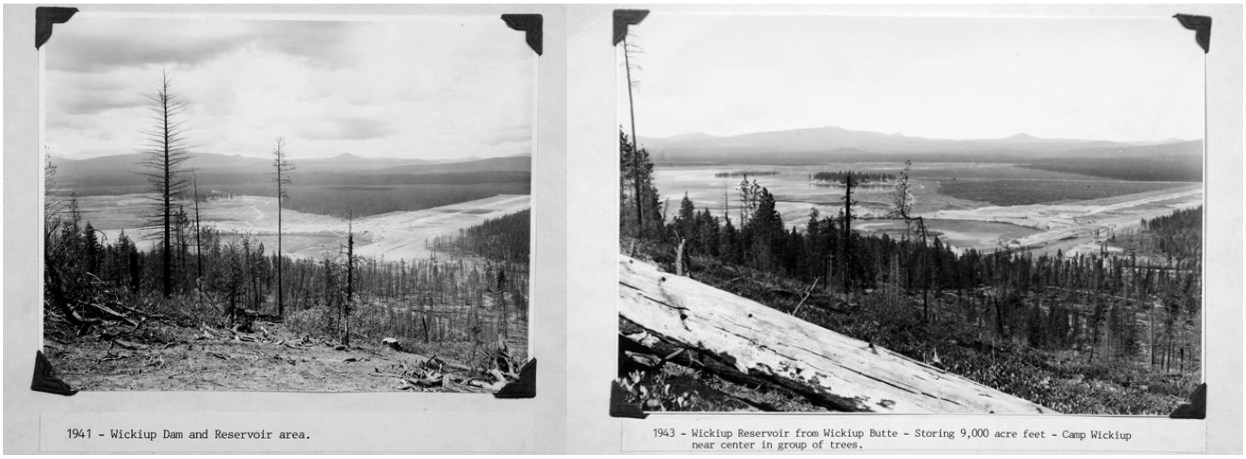
This section will attempt to lay out a brief description of the history of Jefferson County, stretching from the Native Americans' relationship with the land to the 2010s. It is the aim of the author to provide the reader a perspective of time and place, specifically within the physical bounds of the County. The massive water projects of the 1930s, 40s and 50s will be examined and a number of historical photographs are included for reference to the scale of these undertakings. The events described will not be analyzed directly using the described methodologies but form a base for understanding more recent conflicts and their potential solutions.

Before Jefferson County was ever defined or bounded, it was home to a diverse assemblage of Native American cultures: the Northern Paiute dominated the area stretching from the foothills of the Oregonian Cascade to far reaches western Nevada, the Nez Perce and Shoshone ranged to the north and further east, and Sahaptian-speaking Yakima and Umatilla controlled areas along the main riverways of the County (Robbins and OE Staff, 2014). Unlike interior valley or coastal groups, the Native Americans of the Jefferson County area relied on a fixed winter villages followed by much larger seasonal rounds – taking advantage of the healthy migrating deer and elk populations, seasonal and collaborative salmon harvests at the intersection of the Deschutes and Columbia River near Celilo Falls, and waterfowl-hunting and flora-gathering available in the impounded upland wetlands in the foothills of the Cascades and Ochoco Mountains (Robbins and OE Staff, 2014). The healthy ecosystem populations, diverse language groups, and collaborative resource management practices illustrate a landscape in relational harmony with its people.

First contact with European colonizers likely came in the form of Spanish- or French-speaking trappers and missionaries, which was followed quickly by a flood of pioneers and settlers from the nascent United States. Tensions over mining rights with the Northern Paiute of eastern Oregon flared dramatically at the peripheries of the Native Americans' influence: the Paiute Wars of the 1840s and 50s were sparked by a string of miners' and settlers' abuses against unarmed civilians (Tapahe, 2020). Increasingly cut off from their allies, lines of retreat or hope of relief from the rough militias and army battalions now patrolling for them, the tribes of the area signed a peace treaty establishing the Warm Springs Indian Reservation in 1855 (Miller, 2006). The 1855 treaty – like most in eastern Oregon – brought lingually- and culturally-diverse Native Americans together in an often ahistorical fracturing of clans, tribes and bands, but did manage to recognize the fundamental hunting and fishing rights of these groups in the larger area (Miller, 2006). Once the last of the free Native Americans in Oregon were confined in the 1870s and 80s, the entire landscape lay open for a dramatic and unprecedented transformation.

By the 1900s, Jefferson County looked very different: dry-land wheat farming and cattle-ranching by settlers and pioneers dominated (North Unit Irrigation District, 2019). Recognizing the importance of the various waterways in the high desert environment, the immigrant population was proactive in identifying and exploiting the local water resources. In 1902, President Roosevelt established the Reclamation Bureau which enabled the creation of the Deschutes Project in 1913: a planned series of irrigation units that would provide water to 99,330 acres in the Jefferson County area (North Unit Irrigation District, 2019). During the same period Oregon began to codify its patchwork of Prior Appropriation water rights under the Oregon Water Code of 1909, recognizing Prior Appropriation Doctrine in perpetuity. In 1916, the North Unit Irrigation District (NUID) was established to serve the area by local landowners themselves

– although funding opportunities were seriously affected by the First World War (North Unit Irrigation District, 2019). Despite an attempted name-change to the 'Jefferson Water Conservancy District' to boost investment, a cycle of farm failure and abandonment accelerated due to the Great Depression and last drought conditions (North Unit Irrigation District, 2019). The prospects for completion plummeted until 1932 when the New Deal allowed a revival of the Deschutes Project, feasibility studies to be carried out for Wickiup Reservoir, and reconfiguration of the NUID and new Central Oregon Irrigation District (COID) as two separate, operating water systems (North Unit Irrigation District, 2019). Despite environmental, economic, and political pressures, this early history of water use shows the commitment of the local population to securing, developing, and conserving their water resources.



Figures 2 – 3.Wickiup Dam and Reservoir area under construction, in 1941 on the left and in 1943 on the right. (North Unit Irrigation District, 2019).

Though the federal revival of the Deschutes Project would indicate a rapid development, its completion took nearly two decades. Construction of the 200,000 acre-foot Wickiup Reservoir, from which NUID was to draw over 65 miles of main canal to its southern jurisdictional boundary, was not finished until 1947 due to significant leaks (North Unit

Irrigation District, 2019). In 1946 the NUID Main Canal was finally connected to its 235 miles of built lateral canal, after construction was taken over from the Civilian Public Service and Deschutes Project by a series of private contractors as the Second World War ended (North Unit Irrigation District, 2019). The Project included digging massive, concrete irrigation pipes into volcanic rock, constructing multiple rotary fish screens and encasements, earth-ripping 40' deep 'Big Cut' and two huge tunnels through the Smith Rock area on the southern boundary of Jefferson County, and constructing a massive scaffolded and elevated crossing over Willow Creek (North Unit Irrigation District, 2019). It took until 1949 for 50,000 acres of the NUID to be supplied by the Deschutes Project, and in 1957 construction finally finished on Haystack Reservoir – providing the NUID "de-regulating control" over the distribution system and cutting two days of water travel time from Wickiup down the NUID Main Canal (North Unit Irrigation District, 2019). Thirty-four years after the initial conception of the Deschutes Project, water was finally being provided to Jefferson County farmers.

Figures 4 – 5. The North Unit Main Canal's crossing over the Crooked River, under construction in 1945 on the left and complete in 1946 on the right. (North Unit Irrigation District, 2019).

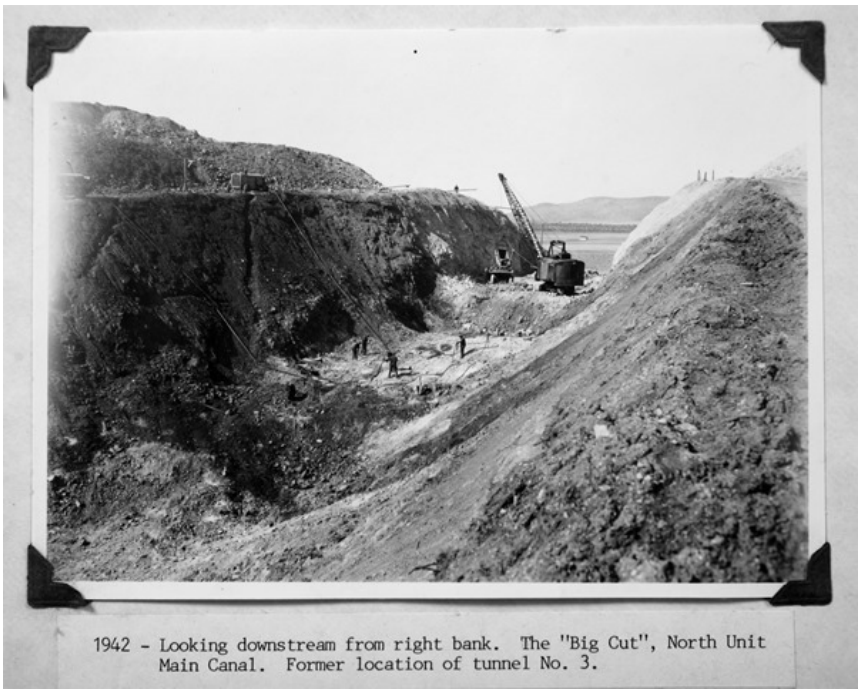


Figure 6. The ‘Big Cut’ – at least 40’ deep by its completion, allowed the Main Canal to connect to the waiting irrigation land just beyond the foothills of the Ochoco Mountains in the background. (North Unit Irrigation District, 2019).

The change in Jefferson County was drastic: agricultural practices changes, the cycle of farm abandonment slowed and the lower economy flourished. Agriculturalist, water engineers and farmers came together in a series of water-related events during the period after the Project’s completion, shown in the inserted images: knowledge was exchanged, connections made, and opportunities created for local people.

Figure 7. Locals in Jefferson County gather to observe the first flooding of an irrigation lateral along the Main Canal in 1946. (North Unit Irrigation District, 2019).

Figure 8. A 'Weed Holiday' held in Madras, Oregon in June, 1952 aimed at bringing farmers together to learn and practice identifying noxious weeds on the canal and lateral systems. (North Unit Irrigation District, 2019).

In 1968, NUID further improved its water system by installing nine, 450-horsepower pumps from the Manhattan Project in the Crooked River to deliver water 125 feet up and out of the river as a supplemental source for farmers; serving to help the "District endure water shortages felt from its primary Deschutes [River] source" at Wickiup Reservoir (North Unit Irrigation District, 2019). This development capped a period of intense infrastructural investment, unique in its dedicated local commitment to an audacious and ambitious water management strategy.

As national sentiment surrounding natural resources changed with federal protections during the 1970s and 80s, water regulations in Jefferson County slowly began to reflect a shift away from a purely agricultural-focus for its water management strategy. This includes the period during which much of the riparian corridors of Jefferson County were protected or reserved under state protection – in 1987 legislation, the Oregon Water Resource Department was given the authority to establish instream water rights for the Oregon Departments of Fish and Wildlife, Environmental Quality, and Park and Recreation (Oregon Water Resources Department, 2018). The protections, and agencies involved, suggest that this shift in interests towards environmental health were largely borne out on a state-level; notably lacking are the investments from the same local interests that helped shape the landscape two decades earlier.

The expansion of water rights in Jefferson County intersects with a series of droughts in the late 1970s (Holst and Schmisseur, 1979) that were precursors to sustained drought conditions that re-emerged in the late 1990s. In 2008, Oregon held a series of Statewide Water Roundtables to better determine the needs and interests of state water users. The regional meeting for Jefferson County occurred to the south, in the major city of Bend. Water users from across irrigation districts came together with water regulators, engineers, and conflict mediators to

describe their needs and concerns: water quantity and quality, funding, and planning issues were all identified at that session (*Statewide Water Roundtables Fall 2008: Synthesis Report*, 2008). Of note, the participants in the Bend Roundtable reported high rates of participation by water utility providers and pessimism in future water availability – despite identifying the issue and threat of aging water infrastructure and the need for an efficient replacement (*Statewide Water Roundtables Fall 2008: Synthesis Report*, 2008). These Roundtables were an unprecedented attempt by state authorities, regional actors, and local parties to come together to discuss water management strategy in Oregon. Eventually these Roundtables would come to inform real strategy during the period of study, but this will be addressed in the next section.

A brief history of Jefferson County reveals several truths: the unique waterways of the area and their associated benefits drew diverse Native cultural and lingual groups together in collaborative resource management, the arrival of European immigrants marked the beginning of a dramatic undertaking to change the hydrologic landscape, and the construction of water management infrastructure in Jefferson County has a historical tendency to face dual environmental and socio-economic pressures that complicate design, force costly revisions or delay completion. Central to the discussions enclosed in this paper are changes to interests and values around water resources and therefore the more recent environmental protections and Statewide Roundtables hint at varying potential conflict scales, diverse parties and interests, and pre-existing attempts at water conflict resolution in the region.

CASE STUDY FINDINGS

The purpose of this section is to define the interests and values the various watersheds within Jefferson County, with particular attention to the ownership of water rights, the community of water users, and ecosystem services present. Following the flow of the main

waterways in Jefferson County, this section will begin with the southernmost watersheds and move northwards. It will briefly describe each waterway in more detail, and examine local events in temporal order by addressing developments in 2011 to 2016. An overview and discussion of recent developments since the end of the timeframe is included at the end.

Middle Deschutes River

The investigation of water conflict in Jefferson County begins with the main southern waterway: the Middle Deschutes River. Figure 9 depicts land ownership along the riparian corridors of Jefferson County. The Middle Deschutes' riparian corridor is managed primarily by the Prineville Office of the BLM and USFS through the Deschutes National Forest (Bureau of Land Management, 1992), though the Oregon Department of Fish and Wildlife (ODFW) assists in issues surrounding fish reintroduction and habitat health. Water rights across Jefferson County are overseen and regulated by the Oregon Water Resources Commission – a state department responsible for the Statewide Water Resources Strategy (Oregon Water Resources Department, 2018), yet unrelated to the federal agencies responsible for overseeing the Middle Deschutes.

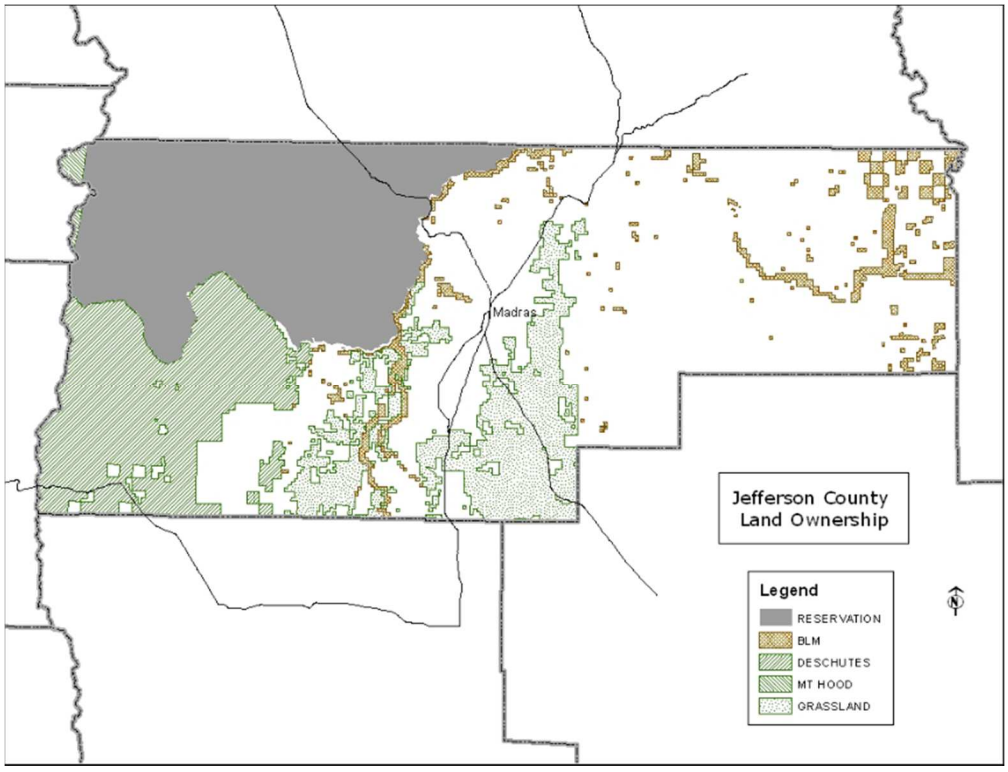


Figure 9. An overview of land ownership in Jefferson County, as divided between the Confederated Tribes of Warm Springs, the Bureau of Land Management, and the Deschutes, Mt. Hood and Crook River Grassland protected areas. Note the land ownership along the riparian corridor of the Deschutes River and the isolated pockets across the county. (*Jefferson County Comprehensive Plan*, 2013).

These jurisdictional divides reflect varying levels of federal and state political interests in natural resource management, echoing the economic interests of local agriculture and the timber industry intersecting with the Middle Deschutes' riparian corridor. ODFW, interestingly, reflects more direct local cultural and social values around fish species, native flora, big game and the Middle Deschutes itself; through that organization's dedication to overall ecosystem health, which is extracted further downstream by licensed and Native American fishermen and hunters. There is one other major ecosystem implicated in the Middle Deschutes: the Crooked River National Grassland (CRNG) lies along the riparian corridor and intersects directly with the Middle Deschutes. It encompasses most of the high desert that surrounds the three southern

waterways of Jefferson County. The National Grassland is the location of intersecting values and interests around migrating deer and elk, and cattle grazing by local farmers. Notably, the Deschutes Canyon-Steelhead Falls Wilderness Study Area (WSA) is located within the Middle Deschutes watershed and used for wilderness inventories and land management research (Bureau of Land Management, 2004). See Figure 12 for a map of the WSA, and its jurisdiction over the riparian corridor of the Middle Deschutes. The National Grassland ranges across both the WSA and the Middles Deschutes' riparian corridor directly implicating both water and land management strategies in Jefferson County. See Figure 10 for a detailed view of how the Middle Deschutes serves as a key interchange for diverse big game species and, when compared to Figure 9, demonstrates the importance of the Crooked River National Grassland in the landscape.

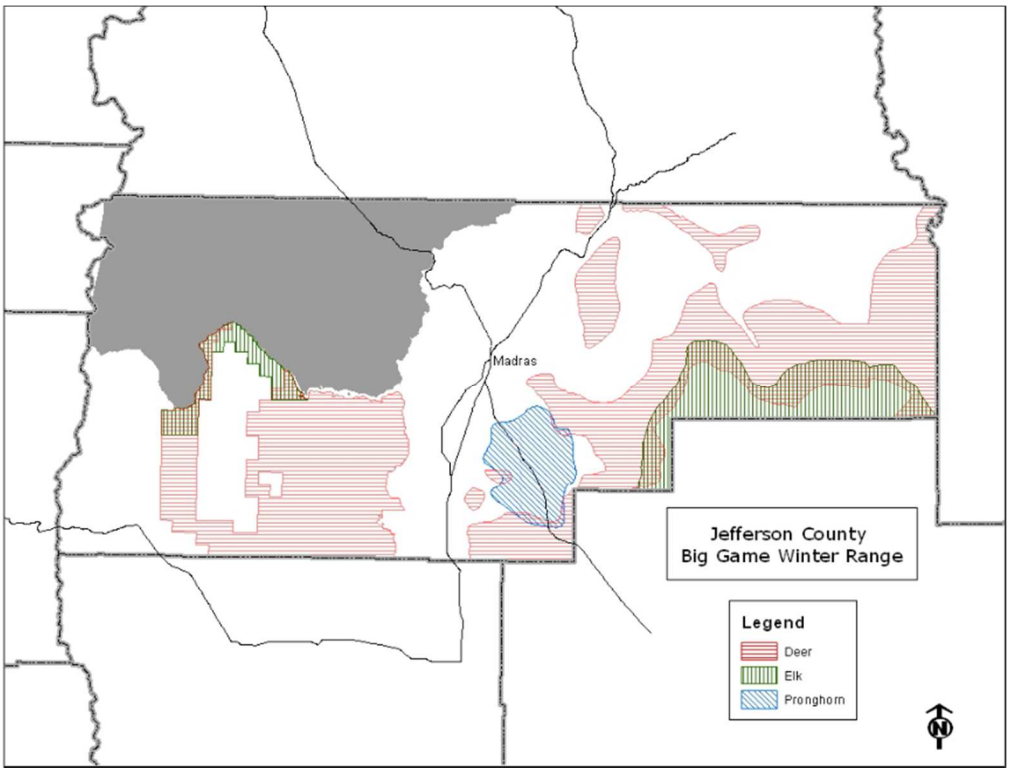


Figure 10. Map denoting the range of deer, elk and pronghorn populations throughout Jefferson County. This figure demonstrates the importance of upstream watersheds, not only for anthropocentric interests but environmental values such as faunal diversity as well. (*Jefferson County Comprehensive Plan*, 2013).

The CRNG is an interesting reflection of economic and political interests in fire management and forage provision for ranching, as well as intersecting cultural and social values of both the Native American and non-indigenous communities. Minor boundary changes between institutions occurred on the Middle Deschutes during the period in question, but these were minimal and for the purpose of better affecting fire management operations. It is important to note that within Jefferson County, the Native American community only borders one of the three major waterways, and yet has cultural, political, economic and social interests across the region. Whereas institutional focuses on species diversity and ecosystem understanding within the CRNG reflect the Native American values of high prairie ecosystems, the less active fire management practices and ranching interests reflect the cultural and economic values of the non-indigenous community. It is safe to say that the Middle Deschutes includes the intersection of multiple interests and values: the presence of unique ecological conditions allowing for unusual floral species, significant cultural importance of watershed health to local populations, substantial fish stocks and the associated recreational opportunities, interconnected and complex hydrologic activity, and outstanding habitat areas (National Wild and Scenic River System, 1999).

The first development referenced in the Events Database concerning the Middle Deschutes in Jefferson County is in 2013, when trail and recreation infrastructure development finished on the Otter Bench, Steelhead Falls and Scout Camp Trails as part of the BLM's Prineville District, (Richard, 2013a). This brought increased recreational use to the Middle Deschutes area, and helped control erosion on the local landscape: dog walking, bird watching, and recreational fishing are all activities promoted by this development (Richard, 2013a). Economic and cultural values are therefore significantly involved early in the temporal frame in

the Middle Deschutes watershed, mainly in the form of fishing access development and extensive reintroduction campaigns. These values were reinforced through a National Marine Fisheries Service ruling continuing reintroduction campaigns in and around the Middle Deschutes watershed in 2013 ("Endangered and Threatened Species", 2013). Further intersections of other political or economic motives across the Middle Deschutes watershed develop over time.

In 2014, the Oregon Natural Desert Association (ONDA) put forth a proposal for a 'Whychus-Deschutes Wilderness' Area to encompass most of the riparian corridors of the Middle Deschutes River and Lower Whychus Creek (Richard, 2014a). Though ultimately unsuccessful, this endeavor by a grassroots organization is notable for its integrative vision of land and water management strategies. The proposal specifically cites the positive effects a Whychus-Deschutes Wilderness Area could have had on the interests of adjacent landowners in the form of competitive economic advantage, and of local fishermen in the form of healthy bull trout populations. Contemporary to the Whychus-Deschutes Wilderness Proposal, ONDA entered an agreement to monitor public lands with the government (Oregon Natural Desert Association, 2022) – a prime example of using water resources and interests as capacity-building across political, cultural, social, and economic interests. There is a clear connection that can be made with these grassroots efforts, and the earlier Statewide Water Roundtables in 2008 which attempted to bring local stakeholders together for the same purposes.

By 2016, environmental conflicts in the Middle Deschutes were gaining momentum. Two lawsuits were filed on behalf of the non-profit WaterWatch of Oregon and the Center for Biological Diversity against the North Unit, Tumalo and Central Oregon Irrigation Units, claiming that authorities – including the Bureau of Reclamation, and stakeholders were too slow

in restoring riparian habitats from endangered species such as the spotted frog (Ditzler, 2016). The lawsuits argued that water from the irrigation units' reservoirs should be diverted to maintain normal streamflow and encourage health habitats in the riparian corridor. As a result, the local farmers of the North Unit Irrigation District along the Middle Deschutes River feared for the potential effects on their access to irrigation water, and their businesses were directly impacted by the market uncertainty generated by the lawsuits. See Figure 11 for map of irrigated lands, showing how agricultural interests are directly connected to the major waterways of Jefferson County.

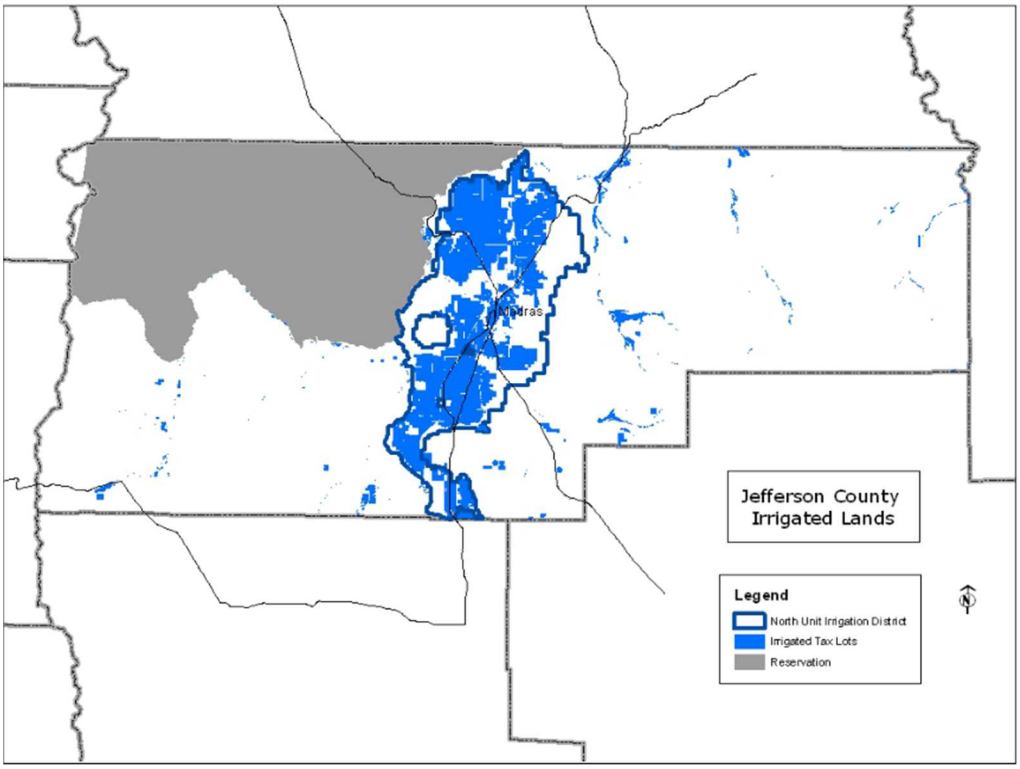


Figure 11. An excellent resource for visualizing the central role irrigated agriculture plays in Jefferson County. Note the intersection of agricultural interests along the riparian corridor of the Deschutes River belonging to the North Unit Irrigation District, and the presence of isolated irrigated lands in eastern reaches of the county. (*Jefferson County Comprehensive Plan*, 2013).

WaterWatch pursued their legal action despite working on the Deschutes River Basin Study Group with the defendant authorities the year before (Ditzler, 2016), in a demonstration of the power of water conflict to divide multilateral action. The big-picture causes of this escalation will be addressed and collated in later sections.

Developing conflict over land and water management strategies in the Middle Deschutes reverberated in the Department of the Interior: the Acting Assistant Director Abbie Jossie testified before the House Natural Resources Committee concerning the Deschutes Canyon-Steelhead Falls WSA (*Statement of Abbie Jossie*, 2016), specifically criticizing technical aspects of legislation that transferred land out of the WSA.

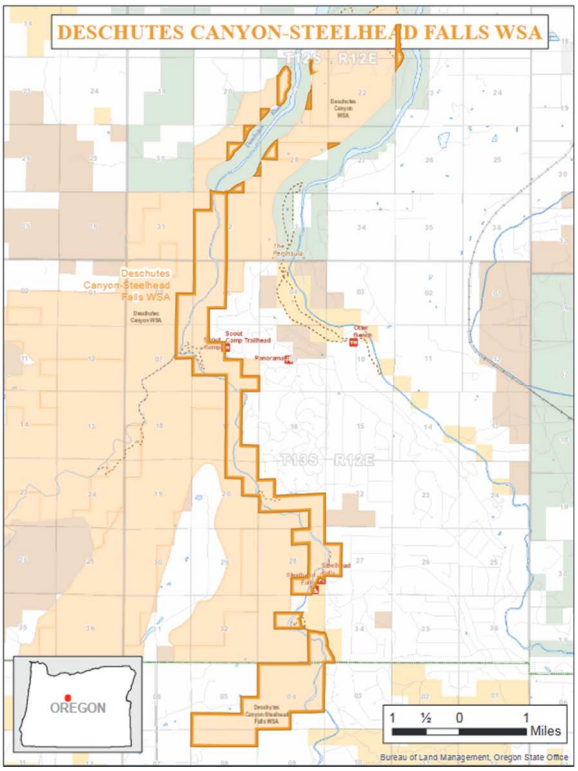


Figure 12. A map over ownership of the riparian corridor in the Deschutes Canyon-Steelhead Falls WSA; a prime example of land and water management in Jefferson County. (Bureau of Land Management, 2004).

The central issue concerned fire prevention in the WSA; the legislation argued threats to private property in the adjacent Crooked River Ranch area required transferring lands along the eastern boundary to facilitate prevention and response (*Crooked River Ranch Fire Protection Act*, 2016). Both the legal suits and house committee testimony involve multiple stakeholders with social, cultural, economic, and political motives that intersect and amplify around water and land management along the Middle Deschutes corridor.

Whychus Creek

Whychus Creek enters Jefferson County via its southern boundary, eventually meandering northeastwards to meet with the Middle Deschutes River. Though a smaller waterway, Whychus Creek encompasses numerous stakeholders and conflict scenarios throughout Jefferson and neighboring Deschutes Counties. As with the Middle Deschutes River, Whychus Creek embodies a transboundary riparian zone with significant implications concerning water conflict within the case study. Comparisons of trail development and habitat restoration along the Whychus Creek between Deschutes and Jefferson Counties demonstrates this waterways' involvement with diverse interests, though action is focused upstream of Jefferson County. This is an excellent example of an oft-observed phenomena in water conflict: issues, interests and eventually conflict amplify from upstream to downstream watersheds across the landscape (Lee & Mitchell, 2019).

Unlike the adjacent Middle Deschutes or Crooked Rivers, much of the riparian corridor of Whychus Creek is the site of protected lands under the Deschutes Land Trust, a regional non-profit organization (Deschutes Land Trust, 2020). Whychus Creek – infamously referred to as 'Squaw Creek' before 2005 – is notable for its intersection of cultural, social, economic and political interests: the Deschutes Land Trust made considerable efforts to improve legal

protections for riparian habitats, and bring diverse stakeholders together for projects throughout the Whychus Creek watershed between 2011 and 2016 (Sullivan, 2014). The timing and duration of these grassroots, natural resource conflict resolution attempts are contemporary with larger attempts – specifically the regional Central Oregon Water Roundtable in 2008 and the Statewide Water Strategy in 2012.

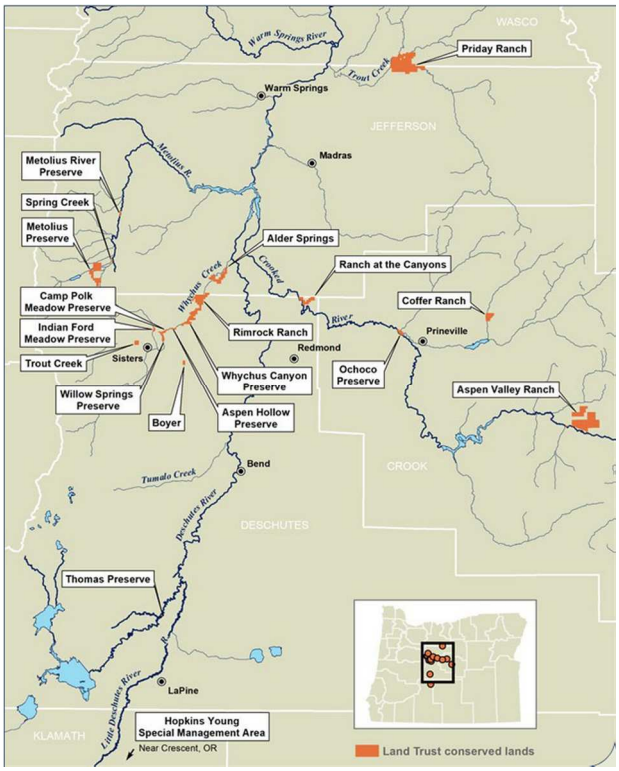


Figure 13. This map clearly denotes the lack of significant riparian restoration in Jefferson County – this map is from after the period in study and there remains next to no development by the Deschutes Land Trust within County boundaries. (Deschutes Land Trust, *2020 Deschutes Land Trust Protected Lands Map*).

Importantly, the name-change of Whychus Creek implicates regional cultural identities and demonstrates an early recognition of cultural importance in the landscape. A 2004 *New York Times* article on the national discussion of shifting norms around historical racism and placenames in the United States specifically cited issues with renaming Whychus Creek as an example (Sanders, 2004). By the beginning of the period of study, the name-change was

complete and accepted as common usage. Though dislocated from a direct border with the Confederated Tribes of Warm Springs, Whychus Creek is a perfect illustration of cultural value in the landscape, and further proof that watershed connectivity can be used as a useful tool in linking disparate interests and values to place and location. The inclusion of Native American interests, values and voices in what was a burgeoning conflict over place, and the local de-escalation and resolution of the issue should be noted. No further sources in the timeframe could be found referencing any developing conflict over the name-change.

In 2015, trail connections finally allowed hikers access to Alder Springs, one of the only protected stretches of Whychus Creek in Jefferson County (Richard, 2015). While social interests in recreational activities along riparian corridors is recognized by Jefferson County, this does not appear to be the main focus along the Whychus Creek corridor. The adjacent and abutting Crooked River National Grassland, managed by the USFS, oversees cattle ranching on the land and implicates agricultural interests along the Whychus watershed (Richard, 2015). Whychus Creek can be typified as a successful water transaction, through the effective management of a complex system of water rights and values, vital fishery and big game interests, and rangeland for cattle-ranching and agricultural interests. Though there are diverse interests involved in the Whychus Creek watershed and a recent history of community engagement in Jefferson County, it is in neighboring Deschutes County where Whychus Creek has received the most care and attention.

In comparison to Jefferson County, the Deschutes Land Trust's restoration along Whychus Creek in neighboring Deschutes County was recognized as having beneficial ecological effects and value-generating solutions for water users (*The Bend Bulletin*, 2013). The aforementioned restoration work carried out along the Whychus watershed in Deschutes County

demonstrates community action, recognizing diverse interests in the landscape including agricultural interests. The Deschutes Land Trust's restoration along the Whychus Canyon Preserve recognized the effects of human intervention of the Whychus Creek flood-plain due to agricultural development and the importance of developing fluctuating wetlands that serve as a valuable water cache, further improving fish habitats and ecosystem diversity (Hill, 2016). The restoration work went further than restoring environmental value: the replacement of traditional water systems along the Whychus Creek as part of restoration efforts were found to use less energy, preserve the environment, protect fish populations and – importantly – shifted interaction away from the center stream of Whychus Creek (Shadler, 2016). The Land Trust's work demonstrates a model of holistic solutions that provide for plural interests including farmers, environmentalists, researchers and scientists, engineers, and local government. These community and institutional interventions along Whychus Creek in Deschutes County serve as a stark mirror image to the undeveloped section of the creek which lies in Jefferson County. Though cultural and social values are important across Whychus Creek, effective action to prevent the deterioration of the local watershed and allow the recognition of multiple interests has been limited within Jefferson County.

Crooked River

The Crooked River joins with the Middle Deschutes and Whychus Creek within Jefferson County, emptying into Lake Billy Chinook – an artificial lake formed by the construction of Round Butte Dam. Here, the interaction of these three waterways have created an awe-inspiring network of weathered canyons and parapets called the Cove Palisades State Park. Meandering through neighboring Deschutes County and bordering large quantities of agricultural land to the

north in Jefferson County, the Crooked River is primarily a water-supply source for the agricultural communities located east of the Deschutes River. However, multiple agents and interests are implicated in a historical analysis of environmental conflict along the Crooked River. After crossing the southern boundary of Jefferson County, the Crooked River continues northwestwards until it reaches its confluence with the Middle Deschutes River and Lake Billy Chinook, but before it does so, it passes the Crooked River Ranch – one of the largest unincorporated communities in the United States. This complexity and interconnectivity of issues and stakeholders, as with the Middle Deschutes and Whychus Creek, demands adaptive, collaborative solutions.

Early references to the Crooked River within the time-frame of the case study mainly concern on-going trail construction connecting outdoor interests to southern watersheds throughout Jefferson County, as well as improvements in the drinking water of the Crooked River Ranch community. In the early 2010s, trail construction allowed connectivity across the Crooked River Ranch area (Richard, 2013a). Interestingly, an early salient issue seems to be the lack of effective mapping of those trails leading to confusion (Richard, 2013b), and an assumable loss of benefits for the local economy. By 2014, trail construction was complemented by extensive development at the Crooked River Ranch, including amenities for visitors and a golf course (Richard, 2014b). Crooked River Ranch stands as a unique interface between developed residential areas and significant waterways in Jefferson County, and therefore the riparian management decisions – trail construction and visitor amenities – reflect the social and economic interests of the unassociated community.

For a waterway which borders significant agricultural areas, the intersection of drinking water as an interest may surprise due to the risk of harmful run-off from industrial agricultural

practices. By operating a series of drinking water wells, pumps and storage facilities along the Crooked River, the community provides water to hundreds of households across Jefferson County. The Crooked River Ranch is not the only community bordering the river along its entire course: the city of Prineville in Crook County to the southeast lies along its riparian corridor. In 2014, the United States federal government went so far as to extend protections along the Crooked River to provide water and job security to the city of Prineville (US Gov't Printing Office, 2014). Interestingly, several datacenters were constructed near Prineville by the software and technology corporation Apple Inc. during the period of study, which were designed to be powered by hydroelectric power (O'Grady, 2014) – another peculiar intersection of diverse interests and values, and excellent example of the transboundary nature of water and water conflict. These federal and private industry interventions match local developments. Jefferson County won awards in 2014 for water quality, using both groundwater wells and direct sources from the Crooked River (Gill, 2014). Within Crooked River Ranch, there was even a 700,000 gallon standpipe constructed to improve water systems for the local community (Parametrix, *Crooked River Ranch Water System Improvements*). These legal protections, awards, and water service developments demonstrate salient intersections of interests from residential communities, the technology and contracting sector, and water system services.

Figure 14. The 700,000 gallon standpipe installed near Crooked River Ranch by Parametrix Services. (Parametrix, *Crooked River Ranch Water System Improvements*).

The investments of time and money in diverse interests along the Crooked River waterway prove the importance of collaborative solutions. Though there is no direct source of environmental conflict along the Crooked River, the Crooked River Ranch is an example of a community with the support and collective resources to invest in active solutions. Connecting social interests to the Crooked River has mirrored its effects along the Deschutes River – increasing trail connectivity allows for increasing social awareness about the landscape and habitat health – and drinking water implicates social, economic and political interests at the local and federal scales.

Metolius River

The Metolius River, which wraps along the forested uplands along western side of Jefferson County, is another prime example of overlapping interests in water resources. Bordered to east by Forest Service land, to the north by the Confederated Tribes of the Warms Spring

(CTWS), and along its corridor by various recreational and hatchery stations, the mountainous Metolius River winds its way first north and then sharply east into Lake Billy Chinook, shown in Figure 15 below. In the first year of the timeframe – 2011, scientific research interests in groundwater mapping and hydrogeology found undiscovered connections between tributaries of the Metolius River, Whychus Creek and the Middle Deschutes River (Hackett, 2011). This impressive hydrologic complexity further implicates water use interests as far away as the Crooked River Grassland; conversely, it is worth noting that subterranean watersheds connections can create uncertainty in a 'closed' system, unless properly understood and accounted for.

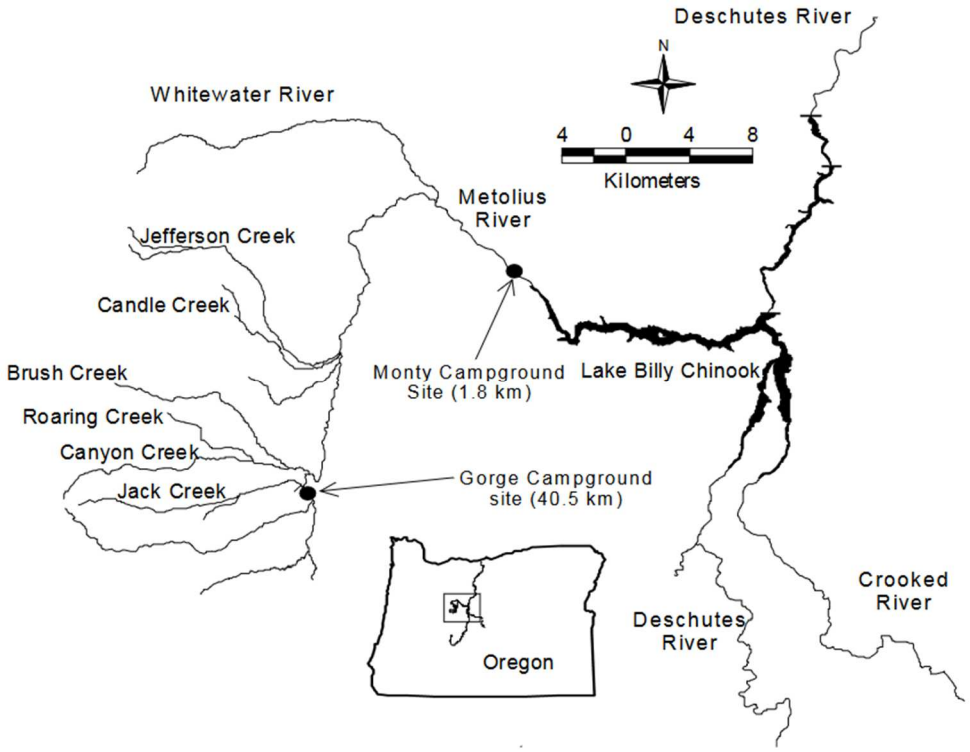


Figure 15. A map denoting the stream complexity of the upland Metolius River, as well as the interfaces for recreation along its course. The majority of the Metolius River lies within Jefferson County – only select sources are derived from across the western boundary. This map also clearly shows the intersection of major waterways at Lake Billy Chinook. (Lewis, 2003).

By 2014, scientific interests had intersected with economic and political interests; a loose coalition of organizations came together to form the 'False Brome Working Group', aimed at tackling the issue of invasive grass at Metolius River headwaters (Savonen, 2014) and restoring the ecology of the riparian corridor. The 'False Brome Working Group' included diverse parties and stakeholders: the Institute for Applied Ecology, the OSU Extension Service, the Nature Conservancy, the Natural Plant Society of Oregon, Starker Forests Inc. – a private lumber contractor, the USDA Forest Service, the BLM, the Oregon Department of Agriculture, and the US Army Corps of Engineers (Savonen, 2014). In an excellent example of the intersection of the diverse stakeholders along the Metolius River and a 'unity of reality or perspective' as described in Max-Neef (2008), when wildfires forced evacuations of properties in the Metolius River watershed in 2014 (Geranios, 2014) the Metolius Fire Project (METOFIRE) was used to quantify carbon pools and productivity in the landscape (Berner & Law, 2016) – implicating many of the same social, economic and political interests as the Working Group. This application of scientific research also clearly demonstrates an intersection of scientific interests with economic values in Jefferson County forests bordering the Metolius River. The generative and proactive effect of scientific research on inter-party solutions is worth noting, as it demonstrates a clear catalyst for bringing various parties and interests together to enable effective natural resource management. This point coincides with Van Vugt's (2008) connection between information, understanding, and the base motives and interests required for successful conflict resolution.

In 2011, Governor Kulongoski signed a motion declaring the Metolius River area an area of critical concern and denying any development prospects (Esteve, 2011), after significant resistance and a unanimous vote to pursue legal action against the state in 2009 by Jefferson

County Commissioners (Brinckman, 2009). Governor Kulongoski's legal protections eventually led to the creation of the Metolius Area of Critical State Concern (MACSC), which afforded the watershed unprecedented ecosystem and habitat protections. The Metolius River system – which includes the Whitewater River from cold, mountain groundwater sources – became the site for significant hatchery development between 2011 and 2016. By 2012, the ODFW was able to return the sockeye salmon to the Metolius watershed – an ecological event not seen since the construction of dam infrastructure over half a century earlier (Landers, 2012). In 2013, the Wild Falls Hatchery – a system of display ponds, landscaped and natural grounds – was releasing spring chinook back into the Metolius and Middle Deschutes (Richard, 2013c). Just two years later, bull trout from the Metolius River were used across Oregon's watersheds to re-stock and replenish fish populations (Goldfarb, 2015). Interests in fishing along the Metolius River between 2011 and 2016 are evidence of intersecting political, cultural and economic perspectives – only through Oregon political legislation was the economic development of hatcheries possible, which in turn recognized critical local and Native American cultural values in fishing. The importance of habitat health and riparian protections along the Metolius are made clear by these developments within the time-frame.

Despite these impressive collaborations, contributions, and interest-recognitions, the Metolius River was not isolated from the effects of environmental conflict and ecological injury. In 2015, researchers published an article outlining significant fish population pressures on young bull trout in the Metolius River: they identified reduced natal habitat capacity as well as bottlenecks and limited prey availability at Lake Billy Chinook as threats (Ratliff et. al. 2015) – all effects of downstream competition over water interests and energy production at the Pelton Round Butte (PRB) Project. In late 2015 there were closures of popular fishing areas across the

state due to fish die-offs, excluding Metolius River (Urness, 2015). At best, this is a neutral event; the unique mountain sources of the Metolius likely insulated the waterway against a collapse of carrying capacity during the period of stress, and can be directly tied to the watersheds' local value and unprecedented recent protections it has enjoyed.

Despite these threats to the Metolius, Governor Kulongoski's 2011 protection of the Metolius River and its unique hydrologic characteristics enabled an environmental resource to flourish within the riparian corridor: birds. In 2012, the Metolius River's riparian habitat drew impressive numbers of warblers that encouraged eco-tourism and birdwatching in the area (Shewey, 2012). In 2013, the riparian corridor of the Metolius Preserve – sponsored by the Deschutes Land Trust – was also reported as a significant bird-watching site (Richard, 2013c) in Jefferson County. The prospect of migratory birds as a cultural and economic value is not unique in Oregon: many of the parks and recreation sites across Jefferson County offer bird-watching or sport hunting. Another interesting intersection of local natural resources and outdoor activities in Jefferson County is offered by a 2011 *New York Times* article citing 'wiking' – that is, hiking and wine tasting – as an activity in the Metolius River area (Margulis, 2011). These natural resource realities reflect a number of underlying interests in the water resources of the Metolius watershed: economic and agricultural interests in vineyards and hatcheries, social and cultural interests in bird-watching and fishing, and even broader political and economic influences from Willamette Valley cities like Salem and Portland in the form of state legislation and tourism developing from the wine-tasting and hiking opportunities of Jefferson County.

Despite state legislative protections, a direct border with the Confederated Tribes of the Warms Springs Reservation, and significant natural water resource value, the Metolius River began to suffer due to unresolved issues with water use further downstream. In 2016, the Oregon

Health Authority (OHA) issued a warning over blue-green algae in the Metolius River – a symptom, the Deschutes River Alliance argued, of dam infrastructure at the PRB Project (Peacher, 2016). This critical environmental and natural resource conflict will be examined further in the next sub-section. It is important to point out that the ecological effects on the Metolius were pronounced, which is unlike the Middle Deschutes or Crooked Rivers, is the only riparian system which draws directly from the mountainous uplands to the east. While the Metolius River may have been touted as the most pristine of Jefferson County's main waterways, it has been shown that significant negative environmental effects of human intervention downstream were felt on the values and interests of local parties there between 2011 and 2016.

Pelton Round Butte Project

Constructed in 1964, the Round Butte Dam was a pioneering piece of industrial engineering that forced the formation of Lake Billy Chinook – and artificial lake named for a Native American scout that assisted United States forces during the Paiute Wars. Lake Billy Chinook, "surrounded by high basalt cliffs and hillsides covered in sagebrush and juniper, is known for its recreational use by large numbers of anglers, boaters, hikers, and sightseers" (Neville, 2011). Round Butte Dam, in a historic 2005 re-licensing agreement, came to be co-owned by Portland General Electric (PGE) and the Confederated Tribes of the Warm Springs Reservation (CTWS). A main component of the agreement included the world's only known dual-use, floating surface fish collection facility and power generator (Neville, 2011). Designed to resolve earlier water resource conflicts over the failure of fish passage systems during the 1960s, the Selective Water Withdrawal (SWW) Tower can gather cutting-edge scientific data about fish migration patterns (Neville, 2011), seen in Figure 16. The modern dam infrastructure, including the downstream Pelton and Deregulating Dams, can produce a net capacity of 465 MW

– most of it sent to Willamette Valley cities like Salem and Portland (Neville, 2011). The PRB Project is a significant source of energy for the entire Pacific Northwest region and has helped all of Oregon develop as a modern economy.

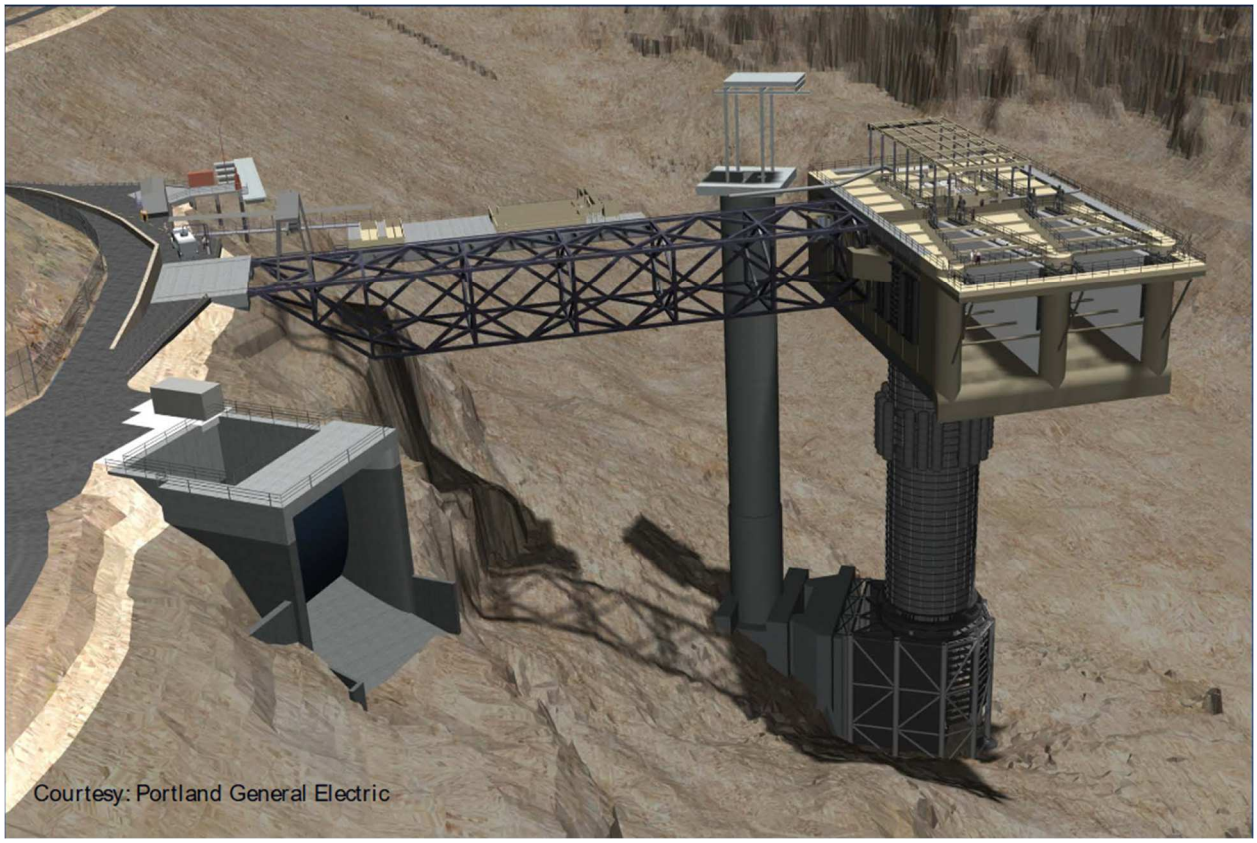


Figure 16. The Selective Water Withdrawal (SWW) Tower that was installed as part of the dam infrastructure at the Pelton Round Butte Project. Note its projection into the middle of the streamway. (Lovtang & Gauvin, *Reintroduction of Fish Passage in the Deschutes River Basin*.)

After considerable debate and conflict over the environmental effects of new infrastructure at Round Butte Dam on local interests, such as deteriorating water quality and elevated water temperature which intersect with fishing and boating traditions, PGE decided to implement their solution. Even whilst in the construction phase, the proposed 'mixing tower' at Round Butte Dam faced issues: it collapsed into the lake (Springhetti, 2009). Costing of $110

million dollars to ultimately install, the SWW Tower eventually began to pull warmer Crooked River water from the reservoir's surface to blend with colder Metolius River water from the bottom (Peacher, 2016). Within this constructed cross-boundary infrastructure, the waters of Lake Billy Chinook are combined: the reservoir's surface water comes from the nutrient-laden Crooked River, which sees heavy agricultural use, and the cold bottom water comes from the mountainous Metolius (Peacher, 2016). By concentrating energy-production infrastructure and natural-resource conflict resolution interventions within the purview of political and economic actors – ODFW and PGE – the entire watershed was implicated in the massive over-investment in the SWW Tower. Even though PGE, Jefferson County and ODFW all recognize the interests of various actors in local watersheds, the choice was made to construct an impressive and expensive piece of infrastructure at an inaccessible, intersectional point in the landscape where all the major waterways of southern and central Jefferson County intersect.

The exclusion of local interests and implication at a watershed-level meant a developing conflict and predictable environmental effect. The impacts of the SWW Tower were felt almost immediately: from lower insect spawn across watersheds to a 25% loss rates of spring chinook smolts passing through ladders (Peacher, 2016). The Deschutes River Alliance activists took water quality measurement into their own hands and recorded 1,200 violations of water quality standards since the installation of the SWW Tower (Peacher, 2016). Despite the Department of Environmental Quality raising concerns over macroinvertebrate populations in the Lower Deschutes, and in the face of increasing activist frustration over 'enabling' behavior between PGE and its regulators, the Deschutes River Alliance formally filed a legal suit against the dam operators for the breach of environmental quality (Peacher, 2016). The main concerns of Deschutes River Alliance activists: water turbidity, imbalanced water pH and elevated water

temperature. In 2015 – before the filing of the legal suit – a group of activists and scientific researchers published a crucial paper on ecology development at Lake Billy Chinook. The paper called for the placement of large deadwood along the reservoir's shorelines for the protection of riparian plantings, and proposed a local action plan with a monitoring plan for evaluation, including the effectiveness of the placed deadwood, the cost of river transport for wood moved below the project, monitoring the project's use by wildlife and fish, and as appropriate, erosion control for the establishment of shoreline riparian vegetation (Hydropower Reform Coalition & River Management Society, 2015). While the paper demonstrates the power of local action in generating effective solutions, the proposals within are unique during the study period in Jefferson County. The paper recognizes the diversity of ecosystems services provided by healthy riparian corridors and describes the means to engage multiple local interests trough information-sharing and accountability. Ultimately, the environmental conflict over the Round Butte Dam remained unresolved with ongoing litigation at the end of the time frame in 2016. Though the SWW Tower and Pelton Round Butte Project were the focal points of environmental conflict and adverse ecological impacts within Jefferson County, it is also crucial to investigate the effects and impacts felt downstream along the Middle Deschutes watershed during the same period.

Downstream Implications

The downstream watershed of the Lower Deschutes River has been fundamentally defined by the operations of upstream dam infrastructure at the PRB Project, and reflected interests along the downstream riparian corridor echo the effects of hydroelectric energy production. During the period of study, the CTWS operated a bio-fuel facility at the juncture of the Shitike Creek and the Lower Deschutes, just outside the town of Warm Springs. In 2016, the

bio-fuel generation was shuttered (CTWS Press Releases, 2016), likely due to the reverberating effects of litigation against the owners of dam infrastructure including the CTWS, and an increasing awareness of the general lack of renewable and fossil-free carbon sources in Jefferson County. One recommendation made by contemporary experts was to harvest carbon from dead stands within riparian corridors (Oregon Forests Resources Institute, 2006). The intersection of significant energy infrastructure downstream demonstrates the cross-boundary nature of energy interests in Jefferson County, as well as the emergent cultural and social values of the CTWS in energy production through renewable and non-detrimental sources, in contrast to other local actors. Through this perspective the shuttering of the CTWS plant can be interpreted as a knock-on, negative effect of environmental conflict upstream.

Despite warnings as early as 2003 that the Pelton Round Butte Project would disrupt critical environmental cycles, no restoration or resource protection was undertaken in the downstream portion of the Deschutes River. Scientists had specifically warned of effects on stream bedload transport of silt and rocks, stream channel morphology and channel-bed texture (Fassnacht et. al. 2003) – all critical ecosystem attributes that intersect with fishing, boating and agricultural interests below dam infrastructure. In 2014, a team of hydropower reformers and local river protection activists published a plan to evaluate gravel mobility, supply, and use by spawning salmonids in the Lower Deschutes River from the Deregulating Dam to the Trout Creek confluence while monitoring geomorphic and biological components (Hydropower Reform Coalition & River Management Society, 2015). Additionally, the plan had included a portion on broadening the restoration effort with an additional plan to implement the Trout Creek habitat enhancement project (Hydropower Reform Coalition & River Management Society, 2015). Unfortunately, this plan for the Lower Deschutes was not carried out in time to offset the

effects of litigation and conflict escalation at the PRB Project. The downstream environmental effects of dam infrastructure have been connected to the conflict at the SSW Tower, crowned by litigation against the dam owners, but little regional support or attention has been given to the proactive solutions generated by locally connecting interests and values up- and downstream of the PRB Project.

CHAPTER VI

ANALYSIS

The conflicts surrounding the construction of the SWW Tower are adversarial-level negotiations, which are about trust-building and focused on the core motives of institutions. The lawsuits filed in 2016 crest a wave of issues across the Jefferson County watersheds, marking a failure to develop reflexive or integrative stages of negotiation; the SWW Tower failed to recognize the degradation of core conflict motives from institutions to information, and of key conflict conditions from trusting to understanding (Wolf, 2008, pp. 30-34) during the period of study. This pattern matches clearly with a Four Worlds Framework of understanding conflict development around natural resources. The SWW Tower was an infrastructural investment by powerful actors in an area already bounded and impacted by three separate dams, and made within the in-accessible portions of an artificial lake. By failing to incorporate the diverse interests, locally-sourced solutions, or develop cross-party incentives, the SWW Tower failed to account for the entirety of the Four Worlds. See Appendices B and C for graphs of the coded data and visual representations of the conflict characteristics.

Four graphs are included in the Appendices section that reflect the raw data that was collected and collated in the Events Database – also in the Appendices section. The four graphs illustrate the amplification of water resource conflict: the graphs break down basic event intensity over time, amplification of conflict scale over time, frequency of positive or negatively coded events across the period of study, and cumulative event intensity by watershed. Reference the graphs in the Appendices section, alongside the Events Database and Mind Map, for a detailed view of the relationships described in this section.

The Pelton Round Butte Project can be interpreted analytically as a realization of Max-Neef's (2005) 'Axiom of the Excluded Middle', wherein the debate over dam infrastructure is reduced to mutually exclusive options of energy resources or natural resources without the recognition of a third option: renewal of natural resources as mutually benefitting energy resources (Max-Neef, 2005). Water conflicts across the Deschutes River Basin also flared at the same time as litigation was filed against dam infrastructure owners, demonstrating the full force of systems and dynamic conflict complexity, as described by Daniels & Walker (2012).

In the Middle Deschutes, litigation filed over failures to implement riparian protections for the Oregon spotted frog by WaterWatch implicated agricultural water use, economic interests, contentious political boundaries, social concerns over fire management, and socio-cultural values attached to riparian species diversity – primarily local fish species, but amphibian and insect species' value have been increasing recently as well. This conflict can also be interpreted as an adversarial-level negotiation – the litigation filed fundamentally questioned the core motives of political institutions in failing to protect riparian ecologies.

Along the Metolius River, parties to water use were directly invested in the conflict over dam infrastructure, considering many of the direct effects were measured along this well-protected riparian corridor. Scientists and activists argued that social interests in watershed health necessitated litigation. Local fishermen formed the cultural interest: both recreational and Native users. PGE obviously has significant economic links to the conflict as majority owner of hydroelectric infrastructure during the time period, and the Oregon Department of Fish and Wildlife (ODFW), the Department for Environmental Quality (DEQ), and state water regulators represented the state and federal political interest.

In each case, scientific monitoring was a key indicator of the move from trust-centered to understanding-centered negotiations. As the real effects of local infrastructural intervention and regional water management were felt by the riparian ecosystems in Jefferson County, social and cultural interests in scientific data were repeatedly triggered. This can also be interpreted as a transboundary issue reliant on a unity of the 'information systems' of Van Vugt (2009), and the reflects the collaborative learning and systems complexity of Daniels & Walker (2012). In other terms, the local water interests in Jefferson County seek to satisfy the need for a clearer picture of their dynamically complex rivers and they repeatedly do so by investing early in regionally-sourced, scientific data that succeeds in linking the detail complexity of smaller watersheds or ecosystems with the larger waterways and hydrology of the entire county or region.

Land and water management strategies across Jefferson County have been shown to involve varied political, social, cultural and economic interests. Solutions to salient environmental conflicts during the period between 2011 and 2016, however, largely failed to recognize interests across the Deschutes River Basin. Recognizing the complexity of interests surrounding environmental issues and the interconnectivity of water-resource conflict, solutions to problems should have included partners from across the Deschutes River Basin in Jefferson County. Though groups such as the Deschutes Land Trust, the False Brome Working Group and the Deschutes River Alliance cooperate and coordinate with multiple agents and interests, environmental conflict in the county became salient due to connected interests on a larger scale. This reality reflects the Four Worlds Framework understanding of moving from watershed- or benefit-level geographic scope to a regional scope in addressing conflict, while simultaneously encouraging equity and capacity-building in the negotiation of environmental conflict. The central conflict over the effects of dam infrastructure on the Deschutes River in 2016

demonstrates how upstream and downstream concerns and interests intersected to conflict with what was already considered a solution to an environmental conflict – the PRB Project and SWW Tower.

Any solution to the water use issue created by dam infrastructure in the Deschutes River Basin must recognize the historical basis for the current paradigm. The original dam infrastructure with its supporting hydraulic network, dependency of the local agricultural system, and urban-use power generation are centralized: this means that removal of dam infrastructure is a non-option for the reliant communities. Recognizing also the checkered placename record of Jefferson County – examples including its moniker-use by a separatist fringe group, and the proactive re-naming of Whychus Creek - and the progress in granting the CTWS water rights at the PRB Project, it is vital that Native American interests are recognized as a means of basic rights recognition by the communities of the Deschutes River Basin, and as a source of expert knowledge in local ecosystem health, design, and services. In the past, though scientific research has repeatedly proven a catalyst for constructive water use solutions in Jefferson County, coordination across the Deschutes River Basin is lacking. Remedying the imbalance of historical and literal power and resolving water use issues in Jefferson County will require an unprecedented level of cooperation and trust across the area of study. Economic, political, social and cultural interests must be heard and acted upon across the Deschutes River Basin instead of being segregated and concentrated, exactly as the Four Worlds Framework would suggest.

CHAPTER VII

RECENT DEVELOPMENTS

Since the end of the case study, there have been several developments – positive and negative – that implicate the same patterns of conflict described in the section above and relate to the recommendations enclosed in the proceeding section. This overview will describe projects in the City of Prineville - just south of where the Crooked River enters Jefferson County, new legislation that has created massive opportunities for Oregonian water users, and how Jefferson County has acted on this new legislation to meet local water use needs and concerns. Events, like in the Case Study Findings section, will be addressed south to north and earliest to latest. These events are not coded, per the Fesler (2007) used in the Events Database, as many of these issues are ongoing or significantly outside the case study parameters.

All the way back in 2004, the City of Prineville recognized the increased residential growth in the area had created the need to replace a $62 million water treatment plant, raising household utility charges by three-fold (*City of Prineville*, 2017). By 2008, Prineville had begun exploring other options and was able to acquire a $75,000 grant from the Economic Development Administration that allowed for several groundwater surveys and 2 wetland test plots (*City of Prineville*, 2017). In January of 2011, the City Council accepted a plan for a 120-acre wetland treatment complex – forecast to reduce household charges to their previous levels and slash treatment costs by almost 90% (*City of Prineville*, 2017). In 2012 Prineville was able to begin the design phase, thanks to regionally-sourced funds from the Oregon Watershed Enhancement Board and Pelton Fund contributing a combined $355,000, with project groundbreaking on April 22nd, 2016 (*City of Prineville*, 2017). Less than a year later, the project was complete; the entire complex is currently open to the public and demonstrates plainly the

power of community-organizing, inter-party facilitation, and ecosystem services. Stakeholders to the wetland complex include the US Department of Agriculture, the Infrastructure Finance Authority, ODEQ, CTWS and PGE, Oregon State Parks, the Prineville Kiwanis, and the East Cascade Audubon Society, with various local schools, USFW, and the NOAA serving as supporting partners (*City of Prineville*, 2017). The diverse interests parties on display hint at an incredibly successful water strategy negotiation that brought together local, state, and federal interests to benefit Prineville water users.

Within the bounds of Jefferson County, the development of the Habitat Conservation Plan (HCP) is a pivotal moment in the recent water conflict. Based largely on the body of research and activist science throughout the Deschutes River Basin, the HCP aimed to manage irrigation water, align conservation measures with agricultural water releases, and establish minimum flows throughout the greater watershed's riparian corridor (USFWS and Soens, n.d.). In Jefferson County this meant defined minimum flows and diversion rates for fish habitat protection, transfers of water rights for in-stream use, maintenance for fish screens, removal of man-made obstacles, and the establishment of a conservation fund for Whychus Creek (USFWS and Soens, n.d.). Adaptations of the same strategy were applied to the Crooked River, with flexible minimum flows for irrigation-based summer use and storage-based winter use (USFWS and Soens, n.d.). Near Cove Palisades along the Middle Deschutes only minimum flows were established for the storage season, and solutions remained undefined for the stretches of the Lower Deschutes below the PRB Project (USFWS and Soens, n.d.). The HCP, however, did bring a diverse group of researchers, government agencies, and irrigation districts together to develop actionable goals for the entire watershed. Following ODFW approval in 2020, and

National Marine Fisheries Service approval in 2021 (USFWS and Soens, n.d.), the HCP was given the go-ahead.

Additionally, on May 21, 2021, HB 2298 was signed into Oregon law – giving ODFW just one year to adopt rules and administer a program for authorizing voluntary environmental restoration weirs in Eastern Oregon's closed basins (Oregon State Legislature, 2021). This unprecedented move brought the Oregon Natural Desert Association (ONDA) and WaterWatch – two Jefferson County activist groups described in earlier sections of this paper – together with Oregon lawmakers to define ways that Oregon's rigid water rights could better serve its citizens. The legislation defines key terms, such as restoration weir, ancient flood plain, and incised or eroded stream: all terms that implicate local values on species diversity, healthy fish populations and streambed morphology (Oregon State Legislature, 2021). The passage of this legislature occurred simultaneously as a period of activity around water resource management in eastern Oregon, specifically linking the development of the Deschutes River Basin HCP and the creation of a new water management strategy – the 2022 Water Bank concept.

On July 1st, 2021, bad news arrived – the NUID Board called local farmers to the Jefferson County Fairgrounds to inform them of a 1.5% cap of daily water allotment deliveries for irrigated farmlands (Kruis, 2021). These water caps, designed to reduce water demand and help restore the storage capacity of Haystack Reservoir in enduring drought conditions, left local farmers without sufficient water flow to even use their irrigation systems (Kruis, 2021). In an incredible reflection of intersecting conflicts, one farmer sarcastically asked if the protected spotted frog felt their pain and another asked if the spotted frog could be "forfeit" (Kruis, 2021), demonstrating clearly how water resources can pull together and amplify conflicts across

watersheds – including the litigation and law enforcement implications for rejecting legal protections of native species.

The situation was so bad for the NUID that it resorted to buying water from the Deschutes Valley Water District and looked at purchasing more from the City of Prineville, even as the COID committed to sharing water with Jefferson County (Kruis, 2021). Nevertheless, local farmers suffered. In December of 2021, Oregon legislation was forced to give $5.5 million to help alleviate the $4.75 million local users spent on irrigation; of which $3 million went to soil conservation, $2 million to irrigation modernization, and $1 million to drought resiliency – all in Jefferson County (Kruis, 2022a). While this may seem like a straight-forward solution, many local farmers still felt direct and negative impacts. More shocking, the entire water conflict during 2021 was linked to the development of the HCP in 2020 (USFWS and Soens, n.d.). Locals were quick to point out that while farmers were struggling to access their full water rights, the HCP was spilling 35,000 acre-feet of water from the irrigation systems to conserve spotted frog and bull trout habitat (Kruis, 2021). The water conflict therefore appears to be increasingly pitting economic, political, cultural and social interests against each other, despite attempts to adapt water use strategies to conservation and resiliency.

In 2022, events amplified further. The COID and NUID finally settled on a strategy for sharing water through a Water Bank, which allowed COID water users to lease their water for use in the North Unit (Kruis, 2022b). Though, at first glance, this appears to be a positive development for Jefferson County farmers, further investigation reveals that the Water Bank concept had caveats. Many of the prospective donors in the COID did not qualify, due to being connected to the wrong canals or adjacent to laterals where water donations would hurt neighbors, and many of the NUID beneficiaries did not qualify, due to limitations for agricultural

use and for users who had not used their full water right for 5 years in a row (Kruis, 2022b). Additionally, the Water Bank adopted an 'all-or-nothing' donation style that forced donors and recipients to use their full water rights and not portions thereof (Kruis, 2022b). In general, the Water Bank concept was geared towards helping the NUID meet the water demands of the Deschutes River Basin HCP (Kruis, 2022b), and not towards alleviating the economic pressure and pain on local Jefferson County farmers.

As the water demands from farmers, environmental restoration projects, and domestic uses amplified, a solution to the increasing water conflict was proposed: a water pumping station located in the heart of the PRB Project to decrease local water dependency on Wickiup Reservoir as part of the state's $1 million drought resiliency program (Kruis, 2022a). While this solution would assist local farmers immediately and directly, there are obvious concerns surrounding this proposal. Early critiques of the plan pointed out the repeated investment in expensive taxpayer-funded infrastructure for private benefit – the proposed pumping station is estimated to cost $400 million – and compared the plan's failure to address the core water resource issues to "re-arranging deck chairs on the Titanic" (Lind, 2021). Recent developments since the case study have amplified the examined water conflict, in spite of local collaboration and significant political and economic investments. The suggestion of a new pumping station amongst the existing PRB Project infrastructure should be interpreted as antithetical to the earlier observations around centralized dam infrastructure and the root of water conflict in Jefferson County. In the authors' opinion, such an investment would commit local water users to a more unstable future: complex and centralized infrastructure is fundamentally more vulnerable to drastic environmental conditions – the initial cause of water insecurity in Jefferson County.

CHAPTER VII

RECOMMENDATION

The recommendation portion of this paper relies heavily on conflict resolution theories indicating shared investment along riparian corridors and throughout watersheds by diverse communities as a path to equity and resource sharing. This section posits that the identification, restoration and development of various wetland types across Jefferson County could seriously alleviate the effects of the conflict over dam infrastructure, until a long-term alternative becomes available. As will be shown, the diverse ecosystem services of this recommendation have the potential to benefit water users across Jefferson County for extended periods of time with flexible, yet durable, water resource availability.

In selecting the spatial and temporal scope of this investigation, the author chose Jefferson County due to the transboundary nature of its water interests, the complexity of its watersheds' hydrology, and intersection of Native American interests with major waterways. The period of study was selected based on the limits of acceptable historical analysis, in which the author has expertise. Initially ignorant, the author had no knowledge of the history, complexity or burgeoning conflicts surrounding the PRB Project or water use in Jefferson County, despite having lived extensively in the Willamette Valley – where most hydroelectric users reside.

One important contribution of this work is to collaborative learning, specifically through the creation of a Frontispiece found in Appendix F, for the use of gaming and simulation in mediations with stakeholders. When interpreted alongside Appendix D, a collated Mind Map of conflicts across Jefferson County, both tools are the foundational tools for conducting water resource mediations on a local level. In analyzing the conflicts in Jefferson County, the central issue of the SWW Tower and PRB Project revolves around a well-documented relationship

described as ‘dueling experts’: experts, brought into conflicts by stakeholders who are missing information, become trapped in a cycle of conflict where they create their own opinions and dismiss other invited experts opinions (Moore & Jarvis, 2020). The dangers that stakeholder invitation of scientific fact into conflict situations pose to conflict entrenchment cannot be underestimated; “stakeholders will carry [a dueling expert] frame with them to future conflicts and expect them to play out in a similar way” (Moore & Jarvis, 2020, p. 39). This recommendation section focuses on building methods for local government to serve as the mediator between scientific research and water resource stakeholders, in order to circumvent this pattern of behavior without undermining stakeholder representation. The issue of dueling experts, ideas of collaborative learning, and gaming come together to form the core of scientific mediation: a form of mediation that “encourages stakeholders to worth with the information they have themselves” (Moore & Jarvis, 2020, p.49) to arrive at consensus within conflict parameters. Gaming and simulations “can be employed to allow stakeholders to gain insight and build relationships…by engaging in analogous conflict outside their role in the overarching conflict” (Moore & Jarvis, 2020, pg. 49). In other words, by playing games, stakeholders and mediators can step out of their entrenched or structured position to undertake collaborative learning, while simultaneously carrying out collaborative investigations of potential solutions. This work is intended to fully demonstrate the utility of combining gaming with conflict analysis in preparing for mediations – particularly where complex and peculiar intersections exist between watersheds, stakeholder interests, and conflict issues.

The inclusion of recommendations herein are central to this piece, due to the constructed and increasing water infrastructure in the PRB Project: its associated issues have already been shown to cascade to connecting waterways. Recent amplifications of the environmental conflict

issues impress the immediate need for conflict resolution recommendations, in the past and presently.

As will be shown, dynamic and detailed wetland management can significantly offset many of the direct issues cited by stakeholders at the heart of Jefferson County's most contentious water conflicts, and offer a full range of ecosystem services to the diverse interests and communities within the county boundaries. This section will attempt to address not only the interest of actors along the Deschutes River Basin, but also various levels of Max-Neef's (2005) notion of interdisciplinarity, including both pragmatic and empirical implications. This recommendation hinges upon the self-enhancing qualities and potential incentives provided by appropriate wetland types, calling upon key conditions and core motives for conflict as referenced by environmental conflict resolution (Van Vugt, 2009), as well as being fundamentally an action-stage and equity-interested concept: qualities espoused by a Four Worlds Framework (Wolf, 2008). The Recommendation Section is therefore reinforced by the body of conflict resolution work cited in the Methodologies Section, providing a continuity of framework and lens throughout.

To begin, the importance of carrying out proper scientific inquiry into environmental interactions across Jefferson County and encouraging research in water dynamics and ecosystem health within riparian corridors cannot be overstated. This would require the use of an officially designated, protected and measured boundary space which can enable scientific facts as seen in the Metolius River and Whychus Creek, to act as a catalyst for information-sharing in environmental conflict resolution across Jefferson County watersheds. Westing (1998) calls this space a 'transfrontier reserve', a concept explored in depth later in this section. Excellent examples of interdisciplinary research from Oregon includes scientific and academic articles

about similar regions' relationship with water, and the complex interaction between cattle husbandry and spawning spring chinook salmon (Ballard & Krueger, 2005). The primary purpose of encouraging scientific research and inquiry is not for its purely generative quality in the area, but also for its necessitated role in identifying management areas. Riparian zone and conflict resolution experts published a paper in 2013, offering a method for delineating management zones through aerial spatial and spectral information (Cohen et. al., 2013). More directly, scientific interests in retaining the dynamic river morphology of the Middle Deschutes could be addressed through proposed wetland restoration and riparian protections, building an incentive for researchers in the area. Riparian vegetation, such as sedges, shrubs and wetland trees, has been identified as significant in meandering river morphodynamics (Perucca, Camporeale & Ridolfi, 2007). – the direct element at threat by the Pelton Round Butte Project. In a study of 53 rivers' stream temperature in the Pacific Northwest, findings proved that complex and parabolic thermal profiles along inland rivers – where downstream cooling was influenced local by cool water inputs – indicates diverse thermal habitats that may promote resilience of aquatic biota to climate change (Fullerton et. al., 2015). This means that complex wetland development and restoration could reinforce aquatic species' resilience through cool water inputs along the watershed. This is crucial in addressing the demands of scientists and activists for solutions to damage done to biotic species' diversity in Jefferson County by the PRB Project. Riparian wetlands have also been shown to improve plant species richness (Pollock, Naiman & Hanley, 1998). In either case, science-based wetland identification must be encouraged and pursued to provide the full ecosystem service benefits of wetlands and healthy riparian corridors, and a better picture of river morphology and regional hydrologic complexity for all users.

In 2013, Jefferson County published its Comprehensive Plan – a lengthy document detailing the intent and goals of the County for the future. While significant effort was contributed to valuing the forest industry in the Comprehensive Plan, the County admitted to not conducting an inventory of wetlands and relying on National Wetland Inventory maps (Jefferson County Board of Commissioners, 2013). The Plan recognized the impasse that water-rights legislation puts on obtaining water rights for users and pointed out that only the Oregon Water Resources Commission could issue a ruling classifying an area for critical groundwater protection (Jefferson County Board of Commissioners, 2013). The jurisdictional divides and lack of locally available data can be interpreted as another level of conflict, in which local, state and federal political interest compete over natural resource management. It is important that this political conflict is openly and clearly addressed in order to regional progress, regardless of the ultimate resolution strategy adopted. Jefferson County stated clearly in its Comprehensive Plan that areas adjacent to rivers, streams, and lakes should be protected through the establishment of a riparian corridor boundary which requires development to meet set back from the water body and maintain riparian vegetation (Jefferson County Board of Commissioners, 2013). Additionally, the Plan acknowledged that on-site stormwater runoff detention is an important method of sustaining water quality by preventing sediments and pollutants from reaching waterways (Jefferson County Board of Commissioners, 2013). The County Comprehensive Plan concluded that, to preserve the flood-carrying capacity of stream channels and prevent damaging increases in flood heights, development in the 100-year floodway should be prohibited or strictly regulated (Jefferson County Board of Commissioners, 2013). Though these protections offer a solution, they fail to deliver a method for diverse actors to retain water access and water use in spite of changing environmental conditions. Moreover, the County emphasizes that most of the

riparian corridor is under State or Federal oversight. However, a cross-party, mutually-beneficial, wetland and riparian corridor development project would provide Jefferson County with a jointly-managed, transfrontier reserve that would also implicate State and Federal interests. An academic article on conflict prevention in *Environmental Conservation* provides an appropriate summation for political interests in the recommendation:

> The political raison d'être of any jointly-managed, transfrontier reserve is its value for conflict prevention and confidence building. Its potential in these regards would be enriching if the instrument that established the transfrontier reserve included comprehensive mechanisms, not merely for the exchange of information, but also for joint action in pertinent training, education, research, eco-tourism, policing, governance, support of local cultural values, and similar cross-border environmental and social opportunities and problems… (Westing, 1998)

Wetland and riparian corridor development would also address political and social concerns over adjacent and intersecting resource management conflicts. In a groundbreaking study of Native American land practices, it was found that riparian and adjacent forestlands were burned synchronously as a low-intensity method of ecosystem regeneration and carbon management during dry periods (Harley et. al., 2020). This unique feature of Oregonian wetlands and riparian corridors as a tool for fire management strategies is a key feature of this recommendation - it fully integrates developing ecosystem- and regional-level concerns. The practice of synchronously burning is mutually beneficial to wetlands and forested areas alike, while varying the landscape morphology, encouraging game populations, and improving species' diversity. This is an excellent opportunity to re-iterate an earlier point: that scientific involvement in management identification, state and local political interest – and economic, timber industry interests – could benefit from using technology, sourced from Oregon, to identify downstream impacts in Jefferson County (Grant & Pacific Northwest Research Station, 1988) in another opportunity to cross-connect diverse interests in the same water resources. Academic

researchers studying the Willamette Valley identified that the most extensive wetland type was wetland prairie which functioned as fall and winter habitat for waterbirds, but only while native Kalapuyans managed the region with fire (Taft & Haig, 2003). In combining disciplines, interests and stakeholders concerned with fire management, the potential to grow Jefferson County's bird-watching and eco-tourism economies is revealed as an incentive for intersecting users to invest in the same wetlands. Most importantly, by advocating County, state, and federal bodies adopt historically-grounded, science-based Native American integrated land, water and fire management strategies, this recommendation embraces the unique ahistorical and unprecedented nature of such an undertaking.

While fire is a current and developing concern, there are also serious implications for the emergent threat of extreme weather events and water scarcity in Eastern Oregon (Dwire, Mellmann-Brown & Gurrieri, 2018). Emergency management concerns and political interests are implicated: in 2013, when Jefferson County and the University of Oregon's Community Service Center reviewed natural hazards, they identified drought as salient - a threat that the state-level Oregon Natural Hazards Mitigation Plan failed to provide ratings for previously when its own assessment was carried out (University of Oregon Community Service Center, 2013). The same Jefferson County review also recorded the history of Emergency Declarations. The increasing frequency of the four reported Jefferson County floods in 1964, 1996, 2004 and 2006 demonstrate local watershed destabilization, and the report went on to identify the specific types of flooding that are a danger within Jefferson County: riverine, flash, shallow area, urban, and snow-melt (University of Oregon Community Service Center, 2013). Another form of flooding in Jefferson County is 'sheet flooding', which can cause water depths of from one to three inches over much of the flat or concave surfaces of the Metolius River Basin (Perucca, Camporeale &

Ridolfi, 2007). The identification of these threats highlights the importance of developing local and regional sources of information and research about the Deschutes River Basin. This recommendation's core theme of wetland and riparian corridor identification, restoration and development addresses flooding concerns: studies from across the United States have shown that wetlands – particularly when interconnected to large river basins – can significantly reduce the effects of flooding through ecosystem services (Acreman and Holden, 2013). In other words, as wetlands are increasingly dynamically-connected and made detail-complex, they become much better at meeting flood demands on the entire watershed- level. Flooding itself is a significant threat to political, social, and economic interests in Jefferson County, unless those interests reflect the diversity and intersectionality of their riparian investments.

Historically, Eastern Oregon has been susceptible to droughts. In 1977, a crippling drought hit ranchers in the Middle Deschutes watershed that forced them to travel over 70,000 miles and spend 14,000 labor hours procuring an extra 5.4 million gallons for livestock supply (Holst and Schmisseur, 1979). This event illustrates the vulnerability of the Main Canal connecting the COID and NUID irrigation systems, built during the 1940s and 50s. While wetland areas serve as an obvious store of water during dry periods, they also serve a large role in this context: equalizing hazard exposure horizontally. Conflict resolution literature cites that while inequality may reinforce intra-ethnic ties and out-group suspicion, equal hazard exposure may create a sense of unity among diverse victims in their collective struggle to cope with harsh environmental conditions (De Juan & Hänze, 2021). The literature's findings indicate that if droughts increase the risk of violent conflict, they seem to do so through mechanisms other than intergroup polarizations and despite their positive association with ethnic trust. This is most likely the case in contexts where there is pronounced horizontal inequality of drought hazards

(De Juan & Hänze, 2021). By expanding the mechanisms for water use and rights beyond the PRB Project through riparian developments, this recommendation seeks to alleviate inequalities in environmental pressures across the landscape – further de-escalating natural resource conflict in Jefferson County, and moving the local discussion and solution-generation away from built and immovable infrastructure.

Wetland development in the Jefferson County area could not only assist in alleviating agricultural, economic, and cultural concerns of drought or flooding but actively remove a commonly-known side-effect of agricultural process on the landscape: nitrate run-off in adjacent watersheds (Hansen et. al., 2018). After an engineered levee breach reconnected Upper Klamath Lake and Agency Lake just to the south of Jefferson County, scientists went about quantifying organic material remineralization in the new wetlands after hydrologic reconnection. They found that the reconnected wetlands served as a source for both macronutrients (dissolved organic carbon [DOC]), soluble reactive phosphorus [SRP], and ammonia) and micronutrients (dissolved iron and manganese) (Kuwabara et. al., 2012). These are just a few of the myriad ecosystem services that wetlands and healthy riparian corridors can deliver agricultural interests. Innovative, sustainable agriculture techniques are further encouraged through the communal development of water storage in the landscape, allowing for more affordable keyline irrigation system installation. Beyond purely economic or political concerns, this recommendation also seeks to acknowledge cultural and social interests.

Fishing concerns over the impacts to salmon populations across Lake Billy Chinook and Lake Simtustus could be alleviated through wetland and riparian restoration which recently has been shown to offset climate change impacts to salmon populations (Justice et. al., 2017). By

directly developing fish habitat in riparian and wetland areas along waterways, the concentration of fishery infrastructure could be further unlinked from the PRB Project.

Interestingly, birding and recreational shooting interests could be recognized and met as well. In newly restored urban riparian areas in Oregon, non-breeding birds were found to have significant migratory connections (Rockwell et. al., 2020), further encouraging the developing of habitat area and therefore species' diversity across rural, residential and urban communities. Areas such as Warm Springs, Madras and Crooked River Ranch would be ideal for such urban or residential riparian development. In a research study of historical wetlands in the Willamette Valley, three types of Oregonian wetland were identified as year-round habitats for non-breeding waterbirds: emergent, riverine, and wetland prairie (Taft and Haig, 2003). Recent research findings show wetland developments in Oregon to have short response time in creating riparian vegetation and bird communities (Stephens, 2017). The Deschutes River Basin has a developed trail network to access the riparian corridor; federal interests recognize the environmental, economic, social health and sustainability interest in trails development along the river system, and the necessitated engagement of the local community and its partners (*The Nugget*, 2015). It should be noted here that conflict resolution experts specifically warn against eco-tourism interests in transboundary areas' conservation and sustainable development:

> Building sustainable peace, in contrast to neoliberal peace, also requires a different economic approach to transboundary conservation…ecotourism is alarming as it proliferates in transboundary protected areas. The critic finds that ecotourism commodifies nature and justifies the privatization of the natural world as human property under the name of conservation and sustainable development. (Hwang, 2021)

The concept of community involvement is key to succeeding at resolving natural resource conflict in Jefferson County, and it should be noted that residential and urban wetlands can foster

eco-tourism benefits for communities directly without infringing on transboundary reserves. Thankfully, practically every community in Jefferson County intersects with potential wetland areas. Even the glacial geology of the Camp Sherman and the Metolius River Basin areas were identified in 2013 as providing partial barriers to the eastward flow of unconfined groundwater between lava flows which causes much of the groundwater to rise, resulting in numerous springs and a high water table which limits the ability to support septic drainfields (Jefferson County Board of Commissioners, 2013) - but ideal terrain for wetland development and ecosystem service investment.

Community development and inclusion is essential in producing any real solution for issues which directly implicates local interests. One example of a functioning community-invested funding scheme are the Deschutes Land Trusts, which aided in restoring the Metolius River and its ACSC. Another scheme Jefferson County could also use is based on regionally-sourced research advocating for a public market for ecosystems development, in exchange for emergent riparian zone as payment (Guillozet, 2015). Concerns of homeowners and local government over land values could also be resolved through wetland development using a similar marketplace. Both avenues for developing incentives could bring diverse interests together, overseen and facilitated by Jefferson County. Studies from 2001 in Oregon show that riparian protections increase residential property values while simultaneously enabling growth in salmon populations and watershed restoration (Mooney and Eisgruber, 2001). For ranching homeowners in Jefferson County, wetland restoration could provide the same hydrological services and benefits: scientific studies have demonstrated that geographically isolated wetlands – that is, those potential wetlands in the boundary areas of agricultural land east the Crooked River – are in fact a crucial part of the hydrological landscape (Rains et. al., 2016), and thus

could have potential rights to those services and benefits of any given wetland restoration in related watersheds. There is already a significant body of literature from Oregon which directly evaluates landowner and Oregon forest landowner concerns about ecosystem services development – specifically in riparian buffer zones (Kooistra et. al., 2018)(Rosenberg et. al., 2016) from which parties could draw expertise. It should be noted that analysis of Oregon's adoption of the Integrated Water Resources Strategy in 2017 reveals that Oregonians responded reflexively and resiliently to changing conditions by adopting a locally-driven, entrepreneurial approach to governance (Watson, Shrubsole & Mitchell, 2019), which merits serious consideration in this recommendation. It should be noted that these are regional-level management decision; there is still a significant lack of watershed- or benefit-level agreements to act upon.

It is vital to note that experts in the fields of architecture and energy analysis have discovered key relationships between hydroelectric power and trends in natural behaviour. One key term that is often utilized in the field of energy analysis is 'emergy' - the available energy of a particular type that is used directly and indirectly to produce a product or provide a service (Odum and Odum, 2006, p. 22). Emergy, originally a systems ecology concept, has been demonstrated as an effective measure of ecosystem service for a wide range of natural and human systems; energy analysts are also quick to point out the longer-term historical trends of growth, stagnation and decline that affect every energy system. Such findings are key to understanding the role and relationship of hydroelectric power in Jefferson County: the unused resource of the Deschutes's water-power is made available for development by a combination of new technologies, government interests, and laws which maximized competitive capitalism and growth (Willingham and USACE, 1987). Water-power, in this case, refers to the stored energy

that is required for gravity to effect water – flowing from its highest it lowest point – in its journey down a given slope. Though originally aimed at profit maximization, the impacts of dam infrastructure on complex water systems are increasing, in turn causing efficiency to become the community priority which allows laws and policy to target luxury and waste within the energy system (Odum and Odum, 2006 p. 29). The amplifying conflicts about the SWW Tower and proposed PRB Project infrastructure demonstrate community clashing with 'luxury' in the form of concentrated and expensive structures along the riparian corridor. The 'waste' products of the PRB Project – ecologically speaking, this means water turbidity, and streambed morphological changes – have also been the inflection points of increasing water resource conflicts.

Interestingly, this energy analysis provides the same argument contained in this Recommendations Section: renewable resources as a viable energy source are possible only with longer-term investments than prescribed by our current economy, and the development of wetlands can effectively filter large amounts of water and provide stores for significant amounts of usable energy for long-term use (Odum and Odum, 2006, p. 27). It is worth investigating this position of energy analysis further, specifically in terms of its applicability to watershed-level conflict. In the case of Jefferson County, the physical force of river systems is valued and collected as electricity. Unfortunately, this energy collection incentivizes the concentration of streamflow, the homogenization of stream morphology, and an increasing feedback loop of built interventions to offset ecosystem effects. It is self-evident that interconnected and diverse riparian zones offset these negative impacts of energy collection, while divesting from the central stream and concentrated flow which hydroelectric infrastructure requires. Through a recognition of the fundamental energy interests in the landscape, wetland development can be clarified as a balancing solution to existing issues around dam infrastructure.

For example, the development of impounded wetlands along the Crooked and Middle Deschutes Rivers that are fed by and feed directly into the riparian corridor could be used as a store of organic energy and water for agriculture use. Turbidity and water temperature would be positively affected, due to the unique ecosystem services of wetlands, which would provide value to hydroelectric interests while avoiding a form of taxation or limitation on water resources for energy production. Emergent wetlands across the eastern reaches of Jefferson County could deliver the same services for agricultural interests as impounded wetlands, but help prevent the loss of seasonal grazing land while providing durable and diverse habitats for vital species in Jefferson County: the spotted frog, pronghorn deer and migratory waterfowl. Wetland development, in this case, would not serve as a drain to the water resources in Jefferson County. Instead, surplus water would be stored in wetlands for alternative uses to energy production - separating the compounded and conflicting interests that are concentrated around the Pelton Round Butte Project. A water reserve and store that is kept within these local wetlands could be directly used by irrigation farmers and ranchers, while providing significant habitat value to local fisherman and allow for the further development of eco-tourism, birding and hunting interests. The development of wetlands along the riparian corridors of Jefferson County, therefore, would follow the advice of energy analysts: anticipate and prevent a reduction in available natural resources for hydroelectric power, while diversifying the uses of 'emergy' across the landscape.

One solution that has been critiqued in this investigation is the reduction or removal of dam infrastructure. Energy analysts posit that measures to limit unnecessary horsepower stimulate the economy, whereas outright taxation or limitation on a useful resource forces the energy system to decrease its resource base - further affecting the use and misuse of energy in the landscape (Odum and Odum, 2006, p. 25). The same authors warn that the full development

of hydroelectric power reduces the food potential of salmon and migratory fisheries during a period of increasing overpopulation and protein-based food shortages, but balanced this observation with the recognition that watershed evaluations found greater community empowerment through a river systems' hydroelectric potential than through its salmon runs (Odum and Odum, 2006, p. 28). Energy analyses such as these reflect the interests and values of diverse parties involved in water resource management in Jefferson County, specifically the competing economic interests of hydroelectric power and the cultural values surrounding robust fish populations.

Finally, it is important to acknowledge the true potential of Jefferson County. Energy analysts, in looking towards the future, identify mountainous regions with access to hydroelectric power as the centers of civilization (Odum and Odum, 2006, p. 28). The high net emergy contribution of water resources in such environments ensures that energy will be durable and available for human use (Odum and Odum, 2006, p. 28), so long as natural systems are responsibly governed. While Jefferson County today exports most of its energy production for use in the Willamette Valley, it is entirely plausible that the power-imbalance between the two regions can flip as energy resources become more unstable in the coming years. It is vital that the energy production at the foothills of mountain ranges is adapted to sustain the maximum interests and values of local parties, and avoids structural frameworks that could enable increasing conflict in these areas. The development of wetlands across Jefferson County has the potential to include such diverse interests and values, while decentralizing parties' active use away from the Pelton Round Butte Project.

One of the primary points of this paper is to link conflict resolution theory with scientific perspectives. The recommendation above recognizes both socio-historical and environmental

realities, while synthesizing various concepts such as community equity and peacebuilding with natural and artificial energy processes and resource balancing. This recommendation also implicates key concepts of riparian conflict resolution and negotiation such as sharing boundary riparian zones as a means of interparty right-needs recognition, though does not use these concepts as foundational or methodological frameworks. Max-Neef's (2005) concept of an Included Middle is encompassed in the recommendation: a third element (T) proves non-contradiction between (A) and (non-A), where T is the recommendation, and A and non-A the positions, interests and values in competition over resources (Max-Neef, 2005). The Third Law of Transdisciplinarity is also used: only because of what is not there, is it possible there is what there is. Only because of what is there, is it possible that there is not what is not there (Max-Neef, 2005). Solutions, in other words, often occur on a scale or level not available to entrenched or structured perspectives about a given environmental conflict. Van Vugt's (2009) work has its influence too: the four key conditions of successful management of shared environmental resources – information, identity, institution, and incentives – have all been addressed in this section (Van Vugt, 2009). The scientific interests described herein reflect Daniels & Walker's (2012) own recommendation that the future role of scientists will involve the management of crucial uncertainties and the assurance of the quality of scientific information provided for policy decisions (Daniels & Walker, 2012). This work has discussed how regional- or locally-sourced scientific information has helped reinforce identity in Jefferson County. It is another core theme of this paper's analysis that there is a significant centralization of resources and interests at the PRB Project which has fueled conflict via litigation. The recommendation section has outlined riparian development could deliver significant services and value away from this center. The importance of resolving the natural resource conflict caused by the Pelton Round Butte Project

cannot be stressed enough, especially in the face of new studies showing the amplifying effect of energy resources on shared river basin conflicts (Lee & Mitchell, 2019). The recommendation section has also addressed the possibility for adjoining artificial wetlands along the NUID, which could cool the Main Canals' 'riparian corridor', and aid institutions deliver incentives and water rights more efficiently.

By addressing the affects of water conflict amplification, especially in the face of recent developments, the recommendation section attempts to assist in regulating the trends analyzed in the Appendices section. By including all available parties, the same recommendation attempts to avoid the missteps made in agreement-making during the period of study. At its core, the recommendation is based on transdisciplinary theory, and supported by the careful analysis of coded events. It is not the intent of the author to deliver a solution, but instead to point to attention of conflict resolution practitioners and community members towards an area of development that will provide water value and de-escalate water conflict.

CHAPTER VIII

CONCLUSION

Jefferson County, between 2011 and 2016, is an excellent case study of emergent water resource and environmental conflict. Three major waterways – the Middle Deschutes, Crooked, and Metolius Rivers – have been examined through a Four Worlds Framework, reinforced by transdisciplinary sources and theories. Tributary creeks and adjacent interests have been identified, and waterway developments have been subjected to thorough analysis. The role of the Pelton Round Butte Dam Project – specifically the SWW Tower – in water conflict in Jefferson County has been demonstrated as clearly focal. Similar conflicts across the watershed have been addressed and shown to be linked to this central conflict. Through a synthesis of environmental conflict resolution theories and pertinent environmental science research, a recommendation has been posited for resolving the conflict. Wetland and riparian corridor development would provide communities in Jefferson the ability to re-negotiate land and water management strategies, insulate local citizens and their environment from the effects of climate change, and provide a means of resilient resource availability and platform to self-mediate moving forward. It is an ambitious proposition yet should be considered with all seriousness. While the environmental conflict may have been emergent during the period in question, there is no doubt that it will amplify if unremedied.

APPENDICES

APPENDIX A – EVENTS DATABASE

Author, *Publisher*	Report Date	Watershed	Event Issues, Key Terms	Interests	Intensity
Terry Richard, *The Oregonian*	2013a	Middle Deschutes River	trail development, eco-tourism	recreational, social, economic	3
The Federal Register	2013	Middle Deschutes River	reintroduction, ruling	fishing, cultural, political	0
Terry Richard, *The Oregonian*	2014a	Middle Deschutes River	riparian corridor, restoration, proposal	grassroots organization, ONDA, scientific	1
Oregon Natural Desert Organization, *ONDA.org*	2014	Middle Deschutes River	monitoring, agreement	grassroots organization, ONDA, political, scientific	4
Joseph Ditzler, *The Statesman-Journal*	2016	Middle Deschutes River	endangered species, riparian corridor, restoration, legal action	agriculture, economic, political	-4
Abbie Jossie, *Crooked River Ranch Fire Protection Act*	2016	Middle Deschutes River	boundary, legislation, criticism	fire prevention, political, economic	-1

Crooked River Ranch Fire Protection Act, 114th Cong.	2016	Middle Deschutes River	legislation, boundary	private property, social, political	4
Terry Richard, *The Oregonian*	2013a	Crooked River	boundary, trail development, eco-tourism	recreational, social, economic	3
Terry Richard, *The Oregonian*	2013b	Crooked River	boundary, mapping	information, political, social	1
Terry Richard, *The Oregonian*	2014b	Crooked River	trail development, eco-tourism	Crooked River Ranch, social, economic	3
Crooked River Collaborative Water Security and Jobs Act of 2014	2014	Crooked River	legislation, water security, water quality, jobs	water rights, economic, political	5
Holly Gill, *The Madras Pioneer*	2014	Crooked River	water quality, award	water rights, economic, political	2
The Bend Bulletin	2013	Whychus Creek*	restoration, award	Deschutes Land Trust, social, political, scientific	2
Bill Sullivan, *The Statesman-Journal*	2014	Whychus Creek	trail development, protection, riparian corridor	Deschutes Land Trust, recreation, social, political	4
Terry Richard, *The Oregonian*	2015	Whychus Creek	trail development, cattle-ranching	agriculture, economic, recreation, social	3
M.W. Hill, *Source Weekly*	2016	Whychus Creek*	restoration, riparian corridor	fishing, social, cultural, agriculture, economic, Deschutes Land Trust, scientific	3

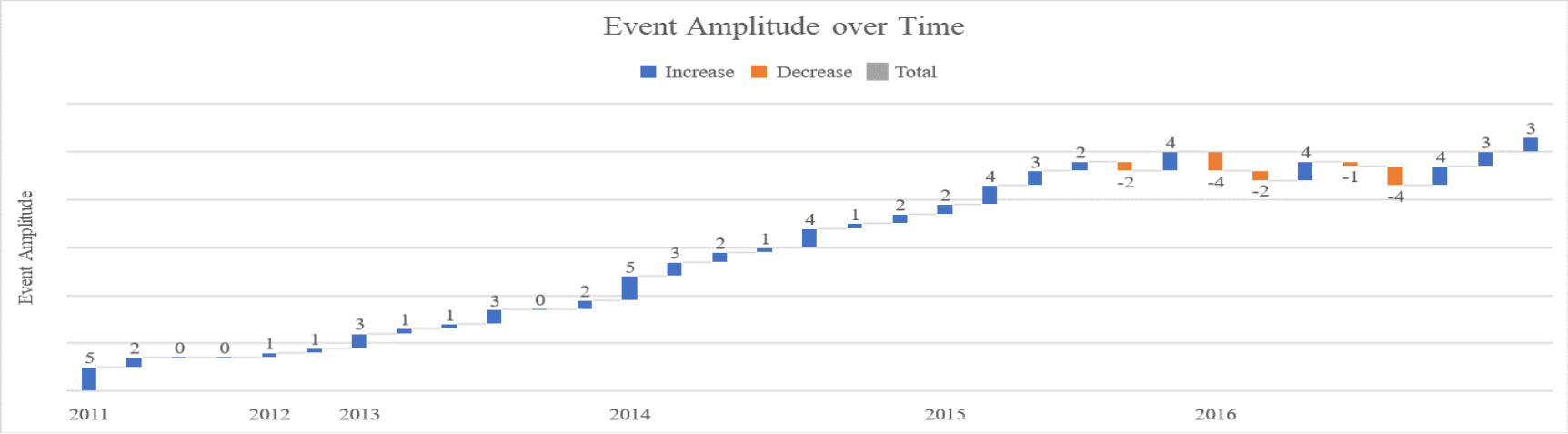
Shadler, *The Daily Evergreen*	2016	Whychus Creek*	restoration, riparian corridor, water systems	agriculture, economic, fishing, social, cultural	2
Hackett, *Portland State University*	2011	Metolius River	watershed interconnectivity, boundary, water quality	research, scientific	0
Harry Esteve, *The Oregonian*	2011	Metolius River	legislation, protection	Oregon Governor, political	5
Jennifer Margulis, *The New York Times*	2011	Metolius River	eco-tourism, trail development	recreational, urban interests, social, economic	1
John Shewey, *Birder's World*	2012	Metolius River	eco-tourism, riparian corridor	recreation, social	1
Rich Landers, *The Spokesman-Review*	2012	Metolius River	reintroduction	fishing, cultural, hatcheries, political, economic	1
Terry Richard, *The Daily News*	2013c	Metolius River	reintroduction, eco-tourism	fishing, social, cultural, hatcheries, political, economic, Deschutes Land Trust, recreational, social	2
Nicholas Geranios, *The Statesman-Journal*	2014	Metolius River	riparian corridor, mapping	fire prevention, Metolius Fire Project, economic, political, research, scientific	4
Ben Goldfarb, *High Country News*	2015	Metolius River	reintroduction, boundary	fishing, cultural, hatcheries, political	3
Ratliff, Hill and Schulz, *North American Journal of Fisheries Management*	2015	Metolius River	riparian corridor, dam infrastructure	fishing, cultural, energy production, economic	-2
Zach Urness, *The Statesman-Journal*	2015	Metolius River	water quality, clozsures	fishing, cultural	0

Amanda Preacher, *The Oregonian*	2016	Metolius River	water quality, warning, dam infrastructure	energy production, economic, grassroots organization, social, scientific	-2
Angela Neville, *Power*	2011	Pelton Round Butte Project	reintroduction, dam infrastructure	energy production, urban interests, economic, fishing, cultural	4
Hydropower Reform Coalition & River Management Society	2015	Pelton Round Butte Project	riparian corridor, restoration, dam infrastructure	fishing, cultural, grassroots organization, social, scientific	2
Amanda Preacher, *The Oregonian*	2016	Pelton Round Butte Project	water quality, water temperature, litigation, dam infrastructure	fishing, cultural, recreational, social, Deschutes River Alliance, grassroots organization, scientific, energy production, economic	-4
Hydropower Reform Coalition & River Management Society	2015	Lower Deschutes River	reintroduction, restoration, riparian corridor, dam infrastructure, proposal	fishing, cultural, energy production, economic, grassroots organization, scientific	-1
Confederated Tribes of Warm Springs, *Press Release*	2016	Lower Deschutes River	bio-fuel infrastructure, closure, riparian corridor	energy production, economic	-3

Table 4. Events Database listing the media sources and official publications referenced in the Findings Section as events across the Deschutes River Basin watershed over the period of study. These coded events are analyzed in Appendices B, C, and D.

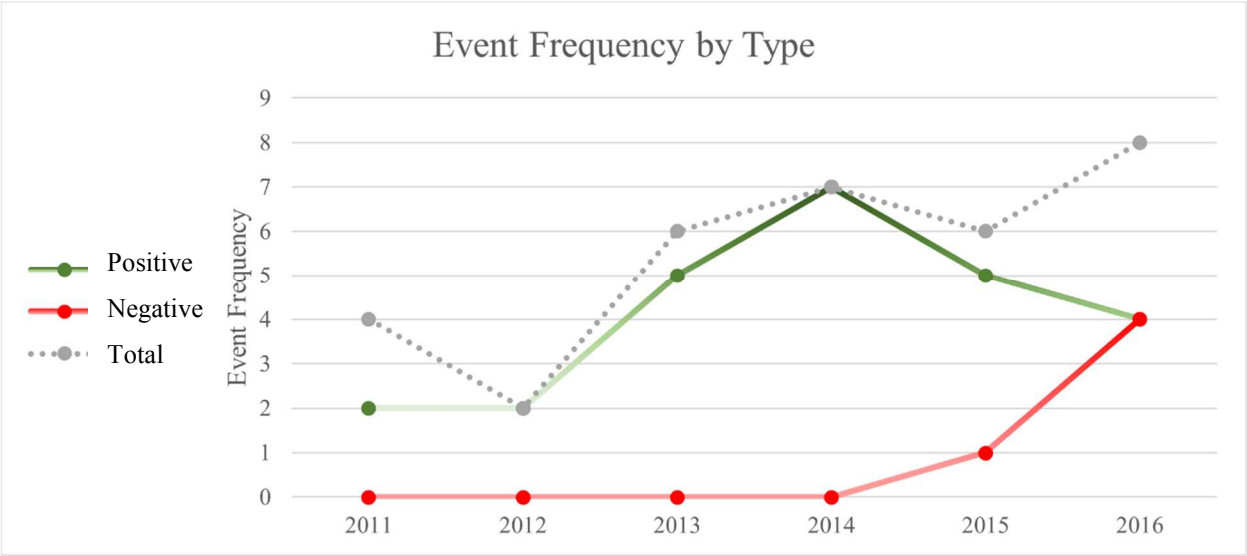
APPENDIX B – GRAPHS 1 & 2

Graph 1: Event intensity during the period of study. Note the peaks and troughs – a potential sign of selective agreements forged between aligned parties, not including all water users, during periods of intense water conflict.

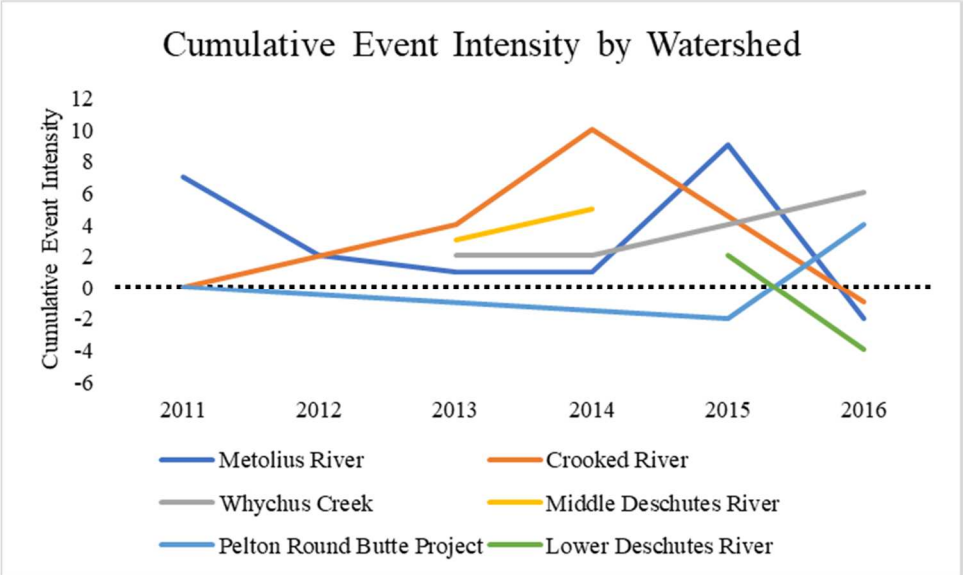


Graph 2: Event amplitude during the period of study. Note the plateaus early in the period of study, suggesting a loss of momentum along the path to productive agreement. Note also that these graphs do not differentiate between agreements made between partisan interest groupings and community-wide agreements.

APPENDIX C – GRAPHS 3 & 4



Graph 3: Positive, negative and total event frequency during the period of study. Note the cresting wave of positive events in 2014, and the upwards arc of both negative and overall events during 2016. These characteristics of coded events visually demonstrate failing agreements and amplifying conflict.



Graph 4: Cumulative intensity – that is, the annual average of recorded events – by watershed. Note the independence of developments along Whychus Creek; this graph includes transboundary events from Deschutes County from the Mind Map found in Appendix D. Note also that as the major waterways of Jefferson County slip into negative cumulative event values in 2016, only the PRB Project markedly increases its values.

APPENDIX D – MIND MAP

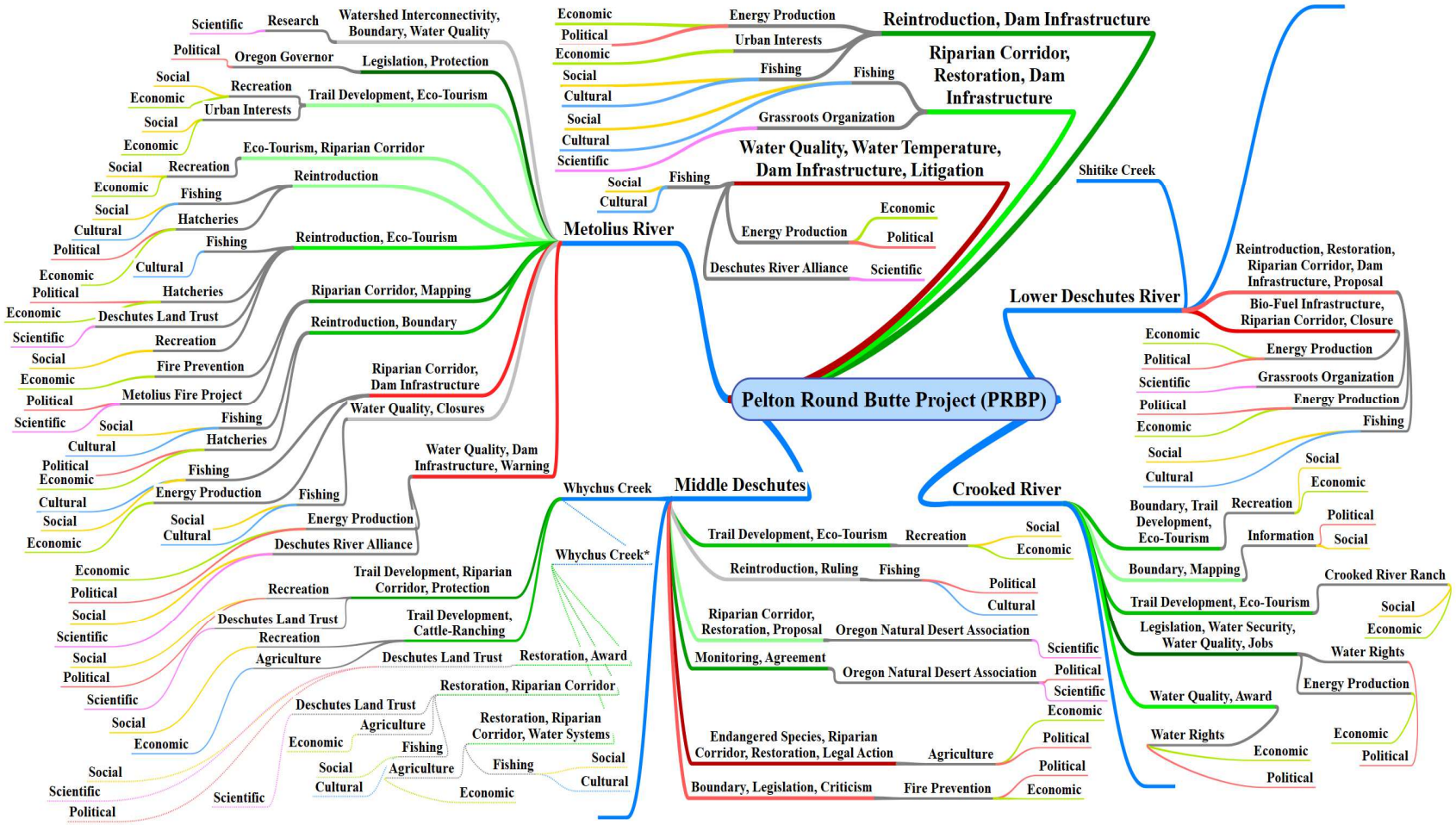


Figure 17. A Mind Map of water conflict occurring in Jefferson County: a Key to the Mind Map can be found in Appendix E. Color-coded links have been made between each identified conflict in the Events Database, based on its intensity (green is agreement, grey is neutral and red is conflict). Further links are then made between conflict interests and their classification as economic, political, et cetera. When gaming, this figure serves as both a game masters' key, or as a record of a historical game session. The image above was created using SimpleMind Pro v. 1.26.0.

APPENDIX E – MIND MAP KEY

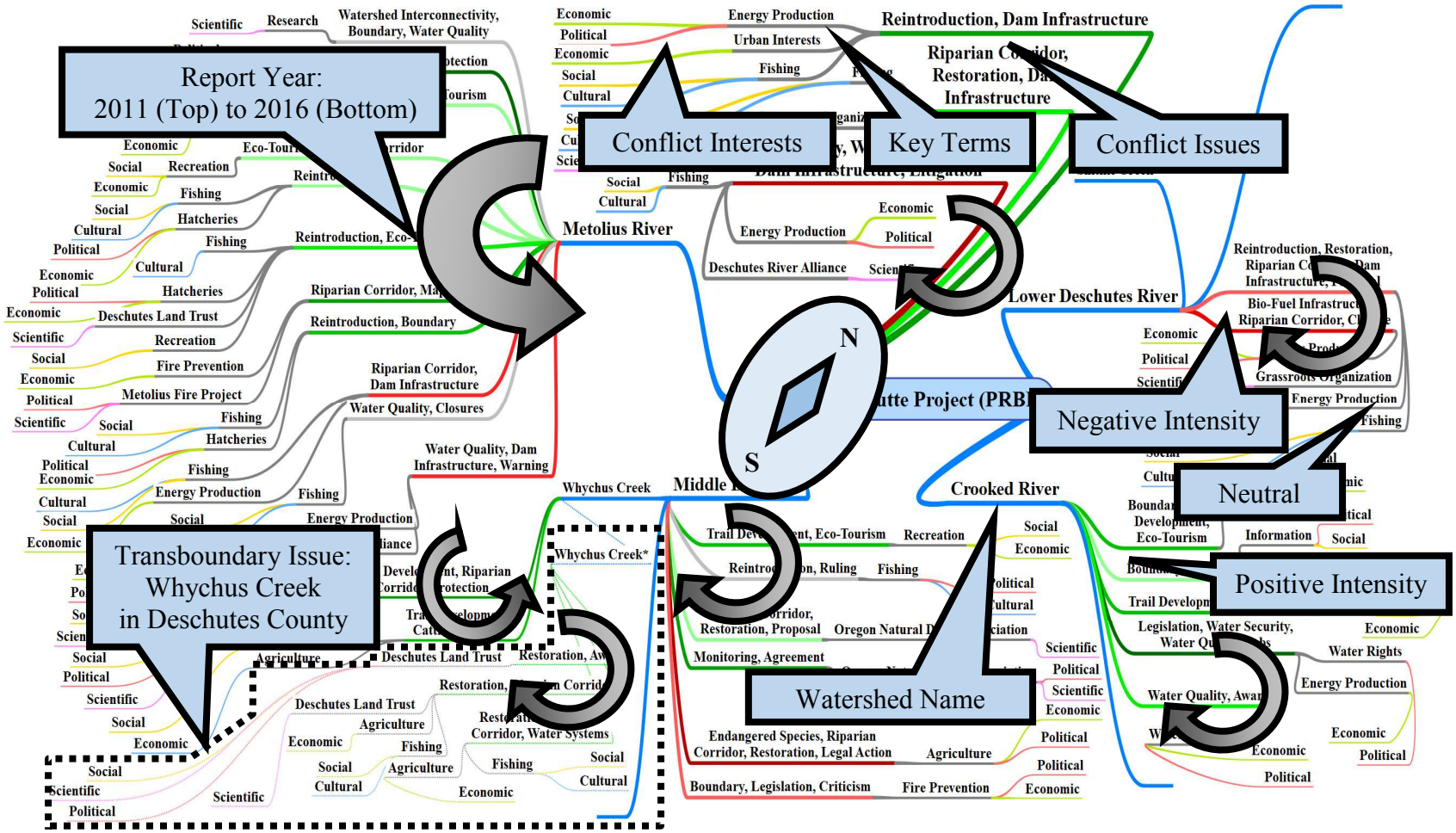


Figure 18: A Key to Appendix D. Events are organized top to bottom, either clockwise or counter-clockwise. The major watersheds examined in this paper are highlighted in blue and labelled with their names. The map function is intended to allow the viewer to easily make transdisciplinary connections across conflicts and agreements in a given river basin.

APPENDIX F – FRONTISPIECE

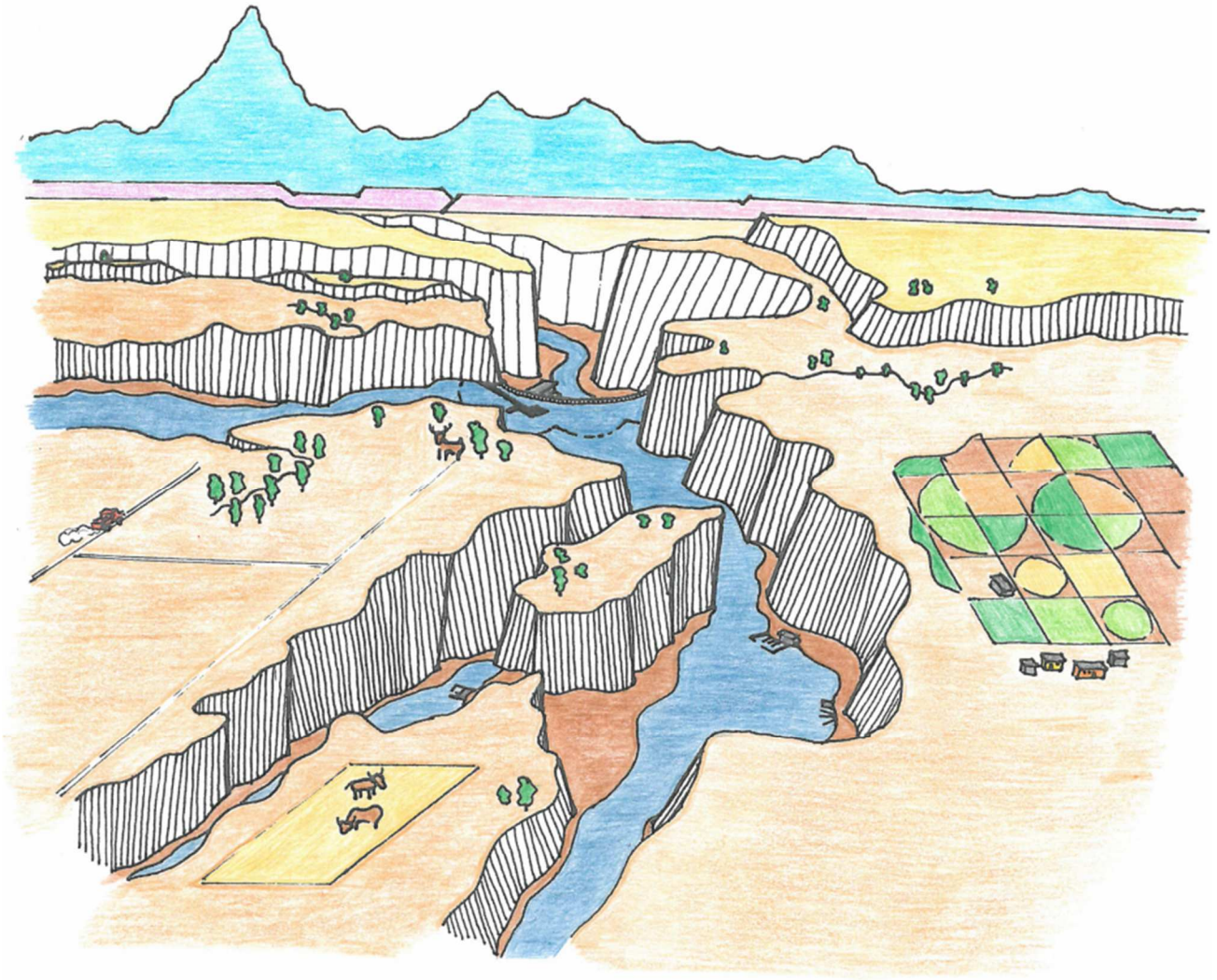


Figure 19: Frontispiece, a demonstration of the visualization of landscape and interests as a creative game-building exercise. Illustration by author, pen and pencil.

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