TRANSITIONING TO A NEW ERA IN WESTERN UNITED STATES WATER GOVERNANCE: EXAMINING SUSTAINABLE AND EQUITABLE WATER POLICY IN THE COLORADO RIVER BASIN

by

JOHN GORDON BERGGREN

B.A., Johns Hopkins University, 2007

M.H.S., Johns Hopkins Bloomberg School of Public Health, 2009

A thesis submitted to the

Faculty of the Graduate School of the

University of Colorado in partial fulfillment

of the requirement for the degree of

Doctor of Philosophy

Environmental Studies Program

2018

This dissertation entitled:
Transitioning to a New Era in Western United States Water Governance: Examining Sustainable and Equitable Water Policy in the Colorado River Basin
written by John Gordon Berggren
has been approved for the Environmental Studies Program

Committee Chair:

Doug Kenney, Ph.D.

Committee Co-Chair:

Lisa Dilling, Ph.D.

Committee Members:

Deserai Crow, Ph.D.

Tanya Heikkila, Ph.D.

Brad Udall, MBA

Date: 11 April 2018

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

IRB protocol # 16-0614

ABSTRACT

Berggren, John Gordon (Ph.D., Environmental Studies)

Transitioning to a New Era in Western United States Water Governance: Examining Sustainable and Equitable Water Policy in the Colorado River Basin

Thesis directed by Dr. Doug Kenney and Dr. Lisa Dilling

Water resources around the world face significant challenges in the 21st century. Ecological degradation, expanding populations and shifting demands, climate change, drought, and numerous other factors increasingly limit the ability of water managers to effectively govern these resources without adversely impacting users and ecosystems in disproportionate ways. Accordingly, water governance principles such as sustainability have emerged as possible guiding mechanisms for addressing these challenges and responding to diverse stakeholder needs. Equity is another principle that is often discussed as a component of sustainability, but it is also an important consideration in its own right. Therefore, this dissertation explores the literature on sustainable and equitable water policy, in conjunction with the adaptive capacity literature, using the Colorado River Basin as a case study. Specifically, it asks how criteria for sustainable and equitable water policy might improve decision-making processes in an era of increasing uncertainty regarding future supplies and demands.

Using a mixed-method approach, this project examines policies and decision-making processes in the Colorado River Basin. An initial literature review regarding sustainability and equity criteria in river-basin decision-making reveals that despite the development of diverse criteria, it remains difficult to implement and utilize these criteria in practice. Then, a systematic analysis of three contemporary Colorado River Basin policies demonstrates how existing institutions have evolved in response to changing biophysical conditions. Collaborative efforts have improved and specific

additional considerations, such as increasing flexibility and accepting uncertainty, are increasingly included in the decision-making process. Additional findings indicate that while stakeholder participation, decision-making transparency, and fairness are important considerations for improving adaptive capacity, maximizing the efficacy of these concepts requires a nuanced and in-depth understanding of their inter-related operation. These findings contribute to the understanding of not only why there must be limits to stakeholder participation and decision-making transparency, but perhaps more importantly, they demonstrate how to effectively consider these limits and institutionalize a fairer and more equitable process. Finally, findings indicate that mechanisms such as utilizing incrementalism, giving flexibility to specific individuals, and developing empathetic and proactive processes may support improved adaptive capacity and facilitate a more sustainable and equitable approach to river-basin management.

ACKNOWLEDGEMENTS

There is no possible way to adequately thank all the people that have helped and supported me throughout this dissertation process. Please forgive me, for I will certainly leave numerous people out. First and foremost, I would like to thank my advisor, mentor, critic, supporter, and good friend, Doug Kenney. Doug's support over the years has been unwavering, both academically and personally, and this dissertation would not have been possible without him. From day one, Doug's trust and faith in my success gave me the confidence to take on this large project, and not to mention the countless number of Colorado River meetings (both formal and informal) he got me in the room for. Thank you, Doug. Similarly, this would not have been possible without my co-advisor and other mentor, critic, supporter, and good friend, Lisa Dilling. I do not think I have met another professor as supportive, encouraging, thoughtful, and engaging with her students and their research than Lisa. Lisa has always been there for me and provided me countless opportunities for research, funding, and other scholarship. During the (many) stumbling blocks during this whole process, Lisa was always available for a chat to offer words of advice and encouragement. Thank you, Lisa. Further, I am deeply indebted to the rest of my dissertation committee. Deserai Crow, Tanya Heikkila, and Brad Udall have been so incredibly inspiring to me personally, not to mention the influence and respect they have in each of their respective fields and careers. I felt truly honored that they accepted my request to be a part of this project, and that I received their support along the way. These three round out what I would consider to be a total all-star committee. Thank you Deserai, Tanya, and Brad.

For just about my entire time here at CU, I have been involved with the Western Water Assessment team, either by receiving funding and research support, through collaboration, or in running workshops. The experience gained working with such an incredible group of people has been indispensable. Not only is this group comprised of a bunch of top-notch researchers, communicators, scientists, engineers, policy experts, and integrative specialists, but they are some of the most genuine, engaged, and active people I have known. Specifically, I would like to thank Jeff Lukas (weather nerd extraordinaire), Eric Gordon, Lisa Dilling, Ursula Rick, Kristyn Averyt, Jen Henderson, Benét Duncan, Bill Travis, Adam Mccurdy, Katie Clifford (office planks for life), Becca Page, Seth Arens, Ben Livneh, Jeff Deems, Noah Molotch, Rebecca Smith, Balaji Rajagopalan and Bets McNie for allowing me to be a part of the team and for being so inspiring. Thank you.

Similarly, I must thank the Center for Science and Technology Policy Research community for always being so welcoming and supportive. My desk for several years was in what was known as the "bull pen", and I cannot count the number of stimulating and helpful conversations I had as people passed through. The CSTPR team truly fosters an interdisciplinary and engaging research environment. Thank you Max Boykoff, Roger Pielke Jr., Bets McNie, Ami Nacu-Schmidt, Bill Travis, Robin Moser, Bobbie Klein, and our friend from across the pond, Sam Tang, among many others. My gratitude also goes out to the CIRES community more broadly, for not only providing financial support, but also allowing me to be a part of so many interesting projects. The folks at CIRES Education and Outreach—Erin Leckey, Lesley Smith, Anne

Gold, and David Oonk—are the best at what they do, so thank you for letting me join the Lens on Climate Change, Tribe's Eye, and Backcountry Limnology projects.

I must also thank the Environmental Studies Program community for bringing together some of the smartest, nicest, and hardest-working faculty and staff I have come to know. I always felt lucky in my PhD program because the faculty and staff were not only truly inspiring and well-respected, but every single person was always available whenever I needed their advice or input. Further, the many professors for whom I worked as a Teaching Assistant have taught me numerous pedagogical lessons which I will always remember. I have heard people say that the one thing they do not teach you in grad school is how to teach—I found this not to be the case. Specifically, I must thank Penny Bates (sorry for all the annoying emails), Carol Wessman, Lisa Dilling, Sarah Rogers, Max Boykoff, Krister Andersson, Ben Hale, Jill Litt, Sam Fitch, Jason Neff, Roger Pielke Jr., Alan Townsend, and Jim White.

Perhaps the most significant part of this dissertation process for me was the incredible network of water nerds, practitioners, and scholars that I have come to know over the years. It never ceased to amaze me how smart, thoughtful, and engaged this network of people were, and still are, and how they always took the time to respond to my questions and inquiries. (For the record, those questions will never stop). Thank you, Mike Cohen, Jennifer Pitt, John Fleck, Steve Wolff, Brad Udall, Eric Kuhn, Terry Fulp (looking forward to that VIP tour of Hoover Dam and water skiing on Lake Mead), Taylor Hawes, Drew Beckwith, Osvel Hinojosa, Aaron Citron, Tony McLeod, Bart Miller, Jorge Figueroa, Robert Wigington, Kevin Wheeler, Hannah Holm, Gigi Richard, Jason Robinson, Dustin Garrick, and Kimery Wiltshire.

Special thanks also go to the water group I helped start here in Boulder—Tributaries—for always wanting to have discussions, movie nights, beers, and generally nerd out on all things water. Thank you, Paul Lander, Aaron Citron, Amorina Lee-Martinez, and Adrianne Kroepsch. I especially want to thank Sara Porterfield for co-founding this group and fostering such a fun (and nerdy) environment. Looking forward to starting our podcast, Sara.

I also need to thank the amazing people in our wildfire policy research group, led by Deserai Crow. Not only has this group helped me gain incredible research and publication experience, but everyone is so dang smart that our projects over the years have been so interesting, engaging, and edifying. Thank you Elizabeth Koebele, Lydia Lawhon, Juhi Huda, Adrianne Kroepsch, Alex DeGolia, and, of course, Deserai.

One person that I truly cannot thank enough is Laura Nash with Graduate Writing Support at the Writing Center here on campus. As my writing therapist, Laura provided hours upon hours of feedback for the past year and a half, and helped to significantly improve my writing and the project overall. Thank you, Laura.

There is a group of friends here in Boulder (although most, unfortunately, have moved elsewhere) that were integral in supporting me during my graduate studies. These are some of the best fishing, skiing, biking, woodworking, cooking, and beer drinking friends out there. Bobby Moelter (see you at the Walnut), Tyler Kohler (you have no idea how much our pacing-around-the-kitchen-with-a PBR-discussions helped me to

stay sane), Sara Porterfield and Jeff Wermer, Sarah Conlin, Mike Scheele and Megan Ottinger, Adrianne Kroepsch and Corey Carlson, Sean Cannon and Jennifer Hyder, Alex Lee and Margi Dashevksy, Meaghan Daly and Sterling Roop, and Logan Callihan. You all rock and thanks for being such good friends. I must also thank Movement Climbing and Fitness for providing me beer money and a much-needed break from the academic world over the years.

Perhaps most importantly I must also thank my incredible family. Mom and Dad, I cannot thank you enough for the unwavering support, incredibly thoughtful editing, words of encouragement, and overall genuine kindness during this time. Grandpa, thank you for always offering kind words, emails, and encouragement over the years. Similarly, to my siblings and their families, I cannot thank you enough for everything you have done. Chris, Sharon, and Owen (future water nerd), Jessie and Kaitie (welcome to family!), and Timmy—you all are the BEST.

Of course, I must thank the two canines in my life, Toby and Josie, for providing much needed joy, love, smiles, and fun after long days on campus.

Finally, to my best friend and girlfriend, Lillian, words cannot express how important you and your support have been over the years. From reading drafts, to listening to my rants, to being my number one advocate and supporter, thank you. Simply put, I could not have done this without you.

Peace, love, and rivers,
John

TABLE OF CONTENTS

LIST OF TABLES

Chapter 3

Chapter 4

Chapter 5

Chapter 6

LIST OF FIGURES

Chapter 2

Chapter 1 – Introduction

1.1 Introduction

> *We are apt to be overawed by the massive grandeur of our large storage dams and by the material things that are to go into a great project like that of the Colorado River. There is another structure, however, which is just as important as, and probably more difficult to rear than the engineering works, and that is the edifice of sound, public opinion, of broad-minded co-operation, leading to a proper mutual adjustment of interests and to a division of the waters to become available from the development of the project. (Eugene W. Burr, District Counsel of the United States Reclamation Service, 1920)*

In December 2014, the Colorado River Basin Water Users Association (CRWUA) held its annual meeting in Las Vegas, Nevada. On the second day, there was a panel entitled, "In the Heat of the Drought: Sustaining Our Basin Supplies", which featured four prominent Colorado River Basin decision-makers: John Entsminger, General Manager of the Southern Nevada Water Authority; Michael Lacey, Director of the Arizona Department of Water Resources; Bill Hasencamp, Colorado River Program Manager at the Metropolitan District of Southern California; and Don Ostler, Executive Director of the Upper Colorado River Commission. In addition to their individual prepared statements, panelists were asked the following question:

"What does sustainability mean to you?"

Each panelist spent a few minutes answering this question with varying responses relating to equilibrium, managed use, adaptation, and risk tolerance. Entsminger started with the idea that sustainability revolves around finding equilibrium in a given water system, and that a system's inflows have to equal the outflows. Further, he specifically discussed how two specific ideas were needed to achieve sustainability: flexibility and balance. Lacey answered by stating that sustainability means Arizona is managing and using the state's full 2.8 million acre-feet apportionment, as allocated under the Law of the River. Hasencamp discussed how

sustainability simply means adapting to change – he further hinted that the current system is not sustainable by noting how available supplies in the system have been reduced over the previous decades. Finally, Ostler also noted that sustainability is something akin to equilibrium, with supply being able to meet demands. More specifically, Ostler suggested that sustainability should include some tolerable level of shortage risk (i.e., supply does not meet demand). Further, he observed that this tolerable level of shortage risk differs by region, and includes not just a hydrological shortage, but also how well the shortages can be managed when they do occur.

This discussion on what sustainability means to each of these Colorado River Basin decision-makers is quite illuminating as it exemplifies one of the major challenges facing societies around the world—the issue of how to sustainability manage water resources. That is, as demands continue to increase and water supplies are threatened by overuse, drought, and climate change—along with issues of ecological impacts, environmental and social justice, and growing sectors such as recreation—how can water resources be managed in way that sustains these growing and changing uses today, without compromising the ability of future generations to also meet their wants and needs.

Importantly, the CRWUA panel discussion is particularly illuminating because of the focus for each of the decision-makers. While their definitions of sustainability differ, what they reveal is a primary focus on human demands and consumptive uses. While these demands and uses are incredibly significant, obviously, they do limit sustainability to one part of the system at the exclusion of numerous other social and environmental components of a river basin. This is especially key considering the numerous ecological impacts from overuse and misuse around the world that already exist today. This includes aquifer depletion, rivers running dry, degraded water

quality, declining riparian habitats, loss of native species, and a host of other impacts to river systems. As the late David Getches once noted:

> "'We get into measuring sustainability by what we're doing to the environment. We look at ecological sustainability, but we can also look at it in terms of economics and in terms of equity. I think on all three of those counts, ecology, economics, and equity, we can draw the judgment that in the Colorado Basin, what we're doing is not sustainable'" (McClurg, 1999, p. 4).

Accordingly, the sustainable use of water resources faces challenges of not only meeting human demands, but doing so without the further degradation of the ecological systems also depending on those resources. In fact, a truly sustainable system would reverse some of the negative impacts already incurred around the world, to ensure the riparian health of every river for decades and centuries to come. In other words—how can we make sure rivers are no longer diverted to extinction before ever reaching the oceans? And ensure that along the way all human populations (including disadvantaged groups) can meet their various needs and goals without systematically marginalizing or excluding communities? These are the broad questions facing water managers when it comes to sustainability.

While numerous definitions exist for sustainability, one of the primary components often included is the idea of equity. Specifically, this concept includes notions of fairness, representation, sharing, and respect, and suggests that in order for a system to be sustainable, it must also be equitable for both current and future generations. It is important to note that equity does not mean equality—that is, equity does not necessarily require everyone to have equal use of water resources. Rather, equity suggests that the decision-making process include a fair approach that considers the input of all stakeholder groups, recognizes and accounts for differing values, and fundamentally shifts the benefits and burdens from a select few to all stakeholders

within that system. Accordingly, while sustainability is often discussed as one of the most important principles, equity deserves a similar focus and consideration.

The following section provides a brief introduction to sustainability and equity as principles for water management. As the next section suggests, sustainability and equity are commonly found in the academic literature as important goals for water managers. But as this dissertation will explore, these concepts become quite challenging in the context of river basin decision-making. Further, in order to develop prescriptions for future policies, these concepts require a context-specific and nuanced understanding of current river basin management and governance.

1.2 Sustainable and equitable water policy

Sustainability is often mentioned as something that water managers frequently desire, but what it looks like in practice is widely debated and contested. Similarly, equity is another broad principle that ostensibly most, if not all, water managers also desire, but again the real-world implications for managing a water system equitably are less understood and will differ depending on perspective. The following section briefly introduces the two concepts as they relate to water management (a more in-depth discussion on the two concepts is presented in Chapter 2).

Sustainability in regard to water policy and management largely stems from the Integrated Water Resources Management (IWRM) framework, formally developed following the Rio World Summit on Sustainable Development in 1992. IWRM is defined as "a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (Global Water Partnership, 2000, p. 22). Building upon IWRM, many scholars and researchers have suggested specific principles for how water systems

could be more sustainably managed. This includes principles such as transparency, participation, integration, considering ethics, flexibility, and being holistic. As Chapter 2 discusses, these principles are numerous and extensive, which can make it difficult for water managers to fully understand how to incorporate these concepts together into their decision-making. Accordingly, a gap in our knowledge still exists for understanding the full extent of sustainability and river basin governance (Wiek & Larson, 2012).

Similar to sustainability, equity has emerged from many decades of research and empirical examinations into water policy and governance. Broadly speaking, equity suggests that all users within a system share in burdens and benefits, have their values represented, and have a right to participate in decisions relating to that system. Historically, equity was actually one of the guiding principles in the development of prior appropriation, the over-arching legal system for water allocation in the western United States. In the late 19th Century, water users began running into the limits of freshwater supplies and needed a way to administer competing water rights. Accordingly, prior appropriation recognized water rights as a matter of priority date—simply put, those users that put a quantified amount of water to beneficial use at an earlier date would have seniority over any users whose initial date of diversion was later in time. In developing this system of water allocation, much of the discussion regarded "equitable apportionment". As noted in one of the seminal court cases solidifying prior appropriation as the rule of law in 1891:

> "The country was without law, but each individual brought with him the principles of equity and justice which were part of his education…Instead of parceling [water] out generally and making it practically valueless to any…they adopted the only rule founded in equity that could be rightfully adopted in the premises, viz., that of prior appropriation" Armstrong v. Larimer County Ditch Co., 27 P. 235, 237 (Colo. Ct. App. 1891).

Despite being a guiding principle for the original system of water allocation, what equity means in practice remains an elusive concept today (Wilder & Ingram, 2016). Acknowledging this uncertainty, some researchers have focused on principles for identifying when equity exists, as opposed to prescribing how water managers could consider more equitable policies (Wilder & Ingram 2016). While useful, and providing excellent case studies for consideration of equity issues, research has yet to fully address uncertainties in how water systems can modify existing institutions to become more equitable.

Ultimately, this dissertation seeks to better understand what these two broad ideas—sustainability and equity—mean in practical river basin management. More specifically, if our society deems sustainability and equity as important concepts for the management of water resources, what options do water managers have for modifying their governance structures in order to manage in a more sustainable and equitable way? For example, demands for more sustainable and equitable approaches often include notions of open, inclusive, and transparent decision-making processes. The actual and practical application of these concepts, however, remains unclear given the political and social realities in many river basins around the world. Accordingly, by empirically measuring the concepts of sustainability and, in particular, equity, this dissertation demonstrates how to incorporate these concepts in day-to-day practical water management.

1.3 Background information and context

The case study for this project, the Colorado River, emerges out of the Rocky Mountains and drains approximately 244,000 square miles before ending up in the Gulf of California just across the Mexico border. Along the way, the river provides at least a partial water supply for nearly 40 million people, irrigates 5.5 million acres of land, and

has approximately 4,200 megawatts of hydroelectricity capacity (Bureau of Reclamation, 2012). Further, the Colorado River Basin is home to 22 federally recognized Native American tribes, 11 National Parks, 7 National Wildlife Refuges, and 4 National Recreation Areas. Known as the "lifeline" of the American Southwest, the Colorado River provides extensive resources for human and environmental needs. Despite the Basin's location in an arid and semi-arid region, these extensive demands have been sustained, in part, by the substantial storage capabilities of the Colorado River. The two largest reservoirs by capacity in the United States – Lakes Powell and Mead – are the primary storage reservoirs in the Colorado River Basin and together can hold approximately 50 million acre-feet of water (MAF), roughly equivalent to almost four years of average historic flow at Lee Ferry, in northern Arizona.

The Colorado River Basin is comprised of seven states in the United States and two states in Mexico. The seven U.S. Basin States and the federal government adopted the Colorado River Compact of 1922, in order to establish the basis under which the waters of the river would be allocated. Not only was this Compact significant to the Basin States themselves, but the control and development of such an important resource was seen as nationally significant. As emphasized by the Governor of Utah at the time:

> "This work of developing the resources of the Colorado for the reclamation of the 244,000 square miles of the Colorado basin will immeasurably increase the wealth of this nation. It will bring not only prosperity to our States but it will bring honor and glory in all the world to our beloved Stars and Stripes!" (League of the Southwest, 1920, p. 153).

Several issues prompted the seven Basin States to develop a compact for allocating the Colorado River. One, California was rapidly growing and needed additional water supplies, but were limited in terms of the ability to build the large reservoirs necessary to sustain this growth. As such, California needed the federal government to take responsibility for building a large storage project. Concurrently, the

states of the soon-to-be-defined Upper Basin were concerned after a Supreme Court decision ruled that prior appropriation applies across state lines (Wyoming v. Colorado 1922, 259 U.S. 419, 468). In other words, California with its rapid growth, could in theory appropriate all the waters of the Colorado River before the Upper Basin States had a chance to appropriate their share of the Colorado River. The federal government agreed to build the big reservoir but only after the states came to agreement on how to manage the river. Therefore, states in both the Upper and Lower Basins had motivation to come to an agreement. California, Nevada, and Arizona would benefit from federally constructed reservoirs and Colorado, Utah, Wyoming, and New Mexico could have assurance that there would be Colorado River water for them to appropriate and that California would have some limit on its growth.

The Colorado River Compact of 1922 divided the Basin into two sub-basins. The Upper Basin is that portion of the river which arises upstream of Lee Ferry, a point one mile below the confluence of the Paria and Colorado Rivers (just downstream of Lake Powell). The Upper Basin includes the states of Colorado, New Mexico, Utah, Wyoming, and a small portion of Arizona. The Lower Basin is that portion of the Basin that drains into the mainstem below Lee Ferry. The Lower Basin States are Arizona, California, and Nevada; small portions of Utah (the Virgin River drainage) and New Mexico (the Gila River drainage) are also located in the Lower Basin.[1]

[1] It is important to note that even though these seven states and Mexico are all, at least in part, located within the hydrologic basin itself, approximately 70 percent of the urban deliveries of Colorado River water occur outside of the Basin through trans-basin diversions (Cohen, 2011). These trans-basin diversions supply water to prominent urban areas in the Southwest including the Front Range in Colorado, the Wasatch Front in Utah, and Los Angeles and San Diego in Southern California. This is an important fact because trans-basin diversions are entirely consumptive for the Colorado River Basin in that there are no return flows back into the hydrologic basin. Thus, these diversions directly limit the amount of available water downstream.

The Colorado River Compact of 1922 and subsequent legislation, congressional acts, court decisions, decrees, and regulatory decisions collectively comprise what is known today as the "Law of the River." Briefly, the Colorado River Compact of 1922 apportioned 7.5 million acre-feet (MAF) annually to both the Upper and Lower Basin States for consumptive use. These apportionments are combined into a management regime that requires the Upper Basin to "not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years." In other words, the Upper Basin has an obligation to deliver 75 MAF over ten years on a rolling average to the Lower Basin. This delivery obligation – which is a contested matter and has not been interpreted by the courts (Robison & Kenney, 2012) – is important to note because it has become clear that the Compact over-allocated the river and the Upper Basin States cannot reasonably consumptively use 7.5 MAF without violating their obligation to the Lower Basin.

The Boulder Canyon Project Act of 1928 further apportioned the Lower Basin's allocation – 4.4 MAF to California, 2.8 MAF to Arizona, and 0.3 MAF to Nevada – and the Upper Colorado River Basin Compact of 1948 further apportioned the Upper Basin's allocation – 51.75% to Colorado, 23% to Utah, 11.25% to New Mexico, and 14% to Wyoming. The allocations utilized by the Upper and Lower Basins highlight two prominent types of allocation schemes in water management – fixed and proportional allocations. The positive and negative attributes for each depend on the context in which they are implemented, but they are important for understanding the potential for flexibility in such an allocation scheme. Mexico was formally included in the Law of the River beginning in 1944 when the two countries signed the Mexican Water Treaty of 1944, committing the United States to annually deliver 1.5 MAF across the international border. Following these initial allocation agreements, dozens of subsequent legislative

acts, court decisions, and guidelines have added to Law of the River governing the Colorado River.

1.4 Contemporary issues in the Colorado River Basin

Despite being an extensively studied and written-about river basin (e.g., Fradkin, 1981; Hundley, 2009; Powell, 2008; Reisner, 1993; Tyler, 2003; Weatherford & Brown, 1983; Worster, 1985), contemporary issues in the Colorado River Basin make it an appropriate subject for further research. In particular, for two reasons discussed below, it provides a uniquely useful case study for an empirical examination and analysis of flexibility in water institutions, with the ultimate goal of understanding sustainable and equitable water policy at the basin-scale.

The Colorado River Basin has developed two related and interconnected features. The first feature is it has become a "closed river basin" since demands have surpassed average available supplies (Falkenmark & Molden, 2008). This feature is readily identifiable in the Lower Basin, in what has become known as the "structural deficit". Also known as the "math problem", the structural deficit in the Lower Basin simply means that more water is delivered out of Lake Mead than enters into the reservoir from the mainstem and tributaries upstream. In average years, approximately 9 MAF enters Lake Mead, while 9.6 MAF is allocated to Lower Basin States and Mexico. Additionally, approximately 0.6 MAF is lost to evaporation, which leads to a 1.2 MAF imbalance in most years for the Lower Colorado River. It is important to note that this problem is an institutional one, as it is a result of management decisions based on the Law of the River. See Appendix A for a complete history of the structural deficit and how it came to exist.

The second feature is that projections suggest average supplies will decline in the coming decades, concurrent with increasing demands, contributing to a growing

supply and demand imbalance (Bureau of Reclamation, 2012). A growing body of scientific literature suggests that the reduced flows (and subsequent impacts on reservoir storage) seen in the early 21st Century will become the norm for the coming decades (e.g., Udall & Overpeck, 2017). Globally, the Intergovernmental Panel on Climate Change (IPCC) concludes that average temperatures have increased, and will continue to increase, due to anthropogenic greenhouse gas emissions (IPCC, 2014). These increases in temperatures are expected to impact the availability of water resources in semi-arid regions, such as the western United States.

Research specific to the Colorado River Basin has found that increasing temperatures will lead to declining snowpack, earlier snowmelt, and increased evaporation, which in conjunction with decadal variations (Hidalgo & Dracup, 2003) and the reoccurrence of intense drought events (Ault et al., 2016; Meko et al., 2007), are all expected to gradually decrease the mean flows of the river (Udall & Overpeck, 2017). The specific impacts to the Colorado River suggest an overall decline in average annual flow in the range of 5-45% (Christensen & Lettenmaier, 2007; Hoerling & Eischeid, 2007; McCabe & Wolock, 2007; Seager et al., 2012). More recent research suggests this range could be reduced to an approximate range of 5-20% (Hoerling et al., 2009), but that this wide divergence in projections is a result of methodological and model differences in the studies that are difficult to reconcile (Vano et al., 2013).

These two features, which lead to an expanding supply and demand imbalance, are particularly salient for this project because the extensive storage capabilities of the Colorado River Basin may become overwhelmed as the imbalance increases. In August of 2013 the Bureau of Reclamation announced for the first time in the history of Glen Canyon Dam that there would be reduced releases from Lake Powell as a result of

projected Lake Mead and Lake Powell elevation levels.[2] This modification of reservoir operations is a result of the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, negotiated by the seven Basin States and Bureau of Reclamation. In addition to reduced deliveries from Lake Powell, the Guidelines prescribe shortages to the Lower Basin States should reservoir levels further decline.

Depending on snowpack conditions, these first ever declared shortages to the Lower Basin might occur as early as 2019 or 2020. Because the Guidelines were put in place to reduce the vulnerability to potential shortages, it may seem the policies governing the Colorado River are working as planned (i.e., even with shortages in 2019 or 2020, they could have come sooner or more drastically without the Guidelines). Given the expected increase in the supply and demand imbalance, however, many Colorado River managers and experts are concerned these existing policies for modifying reservoir operations may not be sufficient in the future (Carpe Diem West, 2011). As summarized by two prominent water scholars and attorneys in 2002:

> "The Law of the River has evolved into an incredibly rigid structure of water rights and entitlements. This structure has survived despite droughts, legal and political challenges, and nearly a century of dramatic economic and social change. The inflexibility of this system is also the source of growing tension, as the historical context that created it is replaced by dynamic contemporary conditions reflecting new needs, desires, and social, environmental, and economic priorities" (Glennon & Culp, 2002, p. 925).

In sum, these contemporary issues in the Colorado River Basin are the source of significant debate regarding how the Basin ought to be managed in the coming decades. As discussed in more detail in future chapters, the Basin States, federal governments in both countries, and a variety of other stakeholders continue to negotiate how the

[2]See: http://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=44245

existing institutions might be modified to better handle the supply and demand imbalance and potential for subsequent shortages. While new policies have been established, the concern is whether they are significant enough to fix the structural deficit or prevent substantial shortages in the future. As Pat Mulroy, former General Manager for the Southern Nevada Water Authority, commented in 2011, "[i]nstitutional change is not happening at the rate that the climate is changing and the conditions are changing" (McClurg, 2011, p. 116).

1.5 Research design

This project will utilize a multi-method case study research strategy (Yin, 2003) to analyze sustainable and equitable water policy in the Colorado River Basin. This multi-method analysis will be used to understand the flexibility of existing Colorado River Basin institutions with respect to sustainability and equity concerns. A case study research approach is appropriate for exploring the research objectives because of the importance of contextual conditions in river basins. This empirical inquiry approach allows for the in-depth analysis of those contextual conditions by acknowledging their importance in achieving an understanding of and in answering the research questions of interest (Yin, 2003).

This proposed case study of the Colorado River Basin will focus primarily on institutions and decision-making at the basin-scale. More specifically, this case study will analyze Basin-related interactions and decision-making at the state, federal government, and international scales. This focus on the basin-scale has been chosen for several reasons. First, as discussed above, the development of the Colorado River Basin has led to basin-scale institutions governed by working relationships between the states and federal government (i.e., Bureau of Reclamation). While each state has some autonomy within the Law of the River, there is substantial federal involvement in

management, particularly in the Lower Basin. The Bureau of Reclamation operates the major reservoirs (e.g., Lake Mead) and contracts with water users to allocate Colorado River water. The Boulder Canyon Project Act of 1928, in addition to apportioning the Lower Basin's 7.5 MAF among the three states, also authorized and directed the Secretary of the Interior to function as the "Watermaster" in the Lower Basin and contractually allocate Colorado River water to the states and users. Conversely, the Upper Basin does not have direct federal oversight (except for the major reservoirs) and instead decision-making is largely guided by the states and the Upper Colorado River Commission, which is comprised of representatives from each of the Upper Basin States. Thus, these different roles between the states and basins – particularly differing levels of power between basins – suggest that a basin-scale level of analysis is appropriate.

Second, the long history of basin-scale conflict, cooperation, and decision-making in the Colorado River Basin provides sufficient data and information for a robust analysis at this scale. As discussed earlier, the Law of the River has been continually developed for almost a century, which allows for a temporal assessment of the governing institutions. Agreements such as the 2007 Interim Guidelines and more recently Minute 323 to the Mexican Treaty of 1944 demonstrate the continued efforts at basin-scale decision-making, as opposed to a rigid compact within which individual states act independently.

The primary theoretical framework to guide this project will be the Institutional Analysis and Development (IAD) framework developed by Elinor Ostrom and colleagues (Ostrom, 2005, 2011). The IAD is a practical framework for analyzing and understanding the various institutions and decision-making processes, often involving collective action problems (Ostrom, 2005). "Institutions" are defined as the

prescriptions, rules, and norms, both formal and informal, which guide the interactions between humans at all scales of decision-making around a given system. The IAD framework is an appropriate framework for designing and guiding this research because of its explicit focus on institutions and how they influence policy decisions. Because the existing institutions explicitly, and implicitly, influence the interactions between actors at the basin-scale, analyzing these institutions allows for an understanding of the decision-making process. Further, the IAD framework's focus on institutions will help develop the appropriate questions to explore concepts relating to the sustainability and equity of water institutions. Finally, while water management has often been thought of as a technical problem with technical solutions, the importance of institutions in defining the problem and shaping potential solutions is well recognized (Anderson, 1983; Blomquist et al., 2004; Kallis et al., 2006). As noted by Anderson, "[t]he water crisis is an institutional crisis, and the rules of the game that determine the demand and supply of water have seriously distorted information and incentives… Since the water crisis is an institutional problem, the solution must also be institutional" (p. 111).

Additionally, the IAD framework stresses the importance of context in an analysis and understanding of the institutions in question (Andersson, 2006; Gibson et al., 2005). River basins and the institutions within a basin are inherently unique due to a variety of factors, including the biophysical conditions, socio-ecological interactions, and the underlying governance structures of those socio-ecological systems. As such, understanding the context is essential when studying institutions at the basin-scale and the IAD framework acknowledges this importance.

Another important aspect of the IAD framework is the hierarchy of decision-making levels and the interactions between these levels (Ostrom, 2005). The level of

decision-making informs a variety of important issues, such as the types of actors likely involved, what types of rules are implemented, and the likelihood for change at each of the levels. Operational decision-making is the lowest level on this hierarchy and guides day-to-day decisions often by actors utilizing the resource of interest (e.g., reservoir operations). Collective-choice decision-making is the next level and involves the decisions and actions for deciding who is eligible to make operational decisions and what rules should guide those operational decisions (e.g., interim guidelines for new reservoir operations). Finally, constitutional decision-making is the highest on this hierarchy and decides overarching rules for the collective-choice level and is the most difficult scale of decision-making to modify (e.g., Law of the River). This hierarchy of decision-making will be utilized to inform the specific rules and measures of interest for this proposed project. As discussed in the previous section, the scale of interest for this project is the basin-scale, but within this scale there are important considerations and implications for sustainability at all three levels of decision-making.

Within these levels of decision-making, the IAD framework provides the ability to link institutional rules with outcomes of interest (Kenney & Lord, 1999; Ostrom, 2005). This linkage is identified by the use of rules as exogenous variables directly affecting the action situations of interests. As such, explicitly examining the institutional rules and their effectiveness in meeting the desired outcomes allows for a robust institutional analysis. Relating to this project, the interactions within the Basin States, and the federal government, are identified as the action situation, which the various rules outlined in the Law of the River and related institutions (e.g., prior appropriation) directly impact. The institutions create the rules and norms for those interactions, and the interactions in turn modify the guiding institutions.

1.6 Dissertation goals and structure

This dissertation is organized into four empirical chapters (Chapters 3-6), along with an in-depth literature review (Chapter 2), which are bookended by this introductory chapter and a brief conclusion chapter. The empirical chapters are largely structured in journal article format for individual publication, so there is some repetition in several chapters related to the case study background and context. Broadly speaking, the goals for this dissertation are to examine the institutions relating to river basin governance, conduct a holistic examination of the decision-making process for sustainability and equity, better understand how decisions are made given complex historical context and significant future uncertainties, and finally to develop a framework for river basin analysis that could be applied in other international river basins.

For Chapter 2, I conducted an in-depth literature review to examine what sustainability and equity criteria currently exist for river basin governance. These criteria are then used to guide research methods and analysis in subsequent chapters. In Chapter 3, I analyzed three contemporary decisions in the Colorado River Basin, focusing on the decision documents themselves, as well as the decision-making process. In Chapter 4, I specifically focus on the decision-making process for those three decisions to identify components of the process that might support, or impede, sustainability goals. Data for this chapter include the decision analysis and an online survey of Colorado River Basin stakeholders. In Chapter 5, I focus on two specific components of the decision-making process often discussed in the context of sustainability and equity: stakeholder participation and decision-making transparency. Two sources of data were utilized in this chapter, the online survey and in-depth, semi-structured interviews with Colorado River Basin decision-makers. In Chapter 6, I focus

on remaining research questions to understand how the decision-making process might be made more sustainable and equitable by improving adaptive capacity in the Basin. The data for this chapter was the same as Chapter 5. The concluding chapter summarizes the main findings and proposes additional research directions for this work.

To conclude this introduction, I turn to a PhD dissertation on the Colorado River Compact published in 1926, which I think captures the fundamental challenge in the Colorado River Basin that, unfortunately, still largely exists to this day. I hope my dissertation in some way may contribute useful information to help meet this challenge.

> *"That the terms of this interstate agreement have not been ratified by the seven legislatures is not surprising. The Compact attempted too much. It was not possible to provide for the division of the waters between the seven states concerned. This plan, as has already been pointed out, was abandoned in the early days of the negotiations. Nor was it possible to divide the water between the Upper Basin and the Lower Basin in a manner satisfactory to all. It is quite unlikely that the Colorado River Compact signed by the representatives of the states in Santa Fe in November, 1922, will ever be ratified by the seven states. A new method must be adopted, and if it is to secure the support of the different states, its first concern must be the development of a governmental instrumentality in which the sections of the Colorado River area will have confidence"* (Olson, 1926, pp. 196–197).

1.7 References

Anderson, T. (1983). *Water crisis: Ending the policy drought*. Baltimore, Maryland: Johns Hopkins University Press. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/pam.4050030228

Andersson, K. (2006). Understanding decentralized forest governance: an application of the institutional analysis and development framework. *Sustainability: Science Practice and Policy*, *2*(1), 25–35.

Ault, T. R., Mankin, J. S., Cook, B. I., & Smerdon, J. E. (2016). Relative impacts of mitigation, temperature, and precipitation on 21st-century megadrought risk in the American Southwest. *Science Advances*, *2*(10), e1600873.

Blomquist, W., Schlager, E., & Heikkila, T. (2004). *Common Waters, Diverging Streams: Linking Institutions to Water Management in Arizona, California, and Colorado*. Washington, DC: Resources for the Future.

Bureau of Reclamation. (2012). *Colorado River Basin Water Supply and Demand Study: Executive Summary*. United States Department of the Interior. Retrieved from https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Executive%20Summary/CRBS_Executive_Summary_FINAL.pdf

Carpe Diem West. (2011). *Thinking Like a River Basin*. Sausalito, CA.

Christensen, N. S., & Lettenmaier, D. P. (2007). A multimodel ensemble approach to assessment of climate change impacts on the hydrology and water resources of the Colorado River Basin. *Hydrology and Earth System Sciences Discussions*, *11*(4), 1417–1434.

Cohen, M. J. (2011). *Municipal Deliveries of Colorado River Basin Water* (p. 73). Oakland, CA: Pacific Institute.

Falkenmark, M., & Molden, D. (2008). Wake Up to Realities of River Basin Closure. *International Journal of Water Resources Development*, *24*(2), 201–215. https://doi.org/10.1080/07900620701723570

Fradkin, P. (1981). *A River No More: The Colorado River and the West*. Los Angeles, CA: University of California Press.

Gibson, C., Andersson, K., Ostrom, E., & Shivakumar, S. (2005). *The Samaritan's Dilemma: The Political Economy of Development Aid*. New York: Oxford University Press.

Glennon, R., & Culp, P. (2002). The Last Green Lagoon: How and Why the Bush Administration Should Save the Colorado River Delta. *Ecology Law Quarterly*, *28*, 903–992.

Global Water Partnership. (2000). *Integrated water resources management*. Stockholm: Global Water Partnership.

Hidalgo, H. G., & Dracup, J. A. (2003). ENSO and PDO effects on hydroclimatic variations of the Upper Colorado River basin. *Journal of Hydrometeorology*, *4*(1). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=1525755X&AN=9048469&h=aUbIY%2Bvq7svPyoitl7QYjmRAdCwCG%2Fz1cxRoPOIEQnF%2FoHZMmMq%2BHN69ULicmN4rT5cRWrWyT9MvHPb5C7cITw%3D%3D&crl=c

Hoerling, M., & Eischeid, J. (2007). Past Peak Water in the Southwest. *Southwest Hydrology*, 187–190.

Hoerling, M., Lettenmaier, D., Cayan, D., & Udall, B. (2009). Reconciling Projections of Colorado River Streamflow. *Southwest*.

Hundley, N. (2009). *Water and the West: The Colorado River Compact and the Politics of Water in the American West* (2nd ed.). Los Angeles: University of California Press.

IPCC. (2014). *Climate Change 2014: Synthesis Report* (Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)). Geneva, Switzerland: IPCC. https://doi.org/10.1017/CBO9780511546013

Kallis, G., Kiparsky, M., Milman, A., & Ray, I. (2006). Glossing Over the Complexity of Water. *Science Letters*, *314*, 1388–1388.

Kenney, D., & Lord, W. (1999). *Analysis of Institutional Innovation in the Natural Resources and Environmental Realm: The Emergence of Alternative Problem-Solving Strategies in the American West*. Natural Resources Law Center, University of Colorado Boulder.

League of the Southwest. (1920). *Proceedings of the Third Convention of the League of the Southwest*. Los Angeles, CA.

McCabe, G. J., & Wolock, D. M. (2007). Warming may create substantial water supply shortages in the Colorado River basin. *Geophysical Research Letters*, *34*(22). https://doi.org/10.1029/2007GL031764

McClurg, S. (1999). Managing the Colorado River. *Water Education Foundation*, (November/December). Retrieved from http://www.watereducation.org/western-water-magazine/managing-colorado-river-0

McClurg, S. (2011). *Colorado River Project Symposium Proceedings* (Solving the Basin's Math Problem: Adapting to Change). Sacramento, California: Water Education Foundation.

Meko, D. M., Woodhouse, C. A., Baisan, C. A., Knight, T., Lukas, J. J., Hughes, M. K., & Salzer, M. W. (2007). Medieval drought in the upper Colorado River Basin. *Geophysical Research Letters*, *34*(10). https://doi.org/10.1029/2007GL029988

Olson, R. (1926). *The Colorado River Compact*. Harvard University, Cambridge, MA.

Ostrom, E. (2005). *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press.

Ostrom, E. (2011). Background on the institutional analysis and development framework. *Policy Studies Journal*, *39*(1), 7–27.

Powell, J. (2008). *Dead Pool: Lake Powell, Global Warming, and the Future of Water in the West*. Los Angeles, CA: University of California Press.

Reisner, M. (1993). *Cadillac Desert: The American West and Its Disappearing Water*. New York: Penguin Books.

Robison, J. A., & Kenney, D. S. (2012). Equity and the Colorado River Compact. *Envtl. L.*, *42*, 1157.

Seager, R., Ting, M., Li, C., Naik, N., Cook, B., Nakamura, J., & Liu, H. (2012). Projections of declining surface-water availability for the southwestern United States. *Nature Climate Change*, *3*(5), 482–486. https://doi.org/10.1038/nclimate1787

Tyler, D. (2003). *Silver Fox of the Rockies: Delphus Carpenter and Western Water Compacts*. University of Oklahoma Press.

Udall, B., & Overpeck, J. (2017). The twenty-first century Colorado River hot drought and implications for the future. *Water Resources Research*, *53*(3), 2404–2418. https://doi.org/10.1002/2016WR019638

Vano, J. A., Udall, B., Cayan, D. R., Overpeck, J. T., Brekke, L. D., Das, T., … Lettenmaier, D. P. (2013). Understanding Uncertainties in Future Colorado River Streamflow. *Bulletin of the American Meteorological Society*, 130625085810007. https://doi.org/10.1175/BAMS-D-12-00228.1

Weatherford, G., & Brown, F. L. (1983). *New Courses for the Colorado River: Major Issues for the Next Century*. Albuquerque, NM: University of New Mexico Press.

Wiek, A., & Larson, K. L. (2012). Water, People, and Sustainability—A Systems Framework for Analyzing and Assessing Water Governance Regimes. *Water Resources Management*, *26*(11), 3153–3171. https://doi.org/10.1007/s11269-012-0065-6

Wilder, M., & Ingram, H. (2016). Knowing Equity When We See It: Water Equity in Contemporary Global Contexts. In *Oxford Handbook on Water Policy and Politics*. Oxford University Press.

Worster, D. (1985). *Rivers of Empire: Water, Aridity, and the Growth of hte American West*. New York, NY: Oxford.

Yin, R. (2003). *Case Study Research Design and Methods* (Third Edition). London, UK: Sage Publications.

Chapter 2 – An Examination of Sustainability and Equity at the Basin-Scale and An Appraisal of Existing Criteria: A Review of the Literature

> *Knowing equity when we see it means engaging in a process of critical inquiry that delves into the value bias of existing institutions and processes, the openness and accessibility of political arenas, an appraisal of what and who is being served by water-related decisions, and what and who may be left out. (Wilder and Ingram 2016, p. 12)*

2.1 Introduction and background

Sustainability and equity are goals for natural resources governance that water managers are increasingly encouraged to strive to attain. For the last few decades, there has been a significant amount of research attempting to understand and develop guidelines or specific criteria that managers could, and should, utilize to maximize the sustainable and equitable use of water resources. This literature review examines those criteria as they relate to basin-scale decision-making. Specifically, this review attempts to understand what the literature says about these criteria and how water managers could consider such criteria in their decision-making process. Before examining the criteria, however, it is important to understand how sustainability and equity concepts have historically evolved from broad, theoretical principles to more specific prescriptions attempting to incorporate the political and physical realities in water management. Before getting into the literature review, a brief discussion of this evolution helps elucidate why the application of sustainability and equity ideals is still an elusive concept in river basin decision-making.

2.1.1 Equity

The concept of equity in western water management can be traced back to the beginning of water law in the western United States. This concern for equity stems from how important water was to livelihoods that were primarily agrarian and required significant irrigation for economic growth (H. Ingram & Lejano, 2009). An 1891 opinion by the Colorado Court of Appeals identified the recent development of prior

appropriation as the rule of law for water management. The Court specifically discussed how the original farmers brought "principles of equity and justice" to the region, and that prior appropriation was "the only rule founded in equity that could be rightfully adopted" (Armstrong v. Larimer County Ditch Co., 1891). Equitable apportionment was solidified in law in 1907 after Kansas filed a lawsuit against Colorado over the Arkansas River, claiming that diversions in Colorado were harming Kansas farmers. The Supreme Court ruled that states are equal—specifically that an "equality of right" exists between two states. While there was insufficient evidence of injury to Kansas, the Court warned that if injury could be proven, Kansas would have the right to call on water from Colorado, under the prior appropriation doctrine. Equitable apportionment then became the guiding principle for water allocation.

Beyond this guiding principle of equitable apportionment, however, equity is still an elusive concept (Ingram et al., 2008). One of the early attempts to clarify what equity actually means in practice came in 1986 when Helen Ingram and colleagues established five principles of equity: reciprocity, value-pluralism, participation, promises, and responsibility (Ingram et al., 1986). *Reciprocity* refers to the idea that all users within a water system should share both the burdens and benefits of access to that system. *Value-pluralism* suggests that users have the right to use water in a way that aligns with their values, as long as that use does not negatively impact other users. The principle of *participation* simply states that members of society have the right to be included in the decision-making process. Further, "[i]t does not seem equitable, then, to attempt either to limit community membership by restricting access to water or to decrease the probability of technically 'inefficient' decisions by restricting the circle of participants" (p. 188). It is important to note that the authors acknowledge a more participatory process will make the "decision process more confused and tempestuous"

(p. 188), but they argue those impacts are better than the potential impacts from a less participatory process. The principle of *promises* suggests that during the process of decision-making and negotiation, promises made to users or groups—particularly with compromises—must be met in good faith. If multiple promises come into conflict, then efforts to focus on flexible and adaptive decisions must be employed. Finally, a *responsibility* principle suggests that all decisions and uses should consider the impact to future generations. The authors note that "[e]quity is also an ethical idea which restrains the undertaking of large risks bearing on the fate, social good, and well-being of future humans" (p. 189).

A more recent review of equity in water policy over the previous two decades found that framing water as an economic good has led to systemic inequitable outcomes (Wilder & Ingram, 2016). Further, Wilder and Ingram suggest that current water management paradigms have failed because they are removed from the politics around governance structures. A reframing that prioritizes equity would allow for more sufficient progress in solving contemporary water problems. As such, the authors provide five "directional principles" that, if water management is seemingly striving to accomplish, would indicate when a more equitable system is being achieved:

1. "Water is treated as a common good that serves multiple values and when it is not reduced to mere property or an economic commodity that serves utilitarian purposes.
2. When it is mindful of the needs of nonhumans, including plants, animals, places, and habitats, as well as of the inheritance of humans in future generations not yet born. It is on the right path when each new generation is socialized into making equity judgments and when spaces exist to reconsider or reimagine the practice of water equity over time.

3. When decision-making processes are open to broad participation of all affected parties, including through such mechanisms as networks, voluntary associations, and public/private partnerships, and when procedural fairness is as important as making fairer water allocation and distribution choices.
4. When there exists not only shared allocation of rights and benefits but also sharing of the risks and burdens associated with population growth, climate change, and emergent technologies.
5. When imbalances in political and economic power are being redressed rather than simply reproduced in water policy" (p. 11).

It is important to note that these are not a check-list of attributes that each system should seek to attain. Rather, they are contextual prescriptions for when water management may be moving towards a more equitable system. As the authors concluded, "[w]hile no one should look to the considerable literature reviewed in this chapter for a set of rules that can be universally applied, equity scholarship provides a lens and perspective that allows us to recognize equity when we see it" (p. 24)

2.1.2 Sustainability

Within the water policy literature, the concept of sustainability has evolved predominately out of the concept of "integrated water management" (White, 1998), and more specifically within the Integrated Water Resources Management (IWRM) framework. Through a multi-decade global effort, IWRM has identified important criteria with regard to sustainable water management at the basin-scale (Global Water Partnership, 2000). IWRM has been described as a process that "provides flexibility through a conceptual framework for responding to diverse water demands in many situations as they are coordinated with needs of multiple sectores" (Grigg, 2016, p. 8). IWRM was originally guided by four broad principles that are necessary for a

sustainable, integrated water management system: "(I) Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment; (II) Water development and management should be based on a participatory approach, involving users, planners, and policy-makers at all levels; (III) Women play a central part in the provision, management, and safeguarding of water; and (IV) Water has an economic value in all its competing uses and should be recognized as an economic good" (Global Water Partnership, 2000, p. 13). More specific principles have been developed and suggest that water governance should be open, transparent, participative, accountable, effective, coherent, efficient, communicative, equitable, integrative, sustainable, and ethical (Rogers & Hall, 2003).

However, as these principles have been furthered refined in an attempt to support water resource managers, there has been a disconnect between achieving these principles and actually implementing this type of integrated approach in a watershed (Blomquist & Schlager, 2005; Rahaman & Varis, 2005). Rahaman and Varis argue that the prominent barrier to IWRM is the transition from these broad, agreed upon principles into actionable policies that can be implemented in an actual river basin. Blomquist and Schlager argue that the implementation of these principles can often fail because of barriers presented by the politics surrounding watersheds, such as boundary definitions, decision-making, and accountability.

Several approaches have been proposed to help overcome some of these barriers to an integrated and sustainable water management approach. For example, *participation* and *integration* in water management have been suggested as two key approaches for evaluating and promoting sustainability (Hedelin, 2007). Participation includes not only more stakeholders in the decision process, but the inclusion of local knowledge and understanding of differing power relations. While the concept of

participation is widely acknowledged as essential to water management, it is important to note that conflicting values and perspectives of various stakeholders are inherent–particularly with regard to water resources–and often lead to difficulty in policy agreement (Larson et al., 2009). Integration suggests the incorporation of differing stakeholders' views across sectors and values. Hedelin 2007 notes that participation and integration are only parts of a more holistic sustainability framework, but that "[u]nderstanding how each individual dimension of sustainable development can be operationalized is an important task" (p. 161).

Other efforts for understanding and achieving water management sustainability include approaches such as *flexibility* and *collaboration*. Flexibility could be incorporated into sustainable water management through a variety of policies, including temporary agreements that require unanimous consent to renew after a specified time period, special provisions for explicitly defined events (e.g., drought), or a joint institutional mechanism with the authority to modify water management (McCaffrey, 2003). *Collaborative* water management has been suggested as a method for reducing transaction costs of coordination with multiple actors (Ananda & Proctor, 2013). This type of approach can help successfully manage across decision-making scales, but requires an institutional structure receptive to collaboration.

Simply proposing normative approaches for sustainable water management, however, does not necessarily prescribe the benefits of implementation in an actual river basin. For example, as discussed above, flexibility has been described as important for sustainable water management. The difficulty lies in understanding what degree of flexibility is the most beneficial for a given water system. Clearly there is a tradeoff between flexibility and certainty, in that a flexible management scheme may actually decrease institutional or water supply certainty. In fact, with regard to water

resources, a system that is too flexible may prove more uncertain for actors, because future institutional arrangements may be quite different from how they currently exist. This is especially salient for water supply planning and operations, which often have decade or longer timescales and contractual obligations to supply a given quantity of water. In other words, a relatively inflexible water management system may provide more certainty, as institutions remain relatively static. The challenge, therefore, is to understand the right balance between flexibility and certainty, while preserving the ability to respond to changing biophysical or social conditions that may or may not have occurred before.

Despite the many efforts to understand particular components of sustainable water management, it appears that, in undertaking empirical research into holistic sustainable management, it is difficult to fully incorporate these identified approaches into one framework (Pahl-Wostl et al., 2010; Parkes et al., 2010). Rather, much of the existing work to date has instead focused on compartmentalized or technical perspectives, only physical system outlooks, or narrow views within the sustainable water management literature (Wiek & Larson, 2012). In response, Wiek and Larson attempt to bridge the gap between these components and build upon much of the sustainable management literature by proposing a holistic sustainability framework incorporating many of the approaches discussed above. As the authors note about these multiple components to sustainability, "[a]ll of these are valuable contributions, yet, they do not capture the full extent and potential of the sustainability concept as it is represented in various strands of literature" (p. 3162).

Wiek and Larson define sustainable water management as "the decision processes of stakeholders who influence and are impacted by activities involving water supplies, deliveries, use, and outflows in ways that ensure a sufficient and equitable

level of social and economic welfare without compromising the viability and integrity of supporting hydro-ecosystems now and into the future". Their proposed comprehensive framework criteria include social-ecological system integrity, resource efficiency and maintenance, livelihood sufficiency and economic opportunity, socio-ecological civility and democratic governance, inter-generational and intra-generational equity, interconnectivity from local to global scales, and precaution (mitigation) and adaptability. To date, this framework has only been tested at the municipality scale, but it has proven effective at providing a better understanding of the holistic sustainability of a given water management system (Larson et al., 2013). Additional applications of this framework in and across different regions "can assist with holistic, interdisciplinary assessments to advance sustainability" (p. 69).

The evolution of sustainability and equity as goals for water managers over the past few decades have demonstrated significant improvements in specificity, nuance, and helpfulness. That being said, there are still limitations on what it actually means for water systems to be sustainable and equitable. As just discussed, specific approaches can be taken, but they are context-dependent and do not necessarily prescribe policy development.

2.2 Criteria

The goal of this literature review is to identify criteria for equitable and sustainable water policy at the river-basin scale. A comprehensive set of criteria may help inform how water managers could, for example, identify their pathway on the set of five directional principles for equity as laid out by Wilder and Ingram 2016. The set of criteria could also help inform a more holistic sustainability appraisal, by specifying the types of criteria to be evaluated in a framework, such as the Wiek and Larson 2012 framework. Further, this literature review will focus on the decision-making process, in

addition to specific water policy outcomes. By including the process, this review will identify criteria important to water governance, in addition to water management. As Lautze et al. 2014 note in their critical review of water resource management concepts:

> "the decision-making process for setting water management goals should not be relegated to a foregone conclusion. On the contrary, it is an effective governance process that is first needed to determine which tenets of IWRM, if any, are desirable for a specific location. Moreover, disregarding local conditions, preferences, and values to uniformly apply IWRM principles everywhere actually reflects poor water governance" (p. 32).

The utility of criteria has been acknowledged in the sustainability assessment and IWRM literature. Gibson et al., 2005 discuss how "the question is not whether there should be decision criteria, but which ones should be used, how they should be selected, whether and when they should be set out explicitly" (p. 89). Even though the context for each decision will be different, criteria help with a starting point for evaluating the decision-making process. Additionally, it is acknowledged that a set of criteria will never be a static list. Instead, the set will—hopefully—continually evolve as social and environmental conditions change.

2.3 Methods

A systematic review of the literature conducted in the fall of 2015 identified criteria as they relate to sustainable or equitable water policy at the basin-scale. Several search terms were used in Google Scholar and Web of Science to identify the relevant literature. The search terms included phrases such as "sustainable water governance holistic basin OR watershed", "equitable water management holistic basin OR watershed", "sustainability criteria water management basin OR watershed", and "equitable framework water governance basin OR watershed." The initial review excluded results that were "urban" or "municipal" in scale, and only included results with articles focused on the developed world. The number of results from these

searches in Google Scholar ranged from 10,700 to 224,000 for the various terms, and from 81-83 for Web of Science. Initially 74 articles were collected and analyzed through this search process, but after further review only 45 articles were ultimately included in the literature review.

Once the final articles were identified, they were systematically coded and analyzed utilizing the qualitative software, NVivo10. An initial coding protocol of specific criteria was developed, and then was expanded organically as each article was coded. In addition to coding for specific criteria, numerous other items of interest were systematically coded throughout the review. This included: (1) geographic scope of the article (e.g., river basin, national, or international); (2) the focus of the article (e.g., processes, outcomes, or mixed); (3) how the article identified the criteria (e.g., from existing literature, empirical examination, or directly from a stakeholder); (4) how the article addressed the perceived gap between theoretical and empirical sustainable or equitable water policy (e.g., the gap exists, does not exist, mixed, or was not discussed); (5) if the article specifically defined sustainable or equitable water policy (including Integrated Water Resources Management); (6) the level of analysis in the article (e.g., operational, collective choice, or constitutional); and (7) the overall perspective of the article (e.g., narrow focus, compartmentalized, technical, holistic, or physical).

The Institutional Analysis and Development (IAD) framework will be utilized to inform the potential for implementation by applying the identified criteria to a combined IAD/Social-ecological Systems framework as proposed by Cole et al., 2014. Specifically, this includes examining where each of the criteria may fit within particular subsystems (e.g., governance systems, actors) of the combined IAD/SES framework in order to better understand how water managers could consider utilizing or applying these criteria.

2.4 Findings

2.4.1 Criteria

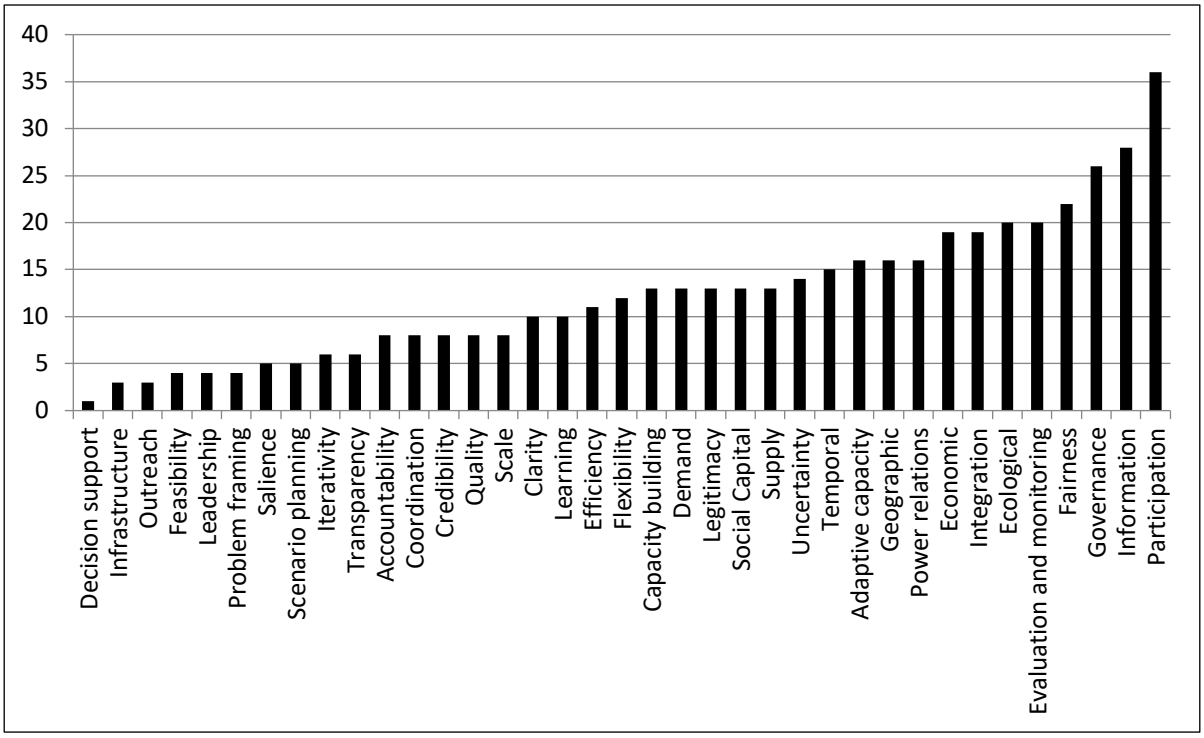
The articles included in the review identified 37 categories of criteria for sustainable or equitable water policy at the basin-scale. Figure 2.1 lists the criteria along with the number of articles that discussed each criterion.[3] The majority of the articles (n=39) identified the criteria from exiting literature, while a minority identified the criteria from empirical examination of a case study (n = 11). Even fewer (n=5) identified the criteria directly from a stakeholder. The number of articles identifying each criterion ranged from only a few articles to a large majority, and the criterion ranged from concepts like feasibility and transparency, to adaptability and participation. Three of the criteria—participation, information, and governance—were found in more than half of the articles and will be discussed in more detail below.

2.4.1.1 Participation

The most common criterion discussed in the literature was the concept of "participation", with the majority of articles (n=36) discussing some form participation. What the literature shows, however, is participation is not a straightforward concept that can be universally applied in all situations. Participation can mean a variety of things to a variety of stakeholders, including *who* can participate, *how* they can participate, *when* they can participate, and *why* they should even participate in the first place (Mostert, 2006). As such, including participation as a criterion for sustainable or equitable water policy requires a nuanced analysis and contextualization to a given river basin.

[3] See Appendix B for a complete list of the criteria and associated literature

Figure 2.1: The 37 criteria identified in the literature review, with the number of articles that discussed each criterion on the y-axis. The number of articles ranges from a high of 36 with the participation criterion, to a low of 1 with the decision support criterion.



For example, there are a variety of reasons for *why* stakeholder participation should be incorporated into river basin decision-making (Hedelin, 2007; Orlove & Caton, 2010; Reeve, 2003; Rinaudo & Garin, 2005; Videira et al., 2006). These goals for participation are varied and include reasons such as the need to represent socially defined goals and values, to integrate and incorporate different knowledge, to handle power asymmetries, to allow for learning, to increase decision-making effectiveness, and to better handle uncertainties.

Perhaps unsurprisingly, one of the most common reasons cited for engaging in stakeholder participation is to better represent social values or meet socially defined goals (Loucks, 2000; Orlove & Caton, 2010; Rinaudo & Garin, 2005). More specifically, water management should be designed so that society can benefit as a whole, and that management of that system can be updated and modified to continually represent

societal values. There are several reasons for the importance of this criterion, including from a problem definition standpoint. Participation may be necessary for a society to begin to agree on, and define, a policy problem in the first place. As such, participation may help decision-makers identify mutual concerns, shared problems, and even help identify problems not currently perceived by decision-makers or the general public. More specifically, participation can help identify issues across different sectors and geographic scales. In other words, a "…multisectoral approach must be taken, one that attempts to integrate what is happening with water in each sector into a holistic view of the overall situation" (Orlove & Caton, 2010, p. 409). From a process standpoint, participation may be necessary for successfully meeting these socially defined goals once they are identified. For example, Clark, 2002 notes that participation is necessary for a system to become "socially sustainable", especially given uncertainties often found in river basin management.

Further, participation can help represent societal values by building trust, social capital, and providing context for how those values may be incorporated into decision-making processes (Reeve, 2003; Richter et al., 2003). Reeve further discusses the concept that if social capital can be equally developed across stakeholder groups, then there will be more of an equitable representation of their respective positions. Richter notes that building trust through participation allows for an easier consensus process.

Another goal of participation is the integration and incorporation of different knowledge sources into the decision-making process. This may include ways of thinking about specific solutions (Orlove & Caton, 2010), combining lay and expert knowledge (Rinaudo & Garin, 2005), the need for experimentation (Claudia Pahl-Wostl et al., 2010), orienting different ideologies (Hedelin, 2007), and ultimately improving the design of a management system (Serageldin, 1995). In addition to improving decision-

making processes, the incorporation of multiple knowledge sources through participation may also help ensure that the differing stakeholders involved support the process. Greater integration can help by "…reducing the risk of rejection, by concerned parties" (Rinaudo & Garin, 2005, p. 291). While laudable, the goal of incorporating different knowledge sets into decision-making may prove difficult, given how diverse relevant stakeholders may be in a water governance setting. Not only may stakeholders have different worldviews, they may even have different epistemological approaches to understanding water policy. Accordingly, another goal related to the incorporation of knowledge is to actually learn from each stakeholder. Promoting learning is the "…only one way to meet the problem related to knowledge in democratic decision-making" (Hedelin, 2007, p. 159). By having a more inclusive decision-making process, much can be learned from the various stakeholders and their diverse backgrounds, including how to incorporate different sets of knowledge.

Another goal of participation that is similar to learning is the ability to handle future uncertainties and ultimately include those uncertainties into the decision-making process (Claudia Pahl-Wostl et al., 2008; Videira et al., 2006). One of the primary challenges of water policy in the 21st Century is the recognition that the future availability of water supplies, and subsequent demands, will most likely be different from what has been seen in historical supplies. Whether due to prolonged drought, climate change, natural variability, or some unforeseen perturbation, it has become evident that the future is fraught with uncertainties. Therefore, inclusivity and stakeholder participation may be one way to overcome the challenge of decision-making under uncertainty (Videira et al., 2006). As noted by Pahl-Wostl 2008, "[i]n times of increasing uncertainties due to climate change and fast changing socio-

economic boundary conditions collaborative problem solving requires active involvement of stakeholders and the public" (p. 493).

Identifying power asymmetries and handling differing power relations is another goal for participation as a criterion (Hedelin, 2007; Reeve, 2003). Inequitable water policy is often seen when certain groups or stakeholders do not have adequate representation or participation, and are marginalized by those with greater decision-making authority or power. Accordingly, these "[m]arginalised groups who may have difficulty in organizing representation and articulating their interests may need support" (Reeve, 2003, p. 5). Power asymmetries not only exclude certain stakeholder groups from decision-making, but also will reduce or limit many of the benefits of participation discussed above. In addition to simply supporting marginalized groups, effective participation must incorporate differing power relations into the structure of the planning process. "From this it follows that a planning methodology or process for sustainable river basin management must…engage itself in the handling of power asymmetries" (Hedelin, 2007, p. 158).

Finally, a common goal of participation is to increase the effectiveness of the decision-making process (B. P. Hooper, 2003; Jaspers, 2003; Claudia Pahl-Wostl et al., 2008; Pereira & Quintana, 2009; Serageldin, 1995; Wiek & Larson, 2012). As succinctly put by Jaspers 2003, "[i]t has become very clear that water resources planning without the participation of stakeholders in decision making is highly ineffective" (p. 80). One way participation can increase the effectiveness is through the generation of ownership of a given policy or decision. "Taking ownership" of a river basin management plan not only increases the overall effectiveness of the process, but also ensures that various stakeholders have a vested interest in the development, implementation, monitoring, and evaluation of that process and plan (Claudia Pahl-Wostl et al., 2008; Serageldin,

1995). Another way participation seeks to enhance decision-making effectiveness is through a peer-review process in which a plan can be substantially vetted and evaluated by those who are participating in the decision-making (Pereira & Quintana, 2009). Pereira and Quintana consider this such an important component that they include "extended peer review" as the "beam" that crosses the three pillars they have identified as essential in river basin governance (inclusive governance, transparent assessments, and socially robust knowledge). As the authors note, "[t]he involvement of the relevant social actors is suggested here as a transversal element to ensure the quality of the whole evaluation procedures in river basin governance. This is intrinsically related to all pillars of this framework and that is why we set extended peer review as a beam that crosses all pillars" (p. 947). Finally, participation that includes local-scale stakeholders will strengthen the overall river basin management (Hooper, 2003). This focus on local empowerment is seen as a way to increase the overall effectiveness of the decision-making process.

Goals in and of themselves, however, are not sufficient for implementing adequate participation in a river basin setting (Hooper 2003). There are many *barriers* to successful participation that have been identified throughout the literature (Clark, 2002; Hedelin, 2007; Swyngedouw et al., 2002). Broadly speaking, there may be differences between stakeholders about what participation means and who is entitled to participate in the decision-making process. Further, there may be differences between stakeholders about who should represent a given group in the participation process. This presents a barrier in that "…participation suffers from an ill-defined and diffuse notion of representation. In particular, it has not outlined any actual system of representation" (Swyngedouw et al., 2002, p. 114).

More fundamentally, many stakeholders in a river basin will simply have different values and worldviews, and therefore different ideas of what water policy should be (Clark, 2002; Hedelin, 2007). Simply put, "it has to be recognized that stakeholders have very different vested interests and value systems, so their aspirations will inevitably be conflicting" (Clark, 2002, p. 353). This is not to say, however, that different value systems are a negative thing, but rather an important consideration to identify when attempting to improve stakeholder participation. As noted during the discussion on goals, participation is essential for learning about different knowledge sets and viewpoints, which can ultimately help increase the effectiveness of decision-making. Given this benefit of including diverse view points and knowledge, "…value differences will, and preferably should, exist" (Hedelin, 2007, p. 159). Differing values are important, but need to be recognized as a potential barrier to successful participation by stakeholders.

In addition to differences in values, there are cultural, institutional, geographic, and sectoral differences between stakeholders that can impose barriers to participation (Pahl-Wostl, 2009; Pahl-Wostl et al., 2008). Simply coming from different backgrounds, irrespective of being in the same river basin, can impede the participatory process in that stakeholders may not have the same basic frameworks for understanding water management. "Individuals belong to different social groups and thus operate within different cultures and institutional settings that belong to different national, regional or organizational boundaries" (Pahl-Wostl et al., 2008, p. 491). It is common when examining water policy at the basin-scale to have stakeholders from multiple sectors in multiple geographic locations, and as such there will be sectoral and geographic differences that may be difficult to reconcile. Basin-scale water policy requires "…coordination with regional planning which is generally impeded by sectoral

fragmentation…In addition stakeholder processes have to be organized to involve stakeholders on different scales. This results in a remarkable complexity in the whole learning process" (Pahl-Wostl et al., 2008, p. 492). This barrier can also be seen with stakeholders who operate at different vertical scales within a river basin (Pahl-Wostl, 2009). For example, participation may mean including stakeholders who may only focus on local water management as well as those who only examine water policy at the national scale. Accordingly, they may have difficulty participating in the same decision-making process.

In addition to the goals for and barriers to participation, it is important to determine *who* can and should participate in decision-making processes (Antunes et al., 2009; Hedelin, 2007; B. P. Hooper, 2003; Renner et al., 2013). Historically, water management at the basin-scale has been typically a top-down process in which government agencies and water utilities are the primary decision-makers. More recently, however, greater attention has been given to a more inclusive process. As such, criteria for sustainable and equitable water policy must include ways to identify a diverse, and fully representative, group of stakeholders participating in the decision-making process. More specifically, "[b]asin-wide planning should balance all user needs for water resources, in the present and the long-term, and it should incorporate spatial developments. Vital human and ecosystem needs have to be given special attention" (B. P. Hooper, 2003, p. 15). There is significant agreement that sustainable and equitable water policy needs to be inclusive, but there is less agreement regarding how to identify the appropriate stakeholders—that is, what, and whom, defines the somewhat vague notion of "vital human and ecosystem needs" (e.g., Antunes et al., 2009; Parkes et al., 2010).

One way to determine who should be a stakeholder in the decision-making process is identifying "…a sufficient number of representatives of all groups affected by a given case" (Renner et al., 2013, p. 237). This too is relatively vague, and subject to subjective definitions, especially given the complexity of water systems at the basin-scale. As a starting point, three broad categories of stakeholders identified include "civil society, government, and industry" (Parkes et al., 2010, p. 695). Antunes et al 2009 adds a fourth broad category that includes "social movements" or NGOs. While these categories are beginning to become prescriptive, there are clearly numerous sub-categories of stakeholders who might be affected by a specific water system. Wiek and Larson 2012 propose that decision-making on water issues should "[i]nvolve all persons or groups who affect or are affected by water governance efforts, including water users, providers, regulators, managers, planners, scientists, environmentalists, and so forth" (p. 3165).

More broadly, some researchers have noted the importance of allowing concerned citizens a place at the table (Pereira & Quintana, 2009). Pereira and Quintana state that because of new decision-making processes, the concept of allowing citizens a voice in basin planning and management is something that has increased in recent years. Others have suggested that while including citizens is important, it is also important that the engaged citizens be educated and informed on the issues important to the basin (Orlove & Caton, 2010). If they lack the appropriate understanding, those citizens' local or indigenous forms of knowledge may not be effectively incorporated into decision-making. The importance of all stakeholders being educated and knowledgeable, in addition to citizens, is another important component to stakeholder engagement. Savenije and van der Zaag 2000 discuss how successful basin

management requires, "…that the parties involved fully understand the complexities of the water resources processes in the entire basin" (p. 21).

While there are specific stakeholder groups, and certain requirements, discussed in regard to who should participate, some researchers have noted that each river basin needs to have its own process for determining stakeholder participation (Hedelin, 2007; Renner et al., 2013). Clearly each river basin is different and thus who should be at the decision-making table will be different. As Hedelin 2007 points out, "[b]ecause the actors who should be involved or represented are context dependent, a methodology or working procedure for sustainable river basin management must include a procedure for defining the actors who should be involved in the particular case" (p. 157). Because the methodology or procedure is developed before the complete stakeholder group can be established, the "…communication of clearly defined criteria for the selection process" is useful for justifying the composition of the stakeholder group (Renner et al., 2013, p. 237).

Decision-making processes at the basin-scale typically take years to complete and therefore consideration needs to be given to *when* stakeholders should participate in the process. At a basic level, many have called for stakeholders to participate often and for their participation to commence early on in the decision-making process (Antunes et al., 2009; Blackstock, Waylen, Dunglinson, & Marshall, 2012; Renner et al., 2013; Rinaudo & Garin, 2005). Reasons for early involvement include the identification of goals (Antunes et al., 2009), adapting decisions to stakeholder expectations (Renner et al., 2013), making the process more credible and transparent (Rinaudo & Garin, 2005), and avoiding prolonging the process (Mostert, 2006). Mostert 2006 notes that if the participation of all relevant stakeholders, particularly the general public, is not implemented early on then any new ideas from those stakeholders may cause significant delays in the process.

Mostert also notes, however, that because the beginning processes may be vague it could be difficult for stakeholders to understand the full relevance. A potential way to mitigate some of these timing issues could be to "…target different stakeholders at different phases: in the early phases only (semi-) professional NGOs and large companies might be involved and in later phases small NGOs, small companies, and individual citizens may be involved as well" (p. 166).

Finally, in addition to the identification of goals, barriers, stakeholders, and timing, there is much consideration to *how* participation can be actively fostered and encouraged. Specifically, the literature considers mechanisms that could be utilized to overcome the barriers discussed above and ultimately meet the stated goals. Many of these tools focus on engaging prolonged participation from stakeholders as "[m]eaningful involvement in decision-making necessitates going beyond the 'invite, inform, ignore' model" (Wiek & Larson, 2012, p. 3165).

The types of methods and tools identified to increase participation in basin-scale decision-making can be as simple as increased face-to-face contact (B. P. Hooper, 2003). Or they can be larger scale systemic changes to the institutional structures, such as utilizing nested governance regimes (Garrick et al., 2011), decentralization (Jaspers, 2003), polycentricity (Pahl-Wostl et al., 2012), and collaborative endeavors (Wiek & Larson, 2012). One view of nested governance in regard to participation is that nested governance "…combines local, private sector innovation from water trusts and basin organizations with complementary institutional arrangements to coordinate public agencies across state and federal jurisdictions" (Garrick et al., 2011, p. 182). Decentralization is another institutional tool that has been proposed to increase stakeholder participation (Jaspers, 2003). By instituting "water management at the lowest appropriate level" (p. 81), stakeholder participation can be increased and thereby

ultimately improve the efficacy of water planning. In addition to decentralization, polycentricity could be utilized to increase stakeholder participation (Pahl-Wostl et al., 2012). "[P]olycentricity is strongly associated with the adoption of good governance principles including stakeholder engagement… Polycentric systems combine decentralization and a distribution of power and authority across levels with effective coordination. Bottom-up and top-down processes are balanced" (p. 29).

Another method is to examine and learn from existing decision-making processes, as decision-makers can see what worked and what did not work in a given a river basin. This includes learning about stakeholder participation from within one's own river basin (Hedelin, 2007) and learning from other river basins (Mostert, 2006). Greater communication via education and outreach (B. P. Hooper, 2003), collaborative and open dialogues (Richter et al., 2003), face-to-face contact (B. P. Hooper, 2003), holding regular meetings (Pahl-Wostl, 2009), the use of workshops (Antunes et al., 2009), and efforts to continue communication throughout the decision-making process (Renner et al., 2013) can also encourage and increase stakeholder participation.

Leadership and facilitation are other types of tools that could potentially help increase stakeholder participation in water decision-making (Mostert, 2006). Specifically, Mostert notes that leadership is not simply telling others what to do, as this "…only triggers resistance, position taking and win-lose negotiations instead of integrative, reflexive win-win bargaining" (p. 162). Instead, it is suggested that a "neutral facilitator" should help lead the process and increase participation. Renner et al., 2013 discuss how "intermediaries" can help gain stakeholder trust and participation, as long as those intermediaries have good reputations within the community. A specific example from Europe suggested that a project leader had an excellent reputation and long-standing relationship with the water community, which

"…substantially increased the stakeholders' willingness to participate in the project" (Renner et al., p. 239). A respected advisory board could be another option for guiding stakeholder participation. In addition to reputation and respect, leaders or facilitators need to have sufficient expertise in their specific water systems, especially in regard to trans-national river basins (Savenije & Van der Zaag, 2000). Given the complexity of such river basins, "[s]ubject matter specialists thus play a crucial role in the evolution of international collaboration" (p. 21).

Evaluation and feedback are additional tools to improve the participatory process and increase stakeholder engagement (Antunes et al., 2009; Mostert, 2006; Pereira & Quintana, 2009). Providing feedback for stakeholders following decision-making processes helps improve future processes as well as demonstrating to the stakeholders the importance of their participation (Mostert, 2006). This evaluation and feedback can be done internally or externally, as "[e]xternal evaluators who were not involved in the process can identify points for improvement that internal evaluators may miss" (p. 167). Pereira and Quintana 2009 discuss the importance of not only conducting evaluations, but also actually incorporating the results into future processes. They note that "institutions have to create ears, i.e. mechanisms by which relevant outcomes are incorporated in the evaluation process" (p. 947).

Another tool to foster participation is to develop river basin plans with a range of stakeholders. This not only includes additional stakeholders in the decision-making process, but also can create more effective basin plans as "…[j]ointly developed plans have more credibility, and hence are more effective, than plans developed by individual states" (Savenije & Van der Zaag, 2000, p. 35). Similarly, jointly participating in research supporting decision-making processes ensures stakeholder participation (Mostert, 2006; Savenije & Van der Zaag, 2000). As noted by Mostert 2006:

> "If water management is to be participatory, the research supporting water management should also be participatory. The research results should be available to the different public groups and be presented in a way that is understandable for them. Moreover, the public should have a say in what exactly is researched and how. Finally, the public may participate in the research itself" (p. 159).

Water-related research can often be quite technical and thus not every stakeholder will have the skills or ability to fully participate in every aspect of the research. In this case, those with less technical skills can help with the context and research agenda setting, as well as developing methods to incorporate the results into decision-making. Further, the general public can be used to "provide data and help to monitor compliance with regulations" (Mostert, p. 160).

While some participation can be ad-hoc or voluntary, it is important to formalize and institutionalize some level of participation (B. P. Hooper, 2003; Mostert, 2006). This could be in the form of "contractual arrangements" that "use powerful information exchange mechanisms to link multiple, distant players; invest in face-to-face contacts and community advisory processes" (B. P. Hooper, 2003, p. 17). It could also be in the form of water users associations that can ensure adequate representation and participation (Mostert, 2006). Water users associations are formal groups of water users that are established for a specific management task (e.g., irrigation, flood control, and infrastructure maintenance). While water users associations are typically found in the developing world, there could be implications of these types of groups for participation in river basin management in the developed world.

A final tool for effective participation is the transparent documentation of the participation itself and how the results of the participatory process are incorporated into decision-making (Wiek & Larson, 2012). This documentation of how stakeholder input is used or not used "…is critical so that input is not simply ignored or dismissed

in the outcomes" (p. 3165). As the quote from the beginning of this section suggests, stakeholder participation in water management needs to move beyond the "invite, inform, ignore" model.

2.4.1.2. Information

The second most common criterion discussed in the literature related to the use of information, with 28 of the articles mentioning some form of information as essential for sustainable and equitable water policy. The specifics of this criterion varied from how information is used (Blackstock et al., 2012; Hooper, 2010; Loucks, 2000; Richter et al., 2003; Videira et al., 2006), to how information is shared and communicated (Giupponi et al., 2006; Hooper, 2010; Jønch-Clausen & Fugl, 2001; Wolf, 1999). This criterion also included the importance of integrating information across disciplines, sectors, and knowledges (Hedelin, 2007; Mostert, 2006; Orlove & Caton, 2010; Pahl-Wostl et al., 2012; Parkes et al., 2010; Rinaudo & Garin, 2005; Wilder & Ingram, 2016) and what types of information are important in the first place (Gleick, 1998; Hooper, 2003; Jønch-Clausen & Fugl, 2001; Juwana et al., 2012; Loucks, 2000; Pahl-Wostl et al., 2010).

Types of information

Beyond the ability of stakeholders and decision-makers to access adequate information, the type of specific information is also important to the decision-making process. Types of information include the amount of surface water available, how that water is being used, details regarding water quality, and any other conditions or trends in water information (Gleick, 1998; Hooper, 2003). Temporally, it is important that information regarding baseline conditions is available, to understand how conditions might change given new decisions or policies (Loucks, 2000). Juwana et al. 2012 discuss the use of indicators for establishing and understanding sustainable water policy, but

they note that "[i]ndicators which have been identified will be less useful when reference or threshold values to assess the indicators are not available" (p. 361). This further establishes the importance of baseline conditions being available.

Perhaps more importantly, however, this information needs to be accurate, credible, and complete (Hughes & McKay, 2009; Pereira & Quintana, 2009; Wiek & Larson, 2012). Having credible and accurate information can lend "credibility to an idea… and allowing for novel policy options based on new understanding" (Hughes & McKay, 2009, p. 191). Pereira and Quintana 2009 discuss what they refer to as "socially robust knowledge", in that knowledge or information is not limited to the science but also includes contextualized and relevant knowledge for the appropriate stakeholders. They go on to explain that socially robust knowledge must be adequate, accurate, and complete. Adequacy means that the knowledge or information can meet the stated goals and fix the problem; accuracy refers to uncertainties in the knowledge or information; and completeness concerns whether or not there are gaps in the knowledge or information.

Scenarios and models are discussed in the literature as useful sources of information for decision-making (Pahl-Wostl et al., 2010; Pereira & Quintana, 2009). "Models used in environmental evaluation processes are not only assessment tools but they should be considered as instruments to structure significant issues as well as to facilitate and to engage the relevant community in a dialog leading to the resolution of conflicts aroused in decision-making processes" (Pereira & Quintana, 2009, p. 951). The use of models in decision-making depends, however, on whether the appropriate stakeholders or end users will accept as valid the information produced by the models. Several concepts to help validate the information include fitness for purpose, legitimacy, and transparency (Pereira & Quintana 2009). Fitness for purpose refers to

whether or not the model is appropriate for the specific problem or question at hand—in other words, is the methodology specific to the context of the decision-making? Legitimacy in this context refers to the point that models, "should be 'certified' by the experts and accepted by the actors involved in the process. This acceptance by social actors is crucial in the case of decision issues where there are conflicts of interests and compromise solutions perhaps might be needed" (Pereira & Quintana, 2009, p. 952). Finally, transparency in the models themselves must be present to allow for the entire decision-making community to understand the model's methodology, assumptions, and results.

Scenarios have been suggested as useful for decision-making processes, as they can be helpful in handling uncertainties in future environmental conditions, particularly with climate variability and change (Pahl-Wostl et al., 2010, 2012). By developing differing potential future scenarios, decision-makers can get a better understanding of potential barriers to successful planning efforts, and ways to potentially overcome these barriers. Ideally, planning efforts would identify approaches that can handle multiple scenarios and outcomes. These "[r]obust approaches may be identified which perform well under different but initially uncertain future developments" (Pahl-Wostl et al., 2010, p. 577).

The use of information

Hooper 2003 notes that "good" river basin governance "use[s] a strong knowledge base that derives from a good, uniform, and comprehensive data network, systems and models for analysis, and that allows 'knowledgeable' natural resources/water management policies and strategies to be developed and implemented" (p. 16). This idea of "data collection networks" or "joint databases" of relevant information appears elsewhere in the literature as an important way to

organize and help use the appropriate information (Jønch-Clausen & Fugl, 2001; Savenije & Van der Zaag, 2000). Further, given its importance, water data itself can be used as capital in negotiation processes (Wolf, 1999). For example, the appropriate data can be used to demonstrate that a particular sticking point in a negotiation may not be as much of a barrier as previously thought.

It is important for decision-makers to incorporate new information as it becomes available (Richter et al., 2003). How to accomplish this incorporation may be difficult without a specific articulation of the incorporating process. One such way to overcome this difficulty could be to establish a "scientific peer review committee, chartered with responsibility for reviewing the design and results of water management experiments and monitoring and making recommendations to a river basin commission or other local or regional management agency with ultimate decision-making authority" (Richter et al, 2003, p. 217). More specifically, Videira et al., 2006 discuss how new scientific information can be used for "evaluation, accounting for the quality of data, the complexity of the problem and the uncertainty of the future" (p. 4).

Communication and sharing of information

The need for efficient and effective communication of information between producers and users—often between scientists and water decision-makers—is discussed throughout the literature as important for sustainable and equitable water policy (Giupponi et al., 2006; Hooper, 2010; Jønch-Clausen & Fugl, 2001). Hooper 2010 examined 115 indicators of best practices for river basin management, grouping them into ten categories. The category "information and research" included indicators emphasizing "protocols to share information" and "a culture of research-knowledge links" (Hooper, 2010, p. 470). This work suggests that institutionalizing communication and information sharing is an important component of river basin management.

Similarly, Jonch-Clausen and Fugl 2001 explore a management "toolbox" that could help water managers implement Integrated Water Resources Management (IWRM). One of the five categories in this toolbox is "communication and information", where the authors suggest "raising awareness is often a potent instrument for improving management, particularly when accompanied by opportunities for informed stakeholder participation (Jønch-Clausen & Fugl, 2001, p. 509). Giupponi et al. 2006 note the suite of available water data and scientific information, but remark that integrating these into decision-making processes is difficult. Thus, the authors conclude that one of the ways to overcome this integration barrier is the "need for efficient communication between the scientific and policy sectors and between decision makers and the stakeholders" (Giupponi et al., 2006, p. 95). Again, there is a strong emphasis on communication and coordination between the producers and users of information.

Integration of information across disciplines, sectors, and knowledge types

Finally, literature emphasizes the need for information to be successfully integrated and utilized across disciplines, sectors, and differing knowledge types (Hedelin, 2007; Mostert, 2006; Orlove & Caton, 2010; Pahl-Wostl et al., 2012; Parkes et al., 2010; Rinaudo & Garin, 2005; Wilder & Ingram, 2016). The theory behind integration is that individual disciplines, such as physical science or social science, are insufficient on their own to handle complex water problems, especially at the basin-scale (Hedelin, 2007; Wilder & Ingram, 2016). Hedelin notes that the social sciences typically focus primarily on anthropocentric processes, at the expense of physical or ecological processes, while the natural sciences do not adequately address the social and institutional processes, including the relationships among stakeholders. Accordingly, "no discipline alone can contribute to the scientific knowledge that is required for regional water management" (Hedelin, 2007, p. 154). In regard to differing

knowledge types, Wilder and Ingram note "[c]onventional science struggles with the often-false dichotomy between humans and nature. Experiential and indigenous knowledge can transcend this divide" (p. 15). Additionally, Orlove and Caton point out that "[w]ater management, whether ancient or modern, depends on various kinds of knowledge" (p. 405). Finally, Rinaudo and Garin found there are several reasons why stakeholders in river basin decision-making have different viewpoints and knowledge, and why it is important to integrate these across sectors and disciplines (Rinaudo & Garin, 2005). One reason is that different categories of stakeholders have different conceptions of time as it relates to river basin planning. For example, lay people may take into consideration recent events more prominently, while experts may take a longer view, based on their experience. Another reason is that different stakeholder groups' notions of geographic scale will differ depending on their specific role in the river basin. A final reason is that stakeholders have their individual interests and values that may influence how they see decision-making at the river basin scale. Further:

> "The stakeholders' vision may reflect one facet only of a complex reality, not necessarily because of insufficient information and knowledge but because they try to influence the debate in a direction favorable to their interests. Similarly, the vision of experts can also be influenced by their technical background; they may be concentrating on issues lying within their field of expertise, underestimating the significance of others and eventually trying to generate new demands for expert advice" (Rinaudo & Garin, 2005, p. 287).

The integration of information across different sectors can strengthen decision-making processes and promote social learning (Mostert, 2006). Despite stakeholders across different sectors having potentially different interests in the decision-making process, the successful integration of these interests, views, and knowledges can actually "provide opportunities for mutually beneficial exchanges" (p. 162). More specifically, Pahl-Wostl collated "regime characteristics" for increased success in river

basin governance, and one of the seven regime measures the author identified was "[o]pen access to information and integration of different kinds of knowledge" (Pahl-Wostl et al., 2012, p. 26). This included the sub-indicators of "consideration of expert and local/traditional knowledge" and "open access to information". As Pahl-Wostl pointed out, "[i]ncluding a broader set of stakeholders gives access to different kinds of knowledge, which may be vital for a full assessment of a resource governance problem and for finding innovative solutions to deal with it" (p. 28).

Attempts to integrate knowledge towards the beginning of the decision-making process may help further strengthen the process and actually decrease the time it takes for collaborative processes to succeed (Rinaudo & Garin, 2005). This integration of knowledge, particularly early in the process, will help ensure that both lay persons and experts are aware of the problems perceived by both groups, ensure that lay persons are aware of problems not currently recognized by the general public, and identify problems for which a more collaborative approach involving local stakeholders is appropriate.

As such, integrating information across disciplines, sectors, and knowledge types is an important element in promoting sustainable and equitable water decision-making at the basin-scale. As Wilder and Ingram conclude with their appraisal of equity in global water governance, "[t]he addition of experiential and indigenous knowledge to that of conventional Western science in water resource decision-making is another contemporary innovation that would seem to serve equity" (Wilder & Ingram, 2016, p. 15).

2.4.1.3 Governance

In the seminal work on sustainability assessment by Gibson et al. 2005, one of the eight proposed categories of decision criteria for sustainability is "socio-ecological civility and democratic governance". In justifying this category, the authors note:

> "[b]etter governance is a prerequisite and probably also a product of steps towards sustainability. As the discussion so far has confirmed, there are few easy answers in the pursuit of sustainability. Even the initial items in the requirements list – dealing with the dynamic complexities of interlinked socio-ecological systems, ensuring sufficiency and opportunity, moving towards intra- and intergenerational equity, and designing efficiency strategies that can win lasting overall gains – demand much more than our present decision-making structures and processes have been able to deliver" (Gibson et al., 2005, p. 107).

Accordingly, the criterion of "governance" was coded for in the literature review, and was found often, with 26 of the articles mentioning some aspect of governance as important for sustainable or equitable water policy. Specific criteria were coded as governance if they included specific water governance tools, laws, regulations, coordinating governance structures, types of governance regimes, or any theoretical governance principles. Specifically, some common governance criterion included mechanisms such as water markets/trading (Garrick et al., 2011) or governance structures and regimes such as polycentricity (Pahl-Wostl et al., 2012) and the appropriate government scale of decision-making (Wagner et al., 2002). Additional criteria included laws or regulations such as flexible and adaptive rules (Pahl-Wostl, 2002) and legislative mandates (Hooper, 2003), or criteria focused on coordinating decision-making such as avoiding fragmentation and overlap, and delegating specific tasks (Jaspers, 2003). Finally, there were numerous criteria focusing on "good governance principles" such as developing strong institutional capacity (Reeve, 2003) and clearly articulating decision-making processes and authority (Richter et al., 2003).

Governance mechanisms

Numerous mechanisms were identified as supportive of sustainable or equitable water policy. Several of these mechanisms involved specific regulatory actions that could be taken by multiple levels of governments. For example, pricing tariffs, subsidies, and permits were discussed as economic instruments that could be used to help reach sustainable uses (Falkenmark, 1997; Jønch-Clausen & Fugl, 2001). Additionally, these mechanisms could be used to reduce pollution and improve water quality, for example with tradable discharge permits (Hooper, 2003). Another regulatory mechanism that could be used by water managers or governments is land-use planning (Jønch-Clausen & Fugl, 2001). One article specifically noted that these planning mechanisms should be created and implemented by local governments (Hooper, 2003).

Water markets are another mechanism identified as important in the literature. Garrick et al 2011 notes that "there are multiple paths to more sustainable water allocation outcomes through water trading" (p. 182). Specifically, a common thread seen across the multiple paths was the presence of nested governance structures that combined public and private partnerships across multiple levels of government. Pahl-Wostl 2002 notes that "[t]rans-nationl management schemes and formal arrangements for trading water rights need to establish efficient institutional settings, preventing transaction costs from becoming too high" (Pahl-Wostl, 2002, p. 409).

Some market-based mechanisms included "polluter-pays", "user-pays", or "cost-sharing programs" principles as instruments to ensure sustainable water management (Hooper, 2003; Serageldin, 1995). These types of principles support water being managed more comprehensively, rather than separated into distinct sectors or

jurisdictions. Issues such as water quality may become problematic if the source of the pollution is not brought into the comprehensive management of the river system.

Level of government, nested governance, polycentricity

In addition to the governance mechanisms and methods discussed above, significant attention is paid to governance organization, how differing levels of government should interact, and at what levels of government water policy decisions should be made. For example, Garrick et al. 2011 discusses the concept of "subsidiarity", which suggests that water policy decisions should be made at the lowest level possible. This does not imply the lowest level of government available, but rather the lowest level of decision-making that can most efficiently address the concerns of interest. Another concept discussed by the authors includes "complementarity", which suggests a nested governance regime in which lower levels of government have necessary autonomy and capacity in making decisions, but these decision-making processes are reinforced "with resources and accountability to larger-scale policy objectives. Consequently, nested governance arrangements provide a venue for coupling local institutional capacity with higher-level resources and authority" (Garrick et al., 2011, p. 169).

Polycentricity is another concept of governance design that has been suggested as a means to improve decision-making in river basins (Pahl-Wostl et al., 2012). Pahl-Wostl et al., 2012 define polycentricity as "complex, modular systems where differently sized governance units with different purposes, organizations and spatial locations interact to form together systems characterized by many degrees of freedom at different levels" (p. 27). The authors go on to specify that this implies that decision-making authority is found at all levels of government (i.e., federal, state, and local), rather than having one level of government tasked with water policy. It is important to note that

the authors make a distinction between polycentricity and decentralization, where polycentric systems have a balanced level of authority both at high and low levels of government. Ultimately, the authors found that "an important condition for improving performance is striving for more polycentric structures. Striving for polycentricity allows river basins, regions and countries to find their own path rather than following narrowly prescribed recipes" (p. 32).

Jaspers 2003 discusses institutionalizing the concept of "decentralization", which is "the process of transferring tasks and competencies permanently or for an indicated period of time (but not incidentally) from the centre of authority to other departments, agencies or administrative levels in order to organise or implement a government function" (p. 84). To achieve successful decentralization, three methods are proposed. "De-concentration" suggests that some tasks and responsibilities be given to offices or authorities outside of the central agency but within the same administrative structure, such as regional offices, even though the central agency still retains ultimate authority. "Delegation" suggests that some tasks and responsibilities be given to offices or authorities that are not necessarily within the same administrative structure (e.g., private agencies) with some transfer of authority, but the central agency still retains some control by creating a regulatory framework. "Devolution" suggests that some tasks and responsibilities be shifted completely to lower level offices or authorities, again not necessarily within the same administrative structure, enabling those agencies to make autonomous decisions. The authors note that devolution is relatively rare, as governments typically do not want to cede authority of public functions, while de-concentration and delegation are more common practices in river basin management.

Further, a common concern in the literature is the role of the federal or top level of government in decision-making (Jønch-Clausen & Fugl, 2001; Reeve, 2003). For

example, the federal role could be to provide an "enabling environment" which includes top-down and bottom-up approaches (Jønch-Clausen & Fugl, 2001). Or the federal role could be a facilitating role as opposed to a "top-down manager". That is, water policies could be formulated at the national level, but lower levels of government direct implementation. In addition to facilitating an enabling environment, the federal government can provide some level of certainty and institutional stability on which lower levels of government can depend. This "[s]trong institutional capacity is required in the upper layers to provide effective processes of political representation, decision-making, judicial review and the clear expression of targets and guidelines decided upon" (Reeve, 2003, p. 5). A level of stability and institutional capacity in the upper levels of government may also allow lower levels of government more flexibility in their decision-making processes, potentially allowing for new or innovative strategies that might otherwise be considered too risky or fraught with uncertainty. The federal role can also be to incorporate water planning efforts into broader national objectives, such as public health and food policy, by establishing a national water policy (Leshy, 2009; Serageldin, 1995). Again, a national water policy could set broad goals and visions, but give flexibility for individual sub-national governments to meet the stated goals and vision.

Legislation

Some of the articles discussed the importance of specifically thinking about legislation that governs river basins (Hooper, 2003; Ioris et al., 2008). For example, it was suggested that a "good" basin organization is one that has "a strong foundation and mandate in legislation that clearly identifies its function, structure, financial base and whose administration and operation is based upon a decision-making process of authority, responsibility and accountability" (Hooper, 2003, p. 17). Hooper 2010

compiled a list of best practices and indicators for river basin organizations, which included a category of the "role of law". Specifically, the category noted the importance of supportive laws that are strong and flexible. Further, one article discussed the importance of having legislation at the river basin scale (Ioris et al., 2008). The authors note that the "experience up till now demonstrates the need to operate at a catchment scale for the establishment of a shared, long-term view of water sustainability (p. 1196). Somewhat conversely, however, one study found that the presence of legal frameworks was a "necessary but not sufficient condition for overall high performance" (Pahl-Wostl et al., 2012, p. 30). More specifically, the authors note that in all countries who demonstrate a high performance in river basin management there was comprehensive water legislation, but that there were numerous countries that had comprehensive water legislation but also had poor performance measures.

Coordination

In addition to the types of governance structures and regulatory directives mentioned above, it is important for governance activities to be coordinated in such a way as to reduce or eliminate fragmentation, overlap of responsibilities, and resistance to new reforms or policy changes (Hooper, 2003; Parkes et al., 2010). For example, when:

> "reforms of the magnitude of river basin management are introduced or expanded, there is resistance to change and concern over infringement on administrative level and agency 'turf', so a strategic planning and implementation process based on communications, coordination, and cooperation within a river basin organisation is developed" (Hooper, 2003, p. 17).

Additionally, decision-making processes need to be coordinated across levels of government, stakeholders, and sectors (Parkes et al., 2010). Water governance that is comprehensive and coordinated "recognizes the interactions between various elements of a river basin's ecosystem and allows for the incorporation of cross-sectoral and

environmental considerations in the design of investments and policies" (Serageldin, 1995, p. 228).

Good governance principles

In addition to the specific governance criteria discussed above, there were many broader calls for good governance principles. These were not necessarily specific prescriptions for water management but rather good practices that water managers should strive for in order to achieve sustainable or equitable water decision-making (Antunes et al., 2009; Pereira & Quintana, 2009). For example, Pereira and Quintana 2009 found in their case study work that quality governance processes included "compliance" with five principles: openness, participation, accountability, effectiveness and coherence. Another example is ensuring that the decision-making process enables inclusive political institutions, as this will help reduce conflicts as they relate to the process (Antunes et al., 2009). "This inclusive political process requires that the interests of civil society, hierarchy (government), social movements (NGOs) and the private sector are included in the policy making discourse" (p. 932). Similarly, others have noted that the organizational design of a decision-making process should utilize democratic processes (Hooper, 2010) and have a "strong institutional capacity" (Reeve, 2003). In this context, a strong institutional capacity refers to "effective processes of political representation, decision-making, judicial review and the clear expression of targets and guidelines decided upon" (Reeve, 2003, p. 5).

While inclusive institutions are important, there is concern that a consensus-based process may lead to the systematic exclusion of certain stakeholders or groups (Hedelin, 2007). At issue here are power imbalances that may lead to the exclusion of marginalized groups if a consensus is necessary for a decision to be made. As such, a good governance principle is to ensure that stakeholders' "ideological orientations are

not suppressed" (Hedelin, 2007, p. 159), by including specific procedures in the decision-making process addressing this particular issue.

More broadly speaking, some researchers have suggested decisions should rely less on new or modified infrastructure policies and more on restructuring the management of existing water systems (Orlove & Caton, 2010). As the authors note, "it is unlikely that significant new sources will be found (through desalination, the discovery of underground aquifers, massive transfers from watersheds with low human populations, and other such methods) to alleviate water scarcity or contamination and that instead a finite and rapidly diminishing resource must be managed" (p. 409).

Another good governance principle is the need to continually incorporate new information into decision-making processes (Richter et al., 2003). More specifically, this process should "include the formation of a scientific peer review committee, chartered with responsibility for reviewing the design and results of water management experiments and monitoring and making recommendations to a river basin commission or other local or regional management agency with ultimate decision-making authority" (p. 217). This governance principle does not only focus on incorporating the latest scientific information, but the process for this incorporation needs to be clearly articulated and transparent. In other words, stakeholders need to know where the information came from and how it is being incorporated into the decision-making process.

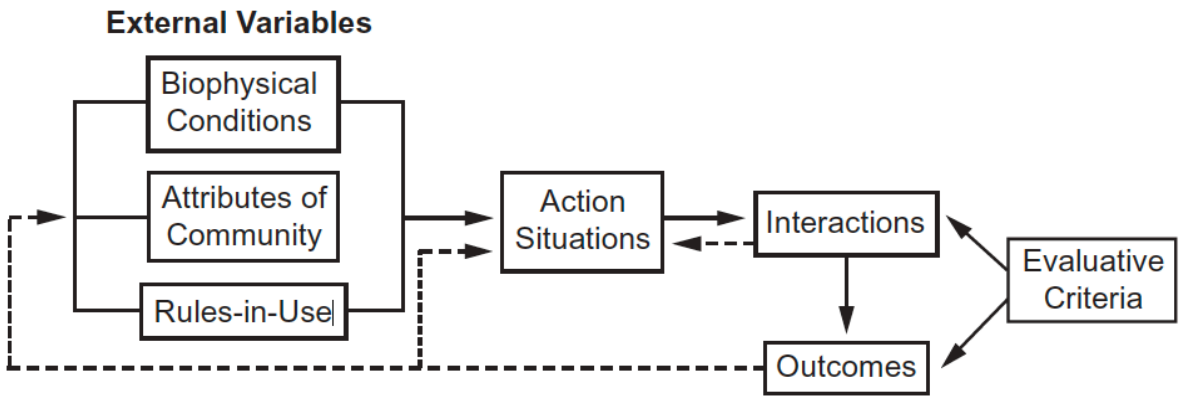
2.5 Sustainability and equity criteria and the Institutional Analysis and Development (IAD) framework

This literature review has revealed not just the diversity and quantity of criteria for sustainable and equitable water policy, but also how even some of the more commonly cited criteria are not entirely straightforward. As discussed above, the

concept of stakeholder participation is quite nuanced and goes well beyond simply saying all impacted stakeholders should be involved in decision-making. Therefore, the question then becomes, what could water managers and decision-makers do with these criteria? As mentioned in the introduction, lists of criteria are not intended to be checkboxes for which a decision-maker can attempt to check-off as many criteria as possible. Rather, these criteria should provide a lens or perspective for how decision-makers could be thinking about basin-scale policy (Wilder & Ingram, 2016). Criteria are not rules to follow—instead they can provide helpful insights for how policy could be shifted towards more sustainable and equitable ideals.

One method for providing this insight might be through the IAD framework, discussed in Chapter 1. In returning to the IAD, we can begin to understand how these criteria can be used in an institutional analysis—that is, where do these criteria overlap with the IAD framework. The basic IAD framework as developed by Elinor Ostrom and colleagues explicitly identifies the context, rules, norms, and incentives for how decisions are made and institutions are developed (Elinor Ostrom, 1990, 2005). As Figure 2.2 demonstrates, the IAD posits that decisions are made in what is known as an "action situation", where actors come together to make decisions, based on a set of rules and norms, as well as "external variables" such as the biophysical conditions of a resource, the community attributes (e.g., culture, religion, socioeconomics), and rules-in-use.

Figure 2.2: The Institutional Analysis and Development Framework (Ostrom 2011)



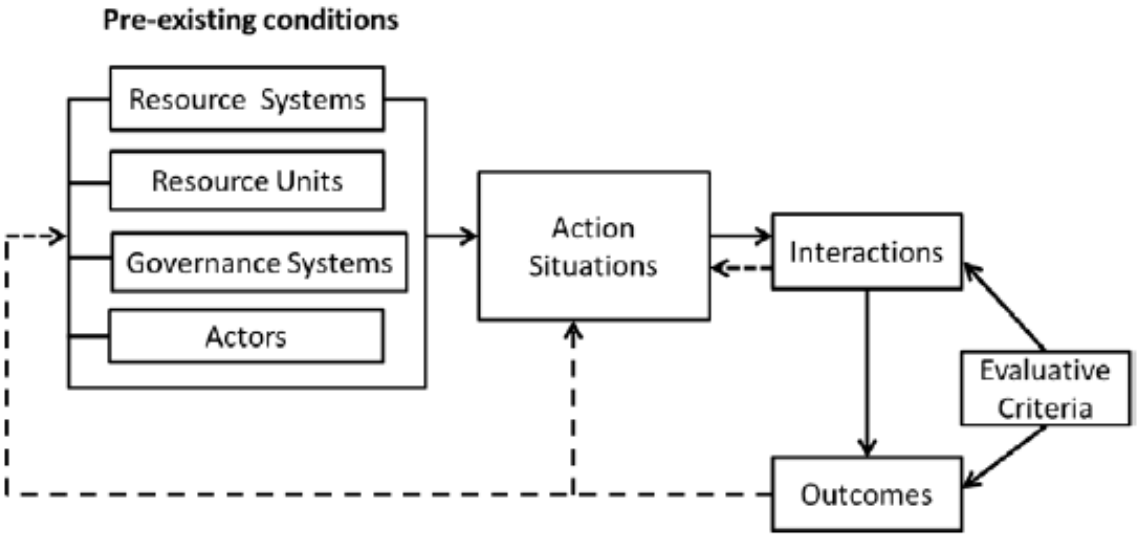
The rules-in-use can be things like monitoring and enforcement, and can be developed and applied at multiple levels of decision-making. From the action situation, patterns of interactions and outcomes can be predicted and identified. Specific criteria can then be used to evaluate those interactions and outcomes. The IAD framework is dynamic because the evaluation of those interactions and outcomes can influence the external variables, modify the actors and action situations, and ultimately modify the interactions and outcomes. The IAD framework is often used to diagnose a specific institution or policy in regard to a resource in question, rather than prescribe how future decision-making should occur.

Importantly, the IAD framework recognizes that there are levels of decision-making, and identifying which level is being analyzed provides better context for the types of changes that are needed or that are possible (Ostrom, 2005). These levels begin with operation situations, which includes day-to-day decision-making around a given resource (e.g., how much water is needed to irrigate a crop). The next level are collective-choice situations which identify and determine what stakeholders can be involved in deciding the operational rules (e.g., who decides how to allocate irrigation

water). Finally, there are the constitutional situations which identify and determine what stakeholders are involved in the collective-choice decision-making (e.g., who decides the rules for how water is allocated). Importantly for an institutional analysis, at each level of decision-making the process for change is much slower and more difficult. In other words, making operational situation changes is quicker and more likely to occur, rather than collective-choice or constitutional situation changes.

One of the major critiques of the IAD framework has been its inability to adequately address and incorporate complex ecological systems (Cole et al., 2014). Ecological systems are incredibly complex, and while the IAD framework has proven successful in analyzing the institutional and social components of a system, it has not been successful in combining the social with ecological and natural systems (Ostrom, 2009; Ostrom & Cox, 2010). In an effort to address this critique, Ostrom then proposed the Social-ecological systems (SESs) framework as a way to explicitly include complex ecosystems in an institutional analysis (Ostrom, 2009). The SES framework divides a system into various subsystems which can then be analyzed through patterns of interactions and outcomes both between individual subsystems and the entirety of the system itself. Despite its benefits in explicitly incorporating social and ecological attributes and diagnosing a complex system, the SES lacks the dynamism of the IAD, rendering it even less capable of policy prescription (Cole et al., 2014). In response to these deficiencies in both frameworks, Cole et al. proposed a combination of the two—incorporate the SES into the IAD so that complex ecological systems can be analyzed while still allowing for the dynamic nature of the IAD to help understand changing conditions over time. Figure 2.3 presents the combined framework.

Figure 2.3: The Combined IAD/SES Framework (Cole et al., 2014)



Cole et al., argue that all of the components in the original IAD are still in the combined framework, but now there is also explicit attention to ecological components (i.e., "Resource Systems" and "Resource Units"). Further, while the action situation is still the primary arena for decision-making, some of the actor context and characteristics have been combined with what was previously the community attributes. By utilizing this combined framework, ecological changes over time can be analyzed and predicted, therefore making it "clearer how social interactions/decisions lead to outcomes that affect those SES variables" (p. 5).

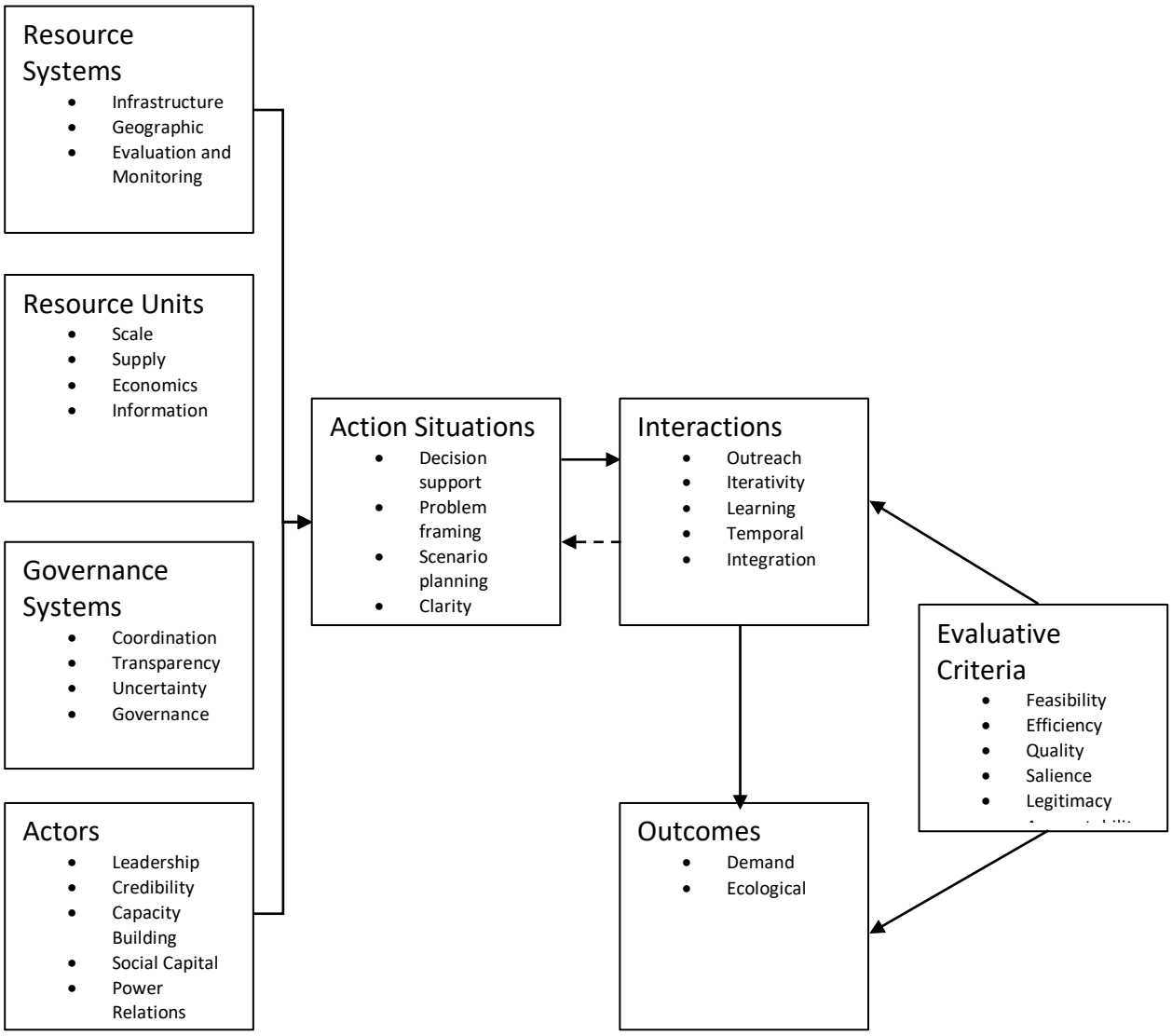
This combined framework—in addition to the benefits of the original IAD such as a focus on rules and norms, and consideration of the levels of decision-making—may provide a mechanism for how decision-makers could think about and view the sustainability and equity criteria identified in the literature review. That is, it may be useful to focus on where each of the criteria may be incorporated into the combined IAD/SES framework. While this is a subjective exercise, and other researchers could

argue the criteria are more appropriate in different subsystem categories, it does provide perspective as to where and how decision-makers could modify their processes. Figure 2.4 presents a conceptual understanding of how the sustainability and equity criteria could be applied to the combined IAD/SES framework.

As shown in Figure 2.4, the sustainability and equity criteria can be integrated throughout the IAD/SES framework. For example, the three criteria discussed in detail above—participation, information, and governance—are within different subsystems of the framework. Participation can be found in the actor subsystem, whereas information is located in resource units and governance in governance systems. Despite the criteria's integration throughout the framework, utilizing the frequency of each criteria in the literature review illuminates some differences among the subsystems. As shown in Figure 2.1 above, the number of articles mentioning each of the criteria ranged from 1 to 36. Accordingly, the relative weight of each subsystem compared to each other—by the number of articles mentioning criteria—suggests some subsystems may be more substantial in influencing sustainability and equity goals.

For example, some of the criteria in the actor subsystem were discussed by many articles, most notably participation and fairness, but also power relations, social capital, and capacity building. Compared with another subsystem that has many fewer articles mentioning the criteria—such as the interaction subsystem—it becomes clear that the actor subsystem might require greater consideration to support sustainability and equity goals. In other words, given decision-makers limited capacity for change, they could focus their efforts on one particular subsystem to effect the most change towards sustainability and equity.

Figure 2.4: Applying sustainability and equity criteria to the combined IAD/SES framework



Another outcome of this approach is helping understand how some criteria might interact within a particular subsystem. If a decision-maker focuses on one subsystem and wants to consider methods for meeting one of the criteria, he or she could think about the other criteria within that subsystem. For example, if a decision-maker's goal is to increase participation in the process, he or she could consider the other criteria within the actor subsystem. In thinking about participation, then, it may

be necessary to consider issues of leadership, credibility, capacity building, social capital, power relations, and fairness. This is not to say the criteria are correlated, but they do reveal how the criteria could be considered in the context of each subsystem.

The application of the sustainability and equity criteria to the combined SES/IAD framework helps begin to understand how these criteria might be utilized by water managers in their decision-making process. As discussed above, this application is a subjective exercise and is not intended to prescribe how each criterion should be applied to the decision-making context, but it does provide a starting point for the utility of the numerous criteria identified. Accordingly, it attempts to bridge the gap discussed in Chapter 1 between the sustainability and equity literature and empirical decision-making, utilizing a well-established theoretical framework, in order to support river basin governance.

2.6 Conclusion

This literature review has revealed numerous criteria deemed as important for the implementation of sustainable and equitable policy. For example, while stakeholder participation was the most commonly cited criterion in the literature, participation is particularly complicated and requires a nuanced consideration of how to think about various stakeholders' participation in decision-making. Further, participation will mean different things to multiple stakeholders, and it requires an understanding not only of how, when, and who can participate, but also why they should participate in the first place.

While some of the other criteria are more straight-forward, others are less so. For example, information was a commonly discussed criterion. Obviously more complete, accurate, and reliable information is important for decision-making, but often in river basins this information is incomplete, unreliable, or lacks credibility. In the Colorado

River Basin, basic information on how much water is used and where it is used is difficult to track down and will differ depending on the reporting agency (Cohen et al., 2013). Even when information is available, it is not always clear how that information could be incorporated into decision-making.

Ultimately this literature review has revealed the importance of examining in detail how a particular criterion can be utilized in river basin decision-making. This will be a primary focus of the proceeding chapters in this dissertation. Further, incorporating these criteria into the IAD/SES framework has also revealed particular subsystems of the framework that may require additional understanding for sustainability and equity implications. For example, the actor, resource unit, governance systems, and interaction subsystems were more commonly associated with the identified criteria than other subsystems. These subsystems will also therefore be a primary focus of the proceeding chapters.

In sum, this chapter identified 37 criteria that are seen as important for sustainability and equity. While incredibly rich and diverse, the difficulty lies in understanding the implications of all or a subset of the criteria for river basin decision-making. The IAD helps identify particular subsystems for which analysis might help understand these implications, as well as understand how the criteria relate to each other. As summarized by Renner et al., 2013 "[k]ey points for more holistic, sustainable water governance have emerged (Hedelin 2007; Pahl-Wostl et al 2010; Wiek and Larson 2012), but ways to put them into practice still seem somewhat elusive" (p. 235). As also summarized by Wilder and Ingram 2016, "[t]wenty-five years of mobilization around the global water management paradigm have not yielded solutions broadly viewed as more equitable nor led to fewer or more malleable conflicts" (p. 5).

2.7 References

Ananda, J., & Proctor, W. (2013). Collaborative approaches to water management and planning: An institutional perspective. *Ecological Economics*, *86*, 97–106. https://doi.org/10.1016/j.ecolecon.2012.10.018

Antunes, P., Kallis, G., Videira, N., & Santos, R. (2009). Participation and evaluation for sustainable river basin governance. *Ecological Economics*, *68*(4), 931–939. https://doi.org/10.1016/j.ecolecon.2008.12.004

Armstrong v. Larimer County Ditch Co., 27 Colorado Court of Appeals § (1891).

Blackstock, K. L., Waylen, K. A., Dunglinson, J., & Marshall, K. M. (2012). Linking process to outcomes — Internal and external criteria for a stakeholder involvement in River Basin Management Planning. *Ecological Economics*, *77*, 113–122. https://doi.org/10.1016/j.ecolecon.2012.02.015

Blomquist, W., & Schlager, E. (2005). Political Pitfalls of Integrated Watershed Management. *Society & Natural Resources*, *18*(2), 101–117. https://doi.org/10.1080/08941920590894435

Clark, M. J. (2002). Dealing with uncertainty: adaptive approaches to sustainable river management. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *12*(4), 347–363. https://doi.org/10.1002/aqc.531

Cohen, M., Christian-Smith, J., & Berggren, J. (2013). WATER TO SUPPLY THE LAND. Retrieved from http://www.pacinst.org/reports/co_river_ag_2013/irrigated_ag_crb.pdf

Cole, D. H., Epstein, G., & McGinnis, M. D. (2014). *Toward a New Institutional Analysis of Social-Ecological Systems (NIASES): Combining Elinor Ostrom's IAD and SES Frameworks* (No. Research Paper Number 299) (p. 23). Maurer School of Law, Indian University.

Falkenmark, M. (1997). Society's interaction with the water cycle: a conceptual framework for a more holistic approach. *Hydrological Sciences Journal*, *42*(4), 451–466. https://doi.org/10.1080/02626669709492046

Garrick, D., Lane-Miller, C., & McCoy, A. L. (2011). Institutional Innovations to Govern Environmental Water in the Western United States: Lessons for Australia's Murray-Darling Basin: LESSONS FROM THE WESTERN U.S. *Economic Papers: A Journal of Applied Economics and Policy*, *30*(2), 167–184. https://doi.org/10.1111/j.1759-3441.2011.00104.x

Gibson, R. B., Holtz, S., Tansey, J., Whitelaw, G., & Hassan, S. (2005). *Sustainability Assessment: Criteria, Processes, and Applications* (1 edition). London ; Sterling, VA: Earthscan.

Giupponi, C., Fassio, A., Vazquez, J. F., & Mysiak, J. (2006). Sustainable Water Management and Decision Making. In *Sustainable Management of Water Resources: An Integrated Approach*. Cheltenham, UK: Edward Elgar Publishing.

Gleick, P. H. (1998). Water in crisis: paths to sustainable water use. *Ecological Applications*, *8*(3), 571–579.

Global Water Partnership. (2000). *Integrated water resources management*. Stockholm: Global Water Partnership.

Grigg, N. S. (2016). *Integrated Water Resource Management*. London: Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-57615-6

Hedelin, B. (2007). Criteria for the Assessment of Sustainable Water Management. *Environmental Management*, *39*(2), 151–163. https://doi.org/10.1007/s00267-004-0387-0

Hooper, B. (2010). River basin organization performance indicators: application to the Delaware River basin commission. *Water Policy*, *12*(4), 461. https://doi.org/10.2166/wp.2010.111

Hooper, B. P. (2003). Integrated water resources management and river basin governance. *Journal of Contemporary Water Research and Education*, *126*(1), 3.

Hughes, S., & McKay, J. (2009). 10 The contribution of actors to achieving sustainability in Australia through water policy transitions. *Water Policy Entrepreneurs: A Research Companion to Water Transitions Around the Globe*, 175.

Ingram, H., & Lejano, R. (2009). Transitions: transcending multiple ways of knowing water resources in the United States. In D. Huitema & S. Meijerink (Eds.), *Water Policy Entrepreneurs: A Research Companion to Water Transitions around the Globe*. Massachusetts, MA: Edward Elgar Publishing.

Ingram, H. M., Scaff, L. A., & Silko, L. (1986). Replacing Confusion with Equity: Alternatives for Water Policy in the Colorado River Basin. In G. Weatherford & F. L. Brown (Eds.), *New Course for the Colorado River: Major Issues for the Next Century*. University of New Mexico Press.

Ingram, H. M., Whiteley, J. M., & Perry, R. W. (2008). The Importance of Equity and the Limits of Efficiency in Water Resources. In J. M. Whiteley, H. M. Ingram, & R. W. Perry (Eds.), *Water, place, and equity*. Cambridge, Mass: MIT Press.

Ioris, A. A. R., Hunter, C., & Walker, S. (2008). The development and application of water management sustainability indicators in Brazil and Scotland. *Journal of Environmental Management*, *88*(4), 1190–1201. https://doi.org/10.1016/j.jenvman.2007.06.007

Jaspers, F. G. W. (2003). Institutional arrangements for integrated river basin management. *Water Policy*, *5*, 77–90.

Jønch-Clausen, T., & Fugl, J. (2001). Firming up the Conceptual Basis of Integrated Water Resources Management. *International Journal of Water Resources Development*, *17*(4), 501–510. https://doi.org/10.1080/07900620120094055

Juwana, I., Muttil, N., & Perera, B. J. C. (2012). Indicator-based water sustainability assessment — A review. *Science of The Total Environment*, *438*, 357–371. https://doi.org/10.1016/j.scitotenv.2012.08.093

Kampragou, E., Eleftheriadou, E., & Mylopoulos, Y. (2007). Implementing Equitable Water Allocation in Transboundary Catchments: The Case of River Nestos/Mesta. *Water Resources Management*, *21*(5), 909–918. https://doi.org/10.1007/s11269-006-9108-1

Kang, M.-G., & Lee, G.-M. (2011). Multicriteria Evaluation of Water Resources Sustainability in the Context of Watershed Management1: Multicriteria Evaluation of Water Resources Sustainability in the Context of Watershed Management. *JAWRA Journal of the American Water Resources Association*, *47*(4), 813–827. https://doi.org/10.1111/j.1752-1688.2011.00559.x

Kranz, R., Gasteyer, S. P., Heintz Jr, H. T., Shafer, R., & Steinman, A. (2010). Conceptual foundations for the sustainable water resources roundtable. *Journal of Contemporary Water Research and Education*, *127*(1), 3.

Larson, Kelli L., Wiek, A., & Withycombe Keeler, L. (2013). A comprehensive sustainability appraisal of water governance in Phoenix, AZ. *Journal of Environmental Management*, *116*, 58–71. https://doi.org/10.1016/j.jenvman.2012.11.016

Larson, K.L., White, D. D., Gober, P., Harlan, S., & Wutich, A. (2009). Divergent perspectives on water resource sustainability in a public–policy–science context. *Environmental Science & Policy*, *12*(7), 1012–1023. https://doi.org/10.1016/j.envsci.2009.07.012

Lautze, Jonathan, Silva, S. de, Giordano, M., & Sanford, L. (2014). Water governance. In Jonathon Lautze (Ed.), *Key Concepts in Water Resource Management: A Review and Critical Evaluation*. Oxon, UK: Routledge. Retrieved from https://cgspace.cgiar.org/handle/10568/65282

Leshy, J. (2009). Notes on a progressive national water policy. *Harv. L. & Pol'y Rev.*, *3*, 133.

Loucks, D. P. (2000). Sustainable Water Resources Management. *Water International*, *25*(1), 3–10. https://doi.org/10.1080/02508060008686793

McCaffrey, S. (2003). The Need for Flexibility in Freshwater Treaty Regimes. *Natural Resourcse Forum*, 156–162.

Mostert, E. (2006). Participation for Sustainable Water Management. In *Sustainable Management of Water Resources: An Integrated Approach*. Cheltenham, UK: Edward Elgar Publishing.

Orlove, B., & Caton, S. C. (2010). Water Sustainability: Anthropological Approaches and Prospects. *Annual Review of Anthropology*, *39*(1), 401–415. https://doi.org/10.1146/annurev.anthro.012809.105045

Ostrom, E. (2009). A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science*, *325*(5939), 419–422. https://doi.org/10.1126/science.1172133

Ostrom, Elinor. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge, UK: Cambridge University Press.

Ostrom, Elinor. (2005). *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press.

Ostrom, Elinor, & Cox, M. (2010). Moving beyond panaceas: a multi-tiered diagnostic approach for social-ecological analysis. *Environmental Conservation*, *37*(04), 451–463. https://doi.org/10.1017/S0376892910000834

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, *19*(3), 354–365.

Pahl-Wostl, Claudia. (2002). Towards sustainability in the water sector–The importance of human actors and processes of social learning. *Aquatic Sciences*, *64*(4), 394–411.

Pahl-Wostl, Claudia, Holtz, G., Kastens, B., & Knieper, C. (2010). Analyzing complex water governance regimes: the Management and Transition Framework. *Environmental Science & Policy*, *13*(7), 571–581. https://doi.org/10.1016/j.envsci.2010.08.006

Pahl-Wostl, Claudia, Lebel, L., Knieper, C., & Nikitina, E. (2012). From applying panaceas to mastering complexity: Toward adaptive water governance in river basins. *Environmental Science & Policy*, *23*, 24–34. https://doi.org/10.1016/j.envsci.2012.07.014

Pahl-Wostl, Claudia, Tàbara, D., Bouwen, R., Craps, M., Dewulf, A., Mostert, E., … Taillieu, T. (2008). The importance of social learning and culture for sustainable water management. *Ecological Economics*, *64*(3), 484–495. https://doi.org/10.1016/j.ecolecon.2007.08.007

Parkes, M. W., Morrison, K. E., Bunch, M. J., Hallström, L. K., Neudoerffer, R. C., Venema, H. D., & Waltner-Toews, D. (2010). Towards integrated governance for water, health and social–ecological systems: The watershed governance prism. *Global Environmental Change*, *20*(4), 693–704. https://doi.org/10.1016/j.gloenvcha.2010.06.001

Pereira, Â. G., & Quintana, S. C. (2009). 3 pillars and 1 beam: Quality of river basin governance processes. *Ecological Economics*, *68*(4), 940–954. https://doi.org/10.1016/j.ecolecon.2006.09.014

Rahaman, M. M., & Varis, O. (2005). Integrated water resources management: evolution, prospects and future challenges. *Sustainability: Science, Practice & Policy*, *1*(1), 15–21.

Reeve, I. (2003). Principles for the nested governance of water resources. *Institute for Rural Futures Occasional Paper*, *1*, 1.

Renner, R., Schneider, F., Hohenwallner, D., Kopeinig, C., Kruse, S., Lienert, J., … Muhar, S. (2013). Meeting the Challenges of Transdisciplinary Knowledge Production for Sustainable Water Governance. *Mountain Research and Development*, *33*(3), 234–247. https://doi.org/10.1659/MRD-JOURNAL-D-13-00002.1

Richter, B. D., Mathews, R., Harrison, D. L., & Wigington, R. (2003). Ecologically sustainable water management: managing river flows for ecological integrity. *Ecological Applications*, *13*(1), 206–224.

Rinaudo, J. D., & Garin, P. (2005). The benefits of combining lay and expert input for water-management planning at the watershed level. *Water Policy*, *7*, 279–293.

Rogers, P., & Hall, A. W. (2003). *Effective water governance*. Stockholm: Global Water Partnership.

Sandoval-Solis, S., McKinney, D. C., & Loucks, D. P. (2010). Sustainability index for water resources planning and management. *Journal of Water Resources Planning and Management*. Retrieved from http://ascelibrary.org/doi/10.1061/(ASCE)WR.1943-5452.0000134

Savenije, H. H., & Van der Zaag, P. (2000). Conceptual framework for the management of shared river basins; with special reference to the SADC and EU. *Water Policy*, *2*(1), 9–45.

Schneider, F., Bonriposi, M., Graefe, O., Herweg, K., Homewood, C., Huss, M., … Weingartner, R. (2014). Assessing the sustainability of water governance systems: the sustainability wheel. *Journal of Environmental Planning and Management*, 1–24. https://doi.org/10.1080/09640568.2014.938804

Serageldin, I. (1995). Water Resources Management: A New Policy for a Sustainable Future. *International Journal of Water Resources Development*, *11*(3), 221–232. https://doi.org/10.1080/07900629550042191

Swyngedouw, E., Page, B., & Kaika, M. (2002). Sustainability and policy innovation in a multi-level context: crosscutting issues in the water sector. In *Participatory Governance in Multi-Level Context* (pp. 107–131). Springer. Retrieved from http://link.springer.com/chapter/10.1007/978-3-663-11005-7_6

Tàbara, J. D., & Ilhan, A. (2008). Culture as trigger for sustainability transition in the water domain: the case of the Spanish water policy and the Ebro river basin. *Regional Environmental Change*, *8*(2), 59–71. https://doi.org/10.1007/s10113-007-0043-3

Van der Zaag, P., Seyam, I. M., & Savenije, H. H. (2002). Towards measurable criteria for the equitable sharing of international water resources. *Water Policy*, *4*(1), 19–32.

Videira, N., Kallis, G., & Antunes, P. (Eds.). (2006). *Integrated Evaluation for Sustainable River Basin Governance*. London: IWA Publishing.

Wagner, W., Gawel, J., Furumai, H., De Souza, M. P., Teixeira, D., Rios, L., … Hemond, H. F. (2002). Sustainable Watershed Management: An International Multi-watershed Case Study. *Ambio*, *31*(1), 2–13.

Wegerich, K. (2007). A critical review of the concept of equity to support water allocation at various scales in the Amu Darya basin. *Irrigation and Drainage Systems*, *21*(3–4), 185–195. https://doi.org/10.1007/s10795-007-9035-1

White, G. F. (1998). Reflections on the 50-year international search for integrated water management. *Water Policy*, *1*(1), 21–27.

Wiek, A., & Larson, K. L. (2012). Water, People, and Sustainability—A Systems Framework for Analyzing and Assessing Water Governance Regimes. *Water Resources Management*, *26*(11), 3153–3171. https://doi.org/10.1007/s11269-012-0065-6

Wilder, M., & Ingram, H. (2016). Knowing Equity When We See It: Water Equity in Contemporary Global Contexts. In *Oxford Handbook on Water Policy and Politics*. Oxford University Press.

Wolf, A. (1999). Criteria for equitable allocations: the heart of international water conflict. *Natural Resources Forum*, *23*, 3–30.

Chapter 3 – Interstate River Compacts and Institutional Adaptation: Examining the Law of the River

> *The driving force behind these workshops was a mutual desire to move beyond the notion that international river management was necessarily a zero-sum game, in which the interests of one country or one water user would prevail over the interests of others—an approach which had repeatedly proved to encourage conflict and legalistic, arms-length relationships between water users in the Colorado River Basin. (King, Culp, & de la Parra, 2014, p. 83)*

3.1 Introduction

River systems around the world are increasingly under pressure as issues of over-allocation, competing demands, climate change, prolonged drought, and a variety of other problems threaten sustainable and equitable water governance (Falkenmark & Molden, 2008; Kenney, 2005; Milly et al., 2008). This is not a recent phenomenon, nor is it simply a result of biophysical or hydrological factors. Water resource managers and users have appropriated and allocated rivers across the planet, often through complex governance mechanisms (Sax et al., 2006). One such mechanism is an interstate compact, commonly used in the western United States to allocate rivers among multiple states (Muys, 1973). Interstate compacts have been largely successful in allowing states to develop their respective water supplies by providing the states with certainty as to how much water they can expect from a given river system. More recently, though, it has become clear that compacts have, in fact, often over-allocated a given river's available supply (i.e., allocated more water on paper than is physically available) (Grant, 2003). Historically, this over-allocation has not created significant problems as sufficient supplies were actually available to meet the various demands. As demands continue to increase, however, over-allocated systems will stress river systems and create uncertainty in water availability for the states involved in each compact.

In recent years, various levels of government have been attempting to quantify over-allocations and identify current and future supply and demand imbalances. In the

Colorado River Basin, for example, the Bureau of Reclamation and seven Basin States conducted a "Basin Study" in 2012 that found an average supply and demand imbalance of 3.2 million acre-feet by 2060 (Bureau of Reclamation, 2012). At the state level, Colorado developed its first ever state water plan in 2015 to quantify potential imbalances (Colorado Water Conservation Board, 2015). The plan identified a potential municipal and industrial supply and demand gap of 310,000 to 560,000 acre-feet by 2050. Imbalances at both regional and state scales pose significant challenges to the way water managers think about their approach as water demands continue to increase and supplies are further strained.

For example, western U.S. states have some of the fastest growing urban centers in the country, leading to uncertainty if growth in those areas can be supported without negatively impacting other sectors, including agriculture and recreation. In addition to finite supplies in surface water, there has been a shift from rural to urban economies as cities continue to grow, leading to questions about sharing water efficiently and equitably among competing uses. Finally, the overarching legal regime that many western states utilize is the doctrine of prior appropriation. Working within the constraints of prior appropriation, it is unclear what legal and policy options exist for managing these supply and demand imbalances, both locally and regionally. These uncertainties and questions ultimately revolve around the ability of water governance systems, especially in the western United States, to respond to changing conditions in the coming years and decades. Accordingly, it is increasingly important to consider the adaptive capacity of these systems to confront the challenges of supply and demand imbalances (Pahl-Wostl, 2009).

While numerous definitions exist, adaptive capacity can be broadly "defined as the ability to recover or adjust to change through learning and flexibility so as to

maintain or improve into a desirable state" (Engle & Lemos, 2010, p. 4). The concept commonly appears in climate change adaptation literature, which suggests that "[i]ncreasing adaptive capacity improves the opportunity of systems to manage varying ranges and magnitudes of climate impacts, while allowing for flexibility to rework approaches if deemed at a later date to be on an undesirable trajectory" (Engle, 2011, p. 647). Adaptive capacity often focuses on governance and institutions as key system attributes for improving a system's ability to adapt to changing socio-ecological conditions (Engle, 2011; Engle & Lemos, 2010). Further, the adaptive capacity literature distinguishes between reactive and proactive mechanisms—the former being more common, while the latter, despite being considered more robust in terms of adaptive capacity, are less common. Typically, reactive mechanisms respond to acute events such as droughts and floods, while proactive mechanisms respond to long-term deficiencies, such as climate change and institutional uncertainty (Hill & Engle, 2015). While acknowledging that historical conditions do not necessarily represent possible future scenarios, especially in the era of climate change, adaptive capacity includes a recognition that "there are important lessons that can be applied from previous experiences in considering anticipatory adaptations, especially in identifying the social mechanisms that might better facilitate, not inhibit, reactive and proactive adaptations (i.e., those mechanisms that increase adaptive capacity)" (Engle, 2011, p. 648).

An emphasis on learning is essential to adaptive capacity: water governance systems should be able to process new information and have the ability to modify actions based on that new information (Pahl-Wostl, 2006). Importantly, this learning should occur across multiple levels of government and as a result, "fosters relationships, builds trust, reconciles diverse views and interests, resolves conflict, and develops shared understandings of problems and potential solutions" (Diduck, 2010,

pp. 199–200). In addition to learning and incorporating new information, adaptive capacity also recognizes the importance of being flexible to experiment with novel approaches (Walker et al., 2002). Such flexibility can allow a system to be resilient in the face of a variety of expected and unexpected perturbations, therefore enhancing adaptive capacity. Similarly, collaboration has been emphasized as an important component for supporting adaptive capacity (Folke et al., 2002). In conjunction with some of the other components already discussed, collaboration can foster systems that "generate a diversity of management options for respond[ing] to uncertainty and surprise" (p. 440).

Researchers have focused on these components as indicators or principles that can be utilized to assess adaptive capacity in a given system (Clarvis & Engle, 2015). The presence or absence of indicators such as networks, flexibility, knowledge, integration, collaboration, learning, social capital, and others can help inform whether or not institutions can adapt in response to changing biophysical conditions or have the ability to respond to new information regarding the resource or its use. For example, Adger identified the presence of various elements of social capital, that are place and context-specific, as important for the ability to adapt to climate change (2003). Other researchers have developed broader categories or requirements for sustainability, for which specific indicators can be organized (Gibson et al., 2005). Gibson et al., created eight sustainability categories or requirements, "all of which would have to be elaborated on and specified for particular places and applications" (p. 95). The present research follows this lead by utilizing the eight categories to group individual indicators specified for the given case study (discussed in more detail below).

In the western United States there are a variety of reasons why the fundamental tenets of interstate water compacts are not likely to be renegotiated, significantly

modified, or eliminated (Gold, 2008; Heinmiller, 2009). These reasons include political restraints, institutional inertia, and risk aversion, which all lead to conservative institutions not readily subject to modification. Therefore, in order to meet the challenges facing the arid West, water managers need to understand how supply and demand imbalances can be resolved *within* the institutional and governance frameworks set up to manage these river systems. Specifically, a critical examination of the institutional and governance frameworks themselves will lead to a better understanding of potential barriers to adaptive capacity as well as mechanisms to overcome any such barriers.

This chapter examines a prominent institutional framework that holds enormous management importance to the western United States—the Colorado River Compact (Hundley, 2009). The broad goal of this analysis is to understand to what extent the existing Colorado River Compact and its associated acts, laws, court rulings and decrees—collectively known as the Law of the River—can support adaptive capacity to overcome current and future challenges. Further, this paper seeks to understand the adaptive capacity of existing institutions in a complex, polycentric system with both vertical and horizontal governance challenges. Few water managers would dispute that the Law of the River will be tested in the coming decades. How the system can respond within the established institutional framework, however, remains a source of significant debate.

3.2 Interstate compacts and adaptive capacity

Previous work examining the institutional frameworks for interstate compacts has utilized Common Pool Resource Theory (CPRT) and, more broadly, the Institutional Analysis and Development Framework (IAD) (Ostrom, 1990, 2005). The IAD is a practical framework for analyzing and understanding the various institutions

and decision-making processes, often involving collective action problems (Ostrom, 2005). "Institutions" are defined as the prescriptions, rules, and norms, both formal and informal, which guide the interactions between humans at all scales of decision-making around a given system. Using these theoretical frameworks, researchers have systematically examined the current and potential future performances of numerous interstate compacts in the western United States (Schlager & Heikkila, 2009, 2011). Specifically, this body of work has studied the adaptive capacity of these compacts as conflicts emerge from supply and demand imbalances.

Perhaps most fundamental to this area of research is the finding that interstate compacts do in fact have the potential to foster increased adaptive capacity. For example, some compacts and their related governance structures are "providing many opportunities for water users to engage in developing rules; providing venues for resolving conflicts; and monitoring, measuring, and making information on water rights and water use widely available" (Schlager & Heikkila, 2011, p. 466). As one such opportunity, many compacts include commissions that are charged with implementing and enforcing the rules of that compact. In fact, compact commissions have been called "essential" for successful interstate compacts (Roper, 2015). Schlager and Heikkila 2009 found that compact commissions can be successful in resolving difficult conflicts between the compact states, even though commissions often require unanimity in their decisions and do not have regulatory authority over water users. As they note, "it appears that unanimity rules do not provide as high a decision-making barrier as the institutional literature suggests" (p. 385). Rather, successful compact implementation can come from voluntary, collaborative approaches that address specific compact deficiencies. Similarly, focusing on finding jointly-agreed-upon compliance mechanisms provides another way to foster these collaborative approaches. For

example, compact commissions that include a representative from each affected party are a typical mechanism to which many states will agree.

However, as the biophysical conditions change in these river systems, interstate compacts in the western United States are not likely to be re-opened and fully renegotiated (Gold, 2008). Therefore, this previous research stresses the importance of instead focusing efforts on more robust "monitoring, compliance, and conflict resolution mechanisms" (Schlager & Heikkila, 2011, p. 469). More robust monitoring includes going beyond stream flow monitoring by supporting joint efforts for hydrologic modeling, often by a commission or "basin watermaster" (Heikkila et al., 2011). CPRT suggests that robust conflict resolution includes "access to rapid, low-cost, local arenas to resolve conflict among users or between users and officials" (Ostrom, 2005, p. 267). Researchers have pointed out that while these types of conflict resolution mechanisms include both formal (e.g., commission) and informal (e.g., phone calls) arrangements, perhaps the most important factor is that they are low-cost and local to the resource (Cox et al., 2010; Garrick et al., 2017; Ostrom, 2005).

While commissions can be successful in resolving conflicts, it is also important to have a "court of equity" available should interstate challenges prove exceedingly difficult. Historically, the Supreme Court provided a conflict resolution mechanism to help compacts adapt and resolve differences when the commissions were unsuccessful. Indeed, "the states took advantage of the equity powers of the court to develop agreements, and negotiate critical institutional changes in compact governing structures" (Schlager & Heikkila, 2009, p. 385). Heikkila et al. 2011 suggest that while the Supreme Court is a higher cost venue compared to compact commissions, the nature of inter-state water allocation disputes may warrant using such a mechanism. Compact commissions may not be able to deal with conflicts that "involve complex

issues, competing demands, uncertain science, and debates over unclear rules. They also deal with resources that are vital to states' economics and livelihoods" (Heikkila et al. 2011, p. 139).

A central component to CPRT is that the rules that govern a given resource should align with the biophysical settings (Ostrom, 2005). In other words, the amount of water allocated by the rules of a compact should not exceed the amount of water physically available in the system. Adaptive capacity is the ability to modify institutions in response to changing biophysical conditions, to ensure the rules stay aligned and allocations do not exceed available supplies. For example, governance arrangements with fixed—rather than proportional—water allocations have more difficulty responding to changes in those biophysical settings (Schlager & Heikkila, 2011). Therefore, it is important for stakeholders to be able to participate in genuine efforts to better align the rules with changing biophysical settings. Efforts must be made to increase flexibility in both supply and demand management, and to support greater efficiency and conservation among all water users, to ultimately increase a system's adaptive capacity.

Schlager & Heikkila, 2011 found that giving stakeholders access to multiple venues to engage in these efforts can promote adaptive capacity in response to hydrologic changes. These findings relate to existing and historical conflicts and do not necessarily highlight how compacts might fair in future years when climate change may impact the hydrologic supply and demand balance. The researchers did suggest, however, that upstream states who are required by a compact to deliver a fixed allocation to downstream states will most likely bear the burden of reduced streamflows due to climate change.

In addition, the authors emphasize the importance of examining cross-scale institutional linkages to understand the relative success of inter-state compacts. A cross-scale linkage is defined as a "point of interaction or cooperation between two or more actors or collective bodies, such as organizations or units of government…that function at different scales or levels of social organization or political jurisdiction" (Heikkila et al., 2011, p. 122). The study suggests that those compacts with robust monitoring and collective-choice decision-making linkages were more successful in implementing constitutional changes in response to biophysical settings and rule disparities. The authors conclude with the need for future research examining the intersection of horizontal and vertical linkage challenges, and understanding how those linkages and challenges may have evolved over time.

Since compacts often involve upstream states having to deliver (or not deplete) a certain quantity or proportion of a river to downstream states, the successful implementation of a compact requires those upstream states to comply with the specific rules and allocations. As noted above, compact commissions and the judicial system are examples of mechanisms to arbitrate or enforce compliance with an interstate compact (Schlager & Heikkila, 2009). Given these multiple mechanisms, it is important to consider how those compliance costs are distributed among the states, and whether they are voluntary or mandatory. Schlager et al., 2012 found that states more equitably share compliance costs when a voluntary venue or mechanism is utilized. Conversely, they found that upstream states typically assume the compliance costs when compulsory venues or mechanisms are utilized. Further, when compliance costs are shared, states are more likely to follow the existing institutional rules, as contrasted to states that do not share costs. This would suggest that voluntary and shared compliance enforcement supports increased adaptive capacity.

As discussed above, adaptive capacity is the ability to modify institutions in response to changing biophysical conditions. Therefore, it becomes important to understand how institutions can be modified at different decision-making scales. Indeed, central to the CPRT literature is a focus on the types of rule changes developed at each of these scales. Rule changes can occur at the operational (e.g., day-to-day decisions such as some reservoir operations), collective choice (e.g., who is eligible to make operational decisions, such as guidelines for new reservoir operations), or constitutional level (e.g., who decides the collective choice rules, such as significant changes to the Law of the River). These different levels are important considerations with regard to adaptive capacity because they allow for a better understanding of what institutions could be modified given new information or changed biophysical conditions. In their study of conflict resolution mechanisms, Schlager and Heikkila found that over two-thirds of the conflict solutions were "operational rule changes, strategy changes, or the maintenance of the status quo" (Schlager & Heikkila, 2009, p. 382). This is unsurprising as the CPRT literature notes that changes to collective choice or constitutional rules are significantly more difficult to achieve than changes to operational rules (Ostrom, 2005). As Schlager & Heikkila, 2009 discuss, "Only on rare occasions do commissions revise their collective choice rules or attempt substantial revisions of a compact. Commissions, charged with administering compact requirements, largely focus their conflict resolution efforts on revising administrative rules" (p. 383). Again, because fundamental compact revisions or modifications are unlikely, a permanent reduction in a state's allocation or a similar collective choice rule seems unlikely. This is despite the need to consider these higher-level changes in building adaptive capacity and being able to fully respond to changing biophysical

conditions, particularly as climate change continues to impact the region's supplies (Mote et al., 2018).

In sum, while some interstate compacts have supported increased adaptive capacity, they still face significant challenges, especially as supply and demand imbalances increase. This previous research has demonstrated that voluntary and collaborative mechanisms can overcome some barriers, such as unanimity rules (Schlager & Heikkila, 2009). Further, adaptive capacity is increased when compliance costs are shared among all of the parties in a compact (Schlager et al., 2012). Social mechanisms, such as social capital and trust-building, have also been shown to increase adaptive capacity (Adger, 2003).

This previous research has also demonstrated the importance of not only aligning rules with biophysical conditions but also providing the flexibility of attempting novel approaches when on an undesirable path (Engle, 2011). Importantly, however, fundamental compact revisions are not likely given the political and legal barriers (Gold, 2008). Therefore, while it may be possible to implement reactive measures, it may be more difficult to consider more transformative, proactive measures. Finally, conflict resolution mechanisms such as compact commissions and courts are important, but other mechanisms need to be considered, especially in the context of the Colorado River Basin (discussed in more detail below). Additional venues, such as collaborative state-to-state negotiations also allow for institutional changes (Schlager & Heikkila, 2009). Further, given the complex, polycentric system in the Colorado River Basin, horizontal and vertical linkages might provide avenues for increasing adaptive capacity by fostering more proactive institutional changes (Heikkila et al., 2011).

3.3 Research questions

As Schlager & Heikkila, 2011 concluded, additional research that "tests the validity of CPRT principles as they relate to institutional capacity, adaptation, and evolution in light of climate change challenges awaits rigorous empirical scholarship" (p. 470). The Colorado River Basin provides a unique opportunity to examine institutional adaptive capacity, given significant governance and hydro-climatological challenges. Not only is there a supply and demand imbalance, but flows in the coming decades are expected to decline as the region warms (Udall & Overpeck, 2017). Further, the Basin is a polycentric system because decisions are made within two countries with significant input from municipalities, states, and federal agencies. For example, decisions within the United States will typically involve key municipalities and irrigation districts, the Seven Basin States, the Upper Colorado River Commission, and the Bureau of Reclamation and Department of the Interior. In addition to a multitude of decision-makers, there are significant horizontal and vertical governance challenges, such as long-standing issues of priority within the Lower Basin States of Arizona, California, and Nevada. Any new decisions could require a difficult and contentious resolution of these long-standing issues and ambiguities in the Law of the River (Kenney et al. 2011). Also, in the Lower Basin, the Secretary of the Interior serves as the "Watermaster" by contracting out Colorado River water to states and users. In the Upper Basin, by contrast, while the Secretary still has significant involvement through the Department of the Interior owning and operating the major reservoirs, the states nonetheless retain significant control through the Upper Colorado River Commission.

As decisions are made in the international context—by, for example, the 1944 Treaty with Mexico—another level of complexity compounds the horizontal and vertical challenges. Further, the United States and Mexico utilize different mechanisms

for managing the ownership of and administration of water rights. In the United States, the states are the primary owners of water rights, whereas in Mexico such rights are centralized at the federal level.

Given these specific challenges, and based on the literature discussed above, several research questions emerge regarding adaptive capacity in the Colorado River Basin:

First, while unanimity rules have not been a significant barrier in other western water compacts, unanimity is more likely to be a barrier in the Colorado River Basin because of the numerous parties involved. Modifications to the Law of the River require agreement between the seven Basin States and the federal government, as well as two countries in the binational context. In addition, there are a host of other organizations that do not necessarily have a vote in the negotiations but can influence the process. That being said, modifications to the Law of the River have been implemented previously, despite the number of the decision-makers involved in the process. Importantly, however, it has been argued that more recent decisions, such as the 2007 Shortage Guidelines and Minute 319, have been more inclusive and comprehensive compared to previous decisions (Fleck, 2016). Given the importance of voluntary and collaborative negotiations in overcoming barriers such as unanimity rules, the following question emerges:

> *RQ1: To what degree have voluntary, collaborative negotiations in the Colorado River Basin evolved over time?*

Second, efforts to better align the institutional rules with the biophysical setting may prove difficult in the Colorado River Basin because of the fixed allocations in the Colorado River Basin, most notably in the Lower Basin and Mexico. Additionally, because the Upper Basin has a fixed downstream delivery obligation, adapting to

changing biophysical conditions may be difficult in the Upper Basin as well. As noted above, these allocation schemes may limit adaptive capacity and present significant barriers to modifying the Law of the River, but renegotiating the fundamental tenets of a compact is unlikely and politically challenging.[4] Therefore:

> *RQ2: How have existing policies modified the Law of the River in response to changing biophysical conditions?*

Third, as indicated above, two primary conflict resolution mechanisms for interstate compacts have been compact commissions and the United States judicial system. Currently, no such overarching compact commission exists for the Colorado River Basin. Without a compact commission, resorting to judicial conflict resolution seems appropriate, but this approach is not necessarily an appropriate or realistic solution for the following reasons. The United States Supreme Court has been an important conflict resolution mechanism for other compacts in the western United States, but this work emphasizing the Court's importance focuses on smaller compacts (e.g., two to three states) (Schlager & Heikkila, 2011). Much of the discussion in the Colorado River Basin suggests that the Supreme Court should not be viewed as the desirable, or even successful, arbiter of conflicts. Colorado River Basin disputes have gone to the Supreme Court before. With regard to the most notable case (Arizona v. California), many stakeholders and scholars suggest that part of the Court's ruling used an incorrect reading of the Colorado River Compact of 1922 and the Boulder Canyon Project Act of 1928 (e.g., MacDonnell, 2012). Whether because of that perceived error, or because of concerns about losing power in any negotiations, Basin State stakeholders

[4] For example, during the 2008 presidential campaign Arizona Senator John McCain told a reporter from Colorado that the Colorado River Compact "needs to be renegotiated over time". Colorado Senator Ken Salazar responded with "over my dead body", highlighting the political minefield of even mentioning renegotiating the Colorado River Compact. See: http://www.chieftain.com/news/local/mccain-renegotiate-western-water-compact/article_b6700db0-5b98-5dd8-ae48-fa27ee5ec866.html

strongly believe that conflict resolution through the courts is undesirable. In fact, a common phrase heard among Colorado River stakeholders is "litigation is failure, and failure is not an option"(e.g., Castle, 2015).

As a further example of this antipathy to judicial resolution of disputes, a panel of Basin State principals were asked during a Colorado River symposium in 2011 to describe what constitutes a worst-case scenario from their perspective. Pat Mulroy, then General Manager of the Southern Nevada Water Authority, stated that litigation was a worst-case scenario and that Nevada would never support going to court over anything. She opined that the lesson learned from the Arizona v. California case was that litigation does not solve anything and instead creates additional problems. In addressing the Upper Basin representatives, Mulroy stated, "And I know you guys and I love you in the Upper Basin but the minute you go to the Supreme Court you too will have a Watermaster" (McClurg, 2011, p. 120). Another panelist, Jennifer Gimbel, then Director for the Colorado Water Conservation Board, stated that "because the Lower Basin has developed using Upper Basin entitlement, it would be very devastating if the federal government forgot the doctrine of federalism, and used this 'for the good of the Basin' approach to long-range solutions, be it with Mexico or within the states. It would be devastating if the Secretary of the Interior decided that he really was the Watermaster for the Upper Basin. We think he's done that a little bit already. So that's the worst case for us" (p. 119).

In sum, the Colorado River Basin lacks two of the primary mechanisms to help resolve conflicts between states. Moreover, the compacts analyzed in those studies discussed above often do not include a federal representative on the compact commission. In the Colorado River Basin, however, the federal government plays a prominent role in management, primarily in the Lower Basin but also operationally in

the Upper Basin (McClurg, 1999). Accordingly, it becomes important to understand if and how the federal government has impacted adaptive capacity in the Basin:

> *RQ3: What role has the Department of the Interior played in resolving conflicts and supporting adaptive capacity in the Colorado River Basin?*

3.4 Case background and context

The three basin-scale policies included in this analysis are: (1) the 2001 Colorado River Interim Surplus Guidelines; (2) the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead; and (3) 2012 Minute 319: Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California. For context and background, each of these three policies are discussed in more detail below.

2001 Colorado River Interim Surplus Guidelines.[5] For many years California had been using upwards of 5.2 MAF annually, significantly more than the 4.4 MAF apportioned in the Boulder Canyon Project Act of 1928. Until the late 1990's, however, other states did not object as the two other Lower Basin States, Arizona and Nevada, were not using their full apportionments, and the "excess" water was considered "surplus". Pursuant to the Arizona v. California Supreme Court Decree, the Colorado River Basin Project Act of 1968, and the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs of 1970, the Secretary of the Interior can declare surplus waters are available to the Lower Basin States. By 1997, however, Nevada was close to using its full apportionment and Arizona implemented a groundwater storage program

[5] U.S. Department of the Interior, Record of Decision – Colorado River Interim Surplus Guidelines (January 16, 2001), *available at* https://www.usbr.gov/lc/region/g4000/surplus/surplus_rod_final.pdf

to fully utilize its apportionment. Accordingly, any "surplus" waters that California would be using—at least on paper—would be coming from unused Upper Basin allocations, and no longer from "unused" Arizona and Nevada allocations. The Secretary of the Interior now would need more specific criteria for how surplus waters would be apportioned in the Lower Basin.

Concurrently, California was negotiating a process for reducing its demand to 4.4 MAF. California contended this process was contingent on specific surplus criteria for which it could plan and to which it could respond. California's hope was to bank as much surplus as possible before it would be forced to only take 4.4 MAF in 2016. The process ultimately became known as the Quantification Settlement Agreement (QSA) and included efficiency upgrades, agriculture-to-urban transfers, and amendments to the priority structure of the Seven Party Agreement from 1931. California now had greater certainty about surplus waters, and the six other Basin States had better certainty about California ultimately reducing its Colorado River usage to its original apportionment of 4.4 MAF. As Bill Rinne, then area manager of the Boulder Canyon Operations Office for the Bureau's Lower Colorado Region, noted, "California needs the Interim Surplus Criteria; the other states need the California plan." (Water Education Foundation, 2000, p. 4).

The Bureau of Reclamation (Reclamation), the National Park Service, and the International Boundary and Water Commission prepared the Environmental Impact Statement (EIS) required by the National Environmental Policy Act (NEPA), which ultimately led to the Record of Decision. Representatives from each of the seven Basin States worked together to create three alternatives considered in the EIS. California proposed one alternative, the remaining six Basin States proposed another, and then the seven Basin States submitted a final alternative, which became the preferred alternative.

A consortium of environmental non-governmental organizations (NGOs), led by the Pacific Institute, submitted an alternative that was included in the EIS, but ultimately not analyzed as a potential alternative. The United States consulted with Mexico regarding potential impacts in Mexico due to the Surplus Criteria, but ultimately took the official stance that the United States does not bear responsibility for environmental impacts in other countries, and that Mexico is autonomous in its use of water once it crosses the international border. Further, the United States claimed that the issues Mexico was bringing up were not related to the Surplus Criteria. As such, "[i]ssues not arising from interim surplus criteria are outside of the scope of this FEIS" (United States Department of the Interior, 2001, p. 3.16-3).

In 1999, Reclamation facilitated four public meetings throughout the Basin to inform the general public and interested parties about the proposed surplus guidelines. Public comments and responses were solicited and addressed at these meetings. Further, Reclamation met with Indian tribes and Indian communities, water resource departments, water agencies, hydropower contractors, environmental groups, and Mexican water agencies. Upon completion of the Draft EIS, Reclamation solicited public comments and feedback during a 60-day review period. These comments were taken into consideration and addressed by Reclamation in the Final EIS. This "included a change in the baseline operating strategy, better definition of Tribal water rights and diversions, inclusion of the Basin States Alternative and refinements in descriptions of alternatives and operational modeling results" (p. 5-2). Table 5-1 of the Final EIS documents all the participants in the EIS process, along with the number of and dates for various meetings.

2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead.[6] Following the completion and implementation of the Interim Surplus Guidelines in 2001, and the QSA in 2003, the states and federal government continued discussions about better, coordinated management of the Colorado River system and the possibility of developing shortage guidelines. Declining snowpack and subsequent runoff increased the urgency of these discussions as 2002 became one of the driest years on record in the Upper Basin. This was the beginning of a multiple-year drought that saw drastic reductions in storage at Lake Powell. Despite 2002 being one of the driest years on record in the Upper Basin, a "surplus" was still declared in the Lower Basin by the Secretary of the Interior that year.

As Lake Powell levels began to decline in the following years, however, concerns about potential shortages increased. Because the existing Law of the River did not specify when, and how, shortages might occur—and there were disagreements regarding various components of the Law of the River, including the Upper Basin's obligation to Mexico (see Balcomb, Mutz, Anderson, D'Antonio, Jr., & Patrick, 2004)—the states, especially the Lower Basin States, looked for certainty as to when and how shortages would be managed. The Secretary of the Interior strongly urged the Basin States to agree on a plan for coordinated operation of the mainstem reservoirs and to develop shortage criteria. The Basin States were also intent on developing such criteria but reaching consensus was increasingly difficult. Eventually the states agreed to work towards consensus, the Secretary of the Interior initiated the NEPA process, a preliminary consensus proposal was reached by the states, and the EIS process resulted

[6] U.S. Department of the Interior, Record of Decision—Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (December 13, 2007), *available at* https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf

in a set of coordinated operations of Lakes Powell and Mead, as well as specific shortage guidelines.

Reclamation developed the EIS, with assistance from the Bureau of Indian Affairs, Fish and Wildlife Service, National Park Service, Western Area Power Administration, and the United States Section of the International Boundary and Water Commission (IBWC). Reclamation also consulted with Tribes who have Colorado River entitlements. This consultation process included attending scoping meetings, public hearings, and submitting public comments. Reclamation worked most closely with the seven Basin States throughout the whole process. This began in 2004 when Reclamation was providing the Basin States technical support in the form of modeling capabilities as the states were developing strategies. Further in the EIS process, the Basin States also submitted a proposed alternative, of which some elements were ultimately included in the Preferred Alternative. Several environmental NGOs were also consulted throughout the process, including Defenders of Wildlife, Environmental Defense, National Wildlife Federation, The Nature Conservancy, Pacific Institute, Sierra Club, Sonoran Institute, and Rivers Foundation of the Americas. This group also submitted an alternative ("Conservation Before Shortage"), of which several elements were incorporated into the Preferred Alternative. Mexican officials were also consulted throughout the EIS process, through the IBWC. This included meeting with the Mexico National Water Commission and the Mexico Secretariat of Foreign Relations. Mexico, however, was not formally involved in the development of the Preferred Alternative.

2012 Minute 319: Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the

Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California.[7]

Despite Mexico's lack of formal involvement in the 2007 Shortage Guidelines, Mexico and the United States agreed in a Joint Statement that bilateral discussions were important. Following that 2007 statement, and a subsequent 2009 declaration supporting the IBWC's efforts, negotiations between the two countries continued to evolve into policy. Minute 316 provided a framework for Mexico and non-federal organizations to use United States infrastructure to store and convey water. Minute 317 followed, which included both countries agreeing to the Colorado River Cooperative Process. This process set the stage for binational cooperation to improve system operations, mitigate environmental impacts, minimize the potential for shortages, and increase system storage.

Negotiations were ongoing, but as Mike Connor, then Commissioner of the Bureau of Reclamation, noted, "My sense was that we were having a little bit of a difficult time focusing those discussions in a way and in array of different aspects of our relationship and our operations and needs that was clearly going to lead to a Minute that would have some long-term benefits for both countries. It was just difficult to get some context around that" (McClurg, 2013, p. 27). Then, on April 4, 2010 a devastating 7.2 magnitude earthquake rocked the Mexicali region of northern Mexico. One of the major impacts of this earthquake was significant damage to Mexico's infrastructure, and in particular, its water infrastructure. The immediate response of the United States section of the IBWC was one of concern and support for how the United States could help those impacted in Mexico, which quickly turned into the idea of allowing Mexico

[7] International Boundary and Water Commission. (2012). Minute 319: Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California. *Retrieved from* http://ibwc.state.gov/Files/Minutes/Minute_319.pdf

to store water—water it would not be able to use due to the damaged infrastructure—in the United States.

It soon became clear, however, that the earthquake and the humanitarian response that followed would help lead to eventual agreement on a new Minute. Though allowing Mexico to store conserved or unused water in United States infrastructure had already been discussed (i.e., the NGO proposal during the 2007 Interim Shortage Guidelines which included "bringing ICS to Mexico"), such measures were supposed to be part of a larger negotiation (King et al., 2014). As Mike Connor stated, "I think [the earthquake] helped, as we were having some difficulty getting some traction and moving forward, to give us a specific problem-solving exercise and what we needed to focus on"(McClurg, 2013, p. 27). Minute 318 was signed soon thereafter, which allowed Mexico to defer delivery of Treaty water in the years following the earthquake, by storing that unusable water in Lake Mead. As Roberto Salmon, Mexico Commissioner for the IBWC, noted, "I just want to say that Minute 318 was a gesture of humanity from the American people that's helped Mexico not to have this water go to the ocean without other use. It gives Mexico an opportunity to decide what to do with this water"(McClurg, 2011, p. 96). Minute 318 ultimately set the stage for the next agreement, Minute 319, which proved to be "probably one of the most important Minutes under the 1944 Treaty; some say the most important since the Treaty was signed in 1944" (McClurg, 2013, p. 23).

Minute 319 was considered important because for the first time in the history of the Law of the River, the United States and Mexico formally established how Mexico would share in potential shortages along with the Lower Basin States. That is, based on system conditions in the United States—Lake Mead elevation levels—Mexico agreed to specific shortages in their allocation as those conditions worsened. In addition to

shortage sharing procedures, Minute 319 enhanced water infrastructure in Mexico, coordinated storage operations, and promoted ecological health in the Colorado River Delta. In terms of infrastructure, a binational program was established to jointly fund efficiency projects in Mexico, with the conserved water being used for exchanges and for environmental flows. Specific rules were also established for the conservation, storage, and delivery of Mexico's Colorado River water in the United States. The ecological health component included a one-time "pulse flow" which released approximately 105,000 acre-feet from the last major dam on the river, Morelos Dam, solely for ecological health in the Delta region. Finally, Minute 319 was important for formally establishing a negotiating framework between the two countries and setting the stage for future Minutes.[8]

3.5 Methods

To examine the adaptive capacity of existing institutions in the Colorado River Basin, these three contemporary basin-scale decisions and their related decision-making processes were systematically analyzed. Not only do these decisions represent contemporary decision-making in the Basin and demonstrate the continuing evolution of the Law of the River, but as policies continue to evolve[9] this analysis may illuminate both barriers to adaptive capacity and mechanisms to potentially overcome those barriers.

A codebook for analysis was developed with several approaches (see Appendix C for the complete coding protocol, including specific instructions). One approach was

[8] Following Minute 319's expiration, Minute 323 was signed in late 2017 and extended the provisions in 319 for another eight years (also to coincide with the expiration of the 2007 Shortage Guidelines in 2026).
[9] The 2007 Interim Guidelines are set to expire to 2026. According to those original Guidelines, the renegotiations for the replacement guidelines must begin by 2020, although many stakeholders contend they have already begun.

to build upon the literature review in Chapter 2 of this dissertation by developing protocol questions grouped into eight sustainability categories as developed by Gibson et al. 2005. The eight categories are: (1) socio-ecological system integrity, (2) livelihood sufficiency and opportunity, (3) intragenerational equity, (4) intergenerational equity, (5) resource maintenance and efficiency, (6) socio-ecological civility and democratic governance, (7) precaution and adaptation, and (8) immediate and long-term integration. These categories provide a framework that incorporates the sustainability and equity criteria identified in Chapter 2 for which the three decisions can be coded and ultimately compared. More specifically, the sustainability and equity criteria were utilized to develop specific questions within each of the eight broad categories. For example, criteria related to socio-ecological system integrity were utilized in creating questions for that category.

Importantly, these broad categories provide a way to systemically compare decisions not only for sustainability and equity, but also adaptive capacity. Table 3.1 presents the broad categories associated with each research question, as well as the key adaptive capacity concepts and sample indicators for how those concepts were coded, based on the literature discussed above. For example, to examine collaboration in the decision-making process, indicators such as including stakeholder groups earlier in the process and including non-traditional stakeholders (non-Basin State or federal) suggests increased adaptive capacity. Similarly, the presence of flexibility is indicated by acknowledging future uncertainties, having flexibility in the decision implementation, and specific rules for how the decision can be modified or terminated, and by whom.

Table 3.1: The criteria associated with each of the research questions, in addition to key concepts utilized to measure those criteria. Also included are sample indicators of how those concepts were coded as directed in the protocol.

Research question	Associated sustainability category(ies)	Key adaptive capacity concepts	Sample indicators of key concepts
RQ1: To what degree have voluntary, collaborative negotiations in the Colorado River Basin evolved over time?	Socio-ecological civility and democratic governance	Collaboration	The decision specifically emphasized collaborative endeavors; each stakeholder group's inputs were incorporated at the appropriate time; includes non-traditional stakeholders (e.g., NGOs)
	Precaution and adaptation	Volunteer compliance costs	The decision includes monitoring and evaluation, explicitly defining how results would impact the decision; all parties agree to trigger points for changes in the decision.
	Socio-ecological civility and democratic governance	Social mechanisms	Negotiations included both formal and informal venues; the process included specific efforts to build trust.
RQ2: How have existing policies modified the Law of the River in response to changing biophysical conditions?	Intergenerational equity; precaution and adaptation	Flexibility	The decision is not permanent, acknowledges future uncertainties, and specifically mentions flexibility in implementation; decision includes specific rules for what actors can modify the decision and/or when the decision is terminated or modified.
	Socio-ecological system integrity	Reactive	Human-ecological relationships are specifically mentioned in the decision, including monitoring and evaluation.
	Immediate and long-term integration	Proactive	The decision establishes a river basin organization; the decision acknowledges tradeoffs between stakeholders, sectors, and objectives.
RQ3: What role has the Department of the Interior played in resolving conflicts and supporting adaptive capacity in the Colorado River Basin?	Socio-ecological civility and democratic governance	Conflict resolution	Decision includes formal or informal conflict resolution mechanisms, accessible to all parties; the venues for mechanisms are at multiple scales of government.
	Resource maintenance and efficiency	Horizontal and vertical linkages	Multiple levels of government are in coordination across collective-choice decision-making, including monitoring and enforcement.

The second approach utilized a method similar to Schlager & Heikkila, 2009 to better understand the specific decision-making process in each of the three decisions analyzed. Specifically, Schlager and Heikkila's protocol questions regarding various compact rules were utilized to better understand how the three decisions in the Basin allow states to utilize their Colorado River apportionments. Accordingly, the second part of the protocol is divided into three sections—operational rules, collective choice rules, and constitutional rules—and includes questions related to specific types of rules. For example, boundary rules relate to the geographic scope of the decision, while authority rules relate to any restrictions on uses or actions required by specific government agencies. It is important to note that this analysis takes a qualitative approach in comparing the decision-making processes, as will be discussed in the results.

These two approaches were combined to develop a comprehensive protocol for which the three decisions and their related processes could be coded and analyzed. In addition to these two components of the protocol—decision-making criteria information (based on the sustainability and equity criteria and categories) and decision-making rules information (based on the Schlager and Heikkila work looking at compact rules), a third component included the basic decision-making context. This component focused on when the decision was negotiated, who was involved, and what were the broad goals of each process. The protocol ultimately included 117 primary questions with 122 secondary questions for a total of 239 questions. Each of the three decision-making processes and the decision documents themselves were analyzed by hand to compare within and across each decision (Miles & Huberman, 1994). This open-ended approach allowed for a better understanding of the entire decision-making context and process within each decision (Crow, 2010). Following this approach, not

only were the decision documents themselves utilized, but a variety of secondary sources were also used as evidence for how the policies were developed. This qualitative coding of each decision-making process allowed for a holistic examination of the process behind each policy, the specific indicators of adaptive capacity, and how these processes have evolved across the three policies.

3.6 Adaptive capacity in the Colorado River Basin

> *RQ1: To what degree have voluntary, collaborative negotiations in the Colorado River Basin evolved over time?*

Comparing the three decision-making processes across the socio-ecological civility and democratic governance category reveals that voluntary, collaborative negotiations have increased in the Basin. Specifically, there was an evolution in who was involved in the negotiations and when they were included. With the 2001 Surplus Guidelines, the decision was negotiated primarily only by the seven Basin States, Department of the Interior, and primary water agencies (Verner, 2003). Additional stakeholder groups were only allowed to contribute during the NEPA-mandated public comment periods, a stage at which large elements of the decision had been mostly agreed upon. For example, some Native American Tribes did submit official comments to the Reclamation in regard to the draft EIS, but the Tribes were concerned they were not being adequately included in the process. Specifically, they contended the "surplus" water was water that was supposed to be held in trust by the federal government, and yet the negotiating process excluded them having their position considered. As noted by a frustrated Gary Hansen, water resources director for the Colorado River Indian Tribes, "the whole thing is being built on the back of the tribes' water and at the same time, they've discouraged our full use of the water" (Water Education Foundation, 2000, p. 11). Similarly, the United States consulted with Mexico

regarding potential impacts in Mexico due to the Surplus Criteria, but ultimately took the official stance that the United States does not bear responsibility for environmental impacts in other countries, and that Mexico is autonomous in its use of water once it crosses the international border. Accordingly, Mexico considered the Surplus Guidelines a "significant disappointment" (King et al., 2014, p. 75).

A similar sequence of events occurred with the 2007 Shortage Guidelines, although some NGOs were included earlier in the process, not just during the public comment periods (McClurg, 2005). Other groups, including Mexico and Tribal representatives were consulted, but not actively included in the negotiations (McClurg, 2008). Initially, there was a proposal to have specified shortages to Mexico, if conditions were such that Lower Basin States were being curtailed, but ultimately these shortages were not included in the final decision (Poulsen, 2006). The final decision only included a consultation requirement with Mexico, should Lake Mead elevation levels decline and require shortages in the United States (see section XI.G.7.B of the Record of Decision).

With Minute 319, the primary negotiators were similar but United States and Mexico NGOs were included much earlier and more formally. An interesting component to the Minute 319 negotiations was a smaller number of overall stakeholders were involved, but those that were included (e.g., NGOs) had a more formal seat at the table (Kendy et al., 2017). Bob Snow, an attorney for the Office of the Solicitor at the Department of the Interior who was directly involved in these negotiations noted that Minute 319, "could not have been completed without…the participation and funding of the NGOs" (McClurg, 2013, p. 26).

More broadly, this evolution in collaboration has continually expanded to include non-traditional stakeholders. For example, this expansion has been

characterized as the Law of the River moving from a decision in 2001 (Surplus Guidelines) that was "heavily prejudiced against the delivery of excess water to Mexico" (Glennon & Culp, 2002, p. 951) to a decision in 2012 (Minute 319) that not only explicitly brought Mexico into the management of the Colorado River through specific surpluses and shortages, but also dedicated some water to the Colorado River Delta[10] purely for environmental reasons (Pitt et al., 2017). During the 2001 negotiations, some stakeholders argued that, under the Surplus Guidelines, the United States must share in the burden of providing water to the Delta; it should not be Mexico's burden alone. Citing equity criteria and the fact that the United States claims over 90% of the Colorado River mainstem—in addition to major tributaries in the United States—it was argued that "[t]o only use Mexico's apportionment to save what little is left of the Delta heaps insult upon injury"(Glennon & Culp, 2002, p. 971). Ten years later, even though negotiators from the United States insisted any environmental mitigation flows should come from Mexico's apportionment, they were much more willing to include such flows in Minute 319. In fact, part of the agreement includes entities in the United States funding conservation and efficiency projects in Mexico necessary to support the Colorado River riparian and delta ecosystems. Minute 319 represents an improvement in these collaborative negotiations by more explicitly incorporating some of Mexico's concerns and ecological benefits to the river system.

As discussed in the methods section, this analysis also included the decision-making context, in addition to the decisions themselves. In examining these contexts,

[10] Historically, the Colorado River Delta was a lush, riparian zone in the Upper Gulf of California providing critical habitat to a variety of flora and fauna. Upstream development on the river, however, has significantly reduced the amount of water that reaches the Delta leading to large-scale desiccation in the region. In recent decades, water has only reached the Delta in particularly wet years when it could not be stored or diverted for human use (Mueller et al., 2017).

specific components of the decision-making process were supportive of voluntary and collaborative negotiations. For example, in leading up to the negotiations of each decision, there was widespread acknowledgement of institutional deficiencies or uncertainties that needed to be addressed. Before the 2001 Surplus Guidelines, the Law of the River lacked specificity in how the Secretary of the Interior would implement surpluses in the Lower Basin and how California could reduce use to its original apportionment (Lochhead, 2003). This lack of specificity was recognized at the state and federal level (Anderson, 2002; Fulp & Harkins, 2001). For example, Jim Lochhead, a prominent water attorney and former Colorado River representative for Colorado, stated that from an Upper Basin perspective, they "could not tolerate the additional uncertainty of a California addiction to surplus water"(Lochhead, 2003, p. 409). A similar recognition of uncertainty or deficiency was seen in the context of developing the 2007 Shortage Guidelines. Further, the Wyoming State Engineer's Office noted how "regulations and operations criteria have been developed for Normal and Surplus conditions, detailed guidelines for a water supply shortage have never been established" (Wyoming State Engineer's Office, 2007).

In the case of Minute 319, negotiators on both sides of the border recognized uncertainties in how declining reservoir storage would impact deliveries to Mexico, in addition to Lower Basin States (International Boundary and Water Commission, 2010). Up until that point, Mexico, in theory, could require the United States to deliver its entire 1.5 MAF every year, regardless of the system conditions upstream. The fact that most, if not all, stakeholders recognized the need for specificity in the Law of the River, and the need to address these institutional deficiencies, allowed the Basin States and Mexico to at least come to the negotiating table (Snow, 2013).

RQ2: How have existing policies modified the Law of the River in response to changing biophysical conditions?

The three policies analyzed represent modifications to the Law of the River in response to changing biophysical conditions. In 2001, the Basin States and federal government were in discussions around additional water in the system (contingent on California reducing its demand), whereas the 2007 Shortage Guidelines and Minute 319 were in the context of reductions in annual flows for the Colorado River and possible shortages in response.

One type of modification found was a growing recognition of uncertainty in the system among the Basin States and federal governments (in both countries) regarding both the hydrology and institutions. In the coding process, uncertainty was identified either when decision-makers specifically acknowledged uncertainty during the decision-making process or when it was incorporated into the decision itself. Once identified, the uncertainty was categorized using uncertainty groups from Gibson et al., 2005. These groups were ignorance, vagueness, and evaluation difficulties, and relate to the precaution and adaptation sustainability category. Ignorance suggests decision-makers did not even know what to expect; vagueness suggests decision-makers had some idea of uncertainty, but it was unclear and they did not fully understand the whole process; and evaluation difficulties suggest decision-makers understood potential uncertainties, but did not have a firm basis for understanding the relationships between uncertainties and outcomes.

Evaluation difficulties were present in all three decisions and decision-making processes. There were, however, some differences in how decision-makers addressed this uncertainty. For example, with the Surplus Guidelines, the Reclamation acknowledged uncertainty in year to year variability, and consequent uncertainty as to

when potential surplus conditions would exist (United States Department of the Interior, 2001). Further, speaking in 2002 shortly after the Surplus Guidelines were finalized, the late David Getches, law professor and water scholar, expressed skepticism and uncertainty in the effectiveness of the Guidelines. His concern was the fragility of the Guidelines, including the Quantification Settlement Agreement, because "[i]t's built on some fairly optimistic assumptions about the weather, that there won't be a severe drought, that surpluses will continue to occur. It's built on an assumption that there won't be any major commitments of water for the environment, including the Delta…The plan is built on the assumption that Indian tribes with entitlements to the Colorado River will not develop their water. Those are some pretty bold assumptions"(McClurg, 2002, p. 123). Getches concerns suggest that the negotiators for the Surplus Guidelines did not adequately consider these uncertainties.

Reclamation also noted there was some uncertainty in its long-term modeling of impacts to the system as a result of implementing both the Surplus and Shortage Guidelines, particularly because of uncertainty in future hydrologic conditions (United States Department of the Interior, 2007). While the Surplus and Shortage Guidelines acknowledge some uncertainty, predominately with future hydrologic conditions, Minute 319 differed because the decision acknowledged uncertainty in the entire system which ultimately led to a much shorter implementation period. As explicitly mentioned in Section III of Minute 319, "Both countries have recognized the value of an interim period of cooperation to proactively manage the Colorado River in light of the historical and potential future increased variability due to climate change" (International Boundary and Water Commission, 2012, p. 3). Further, there was uncertainty in how the binational management would work in practice, given that the two countries had not formally managed the river jointly (McClurg, 2013). For

example, there was uncertainty as to the functioning of the Intentionally Created Mexican Allocation (ICMA). Similar to Intentionally Created Surplus (ICS) in the Lower Basin, ICMA is a concept that would allow Mexico to conserve and store additional water in Lake Mead. The concern was in how ICMA would impact salinity levels being delivered to Mexico, so Section III.5 of the Minute was included to give more flexibility in the implementation of a previous decision that dealt with salinity (Minute 242). Finally, negotiators acknowledged uncertainty in the efficacy of the ecological components of the Minute (McClurg, 2013). Specifically, it was unclear what environmental impacts, if any, the pulse flow would have in the Delta region. Peter Culp, an attorney representing some of the NGOs in the negotiations, noted in 2013 that "[o]ne of the challenges is the sort of uncertainty that exists with regard to how best to do this… On the science side, there is a great deal of uncertainty about, in particular, the infiltration that may occur within the Delta" (p. 46).

Another institutional modification to changing biophysical conditions was to specifically incorporate flexibility into new decisions. Compared to the 2001 Surplus Guidelines, the decision-making process—and in the decisions themselves—for both the 2007 Shortage Guidelines and Minute 319 show more evidence of flexibility being considered and incorporated throughout. For example, flexibility was not mentioned in the Preferred Alternative in the Final Environmental Impact Statement for the Surplus Guidelines. There was some mention in the Final Environmental Impact Statement of "increas[ing] flexibility of water deliveries under a complex allocation system" as one of the primary objectives in overall Colorado River Basin management, but not in the final Guidelines (United States Department of the Interior, 2001, pp. 1–1). By contrast, the Shortage Guidelines specifically mention flexibility in numerous ways. One of the primary consensus items that came from the seven Basin State discussions between

2005 and 2007 was the need to "preserve flexibility to deal with further challenges such as climate change and deepening drought"(United States Department of the Interior, 2007, pp. 1–2). The need for flexibility was noted as especially important for low reservoir conditions—the Guidelines include a January 1 determination for an annual release volume from Lake Powell, but then also include the ability to adjust based on April conditions. This "mid-year review" gives Reclamation flexibility in operating Powell and Mead. With regard to Minute 319, one of the primary components is allowing Mexico more flexibility in how it receives and utilizes its apportionment under the 1944 Treaty (Buono & Eckstein, 2014).

Further, interim policies with defined implementation periods indicate flexibility across the three decisions. The Surplus Guidelines were a 15-year policy, the Shortage Guidelines were a 19-year policy, and Minute 319 was a 5-year policy. With Minute 319, the specific length of the implementation period became a negotiating point in the discussions. While both countries agreed the decision needed to be interim and temporary, Mexico negotiators initially wanted the Minute to last through 2026 (Jenkins, 2014). U.S. negotiators wanted a shorter implementation period of five years, and countered with a proposal to have the Minute only last through 2017, which ultimately became the final length of the pilot. As described in 2014, "Although Minute 319 will be relatively short-lived, it was fashioned as a launch pad for a longer-term successor agreement, and the [Colorado River] Delta's champions hope they can show enough success over the coming years to win a bigger commitment to restoring the Delta. Still, the Big Three [Metropolitan Water District of Southern California, Central Arizona Project, and Southern Nevada Water Authority] have been careful to not commit too much" (Jenkins, 2014, pp. 18–19). All three decisions were interim policies,

but given the many uncertainties with regard to the binational negotiations, Minute 319 had a much shorter implementation period.

RQ3: What role has the Department of the Interior played in supporting adaptive capacity in the Colorado River Basin?

The Department of the Interior, primarily through the Bureau of Reclamation, has played several roles in supporting adaptive capacity across the three decisions-making processes. These roles include both supportive and incentive-based approaches, as well as more unilateral or punitive approaches.

This research found that one of the supporting roles has been providing a technical platform on which the river system can be modeled (Fleck, 2016; King et al., 2014). This type of vertical linkage—upon which the Basin States and other stakeholders have come to trust and rely—is an indicator of adaptive capacity within the resource maintenance and efficiency sustainability category. Reclamation did provide the modeling capabilities for the 2001 Surplus Guidelines and 2007 Shortage Guidelines, but the importance of providing a common technical platform was especially evident in the Minute 319 negotiations. For example, Eric Kuhn, former General Manager for the Colorado River District in Colorado specifically acknowledged the complex hydrology modeling done by Reclamation for the 2007 Shortage Guidelines, calling it "fine work" and "major achievements" (McClurg, 2007, p. 55). But in the context of the Minute 319 negotiations, Reclamation actually led a series of workshops to train Mexican hydrologists on how to use the modeling software, which ultimately gave Mexico equal footing and the ability to run its own models (McClurg, 2013). Edward Drusina, Commissioner for the International Boundary and Water Commissions for the United States Section emphasized the importance of this common technical capability for both Minute 319 and future negotiations: "The fact that… we're

sharing modeling techniques will help us in [future] talks…It is difficult for everyone but fulfilling when you can come together with a good understanding of the issue in a common language and you can agree on the path forward. As a result today working knowledge and relationship with [Bureau of Reclamation], Mexico, the Basin States, and the NGOs is stronger than it ever has been" (McClurg, 2013, p. 30) This facilitation by the Department of the Interior has supported the decision-making process and increased adaptive capacity by establishing a common technical platform that most stakeholders understood and found credible.

Conversely, one of the punitive approaches undertaken by the Department has been the threat of unilateral action if the Basin States cannot come to agreement on decisions. Fear of the Secretary of the Interior acting unilaterally is often enough to create comity among the states and to compel development of agreed-upon decisions, as was the case with the 2007 Shortage Guidelines (McClurg, 2005). For example, the Secretary announced her intent to develop shortage guidelines for the Lower Basin in a 2005 letter to the seven Basin States (Norton, 2005; Schiffer et al., 2007). Secretary Norton specifically mentioned in her letter that "the Department retains authority" to make these operational changes, with or without the Basin States (Norton, 2005, p. 2). Accordingly, the Basin States were concerned that if they could not agree on a proposal the Secretary would implement her own solution, the details of which could differ from the Basin States' desires (e.g., Wyoming State Engineer's Office, 2007). Thus, this fear created an incentive for the states to develop an agreed upon proposal. A proposal that had the approval of each of the seven Basin States, in theory, "would profoundly influence the Secretary's guidelines" (Grant, 2007, p. 979). Indeed, one of the primary reasons the 2007 Interim Guidelines were successfully developed and implemented was

fear of the Secretary of the Interior imposing shortage criteria without the direct input of the seven Basin States.

These supportive and punitive approaches are a type of third-party facilitation that has been discussed as a "low-cost conflict resolution mechanism"—as opposed to traditional compact commissions or litigation—that could overcome notable barriers to resolving interstate allocation disputes (Schlager & Heikkila, 2011). As discussed above, the Colorado River Basin lacks a compact commission and the Basin States see litigation as a failure. The Department of the Interior, however, has been effective at helping the Basin States and other stakeholders come to agreement on these decisions, indicating the presence of an important conflict resolution mechanism. This is important because few formal conflict resolution mechanisms were indicated in the three decisions. The Surplus and Shortage Guidelines included some formal conflict resolution mechanisms, but they simply related to additional consultation and discussion. For example, with the Shortage Guidelines, there is specific language stating that should a conflict arise, "the Secretary shall invite the Governors of all the Basin States, or their designated representatives, and the Department of State and USIBWC as appropriate, to consult with the Secretary in an attempt to resolve such claim or controversy by mutual agreement" (United States Department of the Interior, 2007, p. 54). Minute 319, however, did not include such language and lacked formal mechanisms. In sum, the Department of the Interior has been providing both formal (technical modeling capabilities) and informal (threatening unilateral action) approaches to resolve conflicts and help stakeholders reach agreement.

3.7 Conclusion

This research has demonstrated several important considerations when examining adaptive capacity in the Colorado River Basin. For one, the decision-making

process has improved to be more inclusive and collaborative, including with non-traditional stakeholders. Mexico has become a more active participant in negotiations, and several NGOs from both countries have also been more formally included in the process. Arguably, this has led to better outcomes and much of the discourse around Minute 319 suggests that it is a model for how countries can successfully and equitably manage a river system (e.g., Fleck, 2016). The Minute 319 process, "move[d] beyond the notion that international river management was necessarily a zero-sum game, in which the interests of one country or one water user would prevail over the interests of others--an approach which had repeatedly proved to encourage conflict and legalistic, arms-length relationships between water users in the Colorado River Basin" (King et al., 2014, p. 83). Another consideration for adaptive capacity is the recognition of institutional deficiency by the primary stakeholders before each of the three decisions were negotiated and decided. Despite some disagreements on the specific outcomes, decision-makers were at least in agreement that there needed to be some institutional change, which ultimately supported an agreement being reached.

A further consideration in examining adaptive capacity is understanding how the existing institutions are being modified, in this case the Law of the River. This research found that some of the modifications to the Law of the River involve incorporating uncertainty, institutionalizing flexibility, and aiming for interim modifications with a predetermined implementation period. According to the literature, these modifications indicate improving adaptive capacity in the Basin. Incorporating uncertainty into the decision-making process suggests the decision-makers are open to learning as new information emerges regarding the hydrology and institutional operations. Institutionalizing flexibility will allow decision-makers to rework their approach if any new information indicates they are heading down the

wrong path (e.g., reservoir levels continue to decline). Finally, by making these modifications interim, decisions-makers allow for potential experimentation with novel approaches (e.g., ICMA) to help identify potential new avenues for increased adaptive capacity.

Certainly, the modifications to date have been sufficient to adapt to changing biophysical conditions (i.e., there have not been declared shortages in the Lower Basin), but less certain is their continued efficacy as supply and demand imbalances continue to increase, especially in light of climate change. That is, should a mega-drought occur, or even a series of below average years, it is unclear if the existing institutions could successfully adapt. Accordingly, decision-makers may need to consider more proactive approaches that address fundamental supply and demand imbalances. More specifically, improving adaptive capacity might require proactive, and more significant, modifications to the Law of the River, but what that actually looks like in practice is up for debate. As discussed above, this research has demonstrated the importance of acknowledgement of an institutional deficiency for effecting policy change. While many stakeholders agreed that there were deficiencies before the three decisions analyzed, there is much less agreement about the larger, more structural deficiencies (i.e., the structural deficit in the Lower Basin)[11]. Therefore, it is unclear if a more significant type of modification to the Law of the River is likely to occur.

Finally, this research has demonstrated that the Department of the Interior has taken a variety of roles in supporting adaptive capacity and improved decision-making

[11] Efforts to partially address the structural deficit in the Lower Basin, known as the Drought Contingency Plans (DCPs), have been ongoing for years and as of this writing have yet to be finalized. Significant disagreements, particularly within the state of Arizona, have presented hurdles to completing the Lower Basin DCP. Even if the plan were implemented, however, a severe multi-year drought would still lead to significant shortages in the Lower Basin (Fulp, 2017)

in the Basin. These roles include supportive approaches, such as providing common technical platforms for negotiations to occur, as well as more punitive approaches, such as threatening to act unilaterally without the Basin States' input. Accordingly, the Department of the Interior has become effective in resolving conflicts between the primary decision-makers. As an example of a vertical linkage as discussed by Heikkila et al. 2011, the Secretary of the Interior has become prominently involved in negotiations, and this has largely supported the decision-making process. This is an especially important consideration in light of the fact that the Basin lacks two other conflict resolution mechanisms common to other western U.S. compacts—a compact commission and resorting to the Supreme Court. Given the success of the Department of the Interior to date, this role could potentially be expanded or made more explicit as a mechanism for increasing adaptive capacity.

3.8 References

Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography*, *79*(4), 387–404.

Anderson, D. L. (2002). Utah's Perspective The Colorado River. *Utah Division of Water Resources, Www. Water. Utah. Gov/Interstate/Thecoloradoriverart. Pdf*. Retrieved from http://www.wcwcd.org/wp-content/uploads/2012/09/TheColoradoRiver.pdf

Balcomb, S., Mutz, P., Anderson, L., D'Antonio, Jr., J., & Patrick, T. (2004, October 7). Balcomb Letter. The States of Colorado, New Mexico, Utah and Wyoming Governor's Representatives on Colorado River Operations.

Buono, R. M., & Eckstein, G. (2014). Minute 319: a cooperative approach to Mexico–US hydro-relations on the Colorado River. *Water International*, *39*(3), 263–276. https://doi.org/10.1080/02508060.2014.906879

Bureau of Reclamation. (2012). *Colorado River Basin Water Supply and Demand Study: Executive Summary*. United States Department of the Interior. Retrieved from https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Executive%20Summary/CRBS_Executive_Summary_FINAL.pdf

Castle, A. J. (2015). *The Colorado River: Innovation in the Face of Scarcity*. Presented at the Martz Summer Conference, University of Colorado - Boulder. Retrieved from http://scholar.law.colorado.edu/cgi/viewcontent.cgi?article=1013&context=innovations-in-managing-western-water

Colorado Water Conservation Board. (2015). *Colorado's Water Plan*. Denver, Colorado: Department of Natural Resources. Retrieved from http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=199515&searchid=69705cbe-d4c1-446a-a4b9-00a411d2dad7&&dbid=0

Cox, M., Arnold, G., & Villamayor Tomás, S. (2010). A Review of Design Principles for Community-based Natural Resource Management. *Ecology and Society*, *15*(4). https://doi.org/10.5751/ES-03704-150438

Crow, D. A. (2010). Local Media and Experts: Sources of Environmental Policy Initiation? *Policy Studies Journal*, *38*(1), 143–164. https://doi.org/10.1111/j.1541-0072.2009.00348.x

Diduck, A. (2010). The Learning Dimension of Adaptive Capacity: Untangling the Multi-level Connections. In D. Armitage & R. Plummer (Eds.), *Adaptive Capacity and Environmental Governance* (pp. 199–221). Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-12194-4_10

Engle, N. L. (2011). Adaptive capacity and its assessment. *Global Environmental Change*, *21*(2), 647–656. https://doi.org/10.1016/j.gloenvcha.2011.01.019

Engle, N. L., & Lemos, M. C. (2010). Unpacking governance: Building adaptive capacity to climate change of river basins in Brazil. *Global Environmental Change*, *20*(1), 4–13. https://doi.org/10.1016/j.gloenvcha.2009.07.001

Falkenmark, M., & Molden, D. (2008). Wake Up to Realities of River Basin Closure. *International Journal of Water Resources Development*, *24*(2), 201–215. https://doi.org/10.1080/07900620701723570

Fleck, J. (2016). *Water is for Fighting Over: and Other Myths about Water in the West*. Washington, DC: Island Press.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., & Walker, B. (2002). Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. *AMBIO: A Journal of the Human Environment*, *31*(5), 437–440. https://doi.org/10.1579/0044-7447-31.5.437

Fulp, T. (2017, June). *How does DPC address Lake Mead's "math problem"?* Presented at the Martz Summer Conference, University of Colorado - Boulder, Colorado.

Fulp, T., & Harkins, J. (2001). Policy Analysis Using RiverWare: Colorado River Interim Surplus Guidelines (pp. 1–10). American Society of Civil Engineers. https://doi.org/10.1061/40569(2001)150

Garrick, D. E., Hall, J. W., Dobson, A., Damania, R., Grafton, R. Q., Hope, R., … Money, A. (2017). Valuing water for sustainable development. *Science*, *358*(6366), 1003–1005. https://doi.org/10.1126/science.aao4942

Gibson, R. B., Holtz, S., Tansey, J., Whitelaw, G., & Hassan, S. (2005). *Sustainability Assessment: Criteria, Processes, and Applications* (1 edition). London ; Sterling, VA: Earthscan.

Glennon, R., & Culp, P. (2002). The Last Green Lagoon: How and Why the Bush Administration Should Save the Colorado River Delta. *Ecology Law Quarterly*, *28*, 903–992.

Gold, R. L. (2008). Dividing the Pie-Dealing with Surplus and Drought: Examining the Colorado River Compact of 1922. *J. Land Resources & Envtl. L.*, *28*, 71.

Grant, D. L. (2003). Interstate water allocation compacts: When the virtue of permanence becomes the vice of inflexibility. *U. Colo. L. Rev.*, *74*, 105.

Grant, D. L. (2007). Collaborative Solutions to Colorado River Water Shortages: The Basin States' Proposal and Beyond. *Nev. LJ*, *8*, 964.

Heikkila, T., Schlager, E., & Davis, M. W. (2011). The Role of Cross-Scale Institutional Linkages in Common Pool Resource Management: Assessing Interstate River Compacts*. *Policy Studies Journal*, *39*(1), 121–145.

Heinmiller, B. T. (2009). Path dependency and collective action in common pool governance. *International Journal of the Commons*, *3*(1). Retrieved from

http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=18750281&AN=43900071&h=Q8glF8pbW%2FxLHxdR2ilxsQsd4W3FRYWXTfO5nmPlfx%2B0LWkp9sIlQoWz6mVv5M%2BeYH4HrA66UGd9fKu5RV%2Bl4A%3D%3D&crl=c

Hill Clarvis, M., & Engle, N. L. (2015). Adaptive capacity of water governance arrangements: a comparative study of barriers and opportunities in Swiss and US states. *Regional Environmental Change*, *15*(3), 517–527. https://doi.org/10.1007/s10113-013-0547-y

Hundley, N. (2009). *Water and the West: The Colorado River Compact and the Politics of Water in the American West* (2nd ed.). Los Angeles: University of California Press.

International Boundary and Water Commission. (2010, June 17). Conceptual Framework For U.S.-Mexico Dicussions On Colorado River Cooperative Actions. Retrieved from https://www.ibwc.gov/Files/Minutes/Minute_317.pdf

International Boundary and Water Commission. Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California, Minute No. 319 § (2012). Retrieved from https://www.ibwc.gov/Files/Minutes/Minute_319.pdf

Jenkins, M. (2014). New Hope for the Delta. *High Country News*, *45*(18). Retrieved from http://www.hcn.org/issues/45.18/new-hope-for-the-delta/print_view

Kendy, E., Flessa, K. W., Schlatter, K. J., de la Parra, C. A., Hinojosa Huerta, O. M., Carrillo-Guerrero, Y. K., & Guillen, E. (2017). Leveraging environmental flows to reform water management policy: Lessons learned from the 2014 Colorado River Delta pulse flow. *Ecological Engineering*, *106*, 683–694. https://doi.org/10.1016/j.ecoleng.2017.02.012

Kenney, D. (2005). *In Search of Sustainable Water Management: International Lessons for the American West and Beyond*. Massachusetts, MA: Edward Elgar Publishing.

Kenney, D., Bates, S., Bensard, A., & Berggren, J. (2011). The Colorado River and the Inevitability of Institutional Change. *Public Land and Resources Law Review*, *32 Pub. Land & Resources L. Rev 103*.

King, J. S., Culp, P. W., & de la Parra, C. (2014). Getting to the right side of the river: lessons for binational cooperation on the road to Minute 319. *U. Denv. Water L. Rev.*, *18*, 36.

Lochhead, J. (2003). An Upper Basin Perspective On California's Claims To Water From The Colorado River Part II: The Development, Implementation and Collapse Of California's Plan To Live Within Its Basic Apportionment. *U. Denv. Water L. Rev.*, *6*(318).

MacDonnell, L. (2012). *Arizona v. California Revisited* (SSRN Scholarly Paper No. ID 2691078). Rochester, NY: Social Science Research Network. Retrieved from https://papers.ssrn.com/abstract=2691078

McClurg, S. (1999). *Colorado River Project Symposium Proceedings* (Managing the Colorado River: Past, Present and Future). Sacramento, California: Water Education Foundation.

McClurg, S. (2002). *Colorado River Project Symposium Proceedings* (Coming to Consensus: Sharing the Colorado River). Sacramento, California: Water Education Foundation.

McClurg, S. (2005). *Colorado River Project Symposium Proceedings* (Sharing the Risks: Shortage, Surplus, and Beyond). Sacramento, California: Water Education Foundation.

McClurg, S. (2007). *Colorado River Project Symposium Proceedings* (The Colorado River Compact at 85 and Changes on the River). Sacramento, California: Water Education Foundation.

McClurg, S. (2008). How is the Colorado River Shortage Agreement Working? *Water Education Foundation*, *Colorado River Project-River Report*, 12.

McClurg, S. (2011). *Colorado River Project Symposium Proceedings* (Solving the Basin's Math Problem: Adapting to Change). Sacramento, California: Water Education Foundation.

McClurg, S. (2013). *Colorado River Project Symposium Proceedings* (An Era of New Partnerships on the Colorado River). Sacramento, California: Water Education Foundation.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*. SAGE.

Milly, C., Betancourt, J., Falkenmark, M., Hirsch, R., Kundzewicz, Z., Lettenmaier, D., & Stouffer, R. (2008). Stationarity is Dead: Whither Water Management? *Science*, *319*.

Mote, P. W., Li, S., Lettenmaier, D. P., Xiao, M., & Engel, R. (2018). Dramatic declines in snowpack in the western US. *Npj Climate and Atmospheric Science*, *1*(1). https://doi.org/10.1038/s41612-018-0012-1

Mueller, E. R., Schmidt, J. C., Topping, D. J., Shafroth, P. B., Rodríguez-Burgueño, J. E., Ramírez-Hernández, J., & Grams, P. E. (2017). Geomorphic change and sediment transport during a small artificial flood in a transformed post-dam delta: The Colorado River delta, United States and Mexico. *Ecological Engineering*, *106*, 757–775. https://doi.org/10.1016/j.ecoleng.2016.08.009

Muys, J. C. (1973). Interstate compacts and regional water resources planning and management. *Natural Resources Lawyer*, 153–188.

Norton, G. (2005, May 2). Secretary Norton's Letter to Governor Huntsman. United States Department of the Interior. Retrieved from https://www.doi.gov/sites/doi.gov/files/archive/news/archive/05_News_Releases/050502c.htm

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge, UK: Cambridge University Press.

Ostrom, E. (2005). *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, *19*(3), 354–365.

Pahl-Wostl, Claudia. (2006). Transitions towards adaptive management of water facing climate and global change. *Water Resources Management*, *21*(1), 49–62. https://doi.org/10.1007/s11269-006-9040-4

Pitt, J., Kendy, E., Schlatter, K., Hinojosa-Huerta, O., Flessa, K., Shafroth, P. B., … Glenn, E. P. (2017). It takes more than water: Restoring the Colorado River Delta. *Ecological Engineering*, *106*, 629–632. https://doi.org/10.1016/j.ecoleng.2017.05.028

Poulsen, B. (2006). The North Giveth and the North Taketh Away: Negotiating Delivery Reductions to Mexico through the Colorado River Seven State Agreement for Drought Management - A Potential Conflict? *Environs Envtl. L. & Pol'y J.*, *30*(221), 25.

Roper, C. G. (2015). Interstate Water Compacts: Partnerships for Transboundary Water Resource Management. *Journal of South Carolina Water Resources*, *2*(1), 9.

Sax, J. L., Thompson, B. H., Jr, Leshy, J. D., & Abrams, R. H. (2006). *Legal Control of Water Resources: Cases and Materials* (4th ed. edition). St. Paul, MN: Thomson / West.

Schiffer, W. P., Guenther, H. R., & Carr, T. G. (2007). From A Colorado River Compact Challenge To The Next Era Of Cooperation Among The Seven Basin States. *Ariz. L. Rev.*, *49*(217), 17.

Schlager, E., Heikkila, T., & Case, C. (2012). The Costs of Compliance with Interstate Agreements: Lessons from Water Compacts in the Western United States. *Publius: The Journal of Federalism*, *42*(3), 494–515. https://doi.org/10.1093/publius/pjs017

Schlager, Edella, & Heikkila, T. (2009). Resolving water conflicts: A comparative analysis of interstate river compacts. *Policy Studies Journal*, *37*(3), 367–392.

Schlager, Edella, & Heikkila, T. (2011). Left High and Dry? Climate Change, Common-Pool Resource Theory, and the Adaptability of Western Water Compacts. *Public Administration Review*, *71*(3), 461–470.

Snow, B. (2013). *Minute 319: U.S.-Mexico Cooperation on the Colorado River*. Presented at the Colorado River Project Symposium, Santa Fe, New Mexico.

Udall, B., & Overpeck, J. (2017). The twenty-first century Colorado River hot drought and implications for the future. *Water Resources Research*, *53*(3), 2404–2418. https://doi.org/10.1002/2016WR019638

United States Department of the Interior. (2001). *Colorado River Interim Surplus Criteria, Final Environmental Impact Statement Volume I*. Boulder City, Nevada: Bureau of Reclamation.

United States Department of the Interior. (2007). *Record of Decision: Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead*. Bureau of Reclamation.

Verner, R. E. (2003). Short Term Solutions, Interim Surplus Guidelines, and the Future of the Colorado River Delta. *Colo. J. Int'l Envtl. L. & Pol'y*, *14*(241), 33.

Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M., … Pritchard, R. (2002). Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology*, *6*(1).

Water Education Foundation. (2000). *A Colorado River Compromise* (Western Water). Sacramento, California. Retrieved from http://www.watereducation.org/river-reports/colorado-river-compromise

Wyoming State Engineer's Office. (2007, November). *Colorado River Issues: An Update Presentation*. Presented at the Meeting of the Green River Advisory Group, Green River, Wyoming.

Chapter 4 – Utilizing Sustainability Criteria to Evaluate River Basin Decision-Making: The Case of the Colorado River Basin

…it requires some brainstorming in the safe places without the pressure of all of the sunlight at times. (McClurg 2013, p. 28)

4.1 Introduction

Water resources in the 21st-century face significant supply-and-demand challenges. International river basins are vulnerable as countries attempt to balance the provision of basic human supplies with economic development and healthy ecosystems. Federal rivers—defined as those major rivers that are "within or shared by a federal political system" (Garrick and De Stefano 2016 p. 78)—are governed by multiple countries and levels of government, which creates complex horizontal and vertical governance challenges. Unsurprisingly, then, recent research on water governance has focused on barriers to ensuring secure and reliable water supplies, including increasing demands (Falkenmark and Molden 2008), climate change (Overpeck and Udall 2010), climate variability (Meko et al. 2007), and shifting demands (Smakhtin 2008). These barriers may be exacerbated in federal river basins, where additional complexities include the potential mismatch between governing institutions and biophysical systems, as well as the potential breakdown in polycentric systems when multiple, independent authorities face problems stemming from collective action dilemmas (Schlager and Heikkila 2014).

In response to this research on institutional barriers, a growing body of work usefully focuses on broad reforms such as increased flexibility (McCaffrey 2003; Stakhiv 2011), increased adaptive capacity (Pahl-Wostl 2007), integration of science and policy (Reed and Kasprzyk 2009), collaboration (Sabatier et al. 2005; Ananda and Proctor 2013), and a more holistic sustainable approach that meets both the short and long-term needs of all stakeholders (Kenney 2005; Schlager and Blomquist 2008). Similarly, specific

criteria have been developed to holistically evaluate environmental decision-making (Gibson et al. 2005). Gibson et al. (2005) developed essential elements which could be used to identify and assess sustainable governance systems. Specifically, the authors developed eight sustainability criteria: (1) socio-ecological system integrity; (2) livelihood sufficiency and opportunity; (3) intragenerational equity; (4) intergenerational equity; (5) resource maintenance and efficiency; (6) socio-ecological civility and democratic governance; (7) precaution and adaptation; and (8) immediate and long-term integration. These criteria provide a broad framework for beginning to understand the sustainability of any given system. However, the vertical and horizontal governance dimensions of inter-state and international systems, especially in federal river basins, present significant challenges in meeting these sustainability criteria. Accordingly, a significant gap remains in our understanding of how reforms could be practically implemented to support more sustainable water decision-making (Hedelin 2007; Weik and Larson 2012).

Significant research has also sought to better understand specific regional challenges by focusing on the institutions governing common-pool resources (CPRs). CPR theory posits that institutions which create and implement specific rules—including allowing resource users to participate in decision-making, developing effective monitoring (both in terms of the resource itself and if users are complying with the rules), and creating enforceable conflict resolution mechanisms—will have improved performance outcomes (Ostrom 1990; Ostrom 2005). Additionally, researchers find that institutions should reflect social norms of fairness, which often includes ensuring users not only benefit from the institutional arrangements, but also be required to bear any burdens should they arise (Ostrom 2005). Drawing on these broader insights, key work by Schlager, Heikkila, and colleagues systematically

analyzed institutional design features of interstate water compacts, demonstrating that some of the barriers seen in the literature, such as unanimity rules or the limits of voluntary collaboration, may not be as significant as previously thought (Schlager and Heikkila 2009; Schlager and Heikkila 2011; Schlager et al. 2012)[12]. Additionally, their work confirms the importance of implementing effective monitoring systems of interstate rivers and of having capable conflict resolution mechanisms in place before problems emerge (Schlager and Heikkila 2011). Looking forward, it is unclear if these interstate compacts will be sufficient as both supplies and demands continue to change and compact rules may no longer be adequate for the hydrologic conditions (Schlager et al. 2012).

This paper examines the vertical and horizontal governance challenges in meeting sustainability criteria, including the complexities of large-scale institutional arrangements, by evaluating three contemporary Colorado River Basin ("Basin") decisions and their related decision-making processes: the 2001 Interim Surplus Guidelines, the 2007 Interim Shortage Guidelines, and Minute 319 to the US-Mexico Treaty. While these three decisions do not include all the foundational policies and agreements that have been created over a century of Colorado River governance (e.g., Colorado River Compact of 1922), they do illuminate how the Basin is currently managed, how this governance system continues to evolve, and how institutions operate in terms of specific process components as they adapt to continually changing

[12] Importantly, the interstate compacts analyzed in this work only included agreements with a maximum of three states and did not have a prominent federal presence; compacts with a greater number of states and with multiple levels of government may face additional challenges in implementing successful institutional arrangements, including user participation, effective monitoring mechanisms, and an overall fairer process.

social and environmental conditions.[13] The paper also evaluates how a diverse group of Colorado River stakeholders think about these decision-making processes through a survey that examines perceptions and opinions in relation to sustainability criteria. These two research approaches—a decision analysis and decision-making survey—help us understand why specific components of the decision-making process are important and how they provide opportunities for more sustainable outcomes. As such, this paper asks the following research questions: *What components of the decision-making process are important in meeting sustainability criteria? What are the challenges associated with these components? How might a consideration of these components enable or support more sustainable outcomes?*

First, this paper provides a brief introduction and overview of the Basin as its case study for evaluating water governance sustainability. Next, an overview of the decision-making process in the Basin is discussed to provide context for the research approach. Research methods are then provided which include two distinct, but related approaches. The paper then identifies important components of the decision-making process, including specific challenges associated with those components. Following the results section, the paper discusses implications for decision-making in federal river basins and concludes with potential future research directions.

4.2 Overview of the Colorado River Basin

The Colorado River and its tributaries emerge out of the Rocky Mountains and drain approximately 244,000 square miles before reaching the Gulf of California in Mexico. Along the way, the river provides water, at least in part, for nearly 40 million

[13] The Basin faces some of the prominent challenges that many river basins around the world must confront in the coming decades, most notably over-allocation and reduced flows due to increasing temperatures in the region (Udall and Overpeck 2017).

people, irrigates 5.5 million acres of land, and has approximately 4,200 megawatts of hydroelectricity capacity (Bureau of Reclamation 2012). Further, the Basin is home to 22 federally-recognized Native American tribes, 11 National Parks, 7 National Wildlife Refuges, and 4 National Recreation Areas. Known as the "lifeline" of the American Southwest, the Colorado River provides extensive resources for human and environmental needs.

The Colorado River Compact of 1922 and subsequent legislation, congressional acts, court decisions, decrees, and regulatory decisions collectively comprise what is known today as the "Law of the River." Briefly, the Colorado River Compact of 1922 apportioned 7.5 million acre-feet annually to both the Upper and Lower Basin for consumptive use. The Boulder Canyon Project Act of 1928 further apportioned the Lower Basin's allocation – 4.4 MAF to California, 2.8 MAF to Arizona, and 0.3 MAF to Nevada – and the Upper Colorado River Basin Compact of 1948 further apportioned the Upper Basin's allocation – 51.75% to Colorado, 23% to Utah, 11.25% to New Mexico, and 14% to Wyoming.

Both state and federal governments have played prominent roles in Basin development and management since the early 20th century. While the state and federal governments did come to an agreement on how the interstate waters of the Colorado River would be divided—through the Colorado River Compact of 1922 and subsequent related acts—the states still own the water within their borders. An early 20th century Supreme Court ruling (*Wyoming v. Colorado*[14]) held that the legal doctrine of prior appropriation, which established a system of prioritized water rights, applied across state lines. As such, an interstate compact was needed but again the states retained

[14] Wyoming, State of v. Colorado 259 U.S. 419, 42 S.Ct. 552, 66 L.Ed. 999 (1922)

control and ownership of the waters within each state. So, while the states have significant authority to manage intrastate water, the federal government has built and currently operates the large storage projects on the Colorado River, most notably Lakes Powell and Mead.

Additionally, pursuant to the Boulder Canyon Project Act of 1928 and then reaffirmed in the Supreme Court's 1964 decree stemming from the *Arizona v. California*[15] case, the federal government—acting through the Secretary of the Interior—has been deemed the "Watermaster" in the Lower Basin. The role of Watermaster includes contracting water allocations within the three Lower Basin States, operating the major reservoirs, and, if specific conditions arise, mandating curtailments or allocating surplus to Lower Basin users. More recently, the Bureau of Reclamation has been heavily involved in facilitating interstate and international negotiations, helping develop and model interstate and international policies, and supporting additional stakeholder involvement in these processes.

4.3 Contemporary decision-making processes in the Colorado River Basin

2001 Colorado River Interim Surplus Guidelines.[16] The 2001 Interim Surplus Guidelines established how the Secretary of the Interior would allocate surplus waters in the Lower Basin, and also provided California with certainty in reducing its demands down to its original Colorado River apportionment of 4.4 million acre-feet. The seven Basin States, federal government, and key municipal agencies and irrigation districts were the primary negotiators. A significant horizontal governance challenge was for California to negotiate a process for reducing its demand, which became the

[15] Arizona v. California, 376 U.S. 340, 84 S.Ct. 755, 11 L.Ed.2d 757 (1964)
[16] U.S. Department of the Interior, Record of Decision – Colorado River Interim Surplus Guidelines (January 16, 2001), *available at* https://www.usbr.gov/lc/region/g4000/surplus/surplus_rod_final.pdf

Quantification Settlement Agreement (QSA). A vertical governance challenge included uncertainty in how surplus waters would be apportioned by the Secretary of the Interior. Specifically, California contended the QSA was contingent on having specific federal surplus criteria in place for which it could plan.

2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated operations for Lake Powell and Lake Mead.[17] The 2007 Interim Shortage Guidelines coordinated operations of Lake Powell and Lake Mead and developed shortage-sharing guidelines for the Lower Basin States as Lake Mead elevation levels declined. The seven Basin States, federal government, key municipal agencies and irrigations districts, and some environmental NGOs were the primary negotiators. The Guidelines were in direct response to declining hydrology and loss of storage in key reservoirs, in combination with disagreement among the Basin States regarding various components of the Law of the River (e.g., delivery obligations to Mexico). The Secretary of the Interior at the time, Gale Norton, wrote a letter to the Basin States in 2005 strongly urging the States to reach agreement on shortage guidelines. Secretary Norton threatened a unilaterally imposed solution by Interior under her authority as the Lower Basin "Watermaster" unless the States could agree on the guidelines. This dynamic process again highlights the horizontal and vertical challenges often faced in a federal river basin.

2012 Minute 319: Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the

[17] U.S. Department of the Interior, Record of Decision—Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (December 13, 2007), *available at* https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf

Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California.[18] The United States and Mexico signed Minute 319 in 2012 to guide future management of the Colorado River in both countries. The International Boundaries and Water Commission (IBWC), la Comisiòn Internacional de Límites y Aguas (Mexico's section of the IBWC), the seven United States Basin States, the federal government in both countries, and key municipal agencies and irrigation districts, and environmental NGOs—from both countries—were the primary negotiators. The Minute established shortage sharing procedures, enhanced water infrastructure, coordinated storage operations, and promoted ecological health in the Colorado River Delta. Initially the State Department represented the United States, as opposed to the seven Basin States as had been the case with other negotiations. This presented a significant vertical governance challenge as the seven Basin States own the water within their state boundaries, whereas in Mexico water ownership is centralized at the federal government.

It is important to note that these three policies did not share the same rulemaking procedures. The 2001 Surplus Guidelines and the 2007 Shortage Guidelines were developed through the National Environmental Policy Act (NEPA) process, whereas Minute 319 was developed in the context of an international treaty. Accordingly, both the Surplus and Shortage Guidelines involved public comment periods, stakeholder consultation, and explicit guidelines for how the process occurred. Minute 319 had fewer explicit guidelines and did not involve designated public comment periods or stakeholder consultation, although a similar collaborative process seemed to emerge

[18] International Boundary and Water Commission. (2012). Minute 319: Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California. *Retrieved from* http://ibwc.state.gov/Files/Minutes/Minute_319.pdf

(King et al. 2014). Therefore, both processes provide a similar decision-making context for negotiating and implementing decisions that add to the Law of the River.

Clearly, these processes are not apolitical and there is important historical context for each outcome. For example, despite objections, Mexico was excluded from the 2007 Interim Shortage Guidelines negotiations, leading to mistrust and skepticism in the initial Minute 319 discussions. Mexico contended that any agreement which specifies surpluses or shortages in the United States ultimately impacts downstream interests, and therefore that process should include Mexican input. This highlights the importance of considering who is included or excluded in the process, and the subsequent implications for future decision-making.

4.4 Research methods

To address the research questions, qualitative and quantitative methods were utilized through two efforts: (1) a decision analysis of three recent policies governing the Colorado River to understand how decisions are made, what is included in those decisions, and who was involved in creating them; and (2) a survey of Basin stakeholders and decision-makers to understand perceptions of those decisions and the related decision-making processes. The decision analysis allowed for a direct comparison of the three policies to identify specific components of the decision-making process that are important in considering the sustainability criteria. The survey was then used to better understand stakeholders' perceptions of those components and how they fit within the decision-making process. These two approaches allow for a more complete evaluation of the decision-making process by analyzing not only how decisions are made and what they specifically include, but also what a broad group of stakeholders think of those processes and their outcomes. Accordingly, this analysis bridges a systematic evaluation of sustainability criteria with specific components of the

decision-making process that water managers could utilize to further sustainability outcomes.

4.4.1 Decision analysis

The decision analysis utilized the methods and codebook as developed by Schlager and Heikkila (2009) and then incorporated the sustainability criteria developed by Gibson et al. (2005) discussed above to create a new protocol by which the three decisions could be qualitatively coded and analyzed. Specifically, questions were developed relating to each of the sustainability criteria, in addition to the questions in Schlager and Heikkila's protocol. This included the decision rules for each policy, specific allocations, decision-making processes, and inclusion of specific elements of the sustainability criteria. The protocol ultimately included 117 primary questions with 122 secondary questions for a total of 239 questions.[19] In addition to using the primary decision documents themselves, secondary documents were also used to give context and clarity to specific components of the decision. Secondary documents were particularly useful for understanding who was involved in the decision-making process, and included books, law review articles, court documents, meeting minutes, and various reports. This open-ended codebook protocol and coding methods were established in line with other similar research (Miles and Huberman 1984; Crow 2010).

4.4.2 Colorado River Basin decision-making survey

The second part of this study employed a survey of a significant variety of Basin stakeholders and decision-makers. The survey was developed based upon the literature review and decision analysis discussed in the previous section, and included questions

[19] The complete protocol, including instructions for the coding process, can be found in Appendix C be made available by contacting the author.

pertaining to opinions on decision-making processes, changes to the Law of the River, and the importance of various stakeholder groups. The survey was administered to the members of the Colorado River Water Users Association (CRWUA). CRWUA has a diverse and dynamic membership of approximately 1,000 Basin stakeholders, which includes a variety of water managers, government officials (from multiple levels of government), NGO representatives, Tribal leaders, academics, and concerned citizens. The membership directory for each year is publically available in CRWUA's annual reports. The survey was administered online to 997 unique email addresses in late October of 2016. Two follow-up reminder emails were sent in early- and mid-November. 212 surveys were completed for a 21.3% response rate. Location within the Basin and occupation were the only two demographic questions asked of each respondent, the results of which are detailed in Table 4.1. Because the CRWUA membership changes yearly, it is difficult to say if the survey respondents were representative of the overall membership.

The survey results were then quantitatively analyzed to explore the research questions discussed above. Several regression analyses were conducted to explore relationships between specific variables (discussed in more detail below) and a variety of other answers given regarding respondents' perceptions and opinions on the decision-making process. Most of the questions had Likert-like scale options for the respondents to answer. For some of the statistical analysis, the variables from these answers were left as continuous variables. In other cases, initial analyses found it was necessary to convert these continuous variables to binary variables. For example, several of the questions asked respondents their opinion of when certain significant institutional events may occur (e.g., a compact call between the Upper and Lower Basins by certain years). The scale of responses included very likely (at least 90%),

probable (at least 70%), possible (50/50 probability), unlikely (less than 30%), and very unlikely (less than 10%). Multiple models were explored to determine the appropriate point at which to collapse the responses into a binary scale. Based on these initial model runs, these probability variables were collapsed into two groups: more probable ("probable" and "very likely") and less probable ("possible", "unlikely", and "very unlikely").

Table 4.1: Distribution of survey respondents, by location and occupation.

	Occupation/affiliation					
	Water Manager / Government	Water Professional	Water User	Citizen / Other or Unknown	Non-governmental Organization	**Totals**
Location						
Arizona	44% (22)	40% (20)	6% (3)	4% (2)	6% (3)	23.6% (50)
California	35.71% (10)	39.29% (11)	14.29 (4)	7.14% (2)	3.57% (1)	13.2% (28)
Nevada	80% (12)	6.67% (1)	6.67% (1)	6.67% (1)	0% (0)	7.1% (15)
Colorado	45.1% (23)	27.45% (14)	5.88% (3)	5.88% (3)	15.69% (8)	24.1% (51)
New Mexico	33.33% (4)	33.33% (4)	8.33% (1)	0% (0)	25% (3)	5.7% (12)
Utah	58.33% (14)	33.33% (8)	0% (0)	0% (0)	8.33% (2)	11.3% (24)
Wyoming	40% (2)	40% (2)	20% (1)	0% (0)	0% (0)	2.4% (5)
Mexico	0% (0)	33.33% (1)	0% (0)	0% (0)	66.67% (2)	1.4% (3)
Other / Unknown	50% (12)	20.83% (5)	8.33% (2)	4.17% (1)	16.67% (4)	11.3% (24)
Totals	46.7% (99)	31.13% (66)	7.08% (15)	4.25% (9)	10.85% (23)	100% (212)
Lower Basin	47.3% (44)	34.4% (32)	8.6% (8)	5.4% (5)	4.3% (4)	43.9% (93)
Upper Basin	46.7% (43)	30.4% (28)	5.4% (5)	3.3% (3)	14.1% (13)	43.4% (92)

4.5 Results

4.5.1 What components of the decision-making process are important in meeting sustainability criteria? What are the challenges associated with these components?

Results from the first two research questions illuminate parts of the decision-making process that are important in consideration of the sustainability criteria, including specific challenges. Table 4.2 helps identify these components of each respective process by comparing the three decisions across the eight sustainability criteria. Several components of the decision-making process were recurring themes in this comparison. These components—stakeholder participation, transparency, and fairness—were not only important considerations in the process, but also highlighted specific challenges that need to be overcome in achieving more sustainable outcomes in the Basin.

Stakeholder participation is one factor frequently cited by the water policy and CPR literature as being essential to sustainability (e.g., Ostrom 2005; Mostert 2006). However, the decision analysis revealed that the ultimate success of any decision may be limited by the difficulty in finding a balance between, on the one hand, inclusivity, and on the other, timeliness and effectiveness. For example, as shown in the socio-ecological system integrity criterion in Table 4.2, Minute 319 included a broader consideration of ecological systems compared to the previous two decisions. This broader consideration reflected greater participation by the environmental NGO community. Similarly, in the intragenerational equity criterion, the 2001 Surplus Guidelines and 2007 Shortage Guidelines explicitly excluded certain stakeholder groups. Comparatively, however, while Minute 319 was more inclusive, it still was not comprehensive and some stakeholders felt excluded (e.g., Native American Tribes). Comparing across the socio-ecological civility and democratic governance criterion

reveals why groups who did participate may have been more successful in meeting those broader ecological goals: namely, environmental NGO participants from both countries were included earlier in the process. Also in this criterion, negotiations for the previous two decisions were in the context of an EIS process (requiring public comment periods), whereas Minute 319 did not require any public comment periods and the negotiations were more private. With the 2001 Surplus Guidelines and 2007 Shortage Guidelines, decision-makers made efforts toward inclusivity (i.e., public comment periods), but the inclusivity occurred after the decision had largely been settled, and those outside stakeholder groups' input were not necessarily included and thus came to little effect. Similarly, efforts to include more diverse stakeholder groups earlier on in the process may be limited by the number of participants that can ultimately be included (as was the case with Minute 319). As such, this balance of inclusivity, timeliness, and effectiveness presents a challenge in decision-making.

The decision analysis also revealed that flexibility in what was deemed "participation" by stakeholders seemed to make for a more effective process overall. That is to say, when at certain points negotiations reached an impasse, informal discussions outside of the formal negotiating framework made the process more effective with a diverse suite of stakeholders. For example, in both the 2007 Shortage Guidelines and Minute 319, it was reported that some level of informal agreements among decision-makers was necessary to overcome barriers in the process (McClurg 2013). In some cases, this manifested as trust-building activities between prominent stakeholders. In other cases, it was private, off-the-record discussions among key negotiators. In both circumstances, giving stakeholders the flexibility to engage in off-the-record discussions ultimately supported the success of the overall decision.

Table 4.2: Summary themes from evaluation of the eight criteria categories for the three Colorado River Basin policies

	2001 SURPLUS GUIDELINES	2007 SHORTAGE GUIDELINES	MINUTE 319
Socio-ecological system integrity	Includes specific ecological systems, primarily main-stem endangered species; specifically excludes mitigation of impacts in Mexico; some monitoring for impacts to endangered species and water quality; negligible impacts expected from decision.	Includes specific ecological systems, primarily main-stem endangered species; some monitoring and conservation measures included; negligible impacts expected from decision.	Includes broader ecological systems (i.e., the Colorado River Delta), however human uses still priority; includes comprehensive monitoring; specifically acknowledges previous ecological degradation; primary water quality concern is salinity.
Livelihood sufficiency and opportunity	Primary purposes are agriculture and M&I; does not define priorities for human uses; does not include marginalized groups or non-consumptive uses; does not acknowledge economic impacts; does acknowledge negative impacts in Mexico.	Primary purpose is storage; does not define priorities for human uses; did not include marginalized groups in the process; some mention of non-consumptive uses; includes specific time period for implementation.	Primary purpose is agriculture, M&I, storage, and the environment; does not define priorities for human uses; does include non-consumptive uses (i.e., the Delta); does not acknowledge economic impacts; includes specific time period for implementation.
Intragenerational equity	Excluded some stakeholders from the process (e.g., Mexico); the decision is not permanent; quantified allocation scheme used; included public commenting period; does not include specific funding mechanisms.	Excluded some stakeholder groups from the process (e.g., Mexico); the decision is not permanent; quantified allocation scheme used; included public commenting period; does not include specific funding mechanisms.	More inclusive process, although not comprehensive; decision is not permanent (shortest period of the three with a 5-year implementation period); quantified allocation scheme used; many negotiations were not public; includes specific funding mechanisms.
Intergenerational equity	Limited mention of future generations, although decision can be modified or terminated in future; considers different future	Limited mention of future generations, although decision can be modified or terminated in future; considers different	Limited mention of future generations, although decision specifically mentions a framework for future negotiations; decision

	hydrological scenarios; acknowledges uncertainty in future hydrology; some monitoring, but limited changes in decision implementation.	future hydrological, climate, social, and environmental scenarios, although not all explicitly used in decision; acknowledges uncertainty in future hydrology.	can be modified or terminated; considers different future hydrological, climate, and environmental scenarios; specific inclusion of flexibility.
Resource maintenance and efficiency	Does not discuss the value or efficient use of water; limited transferability of water; specifically acknowledges hydrologic variability; limited discussion on certainty of allocations (i.e. surpluses); multiple government agencies involved, with formal coordination; some discussion of demand management.	Does not discuss the value of water; includes some transferability of water (e.g., Intentionally Created Surplus); acknowledges hydrological, climatological, and historical variabilities; some future allocations are contingent on system conditions; multiple government agencies involved, with formal coordination.	Does not discuss the value of water; does discuss efficient use and transfer of water; includes transferability of water (e.g., Intentionally Created Mexican Allocation), but contingent on future system conditions; some demand management, primarily efficiency upgrades.
Socio-ecological civility and democratic governance	Multiple stakeholder groups involved, primarily the U.S. Basin states, federal government, and primary water agencies; other stakeholder groups (e.g., NGOs) participated in public comment period; negotiations primarily in context of EIS process; Bureau of Reclamation facilitated formal negotiations and provided modeling capabilities.	Multiple stakeholder groups involved, primarily the U.S. Basin states, federal government, and primary water agencies; some NGOs were included earlier in the process; other groups were consulted (e.g., Mexico, Tribes); negotiations primarily in context of EIS process; Bureau of Reclamation facilitated formal negotiations and provided modeling capabilities.	Multiple stakeholder groups involved, although fewer than previous decisions; US and Mexico NGOs involved early on in process; US and Mexico federal governments held informal networking and negotiations early on in process; specifically emphasizes collaborative endeavors; less transparent; both the US and Mexico federal governments provided modeling capabilities.
Precaution and adaptation	Acknowledged uncertainty in the decision, included some flexibility in implementation; does not specific how new information could address uncertainties; hydrologic models and historical/projected streamflow records	Acknowledged uncertainty throughout decision, included flexibility in implementation; limited discussion of penalties for violations; includes trigger points for automatic changes in decision.	Acknowledged uncertainty throughout decision, included flexibility in implementation; no mention of penalties for violations; 5-year implementation period due to uncertainties; includes trigger points for

	used; includes trigger points for automatic changes in decision.		automatic changes in decision.
Immediate and long-term integration	Acknowledged tradeoffs between stakeholder groups; acknowledged tradeoffs between objectives; does not establish a river basin organization or educational outreach.	Acknowledged tradeoffs between stakeholder groups; acknowledged tradeoffs between objectives; does not establish a river basin organization or educational outreach.	Established some priorities for allocations; limited acknowledgement of tradeoffs between stakeholder groups; established a trust to oversee Delta impacts; does not require outreach.

Another component of the process that also emerged was the often-recurring call for transparency. Like stakeholder participation, transparency is often discussed in the literature as essential for water decision-making (e.g., Whiteley, Ingram, and Perry 2008). Indeed, one of the primary goals of the federal NEPA process is for the process to be transparent and publically driven. This decision analysis revealed, however, that there may be some utility in limiting the transparency of some of the negotiations and decision-making. For example, comparing the three decisions across the socio-ecological civility and democratic governance and intragenerational equity criteria demonstrates that Minute 319 was less transparent than the previous two decisions, despite it being more inclusive as discussed above. Accordingly, the ability for decision-makers to agree on the final decision was contingent, at least in part, on being able to have frank discussions behind closed doors. This demonstrates one of the vertical governance challenges in a federal river basin: when the states, who prefer more closed-door discussions, are the primary water rights owners, their processes may have contradictory requirements to those of the federal government. In each of the decisions studied, there were apparent tensions between allowing the Basin States the room to come to agreement privately, while also including other interested stakeholders in ongoing discussions.

Another component commonly identified in the decision analysis was fairness. While a broad concept, fairness is often described in the literature by notions of balanced representation, adequate debate, recognition of diverse values, or an overall more just process (Renner et al. 2013; Wilder and Ingram 2016). Regarding CPR institutions, Ostrom 2005 suggests that institutions are perceived as fairer if they proportionally distribute the benefits and burdens of any decision. Accordingly, the decision analysis reveals that Minute 319 included a fairer process in most of the sustainability criteria. Minute 319 explicitly included comprehensive monitoring (socio-ecological system integrity), specific funding mechanisms (intragenerational equity), a framework for future negotiations (intergenerational equity), and emphasized collaborative endeavors (socio-ecological civility and democratic governance). An example from the decision analysis wherein achieving fairness proved challenging for all three decisions, however, involved determining how to acknowledge and explicitly handle trade-offs between stakeholder groups and decision objectives (immediate and long-term integration) and specific sectors (livelihood sufficiency and opportunity).

Some of these trade-offs exemplify horizontal governance challenges, including the Basin States need to determine which states would take surpluses or shortages, and in what quantity. For example, the 2001 Surplus Guidelines acknowledged that California could continue to use surplus water, but gave the other Basin States certainty that this continued use was temporary. Other trade-offs exemplify vertical governance challenges, such as with the geographic scope of the policy. For example, again with the 2001 Surplus Guidelines, there was debate about whether to include environmental impacts in Mexico in the EIS process (most notably the Colorado River Delta). Ultimately the federal government decided not to include those impacts, much to the dismay of some environmental NGO stakeholders, which led to negative outcomes in

that excluded geographic area (Glennon and Culp 2002). Despite Minute 319 being more successful in creating a fair process, each decision still had some challenges in the achievement of fairness throughout the decision-making process, and the necessity of such achievement proved to be an obstacle to moving towards more sustainable outcomes.

4.5.2 How might a consideration of these components enable or support more sustainable outcomes?

Stakeholder participation

The decision analysis identified that balancing stakeholder inclusivity with timeliness and effectiveness is a significant challenge to meeting sustainable criteria. Building upon this, the survey included several questions in regard to participation and the results of which reveal how a consideration of this balance of stakeholder participation might enable or support more sustainable outcomes. Some of the survey questions queried the respondents' personal involvement in the process while other questions queried respondents' opinions on the general importance of specific stakeholder groups being involved in the process. Utilizing this latter set of questions, an index variable was created to test relationships between support for increased stakeholder participation and a variety of other variables. Table 4.3 presents a description of the two index variables, including some basic statistics.

As noted above, interstate water compact vulnerability and the risk of significant shortages has been called into question, especially in consideration of increasing demands and climate change (Schlager et al. 2012). Interestingly, several regression models identified a significant relationship between survey respondents who think that overall the Basin system is vulnerable, and those who are more likely to support increased stakeholder participation.

Table 4.3: Summary of index variables and survey questions. For the "Fairness" variable questions, respondents were asked to rate their level of agreement with the statements on a Likert scale of five (strongly agree) to one (strongly disagree). For the "Stakeholder Participation" variable, respondents were asked to rate the level of importance of participation for each of the stakeholder groups in Colorado River Basin negotiations and decision-making on a Likert scale of five (extremely important) to one (not important at all). The range of scores are indicated in parentheses following the index variable name.

Index variable	**Survey Questions**	**Mean (SD)**	**Cronbach's alpha**
Fairness (9-30)	The people negotiating and making decisions on Colorado River Basin issues are concerned about my own interests. The people negotiating and making decisions on Colorado River Basin issues have adequate power to protect my own interests. Any new decisions or changes to the current Law of the River will positively impact my own interests. The people negotiating and making decisions on Colorado River Basin issues are trustworthy. Colorado River Basin negotiations and decision-making are transparent. Any new decisions in the Colorado River Basin will require ALL users to agree to undertake shortages.	20.84 (4.47)	.704
Stakeholder Participation (22-50)	The federal government of the United States. The federal government of Mexico. The state governments of the seven U.S. Basin States (Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada, and California). The state governments of the two Mexico States (Baja California and Sonora). Local/municipal governments. Irrigation/conservancy districts. Non-governmental organizations (NGOs). Native American Tribes. Academics/researchers. General public.	36.44 (5.84)	.784

For example, survey respondents who agreed that *all* users will be required to undertake shortages also supported increased levels of stakeholder participation ($b = 3.603$, $p < 0.01$). Similarly, those who thought a compact call between the Lower and Upper Basin by 2026 is probable also supported increased levels of stakeholder participation ($b = 1.458$, $p < 0.1$). This suggests that stakeholders who believe more

drastic steps are necessary to fix any problems (i.e., all users need to undertake shortages), or that a significant legal event may soon occur (i.e., compact call), may see increased levels of stakeholder participation as part of the solution. In other words, highlighting the risk of potential future shortages and/or potential for litigation may support decision-makers in creating a more participatory process.

Also discussed in the introduction, CPR theory notes the importance of decision-making scale and that higher scales of decision-making (i.e., collective-choice or constitutional) present additional challenges for rule modification. Indeed, while there have been significant additions to decision-making rules in the Colorado River Basin (see section 1.1), many have argued that the fundamental Law of the River does not need to be modified or transformed (e.g., Gold 2008). Two survey questions asked respondents how much of a change to the Law of the River were two previous decisions—the 2007 Shortage Guidelines and Minute 319—with possible responses ranging from a fundamental change to no change at all. A fundamental change to the Law of the River would represent a collective-choice or constitutional modification and would therefore be difficult and time-consuming. Using the results of these questions as independent variables, regression models examining the relationship with the stakeholder participation index variable revealed interesting implications for the Law of the River and participation. The more that respondents thought Minute 319 was a change to the Law of the River, the more likely they were to support increased stakeholder participation ($b = 1.898$, $p < 0.05$). This suggests that if more difficult rule modifications at higher decision-making scales are desired, decision-makers might benefit from having a more participatory process. It is important to note, however, that no such relationship was evident with the 2007 Shortage Guidelines.

Fairness

Similar to stakeholder participation, an index variable was created to test relationships between fairness and other variables. The survey included a variety of questions relating to fairness as identified in the decision analysis and literature, including topics such as adequate representation, trust, positive impacts, and requiring all users to bear any burdens (see Table 4.3 above for a description of the index variable). Overall, the more that survey respondents think the system is sustainable and equitable, the more likely they were to think overall decision-making in the Basin is fair ($b = .539$, $p < 0.1$ and $b = .922$, $p < 0.01$, respectively). This suggests that a focus on outcomes considered to be fairer may produce a decision-making environment that is perceived as more sustainable. In returning to the decision analysis, one such opportunity found is the need to focus on not only how shortages and curtailments should be shared among users, but also how potential benefits and surpluses should be shared. Minute 319 specifically allocates how future surpluses—based on specific system conditions—are to benefit users in both the United States and Mexico.

Another opportunity to create a fairer process was a consideration of both which users will be required to undertake curtailments or shortages, and whether these curtailments should be temporary or permanent. In regard to the latter, only 38.4% of the survey respondents agreed or strongly agreed that *permanent* curtailments are necessary. This compares with 69.2% of respondents who agreed or strongly agreed that *temporary* curtailments are necessary. Interestingly, however, those respondents who think that only *"some users"* will need to undertake shortages—as compared with *"no users"* or *"all users"* needing to undertake shortages—are less likely to view the overall system as being fair ($b = -3.365$, $p < 0.01$). Even though there was a significant difference in views on temporary versus permanent curtailments, only requiring "some

users" to undertake curtailments was strongly associated with a perceived decrease in fairness.

Transparency

One survey question asked respondents their level of agreement with the statement that decision-making in the Basin is transparent. Table 4.4 presents the results of multiple logistic regression analyses using the survey respondents' views on transparency as a dependent variable (collapsed into binary outcomes), along with three different groups of independent variables. These groups of independent variables were selected from the survey questions as they relate directly to the specific research questions. It is important to note that the participation questions used here are different from the index variable analyzed above in that they relate to respondents' individual involvement in the decision-making process.

In terms of "barriers," for example, those respondents who see the necessity of "changes to the Law of the River" as a barrier to reaching a decision were less likely to think the overall process was transparent. Similarly, those that view a "lack of trust" as a barrier were also less likely to view the process as transparent. The analysis also revealed that those respondents who describe themselves as having a seat at the negotiating table are less likely to think that the overall process is transparent, compared with those who do not identify themselves as having a seat at the table. Further, those respondents who agreed that Basin negotiators are, "concerned about their own interests," and agreed that those negotiators have, "adequate power" to protect those individual interests, are more likely to think the process is transparent. In other words, those stakeholders not actually at the negotiating table believe the process is more transparent, compared to those who are at the table, who believe the process is less transparent. This seems counter-intuitive because one might expect that those at the

table would believe, or at least report, that their decision-making is transparent. This suggests that those who are actually at the table recognize that certain groups are being excluded or kept in the dark, while those not at the table might not be fully aware of the discussions behind closed doors.

Table 4.4: Logistic regression results of decision-making transparency. Each model tests the role of a specific set of survey questions (barriers, participation, and representation) in survey respondents' perception of decision-making transparency (the dependent variable). A positive coefficient suggests perception of a transparent process, whereas a negative coefficient suggests perception of a lack of transparency.

	Model 1		**Model 2**		**Model 3**	
Independent variables						
Barriers						
Changes to the law	−0.260*	(0.128)				
Local/regional politics	0.213	(0.166)				
Lack of trust	−0.726**	(0.217)				
Need to compromise	0.060	(0.152)				
Risk of litigation	0.066	(0.147)				
Participation						
Seat at the table			−0.625**	(0.207)		
Representative at the table			−0.331	(0.206)		
Consulted after draft			−0.010	(0.156)		
No involvement			0.106	(0.169)		
Representation						
Negotiators concerned					0.419*	(0.172)
Negotiators have power					0.446*	(0.187)
Any changes are positive					0.038	(0.137)
Location (ref=Lower Basin)						
Upper Basin	0.042	(0.315)	−0.005	(0.388)	0.248	(0.328)
Location other	−0.179	(0.575)	−0.345	(0.807)	0.199	(0.651)
Probability > Chi^2 =	0.000		0.000		0.000	
Standard errors in parentheses						

**p < .01, *p < .05

4.6 Discussion

Previous work examining these various concepts in water decision-making have acknowledged the difficulty in prescribing specific criteria that water managers could

follow (Rogers and Hall 2003; Wilder and Ingram 2016). Rogers and Hall (2003) effectively argue that water governance should work to be more open and transparent, inclusive and communicative, coherent and integrative, and equitable and ethical. Recognizing the importance of principles, however, does not change the fact that operationalization remains context dependent for each system. As Wilder and Ingram (2016) note, the principles they propose are effective in *examining* equity, but are less effective at *prescribing* specific governance mechanisms and policy tools. Following along these lines, the findings from this research in the Colorado River Basin suggest that parts of the decision-making process—participation, transparency, and fairness—are important considerations, but they require a context-specific and nuanced understanding as to how they could be actually utilized to support more sustainable outcomes.

For example, much of the discourse around water policy in recent years has focused on increasing stakeholder participation and enlarging the negotiating table to create a more inclusionary process. Indeed, the current era (1990's to present) of federalism and United States water policy has been classified as an era of "restoration and collaboration" (Gerlak 2014). Although less common, there has also been some work suggesting a limitation to participation, especially as it relates to the public (Mostert 2006). This research differs from some of the former literature in that it supports the notion that a myopic focus on a more inclusionary and collaborative process might not be entirely effective, especially in a federalist system, as it does not necessarily lead to better outcomes. Instead, focusing on the process itself—namely when and how to incorporate a broader suite of stakeholder inputs—might ultimately support a more sustainable approach. This focus partially aligns with one of Roger and Hall's (2003) principles that affected stakeholders should be included "throughout the

policy chain", but differs in that "wide participation" is always appropriate (p. 28). For example, as was the case with Minute 319, the early involvement of a select group of stakeholders may support overcoming vertical governance challenges, such as the scope of the decision, to reduce future negative impacts. In the context of the Colorado River Basin, including stakeholders as an end unto itself may not necessarily be the most appropriate route to achieving sustainability.

This research also found that highlighting the likelihood of shortages and/or litigation may lead to decision-makers supporting a more satisfactory inclusive process. Given the significant challenge of effective stakeholder participation discussed above, this suggests that overcoming multi-level coordination challenges may require identifying and highlighting such likelihoods, rather than conducting a top-down or bottom-up push for greater participation in and of itself. Further, when stakeholders are included in the negotiations, allowing them the freedom and flexibility to have discussions outside of the formal negotiating table may lead to more successful results. The challenge of different regulatory processes and responsibilities at different levels of government may require this level of informality.

In consideration of the fairness component, this research found a decrease in perceived fairness when decisions only required some users to undertake curtailments. Therefore, simply acknowledging that all users may have to undertake some level of shortage may lead to greater support for a specific decision. As discussed above, each of the three decisions struggled with inter-state trade-offs regarding who would undertake shortages or surpluses. What this research suggests is that one way to overcome those challenges is to begin by acknowledging that all users might be required to undertake shortages, even if they are temporary. Once it has been established that all users will be required to undertake shortages—something not required by the existing Law of the

River—decision-makers may be able to propose and implement more sustainable outcomes. This finding is supported in the literature that suggests distributing costs and benefits across all users in a given institutional arrangement results in greater support (Schlager and Heikkila 2011). Similarly, this aligns with one of Wilder and Ingram's (2016) directional principles toward equity in water governance: sharing both the benefits and *burdens* associated with overcoming water governance challenges.

This research has also demonstrated the necessity of reconciling the call for transparency with the need for safe, behind-closed-door discussions and negotiations. As with increased stakeholder participation, decision-making transparency is something that ostensibly should be a focal point of decision-making and is often discussed in the literature as important. Indeed, transparency can support the legitimacy of any new decision or outcome (Whiteley, Ingram, and Perry 2008). Less often discussed, however, is that there may be limits to transparency and finding the appropriate balance between privacy and effective decision-making is no trivial task (Tortajada 2010). This research supports the latter in that there appears to be some nuance to the issue of transparency. Instead of focusing only on how to make the decision-making process more transparent, perhaps some institutions that allow for private discussions would facilitate more successful and sustainable policies in the future. As a negotiator heavily involved in these basin-scale decisions noted, "…it requires some brainstorming in the safe places without the pressure of all of the sunlight at times" (McClurg 2013 p. 28).

One possibility for managing the need for both closed-door discussions and transparent decision-making may be to lay the responsibility for overseeing negotiations on an independent government agency with different decision-making authority than the Basin States. Clearly defined roles at each level of government has

been identified as important for federal rivers (Garrick and De Stefano 2016), and this research provides an empirical example of this importance. Because the Basin States are sovereigns, private negotiations could, and should, still occur among those state principals. But again because of the States status as sovereign holders of water rights, it may be in the interest of all involved to have the process at least monitored by a disinterested body or agency. The federal government, for example, could help ensure that discussions do not systematically exclude or disadvantage specific stakeholders, including individual Basin States. The unique authority of the federal government, especially in the Lower Basin, could provide an opportunity for overcoming challenges of transparency and decision-making.

4.7 Conclusion

This research has built upon previous interstate water compact work by incorporating the eight broad sustainability criteria developed by Gibson et al. (2005). This analysis revealed the importance of several process components—stakeholder participation, transparency, and fairness—when considering decision-making sustainability in the Colorado River Basin. Further, it has drawn on that examination to identify how a focus on those components might support decision-makers in meeting more sustainable outcomes. The results of this research suggest that though previous literature has focused on the need for transparency and stakeholder participation, too much of a focus on either might actually impede sustainable decision-making. Focusing on the process—when specific stakeholder groups should be brought into the process or the potential role of the federal government in reconciling the need for transparency and effective decision-making—might allow decision-makers to better identify and implement more effective outcomes.

Future research could further explore this balance of transparency, stakeholder participation, and decision-making. For example, this research found a somewhat counter-intuitive result in that those stakeholders who were not at the actual negotiating table were more likely to think the process is transparent compared to those at the table. Exploring why this might be the case and seeing how these perceptions compare to other river basins would help further understand transparency and decision-making. Similarly, additional research is needed on how informal negotiations influence these decision-making processes. This research seems to suggest that some level of informality is important, if not necessary, but additional research could focus on balancing the formal with the informal. Another area of future research could focus on additional mechanisms for monitoring these private or informal negotiations. This could include designing and implementing specific boundaries around those negotiations—both in terms of timing and authority—to allow those decision-makers flexibility and privacy, while also institutionalizing some level of accountability. Finally, while these future research areas should include additional case studies of other river basins, the large data set collected for this project could also be further analyzed to explore these additional research questions.

4.8 Acknowledgements

The author gratefully acknowledges the reviews, feedback, and support from the special issue editors Drs. Dustin Garrick and Lucia De Stefano, two anonymous reviewers, and the journal editors. Additional thanks to Drs. Lisa Dilling and Deserai Crow for their comments and support.

4.9 References

Ananda J, Proctor W (2013) Collaborative approaches to water management and planning: an institutional perspective. Ecol Econ 86: 97–106. doi: http://dx.doi.org/10.1016/j.ecolecon.2012.10.018

Bureau of Reclamation (2012) Colorado River Basin water supply and demand study: executive summary. Department of the Interior. http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Executive%20Summary/CRBS_Executive_Summary_FINAL.pdf. Accessed 23 September 2016

Crow D (2010) Local media and experts: Sources of environmental policy initiation? Policy Stud J 38: 143-164. doi: 10.1111/j.1541-0072.2009.00348.x

Falkenmark M, Molden D (2008) Wake up to realities of river basin closure. Int J Water Resour D 24: 201–15. doi: 10.1080/07900620701723570

Fleck J (2016) Water is for fighting over and other myths about water in the West. Island Press, Washington DC

Garrick DE, Anderson G, Connell D, Pittock J (2014) Federal rivers: managing water in multi-layered political systems. Edward Elgar, Cheltenham

Garrick DE, Stefano LD (2016) Adaptive capacity in federal rivers: coordinate challenges and institutional responses. Curr Opin Env Sust 21: 78-85. doi: http://dx.doi.org/10.1016/j.cosust.2016.11.003

Gerlak, A (2014) Federalism and US water policy. In: Garrick D, Anderson G, Connel D, Pittock J (eds) Federal rivers: managing water in multi-layered political systems. Edward Elgar, Cheltenham, pp 41-56.

Gibson RB, Hassan S, Holtz S, Tansey J, Whitelaw G (2005) Sustainability assessment: criteria, processes and applications. Earthscan, London

Gold RL (2008) Dividing the Pie – Dealing with Surplus and Drought: Examining the Colorado River Compact of 1922. 28 J. Land Resources & Envtl. L. 71.

Hedelin B (2007) Criteria for the assessment of sustainable water management. Environ Manage 39: 151–63. doi: 10.1007/s00267-004-0387-0

Heikkila T, Schlager E, Davis MW (2011) The role of cross-scale institutional linkages in common pool resource management: assessing interstate river compacts. Policy Stud J 39: 121-45. doi: 10.1111/j.1541-0072.2010.00399.x

Kenney D (2005) In search of sustainable water management: international lessons for the American West and beyond. Edward Elgar, Massachusetts

King JS, Culp PW, De La Parra C (2014) Getting to the right side of the river: lessons for binational cooperation on the road to Minute 319. 18 U. Denv. Water L. Rev. 36.

McCaffrey S (2003) The need for flexibility in freshwater treaty regimes. Nat Resour Forum 27: 156–62. doi: 10.1111/1477-8947.00050

McClurg S (2013) Colorado River Project Symposium Proceedings. Water Education Foundation, Sacramento, California

Meko DM, Woodhouse CA, Baisan CA, Knight T, Lukas JJ, Hughes MK, Salzer MW (2007) Medieval drought in the Upper Colorado River Basin. Geophys Res Lett 34: 1-5. doi: 10.1029/2007GL029988

Miles MB, Huberman AM (1984) Drawing valid meaning from qualitative data: Toward a shared craft. Educ Res 13: 20-30.

Mostert E (2006) Participation for Sustainable Water Management. In: Giupponi C, Jakeman AJ, Karssenberg D, Hare MP (eds) Sustainable management of water resources. Edward Elgar, Cheltenham

Overpeck J, Udall B (2010) Dry times ahead. Science 328: 1642–43. doi: 10.1126/science.1186591

Ostrom E (1990) Governing the Commons. Cambridge University Press, Cambridge

Ostrom E (2005) Understanding Institutional Diversity. Princeton University Press, New Jersey

Pahl-Wostl C (2007) Transitions towards adaptive management of water facing climate and global change. Water Resour Manag 21: 49–62. doi:10.1007/s11269-006-9040-4

Reed PM, Kasprzyk J (2009) Water resources management: the myth, the wicked, and the future. J Water Res Pl-ASCE 135: 411–13. doi: http://dx.doi.org/10.1061/(ASCE)WR.1943-5452.0000047

Renner R, Schneider F, Hohenwallner D, Kopeinig C, Kruse S, Lienert J, Link S, Muhar S (2013) Meeting the challenges of transdisciplinary knowledge production for sustainable water governance. Mt Res Dev 33: 234-247. doi: https://doi.org/10.1659/MRD-JOURNAL-D-13-00002.1

Rogers P, Hall A (2003) Effective Water Governance. Global Water Partnership Technical Committee, Stockholm, Sweden

Sabatier P, Focht W, Lubell M, Trachtenberg Z, Vedlitz A, Matlock M (2005) Swimming upstream: collaborative approaches to watershed management. Massachusetts Institute of Technology, Cambridge

Schlager E, Blomquist W (2008) Embracing watershed politics. University of Colorado Press, Boulder

Schlager E, Heikkila T (2009) Resolving water conflicts: a comparative analysis of interstate river compacts. Policy Stud J 37: 367–92. http://onlinelibrary.wiley.com/doi/10.1111/j.1541-0072.2009.00319.x/abstract

Schlager E, Heikkila T (2011) Left high and dry? Climate change, common-pool resource theory, and the adaptability of western water compacts. Public Admin Rev 71: 461–70. doi: 10.1111/j.1540-6210.2011.02367.x

Schlager E, Heikkila T (2014) Water scarcity, conflict resolution, and adaptive governance in federal transboundary river basins. In: Garrick D, Anderson G, Connel D, Pittock J (eds) Federal rivers: managing water in multi-layered political systems. Edward Elgar, Cheltenham, pp 57-75

Schlager E, Heikkila T, Case C (2012) The costs of compliance with interstate agreements: lessons from water compacts in the Western United States. Publius J Federalism 42: 494–515. doi: https://doi.org/10.1093/publius/pjs017

Smakhtin V (2008) Basin closure and environmental flow requirements. Int J Water Resour D 24: 227–33. doi: http://dx.doi.org/10.1080/07900620701723729

Stakhiv EZ (2011) Pragmatic approaches for water management under climate change uncertainty. J Am Water Resour As 47: 1183–96. doi: 10.1111/j.1752-1688.2011.00589.x

Tortajada C (2010) Water governance: Some critical issues. Int J Water Resour D 26: 297-307. doi: https://doi.org/10.1080/07900621003683298

Udall B, Overpeck J (2017) The twenty-first century Colorado River hot drought and implications for the future. Water Resour Res 53: 2404-2418. doi: 10.1002/2016WR019638

Whiteley JM, Ingram H, Perry RW (2008) Water, Place, and Equity. Massachusetts Institute of Technology, Cambridge

Wiek A, Larson KL (2012) Water, people, and sustainability—A systems framework for analyzing and assessing water governance regimes. Water Resour Manag 26: 3153–71. doi: 10.1007/s11269-012-0065-6

Wilder M, Ingram H (2016) Knowing equity when we see it: water equity in contemporary global contexts. In: Conca K, Weinthal E (eds) The Oxford Handbook of Water Politics and Policy. Oxford University Press. doi: 10.1093/oxfordhb/9780199335084.013.11

Chapter 5 – Are There Limits to Stakeholder Participation and Decision-Making Transparency in River Basin Governance? A Case Study from the Colorado River Basin

> *There is no doctrine of governance without its counter-doctrines, and, unexceptionable though it may seem at first sight, transparency is not an exception to that rule. (Hood, 2006, p. 20)*

5.1 Introduction

Water management in the 21st century faces myriad challenges and complexities which inhibit or interfere with sustainable and equitable water decision-making. Increasing and competing demands, ecological needs, climate change, hydrologic variability, and numerous other factors impact the ability of water managers to effectively balance these competing needs without significantly adversely impacting other stakeholder groups or sectors. Accordingly, water governance principles have emerged as possible guiding mechanisms to overcome these impediments and address diverse stakeholder needs regarding water management. More specifically, "[w]ater governance and water management are interdependent issues in the sense that effective governance systems are meant to enable practical management tools to be applied properly as situations require" (Tortajada, 2010, p. 299).

Analysts of water management have often advocated two specific water governance principles: stakeholder participation and decision-making transparency. Increased stakeholder participation and decision-making transparency may facilitate more effective ways to create and implement sustainable and equitable solutions to imbalances in water supply and demand (Jaspers, 2003; Pahl-Wostl, 2002; Whiteley et al., 2008). As noted by Whiteley et al. in their 2008 book on water governance and equity, "equity requires fair, open, and transparent decision-making processes in which all individuals and groups affected by water decisions have an opportunity to participate" (Whiteley et al., 2008, p. 21). Indeed, as a part of our democratic norm, this

makes intuitive sense. The process of making public policy, especially regarding natural resources, should include those who are potentially impacted by new decisions and the processes by which new policies are devised and adopted should be transparent to the public (S. Bernstein, 2004).

In particular, the concept of transparency has reached an almost mythical level of importance for good governance and successful institutions in the view of many observers (Ward, 2015). Not only do some consider it a "'god' of political and institutional ethics", but they also view transparency as "the answer to bad government, official wrongdoing, and the arrogant power of corporations and news media" (Ward, 2015, p. 45). If there is a governance problem, the conventional wisdom says that bringing transparency to the process will improve or fix the problem.

Despite many years of efforts to create a more inclusive and open process, there is still much uncertainty and confusion regarding the effective implementation of these concepts (Tortajada, 2010). As noted by Tortajada, "[i]n terms of transparency, while there is general consensus that this is an essential component of governance, there is no agreement as to which entity should be most transparent for governance to be credible: government institutions, elected representatives, and/or the general public? … [E]specially as the requirements for transparency are different depending on the groups in question, on their interests and their views" (Tortajada, 2010, p. 302). Similarly, Hood 2006 suggests that "transparency is more often preached than practiced, more often invoked than defined, and indeed might ironically be said to be mystic in essence, at least to some extent" (Hood, 2006, p. 3).

Further, the relevant literature notes that increased participation and transparency can sometimes reduce the efficiency of decision-making or otherwise negatively impact those processes (Irvin & Stansbury, 2004). For example, Stasavage

2006 states that, while much of the literature assumes that greater transparency is "unambiguously beneficial" because with process transparency "representatives are more likely to take decisions with public, rather than private, interests in mind", there has also been some limited discussion about the costs of such transparency (p. 166). Types of costs include decision-makers "posturing" to save political face, "pandering" to avoid taking a new or controversial stance, and offering less support for compromise in a negotiating position (Stasavage, 2006). This analysis argues that broad appeals for inclusive or transparent approaches may not be realistic or effective in all circumstances. In other words, there may be limits to where and how such approaches can effectively work.

This chapter empirically examines these two concepts of participation and transparency in the Colorado River Basin context. The Colorado River provides a good case study for this examination because there have been long-standing debates concerning the inclusivity and transparency of decision-making. More specifically, while there have been calls for more open decision-making processes that incorporate a broader range of stakeholder views, there has also been a contrary movement to keep the processes limited in some respects. Therefore, an examination of these concepts, including an attempt to understand both sides of the debate, has important implications for river basin governance. This analysis is not only relevant to the Colorado River Basin; it is significant for other international rivers struggling with issues of sustainability and equity.

As noted in his 2016 book on water in the Western United States, Colorado River scholar John Fleck acknowledged the difficulty in the Basin of finding an appropriate balance between inclusivity and efficient decision-making. He notes that the "history of the last two decades of problem solving on the Colorado River suggests that progress is

being made on this issue, especially in including environmental interests and the nation of Mexico in the decision-making process. But over and over, those trying to sort out the Colorado River's problems find *that they've drawn the boundaries at the wrong place*, and that something done within the river-management community has an impact on some group, interest, or issue that has been left out" (Fleck, 2016, p. 163; emphasis added).

A specific example of this problem appeared in a discussion at one of the Water Education Foundation's biannual gatherings of prominent Colorado River stakeholders held in Santa Fe, New Mexico. During the 2002 gathering, the late Tom Graff, then Regional Director in California for Environmental Defense, noted, "fast-forwarding, here we are today with a 4.4 [MAF] plan, a quantification settlement agreement, and surplus criteria, and we haven't got a clue what to do about the Salton Sea, about the Colorado River Delta, about those in Imperial Valley who may be harmed by fallowing, or even about the inevitable need to negotiate with Mexican interests over a whole range of Colorado River related problems and opportunities. We have consensus and benefits accruing to the seven states and the southern California interests, but the other interests are now scrambling to be recognized" (Water Education Foundation, 2002, p. 19). It is important to note that Graff was speaking in 2002, and as Fleck notes, some of those boundaries have been redrawn to be more inclusive. But those comments illuminate the problems which may arise when there is an imbalance of participation and transparency.

Ultimately this all leads to the following question: if there are indeed limits to the benefits of increased stakeholder participation and decision-making transparency, what are the implications for developing sustainable and equitable water policy in the future?

The following section briefly reviews the literature regarding stakeholder participation and decision-making transparency. Following a description of the research methods, the results section reports stakeholder perceptions of current decision-making processes. Stakeholders perceived both increased, as well as limited, participation and transparency. The treatment of different stakeholder groups and differences in the level of formality in interactions are also key components of the analysis. Finally, proposals are made to prescribe how limits on participation and transparency may be institutionalized and what that implies for the decision-making process.

5.2 Stakeholder participation and decision-making transparency: a review of the literature

One of the more prominent water policy frameworks, found both in practice by water managers and in the academic literature, is Integrated Water Resources Management (IWRM) (Agarwal et al., 2000; Global Water Partnership, 2000). IWRM has been lauded by numerous researchers for decades as an approach to more effectively and sustainably manage water resources (Lubell & Edelenbos, 2013; Rahaman & Varis, 2005). While the IWRM concept has evolved over time and numerous refinements in approach and frameworks have emerged, some common themes have remained relatively consistent. Some of these consistently included concepts are a participatory approach and decision-making transparency, which are the focus of this chapter.

5.2.1 Participation

There are numerous reasons why increased stakeholder participation should result in better water governance. Specifically, increased participation facilitates a better representation of socially defined goals and values; integration of various

knowledge bases and epistemologies; reduction of power asymmetries; allowance for social learning; better handling of uncertainties; and, ultimately, increased decision-making effectiveness (Hedelin, 2007; Mostert, 2006; Orlove & Caton, 2010; Reeve, 2003; Rinaudo & Garin, 2005; Videira et al., 2006).[20] In addition to improving the process itself, greater stakeholder participation can strengthen the credibility of outcomes and garner greater support as those outcomes are implemented. As noted by Islam and Susskind 2012, "implementation of whatever agreements the groups reach will be a lot easier if everyone affected has a chance to make their interests known. Groups that are excluded may feel obliged to block implementation of the results of negotiations, arguing that the outcome are illegitimate because they were not allowed to participate" (Islam & Susskind, 2012, p. 198).

The literature also reveals, on the other hand, reasons why participatory processes in practice can sometimes be problematic and cumbersome, and may not actually lead to some of the positive outcomes anticipated. For example, in many cases a participatory process may further entrench power imbalances or existing decision-making structures because the process of deciding who participates is inherently based on those existing imbalances and structures (Blomquist & Schlager, 2005). Another problem when implementing participatory processes is that the timing of participation can play a significant role in the success or failure of those processes. It is important to allow participation from all relevant stakeholders, but it is also important to try to determine the most appropriate points in the process for such participation. If some specific stakeholders are not included until near the end of the decision-making process, then not only will it be difficult to incorporate their ideas and contributions, but their

[20] See Chapter 2 for a more in-depth discussion on stakeholder participation

input may actually slow down or even derail the process (Mostert, 2006). This may lead to a perception that while decision-makers have included relevant stakeholders to a degree, in reality the process was not truly participatory. This superficial participation, especially as it relates to the timing, was found in multiple case studies of water policy in the European Union context (Videira et al., 2006). The authors conclude that, "the case studies reviewed in this paper revealed that in many situations the purpose of participation is still limited to providing accountability rather than developing the substance of policy. Moreover, the real impacts of participation stood only for the minimum required level of public information, and there was no true involvement and collaboration of the interested parties in the evaluation processes (with the exception of the Dutch case study)"(Videira et al., 2006, p. 28).

When considering general public participation, problems such as cost, self-selection (i.e., representation problems), complacency, and a lack of authority can inhibit the effectiveness of a participatory process (Irvin & Stansbury, 2004). Some of these barriers are surmountable if the decision-making context includes "low-cost" and "high-benefit" indicators. "Low-cost" indicators include the existence of a small, homogenized community with adequate representation, the decision in question not being technically complex, and citizens having the means to participate without significant impacts to their—or their families'—well-being. "High-benefit" indicators include decision-maker credibility within the community, the specific problem being of notable interest to the community, and citizen representatives having significant influence within the community. Absent some of these indicators, however, public participation may not effectively improve the decision-making process. The authors emphasize that, "[w]ith widespread public benefit as the goal of any public policy process, it behooves the administrator to consider the advantages and disadvantages of

the decision-making process when determining the most effective implementation strategy, bearing in mind that talk is not cheap—and may not even be effective" (p. 63).

Further, if all stakeholders who may be impacted by decision-making in a particular river basin are included in the process—especially if each stakeholder is given significant authority or an effective veto—then it becomes incredibly difficult to complete any decision process; indeed such a process is most likely "destined to fail" (Huffman, 2009, p. 148). An effective veto, most commonly in the form of unanimity requirements for agreement, can lead to a disincentive for a stakeholder group to cooperatively engage in the decision-making process. Huffman contends that the "aspiration of collaborative governance is seldom able to overcome the harsh reality of interest group politics" (Huffman, 2009, p. 146).

5.2.2 Transparency

Similarly, there are benefits and costs to decision-making transparency. In terms of general decision-making (not specific to water policy), not only is it important to make decision-making information available to the public in a timely manner, (e.g., FOIA requests), but that information also must be readily useable. This suggests that, "transparency not only contributes directly to increased quality and legitimacy in the rulemaking process—primarily by allowing the public to monitor agencies and by ensuring a more fair process—but it also contributes indirectly to these goals by allowing for more meaningful public participation" (Coglianese 2008, p. 8). Dawes 2010 discusses two specific principles to ensure that transparency improves decision-making processes: stewardship and usefulness. Stewardship implies that information should be legitimate (responsibly produced and managed) and readily available, while usefulness suggests that information needs to be applicable in such a way that the public can benefit from its availability (Dawes, 2010). Lockwood et al., 2010 suggest that all

decisions regarding natural resource management should in fact be relatively transparent. Specifically, "priorities and investments should be accessible to stakeholders. Transparency is required in who has made a decision; the means by which it has been reached; and its justification" (Lockwood et al., 2010, p. 993)

The benefits of transparency specific to water policy decision-making include helping create effective partnerships, increasing decision-maker accountability, supporting stakeholder buy-in and "real" participation (avoiding the "invite, inform, ignore" model), and increasing the overall legitimacy of decisions and resultant policies (De Stefano et al., 2012; Islam & Susskind, 2012; Judkins & Larson, 2010; Nowlan & Bakker, 2007; Wiek & Larson, 2012). In an international context, a lack of transparency can lead to serious challenges to the legitimacy and credibility of an outcome in one of the affected countries, by allowing the country with greater authority or political clout to determine the specifics of an outcome without much accountability (Judkins & Larson, 2010). In their article examining equity and the Colorado River Compact, Robison and Kenney argue that the "core tenet" of transparency is that "governance structures should be composed so as to promote transparency with respect to the processes used for implementing the substantive terms of apportionment schemes. These processes should be structured in an open and straightforward manner so as to invite engagement by parties whose interests are affected by the schemes. Rationales supporting decisions and attendant actions related to implementation processes should be communicated in explicit, comprehensible terms. These rationales likewise should be responsive to the full scope of viewpoints expressed on relevant matters" (Robison & Kenney, 2012, p. 1180). Further, transparency is seen as an important component to building trust within the decision-making community and those impacted by water

management, and, ultimately, such transparency supports the legitimacy of any decisions or outcomes (Huntjens et al., 2012).

Researchers also consider the transparency of technical information in decision-making as particularly important. In water resource management, this technical information often means operational modeling, which is used to understand how a particular policy or operation may be implemented or may impact different users within the river system. Transparency of this type of information is important to garner greater stakeholder support. Even if the technical capabilities of a specific stakeholder or group are limited, transparency increases the credibility of decision-making (Islam & Susskind, 2012). Another type of transparency is that of the rules themselves. These rules include rules prescribing how decisions are made, who is involved, and where relevant funding is sourced (Leach, 2006). Leach argues that because these rules relate to public policy, the general public should have the right to know the basics about the decision-making process.

Despite the seemingly obvious benefits of having a more transparent decision-making process, there are critics who have identified potential drawbacks (Mol, 2010; Tortajada, 2010). For example, Mol 2010 acknowledges the common hypothesis regarding transparency: "Transparency combines with democracy and participation in striving for emancipatory environmental politics, by giving prevalence to and making room for bottom-up civil society engagements. The common idea is then: the more transparency, the better. That is: better for the environment, better for democracy and better for the empowerment of the oppressed" (Mol, 2010, p. 133). Mol goes on to contend, however, that there are several "pitfalls" of moving toward a more transparent process. One of these pitfalls includes furthering inequality and power imbalances by "empowering the powerful". If strict transparency regulations exist, more powerful

and capable stakeholders have the resources and ability to comply with the regulations (i.e., they are less of a burden), whereas less powerful stakeholders may lack these resources. Similarly, a second pitfall is that certain stakeholders may not have the resources, technical capabilities, or literacy to potentially utilize information that becomes transparent. Conversely, certain stakeholders may not be vulnerable to disclosed information, and therefore might not have an incentive to change their environmentally damaging behavior because of greater transparency. A third pitfall is the potential for transparency regulations to be used for surveillance, rather than correcting poor behavior. A fourth pitfall includes the concern that too much information may in fact have the unintended consequence of becoming so prevalent that it can lose credibility and clout. A fifth pitfall is that greater transparency will not be effective unless strong, credible institutions are the ones producing or brokering disclosed information. Ultimately Mol concludes, "[t]he growing importance attached to transparency in environmental politics ensures that it becomes a central object of power struggles, with uncertain outcomes in terms of democracy. Markets and states will aim to capture transparency arrangements for their own goals, which will not necessarily be in line with the original normative ideas of democracy and participation" (Mol, 2010, p. 141).

5.3 Research questions

While stakeholder participation and decision-making transparency seem like essential water governance principles, it is important to understand how they may impact water management, especially in large, international river basins that include diversity in politics, water use, values, and cultures. As noted by Lautze et al. in their work on water governance, "better governance may not lead to better management" (Lautze, De Silva, Giordano, & Sanford, 2011, p. 6). This chapter analyzes the concepts

of stakeholder participation and transparency to get a better understanding of their strengths and weaknesses, with the goal of answering these specific research questions:

> *RQ1: Should there be limits to participation and transparency in river basin decision-making?*
>
> *RQ2: How can limits be equitably created and implemented, and who should enforce them?*
>
> *RQ3: What are the implications for institutionalizing a limit on participation and transparency?*

5.4 Research methods

The data for this chapter comes from two empirical examinations related to Colorado River Basin decision-making processes. First, in the fall of 2016, an online survey was administered to members of the Colorado River Water Users Association (CRWUA). CRWUA membership consists of a diverse group of Colorado River Basin stakeholders, including local, state, and federal water managers, farmers, irrigation districts, municipalities, Tribes, NGOs, commercial recreational interests, and other similar stakeholders. 997 unique email addresses were identified from the publically-available CRWUA membership directory. After members received an initial email in October, two follow-up emails were sent in November. Ultimately, 212 surveys were completed for a response rate of 21.3%. Survey questions sought respondents' perceptions of the decision-making process, including their views on specific topics such as the adequacy of representation, transparency, equity, shortage-sharing, priorities for specific ongoing negotiations, and others. The survey results were then quantitatively analyzed for this chapter's specific research questions on decision-making transparency and stakeholder participation.

Second, semi-structured, in-depth interviews (Rubin & Rubin, 2005) were conducted with key current and former Colorado River Basin decision-makers,

managers, and stakeholders (see Appendix D for the complete interview protocol). When available, interviews were conducted in person. Due to travel constraints and interviewee availability, approximately half of the interviews were conducted on the phone or by a video conference call. 32 interviews were conducted, and included federal and state Colorado River Basin managers, municipality representatives, irrigation district managers, Tribal representatives, and NGO representatives, both from the United States and Mexico. Interviews lasted between 0.5 and 1.5 hours. All interviews were digitally recorded and transcribed, then analyzed using the qualitative software, NVivo 10. A coding protocol was developed based on the results from previous chapters, as well as some of the literature discussed. The protocol included topics such as barriers to building adaptive capacity, mechanisms to overcome barriers, fairness, participation, and governance (see Appendix E for the complete coding protocol).

5.5 Results

5.5.1 Perceptions of stakeholder participation and transparency in Colorado River Basin decision-making

Both the survey results and in-depth interviews suggest there is a significant range in perceptions of the level of stakeholder participation and decision-making transparency in the Colorado River Basin.[21] Table 5.1 presents the survey results about respondents level of agreement with a specific set of related questions.

[21] See Chapter 3, Section 3.4 for a description of contemporary decision-making in the Colorado River Basin, with regard to the development of three specific policies. Ostensibly, Colorado River decision-making involves the seven Basin States and the federal government, but also tends to include several key water agencies and irrigation districts as part of the inner circle creating policy. The discussions between these groups are generally what is considered "in the room" or "at the table" when negotiating decisions for the Colorado River, although the implications for this are discussed in detail below.

Table 5.1: Survey results where respondents were asked to rate their level of agreement with questions relating to transparency and participation.

	Question	Level of agreement					
		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	N/A
Transparency	Colorado River Basin negotiations and decision-making are transparent.	**11.43**% (24/210)	**30**% (63/210)	**16.67**% (35/210)	**27.62**% (58/210)	**14.29**% (30/210)	
Participation	I feel like I have an adequate seat at the negotiating table when it comes to Colorado River Basin decision-making.	**11.43**% (24/210)	**24.76**% (52/210)	**20.95**% (44/210)	**14.76**% (31/210)	**17.14**% (36/210)	**10.95**% (23/210)
	While I'm not at the actual negotiating table, people who adequately represent my interests are at the table.	**28.37**% (59/208)	**33.65**% (70/208)	**10.10**% (21/208)	**9.13**% (19/208)	**11.54**% (24/208)	**7.21**% (15/208)
	My involvement is typically being consulted about a new decision after it has been drafted.	**15.31**% (32/209)	**32.06**% (67/209)	**11.96**% (25/209)	**14.83**% (31/209)	**14.83**% (31/209)	**11**% (23/209)
	I don't feel involved at all in Colorado River Basin decision-making.	**8.61**% (18/209)	**17.7**% (37/209)	**12.92**% (27/209)	**24.88**% (52/209)	**26.32**% (55/209)	**9.57**% (20/209)

In terms of transparency, respondents were relatively evenly divided in their perceptions of Colorado River Basin negotiations and decision-making. 41.43% (n=87)

somewhat or strongly agreed that these processes are transparent, while 41.91% (n=88) somewhat or strongly disagreed on the issue. 16.67% (n=35) neither agreed nor disagreed. As for participation, 36.19% (n=86) of respondents agreed that they feel they have an adequate "seat at the table," while only 31.9% (n=67) felt they did not.

The relatively low number of respondents who feel they have an adequate seat at the table is to be expected, given that most Colorado River Basin stakeholders do not have an actual seat at the table—that is, there is a relatively low number of decision-makers actually negotiating these policies. This is demonstrated in the subsequent survey question which reveals that 62.02% (n=129) of respondents somewhat or strongly agreed that, while they are not at the actual table, there is someone at the table who represents them. Only 20.67% (n=43) of respondents somewhat or strongly disagreed that they were adequately represented at the table. 47.37% (n=99) of respondents somewhat or strongly agreed that their participation typically takes the form of being consulted about a new decision after it has been developed, while only 26.31% (n=55) of respondents somewhat or strongly agreed that they do not feel involved in decision-making at all.

Similarly, the in-depth interviews revealed a significant range of perceptions regarding transparency and participation. As a measure of participation, interviewees were asked if everyone that should have been included in Basin negotiations was, in fact, included in the negotiations and decision-making. The range of answers included:

- "Yes, I truly believe that."
- "Absolutely."
- "90% of those who should have been there were there."
- "I've always been impressed by the number of stakeholders involved."
- "Depends on the specific issue."
- "We tried to."
- "There's an increasing number involved, but it's not adequate."

- "That's tough to answer."
- "No."
- "No, absolutely not."

With respect to transparency, there was also a significant range of responses to the question of whether Basin negotiations and decision-making processes were transparent:

- "Yes, quite transparent."
- "As transparent as they can be."
- "Not perfectly transparent."
- "They are more transparent today."
- "They could be if the public wants that."
- "Transparent to folks who have skin in the game."
- "No, but getting better."
- "I don't think so."
- "We've agreed to keep these out of the press."
- "Clearly they're not and there's no effort to do so."
- "Transparency is not always a good thing."

While results indicate that participants have widely-varying views regarding the degree of participation and transparency, the results also suggest that much of Colorado River Basin decision-making processes are not very participatory or transparent, and that is by design. The processes have evolved over the past decade, mostly to become more inclusive and transparent, but there are still concerted efforts among the primary Basin negotiators to limit participation in the discussions to a select few participants and to maintain the privacy of those discussions. These efforts for exclusion and privacy, however, are despite significant disagreement between negotiators and other Colorado River stakeholders over whether increased participation and complete transparency are a good thing, or what ideal levels of both might be. As one would expect, those at the actual negotiating table tend to lean toward a positive view of this semi-private process, while those not at the table tend to lean toward a

negative view. Nonetheless, even some stakeholders in the latter group acknowledge the necessity of not always including all interested parties and the importance of keeping those negotiations private. In short, and as will be discussed in the following sections, there were a variety of reasons given to both limit, as well as to increase, stakeholder participation and decision-making transparency. One interviewee seemed to capture this dilemma quite succinctly:

> "Some processes are fairly transparent. A lot are essentially a black box from the perspective of anybody who is not in them. There are pros and cons to that" (DI_11).

5.5.2 Benefits of stakeholder participation and decision-making transparency

While acknowledging that at least some aspects of Colorado River Basin decision-making are not transparent, several interviewees did discuss why maintaining some level of transparency is important. One of the primary reasons cited is that some transparency helps stakeholders know if they are being represented by understanding who is involved in decision-making. When discussing this transparency issue one interviewee noted, however, that it is unclear how the decision-makers determine what participants are allowed in the room. Moreover, that decision has consequences because:

> "[W]ho is in the room frequently has a lot of implications for what the outcomes are. And the failure to include people in the room frequently ends up in a bad place because perspectives are just simply ignored. And it's frequently just a means of disempowering people" (DI_11).

In addition to transparency regarding who is allowed in the room, another interviewee discussed the importance of transparency to those outside the room so that they know who is in the room. For example, the Basin State representatives will have regular, private meetings to discuss ongoing negotiations. Ostensibly, these meetings are just between Basin State representatives or principals and their close legal/technical

advisors, with often a federal representative as well. As several interviewees observed, the Basin States' Governor-appointed representatives are just that—representatives of the constituents of each state. They accordingly contend it is permissible for those negotiations to be private because the participants are representing all of the different stakeholder groups from each state. Several interviewees discussed this type of representation:

> "You are represented. You are represented by the federal agencies, you are represented by the state agencies. The states make up the Basin. Every Tribe is located in one state or another, so if you have an issue you need to work through your state representative, and you need to work through your federal special tribal-federal agency relationship, trust relationship. Same with the environmental organizations" (DI_22).

> "In some ways, sometimes the discussion gets down to almost a philosophical debate between a true republican form of government versus a pure democratic form of government. I'm appointed by the Governor of [Basin State] to represent the people of [Basin State]. When I'm in a room with five or ten or twenty other people, I feel like the [residents of Basin State] are being represented in that room. And ultimately anything that I agree to has to go back to [elected officials] and be approved. So there is transparency in the approval process, I just don't think you can have unlimited transparency at every step of the negotiating process and expect to get things done" (DI_1).

Why transparency becomes important, according to another interviewee, is because those meetings and negotiations will often include more people than just government representatives (i.e., the Basin State principals representing each state):

> "Many of the people who are in those rooms are not states.[22] But they are sort of thought about as being states, but they are not states. They are water agencies within a state, and they're not necessarily representatives of the constituencies that they they're supposed to be representing if they were states. I mean if it was actual states then we wouldn't necessarily need to worry too much about [other] interests—or at least not as much… And there is no representative—it's not representing a broad set of constituencies. It's actually just representing a very particular viewpoint. Those are the places where I think the lack of transparency becomes really problematic" (DI_11).

[22] For clarification, the interviewee is using "states" to refer to "Basin State principals".

Other reasons favoring a more open process include the fact that greater transparency increases the long-term support of a decision once it is negotiated and implemented. If the process was relatively transparent, then those who were not involved might still support the outcome if they have some understanding of who was in the room and why they decided upon a specific outcome. For example, there is an ongoing effort to finalize and implement Drought Contingency Plans (DCPs) in both the Upper and Lower Basins. Part of one of these DCPs includes operational changes to releases from various dams and reservoirs that have historically not been done. One of the interviewees involved in this plan noted how important it has been to explain to the public exactly why water managers are making these proposals. Without that detailed and transparent explanation—namely that these operational changes help support the entire Colorado River Basin system, despite some localized, short-term downsides—the interviewee did not think they would be successful in gaining public support for the DCP.

Further, the survey results revealed some interesting correlations between stakeholder participation and some policy outcomes. Several of the survey questions asked respondents to rate their level of agreement with two ideas: (1) that any new decisions in the Colorado River Basin will require "all" users to undertake shortages; and (2) new decisions would require only "some" users to undertake shortages. This distinction is common in Colorado River Basin discourse as the Law of the River (and systems of water rights more broadly) embraces the concept of seniority and who must curtail water use as less is available. 53.55% (n=113) of respondents "somewhat" or "strongly" believed that "all" users should be required to undertake shortages, while 63.33% (n=133) somewhat or strongly believed that "some" users should accept such shortages. Interestingly, this minor decrease in support from "all" to "some" users

reveals a somewhat substantial difference in how these groups view stakeholder participation. As Table 5.2 demonstrates, survey respondents who thought that "all" users should undertake shortages were significantly more likely to support increased stakeholder participation compared to those who disagreed with the notion that "all" users should be shorted. This relationship was not significant for respondents who thought only "some" users should be shorted, which suggests that those individuals who see the need for all users in the system to experience some level of shortage also think that more stakeholders should be involved in deciding those policies.

Table 5.2: Logistic regression results of stakeholder participation. Both models test the role of certain policy outcomes and events in a survey respondent's perception participation in Colorado River Basin decision-making. "User shortages" related to whether the respondent thought only "some" users will need to undertake shortages versus "all" users will need to undertake shortages. "Compact call by 2026" represents the respondents opinion on the likelihood a compact call between the Upper and Lower Basin occurs by 2026. A positive coefficient suggests the perception that stakeholder participation should be increased.

	Model 1		**Model 2**	
Independent variables				
User shortages				
Shortages for some	1.048	(1.267)		
Shortages for all	3.68***	(1.204)		
Compact call by 2026			1.658*	(.876)
Location (ref=Lower Basin)				
Upper Basin	1.524	(.839)	1.142	(.853)
Location other	0.029	(1.449)	-.699	(1.465)
Probability > *F* =	0.0026		0.086	
Standard errors in parentheses				

***p < .01, **p < .05, *p < .1

Survey respondents were also asked their opinions on the likelihood of specific policy events occurring at various times. One such event was the occurrence of a compact call between the Lower and Upper Basins (i.e., effectively implementing

mandatory shortages to the Upper Basin) occurring by 2026. 32.23% (n=68) of respondents thought the occurrence of this type of outcome was probable or very likely, while 33.18% (n=70) thought it was unlikely or very unlikely.

As shown in Table 5.2, there was a significant correlation between those who did think a compact call occurring by 2026 was likely and those who support greater stakeholder participation. This would suggest that those respondents who are concerned about the occurrence of this type of disruptive and unprecedented event occurring[23] are more likely to support greater participation by a variety of stakeholders in the decision-making process. In other words, if there is a chance for a significant negative outcome, the decision-making process should be more inclusive.

5.5.3 Limiting stakeholder participation and decision-making transparency

There are several reasons why Colorado River Basin negotiations are not completely open to all participants or transparent. The primary reason is that a decision-maker is more likely to propose or discuss a "risky" or "new" policy in a private room. For example, because of previous policies and historical context, no state in the Lower Basin would publically acknowledge or suggest reducing its Colorado River apportionment. Historical inter-state legal battles (e.g., between Arizona and California) and their related resolutions have created an environment in which the proposal of such a policy publicly is simply impossible, because any such proposal might be seen as conceding part of their Colorado River apportionment in the eyes of one's constituents.[24] One interviewee noted that only in private settings could a state

[23] A compact call has never been implemented between the Upper and Lower Basins and would most likely result in years to decades of litigation and uncertainty within and among both Basins.

[24] A specific example of this is when Arizona Senator John McCain made such a comment to reporter in Colorado during his 2008 presidential campaign (Ashby, 2008). After suggesting to the reporter that the Colorado River Compact should be renegotiated, McCain was met with swift political blow-back from stakeholders throughout the Basin. McCain quickly back pedaled his comments saying the Compact

propose accepting shortages, or ask another state to accept shortages. The underlying theory of this line of thinking is that these "risky" solutions, which are obviously ultimately needed to fix a supply and demand imbalance, must be negotiated and agreed to in private long before being announced in public. Another interviewee discussed this political reality (the need for privacy in discussions on the imposition of shortages) despite the acknowledgement by negotiators that such a solution (imposition of shortages) is necessary to stabilize Lake Mead elevations levels. In recognizing this political reality, the interviewee noted:

> "[Lower Basin representatives] know that cut-backs need to be made. They can't say that in a public, political arena—their Governors would get creamed" (DI_2).

Similarly, another interviewee discussed this political problem, and observed that a more private discussion can provide the political "cover" and maneuverability to begin discussing controversial topics:

> "I think often when you sit at the table, and you have the responsibility of representing your state or the federal government, I think that you sometimes just sing a mantra. When you get one-on-one, when you get to talk to people about what it is they are trying to do and their problems, I believe that is part of the art of negotiation and compromise—understanding. And I don't think you get that understanding in those formal settings where people are positioning themselves often or appearing to be: 'you can't do that, it's contrary to the Compact' or 'we've never done that before' situations. I think you need those private settings to come off the mountain and just chat" (DI_26).

Another stated reason for limiting transparency and participation is that it allows prominent decision-makers to establish common ground with less political risk or accountability. In other words, decision-makers might only be able to agree on something if there is not a concern that one of their supervisors or governing boards might reprimand them for even suggesting that specific position. One interviewee, who

---

should not be renegotiated (Hoover, 2008). This example demonstrates how sensitive—both in the general public and for decision-makers—even discussing institutional changes can be in the Colorado River Basin.

has been a state representative for Colorado River negotiations, discussed how these informal, private discussions often occur far away from the formal meeting room. Only during these off-the-record, casual settings—often in restaurants, bars, hotel lobbies, etc.—can representatives feel comfortable suggesting ideas or attempting to find common ground on specific proposals, without concern for political blowback. The interviewee noted:

> "It's that kind of thing—in an informal process you can be more open, potentially, as long as you don't have to draw the line in the sand to protect the ultimate policy position. I just think the kernel of creative thinking that might turn out to be what you incorporate into your deal often comes from just having conversations. You know, like, 'could you see [Basin State] doing x?' 'Well I don't know about x, but maybe x plus y or x minus y.' And it's that kind of discussion that you have, as far as it creates creative thinking and ideas. In kind of, more of a safe, harbored environment than throwing them formally out on the table" (DI_6).

Another interviewee, who also discussed the importance of these informal and private discussions, observed that they were a place for key negotiators to be blunt and argumentative, to help move the discussion along. The interviewee acknowledged that some transparency is important, but:

> "…I'm an unabashed believer in the small room. I don't believe you do deals the way we've done deals on the Colorado River and build the consensus that we've built without being able to have that safe room and to have a candid and sometimes fairly dynamic, bordering on acrimonious discussions. You can't have those discussions in front of a live television audience and expect people to open up and discuss it" (DI_1).

Similarly, the concepts of limited participation and transparency were also often cited as important for simply moving the discussion along and "getting things done". These negotiations are quite complex, with extensive back-and-forth between representatives of the Basin States; therefore opening the process up or being more inclusive would make it logistically impossible to succeed. As one interviewee put it,

an open process "would make it not possible at all. Again I think the process would break down of its own weight" (DI_20).

Another argument for limiting transparency and participation is to reduce or eliminate misinformation or rumors that may harm representatives positions or ability to compromise. This is especially true given the political sensitivity of these topics. As has been discussed, it is important for representatives to be able to have frank and candid conversations, but if those negotiations were more open or transparent, they would run the risk of having to "chill the conversation". If not, conversations may be taken out of context, with resultant political and public ramifications. As one interviewee discussed:

> "You want to be able to come to the table and have a very robust discussion. But if somebody says something as part of that robust discussion, that is taken out of context or outside of that room, it can nearly crash—or it can crash—the negotiations" (DI_12)."

Given this risk for misinformation or rumors, one interviewee who has been involved in Colorado River negotiations for decades described how the key representatives had always had an informal "hand-shake" agreement to always keep the discussions out of the press, and out of the public eye more broadly. Another interviewee also noted this difficulty of controlling misinformation or rumors, especially given how complex the negotiations are:

> "So if people get bits and pieces sometimes, misinformation gets out there. So you want to have your i's dotted and t's crossed when you finally have a conceptual agreement. Then you want to go out and make sure people understand what it is. Because if they get it in bits and pieces, they'll just take one piece and run. There's always people that are against what you're doing, and they can take that information and use it to start their own campaign of negativity. So you want to control that if it's a controversial subject" (DI_15).

5.5.4 Distinguishing transparency and participation among specific groups

The results also suggest it is important to distinguish between transparency to interested stakeholders and transparency to the general public. This distinction is necessary because of the political nature of these discussions (i.e. a state's long-term water supply) and the complex nature of the governance structures. These structures include complex institutions that often require a nuanced and informed understanding of the relevant issues to fully comprehend the implications of any proposed changes. Indeed, many participants in Basin decision-making strongly believe that there is a compelling argument to keep the negotiations entirely away from the general public and the media. As many of the interviewees noted, many of these negotiations are quite dynamic and require a back and forth among states long before the components of a new policy can be discussed in the press. Further, these negotiations involve quite complex and sensitive policy discussions that, the argument goes, are not easily understood by the general public. One interviewee stated that "it can take years to understand a system like the Colorado well enough to really appreciate what's going on, let alone be able to design solutions for it" (DI_11).

Conversely, however, there is a less compelling argument for keeping all negotiations private or shielded from interested stakeholders who are not in the negotiating room (e.g., Tribes, NGOs). Specifically, new decisions in the Basin will impact these types of stakeholders, and, arguably, the process for making and implementing new decisions ought to be made available to interested parties. Many of the interviewees, however, stated that the state principals are the ones who should have the final say because the Basin States are "sovereigns" and hold the water rights. The Basin States are the ones with "skin in the game", as was noted by several interviewees. As outlined by one interviewee:

> "And as a result, each state has a principal, all seven states do, that will guide that states interests as it relates to the larger Basin. So I would view the states role on the Colorado as more than just a stakeholder. We are a sovereign, governing body, that represent each of our constituent people and their interests. So the role in the Basin is that any interpretation, modification, change to the existing Law of the River needs to occur with those state players at the table. And their agreement" (DI_7).

While not disagreeing with this position, several other interviewees suggested that additional stakeholder groups are also sovereigns and should therefore also be included in the decision-making process. Specifically, the Native American Tribes are sovereigns and should therefore no longer be excluded:

> "One place that is lacking is incorporating the Native American voice in the decision-making of the river. When I explain to people why certain people are at the table, I'll talk about being sovereigns. Either the United States or Mexico or the States. The Tribes are sovereigns also, and I think that's one place we can help improve—well, we can improve all of it" (DI_12).

> "I would think, just from a personal reflection, I think one group that really should be at the table more are the Tribes. If any group really ought to be there. And I would like to see those relationships just continue to get stronger, so maybe one day in these small negotiation settings the Tribes are represented somehow. Maybe it could happen soon—I would definitely say for the next round of the [2007 Interim Shortage Guidelines], the Tribes are going to be way more involved than they were. I don't know what that looks like—hopefully it does look like they are part of a small group. And it's not this sort of stove-piped consultation" (DI_24).

Further, because many of these specific groups are directly impacted by Colorado River decision-making, they often have a much better understanding of the complex governance structures than the general public, and are therefore able to effectively contribute to the discussion. For example, one of the reasons several individuals in the environmental NGO community have been somewhat successful in contributing to these discussions is because those individuals have spent many years getting to know how the system works. This includes not only the physical infrastructure and associated system of water rights and administration, but also the institutional and individual context for governance of the Colorado River. In addition

to understanding the complex system, these individuals have also developed trust and respect within the decision-making community. Not only have they gained sufficient understanding of the system to contribute to the negotiations, but they have earned the credibility to do so. One interviewee described why they thought individuals within the NGO community were successful:

> "I think the way people within that community gain access to the real table and gain access to the real decision-making that goes on, on the river, is to build relationships, is to demonstrate that they can be a productive part of the network governance that relies on this river" (DI_1).

This is not to say, however, that all environmental NGO stakeholders are actively involved. Further, the time required to learn the system might prevent groups without dedicated staff or resources from being able to effectively join the conversation. As one interviewee noted, in regard to the 2007 Interim Shortage Guidelines and the 2012 Basin Study, several NGOs were actively involved in those processes:

> "But that was this privileged group of NGOs that participated and there were a lot of NGOs that were excluded. And I'm sure the excluded groups would say that process sucked. And in some ways, from their perspective, they're exactly right. There was picking and choosing that went on, and groups that are extremely litigious were not invited, while others participated" (DI_4).

5.5.5. The importance of informality

One interviewee discussed the perception that Colorado River Basin negotiations and discussions are largely "informally transparent", in that the process becomes transparent to an individual if he or she is able to speak with some of the primary negotiators or has a good relationship with those negotiators. Even if one is not in the actual negotiating room, that person still has an idea of what is transpiring because of those relationships and because of informal discussions with some of the key players. Outside of those relationships, and to the general public, however, the interviewee acknowledged there is little formal transparency regarding how decisions are made,

which has implications for individuals who have not established those relationships (which may or may not be their personal choice).

Additionally, many interviewees noted the importance of informal negotiations and discussions for facilitating dialogue and reaching an agreement. Often these informal gatherings take place in the hallways in between formal meetings, at happy hours and dinners, and in hotel lobbies during travel meetings. One of the primary reasons for these—in addition to building relationships, trust, and social capital—is that they are inherently completely private discussions. New ideas (or "risky" ones as discussed earlier) can be proposed in the safety of informal discussion with no reporters, note-takers, or other stakeholders. As expressed by one interviewee:

> "I think you need an atmosphere where you can speak safely about potential innovative solutions, without fear that you're going to be held to account for those ideas that you're bringing forward and discussing. And you need that environment, and that's again why the relationships are critical. And why you may have different small groups where you have that safe environment to explore options, and try to find innovative solutions. Which you cannot do either in the press or in a giant, public setting" (DI_20).

In one circumstance, decision-makers actually changed the structure of a formal negotiating meeting in recognition of the importance of these informal discussions. Historically, meetings typically lasted all day, with decision-makers flying to the meeting location in the morning, formally meeting all day, and then flying out that evening. This left very little time or room for informal discussions. Accordingly, some participants proposed changing the meeting structure so that an afternoon session was followed by a morning session the next day. This gave decision-makers time to go to happy hour and dinner together that night before reconvening the following morning. "Formalizing the informal"—as one interviewee put it—was essential for moving the discussion and coming to an agreement on the specific issue at hand.

Another example of formalizing the informal came in the lead up to the binational negotiations on Minute 319. In 2011, the Bureau of Reclamation hosted several of the International Boundary and Water Commission (IBWC) Commissioners on a tour of Reclamation facilities throughout the Colorado River Basin. The impetus for this tour was to not only continue the ongoing negotiations, but also to further trust and understanding between the two countries. As Mike Connor, then Commissioner of the Bureau of Reclamation, reflected, "I think that was further building of trust. It's trust between folks, but it's also to be grounded in good facts and understanding and that tour really got us on our way to even a better understanding of each others' systems and our legal foundation, but *also a much more willingness to be very candid about what our respective needs were, and what we needed to see in Minute 319*" (Water Education Foundation, 2013, p. 29; emphasis added). The United States Commissioner on the IBWC, Edward Drusina, noted that the tour was not only "a very exciting process that we went through" but in underscoring the informality also expressed that "I must admit that the molé in Salt Lake City was outstanding" (p. 29).

5.6 Discussion

RQ1: Should there be limits to participation and transparency in river basin decision-making?

The results show there is a range in perceptions as to how participatory and transparent decision-making processes are in the Colorado River Basin. Some stakeholders believe the process is relatively transparent while others think there are large components that are negotiated in a "black-box". Some stakeholders think that all the appropriate people are currently at the decision-making table, while others think that some people are still systematically excluded. Despite this range in perceptions of these processes, it seems that many stakeholders understand that some levels of privacy

and exclusion are necessary for decisions to be effectively negotiated and completed. Even those who are not at the table or cannot hear the discussion acknowledge that sometimes privacy is critical for these politically sensitive negotiations. Many interviewees suggested that, were it not for this privacy, they would not have been able to develop and confirm some of the bigger basin-wide policies, such as the 2007 Interim Guidelines or the on-going Drought Contingency Planning efforts. This would suggest that there should be limits to participation and transparency in river basin decision-making.

An emphasis on the importance of privacy, however, is accompanied by an almost unanimous agreement that participation and transparency in Basin decision-making have improved over the last several decades. Many interviewees cited the example of the environmental NGOs as a modest success story in terms of their gradual increasing presence at the table. Their success came from years of developing relationships, producing credible and viable solutions, and engaging in amiable and productive dialogue with the states and federal government. Subsequent policies, such as the 2007 Interim Shortage Guidelines and Minute 319, were believed improved by including the NGOs and utilizing some of their proposals. Most interviewees acknowledged that a better policy was created through an increased level of participation. As explained by one interviewee who has been involved in Colorado River Basin governance for decades:

> "So I'd say yes it's evolved in the Colorado River Basin. Continually evolved and improved over time. Rewind the past 20 years—a fair amount of conflict, a fair amount of posturing. Key players, states that will get together and advance some agreement to deal with key issues. That builds upon itself so there's more trust among those folks, then there's more willingness to tackle other issues which involve other constituencies. And it expands upon itself, so I think there's been an ever-increasing circle of trust in the Colorado River Basin. So it's an ongoing process of improvement" (DI_13).

Despite this ongoing process of improvement, this research has shown there is no straight linear progression towards greater transparency and inclusivity. That is to say, the negotiating table for the development of Colorado River policies does not necessarily need to be literally and figuratively expanded. As much of the discussion in the previous sections noted, this would be incredibly constraining and make the process much less efficient, if not impossible. Many of the interviewees acknowledged this process of improvement, but continued to grapple with the political and logistical realities of a more open, inclusionary process. For example, some interviewees opined that one way to balance participation and transparency is to employ a parallel process to what the primary negotiators (i.e., Basin State principals) utilize. According to one interviewee, during the negotiations for the 2007 Interim Shortage Guidelines, the Basin State meetings took place, and then there was also a "parallel track" in which interested stakeholders could also provide alternatives for evaluation. Conversely, however, some interviewees noted that such a parallel process is not enough, and those interested stakeholders need to be more directly involved in the primary process. Clearly there is disagreement about the appropriate balance between privacy, openness, and transparency.

The Drought Contingency Plan ("DCP") negotiations, particularly in the Lower Basin, demonstrate why some level of privacy is important when creating and discussing a new policy. One of the more significant components of the Lower Basin DCP requires California to agree to undertake shortages in its Colorado River allocation if elevations in Lake Mead reach specific, critical levels. This is significant because under the Law of the River—specifically the Supreme Court Decree from Arizona v. California in 1963—California technically does not have a legal obligation to take any shortages until Arizona, through the Central Arizona Project, is no longer diverting any

Colorado River water. Arizona agreed to be completely junior in its priority in return for federal funding to construct the Central Arizona Project. Therefore, California's agreement to shortages while Arizona is still diverting (albeit a reduced amount of) Colorado River water could be considered a significant concession by California. In addition to California's agreement to shortages, Arizona agreed to additional, more significant shortages at higher Lake Mead elevation levels than it had agreed to in the earlier 2007 Interim Guidelines. As discussed before, such politically sensitive topics could probably only be proposed in a private setting, where the states can discuss such options long before they are public, and, perhaps more importantly, long before they are formalized and become policy. One interviewee observed how significant it was for Arizona to agree to those shortages. Specifically, it was noted that if those negotiations had included more stakeholders or had been more transparent, "there's no friggin' way there would have ever been a preliminary agreement… there's no friggin' way" (DI_24).

In addition to giving political cover for proposing and considering such a policy, privacy allows the state principals to craft their message that this new shortage arrangement benefits their constituents. In other words, they can control the messaging and portrayal of the policy before it becomes public, and, thus, can potentially secure public support for the new decision. One interviewee stated that, while California agreed to shortages, it was not portraying the DCP as necessarily a shortage decision for its own constituents in California. Rather, the DCP expanded California's access to a specific type of stored water under the 2007 Interim Shortage Guidelines. Specifically, the DCP would allow California to receive "Intentionally Created Surplus" (ICS) water under conditions in Lake Mead that were not previously allowed. Meanwhile, in Arizona, decision-makers were portraying the new preliminary agreement as a win for

Arizona because California agreed to take shortages, despite not having a legal requirement to do so. In the end, both states (and Nevada) have preliminarily agreed to the DCP—something that does require significant reductions in Colorado River allocations should Lake Mead reach dire elevation levels—but they have framed the need for doing so in different ways. Despite several interviewees expressions of frustration that the DCP negotiations were completely private, it seems that such a policy might only be possible under such circumstances.

Ultimately this research has demonstrated that, in the context of the Colorado River Basin, there are indeed limits to the benefits of stakeholder participation and decision-making transparency. The results suggest that increased participation and transparency can sometimes support better and more effective decision-making, but in order for difficult and more transformative solutions to be created, decision-makers need some private space. Finding the appropriate balance of participation and transparency, therefore, seems to be necessary to improve decision-making processes in the future.

RQ2: How can limits be equitably created and implemented, and who should enforce them?

Attempting to prescribe when the balance between inclusivity and privacy may shift in a more equitable and sustainable way is no trivial task. A brief review of the academic literature on water policy revealed that little empirical research has explored the limitations to participation and transparency. Outside of the water policy literature, however, there is increasing discussion about striking the appropriate balance. One such example explored how complete transparency can diminish the efficiency of processes in a variety of businesses and companies (E. Bernstein, 2014). Bernstein examined research from a variety of companies and cultures, and in a number of countries (e.g., mobile phone factory in China, software developer in the United States).

The author ultimately found that complete transparency could actually make employees less efficient and less willing to try new things that might actually help the company. Further, efforts to increase transparency can sometimes have the paradoxical effect of reducing transparency when employees hide any new changes or ideas they have created. In response, the author found that successful companies established specific "boundaries" around individual employees and teams, and were ultimately able to find "the sweet spot between privacy and transparency, getting the benefits of both" (E. Bernstein, 2014, p. 60).

The four boundaries were (1) boundaries around teams, (2) boundaries between feedback and evaluation, (3) boundaries between decision rights and improvement rights, and (4) boundaries around time.

1.) Boundaries around teams embodies the idea that organizations could clearly delineate teams or groups of employees to undertake specific tasks. Once those teams or groups are delineated, they can then attempt to tackle a specific problem or issue. Because of the clear boundary surrounding the group, the group's work may only be transparent within the group itself. This could give the group flexibility and the freedom to develop new or untested ideas, without the risk of being exposed to those not within the group.

    This is somewhat evident in Colorado River Basin, although the boundaries around the decision-making groups are not always clearly delineated. Ostensibly, the boundaries around the primary negotiators are the Governors' representatives for the seven Basin States. Sometimes, however, this group includes additional members—such as a federal representative—and sometimes not all seven Basin States will be present. Often this group can include representatives from the major water utilities—such as the Metropolitan

Water District of Southern California—and, on occasion, includes environmental NGO representatives. It also differs by Basin; in the Upper Basin there is the Upper Colorado River Commission which includes the Governors' representatives for the Upper Basin States and the federal government. In the Lower Basin, no such formal group exists, although the three states are in theory under the auspices of the federal government who is technically the "Watermaster".

2.) Boundaries between feedback and evaluation suggests that there should be specific limits to how employee performance will be monitored and evaluated. This is in contrast to having everything an employee does be monitored and evaluated by anyone with access to that data. With limits on monitoring, an employee does not have to be concerned with managerial impressions about all aspects of his or her work. The author notes that, "tools that separate data-informed feedback from the evaluation process help lower people's defenses and put the focus squarely on productivity and problem solving, where you want it" (E. Bernstein, 2014, p. 63).

For inter-state negotiations and discussions, it seems that Colorado River Basin decision-makers (i.e., the "employees") are successful in drawing this boundary between them and their constituents (i.e., the "manager"). As discussed above, many of the negotiations are private or informal; therefore, not every proposal or idea is reported back to the representative's constituents or supervisor (Governor or Executive Board). Where this boundary is perhaps drawn less successfully is with intra-state negotiations. Once the decision-makers agree to a particular decision, they must go back to their constituents and attempt to convince them that the new decision will be beneficial. It seems that,

at that level of negotiation, much of what the decision-maker is doing with the new decision is constantly being monitored and evaluated by his or her constituents. This could be part of the reason why intra-state negotiations are largely the significant hurdle to creating new policies and decisions.

3.) The next boundary deemed important is between decision rights holders and improvement rights holders. Individuals with decision rights are tasked with making the actual decisions, whereas those with improvement rights can suggest modifications (or improvements) to the process, but lack the authority to implement such changes. Successful companies are able to clearly distinguish between the two, and provide specific roles for individuals with each type of right. Bernstein argues that, while transparency may benefit individuals with decision rights, it may actually harm individuals with improvement rights by limiting individual flexibility to try new things and concepts (i.e., experiments, and not final decisions).

This boundary is interesting in the context of the Colorado River Basin as the benefits of transparency are different from what Bernstein suggests. The individuals with decision rights (i.e. the Basin States) are the ones who currently benefit from a lack transparency, whereas those with improvement rights (i.e., those without water rights), would like additional transparency in the decision-making process. Despite this difference from Bernstein's research, a boundary around decision rights and improvement rights has been evident in the Basin. For example, with the 2007 Interim Shortage Guidelines, the environmental NGOs proposed a concept for intentionally creating surplus in the system, which ultimately was included in the Guidelines. The NGOs, as improvement rights

holders, were able to propose an addition to the draft policy, which the Basin States, as decision rights holders, ultimately included in the final policy.

4.) The final boundary is the importance of experimenting with set periods of time, in which individuals are given the flexibility to engage within the first three boundaries. For example, decision-makers might give a specific team a certain period of time to address a problem or issue, or they might give specified improvement rights to an individual or team for a short period of time. This allows for improvement, but with the knowledge that the flexibility is only permitted for a set period time.

This boundary is often explicitly used in Colorado River Basin decision-making, as all decisions since 2000 are interim agreements with finite lifetimes. For example, the 2007 Interim Shortage Guidelines expire after 20 years, while Minute 319 lasts only five years. Many interviewees emphasized the importance of explicitly designating these agreements as interim, and they provided a variety of reasons for such a time frame. For one, it is more politically tenable to agree to more risky or controversial proposals if the decision-maker knows the proposal will only be in place for a set period of time. If the proposal fails, or causes unforeseen consequences, then the decision-maker can simply not renew it at the end of its planned implementation period. This was evident in the Minute 319 negotiations, where some stakeholders wanted a longer time period (closer to 15 years), but ultimately accepted a five-year plan. Because 319 became a relatively comprehensive arrangement with many new concepts, decision-makers were hesitant to agree to anything longer than five years.

In sum, the identification and application of these four boundaries concepts could prove fruitful in finding the right balance of participation and transparency in Basin decision-making. In the Basin, clearer delineation of the groups of decision-makers could bring greater continuity to process, and help those stakeholders not within the group gain a better understanding of who is present in the group and why. In regard to evaluation and feedback, there is room for improvement in the intra-state negotiations. For decision rights and improvement rights, the holders of the former are fairly well-defined, but holders of the latter could benefit from a more explicit involvement. Finally, decision-makers in the Basin are constantly thinking about interim time periods for the decisions themselves, but perhaps the negotiations also could benefit from the application of additional time boundaries. For example, additional groups could be brought to the negotiating table, but only for a set and pre-determined time period. Obviously, this is not the only process for establishing limits on participation and transparency, but it does provide an example of how to develop such limits, as well as illuminate the potential benefits for such an arrangement.

When considering the enforcement of this type of arrangement, many stakeholders have expressed trust in the Bureau of Reclamation, Department of the Interior and other federal officials involved in Colorado River Basin decision-making. And in some ways, this trust has improved over the last 15 years. The dominant sentiment seems to be that specific individuals sought out and earned that trust—that those individuals' personalities were particularly trustworthy, especially to the Basin States. For example, a specific Bureau of Reclamation Regional Director or Commissioner, or Assistant Secretary or Secretary of the Interior, was particularly trusted and made efforts to build bridges across states and stakeholder groups.

During this same time period, there was another shift in the decision-making process that is less publicly known but also may have played an important role in building trust in the federal government. This shift involved a conscious effort by the Bureau of Reclamation to be more transparent with its technical data and modeling capabilities. For example, not only was Reclamation willing to model any policy, operational change, or concept that one of the Basin States had developed, but it also made those modeling results available to the any other Basin State. Similarly, in the binational context, Reclamation was willing to not only share technical information, but also ensure that their counterparts in Mexico had the capability to utilize and conduct their own technical analysis.

This would all suggest that there may be a role for the federal government, through the Department of Interior and Bureau of Reclamation, to enforce these types of boundaries. Indeed, this sort of watch-dog role is already evident in some respects, and could be expanded to include more formal monitoring and enforcement of the boundaries. For example, one interviewee observed that the federal government already has:

> "strong feelings one way or the other about whether stakeholders that are being represented by someone at the table need to be brought on. Or if that [Basin State Principal] waits too long it could really ruin the negotiations so far, so we'll gently make that suggestion. 'Hey [Basin State], you need to talk to—you need to start expanding these discussions among the state because it could cause a real rift in where we think we're going'" (DI_24).

RQ3: What are the implications for institutionalizing a limit on participation and transparency?

Thus far this chapter has provided evidence that there indeed might be limits to stakeholder participation and decision-making transparency, at least in the context of the Colorado River Basin. The previous section provided an example of how limits might be established and enforced, with a brief evaluation of what those limits might

mean for Colorado River governance. This final section attempts to understand what the implications are for institutionalizing such limits. If such limits were implemented in the Colorado River Basin, that would formalize a private, semi-restricted process that many stakeholders most likely would not support. Accordingly, understanding the implications for such a process—as well as important considerations when implementing said process—become essential components for river-basin governance.

One such implication is that even if successful boundaries are set up around limited participation and transparency, as described above, there is still the potential for certain stakeholders or specific values to be systematically excluded or ignored, should individuals within those boundaries decide to do so. This seems to highlight the importance of individuals or personalities in the implementation of limits or boundaries. It is possible that an individual, even acting within those limits or boundaries, may use the new arrangement as a guise for further disempowering other stakeholders who are currently outside a given limit or boundary. Therefore, such a process might require the inclusion of key individuals or personalities who understand the importance of including all appropriate stakeholder values and viewpoints. Despite having institutional limits or boundaries, individuals and personalities will still be incredibly important.

This importance of individuals or personalities has been evident in current and previous Colorado River decision-making. Many interviewees stated that a particular individual was able to achieve a collaborative outcome or invoke a specific process. For example, Mike Connor, the former Bureau of Reclamation Commissioner and Deputy Secretary of the Interior, was frequently mentioned as being essential for the successful completion of several recent agreements. In the binational negotiation context, for example, Connor understood the importance of the Basin States in developing an

agreement, yet he could see they were being excluded by the State Department and the International Boundary and Water Commission at the formal negotiating table. Several interviewees noted that Connor then urged the inclusion of the States at the table, which in fact happened. This ultimately led to the successful completion of Minute 319. The interviewees suggested that, but for Connor's understanding of the system, and his ability to convince others of the different approach needed, there was some doubt whether the two countries would have been able to agree on the new Minute.

In short, despite the institutionalization of specific limits or boundaries, the identity of the individuals within those limits or boundaries is of critical importance. Individuals have a played a key role thus far in Colorado River Basin decision-making, so it is a reasonable assumption they will continue to do so, even under new institutional arrangements. How this consideration translates into actionable policies or decision-making is a difficult question, but it is something that deserves attention.

Similarly, another implication for this type of arrangement is that we must assume that the informal discussions and negotiations—again often in restaurants, bars, hallways, etc.—would continue, even with formal boundaries or limits on participation and transparency. Therefore, despite having an overarching authority monitoring and enforcing the limits (e.g., the federal government), there will still be informal discussions or negotiations to which not all groups will be privy. As discussed above, this type of informality is often necessary to achieve significant policy reforms. All involved stakeholders must recognize this necessity while also respecting the established boundaries and limits. One possible mechanism for addressing this potential conflict (between the informal and formal means of participation) may be to more formalize, to some extent, stakeholder participation when it does occur. Traditionally, when the more expansive participation has occurred in the Basin, it has

been relatively ad hoc—that is, a particular individual (e.g., NGO representative) has asserted his or her right to inclusion, or someone has advocated on his or her behalf. A more formal participatory approach might include something like a Basin Commission, Stakeholder Advisory Group, or some other entity. Groups like this do exist in the Basin, but only within a subset of the Basin (e.g., Upper Colorado River Commission). No such entity exists for the entire Basin.

A final implication to consider when imposing limits on participation and transparency is federalism and the relationship between levels of government. As mentioned before, the federal government could monitor and enforce any boundaries or limits. For this enforcement to be effective, however, the Basin States, as the primary negotiators and water rights holders, would need to respect the authority of the Department of the Interior. In the Lower Basin, this authority is written into law and the Secretary of the Interior is the "Watermaster". Ostensibly, this gives the Secretary the authority to unilaterally curtail Lower Basin States' allocations. Some of the interviewees mentioned, however, that this authority is not always respected and whether the Lower Basin States will respond to this federal threat depends, in large part, on the individuals within the Interior Department. That is, the Lower Basin States must find the federal "hammer" to be a credible threat, forcing them to act in a particular way. This is an especially important consideration in the Colorado River Basin, given that the states have the legal rights when it comes to governing water, and given that the Colorado is an international river basin.

5.7 Conclusion

In some ways, this semi-private and exclusive process ultimately allows for more robust, adaptive, and effective solutions to the Basin's supply and demand imbalances. Indeed, many agreements once thought of as political non-starters, or

legally impossible, have come to fruition. In late 2017, the Lower Basin DCP was expected to be finalized and signed into agreement, which included California's agreement to accept shortages if Lake Mead reaches critical levels. This is something that even several years ago would have been unthinkable, given the Basin's politics. But through a decision-making process that is largely behind closed doors and conducted by only a select group of stakeholders, the Basin State principals have been able to find common ground to hopefully implement new and more comprehensive reforms. As of this writing, however, the negotiations have stalled and the DCP has yet to be signed by the Lower Basin States (Loomis, 2018). This is largely due to political infighting in Arizona about who ultimately represents Arizona in Colorado River negotiations (Chapter 6 discusses the source of this intrastate disagreement), but it is also due to the fact that some Arizona interests were excluded from the earlier DCP negotiations. In some ways, this provides evidence that transparency and inclusion are important throughout a negotiating process, in order to give a decision widespread support and staying power. But as some of the interviewees discussed above, it is doubtful if the DCP negotiations could have gotten as far as they did if they had been more transparent and inclusive.

Nonetheless, while this semi-private and exclusive process has been somewhat effective, it has also come at the expense of the exclusion of certain stakeholder groups from the decision-making table. Reconciling the need for privacy and exclusivity with recognizing changing societal values and demands is going to be one of the prominent challenges facing Basin managers in the coming decades. What this research has demonstrated, hopefully, is that past successes can shed light on what parts of the process can improve Basin decision-making, or at least make it more efficient. For example, establishing specific boundaries around participation and transparency may

be an effective way to allow for robust discussions without systemically excluding non-traditional stakeholder groups with valuable contributions. In other words, stakeholder participation and decision-making transparency are not necessarily an end goal, in and of themselves. As noted in David Heald's chapter on evaluating transparency from an instrumental value standpoint, "When sunlight becomes searchlight it can be uncomfortable and when it becomes torch it may be destructive" (Heald, 2006, p. 71). Or, as an interviewee for this research put it, "[i]t may not be the most transparent process in the world, but for a resource of this importance, I think it's the right way" (DI_1).

5.8 References

Agarwal, A., delos Angeles, M. S., Bhatia, R., Chéret, I., Davila-Poblete, S., Falkenmark, M., … others. (2000). *Integrated water resources management*. Global water partnership. Retrieved from http://dlc.dlib.indiana.edu/dlc/handle/10535/4986

Ashby, C. (2008, August 15). McCain: Renegotiate 1922 Western water compact. Retrieved August 30, 2017, from http://www.chieftain.com/news/local/mccain-renegotiate-western-water-compact/article_b6700db0-5b98-5dd8-ae48-fa27ee5ec866.html

Bernstein, E. (2014, October 1). The Transparency Trap. Retrieved August 31, 2017, from https://hbr.org/2014/10/the-transparency-trap

Bernstein, S. (2004). Legitimacy in global environmental governance. *J. Int'l L & Int'l Rel.*, *1*, 139.

Blomquist, W., & Schlager, E. (2005). Political Pitfalls of Integrated Watershed Management. *Society & Natural Resources*, *18*(2), 101–117. https://doi.org/10.1080/08941920590894435

Coglianese, C., Kilmartin, H., & Mendelson, E. (2008). Transparency and Public Participation in the Rulemaking Process. Retrieved from https://www.hks.harvard.edu/hepg/Papers/transparencyReport.pdf

Dawes, S. S. (2010). Stewardship and usefulness: Policy principles for information-based transparency. *Government Information Quarterly*, *27*(4), 377–383. https://doi.org/10.1016/j.giq.2010.07.001

De Stefano, L., Hernández-Mora, N., López Gunn, E., Willaarts, B., & Zorrilla-Miras, P. (2012). Public participation and transparency in water management. *Water, Agriculture and the Environment in Spain: Can We Square the Circle*, 217–225.

Fleck, J. (2016). *Water is for Fighting Over: and Other Myths about Water in the West*. Washington, DC: Island Press.

Global Water Partnership. (2000). *Integrated water resources management*. Stockholm: Global Water Partnership.

Heald, D. (2006). Transparency as an Instrumental Value. In C. Hood & D. Heald (Eds.), *Transparency: The Key to Better Governance?* (pp. 58–73). British Academy. https://doi.org/10.5871/bacad/9780197263839.003.0004

Hedelin, B. (2007). Criteria for the Assessment of Sustainable Water Management. *Environmental Management*, *39*(2), 151–163. https://doi.org/10.1007/s00267-004-0387-0

Hood, C. (2006). Transparency in historical perspective. In C. Hood & D. Heald (Eds.), *Transparency: the Key to Better Governance?* (pp. 3–23). Oxford, UK: Oxford University Press. Retrieved from http://www.oup.co.uk/

Hoover, T. (2008, October 4). McCain: Water deal is hands-off. Retrieved August 30, 2017, from http://www.denverpost.com/2008/10/03/mccain-water-deal-is-hands-off/

Huffman, J. L. (2009). Comprehensive river basin management: the limits of collaborative, stakeholder-based, water governance. *Natural Resources Journal*, 117–149.

Huntjens, P., Lebel, L., Pahl-Wostl, C., Camkin, J., Schulze, R., & Kranz, N. (2012). Institutional design propositions for the governance of adaptation to climate change in the water sector. *Global Environmental Change*, *22*(1), 67–81. https://doi.org/10.1016/j.gloenvcha.2011.09.015

Irvin, R. A., & Stansbury, J. (2004). Citizen participation in decision making: Is it worth the effort? *Public Administration Review*, *64*(1), 55–65.

Islam, S., & Susskind, L. E. (2012). *Water Diplomacy: A Negotiated Approach to Managing Complex Water Networks* (1 edition). New York: Routledge.

Jaspers, F. G. W. (2003). Institutional arrangements for integrated river basin management. *Water Policy*, *5*, 77–90.

Judkins, G. L., & Larson, K. (2010). The Yuma desalting plant and Cienega de Santa Clara dispute: a case study review of a workgroup process. *Water Policy*, *12*(3), 401. https://doi.org/10.2166/wp.2009.084

Lautze, J., De Silva, S., Giordano, M., & Sanford, L. (2011). Putting the cart before the horse: Water governance and IWRM. In *Natural Resources Forum* (Vol. 35, pp. 1–8). Wiley Online Library. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1477-8947.2010.01339.x/full

Leach, W. (2006). Collaborative Public Management and Democracy: Evidence from Western Watershed Partnerships.pdf. *Public Administration Review*, *66*, 100–110.

Lockwood, M., Davidson, J., Curtis, A., Stratford, E., & Griffith, R. (2010). Governance Principles for Natural Resource Management. *Society & Natural Resources*, *23*(10), 986–1001. https://doi.org/10.1080/08941920802178214

Loomis, B. (2018, March 2). Arizona water managers disagree on how to prevent a shortage on the Colorado River. *Arizona Central*. Retrieved from https://www.azcentral.com/story/news/local/arizona-environment/2018/03/02/arizona-water-managers-central-arizona-project-colorado-river-conservation-lake-powell-mead/383210002/

Lubell, M., & Edelenbos, J. (2013). Integrated Water Resources Management: A Comparative Laboratory for Water Governance. *International Journal of Water Governance*, *1*(3), 177–196. https://doi.org/10.7564/13-IJWG14

Mol, A. P. (2010). The future of transparency: Power, pitfalls and promises. *Global Environmental Politics*, *10*(3), 132–143.

Mostert, E. (2006). Participation for Sustainable Water Management. In *Sustainable Management of Water Resources: An Integrated Approach*. Cheltenham, UK: Edward Elgar Publishing.

Nowlan, L., & Bakker, K. (2007). *Delegating water governance: Issues and challenges in the BC context*. Program on Water Governance, University of British Columbia Vancouver. Retrieved from http://www.tonydorcey.ca/597/Posts/FBCwatergovernancefinal2.pdf

Orlove, B., & Caton, S. C. (2010). Water Sustainability: Anthropological Approaches and Prospects. *Annual Review of Anthropology*, *39*(1), 401–415. https://doi.org/10.1146/annurev.anthro.012809.105045

Pahl-Wostl, C. (2002). Towards sustainability in the water sector–The importance of human actors and processes of social learning. *Aquatic Sciences*, *64*(4), 394–411.

Rahaman, M. M., & Varis, O. (2005). Integrated water resources management: evolution, prospects and future challenges. *Sustainability: Science, Practice & Policy*, *1*(1), 15–21.

Reeve, I. (2003). Principles for the nested governance of water resources. *Institute for Rural Futures Occasional Paper*, *1*, 1.

Rinaudo, J. D., & Garin, P. (2005). The benefits of combining lay and expert input for water-management planning at the watershed level. *Water Policy*, *7*, 279–293.

Robison, J. A., & Kenney, D. S. (2012). Equity and the Colorado River Compact. *Envtl. L.*, *42*, 1157.

Rubin, H., & Rubin, I. (2005). *Qualitative Interviewing: The Art of Hearing Data* (Second Edition). London, UK: Sage Publications.

Stasavage, D. (2006). Does Transparency Make a Difference? The Example of the European Council of Ministers. In C. Hood & D. Heald (Eds.), *Transparency: The Key to Better Governance?* (pp. 164–179). British Academy. https://doi.org/10.5871/bacad/9780197263839.003.0010

Tortajada, C. (2010). Water Governance: Some Critical Issues. *International Journal of Water Resources Development*, *26*(2), 297–307. https://doi.org/10.1080/07900621003683298

Videira, N., Antunes, P., Santos, R., & Lobo, G. (2006). Public and stakeholder participation in European water policy: a critical review of project evaluation processes. *European Environment*, *16*(1), 19–31. https://doi.org/10.1002/eet.401

Videira, N., Kallis, G., & Antunes, P. (Eds.). (2006). *Integrated Evaluation for Sustainable River Basin Governance*. London: IWA Publishing.

Ward, S. (2015). The Magical Concept of Transparency. In *Ethics for Digital Journalists*. Routledge. Retrieved from https://books.google.com/books/about/Ethics_for_Digital_Journalists.html?id=QJxeBAAAQBAJ

Water Education Foundation. (2002). Coming to Consensus: Sharing the Colorado River. Retrieved August 31, 2017, from http://www.watereducation.org/river-reports/coming-consensus-sharing-colorado-river

Water Education Foundation. (2013). An Era of New Partnerships on the Colorado River. Retrieved August 31, 2017, from http://www.watereducation.org/river-reports/era-new-partnerships-colorado-river

Whiteley, J. M., Ingram, H. M., & Perry, R. W. (Eds.). (2008). *Water, place, and equity*. Cambridge, Mass: MIT Press.

Wiek, A., & Larson, K. L. (2012). Water, People, and Sustainability—A Systems Framework for Analyzing and Assessing Water Governance Regimes. *Water Resources Management*, *26*(11), 3153–3171. https://doi.org/10.1007/s11269-012-0065-6

Chapter 6 – Moving towards a sustainable and equitable approach to water governance: improving adaptive capacity in the Colorado River Basin

> *Empathy—which is a weird word to hear in the water policy arena—but I think empathy for the problems that each state, or water utility, or water interest, or stakeholder might be facing… I think that's key to actually solving the problems, ultimately. (DI_22)*

6.1 Introduction and research questions

In considering sustainability and equity in the Colorado River Basin, several prominent themes and related research questions have emerged. One such theme is the need to balance inclusivity and transparency with effective decision-making. This research has demonstrated that some processes need to be private, including only a select group of decision-makers, even though this privacy compels the exclusion of other stakeholders' input and values. Conversely, requiring a completely open and transparent process leads to guarded negotiators unwilling to discuss or consider new agreements. Clearly, there is a balance between the two extremes and the question remains in finding that appropriate balance:

> RQ1: *How can a balance between privacy and inclusion be institutionalized and monitored in a way that does not systemically exclude certain stakeholder groups?*

Another emerging theme is whether transformative changes to the Law of the River are needed to prevent significant negative impacts throughout the Colorado River Basin. For example, minor modifications to existing institutions have been adequate so far, but more transformative changes might be necessary to achieve a long-term solution for the river's over-allocation problem (Kenney et al., 2011). One example of a transformative change would be modifying the Basin States' Compact apportionments to solve the structural deficit in the Lower Basin. Terry Fulp, Regional Director for the Bureau of Reclamation's Lower Colorado Region Office, publically acknowledged that even the most drastic shortages in the Lower Basin Drought Contingency Plan do not fix the structural deficit problem if a significant, multi-year drought were to occur

(Fulp, 2017). As discussed in previous chapters, however, major changes or modifications to inter-state compacts are extraordinarily difficult and politically untenable, which leads to the question:

> *RQ2: If significant modifications are needed for the Law of the River, how can decision-making processes facilitate a more transformative change?*

The role of specific individuals—particularly individuals in the federal government—in promoting a more inclusive, holistic process is another theme identified in this research. These individuals, most often with the Department of the Interior, have played an important role in informal conflict resolution and in facilitating negotiations. They have successfully advocated for the inclusion of additional stakeholders, but they have also given the Basin States room to negotiate amongst themselves. The additional stakeholder groups include Native American Tribes and environmental non-governmental organizations. Currently, however, the success of facilitating the expansion of the decision-making process has depended, in large part, on individual personalities and motivations. Therefore:

> *RQ3: How can the process for which some individuals have advocated (e.g., more participatory) be institutionalized, irrespective of the specific individuals with authority?*

Finally, this research has highlighted the importance of informal negotiations in achieving specific policy goals. Only through informal, off-the-record conversations are decision-makers often able to find common ground and propose specific policy recommendations. During formal negotiations, it seems, decision-makers find themselves forced to "toe" their respective "lines," out of concern for the way in which any new proposals or agreements might be perceived by their constituents or supervisors. Thus, the following question remains:

> *RQ4: How can informal negotiations continue to occur without systematically excluding stakeholders who are not involved? More specifically, when the informal discussions do occur, can they be monitored and checked for systematic biases?*

Ultimately, these research themes and remaining questions all relate to deficiencies in the governance of the Colorado River, as is often the case in water resource management. As stated by Pahl-Wostl 2012, "Most persistent challenges for dealing with the emerging water crisis lie in the realm of water governance, and many problems can be attributed to governance failures rather than the condition of the resource base itself" (p. 24). In other words, there is often not an underlying biophysical limitation, but rather an institutional barrier limiting the capacity of socio-ecological systems to successfully adapt to changing conditions.

At issue is adaptive capacity, a concept discussed in previous chapters.[25] That is, proactive improvements in adaptive capacity are needed in order to identify and embrace more sustainable and equitable approaches (Pahl-Wostl, 2009). Proactive adaptations in the Colorado River Basin require a consideration of the current gaps in adaptive capacity and ways to foster adaptive capacity in the future. By examining the decision-making process specific themes can be gleaned that might suggest improvements to adaptive capacity in the future.

This chapter explores adaptive capacity in the Colorado River Basin utilizing survey and interview data. After a brief discussion of the methods used in the research, the chapter then considers what is limiting adaptive capacity currently, as identified in the interviews. Following the methods section, each of the four themes and questions discussed above will be examined in detail by considering the implications for adaptive capacity. Results suggest that a fundamental shift in how decision-makers think about the process—including being empathetic with one another—might be required for the

[25] See Chapter 3 for a more in-depth discussion on adaptive capacity.

Basin to ultimately improve adaptive capacity. Comparing survey data across a six-year time period suggests this shift may have already begun, albeit in limited forms. The survey results also identify a concern, however, that a full shift might not be expected in the coming years.

6.2 Methods

The data for this chapter were extracted from the semi-structured interviews (n=32) and the 2016 online survey (n=212) discussed in previous chapters. In addition, a temporal analysis will compare the results from the 2016 survey to a similar online survey conducted in 2010. This 2010 survey, conducted by the same researchers, was comprised of questions that were also included in the 2016 survey. These questions pertained to issues of water supplies, demands and availability, the perceived need for institutional reform, and any potential solution strategies. The survey was administered in the summer of 2010 to then-members of the Colorado River Water Users Association ("CRWUA"), in the same process as the 2016 survey. The 2008 CRWUA membership directory was used and included 903 unique, individual email addresses. The survey yielded 185 unique responses, for a 20.5% response rate (185/903). Because the 2016 survey included the same questions as the 2010 survey, verbatim, the temporal analysis will illuminate how, if at all, perceptions have changed during that six-year period.

6.3 Existing challenges in building adaptive capacity

It is important to understand what gaps or challenges currently exist in Colorado River Basin decision-makers' ability to improve adaptive capacity. As discussed in Chapter 3, indicators of adaptive capacity include flexibility, collaboration, informal social mechanisms, social trust, and the ability to learn and incorporate new information. The following section examines decision-makers' perceived challenges that

currently exist in building adaptive capacity. Specifically, they include constraints in flexibility in decision-making, difficulties in incorporating uncertainty, and the problem of effectively responding to changing biophysical conditions. Examining these challenges allows for a better understanding of how the decision-making process may be improved by building adaptive capacity in the Basin.

One of the more common challenges mentioned by interviewees was the difficulty in having to "sell" a new policy or agreement "back home" when attempting to respond to changing biophysical conditions. Often, the decision-makers in the negotiating room could agree on a particular policy for what was needed. However, unanimous agreement among those decision-makers does little to address the political implications in their home states or municipalities, and those political implications may pose challenges to finalizing and implementing the new policy. Governing boards or other constituents in decision-makers' home states often need to sign-off on any new agreement, therefore presenting this challenge of crafting an agreement that can be sold to those stakeholders. Numerous interviewees emphasized that they were always mindful of local politics during the negotiations—that is, knowing what they could probably "sell" or not "sell" back home. Furthermore, even though they had created an agreement they thought was "saleable", convincing the numerous stakeholders in their home states required significant effort. As one interviewee stated:

> "The biggest difficulty to success is selling some of the agreements back home to legislators; the water using community that's not actively engaged in the River. I think all states have that problem, some to greater degree, some to a lesser degree" (DI_23).

Another interviewee noted the frustration of seeing this challenge have an impact on negotiations:

> "What was really difficult on the River was that each state had its own politics, in-state politics, going on. What was terribly frustrating was to see another state

> taking positions that they knew weren't viable, but had to do it because of their constituency. And that's just a part of the process—it took real leadership on the parts of those at the negotiating table to realize what was in the best interest of the river as a whole. And try to set aside their myopic view of what can we do for that state, particularly" (DI_12).

One interviewee suggested this challenge exists because they have to "sell" an entire "package" to constituents, as these basin-scale decisions often include multiple components. Specifically, most decisions include some aspects that constituents in each state will support, but the difficulty lies in explaining and convincing constituents to accept any concessions in a decision. An example of this difficulty, as given by another interviewee, was a new decision intended to change the operation of certain reservoirs in that interviewee's state. To the general public, the reservoir re-operation seemed like a loss for the state because additional water would be moved to downstream reservoirs. Since this would be immediately seen and felt by local stakeholders, many in the public were skeptical of the entire policy. Accordingly, it became difficult for the interviewee to convince the public of the benefit of the entire policy (temporarily moving water downstream reduces the risk of a compact call). It took many months and years of traveling around the state, engaging with constituents and attempting to explain why some concessions were needed for the greater good, in order to garner public support.

Another common challenge expressed in the interviews was the issue, more generally, of "politics." While used broadly, politics included issues of authority for decision-making, give-and-take in the negotiations process, and priorities for competing partisan interests, and ultimately constrained decision-makers' ability to create more flexible institutions. The Colorado River Basin consists of politically diverse states with a range of economic strengths, values, and socio-economic conditions, all of which influence priorities for the river. An example of challenging political issues was when a negotiator would bring peripheral matters to the Colorado River Basin decision-making

process. One interviewee suggested that unrelated political concerns contributed to the fact that the Lower Basin Drought Contingency Plan (DCP) and new Minute with Mexico had not been completed by the end of the Obama Administration:

> "But I think a few entities that are critical to the agreements brought in other issues that were not specifically Colorado River issues. They were other interests that they had or political concerns that they had not having to do with the Basin and the facts themselves. And I think that impeded progress. And that resulted in there not being a finalized drought contingency plan, a finalized agreement with Mexico, before the end of the Obama Administration. So when people don't stay focused on the issues at hand, and start bringing in extraneous matters into their consideration, that tends to impede congress" (DI_13).

In addition to inter-state political challenges, many of the Basin States also have significant intra-state political considerations that can make modifying institutions difficult. Several interviewees described an intra-state fight between the two primary water agencies in Arizona—the Department of Water Resources and the Central Arizona Water Conservancy District. One interviewee discussed the source of this intra-state tension:

> "The classic example is CAP and Arizona Department of Water Resources—they're always in a struggle about who has the bigger role. One says well we're the state and we're in charge of the state of Arizona, and the other says well we're the ones actually in charge of delivering the water. So they're always trying to figure out who has the greater role and influence between those two, even within the same state" (DI_15).

These types of political challenges are not in and of themselves particularly interesting or unique to the Colorado River Basin, but what is interesting is that many of the interviewees also emphasized how management of the river is largely non-partisan. That is, many interviewees claim they do not allow politics to influence decision-making and that they are able to negotiate strictly on the issues at hand. This disconnect is analogous to the problem of having to promote new policies to constituents: the primary decision-makers tend to agree with each other and can remove themselves from partisan battles in order to address the underlying Basin

problems. Nonetheless, when they are outside of the negotiating room, politics—both inter- and intra-state—still presented a significant challenge in effectively modifying existing institutions.

Another challenge commonly identified by interviewees was the power of the status quo. More specifically, institutional inertia is a significant impediment to progressive decision-making because modifying existing institutions presents numerous challenges (Heinmiller, 2009). Such "path dependency" has been identified as a significant barrier in river basins where the initial institutions were only focused on apportionments, as is the case in the Colorado River Basin. Heinmiller 2009 finds that the:

> [R]esilience of early apportionment institutions can make them very difficult to displace when serious conservation concerns emerge later on, constraining the development of much-needed conservation initiatives. Thus, in many common pools, *institutional legacies* may be just as important as the knowledge, preferences and mutual trust of current actors in determining the outcomes of collective action efforts. (p. 45; emphasis added)

In other words, institutional legacies or inertia are powerful forces that can limit or impede new modifications or decisions in a river basin. Further, this type of inertia often constrains decision-makers' flexibility in modifying existing institutions, especially as biophysical conditions change, impacting overall adaptive capacity (Walker et al., 2002). In the Colorado River Basin, the persistent refusal of states to permanently modify the Colorado River Compact of 1922 demonstrates the power of institutional inertia in limiting adaptive capacity. Any efforts to do so could be seen as threatening a state's fundamental Colorado River rights. One interviewee captured this sentiment well:

> "[I]n every single state you are very focused on the fact that the state, under the Compact, is allowed to develop a certain amount of water. What that amount of water is, how much that really is, is up for interpretation. It's a property right—it's an ingrained property right as far as the States are concerned—and you have

> constituents in your state who worry that tweaking how we operate the river is diminishing our Compact entitlement essentially" (DI_12).

Another interviewee acknowledged this inflexibility or inertia barrier in the context of Native American Tribal water right settlements. Because these settlements are, by their nature, permanent agreements, they exemplify the difficulty of overcoming institutional inertia and modifying existing institutions. Permanent modifications to how the river is governed require complete unanimity among the various stakeholders, and inertia provides political cover should a decision-maker be concerned about such a permanent change. The interviewee suggested that as supply and demand imbalances continue to increase, this barrier may become increasingly formidable:

> "But something more aggressive as in changing the fundamentals of the Law of the River, it ain't going to happen unless all the states agree to it. So, the challenge is maybe greater with climate change, population increases, the loss of traditional supplies given groundwater mining and the contamination of other supplies—we may need some more aggressive action. But it's going to be more difficult if you look to actually amend some fundamentals of the Law of the River" (DI_13).

A final common challenge evident in Colorado River Basin decision-making was both institutional and hydrological uncertainty constraining the ability to learn and incorporate new information. In terms of institutions, several interviewees stated that modifications to existing rules are difficult to accomplish because of uncertainty as to their implementation. Specifically, there could be unanticipated and unforeseen consequences from a new governance scheme. For example, in the binational Minute 319 negotiations, the two involved countries were negotiating several novel ideas. One such idea, which became known as Intentionally Created Mexican Allocation (ICMA), was that the United States could allow Mexico to conserve water through various efficiency upgrades and then store that water in United States reservoirs for use at a later time. Both countries, though, were concerned about uncertainties in the policy's

implementation and practical operation. The complexity of the issues relating to the Colorado River, particularly in the Lower Basin and in binational contexts, led many interviewees to acknowledge that knowing and understanding all of the consequences of new policies, such as ICMA, is all but impossible.

The second uncertainty relates to hydrological conditions. Numerous interviewees noted that despite the existence of incredibly large storage reservoirs in the Colorado River Basin (most notably Lakes Powell and Mead), the reliance on snowpack in the Upper Basin for the majority of Basin runoff leaves the system vulnerable to annual and decadal variations in the river's hydrology. This uncertainty can make it difficult for decision-makers when they create new policies—that can be continually modified as new information is learned—because they are concerned they could be giving away too much (agreeing to shortages when the future hydrology could be more favorable) or they could not be doing enough (agreeing to insufficient shortages to handle less favorable hydrology). An example of this uncertainty occurred with the 2007 Interim Shortage Guidelines. Towards the end of the negotiating process, one Basin State proposed a slight modification to the reservoir operating rules. Other Basin States were hesitant to agree to this new specific operating rule, but the Bureau of Reclamation examined its technical modeling and convinced the hesitant states that the conditions for triggering the proposed rule were extremely rare and would most likely never occur. As noted by one interviewee after describing these last-minute negotiations:

> "Well, the conditions for that [operating rule] happened the second year of the Guidelines" (DI_8).

Despite Reclamation's best efforts to determine the risk for the occurrence of certain system conditions, enough uncertainty exists in the system's inter-annual

variability that certain thresholds can be reached much more quickly than anyone could have predicted. In this case, states were told they could agree to a modified operating agreement because there was such a low risk for the occurrence of that specific condition. And yet within two years, the system once again proved its unpredictability and uncertainty.

Similarly, another interviewee suggested that because of uncertainty in future hydrology, decision-makers could never agree to significant reductions in allocations:

> "[We] will never take a position that we don't have the full developable amount that Compact says [we] have. Even if—whether it's climate change or drought or whatever—it appears to show that there's less water to be divided. We're never going to say that—well, who says that in twenty years maybe the hydrology in 1922 will return again. And if so, we will not have given up any of our rights for our constituents" (DI_7).

The interviewee noted that if there was complete confidence there would be a reduction in Colorado River flows, then they could consider reductions in allocations under the Law of the River. But without that certainty, agreeing to such reductions would amount to needlessly giving away their constituents' rights. This reinforces the barrier of institutional inertia discussed above because it demonstrates how difficult it can be to modify original decisions. That is, the original Compact allocated a set number of acre-feet to the Upper and Lower Basins. Because this inflexible quantity of water is in the original governance structure, it becomes difficult to convince parties to that compact to agree to reduce their allocations because of the inherent uncertainty in future hydrology.

In sum, these challenges identified by the interviewees—having to "sell" a new policy back home, political implications, institutional inertia, and uncertainty—all suggest existing gaps in decision-makers' ability to effectively respond to changing biophysical conditions in the Colorado River Basin. In the following section, potential

mechanisms will be explored to overcome these challenges and ultimately improve adaptive capacity.

6.4 Improving adaptive capacity in the Colorado River Basin

The previous section highlighted some of the common challenges in building adaptive capacity as identified by decision-makers in the Basin. Broadly speaking, these challenges ultimately revolve around the ability for decision-makers to be flexible in modifying institutions as biophysical conditions change. Indeed, the need for flexibility was a common theme discussed by the interviewees. As one interviewee summarized:

> "The problems we face on the River are dynamic—they're not linear in nature and we need to be nimble and flexible and adaptable in terms of meeting these challenges" (DI_20).

Understanding these specific challenges is important for examining the research questions discussed above, as each question relates to a greater ability for decision-makers to effectively create new, flexible institutions—including new policies—that can adapt to, and learn from, changing conditions. Therefore, the following section will explore each of those research questions. One of the first aspects of flexibility that will be considered is how to create a dynamic balance between the need for stakeholder inclusion and the need for negotiating room away from the public eye.

> *RQ1: How can a balance between privacy and inclusion be institutionalized and monitored in a way that does not systemically exclude certain stakeholder groups?*

First, it is important to consider how stakeholder participation and collaboration have evolved in Colorado River Basin decision-making. As has been discussed in previous chapters, stakeholder participation in the decision-making process has increased in the last fifteen or more years; environmental NGOs, Mexico, and some Native American Tribes now have a more significant role. Other stakeholders have

proposed specific policy attributes, contributed significant resources to the process, and supported greater coordination among the various stakeholder groups. Moreover, efforts have been made to include some of these groups earlier in the decision-making process, rather than reaching out for feedback and consultation once a draft policy has been created.

Despite gains in participation, there is still significant room for additional participation. For example, results from the interviews and survey suggested widespread agreement that the Tribes should play a more prominent role in some of these decision-making processes. Numerous interviewees emphasized that the Tribes' lack of direct involvement must change in the coming years. The survey results revealed similar support for the Tribes' involvement.

Table 6.1: Survey respondents were asked to indicate the level of importance for these ten stakeholder groups in terms of participating in the decision-making process.

Stakeholder group	**Percentage of survey respondents indicating stakeholder group's participation as 'extremely' or 'very' important**
United States Seven Basin States	95.73%
United States Federal Government	92.41%
Native American Tribes	77.72%
Mexico Federal Government	73.33%
Irrigation/Conservancy Districts	65.86%
Mexico Basin States	49.04%
Local/Municipal Governments	46.19%
Non-Governmental Organizations	34.76%
General Public	25.71%
Academics/Researchers	21.33%

Table 6.1 demonstrates that the Tribes were the third most "supported" stakeholder group in terms of importance at the negotiating table. Tribes received stronger support than Mexico, irrigation and conservancy districts, and the NGOs, which is interesting in light of the fact that those three stakeholder groups have in fact been increasingly involved in decision-making. This suggests strong support for bringing the Tribes to the negotiating table in a more formal way.

When attempting a balance between privacy and inclusion, consideration must be given to not only which stakeholders should be involved, but also how their involvement could be more formalized. The improvement in participation seen thus far in the Basin has largely been ad hoc, with specific individuals within those stakeholder groups advocating for greater involvement or someone else advocating on their behalf. There has been no structured process for inclusivity outside of the NEPA requirements for public comment and consultation, which only applies to certain decision-making processes (e.g., does not include binational negotiations). There are examples from other river basins that have established Basin Commissions, Stakeholder Advisory Groups, or some type of entity whose purview is the entire river basin (Blomquist et al., 2005). While such organizations do exist in the Colorado River Basin, they are limited in scope to a subset of the entire Basin. For example, the Upper Colorado River Commission represents the Upper Basin States' positions and implements the provisions of the Upper Colorado River Basin Compact of 1948. Another example is the Glen Canyon Dam Adaptive Management Workgroup, which was established as part of the implementation of the Grand Canyon Protection Act of 1992. By mandate, the Workgroup must include certain stakeholder groups, and their positions must be considered when management plans for the Glen Canyon Dam are created or modified.

While a Commission or Workgroup has precedent in other basins and has been proposed in the Colorado River Basin (Getches, 1997), this research found a lack of support for such a commission, as the majority of the interviewees were opposed to the creation of this type of entity. Many interviewees expressed skepticism that a new institution is even needed or that the potential benefits of a new bureaucracy outweigh the potential downsides. For example, one interviewee noted that the existing structure has always been successful and expressed concern about any attempts to modify that structure or bring more formality through a compact commission or authority. Since the current system works, so the thought goes, a new bureaucracy or authority seems unnecessary and particularly risky. Another interviewee expressed concern about the idea of a commission or workgroup:

> "Again, it would be a negotiation in and of itself to form it. You would have to create public processes around it—it would just create more rigidity. More process would create its own bureaucracy. It would have its own budgetary impacts. The problems we face on the River are dynamic—they're not linear in nature and we need to be nimble and flexible and adaptable in terms of meeting these challenges. And they may be coming at us a lot more quickly than we had anticipated. So I think we need processes that can meet that challenge, and in kind of setting up a whole new level of burdensome bureaucracy won't further that process" (DI_20).

In short, while participation and collaboration have evolved and improved over the years, they are still relatively ad hoc. Providing more structure or institutionalizing a more inclusive process is an important consideration when examining the balance between privacy and inclusion. If participation continues to be ad hoc, formalizing that balance is difficult and still relies on individuals to support the participation of additional stakeholder groups. Considering the unlikelihood of the creation of a compact commission or workgroup, other mechanisms may be necessary to help formalize who may participate in decision-making and when such collaboration occurs.

One such mechanism revealed by the interviews involved the establishment of a "parallel process" in which interested stakeholders could have their own formal discussions, separate from the primary negotiating table. This would allow for the primary decision-makers to have their semi-private negotiations, with a limited number of individuals, yet it would provide more formal inclusion of outside stakeholder groups. This type of parallel process was somewhat evident in the 2007 Shortage Guidelines, although several interviewees lamented the fact that no such process exists with the ongoing Drought Contingency Plan processes. As one interviewee noted:

> "Basin Study, Surplus Guidelines, Shortage Guidelines—particularly with the Shortage Guidelines—there was a parallel track in which the Basin States had their own meetings, but there was a public effort to develop proposals. There is no such equivalent for the DCP. They're framing it entirely as an outgrowth of Interim Guidelines, etc. But it's entirely behind closed doors and it's only the contractors and the Basin States themselves, but there's no public process. That's a loss" (DI_4).

Such a parallel process could be an effective way to address this fundamental question of how to balance the need for private, exclusive negotiations with open, inclusive, and transparent decision-making. As indicated, at its basic form, there would be the formal negotiating table, limited to the primary decision-makers, along with a secondary table open to other stakeholders. In order for this parallel process to be effective, however, regular "check-ins" would be needed for the primary decision-makers to communicate their progress to the secondary stakeholders, and the secondary stakeholders to also voice their ideas, concerns, and comments directly to the primary decision-makers. Not only would this institutionalize the balance between privacy and inclusivity, but regular check-ins would also institute some level of self-monitoring to ensure all stakeholder groups' concerns are at least being heard by the primary decision-makers. One interviewee noted that a similar process was originally

proposed for the recent binational negotiations with Mexico, but ultimately abandoned in the end:

> "For example, when we were doing this recent deal with Mexico, that was the way it was supposed to work. We can't have all the [water agencies] in the room negotiating a deal with Mexico. So only the states will do that. What we were told is the state agencies will come back and get input from all of the water agencies—back and forth in the negotiation—and keep us in the loop. But then they ended up not doing that, and started negotiating on their own. That's one of the reasons why we weren't successful in closing the deal, is we weren't kept up to speed on what was going on. I think you can do that without having everyone at the table, as long you communicate out with what is going on to people who are affected by the decision. And getting their input too—not just communicating, but getting their input. You can't be in the room, but I want to hear what you have to say, and then I will consider that when I'm sitting there" (DI_15).

This discussion of balancing privacy with inclusivity highlights the other limitation of stakeholder participation often discussed by the interviewees—the need for consensus within the decision-making process. A parallel process could assist in overcoming the dilemmas surrounding consensus. Interviewees expressed concern that seeking to garner consensus, whether that be at the formal negotiating table or more broadly, will often fail under its own weight or decisions will never be made. Having a parallel process promotes decision-making without necessarily needing consensus among all interested stakeholders. Specifically, the primary decision-makers can come to agreement—hopefully with input from the secondary stakeholders through the check-ins—thus overcoming concerns about all interested stakeholders agreeing on each decision. One interviewee noted the problem with always striving for consensus, in relation to the Salton Sea issue:

> "So there was a talk that Marc Reisner gave 16 or 17 years ago at CRWUA, and he said something like "consensus is the absence of leadership". Which I think in some ways is true because a fully transparent, fully democratic process leads you to the Bay-Delta, where nothing ever gets done. At some point, someone has to make a decision. At some point, you have to say, we cannot have full transparency, we cannot have full information because we'll never get there, and we need to get something done. And that's one of the challenges with the Salton

> Sea, is we need to make some damn decisions and do something. And people complain about too many studies, and to some extent, that's right, because you're never going to have perfect information and perfect transparency. You need to make a decision based upon what you know. Having said that, getting better input from a broader range of stakeholders, means you're going to make better decisions" (DI_4).

This concept of a parallel process reveals how establishing a balance between privacy and inclusivity can ultimately improve flexibility and consequently adaptive capacity. Such a parallel process supports flexibility in formalizing how outside stakeholder groups can contribute to the decision-making process while also allowing the primary decision-makers the privacy needed to negotiate. The flexibility and balance provided by a parallel process would ostensibly make it easier for decision-makers to "sell" new policies back home because many of their constituents would already be aware of the ongoing negotiations, and perhaps would have already participated in the discussions through that parallel process. Further, through the regular check-ins between the primary decision-makers and secondary stakeholders, many of the difficult political issues may be resolved through the back and forth. That is, as the new decisions are being crafted at the primary table, the regular check-ins allow for real-time responses and critiques by secondary stakeholders to those developing decisions, which can then be incorporated into the final decision.

While flexibility is a key component of adaptive capacity, some have suggested that flexibility alone is insufficient and a more robust transformation of the institutions governing the Colorado River is needed (e.g., fixing the structural deficit in the Lower Basin). This type of fundamental transformation may be needed if adaptive capacity within the Basin is currently insufficient to cope with an increasing supply and demand imbalance. Therefore, the next section discusses this second research question:

> *RQ2: How can decision-making processes facilitate a more transformative change for the Law of the River?*

The question of transformative change is interesting for the Law of the River and the Colorado River Basin. On paper, transformative changes are needed to better align the river's institutions with the river's biophysical condition—on average, less water enters Lake Mead than is delivered to downstream users. As noted in the introduction, even the most drastic shortages in the preliminary Lower Basin DCP only fix this over-allocation temporarily and are insufficient should a significant drought event occur or should the Basin experience several years of below-average snowpack. The survey and interviews demonstrate, however, that opinions are quite diverse on whether transformative changes to the Law of the River are possible, let alone needed.

Table 6.2 presents survey respondents' opinions on a variety of questions related to changing the Law of the River. Question 2c, for example, shows that 47.62% of respondents somewhat or strongly agreed that the Law of the River is adequate to handle current and future problems, whereas 43.81% of respondents somewhat or strongly disagreed with this statement. Similarly, in Question 6b, 40% of respondents somewhat or strongly agreed that any new decisions required changing the Law of the River, while 37.62% of respondents somewhat or strongly disagreed that changes are needed. Question 10a shows that 41.91% of respondents somewhat or strongly agreed that fundamental changes are needed to fix the structural deficit, whereas 45.23% of respondents somewhat or strongly disagreed. Question 10b also shows a similar divergence in regard to whether the structural deficit requires minor changes to the Law of the River. Finally, Question 10c shows survey respondents' opinions on whether any changes are needed to the Law of the River to fix the structural deficit. Despite 27.28% of respondents somewhat or strongly agreeing that no changes are required, only 47.85% somewhat or strongly disagreed with the same statement.

Almost 20% of the respondents neither agreed nor disagreed. What these results suggest is that a majority of respondents believe some change to the Law of the River is needed, but there is much less agreement on the degree of change required.

Table 6.2: Survey respondent level of agreement with questions relating to required changes to the Law of the River.

	Respondent level of agreement					
Survey question	Strongly agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Strongly disagree	Not sure
Q2c: The Law of the River is adequate to handle current and future problems	**23.33%** (49/210)	**24.29%** (51/210)	**8.57%** (18/210)	**27.14%** (57/210)	**16.67%** (35/210)	N/A
Q6b: Any new decisions require changing the Law of the River	**11.43%** (24/210)	**28.57%** (60/210)	**22.38%** (47/210)	**15.24%** (32/210)	**22.38%** (47/210)	N/A
Q7a: Significant changes to the Law of the River are a barrier to new decisions	**12.32%** (26/211)	**30.81%** (65/211)	**18.48%** (39/211)	**18.01%** (38/211)	**20.38%** (43/211)	N/A
Q10a: The 'structural deficit' requires fundamental changes to the Law of the River	**16.67%** (35/210)	**25.24%** (53/210)	**10%** (21/210)	**21.9%** (46/210)	**23.33%** (49/210)	**2.86%** (6/210)
Q10b: The 'structural deficit' requires minor changes to the Law of the River	**7.18%** (15/209)	**31.1%** (65/209)	**19.62%** (41/209)	**20.57%** (43/209)	**17.7%** (37/209)	**3.83%** (8/209)
Q10c: The 'structural deficit' requires no changes to the Law of the River	**13.4%** (28/209)	**13.88%** (29/209)	**19.14%** (40/209)	**18.66%** (39/209)	**29.19%** (61/209)	**5.74%** (12/209)

Interestingly, when asked about previous decisions in the Basin, the majority of respondents believed both the 2007 Interim Guidelines and Minute 319 were a significant or fundamental change to the Law of the River. As Table 6.3 demonstrates, only 34.43% of respondents thought the 2007 Interim Guidelines were only a minor change or no change at all to the Law of the River. Similarly, only 33.17% believed Minute 319 was a minor change or no change. This suggests that most respondents think these previous decisions were substantial changes to the Law of the River, but

they would mostly draw the line between significant and fundamental, as less than 10% of respondents thought both the Interim Guidelines and 319 were fundamental changes.

Table 6.3: Survey respondents' opinions on the degree of change to the Law of the River for the 2007 Interim Guidelines and Minute 319.

	Respondent opinion on degree of change				
Survey question	Fundamental change	Significant change	Minor change	No change	Not sure
Q3: How big of a change to the Law of the River were the 2007 Interim Guidelines?	**9.43**% (20/212)	**46.7**% (99/212)	**22.64**% (48/212)	**11.79**% (25/212)	**9.43**% (20/212)
Q4: How big of a change to the Law of the River was Minute 319?	**9.95**% (21/211)	**47.87**% (101/211)	**23.22**% (49/211)	**9.95**% (21/211)	**9**% (19/211)

There was a similar sentiment among the interviewees in regard to the degree of modifications required in the Law of the River. Many interviewees believed that previous decisions were not necessarily changes to the Law of the River, but rather demonstrate a certain flexibility within the Law of the River. As one interviewee noted:

> "Up until this point, everyone has acknowledged we're not modifying the Law of the River, we're just making some tweaks" (DI_15).

Many other interviewees supported this notion that the modifications to the Law of the River to this point have not been significant changes but rather incremental changes as conditions warrant. One interviewee opined that this process has been successful to this point:

> "So I think the incremental is reasonable and responsive to the circumstances at the time. And I think that's what's good about the Law of the River—it has grown in a way that allows adjustments for current or projected circumstances. And so far so good, right? For the most part, all of our cities have been able to turn on their taps. People have plenty of water to drink in this country" (DI_32).

While numerous interviewees agreed with the notion that minor or incremental changes are all that is needed for current and future problems, there were several

dissenting opinions. For example, one interviewee suggested that focusing on minor or incremental changes allowed participants to frame negotiations in a more politically tenable way:

> "I mean, if you go out and say we're going to fundamentally change how water is accounted for in the Colorado River Basin, you're not going to win. But if you frame it as well here's a short-term crisis and we need to make some minor tweaks, then you get the fundamental change in the river. I think most of the people in the Basin, if you ask them, "Does the Law of the River need to be changed, fundamentally?" They're going to say, "No. It works fine." In some ways I think they're right—because it does work fine—because it's allowed for these fundamental changes" (DI_4).

Similarly, another interviewee suggested that while these modifications to the Law of the River are relatively minor, they do have significant implications for the Basin:

> "[S]ome of these things are kind of tweaks, but they have huge impacts. And the DCP, if it's approved, the most severe cuts under the DCP are over a million acre-feet a year at the lower tiers. That's a big chunk of water that we would be giving up without having to change the Compact. So they might be defined as tweaks, but they are major deals" (DI_15).

Ultimately, this distinction between flexibility and/or minor changes to the Law of the River and more fundamental modifications has significant implications for adaptive capacity in the Basin. A primary component of adaptive capacity is the ability to modify institutions in response to changing biophysical conditions. Up until this point, the Basin's institutions have, for the most part, been able to respond to inter-annual variations in the river's flow. Such incremental modifications, as many stakeholders have expressed, are working. As some interviewees noted, however, it is unclear to what extent incremental modifications could prevent significant impacts if Lakes Powell and Mead reach critical levels.

These findings revealed that perhaps transformative changes to the Law of the River should not be the defining goal of the decision-making process. Politics,

institutional inertia, uncertainty, and a host of other issues mean that a "transformative change" is something that Basin decision-makers will never agree to, let alone agree to even discuss, despite there being fundamental flaws in the Law of the River. Therefore, continued incremental approaches may be the most appropriate way to ultimately address the fundamental institutional deficiencies. As one interviewee suggested, this incremental approach is what ultimately leads to fundamental changes:

> "That's where it has to be incremental. I think people are selling it back in California that it's just a temporary thing to get us through a drought. I see what's going to happen is if that hydrology is not a drought and that hydrology becomes the norm, which I think it will. Then that DCP becomes the framework or the outline of how they are going to permanently reduce their demands. You couldn't go back to Arizona or California and say permanently right now we're going to have use 4.1 or 4.0, or the CAP is going to have live with diverting 1.2 million not 1.6—that could not be sold. But you can sell delivering 1.2 in dry years. And then as soon as people become accustomed to that shortage and those hydrologic conditions become permanent, then that's a template for what becomes the permanent reduction the Lower Basin" (DI_23).

In other words, incremental, often temporary changes are pathways to transformative changes that can become permanent changes to the Law of the River. As the interviewee notes, the incremental nature of something like the Lower Basin DCP helps not only overcome some of the common barriers to decision-making (e.g., "selling" a policy back home, politics), but also allows for some agreement between the Basin States. Put another way, by the same interviewee:

> "I don't call it a change to the Law of the River. It's applying the Law of the River to less water. To me, the Law of the River has always been adaptable. So I don't say we're changing the Law of the River, we're just changing our consumptive use to reflect the reality of how much water is available" (DI_23).

Therefore, "[c]hanging our consumptive use to reflect the reality of how much water is available" is the incremental step to a transformative change. This is to say that improving adaptive capacity in the Colorado River Basin may require additional incremental modifications (e.g., the renegotiated 2007 Interim Guidelines in 2026), with

the underlying understanding that they might lead to a transformative modification to solve the more fundamental flaws in the existing Law of the River. Incrementalism also provides the flexibility in addressing some of the challenges discussed above, such as institutional uncertainty and political complications. One interviewee summarized this incremental approach particularly well:

> "I think it's important in that collectively everybody understands that the Colorado River Compact was based on mistaken assumptions about hydrology. And the world changes and nothing lasts forever. So I think we learned a lesson there. We learned about flexibility and adaptability. We also learned about not trying to bite off too much, and to try to be incremental. And have success build on success. Build the relationships, build the success, on an interim, incremental basis. And then build on that to the next success. The key I guess is to keep going, because obviously we need to stay ahead of—if this drought continues or this is the new normal, we can't get caught short" (DI_20).

In addition to incrementalism, the other decision-making process that might facilitate a more transformative change is having those incremental modifications be temporary agreements with set expiration dates. The importance of interim policies has been discussed in earlier chapters in regard to helping previous decisions in the Basin come to fruition. For example, the fact that Minute 319 was only a five-year arrangement allowed negotiators, particularly from the United States, to agree to some of the Minute's politically-sensitive components. Regarding adaptive capacity, interim policies allow for decision-makers to more easily change course should they find themselves on the wrong trajectory (Engle, 2011). Further, interim policies improve adaptive capacity by allowing decision-makers to experiment with novel concepts. This study supports this notion because almost all of the interviewees emphasized the importance of interim policies in allowing the decision-makers to better understand how the system operates, think about what is politically and logistically feasible, and better respond to changing biophysical conditions. One interviewee summarized the

effectiveness of interim policies, including how the existence of an end date for an interim agreement supports additional decision-making:

> "We may as well recognize it's going to change and it's easier to sell it if it's going to change. If you build in a deadline, then it forces people to renegotiate, which is a good thing because conditions are going to change. And I think that's particularly prescient now given climate change and how fast we're seeing changes in the system. Nothing moves somebody like a deadline. And if you see this deadline coming in the future, you're more likely to act than to react. I think interim makes sense—it's an easier sell. So, one, conditions change. The second part is deadlines inspire action. And I guess the third part is it's easier to sell it. If you just say we're doing this—it's kind of a test case, and we're going to see how it goes—people are more likely to embrace it." (DI_4)

The general sentiment was that a permanent agreement, as opposed to an interim one, does not allow for learning with the new agreement's implementation. Uncertainty as to how the agreement would impact all stakeholders led to less support for something that was permanent because flexibility was limited. Accordingly, agreeing to a permanent decision reduces the ability to learn and might actually decrease adaptive capacity. Or, as one interviewee crassly noted:

> "Otherwise you leave yourself—you know, you might be married to a pretty ugly woman for a long time." (DI_7)

Another interviewee summarized the importance of learning in the context of how things have changed over time. This person noted in particular how taking a "try and fix" approach helps decision-makers feel more comfortable with new ideas, similar to the importance of attempting novel approaches and learning from those approaches:

> "Seven years ago, they were saying over my dead body. Again, back to this idea of socializing ideas—by letting them try things and showing that the sky does not fall, is really important. In water management, we have been managing our rivers and our water laws and our allocation system the same way for 120, 150 years. So to change a paradigm or to change people's understanding of how the system operates, does not happen overnight. But it is the most important lever you can pull. The significance or the importance of doing these pilot agreements or short-term agreements is that it lets these parties all be like, 'okay we'll try that. And we know that in five years, we get to come back to the table. And if it didn't work, we can fix it.' So it gives all of them comfort that it's not forever. And we may never do interim guidelines that are forever—that would be a new

> Compact. It lets people hold onto the status quo while getting to try some things that might really improve the situation" (DI_16).

In sum, continued incrementalism and interim policies may be the path towards more transformative changes to the Law of the River. Importantly, however, this research suggests that the stated goal of a new decision or policy cannot be transformative change—that is, despite fundamental deficiencies in the Law of the River, decision-makers cannot simply attempt to fix those deficiencies. Instead, they could continually and temporarily "tweak" the institutions, knowing they may be on the path to transformation.

Another aspect of adaptive capacity that has been theorized is the important role of individuals or leaders willing to champion a particular cause or change (Pahl-Wostl et al., 2007). Importantly, the cause or change does not mean a specific policy outcome, but rather, "collaborative leadership, which can mobilize energies, generate trust, give vision, and support the collective finding of a clear direction in a multiparty process" (p. 8). Resting adaptive capacity, however, on the presence of individuals with the necessary personality or capacity might be seen as fairly risky, especially when considering the ability to adapt for the long-term. Therefore, the following section addresses this third research question:

> *RQ3: How can the process for which some individuals have advocated (e.g., more participatory) be institutionalized, irrespective of the specific individuals with authority?*

This study has demonstrated the importance of specific individuals in facilitating dialogue, expanding the negotiating table, and supporting successful decision-making. This has interesting implications for adaptive capacity in the Basin because it suggests that without some of those key individuals, decision-making would have been less collaborative and more antagonistic. Further, these individuals have demonstrated the

importance of social trust and credibility to effectuate decision-making, through two different processes.

One such process revealed in the interviews involved the threat to the Basin States of action by the Secretary of the Interior, as an attempt to motivate the States to come to an agreement. Chapter 3 provided the example of Secretary Norton threatening the States in 2005 to reach an agreement on the Shortage Guidelines, or else she would be forced to take unilateral action. Concerned that Secretary Norton would follow through with her threat, the States came to an agreement.

The Basin is replete with other examples of the federal government threatening the States or agencies to come to a solution on their own. In the late 1970's Secretary of the Interior Cecil Andrus threatened to withhold funding for the Central Arizona Project, unless Arizona implemented a policy to reduce groundwater overdraft. Despite this initial threat, decision-makers still had not come to an agreement after several months of negotiations. The Governor at the time, Bruce Babbitt, realized the solution to this impasse might be another federal threat:

> "Whereupon I left the negotiations and went back to my office one evening and called the Secretary to explain the problem. I then asked for his assistance. '[Secretary of the Interior Cecil Andrus],' I said, 'you can help me now by publicly repeating your threat to withdraw support for the CAP. And you will surely understand that I will have to respond by again publicly objecting to your officious intermeddling.' He made the threat, I responded, and we finally put together a comprehensive groundwater code which the Arizona Legislature then enacted into law. And it stands to this day as the most comprehensive, effective ground water management effort ever undertaken" (McClurg, 2005, p. 75).

Other examples of the federal threat include a situation in 1991 when Reclamation Commissioner Dennis Underwood "met with the [Imperial Irrigation District] Board to urge the Imperial Valley to undertake voluntary water conservation or 'have somebody do it for you'" (Lochhead, 2003, p. 331). Similarly, in 1997, now Secretary of the Interior Bruce Babbitt had threatened Southern California water

agencies to "get their act together and come to a mutually acceptable deal, [or else] he would be forced to step in and slash water allocations for them" (Fleck, 2016, p. 114). In the early 2000's, the Department of the Interior told the Basin States they needed to come to consensus on the surplus guidelines, "or the DOI would make its own assumptions and determination" (Lochhead, 2003, p. 370). Finally, during her keynote address to the CRWUA annual meeting, Secretary of the Interior Sally Jewel told the Basin States, "[l]ike my predecessors, I'm not going to ignore my [responsibility] to act if conditions worsen and if states can't [reach] consensus on contingency actions. I know you don't want to work that way. I know you want to get to the table and get to the answers yourself. We are happy to be there as a partner, but we're also going to make sure that you are held accountable to making that happen" (Jewell, 2013, p. 8).

All of these examples suggest that this threat of action is institutionalized—that is, the Secretary can threaten the Basin States, and they will act accordingly. What this research found, however, is that the perceived seriousness of these federal threats was largely dependent on who was making the threat (i.e., the individuals at the Department of the Interior). In some instances, the threat was considered real and the States would act, and in other cases the States did not believe the threat to be credible. Accordingly, this perception of credibility highlights just how important individuals are in Colorado River Basin decision-making. As noted by one interviewee:

> "If I've learned one thing in my career… it's that people and personalities are about 90% of every problem. And the substance is the other 10%" (DI_11).

A second process identified was the role of specific individuals for encouraging and facilitating collaborative processes, another key component of adaptive capacity. Many interviewees noted it took real leadership on the parts of some of these

individuals to understand how to overcome specific challenges and determine what was in the best interest of the river as a whole. As one interviewee emphasized:

> "Part of the secret sauce of that is I think having people who have been around for a while, who have developed the institutional knowledge and experience to know how to bring people together. And how to drive decision-making in a big complicated environment" (DI_11).

The interviewee went on to describe Terry Fulp, with the Bureau of Reclamation, as an example of this type of individual:

> "[A] guy like Terry Fulp, for example, who is just key to the whole thing. Because Terry understands the system really, really well, he knows everybody. He's trusted by, and liked by, everybody. And he can make connections between people—say, two brand new people, from two brand new governor's officers are not going to be able to do" (DI_11).

Another key individual often identified was Mike Connor, also with the Bureau of Reclamation and later Deputy Secretary of the Interior. In one case Connor provided important guidance for including the Basin States—then not involved in the negotiations—during the binational negotiations leading up to Minute 319, here described by an interviewee:

> "Mike Connor was essential. I think that Mike had the relationship with the U.S. States, because of his position of Commissioner of Reclamation, that enabled him to understand to reason that the States were essential to the discussion. And that's not something the State Department necessarily understands… But Mike understood that these are the state's water rights that we're talking about. So you really can't do a deal without them. So it was knowing that, and coming from the water background, that would enable you to have that understanding. I think that is really essential. Also because of his background he was able to see the benefit having municipal suppliers involved, and he's just sort of politically and emotionally inclined to bring in the environmental NGOs. So I think he was a key figure" (DI_2).

Fulp and Connor were discussed by many interviewees, but the most frequently cited individual was Bob Snow, an attorney for the Office of the Solicitor at the Department of the Interior. When mentioned, interviewees described Snow as

absolutely essential for decision-making in the Basin. While discussing the role of the federal government, one interviewee added the importance of Snow:

> "While there are appointees, and the appointed people come and go, but their career people are critical. Bob Snow is a career attorney with Interior, who's probably saved more bacon in this Basin than anyone else. He's a guy you want to have good relationships with—and it's easy to have one with him because he is so humble and hard-working and smart, and he's fun to be around. He's a really sharp guy" (DI_7).

Other interviewees described him as "great at herding cats" (DI_8), a "damn good attorney" (DI_12), "master of that informal discussion" (DI_2), and argued that many of the recent policies would not have happened "without the Bob Snows of the world who transcend administrations. Who's been advising 5, 6, or 7 Secretaries on this stuff" (DI_1). When asked what would happen if Snow were to retire or leave the Basin, one interviewee tried to temper his importance by saying no one is irreplaceable, and equally capable people have always replaced outgoing individuals. But the interviewee concluded the thought with:

> "But I do think Bob Snow has played a really important role, and I certainly hope he stays around for a long time" (DI_31).

A final individual often mentioned by interviewees was Pat Mulroy, former General Manager for the Southern Nevada Water Authority. Similarly to the other individuals, many interviewees said Mulroy had the ability to push the conversation forward, build relationships, and support a more collaborative and successful process. After she retired in 2014, several interviewees noted the significant gap left by her absence. Some interviewees even went as far as saying some of the ongoing negotiations would have been completed earlier had she still been involved. For example, one interviewee described Mulroy's negotiating skills and the impact of her absence:

> "In the US delegation Pat Mulroy was a leader, with no doubt. No doubt at all. And I really admired the way she proceeded. And the way she could manage everything… When the negotiations were not very successful along the process, we had meetings directly with her in order to put everything on track... *If Pat Mulroy would have continued in the whole process, Minute 32X*[26] *could have been signed before Donald Trump took office at the White House. I'm sure about that*" (DI_25).

While these findings revealed the importance of specific individuals in facilitating negotiations, advocating for greater inclusion, and supporting effective decision-making, the implications for improving adaptive capacity were less clear. Despite institutionalized authority—for example the Secretary of the Interior's authority to act unilaterally—the effectiveness of the action still depended on the individual. Further, Bob Snow's job description, for example, might not necessarily include having back-channel discussions, offline conversations, and making efforts to truly understand all sides of the argument, yet many interviewees said that is what he does best. The personality, credibility, earned trust, and motivations of the individual are arguably more important than the institution itself.

While underwhelming, one potential conclusion to draw is not to modify the institutions in this regard. That is, the institutions have the flexibility to permit individuals to steer the conversation in a particular direction. Therefore, even without modifications, individuals will still be able to exert their values and advocate for particular decision-making processes. Several interviewees who were at later stages in their careers even acknowledged there is a concerted effort to train early and mid-career employees to continue to push for these more collaborative and open processes.

In some cases, though, the institutions themselves have actually been modified as a result of these individual efforts. For example, because specific individuals in the

[26] Minute 32X became Minute 323 and was finalized and signed in September of 2017, almost a year after the new administration was elected.

Bureau of Reclamation recognized the importance of being transparent with their technical modeling capabilities, Reclamation now has a culture of sharing and openness. The Basin States are no longer the only stakeholders privy to a majority of Reclamation's modeling, and Reclamation employees are given flexibility to collaborate with outside stakeholders (e.g., publishing academic articles). As one interviewee noted in regard to this cultural shift:

> "But I think it's indicative of the evolution of thinking over time. It's a great example of how it's evolved. Now, is it where it really needs to be? Probably not. But all I can say is it will continue to evolve, and it's kind of up to the next group of folks… to keep moving forward. Because it's going to need to be still broader and more collaborative as we go forward" (DI_30).

Another interviewee described this shift as an "ever-expanding circle of trust and collaboration" for which they and other individuals have been advocating. Despite no longer being directly involved, this interviewee expressed hope that the circle would continue to expand because of the individuals still involved:

> "From that standpoint, it's the ever-expanding circle that I mentioned. In the ongoing discussions for a follow-up agreement with Mexico and the drought contingency plan, there's been much more active outreach to tribes. And not just informed of the process, but some of them are actually negotiating certain parameters of what we hope will be part of the framework for the next set of deals or set of agreements" (DI_13).

As discussed above, informal opportunities for stakeholder participation are key to institutional learning and thus important for building and maintaining adaptive capacity. However, informal mechanisms run the risk of becoming "exclusive clubs" because they lack the notification and reporting structures that formal negotiations require. These informal mechanisms therefore must maintain an appropriate balance between informality and transparency to support adaptive capacity. Accordingly, the next section examines this final research question:

RQ4: How can informal negotiations continue to occur without systematically excluding stakeholders who are not involved? More specifically, when the informal discussions do occur, can they be monitored and checked for systematic biases?

As has been discussed in previous chapters, much of the decision-making process in the Colorado River Basin occurs through informal, semi-private discussions and negotiations among the primary decision-makers. Informal networks have been shown to improve adaptive capacity by supporting social learning (Huntjens et al., 2011; Kofinas, 2009; Koontz et al., 2015; C. Pahl-Wostl, 2009). Informal networks also allow for repeated interactions among stakeholders, which allow for social learning, better access to new types of knowledge, and facilitate a scenario planning process (Koontz et al., 2015). These interactions can occur both horizontally and vertically, and across scales, and are beneficial in exposing decision-makers to new or different ideas and in promoting learning. Huntjens et al., (2011) emphasize the importance of social learning for handling uncertainty and implementing new governance systems, and that "the social network of stakeholders is an invaluable asset for dealing with change" (p. 148).

The findings from this research support the literature regarding the importance of informal networks for successful learning and decision-making. Formal negotiating often faces significant hurdles due to some of the barriers discussed above. Politics, having to "sell" a policy back home, and uncertainty can all limit adaptive capacity when formal networks attempt to change the status quo. The informal discussions, meetings, happy hours, and gatherings—examples of horizontal interactions—can overcome those barriers for many of the reasons discussed above regarding the balance of privacy and inclusion. As one interviewee summarized:

> "And it was really, usually the process of going out on field trips, eating together, drinking beer in the evenings, and stuff like that, that made it possible

> for people to trust each other enough to take advantage of an open institutional design to be able to collaborate (DI_11).

Another interviewee noted the importance of these interactions and informal discussions for creating social trust—trust that may be lacking if negotiations only occurred through formal meetings. As discussed above, social trust is an important indicator of adaptive capacity. As another interviewee emphasized, it is the relationships and trust built outside of the formal meeting room that allow for effective decision-making:

> "The key to getting anything done is interpersonal relationships. If you just rely on the meeting itself, people tend to not trust other people. So it does require other conversations, dialogues, get-togethers. So I have an informal meeting with my counterparts at [water agency] and [water agency] on a regular basis. Every few months we get together, check-in with what's going on at each agency. What are the hot issues, what's happening. Then when we get in a more formal meeting, we're more understanding of each other's issues. And have a level of trust that makes it easier to get to a decision" (DI_15).

While the benefits of informal networks and negotiations—promoting learning, handling new information, and collaboration—are important, there are also limitations and problems, inherent in the very nature of these networks. Most obviously, they lack formal rules and oversight as to who can be included in the discussion. For example, they provide an opportunity for horizontal interactions, but not necessarily vertical interactions as these informal discussions most often occur between Basin State principals. Several interviewees noted that it took many years of relationship- and trust-building on the part of the environmental NGOs before a select group of individuals were eventually included in some of these informal discussions. Further, when those discussions do occur, there is little oversight or monitoring, and certainly very little accountability, by authorities or constituents not privy to those discussions. Again, these informal discussions are beneficial and problematic for the same reason—

the potential for systematically excluding certain stakeholders from the decision-making process.

As discussed in the literature and demonstrated in these research findings, informal networks and negotiations are important because they build social trust (Pahl-Wostl et al., 2007). In thinking about improving adaptive capacity in this regard, some level of monitoring of the informal discussions may be necessary in terms of ensuring specific stakeholder groups are not being discounted or excluded from the decision-making process. This is not to say that all informal discussions should be formally monitored, as that would all but eliminate the benefits of the informality. But perhaps, more realistically, this could include allowing specific, trusted individuals to be included in some of the informal discussions. More specifically, these should be individuals who are able to understand when and how certain stakeholder viewpoints are being excluded. One interviewee noted that this type of process has already occurred in some discussions, and suggested that certain federal officials who are within the informal network have used their positions within that network to advocate for greater inclusion:

> "The feds will see or will have strong feelings one way or the other about whether stakeholders that are being represented by someone at the table need to be brought on. Or if that person waits too long it could really ruin the negotiations so far, so we'll gently make that suggestion. 'Hey Arizona, you need to talk to—you need to start expanding these discussions among the state because it could cause a real rift in where we think we're going.' I feel like the model that we've used with policy negotiations, and I think it's been successful, is you start small and then you start to filter it out to other stakeholders" (DI_24).

A potential problem with this approach is that it does rely on individuals who are privy to those conversations to act in the best interests of stakeholders who are not at the negotiating table. In the example just given, it took a federal official who not only understood the system well enough to see when and how certain stakeholder groups

were being excluded, but also had the trust and respect of decision-makers so that they were receptive to the suggestion. But as also discussed above, there is institutional inertia with regards to individuals, especially at the federal government level, who advocate for a more collaborative and stakeholder-driven process. This reliance on those individuals does place significant trust in the purity of their motivations, but perhaps at this point those individuals have earned the trust of many stakeholders in the Basin.

6.5 Cross-cutting themes: the importance of proactive processes and empathy

Interviewees regularly mentioned two concepts that have implications for the four themes and research questions discussed above—the importance of proactive processes and a consideration of empathy.

Multiple interviewees discussed the importance of transitioning towards more process-related criteria or process goals, rather than only focusing on specific outcomes. More specifically, there needs to be a greater focus on proactive decisions that support increased stakeholder participation and collaboration, incorporating science and information, and more holistic planning that prevents significant negative impacts long before short-term curtailments begin. Indeed, all four themes discussed above—balancing inclusivity and privacy, embracing transformative change, recognizing the importance of individuals, and using informal networks—suggest that focusing on the process may be important for increasing adaptive capacity.

Much of the discussion in Colorado River governance to this day has been about reactive outcomes, most notably specific shortages depending on Lake Mead elevation levels. What this research has revealed, however, is that more proactive processes focused on social trust, networks, and collaboration, rather than reactive processes relating to particular outcomes, improves adaptive capacity. While proactive

mechanisms are less common, they are considered more robust in terms of adaptive capacity (Hill & Engle, 2015). Therefore, establishing a distinction between proactive processes and reactive outcomes has important implications for adaptive capacity in the Basin and should become a focal point for future negotiations and governance.

Importantly, however, as discussed above, institutional inertia and the existing interests are powerful forces in preventing changes to how decision-makers govern the Colorado River. More specifically, the current Basin managers and principals are focused on one specific outcome—meeting consumptive demands. Failure to do so might be costly, both politically and legally. While meeting these uses is incredibly important, Basin managers are excluding large components of the system by limiting their considerations to demands only. A shift to focusing on process, or spending political capital on process, could ultimately challenge the power of those traditional stakeholders (i.e., Basin States). This is especially true if changes in process mean additional stakeholders sitting at the table and asserting the importance of their own, additional water rights. In a closed river basin, new water rights mean a loss of water rights elsewhere.

Several interviewees suggested that this transition towards focusing on proactive processes may be already occurring in the Basin. For example, one interviewee thought the Basin has been successful in the past fourteen or fifteen years in focusing more on stakeholder collaboration, rather than on outcomes such as litigation. The interviewee further specified that:

> "Similarly, we've been able to move away from what I would characterize from the early years of my career is primarily an arms-length relationship between stakeholders and the federal government—in which the federal government was more like a referee and we were fighting with each other—towards a substantially more collaborative approach that's focused on finding solutions, instead of finding zero sum outcomes" (DI_11).

Another interviewee also suggested there has been a shift from focusing on meeting all consumptive demands towards a more holistic, process-oriented system:

> "So where the conversation has turned a lot is from, "this is my Compact entitlement and screw you I'm going to develop this Compact, and you can sue me in court if you want. By the time you do I will have used up this water, anyway" to "how do we run a sustainable river." And 319 was very helpful in that kind of Basin-wide, United States, Upper Basin, Lower Basin, Mexico—how do we look at this river sustainably" (DI_12).

While some interviewees expressed optimism in regard to this transition to process, other interviewees suggested that the transition has not been linear and there have been setbacks. For example, several interviewees expressed concern that, while the process around Minute 319 had indeed demonstrated improvement, the subsequent negotiations around the Lower Basin DCP had reverted to the more closed and exclusive discussions in an attempt to agree on specific shortages in consumptive demands. As one interviewee noted in response to the DCP process:

> "So there's a lot of uncertainty right now. And the forums for making decisions are not clear right now" (DI_16).

Perhaps this is all unsurprising as it could cost decision-makers significant political capital to transition towards proactive processes, as was mentioned above. Despite the benefits of this focus on process, there is the possibility of primary decision-makers being challenged by additional stakeholders demanding recognition of their own water rights. Water institutions have traditionally focused on a hierarchy of priorities, and reliability (i.e., meeting consumptive demands) is typically the primary goal of decision-makers (Lach et al., 2004). Accordingly, a full transformation to focusing on proactive processes is difficult and disruptive at best, and all but impossible at worst.

This study, however, may shed some light on how to begin this shift to a focus on proactive processes and how to institutionalize some of the gains made thus far (i.e.,

some of the process related to Minute 319). Specifically, a consideration of the four themes discussed above and their implications for improving adaptive capacity could also support a shift away from only outcome-based governance. For example, formally establishing a parallel process helps institutionalize when and how certain stakeholder groups can collaborate in decision-making. Establishing a boundary between the primary negotiators and all other interested stakeholders—and including specific mechanisms for implementing connections between parallel processes—allows for the decision-making process to proceed efficiently (something that the Basin States want) without systematically excluding certain environmental and social considerations (something non-Basin State stakeholders want).

Similarly, the incremental approach used in recent decades, first for surpluses and then shortages, might also provide a mechanism for shifting towards process-related goals. The likelihood of a complete shift away from outcome-based management is approximately the same as a complete transformative change to the Law of the River—all but impossible. An incremental and flexible approach, however, might provide the political "cover" for the primary decision-makers to begin thinking about process-related goals. This could be as simple as more formal consultations between the Basin States and a broader group of stakeholders—not formally including them in the decision-making matrix, but at least hearing and understanding their primary concerns. Some Basin States already contemplate this and incorporate this type of consultation into their decision-making. One interviewee described such consultation as important to ensure that the stakeholders who are not at the decision-making table will not veto the decision at a later point. It thus becomes extremely important to consult with the "folks that can stop you" (DI_8). Another interviewee

suggested that while some Basin States consider and undertake this consultation process, others, to their detriment, do not (DI_12).

The role of individuals in advocating for more collaborative and open decision-making processes has precedent in the Basin. Additionally, there is precedent for some individuals to contemplate moving beyond meeting consumptive demands and thinking more holistically about the Basin. Several interviewees suggested that Pat Mulroy, mentioned above, was one such individual. Over the course of one interviewee's career, they saw the evolution in Mulroy's thinking and even suggested that Mulroy's contentious and argumentative history gave her more "clout" to advocate for a different viewpoint:

> "I think Pat had made the transition to being a real leader in the Basin, for looking beyond Nevada's specific interests. And saying, here is the challenge we face in the Basin as a whole, you know, and unless we set aside some of our legal differences and positions we're not going to have a strategy to match the challenge. Pat's one example, and I think there are other examples where I think people do step up. And it's particularly effective when those people have been from the more strident fomenters of conflict, historically, and changed their view to be a voice for reason and cooperation" (DI_13).

The effectiveness of Mulroy as she sought to establish a more holistic process suggests that other individuals could have similar success advocating a shift towards more process-related goals. The success of some of the other individuals discussed above indicates how this process might occur. That is, people like Bob Snow or other career officials might have the trust, credibility, authority, and legitimacy to implement some of these needed changes in process. Several interviewees expressed the view that some of these individuals understand the need for this shift in perspective, but they also recognize the existence of many of the institutional barriers. As one interviewee noted:

> "If you aren't careful to try and balance [the interests of non-agencies] consistent with the rights and statutory responsibilities that agencies have, then you're going to have people running to the courtroom" (DI_13).

Clearly individuals have played and will continue to play a prominent role in the evolution of the decision-making process in the Colorado River Basin. Further, some individuals may be able to further shift the emphasis away from a focus on outcomes towards a focus on process. This study suggests that this change has begun in some ways, but it may require many more years of individuals continuing to pursue that shift in focus. Ultimately, moving towards a more sustainable and equitable approach requires thinking about the underlying process and its related impacts on adaptive capacity. In sum, while there has been some movement in this direction, a significant shift away from outcome-based management will be necessary to improve adaptive capacity in the Basin.

This research identified a second significant topic with importance across the themes and research questions discussed above: the idea of empathy in decision-making. Specifically, while it is important to acknowledge the negotiating positions of other decision-makers, there is an equally immense value in taking the time to truly understand their points of view, backgrounds, and values. Numerous interviewees emphasized the importance of this concept. Indeed, one interviewee from Mexico said that there was a Mexican word for this concept: "catarsis." As the interviewee described:

> "Catarsis means you need to understand the other position of your counterparts. You need to accept all the complaints of the other part, you need to understand what those complaints are based on, in order to better establish bridges of communication with the other party" (DI_25).

No such equivalent phrase exists in English, but the concept was perceived as equally important on both sides of the border. One interviewee suggested that one of the reasons for the delays in the Lower Basin DCP and Minute 32X (at the time) was the fact that negotiators did not have time to adequately understand everyone's positions

following the entrance of new federal administrations in both the United States and Mexico:

> "If the same negotiators would have participated in Minute 32X, there would be another scenario. We could have agreed in the extension of Minute 32X, I'm pretty sure about that. But there was a change in people on both sides. And new people haven't had the time for the process of catarsis—understanding their counterparts, understanding the points of view of other parties. We ran out of time. I don't think 32X will be signed by the end of this year" (DI_25).

In its most basic form, this type of empathy is the ability for one stakeholder to understand and express all other stakeholders' positions. One interviewee noted that the Basin State principals all share this level of understanding of each other's viewpoints:

> "But, I think one of the most critical factors, and we may have kind of touched on this, almost everybody involved in the smaller group is perfectly capable of arguing everybody else's position. You know, we can all switch seats, and I can argue [Basin State's] or [Basin State's] position, just as easily I can argue [Basin State's] position. And the same is true of them. They could step in and do my stuff. And that level familiarity, level of understanding, between the people that live and work on this river, to me is really the key to its success" (DI_1).

In addition to simply knowing other decision-makers' positions, these findings suggest the value in truly and empathetically understanding where each decision-maker was coming from. In addition to being empathetic towards one another, this process also led to vast quantities of trust among the negotiators. As one interviewee noted in regard to this process:

> "But I think more importantly it was the ability to build relationships and trust. The ability to understand what other sides needed through process. The ability to understand what is important to them versus—the ability to work to find a middle ground as opposed to taking a strident position just for the sake of taking a strident position" (DI_20).

One interviewee described the evolution of NGO involvement in decision-making, and how, at the beginning of NGO involvement, many decision-makers simply

did not understand the NGOs' goals and values. As the interviewee describes it, the disconnect came from simply not understanding the NGO perspective:

> "Which sometimes was not based on, animosity, but rather simply not understanding or not having taken the time to think through the environmental perspective. Sometimes it was really as simple as, "you have no idea what our interests are." I remember going to a meeting at one point, and someone said, "so why don't you guys like the idea of a pipeline coming in from the Mississippi River? It's more water for the Colorado. Why wouldn't you like that?" And just having to explain what the environmental community's concerns were with that, seems like really genuinely somebody asking me, not getting it. Not understanding" (DI_5).

The interviewee further stated that, by continually explaining the NGO position through credible science, proposing specific policies, and taking a non-disruptive approach, NGO advocates were ultimately understood by the other decision-makers and they became part of the process:

> "That's what began to crack the door open, because it got past that very generalized conception of something that was just like, "oh they want—they're against everything we're trying to do." And so then we could start having conservations about specifics, realizing that there were ways to get there without undermining the basic things the water users and the water managers were trying to achieve" (DI_5).

Another interviewee suggested that this shift towards incorporating empathy and an understanding of each other's values emerged during the negotiations leading up to the 2007 Shortage Guidelines, and has become instrumental in successful decision-making:

> "I think individual states understand what another state might argue, legally or politically, and because of that knowledge and shared understanding—that I think emerged under the '07 Guidelines—and empathy, which is a weird word to hear in the water policy arena, but I think empathy for the problems that each state or water utility or water interest or stakeholder might be facing. I think that's key to actually solving the problems, ultimately" (DI_22).

Indeed, an empathetic approach to decision-making through "catarsis" may be an additional indicator of improved adaptive capacity. For example, in order to successfully balance privacy and inclusivity through a parallel process, regular check-

ins must occur between the two processes. In order for those check-ins to be genuine and fruitful, stakeholders in both processes must be empathetic towards each other's progress and results. Similarly, because transformative change requires an incremental approach, trusting the other decision-makers with each incremental modification requires truly understanding the degree to which each stakeholder group is willing to commit. In order for individuals to successfully advocate for a new approach or process, they must be able to empathize with all other stakeholder groups. Some individuals, as was discussed above, have been successful within the Basin State negotiations, but they must also be able to empathize with environmental NGOs, Native American Tribes, recreationists, and other interested stakeholders who are impacted by decisions in the Basin. It is the same process by which informal networks can successfully improve adaptive capacity—the strength of those networks largely depends on trust and understanding within the network. Without empathy through "catarsis," the decision-making process may be impeded. As the interviewee quoted above noted, the reason the Lower Basin DCP and 32X had not been completed as scheduled was because the decision-makers did not have the time for "catarsis." These research findings suggest that, until the negotiators in a decision-making process have time for "catarsis," the Basin's adaptive capacity may be correspondingly limited.

6.6 A paradigm shift?

When it comes to new interstate operational agreements and binational cooperation, the Colorado River Basin generally exemplifies improved collaboration and significant recent achievements. These agreements and cooperation demonstrate a more inclusive and holistic process, and the policy outcomes represent this shift in governance. Despite these changes, however, the system is still often perceived as and managed in a reactive, crisis-management approach, which is inherently more focused

on meeting (or reducing) consumptive demands rather than achieving truly sustainable management structures. If the future of the Basin focuses on ideals of sustainability and equity, then shifts in system governance are crucial (Schoeman et al., 2014). Specifically, an evolution of the decision-making process—balancing privacy and inclusivity, transformative change through incrementalism, recognizing the role of individuals, and utilizing informal networks—might create a system that has broader stakeholder acceptance and support, improved adaptive capacity, and a greater ability to reflect the diverse set of priorities and values evident throughout the Colorado River Basin.

While shifts in system governance are still needed, this study suggests that there may be reasons for both optimism and pessimism in achieving these fundamental shifts. For one, there is a growing consensus among Basin stakeholders that climate change will have an impact on annual flows. In 2010, 57.1% of survey respondents thought that average natural flows on the river will be lower than in the previous century. In 2016, this increased to 73.71% of respondents. Similarly, not until 2016 did a majority of respondents believe there was a fundamental supply and demand imbalance on the river. In 2010, only 42.4% of respondents thought that current demands have already surpassed supplies, whereas in 2016, 61.32% of respondents acknowledged this fact. Basin stakeholders have also become more concerned about immediate impacts on water users. In 2010, only 18.9% of survey respondents believed there would be a shortage to the Central Arizona Project by 2026, as outlined in the 2007 Shortage Guidelines. By contrast, in 2016, 39.15% of respondents believed this shortage would occur.

Interestingly, however, there was very little change in survey respondents' beliefs regarding a potential compact call between the Lower and Upper Basins by 2026 and 2050. Chapter 3 described some acknowledgement of institutional deficiency

across the three decisions, but survey respondents lacked agreement on more significant deficiencies (e.g., mega drought impacts, structural deficit). These survey results suggest Basin stakeholders are increasingly aware of more minor institutional deficiencies (i.e., more agreement for the likelihood of CAP shortages), but are insufficiently attuned to the potential of larger-scale deficiencies. Accordingly, these results suggest that it will be difficult to adopt new agreements or policies in the coming years that address these larger issues.

The 2010 and 2016 surveys also inquired about specific options and solutions for the Basin, and how to prioritize each one. This also revealed cause for optimism and pessimism. For example, in 2010, only 21.4% of respondents thought that "significant changes" were needed for the Law of the River, while 10.4% thought a "fundamental restructuring" was needed. By 2016, the number of respondents who thought significant changes were needed increased to 32.08%, while the number who thought a fundamental restructuring was needed dropped to only 4.25%. In other words, more respondents in 2016 believe changes are needed to the Law of the River, but fewer respondents think a complete renegotiation is necessary.

Two other types of solutions received more support in 2016 compared to 2010. One such solution involved enhancing or refining rules for the coordinated operation of Lakes Powell and Mead and the other amounted to river augmentation from weather modification (i.e., cloud seeding) and vegetation management (i.e., tamarisk control). Support for coordinated operation rules for Powell and Mead as a high priority went from 29.2% of respondents in 2010 to 46.45% in 2016. Similarly, high priority support for river augmentation went from 29.1% in 2010 to 46.45% in 2016. In both cases, strong support for these solutions went from fewer than a third to almost half of all survey respondents. Perhaps this is unsurprising because in 2010 there was little discussion of

either, other than the implementation of the 2007 Shortage Guidelines, which directed the coordinated operation of the two major reservoirs. In 2016, however, both of these solution types are primary components of the Upper and Lower Basin DCPs. The Lower Basin DCP further defines how Powell and Mead will be operated during low elevation conditions and the Upper Basin DCP utilizes weather modification to increase snowpack in the headwaters regions.

More surprisingly, two other types of solutions received more support in 2016 compared to 2010. One involved the use of pricing incentives to more explicitly promote conservation and discourage waste. This idea went from having high priority support of only 38.8% of respondents in 2010 to 61.61% in 2016. The second solution type promoted voluntary water reallocation across state lines. In 2010, only 23.5% of respondents thought this solution deserved a high priority, but in 2016 this number almost doubled to 55.71% of respondents. In both cases, support increased substantially over the six years. The increase in support for voluntary water reallocation across state lines was particularly surprising because much of the discourse around water marketing across state lines is politically unsupportable, especially in the Upper Basin. But the increase in support for inter-state marketing was fairly equal across both basins. In the Lower Basin, support increased from 30.7% in 2010 to 56.5% in 2016. In the Upper Basin, such support increased from 10.2% in 2010 to 50% in 2016. These results suggest that the political barrier to inter-state water marketing may not be as significant as previously thought, and that there is support for using pricing incentives and other economic tools to promote conservation throughout the Basin.

6.7 Conclusion

Examining these themes and research questions has revealed several important considerations when measuring adaptive capacity in the Colorado River Basin. Specific

indicators of adaptive capacity emerged as particularly important, and broadly revolved around increasing flexibility for decision-makers. For example, on paper, there are obvious fundamental flaws in the Law of the River (e.g., the structural deficit) and a transformative change is needed to successfully manage the river in the long-term. This study suggests, however, that continued incrementalism is not only more achievable, but also might increase adaptive capacity by allowing for novel approaches and learning from those approaches. Further, incrementalism might ultimately lead to transformative change by helping decision-makers grapple with uncertainty, garner support for decisions in their home states, and address tricky political considerations, all of which are primary barriers to improving adaptive capacity. Additionally, previous chapters have discussed the need to balance privacy and inclusivity, and this chapter suggests a parallel process might be an effective mechanism for achieving that balance. A parallel process may also be effective in supporting decision-making processes by fostering more collaborative and flexible approaches, while also developing social trust among the competing interests.

These findings reveal another important factor—the importance of individuals, particularly at the federal level, in advocating for a more holistic and collaborative process, while also being able to nudge negotiations to completion. As some of the interviewees mentioned, the loss of key individuals may have impacted the success of current, ongoing negotiations. That being said, however, numerous interviewees also observed that there was an ever-expanding circle around these negotiations, driven by both former and current negotiators. These interviewees expressed optimism that a culture is being developed around collaboration and they did not believe this trend would be reversed anytime soon. Similarly, these key individuals have earned the trust to allow informal interactions to occur—that were often discussed as absolutely

necessary in creating new policies—while simultaneously ensuring that certain stakeholder groups or values are not being systematically excluded from those discussions. The informality needed to overcome several of the identified challenges to improved adaptive capacity would still be allowed and encouraged, but stakeholders not privy to those conversations could trust that the key individuals are ensuring their adequate representation.

More fundamentally, however, these findings suggest the need to institutionalize more proactive process-related goals by moving away from focusing only on reactive outcomes. If improving adaptive capacity and striving for a more sustainable and equitable approach is the ultimate goal in the Colorado River Basin, this underlying shift in the process of decision-making must happen. Similarly, if this goal is to be achieved, a more empathetic approach might be required. Not only could this help overcome some of the identified challenges, but it could further the collaborative process that has emerged in recent years. The survey results presented above suggest some cause for optimism, in that more stakeholders acknowledge flaws in Colorado River Basin management. But, disconcertingly, stakeholders do not demonstrate a comparable increasing acknowledgement that fundamental problems remain. Similarly, more stakeholders think modifications to the Law of the River are necessary, but fewer think transformative change is needed.

In sum, adaptive capacity in the Colorado River Basin has improved in recent years. This study has demonstrated that adapting to changing biophysical conditions requires flexibility, the ability to learn through incremental, novel, and interim approaches, informal networks and collaboration, and the involvement of trustworthy and credible individuals in key positions. While many stakeholders argue this current approach is successful, others point out it is largely dependent on each year's snowpack

in the Upper Basin. The need for a more proactive process might not emerge until multiple years of low snowpack reduce annual flows and shortages begin to occur in the Lower Basin and Mexico, testing the adaptive capacity of the system. As of this writing, the first of such shortages could happen as soon as 2019.

6.8 References

Blomquist, W., Dinar, A., & Kemper, K. (2005). *Comparison of Institutional Arrangements for River Basin Management in Eight Basins.pdf* (World Bank Policy Research Working Paper No. 3636). World Bank. Retrieved from http://dx.doi.org/10.2139/ssrn.757225

Engle, N. L. (2011). Adaptive capacity and its assessment. *Global Environmental Change*, *21*(2), 647–656. https://doi.org/10.1016/j.gloenvcha.2011.01.019

Engle, N. L., & Lemos, M. C. (2010). Unpacking governance: Building adaptive capacity to climate change of river basins in Brazil. *Global Environmental Change*, *20*(1), 4–13. https://doi.org/10.1016/j.gloenvcha.2009.07.001

Fleck, J. (2016). *Water is for Fighting Over: and Other Myths about Water in the West*. Washington, DC: Island Press.

Fulp, T. (2017, June). *How does DCP address Lake Mead's "math problem"?* Presented at the Clyde Martz Summer Conference, University of Colorado - Boulder.

Garrick, D. E., & De Stefano, L. (2016). Adaptive capacity in federal rivers: coordination challenges and institutional responses. *Current Opinion in Environmental Sustainability*, *21*, 78–85. https://doi.org/10.1016/j.cosust.2016.11.003

Getches, D. H. (1997). Colorado River Governance: Sharing Federal Authority as an Incentive to Create a New Institution. *U. Colo. L. Rev.*, *68*, 573.

Heinmiller, B. T. (2009). Path dependency and collective action in common pool governance. *International Journal of the Commons*, *3*(1). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=18750281&AN=43900071&h=Q8glF8pbW%2FxLHxdR2ilxsQsd4W3FRYWXTfO5nmPlfx%2B0LWkp9sIlQoWz6mVv5M%2BeYH4HrA66UGd9fKu5RV%2Bl4A%3D%3D&crl=c

Hill Clarvis, M., & Engle, N. L. (2015). Adaptive capacity of water governance arrangements: a comparative study of barriers and opportunities in Swiss and US states. *Regional Environmental Change*, *15*(3), 517–527. https://doi.org/10.1007/s10113-013-0547-y

Hill, M., & Engle, N. L. (2013). Adaptive Capacity: Tensions across Scales: Water Governance and Adaptive Capacity. *Environmental Policy and Governance*, *23*(3), 177–192. https://doi.org/10.1002/eet.1610

Huntjens, P., Pahl-Wostl, C., Rihoux, B., Schlüter, M., Flachner, Z., Neto, S., … Nabide Kiti, I. (2011). Adaptive Water Management and Policy Learning in a Changing Climate: a Formal Comparative Analysis of Eight Water Management Regimes in Europe, Africa and Asia: Adaptive Water Management and Policy Learning in a Changing Climate. *Environmental Policy and Governance*, *21*(3), 145–163. https://doi.org/10.1002/eet.571

Jewell, S. (2013, December). *CRWUA 2013 -- Secretary Sally Jewell*. Presented at the Colorado River Water Users Association Annual Conference, Las Vegas, Nevada.

Kenney, D., Bates, S., Bensard, A., & Berggren, J. (2011). The Colorado River and the Inevitability of Institutional Change. *Public Land and Resources Law Review*, *32 Pub. Land & Resources L. Rev 103*.

Kofinas, G. P. (2009). Adaptive Co-management in Social-Ecological Governance. In F. S. Chapin & C. Folke (Eds.), *Principles of Ecosystem Stewardship*. New York, NY: Springer New York. https://doi.org/10.1007/978-0-387-73033-2

Koontz, T. M., Gupta, D., Mudliar, P., & Ranjan, P. (2015). Adaptive institutions in social-ecological systems governance: A synthesis framework. *Environmental Science & Policy*, *53*, 139–151. https://doi.org/10.1016/j.envsci.2015.01.003

Lach, D., Ingram, H., & Rayner, S. (2004). Maintaining the status quo: how institutional norms and practices create conservative water organizations. *Tex L. Rev.*, *83*, 2027.

Lochhead, J. (2003). An Upper Basin Perspective On California's Claims To Water From The Colorado River Part II: The Development, Implementation and Collapse Of California's Plan To Live Within Its Basic Apportionment. *U. Denv. Water L. Rev.*, *6*(318).

McClurg, S. (2005). *Colorado River Project Symposium Proceedings* (Sharing the Risks: Shortage, Surplus, and Beyond). Sacramento, California: Water Education Foundation.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, *19*(3), 354–365.

Pahl-Wostl, Claudia. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, *19*(3), 354–365. https://doi.org/10.1016/j.gloenvcha.2009.06.001

Pahl-Wostl, Claudia, Craps, M., Dewulf, A., Mostert, E., Tabara, D., & Taillieu, T. (2007). Social Learning and Water Resources Management. *Ecology and Society*, *12*(2). https://doi.org/10.5751/ES-02037-120205

Pahl-Wostl, Claudia, Holtz, G., Kastens, B., & Knieper, C. (2010). Analyzing complex water governance regimes: the Management and Transition Framework. *Environmental Science & Policy*, *13*(7), 571–581. https://doi.org/10.1016/j.envsci.2010.08.006

Pahl-Wostl, Claudia, Lebel, L., Knieper, C., & Nikitina, E. (2012). From applying panaceas to mastering complexity: Toward adaptive water governance in river basins. *Environmental Science & Policy*, *23*, 24–34. https://doi.org/10.1016/j.envsci.2012.07.014

Schoeman, J., Allan, C., & Finlayson, C. M. (2014). A new paradigm for water? A comparative review of integrated, adaptive and ecosystem-based water management in the Anthropocene. *International Journal of Water Resources Development*, *30*(3), 377–390. https://doi.org/10.1080/07900627.2014.907087

Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M., … Pritchard, R. (2002). Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology*, *6*(1).

Chapter 7 – Conclusion

7.1 Summary of major findings

This dissertation explored the extensive literature on sustainable and equitable water policy, in conjunction with the adaptive capacity literature, using the Colorado River Basin as a case study. Utilizing the Institutional Analysis and Development framework (IAD) as a guide, it asked how criteria for sustainable and equitable water policy might improve our understanding of decision-making processes under significant uncertainty in future supplies and demands. The timing for this dissertation was quite beneficial: from the beginning of the project, numerous decisions, studies, and agreements were negotiated and implemented. This included the Basin Study in 2012, Minute 319 in 2012, Colorado River Cooperative Agreement in Colorado in 2013, System Conservation Pilot Program in 2014, ongoing Upper and Lower Basin Drought Contingency Plans, and Minute 323 in 2017. Following these processes in real-time provided unique insights into how decisions are made in the Colorado River Basin.

Chapter 2 revealed there are numerous criteria commonly utilized to evaluate sustainable and equitable water policy at the basin-scale. Despite their extensiveness, these criteria remain difficult to utilize in practice, particularly in conjunction with one another. For a subjective exercise in how to apply these criteria, I incorporated them into a combined IAD/SES framework, which revealed how the criteria could be used to consider different subsystems within the decision-making context.

Chapter 3 then systematically analyzed recent decisions in the Colorado River Basin to understand how the existing institutions have evolved in response to changing biophysical conditions. This analysis focused on adaptive capacity and what specific decision attributes contributed to more effective decision-making. Importantly, collaboration in the Colorado River Basin has improved in recent years, especially

considering the Minute 319 process. In terms of institutional modifications, I found decision-makers have incorporated uncertainty and flexibility more explicitly into their process. One of the mechanisms for doing so has been only utilizing interim agreements with finite implementation periods. Further, the Department of the Interior, through the Bureau of Reclamation, has been effective in resolving conflicts though a variety of stick and carrot approaches.

Chapter 4 built upon the previous examination of recent decisions by incorporating a survey of Colorado River stakeholders to understand which components of the decision-making process are important for improving adaptive capacity. Stakeholder participation, transparency, and fairness emerged as important considerations when examining sustainability and adaptive capacity. For example, while stakeholder participation is not necessarily a goal in and of itself, a consideration of when and how stakeholders can participate might lead to more effective outcomes. This chapter also examined the role of federalism in river basin decision-making and found that clearly defined roles and boundaries for each level of government can improve decision-making. These findings contribute to the broader discussion of stakeholder participation in decision-making by providing empirical data regarding the limits of demands for a more inclusive process. Specifically, this work may assist water managers and decision-makers as they grapple with the need to represent more diverse values, while continuing to efficiently and effectively create and implement water policy.

Chapter 5 focused on two of the specific components identified in the previous chapter: stakeholder participation and decision-making transparency. An in-depth analysis of these criteria gave a better understanding of the nuanced approach needed to apply such criteria to the decision-making process. The survey and interviews

revealed a range in perceptions regarding both the levels of participation and transparency, as well as the importance of each component in Basin decision-making. Overall, however, the results suggest that while there should be limits to participation and transparency, specific efforts must be made to ensure that those limits do not compel the systematic exclusion of certain stakeholder groups. I then explored what these efforts could entail and considered four distinct boundaries for effectively reconciling privacy and inclusion. These findings contribute to the understanding of not only why there must be limits to stakeholder participation and decision-making transparency, but perhaps more importantly they demonstrate how to effectively consider these limits and institutionalize a fairer and more equitable process. For example, one of the primary conclusions from this chapter is the importance of specific individuals—driven by personal motivations or otherwise—in helping to effectively balance limitations on participation and transparency, while also including outside stakeholders' input.

Finally, Chapter 6 attempted to prescribe how decision-making could become more sustainable and equitable by overcoming challenges to improving adaptive capacity in the Colorado River Basin. As had been discussed throughout this dissertation, the Basin suffers from a fundamental supply and demand imbalance (the structural deficit). Despite widespread acknowledgement of this problem, transformative change through modifying the Lower Basin States' allocations does not seem possible or appropriate. Instead, a focus on incrementalism is both more achievable and, by allowing for experimentation with novel approaches, possibly more effective. Similarly to Chapter 5, this chapter reveals that specific individuals, particularly at the federal government level, have also been incredibly effective in supporting adaptive capacity in the Basin. These individuals are particularly important

in informal decision-making processes, as they can identify when specific stakeholder groups are being excluded from the discussion.

Chapter 6 also highlighted the importance of developing more proactive process-related efforts, as opposed to an outcome-based system of governance, in facilitating sustainable and equitable decision-making. Striving for proactive processes that include an empathetic approach supports a broader consideration of stakeholder needs and is less focused simply on consumptive uses. This research contributes to the understanding of how this change in process may occur through concepts like balancing inclusivity and privacy, making transformative change through incrementalism, and recognizing the importance of individuals and informal networks. Ultimately, this final data chapter contributes to a better understanding of how to improve adaptive capacity in a complex, polycentric river basin like the Colorado River Basin. These results provide empirical examples of how water managers can improve adaptive capacity through specific decision-making processes. While these processes are context-dependent, they could be utilized to improve adaptive capacity in other international river basins.

7.2 Current status of ongoing Colorado River Basin negotiations

As of the writing of this conclusion in March of 2018, the negotiations for the Lower Basin Drought Contingency Plan (DCP) are still ongoing. Despite having the finalized components for well over a year, significant intra-state issues in Arizona and more recently California have prevented the Lower Basin States from signing the plan into law. In Arizona, long-standing issues regarding what agency should be the primary decision-maker for the state's Colorado River allocation exist. On one side, the Department of Water Resources contends that, since it is the state water agency, it is the Department's responsibility to negotiate and carry out Colorado River decision-making.

On the other, the Central Arizona Water Conservation District, which operates the Central Arizona Project (CAP,) contends that it should have a more prominent role in representing Arizona. This dispute, in conjunction with Arizona law requiring state legislature approval for the DCP, has led to stalled negotiations and the DCP left incomplete.

California had been on track to finalize the deal from their end—especially once the Imperial Irrigation District (IID) agreed the state's latest Salton Sea plan was adequate—but a recent court ruling and subsequent decision by IID's governing board leaves uncertain IID's legal authority to reduce deliveries to its users.[27] Since proactively reducing deliveries and storing that saved water in Lake Mead is the crux for the DCP, this latest twist is another hurdle decision-makers will have to grapple with. Given the latest Bureau of Reclamation projections indicate a possible shortage condition in the Lower Basin as early as 2019[28], decision-makers hope to finalize the plan in the coming months or year.

More substantial progress has been made at the binational level of negotiations, the second significant Basin decision-making process discussed throughout this dissertation. Despite concern regarding the new federal administration in the United States in 2017, negotiators were successful and signed Minute 323, an addendum to the 1944 Water Treaty, on September 27, 2017. The full implementation of Minute 323 still requires the completion of the Lower Basin DCP, but nonetheless the two countries

[27] Rothberg, D. (2018, March 21). Little-Known California Lawsuit Complicates Drought Plan for Lake Mead. *Water Deeply*. Retrieved: from https://www.newsdeeply.com/water/articles/2018/03/21/little-known-california-lawsuit-complicates-drought-plan-for-lake-mead

[28] Bureau of Reclamation (2017, August). The Colorado River System: Projected Future Conditions 2018-2022. Retrieved from: https://www.usbr.gov/lc/region/g4000/crss-5year.pdf

agreed on a broad range of binational issues and extended many of the successful components of Minute 319 through 2026.

Both of these processes are within the context of the upcoming re-negotiations for the 2007 Interim Shortage Guidelines, which are set to expire in 2026. These negotiations are to officially begin in 2021, but many Basin stakeholders have suggested the negotiations surrounding the DCP and Minute 323 are, in effect, the beginning of those re-negotiations. Many have suggested that the rules in the DCP will eventually become the new Shortage Guidelines. Accordingly, it will be interesting to follow these upcoming negotiations and see the new Guidelines developed and implemented.

7.3 Future research

I aim to continue work exploring how water policy can move towards more sustainable and equitable processes, with a focus on improving adaptive capacity. Combining literatures on sustainability, equity, and adaptive capacity offers a compelling approach to understanding river-basin decision-making processes, particularly the nuances of applying specific criteria in practice. Within the Colorado River Basin, I am interested in focusing on Native American issues, as my research suggested significant gaps in the tribes' ability to participate, as well as systematic issues preventing their inclusion. Outside of the Colorado River Basin, I hope to utilize the same research framework (decision analysis of existing policies, survey of broad group of stakeholders, and in-depth interviews with key decision-makers) in other river basins, both nationally and internationally. Additional case studies will be interesting for both cross-case analyses and new decision-making contexts. Finally, I hope to build upon the work for this dissertation. I collected an immense amount of data and further analysis could be done to test new research questions, particularly around the roles of individuals and overcoming challenges at different scales (e.g., intra-state context).

Additionally, I hope to re-administer the online survey every few years to understand if, and how, perceptions of the decision-making process are changing in the Colorado River Basin.

7.4 Concluding thoughts

Throughout the years of working on this dissertation, I have often found myself asking the question, "Well, is the Colorado River Basin sustainable and equitable?". Despite spending so much time examining both the historical and ongoing decision-making processes, I have difficulty answering this question. One way I have attempted to consider this question is thinking about Wilder and Ingram's (2016) directional principles for recognizing equity. They include treating water as a common good with multiple values, being mindful of non-human needs, including broad participation of affected parties, sharing benefits and burdens, and reducing or resolving power imbalances. As I think my dissertation has demonstrated, the Colorado River Basin is equitable in some regard, but significantly inequitable in other regards. That is, the system is improving, but still has a way to go, and I am cautiously optimistic it is on the right path.

In conclusion, I turn again to the dissertation written in 1926 on the Colorado River Compact as noted in the introduction, as I think one of the author's conclusions is particularly salient [*updated with my contributions*]:

> "What, then, is the most urgent need of the Colorado River area? Confidence and trust between the states [*and federal government, Mexico, Native Americans, NGOs, irrigation districts, municipalities, recreationists, academics, and other interested stakeholders*]. How may this spirit be promoted? By wise and judicious men [*and women*] patiently and carefully manipulating the machinery of interstate cooperation" (Olson, R. 1926, p. 210).

BIBLIOGRAPHY

Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. Economic Geography, 79(4), 387–404.

Agarwal, A., delos Angeles, M. S., Bhatia, R., Chéret, I., Davila-Poblete, S., Falkenmark, M., … others. (2000). Integrated water resources management. Global water partnership. Retrieved from http://dlc.dlib.indiana.edu/dlc/handle/10535/4986

Ananda, J., & Proctor, W. (2013). Collaborative approaches to water management and planning: An institutional perspective. Ecological Economics, 86, 97–106. https://doi.org/10.1016/j.ecolecon.2012.10.018

Anderson, D. L. (2002). Utah's Perspective The Colorado River. Utah Division of Water Resources, Www. Water. Utah. Gov/Interstate/Thecoloradoriverart. Pdf. Retrieved from http://www.wcwcd.org/wp-content/uploads/2012/09/TheColoradoRiver.pdf

Anderson, T. (1983). Water crisis: Ending the policy drought. Baltimore, Maryland: Johns Hopkins University Press. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/pam.4050030228

Andersson, K. (2006). Understanding decentralized forest governance: an application of the institutional analysis and development framework. Sustainability: Science Practice and Policy, 2(1), 25–35.

Antunes, P., Kallis, G., Videira, N., & Santos, R. (2009). Participation and evaluation for sustainable river basin governance. Ecological Economics, 68(4), 931–939. https://doi.org/10.1016/j.ecolecon.2008.12.004

Armstrong v. Larimer County Ditch Co., 27 Colorado Court of Appeals § (1891).

Ashby, C. (2008, August 15). McCain: Renegotiate 1922 Western water compact. Retrieved August 30, 2017, from http://www.chieftain.com/news/local/mccain-renegotiate-western-water-compact/article_b6700db0-5b98-5dd8-ae48-fa27ee5ec866.html

Ault, T. R., Mankin, J. S., Cook, B. I., & Smerdon, J. E. (2016). Relative impacts of mitigation, temperature, and precipitation on 21st-century megadrought risk in the American Southwest. Science Advances, 2(10), e1600873.

Balcomb, S., Mutz, P., Anderson, L., D'Antonio, Jr., J., & Patrick, T. (2004, October 7). Balcomb Letter. The States of Colorado, New Mexico, Utah and Wyoming Governor's Representatives on Colorado River Operations.

Bernstein, E. (2014, October 1). The Transparency Trap. Retrieved August 31, 2017, from https://hbr.org/2014/10/the-transparency-trap

Bernstein, S. (2004). Legitimacy in global environmental governance. J. Int'l L & Int'l Rel., 1, 139.

Blackstock, K. L., Waylen, K. A., Dunglinson, J., & Marshall, K. M. (2012). Linking process to outcomes — Internal and external criteria for a stakeholder involvement in River Basin Management Planning. Ecological Economics, 77, 113–122. https://doi.org/10.1016/j.ecolecon.2012.02.015

Blomquist, W., & Schlager, E. (2005). Political Pitfalls of Integrated Watershed Management. Society & Natural Resources, 18(2), 101–117. https://doi.org/10.1080/08941920590894435

Blomquist, W., Dinar, A., & Kemper, K. (2005). Comparison of Institutional Arrangements for River Basin Management in Eight Basins.pdf (World Bank Policy Research Working Paper No. 3636). World Bank. Retrieved from http://dx.doi.org/10.2139/ssrn.757225

Blomquist, W., Schlager, E., & Heikkila, T. (2004). Common Waters, Diverging Streams: Linking Institutions to Water Management in Arizona, California, and Colorado. Washington, DC: Resources for the Future.

Buono, R. M., & Eckstein, G. (2014). Minute 319: a cooperative approach to Mexico–US hydro-relations on the Colorado River. Water International, 39(3), 263–276. https://doi.org/10.1080/02508060.2014.906879

Bureau of Reclamation. (1946). The Colorado River: A Natural Menace Becomes a National Resource. United States Department of the Interior.

Bureau of Reclamation. (2012). Colorado River Basin Water Supply and Demand Study: Executive Summary. United States Department of the Interior. Retrieved from https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Executive%20Summary/CRBS_Executive_Summary_FINAL.pdf

Carpe Diem West. (2011). Thinking Like a River Basin. Sausalito, CA.

Castle, A. J. (2015). The Colorado River: Innovation in the Face of Scarcity. Presented at the Martz Summer Conference, University of Colorado - Boulder. Retrieved from http://scholar.law.colorado.edu/cgi/viewcontent.cgi?article=1013&context=innovations-in-managing-western-water

Christensen, N. S., & Lettenmaier, D. P. (2007). A multimodel ensemble approach to assessment of climate change impacts on the hydrology and water resources of the Colorado River Basin. Hydrology and Earth System Sciences Discussions, 11(4), 1417–1434.

Clark, M. J. (2002). Dealing with uncertainty: adaptive approaches to sustainable river management. Aquatic Conservation: Marine and Freshwater Ecosystems, 12(4), 347–363. https://doi.org/10.1002/aqc.531

Coglianese, C., Kilmartin, H., & Mendelson, E. (2008). Transparency and Public Participation in the Rulemaking Process. Retrieved from https://www.hks.harvard.edu/hepg/Papers/transparencyReport.pdf

Cohen, M. J. (2011). Municipal Deliveries of Colorado River Basin Water (p. 73). Oakland, CA: Pacific Institute.

Cohen, M., Christian-Smith, J., & Berggren, J. (2013). WATER TO SUPPLY THE LAND. Retrieved from http://www.pacinst.org/reports/co_river_ag_2013/irrigated_ag_crb.pdf

Cole, D. H., Epstein, G., & McGinnis, M. D. (2014). Toward a New Institutional Analysis of Social-Ecological Systems (NIASES): Combining Elinor Ostrom's IAD and SES Frameworks (No. Research Paper Number 299) (p. 23). Maurer School of Law, Indian University.

Colorado River Basin Project- Part II, § Committee on Interior and Insular Affairs (1968). United States Government Printing Office.

Colorado Water Conservation Board. (1955). Report on Depletion of Surface Water Supplies of Colorado West of Continental Divide. Washington, D.C.: Colorado Water Conservation Board.

Colorado Water Conservation Board. (2015). Colorado's Water Plan. Denver, Colorado: Department of Natural Resources. Retrieved from http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=199515&searchid=69705cbe-d4c1-446a-a4b9-00a411d2dad7&&dbid=0

Cox, M., Arnold, G., & Villamayor Tomás, S. (2010). A Review of Design Principles for Community-based Natural Resource Management. Ecology and Society, 15(4). https://doi.org/10.5751/ES-03704-150438

Crow, D. A. (2010). Local Media and Experts: Sources of Environmental Policy Initiation? Policy Studies Journal, 38(1), 143–164. https://doi.org/10.1111/j.1541-0072.2009.00348.x

Dawes, S. S. (2010). Stewardship and usefulness: Policy principles for information-based transparency. Government Information Quarterly, 27(4), 377–383. https://doi.org/10.1016/j.giq.2010.07.001

De Stefano, L., Hernández-Mora, N., López Gunn, E., Willaarts, B., & Zorrilla-Miras, P. (2012). Public participation and transparency in water management. Water, Agriculture and the Environment in Spain: Can We Square the Circle, 217–225.

Diduck, A. (2010). The Learning Dimension of Adaptive Capacity: Untangling the Multi-level Connections. In D. Armitage & R. Plummer (Eds.), Adaptive Capacity and Environmental Governance (pp. 199–221). Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-12194-4_10

Ely, N. (1946). Light on the Mexican Water Treaty from the Ratification Proceedings in Mexico (A Report to the Colorado River Water Users' Association). Washington, D.C.

Engle, N. L. (2011). Adaptive capacity and its assessment. Global Environmental Change, 21(2), 647–656. https://doi.org/10.1016/j.gloenvcha.2011.01.019

Engle, N. L., & Lemos, M. C. (2010). Unpacking governance: Building adaptive capacity to climate change of river basins in Brazil. Global Environmental Change, 20(1), 4–13. https://doi.org/10.1016/j.gloenvcha.2009.07.001

Falkenmark, M. (1997). Society's interaction with the water cycle: a conceptual framework for a more holistic approach. Hydrological Sciences Journal, 42(4), 451–466. https://doi.org/10.1080/02626669709492046

Falkenmark, M., & Molden, D. (2008). Wake Up to Realities of River Basin Closure. International Journal of Water Resources Development, 24(2), 201–215. https://doi.org/10.1080/07900620701723570

Fleck, J. (2016). Water is for Fighting Over: and Other Myths about Water in the West. Washington, DC: Island Press.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., & Walker, B. (2002). Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. AMBIO: A Journal of the Human Environment, 31(5), 437–440. https://doi.org/10.1579/0044-7447-31.5.437

Fradkin, P. (1981). A River No More: The Colorado River and the West. Los Angeles, CA: University of California Press.

Fulp, T. (2017, June). How does DPC address Lake Mead's "math problem"? Presented at the Martz Summer Conference, University of Colorado - Boulder, Colorado.

Fulp, T., & Harkins, J. (2001). Policy Analysis Using RiverWare: Colorado River Interim Surplus Guidelines (pp. 1–10). American Society of Civil Engineers. https://doi.org/10.1061/40569(2001)150

Garrick DE, Anderson G, Connell D, Pittock J (2014) Federal rivers: managing water in multi-layered political systems. Edward Elgar, Cheltenham

Garrick, D. E., & De Stefano, L. (2016). Adaptive capacity in federal rivers: coordination challenges and institutional responses. Current Opinion in Environmental Sustainability, 21, 78–85. https://doi.org/10.1016/j.cosust.2016.11.003

Garrick, D. E., Hall, J. W., Dobson, A., Damania, R., Grafton, R. Q., Hope, R., … Money, A. (2017). Valuing water for sustainable development. Science, 358(6366), 1003–1005. https://doi.org/10.1126/science.aao4942

Garrick, D., Lane-Miller, C., & McCoy, A. L. (2011). Institutional Innovations to Govern Environmental Water in the Western United States: Lessons for Australia's

Murray-Darling Basin: LESSONS FROM THE WESTERN U.S. Economic Papers: A Journal of Applied Economics and Policy, 30(2), 167–184. https://doi.org/10.1111/j.1759-3441.2011.00104.x

Gerlak, A (2014) Federalism and US water policy. In: Garrick D, Anderson G, Connel D, Pittock J (eds) Federal rivers: managing water in multi-layered political systems. Edward Elgar, Cheltenham, pp 41-56.

Getches, D. H. (1997). Colorado River Governance: Sharing Federal Authority as an Incentive to Create a New Institution. U. Colo. L. Rev., 68, 573.

Gibson, C., Andersson, K., Ostrom, E., & Shivakumar, S. (2005). The Samaritan's Dilemma: The Political Economy of Development Aid. New York: Oxford University Press.

Gibson, R. B., Holtz, S., Tansey, J., Whitelaw, G., & Hassan, S. (2005). Sustainability Assessment: Criteria, Processes, and Applications (1 edition). London ; Sterling, VA: Earthscan.

Giupponi, C., Fassio, A., Vazquez, J. F., & Mysiak, J. (2006). Sustainable Water Management and Decision Making. In Sustainable Management of Water Resources: An Integrated Approach. Cheltenham, UK: Edward Elgar Publishing.

Gleick, P. H. (1998). Water in crisis: paths to sustainable water use. Ecological Applications, 8(3), 571–579.

Glennon, R., & Culp, P. (2002). The Last Green Lagoon: How and Why the Bush Administration Should Save the Colorado River Delta. Ecology Law Quarterly, 28, 903–992.

Global Water Partnership. (2000). Integrated water resources management. Stockholm: Global Water Partnership.

Gold, R. L. (2008). Dividing the Pie-Dealing with Surplus and Drought: Examining the Colorado River Compact of 1922. J. Land Resources & Envtl. L., 28, 71.

Grant, D. L. (2003). Interstate water allocation compacts: When the virtue of permanence becomes the vice of inflexibility. U. Colo. L. Rev., 74, 105.

Grant, D. L. (2007). Collaborative Solutions to Colorado River Water Shortages: The Basin States' Proposal and Beyond. Nev. LJ, 8, 964.

Grigg, N. S. (2016). Integrated Water Resource Management. London: Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-57615-6

Heald, D. (2006). Transparency as an Instrumental Value. In C. Hood & D. Heald (Eds.), Transparency: The Key to Better Governance? (pp. 58–73). British Academy. https://doi.org/10.5871/bacad/9780197263839.003.0004

Hedelin, B. (2007). Criteria for the Assessment of Sustainable Water Management. Environmental Management, 39(2), 151–163. https://doi.org/10.1007/s00267-004-0387-0

Heikkila, T., Schlager, E., & Davis, M. W. (2011). The Role of Cross-Scale Institutional Linkages in Common Pool Resource Management: Assessing Interstate River Compacts*. Policy Studies Journal, 39(1), 121–145.

Heinmiller, B. T. (2009). Path dependency and collective action in common pool governance. International Journal of the Commons, 3(1).

Hidalgo, H. G., & Dracup, J. A. (2003). ENSO and PDO effects on hydroclimatic variations of the Upper Colorado River basin. Journal of Hydrometeorology, 4(1).

Hill Clarvis, M., & Engle, N. L. (2015). Adaptive capacity of water governance arrangements: a comparative study of barriers and opportunities in Swiss and US states. Regional Environmental Change, 15(3), 517–527. https://doi.org/10.1007/s10113-013-0547-y

Hill, M., & Engle, N. L. (2013). Adaptive Capacity: Tensions across Scales: Water Governance and Adaptive Capacity. Environmental Policy and Governance, 23(3), 177–192. https://doi.org/10.1002/eet.1610

Hoerling, M., & Eischeid, J. (2007). Past Peak Water in the Southwest. Southwest Hydrology, 187–190.

Hoerling, M., Lettenmaier, D., Cayan, D., & Udall, B. (2009). Reconciling Projections of Colorado River Streamflow. Southwest.

Hood, C. (2006). Transparency in historical perspective. In C. Hood & D. Heald (Eds.), Transparency: the Key to Better Governance? (pp. 3–23). Oxford, UK: Oxford University Press. Retrieved from http://www.oup.co.uk/

Hooper, B. (2010). River basin organization performance indicators: application to the Delaware River basin commission. Water Policy, 12(4), 461. https://doi.org/10.2166/wp.2010.111

Hooper, B. P. (2003). Integrated water resources management and river basin governance. Journal of Contemporary Water Research and Education, 126(1), 3.

Hoover, H. Abstract of Secretary Hoover's Statement on the Colorado River, § House Committee on Irrigation and Reclamation (1926).

Hoover, T. (2008, October 4). McCain: Water deal is hands-off. Retrieved August 30, 2017, from http://www.denverpost.com/2008/10/03/mccain-water-deal-is-hands-off/

Huffman, J. L. (2009). Comprehensive river basin management: the limits of collaborative, stakeholder-based, water governance. Natural Resources Journal, 117–149.

Hughes, S., & McKay, J. (2009). 10 The contribution of actors to achieving sustainability in Australia through water policy transitions. Water Policy Entrepreneurs: A Research Companion to Water Transitions Around the Globe, 175.

Hundley, N. (2009). Water and the West: The Colorado River Compact and the Politics of Water in the American West (2nd ed.). Los Angeles: University of California Press.

Huntjens, P., Lebel, L., Pahl-Wostl, C., Camkin, J., Schulze, R., & Kranz, N. (2012). Institutional design propositions for the governance of adaptation to climate change in the water sector. Global Environmental Change, 22(1), 67–81. https://doi.org/10.1016/j.gloenvcha.2011.09.015

Huntjens, P., Pahl-Wostl, C., Rihoux, B., Schlüter, M., Flachner, Z., Neto, S., … Nabide Kiti, I. (2011). Adaptive Water Management and Policy Learning in a Changing Climate: a Formal Comparative Analysis of Eight Water Management Regimes in Europe, Africa and Asia: Adaptive Water Management and Policy Learning in a Changing Climate. Environmental Policy and Governance, 21(3), 145–163. https://doi.org/10.1002/eet.571

Ingram, H. M., Scaff, L. A., & Silko, L. (1986). Replacing Confusion with Equity: Alternatives for Water Policy in the Colorado River Basin. In G. Weatherford & F. L. Brown (Eds.), New Course for the Colorado River: Major Issues for the Next Century. University of New Mexico Press.

Ingram, H. M., Whiteley, J. M., & Perry, R. W. (2008). The Importance of Equity and the Limits of Efficiency in Water Resources. In J. M. Whiteley, H. M. Ingram, & R. W. Perry (Eds.), Water, place, and equity. Cambridge, Mass: MIT Press.

Ingram, H., & Lejano, R. (2009). Transitions: transcending multiple ways of knowing water resources in the United States. In D. Huitema & S. Meijerink (Eds.), Water Policy Entrepreneurs: A Research Companion to Water Transitions around the Globe. Massachusetts, MA: Edward Elgar Publishing.

International Boundary and Water Commission. (2010, June 17). Conceptual Framework For U.S.-Mexico Dicussions On Colorado River Cooperative Actions. Retrieved from https://www.ibwc.gov/Files/Minutes/Minute_317.pdf

International Boundary and Water Commission. Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California, Minute No. 319 § (2012). Retrieved from https://www.ibwc.gov/Files/Minutes/Minute_319.pdf

Ioris, A. A. R., Hunter, C., & Walker, S. (2008). The development and application of water management sustainability indicators in Brazil and Scotland. Journal of Environmental Management, 88(4), 1190–1201. https://doi.org/10.1016/j.jenvman.2007.06.007

IPCC. (2014). Climate Change 2014: Synthesis Report (Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)). Geneva, Switzerland: IPCC. https://doi.org/10.1017/CBO9780511546013

Irvin, R. A., & Stansbury, J. (2004). Citizen participation in decision making: Is it worth the effort? Public Administration Review, 64(1), 55–65.

Islam, S., & Susskind, L. E. (2012). Water Diplomacy: A Negotiated Approach to Managing Complex Water Networks (1 edition). New York: Routledge.

Jaspers, F. G. W. (2003). Institutional arrangements for integrated river basin management. Water Policy, 5, 77–90.

Jenkins, M. (2014). New Hope for the Delta. High Country News, 45(18). Retrieved from http://www.hcn.org/issues/45.18/new-hope-for-the-delta/print_view

Jewell, S. (2013, December). CRWUA 2013 -- Secretary Sally Jewell. Presented at the Colorado River Water Users Association Annual Conference, Las Vegas, Nevada.

Johnson, R. (1977). The Central Arizona Project 1918-1968 (1st edition). Tucson: University of Arizona Press.

Jønch-Clausen, T., & Fugl, J. (2001). Firming up the Conceptual Basis of Integrated Water Resources Management. International Journal of Water Resources Development, 17(4), 501–510. https://doi.org/10.1080/07900620120094055

Judkins, G. L., & Larson, K. (2010). The Yuma desalting plant and Cienega de Santa Clara dispute: a case study review of a workgroup process. Water Policy, 12(3), 401. https://doi.org/10.2166/wp.2009.084

Juwana, I., Muttil, N., & Perera, B. J. C. (2012). Indicator-based water sustainability assessment — A review. Science of The Total Environment, 438, 357–371. https://doi.org/10.1016/j.scitotenv.2012.08.093

Kallis, G., Kiparsky, M., Milman, A., & Ray, I. (2006). Glossing Over the Complexity of Water. Science Letters, 314, 1388–1388.

Kampragou, E., Eleftheriadou, E., & Mylopoulos, Y. (2007). Implementing Equitable Water Allocation in Transboundary Catchments: The Case of River Nestos/Mesta. Water Resources Management, 21(5), 909–918. https://doi.org/10.1007/s11269-006-9108-1

Kang, M.-G., & Lee, G.-M. (2011). Multicriteria Evaluation of Water Resources Sustainability in the Context of Watershed Management1: Multicriteria

Evaluation of Water Resources Sustainability in the Context of Watershed Management. JAWRA Journal of the American Water Resources Association, 47(4), 813–827. https://doi.org/10.1111/j.1752-1688.2011.00559.x

Kendy, E., Flessa, K. W., Schlatter, K. J., de la Parra, C. A., Hinojosa Huerta, O. M., Carrillo-Guerrero, Y. K., & Guillen, E. (2017). Leveraging environmental flows to reform water management policy: Lessons learned from the 2014 Colorado River Delta pulse flow. Ecological Engineering, 106, 683–694. https://doi.org/10.1016/j.ecoleng.2017.02.012

Kenney, D. (2005). In Search of Sustainable Water Management: International Lessons for the American West and Beyond. Massachusetts, MA: Edward Elgar Publishing.

Kenney, D., & Lord, W. (1999). Analysis of Institutional Innovation in the Natural Resources and Environmental Realm: The Emergence of Alternative Problem-Solving Strategies in the American West. Natural Resources Law Center, University of Colorado Boulder.

Kenney, D., Bates, S., Bensard, A., & Berggren, J. (2011). The Colorado River and the Inevitability of Institutional Change. Public Land and Resources Law Review, 32 Pub. Land & Resources L. Rev 103.

King, J. S., Culp, P. W., & de la Parra, C. (2014). Getting to the right side of the river: lessons for binational cooperation on the road to Minute 319. U. Denv. Water L. Rev., 18, 36.

Kofinas, G. P. (2009). Adaptive Co-management in Social-Ecological Governance. In F. S. Chapin & C. Folke (Eds.), Principles of Ecosystem Stewardship. New York, NY: Springer New York. https://doi.org/10.1007/978-0-387-73033-2

Koontz, T. M., Gupta, D., Mudliar, P., & Ranjan, P. (2015). Adaptive institutions in social-ecological systems governance: A synthesis framework. Environmental Science & Policy, 53, 139–151. https://doi.org/10.1016/j.envsci.2015.01.003

Kranz, R., Gasteyer, S. P., Heintz Jr, H. T., Shafer, R., & Steinman, A. (2010). Conceptual foundations for the sustainable water resources roundtable. Journal of Contemporary Water Research and Education, 127(1), 3.

Lach, D., Ingram, H., & Rayner, S. (2004). Maintaining the status quo: how institutional norms and practices create conservative water organizations. Tex L. Rev., 83, 2027.

Larson, K.L., White, D. D., Gober, P., Harlan, S., & Wutich, A. (2009). Divergent perspectives on water resource sustainability in a public–policy–science context. Environmental Science & Policy, 12(7), 1012–1023. https://doi.org/10.1016/j.envsci.2009.07.012

Larson, Kelli L., Wiek, A., & Withycombe Keeler, L. (2013). A comprehensive sustainability appraisal of water governance in Phoenix, AZ. Journal of

Environmental Management, 116, 58–71. https://doi.org/10.1016/j.jenvman.2012.11.016

Lautze, J., De Silva, S., Giordano, M., & Sanford, L. (2011). Putting the cart before the horse: Water governance and IWRM. In Natural Resources Forum (Vol. 35, pp. 1–8). Wiley Online Library. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1477-8947.2010.01339.x/full

Lautze, Jonathan, Silva, S. de, Giordano, M., & Sanford, L. (2014). Water governance. In Jonathon Lautze (Ed.), Key Concepts in Water Resource Management: A Review and Critical Evaluation. Oxon, UK: Routledge. Retrieved from https://cgspace.cgiar.org/handle/10568/65282

Leach, W. (2006). Collaborative Public Management and Democracy: Evidence from Western Watershed Partnerships.pdf. Public Administration Review, 66, 100–110.

League of the Southwest. (1920). Proceedings of the Third Convention of the League of the Southwest. Los Angeles, CA.

Leshy, J. (2009). Notes on a progressive national water policy. Harv. L. & Pol'y Rev., 3, 133.

Lochhead, J. (2003). An Upper Basin Perspective On California's Claims To Water From The Colorado River Part II: The Development, Implementation and Collapse Of California's Plan To Live Within Its Basic Apportionment. U. Denv. Water L. Rev., 6(318).

Lockwood, M., Davidson, J., Curtis, A., Stratford, E., & Griffith, R. (2010). Governance Principles for Natural Resource Management. Society & Natural Resources, 23(10), 986–1001. https://doi.org/10.1080/08941920802178214

Loomis, B. (2018, March 2). Arizona water managers disagree on how to prevent a shortage on the Colorado River. Arizona Central. Retrieved from https://www.azcentral.com/story/news/local/arizona-environment/2018/03/02/arizona-water-managers-central-arizona-project-colorado-river-conservation-lake-powell-mead/383210002/

Loucks, D. P. (2000). Sustainable Water Resources Management. Water International, 25(1), 3–10. https://doi.org/10.1080/02508060008686793

Lubell, M., & Edelenbos, J. (2013). Integrated Water Resources Management: A Comparative Laboratory for Water Governance. International Journal of Water Governance, 1(3), 177–196. https://doi.org/10.7564/13-IJWG14

MacDonnell, L. (2012). Arizona v. California Revisited (SSRN Scholarly Paper No. ID 2691078). Rochester, NY: Social Science Research Network. Retrieved from https://papers.ssrn.com/abstract=2691078

McCabe, G. J., & Wolock, D. M. (2007). Warming may create substantial water supply shortages in the Colorado River basin. Geophysical Research Letters, 34(22). https://doi.org/10.1029/2007GL031764

McCaffrey, S. (2003). The Need for Flexibility in Freshwater Treaty Regimes. Natural Resource Forum, 156–162.

McClurg, S. (1997). Colorado River Project Symposium Proceedings (75th Anniversary Colorado River Compact Symposium). Sacramento, California: Water Education Foundation.

McClurg, S. (1999). Colorado River Project Symposium Proceedings (Managing the Colorado River: Past, Present and Future). Sacramento, California: Water Education Foundation.

McClurg, S. (1999). Managing the Colorado River. Water Education Foundation, (November/December). Retrieved from http://www.watereducation.org/western-water-magazine/managing-colorado-river-0

McClurg, S. (2002). Colorado River Project Symposium Proceedings (Coming to Consensus: Sharing the Colorado River). Sacramento, California: Water Education Foundation.

McClurg, S. (2005). Colorado River Project Symposium Proceedings (Sharing the Risks: Shortage, Surplus, and Beyond). Sacramento, California: Water Education Foundation.

McClurg, S. (2007). Colorado River Project Symposium Proceedings (The Colorado River Compact at 85 and Changes on the River). Sacramento, California: Water Education Foundation.

McClurg, S. (2008). How is the Colorado River Shortage Agreement Working? Water Education Foundation, Colorado River Project-River Report, 12.

McClurg, S. (2011). Colorado River Project Symposium Proceedings (Solving the Basin's Math Problem: Adapting to Change). Sacramento, California: Water Education Foundation.

McClurg, S. (2013). Colorado River Project Symposium Proceedings (An Era of New Partnerships on the Colorado River). Sacramento, California: Water Education Foundation.

Meko, D. M., Woodhouse, C. A., Baisan, C. A., Knight, T., Lukas, J. J., Hughes, M. K., & Salzer, M. W. (2007). Medieval drought in the upper Colorado River Basin. Geophysical Research Letters, 34(10). https://doi.org/10.1029/2007GL029988

Miles MB, Huberman AM (1984) Drawing valid meaning from qualitative data: Toward a shared craft. Educ Res 13: 20-30.

Miles, M. B., & Huberman, A. M. (1994). Qualitative Data Analysis: An Expanded Sourcebook. SAGE.

Milly, C., Betancourt, J., Falkenmark, M., Hirsch, R., Kundzewicz, Z., Lettenmaier, D., & Stouffer, R. (2008). Stationarity is Dead: Whither Water Management? Science, 319.

Mol, A. P. (2010). The future of transparency: Power, pitfalls and promises. Global Environmental Politics, 10(3), 132–143.

Mostert E (2006) Participation for Sustainable Water Management. In: Giupponi C, Jakeman AJ, Karssenberg D, Hare MP (eds) Sustainable management of water resources. Edward Elgar, Cheltenham

Mote, P. W., Li, S., Lettenmaier, D. P., Xiao, M., & Engel, R. (2018). Dramatic declines in snowpack in the western US. Npj Climate and Atmospheric Science, 1(1). https://doi.org/10.1038/s41612-018-0012-1

Mueller, E. R., Schmidt, J. C., Topping, D. J., Shafroth, P. B., Rodríguez-Burgueño, J. E., Ramírez-Hernández, J., & Grams, P. E. (2017). Geomorphic change and sediment transport during a small artificial flood in a transformed post-dam delta: The Colorado River delta, United States and Mexico. Ecological Engineering, 106, 757–775. https://doi.org/10.1016/j.ecoleng.2016.08.009

Muys, J. C. (1973). Interstate compacts and regional water resources planning and management. Natural Resources Lawyer, 153–188.

Norton, G. (2005, May 2). Secretary Norton's Letter to Governor Huntsman. United States Department of the Interior. Retrieved from https://www.doi.gov/sites/doi.gov/files/archive/news/archive/05_News_Releases/050502c.htm

Nowlan, L., & Bakker, K. (2007). Delegating water governance: Issues and challenges in the BC context. Program on Water Governance, University of British Columbia Vancouver. Retrieved from http://www.tonydorcey.ca/597/Posts/FBCwatergovernancefinal2.pdf

Olson, R. (1926). The Colorado River Compact. Harvard University, Cambridge, MA.

Orlove, B., & Caton, S. C. (2010). Water Sustainability: Anthropological Approaches and Prospects. Annual Review of Anthropology, 39(1), 401–415. https://doi.org/10.1146/annurev.anthro.012809.105045

Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge, UK: Cambridge University Press.

Ostrom, E. (2005). Understanding Institutional Diversity. Princeton, NJ: Princeton University Press.

Ostrom, E. (2009). A General Framework for Analyzing Sustainability of Social-Ecological Systems. Science, 325(5939), 419–422. https://doi.org/10.1126/science.1172133

Ostrom, E. (2011). Background on the institutional analysis and development framework. Policy Studies Journal, 39(1), 7–27.

Ostrom, Elinor, & Cox, M. (2010). Moving beyond panaceas: a multi-tiered diagnostic approach for social-ecological analysis. Environmental Conservation, 37(04), 451–463. https://doi.org/10.1017/S0376892910000834

Overpeck J, Udall B (2010) Dry times ahead. Science 328: 1642–43. doi: 10.1126/science.1186591

Pahl-Wostl, C. (2002). Towards sustainability in the water sector–The importance of human actors and processes of social learning. Aquatic Sciences, 64(4), 394–411.

Pahl-Wostl, Claudia, Craps, M., Dewulf, A., Mostert, E., Tabara, D., & Taillieu, T. (2007). Social Learning and Water Resources Management. Ecology and Society, 12(2). https://doi.org/10.5751/ES-02037-120205

Pahl-Wostl, Claudia, Holtz, G., Kastens, B., & Knieper, C. (2010). Analyzing complex water governance regimes: the Management and Transition Framework. Environmental Science & Policy, 13(7), 571–581. https://doi.org/10.1016/j.envsci.2010.08.006

Pahl-Wostl, Claudia, Lebel, L., Knieper, C., & Nikitina, E. (2012). From applying panaceas to mastering complexity: Toward adaptive water governance in river basins. Environmental Science & Policy, 23, 24–34. https://doi.org/10.1016/j.envsci.2012.07.014

Pahl-Wostl, Claudia, Tàbara, D., Bouwen, R., Craps, M., Dewulf, A., Mostert, E., … Taillieu, T. (2008). The importance of social learning and culture for sustainable water management. Ecological Economics, 64(3), 484–495. https://doi.org/10.1016/j.ecolecon.2007.08.007

Pahl-Wostl, Claudia. (2006). Transitions towards adaptive management of water facing climate and global change. Water Resources Management, 21(1), 49–62. https://doi.org/10.1007/s11269-006-9040-4

Pahl-Wostl, Claudia. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. Global Environmental Change, 19(3), 354–365. https://doi.org/10.1016/j.gloenvcha.2009.06.001

Parkes, M. W., Morrison, K. E., Bunch, M. J., Hallström, L. K., Neudoerffer, R. C., Venema, H. D., & Waltner-Toews, D. (2010). Towards integrated governance for water, health and social–ecological systems: The watershed governance prism. Global Environmental Change, 20(4), 693–704. https://doi.org/10.1016/j.gloenvcha.2010.06.001

Pereira, Â. G., & Quintana, S. C. (2009). 3 pillars and 1 beam: Quality of river basin governance processes. Ecological Economics, 68(4), 940–954. https://doi.org/10.1016/j.ecolecon.2006.09.014

Pitt, J., Kendy, E., Schlatter, K., Hinojosa-Huerta, O., Flessa, K., Shafroth, P. B., … Glenn, E. P. (2017). It takes more than water: Restoring the Colorado River Delta. Ecological Engineering, 106, 629–632. https://doi.org/10.1016/j.ecoleng.2017.05.028

Poulsen, B. (2006). The North Giveth and the North Taketh Away: Negotiating Delivery Reductions to Mexico through the Colorado River Seven State Agreement for Drought Management - A Potential Conflict? Environs Envtl. L. & Pol'y J., 30(221), 25.

Powell, J. (2008). Dead Pool: Lake Powell, Global Warming, and the Future of Water in the West. Los Angeles, CA: University of California Press.

Rahaman, M. M., & Varis, O. (2005). Integrated water resources management: evolution, prospects and future challenges. Sustainability: Science, Practice & Policy, 1(1), 15–21.

Reed PM, Kasprzyk J (2009) Water resources management: the myth, the wicked, and the future. J Water Res Pl-ASCE 135: 411–13. doi: http://dx.doi.org/10.1061/(ASCE)WR.1943-5452.0000047

Reeve, I. (2003). Principles for the nested governance of water resources. Institute for Rural Futures Occasional Paper, 1, 1.

Reisner, M. (1993). Cadillac Desert: The American West and Its Disappearing Water. New York: Penguin Books.

Renner, R., Schneider, F., Hohenwallner, D., Kopeinig, C., Kruse, S., Lienert, J., … Muhar, S. (2013). Meeting the Challenges of Transdisciplinary Knowledge Production for Sustainable Water Governance. Mountain Research and Development, 33(3), 234–247. https://doi.org/10.1659/MRD-JOURNAL-D-13-00002.1

Richter, B. D., Mathews, R., Harrison, D. L., & Wigington, R. (2003). Ecologically sustainable water management: managing river flows for ecological integrity. Ecological Applications, 13(1), 206–224.

Rinaudo, J. D., & Garin, P. (2005). The benefits of combining lay and expert input for water-management planning at the watershed level. Water Policy, 7, 279–293.

Robison, J. A., & Kenney, D. S. (2012). Equity and the Colorado River Compact. Envtl. L., 42, 1157.

Rogers, P., & Hall, A. W. (2003). Effective water governance. Stockholm: Global Water Partnership.

Roper, C. G. (2015). Interstate Water Compacts: Partnerships for Transboundary Water Resource Management. Journal of South Carolina Water Resources, 2(1), 9.

Rubin, H., & Rubin, I. (2005). Qualitative Interviewing: The Art of Hearing Data (Second Edition). London, UK: Sage Publications.

Sabatier P, Focht W, Lubell M, Trachtenberg Z, Vedlitz A, Matlock M (2005) Swimming upstream: collaborative approaches to watershed management. Massachusetts Institute of Technology, Cambridge

Sandoval-Solis, S., McKinney, D. C., & Loucks, D. P. (2010). Sustainability index for water resources planning and management. Journal of Water Resources Planning and Management. Retrieved from http://ascelibrary.org/doi/10.1061/(ASCE)WR.1943-5452.0000134

Savenije, H. H., & Van der Zaag, P. (2000). Conceptual framework for the management of shared river basins; with special reference to the SADC and EU. Water Policy, 2(1), 9–45.

Sax, J. L., Thompson, B. H., Jr, Leshy, J. D., & Abrams, R. H. (2006). Legal Control of Water Resources: Cases and Materials (4th ed. edition). St. Paul, MN: Thomson / West.

Schiffer, W. P., Guenther, H. R., & Carr, T. G. (2007). From A Colorado River Compact Challenge To The Next Era Of Cooperation Among The Seven Basin States. Ariz. L. Rev., 49(217), 17.

Schlager E, Blomquist W (2008) Embracing watershed politics. University of Colorado Press, Boulder

Schlager E, Heikkila T (2014) Water scarcity, conflict resolution, and adaptive governance in federal transboundary river basins. In: Garrick D, Anderson G, Connel D, Pittock J (eds) Federal rivers: managing water in multi-layered political systems. Edward Elgar, Cheltenham, pp 57-75

Schlager, E., Heikkila, T., & Case, C. (2012). The Costs of Compliance with Interstate Agreements: Lessons from Water Compacts in the Western United States. Publius: The Journal of Federalism, 42(3), 494–515. https://doi.org/10.1093/publius/pjs017

Schlager, Edella, & Heikkila, T. (2009). Resolving water conflicts: A comparative analysis of interstate river compacts. Policy Studies Journal, 37(3), 367–392.

Schlager, Edella, & Heikkila, T. (2011). Left High and Dry? Climate Change, Common-Pool Resource Theory, and the Adaptability of Western Water Compacts. Public Administration Review, 71(3), 461–470.

Schneider, F., Bonriposi, M., Graefe, O., Herweg, K., Homewood, C., Huss, M., … Weingartner, R. (2014). Assessing the sustainability of water governance systems:

the sustainability wheel. Journal of Environmental Planning and Management, 1–24. https://doi.org/10.1080/09640568.2014.938804

Schoeman, J., Allan, C., & Finlayson, C. M. (2014). A new paradigm for water? A comparative review of integrated, adaptive and ecosystem-based water management in the Anthropocene. International Journal of Water Resources Development, 30(3), 377–390. https://doi.org/10.1080/07900627.2014.907087

Seager, R., Ting, M., Li, C., Naik, N., Cook, B., Nakamura, J., & Liu, H. (2012). Projections of declining surface-water availability for the southwestern United States. Nature Climate Change, 3(5), 482–486. https://doi.org/10.1038/nclimate1787

Serageldin, I. (1995). Water Resources Management: A New Policy for a Sustainable Future. International Journal of Water Resources Development, 11(3), 221–232. https://doi.org/10.1080/07900629550042191

Smakhtin V (2008) Basin closure and environmental flow requirements. Int J Water Resour D 24: 227–33. doi: http://dx.doi.org/10.1080/07900620701723729

Snow, B. (2013). Minute 319: U.S.-Mexico Cooperation on the Colorado River. Presented at the Colorado River Project Symposium, Santa Fe, New Mexico.

Stakhiv EZ (2011) Pragmatic approaches for water management under climate change uncertainty. J Am Water Resour As 47: 1183–96. doi: 10.1111/j.1752-1688.2011.00589.x

Stasavage, D. (2006). Does Transparency Make a Difference? The Example of the European Council of Ministers. In C. Hood & D. Heald (Eds.), Transparency: The Key to Better Governance? (pp. 164–179). British Academy. https://doi.org/10.5871/bacad/9780197263839.003.0010

Subcommitte on Irrigation and Reclamation. H.R. 4671 and similar bills, § Committee on Interior and Insular Affairs (1965). Washington, D.C.: United States Government Printing Office.

Swyngedouw, E., Page, B., & Kaika, M. (2002). Sustainability and policy innovation in a multi-level context: crosscutting issues in the water sector. In Participatory Governance in Multi-Level Context (pp. 107–131). Springer. Retrieved from http://link.springer.com/chapter/10.1007/978-3-663-11005-7_6

Tàbara, J. D., & Ilhan, A. (2008). Culture as trigger for sustainability transition in the water domain: the case of the Spanish water policy and the Ebro river basin. Regional Environmental Change, 8(2), 59–71. https://doi.org/10.1007/s10113-007-0043-3

Tipton, & Kalmbach. (1965). Water Supplies of the Colorado River. Denver, Colorado: Upper Colorado River Commission.

Tortajada, C. (2010). Water Governance: Some Critical Issues. International Journal of Water Resources Development, 26(2), 297–307. https://doi.org/10.1080/07900621003683298

Tyler, D. (2003). Silver Fox of the Rockies: Delphus Carpenter and Western Water Compacts. University of Oklahoma Press.

Udall, B., & Overpeck, J. (2017). The twenty-first century Colorado River hot drought and implications for the future. Water Resources Research, 53(3), 2404–2418. https://doi.org/10.1002/2016WR019638

United States Department of the Interior. (2001). Colorado River Interim Surplus Criteria, Final Environmental Impact Statement Volume I. Boulder City, Nevada: Bureau of Reclamation.

United States Department of the Interior. (2007). Record of Decision: Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead. Bureau of Reclamation.

Van der Zaag, P., Seyam, I. M., & Savenije, H. H. (2002). Towards measurable criteria for the equitable sharing of international water resources. Water Policy, 4(1), 19–32.

Vano, J. A., Udall, B., Cayan, D. R., Overpeck, J. T., Brekke, L. D., Das, T., … Lettenmaier, D. P. (2013). Understanding Uncertainties in Future Colorado River Streamflow. Bulletin of the American Meteorological Society, 130625085810007. https://doi.org/10.1175/BAMS-D-12-00228.1

Verner, R. E. (2003). Short Term Solutions, Interim Surplus Guidelines, and the Future of the Colorado River Delta. Colo. J. Int'l Envtl. L. & Pol'y, 14(241), 33.

Videira, N., Antunes, P., Santos, R., & Lobo, G. (2006). Public and stakeholder participation in European water policy: a critical review of project evaluation processes. European Environment, 16(1), 19–31. https://doi.org/10.1002/eet.401

Videira, N., Kallis, G., & Antunes, P. (Eds.). (2006). Integrated Evaluation for Sustainable River Basin Governance. London: IWA Publishing.

Wagner, W., Gawel, J., Furumai, H., De Souza, M. P., Teixeira, D., Rios, L., … Hemond, H. F. (2002). Sustainable Watershed Management: An International Multi-watershed Case Study. Ambio, 31(1), 2–13.

Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M., … Pritchard, R. (2002). Resilience management in social-ecological systems: a working hypothesis for a participatory approach. Conservation Ecology, 6(1).

Ward, S. (2015). The Magical Concept of Transparency. In Ethics for Digital Journalists. Routledge. Retrieved from https://books.google.com/books/about/Ethics_for_Digital_Journalists.html?id=QJxeBAAAQBAJ

Water Education Foundation. (2000). A Colorado River Compromise (Western Water). Sacramento, California. Retrieved from http://www.watereducation.org/river-reports/colorado-river-compromise

Water Education Foundation. (2002). Coming to Consensus: Sharing the Colorado River. Retrieved August 31, 2017, from http://www.watereducation.org/river-reports/coming-consensus-sharing-colorado-river

Water Education Foundation. (2013). An Era of New Partnerships on the Colorado River. Retrieved August 31, 2017, from http://www.watereducation.org/river-reports/era-new-partnerships-colorado-river

Weatherford, G., & Brown, F. L. (1983). New Courses for the Colorado River: Major Issues for the Next Century. Albuquerque, NM: University of New Mexico Press.

Wegerich, K. (2007). A critical review of the concept of equity to support water allocation at various scales in the Amu Darya basin. Irrigation and Drainage Systems, 21(3–4), 185–195. https://doi.org/10.1007/s10795-007-9035-1

White, G. F. (1998). Reflections on the 50-year international search for integrated water management. Water Policy, 1(1), 21–27.

Whiteley, J. M., Ingram, H. M., & Perry, R. W. (Eds.). (2008). Water, place, and equity. Cambridge, Mass: MIT Press.

Wiek, A., & Larson, K. L. (2012). Water, People, and Sustainability—A Systems Framework for Analyzing and Assessing Water Governance Regimes. Water Resources Management, 26(11), 3153–3171. https://doi.org/10.1007/s11269-012-0065-6

Wilder, M., & Ingram, H. (2016). Knowing Equity When We See It: Water Equity in Contemporary Global Contexts. In Oxford Handbook on Water Policy and Politics. Oxford University Press.

Wolf, A. (1999). Criteria for equitable allocations: the heart of international water conflict. Natural Resources Forum, 23, 3–30.

Worster, D. (1985). Rivers of Empire: Water, Aridity, and the Growth of hte American West. New York, NY: Oxford.

Wyoming State Engineer's Office. (2007, November). Colorado River Issues: An Update Presentation. Presented at the Meeting of the Green River Advisory Group, Green River, Wyoming.

Yin, R. (2003). Case Study Research Design and Methods (Third Edition). London, UK: Sage Publications.

APPENDIX A: THE STRUCTURAL DEFICIT

The structural deficit—historical context and implications for the future

In 2012 the Bureau of Reclamation, in collaboration with the seven Basin States, published the results of the Colorado River Basin Water Supply and Demand Study, also known as the "Basin Study" (Bureau of Reclamation, 2012). The goal of the Basin Study was to quantify historical, current, and projected supplies and demands. The multi-year study projected out approximately 50 years to identify and quantify any supply and demand imbalances. The study also identified specific "options" that could be implemented to reduce, if possible, any imbalances. Reclamation solicited these options from any interested stakeholder, and modeled their effects using Reclamation's technical modeling software. Modeling a variety of supply and demand scenarios, the Basin Study concluded that demands will continue to rise and supplies will stay roughly the same or be slightly reduced. Both contained some uncertainty, especially the supply scenarios, but overall the median difference between supplies and demands by 2060 was a 3.2 million acre-feet shortfall.

Irrespective of future supply and demand imbalances, however, current demands from Lake Mead (the primary "bank account" for the Lower Basin) are greater than average inflows to Lake Mead (outflows from Lake Powell). In an average year, Lake Powell releases 8.23 million acre-feet to satisfy the Upper Basin's obligation not to deplete the flows at Lee Ferry below 75 million acre-feet over any ten-year period, as well as the Upper Basin's half of the 1.5 million acre-feet delivery obligation to Mexico, per the Colorado River Compact of 1922 and Mexican Water Treaty of 1944. Downstream of Lee Ferry, approximately 750,000 additional acre-feet enters the main stem from tributaries in or around the Grand Canyon. Therefore, in average years, approximately 9 million acre-feet flows into Lake Mead. From Lake Mead, there are

numerous releases to satisfy demands of the Lower Basin States, Mexico, and downstream regulation and gains/losses. These outflows total 9.6 million acre-feet. Additionally, approximately 600,000 acre-feet is lost to evaporation at Lake Mead in an average year. Given these average inflows and outflows, in most years Lake Mead loses 1.2 million acre-feet more than is replaced. This 1.2-million-acre-foot imbalance is known as the Lower Basin structural deficit.

The structural deficit, in combination with projections that increase the supply and demand imbalance, has created a situation where more water is allocated than is physically available in most years and this situation will get worse in the coming decades. What this has translated to is a relatively steady decline in Lake Mead elevation levels for the past 15 years. While the structural deficit is a relative non-issue in big snowpack years (e.g., 2011) because there are additional releases above 8.23 million acre-feet from Lake Powell, Lake Mead nonetheless continues to decline: it has been drawn down from about 91% full in 2000 to approximately 40% full in the spring of 2017.

Despite the structural nature of this supply and demand imbalance, until recently the term "structural deficit" was a politically sensitive term and was not often discussed openly—similar to climate change. Accordingly, there have been no explicit attempts to fix the problem. More recently, however, water managers and stakeholders are willing to openly discuss both the structural deficit and climate change. The people negotiating Colorado River Basin decisions and policies know that the long-term situation needs restructuring. As one person interviewed for this project put it, "They all know their current uses are not sustainable."

Because the structural deficit is the result of management of the river and not a hydrological phenomenon, the logical question is how the situation came to be.

Specifically, how did the river become over-apportioned leading to outflows greater than inflows to the system's main reservoir storage? Many have suggested the fatal flaw in Colorado River Basin management dates back to the creation of the original Colorado River Compact of 1922. The average flow of the River around the time the Basin States representatives were negotiating how best to allocate its waters was substantially higher than what became the contemporary average flow. It is assumed that because of this, the representatives simply thought there was more water available in the River than would turn out to be the case. According to the minutes of the Compact negotiations, however, it seems that the representatives did recognize that the flow of the Colorado River would not always be as high as it was during that time period. Despite this, the representatives assumed there would always be sufficient water available to the Basin States, especially because they knew large storage projects would eventually be built throughout the Basin.

Shortly after the Compact was signed in 1922, Secretary of Commerce Herbert Hoover—who was the federal representative for the negotiations and a signatory to the Compact—testified about the Compact before the House Committee on Irrigation and Reclamation. His testimony is quite illuminating about the negotiators' intent with the Compact and their confidence in its allocations. At the time of his testimony in 1926, Arizona had not yet agreed to the Compact citing concerns over Arizona's potential allocation. Discussing these concerns, Hoover describes:

> "I feel that this opposition so far as water rights are concerned arise out of a miscalculation as to the resources of the Colorado River. Certainly for all practical development that could be undertaken within the next 75 years there is more water than can be used by the whole of the 7 states. The Colorado River compact allots approximately 60 per cent of the water. 40 per cent of it as provided in the compact can be reallocated at the end of 40 years. There is ample provision therefore for readjustment in the respective rights of the different states based upon the merits at that time" (Hoover, 1926, p. 5).

Clearly the negotiators thought there was plenty of water for the foreseeable future, and that should states want to develop additional water they could do so after 40 years of the Compact being in place. More interesting, however, is that Hoover goes on to discuss how in general they did not have the audacity to think they could actually allocate the Colorado River indefinitely and for future generations:

> "It seems to me almost fantastical to be fighting the shadows of what may happen under these circumstances 75 years hence. Suppose we had endeavored in 1850 to determine and settle for today what would have been the best solution of any of a hundred problems. For instance, Faraday's great discovery in electrical induction, from which the whole electrical development of the world has sprung – who could have foreseen its effect on the best solution.
>
> I am one of those who have a great deal of confidence that all anticipations over physical questions inevitably bend themselves to the forces of the life *and that if we can provide for equity for the next 40 to 75 years we can trust to the generation after the next to be as intelligent as we are today. They will settle it in the light of the forces of their day"* (emphasis added) (p. 6).

This suggests, at least from Hoover's perspective, that the negotiators of the Compact did not intend to make the original allocations of the Compact static. In fact, though the Compact was put in place indefinitely, the negotiators included a clause for modification of the Compact. Article VI of the Compact allows for States to modify or adjust the Compact if all States agree and are given approval by each State's legislature. Further, Article X of the Compact allows for the termination of the Compact at any time, given unanimous agreement by the Basin States.

In addition to this understanding of the original intent of the Compact, in the decades following its conception a recognition emerged regarding the specifics of how the Colorado River might be over-allocated. Engineering studies began to determine that if many of the projects that Reclamation and the States had started to propose were finally built, the system would not be able to sustain all those demands. For example, Reclamation released a report in 1946 about development potential throughout the

Basin (Bureau of Reclamation, 1946). Using historical records and gauge station data from 1897-1943, Reclamation estimated that the annual average virgin flow of the Colorado River at the International Boundary was 17,720,000 acre-feet. Further, Reclamation estimated that if existing, authorized, or potential projects identified were fully developed, present and potential stream depletions could be as large as 20,197,200 acre-feet annually. It is important to note that Reclamation's long-term estimate of flow at the International Boundary (17,720,000 acre-feet) is well above the 1922 Compact apportionments and subsequent 1944 Treaty with Mexico apportionment. Indeed, as Secretary Hoover noted in his testimony above, they believed there was plenty of water available for the foreseeable future. It is equally important to note that many of the potential projects identified by Reclamation have not come to fruition and will most likely never be built (e.g., Marble Canyon Dam in northern Arizona). In other words, this specific study included more projects than are currently built (or proposed), but the 1946 Reclamation Report is important because it was the beginning of the recognition that the Colorado River Basin had long-term limits on what could reasonably be developed.

Similarly, and also in 1946, a prominent water attorney for California, Northcutt Ely, wrote a report for the Colorado River Water Users' Association (CRWUA) about the recent ratification negotiations for the 1944 Treaty with Mexico (Ely, 1946). In this report, Ely presents a Lower Basin water budget based on the Compact allocations at that point in time. Ely's budget demonstrated that if California were to receive its full allocation of 5,400,000, then there would only be 1,000,000 acre-feet for Arizona (as opposed to its 2,800,000 acre-foot Compact apportionment). Conversely if Arizona were to receive it's full 2,800,000 acre-foot allocation, then California would only be able to use 3,600,000 acre-feet (as opposed to its full 5,400,000 acre-foot Compact

apportionment). It is important to note that this budget is based upon California using 5,400,000 acre-feet as opposed to its original allocation (and what they are currently limited to today) of 4,400,000 acre-feet. Despite this difference in California's use, some basic accounting revealed what could happen, and indeed what is happening today, with the structural deficit. As noted by Ely in his conclusion, "No sound planning can be done for new projects until the water budget is balanced again in some way" (p. 20).

In the following decades, it became more clear that Reclamation may have over-estimated Colorado River flows and that the basic apportionments in the 1922 Compact may not be fully achievable. In 1955, a report by private consultants for the Colorado Water Conservation Board used updated streamflow records to determine the viability of the Upper Basin's apportionment. The report concludes, "All of the 7,500,000 acre-feet of water per annum apportioned to the Upper Basin by the Colorado River compact may not actually be available for use because of the requirement that 75 million acre-feet be delivered at Lee Ferry during each consecutive 10-year period" (Colorado Water Conservation Board, 1955, p. 29). Specifically, the study found that the Upper Basin's total depletions could be no more than 6,200,000 acre-feet annually if they were to comply with the 1922 Compact. It has been suggested this was the first official documentation that even the original Compact may have over-apportioned the River and the Upper Basin might not be able to use its full apportionment (McClurg, 1997, p. 38).

A decade later, the Upper Colorado River Commission contracted an engineering firm to again examine the reliability of the Upper Basin's basic apportionment. The 1965 report determined that the long-term average that the Upper Basin could expect to be available was closer to 5,800,000 acre-feet annually (Tipton & Kalmbach, 1965). Wayne Aspinall, a prominent lawyer and politician from Colorado,

later expressed concern about this already occurring short-fall of the Upper Basin's apportionment during congressional testimony in 1968 regarding additional Colorado River Basin development. Citing these previous engineering studies, Aspinall explains, "Thus, due to the vagaries of nature, the Upper Basin States are already suffering curtailment in their total water resource development to an amount 20% under that apportioned to them by the Colorado River Compact. The risks involved in further curtailment of the Upper Basin's social economic development as the result of further curtailment of their water uses are real, not imaginary" (Colorado River Basin Project-Part II, 1968, pp. 753–754). Aspinall was concerned that additional development of the River in the Lower Basin would exacerbate an already problematic situation for the Upper Basin.

Specifically, Aspinall's concern regarded the proposed Colorado River Basin Project Act. This Act would authorize a number of projects throughout the Basin, most notably the Central Arizona Project (CAP) which would bring a large share of Arizona's Colorado River apportionment to Central Arizona for agricultural and municipal use. As such, there was significant debate about water supply availability for the CAP. Many of the large projects had been built by this time (e.g., Hoover Dam, Glen Canyon Dam)—and in light of the engineering studies discussed above—leading some decision-makers to express uncertainty as to just how much water might be available for long-term use by the CAP.

At the heart of this uncertainty was how much water the CAP could come to rely on in the long-term as both the Lower and Upper Basin moved towards utilizing their full allocations. The Bureau of Reclamation examined this question, and presented some of their findings to Congress in 1965. Reclamation's Commissioner at the time, Floyd Dominy, argued that the CAP should have a reliable supply for the first decade or so,

but, as additional developments occurred throughout the Basin, the CAP's supply would gradually decrease. Specifically, he thought that through 1990 the CAP could reliably divert 1,200,000 acre-feet annually. By the year 2000 this would decrease to approximately 900,000 acre-feet, and finally by the year 2030 this would be down to approximately 580,000 acre-feet. The cause for this decline, Dominy suggested, was increasing depletions in the Upper Basin (Subcommitte on Irrigation and Reclamation, 1965). This suggestion that the available supply for the CAP would decline over the coming decades is quite revealing, given that Dominy was a prominent supporter of many of the existing or proposed projects, including the CAP.

Given this acknowledgement of over-allocation and recognition that the CAP would eventually have to reduce its use, how could Dominy and others still support the Colorado River Basin Project Act? Indeed, the Act was ultimately signed into law in 1968, authorizing the CAP and a number of other development projects. The justification for the Act revolved around a key concept of river basin development that was often discussed in that time period: augmentation. Reclamation, the States, and others knew the only long-term solution to balance the Colorado River budget—especially once projects such as the CAP came online—was to augment the supply of water from other river basins in the United States. Only once new water was brought into the Colorado River Basin could each of the States have a long-term, reliable supply.

Not only did the Act include explicit augmentation language, but much of the discussion during Congressional hearings before the Act passed revolved around augmentation. During the same Congressional testimony where Dominy had discussed a declining availability of water for the CAP, many of the Act's proponents and Congressmen had many discussions about augmentation. For example, Congressman Harold Johnson from California was questioning Secretary Udall and Dominy about

some of the proposed projects. Congressman Johnson wanted to know more about the specifics of augmentation, and whether it would have an impact on California's Colorado River apportionment:

> "Mr. Johnson: In your statement you recognize the fact that you can reclaim a considerable amount of water in the Colorado River Basin at the present time, taking it away from the phreatophytes and other means of diverting water from the river, with lined canals and works of that nature which would recover, I believe you said, something like 650,000 acre-feet of water. Then as we move out into the other areas we have the desalinization program being carried on and other developments in northern California.
>
> I want to say we are now going to be diverting into southern California approximately 2 million acre-feet of water in the near future, and the north coastal area has water not being put to beneficial use at the present time. It is not my understanding that this legislation calls for any of that water to be taken from the 4.4 million acre-feet of water. This legislation would guarantee California 4.4 million acre-feet of water from the Colorado as its proper share.
>
> The legislation does not entail, if we were to bring in a source of saline water for an additional source of water to northern California, that this would have anything to do with the reduction of the amount of water from the Colorado into 4.4 million acre-feet. Is that correct?
>
> Secretary Udall: The gentleman is correct in that assumption.
>
> Mr. Johnson: As we look to the Pacific Northwest and other areas of the United States for water to bring into the Colorado River watershed this would build up the additional 2.5 million acre-feet which you figure is absolutely necessary, and those studies are provided in the legislation.
>
> Secretary Udall: That is correct" (Subcommitte on Irrigation and Reclamation, 1965, p. 131).

A few years later during additional Congressional testimony in 1968, it is evident again that the idea of augmentation is neither controversial nor far-fetched. Congressman Mo Udall from Arizona pressed Dominy on whether or not the CAP had a favorable benefit-cost ratio. To clarify the argument, Udall posited a hypothetical where both the Upper and Lower Basins utilized their full compact allocations, and

questioned whether the CAP would have to reduce its Colorado River use in that scenario. Udall included in this hypothetical an assumption that is particularly revealing: "Let's assume there is no augmentation in the river—not a drop. I think this is a very violent assumption, *because I am as sure as anything in this life that there will be augmentation*" (Colorado River Basin Project- Part II, 1968, p. 837; emphasis added). Clearly Udall thought that augmentation at some point in the future was a given, and water managers could count on supplemental supplies as demands continued to increase.

A book published in 1977 by author Rich Johnson detailing the history of the CAP from 1918-1968 further reveals this focus on augmentation. In the book, Johnson recounts discussion about a previous legislative attempt to authorize the CAP. In 1966, the House was considering H.R. 4671, which would have authorized the CAP and several other Lower Basin projects (this was the predecessor to the Colorado River Basin Project Act). Johnson notes:

> "Secretary Udall and Commissioner of Reclamation Floyd Dominy appeared in support of H.R. 4671. *Both agreed that augmentation of the Colorado River water supply would be necessary if all long-term needs of the Basin were to be met*, and Secretary Udall indicated that such augmentation could be achieved by desalting sea water or by importing fresh water from northern California or from the Columbia River below Bonneville Dam" (Johnson, 1977, p. 186; emphasis added)

As mentioned above, the Colorado River Basin Project Act actually contained specific language about the need for augmentation. In Title II, Section 202 of the final version, there is a revealing paragraph about obligations under the Mexican Water Treaty of 1944 and augmentation:

> "Accordingly, the States of the Upper Division (Colorado, New Mexico, Utah, and Wyoming) and the States of the Lower Division (Arizona, California, and Nevada) shall be relieved from all obligations which may have been imposed

upon them by article III(c)[29] of the Colorado River Compact *so long as the Secretary shall determine and proclaim that means are available and in operation which augment the water supply of the Colorado River system in such quantity as to satisfy the requirements of the Mexican Water Treaty* together with any losses of water associated with the performance of that treaty;

Provided, That the satisfaction of the requirements of the Mexican Water Treaty (Treaty Series 994, 50 Stat. 1219), shall be from the water of the Colorado River pursuant to the treaties, laws, and compacts presently relating thereto, *until such time as a feasible plan showing the economical means of augmenting the water supply available in the Colorado River below Lee Ferry by two and one-half million acre-feet* shall be authorized by the Congress and is in operation as provided in this Act" (emphasis added).

The recognition of the need for augmentation was so prevalent among those crafting the legislation that it concerned Senators in the Pacific Northwest, as much of the discussion was about utilizing the waters of the Columbia River for Colorado River Basin augmentation. These Senators were concerned about potential harm to the Columbia River Basin if significant quantities of water were to be transferred out of that Basin and into the Colorado River Basin. The concern was so strong that in order to get those Senators' support for the Act, the bill's proponents had to include language that would not only halt proposals for augmentation from any river basin in the United States, but would also halt any *studying* of augmentation for a ten-year period. Title II, Section 201 states:

"For a period of ten years from the date of this Act, the Secretary *shall not undertake reconnaissance studies of any plan for the importation of water into the Colorado River Basin from any other natural river drainage basin* lying outside the States of Arizona, California, Colorado, New Mexico, and those portions of Nevada, Utah, and Wyoming which are in the natural drainage basin of the Colorado River" (emphasis added).

[29] Article III (c) of the Colorado River Compact specified how future Mexico allocations would be supplied.

The tension between policy-makers in the southwest and the Pacific northwest is illuminated by a conversation remembered by Colorado River Scholar Brad Udall. During a 2005 talk to the Colorado River Project Symposium in Santa Fe, New Mexico, Brad recalled a conversation between Senator Henry "Scoop" Jackson of Washington and Brad's father, Representative Mo Udall of Arizona, regarding importation of water into the Colorado River Basin. After the language regarding the outlawing of studying importation for ten years was added to the bill, Brad Udall recalled this conversation regarding importation: "my father asked Scoop one time if he could dream about it, if he could even just dream about it, and Scoop said, 'Mo, you're not allowed to dream about it, you're not to think about it. The only thing you're allowed to do is forget about it'" (McClurg, 2005, p. 109). Despite this tension, the Act was ultimately passed and signed into law, in part because of the ten-year moratorium on augmentation reconnaissance.

In sum, it appears the source of the structural deficit is not just because the Colorado River Compact of 1922 was negotiated during a particularly "wet" period. But rather, the intentions of the negotiators were such that future generations could reallocate the Colorado River, as Secretary Hoover put it, "in the light of the forces of their day". Further, many of the negotiators and decision-makers assumed that long-term reliability on the system required augmentation from outside the hydrologic basin. Specifically, they knew that completion of the proposed projects would over-allocate the system, but by the time that over-allocation would physically occur the federal government would have built sufficient augmentation projects to supplement the water of the Colorado River. For a variety of reasons, those augmentation projects have not been built and most likely will never be built. Thus, the structural deficit exists today

and decision-makers are struggling with the consequences. Or, as the interviewee quoted at the beginning noted, "They all know their current uses are not sustainable."

References:

Bureau of Reclamation. (1946). *The Colorado River: A Natural Menace Becomes a National Resource*. United States Department of the Interior.

Bureau of Reclamation. (2012). *Colorado River Basin Water Supply and Demand Study: Executive Summary*. United States Department of the Interior. Retrieved from https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Executive%20Summary/CRBS_Executive_Summary_FINAL.pdf

Colorado River Basin Project- Part II, § Committee on Interior and Insular Affairs (1968). United States Government Printing Office.

Colorado Water Conservation Board. (1955). *Report on Depletion of Surface Water Supplies of Colorado West of Continental Divide*. Washington, D.C.: Colorado Water Conservation Board.

Ely, N. (1946). *Light on the Mexican Water Treaty from the Ratification Proceedings in Mexico* (A Report to the Colorado River Water Users' Association). Washington, D.C.

Hoover, H. Abstract of Secretary Hoover's Statement on the Colorado River, § House Committee on Irrigation and Reclamation (1926).

Johnson, R. (1977). *The Central Arizona Project 1918-1968* (1st edition). Tucson: University of Arizona Press.

McClurg, S. (1997). *Colorado River Project Symposium Proceedings* (75th Anniversary Colorado River Compact Symposium). Sacramento, California: Water Education Foundation.

McClurg, S. (2005). *Colorado River Project Symposium Proceedings* (Sharing the Risks: Shortage, Surplus, and Beyond). Sacramento, California: Water Education Foundation.

Subcommitte on Irrigation and Reclamation. H.R. 4671 and similar bills, § Committee on Interior and Insular Affairs (1965). Washington, D.C.: United States Government Printing Office.

Tipton, & Kalmbach. (1965). *Water Supplies of the Colorado River*. Denver, Colorado: Upper Colorado River Commission.

APPENDIX B: SUSTAINABILITY AND EQUITY CRITERIA AND ASSOCIATED LITERATURE

Criteria	Literature
Accountability	Blackstock et al. (2012), Garrick et al. (2011), Hooper (2003; 2010), Pereira and Quintana (2009), Savenije and van der Zaag (2000), Serageldin (1995), Swyngedouw et al. (2002)
Adaptability	Blackstock et al. (2012), Falkenmark (1997), Hooper (2010), Juwana et al. (2012), Kranz et al. (2004), Loucks (2000), Pahl-Wostl (2002; 2009; 2010; 2012), Parkes et al. (2010), Pereira and Quintana (2009), Richter et al. (2003), Sandoval-Solis et al. (2011), Scheider et al. (2014), Wiek and Larson (2012)
Capacity building	Blackstock et al. (2012), Clark (2002), Garrick et al. (2011), Hedelin (2007), Hooper (2003; 2010), Ioris et al. (2008), Jonch-Clausen and Fugl (2001), Kang and Lee (2011), Kranz et al. (2004), Loucks (2000), Pahl-Wostl (2010), Renner et al. (2013)
Clarity	Blackstock et al. (2012), Hooper (2010), Ioris et al. (2008), Jonch-Clausen and Fugl (2001), Kranz et al. (2004), Pereira and Quintana (2009), Reeve (2003), Renner et al. (2013), Richter et al. (2003), Sandoval-Solis et al. (2011)
Coordination	Hooper (2010), Pahl-Wostl (2008; 2009; 2012), Savenije and van der Zaag (2000), Serageldin (1995), Tabara and Ilhan (2008), Wiek and Larson (2012)
Credibility	Hooper (2003), Loucks (2000), Orlove and Caton (2010), Pahl-Wostl (2009; 2012), Pereira and Quintana (2009), Renner et al. (2013), Savenije and van der Zaag (2000)
Decision support	Clark (2002)
Demand	Falkenmark (1997), Hooper (2003; 2010), Ioris et al. (2008), Kampragou et al. (2007), Kang and Lee (2011), Parkes et al. (2010), Reeve (2003), Savenije and van der Zaag (2000), Schneider et al. (2014), van der Zaag et al. (2002), Wiek and Larson (2012), Wolf (1999)
Ecological	Blackstock et al. (2012), Clark (2002), Falkenmark (1997), Gleick (1998), Hooper (2003), Ioris et al. (2008), Jonch-Clausen and Fugl (2001), Kampragou et al. (2007), Kang and Lee (2011), Kranz et al. (2004), Loucks (2000), Orlove and Caton (2010), Pahl-Wostl (2012), Parkes et al. (2010), Richter et al. (2003), Sandoval-Solis et al. (2011), Schneider et al. (2014), van der Zaag (2002), Wiek and Larson (2012), Wilder and Ingram (2016)
Economic	Falkenmark (1997), Hooper (2003; 2010), Ioris et al. (2008), Jaspers (2003), Jonch-Clausen and Fugl (2001), Kampragou et al. (2007), Kang and Lee (2011), Kranz et al. (2004), Loucks (2000), Orlove and Caton (2010), Pahl-Wostl (2012), Parkes et al. (2010), Savenije and van der Zaag (2000), Schneider et al. (2014), Serageldin (1995), Swyngedouw et al. (2002), Wagner et al. (2002), Wiek and Larson (2012)
Efficiency	Blackstock et al. (2012), Clark (2002), Falkenmark (1997), Garrick et al. (2011), Hooper (2010), Ioris et al. (2008), Jonch-Clausen and Fugl (2001), Pereira and Quintana (2009), Reeve (2003), Serageldin (1995), Wiek and Larson (2012)
Evaluation and monitoring	Antunes et al. (2009), Blackstock et al. (2012), Clark (2002), Gleick (1998), Hooper (2003; 2010), Ioris et al. (2008), Jonch-Clausen and Fugl (2001), Juwana et al. (2012), Kranz et al. (2004), Loucks (2000), Pahl-Wostl (2008; 2009; 2010), Pereira and Quintana (2009), Reeve (2003), Richter et al. (2003), Savenije and van der Zaag (2000), Videira et al. (2006), Wiek and Larson (2012)

Fairness	Blackstock et al. (2012), Gleick (1998), Hedelin (2007), Hooper (2003; 2010), Ioris et al. (2008), Jonch-Clausen and Fugl (2001), Juwana et al. (2012), Kang and Lee (2011), Loucks (2000), Orlove and Caton (2010), Pahl-Wostl (2012), Parkes et al. (2010), Reeve (2003), Renner et al. (2013), Savenije and van der Zaag (2000), Schneider et al. (2014), Serageldin (1995), van der Zaag et al. (2002), Wiek and Larson (2012), Wilder and Ingram (2016)
Feasibility	Blackstock et al. (2012), Hooper (2003), Ioris et al. (2008), Reeve (2003)
Flexibility	Blackstock et al. (2012), Garrick et al. (2011), Gleick (1998), Hooper (2003; 2010), Loucks (2000), Pahl-Wostl (2002; 2012), Renner et al. (2013), Sandoval-Solis et al. (2011), Schneider et al. (2014), Wiek and Larson (2012)
Geographic	Hooper (2003), Ioris et al. (2008), Jaspers (2003), Juwana et al. (2012), Kampragou et al. (2007), Loucks (2000), Pahl-Wostl (2008; 2012), Parkes et al. (2010), Rinaudo and Garin (2005), Savenije and van der Zaag (2000), Serageldin (1995), Tabara and Ilhan (2008), van der Zaag (2002), Wiek and Larson (2012), Wolf (1999)
Governance	Antunes et al. (2009), Falkenmark (1997), Garrick et al. (2011), Gleick (1998), Hedelin (2007), Hooper (2003; 2010), Hughes and McKay (2009), Ioris et al. (2008), Jaspers (2003), Jonch-Clausen and Fugl (2001), Orlove and Caton (2010), Pahl-Wostl (2002; 2009; 2010; 2012), Parkes et al. (2010), Pereira and Quintana (2009), Reeve (2003), Richter et al. (2003), Savenije and van der Zaag (2000), Serageldin (1995), Swyngedouw et al. (2002), Videira et al. (2006), Wagner (2002), Wiek and Larson (2012)
Information	Antunes et al. (2009), Blackstock et al. (2012), Giupponi et al. (2006), Gleick (1998), Hedelin (2007), Hooper (2003; 2010), Hughes and McKay (2009), Jonch-Clausen and Fugl (2001), Juwana et al. (2012), Loucks (2000), Mostert (2006), Orlove and Caton (2010), Pahl-Wostl (2008; 2009; 2010; 2012), Parkes et al. (2010), Pereira and Quintana (2009), Richter et al. (2003), Rinaudo and Garin (2005), Savenije and van der Zaag (2000), Serageldin (1995), Tabara and Ilhan (2008), Videira et al. (2006), Wiek and Larson (2012), Wilder and Ingram (2016), Wolf (1999)
Infrastructure	Falkenmark (1997), Loucks (2000), Parkes et al. (2010)
Integration	Blackstock et al. (2012), Hedelin (2007), Hooper (2003; 2010), Ioris et al. (2008), Jaspers (2003), Jonch-Clausen and Fugl (2001), Juwana et al. (2012), Loucks (2000), Orlove and Caton (2010), Pahl-Wostl (2009, 2012), Parkes et al. (2010), Pereira and Quintana (2009), Rinaudo and Garin (2005), Savenije and van der Zaag (2000), Serageldin (1995), Wagner et al. (2002), Wiek and Larson (2012)
Iterativity	Blackstock et al. (2012), Clark (2002), Gleick (1998), Loucks (2000), Pahl-Wostl (2008), Richter et al. (2003)
Leadership	Blackstock et al. (2012), Hooper (2003), Hughes and McKay (2009), Mostert (2006)
Learning	Antunes et al. (2009), Blackstock et al. (2012), Hedelin (2007), Kranz et al. (2004), Mostert (2006), Pahl-Wostl (2002; 2008; 2009; 2010), Savenije and van der Zaag (2000)
Legitimacy	Blackstock et al. (2012), Gleick (1998), Hedelin (2007), Hooper (2003), Ioris et al. (2008), Loucks (2000), Pahl-Wostl (2009; 2012), Parkes et al. (2010), Pereira and Quintana (2009), Reeve (2003), Renner et al. (2013), Swyngedouw et al. (2002)

Outreach	Renner et al. (2013), Rinaudo and Garin (2005), Sandoval-Solis et al. (2011)
Participation	Antunes et al. (2009), Blackstock et al. (2012), Clark (2002), Garrick et al. (2011), Giupponi et al. (2006), Gleick (1998), Hedelin (2007), Hooper (2003; 2010), Hughes and McKay (2009), Ioris et al. (2008), Jaspers (2003), Jonch-Clausen and Fugl (2001), Juwana et al. (2012), Loucks (2000), Mostert (2006), Orlove and Caton (2010), Pahl-Wostl (2002; 2008; 2009; 2010; 2012), Parkes et al. (2010), Pereira and Quintana (2009), Reeve (2003), Renner et al. (2013), Richter et al. (2003), Rinaudo and Garin (2005), Savenije and van der Zaag (2000), Serageldin (1995), Swyngedouw et al. (2002), Tabara and Ilhan (2008), Videira et al. (2006), Wagner et al. (2002), Wiek and Larson (2012), Wilder and Ingram (2016)
Power relations	Antunes et al. (2009), Blackstock et al. (2012), Hedelin (2007), Hooper (2003), Jaspers (2003), Jonch-Clausen and Fugl (2001), Loucks (2000), Orlove and Caton (2010), Parkes et al. (2010), Reeve (2003), Renner et al. (2013), Schneider et al. (2014), Swyngedouw et al. (2002), Tabara and Ilhan (2008), Wiek and Larson (2012), Wilder and Ingram (2016)
Problem framing	Blackstock et al. (2012), Loucks (2000), Pahl-Wostl (2009; 2010)
Quality	Falkenmark (1997), Ioris et al. (2008), Kang and Lee (2011), Parkes et al. (2010), Sandoval-Solis et al. (2011), Savenije and van der Zaag (2000), Schneider et al. (2014), Wiek and Larson (2012)
Salience	Pereira and Quintana (2009), Renner et al. (2013), Videira et al. (2006), Wiek and Larson (2012), Wolf (1999)
Scale	Garrick et al. (2011), Mostert (2006), Pahl-Wostl (2008), Serageldin (1995), Swyngedouw et al. (2002), Tabara and Ilhan (2008), Wagner et al. (2002), Wiek and Larson (2012)
Scenario planning	Pahl-Wostl (2009; 2010; 2012), Pereira and Quintana (2009), Videira et al. (2006)
Social capital	Blackstock et al. (2012), Garrick et al. (2011), Hedelin (2007), Kang and Lee (2011), Loucks (2000), Orlove and Caton (2010), Pahl-Wostl (2002; 2009), Parkes et al. (2010), Pereira and Quintana (2009), Reeve (2003), Renner et al. (2013), Wilder and Ingram (2016)
Supply	Falkenmark (1997), Gleick (1998), Hooper (2003), Ioris et al. (2008), Jonch-Clausen and Fugl (2001), Kampragou et al. (2007), Kang and Lee (2011), Orlove and Caton (2010), Pahl-Wostl (2012), Parkes et al. (2010), Reeve (2003), Sandoval-Solis et al. (2011), Savenije and van der Zaag (2000)
Temporal	Gleick (1995), Hooper (2003), Ioris et al. (2008), Juwana et al. (2012), Loucks (2000), Mostert (2006), Parkes et al. (2010), Reeve (2003), Richter et al. (2003), Rinaudo and Garin (2005), Savenije and van der Zaag (2000), Schneider et al. (2014), Serageldin (1995), van der Zaag et al. (2002), Wiek and Larson (2012)
Transparency	Blackstock et al. (2012), Hedelin (2007), Hooper 2010), Parkes et al. (2010), Pereira and Quintana (2009), Wiek and Larson (2012)
Uncertainty	Clark (2002), Hedelin (2007), Loucks (2000), Pahl-Wostl (2008; 2009; 2010; 2012), Pereira and Quintana (2009), Richter et al. (2003), Savenije and van der Zaag (2000), Schneider et al. (2014), Videira et al. (2006), Wagner et al. (2002), Wiek and Larson (2012)

APPENDIX C: DECISION-MAKING CODING PROTOCOL

Utilizing Sustainability and Equity Criteria to Evaluate River Basin Decision-Making: A Case Study of the Colorado River Basin and the Law of the River
Methodology and Codebook
August 1, 2016

METHODOLOGY

Description:
The Codebook involves the coding of decision rules as defined in the text of each decision document, including what the decision permits, requires, or forbids states (and other parties) to do in allocating and using waters from a shared river basin. The Codebook is divided into three sections:

- **Basic Decision Information:** this includes some background and basic information about the context of the decision, including when it was negotiated, who was a part of the negotiations, and what was the goal of the decision. These questions do not need to be exhaustive, but rather give some basic information to provide the context for each decision. More specific questions and answers are in the following in sections.
- **Decision-Making Criteria Information:** this includes specific questions relating to sustainability and equity criteria as identified in the literature review. Questions are grouped into eight different categories, each with a different focus of decision-making criteria. These eight categories are from Gibson et al. 2005, and include a brief description of the category. Unless otherwise noted, answers are qualitative and the coder should be as descriptive as possible. These questions were developed in 2016 and have been reviewed, checked, and refined with multiple researchers.
- **Decision-Making Rules Information:** this includes specific questions about the decisions and were developed primarily from previous interstate river compact analysis projects (e.g., Schlager and Heikkila 2009). The questions are grouped into three different categories of rule types (Ostrom 2005):
    - *Operational Rules*: specify what the decision permits, requires, or forbids individual states to do in using or allocating waters from the river basin.
    - *Collective Choice Rules*: specify what the decision permits, requires, or forbids of the decision-making body that administers the decision.
    - *Constitutional Rules:* specify the processes the decision establishes to change or terminate the decision.

Coding instructions:

- Coders will rely primarily on the original text of the decision for coding each question, identified below. If the decision has been changed or modified since its inception, coders will use the most recent version. If the decision text is unclear or vague regarding any of the questions, credible secondary sources may be used to supplement the original decision text. Coders will make a note in the spreadsheet when the answer was not directly from the decision text. Secondary sources include books, journal or law review articles, court documents, meeting

minutes, reports, and/or any other data sets that discuss or interpret the language of the decision document.

- Coders should read through the entire decision document prior to coding.
- Coders should include relevant quotations and other notes in the final column of the codebook spreadsheet ('notes').
- Questions with asterisks are repeated questions. Coders should use the '=cell' function in Excel to auto fill the answers for these questions.
- If the question is not applicable, enter '99' in the cell.

Decisions to be coded, along with primary and potential secondary sources:

2001 Colorado River Interim Surplus Guidelines

- Primary:
  - Record of Decision, DOI FEIS, January 2001
  - http://www.usbr.gov/lc/region/g4000/surplus/surplus_rod_final.pdf
- Secondary:
  - Final Environmental Impact Statement, DOI, December 2000
  - 1997, 1999, 2002, 2003 Colorado River Project Symposium Proceedings
  - Law review articles (e.g., Glennon and Culp 2002)
  - Articles (e.g, Fulp and Harkins 2001)

2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead

- Primary:
  - Record of Decision, DOI, December 2007
  - http://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf
- Secondary
  - Final Environmental Impact Statement, DOI, November 2007
  - 2003, 2005, 2007, 2009, 2011 Colorado River Project Symposium Proceedings
  - Law review articles (e.g., Mulroy 2007)
  - Reports (e.g., Kuhn 2007)

2012 Minute 319 to the 1944 Treaty With Mexico

- Primary
  - Minute NO. 319, IBWC, November 2012
  - http://ibwc.state.gov/Files/Minutes/Minute_319.pdf
- Secondary
  - 2009, 2011, 2013 Colorado River Project Symposium Proceedings
  - Articles (e.g., Buono and Eckstein 2014)
  - Law review articles (e.g., Stanger 2013)

Basic Decision Information		
Q1.	What is the name of the decision?	
Q2.	What prompted the decision?	
********Q3.	In what year/years was the decision negotiated?	
Q4.	In what forum was the decision negotiated?	
Q5.	Were there representatives from each state (of each country)?	
	Q5a.	Were there any other agencies or groups being represented (e.g., municipalities, NGOs, irrigation districts)?
Q6.	Was the federal government (of each country) a party to the decision? Include all federal agencies involved.	
Q7.	What was the stated aim or goal(s) of the decision?	

Decision-Making Criteria Information		
Socio-ecological system integrity *"Build human-ecological relations that establish and maintain the long-term integrity of socio-biophysical systems and protect the irreplaceable life support functions upon which human as well as ecological well-being depends" (Gibson et al. 2005, p. 95).*		
Q8.	Are ecological systems specifically mentioned in the decision?	
	Q8a.	If so, what is the context?
Q9.	Does the decision specifically mention the human-ecological relationship?	
	Q9a.	How does it define this relationship?
	Q9b.	Are there priorities in this relationship?
	Q9c.	Is this relationship integrated throughout the decision?
Q10.	Does the decision mention ecosystem services (explicitly or implicitly)?	
Q11.	Does the decision mandate who is responsible for maintaining ecological functions?	
	Q11a.	Are there specific ecological criteria (e.g., instream flows) that must be met?
	Q11b.	Are there consequences for not maintaining ecological functions?
	Q11c.	Does anything within the decision change based upon changes in ecological function?
Q12.	Does the decision mandate monitoring of ecological systems?	
	Q12a.	If so, who is responsible for monitoring?
	Q12b.	Are there specific indicators used to trigger management actions?
Q13.	Is existing information or science on ecological health incorporated into the decision?	
	Q13a.	Who is responsible for producing or providing this information?
	Q13b.	Does the decision explicitly define how new information in the future should be handled?
*Q14.	Does the decision specifically discuss water quality?	
	*Q14a.	If so, are there baseline conditions that must be met (e.g., TDS, salinity)?
	*Q14b.	Who is responsible for maintaining water quality?
	*Q14c.	Are there specific penalties for violating water quality standards?
Livelihood sufficiency and opportunity		

"Ensure that everyone and every community has enough for a decent life and opportunities to seek improvements in ways that do not compromise future generations' possibilities for sufficiency and opportunity" (Gibson et al. 2005, p. 98)			
Q15.	What are the primary purposes for the water being allocated in the decision? Select all that apply		
	1	Agriculture/irrigation	
	2	M&I	
	3	Hydropower	
	4	Storage (i.e., can include other purposes, but decision also specifically includes storage allocations)	
	5	Recreation	
	6	Environment	
	7	Others? (Write in)	
**********Q16.	Does the decision define objective priorities (e.g., economic growth, environmental health, recreational economies, food security)?		
	Q16b.	Are any of these priorities quantified?	
Q17.	Does the decision define priorities for human water use and consumption?		
	Q17a.	Does this include Native Americans?	
	Q17b.	Does this include any other marginalized or disadvantaged groups?	
	Q17c.	Does this include non-consumptive needs (e.g., recreational, spiritual, environmental)?	
	Q17d.	Are these priorities permanent?	
		Q17e.	If not, who can change these priorities?
	Q17f.	Does this include specific water quality standards?	
Q18.	Does the decision provide a time period for the allocation(s)?		
Q19.	Does the decision mention the economic impact of allocation(s) (e.g., economic growth)?		
Q20.	Does the decision discuss the economic consequences for not implementing the decision?		
	Q20a.	Are there economic consequences for a future failure of the decision or allocation?	
Q21.	Are any citizens, groups of people, etc. impacted by outcomes of this decision (e.g., loss of water, relocation due to new infrastructure)?		
Intragenerational equity *"Ensure that sufficiency and effective choices for all are pursued in ways that reduce dangerous gaps in sufficiency and opportunity (and health, security, social recognition, political influence, etc.) between the rich and the poor" (Gibson et al. 2005, p. 101)*			

Q22.	Does the decision define who was involved in the decision-making process?	
Q23.	Does the decision define who was not involved in the decision-making process?	
	Q23a.	If so, is there recourse for those not involved?
	Q23b.	Are there limits to the recourse?
	Q23c.	Are there allocations decided upon for those not involved?
**Q24.	Are the decision and/or any allocations permanent?	
	**Q24a.	If not, how can the decision be modified and who can do so?
Q25.	Are quantified allocations made in the decision (e.g., AF, cfs)?	
Q26.	Are proportional allocations made in the decision (e.g., %'s)?	
Q27.	Were all negotiations of the decision public?	
	Q27a.	If not, who was involved in private negotiations?
Q28.	Are all allocations or decisions publicly available?	
Q29.	Does the decision allocate funding?	
	Q29a.	If so, who is providing this funding?
	Q29b.	Are there conditions for the funding?
	Q29c.	Are there specific requirements for the funding?
	Q29d.	Is the funding long-term?
	Q29e.	Are there mechanisms for tracking how the funding is used?
Intergenerational equity *"Favour present options and actions that are most likely to preserve or enhance the opportunities and capabilities of future generations to live sustainably" (Gibson et al. 2005, p. 103).*		
Q30.	Are future generations explicitly mentioned in the decision?	
Q31.	Can future generations modify, alter, or eliminate the decision?	
**Q32.	Are the decision and/or any allocations permanent?	
	**Q32a.	If not, how can the decision be modified and who can do so?
***Q33.	Does the decision require new infrastructure to satisfy allocations?	
	***Q33a.	Does the decision require modifications to existing infrastructure to satisfy allocations?
****Q34.	Does the decision consider differing future scenarios? Select all that apply	
	1	Hydrological
	2	Climate
	3	Social
	4	Environmental

	5	Political
	6	Others? (Write in)
	****Q34a.	What were the sources of these projections?
Q35.	Does the decision acknowledge uncertainty in information used in the decision-making process?	
Q36.	Does the decision specifically mention flexibility in its implementation?	
	Q36a.	Does the decision specifically mention flexibility in its allocations?
Q37.	Can new information modify the decision?	
*****Q38.	Does the decision include monitoring and evaluation of the outcomes?	
	*****Q38a.	If so, does the decision define who is responsible for the monitoring and evaluation?
	*****Q38b.	If so, does the decision explicitly define how the results of the monitoring and evaluation impact the decision or may alter the original decision?
Resource maintenance and efficiency *"Provide a larger base for ensuring sustainable livelihoods for all while reducing threats to the long-term integrity of social-ecological systems by reducing extractive damage, avoiding waste and cutting overall material and energy use per unit of benefit" (Gibson et al. 2005, p. 105).*		
Q39.	Does the decision discuss the efficient transfer or use of water?	
	Q39a.	If so, are specific efficiency standards used?
Q40.	Does the decision discuss the value of water being allocated?	
Q41.	Are allocations transferrable?	
	Q41a.	If so, what are the conditions and/or limits?
	Q41b.	If so, who can transfer their allocations?
*****Q42.	Does the decision include monitoring and evaluation of the outcomes?	
	*****Q42a.	If so, does the decision define who is responsible for the monitoring and evaluation?
	*****Q42b.	If so, does the decision explicitly define how the results of the monitoring and evaluation impact the decision or may alter the original decision?
**Q43.	Are the decision and/or any allocations permanent?	
	**Q43a.	If not, how can the decision be modified and who can do so?
Q44.	Does the decision acknowledge any variability in the system (e.g., hydrologic, climate, societal, environmental)?	
	Q44a.	If so, how is variability incorporated into the decision?
Q45.	Can one party to the decision challenge another party's allocation?	

	Q45a.	If so, what rules or venues are required for the challenge?
Q46.	Does the decision discuss the certainty or feasibility of allocations?	
	Q46a.	If so, what conditions are given for allocations?
*Q47.	Does the decision specifically discuss water quality?	
	*Q47a.	If so, are there baseline conditions that must be met (e.g., TDS, salinity)?
	*Q47b.	Who is responsible for maintaining water quality?
	*Q47c.	Are there specific penalties for violating water quality standards?
***Q48.	Does the decision require new infrastructure to satisfy allocations?	
	***Q48a.	Does the decision require modifications to existing infrastructure to satisfy allocations?
Q49.	What government agencies are involved in the decision?	
	Q49a.	If there are multiple government agencies, do they formally coordinate and collaborate with each other?
	Q49b.	Are there specific data-sharing protocols?
Q50.	Does the decision discuss demand management?	
	Q50a.	If so, what specific methods or tools are discussed (e.g., education, water pricing)?
	Q50b.	Are there specific benchmarks for demand (e.g., GPCD)?
Socio-ecological civility and democratic governance *"Build the capacity, motivation and habitual inclination of individuals, communities and other collective decision making bodies to apply sustainability principles through more open and better informed deliberations, greater attention to fostering reciprocal awareness and collective responsibility, and more integrated use of administrative, market, customary, collective and personal decision making practices" (Gibson et al. 2005, p. 107).*		
Q51.	What stakeholders were involved in the decision-making process?	
	Q51a.	Were any non-government groups?
	Q51b.	What levels of government were included?
	*********Q51c.	When was each stakeholder group included in the process?
	Q51d.	How were each stakeholder group's inputs incorporated into the outcome?
	Q51e.	What were the sizes of each stakeholder group?
	Q51f.	Were there any provisions for if/when a stakeholder group left the process?
	Q51g.	Did a specific individual or agency facilitate the negotiations?

Q52.	Does the decision specifically emphasize collaborative endeavors?		
Q53.	What negotiations were formal?		
Q54.	What negotiations were informal?		
	Q54a.	What did this informal process look like?	
Q55.	Was the decision a one-time agreement?		
	Q55a.	If not, did the decision call for additional negotiations or engagements?	
Q56.	Was the decision-making process transparent to the public?		
	Q56a.	Was there much technical information incorporated into the process?	
	**********Q56b.	Was the public actively engaged in the decision?	
		**********Q56c.	If so, what was the process of this engagement?
Q57.	Were there specific mechanisms for decision-maker accountability?		
Q58.	Does the decision rely on any market mechanisms (e.g., user-pays principle, water markets, financial incentives)?		
Q59.	Does the decision rely on any non-market mechanisms (e.g., subsidies, Water Users Associations)?		
Q60.	Were any indigenous or native communities included in the process?		
	Q60a.	If so, was traditional or indigenous knowledge incorporated into the process?	
Q61.	If there are disagreements or conflicts, did the decision include conflict resolution mechanisms?		
********Q62.	In what year/years was the decision negotiated?		
	*********Q62a.	When was each stakeholder group included in the process?	
Q63.	What entity produced the information or science used in the decision-making process?		
	Q63a.	Did any stakeholder groups question the legitimacy of this information?	
	Q63b.	Was all of the information made publicly available?	
Precaution and adaptation *"Respect uncertainty, avoid even poorly understood risks of serious or irreversible damage to the foundations for sustainability, plan to learn, design for surprise and manage for adaptation" (Gibson et al. 2005, p. 111).*			
Q64.	Did the decision-makers acknowledge any uncertainty in the decision?		
	Q64a.	If no, which category best describes the situation? Select one. (Categories are from Gibson et al. 2005, p. 112)	
		1	Ignorance (i.e., decision-makers did not even know what to expect)?

		2	Vagueness (i.e., decision-makers had some idea of uncertainty, but it was unclear and might not have understood the whole process)?
		3	Evaluation difficulties (i.e., decision-makers understood uncertainties but did not have a firm basis for understanding relationships between uncertainties and outcomes)?
	Q64b.	If yes, did decision-makers specifically include or discuss any of the following? Select all that apply, and write in explanation.	
		1	Did they incorporate flexibility into the decision?
		2	Was the precautionary principle discussed or applied?
		3	Did the decision-makers anticipate emerging or new uncertainties in the future?
		4	None of the above.
*******Q65.	What are the consequences or penalties if an allocation is unmet or the decision is violated?		
	*******Q65a.	Who enforces these penalties?	
**Q66.	Are the decision and/or any allocations permanent?		
	**Q66a.	If not, how can the decision be modified and who can do so?	
Q67.	Does the decision define how learning new information could address existing uncertainties?		
*****Q68.	Does the decision include monitoring and evaluation of the outcomes?		
	*****Q68a.	If so, does the decision define who is responsible for the monitoring and evaluation?	
	*****Q68b.	If so, does the decision explicitly define how the results of the monitoring and evaluation impact the decision or may alter the original decision?	
Q69.	What technical data or science was used in negotiating the decision?		
	Q69a.	Were hydrologic models used?	
	Q69b.	Were historical stream flows used?	
	Q69c.	Were estimated projected stream flows used?	
	Q69d.	Does the decision acknowledge uncertainty in this information?	
****Q70.	Does the decision consider differing future scenarios? Select all that apply		

	1	Hydrological
	2	Climate
	3	Social
	4	Environmental
	5	Political
	6	Others? (Write in)
	****Q70a.	What were the sources of these projections?
Q71.	Are there specific triggers or indicators that automatically produce changes in the decision?	
	Q71a.	If so, how were the indicators selected?
**********Q72.	Was the public actively engaged in the decision?	
	**********Q72a.	If so, what was the process of this engagement?
Immediate and long-term integration *"Attempt to meet all requirements for sustainability together as a set of interdependent parts, seeking mutually supportive benefits" (Gibson et al. 2005, 113).*		
******Q73.	Does the decision establish priorities for allocations?	
	******Q73a.	If so, are there priorities within water use and consumption (e.g., M&I, ag, enviro flows)?
	******Q73b.	If so, are there priorities in the decision's objectives (e.g., economic growth, ecological health)
	******Q73c.	If so, are there provisions establishing hierarchies of water storage and/or delivery?
Q74.	Does the decision define or acknowledge any tradeoffs between stakeholder groups (e.g., states)?	
	Q74a.	If so, who defined the tradeoffs?
Q75.	Does the decision define or acknowledge any tradeoffs between sectors (e.g., ag, M&I)?	
	Q75a.	If so, who defined the tradeoffs?
Q76.	Does the decision define or acknowledge any tradeoffs between objectives (e.g., economic development, recreational economies)?	
	Q76a.	If so, who defined the tradeoffs?
Q77.	Does the decision establish a river basin organization?	
	Q77a.	If so, what are the objectives or goals of the organization?
Q78.	Does the decision require or recommend any educational outreach?	

Decision-Making Rules Information			
Operational Rules *"Operational rules directly affect day-to-day decisions made by participants in any setting. These can change relatively rapidly—from day to day" (Ostrom 2005, p. 58).*			
	Boundary Rules		
	Q79.	Is there a defined geographic scope of the decision? Select one, and write-in details.	
		1	State?
		2	Intra-basin?
		3	Entire basin?
		4	International?
	Q80.	Are there defined relationships between political divisions?	
	Q81.	Is there a defined hydrologic scope of the decision?	
	Authority Rules		
	Q82.	Are there restrictions on how parties or states may use their allocations?	
	Q83.	Did the decision include the development of storage for allocations?	
	Q84.	Can allocations from the decision be transferred? Select all that apply	
		1	Intra-state?
		2	Inter-state?
		3	Inter-basin?
		4	International?
	Q85.	Was there federal regulation required for any allocations in the decision?	
	Q86.	Can parties or states bank allocations? Select all that apply.	
		1	Intra-state?
		2	Inter-state?
		3	Inter-basin?
		4	International?
	Allocation Rules		
	Q87.	What is the type of allocation in the decision? If both types are in the decision, specify for which parts of the decision.	
		1	Fixed (e.g., AF)
		2	Proportional (e.g., %)
	Q88.	What is the location of the decision?	
		Q88a.	Any state borders?
		Q88b.	Any tributaries specifically included?
		Q88c.	Specific reach of the river(s)?
	Q89.	What is the scope of the decision?	
		Q89a.	Seasonal?

		Q89b.	River flow?
		Q89c.	Consumptive use?
	Q90.	Are there any limitations to the allocations?	
		Q90a.	Can parties or states use more than apportioned in the decision?
	Q91.	Does the decision allow for future additional allocations?	
		Q91a.	Does the decision discuss how future allocations may occur?
		Q91b.	Are future allocations contingent on another decision?
	******Q92.	Does the decision establish priorities for allocations?	
		******Q92a.	If so, are there priorities within water use and consumption (e.g., M&I, ag, enviro flows)?
		******Q92b.	If so, are there priorities in the decision's objectives (e.g., economic growth, ecological health)?
		******Q92c.	If so, are there provisions establishing hierarchies of water storage and/or delivery?
	Q93.	Are there inter-basin rules in the decision?	
		Q93a.	Are there delivery obligations from one state or basin to another?
	**Q94.	Are the decision and/or any allocations permanent?	
		**Q94a.	If not, how can the decision be modified and who can do so?
	Information Rules		
	Q95.	Are there prescriptions for accounting, reporting, monitoring, and measuring allocations in the decision?	
		Q95a.	Who is responsible for these activities?
		Q95b.	Are these activities regulatory or voluntary?
		Q95c.	How often must these activities occur?
	Q96.	Are there provisions for when this information is not available?	
	Scope Rules		
	Q97.	What is the basis for determining how much water can be allocated from the decision? (E.g., historical flow data, annual flow data)	
		Q97a.	Who is responsible for determination of available water for allocation?
	Q98.	Are there any minimum flows guaranteed downstream?	
		Q98a.	Are there any minimum storage requirements for downstream users?
	Payoff Rules		
	Q99.	Are transmission losses specifically included?	

	*******Q100.	What are the consequences or penalties if an allocation is unmet or the decision is violated?	
		*******Q100a.	Who enforces these penalties?
Collective Choice Rules *"Collective-choice rules affect operational activities and results through their effects in determining who is eligible to be a participant and the specific rules to be used in changing operational rules. These change at a much slower pace (Ostrom 2005, p. 58).*			
	Position Rules		
	Q101.	Did the decision include a representative from each state (of each country)?	
		Q101a.	Did each representative have equal say in the implementation or modification of the decision?
		Q101b.	How were these representatives selected?
	Q102.	Does the decision include a representative from any other government entities or private groups (e.g., water provider, irrigation district)?	
		Q102a.	If yes, how were the entities or groups selected for inclusion?
	Q103.	Does the decision include a representative from the federal government (of each country)? Include all federal agencies involved.	
	Q104.	Does the decision include non-governmental representatives?	
		Q104a.	If yes, how were these representatives selected?
	Q105.	Does the decision include any Native American representatives?	
		Q105a.	If yes, how were the tribes selected for inclusion?
	Authority and Scope Rules		
	Q106.	Does the decision have rules and regulations for how the decision is implemented?	
		Q106a.	Can these rules and regulations be changed?
	*******Q107.	Does the decision have rules and regulations for how the decision is enforced?	
		Q107a.	Does the decision prescribe what constitutes a violation?
	Q108.	Does the decision allow for modification of operational rules?	
	Q109.	Does the decision prescribe who is able to receive new or additional allocations?	
	Information Rules		
	Q110.	Are there regular meetings for the representatives?	
		Q110a.	If so, what are the venues for these meetings?

		Q110b.	Are there reports or minutes issued summarizing the meetings?
	Q111	Does the decision prescribe how information related to decision implementation or enforcement (including violations) is disseminated (if at all)?	
	Payoff Rules		
	Q112	Does the decision prescribe how the cost of implementation will be funded?	
Constitutional Rules *"Constitutional-choice rules first affect collective-choice activities by determining who is eligible to be a participant and the rules to be used in crafting the set of collective-choice rules that, in turn, affect the set of operational rules. Constitutional-choice rules change at the slowest pace" (Ostrom 2005, p. 58)*			
Q113.	Are parties to the decision required to periodically review the decision?		
	Q113a.	If yes, how often?	
Q114.	Can the decision be amended or revised?		
	Q114a.	If yes, must all parties to the original decision approve?	
Q115.	Can the decision be terminated?		
	Q115a.	If yes, how would this occur?	
Q116.	Can a state or party to the decision unilaterally withdraw from the decision?		
Q117.	Are there provisions establishing conflict resolution procedures?		

APPENDIX D: INTERVIEW PROTOCOL

Interviewee:
Date of interview:

Background information:

Q1: What is your current occupation?

Q2: How long have you been in your current position?

Q3: What are your main responsibilities in your current position?

Q4: What is your education and training background?

Provide interviewee background information about the project, including the survey. Also, direct interviewee to answer these interview questions in the context of specific basin decision-making processes they have been involved in.

Overall decision-making process

Q5: What has been your role in Colorado River Basin basin-scale decision-making?

Q6: Broadly speaking, what specific basin decisions and negotiations have you been involved in?

Q7: Broadly speaking, what parts of those decisions did you find successful?

Q8: Broadly speaking, what parts of those decisions did you find not successful?

Participation

Q9: In your opinion, were all specific agencies, organizations, and individuals included in the decision-making process that should have been?

a. If not, who was not included and why do you think they were not included?

b. Did everyone have access to the same information?

c. If you think this is a problem, how do you think future processes could make sure these groups are included?

Q10: Did any individuals or agencies emerge as a leader in the process?

a. Did you get the sense any specific individuals or agencies were essential for the negotiations to be successful?

Q11: In your opinion, did it seem like there was agreement among the key players and agencies about the outcome of the decision?

a. If not, why do you think there was disagreement?

Q12: Do you think all the players and agencies felt like they were equally heard?

a. Did any complain about dominance by some groups?

b. If there were complaints, was anything done to try to gain more proportional representation in the process?

Fairness

Q13: Were there regular formal meetings to discuss the ongoing negotiations?

a. If so, how often were these meetings and who facilitated them?

Q14: Were there any informal meetings or gatherings?

a. If so, who initiated these?

b. What did these informal meetings look like?

Q15: Was anything done to make the process of decision-making transparent to the public? If so, what was that?

a. The 2007 Interim Shortage Guidelines were intended to be public-driven process. How successful do you think the Guidelines were in terms of it being public-driven?

b. If the process had been more transparent, would that have undermined its success?

i. Are there ground rules with regards to these private meetings? After private meetings are there rules saying do not discuss this? What qualifies as a safe place? The "tent' has been broadened a bit by bringing in enviros, why can't the tribes be brought in?

Q16: Results from my survey suggest that many people do not think Colorado River Basin negotiations and decision-making are transparent, but overall they trust and support the current leadership. What would this suggest to you?

Q17: When decisions are made and negotiations occur among Colorado River Basin players and agencies, do you think it's difficult to "sell" the outcomes of those decisions to each agency's respective constituent base back home?

a. If so, what do you think is a potential remedy to this problem?

Q18: Also in regards to my survey results, the majority of respondents said the 2007 Interim Guidelines and Minute 319 were a significant change to the Law of the River, but a minority of the respondents agreed that changes to the Law of the River are necessary to address the structural deficit. In your opinion, is this a terminology issue or actual perceptions of the types of challenges posed by the structural deficit?

a. Are people saying we've already done the big changes and we only need minor stuff? Or is the phrase 'changing the law of the river' just a loaded phrase?

Governance

Q19: Recent decisions have been interim in nature with a finite period for implementation. How important was it for these decisions to be interim as opposed to permanent?

a. Even those these decisions are interim, what impact do you think they have on future generations?

b. Are future generations explicitly considered in the decision-making process?

Q20: Some people have talked about the need for a regional authority that would oversee management in the Basin (e.g., "Colorado River Authority" or "League of the Southwest"). Do you think a new institution like this is necessary or would be beneficial?

Q21: How important are previous decisions or policies in laying the groundwork for the success of later decisions (e.g., 2007 Guidelines as necessary for Minute 319)?

Q22: What role do you see Interior and Reclamation playing in Colorado River Basin negotiations?

a. What impact do you think the change in administrations will have on these negotiations?

b. Do you have any additional thoughts about the relationship between the federal government and the states/local stakeholders?

Q23: Many of the recent decisions could be considered 'incremental' modifications to the Law of the River. Are continued incremental modifications sufficient to address current and future problems and issues?

a. What is a scenario where something more transformative would be necessary?

b. What do you think the chances are of a Lower Basin shortage in 2017 or 2018?
c. What do you think the chances are of significant litigation or a compact call between now and 2026?

Q24: Some of my survey results included a significant increase in interest of voluntarily marketing water across state lines, across the board. Why do you think this interest would have changed so much in the last six years?

Q25: Finally, is there anything about the decision-making process that we didn't talk about, but you think is important for me to know?

Notes:

APPENDIX E: INTERVIEW CODING PROTOCOL

NVivo coding protocol
7/26/17

1. Barriers to building adaptive capacity
    a. Scale
        i. Interstate
        ii. Intrastate
        iii. International
    b. Specific barriers
        i. Communication
        ii. Time investment
        iii. "Selling" a policy outcome
        iv. Representation
        v. Power imbalances
        vi. Consensus
        vii. Public support
        viii. Compromise
        ix. Complexity
        x. Cultural differences
        xi. Weak participation (e.g., 'invite, inform, ignore')
        xii. Status quo/institutional inertia
        xiii. Lack of trust
        xiv. Funding
2. Mechanism to overcome barriers
    a. Scale
        i. Interstate
        ii. Intrastate
        iii. International
    b. Specific mechanisms/policies
        i. Consensus on strategy
        ii. Stakeholder participation
        iii. Decision-making transparency
        iv. Interim policies
        v. Workgroups
        vi. Decisiveness
        vii. Education and outreach
            1. Devoting the necessary time
            2. Focus on benefits of the entire agreement
            3. Policy framing
        viii. Deadlines
        ix. Water markets/transfers
        x. Federalism
        xi. Incrementalism
        xii. Experience/build upon previous success
        xiii. Collaboration
        xiv. Compromise
        xv. Individuals

xvi. Money
xvii. Data/science
xviii. Flexibility
xix. Communication (e.g., institutionalizing communication)
xx. Participation

3. Fairness
    a. Transparency
        i. Benefits of limiting transparency
        ii. Benefits of transparency
    b. Informal negotiations
    c. Formal negotiations
    d. Changes in the process over time
    e. Trust-building/relationships
    f. Politics
4. Participation
    a. Stakeholder
        i. Federal
        ii. State
        iii. Municipality
        iv. Irrigation District
        v. Tribes
        vi. NGOs
        vii. Farmers
        viii. Recreation
        ix. Hydropower
        x. Individuals
    b. Timing
    c. Lack of participation
    d. Parallel process
    e. Leadership
    f. Personnel changes
    g. Individuals mentioned
    h. Catarsis
5. Governance
    a. Finance/investment
    b. Policy length of time
    c. Comprehensiveness
    d. Changes to the Law of the River
    e. Implementation
    f. Decision-making process time (e.g., how long a process takes)
    g. Employee resources (e.g., dedicated staff)
    h. System failure
    i. Institutional changes
    j. Meetings, conferences, or gatherings where negotiations occur
    k. Policy learning
    l. Reasons for 2007 Guidelines success
    m. Reasons for Minute 319 success
    n. Impacts of federal transitions
    o. Role of federal governments

        i. Facilitation
        ii. Leadership
        iii. Trust-building
        iv. Decision-making authority
        v. Operations
        vi. Technical
        vii. Synthesizing
    p. Regional authority or council
    q. Litigation
6. Specific events or policies
    a. 2001 Surplus Guidelines
        i. QSA
    b. 2007 Shortage Guidelines
    c. Minute 319
    d. Minute 32X
        i. Prospects for 32X success
    e. Drought Contingency Planning
        i. LB DCP
        ii. UB DCP
        iii. Prospects for DCP success
    f. Bay-Delta issues
    g. Salton Sea issues
    h. System Conservation Pilot Program
7. Notable quotes